

**LIGHT
DUTY
TRUCK**

**SERVICE
MANUAL**



ST 330-78

1978 CHEVROLET

FOREWORD

This manual includes procedures for diagnosis, maintenance and adjustments, minor service operations, and removal and installation for components of Chevrolet Light Duty Trucks. Procedures involving disassembly and assembly of major components for these vehicles are contained in the 1978 Chevrolet Passenger Car and Light Duty Truck Overhaul Manual. Wiring diagrams for 1978 trucks are contained in a separate Wiring Diagram Booklet.

The Section Index on the contents page enables the user to quickly locate any desired section. At the beginning of each section containing more than one major subject is a Table of Contents, which gives the page number on which each major subject begins. An Index is placed at the beginning of each major subject within the section.

Summaries of Special Tools, when required, and specifications are found at the end of major sections.

When reference is made in this manual to a brand name, number, or specific tool, an equivalent product may be used in place of the recommended item.

This manual should be kept in a handy place for ready reference. If properly used, it will enable the technician to better serve the owners of Chevrolet built vehicles.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

1978 LIGHT DUTY TRUCK (SERIES 10-35) CHASSIS SERVICE MANUAL

CAUTION

This vehicle contains some parts dimensioned in the metric system as well as in the customary system. Some fasteners are metric and are very close in dimension to familiar customary fasteners in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. (Numbers on the heads of metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings.) Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original. For information and assistance, see your authorized dealer.

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SECTION OA

GENERAL INFORMATION

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TRUCK MODEL IDENTIFICATION

All 10-35 series models are identified by the model system shown in the chart on the following page. Basically the designation consists of 7 characters, 2 letters followed by five numbers. The first letter indicates a model and the second identifies the chassis type. The first number designates the GVW range, the second and third identify the cab-to-axle dimension or model type and the last two identify the cab or body style. See Figure OA-1.

VEHICLE IDENTIFICATION NUMBER AND RATING PLATE

A combination vehicle identification number and rating plate used on all models (fig. OA-2) is located on the left door lock pillar of C-K-G models. On Forward Control models, it is attached to the dash and toe panel.

The vehicle identification number stamped on the plate decodes into the information shown in Figure OA-3.

ENGINE NUMBER

The engine number indicates manufacturing plant, month and day of manufacture, and transmission type. A typical engine number would be F1210TFA, which would breakdown thus:

- F - Manufacturing Plant (F-Flint, T-Tonawanda)
- 12 - Month of Manufacture (December)
- 10 - Day of Manufacture (tenth)
- T - Truck
- FA - Transmission and engine type

UNIT AND SERIAL NUMBER LOCATIONS

For the convenience of service technicians and engineers when writing up certain business papers such as Warranty Reports, Product Information Reports, or reporting product failures in any way, the location of the various unit numbers have been indicated. These unit numbers and their prefix or suffix are necessary on these papers for various reasons - such as accounting, follow-up on production, etc.

The prefixes on certain units identify the plant in which the unit was manufactured and thereby permits proper follow-up of the plant involved to get corrections made when necessary.

Always include the prefix in the number.

Axles

Chevrolet Built

- On 10 Series, the Code is stamped on Front of Right Rear Axle Tube.
- On 20-35 Series, the Code is stamped on Upper Surface of the Right Rear Axle Tube.

Dana Built

- On Front Axles, code is stamped on Front Surface of Left Axle Tube.
- On Rear Axles, code is stamped on Rear Surface of Right Axle Tube.

Transmissions

- On 3-Speed Transmissions (except Tremec), the Unit Number is located on Lower Left Side of Case Adjacent to Rear of Cover.
- On Tremec Transmissions, Unit Number is located on Upper Forward Mounting Flange of Case.
- On 70 mm 4-Speed Transmissions, Unit Number is stamped on Upper Center Front of Case. On Borg Warner 4-Speeds, Unit Number is located on Left Side of Case Rearward of Side Cover. Muncie 4-Speeds, Unit Number is located on Rear Face of Case below Retainer.
- On Automatic 350 Transmission, Unit Number is Located on Right Rear Vertical Surface of Oil Pan.
- On the Automatic 400 Transmission, Serial Number is Located on the Light Blue Plate on the Right Side of the Transmission.

Engines

- 6-Cylinder Engine Unit Number Located on Pad at Right Hand Side of Cylinder Block at Rear of Distributor.
- 8-Cylinder Engine Unit Number Located on Pad at Front, Right Hand Side of Cylinder Block.

Generators

Generator Unit Serial Number is located on the Drive End Frame Below the Part Number.

Batteries

Battery Code Number is Located on Cell Cover Top of Battery.

Starters

Starter Serial Number and Production Date are Stamped on Outer Case, Toward Rear.

SERVICE PARTS IDENTIFICATION PLATE

The Service Parts Identification Plate (fig. OA-4) is provided on all Truck models. On most series it will be located on the inside of the glove box door, or, on Forward Control series, it will be located on an inner body panel. The plate lists the vehicle serial number, wheelbase, and all Production options or Special Equipment on the vehicle when it was shipped from the factory including paint information. **ALWAYS REFER TO THIS INFORMATION WHEN ORDERING PARTS.**

TRUCK MODEL IDENTIFICATION

1. C = Chevrolet; T = GMC Truck **C C 10703 + E63 + LG9**
2. Chassis Type _____
3. GVW Range _____
4. CA Dimension/Model Type _____
5. Cab or Body Style _____
6. Body Ordering Code _____
7. Engine Ordering Code _____

②

Chassis Type

- C—Conventional 4 x 2
- G—Forward Control 4 x 2 (Body-Frame Integral)
- K—Conventional 4 x 4 (Four Wheel Drive)
- P—Forward Control 4 x 2 (Conventional)

③

Series/GVW Range

- 1—4800 to 7300
- 2—6400 to 8400
- 3—6400 to 14,500

⑤

Cab or Body Style

- 03—Conventional Cab (C-K models); Cutaway Van, Hi-Cube Van (G models)
- 05—Chevy Van, Vandura
- 06—Suburban/Sportvan, Rally Wagon with Panel Rear Doors
- 16—Blazer, Jimmy
- 32—Motor Home Chassis
- 42—Forward Control Chassis, Step-Van, Value Van
- 43—Bonus Cab, Crew Cab

④

CA Dimension/Model Type

- 05—Blazer, Jimmy, Step-Van, Value Van
- 07—42"/Pickup, Chassis-Cab
- 08—FC or Motor Home Chassis, Step-Van, Value Van
- 09—56"/Suburban, Chassis-Cab, Pickup
- 10—60"/FC Chassis, Chevy Van, Vandura, Sportvan, Rally Wagon, Chassis-Cab, Step-Van, Value Van
- 11—Motor Home Chassis
- 13—Chevy Van, Vandura, Sportvan, Rally Wagon, Cutaway Van, Hi-Cube Van
- 14—84"/FC or Motor Home Chassis, Chassis-Cab, Step-Van, Value Van
- 16—Cutaway Van, Hi-Cube Van
- 18—Motor Home Chassis

⑥

Body Code

- ZW9—Base Body
- Z58—Blazer, Jimmy w/White Top
- Z59—Blazer, Jimmy w/Black Top
- Z64—RV Cutaway Van
- E31—Hi-Cube Van (10' Steel 96" Wide)
- E32—Step-Van, Value Van (Steel)
- E33—Step-Van, Value Van (Aluminum)
- E34—Hi-Cube Van (10' Steel 82" Wide)
- E36—Hi-Cube Van (96" Wide 10' Aluminum)
- E38—Hi-Cube Van (12' Steel 96" Wide)
- E39—Hi-Cube Van (96" Wide 12' Aluminum)
- E55—Suburban (w/End Gate)
- E62—Stepside (Fenderside) Pickup
- E63—Fleetside (Wide Side) Pickup
- E94—Beauville Sportvan, Rally STX

⑦

Engine Code

- LD4—250 Six
- L25—292 Six
- LG9—305-2 V8
- LS9—350-4 V8
- LF4—400-4 V8
- LF8—454-4 V8
- LF9—350-DIESEL

Fig. 0A-1—Truck Model Identification

MFD. BY GENERAL MOTORS CORPORATION	
GVWR <input type="text"/>	
GAWR FRONT <input type="text"/>	GAWR REAR <input type="text"/>
VIN <input type="text"/>	
CAMPER LOADING DATA	
CWR <input type="text"/>	DIM A <input type="text"/> DIM B <input type="text"/>
INFLATION DATA FOR TIRES FURNISHED WITH VEHICLE	
FRONT <input type="text"/>	PRESSURE <input type="text"/>
REAR <input type="text"/>	PRESSURE <input type="text"/>
WARRANTY VOIDED IF LOADED IN EXCESS OF RATINGS <input type="checkbox"/>	
SEE OWNERS MANUAL FOR OTHER LOADING AND INFLATION DATA	

Fig. OA-2—Vehicle Identification Number and Rating Plate Information

KEYS AND LOCKS

Two separate identifiable keys (with different cross section) are provided for the lock cylinders of each vehicle. The key codes are stamped on the "knock out" plug in the key head.

- Key with square head (stamped "J") - or ignition switch only.
- Key with oval head (stamped "K") - or all other locks.

TOWING

Proper lifting or towing equipment is necessary to prevent damage to the vehicle during any towing operation. State (Provincial in Canada) and local laws applicable to vehicles in tow must be followed.

All Except Four Wheel Drive Trucks

Normally this vehicle may be towed on all four wheels, at speeds of less than 35 MPH (60 km/h), for distances up to 50 (80 km/h), provided the driveline, axle and transmission, and steering system are otherwise normally operable. Use only towing equipment specifically designed for this purpose, following the instructions of the equipment manufacturer.

A separate safety chain system must be used. For such

towing the steering must be locked, transmission in neutral and parking brake released. Attachments must be made to main structural members of the vehicle. Do not attach to bumpers or associated brackets. Remember that power brake and power steering assists will not be available when engine is inoperative.

The rear wheels must be raised off the ground or the drive shaft disconnected when the transmission is not operating properly or when a speed of 35 MPH (60 km/h) or distance of 50 miles (80 km/h) will be exceeded.

CAUTION: *If a truck is towed on its front wheels only, the steering wheel must be secured with the wheels in a straight ahead position.*

Four Wheel Drive Trucks

It is recommended that the truck be towed with the front wheels off the ground. The truck can be towed, however, with the rear wheels off the ground if there is damage in the rear wheel area. Refer to Figure OA-5.

STEEL TUBING REPLACEMENT

In the event that replacement of steel tubing is required on brake line, fuel line, evaporative emission, and transmission cooling lines, only the recommended steel replacement tubing should be used.

Only special steel tubing should be used to replace brake lines. That is, a double layer and brazed steel tubing meeting G.M. Specification 123M. Further, any other steel tubing should be replaced only with the released steel tubing or its equivalent. Under no condition should copper or aluminum tubing be used to replace steel tubing. Those materials do not have satisfactory fatigue durability to withstand normal vehicle vibrations.

All steel tubing should be flared using the upset (double lap) flare method.

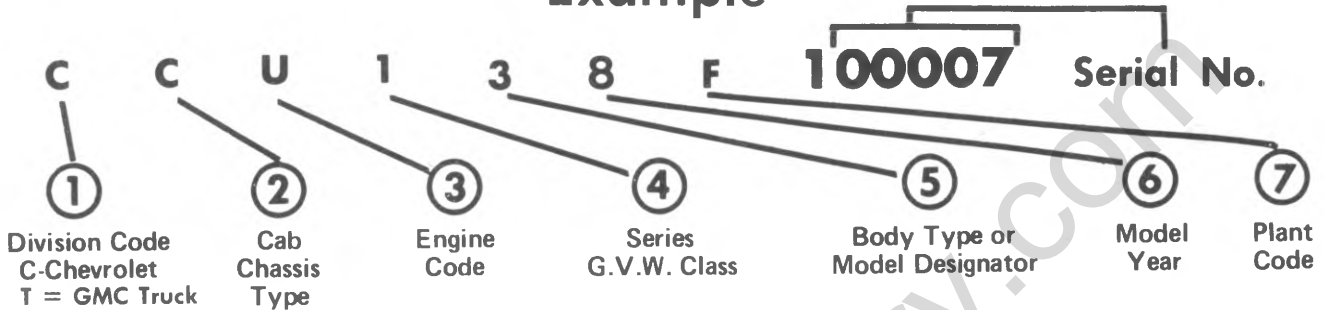
VEHICLE LOADING

Vehicle loading must be controlled so weights do not exceed the numbers shown on the Vehicle Identification Number and Rating Plate for the vehicle.

A typical example of a truck in a loaded condition is shown in Figure OA-6. Note that the axle or GVW capabilities are not exceeded.

1978 LIGHT DUTY TRUCK V.I.N. SYSTEM IDENTIFICATION

Example



- 2.**
CHASSIS TYPE
- C Conventional Cab
 - G Van
 - K 4 x 4
 - P Forward Control
 - T Steel Tilt Cab

3.
ENGINE CODE
Light Duty

Engine Code	Engine Displacement	Engine Type	Carb. Type
A	3.8L (231)	V/6	2-Bbl.
D	4.1L (250)	L/6	1-Bbl.
L	5.7L (350)	V/8	4-Bbl.
M	3.3L (200)	V/6	2-Bbl.
R	6.6L (400)	V/8	4-Bbl.
S	7.4L (454)	V/8	4-Bbl.
T	4.8L (292)	L/6	1-Bbl.
U	5.0L (305)	V/8	2-Bbl.
Z	5.7L (350)	V/8	Dsl.

- 4.**
SERIES
- 1-1/2 Ton
 - 2-3/4 Ton
 - 3-1 Ton
 - 4-1/2 Ton (HD SUSP)

- 5.**
BODY STYLE
- 2 Chassis Cowl & Forward Control Chassis
 - 3 Chassis Cab
 - 4 Cab & Pick-up Box or Hi-Cube Van
 - 5 Van & Step Van
 - 6 Sport Van & Suburban
 - 7 Motor Home Chassis
 - 8 Blazer, Jimmy

- 7.**
PLANT CODE
- | | | | |
|--------------------|------------------|---------------------|--------------------|
| A-Lakewood GA. | J-Janesville WI. | V-Pontiac (GMC) MI. | 3-Detroit MI. |
| B-Baltimore MD. | S-St. Louis MO. | Z-Fremont CA. | 4-Scarborough Ont. |
| F-Flint (Chev) MI. | U-Lordstown OH. | 1-Oshawa Ont. | |

Fig. 0A-3--Vehicle Identification Number

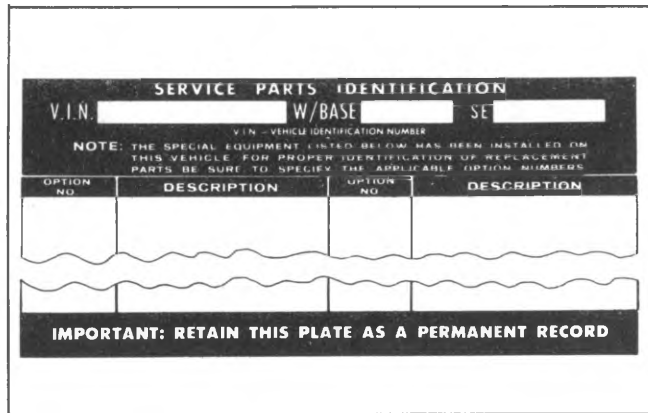


Fig. 0A-4--Service Parts Identification Plate

TIPS FOR TOWING FOUR WHEEL DRIVE VEHICLES

FRONT WHEELS OFF THE GROUND	
FULL TIME (4 X 4) AUTOMATIC TRANSMISSION	PART TIME (4 X 4) MANUAL TRANSMISSION
1. TRANSFER CASE IN NEUTRAL 2. TRANSMISSION IN PARK 3. MAXIMUM SPEED 35 MPH 4. MAXIMUM DISTANCE 50 MILES NOTE: For distances over 50 miles, disconnect rear propshaft at rear axle carrier and secure in safe position.	1. TRANSFER CASE IN 2 H 2. TRANSMISSION IN NEUTRAL 3. MAXIMUM SPEED 35 MPH 4. MAXIMUM DISTANCE 50 MILES NOTE: For distances over 50 miles, disconnect the rear propshaft at rear axle carrier and secure in safe position.
REAR WHEELS OFF THE GROUND	
CAUTION: When towing a vehicle in this position, the steering wheel should be secured to keep the front wheels in a straight ahead position.	
FULL TIME (4 X 4)	PART TIME (4 X 4)
1. TRANSFER CASE IN NEUTRAL 2. TRANSMISSION IN PARK 3. MAXIMUM SPEED 35 MPH 4. MAXIMUM DISTANCE 50 MILES NOTE: For distances over 50 miles, disconnect front propshaft at front axle carrier and secure in safe position.	1. TRANSFER CASE IN 2 H 2. TRANSMISSION IN NEUTRAL 3. MAXIMUM SPEED 35 MPH 4. MAXIMUM DISTANCE 50 MILES NOTE: For distances over 50 miles, disconnect the front propshaft at front axle carrier and secure in safe position.
ALL FOUR WHEELS ON GROUND	
FULL TIME (4 X 4)	PART TIME (4 X 4)
1. TRANSFER CASE IN NEUTRAL 2. TRANSMISSION IN PARK NOTE: Do not exceed speed as per State laws for towing vehicles.	1. TRANSFER CASE IN 2 H 2. TRANSMISSION IN NEUTRAL 3. MAXIMUM SPEED 35 MPH 4. MAXIMUM DISTANCE 50 MILES NOTE: For speeds or distances greater than above, both propshafts must be disconnected at the axle carrier end and secured in a safe position. It is recommended that both propshafts be removed and stored in the vehicle. NOTE: Do not exceed speeds as per State laws for towing vehicles.

Fig. 0A-5--Towing Tips

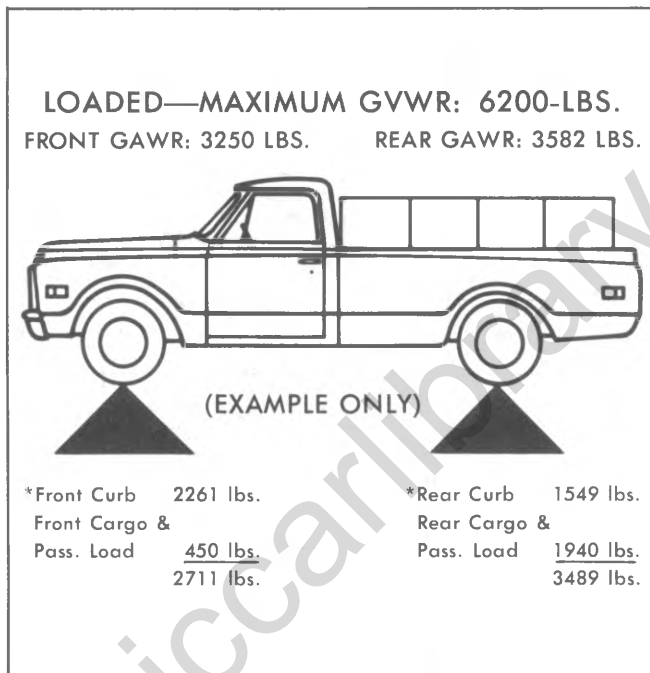


Fig. 0A-6—Typical Vehicle Loaded Condition

SECTION LUBRICATION

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MAINTENANCE SCHEDULE

A separate maintenance folder has been provided with each vehicle which contains a complete schedule and brief explanation of the safety, emission control, lubrication and general maintenance it requires. The maintenance folder information is supplemented by this section of this manual, as well as the separate vehicle and emissions warranty booklet also furnished with each vehicle. Read all three publications for a full understanding of vehicle maintenance requirements.

The time or mileage intervals for lubrication and maintenance services outlined in this section are intended as a general guide for establishing regular maintenance and lubrication periods for trucks with light and heavy duty emission control systems (see Fig. OB-1). Sustained heavy duty and high speed operation or operation under adverse conditions may require more frequent servicing.

ENGINE

Oil and Filter Recommendations

The letter designation "SE" has been established to correspond with the requirements of GM 6136-M. "SE" engine oils will be better quality and perform better than those identified with "SA" through "SD" designations and are recommended for all light-duty gasoline trucks regardless of model year and previous engine oil quality recommendations.

Diesel equipped vehicles require SE/CD engine oil. Oil may be used under certain temperature conditions. See Fig. OB-4.

Oil Change Period

- Use only SE (SE/CD for Diesel) engine oil.
- **Light Duty Emission Vehicles** -Change oil each 12 months or 7,500 miles (12 000 km). If more than 7,500 miles (12 000 km) are driven in a 12 month period, change

oil each 7,500 miles (12 000 km). Change oil every 3,000 miles (4 800 km) if vehicle is equipped with Diesel engine.

- **Heavy Duty Emission Vehicles** -Change oil each 4 months or 6,000 miles (9 600 km). If more than 6,000 miles (9 600 km) are driven in a 4-month period, change oil each 6,000 miles (9 600 km).

- Change oil each 3 months or 3,000 miles (4 800 km) (2 months or 3,000 miles (4 800 km) on Heavy Duty Emission Vehicles), whichever occurs first, under the following conditions:

- Driving in dusty conditions.
- Trailer pulling or camper use.
- Motor Home use.
- Extensive idling.
- Short-trip operation at freezing temperatures (engine not thoroughly warmed-up).

LIGHT AND HEAVY DUTY EMISSION CLASS VEHICLES	
All States Except California	
Light Duty Emission	Heavy Duty Emission
C-10 Pick-Up (Except over 6000 Lbs. GVW)	C-10 Pick-Up & Cab Chassis (Over 6000 Lbs. GVW) C-K 10 Blazer, Jimmy C-K 10-20 Suburban C-20-30 Pick-Up & Cab Chassis K-10-20-30 Pick-Up & Cab Chassis P-10-20-30 Van & F/C Chassis
California	
C-K 10-20 Pick-Up & Cab Chassis C-K 10-20 Suburban C-K 10 Blazer, Jimmy P-20 Van & F/C Chassis	C-K 30 Pick-Up & Cab Chassis P-30 Van & F/C Chassis
NOTE: Calif. vehicles 8500 Lbs. GVW or less will be Light Duty Emission Vehicles; over 8500 Lbs. will be Heavy Duty Emission.	

Fig. OB-1--Emission Class Designation

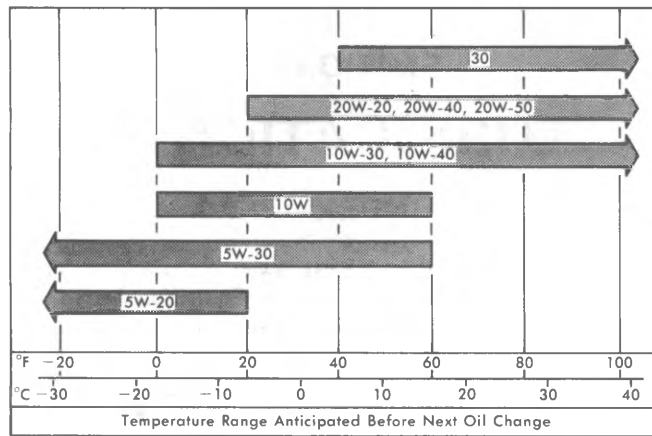


Fig. OB-3—Oil Viscosity Chart Gasoline

● Operation in dust storms may require an immediate oil change.

● For Light Duty Emission Vehicles replace the oil filter at the first oil change, and every second oil change thereafter, if mileage 7,500 miles (12 000 km) is the determining factor. If time (12 month) is the determining factor, then change oil filter with every oil change. Change oil filter every 3,000 miles (4 800 km) if vehicle is equipped with Diesel engine. For Heavy Duty Emission Vehicles, replace the oil filter at the first oil change and every other oil change thereafter using 6,000 miles (9 600 km) or 12 month as the determining factors. AC oil filters (or equivalent) provide excellent engine protection.

The above recommendations apply to the first change as well as subsequent oil changes. The oil change interval for the engine is based on the use of recommended oils and quality oil filters. Oil change intervals longer than those listed above will seriously reduce engine life and may affect the manufacturer's obligation under the provisions of the New Vehicle Warranty.

A high quality SE oil(SE/CD for Diesel) was installed in the engine at the factory. It is not necessary to change this factory-installed oil prior to the recommended normal change period. However, check the oil level more frequently during the break-in period since higher oil consumption is normal until the piston rings become seated.

NOTE: Non-detergent and other low quality oils are specifically not recommended.

Oil Filter Type and Capacity

● Throwaway type, 1 quart U.S. measure, .75 quart Imperial measure.

● 250 and 292 cu. in., AC Type PF-25. 305, 350, 400 and 454 cu. in., AC Type PF-35.

Crankcase Capacity (Does Not Include Filter)

● 292 L6 Engine; 5 quarts U.S. measure, 4.25 quarts Imperial measure.

● All other engines; 4 quarts U.S. measure, 3.25 quarts Imperial measure.

Recommended Viscosity

To help assure good cold and hot starting, as well as maximum engine life, fuel economy, and oil economy, select the proper oil viscosity for the temperature range anticipated from the chart in Fig. OB-3 and Fig. OB-4.

NOTE: SAE 5W-20 oils are not recommended for sustained high-speed driving.

NOTE: For gasoline engine only use single viscosity grade SAE 30 oil when prevailing temperatures will allow. Use multi-viscosity oils only when necessary for starting at low temperature ranges in above chart. (It may be necessary to use an optional engine block heater for starting when ambient temperature is approximately -10°F (-23°C) or lower).

Checking Oil Level

The engine oil should be maintained at proper level. The best time to check it is before operating the engine or as the last step in a fuel stop. This will allow the oil accumulation in the engine to drain back in the crankcase.

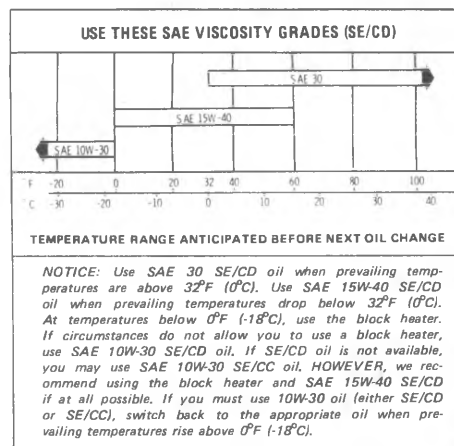


Fig. OB-4--Oil Viscosity Chart Diesel

To check the level, remove the oil gauge rod (dipstick), wipe it clean and reinsert it firmly for an accurate reading. The oil gauge rod is marked "FULL" and "ADD". The oil level should be maintained in the safety margin, neither going above the "FULL" line nor below "ADD" line.

Supplemental Engine Oil Additives

The regular use of supplemental additives is specifically not recommended and will increase operating costs. However, supplemental additives are available that can effectively and economically solve certain specific problems without causing other difficulties. For example, if higher detergency is required to reduce varnish and sludge deposits resulting from some unusual operational difficulty, a thoroughly tested and approved additive - "G.M. Super Engine Oil Supplement" (or equivalent) - is available.

Drive Belts

Drive belts should be checked for proper tension every 7,500 miles (12 000 km) or 12 months on Light Duty Emission vehicles, every 6,000 miles (9 600 km) on Diesel and 6,000 miles (9 600 km) or 4 months Heavy Duty Emission vehicles. A loose belt will affect water pump and generator operation.

Crankcase Ventilation System

Replace Positive Crankcase Ventilation Valve (P.C.V.) every 30,000 miles (48 000 km) on Light Duty Emission vehicles (except Diesel) and 24,000 miles (38 400 km) on Heavy Duty Emission vehicles. Clean all connecting hoses, fittings and flame arrestor. Clean oil fill tube breather cap and filter assemblies (both valve covers) every 6,000 miles (9 600 km) and replace breather cap and valve assembly and flow control valve each 30,000 miles (48 000 km) on diesel equipped vehicles. At every oil change the system should be tested for proper function and serviced, if necessary. (Also see maintenance schedule at end of this section.)

Air Injection Reactor System (A.I.R.)

Controlled Combustion System (C.C.S.)

The Air Injection Reactor system should have the drive belt inspected for wear and tension every 24 months or 30,000 miles (48 000 km) (4 months or 6,000 miles (9 600 km) on Heavy Duty Emission Vehicles), whichever occurs first. In addition, complete effectiveness of either system, as well as full power and performance, depends upon idle speed, ignition timing, and idle fuel mixture being set according to specification. A quality tune-up which includes these adjustments should be performed periodically to assure normal engine efficiency, operation and performance.

Evaporation Control System (E.C.S.)

Every 30,000 miles (48 000 km) 24,000 miles (38 400 km) on Heavy Duty Emission vehicles or 24 months, (more often under dusty conditions) the filter in the base of the canister must be replaced and the canister inspected. Check operation of bowl vent and purge valves.

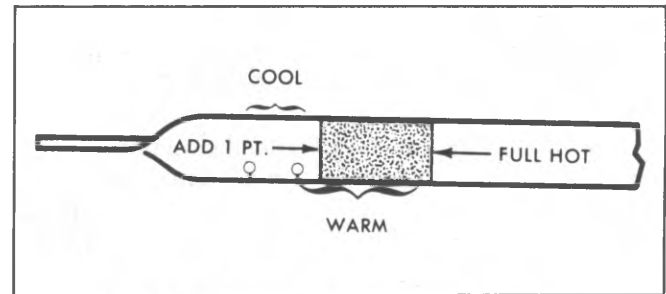


Fig. OB-5--Automatic Transmission Dipstick

Early Fuel Evaporation (E.F.E.) System

First 7,500 miles (12 000 km) or 12 months check valve for freedom of operation. A binding condition must be corrected. Check hoses for cracking, abrasion or deterioration. Replace parts as necessary.

Air Cleaner

CAUTION: Do not remove the engine air cleaner unless temporary removal is necessary during repair or maintenance of the vehicle. When the air cleaner is removed backfiring can cause fire in the engine compartment.

NOTE: Under prolonged dusty driving conditions, it is recommended that these operations be performed more often.

Replace the engine air cleaner element under normal operating conditions every 30,000 miles (48 000 km) on Light Duty Emission vehicles 12,000 miles (19 200 km) on Heavy Duty Emission Vehicles except California 350-400 engines, replace every 24,000 miles (38 400 km).

Fuel Filter

Light Duty Emission Vehicles -Replace filter element located in carburetor inlet every 12 months or 15,000 miles (24 000 km) whichever occurs first, or, if an in-line filter is also used, replace both filters every 30,000 miles (48 000 km)

Heavy Duty Emission Vehicles -Replace filter element in carburetor inlet every 12 months or 12,000 miles (19 200 km), whichever comes first, except Diesel and California 350-400 engines which should be replaced every 24 months or 24,000 miles (38 400 km).

Accelerator Linkage

Lubricate with engine oil every 15,000 miles (24 000 km) (12,000 miles (19 200 km) Heavy Duty Emission Vehicles) as follows:

1. On V8 engine, lubricate the ball stud at the carburetor lever.
2. On L6 engine, lubricate the two ball studs at the carburetor lever and lubricate the lever mounting stud. Do not lubricate the accelerator cable.

AUTOMATIC TRANSMISSION

Fluid Recommendations

Use automatic transmission fluids identified with the mark DEXRON® II or equivalent.

Check the fluid level at each engine oil change period.

Automatic transmissions are frequently overfilled because the fluid level is checked when the fluid is cold and the dipstick indicates fluid should be added. However, the

low reading is normal since the level will rise as the fluid temperature increases. A level change of over 3/4 inch will occur as fluid temperature rises from 60°F to 180°F (16°C to 82°C).

Overfilling can cause foaming and loss of fluid through the vent. Slippage and transmission failure can result.

Fluid level too low can cause slipping, particularly, when the transmission is cold or the vehicle is on a hill.

Check the transmission fluid level with engine running, the shift lever in **PARK** and the vehicle level.

NOTE: If the vehicle has recently been operated for an extended period at high speed or in city traffic in hot weather or the vehicle is being used to pull a trailer, an accurate fluid level cannot be determined until the fluid has cooled down - usually about 30 minutes after the vehicle has been parked.

Remove the dipstick and touch the transmission end of the dipstick cautiously to find out if the fluid is cool, warm or hot.

Wipe it clean and re-insert until cap seats. Remove dipstick and note readings.

- If the fluid feels cool, about room temperature 65°F to 85°F (18°C to 29°C) the level should be 1/8 to 3/8 inch below the **ADD** mark. The dipstick has two dimples below the " **ADD** " mark to show this range (fig. OB-1).

- If it feels warm, the level should be close to the **ADD** mark (either above or below).

- If it feels hot (cannot be held comfortably), the level should be between the **ADD** and **FULL** marks.

Drain Intervals

The transmission operating temperature resulting from the type of driving conditions under which your vehicle is used is the main consideration in establishing the proper frequency of transmission fluid changes.

Change the transmission fluid and filter every 15,000 miles (24 000 km) on Light Duty Emission vehicles except Diesel and Heavy Duty Emission vehicles which are changed every 12,000 miles (19 200 km), if the vehicle is usually driven under one or more of the following conditions which are considered severe transmission service:

- In heavy city traffic where the outside temperature regularly reaches 90°F (32°C).
- In very hilly or mountainous areas.
- Frequent trailer pulling.
- Commercial uses, such as taxi, police car or delivery service.

If you do not use your vehicle under any of these conditions, change the fluid and filter every 60,000 miles (96 000 km) on Light Duty Emission vehicles, 12,000 miles (19 200 km) on Diesel and 24,000 miles (19 200 km) on Heavy Duty Emission vehicles.

To Change Automatic 400 and Automatic 350 transmission fluid, remove fluid from the transmission sump, add approximately 7.5 pints U.S. measure (6.25 pints Imperial measure) of fluid for the Automatic 400 and add 2-1/2 qts. U.S. measure (2 qts. Imperial measure) of fluid for the Automatic 350, to return level to proper mark on the dipstick.

3-AND 4-SPEED MANUAL TRANSMISSION

Lubricant

Every 12 months or 7,500 miles (12 000 km) on Light Duty Emission vehicles (4 months or 6,000 miles (9 600 km) on Heavy Duty Emission vehicles), whichever occurs first, check lubricant level and add lubricant, if necessary, to fill to level of filler plug hole with SAE 80W or SAE 80W-90 GL-5 Gear Lubricant. If temperatures below +32°F (0°C) are expected, use SAE 80W GL-5 Gear Lubricant only. For those vehicles normally operated in Canada, use SAE 80W GL-5 Gear Lubricant only.

TRANSMISSION SHIFT LINKAGE

(MANUAL AND AUTOMATIC)

Every 7,500 miles (12 000 km) or 12 months on Light Duty Emission vehicles (6,000 miles (9 600 km) or 4 months on Heavy Duty Emission vehicles), lubricate shift linkage and, on Manual transmission floor control, lever contacting faces with water resistant EP chassis lubricant which meets General Motors Specification GM6031-M.

Clutch

The clutch pedal free travel should be checked at regular intervals.

Lubricate the clutch cross-shaft at fitting (on Series 10 Forward Control models also lubricate the clutch linkage idler lever at fitting) every 7,500 miles (12 000 km) or 12 months on Light Duty Emission vehicles (6,000 miles (9 600 km) or 4 months on Heavy Duty Emission vehicles) with water resistant EP chassis lubricant which meets General Motors Specification GM 6031-M.

REAR AXLES

Standard

Every 12 months or 7,500 miles (12 000 km) on Light Duty Emission vehicles 4 months or 6,000 miles (9 600 km) on Heavy Duty Emission vehicles, whichever occurs first and every 6,000 miles (9 600 km) for Diesel, check lubricant level and add lubricant, if necessary. Fill to level of filler plug hole. Use SAE 80W or SAE 80W-90 GL-5 Gear Lubricant. For those vehicles normally operated in Canada, use SAE 80W GL-5 Gear Lubricant.

Positive Locking or Positraction

Every 12 months or 7,500 miles (12 000 km) on Light Duty Emission vehicles; 4 months or 6,000 miles (9 600 km) on Heavy Duty Emission vehicles, whichever occurs first and every 6,000 miles (9 600 km) for Diesel, check lubricant level and add SAE 80W or SAE 80W-90 GL5 gear lubricant, if necessary, to fill to level of filler plug hole.

PROPELLER SHAFT SLIP JOINTS

Propeller shaft slip joints should be lubricated every 7,500 miles (12 000 km) or 12 months on Light Duty Emission vehicle, 6,000 miles (9 600 km) on Diesel and 6,000 miles (9 600 km) or 4 months on Heavy Duty Emission vehicles with water resistant EP chassis lubricant which meets General Motors Specification GM 6031-M.

UNIVERSAL JOINTS

All universal joints are the needle bearing type. Lubricate those universal joints (depending on truck model) equipped with lube fittings every 7,500 miles (12 000 km) or 12 months on Light Duty Emission vehicles, 6,000 miles

(9 600 km) on Diesel and 6,000 miles (9 600 km) or 4 months on Heavy Duty Emission vehicles with water resistant EP chassis lubricant which meets General Motors Specification GM 6031-M. More frequent lubes may be required on heavy duty or "Off the Road" operations.

WHEEL BEARINGS

Front

NOTE: Use wheel bearing lubricant GM Part No. 1051344 or equivalent which meets all requirements of General Motors Specification GM 6031-M.

Due to the weight of the tire and wheel assembly it is recommended that they be removed from hub before lubricating bearings to prevent damage to oil seal. Then remove the front wheel hub to lubricate the bearings. The bearings should be thoroughly cleaned before repacking with lubricant.

Front wheels are equipped with tapered roller bearings on all trucks. Wheel bearings should be repacked at each brake relining or 30,000 miles (48 000 km) for Light Duty Emission vehicles and 12,000 miles (19 200 km) for Heavy Duty Emission and four wheel drive vehicles. Do not mix wheel bearing lubricants.

CAUTION: "Long fibre" type greases should not be used on roller bearing front wheels.

Rear

The rear wheel bearings receive their lubrication from the rear axle. When installing bearings which have been cleaned, prelube with wheel bearing grease.

BRAKE MASTER CYLINDER

Check master cylinder fluid level in both reservoirs every 7,500 (12 000 km) or 12 months on Light Duty Emission vehicles, 6,000 miles (9 600 km) on Diesel and 6,000 miles (9 600 km) or 4 months on Heavy Duty Emission vehicles. If the fluid is low in the reservoir, it should be filled to a point about 1/4" from the top rear of each reservoir with Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent.

BRAKE AND CLUTCH PEDAL SPRINGS

Lubricate brake and clutch pedal springs every 7,500 miles or 12 months (6,000 miles (9 600 km) or 4 months on Heavy Duty Emission vehicles) with engine oil for all models.

PARKING BRAKE

Every 7,500 miles (12 000 km) or 12 months on Light Duty Emission Vehicles, 6,000 miles (9 600 km) on Diesel and 6,000 miles (9 600 km) or 4 months on Heavy Duty Emission vehicles clean and lubricate all parking brake pivot points with water resistant EP chassis lubricant which meets General Motors Specification GM 6031-M.

STEERING

Manual Steering Gear

The steering gear is factory-filled with steering gear lubricant. Seasonal change of this lubricant should not be performed and the housing should not be drained. No lubrication is required for the life of the steering gear.

Every 30,000 miles (48 000 km) on Light Duty Emission vehicles (36,000 miles (57 600 km) on Heavy Duty Emission vehicles), the gear should be inspected for seal leakage (actual solid grease-not just oily film). If a seal is

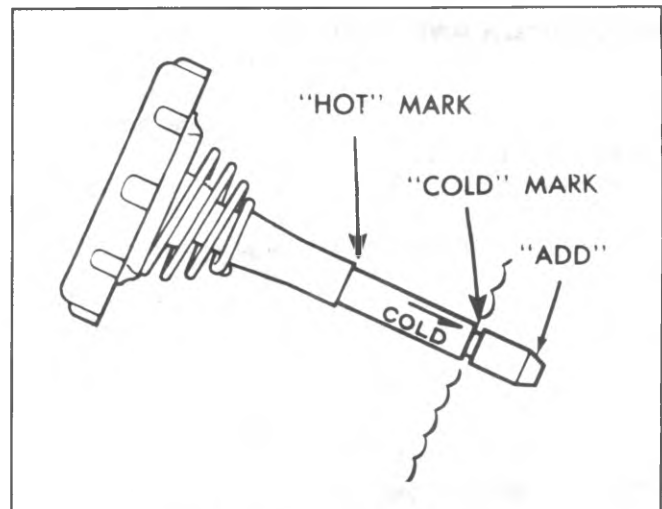


Fig. OB-6 Power Steering Filler Cap Indicator

replaced or the gear is overhauled, the gear housing should be refilled with No. 1051052 (13 oz. container) Steering Gear Lubricant which meets GM Specification GM4673-M or its equivalent.

NOTE: Do not use EP Chassis Lube, which meets GM Specification GM 6031-M, to lubricate the gear. DO NOT OVER-FILL the gear housing.

Power Steering System

Check the fluid level in the pump reservoir at each oil change period. Add GM Power Steering Fluid (GM 1050017 or equivalent) as necessary to bring level into proper range on filler cap indicator depending upon fluid temperature.

If at operating temperature (approximately 150°F (66°C) hot to the touch), fluid should be between "HOT" and "COLD" marks.

If at room temperature (approximately 70°F or 21°C), fluid should be between "ADD" and "COLD" marks. Fluid does not require periodic changing.

Linkage and Suspension

Maintain correct front end alignment to provide easy steering, longer tire life, and driving stability.

Check control arm bushings and ball joints for wear.

Lubricate tie rods, upper and lower control arms, and ball joints at fittings with water resistant EP chassis lubricant which meets General Motors Specification GM 6031-M every 7,500 miles (12 000 km) or 12 months for Light Duty Emission vehicles, 6,000 miles (9 600 km) for Diesel equipped vehicles and 6,000 miles or 4 months on Heavy Duty Emission vehicles.

Lubricate every 3,000 miles (4 800 km) or 3 months (2 months on Heavy Duty Emission Vehicles), whichever occurs first, under the following conditions:

- Driving in dusty or muddy conditions.
- Extensive off-road use.

NOTE: Ball joints must be at +10°F (-12°C) or more before lubricating.

Keep spring to axle U bolts and shackle bolts properly tightened (see Specifications Section for torque recommendations). Check U bolt nuts after the first 1,000 miles (1 600 km) of operation if the U bolt or U bolt nuts are changed in service.

HOOD LATCH AND HOOD HINGE

Every 7,500 miles (12 000 km) or 12 months (6,000 miles (9 600 km) or 4 months on Heavy Duty Emission vehicles), whichever occurs first, lubricate hood latch assembly and hood hinge assembly as follows:

1. Wipe off any accumulation of dirt or contamination on latch parts.
2. Apply lubriplate or equivalent to latch pilot bolt and latch locking plate.
3. Apply light engine oil to all pivot points in release mechanism, as well as primary and secondary latch mechanisms.
4. Lubricate hood hinges.
5. Make hood hinge and latch mechanism functional check to assure the assembly is working correctly.

BODY LUBRICATION

Normal use of a truck causes metal-to-metal movement at certain points in the cab or body. Noise, wear and improper operation at these points will result when a protective film of lubricant is not provided.

For exposed surfaces, such as door checks, door lock bolts, lock striker plates, dovetail bumper wedges, etc. apply a thin film of light engine oil.

Where oil holes are provided in body parts a dripless oil can be safely used, but any lubricant should be used sparingly, and after application all excess should be carefully wiped off.

The seat adjusters and seat track, ordinarily overlooked, should be lubricated with water resistant EP chassis lubricant which meets General Motors Specification GM 6031-M.

There are other points on bodies which may occasionally require lubrication and which are difficult to service. window regulators and controls are confined in the space between the upholstery and the outside door panel.

Easy access to the working parts may be made by removing the trim. Door weatherstrips and rubber hood bumpers should be lightly coated with a rubber lubricant.

UNDERBODY MAINTENANCE

Corrosive materials used for ice and snow removal and dust control accumulate on the underbody. If allowed to remain, these materials can result in accelerated rusting and deterioration of underbody components such as fuel lines, frame and floor pan, exhaust system, etc. At least once each year, preferably after a winter's exposure these corrosive materials should be removed by flushing the underbody with plain water. Particular attention should be given to cleaning out those areas where mud and other foreign materials collect.

SPEEDOMETER ADAPTER

On vehicles so equipped, lubricate adapter at fitting with water resistant EP chassis grease which meets General Motors Specification GM 6031-M every 7,500 miles (12 000 km) or 12 months on Light Duty Emission vehicles, 6,000 miles (9 600 km) on Diesel equipped vehicles and 6,000 miles (9 600 km) or 4 months on Heavy Duty Emission vehicles.

COMPLETE VEHICLE MAINTENANCE SCHEDULE

Four separate Maintenance Schedules are used for the 1978 light duty truck models. Two schedules are used for Light Duty Emission vehicles while Heavy Duty Emission and Diesel equipped vehicles each have their own schedule.

Presented on the following pages are the Maintenance Schedules, followed immediately by the schedule explanation.

COMPLETE VEHICLE MAINTENANCE SCHEDULE I

Light Duty Emission System

This Maintenance Schedule is applicable to all engines which do not contain the letter "U" in the engine identification code (which begins with the numeral "8") shown in the upper left corner of the under hood "Vehicle Emission Control Information" label. (Example: .812Y2).

When To Perform Services (Months or Miles, Whichever Occurs First)	Item No.	Services
Section A—Lubrication and General Maintenance		
Every 12 Months or 7,500 Miles (12 000 km)	A-1	Chassis Lubrication
	A-2	•Fluid Levels Check
	A-3	*Engine Oil Change
See Explanation	A-4	*Oil Filter Change
	A-5	Tire Rotation
	A-6	Rear Axle Lube Change
Every 12 Months or 15,000 Miles (24 000 km)	A-7	*Cooling System Check
	A-8	Wheel Bearing Repack
Every 30,000 Miles (48 000 km)	A-9	Manual Steering Gear Check
	A-10	Clutch Cross Shaft Lubrication
Every 60,000 Miles (96 000 km)	A-11	Auto. Trans. Fluid & Filter Change
Section B—Safety Maintenance		
Every 12 Months or 7,500 Miles (12 000 km)	B-1	Owner Safety Checks
	B-2	Tire, Wheel and Disc Brake Check
	B-3	*Exhaust System Check
	B-4	Suspension and Steering Check
	B-5	Brake and Power Steering Check
Every 12 Months or 15,000 Miles (24 000 km)	B-6	*Drive Belt Check
	B-7	Drum Brake and Parking Brake Check
	B-8	Throttle Linkage Check
	B-9	Underbody Flush & Check
Section C—Emission Control Maintenance		
At First 6 Months or 7,500 Miles (12 000 km) —Then at 18 Month/ 22,500 Mile (36 000 km) Intervals as Indicated in Log	C-1	Thermo. Controlled Air Cleaner Check
	C-2	Carburetor Choke Check
	C-3	Engine Idle Speed Adjustment
	C-4	EFE System Check
	C-5	Carburetor Mounting Torque
	C-6	Vacuum Advance System, Hoses Check
Every 12 Months or 15,000 Miles (24 000 km)	C-7	Fuel Filter Replacement
	C-8	PCV System Check PCV Valve & Filter Replacement
Every 22,500 Miles (36 000 km)	C-9	Spark Plug Wires Check
	C-10	Idle Speed-Up Solenoid Check
	C-11	Spark Plug Replacement
	C-12	Engine Timing Adjustment & Dist. Check
	C-13	Carburetor Vacuum Break Adjustment (1)
Every 24 Months or 30,000 Miles (48 000 km)	C-14	ECS System Check & Filter Replacement
	C-15	Fuel Cap, Tank and Lines Check
Every 30,000 Miles (48 000 km)	C-16	Air Cleaner Element Replacement

•Also A Safety Service

*Also An Emission Control Service

(1) All 305, all 454, all high altitude and all California engines receive this service

EXPLANATION OF COMPLETE 1978 VEHICLE MAINTENANCE SCHEDULE

Presented below is a brief explanation of each of the services listed in the preceding Complete Vehicle Maintenance Schedule.

NORMAL VEHICLE USE—The owner's maintenance instructions contained in this maintenance schedule are based on the assumption that your vehicle will be used as designed:

- to carry passengers and cargo within the limitations indicated on the VIN plate affixed to the edge of the driver's door,
- on reasonable road surfaces within legal operating limits,
- on a daily basis, as a general rule, for at least several miles/kilometres, and
- on unleaded fuel.

Unusual operating conditions will require more frequent vehicle maintenance as specified in the respective sections included below.

After each of the following maintenance services is performed, it is recommended that you insert the month, day and mileage in the maintenance schedule under the appropriate "Owner Service Log" column.

SECTION A—LUBE & GENERAL MAINTENANCE

ITEM NO. SERVICES

A-1 CHASSIS—Lubricate all grease fittings in front suspension and steering linkage. Also lubricate transmission shift linkage, hood latch, hood and door hinges, and parking brake cable guides and linkage, clutch linkage, propeller shaft slip joint, universal joints and brake and clutch pedal springs. Lubricate suspension and steering linkage every 3 months or 3,000 miles (4 800 km) when operating under dusty or muddy conditions and in extensive off-road use. Also see Item B-8[▲].

A-2 FLUID LEVELS—Check level of fluid in brake master cylinder[▲], power steering pump[▲], battery, engine^{*}, axle, transmission, and windshield washer[▲]. Engine coolant should be checked for proper level and freeze protection to at least -20° F (-29° C) or to the lowest temperature expected during the period of vehicle operation.^{*} Proper engine coolant also provides corrosion protection.

Any significant fluid loss in any of these systems or units could mean that a malfunction is developing and corrective action should be taken im-

mediately. A low fluid level in the brake master cylinder reservoir(s) could also be an indicator that the disc brake pads or drum brake linings need replacing.

A-3 ENGINE OIL*—Change each 12 months or 7,500 miles (12 000 km), whichever occurs first under normal driving conditions, or each 3 months or 3,000 miles (4 800 km) when the vehicle is operated under the following conditions: (a) driving in dusty conditions, (b) trailer pulling, (c) extensive idling or (d) short-trip operation at freezing temperatures (with engine not thoroughly warmed-up). See your Owner's and Driver's Manual for additional details on engine oil.

A-4 ENGINE OIL FILTER*—Replace at the first oil change and every other oil change thereafter, if mileage (7,500 miles) (12 000 km) is the determining factor. If time (12 months) is the determining factor, then change oil filter with every oil change.

A-5 TIRES—To equalize wear, rotate tires and adjust inflation pressures as indicated in your Owner's and Driver's Manual. **Passenger Type Tires:** Bias or Bias-Belted, rotate every 7,500 miles (12 000 km); Radial, rotate first 7,500 miles (12 000 km) and at least every 15,000 miles (24 000 km) thereafter. **Light Truck Type Tires:** Bias or Bias-Belted, rotate every 6,000 miles (9 600 km); Radial, rotate first 6,000 miles (9 600 km) and at least every 12,000 miles (19 200 km) thereafter.

A-6 REAR AXLE—Change lubricant every 7,500 miles (12 000 km) on all type rear axles or final drives when using vehicle to pull a trailer.

FRONT AXLE AND TRANSFER CASE—Check every 7,500 miles (12 000 km). See Owner's and Driver's Manual for further information.

A-7 COOLING SYSTEM*—At 12-month or 15,000-mile (24 000 km) intervals, wash radiator cap and filler neck with clean water, pressure test system and radiator cap for proper pressure holding capacity, tighten hose clamps and inspect condition of all cooling and heater hoses. Replace hoses if checked, swollen or otherwise deteriorated. Clean exterior of radiator core and air conditioning condenser. Every 24 months or 30,000 miles (48 000 km), drain, flush, and refill the cooling system with a new coolant solution as described in your Owner's and Driver's Manual.

A-8 WHEEL BEARINGS—Clean and repack front wheel bearings at each brake relining or 30,000 miles (48 000 km), whichever comes first. Use a lubricant as specified in the "Recommended Fluid & Lubricants" chart in this folder.

[▲]Also a Safety Service
^{*}Also an Emission Control Service

A-9 MANUAL STEERING GEAR—Check for seal leakage around the pitman shaft and housing. If leakage is evident (solid grease oozing out—not just oily film), it should be corrected immediately.

A-10 CLUTCH CROSS SHAFT—Lubricate clutch cross shaft lever.

A-11 AUTOMATIC TRANSMISSION FLUID—Under normal driving conditions, change the transmission fluid and service the sump filter every 60,000 miles (96 000 km). Under unusual conditions such as constant driving in heavy city traffic, trailer pulling, and commercial applications, services should be performed at 15,000-mile (24 000 km) intervals. See your Owner's and Driver's Manual for further details on transmission care.

SECTION B—SAFETY MAINTENANCE

NOTICE:—Items B-1 (a) thru (v) can be checked by the owner, or driver while **Items B-2 thru B-9 should only be checked by a qualified mechanic.** It is particularly important that any safety systems which may have been adversely affected in an accident be checked and repaired as necessary before the vehicle is returned to use.

B-1 SAFETY CHECKS TO BE PERFORMED BY OWNER OR DRIVER—The following checks should be made regularly during operation at no greater interval than 12 months or 7,500 miles (12 000 km), whichever occurs first, and more often when the need is indicated. Any deficiencies should be brought to the attention of your dealer or another service outlet, as soon as possible, so the advice of a qualified mechanic is available regarding the need for repairs or replacements.

(a) **STEERING COLUMN LOCK (EXCEPT VAN)**—Check for proper operation by attempting to turn key to Lock position in the various transmission gear ranges when the vehicle is stationary. Key should turn to Lock position only when shift lever is in Park ("P"). Key should be removable only in Lock position.

(b) **PARKING BRAKE**—Check parking brake holding ability by parking on a fairly steep hill and restraining the vehicle with the parking brake only.

CAUTION: Before making checks (c) or (d) below, be sure to have a clear distance ahead and behind the vehicle, set the parking brake and firmly apply the regular brake. Do not depress accelerator pedal. Be prepared to turn off ignition

switch immediately if engine should start. If precautions aren't followed vehicle may move unexpectedly, possibly causing personal injury.

- (c) **STARTER SAFETY SWITCH (AUTOMATIC TRANSMISSION VEHICLES)**—Check starter safety switch by attempting to start the engine with the transmission in each of the driving gears. The starter should operate only in the Park ("P") or Neutral ("N") positions.
- (d) **STARTER SAFETY SWITCH (MANUAL TRANSMISSION VEHICLES)**—To check, place the shift lever in neutral, depress the clutch halfway, and attempt to start. The starter should operate only when clutch is fully depressed.
- (e) **TRANSMISSION SHIFT INDICATOR**—Check to be sure automatic transmission shift indicator accurately indicates the shift position selected.
- (f) **STEERING**—Be alert to any changes in steering action. The need for inspection or servicing may be indicated by increased effort to turn the steering wheel, excessive free play or unusual sounds when turning or parking.
- (g) **WHEEL ALIGNMENT, BALANCE AND TIRES**—In addition to uneven or abnormal tire wear, the need for wheel alignment service may be indicated by a pull to the right or left when driving on a straight and level road. The need for wheel balancing is usually indicated by a vibration of the steering wheel or seat while driving at normal highway speeds. Check tire inflation pressure (including spare tire) when tires are "cold" at least monthly, or more often, if driver daily check indicates the need.—See Owner's and Driver's Manual Driver's Daily Checklist.
- (h) **BRAKES**—Be alert to illumination of the brake warning light or changes in braking action, such as repeated pulling to one side, unusual sounds either when braking or between brake applications, or increased brake pedal travel. Any of these could indicate the need for brake system inspection and/or service.
- (i) **EXHAUST SYSTEM**—Be alert to any change in the sound of the exhaust system or a smell of fumes which may indicate a leak or overheat condition requiring inspection and/or service. (See also Engine Exhaust Gas Caution and Catalytic Converter information in Owner's and Driver's Manual and Item B-3 in this folder.)
- (j) **WINDSHIELD WIPERS AND WASHERS**—Check operation of wipers, as well as condition and alignment of wiper blades. Check amount and direction of fluid sprayed by washers during use.

- (k) **DEFROSTER**—Check performance by moving controls to "Def" and noting amount of air directed against the windshield.
- (l) **REARVIEW MIRRORS AND SUN VISORS**—Check that mirrors and sun visors stay in the selected position.
- (m) **HORN**—Blow the horn occasionally to be sure that it works. Check all button locations.
- (n) **LAP AND SHOULDER BELTS**—Check belts, buckles, latch plates, retractors, reminder systems, guide loops, clips, and anchors for proper operation and for damage.
- (o) **SEAT ADJUSTERS**—Check that seat adjusters (and swivel seat lock, if present) securely engage by pushing forward and backward (and twisting) whenever seat is adjusted.
- (p) **SEATBACK LATCHES (IF SO EQUIPPED)**—Check to see that seatback latches are holding by pulling forward on the top of each folding seatback.
- (q) **LIGHTS AND BUZZERS**—Check all instrument panel illuminating and warning lights, seat belt reminder light and buzzer (if so equipped), interior lights, license plate lights, side marker lights, headlamps, parking lamps, identification or clearance lights, tail lamps, brake lights, turn signals, backup lamps, and hazard warning flashers. Have headlamp aim checked every 12 months or 15,000 miles (24 000 km) or more often if light beams seem to be aimed improperly.
- (r) **GLASS**—Check for broken, scratched, dirty or damaged glass on vehicle that could obscure vision or become an injury hazard.
- (s) **DOOR LATCHES**—Check for positive closing, latching and locking.
- (t) **HOOD LATCHES**—Check to make sure hood closes firmly by lifting on the hood after each closing. Check also for broken, damaged or missing parts which might prevent secure latching.
- (u) **FLUID LEAKS**—Check for fuel, water, oil or other fluid leaks by observing the surface beneath the vehicle after it has been parked for a while. (Water dripping from air conditioning system after use is normal.) If gasoline fumes or fluid are noticed **at any time**, the cause should be determined and corrected without delay because of the possibility of fire.
- (v) **SPARE AND JACK**—Check that spare tire assembly and jack equipment are securely stowed at all times.

B-2 TIRES, WHEELS AND DISC BRAKES—Check disc brake pads for wear and surface condition of rotors while wheels are removed during tire rotation (see Item A-5). Check tires for excessive wear or damage. Make certain wheels are not bent or

cracked and that wheel nuts have been tightened to the torque value shown in the Owner's and Driver's Manual. (See "In Case of Emergency" section).

- B-3 EXHAUST SYSTEM***—Check complete exhaust system including catalytic converter and nearby body areas for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the passenger compartment. Any necessary corrections should be made immediately. To help continue integrity, exhaust system pipes and resonators rearward of the muffler must be replaced whenever a new muffler is installed. Also see Item B-1 (i).
- B-4 SUSPENSION AND STEERING**—Check for damaged, loose or missing parts, or parts showing visible signs of excessive wear or lack of lubrication in front and rear suspension and steering system. Questionable parts noted should be replaced by a qualified mechanic without delay.
- B-5 BRAKES AND POWER STEERING**—Check lines and hoses for proper attachment, leaks, binding, cracks, chafing, deterioration, etc. Any questionable parts noted should be replaced or repaired immediately. When abrasion or wear is evident on lines or hoses, the cause must be corrected.
- B-6 ENGINE DRIVE BELTS***—Check belts driving fan, AIR pump, generator, power steering pump and air conditioning compressor for cracks, fraying, wear and tension. Adjust or replace as necessary.
- B-7 DRUM BRAKES AND PARKING BRAKE**—(See Item B-2 for disc brake check.) Check drum brake linings for wear or cracks and other internal brake components at each wheel (drums, wheel cylinders, etc.). Parking brake adjustment also should be checked whenever drum brake linings are checked.
NOTICE: More frequent brake checks should be made if driving conditions and habits result in frequent brake application.
- B-8 THROTTLE LINKAGE**—Lubricate as covered in Owner's and Driver's Manual. Check for damaged or missing parts, interference or binding. Any deficiencies should be corrected without delay by a qualified mechanic.
- B-9 UNDERBODY**—Corrosive materials used for ice and snow removal and dust control can accumulate on the underbody. If allowed to remain, these materials can result in accelerated rusting and deterioration of underbody components such as fuel lines, frame and floor pan, exhaust system, etc. At least once each year, preferably after a winter's exposure, these corrosive materials should be removed by flushing the underbody

with plain water. Particular attention should be given to cleaning out those areas where mud and other foreign materials collect.

SECTION C—EMISSION CONTROL MAINTENANCE

SCHEDULE I

NOTICE: Additional recommended maintenance instructions relating to vehicle use, evidence of maintenance, and service replacement parts are included in the New Vehicle Warranty Information folder.

- C-1 THERMOSTATICALLY CONTROLLED AIR CLEANER**—Inspect installation to make certain that all hoses and ducts are connected and correctly installed. Also check valve for proper operation.
- C-2 CARBURETOR CHOKE AND HOSES**—Check choke mechanism and vacuum break for proper operation. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor choke hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary.
- C-3 ENGINE IDLE SPEED**—Adjust engine idle speed accurately (following the specifications shown on the label under the hood). Adjustments must be made with test equipment known to be accurate.
- C-4 EARLY FUEL EVAPORATION (EFE) SYSTEM**—Check valve for proper operation. A binding condition must be corrected. Check thermal vacuum switch for proper operation. Check hoses for cracking, abrasion or deterioration. Replace parts as necessary.
- C-5 CARBURETOR MOUNTING**—At designated intervals torque carburetor attaching bolts and/or nuts to compensate for compression of the gasket.
- C-6 VACUUM ADVANCE SYSTEM AND HOSES**—Check system for proper operation and hoses for proper connection, cracking, abrasion or deterioration. Replace parts as necessary.
- C-7 FUEL FILTER**—Replace filter in carburetor at designated intervals or more frequently if clogged.
- C-8 POSITIVE CRANKCASE VENTILATION SYSTEM (PCV)**—Check the PCV system for satisfactory operation at 15,000-mile (24 000 km) intervals, and clean filter. Replace the PCV valve at 30,000-mile (48 000 km) intervals. Replace deteriorated hoses.
The PCV filter (located in the air cleaner) should be replaced whenever the air cleaner element is replaced.

C-9 SPARK PLUG WIRES—Clean exterior of wires; remove any evidence of corrosion on end terminals. Inspect spark plug wires for evidence of checking, burning, or cracking of exterior insulation and tight fit at distributor cap and spark plugs or other deterioration. If corrosion cannot be removed or other conditions above are noted, replace wire.

C-10 IDLE SPEED-UP SOLENOID—Check for proper operation. An inoperative solenoid must be replaced.

C-11 SPARK PLUGS—Replace plugs at 22,500-mile (36 000 km) intervals with type specified in Owner's and Driver's Manual.

C-12 TIMING AND DISTRIBUTOR CAP—Adjust ignition timing following the specifications shown on label under hood. Also, carefully inspect the interior and exterior of the distributor cap and rotor for cracks, carbon tracking and terminal corrosion. Clean or replace as necessary.

C-13 CARBURETOR VACUUM BREAK ADJUSTMENT—Inspect vacuum break linkage for proper operation. A binding condition must be corrected. Check hoses for proper connection, cracking, abrasion or deterioration. Replace parts as necessary. Adjust vacuum break at specified intervals following procedures and specifications found in appropriate service manual.

C-14 EVAPORATION CONTROL SYSTEM (ECS)—Check all fuel and vapor lines and hoses for proper connections and correct routing as well as condition. Check operation of bowl vent and purge valves, where applicable. Remove canister and check for cracks or damage. Replace damaged or deteriorated parts as necessary. Replace filter in lower section of canister. Off road operation of four wheel drive vehicles may necessitate more frequent filter replacement.

- C-15 FUEL CAP, FUEL LINES AND FUEL TANK**—
1. Inspect the fuel tank, cap and lines for damage which could cause leaks.
 2. Remove fuel cap and inspect gasket for an even imprint from the filler neck, and any indications of physical damage.
 3. Replace any damaged or deteriorated parts.

C-16 AIR CLEANER ELEMENT—Replace the engine air cleaner element at designated intervals. Operation of vehicle in dusty areas will necessitate more frequent replacements. Your dealer can be

of assistance in determining the proper replacement frequency for the conditions under which you operate your vehicle.

NOTICE: Do not operate the engine without the air cleaner unless temporary removal is necessary during repair or maintenance of the vehicle. When the air cleaner is removed, backfiring can cause fire in the engine compartment.

COMPLETE VEHICLE MAINTENANCE SCHEDULE II

Light Duty Emission System

This Maintenance Schedule is applicable to all engines which contain the letter "U" in the engine identification code (which begins with the numeral "8") shown in the upper left corner of the under hood "Vehicle Emission Control Information" label. (Example: 812F1U).

When To Perform Services (Months or Miles, Whichever Occurs First)	Item No.	Services
Section A—Lubrication and General Maintenance		
Every 12 Months or 7,500 Miles (12 000 km)	A-1	Chassis Lubrication
	A-2	•Fluid Levels Check
	A-3	*Engine Oil Change
See Explanation	A-4	*Oil Filter Change
	A-5	Tire Rotation
	A-6	Rear Axle Lube Change
Every 12 Months or 15,000 Miles (24 000 km)	A-7	*Cooling System Check
See Explanation	A-8	Wheel Bearing Repack
Every 30,000 Miles (48 000 km)	A-9	Manual Steering Gear Check
	A-10	Clutch Cross Shaft Lubrication
Every 60,000 Miles (96 000 km)	A-11	Auto. Trans. Fluid & Filter Change
Section B—Safety Maintenance		
Every 12 Months or 7,500 Miles (12 000 km)	B-1	Owner Safety Checks
	B-2	Tire, Wheel and Disc Brake Check
	B-3	*Exhaust System Check
	B-4	Suspension and Steering Check
	B-5	Brake and Power Steering Check
Every 12 Months or 15,000 Miles (24 000 km)	B-6	*Drive Belt Check
	B-7	Drum Brake and Parking Brake Check
	B-8	Throttle Linkage Check
	B-9	Underbody Flush & Check
Section C—Emission Control Maintenance		
See Explanation	C-1	Carburetor Choke Check
At First 6 Months or 7,500 Miles (12 000 km)—Then at 24 Month/ 30,000 Mile (48 000 km) Intervals as Indicated in Log	C-2	Thermo. Controlled Air Cleaner Check
	C-3	Engine Idle Speed Adjustment
	C-4	EFE System Check
	C-5	Carburetor Mounting Torque
	Every 12 Months or 15,000 Miles (24 000 km)	C-6
C-7		Fuel Filter Replacement
		PCV System Check
C-8		PCV Valve & Filter Replacement
Every 30,000 Miles (48 000 km)	C-9	Spark Plug Wires Check
	C-10	Idle Solenoid Check
	C-11	Spark Plug Replacement
	C-12	Engine Timing Adjustment & Dist. Check
	C-13	Air Cleaner Element Replacement
	C-14	Carburetor Vacuum Break Adjustment (1)
	Every 24 Months or 30,000 Miles (48 000 km)	C-15
C-16		Fuel Cap, Tank and Lines Check

•Also A Safety Service

*Also An Emission Control Service

(1) All 454, all high altitude 6 cylinder, and all California 6 cylinder engines receive this service.

EXPLANATION OF COMPLETE 1978 VEHICLE MAINTENANCE SCHEDULE

Presented below is a brief explanation of each of the services listed in the preceding Complete Vehicle Maintenance Schedule.

NORMAL VEHICLE USE—The owner's maintenance instructions contained in this maintenance schedule are based on the assumption that your vehicle will be used as designed:

- to carry passengers and cargo within the limitations indicated on the VIN plate affixed to the edge of the driver's door,
- on reasonable road surfaces within legal operating limits,
- on a daily basis, as a general rule, for at least several miles/kilometres, and
- on unleaded fuel.

Unusual operating conditions will require more frequent vehicle maintenance as specified in the respective sections included below.

After each of the following maintenance services is performed, it is recommended that you insert the month, day and mileage in the maintenance schedule under the appropriate "Owner Service Log" column.

SECTION A—LUBE & GENERAL MAINTENANCE

ITEM NO. SERVICES

- A-1 CHASSIS**—Lubricate all grease fittings in front suspension and steering linkage. Also lubricate transmission shift linkage, hood latch, hood and door hinges, and parking brake cable guides and linkage, clutch linkage, propeller shaft slip joint, universal joints and brake and clutch pedal springs. Lubricate suspension and steering linkage every 3 months or 3,000 miles (4 800 km) when operating under dusty or muddy conditions and in extensive off-road use. Also see Item B-8^a.
- A-2 FLUID LEVELS**—Check level of fluid in brake master cylinder^a, power steering pump^a, battery, engine^a, axle, transmission, and windshield washer^a. Engine coolant should be checked for proper level and freeze protection to at least -20° F (-29° C) or to the lowest temperature expected during the period of vehicle operation. Proper engine coolant also provides corrosion protection.
- Any significant fluid loss in any of these systems

or units could mean that a malfunction is developing and corrective action should be taken immediately. A low fluid level in the brake master cylinder reservoir(s) could also be an indicator that the disc brake pads or drum brake linings need replacing.

- A-3 ENGINE OIL***—Change every 12 months or 7,500 miles (12 000 km), whichever occurs first under normal driving conditions, or each 3 months or 3,000 miles (4 800 km) when the vehicle is operated under the following conditions: (a) driving in dusty conditions, (b) trailer pulling, (c) extensive idling or (d) short-trip operation at freezing temperatures (with engine not thoroughly warmed-up). See your Owner's and Driver's Manual for additional details on engine oil.
- A-4 ENGINE OIL FILTER***—Replace at the first oil change and every other oil change thereafter, if mileage (7,500 miles) (12 000 km) is the determining factor. If time (12 months) is the determining factor, then change oil filter with every oil change.
- A-5 TIRES**—To equalize wear, rotate tires and adjust inflation pressures as indicated in your Owner's and Driver's Manual. **Passenger Type Tires:** Bias or Bias-Belted, rotate every 7,500 miles (12 000 km); Radial, rotate first 7,500 miles (12 000 km) and at least every 15,000 miles (24 000 km) thereafter. **Light Truck Type Tires:** Bias or Bias-Belted, rotate every 6,000 miles (9 600 km); Radial, rotate first 6,000 miles (9 600 km) and at least every 12,000 miles (19 200 km) thereafter.
- A-6 REAR AXLE**—Change lubricant every 7,500 miles (12 000 km) on all type rear axles or final drives when using vehicle to pull a trailer.
- FRONT AXLE AND TRANSFER CASE**—Check every 7,500 miles (12 000 km). See Owner's and Driver's Manual for further information.
- A-7 COOLING SYSTEM***—At 12-month or 15,000 mile (24 000 km) intervals, wash radiator cap and filler neck with clean water, pressure test system and radiator cap for proper pressure holding capacity, tighten hose clamps and inspect condition of all cooling and heater hoses. Replace hoses if checked, swollen or otherwise deteriorated. Clean exterior of radiator core and air conditioning condenser. Every 24 months or 30,000 miles (48 000 km), drain, flush, and refill the cooling system with a new coolant solution as described in your Owner's and Driver's Manual.
- A-8 WHEEL BEARINGS**—Clean and repack front wheel bearings at each brake relining or 30,000 miles (48 000 km), whichever comes first. Use a lubricant as specified in the "Recommended Fluid & Lubricants" chart in this folder.
- A-9 MANUAL STEERING GEAR**—Check for seal leakage around the pitman shaft and housing. If leakage

is evident (solid grease oozing out—not just oily film), it should be corrected immediately.

A-10 CLUTCH CROSS SHAFT—Lubricate clutch cross shaft lever.

A-11 AUTOMATIC TRANSMISSION FLUID—Under normal driving conditions, change the transmission fluid and service the sump filter every 60,000 miles (96 000 km).

Under unusual conditions such as constant driving in heavy city traffic, trailer pulling, and commercial applications, services should be performed at 15,000-mile (24 000 km) intervals. See your Owner's and Driver's Manual for further details on transmission care.

^a Also a Safety Service
* Also an Emission Control Service

SECTION B—SAFETY MAINTENANCE

NOTICE:—Items B-1 (a) thru (v) can be checked by the owner or driver, while **Items B-2 thru B-9 should only be checked by a qualified mechanic.** It is particularly important that any safety systems which may have been adversely affected in an accident be checked and repaired as necessary before the vehicle is returned to use.

B-1 SAFETY CHECKS TO BE PERFORMED BY OWNER OR DRIVER—The following checks should be made regularly during operation at no greater interval than 12 months or 7,500 miles (12 000 km), whichever occurs first, and more often when the need is indicated. Any deficiencies should be brought to the attention of your dealer or another service outlet, as soon as possible, so the advice of a qualified mechanic is available regarding the need for repairs or replacements.

- (a) **STEERING COLUMN LOCK (EXCEPT VAN)**—Check for proper operation by attempting to turn key to Lock position in the various transmission gear ranges when the vehicle is stationary. Key should turn to Lock position only when shift lever is in Park ("P"). Key should be removable only in Lock position.
- (b) **PARKING BRAKE**—Check parking brake holding ability by parking on a fairly steep hill and restraining the vehicle with the parking brake only.

CAUTION: Before making checks (c) or (d) below, be sure to have a clear distance ahead and behind the vehicle, set the parking brake and firmly apply the regular brake. Do not depress accelerator pedal. Be prepared to turn off ignition switch immediately if engine should start. If pre-

cautions aren't followed vehicle may move unexpectedly, possibly causing personal injury.

- (c) **STARTER SAFETY SWITCH (AUTOMATIC TRANSMISSION CARS)**—Check starter safety switch by attempting to start the engine with the transmission in each of the driving gears. The starter should operate only in the Park ("P") or Neutral ("N") positions.
- (d) **STARTER SAFETY SWITCH (MANUAL TRANSMISSION VEHICLES)**—To check, place the shift lever in neutral, depress the clutch halfway, and attempt to start. The starter should operate only when clutch is fully depressed.
- (e) **TRANSMISSION SHIFT INDICATOR**—Check to be sure automatic transmission shift indicator accurately indicates the shift position selected.
- (f) **STEERING**—Be alert to any changes in steering action. The need for inspection or servicing may be indicated by increased effort to turn the steering wheel, excessive free play or unusual sounds when turning or parking.
- (g) **WHEEL ALIGNMENT, BALANCE AND TIRES**—In addition to uneven or abnormal tire wear, the need for wheel alignment service may be indicated by a pull to the right or left when driving on a straight and level road. The need for wheel balancing is usually indicated by a vibration of the steering wheel or seat while driving at normal highway speeds. Check tire inflation pressure (including spare tire) when tires are "cold" at least monthly, or more often, if driver daily check indicates the need.—See Owner's and Driver's Manual Driver Daily Checklist.
- (h) **BRAKES**—Be alert to illumination of the brake warning light or changes in braking action, such as repeated pulling to one side, unusual sounds either when braking or between brake applications, or increased brake pedal travel. Any of these could indicate the need for brake system inspection and/or service.
- (i) **EXHAUST SYSTEM**—Be alert to any change in the sound of the exhaust system or a smell of fumes which may indicate a leak or overheat condition requiring inspection and/or service. (See also Engine Exhaust Gas Caution and Catalytic Converter information in Owner's and Driver's Manual and Item B-3 in this folder.
- (j) **WINDSHIELD WIPERS AND WASHERS**—Check operation of wipers, as well as condition and alignment of wiper blades. Check amount and direction of fluid sprayed by washers during use.

- (k) **DEFROSTERS**—Check performance by moving controls to "Def" and noting amount of air directed against the windshield.
- (l) **REARVIEW MIRRORS AND SUN VISORS**—Check that mirrors and sun visors stay in the selected position.
- (m) **HORN**—Blow the horn occasionally to be sure that it works. Check all button locations.
- (n) **LAP AND SHOULDER BELTS**—Check belts, buckles, latch plates, retractors, reminder systems, guide loops, clips, and anchors for proper operation and for damage.
- (o) **SEAT ADJUSTERS**—Check that seat adjusters (and swivel seat lock, if present) securely engage by pushing forward and backward (and twisting) whenever seat is adjusted.
- (p) **SEATBACK LATCHES (IF SO EQUIPPED)**—Check to see that seatback latches are holding by pulling forward on the top of each folding seatback.
- (q) **LIGHTS AND BUZZERS**—Check all instrument panel illuminating and warning lights, seat belt reminder light and buzzer, interior lights, license plate lights, side marker lights, headlamps, parking lamps, identification or clearance lights, tail lamps, brake lights, turn signals, backup lamps, and hazard warning flashers. Have headlamp aim checked every 12 months or 15,000 miles (24 000 km) or more often if light beams seem to be aimed improperly.
- (r) **GLASS**—Check for broken, scratched, dirty or damaged glass on vehicle that could obscure vision or become an injury hazard.
- (s) **DOOR LATCHES**—Check for positive closing, latching and locking.
- (t) **HOOD LATCHES**—Check to make sure hood closes firmly by lifting on the hood after each closing. Check also for broken, damaged or missing parts which might prevent secure latching.
- (u) **FLUID LEAKS**—Check for fuel, water, oil or other fluid leaks by observing the surface beneath the vehicle after it has been parked for a while. (Water dripping from air conditioning system after use is normal.) If gasoline fumes or fluid are noticed at any time, the cause should be determined and corrected without delay because of the possibility of fire.
- (v) **SPARE AND JACK**—Check that spare tire assembly and jack equipment are securely stowed at all times.

B-2 TIRES, WHEELS AND DISC BRAKES—Check disc brake pads for wear and surface condition of rotors while wheels are removed during tire rotation (see Item A-5). Check tires for excessive wear or damage. Make certain wheels are not bent or

cracked and that wheel nuts have been tightened to the torque value shown in the Owner's and Driver's Manual. (See "In Case of Emergency" section.)

B-3 EXHAUST SYSTEM*—Check complete exhaust system including catalytic converter and nearby body areas for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the passenger compartment. Any necessary corrections should be made immediately. To help continue integrity, exhaust system pipes and resonators rearward of the muffler must be replaced whenever a new muffler is installed. Also see Item B-1 (i).

B-4 SUSPENSION AND STEERING—Check for damaged, loose or missing parts, or parts showing visible signs of excessive wear or lack of lubrication in front and rear suspension and steering system. Questionable parts noted should be replaced by a qualified mechanic without delay.

B-5 BRAKES AND POWER STEERING—Check lines and hoses for proper attachment, leaks, binding, cracks, chafing, deterioration, etc. Any questionable parts noted should be replaced or repaired immediately. When abrasion or wear is evident on lines or hoses, the cause must be corrected.

B-6 ENGINE DRIVE BELTS*—Check belts driving fan, AIR pump, generator, power steering pump and air conditioning compressor for cracks, fraying, wear and tension. Adjust or replace as necessary.

B-7 DRUM BRAKES AND PARKING BRAKE—(See Item B-2 for disc brake check.) Check drum brake linings for wear or cracks and other internal brake components at each wheel (drums, wheel cylinders, etc.). Parking brake adjustment also should be checked whenever drum brake linings are checked.

NOTICE: More frequent brake checks should be made if driving conditions and habits result in frequent brake application.

B-8 THROTTLE LINKAGE—Lubricate as covered in Owner's and Driver's Manual. Check for damaged or missing parts, interference or binding. Any deficiencies should be corrected without delay by a qualified mechanic.

B-9 UNDERBODY—Corrosive materials used for ice and snow removal and dust control can accumulate on the underbody. If allowed to remain, these materials can result in accelerated rusting and deterioration of underbody components such as fuel lines, frame and floor pan, exhaust system, etc. At least once each year, preferably after a winter's exposure, these corrosive materials should be removed by flushing the underbody

with plain water. Particular attention should be given to cleaning out those areas where mud and other foreign materials collect.

SECTION C—EMISSION CONTROL MAINTENANCE

SCHEDULE II

NOTICE: Additional recommended maintenance instructions relating to vehicle use, evidence of maintenance, and service replacement parts are included in the New Vehicle Warranty Information folder.

- C-1 CARBURETOR CHOKE AND HOSES**—Check choke mechanism and vacuum break for proper operation. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor choke hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary. Check operation at 6 months or 7,500 miles (12 000 km), 24 months or 30,000 miles (48 000 km) and every 12 months or 15,000 miles (24 000 km) thereafter.
- C-2 THERMOSTATICALLY CONTROLLED AIR CLEANER**—Inspect installation to make certain that all hoses and ducts are connected and correctly installed. Also check valve for proper operation.
- C-3 ENGINE IDLE SPEED**—Adjust engine idle speed accurately (following the specifications shown on the label under the hood). Adjustments must be made with test equipment known to be accurate.
- C-4 EARLY FUEL EVAPORATION (EFE) SYSTEM**—Check valve for proper operation. A binding condition must be corrected. Check thermal vacuum switch for proper operation. Check hoses for cracking, abrasion or deterioration. Replace parts as necessary.
- C-5 CARBURETOR MOUNTING**—At designated intervals torque carburetor attaching bolts and/or nuts to compensate for compression of the gasket.
- C-6 VACUUM ADVANCE SYSTEM AND HOSES**—Check system for proper operation and hoses for proper connection, cracking, abrasion or deterioration. Replace parts as necessary.
- C-7 FUEL FILTER**—Replace filter in carburetor at designated intervals or more frequently if clogged.
- C-8 POSITIVE CRANKCASE VENTILATION SYSTEM (PCV)**—Check the PCV system for satisfactory operation at 15,000-mile (24 000 km) intervals, and clean filter. Replace the PCV valve at 30,000-mile (48 000 km) intervals. Replace deteriorated hoses. The PCV filter (located in the air cleaner) should be replaced whenever the air cleaner element is replaced.
- C-9 SPARK PLUG WIRES**—Clean exterior of wires; remove any evidence of corrosion on end terminals. Inspect spark plug wires for evidence of checking, burning, or cracking of exterior insulation and tight fit at distributor cap and spark plugs or other deterioration. If corrosion cannot be removed or other conditions above are noted, replace wire.
- C-10 IDLE SOLENOID**—Check for proper operation. An inoperative solenoid must be replaced.
- C-11 SPARK PLUGS**—Replace plugs at designated intervals with type specified in Owner's and Driver's Manual.
- C-12 TIMING AND DISTRIBUTOR CAP**—Adjust ignition timing following the specifications shown on label under the hood. Also, carefully inspect the interior and exterior of the distributor cap and rotor for cracks, carbon tracking and terminal corrosion. Clean or replace as necessary.
- C-13 AIR CLEANER ELEMENT**—Replace the engine air cleaner element at designated intervals. The PCV filter should be replaced at the same interval. Operation of vehicle in dusty areas will necessitate more frequent replacement. Your dealer can be of assistance in determining the proper replacement frequency for the conditions under which you operate your vehicle.
- NOTICE: Do not operate the engine without the air cleaner unless temporary removal is necessary during repair or maintenance of the vehicle. When the air cleaner is removed, backfiring can cause fire in the engine compartment.
- C-14 CARBURETOR VACUUM BREAK ADJUSTMENT**—Inspect vacuum break linkage for proper operation. A binding condition must be corrected. Check hoses for proper connection, cracking, abrasion or deterioration. Replace parts as necessary. Adjust vacuum break at specified intervals following procedures and specifications found in appropriate service manual.
- C-15 EVAPORATION CONTROL SYSTEM (ECS)**—Check all fuel and vapor lines and hoses for proper connections and correct routing as well as condition. Check operation of bowl vent and purge valves, where applicable. Remove canister and check for cracks or damage. Replace damaged or deteriorated parts as necessary. Replace filter in lower section of canister. Off road operation of four-wheel drive vehicles may necessitate more frequent filter replacement.
- C-16 FUEL CAP, FUEL LINES AND FUEL TANK**—
1. Inspect the fuel tank, cap and lines for damage which could cause leaks.
 2. Remove fuel cap and inspect gasket for an even imprint from the filler neck, and any indications of physical damage.
 3. Replace any damaged or deteriorated parts.

COMPLETE VEHICLE MAINTENANCE SCHEDULE

Heavy Duty Emission System

When To Perform Services (Months or Miles/Kilometres, Whichever Occurs First)	Item No.	Services (For Details, See Numbered Paragraphs)
Section A—Lubrication and General Maintenance		
Every 4 months or 6,000 miles (9 600 km)	A-1	Chassis Lubrication
	A-2	•Fluid Levels Check
	A-3	*Engine Oil Change
See Explanation	A-4	Tire Rotation
	A-5	*Engine Oil Filter Change
	A-6	Rear & Front Axle Lube Change
See Explanation	A-7	Wheel Bearings Repack
Every 12 months or 12,000 miles (19 200 km)	A-8	Cooling System Check
Every 24,000 miles (38 400 km)	A-9	Auto. Trans. Fluid & Filter Change
Every 36,000 miles (57 600 km)	A-10	Manual Steering Gear Check
Section B—Safety Maintenance		
Every 4 months or 6,000 miles (9 600 km)	B-1	Owner Safety Checks
	B-2	Tires and Wheels Check
	B-3	Exhaust System Check
	B-4	*Engine Drive Belts Check
	B-5	Suspension and Steering Check
	B-6	Brakes and Power Steering Check
Every 6,000 miles (9 600 km)	B-7	Disc Brakes Check
Every 12 months or 12,000 miles (19 200 km)	B-8	Drum Brakes and Parking Brake Check
	B-9	Throttle Linkage Check
	B-10	Underbody Flush & Check
Section C—Emission Control Maintenance		
At 1st 4 months or 6,000 miles (9 600 km)—then at 12 month/ 12,000 mile (19 200 km) intervals	C-1	Carburetor Choke and Hoses Check
	C-2	Engine Idle Speed Adjustment
	C-3	Carburetor Mounting Torque
Every 12 months or 12,000 miles (19 200 km)	C-4	Thermo. Controlled Air Cleaner Check
	C-5	Manifold Heat Valve Check
Every 12,000 miles (19 200 km)	C-6	Spark Plugs Replacement
	C-7	Engine Timing Adjust. & Distributor Check
	C-8	EGR System Check
Every 12 months or 12,000 miles (19 200 km)	C-9	Carburetor Fuel Filter Replacement
	C-10	Engine Idle Mixture Adjust
	C-11	Throttle Return Control Check
	C-12	Idle Stop Solenoid Check
	C-13	PCV System Check
Every 24 months or 24,000 miles (38 400 km)	C-14	ECS System Check
	C-15	Fuel Cap, Tank and Lines Check
Every 12,000 miles (19 200 km)	C-16	Air Cleaner Element Replacement
Every 12 months or 12,000 miles (19 200 km)	C-17	Spark Plug and Ignition Coil Wires Check

*Also an Emission Control Service •Also a Safety Service

(1) All except California 350 CID & 400 CID engines which receive this service at 24 months or 24,000 miles (38 400 Km).

(2) All except California 350 CID & 400 CID engines which receive this service at 24,000 miles (38 400 Km).

EXPLANATION OF COMPLETE 1978 VEHICLE MAINTENANCE SCHEDULE

Presented below is a brief explanation of each of the services listed in the preceding Complete Vehicle Maintenance Schedule.

NORMAL VEHICLE USE—The owner's maintenance instructions contained in this maintenance schedule are based on the assumption that your vehicle will be used as designed:

- to carry passengers and cargo within the limitations indicated on the VIN plate,
- on reasonable road surfaces within legal operating limits, and
- on a daily basis, as a general rule, for at least several miles/kilometres.

Unusual operating conditions will require more frequent vehicle maintenance as specified in the respective sections included below.

After each of the following maintenance services is performed, it is recommended that you insert the month, day and mileage in the maintenance schedule under the appropriate "Owner Service Log" column.

SECTION A—LUBE & GENERAL MAINTENANCE

ITEM

NO. SERVICES

A-1 CHASSIS—Lubricate all grease fittings in front suspension, steering linkage, and constant velocity universal joint. Also lubricate transmission and transfer case shift linkage, hood latch, hood and door hinges, parking brake cable guides and linkage, clutch linkage, propeller shaft slip joint, universal joints, and brake and clutch pedal springs. Lubricate suspension and steering linkage every 2 months or 3,000 miles (4 800 km) when operating under dusty or muddy conditions and in extensive off-road use. See your Owner's and Driver's manual for additional services required on four wheel drive models. Also see item B-9.▲

A-2 FLUID LEVELS—Check level of fluid in brake master cylinder▲, power steering pump▲, battery, engine, axles, transmission, transfer case and windshield washer▲. Check coolant for proper level regularly (daily if necessary, depending on severity of service), and every 4 months or 6,000 miles (9 600 km) for freeze protection to at least -20° F (-29° C) or to the lowest temperature expected during the period

▲Also a Safety Service

*Also an Emission Control Service

of vehicle operation.* Proper engine coolant also provides corrosion protection.

Any significant fluid loss in any of these systems or units could mean that a malfunction is developing and corrective action should be taken immediately. A low fluid level in the brake master cylinder reservoir(s) could also be an indicator that the disc brake pads or drum brake linings need replacing.

A-3 ENGINE OIL*—Change each 4 months or 6,000 miles (9 600 km), whichever occurs first, or each 2 months or 3,000 miles (4 800 km) when the vehicle is operated under the following conditions: (a) driving in dusty conditions, (b) trailer pulling, (c) extensive idling or (d) short-trip operation at freezing temperatures (with engine not thoroughly warmed-up). See your Owner's and Driver's Manual for additional details.

A-4 TIRES—To equalize wear, rotate tires and adjust inflation pressures as indicated in your Owner's and Driver's Manual. **Passenger Type Tires:** Bias or Bias-belted, rotate every 7,500 miles (12 000 km); Radial, rotate first 7,500 miles (12 000 km) and at least every 15,000 miles (24 000 km) thereafter. **Light Truck Type Tires:** Bias or Bias-belted, rotate every 6,000 miles (9 600 km); Radial, rotate first 6,000 miles (9 600 km) and at least every 12,000 miles (19 200 km) thereafter.

A-5 ENGINE OIL FILTER*—Replace at the first oil change and every other oil change thereafter, if mileage (6,000 miles) (9 600 km) is the determining factor. If time (4 months) is the determining factor, then change oil filter with every oil change.

A-6 REAR AXLE—On 20 and 30 Series trucks, change lubricant every 24,000 miles (38 400 km). Change lubricant every 12,000 miles (19 200 km) on all type rear axles under severe operating conditions.

FRONT AXLE AND TRANSFER CASE—Check every 6,000 miles (9 600 km). See Owner's and Driver's Manual for further information.

A-7 WHEEL BEARINGS—Clean and repack front wheel bearings at each brake lining replacement or 12,000 miles (19 200 km) whichever occurs first. Use a lubricant as specified in the "Recommended Fluids & Lubricants" chart in this folder.

A-8 COOLING SYSTEM—At 12-month or 12,000 mile (19 200 km) intervals, wash radiator cap and filler neck with clean water, pressure test system and radiator cap for proper pressure holding capacity, tighten hose clamps and inspect condition of all cooling and heater hoses. Replace hoses if checked, swollen or otherwise deteriorated. Clean exterior of radiator core and air conditioning condenser. Every 24 months or 24,000 miles

(38 400 km), drain, flush, and refill the cooling system with a new coolant solution as described in your Owner's and Driver's Manual.

A-9 AUTOMATIC TRANSMISSION FLUID—Under normal driving conditions, change the transmission fluid and service the sump filter every 24,000 miles (38 400 km). Under unusual conditions such as constant driving in heavy city traffic during hot weather, trailer pulling, etc., these services should be performed at 12,000-mile (19 200 km) intervals. See your Owner's and Driver's Manual for further details on transmission care.

A-10 MANUAL STEERING GEAR—Check for seal leakage around the pitman shaft and housing. If leakage is evident (solid grease oozing out—not just oily film), it should be corrected immediately.

SECTION B—SAFETY MAINTENANCE

NOTICE:—Items B-1(a) thru (v) can be checked by the owner or driver, while **Items B-2 thru B-10 should only be checked by a qualified mechanic.** It is particularly important that any safety systems which may have been adversely affected in an accident be checked and repaired as necessary before the vehicle is returned to use.

B-1 SAFETY CHECKS TO BE PERFORMED BY OWNER OR DRIVER—The following checks should be made regularly during operation at no greater interval than 4 months or 6,000 miles (9 600 km), whichever occurs first, and more often when the need is indicated. Any deficiencies should be brought to the attention of your dealer or another service outlet, as soon as possible, so the advice of a qualified mechanic is available regarding the need for repairs or replacements.

(a) **STEERING COLUMN LOCK (IF SO EQUIPPED)**—Check for proper operation by attempting to turn key to Lock position in the various transmission gear ranges when the vehicle is stationary. Key should turn to Lock position only when shift lever is in Park ("P"). Key should be removable only in Lock position.

(b) **PARKING BRAKE**—Check parking brake holding ability by parking on a fairly steep hill and restraining the vehicle with the parking brake only.

CAUTION: Before making checks (c) or (d) below, be sure to have a clear distance ahead and behind the vehicle, set the parking brake and firmly

apply the regular brake. Do not depress accelerator pedal. Be prepared to turn off ignition switch immediately if engine should start. If precautions aren't followed vehicle may move unexpectedly, possibly causing personal injury.

(c) **STARTER SAFETY SWITCH (AUTOMATIC TRANSMISSION VEHICLES)**—Check starter safety switch by attempting to start the engine with the transmission in each of the driving gears. The starter should operate only in the Park ("P") or Neutral ("N") positions.

(d) **STARTER SAFETY SWITCH (MANUAL TRANSMISSION VEHICLES)**—To check, place the shift lever in neutral, depress the clutch halfway, and attempt to start. The starter should operate only when clutch is fully depressed.

(e) **TRANSMISSION SHIFT INDICATOR**—Check to be sure automatic transmission shift indicator accurately indicates the shift position selected.

(f) **STEERING**—Be alert to any changes in steering action. The need for inspection or servicing may be indicated by increased effort to turn the steering wheel, excessive free play or unusual sounds when turning or parking.

(g) **WHEEL ALIGNMENT, BALANCE AND TIRES**—In addition to uneven or abnormal tire wear, the need for wheel alignment service may be indicated by a pull to the right or left when driving on a straight and level road. The need for wheel balancing is usually indicated by a vibration of the steering wheel or seat while driving at normal highway speeds. Check tire inflation pressure (including spare tire) when tires are "cold" at least monthly, or more often, if driver daily check indicates the need.—See Owner's and Driver's Manual Driver Daily Checklist.

(h) **BRAKES**—Be alert to illumination of the brake warning light or changes in braking action, such as repeated pulling to one side, unusual sounds when braking, or increased brake pedal travel. Any of these could indicate the need for brake system inspection and/or service.

(i) **EXHAUST SYSTEM**—Be alert to any change in the sound of the exhaust system or a smell of fumes which may indicate a leak requiring inspection and/or service. (See also Engine Exhaust Gas Caution in Owner's and Driver's Manual and Item B-3 in this folder.)

(j) **WINDSHIELD WIPERS AND WASHER**—Check operation of wipers, as well as condition and alignment of wiper blades. Check amount and direction of fluid sprayed by washers during use.

(k) **DEFROSTER**—Check performance by moving controls to "Def" and noting amount of air directed against the windshield.

(l) **REARVIEW MIRRORS AND SUN VISORS**—Check that mirrors and sun visors stay in the selected position.

(m) **HORN**—Blow the horn occasionally to be sure that it works. Check all button locations.

(n) **LAP AND SHOULDER BELTS**—Check belts, buckles, latch plates, retractors, reminder systems, guide loops, clips, and anchors for proper operation and for damage.

(o) **SEAT ADJUSTERS**—Check that seat adjusters (and swivel seat lock, if so equipped) securely engage by pushing forward and backward (and twisting) whenever seat is adjusted.

(p) **SEATBACK LATCHES (IF SO EQUIPPED)**—Check to see that seatback latches are holding by pulling forward on the top of each folding seatback.

(q) **LIGHTS AND BUZZERS**—Check all instrument panel illuminating and warning lights, seat belt reminder light and buzzer (if so equipped), interior lights, license plate lights, side marker lights, headlamps, parking lamps, identification or clearance lights, tail lamps, brake lights, turn signals, backup lamps, and hazard warning flashers. Have headlamp aim checked every 12 months or 15,000 miles (24 000 km) or more often if light beams seem to be aimed improperly.

(r) **GLASS**—Check for broken, scratched, dirty or damaged glass on vehicle that could obscure vision or become an injury hazard.

(s) **DOOR LATCHES**—Check for positive closing, latching and locking.

(t) **HOOD LATCHES**—Check to make sure hood closes firmly by lifting on the hood after each closing. Check also for broken, damaged or missing parts which might prevent secure latching.

(u) **FLUID LEAKS**—Check for fuel, water, oil or other fluid leaks by observing the surface beneath the vehicle after it has been parked for a while. (Water dripping from air conditioning system after use is normal.) If gasoline fumes or fluid are noticed **at any time**, the cause should be determined and corrected without delay because of the possibility of fire.

(v) **SPARE AND JACK**—Check that spare tire assembly and jack equipment are securely stowed at all times.

B-2 TIRES, AND WHEELS—Check tires for excessive wear or damage. Make certain wheels are not bent or cracked and that wheel nuts have been tightened to torque value shown in Owner's and Driver's

Manual. (See "In Case of Emergency" section) For trucks with dual wheels, also set wheel nut torque to the value shown in the Owner's and Driver's Manual, at first 100 miles (160 km), 1,000 miles (1 600 km) and 6,000 miles (9 600 km).

B-3 EXHAUST SYSTEM—Check complete exhaust system and nearby body areas for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the passenger compartment. Any necessary corrections should be made immediately. To help continue integrity, exhaust system pipes and resonators rearward of the muffler must be replaced whenever a new muffler is installed. Also see Item B-1(i).

B-4 ENGINE DRIVE BELTS—Check belts driving fan, AIR pump, generator, power steering pump and air conditioning compressor for cracks, fraying, wear and tension. Adjust or replace as necessary.

B-5 SUSPENSION AND STEERING—Check for damaged, loose or missing parts, or parts showing visible signs of excessive wear or lack of lubrication in front and rear suspension and steering system. Questionable parts noted should be replaced by a qualified mechanic without delay.

B-6 BRAKES AND POWER STEERING—Check lines and hoses for proper attachment, binding, leaks, cracks, chafing, deterioration, etc. Any questionable parts noted should be replaced or repaired immediately. When abrasion or wear is evident on lines or hoses, the cause must be corrected.

B-7 DISC BRAKES—Check brake pads for wear and surface condition of rotors while wheels are removed during tire rotation. (See Item A-4).

NOTICE: More frequent brake checks should be made if driving conditions and habits result in frequent brake application.

B-8 DRUM BRAKES AND PARKING BRAKE—Check drum brake linings for wear or cracks and other internal brake components at each wheel (drums, wheel cylinders, etc.). Parking brake adjustment also should be checked whenever drum brake linings are checked.

NOTICE: More frequent brake checks should be made if driving conditions and habits result in frequent brake application.

B-9 THROTTLE LINKAGE—Lubricate as covered in Owner's and Driver's Manual. Check for damaged or missing parts, interference or binding. Any deficiencies should be corrected without delay by a qualified mechanic.

B-10 UNDERBODY—Corrosive material used for ice and snow removal and dust control can accumulate on the underbody. If allowed to remain, these materials can result in accelerated rusting and

deterioration of underbody components such as fuel lines, frame and floor pan, exhaust system, etc. At least once each year, preferably after a winter's exposure, these corrosive materials should be removed by flushing the underbody with plain water. Particular attention should be given to cleaning out those areas where mud and other foreign materials collect.

SECTION C—EMISSION CONTROL MAINTENANCE

NOTICE: Additional recommended maintenance instructions relating to vehicle use, evidence of maintenance, and service replacement parts are included in the New Vehicle Warranty Information folder.

- C-1 CARBURETOR CHOKE AND HOSES**—Check choke mechanism for proper operation. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor choke hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary.
- C-2 ENGINE IDLE SPEED ADJUSTMENT**—Adjust engine idle speed accurately (following the specifications shown on the label under the hood). Adjustments must be made with test equipment known to be accurate.
- C-3 CARBURETOR MOUNTING**—At designated intervals torque carburetor attaching bolts and/or nuts to compensate for compression of the gasket.
- C-4 THERMOSTATICALLY CONTROLLED AIR CLEANER**—Inspect installation to make certain that all hoses and ducts are connected and correctly installed. Also check valve for proper operation.
- C-5 MANIFOLD HEAT VALVE**—Some engines are equipped with a manifold heat valve which should be inspected and repaired as necessary to insure free operation.
- C-6 SPARK PLUGS**—Replace at designated intervals with type specified in Owner's and Driver's Manual.
- C-7 ENGINE TIMING ADJUSTMENT & DISTRIBUTOR CHECK**—Adjust ignition timing following the specifications shown on label under the hood. Also, carefully inspect the interior and exterior of the distributor cap and rotor for cracks, carbon tracking and terminal corrosion. Clean or replace as necessary.
- C-8 EXHAUST GAS RECIRCULATION SYSTEM (EGR)**—At 12 month/12,000 mile (19 200 km) intervals, inspect and if deposits exist, clean the EGR valve. Inspect the EGR passages in the inlet manifold and clean as required. A damaged EGR valve must be repaired or replaced. Check thermal switch for proper operation. A malfunctioning switch must be replaced. Check hoses for proper connection, cracking, abrasions, or deterioration and replace as required.
- C-9 CARBURETOR FUEL INLET FILTER**—Replace filter at designated intervals or more frequently if clogged.
- C-10 ENGINE IDLE MIXTURE**—At designated intervals or in case of a major carburetor overhaul, or when poor idle quality exists, adjust mixture by a mechanical method (lean drop), following the specifications shown on the label under the hood.
- C-11 THROTTLE RETURN CONTROL (TRC) SYSTEM**—Check hoses for proper connections, cracking, abrasion, or deterioration and replace as necessary. Check for proper operation of system.
- C-12 IDLE STOP SOLENOID**—Check for proper operation. An inoperative solenoid must be replaced.
- C-13 POSITIVE CRANKCASE VENTILATION SYSTEM (PCV)**—Check the PCV system for satisfactory operation at 12-month or 12,000-mile (19 200 km) intervals. Replace the PCV valve at 24-month or 24,000-mile (38 400 km) intervals and replace the filter. The PCV valve should be replaced at 12-month or 12,000-mile (19 200 km) intervals when the vehicle is used in operations involving heavy dust, extensive idling, trailer pulling, and short trip use at freezing temperatures where engine does not become thoroughly warmed up. The PCV filter should be replaced at 12-month/12,000-mile (19 200 km) intervals under dusty driving conditions.
- C-14 EVAPORATION CONTROL SYSTEM (ECS)**—Check all fuel and vapor lines and hoses for proper connections and correct routing as well as condition. Check operation of bowl vent and purge valves, where applicable. Remove canisters and check for cracks or damage. Replace damaged or deteriorated parts as necessary. Replace filter in lower section of canister. If vehicle is equipped with two canisters, filter is located in lower canister only. Off road operation of four-wheel drive vehicles may necessitate more frequent filter replacement.
- C-15 FUEL CAP, FUEL LINES AND FUEL TANK**—Inspect the fuel tank, cap and lines for damage which could cause leakage. Inspect fuel cap for correct sealing ability and indications of physical damage. Replace any damaged or malfunctioning parts.
- C-16 AIR CLEANER ELEMENT**—Replace the engine air cleaner element at designated intervals. Operation of vehicle in dusty areas will necessitate more frequent element replacement. Your dealer can be of assistance in determining the proper replacement frequency for the conditions under which you operate your vehicle.

NOTICE: Do not operate the engine without the air cleaner unless temporary removal is necessary during repair or maintenance of the vehicle. When the air cleaner is removed, backfiring can cause fire in the engine compartment.

- C-17 SPARK PLUG AND IGNITION COIL WIRES**—Clean exterior of wires; remove any evidence of corrosion on end terminals. Inspect spark plug and ignition coil wires for evidence of checking, burning, or cracking of exterior insulation and tight fit at distributor cap and spark plugs, or other deterioration. If corrosion cannot be removed, or other conditions above are noted, replace wire.

COMPLETE VEHICLE MAINTENANCE SCHEDULE V-8 DIESEL ENGINE

When To Perform Services (Months or Miles, Whichever Occurs First)	Item No.	Services (For Details, See Numbered Paragraphs)
SECTION A—Lubrication and General Maintenance		
Every 3,000 Miles (4 800 km)	A-1	*Engine Oil Change
	A-2	*Oil Filter Change
Every 6,000 Miles (9 600 km)	A-3	Chassis Lubrication
	A-4	●Fluid Levels Check
See Explanation	A-5	Rear Axle Lubricant Check
	A-6	Tire Rotation
Every 12 Months or 12,000 Miles (19 200 km)	A-7	*Cooling System Check
	A-8	Wheel Bearings Repack
See Explanation	A-9	Manual Steering Gear Check
Every 30,000 Miles (48 000 km)	A-9	Manual Steering Gear Check
Every 12,000 Miles (19 200 km)	A-10	Auto Trans. Fluid and Filter Change
SECTION B—Safety Maintenance		
Every 12 Months or 6,000 Miles (9 600 km)	B-1	Owner Safety Checks
	B-2	Tire, Wheels and Disc Brake Check
	B-3	*Exhaust System Check
	B-4	Suspension and Steering Check
	B-5	Brakes and Power Steering Check
	B-6	*Drive Belt Check
Every 12 Months or 15,000 Miles (24 000 km)	B-7	Drum Brakes and Parking Brake Check
	B-8	Throttle Linkage Check
	B-9	Underbody Flush and Check
SECTION C—Emissions Control Maintenance		
Every 24,000 Miles (38 400 km)	C-1	Fuel Filter Replacement
Every 6,000 Miles (9 600 km)	C-2	Crankcase Ventilation System
At First 3,000 Miles (4 800 km) Then at 30,000 Mile (48 000 km) Intervals	C-3	Engine Idle Speeds Adjust
Every 30,000 Miles (48 000 km)	C-4	Air Cleaner Element Replacement

●Also A Safety Service

*Also An Emission Control Service

EXPLANATION OF COMPLETE 1978 VEHICLE MAINTENANCE SCHEDULE

Presented below is a brief explanation of each of the services listed in the preceding Complete Vehicle Maintenance Schedule.

NORMAL VEHICLE USE—The owner's maintenance instructions contained in this maintenance schedule are based on the assumption that your vehicle will be used as designed:

- to carry passengers and cargo within the limitations indicated on the VIN plate,
- on reasonable road surfaces within legal operating limits, and
- on a daily basis, as a general rule, for at least several miles/kilometres.

Unusual operating conditions will require more frequent vehicle maintenance as specified in the respective sections included below.

After each of the following maintenance services is performed, it is recommended that you insert the month, day and mileage in the maintenance schedule under the appropriate "Owner Service, Log" column.

SECTION A—LUBE & GENERAL MAINTENANCE

ITEM

NO. SERVICES

- A-1 ENGINE OIL***—Change every 3,000 miles (4 800 km). See Owner's and Driver's Manual for additional details on engine oil.
- A-2 ENGINE OIL FILTER***—Replace at every oil change.
- A-3 CHASSIS**—Lubricate all grease fittings in front suspension, steering linkage. Also lubricate transmission shift linkage, hood latch, hood and door hinges, parking brake cable guides and linkage, clutch linkage, propeller shaft slip joint, universal joints, and brake pedal springs. Lubricate suspension and steering linkage every 2 months or 3,000 miles (4 800 km) when operating under dusty or muddy conditions and in extensive off-road use. Also see item B-8.
- A-4 FLUID LEVELS**—Check level of fluid in brake master cylinder^A, power steering pump^A, battery, engine^A, axle, transmission, and windshield washer^A. Engine coolant should be checked for proper level and freeze protection to at least -20° F (-29° C) or to the lowest temperature expected during the period of vehicle operation.* Proper engine coolant also provides corrosion protection.

A-5 REAR AXLE—Check lubricant every 6,000 miles (9 600 km).

A-6 TIRES—To equalize wear, rotate tires and adjust inflation pressures as stated in your Owner's and Driver's Manual. Radial tires should be rotated at first 6,000 miles (9 600 km) and then at every 12,000 miles (19 200 km) thereafter. Bias-belted tires should be rotated every 6,000 miles (9 600 km). In addition to these rotation schedules both bias-belted and radial tires should be rotated whenever uneven tire wear is noticed.

A-7 COOLING SYSTEM*—At 12-month or 12,000-mile (19 200 km) intervals, wash radiator cap and filler neck with clean water, pressure test system and radiator cap for proper pressure holding capacity, tighten hose clamps and inspect condition of all cooling and heater hoses. Replace hoses if checked, swollen or otherwise deteriorated. Clean exterior of radiator core and air conditioning condenser. Every 24 months or 24,000 miles (38 400 km), drain, flush, and refill the cooling system with a new coolant solution as described in your Owner's and Driver's Manual.

A-8 WHEEL BEARINGS—Clean and repack front wheel bearings at each brake relining or 30,000 miles (48 000 km) whichever comes first. Use a lubricant as specified in the "Recommended Fluids & Lubricants" chart in this folder.

A-9 MANUAL STEERING GEAR—Check for seal leakage around the pitman shaft and housing. If leakage is evident (solid grease oozing out—not just oily film), it should be corrected immediately.

A-10 AUTOMATIC TRANSMISSION FLUID—Change the transmission fluid and service the sump filter every 12,000 miles (19 200 km). See your Owner's and Driver's Manual for further details on transmission care.

- *Also a Safety Service
- *Also an Emission Control Service

SECTION B—SAFETY MAINTENANCE

NOTICE—Items B-1 (a) thru (u) can be checked by the owner or driver, while **Items B-2 thru B-9 should only be checked by a qualified mechanic.** It is particularly important that any safety systems which may have been adversely affected in an accident be checked and repaired as necessary before the vehicle is returned to use.

B-1 SAFETY CHECKS TO BE PERFORMED BY OWNER OR DRIVER—The following checks should be made regularly during operation at no greater interval than 12 months or 6,000 miles (9 600 km), whichever occurs first, and more often when the need is indicated. Any deficiencies should be brought to the attention of your dealer or another service outlet, as soon as possible, so the advice of a qualified mechanic is available regarding the need for repairs or replacements.

- (a) **STEERING COLUMN LOCK**—Check for proper operation by attempting to turn key to Lock position in the various transmission gear ranges when the vehicle is stationary. Key should turn to Lock position only when shift lever is in Park ("P") on automatic transmission models. Key should be removable only in Lock position.
- (b) **PARKING BRAKE**—Check parking brake holding ability by parking on a fairly steep hill and restraining the vehicle with the parking brake only.

CAUTION: Before making check (c) below, be sure to have a clear distance ahead and behind the vehicle, set the parking brake and firmly apply the regular brake. Do not depress accelerator pedal. Be prepared to turn off ignition switch immediately if engine should start. If precautions aren't followed vehicle may move unexpectedly, possibly causing personal injury.

- (c) **STARTER SAFETY SWITCH (AUTOMATIC TRANSMISSION VEHICLES)**—Check starter safety switch by attempting to start the engine with the transmission in each of the driving gears. The starter should operate only in the Park ("P") or Neutral ("N") positions.
- (d) **TRANSMISSION SHIFT INDICATOR**—Check to be sure automatic transmission shift indicator accurately indicates the shift position selected.
- (e) **STEERING**—Be alert to any changes in steering action. The need for inspection or servicing may be indicated by increased effort to turn the steering wheel, excessive free play or unusual sounds when turning or parking.
- (f) **WHEEL ALIGNMENT, BALANCE AND TIRES**—In addition to uneven or abnormal tire wear, the need for wheel alignment service may be indicated by a pull to the right or left when driving on a straight and level road. The need for wheel balancing is usually indicated by a vibration of the steering wheel or seat while driving at normal highway speeds. Check tire inflation pressure (including spare tire) when tires are "cold" at least monthly, or more often, if driver daily check indicates the need.—See Owner's and Driver's Manual Driver's Daily Checklist.

- (g) **BRAKES**—Be alert to illumination of the brake warning light or changes in braking action, such as repeated pulling to one side, unusual sounds either when braking or between brake applications, or increased brake pedal travel. Any of these could indicate the need for brake system inspection and/or service.
- (h) **EXHAUST SYSTEM**—Be alert to any change in the sound of the exhaust system or a smell of fumes which may indicate a leak requiring inspection and/or service. (See also Engine Exhaust Gas Caution and information in Owner's and Driver's Manual and Item B-3 in this folder.)
- (i) **WINDSHIELD WIPERS AND WASHERS**—Check operation of wipers, as well as condition and alignment of wiper blades. Check amount and direction of fluid sprayed by washers during use.
- (j) **DEFROSTER**—Check performance by moving controls to "Def" and noting amount of air directed against the windshield.
- (k) **REARVIEW MIRRORS AND SUN VISORS**—Check that mirrors and sun visors stay in the selected position.
- (l) **HORN**—Blow the horn occasionally to be sure that it works. Check all button locations.
- (m) **LAP AND SHOULDER BELTS**—Check belts, buckles, latch plates, retractors, reminder systems, guide loops, clips, and anchors for proper operation and for damage.
- (n) **SEAT ADJUSTERS**—Check that seat adjusters securely engage by pushing forward and backward whenever seat is adjusted.
- (o) **SEATBACK LATCHES**—Check to see that seatback latches are holding by pulling forward on the top of each folding seatback.
- (p) **LIGHTS AND BUZZERS**—Check all instrument panel illuminating and warning lights, seat belt reminder light and buzzer (if so equipped), interior lights, license plate lights, side marker lights, headlamps, parking lamps, identification and clearance lights, tail lamps, brake lights, turn signals, backup lamps, and hazard warning flashers. Have headlamp aim checked every 12 months or 15,000 miles (24 000 km) or more often if light beams seem to be aimed improperly.
- (q) **GLASS**—Check for broken, scratched, dirty or damaged glass on vehicle that could obscure vision or become an injury hazard.
- (r) **DOOR LATCHES**—Check for positive closing, latching and locking.

- (s) **HOOD LATCHES**—Check to make sure hood closes firmly by lifting on the hood after each closing. Check also for broken, damaged or missing parts which might prevent secure latching.
- (t) **FLUID LEAKS**—Check for fuel, water, oil or other fluid leaks by observing the surface beneath the vehicle after it has been parked for a while. (Water dripping from air conditioning system after use is normal.) If gasoline fumes or fluid are noticed **at any time**, the cause should be determined and corrected without delay because of the possibility of fire.
- (u) **SPARE AND JACK**—Check that spare tire assembly and jack equipment are securely stowed at all times.

B-2 TIRES, WHEELS AND DISC BRAKES—Check disc brake pads for wear and surface condition of rotors while wheels are removed during tire rotation (see Item A-6). Check tires for excessive wear or damage. Make certain wheels are not bent or cracked and that wheel nuts have been tightened to the torque value shown in Owner's and Driver's Manual. (See "In Case of Emergency" section).

B-3 EXHAUST SYSTEM*—Check complete exhaust system and nearby body areas for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the passenger compartment. Any necessary corrections should be made immediately. To help continue integrity, exhaust system pipes and resonators rearward of the muffler must be replaced whenever a new muffler is installed. Also see Item B-1 (h).

B-4 SUSPENSION AND STEERING—Check for damaged, loose or missing parts, or parts showing visible signs of excessive wear or lack of lubrication in front and rear suspension and steering system. Questionable parts noted should be replaced by a qualified mechanic without delay.

B-5 BRAKES AND POWER STEERING—Check lines and hoses for proper attachment, leaks, binding, cracks, chafing, deterioration, etc. Any questionable parts noted should be replaced or repaired immediately. When abrasion or wear is evident on lines or hoses, the cause must be corrected.

B-6 ENGINE DRIVE BELTS*—Check belts driving fan, generator, power steering pump and air conditioning compressor for cracks, fraying, wear and tension. Adjust or replace as necessary.

B-7 DRUM BRAKES AND PARKING BRAKE—(See Item B-2 for disc brake check.) Check drum brake linings for wear or cracks and other internal brake components at each wheel (drums, wheel cylinders,

etc.). Parking brake adjustment also should be checked whenever drum brake linings are checked.

NOTICE: More frequent brake checks should be made if driving conditions and habits result in frequent brake application.

B-8 THROTTLE LINKAGE—Lubricate as covered in Owner's and Driver's Manual. Check for damaged or missing parts, interference or binding. Any deficiencies should be corrected without delay by a qualified mechanic.

B-9 UNDERBODY—Corrosive materials used for ice and snow removal and dust control can accumulate on the underbody. If allowed to remain, these materials can result in accelerated rusting and deterioration of underbody components such as fuel lines, frame and floor pan, exhaust system, etc. At least once each year, preferably after a winter's exposure, these corrosive materials should be removed by flushing the underbody with plain water. Particular attention should be given to cleaning out those areas where mud and other foreign materials collect.

SECTION C—EMISSION CONTROL MAINTENANCE

NOTICE: Additional recommended maintenance instructions relating to vehicle use, evidence of maintenance, and service replacement parts are included in the New Vehicle Warranty Information folder.

C-1 FUEL FILTER—Replace filter (located at the top rear of engine) at designated intervals or more frequently if clogged.

C-2 CRANKCASE VENTILATION SYSTEM—Clean breather cap and valve assembly and ventilation filter assemblies (both valve covers) each 6,000 miles (9 600 km.)

Replace breather cap and valve assembly and flow control valve each 30,000 miles (48 000 km). Inspect rubber fittings and replace as required, and clean tubes each 30,000 miles (48 000 km).

C-3 ENGINE IDLE SPEEDS—Adjust engine idle speed accurately (following the specifications shown on the label under the hood). Adjustments must be made with test equipment known to be accurate.

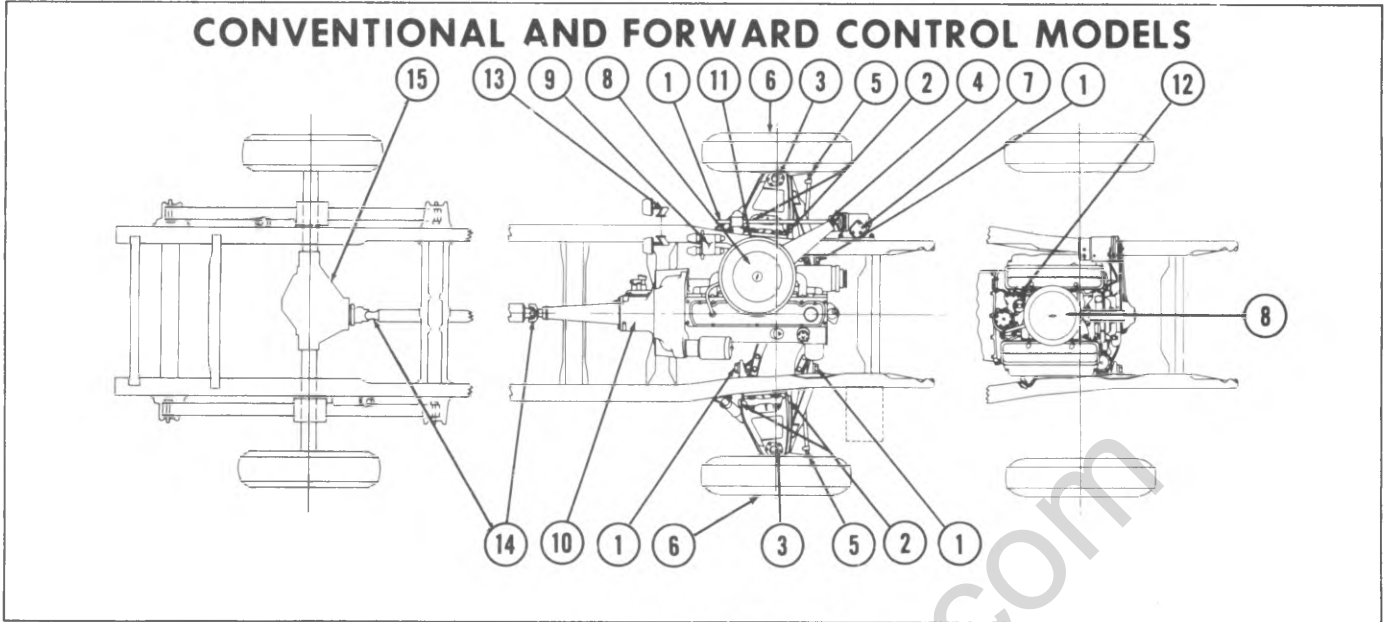
C-4 AIR CLEANER ELEMENT—Replace the engine air cleaner element at designated intervals. Operation of vehicle in dusty areas will necessitate more frequent replacements. Your dealer can be of assistance in determining the proper replacement frequency for the conditions under which you operate your vehicle.

RECOMMENDED FLUIDS & LUBRICANTS

USAGE	FLUID/LUBRICANT
Power steering system and pump reservoir	GM power steering fluid Part No. 1050017 or equivalent
Differential—standard	SAE-80W or SAE-80W-90 GL-5 gear lubricant (SAE-80W—GL-5 in Canada) GM Part No. 1052271 or 1052272
Differential—Positraction	Lubricant GM Part No. 1052271
Manual steering gear, except Corvette	Lubricant GM Part No. 1051052
Manual steering gear, Corvette	Lubricant GM Part No. 1052084
Manual transmission 3 & 4 speed	SAE-80W or SAE-80W-90 GL-5 gear lubricant (SAE-80W—GL-5 in Canada)
Manual transmission 5 speed	DEXRON® II automatic transmission fluid
Brake system and master cylinder	Delco Supreme 11 fluid or DOT-3
Clutch linkage (Man. trans. only) a. Pivot points b. Push rod to clutch fork joint, and cross shaft pressure fitting	Engine oil Chassis grease meeting requirements of GM 6031-M
Manual transmission shift linkage, column shift	Chassis grease
Shift linkage, floor shift	Engine oil
Hood Latch assembly a. Pivots and spring anchor b. Release pawl	Engine oil Chassis grease
Hood and Door hinges	Engine oil
Automatic transmission shift linkage	Engine oil
Chassis lubrication	Chassis grease meeting requirements of GM 6031-M
Automatic transmission	DEXRON® II automatic transmission fluid
Parking brake cables	Chassis grease
Front wheel bearings	Wheel bearing lubricant GM Part No. 1051344
Rear wheel inner bearing—Corvette	Lubricant GM Part No. 1050679
Body door hinge pins, station wagon tailgate hinge and linkage, station wagon folding seat, fuel door hinge, rear compartment lid hinges	Engine oil
Windshield washer solvent	GM Optikleen washer solvent Part No. 1051515 or equivalent
Engine coolant	Mixture of water and high quality Ethylene Glycol base type anti-freeze conforming to GM Spec. 1899-M

NOTE: Fluids and lubricants identified with GM part numbers or GM specification numbers may be obtained from your Chevrolet dealer.

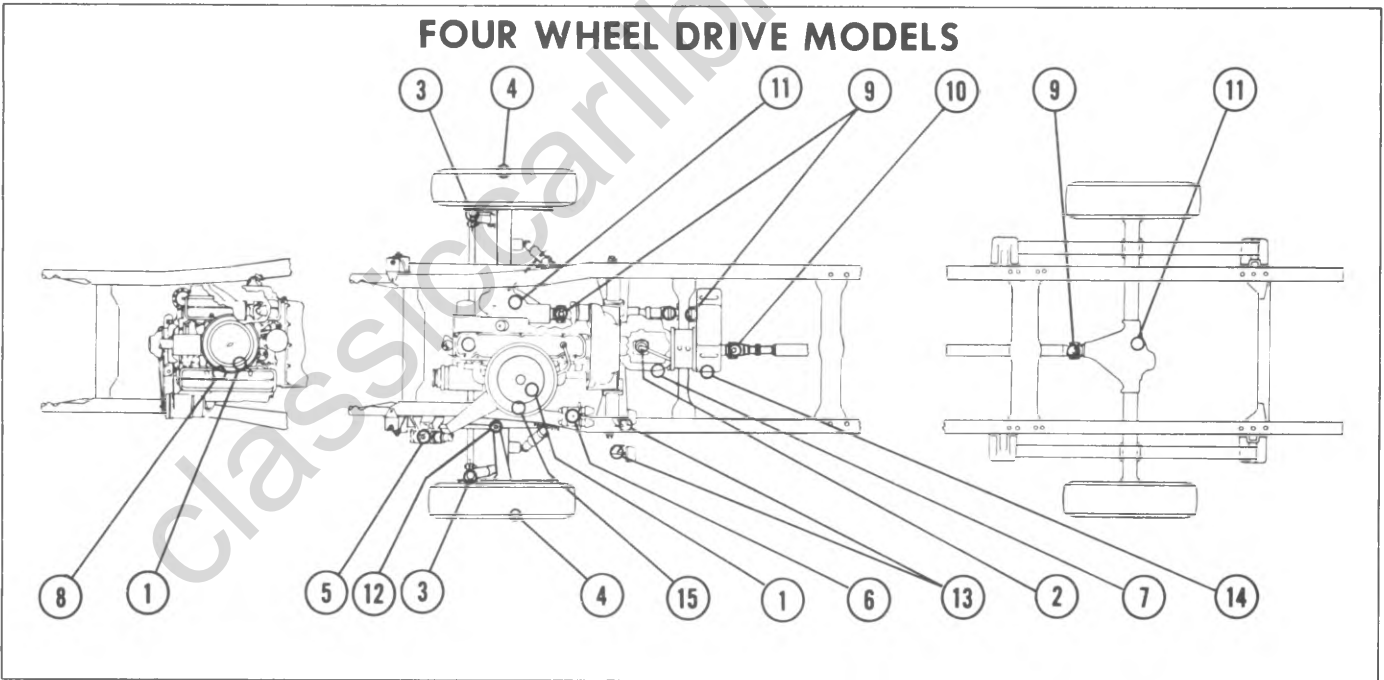
CONVENTIONAL AND FORWARD CONTROL MODELS



LUBRICATION POINTS

- | | | |
|---|---|-----------------------------------|
| 1 Lower Control Arms | 6 Wheel Bearings | 11 Throttle Bell Crank – L-6 |
| 2 Upper Control Arms | 7 Steering Gear | 12 Carburetor Linkage – V-8 |
| 3 Upper and Lower Control Arm Ball Joints | 8 Air Cleaner – Element | 13 Brake and Clutch Pedal Springs |
| 4 Intermediate Steering Shaft (PA10) | 9 Master Cylinder | 14 Universal Joints |
| 5 Tie Rod Ends | 10 Transmission – Manual
– Automatic | 15 Rear Axle |

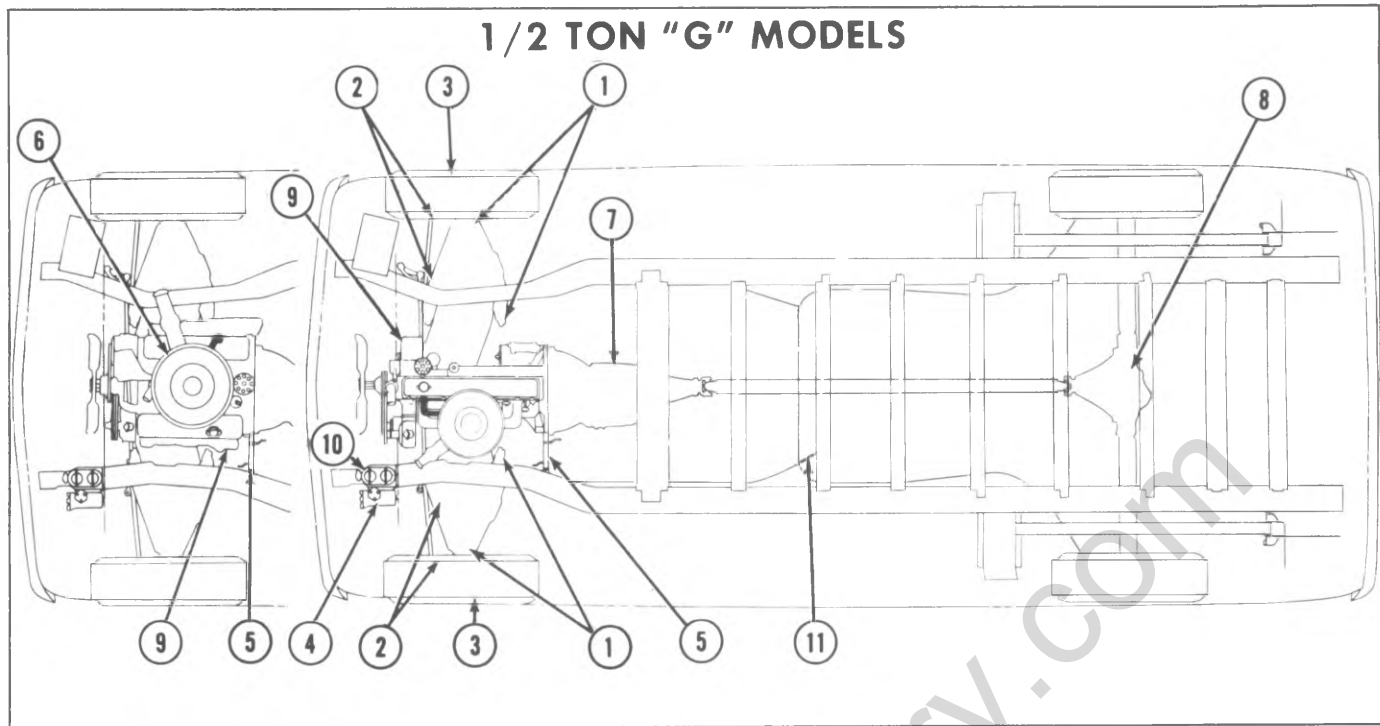
FOUR WHEEL DRIVE MODELS



LUBRICATION POINTS

- | | | |
|--------------------------|--|-----------------------------------|
| 1 Air Cleaner | 6 Master Cylinder | 11 Front and Rear Axle |
| 2 Control Linkage Points | 7 Transmission – Manual
– Automatic | 12 Drag Link |
| 3 Tie Rod Ends | 8 Carburetor Linkage – V-8 | 13 Brake and Clutch Pedal Springs |
| 4 Wheel Bearings | 9 Universal Joints | 14 Transfer Case |
| 5 Steering Gear | 10 Propeller Shaft Slip Joints | 15 Throttle Bell Crank – L-6 |

Lubrication Points (Conventional & Four Wheel Drive)



LUBRICATION POINTS

- | | | | | | |
|---|--------------------------------------|---|-----------------------|----|-----------------------|
| 1 | Control Arm Bushings and Ball Joints | 5 | Trans. Control Shaft | 8 | Rear Axle |
| 2 | Tie Rod Ends | 6 | Air Cleaner - Element | 9 | Oil Filter |
| 3 | Wheel Bearings | 7 | Transmission - Manual | 10 | Brake Master Cylinder |
| 4 | Steering Gear | | - Automatic | 11 | Parking Brake Linkage |
| | Clutch Cross-Shaft | | | | |

Lubrication Points 1/2 Ton G-Van

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SECTION 1A

HEATER

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STANDARD HEATER

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GENERAL DESCRIPTION

Heating components are attached to the dash panel on the right side of the vehicle. The blower and air inlet assembly and water hoses are located on the forward side of the dash panel while the heater core and distributor duct are on the passenger side.

The heater system is an air mix type system in which outside air is heated and then mixed in varying amounts with cooler outside air to attain the desired air temperature. The system consists basically of three parts: (1) the blower and air inlet assembly, (2) the heater distributor assembly and (3) the heater control assembly.

BLOWER AND AIR INLET ASSEMBLY

The blower and air inlet assembly draws outside air through the outside air inlet grille located forward of the windshield reveal molding and channels the air into the heater distributor assembly. The operation of the blower motor is controlled by the FAN switch on the heater control. The motor is connected in series with the FAN switch and also the blower resistor assembly. Located in the fuse block, in series between the blower motor and the battery, is a 25 amp. fuse C-K models - a 20 amp fuse on G models.

HEATER DISTRIBUTOR ASSEMBLY

The heater distributor assembly houses the heater core and the doors necessary to control mixing and channeling of the air. Since the unit has no water valve, water circulation keeps the core hot at all times. That portion of the air passing through the core receives maximum heat from the core. Air entering the distributor assembly is channeled as follows:

C-K Models

Air entering the distributor can be directed out the purge door opening, on the right end of the distributor assembly, by the purge door. If the purge door is closed, then air is directed through and/or around the heater core by the temperature door. Air is then directed into the passenger compartment through the heater (floor) outlets and/or the defroster (dash) outlets by the defroster door. The temperature of the outlet air is dependent on the ratio of heated to unheated air (controlled by the temperature door).

G Models

Air flow is controlled by doors in the distributor assembly. The air door can be adjusted to vary airflow. If air is allowed to enter the distributor assembly, it is then directed through and/or around the heater core by the temperature door. Air is directed into the passenger compartment through the heater (floor) and/or defroster (dash) outlets by the defroster door. The temperature of the outlet air is dependent of the radio of heated to unheated air (controlled by the temperature door).

CONTROLS**C-K Models (Fig. 1A-2)**

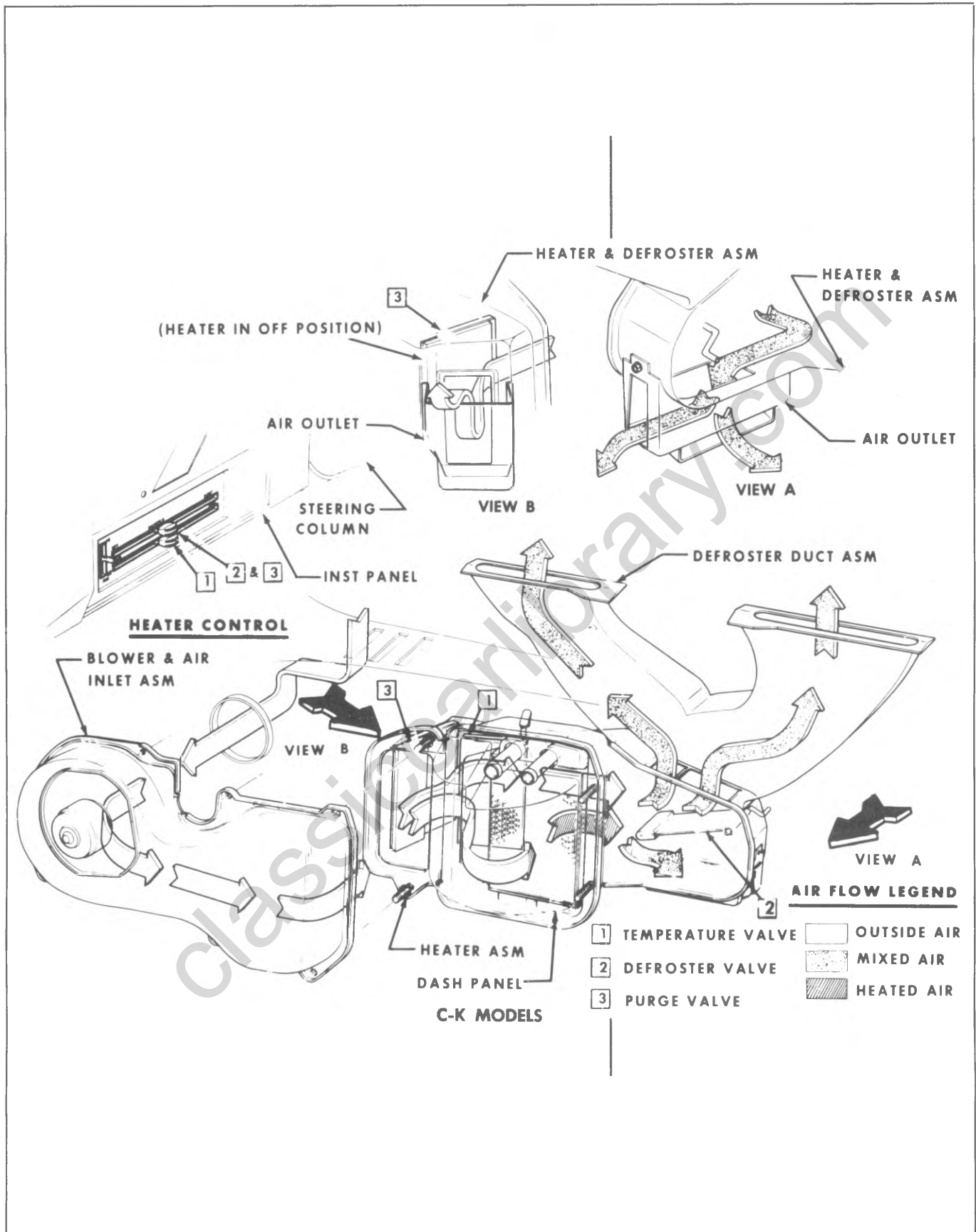


Fig. 1A-1-Heater Air Flow Schematic--C-K Models

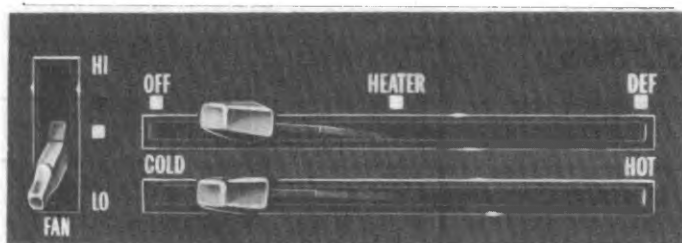


Fig. 1A-2--Heater Control--C-K Models

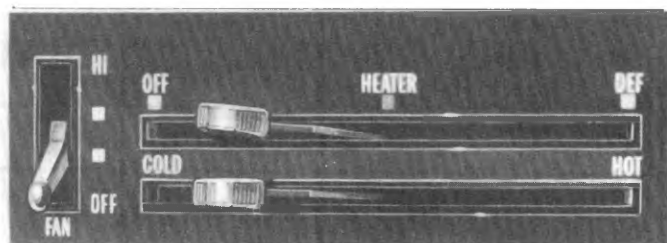


Fig. 1A-3--Heater Control--G Models

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DIAGNOSIS

TROUBLE	CAUSE AND CORRECTION
Temperature of heater air at outlets too low to heat up passenger compartment.	1. See "Insufficient Heat Diagnostic Chart".
Temperature of heater air at outlets adequate but the vehicle will not build up sufficient heat.	<p>Check for body leaks such as:</p> <ol style="list-style-type: none"> 1. Floor side kick pad ventilators partially open. 2. Leaking grommets in dash. 3. Leaking welded seams along rocker panel and windshield. 4. Leaks through access holes and screw holes. 5. Leaking rubber molding around door and windows. 6. Leaks between sealing edge of blower and air inlet assembly and dash, and between sealing edge of heater distributor assembly and dash.
Inadequate defrosting action.	<ol style="list-style-type: none"> 1. Check that DEFROST lever completely opens defroster door in DEF position - Adjust if necessary. 2. Insure that temperature and air doors open fully - Adjust. 3. Look for obstructions in defroster ducts - Remove any obstructions. 4. Check for air leak in ducting between defroster outlet on heater assembly and defroster duct under instrument panel - Seal area as necessary. 5. Check position of bottom of nozzle to heater locating tab - Adjust. 6. Check position of defroster nozzle openings relative to instrument panel openings. Mounting tabs provide positive position if properly installed.
Inadequate circulation of heated air through vehicle.	<ol style="list-style-type: none"> 1. Check heater air outlet for correct installation - Reinstall. 2. Inspect floor carpet to insure that carpet lies flat under front seat and does not obstruct air flow under seat, and also inspect around outlet ducts to insure that carpet is well fastened to floor to prevent cupping of air flow - Correct as necessary.
Erratic heater operation.	<ol style="list-style-type: none"> 1. Check coolant level - Fill to proper level. 2. Check for kinked heater hoses - relieve kinks or replace hoses. 3. Check operation of all bowden cables and doors - Adjust as necessary. 4. Sediment in heater lines and radiator causing engine thermostat to stick open - flush system and clean or replace thermostat as necessary. 5. Partially plugged heater core - backflush core as necessary.
Hard operating or broken controls.	<ol style="list-style-type: none"> 1. Check for loose bowden cable tab screws or mis-adjusted bowden cables - Correct as required. 2. Check for sticking heater system door(s) - Lubricate as required using a silicone spray.

INSUFFICIENT HEAT DIAGNOSIS

Position the controls so that the:
 Temperature lever is on full heat.
 Selector or heater lever is on Heater.
 Fan switch is on Hi.

*CHECK DUMP DOOR OUTLET FOR AIR FLOW

NO AIR FLOW

CHECK DEFROSTER OUTLETS FOR AIR FLOW
 (If in doubt as to High or Low air flow set selector on DEF which is High and compare. Reset selector on Heater)

AIR FLOW

Adjust dump door for no air flow.

NO OR LOW AIR FLOW

CHECK HEATER OUTLET AIR FLOW
 (If in doubt, switch fan switch from Hi to Lo)

HIGH AIR FLOW

Adjust defroster door for low air flow.

CHANGE IN AIR FLOW

LITTLE OR NO CHANGE IN AIR FLOW

NORMAL AIR FLOW

Check heater outlet temperature with 220° F range thermometer.

LOW OR NO AIR FLOW

**Check shutoff door position for full system air flow. Adjust if necessary.

(approximate outlet air temperatures)

Outlet Air	145	150	155	165
Ambient Air	0	25	40	75

NORMAL TEMPERATURE

Remove all obstructions under front seat.

Car does not build up heat - operate vent controls and see that the air vent doors close completely, if not, adjust.

LOW TEMPERATURE

(Check the system temperature after repairing the item checked to complete the diagnosis.)

Check coolant level; if low, fill. Look for or feel all radiator and heater hoses and connections for leaks. Repair or replace. Check the radiator cap for damage and replace if required.

Check heater and radiator hoses for kinks - straighten and replace as necessary.

Check temperature door for max heat position. Adjust if necessary.

HEATER CORE

Feel temperatures of heater inlet and outlet hoses.

WARM INLET AND OUTLET HOSES

Check engine thermostat.

HOT INLET AND WARM OUTLET HOSES

Check pulleys, belt tension, etc., for proper operation. Replace or service as necessary.

Remove hoses from heater core. Reverse flush with tap water. If plugged, repair or replace.

LOW AIR FLOW

Check heater outlet for obstruction - remove.

Check motor voltage at closest motor line connection with a voltmeter.

UNDER 10 VOLTS OVER 10 VOLTS

Check battery volts - under 10 volts, recharge then recheck motor voltage.

Check wiring and connections for under 10 volts from motor to fan switch. Repair or replace last point of under 10 volt reading.

Apply external ground, (jumper wire) to motor case. INCREASED AIR FLOW - repair ground.

SAME AIR FLOW - remove motor and check for obstruction in system opening. If none, REPLACE MOTOR. If obstruction, remove material and re-install motor.

NO AIR FLOW

CHECK FUSE

FUSE BLOWN - replace fuse.

AIR FLOW - system okay.

BLOWS FUSE

Remove positive lead from motor and replace fuse.

FUSE REMAINS OK - remove motor and check for obstruction in system opening, if none, REPLACE MOTOR. If obstruction, remove material and re-install motor.

BLOWS FUSE - check for shorted wire in blower electric circuit - See Heater Circuit Diagnostic Chart.

FUSE OK

FUSE OK - See Heater Circuit Diagnostic Chart.

*CHECK FOR C K MODELS ONLY

**CHECK FOR G MODELS ONLY

HEATER CIRCUIT DIAGNOSIS*

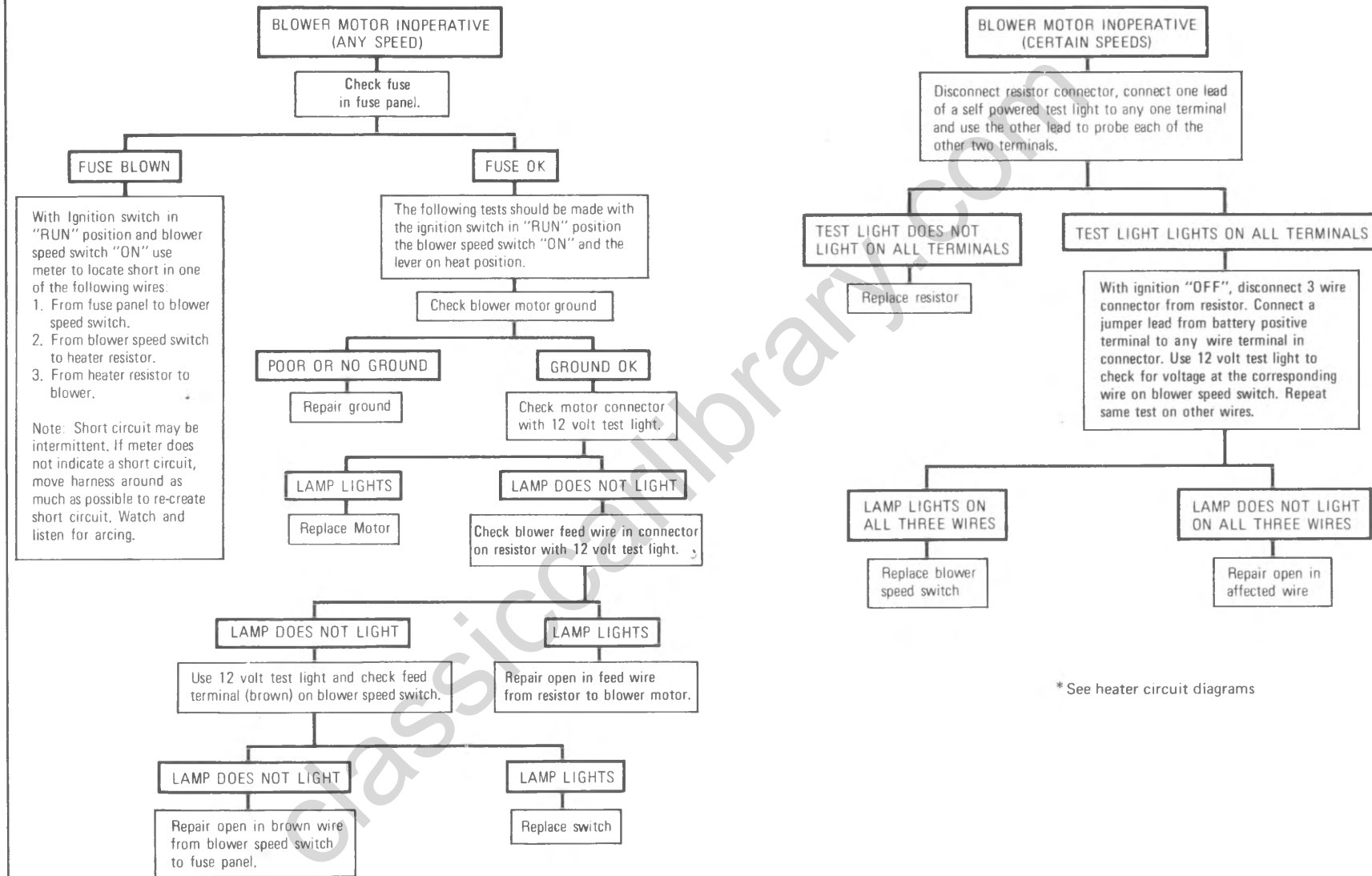


Fig. 1A-4-Heater Circuit Diagnosis

* See heater circuit diagrams

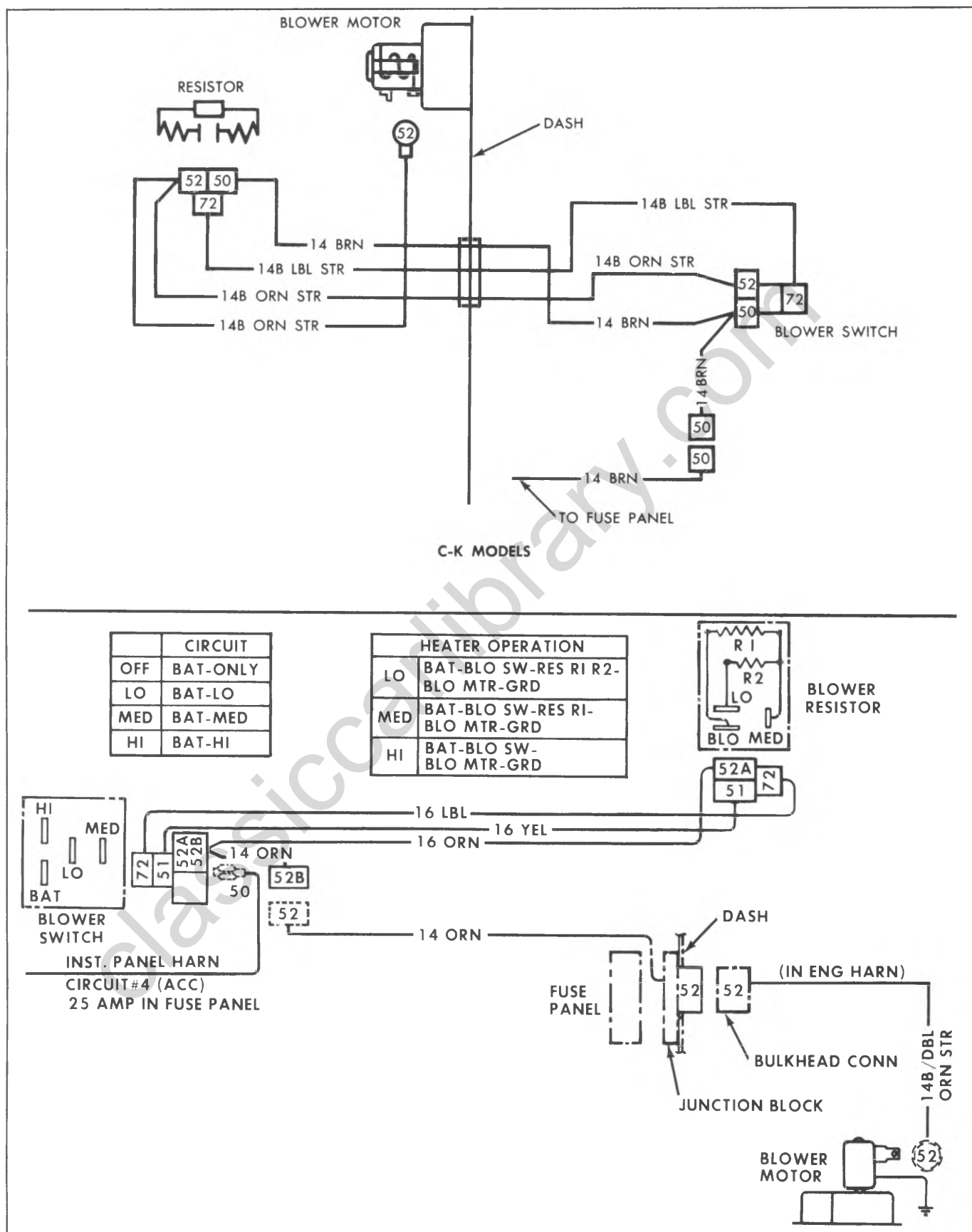


Fig. 1A-5-Heater Wiring Diagrams

ON VEHICLE SERVICE

BLOWER MOTOR

Removal (Fig. 1A-6)

1. Disconnect battery ground cable.

G Models - Remove the battery.

2. Disconnect the blower motor lead wire.
3. Remove the five blower motor mounting screws and remove the motor and wheel assembly. Pry gently on the blower flange if the sealer acts as an adhesive.

4. Remove the blower wheel to motor shaft nut and separate the wheel and motor assemblies.

5. To install a new motor, reverse Steps 1-4 above.

NOTE: The following precautions should be taken to assure proper installation:

- a. Assemble the blower wheel to the motor with the open end of the wheel away from the blower motor.
- b. If the motor mounting flange sealer has hardened, or is not intact, remove the old sealer and apply a new bead of sealer to the entire circumference of the mounting flange.
- c. Check blower operations: blower wheel should rotate freely with no interference.

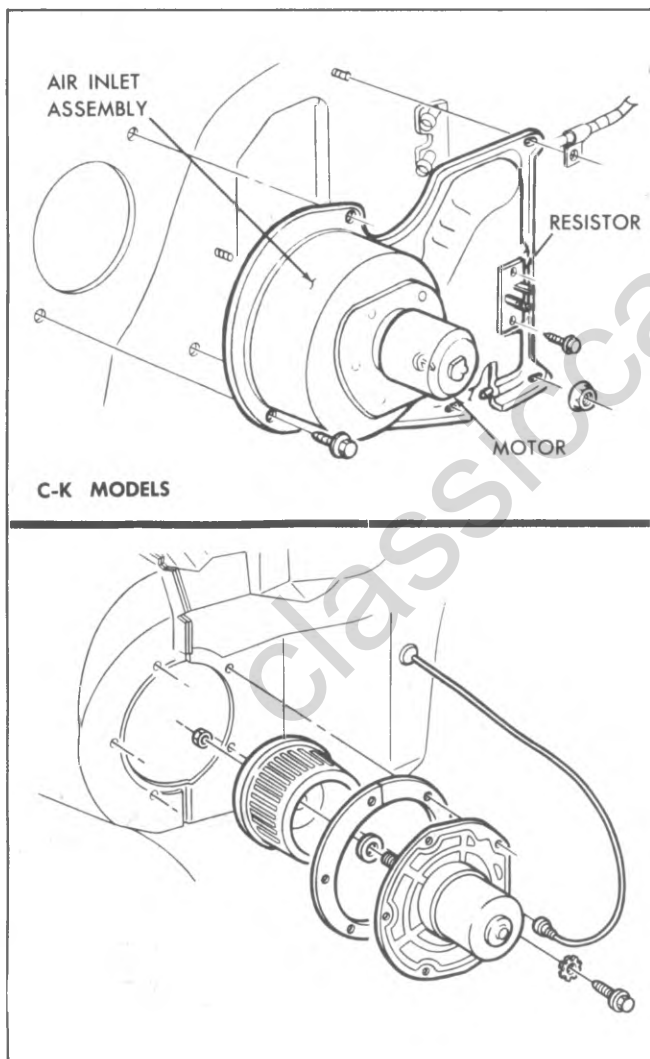


Fig. 1A-6-Blower Motor Assembly

HEATER DISTRIBUTOR AND CORE ASSEMBLY

C-K Models

Replacement (Fig. 1A-7)

1. Disconnect the battery ground cable.
2. Disconnect the heater hoses at the core tubes and drain engine coolant into a clean pan. Plug the core tubes to prevent coolant spillage at removal.
3. Remove the nuts from the distributor duct studs projecting into the engine compartment.
4. Remove the glove box and door assembly.
5. Disconnect the Air-Defrost and Temperature door cables.
6. Remove the floor outlet and remove the defroster duct to heater distributor duct screw.
7. Remove the heater distributor to dash panel screws. Pull the assembly rearward to gain access to wiring harness and disconnect all harnesses attached to the unit.
8. Remove the heater-distributor from the vehicle.
9. Remove the core retaining straps and remove the core.
10. To install, reverse Steps 1-9 above.

NOTE: Be sure core to case and case to dash panel sealer is intact before assembling unit.

G Models

Replacement (Fig. 1A-8)

1. Disconnect the battery ground cable.
2. Place a clean pan under the vehicle and then disconnect the heater core inlet and outlet hoses at the core connections (see "Heater Hoses-Replacement" later in this section). Quickly plug the heater hoses and support them in a raised position. Allow the coolant in the heater core to drain into the pan on the floor.
3. Remove heater distributor duct to distributor case attaching screws and distributor duct to engine cover screw and remove duct.
4. Remove defroster duct to distributor case attaching screw.

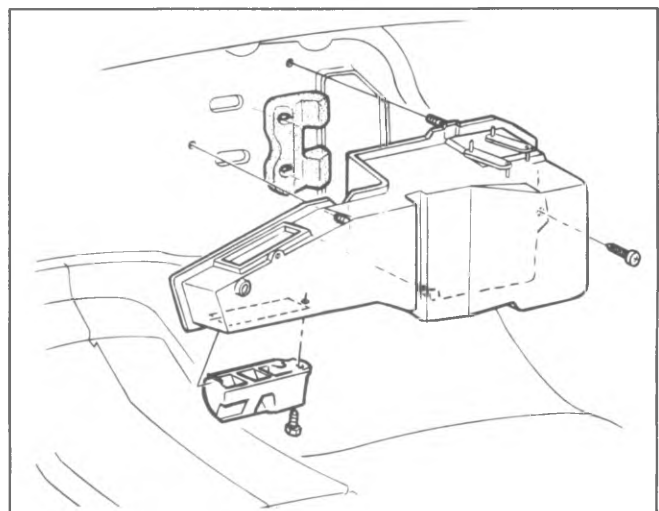


Fig. 1A-7-Heater Distributor Assembly-C-K Models

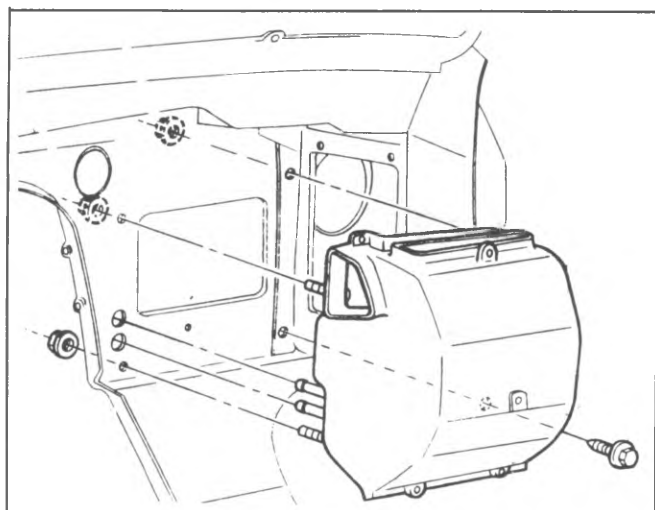


Fig. 1A-8--Heater Distributor - G Models

5. Disconnect temperature door cable and fold cable back for access.

6. Remove three (3) nuts at engine compartment side of distributor case and one (1) screw on passenger side.

7. Remove the heater case and core as an assembly. Tilt the case assembly rearward at the top while lifting up until the core tubes clear the dash openings.

8. Remove the core retaining strap screws and remove the core.

9. To install a new core, reverse Steps 1-7 above.

NOTE: Be sure core to case and case to dash panel sealer is intact before assembling unit.

HEATER HOSES

Heater hoses are routed from the thermostat housing or inlet manifold and water pump (radiator on some automatic transmission vehicles) to the core inlet and outlet pipes as shown in Figure 1A-9. Hoses are attached at each end with screw type clamps.

Replacement

The heater core can be easily damaged in the area of the core tube attachment seams whenever undue force is exerted on them. Whenever the heater core hoses do not readily come off the tubes, the hoses should be cut just forward of the core tubes. The portion of the hose remaining on the core tube should then be split longitudinally. Once the hoses have been split, they can be removed from the tubes without damage to the core.

CENTER DISTRIBUTOR DUCT - G Models

Replacement (Fig. 1A-10)

1. Disconnect the battery ground cable.

2. Unsnap the engine cover front latches. Remove the two cover to floorpan screws and remove the cover.

3. Remove the heater distributor duct to case attaching screws as illustrated in Figure 1A-10.

4. Remove one (1) screw at left center of distributor duct.

5. Pull the center distributor duct to the right and remove it from the vehicle.

6. To install, reverse Steps 1-5 above.

NOTE: Check cable and door operation; cables should

be free from kinks or binding and doors should close properly. If cable adjustment is necessary, see "Bowden Cable-Adjustment."

DEFROSTER DUCT

Defroster assemblies attachment is illustrated in Figure 1A-11.

CONTROL ASSEMBLY

C-K Models

Replacement (Fig. 1A-12)

1. Disconnect the battery ground cable.

2. Remove the instrument panel bezel.

3. Disconnect the bowden cables and the blower switch wiring harness.

CAUTION: Be careful not to kink the bowden cables.

4. Remove the control through the opening above the control.

5. If a new unit is being installed, transfer the blower switch to the new unit.

6. To reinstall, reverse Steps 1-4 above.

G Models

Replacement (Fig. 1A-13)

1. Disconnect the battery ground cable.

2. Remove the control to instrument panel mounting screws and carefully lower the control far enough to gain access to the bowden cable attachments.

CAUTION: Care should be taken to prevent kinking the bowden cables while lowering the control.

3. Disconnect the three bowden cables, the control illumination bulb, the blower switch connector and remove the control from the vehicle.

4. Remove the blower switch screws and remove the blower switch.

5. To install, reverse Steps 1-4 above.

CONTROL CABLES

C-K Models

Replacement

1. Disconnect the battery ground cable.

2. Remove the instrument panel bezel.

3. Remove the control to instrument panel screws.

4. Raise or lower control as necessary to remove cable push nuts and tab attaching screws.

5. Remove glove box and door as an assembly.

6. Remove cable push nut and tab attaching screw at door end of cable.

7. Remove cable from retaining clip and remove cable assembly.

8. To install, reverse Steps 1-7 above.

CAUTION: Be careful not to kink the cable during installation. Be sure to route the cable as when removed. Check cable adjustment.

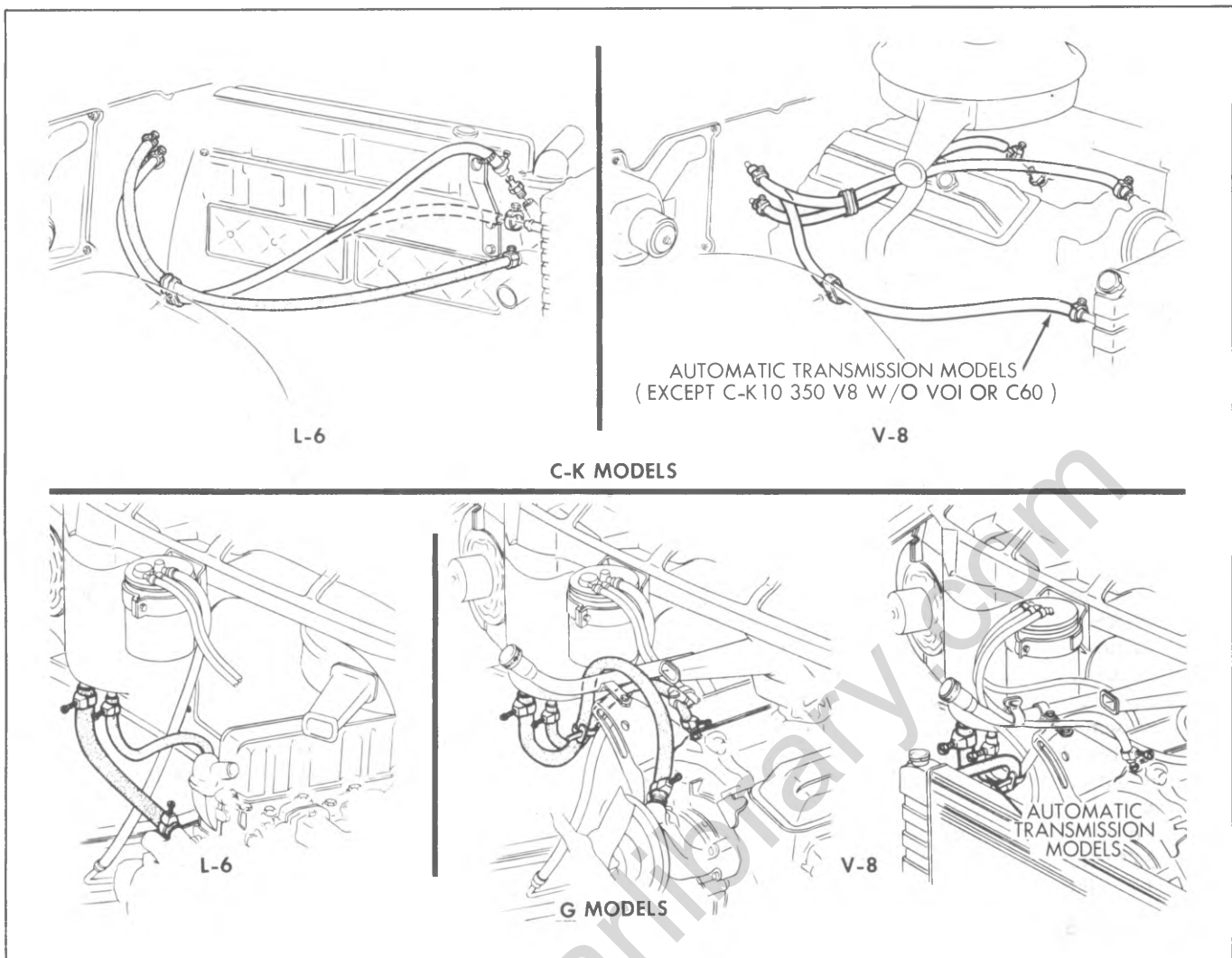


Fig. 1A-9-Heater Hose Routings

G Models

Replacement (Fig. 1A-15)

Heater and defroster cable routing and attachment to control and to distributor case is illustrated in Figure 1A-14.

NOTE: If cable adjustment is required, see below.

Adjustment - CK Series

1. Disconnect the battery ground cable.
2. Remove glove box and door as an assembly.
3. Pry off the appropriate cable eyelet clip and disconnect the cable from the door.
4. Remove the cable retaining screw.
5. While holding the cable with pliers, rotate the mounting tab on the cable to lengthen or shorten the cable, whichever is required.

NOTE: Do not pinch the cable too tightly or damage to the cable could result.

6. Install the cable, reversing Steps 1-4 above.

Adjustment - G Van

1. Attach inner cable and sheath to I.P. Control.
2. With I.P. installed, move temperature cable to cold and attach loop on inner cable to temperature door on heater case.

3. Attach cable sheath to heater case.

4. Move temperature lever to full heat. This will require some effort due to force required to slide inner cable clip to its proper position.

BLOWER SWITCH

C-K Models

Replacement (Fig. 1A-12)

1. Disconnect the battery ground cable.
2. Remove the instrument panel bezel.
3. Remove the control to instrument panel screws and lower the control onto the radio.
4. Disconnect the switch electrical harness.
5. Remove the switch attaching screws and remove the switch.
6. To install, reverse Steps 1-5 above.

G Models

Replacement (Fig. 1A-13)

1. Disconnect the battery ground cable.
2. Disconnect the blower switch wiring harness connector at the switch.
3. Remove the two switch attaching screws and remove the switch assembly.

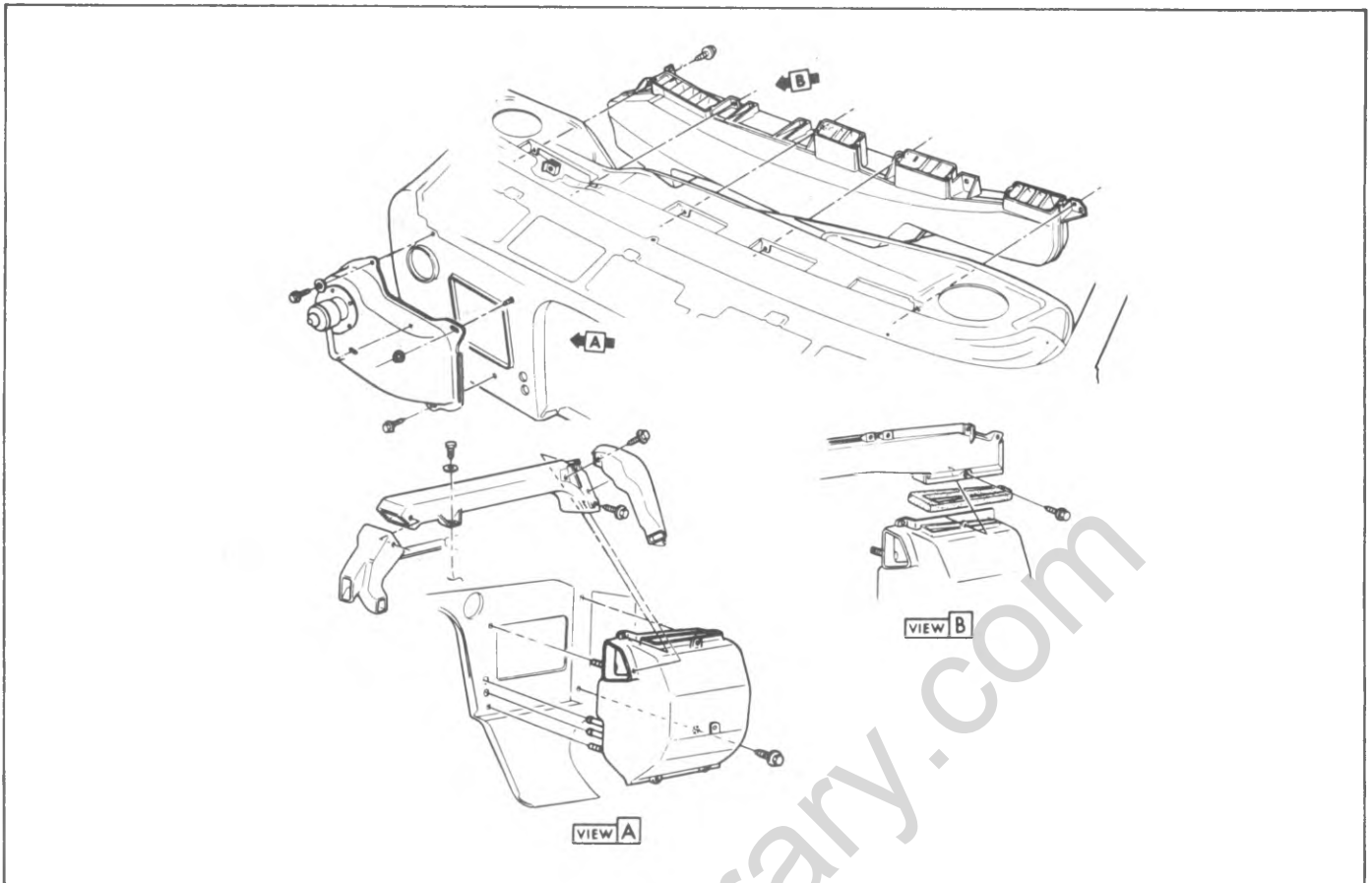


Fig. 1A-10--Distributor Ducts--G Models

4. To install a new switch, reverse Steps 1-3 above.

RESISTOR

Replacement (Figs. 1A-6 and 1A-8)

1. Disconnect the wiring harness at the resistor connector.

2. Remove the two resistor mounting screws and remove the resistor.

3. To install a new resistor, reverse Steps 1 and 2 above.

1A-12 HEATER

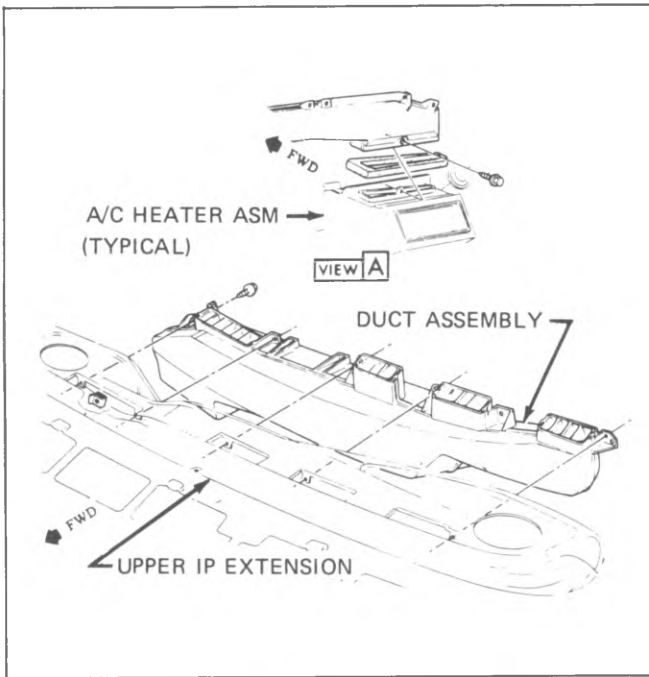


Fig. 1A-11--Defroster Outlets

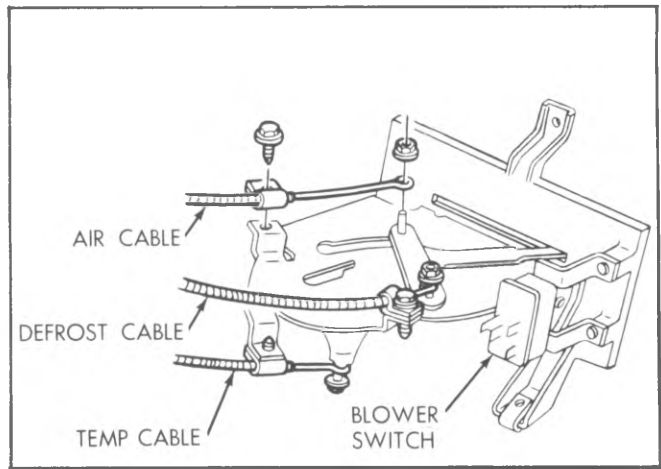


Fig. 1A-13--Control Assembly-G Models

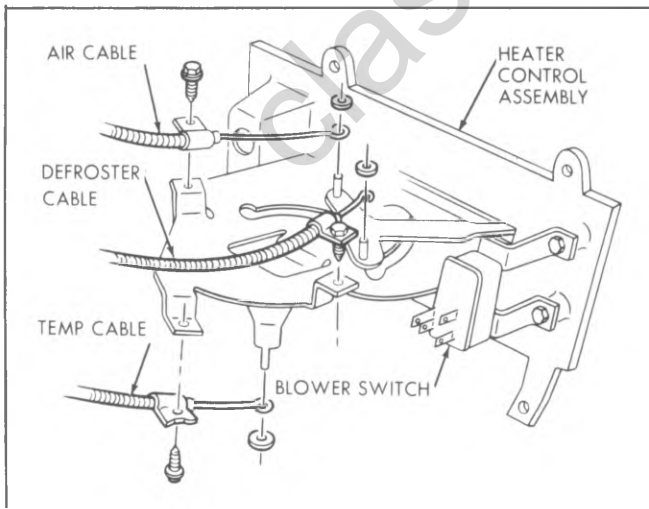


Fig. 1A-12--Control Assembly-C-K Models

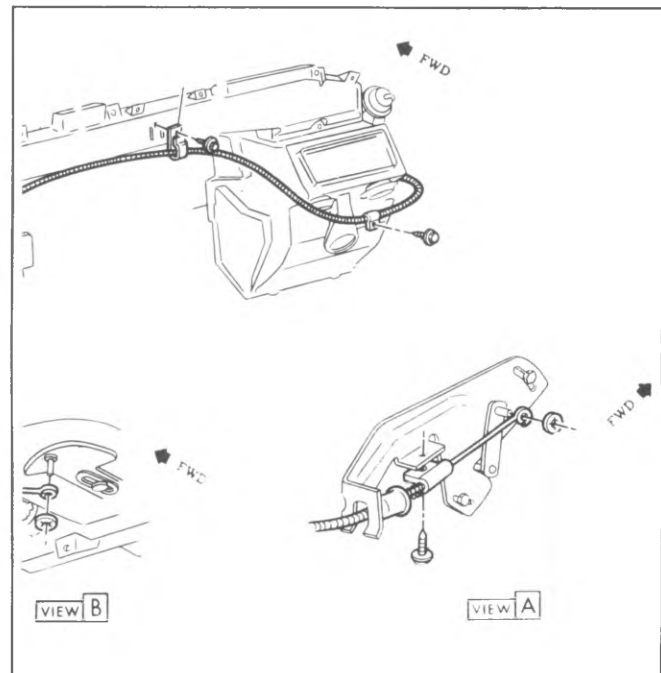


Fig. 1A-14--Control Cable Routing--G Models

AUXILIARY HEATER

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GENERAL DESCRIPTION

An auxiliary heater is available as a dealer installed accessory to provide additional heating capacity for the rearmost extremities of the C-K (06) and G (05 and 06) models.

This unit operates entirely independent of the standard heater and is regulated through its own controls at the instrument panel.

This system consists of a separate core and fan unit mounted as shown in Figures 1A-15 and 1A-16.

Heater hoses extend from the unit to the front of the vehicle where they are connected to the standard heater hoses with "tees". An "on-off" water valve is installed in the heater core inlet line in the engine compartment. This valve must be operated manually--"on" for cold weather, "off" in warm weather. The purpose of the valve is to cut off coolant flow to the auxiliary core during warm weather and eliminate the radiant heat that would result.

CONTROLS

Two methods of control are employed with this system:

Water Valve (Fig. 1A-17)

When heat is desired, the water valve must be in the "on" position (valve located in the engine compartment in the core inlet line). During the summer months, this valve should be placed in the "off" position.

Fan Switch (Fig. 1A-18)

The three speed fan switch (LOW-MED-HI) is located in the instrument panel, to the right of the steering column. Full down, the blower is inoperative; fully up the blower is on HI.

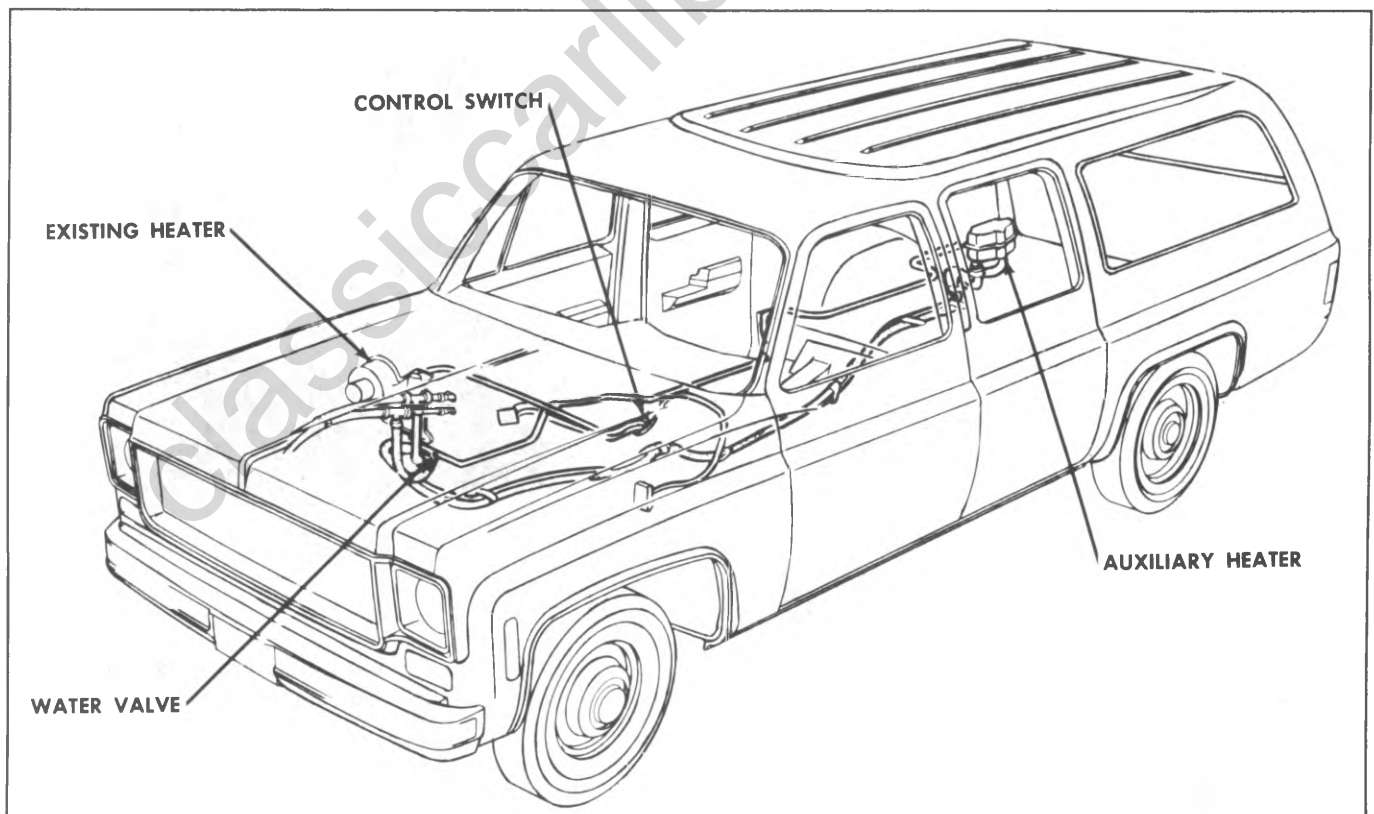


Fig. 1A-15--Auxiliary Heater Installations (C-K Models)

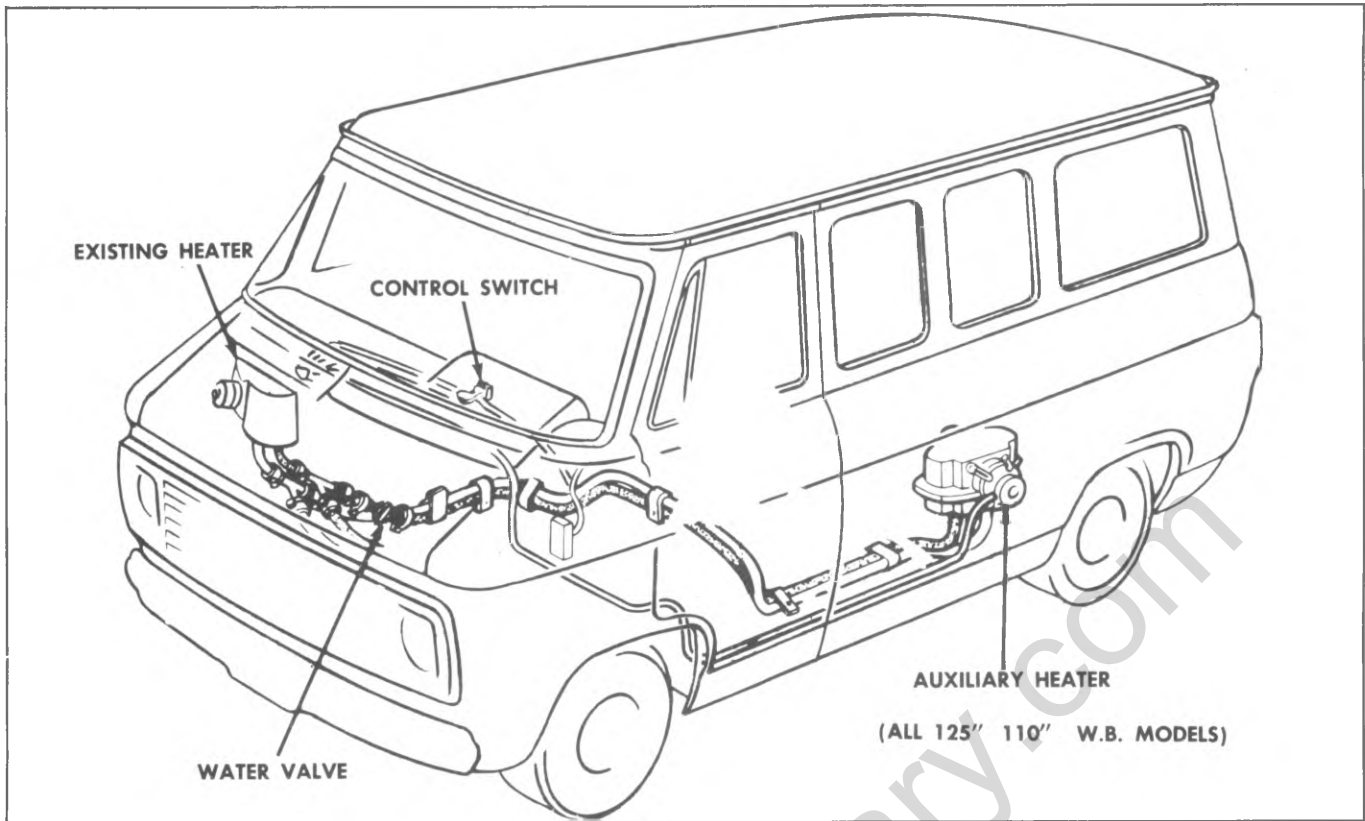


Fig. 1A-16--Auxiliary Heater Installations (G Models)

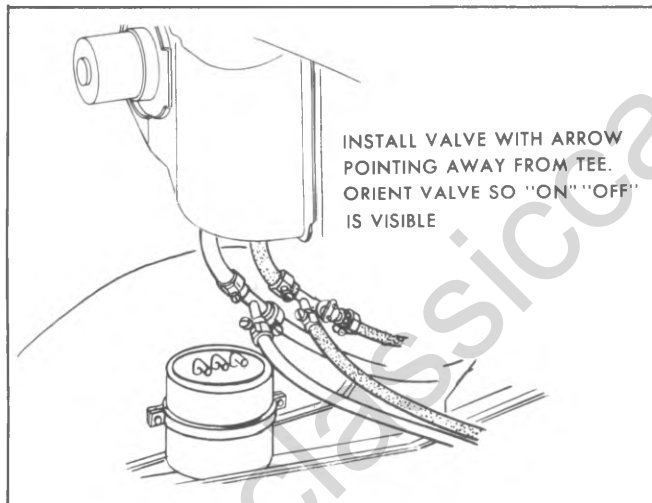


Fig. 1A-17--Water Valve Installation - G Model Shown as Typical



Fig. 1A-18--Auxiliary Heater Control

DIAGNOSIS

Refer to the "Standard Heater" section of this manual for diagnostic information; see Electrical Diagram Figure 1A-19.

NOTE: If the heater blower motor is inoperative on C-K models (equipped with Overhead Air

Conditioning), check that the connectors have not been interchanged with one another.

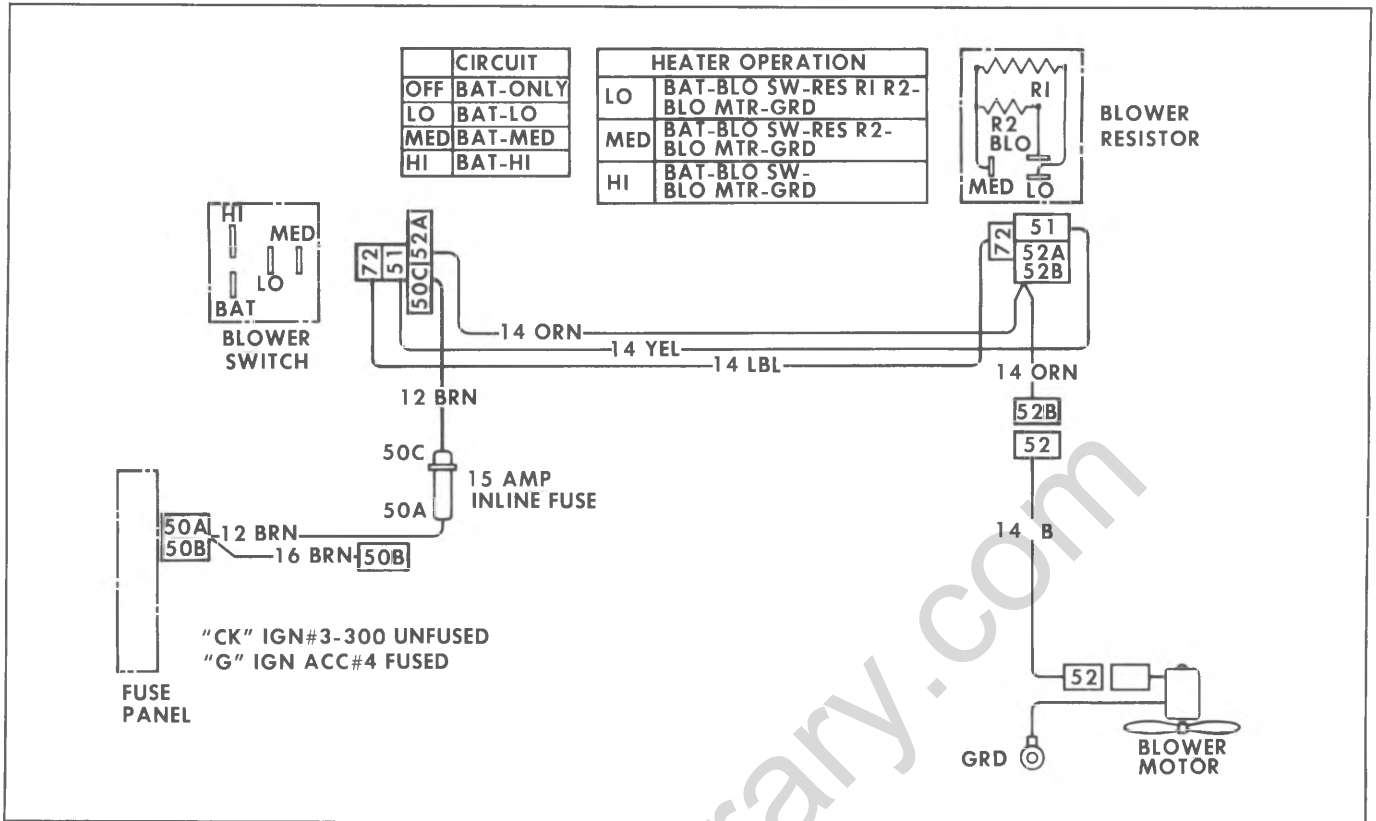


Fig. 1A-19--Electrical Diagram - All Models

ON VEHICLE SERVICE

Since a detailed list of installation instructions is included with the auxiliary heater unit, replacement procedures will not be repeated in this section.

CAUTION: *G Models*--When replacing heater hoses, maintain a 1/2" minimum clearance between hose clip and upper control arm, a 1-1/2" minimum clearance between hoses and propshaft and a 1-1/4" minimum clearance between the

auxiliary heater core lines and the exhaust pipe as shown in Figure 1A-21. All Models--Draw hoses tight to prevent sag or rub against other components. Be sure to route hoses through all clamps as originally installed.

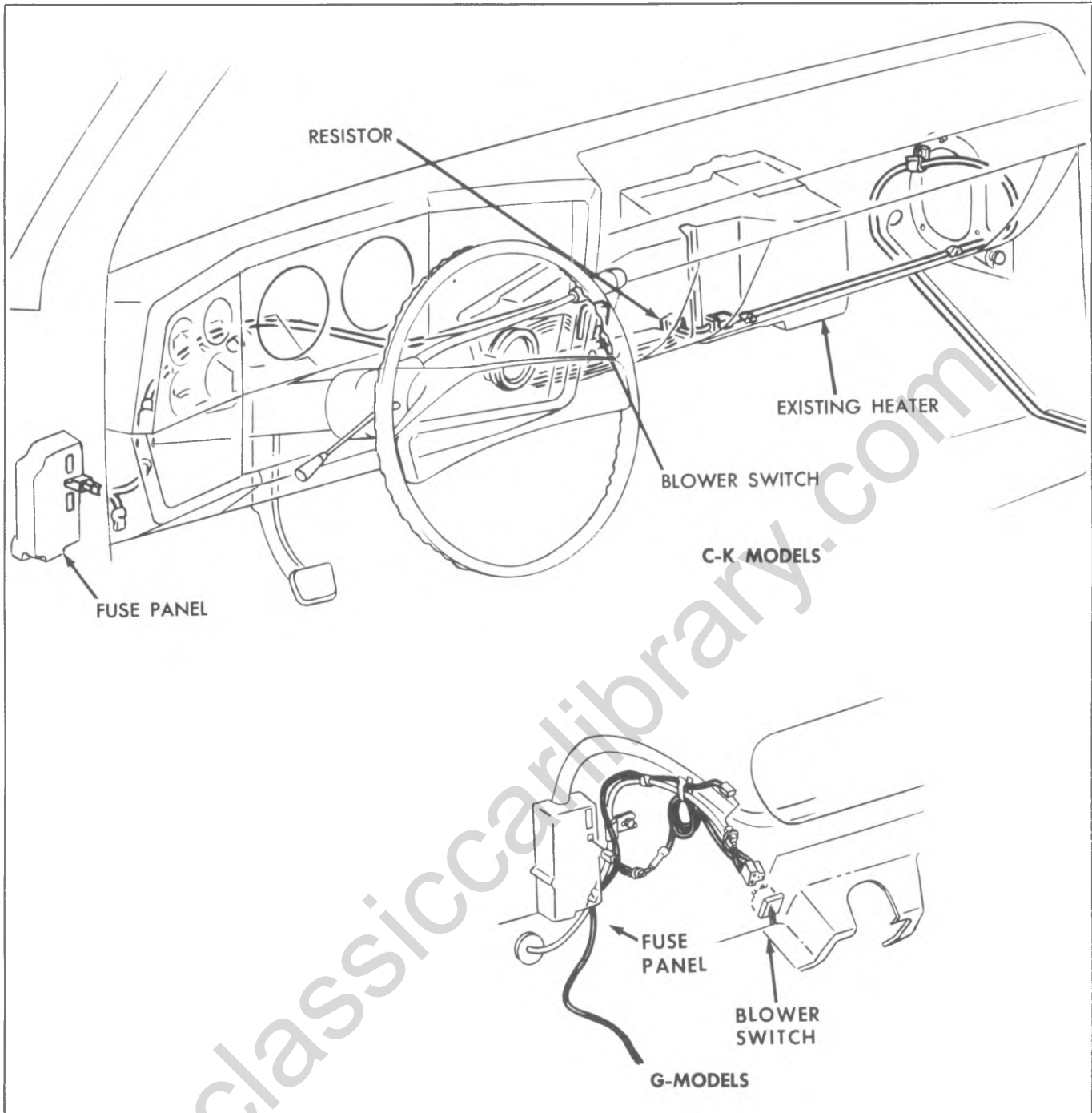


Fig. 1A-20--Control and Resistor Mountings

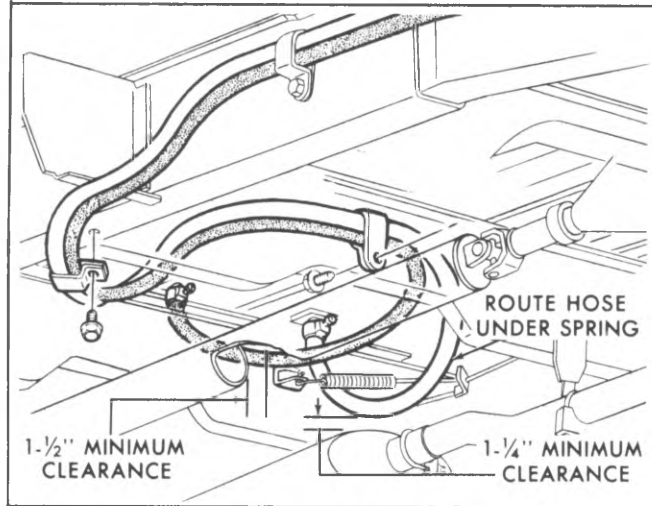


Fig. 1A-21--Heater Hose Routing - G Models

SPECIFICATIONS

SECTION 1A

HEATER

	<u>Volts</u>	<u>Amps. (Cold)</u>	<u>RPM (Cold)</u>
Blower Motor			
C-K Models	13.5	6.25 Max.	2550 Min. 2950 Max.
G Models	13.5	7.1 Max.	2850 Min. 3250 Max.

Fuses

C-K Models	20 Amp.
G Models	20 Amp.

AUXILIARY HEATER

	<u>Volts</u>	<u>Amps. (Cold)</u>	<u>RPM (Cold)</u>
Blower Motor	13.5	9.6 Max.	2700 Min.

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SECTION 1B

AIR CONDITIONING

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Master Switch and/or Blower Switch.....	1B-30	Blower Assembly.....	1B-45
Vacuum Tank.....	1B-30	Expansion Valve, Evaporator Case or Core.....	1B-46
Blower Resistor Unit.....	1B-30	Thermostatic and/or Blower Switches.....	1B-47
Thermostatic Switch.....	1B-31	Resistor.....	1B-47
Discharge Pressure Switch.....	1B-31	Fuse.....	1B-47
Fuse.....	1B-31	Specifications.....	1B-48
Overhead System--C-K Models.....	1B-31	Special Tools.....	1B-49
Rear Duct.....	1B-31		
Blower Motor Resistor.....	1B-32		

GENERAL DESCRIPTION

FOUR-SEASON SYSTEM

Both the heating and cooling functions are performed by this system. Air entering the vehicle must pass through the cooling unit (evaporator) and through (or around) the heating unit, in that order, and the system is thus referred

to as a "reheat" system.

The evaporator provides maximum cooling of the air passing through the core when the air conditioning system is calling for cooling. A thermostatic switch, located on the blower-evaporator case, acts to control compressor

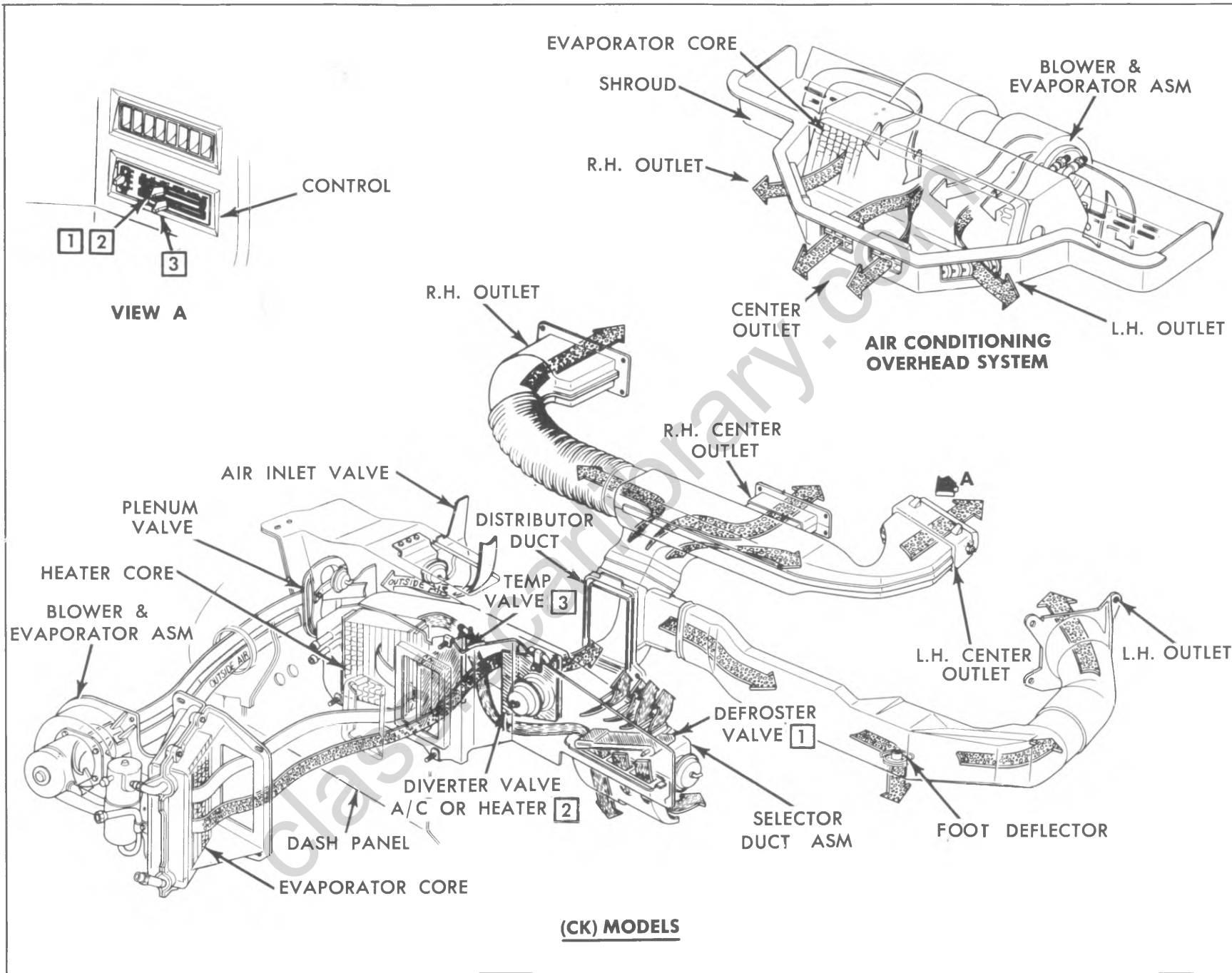


Fig. 1B-1--Airflow Chart - CK Models

operation by sensing the evaporator inlet line temperature.

System operation is as follows" Air, either outside air or recirculated air, enters the system and is forced through the system by the blower. As the air passes through the evaporator core, it receives maximum cooling if the air conditioning controls are calling for cooling. After leaving the evaporator, the air enters the Heater and Air Conditioner Selector Duct Assembly where, by means of diverter doors, it is caused to pass through or to bypass the heater core in the proportions necessary to provide the desired outlet temperature. Conditioned air then enters the vehicle through either the floor distributor duct or the dash outlets. When, during cooling operations, the air is cooled by the evaporator to below comfort level, it is then warmed by the heater to the desired temperature. During "heating only" operations, the evaporator will not be in operation and ambient air will be warmed to the desired level in the same manner.

CK Series

The dash outlets are rectangular in design. The outlets can be rotated horizontally or vertically to direct air as desired. Under the left distributor duct is located a floor cooler which can be rotated to provide cooling air or shut off completely.

G-Van

The dash outlets are rectangular in design and can be rotated horizontally or vertically to direct air as desired. Foot coolers are provided on both driver and passenger side.

In the heater-defrost modes, the air conditioning outside air door is closed. The heater air door is open and outside air is allowed to pass through the heater core (receiving maximum heating) and is then directed into the passenger compartment through the heater and/or defroster outlets.

OVERHEAD SYSTEMS (C-K-G MODELS)

These systems (C69 on C-K-G Models) operate in conjunction with the Four-Season System (C-K Models) or C60 System (G Models)--they do not operate independently.

NOTE: Overhead system kits are available for non-factory installation on C-K Models, providing the vehicle is equipped with the front system.

These units are self contained, operating on inside (recirculated) air only. Air is drawn into the unit, passed through the evaporator core and then directed into the passenger compartment through the air distributor duct.

System control is through the front system. The only control on the overhead system is a three speed blower switch.

MOTOR HOME CHASSIS SYSTEM

This system performs the cooling functions only. When heating (above ambient temperatures) is desired, the vehicle heater must be used. When air conditioning is desired, the heater should be completely shut off.

This self-contained unit is bracket mounted to the dash by the body manufacturer. It operates on inside (recirculated) air only. Air is drawn into the unit, passed through the evaporator core (receiving maximum cooling) and then directed into the vehicle through adjustable outlets.

A thermostatic switch, located on the face plate is used to control compressor operation by sensing air temperature

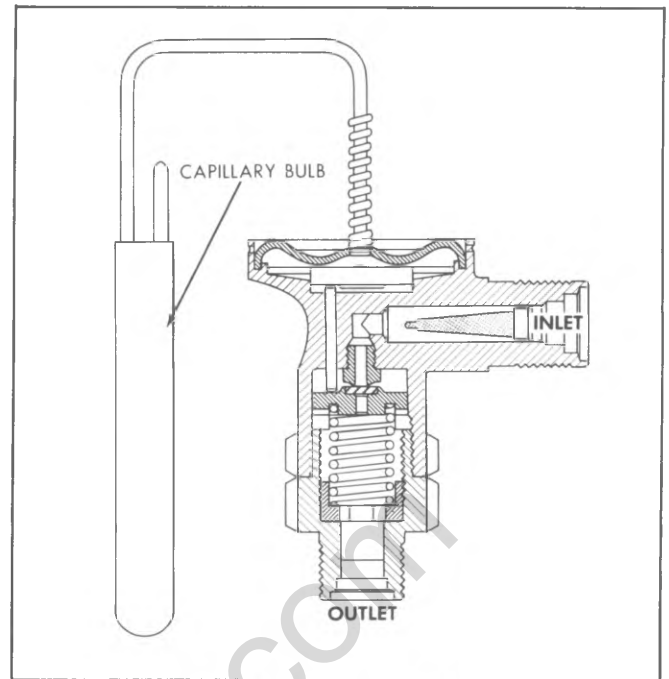


Fig. 1B-2--Expansion Valve

as it leaves the evaporator core.

Receiver-Dehydrator (Motor Home Chassis Models)

The receiver-dehydrator, serving as a reservoir for storage of high pressure liquid produced in the condenser, incorporates a screen sack filled with the dehydrating agent.

The receiver-dehydrator, used primarily as a liquid storage tank, also functions to trap minute quantities of moisture and foreign material which may have remained in the system after installation or service operations. A refrigerant sight glass is built into the receiver-dehydrator to be used as a quick check of the state and condition of charge of the entire system. The receiver-dehydrator is mounted near the condenser.

Sight Glass (Motor Home Chassis Models)

While having no real function to perform in the system, the sight glass is a valuable aid in determining whether or not the refrigerant charge is sufficient and for eliminating some guess work in diagnosing difficulties. The sight glass, is built into the receiver-dehydrator outlet connection and is designed and located so that a shortage of refrigerant at this point will be indicated by the appearance of bubbles beneath the glass. The dust cap provided should be kept in place when the sight glass is not in use.

Thermostatic Expansion Valve (Fig. 1B-2)

C-K Overhead, G C60 and Overhead and Motor Home Chassis systems use a thermostatic expansion valve in place of a float system.

The valve consists primarily of the power element, body, actuating pins, seat and orifice. At the high pressure liquid inlet, is a fine mesh screen which prevents dirt, filings or other foreign matter from entering the valve orifice.

When the valve is connected in the system, high pressure liquid refrigerant enters the valve through the screen from the receiver-dehydrator or condenser and

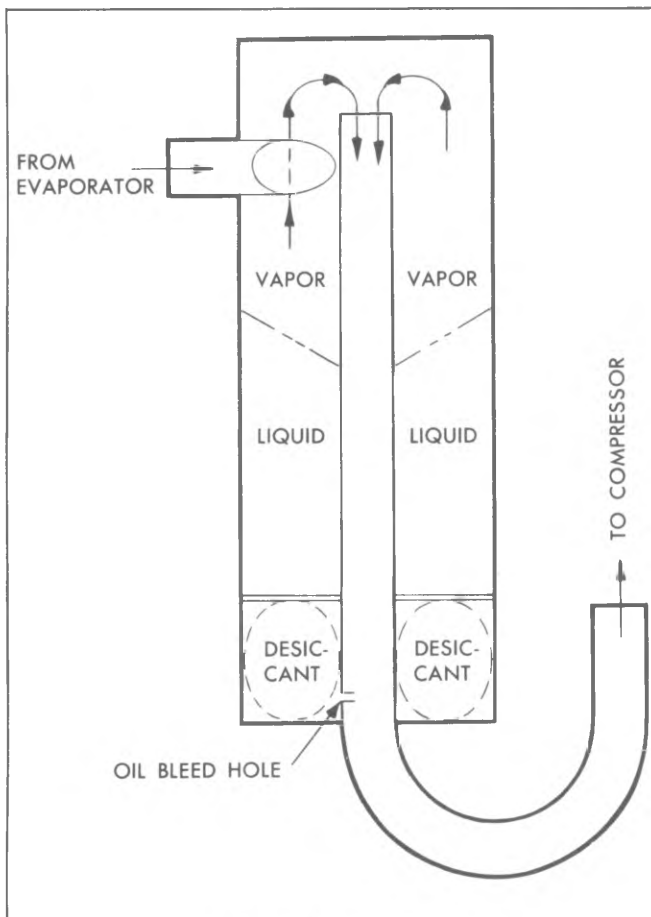


Fig. 1B-3--Accumulator

passes on to the seat and orifice. Upon passing through the orifice the high pressure liquid becomes low pressure liquid. The low pressure liquid leaves the valve and flows into the evaporator core where it absorbs heat from the evaporator core and changes to a low pressure vapor, and leaves the evaporator core as such. The power element bulb is clamped to the low pressure vapor line just beyond the outlet of the evaporator (fig. 1B-2).

Accumulator--C-K, G Models (Fig. 1B-3)

The accumulator is located at the evaporator outlet. Its most important function is not to "accumulate" although this too is important. Its primary function is to separate liquid retained from vapor, retain the liquid and release the vapor to the compressor.

Thus, in an ideal accumulator with no oil bleed hole, and in a correctly designed system, no liquid can get to the compressor.

In an actual accumulator, there is some entrained liquid in the vapor stream to the compressor. The measure of a good accumulator is how well it separates vapor from liquid and how little entrained liquid is released to the compressor. Also, in an actual accumulator, an oil bleed hole is required to prevent trapping of oil in the bottom of the accumulator; this oil bleed hole bleeds some liquid refrigerant as well.

Therefore, flow out of the accumulator to the compressor consists mostly of vapor with the addition of entrained liquid and liquid flow through the oil bleed hole.

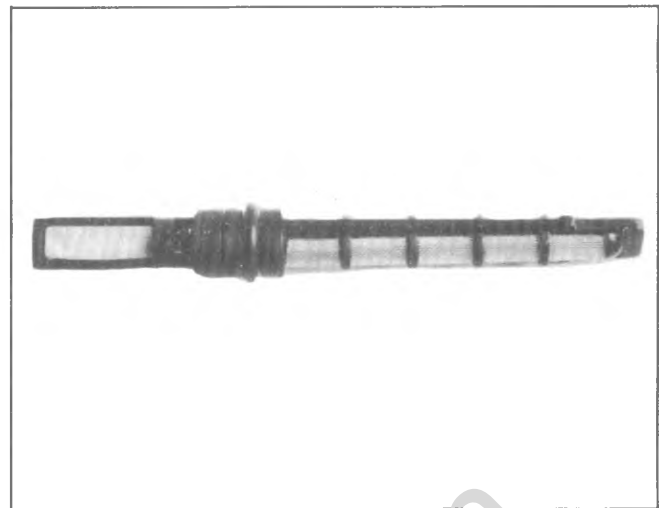


Fig. 1B-4--Expansion Tube

A bag of desiccant (dehydrating agent) is located in the base of the accumulator as a moisture collecting device.

NOTE: There is no sight glass in the accumulator-clutch cycle system.

Expansion Tube--C-K, G Models

Expansion tube flow rate depends on pressure difference and on subcooling; however, the flow rate is more sensitive to subcooling.

The expansion tube is located in the evaporator inlet line (fig. 1B-4).

Thermostatic Switch

System temperature is controlled by running the compressor intermittently, automatically turning it on and off as necessary to maintain proper temperatures. The compressor is started and stopped through the use of an electro-magnetic clutch and a thermostat affected by variations in temperature.

The thermostatic switch incorporates a metallic tube which contains a highly expansive gas. This tube is inserted into the evaporator inlet line (C-K, G Four-Season System) or is located in the air stream as it leaves the evaporator (Motor Home Chassis Unit). The tube leads to a bellows operated switch. As air temperature rises, the gas inside the tube expands, travels through the tube to the bellows and closes the electrical switch which engages the compressor clutch.

As soon as the compressor starts running, the temperature begins to go down. As the air being cooled gets colder, the gas in the thermostatic tube begins to reduce the pressure on the switch bellows. This allows the switch contact to open and the compressor clutch disengages.

Low Refrigerant Charge Protection System

C-K-G Models

The compressor discharge pressure switch performs the function of shutting off the compressor when it senses low refrigerant pressure. The switch is located in the evaporator inlet line (high pressure). The switch electrically is wired in series between the compressor clutch and the master switch on the control. When the switch senses low pressure it breaks contact and opens the circuit to the

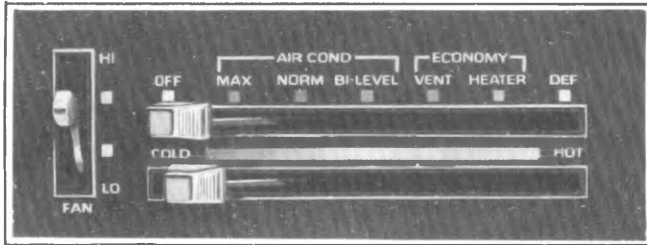


Fig. 1B-5--Four-Season System Controls (C-K Models)

compressor clutch, thus shutting off the A/C system and preventing compressor failure or seizure.

The compressor discharge pressure switch also performs the function of the ambient switch as the pressure at the switch varies directly with ambient temperatures. The compressor should **not** run below 25°F (-3.9°C) ambient or 37 psi at the switch. The compressor should run in A/C modes above 45°F (7.2°C) ambient or 42 psi at the switch.

The switch interacts with other switches so that in an A/C system where the compressor will **not** operate above 45°F (7.2°C) ambient the following components should be checked for continuity:

1. Compressor discharge pressure switch.
2. Master switch (on control head).

If both switches show proper continuity, check the harness for shorts or improper ground conditions.

SYSTEM CONTROLS

FOUR-SEASON SYSTEM (C-K MODELS) - FIG. 1B-5

System Operation - CK Truck

System operation is as illustrated in Fig. 1B-6.

Vacuum Schematic - CK Truck

The CK Truck air conditioning vacuum schematic is illustrated in Figure 1B-7.

OVERHEAD SYSTEM (C-K MODELS)

This system operates in conjunction with the Four-Season System. Since refrigerant flow is controlled by the front system, the only control provided for on the overhead system is a three-speed fan switch (LOW, MED, HI). The fan switch is mounted in the instrument panel, to the right of the steering column (fig. 1B-8).

In the OFF position, the blower is inoperative; however, refrigerant is circulating in the system if the Four-

Season System is ON. In any of the three blower positions (LOW, MED, HI), the blower will be operative regardless if the Four-Season System is ON.

NOTE: To obtain maximum cooling, the Four-Season System should be on A/C, temperature lever on COLD, blower switch on HI and the overhead unit blower switch should be on HI.

C60 SYSTEM CONTROL (G MODELS)--FIG. 1B-9)

OVERHEAD SYSTEM (G MODELS)

This system operates in conjunction with the C60 system. Since refrigerant is controlled by the C60 system, the only control provided on the rear overhead system is a three speed blower switch (fig. 1B-10).

In the OFF position, the blower is inoperative; however, refrigerant is circulating in the system if the front system is ON. To operate the rear overhead system, simply select the desired blower speed (LOW, MED, HI).

When air circulation only is desired, the rear A/C blower motor may be operated independent of the front A/C blower motor and without the cooling function.

DASH MOUNTED UNIT (MOTOR HOME CHASSIS UNITS)

This system is self contained and is mounted below the dash by the body manufacturer. System controls consist of an AIR knob and TEMP knob located in the center of the unit face plate (fig. 1B-11).

Air Knob

Turning the AIR knob clockwise operates a three speed (LOW-MED-HI) blower motor.

Temp Knob

This knob is used to control the degree of cooling desired. Fully clockwise at CITY provides maximum cooling, while turning the knob to HIWAY provided adequate cooling for highway operation.

NOTE: Reduced cooling could be encountered when operating at highway speeds with the controls at the CITY setting. The heater must be fully off to obtain maximum cooling.

SYSTEM OPERATION - CK TRUCK

SELECTOR LEVER POSITION	COMPRESSOR	BLOWER SPEEDS AVAIL	AIR SOURCE	AIR ENTERS VEHICLE	HEATER A/C DOOR-OPEN TO:	HEATER DEFROSTER DOOR-OPEN TO:
OFF	OFF	LOW	OUTSIDE	FLOOR OUTLETS	HEATER	HEATER
MAX A/C	ON	HI	INSIDE%	DASH OUTLETS	A/C	HEATER
NORM A/C	ON	ALL	OUTSIDE	DASH OUTLETS	A/C	HEATER
BI-LEVEL	ON	ALL	OUTSIDE	FLOOR AND DASH OUTLETS	A/C & HEATER	HEATER
VENT	OFF	ALL	OUTSIDE	DASH OUTLETS	A/C	HEATER
HTR	OFF	ALL	OUTSIDE	FLOOR OUTLETS	HEATER	HEATER
DEF	ON	ALL	OUTSIDE	DEFROST OUTLETS	HEATER	DEFROST

NOTE % 100% Inside air is not available, some bleed through of outside air is allowed.

Fig. 1B-6--System Operation - CK Truck

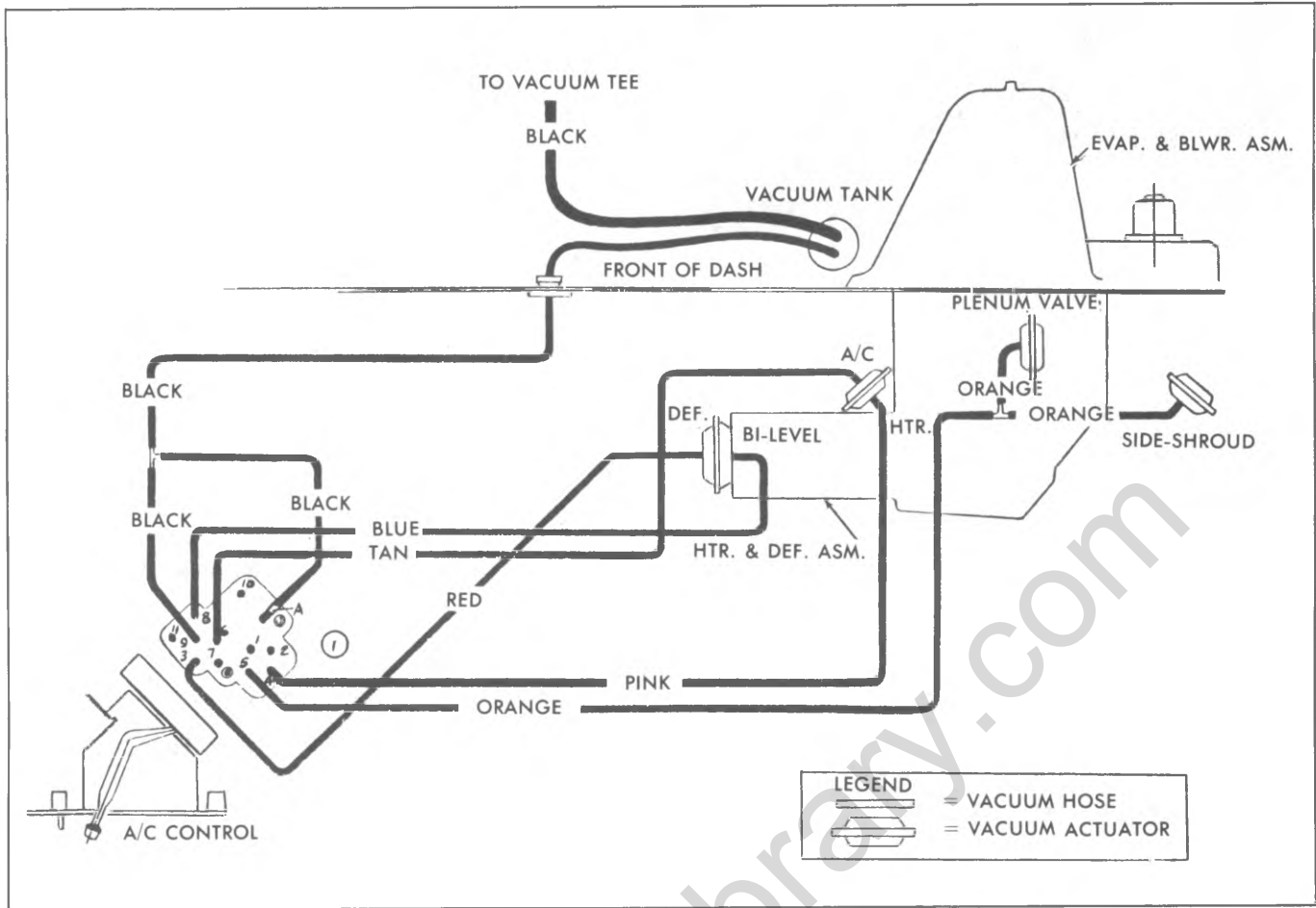


Fig. 1B-7--Air Conditioning Vacuum Schematic - CK Truck

REFRIGERANT LINE CONNECTIONS

"O" Rings

Always replace the "O" ring when a connection has been broken. When replacing the "O" ring, first dip it in clean refrigeration oil. Always use a backing wrench on "O" ring fittings to prevent the pipe from twisting and damaging the "O" ring. Do not overtighten. Correct torque specifications are as follows:

CAUTION: Where steel to aluminum connections are being made, use torque for aluminum tubing.

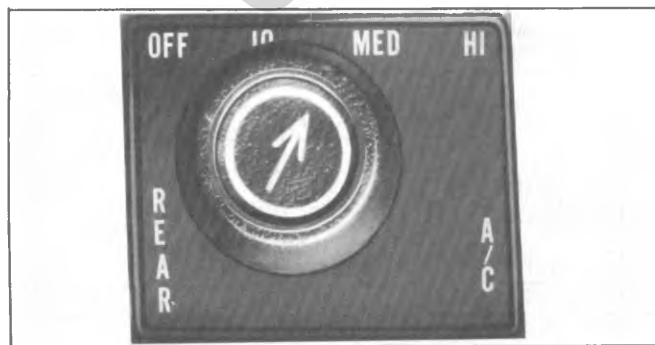


Fig. 1B-8--Overhead Unit Control (C-K Models)

Hose Clamps

When hose clamp connections are encountered, special procedures are necessary for both removal and installation.

Removal

1. Carefully, with a sharp knife, make an angle cut in the hose as shown in Figure 1B-12. This should loosen the hose so that it may be worked off the fittings.
2. Cut off slit end of hose.

CAUTION: Use only approved refrigeration hose. Never use heater hose. Use extreme care not to nick or score the sealing beads when cutting off the hose. Cutting the hose lengthwise may result in this problem.

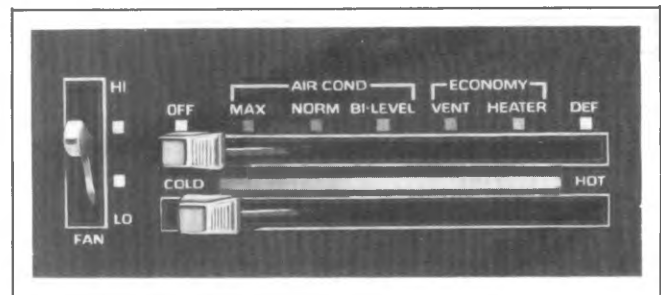


Fig. 1B-9--C60 System Controls (G Models)

COMPRESSOR		BLOWER SPEEDS AVAIL	AIR SOURCE	AIR ENTERS VEHICLE	HEATER DEFROSTER DOOR	HEATER A/C DOOR
OFF	OFF	NONE	OUTSIDE	FLOOR OUTLETS	OPEN TO	OPEN TO
					HEATER	HEATER-DEF
MAX	ON	ALL	INSIDE %	DASH OUTLETS	HEATER	A/C
NORM	ON	ALL	OUTSIDE	DASH OUTLETS	HEATER	A/C
BI LEV	ON	ALL	OUTSIDE	DASH OUTLETS FLOOR OUTLETS	HEATER	A/C & HEATER
VENT	OFF	ALL	OUTSIDE	DASH OUTLETS	HEATER	A/C
HEATER	OFF	ALL	OUTSIDE	BLEED TO DEFROST & FLOOR OUTLETS	HEATER	HEATER
DEFR	ON*	ALL	OUTSIDE	DEFROST OUTLETS	DEFROST	HEATER

*PROVIDED COMPRESSOR PRESSURE SWITCH CLOSED

Installation

1. Coat tube and hose with clean refrigeration oil.
2. Carefully insert hose over the three beads on the fitting and down as far as the fourth, or locating bead. Hose must butt against this fourth bead.

CAUTION: Use no sealer of any kind.

3. Install clamps on hose, hooking the locating arms over the cut end of the hose.

4. Tighten the hose clamp screw to 35-42 in. lbs. (3.9-4.7 N·m) torque. **DO NOT RETORQUE.** The clamp screw torque will normally decrease as the hose conforms to the force of the clamp. The screw should be retorqued only if its torque falls below 10 in. lbs. (1.1 N·m). In this case, retorque to 20-25 in. lbs. (2.3-2.8 N·m). Further tightening may damage the hose.



Fig. 1B-10--Overhead Unit Control (G Models)

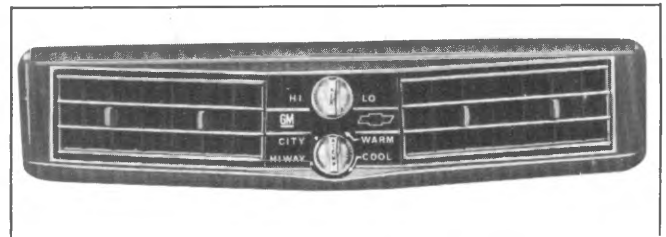


Fig. 1B-11--Motor Home Unit Control

Metal Tube O.D.	Thread and Fitting Size	Alum. Tubing Torque*
1/4	7/16	6
3/8	5/8	12
1/2	3/4	18
5/8	7/8	24
3/4	1-1/16	30

*Foot Pounds

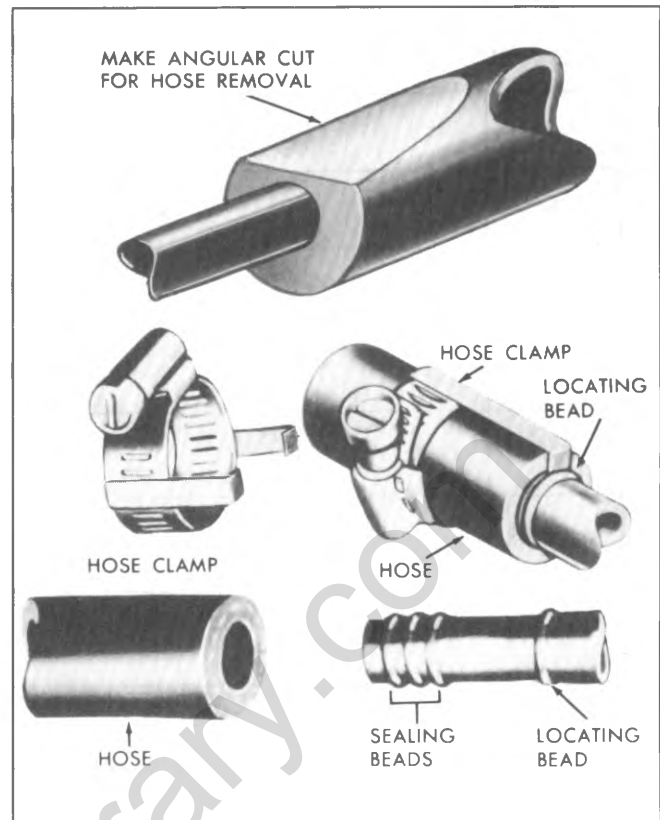


Fig. 1B-12--Hose Clamp Connections

DIAGNOSIS

REFRIGERANT SYSTEM

CAUTION: When performing air conditioning diagnosis on vehicles equipped with a catalytic converter, it will be necessary to *WARM* the engine to a *NORMAL* operating temperature *BEFORE* attempting to idle the engine for periods reater than five (5) minutes. Once to a normal idle, diagnosis and adjustments can be made.

The following is a description of the type of symptom each refrigerant component will evidence if a defect occurs:

COMPRESSOR

A compressor defect will appear in one of four ways: Noise, seizure, leakage, or low discharge pressure.

NOTE: Resonant compressor noises are not cause for alarm; however, irregular noise or rattles may indicate broken parts or excessive clearances due to wear. To check seizure, de-energize the magnetic clutch and check to see if drive plate can be rotated. If rotation is impossible, compressor is seized (See "False Compressor Seizure"). To check for a leak, refer to leak testing in the service manual. Low discharge pressure may be due to a faulty internal seal of the compressor, or a restriction in the compressor.

Low discharge pressure may also be due to an insufficient refrigerant charge or a restriction elsewhere in the system. These possibilities should be checked prior to servicing the compressor. If the compressor is inoperative, but is not seized, check to see if current

is being supplied to the magnetic clutch coil terminals.

CONDENSER

A condenser may be defective in two ways: it may leak, or it may be restricted. A condenser restriction will result in excessive compressor discharge pressure. If a partial restriction is present, sometimes ice or frost will form immediately after the restriction as the refrigerant expands after passing through the restriction. If air flow through the condenser or radiator is blocked, high discharge pressures will result. During normal condenser operation, the outlet pipe will be slightly cooler than the inlet pipe.

RECEIVER-DEHYDRATOR - MOTOR HOME CHASSIS

A defective receiver-dehydrator may be due to a restriction inside the body of the unit. A restriction at the inlet to the receiver-dehydrator will cause high head pressures. Outlet tube restrictions will be indicated by low head pressures and little or no cooling. An excessively cold receiver-dehydrator outlet may be indicative of a restriction.

EXPANSION VALVE

A malfunction of the expansion valve will be caused by one of the following conditions: valve stuck open, valve stuck closed, broken power element, a restricted screen or an improperly located or installed power element bulb. The first three conditions require valve replacement. The last two may be corrected by replacing the valve inlet screen and by properly installing the power element bulb.

Attachment of the expansion valve bulb to the evaporator outlet line is very critical. The bulb must be attached tightly to the line and must make good contact with the line along the entire length of the bulb. A loose bulb will result in high low side pressures and poor cooling.

Indications of expansion valve trouble are provided by Performance Tests; consult Diagnostic Charts.

VALVE STUCK OPEN

NOISY COMPRESSOR.

No Cooling - Freeze Up.

VALVE STUCK CLOSED, BROKEN POWER ELEMENT OR PLUGGED SCREEN

Very Low Suction Pressure.

No Cooling.

POORLY LOCATED POWER ELEMENT BULB

Normal Pressure.

Poor Cooling.

Diagnosis for Defective Valve

The following procedure must be followed to determine if a malfunction is due to a defective expansion valve.

1. Check to determine if the system will meet the performance test as outlined previously. If the expansion valve is defective, the low pressure readings (evaporator pressure) will be above specifications.

2. The loss of system performance is not as evident when the compressor head pressure is below 200 psi (1 379 kPa). Therefore, it may be necessary to increase the system head pressure by partially blocking the condenser. Disconnect the blower lead wire and repeat the "performance check" to determine if the evaporator pressure can be obtained.

3. The system will also indicate a low refrigerant charge by bubbles occurring in the sight glass (Motor Home Chassis Systems).

EVAPORATOR

When the evaporator is defective, the trouble will show up as an inadequate supply of cool air. A partially plugged core due to dirt, a cracked case, or a leaking seal will generally be the cause.

REFRIGERANT LINE RESTRICTIONS

Restrictions in the refrigerant lines will be indicated as follows:

1. Suction Line - A restricted suction line will cause low suction pressure at the compressor, low discharge pressure and little or no cooling.

2. Discharge Line - A restriction in the discharge line generally will cause the pressure relief valve to open.

3. Liquid Line - A liquid line restriction will be evidenced by low discharge and suction pressure, and insufficient cooling.

Sight Glass Diagnosis (Motor Home Chassis Units)

At temperatures higher than 70°F (21°C), the sight glass may indicate whether the refrigerant charge is sufficient. A shortage of liquid refrigerant is indicated after above five minutes of compressor operation by the appearance of slow-moving bubbles (vapor) or a broken column of refrigerant under the glass. Continuous bubbles may appear in a properly charged system on a cool day. This is a normal situation. If the sight glass is generally clear and performance is satisfactory, occasional bubbles do not

indicate refrigerant shortage.

If the sight glass consistently shows foaming or a broken liquid column, it should be observed after partially blocking the air to the condenser. If under this condition the sight glass clears and the performance is otherwise satisfactory, the charge shall be considered adequate.

In all instances where the indications of refrigerant shortage continues, additional refrigerant should be added in 1/4 lb. increments until the sight glass is clear. An additional charge of 1/2 lb. should be added as a reserve after the glass clears. In no case should the system be overcharged.

VACUUM SYSTEM DIAGNOSIS

(C-K-G FOUR-SEASON SYSTEM)

Start the engine and allow it to idle - move the selector lever to each position and refer to the vacuum diagrams and operational charts for proper airflow, air door functioning and vacuum circuits. If air flow is not out of the proper outlets at each selector lever position, then proceed as follows:

1. **Check for good hose connections** --at the vacuum actuators, control head valve, reservoir, tees, etc.

2. **Check the vacuum source circuit as follows:**

Install vacuum tee and gage (with restrictor) at the vacuum tank outlet (see Vacuum Diagram). Idle the engine and read the vacuum (a normal vacuum is equivalent to manifold vacuum) at all selector lever positions.

a. **Vacuum Less Than Normal At All Positions**

Remove the tee and connect the vacuum gage line directly to the tank - read the vacuum. If still low, then the problem lies in the feed circuit, the feed circuit to the tank or in the tank itself. If vacuum is now normal, then the problem lies downstream.

b. **Vacuum Less Than Normal at Some Positions -**

If vacuum was low at one or several of the selector lever positions, a leak is indicated in these circuits.

c. **Vacuum Normal at All Positions -**

If vacuum was normal and even at all positions, then the malfunction is probably caused by improperly connected or plugged lines or a defective vacuum valve or valves.

3. **Specific Vacuum Circuit Check**

Place the selector lever in the malfunctioning position and check for vacuum at the pertinent vacuum actuators. If vacuum exists at the actuator but the door does not move, then the actuator is defective or the door is mechanically bound. If low or no vacuum exists at the actuator, then the next step is to determine whether the cause is the vacuum harness or the vacuum valve. Check the vacuum harness first.

4. **Vacuum Harness Circuit Check**

a. Disconnect the vacuum harness at the control head.
b. The black line (#1) should show engine vacuum - if not, trace back through connector to vacuum tank.

c. To check any individual circuit place the selector lever at the involved circuit position and check for vacuum presence.

COMPRESSOR DIAGNOSIS

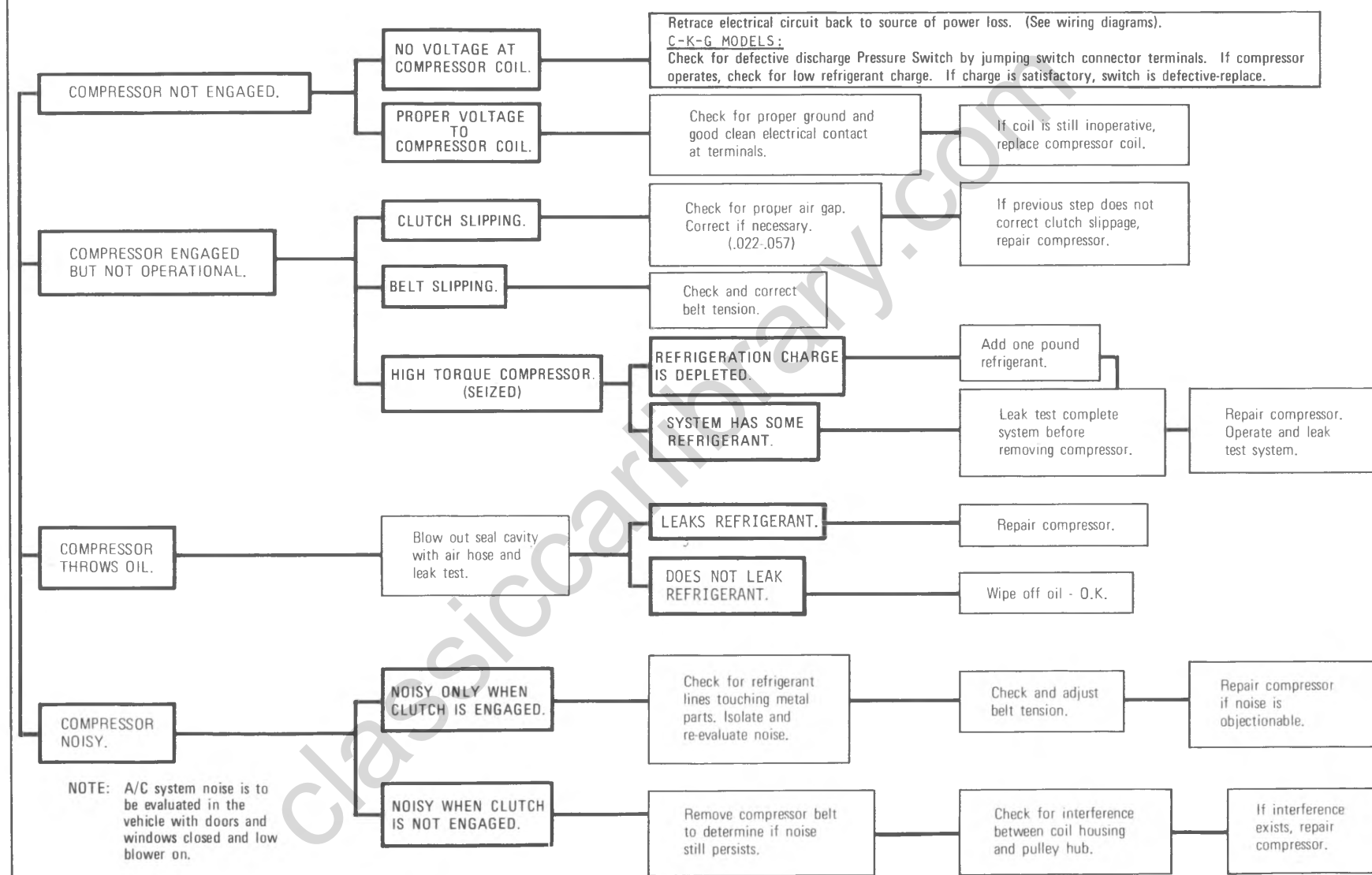
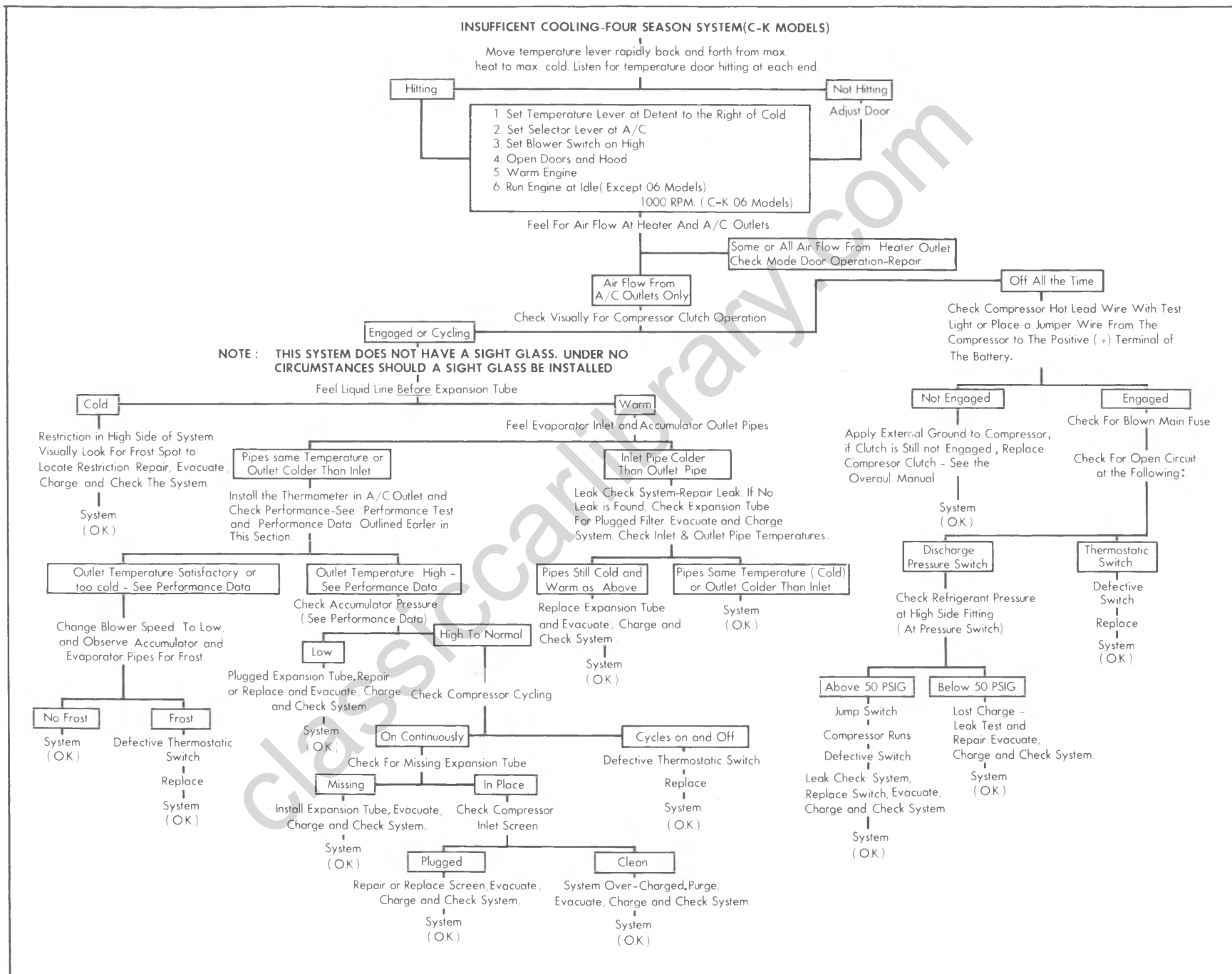


Fig. 1B-13--Compressor Diagnosis

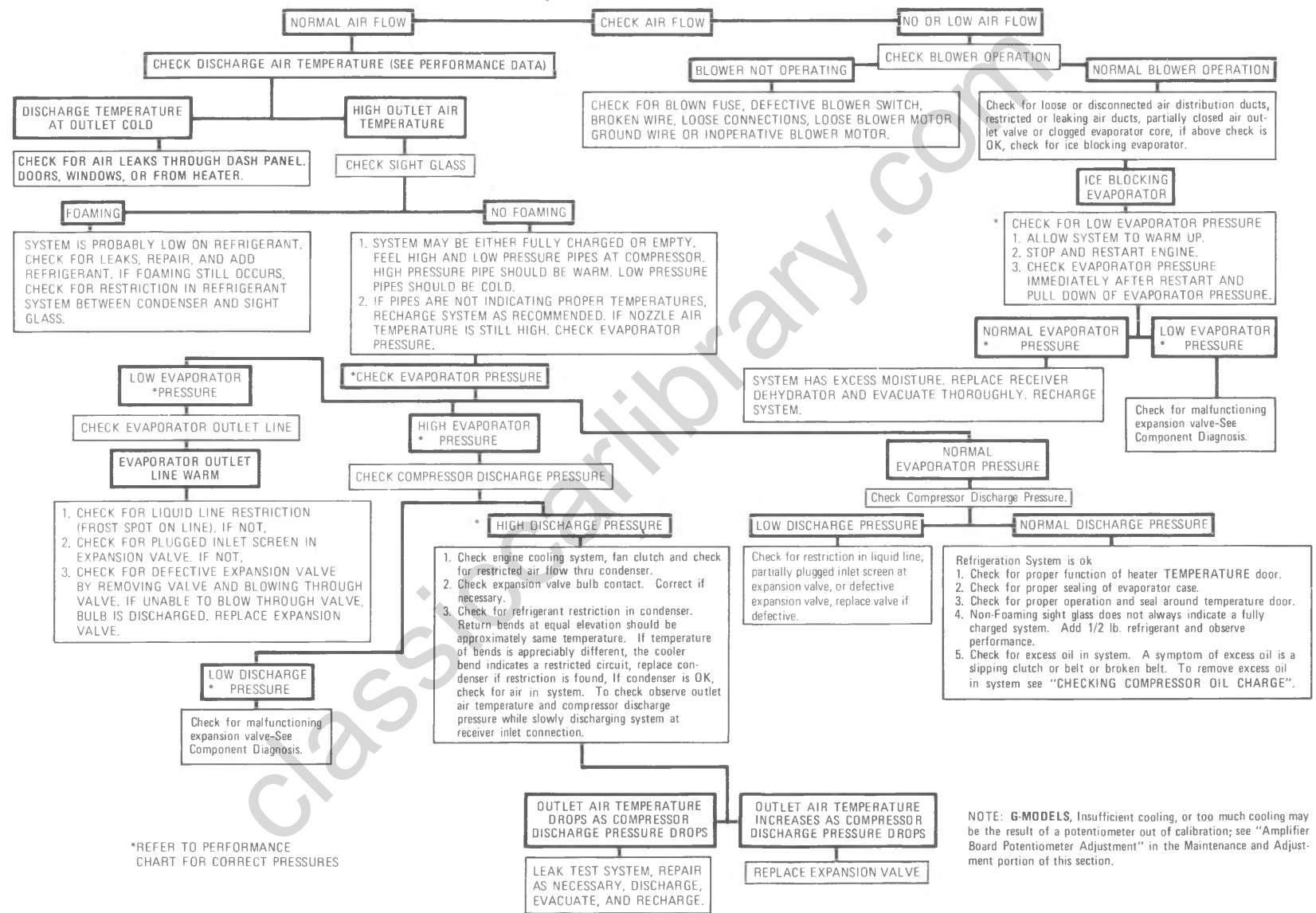
NOTE: A/C system noise is to be evaluated in the vehicle with doors and windows closed and low blower on.

Fig. 1B-14--Insufficient Cooling Diagnosis--C-K Four-Season System



INSUFFICIENT COOLING DIAGNOSIS CHART (EXCEPT C-K FOUR-SEASON SYSTEM)

- The following procedures should be applied before performance testing an A/C System.
1. Check for proper belt installation and tension with J-23600.
 2. Check for proper clutch coil terminal connector installation.
 3. Check for clutch air Gap (.022 - .057).
 4. Check for broken, burst, or cut hoses. Also check for loose fittings on all components.
 5. Check for condenser air blockage due to foreign material.
 6. Check for proper air ducting hose connections.
 7. Check heater temperature door adjustment, adjust if incorrect.
 8. Check evaporator sealing for air leak, repair if leaking.
 9. Install pressure gages and thermometer and make performance test.



*REFER TO PERFORMANCE CHART FOR CORRECT PRESSURES

NOTE: G-MODELS, Insufficient cooling, or too much cooling may be the result of a potentiometer out of calibration; see "Amplifier Board Potentiometer Adjustment" in the Maintenance and Adjustment portion of this section.

Fig. 1B-15--Insufficient Cooling Diagnosis--Motor Home Chassis Unit

ELECTRICAL SYSTEM DIAGNOSTIC CHART

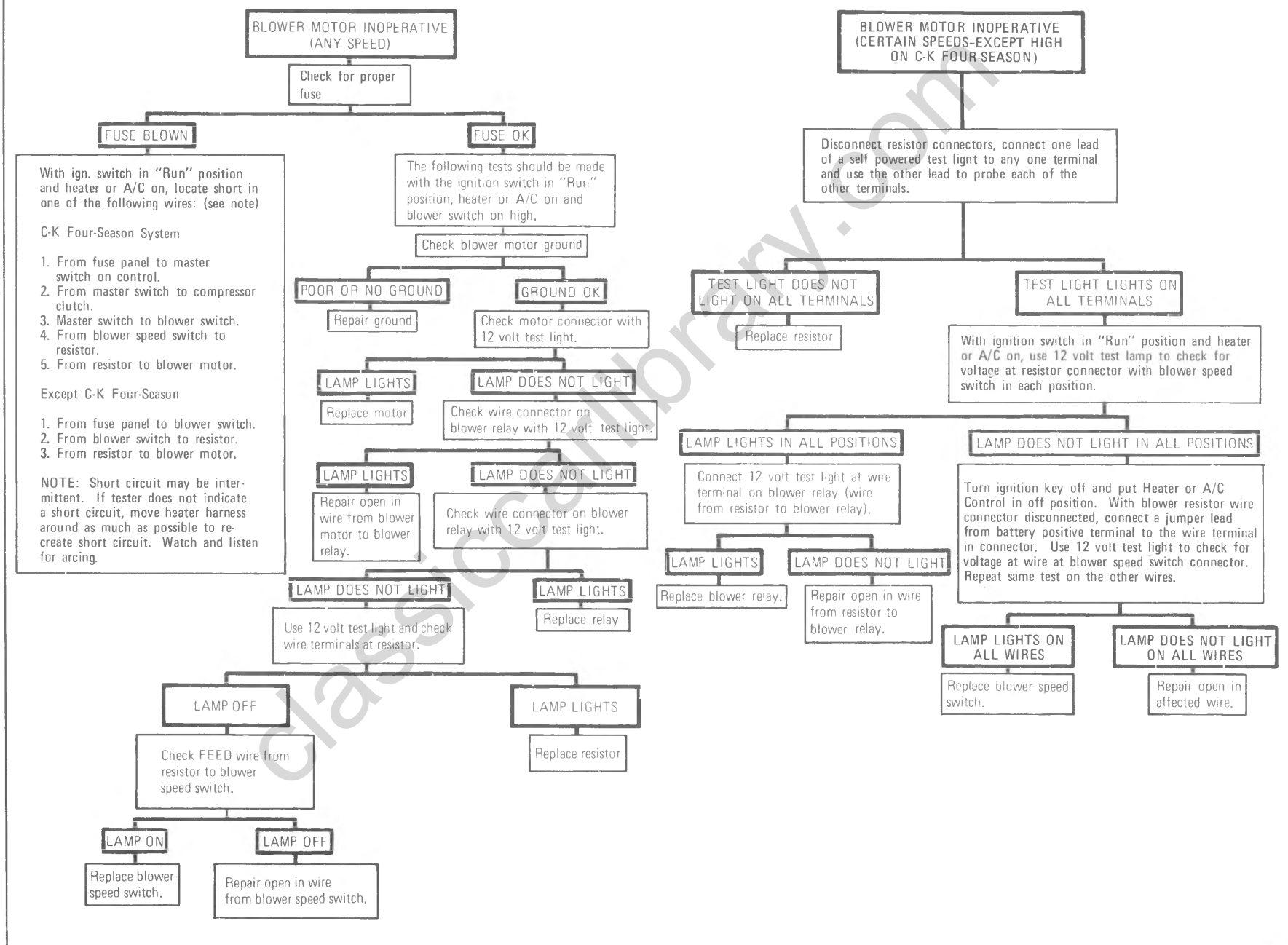


Fig. 1B-16--Electrical System Diagnosis Chart

ELECTRICAL SYSTEM DIAGNOSTIC CHART

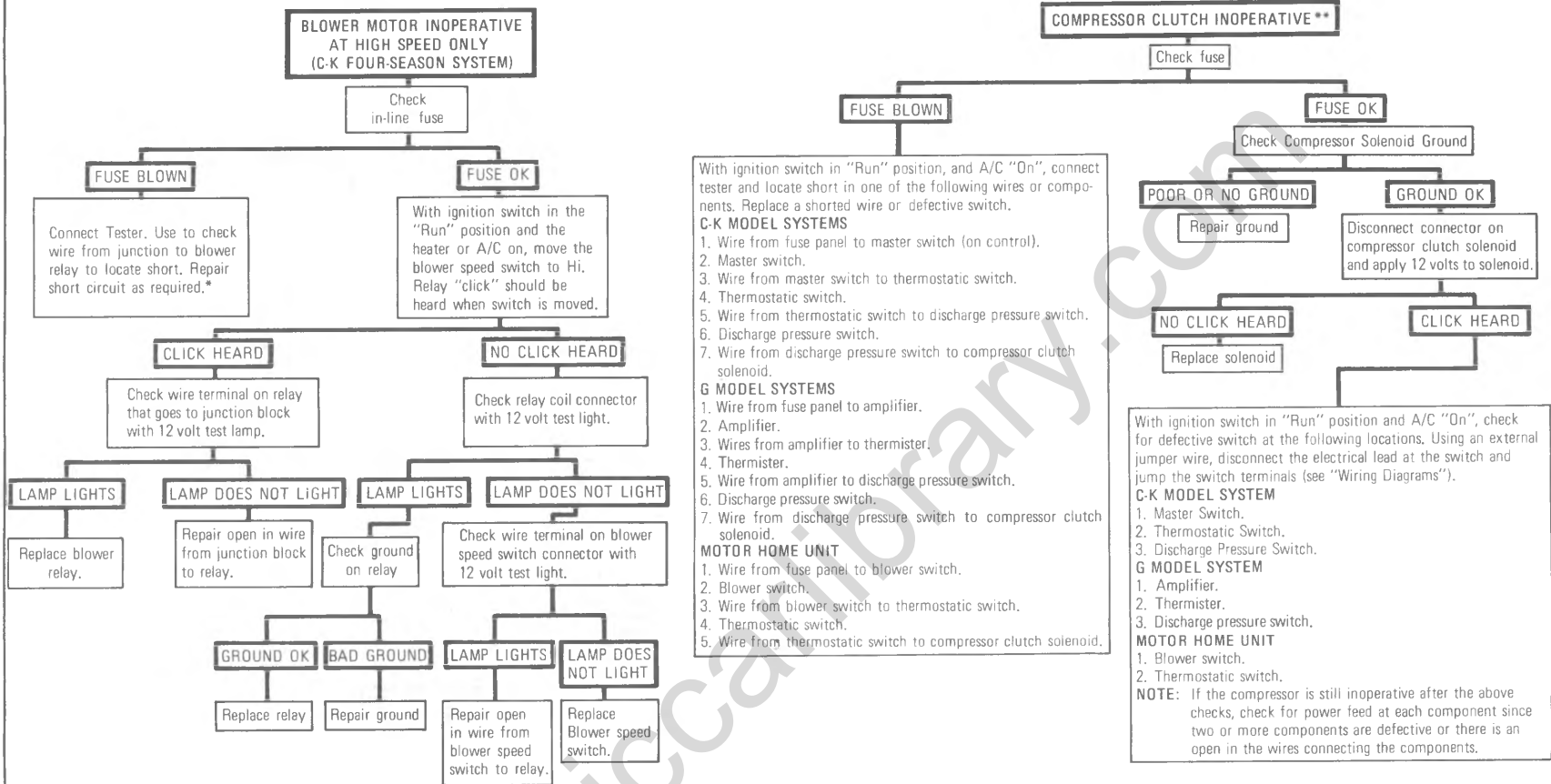
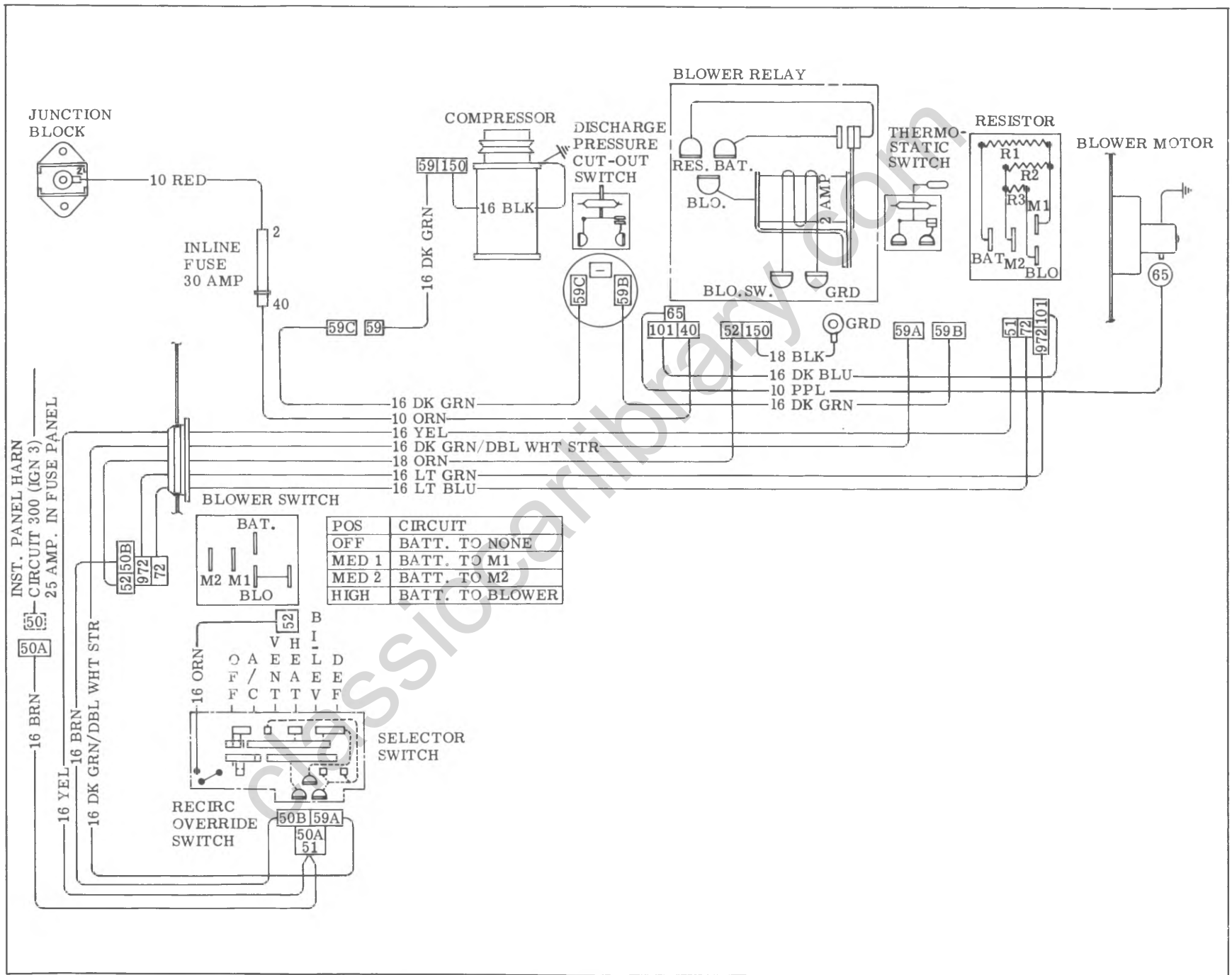


Fig. 1B-17--Electrical System Diagnosis Chart

*Short circuit may be intermittent. If tester does not indicate a short circuit, move harness around as much as possible to re-create short circuit. Watch and listen for arcing.

**Refer to Wiring Diagrams while performing the following checks.

Fig. 1B-18--Four-Season System Wiring Diagram (C-K Models)



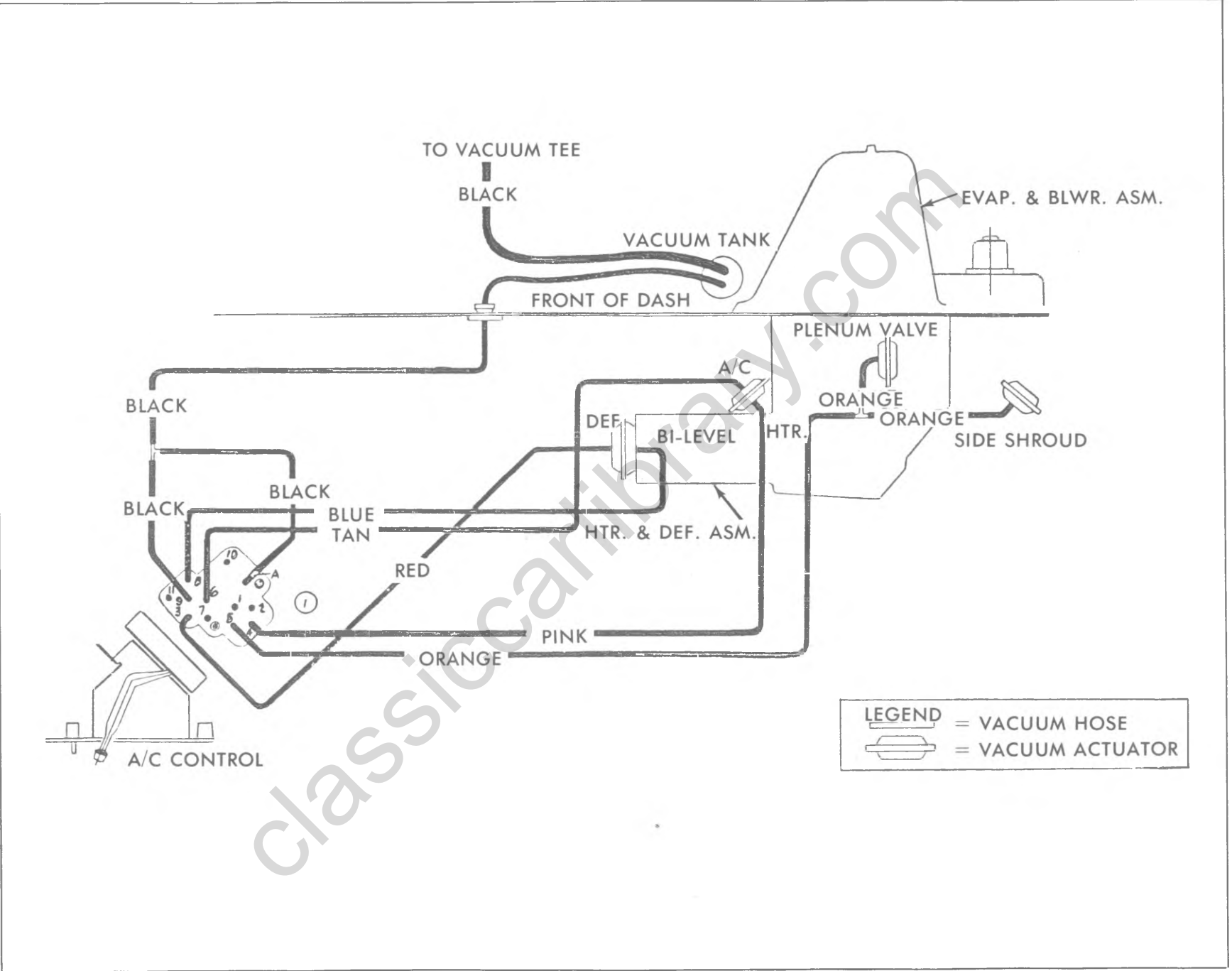
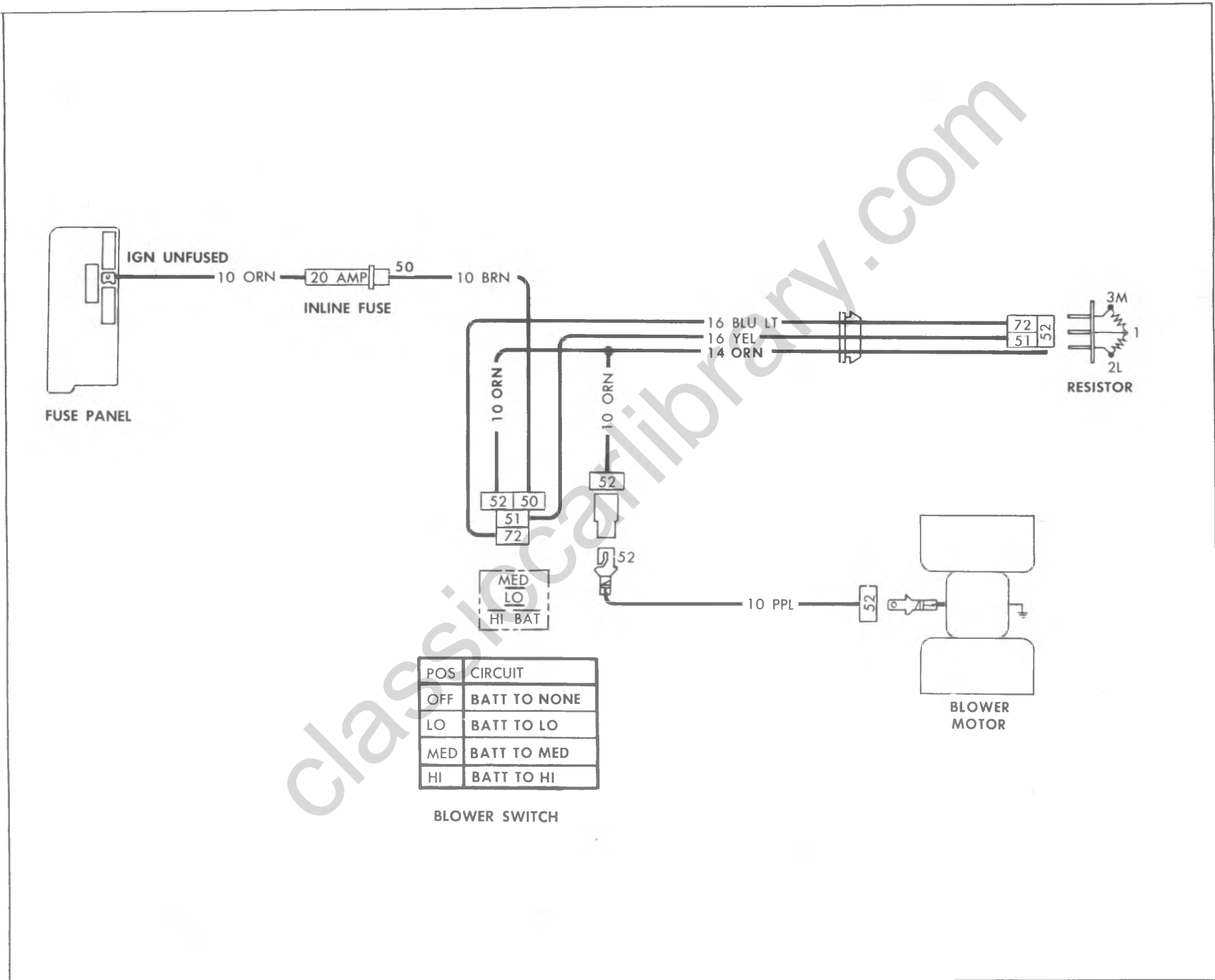


Fig. 1B-19--Four-Season System Vacuum Diagram (C-K Models)

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Fig. 1B-20--Overhead System Wiring Diagram (C-K Models)



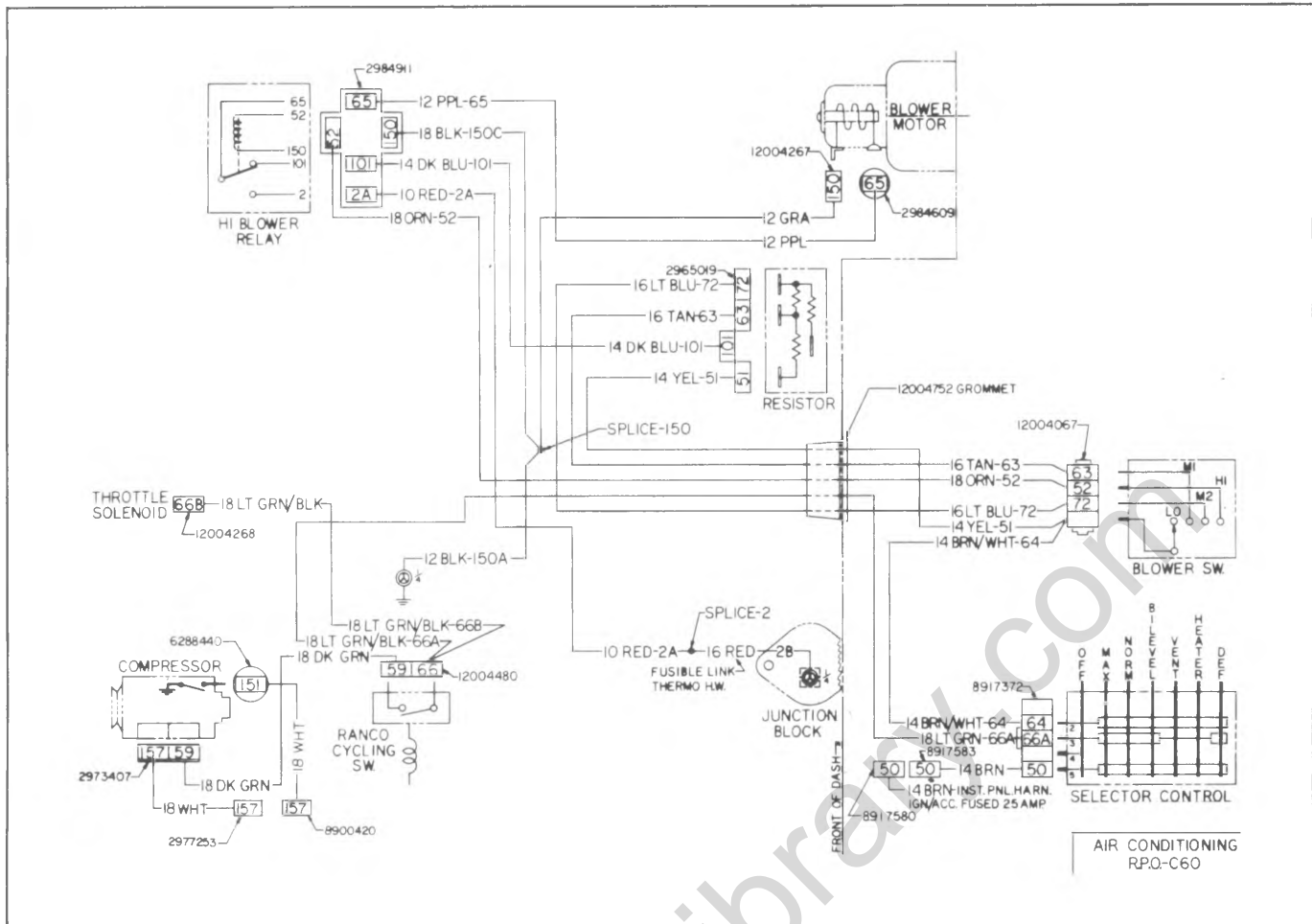


Fig. 1B-21-C60 System Wiring Diagram.(G Models)

CHECKING SYSTEM OPERATION

1. Operate system for a maximum of five minutes at maximum cooling, high blower speed and with engine operating at 2000 RPM (exhaust should be vented if inside).
2. When system is stabilized, the pressure gages on the charging station should read pressures corresponding to values listed under **PERFORMANCE DATA**.
3. When correct system pressures are observed, check system charge as described under "Refrigerant Quick Check Procedure".
4. Feel outlet air distribution to ensure that cold air is being distributed.
5. Disconnect gage lines and cap fittings.

CAUTION: When removing gage lines from fittings, be sure to remove the adapters from the fittings rather than the gage lines from the adapters.

PERFORMANCE TEST

Under normal circumstances, it will not be necessary to Performance Test a system as outlined below; however, in certain instances, the following procedure may be advantageous in diagnosing system malfunction.

The following fixed conditions must be adhered to in order to make it possible to compare the performance of the system being tested with the standards below:

1. Doors and window closed. (Vehicle inside or in

shade.)

2. Hood up and engine exhaust suitably ventilated.
3. Vehicle in **NEUTRAL** with engine running at 2000 rpm.
4. Air Conditioning controls set for -
 - Maximum cooling.
 - High blower speed
5. **TEMP** control set at "COLD" and all air conditioning outlets open.
6. Gage set installed.
7. System settled out (run-in approximately 10 minutes).
8. A thermometer placed in front of vehicle grille and another in the right hand diffuser outlet.

NOTE: On Overhead Systems, place a third thermometer in the rear unit center outlet.

9. An 18" fan placed in front of the vehicle and blowing into the condenser.

NOTE: Higher temperatures and pressures will occur at higher ambient temperatures. In areas of high humidity it is possible to have thermometer and gage readings approach but not reach the figures listed in the performance tables and still have a satisfactory operating unit. However, it is important to remember that low pressure has a direct relationship to nozzle outlet temperature. If pressure is too low, ice will gradually form on the evaporator fins, restricting air

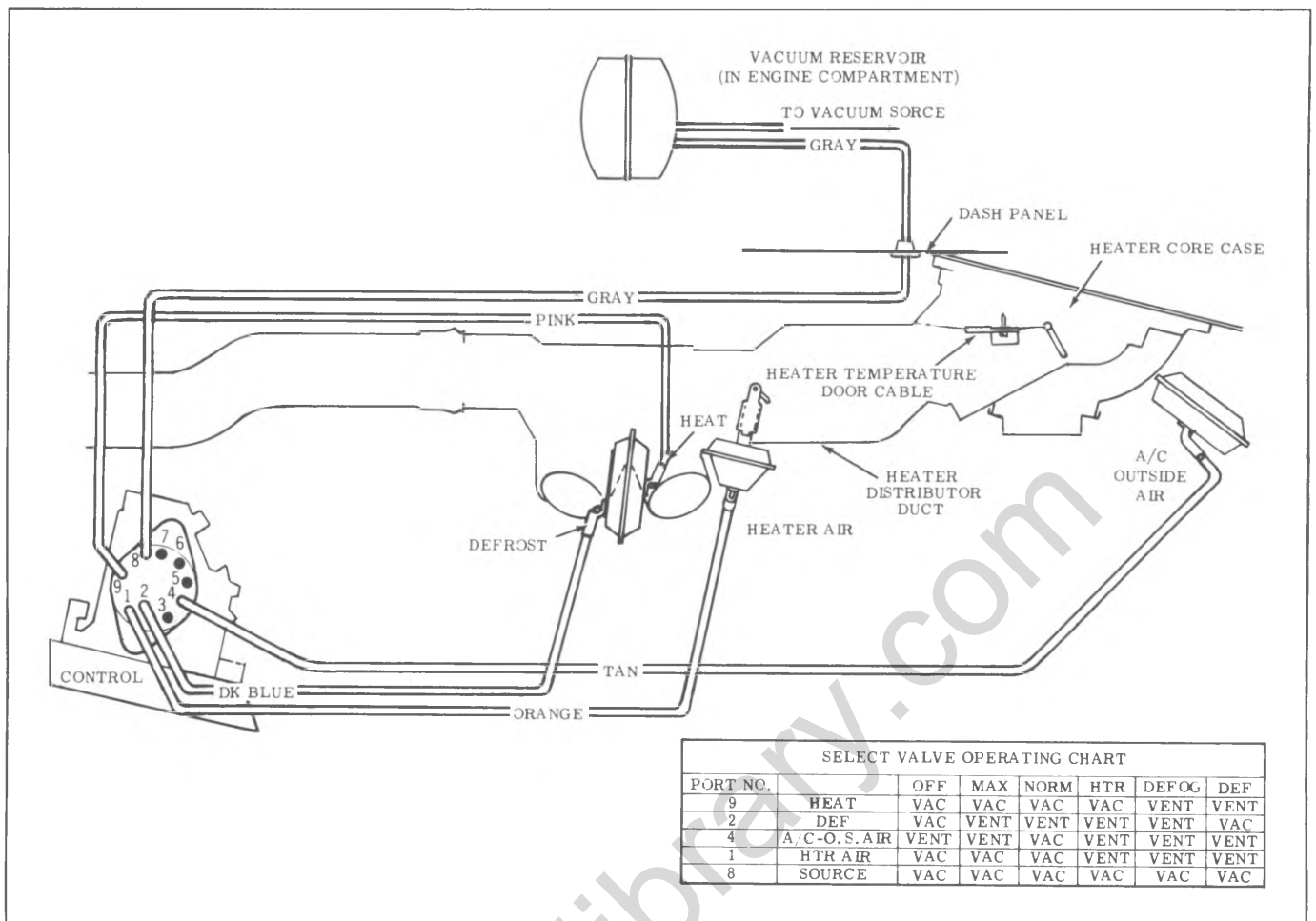


Fig. 1B-22-C60 System Vacuum Diagram (G Models)

flow into the passenger area and resulting in insufficient or no cooling.

PERFORMANCE DATA

The following Performance Data define normal operation of the system under the above conditions. Relative humidity does not appear in the tables because after running the prescribed length of time on recirculated air and maximum cooling, the relative humidity of the air passing over the evaporator core will remain at approximately 35% to 40% regardless of the ambient temperature or humidity.

CHECKING OIL

In the six cylinder compressor it is not recommended that the oil be checked as a matter of course. Generally, compressor oil level should be checked only where there is evidence of a major loss of system oil such as might be caused by:

- A broken refrigerant hose
- A severe hose fitting leak
- A very badly leaking compressor seal
- Collision damage to the system components

As a quick check on compressor oil charge, operate the engine at **idle** on maximum cold for approximately 10 minutes, turn off the engine and momentarily crack open the oil drain plug on bottom of the compressor letting a slight amount of oil drain out. Retighten plug. Again slightly crack open the plug. If oil comes out, the

compressor has the required amount of oil.

NOTE: The oil may appear foamy. This is considered normal.

To further check the compressor oil charge, should the above test show insufficient oil, it is necessary to remove the compressor from the vehicle, drain and measure the oil as outlined under "Checking Compressor Oil Charge."

Checking Compressor Oil Charge

1. Run the system for 10 minutes at 500-600 engine rpm with controls set for maximum cooling and high blower speed.

2. Turn off engine, discharge the system, remove compressor from vehicle, place it in a horizontal position with the drain plug downward. Remove the drain plug and, tipping the compressor back and forth and rotating the compressor shaft, drain the oil into a clean container, measure and discard the oil.

3. Add new refrigeration oil to the compressor as follows.

a. If the quantity drained was 4 fluid oz. or more, add the same amount of new refrigeration oil to the replacement compressor.

b. If the quantity drained was less than 4 fluid oz., add 6 fluid oz. of new refrigeration oil to the replacement compressor.

c. If a new service compressor is being installed, drain all oil from it and replace only the amount specified in Steps

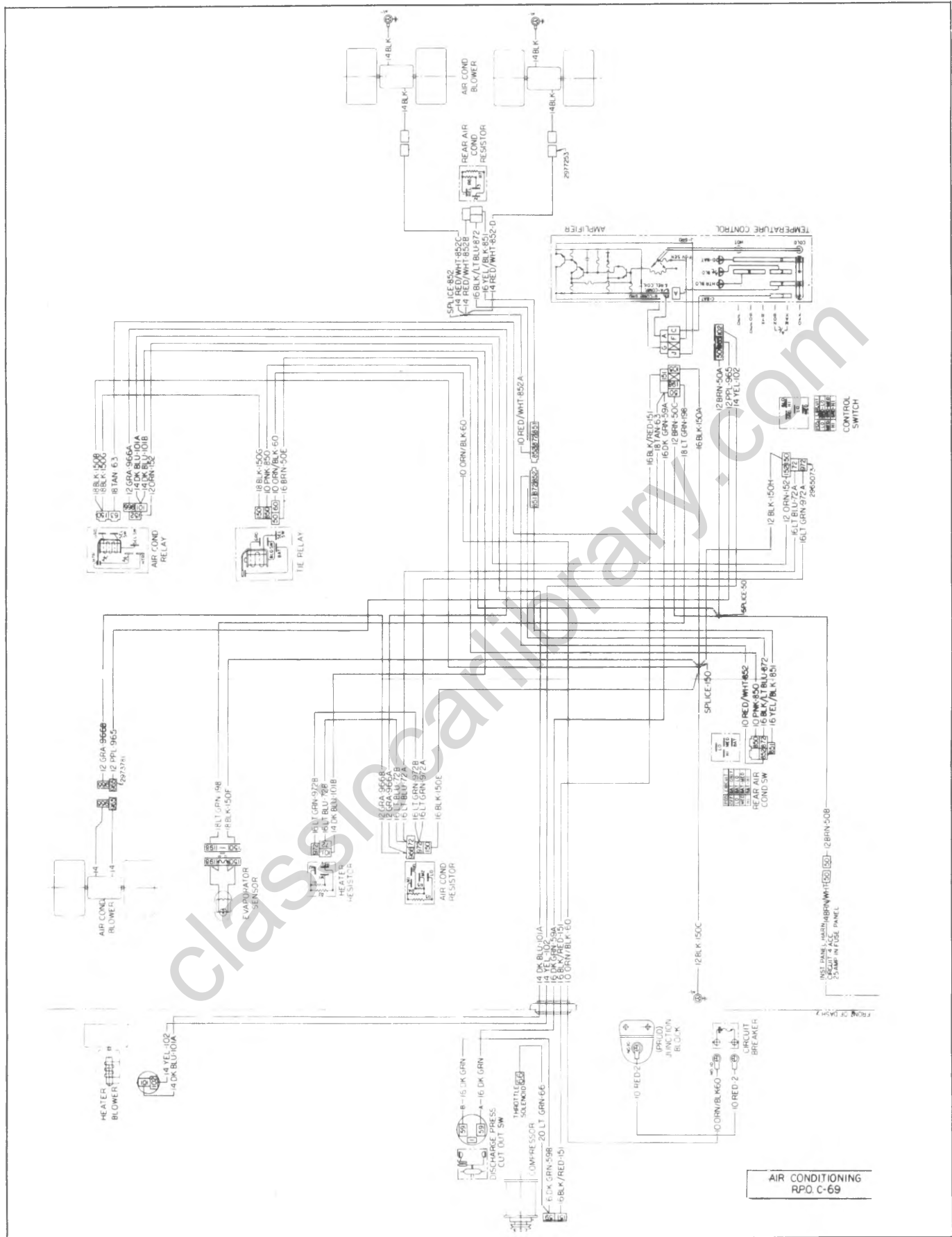


Fig. 1B-23-C69-Overhead System Wiring Diagram (G Models)

Four-Season Air Conditioning (C-K Models)

(Refrigerant Charge - 3 Lbs. - 12 oz.)					
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°
Engine rpm	2000				
Compressor Head Pressure *	150-205	170-220	190-240	220-270	240-290
Accumulator Pressure *	20-26	20-28	21-29	22-30	23-32
Discharge Air Temp. at Right Hand Outlet *	41-47	41-47	42-50	43-51	43-51

3a and 3b above.

d. If a field repaired compressor is being installed, add one additional fluid oz. to the compressor.

4. In the event that it is not possible to idle the compressor as outlined in Step 1 to effect oil return to it, proceed as follows:

a. Remove the compressor, drain, measure and discard the oil.

b. If the amount drained is more than 1-1/2 fluid oz. and the system shows no signs of a major leak, add the same amount to the replacement compressor.

c. If the amount drained is less than 1-1/2 fluid oz. and the system appears to have lost an excessive amount of oil, add 6 fluid oz. of clean refrigeration oil to replacement compressor, 7 fluid oz. to a repaired compressor.

If the oil contains chips or other foreign material, replace the receiver-dehydrator (expansion tube on C-K, G models) and flush or replace all component parts as necessary. Add the full specified volume of new refrigeration oil to the replacement compressor.

5. Add additional oil in the following amounts for any system components being replaced.

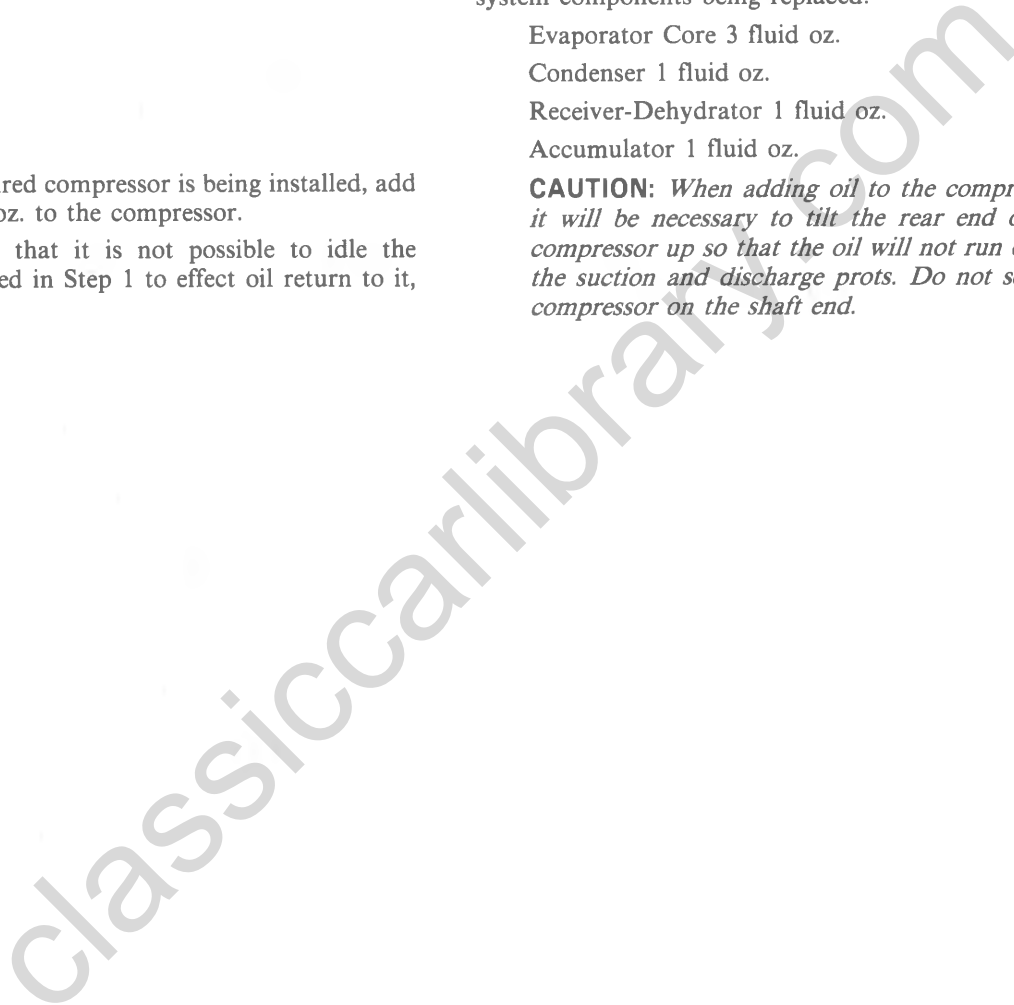
Evaporator Core 3 fluid oz.

Condenser 1 fluid oz.

Receiver-Dehydrator 1 fluid oz.

Accumulator 1 fluid oz.

CAUTION: When adding oil to the compressor, it will be necessary to tilt the rear end of the compressor up so that the oil will not run out of the suction and discharge ports. Do not set the compressor on the shaft end.



Overhead System (G Models)

(Refrigerant Charge — 5 lbs.-4 oz.)						
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°	120°
Engine rpm	2000					
Compressor Head Pressure*	50-200	160-210	200-250	225-275	250-300	280-320
Suction Pressure*	13-19	13-21	16-24	19-27	23-31	26-34
Discharge Air Temp. at Right Front Upper Outlet*	38-44	38-44	39-47	45-53	50-58	54-62

Rear system temperatures at center outlet run 5 - 10° higher than front system.

Dash Mounted Unit (Motor Home Chassis)

(Refrigerant Charge — 3 lbs.-4 oz.)						
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°	120°
Engine rpm	2000					
Compressor Head Pressure*	110-120	135-145	160-170	190-200	220-230	260-270
Suction Pressure psi*	6	7	9	10	10	13
Discharge Air Temperature*	40-45	41-46	41-46	42-47	44-49	44-49

*Just prior to compressor clutch disengagement.

Overhead System (C-K Models)

(Refrigerant Charge - 5 lbs.-4 oz.)					
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°
Engine rpm	2000				
Compressor Head Pressure *	135-185	160-210	195-245	230-280	270-320
Accumulator Pressure *	22-28	22-30	30-38	33-41	37-47
Discharge Air Temp. at Right Hand Outlet *	42-48	42-48	50-58	54-62	57-67
Rear Center Outlet *	43-49	47-53	50-58	55-63	58-68

C60 System (G Models)

(Refrigerant Charge — 3 lbs.)						
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°	120°
Engine rpm	2000 RPM					
Compressor Head Pressure*	10-60	20-70	140-190	160-210	190-240	210-260
Suction Pressure*	3-9	3-9	3-9	4-10	7-14	10-18
Discharge Air Temp. at Right Upper Outlet*	42-48	42-48	43-49	45-57	49-56	53-60

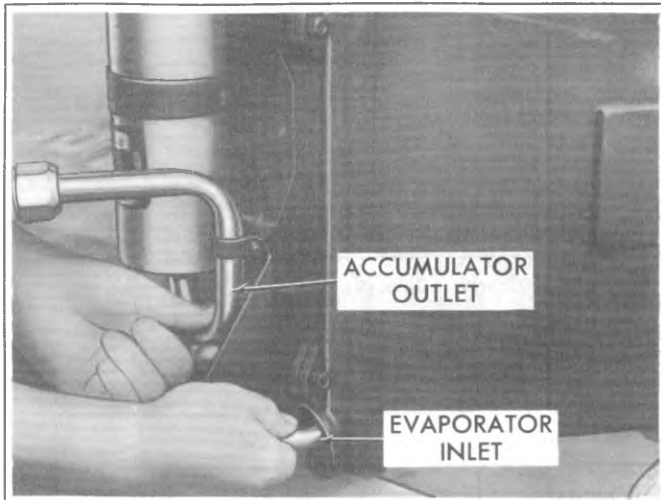


Fig. 1B-25--Checking Evaporator Inlet and Accumulator Outlet Temperatures

ON VEHICLE SERVICE

THERMOSTATIC SWITCH

C-K and G Systems and Motor Home Chassis Units make use of a thermostatic switch with either an air or evaporator inlet line sensing capillary. This capillary controls the switch by sensing the temperature of the air leaving the evaporator core (Motor Home Units) or temperature of the core fins (C-K, G models).

Checking for Proper Operation

Motor Home Chassis Units

1. Install the gage set and set up the vehicle as described under "Performance Test."
2. Movement of the temperature control knob should result in a definite change in suction pressure and cycling of the compressor clutch.
 - If compressor continued to operate regardless of the knob adjustment, it indicates that the switch points are fused which will lead to evaporator freeze-up. Replace the switch.
 - If the compressor does not operate, regardless of the position of the knob, a loss of the power element charge is indicated (provided that it has been established that power is supplied to the switch). This, of course, results in no cooling. Replace the switch.

C-K Models

1. Install the gage set and set up the vehicle as described under "Performance Test".
2. Set the control at A/C, HI blower, max COLD and run the engine at 2000 rpm.
 - The thermostatic switch should cycle the compressor off when the low limit of the outlet air temperature is reached (see Performance Data). If it does not, the switch points are fused which will lead to evaporator freeze up. Replace the switch.
 - If the compressor does not operate, a loss of power element charge is indicated (provided that it has been established that power is supplied to the switch). This, of course, results in no cooling. Replace the switch.

NOTE: Do not attempt to run a Performance Check with the system disassembled since inaccurate readings would be the result. ALWAYS reinstall switch and capillary and any duct work before running a performance check.

EXPANSION VALVE (Fig. 1B-26)

An expansion valve is used on C-K Model Overhead Systems, all G Model overhead systems and Motor Home Chassis Units.

A malfunction of the expansion valve will be caused by one of the following conditions; valve stuck open, valve stuck closed, broken power element, a restricted screen or

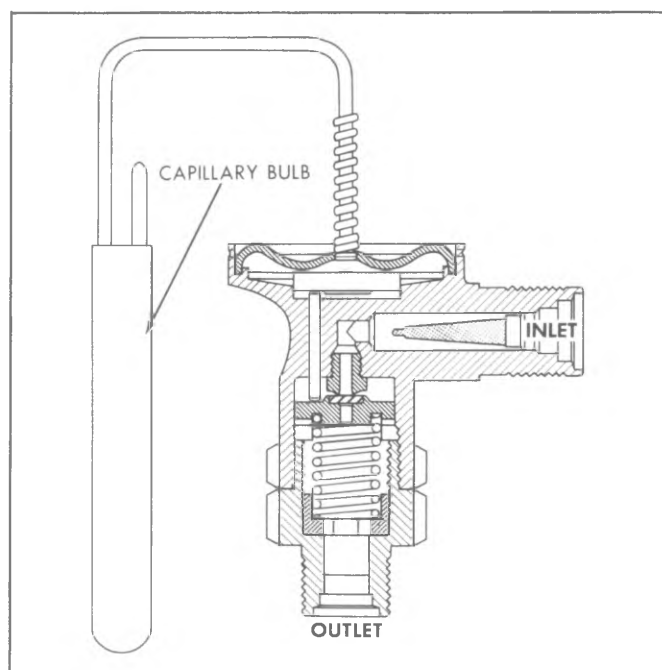


Fig. 1B-26--Expansion Valve

an improperly located or installed power element bulb.

Attachment of the expansion valve bulb to the evaporator outlet pipe is very critical. The bulb must be attached tightly to the pipe and must make good contact with the pipe along the entire length of the bulb. A loose bulb will result in high "high side" pressures and poor cooling.

Indications of expansion valve trouble provided by the Performance Test are as follows:

VALVE STUCK OPEN

Noisy Compressor.

No Cooling - Freeze Up.

VALVE STUCK CLOSED, PLUGGED SCREEN OR BROKEN POWER ELEMENTS

Very Low Suction Pressure.

No Cooling.

POORLY LOCATED POWER ELEMENT BULB

Normal Pressure.

Poor Cooling.

Check for Defective Valve

The following procedure must be followed to determine if a malfunction is due to a defective expansion valve.

1. Check to determine if the system will meet the performance test as outlined previously. If the expansion valve is defective, the low pressure readings will be above specification.

2. The loss of system performance is not as evident when the high side pressure is below 200 PSI (1 379 kPa). Therefore, it may be necessary to increase the system high side pressure by partially blocking the condenser. Disconnect the blower lead wire and repeat the "Performance Check" to determine if the low side pressure can be obtained.

3. The system will also indicate a low refrigerant charge by bubbles occurring in the sight glass.

ENGINE IDLE COMPENSATOR

This additional aid to prevent stalling during prolonged hot weather periods is included with all air conditioned vehicles. The idle compensator is a thermostatically controlled air bleed which supplies additional air to the idle mixture. On V-8 engines, with factory installed air conditioning systems, the compensator is located within the carburetor and is accessible when the engine air cleaner is removed.

COMPRESSOR

C-K Models

Removal (Fig. 1B-27)

1. Purge the refrigerant from the system.
2. Remove connector attaching bolt and connector. Cap or plug open connections at once.
3. Disconnect electrical lead to clutch actuating coil.
4. Loosen brace and pivot bolts and detach belt.
5. Remove the nuts and bolts attaching the compressor brackets to the mounting bracket. Remove the compressor.
6. Before beginning any compressor disassembly, drain and measure oil in the compressor. Check for evidence of contamination to determine if remainder of system requires servicing. Compressor servicing information is located in the Overhaul Manual.

Installation

1. If oil previously drained from the compressor upon removal shows no evidence of contamination, replace a like amount of fresh refrigeration oil into the compressor before reinstallation. If it was necessary to service the entire system because of excessive contamination in the oil removed, install a full charge of fresh refrigeration oil into the compressor.

2. Position compressor on the mounting bracket and install all nuts, bolts and lock washers.

3. Install the connector assembly to the compressor rear head, using new "O" rings coated with clean refrigeration oil.

4. Connect the electrical lead to the coil and install and adjust compressor belt.

5. Evacuate, charge and check the system.

G and Motor Home Chassis Models

Removal (Fig. 1B-27)

1. Disconnect battery ground cable.
2. Disconnect compressor clutch connector.
3. Purge the system of refrigerant.
4. Release the belt tension at the idler pulley and remove the belt from the compressor pulley. On some vehicles it may be necessary to remove the crankshaft pulley in order to remove the belt.
5. **G Models** --Remove the two bolts and two clamps that hold the engine cover and remove the cover.
6. Remove the air cleaner to aid access to the compressor.
7. Remove fitting and muffler assembly and cap or plug all open connections.
8. Remove the nuts and bolts attaching the compressor to the bracket.
9. Remove the engine oil tube support bracket bolt and nut from the compressor, also compressor clutch ground lead.

Before beginning any compressor disassembly, drain and measure oil in the compressor. Check for evidence of contamination to determine if remainder of system requires servicing. Compressor Servicing information is located in the Overhaul Manual.

Installation

1. If the oil drained from the compressor showed no evidence of contamination replace a like amount of fresh refrigeration oil into the compressor before reinstallation. If it was necessary to service the entire system because of excessive contamination in the oil removed, install a full charge of fresh refrigeration oil in the compressor. (See Checking Compressor Oil Charge in the Diagnosis Section of this Service Manual.)

2. Position compressor on the mounting bracket and install all nuts, bolts, lock washers, and ground wire.

3. Install the connector assembly to the compressor rear head, using new "O" ring coated with clean refrigeration oil.

4. Connect the electrical lead to the coil and install and adjust compressor belt, using idler pulley. See "Compressor Belt Tension Adjustment."

5. Evacuate, charge and check the system.

6. Replace air cleaner. On G models, replace the engine cover.

7. Connect the battery ground cable.

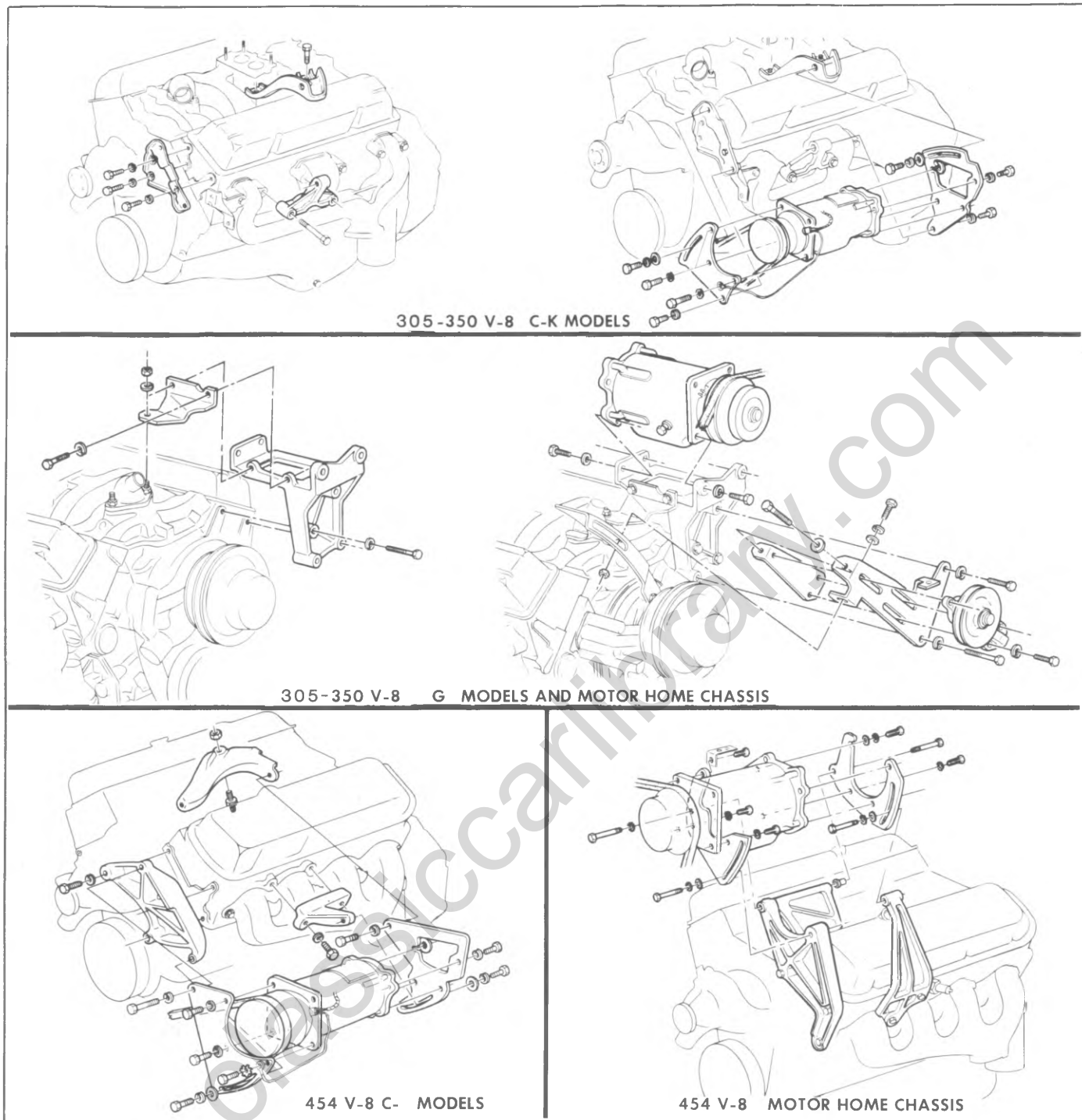


Fig. 1B-27--Compressor Mountings

Compressor Belt Tension Adjustment

Adjust the compressor belt to the specifications shown in the Tune-Up chart in the Engine section of the Service Manual.

NOTE: On some G and Motor Home Chassis models it may be necessary to increase idler pulley slack adjustment. This may be accomplished by (1) Remove and discard the idler adjustment bolt. (2) Remove the idler backing plate and elongate all 3 adjusting slots 1/2 inch inboard or outboard as required. (3) Reinstall the

idler assembly and adjust belt tension using a lever (screwdriver, etc.) to move the pulley outboard until proper belt tension is reached. If the belt is being replaced it may be necessary to remove and replace the throttle cable during the belt replacement. If so check throttle cable adjustment upon completion. It may also be necessary to remove the crankshaft pulley to install a new compressor belt.

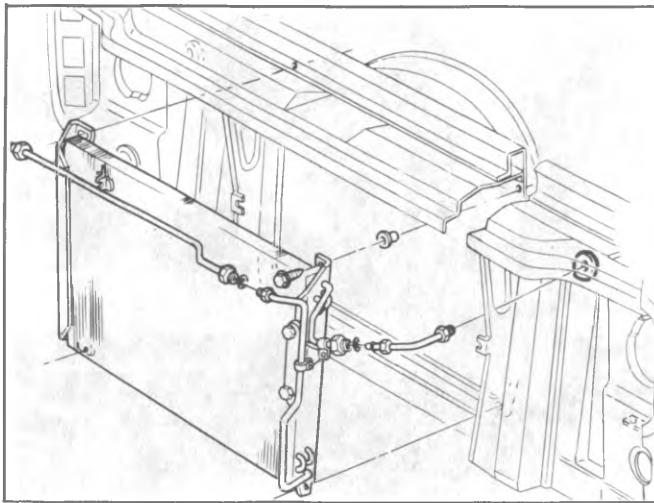


Fig. 1B-28--Condenser Installation (C-K Models)

FOUR-SEASON SYSTEM--C-K MODELS

CONDENSER

Replacement (Fig. 1B-28)

1. Disconnect battery ground cable.
2. Purge the system of refrigerant.
3. Remove the grille assembly.
4. Remove the radiator grille center support.
5. Remove the left grille support to upper fender support (2) screws.
6. Disconnect the condenser inlet and outlet lines and the outlet tube line at the right end of the condenser. Cap or plug all open connections at once.
7. Remove the condenser to radiator support screws.
8. Bend the left grille support outboard to gain clearance for condenser removal.
9. Remove the condenser assembly by pulling it forward and then lowering it from the vehicle.
10. To install a new condenser, reverse Steps 1-9 above. Add one fluid ounce of clean refrigeration oil to a new condenser.

NOTE: Use new "O" rings, coated with clean refrigeration oil, when connecting all refrigerant lines.

11. Evacuate, charge and check the system.

ACCUMULATOR

Replacement (Fig. 1B-29)

1. Disconnect the battery ground cable and the

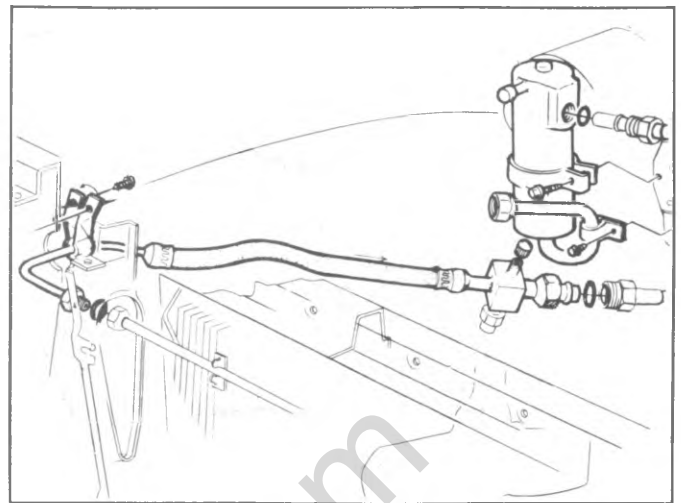


Fig. 1B-29--Accumulator Installation (C-K Models)

compressor clutch connector.

2. Purge the system of refrigerant.

WARNING: Be sure system is completely purged of refrigerant before completely disconnecting refrigerant lines. Visually check the accumulator for frost. The presence of frost indicates that the system is not fully discharged. To complete purging, connect the vacuum line to the vacuum pump, turn on the vacuum pump and open vacuum control valve. An alternate method would be to place warm water soaked cloths (not exceeding (125°F) (51°C) around the accumulator to boil off any remaining refrigerant.

3. Disconnect the accumulator inlet and outlet lines and cap or plug the open connections at once.
4. Remove the accumulator bracket screws and remove the accumulator from the vehicle.
5. Drain any excess refrigerant oil from the accumulator into a clean container. Measure and discard the oil.
6. If a new accumulator is being installed, add one ounce of clean refrigeration oil to the new accumulator **PLUS** an amount equal to that drained in Step 5 above.
7. To install the new accumulator, reverse Steps 1-4 above. Connect all lines using new "O" rings, coated with clean refrigeration oil.

CAUTION: Do not uncap the new unit until ready to fasten the inlet and outlet line to the unit.

8. Evacuate charge and check the system.

BLOWER ASSEMBLY

Replacement

1. Disconnect the battery ground cable.
2. Disconnect the blower motor lead and ground wires.
3. Disconnect the blower motor cooling tube.
4. Remove the blower to case attaching screws and

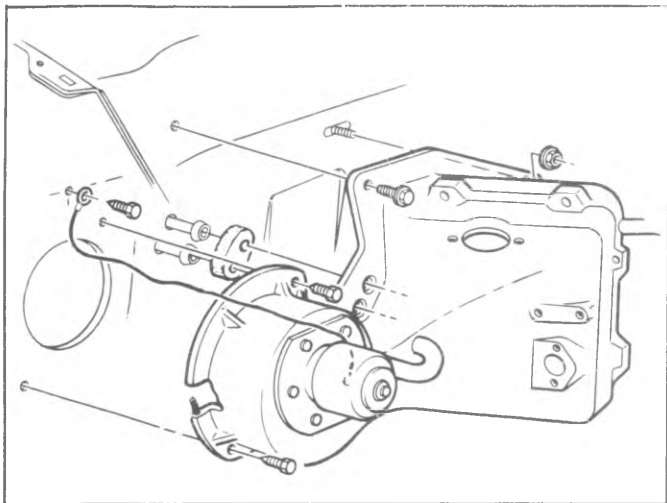


Fig. 1B-30--Blower-Evaporator (C-K Models)

remove the blower assembly. Pry the blower flange away from the case carefully if the sealer acts as an adhesive.

5. Remove the nut attaching the blower wheel to the motor shaft and separate the assemblies.

6. To install, reverse Steps 1-5 above; replace sealer as necessary.

EVAPORATOR CORE

Replacement (Fig. 1B-30)

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.
3. Remove the nuts from the selector duct studs projecting through the dash panel.
4. Remove the cover to dash and cover to case screws and remove the evaporator case cover.
5. Disconnect the evaporator core inlet and outlet lines and cap or plug all open connectins at once.
6. Remove the thermostatic switch and the expansion tube assemblies.
7. Remove the evaporator core assembly.
8. To install, reverse Steps 1-7 above. Add three ounces of clean refrigeration oil to a new evaporator core.

CAUTION: Be sure to install the thermostatic switch capillary in the same position as when removed. See Thermostatic switch replacement.

NOTE: Use new "O" rings, coated with clean refrigeration oil, when connecting refrigerant lines.

Be sure cover to case and dash panel sealer is intact before reinstalling cover.

9. Evacuate, charge and check the system.

EXPANSION TUBE-CK, G

The expansion tube is located in the evaporator core inlet line.

Replacement (Fig. 1B-31)

1. Purge the system of refrigerant.
2. Disconnect the condenser to evaporator line at the evaporator inlet. Cap the open line at once.
3. Using needle-nose pliers, remove the expansion tube from the evaporator core inlet line (fig. 1B-37).
4. Remove the expansion tube "O" ring from the core inlet line.
5. To install, reverse Steps 1-4 above.

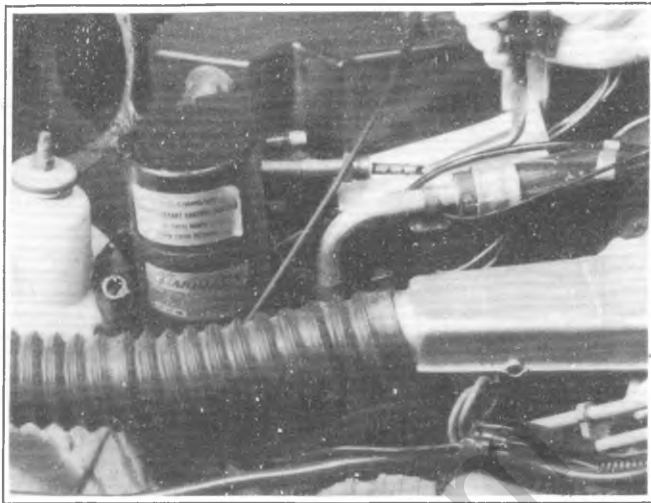


Fig. 1B-31--Expansion Tube (C-K and G Four-Season System)

NOTE: Install the expansion tube using a new "O" ring coated with clean regrigeration oil, by inserting the short screen end of the tube into the evaporator inlet line.

6. Evacuate, charge and check the system.

SELECTOR DUCT AND HEATER CORE ASSEMBLY-CK

Replacement (Figs. 1B-32 and 1B-33)

1. Disconnect the battery ground cable.
2. Drain the radiator and remove the heater hoses from the core tubes. Plug the core tubes to prevent coolant spillage during removal.
3. Remove the glove box and door as an assembly.
4. Remove the center duct to selector duct and instrument panel screws and remove the center lower and center upper ducts.
5. Disconnect the bowden cable at the temperature door.
6. Remove the nuts from the three selector duct studs projecting through the dash panel.
7. Remove the selector duct to dash panel screw (inside

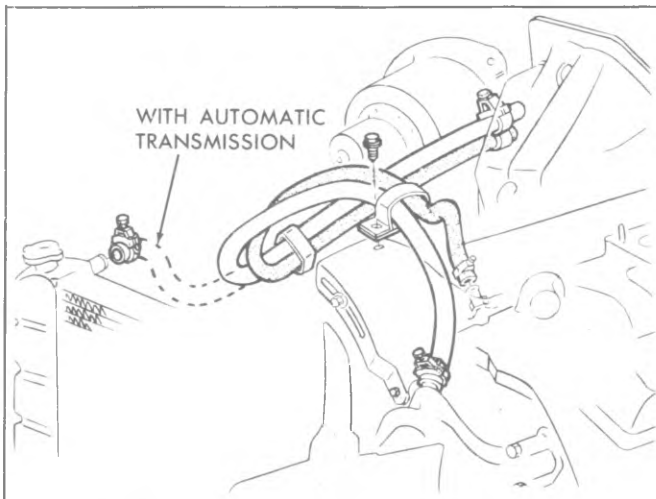


Fig. 1B-32--Heater Hose Routings (C-K Models)

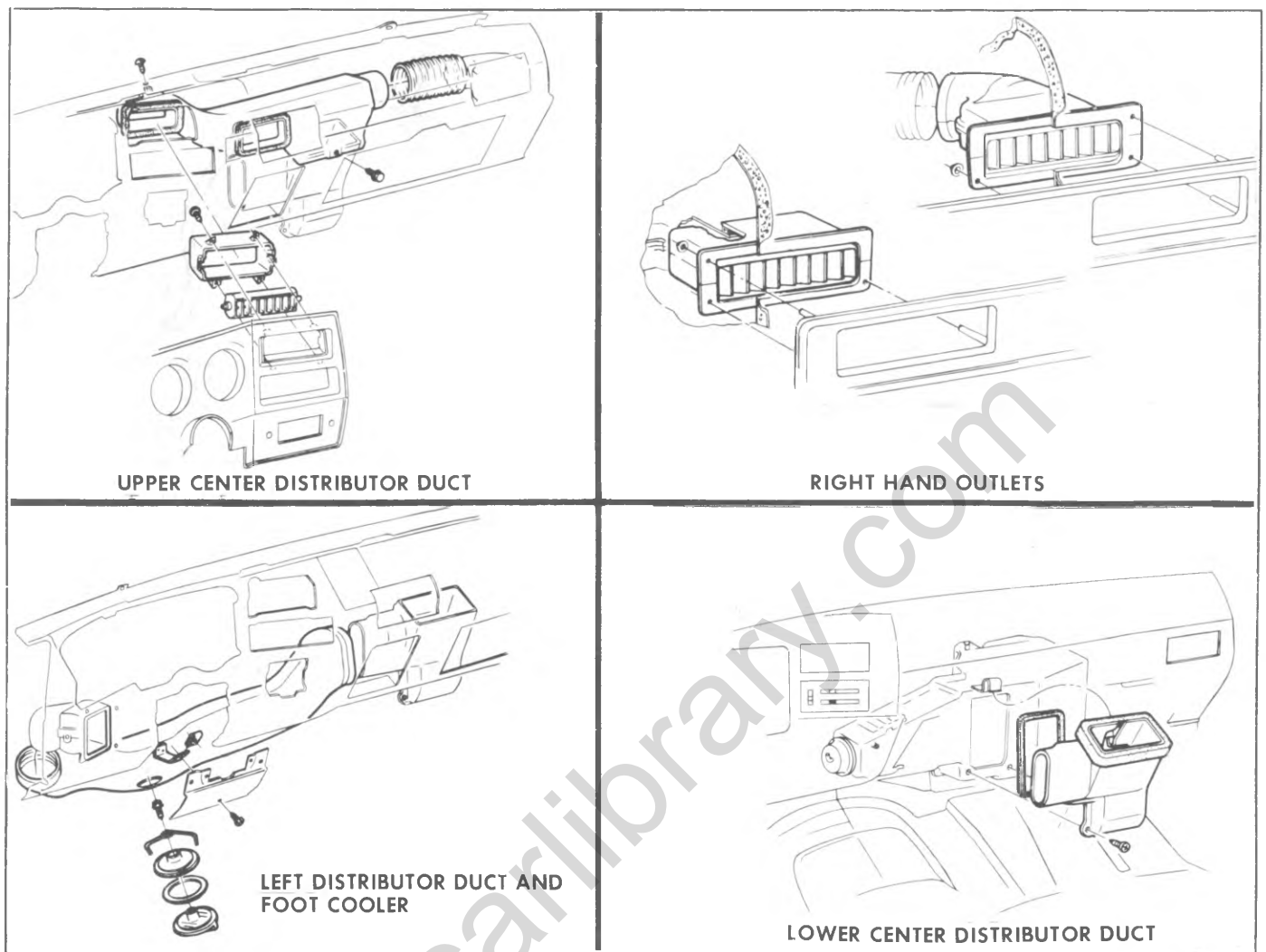


Fig. 1B-33—Air Selector and Ducts (C-K Models)

vehicle).

8. Pull the selector duct assembly rearward until the core tubes clear the dash panel. Lower the selector assembly far enough to gain access to all vacuum and electrical harnesses.

9. Disconnect the vacuum and electrical harness and remove the selector duct assembly.

10. Remove the core mounting strap screws and remove the core.

11. To install, reverse Steps 1-10 above.

12. Refill coolant system and connect the battery ground strap. Check temperature door cable adjustment.

KICK PAD VALVE

Replacement (Fig. 1B-34)

1. Disconnect the vacuum hose at the actuator.
2. Unhook the valve return spring at the actuator end.
3. Remove the actuator bracket mounting screws.
4. Remove the cam to actuator arm screw and separate the actuator and bracket from the cam.
5. Remove the actuator to bracket nuts and separate the actuator and bracket.
6. To install reverse Steps 1-5 above.

PLENUM VALVE

Replacement (Fig. 1B-34)

1. Raise the hood.
2. Remove the plastic grille.
3. Remove the three cowl to valve assembly screws and remove the valve assembly from the vehicle.
4. Remove the actuator arm push nut.
5. Remove the actuator to valve nuts and separate the valve and actuator.
6. To install, reverse Steps 1-5 above.

CONTROL ASSEMBLY

Removal (Fig. 1B-35)

1. Disconnect the battery ground cable.
2. Remove the radio as outlined in Section 9 of this manual.
3. Remove the instrument panel bezel.
4. Remove the control to instrument panel screws and lower the control far enough to gain access to the control assembly.

CAUTION: Be careful not to kink the bowden cable.

5. Disconnect the bowden cable, vacuum harness and

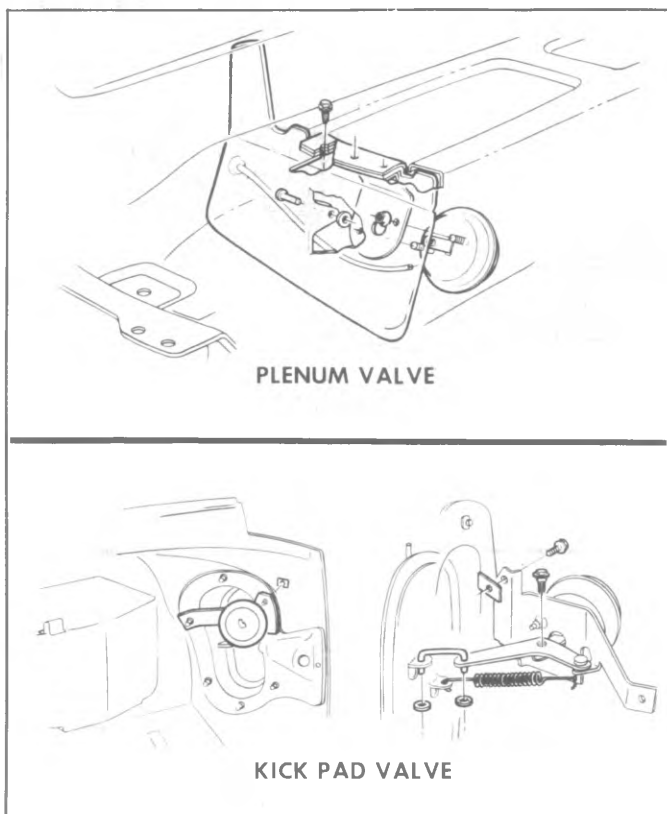


Fig. 1B-34--Air Inlet Valves (C-K Models)

electrical harness at the control.

6. Remove the control.
7. If a new unit is being installed, transfer the master blower switches to the new control.
8. To reinstall, reverse Steps 1-6 above. Check control operation.

TEMPERATURE DOOR CABLE ADJUSTMENT

1. Remove glove box and door assembly.
2. Loosen the cable attaching screw at the selector duct assembly.
3. Make sure the cable is installed in the bracket on the

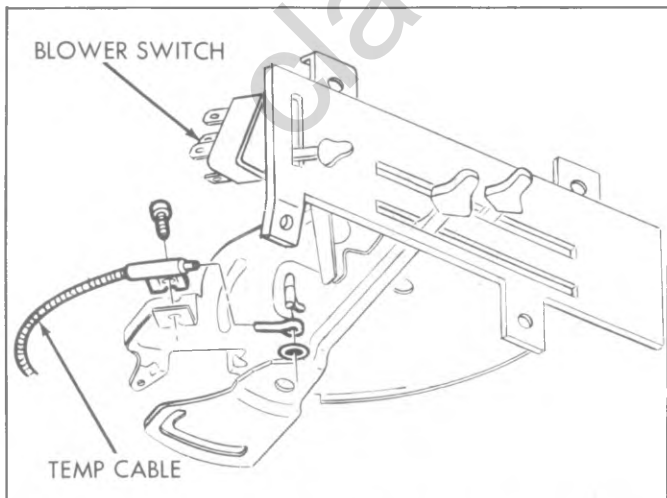


Fig. 1B-35--Control Assembly (C-K Four-Season System)

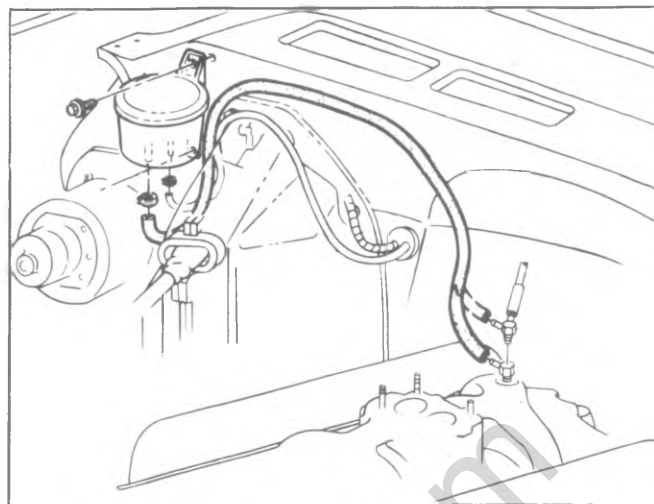


Fig. 1B-36--Vacuum Tank (C-K Models)

selector duct assembly.

4. Place temperature lever in full COLD position and hold while tightening cable attaching screw.

MASTER SWITCH AND/OR BLOWER SWITCH

The master switch is located on rear of the control assembly.

Replacement

1. Disconnect the battery ground cable.
2. Remove the instrument panel bezel.
3. Remove the control to instrument panel screws and allow control to rest on top of the radio.
4. Remove the switch to control screws, disconnect the electrical harness (and vacuum harness on master switch) at the switch and remove the switch assembly.
5. To install a new switch, reverse Steps 1-4 above.

VACUUM TANK

The vacuum tank is mounted to the engine side of the dash panel above the blower assembly (fig. 1B-36).

Replacement

1. Disconnect the vacuum lines at the tank.
2. Remove the tank to dash panel screws and remove the tank.
3. To install, reverse Steps 1 and 2 above.

BLOWER MOTOR RESISTOR

The blower motor resistor is located in the blower side of the blower-evaporator case (fig. 1B-37).

Replacement

1. Disconnect the wiring harness at the resistor.
2. Remove the resistor to case attaching screws and remove the resistor.
3. Place the new resistor in position and install the attaching screws.
4. Connect the resistor wiring harness.

BLOWER MOTOR RELAY

The blower motor relay is located on the blower side of the blower-evaporator case (fig. 38).

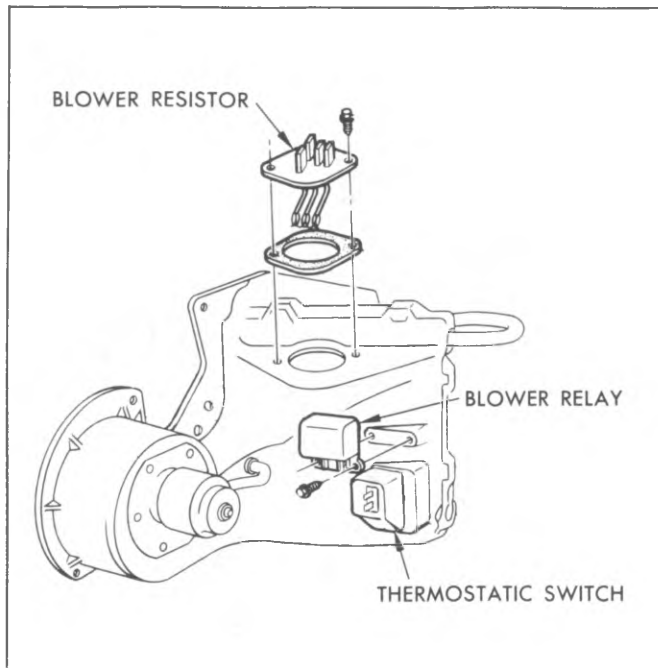


Fig. 1B-37--Resistor, Relay and Thermostatic Switch (C-K Models)

Replacement

1. Disconnect the wiring harness at the relay.
2. Remove the relay to case attaching screws and remove the relay.
3. Place the new relay in position and drive the mounting screws.
4. Connect the relay wiring harness.

THERMOSTATIC SWITCH-CK and G Series

The thermostatic switch is mounted on the bracket which supports the inlet tube in position at the evaporator case. The switch sensing capillary is attached by means of a clamp to the evaporator inlet tube.

Removal

1. Remove electrical connectors to the switch.
2. Remove screws to loosen body from evaporator case.
3. A capillary line (small tube) extends from the switch with the other end attached to the evaporator inlet pipe (1/2" O.D.) with two clamps. This end is covered with an insulation material. Carefully remove the insulation and loosen clamps enough to pull the formed end of the capillary tube out from under the clamps. Solvent clean pipe area to remove remaining insulation material and dirt.

4. Identify area by marking the capillary tube location on the inlet pipe from where it was removed. **The replacement switch's tube should be installed at this location.**

Installation

1. Mount switch body to previous location. Do not over-torque screws. The recommended reassembly torque is 15-20 in. lbs. (1.6-2.3 N·m) Do not damage or distort the switch body, as this may affect switch calibration.

2. Mount formed end of capillary tube to the inlet pipe in **SAME POSITION AS THE ORIGINAL tube. DO NOT INSTALL NEW TUBE MORE THAN 1/2"** in either direction of previously marked location.

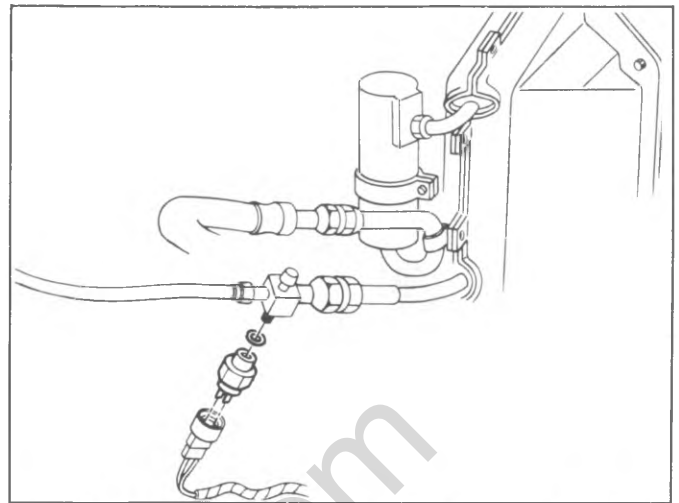


Fig. 1B-38--Discharge Pressure Switch-Typical C-K and G

3. Adjust each clamp before tightening so that width of the clamp covers the capillary tube's formed end. Tighten to 1.6 to 2.3 N·m (15 to 20 in. lbs.) of torque. Do not overtorque.

4. Re-cover tube and pipe with insulation material. If original insulation is damaged, replace with same type material. (GMPD Part No. 3014431 or equivalent).

5. Reconnect electrical terminals.

DISCHARGE PRESSURE SWITCH

The discharge pressure switch is located in the condenser to evaporator line (fig. 1B-38).

Replacement

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.
3. Disconnect the wiring harness at the switch.
4. Remove the switch from the refrigerant line.
5. To replace, reverse Steps 1-4 above.

NOTE: Be sure to use new "O" rings, coated with clean refrigeration oil, when installing the switch.

6. Evacuate charge and check system operation.

FUSE

A 25 amp fuse, located in the junction block protects the entire air conditioning system except for the blower circuit, the fuse for the blower circuit is located in the electrical wiring between the junction block and the blower relay (fig. 1B-39).

OVERHEAD SYSTEM-C-K MODELS

The Overhead System is used in conjunction with the Four-Season System. Since replacement of Four-Season System components has been covered previously, only those components peculiar to the Overhead System will be covered in this section.

REAR DUCT

This duct covers the blower-evaporator assembly, at the rear of the vehicle, and incorporates four adjustable air outlets (fig. 1B-40).

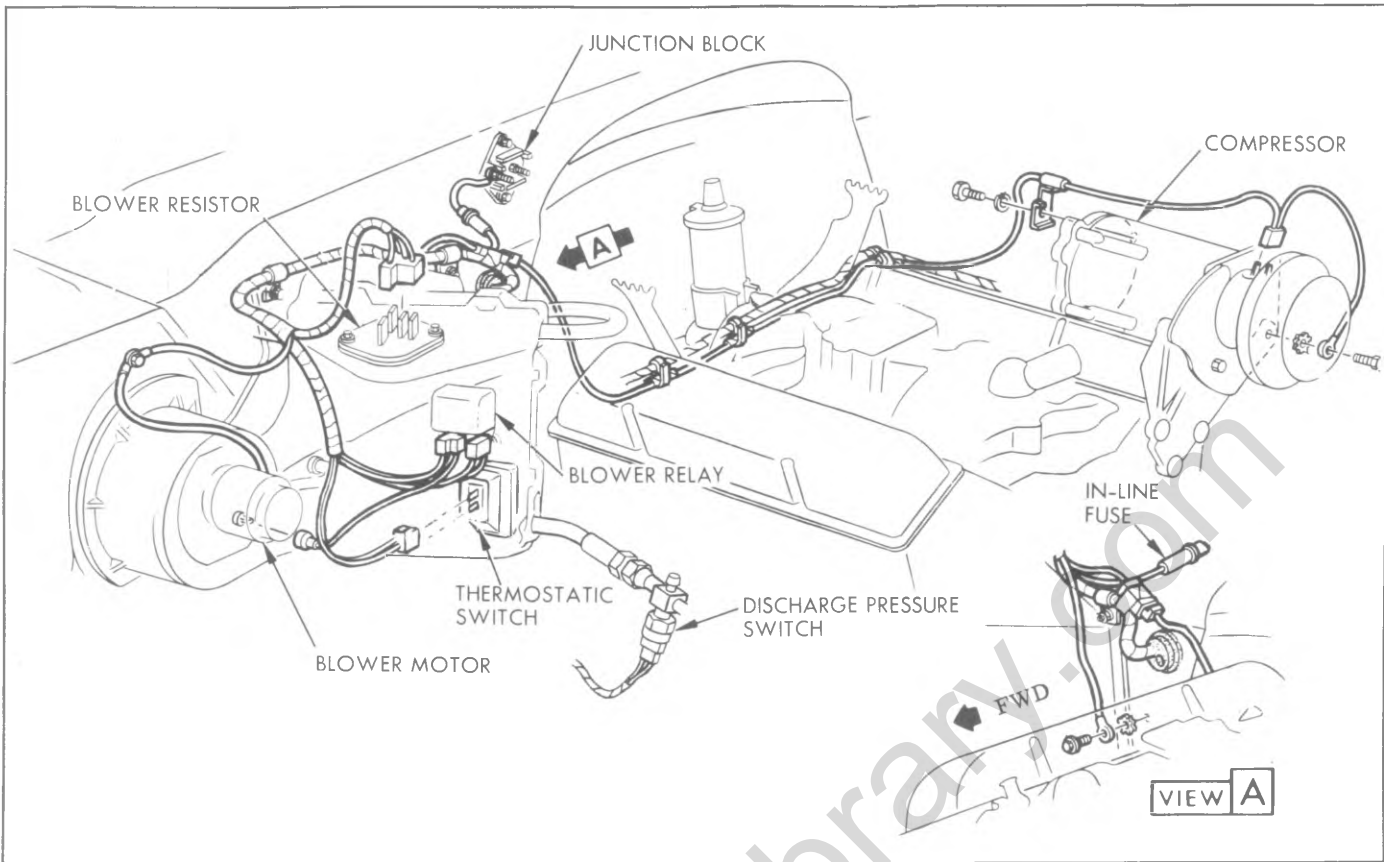


Fig. 1B-39--Engine Compartment Wiring Harness (C-K Models)

Replacement

1. Disconnect the battery ground cable.
2. Disconnect the drain tube from the rear duct.
3. Remove the screws securing the duct to the roof panel and rear header brackets.
4. Remove the duct.
5. To install, reverse Steps 1-4 above.

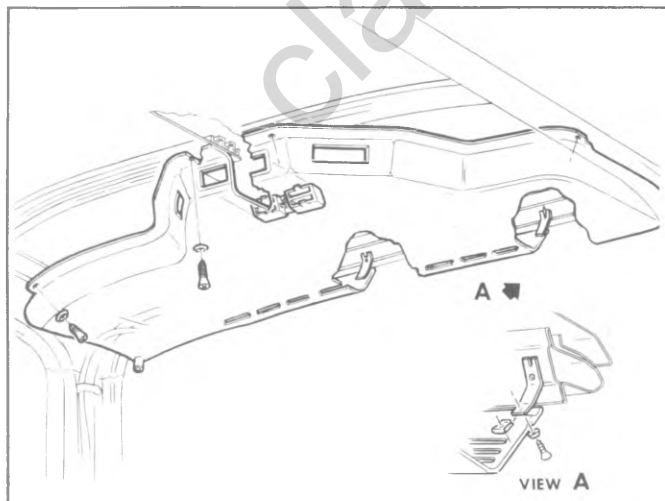


Fig. 1B-40--Rear Duct (C-K Overhead System)

BLOWER MOTOR RESISTOR

The blower motor resistor is located on the cover side of the Four-Season System blower-evaporator as shown in Figure 1B-41.

Replacement

1. Disconnect battery ground cable.
2. Disconnect the electrical harness at the resistor.
3. Remove the resistor attaching screws and remove the resistor.
4. To install a new resistor, reverse Steps 1-3 above.

BLOWER MOTOR ASSEMBLY

Removal (Fig. 1B-42)

1. Disconnect the battery ground cable.
2. Remove the rear duct as outlined previously.
3. Disconnect the blower motor ground strap.
4. Disconnect the blower motor lead wire.
5. Remove the lower to upper blower-evaporator case screws and lower the lower case and motor assembly.
CAUTION: Before removing the case screws, support the lower case to prevent damage to the case or motor assemblies.
6. Remove the motor retaining strap and remove the motor and wheels. Remove the wheels from the motor shaft.

Installation

1. Place the blower wheels onto the motor shaft making sure the wheel tension springs are installed on hub of wheels.
CAUTION: Be sure that the blower wheels are installed as shown in Figure 1B-43.

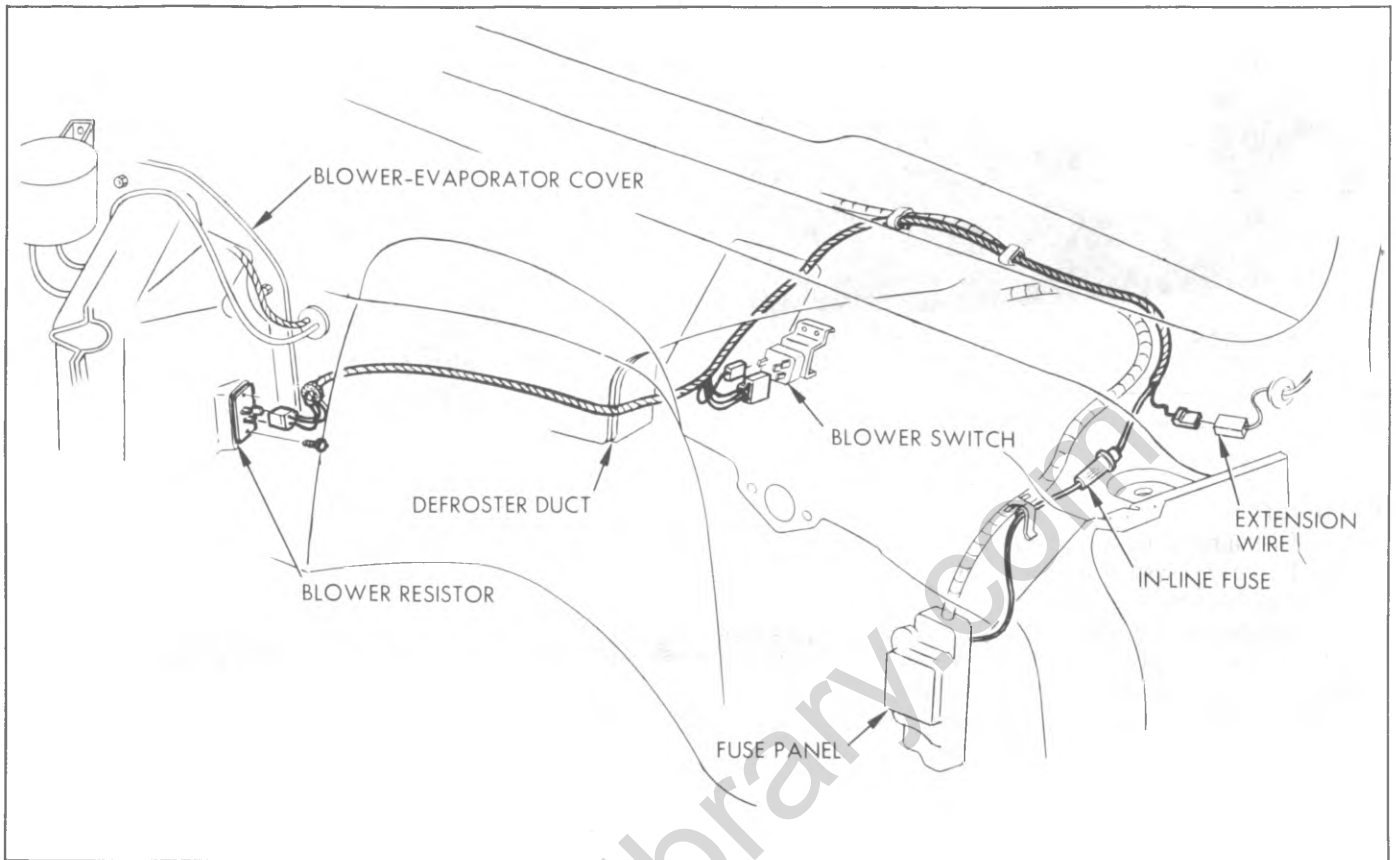


Fig. 1B-41--Overhead System Front Wiring (C-K Models)

2. Install the blower motor retaining strap and foam.
3. Place the blower motor and wheel assembly into the lower case. Align the blower wheels so that they do not contact the case.
4. Place the lower case and blower motor assembly in position in the vehicle and install the lower to upper case screws.

NOTE: Rotate the blower wheels to make sure that they do not rub on the case.

5. Install the center ground wire and connect the

blower lead wire.

6. Install the rear duct assembly as described previously.

7. Connect the battery ground cable.

EXPANSION VALVE

This system incorporates an expansion valve which does not utilize an external equalizer line (fig. 1B-44).

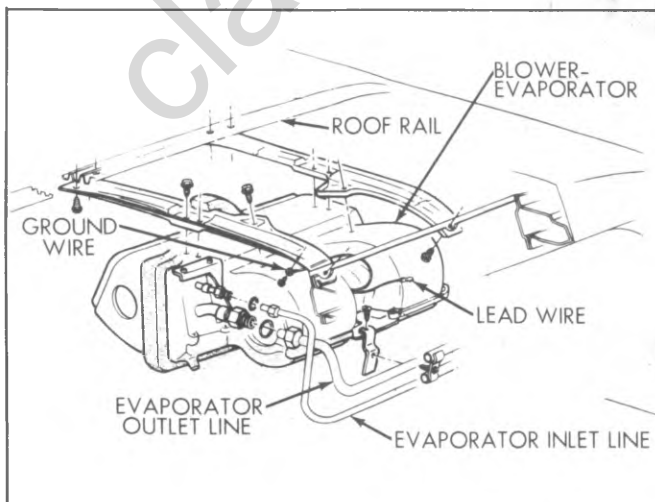


Fig. 1B-42--Blower-Evaporator (C-K Overhead System)

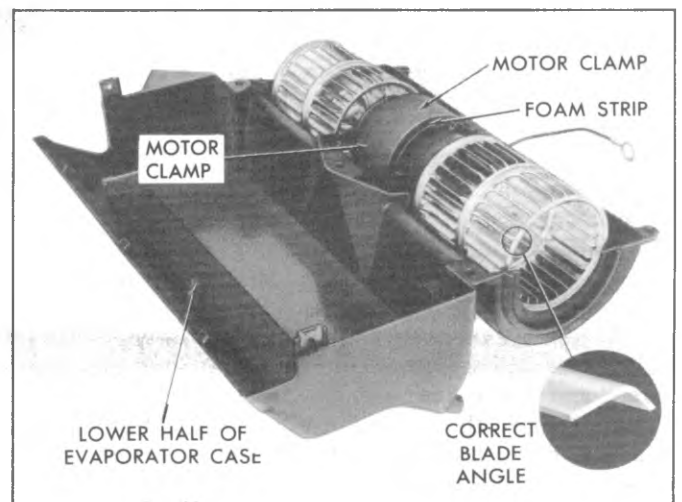


Fig. 1B-43--Blower Motor (C-K Overhead System)

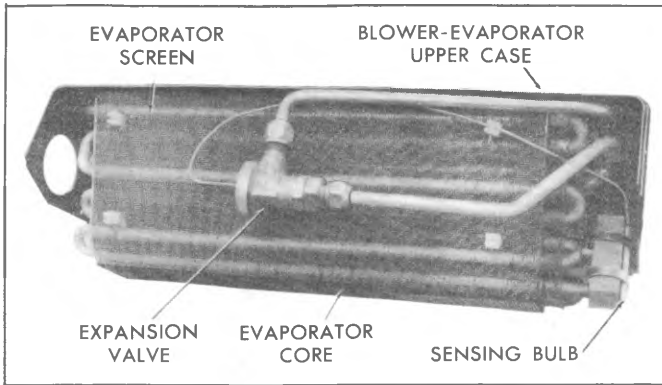


Fig. 1B-44--Expansion Valve C69 System

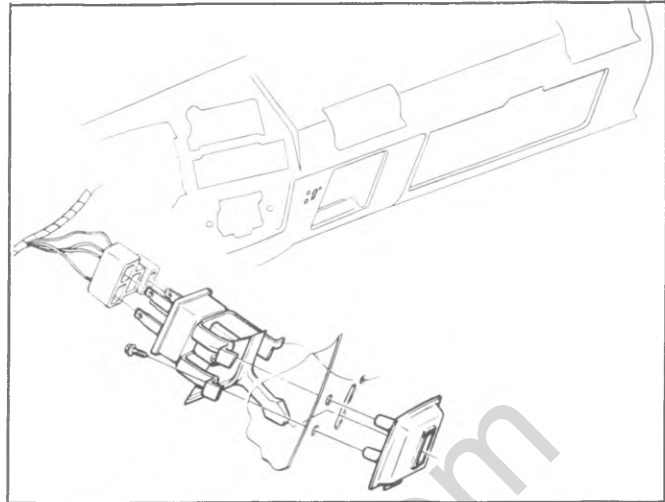


Fig. 1B-45--Blower Switch (C-K Overhead System)

Removal

1. Disconnect battery ground cable.
 2. Purge the system of refrigerant.
 3. Remove the rear duct as outlined previously.
 4. Disconnect the blower motor lead and ground wires.
 5. Remove the lower to upper blower-evaporator case screws and lower the lower case and motor assembly.
- CAUTION:** Before removing the case screws, support the lower case and motor assemblies.
6. Remove the expansion valve sensing bulb clamps.
 7. Disconnect the valve inlet and outlet lines and remove the expansion valve assembly. Cap or plug the open connections at once.

Installation

1. Remove caps or plugs from system connections and install the new valve assembly using new "O" rings coated with clean refrigeration oil.
2. Install the sensing bulb, making sure that the bulb makes good contact with the core outlet line.
3. Install the lower case and blower motor assemblies. Connect the blower motor lead and ground wires.
4. Install the rear duct as outlined previously.
5. Connect the battery ground cable.
6. Evacuate, charge and check the system.

EVAPORATOR CORE (Fig. 1B-44)

Removal

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.
3. Remove the rear duct as outlined previously.
4. Disconnect the blower motor lead and ground wire connections.
5. Disconnect the refrigerant lines at the rear of the blower-evaporator assembly. Cap or plug the open connections at once.
6. Remove the blower-evaporator support to roof rail screws, lower the blower-evaporator assembly and place it on a work bench upside down.
7. Remove the lower to upper case screws and remove the lower case assembly. Remove the support to upper case screws and remove the upper case from the evaporator core.
8. Remove the expansion valve inlet and outlet lines and cap or plug the open connections at once. Remove the expansion valve capillary bulb from the evaporator outlet line and remove the valve.
9. Remove the plastic pins holding the screen to the

core and remove the screen.

Installation

1. Install the wire screen to the front of the core and insert the plastic pins.
 2. Install the expansion valve inlet and outlet lines using new "O" rings coated with clean refrigeration oil. Install the sensing bulb to the evaporator outlet line as shown in Figure 1B-44; make sure the bulb has good contact with the line.
- NOTE:** Add 3 oz. clean refrigeration oil when installing a new core.
3. Install the upper case and supports to the core.
 4. Install the lower core case and blower assembly.
 5. Install the blower-evaporator assembly to the roof and install the support to roof rail screws.
 6. Connect the refrigerant lines to the blower-evaporator unit using new "O" rings coated with clean refrigeration oil.
 7. Connect the blower lead and ground wires.
 8. Install the rear duct as outlined previously.
 9. Connect the battery ground cable.
 10. Evacuate, charge and check the system.

BLOWER MOTOR SWITCH

The three-speed (LO-MED-HI) blower motor switch is located in the instrument panel, just to the left of the ash tray (fig. 1B-50).

Replacement

1. Disconnect the battery ground cable.
2. Remove the switch retaining screws.
3. Disconnect the wiring harness at the switch and remove the switch.
4. To install, reverse Steps 1-3 above.

FUSE

The Four Season portion of this system is protected by a 25 amp fuse in the junction block.

The rear blower high speed circuit is protected by a 20 amp in-line fuse, located between the junction block and the rear blower motor switch.

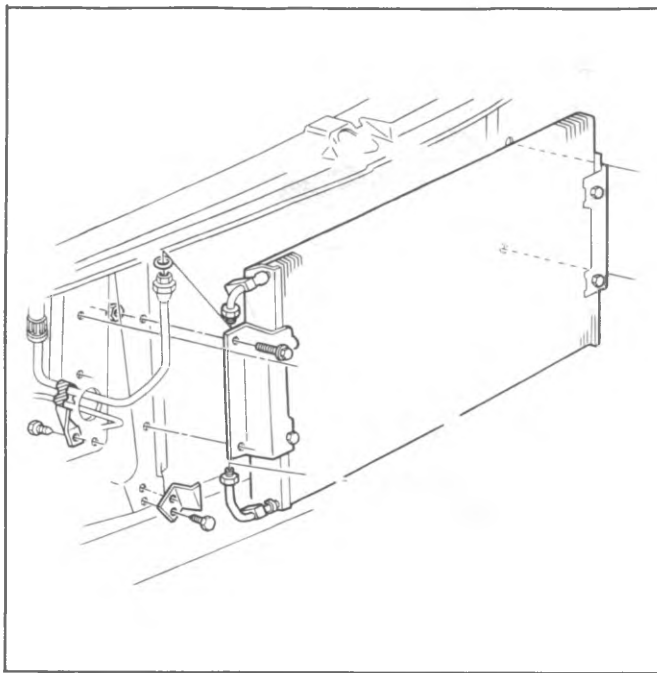


Fig. 1B-46--Condenser (G Models)

C60 SYSTEM--G MODELS

CONDENSER

Replacement (Fig. 1B-46)

1. Disconnect battery ground cable.
2. Purge the system of refrigerant.
3. Remove grille, and hood lock and center hood lock support as an assembly.
4. Disconnect condenser inlet and outlet lines at condenser.
5. Remove screws attaching left side condenser bracket to radiator.
6. Remove screws attaching right side condenser bracket to condenser.
7. Remove condenser from vehicle.
8. Remove left hand bracket from condenser.
9. To install new condenser, reverse steps 3 thru 8 above.

Add 1 ounce of clean refrigeration oil to a new condenser.

10. Evacuate charge and test the system.

Refer to figures 1B-56 thru 1B-61 for condenser inlet and outlet connections, compressor refrigerant line connections, and general refrigerant line routing and connections.

HEATER AIR DISTRIBUTOR AND EXTENSION DUCT - G MODEL

Replacement (Fig. 1B-47)

1. Disconnect battery ground cable.
2. Remove engine cover.
3. Remove evaporator-blower shield.
4. Remove shield bracket.
5. Remove left floor outlet deflector and bracket.
6. Loosen steering column to instrument panel reinforcement screws. Remove one screw. Torque both

screws on installation.

7. Disconnect speedometer cable at meter.

HEATER CORE

Replacement

1. Disconnect battery ground cable.
2. Remove engine cover as outlined in Section 6A of this manual.
3. Remove steering column to instrument panel attaching bolts and lower column.
4. Remove upper and lower instrument panel attaching screws and radio support bracket attaching screw.
5. Raise and support right side of instrument panel.
6. Remove right lower instrument panel support bracket.
7. Remove recirculating air door vacuum actuator. See Figure 1B-48.
8. Disconnect temperature cable and vacuum hoses at distributor case.
9. Remove heater distributor duct. (Figure 1B-49.
10. Remove 2 defroster duct to dash panel attaching screws (below windshield).
11. Working from the engine compartment, disconnect heater hoses and plug to prevent water spillage.
12. Remove three (3) nuts from bolts attaching heater core case to dash panel and one (1) screw at lower right corner (inside).
13. Remove distributor assembly from vehicle.
14. Remove gasket (Fig. 1B-50) to expose screws attaching case sections together.
15. Remove temperature cable support bracket.
16. Remove case attaching screws and separate case.
17. Remove heater core.
18. To install new heater core, reverse steps 2 through 17 above.

EVAPORATOR CORE

Replacement (Fig. 1B-12)

1. Disconnect battery ground cable.
2. Purge system of refrigerant.
3. Remove coolant recovery tank and bracket as outlined earlier.
4. Disconnect all electrical connectors from core case assembly.
5. Remove bracket at evaporator case.
6. Remove right hand marker lamp for access.
7. Remove screws attaching thermostatic switch to case and remove capillary tube insulation.
8. Remove thermal bulb to inlet line clamp and remove thermostatic switch.
9. Disconnect accumulator inlet and outlet lines and 2 brackets attaching accumulator to case.
10. Disconnect evaporator inlet line.
11. Remove three (3) nuts and one (1) screw attaching module to dash panel. (Fig. 1B-10).
12. Remove core case assembly from vehicle.
13. Remove screws and separate case sections.
14. Remove evaporator core.
15. To install new core, reverse steps 3 thru 14 above.
16. Add 3 oz. 525 viscosity refrigeration oil to a new condenser.
17. Evacuate charge and check the system.

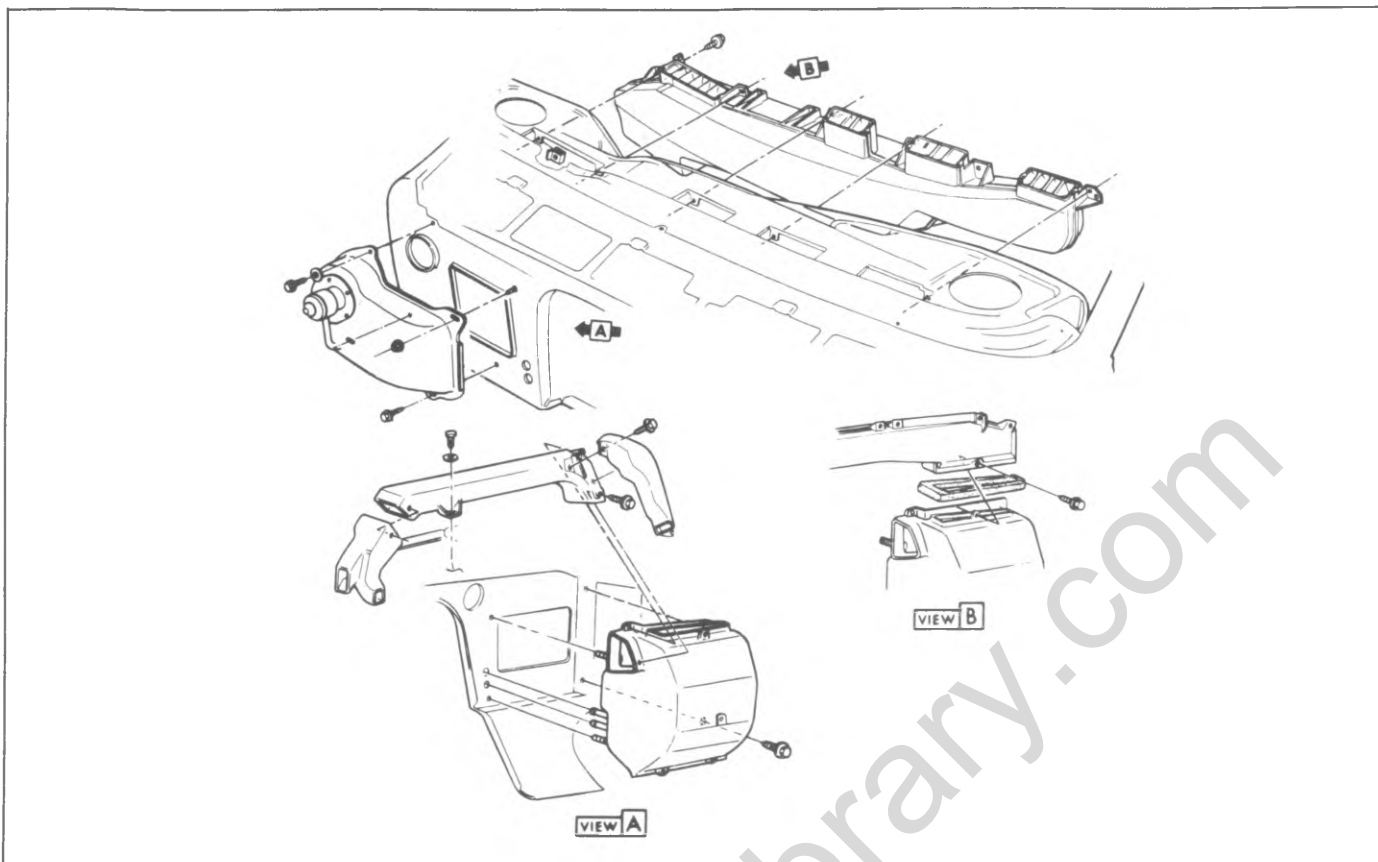


Fig. 1B-47--Heater Distributor Duct-G Model

AIR INLET VALVE - G MODEL

Replacement (Fig. 1B-51)

Follow Steps 1-10 of "Heater Air Distributor and Extension Duct Replacement" procedure.

11. Remove duct assembly. Disconnect vacuum hose.
12. Remove vacuum valve.
13. To reassemble, Reverse Steps 1-12.

TEMPERATURE DOOR CABLE - G MODEL

Replacement

Follow Steps 1-10 of "Heater Air Distributor and Extension Duct Replacement" procedure.

11. Disconnect temperature door control cable at heater case.
12. Disconnect temperature door control cable at control.
13. Make up new cable.
14. To reassemble, Reverse Steps 1-13.

CONTROL

Replacement (Fig. 1B-52)

1. Disconnect the battery ground cable.
2. Remove the headlamp switch control knob.
3. Remove the instrument panel bezel.
4. Remove the control to instrument panel attaching screws.
5. Remove the temperature cable eyelet clip and mounting tab screw.
6. Pull the control through the instrument panel opening as follows: First pull the lower right mounting tab

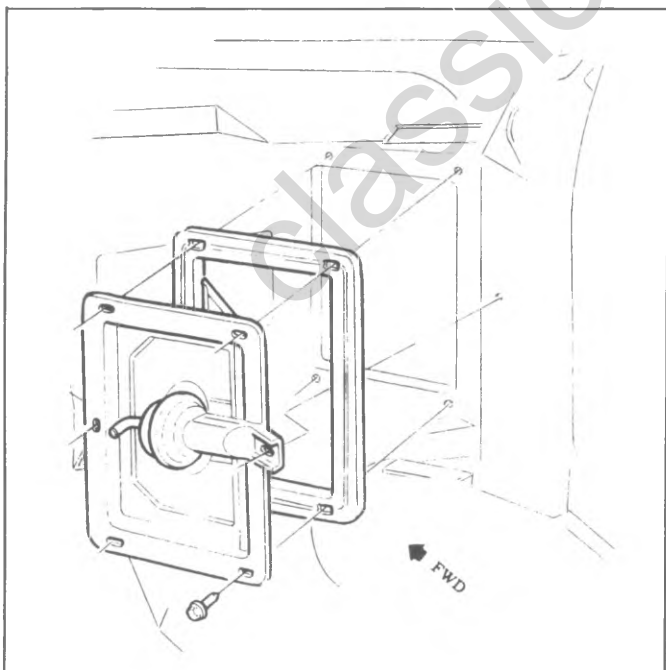


Fig. 1B-48--Recirculating Air Door Vacuum Actuator

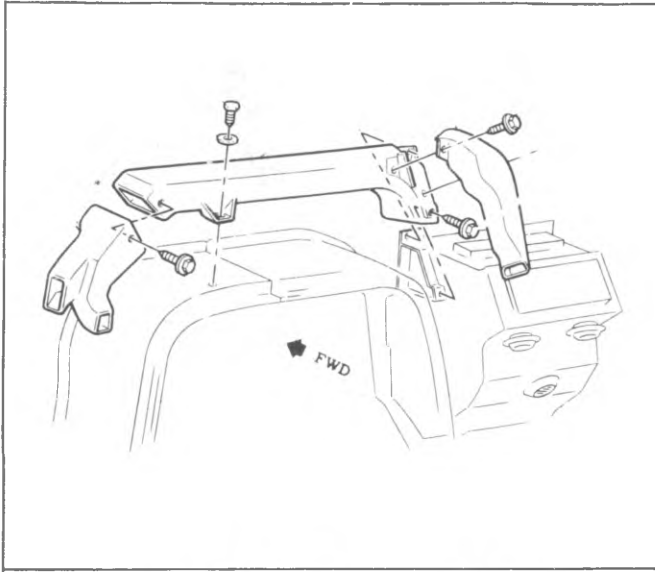


Fig. 1B-49--Heater Distributor Duct

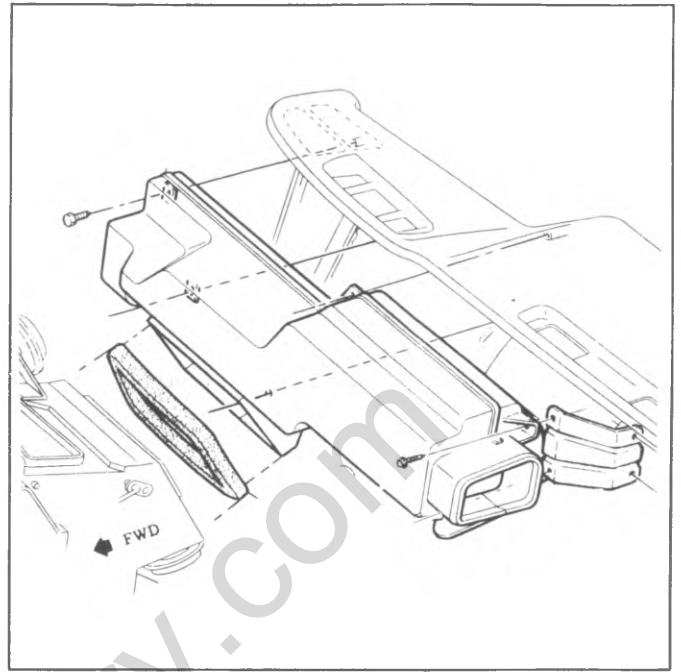


Fig. 1B-50--Distributor Gasket

through the opening, then the upper tab and finally the lower right tab.

7. Disconnect electrical and vacuum connections and remove the control assembly.

8. To install, reverse Steps 1-7 above. Check temperature door operation; adjust if necessary.

BLOWER SWITCH

Replacement (Fig. 1B-52)

1. Disconnect the battery ground cable.
2. Remove the left foot cooler outlet assembly at the instrument panel attachment.
3. Disconnect the switch electrical harness.
4. Remove the switch mounting screws and remove the switch.
5. To install, reverse Steps 1-4 above.

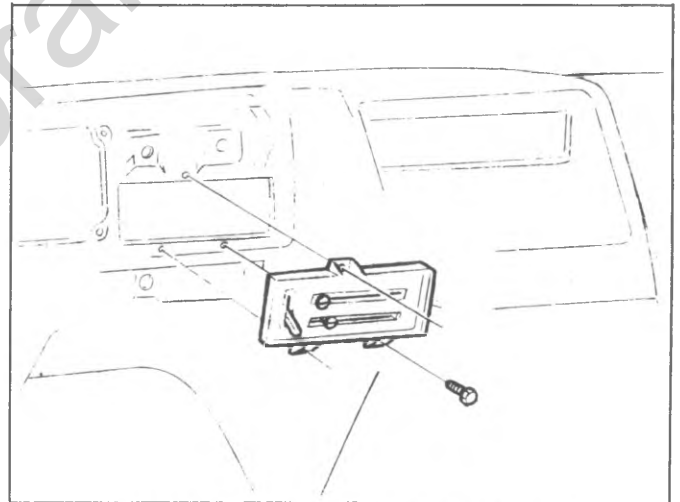


Fig. 1B-51--Air Inlet Valve (G Model C60 System)

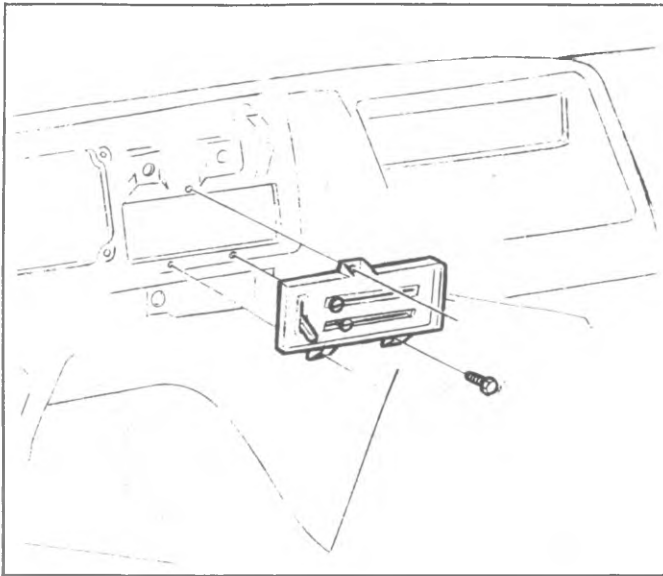


Fig. 1B-52--Control (G Model C60 System)

RESISTORS

The heater blower motor resistor is mounted in the right hand plenum (in the same position as without air conditioning). The A/C blower motor resistor is mounted in the forward face of the A/C air distribution duct (fig. 1B-52).

Replacement

1. Follow Steps 1-8 of "A/C Air Distributor Duct-Replacement".
2. Disconnect electrical harness at the resistor.
3. Remove the resistor mounting screws and remove the resistor.
4. To install, reverse Steps 1-3 above.

BLOWER MOTOR RELAY

The blower motor relay is attached to the left end of the heater air distributor duct (fig. 1B-53).

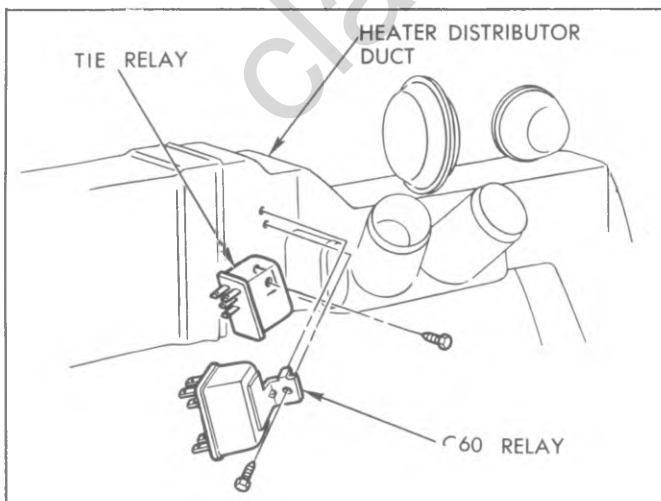


Fig. 1B-53--Relays (C60 and Tie Relay with C69)

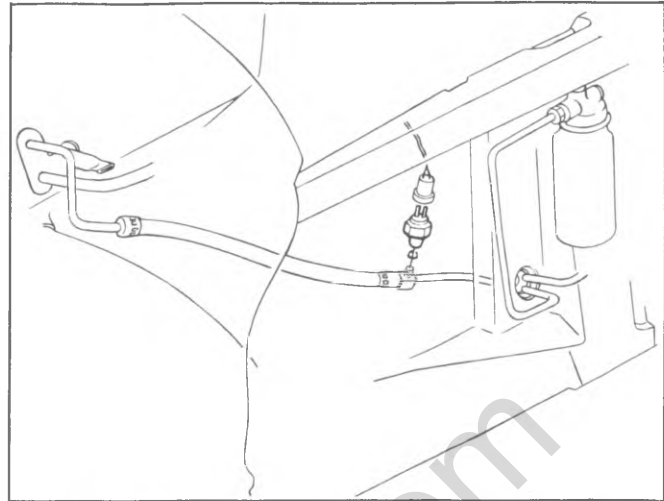


Fig. 1B-54--Discharge Pressure Switch (G Models)

Replacement

1. Follow Steps 1-8 of "A/C Air Distributor Duct-Replacement".
2. Disconnect electrical harness at the relay.
3. Remove the relay mounting screw and remove the relay.
4. To install, reverse Steps 1-3 above.

DISCHARGE PRESSURE SWITCH

Replacement (Fig. 1B-60)

1. Raise the hood.
2. Purge the system of refrigerant.
3. Disconnect the electrical harness at the switch.
4. Remove the switch from the refrigerant line.
5. To install, reverse Steps 1-4 above.

NOTE: Use a new "O" ring coated with clean refrigeration oil, when installing switch.

6. Evacuate, charge and check system operation.

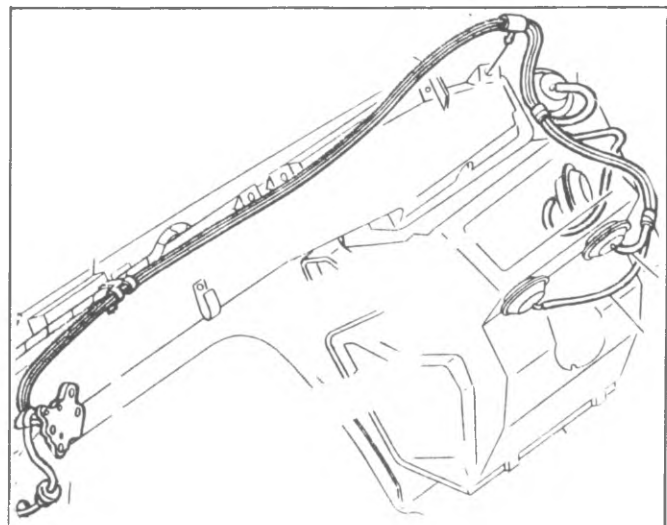


Fig. 1B-55--Vacuum Harness (G Models)

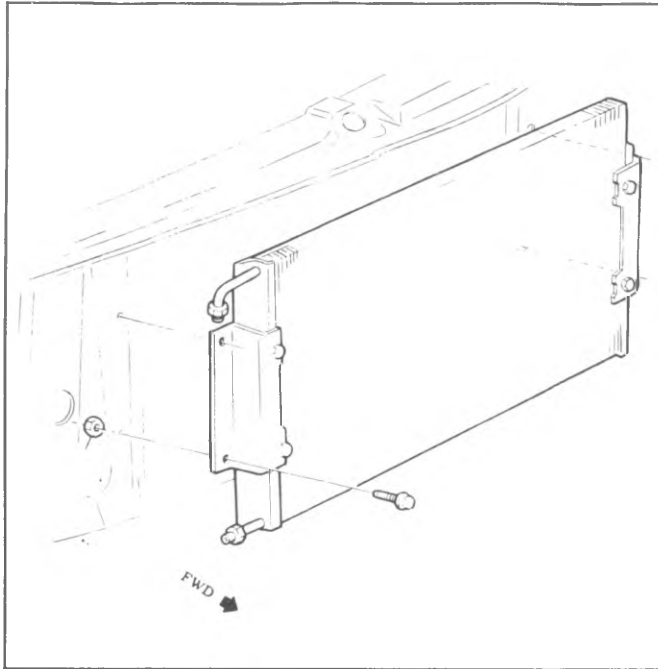


Fig. 1B-56--Condenser Installation

Vacuum Tank

Replacement

Vacuum tank attachment and locations for G, and CK Series vehicles with LF9 engine are illustrated in Figures 1B-62 through 1B-65.

VACUUM LINES-G VAN

Replacement

Vacuum line routing is illustrated in Figure 1B-65.

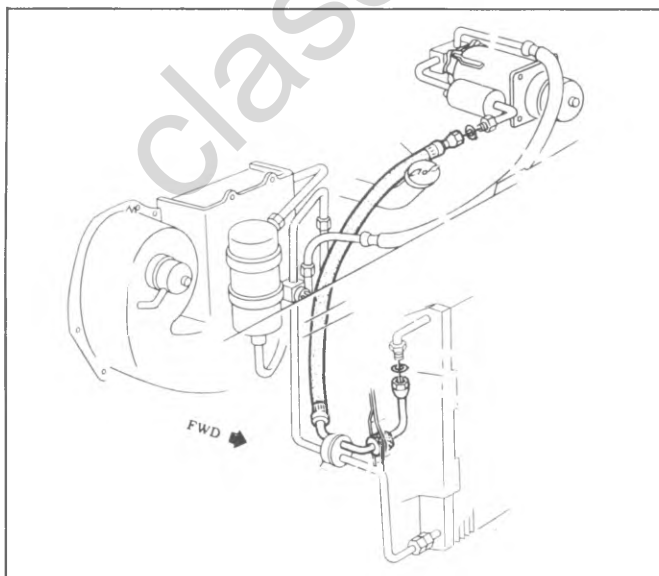


Fig. 1B-57--Refrigerant Lines-Condenser Inlet

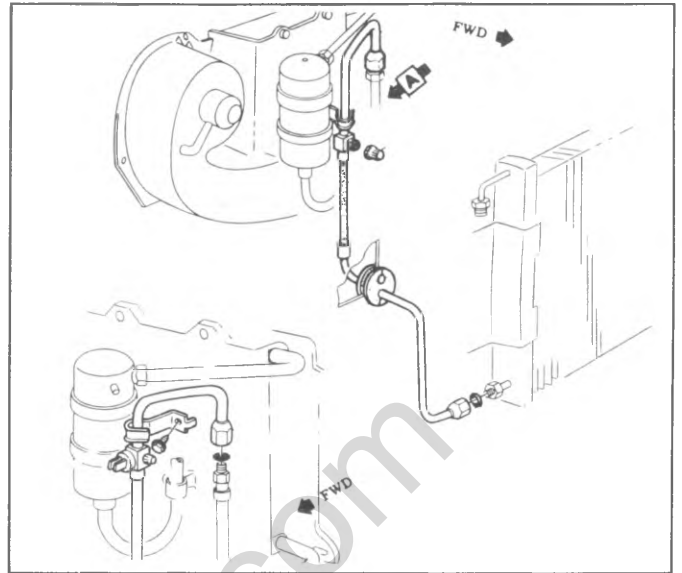


Fig. 1B-58--Refrigerant Line-Condenser Outlet

COMPRESSOR

Compressor mounting is illustrated in Figures 1B-23 through 1B-25.

HEATER HOSE

Heater hose routing is illustrated in Figure 1B-26 and 1B-27.

A/C Ductwork

Air Conditioning duct attachment is illustrated in Figure 1B-71.

Defroster Duct

Defroster duct mounting is illustrated in Figure 1B-72.

Temperature Door Cable

Temperature cable attachment and routing is illustrated in Figure 1B-73.

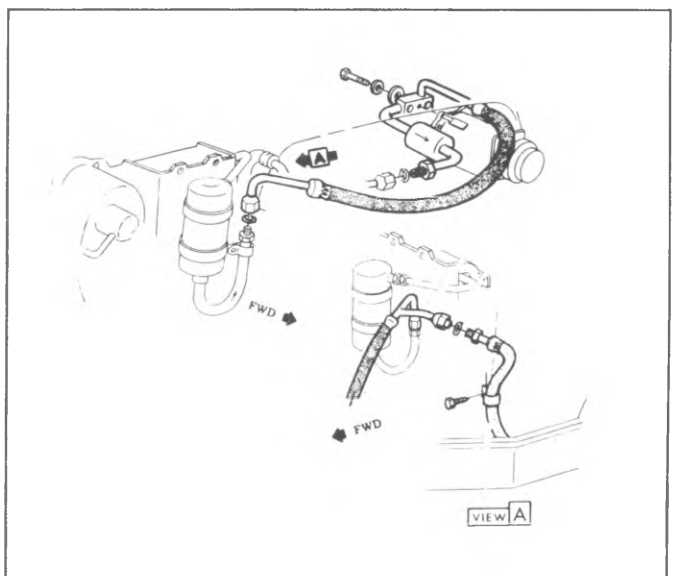


Fig. 1B-59--Fitting and Muffler Assembly

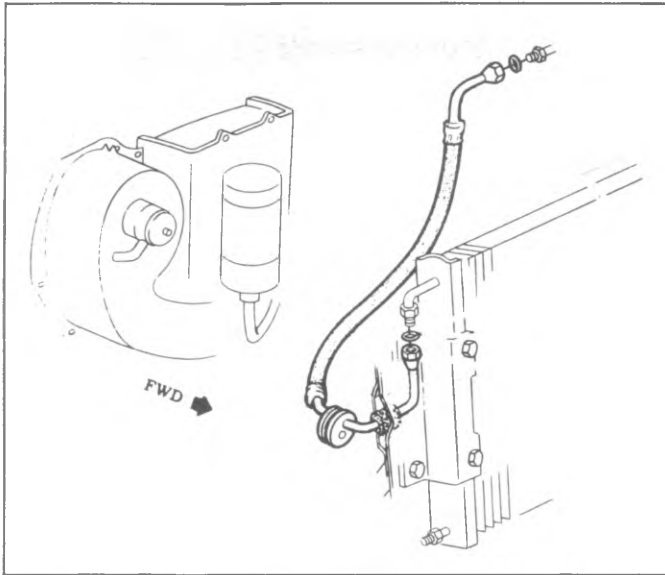


Fig. 1B-60--Refrigerant Line-Condenser Inlet-6 Cyl Engine

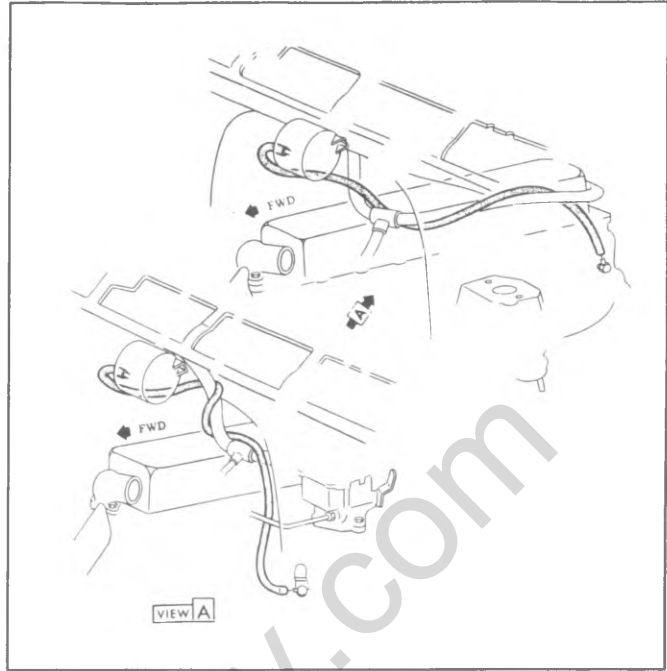


Fig. 1B-62--Vacuum Tank-G Series with 6 Cyl. Engine

VACUUM TANK

Replacement (Fig. 1B-62)

1. Raise the hood.
2. Disconnect the vacuum harness at the tank.
3. Remove the tank attaching screws and remove the tank.
4. To install, reverse Steps 1-3 above.

CIRCUIT BREAKER

The entire air conditioning system is protected by a 45 amp circuit breaker located on the left side of the dash, in the engine compartment.

OVERHEAD SYSTEM-G MODELS

This system is used in conjunction with the C60 system. Since replacement of the C60 System Components has been covered previously, only those components peculiar to the Overhead system will be covered in this section.

The G Van C69 system is almost identical to the CK Series overhead system. Refer to CK Series overhead system service procedures.

TIE RELAY

Replacement

1. Disconnect the battery ground cable.
2. Remove screws securing the blower-evaporator shield; remove the shield. Remove the shield bracket to instrument panel reinforcement screws and remove the bracket.
3. Remove the heater intermediate duct to A/C distributor duct screw and remove the duct.
4. Unsnap the engine cover latches, remove the lower

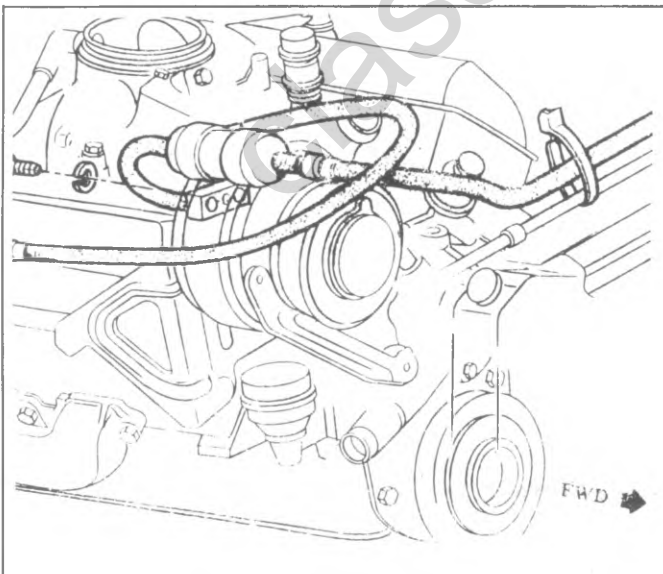


Fig. 1B-61--Refrigerant Lines-Diesel Engine

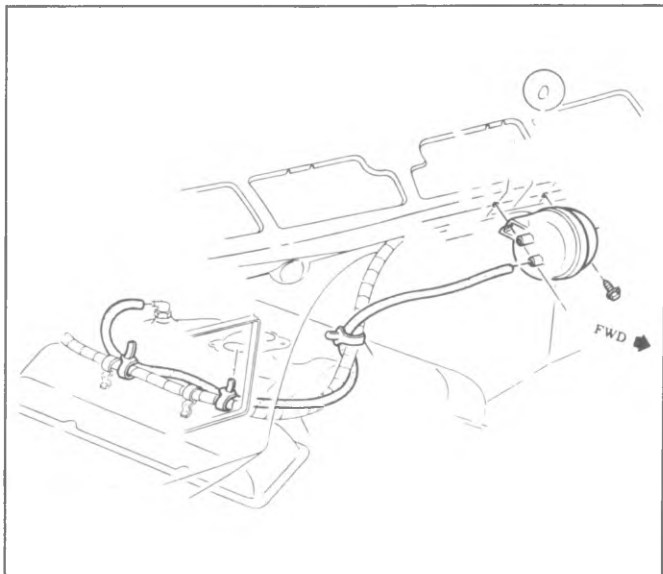


Fig. 1B-63--Vacuum Tank G Series-V8 Engine

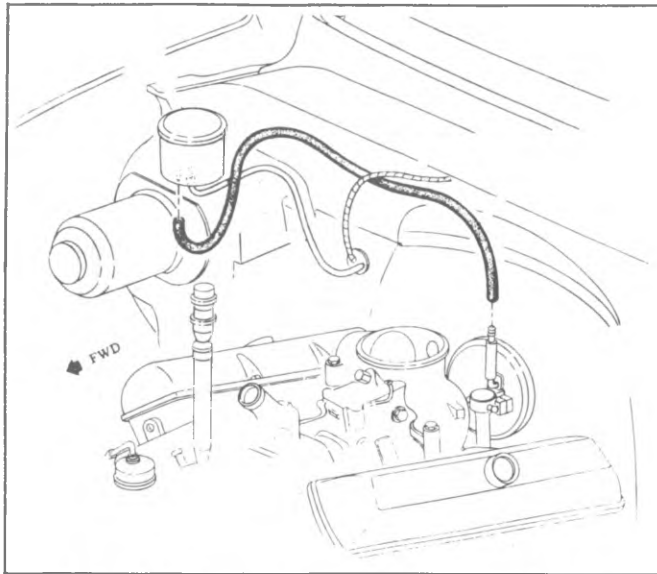


Fig. 1B-64--Vacuum Tank CK Series-Diesel Engine

tab mounting bolts and remove the engine cover.

5. Loosen both steering column instrument panel reinforcement screws; remove one screw.

6. Remove the left foot cooler bracket to instrument panel reinforcement screws, disconnect the outlet from the duct and remove the outlet and bracket assembly.

7. Disconnect the speedometer cable.

8. Remove the instrument panel to lower reinforcement attaching screws. Rotate the instrument panel up to gain access to the relay.

9. Disconnect electrical harness at the relay.

10. Remove the relay mounting screw and remove the relay.

11. To install, reverse Steps 1-10 above.

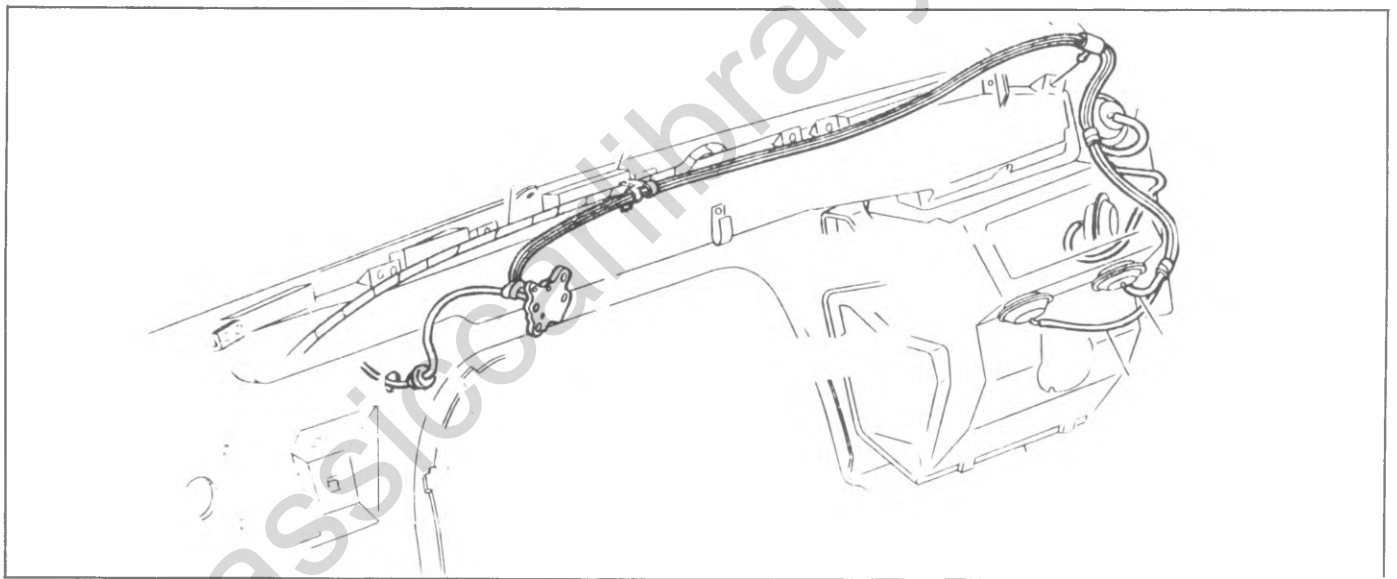


Fig. 1B-65--Vacuum Lines-G Series

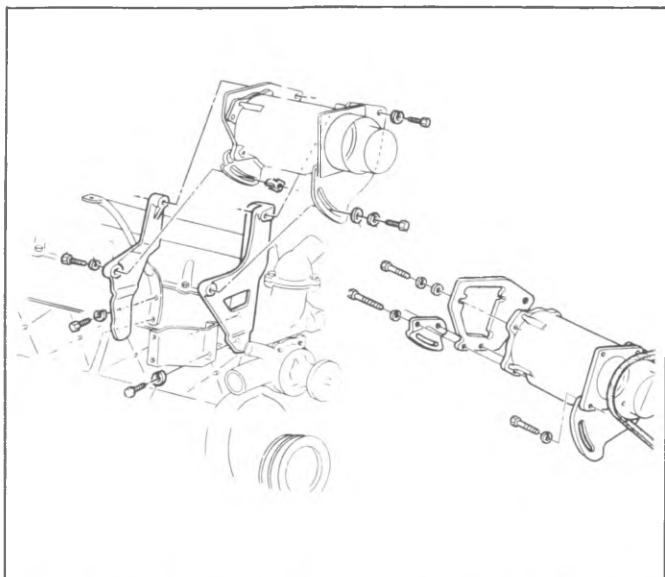


Fig. 1B-66--Compressor Mounting G Series-6 Cyl. Engine

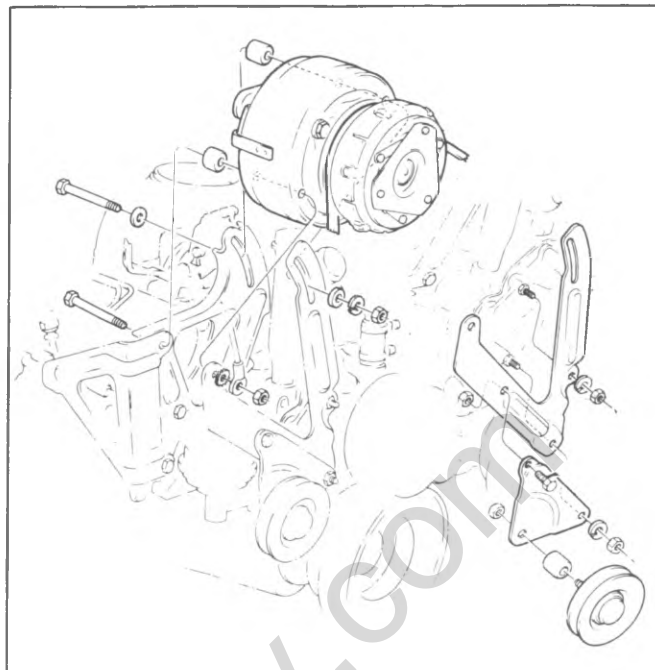


Fig. 1B-68--Compressor Mounting-CK Series-Diesel Engine

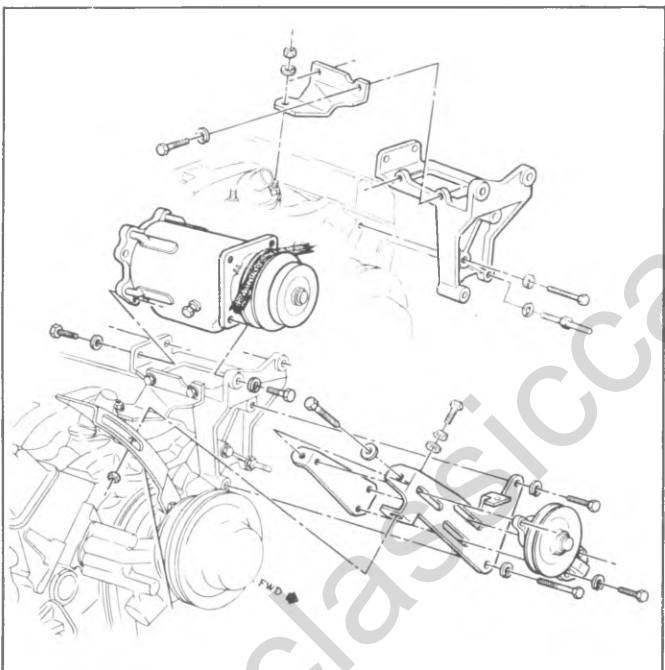


Fig. 1B-67--Compressor Mounting G Series-V8 Engine

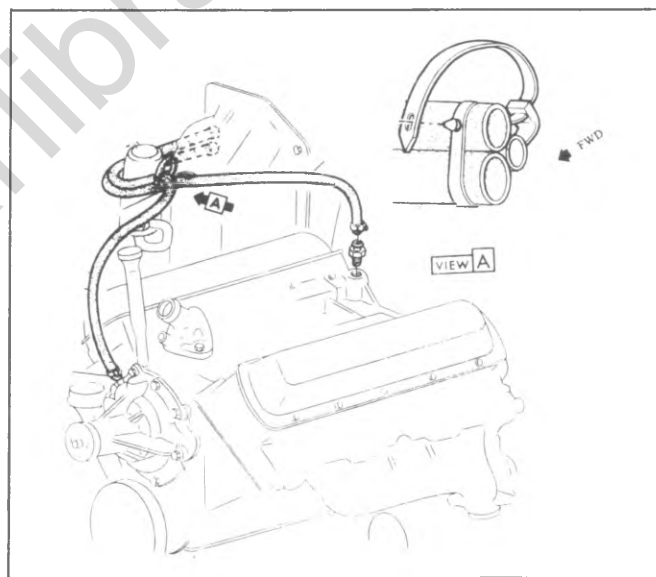


Fig. 1B-69--Heater Hose Routing CK Series - LF9

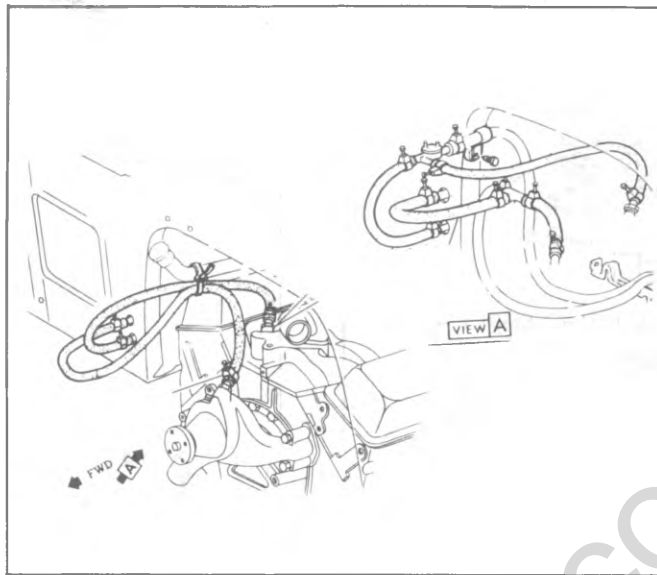


Figure 1B-70--Heater Hose Routing-G Series

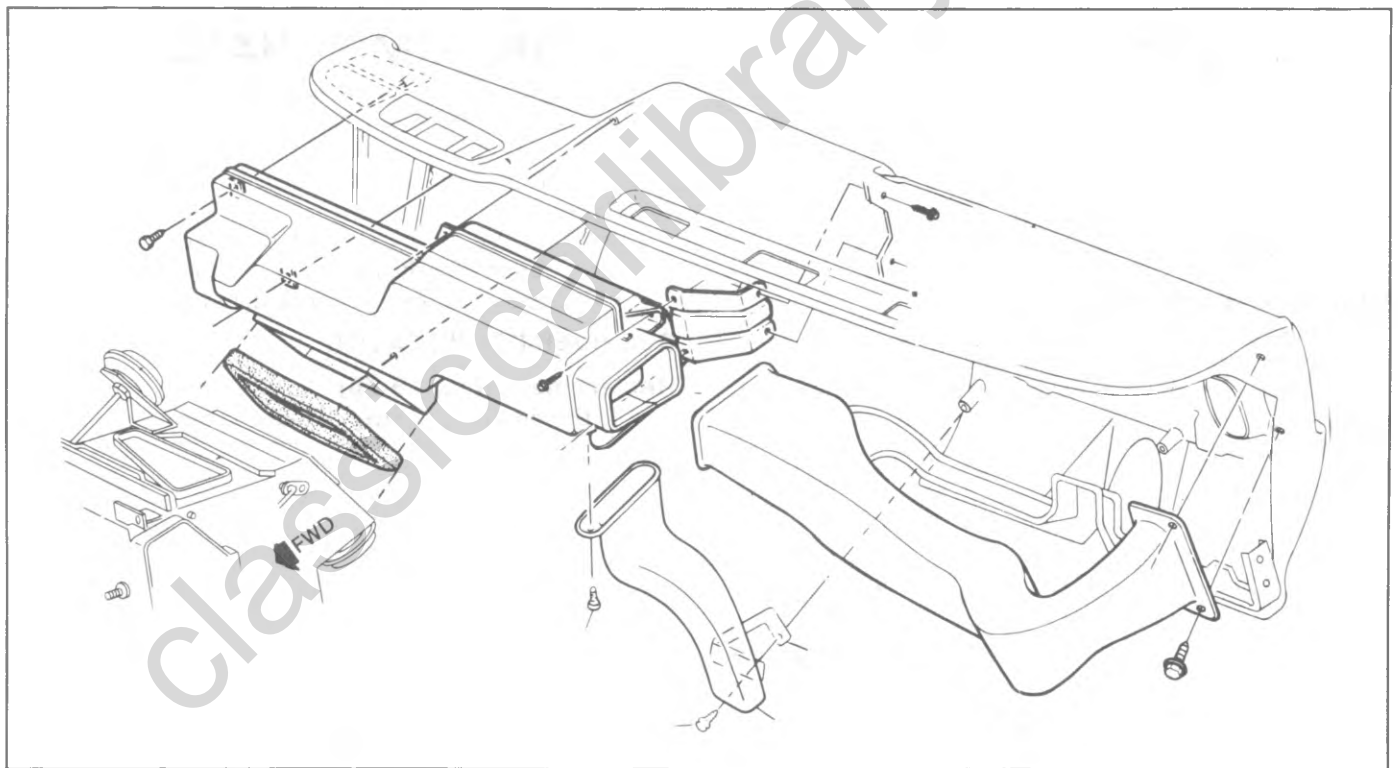


Fig. 1B-71--A/C Ducts-G Series

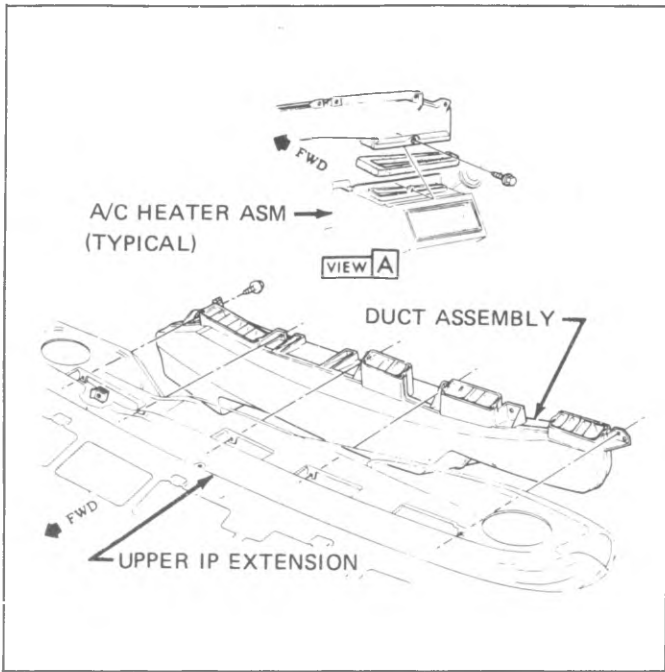


Fig. 1B-72--Defroster Duct-G Series

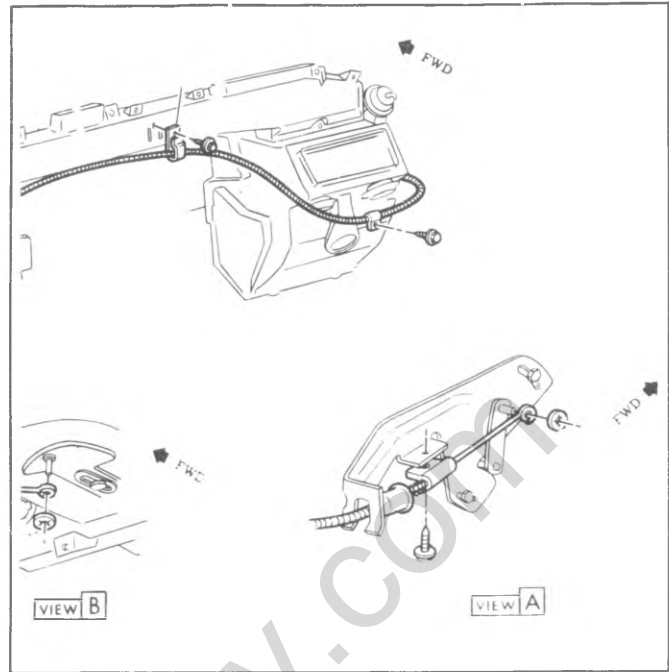


Fig. 1B-73--Temperature Cable-G Series

DASH MOUNTED SYSTEM--MOTOR HOME CHASSIS

This system is installed on the vehicle and checked at assembly. The blower-evaporator is then disconnected and shipped with the chassis unit to the body supplier. For this reason, it will only be possible to give basic replacement procedures on some components.

CONDENSER

Replacement (Fig. 1B-74)

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.
3. Disconnect the condenser inlet and outlet lines and cap or plug all open connections at once.

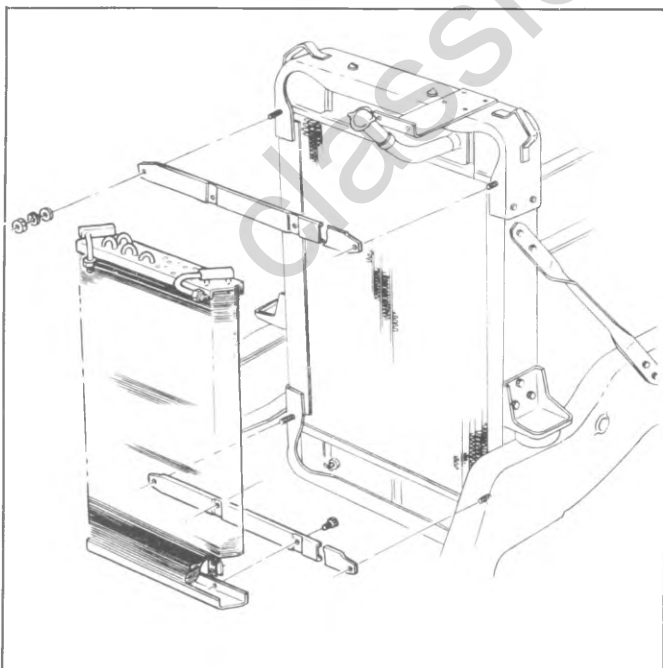


Fig. 1B-74--Condenser (Motor Home Chassis Unit)

4. Remove the condenser to radiator support screws and remove the condenser.
5. To install a new condenser, reverse Steps 1-4 above. Add one foud ounce of clean refrigeration oil to a new condenser.

NOTE: Use new "O" rings, coated with clean refrigeration oil, when connecting all refrigerant lines.

6. Evacuate, charge and check the system.

RECEIVER-DEHYDRATOR

Replacement (Fig. 1B-75)

1. Disconnect the battery ground cable.

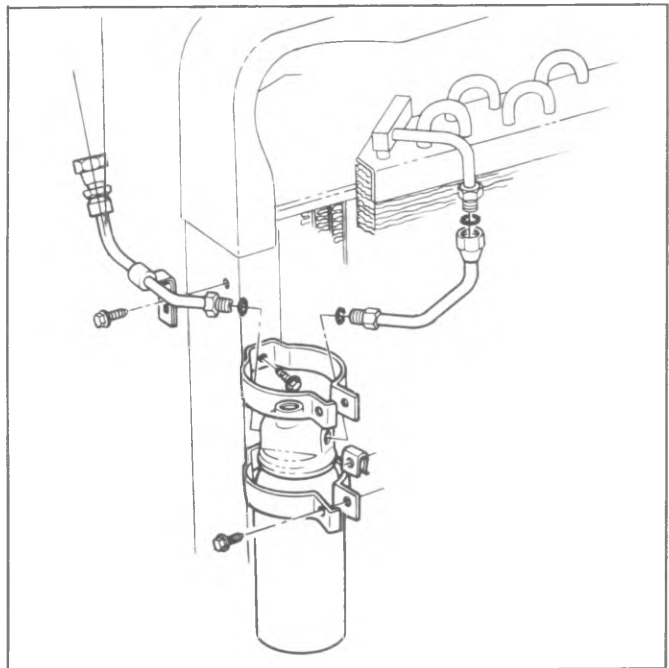


Fig. 1B-75--Receiver-Dehydrator (Motor Home Chassis Unit)

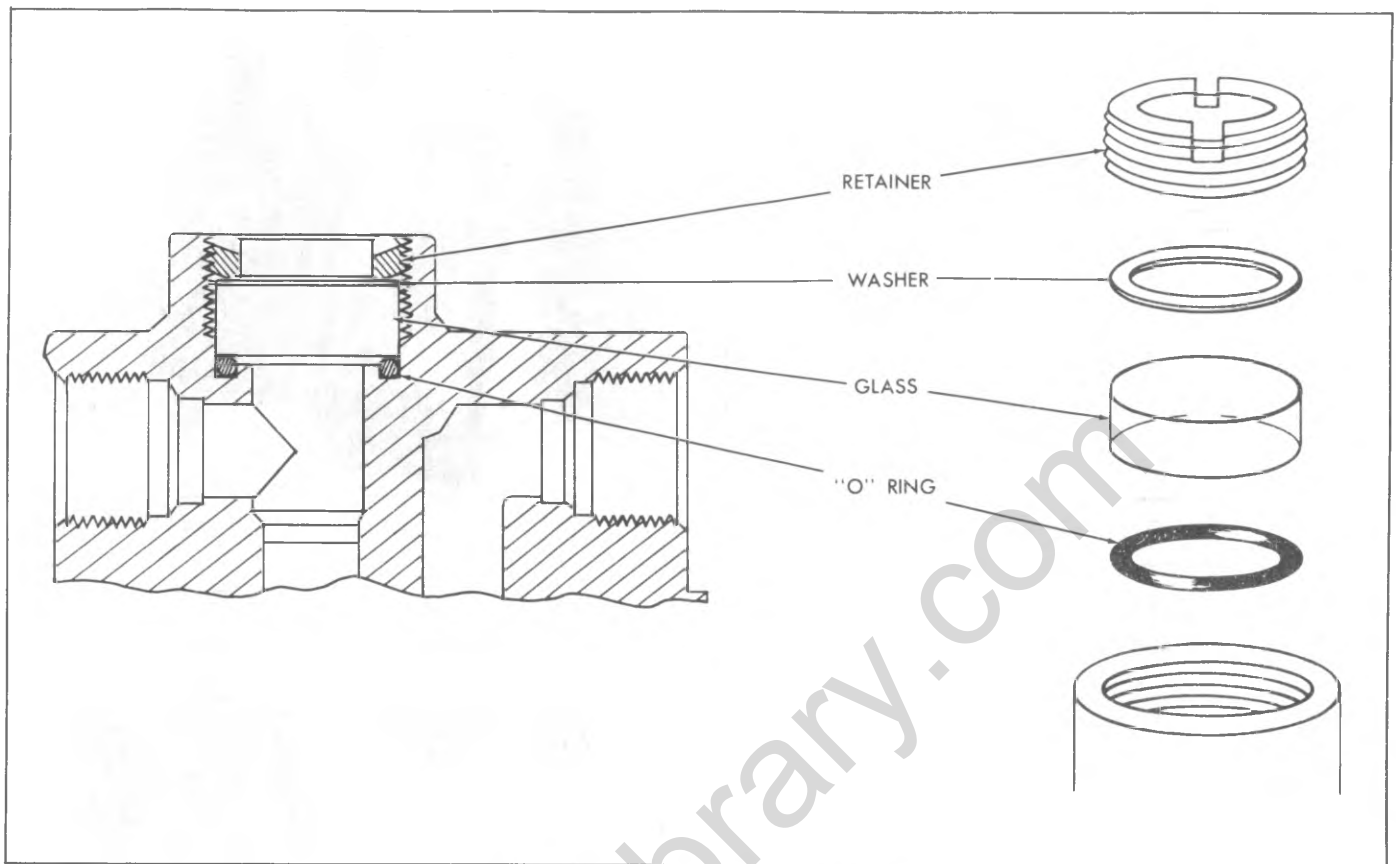


Fig. 1B-76--Sight Glass Replacement

2. Purge the system of refrigerant.
 3. Disconnect the inlet and outlet lines at the receiver-dehydrator and cap or plug the open lines at once.
 4. Remove the receiver-dehydrator bracket attaching screws and remove the bracket and receiver-dehydrator.
 5. To install a new receiver-dehydrator, reverse Steps 1-4 above. Add one fluid ounce of clean refrigeration oil to a new receiver-dehydrator.
- NOTE:** Use new "O" rings, coated with clean refrigeration oil, when connecting all refrigerant lines.
6. Evacuate, charge and check the system.

SIGHT GLASS REPLACEMENT

If damage to the sight glass should occur, a new sight glass kit should be installed. The kit contains the sight glass, seal and retainer. (See Figure 1B-76).

1. Purge system.
2. Remove the sight glass retainer nut using a screwdriver and remove old glass and "O" ring seal.
3. Install the new glass and seal and retainer nut, being careful not to turn the nut past the face of the housing. To do so may damage the "O" ring seal.
4. Evacuate, charge and check the system.

BLOWER-EVAPORATOR ASSEMBLY (Fig. 1B-77)

Removal

1. Disconnect battery ground cable.
2. Purge system of refrigerant.
3. Disconnect inlet and outlet refrigerant lines from the back of unit. Cap or plug all open connections at once.
4. Disconnect drain tubes from evaporator case.

5. Disconnect electrical connector from compressor. Remove the terminal (See Figure 1B-78) and allow connector to hang on ground wire.

6. Remove screws securing grommet retainer to dash panel. Remove wire from grommet through slit.

7. Disconnect electrical lead at connector.

8. Remove unit mounting bolts. Remove unit from vehicle, carefully pulling compressor electrical lead through dash panel.

Once the unit has been removed from the vehicle, continue with component replacement as follows:

BLOWER ASSEMBLY

Removal (Fig. 1B-79)

1. Remove the cover plate and separate the upper and lower case halves. Remove blower motor mounting strap screw and remove strap.
2. Remove blower assembly. Remove the wheels from the motor shaft.

Installation

1. Install the blower wheels on the motor so that the lower blades curve toward the dash panel side of the unit when the motor is placed in the case as illustrated in Figure 1B-79.

2. Place the motor in the bracket with the electrical connector side of the motor to the right side of the bracket. Attach the mounting strap. Align blower wheels so that they do not contact case.

3. Assemble the case halves and attach the cover plate.

4. Reverse Steps 1-8 on the "Blower-Evaporator Assembly" removal procedure.

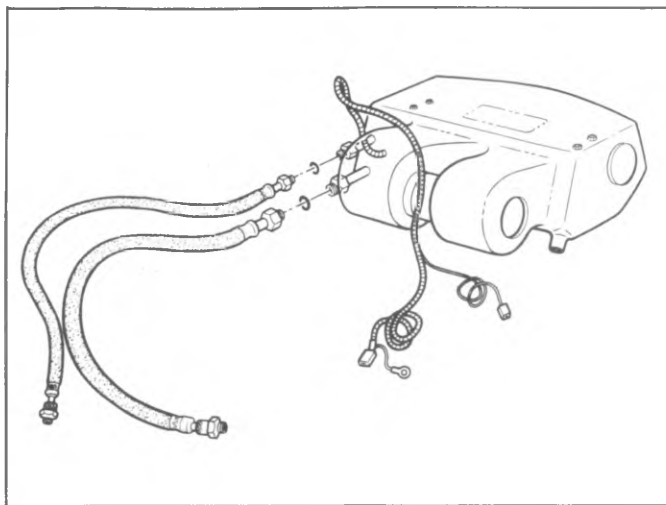


Fig. 1B-77-Blower-Evaporator (Motor Home Chassis Units)

5. Evacuate, charge and check the system.

EXPANSION VALVE, EVAPORATOR AND/OR EVAPORATOR CASE

Removal (Fig. 1B-80)

1. Remove the cover plate and separate upper and lower case halves.
2. Remove inlet and outlet lines from the expansion valve. Remove sensing bulb from the evaporator outlet manifold. Remove expansion valve. Cap or plug open connections at once.
3. Remove evaporator core retaining screws and remove core.
4. Remove blower motor and harness assembly from case.

Installation

1. Reverse applicable steps in the removal procedure.

CAUTION: Use new "O" rings coated with clean refrigeration oil when connecting lines. Add 3 oz. of new refrigeration oil to a new core.

2. Reverse steps 1-8 of the "Blower Evaporator Assembly" removal procedure.
3. Evacuate, charge and check the system.

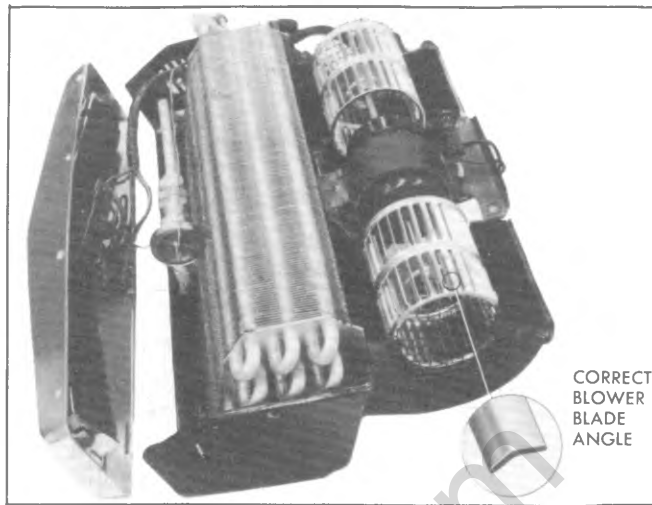


Fig. 1B-79-Blower Assembly (Motor Home Chassis Unit)

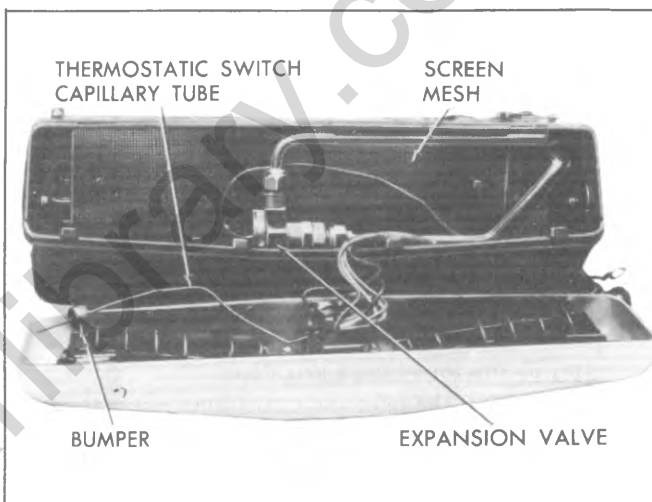


Fig. 1B-80-Expansion Valve (Motor Home Chassis Unit)

THERMOSTATIC AND/OR BLOWER SWITCHES

Replacement

1. Remove the cover plate assembly from the evaporator case.
2. Remove two screws securing either switch to the cover plate and remove appropriate switch (fig. 1B-81).

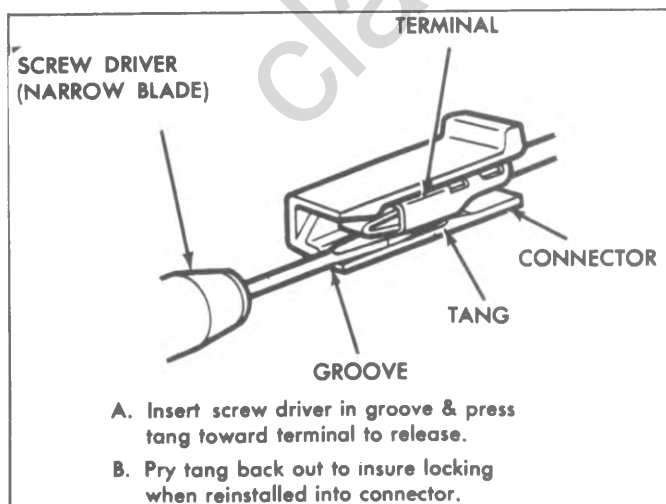


Fig. 1B-78-Terminal Removal

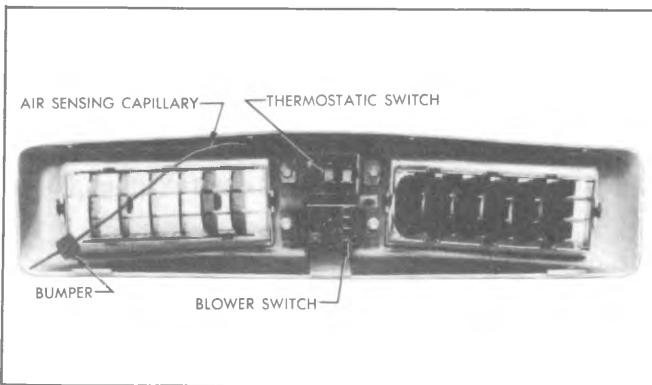


Fig. 1B-81-Thermostatic and Blower Switches

3. Install replacement switch, reinstall cover plate and reverse steps 1-8 of the "Blower-EVaporator Assembly" removal procedure.

NOTE: When installing thermostatic switch, be sure to position sensing capillary as when unit was removed.

RESISTOR

The blower motor resistor is located on the top of the unit. The entire unit must be removed to replace the resistor.

FUSE

This Unit does not incorporate an in-line fuse. The lead wire is connected to the Heater Wiring Harness and operates off the 20 amp Heater Fuse.

SPECIFICATIONS

AIR CONDITIONING			
Compressor			
Make		Frigidaire	C-K Four-Season System 3 lbs.
Type		6 Cylinder Axial	C-K-G Overhead Systems 5 lbs. 4 oz.
Displacement		12.6 Cu. In.	G Floor System 3 lbs. 4 oz.
Rotation.		Clockwise	Motor Home Chassis Unit 3 lbs. 4 oz.
	<u>Volts</u>	<u>Amps. (Cold)</u>	<u>RPM (Cold)</u>
Blower Motor			
C-K Four Season . .	12.0	12.8 Max.	3400 Min.
C-K-G Overhead, G Floor and Motor Home Units	12.0	13.7 Max.	3400 Min.
Compressor Clutch Coil			
Ohms (at 80°F)		3.70	
Amps. (at 80°F)		3.33 @ 12 volts	
System Capacities			
Refrigerant 12			
Torque Specifications			
Compressor Suction and Discharge			
Connector Bolt			25 ft. lbs.
Rear Head to Shell Stud Nuts			23 ft. lbs.
Shaft Mounting Nut			20 ft. lbs.
Compressor Mounting Bracket Bolts			25 ft. lbs.
Front Bracket to Compressor Bolts			20 ft. lbs.
Belt Tension			See Tune Up Chart
Fuses			
Fuse Block—			
C-K Systems			25 Amp.
Motor Home Chassis Unit			20 Amp.
In-Line—			
C-K Systems			25 Amp.
Motor Home Chassis Unit			None
Circuit Breaker			
G Model Systems			45 Amp.

SPECIAL TOOLS

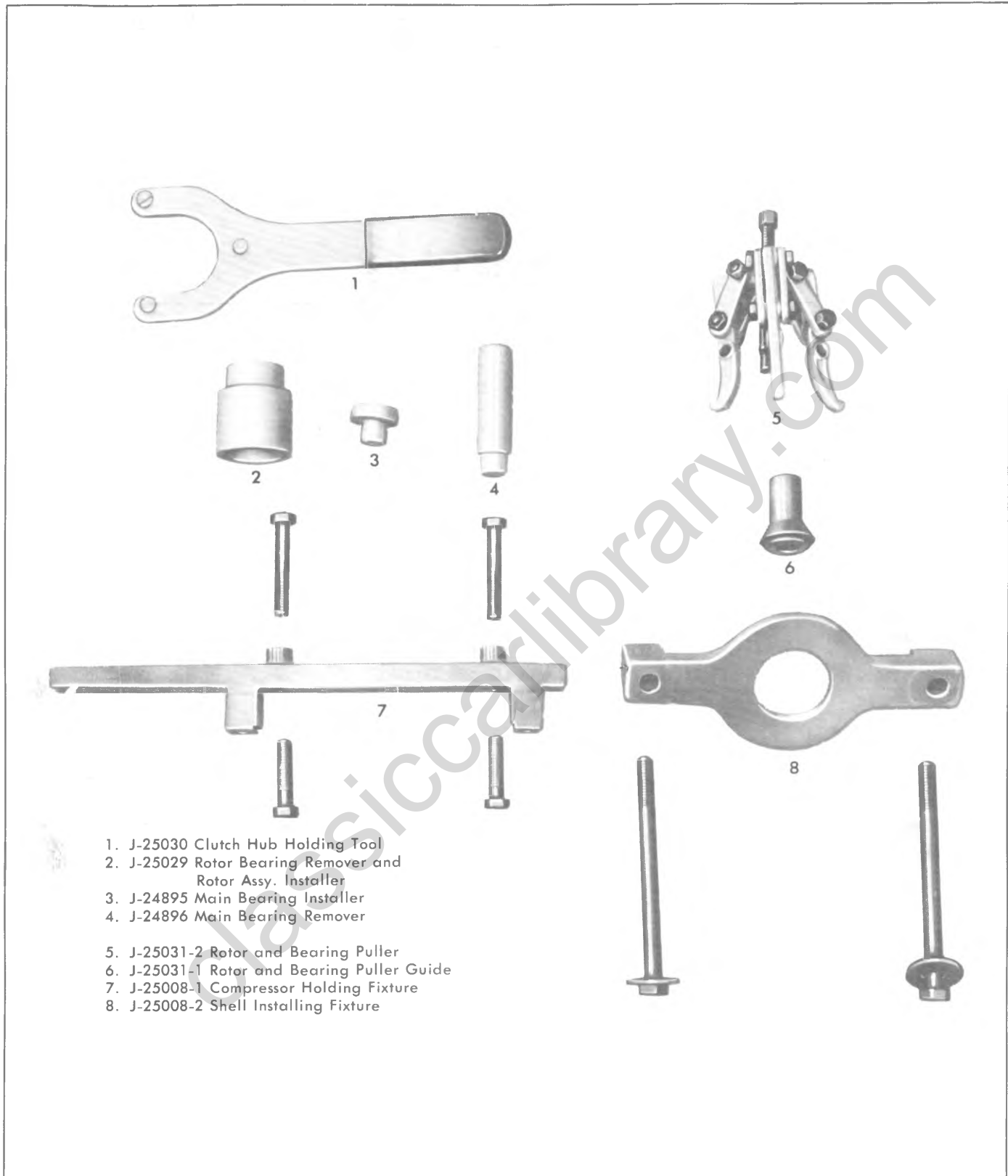
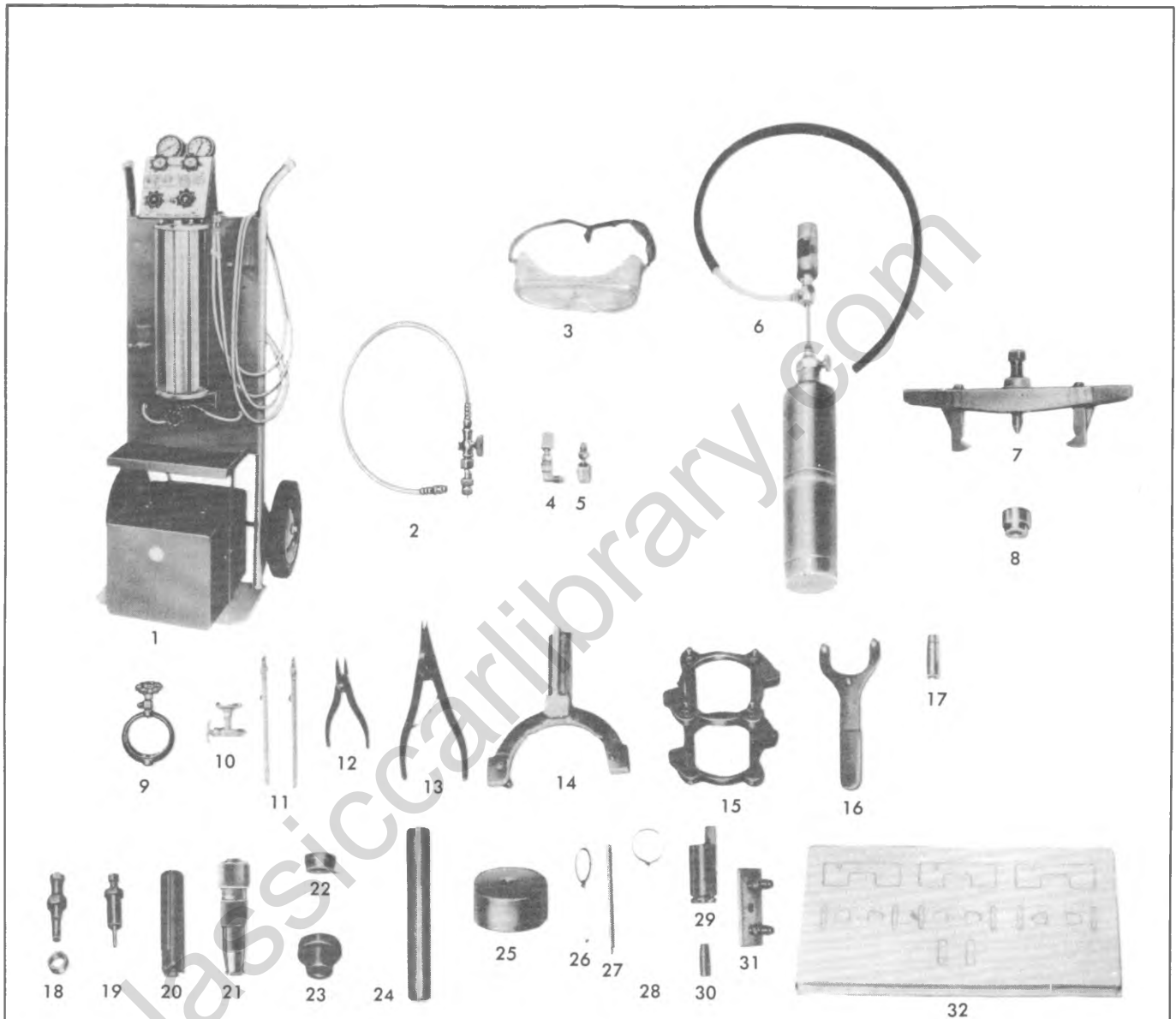


Fig. 1B-82--Air Conditioning Special Tools

SPECIAL TOOLS



- | | | | | | |
|---------------|----------------------------------|---------------|--|---------------|---------------------------------|
| 1. J-8393 | Charging Station | 11. J-5421-02 | Pocket Thermometers (2) | 22. J-9398 | Pulley Bearing Remover |
| 2. J-24095 | Oil Inducer | 12. J-5403 | No. 21 Snap Ring Pliers | 23. J-9481 | Pulley and Bearing Installer |
| 3. J-5453 | Goggles | 13. J-6435 | No. 26 Snap Ring Pliers | 24. J-8092 | Handle |
| 4. J-9459 | 7/16"-20 90° Gauge Line | 14. J-9396 | Compressor Holding Fixture | 25. J-21352 | Internal Assembly Support Block |
| J-25499 | 3/8"-24 Adapter | 15. J-25030 | Compressing Fixture | 26. J-5139 | Oil Pickup Tube Remover |
| 5. J-5420 | 7/16"-20 Straight Gauge Line | 16. J-9403 | Clutch Hub Holding Tool | 27. J-9432 | Needle Bearing Installer |
| J-25498 | 3/8" Adapter | 17. J-9399 | 9/16" Thin Wall Socket | 28. J-9553-01 | Seal Seat "O" Ring Remover |
| 6. J-6084 | Leak Detector | 18. J-9401 | Hub and Drive Plate Assembly Remover | 29. J-21508 | Seal Seat "O" Ring Installer |
| 7. J-8433 | Puller | 19. J-9480-01 | Hub and Drive Plate Assembly Installer | 30. J-22974 | Shaft Seal Protector |
| 8. J-9395 | Puller Pilot | 20. J-9392 | Seal Remover | 31. J-9625 | Pressure Test Connector |
| 9. J-23595 | Refrigerant Can Valve (Side-Tap) | 21. J-23128 | Seal Seat Remover | 32. J-9402 | Parts Tray |
| 10. J-6271-01 | Refrigerant Can Valve (Top-Tap) | | | | |

Fig. 1B-83--Air Conditioning Special Tools

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SECTION 2A

FRAME

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General Description.....	2A-1
On-Vehicle Service.....	2A-1
Maintenance and Inspection.....	2A-1
Underbody Inspection.....	2A-1
Frame Inspection.....	2A-1
Frame Alignment.....	2A-1
Underbody Alignment.....	2A-2
Excessive Body Damage.....	2A-4

GENERAL DESCRIPTION

Light duty 10-30 Series frames are of the ladder channel section riveted type.

Figure 2A-1 thru 2A-4 illustrates typical light duty truck frames with crossmembers, body mounts and suspension attaching brackets. This section also includes general instructions for checking frame alignment and recommendations on frame repair.

The G-Van frame side rails, cross sills and outriggers

are part of the underbody assembly which is a welded unit.

Misalignment of the underbody can affect door opening fits and also influence the suspension system, causing suspension misalignment. It is essential, therefore, that underbody alignment be exact to within - 1/16" of the specified dimensions.

ON-VEHICLE SERVICE

MAINTENANCE AND INSPECTION

UNDERBODY INSPECTION

Raise the vehicle on a hoist (preferably a twin-post type).

Check for obvious floor pan deterioration.

Check for loose dirt and rust around the inside of the floor pan reinforcement member access holes. This is the first indication that corrosion may exist in hidden areas, and that repairs might be required before the final cleaning and protective treatment is performed.

Using a chisel, ensure that the drain provisions in the floor pan reinforcement members are open.

There are drain holes in the body side panels also. These holes can be opened by using a punch or drift. The side panel drain holes are in the rear section of the rocker panels, and in the lower rear quarter panels.

FRAME INSPECTION

Raise the vehicle on a hoist (preferably a twin-post type).

Check for obvious floor pan deterioration.

Check for loose dirt and rust around the inside of the frame rails, on top and at the ends where corrosion may exist in hidden areas. Check especially in the frame box sections for accumulation of debris.

FRAME ALIGNMENT

Horizontal frame checking can be made with tramming gages applied directly to the frame or by transferring selected points of measurement from the frame to the floor by means of a plum bob and using the floor layout for measuring. Figure 2A-2 or 2A-4 may be used as a general

guide in the selection of checking points; however, selection of these points is arbitrary depending on accessibility and convenience. An important point to remember is that for each point selected on one side of the frame, a corresponding point on the opposite side of the frame must be used for vertical checks, opposite and alternate sides for horizontal checks.

Vehicle Preparation

Points to remember when preparing vehicle for frame checking:

1. Place vehicle on a level surface.
2. Inspect damaged areas for obvious frame misalignment to eliminate unnecessary measuring.
3. Support vehicle so that frame sidemembers are parallel to the ground.

Tramming Sequence (Fig. 2A-1)

1. Dimensions to bolts and/or holes in frame extend to dead center of the hole or bolt.
2. Dimensions must be within 3/16".
3. If a tram bar is used, for horizontal alignment "X" - check from opposite and alternate reference points AA, BB and CC, as illustrated by the lines in Figure 2A-1. Error will result if a tram bar is not level and centered at the reference points.
4. Obtain vertical dimensions and compare the differences between these dimensions with the dimensions as shown in figure 2A-3 or 2A-4.

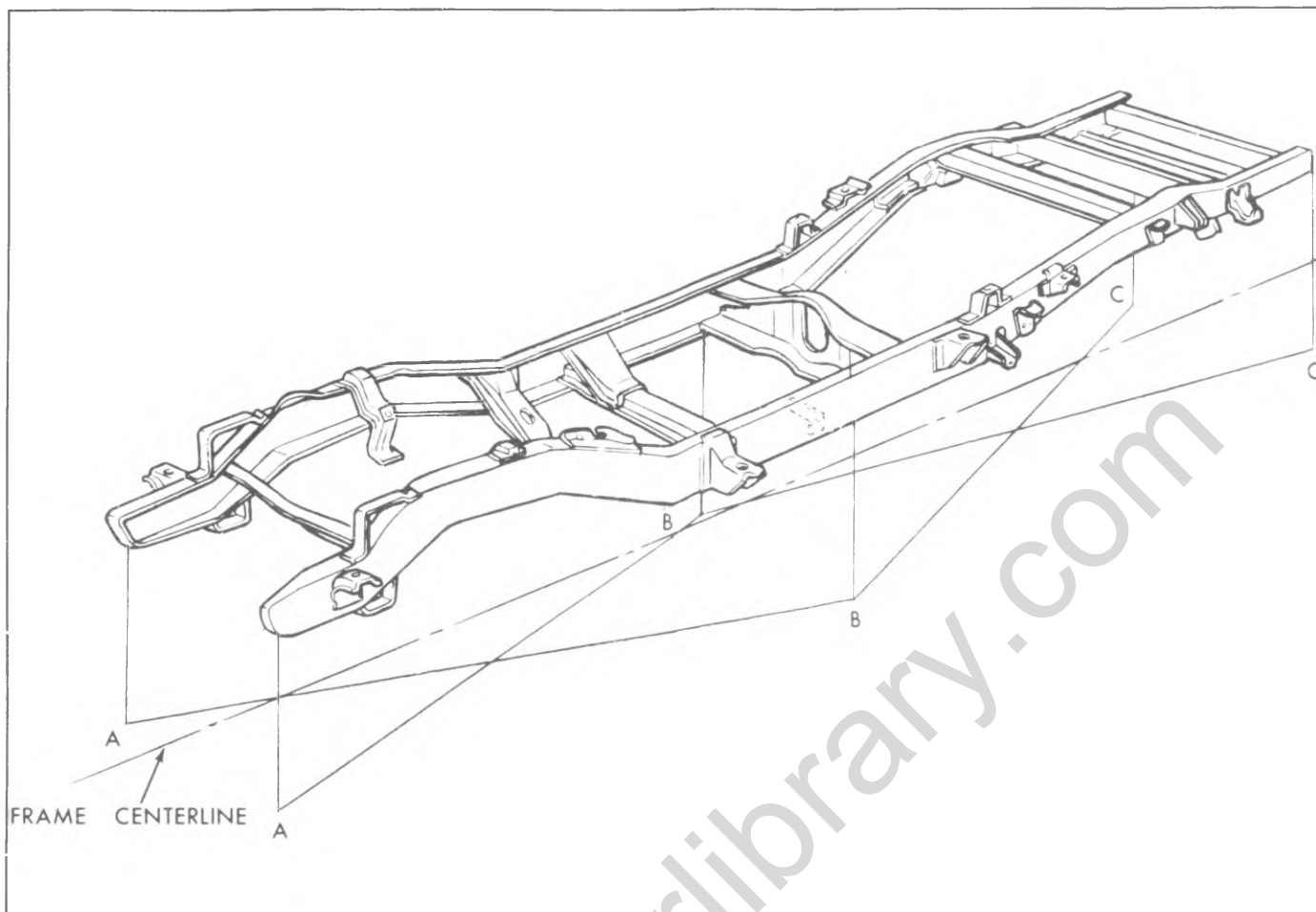


Fig. 2A-1--Frame Horizontal Checking--Typical

Horizontal Check

1. Measure frame width at front and rear. If widths correspond to specifications, draw centerline full length of vehicle halfway between lines indicating front and rear widths. If frame widths are not correct, layout centerline as shown in Step 4.

2. Measure distance from centerline to corresponding points on each side of frame layout over entire length. Opposite side measurement should correspond within $3/16$ ".

3. Measure diagonals marked A, B and C. If the lengths of intersecting diagonals are equal and these diagonals intersect the centerline, frame area included between these points of measurement may be considered in alignment.

4. If front or rear end of frame is damaged and width is no longer within limits, frame centerline may be drawn through the intersection of any two previously drawn pairs of equal, intersecting diagonals.

Vertical Check

Vertical dimensions are checked with a tramming bar from indicated points on the frame (figs. 2A-2 and 2A-4). For example, if the tram bar is set at point B with a vertical pointer length of 8-1/4 inches, and at point E with a vertical pointer length of 5-1/4 inches (a height difference of 3 inches), the tram bar should be parallel with the frame. If the area is twisted or misaligned in any way, tram bar will

not be parallel. Placing the tram bar vertical pointers on opposite sides of the frame side rail is preferable in that frame twist will show up during this vertical check. Figures 2A-2 and 2A-4 show typical checking points, with dimensions for various frames shown in figure 2A-3.

Frame Repair

Welding

Before welding up a crack in frame, a hole should be drilled at the starting point of the crack to prevent spreading. Widen V groove crack to allow complete weld penetration.

NOTE: Do not weld into corners of frame or along edges of side rail flanges. Welding at these points will tend to weaken the frame and encourage new cracks.

Bolting

Wherever rivets or failed bolts are replaced, bolt hole must be as near the O.D. of the bolt as possible to prevent bolt from working and wearing. Drill out and line ream hole (or holes) to the bolt O.D.

UNDERBODY ALIGNMENT

One method of determining the alignment of the underbody is with a tram gage which should be sufficiently flexible to obtain all necessary measurements up to three quarters the length of the vehicle. A good tramming tool is essential for analyzing and determining the extent of

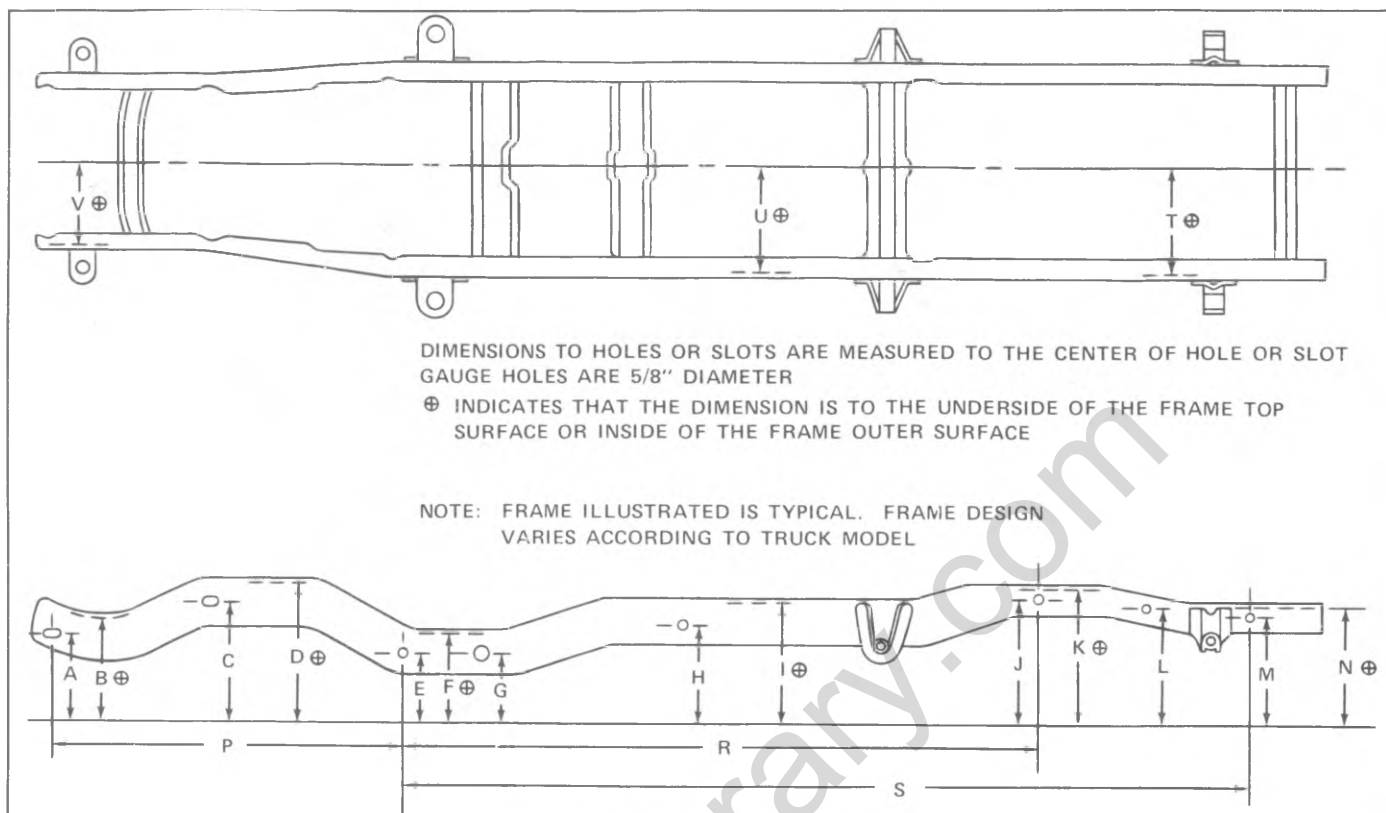


Fig. 2A-2--C-K-P Series Truck Frame

collision misalignment present in underbody construction.

Model	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	R	S	T	U	V
CA107	13-3/8	15-1/4	16	19-7/8	12	13	10	14-7/8	17-3/4	17-3/4	19-7/8	16-3/4	15-5/8	17-3/4	69-5/8	76-1/2	110	16-7/8	16-7/8	14
CA109	13-3/8	15-1/4	16	19-7/8	12	13	10	14-7/8	17-3/4	17-3/4	19-7/8	16-3/4	15-5/8	17-3/4	69-5/8	86-1/2	120	16-7/8	16-7/8	14
CA209	13-3/8	15-1/4	17	19-7/8	12	13	10	14-7/8	17-3/4	17-3/4	19-7/8	16-3/4	15-5/8	17-3/4	69-5/8	86-1/2	120	16-7/8	16-7/8	14
CA ²¹⁰ ₃₁₀	13-3/4	15-1/4	16	18-1/2	10	13	10	14-1/4	17-3/4	17-3/4	19-7/8		15-5/8	17-3/4	69-7/8	105	131	16-7/8	16-7/8	14
CA314	13-3/8	14-7/8	16	18-1/2	10	13	10	14-1/4	17-3/4	17-3/4	19-7/8		15-5/8	17-3/4	69-7/8	129	155-1/2	16-7/8	16-7/8	14
KA107	13-3/8	15-1/4	17	19-7/8	12-1/2	13	10	14-7/8	17-3/4	17-3/4	19-7/8	16-3/4	15-5/8	17-3/4	69-5/8	76-1/2	110	16-7/8	16-7/8	14
KA ¹⁰⁹ ₂₀₉	13-3/8	15-1/4	17	19-7/8	12-1/2	13	10	14-7/8	17-3/4	17-3/4	19-7/8	16-3/4	15-5/8	17-3/4	69-5/8	86-1/2	120	16-7/8	16-7/8	14
PA100	7-5/8	9-3/8	11	14-5/8	9-1/2	13	10			9-1/2	13		10-7/8	13	71-7/8	36	89	16-7/8	16-7/8	14
PA ²⁰⁸ ₃₀₈	7-5/8	9-3/8	11-5/8	14-5/8	9-1/2	13	10	9-1/2	13	9-1/2	13		10-7/8	13	72-1/4	59	131	16-7/8	16-7/8	14
PA ²¹⁰ ₃₁₀	7-5/8	9-3/8	11-5/8	14-5/8	9-1/2	13	10	9-1/2	13	9-1/2	13	10-7/8	10-7/8	13	71-7/8	67	153	16-7/8	16-7/8	14
PA314	7-5/8	9-3/8	11-5/8	14-5/8	9-1/2	13	10	9-1/2	13	9-1/2	13	10-7/8	10-7/8	13	71-7/8	91	177	16-7/8	16-7/8	14
CA105	13-3/8	15-1/4	17	19-7/8	12	13	10			14-1/4	20	17-3/4	15-5/8	17-3/4	69-5/8	46	88	16-7/8	16-7/8	14
KA105	13-3/8	15-1/4	17	19-7/8	12-1/2	13	10			14-1/4	20	17-3/4	15-5/8	17-3/4	69-5/8	46	88	16-7/8	16-7/8	14
PE 31132 (137)	9-1/8	11-1/2	10-7/8		9-1/2	13	10	9-1/2	13	9-1/2	13	10-7/8	10-7/8	13	68-1/2	71	157	16-7/8	16-7/8	14
PE 31432 (157)	9-1/8	11-1/2	10-7/8		9-1/2	13	10	9-1/2	13	9-1/2	13	9-7/8	10-7/8	13	68-1/2	92-1/2	178-1/2	16-7/8	16-7/8	14
PE 31832	9-1/8	11-1/2	10-7/8		9-1/2	13	10	9-1/2	13	9-1/2	13	10-7/8	10-7/8	13	68-1/2	112	240-3/16	16-7/8	16-7/8	14

Fig. 2A-3--C-K-P Series Frame Reference Dimensions

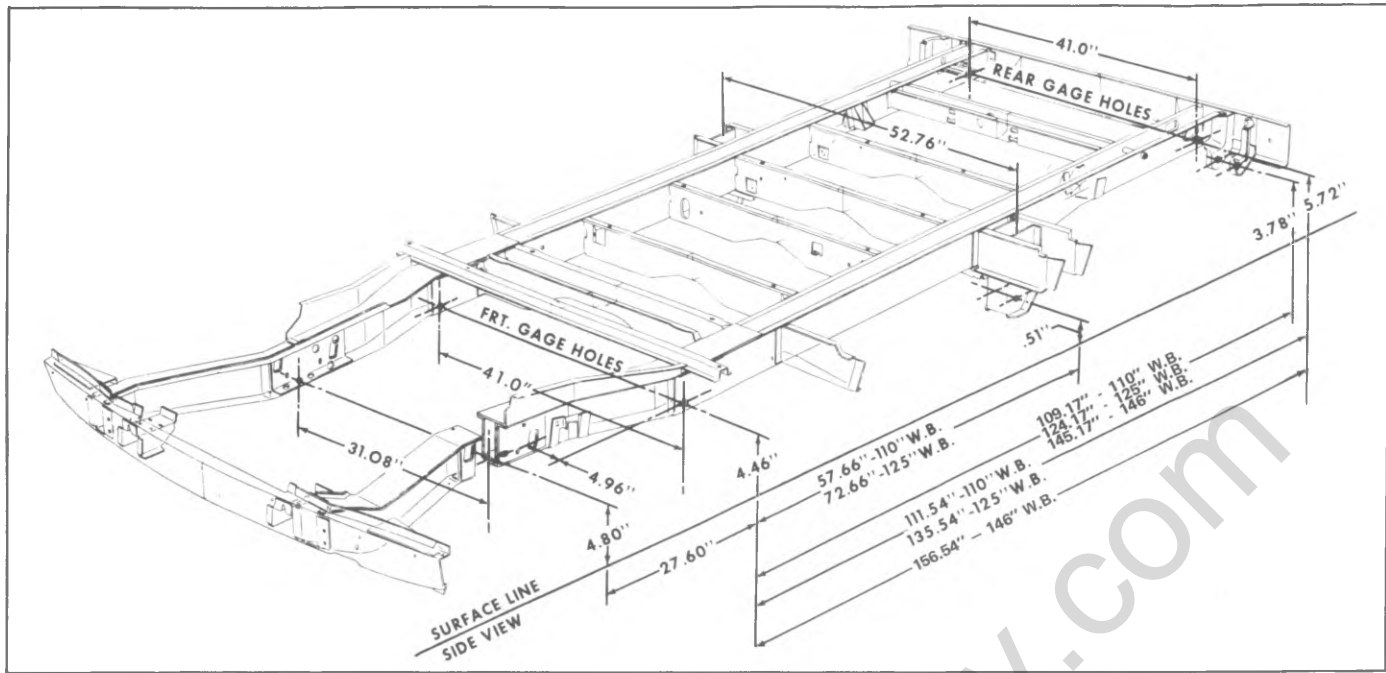


Fig. 2A-4-G Van Truck Reference Dimensions

MEASURING

To measure the distance accurately between any two reference points on the underbody, two specifications are required.

1. The horizontal dimension between the two points to be trammed.
2. The vertical dimension from the datum line to the points to be trammed.

The tram bar should be on a parallel to that of the body plane. The exception to this would be when one of the reference locations is included in the misaligned area; then the parallel plane between the body and the tram bar may not prevail. After completion of the repairs, the tram gage

should be set at the specified dimension to check the accuracy of the repair operation.

EXCESSIVE BODY DAMAGE

If damage is so extensive that key locations are not suitable as reference points, repair operations should always begin with the underbody area. All other components should be aligned progressively from this area. Unlike the conventional type of frame design, the unitized type of body construction seldom develops the two conditions of "twist" and "diamond" in the underbody area as a result of front or rear end collisions, therefore, there usually is an undamaged area suitable as a beginning reference point.

SECTION 2B BUMPERS

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Rear Step Bumper - C and K Models.....	2B-1		

GENERAL DESCRIPTION

All 1978 truck front and rear bumpers are of a single piece design. Bumper attachments are the standard bracket and brace to frame mountings. This section contains

procedures for the removal and installation of face bar, brackets, braces and license plate brackets.

SERVICE PROCEDURES-10 THRU 30 SERIES

FRONT BUMPER-C, K AND P MODELS

Removal Fig. 2B-1, 2B-2

1. Remove bolts securing two bumper brackets to frame.
2. Remove bolts securing bumper face bar to frame, and left and right bumper braces and remove bumper from vehicle.
3. If necessary, disassemble bumper by removing bolts attaching brackets and braces to bumper face bar.
4. If equipped with bumper guards (Fig. 2B-2) remove remaining nuts and bolts.

Installation

Assemble and install front bumper following the removal procedure in reverse order.

REAR BUMPER-C AND K MODELS (FIG 2B- 3)

Removal

1. Remove bolts attaching bumper to each bumper brace. Disconnect license lamp wiring on suburban and panels and pickup.
2. Remove bolts attaching bumper to frame.
3. Remove bumper from vehicle.
4. If necessary, replace body splash shield.

Installation

Install rear bumper following removal procedure in reverse order. Connect license lamp wiring on suburban panel, and pickup models.

REAR STEP BUMPER C AND K MODELS

Removal (Fig. 2B-4)

1. Disconnect license lamp wiring.
2. Remove bolts connecting bumper to braces.
3. Remove bumper assembly.

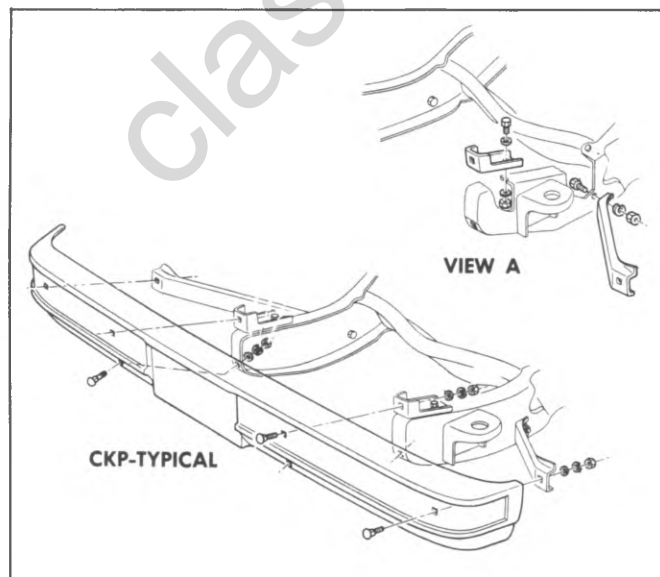


Fig. 2B-1--Front Bumper-C, K and P Models

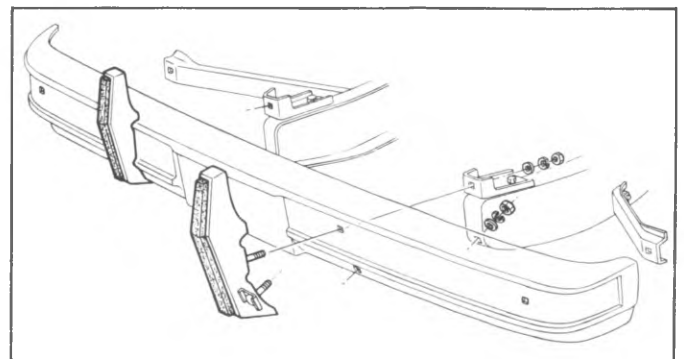


Fig. 2B-2--C, K Model Front Bumper Guards

2B-2 BUMPERS

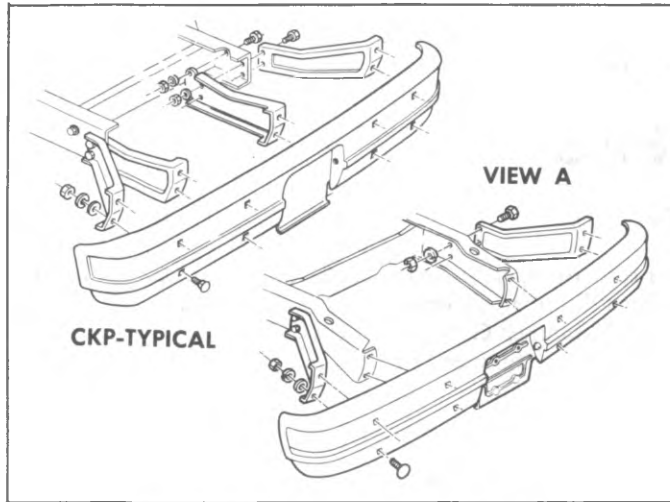


Fig. 2B-3--Rear Bumper - C, K Models

4. Remove bolts securing bumper brace to frame and remove brace.

Installation

Install rear step bumper by reversing removal procedure. Connect license lamp wiring.

FRONT BUMPER - G MODELS

Removal Fig. 2B-5, 2B-6

1. Remove nuts securing bumpers to brackets and braces from left and right side. Remove bumper.
2. Remove the license plate support nut and bolts.
3. If necessary to remove the braces and brackets, remove screws securing brackets and braces to sheet metal.

NOTE: The bumper may be removed with the brackets and braces attached.

4. If equipped with bumper guards (Fig. 2B-6) they may be removed from the face bar at this time.

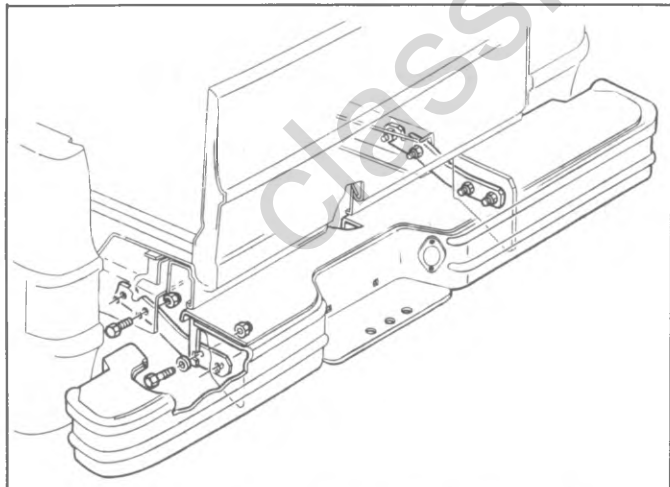


Fig. 2B-4--Rear Step Bumper C and K Models

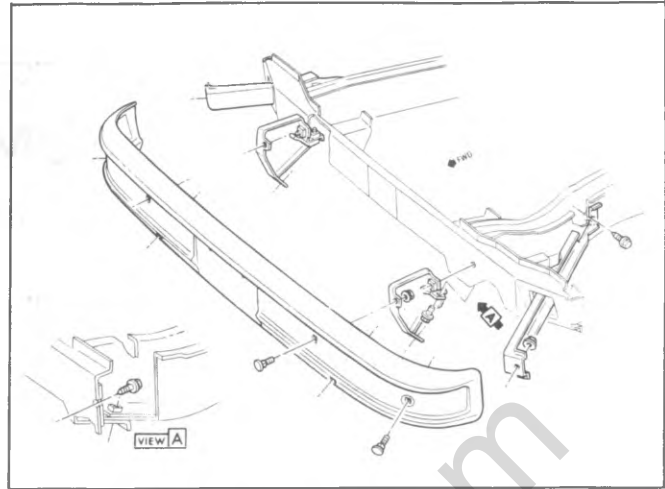


Fig. 2B-5--Front Bumper - G Models

Installation

Reverse removal steps to install bumpers.

REAR BUMPER-G MODELS

Removal Fig. 2B-7, 2B-8

1. Remove nuts securing bumper to brackets and braces and remove the bumper.
2. Remove brackets and braces from vehicle.

NOTE: The bumper may be removed with brackets and braces attached if necessary.

Installation

Install in reverse order of removal.

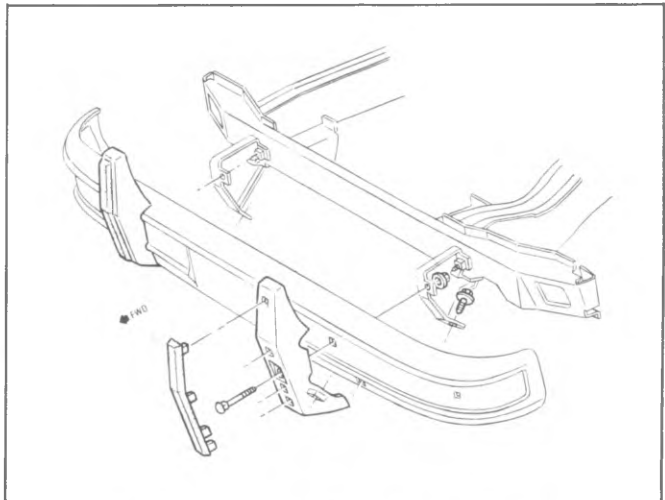


Fig. 2B-6--G-Models Front Bumper Guards

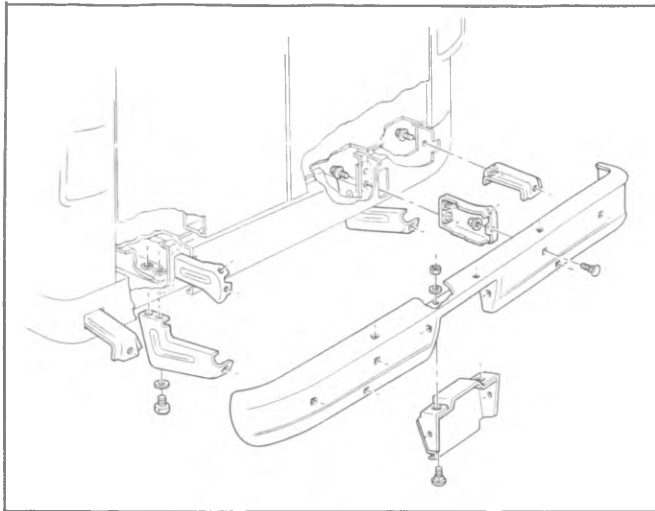


Fig. 2B-7--Rear Bumper-G Models

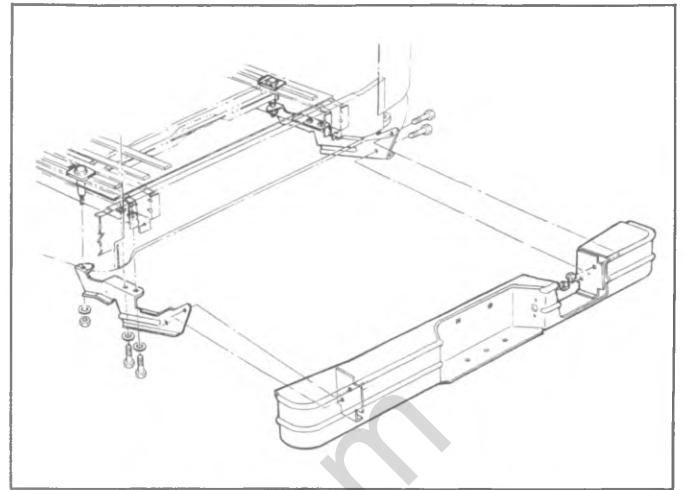


Fig. 2B-8--G-Model Rear Step Bumper

SPECIFICATIONS

TORQUE SPECIFICATIONS C, P AND K

Front Bumper35 ft.-lbs.
Front Bumper Bracket and Brace70 ft.-lbs.
Rear Bumper to Outer Bracket35 ft.-lbs.
Rear Bumper Outer Bracket and Brace50 ft.-lbs.
License Plate Bracket18 ft.-lbs.
Gravel Deflector85 in.-lbs.
Rear Step Bumper to Bracket or Frame40 ft.-lbs.

TORQUE SPECIFICATIONS G

Front Face Bar to Bracket24 ft.-lbs.
Bracket to Cross Sill24 ft.-lbs.
License Plate Bracket to Face Bar100 in.-lbs.
Rear Face Bar to Brackets55 ft.-lbs.
Bracket to Floor55 ft.-lbs.

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SECTION 2C

CHASSIS SHEET METAL

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GENERAL DESCRIPTION

CK Series

The chassis sheet metal assembly is attached to the frame and body at adjustment points. The front of the assembly is supported by two mounts located at the frame side rails. Fore and aft and side adjustment is allowed by oversize holes at the fender rear attaching point and chassis sheet metal mounts. Special shims at the rear locations allow adjustment of the rear of the assembly. The lower rear edge of the assembly is attached to the body at the rocker panel by bolts on each side. Shims are used at this location to provide in and out adjustment at the rear of the fender. The bolts that retain the sheet metal braces must be torqued to

the required torques. If these bolts are loose, the braces will not provide additional support for the sheet metal assembly.

G Series

The front end sheet metal design does not include the radiator support and fenders as loose items inasmuch that these items are welded together as an integral part of the body.

Front end sheet metal includes the hood assembly, hood hinges, hood lock catch and support, a hood rod assembly which supports the hood, a bolted radiator-upper tie bar, and series designation plates and hoods emblems.

ON VEHICLE SERVICE

HOOD ASSEMBLY - CK MODELS

Hood Hinge Spring Replacement

For Hinge Spring Replacement, a tool can be made to dimensions as shown in Figure 2C-1.

1. Raise and safely support the hood in full open position.

2. As shown in Figure 2C-2, engage hooked end of tool to spring, then carefully pull forward to engage or disengage spring from hinge assembly.

Hood Hinge (Fig. 2C-2)

Removal

1. Prop the hood in the extreme open position and place protective covering over the cowl and fenders.

2. Scribe position of hinge attachment on hood rear reinforcement and remove two bolts.

3. Remove hood hinge spring as described above.

4. Scribe position of hinge attachment on fender assembly and remove bolts.

5. Remove hinge.

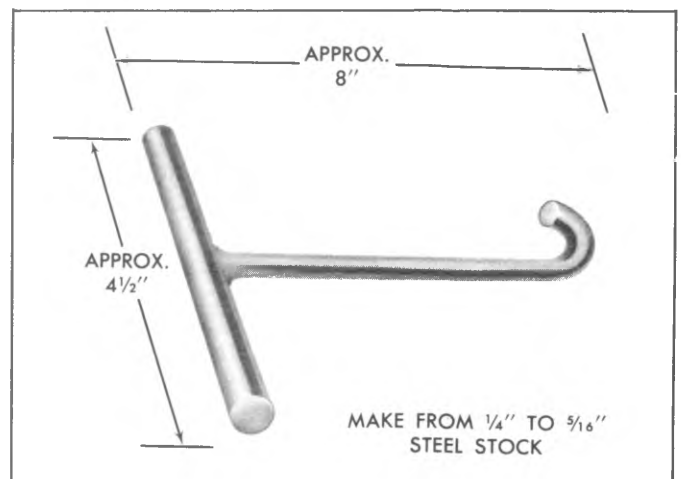


Fig. 2C-1--Hood Hinge Spring Remover/Installer

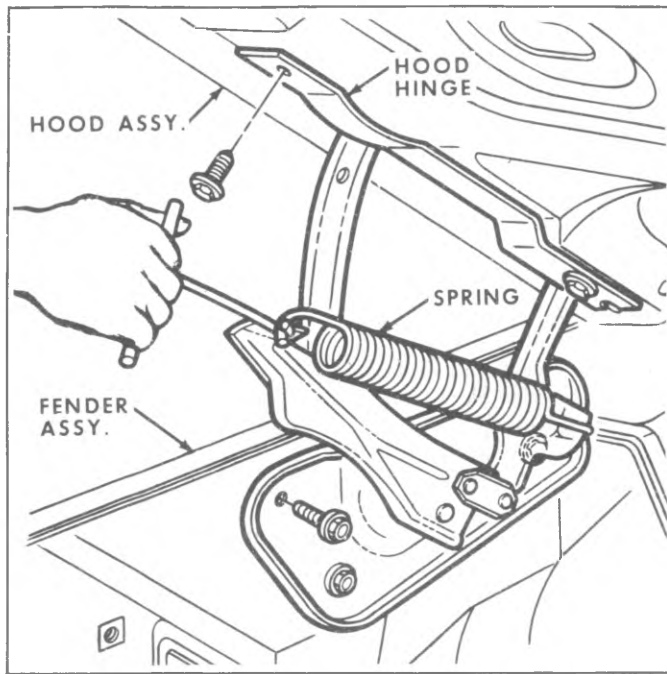


Fig. 2C-2--Hood Hinge and Spring--CK Models

Installation

1. Install hinge assembly to fender and align within scribe marks. Install bolts.
2. Install hood hinge spring.
3. Install bolts and align hood. See Hood Alignment in this section.

Hood Lock Assembly

A bolt-type hood lock is used as shown in Figure 2C-5. The lock bolt, located on the hood dovetails with the mounted striker plate, preventing upward or downward movement of the hood while the vehicle is in motion. Integral with the striker plate is the combination lock release lever and safety catch.

Replacement

1. Open hood and remove the four bolts holding the combination lock support and lock bolt.
- NOTE:** If original hood lock assembly is to be replaced, scribe a line around lock for alignment on installation.
2. Place hood lock assembly in position.
 3. Adjust as outlined under Adjustments.

Adjustment (Fig. 2C-5)

1. Loosen lock nut on lock bolt and adjust lock bolt approximately 2 7/16 inches from bottom of lock bolt to bottom of support.
2. Adjust tightness of support screws so they are just snug enough to hold support in position.
3. Adjust support fore and aft until nubble enters center of elongated guide. Bending nubble to accomplish this adjustment may seriously effect lock operation and safety latch engagement and is, therefore, not recommended.
4. Tighten screws to 140 pound inches.
5. Adjust lock bolt to obtain a secure hood closure and reasonable lock release effort.

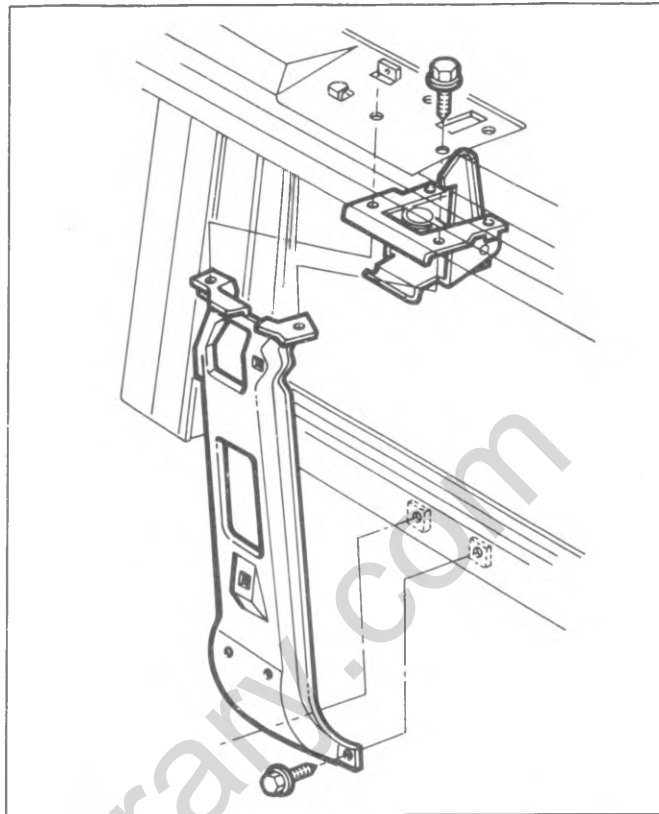


Fig. 2C-3--Hood Lock Catch and Support--CK Models

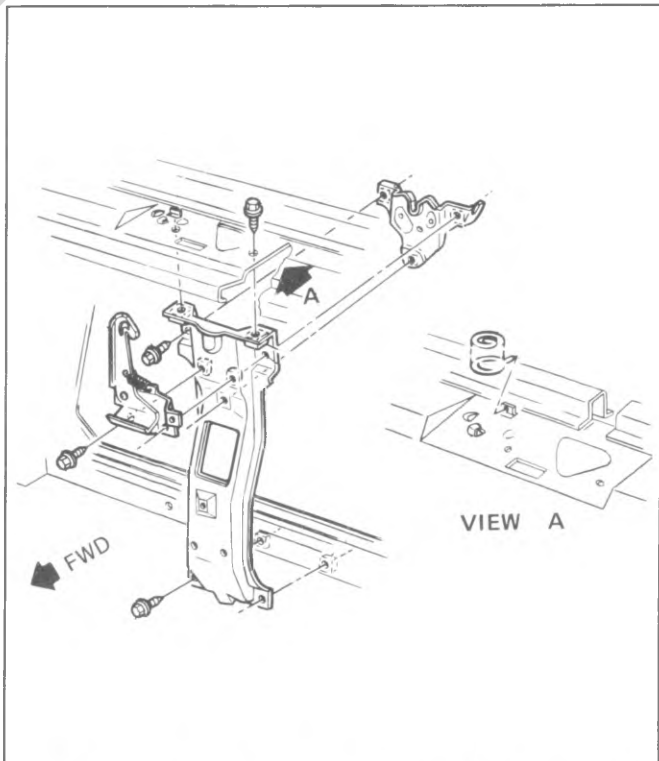


Fig. 2C-4--Hood Lock Catch and Support--CK Models with T-
44

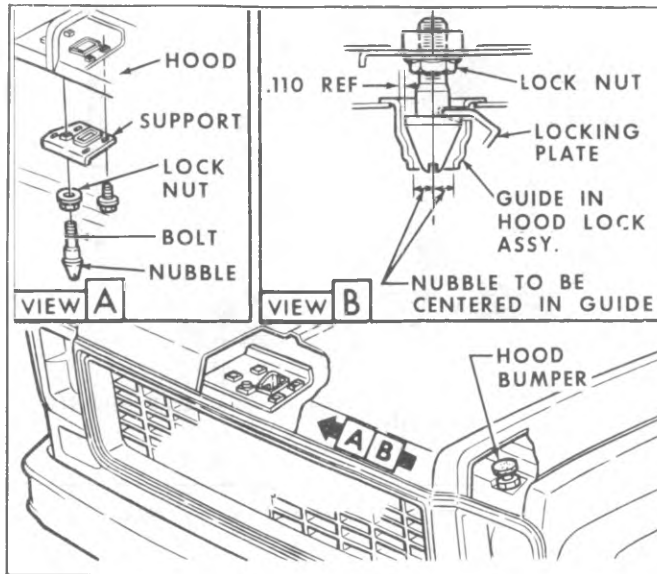


Fig. 2C-5--Hood Lock Bolt and Bumper-CK Models

Hood Bumper Adjustment

Hood Bumpers must be adjusted until hood and fender line up flush at front corner. Adjust hood lock bolt to obtain a minimum load of 45 pounds to a maximum load of 55 pounds on each bumper after hood is firmly slammed.

Hood Assembly

Removal

1. Open hood and prop in full open position.

NOTE: If hood is to be reinstalled and present alignment is satisfactory, mark each hinge in relation to hood, to assure original alignment.

2. Remove two (2) cap screws which attach each hinge to hood; then with a helper remove hood from vehicle.

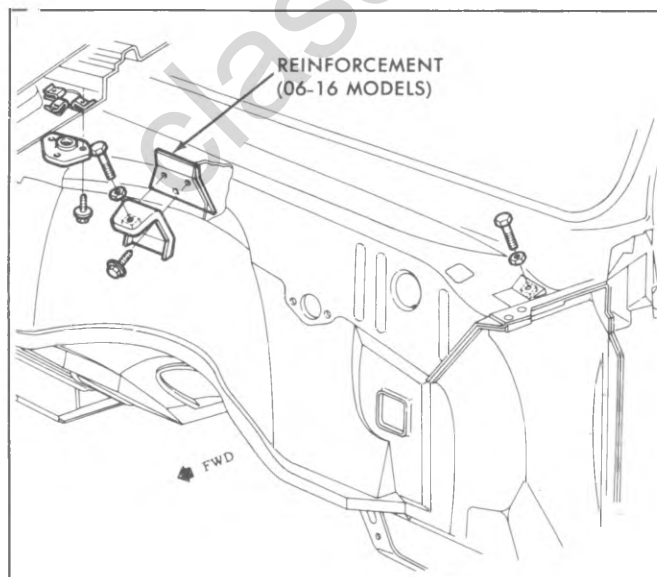


Fig. 2C-6--Hood Stop Bolt CK Models

Installation

1. If original hood is to be installed, position hood to hinges and install four cap screws snug which attach hinges to hood.

NOTE: If a new hood is to be installed, perform procedures as outlined under Alignment, directly below.

2. Shift hood on hinges to location marks made before removal of hood, then tighten attaching cap screws at hinges firmly. Close hood and check fit. If necessary to align hood perform procedure as outlined under "Alignment" which follows.

Alignment

1. Loosen hood hinge bolts. Note that rear most bolt hole in hinge is slotted to allow hood trailing edge to move up and down.

2. Adjust hood rear bumper bolt so that bumper is flush with fender. Nut must be threaded completely onto bolt before torquing to maintain design height.

3. Perform hood lock adjustment as outlined in this section if necessary.

Hood Assembly - G Series

The alignment of the hood is controlled by the position of the hood hinges and the height of the two bumpers located one at each side of the radiator support. The adjustment at the hood lock must be made after the hinges and bumpers are properly adjusted (refer to Hood Lock Adjustment fig. 2C-9). To align the hood and lock proceed as follows:

Hood Hinge (Fig. 2C-7)

Hood Lock Assembly

A bolt-type hood lock is used as shown in Figure 2C-9. The lock bolt, located on the hood, dovetails with the mounted striker plate, preventing upward or downward movement of the hood while the vehicle is in motion. Integral with the striker plate is the combination lock release lever and safety catch.

1. Scribe a line around the entire hinge plate to be repositioned.

2. Loosen the appropriate screws and shift the position of the hood into correct alignment using the scribe marks to check amount of movement. Check alignment by tightening screws and closing the hood.

Replacement

1. Open hood and remove the four bolts holding the combination lock catch and lock bolt.

NOTE: If original hood lock assembly is to be replaced, scribe a line around lock for alignment on installation.

2. Place hood lock assembly in position.
3. Adjust as outlined under Adjustments.

Adjustment

CAUTION: Hood lock assembly to be adjusted fore and aft until hood lock bolt enters center of elongated guide. Bending bolt to accomplish this adjustment may seriously effect lock operation and safety catch engagement and is, therefore not recommended.

1. Adjust lock bolt as shown in Figure 2C-9.
2. Open hood and adjust tightness of catch assembly

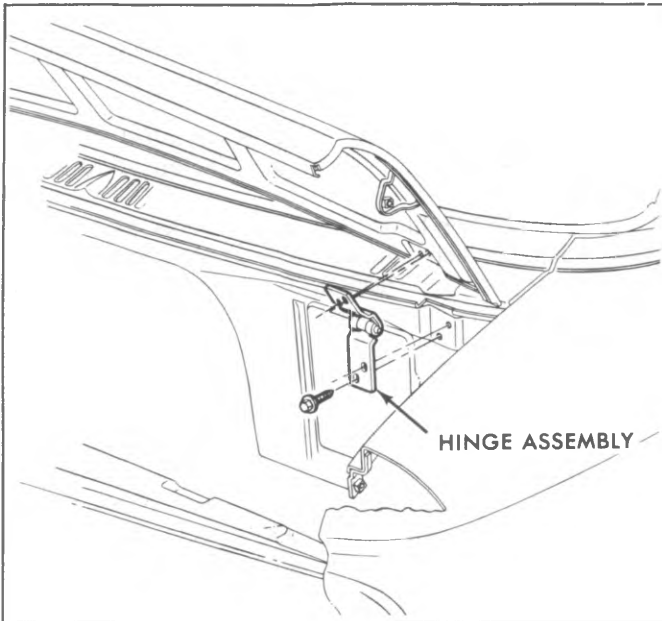


Fig. 2C-7--Hood Hinge-G Model

so that it is just "snug" enough to hold lock bolt in position.

3. Close hood in a normal manner.

4. Raise hood again; lock bolt assembly will have shifted to operating position. Tighten bolts fully. Further adjustment may be made at lock bolt support, if necessary.

5. Adjust lock bolt to obtain a secure hood closure and reasonable lock release effort.

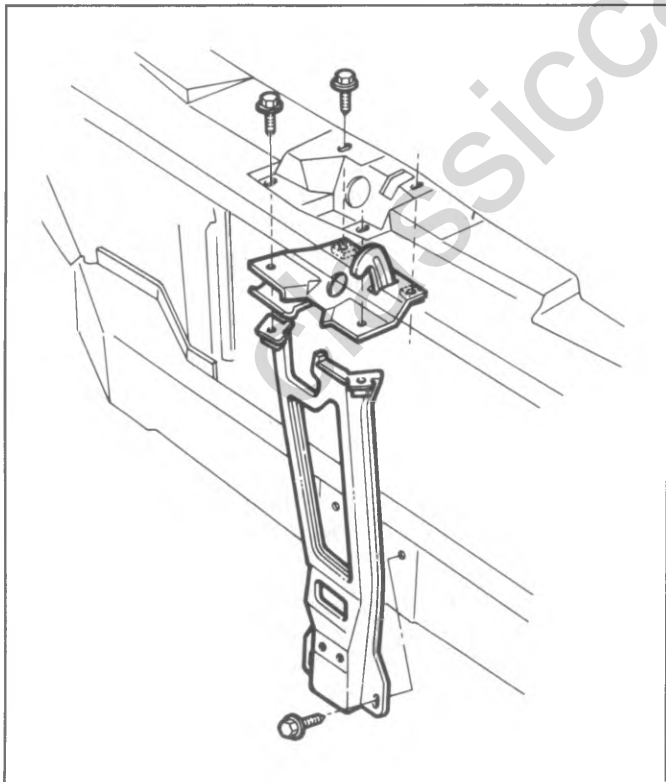


Fig. 2C-8--Hood Lock Catch Assembly-G Model

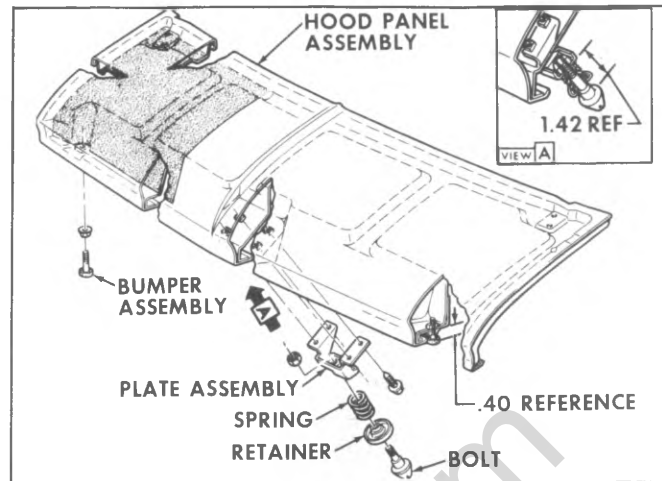


Fig. 2C-9--Hood, Bumpers and Latch-G Model

HOOD LATCH CABLE RELEASE - CK MODELS (FIG. 2C-10)

Replacement

1. Release the hood from below, using a suitable rod, by pressing on the hood release tab at the right side of the lock assembly.

2. Remove the cable at the lock assembly.

3. Remove hood release handle to kickpad attaching screws.

4. Remove hood release cable.

5. To install, reverse steps 2 through 4 above.

HOOD EMBLEM - CK MODELS (FIG. 2C-11)

Hood Bumper

Adjust hood bumpers so that hood top surface is flush with the fender and grille top surfaces. Refer to Figure 13 for correct sheet metal adjustment dimensions.

Hood Assembly-G Model (Fig. 2C-9)

Removal

1. Lay a fender cover along cowl top to prevent hood from scratching painted surfaces.

2. Open hood and prop in full open position.

NOTE: If hood is to be reinstalled and present alignment is satisfactory, mark each hinge in relation to hood, to assure original alignment.

3. Remove two cap screws which attach each hinge to hood; (Fig. 2C-7) then with a helper remove hood from vehicle.

Installation

1. If original hood is to be installed, position hood to hinges with helper and install four cap screws snug which attach hinges to hood.

2. Install rod assembly.

NOTE: If a new hood is to be installed, perform procedures as outlined under Alignment, directly below.

3. Shift hood on hinges to location marks made before removal of hood, then tighten attaching cap screws at hinges firmly. Close hood and check fit. If necessary to align hood perform procedure as outlined under "Alignment" which follows.

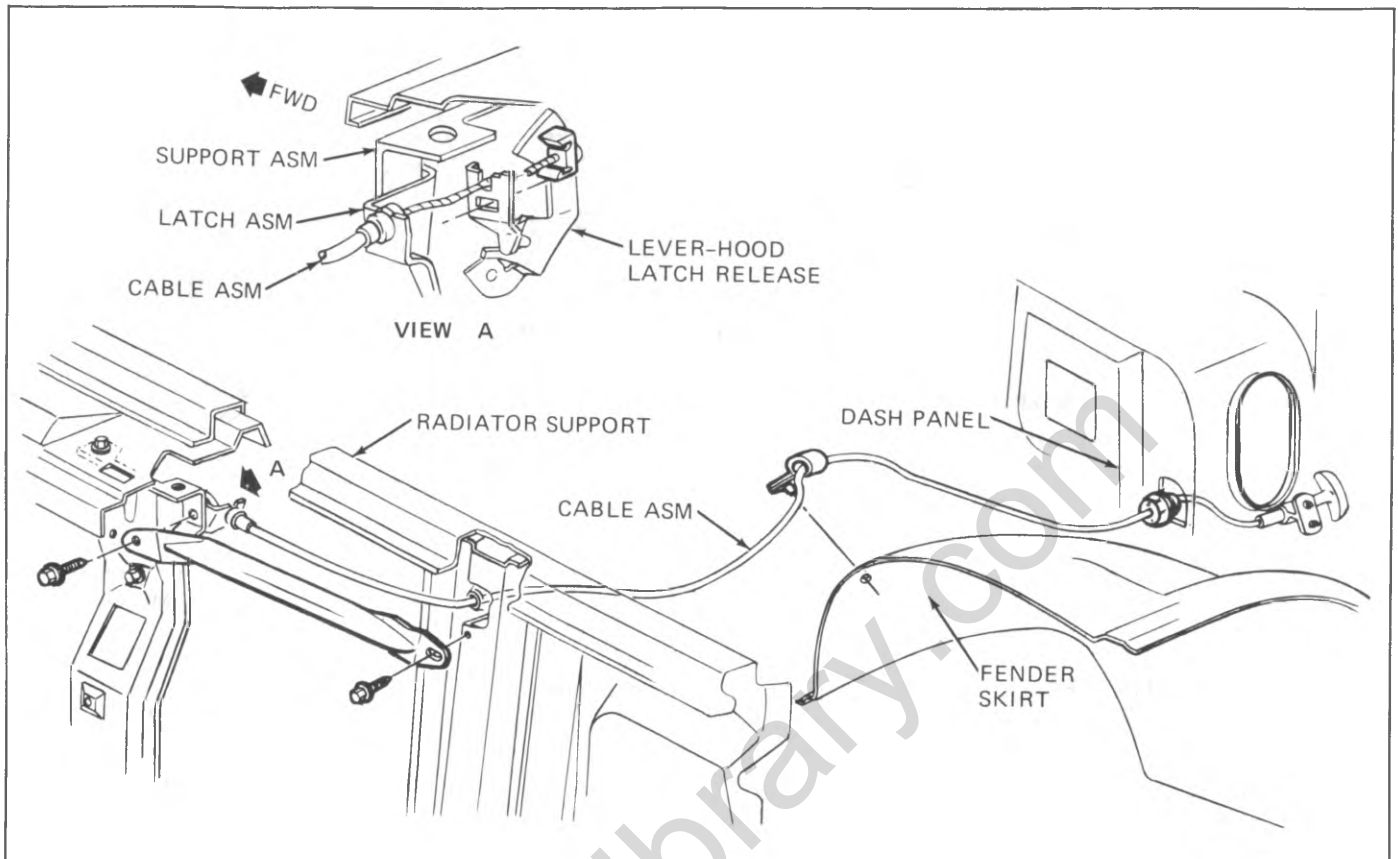


Fig. 2C-10--Hood Release Cable - CK Models

Alignment

1. Loosen hood hinge bolts. Note that rear bolt holes in hinge is slotted to allow hood trailing edge to move up and down.
2. Adjust hood bumpers so that hood and adjacent surfaces are flush.
3. Perform hood lock adjustment as outlined in this section if necessary.

NOTE: Hood Lock Assembly to be adjusted fore and aft until nubble (part of Hood Lock Bolt Support Assembly) enters center of elongated guide (Socket). Bending nubble to accomplish this adjustment may seriously effect lock operation and safety catch engagement and is, therefore, **NOT RECOMMENDED.**

Hood Rod Support - G-Model

Refer to Fig. 2C-12 for removal and installation of hood rod support.

CARBURETOR OUTSIDE AIR INLET

SNORKELS (Fig. 2C-13)

Removal

1. Raise hood and remove carburetor air duct from air snorkel by sliding duct rearward.
2. Remove two (2) screws attaching air snorkel to radiator support and remove from vehicle.

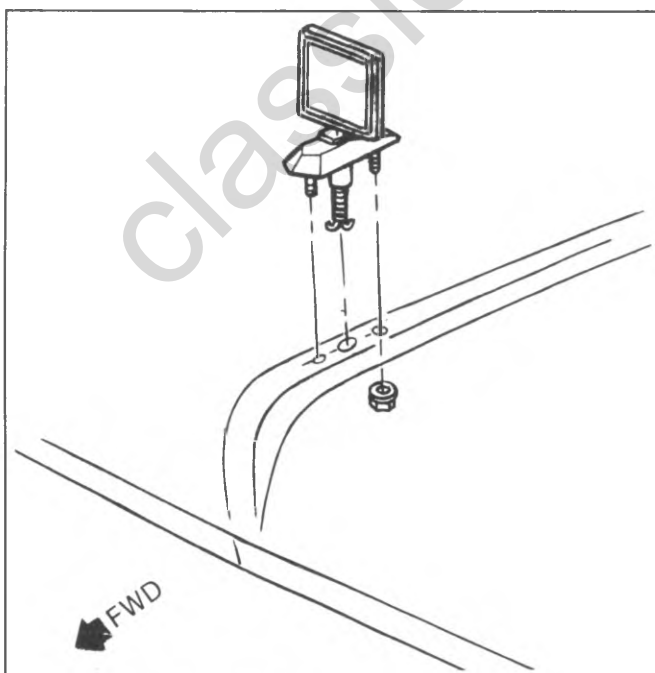


Fig. 2C-11--Hood Emblem - CK Models

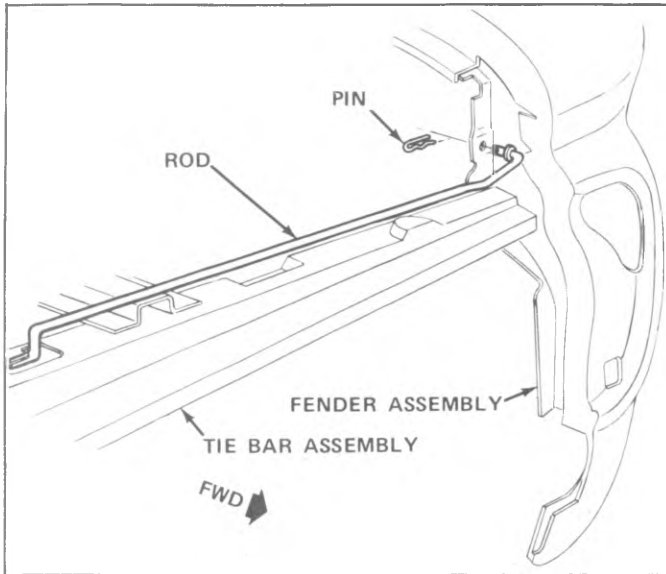


Fig. 2C-12--Hood Rod Support - G-Model

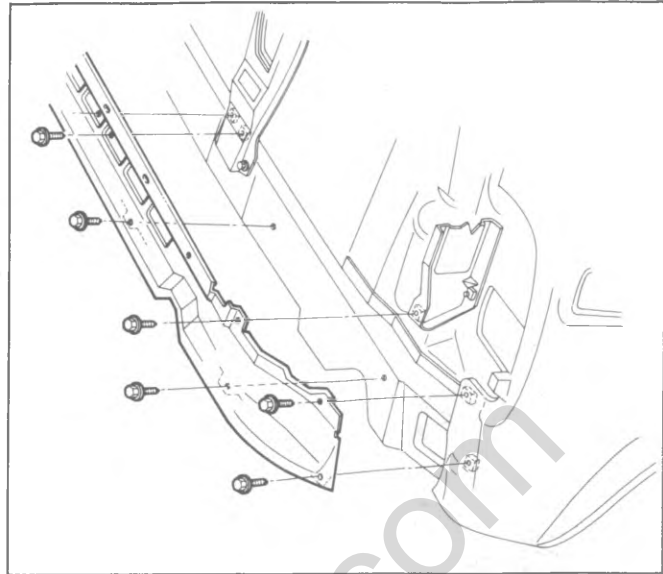


Fig. 2C-14--Lower Radiator Grille - G Models

LOWER RADIATOR GRILLE - G MODEL (FIG. 2C-14)

RADIATOR GRILLE AND BRACKETS CK, G-MODELS (FIG. 2C-15)

RADIATOR GRILLE MOLDING - CK, G MODELS (FIG. 2C-16)

FRONT SHEET METAL ASSEMBLY-CK SERIES

Removal of entire front sheet metal assembly including radiator involves disassembly of mounts, disconnecting radiator hoses and removal of front bumper. Vehicles equipped with air conditioning and/or power steering will require special handling.

Refer to appropriate sections of this manual for instructions.

Shims which are found at various locations should be recorded to ease installation of sheet metal assembly.

Refer to Figure 2C-17 for sheet metal clearance.

Removal

1. Drain radiator and remove radiator hoses. Disconnect oil cooler lines if so equipped.
2. Disconnect wire connectors at the dash and toe panel and wire connector to horn and voltage regulator.
3. Disconnect battery and generator wires.
4. Remove front bumper bolts and remove bumper.

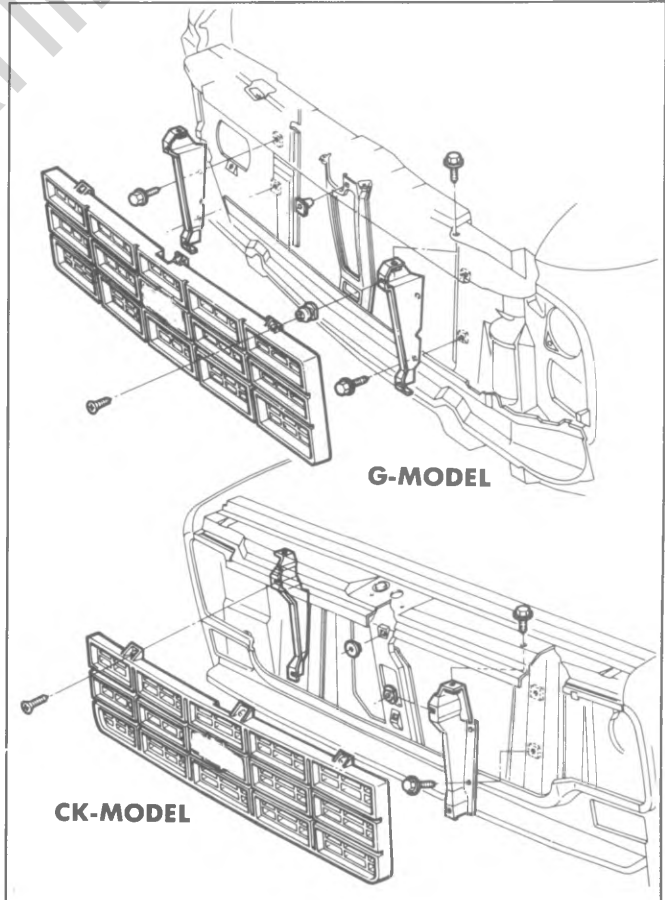


Fig. 2C-15--Radiator and Grille Brackets

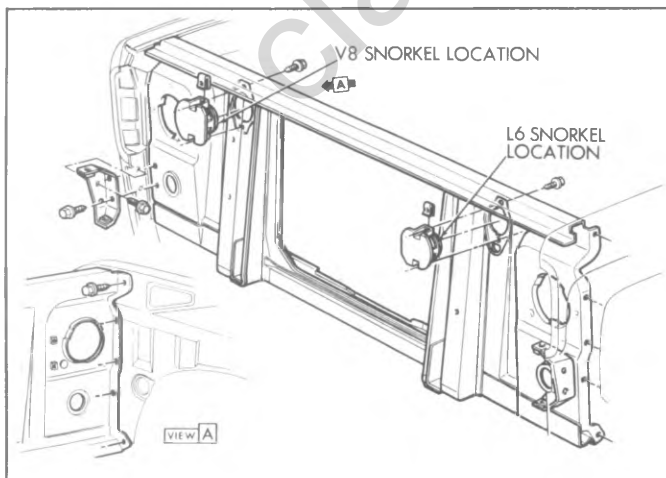


Fig. 2C-13--Carburetor Outside Air Inlet Snorkels--CK Model

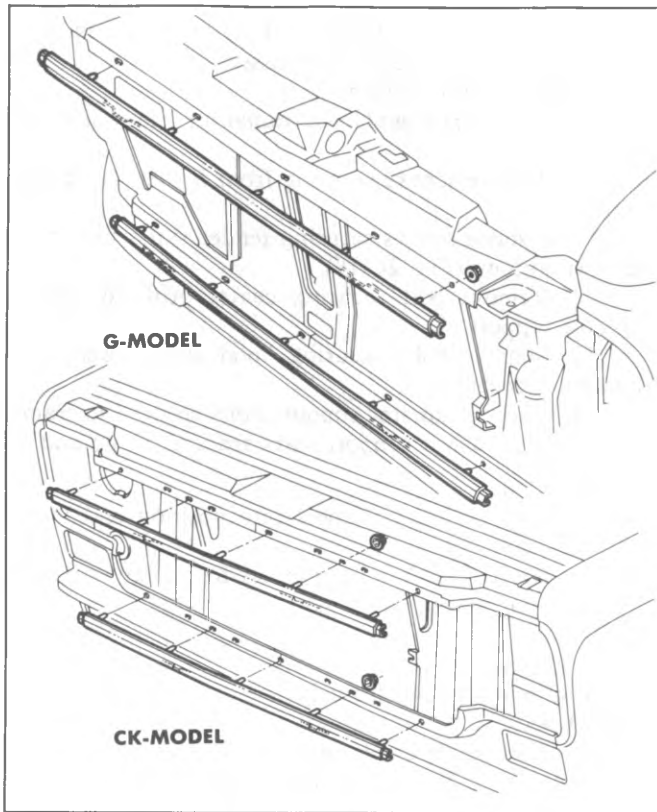


Fig. 2C-16--Radiator Grille Moldings - CK, G Models

5. Remove bolts attaching fender upper edge to cowl door frame.
6. Remove fan shroud.
7. Working from underneath rear of fender, remove attachment from each fender at the hinge pillar.
8. Remove bolt from each radiator support mounting.
9. Remove bolts at each fender skirt to cab underbody (fig. 2C-18).
10. With a helper, remove front sheet metal assembly, with radiator, battery, horn and voltage regulator attached.

Installation

1. With a helper place sheet metal assembly in position. **NOTE:** Install all bolts loosely to facilitate aligning after complete installation.
2. Install fender bolts at cowl.
3. Install combination bolt and flat washer assembly into each fender reinforcement while inserting shims required between fender reinforcement and body (See Figure 2C-19).
4. Install two bolts and shims required at each fender rear lower edge to hinge pillar.
5. Install bolt in each fender skirt to underbody.
6. Install bolts at steering column skirt reinforcement, final torque 25 ft. lbs.
7. Tighten each radiator support mounting bolt 33 ft. lbs.
8. Torque bolts at fender to cowl 25 ft. lbs.
9. Install front bumper.
10. Connect wire connectors at dash and toe panel. Attach generator and regulator wires.
11. Connect upper and lower radiator hoses. Connect oil cooler lines to the radiator on models so equipped.

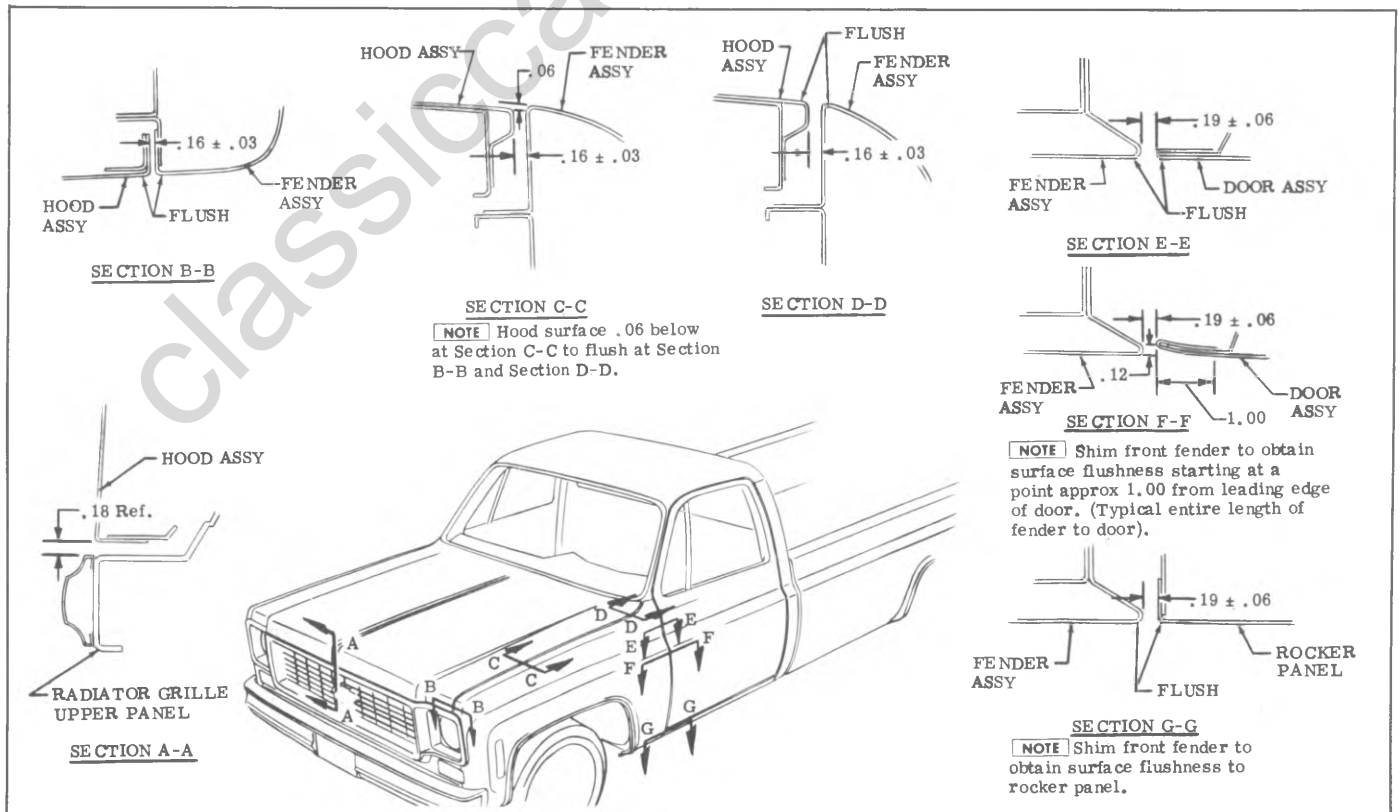


Fig. 2C-17--Sheet Metal Clearance-CK Model

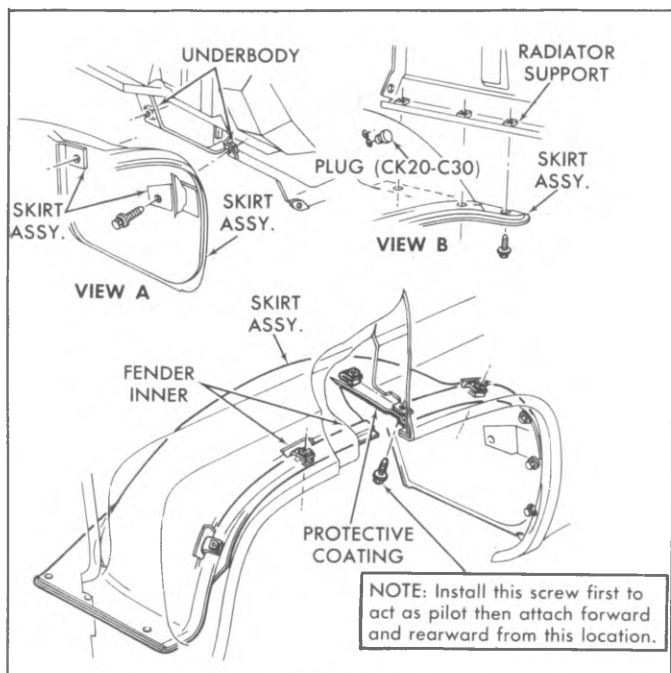


Fig. 2C-18--Fender Skirt Assembly--CK Model

12. Connect battery and fill radiator. Start engine and check for leaks.

Radiator Support

Removal

1. Remove hood as described in this section.
2. Drain radiator, saving coolant, loosen attachments and remove radiator and coolant recovery tank.
3. Disconnect and remove battery.
4. Remove battery tray with battery hanger.
5. Remove wiring from radiator support.

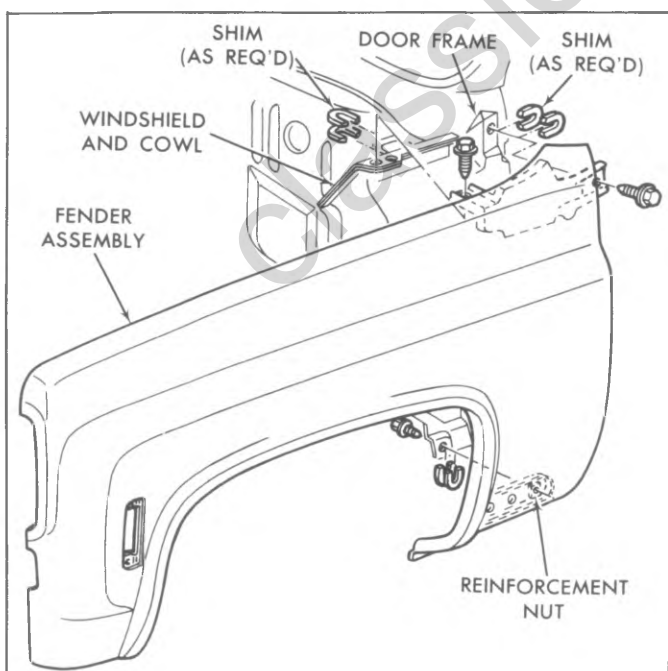


Fig. 2C-19--Front Fender Assembly--CK Model

6. Disconnect fan shroud and lay back on engine.
7. Remove both head lamp assemblies.
8. Remove grille assembly.
9. Remove upper and lower radiator grille panels. (Fig. 2C-20).
10. Remove screws securing front fenders to radiator support.
11. Remove screws securing fender skirts to radiator support bottom. (Fig. 2C-18).
12. Remove bolt securing center grille support to radiator support.
13. Remove bolts securing hood catch assembly to radiator support.
14. Remove radiator support bolts secured to frame.
15. Tilt radiator support rearward and lift up and off.

Installation

1. Rotate radiator support into position and loosely install attachments to frame.
2. Connect center grille support to radiator support.
3. Connect hood latch plate.
4. Connect radiator support brackets to fenders.
5. Connect support to fenders.
6. Connect screws from underside of fender skirts to support bottom.
7. Attach grille upper panel to fenders loosely.
8. Attach grille lower panel to fenders.
9. Tighten radiator support bolts.
10. Place battery tray in position and fasten to radiator support.
11. Install radiator coolant recovery tank hoses and shroud.
12. Connect removed wiring to radiator support.
13. Install both head lamp assemblies.
14. Tighten all previously installed bolts and screws.
15. Install battery and connect leads and wires.
16. Install grille assembly.
17. Fill radiator with coolant as specified in Section 13.
18. Install hood on previously marked outline.

FRONT FENDER (FIG. 2C-19)

Removal

1. Remove hood and hinge assembly.
2. Remove head lamp bezel, wiring and attachments from fender.
3. Remove screws attaching upper and lower radiator grille panels.
4. Remove screws attaching fender wheel opening flange to skirt.
5. Remove skirt to fender bolts, located inboard on underside of skirt.
6. Remove two (2) screws attaching support bracket to fender.
7. Remove five (5) screws attaching radiator support to front fender.
8. Remove bolt and shim attaching trailing edge of fender to hinge pillar.
9. Remove two bolts and shims at top rear of fender attaching to cowl.

Installation

To install, reverse the removal procedure using sealing tape between filler panel and fender. Check sheet metal alignment.

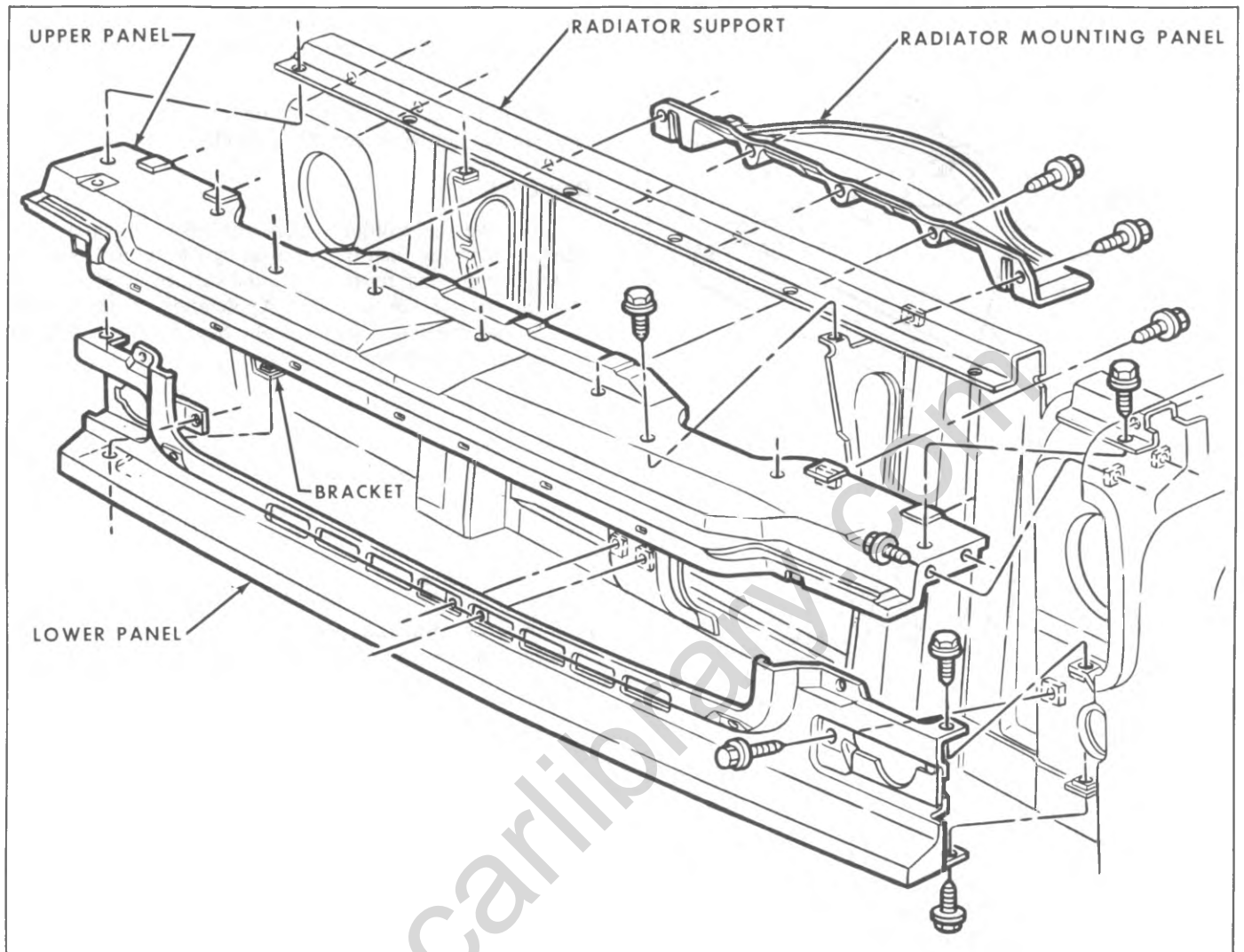


Fig. 2C-20--Radiator Upper and Lower Grille Panels--CK Models

FRONT FENDER AND SKIRT (FIGS. 2C-18 AND 2C-19)

Removal

1. Remove hood and hood hinge assembly.
2. Disconnect and remove battery (right side or auxiliary left side).
3. Remove head lamp bezel, wiring and attachments from fender.
4. Remove screws attaching upper and lower radiator grille panels.
5. Remove screws attaching skirt to radiator support.
6. Remove two (2) top rear fender bolts and shims.
7. Remove bolt and shims at bottom of fender.
8. Remove bolt and shim(s) attaching skirt to underbody.
9. Remove two (2) screw attaching support bracket to fender.
10. Remove five (5) screws attaching radiator support to front fender.
11. Lift fender and skirt from truck.

Installation

Install front fender and skirt assembly in reverse order of removal.

RUNNING BOARDS

Refer to figure 2C-21 for removal and installation of running boards.

SHEET METAL CHECKING--G-MODEL

Refer to the sheet metal checking illustration figure 2C-22 for proper gaps and hood adjustments.

Fender Skirt - P Model

Refer to figure 2C-23 for removal and installation of fender skirt, brackets, rear supports and hangers.

WOOD GRAIN APPLIQUE

INSTALLATION PROCEDURE

General

The wood grain applique (transfer film) is a vinyl material with a pressure sensitive adhesive backing. The transfers are serviced in pre-cut panels. The transfers are designed with an appealing wood grain pattern and a 50 degree or semi-gloss finish.

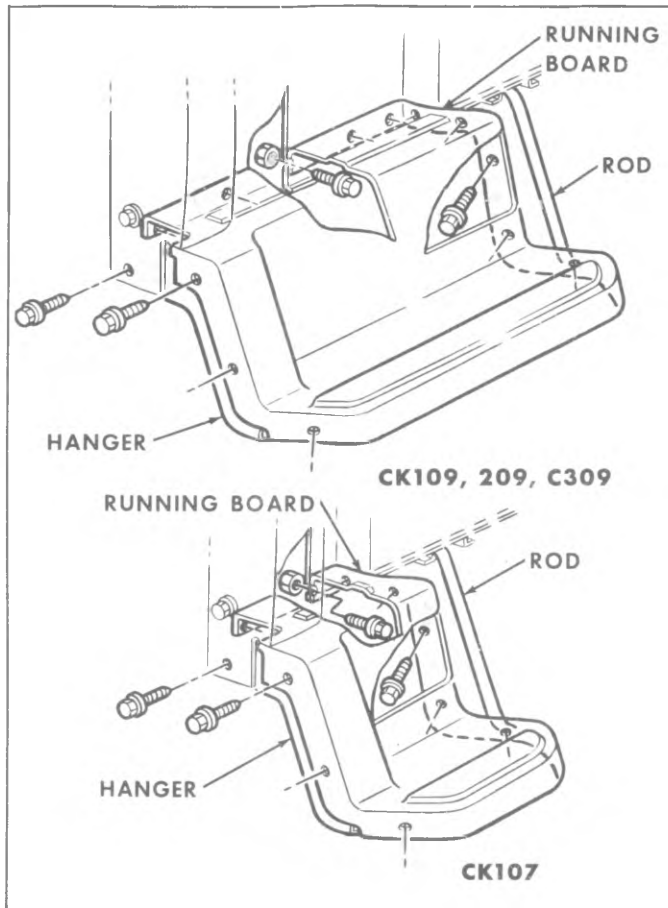


Fig. 2C-21--Running Boards--CK Models

Preparation of the surface to which the transfer will be applied is very important. In cases where body metal repair has been made it is necessary to prime and color coat these areas to blend with the undamaged surface. Apply the transfer film to color coated panels only, never to bare metal or primer.

The surface must be free of any imperfections that might high-light through the film. Remove dirt nibs and other foreign material in the paint by light sanding with 600 grit sandpaper.

The temperature of the body must be maintained at a moderate level between approximately 70 and 90°F (21 and 32°C). Too warm a body will cause the wood grain film to stick prematurely while too cool a body will reduce the adhesion of the wood grain film. Cool the body panel with cool water when too warm and heat the body panel with a heat gun or a heat lamp when too cold.

Transfers should not be replaced in temperatures below 65 degrees Fahrenheit (18°C). The transfer should not be

subjected to temperature greater than 175°F (79°C) and should not be left at or near this temperature for extended periods of time.

Shelf life of the transfer material is 90 days at a temperature not to exceed 105°F (40°C).

Removal

Remove the moldings from the affected panel. The transfer film may then be removed by lifting an edge and peeling the material from the painted surface. Exercise care so as not to damage the paint. Application of heat to the transfer and the panel by means of a heat gun or heat lamp will aid in the removal.

Installation

1. With a solvent dampened sponge, clean entire surface to be covered with applique.
2. Wipe area dry with a clean cloth.
3. Prior to application of transfer, wet down the complete transfer surface of the fender with a solution of 1/4 oz. of neutral detergent cleaner (must not contain oils, perfumes, or bleaches) per gallon of clear water. It is essential that no substitute for this solution be used and that the specified proportions be maintained.
4. While entire area is still wet with solution, remove paper backing from transfer and align upper edge with pierced holes in fender and press on lightly.
5. Start at center of transfer and squeeze outboard from middle to edges removing all air bubbles and wetting solution to assure a satisfactory bond. Use teflon-backed plastic squeegee only.
6. Notch applique at fender rear contour bend areas with scissors. Also notch out front marker lamp.
7. Fold ends of applique over fender flanges using squeegee. Heat the wrap-around area of applique with a heat lamp or gun to approximately 90°F (32°C) and press with squeegee to secure entire edge surface.
8. If the wrap-around of the transfer has trouble sticking to fender edges, brush vinyl adhesive onto the fender or transfer area. Allow the adhesive to set for one minute then press transfer to fender for adhesion.
9. Inspect transfer installation from critical angle using adequate light reflection to detect any irregularities that may have developed during installation. Remove all air or moisture bubbles by piercing each at an acute angle with a fine pin or needle and by pressing the bubble down.
10. Install previously removed parts and clean up vehicle as required.

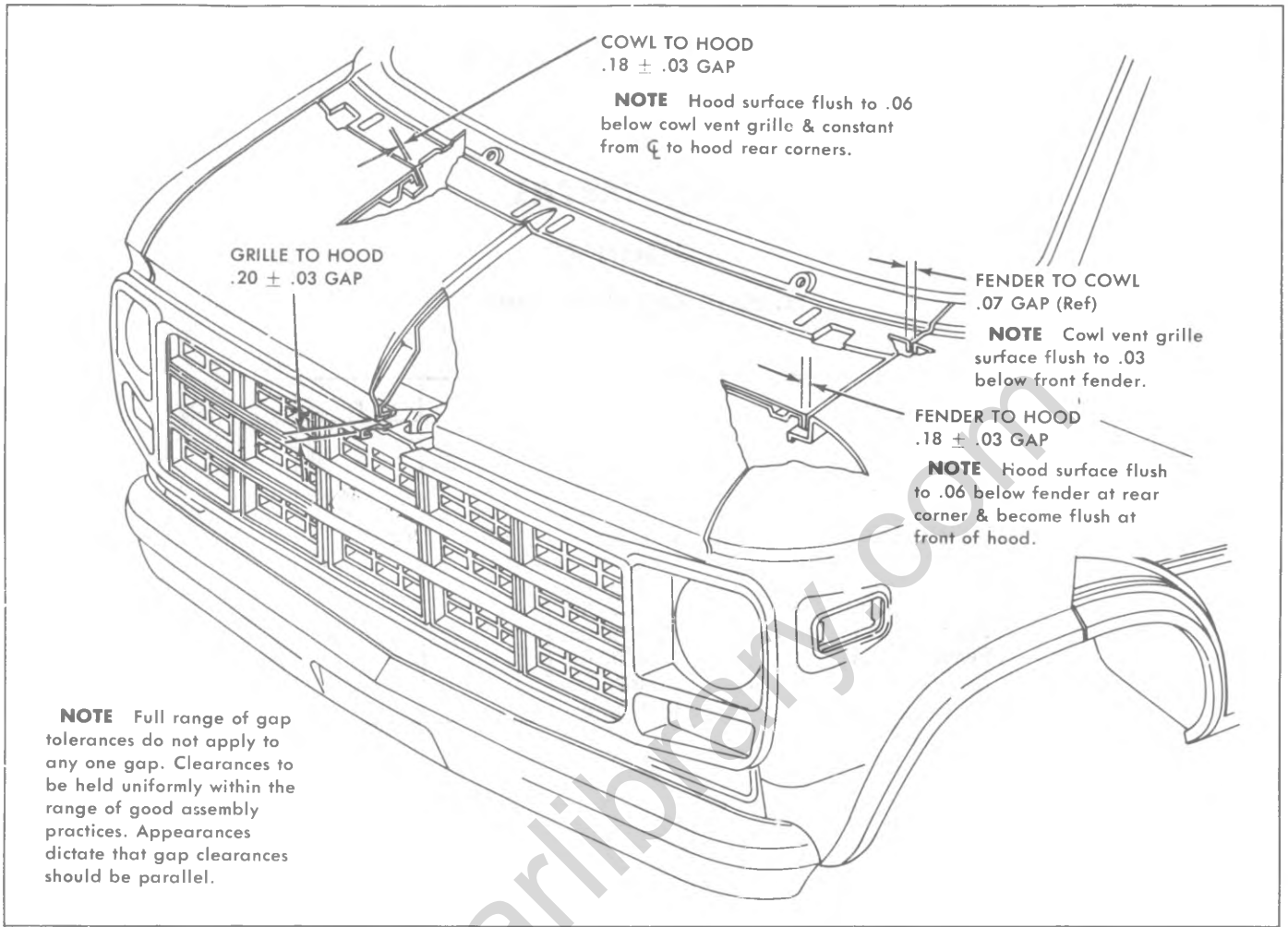


Fig. 2C-22--Front End Sheet Metal Checking--G Model

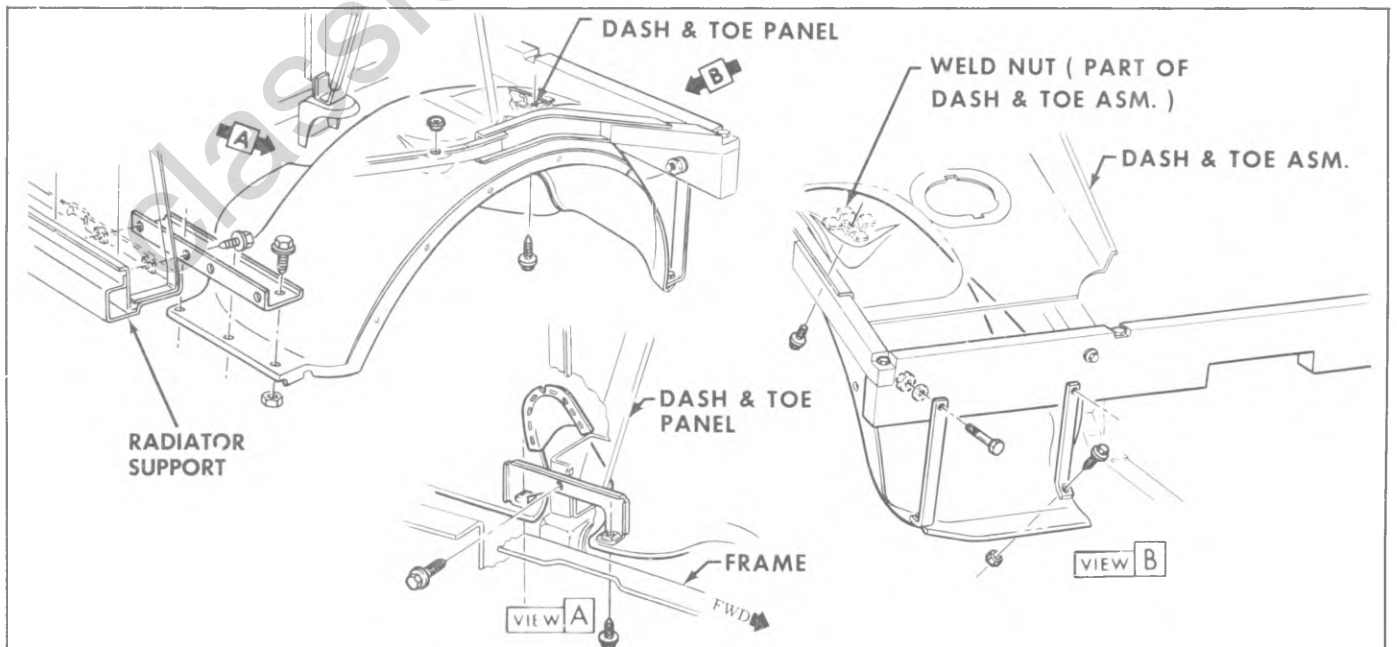


Fig. 2C-23--Fender Skirt, Dash and Toe Pan--P Series

SPECIFICATIONS

SHEET METAL

SECTION 2C

TORQUE SPECIFICATIONS

	CK	G	P
Lock Support to Hood	150 in. lbs.	150 in. lbs.	
Lock Bolt Nut	30 ft. lbs.	40 ft. lbs.	
Bumper Bolt Nut	85 in. lbs.	150 in. lbs.	
Hood Hinge	35 ft. lbs.	18 ft. lbs.	
Hood Lock Catch	150 in. lbs.	18 ft. lbs.	
Lock Support to Rad. Support	150 in. lbs.	18 ft. lbs.	
Rad. Support to Frame	35 ft. lbs.		30 ft. lbs.
Rad. Support to Fender	150 in. lbs.		
Fender Skirt to Fender	150 in. lbs.		150 in. lbs.
Fender to Cowl	35 ft. lbs.		
Rad. Grille Panel Upper	150 in. lbs.		
Rad. Grille Panel Lower	150 in. lbs.		

SECTION 2D

CAB AND BODY

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 1 of this Section".

CAUTION: *THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR OF SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART*

CONTENTS OF THIS SECTION

General Description.....	2D-1
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G Models.....	2D-2
On Vehicle Service.....	2D-4
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GENERAL DESCRIPTION

On the following pages, service procedures will be given for components on all 10-20-30 series trucks in C, K and G models. Reference will be made, both in text and illustrations, to vehicle model lines and to individual model numbers within these model lines.

As an aid to identification of specific models, the following general descriptions are given.

Chassis/Cabs

All chassis cabs use "03" as the model identification. See figure 2D-1. Two-wheel drive units come in C10, C-20 and C-30 series. Four-wheel drive units may be either K-10 or K-20. Optional pickup boxes are available.

Crew Cab/Chassis

Model number "63" designates the crew cab/chassis models. See figure 2D-2. Optional pickup boxes are available.

Coach

The four-door coach model number is "06". See figure 2D-3. Base models have rear cargo doors. An optional endgate with moveable window is available.

Utility

Utility models are designated with the number "16". See figure 2D-4. An optional removable roof is also available.

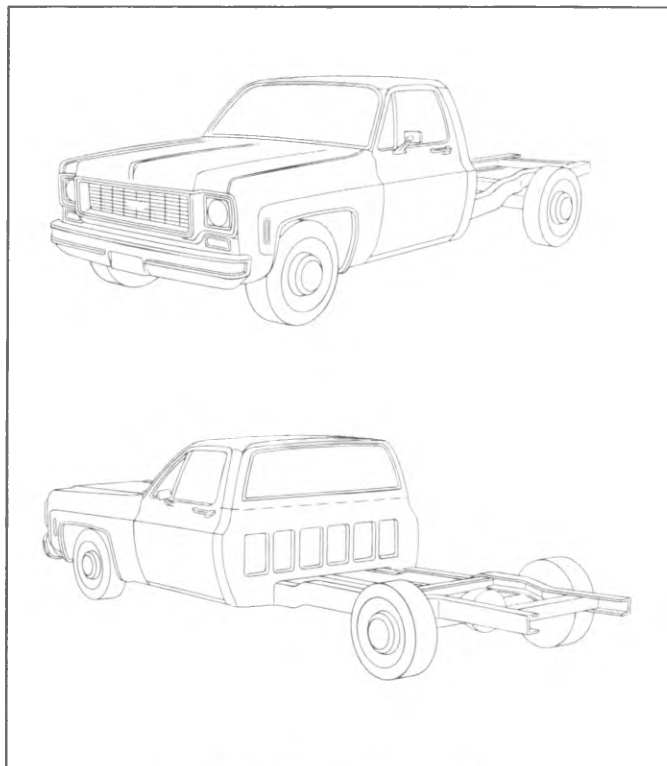


Fig. 2D-1--Typical Chassis/Cab

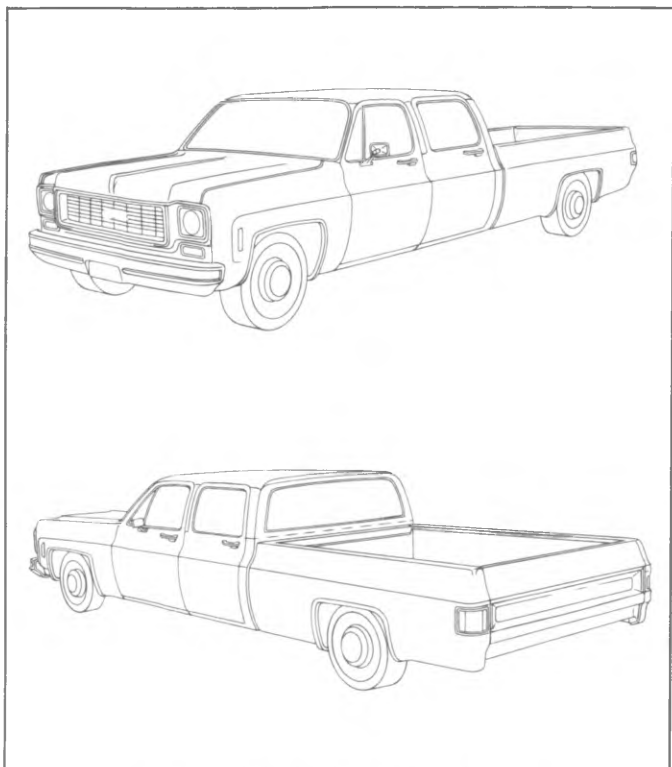


Fig. 2D-2--Typical Crew Cab/Chassis



Fig. 2D-4--Typical Utility Vehicle



Fig. 2D-3--Typical Coach

Vans

G-Series Vans are available in three model number designations. See figures 2D-5 and 2D-6. Vans without body windows use number "05"; vans with body windows are "06" models; "03" vans have an open cargo area, as shown in figure 2D-6.

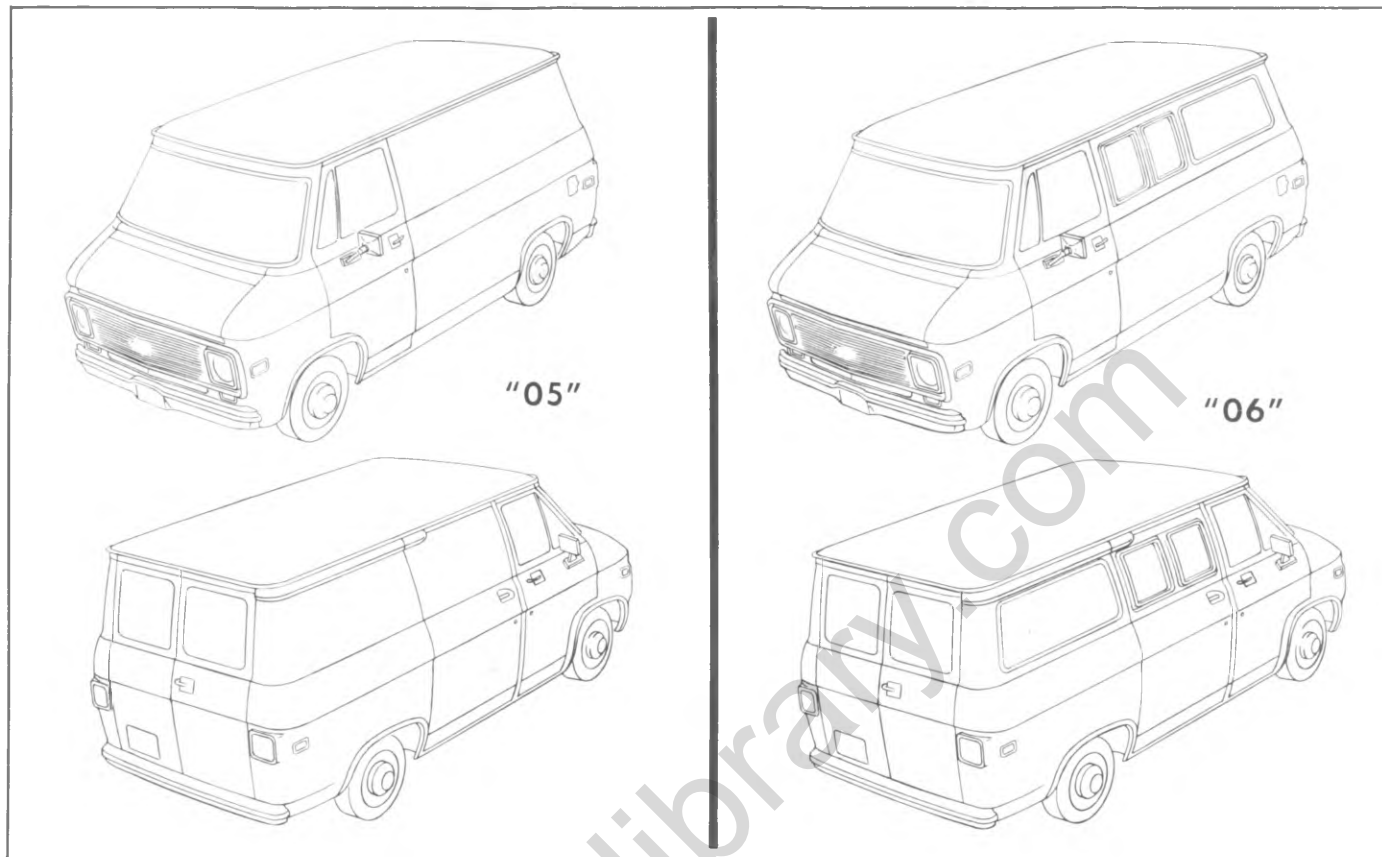


Fig. 2D-5--Typical "05" and "06" Vans

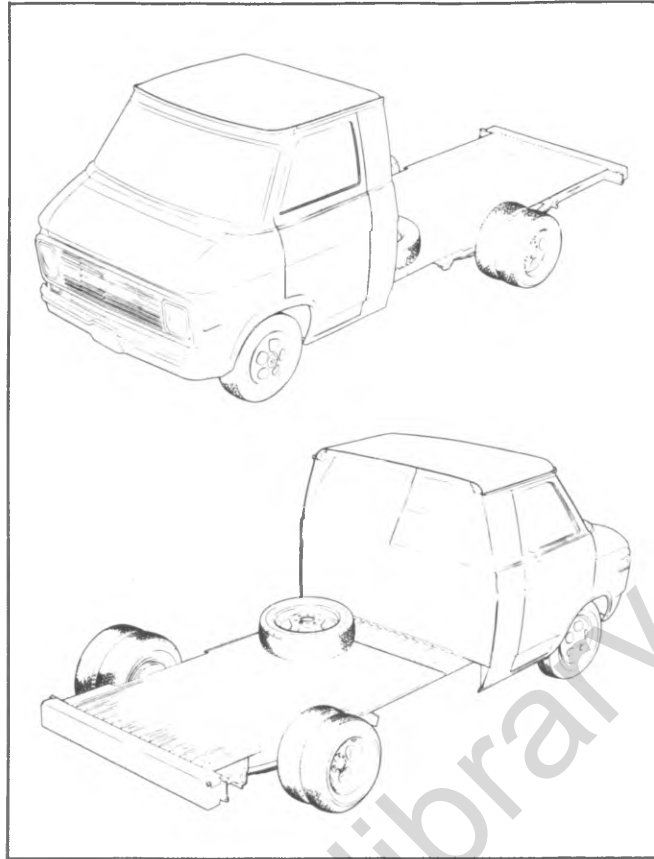


Fig. 2D-6--Typical "03" Van

ON VEHICLE SERVICE C-K MODELS

INDEX

Front End		Replacement	2D-16
Windshield Wipers.....	2D-5	Hinges.....	2D-16
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Body Glass		Locks, Handles, Rods.....	2D-18
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Side Doors		Adjustments.....	2D-19
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Hinges.....	2D-11	Endgates	2D-21
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FRONT END

WINDSHIELD WIPERS

Windshield wiper units on all models are of the two-speed electric type. A single wiper motor unit, mounted to the left side of the dash panel inside the engine compartment, powers both wiper blades. The wiper blade operating link rods and pivot mountings on these models are located in the outside air inlet plenum chamber.

Arm Adjustment

To adjust sweep of blades, turn on wipers and note sweep of arms. If necessary, remove one or both arms as follows: Pull outer end of arm away from glass which will trip lock spring at base of arm and release spring from undercut of pivot shaft. While holding arm in this position, pull outward on cap section at base of arm to remove arm. Arm can be reinstalled in any one of several positions due to serrations on pivot shaft and in arm cap. See figure 2D-7.

Wiper Arm Pivot Shafts and Linkage

Removal

1. Remove windshield wiper arms from pivot shafts. Procedure for removing arms is explained previously under "Arm Adjustment".

2. Remove two nut and lock washer assemblies from the connector link to motor drive arm via the plenum access hole.

3. Remove two screws from each transmission pivot shaft assembly to windshield frame. Remove wiper linkage and transmission from plenum.

Installation

1. Place wiper linkage and transmission into position. Secure assembly with two screws at each transmission.

2. Attach end of cross rod to drive arm of motor assembly. Secure rod.

3. Before installing wiper arms, operate wiper motor momentarily which should rotate pivot shafts to park position. Install arms and shafts.

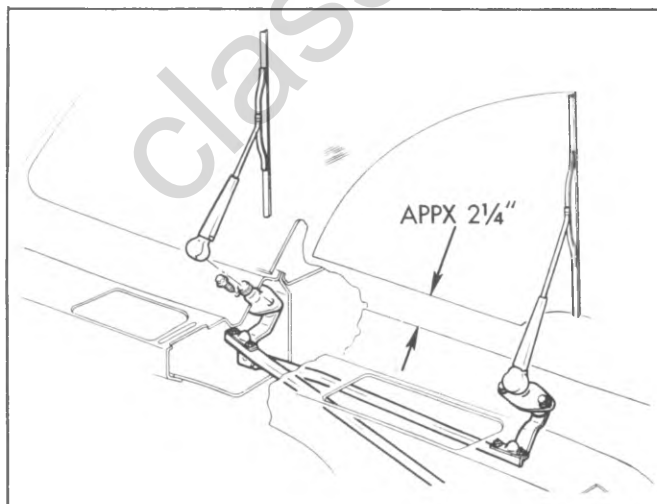


Fig. 2D-7--Windshield Wipers

INSTRUMENT PANEL COMPARTMENT AND LOCK

Replacement

Removal of the entire assembly including door may be accomplished by removing four screws which attach hinge just below box. See figure 2D-8. The outer door panel may be removed, leaving the compartment intact, by removal of four screws. Access to the door stop bumper is gained by reaching into compartment opening with door partially open.

Adjustment

Engagement of lock in striker may be adjusted by loosening striker retaining screws and moving the striker to desired position.

OUTSIDE REAR VIEW MIRRORS

Rear view mirror installations are shown in figure 2D-9, 2D-10 and 2D-11. Occasional tightening of mounting and assembly bolts and screws will sharply decrease occurrence of failure due to door slamming or road shock.

NOTE: Camper mirror installation is similar to the below eyeline mirror installation.

INSIDE REAR VIEW MIRROR - FIGURE 2D-11

Replacement

1. Remove screw retaining mirror to its glass-mounted bracket and remove mirror.

2. Install mirror into its mounting bracket. Torque screw to specifications.

COWL VENT VALVE - FIGURE 2D-12

Two styles are shown in Figure 2D-12. Removing the attaching screws allows removal of the valve from the side panels.

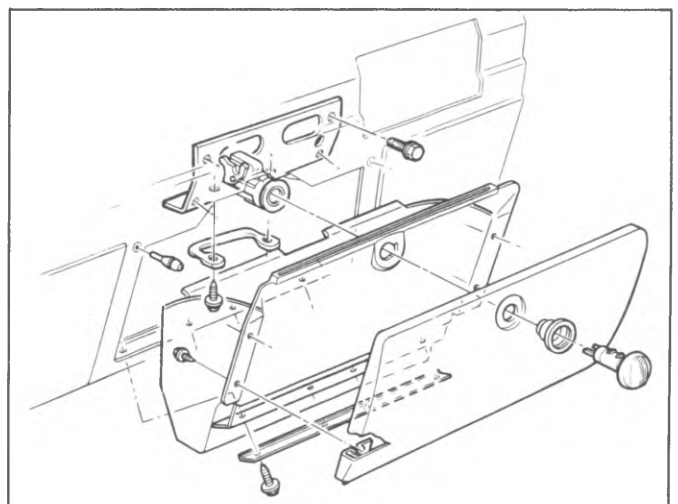


Fig. 2D-8--Glove Box

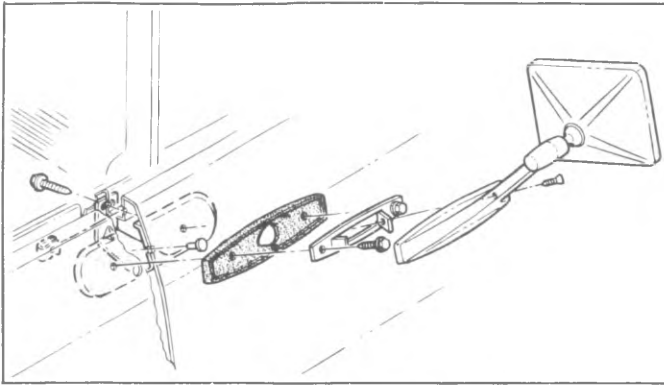


Fig. 2D-9--Rear View Mirror - Base

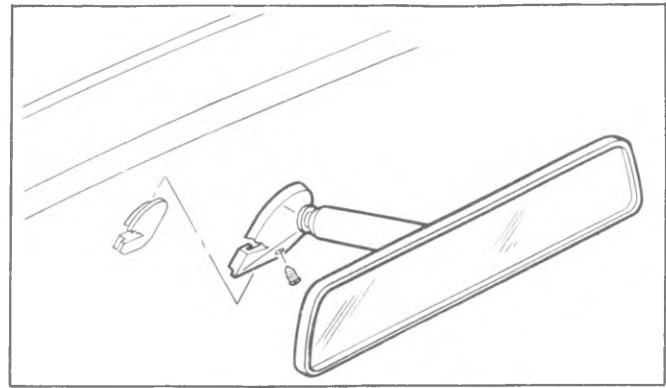


Fig. 2D-11--Inside Rear View Mirror

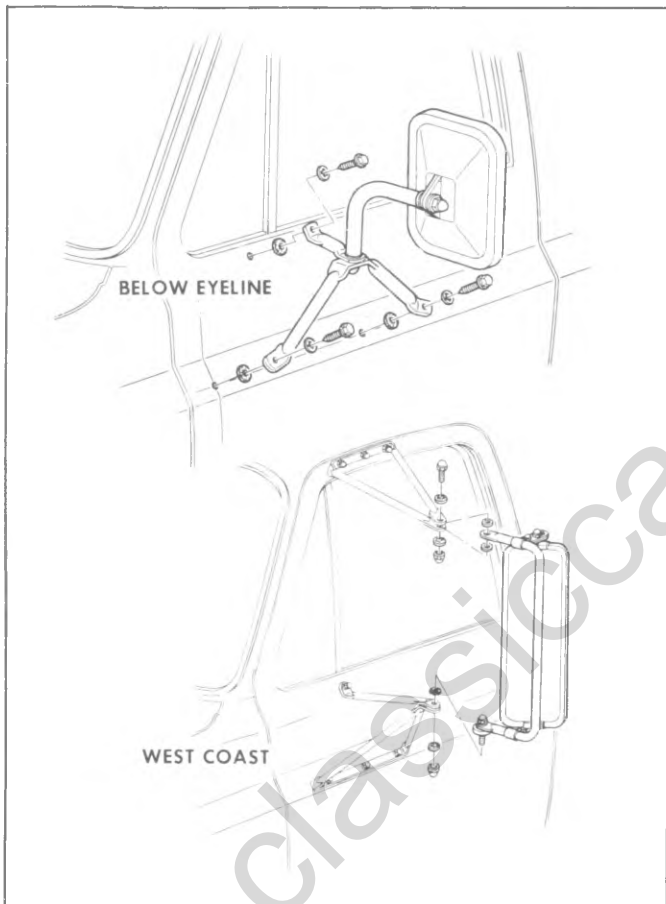


Fig. 2D-10--Rear View Mirrors

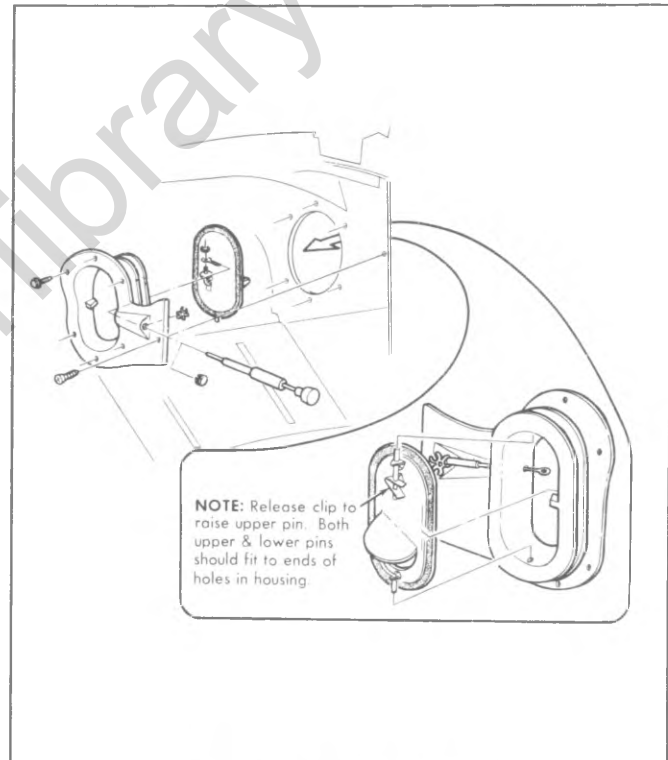


Fig. 2D-12--Cowl Vent Valves

BODY GLASS

WARNING: Always wear gloves when handling glass.

WINDSHIELD GLASS

The windshield is a one-piece type and is retained in the windshield opening by a molded rubber weatherstrip. See figure 2D-13.

When replacing a cracked windshield glass, it is very important that the cause of the glass breakage be determined and the condition corrected before a new glass is installed. Otherwise, it is highly possible that a small obstruction or high spot somewhere around the windshield opening will

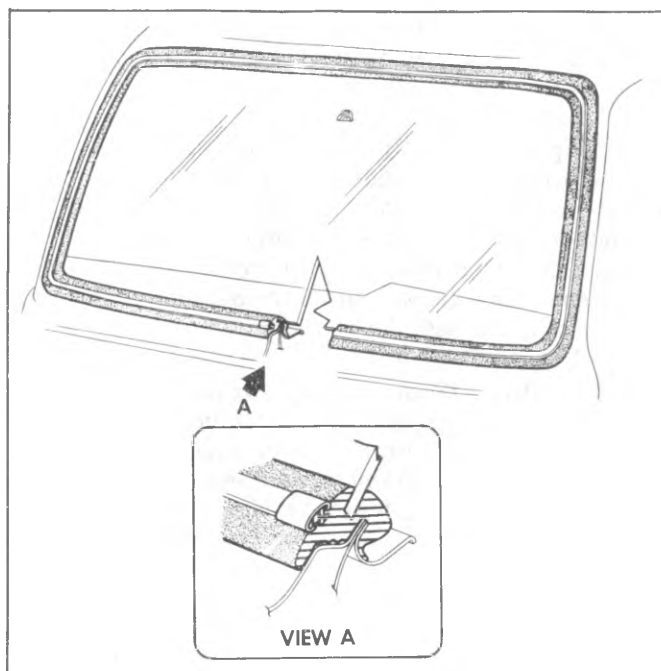


Fig. 2D-13--Typical Windshield

continue to crack or break the newly installed windshield especially when the strain on the glass caused by this obstruction is increased by such conditions as wind pressures, extremes of temperature, motion of the vehicle, etc.

NOTE: The procedure for removal of the windshield applies to other stationary glass applications, such as in figures 2D-20 and 2D-21.

Removal

1. Before removing the windshield, mark the location of the break on the windshield rubber channel and the body. Protect the paint finish inside of the cab. Mask around the windshield opening and outside, lay a suitable covering across the hood and fenders.

NOTE: The windshield glass rubber weatherstrip is one piece. The glass is held in a channel within the weatherstrip.

2. **On vehicles without reveal moldings,** "unzip" the locking strip shown in figure 2D-18.

3. **On vehicles with reveal moldings, remove reveal molding with tools show in figure 2D-19.**

4. To free windshield rubber channel of weatherstrip loosen the lip of the windshield weatherstrip from the pinchweld flange along the top and at the sides by applying firm, controlled pressure to the edge of the glass. At the same time assist the lip of the rubber weatherstrip channel over the pinchweld flange with a flat bladed tool. See figures 2D-14 and 2D-15.

5. With the aid of an assistant outside the cab, remove the windshield from the opening. See figure 2D-16.

Checking Windshield Opening

Due to the expanse and contour of the windshield it is imperative in the event of a stress crack that the windshield opening be thoroughly checked before installing a replacement windshield. The replacement glass is used as



Fig. 2D-14--Applying Pressure to Windshield

a template.

1. Check for the following conditions at the previously marked point of fracture.

- a. Chipped edges on glass.
- b. Irregularities in body opening.
- c. Irregularities in rubber channel weatherstrip.

2. Check flange area for solder, weld high spots, or hardened spot-weld sealer. Remove all high spots.

3. Check windshield glass to opening, by supporting glass with six spacers contained in packet J-22577. See figure 2D-17.

CAUTION: Do not strike glass against body metal. Chipped edges on the glass can lead to future breaks.

4. With the windshield supported and centered in its opening, check the relationship of the glass to the body opening flange around the entire perimeter of the glass.

5. Check the relationship of glass to opening as follows:

- a. Inside edge of glass to body flange.
- b. Outer edge of glass to parallel body metal.

6. Mark areas of body metal or flange to be reformed remove glass and correct as necessary.

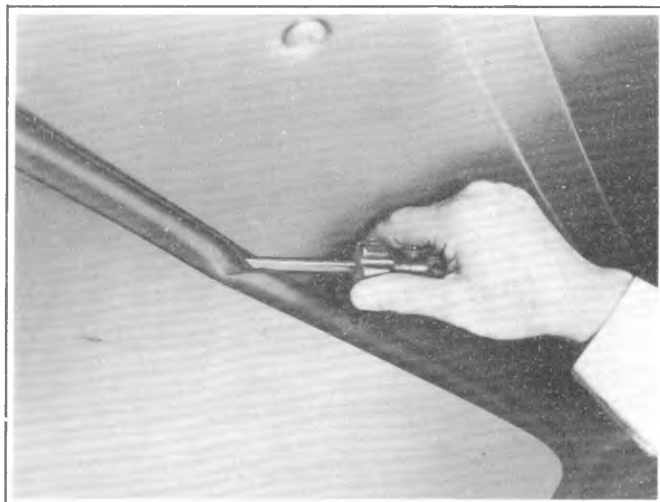


Fig. 2D-15--Assisting Weatherstrip over Flange

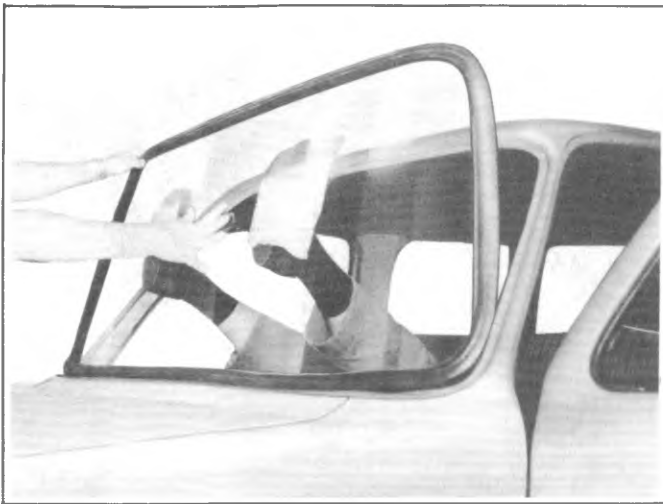


Fig. 2D-16--Removing Windshield from Opening

7. Recheck windshield in its opening and if satisfactory proceed as follows:

WINDSHIELD INSTALLATION (CK TRUCK) FIG. 2D-18

Installation of the windshield requires a number of timed (cure time) steps. This timing is important and must be followed. All cure times are minimum, unless indicated otherwise. It is permissible to go slightly over, but never under, the minimum times given. When performing a step that requires a cure time, it is not necessary to stop and wait for the cure time to elapse. Make a note of the cure time and move on to any following step that does not interfere with the timed sequence.

1. Wipe pinch-weld clean with a dry cloth. Make sure most of the previous urethane has been removed.

2. Apply pinch-weld primer P/N 9981748 (or equivalent) to pinch-weld as shown in View B. Allow primer to cure for at least 30 minutes.

3. Apply cleaner P/N 9985358 (or equivalent) to both channels of rubber weatherstrip as shown in View A. Allow cleaner to remain for at least 5 minutes, then wipe both channels with a clean dry cloth.



Fig. 2D-17--Checking Windshield Opening

4. Apply primer P/N 9985359 (or equivalent) to both channels of rubber weatherstrip that were cleaned in the previous step and are shown in View A. Allow primer to cure for at least 30 minutes.

5. Apply cleaner P/N 9981535 (or equivalent) in a 0.4 inch wide band on the inside of the windshield glass around the entire periphery as shown in View C. Wait for at least 5 minutes and then wipe with a clean dry cloth.

An alcohol dampened clean cloth may be used to thoroughly clean the windshield. Application is the same as outlined above with the exception that the cleaned area should be allowed to air dry.

CAUTION: When cleaning windshield glass, avoid contacting edge of plastic laminate material (on edge of glass) with volatile cleaner. Contact may cause discoloration and deterioration of plastic laminate by wicking action. DO NOT use a petroleum base solvent such as kerosene or gasoline. The presence of oil will prevent adhesion of new material.

6. Apply blackout primer P/N 9981536 (or equivalent) to the same area of the windshield glass that was cleaned in the previous step and is shown in View C allow to dry to touch.

7. Apply a 3/16 inch bead of urethane adhesive P/N 9981450 (or equivalent) around pinch-weld flange as shown in View B.

NOTE: Windshield glass must be installed within 20 minutes after performing this step.

8. Apply a mist of plain water to the urethane bead on the pinch-weld flange, wetting it fully.

9. Install rubber weatherstrip to the pinch-weld flange.

10. Apply a 3/16 inch bead of urethane adhesive P/N 9981450 (or equivalent) to rubber weatherstrip glass channel as shown in View D.

11. Apply lubricant P/N 473998 (or equivalent), or a plain soapy water solution, to surface "C" or weatherstrip as shown in View D. In the absence of the aforementioned lubricant, assembly may be accomplished without lube or by use of water only which will require greater assembly effort and a higher degree of care in seating the windshield in the weatherstrip.

12. On windshields equipped with embedded antenna, tape pigtail of antenna to inside surface of windshield glass in a convenient and accessible position.

13. With the aid of a helper, lift glass into window opening. Suction cups may be used but are not mandatory. Then, install glass in channel of weatherstrip.

14. Apply lubricant 473998 (or equivalent), or a plain soapy water solution to lockstrip channel of weatherstrip. If adequate precaution is taken not to spill or otherwise contaminate the urethane adhesive, the substitute lubricants may be used.

15. Use J-2189 weatherstrip tool set and install lockstrip in channel of weatherstrip. Install lockstrip cap at lockstrip joint.

16. Install windshield wiper arms and blades.

17. On windshields equipped with embedded antenna, connect antenna pigtail to radio antenna lead.

18. Install inside trim panels.

19. Install rear view mirror to windshield.

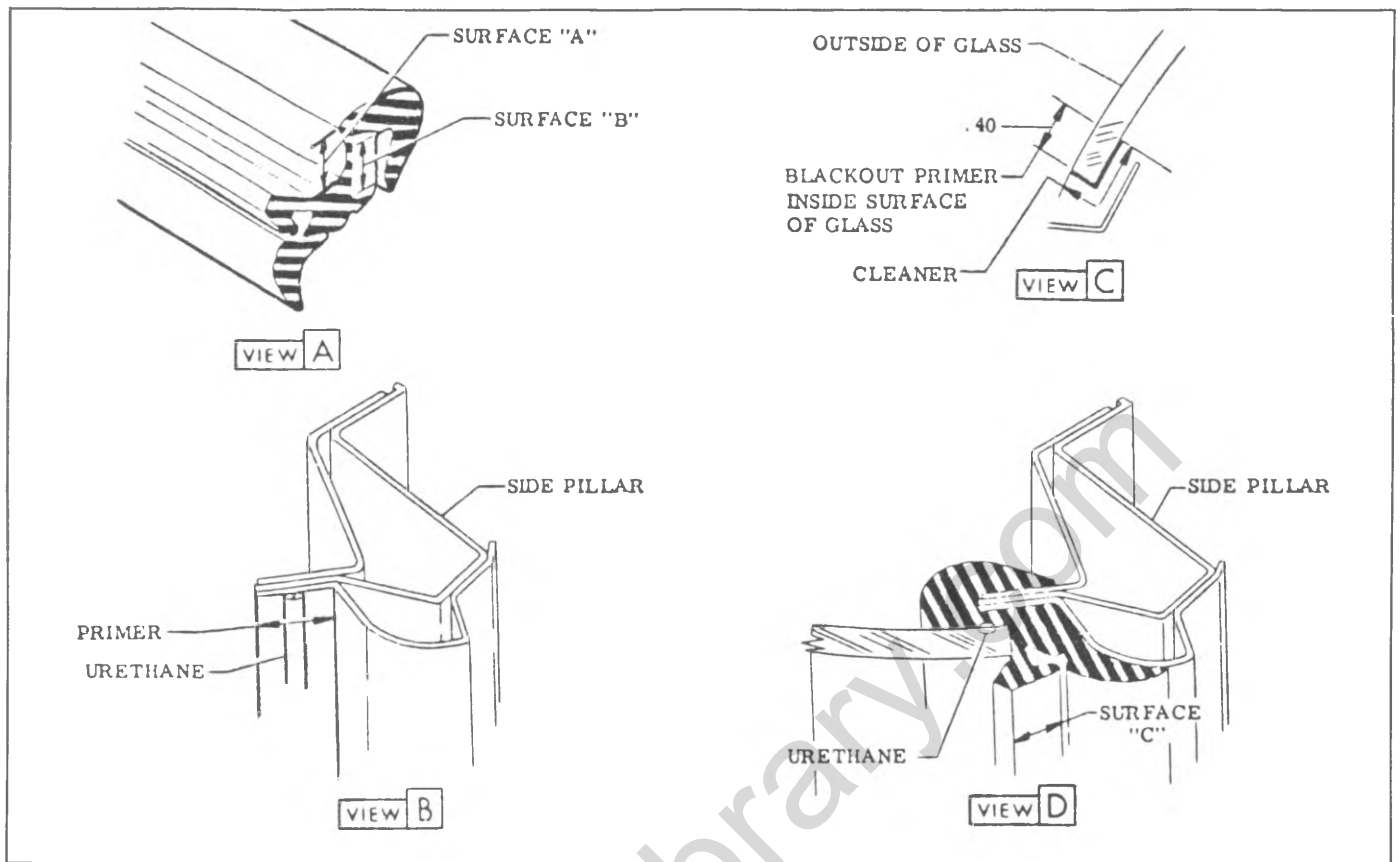


Fig. 2D-18--Windshield Installation-C10-30 Truck

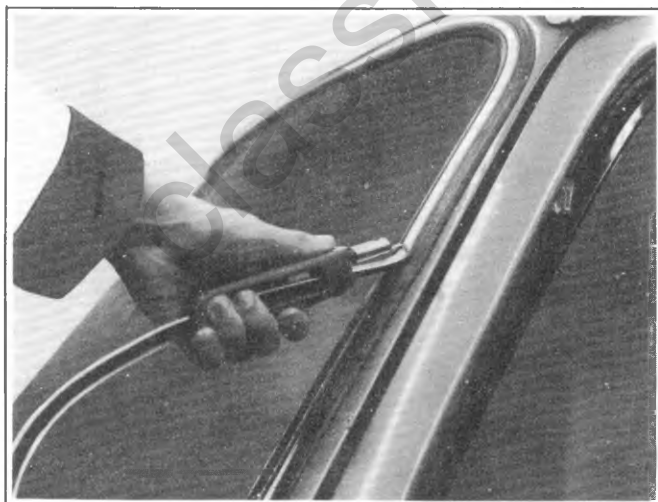


Fig. 2D-19--Installing Reveal Molding

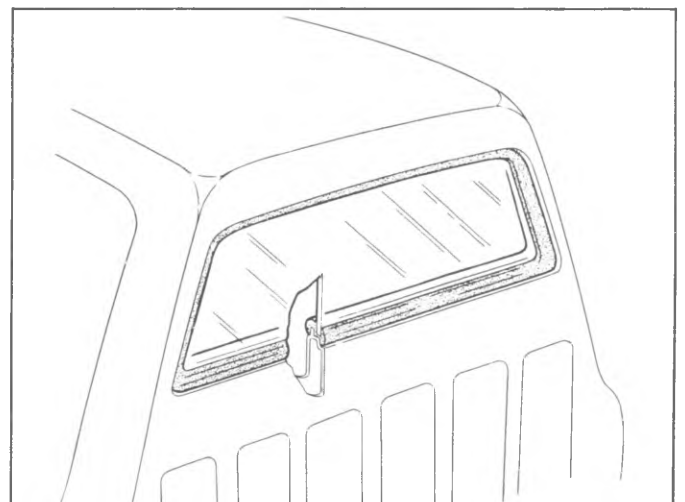


Fig. 2D-20--Back Window Glass - (03, 63)

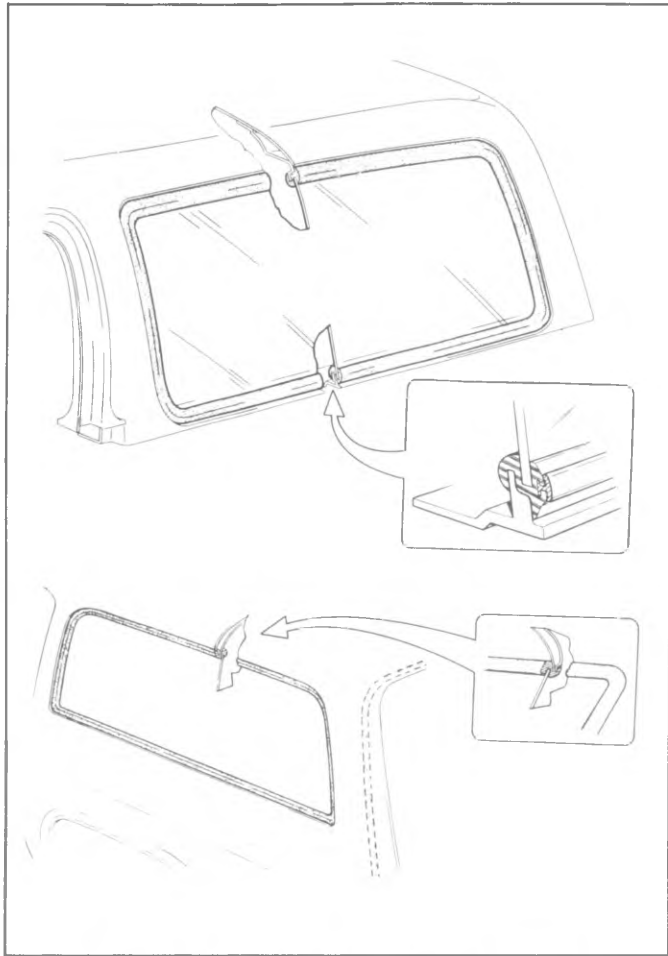


Fig. 2D-21--Body Side Window - (14 and 06)

STATIONARY BODY GLASS

Replacement

The method used to remove the windshield glass may be applied to other stationary glass, such as shown in figures 2D-20 and 2D-21. Remember to check for cause of breakage, and to always wear gloves when handling glass. Installation procedures are similar to G-Van windshield. Refer to figures 2D-94 and 2D-95, later in this section.

BODY SIDE DOORS

DOOR ADJUSTMENTS

Doors can be adjusted for alignment of clearance in the cab door opening, and for proper latching. Door alignment adjustments are made at the striker bolt, and at door hinges. The door, when properly located in door opening, will have .19 inch clearance at the top and side edges, and .25 inch clearance at the bottom. The door should be adjusted in the opening so the edge of the door across the top and also at the lock side is parallel with the body opening as nearly as possible.

Hinge Adjustment

Door hinge bolt holes are oversized to make adjustment possible. Alignment adjustments can be made by loosening the proper hinge bolts, aligning door to proper position, and tightening bolts securely. See figure 2D-22, for typical adjustments.

Striker Bolt Adjustment

With the use of J-23457, shown in figure 2D-23, the striker bolt can be adjusted in any of three ways. See figure 2D-24.

1. **Up and down** - To adjust striker up or down, loosen bolt, adjust to desired height, and tighten bolt securely.

NOTE: This adjustment is important to assure that the right proportion of door's weight will rest on striker bolt when door is closed. If bolt is positioned too high on pillar, rapid wear will occur to the lock cam; if too low, an extra load will be placed on door hinges as well as pull door downward and out of alignment.

2. **In and Out** - To adjust striker in and out, loosen bolt, adjust horizontally to desired position and tighten bolt securely.

3. **Foreward and Rearward** --To make this adjustment, loosen striker bolt, shim to desired position, and tighten bolt securely.

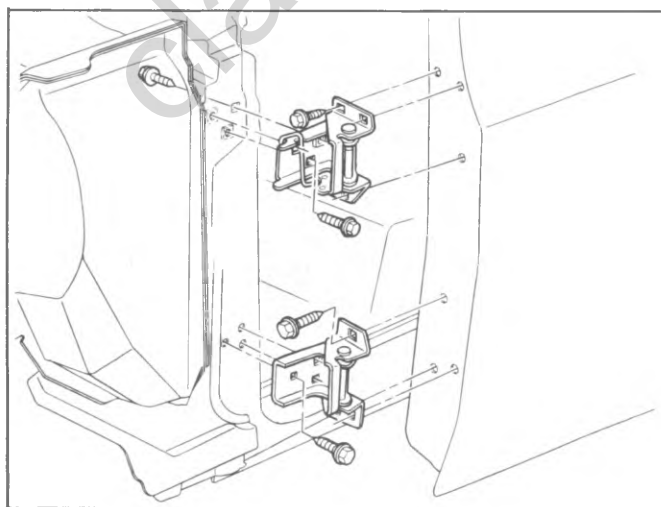


Fig. 2D-22--Door Hinge

FRONT DOOR ASSEMBLY

Replacement

Remove the door assembly from the body by removing the hinges from the door.

DOOR HINGE

The door check is part of the front door upper hinge. The front door torque rod check holds the door in either of two positions between full open and closed. The front door check-hinge assembly is replaced as a complete unit as follows. See figure 2D-22.

Removal

1. Loosen front fender rear bolts.
2. With special Tool J-22585 remove 3 bolts securing front door upper hinge to cowl pillar.
 - a. Remove the door to upper hinge retaining bolts.
 - b. With aid of an assistant to support weight of door, remove the door to lower hinge retaining bolts and remove door.

Installation

1. Install hinge snugly on pillar in same location as hinge removed.
2. With the aid of an assistant fasten the door to the hinge.
3. Adjustment of the door lock and striker plate should be made after the door is positioned in the opening.

DOOR TRIM PANELS - CK MODELS

Door trim panel installation is illustrated in Fig. 2D-25.

DOOR VENTILATOR ASSEMBLY--Fig. 2D-26

Removal

NOTE: The channel between the door window glass and door vent is removed as part of the vent assembly.

1. Regulate the door window glass to the full down position.
2. Remove clip from the window regulator handle, and knob from lock rod.
3. Remove arm rest screws and rim panel. See figure

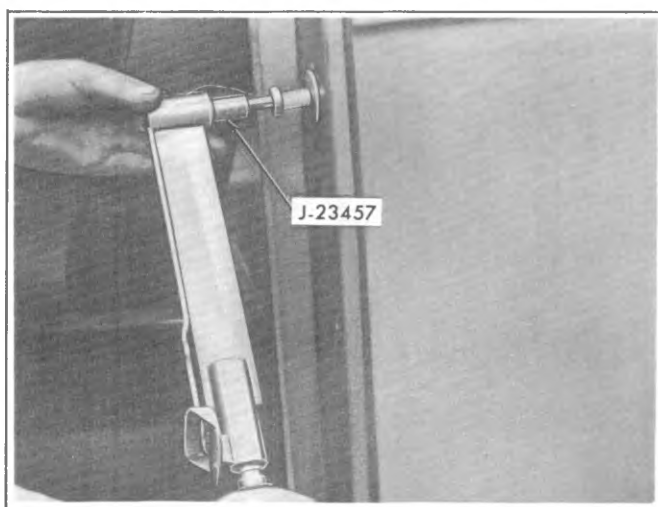


Fig. 2D-23--Loosening Striker Bolt

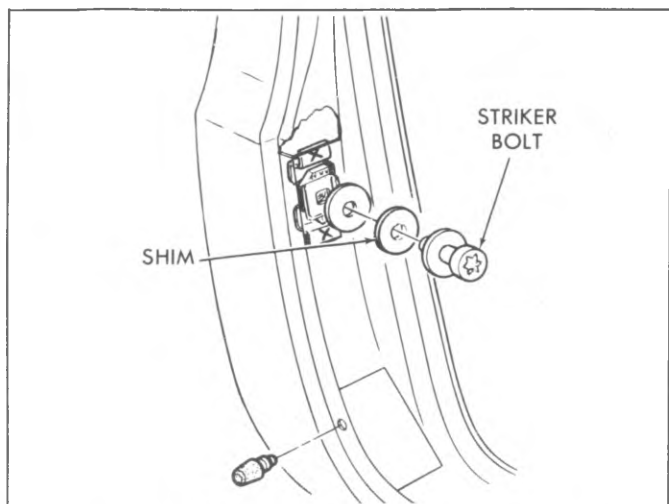


Fig. 2D-24--Typical Striker Bolt Adjustment

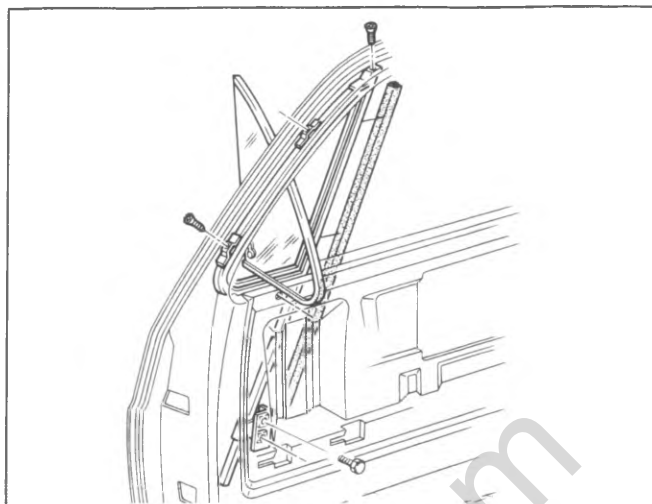


Fig. 2D-26--Door Ventilator Assembly

2D-27.

4. Remove screws attaching ventilator lower assembly to door panel.
5. Loosen inner to outer panel attaching screw through access hole just rearward of the lower vent pivot.
6. Slide door window glass rearward away from ventilator.
7. Remove three screws at the upper front of the door frame.
8. Turn vent assembly 90° and carefully remove by guiding up and out. See figure 2D-28.

Ventilator Glass Replacement

1. Using an oil can or similar means, squirt prepsol or equivalent on the glass filler all around the glass channel or frame to soften the old seal. When the seal has softened, remove the glass from the channel.
2. Thoroughly clean the inside of the glass channel with sandpaper, removing all rust, etc.
3. Using new glass channel filler, cut the piece to be

installed two inches longer than necessary for the channel. Place this piece of filler (soapstoned side of filler away from glass) evenly over the edge of the glass which will fit in the channel. The extra filler extending beyond the rear edge of the glass should be pinched together to hold it in place during glass installation.

NOTE: One side of this filler (the outside of the roll) is soapstoned. This is the side which goes into the metal channel.

4. Brush the inside of the metal glass channel freely with ordinary engine oil. This will enable the glass and filler to slide freely into the channel. Push the glass with the filler around it into the channel until it is firmly seated. After the glass is firmly in place, the oil softens the filler, causing it to swell, thereby making a watertight seal. Trim off the excess filler material around the channel and at the ends of the channel.

NOTE: Glass should be installed so that rear edge is parallel to the division post. Allow full cure before water testing.

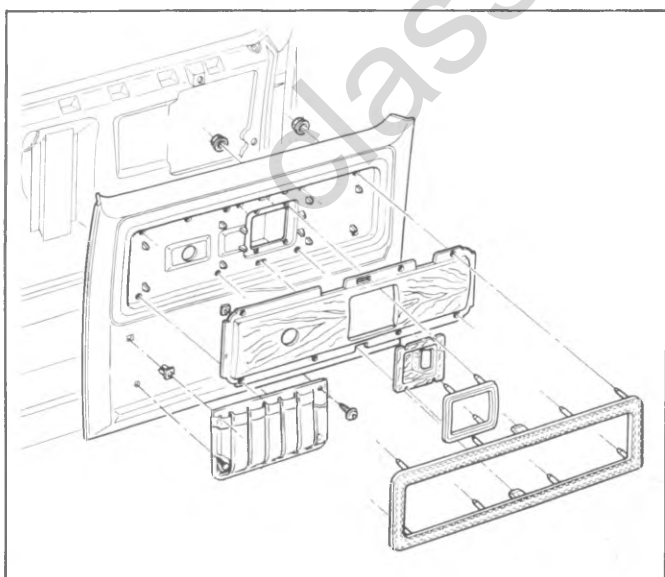


Fig. 2D-25--Door Trim Panel

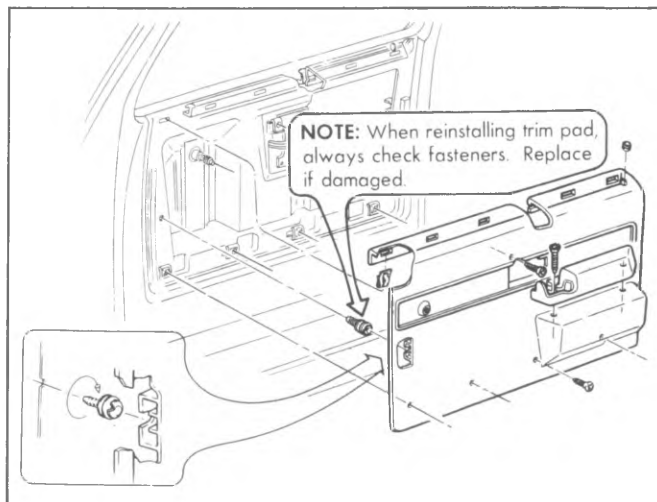


Fig. 2D-27--Door Trim Pad



Fig. 2D-28--Removing Ventilator Assembly

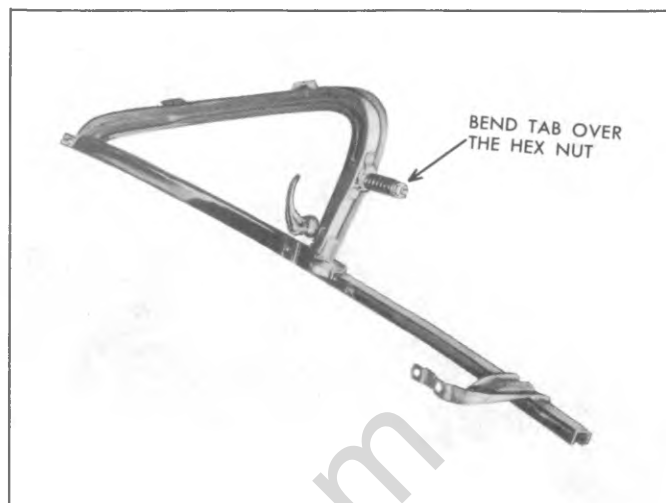


Fig. 2D-30--Bend Tabs Over Hex Nut

Installation

NOTE: Replace the door window glass and regulate to the full down position before installing the door ventilator assembly.

1. Lower the ventilator assembly into the door frame.
2. Make certain the rubber lip is positioned inside the inner and outer panel before tightening screws.
3. Slide door glass forward engaging glass in vent channel.
4. Reinstall all screws and tighten.
5. Install and tighten the three screws at the upper front of the door.

Adjustment

1. Adjust the ventilator by placing wrench on adjusting nut thru access hole and **turning vent window** to the desired tension. See figure 2D-29.
2. After making adjustment bend tabs over the hex nut on base of assembly. See figure 2D-30.
3. Install arm rest screws and trim panel.
4. Install window regulator handle.

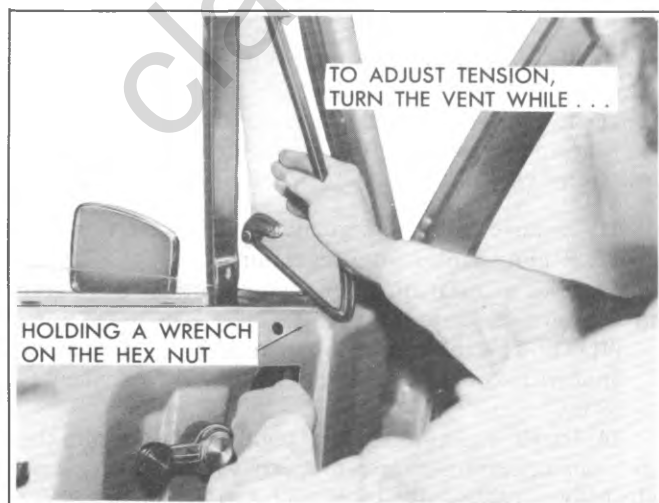


Fig. 2D-29--Adjusting Tension

DOOR WINDOW ASSEMBLY--FIG. 2D-31

Replacement

1. Completely lower glass to bottom of door.
2. Remove window regulator handles using tool J-7797, and remove remote control push button knob.
3. Remove door arm rest and trim pad.
4. Mask or cover upper portion of door window frame. Remove ventilator assembly as previously outlined.
5. Slide glass forward until front roller is in line with notch in sash channel. Disengage roller from channel.
6. Push window forward and tilt front portion of window up until rear roller is disengaged. See figure 2D-32.
7. Put window assembly in normal position (level) and raise straight up and out.
8. Reverse above procedure for installation.

WINDOW REGULATOR-MANUAL--FIG. 2D-31

Replacement

1. Remove ventilator assembly and door window as outlined previously.
2. Remove screws attaching regulator to door inner panel.

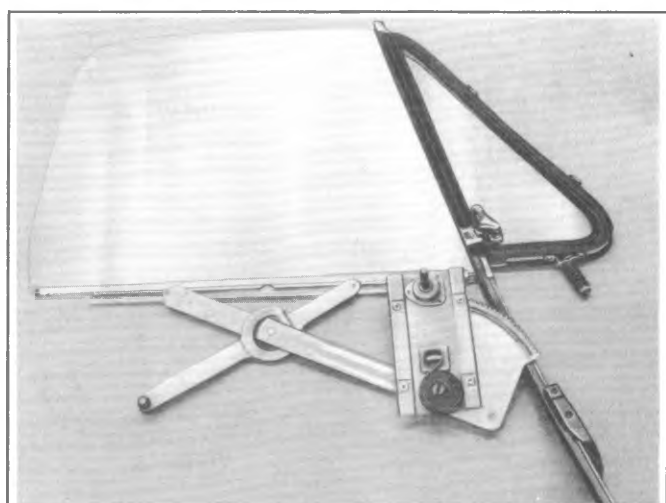


Fig. 2D-31--Door Window and Regulator

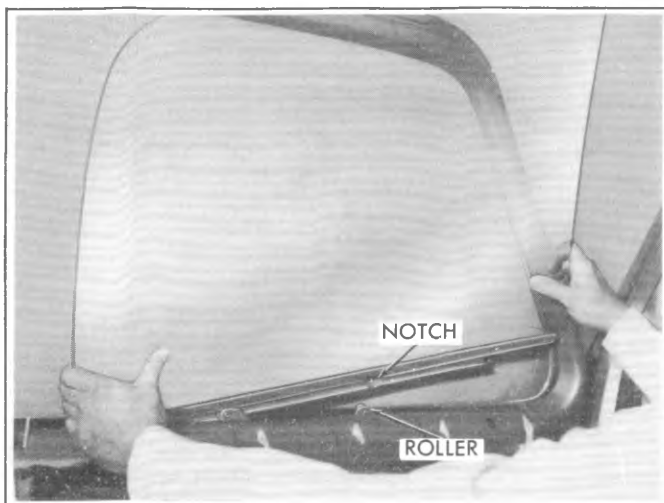


Fig. 2D-32--Removing Door Glass

3. Remove regulator assembly through door opening.
4. Install regulator by reversing above steps. Lubricate regulator gear with lubriplate or equivalent.

WINDOW REGULATOR - POWER - CK MODELS

In the case that window will not operate, check electrical connections first. Figure 2D-33 illustrates location of junctions, switch, relay and circuit breaker.

Replacement

CAUTION: *Electrical connectors must be removed from window lift motor before performing any operation on the regulator. Figure 2D-34 illustrates location of regulator on door and wiring.*

1. Disconnect battery ground cable.
2. Remove door upper trim panel.
3. Remove arm rest bracket and pull assist handle bracket.
4. Remove remote control bolts and lay control

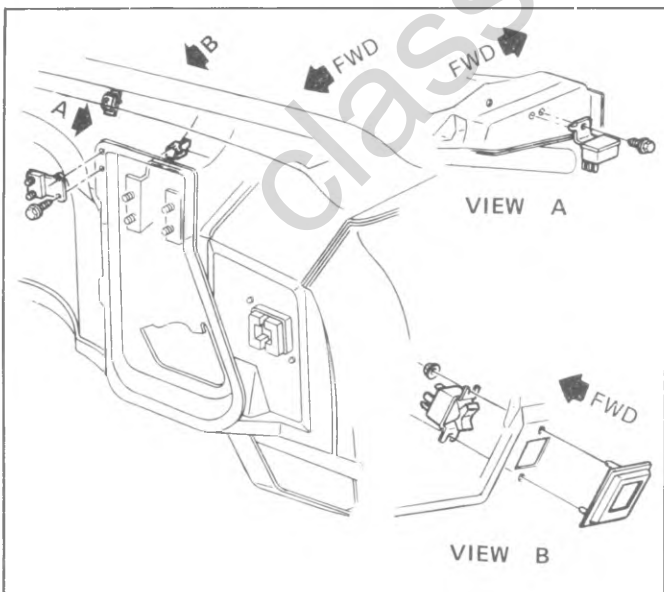


Fig. 2D-33--Power Window Switch, Relay and Breaker Assembly

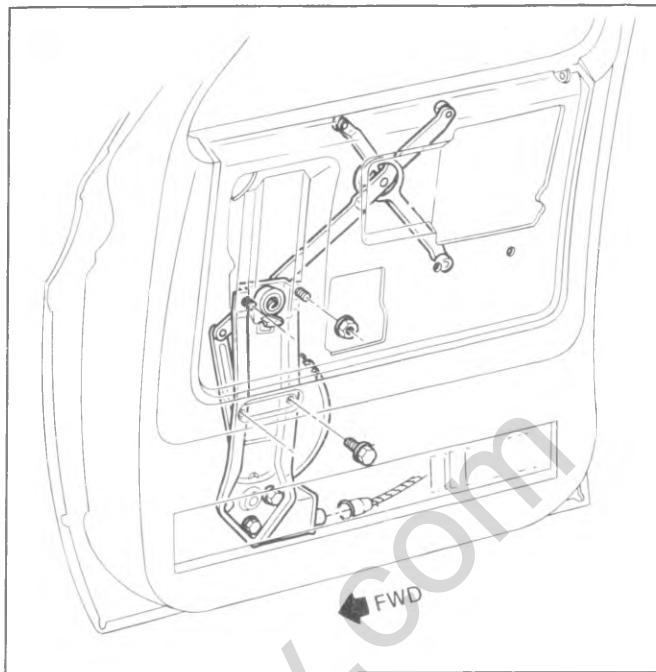


Fig. 2D-34--Power Window Regulator, Motor and Connector

assembly aside for access.

5. Remove glass outer seal.
6. Remove rear glass run channel.
7. Remove regulator to door panel attaching nuts and screws, and pull rear of glass up as far as possible and rotate clockwise approximately 90° to remove glass from door.
8. Disconnect harness from regulator.
9. Rotate motor regulator approximately 90° to access hole in door.

WARNING: Step 10 must be performed when regulator is removed from door. The regulator lift arms are under tension from the counterbalance spring and can cause serious injury if the motor is removed without locking the sector gear in position.

10. Drill a hole through the regulator sector gear and back plate. **DO NOT** drill hole closer than 1/2" (12.7mm) to edge of sector gear or back plate. Install a pan head sheet metal tapping screw (No. 10 - 12 x 3/4) in drilled hole to **lock** sector gear in position.

11. Remove motor to regulator attaching screws.
12. Remove motor from regulator.
13. Prior to installation, lubricate the motor drive gear and regulator sector teeth.

NOTE: The lubrication used must be cold weather approved to a minimum of minus 20° fahrenheit (-29°C).

14. Install regulator motor to regulator. Make sure the motor pinion gear teeth mesh properly with the sector gear teeth before installing the three motor attaching screws.

15. Remove screw locking sector gear in a fixed position.

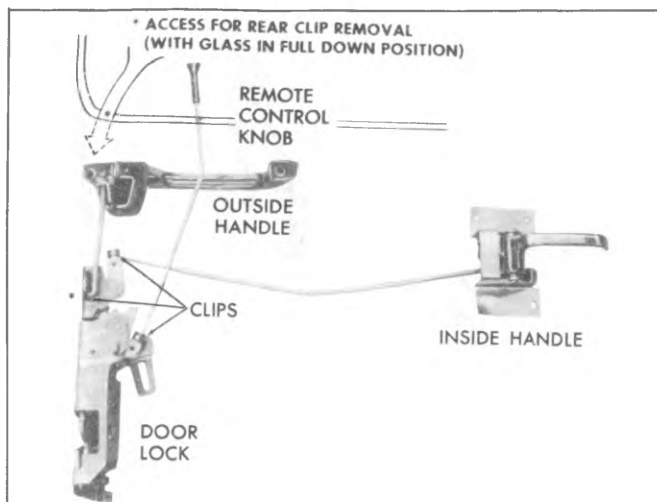


Fig. 2D-35--Lock, Handles and Rods

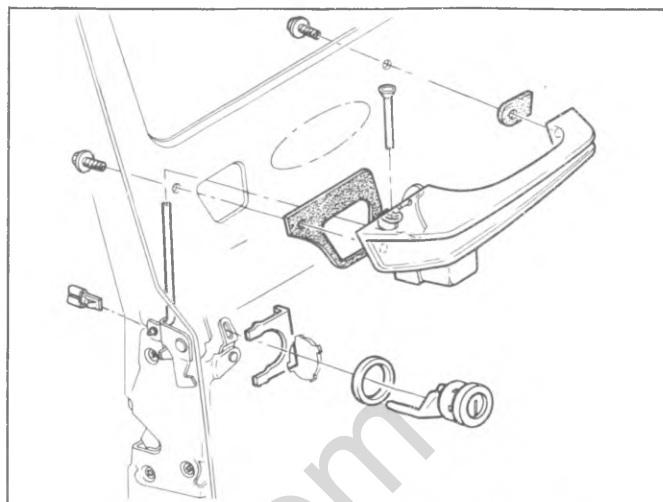


Fig. 2D-36--Outside Handle and Lock Cylinder

16. Insert regulator into door in such a position that motor connector can be installed onto motor.

17. Reinstall regulator into door.

LOCKS, HANDLES AND RODS

The door lock, handles and control rods are shown in figure 2D-32 as they would be installed in the vehicle. Note the clips which attach the three control rods to the lock assembly.

NOTE: All clips which attach control rods to lock assembly must be replaced whenever removed.

Door Lock Assembly

Replacement

1. Raise window to gain access to lock.
2. Remove regulator handle.
3. Remove remote control push button knob.
4. Remove trim panel.
5. Remove clip from inside handle rod-to-lock.
6. Remove clip from outside handle rod-to-lock. This is best accomplished by inserting a long screwdriver through the daylight opening, as shown in figure 2D-35.
7. Remove screws which attach lock assembly to door panel.
8. Remove lock and remote control rod as an assembly.
9. To install lock assembly, reverse above steps. Be sure to replace all clips removed earlier.

Door Outside Handle--Fig. 2D-36

Replacement

1. Raise window to gain access to lock.
2. Remove window regulator handle.
3. Remove remote control rod.
4. Remove trim panel.
5. Remove clip from outside handle rod-to-lock. This is best accomplished by inserting a long screwdriver through the daylight opening, as shown in figure 2D-35.
6. Remove screws which retain outside handle to door panel.
7. Remove handle and control rod.
8. Reverse above procedures to install outside handle.

Door Lock Cylinder -Fig 2D-36

Replacement

1. Raise door window.
2. Remove window regulator handle, remote control knob and trim panel.
3. Use a screwdriver or other suitable tool to slide the lock cylinder retaining clip out of engagement with the lock cylinder.
4. Remove lock cylinder.
5. To install, reverse the above steps.

Door Inside Handle

Replacement

1. Remove window regulator handle, remote control push button knob and trim panel.
2. Disconnect control rod from inside handle, as shown in figure 2D-37.
3. Remove screws retaining inside handle to door.
4. Remove inside handle.
5. Reverse above steps to install.

POWER DOOR LOCKS - CK MODELS (Fig. 2D-2)

Replacement

1. Disconnect battery ground cable.
2. Remove door trim panel (fig. 2D-25) to gain access to power door lock motor. If equipped with optional trim, remove pull handle assist bracket.
3. Disconnect electrical connector from motor.
4. Remove screws attaching motor to door inner panel.
5. Remove door lock lever from rubber mount at top of motor actuator and remove motor through access hole.
6. To install, reverse steps 1 through 5 above.

DOOR TO BODY OPENING WEATHERSTRIP--FIGS. 2D-39, 2D-40

Side door sealing incorporates an inner seal. The inner seal is mounted on the body opening welding flange and goes completely around the periphery of the opening. The molded weatherstrip material is snapped in place.

Success of weatherstrip replacement depends entirely

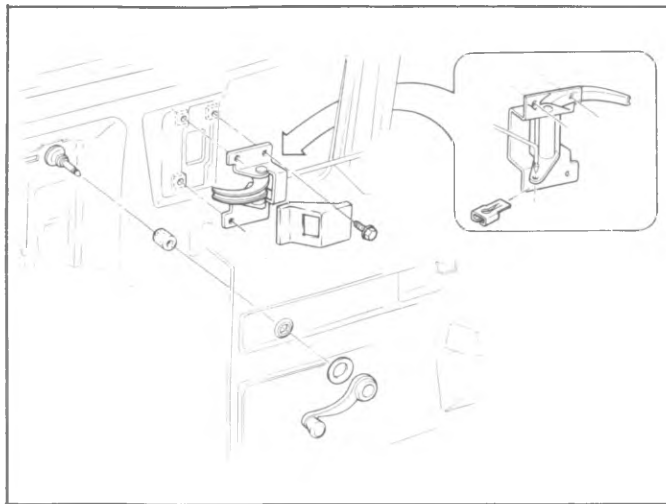


Fig. 2D-37--Inside Handle

upon the quality of the cement used and the care with which it is applied. All rust, road dirt and grease or oil must be completely removed as should all old cement and bits of old weatherstrip. After removing all foreign material from door opening surface proceed as follows:

1. Open door and block open.
2. Remove sill plate retaining screws and remove sill plate.
3. Remove side door inner weatherstrip seal.
4. Install molded corner of inner weatherstrip, starting at the bottom of the door opening.
5. Trim inner weatherstrip with a notch and butt ends together.
6. Reinstall sill plate and sill plate retaining screws.

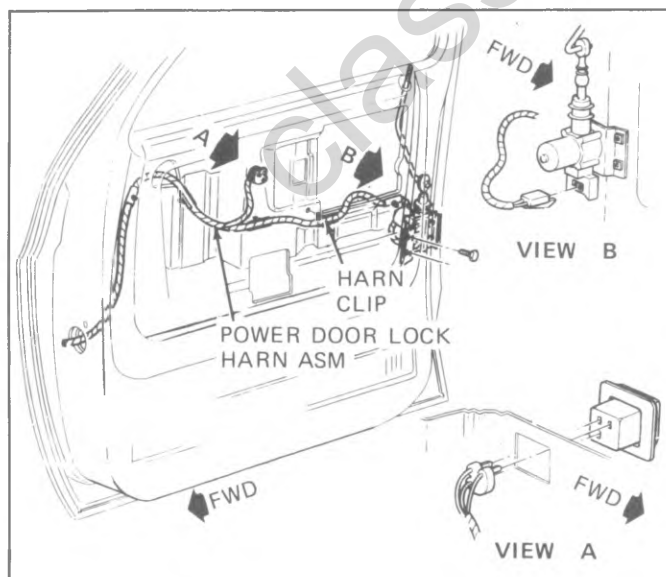


Fig. 2D-38--Power Door Lock Assembly

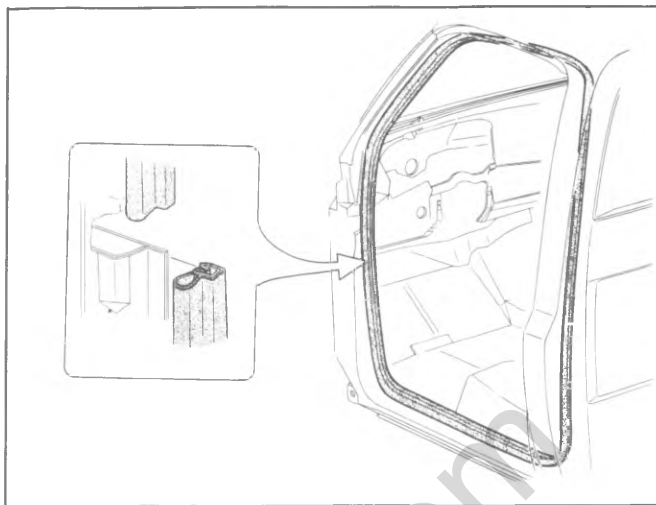


Fig. 2D-39--Door Weatherstrip (03-63-06)

REAR SIDE DOOR (06 AND 63 ONLY)

Adjustments and Hinge Replacement

The procedures for hinge replacement, and for hinge and striker bolt adjustment are similar to those detailed in the front door adjustment procedure. Access to the hinges of the rear door is shown in figure 2D-41.

STATIONARY GLASS-REAR DOOR

Replacement

1. Lower window to full down position.
2. Remove remote control knob and window regulator handle.
3. Remove screws retaining door rim pad, and remove trim pad. See figure 2D-42.
4. Remove glass run channel by removing screws retaining channel to door. See figure 2D-43.
5. Remove stationary glass.
6. Replace glass by reversing above procedure.

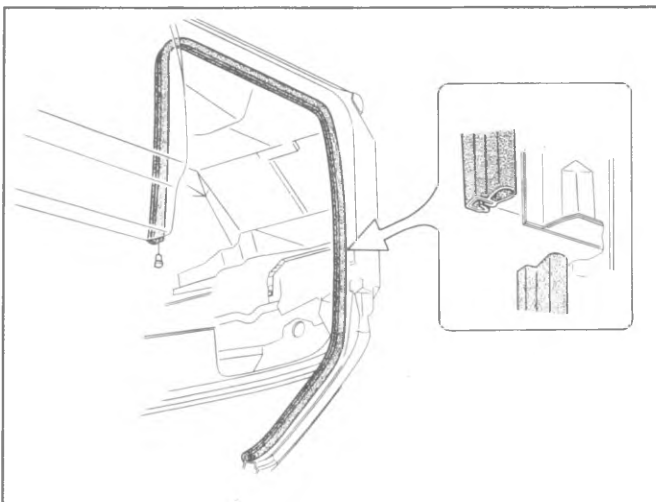


Fig. 2D-40--Door Weatherstrip (14)

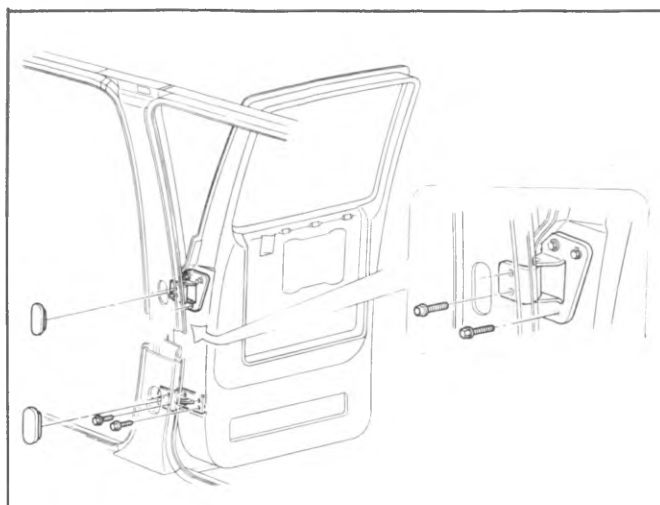


Fig. 2D-41--Rear Door Hinge Location

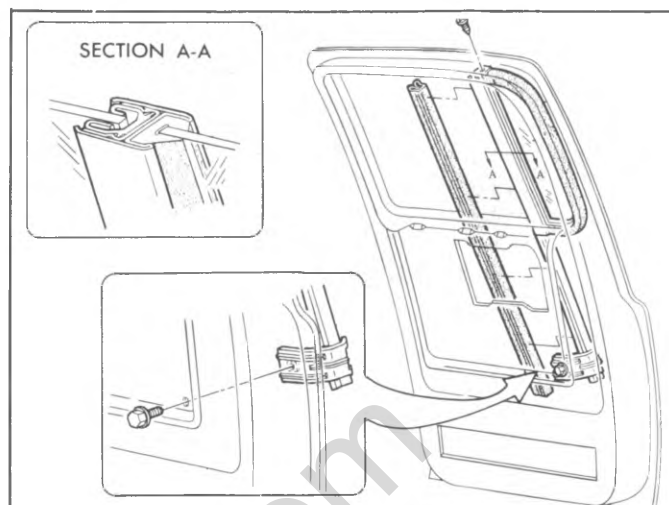


Fig. 2D-43--Glass Run Channel

Glas Run Channel Adjustment

Figure 2D-44 illustrates the front run channel. At the lower end, a slotted bracket provides for in-and-out adjustment. The screw and locknut at that bracket allow fore-and-aft adjustment. Together, this allows proper alignment of the glass to the rear glass run channel for full up and down travel.

WINDOW GLASS--FIG. 2D-45

Replacement

1. Lower glass to full down position.
2. Remove remote control push botton knob, window regulator handle and trim pad.
3. Remove stationary glass as previously outlined. Remove screws from rear division channel, and slide channel rearward in the opening.
4. Raise glass as far as possible, then slide glass until the roller is in line with the notch in the sash channel. See figure 2D-45. Disengage roller from channel.
5. Tilt window outboard and move until other roller can be removed from channel.

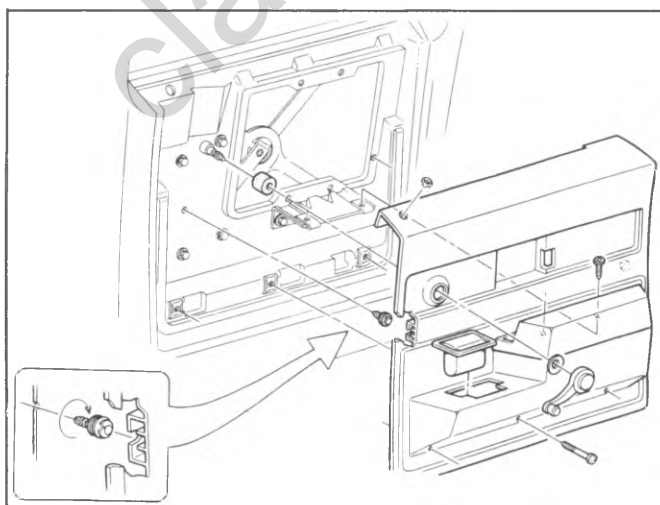


Fig. 2D-42--Side Rear Door Trim Pad

6. Raise window up and out.
7. Reverse above procedure for installation.

WINDOW REGULATOR ASSEMBLY--FIG. 2D-45

Replacement

1. Remove trim pad, stationary glass, and window glass as outlined earlier.
2. Remove screws attaching regulator assembly to door inner panel.
3. Remove regulator assembly through opening in door.
4. Install regulator by reversing above procedure. Lubricate regulator gear with lubriplate or equivalent.

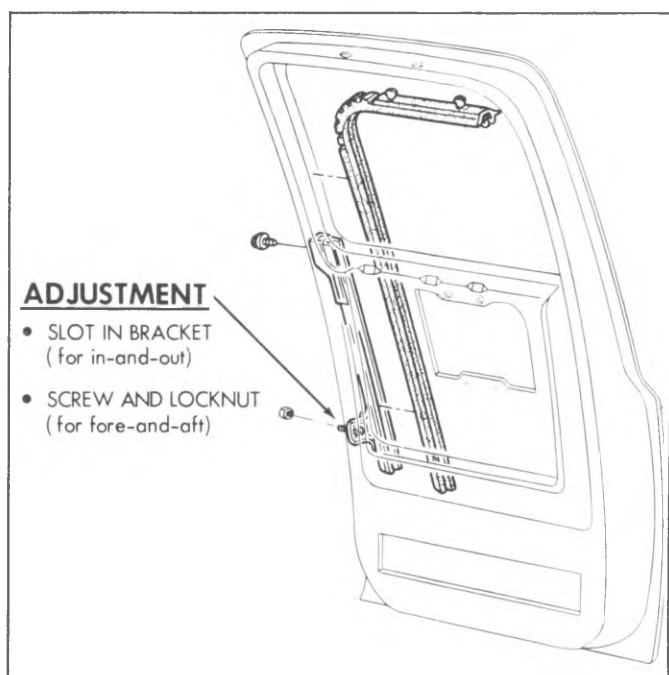


Fig. 2D-44--Glass Run Channel Adjustment

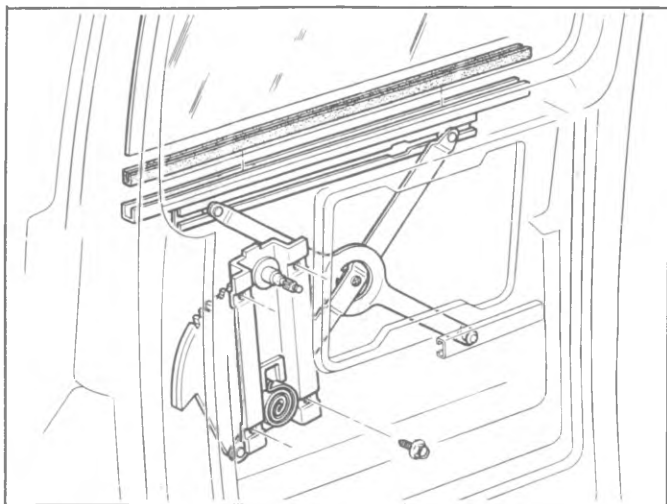


Fig. 2D-45--Window Glass and Regulator Assembly

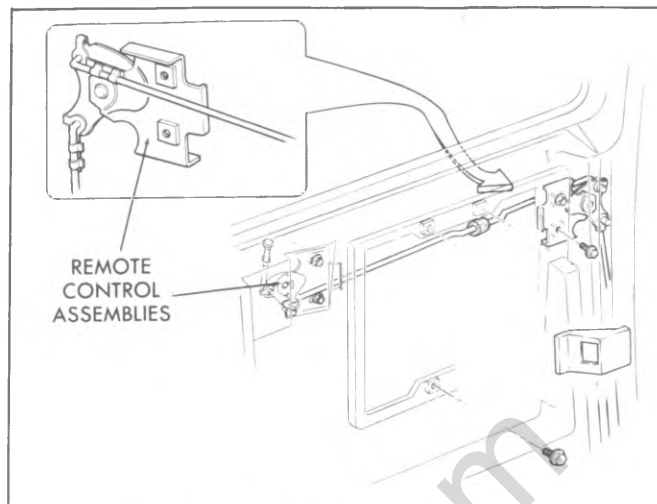


Fig. 2D-47--Remote Control Assembly

LOCKS HANDLES AND RODS

Lock Assembly--Fig. 2D-46

Replacement

1. Remove window regulator handle and remote control push button knob.
2. Remove trim pad.
3. Disengage three clips which retain control rods to lock assembly.
 - a. Inside handle control rod.
 - b. Remote control lower rod.
 - c. Outside handle control rod.
4. Remove screws retaining lock assembly to door panel, then remove lock assembly.
5. Install lock by reversing above procedure. Be sure to replace all clips removed with new clips on installation.

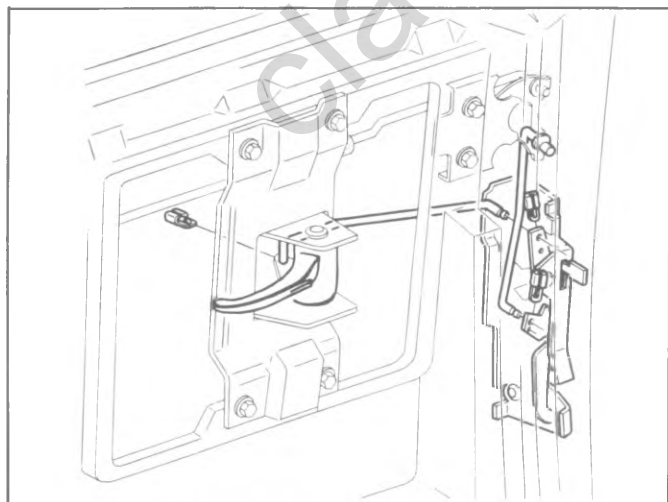


Fig. 2D-46--Lock Assembly and Inside Handle

Inside Handle--Fig. 2D-46

Replacement

1. Remove regulator handle, remote control knob and trim pad as outlined previously.
2. Disconnect control rod from inside handle by removing clip as shown in figure 2D-46.
3. Remove inside handle by removing four screws which secure handle to door panel.
4. Replace handle by reversing above procedure. Install new clip when installing control rod.

Remote Control--Fig. 2D-47

Replacement

1. Remove regulator handle, remote control knob and trim pad.
2. Disconnect remote control lower rod from door lock assembly.
3. Remove two screws securing each remote control lever to door panel.
4. Remove remote control levers and rods through door opening.
5. Replace by reversing above procedure.

Outside Handle--Fig. 2D-48

Replacement

1. Remove regulator handle, remote control rod and trim pad.
2. Disengage outside handle control rod from lock assembly by removing clip, as shown in figure 2D-43.
3. Remove two screws securing outside handle to door panel.
4. Remove handle assembly.
5. Replace by reversing above procedure. Be sure to use new clip when attaching control rod to lock assembly.

WEATHERSTRIP--FIG. 2D-49

The procedure outlined in Front Door Weatherstrip may be applied to the Rear Side Door Weatherstrip, shown in figure 2D-49.

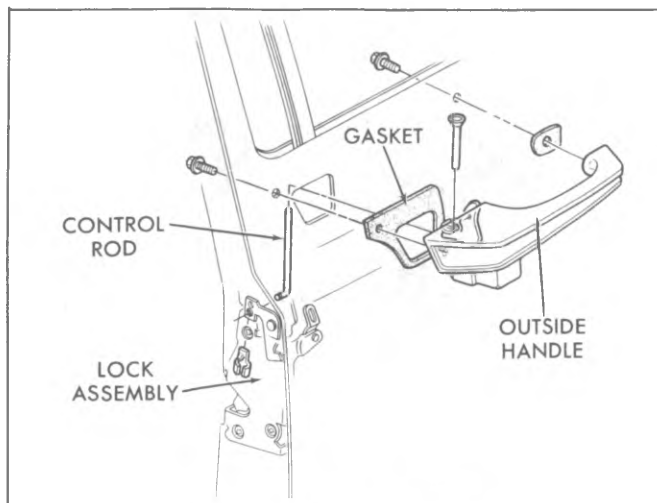


Fig. 2D-48--Outside Handle

REAR DOORS (06 ONLY)

Adjustments

Rear doors may be adjusted in the body opening by loosening hinge bolts and repositioning door, then retightening bolts. See figure 2D-53 for hinge bolt location. Rear door wedges and strikers should be adjusted as shown in figure 2D-48.

Glass Run Channel Adjustment

Figure 2D-50 illustrates the front run channel. At the lower end, a slotted bracket provides for in-and-out adjustment. The screw and locknut at that bracket allow fore-and-aft adjustment.

Together, this allows proper alignment of the glass to the rear glass run channel for full up and down travel.

LOCKS, HANDLES AND RODS

The rear door lock, outside handle, lock cylinder, control rods and latch are shown in figures 2D-51 and 2D-52. The rods can be disconnected from the lock, latch or handle by disengaging the retaining clips, as shown. The lock cylinder is removed in the same manner as the front side door lock cylinder.

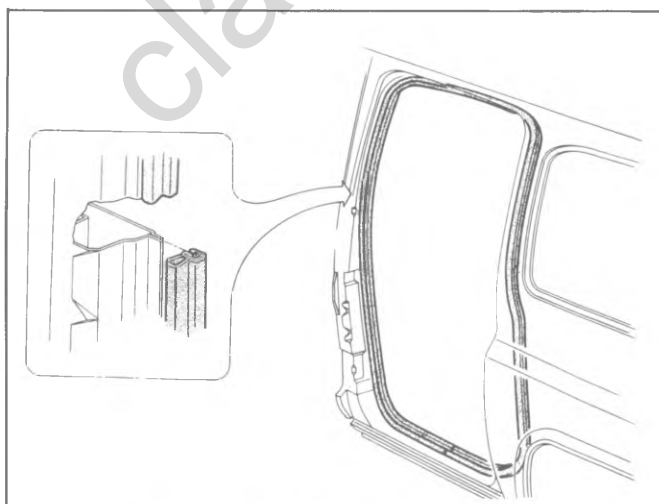


Fig. 2D-49--Side Rear Door Weatherstrip

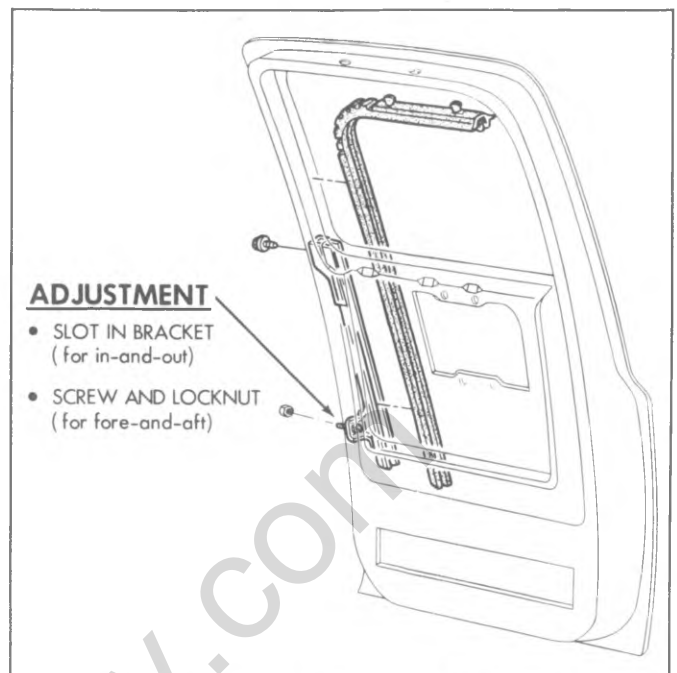


Fig. 2D-50--Glass Run Channel Adjustment

REAR DOOR--Fig. 2D-53

Replacement

1. Remove bolts securing check arm bracket to body pillar.
2. Remove upper and lower hinge bolts, and with aid from an assistant, remove the rear door.
3. Reverse above steps for reinstallation.

REAR DOOR CHECK STRAP

Model 06

Figure 2D-53 shows the cloth check strap used for rear doors. The door may be completely opened by removing the strap pin from the bracket. The bracket attaches to the pillar with three screws; the strap is fastened to the door panel with two screws and an attaching bar.

REAR DOOR--STRIKER AND WEDGE ADJUSTMENTS

Figure 2D-54 illustrates the rear door latch strikers and door wedges. Be sure that adjustments are as shown to insure proper latching of the rear doors.

CHECK ARM--FIG. 2D-53

Replacement

1. Remove bolts securing check arm bracket to body pillar.
2. Remove check arm access cover.
3. With one hand supporting housing assembly and insulator on the inside of the door panel, remove bolts securing housing assembly to door.
4. Remove housing, insulator and check arm.
5. To separate check arm from bracket, remove holding pin connecting the two parts.
6. To install check arm, reverse the procedure above.

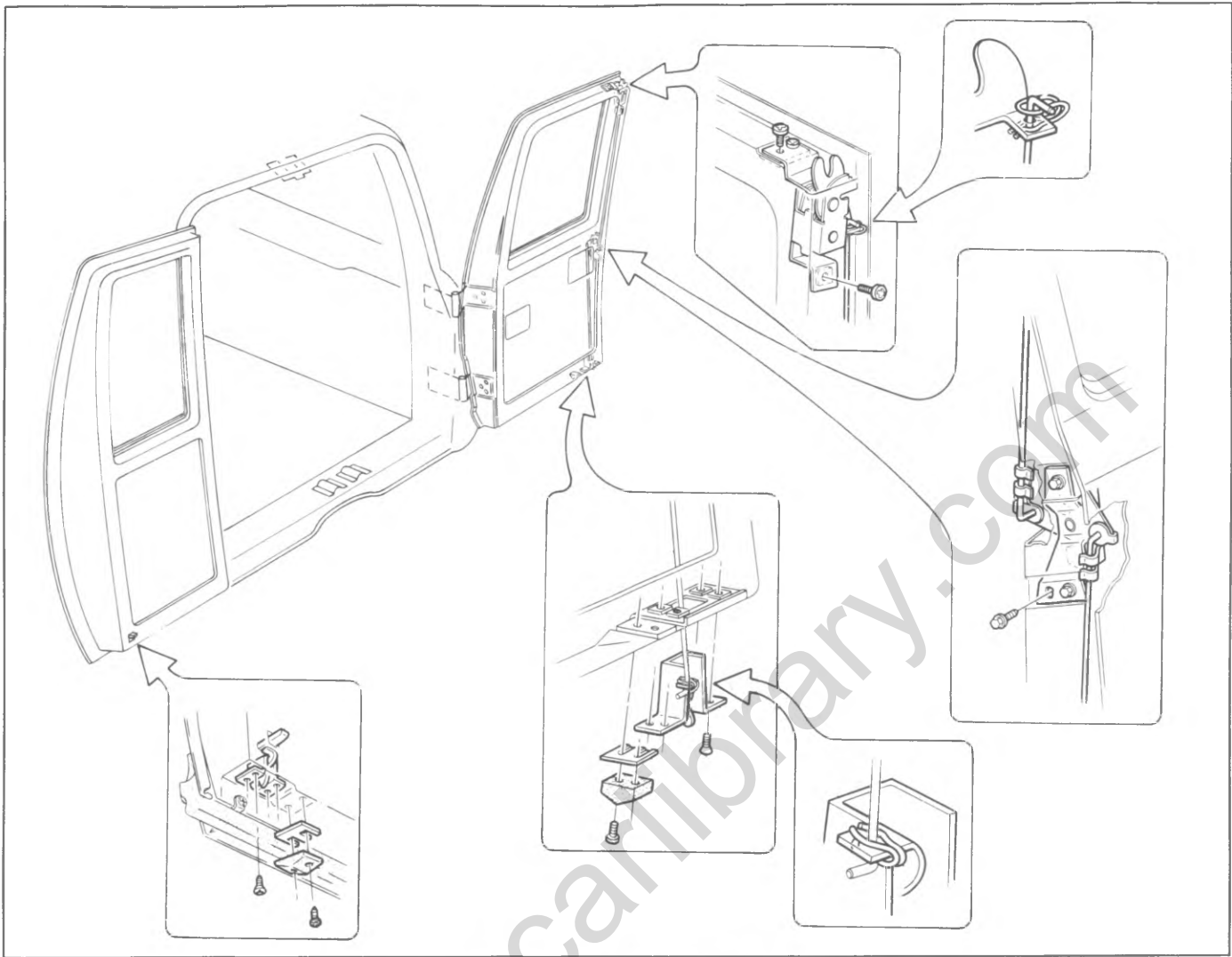


Fig. 2D-51--Rear Door Controls

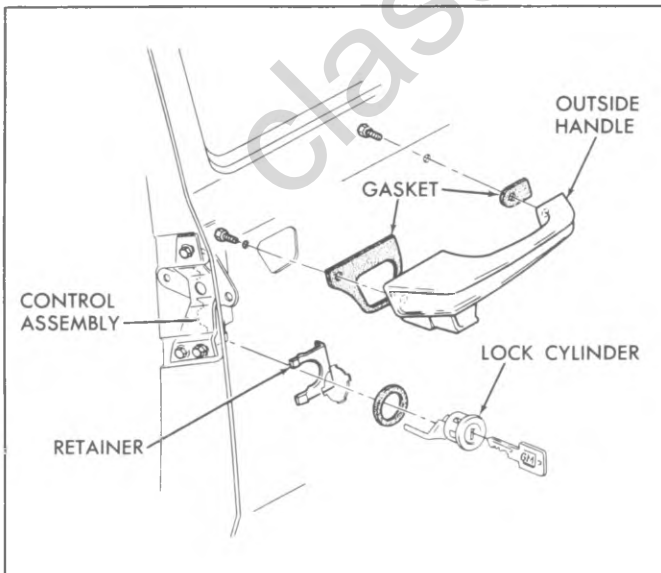


Fig. 2D-52--Rear Door Outside Handle and Lock Cylinder

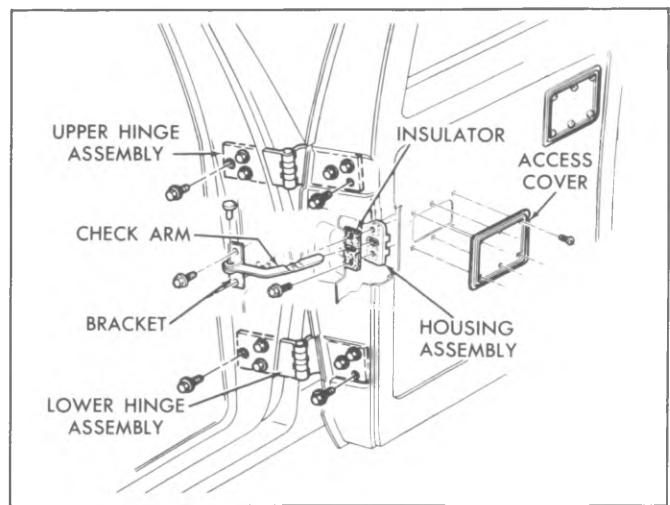


Fig. 2D-53--Rear Door Hinges and Check Arm

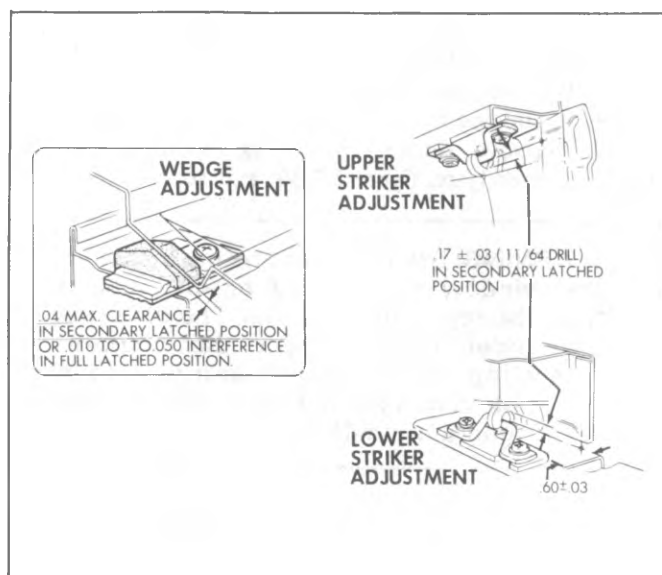


Fig. 2D-54--Wedge and Striker Adjustments

WEATHERSTRIP

Weatherstrip installation is shown in figure 2D-55. Proper installation is dependent on completely cleaning all foreign material from old installation and using a quality cement on the new installation.

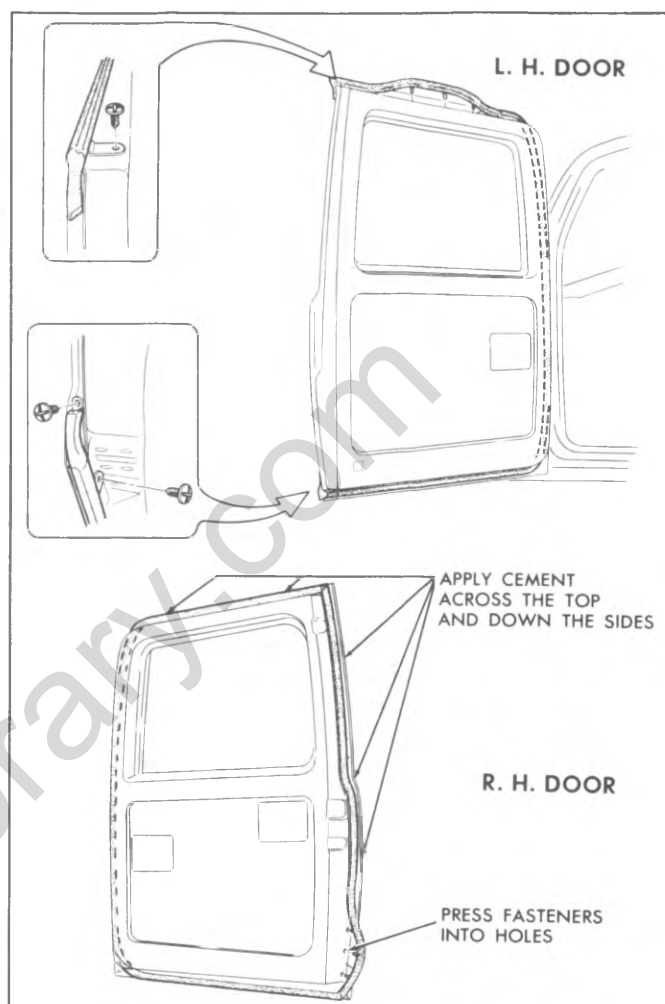


Fig. 2D-55--Weatherstrip--L.H. and R.H. Rear Door

ENDGATES (06 AND 14)

Coach models (06) and utility models (14) use endgates of similar, yet distinct design. Separate procedures follow for service on each of these endgates.

ENDGATE ASSEMBLY - (06) MODELS ONLY

Replacement

1. Lower endgate, and removed hinge access covers. See figure 2D-56.
2. Remove endgate-to-hinge bolts.
3. Remove L.H. torque rod bracket, shown in figure 2D-57.
4. If equipped with electric powered window, disconnect wiring harness.
5. Lift endgate to almost closed position and remove support cables.
6. Remove endgate with torque rod.
7. To install, reverse removal procedure.

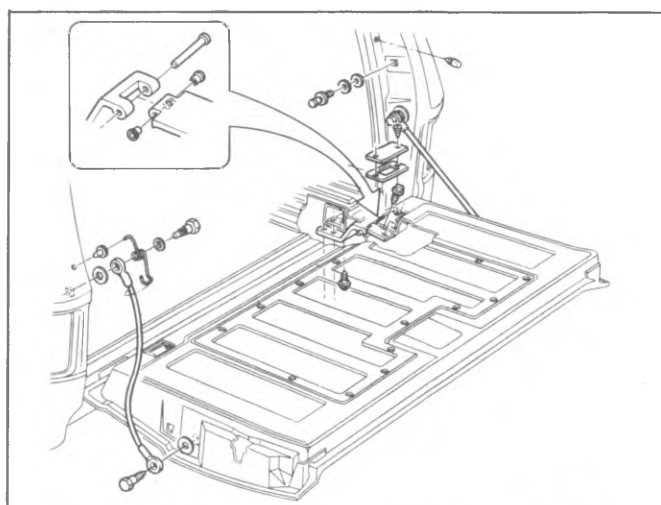


Fig. 2D-56--Endgate, Hinges and Supports--(06 Only)

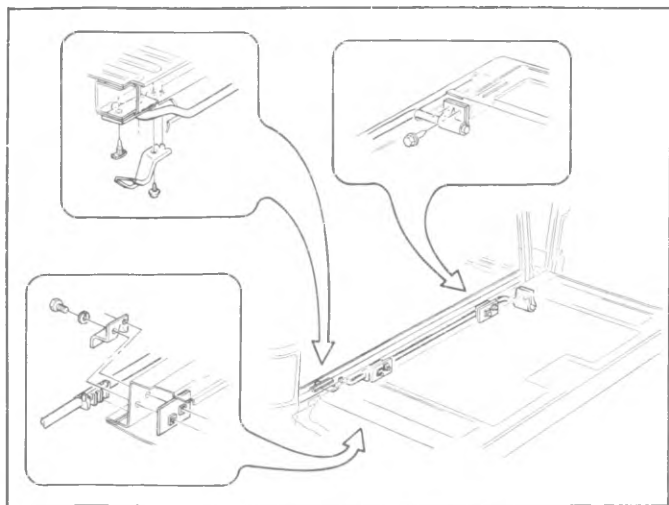


Fig. 2D-57--Torque Rod--(06 Only)

HINGES

Replacement

If necessary to remove hinges, remove endgate as outlined previously, and proceed as follows:

1. Remove bolts from each of the hinge assemblies on the underside of the body. See figure 2D-56.
2. Remove hinge assemblies. If the hinge pins are to be removed, note the position of bushings so they may be reinstalled in the same position.
3. Reverse procedure to install.

ENDGATE DISASSEMBLY

1. Remove access cover shown in figure 2D-58, to gain access to interior components.
2. Detach remote control rods from lock assembly by removing clips.
3. Remove bolts securing lock assembly, and remove lock assembly.
4. Remove handle assembly bolts and remove inside handle.
5. Remove R.H. torque rod bracket screws, figure 2D-57, then remove torque rod from endgate.

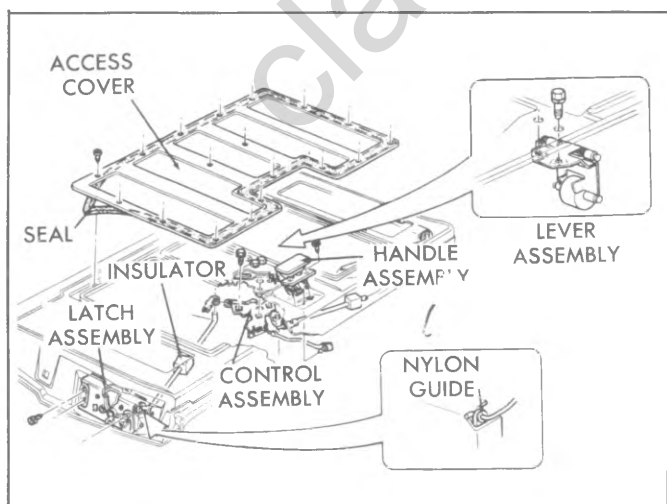


Fig. 2D-58--Latch and Remote Controls--(06 Only)

6. Remove screws connecting cam assemblies to sash assembly, figure 2D-59, then remove cam assemblies.
7. Remove glass from endgate.
8. Unclip and remove inner and outer seal assemblies.
9. Remove screws connecting window regulator assembly to endgate, figure 2D-59, and remove regulator.

WARNING: Step 10 must be performed if the window is removed or disengaged from the regulator lift arms. The lift arms are under tension from the counterbalance spring, and can cause injury if the motor is removed without locking the sector gears in position.

10. For endgates with electric window, secure the window regulator lift arms before removing the electric motor, when the window glass has been removed or disengaged from the lift arms.
 - a. Drill a 1/8 (3.1mm) inch hole through the sector gear and back plate, as shown in figure 2D-59. Install a sheet metal tapping screw into the hole to lock the sector gears in position.
 - b. Remove the regulator motor attaching screws and remove the motor assembly.
11. From inside the endgate, remove the nuts fastening the outside handle to endgate and remove the outside handle. See figure 2D-60.

NOTE: If equipped with power tailgate window, detach wiring harness from motor.
12. Remove side bolts connecting left and right glass channels to endgate and remove channels.
13. Remove side latch bolts and remove side latches with control rods. See figure 2D-58.

NOTE: Detach wiring harness from R.H. latch if so equipped.
14. Separate side latch from control rod by pulling control rod thru nylon guide.
15. Reverse the above procedure for reassembly and installation.

Adjustments

Loosen bolts, adjust at either endgate hinge position or endgate latch, then retighten bolts.

ENDGATE ASSEMBLY--(14) MODELS ONLY

Replacement

1. Lower endgate, then remove four bolts securing hinge to body on each side. See figure 2D-61. Disconnect wiring harness, if so equipped.
2. Disconnect torque rod anchor plate on each side. It is necessary to remove lower bolt only, then let plate swing down. See figure 2D-65.
3. With an assistant, raise endgate part way, then disconnect support cables from endgate. See figure 2D-61.
4. Remove endgate by pulling disconnected hinge from body, figure 2D-62, then grasping torque rod with one hand and pulling torque rod over gravel deflector, as shown in figure 2D-63.
5. Individual components may be removed from the endgate now, or after reinstallation.
6. To install endgate, reverse the above procedure.

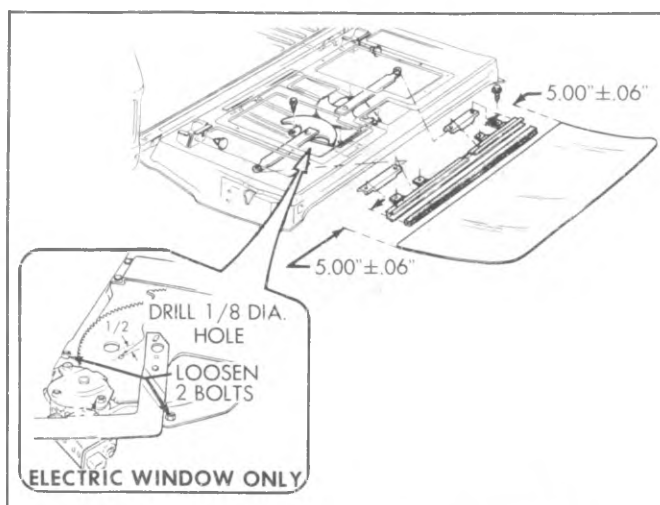


Fig. 2D-59--Window Glass and Regulator--(06 Only)

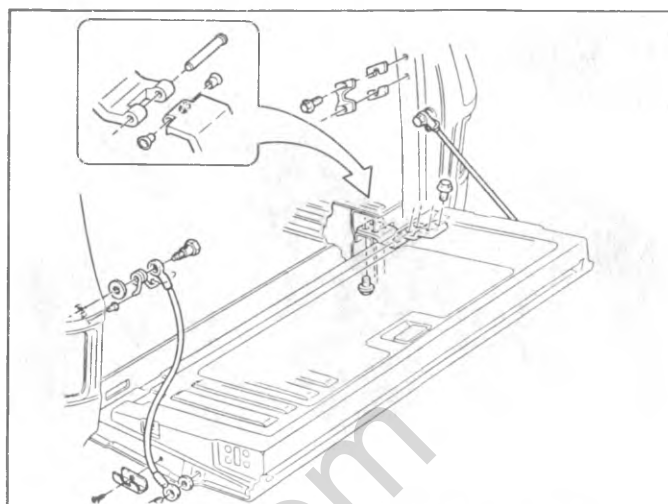


Fig. 2D-61--Endgate, Hinges and Support (14)

HINGE

Replacement

1. Lower endgate and disconnect hinge to be replaced by removing hinge-to-body bolts. See figure 2D-61.
2. At the other hinge, **loosen** the hinge-to-body bolts.
3. On the hinge to be replaced, remove the hinge-to-endgate bolts.
4. Pull the endgate away from the body several inches and withdraw hinge from body. Then lift endgate slightly to allow removal of hinge from endgate. See figure 2D-62.
5. To install hinge, reverse the above procedure. Be sure to install hinge into endgate first, then into the body.

TORQUE ROD

Replacement

1. Lower endgate and remove access cover, as shown in figure 2D-64.
2. Disconnect torque rod anchor plate. It is necessary to remove the lower bolt only, then let plate swing down. See figure 2D-65.
3. Loosen four bolts retaining endgate hinge to body.
4. Move endgate slightly away from body.

5. Remove torque rod retaining bracket on lower edge of endgate. See figure 2D-65.
6. Remove torque rod retaining clip on side edge of endgate.
7. Lift torque rod up and slide from endgate as shown in figure 2D-66.
8. Reverse the procedure above for installation.

ENDGATE DISASSEMBLY

1. Lower endgate and remove access cover.
2. Disconnect side latch remote control rods from center control by removing retaining clips. See figure 2D-67.
3. Remove four screws from each side latch, and withdraw latch and control rod from endgate, as shown in figure 2D-68.
4. Disconnect control rod from latch.
5. Refer to figure 2D-69 for installation of latch control and blackout rod.
6. Disconnect blackout rod from control assembly by detaching spring and removing two screws retaining rod to inner panel.
7. Disconnect inside handle control rod from control assembly, then remove screws which secure inside handle

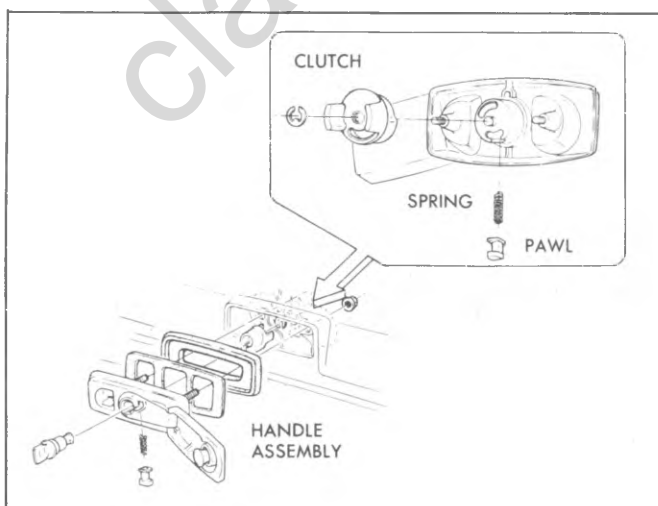


Fig. 2D-60--Outside Handle (06 and 14)

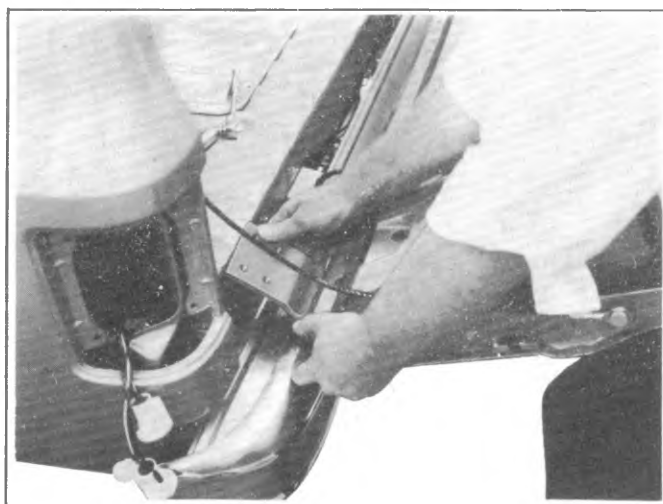


Fig. 2D-62--Pulling Hinge Away From Body (14)

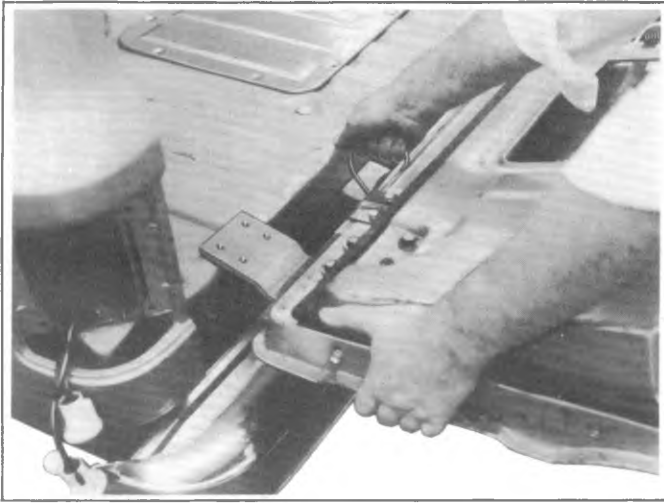


Fig. 2D-63--Grasping Torque Rod (14)

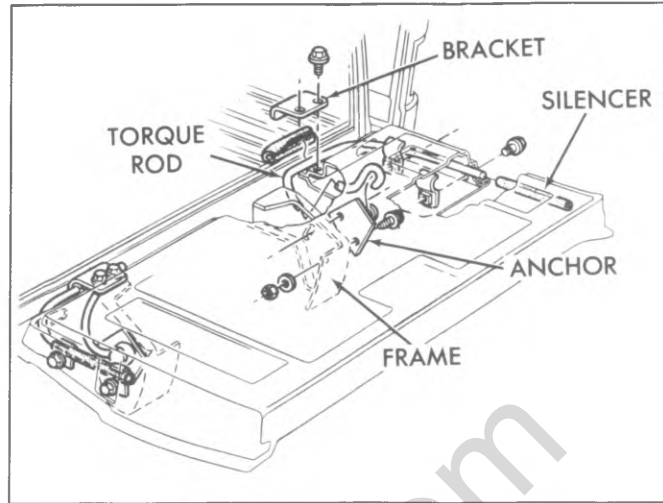


Fig. 2D-65--Torque Rod Installation (14)

to inner panel.

8. Remove three screws which retain remote control assembly to inner panel.

9. Remove control assembly and inside handle as shown in figure 2D-70.

10. Refer to figure 2D-71 for window and regulator installation.

11. Roll window to up position.

12. Disconnect sash from regulator as shown in figure 2D-72.

13. Remove glass from endgate.

14. Remove four regulator attaching screws and withdraw regulator from endgate as shown in figure 2D-73.

15. Remove outside handle by removing nuts from inside of outer panel. See figure 2D-74.

16. Reverse the above steps for reassembly.

TAILGATES (03, 63 and 14)

Replacement

Utility vehicles (14) without removable tops utilize a tailgate shown in figure 2D-75. Chassis/cab (03 and 63) models have optional pickup units which utilize tailgates as

shown in figures 2D-75 and 2D-76.

The tailgate shown in figure 2D-75 can be removed by disconnecting both links from the tailgate, removing screws attaching both trunnions to body, and lifting the tailgate off the vehicle.

The tailgate shown in figure 2D-76 can be separated from the vehicle by removing the bolt and lock washer from each trunnion in carrier box, and removing the tailgate.

REMOVABLE TOP-FOLDING TOP (16 ONLY)

Removal

1. Remove the bracket-to-roof bolt from each of the top-to-header panel attaching brackets as shown in Figure 2D-77.

2. Remove the bolts which retain the top to the body side panels, shown in figure 2D-78.

3. Lower the rear window into the endgate, and lower endgate.

4. Lower the door windows.

5. Slide top rearward approximately 18" to expose the bottom rear top-to-pickup box attaching holes.

6. To prevent possible flexing of the sides on removal,

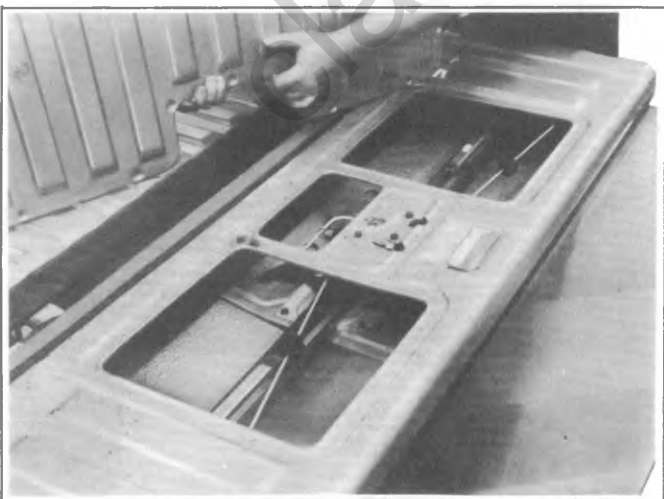


Fig. 2D-64--Removing Access Cover (14)

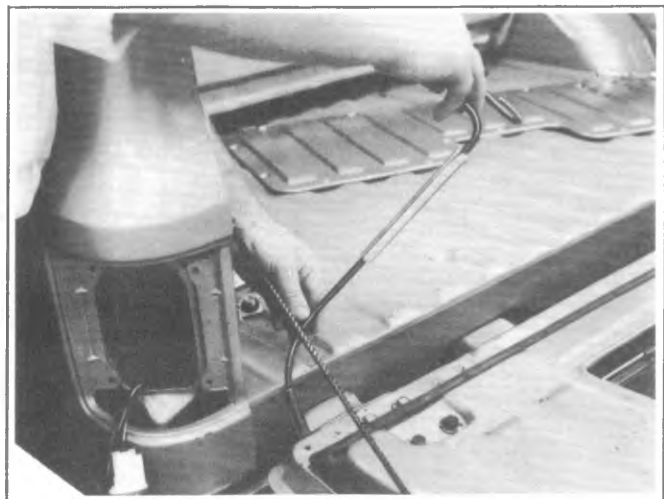


Fig. 2D-66--Removing Torque Rod (14)

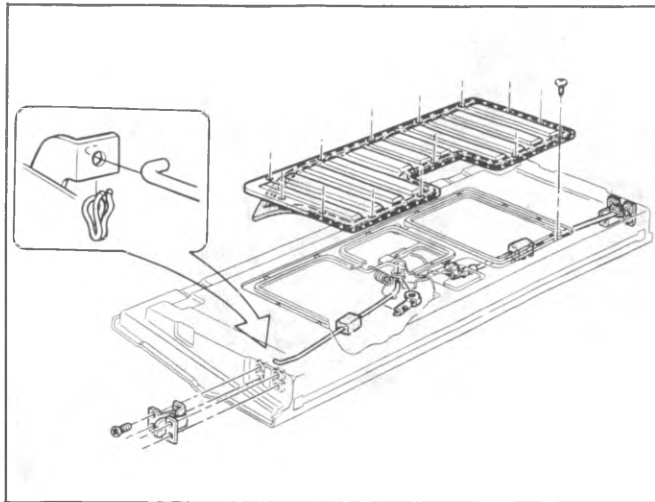


Fig. 2D-67--Latches and Rods

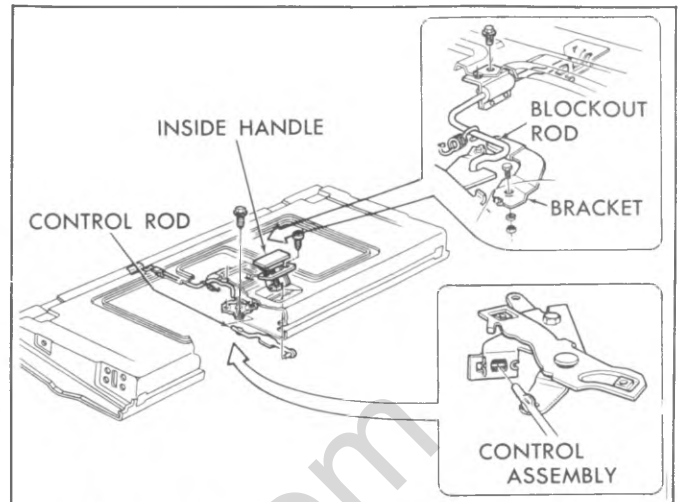


Fig. 2D-69--Control Assembly and Blockout Rod

connect the sides of the top with support braces as follows.

- a. Fabricate 2 braces 72" long from wood or square aluminum tubing. Drill two (2) 3/8" diameter holes, 63 inches apart in the brace.
- b. Attach one brace to the holes exposed in Step 7.
- c. Slide top forward to expose the front bottom top-to-pickup box attaching holes.
- d. Attach the second brace to these holes.

7. With assistance, lift the top and move it rearward for removal.

Mandatory Assembly Sequence (Fig. 2D-78)

Removable top must be clamped in direction of arrow A at points X and Y. Clamp load must be great enough to force the removable top against the steel cab at the attachment locations. After clamping, bolting must start with the rear vertical bolt (1) and then going forward, install (2), (3) and (4). When all but the front bolt (5) are in place, release the clamp and drive the front bolt. Then drive the horizontal bolts into the steel cab.

SEATS

Care and Cleaning of Interior Soft Trim

Dust and loose dirt that accumulate on interior fabric trim should be removed frequently with a vacuum cleaner, whisk broom or soft brush. Vinyl or leather trim should be wiped clean with a damp cloth. Normal cleanable trim soilage, spots or stains can be cleaned with the proper use of trim cleaners available through General Motors dealers or other reputable supply outlets. Before attempting to remove spots or stains from upholstery, determine as accurately as possible the nature and age of the spot or stain. Some spots or stains can be removed satisfactorily with water or mild soap solution (refer to accompanying "Removal of Specific Stains"). For best results, spots or stains should be removed as soon as possible. Some types of stains or soilage such as lipsticks, some inks, certain types of grease, mustard, etc., are extremely difficult and, in some cases, impossible to completely remove. When cleaning this type of stain or soilage, care must be taken not to enlarge the soiled area. It is sometimes more desirable to have a small stain than an enlarged stain as a result of careless cleaning.

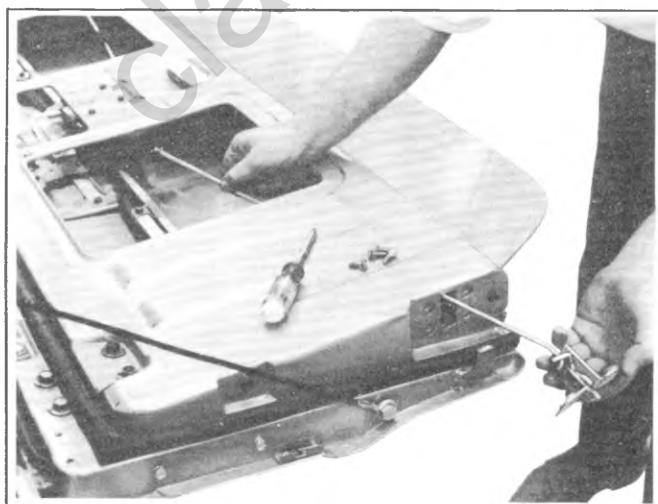


Fig. 2D-68--Removing Side Latch

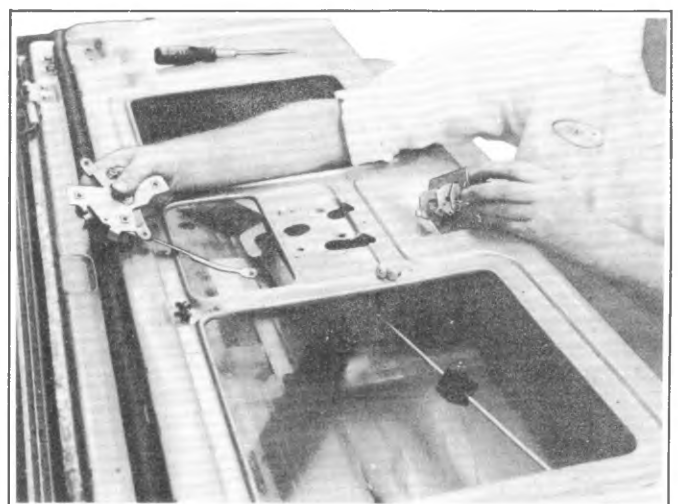


Fig. 2D-70--Removing Control Assembly and Inside Handle

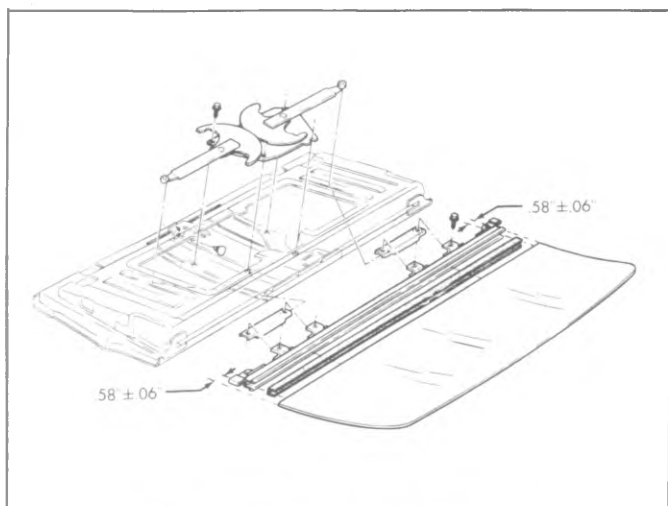


Fig. 2D-71--Window and Regulator



Fig. 2D-73--Removing Regulator

CAUTION: When cleaning interior soft trim such as upholstery or carpeting, do not use volatile cleaning solvents such as: acetone, lacquer thinners, carbon tetrachloride, enamel reducers, nail polish removers; or such cleaning materials as laundry soaps, bleaches or reducing agents (except as noted in the instructions on stain removal). Never use gasoline or naphtha for any cleaning purpose. These materials may be toxic or flammable, or may cause damage to interior trim.

Cleaning Fabrics with Cleaning Fluid

This type of cleaner should be used for cleaning stains containing grease, oil or fats. Excess stain should be gently scraped off trim with a clean dull knife or scraper. Use very little cleaner, light pressure, and clean cloths (preferably cheese cloth). Cleaning action with cloth should be from outside of stain towards center and constantly changing to a clean section of cloth. When stain is cleaned from fabric, immediately wipe area briskly with a clean absorbent towel or cheese cloth to help dry area and prevent a cleaning ring. If ring forms, immediately clean entire area or panel section of the trim assembly.

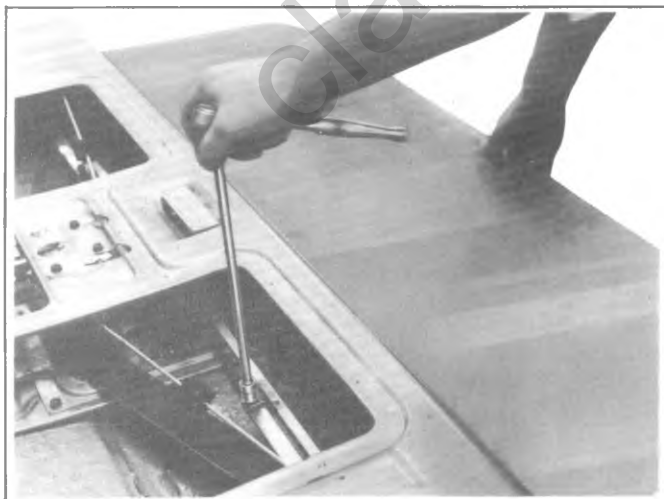


Fig. 2D-72--Disconnecting Sash from Regulator

NOTE: Sometimes a difficult spot may require a second application of cleaning fluid followed immediately by a soft brush to completely remove the spot.

Cleaning Fabrics with Detergent Foam Cleaners

This type of cleaner is excellent for cleaning general soilage from fabrics and for cleaning a panel section where a minor cleaning ring may be left from spot cleaning. Vacuum area to remove excess loose dirt. Always clean at least a full trim panel or section of trim. Mask adjacent trim along stitch or weld lines. Mix detergent type foam cleaners in strict accordance with directions on label of container. Use foam only on a clean sponge or soft bristle brush. Do not wet fabric excessively or rub harshly with brush. Wipe clean with a slightly damp absorbent towel or cloth. Immediately after cleaning fabric, dry fabric, with a dry towel or hair dryer. Rewipe fabric with dry absorbent towel or cloth to restore the luster of the trim and to eliminate any dried residue.

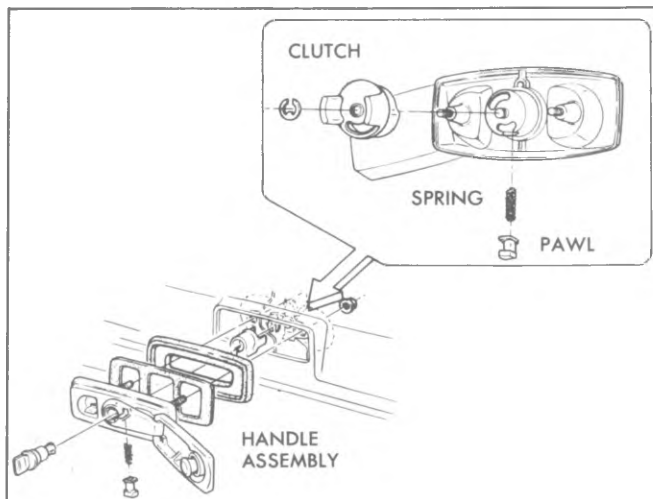


Fig. 2D-74--Outside Handle

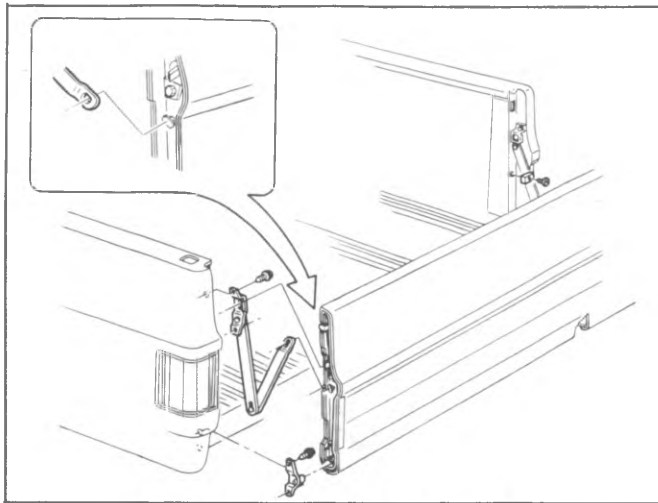


Fig. 2D-75--Tailgate (14, 03 and 63)

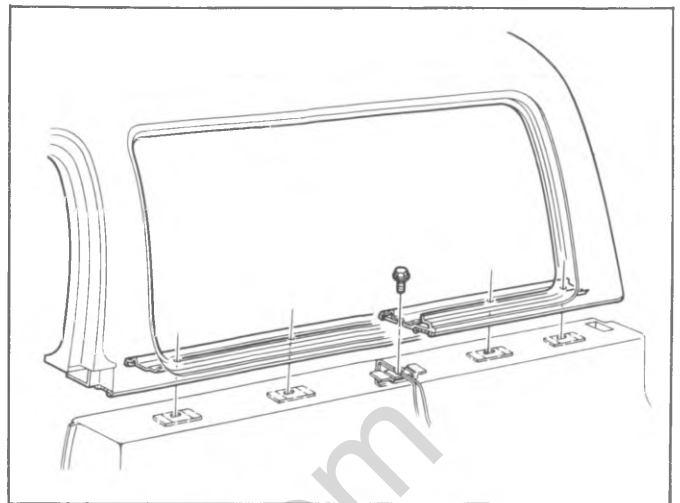


Fig. 2D-77--Roof-to-Header Brackets

Removal of Specific Stains

Candy

Chocolate, use cloth soaked in lukewarm water; other than chocolate, use very hot water. Dry. If necessary, clean lightly with fabric cleaning fluid.

Chewing Gum

Harden gum with ice cube and scrape off with dull knife. Moisten with fabric cleaning fluid and scrape again.

Fruit Stains, Coffee, Soft Drinks, Ice Cream and Milk

Wipe with cloth soaked in cold water. If necessary clean lightly with fabric cleaning fluid. Soap and water is not recommended as it might set the stain.

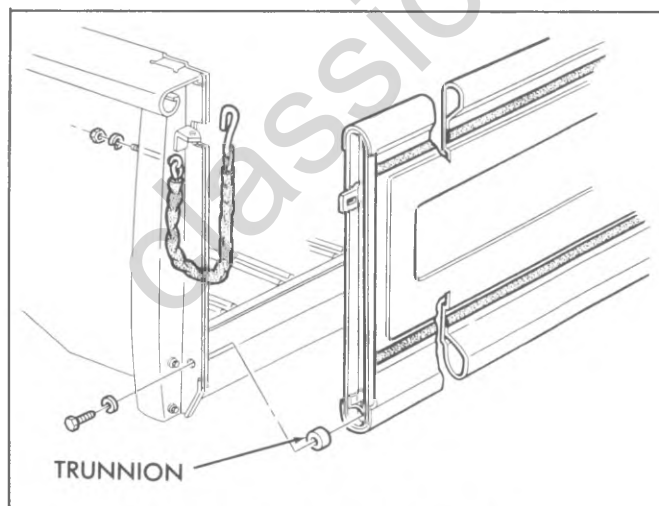


Fig. 2D-76--Tailgate (03 and 63)

Catsup

Wipe with cloth soaked in cool water. If further cleaning is necessary, use a detergent foam cleaner.

Grease, Oil, Butter, Margarine and Crayon

Scrape off excess with dull knife. Use fabric cleaning fluid.

Paste or Wax Type Shoe Polish

Light application of fabric cleaning fluid.

Tar

Remove excess with dull knife, moisten with fabric cleaning fluid, scrape again, rub lightly with additional cleaner.

Blood

Wipe with clean cloth moistened with cold water. Use no soap.

Urine

Sponge stain with lukewarm soap suds from mild neutral soap and clean cloth, rinse with cloth soaked in cold water, saturate cloth with one part household ammonia water and 5 parts water, apply for 1 minute, rinse with clean, wet cloth.

Vomit

Sponge with clean cloth dipped in clean, cold water. Wash lightly with lukewarm water and mild neutral soap. If odor persists, treat area with water-baking soda solution (1 teaspoon baking soda to one cup of tepid water). Rub again with cloth and cold water. Finally, if necessary, clean lightly with fabric cleaning fluid.

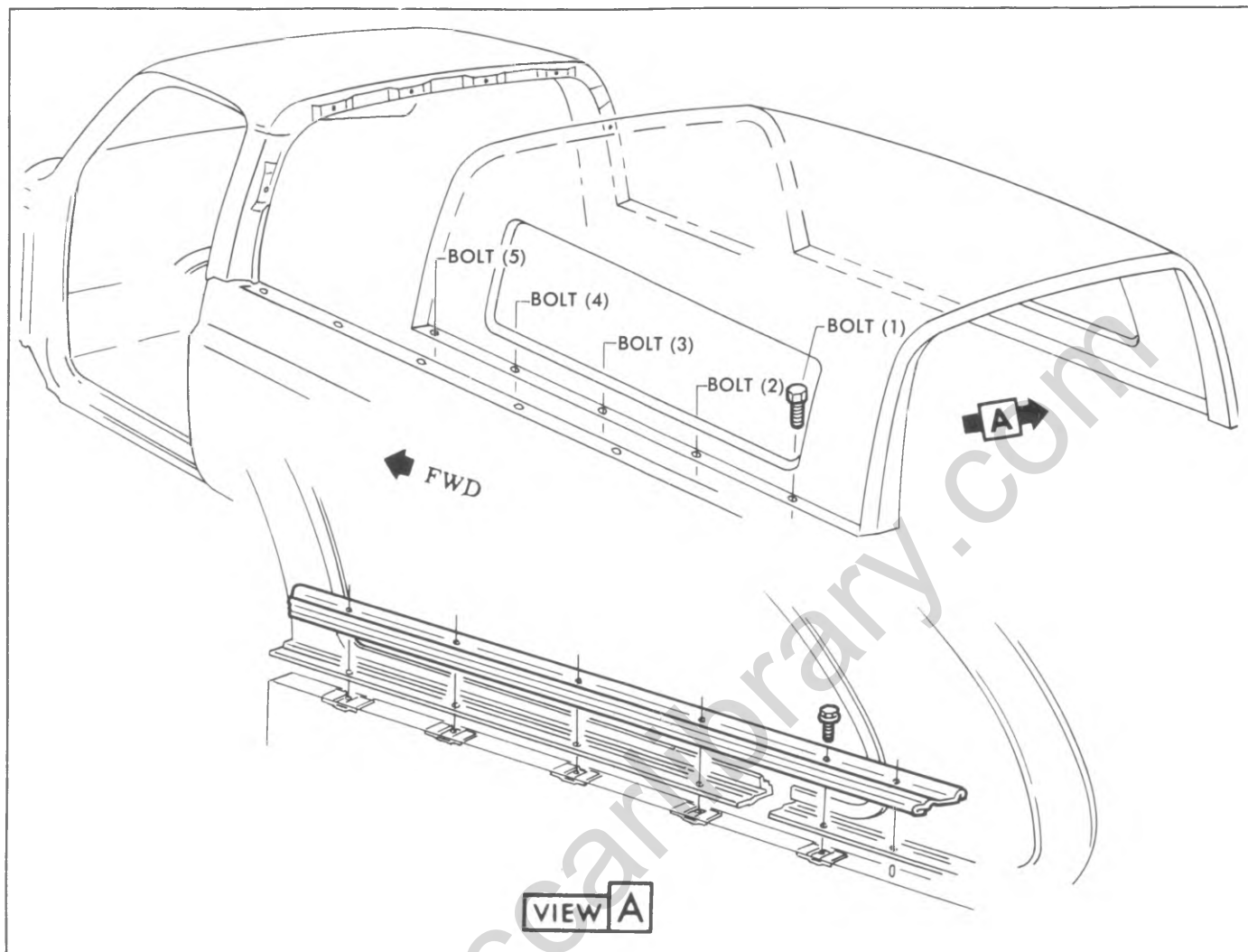


Fig. 2D-78--Removable Top

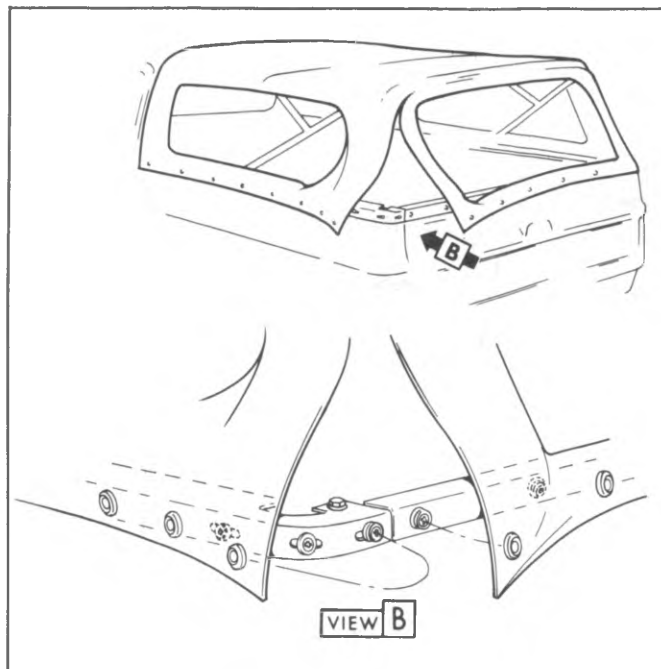


Fig. 2D-79--Folding Top Assembly

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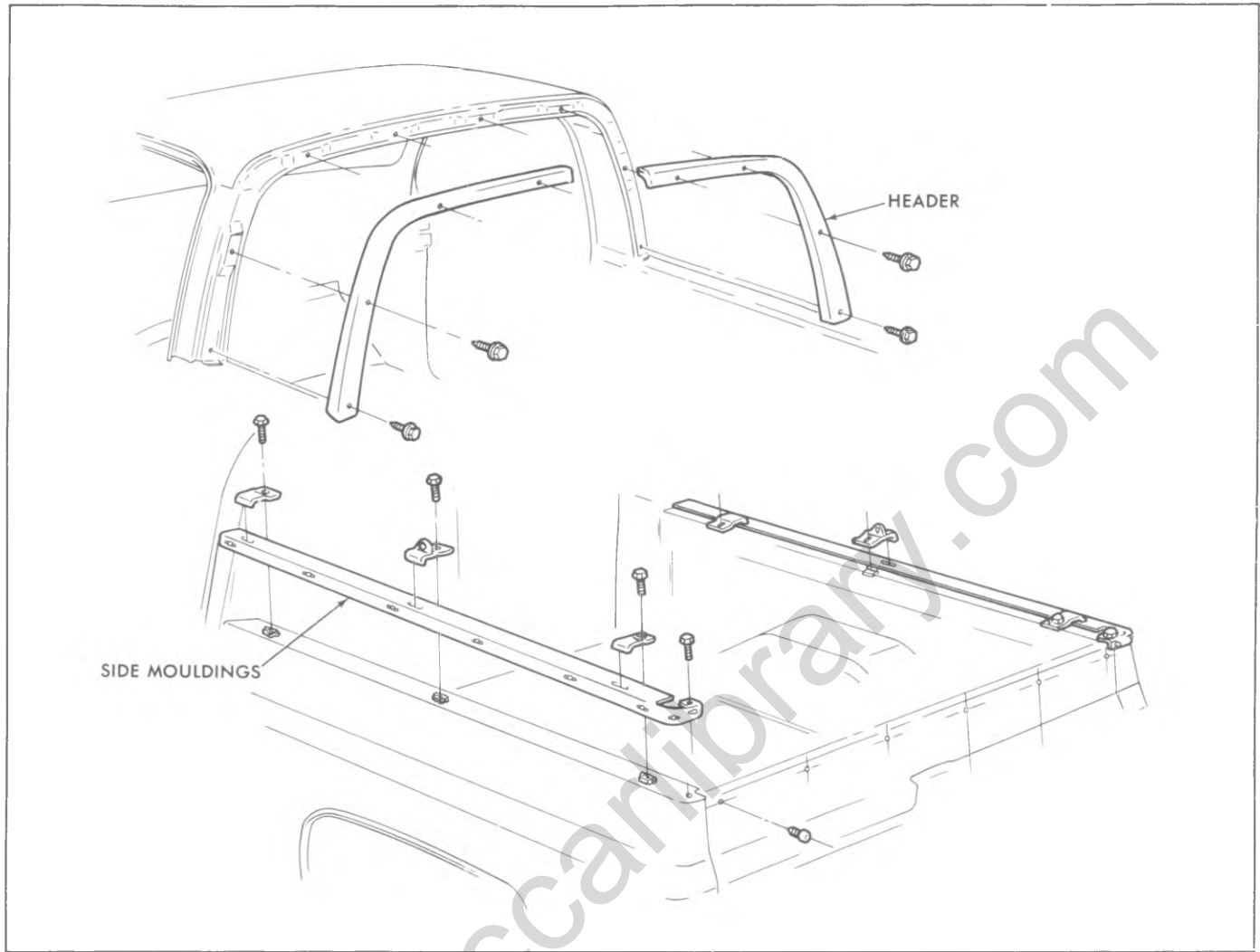


Fig. 2D-80--Folding Top Side Moldings and Header

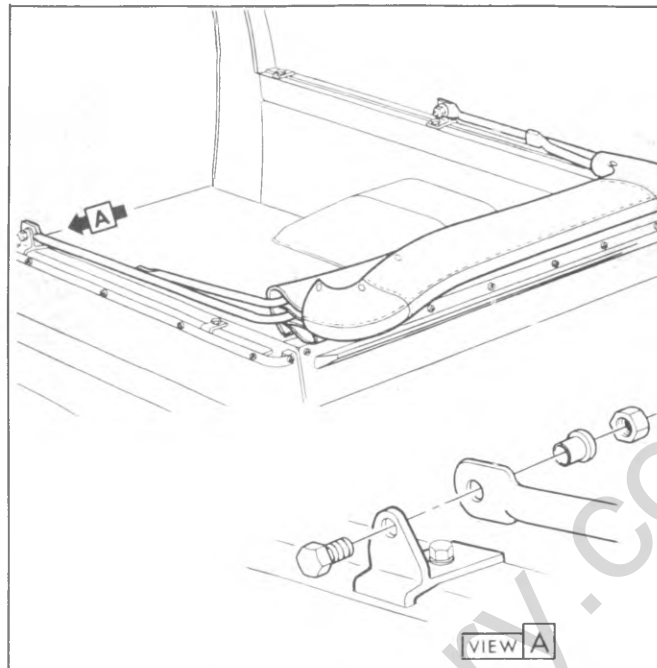


Fig. 2D-81--Folding Top Assembly and Storage

SEAT MOUNTING

Typical Seat Mounting provisions are shown in figures 2D-82 through 2D-90.

CAUTION: See *CAUTION* on page 1 of this section regarding fasteners used on seats and seat belts.

BODY MOUNTING

The sequence of mounting attachments is shown in figures 2D-91 through 2D-94.

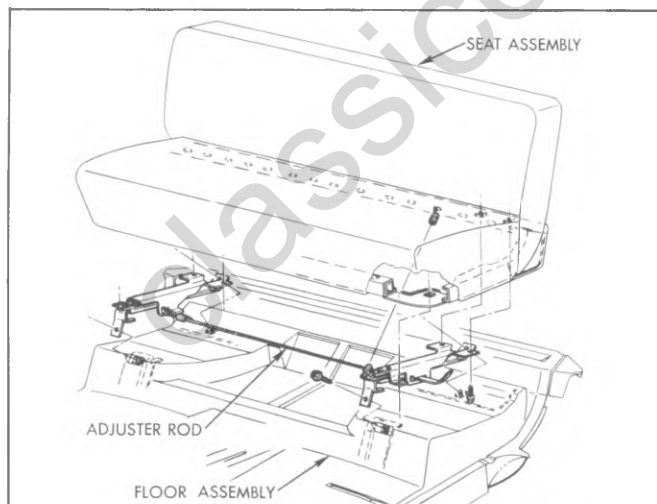


Fig. 2D-82--Front Bench Seat (03, 06 and 63)

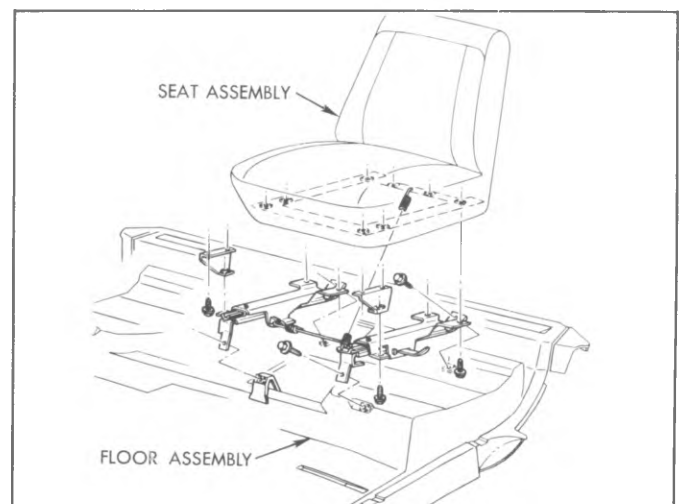


Fig. 2D-83--Driver's Bucket Seat (03)

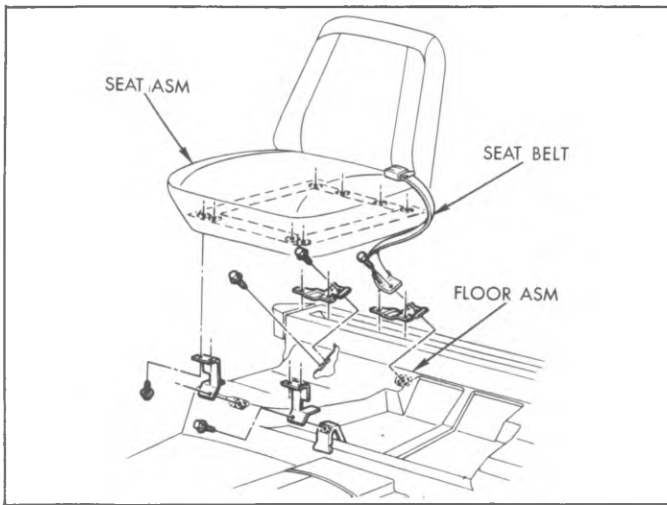


Fig. 2D-84--Passenger's Bucket Seat (03)

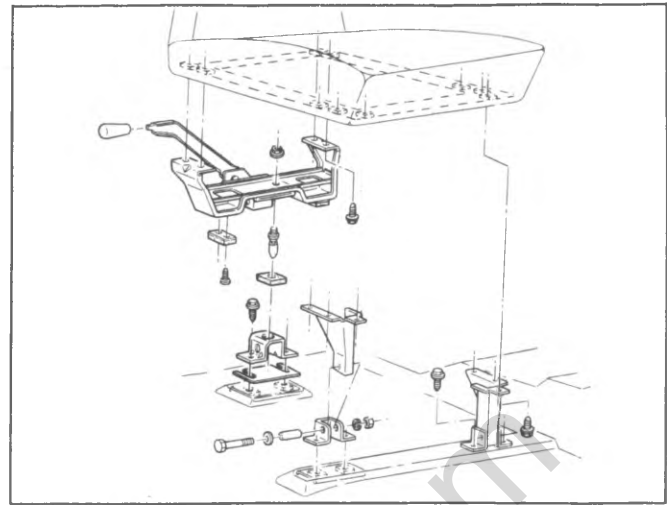


Fig. 2D-86--Passenger's Bucket Seat (14)

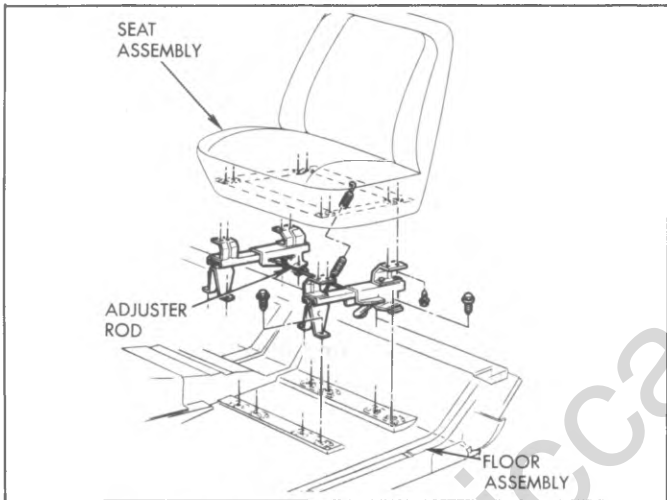


Fig. 2D-85--Driver's Bucket Seat (14)

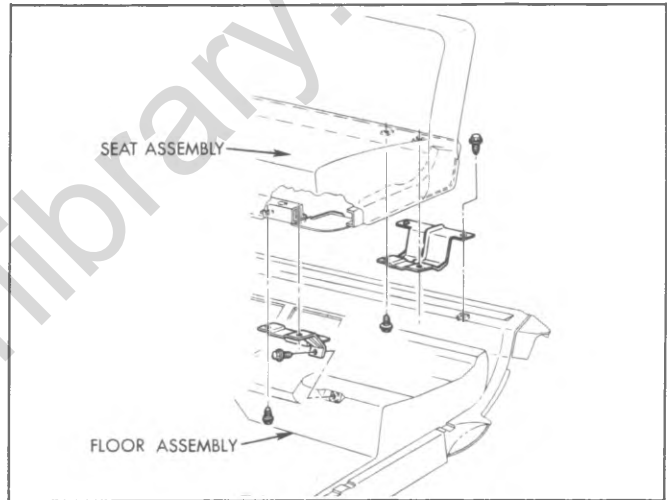


Fig. 2D-87--Rear Bench Seat (63)

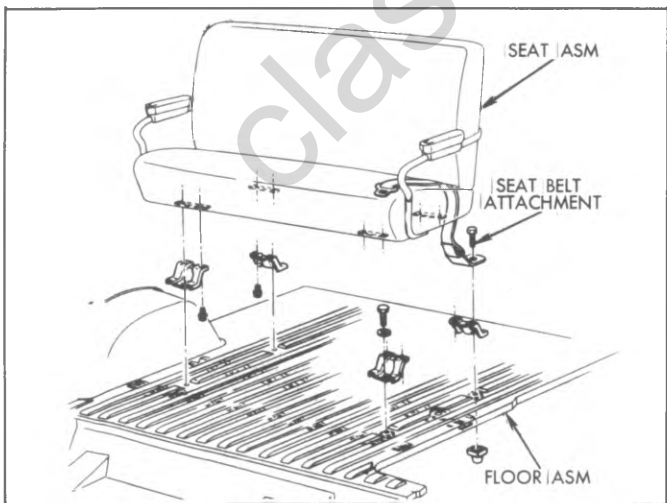


Fig. 2D-88--Rear Bench Seat (06)

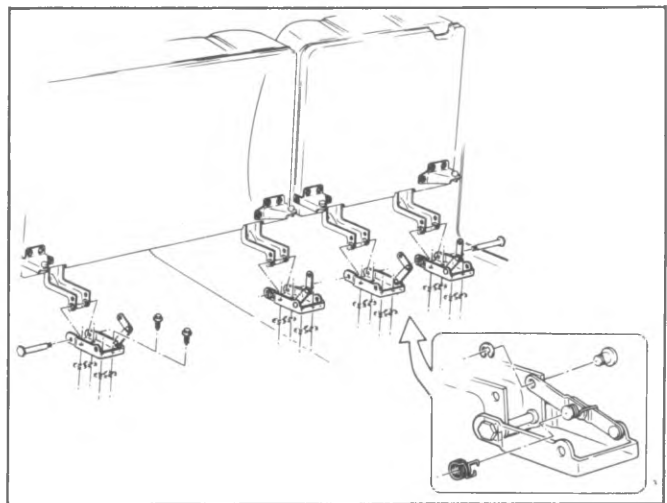


Fig. 2D-89--Rear Folding Seat (06)

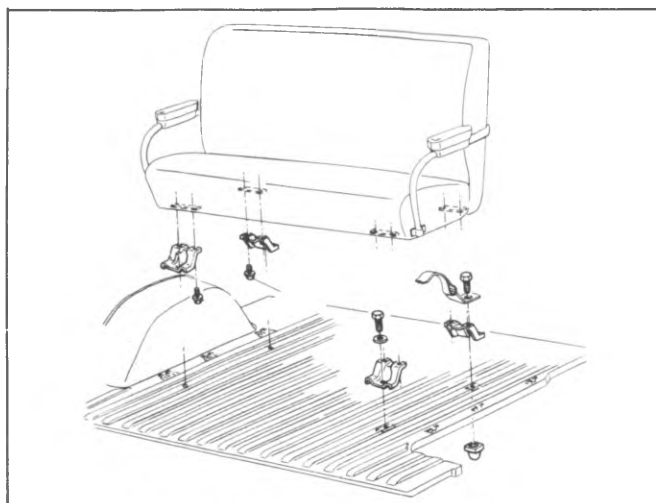


Fig. 2D-90--Rear Bench Seat (14)

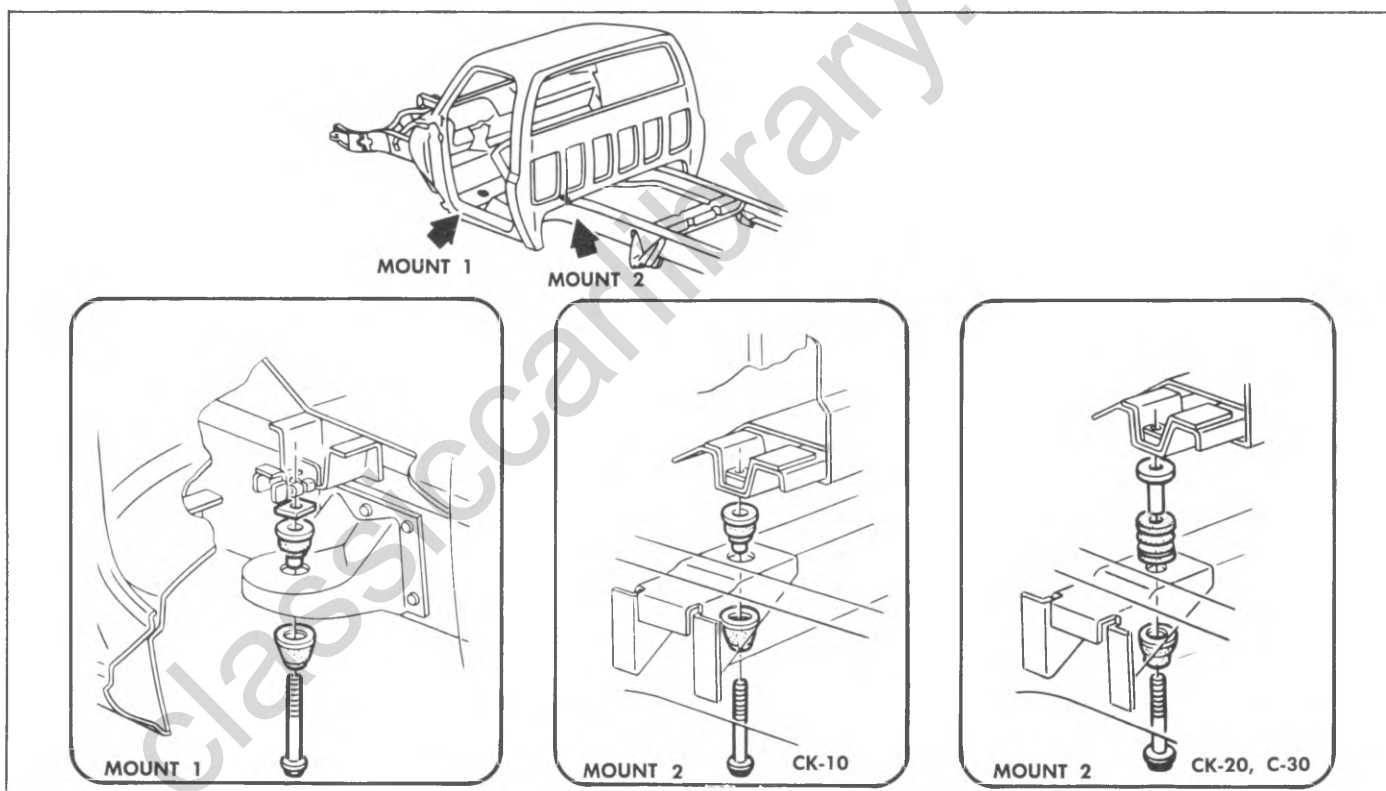


Fig. 2D-91--Body Mounting (03)

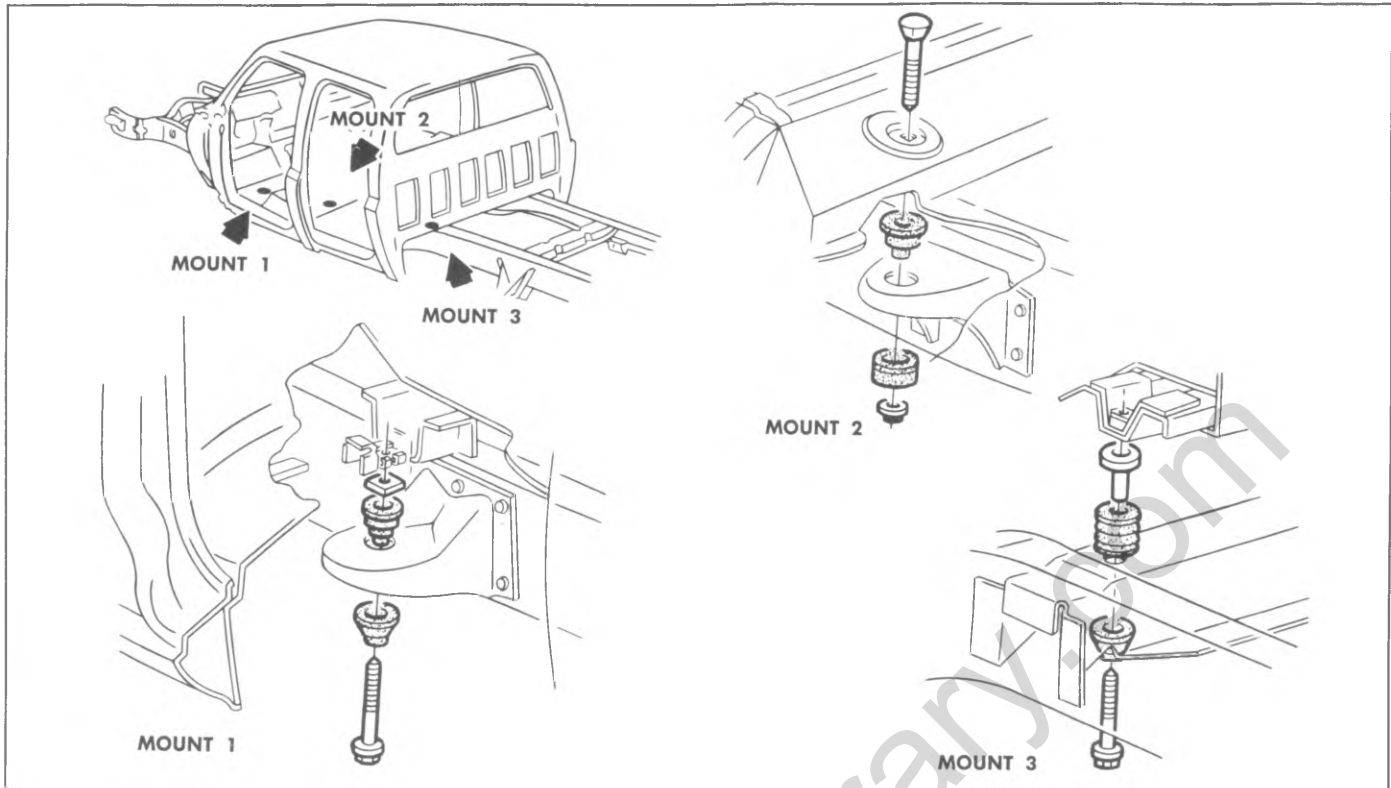


Fig. 2D-92--Body Mounting (63)

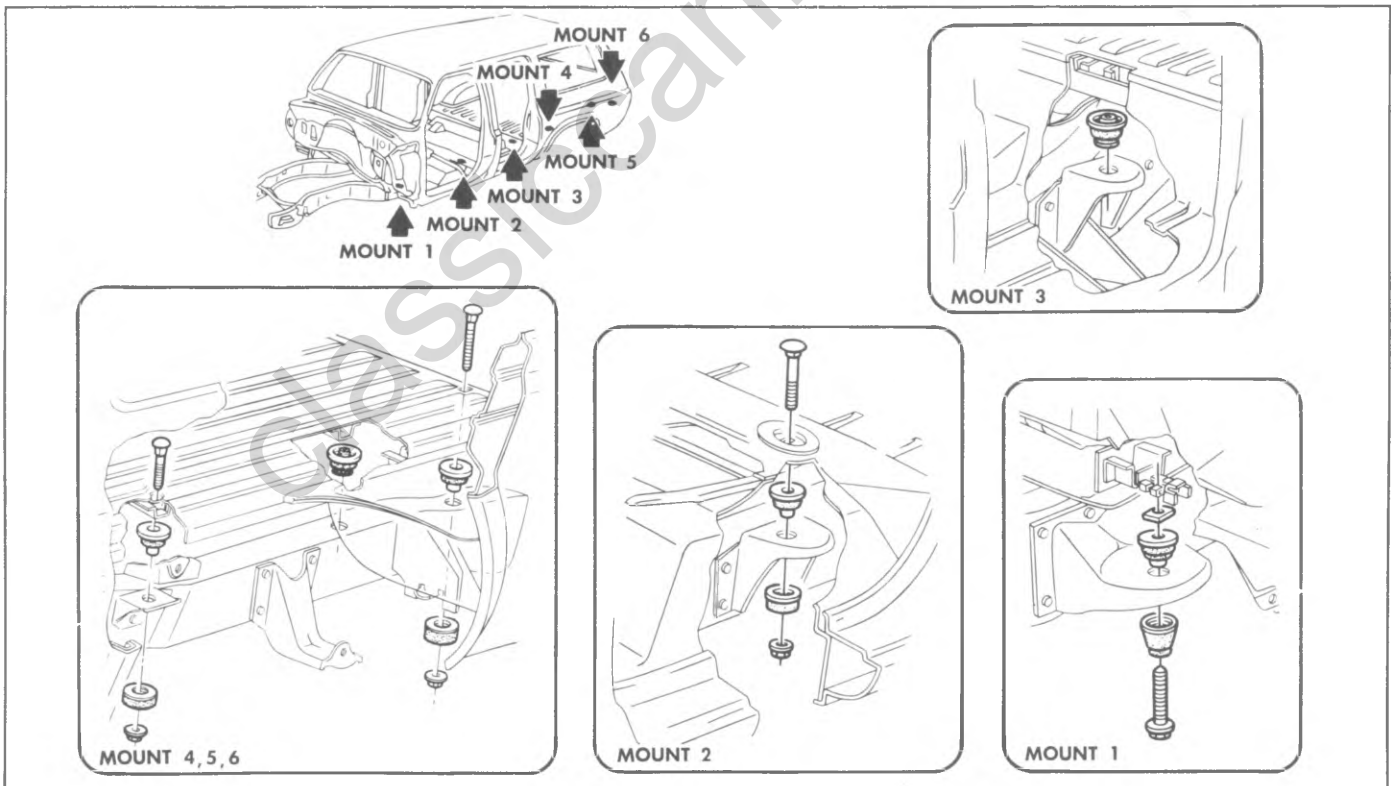


Fig. 2D-93--Body Mounting (06)

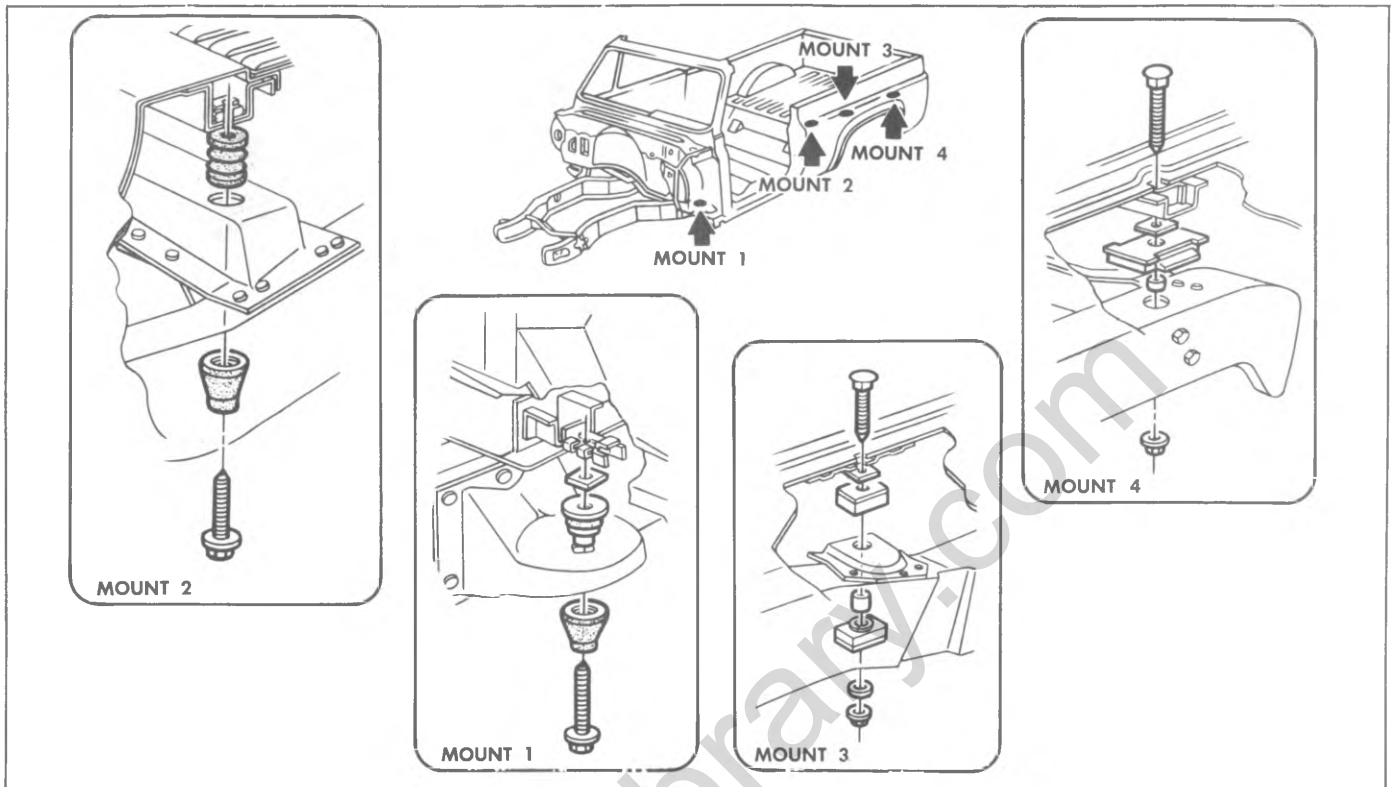


Fig. 2D-94--Body Mounting (14)

G MODELS

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FRONT END

WINDSHIELD WIPERS

Windshield wiper units on all models are of the two-speed electric type. A single wiper motor unit, mounted to dash panel at top and to left of engine cover inside cab,

powers both wiper blades. The wiper blade operating link rods and pivot mountings on these models are located in the outside air inlet plenum chamber.

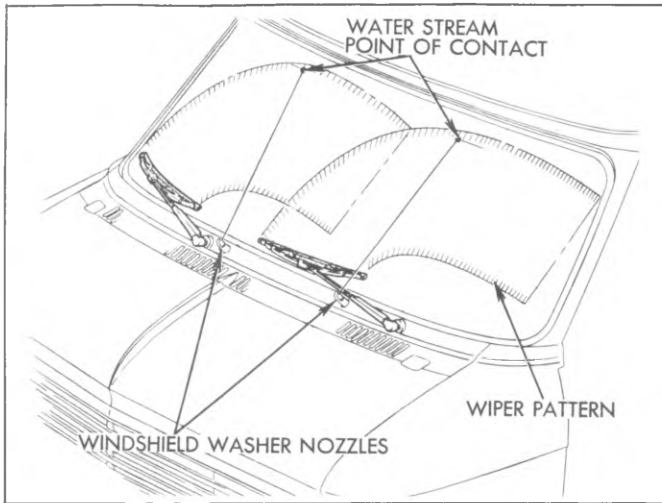


Fig. 2D-95--Wiper Pattern

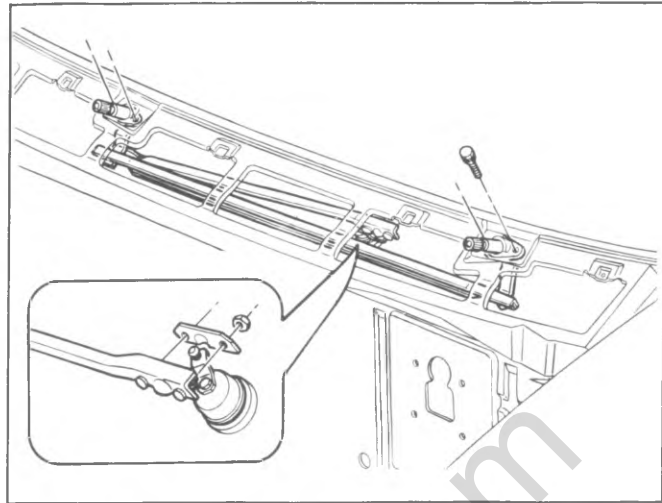


Fig. 2D-96--Windshield Wiper Linkage

Arm Adjustment

To adjust sweep of blades turn on wipers, then note sweep of arms. If necessary, remove one or both arms as follows: Pull out end of arm away from glass which will trip lock spring at base of arm and release spring from undercut of pivot shaft. While holding arm in this position, pull outward on cap section at base of arm to remove arm. Arm can be reinstalled in any one of several positions due to serrations on pivot shaft and in arm cap. See figure 2D-95.

WIPER ARM PIVOT SHAFTS AND LINK ROD—FIG. 2D-96

Removal

1. Remove windshield wiper arms from pivot shafts. Procedure for removing arms is explained previously under "Arm Adjustments."
2. Remove screws which attach outside air cowl ventilator grille to cowl. Carefully remove grille from cowl.
3. At center of cowl, remove two attaching nuts which attach link rod to motor drive. Disengage link rods from pins.
4. Remove screws which attach each arm transmission pivot shaft assembly to cowl. Remove pivot shaft assembly with link rod from plenum chamber.

Installation

1. Place pivot shaft assembly with link rod into position at cowl bracket. Secure assembly to bracket with two screws.
2. Attach end of link rod to motor drive and arm. Secure rod with the two attaching nuts.
3. Install outside air cowl ventilator grille to top of cowl.
4. Before installing wiper arms, operate wiper motor momentarily which should rotate pivot shafts to park position. Install arms.

COWL VENTILATOR GRILLE

Replacement

1. Remove windshield wiper blades.
2. Remove screws retaining grille, figure 2D-97.
3. Remove grille and seal.
4. Reverse above steps to install grille.

Replacement

1. Remove screws retaining valve guide to panel, as shown in figure 2D-98.
2. Remove valve assembly by depressing pins at top and bottom of valve.
3. Reverse the above steps for installation.

REAR VIEW MIRRORS

Inside Rear View Mirror

Replacement

The inside mirror may be removed by removing screw retaining mirror to its glass-mounted bracket, and lifting mirror off bracket.

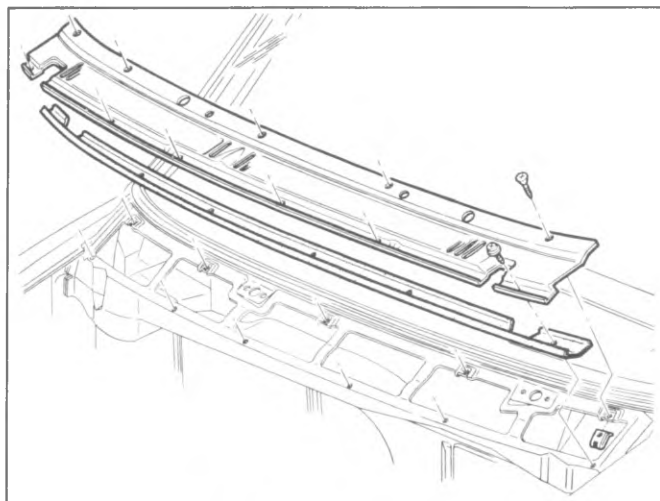


Fig. 2D-97--Cowl Ventilator Grille

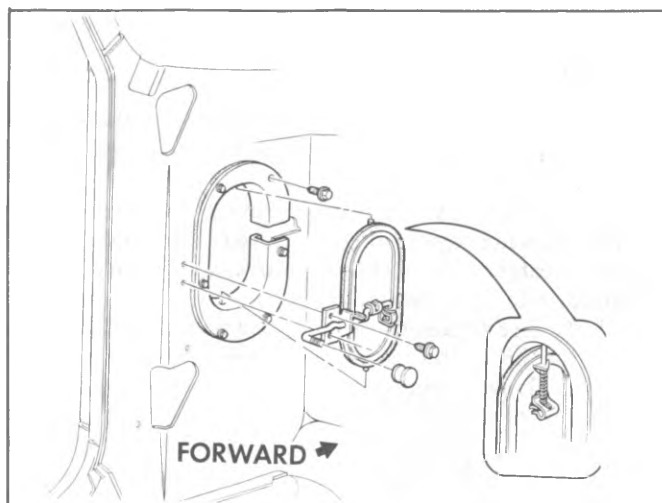


Fig. 2D-98--Side Cowl Ventilator

Outside Rear View Mirrors

Outside rear view mirror installations are shown in figure 2D-100. Occasional tightening of mounting and assembly bolts and screws will sharply decrease occurrence of failure due to door slamming or road shock.

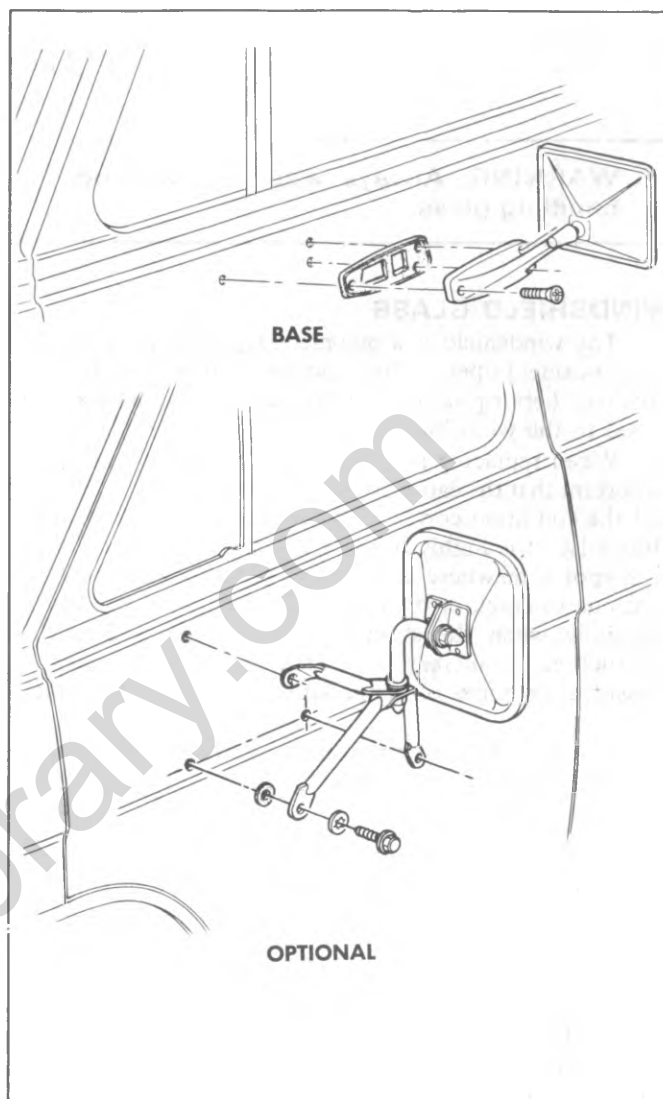


Fig. 2D-100--Outside Rear View Mirrors

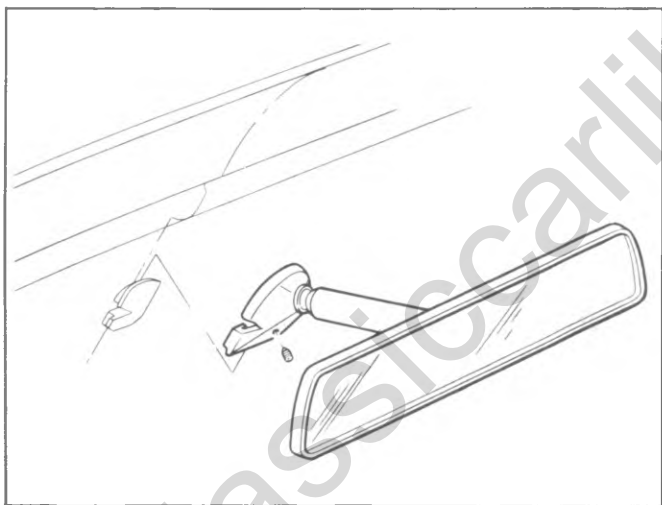


Fig. 2D-99--Inside Rear View Mirror

BODY GLASS

WARNING: Always wear gloves when handling glass.

WINDSHIELD GLASS

The windshield is a one-piece type and is retained in the windshield opening by a moulded rubber weatherstrip. This weatherstrip is sealed in the windshield opening and sealed to the windshield glass. See figure 2D-101.

When replacing a cracked windshield glass, it is very important that the cause of the glass breakage be determined and the condition corrected before a new glass is installed. Otherwise, it is highly possible that a small obstruction or high spot somewhere around the windshield opening will continue to crack or break the newly installed windshield, especially when the strain on the glass caused by this obstruction is increased by such conditions as wind pressures, extremes of temperature, motion of the vehicle, etc.

The procedure for removal of the windshield applies to the complete windshield assembly and to other stationary glass, such as in figure 2D-104.

Removal

NOTE: Refer to figures 2D-14 to 2D-16 in the "C-K Models" portion of this section for illustration of removal technique.

1. Before removing the windshield, mark the location of the break on the windshield rubber channel and the body. Protect the paint finish inside of the cab. Mask around the windshield opening and outside, lay a suitable covering across the hood and fenders.



Fig. 2D-101--Windshield Glass

NOTE: The windshield glass rubber weatherstrip is one piece. The glass is held in a channel within the weatherstrip.

2. Do not try to remove reveal moldings while windshield is in body opening. Remove reveal molding from custom weatherstrip retention groove after windshield is removed from body opening.

3. To free windshield rubber channel of weatherstrip loosen the lip of the windshield weatherstrip from the pinchweld flange along the top and at the sides by applying firm, controlled pressure to the edge of the glass. At the same time assist the lip of the rubber weatherstrip channel over the pinchweld flange with a flat bladed tool.

Checking Windshield Opening

Due to the expanse and contour of the windshield it is imperative in the event of a stress crack that the windshield opening be thoroughly checked before installing a replacement windshield. The replacement glass is used as a template.

1. Check for the following conditions at the previously marked point of fracture.

- Chipped edges on glass.
- Irregularities in body opening.
- Irregularities in rubber channel weatherstrip.

2. Remove all sealer from flange and body around windshield opening.

3. Check flange area for solder, weld high spots, or hardened spot-weld sealer. Remove all high spots.

4. Check windshield glass to opening, by supporting glass with six spacers contained in packet J-22577, as shown in figure 2D-102.

CAUTION: Do not strike glass against body metal. Chipped edges on the glass can lead to future breaks.

NOTE: It is necessary to modify the spacers by cutting off 3/16" from the back of the spacer with a knife, as shown in figure 2D-102.

With the windshield supported and centered in its opening, check the relationship of the glass to the body

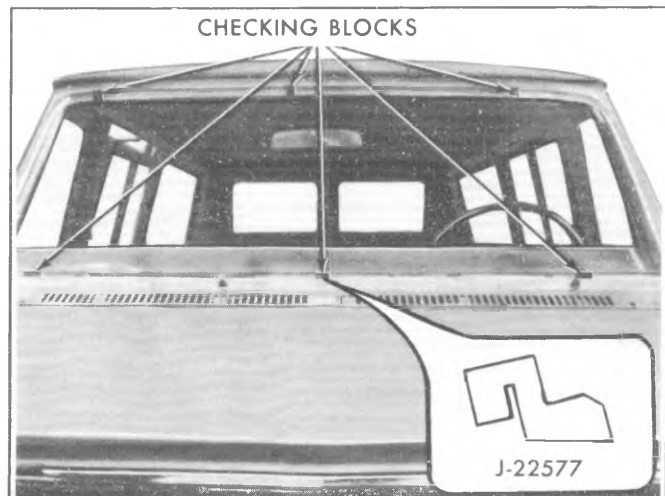


Fig. 2D-102--Checking Windshield Opening

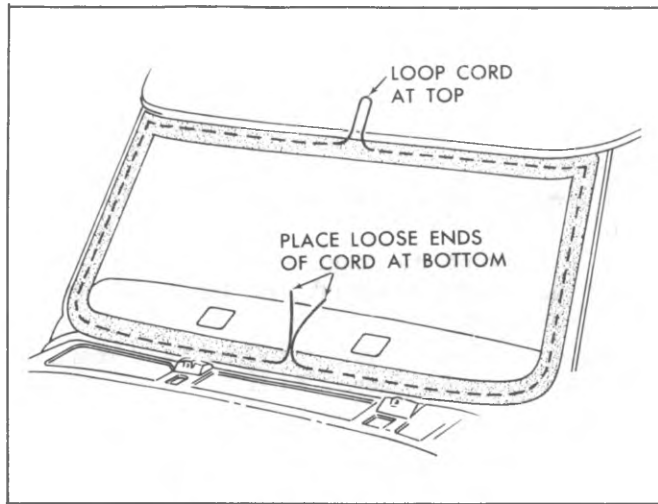


Fig. 2D-103--Cord Installation

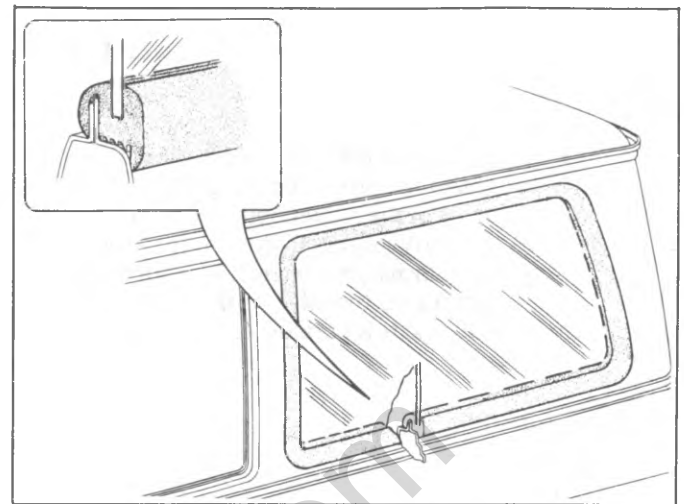


Fig. 2D-104--Body Window Glass

opening flange around the entire perimeter of the glass.

6. Check the relationship of glass to opening as follows:
 - a. Inside edge of glass to body flange.
 - b. Outer edge of glass to parallel body metal.

7. Mark areas of body metal or flange to be reformed, remove glass and correct as necessary.

8. Recheck windshield in its opening and if satisfactory proceed as follows:

Installation

1. Apply sealer to weatherstrip and install on glass.
2. Install a cord around periphery of weatherstrip, leaving a loop at the top and the loose ends at the bottom. See figure 2D-103.
3. Place protective covering over plenum grille, front fenders and hood.
4. Place windshield and weatherstrip assembly in opening. With one technician lightly pushing in on windshield, another technician within the cab should pull on the cord as follows:
 - a. Pull on loose ends until each is within 2" of its respective upper corner.
 - b. Pull on loop until cord is within 2" of the upper corners.
 - c. Finish seating corners by simultaneously pulling on both ends of the cord at each corner. This will insure proper positioning of the critical upper corners.
 - d. Seal windshield to weatherstrip and weatherstrip to body.

SWINGOUT WINDOW

Removal

1. Swing out the window. See figure 2D-105.
2. Remove screws retaining latch to body.
3. Remove window hinge retaining screws and window.
4. Remove latch from glass.

Installation

1. Install latch to glass using escutcheon, spacer, washer latch and screw. Torque to specifications.
2. Place window into opening and install hinge retaining screws and window.
3. Install latch to glass.

LATCH SWINGOUT WINDOW

Replacement

1. Swing out the window.
2. Remove latch to body and latch to window screws and remove latch.
3. Reverse above steps for installation.

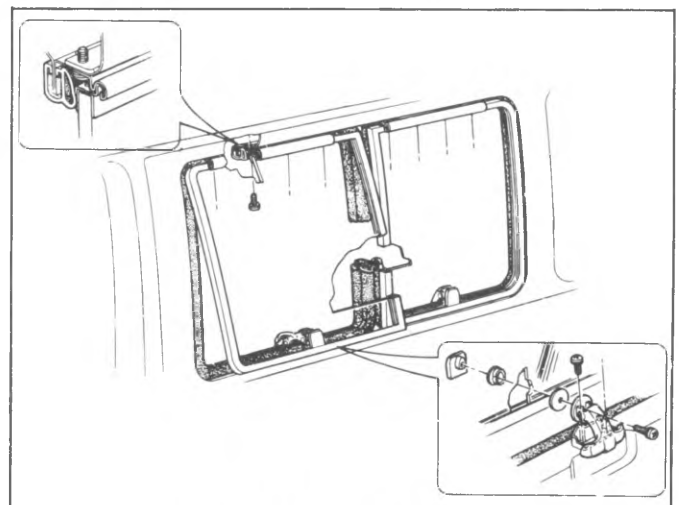


Fig. 2D-105--Swingout Window

FRONT DOOR

DOOR ADJUSTMENTS

Doors can be adjusted for alignment of clearance in the cab door opening, and for proper latching. Door alignment adjustments are made at the striker bolt, and at door hinges. The door, when properly located in door opening, will have equal clearance around its perimeter. The door should be adjusted in the opening so the edge of the door across the top and also at the lock side is parallel with the body opening as nearly as possible.

Hinge Adjustment

Door hinge bolt holes are oversized to make adjustment possible. Alignment adjustments can be made by loosening the proper hinge bolts, aligning door to proper position, and tightening bolts securely. See figure 2D-106, for typical adjustments.

Striker Bolt Adjustment

With the use of J-23457, shown in figure 2D-107, the striker bolt can be adjusted in any of three ways. See figure 2D-108.

1. **Up and down** -To adjust striker up or down, loosen bolt, adjust to center of lock entry, and tighten bolt securely.

NOTE: This adjustment is important to assure that the right proportion of door's weight will rest on striker bolt when door is closed. If bolt is positioned too high on pillar, rapid wear will occur to the lock cam; if too low, an extra load will be placed on door hinges as well as pull door downward and out of alignment.

2. **In and Out** -To adjust striker in and out, loosen bolt, adjust horizontally to match the door surface to the body surface, and tighten bolt securely.

3. **Forward and Rearward** -To make this adjustment, loosen striker bolt, shim to desired position, and tighten bolt securely.

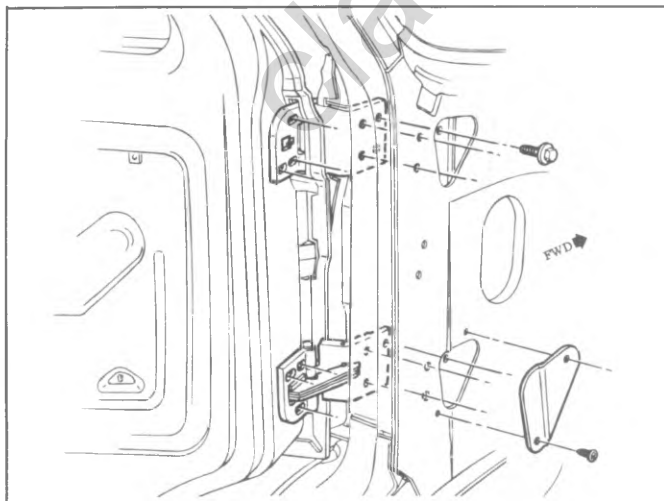


Fig. 2D-106--Door Hinge

DOOR HINGE

Remove

1. Remove hinge access hole cover from door hinge pillar.
2. If removing one hinge, support door in such a manner that weight is taken off other hinge, and that the door will not move.
3. Remove hinge screws from both body and from door and remove hinge. See figure 2D-106.

Installation

1. Install hinge to door and body. Snug bolts.
2. Remove door supports.
3. Adjust door as outlined under "Door Adjustment".
4. Torque bolts to specifications.
5. Install hinge access hole covers.

DOOR WEATHERSTRIP

Success of weatherstrip replacement depends entirely upon the quality of the cement used and the care with which it is applied. All rust, road dirt and grease or oil must be completely removed as should all old cement and bits of old weatherstrip. After removing all foreign material from door opening surface, wipe down with prepsol or its equivalent. Use only a good quality cement which is made specially for weatherstrip installation, following the manufacturer's directions. Proceed as follows:

1. Open door and block open.
2. Remove side door weatherstrip.
3. Remove used adhesive from door with adhesive or cement remover, and remove all plastic nails.
4. Apply adhesive to door.
5. Position weatherstrip by locating part number at top of vent window, making sure that plastic nails align with holes in door.
6. Install weatherstrip by pressing each nail into the door.

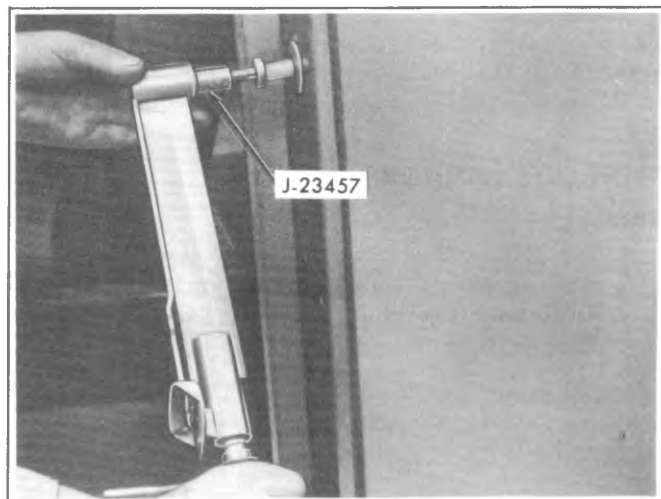


Fig. 2D-107--Loosening Striker Bolt

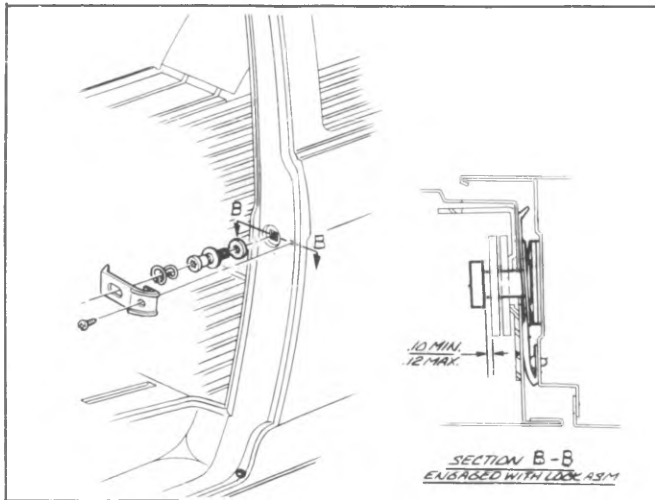


Fig. 2D-108--Typical Striker Bolt Adjustment

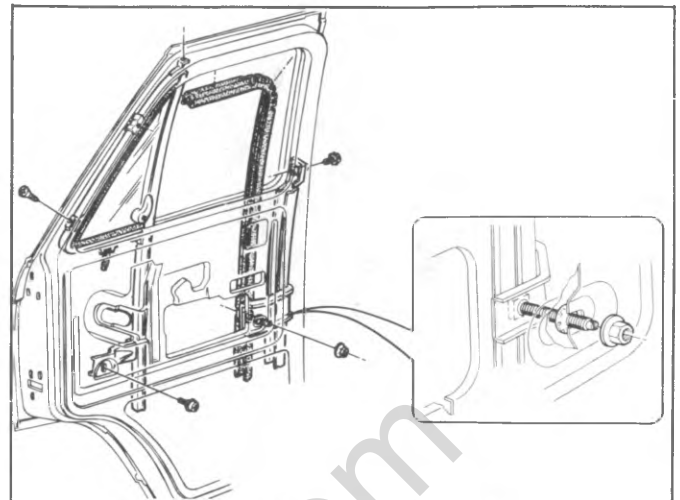


Fig. 2D-109--Ventilator Assembly

TRIM PANEL, ARM REST AND HANDLES

Removal

1. Remove screws retaining arm rest to trim panel.
2. Remove door handles with Tool J-7797 and pull from shaft.
3. Remove trim panel screws and remove panel. If seal is damaged, replace seal.

Installation

1. Install trim panel.
2. Install arm rest. Install door handle washers and handles.

DOOR VENTILATOR ASSEMBLY

Removal

NOTE: The channel between the door window glass and door vent is removed as part of the vent assembly.

1. Regulate the door window glass to the full down position.
2. Remove door handles with Tool J-7797.
3. Remove trim panel.
4. Remove rear window run channel screws.
5. Slide door window glass rearward away from ventilator.
6. Remove three screws at the upper front of the door, as shown in figure 2D-109.
7. Turn the vent assembly 90° and carefully remove by guiding up out, as shown in figure 2D-109.

Ventilator Glass Replacement

1. Using an oil can or similar means, squirt prepsol on the glass filler all around the glass channel or frame to soften the old seal. When the seal has softened, remove the glass from the channel.
2. Thoroughly clean the inside of the glass channel with sandpaper, removing all rust, etc.
3. Using new glass channel filler, cut the piece to be installed two inches longer than necessary for the channel. Place this piece of filler (soapstoned side of filler away from glass) evenly over the edge of the glass which will fit in the channel. The extra filler extending beyond the rear edge of the glass should be pinched together to hold it in place during glass installation.

NOTE: One side of this filler (the outside of the roll) is soapstoned. This is the side which goes into the metal channel.

4. Brush the inside of the metal glass channel freely with ordinary engine oil. This will enable the glass and filler to slide freely into the channel.

NOTE: Glass should be installed so that rear edge is parallel to the division post. Allow full cure before water testing.

Installation

NOTE: Replace the door window glass and regulate to the full down position before installing the door ventilator assembly.

1. Lower the ventilator assembly into the door frame. Center into position.
2. Make certain the rubber lip is positioned before tightening screws.
3. Slide door glass forward engaging glass in vent channel.
4. Reinstall all screws and tighten.
5. Install and tighten the three screws at the upper front of the door.

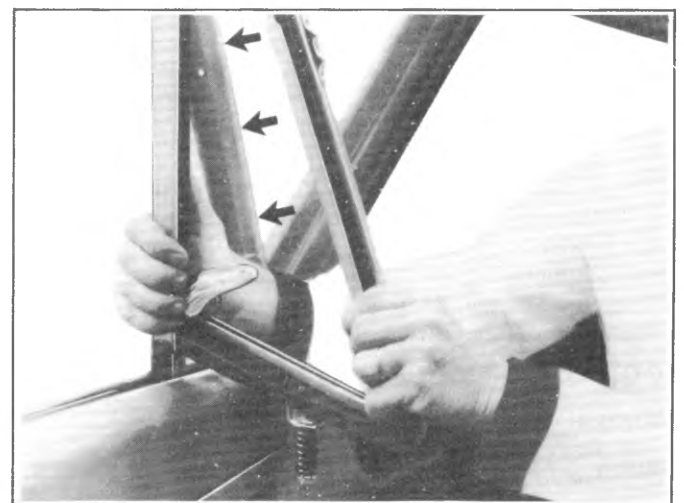


Fig. 2D-110--Removing Ventilator

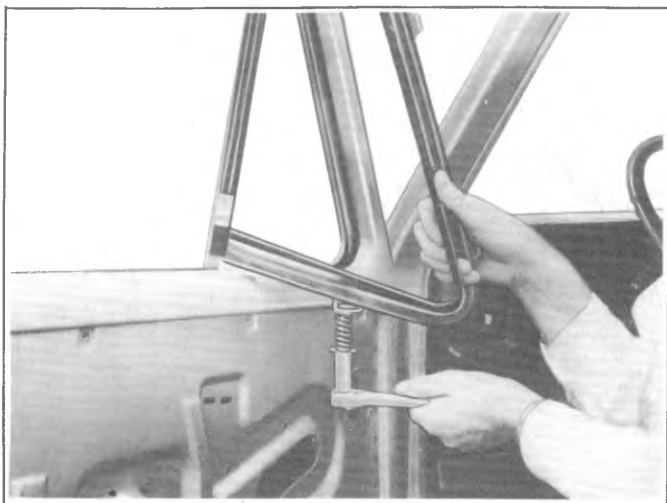


Fig. 2D-111--Adjusting Ventilator Tension

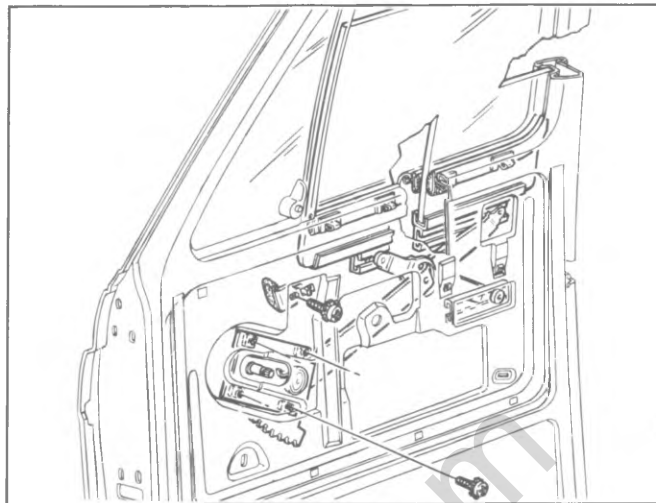


Fig. 2D-112--Window and Regulator

Adjustment

1. Adjust the ventilator adjusting nut by turning clockwise to increase operating tension, as shown in figure 2D-111.
2. After making adjustment bend tabs over the hex nut.
3. Install trim panel.
4. Install door and window regulator handles.

DOOR WINDOW ASSEMBLY

Replacement

1. Completely lower glass to bottom of door.
 2. Remove inside door and window regulator handles using Tool J-7797.
 3. Remove door arm rest and trim pad.
 4. Mask or cover upper portion of door window frame.
- Remove ventilator assembly as previously outlined.
5. Slide glass forward until front roller is in line with notch in sash channel. Disengage roller from channel. See figure 2D-112.
 6. Push window forward and tilt front portion of window up until rear roller is disengaged.
 7. Put window assembly in normal position (level) and raise straight up and out.
 8. Reverse above procedure for installation.

WINDOW REGULATOR

Replacement

1. Wind window all the way up.
2. Remove inside door handles with Tool J-7797.
3. Remove door trim pad.
4. Remove screws securing regulator to inner panel.
5. Push regulator out of door opening while holding rear of assembly, then slide assembly to the notches in the carrier channel and out through the door access hole.
6. Install regulator in reverse order of removal, lubricate regulator gears with lubriplate or equivalent.

DOOR LOCK-FIGURE 2D-113

Removal

1. Raise window.
2. Remove inside handles with Tool J-7797.
3. Remove trim panel.
4. Remove remote control sill knob.

5. From outside the door remove screws retaining lock to door edge and lower the lock assembly.
6. Remove screws retaining remote control.
7. Remove screws securing glass run guide channel.
8. Remove lock, push button rod and remote control rod as an assembly.

Installation

1. Transfer remote rod with clip to new lock.
2. Connect remote door handle rod to lock after lock is positioned.
3. Secure lock screws.
4. Secure remote handle.
5. Check all controls for proper operation before reinstalling trim and handles.
6. Install remote control sill knob.

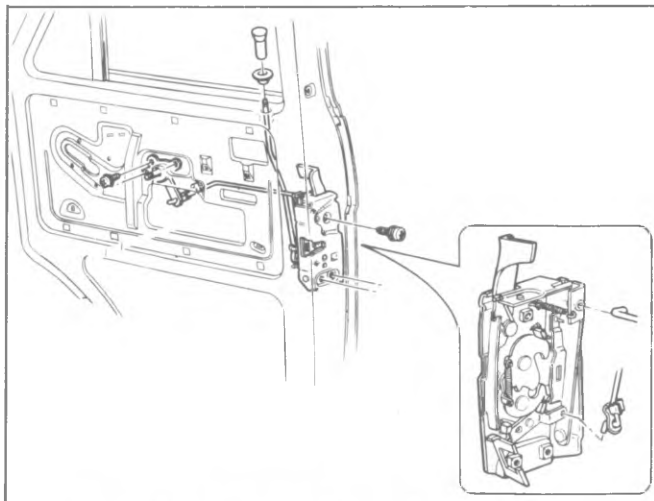


Fig. 2D-113--Lock and Remote Control Assembly

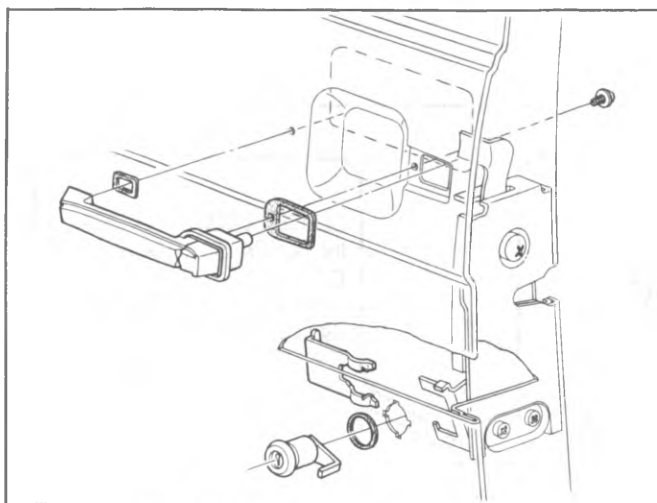


Fig. 2D-114--Lock Cylinder Assembly

REMOTE CONTROL AND CONNECTING**ROD--Fig. 2D-113****Replacement**

1. Raise door window and remove door trim pad.
2. Remove bolts securing remote control to door inner panel.
3. Pivot remote inboard slightly, to disengage connecting rod, and remove remote control from door.

NOTE: Connecting rod can be removed at this point by disconnecting spring clip from lock.

4. To install, reverse removal procedure.

LOCK CYLINDER ASSEMBLY--FIG. 2D-114**Replacement**

1. Raise door window and remove door trim pad.
2. With a screwdriver, or other suitable tool, slide lock cylinder retaining clip (on door outer panel) out of engagement and remove lock cylinder.
3. To install, reverse removal procedure.

SLIDING SIDE DOOR**DESCRIPTION**

The weight of the sliding side door is supported by the upper rear hinge-and-roller assembly, and by the lower front catch-and-roller assembly. The front and rear latches retain the door in the locked position, while the rear wedge assembly restricts door vibration on rough road surfaces.

ADJUSTMENTS

CAUTION: See *CAUTION* on page 1 of this section regarding all sliding door fasteners and adjustments found below.

The side door can be adjusted for alignment and/or clearance in the body opening and for proper latching. When properly positioned in the body opening, the door should have equal clearances around its perimeter. Adjustments for door positioning and proper latching can be made at the locations shown in figure 2D-115.

Up and Down

Up and down adjustments are provided by means of slotted holes located at the upper front roller, view B of figure 2D-112; at the lower front catch-and-roller, view D; and at the upper rear hinge-and-roller assembly, view A. To reposition the door up or down:

1. Partially open door and loosen front latch striker on pillar.
2. Remove upper rear hinge cover, shown in figure 2D-116.
3. Loosen upper rear hinge-to-door bolts.
4. Loosen rear lock striker and door wedge assembly.
5. Align rear edge of door up or down, then tighten upper rear hinge-to-door bolts to specifications.
6. Loosen upper front roller bracket-to-door bolts.
7. Partially close door and align front edge of door up or down by loosening front lower hinge-to-door bolts. When door is correctly positioned, tighten bolts to specifications.
8. Position upper front roller in center of track, then tighten roller bracket to door.

9. Adjust front and rear strikers and rear wedge assembly as outlined in their respective procedures later in this section.

In and Out

Front in and out adjustments are provided by means of an adjustable lower roller mounting bracket, view D of figure 2D-115, and by a slotted upper bracket, view B of figure 2D-115. Rear in and out adjustment is provided by adjusting the rear latch striker, view E of figure 2D-115. To position the door in or out:

1. Loosen front latch striker.
2. Loosen upper front roller from its bracket.
3. Loosen lower front roller bracket-to-arm bolts.
4. Adjust front of door in or out, then tighten bolts to specifications.
5. Adjust door hold open catch bracket, rear wedge assembly, rear latch striker, upper front roller and front latch striker as outlined later in "Adjustments".

Fore and Aft

Fore and aft adjustment is provided at the upper rear hinge striker by means of a slotted bracket mounted to the body, view A of figure 2D-115.

1. Partially open door and remove front latch striker and rear lock striker.
2. Loosen rear wedge assembly.
3. Remove upper rear track cover.
4. Loosen upper rear hinge striker.
5. Move door assembly forward or rearward, then tighten striker bolts to specifications.
6. Reinstall upper rear track cover.
7. Reinstall front and rear latch strikers.
8. Adjust latch strikers and rear wedge assembly as outlined below.

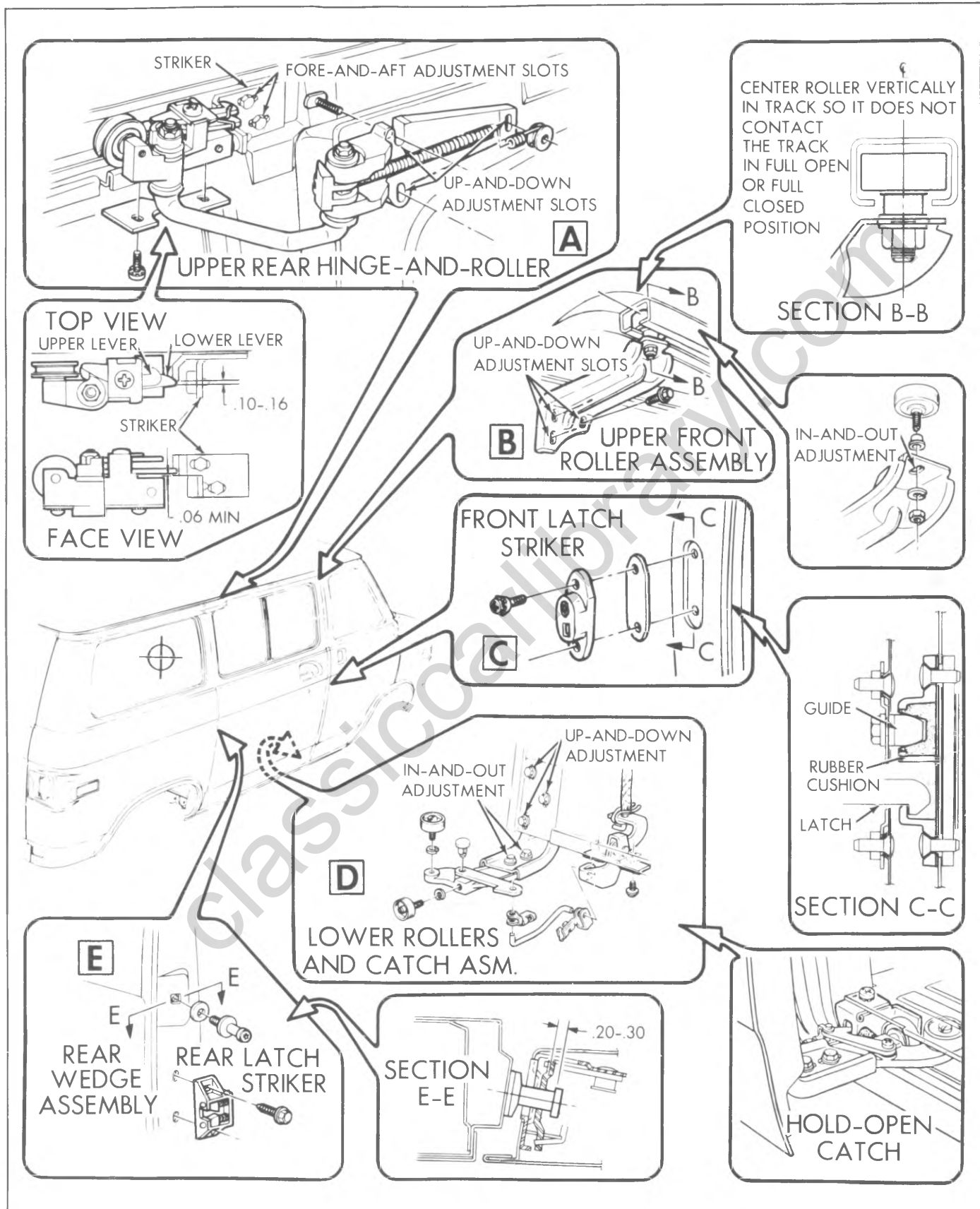


Fig. 2D-115--Sliding Side Door Adjustment Locations

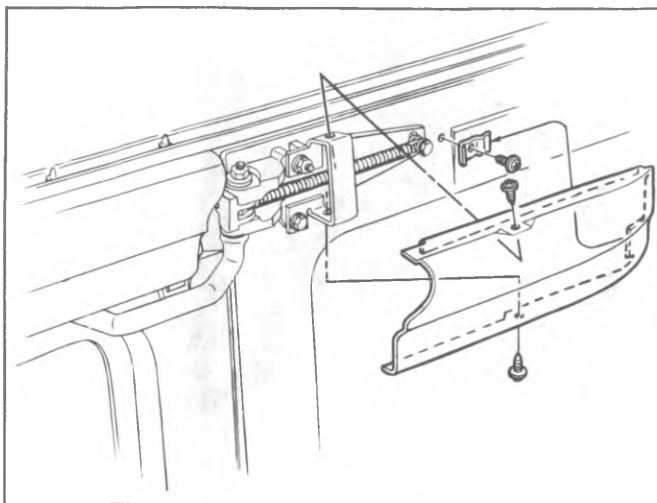


Fig. 2D-116--Hinge Cover

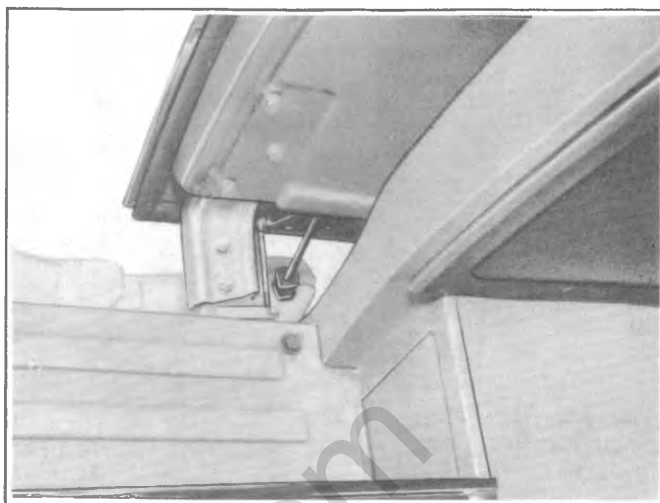


Fig. 2D-117--Hold-Open Catch

Latch Striker Adjustments

Front Striker

1. Loosen front latch striker screws, view C of figure 2D-115.
2. Visually align latch-to-striker relationship and adjust if necessary.
3. Slide door slowly toward striker. The guide on the door, just above the latch, must fit snugly within the rubber-lined opening on the striker assembly.
4. Assure that the latch engages fully into the striker. Add or delete shims behind the striker as necessary.
5. Tighten striker screws to specified torque.

Rear Striker

1. Loosen striker with J-23457.
2. Loosen rear wedge assembly.
3. Center the striker vertically to door striker opening.
4. Adjust the striker laterally to match outer panel to the body panel surfaces, view E of figure 2D-116.
5. Apply grease to the striker.
6. Gently push the door in until the rear lock contacts the striker enough to make an impression in the grease.
7. Open the door and measure the distance from the rear of the striker head to the impression. The distance should be between .20 inch and .30 inch. Refer to view E of figure 2D-115.
8. Adjust position of striker by adding or deleting shims between the striker and the pillar.
9. Adjust rear wedge assembly as outlined later in this section, and torque all fasteners to specifications.

Upper Rear Hinge-To-Striker Adjustment

CAUTION: If door has been removed and is being reinstalled, adjust striker-to-lower hinge lever before closing door. Failure to do so may cause possible lever breakage.

- The upper rear hinge must be positioned as shown in view A of figure 2D-116, in order to insure proper latching.
1. The hinge lower lever must contact the striker at least .06 inch above the lower edge of the striker tang.
 2. The lower lever must extend at least .10 inch outboard of the striker tang. Add or delete shims between the striker and the body as necessary.

3. If necessary to shim roller away from guide, shims are added between the nylon block and hinge and between roller and hinge. They must be installed in pairs. For example, if one shim is added behind the nylon block another must be added behind the roller.

Door Hold-Open Catch Adjustment

This catch, mounted on the lower front roller bracket, holds the door in the full open position. See figure 2D-117. The catch engages a striker installed at the rear of the lower roller channel, view D of figure 2D-115.

1. Loosen the screws retaining the catch rod bracket to bottom of door.
2. Adjust catch-to-striker engagement by sliding the bracket laterally. Catch should fully engage striker.

Rear Wedge Assembly Adjustment

1. Loosen screws attaching rear wedge assembly to the body pillar, then close the door to the fully latched position.
2. Center the wedge assembly on the door wedge, as shown in figure 2D-118, and scribe a line around the wedge assembly.
3. Open the door, and move the wedge assembly 3/16 inch.

FRONT LATCH ASSEMBLY

Removal

1. Remove trim panel, if so equipped.
2. Remove access cover.
3. Unscrew door lock knob from rod.
4. Disconnect the following rods from latch, shown in figure 2D-119.
 - a. Rear latch rods.
 - b. Lock cylinder rod.
 - c. Door lock rod.
5. Remove door handle.
6. Remove screws retaining latch assembly to door.
7. Slide latch rearward and lift front of latch. Disconnect rod leading to lower hinge door catch by pushing rod out of hole and rotating rod clear of latch. See figure 2D-119.
8. Remove latch assembly from door.

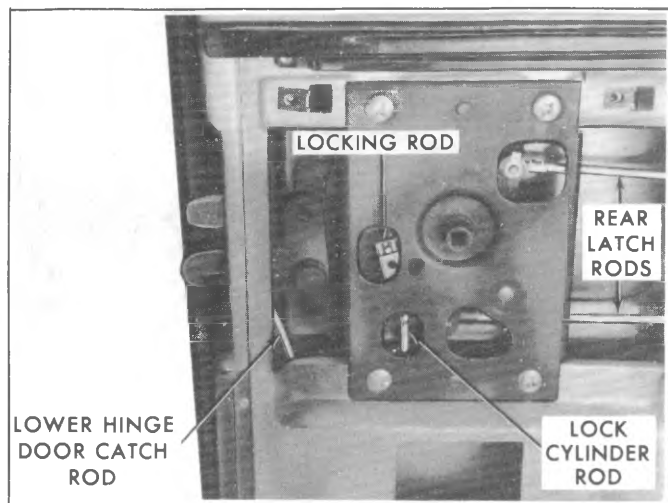


Fig. 2D-118--Adjusting the Rear Wedge Assembly

Installation

1. Install latch assembly into door by working latch assembly behind the lower hinge door catch.
2. Connect lower hinge door catch, lock cylinder rod, door lock rod, and both rear latch rods.
3. Install latch assembly-to-door attaching screws. Torque to specifications.
4. Install door lock knob and door handle.
5. Install access cover and trim panel.
6. Adjust door front striker as outlined earlier under "Adjustments".

REAR LATCH AND/OR LATCH ACTUATING RODS

Removal

1. Remove trim panel (if so equipped).
2. Remove front latch assembly access cover.
3. Disconnect rear latch rods from front latch assembly, shown in figure 2D.
4. Remove rear latch attaching screws. See figure 2D-121.
5. Slide rear latch toward front of door until rod clips

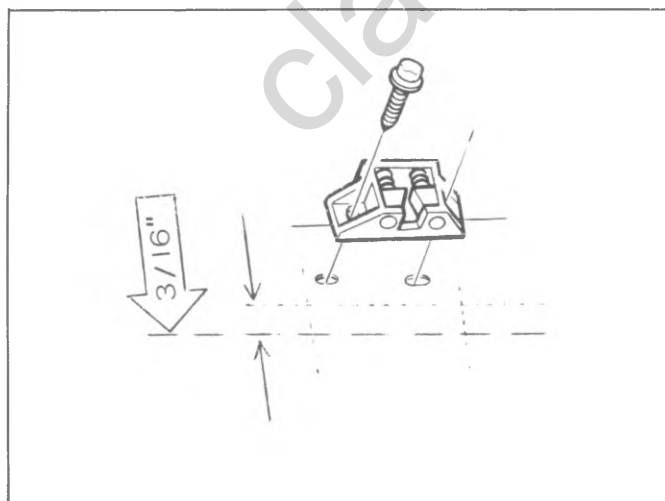


Fig. 2D-119--Sliding Door Front Latch

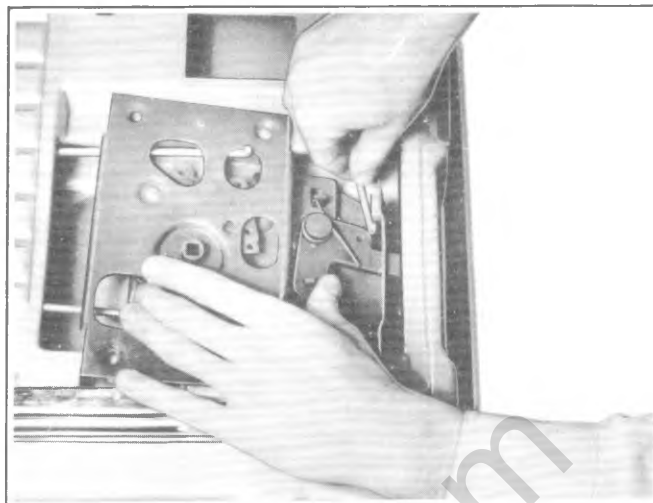


Fig. 2D-120--Disconnecting Lower Latch Rod from Latch

become exposed. Disconnect rod clips and remove latch from door.

Installation

1. Connect rods to latch and install latch to door. Torque screws to specifications.
2. Connect rods to front latch assembly.
3. Install access covers and trim panels (if so equipped).
4. Adjust rear latch striker as outlined earlier under "Adjustments".

UPPER REAR HINGE

Removal

1. Remove the hinge cover and rear track cover. See figures 2D-116 and 2D-122.
2. Open the door.
3. Disengage spring from bolt, using a spring removal tool.
4. Close the door.
5. Remove the hinge assembly.

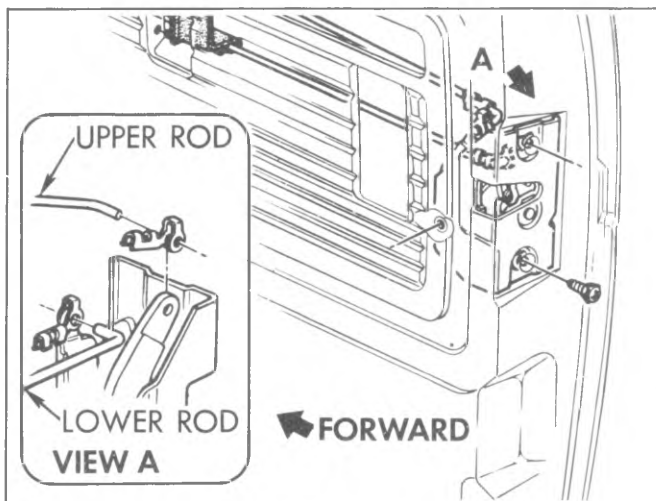


Fig. 2D-121--Sliding Door Rear Latch

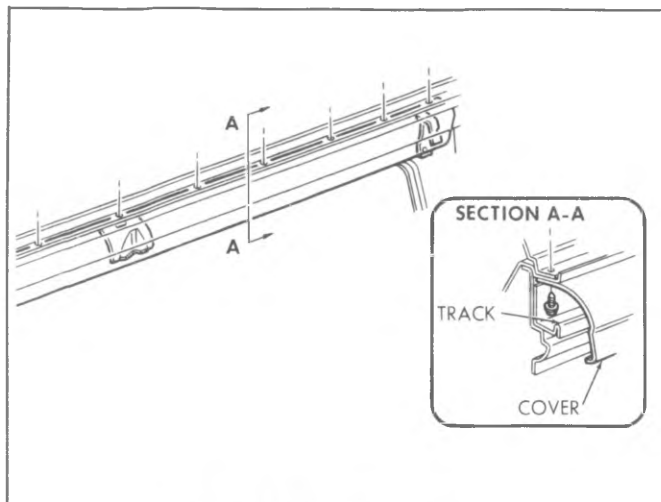


Fig. 2D-122--Rear Track Cover

Installation

NOTE: When holding hinge assembly as in figure 2D-124, the lower latch must engage cam.

1. Install hinge assembly to door. Torque bolts to specifications.
2. Check and adjust latch to striker position as outlined under "Adjustments".
3. Open the door and reconnect the hinge spring.
4. Install the rear track cover and hinge cover.
5. Check the operation of the door hinge.

STRIKERS

The front and rear strikers are shown in figure 2D-115. The rear striker can be removed with J-23457 as in figure 2D-107, and the front striker can be removed by removing attaching screws. Refer to "Adjustments" when reinstalling.

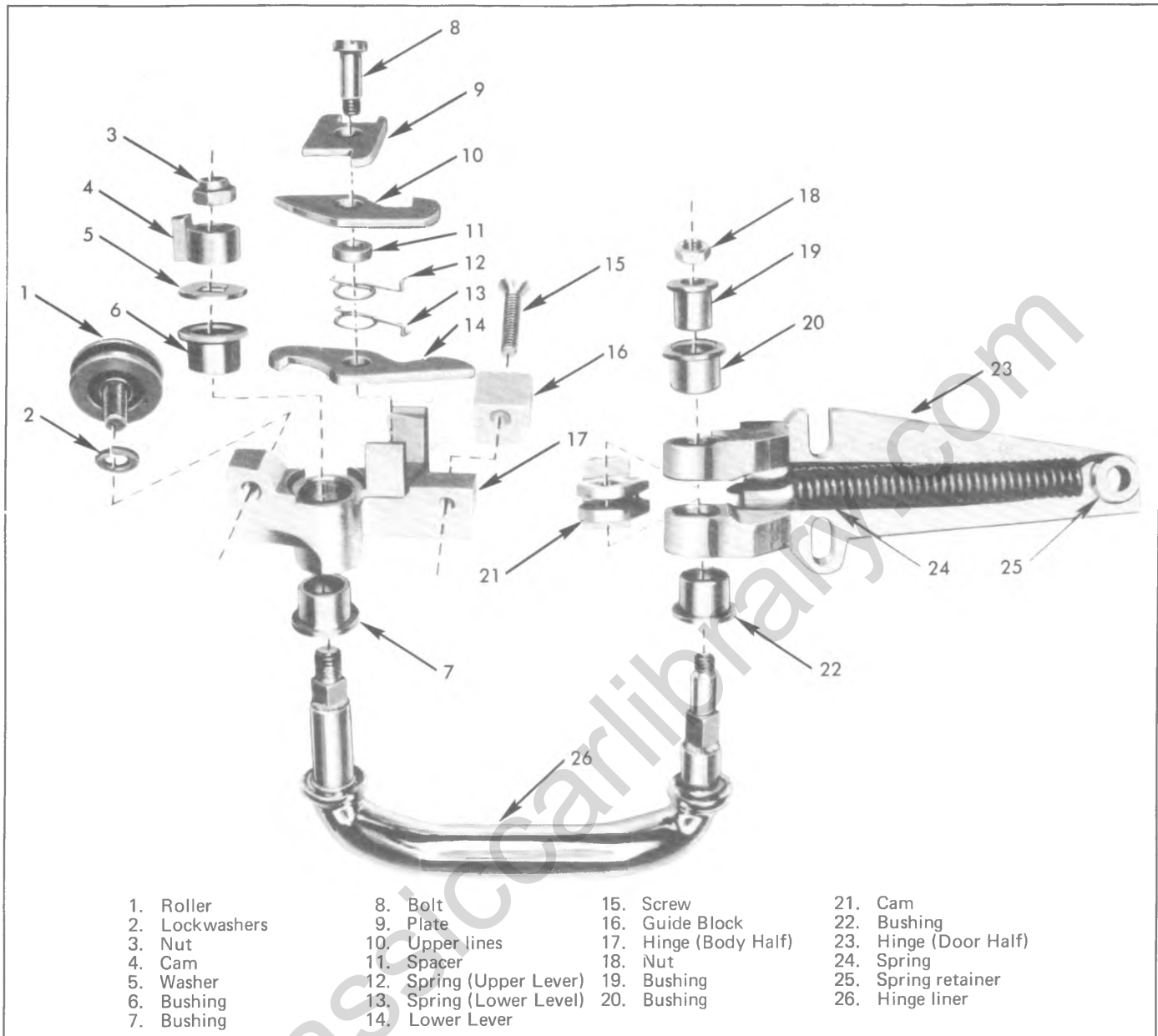


Fig. 2D-123--Upper Rear Hinge Components

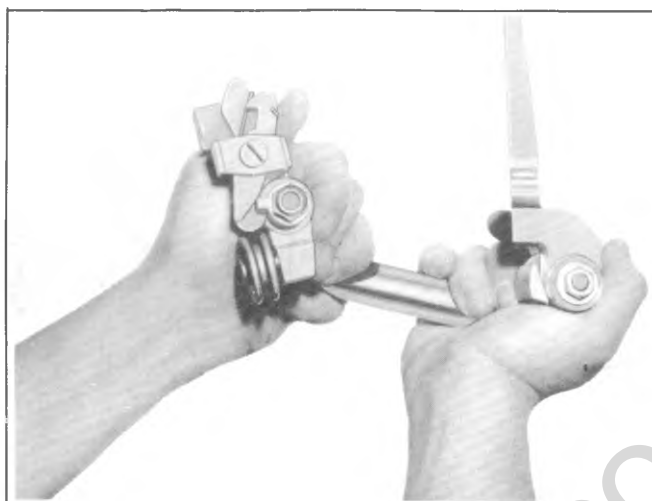


Fig. 2D-124--Checking Assembly of Hinge

REAR DOORS

REAR DOOR HINGE STRAP

Replacement

1. Remove strap release pin. See figure 2D-125.
2. Remove screws retaining strap to door.
3. Install strap to door. Torque retaining screws to specifications.

REAR DOOR HINGE

Removal

1. Open door. Support door so that when hinge screws are removed door weight will be on support.
2. Remove hinge strap release pin.

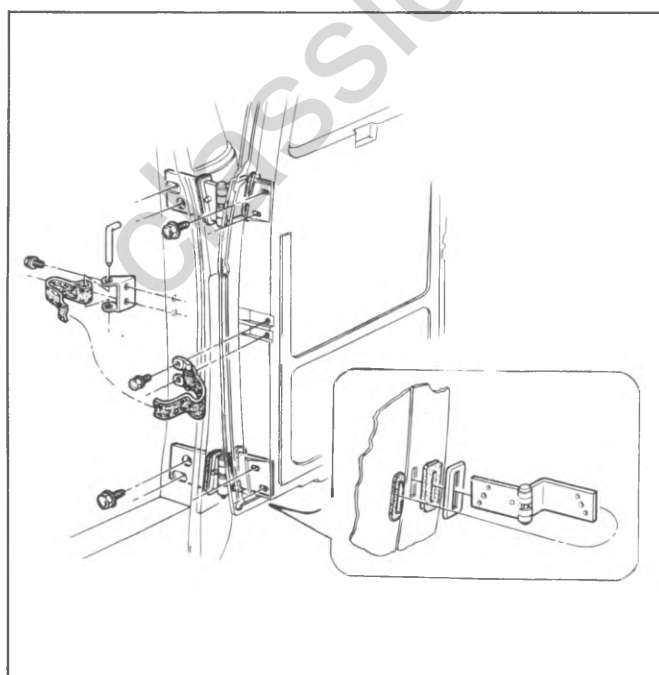


Fig. 2D-125--Rear Door Hinges and Strap

3. Remove hinge-to-door bolts and remove door assembly.
4. Remove hinge-to-body bolts and hinge.

Installation

1. Install grommet into door hinge opening (if removed).
2. Install hinge into door. Snug bolts.
3. Install seal and retainer on body half of hinge (if removed).
4. Install hinge into body opening and install bolts.
5. Take care to compress seal between body and retainer and snug bolts.
6. Install hinge strap and its retaining pin.
7. Adjust door and torque hinge bolts to specification.

REAR DOOR REMOTE CONTROL

Removal

1. Remove trim panel.
2. Disengage upper and lower latch rods from control by removing retaining clips. See figure 2D-126.
3. Remove remote control by removing its retaining screws.

Installation

1. Install remote control screws loosely.
2. Attach upper and lower control rods.
3. Rotate remote control lever clockwise, and hold in this position while torquing the screws to specifications.
4. Install the trim panel.

REAR DOOR UPPER OR LOWER LATCHES AND/OR LATCH RODS

Removal

1. Remove trim panel.
2. Disengage rod from remote control assembly. See figure 2D-126.
3. Remove latch retaining screws and withdraw latch and control rod.
4. Remove spring clip retaining rod to latch.

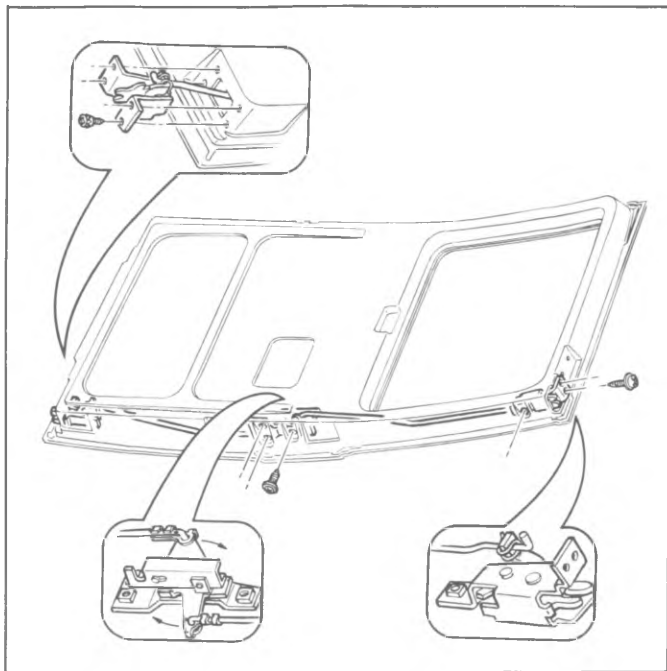


Fig. 2D-126--Remote Control and Latch

Installation

1. Install latch rod to latch.
- NOTE:** When reinstalling the lower latch rod to control, the short straight section attaches to the latch.
2. Install latch and rod assembly into door and connect rod to remote control.
3. Install latch retaining screws and torque to specifications.
4. Adjust latch to strikers.

REAR DOOR OUTSIDE HANDLE

Removal

1. Remove trim panel.
2. Remove door handle retaining screws, handle and gaskets. See figure 2D-127.

Installation

1. Apply grease to remote control where handle plunger makes contact.
2. Install handle and gaskets. Torque screws to specifications.
3. Install trim panel.

REAR DOOR LOCK CYLINDER

Removal

1. Remove trim panel.
2. Remove remote control.
3. Remove lock cylinder retainer and lock cylinder.

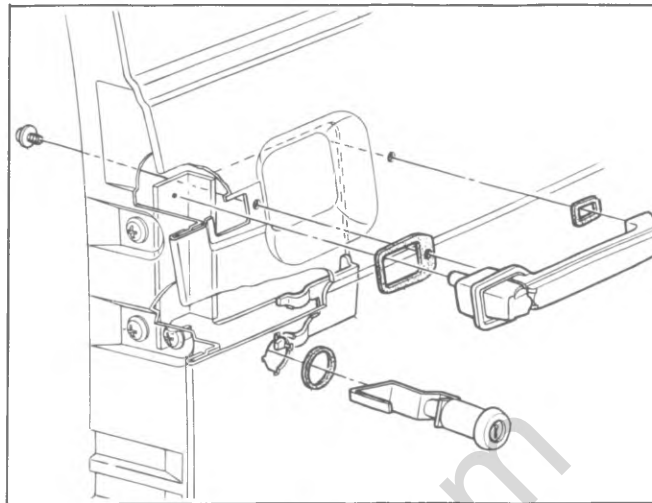


Fig. 2D-127--Outside Handle and Lock Cylinder

Installation

1. Install lock cylinder and retainer.
2. Install remote control. Torque screws to specifications.
3. Install trim panel.

REAR DOOR GLASS AND WEATHERSTRIP

Removal and installation procedures are the same as for the stationary body side windows. Refer to those procedures for rear door glass and weatherstrip replacement.

REAR DOOR ADJUSTMENTS

NOTE: Door adjustments are provided by slotted holes, at hinge attachment, in body and door.

1. Remove or loosen door strikers and wedges.
2. Loosen door hinge bolts and adjust door to provide equal clearances between body and door around perimeter of door.
3. Adjust door in and out so that door panel is flush with body.
4. Install door strikers and wedges and adjust as outlined under door striker adjustment.

REAR DOOR STRIKER AND WEDGE ADJUSTMENT

CAUTION: See **CAUTION** on page 1 of this section regarding Rear Door Striker fasteners.

1. Adjust striker by adding or deleting shims as necessary to obtain dimension as shown in figure 34G. This dimension can be checked by applying grease to the latch and slowly closing door until striker fully engages latch. Then open door and measure from grease impression to bottom of latch slot. Torque to specifications.

2. Adjust door wedge by adding or deleting shims as necessary so that wedge contact ramp on body when door is closed. See figure 2D-128.

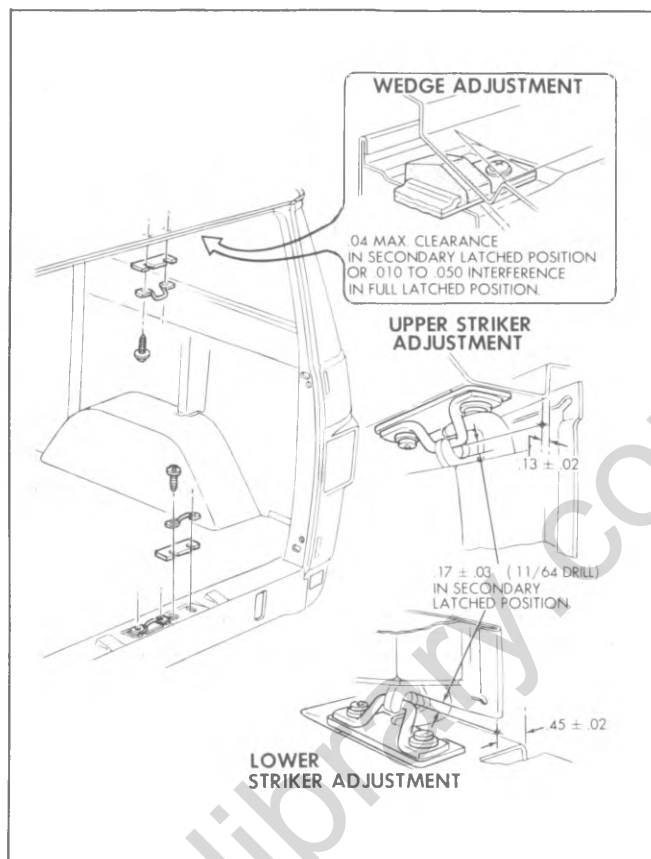


Fig. 2D-128--Rear Door Striker and Wedge Adjustment

SEATS

CAUTION: See *CAUTION* on page 1 of this section regarding fasteners used on seats and seat belts.

DRIVERS SEAT

Seat Adjuster

Replacement

1. Remove seat by removing nuts securing seat adjuster to seat riser.
2. Remove adjuster from seat. See figure 2D-129.
3. Install seat adjuster to seat. Torque bolts to specifications.
4. Install seat onto seat riser, and torque nuts to specifications.

SEAT RISER

Replacement

1. Remove seat and adjusters as an assembly by removing nuts securing seat to riser.
2. Remove nuts securing seat riser to floor.
3. Install seat riser to floor. Torque nuts to specifications.
4. Install seat and torque nuts to specifications.

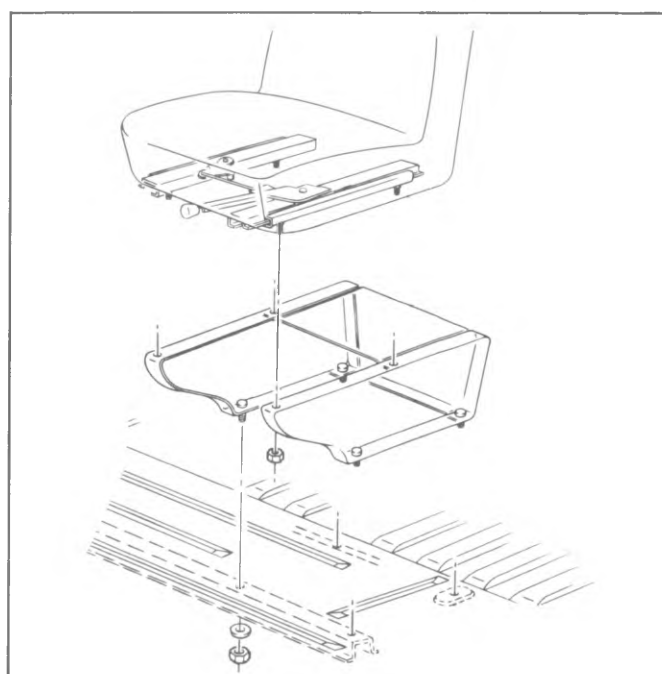


Fig. 2D-129--Driver's Seat

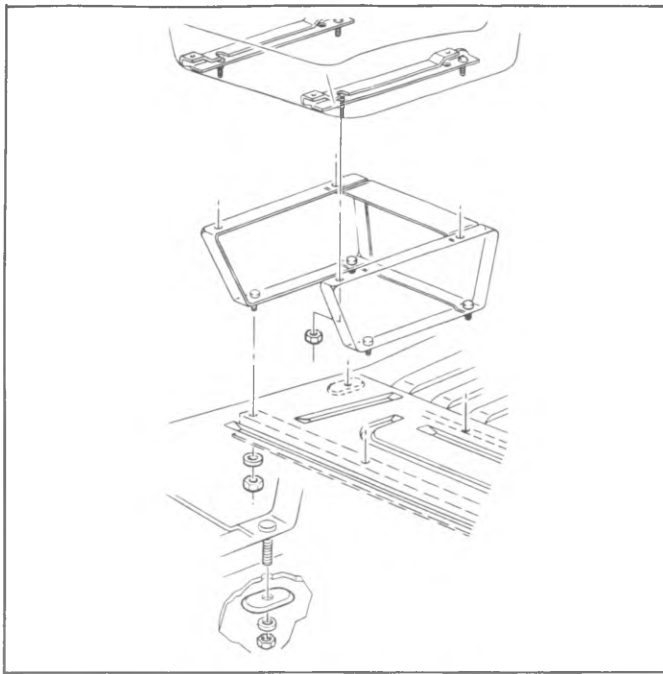


Fig. 2D-130--Passenger Seat

PASSENGER SEAT-MOUNTING BRACKETS

Removal

1. Remove seat and brackets from seat riser. See figure 2D-130.
2. Remove brackets from seat.

Installation

1. Install brackets to seat. Torque to specifications.
2. Install seat to seat riser. Torque to specifications.

SEAT RISER

Removal

1. Remove seat and mounting bracket as an assembly.
2. Remove riser from floor.

Installation

1. Install riser to floor. Torque nuts to specifications.
2. Install seat riser. Torque nuts to specifications.

All models equipped with 2nd, 3rd and 4th bench seat assemblies feature a quick release mechanism which facilitates removal of the seats for added cargo space.

Instead of the conventional clamp and bolt method of seat retention, cam type latch assemblies and hooked retainers, which fit onto anchor pins in floor anchor plates are used. When the latch assemblies are depressed, their cams and the hooks of the retainers are drawn tightly onto the anchor pins for secure seat attachment.

Removal is accomplished using the following procedure:

1. Pull up on quick release latches located at lower front of seat legs (right and left hand sides).
2. Tilt up front of seat and push seat rearward to clear anchor pins located beneath floor at front and rear of seat legs.
3. Lift seat up and remove from van.
4. To replace, reverse steps 1 to 3.

CAUTION: When replacing seats make sure that seat retainer hooks are fully engaged with anchor pins and latching assembly is fully depressed into place.

SWIVEL BUCKET SEATS - G MODELS

Refer to the illustration in Figure 2D-132 for swivel Bucket Seat Assembly installation.

ROOF VENT - G MODELS

Roof vent installation is illustrated in Figure 2D-133.

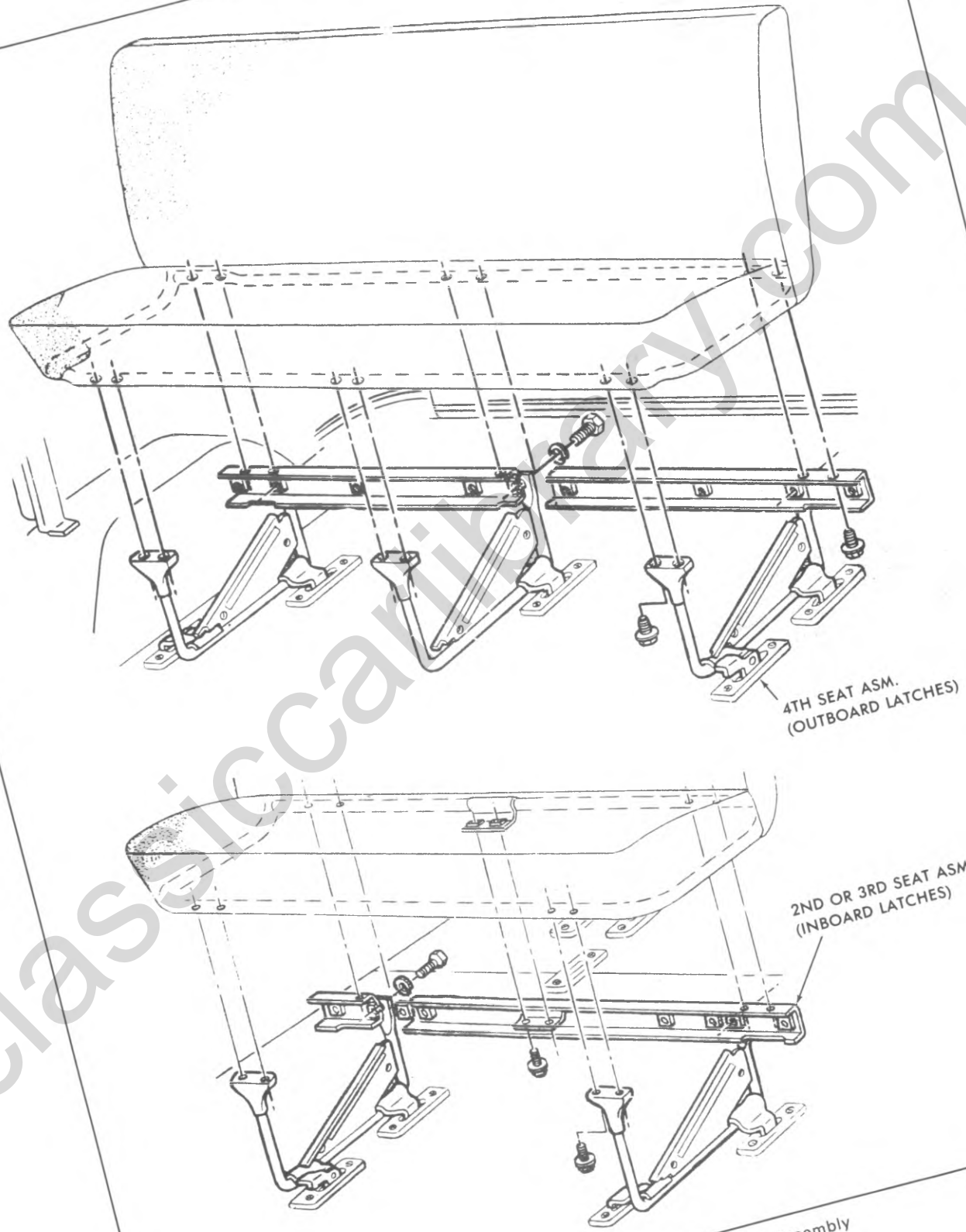


Fig. 2D-131—Quick Release Seat Assembly

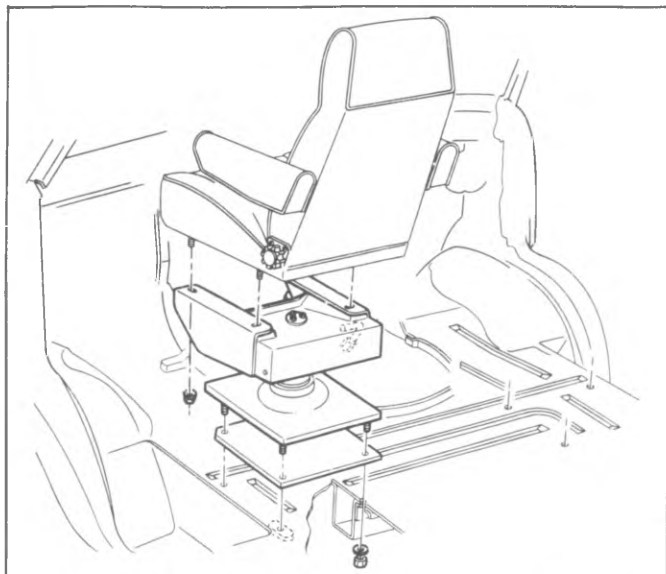


Fig. 2D-132--Swivel Bucket Seat Assembly - G Series

CARE AND CLEANING OF SEATS

Instructions on care and cleaning of interior soft trim may be found in "C-K Models--Seats", earlier in this section.

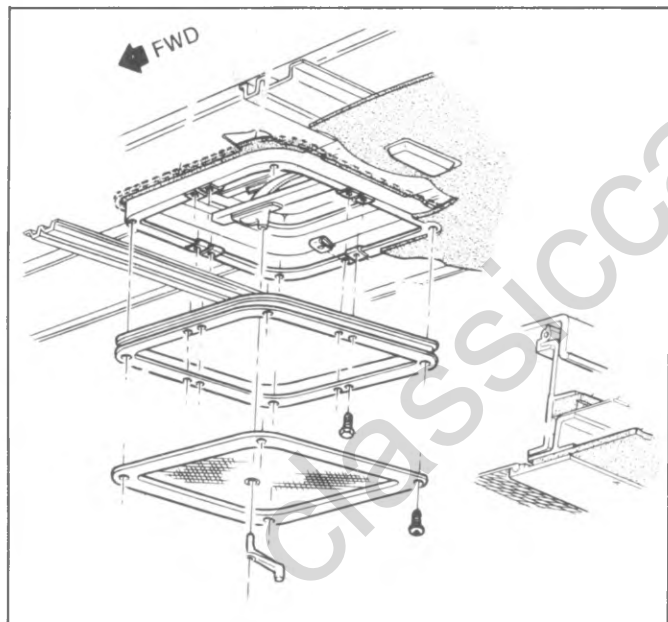


Fig. 2D-133--Roof Vent - G Series

SPECIFICATIONS

BODY

SECTION 2D

C AND K MODELS

FRONT END

Windshield Wiper Linkage to Plenum	25 in. lb.
Sunshade Support	20 in. lb.
Inside Rear View Mirror to Bracket	45 in. lb.
Outside Rear View Mirror to Door Panel -	
Base Mirror	25 in. lb.
West Coast Mirror-Lower Bracket to Door	20 in. lb.
-Upper Bracket to Door.	45 in. lb.

DOORS

Window Regulator Assembly to Door Panel	85 in. lb.
Remote Control Door Lock to Door Panel	45 in. lb.
Lock Striker to Body Pillar	45 ft. lb.
Outside Door Handle.	85 in. lb.
Inside Door Handle	85 in. lb.
Hinges to Body and Door	35 ft. lb.
Front Door-Window Run Channel	
Upper Screw Assembly	85 in. lb.
Lower Bolt Assembly	18 in. lb.
Front Door-Ventilator Assembly	
Top Vent Screw	18 in. lb.
Side Vent Screws and Spacers	25 in. lb.
Lower Vent Channel Bolts	40 in. lb.
Side Rear Door-Run Channel	
Front Upper to Door	40 in. lb.
Rear Upper to Door	20 in. lb.
Front and Rear Lower to Door.	85 in. lb.
Lock Lever to Door	85 in. lb.
Rear Door-Lock Striker (06)	95 in. lb.
Rear Door-Latch L.H. and R.H. to Door (06)	85 in. lb.
Rear Door-Latch Control Assembly to Door (06)	
-Upper Assembly	85 in. lb.
-Lower Assembly	90 in. lb.
Rear Door-Weatherstrip L.H. (06)	18 in. lb.

END GATE (14)

Hinges-Body Half and Gate Half	35 ft. lb.
Support Assembly-Body to End Gate	25 ft. lb.
Torque Rod-Retainer Assembly.	85 in. lb.
-Anchor Assembly	18 ft. lb.
Latch Assembly to End Gate	85 in. lb.
Latch Control Assembly to End Gate	40 in. lb.
Access Cover	18 in. lb.
Handle to Latch Control Assembly	55 in. lb.
Glass Channel Assembly to End Gate	85 in. lb.
Cap Assembly to Channel Assembly.	24 in. lb.
Striker-Body Mounted	18 ft. lb.

END GATE (06)

Hinges-Hinge to Body	35 ft. lb.
-Hinge to End Gate.	20 ft. lb.
Support Cable Bolts	25 ft. lb.
Torque Rod-Silencer Bracket	40 in. lb.
-End Support Bracket.	90 in. lb.
Latch Assembly to End Gate	20 ft. lb.
Latch Remote Control Assembly to End Gate	40 in. lb.
Access Cover	18 in. lb.
Outside Handle	55 in. lb.
Glass Channel	45 in. lb.

TAILGATE (03, 63-with E63)

Trunnion Assembly	18 ft. lb.
Linkage and Striker Assembly-Support	25 in. lb.

TAILGATE (03, 63-with E62)

Trunnion Assembly	35 ft. lb.
Chain Support Assembly	90 in. lb.

SEATS

Front Bench Seat	
Adjuster-to-Seat	155 in. lb.
Adjuster-to-Floor	25 ft. lb.
Front Bucket Type (14, 03)	
Driver	
Adjuster-to-Seat	18 ft. lb.
Adjuster-to-Floor	25 ft. lb.
Passenger (03)	
Support-to-Seat	18 ft. lb.
Support-to-Floor (Front)	25 ft. lb.
Support-to-Floor (Rear)	40 ft. lb.
Passenger (14)	
Latch Support-to-Seat (Rear)	18 ft. lb.
Striker-to-Floor (Rear)	25 ft. lb.
Support (Upper)-to-Seat (Front)	18 ft. lb.
Support (Lower)-to-Floor (Front)	25 ft. lb.
Support (Upper)-to-Support (Lower)	30 ft. lb.
Rear Bench (06, 14)	
Support-to-Seat	18 ft. lb.
Support-to-Floor	50 ft. lb.
Rear Bench (63)	
Support-to-Seat	150 in. lb.
Support-to-Floor	35 in. lb.
Folding Rear Seat (06)	
Support Asm-to-Floor	150 in. lb.
Seat-to-Support Asm	18 in. lb.

BODY MOUNTING (C-K MODELS)—FT. LBS.

Model	#1	#2	#3	#4	#5	#6
(03)	45	45	—	—	—	—
(06)	35	35	—	35	—	35
(14)	55	45	35	35	—	—
(63)	55	35	55	—	—	—

G MODELS

MIRRORS AND SUNSHADE

Inside Rear View Mirror to Bracket 15 in. lb.
 Outside Rear View Mirror to Panel 40 in. lb.
 Sunshade Support to Header Panel 15 in. lb.

SIDE WINDOW (SWINGOUT)

Latch to Body 40 in. lb.
 Latch to Glass 40 in. lb.
 Hinge to Body 40 in. lb.

FRONT SIDE DOORS

Door Hinges 30 ft. lb.
 Door Hinge Access Hole Cover 18 in. lb.
 Door Lock Striker 45 ft. lb.
 Door Lock to Door 20 ft. lb.
 Outside Door Handle 45 in. lb.

REAR DOOR

Hinge Strap to Door 45 in. lb.
 Hinge Strap Bracket to Body 45 in. lb.
 Hinge (to body and door) 30 ft. lb.
 Remote Control Retaining Screws 85 in. lb.
 Latch-to-Door Retaining Screws 90 in. lb.
 Door Strikers-to-Body 90 in. lb.
 Outside Door Handle 45 in. lb.

SLIDING SIDE DOOR

Remote Control (front latch) to Door 90 in. lb.
 Rear Latch to Door 90 in. lb.
 Rear Plate to Door 90 in. lb.
 Lower Front Roller and Roller Support
 Support-to-Door 24 ft. lb.
 Support to Roller Bracket 24 ft. lb.
 Roller to Roller Bracket 20 ft. lb.
 Catch to Roller Bracket 45 in. lb.
 Upper Front Roller Bracket
 Bracket to Door 24 ft. lb.
 Roller to Bracket 20 ft. lb.
 Upper Left Hinge (Door Half)
 Hinge to Door 25 ft. lb.
 Upper Left Hinge (Body Half)
 Roller to Hinge 20 ft. lb.
 Guide Block to Hinge 40 in. lb.
 Lever Arm-to-Hinge Retaining Nut 120 in. lb.
 Lever Retaining Screw 40 in. lb.
 Striker to Body 20 ft. lb.
 Rear Striker Bolt (Body Mounted) 45 ft. lb.
 Front Striker Retaining Screws (Body Mounted) . . 90 in. lb.

SEATS

Seat Belt to Seat 37 ft. lb.
 Passenger and Drivers
 Seat to Adjuster (Mounting Bracket) 18 ft. lb.
 Seat to Riser 18 ft. lb.
 Seat Riser-to-Floor 50 ft. lb.
 Bench Seats
 Seat to Seat Support 18 ft. lb.
 Seat Support to Floor Clamps 40 ft. lb.

SPECIAL TOOLS

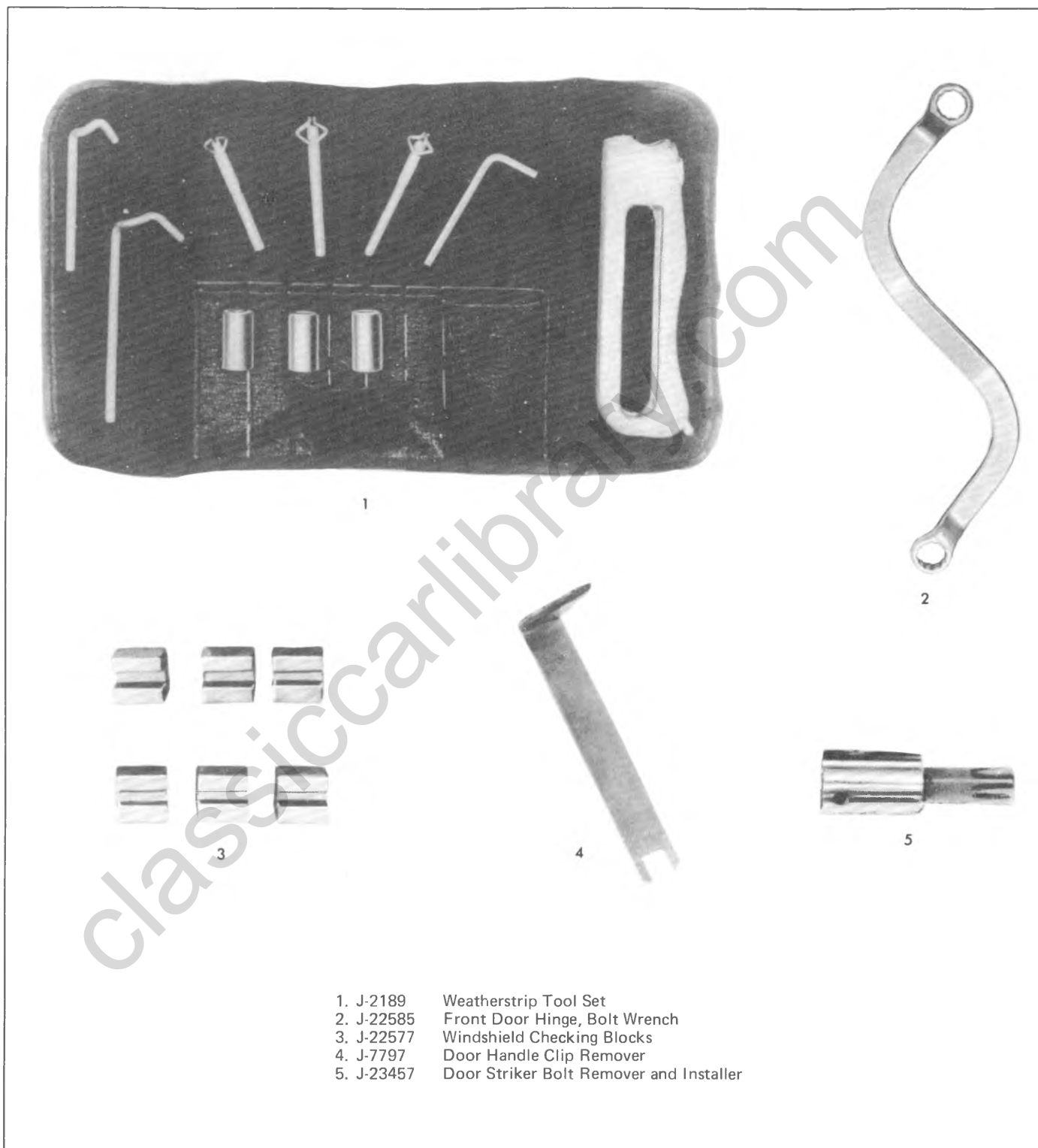


Fig. 2D-134--Special Tools

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SECTION 3A

FRONT ALIGNMENT

CONTENTS

General Description.....	3A-1
Maintenance and Adjustments.....	3A-2
Specifications.....	3A-6

GENERAL DESCRIPTION

FRONT ALIGNMENT

The term "front alignment" refers to the angular relationships between the front wheels, the front suspension attaching parts and the ground.

The pointing in or "toe-in" of the front wheels, the tilt of the front wheels from vertical (when viewed from the front of the vehicle) and the tilt of the suspension members from vertical (when viewed from the side of the vehicle), all these are involved in front alignment. The various factors that enter into front alignment are covered here each one under its own heading.

CASTER

Caster is the tilting of the front steering axis either forward or backward from the vertical (when viewed from the side of the vehicle). A backward tilt is said to be positive (+) and a forward tilt is said to be negative (-).

On the short and long arm type suspension you cannot see a caster angle without a special instrument, but you can understand that if you look straight down from the top of the upper control arm to the ground you would find that the ball joints do not line up (fore and aft) when a caster angle other than 0° is present. If you had a positive caster angle the lower ball joint would be slightly ahead (toward the front of the vehicle) of the upper ball joint center line. In short then, caster is the forward or backward tilt of the steering axis as viewed from a side elevation. Caster is

designed into the front axle assembly on all K series vehicles (four-wheel drive), and is non-adjustable. See caster copy under ADJUSTMENTS.

CAMBER

Camber is the tilting of the front wheels from the vertical when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is said to be positive (+). When the wheels tilt inward at the top, the camber is said to be negative (-). The amount of tilt is measured in degrees from the vertical and this measurement is called the camber angle. Camber is designed into the front axle assembly of all K series vehicles and is non-adjustable. See camber copy under ADJUSTMENTS.

TOE-IN

Toe-in is the turning in of the front wheels. The actual amount of toe-in is normally only a fraction of an inch. The purpose of a toe specification is to ensure parallel rolling of the front wheels. (Excessive toe-in or toe-out will cause tire wear). Toe-in also serves to offset the small deflections of the wheel support system which occurs when the vehicle is rolling forward. In other words, even when the wheels are set to toe-in slightly when the vehicle is standing still, they tend to roll parallel on the road when the vehicle is moving. See toe-in copy under ADJUSTMENTS.

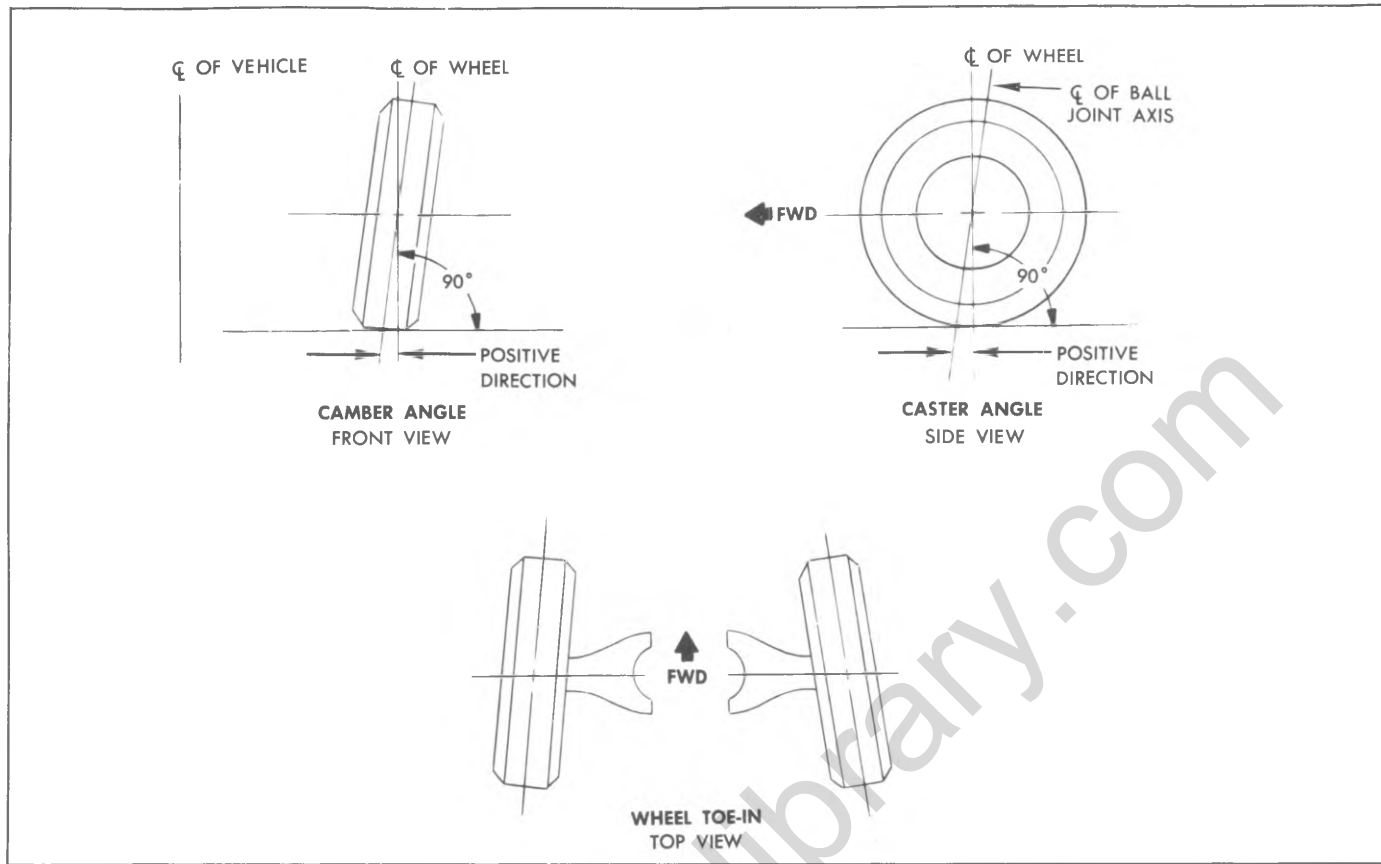


Fig. 3A-1--Caster - Camber - Toe-In

MAINTENANCE AND ADJUSTMENTS

PRELIMINARY CHECKS PRIOR TO ADJUSTING FRONT ALIGNMENT

Before making any adjustment affecting caster, camber or toe-in, the following checks and inspections should be made to insure correctness of alignment readings and alignment adjustments.

1. Check all tires for proper inflation pressures and approximately the same tread wear.
2. Check front wheel bearings for looseness (.001-.008 end play is correct) and adjust if necessary.
3. Check for looseness of ball joints, tie rod ends and steering relay rods; if excessive looseness is noted, it must be corrected before adjusting.
4. Check for run-out of wheels and tires.
5. Check vehicle trim heights; if out of specifications and a correction is to be made, the correction must be made before adjusting caster, camber or toe-in.
6. Check for steering gear looseness at frame.
7. Check for improperly operating shock absorbers.
8. Check for loose control arms.
9. Check for loose or missing stabilizer bar attachments.
10. Consideration must be given to excess loads, such as tool boxes. If this excess load is **normally** carried in the vehicle, it should remain in the vehicle during alignment checks.
11. Consider the condition of the equipment being used

to check alignment and follow the manufacturer's instructions.

12. Regardless of equipment used to check alignment, the vehicle must be on a level surface both fore and aft and transversely.

13. Steering and vibration complaints are not always the result of improper alignment. An additional item to be checked is the possibility of tire lead due to worn or improperly manufactured tires. "Lead" is the deviation of the vehicle from a straight path on a level road without hand pressure on the steering wheel. Section 3E of this manual, "Wheels and Tires", contains a procedure for determining the presence of a tire lead problem.

FRONT ALIGNMENT REQUIREMENTS

Satisfactory vehicle operation may occur over a wide range of front end wheel alignment settings. Nevertheless, should settings vary beyond certain tolerances, readjustments of alignment is advisable. The specifications stated in column 1 of the chart in the specifications section of this manual should be used by owners, dealers and repairmen as guidelines in vehicle diagnosis either for repairs under the new vehicle warranty or for maintenance service at customer's request. These specifications provide an acceptable all-around operating range in that they prevent abnormal tire wear caused by wheel alignment.

Governmental Periodic Motor Vehicle Inspection

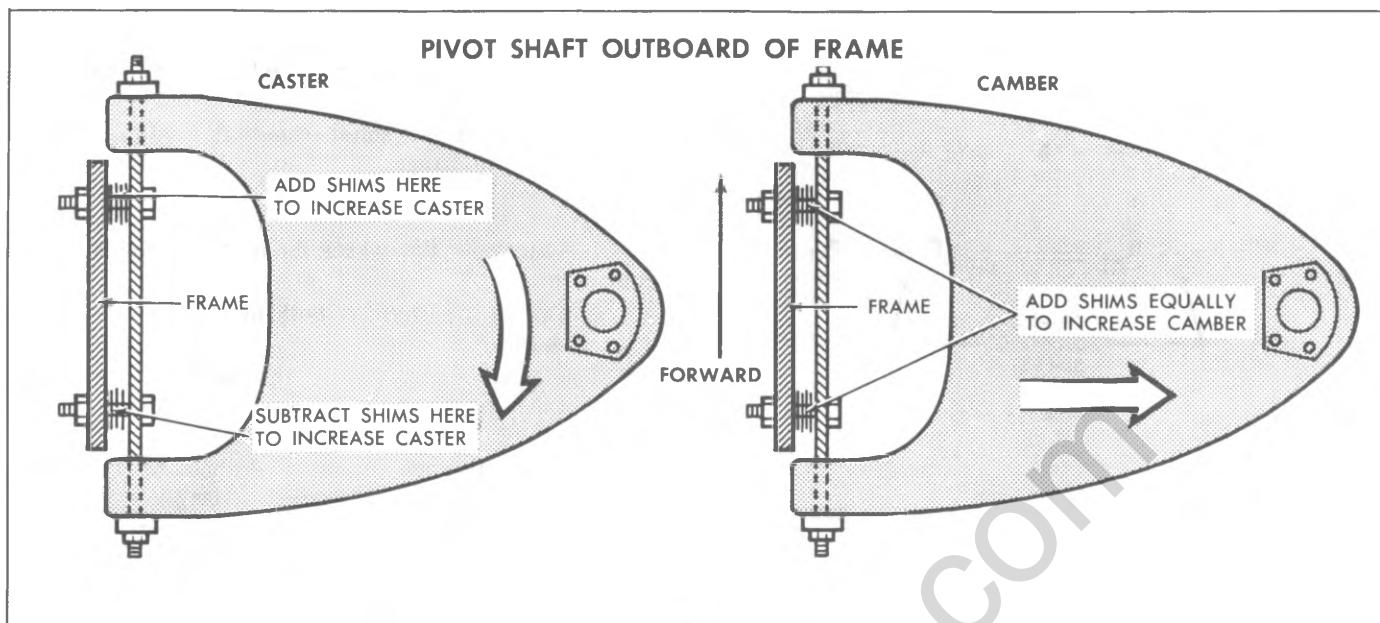


Fig. 3A-2--Caster - Camber Adjustment

programs usually include wheel alignment among items that are inspected. To provide useful information for such inspections, the specifications stated in column 2 of the wheel alignment chart are given and these are well within the range of safe vehicle operation.

In the event the actual settings are beyond the specifications set forth in column 1 or 2 (whichever is applicable), or whenever for other reasons the alignment is being reset, the specifications given in column 3 of the wheel alignment chart should be used.

NOTE: It is good practice to set front end alignment to specifications while the vehicle is in its **normally loaded** condition. Trucks which are **consistently operated with heavy loads should have toe-in adjusted with the truck under heavy load.** This procedure should result in longer tire life.

ALIGNMENT ADJUSTMENTS

NOTE: A normal shim pack will leave at least two (2) threads of the bolt exposed beyond the nut. If two (2) threads cannot be obtained, check for damaged control arms and related parts. The difference between front and rear shim packs must not exceed .30 inches. Front shim pack must be at least .24 inches.

Access to Shim Packs

G10-20 Models, C10 Models with 3/4" Nut:

With vehicle on front end rack, jack at frame and raise the wheel off the ground. This will allow the upper control arm to pivot down far enough to use a socket on the nuts and permit shim removal.

G30 Models, C20 and 30 Models with 7/8" Nut:

Remove the upper control arm bumper; then follow the same procedure as above. Reinstall the upper control arm bumper when alignment is completed.

Caster

All caster specifications are given assuming a frame angle of zero. Therefore, it will be necessary to know the angle of the frame (whether "up" in rear or "down" in rear) before a corrected caster reading can be determined. Camber and toe can be read "as is" from the alignment equipment.

How to Determine Caster (Fig. 3A-4)

1. With the vehicle on a level surface, determine the frame angle "B" in Fig. 3A-4, using a bubble protractor or inclinometer.
2. Draw a graphic as in Fig. 3A-4 that is representative of the frame angle (either "up" in rear or "down" in rear).
3. Determine the caster angle from the alignment equipment and draw a line that is representative of the caster reading.
4. To determine an "actual (corrected) caster reading" with various frame angles and caster readings, one of the following rules applies:
 - a. A **DOWN IN REAR** frame angle must be **SUBTRACTED** from a **POSITIVE** caster reading.
 - b. An **UP IN REAR** frame angle must be **ADDED** to a **POSITIVE** caster reading.
 - c. A **"DOWN IN REAR"** frame angle must be **ADDED** to a **NEGATIVE** caster reading.
 - d. An **"UP IN REAR"** frame angle must be **SUBTRACTED** from a **NEGATIVE** caster reading.

How to Adjust Caster

5. Add or subtract as necessary to arrive at the corrected caster angle.
6. Measure dimension "A" (bump stop bracket to frame) and check the specifications for that dimension.
7. Correct the actual caster angle, as arrived at in Step 4, as necessary to keep within the specifications by adding or subtracting shims from the front or rear bolt on the upper control arm shaft, shown in Figure 3A-2.

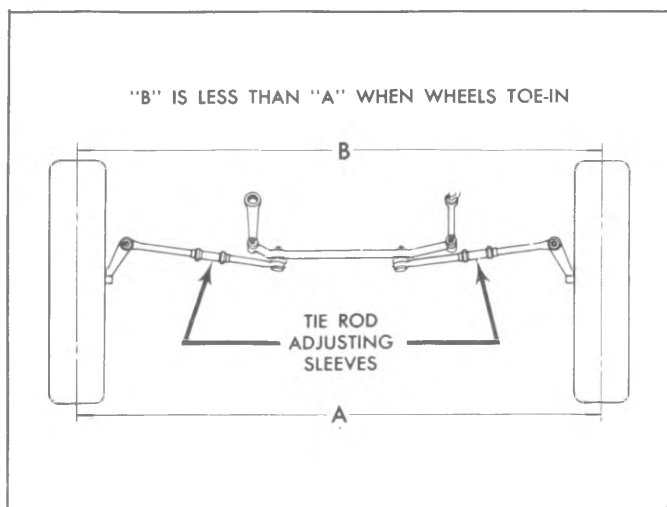


Fig. 3A-3--Toe-In Adjustment

Camber

1. Determine the camber angle from the alignment equipment.
2. Add or subtract shims from both the front and rear bolts to affect a change.

Toe-In

1. Determine the wheel toe-in from the alignment equipment.
2. Change the length of both tie rod sleeves to affect a toe change.

Toe-in can be increased or decreased by changing the length of the tie rods. A threaded sleeve is provided for this purpose.

When the tie rods are mounted ahead of the steering knuckle they must be decreased in length in order to increase toe-in. When the tie rods are mounted behind the steering knuckle they must be lengthened in order to increase toe-in.

See Section 3B for proper tie rod clamp orientation and positioning.

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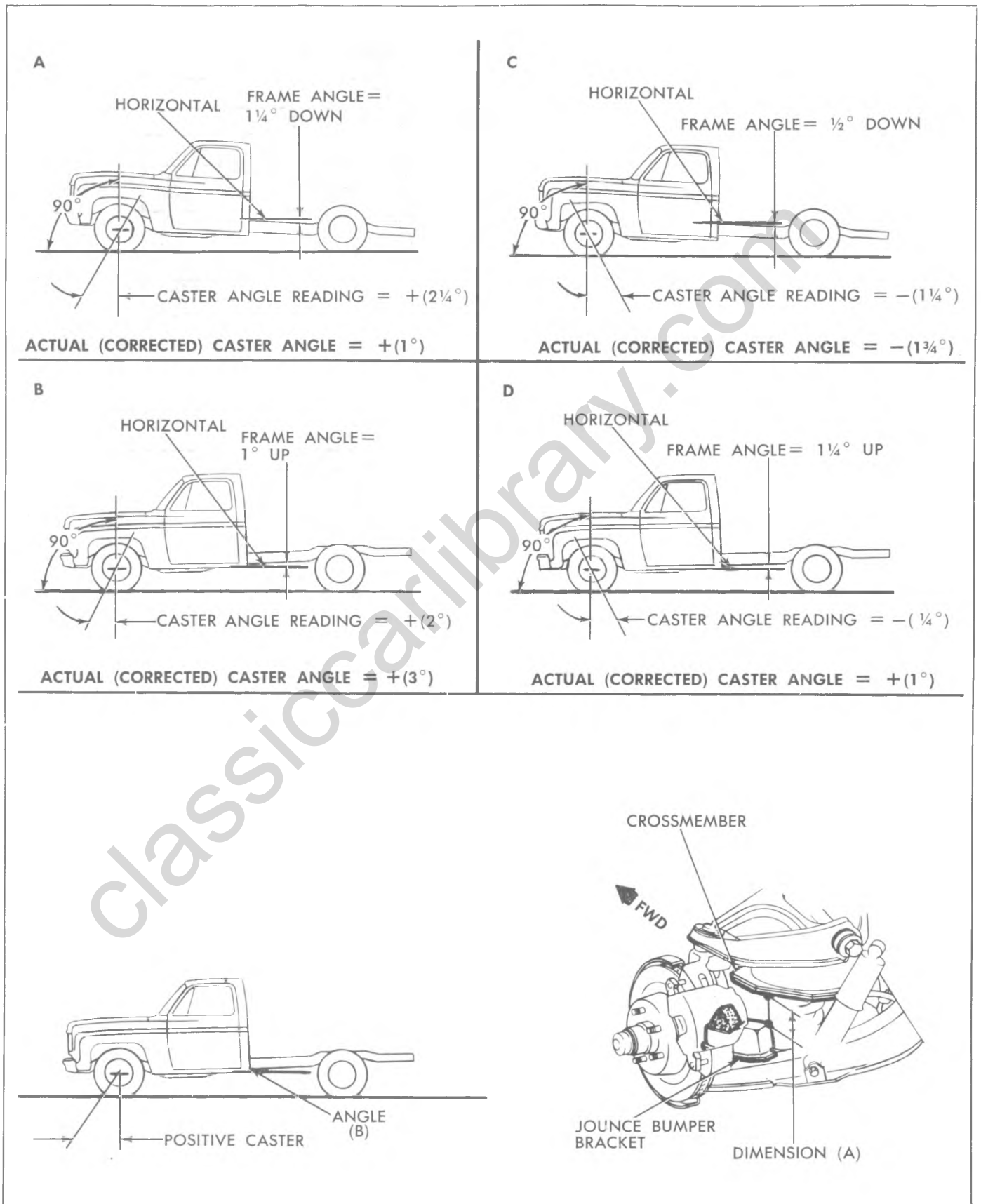


Fig. 3A-4--Determining Caster

SPECIFICATIONS

WHEEL ALIGNMENT SPECIFICATIONS

CASTER*											
Models	DIMENSION "A" IN INCHES*										
	2 1/2"	2 3/4"	3"	3 1/4"	3 1/2"	3 3/4"	4"	4 1/4"	4 1/2"	4 3/4"	5"
C10			+2°	+1 1/2°	+1 1/4°	+1°	+3/4°	+1/2°	+1/4°	+0°	-1/2°
C20, C30	+1 1/2°	+1 1/4°	+1°	+3/4°	+1/2°	+1/4°	+0°	-1/4°	-1/2°	-3/4°	-1°
K10, K20, K30	(8°) (NO ADJUSTMENT PROVISION)										
G10, G20	+3 1/4°	+3°	+2 3/4°	+2 1/2°	+2 1/2°	+2 1/4°	+2°	+2°	+1 3/4°	+1 1/2°	+1 1/2°
G30	+2 1/4°	+2°	+1 1/2°	+1 1/4°	+1°	+3/4°	+1/2°	+1/4°	0°	-1/4°	-1/2°
P10, P20, P30	+2 1/2°	+2 1/4°	+2°	+1 3/4°	+1 1/2°	+1°	+3/4°	+1/2°	+1/4°	0°	-1/4°
Motor Home (32)	+5 3/4	+5 1/2	+5	+5	+4 1/2	+4 1/4	+4	+4	+3 1/2	+3 1/4	+3

CAMBER													
C10, C20, C30	+1/4°												
K10, K20, K30	NO ADJUSTMENT PROVISION												
G10, G20, G30	+1/4°												
P10 P20, P30 Motor Home (32)	Camber on P-Truck is dependent on dimension 'A'. After measuring dimension 'A' set camber as follows:												
	2 1/2"	2 3/4"	3"	3 1/4"	3 1/2"	3 3/4"	4"	4 1/4"	4 1/2"	4 3/4"	5"	5 1/4"	5 1/2"
	0	0	+1/4°	+1/4°	+1/4°	+1/4°	+1/4°	0°	0°	0°	-1/4°	-1/2°	-3/4°
	0	0	+1/4°	+1/4°	+1/4°	+1/4°	+1/4°	+1/4°	0°	0°	-1/4°	-1/2°	-3/4°
	0	0	+1/4°	+1/4°	+1/4°	+1/4°	0°	0°	0°	-1/4°	-1/2°	-3/4°	-1°

TOE-IN	
C10, C20 C30	3/16"
K10, K20, K30	0
G10, G20, G30	3/16"
P10, P20, P30	3/16"
Motor Home P30 (32)	5/16"

ALIGNMENT TOLERANCES			
	Warranty Repair Checking	Resetting Target	Periodic Motor Vehicle Inspection
Caster	± 1°	± 1/2°	± 2°
Camber	± 3/4°	± 1/2°	± 1 1/2°
Toe-In	± 1/8"	± 1/16"	± 3/8"

SECTION 3B

STEERING

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 1 of this Section".

CAUTION THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OF WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

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GENERAL DESCRIPTION

The steering gear is of the recirculating ball type. This gear provides for ease of handling by transmitting forces from the wormshaft to the pitman shaft through the use of ball bearings.

The steering column is connected to the steering gear by a flexible coupling. This coupling incorporates a capturing strap which is designed to prevent column-to-coupling deflection from exceeding the length of the

coupling alignment pins.

The trucks incorporate "Forward Steering" whereas the steering linkage is located forward of the front crossmember. Steering effort is transmitted to left and right hand adjustable tie rod through a relay rod. The relay rod is connected to an idler arm on the right and to the pitman arm on the left.

DIAGNOSIS C AND K STEERING COLUMNS

This section contains diagnostic information to help locate the cause of the problem in the column. Reference should be made to the correct method of column disassembly, repair, adjustment and reassembly. Damaged, broken or deformed parts must be replaced with the correct replacement.

GENERAL INFORMATION

(Figs. 3B-2 through 3B-11)

All C and K models are equipped with function locking energy absorbing Steering Columns. The columns are of five basic designs as follows:

1. **SYNCHROMESH** - The synchromesh column is used on models with the standard transmission and column mounted shift levers. The shift tube, within the outer column jacket, includes two lower shift levers for connection to the transmission control linkage.

2. **FLOOR SHIFT** - This column is used on models equipped with a manual transmission with the shift lever on the floor. This column does not incorporate a shift tube.

3. **AUTOMATIC TRANSMISSION** - Available with column shift only, Locks the transmission and steering wheel while in park position and the lock cylinder is in "Lock" position.

4. **TILT WHEEL OPTION** - The upper end and steering shaft of this column is specifically designed to accommodate the optional tilt steering wheel. It is available with either manual (the fourth column type) or automatic transmission on (the fifth column type).

To perform diagnostic procedures on the steering column upper end components, it is not necessary to remove the column from the vehicle.

The steering wheel, horn components, directional signal switch, ignition switch and lock cylinder may be removed with the column remaining in the vehicle as described in the Service Manual under "Component Part Replacement".

CAUTION: The outer mast jacket shift tube, steering shaft and instrument panel mounting bracket are designed as energy absorbing units. Because of the design of these components, it is absolutely necessary to handle the column with care when performing any service operation. Avoid hammering, jarring, dropping or leaning on any portion of the column. When reassembling the column components, use only the specified screws, nuts and bolts and tighten to specified torque. Care should be exercised not to use over-length screws or bolts as they may prevent a portion of the column from compressing under impact.

STEERING COLUMN ELECTRICAL ANALYZER J-23980 FOR C AND K SERIES COLUMNS (FIG. 3B-1)

Tool J-23980 will help the technician analyze the steering column wiring harness for electrical problems. The tool in actuality eliminates the steering column, related wiring and components; and replaces them with the tool itself. In this way disassembly of the column is not performed until the problem has been determined to be in the column. By moving the tester switch, (with the key in the "on" position), the various functions may be checked. The switch positions are "OFF", "HORN", "LEFT TURN", "RIGHT TURN", "KEY BUZZER", and "HAZARD". (Trucks do not incorporate a Key Buzzer Switch) if the systems function properly while using the tester, then the malfunction has been narrowed to the column wiring or components. When this has been determined then the column may be serviced to correct the malfunction.

To use the tool just unfasten the harmonica connector on the column and plug the harness from J-23980 into the vehicle chassis harness. The "A", "B", and "C" terminals on the tester will overhang the chassis connector. This does not affect the test results. These terminals are for vehicles with cornering lights. Connect the single black jumper to a good ground. The tester is now ready for use (Fig. 3B-1).

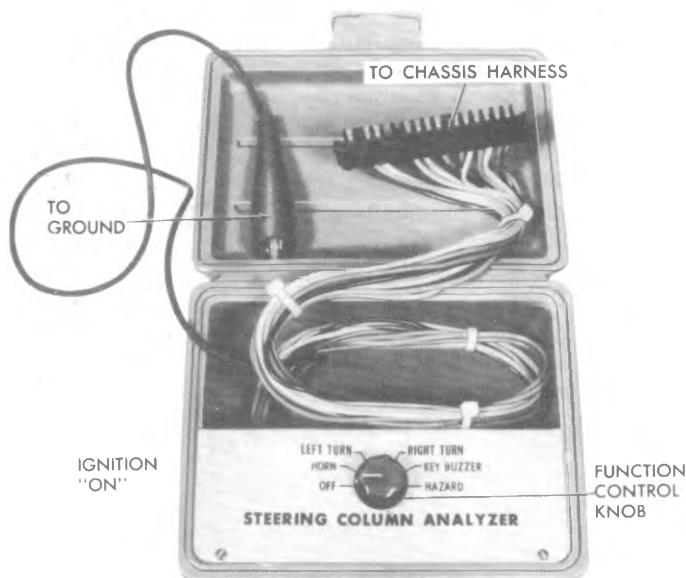


Fig. 3B-1--Steering Column Electrical Analyzer J-23980

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Excessive Play or Looseness in Steering System.</p>	<p>Front wheel bearings loosely adjusted.</p> <p>Worn steering shaft couplings.</p> <p>Worn upper ball joints.</p> <p>Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms or steering linkage ball studs.</p> <p>Steering gear thrust bearings loosely adjusted.</p> <p>Excessive over-center lash in steering gear.</p> <p>Worn intermediate rod or tie rod sockets.</p>	<p>Adjust bearings to obtain proper end play.</p> <p>Replace part.</p> <p>Check and replace if necessary.</p> <p>Tighten to specified torque, or replace if necessary.</p> <p>Adjust preload to specification.</p> <p>Adjust preload to specification.</p> <p>Replace worn part.</p>
<p>Excessive looseness in tie rod or intermediate rod pivots, or excessive vertical lash in idler support.</p>	<p>Seal damage and leakage resulting in loss of lubricant, corrosion and excessive wear.</p>	<p>Replace damaged parts as necessary. Properly position upon reassembly.</p>

Fig. 3B-2--Steering Linkage Diagnosis ChartA

3B-4 STEERING

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Hard Steering – Excessive Effort Required at Steering Wheel.</p>	<p>Low or uneven tire pressure.</p> <p>Steering linkage or bolt joints need lubrication.</p> <p>Tight or frozen intermediate rod, tie rod or idler socket.</p> <p>Steering gear to column misalignment.</p> <p>Steering gear adjusted too tightly.</p> <p>Front wheel alignment incorrect. (manual gear)</p>	<p>Inflate to specified pressures.</p> <p>Lube with specified lubricant.</p> <p>Lube replace or reposition as necessary.</p> <p>Align column.</p> <p>Adjust over-center and thrust bearing preload to specification.</p> <p>Check alignment and correct as necessary.</p>
<p>Poor Returnability.</p>	<p>Steering linkage or ball joints need lubrication.</p> <p>Steering gear adjusted too tightly.</p> <p>Steering gear to column misalignment.</p> <p>Front wheel alignment incorrect. (Caster)</p>	<p>Lube with specified lubricant.</p> <p>Adjust over-center and thrust bearing preload to specifications.</p> <p>Align column.</p> <p>Check alignment and correct as necessary.</p>

Fig. 3B-3--Steering Linkage Diagnosis Chart B

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Rattle or Chuck in Steering Gear.</p>	<p>Insufficient or improper lubricant in steering gear.</p> <p>Pitman arm loose on shaft or steering gear mounting bolt loose.</p> <p>Loose or worn steering shaft bearing.</p> <p>Excessive over-center lash or worm thrust bearings adjusted too loose.</p> <p>NOTE: On turns a slight rattle may occur, due to the increased lash between ball nut and pitman shaft as gear moves off the center of "high point" position. This is normal and lash must not be reduced to eliminate this slight rattle.</p>	<p>Add lube specified.</p> <p>Tighten to specified torque.</p> <p>Replace steering shaft bearing.</p> <p>Adjust steering gear to specified preloads.</p>
<p>Poor Returnability</p>	<p>Steering column misaligned.</p> <p>Insufficient or improper lubricant in steering gear or front suspension.</p> <p>Steering gear adjusted too tight.</p> <p>Front wheel alignment incorrect (Caster)</p>	<p>Align column.</p> <p>Lubricate as specified.</p> <p>Adjust over-center and thrust bearing preload to specifications.</p> <p>Adjust to specifications.</p>

Fig. 3B-4--Manual Gear Diagnosis Chart A

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Excessive Play or Looseness in Steering System.</p>	<p>Front wheel bearings loosely adjusted.</p> <p>Worn upper ball joints.</p> <p>Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms or steering linkage ball nuts.</p> <p>Excessive over-center lash.</p> <p>Worm thrust bearings loosely adjusted.</p>	<p>Adjust to obtain proper end play.</p> <p>Check and replace ball joints if necessary.</p> <p>Tighten to specification, replace if worn or damaged.</p> <p>Adjust over-center preload to specifications.</p> <p>Adjust worm thrust bearing preload to specifications.</p>
<p>Hard Steering – Excessive Effort Required at Steering Wheel</p>	<p>Low or uneven tire pressure.</p> <p>Insufficient or improper lubricant in steering gear or front suspension.</p> <p>Steering shaft flexible coupling misaligned.</p> <p>Steering gear adjusted too tight.</p> <p>Front wheel alignment incorrect. (Manual Gear)</p>	<p>Inflate to specified pressures.</p> <p>Lubricate as specified. Re-lubricate at specified intervals.</p> <p>Align column and coupling.</p> <p>Adjust over-center and thrust bearing preload to specifications.</p> <p>Adjust to specifications.</p>

Fig. 3B-5--Manual Gear Diagnosis Chart B

COLLISION DIAGNOSIS (FIGS. 3B-6 THROUGH 3B-11)

To determine if the energy absorbing steering column components are functioning as designed, or if repairs are required, a close inspection should be made. An inspection is called for in all cases where damage is evident or whenever the vehicle is being repaired due to a front end collision. Whenever a force has been exerted on the steering wheel or steering column, or its components, inspection should also be made. If damage is evident, the affected parts must be replaced.

The inspection procedure for the various steering column components on C and K trucks is as follows:

Column Support Bracket

Damage in this area will be indicated by separation of the mounting capsules from the bracket. The bracket will have moved forward toward the engine compartment and will usually result in collapsing of the jacket section of the steering column.

COLUMN JACKET

Inspect jacket section of column for looseness, and/or bends.

SHIFTER SHAFT

Separation of the shifter shaft sections will be internal and cannot be visually identified. Hold lower end of the "shifter shaft" and move "shift lever" on column through its ranges and up and down. If there is little or no movement of the "shifter shaft", the plastic joints are sheared.

Steering Shaft

If the steering shaft plastic pins have been sheared, the shaft will rattle when struck lightly from the side and some lash may be felt when rotating the steering wheel while holding the rag joint. It should be noted that if the steering shaft pins are sheared due to minor collision with no appreciable damage to other components, that the vehicle can be safely steered; however, steering shaft replacement is recommended.

Because of the differences in the steering column types, be sure to refer to the set of instructions below which apply to the column being serviced.

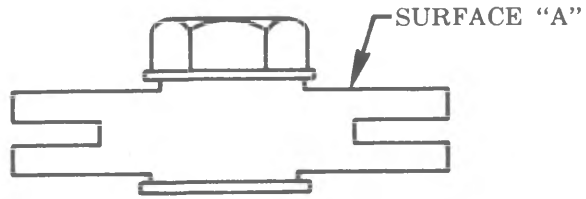
METHOD TO DETERMINE COLUMN COLLAPSE

Measure distance between top of neutral-start switch window opening and the bottom of the upper jacket. The correct value is shown below:

- a. C-Truck 5 11/16" to 5 1/2".
- b. K-Truck 5 11/16" to 5 1/2".

Instrument Panel Bracket Capsule Damage

NOTE: The bolt head must not contact surface "A". If contact is made, the capsule shear load will be increased. If this condition exists replace the bracket.



AUTOMATIC TRANSMISSION COLUMNS

LOCK SYSTEM – WILL NOT UNLOCK

Cause	Solution
A. Lock bolt damaged.	A. Replace lock bolt.
B. Defective lock cylinder.	B. Replace or repair lock cylinder.
C. Damaged housing.	C. Replace housing.
D. Damaged or collapsed sector.	D. Replace sector.
E. Damaged rack.	E. Replace rack.
F. Shear Flange on sector shaft collapsed.	F. Replace.

LOCK SYSTEM - WILL NOT LOCK

Cause	Solution
A. Lock bolt spring broken or defective.	A. Replace spring.
B. Damaged sector tooth, or sector installed incorrectly.	B. Replace, or install correctly.
C. Defective lock cylinder.	C. Replace lock cylinder
D. Burr or lock bolt or housing.	D. Remove Burr.
E. Damaged housing.	E. Replace housing.
F. Transmission linkage adjustment incorrect.	F. Readjust (see Sec. 7).
G. Damaged rack.	G. Replace rack.
H. Interference between bowl and coupling (tilt).	H. Adjust or replace as necessary.
I. Ignition switch stuck.	I. Readjust or replace.
J. Actuator rod restricted or bent.	J. Readjust or replace.

LOCK SYSTEM – HIGH EFFORT

Cause	Solution
A. Lock cylinder defective.	A. Replace lock cylinder.
B. Ignition switch defective.	B. Replace switch.
C. Rack preload spring broken or deformed.	C. Replace spring.
D. Burrs on sector, rack, housing, support, tang of shift gate or actuator rod coupling.	D. Remove Burr.
E. Bent sector shaft.	E. Replace shaft.
F. Distorted rack.	F. Replace rack
G. Misalignment of housing to cover (tilt only).	G. Replace either or both.

Fig. 3B-6--Automatic Transmission Column Diagnosis Chart A

LOCK SYSTEM – HIGH EFFORT (CONT'D.)	
Cause	Solution
H. Distorted coupling slot in rack (tilt). I. Bent or restricted actuator rod. J. Ignition switch mounting bracket bent.	H. Replace rack. I. Straighten remove restriction or replace. J. Straighten or replace.
HIGH EFFORT LOCK CYLINDER – BETWEEN "OFF" AND "OFF-LOCK" POSITIONS	
Cause	Solution
A. Burr on tang of shift gate. B. Distorted rack.	A. Remove burr. B. Replace rack.
STICKS IN "START" POSITION	
Cause	Solution
A. Actuator rod deformed. B. Any high effort condition.	A. Straighten or replace. B. Check items under high effort section.
KEY CAN NOT BE REMOVED IN "OFF-LOCK" POSITION	
Cause	Solution
A. Ignition switch is not set correctly. B. Defective lock cylinder.	A. Readjust ignition switch. B. Replace lock cylinder.
LOCK CYLINDER CAN BE REMOVED WITHOUT DEPRESSING RETAINER	
Cause	Solution
A. Lock cylinder with defective retainer. B. Lock cylinder without retainer. C. Burr over retainer slot in housing cover.	A. Replace lock cylinder. B. Replace lock cylinder. C. Remove burr.
LOCK BOLT HITS SHAFT LOCK IN "OFF" AND "PARK" POSITIONS	
Cause	Solution
A. Ignition switch is not set correctly.	A. Readjust ignition switch.
IGNITION SYSTEM – ELECTRICAL SYSTEM WILL NOT FUNCTION	
Cause	Solution
A. Defective fuse in "accessory" circuit. B. Connector body loose or defective. C. Defective wiring.	A. Replace fuse. B. Tighten or replace. C. Repair or replace.

Fig. 3B-7--Automatic Transmission Column Diagnosis Chart B

**IGNITION SYSTEM – ELECTRICAL SYSTEM –
WILL NOT FUNCTION (CONT'D.)**

Cause	Solution
D. Defective ignition switch. E. Ignition switch not adjusted properly.	D. Replace ignition switch. E. Readjust ignition switch.
SWITCH WILL NOT ACTUATE MECHANICALLY	

Cause	Solution
A. Defective ignition switch.	A. Replace ignition switch.
SWITCH CAN NOT BE SET CORRECTLY	

Cause	Solution
A. Switch actuator rod deformed. B. Sector to rack engaged in wrong tooth (tilt).	A. Repair or replace switch actuator rod. B. Engage sector to rack correctly.
NOISE IN COLUMN	

Cause	Solution
A. Coupling bolts loose. B. Column not correctly aligned. C. Coupling pulled apart. D. Sheared intermediate shaft plastic joint. E. Horn contact ring not lubricated. F. Lack of grease on bearings or bearing surfaces. G. Lower shaft bearing tight or frozen. H. Upper shaft tight or frozen. I. Shaft lock plate cover loose. J. Lock plate snap ring not seated. K. Defective buzzer dog cam on lock cylinder. L. One click when in "off-lock" position and the steering wheel is moved.	A. Tighten pinch bolts to specified torque. B. Realign column. C. Replace coupling and realign column. D. Replace or repair steering shaft and realign column. E. Lubricate with lubriplate. F. Lubricate bearings. G. Replace bearing. Check shaft and replace if scored. H. Replace housing assembly. I. Tighten three screws or, if missing, replace. CAUTION: Use specified screws. (15 in. lbs.) J. Replace snap ring. Check for proper seating in groove. K. Replace lock cylinder. L. Normal condition - lock bolt is seating.

Fig. 3B-8--Automatic Transmission Column Diagnosis Chart C

HIGH STEERING SHAFT EFFORT

Cause	Solution
<ul style="list-style-type: none"> A. Column assembly misaligned in vehicle. B. Improperly installed or deformed dust seal. C. Tight or frozen upper or lower bearing. D. Flash on I.D. of shift tube from plastic joint. 	<ul style="list-style-type: none"> A. Realign. B. Remove and replace. C. Replace affected bearing or bearings. D. Replace shift tube.

HIGH SHIFT EFFORT

Cause	Solution
<ul style="list-style-type: none"> A. Column not aligned correctly in car. B. Improperly installed dust seal. C. Lack of grease on seal or bearing areas. D. Burr on upper or lower end of shift tube. E. Lower bowl bearing not assembled properly (tilt). F. Wave washer with burrs (tilt only). 	<ul style="list-style-type: none"> A. Realign. B. Remove and replace. C. Lubricate bearings and seals. D. Remove burr. E. Reassemble properly. F. Replace wave washer.

IMPROPER TRANSMISSION SHIFTING

Cause	Solution
<ul style="list-style-type: none"> A. Sheared shift tube joint. B. Improper transmission linkage adjustment. C. Loose lower shift lever. D. Improper gate plate. E. Sheared lower shift lever weld. 	<ul style="list-style-type: none"> A. Replace shift tube assembly. B. Readjust linkage. C. Replace shift tube assembly. D. Replace with correct part. E. Replace tube assembly.

LASH IN MOUNTED COLUMN ASSEMBLY

Cause	Solution
<ul style="list-style-type: none"> A. Instrument panel mounting bolts loose. B. Broken weld nuts on jacket. C. Instrument panel bracket capsule sheared. D. Instrument panel to jacket mounting bolts loose. E. Loose shoes in housing (tilt only). F. Loose tilt head pivot pins (tilt only). G. Loose shoe lock pin in support (tilt only). 	<ul style="list-style-type: none"> A. Tighten to specifications. (20 ft. lbs.) B. Replace jacket assembly. C. Replace bracket assembly. D. Tighten to specifications. (15 ft. lbs.) E. Replace. F. Replace. G. Replace.

MISCELLANEOUS

Cause	Solution
<ul style="list-style-type: none"> A. Housing loose on jacket - will be noticed with ignition in "Off-Lock" and a torque applied to the steering wheel. B. Shroud loose on shift bowl. 	<ul style="list-style-type: none"> A. Tighten four mounting screws - (60 in. lbs.) B. Bend tabs on shroud over lugs on bowl.

Fig. 3B-9--Automatic Transmission Column Diagnosis Chart D

MANUAL TRANSMISSION COLUMNS

GENERAL INFORMATION

All of the preceding diagnosis information for automatic transmission will apply to the manual transmission. The following information is supplied in addition to and specifically for manual transmission columns.

DRIVER CAN LOCK STEERING IN SECOND GEAR

Cause	Solution
A. Defective upper shift lever.	A. Replace shift lever.
B. Defective shift lever gate.	B. Replace shift lever gate.
C. Loose relay lever on shift tube.	C. Replace shift tube assembly.
D. Use of upper shift lever prior to 1969 model year.	D. Replace with current lever.

HIGH SHIFT EFFORT

Cause	Solution
A. Column not aligned correctly in car.	A. Realign column.
B. Lower bowl bearing not assembled correctly.	B. Reassemble correctly.
C. Improperly installed seal.	C. Remove and replace.
D. Wave washer in lower bowl bearing defective.	D. Replace wave washer.
E. Improper adjustment of lower shift levers.	E. Readjust (see Sec. 7).
F. Lack of grease on seal, bearing areas or levers.	F. Lubricate seal, levers and bearings.
G. Damaged shift tube in bearing areas.	G. Replace shift tube assembly.

IMPROPER TRANSMISSION SHIFTING

Cause	Solution
A. Loose relay lever on shift tube.	A. Replace shift tube assembly.

TILT COLUMNS

GENERAL INFORMATION

All of the preceding diagnosis will generally apply to tilt columns. The following is supplied in addition to and specifically for tilt columns.

HOUSING SCRAPPING ON BOWL

Cause	Solution
A. Bowl bent or not concentric with hub.	A. Replace bowl.

Fig. 3B-10--Manual Transmission Column Diagnosis

STEERING WHEEL LOOSE

Cause	Solution
<ul style="list-style-type: none"> A. Excessive clearance between holes in support or housing and pivot pin diameters. B. Defective or missing anti-lash spring in spheres. C. Upper bearing seat not seating in bearing. D. Upper bearing inner race seat missing. F. Loose support screws. G. Bearing preload spring missing or broken. 	<ul style="list-style-type: none"> A. Replace either or both. B. Add spring or replace both. C. Replace both. D. Install seat. F. Tighten to 60 in. lbs. G. Replace preload spring.

STEERING WHEEL LOOSE EVERY OTHER TILT POSITION

Cause	Solution
<ul style="list-style-type: none"> A. Loose fit between shoe and shoe pivot pin. 	<ul style="list-style-type: none"> A. Replace both.

NOISE WHEN TILTING COLUMN

Cause	Solution
<ul style="list-style-type: none"> A. Upper tilt bumper worn. B. Tilt spring rubbing in housing. 	<ul style="list-style-type: none"> A. Replace tilt bumper. B. Lubricate.

STEERING COLUMN NOT LOCKING IN ANY TILT POSITION

Cause	Solution
<ul style="list-style-type: none"> A. Shoe seized on its pivot pin. B. Shoe grooves may have burrs or dirt. C. Shoe lock spring weak or broken. 	<ul style="list-style-type: none"> A. Replace shoe and pivot pin. B. Replace shoe. C. Replace lock spring.

STEERING WHEEL FAILS TO RETURN TO TOP TILT POSITION

Cause	Solution
<ul style="list-style-type: none"> A. Pivot pins are bound up. B. Wheel tilt spring is defective. C. Turn signal switch wires too tight. 	<ul style="list-style-type: none"> A. Replace pivot pins. B. Replace tilt spring. C. Reposition wires.

Fig. 3B-11--Tilt Column Diagnosis

TURN SIGNAL DIAGNOSIS C AND K SERIES (FIGS. 3B-12 THROUGH 3B-19)

When a complaint is made involving the turn signal system, it must first be determined whether the problem is mechanical or electrical. If mechanical, the switch itself is at fault and must be repaired or replaced. If electrical, J-23980 should be used to determine whether the switch, or the chassis wiring is in need of repair or replacement.

This diagnostic procedure has been designed to guide the mechanic through the proper diagnosis and repair of the turn signal system. The service section is to be used where assembly and/or disassembly procedures are required. The wiring diagram, found in Section 12, should be used to trouble shoot the chassis and body wiring after the problem has been isolated.

The nature of the customer complaint will generally point to the problem area.

Electrical

Chassis Electrical

The most common turn signal system problems are generally electrical and may easily, be fixed by the replacement of **fuses, bulbs, or flashers**.

First make these checks and replace any non-operative components.

1. **Check fuses** (Figure 3B-12). Replace if blown. If new fuse blows, replace flasher in system. (There are 2 flashers in the signal switch system. The hazard warning flasher and turn signal flasher are located on the fuse block.

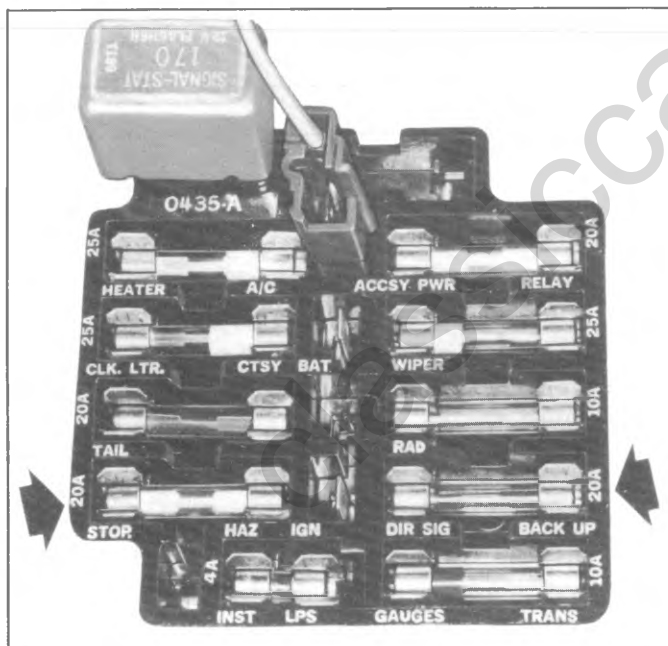


Fig. 3B-12--Checking Fuses on Fuse Block

2. Check for secure connection at the chassis to switch connector. This is the harmonica connector on the column (Figure 3B-13). Secure if loose. Check all individual wire terminals for proper seating in the connector bodies. Terminals should be locked in place.

3. Depress hazard warning button and check all lights in signal switch system. Replace any which do not work. If **all** lamps light when hazard warning is depressed, but flashing does not occur, replace hazard warning flasher. (On fuse block) (Figure 3B-14).

4. If **all** directional lamps light when lane change or turn indicator is actuated, but no flashing occurs, replace the turn signal flasher.

The above four steps will, in most cases, cure the common signal switch system troubles. If the system is still not operating correctly, use J-23980 to determine whether the chassis wiring or the signal switch itself is at fault.

Mechanical

1. If the customer's complaint indicates the problem is in the switch, function check as to return from full left and full right turns.

Actuate the turn lever into a full turn position in either direction, then turn the steering wheel (motor on - power steering) at least 1/4 turn in the direction indicated and then back to center. Do this in both directions. If the lever does not return to the neutral position, disassemble the upper part of the column until the switch is visible.

2. Check the return from lane change by holding the lever in lane change and releasing (both left and right). If the lever does not return to neutral, disassemble the upper part of the column.

3. If the hazard warning button cannot be depressed or released, the switch must be replaced.

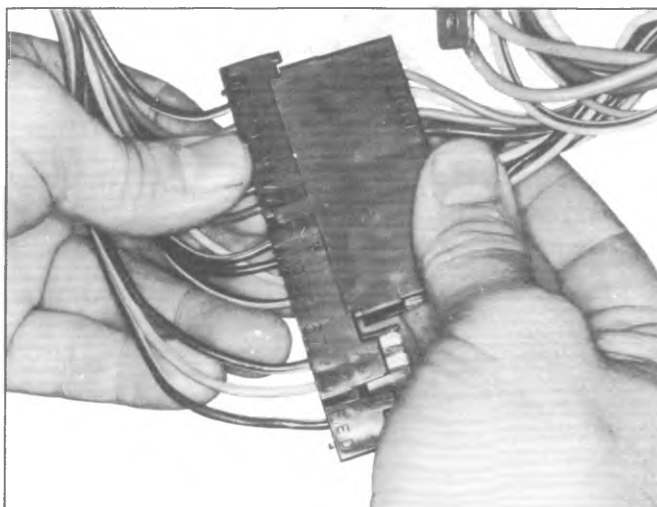


Fig. 3B-13--Checking Harmonica Connector on Column

Switch Visual Inspection

1. With the upper part of the column disassembled so that the signal switch is visible (Figure 3B-15) check for missing springs. Replace any spring that is missing, inspecting the molded pins which secure them. If these pins are broken, the switch must be replaced.

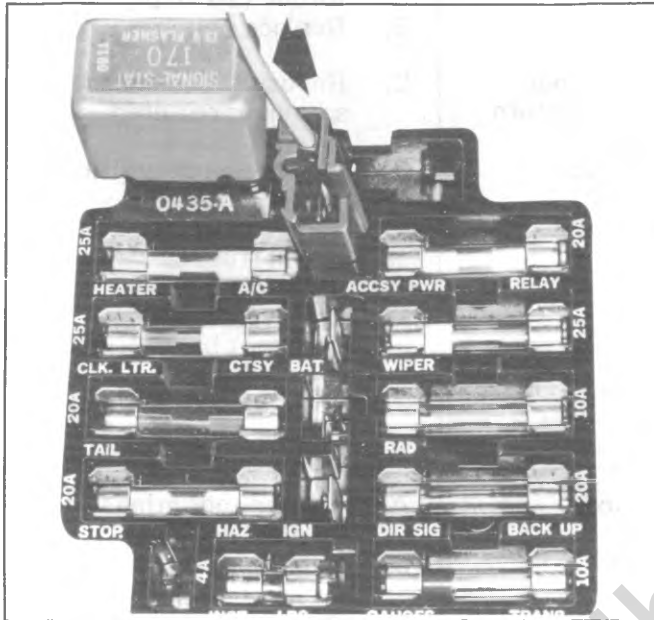


Fig. 3B-14--Checking Hazard Warning Flasher

2. Check the position of the switch in the bowl. If it appears cocked or crooked, loosen the securing screws (3) and visually inspect the switch. If any of the plastic is broken or badly deformed, the switch must be replaced.

3. If the switch appears undamaged, replace it being careful to seat the pilot into the housing, tighten the screws to 25 lbs. in. of torque.

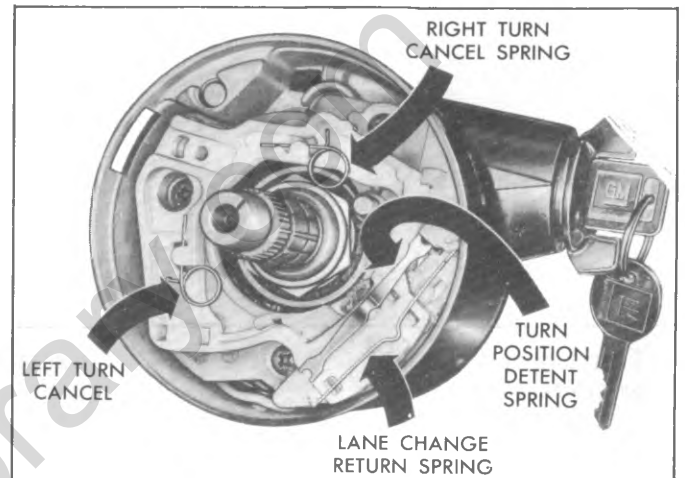


Fig. 3B-15--Checking Turn Signal Switch Visually

SIGNAL SWITCH DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Turn signal will not cancel	<ul style="list-style-type: none"> A. Loose switch mounting screws B. Switch or anchor bosses broken C. Broken, missing or out of position detent, return or cancelling spring D. Uneven or incorrect cancelling cam to cancelling spring interference. (.120)/side 	<ul style="list-style-type: none"> A. Tighten to specified torque (25 in-lbs) B. Replace switch C. Reposition or replace springs as required D. Adjust switch position <ol style="list-style-type: none"> 1. If interference is correct and switch will still not cancel, replace switch. 2. If interference cannot be corrected by switch adjustment, replace cancelling cam.
Turn signal difficult to operate	<ul style="list-style-type: none"> A. Actuator rod loose B. Yoke broken or distorted C. Loose or misplaced springs D. Foreign parts and/or materials E. Switch mounted loosely 	<ul style="list-style-type: none"> A. Tighten mounting screw (12 in-lb) B. Replace switch C. Reposition or replace springs D. Remove foreign parts and/or material E. Tighten mounting screws (25 in-lbs)
Turn signal will not indicate lane change	<ul style="list-style-type: none"> A. Broken lane change pressure pad or spring hanger B. Broken, missing or misplaced lane change spring C. Jammed base or wires 	<ul style="list-style-type: none"> A. Replace switch B. Replace or reposition as required C. Loosen mounting screws, reposition base or wires and retighten screws (25 in-lbs)
Turn signal will not stay in turn position	<ul style="list-style-type: none"> A. Foreign material or loose parts impeding movement of yoke B. Broken or missing detent or cancelling springs C. None of the above 	<ul style="list-style-type: none"> A. Remove material and/or parts B. Replace spring C. Replace switch
Hazard switch cannot be turned off	<ul style="list-style-type: none"> A. Foreign material between hazard support cancelling leg and yoke 	<ul style="list-style-type: none"> A. Remove foreign material <ol style="list-style-type: none"> 1. No foreign material impeding function of hazard switch — replace turn signal switch

Fig. 3B-16--Turn Signal Switch Diagnosis Chart A

SIGNAL SWITCH DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Hazard switch will not stay on or difficult to turn off	<ul style="list-style-type: none"> A. Loose switch mounting screws B. Interference with other components C. Foreign material D. None of the above 	<ul style="list-style-type: none"> A. Tighten mounting screws (25 in-lbs) B. Remove interference C. Remove foreign material D. Replace switch
No turn signal lights	<ul style="list-style-type: none"> A. Defective or blown fuse B. Inoperative turn signal flasher C. Loose chassis to column connector D. Disconnect column to chassis connector. Connect new switch to chassis and operate switch by hand. If vehicle lights now operate normally, signal switch is inoperative E. If vehicle lights do not operate check chassis wiring for opens, grounds, etc. 	<ul style="list-style-type: none"> A. Replace fuse and check operation B. Replace turn signal flasher C. Connect securely, check operation D. Replace signal switch E. Repair chassis wiring as required using manual as guide
Turn indicator lights on, but not flashing	<ul style="list-style-type: none"> A. Inoperative turn flasher B. Loose chassis to column connection C. Inoperative turn signal switch D. To determine if turn signal switch is defective, substitute new switch into circuit and operate switch by hand. If the vehicle's lights operate normally, signal switch is inoperative E. If the vehicle's lights do not operate, check light sockets for high resistance connections, the chassis wiring for opens, grounds, etc. 	<ul style="list-style-type: none"> A. Replace turn flasher Note: There are two flashers in the system. Consult manual for location. B. Connect securely and check operation C. Replace turn signal switch D. Replace signal switch E. Repair chassis wiring as required using manual as guide

Fig. 3B-17--Turn Signal Switch Diagnosis Chart B

SIGNAL SWITCH DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Front or rear turn signal lights not flashing	<p>A. Burned out fuse</p> <p>B. Burned out or damaged turn signal bulb</p> <p>C. High resistance connection to ground at bulb socket</p> <p>D. Loose chassis to column connector</p> <p>E. Disconnect column to chassis connector. Connect new switch into system and operate switch by hand. If turn signal lights are now on and flash, turn signal switch is inoperative.</p> <p>F. If vehicle lights do not operate, check chassis wiring harness to light sockets for opens, grounds, etc.</p>	<p>A. Replace fuse and check operation</p> <p>B. Replace bulb</p> <p>C. Remove or repair defective connection and check operation</p> <p>D. Connect securely and check operation</p> <p>E. Replace turn signal switch.</p> <p>F. Repair chassis wiring as required using manual as guide</p>
Stop light not on when turn indicated	<p>A. Burned out fuse</p> <p>B. Loose column to chassis connection</p> <p>C. Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If brake lights work with switch in the turn position, signal switch is defective</p> <p>D. If brake lights do not work check connector to stop light sockets for grounds, opens, etc.</p>	<p>A. Replace fuse and check operation</p> <p>B. Connect securely and check operation</p> <p>C. Replace signal switch</p> <p>D. Repair connector to stop light circuits using manual as guide.</p>
Turn indicator panel lights not flashing	<p>A. Burned out bulbs</p> <p>B. High resistance to ground at bulb socket</p> <p>C. Opens, grounds in wiring harness from front turn signal bulb socket to indicator lights</p>	<p>A. Replace bulbs</p> <p>B. Replace socket</p> <p>C. Locate and repair as required. Use shop manual as guide.</p>

Fig. 3B-18--Turn Signal Switch Diagnosis Chart C

SIGNAL SWITCH DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Turn signal lights flash very slowly	<p>A. Inoperative turn signal flasher</p> <p>B. System charging voltage low</p> <p>C. High resistance ground at light sockets</p> <p>D. Loose chassis to column connection</p> <p>E. Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If flashing occurs at normal rate, the signal switch is defective.</p> <p>F. If the flashing rate is still extremely slow, check chassis wiring harness from the connector to light sockets for grounds, high resistance points, etc.</p>	<p>A. Replace turn signal flasher</p> <p>B. Increase voltage to specified. See Sec. 6Y</p> <p>C. Repair high resistance grounds at light sockets</p> <p>D. Connect securely and check operation</p> <p>E. Replace signal switch</p> <p>F. Locate and repair as required. Use manual as guide. See Section 12</p>
Hazard signal lights will not flash — turn signal functions normally	<p>A. Blown fuse</p> <p>B. Inoperative hazard warning flasher</p> <p>C. Loose chassis to column connection</p> <p>D. Disconnect column to chassis connector. Connect new switch into system without removing old. Depress the hazard warning button and observe the hazard warning lights. If they now work normally, the turn signal switch is defective.</p> <p>E. If the lights do not flash, check wiring harness "K" lead (brown) for open between hazard flasher and harmonica connector. If open, fuse block is defective.</p>	<p>A. Replace fuse and check operation</p> <p>B. Replace hazard warning flasher</p> <p>C. Connect securely and check operation</p> <p>D. Replace the turn signal switch</p> <p>E. Replace fuse block (See Sec. 12)</p>

Fig. 3B-19--Turn Signal Switch Diagnosis Chart D

POWER STEERING SYSTEM DIAGNOSIS (FIGS. 3B-20 THROUGH 3B-28)

Complaints of faulty steering are frequently the result of problems other than the steering gear or pump. Those areas of the steering system which can be easily checked and quickly corrected without disassembly and overhaul of any major components should be attempted first.

Conditions such as hard or loose steering, road shock or vibrations are not always due to the steering gear or pump, but are often related instead to such factors low tire pressure and front end alignment. These factors should be checked and corrected before any adjustment or disassembly of the power steering gear or pump is attempted.

System Checks

Many factors affect power operation of the steering system, of which the most common are:

1. Fluid level and condition.
2. Drive belt tension.
3. Loose component mountings.
4. Loose pump pulley.

These factors must be checked and corrected before making any further diagnosis of the steering system. The need for proper diagnosis cannot be over-emphasized.

After the source of the problem has been found, determine the cause. For example, if the oil level in the reservoir is found to be low, refill and check the entire hydraulic system for oil leaks. Refilling the reservoir will not necessarily correct problem.

Fluid Level

1. Run engine to normal operating temperature, then shut engine off. Remove reservoir filler cap and check oil level to "hot" mark on dipstick.

2. If oil level is low, add hydraulic fluid to proper level on dipstick and replace filler cap.

NOTE: When adding or making a complete fluid change, always use GM power steering fluid or equivalent.

3. When checking fluid level after the steering system has been serviced, air must be bled from the system. Proceed as follows:

a. With wheels turned all the way to the left, add power steering fluid to "Cold" mark on dipstick.

b. Start engine, and running at fast idle, recheck fluid level. Add fluid if necessary to "Cold" mark on dipstick.

c. Bleed system by turning wheels from side to side without hitting stops. Maintain fluid level just above internal pump casting. Fluid with air in it will have a light tan or red appearance. This air must be eliminated from fluid before normal steering action can be obtained.

d. Return wheels to center position and continue to run engine for two or three minutes, then shut engine off.

e. Road test car to make sure steering functions normally and is free from noise.

f. Recheck fluid level as described in steps 1 and 2, making sure fluid level is at "hot" mark on dipstick after the system has stabilized at its normal operating temperature approximately 170° to 190°F (76° to 88°C).

Belt Adjustment

When adjusting a power steering pump belt, never pry against the pump reservoir or pull against the filler neck. To increase belt tension move the pump outward by prying against the pump housing casting extension directly behind the pump drive pulley.

A belt that has been previously tensioned is considered to be a used belt and should be tightened to 75 pounds. A belt that has never been tensioned is considered to be a new belt and should be tightened to 125 pounds.

Place belt tension gage, J-23600 or equivalent midway between the pulleys on drive belt being checked. If the belt tension is incorrect proceed as follows:

1. When power steering pump is driven by a single belt:
 - a. Loosen the pump attaching bolts and adjust the belt to correct tension by moving the pump outward, away from the engine.
 - b. Snug all pump mounting bolts and remove pry bar.
 - c. Tighten all pump mounting bolts to specified torque.
 - d. Check belt tension and remove the belt tension gage.

Hydraulic System Checks

The following procedure outlines methods to identify and isolate power steering hydraulic circuit difficulties. The test provides means of determining whether power steering system hydraulic parts are actually faulty. This test will result in readings indicating faulty hydraulic operation, and will help to identify the faulty component.

Before performing hydraulic circuit test, carefully check belt tension, fluid level and condition of driving pulley.

Power Steering Hydraulic System Test

Engine must be at normal operating temperature. Inflate front tires to correct pressure. All tests are made with engine idling, check idle adjustment and if necessary adjust engine idle speed to correct specifications listed in Section 6C and proceed as follows:

1. With engine NOT running disconnect pressure hose from pump and install Tool J-5176 using a spare pressure hose between gauge and pump. Gauge must be between shut-off valve and pump. Open shut-off valve. See Fig. 3B-25.
2. Remove filler cap from pump reservoir and check fluid level. Fill pump reservoir to full mark on dipstick. Start engine and, momentarily holding steering wheel against stop, check connections at Tool J-5176 for leakage.
3. Bleed system as outlined under Maintenance and Adjustments.
4. Insert thermometer (Tool J-5421) in reservoir filler opening. Move steering wheel from stop to stop several times until thermometer indicates that hydraulic fluid in reservoir has reached temperature of 150° to 170°F (66° to 76°C).

CAUTION: *To prevent scrubbing flat spots on tires, do not turn steering wheel more than five times without rolling vehicle to change tire-to-floor contact area.*

5. Start engine and check fluid level adding any fluid if required. When engine is at normal operating temperature, the initial pressure read on the gauge (valve open) should be in the 80-125 PSI range. Should this pressure be in excess of 200 PSI - check the hoses for restrictions and the poppet valve for proper assembly.

6. Close gate valve fully 3 times. Record the highest pressures attained each time.

CAUTION: Do not leave valve fully closed for more than 5 seconds as the pump could be damaged internally .

a. If the pressures recorded are within the listed specs and the range of readings are within 50 PSI, the pump is functioning within specs. (EX. Spec. 900 - 1500 PSI - readings - 1270 - 1275 - 1280).

b. If the pressures recorded are high, but do not repeat within 50 PSI, the flow controlling valve is sticking. Remove the valve, clean it and remove any burrs using crocus cloth or fine hone. If the system contains some dirt, flush it. If it is exceptionally dirty, both the pump and the gear must be completely disassembled, cleaned, flushed and reassembled before further usage.

c. If the pressures recorded are constant, but more than 100 PSI, below the low listed spec., replace the flow control valve and recheck. If the pressures are still low, replace the rotating group in the pump.

7. If the pump checks within specifications, leave the valve open and turn (or have turned) the steering wheel into both corners. Record the highest pressures and compare with the maximum pump pressure recorded. If this pressure cannot be built in either (or one) side of the gear, the gear is leaking internally and must be disassembled and repaired. See the current Unit Repair Manual.

8. Shut off engine, remove testing gauge, spare hose, reconnect pressure hose, check fluid level and/or make needed repairs.

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>SYSTEM NOISE</p> <p>There is some noise in all power steering systems.</p> <p>Common complaints are listed as follows:</p>		
Pump noise-"chirp".	Loose belt.	Adjust belt tension to specification.
Belt squeal.	Loose belt.	Adjust belt tension to specification.
Gear noise ("hissing" sound)	There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. There is no relationship between this noise and performance of the steering. "Hiss" may be expected when steering wheel is at end of travel or when slowly turning at standstill.	Do not replace valve unless "hiss" is extremely objectionable. Slight "hiss" is normal and in no way affects steering. A replacement valve will also exhibit slight noise and is not always a cure for the objection. Investigate clearance around flexible coupling rivets. Be sure steering shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates. Any metal-to-metal contacts through flexible coupling will transmit "hiss" into passenger compartment.
Rattle.	<p>Pressure hose touching other parts of car.</p> <p>Loose pump pulley nut</p> <p>Pump vanes not installed properly.</p> <p>Pump vanes sticking in rotor slots.</p>	<p>Adjust hose position.</p> <p>Replace nut, torque to specs.</p> <p>Install properly.</p> <p>Free up by removing burrs, varnish or dirt.</p>
Gear noise (rattle or chuckle).	<p>Improper over-center adjustment</p> <p>NOTE: A slight rattle may occur on turns because of increased clearance off the "high point". This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle.</p> <p>Loose pitman arm.</p> <p>Gear loose on frame.</p>	<p>Adjust to specifications.</p> <p>Tighten to specifications</p> <p>Check gear-to-frame mounting bolts. Tighten bolts to 70 foot-pounds.</p>
Rattle or chuckle.	Steering linkage looseness.	Check linkage pivot points for wear. Replace if necessary.
Groan.	Low oil level.	Fill reservoir to proper level.
Groan.	Air in the oil. Poor pressure hose connection.	Bleed system by operating steering from right to left - full turn. Check connections, torque to specs.
Growl.	Excessive back pressure caused by hoses or steering gear. (restriction)	Locate restriction and correct. Replace part if necessary.

Fig. 3B-20--Power Steering System Diagnosis Chart A

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Pump growl Note: Most noticeable at full wheel travel and stand still parking</p>	<p>Scored pump pressure plates, thrust plate or rotor. Extreme wear of pump cam ring.</p>	<p>Replace affected parts, flush system. Replace affected parts.</p>
<p>Swish in pump</p>	<p>Defective pump flow control valve</p>	<p>Replace valve</p>
<p>Whine in pump</p>	<p>Pump shaft bearing scored.</p>	<p>Replace housing and shaft, flush system</p>
<p>Squawk in gear (not belt)</p>	<p>Dampener "O" ring on valve spool cut</p>	<p>Replace "O" ring.</p>
<p>SYSTEM OPERATION Excessive wheel kick-back or loose steering.</p>	<p>Backlash in steering linkage. Air in system. Excessive "over-center" lash. Loose thrust bearing preload adjustment. Worn poppet valve (Gear) Steering gear loose on frame. Steering gear flexible coupling too loose on shaft or rubber disc mounting screws loose. Steering linkage ball studs worn enough to be loose. Front wheel bearings incorrectly adjusted or worn.</p>	<p>Adjust parts affected or replace worn parts. Add oil to pump reservoir and bleed by operating steering. Check all connections. Adjust to specification. Adjust to specification. Replace poppet valve. Tighten attaching bolts to 70 foot-pounds. Tighten flange pinch bolts to 30 foot-pounds, if serrations are not damaged. Tighten upper flange to coupling nuts to 20 foot-pounds. Replace loose components. Adjust bearings or replace with new parts as necessary.</p>
<p>Poor return of steering.</p>	<p>Tires under-inflated. Lower coupling flange rubbing against steering gear adjuster plug. Steering wheel rubbing against directional signal housing. Tight or frozen steering shaft bearings. Steering linkage or ball joints binding. Steering gear to column misalignment. Tie rod pivots not centralized. Lack of lubricant in suspension ball joints and steering linkage</p>	<p>Inflate to specified pressure. Loosen pinch bolt and assemble properly. Adjust steering jacket. Replace bearings. Replace affected parts. Align steering column. Adjust tie rod ends as required to center pivots. Lubricate and relubricate at proper intervals</p>

Fig. 3B-21—Power Steering System Diagnosis Chart B

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Poor return of steering. (Cont'd.)</p>	<p>Steering gear adjustments over specifications.</p> <p>Sticky or plugged valve spool.</p> <p>Rubber spacer binding in shift tube.</p> <p>Improper front suspension alignment.</p> <p>Tight steering shaft bearings.</p>	<p>Check adjustment with pitman arm disconnected. Readjust if necessary.</p> <p>Remove and clean or replace valve.</p> <p>Make certain spacer is properly seated. Lubricate inside diameter with silicone lubricant.</p> <p>Check and adjust to specifications.</p> <p>Replace bearings.</p>
<p>Car leads to one side or the other. (Keep in mind road condition and wind. Test car on flat road going in both directions)</p>	<p>Front suspension misaligned</p> <p>Steering shaft rubbing ID of shift tube.</p> <p>Unbalanced or badly worn steering gear valve.</p> <p>NOTE: If this is cause, steering effort will be very light in direction of lead and heavy in opposite direction.</p> <p>Steering linkage not level.</p>	<p>Adjust to specifications.</p> <p>Align column.</p> <p>Replace valve.</p> <p>Adjust as required.</p>
<p>Steering wheel surges or jerks when turning with engine running especially during parking.</p>	<p>Low oil level in pump.</p> <p>Loose pump belt.</p> <p>Sticky flow control valve.</p> <p>Insufficient pump pressure.</p> <p>Steering linkage hitting engine oil pan at full turn.</p>	<p>Check oil level, add as necessary.</p> <p>Adjust tension to specification.</p> <p>Inspect for varnish or damage, replace if necessary.</p> <p>Check pump pressure. (See pump pressure test). Replace relief valve if defective.</p> <p>Correct clearance.</p>
<p>Momentary increase in effort when turning wheel fast to right or left.</p>	<p>Pump belt slipping.</p> <p>Low oil level in pump.</p> <p>High internal leakage.</p>	<p>Tighten or replace belt.</p> <p>Check oil level, add as necessary.</p> <p>Check pump pressure (Test)</p>
<p>Hard steering or lack of assist.</p>	<p>High internal leakage. (Gear or pump)</p> <p>Loose pump belt.</p> <p>Low oil level in reservoir.</p>	<p>Check pump pressure. (See pump pressure test).</p> <p>Adjust belt tension to specification.</p> <p>Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage, torque to specs.</p>

Fig. 3B-22--Power Steering Diagnosis Chart C

CONDITION	POSSIBLE CAUSE	CORRECTION
Hard Steering or lack of assist (Continued)	<p>Lack of lubricant in suspension or ball joints.</p> <p>Tires not properly inflated.</p> <p>Steering gear to column misalignment.</p> <p>Steering gear adjusted too tight.</p> <p>Excessive friction in steering linkage.</p> <p>Lower coupling flange rubbing against steering gear adjuster plug.</p> <p>Sticky flow control valve.</p> <p>Frame bent.</p> <p>Front springs weak and sagging.</p> <p>Insufficient oil pressure.</p>	<p>Lubricate, relubricate at proper intervals.</p> <p>Inflate to recommended pressure.</p> <p>Align steering column.</p> <p>Test steering system for binding with front wheels off floor. Adjust as necessary.</p> <p>Check tie rod pivot points for excessive friction. Replace the affected pivot.</p> <p>Loosen pinch bolt and assemble properly.</p> <p>Replace or clean valve.</p> <p>Check frame for proper alignment or cracking. Repair or replace as necessary.</p> <p>Check standing height. Weak or sagging springs should be replaced with new ones.</p> <p>If above checks do not reveal cause of hard steering, diagnose hydraulic system to determine problem.</p>
Low oil pressure due to restriction in hoses:	<p>Check for kinks in hoses.</p> <p>Foreign object stuck in hose.</p>	<p>Remove kink.</p> <p>Remove hoses and remove restricting object or replace hose.</p>
Low oil pressure due to steering gear: (See pump pressure test)	<p>Pressure loss in cylinder due to worn piston ring or scored housing bore.</p> <p>Leakage at valve rings, valve body to worm seal.</p> <p>Loose fit of spool in valve body or leaky valve body.</p> <p>Damaged poppet valve.</p>	<p>Remove gear from car for disassembly and inspection of ring and housing bore. Replace affected parts.</p> <p>Remove gear from car for disassembly and replace seals.</p> <p>Replace valve.</p> <p>Replace valve.</p>

Fig. 3B-23--Power Steering System Diagnosis Chart D

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Low oil pressure due to steering pump: (See pump pressure test.)</p> <p>Note: Steering system external leakage</p> <p>Foaming milky power steering fluid, low level and possible low pressure.</p>	<p>Loose belt.</p> <p>Low oil level.</p> <p>Air in the oil.</p> <p>Defective hoses or steering gear.</p> <p>Flow control valve stuck or inoperative.</p> <p>Loose screw in end of flow control valve.</p> <p>Cracked or broken thrust or pressure plate.</p> <p>Pressure plate not flat against cam ring.</p> <p>Extreme wear of cam ring.</p> <p>Scored pressure plate, thrust plate or rotor.</p> <p>Vanes not installed properly.</p> <p>Vanes sticking in rotor slots.</p> <p>Air in the fluid, and loss of fluid due to internal pump leakage causing overflow.</p>	<p>Adjust tension to specification</p> <p>Fill reservoir to proper level.</p> <p>Locate source of leak and correct. Bleed system.</p> <p>Correct as necessary.</p> <p>Remove burrs or dirt or replace.</p> <p>Tighten.</p> <p>Replace part.</p> <p>Replace pressure plate.</p> <p>Replace parts, flush system</p> <p>Replace parts. (If rotor, replace with rotating group kit), flush system</p> <p>Install properly. Radius edge to outside.</p> <p>Free-up by removing burrs, varnish or dirt.</p> <p>Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeration should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from housing. Check welsh plug and housing for cracks. If plug is loose or housing is cracked, replace housing.</p>

Fig. 3B-24--Power Steering System Diagnosis Chart E

Power Steering System External Leakage

General Procedure

1. Wipe suspected area dry.
2. Check for overfilled reservoir.
3. Check for oil aeration and overflow.
4. Check hose connections - tighten if necessary.
5. Verify exact point of leakage.

Example: Torsion bar, stub shaft and adjuster seals are close together; exact leakage point could be confused.

Example: The point oil drips from is not necessarily the leakage point - oil overflowing from reservoir for instance.

6. When service is required:
 - A. Clean leakage area upon disassembly.
 - B. Replace leaking seal.
 - C. Check component sealing surfaces for damage.
 - D. Reset bolt torque to specifications where required.
- Some of the customer complaints associated with the

power steering system may be reported as:

1. Oil leakage on garage floor.
2. Oil leaks visible on steering gear, pump, or anywhere else on the left side of engine compartment.
3. Growling noise especially when parking or when engine is cold.
4. Loss of power when parking.
5. Heavy steering effort.

For the purpose of trouble shooting complaints of this nature, assume that there is an external leak in the power steering system.

Leakage Diagnosis (Fig. 3B-26)

This section is a guide, which when used in conjunction with your service manual will enable you, a service mechanic, to locate, identify, and repair leaks in the power steering system. It contains:

- A. Diagram of the complete power steering system with the areas of potential leakage identified.

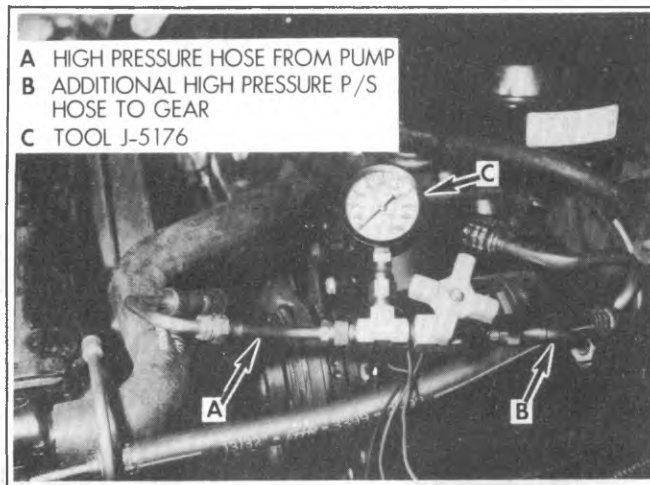


Fig. 3B-25--Checking Power Steering Pressures

B. Recommended procedure for locating external leakage in the vehicle.

C. Areas of leakage to be checked, which can be serviced at once.

D. Part replacement recommendations.

E. Diagram of the actual areas where leakage will be observed and the action recommended to repair this leakage.

Leakage Check

The purpose of the diagnostic procedure is to pin-point the location of the leak. The method outlined in this manual can be followed to locate the leak and repair it.

In some cases you will be able to locate the leak easily. However, seepage type leaks may be more difficult to isolate. For seepage leaks, the following method is recommended.

A. With the vehicle's engine off, wipe the complete power steering system dry (gear, pump, hoses, and connections).

B. Check oil level in pump's reservoir and adjust as directed in maintenance section.

C. Start engine and turn steering wheel from stop to stop several times. Do not hold in corner for any length of time as this can damage the power steering pump. It is easier if someone else operates the steering wheel while you search for the seepage.

D. Find the exact area of leakage.

E. Refer to the diagnostic chart to find the recommended method of repair.

Quick Fixes

The purpose of this section is to acquaint you with the types of leakage which can be repaired very easily. It contains information on reservoir oil level, the hoses and the hose connections.

An overfilled pump reservoir can be a cause for leakage complaint. The oil in the steering system expands as heated during normal usage. If overfilled the excess is forced through the breather cap hole and may be sprayed over the engine by air blast. Operate the engine and steering system until normal operating temperature is obtained. Remove the reservoir cap and check the graduated level on the dipstick. Adjust the oil level as required.

Seepage at the hose connections can be a cause for

leakage complaint and can be due to loose connection nuts. If leakage is observed at the hose connections, and the nut is not cross threaded, tighten the nuts at the gear to 30 foot pounds.

The nut at the power steering pump should be tightened to 40 foot pounds. If tightening to this torque does not stop the leak, refer to the diagnostic chart.

If either the return hose or the pressure hose leaks, replace the hose.

Component Replacement

Lip seals, which seal rotating shafts, require special treatment. This type of seal is used on the steering gear at the pitman shaft, at the stud shaft, and on the drive shaft of the pump. When leakage occurs in one of these areas, always replace the seal(s), after inspecting and thoroughly cleaning the sealing surfaces. Replace the shaft only if very severe pitting is found. If the corrosion in the lip seal contact zone is slight, clean the surface of the shaft with crocus cloth. Replace the shaft only if the leakage cannot be stopped by smoothing with crocus cloth first.

Housing or Cover Seepage - Both the power steering gear and pump assemblies are leakage checked before shipment. However, occasionally oil seepage may occur from the gear or pump other than the seal areas. If this type of leakage is found, replace the leaking part.

The following diagrams have been prepared to show the potential areas of leakage. If leakage occurs in the zones shown, replace the part listed using the service manual as a guide.

Steering Gear Leakage Diagrams (Fig. 3B-27)

Pay particular attention to the exact source of leakage as an improper diagnosis will result in an ineffective repair.

1. Replace adjuster plug "O" RING SEAL.
2. Replace dust and stub shaft seals. Refer to above on stub shaft seal ride.
3. Replace rotary valve assembly.
4. Seat ball flush with punch and restake. If seepage persists, replace housing.
5. Replace both pitman shaft seals. Refer to above on seal ride area of pitman shaft.
6. Replace end plug "O" ring seal.
7. Tighten nut to 35 pounds foot. Replace nut if leakage persists.
8. Replace side cover "O" ring seal.
9. If leakage persists upon tightening the fitting nut (30 foot pounds), replace brass connector and reface hose tube flare. If leakage is due to damaged threads (cross threaded), replace brass connector. Repair fitting nut or replace hose as required. If housing threads are badly stripped, replace housing.

Pump Leakage Diagrams (Fig. 3B-28)

10. Tighten hose fitting nut to 40 pounds foot. If leakage persists, replace discharge fitting and reface hose tube flare or replace hose as required.
11. Tighten fitting to 35 pounds foot. If leakage persists, replace both "O" ring seals.
12. Replace reservoir "O" ring.
13. Replace drive shaft seal. Refer to above on seal ride area of drive shaft.
14. Replace reservoir.
15. Check oil level. If leakage persists with the level right and the cap tight, replace the cap.

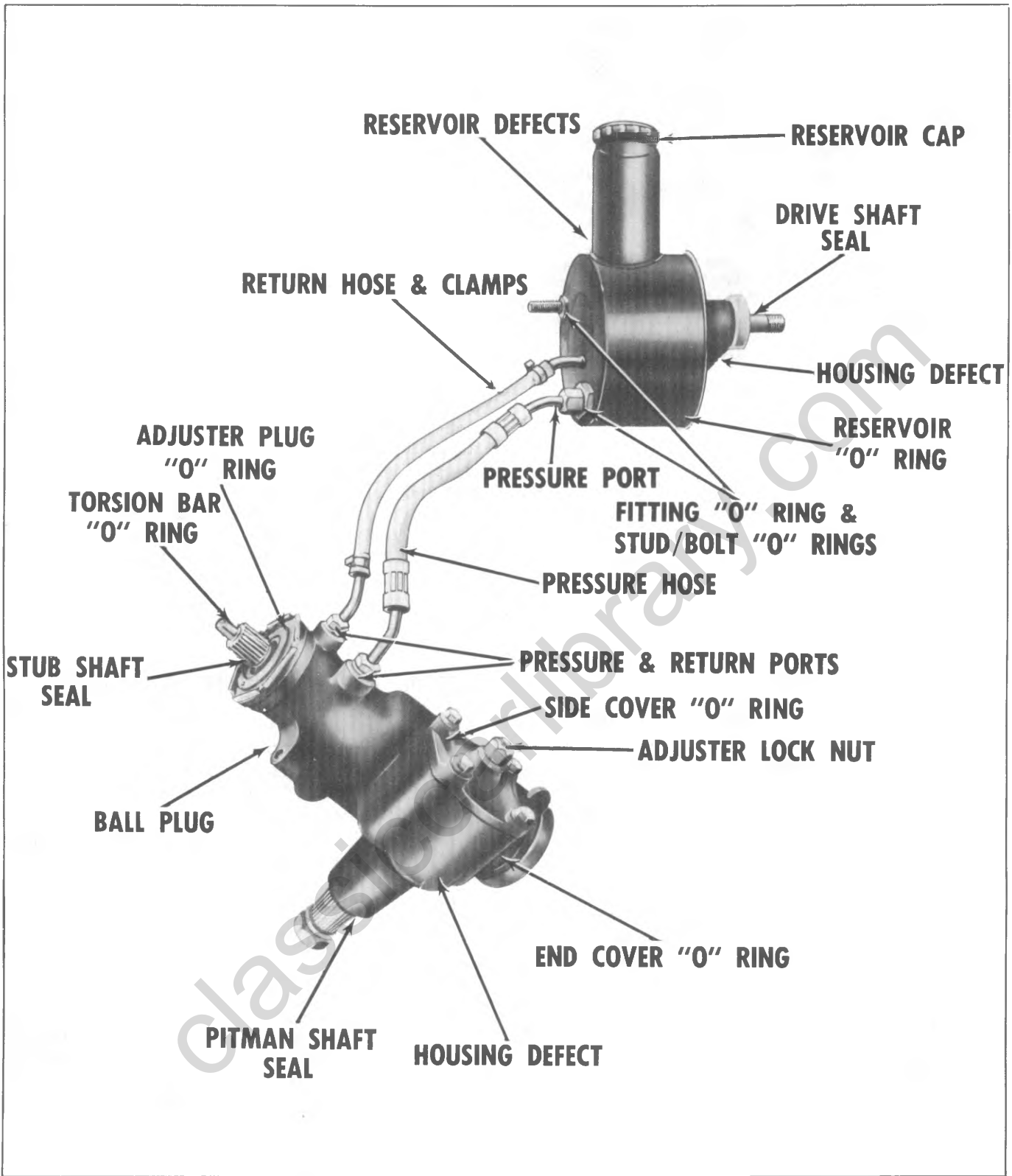


Fig. 3B-26--Power Steering System Potential Leakage Areas

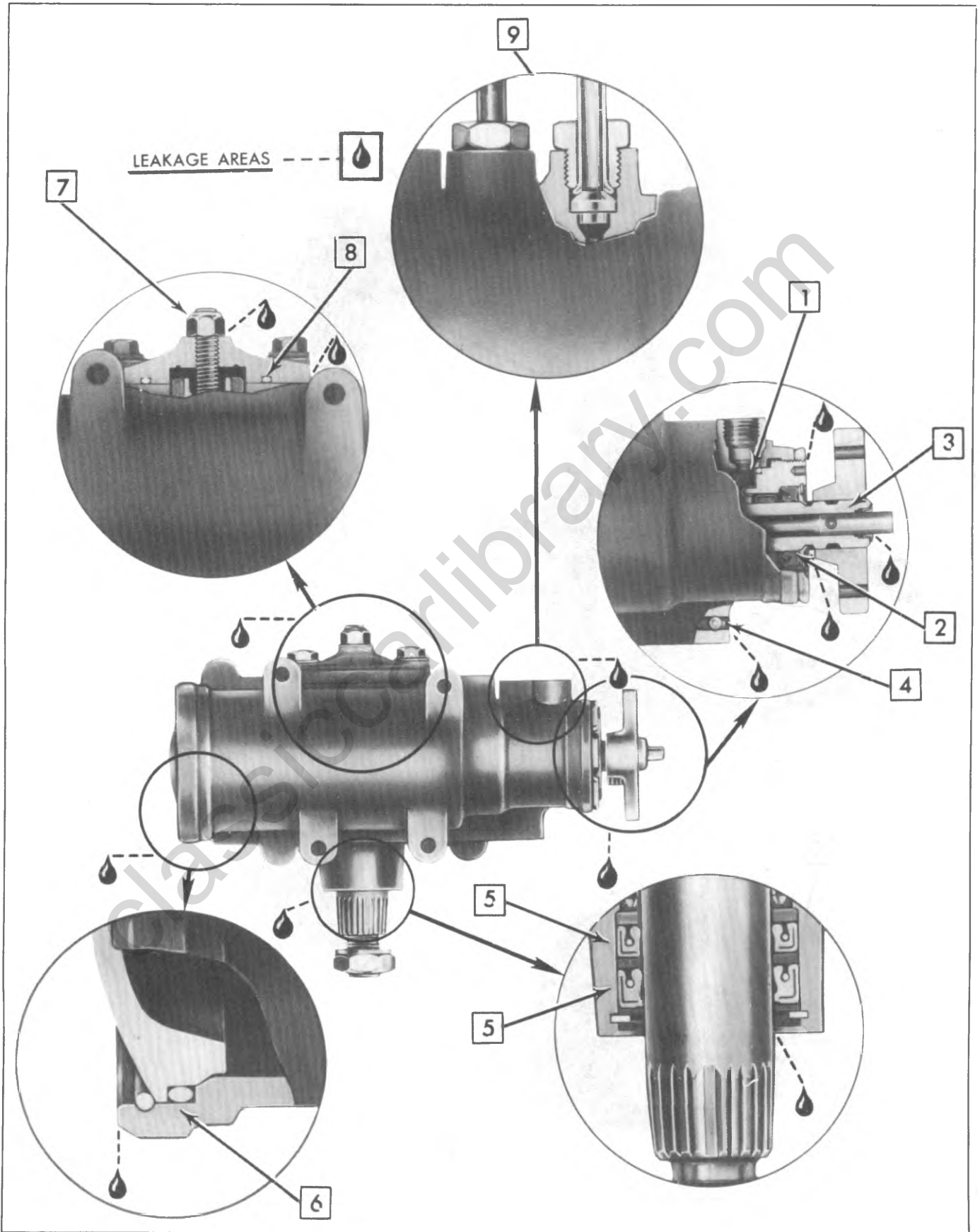


Fig. 3B-27--Power Steering Gear Leakage

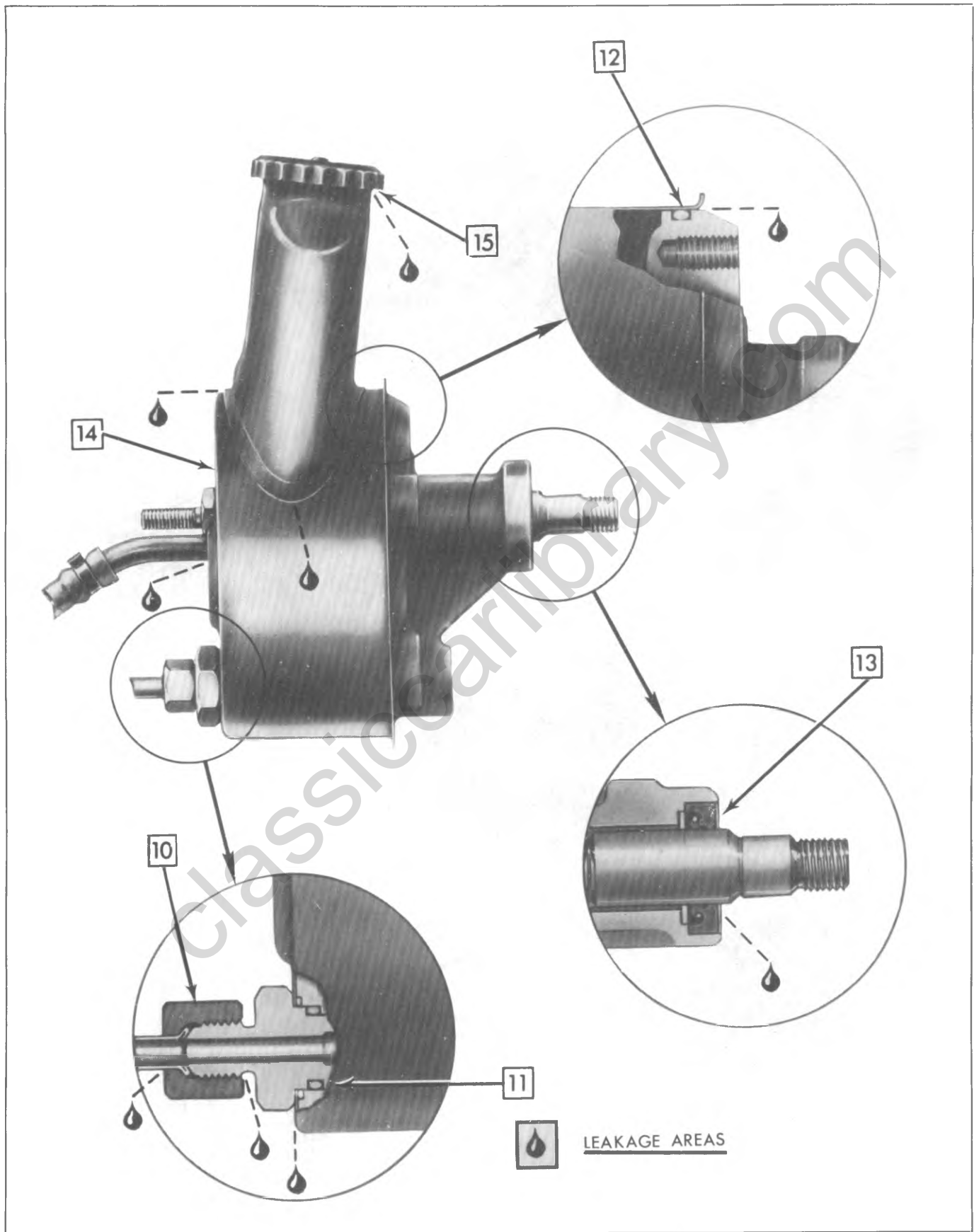


Fig. 3B-28--Power Steering Pump Leakage

MAINTENANCE AND ADJUSTMENTS

LUBRICATION

Lubrication of Manual Steering Gear

The manual steering gear is factory-filled with steering gear lubricant. Seasonal change of this lubricant should not be performed and the housing should not be drained— **no lubrication is required for the life of the steering gear** .

Every 36,000 miles (57 600 km), the manual gear should be inspected for seal leakage (**actual solid grease - not just oily film**) . If a seal is replaced or the gear is overhauled, the gear housing should be refilled with **1051052 (13 oz. container) Steering Gear Lubricant which meets GM Specification GM 4673M, or its equivalent.**

NOTE: Do not use EP Chassis Lube, which meets GM Specification GM 6031M, to lubricate the gear **DO NOT OVER-FILL** the gear housing.

Lubrication of Steering Linkage

The steering linkage under normal conditions should be lubricated with any water resistant EP type chassis lubricant every 7,500 miles (12 000 km) or six months, whichever occurs first. Lubricate every 3,000 miles (4 800 km) or two months whichever occurs first when operating in dusty or muddy conditions or if the vehicle is used "off-road" . Lubrication points and additional information on the chassis lubricant recommended can be found in Section 0--General Information and lubrication.

Lubrication of Power Steering Pump

Use only an approved power steering lubricant in the pump.

NOTE: Never use brake fluid in the power steering pump.

ADJUSTMENTS

CAUTION: See *Caution on page one of this section regarding the fasteners referred to in steps 9d and 10.*

Manual Steering Gear

CAUTION: See *CAUTION on page 1 of this section regarding the fastener referred to in step 10.*

Before any adjustments are made to the steering gear attempt to correct complaints of loose or hard steering, or other wheel disturbances, a careful check should be made of front end alignment, shock absorbers, wheel balance and tire pressure for possible steering system problems. See Diagnosis in sections 3A and 3B.

Correct adjustment of steering gear is very important. While there are but two adjustments to be made, the following procedure must be followed step-by-step in the order given.

1. Disconnect the battery ground cable.
2. Raise the vehicle.
3. Remove the pitman arm nut. Mark the relationship of the pitman arm to the pitman shaft. Remove the pitman arm with Tool J-6632 or J-5504 as shown in Figure 3B-50.
4. Loosen the steering gear adjuster plug locknut and back the adjuster plug off 1/4 turn (fig. 3B-29).

5. Remove the horn shroud or button cap.

6. Turn the steering wheel gently in one direction until stopped by the gear; then turn back one-half turn.

CAUTION: Do not turn the steering wheel hard against the stops when the steering linkage is disconnected from the gear as damage to the ball guides could result.

7. Measure and record "bearing drag" by applying a torque wrench with a socket on the steering wheel nut and rotating through a 90° arc (fig. 3B-30A).

NOTE: Do not use a torque wrench having a maximum torque reading of more than 50 inch pounds.

8. Adjust "thrust bearing preload" by tightening the adjuster plug until the proper "thrust loading preload" is obtained (See specifications section). When the proper preload has been obtained, tighten the adjuster plug locknut to specifications and recheck torque. If the gear feels "lumpy" after adjustment, there is probably damage in the bearings due to severe impact or improper adjustment; the gear must be disassembled and inspected for replacement of damaged parts.

9. Adjust "over-center preload" as follows:

a. Turn the steering wheel gently from one stop all the way to the other carefully counting the total number of turns. Turn the wheel back exactly half-way, to center position.

b. Turn the lash adjuster screw clockwise to take out all lash between the ball nut and pitman shaft sector teeth and then tighten the locknut.

c. Check the torque at the steering wheel, taking the highest reading as the wheel is turned through center position. See the Specifications Section for proper over-center preload.

d. If necessary, loosen locknut and readjust lash adjuster screw to obtain proper torque. Tighten the locknut to specifications and again check torque reading through center of travel.

NOTE: If maximum specification is exceeded, turn lash adjuster screw counterclockwise, then come up on

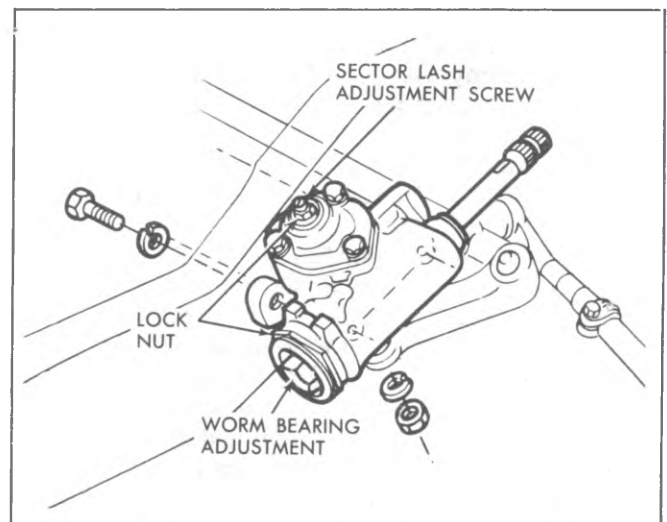


Fig. 3B-29--Steering Gear Adjustment Points-Typical

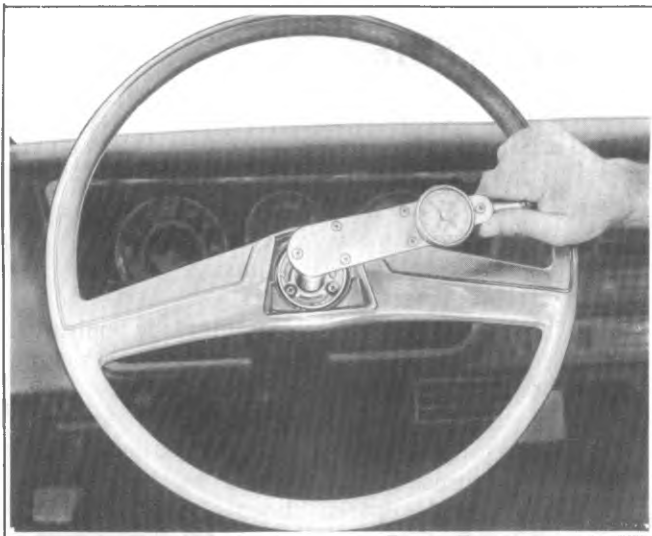


Fig. 3B-30A--Checking Torque at Steering Wheel

adjustment by turning the adjuster in a clockwise motion.

10. Reassemble the pitman arm to the pitman shaft, lining up the marks made during disassembly. Torque the pitman shaft nut to specifications.

CAUTION: *If a clamp type pitman arm is used, spread the pitman arm just enough, with a wedge, to slip the arm onto the pitman shaft. Do not spread the clamp more than required to slip over pitman shaft with hand pressure. Do not hammer the pitman arm onto the pitman shaft. Be sure to install the hardened steel washer before installing the nut.*

11. Install the horn button cap or shroud and connect the battery ground cable.

12 Lower the vehicle to the floor.

Steering Damper Check (Fig. 3B-30B)

This type of steering damper is nonadjustable, nonrefillable and is not repairable. At each lubrication interval make check #1 and #2 on the steering damper system.

1. **Inspecting Damper Mountings :** Check the damper attachments to be sure they are properly and securely installed. (Tighten, if loose). Replace the damper assembly if the rubber bushings are badly worn.

2. **Inspecting Damper For Leaks :** Inspect the damper for evidence of fluid leakage. A light film of fluid is permissible on the body of the damper near the shaft seal. A dripping damper should be replaced.

If a Functional or Noise Complaint is Reported, Make the Following Inspections:

3. **Inspecting Damper For Noise :** Disconnect the frame or axle end of the damper. Extend and compress the damper using as much travel as possible. The damper action should be smooth throughout each stroke.

4. **Inspecting Damper For Functioning:** While checking the damper in step (3) above, observe the operation of the damper for fluid leakage, effort and lag. Items from this check that require damper replacement are:

A. Any fluid leakage during this check.

B. Seizing or binding condition during travel of damper.

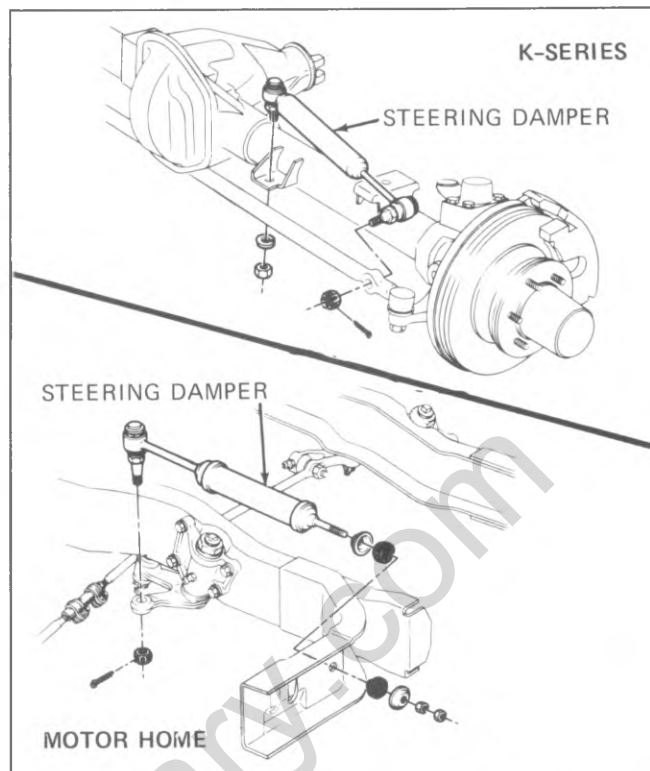


Fig. 3B-30B--Steering Dampers

C. A skip or lag at reversal near mid-stroke of damper.

5. **Reinstall Disconnected End of Damper Using Proper Torque.**

Steering Gear High Point Centering

1. Set front wheels in straight ahead position. This can be checked by driving vehicle a short distance on a **flat** surface to determine steering wheel position at which vehicle follows a straight path.

2. With front wheels set straight ahead, check position of mark on wormshaft designating steering gear high point. This mark should be at the top side of the shaft at 12 o'clock position and lined up with the mark in the coupling lower clamp.

3. On C, G and P series if gear has been moved off high point when setting wheel in straight ahead position. Loosen adjusting sleeve clamps on both left and right hand tie rods, then turn both sleeves an equal number of turns in the same direction to bring gear back on high point.

NOTE: Turning the sleeves an unequal number of turns or in different directions will disturb the toe-in setting of the wheels.

4. On K series if the gear has been moved off high point when setting wheels in straight ahead position. Loosen adjusting sleeve clamps on the connecting rod then turn sleeve to bring gear back on high point.

5. Readjust toe-in as outlined in Section 3A (if necessary).

6. Be sure to properly orient sleeves and clamps as shown in figures 3B-104, 3B-106 and 3B-109 when fastening and torquing clamps to proper specifications.

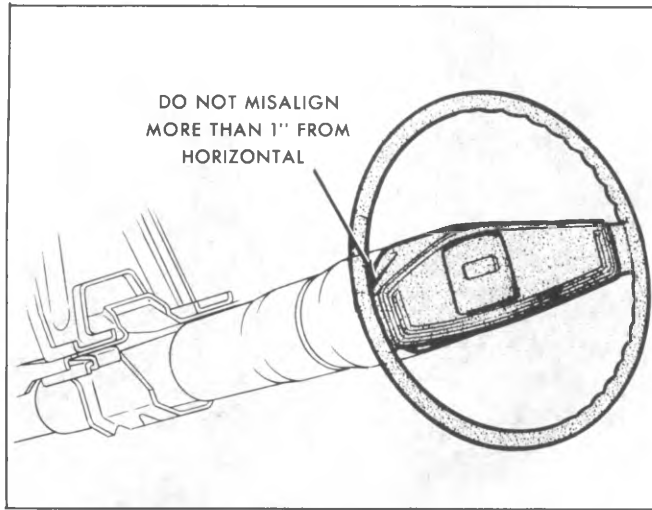


Fig. 3B-31--Steering Wheel Alignment

Steering Wheel Alignment

NOTE: On all series vehicles check steering gear for high point centering before checking steering wheel alignment.

1. Set wheels in straight ahead position by driving vehicle a short distance.
2. Note steering wheel position. If off more than 1 inch from center (fig. 3B-31), remove steering wheel as outlined under "Steering Wheel - Removal", center high point on gear, reposition and reinstall the wheel.

Steering Column Lower Bearing Adjustment G and P Series

1. Loosen clamp on steering shaft.
2. Applying 50 lb. force to the steering wheel end of the steering shaft, adjust clamp to obtain clearances indicated in Figure 3B-32.
3. Tighten clamp bolt to specified torque.

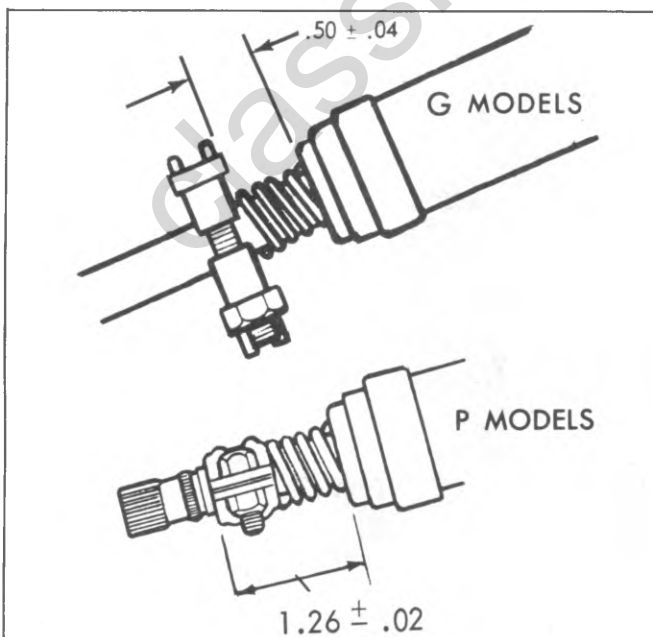


Fig. 3B-32--Steering Column Lower Bearing Adjustment

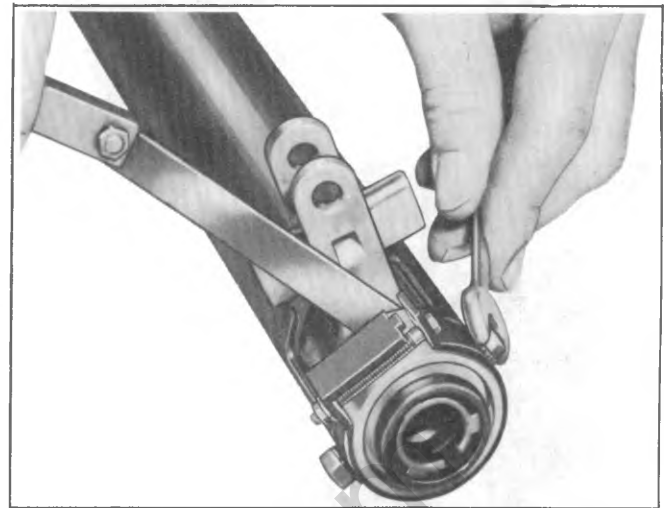


Fig. 3B-33--Shift Tube Adjustment-3 Speed Manual Transmission

Shifter Tube Adjustment G and P Series

3-Speed Transmission

1. Loosen adjusting ring attaching screws and clamp bolt.
2. Rotate adjusting ring to give .005" end play between adjusting ring and first and reverse shifter lever (fig. 3B-33).
3. Tighten attaching screws and clamp bolt.

Automatic Transmission

1. Place the shift tube lever in "Neutral" or "Drive".
2. Loosen adjusting ring clamp screws and rotate the shift tube adjusting ring to obtain .33" to .36" clearance between the shift tube lever and adjusting ring (fig. 3B-34).
3. Tighten the adjusting ring clamp screws to 70 in. lbs.

Power Steering Gear Adjustment Procedure

Adjustment of the steering gear in the vehicle is discouraged because of the difficulty encountered in adjusting the worm thrust bearing preload and the confusing effects of the hydraulic fluid in the gear. Since a gear adjustment is made only as a correction and not as a periodic adjustment, it is better to take the extra time and make the adjustment correctly the first time.

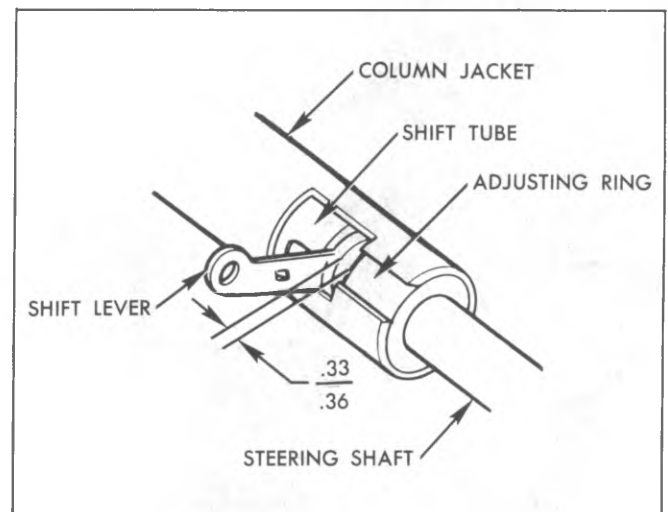


Fig. 3B-34--Shift Tube Adjustment-Automatic Transmission



Fig. 3B-35--Loosening Lock Nut

Since a handling stability complaint can be caused by improperly adjusted worm bearings as well as an improper gear over-center adjustment, it is necessary that the steering gear assembly be removed from the vehicle and both thrust bearing and over-center preload be checked and corrected as necessary. An in-vehicle check of the steering gear will not pin-point a thrust bearing looseness.

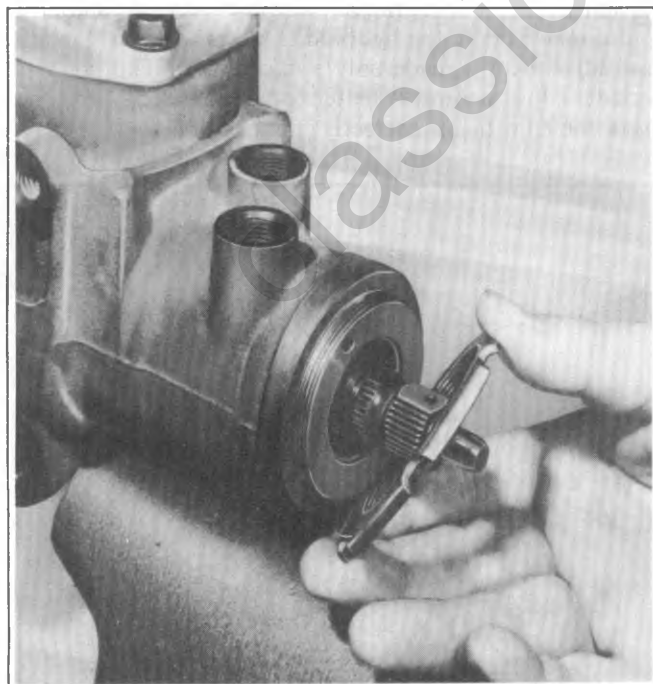


Fig. 3B-36--Removing Lock Nut

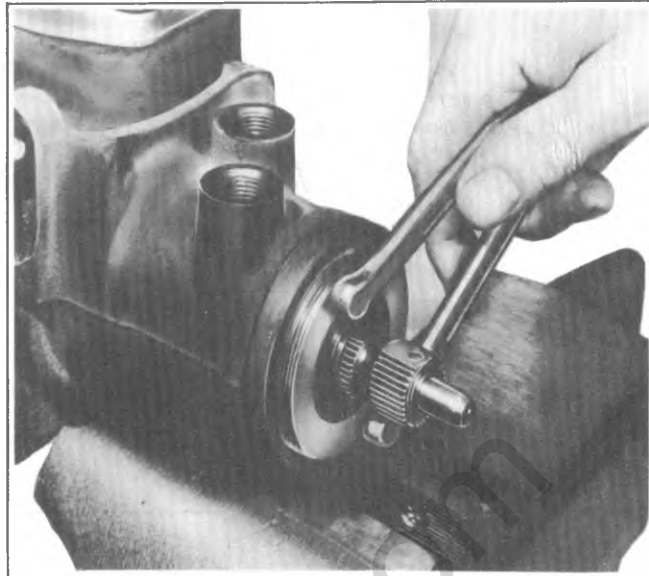


Fig. 3B-37--Bottoming Adjuster Plug

Thrust Bearing Adjustment

If a gear is known to contain the new thrust bearing parts, thrust bearing adjustment in service is simplified. Recommended procedure:

1. Drain power steering fluid from gear by rotating the stub shaft full travel in both directions several times.
2. Loosen and remove adjuster plug lock nut (Fig. 3B-35 and 3B-36).
3. Using spanner wrench J-7624, turn the adjuster plug in (clockwise) until the plug and thrust bearing are firmly bottomed approximately 20 foot-pounds (Fig. 3B-37).
4. Mark the housing even with one of the holes in the face of the adjuster plug (Fig. 3B-38).
5. Measure back (CCW direction) 1/2 inch and place a second mark on the housing (Fig. 3B-39).

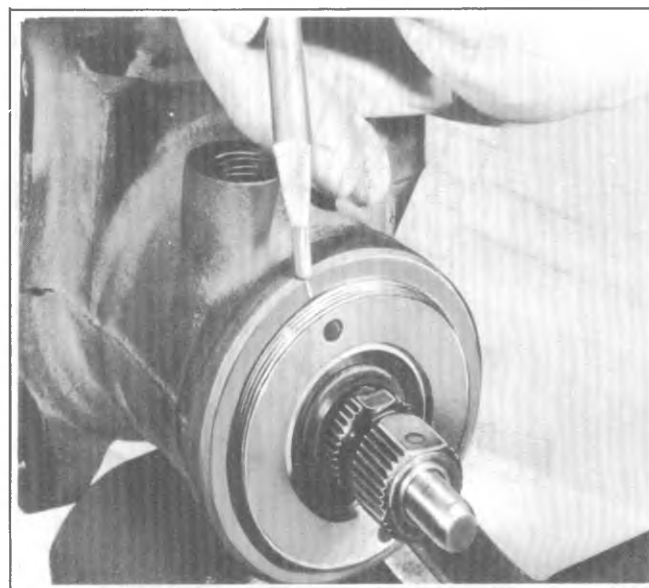


Fig. 3B-38--Marking Housing

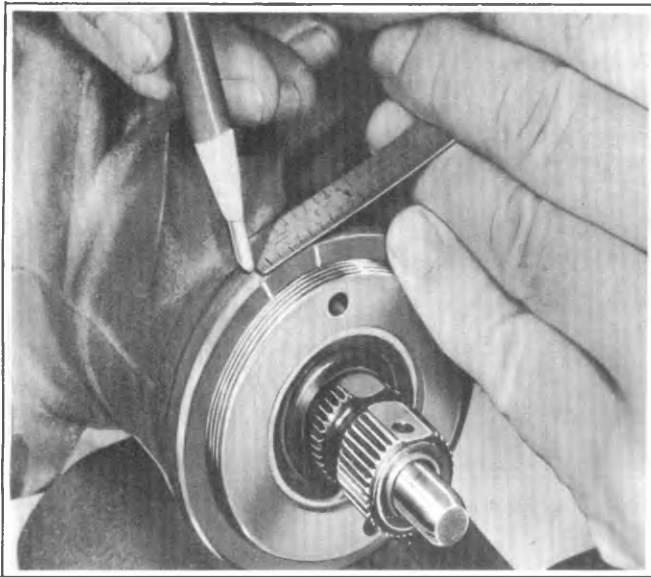


Fig. 3B-39--Measure Back and Remark Housing

6. Turn adjuster plug counterclockwise until the hole in the face of the adjuster plug, which was even with the first mark is in line with second mark (Fig. 3B-40).

7. Tighten lock nut securely. Hold (or have held) adjuster plug to maintain alignment of hole with mark (Fig. 3B-41).

Pump Belt Tension

1. Loosen pivot bolt and pump brace adjusting nuts.

CAUTION: Do not move pump by prying against reservoir or by pulling on filler neck.

2. Move pump, with belt in place until belt is tensioned to specifications as indicated by Tool J-23600 (Fig. 3B-42).

3. Tighten pump brace adjusting nut. Then tighten pivot bolt nut.



Fig. 3B-40--Align Hole With Second Mark

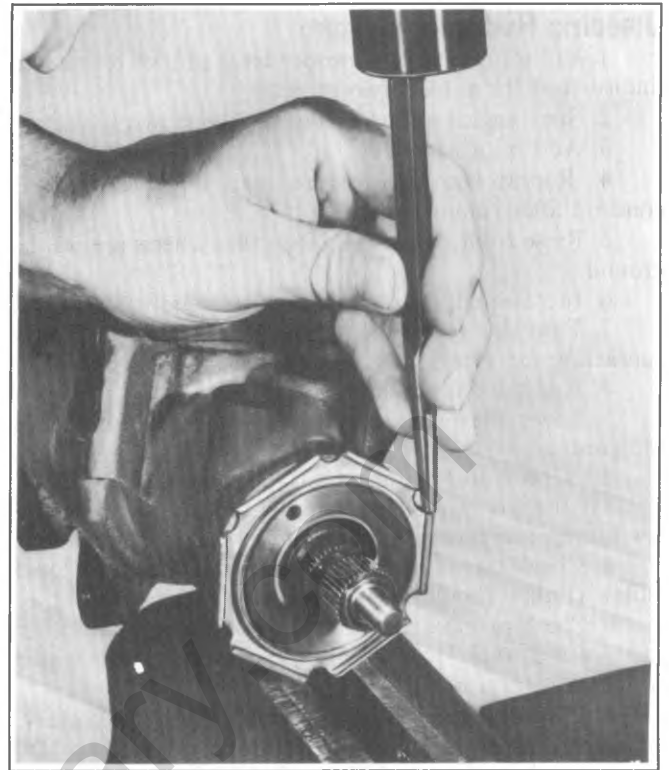


Fig. 3B-41--Tightening Lock Nut

Fluid Level

1. Check oil level in the reservoir by checking the dipstick when oil is at operating temperature. On models equipped with remote reservoir, the oil level should be maintained approximately 1/2 to 1 inch from top with wheels in full left turn position.

2. Fill, if necessary, to proper level with GM Power Steering Fluid or equivalent.

NOTE: Never use brake fluid in the power steering pump.



Fig. 3B-42--Checking Belt Tension with J-23600

Bleeding Hydraulic System

1. Fill oil reservoir to proper level and let oil remain undisturbed for at least two minutes.
2. Start engine and run only for about two seconds.
3. Add oil if necessary.
4. Repeat above procedure until oil level remains constant after running engine.
5. Raise front end of vehicle so that wheels are off the ground.
6. Increase engine speed to approximately 1500 rpm.
7. Turn the wheels (off ground) right and left, lightly contacting the wheel stops.
8. Add oil if necessary.
9. Lower the vehicle and turn wheels right and left on the ground.
10. Check oil level and refill as required.
11. If oil is extremely foamy, allow vehicle to stand a few minutes with engine off and repeat above procedure.
 - a. Check belt tightness and check for a bent or loose pulley. (Pulley should not wobble with engine running.)
 - b. Check to make sure hoses are not touching any other parts of the truck, particularly sheet metal except where design calls for a clamp.
 - c. Check oil level, filling to proper level if necessary, following operations 1 through 10. This step and Step "D" are extremely important as low oil level and/or air in the oil are the most frequent causes of objectional pump noise.
 - d. Check the presence of air in the oil. If air is present, attempt to bleed system as described in operations 1 through 10. If it becomes obvious that the pump will not bleed after a few trials, proceed as outlined under Hydraulic System Checks.

Hydraulic System Checks

The following procedure outlines methods to identify and isolate power steering hydraulic circuit difficulties. The test provides means of determining whether power steering system hydraulic parts are actually faulty. This test will result in readings indicating faulty hydraulic operation, and will help to identify the faulty component.

Before performing hydraulic circuit test, carefully check belt tension, fluid level and condition of driving pulley.

Power Steering Hydraulic System Test

Engine must be at normal operating temperature. Inflate front tires to correct pressure. All tests are made with engine idling, check idle adjustment and if necessary adjust engine idle speed to correct specifications listed in Section 6C and proceed as follows:

1. With engine **NOT** running disconnect pressure hose from pump and install Tool J-5176 using a spare pressure hose between gauge and pump. Gauge must be between shut-off valve and pump (Fig. 3B-43), Open shut-off valve.
2. Remove filler cap from pump reservoir and check fluid level. Fill pump reservoir to full mark on dip stick. Start engine and, momentarily holding steering wheel against stop, check connections at Tool J-5176 for leakage.
3. Bleed system as outlined under Maintenance and Adjustments.
4. Insert thermometer (Tool J-5421) in reservoir filler opening. Move steering wheel from stop to stop several

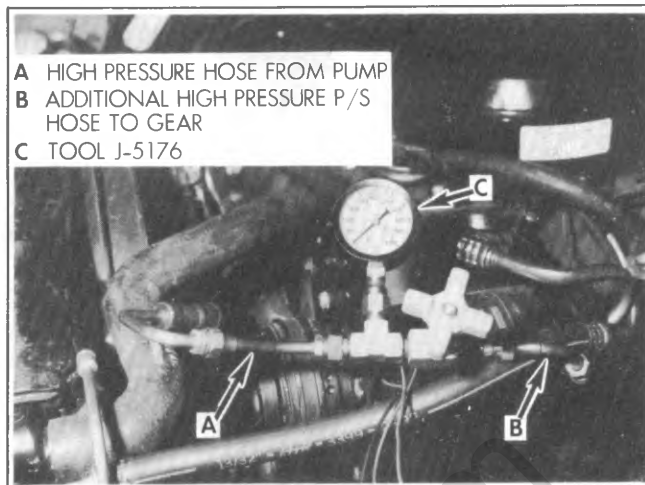


Fig. 3B-43--Checking Power Steering Pressures

times until thermometer indicates that hydraulic fluid in reservoir has reached temperature of 150° to 170°F.

CAUTION: To prevent scrubbing flat spots on tires, do not turn steering wheel more than five times without rolling vehicle to change tire-to-floor contact area.

5. Start engine and check fluid level adding any fluid if required. When engine is at normal operating temperature, the initial pressure read on the gage (valve open) should be in the 80-125 PSI range. Should this pressure be in excess of 200 PSI - check the hoses for restrictions and the poppet valve for proper assembly.

6. Close gate valve fully 3 times. Record the highest pressures attained each time.

CAUTION: Do not leave valve fully closed for more than 5 seconds as the pump could be damaged internally.

a. If the pressures recorded are within the listed specs and the range of readings are within 50 PSI, the pump is functioning within specs. (Ex. Spec. 1250 - 1350 PSI - readings - 1270 - 1275 - 1280).

b. If the pressures recorded are high, but do not repeat within 50 PSI, the flow controlling valve is sticking. Remove the valve, clean it and remove any burrs using crocus cloth or fine hone. If the system contains some dirt, flush it. If it is exceptionally dirty, both the pump and the gear must be completely disassembled, cleaned, flushed and reassembled before further usage.

c. If the pressures recorded are constant, but more than 100 PSI, below the low listed spec., replace the flow control valve and recheck. If the pressures are still low, replace the rotating group in the pump.

7. If the pump checks within specifications, leave the valve open and turn (or have turned) the steering wheel into both corners. Record the highest pressures and compare with the maximum pump pressures and compare with the maximum pump pressure recorded. If this pressure cannot be built in either (or one) side of the gear, the gear is leaking internally and must be disassembled and repaired. See the current Overhaul Manual.

8. Shut off engine, remove testing gauge, spare hose, reconnect pressure hose, check fluid level and/or make needed repairs.

COMPONENT REPLACEMENT AND REPAIRS

Steering Wheel

Removal G and P Series

1. Disconnect battery ground cable.
2. Remove horn button or shroud, receiving cup, belleville spring and bushing and mark steering wheel to steering shaft relationship.
3. Remove snap ring, steering shaft nut and washer.
4. Use Tool J-2927 to remove wheel (Fig. 3B-44).

Installation

CAUTION: See *CAUTION* on page 1 of this section regarding the fastener referred to in step 2.

Directional signal control assembly must be in neutral position when assembling steering wheel to prevent damage to cancelling cam and control assembly.

1. Place the steering wheel onto the steering shaft, aligning the marks made at removal.
2. Position into place and secure to proper torque with washer and nut. Install snap ring.
3. Install belleville spring, receiving cup, bushing and attaching screws.
4. Install horn button assembly.
5. Connect battery ground cable.

Removal C and K Series

1. Disconnect battery ground cable.
2. Remove horn button cap.
3. Remove snap ring and steering wheel nut.
4. Using tool J-2927, thread puller anchor screws into holes provided on steering wheel. Turn center bolt of tool clockwise to remove wheel.

NOTE: Do not hammer on puller. The tool centering adapters need not be used.

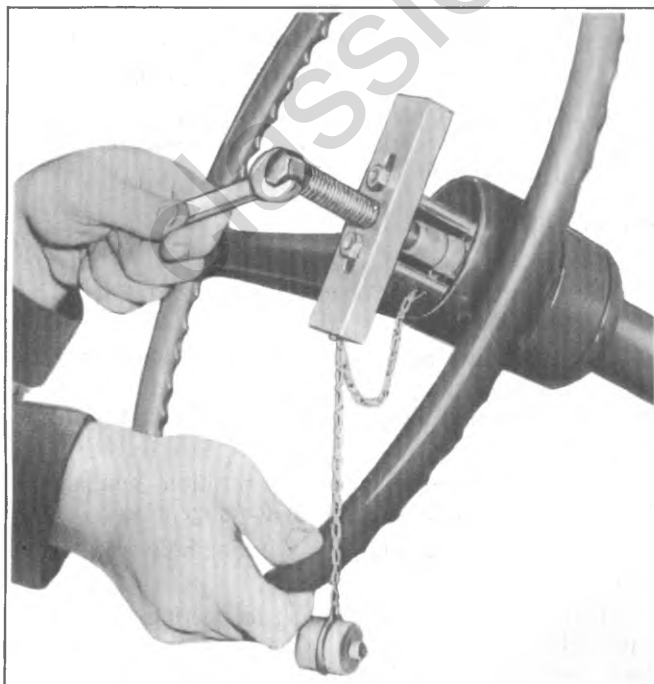


Fig. 3B-44--Steering Wheel Removal-Typical

Installation

CAUTION: See *CAUTION* on page 1 of this section regarding the fasteners referred to in step 1.

1. With turn signal in neutral position, align marks and set wheel onto steering shaft. Torque steering shaft nut to specifications and install snap ring.

CAUTION: Do not over torque shaft nut or steering wheel rub may result.

2. Place steering wheel horn button on wheel and snap into proper position.
3. Connect battery ground cable.

Steering Coupling (Flexible Type Fig. 3B-45)

Removal

1. Remove the coupling to steering shaft flange bolt nuts.
 2. Remove the coupling clamp bolt.
- NOTE:** This is a special bolt and will require a 12 pt. socket or box wrench.
3. Remove the steering gear to frame bolts and lower the steering gear far enough to remove the flexible coupling.
- NOTE:** It is not necessary to disconnect the pitman arm from the pitman shaft.
4. Tap lightly on the flexible coupling with a soft mallet to remove the coupling from the steering gear wormshaft.

Installation

CAUTION: See *CAUTION* on page 1 of this section regarding the fasteners referred to in steps 2, 4 and 5.

1. Install the flexible coupling onto the steering gear wormshaft, aligning the flat on the shaft with the flat in the coupling.

NOTE: Push the coupling onto the wormshaft until the coupling reinforcement bottoms against the end of the worm.

2. Install the special bolt into the split clamp and torque to specifications.

NOTE: The bolt must pass through the shaft undercut.

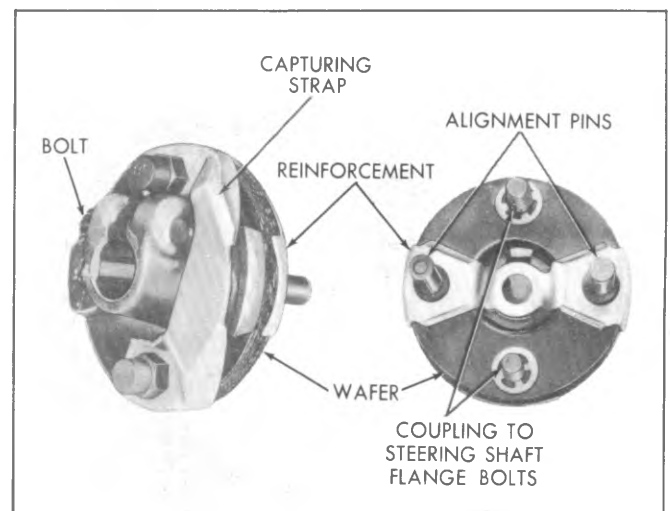


Fig. 3B-45--Flexible Type Steering Coupling-Manual

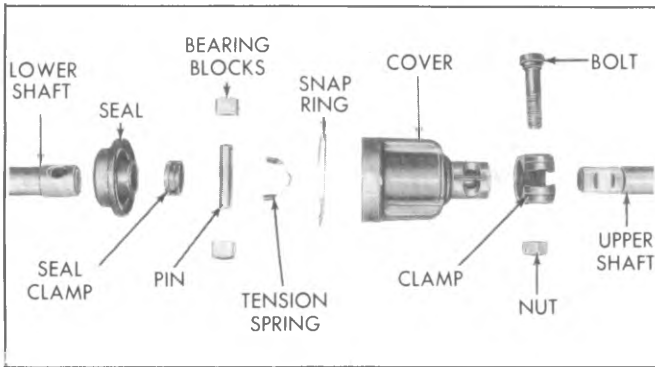


Fig. 3B-46--Steering Shaft Intermediate Coupling

3. Place the steering gear into position, guiding the flexible coupling bolts into the proper holes in the steering shaft flange.

4. Install and tighten the steering gear to frame bolts.

5. Install the coupling to flange bolt nuts and washers and torque to specifications. Be sure to maintain a coupling to flange dimension of .250" to .375". The coupling alignment pins should be centered in the flange slots.

Intermediate Steering Shafts With Pot Joint Couplings

Removal (Fig. 3B-46)

1. Remove the lower shaft flange to flexible coupling bolts.
2. Remove upper shaft to intermediate coupling bolt.
3. If necessary, remove the steering gear to frame bolts and lower the steering gear far enough to remove the intermediate shaft assembly.

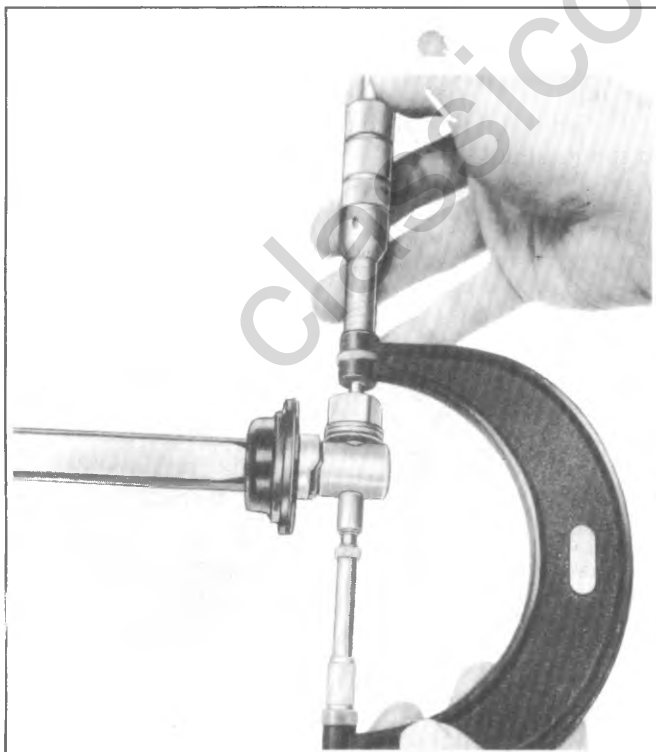


Fig. 3B-47--Checking Coupling Pin Centering

NOTE: It is not necessary to remove the pitman arm from the pitman shaft.

Disassembly

1. Mark cover to shaft relationship. Pry off snap ring and slide cover from shaft.
2. Remove bearing blocks and tension spring from pivot pin.
3. Clean grease off pin and end of shaft. Scribe location mark on pin on same side as chamfer in shaft.
4. Supporting shaft assembly securely, with chamfer up, press pin out of shaft with arbor press.

CAUTION: Do not drive pin out with hammer. This will cause sticky or binding bearings when reassembled.

5. Remove seal clamp and slide seal off end of shaft.

Assembly

1. Be sure all parts are free of dirt. Slide seal onto steering shaft. With lip of seal against step in shaft clamp seal.

2. Press pin back into shaft from chamfered side. Locate pin in shaft using scribe mark as reference.

CAUTION: Pin must be centered within .012 in. or binding in the coupling will result.

3. Check centering of pin (fig. 3B-47).
 - a. Place just enough 3/8" flat washers on pin to prevent bearing block from bottoming when installed.
 - b. Measure distance from end of pin to top of bearing with micrometer.
 - c. Remove bearing and washers and place same bearing and washers on other end of pin. Measure distance from end of pin to top of bearing. If micrometer readings in Steps b and c differ more than .012, repeat last part of Step 2 and recheck.

4. Apply a liberal amount of wheel bearing grease to inside and outside of bearing blocks and inside of cover.

5. Position tension spring and bearing blocks on pin.

6. Slide cover over bearing blocks aligning reference mark on cover with mark on shaft. Install seal into end of cover and secure with snap ring retainer.

Installation

CAUTION: See CAUTION on page 1 of this section regarding the fasteners referred to in steps 1, 3 and 4.

1. Install the intermediate shaft assembly onto the steering shaft, aligning the flat on the shaft with the flat in the coupling. Install the pot joint clamp bolt and torque to specifications.

2. Lift the steering gear into position, guiding the flexible coupling bolts into the shaft flange holes.

3. Install the steering gear to frame bolts and torque to specifications.

4. Install the flexible coupling to steering shaft flange bolt lockwashers and nuts. Check that the coupling alignment pins are centered in the flange slots and then torque the coupling bolts to specifications.

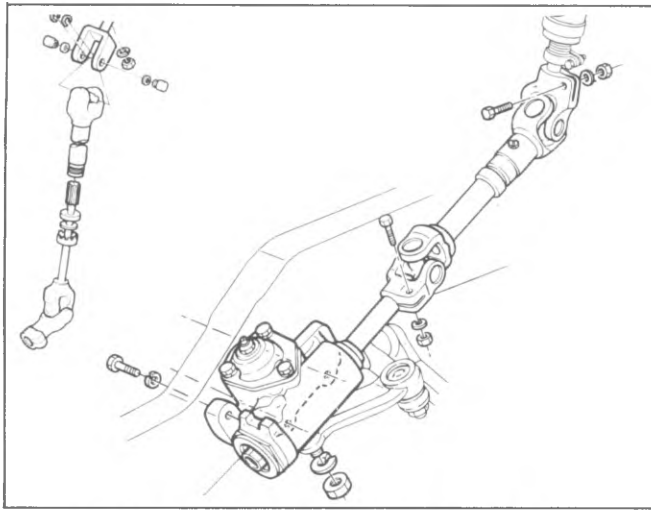


Fig. 3B-48--Intermediate Steering Shaft-P Series

Intermediate Steering Shaft With Universal Joint Couplings

Removal (Fig. 3B-48)

1. Set front wheels in straight ahead position. This can be done by driving the vehicle a short distance on a flat surface.

2. Mark upper universal joint yoke to steering shaft relationship and lower yoke to steering gear wormshaft relationship.

3. Remove both upper and lower universal yoke pinch bolts.

4. Remove steering gear to frame bolts and lower the gear.

NOTE: It is not necessary to disconnect the pitman arm from the steering gear pitman shaft.

5. Remove the intermediate steering shaft and universal joint assembly.

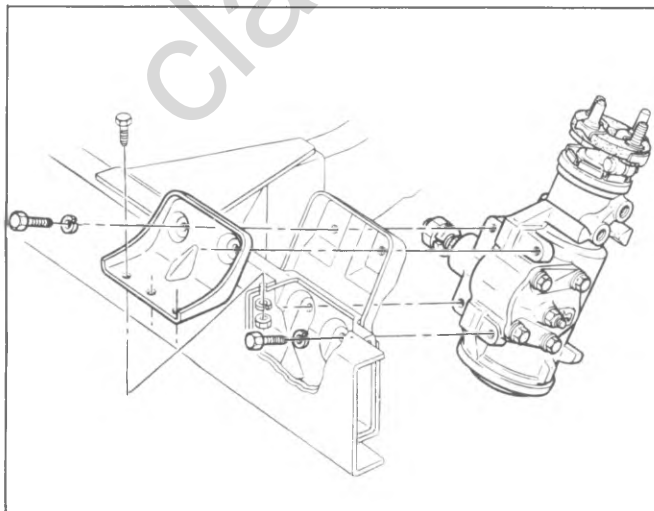


Fig. 3B-49--Steering Gear Mounting-Motor Home-Typical

Disassembly

1. If the upper or lower half of the intermediate steering shaft is to be replaced, proceed as follows:

a. With the shaft assembly on a bench, straighten the tangs on the dust cap. Separate the upper and lower portions of the shaft assembly.

b. Remove the felt washer, plastic washer and dust cap. Discard the felt washer.

2. If the trunnion assemblies are to be replaced, proceed as follows:

a. Remove the snap rings retaining the trunnion bushings in one of the yokes.

b. Support the yoke on a bench vise and drive out one bushing by tapping on the opposite bushing using a soft drift and hammer.

c. Support the other side of the yoke and drive out the remaining bushing as in Step b above.

d. Move the yoke on the trunnion as necessary to separate the upper and lower yokes.

e. Remove the trunnion from the lower yoke as outlined in Steps a through d above. Remove and discard the seals.

Assembly

1. If the yoke trunnions were removed, reassemble as follows:

a. Place the new trunnion into the lower yoke.

b. Place new seals onto the trunnion and then press the new bushings into the yoke and over the trunnion hubs far enough to install the snap rings.

c. Install the snap rings.

d. Repeat Steps a through c to attach the upper yoke to the trunnion.

2. Reassemble the intermediate shaft assembly as follows:

a. Place the dust cap, plastic washer and a new felt seal over the shaft on the lower yoke assembly.

b. Align the arrow on the lower yoke assembly shaft with the arrow on the upper yoke assembly tube and push the two assemblies together.

c. Push the dust cap, plastic washer and felt washer into position on the lower end of the upper yoke assembly and bend the tangs of the dust cap down against the yoke tube.

Installation

CAUTION: See *CAUTION* on page 1 of this section regarding the fasteners referred to in steps 1, 3 and 4.

1. Align the marks made at removal and assemble the intermediate shaft lower yoke onto the steering gear wormshaft. Install the pinch bolt and torque to specifications.

NOTE: The pinch bolt must pass through the shaft undercut. If a new yoke was installed, the slit in the yoke should be up (12 o'clock position).

2. Raise the steering gear into position while guiding the upper yoke assembly onto the steering shaft.

NOTE: The marks on the coupling and steering shaft must align. If a new yoke was installed, assemble the upper yoke to the steering shaft with the steering wheel in straight ahead position (gear must be on high point).

3. Install the steering gear to frame bolts and torque to specifications.

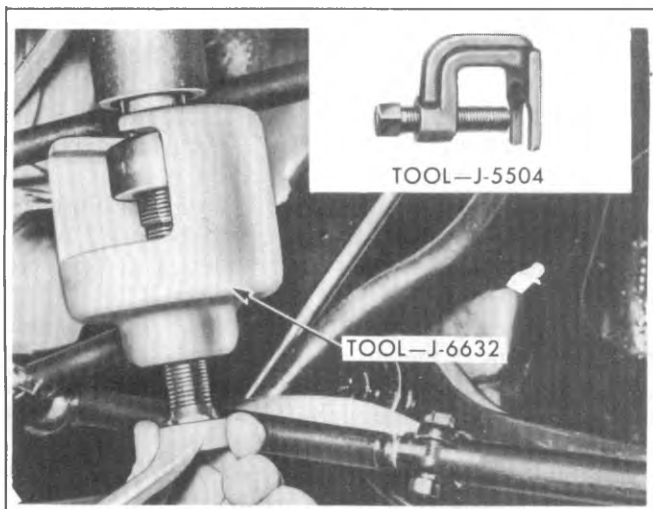


Fig. 3B-50--Removing Pitman Arm-Typical

4. Install the upper yoke to steering shaft pinch bolt and torque to specifications.

NOTE: The pinch bolt must pass through the shaft undercut.

Steering Gear

Removal

1. Set the front wheels in straight ahead position by driving vehicle a short distance on a flat surface.

2. Remove the flexible coupling to steering shaft flange bolts (C-K models) or the lower universal joint pinch bolt (P models). Mark the relationship of the universal yoke to the wormshaft.

3. Mark the relationship of the pitman arm to the pitman shaft. Remove the pitman shaft nut or pitman arm pinch bolt and then remove the pitman arm from the pitman shaft using Puller J-6632 (fig. 3B-50).

4. Remove the steering gear to frame bolts and remove the gear assembly.

5. **C-K Models** - Remove the flexible coupling pinch bolt and remove the coupling from the steering gear wormshaft.

Installation

CAUTION: See **CAUTION** on page 1 of this section regarding the fasteners referred to in steps 1a, 1c, 1d, 1e, 2b, 2c and 3.

1. C-K Models

a. Install the flexible coupling onto the steering gear wormshaft, aligning the flat in the coupling with the flat on the shaft. Push the coupling onto the shaft until the wormshaft bottoms on the coupling reinforcement. Install the pinch bolt and torque to specifications.

NOTE: The coupling bolt must pass through the shaft undercut.

b. Place the steering gear in position, guiding the coupling bolt into the steering shaft flange.

c. Install the steering gear to frame bolts and torque to specifications.

d. If flexible coupling alignment pin plastic spacers were used, make sure they are bottomed on the pins, torque the flange bolt nuts to specifications and then remove the plastic spacers.

e. If flexible coupling alignment pin plastic spacers

were not used, center the pins in the slots in the steering shaft flange and then install and torque the flange bolt nuts to specifications.

2. P Models

a. Place the steering gear in position, guiding the wormshaft into the universal joint assembly and lining up the marks made at removal.

NOTE: If a new gear was installed, line up the mark on the wormshaft with the slit in the universal joint yoke.

b. Install the steering gear to frame bolts and torque to specifications.

c. Install the universal joint pinch bolt and torque to specification.

NOTE: The pinch bolt must pass through the shaft undercut.

3. Install the pitman arm onto the pitman shaft, lining up the marks made at removal. Install the pitman shaft nut or pitman arm pinch bolt and torque to specifications.

CAUTION: If a clamp type pitman arm is used, spread the pitman arm just enough, with a wedge, to slip the arm onto the pitman shaft. Do not spread the clamp more than required to slip over pitman arm onto the pitman shaft. Be sure to install the hardened steel washer before installing the nut.

Pitman Shaft Seal Replacement

Manual Steering Gear

A faulty seal may be replaced without removal of steering gear from C, G and P trucks by removing pitman arm as outlined under Maintenance and Adjustments - Steering Gear Adjustments and proceed as follows:

NOTE: On K series vehicles remove the gear from the vehicle first.

1. Rotate the steering wheel from stop to stop, counting the total number of turns. Then turn back exactly half-way, placing the gear on center (the wormshaft flat should be at the 12 o'clock position).

2. Remove the three self-locking bolts attaching side cover to the housing and lift the pitman shaft and side cover assembly from the housing.

3. Pry the pitman shaft seal from the gear housing using a screwdriver and being careful not to damage the housing bore.

CAUTION: Inspect the lubricant in the gear for contamination. If the lubricant is contaminated in any way, the gear must be removed from the vehicle and completely overhauled as outlined in the Overhaul Manual.

4. Coat the new pitman shaft seal with Steering Gear Lubricant meeting GM Specification GM4673M (or equivalent). Position the seal in the pitman shaft bore and tap into position using a suitable size socket.

5. Remove the lash adjuster lock nut. Remove the side cover from the pitman shaft assembly by turning the lash adjuster screw clockwise.

6. Place the pitman shaft in the steering gear such that the center tooth of the pitman shaft sector enters the center tooth space of the ball nut.

7. Fill the steering gear housing with Steering Gear Lubricant meeting GM Specification GM4673M (or equivalent).

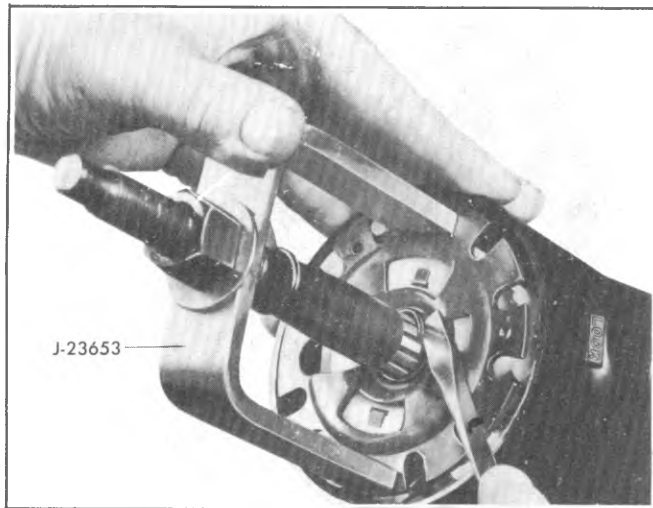


Fig. 3B-51--Removing Lock Plate Retaining Ring

8. Install a new side cover gasket onto the gear housing.
9. Install the side cover onto the lash adjuster screw by reaching through the threaded hole in the side cover with a small screwdriver and turning the lash adjuster screw counter-clockwise until it bottoms and turns back in 1/4 turn.
10. Install the side cover bolts and torque to specifications.
11. Install the lash adjuster screw locknut, perform steering gear adjustment and install the pitman arm as outlined under "Maintenance and Adjustments".

NOTE: On K series install the gear into the vehicle using previously outlined procedure.

Directional Signal Switch

The directional signal switch can be removed with the steering column in the vehicle and without disturbing any of the column mountings.

C and K Series

Removal

1. Remove the steering wheel as outlined under "Steering Wheel - Removal".
2. Remove the column to instrument panel trim cover.
3. Position screwdriver blade into cover slot. Pry up and out to free cover from lock plate.
4. Screw the center post of Lock Plate Compressing Tool J-23653 onto the steering shaft as far as it will go. Compress the lock plate by turning the center post nut clockwise (fig. 3B-51). Pry the round wire snap ring out of the shaft groove and discard the ring. Remove Tool J-23653 and lift the lock plate off the end of the shaft.

CAUTION: If the column is being disassembled on the bench, with the snap ring removed the shaft could slide out of the lower end of the mast jacket, damaging the shaft assembly.

5. Slide the directional signal cancelling cam, upper bearing preload spring and thrust washer off the end of the shaft.
6. Remove the directional signal lever screw and remove the lever.
7. Push the hazard warning knob in and unscrew the knob.

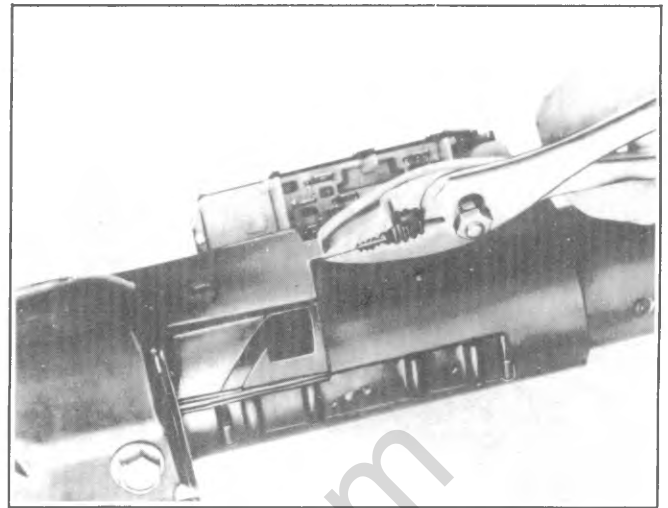


Fig. 3B-52--Removing Directional Signal Wire Protector

8. Remove the three switch mounting screws.
9. **All Columns** - Pull the switch connector out of the bracket on the jacket and feed switch connector through column support bracket and pull switch straight up, guiding the wiring harness through the column housing and protector.
10. Remove wire protector by pulling downward out of column with pliers using tab provided (fig. 3B-52).
- Tilt Column** - Position the direction signal and shifter housing in the "low" position. Remove the harness cover by pulling toward the lower end of the column, be careful not to damage the wires.
11. Remove the three switch mounting screws and pull the switch straight up, guiding the wiring harness and cover through the column housing (fig. 3B-53).

Installation

CAUTION: It is extremely important that only the specified screws, bolts and nuts be used at assembly. Use of overlength screws could prevent a portion of the assembly from compressing under impact.

1. **All except Tilt** - Be sure that the wiring harness

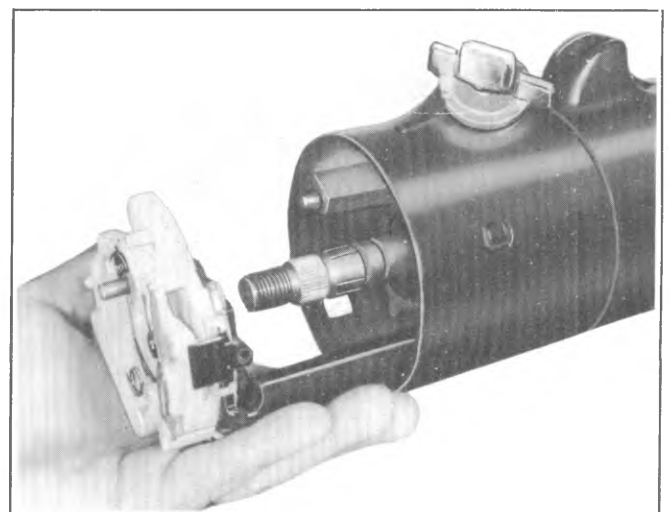


Fig. 3B-53--Removing Directional Signal Switch Assembly

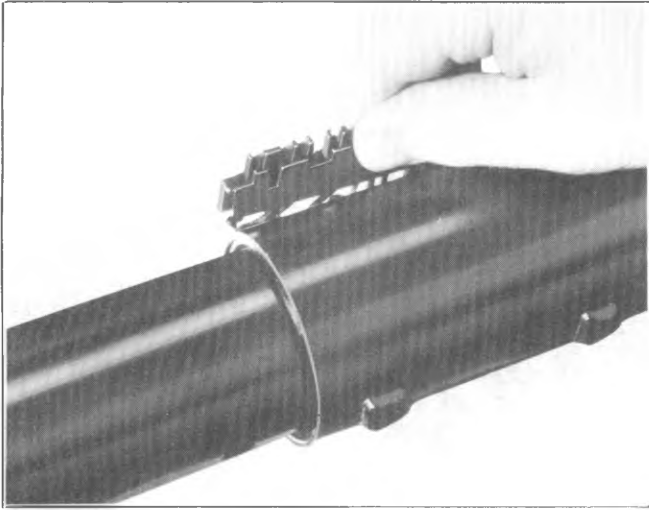


Fig. 3B-54--Installing Switch Connector Onto Jacket Clips



Fig. 3B-56--Lock Cylinder Removal

is in the protector. Feed the connector and cover down through the housing and under the mounting bracket (column in vehicle).

Tilt - Feed the connector down through the housing and under the mounting bracket. Then install the cover on the harness.

2. Install the three mounting screws and clip the connector to the bracket on the jacket (fig. 3B-54).

3. Install the column to instrument panel trim plate.

4. Install the hazard warning knob and directional signal lever.

5. Make certain that the switch is in "Neutral" and the hazard warning knob is out. Slide the thrust washer, upper bearing preload spring and cancelling cam onto the upper end of the shaft.

6. Place the lock plate onto the end of the shaft. Screw the center post of Lock Plate Compressing Tool J-23653 onto the steering shaft as far as it will go. Place a NEW snap ring over the center post. Place the "C" bar over the center post and then compress the lock plate by turning the nut clockwise. Slide the new snap ring down the tapered center post and into the shaft groove (fig.3B-55). Remove Tool J-23653.

CAUTION: Always use a new snap ring when reassembling.

7. Place cover on the lock plate and snap into position.

8. Install the steering wheel as outlined under "Steering Wheel-Installation".

Lock Cylinder (C and K Series)

The lock cylinder is located on the upper right hand side of the column. The lock cylinder should be removed in the "RUN" position only.

Removal

1. Remove the steering wheel as outlined under "Steering Wheel - Removal".

2. Remove the directional signal switch as outlined under "Directional Signal Switch - Removal".

NOTE: It is not necessary to completely remove the directional signal switch from the column. Pull the switch rearward far enough to slip it over the end of



Fig. 3B-55--Installing Snap Ring

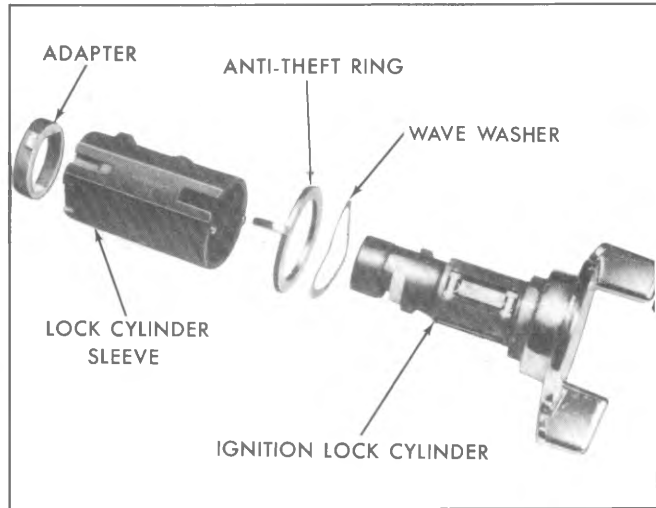


Fig. 3B-57--Ignition Lock Cylinder-Exploded

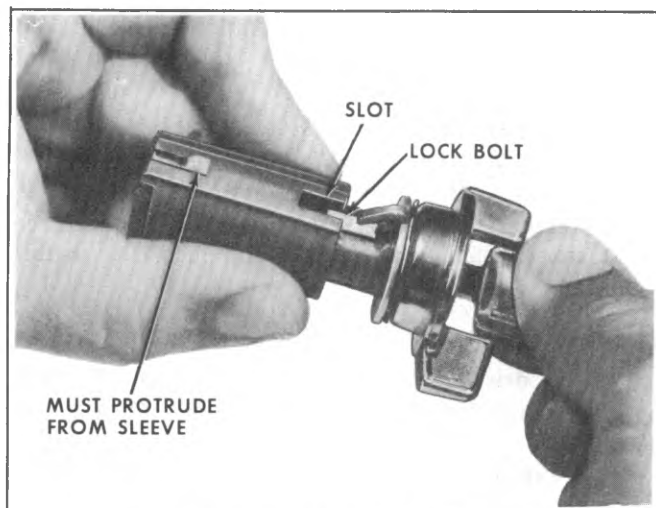


Fig. 3B-58--Ignition Lock Cylinder Assembly

the shaft - do not pull the harness out of the column.
 3. Insert a small screwdriver or similar tool into the turn signal housing slot as shown in Figure 3B-56. Keeping the tool to the right side of the slot, break the housing flash loose and at the same time depress the spring latch at the lower end of the lock cylinder. With the latch depressed, the lock cylinder can be removed from the housing.

Assembly (Fig. 3B-57)

1. Place the key part way into the lock cylinder assembly. Place the wave washer and anti-theft ring onto the lower end of the lock cylinder.

NOTE: If the key is installed all the way into the lock cylinder, the plastic keeper in the lock cylinder protrudes and prevents installation of the sleeve assembly.

2. Make sure that the plastic keeper in the sleeve assembly protrudes from the sleeve (fig. 3B-58).

3. Align the lock bolt on the lock cylinder and the tab on the anti-theft washer and the slot in the sleeve assembly (fig. 3B-58). Push the sleeve all the way onto the lock cylinder assembly, push the ignition key the rest of the way in and rotate the lock cylinder clockwise.

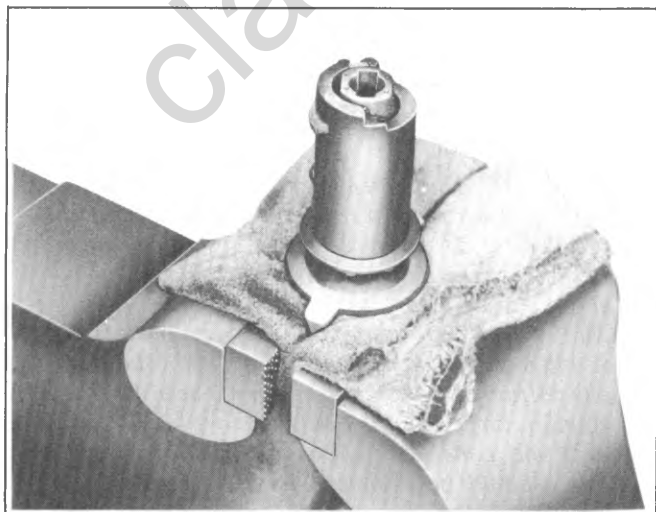


Fig. 3B-59--Ignition Lock Cylinder Installed in a Vise

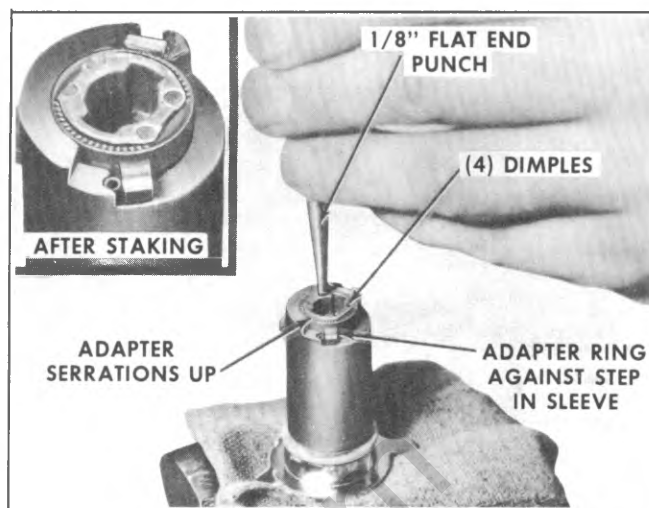


Fig. 3B-60--Installing Adapter Ring

4. Rotate the lock counter-clockwise into "LOCK" position.

5. Place the lock in a brass jawed vise or between two pieces of wood (fig. 3B-59).

NOTE: If a vise is used, place cloth around the knob to prevent marring the knob surface.

6. Place the adapter ring onto the lower end of the cylinder so that the finger of the adapter is located at the step in the sleeve and the serrated edge of the adapter is visible after assembly to the cylinder and before "staking" (fig. 3B-60). The key must be free to rotate at least 1/3 of a circle (120°).

NOTE: Tap the adapter onto the cylinder until it is stopped at the bottom of the cylinder flats (cylinder will extend above adapter approximately 1/16").

7. Using a small flat punch, at least 1/8" in diameter, stake the lock cylinder over the adapter ring in four places just outboard of the four dimples as shown in Figure 3B-60.

8. Check lock operation before reinstalling vehicle.

Installation

1. Hold the lock cylinder sleeve and rotate the knob clockwise against the stop, Insert the cylinder into the housing bore with the key on the cylinder sleeve aligned with the keyway in the housing. Push the cylinder into abutment of cylinder and sector. Hold an .070" drill between the lock bezel and housing. Rotate the cylinder counterclockwise, maintaining a light pressure until the drive section of the cylinder mates with the sector. Push in until the snap ring pops into the grooves and lock cylinder is secured in the housing. Remove the .070" drill. Check lock cylinder for freedom of rotation.

2. Install the Direction Signal Switch and Steering Wheel as outlined previously in this section.

Ignition Switch (C and K Series)

The ignition switch is mounted on top of the column jacket near the front of the dash. For anti-theft reasons, the switch is located inside the channel section of the brake pedal support and is completely inaccessible without first lowering the steering column (see steering column removal).

The switch is actuated by a rod and rack assembly. A portion of the rack is toothed and engages a gear on the end of the lock cylinder, thus enabling the rod and rack to be

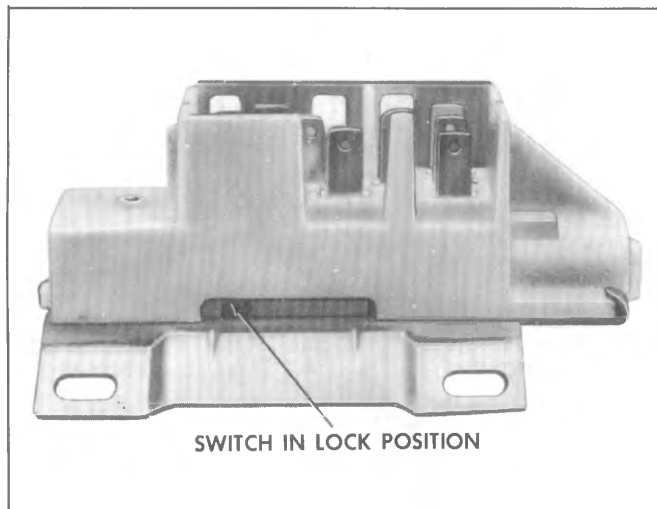


Fig. 3B-61--Ignition Switch Assembly

moved axially (with respect to the column) to actuate the switch when the lock cylinder is rotated.

Removal

1. Lower the steering column as outlined under "Steering Column Removal" later in this section. It is not necessary to remove the steering wheel.

CAUTION: *If the steering column is not removed from the vehicle, be sure that it is properly supported, before proceeding.*

2. The switch should be positioned in "Lock" position before removing. If the lock cylinder has already been removed, the actuating rod to the switch should be pulled up until there is a definite stop, then moved down one detent, which is the "Lock" position.

3. Remove the two switch screws and remove the switch assembly.

Installation

1. Before replacing the switch, be sure that the lock is in the "Lock" position (fig. 3B-61); if it is not, a screwdriver (placed in the locking rod slot) can be used to move the switch to "Lock".

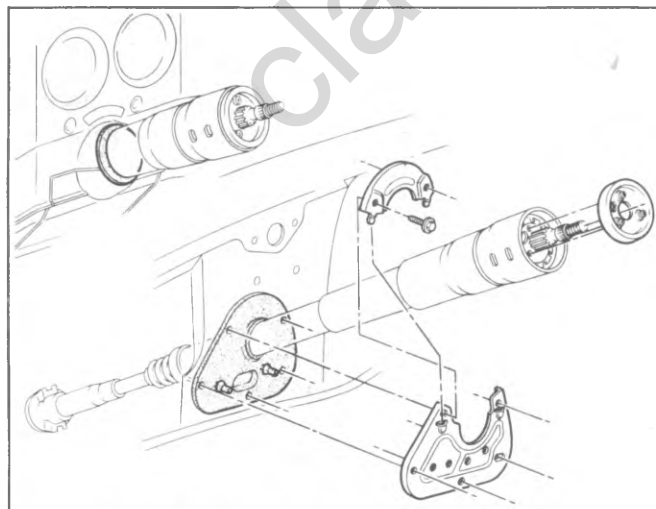


Fig. 3B-62--Steering Column Cover and Seal

2. Install the activating rod into the switch and assemble the switch on the column; tighten the mounting screws.

CAUTION: *Use only the specified screws since over-length screws could prevent a portion of the assembly from compressing under impact.*

3. Reinstall the steering column assembly following the "Mandatory Installation Sequence" outlined later in this section.

Steering Column

All models which are equipped with the Function Locking Energy Absorbing Steering Columns are one of five basic designs.

1. **Synchromesh** - The synchromesh column is used on models with the standard transmission and column mounted shift levers. The shift tube, within the outer column jacket, includes two lower shift levers for connection to the transmission control linkage. This column does not lock the transmission when the lock cylinder is in the "lock" position.

2. **Floor Shift** - This column is used on models equipped with a manual transmission with the shift lever on the floor. This column does not lock the transmission when the lock cylinder is in the "lock" position.

3. **Automatic Column Shift** - This column has a single lower shift lever for shifting the automatic transmission.

The transmission is locked in Park when the lock cylinder is in "Lock".

4. **Tilt Column Option automatic transmission** - The upper end and steering shaft of this column is specifically designed to accommodate the optional tilt steering wheel. The lower portion of the column is the same as in item number 3.

5. **Tilt Column Option Manual Transmission** - This column is the same as the automatic transmission tilt column except incorporating provisions for the manual transmission shifting and the transmission is not locked when the lock cylinder is in "Lock" position.

To perform service procedures on the steering column upper end components, it is not necessary to remove the column from the vehicle.

The steering wheel, horn components, directional signal switch, and ignition lock cylinder may be removed with the column remaining in the vehicle as described earlier in this section.

CAUTION: *The outer mast jacket shift tube, steering shaft and instrument panel mounting bracket are designed as energy absorbing units. Because of the design of these components, it is absolutely necessary to handle the column with care when performing any service operation. Avoid hammering, jarring, dropping or leaning on any portion of the column. When reassembling the column components, use only the specified screws, nuts and bolts and tighten to specified torque. Care should be exercised in using over-length screws or bolts as they may prevent a portion of the column from compressing under impact.*

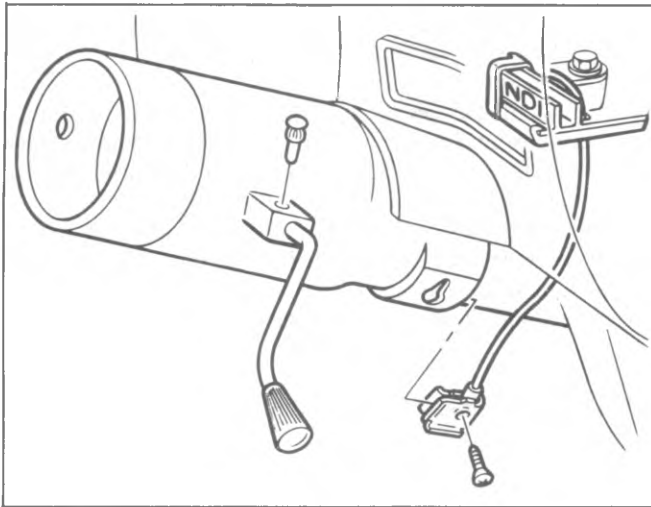


Fig. 3B-63--Automatic Transmission Indicator Connection-CK-Typical

Inspection

To determine if the energy absorbing steering column components are functioning as designed, or if repairs are required, a close inspection should be made. Inspection is called for in all cases where damage is evident or whenever the vehicle is being repaired due to a front end collision. Whenever a force has been exerted on the steering wheel or steering column, or its components, inspection should also be made. If damage is evident, the affected parts must be replaced.

The inspection procedure for the various steering column components on all C and K Series Trucks is as follows:

Column Support Bracket

Damage in this area will be indicated by separation of the mounting capsules from the bracket. The bracket will have moved forward toward the engine compartment and will usually result in collapsing of the jacket section of the steering column.

Column Jacket

Inspect jacket section of column for looseness, and/or bends.

Shifter Shaft

Separation of the shifter shaft sections will be internal and cannot be visually identified. Hold lower end of the "shifter shaft" and move "shift lever" on column through its ranges and up and down. If there is little or no movement of the "shifter shaft", the plastic joints are sheared.

Steering Shaft

If the steering shaft plastic pins have been sheared, the shaft will rattle when struck lightly from the side and some lash may be felt when rotating the steering wheel while holding the rag joint. It should be noted that if the steering shaft pins are sheared due to minor collision the vehicle can be safely steered; however, steering shaft replacement is recommended.

Because of the differences in the steering column types, be sure to refer to the set of instructions below which apply to the column being serviced.

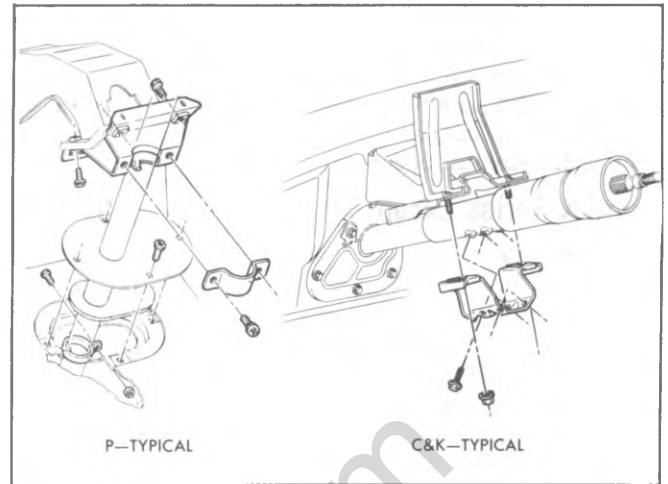


Fig. 3B-64--Steering Column to Dash Panel-C, K & P Typical

C and K Columns

Removal

NOTE: Front of dash mounting plates must be loosened whenever the steering column is to be lowered from the instrument panel.

1. Disconnect the battery ground cable.
2. Remove the steering wheel as outlined under "Steering Wheel Removal".
3. Remove the nuts and washers securing the flanged end of the steering shaft to the flexible coupling.
4. Disconnect the transmission control linkage from the column shift tube levers.
5. Disconnect the steering column harness at the connector. Disconnect the neutral-start switch and back-up lamp switch connectors if so equipped.
6. Remove the floor pan trim cover screws and remove the cover.
7. Remove the screws securing the two halves of the floor pan cover; then remove the screws securing the halves and seal to the floor pan and remove the covers (fig. 3B-64 and 3B-65).
8. Remove the transmission indicator cable, if so equipped (fig. 3B-63).

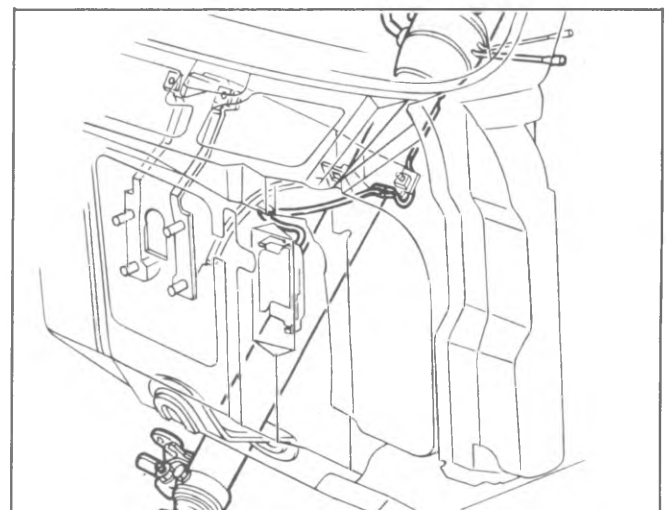


Fig. 3B-65--Steering Columns to Dash Panel-G

9. Move the front seat as far back as possible to provide maximum clearance.

10. Remove the two column bracket-to-instrument panel nuts and carefully remove from vehicle. Additional help should be obtained to guide the lower shift levers through the firewall opening.

C and K Series Except Tilt Columns-(Fig. 3B-66)

Disassembly

NOTE: G and P Series columns differ from those shown in Figures 3B-66 thru 3B-74.

1. Remove the four dash panel bracket-to-column screws and lay the bracket in a safe place to prevent damage to the mounting capsules.

2. Place the column in a vise using both weld nuts of either Set A or B as shown in Figure 3B-67. The vise jaws must clamp onto the sides of the weld nuts indicated by arrows shown on Set B.

CAUTION: Do not place the column in a vise by clamping onto one weld nut of both sets A and B or by clamping onto the sides not indicated by arrows, since damage to the column could result.

3. Remove the Directional Signal Switch, Lock Cylinder, and Ignition Switch as outlined previously in this section.

4. **Column Shift Models** - Drive out the upper shift lever pivot pin and remove the shift lever.

5. Remove the upper bearing thrust washer. Remove the four screws attaching the turn signal and ignition lock housing to the jacket and remove the housing assembly (fig. 3B-68).

6. Remove the thrust cap from the lower side of the housing.

7. Lift the ignition switch actuating rod and rack assembly, the rack preload spring and the shaft lock bolt and spring assembly out of the housing (fig. 3B-69).

8. Remove the shift lever detent plate (shift gate).

9. Remove the ignition switch actuator sector through the lock cylinder hole by pushing firmly on the block tooth of the sector with a blunt punch or screwdriver (fig. 3B-70).

10. Remove the gearshift lever housing and shroud from the jacket assembly (transmission control lock tube housing and shroud on floor shift models).

11. Remove the shift lever spring from the gearshift lever housing (lock tube spring on floor shift models).

12. Pull the steering shaft from lower end of the jacket assembly.

13. Remove the two screws holding the back-up switch or neutral-safety switch to the column and remove the switch.

14. Remove the lower bearing retainer clip (fig. 3B-71).

15. **Automatic and Floorshift Columns** - Remove the lower bearing retainer, bearing adapter assembly, shift tube thrust spring and washer. The lower bearing may be removed from the adapter by light pressure on the bearing outer race. Slide out the shift tube assembly.

Manual Transmission - Column Shift - Remove the lower bearing adapter, bearing and the first reverse shift lever. The lower bearing may be removed from the adapter by light pressure on the bearing outer race. Remove the three screws from bearing at the lower end and slide out the shift tube assembly. Remove the gearshift housing lower bearing from the upper end of the mast jacket.

Assembly-All Except Tilt Columns

NOTE: Apply a thin coat of lithium soap grease to all friction surfaces.

1. Install the sector into the turn signal and lock cylinder housing. Install the sector in the lock cylinder hole over the sector shaft with the tang end to the outside of the hole. Press the sector over the shaft with a blunt tool.

2. Install the shift lever detent plate onto the housing.

3. Insert the rack preload spring into the housing from the bottom side. The long section should be toward the handwheel and hook onto the edge of the housing (fig. 3B-72).

4. Assemble the locking bolt onto the crossover arm on the rack and insert the rack and lock bolt assembly into the housing from the bottom with the teeth up (toward hand-wheel) and toward the centerline of the column (fig. 3B-69). Align the 1st tooth on the sector with the 1st tooth on the rack; if aligned properly, the block teeth will line up when the rack assembly is pushed all the way in.

5. Install the thrust cup on the bottom hub of the housing.

6. Install the gearshift housing lower bearing. Insert the bearing from the very end of the jacket. Aligning the indentations in the bearing with the projections on the jacket (fig. 3B-73).

CAUTION: If the bearing is not installed correctly, it will not rest on all of the stops provided.

7. Install the shift lever spring into the gearshift lever (or lock tube) housing. Install the housing and shroud assemblies onto the upper end of the mast jacket. Rotate the housing to be sure it is seated in the bearing.

8. With the shift lever housing in place, install the turn signal and lock cylinder housing onto the jacket. The gearshift housing should be in "Park" position and the rack pulled downward. Be sure the turn signal housing is seated on the jacket and drive the four screws.

9. Press the lower bearing into the adapter assembly.

10. Insert the shift tube assembly into the lower end of the jacket and rotate until the upper shift tube key slides into the housing keyway.

11. **Automatic and Floor shift Columns** - Assemble the spring and lower bearing and adapter assembly into the bottom of the jacket. Holding the adapter in place, install the lower bearing reinforcement and retainer clip. Be sure the clip snaps into the jacket and reinforcement slots.

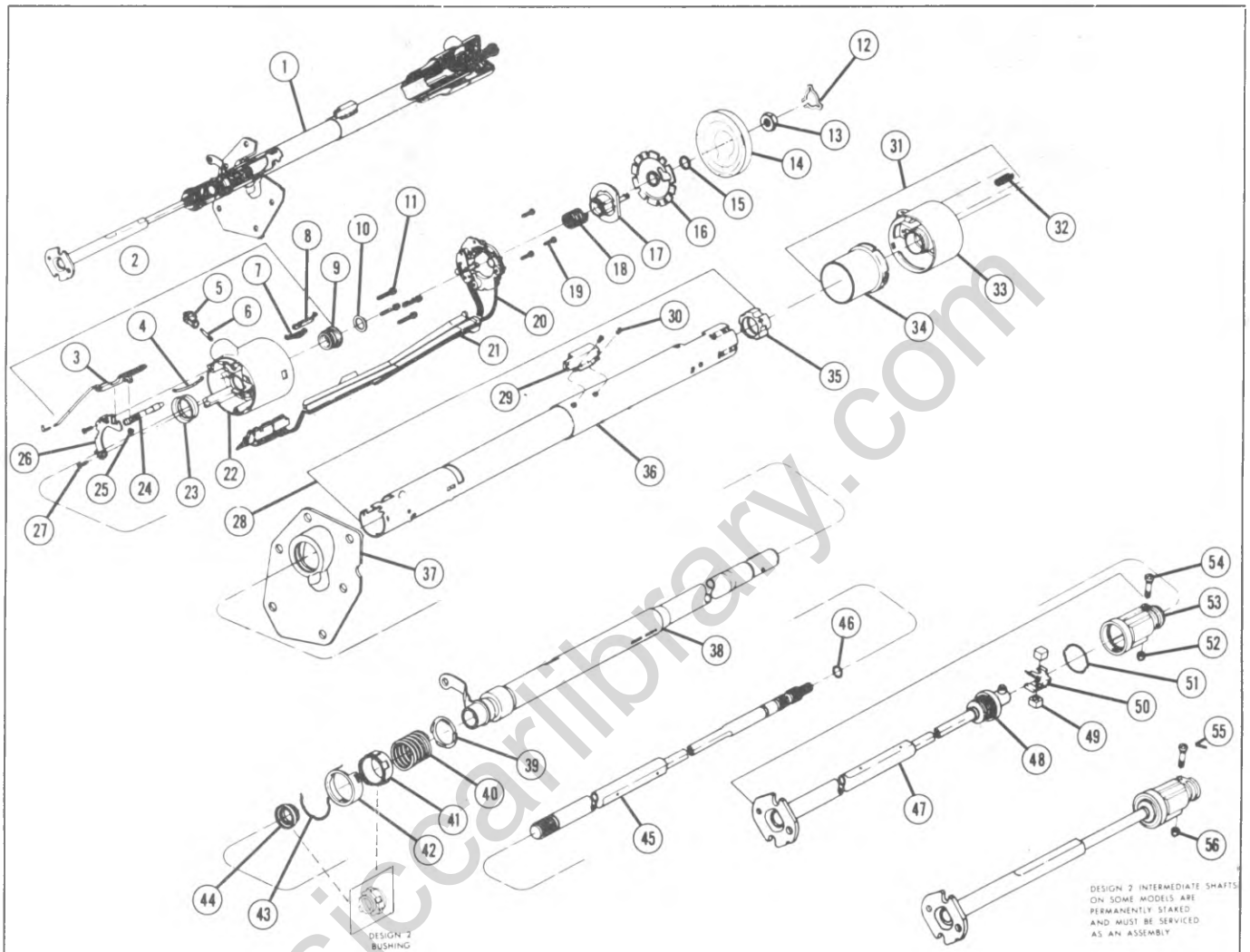
12. **Manual Transmission - Column Shift** - Loosely attach the three screws in the jacket and shift tube bearing.

Assemble the 1st-Reverse lever and lower bearing and adapter assembly into the bottom of the jacket. Holding the adapter in place, install the bearing reinforcement and retaining clip. Be sure the retaining clip snaps into the jacket and reinforcement slots.

Place a .005" shim between the 1st-Reverse lever and lever spacer and turn the upper shift tube bearing down and tighten the three screws. Remove the shim (fig. 3B-74).

13. Install the neutral-safety or back-up switch as outlined in Section 12 of this manual.

14. Slide the steering shaft into the column and install the upper bearing thrust washer.



Key No. Part Name

- 1 - COLUMN ASM
- 2 - HOUSING ASM
- 3 - RACK ASM
- 4 - SPRING
- 5 - SECTOR
- 6 - SHAFT
- 7 - CLIP
- 8 - SWITCH
- 9 - BEARING
- 10 - WASHER
- 11 - SCREW (4)
- 12 - RETAINING RING
- 13 - NUT
- 14 - COVER ASM (SHIPPED SEPARATELY)
- 15 - RING
- 16 - LOCK
- 17 - CAM ASM
- 18 - SPRING SCREW (3)

Key No. Part Name

- 20 - SWITCH ASM
- 21 - PROTECTOR WIRE
- 22 - HOUSING
- 23 - CUP
- 24 - BOLT ASM
- 25 - WASHER
- 26 - GATE
- 27 - SCREW (2)
- 28 - JACKET ASM
- 29 - SWITCH ASM, IGNITION
- 30 - SCREW (2)
- 31 - BOWL ASM
- 32 - SPRING
- 33 - BOWL
- 34 - SHROUD
- 35 - BEARING
- 36 - JACKET ASM
- 37 - SEAL-DASH
- 38 - TUBE ASM

Key No. Part Name

- 39 - WASHER
- 40 - SPRING
- 41 - ADAPTER
- 42 - RETAINER
- 43 - BEARING
- 44 - RING
- 45 - SHAFT ASM
- 46 - CLIP
- 47 - SHAFT ASM
- 48 - COUPLING ASM
- 49 - BOLT
- 50 - NUT
- 51 - RING
- 52 - SPRING
- 53 - BEARING (2)
- 54 - ABRASION SHIELD
- 55 - BOLT
- 56 - NUT

Fig. 3B-66--Typical Standard Column

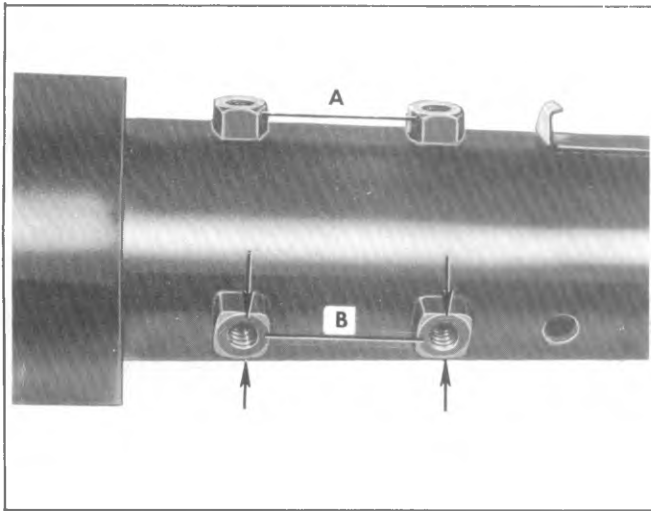


Fig. 3B-67--Installing Steering Column in Vise

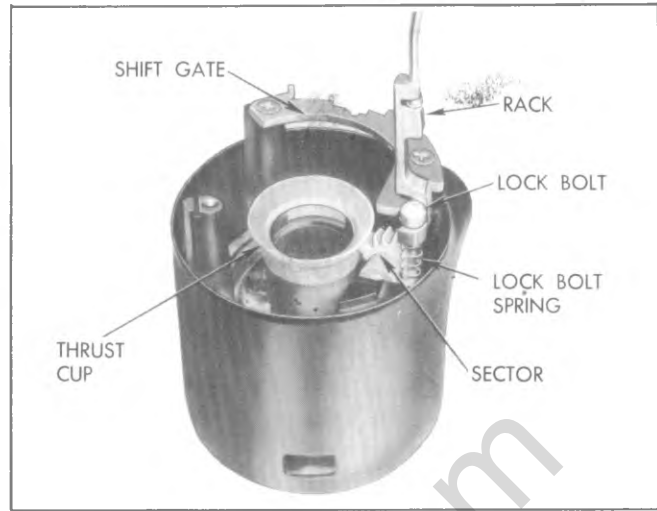


Fig. 3B-69--Turn Signal Housing Assembly

15. Install the turn signal switch, lock cylinder assembly and ignition switch as previously outlined in this section.

16. Install the shift lever and shift lever pivot pin.

17. Remove the column from the vise.

18. Install the dash bracket to the column; torque the screws to specifications.

Disassembly-Tilt Columns (Fig. 3B-75)

NOTE: Steps 3-14 may be performed with the steering column in the vehicle.

1. Remove the four screws retaining the dash mounting bracket to the column and set the bracket aside to protect the breakaway capsules.

2. Mount the column in a vise using both weld nuts of either Set A or B as shown in Figure 3B-67. The vise jaws must clamp onto the sides of the weld nuts indicated by arrows shown on Set B.

CAUTION: Do not place the column in a vise by clamping onto only one weld nut, by clamping onto one weld nut of both Sets A and B or by clamping onto the sides not indicated by arrows, since damage to the column could result.

3. Remove the directional signal switch, lock cylinder and ignition switch as outlined previously in this section.

4. Remove the tilt release lever. Drive out the shift lever pivot pin and remove the shift lever from the housing.

5. Remove the three turn signal housing screws and remove the housing.

6. Install the tilt release lever and place the column in the full "up" position. Remove the tilt lever spring retainer using a #3 phillips screwdriver that just fits into the slot opening. Insert the phillips screwdriver in the slot, press in approximately 3/16", turn approximately 1/8 turn counterclockwise until the ears align with the grooves in the housing and remove the retainer, spring and guide (fig. 3B-76).

7. Remove the pot joint to steering shaft clamp bolt and remove the intermediate shaft and pot joint assembly.

Push the upper steering shaft in sufficiently to remove the steering shaft upper bearing inner race and seat. Pry off the lower bearing retainer clip and remove the bearing reinforcement, bearing and bearing adapter assembly from the lower end of the mast jacket.

8. Remove the upper bearing housing pivot pins using

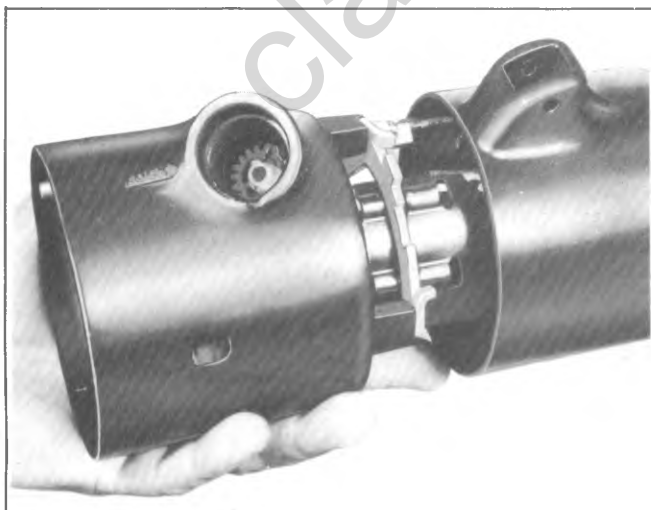


Fig. 3B-68--Removing Turn Signal Housing

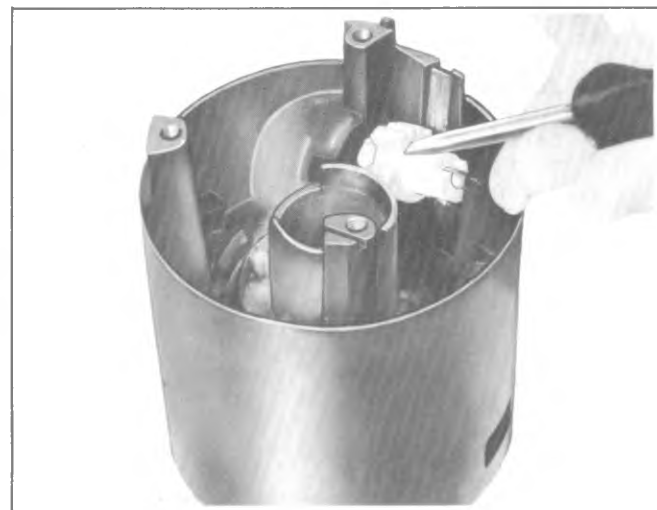


Fig. 3B-70--Removing Ignition Switch Actuator Sector

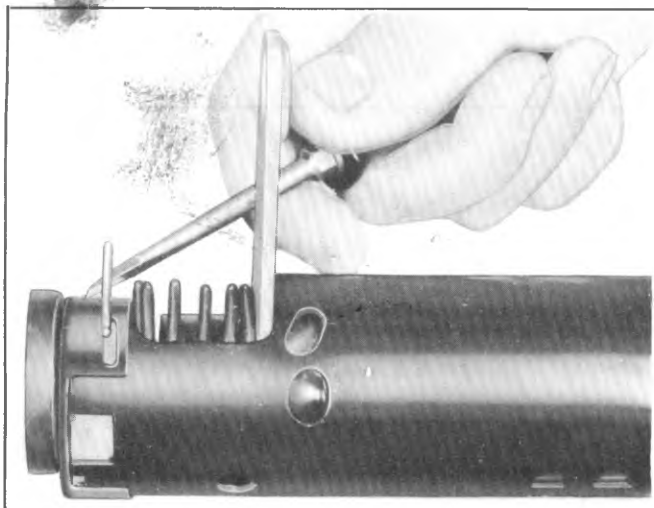


Fig. 3B-71--Removing Lower Bearing Retainer



Fig. 3B-73--Installing Gearshift Housing Lower Bearing

Tool J-21854-1 (fig. 3B-77).

9. Install the tilt release lever and disengage the lock shoes. Remove the bearing housing by pulling upward to extend the rack full down, and then moving the housing to the left to disengage the ignition switch rack from the actuator rod.

10. Remove the steering shaft assembly from the upper end of the column.

11. Disassemble the steering shaft by removing the centering spheres and the anti-lash spring.

12. Remove the transmission indicator wire, if so equipped.

13. Remove the four steering shaft bearing housing support to gearshift housing screws and remove the bearing housing support. Remove the ignition switch actuator rod.

14. Remove the shift tube retaining ring with a screwdriver and then remove the thrust washer.

15. Install Tool J-23072 into the lock plate, making sure that the tool screws have good thread engagement in the lock plate. Then, turning the center screw clockwise, force the shift tube from the housing (fig. 3B-78). Remove the shift tube (transmission control lock tube on floor shift

models) from the lower end of the mast jacket. Remove Tool J-23072.

CAUTION: When removing the shift tube, be sure to guide the lower end through the slotted opening in the mast jacket. If the tube is allowed to interfere with the jacket in any way, damage to the tube and jacket could result.

16. Remove the bearing housing support lock plate by sliding it out of the jacket notches, tipping it down toward the housing hub at the 12 o'clock position and sliding it under the jacket opening. Remove the wave washer.

17. **All Columns** - Remove the shift lever housing from the mast jacket (transmission control lock tube housing on floor shift models). Remove the shift lever spring by winding the spring up with pliers and pulling it out. On floor shift models, remove the spring plunger.

18. Disassemble the bearing housing as follows:

a. Remove the tilt lever opening shield.

b. Remove the lock bolt spring by removing the retaining screw and moving the spring clockwise to remove it from the bolt (fig. 3B-79).

c. Remove the snap ring from the sector drive shaft. With a small punch, lightly tap the drive shaft from the

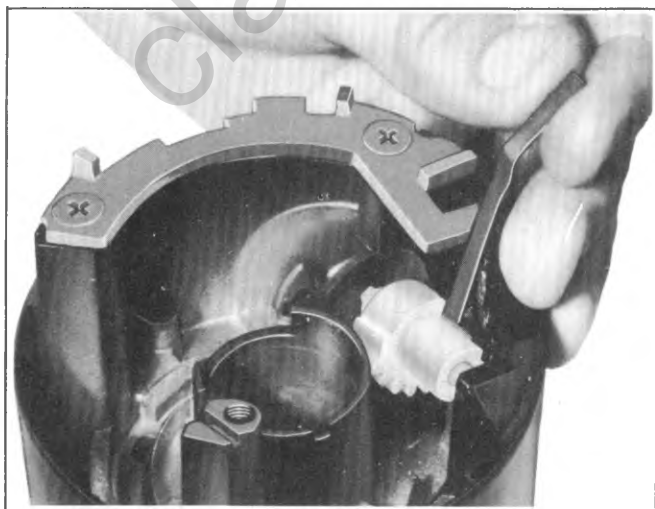


Fig. 3B-72--Installing Rack Preload Spring

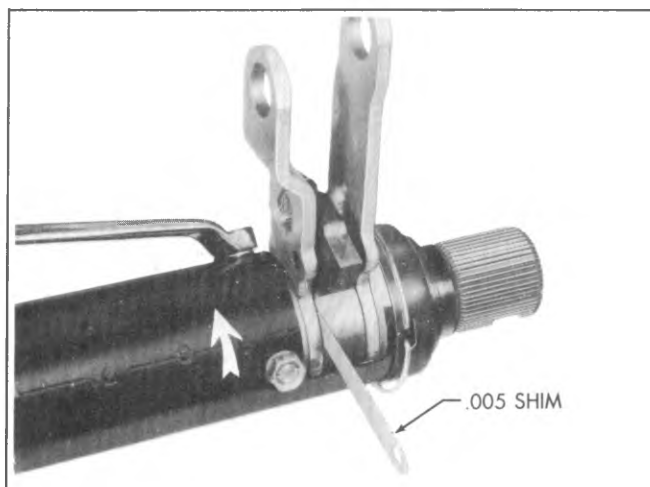


Fig. 3B-74--Adjusting Lower Bearing-Typical

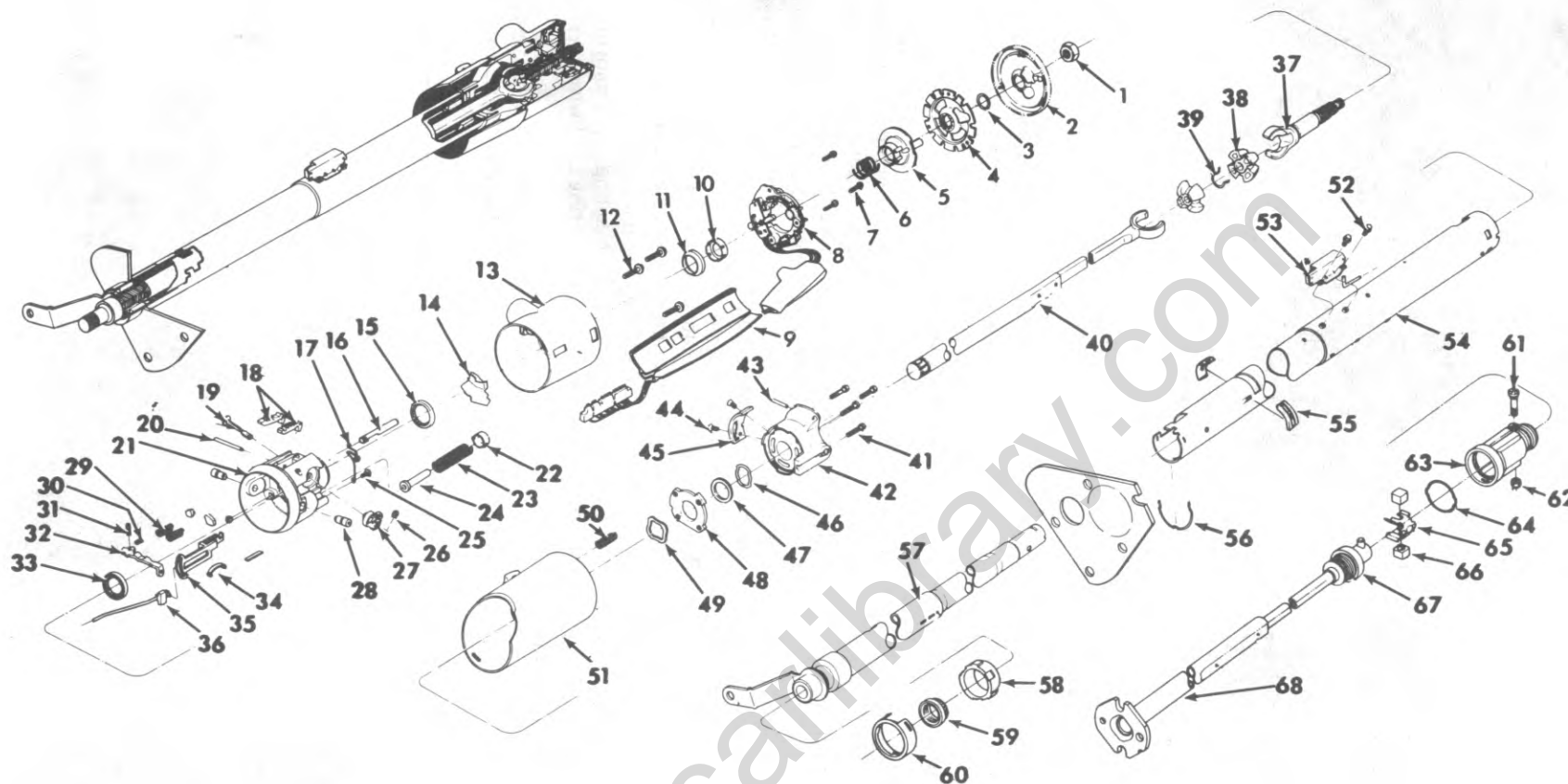


Fig. 3B-75--Tilt Steering Column Assembly-CK Typical

- | | | | |
|--------------------------------|---------------------------------|------------------------------------|---------------------------------|
| 1. Shaft Nut | 17. Lock Bolt Spring | 35. Ignition Switch Rack | 53. Ignition Switch |
| 2. Cover | 18. Lock Shoes | 36. Ignition Switch Rod | 54. Mast Jacket |
| 3. Lock Plate Retaining Ring | 19. Sector Shaft | 37. Upper Steering Shaft | 55. Neutral-Safety or Back-Up |
| 4. Lock Plate | 20. Lock Shoe Pin | 38. Centering Spheres | 56. Retainer |
| 5. Cancelling Cam | 21. Bearing Housing | 39. Center Sphere Spring | 57. Shift Tube |
| 6. Bearing Preload Spring | 22. Tilt Lever Spring Retainer | 40. Lower Steering Shaft | 58. Lower Bearing Adapter |
| 7. Turn Signal Screws | 23. Tilt Lever Spring | 41. Bearing Housing Support Screws | 59. Lower Bearing |
| 8. Turn Signal Switch | 24. Tilt Lever Spring Guide | 42. Bearing Housing Support | 60. Lower Bearing Reinforcement |
| 9. Protector Cover | 25. Lock Bolt Spring Screw | 43. Pin | 61. Pot Joint Bolt |
| 10. Upper Bearing Seat | 26. Sector Snap Ring | 44. Shift Tube Index Plate Screws | 62. Nut |
| 11. Upper Bearing Race | 27. Sector | 45. Shift Tube Index Plate | 63. Pot Joint Cover |
| 12. Turn Signal Housing Screws | 28. Bearing Housing Pivot Pins | 46. Support Retaining Ring | 64. Seal Retaining Ring |
| 13. Turn Signal Housing | 29. Shoe Release Springs | 47. Support Thrust Washer | 65. Bearing Spring |
| 14. Tilt Lever Opening Shield | 30. Spring | 48. Support Plate Lock | 66. Bearing Blocks |
| 15. Upper Bearing | 31. Shoe Release Lever Pin | 49. Support Wave Washer | 67. Pot Joint Seal |
| 16. Shaft Lock Bolt | 32. Shoe Release Lever | 50. Gearshift Lever Spring | 68. Intermediate Shaft |
| | 33. Lower Bearing | 51. Gearshift Lever Housing | |
| | 34. Ignition Switch Rack Spring | 52. Ignition Switch Screws | |

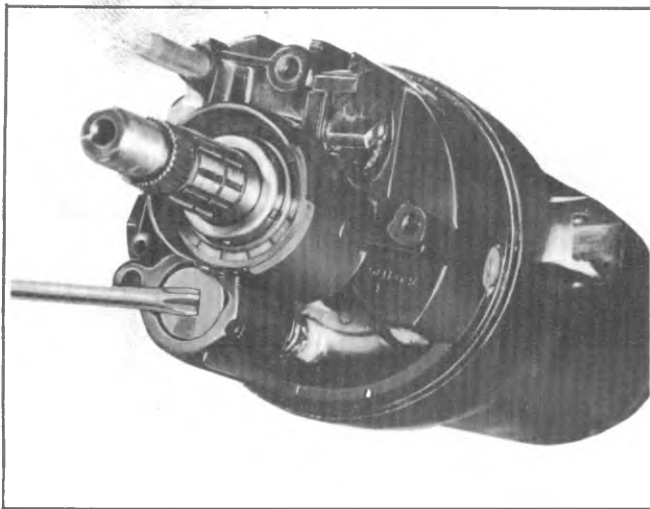


Fig. 3B-76--Removing Tilt Lever Spring Retainer

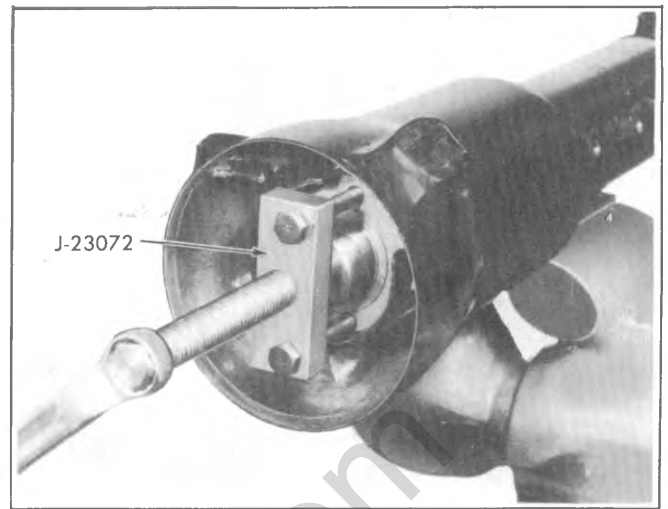


Fig. 3B-78--Removing Shift Tube

sector (fig. 3B-80). Remove the drive shaft, sector and lock bolt. Remove the rack and rack spring.

d. Remove the tilt release lever pin with a punch and hammer. Remove the lever and release lever spring. To relieve the load on the release lever, hold the shoes inward and wedge a block between the top of the shoes (over slots) and bearing housing.

e. Remove the lock shoe retaining pin with a punch and hammer. Remove the lock shoes and lock shoe springs.

NOTE: With the tilt lever opening on the left side and shoes facing up, the four slot shoe is on the left.

f. Remove the bearings from the bearing housing only if they are to be replaced. Remove the separator and balls from the bearings. Place the housing on work bench and with a pointed punch against the back surface of the race, carefully hammer the race out of the housing until a bearing puller can be used. Repeat for the other race.

Assembly-Tilt Columns

Apply a thin coat of lithium grease to all friction surfaces.

1. If the bearing housing was disassembled, repeat the following steps:

a. Press the bearings into the housing, if removed, using a suitable size socket. Be careful not to damage the housing or bearing during installation.

b. Install the lock shoe springs, lock shoes and shoe pin in the housing. Use an approximate .180" rod to line up the shoes for pin installation.

c. Install the shoe release lever, spring and pin.

NOTE: To relieve the load on the release lever, hold the shoes inward and wedge a block between the top of the shoes (over slots) and bearing housing.

d. Install the sector drive shaft into the housing. Lightly tap the sector onto the shaft far enough to install the snap ring. Install the snap ring.

e. Install the lock bolt and engage it with the sector cam surface. Then install the rack and spring. The block tooth on the rack should engage the block tooth on the sector (fig. 3B-81). Install the external tilt release lever.

f. Install the lock bolt spring and retaining screw (fig. 3B-76). Tighten the screw to 35 in. lbs.

2. Install the shift lever spring into the housing by winding it up with pliers and pushing it into the housing. On floor shift models, install the plunger, slide the gearshift



Fig. 3B-77--Removing Bearing Housing Pivot Pins

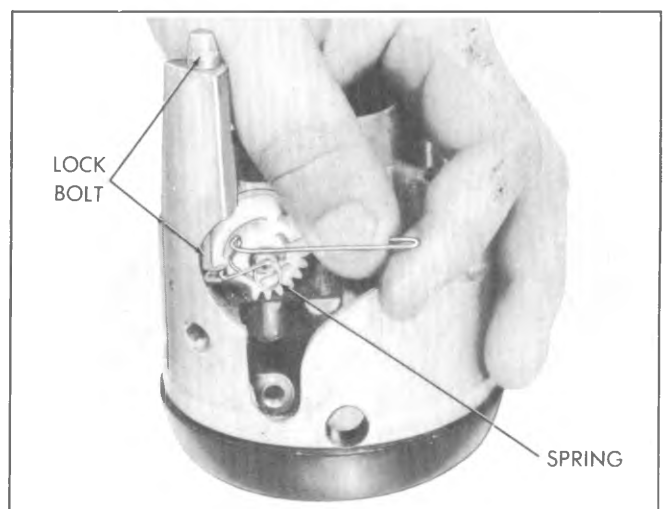


Fig. 3B-79--Replacing Lock Bolt Spring

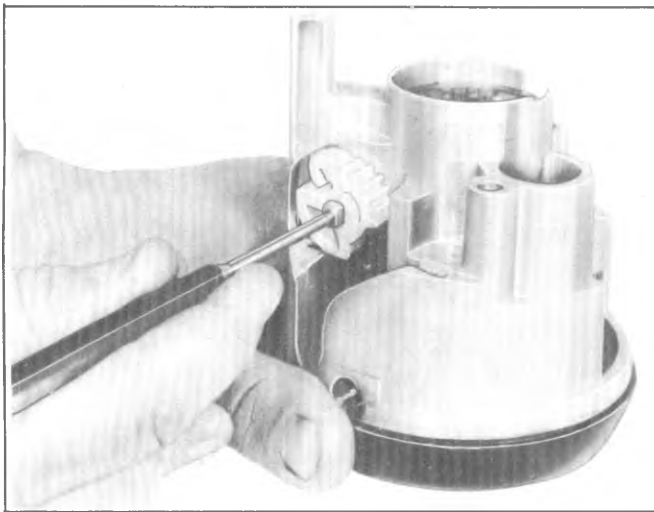


Fig. 3B-80--Removing Sector Drive Shaft

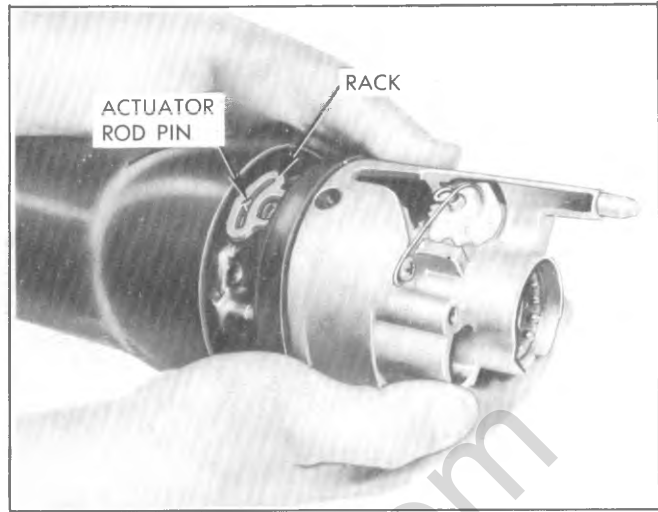


Fig. 3B-82--Installing Bearing Housing

lever housing onto the mast jacket.

3. Install the bearing support lock plate wave washer.

4. Install the bearing support lock plate. Work it into the notches in the jacket by tipping it toward the housing hub at the 12 o'clock position and sliding it under the jacket opening. Slide the lock plate into the notches in the jacket.

5. Carefully install the shift tube into the lower end of the mast jacket. Align keyway in the tube with the key in the shift lever housing. Install the wobble plate end of Tool J-23073 into the upper end of the shift tube far enough to reach the enlarged portion of the tube. Then install the adapter over the end of the tool, seating it against the lock plate. Place the nut on the threaded end of the tool and pull the shift tube into the housing (fig. 3B-83). Remove Tool J-23073.

CAUTION: Do not push or tap on the end of the shift tube. Be sure that the shift tube lever is aligned with the slotted opening at the lower end of the mast jacket or damage to the shift tube and mast jacket could result.

6. Install the bearing support thrust washer and retaining ring by pulling the shift lever housing up far

enough to compress the wave washer.

7. Install the bearing support by aligning the "V" in the support with the "V" in the jacket. Insert the screws through the support and into the lock plate and torque to 60 lbs. in.

8. Align the lower bearing adapter with the notches in the jacket and push the adapter into the lower end of the mast jacket. Install lower bearing, bearing reinforcement and retaining clip, being sure that the clip is aligned with the slots in the reinforcement, jacket and adapter.

9. Install the centering spheres and anti-lash spring in the upper shaft. Install the lower shaft from the same side of the spheres that the spring ends protrude.

10. Install the steering shaft assembly into the shift tube from the upper end. Carefully guide the shaft through the shift tube and bearing.

11. Install the ignition switch actuator rod through the shift lever housing and insert in the slot in the bearing support. Extend the rack downward from the bearing housing.

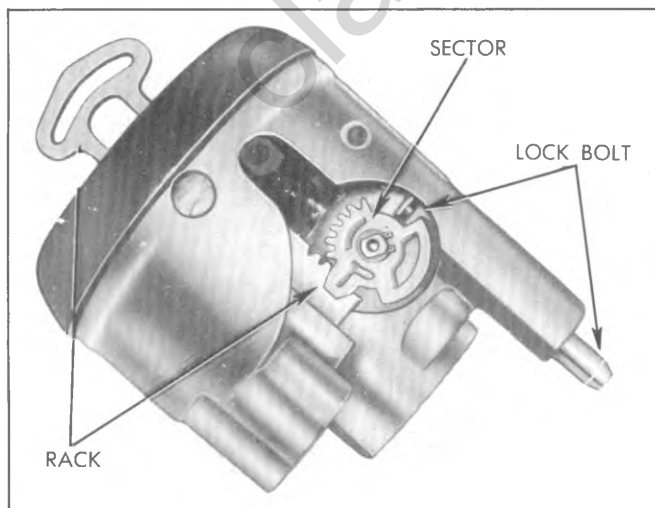


Fig. 3B-81--Installing Lock Bolt and Rack Assemblies

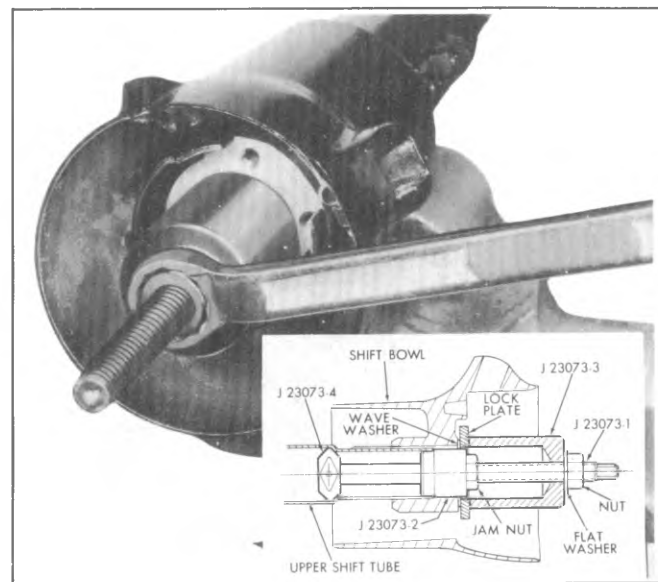


Fig. 3B-83--Installing Shift Tube

12. Assemble the bearing housing over the steering shaft and engage the rack over the end of the actuator rod (fig. 3B-82).

13. With the external release lever installed, hold the lock shoes in the disengaged position and assemble the bearing housing over the steering shaft until the pivot pin holes line up.

14. Install the pivot pins.

15. Place the bearing housing in the full "up" position and install the tilt lever spring guide, spring and spring retainer. With a suitable screwdriver, push the retainer in and turn clockwise to engage in the housing.

16. Install the upper bearing inner race and race seat.

17. Install the tilt lever opening shield.

18. Remove the tilt release lever, install the turn signal housing and torque the three retaining screws to 45 lbs. in.

19. Install the tilt release lever and shift lever. Drive the shift lever pin in.

20. Install the lock cylinder, turn signal switch and ignition switch as outlined previously in this section.

21. Align the groove across the upper end of the pot joint with the flat on the steering shaft. Assemble the intermediate shaft assembly to the upper shaft. Install the clamp and bolt and torque the nut to specifications.

NOTE: The clamp bolt must pass through the shaft under cut.

22. Install the neutral-safety switch or back-up switch as outlined in Section 12 of this manual.

23. Install the four dash panel bracket to column screws and torque to specifications.

CAUTION: Be sure that the slotted openings in the bracket (for the mounting capsules) face the upper end of the steering column.

COLUMN INSTALLATION- MANDATORY SEQUENCE

C and K SERIES VEHICLES (Fig. 3B-84)

Mandatory Instructions

1. Assemble lower dash cover (A) and upper dash cover (B) to seal (C) with "Carrots" (part of seal).

2. Attach bracket (D) to jacket and tighten four bolts (E) to specified torque.

Mandatory Installation Sequence

1. Position column in body and position flange to rag joint and install lock washers and nuts (F) (May be tightened to specified torque at this time).

NOTE: Coupling (G) on manual steering must be installed prior to column installation.

2. Loosely assemble (2) capsules nuts (H) at the instrument panel bracket (D).

3. Position lower clamp (J) and tighten attaching nuts (K) to specified torque.

4. Tighten two nuts (H) at capsules to specified torque.

5. Install seal (C) and covers (A and B) to dash.

6. Install attaching screws (L) and tighten to specified torque.

7. Tighten two nuts (F) at capsules to specified torque if not already done.

8. Remove plastic spacers from flexible coupling pins.

9. Install transmission indicator cable on column automatics.

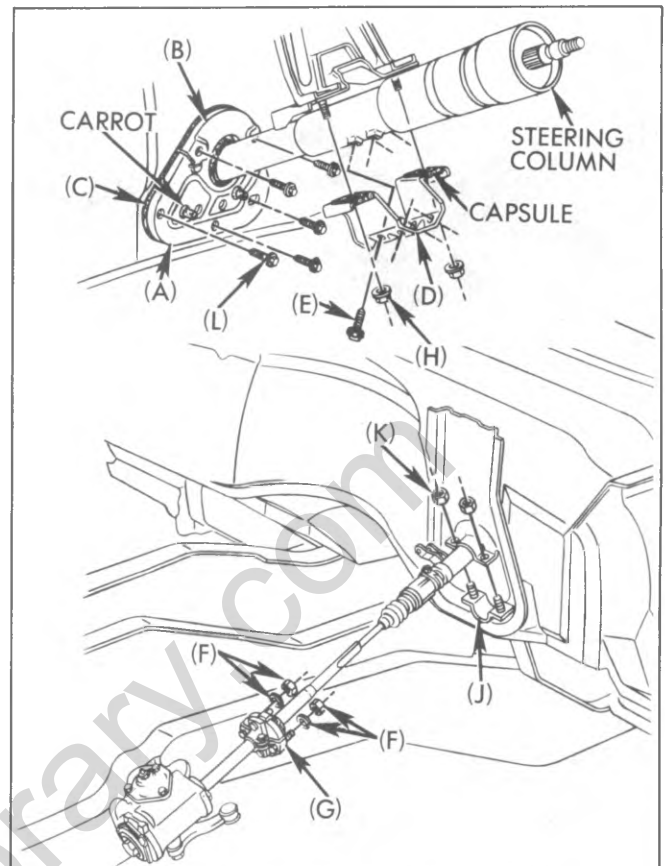


Fig. 3B-84--Steering Column Installation-CK

10. Install the instrument panel trim cover.

11. Connect the transmission control linkage at the shift tube levers.

12. Install the steering wheel as outlined previously in this section.

13. Connect the battery ground cable.

Mandatory System Requirements

1. Pot joint operating angle must be $1\ 1/2^\circ \pm 4^\circ$.

2. Flexible coupling must not be distorted greater than $\pm .06$ due to pot joint bottoming, in either direction.

STEERING COLUMN SERVICE FOR G AND P SERIES

STEERING COLUMN UPPER BEARING-G AND P SERIES

Standard Column

Removal

1. Remove steering wheel as outlined in this section.

2. Remove directional signal cancelling cam.

3. Pry out upper bearing.

Installation

CAUTION: See CAUTION on page 1 of this section regarding the fasteners referred to in step 1.

1. Replace all component parts in reverse order of removal making sure that directional switch is in neutral position before installing steering wheel. Torque steering wheel nut to specifications.

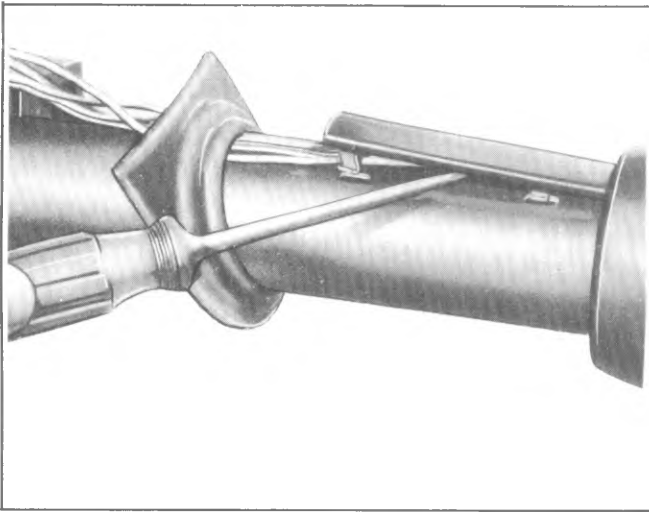


Fig. 3B-85--Removing Wiring Harness Protector

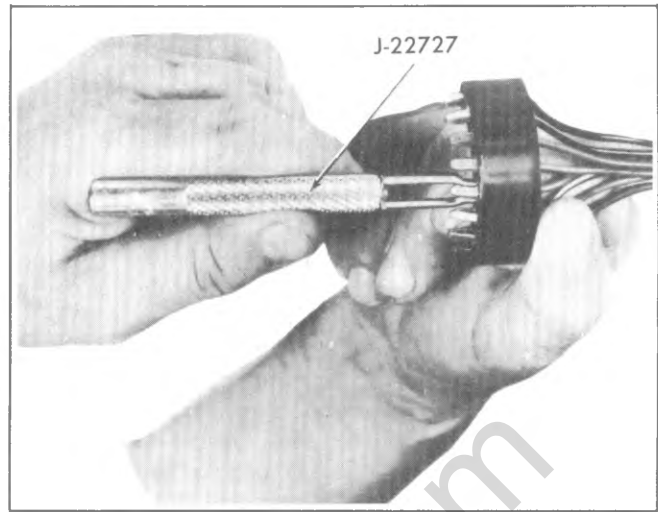


Fig. 3B-86--Removing Wires from Connector

Tilt Column

The upper bearings on the tilt column are spun into the bearing housing assembly. If the bearings indicate need of replacement, the entire bearing housing must be replaced. See "Tilt Steering Column - Disassembly and Assembly" for the correct replacement procedure.

STEERING COLUMN LOWER BEARING P SERIES

Removal

1. Remove the intermediate steering shaft and universal joint assembly as outlined earlier in this section. Remove the preload spring clamp and spring from the end of the steering shaft.
2. Pry out the lower bearing assembly.

Installation

CAUTION: See CAUTION not on page 1 of this section regarding fasteners referred to in step 2.

1. Place the new bearing over the end of the steering shaft and press into position in the column.
2. Install the preload spring and clamp and torque the clamp bolt nut to specifications while maintaining the dimension shown in Figure 36. Reinstall the intermediate shaft and universal joint assembly as outlined under "Intermediate Steering Shaft with Universal Joint Couplings - Installation".

DIRECTIONAL SIGNAL SWITCH-G AND P SERIES COLUMNS

If the directional signal switch must be replaced, the steering column does not have to be removed from the vehicle.

Removal

1. Remove the steering wheel as outlined under "Steering Wheel - Removal".
2. Remove the directional signal switch cancelling cam and spring.
3. Remove the column to instrument panel trim plate (if so equipped).
4. Disconnect the directional signal switch wiring harness at the half-moon connector.
5. Pry the wiring harness protector out of the column

retaining slots as shown in Figure 3B-85.

6. Mark the location of each wire in the half-moon connector and then remove each individual wire from the connector using Tool J-22727 (fig. 3B-86). Insert the tool into the lower end of the connector and push in until the tool bottoms on the connector. Remove the tool and then pull the wire from the connector.

7. Remove the directional signal lever screw and remove the lever.

8. Push in on the hazard warning light knob and then unscrew and remove the knob.

9. Tilt Columns Only

a. Automatic Transmission Models - Remove the PRNDL dial screws and remove the dial and indicator needle. Remove the cap and dial illumination bulb from the housing cover.

b. Unscrew and remove the tilt release lever.

c. Assemble Tool J-22708 inside the directional signal housing cover; push in until the tangs lock inside the cover flange (fig. 3B-87). Turn the tool center screw clockwise to pull the cover from the housing.

10. Remove the three directional signal switch

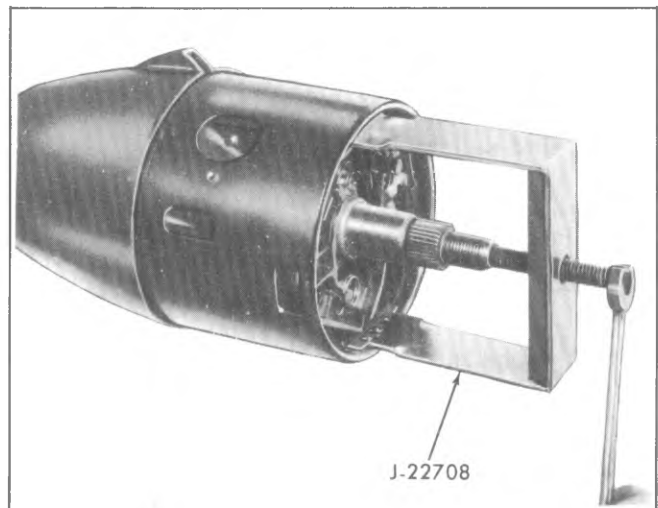


Fig. 3B-87--Removing Directional Signal Housing Cover

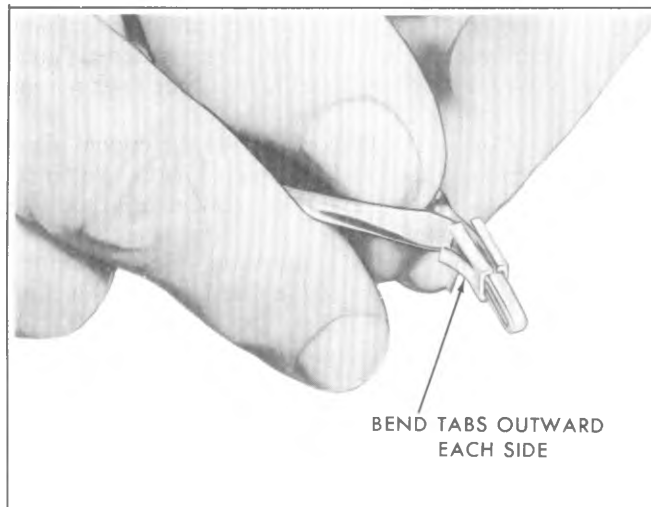


Fig. 3B-88--Preparing Wire Retaining Tabs for Installation

mounting screws and then carefully remove the switch assembly from the column while guiding the wiring harness through the opening in the shift lever housing.

Installation

CAUTION: See *CAUTION* on page 1 of this section regarding the fasteners referred to in step 9.

1. Wrap the ends of the directional signal switch wires with tape and then guide them through the opening at the lower left hand side of the bearing housing (tilt columns) out the lower end of the shift lever housing and under the dash seal.

2. Place the directional signal switch in position and install the three mounting screws; torque to 25 lbs. in. after screw head has been firmly seated.

3. Tilt Columns Only-

a. Align the openings in the directional signal switch cover with the proper lever positions and tap the cover into place using a plastic hammer.

b. Install the tilt release lever.

c. Automatic Transmission Model - Install the PRNDL dial, pointer, dial illumination bulb and cap.

4. Install the directional signal switch lever and hazard warning knob.

5. Bend the wire retaining tabs slightly outward on each wire in the wiring harness as shown in Figure 3B-88; this will provide proper retention of the wire in the half-moon connector.

6. Install each wire in its marked location in the half-moon connector. Push in until square part of clip is flush with the bottom side of the connector. Connect the directional signal switch wiring harness.

7. Snap the wiring harness protector into the column retaining slots.

8. Install the directional signal cancelling cam and spring.

9. Install the steering wheel as outlined under "Steering Wheel - Installation".

10. Install the column to instrument panel trim plate (if so equipped).

TILT COLUMN BEARING HOUSING ASSEMBLY - G AND P SERIES

Removal (Column in Vehicle)

1. Disconnect the battery ground cable.

2. Remove the steering wheel as outlined under "Steering Wheel - Removal".

3. Remove the directional signal switch as outlined under "Directional Signal Switch - Removal".

4. **Column Shift Models** - Using a suitable size punch, drive out the shift lever pivot pin and remove the shift lever.

5. Install the tilt release lever and place the column in the full "up" position. Remove the tilt lever spring and retainer using a screwdriver that just fits into the slot opening. Insert the screwdriver into the slot, push in approximately 3/16", rotate clockwise approximately 1/8 turn until the retainer ears align with the grooves in the housing and remove the retainer and spring.

6. Remove the steering shaft bearing locknut using Socket J-22599. Remove the upper bearing race seat and race.

7. Remove the two bearing housing pivot pins using Tool J-21854.

8. Pull up on the tilt release lever (to disengage the lock shoes) and remove the bearing housing.

If the bearing housing is being replaced or it is necessary to disassemble the bearing housing, proceed as follows:

a. Press the upper and lower bearings out of the housing.

b. Using Puller J-5822 and Slide Hammer J-2619, pull the bearing races from the housing.

c. Remove the tilt release lever.

d. Drive out the shoe release pivot pin using Tool J-22635 or a suitable punch. Remove the lever spring and remove the wedge.

e. Using a suitable size punch, drive out the lock shoe retaining pin. Remove the shoes and shoe springs.

If the upper steering shaft, lower steering shaft, or centering spheres are being removed, proceed as follows:

9. To remove the steering shaft assembly through the upper end of the column. If it is necessary to disassemble the shaft, proceed as follows:

a. To remove the lower steering shaft first disconnect the shaft at the pot joint coupling clamp.

b. Turn the upper shaft 90° to the lower shaft and slide the upper shaft and centering spheres from the lower shaft.

c. Rotate the centering spheres 90° and remove the centering spheres and preload spring from the upper shaft.

If the bearing housing support is being replaced, proceed as follows:

10. Remove the four bearing housing support screws and remove the support.

Assembly

CAUTION: See caution note on page 7 of this section regarding the fasteners referred to in steps 3, 9 and 11.

1. Assemble the steering shaft as follows:

a. Lubricate and assemble the centering spheres and preload spring.

b. Install the spheres into the upper (short) shaft and rotate 90°.

c. Install the lower shaft 90° to the upper shaft and over the centering spheres. Slowly straighten the shafts while compressing the preload spring.

2. Install the shaft assembly into the housing from the upper end.

3. Install the lower shaft to the pot joint coupling clamp. Install the coupling clamp bolt and torque to specifications.

NOTE: The coupling bolt must pass through the shaft undercut.

4. Assemble the bearing housing as follows:

a. Press the new upper and lower bearing races into the bearing housing.

b. Lubricate and install the bearings into the bearing races.

c. Place the lock shoe springs in position in the housing. Install each shoe in place and compress the spring until a suitable size straight punch can be used to hold the shoe in position (it may be necessary to acquire assistance to install the shoes). Once the shoes are in place, drive in the shoe retaining pin.

d. Install the shoe release lever and drive in the pivot pin.

e. Install the tilt release lever.

f. Lubricate the shoes and release lever.

5. Install the bearing housing assembly to the support. Hold the tilt release lever in the "up" position until the shoes have fully engaged the support. Lubricate and install the bearing housing pivot pins. Press the pins in flush with the housing.

6. Place the housing in the full "up" position and then install tilt spring and retainer (tapered end of spring first). Push into the housing approximately 3/16" and rotate counterclockwise 1/8 turn.

7. Lubricate and install the upper bearing race, race seat and locknut. Tighten the locknut (using Socket J-22599) to remove the lash and then carefully further tighten 1/16 to 1/8 of a turn (column must be in straight ahead position).

8. Remove the tilt release lever.

9. Install the directional signal switch as outlined under "Directional Signal Switch - Installation".

10. Column Shift Models - Install the shift lever and pivot pin.

11. Install the steering wheel as outlined under "Steering Wheel - Installation".

12. Check electrical and mechanical functioning of column.

STEERING COLUMN G AND P SERIES

Removal (Fig. 3B-89)

1. Disconnect the battery ground cable.

2. Column Shift Models - Disconnect transmission shifter rods at the lower end of the column.

3. **G Models** - Remove the intermediate steering shaft flange to flexible coupling bolts.

P Models - Remove the intermediate steering shaft upper universal yoke to steering shaft pinch bolt. Mark the coupling to shaft relationship.

4. Remove column clamp screw(s) on engine side of firewall, if equipped, and remove or slide the clamp down the column.

5. From inside the vehicle, remove the screws from the

toe pan cover and slide the cover and seal up the column.

6. Remove the steering wheel as outlined under "Steering Wheel-Removal", and reinstall the shaft nut and washer.

7. All Columns - Disconnect the directional signal wiring harness. Standard Column with Automatic Transmission - Disconnect the conductor tube (for transmission indicator) at the instrument panel.

Tilt Column with Automatic Transmission - Disconnect the single wire at the fuse block and unclip it from the parking brake bracket.

8. Remove the cap screws from the column support bracket at the dash panel.

9. Carefully lower and then withdraw the column assembly, rotating so that the shift levers clear the toe pan opening.

Standard Column (Fig. 3B-90)

Disassembly

NOTE: For floor shift transmission models, omit Steps 4, 14, 15 and 16.

1. Remove the steering wheel nut and lock washer and then slide the steering shaft assembly from the lower end of the column.

2. G Models - Remove the lower bearing preload spring and clamp from the steering shaft.

P Models - Remove the lower bearing preload spring and clamp.

3. Remove the back-up lamp switch.

4. Drive out the shift lever pivot pin and remove the shift lever.

5. Remove the directional signal cancelling cam. Remove the directional signal switch lever.

6. Remove the column wiring harness cover.

7. Remove the directional signal switch screws.

8. Rotate the directional signal switch housing counterclockwise and remove the housing from the column.

NOTE: The housing and switch cannot be fully removed from the column until the shift lever housing is removed.

9. Remove the plastic thrust washer assembly and then remove the shift lever housing (or extension housing) from the column.

10. Separate the directional signal switch, switch control support assembly, directional signal housing and shift lever housing (or housing extension) assemblies.

11. Press the steering shaft upper bearing out of the switch contact support.

12. Remove the shift lever housing (or extension housing) seat and bushing from the upper end of the column.

13. Remove the bolt and screws from the adjusting ring clamp and remove the clamp, adjusting ring and lower bearing. Press the lower bearing out of the adjusting ring.

14. 3-Speed Columns - Remove 1st-reverse shift lever and lever spacer.

Automatic Columns - Remove the selector plate clamping ring screws (3).

15. Place the column upright on the floor, supporting it with two pieces of wood. Place a block of wood on the upper end of the shift tube. Press down on the shift lever with foot while tapping on the wood block to withdraw the tube from the column jacket.

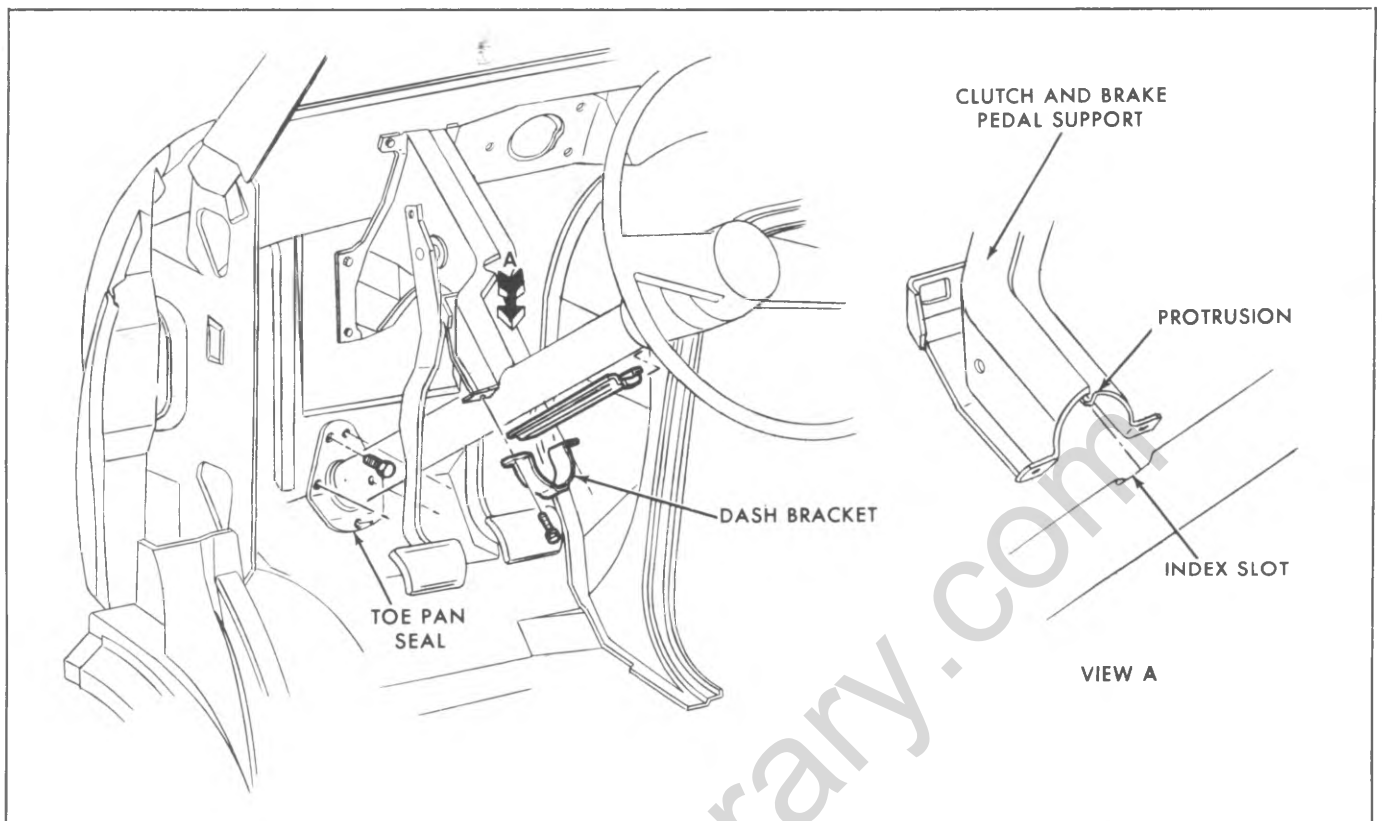


Fig. 3B-89--Steering Column Installation-G Series

NOTE: In some tolerance stack-up cases it may be necessary to use a press. Be careful not to damage the tube or jacket.

16. Remove the felt seal from the shift tube.

17. Remove firewall clamp, toe pan seal and dash panel seals from the jacket.

Assembly

NOTE: In the following assembly sequence use any general purpose lithium soap grease for lubricating those components so indicated.

1. Install the dash panel seal, toe panel and firewall clamps over the end of the jacket.

2. Lubricate all bearing surfaces on the shift tube.

3. Place the felt seal onto the shift tube (next to spring) and then place the shift tube in the jacket.

4. 3-Speed Columns - Temporarily install spacer, 1st-reverse shift lever and lower adjusting ring. Place a block of wood on top of the adjusting ring and tap until the shift tube bottoms. Remove adjusting ring, shift lever and spacer.

Automatic Columns - Align the three holes in the selector plate with the three holes in the jacket, position the clamping ring and install the three screws.

NOTE: The shift tube spring retainer must be bottomed against the jacket stops.

5. 3-Speed Columns-Lubricate and install the spacer and 1st-reverse shift lever (tang of lever towards top of column).

6. Install lower bearing in the adjusting ring and then install the adjusting ring, clamp and screws.

7. Install the shift lever housing (or extension housing) seat and bushing to upper end of housing.

8. Thread directional signal switch wiring harness

through the switch and lever (or extension) housings, lubricate the inner diameter of the shift housing, and then place the shift lever (or extension) housing onto the upper end of the column.

9. Install the switch housing plastic washer assembly. Press the upper bearing into the switch contact support.

10. Install the directional signal switch housing, contact support, bearing and switch and torque the switch screws to 25 lbs. in.

11. Install the column wiring harness cover and back-up lamp switch.

12. Install the directional signal and gearshift levers.

13. Adjust the shift tube as outlined under "Shifter Tube Adjustment."

14. Loosely install the lower bearing preload spring and clamp.

15. Slide the steering shaft assembly up through the column assembly. Install the directional signal cancelling cam, steering shaft nut and lock washer.

Tilt Column (Fig. 3B-91)

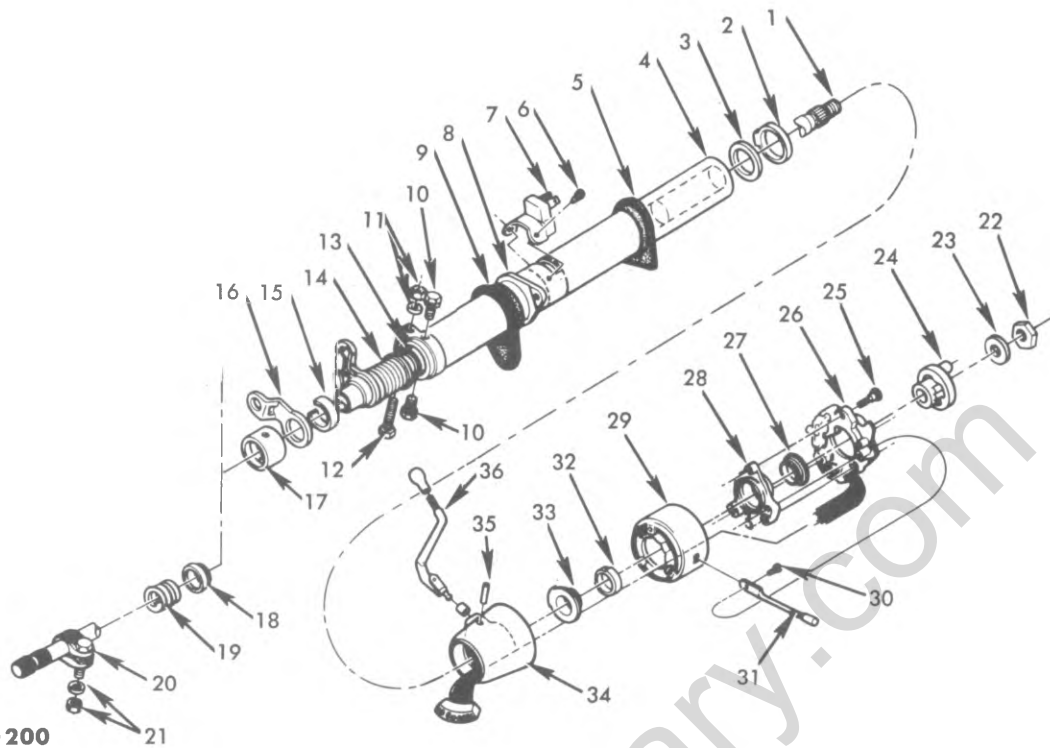
Disassembly

1. If the column is removed from the vehicle, place the column in a bench vise using Holding Fixtures J-22573 (fig. 3B-92).

CAUTION: Clamping the column directly in a vise, could result in a damaged column.

2. Remove the directional signal switch as outlined under "Directional Signal Switch-Removal".

3. Remove the lower steering shaft and pot joint assembly and lower bearing and adapter assembly as outlined under "Lower Bearing and Adapter-Removal".



GA & PA 100-200

- | | | |
|---------------------------------|----------------------------------|------------------------------------|
| 1. Upper Steering Shaft | 13. Shift Tube Felt Washer | 25. Turn Signal Switch Screw |
| 2. Shift Housing Bushing | 14. Shift Tube Assembly | 26. Turn Signal Switch |
| 3. Bushing Seat | 15. Shift Lever Spacer | 27. Steering Shaft Upper Bearing |
| 4. Mast Jacket | 16. 1st-Reverse Shift Lever | 28. Switch Contact Support |
| 5. Column Cover | 17. Adjusting Ring | 29. Turn Signal Housing |
| 6. Back-Up Lamp Switch Screw | 18. Shaft Lower Bearing | 30. Turn Signal Switch Lever Screw |
| 7. Back-Up Lamp Switch | 19. Lower Bearing Preload Spring | 31. Turn Signal Switch Lever |
| 8. Toe Pan Seal Retainer | 20. Preload Spring Clamp | 32. Rubber Ring |
| 9. Toe Pan Seal | 21. Nut and Lockwasher | 33. Plastic Thrust Washer |
| 10. Adjusting Ring Clamp Screws | 22. Steering Shaft Nut | 34. Shift Lever Housing |
| 11. Nut and Lockwasher | 23. Lockwasher | 35. Shift Lever Pin |
| 12. Adjusting Ring Clamp Bolt | 24. Turn Signal Cancelling Cam | 36. Shift Lever |

Fig. 3B-90--Standard Column-Typical G & P

4. Column Shift Models - Using a suitable size punch, drive out the shift lever pivot pin and remove the shift lever.

5. Install the tilt release lever and place the column in the full "up" position. Remove the tilt lever spring and retainer using a screwdriver that just fits into the slot opening (fig. 3B-93). Insert the screwdriver clockwise approximately 1/8 turn until the retainer ears align with the grooves in the housing and remove the retainer and spring.

6. Remove the steering shaft bearing locknut using socket J-22599. Remove the upper bearing race seat and race.

7. Remove the two bearing housing pivot pins using Tool J-21854 (fig. 3B-94).

8. Pull up on the tilt release lever (to disengage the lock shoes) and remove the bearing housing. If it is necessary to disassemble the bearing housing, proceed as follows:

- Press the upper and lower bearings out of the housing.
- Using Puller J-5822 and Slide Hammer J-2619 pull the bearing races from the housing (fig. 3B-95).
- Remove the tilt release lever.
- Drive out the shoe release lever pivot pin using Tool

J-22635 or a suitable punch (fig. 3B-96). Remove the lever spring and remove the wedge.

e. Using a suitable size punch, drive out the lock shoe retaining pin. Remove the shoes and shoe springs.

9. Remove the steering shaft assembly through the upper end of the column. If it is necessary to disassemble the shaft proceed as follows:

- Turn the upper shaft 90° to the lower shaft and slide the upper shaft and centering spheres from the lower shaft.
- Rotate the centering spheres 90° and remove the center spheres and preload spring from the upper shaft.

10. Remove the four bearing housing support screws and remove the support.

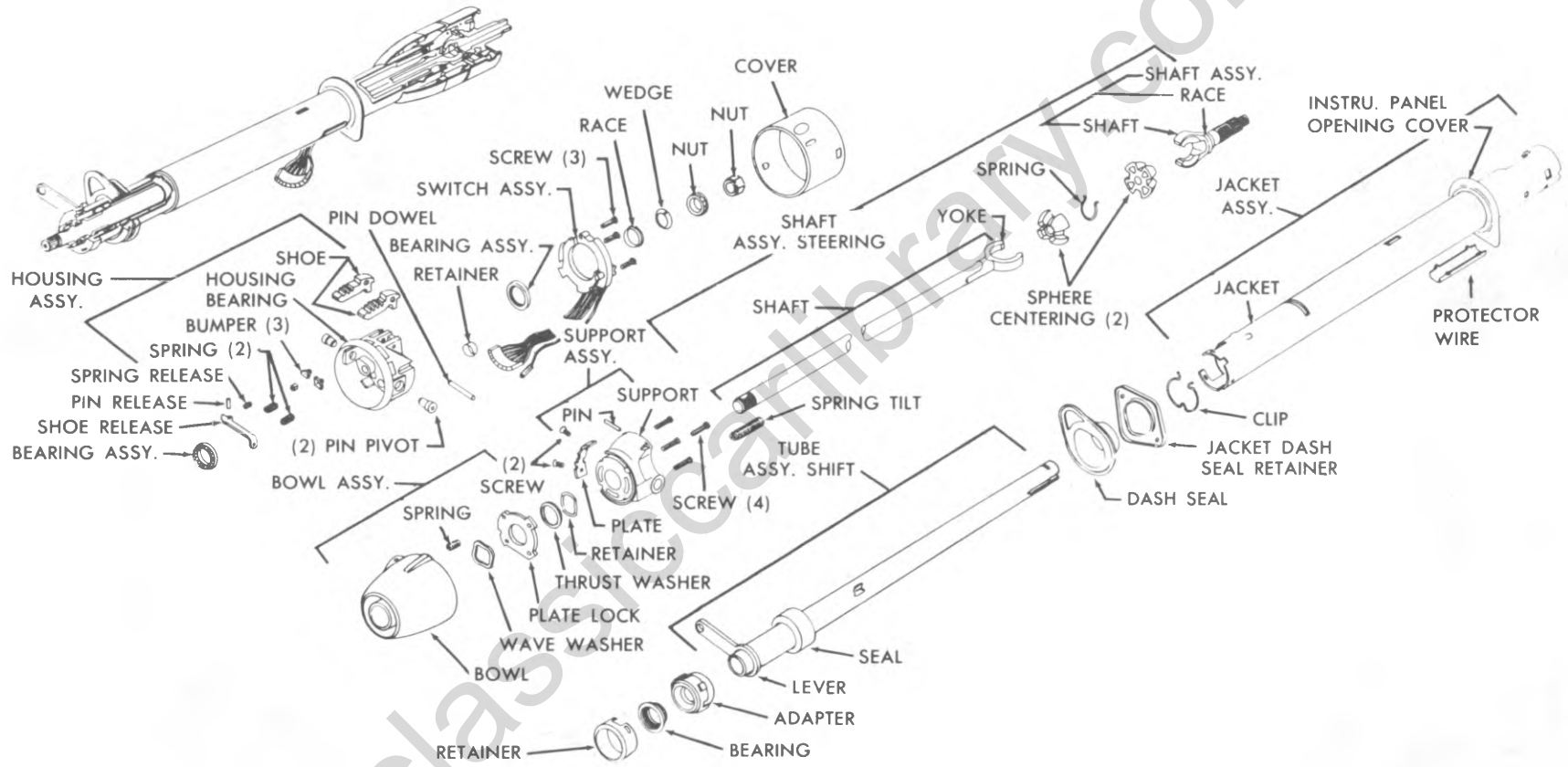
Column Shift Models - If the shift tube index plate must be removed, remove the two retaining screws and remove the plate.

11. Remove the shift tube retaining ring with a screwdriver (fig. 3B-97). Remove the thrust washer.

12. Remove the neutral-safety or back-up lamp switch screws and remove the switch.

13. Rework Shift Tube Removing Tool J-22551 by removing 1/2" from the pilot end of the tool (Fig. 3B-98).

Fig. 3B-91-Tilt Steering Column-G & P



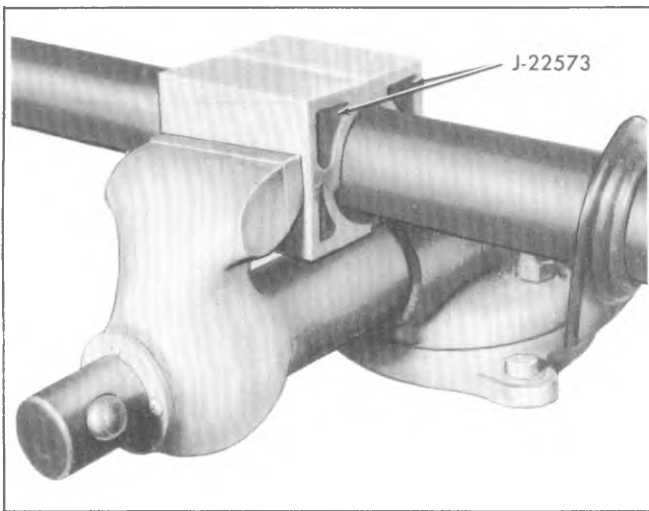


Fig. 3B-92--Securing Column with J-22573

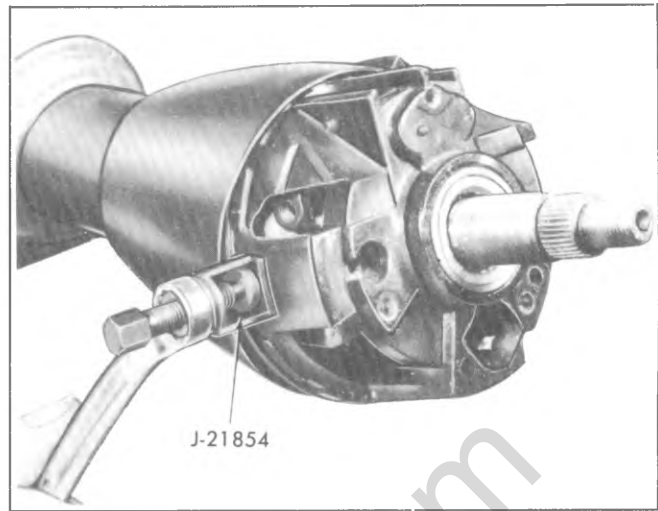


Fig. 3B-94--Removing Bearing Housing Pivot Pin

This allows the shift tube to be pushed further out of the housing and will not affect the use of the tool on other columns.

14. Remove the shift tube assembly using Tool J-22551 (fig. 3B-99). Insert the hooked end of the tool into the notch in the shift tube just below the shift lever housing key. Pilot the sleeve over the threaded end of the tool and into the upper end of the shift tube. Force the shift tube out of the housing by turning the nut onto the tool. If the shift tube is not completely free when the nut is bottomed on the threads, complete the removal by hand.

CAUTION: Do not hammer or pull on the shift tube during removal. On column shift models, guide the lower shift lever through the slotted opening in the column to prevent damage to the tube or column.

15. Remove the lock plate by sliding out of the column notches, tipping the plate downward toward the housing (to compress the wave washer) and then removing as shown in Figure 3B-100. Remove the wave washer.

16. Remove the shift lever housing.

17. Column Shift Models - Remove the shift lever

spring by winding the spring up with pliers.

18. If necessary, remove the dash panel seal, mounting plate and the instrument panel seal from the column jacket.

Assembly

NOTE: When lubricating components during the following installation sequence, use any general purpose lithium soap grease.

1. Install the dash panel seal, mounting plate and the instrument panel seal on the column.

2. Column Shift Models - Press a new shift lever spring into the shift lever housing.

3. Slide the shift lever housing over the upper end of the column.

4. Place the wave washer and lock plate in position. Work the lock plate into the notches by tipping the plate toward the housing (compressing the wave washer) at the open side of the column. Lubricate the lock plate and upper end of the shift tube.

5. Carefully install the shift tube into the lower end of the column (make sure the foam seal is at lower end of the shift tube). Align the keyway in the tube with the key in the shift lever housing and complete installation of the shift tube

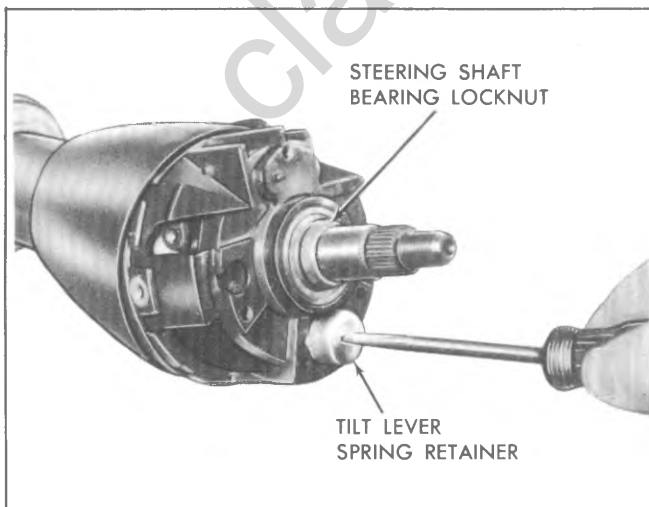


Fig. 3B-93--Removing Tilt Spring and Retainer

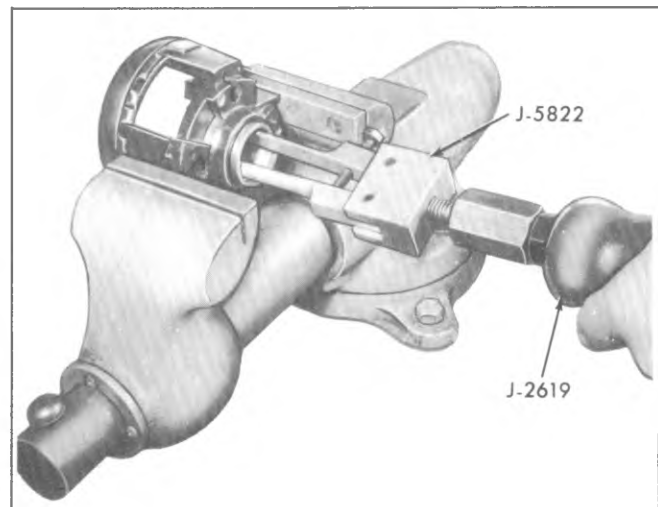


Fig. 3B-95--Removing Bearing Race

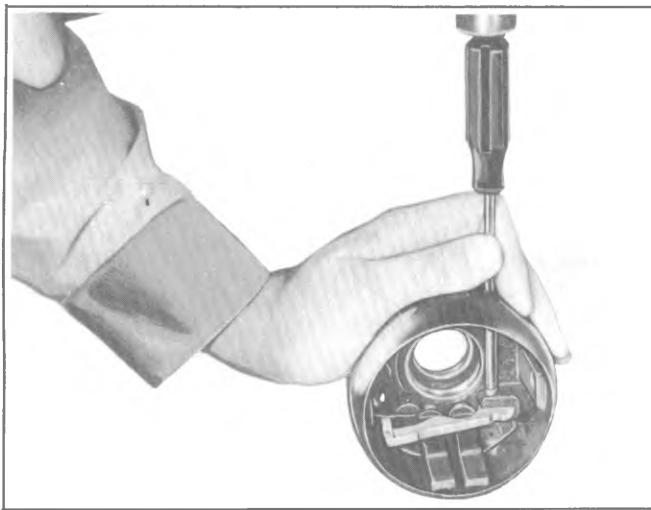


Fig. 3B-96--Removing Release Lever Pivot Pin

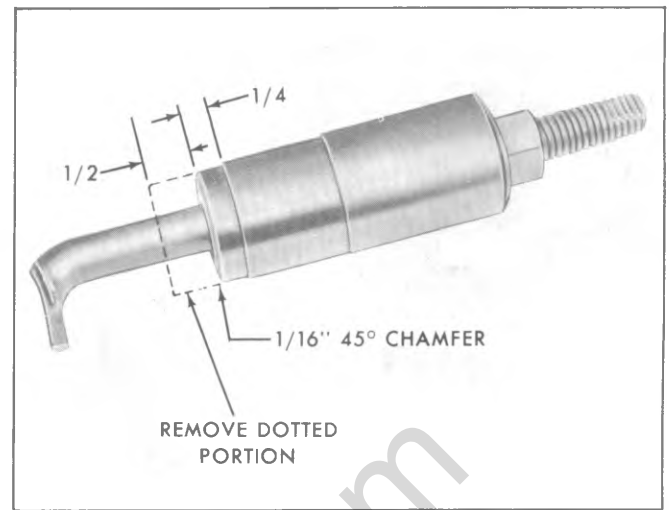


Fig. 3B-98--Revised Shift Tube Removing Tool J-22551

using Tool J-22549 (fig. 3B-101). The shift lever housing key must bottom in the shift tube slot to be fully installed. Remove Tool J-22549 from the column. Lubricate and push foam seal in flush with column housing.

CAUTION: Do Not hammer or force the tube when installing in the column.

6. Pull up on the shift lever housing (to compress the wave washer) and install the thrust washer and retaining ring. Be sure the ring is seated in both slots of the shift tube.

7. Lubricate the I.D. of the bearing housing support and install the support, aligning the bolt holes in the support with the bolt holes in the lock plate. Install the four support screws and torque to 45 in. lbs.

8. Assemble the steering shaft as follows:

a. Lubricate and assemble the centering spheres and preload spring.

b. Install the spheres into the upper (short) shaft and rotate 90°.

c. Install the lower shaft 90° to the upper shaft and over the centering spheres. Slowly straighten the shafts while compressing the preload spring.

9. Install the shaft assembly into the housing from the

upper end.

10. Install the lower bearing and adapter, bearing reinforcement, wire clip, pot joint coupling and lower shaft as described under "Lower Bearing Installation".

11. Assemble the bearing housing as follows:

a. Press the new upper and lower bearing races into the bearing housing.

b. Lubricate and install the bearings into the bearing races.

c. Place the lock shoe springs in position in the housing. Install each shoe in place and compress the spring until a suitable size straight punch can be used to hold the shoes in position (it may be necessary to acquire assistance to install the shoes). Once the shoes are in place, drive in the shoe retaining pin.

d. Install the shoe release lever and drive in the pivot pin.

e. Install the tilt release lever.

f. Lubricate the shoes and release lever.

12. Install the bearing housing assembly to the support. Hold the tilt release lever in the "up" position until the shoes

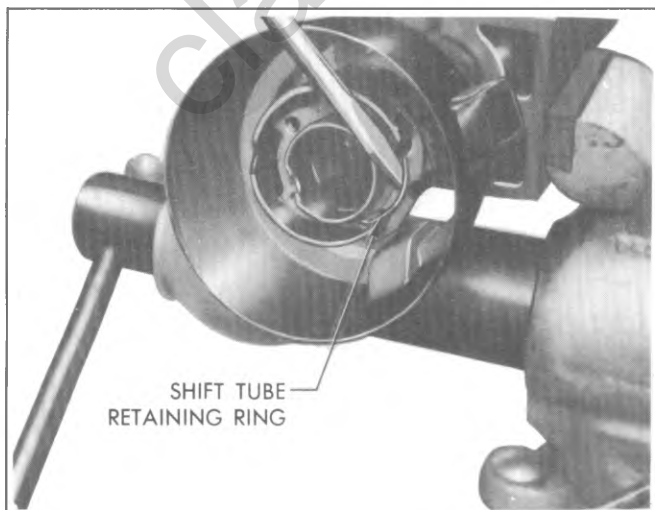


Fig. 3B-97--Removing Shift Tube Retaining Ring

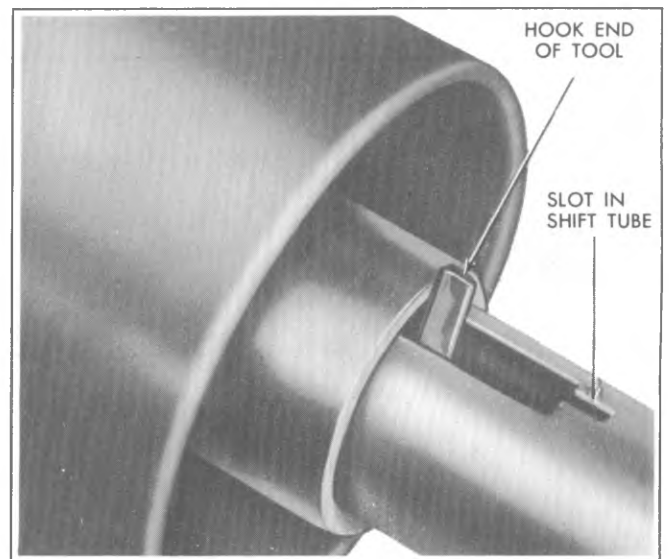


Fig. 3B-99--Removing Shift Tube Assembly

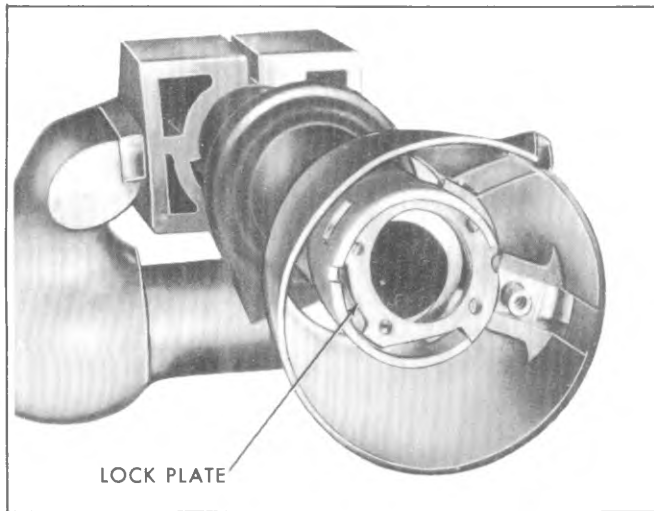


Fig. 3B-100--Removing Lock Plate Assembly

have fully engaged the support. Lubricate and install the bearing housing pivot pins. Press the pins in flush with the housing.

13. Place the housing in the full "up" position and then install tilt spring and retainer (tapered end of spring first). Push into the housing approximately 3/16" and rotate counter clockwise 1/8 turn.

14. Lubricate and install the upper bearing upper race, race seat and locknut. Tighten the locknut (using Socket J-22599) to remove the lash and then further tighten 1/16 to 1/8 of a turn (column must be in straight ahead position).

15. Remove the tilt release lever.

16. Install the directional signal switch as outlined under "Directional Signal Switch-Installation".

17. Column Shift Models - Install the shift lever and pivot pin.

18. Install the neutral-safety or back-up lamp switch.

19. Remove the column from the bench vise.

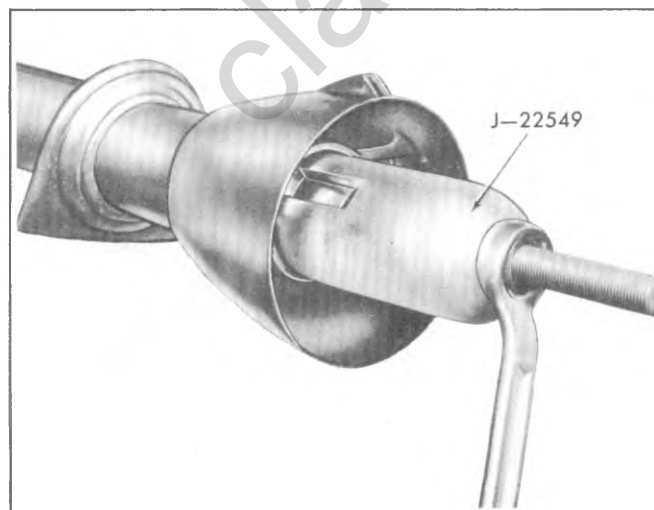


Fig. 3B-101--Installing Shift Pin Tube

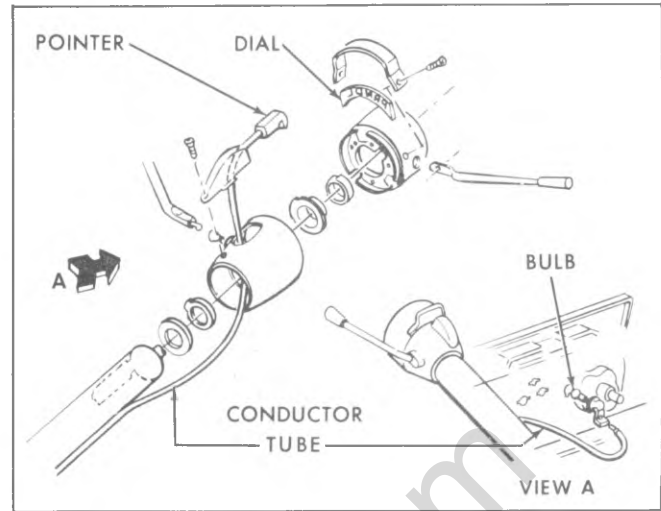


Fig. 3B-102--Conductor Tube for Automatic Transmission Indicator

COLUMN INSTALLATION

Mandatory Sequence P Series (Fig. 3B-89)

CAUTION: See CAUTION note on page 1 of this section regarding the fasteners referred to in steps 1, 2, 3 and 10.

1. Applying 50 lbs. force on the steering wheel end of the steering shaft, adjust the lower bearing preload to allow steering shaft end play as indicated in Figure 3B-38. Tighten the shaft clamp on pot joint bolt to specifications.

2. From the passenger side of the dash panel, carefully insert the lower end of the steering column through the toe panel opening.

Guide the steering shaft into the universal yoke, lining up the marks made at removal. Install the yoke pinch bolt and torque to specifications. The pinch bolt must pass through the shaft undercut.

3. Position and attach the lower clamp mounting bracket to the firewall. Locate the steering column protrusions against the toe pan bracket while at the same time, aligning protrusion in brake and clutch pedal support with index slot in the steering column, as shown in Figure

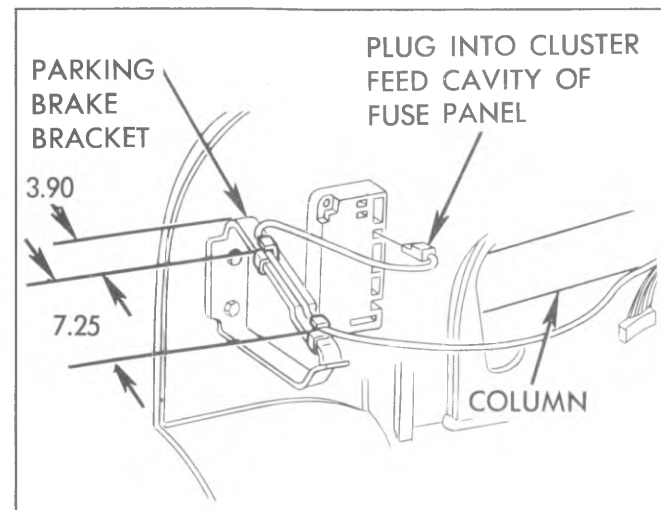


Fig. 3B-103--Tilt Column Shift Indicator Light

3B-89. Install the column to bracket clamp and torque the clamp bolt to specifications.

NOTE: The toe pan bracket must not override the protrusions on the steering column.

4. Position the steering column to dash panel bracket, install the attaching bolts and torque to specifications.

5. If plastic spacers were used on the flexible coupling alignment pins, remove the spacers after all bolts have been properly torqued.

6. Install the seal at the toe pan and then install the toe pan bracket screws; torque to specifications.

7. Install the dash panel trim plate (if so equipped).

8. Connect the transmission shift linkage on column shift models.

9. All Columns - Connect the directional signal wiring harness.

Standard Column with Automatic Transmission - Connect the conductor tube (for transmission indicator) at the instrument panel (fig. 3B-102).

10. Install steering wheel as outlined under "Steering Wheel-Installation".

11. Connect battery ground cable.

Mandatory Installation Sequence G Series

CAUTION: See CAUTION on page 1 of this section regarding the fasteners referred to in steps 3 and 10.

1. Adjust the column lower bearing preload by applying a force on the steering wheel end of the steering shaft (A). Position the spring and clamp to maintain the dimension as shown in Figure 3B-38.

2. Install the plastic spacers onto the flexible coupling alignment pins.

3. From inside the vehicle, carefully insert the lower end of the column through the toe pan opening guiding the steering shaft flange onto the flexible coupling. Install and torque the flange to coupling bolts.

4. Locate the index slot in the column jacket with the protrusion on the clutch and brake pedal support.

5. Loosely install the column dash bracket and screws.

6. Push the column down until the steering shaft flange bottoms on the plastic spacers on the flexible coupling and then torque the dash bracket screws.

7. Remove the plastic spacer from the alignment pins using a wire hook. Check the rag joint to steering shaft flange clearance (.25" to .325"), if not within specifications, the dash bracket screws must be loosened and the column raised or lowered as required. Retorque the bracket screws.

CAUTION: The alignment pin plastic spacers must be removed before the vehicle can be driven.

8. Push the toe pan seal to the toe pan, install and torque the mounting screws.

9. All Columns Connect the directional signal switch wiring harness.

Automatic Columns-Connect the conductor tube (for transmission indicator) to the instrument panel.

10. Install the steering wheel as outlined under "Steering Wheel Installation".

11. Connect the transmission linkage.

12. Connect the battery ground cable.

STEERING LINKAGE

CAUTION: See CAUTION on page 1 of this section regarding all fasteners referred to in servicing steering linkage components.

Tie Rods

Removal

1. Raise vehicle on hoist.

2. Remove cotter pins from ball studs and remove castellated nuts.

3. To remove outer ball stud, tap on steering arm at tie rod end with a hammer while using a heavy hammer or similar tool as a backing (fig. 3B-105).

4. Remove inner ball stud from relay rod using same procedure as described in Step 3.

5. To remove tie rod ends from tie rod, loosen clamp bolts and unscrew end assemblies.

Installation

CAUTION: See the CAUTION on page 1 of this section regarding the fasteners referred to in steps 4 and 6.

NOTE: Tie rod adjuster components often become rusted in service. In such cases, it is recommended that if the torque required to remove the nut from the bolt after breakaway exceed 7 pounds, discard the nuts and bolts. Apply penetrating oil between the clamp and tube and rotate the clamps until they move freely. Install new bolts and nuts having the same part number to assure proper clamping at the specified nut torque.

CAUTION: As a guide to correct orientation of the inner tie rod end relative to the outer tie rod end, rotate both ends to the extremes of travel in the same direction before clamping. The position of each tie rod end must be maintained as the clamps are tightened to ensure free movement of each joint. Return the rod assembly to midposition of its travel. This should result in the inner and outer ball studs being retained in a parallel relationship with the intermediate (relay) rod and steering knuckle (arm) respectively. The following procedure should be used when installing tie rods.

1. If the tie rod ends were removed, lubricate the tie rod threads with EP Chassis lube and install ends on tie rod making sure both ends are threaded an equal distance from the tie rod.

2. Make sure that threads on ball studs and in ball stud nuts are perfectly clean and smooth. Check condition of ball stud seals; replace if necessary.

NOTE: Tool J-24434 may be used to install ball stud seals.

If threads are not clean and smooth, ball studs may turn in tie rod ends when attempting to tighten nut.

3. Install ball studs in steering arms and relay rod.

4. Install ball stud nut, tighten to specifications and install new cotter pins; see Specifications Section at rear of manual. Lubricate tie rod ends.

NOTE: Never back off nut to align the cotter pin, always tighten nut to next slot that lines up with hole in stud.

5. Adjust toe-in as described in Section 3A.

CAUTION: Before tightening the tie rod adjusting

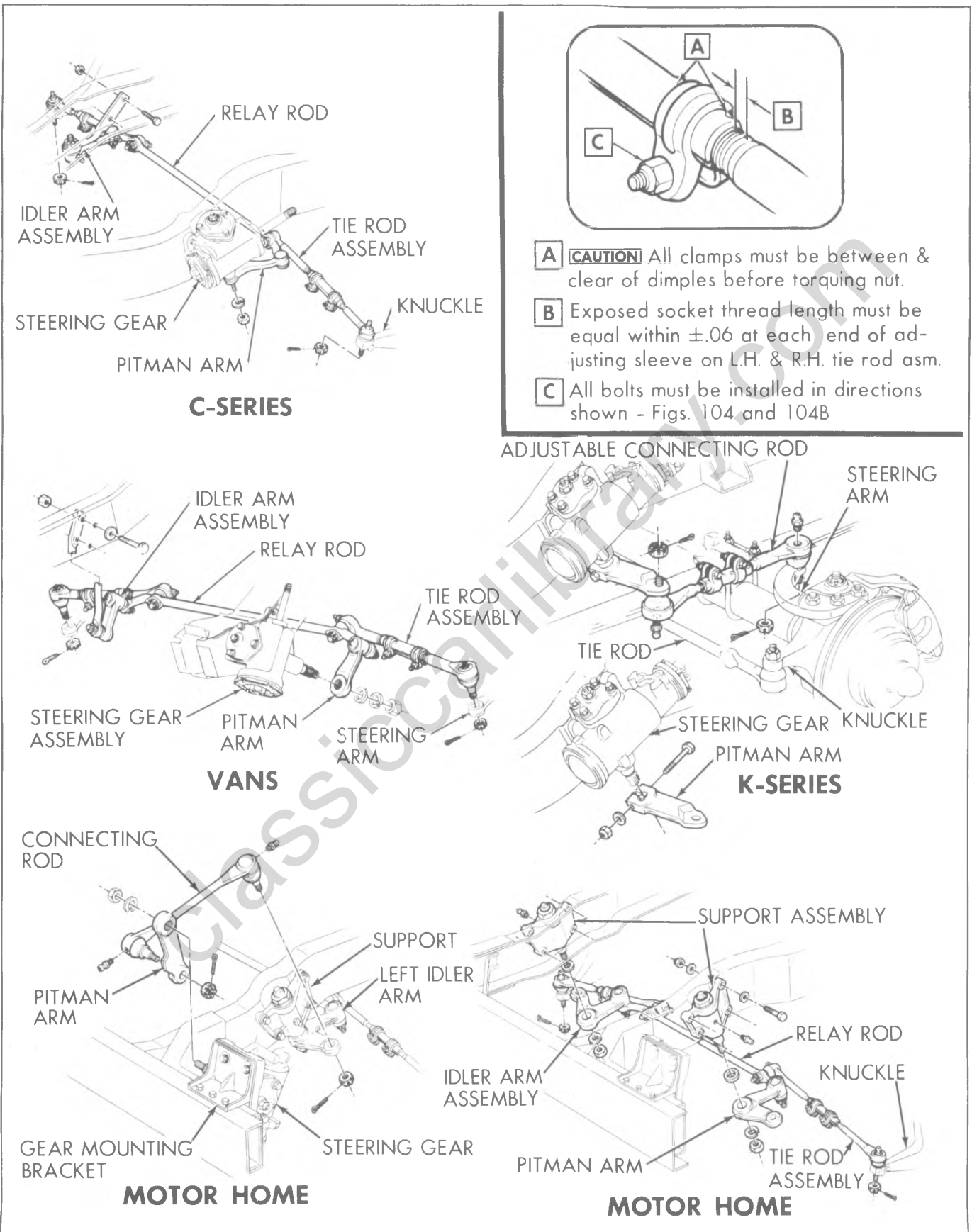


Fig. 3B-104--Steering Linkage

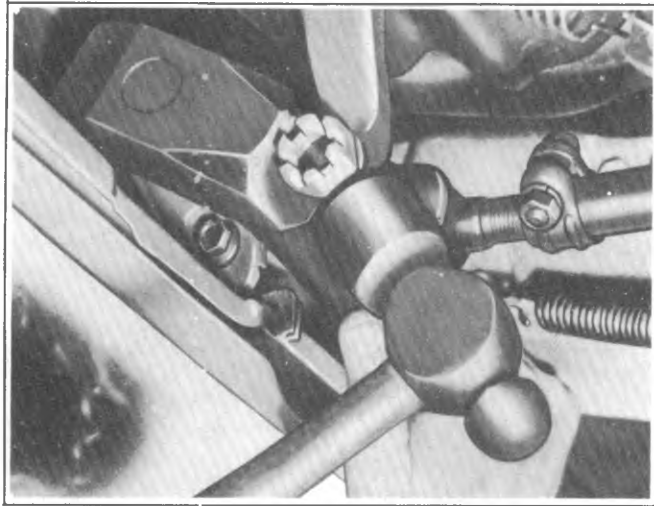


Fig. 3B-105--Ball Stud Removal-Typical

sleeve clamp bolts, be sure that the following conditions have been met:

- a. The sleeve clamps must be positioned between the locating dimples at either end of the sleeve.
- b. The clamps must be positioned within the angular travel indicated in Figure 3B-106.
- c. The relationship of the clamp slot with the slit in the sleeve should be maintained as shown in Figure 3B-106.
- d. Rotate both inner and outer tie rod housing rearward to the limit of ball joint travel before tightening clamps.

Tighten clamps to specifications. Return tie rod assembly to the center of travel.

e. All procedures for alignment, adjustment and assembly of tie rods applies to each side.

f. Check each assembly to be sure that a total travel of at least 35° can be obtained using a bubble protractor and a pair of vise grips (Fig. 3B-107).

Inspection

To ensure proper installation, it is necessary to perform the following inspection after any change of toe setting or removal of any ball stud:

1. Check the total rotation of the tie rod assembly using the following procedure:
 - a. Lubricate inner and outer tie rod ends.
 - b. Attach vise grip pliers to the outer tie rod end.
 - c. Rotate outer tie rod end counterclockwise (up) to maximum position. Attach bevel protractor as shown in Figure 3B-107. Center protractor bubble indicator and record reading.
 - d. Rotate tie rod end clockwise (down) to maximum position. Center protractor bubble indicator and record reading.
 - e. Compare protractor readings obtained in Specs c and d. Total rotation of tie rod assembly should measure at least 35°.
 - f. If rotation is less than 35°, loosen one tie rod sleeve clamp and rotate both tie rod ends to their maximum limit; **both ends must be rotated in the same direction.**
 - g. Tighten tie rod clamp and again rotate both ends to

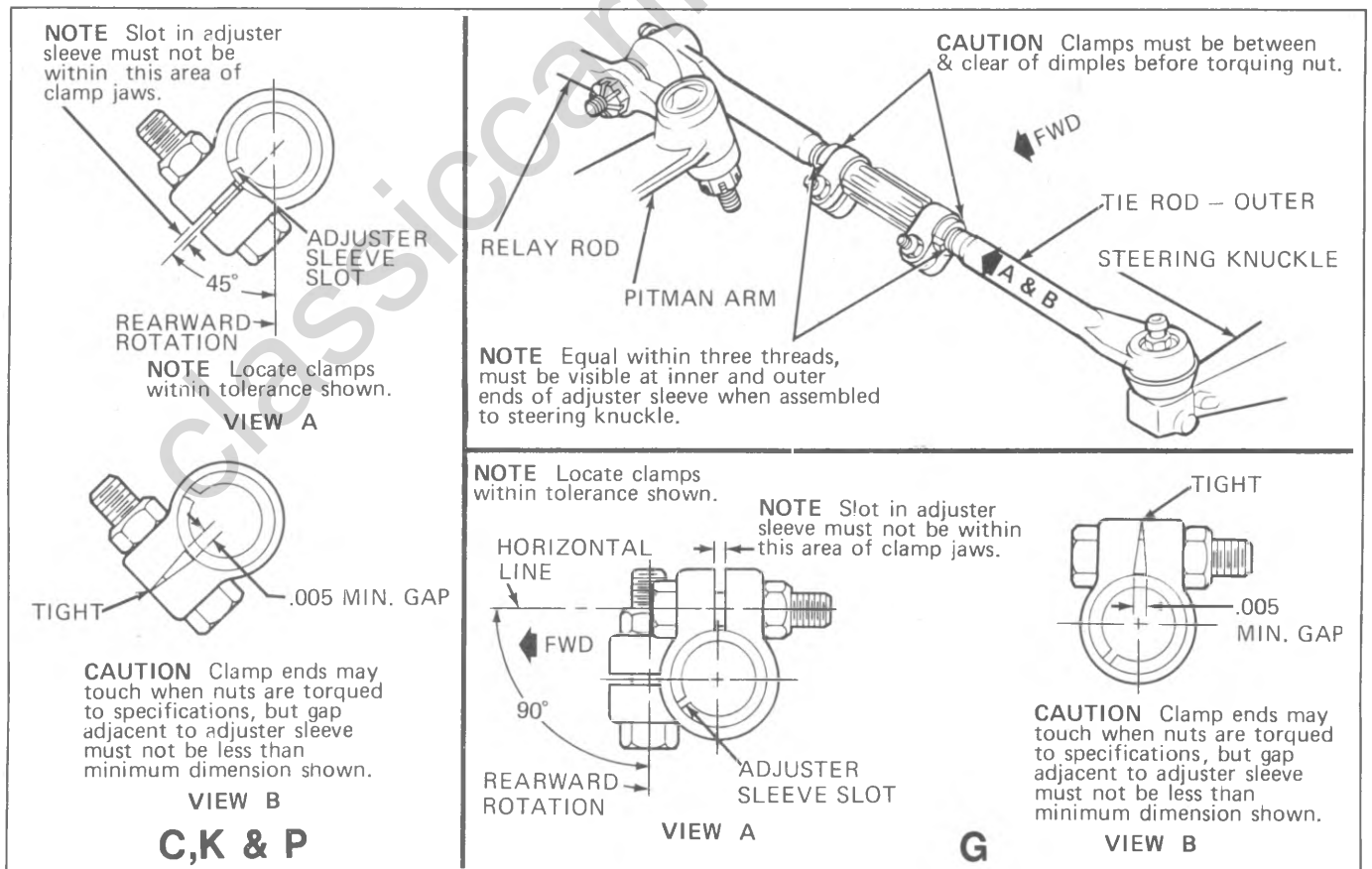


Fig. 3B-106--Tie Rod Clamp Relationship

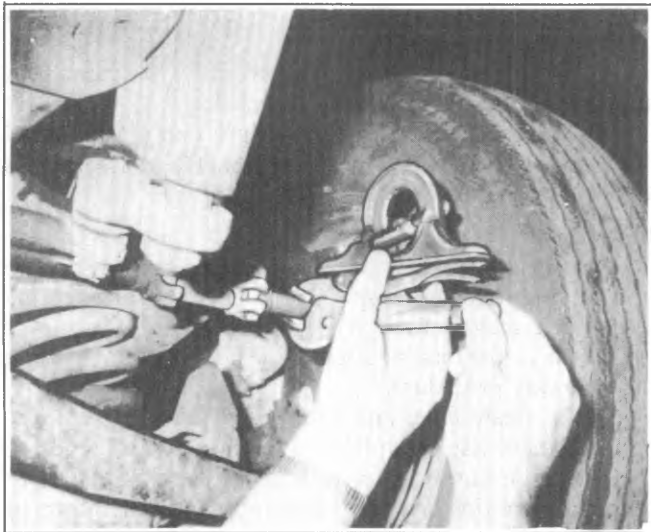


Fig. 3B-107--Tie Rod Inspection

their maximum limits, repeating Steps c and d. This recheck of total rotation will result in a minimum of 35° travel.

h. After obtaining the correct amount of rotation (35° or greater), position the outer tie rod end approximately midway in this travel.

If rotating checks, outlined above, reveal a rough or lumpy feel, the inner or outer tie rod end assembly may have excessive wear and should be replaced.

If all of the above mentioned conditions are met, proper tie rod installation is assured.

Relay Rod

Removal

1. Raise vehicle on hoist.
2. Remove inner ends of the tie rods from relay rod as described under "Tie Rod-Removal".
3. Remove the cotter pins from the pitman and idler arm ball studs at the relay rod. Remove the castellated nuts.
4. Remove the relay rod from the pitman and idler arms by tapping on the relay rod ball stud bosses with a hammer, while using a heavy hammer as a backing (fig. 3B-105).
5. Remove the relay rod from the vehicle.

Installation

CAUTION: See the CAUTION on page 1 of this section regarding the fasteners referred to in steps 2 and 3.

1. Make sure that threads on the ball studs and in the ball stud nuts are perfectly clean and smooth. Check condition of ball stud seals; replace if necessary.

NOTE: If threads are not clean and smooth, ball studs may turn in sockets when attempting to tighten nut.

2. Install the relay rod to the idler arm and pitman arm ball studs, making certain the seals are in place. Install and torque the nut to specifications and then install the cotter pin.

NOTE: Never back off the nut to align cotter pin, always tighten nut to next slot that lines up with hole in stud.

3. Install the tie rods to the relay rod as previously described under "Tie Rod- Installation". Lubricate the tie

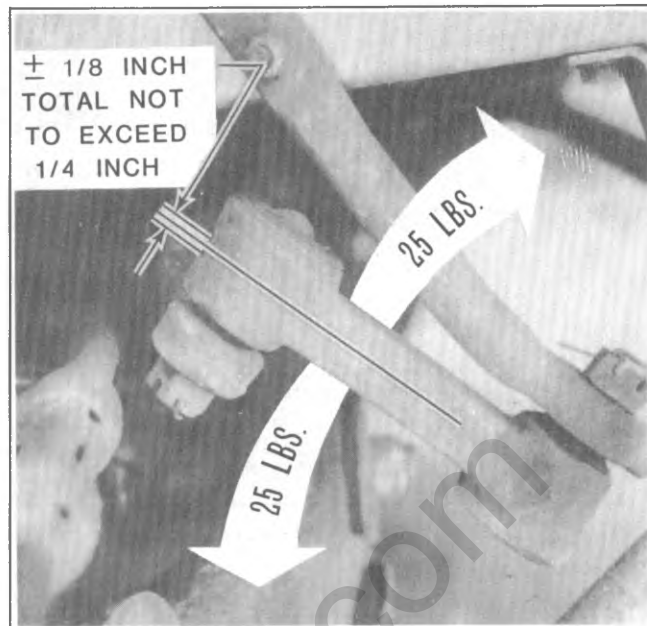


Fig. 3B-108--Checking Idler Movement

rod ends.

4. Lower the vehicle to the floor.

5. Adjust toe-in (see Section 3A) and align steering wheel as described previously in this section under "Steering Wheel Alignment and High Point Centering".

Idler Arm

Use of the proper diagnosis and checking procedure is essential to prevent needless replacement of good idler arms.

1. Raise the vehicle in such a manner as to allow the front wheels to rotate freely and the steering mechanism freedom to turn. Position the wheels in a straight ahead position.

2. Using a push pull type spring scale located as near the relay rod end of the idler arm as possible, exert a 25 lb. force upward and then downward while noticing the total distance the end of the arm moves. This distance should not exceed $\pm 1/8$ inch for a total acceptable movement of $1/4$ inch (Figure 3B-108). It is necessary to ensure that the correct load is applied to the arm since it will move more when higher loads are applied. It is also necessary that a scale or ruler be rested against the frame and used to determine the amount of movement since observers tend to over-estimate the actual movement when a scale is not used. The idler arm should always be replaced if it fails this test.

NOTE: Jerking the right front wheel and tire assembly back and forth thus causing an up and down movement in the idler arm is not an acceptable method of checking since there is no control on the amount of force being applied.

Caution should be used in assuming shimmy complaints are caused by loose idler arms. Before suspecting suspension or steering components, technicians should eliminate shimmy excitation factors, such as dynamic imbalance, run-out or force variation of wheel and tire assemblies and road surface irregularities.

Removal

1. Raise vehicle on a hoist.
2. Remove the cotter pin and castellated nut from ball stud at the relay rod. Remove the ball stud from the relay rod by tapping on the relay rod boss with a hammer, while using a heavy hammer as a backing (fig. 3B-105).
3. Remove the idler arm to frame bolt and remove the idler arm assembly.

Installation

CAUTION: See the *CAUTION* on page 1 of this section regarding the fasteners referred to in steps 1 and 3.

1. Position the idler arm on the frame and install the mounting bolts (special plain washers under bolt heads); torque the nuts to specifications.
2. Make sure that the threads on the ball stud and in the ball stud nut are perfectly clean and smooth. Check condition of ball stud seal; replace if necessary.

NOTE: If threads are not clean and smooth, ball stud may turn in the socket when attempting to tighten nut.

3. Install the idler arm ball stud in the relay rod, making certain the seal is positioned properly; install the nut and torque to specifications.

NOTE: Never back off nut to align cotter pin, always tighten nut to the next slot that lines up with the hole in the stud.

4. Install cotter pin.
5. Lower the vehicle to the floor.

Pitman Arm**Removal**

1. Raise vehicle on hoist.
2. Remove cotter pin from pitman arm ball stud and remove nut.
3. Remove pitman arm or relay rod from ball stud by tapping on side of rod or arm (in which the stud mounts) with a hammer while using a heavy hammer or similar tool as a backing (fig. 3B-105). Pull on linkage to remove from stud.
4. Remove pitman arm nut from pitman shaft or clamp bolt from pitman arm, and mark relation of arm position to shaft.
5. Remove pitman arm, using Tool J-6632 or J-5504 (Fig. 3B-50).

Installation

CAUTION: See the *CAUTION* on page 1 of this section regarding the fasteners referred to in steps 3 and 4.

1. Install pitman arm on pitman shaft, lining up the marks made upon removal.

CAUTION: If a clamp type pitman arm is used, spread the pitman arm just enough, with a wedge, to slip arm onto pitman shaft. Do not spread pitman arm more than required to slip over pitman shaft with hand pressure. Do not hammer or damage to steering gear may result. Be sure to install the hardened steel washer before installing the nut.

2. Make sure that threads on ball studs and in ball stud nuts are clean and smooth. Check condition of ball stud seals; replace if necessary.

NOTE: If threads are not clean and smooth, ball studs

may turn in sockets when attempting to tighten nut.

3. Install pitman shaft nut or pitman arm clamp bolt and torque to specifications.

4. Position ball stud onto pitman arm or relay rod. Install nut and torque to specifications.

5. Install cotter pin.

NOTE: Never back off nut to align cotter pin, always tighten nut to next slot that lines up with hole in stud.

6. Lubricate ball studs.
7. Lower the vehicle to the floor.

Steering Connecting Rod**Removal**

1. Remove cotter pins from ball studs and remove castellated nuts.
2. Remove ball studs from steering arm and pitman arm boss with a heavy hammer and striking other side of boss with lighter hammer (similar to method shown in (fig. 3B-105)).

Installation

CAUTION: See the *CAUTION* on page 1 of this section regarding the fasteners referred to in step 3.

1. Make sure that threads on ball studs and in ball stud nuts are clean and smooth. Check condition of ball stud seals-replace if necessary.

NOTE: If threads are not clean and smooth, ball studs may turn in connecting rod when attempting to tighten nut.

2. Install ball studs in steering arm and pitman arm. Be sure to install the long end of the connecting rod assembly to the pitman arm.

3. Install ball stud nuts and torque to specifications.

NOTE: Never back off nut to align cotter pin, always tighten nut to next slot that lines up with hole in stud.

4. Install cotter pins and lubricate ball studs.

NOTE: For proper alignment and orientation of connecting rod clamps see figure 3B-109.

POWER STEERING SYSTEM**Power Steering Gear****Removal**

1. Disconnect hoses at gear. When hoses are disconnected, secure ends in raised position or prevent drainage of oil. Cap or tape the ends of the hoses to prevent entrance of dirt.

2. Install two plugs in gear fittings to prevent entrance of dirt.

3. Remove the flexible coupling to steering shaft flange bolts (G, C and K models) or the lower universal joint pinch bolt (P models). Mark the relationship of the universal yoke to the stub shaft.

4. Mark the relationship of the pitman arm to the pitman shaft. Remove the pitman shaft nut or pitman arm pinch bolt and then remove the pitman arm from the pitman shaft using Puller J-6632 (fig. 3B-50).

5. Remove the steering gear to frame bolts and remove the gear assembly.

6. G, C and K Models - Remove the flexible coupling pinch bolt and remove the coupling from the steering gear stub shaft.

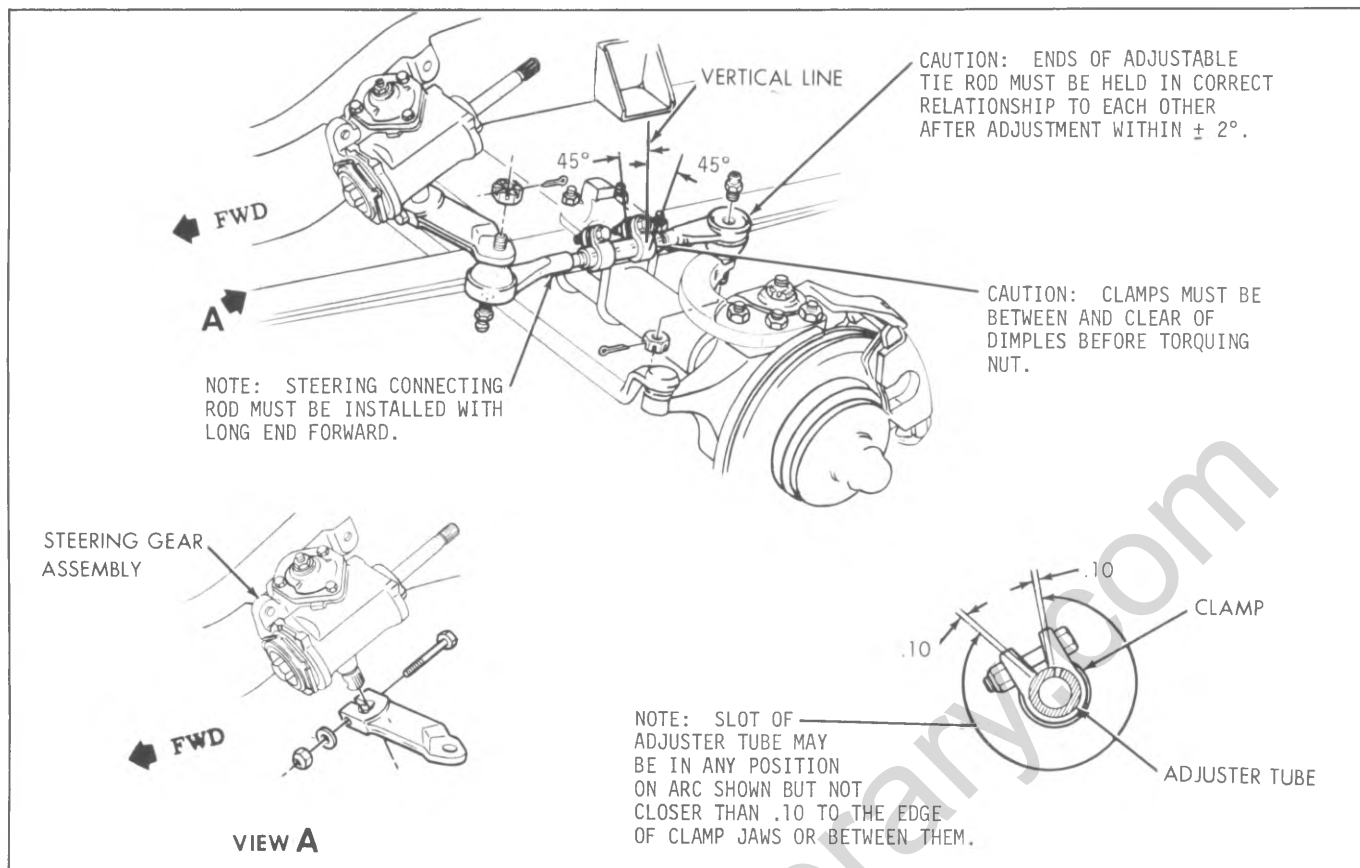


Fig. 3B-109--Adjustable Connecting Rod Assembly-K Series

Installation (Fig. 3B-110)

CAUTION: See *CAUTION* on page 1 of this section regarding the fasteners referred to in steps 1, 3, 4 and 5.

1. Install the flexible coupling onto the steering gear stub shaft, aligning the flat in the coupling with the flat on the shaft. Push the coupling onto the shaft until the stub shaft bottoms on the coupling reinforcement. Install the pinch bolt and torque to specifications.

NOTE: The coupling bolt must pass through the shaft undercut.

2. Place the steering gear in position, guiding the decoupling bolt into the steering shaft flange.

3. Install the steering gear to frame bolts and torque to specifications.

4. If flexible coupling alignment pin plastic spacers were used, make sure they are butted on the pins, tighten the flange bolt nuts to specifications and then remove the plastic spacers.

5. If flexible coupling alignment pin plastic spacers were not used, center the pins in the slots in the steering shaft flange and then install and torque the flange bolt nuts to specifications.

P Models

a. Place the steering gear in position, guiding the stub shaft into the universal joint assembly and lining up the marks made at removal.

NOTE: If a new gear was installed, line up the mark on the stub shaft with the mark on the universal yoke.

b. Install the steering gear to frame bolts and torque to specifications.

c. Install the universal joint pinch bolt and torque to specification.

NOTE: The pinch bolt must pass through the shaft undercut.

All Models

6. Install the pitman arm onto the pitman shaft, lining up the marks made at removal. Install the pitman shaft nut or pitman arm pinch bolt and torque to specifications.

7. Remove the plugs and caps from the steering gear

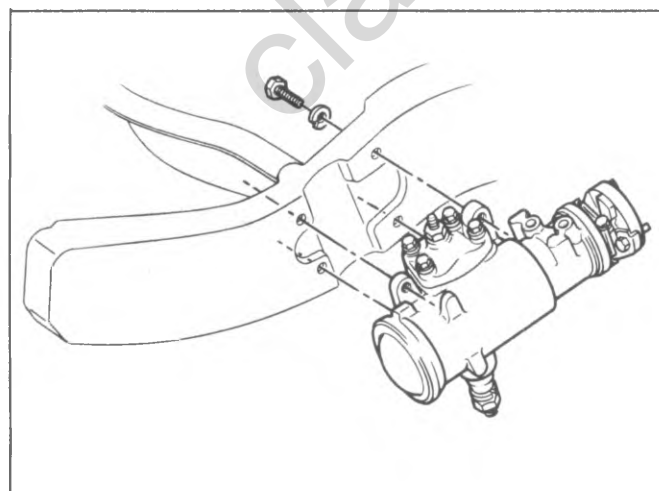


Fig. 3B-110--Power Steering Gear Mounting-Typical

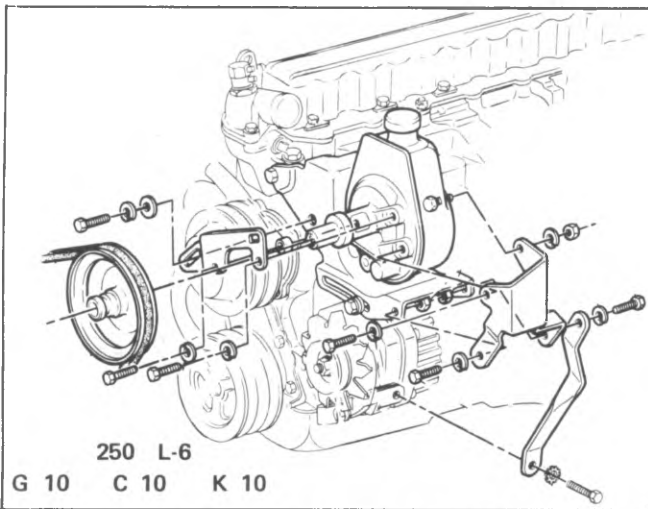


Fig. 3B-111--Power Steering Pump-250 L-6

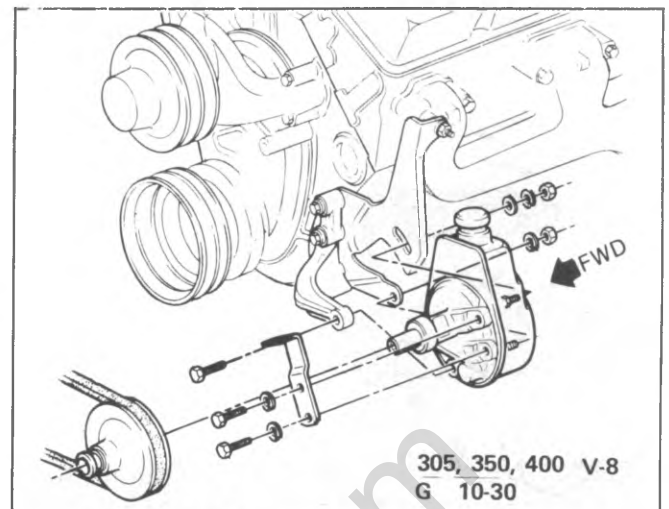


Fig. 3B-113--Power Steering Pump-G Series

and hoses and connect the hoses to the gear. Tighten the hose fittings to specified torque.

Power Steering Pump (3B-111 through 3B-117)

Removal

1. Disconnect hoses at pump. When hoses are disconnected, secure ends in raised position to prevent drainage of oil. Cap or tape the ends of the hoses to prevent entrance of dirt.

On Models with remote reservoir, disconnect reservoir hose at pump and secure in raised position. Cap hose pump fittings.

2. Install two caps at pump fittings to prevent drainage of oil from pump.

3. Loosen bracket-to-pump mounting nuts.

4. Remove pump belt.

5. Remove pump from attaching parts and remove pump from vehicle.

Installation

1. Position pump assembly on vehicle and install attaching parts loosely.

2. Connect and tighten hose fittings.

3. Fill reservoir. Bleed pump by turning pulley backward (counter-clockwise as viewed from front) until air bubbles cease to appear.

4. Install pump belt over pulley.

5. Tension belt as outlined under "Pump Belt Tension-Adjustment" in this section.

6. Bleed as outlined under "Bleeding Power Steering Systems."

Power Steering Hoses

When servicing the power steering hoses be sure to align the hoses in their correct position as shown in Figs. 3B-118-3B-113.

It is important that the power steering hoses be installed correctly. Hoses installed out of position may be subjected to chafing or other abuses during sharp turns. Do not twist hoses unnecessarily during installation.

CAUTION: Do not start engine with any power steering hose disconnected.

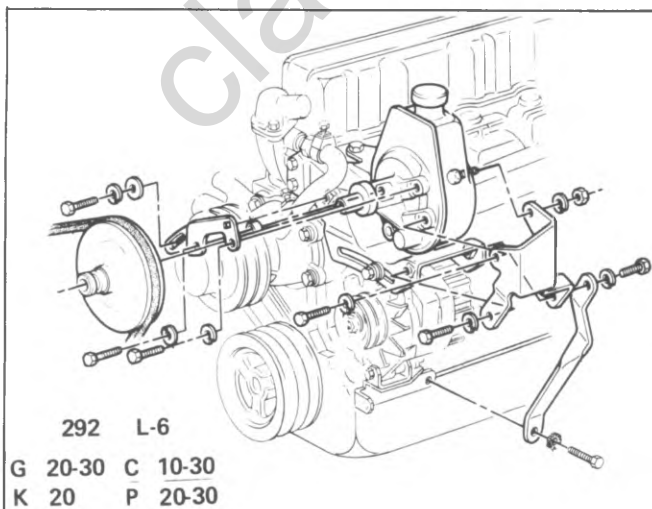


Fig. 3B-112--Power Steering Pump-292 L-6

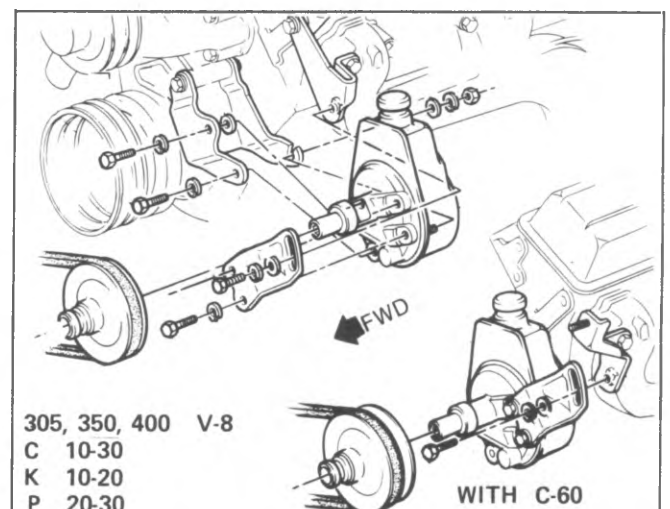


Fig. 3B-114--Power Steering Pump-C, K & P Series

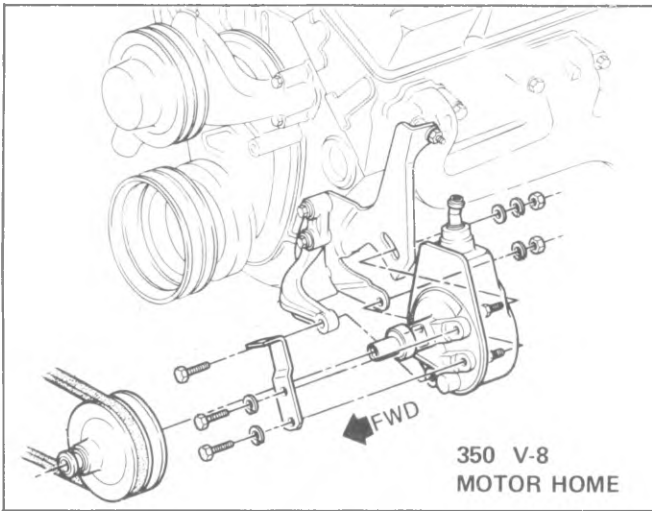


Fig. 3B-115--Power Steering Pump-350 V-8 Motor Home

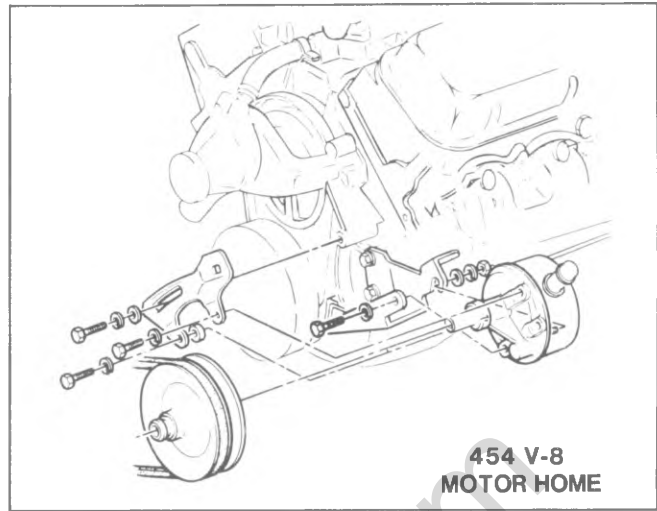


Fig. 3B-117--Power Steering Pump-454 V-8 Motor Home

Bleeding Power Steering Systems

When a power steering pump or power gear has been installed, the air that has entered the system must be bled out before the vehicle is again operated. If air is allowed to remain in the power steering fluid system, moisy and unsatisfactory operation of the system will result. Bleed air from the hydraulic system as follows:

NOTE: When power steering fluid is added to power steering system, only clean new power steering fluid should be used (GM #1050017), or equivalent.

1. Fill oil reservoir to proper level and let oil remain undisturbed for at least two minutes.
2. Start engine and run momentarily.
3. Add oil, if necessary.
4. Repeat above procedure until oil level remains constant after running engine.
5. Raise front end of vehicle so that wheels are off the ground.
6. Turn the wheels (off ground) right and left, lightly contacting the wheel stops.
7. Add oil if necessary.

8. Lower the vehicle and turn wheels right and left on the ground.

9. Check oil level and refill as required.

10. If oil is extremely foamy, allow vehicle to stand a few minutes with engine off and repeat above procedure.

a. Check belt tightness and check for a bent pulley. (Pulley should not wobble with engine running.)

b. Check to make sure hoses are not touching any other parts of the vehicle, particularly sheet metal.

c. Check oil level, filling to proper level if necessary, following operations 1 through 10. This step and Step "d" are extremely important as low oil level and/or air in the oil are the most frequent causes of objectionable pump noises.

d. Check the presence of air in the oil. Air will show up as milky appearing oil. If air is present, attempt to bleed system as described in operations 1 through 10.

11. The presence of trapped air in the system will cause the fluid level in the pump to rise when the engine is turned off. Continue to bleed system until this condition no longer occurs.

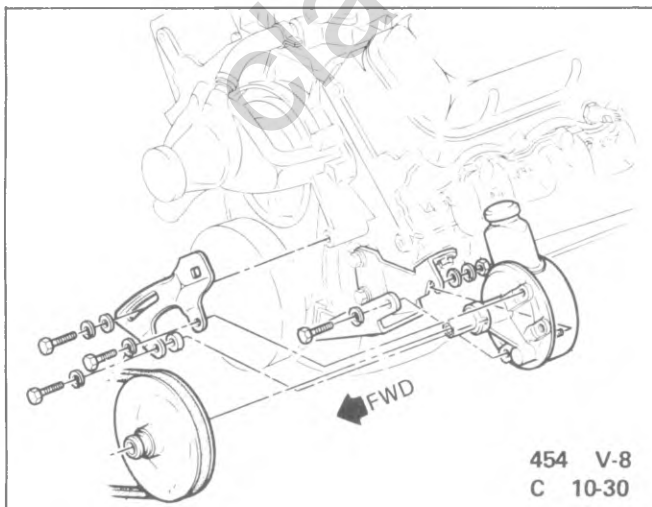


Fig. 3B-116--Power Steering Pump-454 V-8

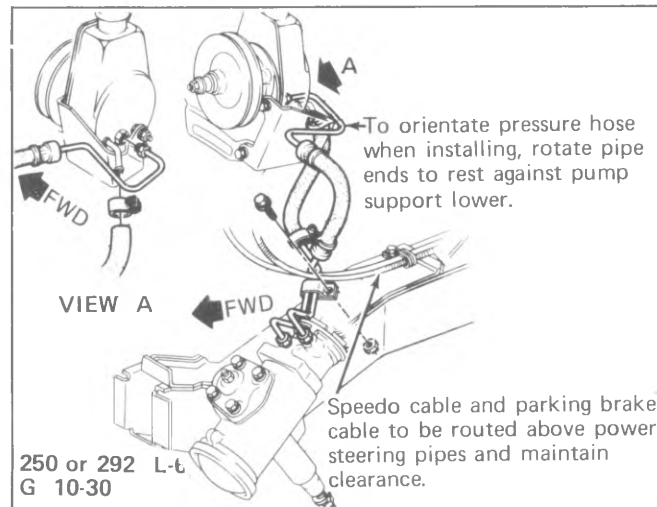


Fig. 3B-118--Power Steering Hose Routing

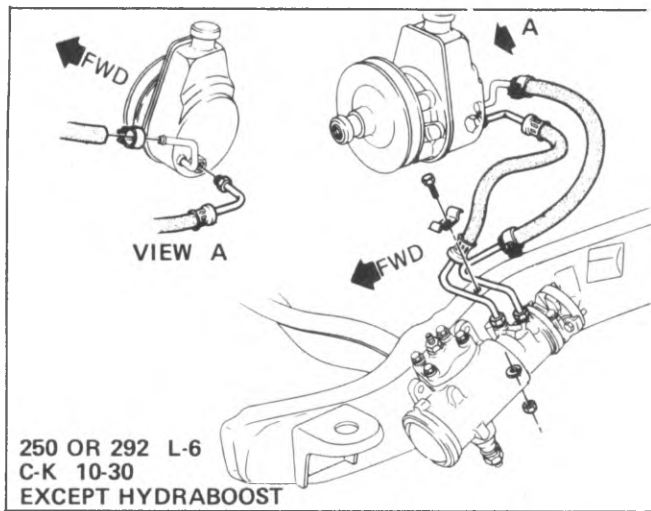


Fig. 3B-119--Power Steering Hose Routing

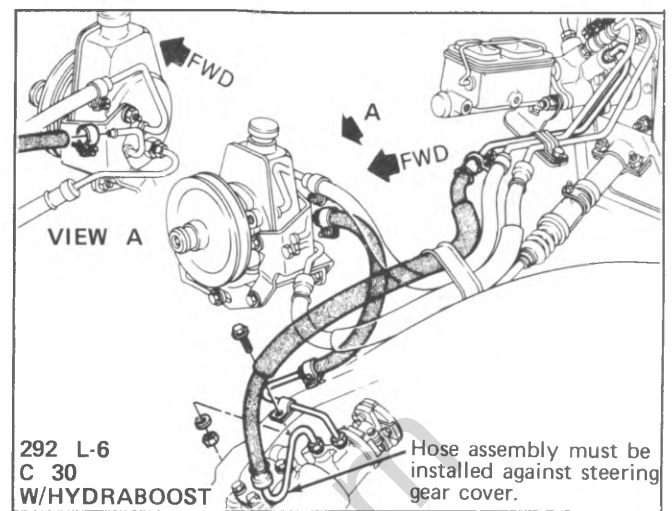


Fig. 3B-121--Power Steering Hose Routing

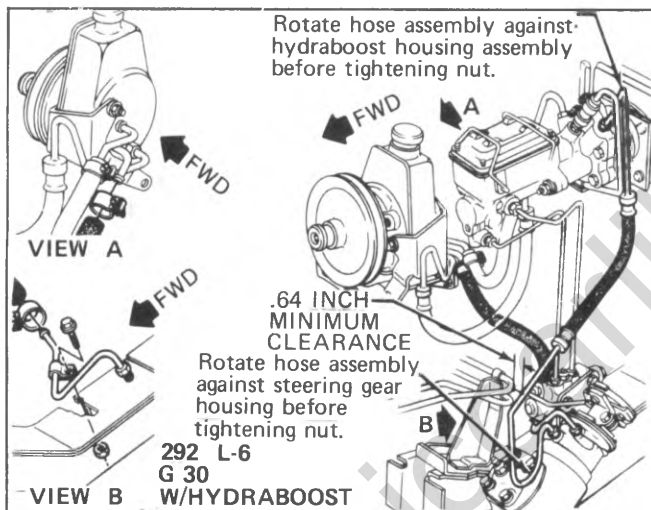


Fig. 3B-120--Power Steering Hose Routing

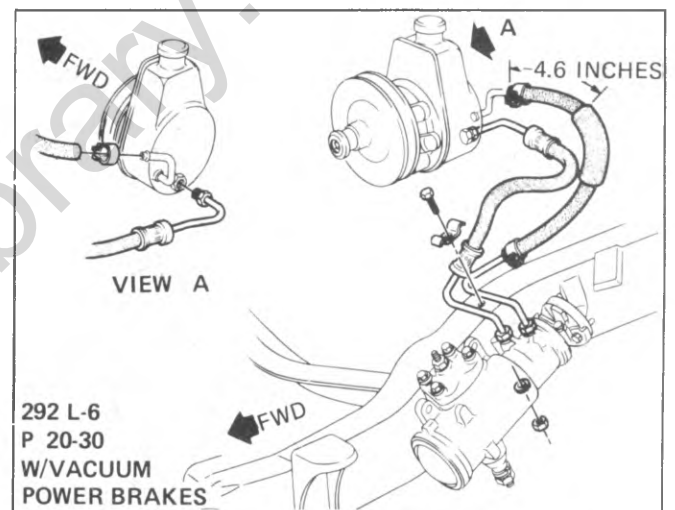


Fig. 3B-122--Power Steering Hose Routing

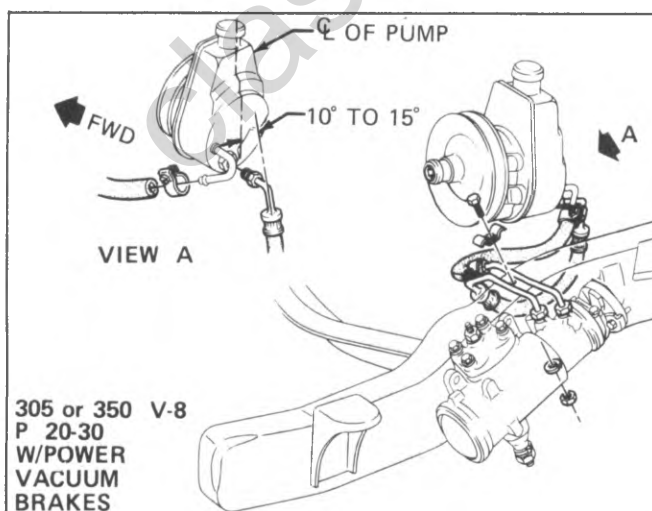


Fig. 3B-123--Power Steering Hose Routing

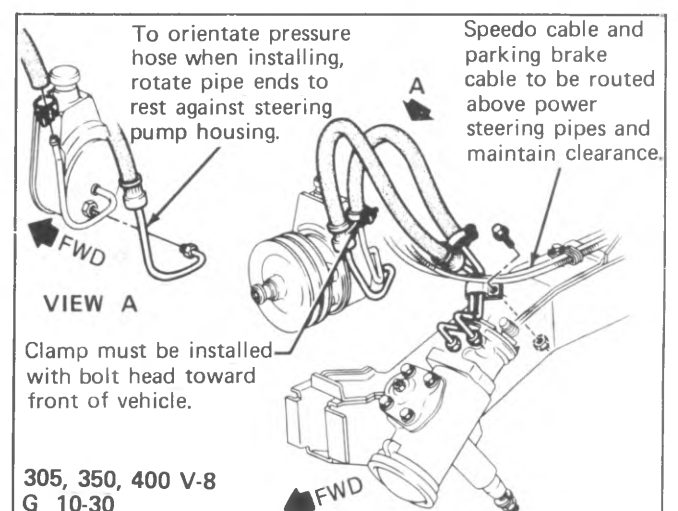


Fig. 3B-124--Power Steering Hose Routing

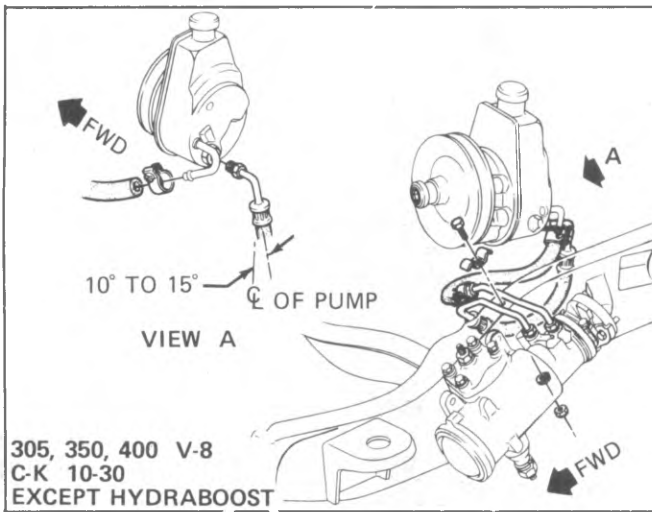


Fig. 3B-125--Power Steering Hose Routing

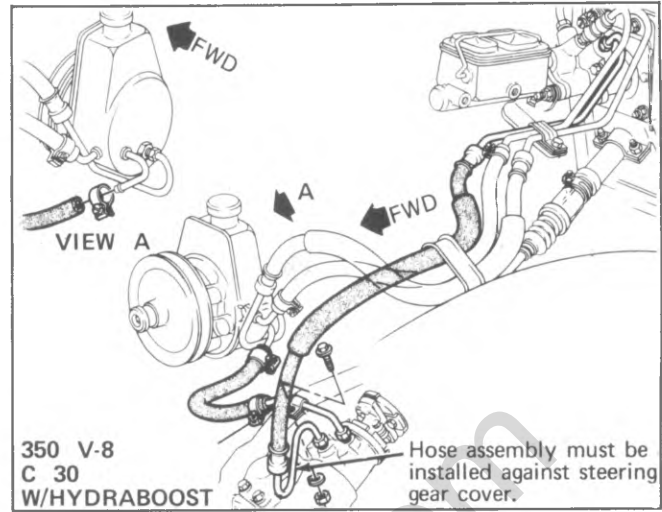


Fig. 3B-127--Power Steering Hose Routing

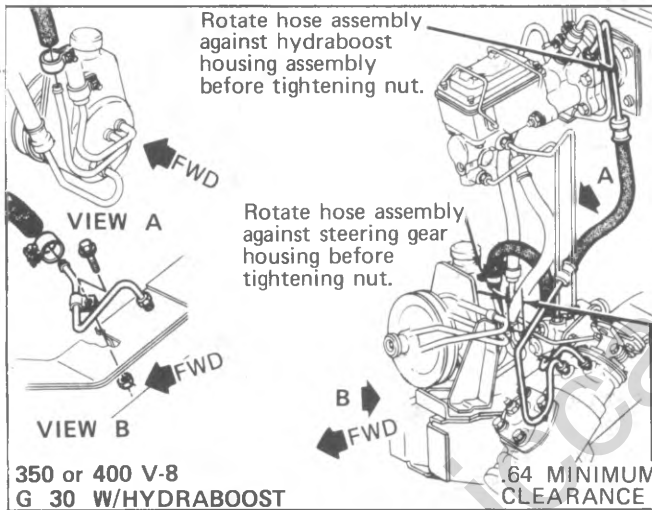


Fig. 3B-126--Power Steering HOse Routing

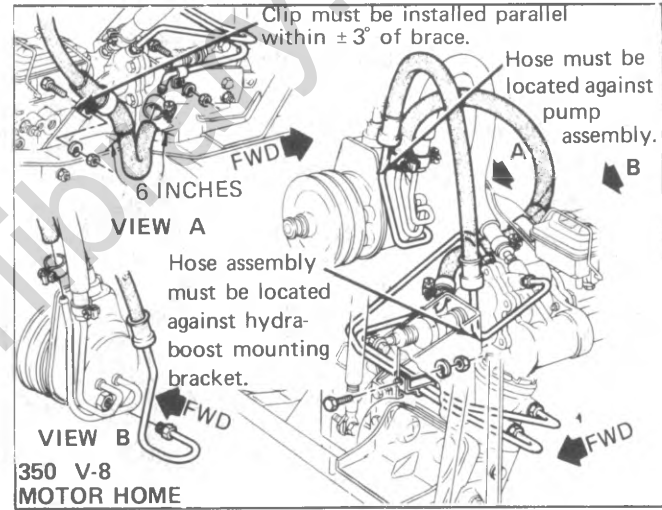


Fig. 3B-128--Power Steering HOse Routing

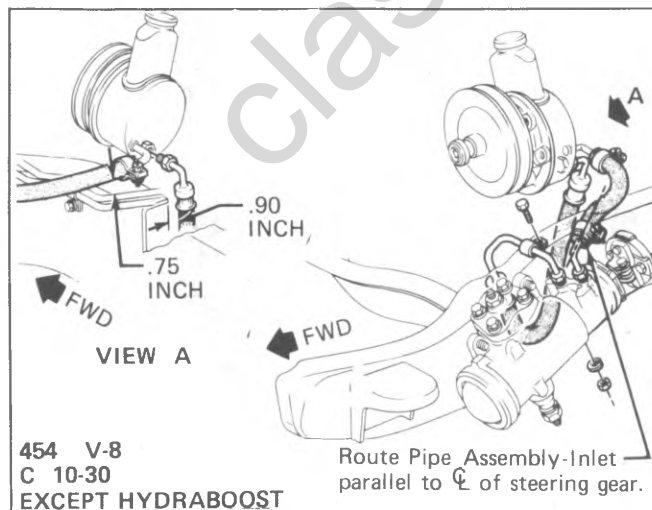


Fig. 3B-129--Power Steering Hose Routing

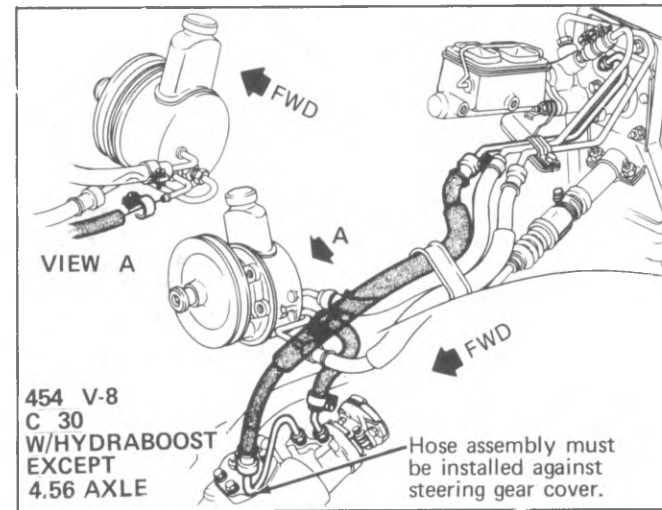


Fig. 3B-130--Power Steering Hose Routing

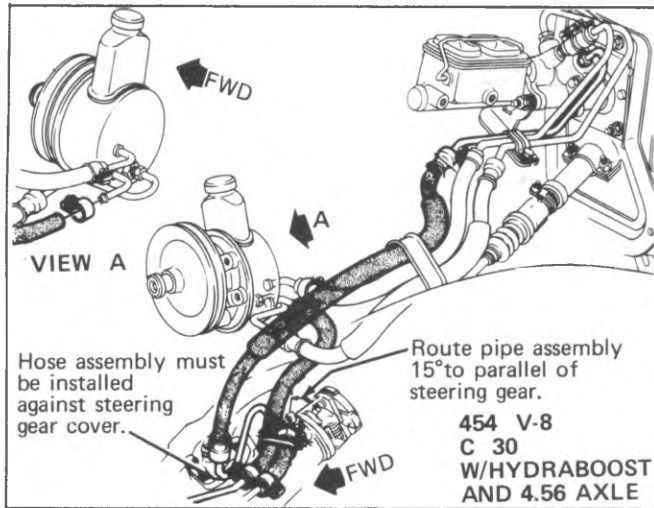


Fig. 3B-131--Power Steering Hose Routing

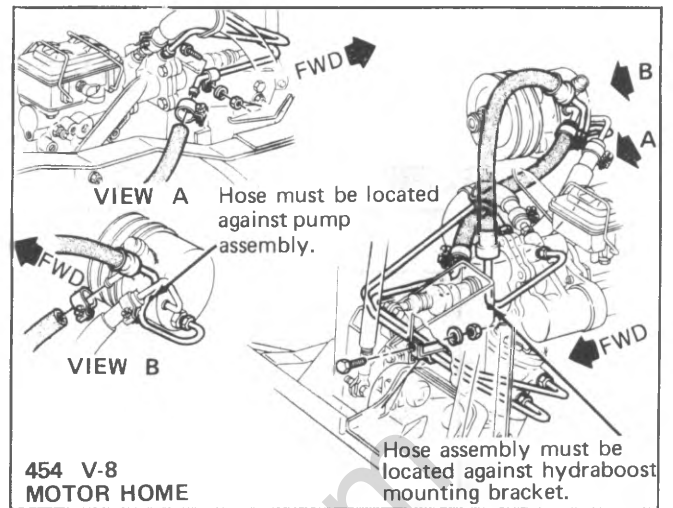


Fig. 3B-133--Power Steering Hose Routing

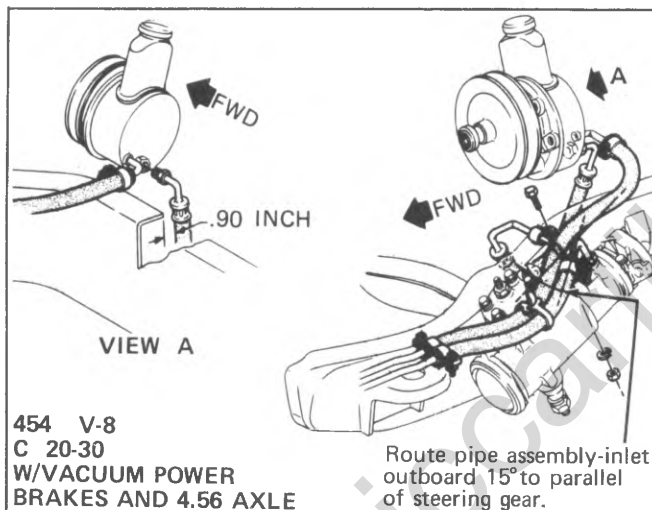


Fig. 3B-132--Power Steering Hose Routing

SPECIFICATIONS

STEERING GEAR RATIOS

Vehicle	Manual		Power	
	Gear Ratio	Overall Ratio	Gear Ratio	Overall Ratio
G10-20	24:1	29.4:1 to 36.7:1	14:1	21.4:1 to 26.7:1
G30	24:1	29.4:1 to 36.4:1	14:1	21.4:1 to 26.5:1
P10	24:1	29.1:1 to 35.5:1	17.5:1	21.2:1 to 25.7:1
P20-30	24:1	29.1:1 to 35.3:1	17.5:1	21.2:1 to 25.7:1
Motor Home	—	—	14:1	16.0:1 to 21.9:1
C 10	24:1	29.1:1 to 37.0:1	16:1 to 13:1	16.9:1 to 20.2:1
C20-30	24:1	29.4:1 to 36.3:1	16:1 to 13:1	17.2:1 to 20.6:1
K10-20	24:1	24.6:1 to 28.0:1	16:1 to 13:1	13.2:1 to 17.2:1

MANUAL STEERING GEAR

Components	G10 - 30	C10 - 30 P10	K10 - 20	P20 - 30
Thrust Bearing Preload	6 to 11 lbs. in.	4 to 6 lbs. in.		9 to 12 lbs. in.
Adjuster Plug Lock Nut	85 lbs. ft.			
Over Center Preload	5 to 11 lbs. in.*	4 to 10 lbs. in.*		9 to 13 lbs. in.*
Over Center Lock Nut	25 lbs. ft.			
Total Steering Gear Preload	18 lbs. in. Max.	14 lbs. in. Max.	25 lbs. in. Max.	

*In excess of thrust bearing preload.

POWER STEERING GEAR

Components	All C, P, K and G
Steering Gear Ball Drag	3 lbs. in. Max.
Thrust Bearing Preload	1/2 to 2 lbs. in.*
Adjuster Plug Locknut	80 lbs. ft.
Over-Center Preload	5 lbs. in.
Over-Center Adjusting Screw Locknut	35 lbs. ft.
Total Steering Gear Preload	14 lbs. in. Max.

*In excess of ball drag.

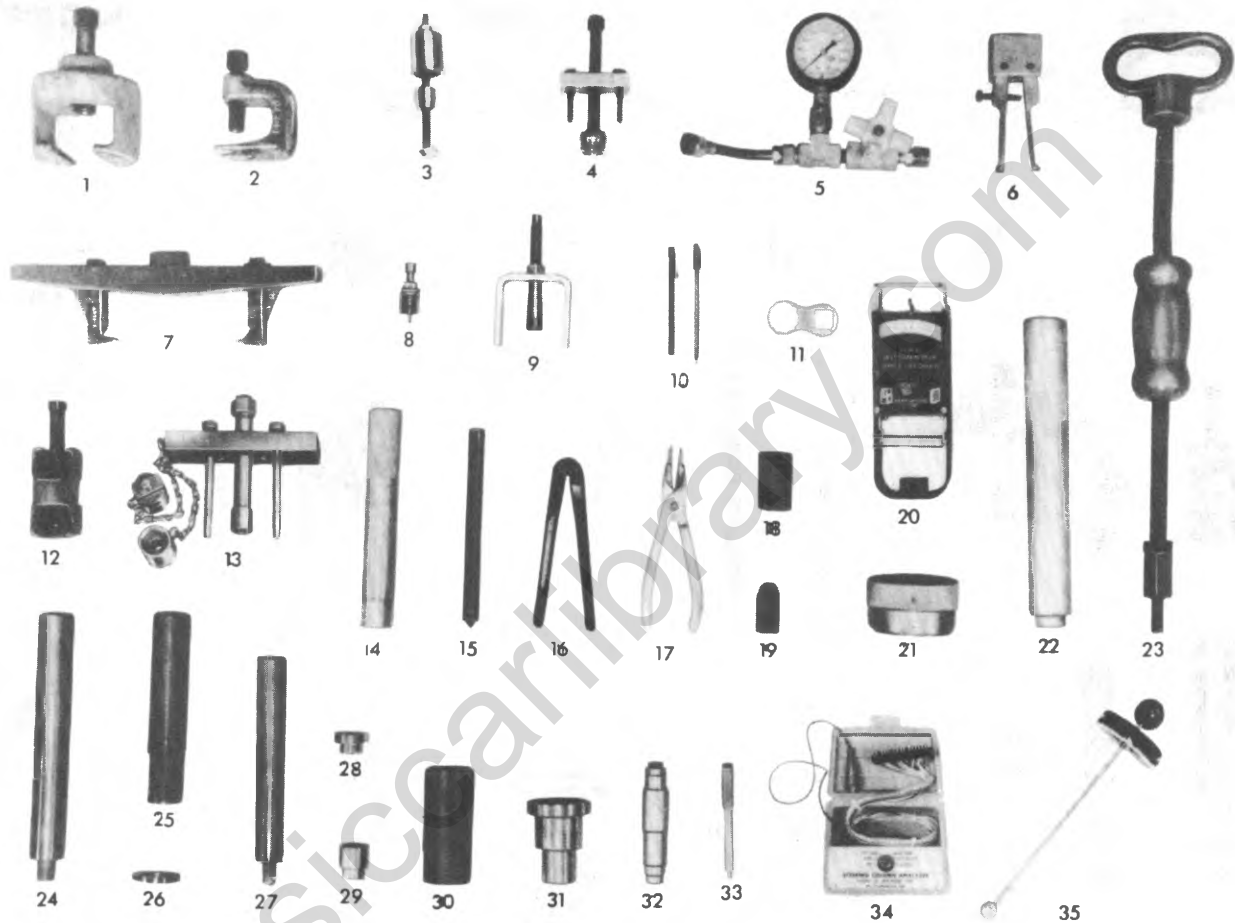
**In excess of ball drag and thrust bearing preload.

POWER STEERING PUMP PRESSURES

Vehicle	Pressure
C10-30	1200 - 1300 psi
G10-20	900 - 1000 psi
G30	1200 - 1300 psi
P10-30	1200 - 1300 psi
Motor Home & K	1350 - 1450 psi

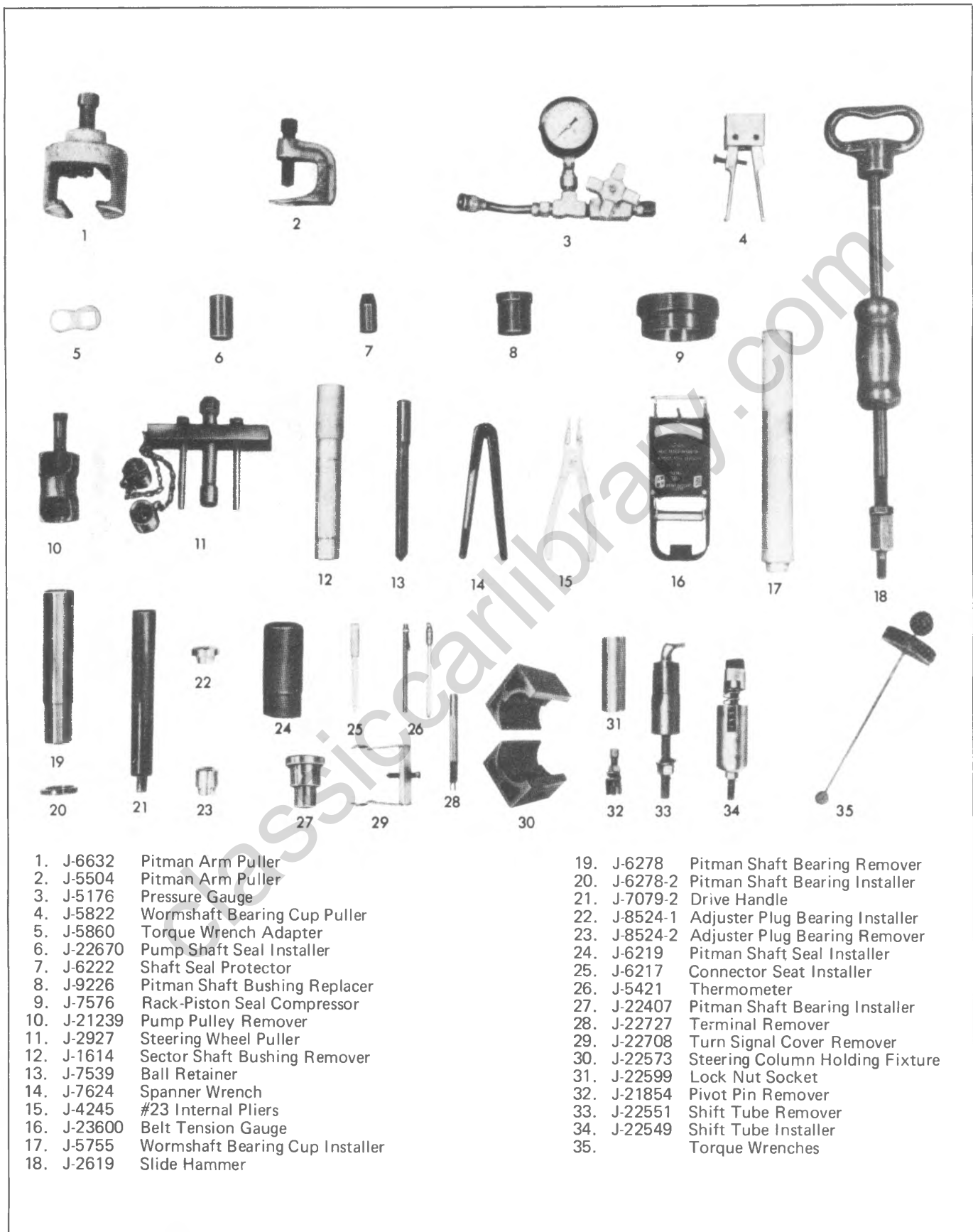
Fig. 3B-134--Specs

SPECIAL TOOLS



- | | | | | | |
|-----|---------|--------------------------------------|-----|----------|-------------------------------------|
| 1. | J-6632 | Pitman Arm Puller | 19. | J-6222 | Shaft Seal Protector |
| 2. | J-5504 | Pitman Arm Puller | 20. | J-23600 | Belt Tension Gauge |
| 3. | J-23073 | Shift Tube Installer | 21. | J-8947 | Rack-Piston Seal Compressor |
| 4. | J-23072 | Shift Tube Remover | 22. | J-5755 | Wormshaft Bearing Race Installer |
| 5. | J-5176 | Oil Pressure Gauge | 23. | J-2619 | Slide Hammer |
| 6. | J-5822 | Wormshaft Bearing Cup Remover | 24. | J-8092 | Handle |
| 7. | J-8433 | Pump Pulley Remover (Cast Pulley) | 25. | J-6278 | Pitman Shaft Bearing Remover |
| 8. | J-21854 | Column Pivot Pin Remover | 26. | J-6278-2 | Pitman Shaft Bearing Installer |
| 9. | J-23653 | Lock Plate Compressor | 27. | J-7079-2 | Handle |
| 10. | J-5421 | Thermometer | 28. | J-8524-1 | Adjuster Plug Bearing Installer |
| 11. | J-5860 | Torque Wrench Adapter | 29. | J-8524-2 | Adjuster Plug Bearing Remover |
| 12. | J-21239 | Pump Pulley Remover (Stamper Pulley) | 30. | J-6219 | Pitman Shaft Seal Installer |
| 13. | J-2927 | Steering Wheel Puller | 31. | J-22407 | Pitman Shaft Bearing Installer |
| 14. | J-1614 | Sector Shaft Bushing Remover | 32. | J-8937 | Ball Seal Remover |
| 15. | J-7539 | Ball Retainer | 33. | J-6217 | Connector Seat Installer |
| 16. | J-7624 | Spanner Wrench | 34. | J-23980 | Steering Column Electrical Analyzer |
| 17. | J-4245 | #23 Internal Pliers | 35. | | Torque Wrenches |
| 18. | J-22670 | Pump Shaft Seal Installer | | | |

Fig. 3B-1ST--Special Tools C and K Models



- | | | | |
|-------------|---------------------------------|--------------|---------------------------------|
| 1. J-6632 | Pitman Arm Puller | 19. J-6278 | Pitman Shaft Bearing Remover |
| 2. J-5504 | Pitman Arm Puller | 20. J-6278-2 | Pitman Shaft Bearing Installer |
| 3. J-5176 | Pressure Gauge | 21. J-7079-2 | Drive Handle |
| 4. J-5822 | Wormshaft Bearing Cup Puller | 22. J-8524-1 | Adjuster Plug Bearing Installer |
| 5. J-5860 | Torque Wrench Adapter | 23. J-8524-2 | Adjuster Plug Bearing Remover |
| 6. J-22670 | Pump Shaft Seal Installer | 24. J-6219 | Pitman Shaft Seal Installer |
| 7. J-6222 | Shaft Seal Protector | 25. J-6217 | Connector Seat Installer |
| 8. J-9226 | Pitman Shaft Bushing Replacer | 26. J-5421 | Thermometer |
| 9. J-7576 | Rack-Piston Seal Compressor | 27. J-22407 | Pitman Shaft Bearing Installer |
| 10. J-21239 | Pump Pulley Remover | 28. J-22727 | Terminal Remover |
| 11. J-2927 | Steering Wheel Puller | 29. J-22708 | Turn Signal Cover Remover |
| 12. J-1614 | Sector Shaft Bushing Remover | 30. J-22573 | Steering Column Holding Fixture |
| 13. J-7539 | Ball Retainer | 31. J-22599 | Lock Nut Socket |
| 14. J-7624 | Spanner Wrench | 32. J-21854 | Pivot Pin Remover |
| 15. J-4245 | #23 Internal Pliers | 33. J-22551 | Shift Tube Remover |
| 16. J-23600 | Belt Tension Gauge | 34. J-22549 | Shift Tube Installer |
| 17. J-5755 | Wormshaft Bearing Cup Installer | 35. | Torque Wrenches |
| 18. J-2619 | Slide Hammer | | |

Fig. 3B-2ST--Special Tools G and P Models

SECTION 3C

FRONT SUSPENSION

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 1 of this section".

CAUTION: *THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OF WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.*

CONTENTS OF THIS SECTION

Front Suspension (C-G-P Series)	3C-1
Front Suspension (K-Series).....	3C-23

FRONT SUSPENSION, TWO-WHEEL DRIVE**INDEX**

General Description.....	3C-1	Lower Control Arm Shaft.....	3C-16
Maintenance and Adjustments.....	3C-3	Upper Control Arm.....	3C-17
Diagnosis.....	3C-3	Lower Control Arm.....	3C-18
Component Parts Replacement.....	3C-14	Ball Joint.....	3C-20
Wheel Hubs, Bearings.....	3C-14	Steering Knuckle.....	3C-21
Shock Absorber.....	3C-14	Suspension Unit.....	3C-21
Stabilizer.....	3C-15	Specifications.....	3C-37
Coil Spring.....	3C-15	Special Tools.....	3C-38
Upper Control Arm Shaft.....	3C-16		

GENERAL DESCRIPTION**C-G-P Series**

The C-G-P Series trucks incorporate an independent coil spring front suspension system, as shown in Figures 3C-1 and 3C-2. The control arms are of unequal length (S.L.A. Type).

This suspension system consists of upper and lower control arms pivoting on steel threaded or rubber bushings on upper and lower control arm shafts. The lower control arms are attached to the crossmember. The upper control

arms are attached to a frame bracket. These control arms are connected to the steering knuckle through pivoting ball joints.

A coil spring is located between the lower control arm and a formed seat in the suspension crossmember, thus the lower control arm is the load carrying member. Double acting shock absorbers are also attached to the lower control arms and connect with the frame to the rear on the upper end. The front wheel bearings are tapered roller type and are used on all models.

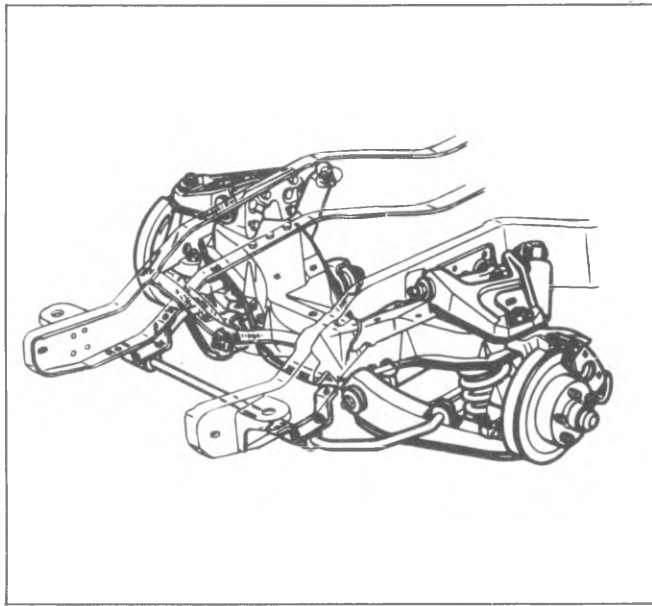


Fig. 3C-1--Front Suspension, C-P Series

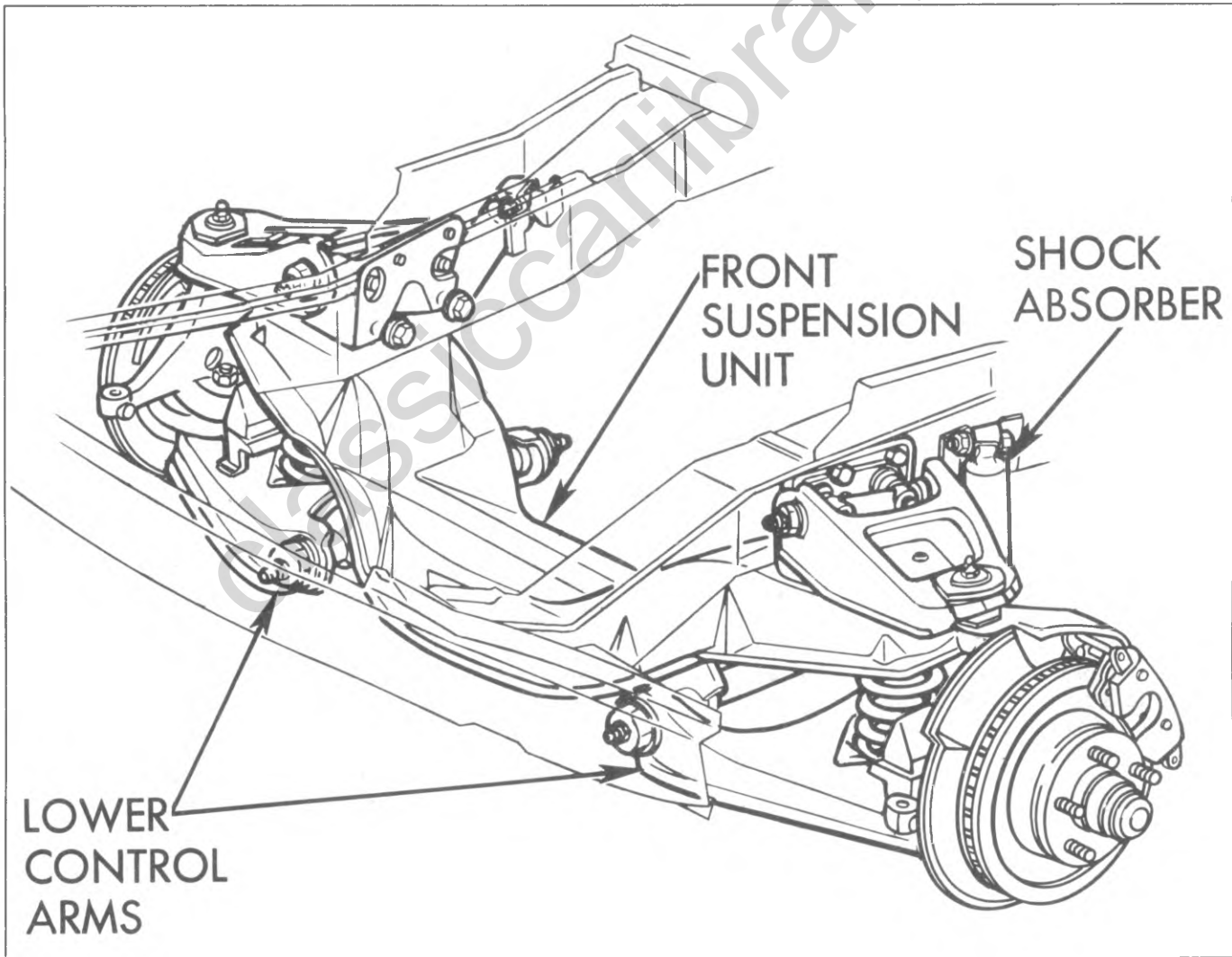


Fig. 3C-2--Front Suspension - G-Typical

MAINTENANCE AND ADJUSTMENTS

CAUTION: See *CAUTION* on page 1 of this section regarding the fasteners referred to in the maintenance and adjustment procedures below.

WHEEL BEARINGS-CHECK ADJUSTMENT

CAUTION: Tapered roller bearings are used on all series vehicles and they have a slightly loose feel when properly adjusted. A design feature of front wheel taper roller bearings is that they must **NEVER** be pre-loaded. Damage can result by the steady thrust on roller ends which comes from preloading.

1. Raise vehicle and support at front lower control arm.
2. Spin wheel to check for unusual noise or roughness.
3. If bearings are noisy, tight, or excessively loose, they should be cleaned, inspected and relubricated prior to adjustment. If it is necessary to inspect bearings, see "Wheel Hubs, Bearings" under "Component Parts Replacement."

NOTE: To check for tight or loose bearings, grip the tire at the top and bottom and move the wheel assembly in and out on the spindle. Measure movement of hub assembly. If movement is less than .001" or greater than .005", adjust bearings per adjustment procedure.

ADJUSTMENT OF WHEEL BEARINGS (FIG. 3C-3)

1. Remove hub cap or wheel disc from wheel.
2. Remove dust cap from hub.
3. Remove cotter pin from spindle and spindle nut.
4. Tighten the spindle nut to 12 ft. lbs. while turning the wheel assembly forward by hand to fully seat the bearings. This will remove any grease or burrs which could cause excessive wheel bearing play later. See Fig. 3C-3.
5. Back off the nut to the "just loose" position.
6. Hand tighten the spindle nut. Loosen spindle nut until either hole in the spindle lines up with a slot in the nut. (Not more than 1/2 flat).
7. Install new cotter pin. Bend the ends of the cotter pin against nut, cut off extra length to ensure ends will not interfere with the dust cap.
8. Measure the looseness in the hub assembly. There will be from .001 to .005 inches end play when properly adjusted.
9. Install dust cap on hub.
10. Replace the wheel cover or hub cap.

11. Lower vehicle to floor.

12. Perform the same operation for each front wheel.

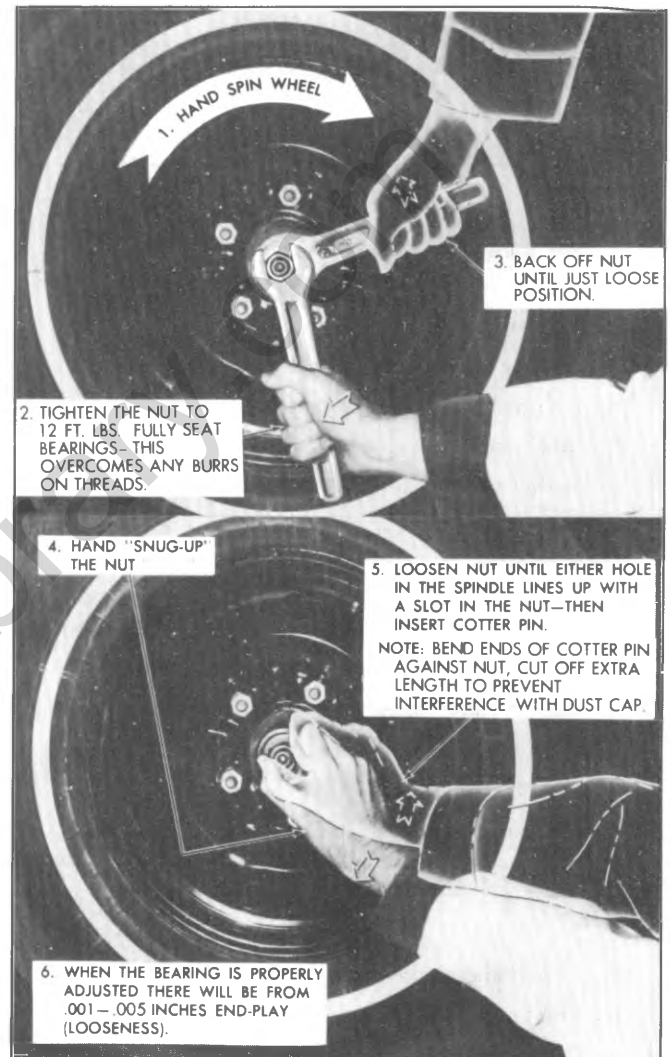


Fig. 3C-3--Wheel Bearing Adjustment

DIAGNOSIS

SHOCK ABSORBER DIAGNOSIS

ON VEHICLE CHECKS

(Follow the Procedures Outlined Below in the Order Indicated).

Preliminary Inspection and Ride Test:

Tire Pressure

Check tire pressure compare to vehicle specifications and adjust as required. Poor vehicle control and ride complaints are caused in many cases by improper tire inflation.

Special Suspension Equipment

Check Service Parts Identification Sticker for any special suspension equipment; such as, a heavy duty suspension. Vehicles equipped with this type of option have a somewhat stiffer or harsh ride, and this should be kept in mind during the following tests. If complaint about stiffness should occur while vehicle is still new (under 5,000 miles) (8 000 km), owner should be advised to have ride rechecked after 7,000 to 8,000 miles (11 200 to 12 800 km).

HARD STEERING

Probable Cause

Probable Remedy

- | | |
|--|---|
| a. Ball joints and steering linkage need lubrication | a. Lubricate ball joints and linkage |
| b. Low or uneven front tire pressure | b. Inflate tires to the proper recommended pressure |
| c. Power steering partially or not operative | c. Check power steering components for proper operation |
| d. Steering gear not properly adjusted | d. Adjust steering gear |
| e. Incorrect front wheel alignment (manual steering) | e. Check and align front suspension |

POOR DIRECTIONAL STABILITY

- | | |
|--|---|
| a. Ball joints and steering linkage need lubrication | a. Lubricate at proper intervals |
| b. Low or uneven front or rear tire pressure | b. Inflate tires to the proper recommended pressure |
| c. Loose wheel bearings | c. Adjust wheel bearings |
| d. Steering Gear not on high point | d. Adjust steering gear |
| e. Incorrect front wheel alignment (caster) | e. Check and align front suspension |
| f. Broken springs | f. Replace springs |
| g. Malfunctioning shock absorber. | g. Diagnose shock absorbers. |
| h. Broken stabilizer bar, or missing link | h. Replace stabilizer or link |

**FRONT WHEEL SHIMMY
(SMOOTH ROAD SHAKE)**

- | | |
|---|---------------------------------|
| a. Tire and wheel out of balance, or out of round | a. Balance tires, check run-out |
| b. Worn or loose wheel bearings | b. Adjust wheel bearings |
| c. Worn tie rod ends | c. Replace tie rod end |
| d. Worn ball joints | d. Replace ball joints |
| e. Malfunctioning shock absorber | e. Diagnose shock absorbers |

**VEHICLE PULLS TO ONE SIDE
(NO BRAKING ACTION)**

- | | |
|---|---|
| a. Low or uneven tire pressure | a. Inflate tires to the proper recommended pressure |
| b. Front or rear brake dragging | b. Adjust brakes |
| c. Broken or sagging front spring | c. Replace spring |
| d. Incorrect front wheel alignment (Camber) | d. Check and align front suspension |

EXCESSIVE PLAY IN STEERING

- | | |
|---------------------------------------|-------------------------|
| a. Incorrect steering gear adjustment | a. Adjust steering gear |
| b. Worn steering gear parts | b. Overhaul Gear |

Fig. 3C-4--Front Suspension Diagnosis Chart A

NOISE IN FRONT END	
<u>Probable Cause</u>	<u>Probable Remedy</u>
<ul style="list-style-type: none"> a. Ball joints and steering linkage need lubrication b. Shock absorber loose or bushings worn c. Worn control arm bushings d. Worn tie rod ends e. Worn or loose wheel bearings f. Loose stabilizer bar g. Loose wheel nuts h. Spring improperly positioned i. Loose suspension bolts 	<ul style="list-style-type: none"> a. Lubricate at recommended intervals b. Tighten bolts and/or replace bushings c. Replace bushings d. Replace tie rod ends e. Adjust or replace wheel bearings f. Tighten all stabilizer bar attachments g. Tighten the wheel nuts to proper torque h. Reposition i. Torque to specifications or replace
WHEEL TRAMP	
<ul style="list-style-type: none"> a. Tire and wheel out of balance b. Tire and wheel out of round c. Blister or bump on tire d. Improper shock absorber action 	<ul style="list-style-type: none"> a. Balance wheels b. Replace tire c. Replace tire d. Replace shock absorber
EXCESSIVE OR UNEVEN TIRE WEAR	
<ul style="list-style-type: none"> a. Underinflated or overinflated tires b. Improper toe-in c. Wheels out of balance d. Hard Driving e. Over loaded vehicle 	<ul style="list-style-type: none"> a. Inflate tire to proper recommended pressure b. Adjust toe-in c. Balance wheels d. Instruct driver e. Instruct driver
SCUFFED TIRES	
<ul style="list-style-type: none"> a. Toe-in incorrect b. Excessive speed on turns c. Tires improperly inflated d. Suspension arm bent or twisted 	<ul style="list-style-type: none"> a. Adjust toe-in to specifications b. Advise driver c. Inflate tires to proper recommended pressure d. Replace arm
CUPPED TIRES	
<ul style="list-style-type: none"> a. Front shock absorbers defective b. Worn ball joints c. Wheel bearings incorrectly adjusted or worn d. Wheel and tire out of balance e. Excessive tire or wheel runout 	<ul style="list-style-type: none"> a. Replace shock absorbers b. Replace ball joints c. Adjust or replace wheel bearings d. Balance wheel and tire e. Compensate for runout

Fig. 3C-5--Front Suspension Diagnosis Chart B

"DOG" TRACKINGProbable CauseProbable Remedy**LEAF TYPE REAR SPRING**

- | | |
|---|---|
| <ul style="list-style-type: none"> a. Rear leaf spring broken b. Bent rear axle housing c. Frame or underbody out of alignment | <ul style="list-style-type: none"> a. Replace spring b. Replace housing c. Align frame |
|---|---|

COIL TYPE REAR SPRING

- | | |
|---|---|
| <ul style="list-style-type: none"> a. Damaged rear suspension arm and/or worn bushings b. Frame out of alignment c. Bent rear axle housing | <ul style="list-style-type: none"> a. Replace suspension arm and/or bushings b. Align frame c. Replace housing |
|---|---|

RETURNABILITY POOR

- | | |
|---|---|
| <ul style="list-style-type: none"> a. Steering column alignment b. Steering linkage needs lubrication c. Idler arm bushing worn d. Steering gear adjustment e. Power steering gear valve spool binding f. Obstruction within power steering gear g. Improper caster setting (negative) | <ul style="list-style-type: none"> a. See Section 3b in shop manual for proper alignment b. Lubricate chassis c. Replace idler arm d. Adjust gear as outlined in Section 3b of shop manual e. See Section 3b in shop manual f. See Section 3b in shop manual g. Check and reset if necessary |
|---|---|

ERRATIC STEERING ON BRAKE APPLICATION

- | | |
|---|--|
| <ul style="list-style-type: none"> a. Low or uneven tire pressure b. Front wheel bearing incorrectly adjusted c. Brakes incorrectly or unevenly adjusted d. Front spring sagged e. Steering gear off high point f. Incorrect or uneven caster g. Leaking wheel cylinders | <ul style="list-style-type: none"> a. Inflate tires to proper recommended pressure b. Adjust bearing as necessary c. Adjust brakes as necessary d. Check shop manual for proper riding heights and replace spring if necessary e. Check and correct steering if necessary f. Check and adjust caster as necessary g. Replace (See sec. 5) |
|---|--|

Fig. 3C-6--Front Suspension Diagnosis Chart C

BALL JOINT DIAGNOSTIC PROCEDURE

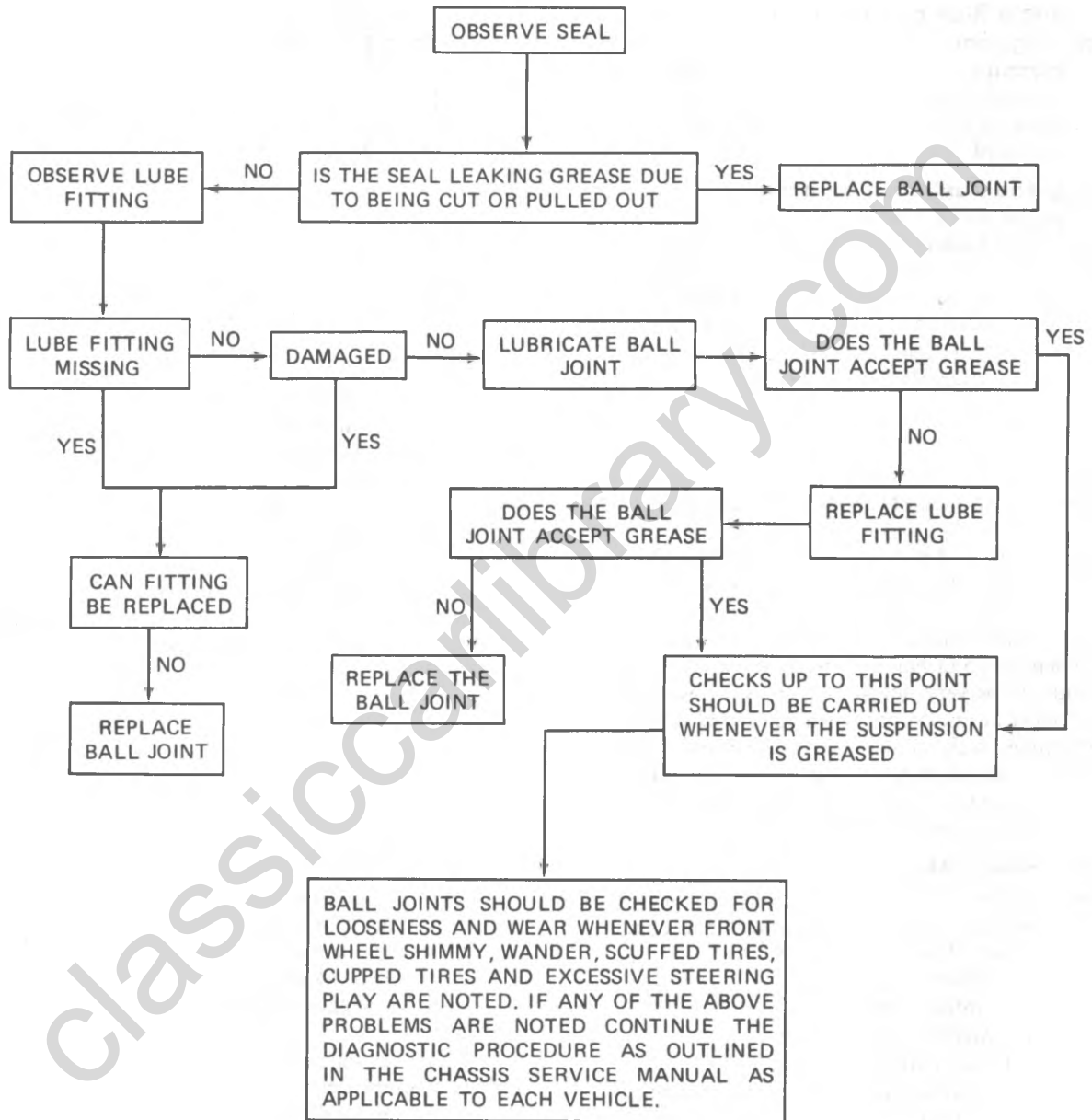


Fig. 3C-7--Ball Joint Diagnostic Procedure

Vehicle Load Conditions

Note any exceptional load conditions under which the owner normally operates the vehicle; such as, large tool boxes full of tools, pick up bed full etc. If exceptional loading is apparent, check the distribution of this weight. Note if it is all toward one side of the vehicle or at the extreme rear of the vehicle. Reposition load as required to obtain a more uniform weight distribution.

Check Vehicle Ride and Handling

After completing previous checks, ride vehicle with owner to determine if problem has been corrected or to definitely establish type of problem that still exists. If problem still exists (poor handling, bottoming, noise, ride sway, etc.), proceed.

Inspecting and Testing the Shocks

Three procedures are included in this step. They are (a) Bounce Test, (b) Inspecting Shock Mountings for Noise (Looseness) and (c) Manually Operating Shocks to Determine if Shocks are Weak, Leaking Hydraulic Fluid, and/or if Shocks have an Internal Noise Condition.

Test procedures (b) and (c) require vehicle to be on a hoist that supports wheels or rear axle housing and front lower control arms.

Bounce Test

NOTE: This is only a comparison type test to help locate the suspected shock or noise condition before proceeding.

Test each front and rear shock by bouncing each corner of the vehicle. This can usually be done by lifting up and pushing down on the end of the bumper near each corner of the vehicle until maximum movement up and down is reached. Then let go of bumper and observe if the up and down motion stops very quickly. If up and down motion continues longer at one corner when compared to opposite corner (example, both front shocks), the one having the longer up and down motion may be suspect. **Do Not** compare front to rear. If complaint is noise, this test should help to locate the suspected area.

Inspecting Shock Mountings

If noisy and/or loose shock mountings are suspected, place vehicle on hoist that supports wheels and check all mountings for the following conditions:

- (1) Worn or defective grommets
- (2) Loose mounting nuts
- (3) Possible interference condition
- (4) Bump stops missing

If no apparent defects are noted in this step but noise condition still exists when vehicle is bounced up and down, proceed.

Inspecting Shocks for Leaks and

Manually Operating Shocks

This procedure is sub-divided into two general areas, (1) Inspecting Shocks for Loss of Hydraulic Fluid and (2) Manually Operating Shock. It should aid the technician to localize defective shocks caused by internal noise in the shock, weak, leaking, etc.

1. Inspecting Shocks for Possible Loss of Hydraulic Fluid

(a) Disconnect each shock lower mounting as required and pull down on the shock until it is fully extended.

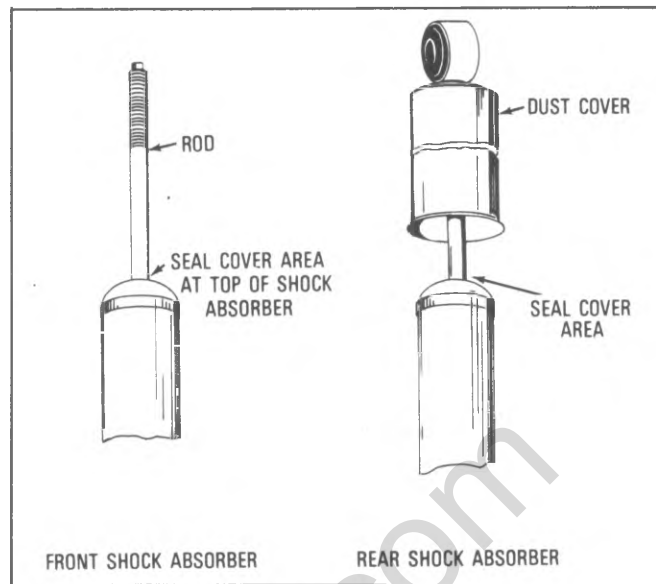


Fig. 3C-8--Seal Cover Area of Shock

(b) Inspect shocks for leaks in seal cover area. Shock fluid is a very thin hydraulic fluid and has a characteristic odor and dark brown tint (Figure 3C-8).

Certain precautions should be observed when inspecting shocks for leaks:

- shocks may have glossy paint on them. Do not confuse this paint with a leak condition.
- a slight trace of shock fluid around the seal cover area is **not** cause for replacement. The shock seal is engineered to permit a slight seepage to lubricate the rod. The shock absorber has reserve fluid to compensate for the slight seepage.
- shocks are sometimes incorrectly diagnosed as leakers due to oil spray originating from some other source. If in doubt, wipe the wet area from and manually operate shock as described in Step (2). Fluid will reappear if shock is leaking.

2. Manually Operating Shocks

NOTE: It may be necessary with certain types of shock mountings to fabricate a bracket that can be installed on a shock to enable a technician to securely grip the shock when manually operating the shock. See Figure 3C-9 for suggested methods of providing temporary grip.

This test should help the mechanic to isolate the following shock defects:

- binding condition internally
- verify leaking shock
- improper or defective valving

(a) If suspected problem is in front shocks, disconnect both front shock lower mountings and stroke each shock as follows: Grip the lower end of the shock securely and pull down (rebound stroke) then push up (compression stroke). The control arms will limit the movement of the front shocks during the compression stroke. Compare the rebound resistance between both front shocks, then compare the compression resistance. If a noticeable difference can be felt during either stroke, usually the shock having the least resistance is at fault.

(b) If shock has an internal noise condition, extend

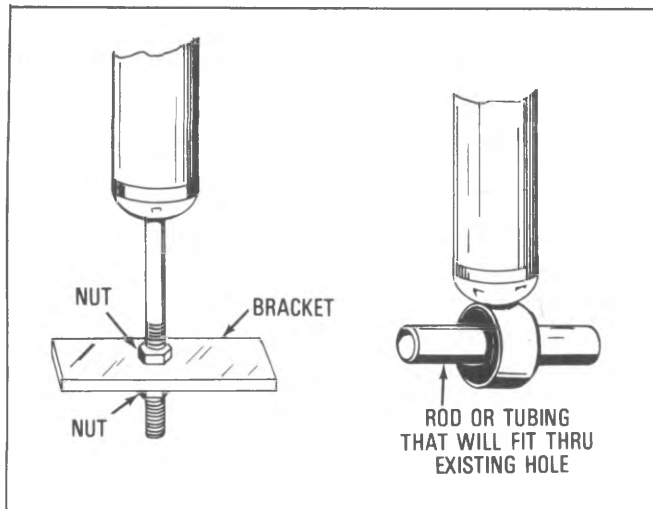


Fig. 3C-9--Gripping Methods

shock fully, then exert an extra pull. If noisy shock should be replaced.

Other noise conditions that require shock replacement are:

- a grunt or squeal after one full stroke in both directions
- a clicking noise on fast reverse
- a skip or lag at reversal near mid-stroke

When air adjustable shocks are being manually operated, the air line must be disconnected at the shock absorber.

BENCH CHECKS

The bench checks are recommended if the proper type hoist is not available to perform the "on vehicle" tests, or if there is still some doubt as to whether the shocks are defective. In addition, the bench test allows a more thorough visual inspection.

Bench check procedures are discussed for three general types of shocks.

SPIRAL GROOVE RESERVOIR

If this type of shock has been stored or allowed to lay in a horizontal position for any length of time, an air void will develop in the pressure chamber of the shock absorber. This air void if not purged, can cause a technician to diagnose the shock as defective. To purge the air from the pressure chamber, proceed as follows: (Refer to Figure 3C-10)

- (a) Holding the shock in its normal vertical position (top end up), fully extend shock.
- (b) Hold the top end of the shock **down** and fully collapse the shock.
- (c) Repeat Steps (a) and (b) at least five (5) times to assure air is purged.

Bench Test Procedure

1. This is a comparison type test. If possible, obtain a new or known good shock with same part number as shock under test.
2. With shocks in vertical position (top end up), clamp bottom mounts in vise.

CAUTION: Do not clamp on reservoir tube or mounting threads.

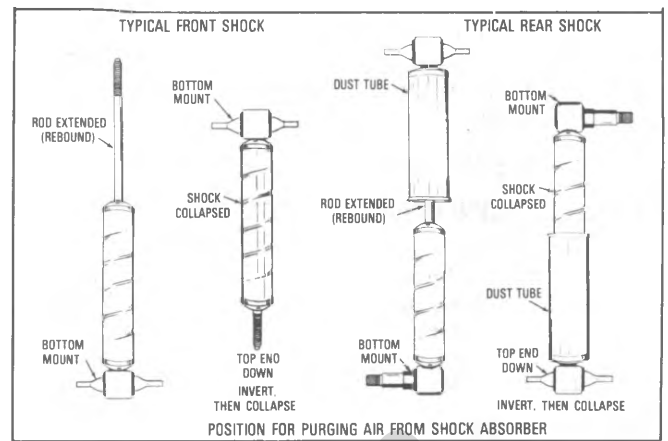


Fig. 3C-10--Position for Purging Air From Shocks

3. Manually pump each shock by hand at various rates of speed and compare resistance of suspected shock with the new one.

NOTE: Rebound resistance (extending the shock) is normally stronger than the compression resistance (approximately 2:1). However, resistance should be smooth and constant for each stroking rate.

4. Observe or listen for the following conditions that will indicate a defective shock:

- a skip or lag when reversing stroke at mid travel.
- seizing or binding condition except at extreme end of either stroke.
- a noise, such as a grunt or squeal, after completing one full stroke in both directions.
- a clicking type noise at fast reversal.
- fluid leakage.

5. To check for a loose piston, completely extend shock to full rebound; then exert an extra hard pull. If a give is felt, a loose piston is indicated and shock should be replaced.

PLIACELL OR GENETRON

Pliacell and Genetron are some of the trade names used to indicate a gas-filled cell in the shock reservoir. The reservoirs of Pliacell and Genetron shocks are smooth, compared to the spiral groove type. The cell takes the place of air in the reservoir. Thus, aeration or foaming of the fluid is eliminated, as air and fluid cannot mix.

Due to this feature, these shocks should be bench checked in an **inverted position** (top end down). If, when stroked, a lag is noticed, it means the gas-filled cell has been ruptured, and the shock should be replaced. If no lag is noticed, the remainder of the bench check is the same as given in the Spiral Groove Reservoir, Section 1, Bench Check Procedure.

AIR ADJUSTABLE SHOCKS

This type of shock contains an air chamber like the spiral groove reservoir type, and must have the air purged from the working chamber. See Section 1, Spiral Groove Reservoir. After air has been purged from shock, proceed as follows:

- (a) Clamp lower shock mounting ring in vise in vertical position with larger diameter tube at the top.
- (b) Pump unit by hand at different rates of speed. Smooth resistance should be felt through the length of the stroke. Since the units are normally pressurized, the sound

of air bubbles or a gurgling noise is **normal** .

(c) The remainder of the bench check is the same as given in the Spiral Groove Reservoir, Section 1, Bench Check Procedure.

BEARINGS AND RACES

BENCH DIAGNOSTIC PROCEDURE

This section describes common types of bearing distress and their causes. Illustrations are included to help diagnose the cause of distress and comments are provided to help make effective repairs.

Consider The Following Factors When

Diagnosing Bearing Distress:

1. Note General Condition of all parts during teardown and examinations.
2. Classify the failure with the aid of these illustrations where possible.
3. Determine the cause. Recognizing the cause will permit correction of the problem and prevent a repeat

failure of the same type.

4. Make all repairs following recommended procedures.

Common Causes For Bearing Distress

Include The Following:

1. Improper adjustment or preloading.
2. Mounting or teardown abuse.
3. Improper mounting methods.
4. Inadequate or wrong lubricants.
5. Entrance of dirt or water.
6. Wear from dirt or metal chips.
7. Corrosion or rusting.
8. Seizing or smearing from overload.
9. Overheating causing tempering.
10. Fretting of bearing seats.
11. Brinelling from impact loads and shipping.
12. Manufacturing defects.

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BEARINGS AND RACES

FRONT WHEEL, PINION, DIFFERENTIAL SIDE AND REAR WHEEL ROLLER BEARINGS

DIAGNOSIS

	EXCESS NOISE COMPLAINT DIAGNOSTIC PROCEDURE
Road Test	<ol style="list-style-type: none"> 1. Check tires for irregular wear 2. Check tire pressure 3. Check lubricant level 4. Drive to warm-up rear axle 5. Test at various speeds in drive, float, coast and cornering
Tire Noises	<ol style="list-style-type: none"> 1. Change tire pressure to minimize noises 2. Drive over different road surfaces 3. Smooth black-top minimizes tire noise 4. Cross switch tires, if necessary 5. Snow tire treads and studs caused added noises
Engine or Exhaust Noises	<ol style="list-style-type: none"> 1. Drive slightly above speed where noise occurs, place transmission in neutral 2. Let engine speed drop to idle 3. Stop car 4. Run engine at various speeds
Test for Wheel Bearing Noise	<ol style="list-style-type: none"> 1. Drive car at low speed on a smooth road 2. Turn car to develop left and right motions, traffic permitting 3. Noise should change due to cornering loads 4. Jack-up wheels to verify roughness at wheels
Test for Differential Bearing Noise	<ol style="list-style-type: none"> 1. Drive car at low speed on a smooth road 2. Constant low pitch bearing noise may be heard 3. Noise should not change in reversing turns 4. Noise pattern should vary with wheel speed
Test for Pinion Bearing Noise	<ol style="list-style-type: none"> 1. Roughness or whine noise should increase with speed 2. Noise pitch should be higher than differentials 3. Test on smooth road to minimize tire noises 4. Test at various speeds in drive, float, and coast 5. Rear pinion bearing noise may be louder on acceleration 6. Front pinion bearing noise may be louder on deceleration 7. Gear noises tend to peak in a narrow speed range

Fig. 3C-11--Bearing Diagnosis Chart

FRONT WHEEL BEARING DIAGNOSIS

CONSIDER THE FOLLOWING FACTORS WHEN DIAGNOSING BEARING CONDITION:

1. GENERAL CONDITION OF ALL PARTS DURING DISASSEMBLY AND INSPECTION.
2. CLASSIFY THE FAILURE WITH THE AID OF THE ILLUSTRATIONS.
3. DETERMINE THE CAUSE.
4. MAKE ALL REPAIRS FOLLOWING RECOMMENDED PROCEDURES.










 <p>ABRASIVE ROLLER WEAR</p> <p>PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES.</p> <p>CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.</p>	 <p>GALLING</p> <p>METAL SMEARS ON ROLLER ENDS DUE TO OVERHEAT, LUBRICANT FAILURE OR OVERLOAD (WAGON'S)</p> <p>REPLACE BEARING -- CHECK SEALS AND CHECK FOR PROPER LUBRICATION.</p>	 <p>BENT CAGE</p> <p>CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.</p> <p>REPLACE BEARING.</p>
 <p>ABRASIVE STEP WEAR</p> <p>PATTERN ON ROLLER ENDS CAUSED BY FINE ABRASIVES.</p> <p>CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.</p>	 <p>ETCHING</p> <p>BEARING SURFACES APPEAR GRAY OR GRAYISH BLACK IN COLOR WITH RELATED ETCHING AWAY OF MATERIAL USUALLY AT ROLLER SPACING.</p> <p>REPLACE BEARINGS -- CHECK SEALS AND CHECK FOR PROPER LUBRICATION.</p>	 <p>BENT CAGE</p> <p>CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.</p> <p>REPLACE BEARING.</p>
 <p>INDENTATIONS</p> <p>SURFACE DEPRESSIONS ON RACE AND ROLLERS CAUSED BY HARD PARTICLES OF FOREIGN MATERIAL.</p> <p>CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY.</p>	 <p>CAGE WEAR</p> <p>WEAR AROUND OUTSIDE DIAMETER OF CAGE AND ROLLER POCKETS CAUSED BY ABRASIVE MATERIAL AND INEFFICIENT LUBRICATION.</p> <p>CLEAN RELATED PARTS AND HOUSINGS. CHECK SEALS AND REPLACE BEARINGS.</p>	 <p>MISALIGNMENT</p> <p>OUTER RACE MISALIGNMENT DUE TO FOREIGN OBJECT.</p> <p>CLEAN RELATED PARTS AND REPLACE BEARING. MAKE SURE RACES ARE PROPERLY SEATED.</p>

Fig. 3C-12--Bearing Diagnosis Illustration A

FRONT WHEEL BEARING DIAGNOSIS (CONT'D)








 <p style="text-align: center;">CRACKED INNER RACE</p> <p>RACE CRACKED DUE TO IMPROPER FIT, COCKING, OR POOR BEARING SEATS.</p> <p>REPLACE BEARING AND CORRECT BEARING SEATS.</p>	 <p style="text-align: center;">FATIGUE SPALLING</p> <p>FLAKING OF SURFACE METAL RESULTING FROM FATIGUE.</p> <p>REPLACE BEARING -- CLEAN ALL RELATED PARTS.</p>	 <p style="text-align: center;">BRINELLING</p> <p>SURFACE INDENTATIONS IN RACEWAY CAUSED BY ROLLERS EITHER UNDER IMPACT LOADING OR VIBRATION WHILE THE BEARING IS NOT ROTATING.</p> <p>REPLACE BEARING IF ROUGH OR NOISY.</p>
 <p style="text-align: center;">FRETTAGE</p> <p>CORROSION SET UP BY SMALL RELATIVE MOVEMENT OF PARTS WITH NO LUBRICATION.</p> <p>REPLACE BEARING. CLEAN RELATED PARTS. CHECK SEALS AND CHECK FOR PROPER LUBRICATION.</p>	 <p style="text-align: center;">STAIN DISCOLORATION</p> <p>DISCOLORATION CAN RANGE FROM LIGHT BROWN TO BLACK CAUSED BY INCORRECT LUBRICANT OR MOISTURE.</p> <p>RE-USE BEARINGS IF STAINS CAN BE REMOVED BY LIGHT POLISHING OR IF NO EVIDENCE OF OVER-HEATING IS OBSERVED.</p> <p>CHECK SEALS AND RELATED PARTS FOR DAMAGE.</p>	 <p style="text-align: center;">HEAT DISCOLORATION</p> <p>HEAT DISCOLORATION CAN RANGE FROM FAINT YELLOW TO DARK BLUE RESULTING FROM OVER-LOAD (WAGON'S) OR INCORRECT LUBRICANT.</p> <p>EXCESSIVE HEAT CAN CAUSE SOFTENING OF RACES OR ROLLERS.</p> <p>TO CHECK FOR LOSS OF TEMPER ON RACES OR ROLLERS A SIMPLE FILE TEST MAY BE MADE. A FILE DRAWN OVER A TEMPERED PART WILL GRAB AND CUT METAL. WHEREAS, A FILE DRAWN OVER A HARD PART WILL GLIDE READILY WITH NO METAL CUTTING.</p> <p>REPLACE BEARINGS IF OVER HEATING DAMAGE IS INDICATED. CHECK SEALS AND OTHER PARTS.</p>
 <p style="text-align: center;">SMEARS</p> <p>SMEARING OF METAL DUE TO SLIPPAGE. SLIPPAGE CAN BE CAUSED BY POOR FITS, LUBRICATION, OVERHEATING, OVERLOADS OR HANDLING DAMAGE.</p> <p>REPLACE BEARINGS, CLEAN RELATED PARTS AND CHECK FOR PROPER FITS AND LUBRICATION.</p>		

Fig. 3C-13--Bearing Diagnosis, Illustration B

COMPONENT PARTS REPLACEMENT

WHEEL HUBS, BEARINGS (Fig. 3C-14)

Removal C, G and P Series

1. Raise vehicle on hoist and remove wheel and tire assembly. Remove dust cap from end of hub and withdraw cotter pin.

2. Remove the brake caliper and hang by wire to the suspension.

CAUTION: Do not allow the caliper assembly to hang by the brake flex line.

3. Remove hub and disc assembly.

4. Remove outer bearing from hub. The inner bearing will remain in the hub and may be removed by prying out the inner grease seal.

5. Wash all parts in cleaning solvent.

Inspection

1. Check all bearings for cracked bearing cages, worn or pitted rollers.

2. Check bearing races for cracks or scoring, check brake discs for out-of-round or scored conditions and check bearing outer races for looseness in hubs.

Repairs

Replacement of Bearing Cups

If necessary to replace an outer race, drive out old race from the hub with a brass drift inserted behind race in notches in hub. Install new race by driving it into hub with the proper race installer J-8457, J-8458, J-8849 or J-9276-2. Remove and install the inner race in the same manner.

CAUTION: Use care when installing new race to start it squarely into hub, to avoid distortion and possible cracking.

Wheel Stud Replacement (Fig. 3C-14)

NOTE: Use a piece of water pipe or other similar tool to support the hub while pressing a wheel stud either in or out.

Installation

CAUTION: See CAUTION on page 1 of this section regarding the fasteners referred to in steps 8 and 9.

1. Clean off any grease in the hub and spindle and thoroughly clean out any grease in the bearings. Use cleaning solvent. Use a small brush with no loose bristles to clean out all old grease. Do not spin the bearing with compressed air while drying it or the bearing may be damaged.

2. Use a GM approved high temperature front wheel bearing grease or equivalent. Do not mix greases as mixing may change the grease properties and result in poor performance.

3. Apply a thin film of grease to the spindle at the outer bearing seat and at the inner bearing seat, shoulder, and seal seat.

4. Put a small quantity of grease inboard of each bearing cup in the hub. This can be applied with your finger forming a dam to provide extra grease availability to the bearing and to keep thinned grease from flowing out of the bearing.

5. Fill the bearing cone and roller assemblies 100% fill

of grease. A method for doing this is with a cone type grease machine that forces grease into the bearing. If a cone greaser is not available, the bearings can be packed by hand. If hand packing is used, it is extremely important to work the grease thoroughly into the bearings between the rollers, cone, and the cage. Failure to do this could result in premature bearing failure.

6. Place the inner bearing cone and roller assembly in the hub. Then using your finger, put an additional quantity of grease outboard of the bearing.

7. Install a new grease seal using a flat plate until the seal is flush with the hub. Lubricate the seal lip with a thin layer of grease.

8. Carefully install the hub and rotor assembly. Place the outer bearing cone and roller assembly in the outer bearing cup. Install the washer and nut and initially tighten the nut to 12 ft. lbs. while turning the wheel assembly forward by hand. Put an additional quantity of grease outboard the bearing. This provides extra grease availability to the bearing.

9. Final wheel bearing adjustment should be performed as previously outlined.

SHOCK ABSORBER

Removal (Fig. 3C-15)

1. Raise vehicle on hoist.

2. Remove nuts and eye bolts securing upper and lower shock absorber eyes.

3. Withdraw shock absorber and inspect rubber eye bushings. If defective, replace shock absorber assembly.

Installation

Place shock absorber into position over mounting bolts or into mounting brackets. Install eye bolts and nuts and torque as shown in Specifications Section. Lower vehicle to floor.

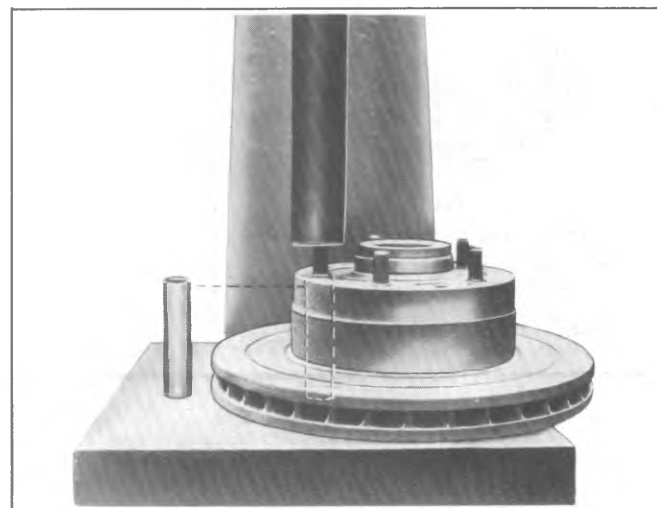


Fig. 3C-14--Pressing Stud

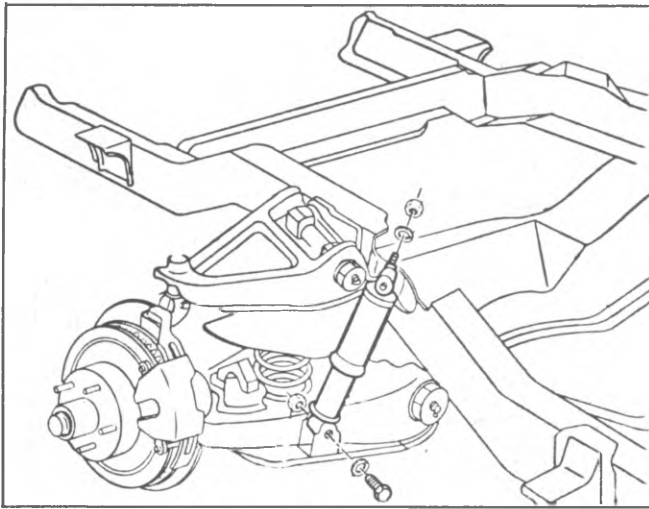


Fig. 3C-15--Shock Absorber Attachments

STABILIZER BAR

Removal (Fig. 3C-16)

1. Raise vehicle on hoist and remove nuts and bolts attaching stabilizer brackets and bushings at frame location.
2. Remove brackets and bushings at lower control arms and remove stabilizer from vehicle.

Inspection

Inspect rubber bushings for excessive wear or aging—replace where necessary. Use rubber lubricant when installing bushings over stabilizer bar.

Installation

CAUTION: See *CAUTION* on page 1 of this section regarding the fasteners referred to in step 2.

NOTE: Slit in bar to frame bushings should be facing forward.

1. Place stabilizer in position on frame and install frame brackets over bushings. Install nuts and bolts loosely.
2. Install brackets over bushings at lower control arm location. Be sure brackets are positioned properly over bushings. Torque all nuts and bolts to specifications.

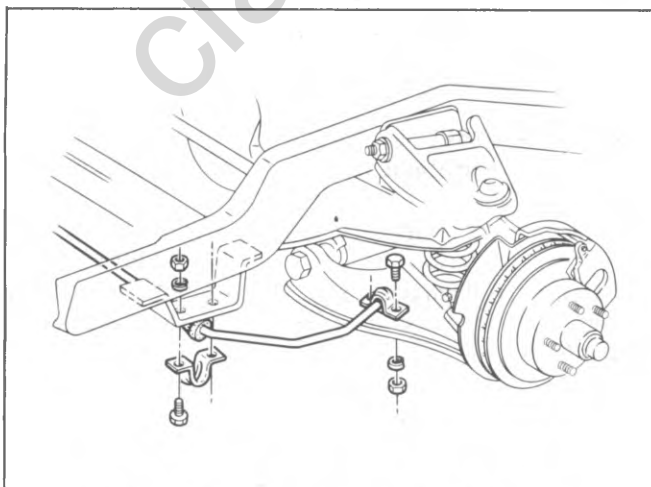


Fig. 3C-16--Stabilizer Bar - C, P and G Typical

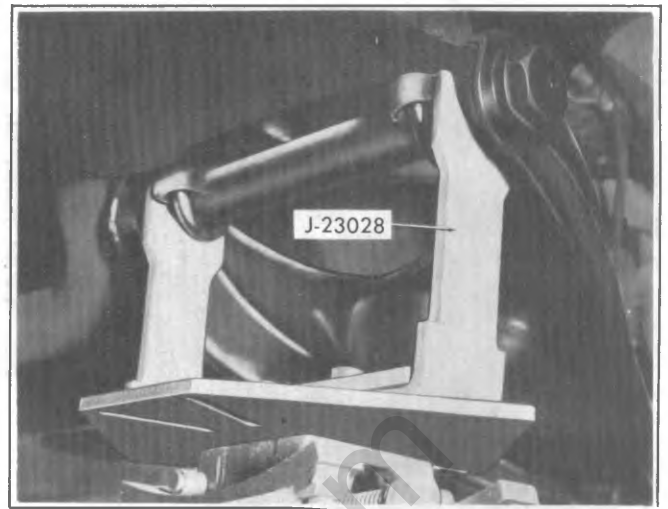


Fig. 3C-17--Removing Coil Spring with Tool J-23028

3. Lower vehicle to floor.

COIL SPRING

Removal (Fig. 3C-17)

1. Place vehicle on hoist and place jack stands under frame, allowing control arms to hang free.
2. Disconnect shock absorber at lower end and move aside. Disconnect the stabilizer bar attachments to the lower control arm.
3. Bolt Tool J-23028 to a suitable jack.
4. Place tool under cross-shaft so that the cross-shaft seats in the grooves of the tool. As a safety precaution install and secure a chain through the spring and lower control arm.
5. Raise the jack to remove tension on the lower control arm cross-shaft and remove the two "U" bolts securing the cross-shaft to crossmember.

WARNING: The crossshaft and lower control arm keeps the coil spring compressed. Use care when lowering.

6. Lower control arm by slowly releasing the jack until spring can be removed. Be sure all compression is relieved from spring.
7. Remove spring.

Installation

CAUTION: See *CAUTION* on page 1 of this section regarding the fasteners referred to steps 3 and 4.

1. Properly position spring on the control arm, and lift control arm using jack and tool J-23028.

NOTE: Some models are equipped with air cylinders in the coil springs. These cylinders should be checked for leaks and damage at this time. Air pressure in these cylinders should be 40 PSI.

2. Position control arm cross-shaft to crossmember and install "U" bolts and attaching nuts. Make certain front indexing hole in cross-shaft is lined up with crossmember attaching saddle stud.

3. Torque nut to specifications.

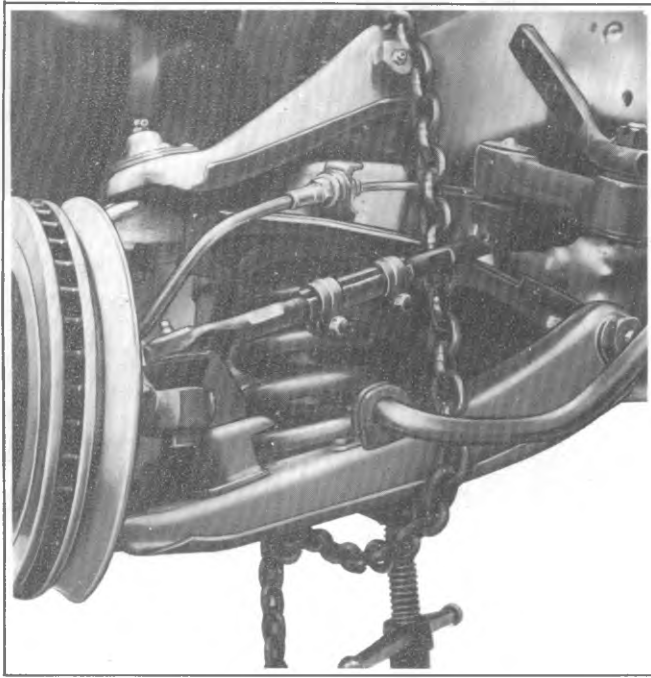


Fig. 3C-18--Removing Inner Pivot Shaft

4. Install shock absorber to lower control arm and install stabilizer bar.
5. Remove tool J-23028 and safety chain.
6. Lower vehicle to floor.

UPPER CONTROL ARM INNER PIVOT SHAFT AND/OR BUSHING REPLACEMENT

C20-30, G30 and P10-30 (Steel Bushings)

Pivot Shaft Removal

1. Raise vehicle and remove tire and wheel assembly.
2. Support the lower control arm with a floor jack.
NOTE: Position jack under the ball joint assembly or as near as possible and still have good support.
3. Loosen the upper control arm shaft end nuts before loosening the shaft to frame attaching nuts.
4. Loosen the shaft to frame nuts and remove the caster and camber shims.
NOTE: Tape the shims together as they are removed and mark for position.
5. Remove the pivot shaft to frame nuts but do not allow the arm to swing too far away from the frame.
NOTE: Use a safety chain to retain the arm in a close relationship to the frame. See Fig. 3C-18.
6. Remove the shaft end nuts and remove shaft from arm.

Bushing Replacement (Steel Bushings)

1. Remove grease fittings from bushing outer ends and unscrew bushings from control arm and shaft.
2. Slide new seal on each end of shaft and insert shaft into control arm.
3. Start new bushings on shaft and into control arm. Adjust shaft until it is centered in control arm, then turn bushings in and torque to specifications. Figure 3C-19 shows correct final positioning of shaft. Check shaft for free rotation and install grease fittings.

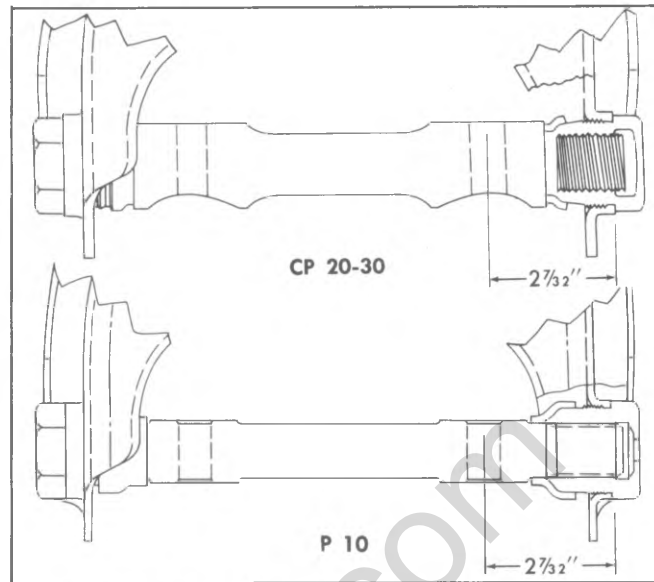


Fig. 3C-19--Positioning U.C.A. Shaft (Steel Bushings)

Installation

CAUTION: See **CAUTION** on page 1 of this section regarding the fasteners referred to in steps 3, 5 and 6.

NOTE: When installing the upper control arm be sure to properly position the special aligning washers to the pivot shaft with convex and concave sides together.

1. Install the shaft to the control arm and install end nuts. Do not torque nuts at this time.
2. Position cross shaft to frame bolts and start cross shaft nuts.
3. Torque the shaft end nuts. See Fig. 3C-19 for proper spacing.
NOTE: The shaft should rotate by hand after the nuts are torqued.
4. Install caster and camber shim in their appropriate places.
5. Torque the cross-shaft to frame nuts.
6. Remove the safety chain and install the tire.
7. Lower vehicle to the floor.

LOWER CONTROL ARM INNER PIVOT SHAFT AND/OR BUSHING REPLACEMENT

C20-30, G30, P10-30 (Steel Bushings)

Lower-Removal (Fig. 3C-18)

1. Raise vehicle and support the frame so that control arms hang free.
2. Position an adjustable floor jack under the control arm inboard of spring and into depression in lower arm.
3. Install a chain over upper arm (Fig. 3C-18). Inboard of stabilizer and outboard of shock absorber as a safety measure.
4. Disconnect shock absorber at lower control arm.
5. Loosen shaft end nuts.
6. Remove "U" bolts.
7. Lower jack just enough to get at shaft.
8. Remove shaft end nuts and remove shaft.

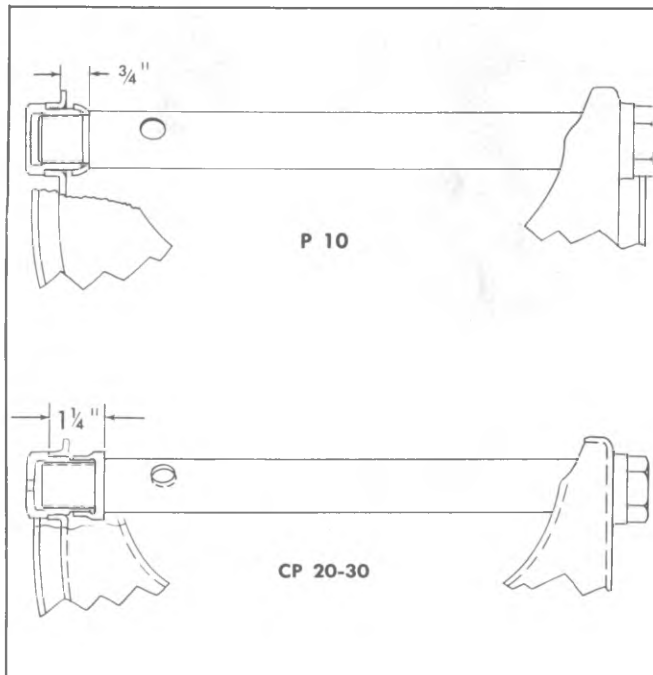


Fig. 3C-20--Positioning L.C.A. Shaft (Steel Bushings)

Bushing Replacement (Steel Bushings)

1. Remove grease fittings from ends of bushings and unscrew bushings from shaft and control arm. Remove shaft and seals.
2. Slide new seal on each end of shaft and insert shaft into control arm.
3. Start new bushings on shaft and into control arm. Adjust shaft until it is centered in control arm, then turn bushings in and torque to specifications. Check shaft for free rotation. Figure 3C-20 shows correct final positioning of shaft.

Installation

CAUTION: See **CAUTION** on page 1 of this section regarding the fasteners referred to in steps 4 and 5.

1. Install shaft to control arm and install end nuts. Do not torque nuts at this time.
 2. Raise jack and position shaft into crossmember saddle. Be sure to index hole in shaft to mate with bolt head in saddle.
 3. Install "U" bolts. Do not torque nuts at this time.
 4. Torque cross-shaft end nuts.
- NOTE:** The shaft should rotate by hand after the nuts are torqued.
5. Torque "U" bolt nuts.
 6. Remove safety chain.
 7. Lower vehicle to floor.

UPPER CONTROL ARM ASSEMBLY

All Removal

1. Raise vehicle on hoist, remove wheel and tire assembly and support lower control arm assembly with adjustable jackstand.
2. Remove cotter pin from upper control arm ball stud and loosen stud nut one turn.
3. Loosen upper control arm ball stud in steering

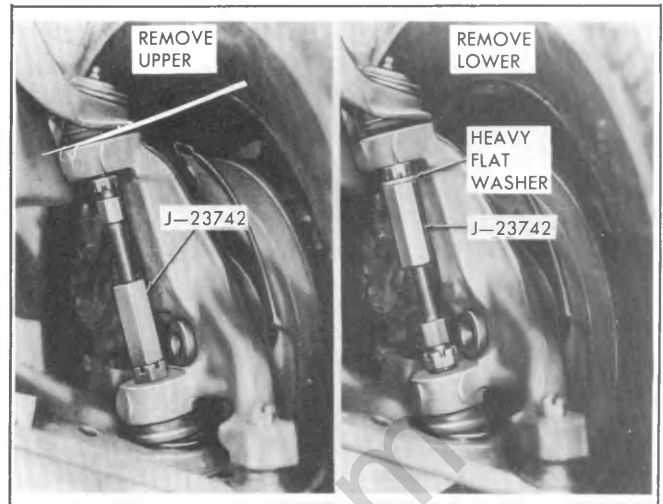


Fig. 3C-21--Disconnecting Ball Joints from Knuckle

knuckle, using Tool J-23742 position as shown in Figure 3C-21. Remove the nut from the ball stud and raise upper arm to clear steering knuckle.

NOTE: It is necessary to remove the brake caliper assembly and wire it to the frame to gain clearance for tool J-23742. See section 5 for proper procedure.

4. Remove nuts securing control arm shaft to frame. Withdraw control arm assembly.

NOTE: Tape shims together and tag for proper relocation when control arm is reinstalled.

Upper Control Arm Inner Pivot Shaft and/or Bushing Replacement

C10, G10-20 (Rubber Bushings)

Removal (Fig. 3C-22)

1. Remove the upper control arm using the preceding procedure and mount the control arm in a vise.
2. Install remover J-24435-1, receiver J-24435-3 and "C" clamps J-24435-7 as shown in Figure 3C-22.
3. Tighten the clamp to draw out the old bushing. Discard old bushing.

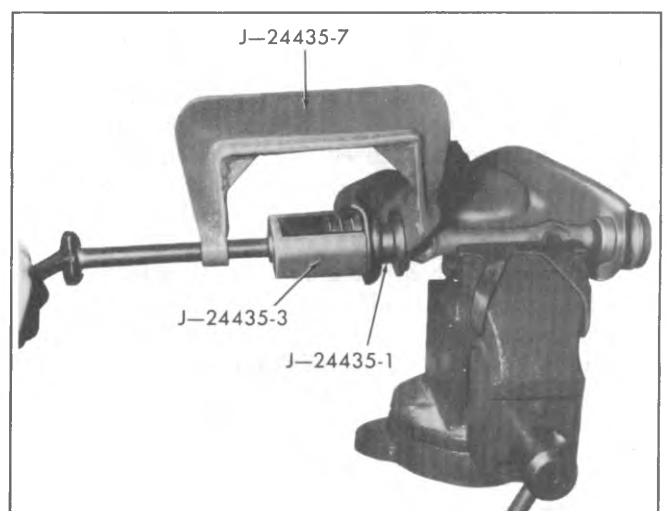


Fig. 3C-22--U.C.A. Rubber Bushing Removal

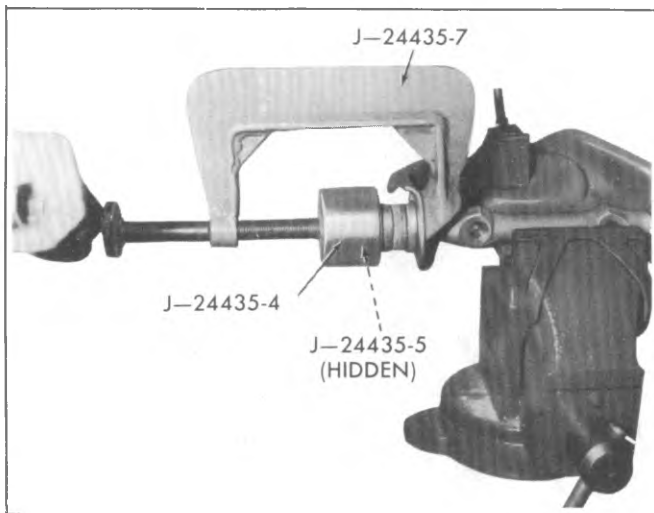


Fig. 3C-23--U.C.A. Rubber Bushing Installation

4. The pivot shaft may now be removed from the control arm assembly.

5. Reposition the control arm in the vise and repeat the removal procedure on the remaining bushing.

Bushing Installation

1. Again using "C" clamp J-24435-7 and installers J-24435-4 (outer) and J-24435-5 (inner) tighten clamp to install bushing onto control arm.

2. Install pivot shaft into inside diameter of first installed bushing.

3. Install remaining bushing as shown in Figure 3C-23 and described in step 1.

4. Remove tools and install control arm on vehicle following procedure described below. Torque all fasteners to proper specifications.

Upper Control Arm Installation

CAUTION: See CAUTION on page 1 of this section regarding the fasteners referred to in steps 1, 2 and 3.

NOTE: When installing the upper control arm be sure to position the special aligning washers to the pivot shaft with concave and convex sides together.

1. Place control arm in position on bracket and install nuts. Before tightening nuts, insert caster and camber shims in the same order as when removed. Torque the nuts to specifications.

NOTE: A normal shim pack will leave at least two (2) threads of the bolt exposed beyond the nut. If two (2) threads cannot be obtained: Check for damaged control arms and related parts. Difference between front and rear shim packs must not exceed .30 inches. Front shim pack must be at least .24 inches.

Always tighten the thinner shim packs' nut first for improved shaft to frame clamping force and torque retention.

2. Insert ball joint stud into steering knuckle and install nut. Torque stud nut to specifications and install cotter pin.

3. Install brake caliper assembly if removed (see section 5).

4. Remove adjustable support from under lower control arm. Install wheel and tire assembly.

5. Lower the vehicle to the floor.

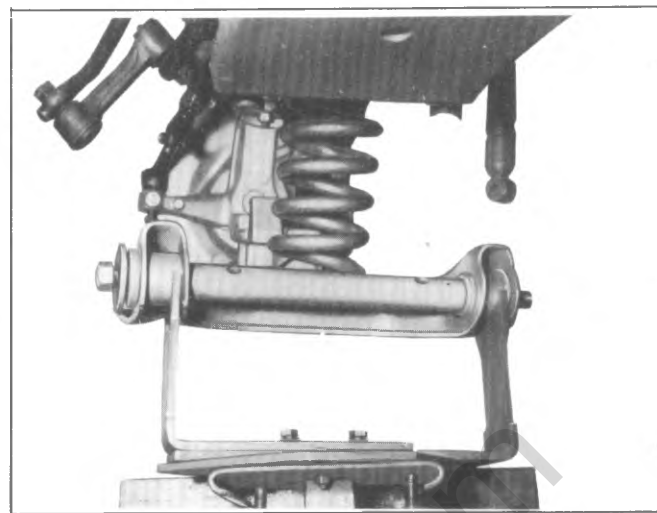


Fig. 3C-24--Lowering Control Arm for Bushing Replacement

LOWER CONTROL ARM ASSEMBLY

Removal

1. Raise vehicle on hoist and remove spring as outlined under spring removal.

NOTE: Support the inboard end of the control arm after spring removal.

2. Remove cotter pin from lower ball stud and loosen stud nut one turn.

3. Install Ball Stud Remover J-23742, position large cup end of the tool over the upper ball stud nut and piloting the threaded end of tool on end of the lower ball stud. Extend bolt from Tool J-23742 to loosen lower ball stud in steering knuckle. When stud is loosened, remove tool and nut from lower stud.

NOTE: It is necessary to remove the brake caliper assembly and wire it to the frame to gain clearance for tool J-23742. See section 5 for proper procedure.

4. Remove the lower control arm.

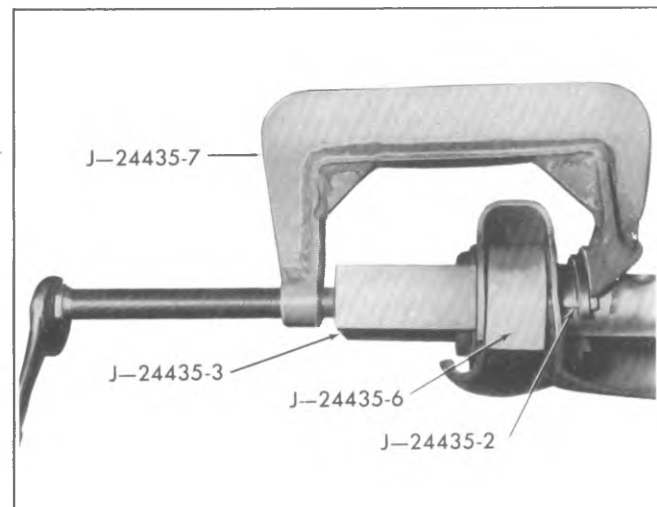


Fig. 3C-25--L.C.A. Rubber Bushing Removal

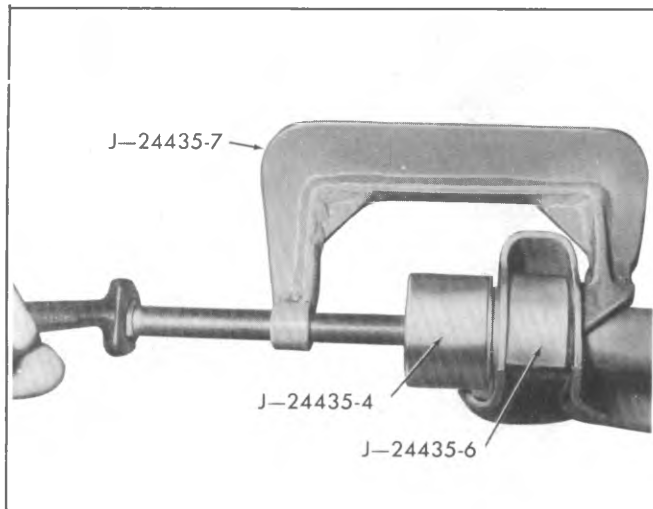


Fig. 3C-26--L.C.A. Rubber Bushing Installation

Lower Control Arm Inner Pivot Shaft and/or Bushing Replacement-On Vehicle

C10 (Rubber Bushings)

Removal (Figs. 3C-24, 3C-25)

NOTE: If just bushings or pivot shaft are to be replaced the lower control arm does not have to be removed from the vehicle.

1. Raise vehicle on hoist and support the frame so that the control arms hang free.
2. Position an adjustable floor jack under the lower control arm inboard of spring and into depression of control arm.
3. Install a chain over the upper arm inboard of the stabilizer and outboard of shock absorber as a safety measure.
4. Disconnect shock and stabilizer bar attachments at lower control arm.
5. Loosen shaft end nuts.
6. Remove "U" bolts that retain the inboard end of the lower control arm.
7. Lower jack SLOWLY to release spring compression (Fig. 3C-24) and gain clearance to remove bushings.

WARNING: Be sure all compression is released from coil springs.

8. Remove the stakes on the front bushing using tool J-22717 or equivalent tool.
9. Bushings may now be replaced. Install "C" clamps J-24435-7 and receiver J-24435-3 with remover J-24435-2 and spacer J-24435-6 as shown in Figure 3C-25.
10. Tighten the "C" clamp to remove the bushing.
11. Remove tools and discard old bushing.
12. Pivot shaft may now be removed if necessary.
13. Remove second bushing (leave pivot shaft in to pilot tool) by the same method as in steps 8-12.

Bushing Installation (Fig. 3C-26)

CAUTION: See CAUTION on page 1 of this section regarding the fasteners referred to in step 5.

1. Install new bushings as shown in Figure 3C-26 using spacer J-24435-6, installer J-24435-4 and "C" clamp J-24435-7.
2. Turn clamp in until bushing seats firmly.
- CAUTION:** Be sure spacer J-24435-6 is in position as shown in Figure 3C-26 to avoid collapsing control arm during assembly.
3. Install one bushing then insert the pivot shaft and install second bushing.
4. Stake front bushing at least in two places when installed.
5. Install the lower control arm to the vehicle as described under "Lower Control Arm - Installation", being sure to torque all fasteners to the proper specification.

Lower Control Arm Inner Pivot Shaft And Bushing Replacement-G10-G20 Models

Removal

1. Remove lower control arm as previously outlined.
2. Remove pivot shaft nuts.
3. Place control arm in an arbor press, press front end of pivot shaft to remove rear bushing, and pivot shaft assembly.
4. Remove the stakes on the front bushing using Tool J-22717 or equivalent tool.
5. Install "C" clamp J-24435-7 and receiver J-24435-3 with remover J-24435-2 and spacer J-24435-6 as shown in Figure 3C-25.
6. Tighten "C" clamp to remove the bushing.

Installation

CAUTION: See CAUTION on page 1 of this section in the 1977 Service Manual regarding the fasteners referred to in step 5.

1. Install new bushings as shown in Figure 3C-26 using spacer J-24435-6, installer J-24435-4 and "C" clamp J-24435-7.
2. Turn clamp in until bushing seats firmly.
- CAUTION:** Be sure spacer J-24435-6 is in position as shown in Figure 3C-26 to avoid collapsing control arm during assembly.
- NOTE:** Be sure outer tube hole is to the front or forwards to the staked bushing.
3. Stake front bushing at least in two places when installed.
4. Insert the pivot shaft and install second bushing.
5. Install the lower control arm to the vehicle as described under "Lower Control Arm - Installation", being sure to torque all fasteners to the proper specification.

Lower Control Arm Installation

CAUTION: See CAUTION on page 1 of this section regarding the fasteners referred to in steps 2 and 3.

1. Install lower ball stud through steering knuckle and tighten nut.
2. Install spring and control arm as outlined under spring installation.
3. Torque lower control arm ball stud to specifications

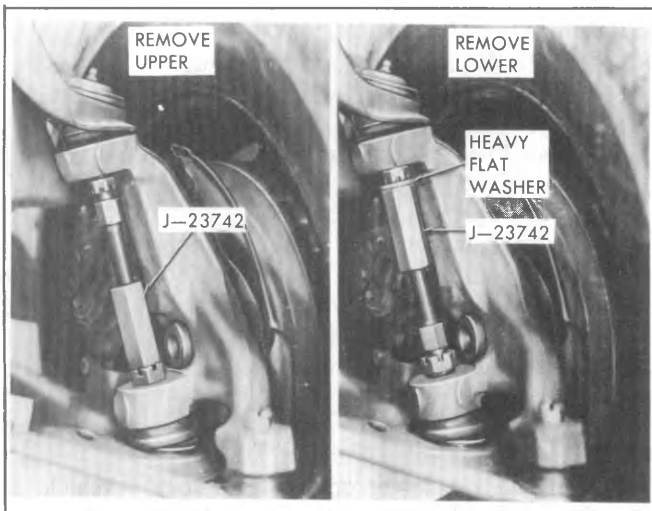


Fig. 3C-27--Disconnecting Ball Joints—Typical

and install cotter pin.

4. Install brake caliper assembly if removed (see section 5).
5. Lower the vehicle to the floor.

BALL JOINT SERVICE—ON VEHICLE

Ball Joint—Inspection

The upper ball stud is spring loaded in its socket. This minimizes looseness at this point and compensates for normal wear, if the upper stud has any perceptible lateral shake, or if it can be twisted in its socket with the fingers, the upper ball joint should be replaced.

Upper—Removal

1. Raise vehicle on hoist. If a frame hoist is used, it will be necessary to support the lower control arm with a floor jack.
2. Remove cotter pin from upper ball stud and loosen stud nut (two turns) but do not remove nut.
3. Install J-23742 between the ball studs as shown in Figure 3C-27.

NOTE: It is necessary to remove the brake caliper assembly and wire it to the frame to gain clearance for tool J-23742. See section 5 for the proper procedure.

CAUTION: Before proceeding with Step 4, be sure lower control arm is supported as pointed out in Step 1.

4. Extend bolt from Tool J-23742 to loosen ball stud in steering knuckle. When stud is loose, remove tool and stud nut.
5. Center punch rivet heads and drill out rivets.
6. Remove the ball joint assembly.

Installation

CAUTION: See CAUTION on page 1 of this section regarding the fasteners referred to in steps 1, 3 and 6.

1. Install new service ball joint, using bolts and nuts supplied with joint, to upper arm. Torque nuts to 45 ft. lbs.
2. Mate ball stud to steering knuckle and install stud nut.
3. Torque the ball stud nut as follows:
 - A. 10 Series 40–60 ft. lbs. plus additional torque to align cotter pin not to exceed 90 ft. lbs. Never back off to

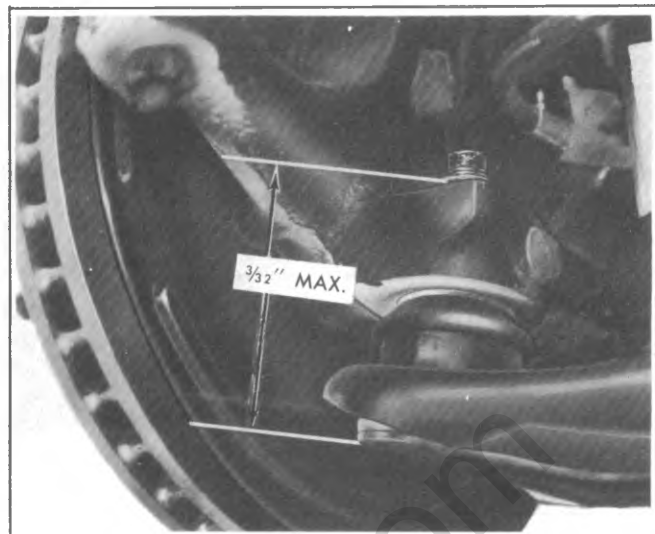


Fig. 3C-28--Checking Lower Ball Joint

align cotter pin.

B. 20–30 Series 80–100 ft. lbs. plus additional torque to align cotter pin not to exceed 130 ft. lbs. Never back off to align cotter pin.

4. Install new cotter pin.
5. Install lube fitting and lube new joint.
6. Install brake caliper assembly if removed (see section 5).
7. Install tire and wheel assembly.
8. Lower the vehicle to the floor.

Ball Joint—Inspection

Lower

Lower ball joints are a loose fit when not connected to the steering knuckle. Wear may be checked without disassembling the ball stud, as follows:

1. Support weight of control arms at wheel hub and drum.
2. Accurately measure distance between tip of ball stud and tip of grease fitting below ball joint.
3. Move support to control arm to allow wheel hub and drum to hang free. Measure distance as in Step 2. If the difference in measurements exceeds .094" (3/32") for all models, ball joint is worn and should be replaced (Fig. 3C-28).

Lower—Removal

1. Raise vehicle on a hoist. If a frame hoist is used it will be necessary to support the lower control arm with a floor stand.
2. Remove the tire and wheel assembly.
3. Remove the lower stud cotter pin and loosen (two turns) but do not remove the stud nut.
4. Install J-23742 between the ball studs as shown in Figure 3C-27.

NOTE: It may be necessary to remove the brake caliper assembly and wire it to the frame to gain clearance for tool J-23742. See section 5 for proper procedure.

CAUTION: Before proceeding with Step 5, be sure lower control arm is supported as pointed out in Step 1.

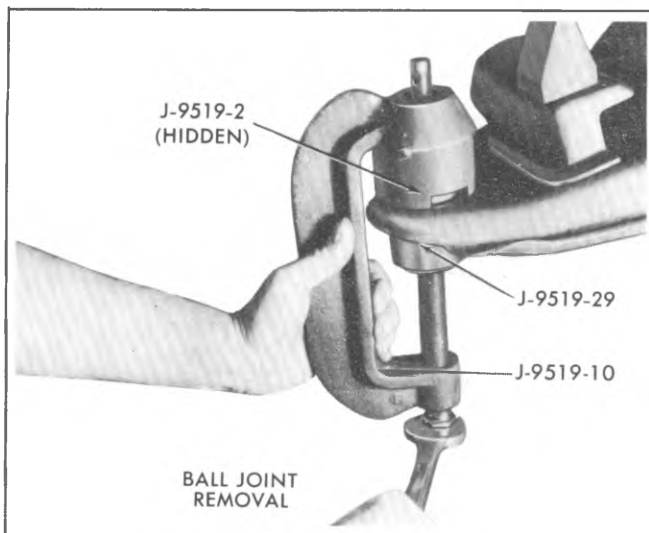


Fig. 3C-29--Ball Joint Removal

5. Extend bolt from Tool J-23742 to loosen ball stud in steering knuckle. When stud is loosened, remove tool and ball stud nut.

6. Pull the brake disc and knuckle assembly up off the ball stud and support the upper arm with a block of wood so that assembly is out of working area.

CAUTION: Do not put stress on the brake line flex hose.

7. Install Tools J-9519-10 and J-9519-2 and J-9519-29 as shown in Fig. 3C-29.

8. Turn hex head screw until ball joint is free of control arm.

9. Remove tools and the ball joint.

Installation (Fig. 3C-30)

CAUTION: See CAUTION on page 1 of this section regarding the fasteners referred to in steps 4, 5 and 7.

1. Start the new ball joint into the control arm and install J-9519-10 and J-10519-16 as shown.

NOTE: Position bleed vent in rubber boot facing inward.

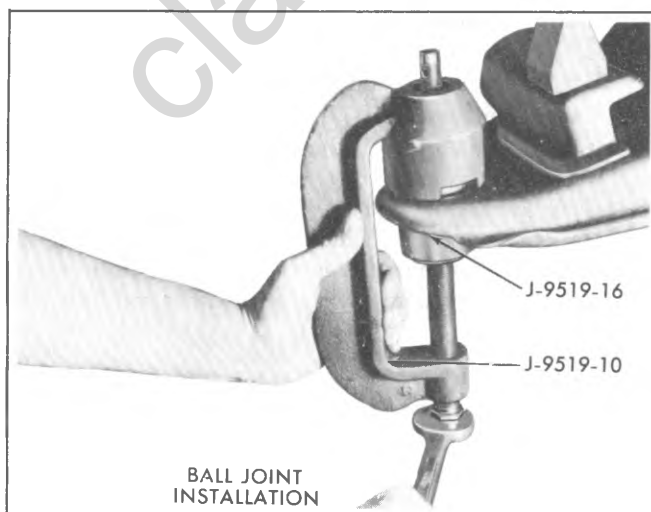


Fig. 3C-30--Installing Ball Joint

2. Turn hex head screw until ball joint is seated in control arm.

3. Lower the upper arm and mate the steering knuckle to the lower ball stud.

4. Install brake caliper assembly if removed (see Section 5).

5. Install ball stud nut and torque as follows. All Series, 80–100 ft. lbs. plus additional torque to align cotter pin hole not to exceed 130 ft. lbs. maximum. Never back off to align cotter pin.

6. Install a lube fitting and lube the joint.

7. Install tire and wheel assembly and lower vehicle to floor.

STEERING KNUCKLE

It is recommended that vehicle be raised and supported as on a twin-post hoist so that the front coil spring remains compressed, yet the wheel and steering knuckle assembly remain accessible. If a frame hoist is used, support lower control arm with an adjustable jackstand to safely retain spring in its curb height position.

Removal

1. Raise vehicle on hoist and support lower control arm as noted above.

2. Remove wheel and tire assembly.

3. Remove caliper as outlined under "Front Wheel Hub - Removal".

4. Remove disc splash shield bolts securing the shield to the steering knuckle. Remove Shield.

5. Refer to Section 3B-Steering for service removal operations.

6. Remove upper and lower ball stud cotter pins and loosen ball stud nuts. Free steering knuckle from ball studs by installing Special Tool J-23742. Remove ball stud nuts and withdraw steering knuckle.

Installation

CAUTION: See CAUTION on page 1 of this section regarding the fasteners referred to in steps 2, 3, 4 and 5.

1. Place steering knuckle in position and insert upper and lower ball studs into knuckle bosses.

CAUTION: Steering knuckle hole, ball stud and nut should be free of dirt and grease before tightening nut.

2. Install ball stud nuts and tighten nut to specifications. (See Specification Section.)

CAUTION: If necessary, tighten one more notch to insert cotter pins. Do not loosen nut to insert cotter pin. Refer to Ball Joint text for proper nut installation sequence.

3. Reverse remaining removal procedure, and tighten splash shield mounting bolt. Tighten two caliper assembly mounting bolts to 35 ft. lb. torque.

4. Adjust wheel bearings as outlined under Front Wheel Bearing Adjustment.

5. Tighten wheel nuts to 75 ft. lb.

CROSSMEMBER AND SUSPENSION UNIT

Component parts of the front suspension may be serviced separately as outlined in the preceding service operations. However, if extensive service is to be performed to crossmember, frame, etc., the unit can be removed and installed as follows:

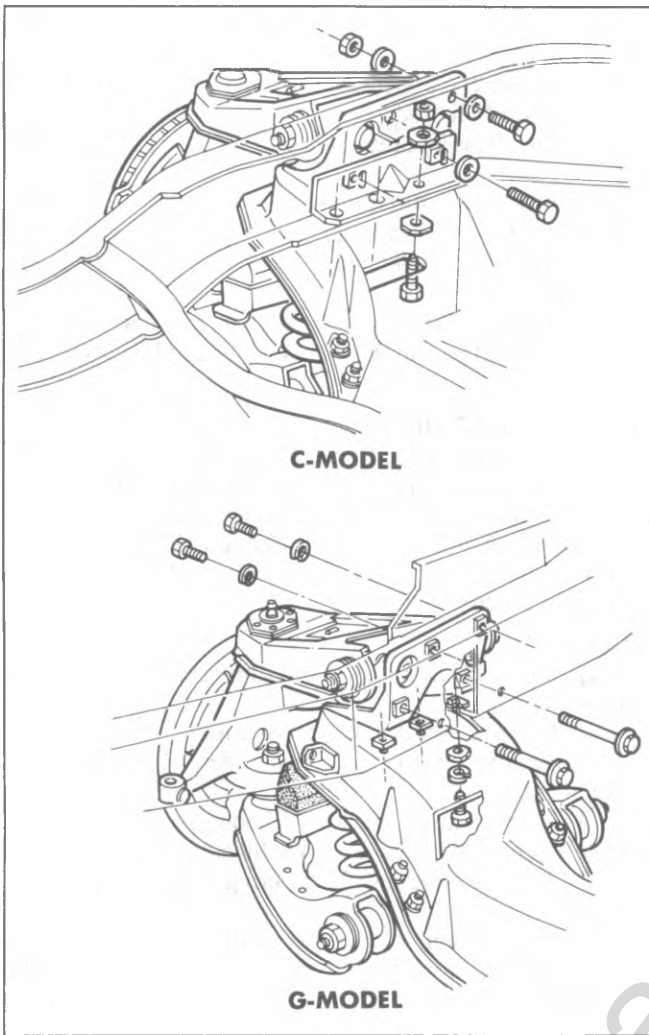


Fig. 3C-31--Suspension Unit to Frame

Removal (Fig. 3C-31)

1. Raise hood and disconnect negative battery cable from battery.
2. Raise vehicle on hoist.
3. Remove front wheels.
4. Disconnect front brake hose clip from each upper control arm.
5. Support front of vehicle with jack stands at frame side rails. Lower front hoist.
6. Clean area adjacent to brake hose fittings. Disconnect front brake hoses from calipers. Discard special washers (2 each hose). Cover disconnected end of each hose with suitable material.
7. Disconnect tie rod ends from steering knuckles. Discard cotter pins. Refer to Section 3B.
8. If equipped, disconnect front stabilizer from lower control arms.
9. Disconnect front shock absorbers from lower control arms.
10. Remove brake line clip bolts from front suspension crossmember. On C-Models the clip is located under right hand engine mount support bracket.

CAUTION: Failure to disconnect these clips from the front suspension unit will result in severe damage to the brake line when unit is lowered from vehicle.

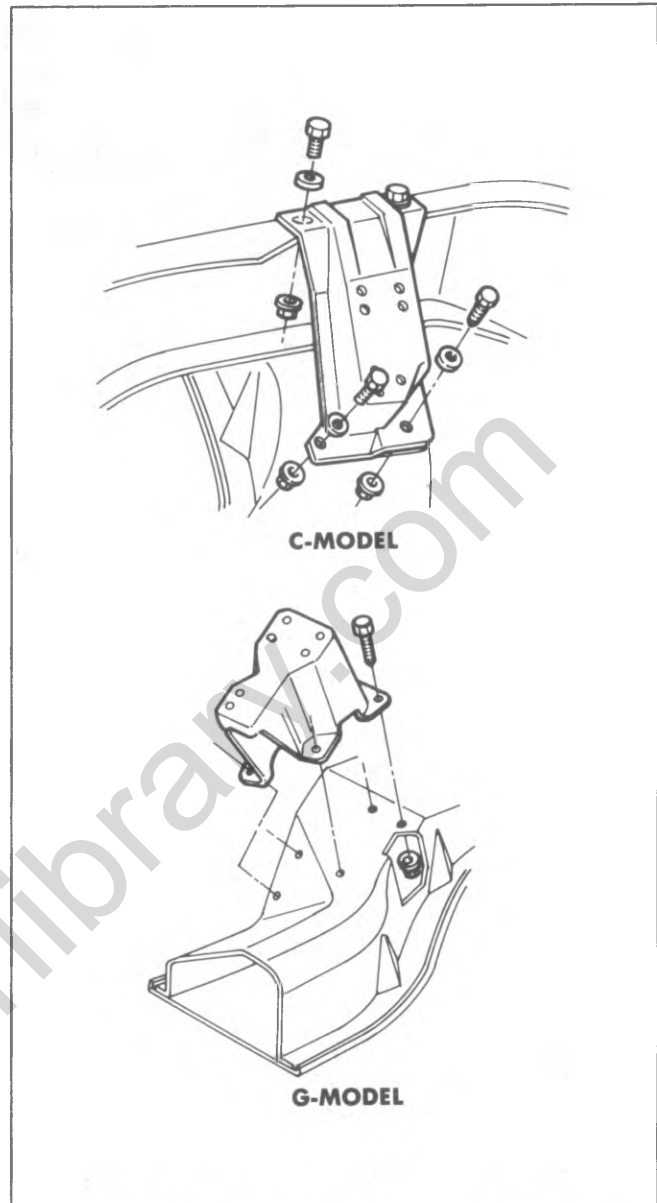


Fig. 3C-32--Engine Front Mounting Bracket

11. Remove engine mount support bracket to front suspension crossmember bolts.
12. Remove crossmember to lower frame rail bolts.
13. Raise hoist to support front suspension unit.
14. Support engine.

CAUTION: Engine must be supported adequately before front suspension unit is lowered from vehicle.

15. Remove upper control arm bracket to frame side rail bolts. Suspension unit is now disconnected from vehicle.
16. Lower hoist to lower front suspension unit from vehicle.

Installation

1. Raise hoist to align new suspension unit with frame rail holes.

CAUTION: See CAUTION, on page 1 of this section regarding fasteners referred to in steps 2-14.

2. Assemble (finger-tight) upper control arm bracket bolts and crossmember bolts to frame rails.
3. Torque upper control arm bracket bolts to frame side rails to 65 ft. lbs.
NOTE: Control arm bracket bolts must be torqued before crossmember bolts are torqued. Crossmember must be in contact with siderails.
4. Torque crossmember bolts to frame lower rails 100 ft. lbs.
NOTE: Engine support can be removed at this time.
5. Lower hoist.
6. Assemble (finger-tight) engine mount support bracket to front suspension crossmember bolts.
7. Torque engine mount support bracket bolts to 35 ft. lbs.
8. Install brake line clip bolt to front suspension crossmember. Torque to 150 in. lbs. (C-models), 100 in. lbs. (G-models).

9. Connect front shock absorbers to L.C.A.'s. Torque to 60 ft. lbs. (C-models), 70 ft. lbs. (G-models).
10. If equipped, connect front stabilizer to L.C.A.'s. Torque to 25 ft. lbs.
11. Connect tie rod ends to steering knuckles. Refer to Section 3B.
12. Connect front brake hose to caliper, using new special washers. Refer to Section 5.
13. Connect front brake hose clips to upper control arms. Torque nuts to 150 in. lbs.
14. Lubricate upper and lower ball joints.
15. Install front wheels.
16. Bleed brake system. Refer to Section 5 for correct bleeding procedures.
17. Lower vehicle.
18. Connect battery cable.

FRONT SUSPENSION, FOUR-WHEEL DRIVE SERIES K10, K20, K30

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GENERAL DESCRIPTION

Front drive axles used on K10, K20, and K30 trucks have several styles of wheel-end construction.

At the wheel ends of the axle tubes, two types of steering knuckle attachment are used. Figures 3C-1K and 3C-2K show the K10 and K20 knuckle attached with ball joints. Figure 3C-3K shows the king-pin attachment used in K30. The tapered upper king pin fits in a tapered nylon bushing. The lower king pin is part of the bearing cap, and this king pin rides in a tapered roller bearing.

All trucks with full-time four-wheel drive use a locked hub, as shown in Figure 3C-1K (for K10, K20), and in Figure 3C-3K (for K30). A free-wheeling hub is used on trucks equipped with part-time four-wheel drive. The free-wheeling hub (for K10, K20) is shown in Figure 3C-2K. This hub allows the driver to manually engage or disengage the hub from the axle shafts.

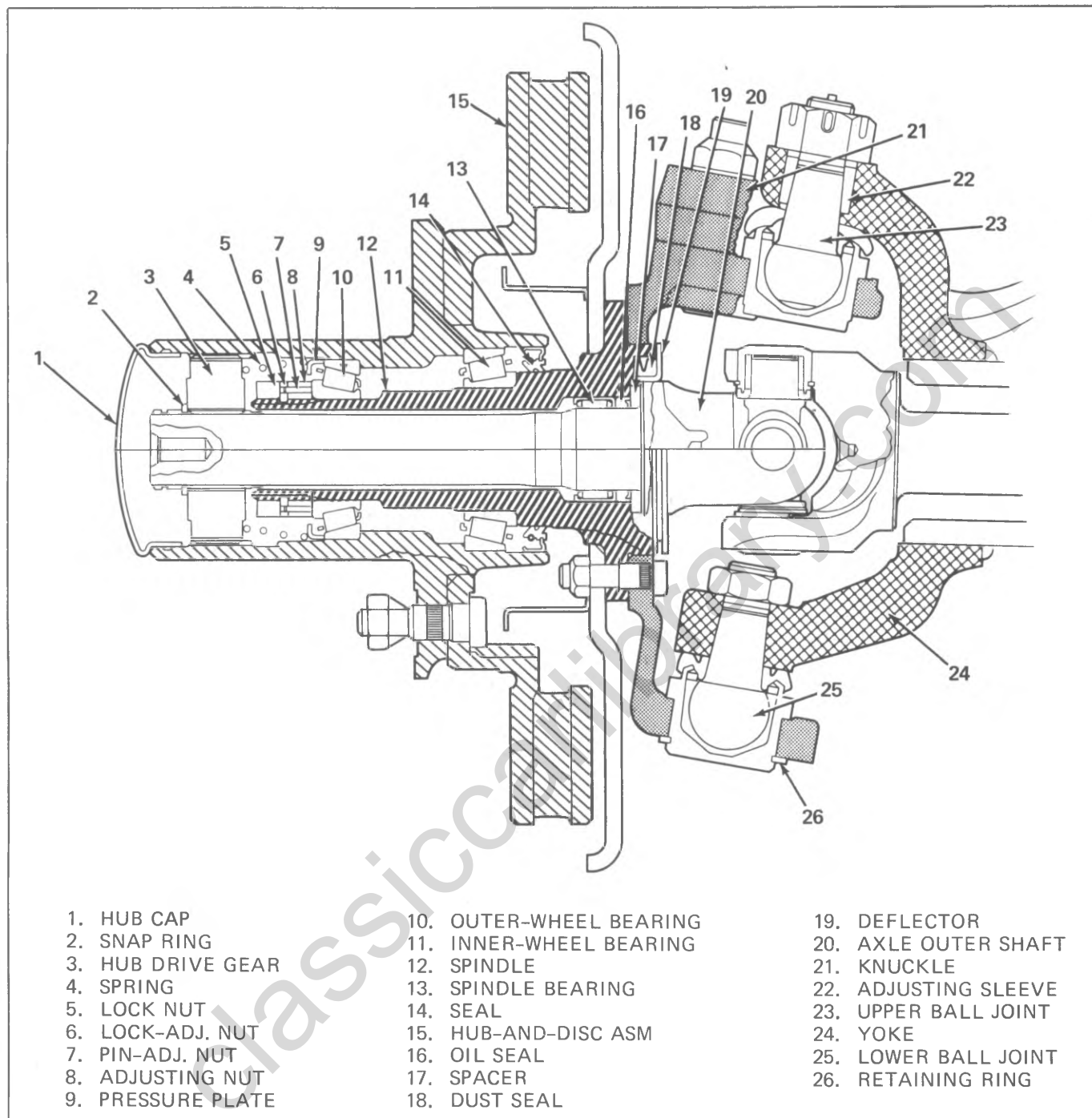


Fig. 3C-1K-K10, K20 with Locked Hub and Ball Joints

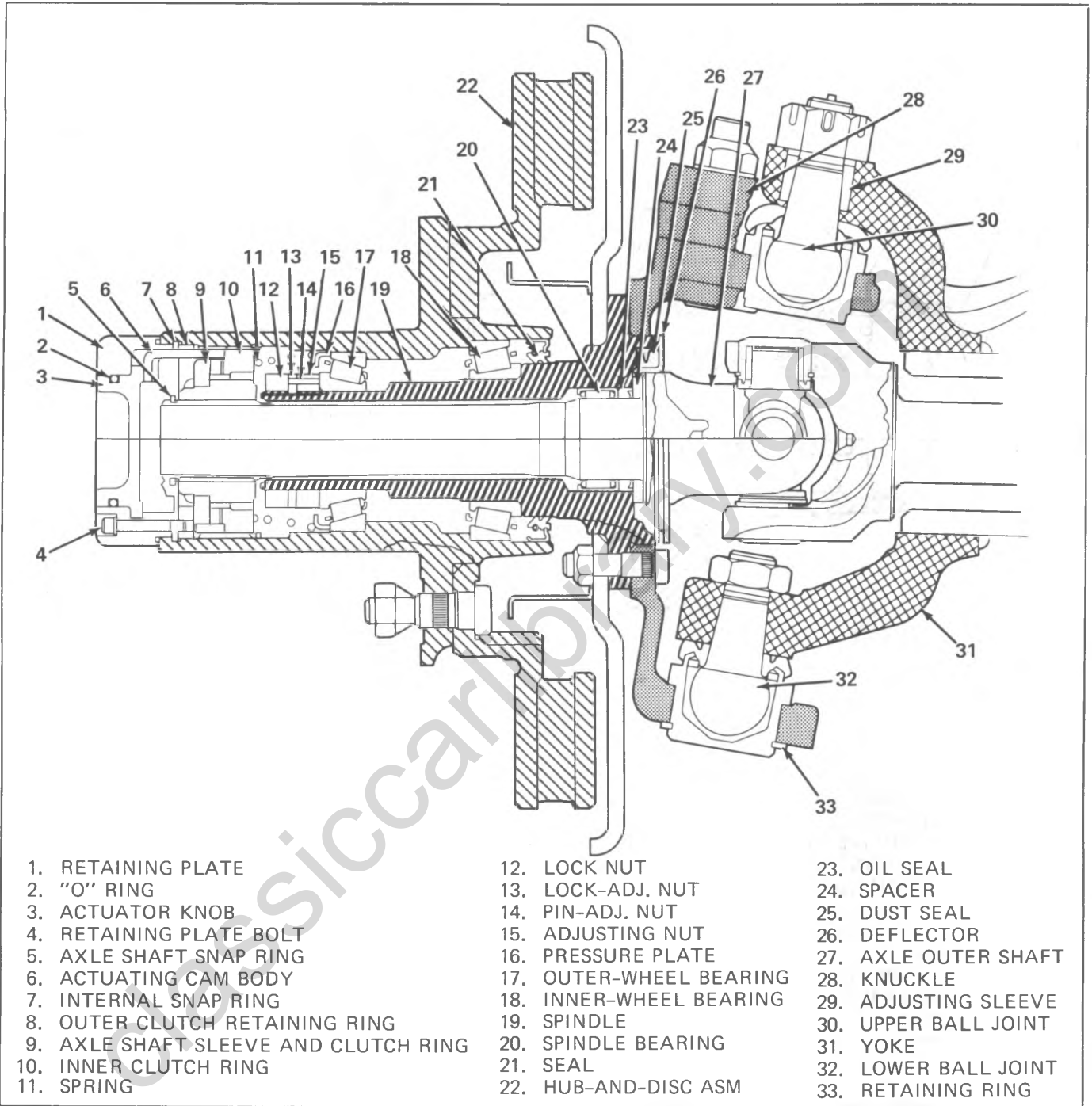


Fig. 3C-2K-K10, K20 with Free-Wheeling Hub and Ball Joints

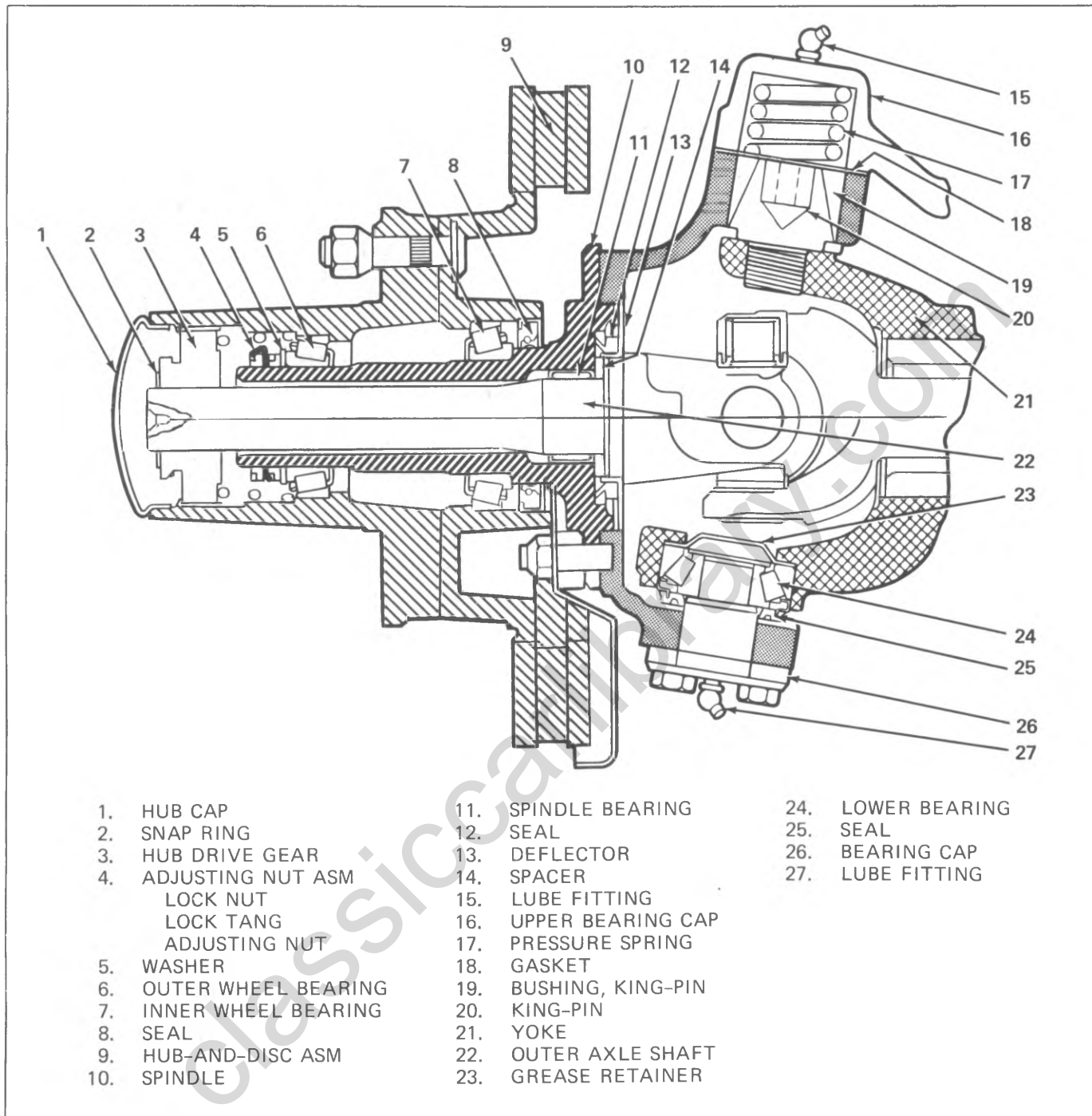


Fig. 3C-3K-K30 with Locked Hub and King-Pins

MAINTENANCE AND ADJUSTMENTS

BALL JOINT ADJUSTMENT (K10, K20)

Front axle ball joint adjustment is generally necessary only when there is excessive play in steering, irregular wear on tires or persistent loosening of the tie rod is observed.

1. Raise vehicle on hoist then place jack stands just inside of front springs.

2. Disconnect connecting rod and tie rod to allow independent movement of each steering knuckle.

3. Apply a fish-scale to the tie rod mounting hole of

the steering knuckle arm. With the knuckle assembly in the straight-ahead position, determine the right angle pull required to keep the knuckle assembly turning after initial break-away. This pull should not exceed 25 lbs., for each knuckle assembly, in either direction. See Figure 3C-4K.

4. If the effort exceeds 25 lbs., remove the upper ball stud nut, and loosen the ball stud adjusting sleeve as required. Re-torque the ball stud nut and recheck the turning effort.

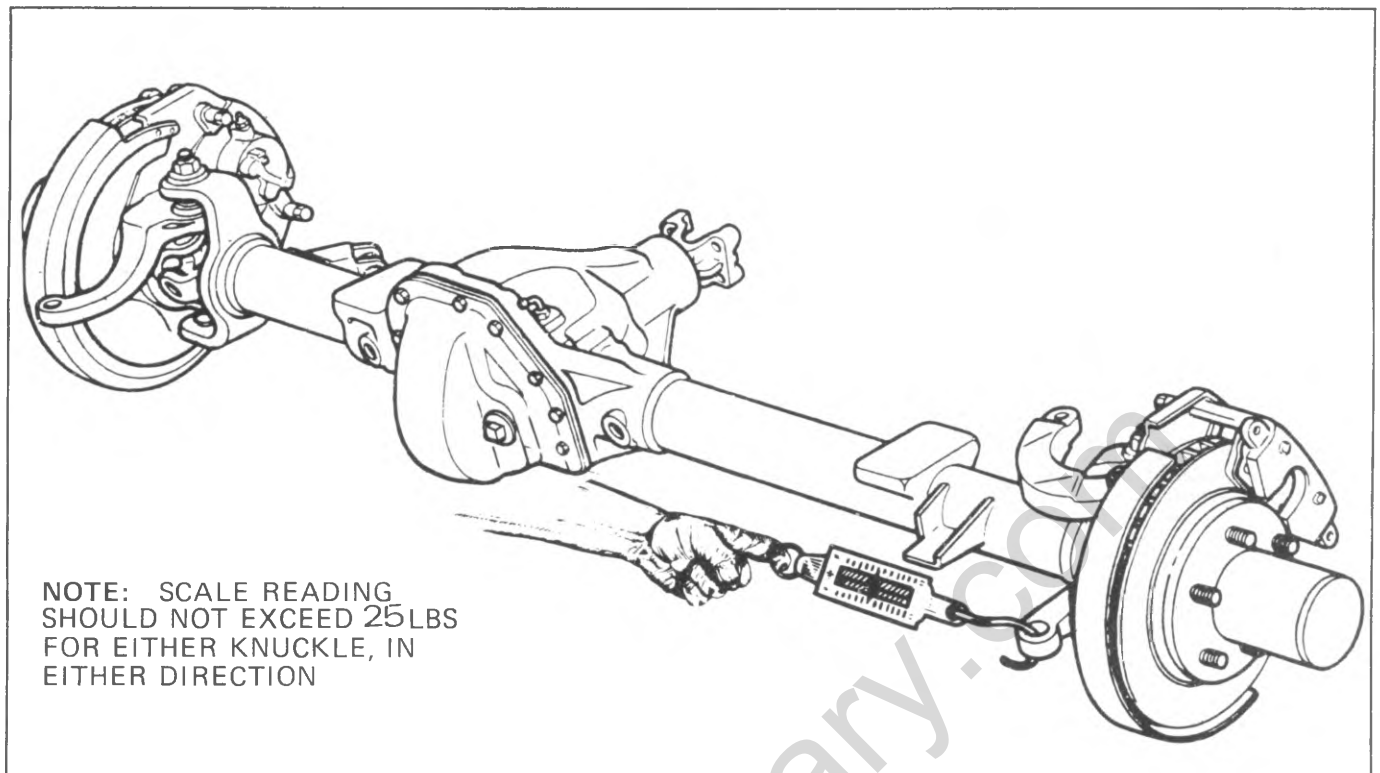


Fig. 3C-4K--Determining Front Axle Ball Joint Adjustment

BEARING LUBRICATION

Front Wheel Bearings

Spindle Bearings

Whenever front wheel bearings are lubricated, the spindle needle bearings should also be lubricated, with the same chassis grease. Under normal conditions, the lubrication interval should be 12,000 miles; off-road use such as in mud or water will require shorter intervals. The spindle bearings are accessible after removing the spindle, as shown in Figure 3C-6K.

WHEEL BEARING ADJUSTMENT

1. After lubricating the wheel bearings and the spindle bearings, install the hub-and-disc, and the outer wheel bearing to the spindle.

2. Torque the inner adjusting nut to 50 foot pounds, while rotating the hub-and-disc to seat the bearings. Use Tool J-6893 and Adapter J-23446 or J-6893-01 for K10,

K20; use J-26878 for K30. Back off the inner adjusting nut and retorque to 35 ft. lbs. while the hub is being rotated.

3. Back off the inner adjusting nut again 3/8 turn maximum.

a. For K10 and K20, assemble adjusting nut lock by aligning nearest hole in lock with adjusting nut pin. Install outer lock nut and torque to 50 ft. lbs. (minimum).

b. For K30, assemble lockwasher and outer locknut. Torque outer locknut to 65 ft. lbs. (minimum). Bend one ear of lockwasher over the inner nut a minimum of 30°. Bend one ear of lockwasher over the outer nut a minimum of 60°.

NOTE: Hub assembly should have .001 to .010 inch end play, for all K10, K20 and K30 models.

4. If vehicle is equipped with locked hubs, install the hub cap assembly. If the vehicle is equipped with free-wheeling hubs, refer to free-wheeling hub assembly and installation procedures.

COMPONENT REPLACEMENT

HUB REPLACEMENT

CAUTION: See CAUTION on page 1 of this section, regarding the fasteners in the following procedures for Hub Replacement.

FREE-WHEELING HUBS

K10, K20 (PART-TIME)

Hub Removal

1. Turn actuator lever to set hub to "LOCK" position (Fig. 3C-5K) and raise vehicle on hoist.

2. Remove six retaining plate bolts and remove retaining plate actuating knob and "O" ring.

3. Remove internal snap ring, outer clutch retaining ring and actuating cam body.

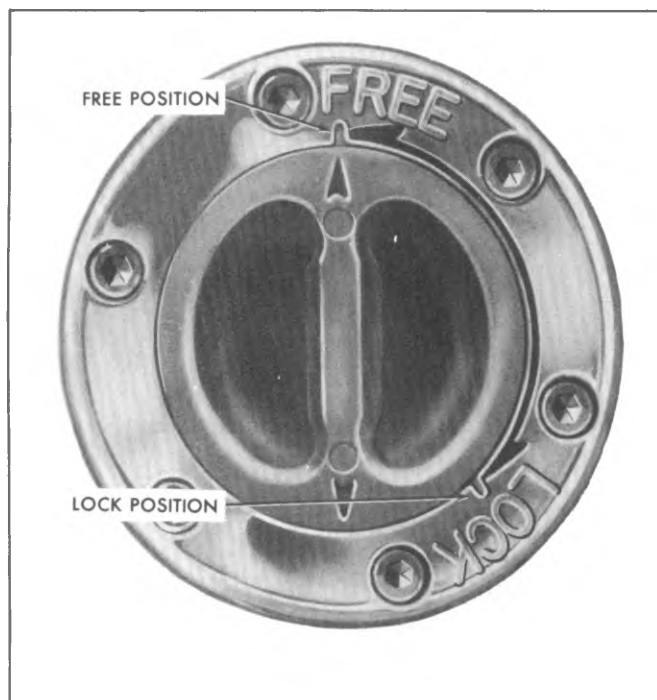


Fig. 3C-5K--Hub Key Position - Typical

4. Relieve pressure on the axle shaft snap ring and remove snap ring.

5. Remove the axle shaft sleeve and clutch ring assembly and inner clutch ring and bushing assembly.

6. Remove pressure spring and spring retainer plate.

7. Remove the wheel bearing outer lock nut, lock ring, and wheel bearing inner adjusting nut using Tool J-6893 and Adapter J-23446 or Tool J-6893-01.

NOTE: If the disc or other brake components require repairs or replacement, refer to Section 5.

8. Remove the hub-and-disc assembly, outer wheel bearing and the spring retainer plate.

a. Remove the oil seal and inner bearing cone from the hub using a brass drift and tapping with a hammer. Discard the oil seal.

b. Remove the inner and outer bearing cups using a brass drift and hammer.

c. Clean, inspect and lubricate all parts as required.

Servicing Actuating Parts

1. Remove actuator knob and "O" ring from retaining plate, discard "O" ring and replace with a new "O" ring during assembly.

2. Slide inner clutch ring and bushing assembly from axle sleeve and clutch ring assembly.

3. Wash all parts in solvent and air dry.

4. Inspect all parts for wear, cracks or broken teeth.

5. Replace all "O" rings during assembly.

6. Place new "O" ring seal on actuator knob. Apply Lubri-plate, or equivalent, to "O" ring and place actuator knob in retaining plate.

Installation of Hub

NOTE: All parts should be lubricated for normal operation during assembly with an ample amount of high speed grease. Lubrication **MUST** be applied to prevent deterioration before the unit is placed in

service.

1. Assemble the outer wheel bearing cup into the wheel hub using Installer J-6368 and Driver Handle J-8092.

2. Assemble the inner wheel bearing cup into the wheel hub using Installer J-23448 and Driver Handle J-8092.

3. Pack the wheel bearing cone with a high melting point type wheel bearing grease and insert the cone into the cup.

4. After lubricating the wheel bearings, install the hub-and-disc and the bearings to the spindle.

5. Torque the inner adjusting nut to 50 foot pounds, while rotating the hub-and-disc to seat the bearings. Use Tool J-6893 and Adapter J-23446 or J-6893-01. Back off the inner adjusting nut and retorquer to 35 ft. lbs. while the hub is being rotated.

6. Back off the inner adjusting nut again 3/8 turn maximum. Assemble the adjusting nut lock by aligning the nearest hole in lock with the adjusting nut pin. Install outer lock nut and torque to 50 ft. lbs. (minimum).

NOTE: Hub assembly should have .001 to .010 inch end play.

7. Install spring retainer plate (flange side facing bearing) over spindle nuts and seat retainer against bearing outer cup.

8. Install pressure spring into position. Large O.D. seats against spring retaining plate.

NOTE: Spring is an interference fit. When spring is seated, spring extends past the spindle nuts by approximately 7/8".

9. Place inner clutch ring and bushing assembly into axle shaft sleeve and clutch ring assembly and install as an assembly onto the axle shaft. Press in on assembly and install axle shaft snap ring.

NOTE: Install 7/16 x 20 bolt in axle shaft end and pull outward on axle shaft to aid in installing snap rings.

10. Install actuating cam body (cams facing outward), outer clutch retaining ring and internal snap ring.

11. Install "O" ring on retaining plate and install actuating knob and retaining plate.

NOTE: Install actuating knob with knob in "LOCK" position--grooves in knob must fit into actuator cam body.

12. Install six cover bolts and seals, and torque to 35-40 in. lbs.

13. Turn knob to "FREE" position to check for proper operation.

14. Lower vehicle to floor.

LOCKED HUBS

K10, K20, K30 (FULL-TIME)

Removal and Service

1. Remove the hub cap and snap ring.

2. Remove the drive gear and, on K10 and K20, the pressure spring. Place a hand over the drive gear and use a screwdriver to pry the gear out.

3. Remove the wheel bearing outer lock nut, lock ring, and wheel bearing inner adjusting nut using Tool J-6893 and Adapter J-23446 or tool J-6893-01 for K10, K20; use J-26878 for K30.

NOTE: If the disc or other brake components require repairs or replacement, refer to Section 5.

4. Remove the hub-and-disc assembly, outer wheel bearing and the spring retainer plate.

a. Remove the oil seal and inner bearing cone from the hub using a brass drift and tapping with a hammer. Discard the oil seal.

b. Remove the inner and outer bearing cups using a brass drift and hammer.

c. Clean, inspect and lubricate all parts as required.

Installation

1. Assemble the outer wheel bearing cup into the wheel hub.

a. Use installer J-6368 and Driver Handle J-8092 for K10, K20.

b. Use J-8608 for K-30.

2. Assemble the inner wheel bearing cup into the wheel hub.

a. Use J-23448 and Driver Handle J-8092 for K10, K20.

b. Use J-22306 for K-30.

3. Pack the wheel bearing cone with a high melting point type wheel bearing grease.

a. Insert the cone into the cup.

b. Install new grease seal into inboard end of hub. Use J-24428 for K30.

4. After lubricating the wheel bearings, install the hub-and-disc and the bearings to the spindle.

5. Torque the inner adjusting nut to 50 ft. lbs. while rotating the hub-and-disc to seat the bearings. Back off the inner adjusting nut and retorqued to 35 ft. lbs. while the hub is being rotated.

6. Back off the inner adjusting nut again 3/8 turn maximum.

a. **For K10 and K20**, assemble the adjusting nut lock by aligning the nearest hole in lock with the adjusting nut pin. Install outer lock nut and torque to 50 ft. lbs. (minimum).

b. **For K30**, assemble lockwasher and outer locknut. Torque outer locknut to 65 ft. lbs. (minimum). Bend one ear of lockwasher over the inner nut a minimum of 30°. Bend one ear of lockwasher over outer nut, a minimum of 60°.

NOTE: Hub assembly should have .001 to .010 inch end play, for all K10, K20 and K30 models.

CAUTION: See *CAUTION* on page 1 of this section.

7. Install the pressure spring (on K10 and K20), drive gear, snap ring and hub cap.

SPINDLE

Removal

1. Remove the hub-and-disc assembly as outlined earlier.

2. Remove the spindle retaining bolts.

3. Remove the spindle and bronze thrust washer by tapping the end of the spindle lightly with a soft hammer to break it loose from the knuckle as shown in Figure 3C-6K. Replace the thrust washer if excessive wear has occurred.

Servicing Spindle Components

NOTE: When servicing the spindle check the spindle grease seals (Fig. 7K).

1. Secure the spindle in a vise by locating on the high step diameter. Be sure that the machined surface of the spindle will not be damaged by the vise jaws.

2. Remove the oil seal.

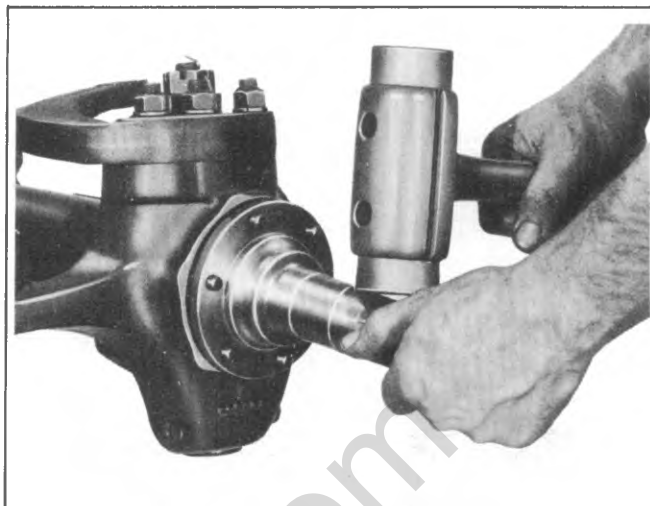


Fig. 3C-6K--Removing Spindle and Thrust Washer

3. Remove the needle roller bearing.

4. Place the spindle in a vise on the high step and install needle roller bearing.

a. Use J-23445 and Drive Handle J-8092 for K10, K20.

b. Use J-21465-17 for K-30.

5. Install grease seal onto slinger with lip toward spindle.

6. Relubricate the needle bearing and the spindle end with a high melting point type wheel bearing grease.

Installation

1. Install the bronze thrust washer over the axle shaft with the chamfer toward the slinger and install the spindle as shown in Figure 3C-8K.

2. Assemble spindle to knuckle.

NOTE: Torque spindle nuts to 25 ft. lbs. (for K10, K20); torque to 60 ft. lbs. (for K30).

CAUTION: See *CAUTION* on page 1 of this section.

KNUCKLE

K10, K20, (WITH BALL JOINTS)

Removal

1. Remove hub and spindle components as outlined earlier.

2. If the steering arm is to be removed, disconnect the tie rod.

a. Remove cotter pin.

b. Loosen tie rod nuts and tap on nut with a soft hammer to break the studs loose from the knuckle arm.

c. Remove nuts and disconnect the tie rod.

CAUTION: If it is necessary to remove the steering arm, discard the self-locking nuts (Fig. 3C-9K) and replace with new nuts at assembly.

3. Remove the cotter pin from the upper ball socket nut.

4. Remove the retaining nuts from the upper and lower ball sockets as shown in Figure 3C-10K.

5. Remove the knuckle assembly from the yoke by inserting a suitable wedge-shaped tool between the lower ball stud and the yoke and tapping on the tool to release the knuckle assembly. Repeat as required at the upper ball stud location.

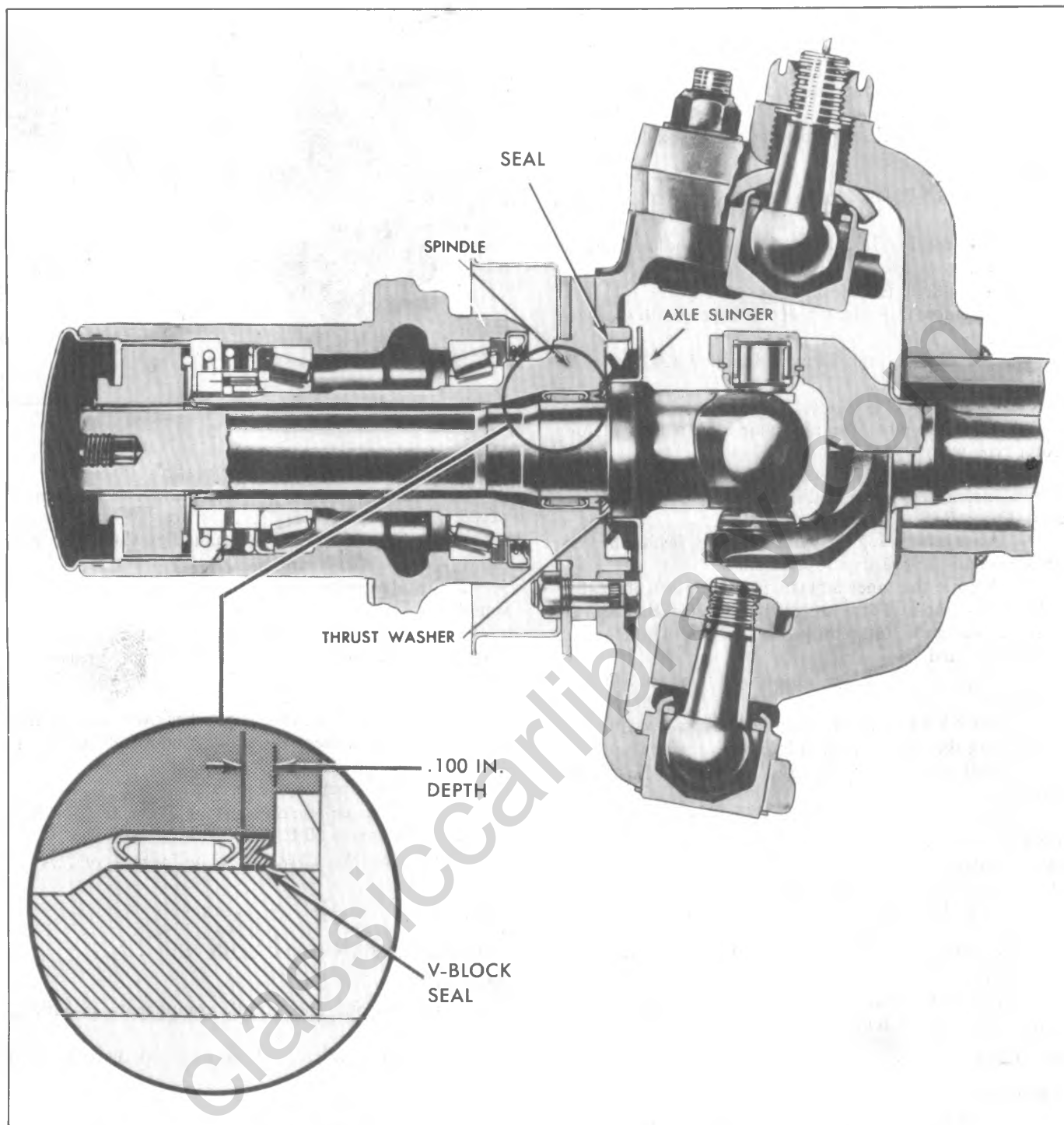


Fig. 3C-7K--Front Spindle Grease Seals

Ball Joint Service

CAUTION: Do not remove the yoke upper ball stud adjusting sleeve unless new ball studs are being installed. If it is necessary to loosen the sleeve to remove the knuckle, do not loosen it more than two threads using Spanner J-23447 as shown in Figure 3C-15K. The nonhardened threads in the yoke can be easily damaged by the hardened threads in the adjusting sleeve if caution is not used during knuckle removal.

NOTE: Remove the lower ball joint snap ring before beginning. Lower ball joint must be removed before any service can be performed on the upper ball joint.

1. Remove the lower ball joint using tools J-9519-10, J-23454-1, and sleeve J-6382-3 or equivalent as shown in Figure 3C-11K.

NOTE: If Tool J-6382-3 is not available, a suitable tool may be fabricated from 2-1/2" O.D. steel tubing with 3/16" wall thickness, cut 2-1/2" long.

2. Remove the upper ball joint using tools J-9519-10,

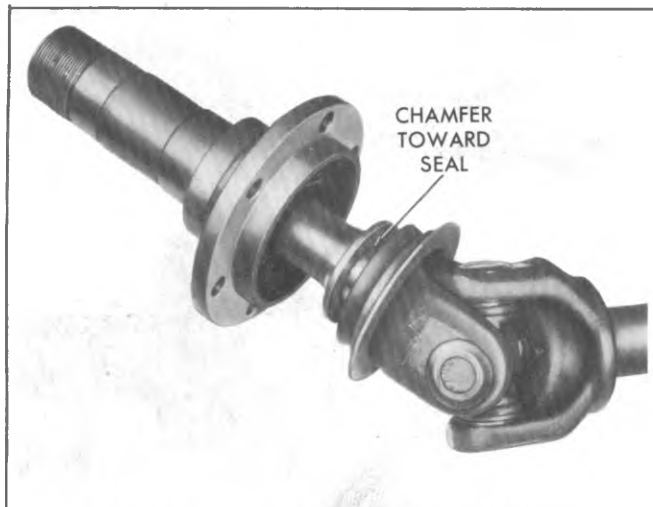


Fig. 3C-8K--Installing Spindle and Thrust Washer

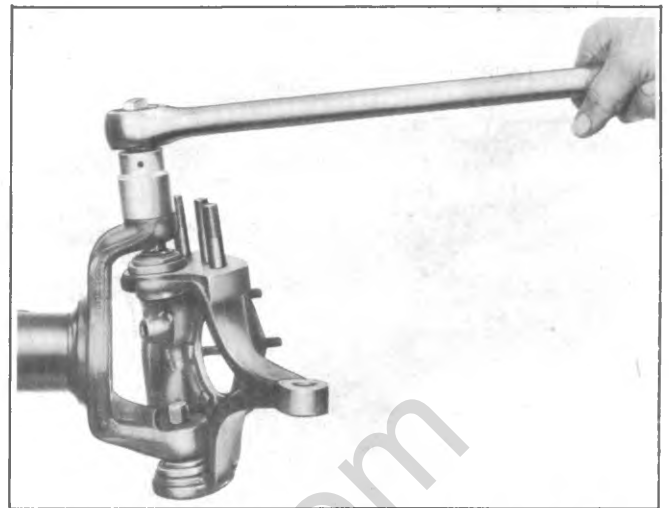


Fig. 3C-10K--Removing Ball Socket Retaining Nut

J-23454-1, and sleeve J-6382-3 or equivalent as shown in Figure 3C-12K.

3. Install the lower ball joint into the knuckle. Make sure that the lower ball joint (the joint without cotter pin hole in the stud end) is straight. Press the stud into the knuckle until properly seated using tools J-9519-10, J-23454-2, and J-6382-3 or equivalent as shown in Figure 3C-13K and install snap ring.

4. Install the upper ball joint into the knuckle. Press the stud into the knuckle until properly seated using Tools J-9519-10, J-23454-2, and J-6382-3 or equivalent as shown in Figure 3C-14K.

Installation

CAUTION: See *CAUTION* on page 1 of this section regarding the fasteners in the following steps.

1. Position the knuckle and sockets to the yoke. Install new nuts finger tight to the upper (the nut with the cotter pin slot) and lower ball socket studs.

2. Push up on the knuckle (to keep the ball socket from turning in the knuckle) while tightening the lower socket retaining nut. Torque lower nut to 70 ft. lbs.

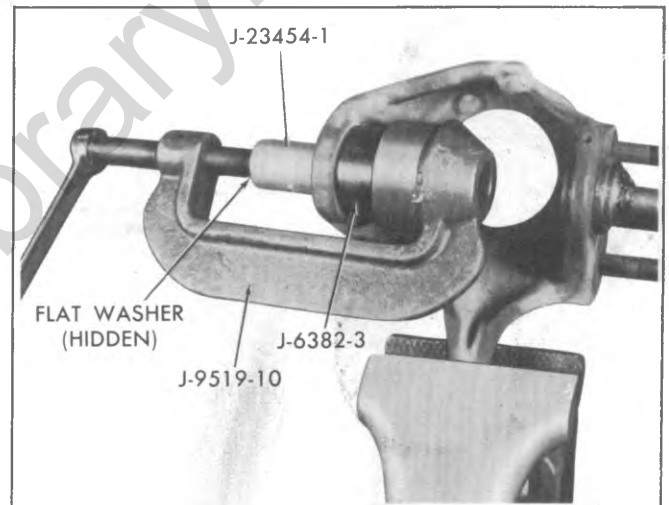


Fig. 3C-11K--Removing Lower Ball Joint

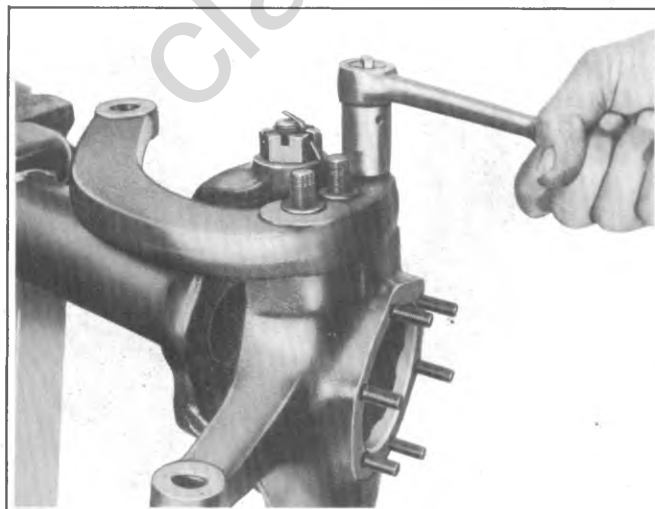


Fig. 3C-9K--Removing Steering Arm Nuts

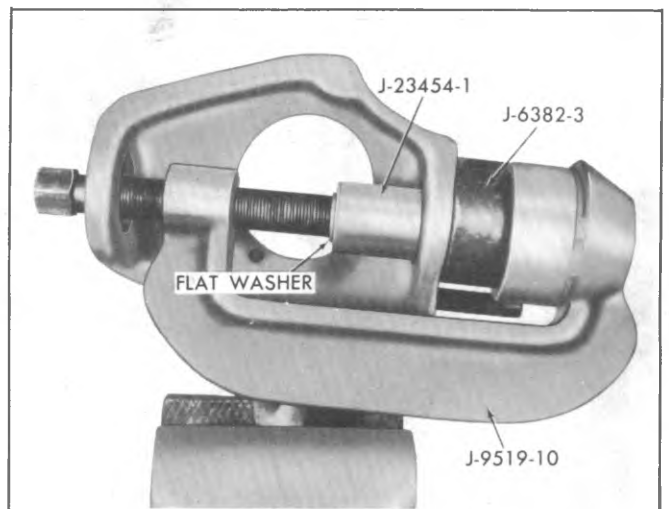


Fig. 3C-12K--Removing Upper Ball Joint

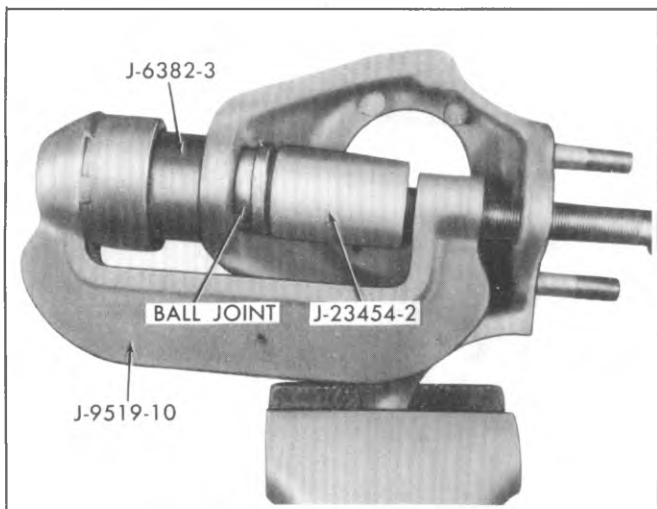


Fig. 3C-13K--Installing Lower Ball Joint

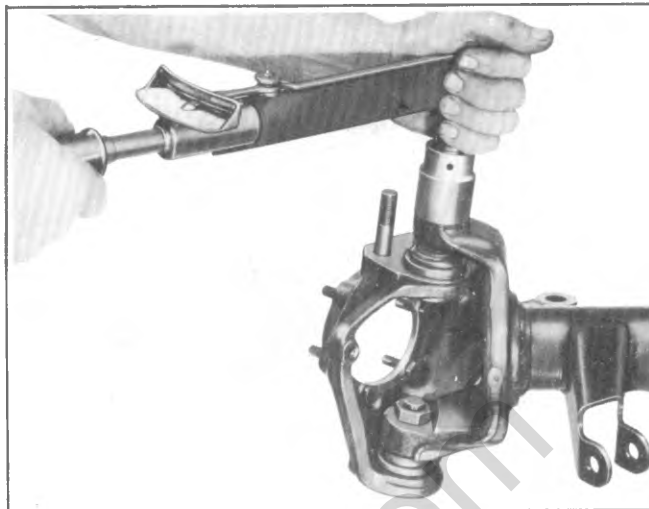


Fig. 3C-16K--Torquing Upper Ball Socket Nut

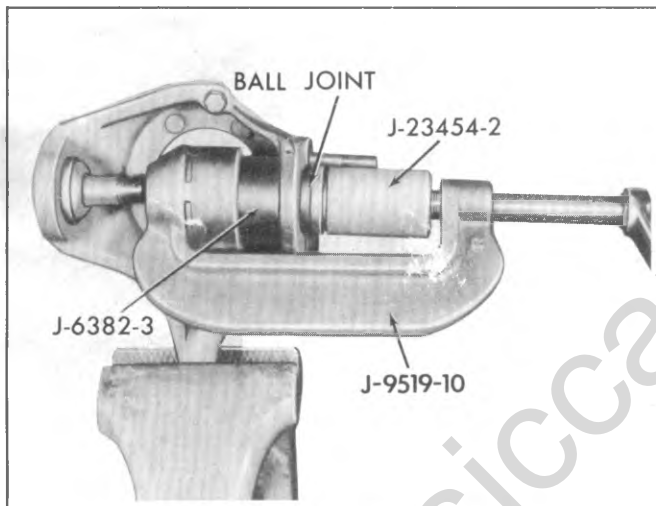


Fig. 3C-14K--Installing Upper Ball Joint

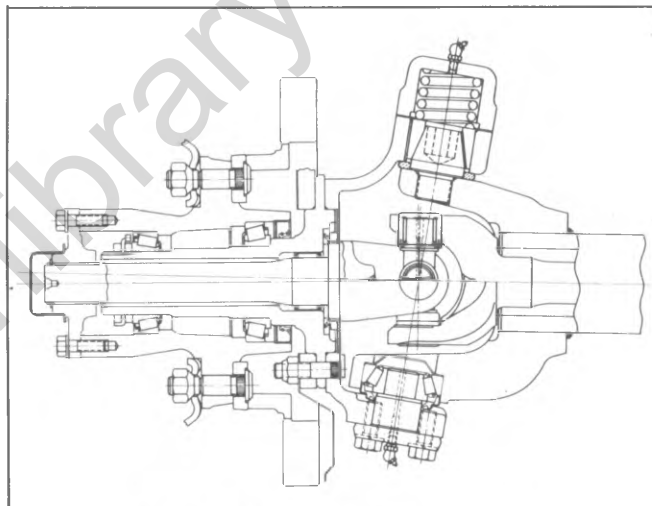


Fig. 3C-17K--Knuckle with King-Pins

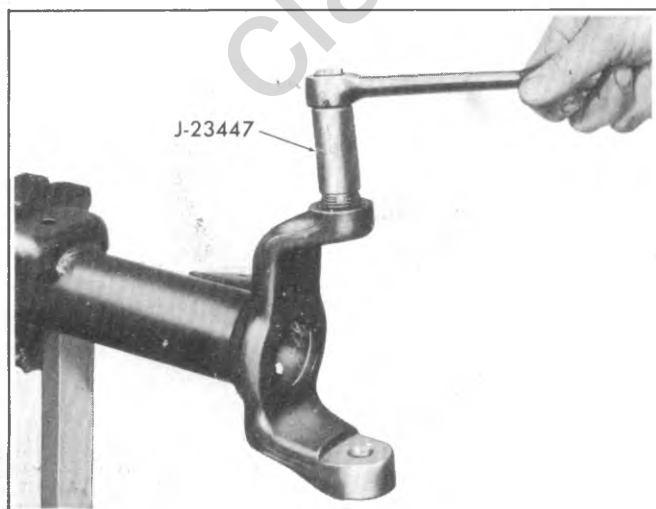


Fig. 3C-15K--Ball Stud Adjusting Sleeve

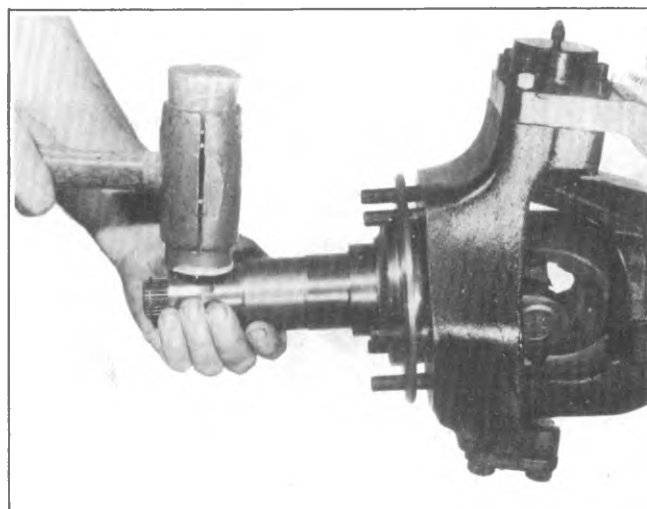


Fig. 3C-18K--Removing Spindle

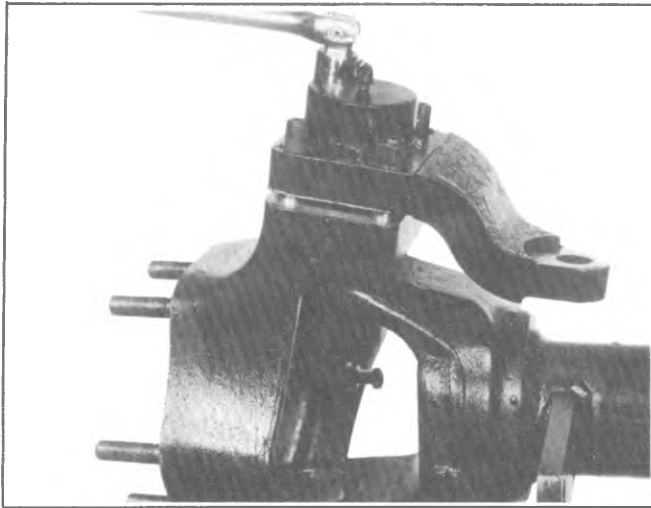


Fig. 3C-19K--Removing Nuts Alternately

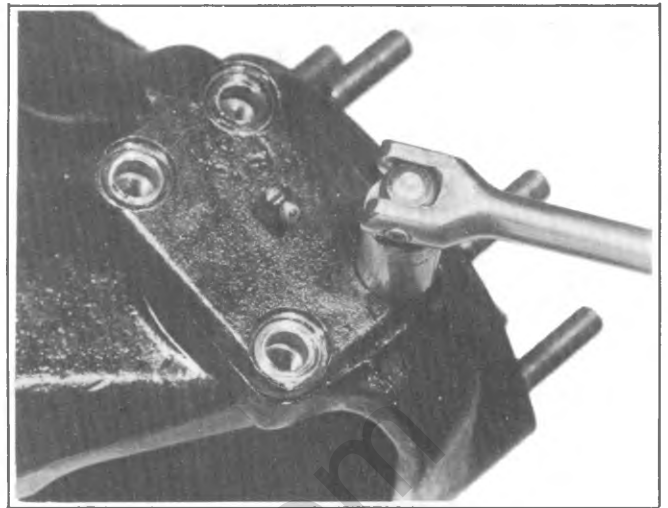


Fig. 3C-21K--Removing Lower Bearing Cap

3. Torque the yoke upper ball stud adjusting sleeve to 50 ft. lbs. using Spanner J-23447. See Figure 3C-15K.

4. Torque the upper ball socket nut to 100 ft. lbs. as shown in Figure 3C-16K. After torquing the nut, do not loosen to install cotter pin, apply additional torque, if necessary, to line up hole in stud with slot in nut.

5. If the tie rod and steering arm were removed:

a. Assemble the steering arm using the three stud adapters and three new self-locking nuts. Torque the nuts to 90 ft. lbs.

b. Assemble the tie rod to the knuckle arm. Torque the tie rod nuts to 45 ft. lbs. and install cotter pin.

KNUCKLE

K30 (WITH KING PINS)

Removal (Fig. 3C-17K)

1. Remove the hub and spindle as outlined earlier. If necessary, tap lightly with a rawhide hammer to free it from the knuckle. Check bronze spacer located between axle shaft joint assembly and bearing. If wear is evident, replace with a new one. See Figure 3C-18K.

2. Remove four nuts from upper king pin cap. Remove

nuts alternately as compression spring will force cap up. Refer to Figure 3C-19K.

3. Remove cap, compression spring, and gasket, as shown in Figure 3C-20K. Discard gasket, replace with new one at time of assembly.

4. From the underside of the knuckle, remove four cap screws from the lower king pin bearing cap. Remove the bearing cap-and-lower king pin. See Figure 3C-21K.

5. Remove upper king pin tapered bushing and knuckle from yoke. Remove king-pin felt seal. See Figure 3C-22K. Remove knuckle.

6. Remove upper king-pin from yoke with large breaker bar and J-26871, as seen in Figure 3C-23K.

NOTE: Torque specification is 500-600 ft. lbs.

7. Remove lower king pin bearing cup, cone, grease retainer, and seal all at the same time, as shown in Figure 3C-24K. Discard seal and replace with new one at time of assembly. If grease retainer is damaged, replace with new one at time of assembly.

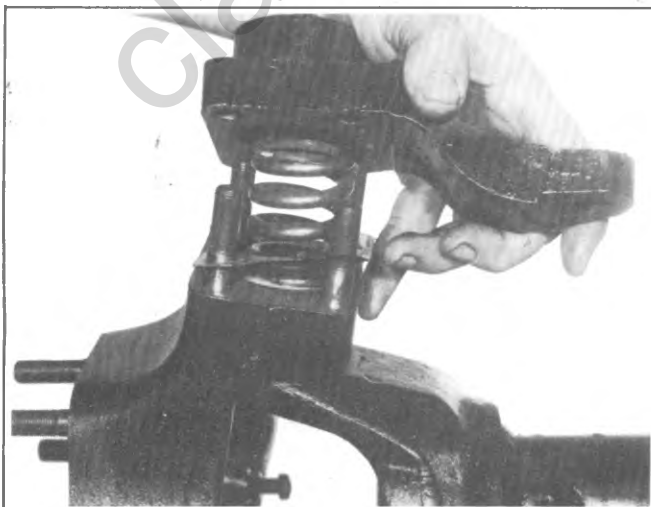


Fig. 3C-20K--Removing Cap, Spring and Gasket

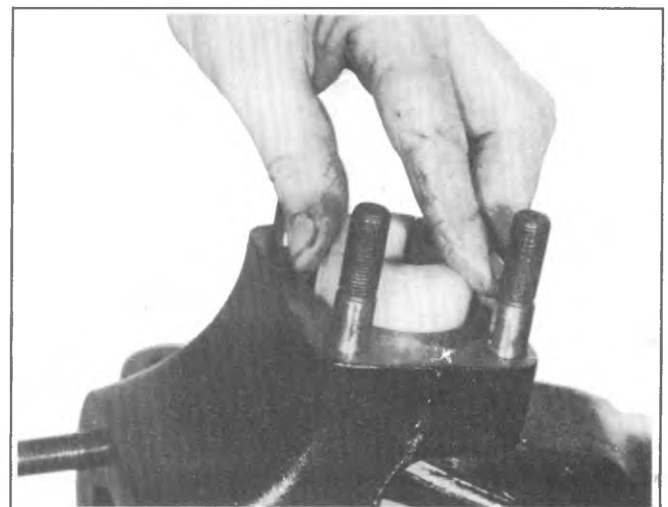


Fig. 3C-22K--Removing Tapered Bushing

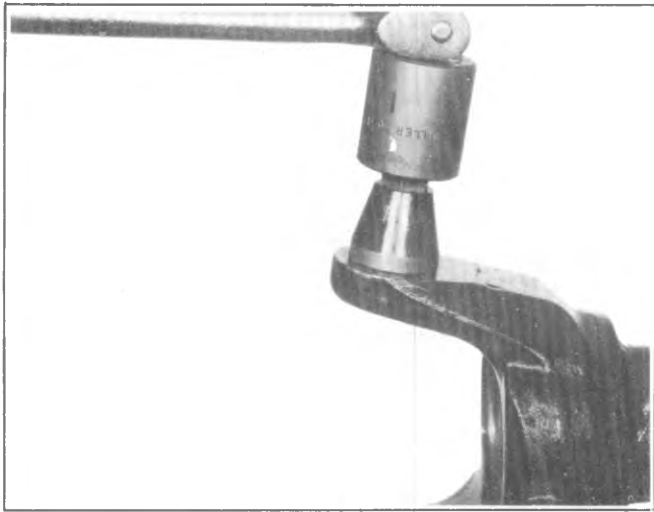


Fig. 3C-23K--Removing Upper King Pin



Fig. 3C-26K--Installing Oil Seal



Fig. 3C-24K--Removing Cup, Cone and Seal

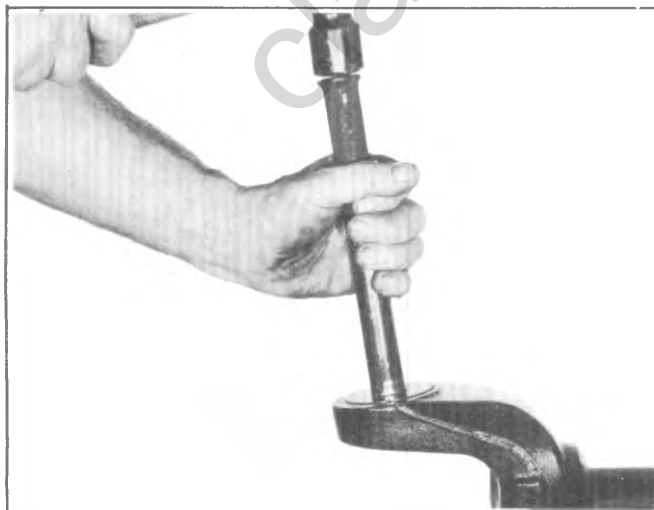


Fig. 3C-25K--Installing Grease Retainer

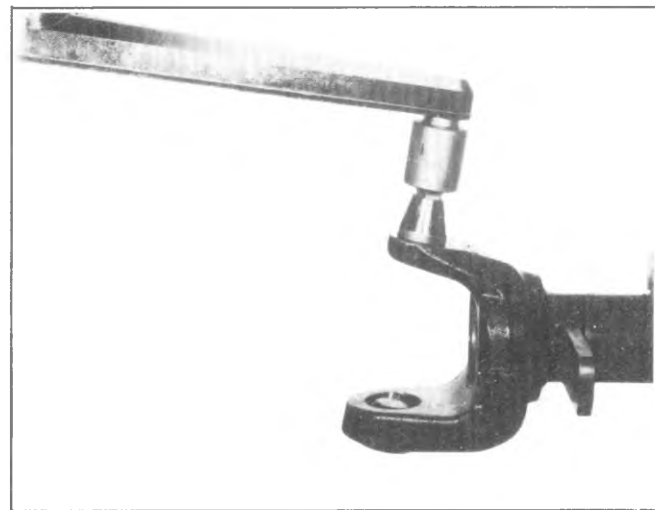


Fig. 3C-27K--Installing Upper King-Pin

Installation

CAUTION: See the **CAUTION** on page 1 of this section regarding the fasteners in the following steps.

1. Assemble new grease retainer and lower king pin bearing cup, using J-7817, as shown in Figure 3C-25K.

2. Fill the area in grease retainer with specified grease, then grease the bearing cone and install. Install new lower king pin bearing oil seal, using J-22281, as shown in Figure 3C-26K.

NOTE: Do not distort oil seal. It will protrude slightly from the surface of yoke flange when fully installed.

3. Install upper king-pin, using J-27871 as shown in Figure 3C-27K. Torque to 500-600 ft. lbs.

4. Assemble felt seal to king pin, assemble knuckle, assemble tapered bushing over king pin, as shown in Figure 3C-28K.

5. Assemble lower bearing cap-and-king pin with four cap screws. Tighten cap screws alternately and evenly; see Figure 3C-29K. Torque cap screws to 70-90 ft. lbs.

6. Assemble compression spring on upper king pin bushing. Assemble bearing cap, with new gasket, over four studs. Tighten nuts alternately and evenly. Torque nuts to 70-90 Lb. Ft. See Figure 3C-30K.

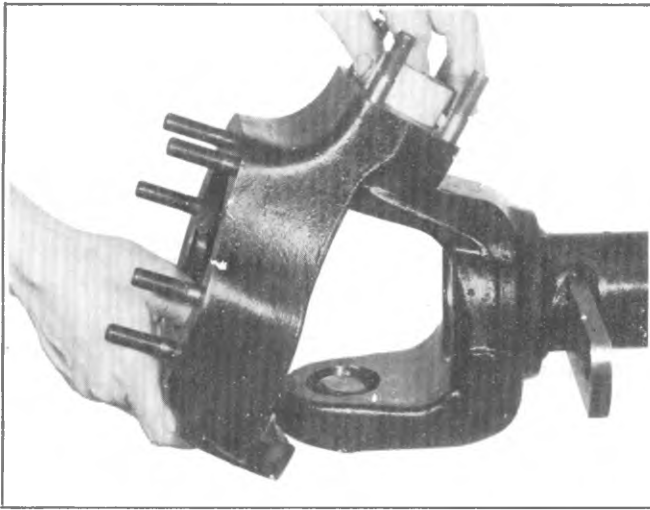


Fig. 3C-28K--Installing Knuckle to Yoke

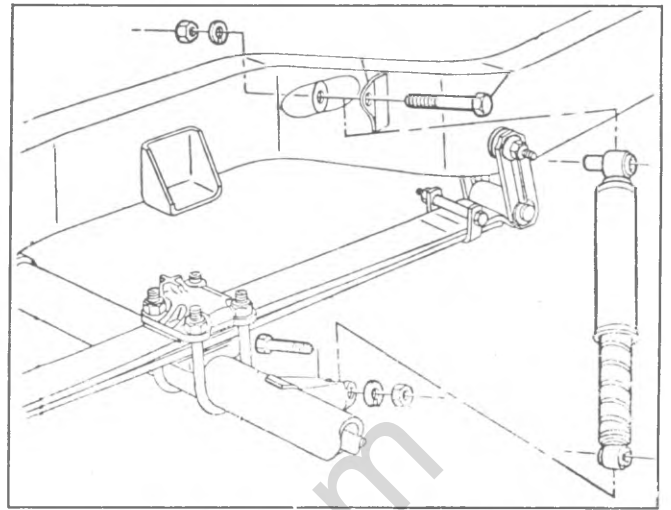


Fig. 3C-31K--Shock Absorber Attachment

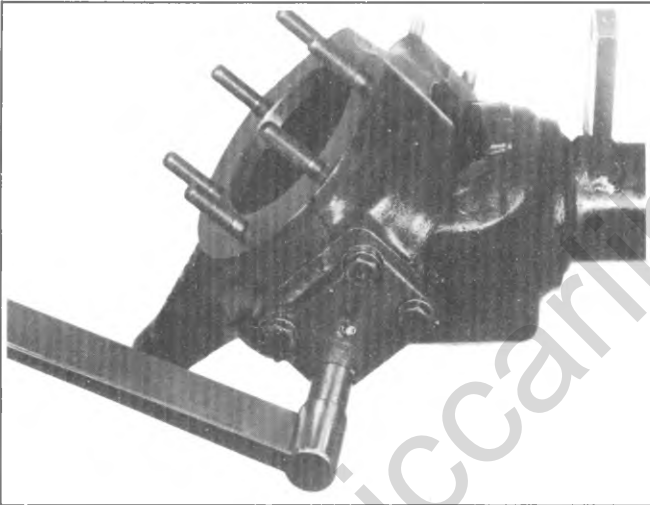


Fig. 3C-29K--Installing Lower Bearing Cap-and-King Pin

SHOCK ABSORBER

Removal (Fig. 3C-31K)

1. Raise vehicle on hoist.
2. Remove nuts and eye bolts securing upper and lower shock absorber eyes.
3. Withdraw shock absorber and inspect rubber eye bushings. If defective, replace shock absorber assembly.

Installation

Place shock absorber into position over mounting bolts or into mounting brackets. Install eye bolts and nuts and torque as shown in Specifications Section. Lower vehicle to floor.

STABILIZER BAR-TYPICAL

Removal (Fig. 3C-32K)

1. Raise vehicle on hoist and remove nuts and bolts attaching stabilizer brackets and bushings at frame location.
2. Remove brackets and bushings at lower spring anchor plates and remove stabilizer from vehicle.

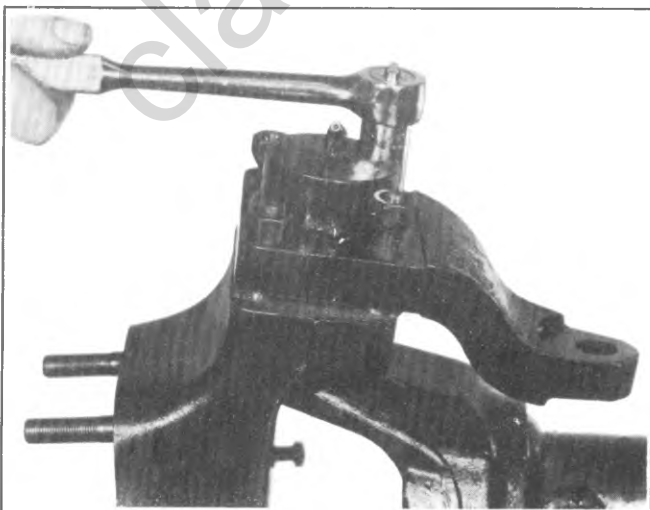


Fig. 3C-30K--Installing Bearing Cap/Steering Arm

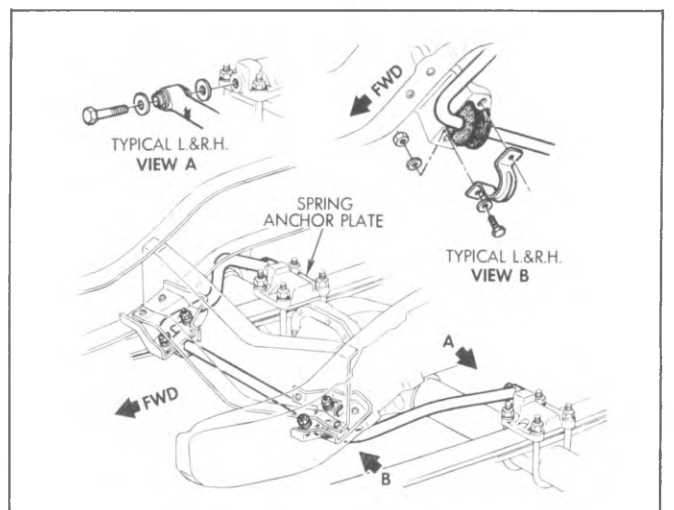


Fig. 3C-32K--Stabilizer Bar Attachment

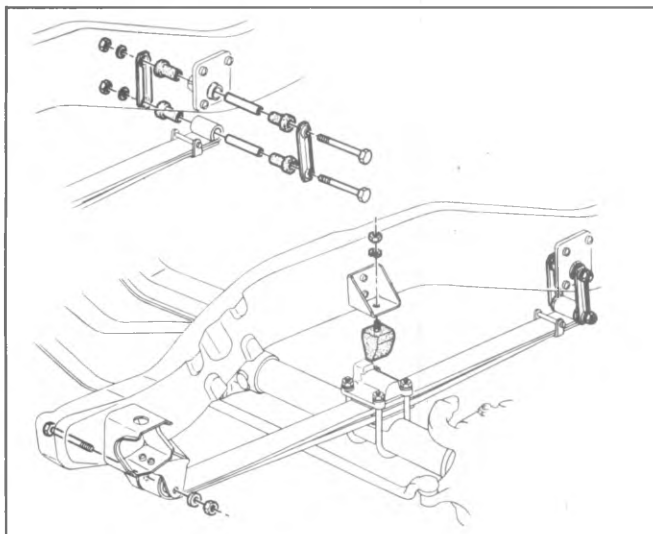


Fig. 3C-33K--Leaf Spring Assembly

Inspection

Inspect rubber rushings for excessive wear or aging—replace where necessary. Use rubber lubricant when installing bushings over stabilizer bar.

Installation

CAUTION: See *CAUTION* on page 1 of this section regarding the fasteners referred to in step 2.

NOTE: Slit in bar to frame bushings should be facing forward.

1. Place stabilizer in position on frame and install frame brackets over bushings. Install nuts and bolts loosely.
2. Install brackets over bushings at lower control arm location. Be sure brackets are positioned properly over bushings. Torque all nuts and bolts to specifications.
3. Lower vehicle to floor.

LEAF SPRING AND BUSHINGS

Removal

1. Raise vehicle on hoist.
2. Place adjustable lifting device under axle.
3. Position axle so that all tension is relieved from spring.
4. Remove shackle upper retaining bolt.
5. Remove front spring eye bolt.
6. Remove spring-to-axle u-bolt nuts and remove spring, lower plate and spring pads.
7. Remove shackle to spring bolt and remove bushings and shackle.

Bushing Replacement

1. Place spring on press and press out bushing using a suitable rod, pipe, or tool.
2. Press in new bushing; assure that tool presses on steel outer shell of bushing. Install until bushing protrudes an equal amount on each side of spring.

Spring Inserts (Liners) or Leaf Replacement

1. Place spring in vise and remove clips.
2. Remove center bolt. Open vise slowly, allowing spring to expand.
3. Wire brush, clean, and inspect for broken leaves.
4. Replace leaf or liners.

Installation

CAUTION: See *CAUTION* note on page one of this section regarding the fasteners referred to in steps 5 and 6.

1. Install spring shackle bushings into spring and attach shackle. Do not tighten bolt.
2. Position spring upper cushion on spring.
3. Insert front of spring into frame and install bolt. Do not tighten.
4. Install shackle bushings into frame and attach rear shackle. Do not tighten bolt.
5. Install lower spring pad and spring retainer plate. Torque bolts to specifications.
6. Torque front and rear spring eye and shackle bolts to specifications.
7. Remove stands and lower vehicle to floor.

SPECIFICATIONS

FRONT SUSPENSION BOLT TORQUE (ft. lbs.) * †

	CP-10	CP-20-30	K-All	G-10-20	G-30
Lower Control Arm Shaft U-Bolt	85	85	—	65	85
Upper Control Arm Shaft Nuts	70	105	—	70	105
Control Arm Rubber Bushings	115	—	—	115	—
Upper Control Arm Bushing Steel ††		New 190 Used 115	—	—	New 190 Used 115
Lower Control Arm Bushing Steel ††		New 280 Used 130	—	—	New 280 Used 130
Upper Ball Joint Nut	* 50	**90	**100	* 50	**90
Lower Ball Joint Nut	**90	**90	***80	**90	**90
Crossmember to Side Rail •	65	65	—	65	65
Crossmember to Bottom Rail ••	90	90	—	90	90
Crossmember Brake Support Struts	60	60		60	60
Stabilizer Bar to Control Arm	25	25	Anchor Plate —130	25	
Stabilizer Bar to Frame	25	25	.55	25	
Shock Absorber Upper End	140	140	65	75	
Shock Absorber Lower End	60	60	65	75	
Brake Splash Shield to Knuckle	120 in. lbs.	120 in. lbs.	120 in. lbs.	120 in. lbs.	
Wheel Bearing Adjustment	—	—	Inner #-35 Outer -50	—	
Wheel Bearing Preload	Zero	Zero	Zero	Zero	
Wheel Bearing End Movement	.001-.005"	.001-.005"	.001-.010"	.001-.005"	
Caliper Mounting Bolt	35	35	35	35	
Spring — Front Eye Bolt	—	—	90	—	
Spring — Rear Eye Bolt	—	—	50	—	
Spring — To Rear Shackle Bolt	—	—	50	—	
Spring — To Axle U-Bolt	—	—	150	—	
Spring — Front Support to Frame	—	—	25	—	
Suspension Bumper	15	15	25	15	
Stabilizer to Spring Plate	—	—	130	—	

* Plus additional torque to align cotter pin. Not to exceed 90 ft. lbs. maximum.

** Plus additional torque to align cotter pin. Not to exceed 130 ft. lbs. maximum.

*** Plus additional torque to align cotter pin.

Back nut off to align cotter pin at nearest slot.

† All specifications are given in foot pounds of Torque unless indicated otherwise.

†† C10, G10-20 Rubber Bushings; C20-30, P10-30 Steel Bushings.

• P300 (32), P300 (42) and JF9 — 100 ft. lbs.

•• P300 (32) — 215 ft. lbs., P300 (42) and JF9 — 130 ft. lbs.

SPECIAL TOOLS

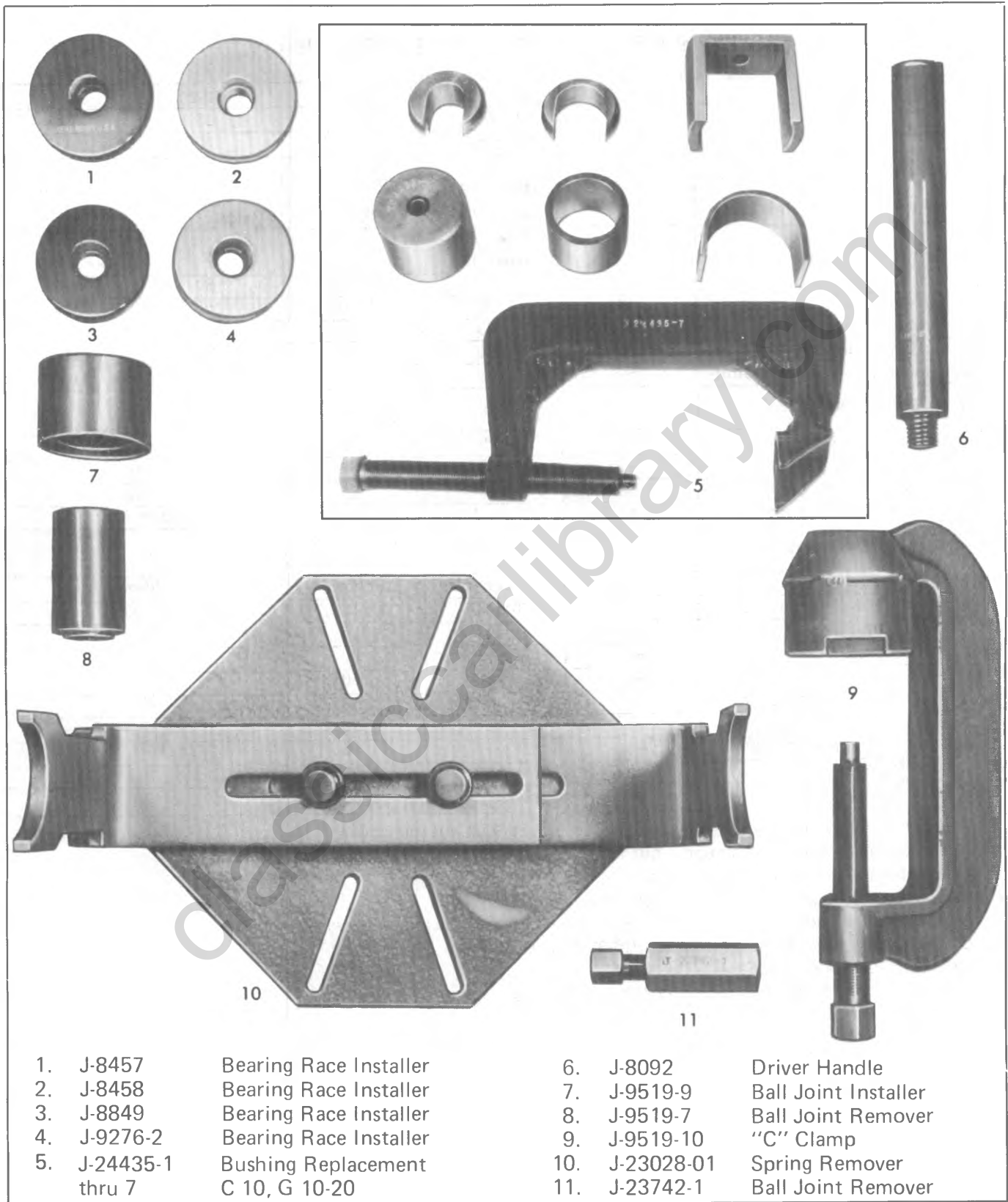


Fig. 3C-ST- Special Tools

SECTION 3D

REAR SUSPENSION

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at the appropriate locations by the terminology "See Caution on page 1 of this Section".

CAUTION: *THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.*

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GENERAL DESCRIPTION

All 10-30 series vehicles use a leaf spring/solid rear axle suspension system. Typical systems are illustrated in Fig. 3D-1, 3D-2 and 3D-3.

The rear axle assembly is attached to multi-leaf springs by "U" bolts. The spring front eyes are attached to the frame at the front hangers, through rubber bushings. The rear ends of the springs are attached to the frame by the use of shackles which allow the spring to "change its length" while the vehicle is in motion. Control arms are not used with leaf springs.

Ride control is provided by two identical direct double acting shock absorbers angle-mounted between the frame and brackets attached to the axle tubes.

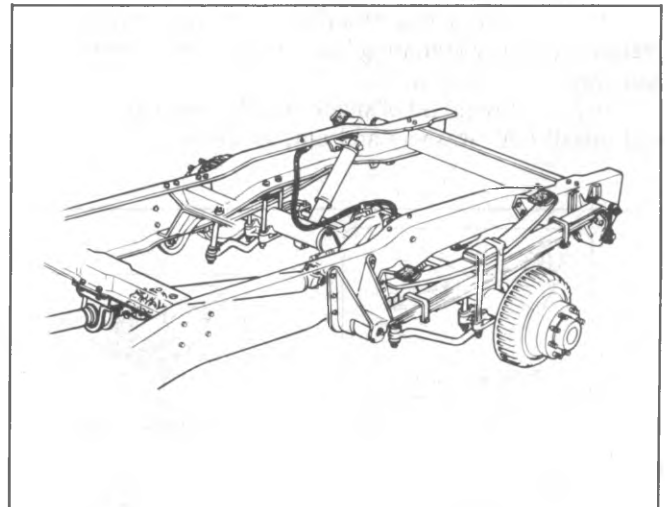


Fig. 3D-1--Typical C-30 H.D. Truck Rear Suspension

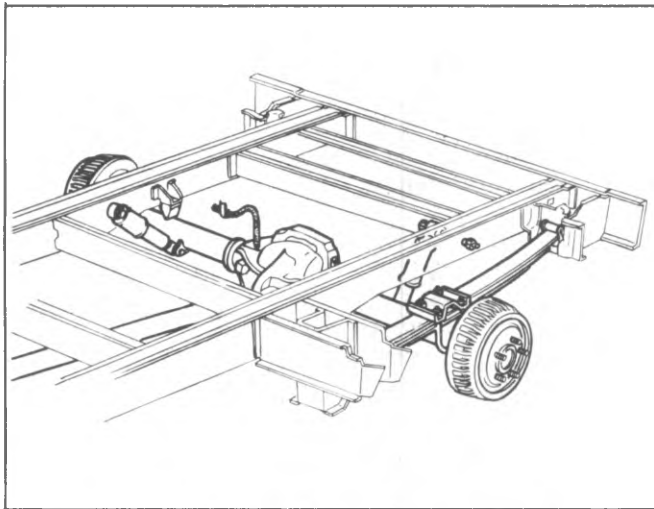


Fig. 3D-2--Typical G-Truck Rear Suspension

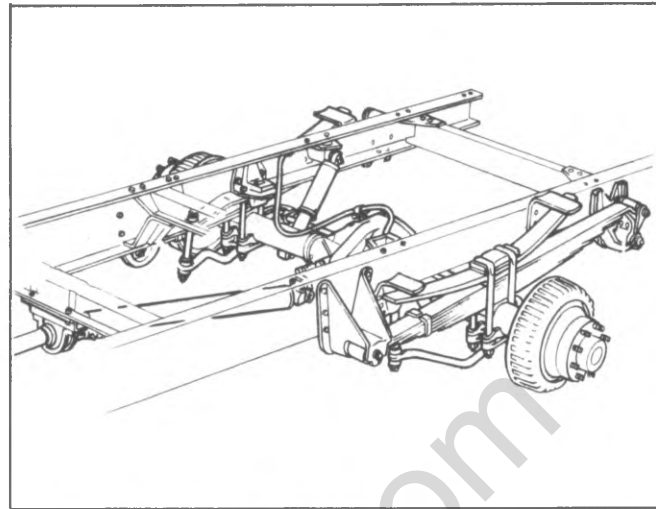


Fig. 3D-3--Typical P-30 H.D. Truck Rear Suspension

COMPONENT PARTS REPLACEMENT

SHOCK ABSORBERS

Replacement

Refer to Figs. 3D-4 through 3D-8 for specific vehicle mounting provisions.

1. Raise vehicle on hoist, and support rear axle.
2. At the upper mounting location, disconnect shock absorber by removing nut and washers shown, and bolt on G-models.
3. At the lower mounting location, remove nut, washers and bolt as shown.
4. Remove shock absorbers from vehicle.
5. To install shock absorber, place into position and reattach at upper mounting location. Be sure to install nuts and washers as shown.
6. Align lower end of shock absorber with axle bracket, and install bolt, washers and nut, as shown.

7. Tighten nuts to specifications.

CAUTION: See *CAUTION* on page 1 of this section regarding shock absorber fasteners.

8. Lower vehicle and remove from hoist.

STABILIZER SHAFTS

Refer to Fig. 3D-9, 3D-10 and 3D-11 for specific rear stabilizer shaft mounting on C and P models.

Replacement

1. Raise vehicle on hoist and support rear axle.
2. Remove nut, washer and grommet from link bolt at the frame side member on each side.
3. Withdraw link bolt, washers, grommets and spacer.
4. Remove brackets from anchor plates by removing attaching screws.
5. Remove stabilizer shafts.

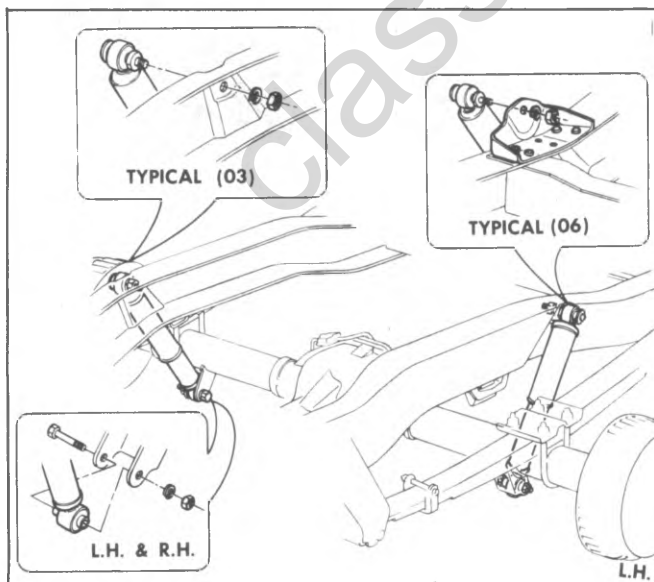


Fig. 3D-4--Shock Absorber-CK-10, CK-20 (03, 06)

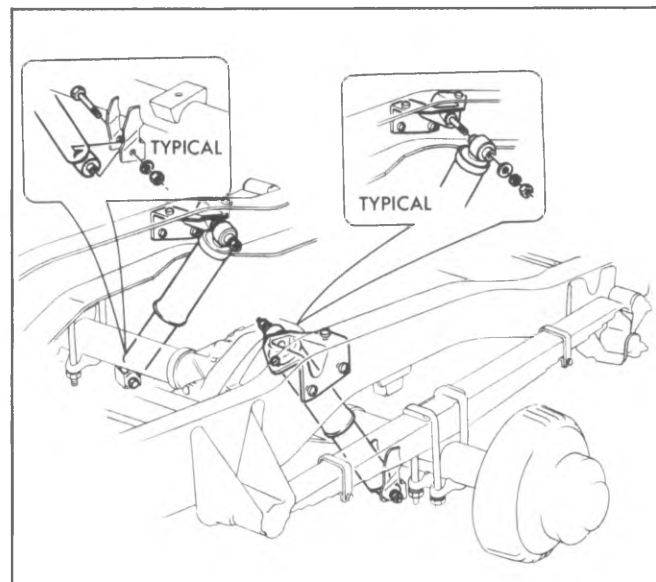


Fig. 3D-5--Shock Absorber-CK-20 (43), CK30

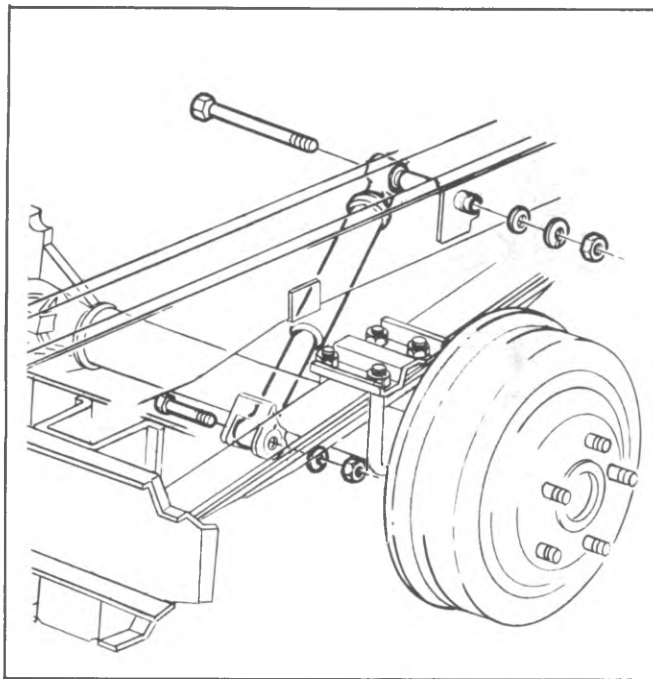


Fig. 3D-6--Shock Absorber-G-10, 20, 30

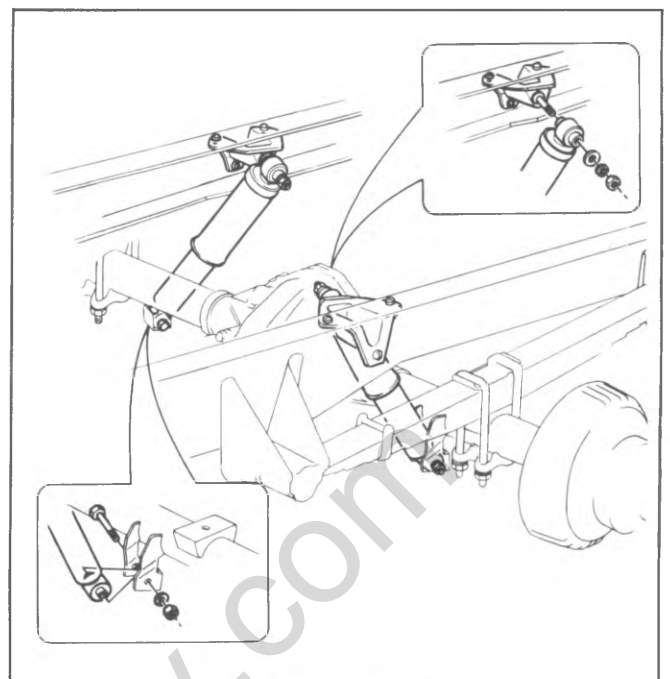


Fig. 3D-8--Shock Absorber-P30

6. Reverse above steps to install stabilizer shaft. On installation, position shaft so parking brake cable is routed over stabilizer.

7. Torque all bolts to specifications.

CAUTION: See CAUTION on page 1 of this section, regarding stabilizer fasteners.

8. Lower hoist and remove vehicle.

LEAF SPRING ASSEMBLY

Refer to Figs. 3D-12, 3D-13, 3D-14 and 3D-15 for specific leaf spring mounting provisions of C, K, G and P models. Fig. 3D-17 illustrates a typical U-bolt anchor plate installation with the mandatory tightening sequence.

CAUTION: See CAUTION on page 1 of this section, regarding leaf spring fasteners.

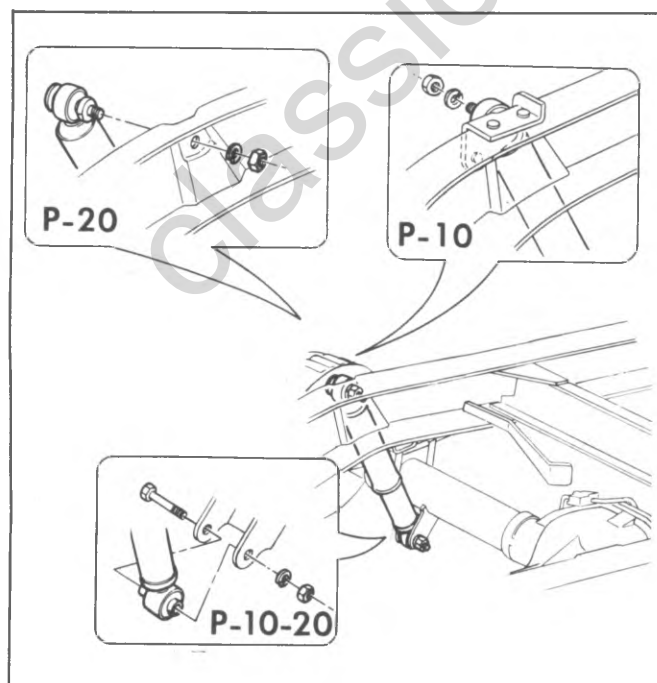


Fig. 3D-7--Shock Absorber-P-10, 20

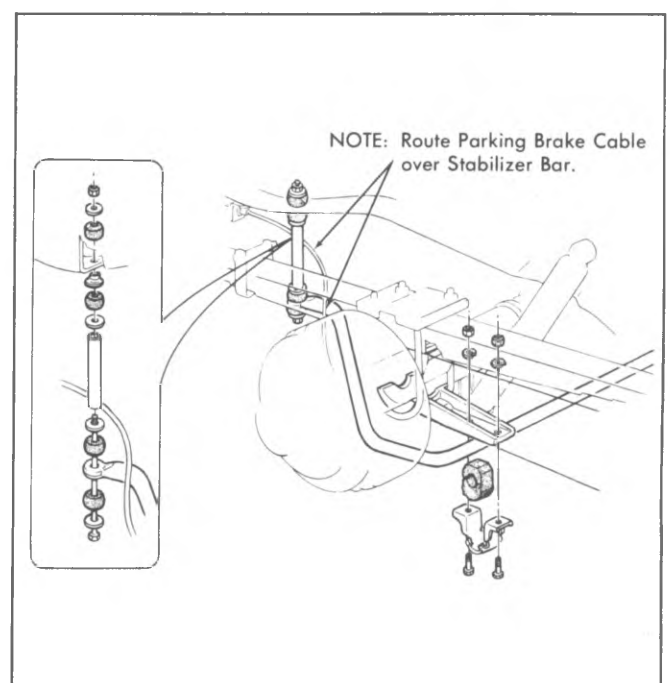


Fig. 3D-9--Rear Stabilizer Shaft-C-20(03)

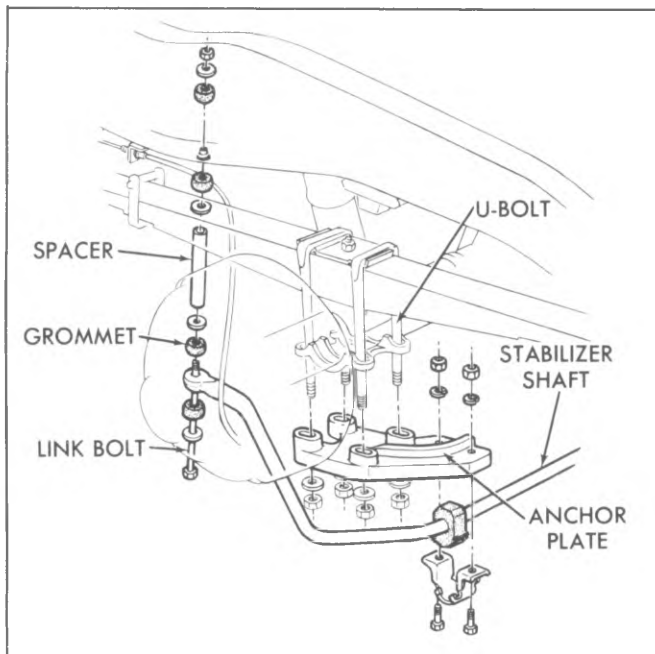


Fig. 3D-10--Rear Stabilizer Shaft-C-20(43), C-30

Removal

1. Raise vehicle on hoist so that tension in spring is relieved.
2. Loosen, but do not remove, spring-to-shackle retaining nut.
3. Remove nut and bolt securing shackle to spring hanger.
4. Remove nut and bolt securing spring to front hanger.
5. Remove "U" bolt retaining nuts, withdraw "U" bolts and spring plate from spring-to-axle housing attachment.
6. Withdraw spring from vehicle.
7. Inspect spring. Replace bushings, repair or replace spring unit as outlined in this section.

Bushing Replacement

1. Place spring on press and press out bushing using a suitable rod, pipe or tool as shown in Fig. 3D-16.
2. Press in new bushing; assure that tool presses on steel outer shell of bushing.

NOTE: Rear Spring, Front Eye-Heavy Duty leaf springs on C20 and C30 trucks use a staked-in-place front eye bushing. Before this bushing is pressed out of the spring, the staked locations must be straightened with a chisel or drift. After a new bushing is installed, it must be staked in three equally spaced locations.

Spring Leaf Replacement

1. Place spring assembly in a bench mounted vise and remove spring clips.
2. Position spring in vise jaws, compressing leaves at center and adjacent to center bolts.
3. File peened end of center bolt and remove nut. Open vise slowly to allow spring assembly to expand.
4. Wire brush and clean spring leaves. Inspect spring leaves to determine if replacement is required; also replace defective spring leaf liners at this time.
5. Align center holes in spring leaves by means of a long drift and compress spring leaves in a vise.
6. Remove drift from center hole and install a new

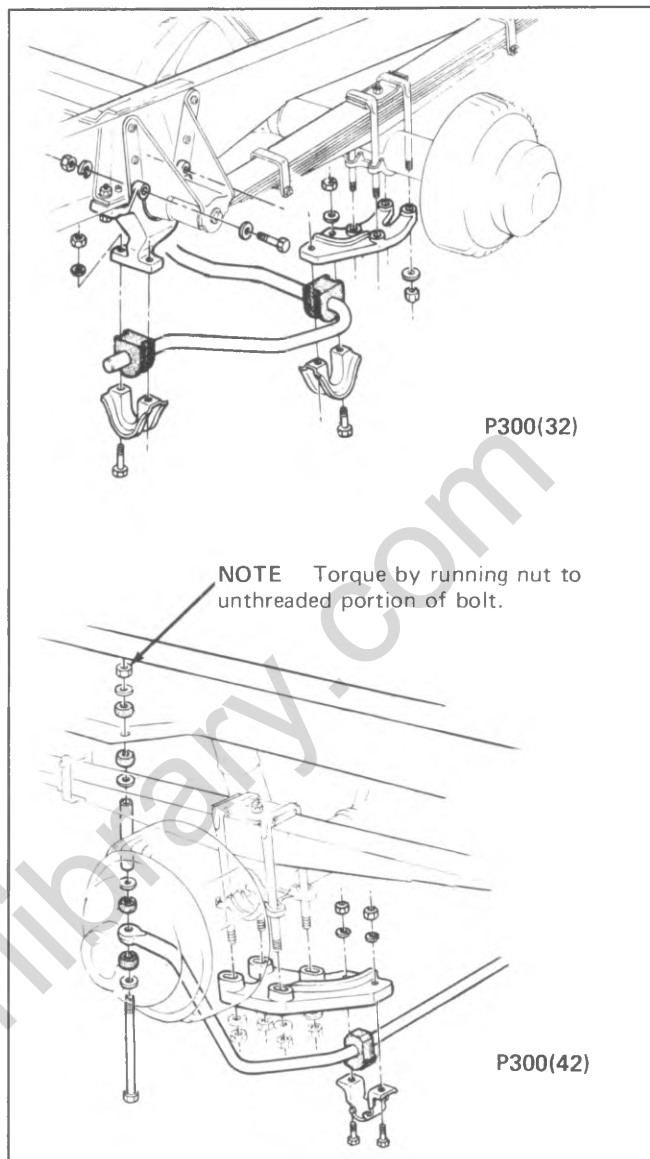


Fig. 3D-11--Rear Stabilizer Shaft-P30

center bolt. Peen bolt to retain nut.

7. Align spring leaves by tapping with hammer, then bend spring clips into place or install bolts and spacer if so equipped.

NOTE: Spring clips should be bent sufficiently to maintain alignment, but not tight enough to bind spring action.

Leaf Spring Installation

1. Position spring assembly to axle. Make sure spring is in position at both spring hangers.
- NOTE:** The shackle assembly must be attached to the rear spring eye before installing shackle to rear hanger.
2. Install spring retainer plate and "U" bolts. Loosely install retaining nuts, but do not torque at this time.
3. Jack frame as required to align spring and shackle with spring hangers.
4. Install shackle bolt and nut and again reposition spring, if necessary to align front eye. Install front eye bolt and nut. Torque hanger and shackle fasteners to specifications.

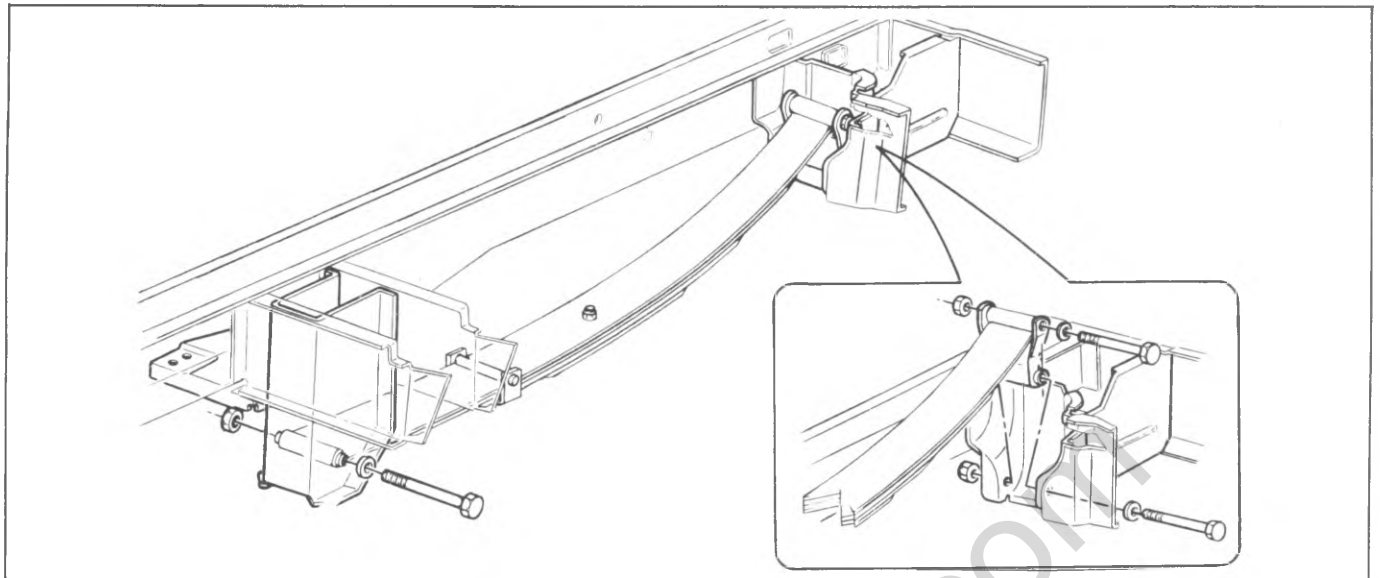


Fig. 3D-12--Rear Spring Installation-G Models

NOTE: Make certain that the bolts are free-turning in their bushings prior to torquing.

suspension components and torque U-bolt nuts to specifications.

5. Lower vehicle so that weight of vehicle is on

6. Lower vehicle and remove from hoist.

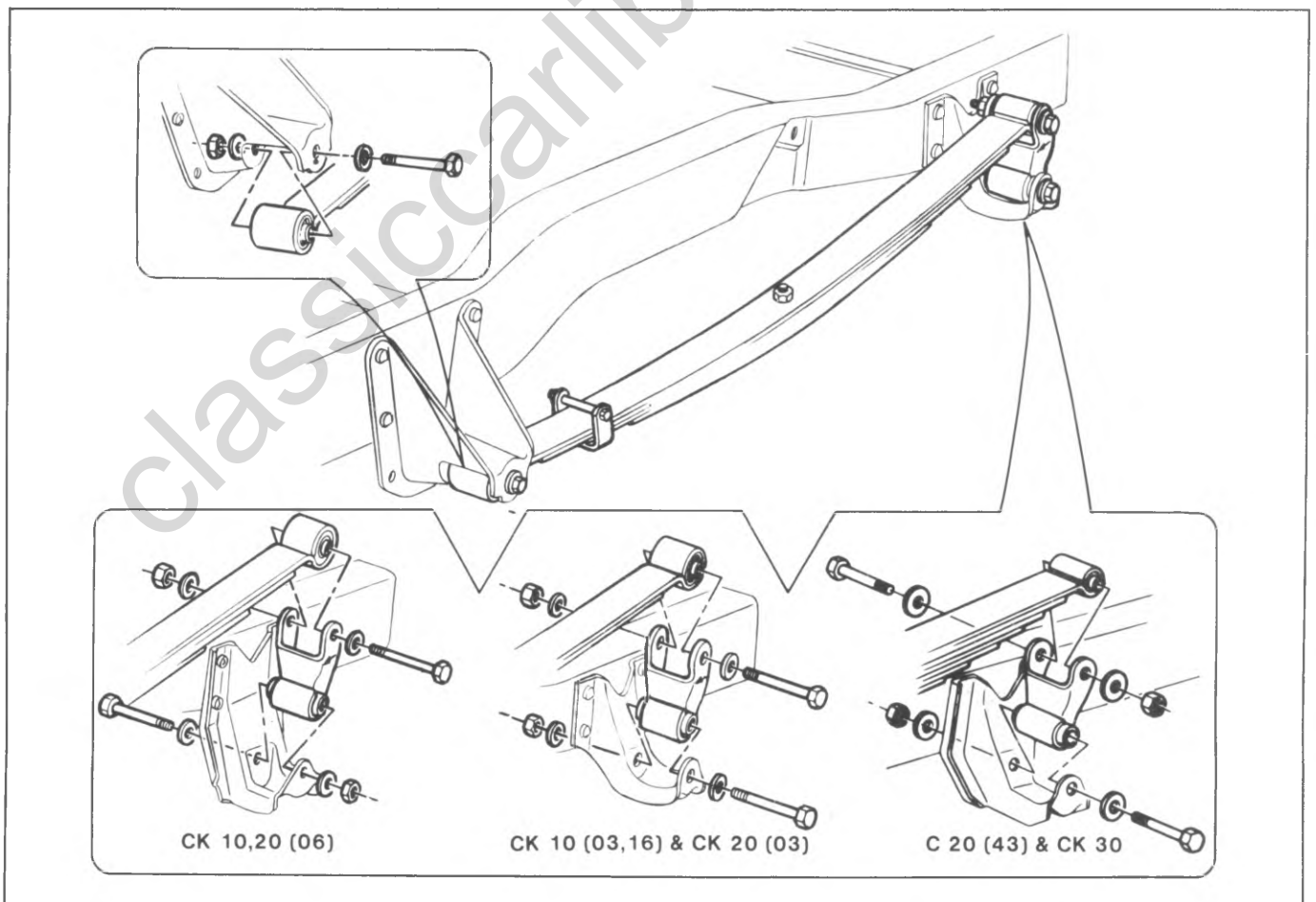


Fig. 3D-13--Rear Spring Installation-C-K Models

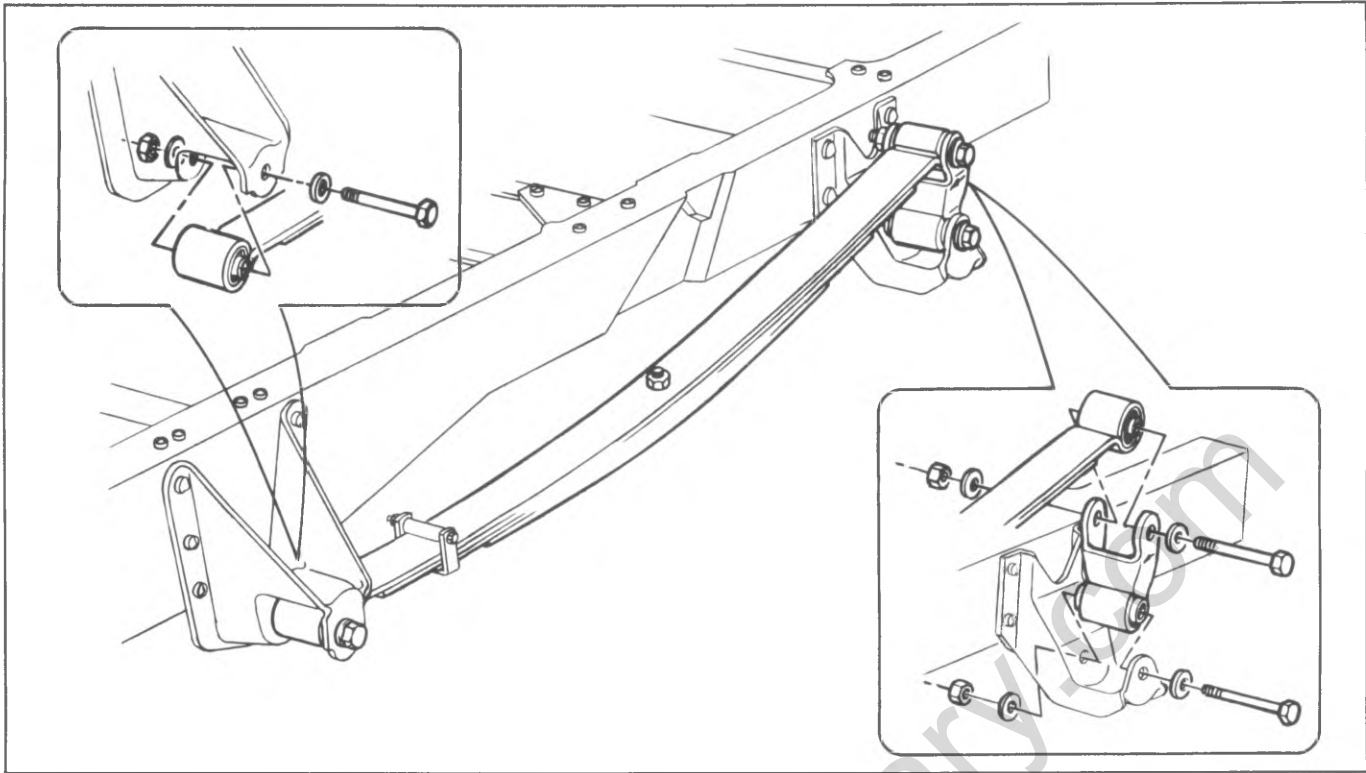


Fig. 3D-14--Rear Spring Installation-P10.20

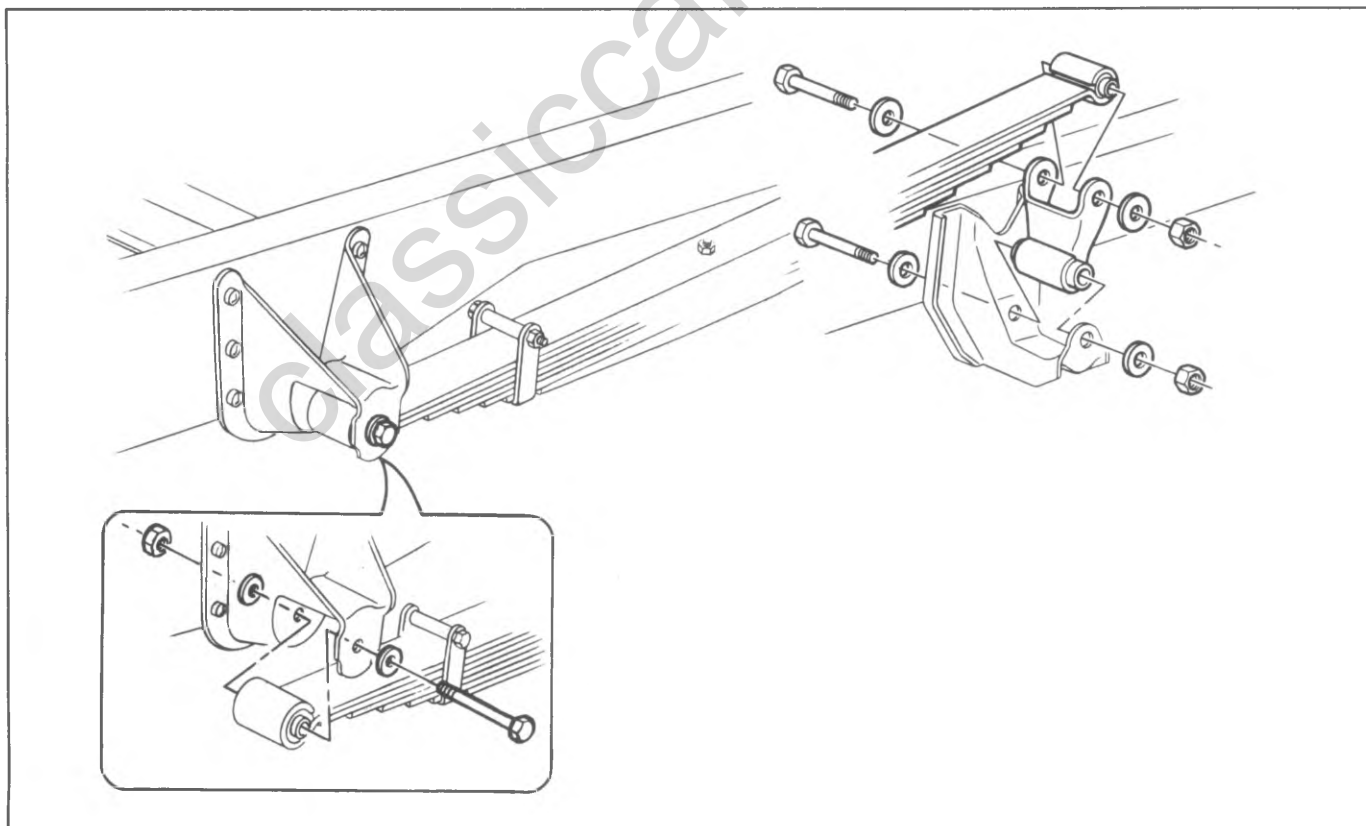


Fig. 3D-15--Rear Spring Installation-P30

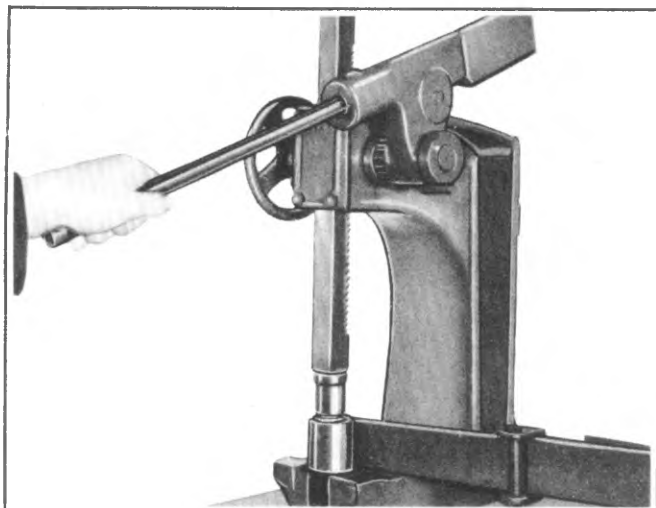


Fig. 3D-16--Pressing Out Bushing

U-Bolt and Anchor Plate Installation

Fig. 3D-17 illustrates the mandatory sequence of tightening U-bolt nuts. Tighten diagonally opposite nuts to 40-50 foot pounds, then tighten all nuts as shown to specifications.

CAUTION: See *CAUTION* on page 1 of this section, regarding "U"-Bolt fasteners.

SHACKLE REPLACEMENT

1. Raise vehicle on hoist. Place adjustable lifting device under axle.
2. Remove load from spring by jacking frame.

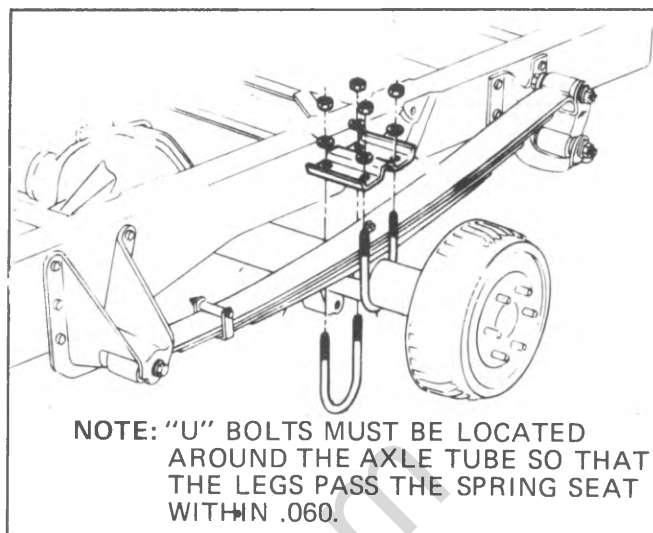


Fig. 3D-17--U-Bolt Installation

NOTE: "U" BOLTS MUST BE LOCATED AROUND THE AXLE TUBE SO THAT THE LEGS PASS THE SPRING SEAT WITHIN .060.

3. Loosen spring-to-shackle retaining bolt, but do not remove.
4. Remove shackle-to-frame bracket retaining bolt then remove shackle bolt from spring eye.
5. Position shackle to spring eye and loosely install retaining bolt. Do not torque retaining bolt at this time.
6. Position shackle to frame bracket and install retaining bolt.
7. Rest vehicle weight on suspension components and torque both shackle bolt retaining nuts to specifications.

CAUTION: See *CAUTION* on page 1 of this section, regarding these fasteners.

8. Lower vehicle and remove from hoist.

SPECIFICATIONS

TORQUE SPECIFICATION

	C-K	G	P
Spring-to-Axle "U" Bolt Nuts	140	G10 120 G20 120 G30 150	P10 140 P20 140 P30 170 (Exc. W/3/4" Bolt) 200 (W/3/4" Bolt)
Leaf Spring			
—Front Bushing Bolt	110	90/135* (G316 . . .90)	110
—Rear Shackle Bolt	110	90/135* (G316 . . .90)	110
Shock Absorber			
—Upper Attachment	150	75	P10 25 P20 140 P30 50
—Lower Attachment	115	75	115
Propeller Shaft			
To Rear Axle (Strap)	12-17	12-17	12-17
To Rear Axle ("U" Bolt)	18-22	18-22	18-22
Bearing Support-to-Hanger	20-30	20-30	20-30
Hanger-to-Frame	40-50	—	—
Rear Stabilizer-to-Anchor Plate	20-30	—	20-30

*90 Ft. Lbs. when tightening the nut.
135 Ft. Lbs. when tightening the bolt.

SECTION 3E

WHEELS AND TIRES

INDEX

General Description.....	3E-1	Service Operations	3E-5
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Wheel Nut Torques	3E-2	Tire Mounting and Demounting.....	3E-7
Tire Inspection and Rotation.....	3E-2	Dual Wheel Attachment P300 Models.....	3E-8
Tire Inflation Pressure.....	3E-2		

GENERAL DESCRIPTION

Trucks are equipped with a wide range of tube or tubeless type tires and wheels selected according to the truck Gross Vehicle Weight Rating (GVWR) and type of service. The dual rear wheel option is available on Series 30 trucks. The factory installed bias belted tires are selected to provide the best all around tire performance for all normal operations. All tires are manufactured for use on wheels of specific size, configuration and load carrying capacity. When replacing a worn or damaged tire it is essential that you use a replacement tire of the same size and load rating as that with which the vehicle was equipped when manufactured. Use of any other size of tire may seriously affect ride, handling, ground clearance, tire clearance and speedometer calibration. Similarly, use of wheels with offsets other than recommended, or use of what are commonly referred to as "reversed rims" may seriously overload wheel bearings or other axle components causing rapid wear or failure of these parts and void the vehicle warranty. To achieve best all around vehicle handling performance belted tires and bias ply tires should not be mixed on the same truck. Because of possible adverse effects

on vehicle handling, do not mix radial ply tires with other type tires on the same vehicle.

NOTE: On four-wheel drive vehicles all tires must be of equal size (but not necessarily ply rating) and of same tread configuration.

TUBELESS TIRES

These tires have an inner liner which, if punctured, tends to cling to the penetrating object forming a partial seal until the object is removed from the tire. It is essential to conduct a periodic pressure check according to the tire inflation tables on the following pages plus a visual tire inspection to detect imbedded objects which might otherwise go unnoticed and cause serious casing damage.

TUBE TIRES

Some commercial vehicles are equipped (at customer option) with synthetic rubber tires and tubes.

MAINTENANCE

WHEEL REPLACEMENT CONSIDERATIONS

Wheels must be replaced if bent, heavily rusted, leak air, or if lug nuts continually loosen. Do not straighten bent wheels or use inner tubes in leaking wheels used with tubeless tires. The wheels originally equipped on the vehicle will provide optimum life up to the maximum load and inflation pressures as shown in the Wheel Code and Limits Chart. Maximum loads, maximum inflation pressures, wheel identification codes, and wheel sizes are stamped on each wheel.

When replacing wheels for any reason, the replacement wheels should be equivalent in load capacity, inflation pressure capacity, diameter, width, offset, and mounting configurations to those originally installed on the vehicle.

A wheel of improper size or type may adversely affect load carrying capacity, wheel and bearing life, brake cooling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to the body and chassis. Replacement with "used" wheels which may have been subjected to harsh operating conditions or very high mileage is not recommended. These wheels may fail prematurely without any prior visual indication.

NOTE: The use of wheels and/or tires with higher load carrying capacity than originally equipped on the vehicle does not necessarily increase the GAWR's or the GVWR of the vehicle. Wheels having diameters ranging from 16 inch through 19.5 inch diameter that have also been certified for radial tire application up to the maximum load and maximum tire pressure wheel limits shown in the Wheel Code and Limits Chart have the word "radial" stamped on the rim. Wheels in the 16 inch through 19.5 inch diameter range without the "radial" identification stamp are not to be used with radial tires.

WHEEL NUT TORQUES

On a new vehicle or after the wheel has been changed, the wheel nut torque must be checked at 100, 1,000 and 6,000 miles and every 6,000 miles (160, 1 600 and 9 600 km) thereafter.

TIRE INSPECTION AND ROTATION (Fig. 3E-1)

Front and rear tires perform different jobs and can wear differently depending on the type of roads driven, individual driving habits, etc. To obtain maximum tire life, tires should be inspected and rotated regularly at the following intervals:

Passenger Type Tires: Bias or Bias-Belted, rotate every 7,500 miles (12 000 km); Radial, rotate first 7,500 miles (12 000 km) and at least every 15,000 miles (24 000 km) thereafter.

Light Truck Tires: Bias or Bias-Belted, rotate every 6,000 miles (9 600 km); Radial, rotate first 6,000 miles (9 600 km) and at least every 12,000 miles (19 200 km) thereafter.

For the longest tire life, any time irregular wear is noticed, the tires should be inspected and rotated and the cause of the uneven wear corrected. Be certain to check wheel nut tightness and to adjust the tire pressures, front and rear, after rotation to agree with those recommended in the tire inflation charts.

The outer tire on a dual wheel will skid or drag on a turn because of the difference in the turning radii of the inner and outer tires. This results in faster wear of the outer tire. In general, the tire with the largest diameter or least wear should be at the outside of each dual wheel. In addition, when trucks are operated continuously on high crown roads an increase in air pressure of from 5 to 10 PSI in the outside tire of each dual produces maximum tire life.

INFLATION PRESSURE

The maximum cold inflation pressures for the factory installed tires are listed on the VIN plate. Tires must be inflated to these pressures when the GVWR or an axle GAWR is reached. Improper tire inflation pressures for the load the vehicle is carrying can adversely affect tire life and vehicle performance.

Too low an air pressure can result in tire overloading, abnormal tire wear, adverse vehicle handling, and reduced fuel economy. The tire flexes more and can build up excessive heat, weakening the tire and increasing susceptibility to damage or failure. Too high an air pressure can result in abnormal wear, harsh vehicle ride, and increased susceptibility to damage from road hazards. Lower inflation pressures should be used only with reduced vehicle loads and the rear tire pressure should be equal to or greater than the front pressure on single wheel application. After determining the load on each tire by weighing the vehicle on a scale, the correct cold inflation pressures for the actual tire loads can be obtained from the Tire/Wheel Load and Inflation Pressure Chart shown in this section.

Tire inflation pressures should be checked at least monthly when the tires are "cold" and when changing the load the vehicle is carrying.

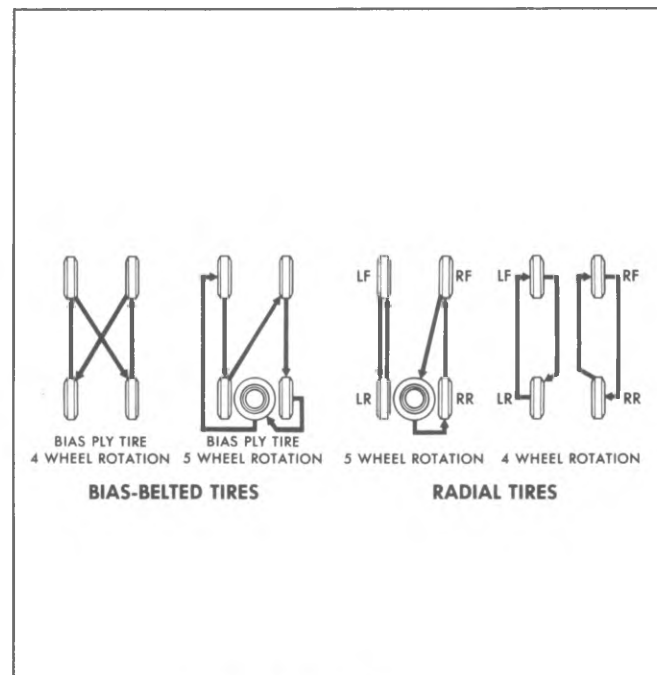


Fig. 3E-1--Tire Rotation

WHEEL USAGE AND TIRE LOAD LIMITS AT VARIOUS INFLATION PRESSURES*
PASSENGER TYPE TIRES FOR LIGHT TRUCKS USED IN HIGHWAY SERVICE

Wheel Code		Tire Size	Load Range	Tire Load Limits at Various Inflation Pressures								
Regular	Rally/Spoke			24	26	28	30	32	34	36	38	40
XU, XH, DT	—	E78-15	B	1081	1127	1181	1227	1270				
XU, XH, DT	BC, CU	G78-15	B	1254	1309	1363	1418	1470				
XU, XH, DT	BC, CU	G78-15	D	1254	1309	1363	1418	1470	1527	1572	1618	1663
XU, XH, DT	BC, CU	H78-15	B	1372	1436	1500	1554	1605				
AX, FT	BC, CU	H78-15	D	1372	1436	1500	1554	1605	1663	1718	1772	1827
AX, FT	CT, BM, CX, CW	L78-15	B	1527	1590	1663	1727	1790				
AX, FT	CT, BM, CX, CW	LR78-15	C	1527	1590	1663	1727	1790	1854	1905		
AX, FT	CT, BM, CX, CW	L78-15	D	1527	1590	1663	1727	1790	1854	1905	1972	2025
—	CT, BM, CX, CW	LR60-15	B	1527	1590	1663	1727	1790				
XU, XH, DT	—	8.25-15	D	1254	1309	1363	1418	1470	1527	1572	1618	1663

NOTE: The load at maximum inflation pressure stamped on the tire sidewall of passenger tires will differ from the load shown in this table. This is in accordance with Tire and Rim Association standards requiring a reduced loading factor of approximately 91% for passenger type tires used on trucks and multipurpose passenger vehicles.

TRUCK RADIAL TIRES USED AS SINGLES

Wheel Code		Tire Size	Load Range	Tire Load Limits at Various Inflation Pressures						
Regular	Rally			35	40	45	50	55	60	65
DJ	—	9.50R-16.5	D	1860	2030	2190	2350	2500	2650	2780

* Wheel load limits are shown on page 0. Vehicle loading must be limited such that neither the wheel or tire load limits are exceeded.

Fig. 3E-2--Tire/Wheel Load and Inflation Pressure 1 of 5

WHEEL USAGE AND TIRE LOAD LIMITS AT VARIOUS INFLATION PRESSURES*
TIRES FOR LIGHT TRUCKS USED IN HIGHWAY SERVICE
TIRES USED AS SINGLES

Wheel Code		Tire Size	Load Range	Tire Load Limits at Various Inflation Pressures									
Regular	Rally			30	35	40	45	50	55	60	65	70	75
TUBE TYPE TIRES MOUNTED ON 5° TAPERED BEAD SEAT RIMS													
DD, BR	—	6.50-16	C	1270	1390	1500	1610						
AX, FT	—	7.00-15	C	1350	1480	1610	1720						
AX, FT	—	7.00-15	D	1350	1480	1610	1720	1830	1940	2040			
DD, BR	—	7.00-16	C	1430	1560	1680	1800						
XS	—	7.50-16	C	1620	1770	1930	2060						
XS	—	7.50-16	D	1620	1770	1930	2060	2190	2310	2440			
XS	—	7.50-16	E	1620	1770	1930	2060	2190	2310	2440	2560	2670	
TUBELESS TIRES MOUNTED ON 15° TAPERED BEAD SEAT DROP CENTER RIMS													
FA	—	8.19-5	D	—	—	—	—	2110	2270	2410	2540	2680	2800

* Wheel load limits are shown on the page 0. Vehicle loading must be limited such that neither the wheel or tire load limits are exceeded.

Fig. 3E-3--Tire/Wheel Load and Inflation Pressure 2 of 5

3E-4 WHEELS AND TIRES

WHEEL USAGE TIRE LOAD LIMITS AT VARIOUS INFLATION PRESSURES*
TIRES FOR LIGHT TRUCKS USED IN HIGHWAY SERVICE (Cont'd.)
WIDE BASE TUBELESS TIRES USED AS SINGLES

Wheel Code		Tire Size	Load Range	Tire Load Limits at Various Inflation Pressures									
Regular	Rally/Spoke			20	22	24	26	28	30	32	34	36	38
BS	CT, BM	10-15	B	1390	1470	1540	1620	1690	1760				
				30	35	40	45	50	55	60	65	70	75
DK, DJ	—	8.00-16.5	C	1360	1490	1610	1730						
DK, DJ	—	8.00-16.5	D	1360	1490	1610	1730	1840	1945	2045			
DK, DJ	—	8.00-16.5	E	1360	1490	1610	1730	1840	1945	2045	2145	2240	2330
DK, DJ	—	8.75-16.5	C	1570	1720	1850	1990						
DK, DJ	—	8.75-16.5	D	1570	1720	1850	1990	2110	2240	2350			
DJ	—	8.75-16.5	E	1570	1720	1850	1990	2110	2240	2350	2470	2570	2680
DJ	—	9.50-16.5	D	1860	2030	2190	2350	2500	2650	2780			
DJ	—	9.50-16.5	E	1860	2030	2190	2350	2500	2650	2780	2920	3050	3170
BH	—	10-16.5	C	1840	2010	2170	2330						
BH	—	10-16.5	D	1840	2010	2170	2330	2480	2620	2750			

* Wheel load limits are shown on the page 0. Vehicle loading must be limited such that neither the wheel or tire load limits are exceeded.

Fig. 3E-4--Tire/Wheel Load and Inflation Pressure 3 of 5

WHEEL USAGE AND TIRE LOAD LIMITS AT VARIOUS INFLATION PRESSURES*
TIRES FOR LIGHT TRUCKS USED IN HIGHWAY SERVICE
TIRES USED AS DUALS

Wheel Code		Tire Size	Load Range	Tire Load Limits at Various Inflation Pressures									
Regular	Rally			30	35	40	45	50	55	60	65	70	75
TUBE TYPE TIRES MOUNTED ON 5° TAPERED BEAD SEAT RIMS													
FR	—	6.50-16	C	1120	1225	1320	1420						
FR	—	7.00-16	C	1260	1365	1475	1580						
FR	—	7.00-16	D	1260	1365	1475	1580	1685	1780	1870			
FR	—	7.50-16	C	1430	1565	1690	1815						
FR	—	7.50-16	D	1430	1565	1690	1815	1930	2040	2140			
TUBELESS TIRES MOUNTED ON 15° TAPERED BEAD SEAT DROP CENTER RIMS													
CA	—	8.00-17.5	D	1445	1575	1700	1820	1935	2050	2155			
FB, UH	—	8-19.5	D	—	—	1850	1990	2110	2230	2350	2460		
UH	—	8-19.5	E	—	—	1850	1990	2110	2230	2350	2460	2570	2680 (#)

* Wheel load limits are shown on page 0. Vehicle loading must be limited such that neither the wheel or tire load limits are exceeded.

#2780 lbs. at 80 lbs. pressure.

Fig. 3E-5--Tire/Wheel Load and Inflation Pressure 4 of 5

WHEEL USAGE AND TIRE LOAD LIMITS AT VARIOUS INFLATION PRESSURES*
TIRES FOR LIGHT TRUCKS USED IN HIGHWAY SERVICE (Cont'd.)
WIDE BASE TUBELESS TIRES USED AS DUALS

Wheel Code		Tire Size	Load Range	Tire Load Limits at Various Inflation Pressures										
Regular	Rally			30	35	40	45	50	55	60	65	70	75	
AN	—	8.00-16.5	C	1195	1310	1415	1520							
AN	—	8.00-16.5	D	1195	1310	1415	1520	1620	1710	1800				
AN	—	8.75-16.5	C	1380	1515	1630	1750							
AN	—	8.75-16.5	D	1380	1515	1630	1750	1855	1970	2070				
AN	—	8.75-16.5	E	1380	1515	1630	1750	1855	1970	2070	2175	2260	2360	

* Wheel load limits are shown below. Vehicle loading must be limited such that neither the wheel or tire load limits are exceeded.

WHEEL CODE AND LIMITS

Code	Size of Wheel	Wheel Limits	
		Max. Load (Lbs.)	Max. Press. (PSI)
BC, CU	15 x 7 JJ	1670	40
CT, BM	15 x 8 JJ	1910	40
BS	15 x 8 JJ	1760	40
DT	15 x 6 JJ	1670	55
AN	16.5 x 6.00	2680	85
XH	15 x 6 JJ	1670	55
DD	16 x 5 K	1800	55
XU	15 x 6 JJ	1670	55
BR	16 x 5 K	1800	55
FB	19.5 x 6.00	2540	80
CX, CW	15 x 8 JJ	2030	40

Code	Size of Wheel	Wheel Limits	
		Max. Load (Lbs.)	Max. Press. (PSI)
DK	16.5 x 6.00	2350	70
DJ	16.5 x 6.75	3170	85
XG	16 x 6½ L	2780	85
BH	16.5 x 8.25	2750	70
FT	15 x 6 JJ	1910	70
AX	15 x 6 JJ	2040	70
UH	19.5 x 6.00	2780	95
FR	16 x 6 KS	2440	75
FA	19.5 x 6.75	2850	90
CA	17.5 x 5.25	2155	70

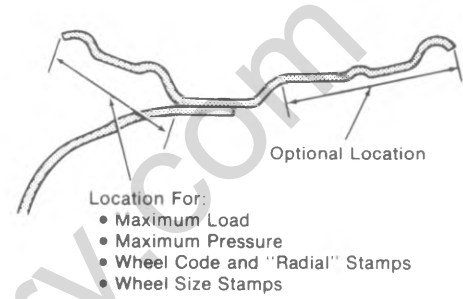


Fig. 3E-6--Tire/Wheel Load and Inflation Pressure 5 of 5

SERVICE OPERATIONS

CAUTION: Servicing of tires mounted on multi-piece rims requires proper tools, safety equipment and specialized training. Severe injuries can result from improper servicing techniques. It is recommended that tires on multi-piece rims be serviced only by competent personnel with proper equipment or by competent truck tire repair shops.

CORRECTING IRREGULAR TIRE WEAR

Heel and Toe Wear

This is a saw-toothed effect where one end of each tread block is worn more than the other. The end that wears is the one that first grips the road when the brakes are applied.

Heel and toe wear is less noticeable on rear tires than on front tires, because the propelling action of the rear wheels creates a force which tends to wear the opposite end of the tread blocks. The two forces, propelling and braking, make for more even wear of the rear tires, whereas only the braking forces act on the front wheels, and the saw-tooth effect is more noticeable.

A certain amount of heel and toe wear is normal. Excessive wear is usually due to high speed driving and excessive use of brakes. The best remedy, in addition to cautioning the owner on his driving habits, is to interchange tires regularly.

Side Wear

This may be caused by incorrect wheel camber, underinflation, high cambered roads or by taking corners at too high a rate of speed. The first two causes are the most common. Camber wear can be readily identified because it occurs only on one side of the treads, whereas underinflation

causes wear on both sides. Camber wear requires correction of the camber first and then interchanging tires. There is, of course, no correction for high cambered roads. Cornering wear is discussed further on.

Misalignment Wear

This is wear due to excessive toe-in or toe-out. In either case, tires will revolve with a side motion and scrape the tread rubber off. If misalignment is severe, the rubber will be scraped off of both tires; if slight, only one will be affected. The scraping action against the face of the tire causes a small feather edge of rubber to appear on one side of the tread and this feather edge is certain indication of misalignment. The remedy is readjusting toe-in, or rechecking the entire front end alignment if necessary.

Uneven Wear

Uneven or spotty wear is due to such irregularities as unequal caster or camber, bent front suspension parts, out-of-balance wheels, brake drums out of round, brakes out of adjustment or other mechanical conditions. The remedy in each case consists of locating the mechanical defect and correcting it.

Cornering Wear

When a truck makes an extremely fast turn, the weight is shifted from an even loading on all wheels to an abnormal load on the tires on the outside of the curve and a very light load on the inside tires, due to centrifugal force. This unequal loading may have two unfavorable results.

First, the rear tire on the inside of the curve may be relieved of so much load that it is no longer geared to the road and it slips, grinding off the tread on the inside half of the tire at an excessive rate. This type of tire shows much

the same appearance of tread wear as tire wear caused by negative camber.

Second, the transfer of weight may also overload the outside tires so much that they are laterally distorted resulting in excessive wear on the outside half of the tire, producing a type of wear like that caused by excessive positive camber.

Cornering wear can be most easily distinguished from abnormal camber wear by the rounding of the outside shoulder or edge of the tire and by the roughening of the tread surface which denotes abrasion.

Cornering wear often produces a fin or raised portion along the inside edge of each row in the tread pattern. In some cases this fin is almost as pronounced as a toe-in fin, and in others, it tapers into a row of tread blocks to such an extent that the tire has a definite "step wear" appearance.

The only remedy for cornering wear is proper instruction of operators. Driving more slowly on curves and turns will avoid grinding rubber off tires. To offset normal cornering wear as much as possible tires should be interchanged at regular intervals.

Wheel and Tire Balancing

It is desirable from the standpoints of tire wear and vehicle ride and handling ease to maintain proper balance of wheel and tire assemblies on all models. This may be accomplished by either of the two types of balancing systems in current use which balance wheels either on the vehicle or off. The "on the vehicle" type, however, is the more desirable in that all rolling components (brake drums, bearings, seals, etc.) are included in the balancing procedure and thereby have any existing unbalance corrected.

Truck Wheel Balance Weights

All 1978 truck wheels equipped with a tubular side ring (rolled flange rim) on the outboard side of the wheel rims require special design weights to fit. Dynamic balancing can be accomplished through use of these special balance weights which are designed only for installations on the outboard side of these wheels. Conventional weights fit only the inboard side of these wheels.

Static Balance

Static balance (sometimes called still balance) is the equal distribution of weight of the wheel and tire assembly about the axis of rotation in such a manner that the assembly has no tendency to rotate by itself, regardless of its position. For example: A wheel with chunk of dirt on the rim will always rotate by itself until the heavy side is at the bottom. Any wheel with a heavy side like this is statically out of balance. Static unbalance of a wheel causes a hopping or pounding action (up and down) which frequently leads to wheel "flutter" and quite often to wheel "tramp".

Dynamic Balance

Dynamic balance (sometimes called running balance) means that the wheel must be in static balance, and also run smoothly at all speeds.

To insure successful, accurate balancing, the following precautions must be observed:

- Wheel and tire must be clean and free from all foreign matter.
- The tires should be in good condition and properly mounted with the balance mark on the tire, if any, lined up

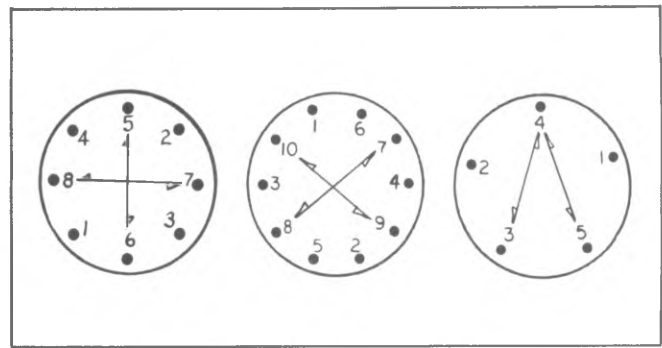


Fig. 3E-7--Wheel Nut Tightening Sequence

with the valve.

- Bent wheels that have runout over 1/16" should be replaced.

- Inspect tire and wheel assembly to determine if an eccentric or out-of-round condition exists. Note that this condition, if severe, cannot be "balanced out". An assembly which has an out-of-round condition exceeding 3/16" on tire sizes through 19.5" is not suitable for use on the front of the vehicle. Its use on the rear should be governed by its general condition and whether the roundness defect seriously detracts from overall ride quality.

- When balancing wheels and tires, it is recommended that the instructions covering the operation of the wheel balancer being used be closely followed.

- When balancing truck type nylon tires, tires must be hot (run for several miles) before raising vehicle to balance so that flat spot is eliminated. A tire which is flat spotted will be incorrectly balanced.

WHEEL REMOVAL AND INSTALLATION

Jacking Instructions

Place vehicle jack supplied or recommended as follows: To raise a rear wheel, place jack under axle housing; to raise front wheel of C, G, P models, place jack under lower control arm pivot; to raise front wheel of K models, place jack under front axle near spring seat.

Dual and Single Wheels

When installing the tire and wheel on the vehicle, the following procedure should be followed:

After wheel nuts are put on loosely, turn the wheel until one nut is at the top of the bolt circle; tighten the nut just snug. Snug up the remaining nuts criss-cross to minimize runout, then tighten the nuts to the recommended torque alternately and evenly to avoid excessive runout.

When installing wheels on vehicles with dual rear wheels:

1. Install inner and outer wheel and clamp ring on rear, or wheel and clamp ring on front (be sure pins on clamp ring face outboard).

2. Install and snug nuts finger tight.

3. Torque nuts to specified torque in sequence shown in Fig. 3E-7.

Lateral runout should not exceed 1/8" on front wheel or 3/16" on rear wheel.

Matching Side and Lock Rings

Side and lock rings of different rim types are not interchangeable. Some may appear to be, but they do not fit properly on the rim base. Serious accidents have resulted from the use of mismatched rings. Rim base and rings must be matched according to manufacturer, size and type. This information is stamped on each part.

Installing Synthetic Tubes

CAUTION: *When tube and flap are not properly lubricated and mounted, they will stretch thin in the tire bead and rim region. This will cause premature failure.*

1. Before installing tube in tire, clean inside of casing thoroughly.
2. Insert tube in tire and inflate until it is nearly rounded out.
3. Inspect rim for rust scale and bent flanges--clean rust scale and straighten flanges where necessary.
4. Using a brush or cloth swab, apply a solution of neutral vegetable oil soap to the inside and outside of tire beads and also the the rim side of the tube. Do not allow soap solution to run down into tire.
5. When mounting tire and tube on a drop center rim, follow the standard procedure. Be sure tire is centered on rim so that beads are out of rim well before inflating. Do not allow tire to hang loosely on wheel while inflating.
6. Center valve and pull it firmly against the rim. Hold in this position and inflate until tire beads are firmly seated on rim against flanges.
7. Completely deflate tire by removing valve core.
8. Reinflate tire to recommended pressure.

TUBELESS TIRES

Tubeless tires mounted on one piece full drop center rims are standard on some trucks. These tires have a safety inner liner which if punctured, tends to cling to the penetrating object forming a partial seal until the object is removed from the tire.

The mounting and demounting of tubeless truck tires will present no problem when a rubber lubricant, such as Ru-Glyde or equivalent is applied to tire beads and rim flanges. Ru-Glyde or equivalent in addition to materially assisting in mounting and demounting also prevents rusting at the tire sealing area and thus prevents tires from adhering to the wheel.

CAUTION: *A hammer, or tools with sharp edges, should never be used to demount or mount tubeless tires as damage to rim flange or tire sealing bead may result.*

Inspection for Leaks

1. With wheel assembly removed from vehicle, inflate the tire to recommended operating pressure.
2. Check for leaks at rim bead by placing wheel and tire horizontal and allowing water to stand in groove between rim and tire. Check for large leaks by lowering assembly into water tank or running water over tire.

Demounting

1. Remove valve core to completely deflate tire. With tire lying flat on floor, loosen beads from rim seats by walking around on tire with heels at points close to rim. With wide side of rim down, apply tire lubricant to top bead. With stops toward rim, insert spoon ends of two tire irons

about 10" apart. While standing on tire to hold bead in gutter, pull one tool toward center of rim.

2. Hold one iron in position with foot and pull second iron toward center of rim. Progressively work bead off rim, taking additional bites if necessary.

3. Stand assembly in vertical position. Lubricate second bead. At top of assembly insert straight end of tire iron between bead and back flange of rim at about a 45 degree angle.

4. Turn iron so that it is perpendicular to rim. Pry second bead off.

Mounting

All tubeless tires will be mounted as follows:

1. Inspect rim to insure bead seats are clean and smooth. Then place rim on floor with wide side down and lubricate first bead of tire and upper bead seat of rim.

2. Push first bead into well of rim and onto rim as far as possible. Using straight end of tire iron and with stop resting on rim flange, work remaining section of first bead over rim.

3. Hold second bead in well by standing on tire. When necessary, push section of bead into rim well and anchor with vise-grip pliers by pinching pliers on rim flange. Using spoon end of tire iron with stop toward rim, work progressively around bead using small bites until bead slips over flange onto rim base. If necessary, insert second tire iron and lubricate last 6" of bead before completing.

4. Check valve to be certain that hex nut at the valve base is tight. Inflate tire to recommended operating pressure. Check assembly for air leaks.

RADIAL TIRES

Recommended truck tire mounting and inflation procedures are especially important with radial truck tires. Failure to follow these recommendations can cause bead deformation in both tube type and tubeless tires due to incorrect bead seating. Bead deformation may lead to chafing, lower sidewall and bead area cracking, demounting difficulties, eccentric wear, ride vibration and non-retreadable casing.

Mounting

To insure correct mounting and bead seating and to prevent bead deformation, the following steps must be taken:

A. Tube Type Tires

1. Only use rims approved for radial tire usage by rim manufacturer. Thoroughly clean rim parts, removing all rust and other foreign material. Make sure rim parts match and are not sprung or broken.

2. Thoroughly lubricate tire beads, portion of tube between beads, and flaps with an approved rubber lubricant. Radial tubes are identifiable by the letter "R" in the size designation. Example 100R20. Also, to further identify the radial tube, a red band on the valve stem has been required since March, 1975. Radial flaps are also identified by the letter "R". Example - 20R8.

CAUTION: *Do not use silicone base lubricants - this could cause the tire to slip on the wheel.*

3. Double inflate. Inflate to operating pressure, deflate completely and reflate to operating pressure. This allows tube, flap and tire to fit together properly.

4. Check bead seating. Visually check slot and side ring gap (on two piece rim) to make sure bead is seated. The

flange and one of the three lower sidewall rim line rings while the tire is laying flat (measurements should be taken each 90° around the circumference of the rim flange). If spacing is uneven around bead from side to side, repeat Step 1 through 3, and recheck.

B. Tubeless Tires.

1. Only use rims approved for radial tire usage by rim manufacturer. Thoroughly clean rim, removing all rust and other foreign material.

2. Thoroughly lubricate tire beads and rim bead seats with an approved rubber lubricant.

CAUTION: *Do not use silicone base lubricants - this could cause the tire to slip on the wheel.*

3. Inflation. Inflate tire to operating pressure. Due to the construction of radial truck tires, particularly in the lower sidewall and bead area, it may be difficult to get the tire to take air. An inflation aid may be necessary to help seat the bead of tubeless radial tires. Two types of inflation aids are commercially available, (1) metal rings which use compressed air to seat beads, and (2) rubber rings which seal between the tirebead and rim bead seat allowing the bead to move out and seat. Lubrication is mandatory with both items.

4. Check bead seating. This check is made by measuring the space between the rim flange and one of the three lower sidewall rim line rings while the tire is laying flat (measurements should be taken each 90° around the circumference of the rim flange). If spacing is uneven around the bead from side to side, repeat Steps 1 through 3, and recheck.

It is that this procedure be followed to insure proper bead seating in order to prevent bead deformation.

NOTE: Radial tires, as well as the bias tires, must be mounted and inflated in accordance with safety precautions noted in RMA Radial and Bias Truck Tire Service Manuals.

ATTACHMENT OF DUAL WHEELS ON P300 MODELS

To assure secure attachment of the dual disc wheels, it is important that all dirt or rust scale be removed from the mating surface of the wheels, hub, and clamp ring as well as the stud and nut. **POWER DRIVE NUTS THEN MANUALLY INSPECT TORQUE AT 130-180 FT. LBS. MANUAL TORQUE ONLY: 150-200 FT. LB.**

SECTION 4A

PROPELLER SHAFT

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 1 of this Section".

CAUTION: *THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OF WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.*

CONTENTS

General Description.....	4A-1
Universal Joints.....	4A-1
Propeller Shaft.....	4A-2
Diagnosis.....	4A-3
On Car Service.....	4A-5

GENERAL DESCRIPTION

Universal Joints

The simple universal joint is basically two Y-shaped yokes connected by a crossmember called a spider. The spider is shaped like an X and arms that extend from it are called trunnions. See figure 4A-1.

The spider allows the two yoke shafts to operate at an angle to each other. When torque is transmitted at an angle, through this type of joint, the driving yoke rotates at a constant speed while the driven yoke speeds up and slows down twice per revolution. This changing of velocity (acceleration) of the driven yoke increases as the angle

between the two yoke shafts increases. This is the prime reason why single universal joints are not used for angles greater than three to four degrees. At four degrees, for example the change of velocity is .5%. At ten degrees it is 3%. If the universal joint were set at 30 degrees and the driving yoke were turning at 1000 RPM the velocity of the driven yoke would change from 856 RPM to 1155 RPM in one quarter of a revolution. In the remaining quarter revolution the velocity would change from 1155 RPM to 866 RPM.

On a one-piece drive shaft this problem can be eliminated by arranging two simple universal joints so that the two driving yokes are rotated 90 degrees to each other. However the angle between the drive and driven yokes must be very nearly the same on both joints for this to work. Refer to figure 4A-2. This allows the alternate acceleration and deceleration of one joint to be offset by the alternate deceleration and acceleration of the second joint. When the two joints do not run at approximately the same angle, operation can be rough and an objectionable vibration can be produced.

Universal joints are designed to consider the effects of various loadings and rear axle windup, during acceleration. Within the design angle variations the universal joints will operate safely and efficiently. However, when the design angles are exceeded the operational life of the joints may decrease.

The bearings used in universal joints are the needle roller type. The needle rollers are held in place on the trunnion by round bearing cups. The bearing cups are held in the yoke by either (depending on the manufacturer) snap

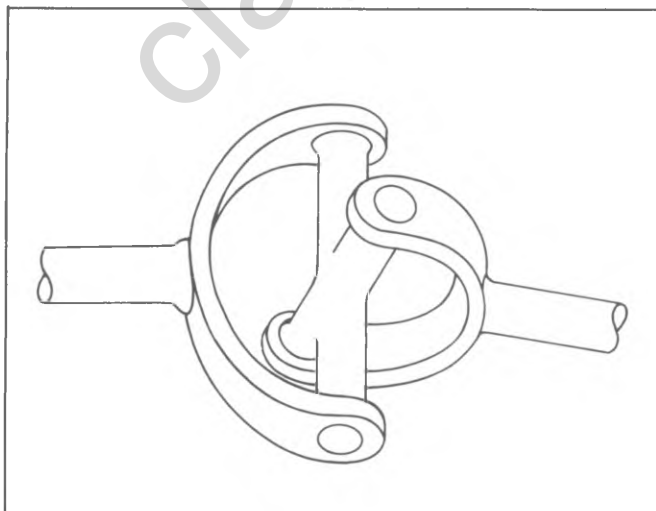


Fig. 4A-1--Simple Universal Joint

4A-2 PROPELLER SHAFT

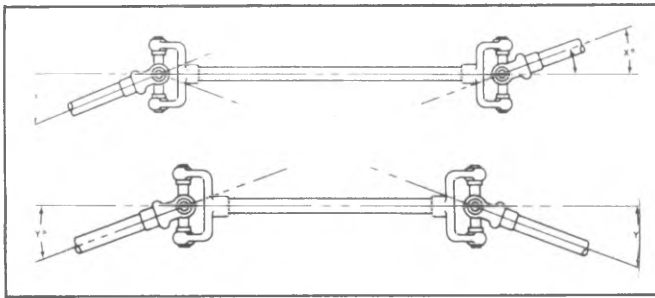


Fig. 4A-2--Universal Joints Arranged for Constant Velocity

rings or plastic injection. These joints usually are lubricated for life and cannot be lubricated while on the vehicle.

Constant Velocity Joint--Double Cardan Joint

As mentioned previously, the simple universal joint will operate efficiently through small angles only. Also, two simple universal joints phased properly and operating through the same angle will transmit constant velocity. When a large angle is encountered in a driveline, a simple universal joint will introduce two vibrations in each revolution. It is in this situation that a constant velocity joint is used.

Essentially, the constant velocity joint is two simple universal joints closely coupled by a coupling yoke, phased properly for constant velocity.

A centering ball socket between the joints maintains the relative position of the two units. This centering device causes each of the two units to operate through one-half of the complete angle between the drive shaft and differential carrier. See figure 4A-3.

NOTE: The ball/socket on this Constant Velocity joint requires periodic lubrication. A lubrication fitting is provided for this purpose, and is illustrated later in this section.

Propeller Shafts

The propeller shaft is a steel tube which is used to transmit power from the transmission output shaft to the differential. To accommodate various model, wheelbase and transmission combinations, drive shafts differ in length, diameter and the type of splined yoke. On some models the

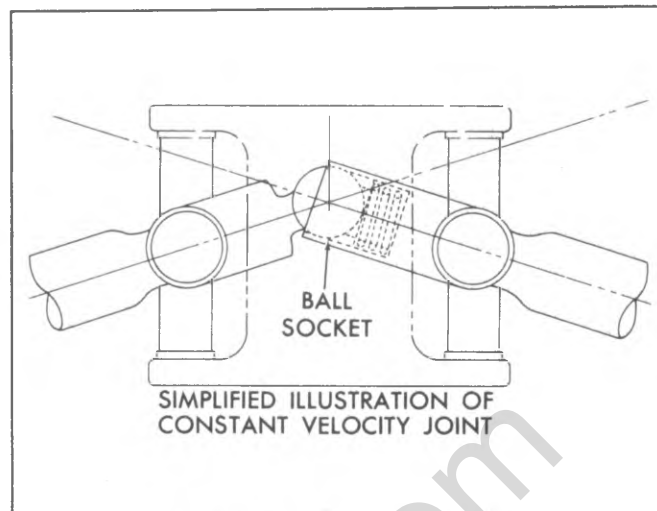


Fig. 4A-3--Ball-Socket Location

drive shaft is made up of concentric steel tubes with rubber elements between.

Each shaft is installed in the same manner. A universal joint and splined slip yoke are located at the transmission end of the shaft, where they are held in alignment by a bushing in the transmission rear extension. The slip yoke permits fore and aft movement of the drive shaft as the differential assembly moves up and down. The spline is lubricated internally by transmission lubricant or grease. An oil seal at the transmission prevents leakage and protects the slip yoke from dust, dirt and other harmful material.

Since the drive shaft is a balanced unit, it should be kept completely free of undercoating and other foreign material which would upset shaft balance.

Both one piece and two piece propeller shafts are used depending on the model. All are tubular and use needle bearing type universal joints.

On models that use a two piece shaft, the shaft is supported near its splined end in a rubber cushioned ball bearing which is mounted in a bracket attached to a frame crossmember. The ball bearing is permanently lubricated and sealed.

Four wheel drive models use a front propeller shaft incorporating a constant velocity joint.

PROPELLER SHAFT AND UNIVERSAL JOINT DIAGNOSIS

Checking and Correcting

Propeller Shaft Unbalance

1. Place vehicle on a twin post hoist so that the rear wheels are free to rotate.

2. Remove both rear tire and wheel assemblies and brake drums.

CAUTION: Use care not to apply brakes with drums removed.

3. Visually inspect propshaft, U-Joints and attachments for mud undercoating or other discrepancies. Make necessary corrections prior to running.

4. With vehicle running in gear at the indicated speed where disturbance is at its peak, observe the intensity of the disturbance.

5. Stop engine and disconnect drive shaft from companion flange. Reinstall shaft by rotating it 180° from its original position. Determine which position of the companion flange gives the best balance.

6. Install rear drums and wheels, and road test vehicle for final check of balance. If balance is still unacceptable, replace drive shaft.

DIAGNOSTIC CHART

COMPLAINT	POSSIBLE CAUSE	CORRECTION
Leak at front slip yoke. <div style="border: 1px solid black; padding: 5px;"> NOTE: An occasional drop of lubricant leaking from splined yoke is normal and requires no attention. </div>	a. Rough outside surface on splined yoke. b. Defective transmission rear oil seal.	a. Replace seal if cut by burrs on yoke. Minor burrs can be smoothed by careful use of crocus cloth or honing with a fine stone. Replace yoke if outside surface is rough or burred badly. b. Replace transmission rear oil seal. c. Bring transmission oil up to proper level after correction.
Knock in drive line, clunking noise when car is operated under floating condition at 10 mph in high gear or neutral.	a. Worn or damaged universal joints. b. Side gear hub counterbore in differential worn oversize.	a. Disassemble universal joints, inspect and replace worn or damaged parts. b. Replace differential case and/or side gears as required.
Ping, Snap or Click in drive line. <div style="border: 1px solid black; padding: 5px;"> NOTE: Usually occurs on initial load application after transmission has been put into gear, either forward or reverse. </div>	a. Loose upper or lower control arm bushing bolts. b. Loose companion flange.	a. Tighten bolts to specified torque. b. Remove companion flange, turn 180° from its original position, apply white lead to splines and reinstall. Tighten pinion nut to specified torque.

Fig. 4A-4--Diagnosis Chart A

COMPLAINT	POSSIBLE CAUSE	CORRECTION
<p>Roughness, Vibration or Body Boom at any speed.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>NOTE: With tachometer installed in car, determine whether propeller shaft is cause of complaint by driving through speed range and note the engine speed (rpm) at which vibration (roughness) is most pronounced. Then, shift transmission to a different gear range and drive car at same engine speed (rpm) at which vibration was noted before. Note the effect on the vibration.</p> <p>If vibration occurs at the same engine speed (rpm), regardless of transmission gear range selected, drive shaft assembly is <u>not</u> at fault, since the shaft speed (rpm) varies.</p> <p>If vibration decreased, or is eliminated, in a different gear range but at the same engine speed (rpm), check the possible causes:</p> </div>	<ul style="list-style-type: none"> a. Bent or dented drive shaft. b. Undercoating on drive shaft. c. Tire unbalance. (30-80 mph, not throttle conscious) d. Excessive U-bolt torque. e. Tight universal joints. f. Worn universal joints. g. Burrs or gouges on companion flange. Check snap ring locating surfaces on flange yoke. h. Drive shaft or companion flange unbalance. i. Excessive looseness at slip yoke spline. j. Drive shaft runout (50-80 mph throttle conscious) 	<ul style="list-style-type: none"> a. Replace. b. Clean drive shaft. c. Balance or replace as required. d. Check and correct to specified torque. e. Impact yokes with a hammer to free up. Overhaul joint if unable to free up or if joint feels rough when rotated by hand. f. Overhaul, replacing necessary parts. g. Rework or replace companion flange. h. Check for missing balance weights on drive shaft. Remove and reassemble drive shaft to companion flange, 180° from original position. i. Replace necessary parts. j. Check drive shaft runout at front and rear. Should be less than specified. If above, rotate shaft 180° and recheck. If still above specified, replace shaft.
<p>Roughness usually at low speeds, light load, 15-35 mph.</p>	<ul style="list-style-type: none"> a. U-bolt clamp nuts excessively tight. 	<ul style="list-style-type: none"> a. Check and correct torque to that specified. If torque was excessive or if brenelled pattern on trunnions is evident, replace joints.
<p>Scraping noise.</p>	<ul style="list-style-type: none"> a. Slinger, companion flange, or end yoke rubbing on rear axle carrier. 	<ul style="list-style-type: none"> a. Straighten slinger to remove interference.
<p>Roughness on heavy acceleration (short duration.)</p>	<ul style="list-style-type: none"> a. Double cardan joint ball seats worn. Ball seat spring may be broken. 	<ul style="list-style-type: none"> a. Replace joint and shaft assembly.
<p>Roughness -- above 35 mph felt and/or heard.</p>	<ul style="list-style-type: none"> a. Tires unbalanced or worn. 	<ul style="list-style-type: none"> a. Balance or replace as required.

Fig. 4A-5--Diagnosis Chart B

UNIT REPAIR

PROPELLER SHAFT

NOTE: The rear universal joint to propshaft bolt on some CK 1 ton dual wheel models requires a #10 "Six Lobed Socket" (J-25085), for proper removal and installation. (Torque to 25 lbs. ft.).

Removal

1. Raise vehicle on hoist. Mark relationship of shaft to companion flange and disconnect the rear universal joint by removing trunnion bearing "U" bolts or straps. Tape bearing cups to trunnion to prevent dropping and loss of bearing rollers.

2. For models with two-piece shafts remove bolts retaining bearing support to hanger.

3. Slide propeller shaft forward disengaging trunnion from axle flange, then slide assembly rearward disengaging from transmission.

NOTE: For models using strap or U-bolt attachments to transmission or transfer case use same removal procedure as above.

Universal Joints

On models with between center slip propshaft it is important that components are marked prior to disassembly for proper phasing. Arrows are stamped on assemblies as shown in Fig. 4A-7.

NOTE: The universal joints are of the extended-life design and do not require periodic inspection or lubrication; however, when these joints are disassembled, repack bearings and lubricate reservoir at end of trunnions with high-melting point wheel bearing lubricant use care not to damage or dislodge seals from trunnion.

Snap Ring Type

Disassembly

1. Remove bearing lock rings from trunnion yoke.
2. Support trunnion yoke on a piece of 1-1/4" I.D. pipe on an arbor bed.

NOTE: Due to length of the propeller shaft it may be more convenient to use a bench vise, for removal and

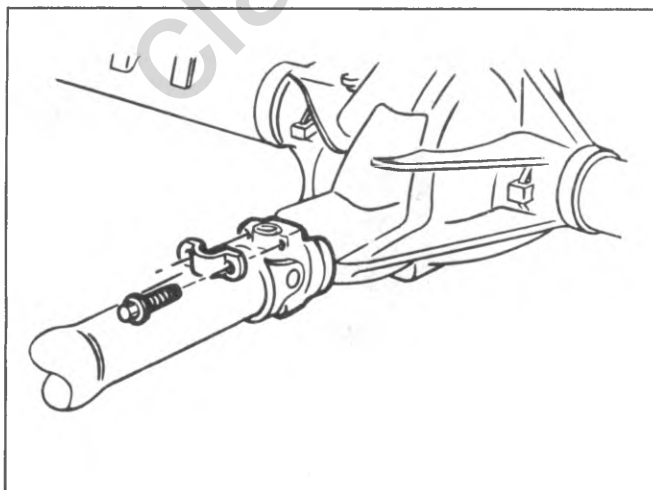


Fig. 4A-6--Strap Attachment

installation, instead of an arbor press. In this case, proceed with disassembly and assembly procedure as with an arbor press Fig. 4A-8 and 4A-9.

3. Using a suitable socket or rod, press on trunnion until bearing cup is almost out. Grasp cup in vise and work cup out of yoke. See figures 4A-8 and 4A-9.

NOTE: The bearing cup cannot be fully pressed out.

4. Press trunnion in opposite direction and remove other cup as in Step 3.

5. Clean and inspect dust seals, bearing rollers, and trunnion. Relubricate bearings as indicated in Section 0.

NOTE: In addition to packing the bearings, make sure that the lubricant reservoir at the end of each trunnion is completely filled with lubricant. In filling these reservoirs, pack lubricant into the hole so as to fill from the bottom (use of squeeze bottle is recommended). This will prevent air pockets and ensure an adequate supply of lubricant.

Reassembly Fig. 4A-10

1. Position trunnion into yoke. Partially install one bearing cup into yoke. Start trunnion into bearing cup. Partially install other cup. Align trunnion into cup, and press cups into yoke.

2. Install lock rings.

Injected Plastic Type

Disassembly

NOTE: Never clamp drive shaft tubing in a vise as the tube may be dented. Always clamp on one of the yokes, and support the shaft horizontally. Avoid damaging the slip yoke sealing surface. Nicks may damage the bushing or cut the seal lip.

1. Support the drive shaft in a horizontal position in

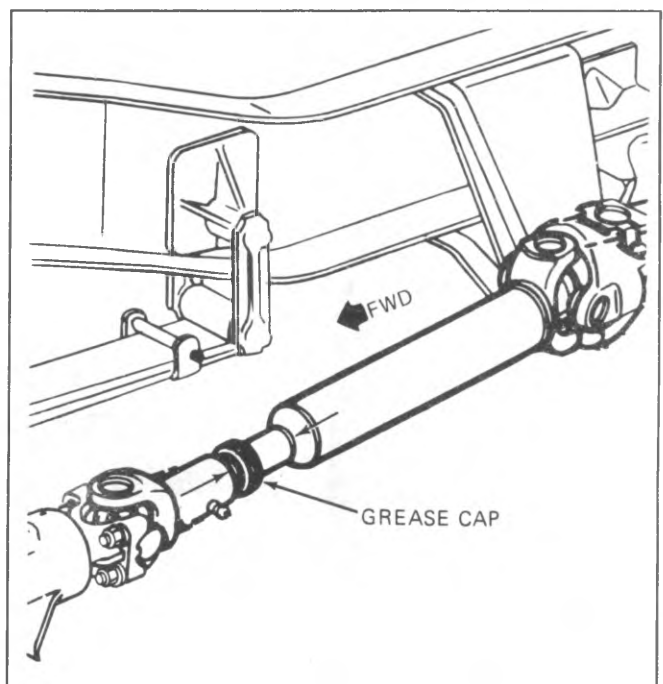


Fig. 4A-7--Proper Alignment

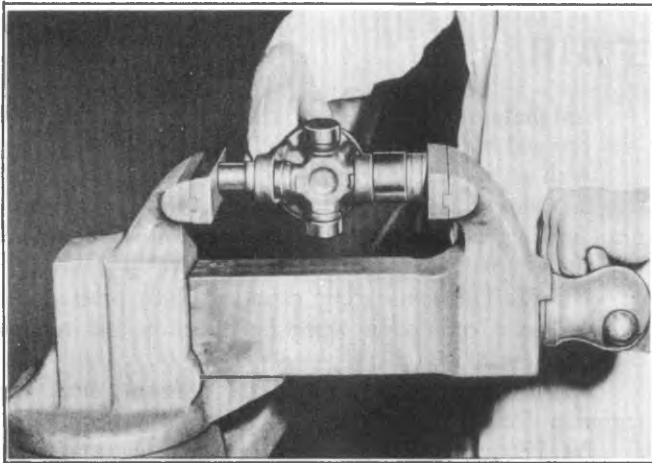


Fig. 4A-8--Bearing Cup Removal with Vise

ine with the base plate of a press. Place the universal joint so that the lower ear of the shaft yoke is supported on a 1-1/8" socket. Place the cross press, J-9522-3, on the open horizontal bearing cups, and press the lower bearing cup out of the yoke ear as shown in figure 4A-11. This will shear the plastic retaining the lower bearing cup.

2. If the bearing cup is not completely removed, lift the cross and insert Spacer J-9522-5 between the seal and bearing cup being removed, as shown in figure 4A-12.

Complete the removal of the bearing cup, by pressing it out of the yoke.

3. Rotate the drive shaft, shear the opposite plastic retainer, and press the opposite bearing cup out of the yoke as before, using Spacer J-9522.

4. Disengage cross from yoke and remove.

NOTE: Production universal joints cannot be reassembled. There are no bearing retainer grooves in production bearing cups. Discard all universal joint parts removed.

5. Remove the remains of the sheared plastic bearing retainer from the ears of the yoke. This will aid in reassembly of the service joint bearing cups. It usually is easier to remove plastic if a small pin or punch is first driven through the injection holes.

6. If the front universal joint is being serviced, remove

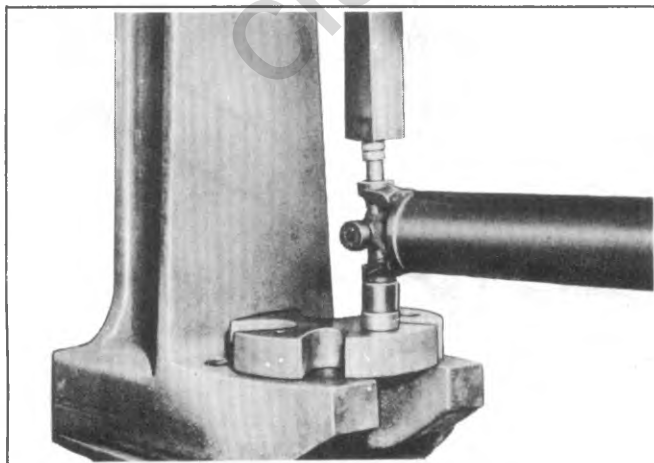


Fig. 4A-9--Bearing Cup Removal with Press

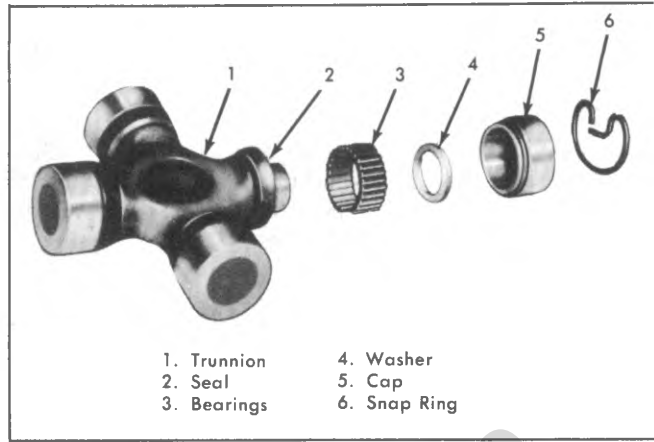


Fig. 4A-10--Universal Joint Repair Kit

the pair of bearing cups from the slip yoke in the same manner.

Reassembly

A universal joint service kit is used when reassembling this joint. See figure 4A-13. This kit includes one pregreased cross assembly, four service bearing cup assemblies with seals, needle rollers, washers, grease and four bearing retainers.

Make sure that the seals are in place on the service bearing cups to hold the needle rollers in place for handling.

1. Remove all of the remains of the sheared plastic bearing retainers from the grooves in the yokes. The sheared plastic may prevent the bearing cups from being pressed into place, and this prevent the bearing retainers from being properly seated.

2. Install one bearing cup part way into one side of the yoke, and turn this yoke ear to the bottom.

3. Insert cross into yoke so that the trunnion seats freely into bearing cup as shown in figure 4A-14.

4. Install opposite bearing cup part way. Make sure that both trunnions are started straight and true into both bearing cups.

5. Press against opposite bearing cups, working the cross all of the time to check for free movement of the

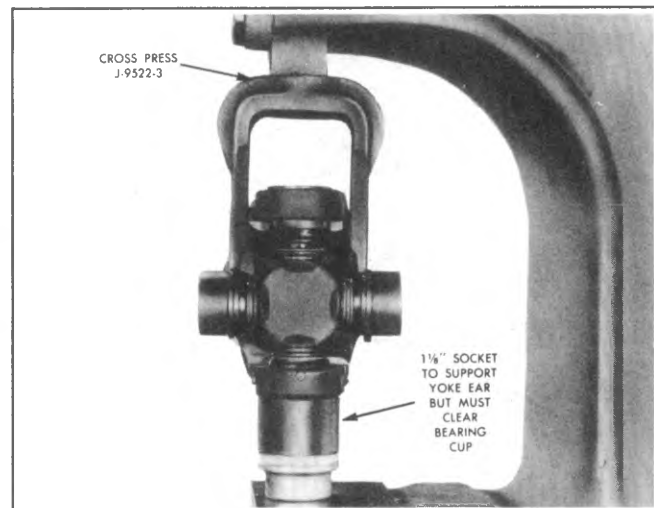


Fig. 4A-11--Pressing Out Bearing Cup

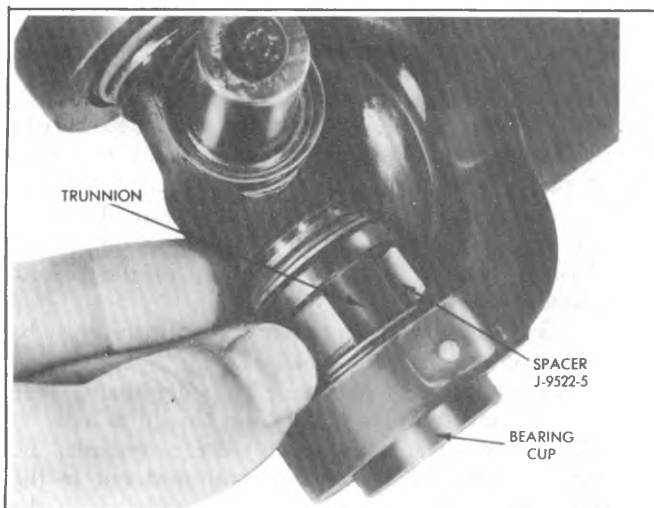


Fig. 4A-12--Using Spacer to Remove Bearing Cup

trunnions in the bearings. If there seems to be a hang-up, stop pressing and recheck needle rollers, to determine if one or more of them has been tipped under the end of the trunnion.

6. As soon as one bearing retainer groove clears the inside of the yoke, stop pressing and snap the bearing retainer into place as shown in figure 4A-15.

7. Continue to press until the opposite bearing retainer can be snapped into place. If difficulty is encountered, strike the yoke firmly with a hammer to aid in seating bearing retainers. This springs the yoke ears slightly. See figure 4A-16.

8. Assemble the other half of the universal joint in the same manner.

9. Check the freedom of rotation of both sets of trunnions of the cross. If too tight, again rap the yoke ears as described above. This will loosen the bearings and help seat the bearing retainers.

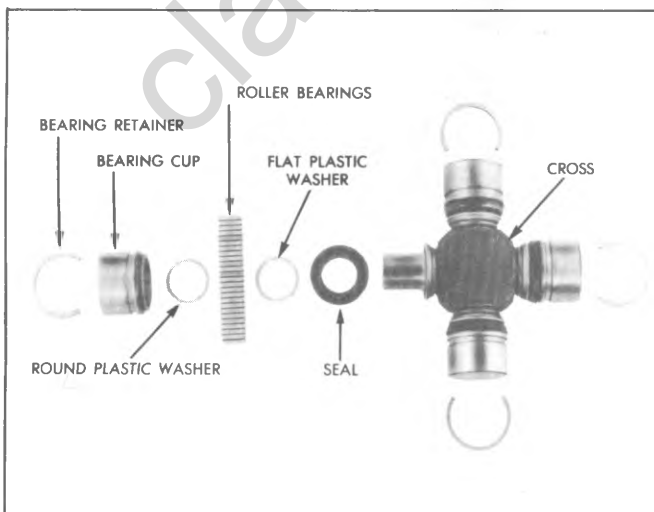


Fig. 4A-13--Repair Kit

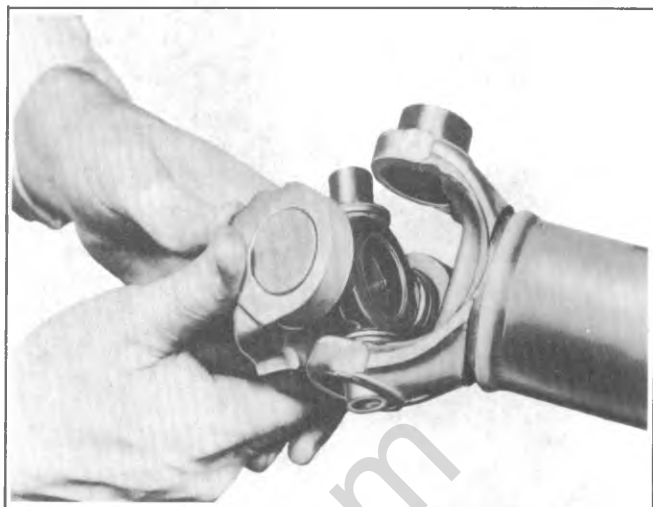


Fig. 4A-14--Installing Trunnion into Yoke

CENTER SUPPORT BEARING--FIG. 4A-17

CAUTION: See CAUTION on page 1 of this section regarding Center Support Bearing fasteners.

1. Remove strap retaining rubber cushion from bearing support.
2. Pull support bracket from rubber cushion and pull cushion from bearing.
3. Pull bearing assembly from shaft.
4. Assemble bearing support as follows:
 - a. Install inner deflector on propeller shaft, if removed, and prick punch deflector at two opposite points to make sure it is tight on shaft (Dana Style).
 - b. Fill space between inner dust shield and bearing with lithium soap grease (Dana Style).
 - c. Start bearing and slinger assembly straight on shaft journal. Support propeller shaft and, using suitable length of pipe over splined end of shaft, press bearing and inner slinger against shoulder on shaft.
 - d. Install dust shield over shaft, small diameter (Dana Style). Install bearing retainer (GM Style).
 - e. Install rubber cushion onto bearing.

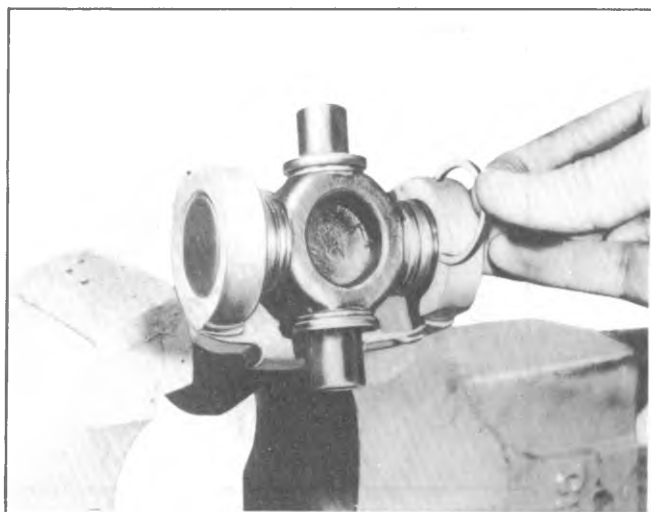


Fig. 4A-15--Installing Snap Ring to Retain Trunnion

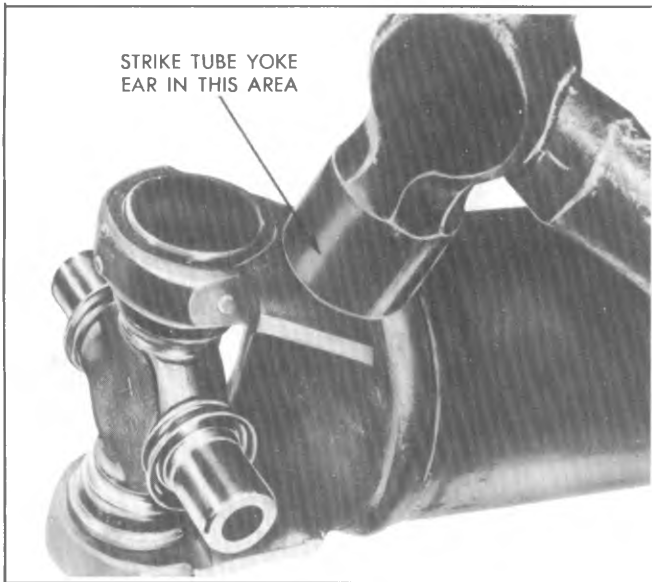


Fig. 4A-16--Seating Snap Rings

- f. Install bracket onto cushion.
- g. Install retaining strap.

Installation of Propshafts

NOTE: When reinstalling propshafts, it is necessary to place the shafts into particular positions to assure proper operation. This is called phasing.

All models with 32 splines use an alignment key, as shown in figure 4A-18, to obtain proper phasing. The shafts can mate only in the correct position.

G and K models with 16 splines must be phased as shown in figure 4A-19.

1. For models with one piece propeller shafts, slide shaft into transmission and attach rear U-joint to axle.

NOTE: On vehicles with two piece propshafts, the front propshaft yoke must be bottomed out in the transmission fully forward before installation of the hanger.

2. For C-P models with two-piece propeller shafts, proper phasing is accomplished with the alignment key, shown in figure 4A-18.

3. For G-K models with two piece shafts, install front half into transmission and bolt support to crossmember.

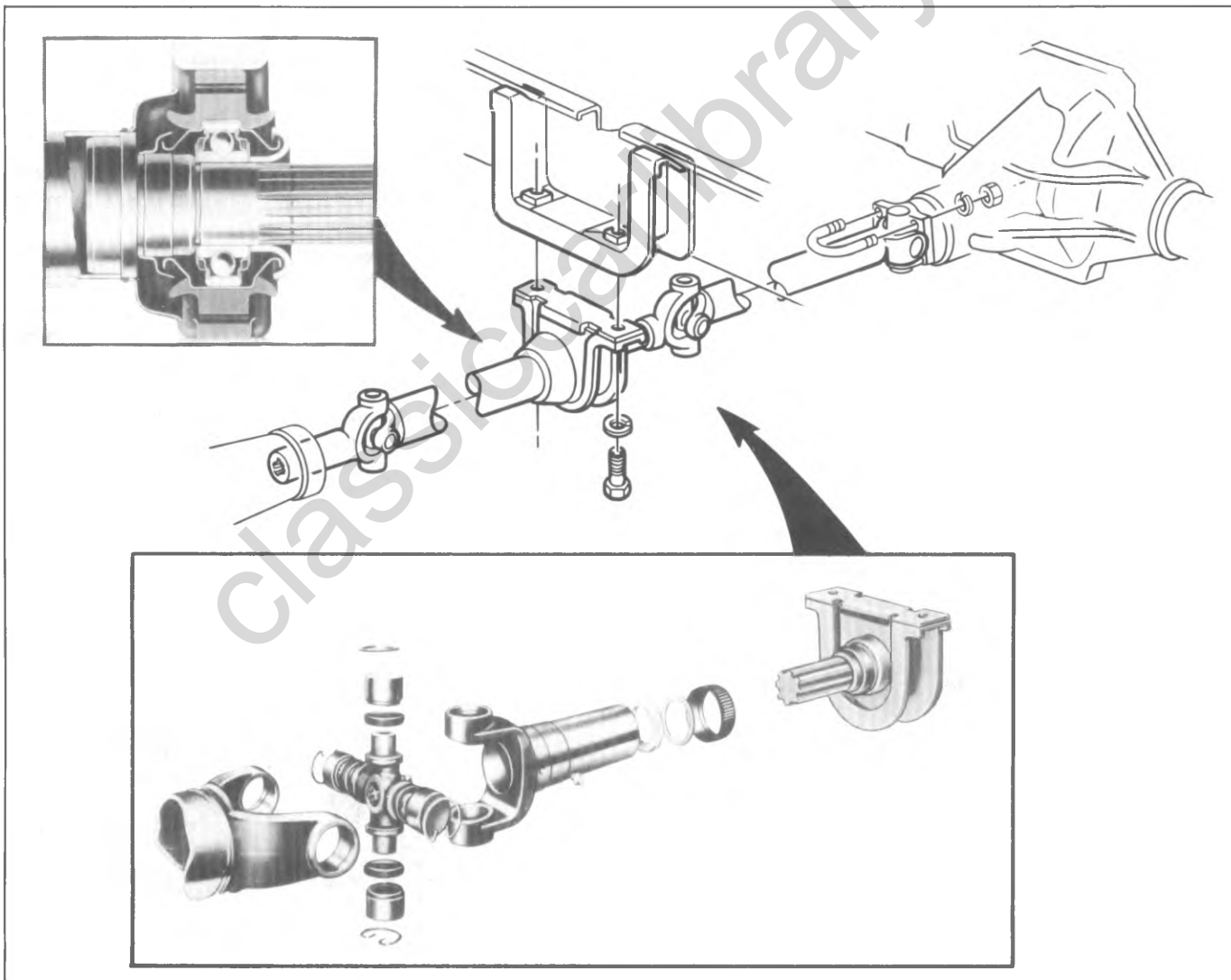


Fig. 4A-17--Propeller Shaft, Universal Joint and Bearing Support

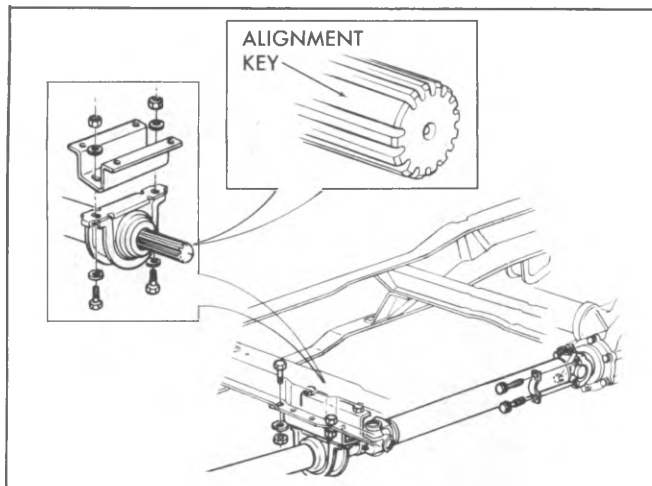


Fig. 4A-18--Alignment Key

- a. Slide grease cap and gasket onto rear splines.
- b. Rotate shaft so front U-joint trunnion is in correct position. See figure 4A-19.
- c. Take rear propeller shaft and before installing, align U-joint trunnions as shown in figure 4A-19. Attach rear

U-joint to axle. Tighten grease cap.

- d. Torque bearing support to crossmember and U-joint to axle attachments.

CONSTANT VELOCITY UNIVERSAL JOINT (Snap Ring Type) RETENTION

Disassembly

1. Remove auxiliary front propeller shaft from vehicle.
 2. Remove rear trunnion snap rings from center yoke.
- Remove grease fitting.

3. Place propeller shaft in vice as shown in figure 4A-20. Drive one rear trunnion bearing cap from center yoke as shown in figure 4A-20 until it protrudes approximately 3/8".

NOTE: Keep rear portion of propeller shaft up to avoid interference of rear yoke half with center yoke.

4. Once the bearing cup protrudes 3/8", release vice. Grasp protruding portion of cup in vice and strike center yoke as shown in Figure 4A-21 until cup is removed. Remove cup seal by prying off with a thin screwdriver.

5. Repeat steps 3 and 4 for remaining bearing cup.

6. Once the center yoke cups have been removed, remove rear yoke half bearing cups. Remove rear trunnion.

7. Gently pull rear yoke half from prop shaft. Remove all loose needle bearings. Remove spring seal.

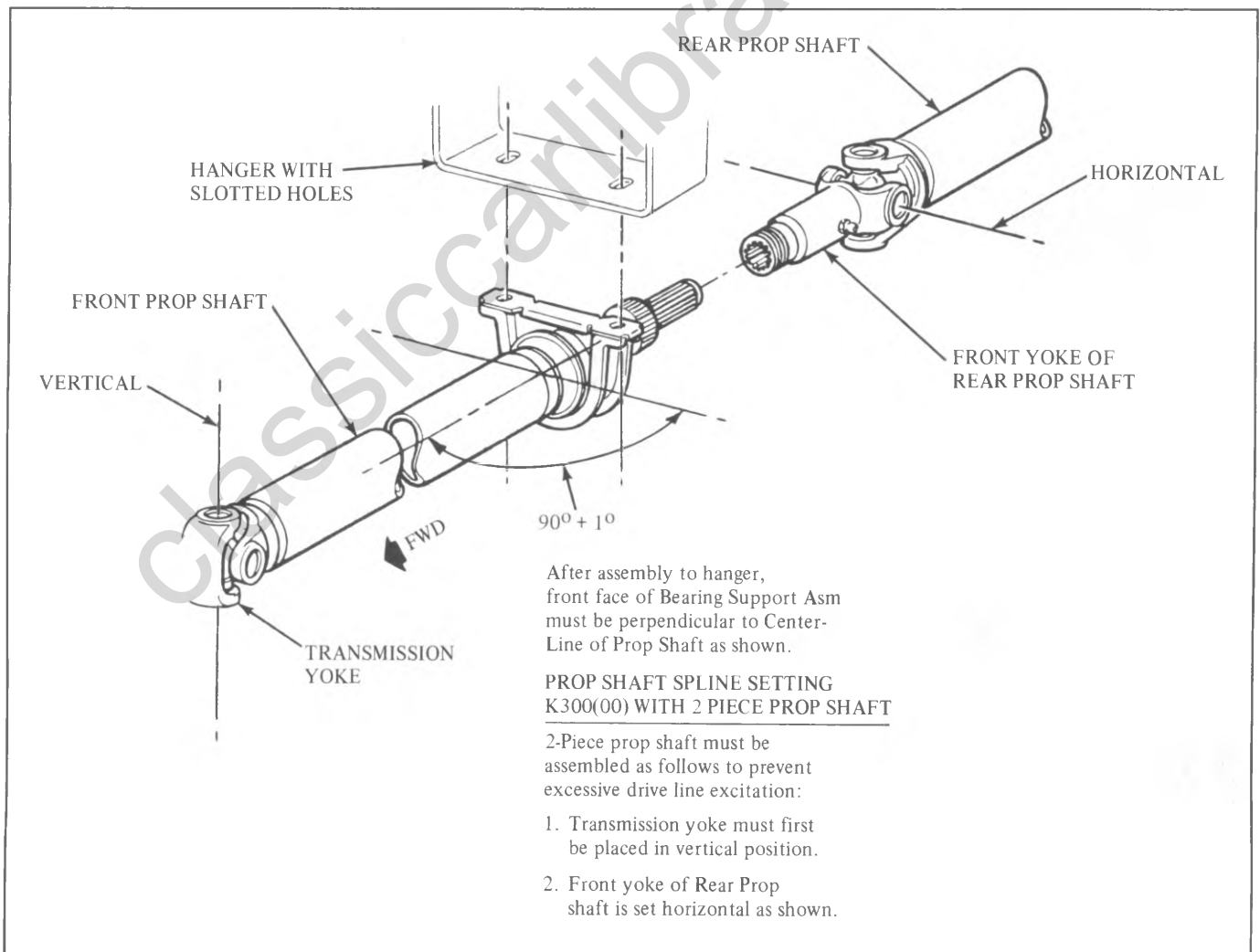


Fig. 4A-19--Alignment for Phasing

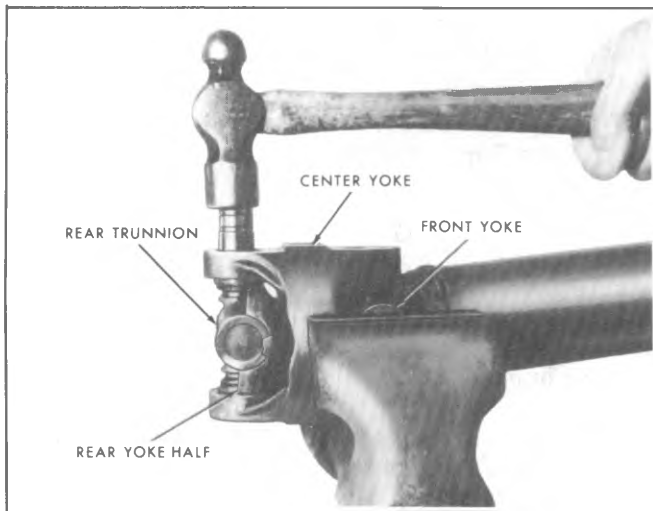


Fig. 4A-20--Driving Out Bearing Cups

8. Remove front trunnion from center and front yoke in same manner as described in Steps 2, 3 and 4.

NOTE: Before front trunnion can be removed all four (4) bearing caps must be removed.

Assembly

1. Clean and inspect all needle bearings, cups, seals, fittings, trunnions and yokes. Assemble all needle bearings in caps (27 per cap); assemble needle bearings in front yoke (28 total). Retain bearings with a heavy grease. Assemble seals to bearing cups.

NOTE: If seals are damaged U-joint should be replaced.

2. Place front trunnion in drive shaft. Place center yoke on front trunnion. Install one bearing cup assembly in front yoke. Drive in to a depth that the snap ring can be installed. Install snap ring. Install remaining cup in front yoke. Install snap ring.

3. Install front trunnion bearing cups in center yoke in same manner.

4. With front trunnion completely installed, install seal on prop shaft (large face first). Gently slip rear yoke half on prop shaft using care not to upset rollers. Insert rear

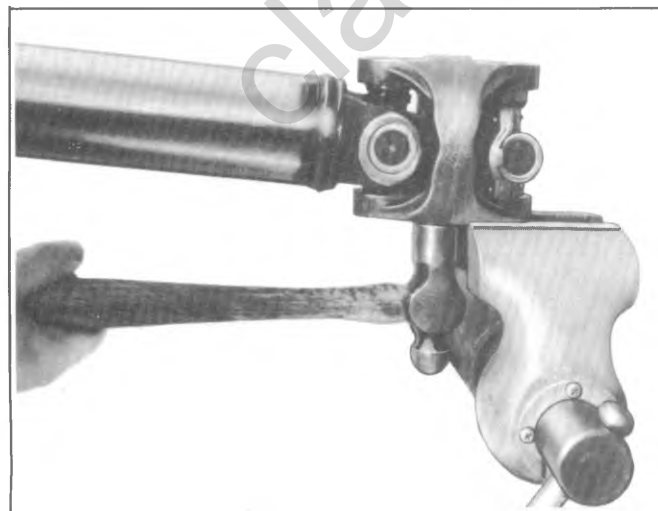


Fig. 4A-21--Bearing Cup Removal

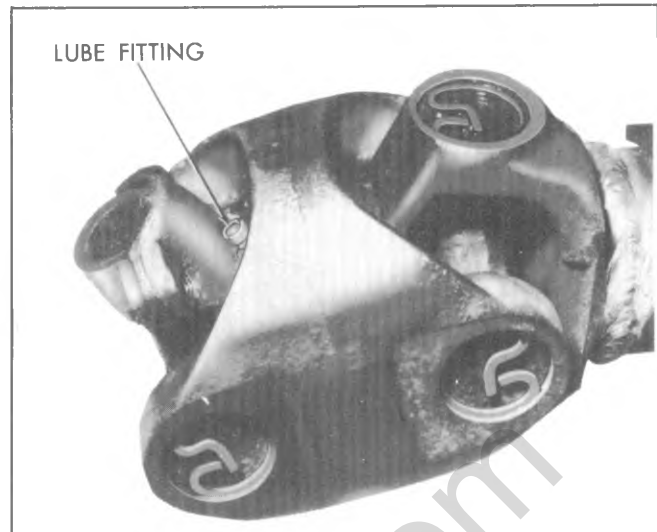


Fig. 4A-22--Lubrication Fitting Dana Style

trunnion in center yoke. Install rear yoke half bearing caps on rear trunnion. Install one rear trunnion bearing cap in center yoke and press into yoke until snap ring can be installed. Install remaining cap and snap ring.

5. Grease centering ball. The lubrication fitting location for Dana Style and GM Style propeller shafts are shown in Figures 4A-22 and 4A-24. A needle nose grease gun adapter J-25512 should be used.

NOTE: The access hole in the crossmember should be used to help locate the lube fitting.

6. Install propeller shaft with constant velocity joint next to transfer case. Torque to specifications.

DOUBLE CARDAN TYPE-CV JOINT

Inspection

An inspection kit including two bearing caps and two snap rings is available to allow the removal of the two trunnion caps shown at location 1, in figure 4A-23. Mark the flange yoke and coupling yoke for reassembly in the same position, as shown in figure 4A-24.

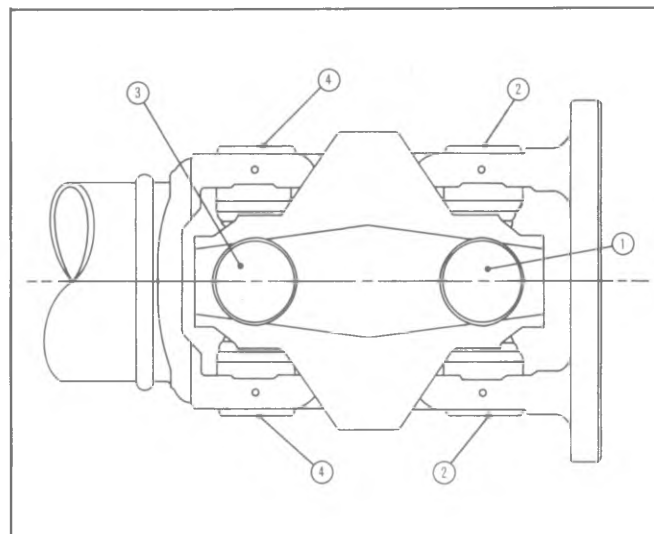


Fig. 4A-23--Bearing Cap Removal Sequence

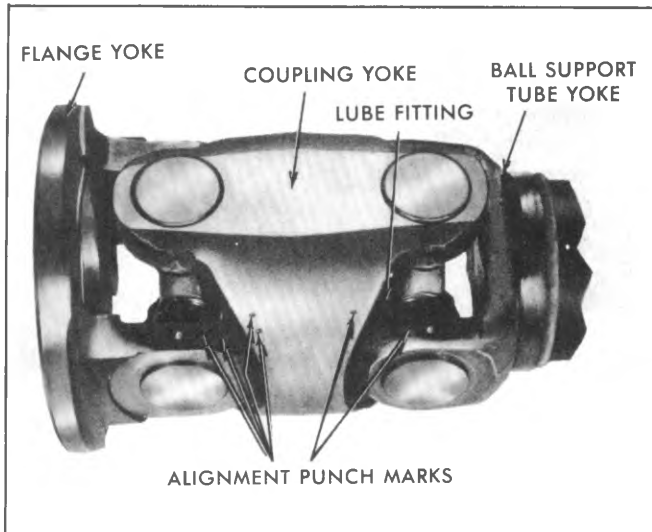


Fig. 4A-24--Reassembling Coupling Yoke

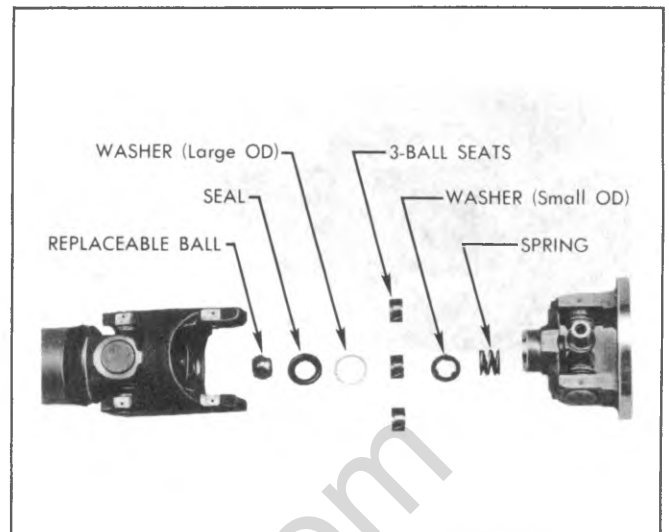


Fig. 4A-26--Exploded View of Centering Ball Mechanism

NOTE: To service the trunnion caps, use the appropriate procedures given in the beginning of this Section.

When both bearing cups are free, disengage the flange yoke and trunnion from the centering ball. Note that the ball socket is part of the flange yoke assembly, while the centering ball is pressed onto a stud and is part of the ball stud yoke. See figure 4A-25. Pry the seal from the ball socket and remove washers, spring and the three ball seats as illustrated in figure 4A-26.

1. Clean and inspect ball seat insert bushing for wear. If bushing is worn, replace flange yoke and cross assembly.
2. Clean and inspect seal and ball seats along with spring and washers. If any parts show indication of excessive wear or are broken, replace the entire set with a service kit.

NOTE: Whenever the seal is removed to inspect ball seat parts, it should be discarded and replaced with a new seal.

3. Remove all plastic from groove of coupling yoke.

4. Inspect the centering ball surface. If it shows signs of wear beyond smooth polish, replace it.

Centering Ball Replacement

1. Place fingers of inner part of Tool J-23996 under ball as shown in figure 4A-27.
2. Place outer cylinder of Tool J-23996 over outside of ball as shown in figure 4A-28.
3. Thread nut on Tool J-23996 and draw ball off stud, using wrench as shown in figure 4A-29.
4. Place the replacement ball on stud.
5. Using Tool J-23996, drive ball onto stud as in figure 4A-30, until the ball can be seen to seat firmly against the shoulder at the base of the stud. This is important as the center of the double Cardan joint is determined by the ball seating tightly in the proper location.

6. Using grease provided in the ball seat kit, lubricate all parts and insert them into the clean ball seat cavity in the following order: spring, washer (smallest OD), three ball seats (with largest opening outward to receive ball), washer (largest OD) and seal.

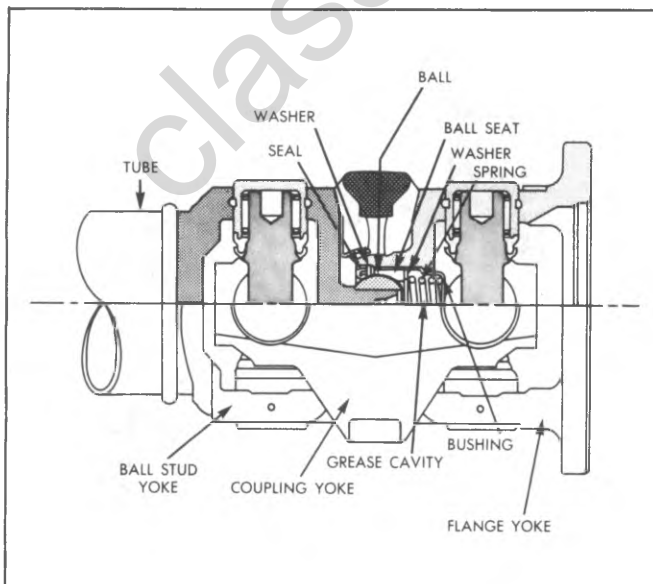


Fig. 4A-25--Cross Sectional View of CV Joint

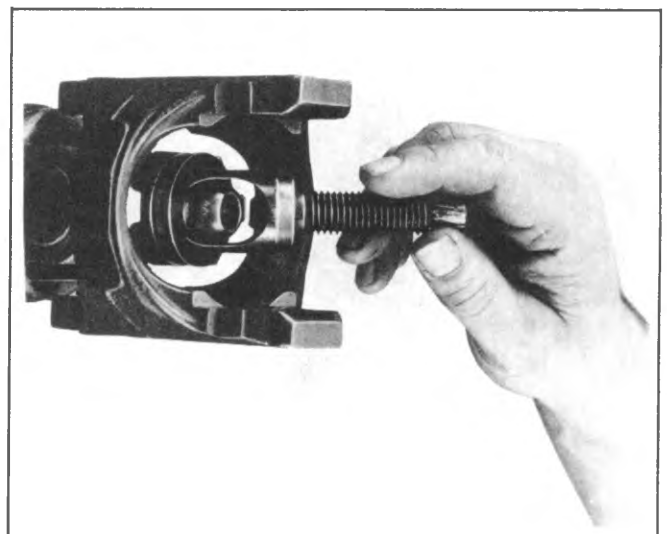


Fig. 4A-27--Installing Tool J-23996 Over Ball

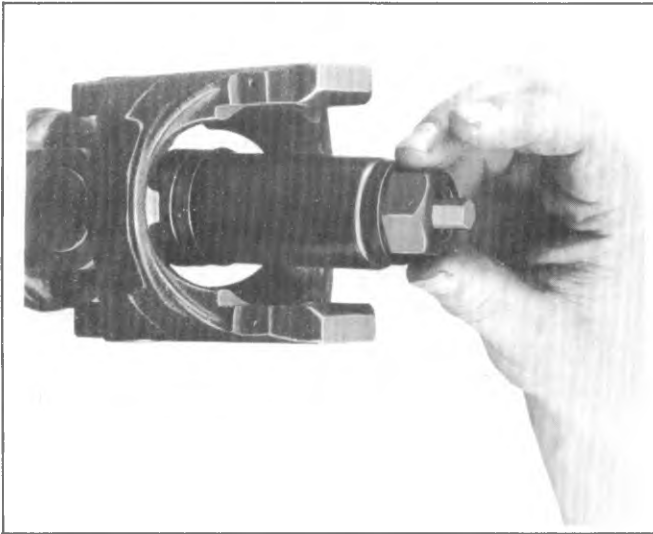


Fig. 4A-28--Installing Outer Cylinder of Tool J-23996 Over Ball

7. Lubricate seal lip and press seal flush with Tool J-23694, as shown in figure 4A-31. Sealing lip should tip inward.

8. Fill cavity with grease provided in kit.

9. Install flange yoke to centering ball as shown in figure 4A-32, making sure alignment marks are correctly positioned. Install trunnion and bearing caps as previously outlined.

LUBRICATION

The front axle propshaft found on all four-wheel drive trucks requires special lubrication procedures at two locations: The C/V joint, and the slip yoke.

All Constant Velocity Joints (C/V)

The constant velocity (C/V) joint, located at the transfer case end of the front propshaft, must be lubricated periodically with special lubricant, #1050679, or equivalent. If the fitting cannot be seen from beneath the vehicle Figure 4A-33 shows how the fitting may be lubricated from above the C/V joint, with a special adapter J-25512-2 on the end of a flex hose.

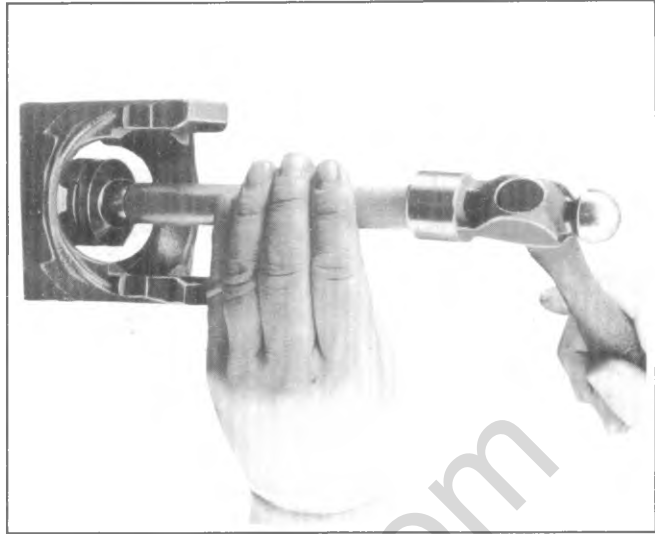


Fig. 4A-30--Installing Centering Ball

Slip Spline

● **Dana Style Propshaft** - First loosen the screw-on grease cap, shown in Figure 4A-34 and slide the collar back to reveal the sealing area. Apply chassis lubricant at the fitting until grease begins to leave through the vent hole. Cover the vent hole with your finger and continue applying lubricant until it can be seen leaving at the slip yoke seal. Reinstall the grease cap.

NOTE: If the slip spline is dry or corroded, it may be necessary to disconnect the propshaft from the truck, remove the slip yoke, and wire brush the affected areas. Wipe clean before reinstallation. When installing the propshaft to transfer case attaching bolts, torque to specification (20-30 ft. lbs.).

● **GM Style Propshaft** - Apply chassis lubricant at the fitting until grease begins to leave through the vent hole.

NOTE: If the slip spline is dry or corroded, it may be necessary to disconnect the propshaft from the truck, remove the slip yoke, and wire brush the affected areas. Wipe clean before reinstallation. When installing the propshaft to transfer case front output flange attaching bolts, torque to specification (70-80 ft. lbs.).

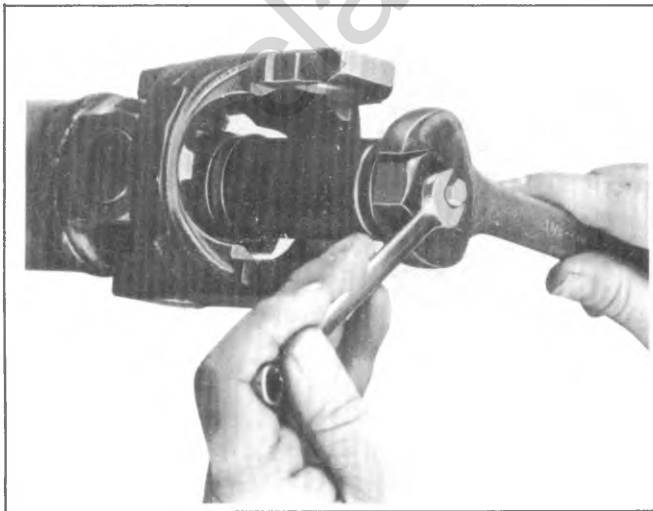


Fig. 4A-29--Removing Centering Ball



Fig. 4A-31--Installing Centering Ball Seal

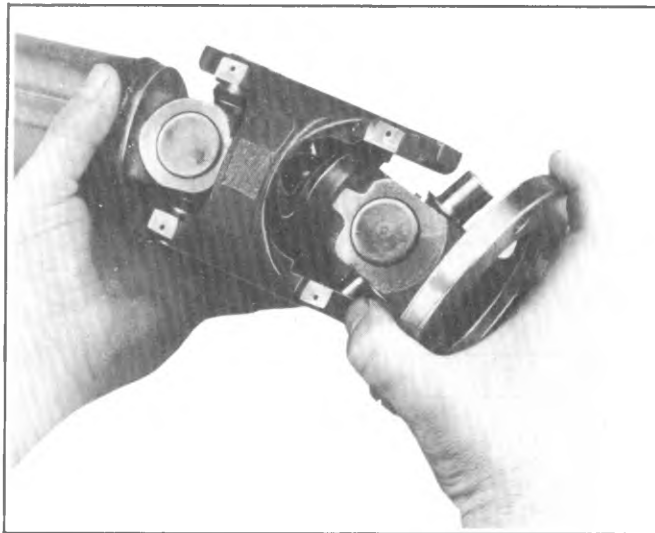


Fig. 4A-32--Reassembling Flange Yoke

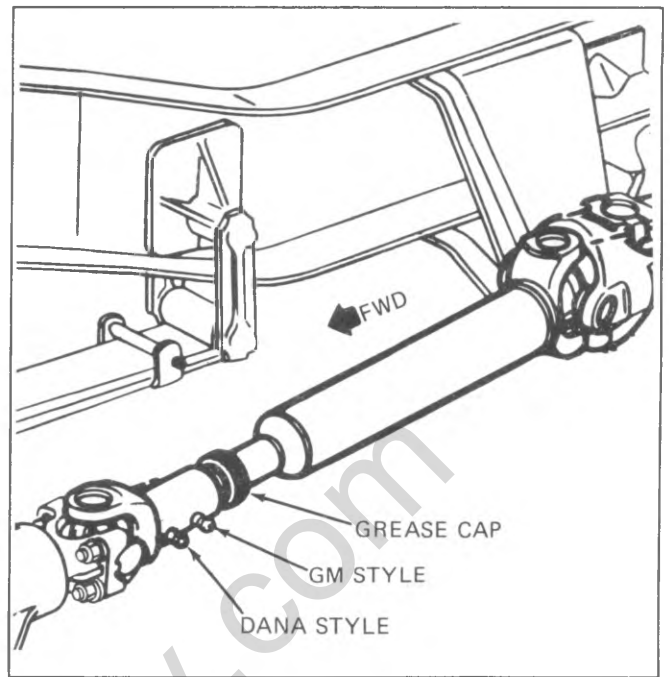


Fig. 4A-34--Slip Yoke Lubrication

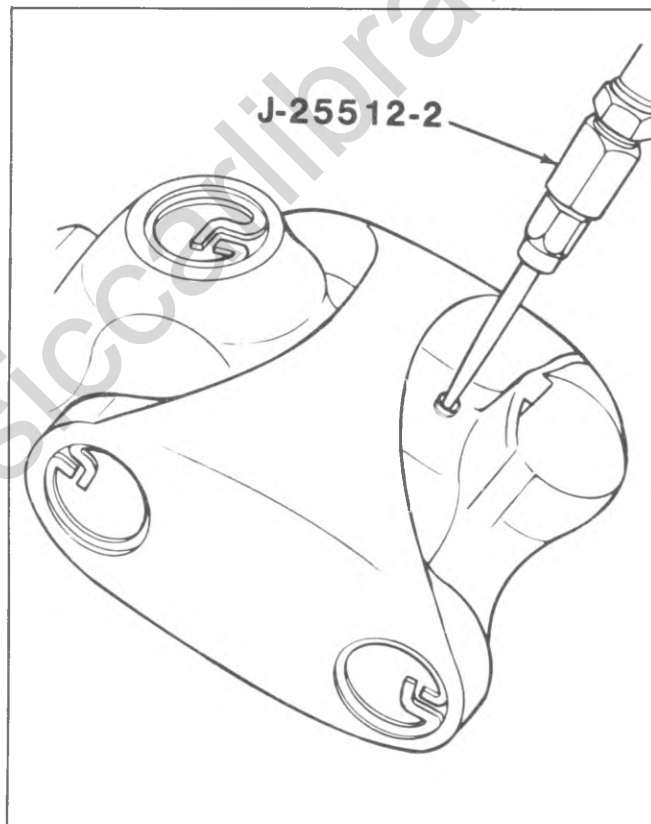


Fig. 4A-33--Dana Style Propshaft

SPECIFICATIONS

PROPELLER SHAFT

	CK	G	P
Propeller Shaft			
To Rear Axle (Strap)	12-17	12-17	12-17
Bearing Support-to-Hanger	20-30	20-30	20-30
Hanger-to-Frame	40-50	—	—
To Transfer Case			
Dana Style	20-30		
GM Style	70-80		

Torque Specifications (Ft.-Lbs.)

SECTION 4B

REAR AXLE

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on Page 1 of this Section".

CAUTION: *THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.*

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GENERAL DESCRIPTION

A differential is an arrangement of gears that divides the torque between the axle shafts and allows them to rotate at different speeds. A basic differential consists of a set of four gears. Two of these gears are called differential side gears, and the other two are differential pinion gears. Some differentials have more than two pinion gears. Each side gear is splined to an axle shaft. Consequently, each axle shaft must turn when its side gear rotates.

The differential pinion gears are mounted on a differential pinion shaft, and the gears are free to rotate on this shaft. The pinion shaft is fitted into a bore in the differential case and is at right angles to the axle shafts.

Power flow through the differential is as follows: The drive pinion rotates the ring gear. The ring gear, being bolted to the differential case, rotates the case. The differential pinion, as it rotates with the case, forces the pinion gears against the side gears. When both wheels have equal traction, the pinion gears do not rotate on the pinion shaft because the input force on the pinion gear is equally divided between the two side gears. See figure 4B-1. Consequently, the pinion gears revolve with the pinion shaft, but do not rotate around the shaft itself. The side gears, being splined to the axle shafts and in mesh with the pinion gears, rotate the axle shafts.

If a vehicle were always driven in a straight line, the ring and pinion gears would be sufficient. The axle shaft could then be solidly attached to the ring gear and both driving wheels would turn at equal speeds.

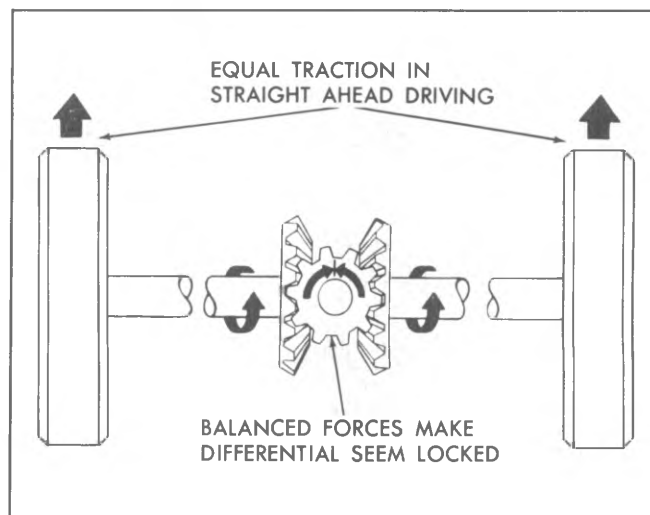


Fig. 4B-1--Differential Inactive

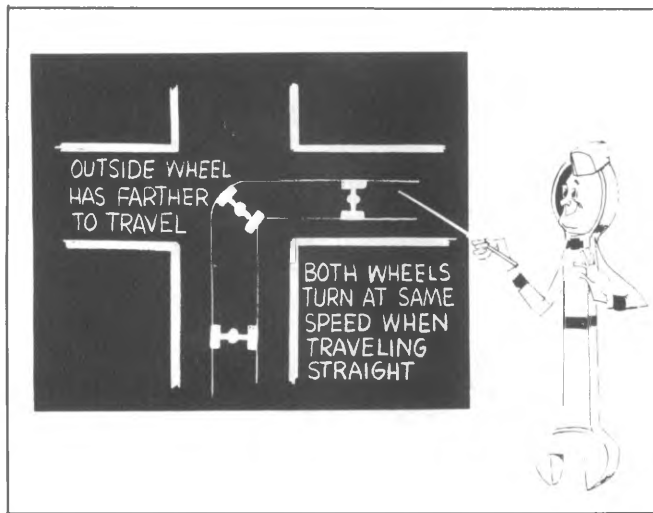


Fig. 4B-2--Need for Differential Action

However, if it became necessary to turn a corner, the tires would scuff and slide because the outer wheel would travel further than the inner wheel, as in figure 4B-2. To prevent tire scuffing and sliding, the differential becomes effective and allows the axle shafts to rotate at different speeds.

As the inner wheel slows down, the side gear splined to that axle shaft also slows down. At this point, the pinion gears act as balancing levers by maintaining equal speeds of rotation of the axle shafts. See figure 4B-3. If the vehicle speed remains constant and the inner wheel slows to 90% of vehicle speed, the outer wheel speeds up to 110%. If the inner wheel slows to 75%, the outer wheel would turn 125%. If one wheel stopped, the other wheel would turn 200%.

Six distinct axles compromise the truck line-up. These six, categorized by ring gear diameter, are a) 8-1/2" and b) 8-7/8" Ring Gear, c) Chevrolet 10-1/2" Ring Gear, d) Dana 10-1/2" Ring Gear, e) Dana 9-3/4" Ring Gear and f) Chevrolet 12-1/4" Ring Gear.

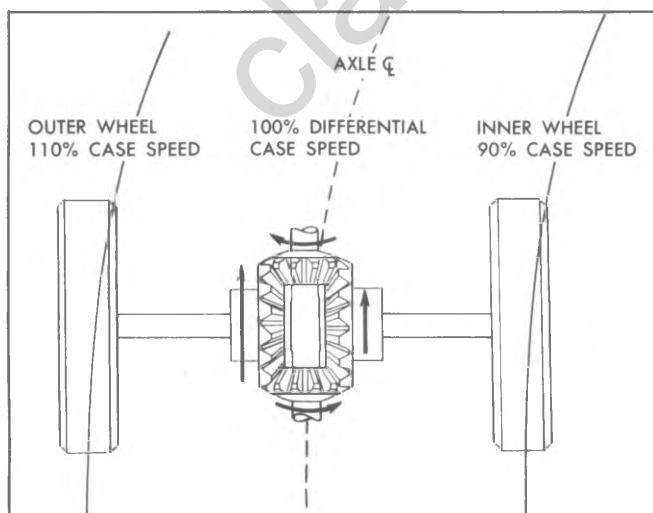


Fig. 4B-3--Differential Action on Turns

8-1/2" and 8-7/8" Ring Gear Axle

The axle shown in figure 4B-4 is a semifloating, fabricated constructed type consisting of a cast carrier with large bosses on each end into which two welded steel tubes are fitted. The carrier contains an overhung hypoid pinion and ring gear. The differential is a two pinion arrangement.

The axle housing is made up of two steel welded tubes pressed into the crossbore of the cast carrier. Each tube is puddle welded to the carrier. Welded-on brackets provide attachment points for suspension components such as shock absorbers and leaf springs. A welded flange is provided for brake flange plate attachment.

An overhung hypoid drive pinion is supported by two preloaded tapered roller bearings. The pinion shaft is sealed by means of a molded, spring loaded, rubber seal. The seal is mounted on the pinion flange which is splined and bolted to the hypoid pinion shaft.

The hypoid ring gear is bolted to a one-piece differential case which is supported by two preloaded tapered roller bearings.

Chevrolet 10-1/2" Ring Gear Axle

The axle shown in figure 4B-5 is of the full floating type with hypoid ring gear and drive pinion. The full floating construction enables easy removal of axle shafts without removing truck load and without jacking up the axle. The differential carrier is heavily ribbed to provide rigid support for the differential assembly.

The straddle-mounted drive pinion is supported at the front by two opposed tapered roller bearings. The pinion straddle bearing is a roller bearing assembly consisting of an outer race and roller assembly. A precision ground diameter on the pinion pilot functions as an inner race.

Side bearing preload and ring gear-to-pinion backlash are controlled by side bearing adjusting nuts threaded into the carrier near the axle tubes. Pinion depth is controlled by a shim located between the pinion bearing retainer assembly and the differential carrier.

Dana 10-1/2" Ring Gear Axle

The Dana axle shown in figure 4B-6 is a Salisbury-type similar in design to the 8-7/8" ring gear axle in figure 4B-4. It does differ in several points, however. The axle shafts are full floating; the carrier must be spread to remove the differential; and the drive pinion incorporates two shim packs. The inner pack controls pinion depth, while the outer pack controls pinion bearing preload.

Dana 9-3/4" Ring Gear Axle

The Dana axle shown in figure 4B-7 is similar to the unit shown in 4B-6; however, the differential side bearing shims are located between the case and the side bearings.

Chevrolet 12-1/4" Ring Gear Axle

(11,000 Pound Capacity)

The 11,000 lb. capacity, single-speed hypoid axle, illustrated in figure 4B-8, has a straddle mounted drive pinion which is supported at the rear by a straight roller bearing. The pinion front bearing consists of a double row ball bearing.

The differential is a conventional four-pinion type. Thrust washers are used between the side gears and case and also between differential pinions and the differential case.

A thrust pad mounted on the end of an adjusting screw

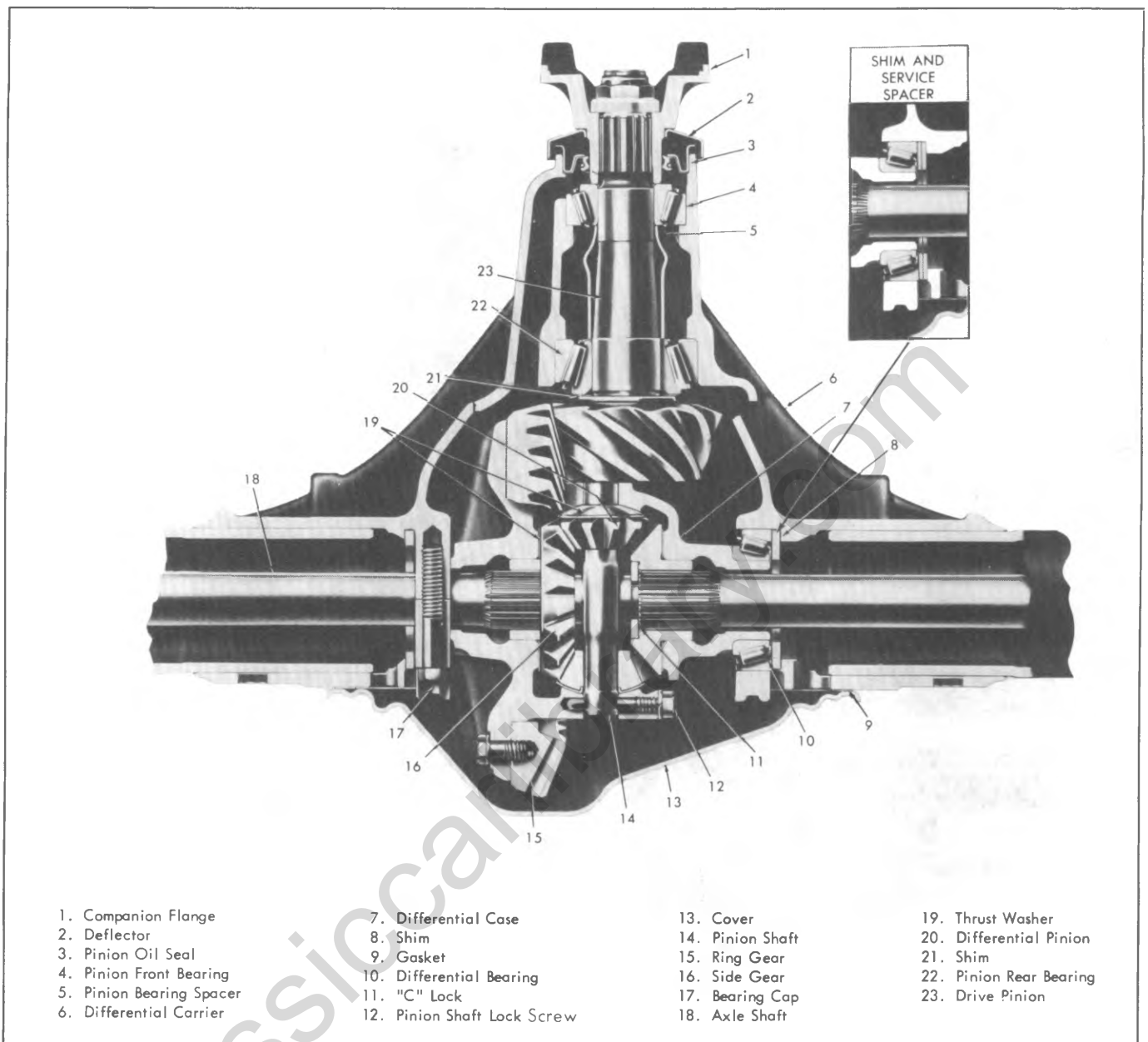


Fig. 4B-4--8-1/2" and 8-7/8" Ring Gear Axle Cross-Section Typical

threaded into the carrier housing limits deflection of the ring gear under high torque conditions.

Involute splines are incorporated in the axle shaft flange and in the wheel hubs. This design provides for the

driving torque to be transmitted from the axle shaft to the hub through the mating splines.

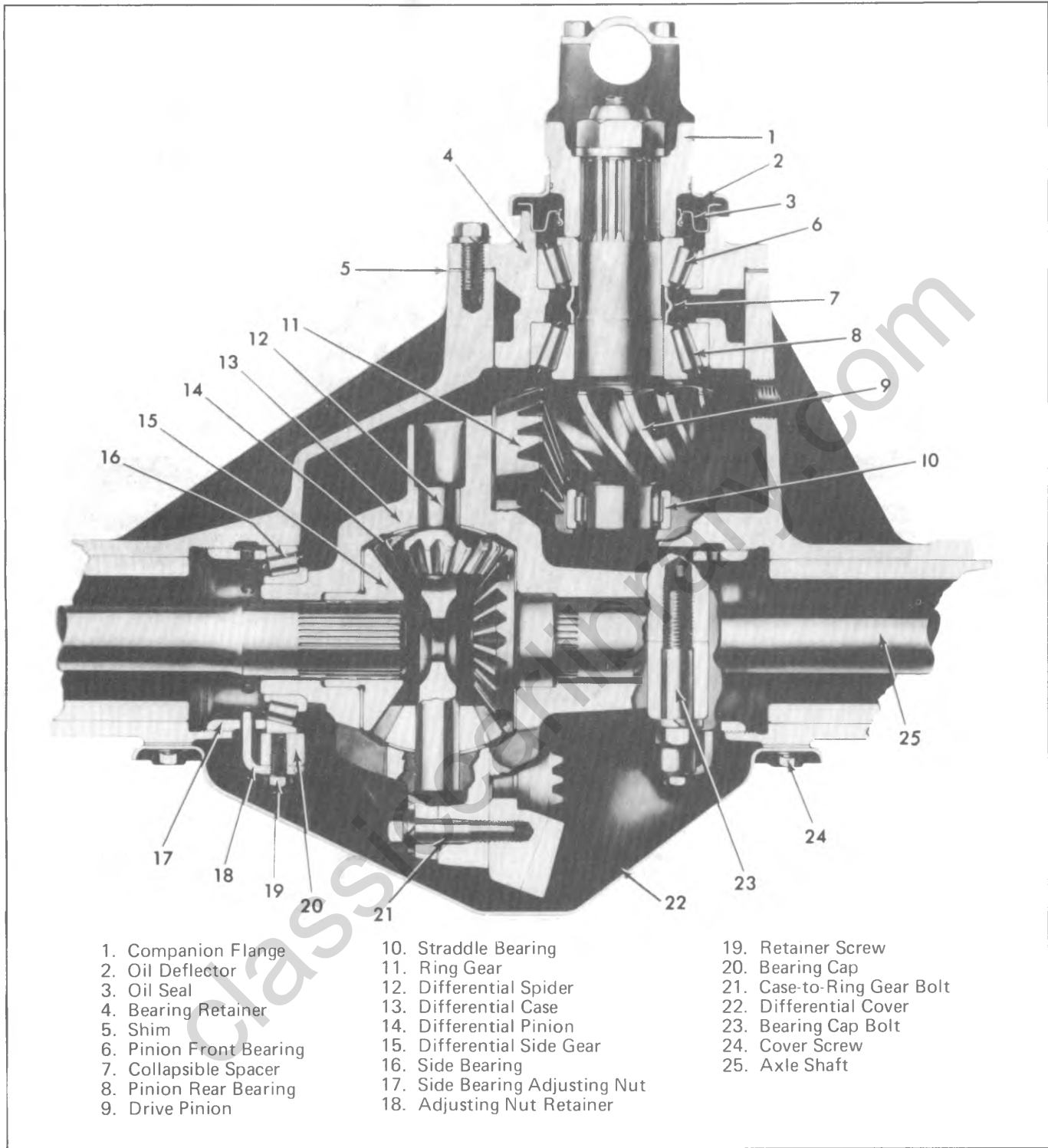


Fig. 4B-5--Chevrolet 10-1/2" Ring Gear Axle Cross-Section

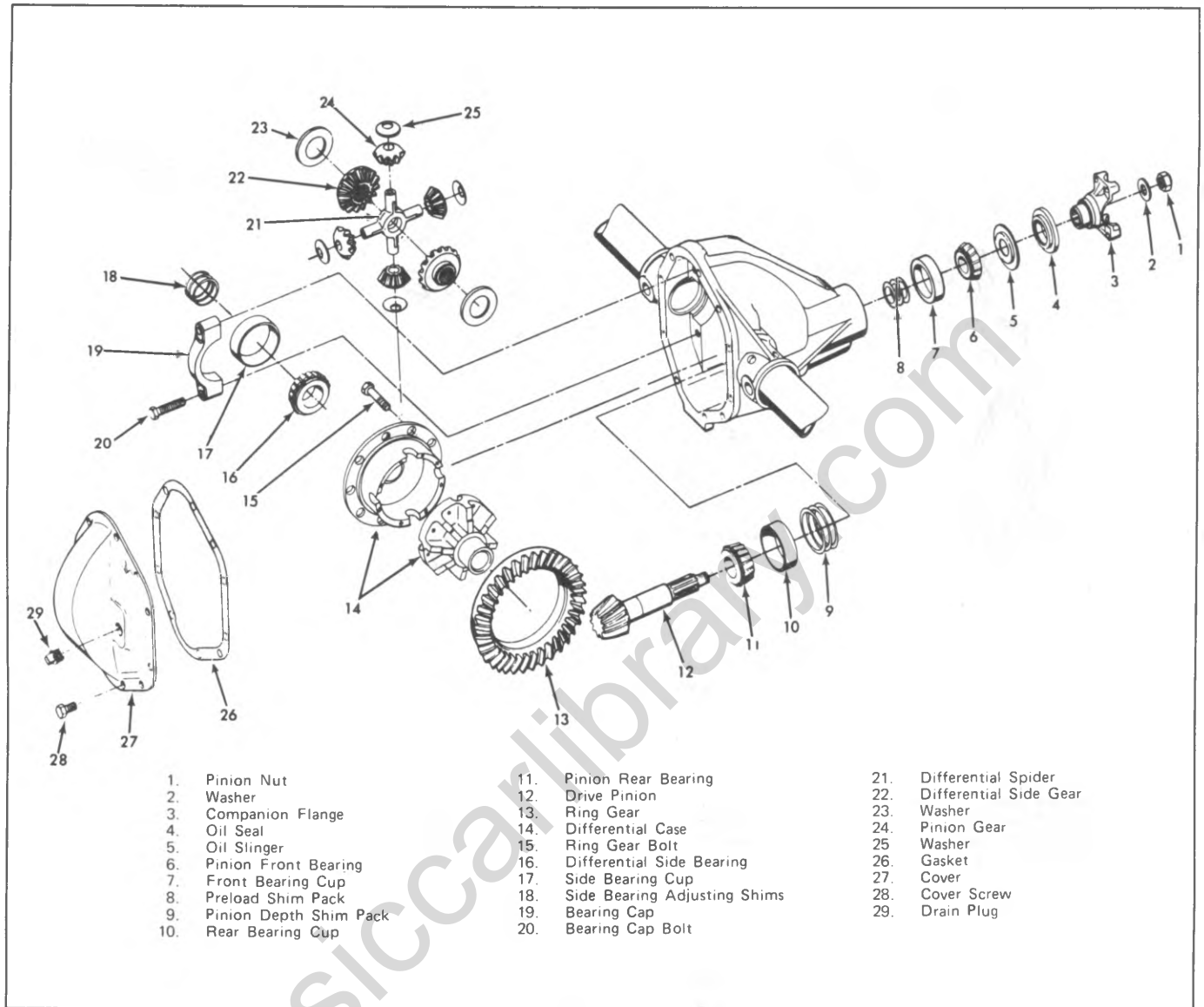


Fig. 4B-6--Dana 10-1/2" Ring Gear Axle Exploded View

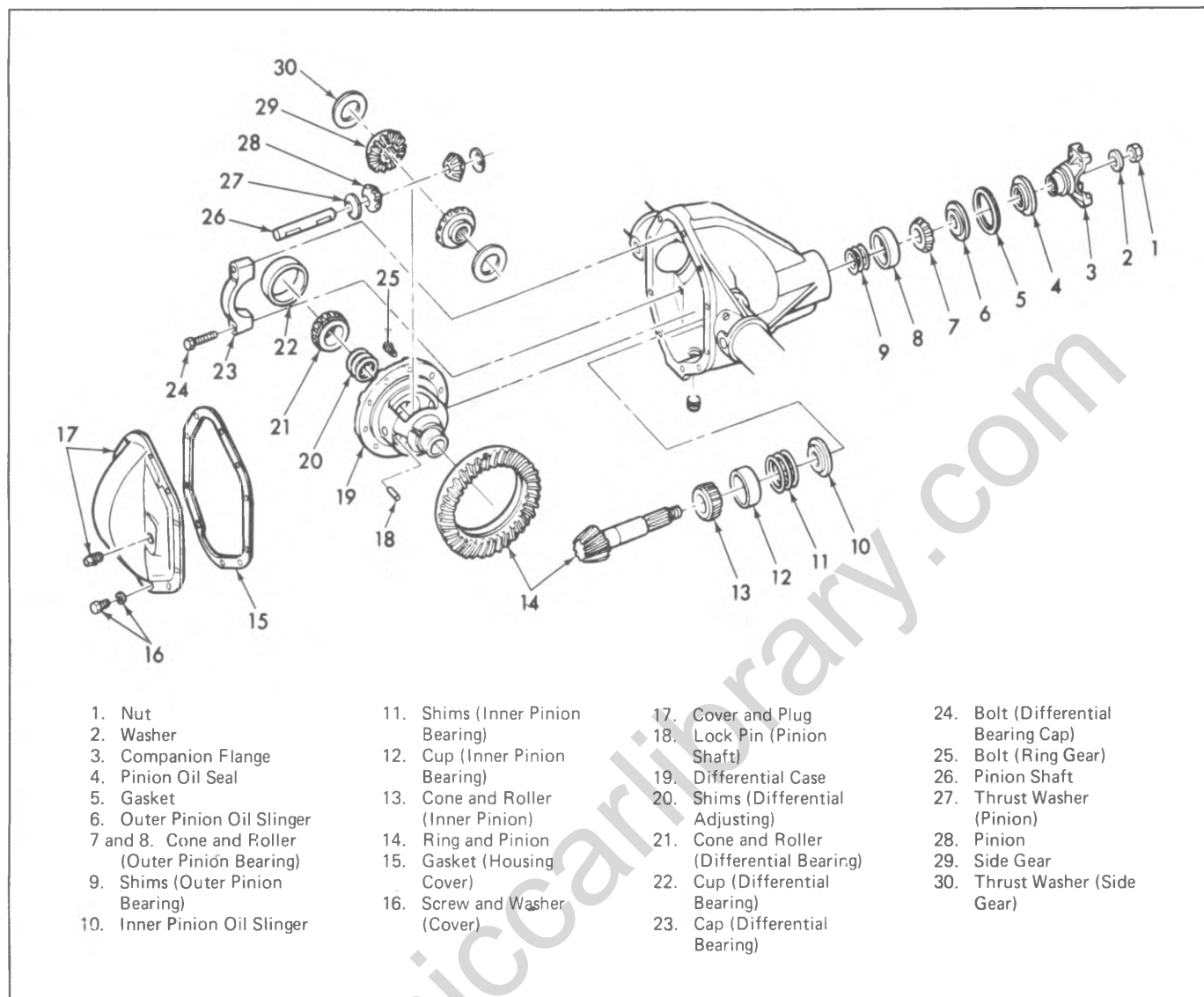


Fig. 4B-7--Dana 9-3/4" Ring Gear Axle Exploded View

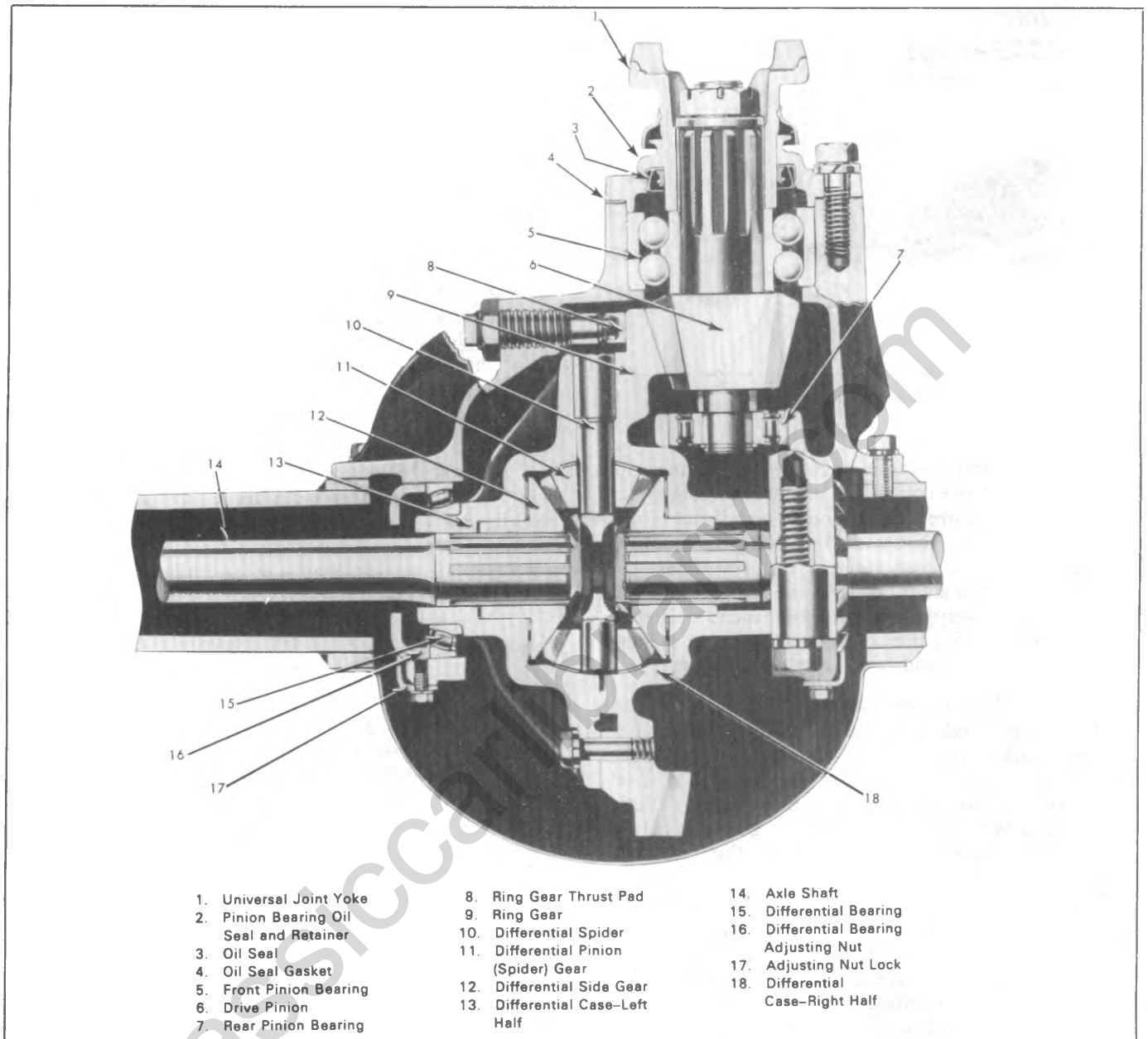


Fig. 4B-8--Chevrolet 12-1/4" Ring Gear Axle-11,000# Capacity

DIFFERENTIAL DIAGNOSIS

STANDARD DIFFERENTIAL

Noise

The most essential part of rear axle service, as with any mechanical repair, is proper diagnosis of the problem, and, in axle work one of the most difficult areas to diagnosis is noise. Locating a broken axle shaft, or broken differential gear, presents little or no problem, but, locating and isolating axle noise can be an entirely different matter.

Degree of Noise

Any gear driven unit, and especially an automotive drive axle where engine torque multiplication occurs at a 90° turn in the drive line, produces a certain amount of

noise. Therefore, an interpretation must be made for each vehicle to determine whether the noise is normal or if a problem actually exists. A normal amount of noise must be expected and cannot be eliminated by conventional repairs or adjustment. See figure 4B-9.

Acceptable noise can be defined as a slight noise heard only at a certain speed or under unusual or remote conditions. For example, this noise tends to reach a "peak" at speeds from 40 to 60 miles per hour (60 to 100 km/h) depending on road and load conditions, or on gear ratio and tire size. This slight noise is in no way indicative of trouble in the axle assembly.

Drive line noises may baffle even the best diagnostician. Vehicle noises coming from tires, transmission, propeller



Fig. 4B-9--Noise Level

shaft, universal joints, and front or rear wheel bearings, are often mistaken for axle noise. Such practices as: raising tire pressure to eliminate tire noise (although this will not silence tread noise of mud and snow tires), listening for the noise at varying speeds and road surfaces, on drive, float, and coast conditions will aid in locating the source of alleged axle noises. Thus, every effort should be made to isolate the noise to a specific drive line component instead of making a random guess that could be a costly waste of time.

Elimination of External Noises

When a rear axle is suspected of being noisy, it is advisable to make a thorough test to determine whether the noise originates in the tires, road surface, front wheel bearings, engine, transmission, or rear axle assembly. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle assembly.

Road Noise –Some road surfaces, such as brick or rough-surfaced concrete, cause noise which may be mistaken for tire or rear axle noise. Driving on a different type of road, such as smooth asphalt or dirt, will quickly show whether the road surface is the cause of noise. Road noise usually is the same on drive or coast.

Tire Noise –Tire noise may easily be mistaken for rear axle noise, even though the noisy tires may be located on the front wheels. Tires worn unevenly, or having surfaces on non-skid divisions worn in saw-tooth fashion, are usually noisy and may produce vibrations which seem to originate elsewhere in the vehicle. This is particularly true with low tire pressure.

Test for Tire Noise –Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to approximately 50 pounds pressure, **for test purposes only** will materially alter noise caused by tires but will not affect noise caused by the rear axle. Rear axle noise usually ceases when coasting at speeds under 30 miles per hour; however, tire noise continues but with lower tone as vehicle speed is reduced. Rear axle noise usually changes when comparing "pull" and "coast" but tire noise remains about the same.

Engine and Transmission Noises –Sometimes a noise which seems to originate in the rear axle is actually

caused by the engine or transmission. To determine which unit is actually causing the noise, observe approximate car speeds and conditions under which the noise is most pronounced; then stop vehicle in a quiet place to avoid interfering noises. With transmission in neutral, run engine slowly up and down through engine speeds corresponding to vehicle speed at which the noise was most pronounced. If a similar noise is produced with vehicle standing, it is caused by the engine or transmission and not the rear axle.

Front Wheel Bearing Noise –Loose or rough front wheel bearings will cause noise which may be confused with rear axle noises; however, front wheel bearing noise does not change when comparing "pull" and "coast". Light application of brake, while holding vehicle speed steady, will often cause wheel bearing noise to diminish, as this takes some weight off the bearing. Front wheel bearings may be easily checked for noise by jacking up the wheels and spinning them, and also be shaking wheels to determine if bearings are excessively loose.

Body Boom Noise or Vibration

Objectional "body boom" noise or vibration at 55-65 mph (90-100 km/h) can be caused by an unbalanced propeller shaft. Excessive looseness at the spline can contribute to this unbalance.

Other items that may also contribute to the noise problem are as follows:

1. Undercoating or mud on the shaft, causing unbalance.
2. Shaft or companion flange balance weights missing.
3. Shaft damage, such as bending, dents, or nicks.
4. Tire-type roughness. Switch tires from a known good car to determine tire fault.

If, after making a comprehensive check of the vehicle, all indications point to the rear axle, further diagnostic steps are necessary to determine the axle components at fault. True axle noises generally fall into two categories: gear noise and bearing noise.

Rear Axle Noises

If a careful test of vehicle shows that noise is not caused by external items it is then reasonable to assume that noise is caused by rear axle assembly. The rear axle should be tested on a smooth level road to avoid road noise. It is not advisable to test rear axle for noise by running with rear wheels jacked up.

Noises in rear axle assembly may be caused by a faulty propeller shaft, faulty rear wheel bearings, faulty differential or pinion shaft bearings, misalignment between two U-joints, or worn differential side gears and pinions; noises may also be caused by mismatched, improperly adjusted, or scored ring and pinion gear set.

Rear Wheel Bearing Noise –A rough rear wheel bearing produces a vibration or growl which continues with vehicle coasting and transmission in neutral. A brinelled rear wheel bearing causes a knock or click approximately every two revolutions of rear wheel, since the bearing rollers do not travel at the same speed as the rear axle and wheel. With rear wheels jacked up, spin rear wheels by hand while listening at hubs for evidence of rough or brinelled wheel bearing.

Differential Side Gear and Pinion Noise – Differential side gears and pinions seldom cause noise since their movement is relatively slight on straight ahead driving.

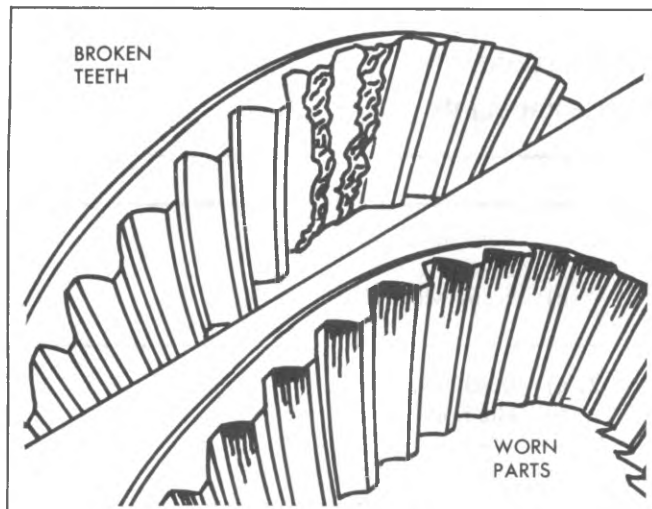


Fig. 4B-10--Two Causes of Gear Noise

Noise produced by these gears will be most pronounced on turns.

Pinion Bearing failures can be distinguished because they rotate at higher speeds than differential side bearings and axle shaft bearings. Rough or brinelled pinion bearings produce a continuous low pitched whirring or scraping noise starting at relatively low speed.

Side Bearings produce a constant rough noise of a lower pitch than pinion bearings. Side bearing noise may also fluctuate in the above wheel bearing test.

NOTE: Bearing Diagnosis Charts appear later in this section.

Gear Noise

There are two basic types of gear noise. The first type is produced by broken, bent, or forcibly damaged gear teeth and is usually quite audible over the entire speed range and presents no particular problem in diagnosis.

For example, hypoid gear tooth scoring as seen in figure 4B-10 generally results from the following: insufficient lubricant improper breakin, improper lubricant, insufficient gear backlash, improper ring and pinion gear alignment, or loss of drive pinion nut torque. The scoring will progressively lead to complete erosion of the gear tooth, or gear tooth pitting and eventual fracture if the initial scoring condition is not corrected. Another cause of hypoid tooth fracture is extended overloading of the gear set which will produce fatigue fracture, or shock loading which will result in sudden failure.

Differential pinion and side gears rarely give trouble. Common causes of differential failure are shock loading, extended overloading, and seizure of the differential pinions to the cross shaft resulting from excessive wheel spin and consequent lubrication breakdown.

The second type of gear noise pertains to the mesh pattern of the gear teeth. This form of abnormal gear noise can be recognized as it produces a cycling pitch (whine) and will be very pronounced in the speed range at which it occurs, appearing under either "drive", "float" or "coast" conditions. "Drive" is acceleration or heavy pull. "Coast" is with a closed throttle and vehicle in gear and "float" is using just enough throttle to keep the car from driving the engine—the vehicle slows down gradually but engine still pulls slightly. Gear noise tends to peak in a narrow speed range or ranges, and will tend to remain constant in pitch. Bearing noise will vary in pitch with vehicle speeds. See figure 4B-11.

**A GENERAL DIAGNOSTIC PROCEDURE FOR
ISOLATING REAR AXLE NOISE PROBLEMS**

Problem	Cause
1. Noise is the same in drive or coast	1. a) Road noise b) Tire noise c) Front wheel bearing noise
2. Noise changes on a different type of road	2. a) Road noise b) Tire noise
3. Noise tone lowers as car speed is lowered	3. Tire noise
4. Similar noise is produced with car standing and driving	4. a) Engine noise b) Transmission noise
5. Vibration	5. a) Rough rear wheel bearing b) Unbalanced or damaged propeller shaft c) Tire unbalance d) Worn universal joint in propeller shaft e) Mis-indexed propeller shaft at companion flange f) Companion flange runout too great
6. A knock or click approximately every two revolutions of rear wheel	6. A brinelled rear wheel bearing
7. Noise most pronounced on turns	7. Differential side gear and pinion
8. A continuous low pitch whirring or scraping noise starting at relatively low speed	8. Pinion bearing
9. Drive noise, coast noise or float noise	9. Ring and pinion gear
10. Clunk on acceleration or deceleration	10. Worn differential cross shaft in case
11. Grunt on stops	11. No grease in propeller shaft slip yoke
12. Groan in Forward or Reverse	12. Wrong lube in differential
13. Chatter on turns	13. a) Wrong lube in differential b) Clutch plates worn
14. Clunk or knock on rough road operation	14. Excessive end play of axle shafts to differential cross shaft

Fig. 4B-11--Diagnosis of Noise Problems

DIFFERENTIAL AND REAR AXLE BEARING DIAGNOSIS

CONSIDER THE FOLLOWING FACTORS WHEN DIAGNOSING BEARING CONDITION:

1. GENERAL CONDITION OF ALL PARTS DURING DISASSEMBLY AND INSPECTION.
2. CLASSIFY THE FAILURE WITH THE AID OF THE ILLUSTRATIONS.
3. DETERMINE THE CAUSE.
4. MAKE ALL REPAIRS FOLLOWING RECOMMENDED PROCEDURES.



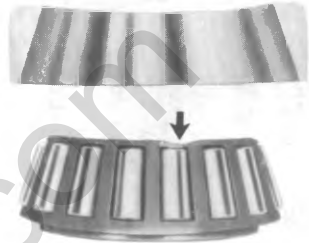

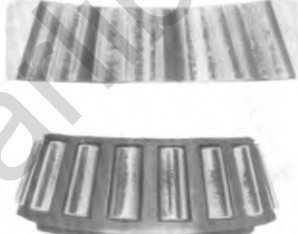
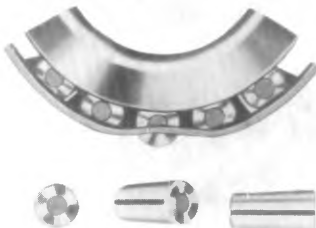



 <p style="text-align: center;">ABRASIVE ROLLER WEAR</p> <p>PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES.</p> <p>CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.</p>	 <p style="text-align: center;">GALLING</p> <p>METAL SMEARS ON ROLLER ENDS DUE TO OVERHEAT, LUBRICANT FAILURE OR OVERLOAD (WAGON'S).</p> <p>REPLACE BEARING - CHECK SEALS AND CHECK FOR PROPER LUBRICATION.</p>	 <p style="text-align: center;">BENT CAGE</p> <p>CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.</p> <p>REPLACE BEARING.</p>
 <p style="text-align: center;">ABRASIVE STEP WEAR</p> <p>PATTERN ON ROLLER ENDS CAUSED BY FINE ABRASIVES.</p> <p>CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.</p>	 <p style="text-align: center;">ETCHING</p> <p>BEARING SURFACES APPEAR GRAY OR GRAYISH BLACK IN COLOR WITH RELATED ETCHING AWAY OF MATERIAL USUALLY AT ROLLER SPACING.</p> <p>REPLACE BEARINGS - CHECK SEALS AND CHECK FOR PROPER LUBRICATION.</p>	 <p style="text-align: center;">BENT CAGE</p> <p>CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.</p> <p>REPLACE BEARING.</p>
 <p style="text-align: center;">INDENTATIONS</p> <p>SURFACE DEPRESSIONS ON RACE AND ROLLERS CAUSED BY HARD PARTICLES OF FOREIGN MATERIAL.</p> <p>CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY.</p>	 <p style="text-align: center;">CAGE WEAR</p> <p>WEAR AROUND OUTSIDE DIAMETER OF CAGE AND ROLLER POCKETS CAUSED BY ABRASIVE MATERIAL AND INEFFICIENT LUBRICATION.</p> <p>CLEAN RELATED PARTS AND HOUSINGS. CHECK SEALS AND REPLACE BEARINGS.</p>	 <p style="text-align: center;">MISALIGNMENT</p> <p>OUTER RACE MISALIGNMENT DUE TO FOREIGN OBJECT.</p> <p>CLEAN RELATED PARTS AND REPLACE BEARING. MAKE SURE RACES ARE PROPERLY SEATED.</p>

Fig. 4B-12--Differential and Axle Bearing Diagnosis Chart A

DIFFERENTIAL AND REAR AXLE BEARING DIAGNOSIS (CONT'D)








 <p style="text-align: center;">CRACKED INNER RACE</p> <p>RACE CRACKED DUE TO IMPROPER FIT, COCKING, OR POOR BEARING SEATS.</p> <p>REPLACE BEARING AND CORRECT BEARING SEATS.</p>	 <p style="text-align: center;">FATIGUE SPALLING</p> <p>FLAKING OF SURFACE METAL RESULTING FROM FATIGUE.</p> <p>REPLACE BEARING -- CLEAN ALL RELATED PARTS.</p>	 <p style="text-align: center;">BRINELLING</p> <p>SURFACE INDENTATIONS IN RACEWAY CAUSED BY ROLLERS EITHER UNDER IMPACT LOADING OR VIBRATION WHILE THE BEARING IS NOT ROTATING.</p> <p>REPLACE BEARING IF ROUGH OR NOISY.</p>
 <p style="text-align: center;">FRETTAGE</p> <p>CORROSION SET UP BY SMALL RELATIVE MOVEMENT OF PARTS WITH NO LUBRICATION.</p> <p>REPLACE BEARING. CLEAN RELATED PARTS. CHECK SEALS AND CHECK FOR PROPER LUBRICATION.</p>	 <p style="text-align: center;">STAIN DISCOLORATION</p> <p>DISCOLORATION CAN RANGE FROM LIGHT BROWN TO BLACK CAUSED BY INCORRECT LUBRICANT OR MOISTURE.</p> <p>RE-USE BEARINGS IF STAINS CAN BE REMOVED BY LIGHT POLISHING OR IF NO EVIDENCE OF OVERHEATING IS OBSERVED.</p> <p>CHECK SEALS AND RELATED PARTS FOR DAMAGE.</p>	 <p style="text-align: center;">HEAT DISCOLORATION</p> <p>HEAT DISCOLORATION CAN RANGE FROM FAINT YELLOW TO DARK BLUE RESULTING FROM OVERLOAD (WAGON'S) OR INCORRECT LUBRICANT.</p> <p>EXCESSIVE HEAT CAN CAUSE SOFTENING OF RACES OR ROLLERS.</p> <p>TO CHECK FOR LOSS OF TEMPER ON RACES OR ROLLERS A SIMPLE FILE TEST MAY BE MADE. A FILE DRAWN OVER A TEMPERED PART WILL GRAB AND CUT METAL, WHEREAS, A FILE DRAWN OVER A HARD PART WILL GLIDE READILY WITH NO METAL CUTTING.</p> <p>REPLACE BEARINGS IF OVER HEATING DAMAGE IS INDICATED. CHECK SEALS AND OTHER PARTS.</p>
 <p style="text-align: center;">SMEARS</p> <p>SMEARING OF METAL DUE TO SLIPPAGE. SLIPPAGE CAN BE CAUSED BY POOR FITS, LUBRICATION, OVERHEATING, OVERLOADS OR HANDLING DAMAGE.</p> <p>REPLACE BEARINGS, CLEAN RELATED PARTS AND CHECK FOR PROPER FITS AND LUBRICATION.</p>		

Fig. 4B-13--Differential and Axle Bearing Diagnosis Chart B

ON-VEHICLE SERVICE

8-1/2" and 8-7/8" RING GEAR AXLE

AXLE ASSEMBLY

Construction of the axle assembly is such that service operations may be performed with the housing installed in the vehicle or with the housing installed in a holding fixture. The following removal and installation procedure is necessary only when the housing requires replacement.

CAUTION: See *CAUTION* on page 1 of this section, regarding Axle Assembly fasteners.

Removal

1. Raise vehicle on hoist.
 2. Support rear axle assembly with suitable lifting device, so that tension is relieved in springs and shock absorbers.
 3. Remove trunnion bearing "U" bolts from the axle companion flange, separate trunnion from flange, position propeller shaft to one side and tie it to frame side rail.
- NOTE:** Secure trunnion bearing caps to trunnion, using masking tape or a large rubber band, to prevent loss of bearings.
4. Disconnect shock absorbers at lower attachment points and position out of the way.
 5. Disconnect axle vent hose from vent connector and position vent hose to one side.
 6. Disconnect hydraulic brake hose at connector on axle housing. Remove brake drum, disconnect parking brake cable at actuating levers and at flange plate. Refer to Section 5 for cable removal and brake details. Remove axle "U" bolt nuts, "U" bolts, spacers and clamp plates.
 7. Lower axle assembly and remove from vehicle.

Installation

1. Position axle assembly under vehicle and align with springs.
2. Install spacer, clamp plate and "U" bolts to axle assembly, loosely install retaining nuts to "U" bolts.
3. Position shock absorbers in lower attachment brackets and loosely install nut to retain shock.
4. Connect axle vent hose to vent connector at carrier.
5. Connect hydraulic brake hose to connector on axle housing, connect parking brake cable to actuating levers. Install brake drum and wheel and tire assembly—bleed brakes and adjust parking brake as outlined in applicable portion of Section 5.
6. Reassemble the propeller shaft to companion flange, making sure that bearing caps are indexed in flange seat. Torque bearing cap retaining nuts to specifications.
7. Position vehicle so that weight is placed on suspension components and torque affected parts to specifications.
8. Lower vehicle and remove from hoist.

AXLE SHAFT

Removal

1. Raise vehicle on hoist. Remove wheel and tire assembly and brake drums.
2. Clean all dirt from area of carrier cover.
3. Drain lubricant from carrier by removing cover.
4. Remove the differential pinion shaft lock screw and

the differential pinion shaft as shown in figure 4B-14.

5. Push flanged end of axle shaft toward center of vehicle and remove "C" lock from button end of shaft.

6. Remove axle shaft from housing, being careful not to damage oil seal.

NOTE: Axles equipped with 8-7/8" ring gears and Eaton Locking differentials use a thrust block on the pinion shaft which affects the removal of axle shafts as noted below.

1. Raise the vehicle on a hoist. Remove both rear wheel and tire assemblies and both rear brake drums.

2. Remove the rear cover and drain the lubricant.

3. Rotate the case **to the position shown in figure 4B-15**. Support the pinion shaft so that it cannot fall into the case, then remove the lock screw.

4. Carefully withdraw the pinion shaft part-way out, as shown in figure 4B-16. Rotate the case until the shaft touches the housing.

5. Reach into the case with a screwdriver or similar tool, and rotate the C-lock until its open end points directly inward, as shown in figure 4B-17. The axle shaft cannot be pushed inward until the C-lock is properly positioned.

Do not force or hammer the axle shaft in an attempt to gain clearance.

6. When the C-lock is positioned to pass through the end of the thrust block, push the axle shaft inward as shown in figure 4B-18, and remove the C-lock. Remove the axle shaft and repeat steps 5 and 6 for the opposite axle shaft.

7. When installing C-locks keep the pinion shaft partially withdrawn. Place the C-lock in the same position shown in figure 4B-17. Carefully withdraw the axle shaft until the C-lock is clear of the thrust block. When both locks are installed, install the pinion shaft and lock screw.

Oil Seal/Bearing—Replacement Fig. 4B-19

1. Remove oil seal by using button end of axle shaft. Insert button end behind the steel case of the oil seal, then pry seal out of bore being careful not to damage seal. If both seal and bearing are being replaced proceed to step 2.

2. Using J-23689, insert into bore so that tool grasps

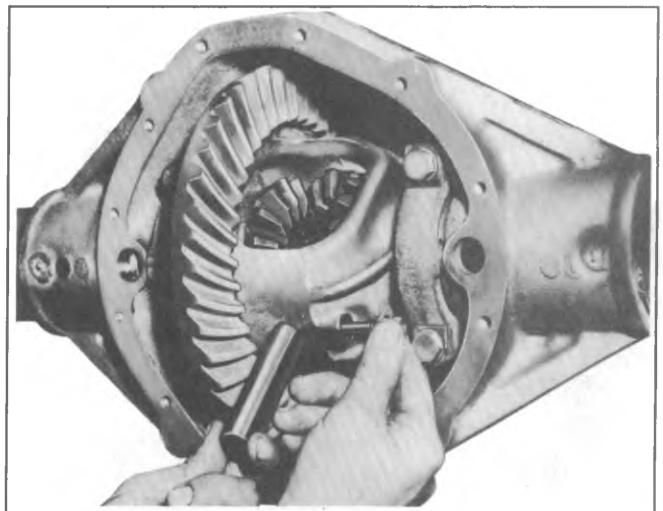


Fig. 4B-14—Differential Pinion Shaft Removal

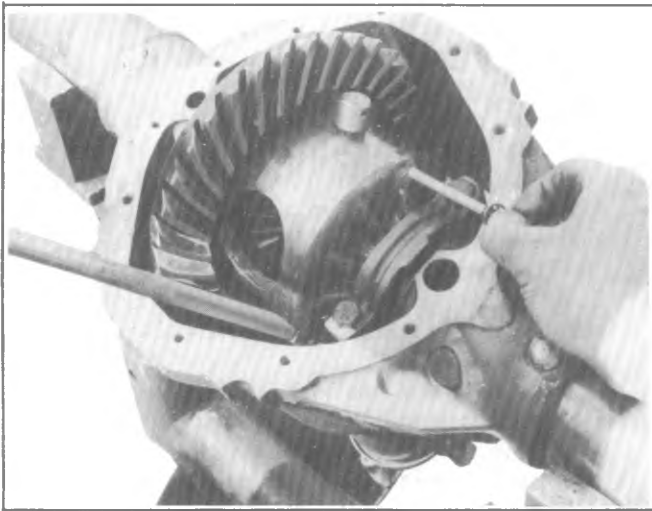


Fig. 4B-15--Removing Lock Screw

behind the bearing. See figure 4B-20. Slide washer against outside of seal (or bearing) and turn nut finger tight against washer. Attach Slide Hammer J-2619 and remove bearing and seal.

3. Back off nut and remove bearing and seal from tool.
4. Lubricate cavity between seal lips with wheel bearing lubricant and also lubricate new bearing with wheel bearing lubricant.
5. To reinstall bearing, use J-23690 Installer. Install bearing until tool bottoms against tube as illustrated in figure 4B-21.
6. To install oil seal, place seal on J-21128 and drive into bore until tool bottoms against end of tube. See figure 4B-22. This tool installs the seal flush with the end of the tube.

Brake Backing Plate--Replacement

1. Remove brake line at wheel cylinder inlet and disassemble brake components from flange plate. Refer to Section 5 for brake disassembly procedure.
2. Remove bolts retaining flange plate to axle, and remove flange plate.
3. Install new flange plate to axle housing and torque

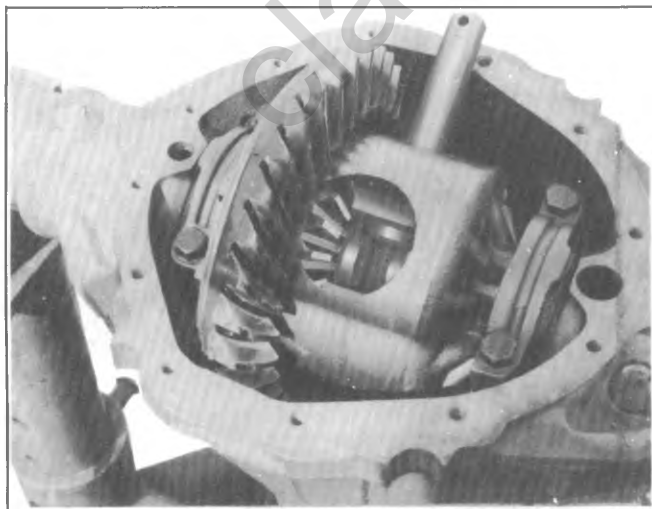


Fig. 4B-16--Positioning Case For Best Clearance

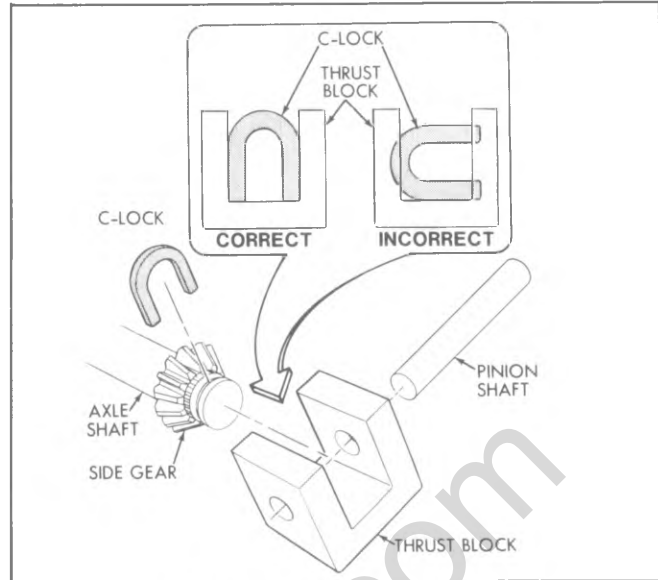


Fig. 4B-17--Correct C-Lock Position

nuts to specifications.

4. Install brake components on flange and connect hydraulic line to wheel cylinder inlet. See Section 5 for brake assembly, bleeding and adjustment procedures.

Axle Shaft--Installation

1. Slide axle shaft into place.
CAUTION: Exercise care that splines on end of shaft do not damage oil seal and that they engage with splines of differential side gear.
2. Install axle shaft "C" lock on button end of axle shaft and push shaft outward so that shaft lock seats in counterbore of differential side gear.
3. Position differential pinion shaft through case and pinions, aligning hole in shaft with lock screw hole. Install lock screw.
4. Using a new gasket, install carrier cover.

CAUTION: Make sure both gasket surfaces on carrier and cover are clean before installing new gasket. Torque carrier cover bolts in a crosswise

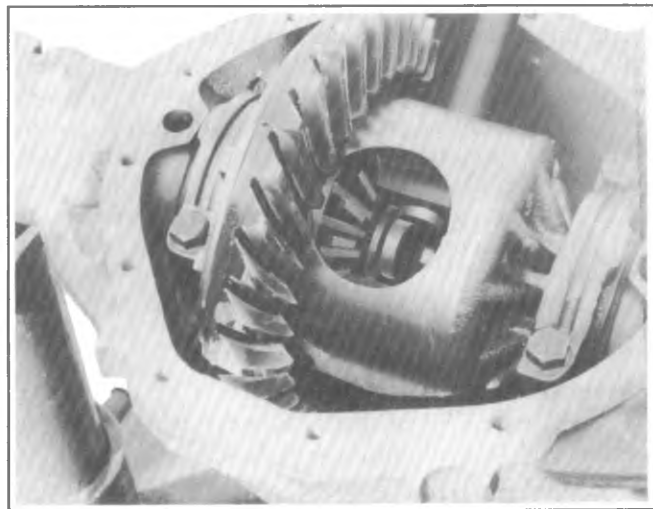


Fig. 4B-18--Push Axle Shaft Inward

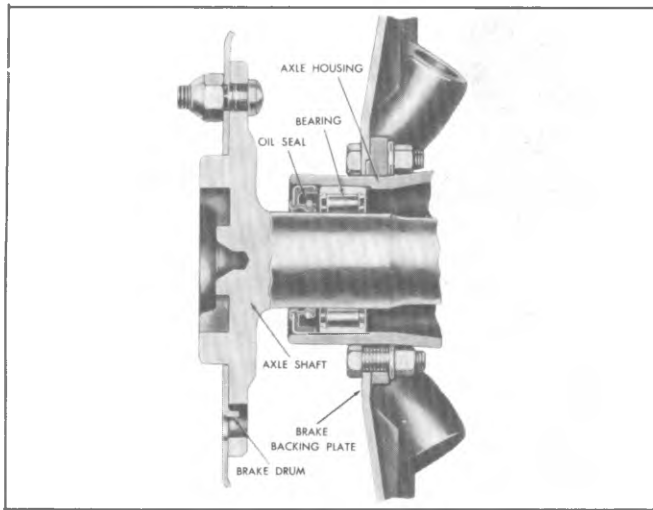


Fig. 4B-19--Oil Seal and Wheel Bearing

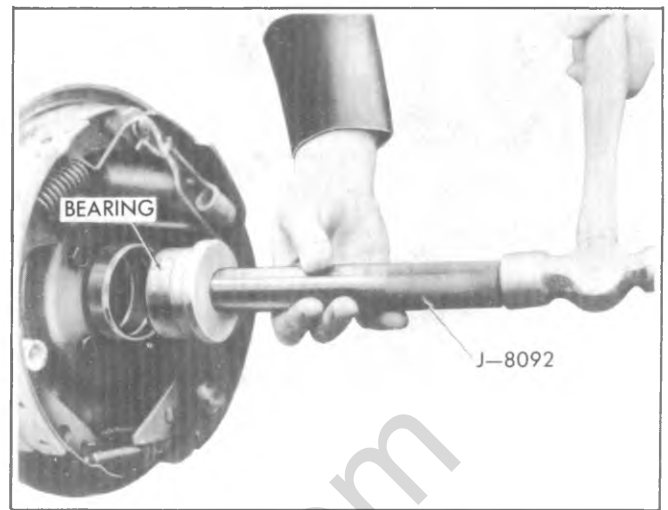


Fig. 4B-21--Wheel Bearing Installation

pattern to ensure uniform draw on cover gasket.

5. Fill axle with lubricant as specified in Section 0 of this manual to a level even with the bottom of filler hole.
6. Install brake drum and wheel and tire assembly.
7. Lower vehicle and remove from hoist.

Wheel Bolt-Replacement

1. Raise vehicle on hoist allowing axle to hang freely.
2. Remove wheel and tire and brake drum.
3. Using Tool J-5504 or J-6627 press out stud as shown in figure 4B-23.
4. Place new stud in axle flange hole. Slightly start stud serrations in hole by firmly pressing back of stud with your hand.
5. Install a lug nut with flat side first (tapered face outboard). Tighten on lug nut drawing stud into flange until stud head is bottomed on back side of flange.
6. Remove lug nut.
7. Reinstall brake drum and wheel and tire.
8. Lower vehicle and remove from hoist.

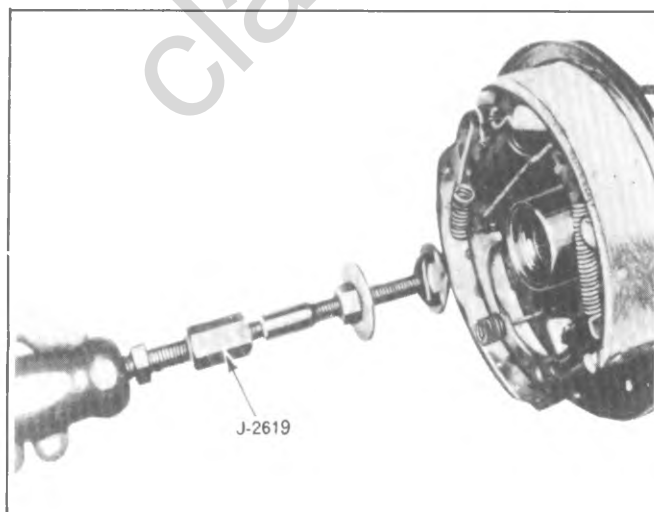


Fig. 4B-20--Wheel Bearing Removal

PINION FLANGE, DUST DEFLECTOR AND/OR OIL SEAL

Removal

1. Raise vehicle on hoist.
2. Disconnect propeller shaft from axle.
3. Position propeller shaft to one side and tie it to frame side rail.
4. Measure the torque required to rotate the pinion, as shown in figure 4B-24. Record the torque for later reference.
5. Scribe a line down pinion stem, pinion nut, and flange to aid on reinstallation. Make sure lines show the relationship of components accurately. Count the number of exposed threads on pinion stem, and record for later reference. See figure 4B-25.
6. Install Tool J-8614-11 on pinion flange and remove pinion flange self-locking washer faced nut as shown in figure 4B-26. (Position J-8614-11 on flange so that the four notches are toward flange.) Save scribed nut for reinstallation.
7. Thread pilot end of Tool J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in Step

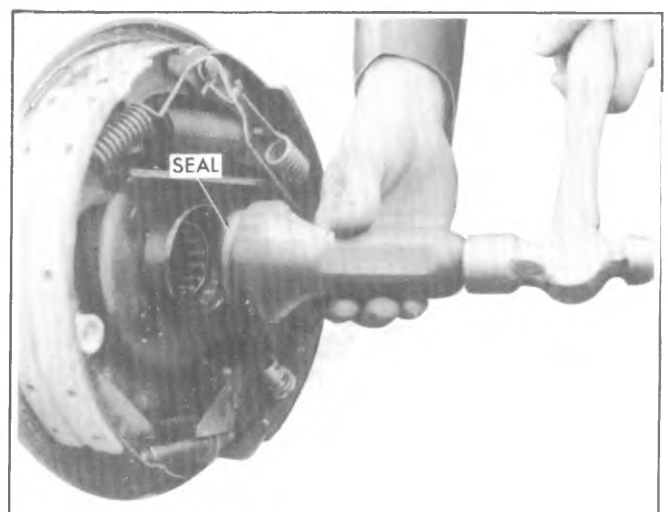


Fig. 4B-22--Seal Installation

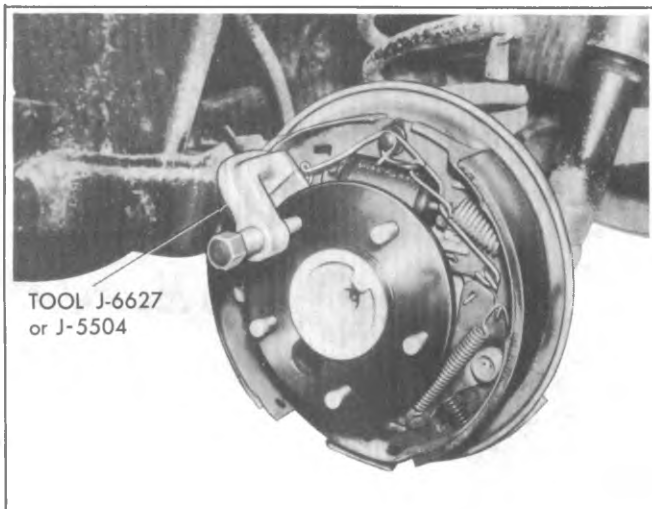


Fig. 4B-23--Pressing Out Wheel Stud

6, insert J-8614-2 into J-8614-11 and turn it 45 degrees to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 4B-27.

8. Pry old seal out of bore, using a screw driver or a hammer and chisel.

Inspection

1. Inspect pinion flange for smooth oil seal surface, worn drive splines, damaged ears, and for smoothness of bearing contact surface. Replace if necessary.

2. If deflector requires replacement, remove by tapping from flange, clean up stake points; install new deflector, and stake deflector at three new equally spaced positions.

NOTE: Staking operation must be performed in such a manner that the seal operating surface is not damaged.

Installation

1. Lubricate cavity between the seal lips of the pinion flange oil seal with a lithium-base extreme pressure lubricant.

2. Position seal in bore and place gauge plate J-22804-1 over seal and against seal flange. The gauge plate assures

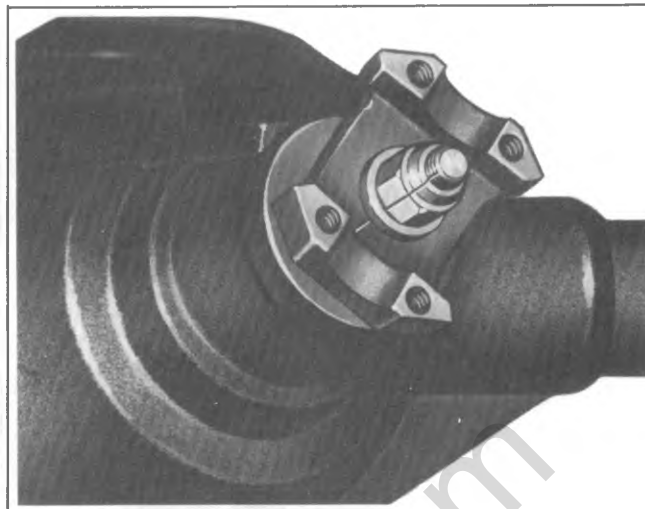


Fig. 4B-25--Scribe Marks

proper seating of seal in carrier bore.

3. Use J-21057, as shown in figure 4B-28, to press seal into carrier bore until gauge plate is flush with the carrier shoulder and seal flange. Turn gauge plate 180° from installed position; seal must be square in carrier bore to seal properly against pinion flange.

4. Pack the cavity between end of pinion splines and pinion flange with a non-hardening sealer (such as Permatex Type A or equivalent) prior to installing washer and nut on pinion.

5. Using J-8614-11 as shown in figure 4B-29, install flange onto pinion. Install washer and nut, and tighten nut to original position. Refer to scribe marks and number of exposed threads, recorded earlier.

NOTE: Do not attempt to hammer the flange onto pinion shaft. To do so may damage the ring gear and pinion.

6. Measure rotating torque of pinion and compare with torque recorded before removal. Tighten pinion nut in additional **small** increments until the torque necessary to rotate the pinion exceeds the original figure by 1 to 5 inch pounds. **Do not** exceed the original torque by more than

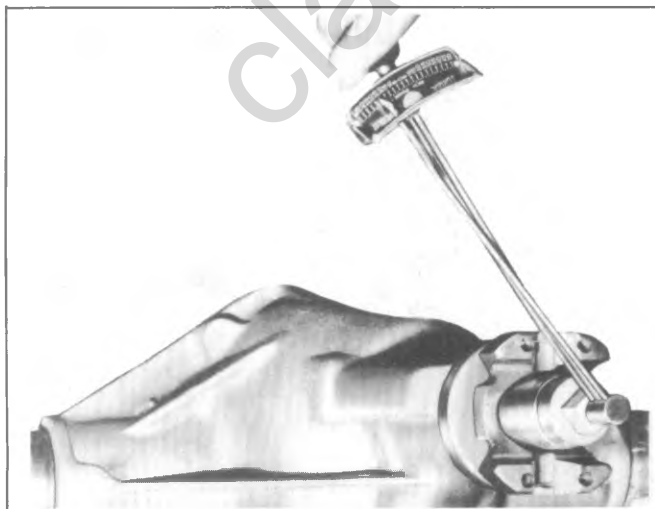


Fig. 4B-24--Measuring Pinion Rotating Torque

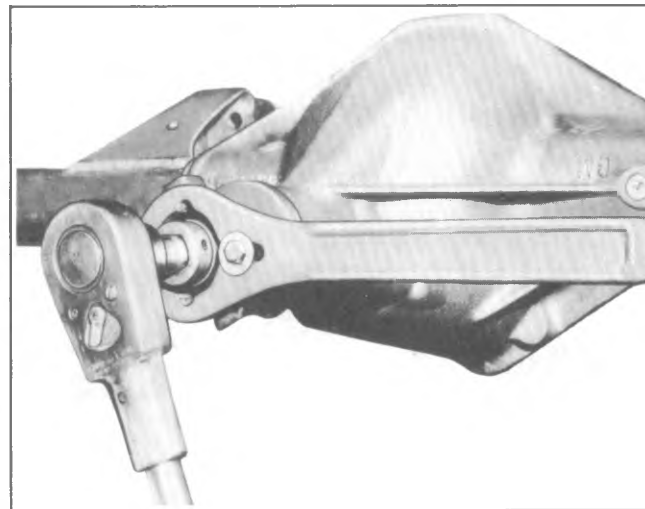


Fig. 4B-26--Removing Nut from Drive Pinion

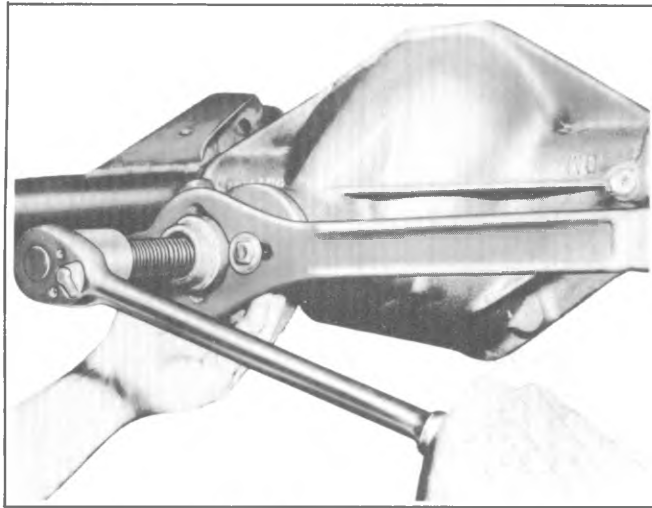


Fig. 4B-27--Drive Pinion Flange Removal

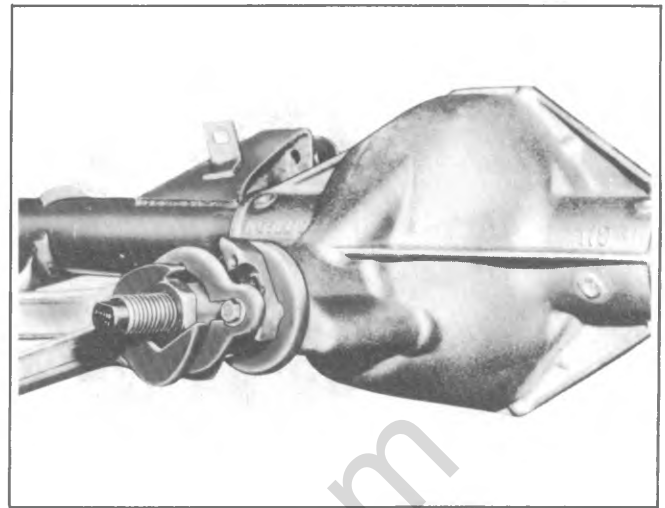


Fig. 4B-29--Installing Pinion Flange

5 inch pounds.

7. Reattach propeller shaft and torque to specifications. Reinstall brake drums and wheels.

CAUTION: See *CAUTION* on page 1 of this section regarding the fasteners referred to in step 7.

8. Lower vehicle and remove from hoist.

CHEVROLET 10-1/2" RING GEAR AXLES

AXLE ASSEMBLY

Service operations on these axle assemblies may be performed with the housing installed in the vehicle or with the housing installed in a holding fixture. There may be occasions, however, when it will be necessary to remove the complete housing assembly. The following axle assembly removal and installation procedure, therefore, is necessary only when housing replacement is required.

CAUTION: All axle attachments are important attaching parts. See *CAUTION* on page 1 of this section.

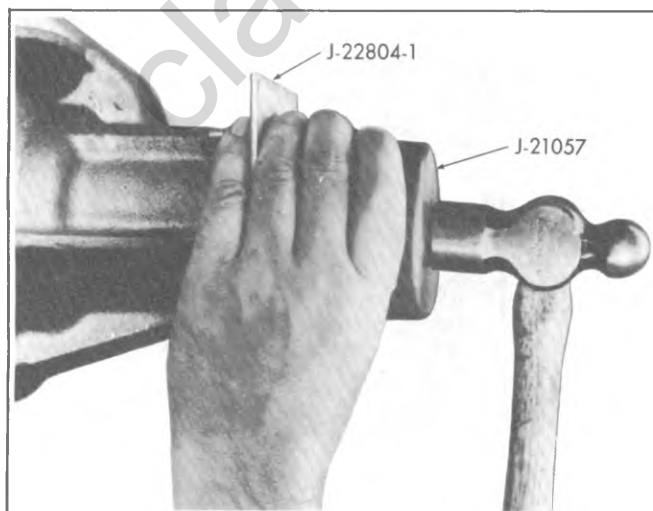


Fig. 4B-28--Pinion Oil Seal Installation

Removal

1. Raise vehicle, place stand jacks under frame side rails, and remove rear wheels.
2. Remove two trunnion bearing "U" bolts from the rear yoke, split rear universal joint, position propeller shaft to one side, and tie it to the frame side rail.

NOTE: The bearings can be left on the trunnion and held in place with tape.
3. Remove hub and drum assembly and disconnect parking brake cable at lever and at flange plate. See Section 5 for cable removal.
4. Disconnect hydraulic brake hose at connector on rear axle housing. Refer to Section 5.
5. Disconnect shock absorbers at axle brackets.
6. Support axle assembly with hydraulic jack, remove spring "U" bolts, and lower axle assembly to the floor.

Installation

1. Place axle assembly under vehicle, raise into position, install spring "U" bolts, anchor plates and nuts, and tighten securely.
2. Connect and secure shock absorbers to axle brackets.
3. Connect brake hose at connector on rear axle housing.
4. Connect parking brake cable at lever and flange plate. Install hub and drum assembly. Bleed brake hydraulic system and adjust parking brake.

NOTE: Before reinstalling wheel hub and drum assembly replace hub oil seal.
5. Reassemble the rear universal joint, making sure that "U" bolts are drawn up tight and locked properly. Caution should be taken not to overtighten "U" bolt nuts and cause bearing cups to become distorted.
6. Install rear wheels, remove stand jacks, and lower vehicle.
7. Test operation of brakes and rear axle.

AXLE SHAFT

Replacement

1. Remove bolts that attach the axle shaft flange to the wheel hub. See figure 4B-30.
2. Rap on flange with a soft-faced hammer to loosen shaft. Grip the rib on end of flange with a pair of locking

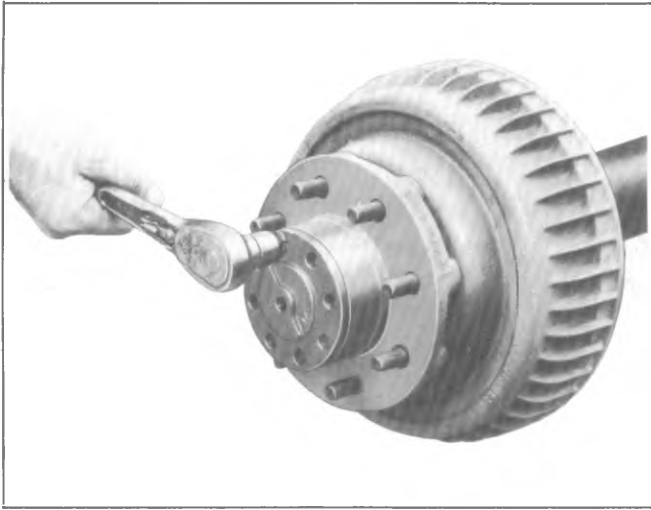


Fig. 4B-30--Removing Flange-to-Hub Bolts

pliers and twist to start shaft removal. Remove shaft from axle tube.

3. Thoroughly clean both the axle shaft flange and the end of the wheel hub.

NOTE: Any lubricant on these surfaces tends to loosen axle shaft flange bolts.

4. Place a new gasket over the axle shaft and position the axle shaft in the housing so that the shaft splines enter the differential side gear. Position gasket so that holes are in alignment and install flange-to-hub attaching bolts. Torque bolts to specifications.

HUB AND DRUM ASSEMBLY—FIG. 4B-31

Removal

1. Remove axle shaft as outlined earlier.

2. Disengage tang of retainer from slot or flat of locknut, then remove locknut from housing tube, using J-2222, as shown in figure 4B-32.

3. Disengage tang of retainer from slot or flat of adjusting nut and remove retainer from housing tube.

4. Use appropriate tool as specified in Step 2 to remove adjusting nut from housing tube.

NOTE: Remove thrust washer from housing tube.

5. Pull hub and drum assembly straight off axle housing.

6. Remove oil seal, and discard.

Bearing/Cup—Removal

1. Use a hammer and long drift to knock the **inner** bearing, cup and oil seal from the hub assembly.

2. Remove **outer** bearing snap ring with a pair of pliers.

3. With J-24426 on Handle J-8092, as shown in figure 4B-33, drive **outer** bearing and cup from the hub assembly.

Inspection and Cleaning of Bearings

1. Inspect bearing rollers for excessive wear, chipped edges, and other damage. Slowly move rollers around cone to detect any flat or rough spots on rollers or cone.

2. Examine bearing cups in hub for pits, cracks, and other damage.

3. Examine axle shaft flange studs, wheel studs, hub splines, hub bore, and tapped holes for evidence of damage. Clean up threads or replace parts where required.

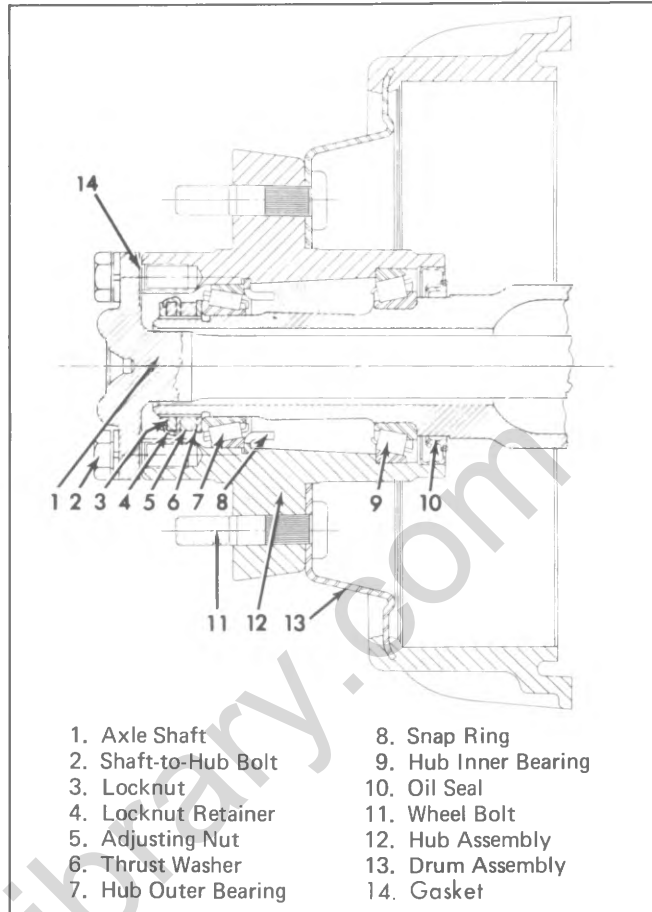


Fig. 4B-31--Hub and Drum Assembly—10-1/2" Axles

4. Examine oil seal sleeve for evidence of wear or roughness, check axle housing oil deflector and brake drum oil deflector for evidence of damage. Replace parts where required.

5. Examine brake drum for excessive scoring and other damage. To replace brake drum refer to "Brake Drum Replacement."

6. Immerse bearing cone and roller assemblies in

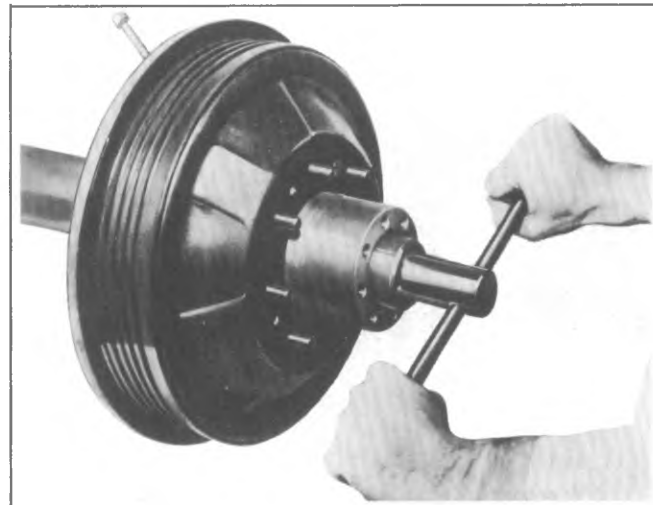


Fig. 4B-32--Removing Lock Nut—Typical



Fig. 4B-33--Removing Outer Bearing and Cup

cleaning solvent. Clean with stiff brush to remove old lubricant. Blow bearings dry with compressed air, directing air stream across bearing. Do not spin bearings while blowing them dry.

7. Thoroughly remove all lubricant from axle housing tube and from inside the hub, wipe dry. Make sure all particles of gasket are removed from outer end of hub, axle shaft, and hub cap.

8. Scrape old sealing compound out of oil seal bore in the hub.

Bearing/Cup-Installation

1. Place **outer** bearing into hub.
2. Install cup of outer bearing into hub by using Handle J-8092 and J-8608, **installed upside-down**. Be sure J-8608 is upside down on driver handle, so that chamfer does
3. Drive cup **beyond** the snap ring groove.
4. Using a pair of pliers, install snap ring into its groove.
5. Drive cup back **against** snap ring by using J-24426, as shown in figure 4B-33.
6. To install **inner** bearing cup, use J-24427 on Handle J-8092. Drive cup into place until it seats against shoulder of hub bore.
7. Install new oil seal with J-24428.

Drum-Non-Remountable-Type-Fig. 4B-31

Replacement

Construction of the nondemountable-type hub and drum assembly is such that replacement cannot be accomplished with the hub assembly installed on the vehicle.

1. Separate the drum and hub by removing the drum-to-hub retaining bolts, hub stud nuts, or by pressing out the wheel studs, as applicable.
2. Position brake drum to hub assembly, making certain that all drain holes are in alignment.
3. Apply a light, even coating of sealing compound to the hub oil deflector contact surface, and position deflector to drum.
4. Install drum-to-hub retaining bolts, hub stud nuts, or press wheel studs into drum, as applicable.

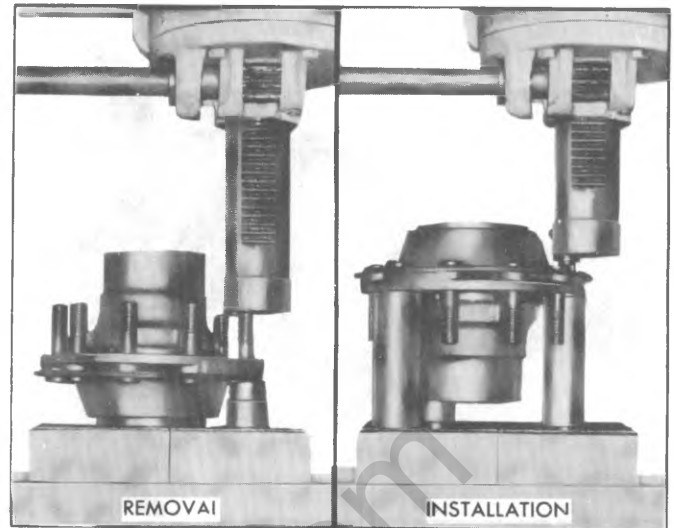


Fig. 4B-34--Wheel Bolt Replacement

Wheel Bolt

Replacement

Wheel bolts are serrated and may also be swaged in place; however, replacement procedure remains the same for both types of installation.

Press bolts out of hub flange and press new bolts into place, making sure they are a tight fit. If all bolts are removed, be sure that hub oil deflector is in position under bolt heads. See figure 4B-34.

Installation of Hub and Drum Assembly

1. Using a high melting point EP bearing lubricant, liberally pack bearings and apply a light coat on I.D. of hub bearing contact surface and O.D. of axle housing tube.
2. Make sure inner bearing, oil seal, axle housing oil deflector, and inner bearing race and oil seal are properly positioned.
3. Install hub and drum assembly on axle housing, exercising care so as not to damage oil seal or dislocate other internal components.
4. Install thrust washer so that tang on I.D. of washer is in keyway on axle housing.
5. Install adjusting nut and complete the installation as directed under "Bearing Adjustment."

BEARING ADJUSTMENT

Before checking bearing adjustment, make sure brakes are fully released and do not drag.

Check bearing play by grasping tire at top and pulling back and forth, or by using a pry bar under tire. If bearings are properly adjusted, movement of brake drum in relation to brake flange plate will be barely noticeable and wheel will turn freely. If movement is excessive, adjust bearing as follows:

1. Remove axle shaft and raise vehicle until wheel is free to rotate.
2. Disengage tang of retainer from locknut and remove both locknut and retainer from axle housing tube.
3. Using J-2222, tighten inner adjusting nut to specified torque at the same time rotating hub to make sure all bearing surfaces are in contact. Then back off inner nut to specified amount of turn-back.

See figure 4B-35, and refer to Specifications Section for

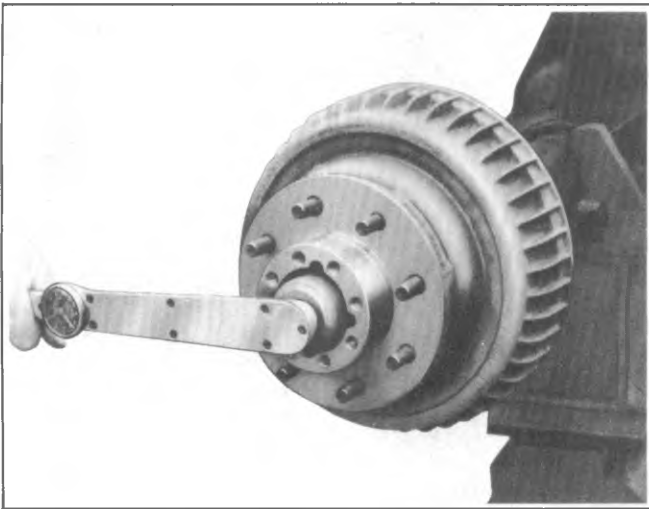


Fig. 4B-35--Tightening Adjusting Nut--Typical

torque values.

4. Install tanged retainer against the inner adjusting nut. Align inner adjusting nut so short tang of retainer will engage nearest slot on inner adjusting nut.

5. Install outer locknut and tighten to correct specified torque. Then bend long tang of retainer into slot of outer nut. This method of adjustment will result in the proper bearing adjustment.

DRIVE PINION OIL SEAL

Replacement

NOTE: The pinion oil seal may be replaced with the carrier assembly installed in the vehicle.

1. Disconnect propeller shaft.
2. Scribe a line down the pinion stem, pinion nut and companion flange.
3. Use J-8614-11 to remove the pinion nut and the companion flange.
4. Pry the oil seal from the bore, using care not to damage the machined surfaces. Thoroughly clean all foreign material from contact area.
5. Lubricate the cavity between the seal lips with a high melting point bearing lubricant.
6. Install a new pinion oil seal into the bore, using J-24434.
7. Reinstall the companion flange, pinion nut and propeller shaft.

CAUTION: See **CAUTION** on page 1 of this section, regarding the above fasteners.

DANA 10-1/2" RING GEAR AXLE

DANA 9-3/4" RING GEAR AXLE

Procedures for service to axle assembly, axle shafts, hub and drum components and bearing adjustments are identical to those listed for "Chevrolet 10-1/2 Ring Gear Axle".

Drive pinion oil seal replacement requires different special tools for the Dana axles. Follow the same procedure listed for "Chevrolet 10-1/2" Ring Gear Axle"; use J-24384 for seal replacement on Dana 10-1/2" Ring Gear Axles, and use J-22281 for pinion oil seal replacement on Dana 9-3/4" Ring Gear Axles.

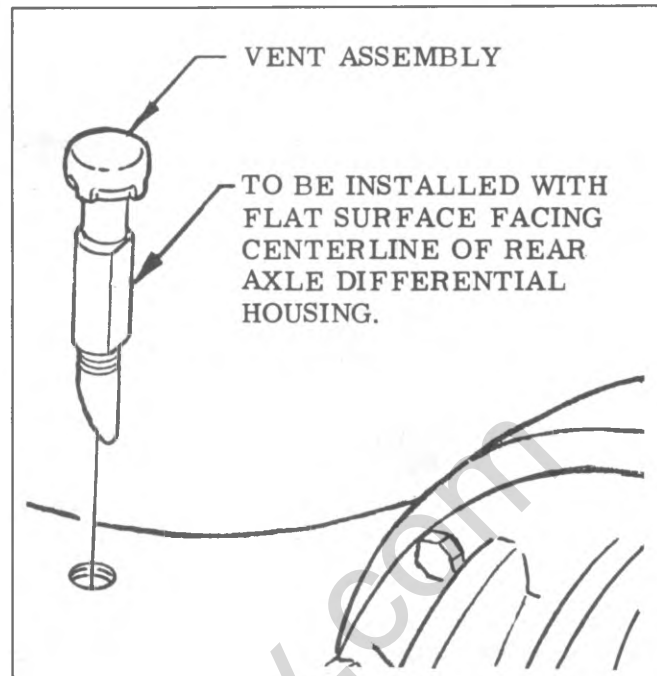


Fig. 4B-36--Typical Axle Vent Installation

12-1/4" RING GEAR AXLE

AXLE ASSEMBLY

The axle assembly removal and installation is identical to the procedure given earlier for "Chevrolet 10-1/2" Ring Gear Axle".

AXLE VENT

Replacement

Service replacement axle housing assemblies are not equipped with an axle vent; therefore, always make sure that a new vent assembly is installed when replacing the housing. If axle vent requires replacement, pry old vent from housing being sure that entire vent is removed. Prick punch around carrier hole to insure fit of replacement vent. Tap new vent into housing using a soft-faced hammer. Vent should be positioned in housing so that flat surface is toward centerline of differential carrier. See figure 4B-36.

AXLE SHAFT

Replacement

1. Remove hub cap, and install Tool J-8117 in tapped hole on shaft flange.
2. Install slide hammer, Tool J-2619, and remove axle shaft.
3. Thoroughly remove old gasket material from hub and hub cap. Clean shaft flange and mating surfaces in the wheel hub.
4. Install axle shaft so that the flange splines index into hub splines. Tap shaft into position, using J-8117 and J-2619.
5. Install new gasket, position flange to hub and install attaching bolts. Torque bolts to specifications.

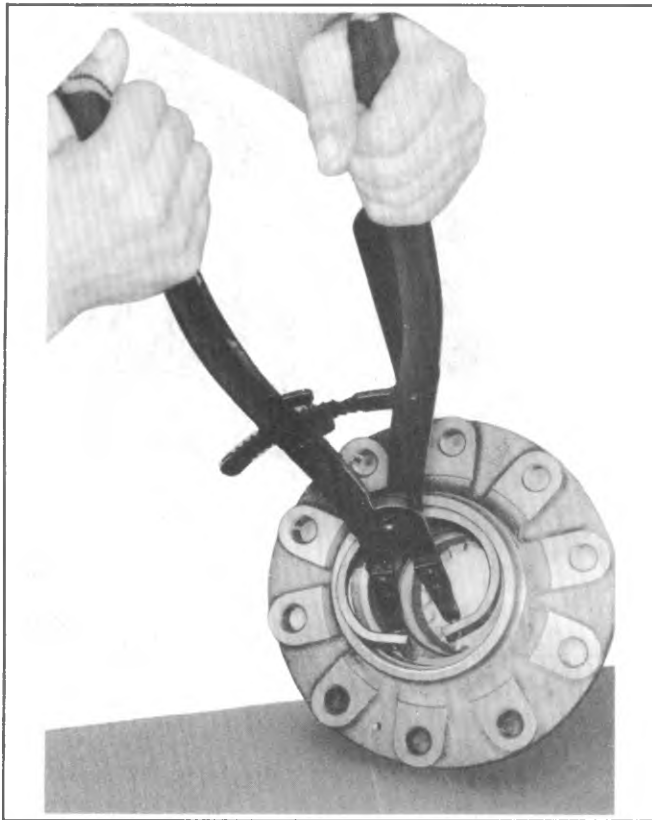


Fig. 4B-37--Removing Hub Outer Bearing Retainer Ring

HUB AND DRUM ASSEMBLY

Removal

Use the procedure given for "Chevrolet 10-1/2" Ring Gear Axle", and use J-0870 to remove the adjusting nut. Refer to figure 65.

Bearing Cup-Removal

1. Cut a suitable length of 1/2 inch steel bar stock for press-out tool.
2. Place bar stock tool behind inner bearing cup, index tool in provided notches, and press out cup with an arbor press.
3. Use J-22380, as shown in figure 4B-37, to remove outer bearing retainer ring.
4. Remove the outer bearing by driving on the axle shaft spacer, using the splined flange cut from an old axle shaft, as shown in figure 4B-38.

Inspection and Cleaning of Bearings

Refer to procedures listed for "Chevrolet 10-1/2" Ring Gear Axle.

Bearing Cup-Installation

1. To install **outer** bearing, place axle shaft spacer in hub, followed by the outer bearing. The larger O.D. of the bearing goes toward the outer end of the hub.
2. Position outer bearing cup in hub with the thin edge of the cup toward the outer end of the hub.
3. Press the cup into the hub, using J-8114 and Handle J-8092.
4. Withdraw cup installer, then install retainer ring, using J-22380 as shown in figure 4B-37. Press the cup into contact with the retainer ring as shown in figure 4B-38.

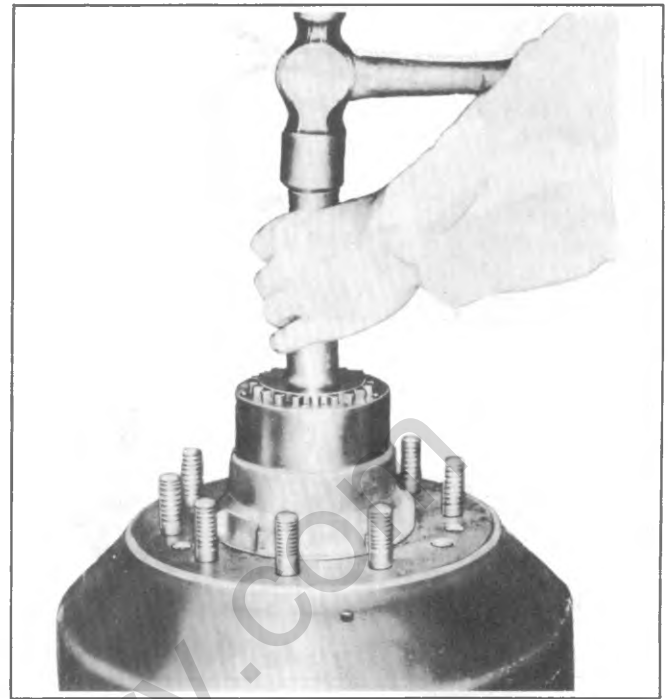


Fig. 4B-38--Removing Hub Outer Bearing

NOTE: The bearing cup-to-retainer ring seating procedure is essential to assure that an accurate wheel bearing adjustment will be obtained, and that the adjustment will not loosen during vehicle operation.

5. To install **inner** bearing, use J-8093 with Handle J-8092 to drive cup into hub bore, as shown in figure 4B-39.

6. Install new oil seal, using J-22354 as shown in figure 4B-40.

DRUM-DEMOUNTABLE-TYPE

Replacement

The demountable-type drum may be separated from the hub and removed from the vehicle without disturbing the axle shaft and hub. The drum is held to the hub by countersunk, slotted screws, which are easily removed with a screw driver.

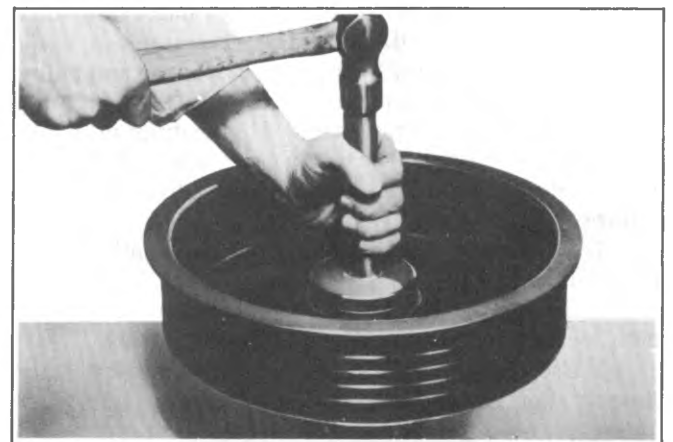


Fig. 4B-39--Installing Hub Inner Bearing Cup



Fig. 4B-40--Installing Hub Oil Seal

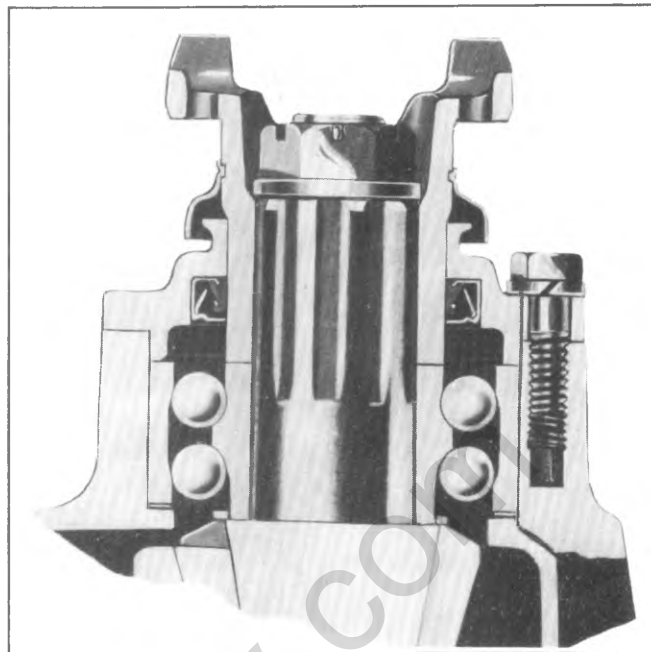


Fig. 4B-41--Pinion Oil Seal-12-1/4" Axle

WHEEL BOLT REPLACEMENT

Refer to figure 4B-34 and to procedure listed under "Chevrolet 10-1/2" Ring Gear Axle.

INSTALLATION OF HUB AND DRUM ASSEMBLY

1. Using a high melting point EP bearing lubricant, liberally pack bearings and apply a light coat on I.D. of hub bearing contact surface and O.D. of axle housing tube.

2. Make sure inner bearing, oil seal, axle housing oil deflector, and inner bearing race and oil seal are properly positioned.

3. Install hub and drum assembly on axle housing, exercising care so as not to damage oil seal or dislocate other internal components.

4. Place outer bearing cone and roller assembly on axle housing and press firmly into hub with hand.

5. Install adjusting nut and complete the installation as directed under "Bearing Adjustment".

BEARING ADJUSTMENT

Before checking bearing adjustment, make sure brakes are fully released and do not drag.

Check bearing play by grasping tire at top and pulling back and forth, or by using a pry bar under tire. If bearings are properly adjusted, movement of brake drum in relation to brake flange plate will be barely noticeable and wheel will turn freely. If movement is excessive, adjust bearing as follows:

1. Remove axle shaft and raise vehicle until wheel is free to rotate.

2. Disengage tang of retainer from locknut and remove both locknut and retainer from axle housing tube.

3. Use J-0870 to tighten inner adjusting nut at the same time rotating hub to make sure all bearing surfaces are in

contact. Then back off inner nut to specified amount of turn-back Fig. 4B-35.

4. Install tanged retainer against the inner adjusting nut. Align inner adjusting nut so short tang of retainer will engage nearest slot on inner adjusting nut.

5. Install outer locknut and tighten to correct specified torque. Then bend long tang of retainer into slot of outer nut. This method of adjustment will result in the proper bearing adjustment.

DRIVE PINION OIL SEAL

Replacement

NOTE: The pinion oil seal may be replaced with the carrier assembly installed in the vehicle.

1. Disconnect propeller shaft.

2. Scribe a line down the pinion stem, pinion nut and companion flange.

3. Use J-8614-11 to remove the pinion nut and the companion flange.

4. Remove the bolts retaining the oil seal retainer to the carrier, and remove the retainer. See figure 4B-41.

5. Pry the oil seal from the bore, using care not to damage the machined surfaces. Thoroughly clean all foreign material from contact area.

6. Lubricate the cavity between the seal lips with a high melting point bearing lubricant.

7. Install a new pinion oil seal into the bore, using J-22281. Be sure seal bottoms against shoulder in bore.

8. Install the bearing retainer to the carrier.

9. Reinstall the companion flange, pinion nut and propeller shaft.

CAUTION: See CAUTION on page 1 of this section, regarding the above fasteners.

SPECIFICATIONS

DIFFERENTIAL SPECIFICATIONS

	8 1/2"	8 7/8"	Dana 10 1/2" 9 3/4"	Chevrolet 10 1/2"	12 1/4"
Gear Backlash Preferred	.005"- .008"	.005"- .008"	.004"- .009"	.005"- .008"	.005"- .008"
Min. and Max.	.003"- .010"	.003"- .010"	.004"- .009"	.003"- .012"	.003"- .012"
Pinion Bearing Preload (In.-Lbs.)					
— New	15-30	15-30	20-40	25-35	
— Used	5-10	5-10	10-20	5-15	

BOLT TORQUES (FT.-LBS.)▲

	8 1/2"	8 7/8"	Dana 10 1/2" 9 3/4"	Chevrolet 10 1/2"	12 1/4"
Filler Plugs	25	18	10	18	10
Differential Pinion Lock	20" #	20" #	—	—	—
Drive Pinion Nut		—	*	*	220
Differential Carrier to Axle Housing		—	—	—	85
Differential Bearing Adjusting Lock		—	—	20	15
Pinion Bearing Cage To Carrier		—	—	65	165
Thrust Pad Lock Nut		—	—	—	135
Brake Backing Plate	35	35	105	105	155
Axle Shaft To Hub Bolts		—	115	115	15

BOLT TORQUES (FT.-LBS.)▲

Carrier Cover	20	20	35	30	—
Ring Gear	80	50	110	120	105
Differential Bearing Caps	55	55	85	135	205

▲Except where noted otherwise.

*Torque as necessary to obtain correct preload.

Ring Gear Size	Lubricant Capacity
8 1/2"	4.2 Pints
8 7/8"	3.5 Pints
Chevrolet 10 1/2"	5.4 Pints
Dana 10 1/2"	7.2 Pints
Dana 9 3/4"	6.0 Pints
12 1/4"	14.0 Pints

MODEL	SOURCE	TYPE/CAPACITY	RING GEAR SIZE
C10	Chevrolet	Salisbury/3750#	8-7/8"
C10	Chevrolet	Salisbury/3750#	8-1/2"
K10	Chevrolet	Salisbury/3750#	8-7/8"
K10	Chevrolet	Salisbury/4000#	8-7/8"
P10	Chevrolet	Salisbury/3500#	8-7/8"
G10	Chevrolet	Salisbury/3500 #	8-7/8"
G10	Chevrolet	Salisbury/3100#	8-1/2"

C20 (Except Crew Cab)	Chevrolet	Salisbury/5700#	10-1/2"
C20 (Crew Cab)	Chevrolet	Salisbury/7500#	10-1/2"
K20	Chevrolet	Salisbury/5700#	10-1/2"
P20	Chevrolet	Salisbury/5700#	10-1/2"
G20	Chevrolet	Salisbury/3500#	8-7/8"
G20	Chevrolet	Salisbury/3500#	8-1/2"

C30 K30 (Except Dual Wheel Camper)	Chevrolet	Salisbury/7500#	10-1/2"
C30 K30 (Dual Wheel Camper)	Dana	Salisbury/7500#	10-1/2"
P30	Chevrolet	Salisbury/7900#	10-1/2"
P30 (With H22/H23)	Chevrolet	Banjo/11,000#	12-1/4"
G30	Chevrolet	Salisbury/5700#	10-1/2"
G30 (Dual Wheel)	Dana	Salisbury/6200#	9-3/4"
G30 (Dual Wheel)	Dana	Salisbury/7500#	10 1/2"

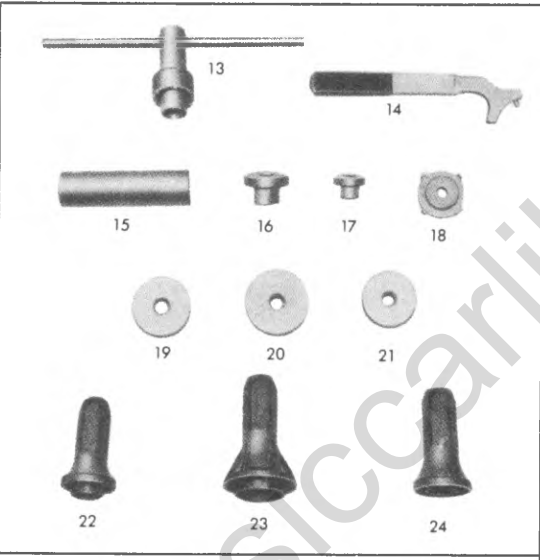
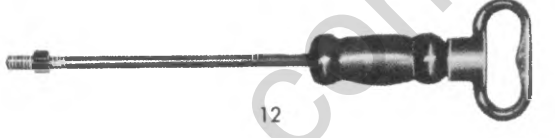
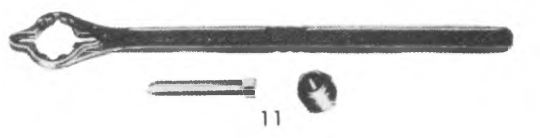
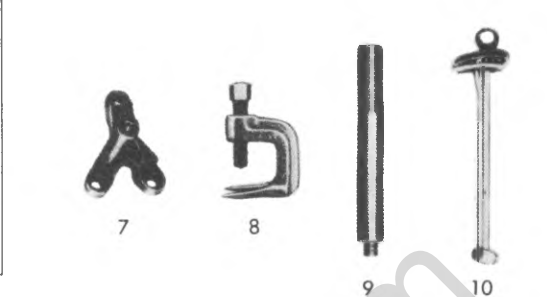
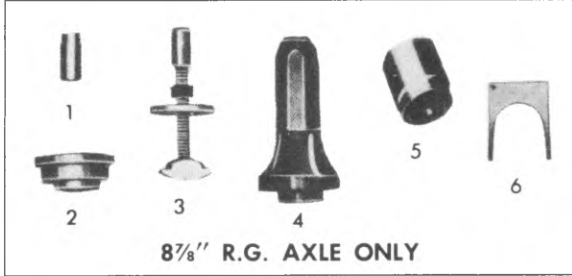
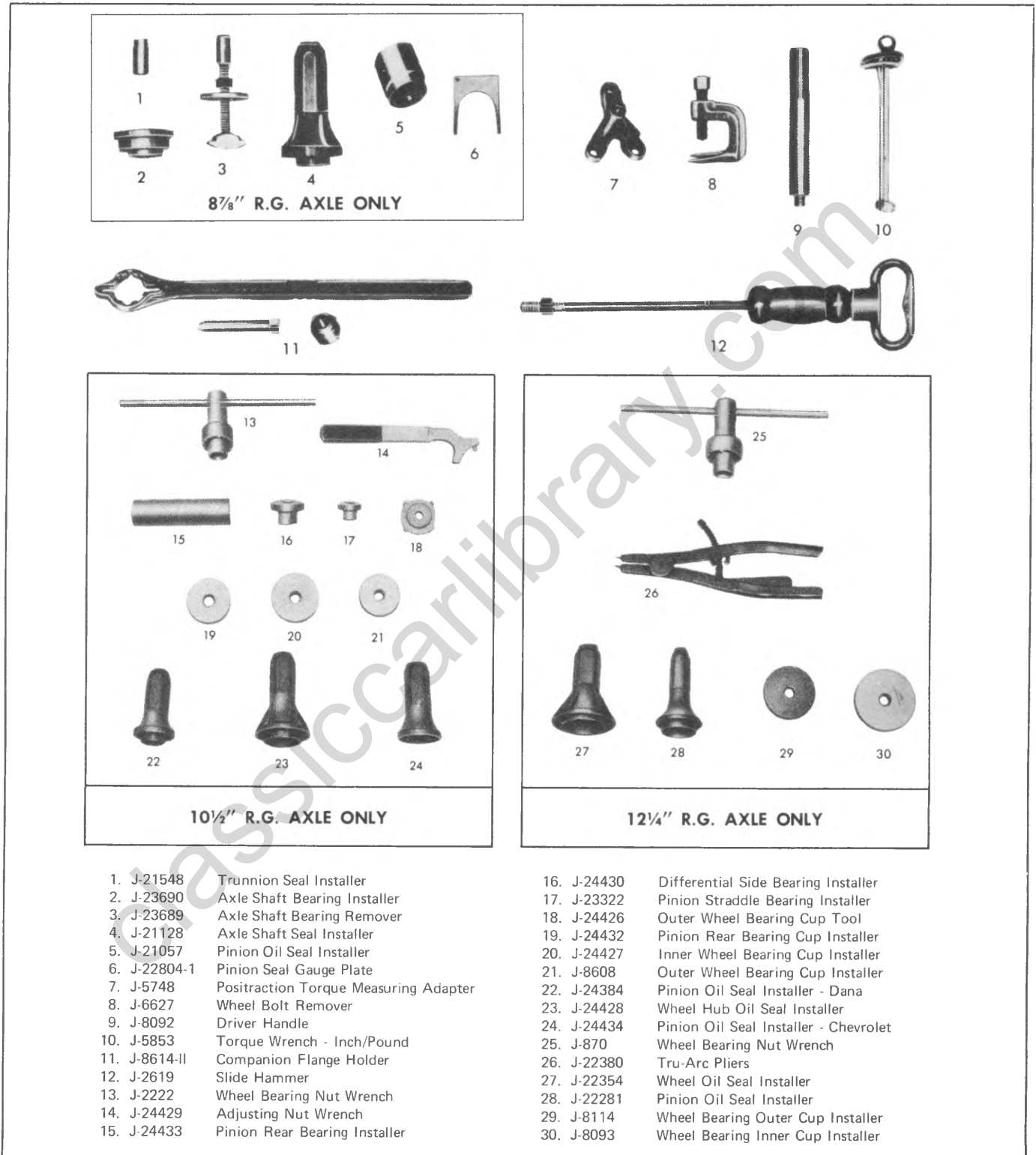
REAR WHEEL BEARING ADJUSTMENT SPECIFICATION

RING GEAR SIZE	BEARING ADJUSTING NUT TORQUE*	ADJUSTING NUT BACK-OFF*	OUTER LOCKNUT TORQUE	RESULTING BEARING ADJUSTMENT	TYPE OF BEARING
10-1/2" AND 9-3/4"	50 FT. LBS.	**	65 FT. LBS.	.001 TO .010 END PLAY	TAPERED ROLLER
12-1/4"	90 FT. LBS.	1/8 *	250 FT. LBS.	SLIGHT PRELOADED	BARREL ROLLER

**Back-off nut and retighten to 35 Ft. Lbs. then, back-off nut 1/4 turn.

*With wheel rotating.

SPECIAL TOOLS



10 1/2" R.G. AXLE ONLY

12 1/4" R.G. AXLE ONLY

- | | | | |
|---------------|---------------------------------------|-------------|---------------------------------------|
| 1. J-21548 | Trunnion Seal Installer | 16. J-24430 | Differential Side Bearing Installer |
| 2. J-23690 | Axle Shaft Bearing Installer | 17. J-23322 | Pinion Straddle Bearing Installer |
| 3. J-23689 | Axle Shaft Bearing Remover | 18. J-24426 | Outer Wheel Bearing Cup Tool |
| 4. J-21128 | Axle Shaft Seal Installer | 19. J-24432 | Pinion Rear Bearing Cup Installer |
| 5. J-21057 | Pinion Oil Seal Installer | 20. J-24427 | Inner Wheel Bearing Cup Installer |
| 6. J-22804-1 | Pinion Seal Gauge Plate | 21. J-8608 | Outer Wheel Bearing Cup Installer |
| 7. J-5748 | Positraction Torque Measuring Adapter | 22. J-24384 | Pinion Oil Seal Installer - Dana |
| 8. J-6627 | Wheel Bolt Remover | 23. J-24428 | Wheel Hub Oil Seal Installer |
| 9. J-8092 | Driver Handle | 24. J-24434 | Pinion Oil Seal Installer - Chevrolet |
| 10. J-5853 | Torque Wrench - Inch/Pound | 25. J-870 | Wheel Bearing Nut Wrench |
| 11. J-8614-II | Companion Flange Holder | 26. J-22380 | Tru-Arc Pliers |
| 12. J-2619 | Slide Hammer | 27. J-22354 | Wheel Oil Seal Installer |
| 13. J-2222 | Wheel Bearing Nut Wrench | 28. J-22281 | Pinion Oil Seal Installer |
| 14. J-24429 | Adjusting Nut Wrench | 29. J-8114 | Wheel Bearing Outer Cup Installer |
| 15. J-24433 | Pinion Rear Bearing Installer | 30. J-8093 | Wheel Bearing Inner Cup Installer |

Fig. 4B-42--Special Tools

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SECTION 4C

FRONT WHEEL DRIVE

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 1 of this Section".

CAUTION: *THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE, IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY. OR SUBSTITUTE DISIGN TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.*

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Specifications	4C-4

GENERAL DESCRIPTION

The front axle is a hypoid gear axle unit equipped with steering knuckles. Axle assembly number and production date are stamped on left tube of assembly. Conventional truck service brakes are provided on all 4-wheel drive units.

K10-20 Models use a Chevrolet or the Dana (44 Series)

front axle, both incorporate a 8-1/2" ring gear. A 4500 lb. capacity unit is used on the K-30 Model. The K-30 axle assembly is a Dana (60 Series) which incorporates a 9-3/4" ring gear.

FRONT AXLE ASSEMBLY (Refer to Fig. 4C-2)

Removal

1. Disconnect propeller shaft from front axle differential.
2. Raise front of vehicle on hoist until weight is removed from front springs. Support truck with jack stands behind front springs.
3. Disconnect connecting rod from steering arm.
4. Disconnect brake hoses from frame fittings and cap all fitting ends or cover with a rag to prevent contamination.
5. Disconnect shock absorbers from axle brackets.
6. Disconnect axle vent tube clip at the differential housing (see fig. 4C-3).
7. Dismount "U" bolts from axle to separate axle from truck springs.
8. Raise truck to clear axle assembly and roll front axle out from under the truck.

Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 3, 5, 6 and 8.*

1. Truck should be on jack stands as in Step 2 of removal instructions.
2. Place axle in position under truck.
3. Install "U" bolts attaching axle to front springs.
4. Attach shock absorbers to axle brackets.
5. Connect brake hoses to frame fittings bleed the brake system (see Section 5).
6. Attach connecting rod to steering arm.
7. Remove jack stands and lower front of truck.
8. Assemble propeller shaft to front axle differential.
9. Lower vehicle to floor.

BEARINGS AND RACES

FRONT WHEEL, PINION, DIFFERENTIAL SIDE AND REAR WHEEL ROLLER BEARINGS

DIAGNOSIS

	EXCESS NOISE COMPLAINT DIAGNOSTIC PROCEDURE
Road Test	<ol style="list-style-type: none"> 1. Check tires for irregular wear 2. Check tire pressure 3. Check lubricant level 4. Drive to warm-up rear axle 5. Test at various speeds in drive, float, coast and cornering
Tire Noises	<ol style="list-style-type: none"> 1. Change tire pressure to minimize noises 2. Drive over different road surfaces 3. Smooth black-top minimizes tire noise 4. Cross switch tires, if necessary 5. Snow tire treads and studs caused added noises
Engine or Exhaust Noises	<ol style="list-style-type: none"> 1. Drive slightly above speed where noise occurs, place transmission in neutral 2. Let engine speed drop to idle 3. Stop car 4. Run engine at various speeds
Test for Wheel Bearing Noise	<ol style="list-style-type: none"> 1. Drive car at low speed on a smooth road 2. Turn car to develop left and right motions, traffic permitting 3. Noise should change due to cornering loads 4. Jack-up wheels to verify roughness at wheels
Test for Differential Bearing Noise	<ol style="list-style-type: none"> 1. Drive car at low speed on a smooth road 2. Constant low pitch bearing noise may be heard 3. Noise should not change in reversing turns 4. Noise pattern should vary with wheel speed
Test for Pinion Bearing Noise	<ol style="list-style-type: none"> 1. Roughness or whine noise should increase with speed 2. Noise pitch should be higher than differentials 3. Test on smooth road to minimize tire noises 4. Test at various speeds in drive, float, and coast 5. Rear pinion bearing noise may be louder on acceleration 6. Front pinion bearing noise may be louder on deceleration 7. Gear noises tend to peak in a narrow speed range

Fig. 4C-1--Bearing Diagnosis

Disassembly

Refer to Section 3C for hub, spindle and knuckle removal and installation procedures.

1. Securely mount the axle assembly in a suitable holding fixture.

2. If the vehicle is not equipped with RPO F76 freewheeling hubs, remove the hub cap and snap ring.

3. Remove the drive gear and pressure spring. Place a hand over the drive gear and use a screwdriver to pry the gear out.

4. Remove the wheel bearing outer lock nut, lock ring, and wheel bearing inner adjusting as outlined in Section 3C.

5. Remove the disc assembly outer wheel bearing and the spring retainer plate.

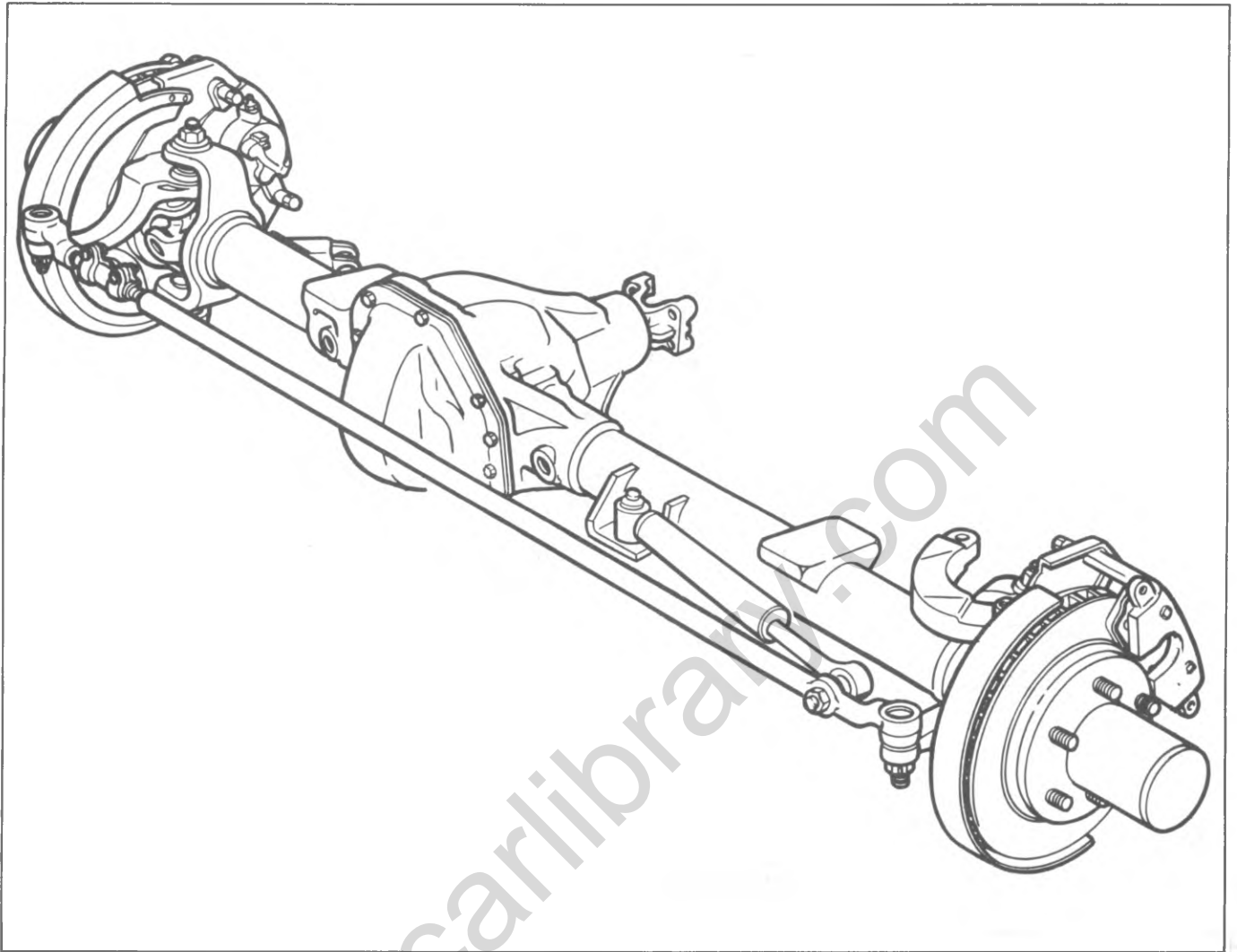


Fig. 4C-2--Front Drive Axle Typical

NOTE: If the disc or other brake components require repairs or replacement, refer to Section 5.

Repair The Axle Joint Components:

1. Remove the lock rings after removing pressure from the trunnion bearings by squeezing the ends of the bearing in a vise.
2. Support the shaft yoke in a bench vise or on a short length of pipe.
3. Using a brass drift and a soft hammer, drive on end of one trunnion bearing just far enough to drive opposite bearing from yoke.
4. Support the other side of the yoke in the vise and drive the other bearing out by tapping on the end of the trunnion using a brass drift.

5. Remove trunnion.

6. Clean and inspect bearings. Lubricate with a high melting point type wheel bearing grease.

7. Replace trunnion and press new or relubricated bearings into yoke and over trunnion hubs far enough to install lock rings.

8. Hold trunnion in one hand and tap yoke lightly to seat bearings against lock rings.

Assembly

Reverse disassembly procedure.

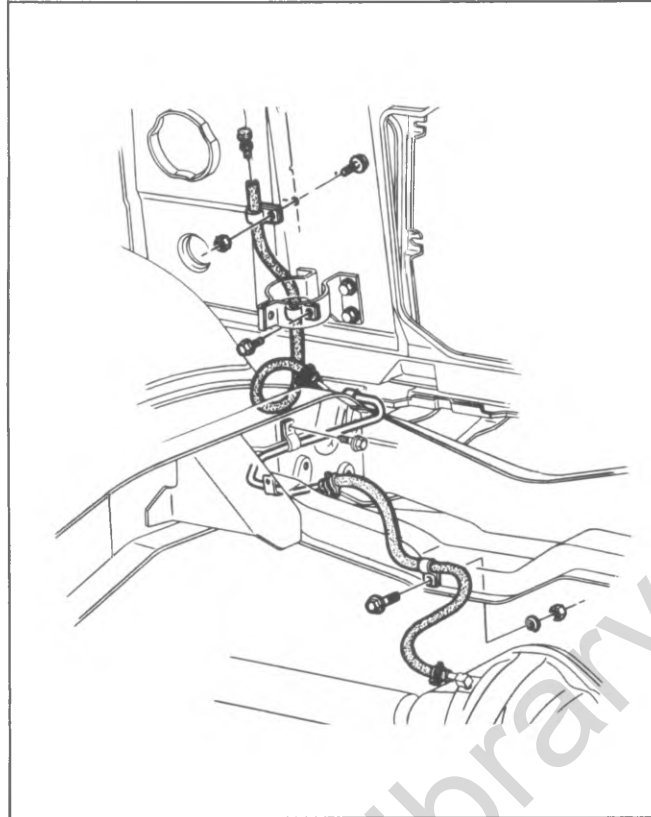


Fig. 4C-3--Axle Vent Hose Routing Typical

SPECIFICATIONS

CHEVROLET

Axle	Bolt Torques (Ft.-Lbs.)	Axle	Bolt Torques (Ft.-Lbs.)
Gear and Backlash Preferred	.005-.008	Carrier Cover	20
Min. and Max.	.003-.010	Ring Gear	80
New Pinion Bearing Preload	15-30 in.-lbs.	Differential Bearing Caps	55
Used Pinion Bearing Preload	5-10 in.-lbs.	Filler Plugs	25
		Caliper Mounting Bracket—K10, K20	35
		Axle Shaft to Hub Bolts—K10, K20	60

DANA

Axle	Bolt Torques (Ft.-Lbs.)	Axle	Bolt Torques (Ft.-Lbs.)
Gear Backlash Preferred	.004"-.009"	Carrier Cover	35
Min. and Max.	.004"-.009"	Ring Gear* — K-30	110
New Pinion Bearing Preload	20-40 in.-lbs.	Differential Bearing Caps	85
Used Pinion Bearing Preload	10-20 in.-lbs.	Filler Plugs	10
		Drive Pinion Nut** — K-30	270
		Caliper Mounting Bracket—K10, K20	35
		Caliper Mounting Bracket—K30	105
		Axle Shaft to Hub Bolts — K10, K20	60
		Axle Shaft to Hub Bolts — K30	90

*K-10-20

**K-10-20

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SECTION 5

BRAKES

The following warning and caution notes apply to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Warning/Caution on page 1 of this section".

Warning: When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel brake parts with a dry brush or with compressed air. (A water dampened cloth should be used.) Many wheel brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm."

CAUTION: THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART

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GENERAL DESCRIPTION

All vehicles are equipped with a dual hydraulic brake system.

The split system consists basically of two separate brake systems. When a failure is encountered on either, the other is adequate to stop the vehicle. If one system is not functioning, it is normal for the brake pedal lash and pedal effort to substantially increase. This occurs because of the design of the master cylinder which incorporates an actuating piston for each system. When the rear system loses

fluid, its piston will bottom against the front piston. When the front system loses fluid, its piston will bottom on the end of the master cylinder body. The pressure differential in one of the systems causes an uneven hydraulic pressure balance between the front and rear systems. The combination valve (near the master cylinder) detects the loss of pressure and illuminates the brake alarm indicator light on the instrument panel. The pressure loss is felt at the brake pedal by an apparent lack of brakes for most of the brake

travel and then, when failed chamber is bottomed, the pedal will harden.

If a vehicle displays these symptoms, it is a good indication that one of the systems contains air or has failed, and it is necessary to bleed or repair the brakes.

MASTER CYLINDER

The system is designed with a separate hydraulic system for the front and rear brakes using a dual master cylinder. The cylinder has two separate reservoirs and outlets in a common body casting.

COMBINATION VALVE

All models, except JF9 equipped vehicles, have a combination valve. The front and rear hydraulic lines are routed through this combination "metering" and "brake failure warning switch" to their appropriate wheel cylinders or caliper.

The metering portion of the combination valve tends to "hold off" front hydraulic pressure until the rear brake system overcomes the pull back springs; then pressure is allowed to flow with the result being a good distribution of braking effort.

The brake failure warning switch portion of the combination valve "senses" a loss of hydraulic pressure, if

a failure should occur, and turns "on" a red light in the dash to warn the operator of the failure.

DISC BRAKES FRONT

All models have disc brakes on the front. The one piece caliper mounts on the steering knuckle/steering arm, which is also a one piece casting, and astride the brake disc. The caliper is the single piston design which is said to be a sliding caliper sliding piston. No front brake adjustment is necessary once the system is in operation and the pedal has been stroked to "seat" the shoes to the caliper.

DISC BRAKES REAR (JF9)

Rear disc brakes operate in the same manner as front disc brakes except the caliper is mounted to a support attached to the axle flange.

DRUM BRAKES REAR

The rear brakes are duo servo and self adjusting. Brake adjustment takes place when the brakes are applied with a firm pedal effort while the vehicle is backing up. Applying the brakes moves the actuator which turns the star wheel and lengthens the adjuster screw assembly. This action moves the shoes outward until clearance between the lining and drum is within proper limits.

DIAGNOSIS

INSPECTION AND TESTING BRAKES

Testing Brakes

CAUTION: *New linings must be protected from severe use for several hundred miles.*

Brakes should be tested on dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if roadway is wet, greasy or covered with loose dirt so that all tires do not grip the road equally. Testing will also be adversely affected if roadway is crowned so as to throw weight of vehicle toward wheels on one side or if roadway is so rough that wheels tend to bounce.

Test brakes at different vehicle speeds with both light and heavy pedal pressure; however, avoid locking the wheels and sliding the tires on roadway. Locked wheels and sliding tires do not indicate brake efficiency since heavily braked but turning wheels will stop vehicle in less distance than locked wheels. More tire-to-road friction is present with a heavily braked turning tire than with a sliding tire.

External Conditions that Affect Brake Performance

1. **Tires**-- Tires having unequal contact and grip on road will cause unequal braking. Tires must be equally inflated and tread pattern of right and left tires must be approximately equal.

2. **Vehicle Loading**-- When vehicle has unequal loading, the most heavily loaded wheels require more braking power than others. A heavily loaded vehicle requires more braking effort.

3. **Front Wheel Bearings**-- A loose front wheel bearing permits the drum to tilt and have spotty contact with the brake shoe linings causing erratic action.

4. **Front End Alignment**-- Misalignment of the front end, particularly in regard to limits on camber and theoretical king pin inclination, will cause the brakes to pull

to one side.

HYDRO-BOOST

Prior to performing the Booster Function Tests, or the Accumulator Leakdown Test, the following preliminary checks must be made:

CAUTION: *Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.*

1. Check all power steering and brake lines and connections for leaks and/or restrictions.

2. Check and fill brake master cylinder with BRAKE FLUID.

3. Check and fill power steering pump reservoir with POWER STEERING FLUID. Be sure fluid is not aerated (air mixed with fluid).

4. Check power steering pump belt for tension and/or damage. Adjust if necessary.

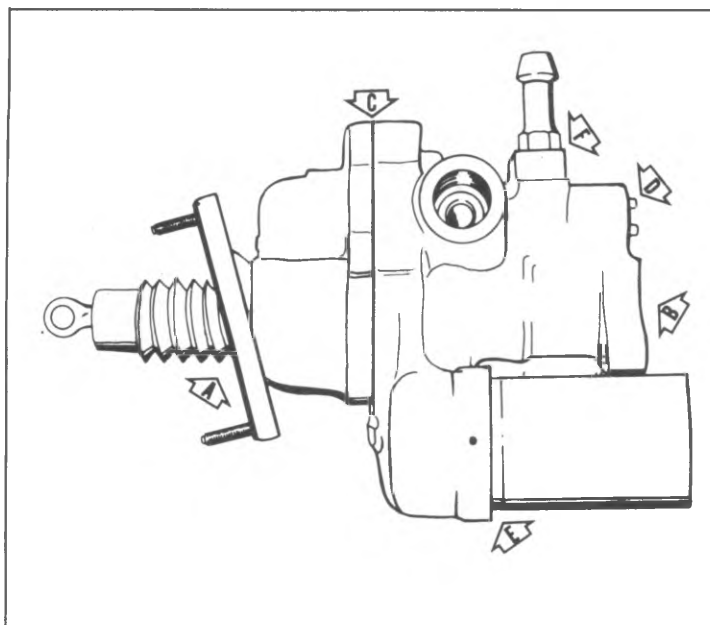
5. Check engine idle speed and adjust if necessary.

6. Check steering pump pressure; Refer to Section 3B.

SEAL LEAK DIAGNOSIS

1. **INPUT ROD SEAL:** A damaged seal will show up as a fluid leak from the mounting bracket vent hole. The booster must be removed from the vehicle and disassembled. The input rod bore should be checked for any scratches that may cause the leak. If scratches are present, housing cover must be replaced. If no excessive scratches are present, then the booster seal kit can be used to replace the appropriate seals.

2. **POWER PISTON SEAL:** Power piston seal damage will be noticed by fluid leaking out at the common master cylinder-brake booster vent and possible reduction in power assist. The booster must be removed from the vehicle and disassembled. The piston should be checked for any



HYDRO— BOOST SEAL LEAKAGE

- A. INPUT SEAL LEAK — Fluid leakage from housing cover end of booster near reaction bore. Replace seal(s).
- B. PISTON SEAL LEAK — Fluid leakage from vent at front of unit near master cylinder. Replace seal.
- C. HOUSING — Fluid leakage between the housing and housing cover. Replace seal.
- D. SPOOL VALVE SEAL — Fluid leakage near plug area. Replace seal.
- E. ACCUMULATOR CAP SEAL — Fluid leakage from accumulator area. Replace seal.
- F. RETURN PORT FITTING SEAL — Replace seal.

scratches that may be the cause of the leak. If scratches are present, then the input rod and power piston assembly must be replaced. If no excessive scratches are present, then the booster seal kit can be used to replace the appropriate seals.

3. **HOUSING SEAL:** If the housing seal is damaged, fluid will leak out from between the two housings. The booster must be removed from the vehicle and disassembled. The booster seal kit should be used to replace the housing and input rod and power piston seals.

4. **SPOOL VALVE PLUG "O" RING SEAL:** Damage to this seal will be noticed by fluid leaking out past the plug. The booster need not be removed from the vehicle. The master cylinder should be disconnected from the booster.

Press in on spool plug, insert a small screwdriver between snap ring and housing bore. This unseats one side of the spool plug snap ring from its groove in the bore. Then remove the snap ring from the bore.

5. **ACCUMULATOR "O" RING SEAL:** Damage to this seal will result in fluid leakage past the accumulator cap. The seal can be replaced while the booster is installed on the vehicle. A catch basin should be placed under the booster to catch the fluid when the accumulator or spring cap is removed.

CAUTION: Before removing the cap, the brake pedal must be pumped 4-5 times to deplete accumulator pressure. Refer to "Pneumatic Accumulator On-Vehicle Service Procedure".

6. External leakage at the return port fitting: tighten fitting to 7 ft.lbs. If it continues to leak, replace "O" ring under fitting.

7. External leakage at the high pressure gear or pump port: torque tube nut to 30 ft.lbs. If it continues to leak, check for damaged tube flares; if OK, replace tube seats.

TROUBLE SHOOTING AND TESTING

The Hydro-Boost differs from vacuum brake boosters not only in the source of power (hydraulic versus vacuum) but in the fact that it is also a part of another major sub-system of the vehicle--the power steering system. Therefore,

problems or malfunctions in the steering system may affect the operation of the booster, just as a problem in the booster may affect the steering system. The following noises are associated with the Hydro-boost system and may or may not be cause for customer complaint. Some are normal and for the most part temporary in nature. Others may be a sign of excessive wear or the presence of air in either the booster or the steering system.

1. Moan or low frequency hum usually accompanied by a vibration in the pedal and/or steering column may be observed during parking maneuvers or other very low speed maneuvers. This may be caused by a low fluid level in the power steering pump or by air in the power steering fluid due to holding the pump at relief pressure (steering wheel held all the way in one direction) for an excessive amount of time (more than 5 seconds). Check the fluid level and fill to mark. System must sit for 1 hour to remove the air. If the condition persists, this may be a sign of excessive pump wear and the pump should be checked; Refer to Section 3B.

2. At or near power runout, (brake pedal near fully depressed position) a high speed fluid noise (faucet type) may be heard. This is a normal condition and will not be heard except in emergency braking conditions, or with vehicle stopped and pedal pushed near fully depressed position.

3. Whenever the accumulator pressure is used, a slight hiss may be noticed. It is the sound of the hydraulic fluid escaping through the accumulator valve, and is completely normal.

4. After the accumulator has been emptied, and the engine is started again, another hissing sound may be heard during the first brake application or the first steering maneuver. This is caused by the fluid rushing through the accumulator charging orifice. It is normal and will only be heard once after the accumulator is emptied. However, if this sound continues, even though no apparent accumulator pressure assist was made, it could be an indication that the accumulator is not holding pressure and should be checked using the procedure for "ACCUMULATOR

HYDRO — BOOST DIAGNOSIS

CONDITION	CAUSE	CORRECTION
Excessive Brake Pedal Effort	Loose or broken power steering pump belt.	Tighten or replace the belt.
	No fluid in power steering reservoir.	Fill reservoir and check for external leaks.
	Leaks in Hydro-Boost	Replace faulty parts.
	Leaks at Hydro-Boost tube fittings.	Tighten fittings or replace tube seats, if faulty.
	External leakage at accumulator	Replace "O" ring and retainer.
	Faulty booster piston seal causing leakage at booster flange vent.	Overhaul with new seal or input rod and piston assembly.
	Faulty booster input rod seal with leakage at input rod end.	Overhaul with new seal kit.
Slow Brake Pedal Return	Faulty booster cover seal with leakage between housing and cover.	Overhaul with new seal kit.
	Faulty booster spool plug seal.	Overhaul with spool plug seal kit.
	Excessive seal friction in booster.	Overhaul with new seal kit.
	Faulty spool action.	Flush steering system while pumping brake pedal.
Grabby Brakes	Restriction in return line from booster to pump reservoir.	Replace line.
	Damaged input rod end.	Replace input rod and piston assembly.
Booster Chatters - Pedal Vibrates	Faulty spool action caused by contamination in system.	Flush steering system while pumping brake pedal.
	Power steering pump belt slips.	Tighten belt.
	Low fluid level in power steering pump reservoir.	Fill reservoir and check for external leaks.
Accumulator Leak Down-System does not hold charge	Faulty spool operation caused by contamination in system.	Flush steering system while pumping brake pedal.
	Contamination in steering hydro-boost system	Flush steering system while pumping brake pedal
	Internal leakage in accumulator system	Overhaul unit using accumulator rebuild kit and seal kit.

LEAKDOWN TEST".

5. After bleeding, a "gulping" sound may be present during brake applications as noted in the bleeding instructions.

CHECKING THE RESERVE SYSTEM

1. Start engine and charge accumulator by applying the brake pedal or by turning the steering wheel from stop to stop. Turn off engine and let vehicle sit for one hour. After one hour there should be at least two power assisted

applications with the engine off.

2. If the reserve system will not retain a charge for one hour, but functions normally immediately following charging, the accumulator valves are at fault and the booster must be disassembled and the accumulator valves replaced.

3. If the accumulator can be heard charging and discharging, but it does not hold a charge, disassemble the booster and replace the accumulator valves.

4. Deplete the accumulator by pressing the brake pedal

4 or 5 times. If the accumulator can has lost its gas charge, it is possible to rotate or wobble the accumulator can with respect to the housing. Replace the accumulator assembly.

BOOSTER FUNCTIONAL TEST

With the engine off, apply the brake pedal several times until the accumulator is completely depleted. Depress the brake pedal (approximately 40 pounds pedal force) and start the engine. The pedal should fall and then push back against driver's foot.

ACCUMULATOR LEAKDOWN TEST

Start engine and charge accumulator by either applying the brake pedal (approximately 100 pounds force) or by turning the steering wheel from stop to stop. Turn off engine and let vehicle sit for one hour. After one hour there should be two power assisted applies with engine stopped.

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CONDITION	POSSIBLE CAUSE	CORRECTION
Pulls	1. Incorrect tire pressures.	1. Inflate evenly on both sides to the recommended pressures.
	2. Front end out of line.	2. Check and align to manufacturer's specifications.
	3. Unmatched tires on same axle. For radial tire lead refer to Section 3E.	3. Tires with approximately the same amount of tread should be used on the same axle.
	4. Restricted brake pipes or hoses.	4. Check for soft hoses and damaged lines. Replace with new hoses and new double-walled steel brake tubing.
	5. Malfunctioning caliper assembly.	5. Check for stuck or sluggish pistons, proper lubrication. Remove and rebuild caliper.
	6. Defective or damaged shoe and lining (grease or brake fluid on lining or bent shoe).	6. Install new shoe and lining in complete axle sets.
	7. Malfunctioning rear brakes.	7. Check for inoperative auto adjusting mechanism, defective lining (grease or brake fluid on lining) or defective wheel cylinders. Repair as necessary.
	8. Loose suspension parts.	8. Check and torque all suspension mountings to specifications.
	9. Loose calipers.	9. Check and torque bolts to specifications.
Noise (high pitched squeak without brake applied).	1. Front linings worn out.	1. Replace linings.
Brake roughness or chatter (Pedal Pulsates)	1. Excessive lateral runout.	1. Check per instructions and replace or machine rotor, if not within specifications.
	2. Parallelism not within specifications.	2. Check per instructions and replace or machine the rotor, if not within specifications.
	3. Wheel Bearings not adjusted.	3. Adjust wheel bearings to correct specifications.
	4. Rear drums out of round.	4. Check runout and, if not within specifications, turn the drums (not over maximum of 0.060 on the diameter).

CONDITION	POSSIBLE CAUSE	CORRECTION
Brake roughness or chatter (Pedal Pulsates) — Continued	5. Shoe reversed (steel against iron).	5. Replace shoe and lining and machine rotor within specifications.
Excessive Pedal Effort	1. Malfunctioning power brake.	1. Check power brake and repair if necessary.
	2. Partial system failure.	2. Check front and rear brake system and repair, if necessary. Also, check and repair brake warning light circuit if a failed system is found and light did not function.
	3. Excessively worn shoe and lining.	3. Check and replace in axle sets.
	4. Piston in caliper stuck or sluggish.	4. Remove caliper and rebuild.
	5. Fading brakes due to incorrect lining.	5. Remove and replace with original equipment lining (or equivalent).
Excessive Pedal Travel	1. Partial brake system failure.	1. Check both front and rear system for a failure and repair. Also check and repair warning light circuit. It should have indicated a failure.
	2. Insufficient fluid in master cylinder.	2. Fill reservoirs with approved brake fluid. Check for leaks. Check warning light.
	3. Air trapped in system.	3. Bleed system.
	4. Rear brake not adjusting.	4. Adjust rear brakes and repair auto adjusters.
	5. Bent shoe and lining.	5. Replace axle set of shoe and lining.
Dragging Brakes (A very light drag is present in all disc brakes immediately after pedal is released.)	1. Master cylinder pistons not returning correctly.	1. With reservoir cover off, check for fluid spurt at bypass holes as pedal is depressed. Adjust push rod, if necessary, or rebuild master cylinder.
	2. Restricted brake pipes or hoses.	2. Check for soft hoses or damaged pipes and replace with new hoses and new double-walled steel brake tubing.

CONDITION	POSSIBLE CAUSE	CORRECTION
Dragging Brakes (A very light drag is present in all disc brakes immediately after pedal is released.) — Continued	3. Incorrect parking brake adjustment on rear brakes.	3. Check and readjust to correct specifications.
	4. Check valve installed in outlet to front disc brakes.	4. Check master cylinder outlet and remove check valve if present.
	5. Incorrect installation of inboard shoe and lining.	5. Refer to caliper installation in this section.
Grabbing or Uneven Braking Action	1. All conditions listed under "PULLS".	1. All corrections listed under "PULLS".
	2. Malfunction of combination valve.	2. Replace and bleed system.
	3. Malfunction of power brake unit.	3. Check operation and repair, if necessary.
	4. Binding brake pedal mechanism.	4. Check and lubricate, if necessary. Possibly replace pedal bushing and/or spacer.
Pulsation (roughness) Felt during normal brake application.	1. Uneven pad wear caused by caliper not sliding due to improper clearance or dirt.	1. Remove caliper and correct as necessary.
	2. Uneven rotor wear causing a thickness variation between the two braking surfaces.	2. Machine rotors as follows: <ol style="list-style-type: none"> Machine rotors to obtain a circumferential thickness variation no greater than .0005" in 360° and a lateral runout no greater than .004" (max. rate of change not exceed .001" in 30°). Check caliper freeness. With rotor removed, install caliper and mounting bolts (pins). Check for .005"-.012" clearance at both top and bottom of caliper. If less than .005" is found, file with a flat file until at least .005" is obtained. DO NOT EXCEED A MAXIMUM of .012" per end or .024" total clearance. Caliper clearance to inboard and outboard reaction pads must be equal within .004" both at the top and bottom of the caliper. This is to ensure correct alignment of caliper to knuckle during a brake application. Remove caliper after freeness check. Clean pins and sleeves, replace "O" rings, and apply a light coating of silicone grease or equivalent to all contact points and "O" rings.

CAUSE	SYMPTOM	Excessive Brake Pedal Travel	Brake Pedal Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow to Respond	Brakes Slow to Release	Brakes Drag (Side to Side)	Uneven Braking Action (Front to Rear)	Uneven Braking Action (Side to Side)	Scraping Noise from Brakes	Brakes Squeak During Application	Brakes Squeak During Stop	Brakes Chatter During Stop	Brakes Groan (Roughness)	Brake Tell-Tale Glows During Stop
Leaking Brake Line or Connection		X	XX									X				XX
Leaking Wheel Cylinder or Piston Seal		X	XX			X					X					X
Leaking Master Cylinder		X	XX													X
Air In Brake System		XX										X				XX
Contaminated or Improper Brake Fluid							X	X	X							X
Leaking Vacuum System					XX		X									
Restricted Air Passage in Power Head					X		XX	X								
Damaged Power Head					X	X	X	X	X							
Improperly Assembled Power Head Valving					X	X	X	X	XX							
Worn Out Brake Lining - Replace					X	X					X	X	X	X	X	X
Uneven Brake Lining Wear - Replace and Correct		X				X					X	X	X	X	XX	X X
Glazed Brake Lining					XX		X				X	X		X	X	
Incorrect Lining Material - Replace					X	X					X	X			X	X
Contaminated Brake Lining - Replace						XX					XX	XX	X	X	X	X
Linings Damaged by Abusive Use - Replace					X	XX					X	X	X	X	X	X
Excessive Brake Lining Dust					X	XX					XX	XX		X	XX	X
Heat Spotted or Scored Brake Drums or Rotors						X					X	X		X	X	XX X
Out-of-Round or Vibrating Brake Drums															X	XX
Out-of-Parallel Brake Rotors																XX
Excessive Rotor Run-Out																X
Faulty Automatic Adjusters		X									X	X	X			X
Incorrect Wheel Cylinder Sizes						X	X					X	X			
Weak or Incorrect Brake Shoe Retention Springs						X		X	XX	X	X	XX	X	XX		
Brake Assembly Attachments - Missing or Loose		X									X	X	X	X	X	X
Insufficient Brake Shoe Guide Lubricant									X	X	X	X	XX	XX		
Restricted Brake Fluid Passage or Sticking Wheel Cylinder Piston					X	X	X	X	X	X	X	X				
Faulty Metering Valve		X			X	X	X	X	X	X		X				X
Brake Pedal Linkage Interference or Binding					X		X	XX	XX							
Improperly Adjusted Parking Brake											X					
Drums Tapered or Threaded													XX			
Incorrect Front End Alignment												XX				
Incorrect Tire Pressure												X	X			
Incorrect Wheel Bearing Adjustment		X											X		X	
Loose Front Suspension Attachments												X		XX		X X
Out-of-Balance Wheel Assemblies																XX
Operator Riding Brake Pedal		X	X	X						X		X				X
Improperly Adjusted Master Cylinder Push Rod		X						X	XX							X
Sticking Wheel Cylinder or Caliper Pistons					X		X	X	X	X		X				
Faulty Proportioning Valve					X		X	X	X							

XX - Indicates more probable cause(s)

X - Indicates causes

ON-VEHICLE SERVICE

PEDAL TRAVEL

At reasonably frequent intervals, the brakes should be inspected for pedal travel, which is the distance the pedal moves toward the floor from a fully-released position. Inspection should be made with the brake pedal firmly depressed (approximately 90 lbs.) while the brakes are cold.

_____ C-K-G Manual	4.5"
_____ C-K-G Power	3.5"
_____ P (Except JF9)	3.5"
_____ P (JF9)	6.0"

On power brake-equipped vehicles, pump the pedal a minimum of 3 times with the engine off before making pedal travel checks. This exhausts all vacuum from the power booster.

STOP LIGHT SWITCH

Adjustment

The stop light switch is mounted on a flange protruding from the brake pedal support.

1. Release the brake pedal to its normal position.
2. Adjust switch by turning in or out as necessary.

Electrical contact should be made when the brake pedal is depressed 1.0-1.24" (C-K models), .45-.95" (G-P models) from its fully released position.

3. Tighten switch locknut, if so equipped, and connect electrical harness.

BLEEDING AND FLUSHING BRAKE SYSTEM

Bleeding Brake Hydraulic System

A bleeding operation is necessary to remove air whenever it is introduced into the hydraulic brake system.

It may be necessary to bleed the hydraulic system at all four wheel cylinders if air has been introduced through low fluid level or by disconnecting brake pipes at master cylinder. If brake pipe is disconnected at any wheel cylinder, then that wheel cylinder only need be bled. If pipes are disconnected at any fitting located between master cylinder and wheel cylinders, then all wheel cylinders served by the disconnected pipe must be bled.

Manual Bleed

If the vehicle is equipped with power brakes, deplete the vacuum reserve by applying the brakes several times.

1. Fill master cylinder with brake fluid and keep at least one-half full of fluid during bleeding operation.

Bleed right rear brake, left rear brake, right front brake and left front brake.

2. With the proper size box end wrench or Tool J-21472 over bleeder valve, attach bleeder tube to valve and allow tube to hang submerged in brake fluid in a clean glass jar (fig. 5-1).

3. Open the bleeder valve and fully depress the brake pedal.

4. Close bleeder valve and release brake pedal.

5. Repeat steps 3 and 4 until all air is evacuated.

Check and refill master cylinder reservoir as required to prevent air from being drawn through master cylinder.

6. Repeat the bleeding procedure at all wheels if the entire system is to be bled.

7. Check the brake pedal, feel for "sponginess" and repeat entire bleeding procedure if necessary.

Pressure Bleeding

Pressure bleeding equipment must be of the diaphragm type. That is, it must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil and other contaminants from entering the hydraulic system.

1. Install pressure bleeding adapter J-23518 to the master cylinder.

2. Make sure the pressure tank is at least 1/3 full of Supreme #11 brake fluid or its equivalent.

NOTE: The bleeder ball must be re-bled each time fluid is added.

3. Charge the bleeder ball to between 20 and 25 psi.

4. When ready to begin bleeding, connect hose to master cylinder bleeder adapter and open the tank valve.

5. Disc brakes require a manual override of the front brake metering or combination valve to permit flow to the front wheels. Therefore, it will be necessary to hold the valve stem open manually pressure bleeding.

To hold the metering valve open to bleed the front brakes, the valve stem must be either pushed in or pulled out. Install metering valve actuator J-23709.

6. Bleed the brakes in the following sequence: right rear, left rear, right front and left front.

7. With the proper size wrench over the bleeder valve attach bleeder tube. The discharge end must hang submerged in a clean container partially filled with brake fluid.

8. Open the bleeder valve at least 3/4 turn and allow flow to continue until no air is seen in the fluid.

9. Close the bleed valve; Be sure it seals.

10. Repeat Steps 7-9 for the remaining bleeder valves (see Step 6 for sequence).

11. Check the pedal feel for "sponginess" and repeat the entire procedure if necessary.

12. Dispose of all removed brake fluid.

13. Remove Tool J-23709 from the combination valve

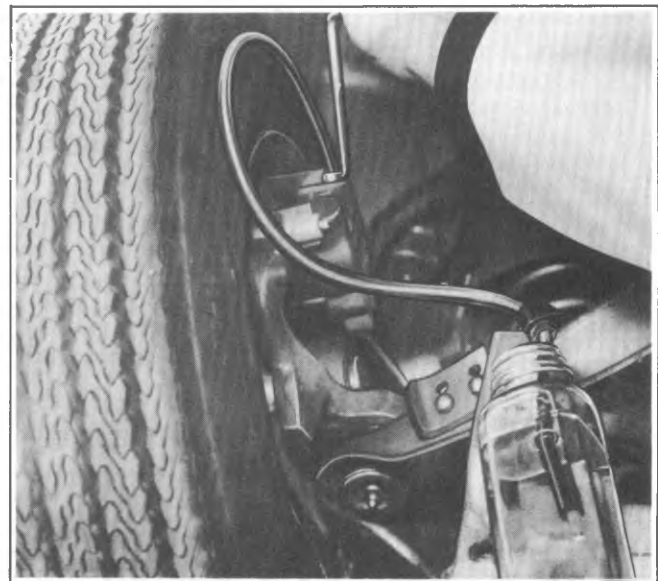


Fig. 5-1--Bleeding Wheel Cylinder

and tighten the mounting bolt.

14. Disconnect bleeder equipment from the brake bleeder adapter.

15. Remove bleeder adapter. Wipe all areas dry if fluid was spilled during adapter removal.

16. Fill master cylinder reservoir(s) to proper level and install master cylinder diaphragm and cover.

Flushing Brake Hydraulic System

It is recommended that the entire hydraulic system be thoroughly flushed with clean brake fluid whenever new parts are installed in the hydraulic system.

Flushing is also recommended if there is any doubt as to the grade of fluid in the system. If fluid has been used which contains the slightest trace of mineral oil, all rubber parts that have been subjected to the contaminated fluid should be replaced.

BLEEDING HYDRO-BOOST/POWER

STEERING HYDRAULIC SYSTEM

The following procedure should be used to bleed the power steering hydraulic system on hydro-boost vehicles.

NOTE: If the power steering fluid has foamed due to low fluid level, it will be necessary to park the vehicle for approximately one hour (reservoir cap loose) so that the foam can dissipate.

1. Raise the front of the vehicle on a hoist so that the tires are clear of the floor.

2. Check reservoir and fill with GM Power Steering Fluid (or equivalent).

NOTE: Leave the reservoir cap off during entire bleed procedure.

3. Install a remote control starter switch so that engine can be cranked but not started.

CAUTION: *Whenever the engine is cranked remotely at the starter, with a special jumper or other means, the distributor primary lead must be disconnected from the negative post on the coil.*

4. Crank engine for 4 to 5 second intervals while pouring fluid into the reservoir.

5. Fill reservoir and crank as in step 4 until system will no longer accept fluid. It is normal that fluid may spill when cranking stops (it is the result of air in the system trying to escape). To prevent spilling, crank engine.

6. Remove remote control starter switch. Reinstall distributor primary lead.

7. Start engine and allow to run 2 seconds.

8. Check and refill fluid reservoir if necessary.

9. Start engine and depress the brake pedal several times while rotating the steering wheel from stop to stop.

10. Turn engine off and then pump brake pedal 4-5 times to deplete accumulator pressure.

11. Check and refill fluid reservoir if necessary.

12. Repeat Steps 9, 10 and 11. Install pump reservoir

13. Remove vehicle from hoist.

BRAKE PIPES

Replacement (Figs. 5-2 thru 5-4)

WARNING: NEVER USE COPPER TUBING BECAUSE COPPER IS SUBJECT TO FATIGUE CRACKING AND CORROSION WHICH COULD RESULT IN BRAKE FAILURE.

1. Procure the recommended tubing and steel fitting nuts of the correct size. (Outside diameter of tubing is used to specify size.)

2. Cut tubing to length. Correct length may be determined by measuring old pipe using a cord and adding 1/8" for each double flare.

3. Double flare tubing ends using a suitable flaring tool such as J-23530. Follow instructions included in tool set.

Make sure fittings are installed before starting second flare.

WARNING: DOUBLE FLARING TOOL MUST BE USED AS SINGLE FLARING TOOLS CANNOT PRODUCE A FLARE STRONG ENOUGH TO HOLD THE NECESSARY PRESSURE.

4. Bend pipe assembly to match old pipe using a tubing bender. Clearance of .75" must be maintained to all moving or vibrating parts.

BRAKE HOSES

Inspection

The flexible hydraulic brake hose which transmits hydraulic pressure from the steel brake pipe on the frame to the rear axle and to the calipers should be inspected every 4 months or 6,000 miles (9 600 km) (heavy duty emission vehicles), every 12 months or 7,500 miles (12 000 km) (light duty emission vehicles). The brake hose assembly should be checked for road hazard damage, for cracks and chafing of the outer cover, and for leaks and blisters. A light and mirror may be needed for an adequate inspection. If any of the above conditions are observed on the brake hose, it will be necessary to replace it.

Front Brake Hose

Removal (figs. 5-2 thru 5-4)

1. Raise vehicle on hoist.

2. Clean dirt and foreign material from both hose end fittings.

3. Disconnect brake pipe from hose fitting using a back-up wrench on fitting. Be careful not to bend frame bracket or brake pipe. It may be necessary to soak the connections with penetrating oil.

4. Remove "U" clip from female fitting at bracket and remove hose from bracket.

5. Remove bolt from caliper end of hose. Remove hose from caliper, and discard the two copper gaskets on either side of fitting block.

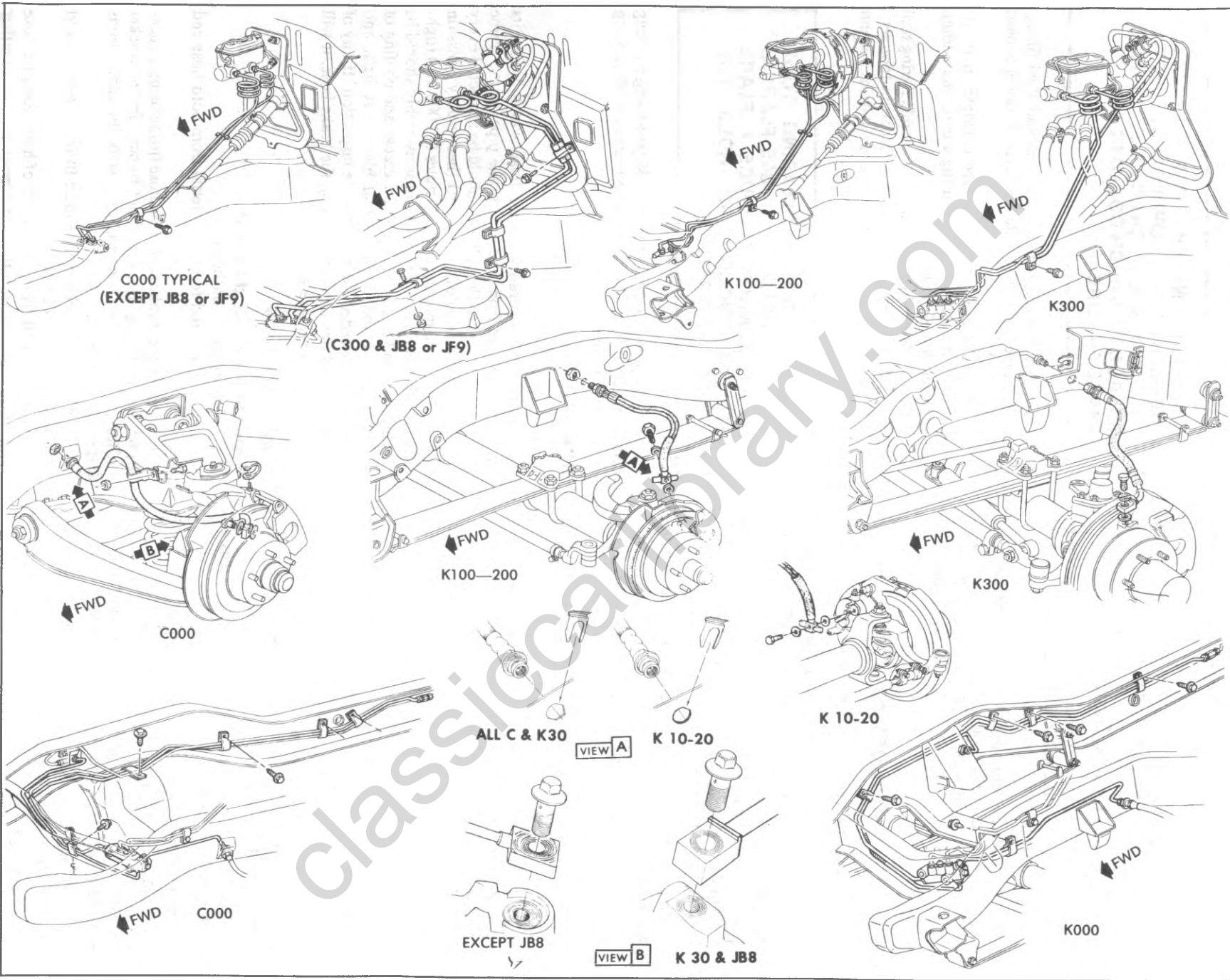
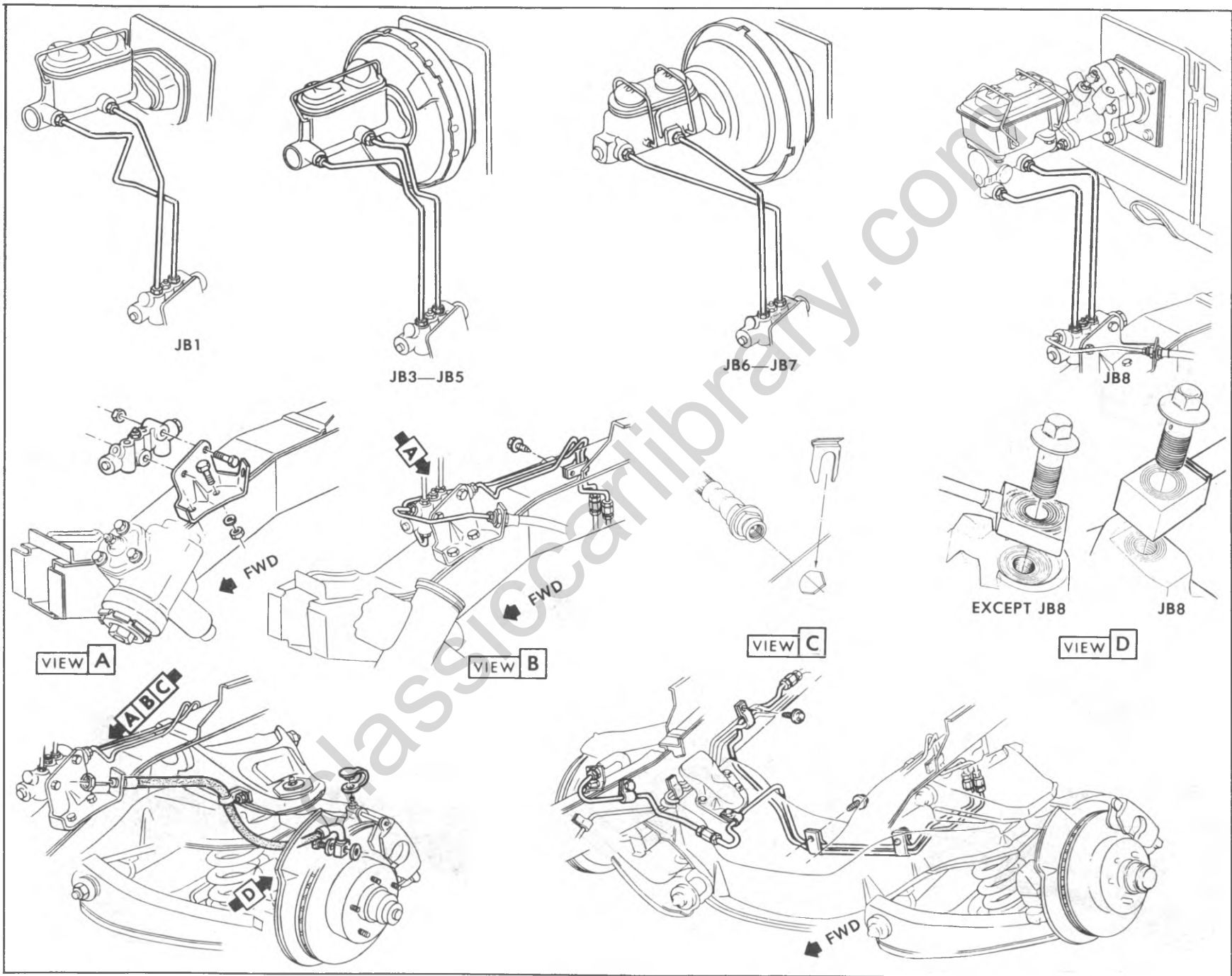


Fig. 5-2-Front Brake Pipes and Hoses-C-K Models

Fig. 5-3-Front Brake Pipes and Hoses-G Models



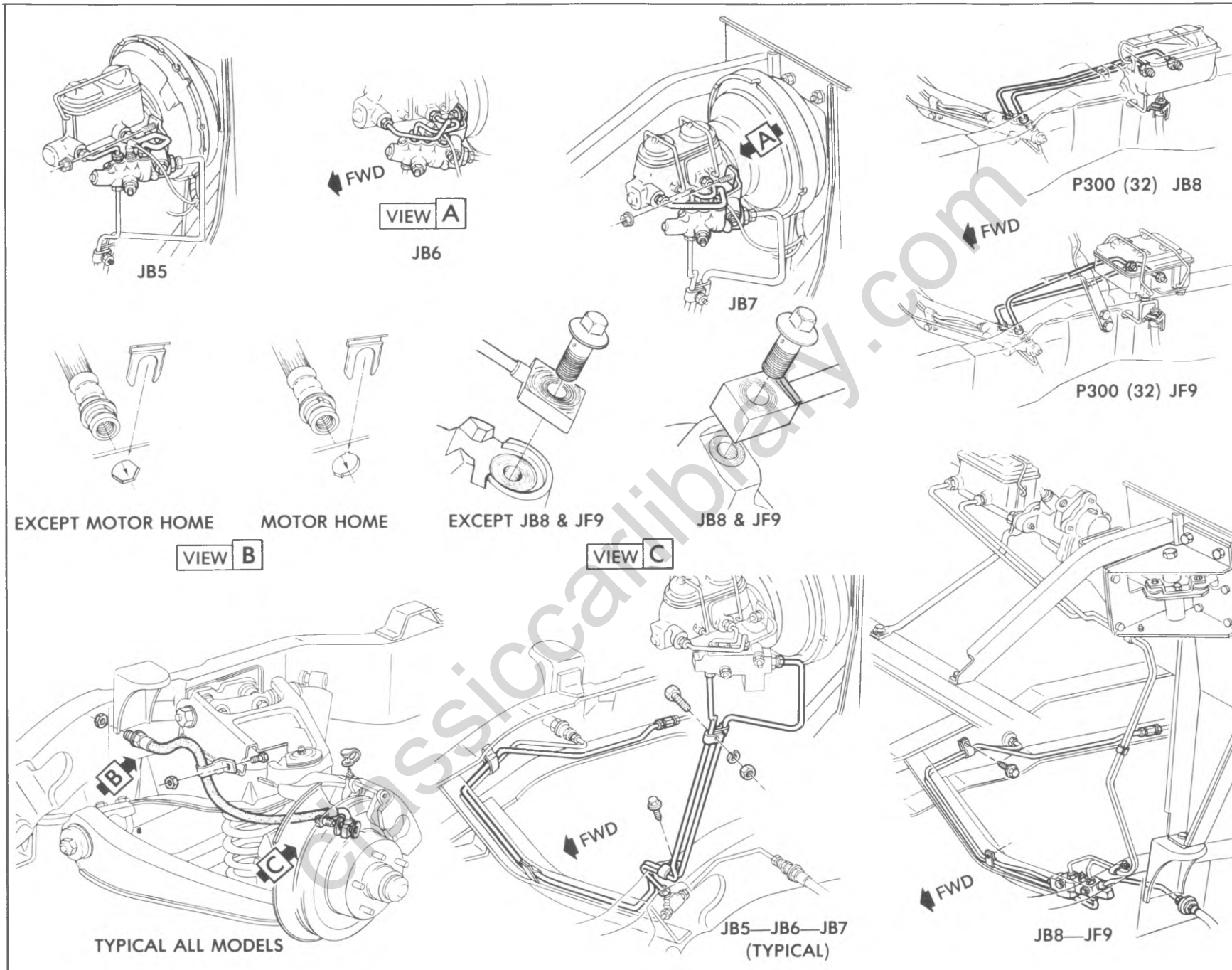


Fig. 5-4--Front Brake Pipes and Hoses--P Models

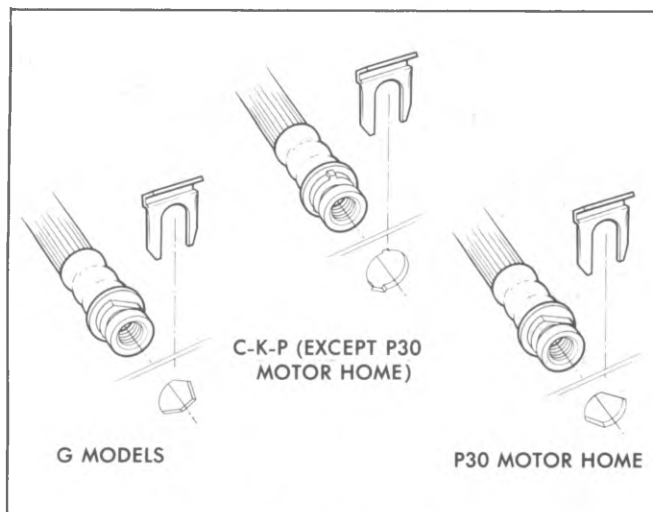


Fig. 5-5--Typical Rear Hose Fittings

Installation

1. Use new copper gaskets on both sides of fitting block, wet bolt threads with brake fluid, then with fitting orientation flange engaged with the caliper orientation ledge on JB8 and JF9 (hose located in caliper gate on all except JB8 and JF9), fasten hose to caliper; torque to specifications.
2. With weight of vehicle on suspension, pass female fitting through frame or frame bracket. Fitting fits the bracket in only one position. With least amount of twist in hose, install fitting in this position. There should be no kinks in hose.
3. Install "U" clip to female fitting at frame bracket.
4. Attach brake pipe to hose fitting using a backup wrench on fitting; torque to specifications.
5. Inspect to see that hose doesn't make contact with any part of suspension. Check in extreme right hand and extreme left hand turn conditions. If hose makes any contact, remove and correct.
6. Bleed brake system.
7. Lower vehicle from hoist.

Rear Brake Hose

Removal

1. Raise vehicle on hoist.
2. Remove all three brake pipes from hose, two at junction block and, with the use of a back-up wrench, one on the female fitting at bracket. Be careful not to bend bracket or pipes; use penetrating oil if necessary.
3. Remove "U" clip and take female fitting out of bracket (fig. 5-5).
4. Observe position at which junction block is mounted to the axle. When installing new hose be sure this junction block is in the same position.
5. Remove bolt attaching junction block to axle.

Installation

1. Thread both rear axle pipes into junction block.
2. Bolt junction block to axle and then torque rear pipes into block.
3. Pass female end of hose through bracket; female fitting will fit bracket in only 1 position (except G models), 2 positions (G models). Without twisting hose, position female end in bracket.

4. Install "U" clip.

5. Attach pipe to female fitting using a back-up wrench on fitting; torque to specification, again be careful not to bend bracket or pipe. Check to see that hose installation did not loosen frame bracket. re-torque bracket if necessary.

6. Bleed system.

7. Lower vehicle from hoist.

PARKING BRAKE PEDAL OR HANDLE

Removal (Fig. 5-9)

1. Place parking brake pedal or handle in the released position.

2. Remove nuts from the engine compartment on C, K and G models or bolts from mounting bracket on P models.

NOTE: Take notice of the spacers on P models for reinstallation.

3. Disconnect the release handle rod at the parking brake assembly end (C-K models).

4. Remove the bolts from the underside of the dash and lower the brake assembly (C-K-G Models).

5. **C-K-G Models-** Disconnect the cable ball from the parking brake clevis and remove the assembly.

- P Models-** Remove the clevis pin and disconnect the cable from the brake assembly; remove the assembly.

Installation

Reverse the removal procedure. Torque all bolts and nuts. After installing the clevis-pin, use a new cotter pin to secure the clevis pin. Adjust the cable if necessary as outlined below.

CAUTION: See "Caution" on Page 1 of this section.

PARKING BRAKE ADJUSTMENT

Adjustment of parking brake cable is necessary whenever holding ability is not adequate or whenever the center brake cables have been disconnected.

NOTE: The service brake must be properly adjusted as a base for parking brake adjustment; conversely the parking brake must be properly adjusted for the service brake to function as intended.

Inspection

If complete release of the parking brake is not obtained, unless it is forcibly returned to its released position, or if application effort is high, check parking brake assembly for free operation. If operation is sticky or a bind is experienced, correct as follows:

1. Clean and lubricate brake cables and equalizer with Delco Brake Lube (or equivalent).
2. Inspect brake assembly for straightness and alignment (replace if necessary).
3. Clean and lubricate parking brake assembly with Delco Brake Lube (or equivalent).
4. Checking routing of cables for kinks or binding.

Adjustment--Foot Pedal Type

NOTE: Before adjusting parking brake, check service brake condition and adjustment.

1. Raise vehicle on hoist.
2. Loosen the equalizer adjusting nut.
3. Apply parking brake 4 notches from fully released position.
4. Tighten the equalizer nut until a moderate drag is

felt when the rear wheels are rotated forward.

CAUTION: See "Caution" on Page 1 of this section.

5. Fully release parking brake and rotate the rear wheels. No drag should be present.
6. Remove vehicle from hoist.

Adjustment--Orscheln Lever Type

1. Turn adjusting knob on parking brake lever counterclockwise to stop.
2. Apply parking brake.
3. Raise vehicle on a hoist.
4. Loosen nut at intermediate cable equalizer and then adjust nut to give light drag at rear wheels.

CAUTION: See "Caution" on Page 1 of this section.

5. Readjust parking brake lever knob to give a definite snap-over-center feel.

PARKING BRAKE (PROPELLER SHAFT)- INTERNAL EXPANDING

Adjustment-Drum On

1. Jack up at least one rear wheel. Block wheels and release hand brake.
2. Remove cotter pin and clevis pin connecting pull rod and relay lever. This will assure freedom for full shoe release.

CAUTION: It may be necessary to knock out lanced area in brake drum with punch and hammer to gain entry into adjusting screw through brake drum. Be sure all metal has been removed from parking brake compartment.

3. Rotate brake drum to bring one of access holes into line with adjusting screw at bottom of shoes (manual transmission), top of shoes (automatic transmission).

4. Expand shoes by rotating adjusting screws with screwdriver inserted through hole in drum. Move outer end of screwdriver away from drive shaft. Continue adjustment until shoes are tight against drum and drum cannot be rotated by hand. Back off adjustment ten notches and check drum for free rotation.

5. Place parking brake lever in fully released position. Take up slack in brake linkage by pulling back on cable just enough to overcome spring tension. Adjust clevis of pull rod or front cable to line up with hole in relay levers.

a. Insert clevis pin and cotter pin, then tighten clevis locknut.

b. Install a new metal hole cover in drum to prevent contamination of brake.

c. Lower rear wheels. Remove jack and wheel blocks.

CAUTION: See "Caution" on Page 1 of this section.

Adjustment--Drum Off

1. With parking brake drum off, use special Tool J-21177 or J-22364, Drum to Brake Shoe Clearance Gauge, to check diameter of drum clearance surface.

2. Turn the tool to the opposite side and fit over brake shoes by turning the star wheel until the gauge just slides over the linings.

3. Rotate the gauge around the brake shoe lining surface to insure proper clearance.

4. Install propeller shaft flange at mainshaft as outlined in transmission section.

5. Lower rear wheels. Remove jack and wheel blocks.

PARKING BRAKE CABLES

Front Parking Brake Cable Replacement

1. Raise vehicle on hoist.
2. Remove adjusting nut from equalizer.
3. Remove retainer clip from rear portion of front cable at frame and from lever arm.
4. Disconnect front brake cable from parking brake pedal or lever assemblies. Remove front brake cable. On some models it may assist installation of new cable if a heavy cord is tied to other end of cable in order to guide new cable through proper routing.
5. Install cable by reversing removal procedure.
6. Adjust parking brake.

Center Parking Brake Cable Replacement

1. Raise vehicle on hoist.
2. Remove adjusting nut from equalizer.
3. Unhook connector at each end and disengage hooks and guides.
4. Install new cable by reversing removal procedure.
5. Adjust parking brake.
6. Apply parking brake 3 times with heavy pressure and repeat adjustment.

Rear Parking Brake Cable Replacement

1. Raise vehicle on hoist.
2. Remove rear wheel and brake drum.
3. Loosen adjusting nut at equalizer.
4. Disengage rear cable at connector.
5. Bend retainer fingers.
6. Disengage cable at brake shoe operating lever.
7. Install new cable by reversing removal procedure.
8. Adjust parking brake.

COMBINATION VALVE

Testing Electrical Circuit of Combination Valve

1. Disconnect wire from switch terminal and use a jumper to connect wire to a good ground.

2. Turn ignition key on "On" - warning lamp should light. If lamp does not light, bulb is burned out or electrical circuit is defective. Replace bulb or repair electrical circuit as necessary.

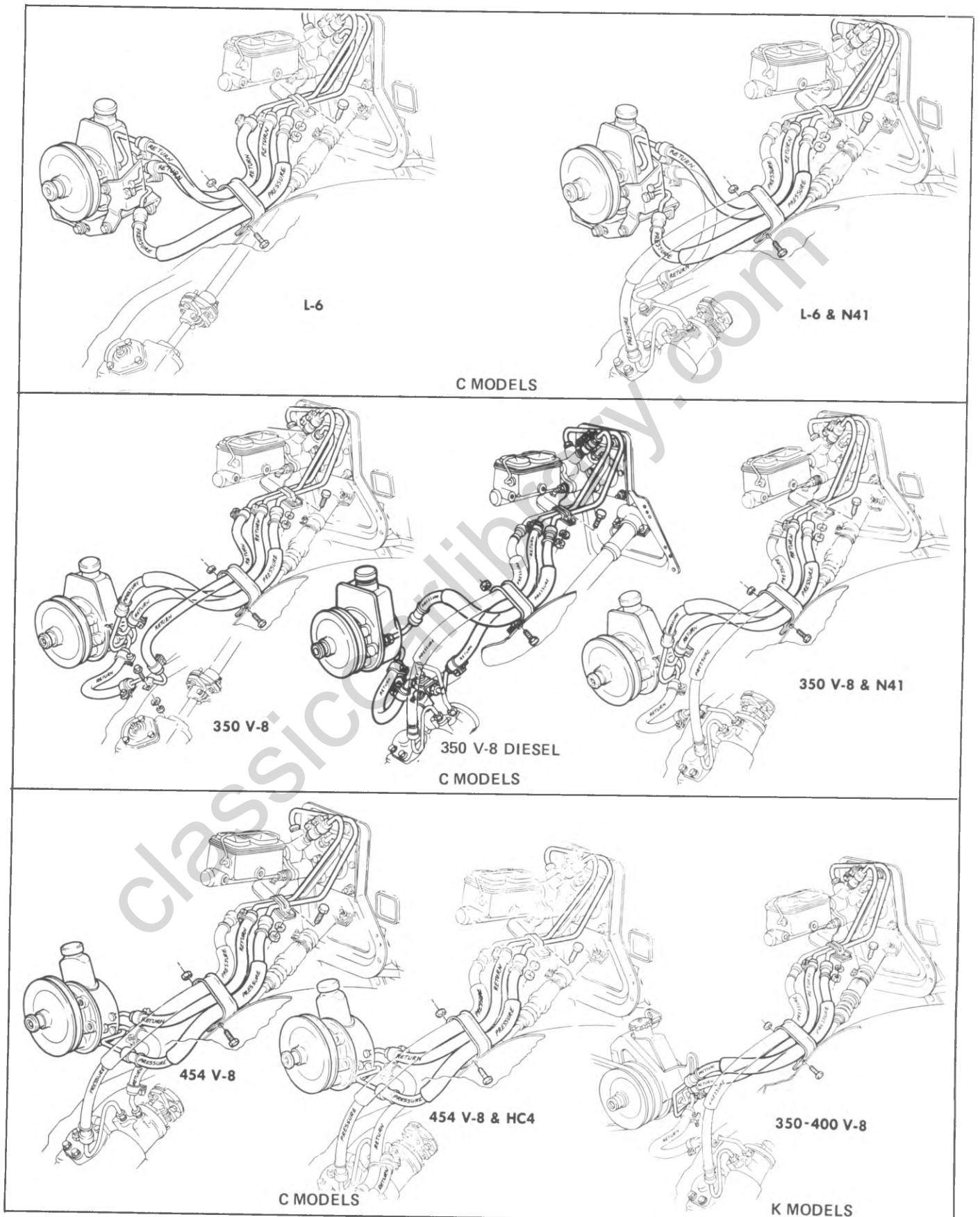


Fig. 5-6--Power Steering Hose Routing--C-K Models

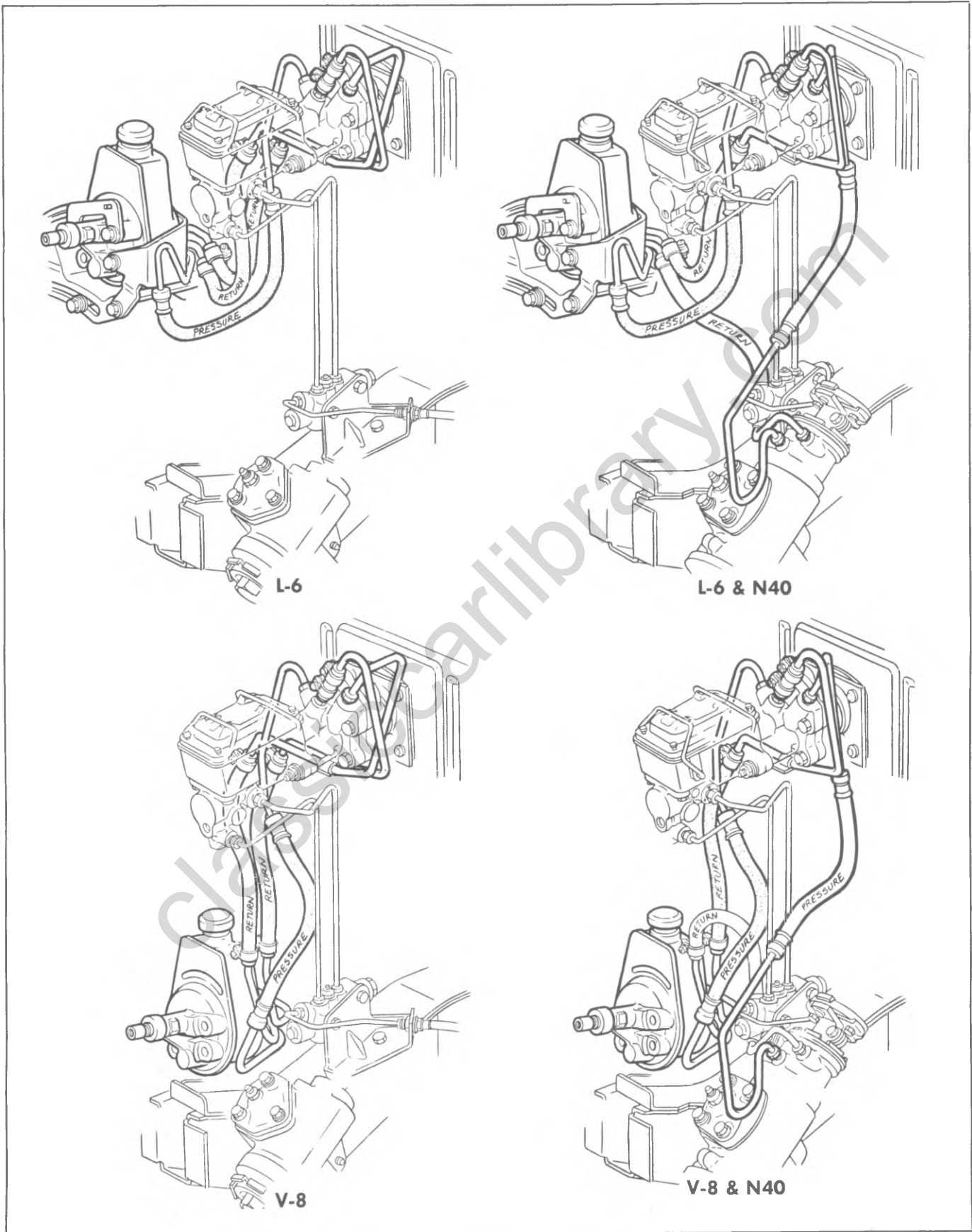
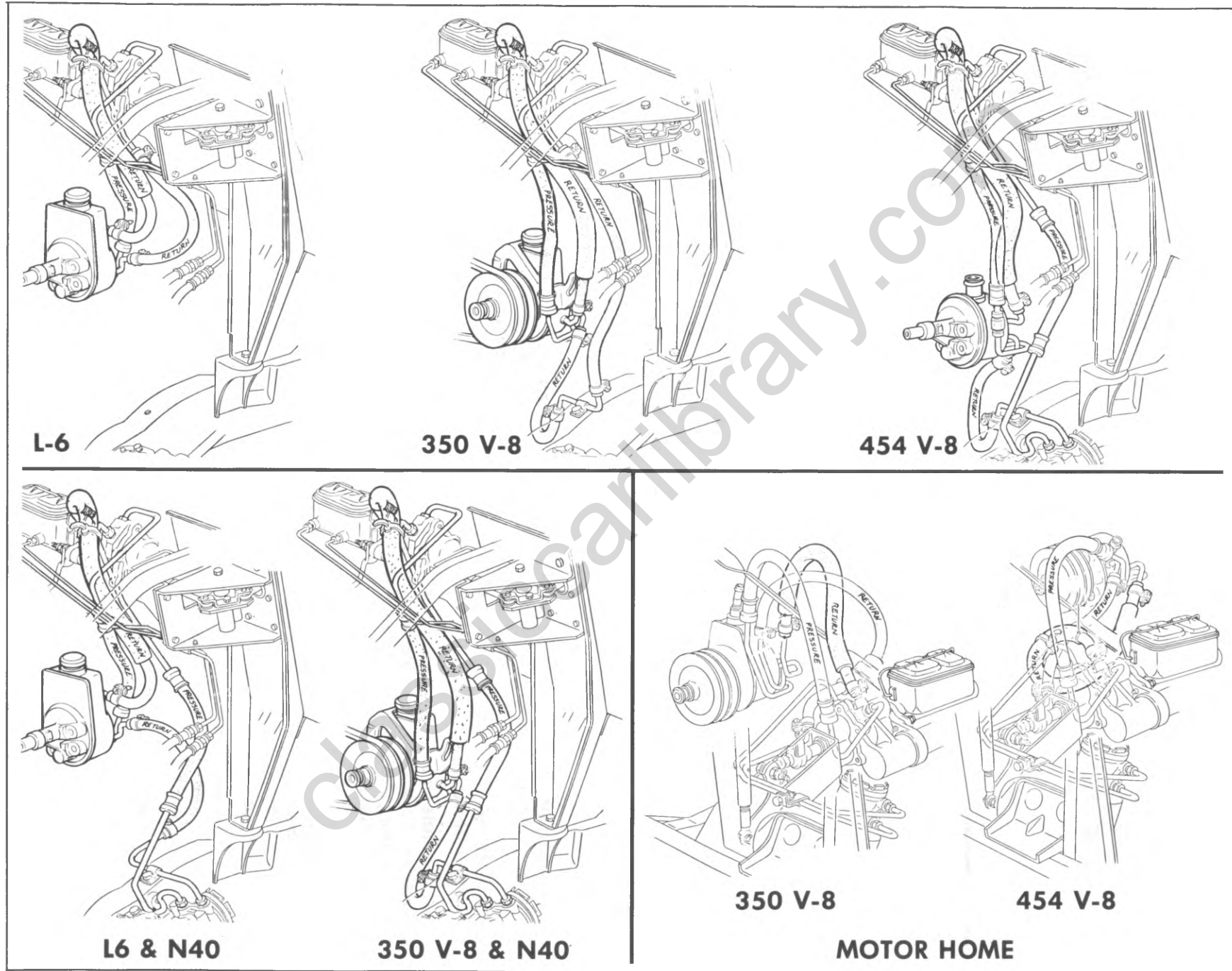


Fig. 5-7--Power Steering Hose Routing--G Models

Fig. 5-8--Power Steering Hose Routing--P Models



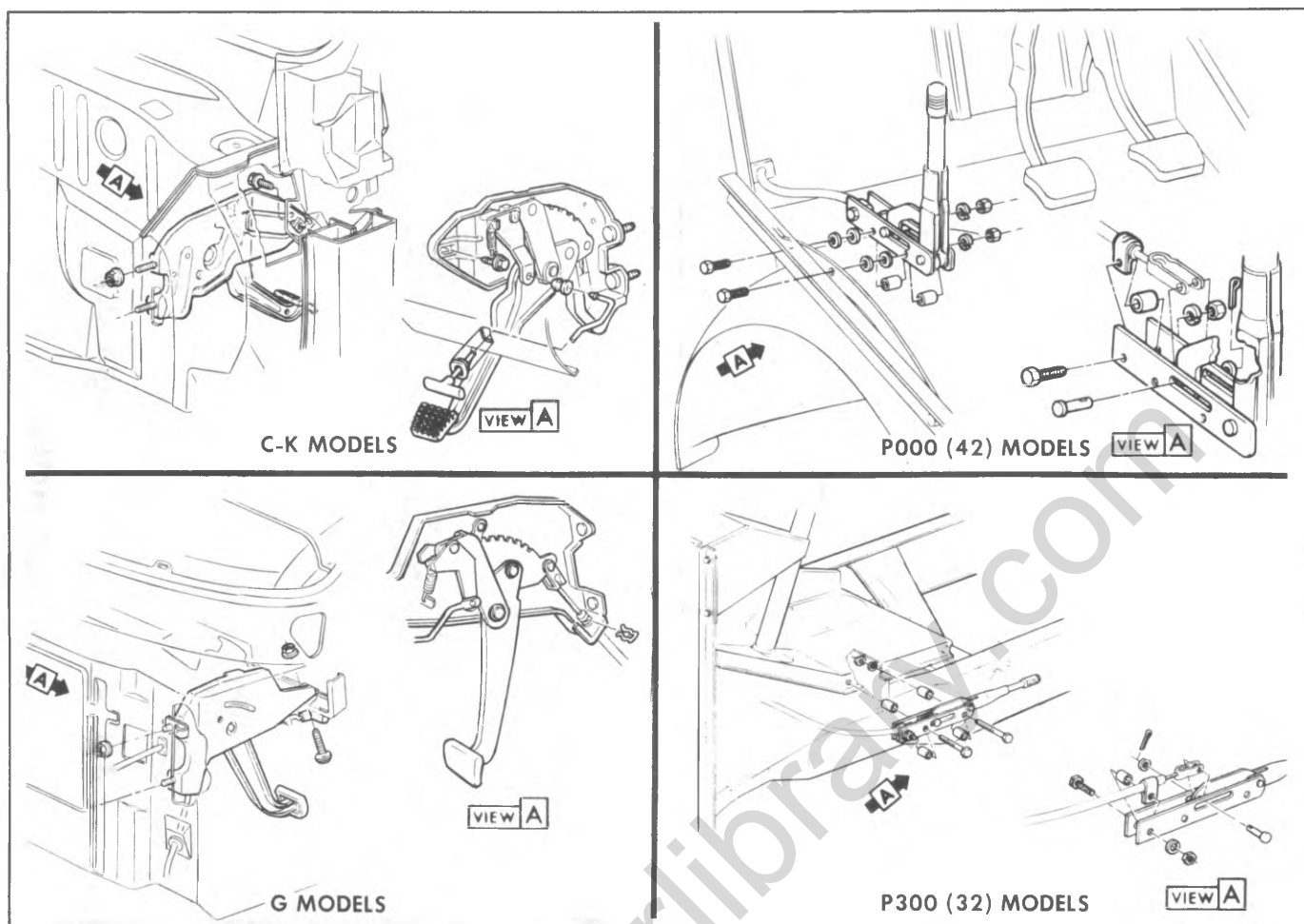


Fig. 5-9--Parking Brake Assembly--Typical

3. When warning lamp lights, turn ignition switch off. Disconnect jumper and reconnect wire to switch terminal.

Testing Warning Light Switch Portion of Combination Valve

1. Raise vehicle on hoist. Attach a bleeder hose to a rear brake bleed screw and immerse the other end of the hose in a container partially filled with clean brake fluid. Be sure master cylinder reservoir is full.

2. Turn ignition switch to "On"; open bleeder screw while a helper applies moderate pressure to the brake pedal; warning lamp should light. Close bleeder screw before helper releases brake pedal. Reapply brake pedal with moderate-to-heavy pressure; light should go out.

3. Attach the bleeder hose to a front brake bleeder screw and repeat above test. Warning lamp action should be the same as in Step No. 2. Turn ignition switch off.

4. If warning lamp does not light during Steps 2 and 3 but does light when a jumper is connected to ground, the warning light switch portion of the combination valve is defective. Do not attempt to disassemble the combination valve. If any portion of the combination valve is defective, it must be replaced with a new combination valve.

5. Lower vehicle to floor. Check and refill master cylinder to proper level.

Replacement

The combination valve is not repairable and must be serviced as a complete assembly.

1. Disconnect hydraulic lines at combination valve. Plug lines to prevent loss of fluid and entrance of dirt. Disconnect warning switch wiring harness from valve switch terminal.

2. Remove combination valve.

3. Install combination valve by reversing removal steps.

4. Bleed entire brake system. Do not move vehicle until a firm brake pedal is obtained.

BRAKE PEDAL

NOTE: The brake pedal mounting is an integral design with the clutch pedal (except automatic transmission), necessitating the removal of the clutch pedal before removing the brake pedal.

Removal (Fig. 5-12)

1. Remove the pull back spring from the body or brake pedal support bracket.

2. **Manual Transmission Vehicles--** Remove the clutch pedal as outlined under "Clutch Pedal" in Section 7C.

Automatic Transmission Vehicles-- Remove pedal pivot bolt nut or pivot pin retainer and remove bolts or pin and bushings.

3. **P Models--** Remove the sleeve assembly screw

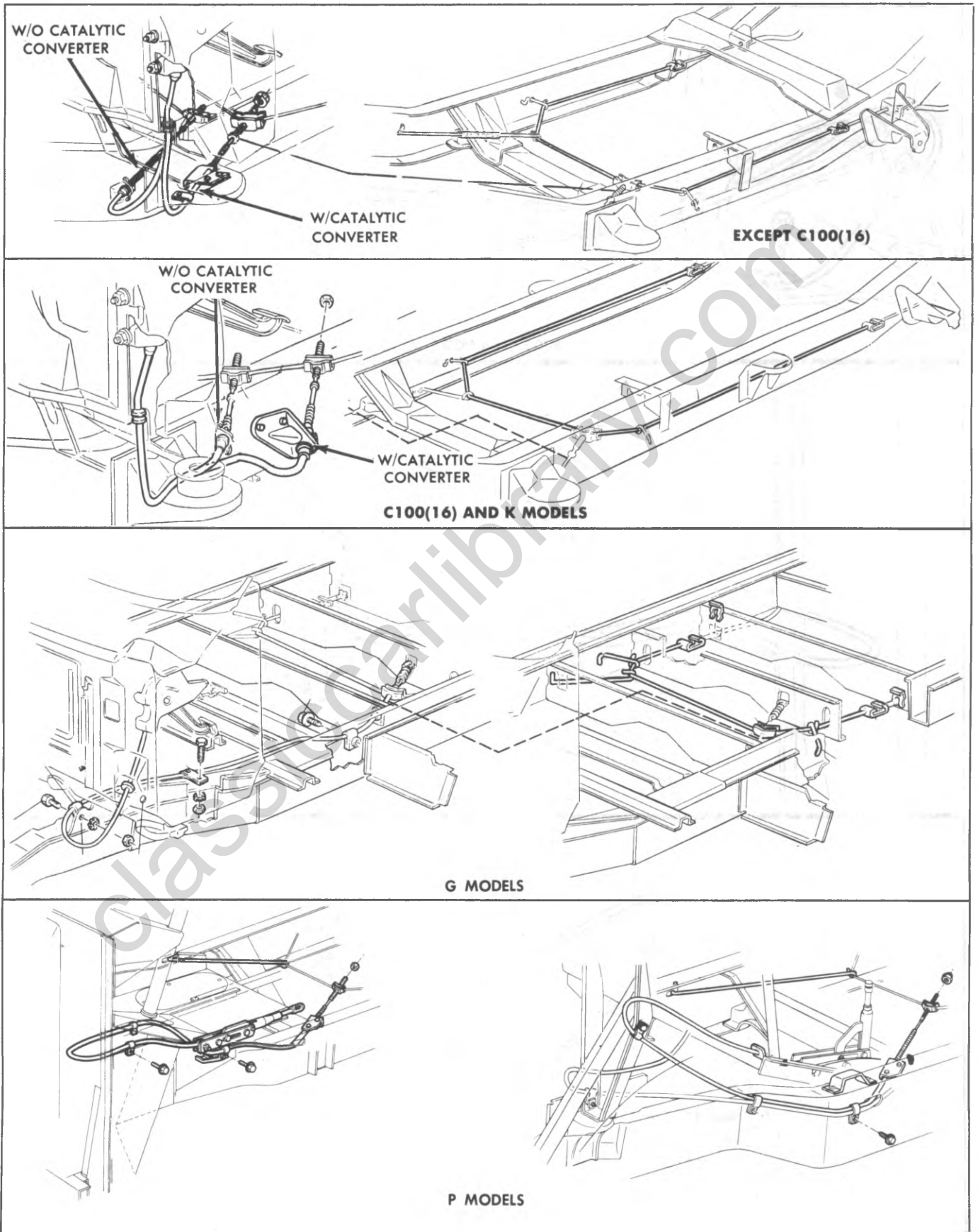


Fig. 5-10--Parking Brake System--Typical

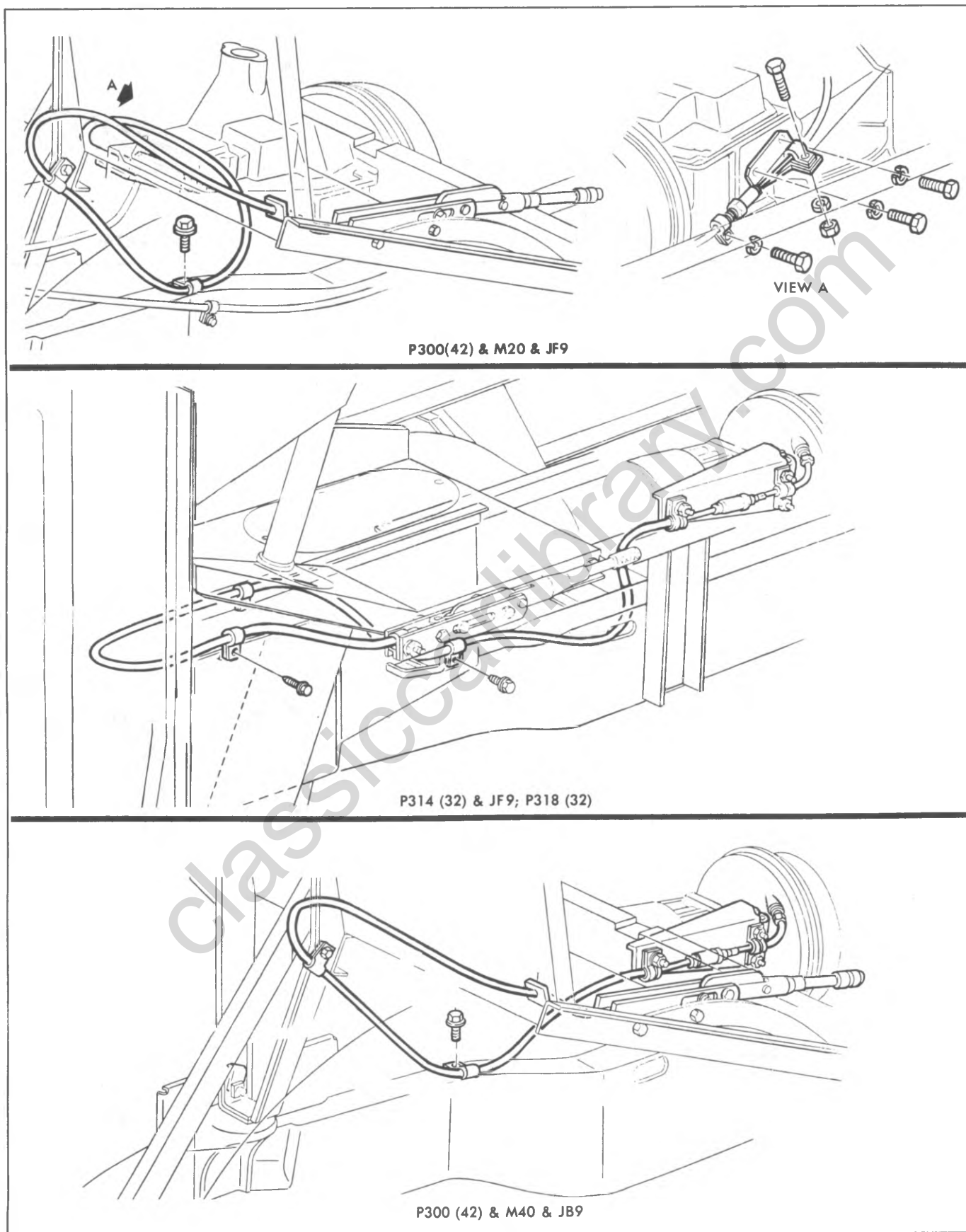


Fig. 5-11--Parking Brake System (Propshaft)

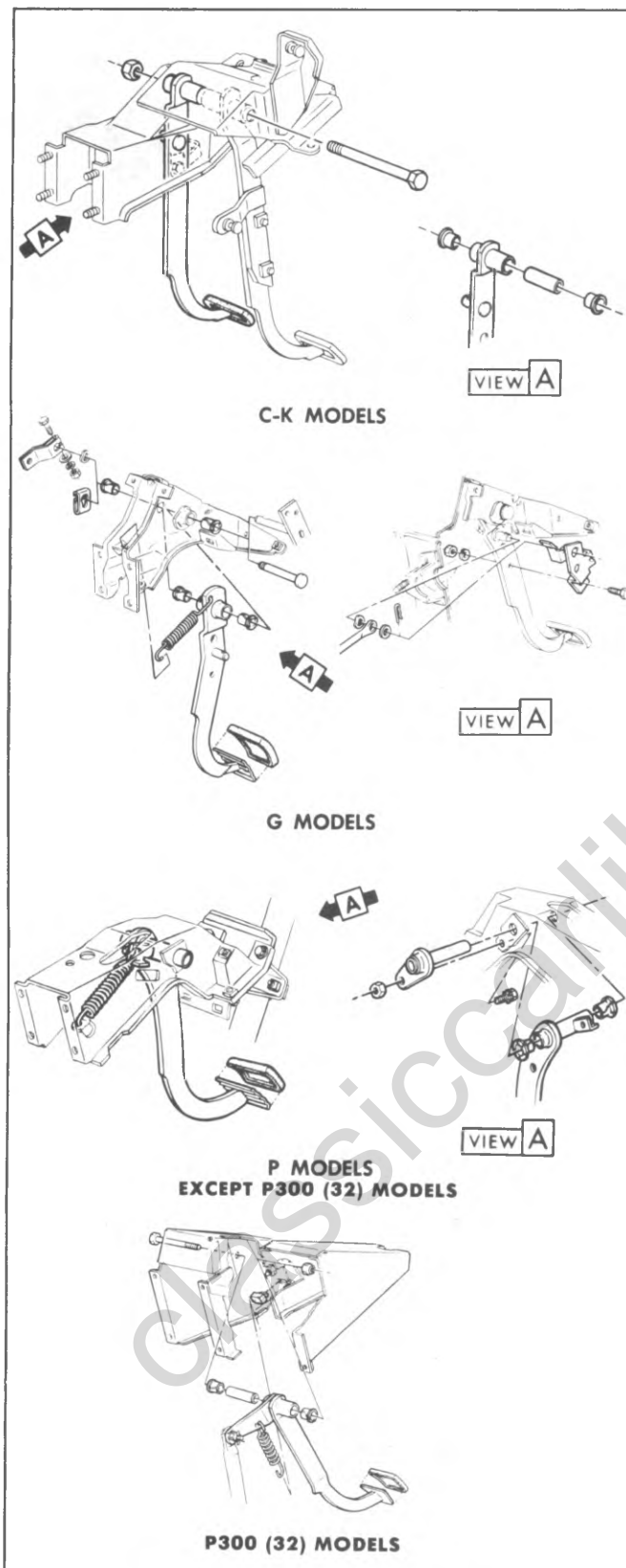


Fig. 5-12--Brake Pedal Installation

attachment and remove sleeve.

4. Disengage the push rod from the master cylinder and remove the pedal.

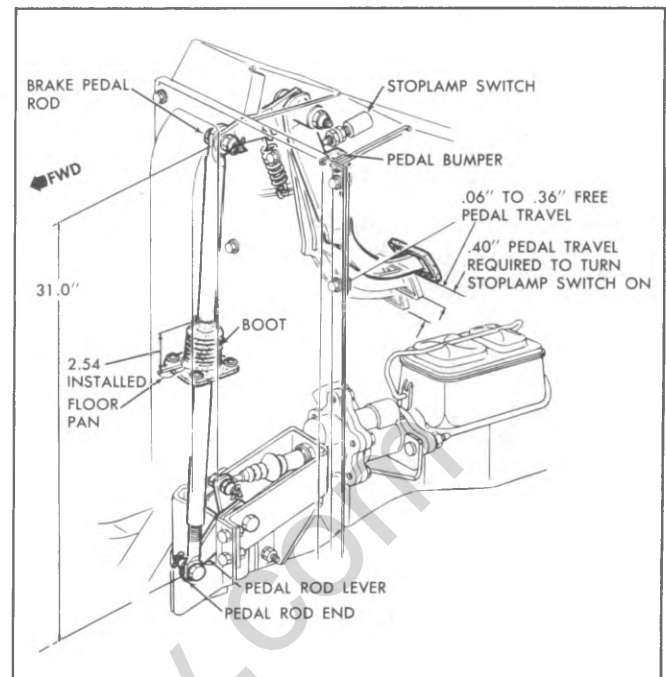


Fig. 5-13--Brake Pedal and Stop Lamp Adjustment P30(32) Model

Inspection

Clean all parts and inspect for wear, cracks or any other damage that might impair operation; replace if required.

Installation

Reverse the above procedure and make certain the brake pedal is secure and adjusted properly before operating the vehicle. Lubricate pedal pivot bushings and pivot pin, bolt or sleeve with Delco Brake Lube (or equivalent). Adjust stoplamp switch.

CAUTION: See "Caution" on Page 1 of this section.

BRAKE PEDAL ROD

P30(32) Models

Replacement (Fig. 5-13)

1. Remove the cotter pin, nut, special washers and bolt at the brake pedal lever end of rod; discard the cotter pin.
2. Remove the boot to floorpan screws.
3. Raise the vehicle on a hoist.
4. Remove the cotter pin, nut, special washers and bolt at the lower end of the rod and remove the pedal rod assembly. Discard the cotter pin.
5. To install a new rod, adjust the rod length to 31.00" (center of upper attachment to center of lower attachment).
6. Lubricate the pedal rod bolts and special washers with Delco Brake Lube (or equivalent).
7. Install the rod up through the floorpan opening and install the lower pivot bolt, special washers and nut. Tighten the nut to 22-30 ft. lbs. and install a NEW cotter pin.
8. Push the boot up to the floorpan.
9. Lower the vehicle from the hoist.
10. Install the rod upper pivot bolt, special washers and nut. Tighten the nut to 22-30 ft. lbs. and install a NEW cotter pin.
11. Fasten the boot to the floorpan and compress the boot to 2.54" installed height; tighten the boot to 2.54"

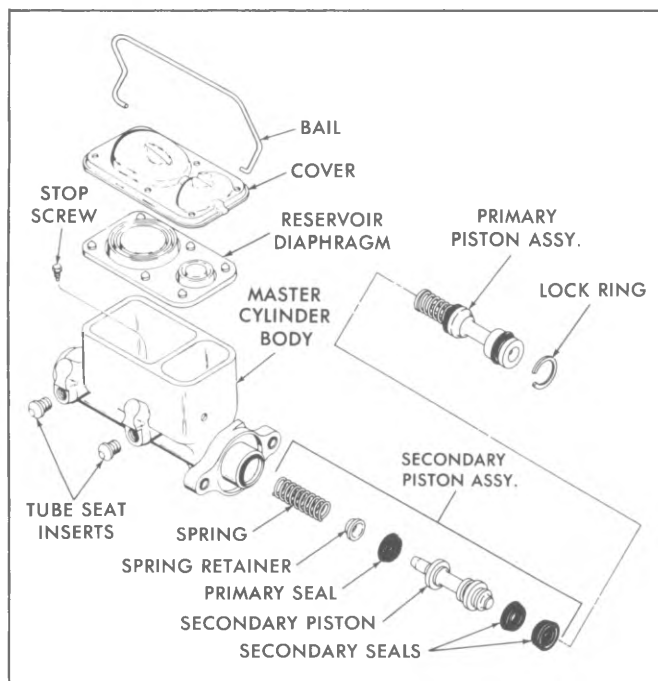


Fig. 5-14--Delco Master Cylinder--Exploded View

installed height; tighten the boot screws to 13-18 in. lbs. (Refer to Figure 5-13).

12. Adjust brake pedal and stoplamp switch as outlined previously.

P30(42) and G Models

Replacement

1. **G Models**- Remove the brake pedal striker screw and remove the striker. Remove the cotter pin and washer and disconnect the pedal rod from the brake pedal.

2. **P30(42) Models**- Remove the cotter pin nut and bolt to disconnect the pedal rod from the brake pedal.

3. Remove the pedal rod retainer bolt (at the rod pivot) and remove the retainer.

4. Remove the cotter pin and washer and remove the pedal rod.

5. To install a new rod, reverse Steps 1-4 above.

NOTE: Lubricate pivot points with Delco Brake Lube (or equivalent).

CAUTION: See "Caution" on Page 1 of this section.

6. Check brake pedal and stoplamp switch adjustments as outlined previously.

MASTER CYLINDER

Filling Brake Master Cylinder

The master cylinder must be kept properly filled to insure adequate reserve and to prevent air from entering the hydraulic system. However, because of expansion due to heat absorbed from brakes and from engine, master cylinder must not be overfilled.

The brake fluid reservoir is on the master cylinder which is located under the hood on the left side of the dash.

Thoroughly clean reservoir cover before removal to avoid getting dirt into reservoir. Remove cover and diaphragm. Add fluid as required to bring level to 1/4" (plus or minus 1/8") from the lowest portion of the top of

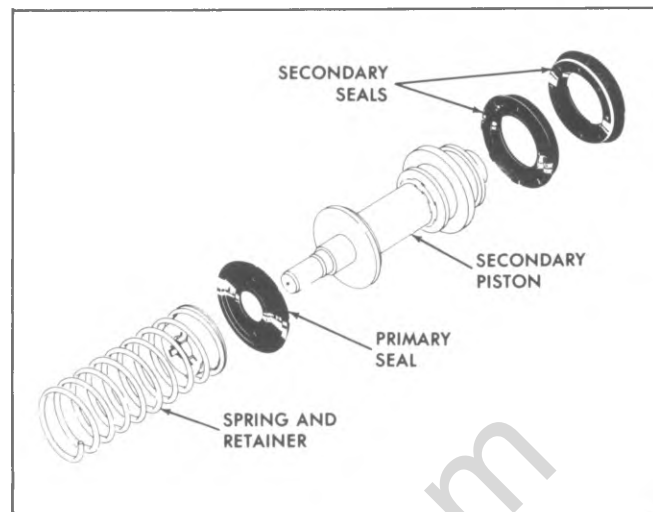


Fig. 5-15--Delco Secondary Piston - Exploded View

each reservoir. Use Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent.

Do not use shock absorber fluid or any other fluid which contains mineral oil. Do not use a container which has been used for mineral oil or a container which is wet from water. Mineral oil will cause swelling and distortion of rubber parts in the hydraulic brake system and water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent water contamination.

Except Bendix Mini-Master Cylinder

Removal

1. Disconnect brake pipes from master cylinder and tape end of pipes to prevent entrance of dirt.

2. **Manual brake only**-- Disconnect brake pedal from master cylinder push rod.

3. Remove two nuts holding master cylinder to dash or power cylinder and remove master cylinder from vehicle. Be careful not to drip brake fluid on exterior paint.

Disassembly (Figs. 5-14 and 5-15)

1. Clean outside of master cylinder thoroughly. Remove reservoir cover and diaphragm. Turn cylinder over and pump push rod by hand to drain all brake fluid. Always discard used fluid.

2. **Manual brake only**-- Pull boot away from master cylinder to uncover push rod retainer. The retainer has a small, depressed tab in the side. This tab must be pried up to release retainer.

3. Depress piston and remove secondary piston stop bolt from bottom of front fluid reservoir (if so equipped).

4. Place master cylinder in a vise so that lock ring can be removed from groove in the inside diameter of bore. Remove lock ring and primary piston assembly. Remove secondary piston, secondary piston spring and retainer by blowing air through the outlet port.

5. Place master cylinder in vise, so that outlet holes are up. Enlarge hole in tube fitting insert using a 13/64" drill. Place a heavy washer over outlet on master cylinder and thread a 1/4-20 x 3/4" screw into the insert. Tighten screw until insert is unseated. Remove insert, screw, and washer.

6. Remove primary seal, and secondary seal from secondary piston.

7. Use clean brake fluid to clean all metal brake parts thoroughly. Air dry and place cleaned parts on clean paper or lint free clean cloth.

Do not use anti-freeze alcohol, gasoline, kerosene, or any other cleaning fluid that might contain even a trace of mineral oil.

Inspection

Inspect cylinder bore for scoring or corrosion. It is best to replace a corroded cylinder. Corrosion can be identified as pits or excessive roughness.

Polish any discolored or stained area with crocus cloth by revolving cylinder on cloth supported by finger.

Rinse cylinder in clean brake fluid. Shake excess rinsing fluid from cylinder. Do not use a rag to dry cylinder, as lint from rag cannot be kept from cylinder bore surfaces.

Make certain that compensating port in cylinder is clear.

If scratches or corroded spots are too deep to be polished satisfactorily, the cylinder should be replaced.

Assembly

1. Place brass tube fitting insert (new parts) in outlet holes so that it is in a position to be pressed into outlet hole. The recommended method of inserting tube fitting insert is to thread a spare brake line tube nut into outlet hole and turn nut down until tube fitting insert bottoms. Remove tube nut and check outlet hole for loose burrs, which might have been turned up when tube fitting insert was pressed down.

2. Put new secondary seal in groove in end of secondary piston (fig. 5-15).

3. Assemble a new primary seal over end of secondary piston, so that flat side of the seal seats against flange of piston (fig. 5-15).

4. Assemble new secondary seal into groove on end of the secondary piston.

5. In order to insure correct assembly of the primary assembly, a complete primary piston assembly is included in the repair kits.

6. Coat bore of master cylinder with clean brake fluid. Coat primary and secondary seals on secondary piston with clean brake fluid. Insert the secondary piston spring retainer into secondary piston spring. Place retainer and spring over end of secondary piston, so that retainer locates inside lip of primary cup.

7. Hold master cylinder with open end of bore down, push secondary piston into bore, so that spring will seat against closed end of bore.

8. Place master cylinder in a vise with open end of bore up. Coat primary and secondary seal on primary piston with clean brake fluid. Push primary piston assembly, spring end first, into bore of master cylinder. Hold the piston down and snap lock ring into position in groove in inside diameter of bore.

9. Install a new reservoir diaphragm in reservoir cover where needed, and install cover on master cylinder. Beaded side faces master cylinder casting to insure positive sealing. The bail wire is now pushed into position to hold reservoir cover.

10. **Manual brake only--** Assemble push rod through push rod retainer, if it has been disassembled. Push retainer over end of master cylinder. Assemble new boot over push rod and press it down over the push rod retainer.

Installation

CAUTION: Refer to "Caution" on Page 1 of this section regarding fasteners referred to in Steps 1 and 2 below.

1. **Manual brake only--** Connect push rod to brake pedal pin and install retainer while holding master cylinder in place.

2. Install master cylinder on dash or power cylinder; torque nuts to specifications.

3. Connect brake pipes to master cylinder.

4. Bleed hydraulic system.

5. Road test vehicle for proper brake performance.

All Models

Bench Bleeding

NOTE: The time required to bleed the hydraulic system later on can be reduced if the master cylinder is filled with fluid and as much air as possible expelled before the cylinder is installed on the car.

1. Insert threaded plugs into outlets and fill reservoirs with brake fluid.

2. Loosen one plug at a time and push piston into bore to force air from the master cylinder. To prevent air from being sucked back into the master cylinder, you must tighten outlet plugs before allowing piston to return to its original position.

3. Stroke the master cylinder 3-4 times for each outlet to assure expelling all air out of the master cylinder.

4. Fill the master cylinder reservoir and install cover.

Bendix Mini-Master Cylinder

NOTE: Removal, Inspection and Installation procedures are the same as described for "Except Bendix Mini-Master Cylinder".

Disassembly

1. Remove the reservoir cover and diaphragm, and drain the fluid from the reservoir.

2. Remove the four bolts that secure the body to the reservoir using Socket J-25085.

3. Remove the small "O" ring and the two compensating valve seals from the recessed areas on the bottom side of the reservoir.

NOTE: Do not remove the two small filters from the inside of the reservoir unless they are damaged and are to be replaced.

4. Depress the primary piston using a tool with a smooth rounded end. Then remove the compensating valve poppets and the compensating valve springs from the compensating valve ports in the master cylinder body.

5. Using a small screwdriver, remove the snap ring at the end of the master cylinder bore. Then release the piston and remove the primary and secondary piston assemblies from the cylinder bore. It may be necessary to plug the front outlet port and to apply low air pressure to the front compensating valve port to remove the secondary piston assembly.

Assembly

1. Lubricate the secondary piston assembly and the master cylinder bore with clean brake fluid.

2. Assemble the secondary spring (shorter of the two springs) in the open end of the secondary piston actuator, and assemble the piston return spring (longer spring) on the

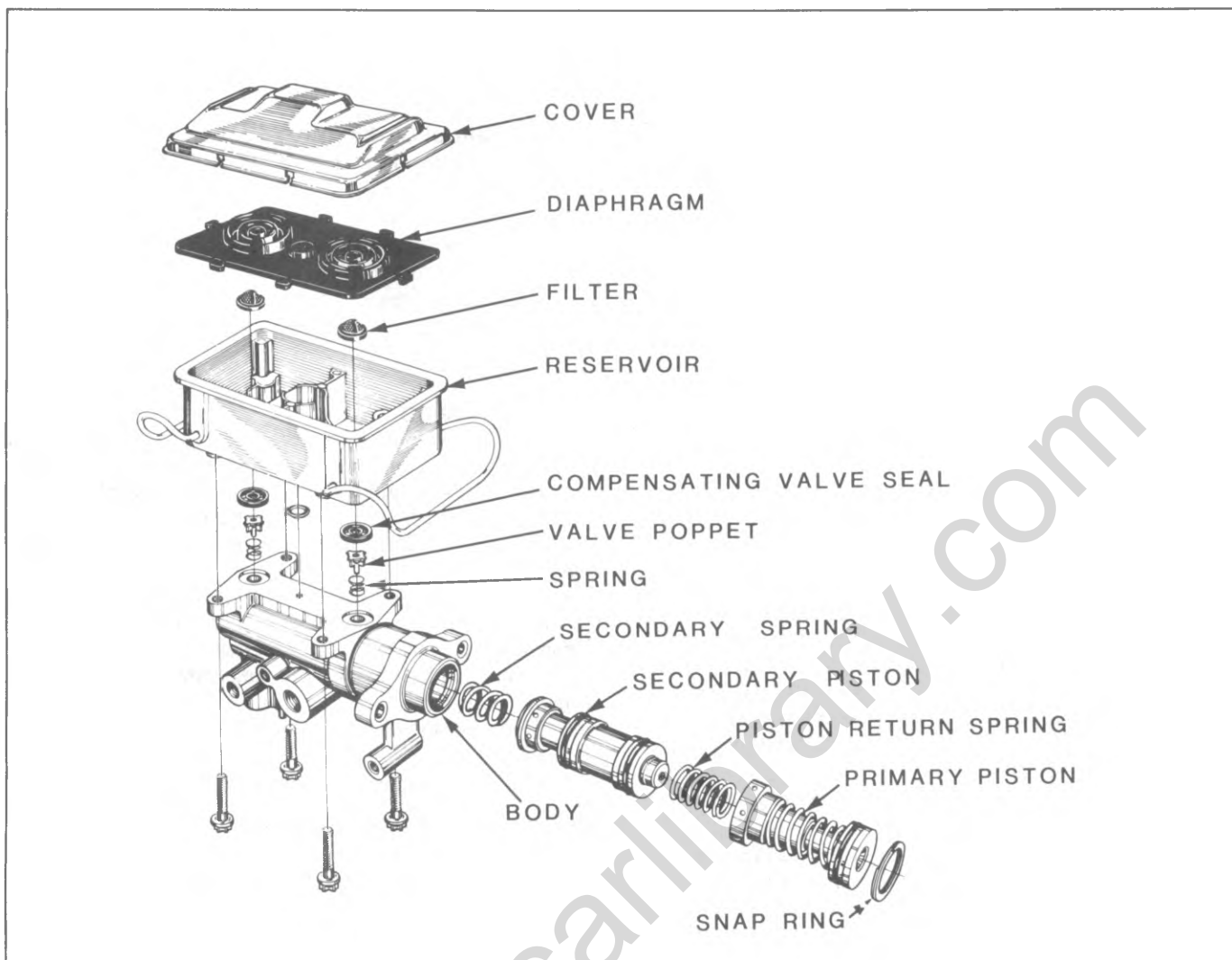


Fig. 5-16--Bendix Mini-Master Cylinder--Exploded View

projection at the rear of the secondary piston.

3. Insert the secondary piston assembly, actuator end first, into the master cylinder bore, and press assembly to the bottom of the bore.

4. Lubricate the primary piston assembly with clean brake fluid. Insert the primary piston assembly, actuator end first, into the bore.

5. Place the snap ring over a smooth round ended tool and depress the pistons in the bore.

6. Assemble the retaining ring in the groove in the cylinder bore.

7. Assemble the compensating valve seals and the small "O" ring seal in the recesses on the bottom of the reservoir. Be sure that all seals are fully seated.

8. While holding the pistons depressed, assemble the compensating valve springs and the compensating valve poppets in the compensating valve ports.

9. Holding the pistons compressed, position the reservoir on the master cylinder body and secure with the four mounting bolts. Tighten the bolts to 12-15 ft. lbs.

DELCO DISC BRAKE SHOE AND LINING

Lining Inspection

Inspect the brake linings every 7,500 miles (12 000 km) and any time that the wheels are removed (tire rotation, etc.). Check both ends of the outboard shoe by looking in at each end of the caliper (fig. 5-18). These are the points at which the highest rate of wear normally occurs. However, at the same time, check the lining thickness on the inboard shoe to make sure that it has not worn prematurely. Look down through the inspection hole in the top of the caliper to view the inboard shoe. Whenever the thickness of any lining is worn to within .030" of rivet at either end of the shoe, all disc brake shoe and lining assemblies should be replaced at the same time (fig. 5-19).

Caliper Removal

WARNING: See "Warning" on Page 5-1 of this section.

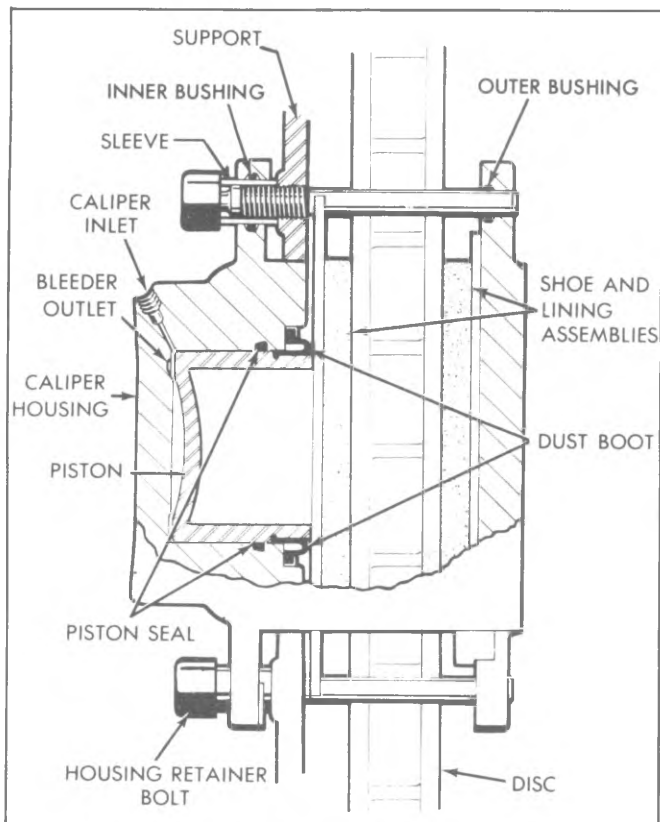


Fig. 5-17--Delco Single Piston Disc Brake

1. Remove two thirds of the total fluid capacity from the front master cylinder reservoir. Removal of the fluid is necessary to prevent reservoir overflow when the caliper piston is pushed back in its bore to remove the caliper. This may be done by breaking the front line connection at the master cylinder and bleeding down the fluid level. Do not

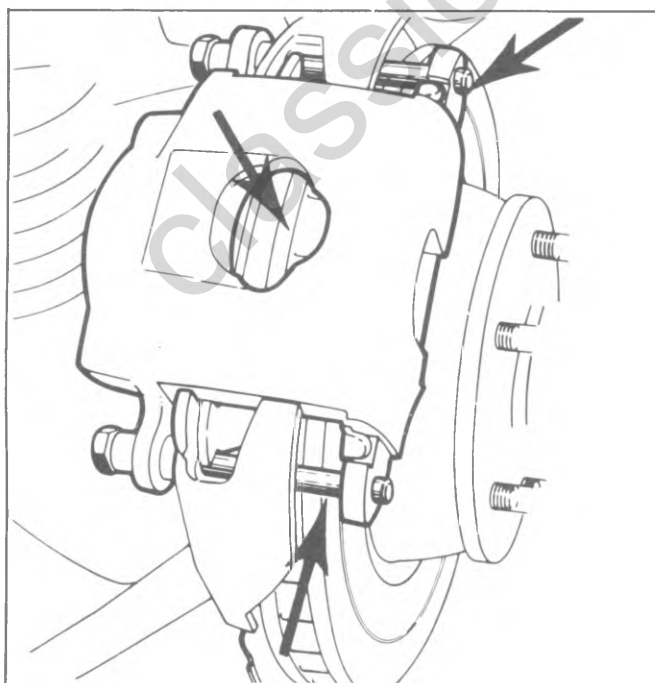


Fig. 5-18--Lining Inspection

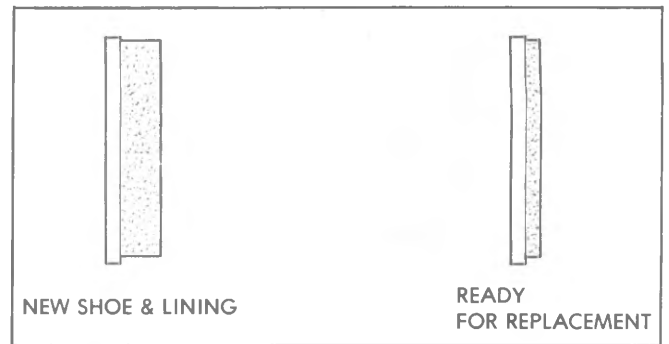


Fig. 5-19--New and Worn Linings

remove the brake line or completely empty the reservoir or it will be necessary to bleed the hydraulic system. Discard -- do not attempt to reuse -- the brake fluid removed.

2. Raise the vehicle on a hoist and remove the wheel covers and wheel assemblies. Position a 7 inch "C" clamp on the caliper so that solid side of the clamp rests against the metal part of the outboard shoe (fig. 5-20). Tighten the "C" clamp until the caliper moves away from the vehicle far enough to push the piston to the bottom of the piston bore. This will allow the shoes to back off from the rotor surfaces. Remove the "C" clamp.

3. It is not necessary to disconnect the brake hose for shoe and lining replacement. Remove the two mounting bolts which attach the caliper to the support bracket (fig. 5-21). Lift the caliper off the rotor and remove the inboard shoe. *Dislodge the outboard shoe and position the caliper on the front suspension arm so that the brake hose will not support the weight of the caliper. Remove the shoe support spring from the cavity in the piston.*

4. Using Tool J-22835, remove the sleeves from the inboard ears of the caliper (fig. 5-22). Next, remove the rubber bushings from the grooves in each of the four caliper

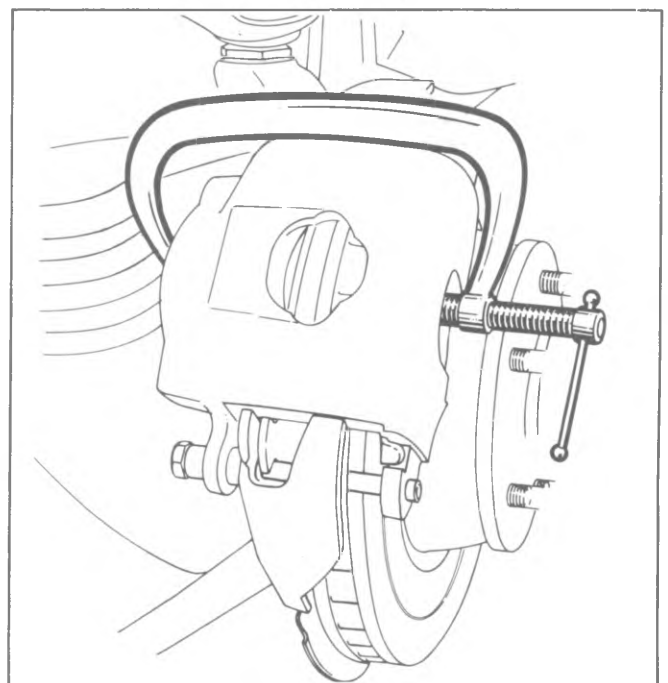


Fig. 5-20--Use of "C" Clamp

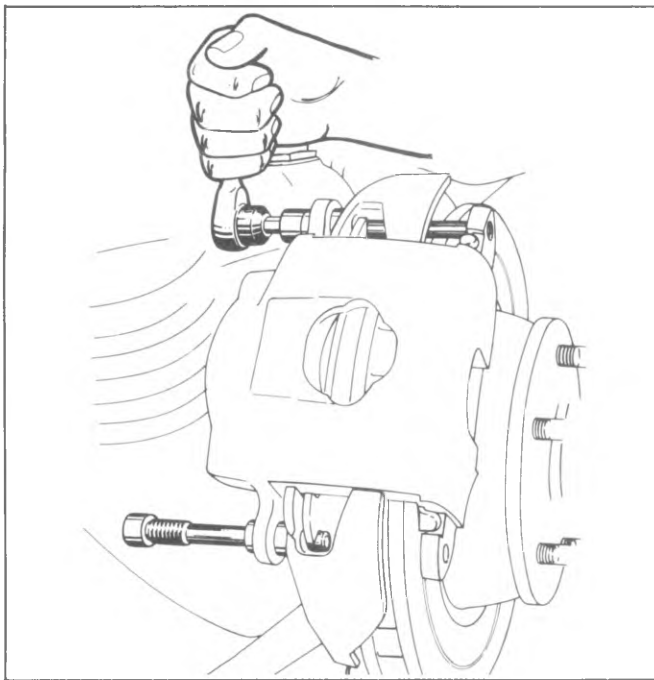


Fig. 5-21--Removing Mounting Bolts

cars.

Cleaning and Inspection

1. Thoroughly clean the holes and the bushing grooves in the caliper ears. Wipe all dirt from the mounting bolts. Do not use abrasives on the bolts since this will damage the plating. If the bolts are corroded, or damaged, they should be replaced.

2. Examine the inside of the caliper for evidence of fluid leakage. If leakage is noted, the caliper should be overhauled. Wipe the inside of the caliper clean, including the exterior of the dust boot. Check the boot for cuts, cracks or other damage. Make sure that the boot is properly engaged in the groove in the piston and also in the caliper counter-bore (fig. 5-24).

CAUTION: Do not use compressed air to clean the inside of the caliper since this may cause the dust boot to become unseated.

3. If the vehicle has a brake problem and diagnosis

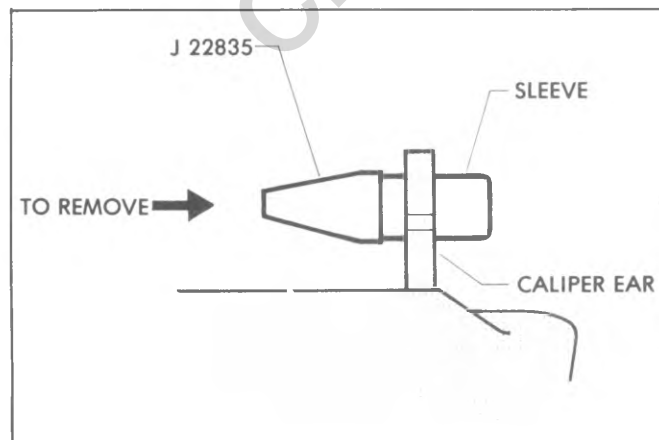
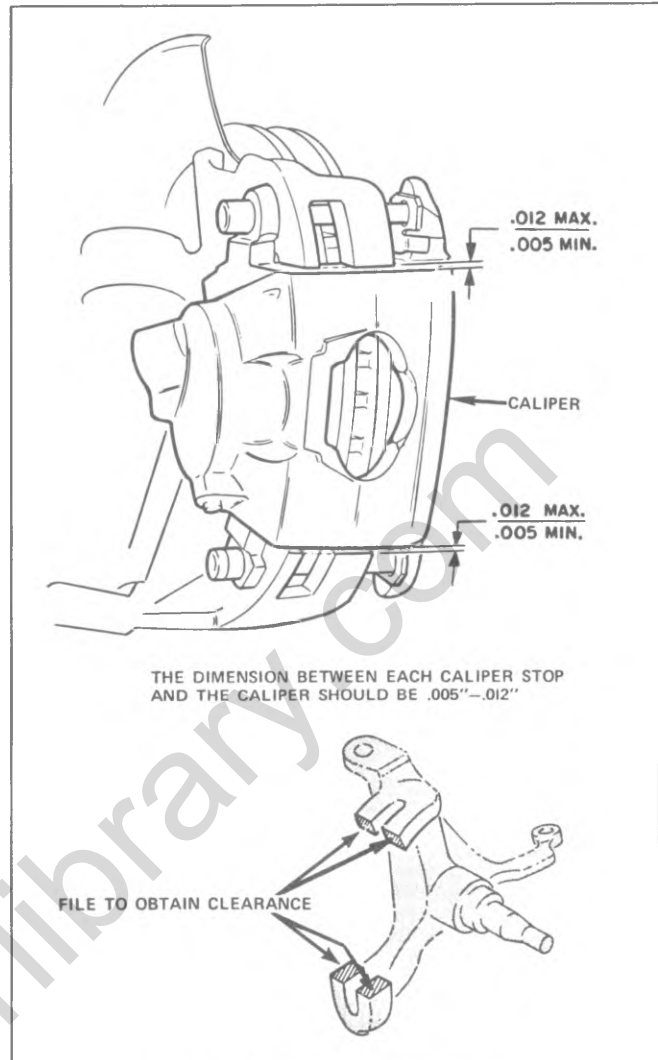


Fig. 5-22--Removing Sleeves



THE DIMENSION BETWEEN EACH CALIPER STOP AND THE CALIPER SHOULD BE .005"-.012"

Fig. 5-23--Caliper to Stop Clearance

points to the rotor, it should be inspected and checked for runout at this time.

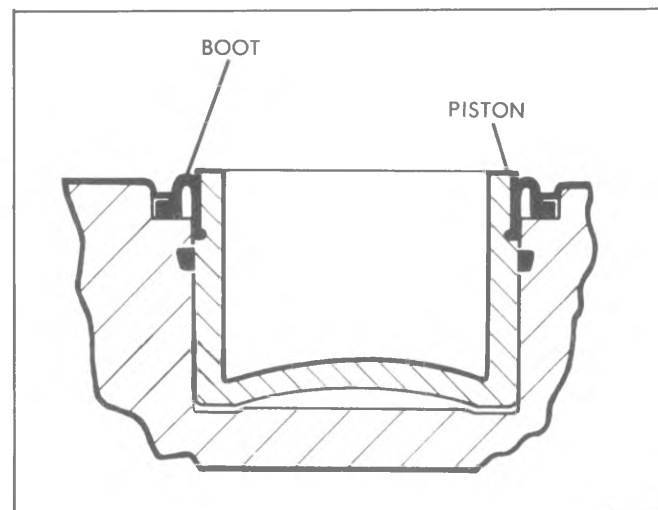


Fig. 5-24--Boot Installation

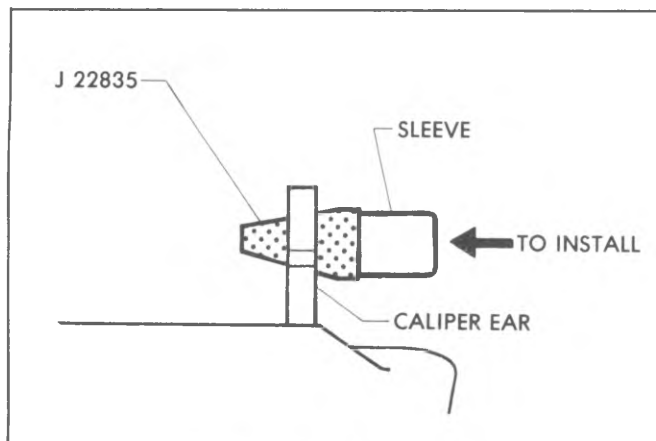


Fig. 5-25--Sleeve Installation

Caliper Installation

1. Install rubber bushings in all four caliper ears.

CAUTION: *It is essential that the new sleeves and rubber bushings be used in order to insure the proper functioning of the sliding caliper design.*

2. Use Tool, J-22835, to install the sleeves (fig. 5-25). Position the sleeves so that the end toward the shoe and lining assemblies is flush with the machined surface of the ear.

3. Install the shoe support spring by replacing the single tang end of the spring over the notch in the center of the edge of the shoe. Then press the two tangs at the spring end of the inboard shoe spring over the bottom edge of the shoe so that they engage the shoe securely, as shown in Figure 5-26.

4. Position the inboard shoe and lining assembly (with spring attached) in the caliper so that the ear end of the shoe and lining is down and the bottom end up at an angle with the spring resting on the piston I.D. (fig. 5-27). Press down on both ends of the shoe until the shoe is in a flat position, resting on the piston. The spring end of the inboard shoe support spring should be resting on the I.D. of the piston.

CAUTION: *On inboard shoes there is a specific left hand and right hand shoe. When properly*

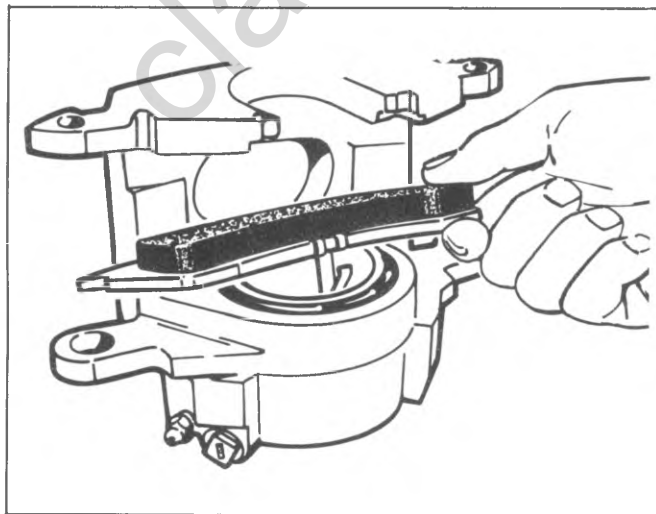


Fig. 5-26--Inserting Shoe Support Spring

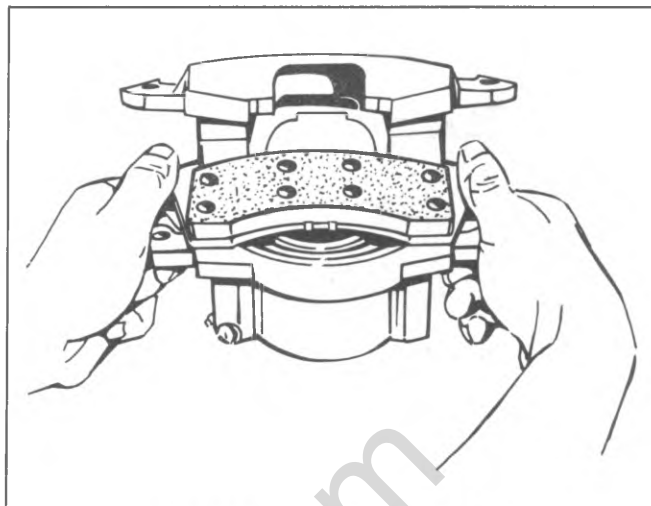


Fig. 5-27--Installing Inboard Shoe

installed the wear sensor will be toward rear of caliper.

5. Position the outboard shoe in the caliper, with the ears at the top of the shoe over the caliper ears and the tab at the bottom of the shoe engaged in the caliper cut-out (see fig. 5-28). Be sure to note right and left brake shoes. 6. Position the caliper over the rotor, lining up the holes in the caliper ears with the holes in the mounting bracket.

CAUTION: *When reinstalling caliper be sure you haven't turned it over, end over end. This would cause a severe twist in the brake hose. After positioning caliper on disc, observe brake hose being sure it is not twisted.*

Start the bolts through the sleeves in the inboard caliper ears and through the mounting bracket, making sure that the ends of the bolts pass under the retaining ears on the inboard shoe (fig. 5-29). Push bolts on through to engage the holes in the outboard shoes and the outboard caliper ears at the same time, threading the bolts into the mounting bracket. Torque the bolts to 35 ft. lbs.

CAUTION: *See "Caution" on Page 1 of this section.*

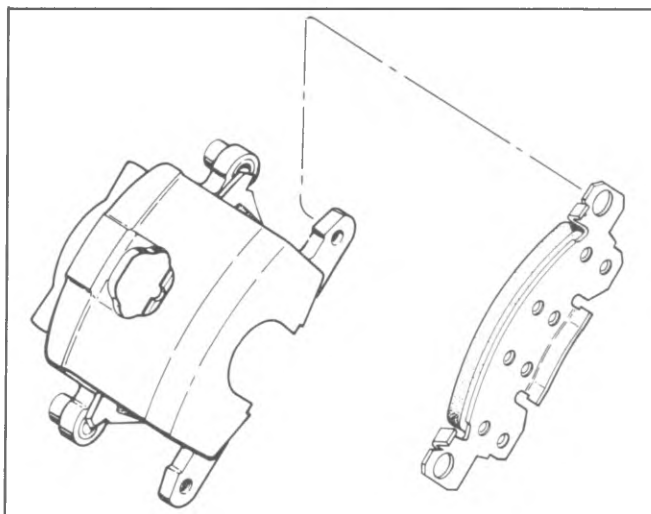


Fig. 5-28--Installing Outboard Shoe

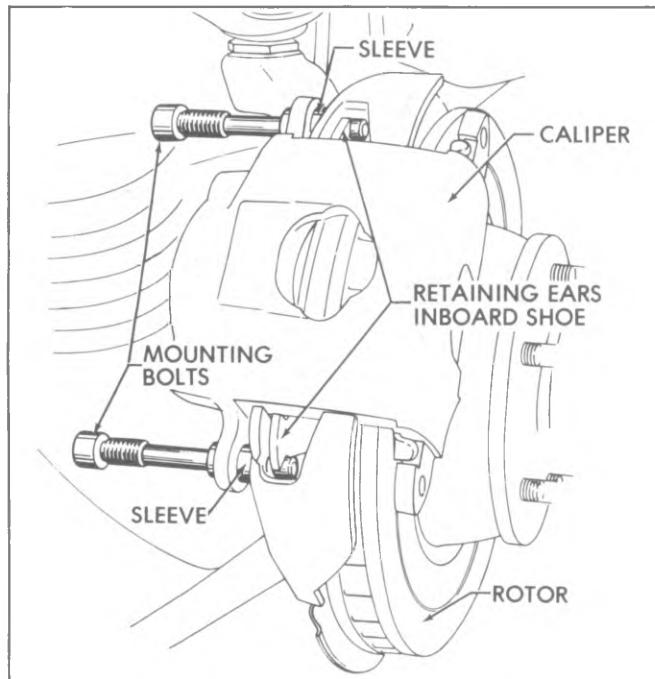


Fig. 5-29—Installing Mounting Bolts

7. Add fresh approved brake fluid to the master cylinder reservoirs to bring the level up to within 1/8 inch of the top.

8. Pump brake pedal to seat linings against rotor.

9. Clinch upper ears of outboard shoe by positioning channel lock pliers with one jaw on top of upper ear and one jaw in notch on bottom of shoe opposite upper ear (fig. 5-30).

10. After clinching, ears are to be flat against caliper housing with no radial clearance.

11. If radial clearance exists, repeat clinching procedure.

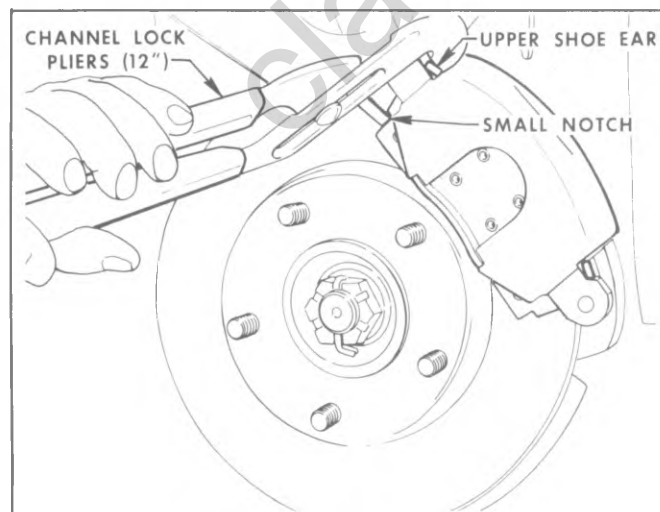


Fig. 5-30—Clinching Outboard Shoe

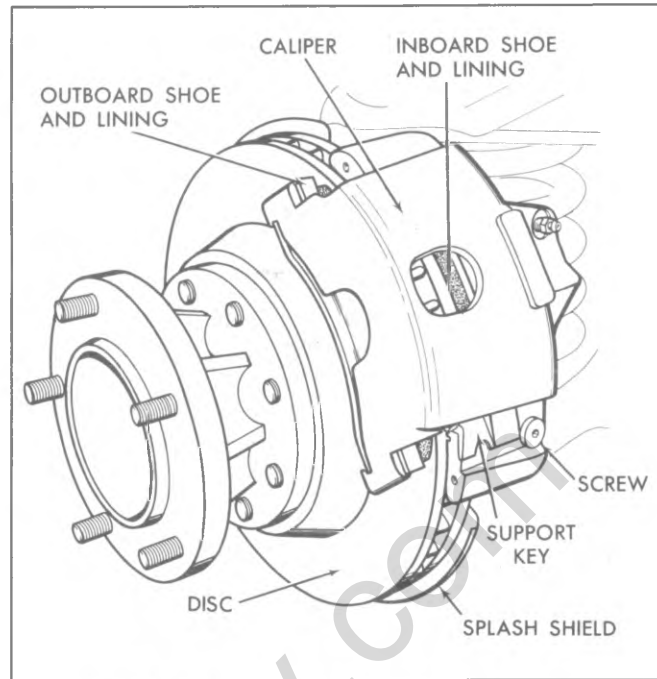


Fig. 5-31—Bendix Disc Brake Caliper Assembly

Completion

1. Replace the shoe and linings on the other front wheel disc brake in exactly the same manner as just described. Relining is to be done in full axle sets only. When completed, reinstall the wheel and tire assemblies. Torque wheel nuts to specifications. Install wheel covers and lower the vehicle to the floor.

CAUTION: See "Caution" on Page 1 of this section.

2. Whenever the front wheel disc brakes are relined, the rear drum brakes should be checked also.

BENDIX DISC BRAKE SHOE AND LINING

The brake linings should be inspected any time the wheels are removed. Check both ends of the outboard shoe by looking in at each end of the caliper (fig. 5-31). This is the point at which the highest rate of wear normally occurs. At the same time, check the lining thickness on the inboard shoe by looking down through the inspection hole in the top of the caliper; see "Brake Inspection" portion of this section. The inboard shoe is installed with the ends of the shoe resting in the steering knuckle. The large tab at the bottom of the outboard shoe is bent over at the right angle and fits in the cutout in the outboard section of the caliper.

NOTE: The inboard shoe does not incorporate a lining wear sensor as with standard disc brakes.

Removal

WARNING: See "Warning" on page 1 of this section.

1. Remove master cylinder cover and observe brake fluid level in front reservoir is more than 1/3 full, siphon the necessary amount out to bring the level to 1/3 full. This step is taken to avoid reservoir overflow when the caliper

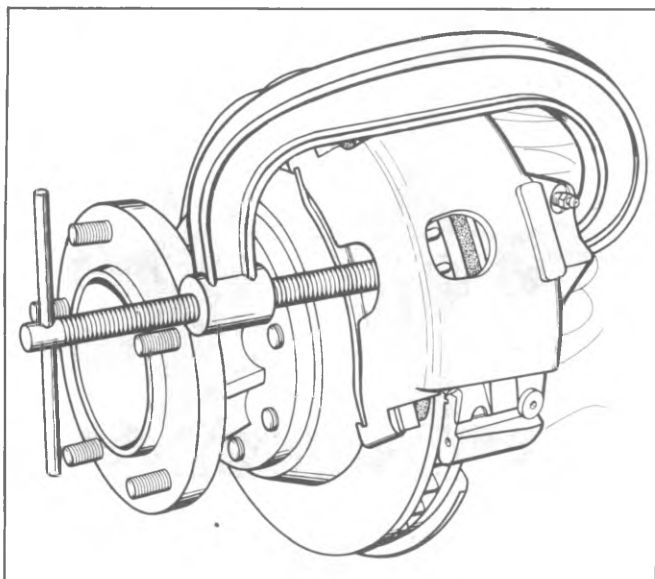


Fig. 5-32--Pushing Piston into Bore Using a "C" Clamp

piston is pushed back into its bore. Discard the brake fluid removed. Never reuse brake fluid.

2. Raise the front of the vehicle on a hoist and remove the front wheels.

3. Push the piston back into its bore. This can be accomplished by using a "C" clamp as shown in Figure 5-32.

4. Remove the bolt at the caliper support key. Using a brass punch, remove the key and spring (fig. 5-33).

5. Lift the caliper off the disc and support in a raised position with a heavy wire (fig. 5-34).

CAUTION: Do not support the weight of the caliper on the brake hose.

6. Remove the inboard shoe from the steering knuckle. Remove and discard the inboard shoe clip. Remove the outboard shoe from the caliper. It may be necessary to tap the shoe to loosen it in the caliper housing.

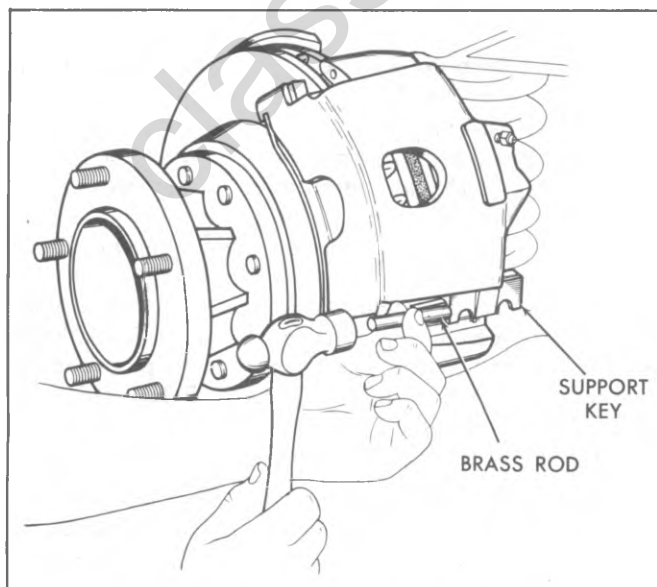


Fig. 5-33--Removing the Caliper Support Key

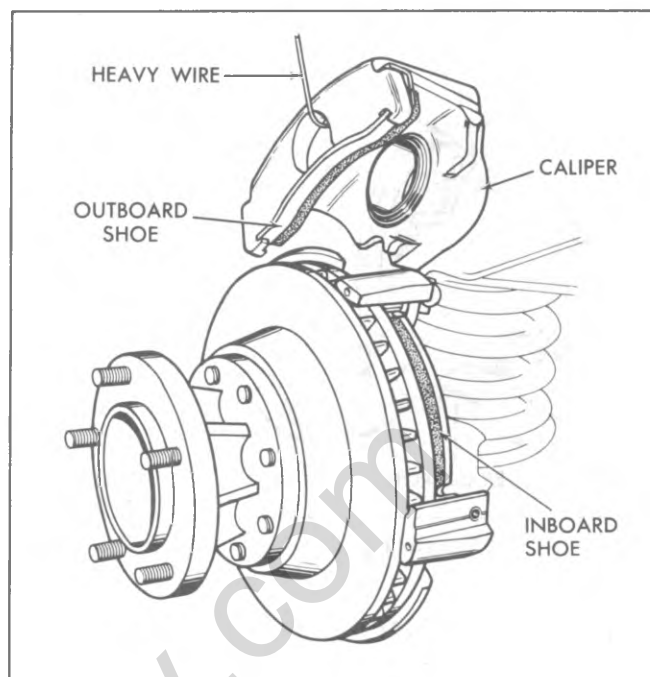


Fig. 5-34--Removing Caliper from the Disc

CAUTION: Mark disc pad positions if pads are to be reinstalled.

Cleaning and Inspection

NOTE: The shoes should be replaced when the lining is worn to approximately 1/32" thickness over the rivet heads. Replace shoes in axle sets.

1. Examine the inside of the caliper for evidence of fluid leakage. If leakage is noted, the caliper should be overhauled.

2. Wipe the inside of the caliper clean, including the exterior of the dust boot. Check the boot for cuts, cracks or other damage.

CAUTION: Do not use compressed air to clean the inside of the caliper.

3. Use a wire brush to remove any rust or corrosion from the machined surfaces of the steering knuckle and caliper. It is important to clean those areas of the caliper and spindle assembly that are in contact during the sliding action of the caliper.

Installation

CAUTION: If original disc pads are being reinstalled, they must be installed in original positions (as marked at removal).

1. Lubricate the caliper and steering knuckle sliding surfaces and the support spring with Delco Silicone Lube (or equivalent).

2. Install a NEW inboard shoe clip in the steering knuckle. Be sure the tabs are positioned correctly and the loop-type spring positioned away from the rotor. Install the lower end of the inboard shoe into the groove provided in the steering knuckle (against the spring clip). Slide the upper end of the shoe into position. Be sure the clip remains in position.

3. Position the outboard shoe in the caliper with the ears at the top of the shoe over the caliper ears and the tab at the bottom of the shoe engaged in the caliper cutout. If

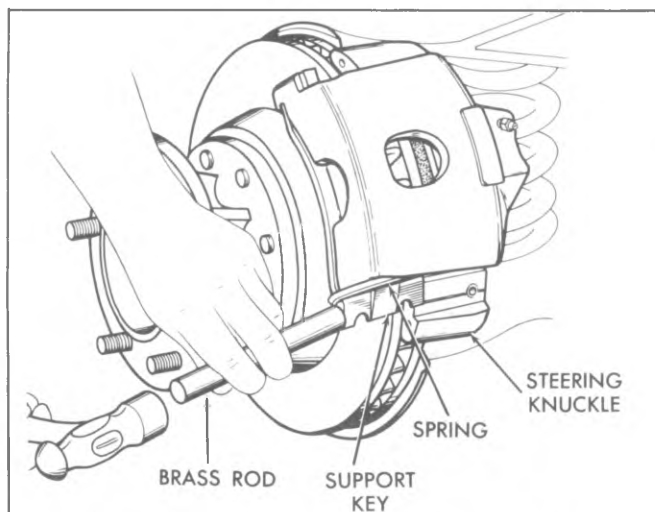


Fig. 5-35—Installing the Caliper Support Key

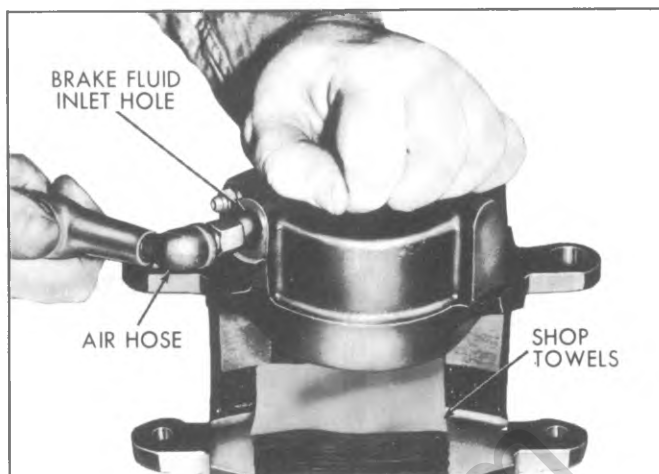


Fig. 5-36—Removing Piston

assembly is difficult, a "C" clamp may be used. Be careful not to mar the lining.

4. With both shoes installed, lift up the caliper and rest the bottom edge of the outboard lining on the outer edge of the brake disc to make sure there is no clearance between the tab at the bottom of the outboard shoe and the caliper abutment. The outboard shoe should fit tightly in the caliper and should not rattle.

5. Position the caliper over the brake disc, guiding the upper caliper groove onto the mating surface of the steering knuckle. Position the caliper to the lower steering knuckle sliding surface.

NOTE: Make sure that the brake hose is not twisted or kinked.

6. Place the spring over the caliper support key, install the assembly between the steering knuckle and lower caliper groove. Tap into place (until the key retaining screw can be installed) using a brass punch and a light hammer (fig. 5-35).

7. Install the screw and torque to 12 to 18 ft. lbs.

CAUTION: The bolt boss must fit fully into the circular cutout in the key.

See "Caution" on Page 1 of this section.

8. Reinstall the front wheel and tire assembly.

9. Add brake fluid to the master cylinder reservoir to bring the fluid level up to within 1/4 inch of the top.

NOTE: Before moving the vehicle, pump the brake pedal several times to make sure that it is firm. Do not move vehicle until a firm pedal is obtained. Check master cylinder fluid level again after pumping the brake pedal.

CALIPER OVERHAUL

Delco

Removal

1. Removal of the caliper for overhaul is the same as for shoe and lining replacement except that it will be necessary to disconnect the brake hose; (Refer to front brake hose replacement).

2. First, disconnect the hose from the steel brake pipe and cap the fittings to prevent dirt from entering the pipe or the hose. Then, remove the U-shaped retainer from the hose fitting. Withdraw the hose from the frame support

bracket and remove the caliper -- with hose attached -- to a work bench for overhaul.

Disassembly

1. Before beginning disassembly, thoroughly clean the exterior of the caliper using brake cleaner. Place the caliper on a clean work surface.

2. Remove the brake hose from the caliper, discarding the copper gasket. Check the hose for worn spots, cracks or other signs of deterioration, discard the hose, if damaged, to be replaced with a new hose at reassembly. Drain brake fluid from the caliper.

3. Use clean shop towels to pad the interior of the caliper.

WARNING: DO NOT PLACE THE FINGERS IN FRONT OF THE PISTON IN AN ATTEMPT TO CATCH OR PROTECT IT WHEN APPLYING COMPRESSED AIR. THIS COULD RESULT IN SERIOUS INJURY.

Remove the piston by directing compressed air into the caliper inlet hole (fig. 5-36).

CAUTION: Use just enough air pressure to ease the piston out of the bore. If the piston is blown out, even with padding provided, it may become damaged.

4. Use a screwdriver to pry the boot out of the caliper. Extend the screwdriver across the caliper bore, under the boot, and pry up. Be careful not to scratch the caliper bore.

5. Use a piece of wood or plastic -- a plastic toothpick is ideal -- to remove the piston seal from its groove in the caliper bore. **DO NOT USE A METAL TOOL OF ANY TYPE FOR THIS OPERATION.**

6. Remove the bleeder valve from the caliper.

Cleaning and Inspection

1. The boot, piston seal, rubber bushings and sleeves are to be replaced each time the caliper is overhauled. Discard, do not bother to clean and inspect, these parts.

2. Clean all other parts in clean denatured alcohol or

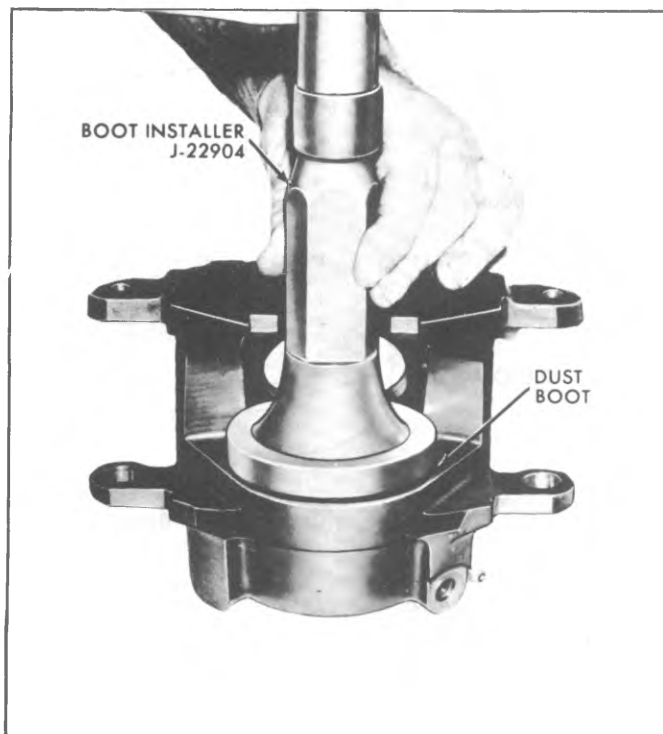


Fig. 5-37--Seating Boot

brake cleaner. Use dry, filtered compressed air to dry parts and blow out all passages in the caliper and bleeder valves.

The use of lubricated shop air will leave a film of mineral oil on the metal parts. This may damage rubber parts when they come in contact after reassembly.

3. Check the mounting for corrosion, breaks in the plating or other damage. Do not use abrasives in an attempt to clean the pins -- replace them.

4. Carefully examine the piston outside diameter for scoring, nicks, corrosion and worn or damaged chrome plating. If any surface defects are detected, replace the piston.

5. Check the bore in the caliper for the same defects as the piston with the exception of plating damage. The piston bore is not plated and stains or minor corrosion can be polished with crocus cloth. Do not use emery cloth. Thoroughly clean the caliper after the use of crocus cloth. If the bore cannot be cleaned up in this manner, replace the caliper.

Reassembly

1. Lubricate the bore in the caliper and the new piston seal with clean brake fluid. Position the seal in the caliper bore groove. Lubricate the piston with clean brake fluid and assemble a new boot into the groove in the piston so that the fold faces the open end of the piston. Insert the piston into the caliper bore, using care not to unseat the seal and force down to the bottom in the bore. This will require a force of 50 to 100 pounds. Position the outside diameter of the boot in the caliper counterbore and seat with Tool J-22904 (fig. 5-37).

2. Check the boot installation to make sure that the retaining ring molded into the boot is not bent and that the

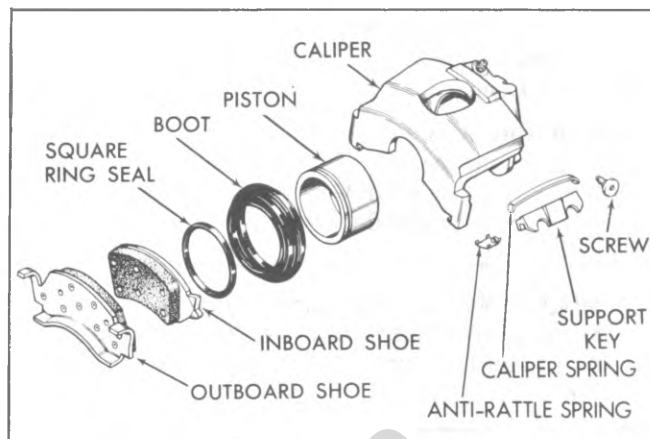


Fig. 5-38--Bendix Brake Caliper Assembly

boot is installed fully, below the caliper face, and evenly all around. Otherwise dirt or moisture may enter the bore and cause damage or corrosion.

3. Install the brake hose in the caliper inlet using a new copper gasket.

Installation

1. Installation of the caliper and mounting parts (rubber bushing, sleeves, shoe and lining assemblies and pins) is the same as for lining replacement except for the following:

a. The brake hose must be connected to the brake pipe at the frame or frame bracket.

Use extreme care to orient the hose so that the keyed hose end fitting aligns with the slot in the bracket without twisting or kinking the hose.

b. After overhaul -- or any time that the brake hose or line is disconnected -- the calipers must be bled.

Bendix

Removal

CAUTION: Clean dirt from hose to caliper connection before proceeding with removal.

1. Remove the hose to caliper bolt and cap or tape the open connections to prevent dirt from entering the hose or

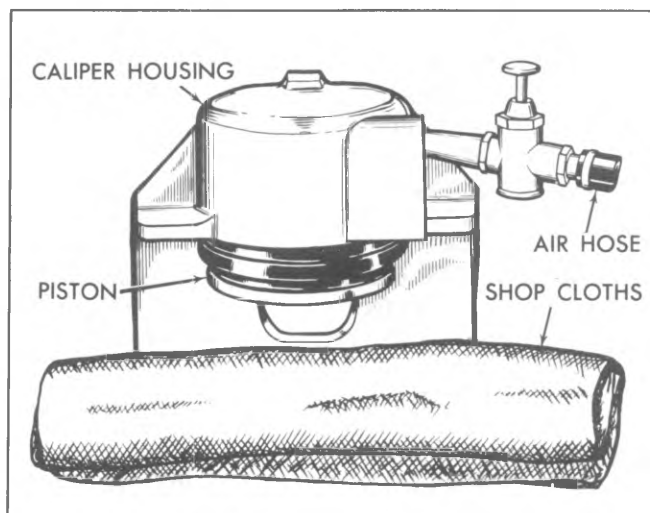


Fig. 5-39--Removing the Caliper Piston

caliper. Discard the copper gaskets.

2. Remove the caliper assembly as described under "Shoe and Linings-Removal".

Disassembly (Fig. 5-38)

1. Clean the exterior of the caliper using clean brake fluid and place on a clean work surface.

2. Drain the brake fluid from the caliper.

WARNING: Do not place the fingers in front of the piston in an attempt to catch or protect it when applying compressed air.

3. Using clean shop cloths, pad the interior of the caliper and remove the piston by directing compressed air into the caliper inlet hole (fig. 5-39).

CAUTION: Use just just enough air pressure to ease the piston out of the bore. Do not blow piston out of the bore. If the piston is seized or cocked or does not come out readily, release the air pressure and use a soft (brass) hammer to rap sharply on and around the end of the piston. Reapply air pressure to remove the piston.

NOTE: An alternate method of removing the piston is to stroke the brake pedal (gently) while the hydraulic lines are still connected. This will push the piston out of the caliper bore.

4. Remove the boot from the piston bore.

5. Using a small piece of wood or plastic, remove the square ring seal from the piston bore.

CAUTION: Do not use a metal tool of any kind for this operation as it may damage the bore.

6. Remove the bleeder valve from the caliper.

Cleaning and Inspection

CAUTION: The dust boot and piston seal are to be replaced whenever the caliper is overhauled. Discard these parts.

1. Clean all parts (other than those mentioned above in clean brake fluid. Use dry, filtered, compressor air to blow out all passages in the caliper and bleeder valve.

CAUTION: The use of lubricated shop air will leave a film of mineral oil on the metal parts. This may damage rubber parts when they come in contact after reassembly.

2. Check the sliding surfaces of the caliper, steering knuckle and support spring for rust or corrosion. Clean up any surface defects with crocus cloth.

3. Carefully examine the outside surface of the piston for scoring, nicks, corrosion and worn or damaged plating. If any surface defects are detected, replace the piston.

CAUTION: The piston outside diameter is the primary sealing surface in the caliper assembly. It is manufactured and plated to close tolerances. Refinishing by any means or the use of any abrasive is not acceptable practice.

4. Check the bore in the caliper for the same defects as the piston. The piston bore, however, is not plated and stains or minor corrosion can be polished with crocus cloth.

CAUTION: Do not use emery cloth or any other form of abrasive. Thoroughly clean the caliper

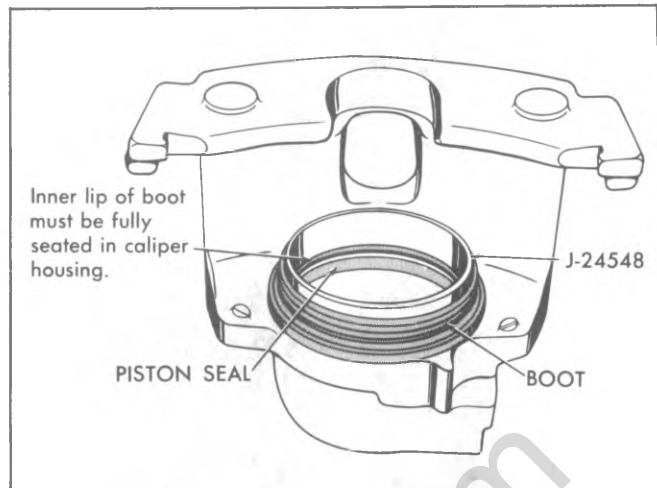


Fig. 5-40—Installing Caliper Piston Boot

after the use of crocus cloth. If the bore cannot be cleaned up in this manner, replace the caliper.

Assembly

1. Lubricate the caliper piston bore and the NEW piston seal with the clean brake fluid. Position the square ring seal in the caliper bore groove.

2. Lubricate both sealing lips of the dust boot and the piston with a light film of clean brake fluid. Place the new boot over Piston Installer Tool J-24548. This is most easily accomplished by placing the boot large diameter over the tool first, then riding the smaller diameter onto the tool. The large diameter lip must then be slid off the tool to make ready for installation into the bore groove. Install the boot (large bead) into the piston bore groove by reaching inside of Tool J-24548 and pressing the boot bead into the groove (fig. 5-40).

CAUTION: Be sure boot is fully seated in the

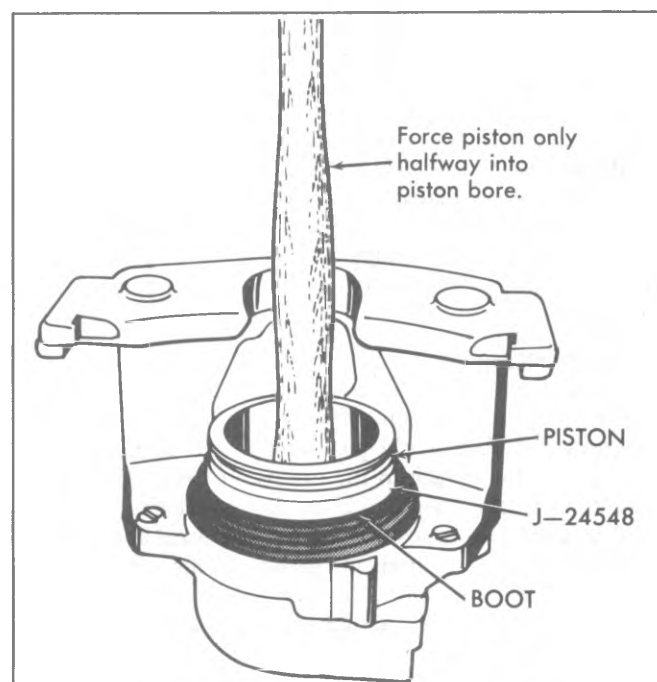


Fig. 5-41—Installing Piston in Caliper

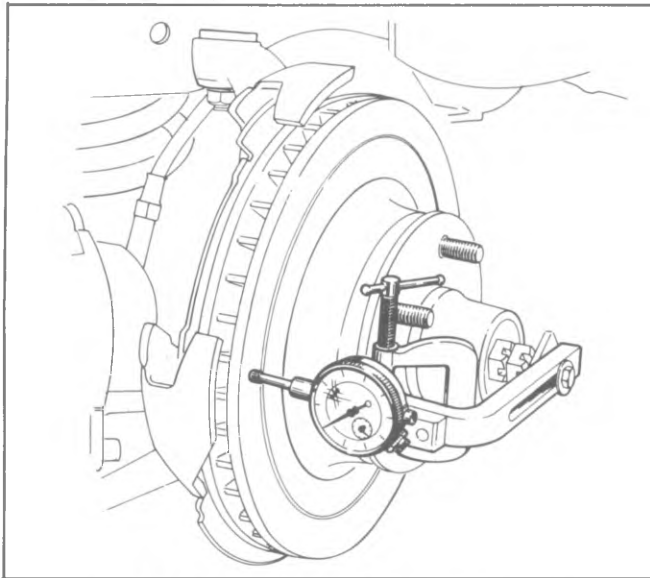


Fig. 5-42--Checking Rotor for Lateral Runout

groove before proceeding.

3. Place the piston inside of Tool J-24548, force the piston halfway into the piston bore using a wood hammer handle or "C" clamp (fig. 5-41); remove Tool J-24548. Check to be sure the boot was not unseated at piston installation. Make sure the outer bead of the boot is seated in the piston outer groove.

Installation

NOTE: Installation of the caliper and mounting parts is the same for: "Shoe and Lining-Disc Brake" except for steps given below:

1. Connect the brake hose to the caliper using NEW copper gaskets.

CAUTION: *Hose must be properly positioned to prevent hose twist or misalignment.*

2. Bleed the caliper assemblies as outlined earlier in this section.

ROTOR SERVICING

Checking Lateral Runout

1. Lateral runout is the movement of the rotor from side to side as it rotates on the steering knuckle spindle. This could be described as "rotor wobble".

2. The movement of the rotor from side to side in the lateral plane causes the brake shoe and lining and pistons to be knocked back into their bores. This results in additional pedal travel required and a vibration during the braking action.

3. To check lateral runout, first tighten the wheel bearings until all of the play is out of the bearings. Fasten a dial indicator to some portion of the suspension so that the point of the stylus contacts the rotor face approximately one inch from the rotor edge (fig. 5-42). Set the dial at zero. Move the rotor one complete rotation, checking the indicator as the rotor moves.

4. Lateral runout should not be over .004" total indicator reading.

ROTOR THICKNESS	
MINIMUM AFTER REFINISHING	REPLACEMENT (DISCARD)
1.480	1.465
1.230	1.215
.980	.965

Parallelism Check

1. Parallelism is the measurement of the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor.

2. A rotor that varies over .0005" causes pedal vibration, as well as front end vibration during brake applications. A rotor that does not meet these specifications may be refinished to specifications if precision equipment is available.

Rotor Tolerance and Surface Finish

In manufacturing the brake rotor, tolerances of the rubbing surfaces for flatness, for parallelism and for lateral runout are held very closely. The maintenance of these close controls on the shape of the rubbing surfaces is necessary to prevent brake roughness.

In addition to these tolerances, the surface finish must be held to a specified range. The control of the rubbing surface finish is necessary to avoid pulls and erratic performance and to extend lining life.

Light scoring of the rotor surfaces not exceeding .015" in depth, which may result from normal use, is not detrimental to brake operation.

Machining

Since accurate control of the rotor tolerances is necessary for proper performance of the disc brakes, machining of the rotor should be done only with precision equipment.

WARNING: ALL BRAKE ROTORS HAVE A MINIMUM THICKNESS DIMENSION CAST INTO THEM. THIS DIMENSION IS THE MINIMUM WEAR DIMENSION AND NOT A REFINISH DIMENSION. DO NOT USE A BRAKE ROTOR THAT WILL NOT MEET THE SPECIFICATIONS, AS SHOWN BELOW, AFTER REFINISHING. REPLACE WITH NEW BRAKE ROTOR.

Wheel Bolt Replacement (Disc Brakes)

1. Remove hub and rotor assembly from vehicle.
2. Mark rotor to hub location and remove bolts attaching hub to rotor.
3. The wheel bolts on disc brakes can be pressed out from the outside of the hub and installed from inside the rotor by pressing into place. No drilling or cutting is required.
4. Reinstall assembly and adjust wheel bearings.

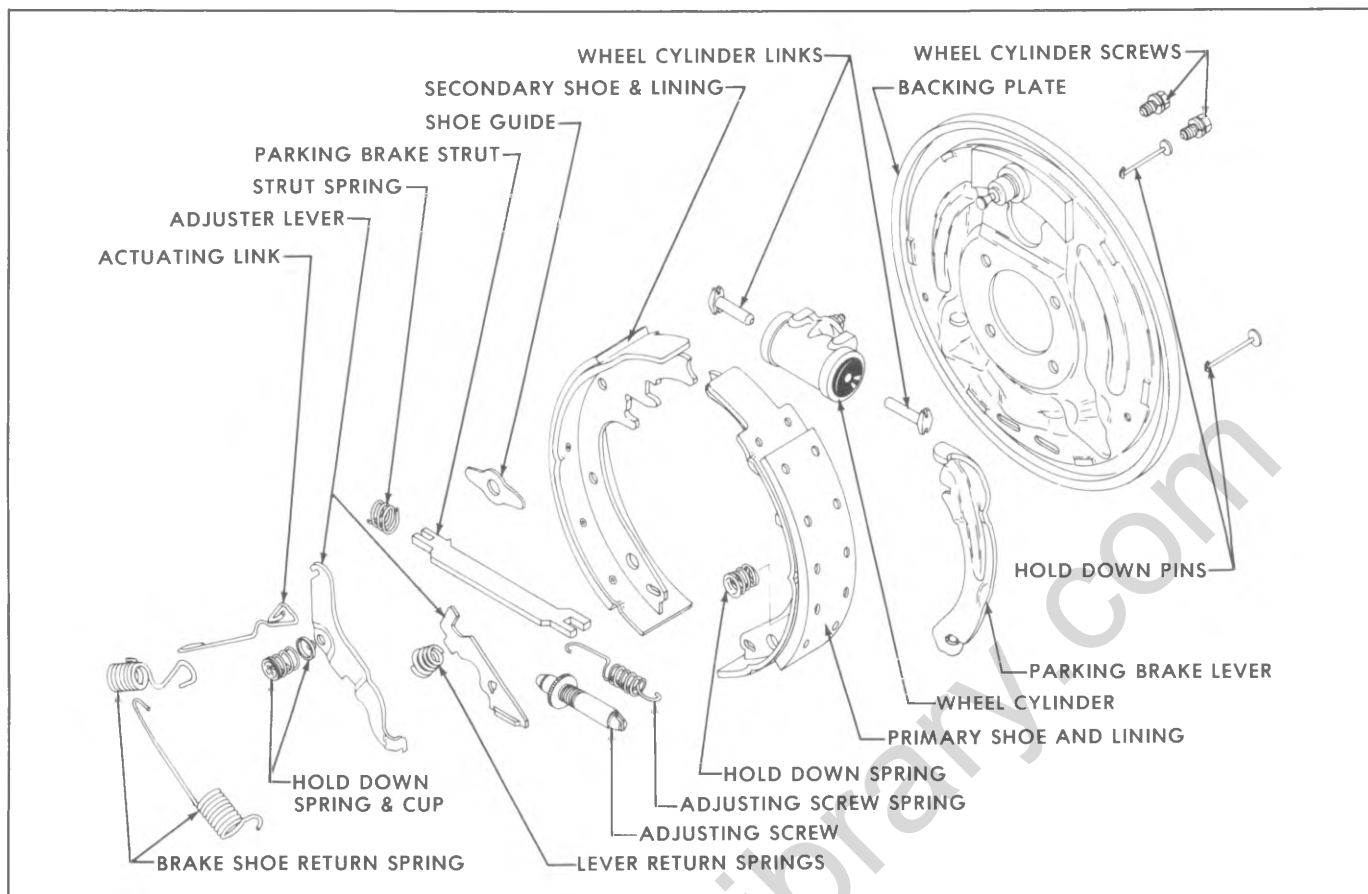


Fig. 5-43--Typical Drum Brake Assembly

DRUM BRAKE SHOE AND LINING

Service Brake

Adjustment

1. Using a punch, knock out lanced area in brake drum. If this is done with the drum installed on the vehicle, the drum must be removed and all metal cleaned out of the brake compartment. Be sure to procure a new **metal** hole cover and install it in the drum after adjustment to prevent dirt and water from getting into the brakes. Use J-6166 to turn brake adjusting screw; expand brake shoes at each wheel until the wheel can just be turned by hand. The drag should be equal at all wheels.

2. Back off brake adjusting screw at each wheel 30 notches. If shoes still drag lightly on drum, back off adjusting screw one or two additional notches. Brakes should be free of drag when screw has been backed off approximately 12 notches. Heavy drag at this point indicates tight parking brake cables.

3. Install metal adjusting hole cover in brake drum.
4. Check parking brake adjustment.

Removal and Inspecting

WARNING: See "Warning" on Page 1 of this section.

1. Raise vehicle on hoist. Remove wheel and brake drum. It may be necessary to back off the brake shoe adjustment before the brake drums can be removed. To back off shoe adjustment, rotate shoe adjusting screw downward.

NOTE: On JB6, JB7 and JB8 equipped vehicles, it is necessary to remove the axle shafts to remove the hub and drum assembly; refer to Section 4B of this manual.

2. Unhook the primary and secondary shoe return springs using large pliers.

3. Remove shoe hold down springs.

4. Lift up on actuator, unhook actuating link from anchor pin, then remove.

5. Spread shoes to clear wheel cylinder connecting links, remove parking brake strut and spring, disconnect cable from parking brake lever, remove shoes from the backing plate.

6. Separate the brake shoes by removing adjusting-screw and lock spring. Remove parking brake lever and secondary brake shoe.

7. Clean all dirt out of brake drum. Inspect drums and replace or recondition if required.

8. Clean all dirt from brake assemblies and inspect for any unusual condition.

9. Wheel cylinders having torn, cut, or heat-cracked boots should be completely overhauled.

Inspection for leakage may be accomplished at the boot center hole after removal of link pin. Fluid coatings on piston within cylinder and on end of link pin removed from boot are normal, as cylinder contains a porous PISTON WHICH IS IMPREGNATED WITH A CORROSION

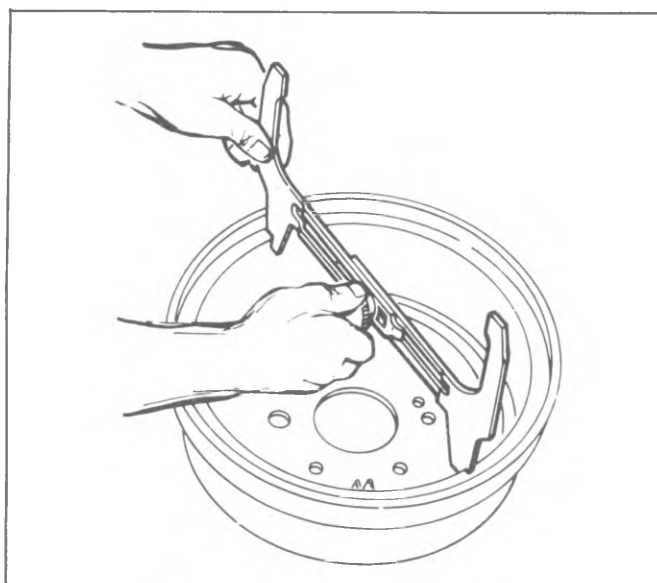


Fig. 5-44--Measuring Brake Drum I.D.

INHIBITING FLUID. Fluid spilling from boot center hole, after link pin is removed, indicates cup leakage and necessity for completely over-hauling cylinder.

10. Inspect backing plate for oil leakage past wheel bearing oil seals. Correct any leak by installation of new seals (See Section 4B).

11. Check all backing plate attaching bolts to make sure they are tight. Using fine emery cloth, clean all rust and dirt from shoe contact surfaces on plate.

Relining Brake Shoes

If old brake shoes are to be relined, inspect shoes for distortion and for looseness between the rim and web; these are the causes for discarding any shoe. If shoes are serviceable, be governed by the following points in installing new linings:

1. Remove old linings by drilling out rivets. Punching rivets out will distort shoe rim. Thoroughly clean surface of shoe rim and file off any burrs or high spots.

2. Use GM brake lining (or equivalent) and the rivets included in lining package which are of the correct size. The rivets must fit the holes with the solid body of rivet extending through the shoe rim, but no farther.

Keep hands clean while handling brake lining.

3. Start riveting at center of shoe and lining and work toward the ends. Use a roll set for riveting; a star set might split the tubular end and then the rivet would not fill the hole. The primary lining is shorter than secondary lining; therefore, the rivet holes at each end of the shoe rim are not used.

4. After riveting is completed, lining must seat snugly against shoe with no more than .005" separation midway between rivets. Check with a .004" (go) and a .006" (No Go) feeler gage.

Installation and Adjustment

1. Lubricate fulcrum end of parking brake lever with Delco Brake Lubricant or equivalent, then attach lever to secondary shoe. Make sure that lever is free moving.

2. Connect brake shoes together with adjusting screw spring, then place adjusting screw in position. When

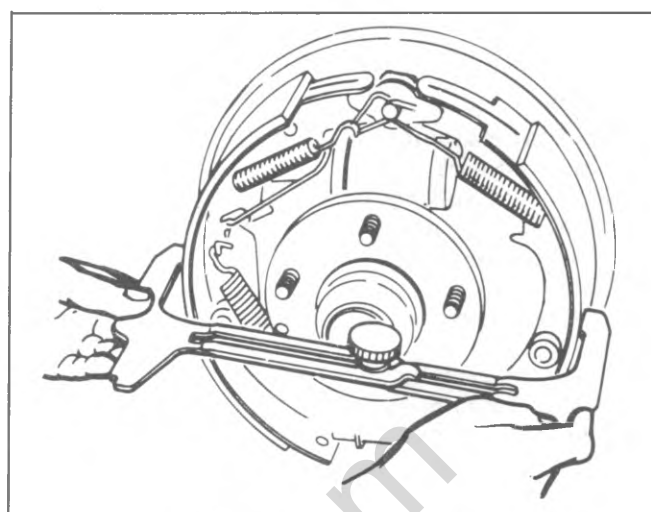


Fig. 5-45--Adjusting Brake Shoes

installing the adjusting screw spring and adjusting screw, make sure the spring does not touch the starwheel portion of the adjusting screw; and, also, when installing adjusting screw, make sure right hand thread adjusting screw is on left side of vehicle and left hand thread adjusting screw is on right side of vehicle. Make certain starwheel lines up with adjusting hole in backing plate.

3. Lubricate shoe contact surfaces on backing plate with a thin coating of Delco Brake Lubricant or equivalent. Sparingly apply same lubricant where brake cable contacts backing plate.

4. Place brake shoes on backing plate, at the same time engaging shoes with wheel cylinder links. The primary shoe (short lining) goes toward front of vehicle. Connect cable to parking brake lever and install strut and spring between lever and primary shoe.

5. Install actuator, actuator return spring and actuating link. If old brake shoe return springs are nicked, distorted or of doubtful strength (discolored from heat), it is advisable to install new parts.

6. Install shoe hold down springs.

7. Install the primary and secondary shoe return springs using large pliers. Be careful not to distort springs.

8. Measure brake drum I.D. using inside caliper portion of Tool J-21177 (fig. 5-44). Adjust brake shoes to dimension obtained on outside caliper portion of Tool J-21177 (fig. 5-45).

9. Install brake drums and wheels.

10. If any hydraulic connections were disturbed, bleed hydraulic system.

11. Adjust parking brake.

12. Inspect all brake pipes, hoses and connections for evidence of fluid leakage. Tighten any leaking connection. Then apply heavy pedal pressure to brake pedal and recheck connections.

13. Check fluid level in master cylinder and add fluid if necessary.

14. Check brake pedal for proper feel and for proper return.

15. Remove vehicle from hoist and road test for proper brake action. Brakes must not be severely applied immediately after installation of new brake shoes or linings. Severe application may permanently damage new linings

and may score brake drums. When linings are new, they must be given moderate use for several hundred miles of burnishing.

Repair Brake Lining

This procedure is to be used when brake action is unequal, severe, hard, noisy or otherwise unsatisfactory and when brake linings have had little wear.

1. Check fluid in master cylinder and add fluid if necessary.
2. Check brake pedal for proper feel and for proper return.
3. Raise vehicle on hoist and remove all wheels.
4. Remove all brake drums. Brake pedal must not be operated while drums are removed.

WARNING: See "Warning" on page 1 of this section.

5. Clean all dirt out of brake drums. Inspect drums and replace or recondition if required.

6. Clean all dirt from brake assemblies, then inspect brake linings for uneven wear, oil soaking, loose rivets or imbedded foreign particles. If linings are oil soaked, replacement is required.

7. If linings are otherwise serviceable, tighten or replace loose rivets and thoroughly clean all steel or other imbedded particles from surfaces and rivet counterbores of linings.

8. Check all backing plate bolts to make sure they are tight. (Refer to Section 4B for wheel stud replacement procedure.)

9. Measure brake drum I.D. using inside caliper portion of Tool J-21177. Adjust brake shoes to dimension obtained on outside caliper portion of Tool J-21177 (figs. 5-44 and 5-45).

10. Install drum and wheel and tire assemblies.

11. Remove vehicle from hoist and road test for proper brake action. Brakes must not be severely applied immediately after installation. Severe application may permanently damage new linings and may score brake drums. When linings are new, they must be given moderate use for several hundred miles of burnishing.

Propeller Shaft Brake

Removal (Fig. 5-46)

1. Remove the propeller shaft; see Section 4A.
2. Remove the brake drum.

NOTE: It may be necessary to back off the shoe adjustment before removing the drum.

On automatic transmission models, the exhaust crossover pipe may be in the way. If so, loosen the transmission rear mounting bolts and jack the transmission sufficiently for brake drum to clear the pipe.

3. Remove the two pull back springs.
4. Remove the guide plate from anchor pin.
5. Remove shoe hold down cups, springs, and washers from hold down pins--remove pins.
6. Pull brake shoe and lining assemblies away from anchor pin and remove the strut and spring.
7. Lift the brake shoes and linings with the adjusting nut and bolt and connecting spring off the flange plate.
8. Move the shoes toward each other until the adjusting

bolt and connecting spring drop off.

9. Remove the clip holding the brake lever to the primary shoe (shoe with short lining).

10. Compress the spring on the brake cable and remove the cable from the lever.

11. If necessary to remove the anchor pin, straighten the washer from pin hex and reinforcement. Remove reinforcement and washer with anchor pin.

12. If necessary to remove the cable, compress tangs on cable and pull assembly out of the hole in the flange plate.

13. If necessary to remove the flange plate, remove the transmission flange nut and transmission output flange. Remove bolts holding the flange plate to bearing retainer and remove the flange plate.

Inspection

Replace any worn or broken parts.

Installation

CAUTION: Refer to "Caution" on Page 1 of this section when installing fasteners in steps 1, 2 and 4 below.

1. Place the flange plate in position on the rear bearing retainer and fasten with four bolts. Torque bolts to 24 foot pounds.

2. Install transmission output flange on spline of mainshaft and fasten with flange nut. Torque nut to 100 ft. lbs.

3. Install cable assembly from back of flange plate. Push retainer through hole in flange plate until tangs securely grip the inner side of the plate.

4. Place washer and reinforcement over the threaded end of anchor pin. Hold anchor pin nut (flat side against flange on flange plate) in position behind flange plate and insert threaded end of anchor pin from front side. Thread the anchor pin into nut and tighten securely (140 foot pounds torque). Bend tang of washer over reinforcement and side of washer over hex of anchor pin.

5. Install lever on cable by compressing spring and inserting cable in channel of lever. Release spring.

6. Install primary shoe (short lining) to lever as follows: Place pin in lever, place washer on pin and push pin through hole in primary shoe. Fasten parts together by installing the clip in groove of pin.

7. Fasten two brake shoes and linings together by installing connecting spring. Move the shoes toward each other and install adjusting screw.

8. Lubricate the flange plate contact surfaces with a very light coat of Delco Brake Lube (or equivalent).

9. Place shoe and linings in position on flange plate.

NOTE: When facing the brake assembly, the shoe with the short lining should be to the left with the lever assembled to it (automatic transmission), to the right (manual transmission).

10. Pull brake shoes apart and install strut lever and spring between them. The loop on the strut spring should be in the "up" position.

11. Install hold down pins, washers, springs and cups from flange plate to shoes.

12. Place guide plate on anchor pin.

13. Install pull back springs.

14. Remove the "knock out" plug (if necessary) and install a new metal plug in the brake drum adjusting hole.

15. Install the brake drum.

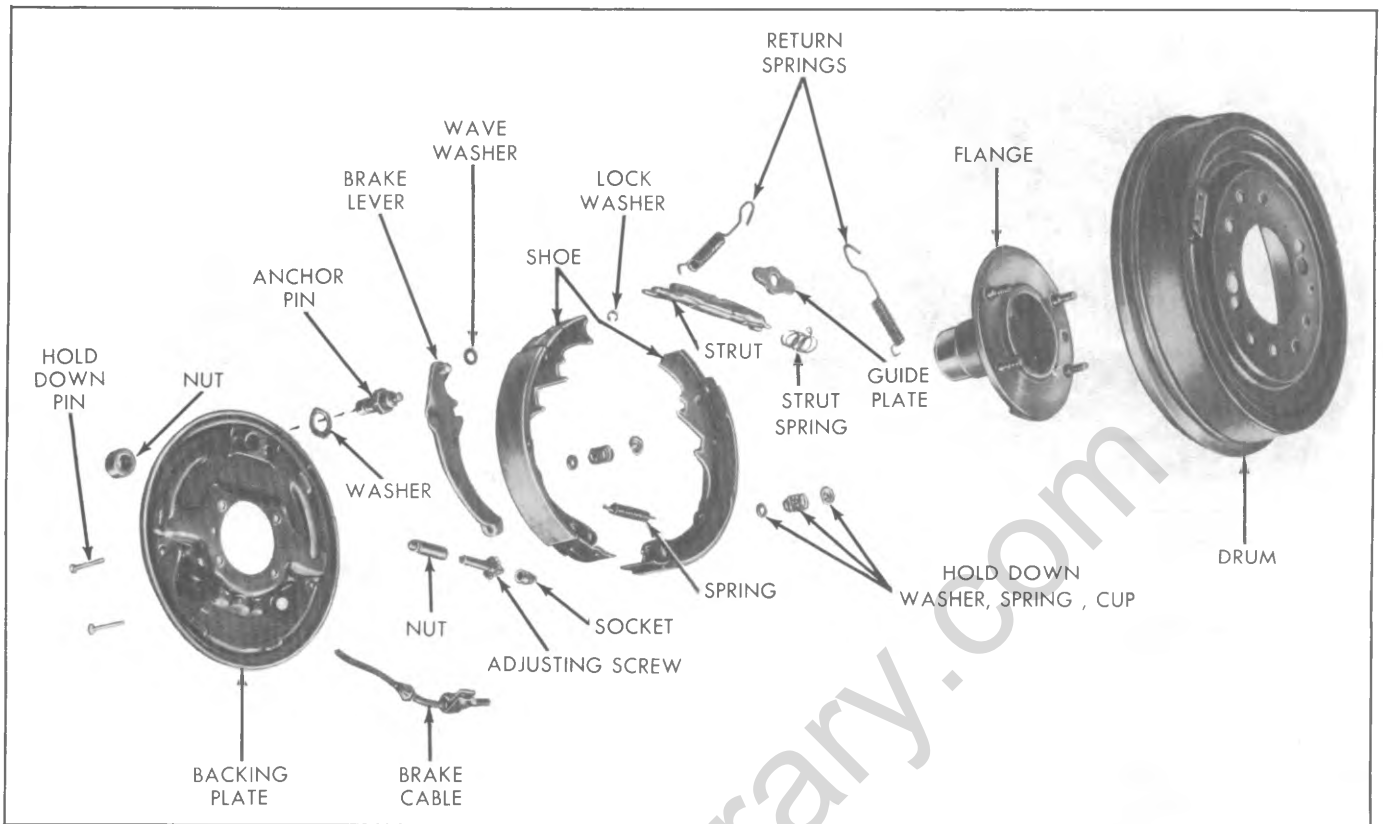


Fig. 5-46--Propshaft Parking Brake Components

16. Install the propeller shaft.

RPO H22 Rear Drum Brakes

Removal (Fig. 5-47)

1. Raise the vehicle on a hoist.
2. Retract self adjusters if necessary and remove brake drums.
3. Using Tool J-22348, remove the brake shoe pull back springs (fig. 5-48).
4. Loosen the actuating lever cam cap screw and while

WARNING: See "Warning" on Page 1 of this section.

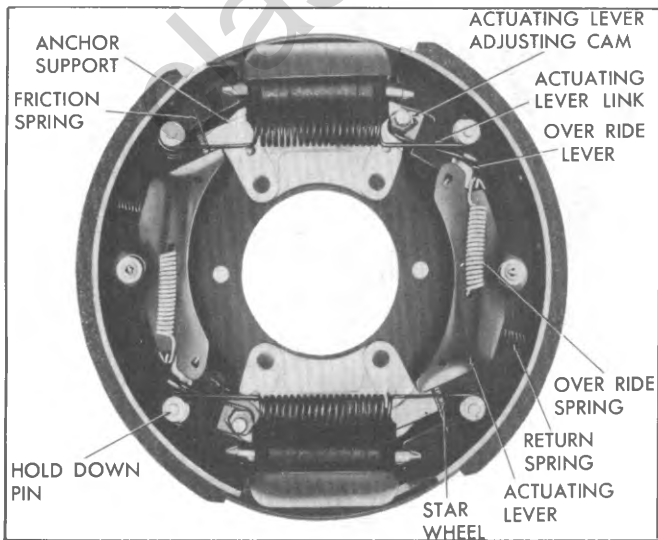


Fig. 5-47--Rear Brake--Used with RPO H-22

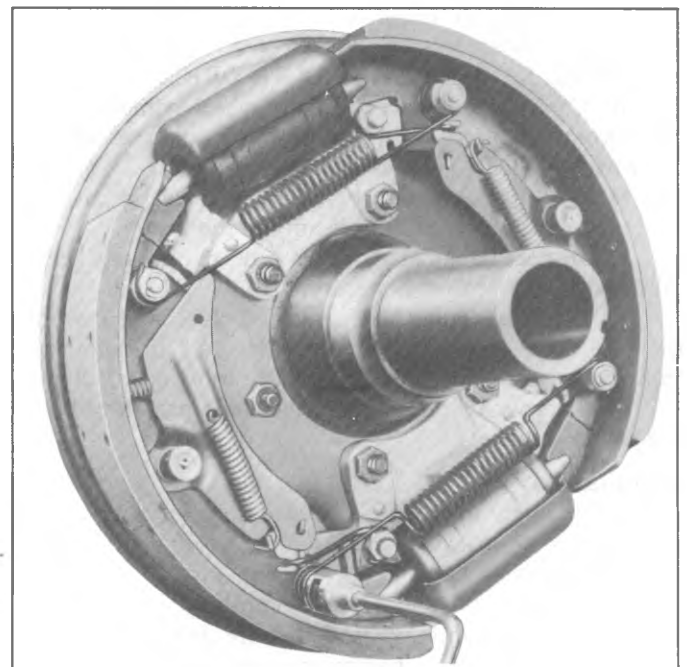


Fig. 5-48--Removing Pull Pack Spring with Tool J-22348

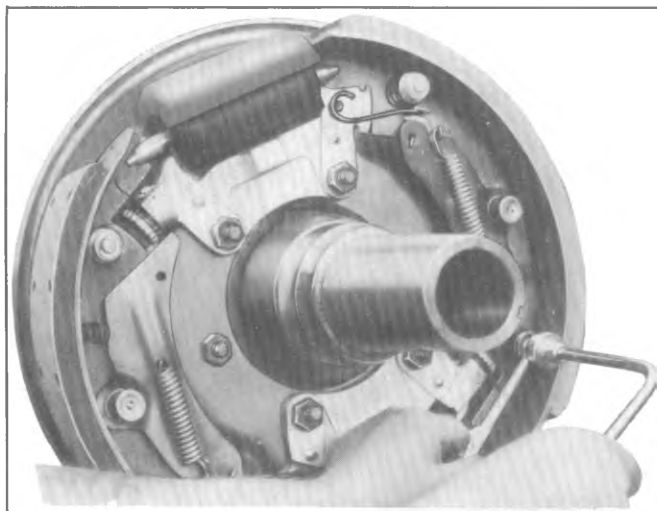


Fig. 5-49--Removing Hold Down Pins Using J-22348

holding the star wheel end of the actuating lever past the star wheel, remove the cap screw and cam.

5. Remove the brake shoe hold down springs and pins by compressing the spring with Tool J-22348 and, at the same time, pushing the pin back through the flange plate toward the tool. Then, keeping the spring compressed, remove the lock from the pin with a magnet (fig. 5-49).

6. Lift off the brake shoe and self adjuster as an assembly.

7. The self adjuster can now be removed from the brake shoe by removing the hold down spring and pin.

NOTE: The actuating lever, override lever and spring are an assembly. It is recommended that they not be disassembled for service purposes unless they are broken. It is much easier to assemble and disassemble the brakes leaving them intact.

8. Thread the adjusting screw out of the anchor support and remove and discard the friction spring.

9. Clean all dirt out of brake drum. Inspect drums for roughness, scoring or out-of-round. Replace or recondition drums as necessary.

NOTE: See Section on "BRAKE DRUMS".

10. Carefully pull lower edges of wheel cylinder boots away from cylinders. If brake fluid flows out, overhaul of the wheel cylinders is necessary.

NOTE: A slight amount of fluid is nearly always present and acts as a lubricant for the piston.

11. Inspect flange plate for oil leakage past axle shaft oil seals. Install seals if necessary.

12. Check all flange plate attaching bolts to make sure they are tight (150 ft. lbs. torque). Clean all dirt and rust from shoe contact faces on flange plate using emery cloth.

13. Thoroughly clean adjusting screws and threads in the anchor brackets.

Installation

1. Put a light film of Delco Brake Lube (or equivalent) on shoe bearing surfaces of brake flange plate and on threads of adjusting screw.

2. Thread adjusting screw completely into anchor bracket without friction spring to be sure threads are clean and screw turns easily. Then remove screw, position a new friction spring on screw and reinstall in anchor bracket.

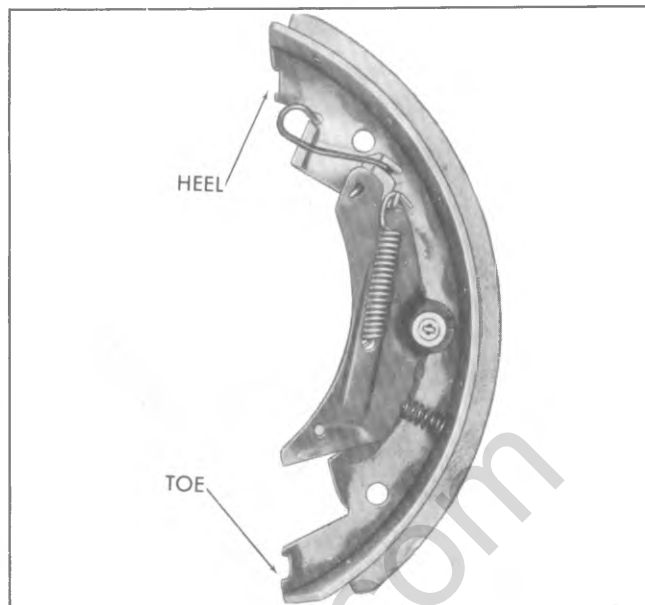


Fig. 5-50--Brake Shoe and Self Adjuster Assembly

CAUTION: See "Caution" on Page 1 of this section.

3. Assemble self adjuster assembly to brake shoe and position actuating lever link on override lever.

4. Position hold down pins in flange plate.

5. Install brake shoe and self adjuster assemblies onto hold down pins, indexing ends of shoes with wheel cylinder push rods and legs of friction springs.

NOTE: Make sure the toe of the shoe is against the adjusting screw (fig.5-50).

6. Install cup, spring and retainer on end of hold down pin. Using Tool J-22348, compress the spring. With spring compressed, push the hold down pin back through the

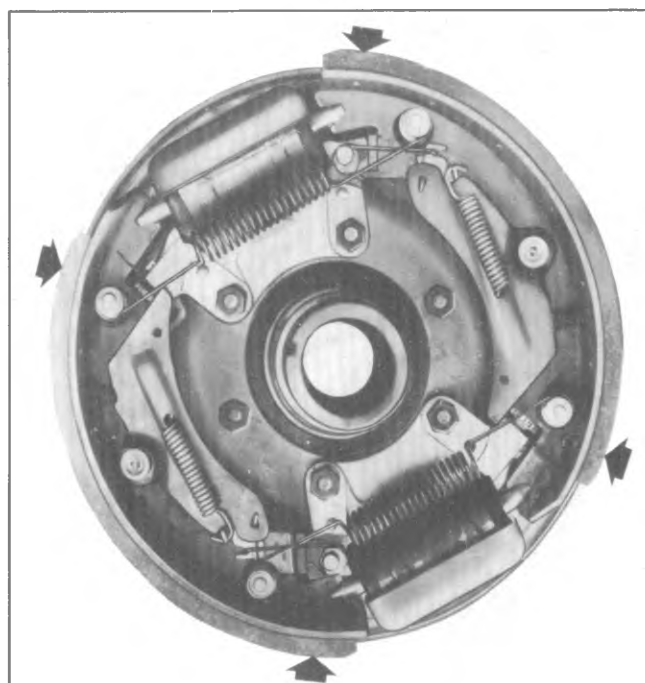


Fig. 5-51--Measuring Points for Shoe Centering

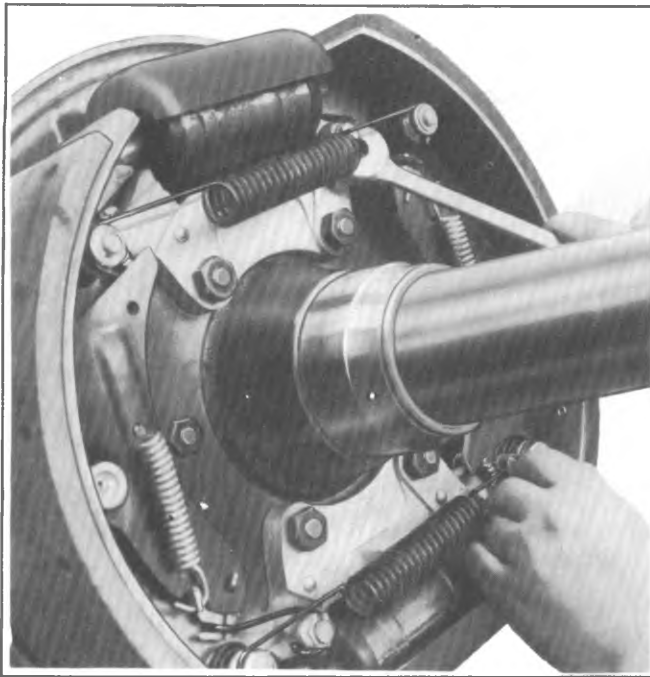


Fig. 5-52--Positioning Actuator Lever

flange plate toward the tool and install the lock on the pin.

7. Using Tool J-22348, install brake shoe return springs.

8. Holding the star wheel end of the actuating lever as far as possible past the star wheel, position the adjusting lever cam into the actuating lever link and assemble with cap screw.

9. Check the brake shoes for being centered by measuring the distance from the lining surface to the edge of the flange plate at the points shown in Figure 5-51. To center the shoes, tap the upper or lower end of the shoes with a plastic mallet until the distances at each end become equal.

10. Locate the adjusting lever .020" to .039" above the outside diameter of the adjusting screw thread by loosening the cap screw and turning the adjusting cam.

NOTE: To determine .020" to .039", turn the adjusting screw 2 full turns out from the fully retracted position. Hold a .060" plug gage (from J-9789-01 Universal Carburetor Gage Set) at a 90° angle with the star wheel edge of the actuating lever. Turn the adjusting cam until the actuating lever and threaded area on the adjusting screw just touch the gage (figs. 5-52 and 5-53).

11. Secure the adjusting cam cap screw and retract the adjusting screw.

12. Install brake drums and wheels and remove vehicle from jack stands.

13. Adjust the brakes by making several forward and

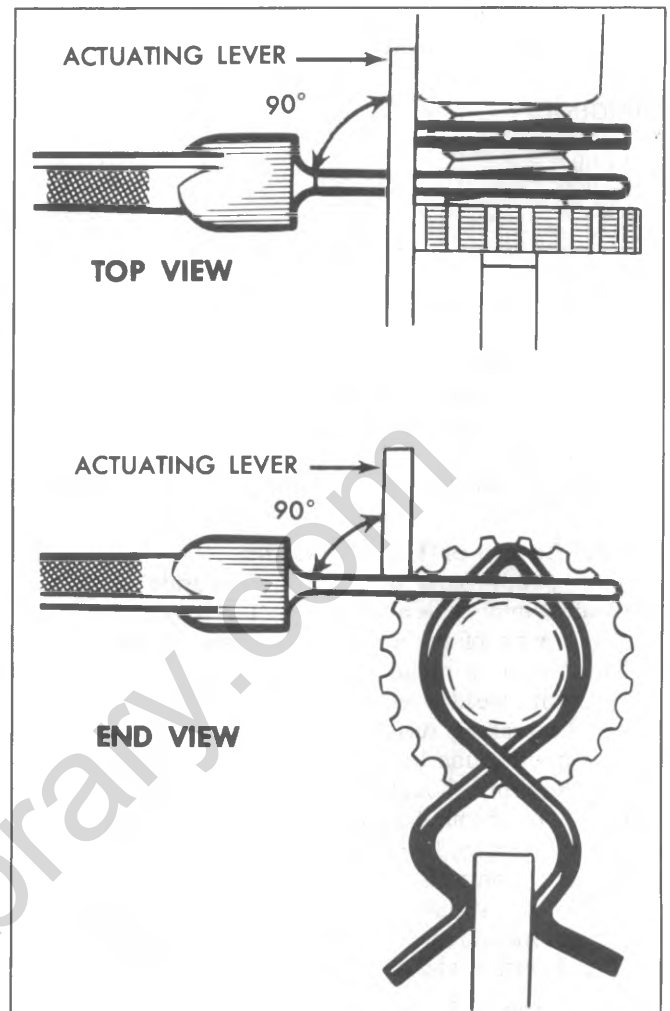


Fig. 5-53--Pull Gage Positioning for Correct Actuator Lever Adjustment

a satisfactory brake pedal height results.

BRAKE DRUMS

Inspection and Reconditioning

WARNING: See "Warning" on Page 1 of this section.

Whenever brake drums are removed, they should be thoroughly cleaned and inspected for cracks, scores, deep grooves and out-of-round.

Cracked, Scored, or Grooved Drum

A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum.

Smooth up any slight scores. Heavy or extensive scoring will cause excessive brake lining wear, and it will probably be necessary to rebore in order to true up the braking surface.

If the brake linings are slightly worn and the drum is grooved, the drum should be polished with fine emery cloth but should not be turned. At this stage, eliminating the grooves in drum would necessitate removal of too much metal, while if left alone, the grooves and lining ridges

DRUM DIAMETERS		
ORIGINAL	MAXIMUM REFINISH	REPLACEMENT (DISCARD)
11.000	11.060	11.090
12.000	12.060	12.090
13.000	13.060	13.090

match and satisfactory service can be obtained.

If brake linings are to be replaced, a grooved drum should be turned for use with new linings. A grooved drum, if used with new lining, will not only wear the lining, but will make it difficult, if not impossible to obtain efficient brake performance.

Out-Of-Round or Tapered Drum

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum can also cause severe and irregular tire tread wear as well as pulsating brake pedal. When the braking surface of a brake drum exceeds the factory specification limits in taper (and/or) being out-of-round, the drum should be turned to true up the braking surface. Out-of-round as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

When measuring a drum for out-of-round, taper and wear, take measurements at the open and closed edges of machined surface and at right angles to each other.

Turning Brake Drums

If a drum is to be turned, only enough metal should be removed to obtain a true, smooth braking surface. If a drum does not clean-up when turned to a maximum diameter as shown in the general specification, it must be replaced. Removal of more metal will affect dissipation of heat and may cause distortion of the drum.

All brake drums have a maximum diameter cast into them. This diameter is the maximum wear diameter and not a refinish diameter. Do not refinish a brake drum that will not meet the specifications, as shown below, after refinishing.

Brake Drum Balance

During manufacture, brake drums are balanced within three ounce inches. These weights must not be removed.

WHEEL CYLINDER

Removal

1. Remove wheel, drum and brake shoes. Be careful not to get grease or dirt on brake lining.
2. Remove wheel cylinder from backing plate.

Disassembly

1. Inspect cylinder bore for scoring or corrosion. It is best to replace a corroded cylinder.
2. Polish any discolored or stained area with crocus cloth by revolving cylinder on cloth supported by a finger.
3. Rinse cylinder in clean brake fluid.
4. Shake excessive rinsing fluid from cylinder. Do not use a rag to dry cylinder, as lint from the rag cannot be kept

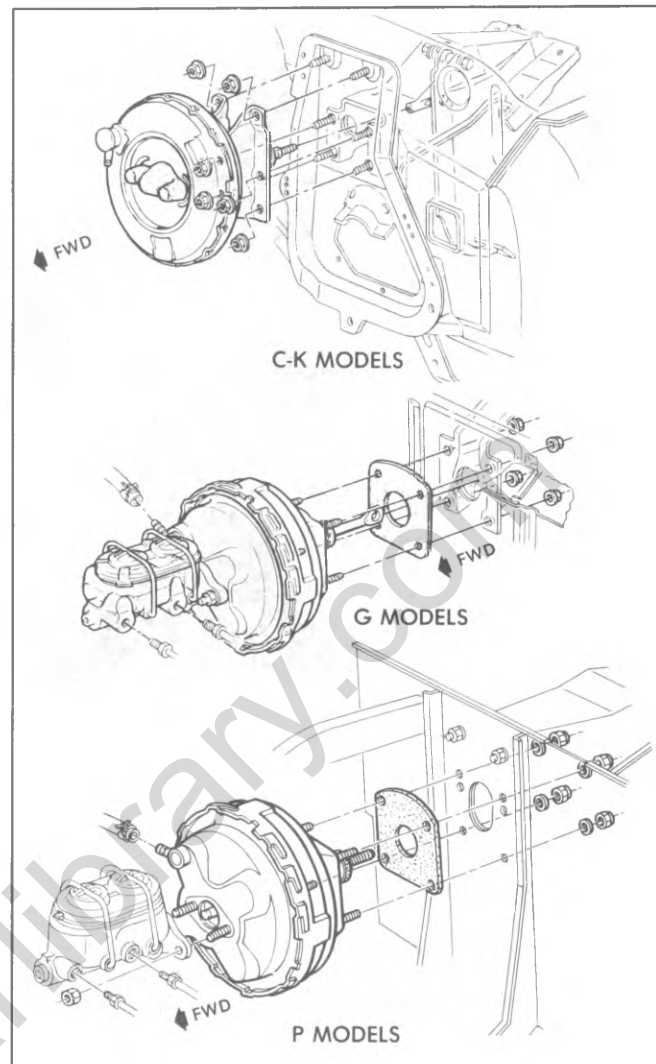


Fig. 5-54--Vacuum Booster Installation

from cylinder bore surfaces.

Assembly

1. Lubricate cylinder bore and counterbore with clean brake fluid and insert spring-expander assembly.
2. Install new cups. (Be sure cups are lint and dirt free.) Do not lubricate cups prior to assembly.
3. Install new pistons.
4. Press new boots into cylinder counterbores by hand. Do not lubricate boots prior to assembly.

Installation

1. Install wheel cylinder on brake backing plate and connect brake pipe to hose. Torque rear wheel brake pipe to wheel cylinder to specifications.
2. Install brake shoes, drum and wheel; then flush and bleed hydraulic system.

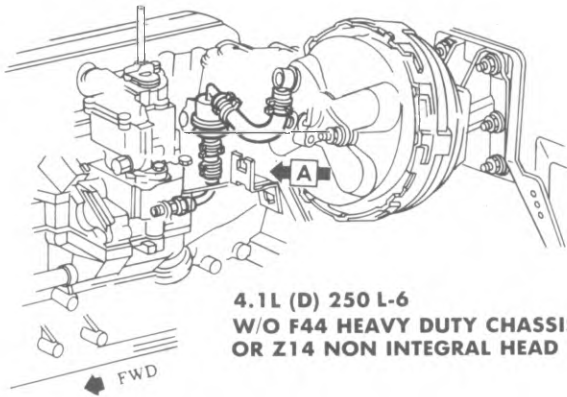
POWER BRAKE UNIT

Vacuum Booster

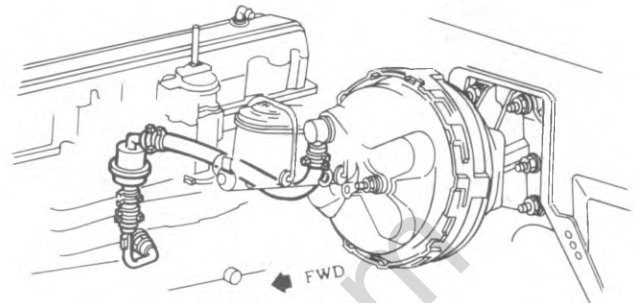
Replacement (Fig. 5-54)

A power brake vacuum hose filter is installed between the vacuum source and the power brake unit check valve (fig. 5-55 and 5-56).

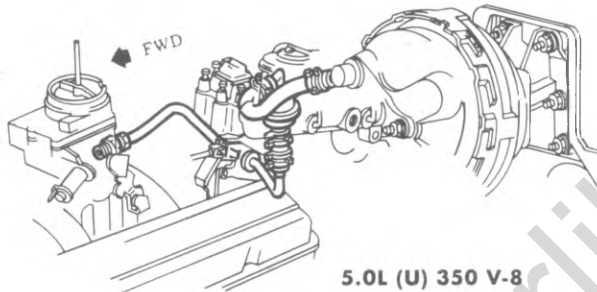
C-K MODELS



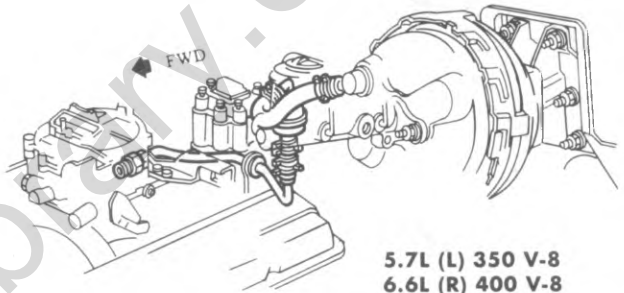
**4.1L (D) 250 L-6
W/O F44 HEAVY DUTY CHASSIS
OR Z14 NON INTEGRAL HEAD**



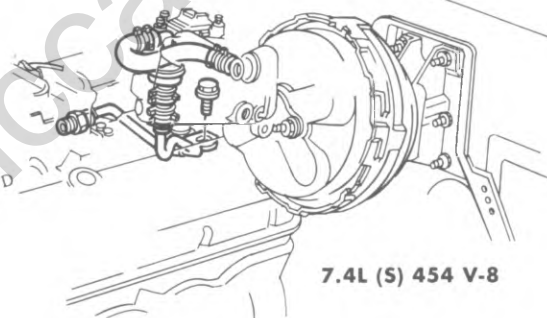
**4.1L (D) 250 L-6
W/ F44 HEAVY DUTY CHASSIS
OR Z14 NON INTEGRAL HEAD**



5.0L (U) 350 V-8

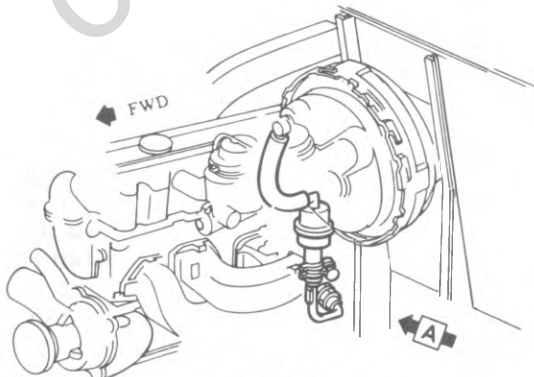


**5.7L (L) 350 V-8
6.6L (R) 400 V-8**

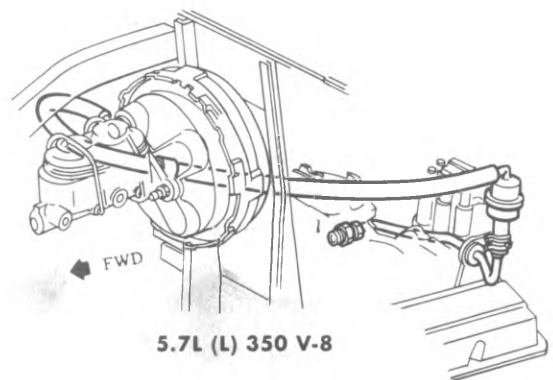


7.4L (S) 454 V-8

P MODELS



4.8L (T) 292 L-6



5.7L (L) 350 V-8

Fig. 5-55--Power Brake Vacuum Hose Filter Installation--C-K-P Trucks

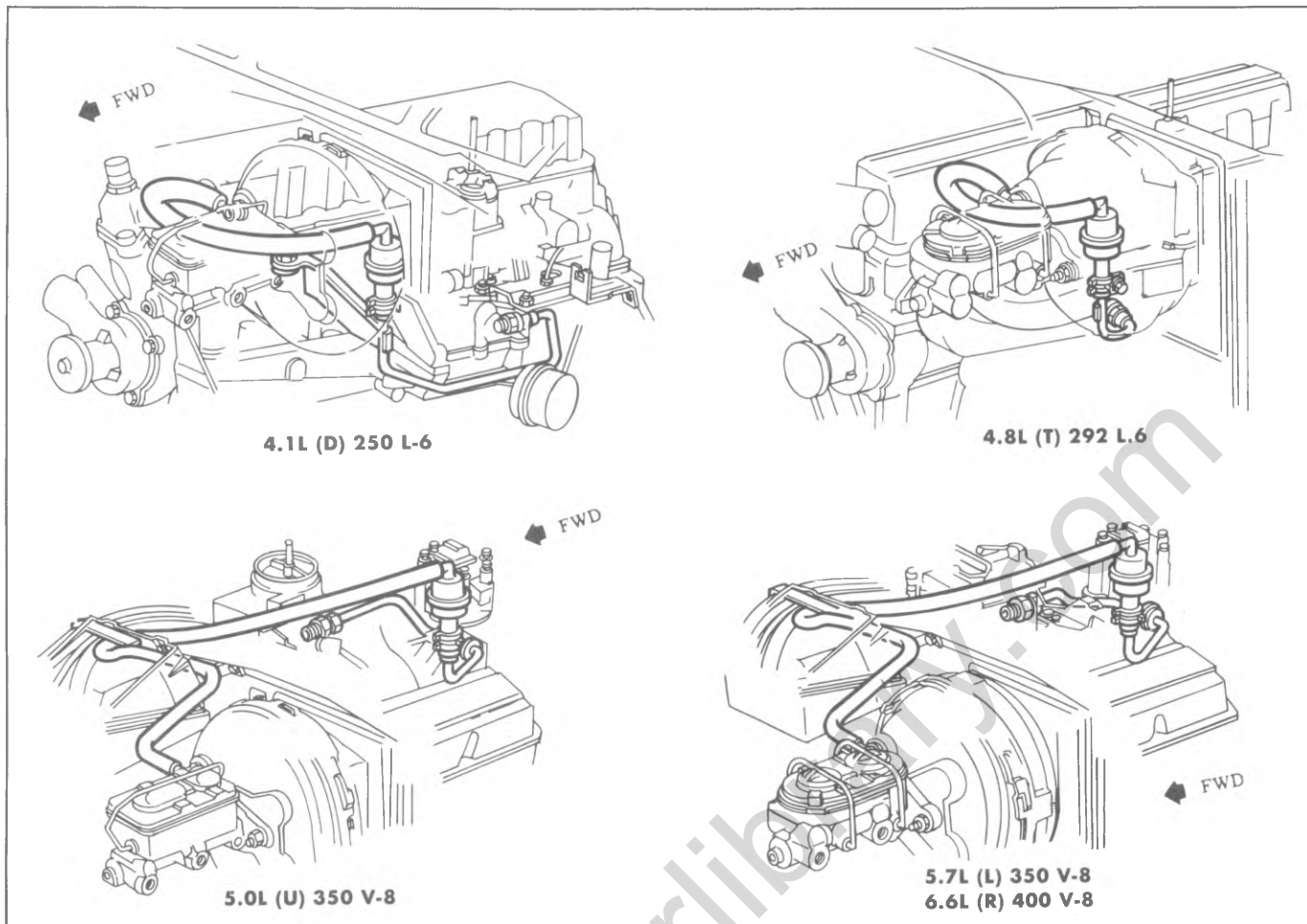


Fig. 5-56--Power Brake Vacuum Hose Filter Installation--G Models

CAUTION: See "Caution" on page 1 of this section when installing fasteners referred to in steps 6, 7 and 9 below.

1. Remove two nuts holding master cylinder to power cylinder and position it away from power cylinder.

CAUTION: Do not disconnect hydraulic brake lines; be careful not to bend or kink pipes.

2. Disconnect the vacuum hose from the vacuum check valve on the front housing of the power head. Plug vacuum hose to prevent dust and dirt from entering hose.

3. Disconnect the power brake push rod from the brake pedal.

4. Remove the four nuts from the mounting studs which hold the power brake to the cowl.

5. Carry the power brake to a clean work area and clean the exterior of the power brake prior to disassembly.

6. Mount power brake assembly to cowl and torque nuts to specified torque.

7. Connect power brake push rod to brake pedal.

8. Connect vacuum hose to vacuum check valve.

9. Connect master cylinder to power cylinder and torque nuts to specifications.

HYDRO-BOOST BRAKE SYSTEM

CAUTION: Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.

NOTE: The following operations can be performed with the booster installed in the vehicle; exceptions to this statement may exist where Body Manufacturers sheet metal ("P" Models) would require removal of the booster from the vehicle.

Pneumatic Accumulator

WARNING: The accumulator contains compressed gas. Always use proper tools and follow recommended procedures or personal injury may result. Do not apply heat to accumulator. Do not attempt to repair an inoperative accumulator, always replace with a new accumulator. Dispose of an inoperative accumulator by drilling a 1/16" diameter hole through the end of the accumulator can opposite the "O" ring.

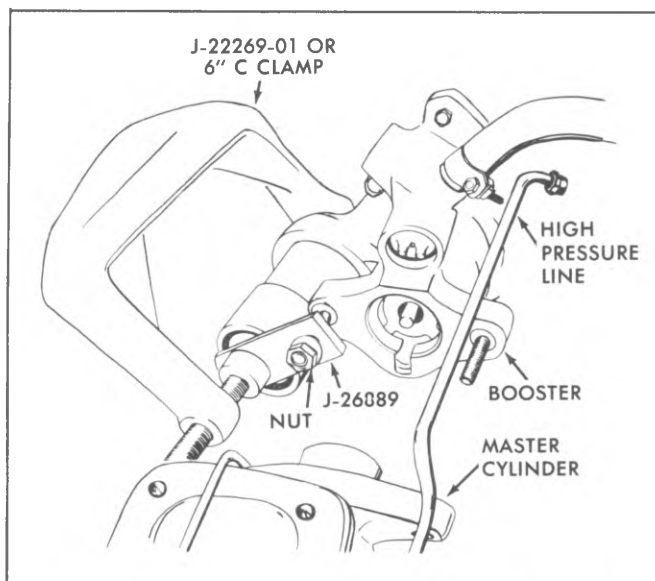


Fig. 5-57--Compressing Accumulator With J-26889

Removal

1. Turn engine off and pump brake pedal 4 or 5 times to deplete accumulator.

2. Disconnect the high pressure hose.

3. Remove two nuts from master cylinder, then move master cylinder away from booster with brake lines attached.

4. Place the accumulator retaining cap Tool J-26889 over the master cylinder stud and install the nut as shown in Figure 5-57.

5. Using Tool J-22269-01 or a large "C" clamp (6" minimum), depress the accumulator. Insert a punch into the hole in the housing and remove retaining ring with a small screwdriver, (fig. 5-57).

NOTE: If the accumulator is not easily compressed approximately 1/8", it is still charged. This indicates

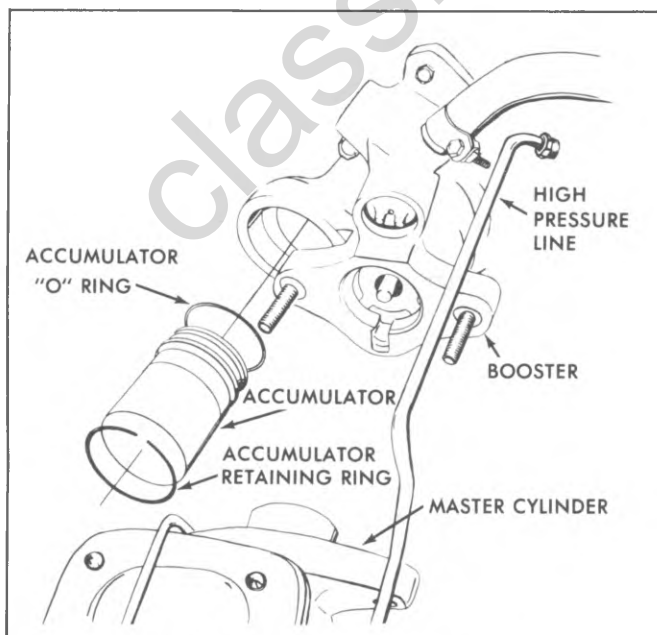


Fig. 5-58--Accumulator Installation

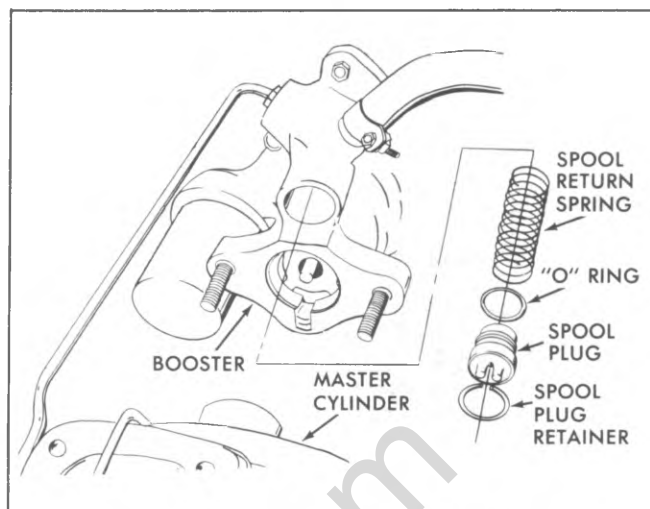


Fig. 5-59--Spool Valve Plug Removal

an internal problem with the accumulator valves and the booster must be disassembled.

6. Slowly back off the clamp until tension on the accumulator is released; remove accumulator and "O" ring.

Installation

1. Using clean power steering fluid, lubricate accumulator seal. Install seal and accumulator in housing and then place the retaining ring over the accumulator (fig. 5-58). Place Tool J-26889 over accumulator.

2. Using Tool J-22269-01 or a large "C" clamp (6" minimum) depress the accumulator making certain that the accumulator is compressed straight (fig. 5-57).

3. Snap the retaining ring into the housing groove by pushing it down all the way around with a small screwdriver.

4. Remove Tool J-22269-01 or "C" clamp and retaining cap Tool J-26889.

CAUTION: Carefully check to make sure the retaining ring was completely installed properly.

5. Connect high pressure hose and check power steering fluid.

6. Install the master cylinder two nuts and accumulator retaining cap Tool J-26889 and close the vehicle hood. Test the unit by starting the engine and turning the steering wheel from stop to stop a few times. Turn off engine and apply brake pedal 4 or 5 times.

7. Remove accumulator retaining cap Tool J-26889 and install master cylinder nut.

CAUTION: See "Caution" on Page 1 of this section.

Spool Valve Plug

Removal

1. Turn engine off and pump brake pedal 4 or 5 times to deplete accumulator.

2. Remove two nuts from master cylinder, then move master cylinder away from booster with brake lines attached.

3. Push spool valve plug in and use a small screwdriver to remove retaining ring (fig. 5-59).

4. Remove spool valve plug and "O" ring.

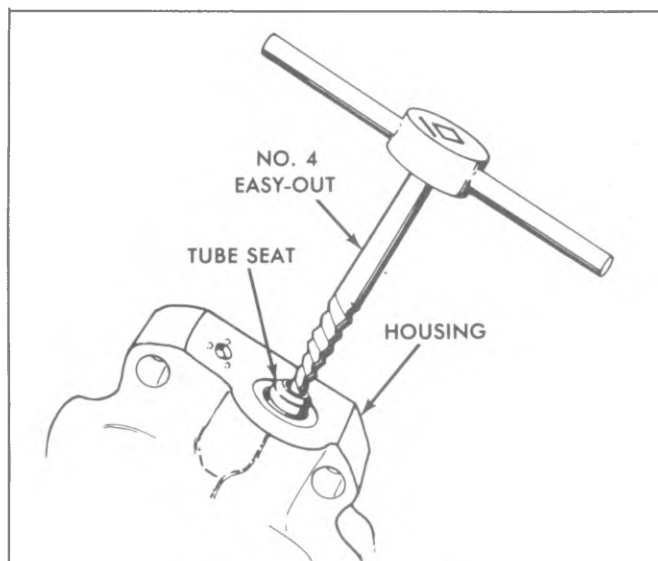


Fig. 5-60—Removing Tube Seat

Installation

1. Install "O" ring and spool valve plug (fig. 5-59).
2. Push spool valve plug in and install retaining ring.
3. Install master cylinder and two nuts to booster.

CAUTION: See "Caution" on Page 1 of this section.

4. Bleed system. Refer to "HYDRO-BOOST BLEEDING PROCEDURE".

Tube Seat

Replacement

1. Turn engine off and pump brake pedal 4 or 5 times to deplete accumulator.
2. Clean dirt around fitting before removing fitting, then disconnect pressure hose at Hydro-Boost and secure

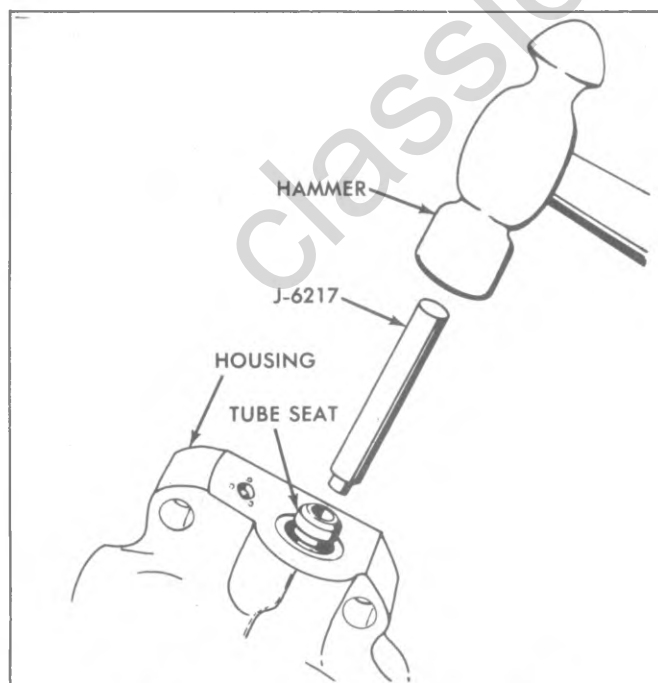


Fig. 5-61—Installing Tube Seat Using J-6217

hose in a raised position to prevent loss of fluid.

3. To prevent metal chips from entering booster, pack inside of tube seat with petrolatum.

4. Remove tube seat using No. 4 easy-out as shown in Figure 5-60.

5. Wipe petrolatum from housing and clean housing thoroughly to remove any metal chips or dirt.

6. Install tube seat with Tool J-6217 as shown in Figure 5-61.

7. Fill and bleed system. Refer to "HYDRO-BOOST BLEEDING PROCEDURE".

Hydro-Boost Unit

Replacement (fig. 5-62)

1. Depress and release the brake pedal several times (engine not running) to be sure that all pressure is discharged from the accumulator prior to disconnecting the hoses from the booster.

2. **P30(32) Models-** Raise the vehicle on a hoist.

3. Clean all dirt from the booster at the hydraulic line connections and master cylinder.

4. Remove the nuts and lockwashers that secure the master cylinder to the booster and the support bracket. Support the master cylinder, being careful to avoid kinking or bending the hydraulic lines attached to the master cylinder. Cover the end of the master cylinder with a clean cloth.

NOTE: It should not be necessary to disconnect the hydraulic lines from the master cylinder.

5. Disconnect the hydraulic lines from the booster ports. Plug all lines and the booster ports to prevent loss of fluid and to keep out foreign material.

6. **P30(42) and C-K-G Models-**

a. Remove booster pedal push rod cotter pin and washer and disconnect the push rod from the brake pedal (C and K models) or booster bracket pivot lever (G and P models).

b. Remove the booster support bracket on C and K models, support braces on G and P30(42) models.

c. Remove the booster bracket to dash panel or support bracket nuts and remove the booster assembly.

7. **P30(32) Models-**

a. Remove the cotter pin, nut, bolt and washers that secure the operating lever to the vertical brake rod.

b. Remove the six nuts, lock washer and bolts that secure the booster linkage bracket to the front and rear support brackets, and remove the booster from the vehicle by sliding the booster off the rear support studs.

c. Remove the cotter pin, nut, washer and bolt that secures the operating lever to the pedal rod.

d. Remove the brake pedal rod lever nut and bolt and then remove the lever, sleeve and bushings.

8. To install, reverse Steps 1-7 above. Torque all hydraulic lines and attaching bolts to specifications.

NOTE: Lubricate pedal rod and linkage pivot bolts, pins, sleeves and bushings with Delco Brake Lube (or equivalent).

CAUTION: See "Caution" on Page 1 of this section.

9. Fill and bleed system. Refer to "Hydro-Boost bleeding procedure."

10. Check brake pedal and stoplamp switch adjustment.

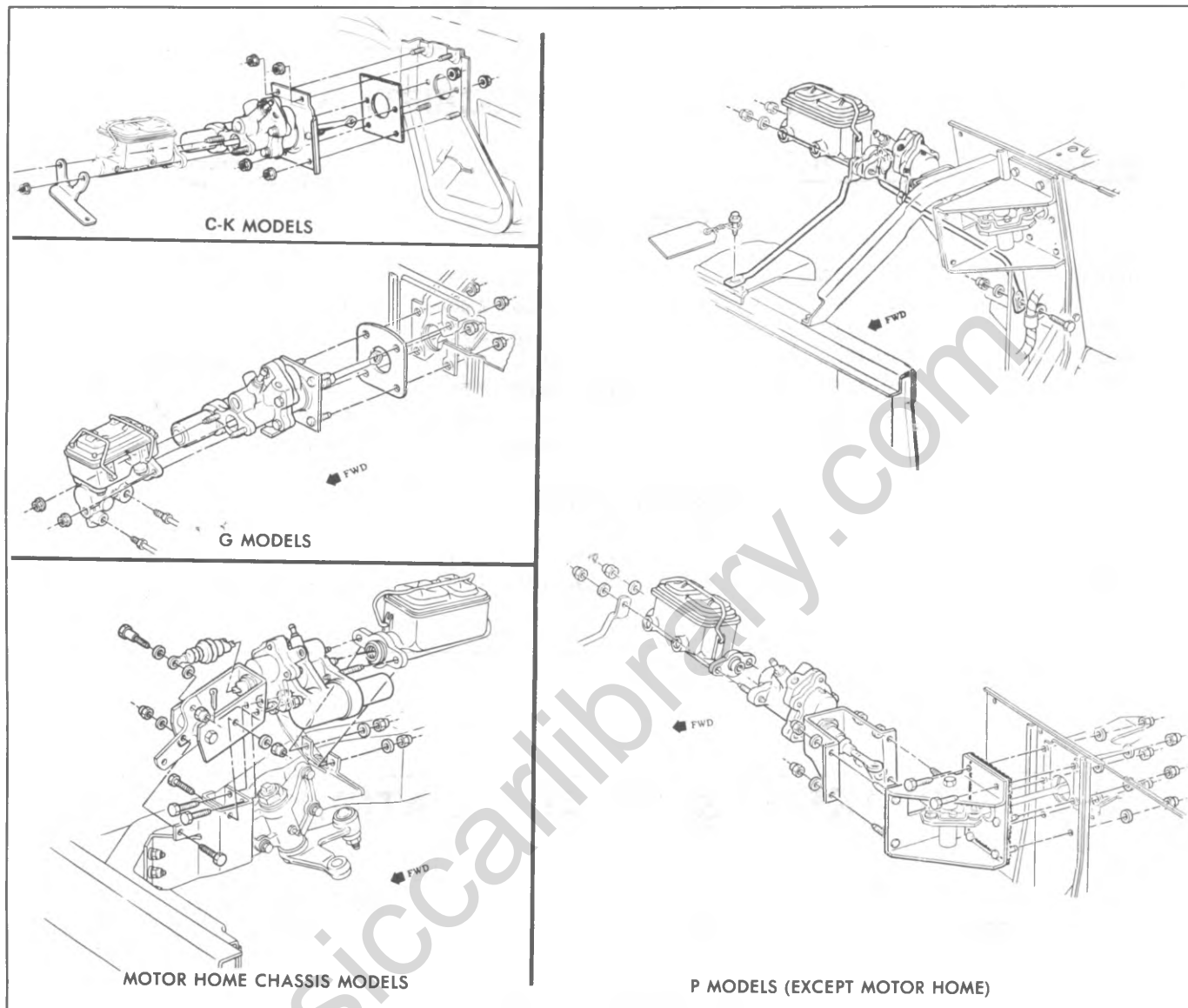


Fig. 5-62--Booster Installation (Hydro-Boost)

SPECIFICATIONS

BRAKE SYSTEM DESCRIPTION

<u>SYSTEM</u>	<u>FRONT BRAKES</u>	<u>REAR BRAKES</u>	<u>BRAKE ASSIST</u>
<u>GASOLINE ENGINE VEHICLES</u>			
JB1	Disc 11.86 x 1.28	Drum 11.00 x 2.00	None (Manual Brakes)
JB3	Disc 11.86 x 1.28	Drum 11.00 x 2.00	Vacuum — Single Diaphragm
JB5	Disc 11.86 x 1.28	Drum 11.15 x 2.75	Vacuum — Dual Diaphragm
JB6	Disc 12.50 x 1.28	Drum 11.15 x 2.75	Vacuum — Dual Diaphragm
JB7	Disc 12.50 x 1.28	Drum 13.00 x 2.50	Vacuum — Dual Diaphragm
JB8	Disc 12.50 x 1.53	Drum 13.00 x 3.50	Hydraulic — Hydroboost
JF9	Disc 14.25 x 1.53	Disc 13.75 x 1.53	Hydraulic — Hydroboost
<u>DIESEL ENGINE VEHICLES</u>			
JD3	Disc 11.86 x 1.28	Drum 11.00 x 2.00	Hydraulic — Hydroboost
JD5	Disc 11.86 x 1.28	Drum 11.15 x 2.75	Hydraulic — Hydroboost

BRAKE SYSTEM APPLICATION

<u>MODEL</u>	<u>TON RATING</u>	<u>WHEELBASE</u>	<u>GVW RATING</u>	<u>MERCHANDISING OPTION</u>	<u>BRAKE SYSTEM</u>
<u>DIESEL ENGINE VEHICLES</u>					
C10703	1/2	117.5	5300-5600	Base	JD3
			5300-5600	J55*	JD5*
			6050-6200	J55	JD5
C10903		131.5	5300-5600	Base	JD3
			5300-5600	J55*	JD5*
			6050-6200	J55	JD5

*Optional Heavy Duty Brakes

BRAKE SYSTEM APPLICATION (continued)

<u>MODEL</u>	<u>TON RATING</u>	<u>WHEELBASE</u>	<u>GVW RATING</u>	<u>MERCHANDIZING OPTION</u>	<u>BRAKE SYSTEM</u>
<u>GASOLINE ENGINE VEHICLES</u>					
C10516	1/2	106.5	6200	Base	JB5
C10703		117.5	4900	Base	JB1
			5300-5600	J50	JB3
			5300-5600	J55*	JB5*
			6050-6200	J55	JB5
C10903		131.5	4900	Base	JB1
			5300-5600	J50	JB3
			5300-5600	J55*	JB5*
			6050-6200	J55	JB5
C10906		129.5	6050-7000	Base	JB5
C20903	3/4	131.5	6400-7100	Base	JB6
			6400-7100	J55*	JB7*
			7500-8200	J55	JB7
C20906		129.5	7100	Base	JB6
			7100	J55*	JB7*
			7500-8200	J55	JB7
C20943		164.5	7500-8200	Base	JB7
C20963			8200	Base	JB7
C30903	1	131.5	6600-8200	Base	JB7
			6600-8200	J55*	JB8*
			9000-10000	J55	JB8
C30943		164.5	9000-10000	Base	JB8
C31003		135.5	6600-8200	Base	JB7
			6600-8200	J55*	JB8*
			9000-10000	J55	JB8
C31403		159.5	6600-8200	Base	JB7
			6600-8200	J55*	JB8*
			9000-10000	J55	JB8

*Optional Heavy Duty Brakes.

BRAKE SYSTEM APPLICATION (continued)

<u>MODEL</u>	<u>TON RATING</u>	<u>WHEELBASE</u>	<u>GVW RATING</u>	<u>MERCHANDIZING OPTION</u>	<u>BRAKE SYSTEM</u>
K10516	1/2	106.5	6200	Base	JB5
K10703		117.5	6200	Base	JB5
K10903		131.5	6200	Base	JB5
K10906		129.5	6200-7300	Base	JB5
K20903	3/4	131.5	6800 6800 7500-8400	Base J55* J55	JB6 JB7* JB7
K20906		129.5	6800 6800 7500-8400	Base J55* J55	JB6 JB7* JB7
K30903	1	131.5	8600-10000	Base	JB8
K30943		164.5	9200-10000	Base	JB8
K31003		135.5	8600-10000	Base	JB8
K31403		159.5	10000	Base	JB8

*Optional Heavy Duty Brakes.

BRAKE SYSTEM APPLICATION (continued)

MODEL	TON RATING	WHEELBASE	GVW RATING	MERCHANDIZING OPTION	BRAKE SYSTEM
G11005	1/2	110	4900	Base	JB1
			4900	J50*	JB3*
			5400-5600	J50	JB3
			5400-5600	J55*	JB5*
			6000	J55	JB5
G11006			5600	Base	JB3
			6000	J55	JB5
G11305		125	4900	Base	JB1
			4900	J50*	JB3*
			5400-5600	J50	JB3
			5400-5600	J55*	JB5*
			6000	J55	JB5
G11306			5600	Base	JB3
			5600	J55*	JB5*
			6000	J55	JB5
G21005	3/4	110	6400	Base	JB5
G21006			6400	Base	JB5
G21305		125	6600	Base	JB5
G21306			6600	Base	JB5
G31005	1	110	6400-7100	Base	JB6
			6400-7100	J55*	JB7*
			7700-8100	J55	JB7
G31305		125	6600-7400	Base	JB6
			6600-7400	J55*	JB7*
			7900-8400	J55	JB7
G31306			6600-7400	Base	JB6
			6600-7400	J55*	JB7*
			8150	J55	JB7
G31303			7400-8400	Base	JB7
			8900	R05	JB8
G31603		146	8900-10500	Base	JB8

*Optional Heavy Duty Brakes.

BRAKE SYSTEM APPLICATION (continued)

<u>MODEL</u>	<u>TON RATING</u>	<u>WHEELBASE</u>	<u>GVW RATING</u>	<u>MERCHANDIZING OPTION</u>	<u>BRAKE SYSTEM</u>
P10542	1/2	102	6200	Base	JB5
P20842	3/4	125	6800 6800 7500-8000	Base J55* J55	JB6 JB7* JB7
P21042		133	6800 6800 7500-8000	Base J55* J55	JB6 JB7* JB7
P30842	1	125	7600-8200 7600-8200 9000-10000 12000-14000	Base J55* J55 H22 or H23	JB7 JB8* JB8 JF9
P30832			10500-12500	Base	JB8
P31042		133	7600-8200 7600-8200 9000-10000 12000-14000	Base J55* J55 H22 or H23	JB7 JB8* JB8 JF9
P31132		137	10500-12500	Base	JB8
P31432		158.5	10500-12500 14500	Base HF7 or HF8	JB8 JF9
P31442		157	7600-8200 7600-8200 9000-10000 12000-14000	Base J55* J55 H22 or H23	JB7 JB8* JB8 JF9
P31832		178	14500	Base	JF9

*Optional Heavy Duty Brakes.

SPECIFICATIONS

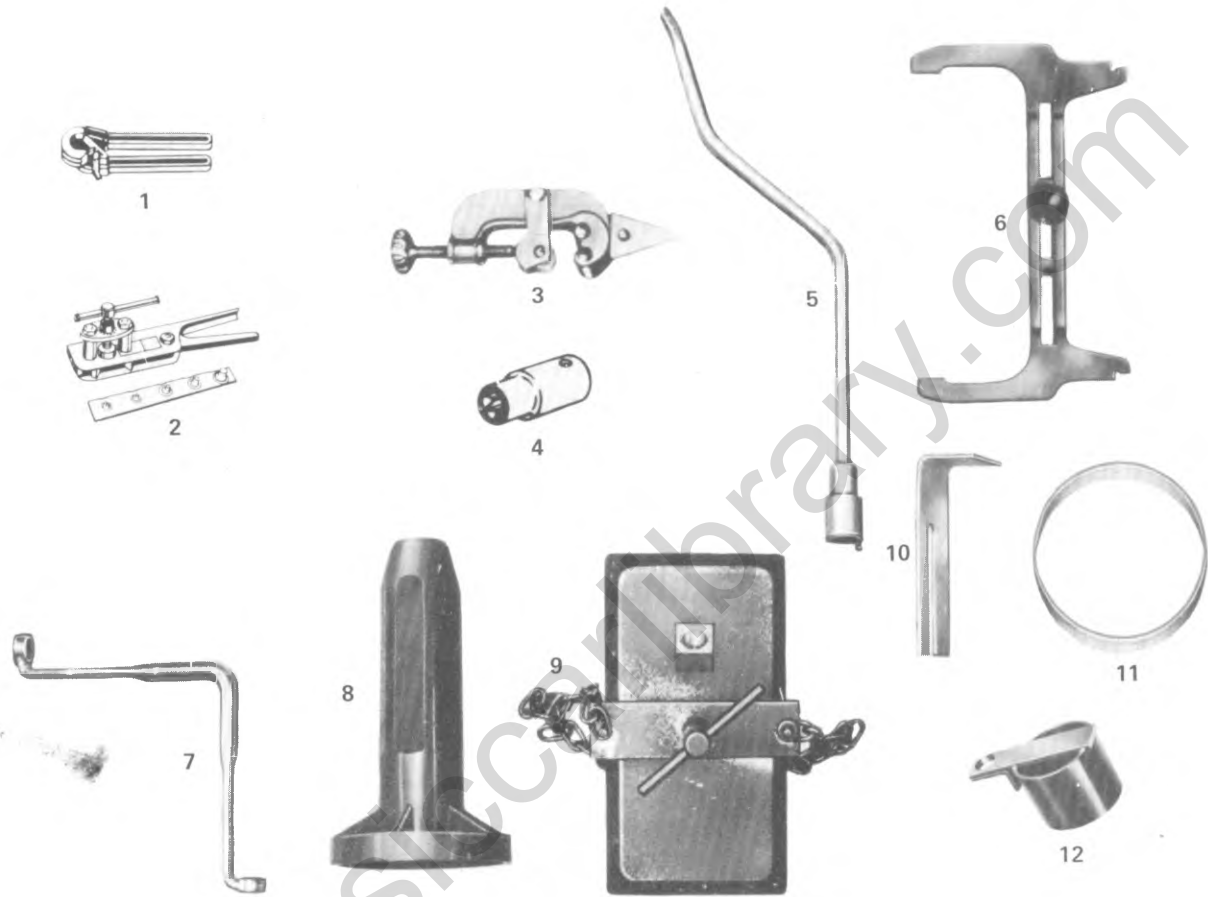
	C	K	G	P
Master Cylinder - to Dash or Booster	**25 ft. lbs.	**25 ft. lbs.	25 ft. lbs.	25 ft. lbs.
Booster to Dash or Frame	**25 ft. lbs.	**25 ft. lbs.	25 ft. lbs.	25 ft. lbs.
Combination Valve - Mounting Bolts	150 in. lbs.	150 in. lbs.	17 ft. lbs.	17 ft. lbs.
- Bracket	-	-	25 ft. lbs.	25 ft. lbs.
Caliper - Mounting Bolt	35 ft. lbs.			
- Support Plate to Knuckle	140 in. lbs.			
Brake Pedal - Bracket to Dash	25 ft. lbs.	25 ft. lbs.	150 in. lbs.	25 ft. lbs.
- Bracket to I.P.	25 in. lbs.	25 in. lbs.	-	-
- Pivot Bolt Nut	25 ft. lbs.	25 ft. lbs.	-	45 ft. lbs.
- Sleeve to Bracket	-	-	-	85 in. lbs.
- Stoplamp Switch Bracket	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.	-
- Push Rod to Pedal	-	-	-	25 ft. lbs.
- Push Rod Adjusting Nut	-	-	-	22 ft. lbs.
Parking Brake - to Dash	100 in. lbs.	100 in. lbs.	100 in. lbs.	-
- to I.P., Kick Panel or Floorpan	150 in. lbs.	150 in. lbs.	100 in. lbs.	18 ft. lbs.
- Cable Clips - Screws	17 N·m(150in.lbs.)	-	12 N·m(100in.lbs.)	17 N·m(150in.lbs.)
- Bolts	150 in. lbs.	-	18 ft. lbs.	55 in. lbs.
Propshaft Parking Brake - Adjusting Nut	-	-	-	30 ft. lbs.
- Bracket to Trans.	-	-	-	20 ft. lbs.
- Cable Clip to Frame	-	-	-	150 in. lbs.
- Cable Clip to Dash	-	-	-	55 in. lbs.
- Cable Clip to Trans. Brkt.	-	-	-	20 ft. lbs.
- Flange Plate	-	-	-	30 ft. lbs.
- Drum	-	-	-	80 ft. lbs.
Wheel Cylinder to Flange Plate Bolt	50 in. lbs. (180 in. lbs. on JB5, JB6, JB7 and JB8)			
Rear Brake Anchor Pin	140 ft. lbs. (230 ft. lbs. JB7 and JB8)			
Front Brake Hose - to Caliper	44 N·m(32ft.lbs.)			
- to Frame Nut	58 in. lbs.			
- Bracket Bolt	150 in. lbs.	-	150 in. lbs.	150 in. lbs.
Rear Brake Hose - to Axle Bracket	150 in. lbs.	150 in. lbs.	90 in. lbs.	150 in. lbs.
- Bracket to Axle	150 in. lbs.*	150 in. lbs.*	-	150 in. lbs.*
Brake Line - Attaching Nuts	150 in. lbs.			
- Retaining Clips - Screws	17 N·m(150in.lbs.)	17N·m(150in.lbs.)	12 N·m(100in.lbs.)	17 N·m(150in.lbs.)
- Bolts	-	-	150 in. lbs.	18 ft. lbs.
Brake Bleeder Valves	60 in. lbs.			
Hydro-Boost - Pedal Rod - P30(32) Models	-	-	-	25 ft. lbs.
- Pedal Rod Boot - P30(32)Models	-	-	-	15 in. lbs.
- Pivot Lever Rod Retainer	-	-	-	25 ft. lbs.
- Pivot Lever Bolt	-	-	-	45 ft. lbs.
- Booster Brackets	-	-	-	25 ft. lbs.
- Booster Brace at Dash or Rad. Supt.	-	-	-	150 in. lbs.
- Power Steering Pump to Booster Line	25 ft. lbs.			
- Booster to Gear Line	25 ft. lbs.			
- Return Line at Booster & Gear	25 ft. lbs.			
- Return Line Clamp Screw	15 in. lbs.			
- Line Clamp to Bracket Screw	150 in. lbs.			
- Hose Clamp to Skirt Screw	40 in. lbs.	-	-	-
- Line Clamp to Frame Bolt	150 in. lbs.	-	-	150 in. lbs.

*20 ft. lbs. (CKP20-30)

**32 ft. lbs. — Master Cylinder to Booster

↪ Master Cylinder or Booster to Dash Reinforcement

SPECIAL TOOLS



- 1. J-25310 Tubing Bender
- 2. J-23530 Flaring Tool
- 3. J-23533 Tubing Cutter
- 4. J-25085 Socket
- 5. J-8049 or J-22348 Spring Remover
- 6. J-21177 or J-22364 Drum/Shoe Gauge

- 7. J-21472 or J-22364 Bleeder Wrench
- 8. J-22904 Dust Boot Installer
- 9. J-23518 Bleeder Adapter
- 10. J-23709 Combination Valve Pin Retainer
- 11. J-24548 Dust Boot Installer
- 12. J-26889 Accumulation Piston Compressor

Fig. 5-63--Special Tools

SECTION 6A

ENGINE MECHANICAL

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ENGINE IDENTIFICATION

THIRD CHARACTER IS ENGINE CODE T C D 1 4 8 1 1 0 0 0 1			
CODE	TYPE	DISP. Litre/Cu. In.	SECTION
D	L6	4.1L/250	6A1
T	L6	4.8L/292	6A1
U	V8	5.0L/305	6A2
L	V8	5.7L/350	6A2
R	V8	6.6L/400	6A2
S	V8	7.4L/454	6A2
Z	V8 DIESEL	5.7L/350	6A3

Fig. 6A-1—Engine Codes

All engines used in 1978 are referred to by their litre displacement followed by the VIN code letter in parenthesis. This VIN code can be found on the vehicle by observing the VIN plate located on the left door striker pillar. The third character in the VIN code identifies the engine (fig. 6A-1).

All engines have a portion of the VIN number and a build date code stamped on the cylinder case.

The 6-cylinder stamping is on the right hand side on the distributor pad. An optional code location is at the left rear of the cylinder and case on the bellhousing/converter housing mounting surface (Fig. 6A-2).

Small block 8-cylinder engines have the stamping on top front of right hand bank of cylinder and case. The optional location is rear of the oil filter on the left side of the engine (Fig. 6A-2).

The Mark IV 8-cylinder engines (big block) have the same stamping locations as the small blocks with the addition of a stamping location in front of the engine, above the timing chain cover (Fig. 6A-3).

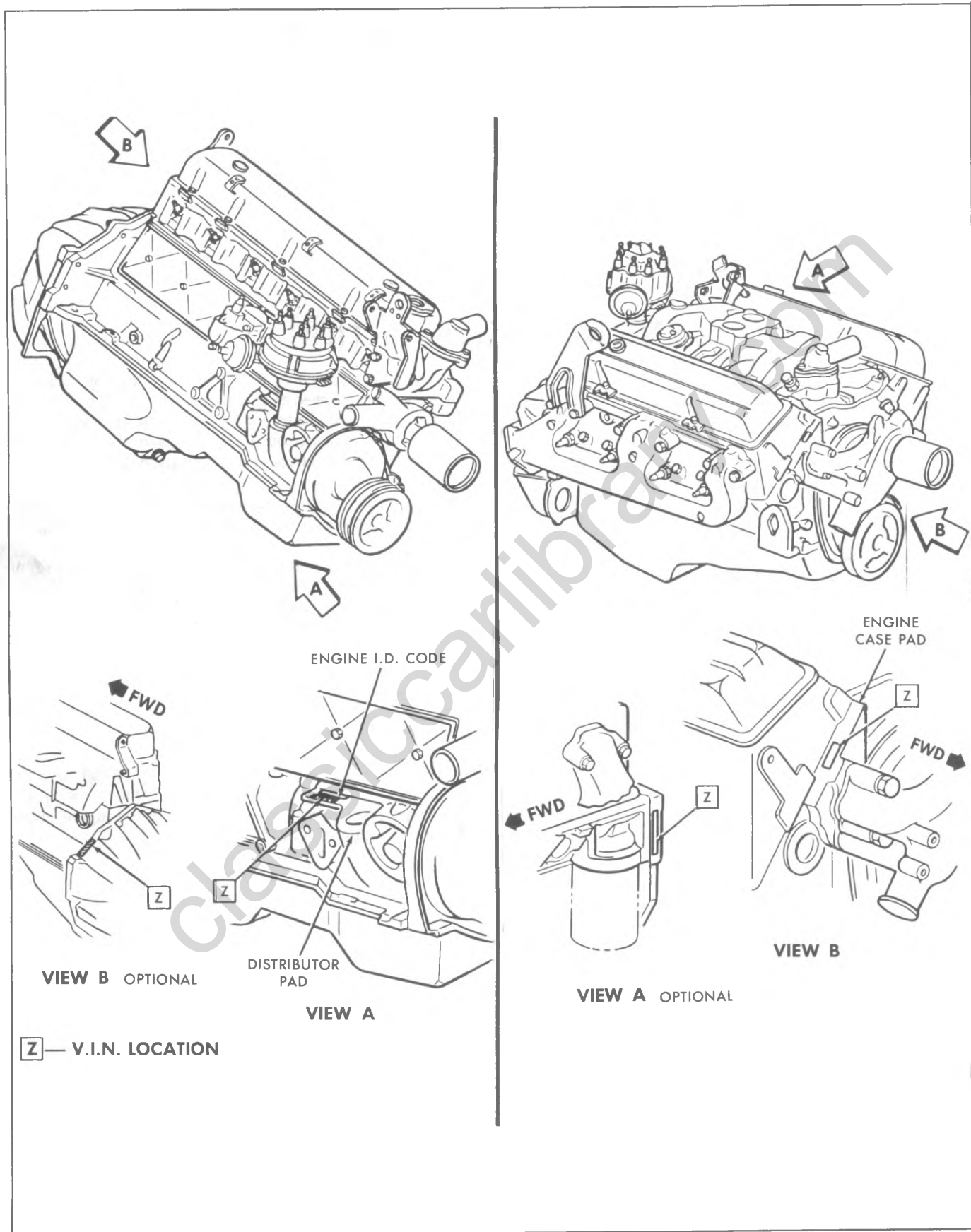


Fig. 6A-2--VIN Locations L-6 & Small V-8

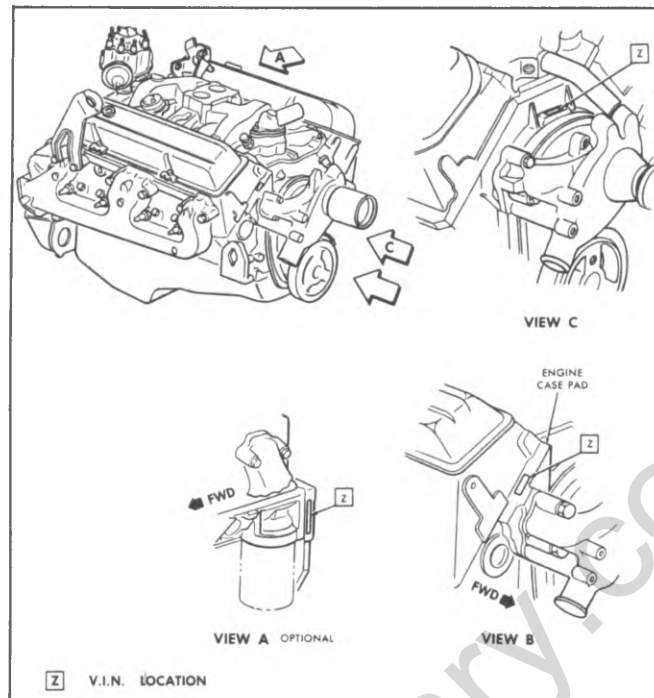


Fig. 6A-3--VIN Locations (MK IV V-8)

DIAGNOSIS

ENGINE FAILS TO START

- a. Check for sufficient fuel to operate engine.
- b. Carburetor flooded and/or fuel level in carburetor bowl not correct.
- c. Dirt and water in gas line or carburetor.
- d. Sticking choke.
- e. Faulty fuel pump.
- f. Corroded or loose battery terminal connections and/or weak battery.
- g. Broken or loose ignition wires and/or faulty ignition switch.
- h. Excessive moisture on plugs, caps or ignition system.
- i. Damaged distributor rotor or cracked distributor cap.
- j. Fouled spark plugs and/or improper spark plug gap.
- k. Weak or faulty coil.
- l. Faulty solenoid or starting motor.
- m. Park or neutral switch inoperative.

ENGINE LOPES WHILE IDLING

- a. Check for air leaks between intake manifold and head.
- b. Check for blown head gasket.
- c. Check for worn timing gears, chain or sprockets.
- d. Check for worn camshaft lobes.
- e. Check for overheated engine.
- f. Check for plugged crankcase vent valve.
- g. Check for faulty fuel pump.
- h. Check for leaky EGR valve.

ENGINE MISSES WHILE IDLING

- a. Check, inspect and regap spark plugs. Replace as necessary.
- b. Remove moisture from spark plug wires and/or distributor cap.
- c. Check for broken or loose ignition wires. Repair or replace as necessary.
- d. Check condition of cylinders for uneven compression. Repair as necessary.
- e. Check for weak or faulty HEI system coil as outlined in Section 6D of this manual.
- f. Inspect condition of distributor cap and rotor. Replace if damaged or cracked.
- g. Check carburetor for internal obstructions, incorrect idle speed, faulty altitude compensator, sticking choke or

enrichment system and adjust, repair or replace as necessary.

h. Inspect carburetor fuel filter for presence of water and/or impurities and correct as necessary.

i. Check carburetor mounting gasket for air leaks. Repair as necessary.

j. Check distributor spark advance mechanism for proper operation. Repair or replace as necessary.

k. Inspect valve train components. Adjust, repair and/or replace as necessary.

l. Check engine for low compression. Repair as

necessary.

m. Check operation of exhaust gas recirculation valve. Repair or replace as necessary.

n. Check ignition timing, and condition of ignition system as outlined in Section 6D of this manual. Correct as necessary.

o. Check for vacuum leaks. Correct as necessary.

p. Check operation of EFE valve as outlined in Section 6E of this manual. Repair or replace as necessary.

ENGINE MISSES AT VARIOUS SPEEDS

a. Inspect carburetor fuel filter for presence of water and/or impurities. Correct as necessary.

b. Check fuel system for leaks, plugged fuel lines, incorrect fuel pump pressure and/or plugged carburetor jets. Correct as necessary.

c. Check ignition timing. Correct as necessary.

d. Check for excessive play in distributor shaft. Repair or replace as necessary.

e. Check for weak or faulty H.E.I. system coil as outlined in Section 6D of this manual.

f. Check, inspect and regap spark plugs. Replace as necessary.

g. Detonation and pre-ignition may be caused by using sub-standard fuel. Correct as necessary.

h. Check for weak valve springs and condition of

camshaft lobes. Repair or replace as necessary.

i. Check engine operating temperature. Correct as necessary.

j. Check operation of exhaust gas recirculation valve. Repair or replace as necessary.

k. Inspect distributor cap for evidence of carbon tracking. Replace if necessary.

l. Check for faulty altitude compensator and incorrect carburetor adjustments. Correct as necessary.

m. Check for vacuum leaks. Correct as necessary.

n. Check operation EFE valve as outlined in Section 6E of this manual. Repair or replace as necessary.

ENGINE STALLS

a. Check carburetor for incorrect and/or misadjusted idle speed, float level, leaking needle and seat, air valve, sticking choke or enrichment system and secondary vacuum break operation. Adjust, repair or replace as necessary.

b. Inspect carburetor fuel filter for presence of water and/or impurities. Correct as necessary.

c. Check H.E.I. system as outlined in Section 6D of this manual.

d. Check, inspect and regap spark plugs. Replace as necessary.

e. Check distributor spark advance mechanism for proper operation. Repair or replace as necessary.

f. Inspect exhaust system for restrictions. Correct as necessary.

g. Check carburetor mounting gasket for air leaks. Repair as necessary.

h. Check and adjust valve lash.

i. Check for burned, warped or sticking valves. Repair

or replace as necessary.

j. Check engine for low compression. Repair as necessary.

k. Check engine operating temperature. Correct as necessary.

l. Check for loose, corroded or leaking wiring connections (bulk-head connectors, etc.). Repair as necessary.

m. Check operation of exhaust gas recirculation system. Repair or replace as necessary.

n. Check fuel system for leaks and/or obstructions. Repair as necessary.

o. Check for vacuum leaks. Correct as necessary.

p. Check operation of EFE valve as outlined in Section 6E of this manual. Repair or replace as necessary.

ENGINE HAS LOW POWER

a. Check for weak or faulty H.E.I. system coil as outlined in Section 6D of this manual.

b. Check ignition timing. Correct as necessary.

c. Check for excessive play in distributor shaft. Repair or replace as necessary.

d. Check, inspect and regap spark plugs. Replace as necessary.

e. Check carburetor for incorrect and/or misadjusted idle speed, float level, leaking needle and seat, air valve and sticking choke or enrichment system. Adjust, repair or replace as necessary.

f. Inspect carburetor fuel filter for presence of water and/or impurities. Correct as necessary.

g. Check fuel pump for leaks and proper operation.

Correct as necessary.

h. Check for sticking valves, weak valve springs, incorrect valve timing, lifter noise and worn camshaft lobes. Adjust, repair or replace as necessary.

i. Check for excessive piston to bore clearance. Correct as necessary.

j. Check condition of cylinders for uneven compression and/or blown head gasket. Repair as necessary.

k. Check power steering flow control valve operation. Repair or replace as necessary.

l. Check for clutch slippage (vehicles with manual transmissions) and adjust or replace as necessary.

m. Check hydraulic brake system for proper operation. Correct as necessary.

n. Check engine operating temperature. Correct as necessary.

o. Check pressure regulator valve (automatic transmission) for proper operation. Repair as necessary.

p. Check transmission fluid level. Correct as necessary.

q. Loss of power may be caused by using sub-standard fuel. Correct as necessary.

r. Check operation of EFE valve as outlined in Section 6E of this manual. Repair or replace as necessary.

s. Check operation of diverter valve (A.I.R. system). Repair or replace as necessary.

t. Check for engine vacuum leaks. Correct as necessary.

ENGINE DIESELING ON SHUT OFF

a. Check base idle speed for improper adjustment and correct as necessary.

b. Check ignition timing and reset to specifications if required.

c. Check idle mixture setting and correct as necessary.

d. Check accelerator and choke linkage operation and correct as necessary.

e. Check engine operating temperature and correct as necessary.

f. Check thermac valve for sticking and correct as necessary.

ENGINE DETONATION

a. Check for overadvanced ignition timing and/or faulty ignition system and correct as necessary.

b. Check for loose or improper application of spark plugs, or spark plugs with cracked or broken ceramic cores and replace as necessary.

c. Check for the use of sub-standard fuel and correct as necessary.

d. Check for foreign material in fuel lines and/or carburetor and correct as necessary.

e. Check for restricted fuel delivery to carburetor (pinched lines, faulty fuel tank cap or pick-up) and correct as necessary.

f. Check fuel pump operation and replace if necessary.

g. Check EFE system operation and repair or replace as necessary.

h. Check EGR system operation and correct as

necessary.

i. Check thermostatically controlled air cleaner operation and correct as necessary.

j. Check P.C.V. system operation and correct as necessary.

k. Check for vacuum leaks and repair or replace as necessary.

l. Check engine operating temperature and correct as necessary.

m. Check for excessive combustion chamber deposits and correct as necessary.

n. Check for leaking, sticking, or broken valves and repair or replace as necessary.

EXTERNAL OIL LEAKAGE

a. Check for improperly seated or fuel pump gasket. Replace as necessary.

b. Check for improperly seated or broken push rod cover gasket. Replace as necessary.

c. Check for improperly seated or broken oil filter gasket. Replace as necessary.

d. Check for broken or improperly seated oil pan gasket. Replace as necessary.

e. Inspect gasket surface of oil pan to be bent or distorted. Repair or replace as necessary.

f. Check for improperly seated or broken timing chain cover gasket. Replace as necessary.

g. Inspect timing cover oil seal. Replace if necessary.

h. Check for worn or improperly seated rear main

bearing oil seal. Replace if necessary.

i. Inspect for loose oil line plugs. Repair or replace if necessary.

j. Check for engine oil pan drain plug improperly seated. Correct as necessary.

k. Inspect camshaft rear bearing drain hole for obstructions. Correct as necessary.

l. Check for loose rocker arm cover. Broken or distorted cover correct as necessary.

m. Check EFE valve switch for leakage. Replace if necessary.

n. Check oil pressure switch for leakage. Replace if necessary.

EXCESSIVE OIL CONSUMPTION DUE TO OIL ENTERING COMBUSTION CHAMBER THROUGH HEAD AREA

- a. Check for intake valve seats to be damaged, missing or loose. Repair or replace as necessary.
 - b. Check for worn valve stems or guides. Repair as necessary.
 - c. Inspect for plugged oil drain back holes in head.
 - d. Inspect PCV system operation. Correct as necessary.
- Correct as necessary.

EXCESSIVE OIL CONSUMPTION DUE TO OIL ENTERING COMBUSTION CHAMBER BY PASSING PISTON RINGS

- a. Check engine oil level too high. Correct as necessary.
- b. Check for piston ring gaps not staggered and correct as necessary.
- c. Check for incorrect size rings installed and correct as necessary.
- d. Check for piston rings out of round, broken or scored and replace as necessary.
- e. Inspect insufficient piston ring tension due to engine overheating and replace as necessary.
- f. Check for ring grooves or oil return slots clogged and corrected as necessary.
- g. Inspect rings sticking in ring grooves of piston and correct as necessary.
- h. Inspect ring grooves worn excessively in piston and correct as necessary.
- i. Inspect compression rings installed upside down and correct as necessary.
- j. Check for excessively worn or scored cylinder walls and correct as necessary.
- k. Inspect oil too thin and replace if necessary.
- l. Inspect mis-match of oil ring expander and rail and correct as necessary.

NO OIL PRESSURE WHILE IDLING

- a. Check faulty oil gauge sending unit, and correct as necessary.
- b. Check for oil pump not functioning properly. (Regulator ball stuck in position by foreign material) and correct as necessary.
- c. Inspect for excessive clearance at main and connecting rod bearings and correct as necessary.
- d. Inspect for loose camshaft bearings and correct as necessary.
- e. Inspect leakage at internal oil passages and correct as necessary.

NO OIL PRESSURE WHILE ACCELERATING

- a. Check low oil level in oil pan and correct as necessary.
- b. Inspect leakage at internal oil passages and correct as necessary.
- c. Check oil pump suction screen loose or fallen off and correct as necessary.

BURNED, STICKING OR BROKEN VALVES

- a. Check for weak springs and replace as necessary.
- b. Check for improper valve lifter clearance and adjust as necessary.
- c. Check for improper valve guide clearance and/or worn valve guides and correct as necessary.
- d. Check for out-of-round valve seats or incorrect valve seat width and correct as necessary.
- e. Check for deposits on valve seats and/or gum formation on stems or guides and correct as necessary.
- f. Check for warped valves or faulty valve forgings and correct as necessary.
- g. Check for exhaust back pressure and correct as necessary.
- h. Check improper spark timing and correct as necessary.
- i. Check excessive idling and correct as necessary.

NOISY VALVES

- a. Check and adjust valve lash if necessary.
- b. Check for excessively worn, dirty or faulty valve lifters. Replace if necessary.
- c. Check for worn valve guides. Repair as necessary.
- d. Check for excessive run-out of valve seat or valve face. Repair as necessary.
- e. Check for worn camshaft lobes. Replace camshaft

if necessary.

f. Inspect for pulled or loose rocker arm studs. Repair or replace as necessary.

g. Check for bent push rods. Replace if necessary.

h. Inspect for broken valve spring. Replace if necessary.

NOISY PISTONS AND RINGS

a. Check for excessive piston to bore clearance. Correct as necessary.

b. Inspect for improper fit of piston pin. Correct as necessary.

c. Inspect for excessive accumulation of carbon in combustion chamber or on piston tops. Clean and/or repair as necessary.

d. Check for connecting rods alignment. Correct as necessary.

e. Inspect for excessive clearance between rings and grooves. Repair or replace as necessary.

f. Check for broken piston rings. Replace as necessary.

BROKEN PISTONS AND/OR RINGS

a. Check for undersize pistons. Replace if necessary.

b. Check for wrong type and/or size rings installed. Replace if necessary.

c. Check for tapered or eccentric cylinder bores. Correct as necessary.

d. Check connecting rod alignment. Replace if necessary.

e. Check for excessively worn ring grooves. Replace if necessary.

f. Check for improperly assembled piston pins. Replace as necessary.

g. Check for insufficient ring gap clearance. Correct as necessary.

h. Inspect for engine overheating. Correct as necessary.

i. Check for sub-standard fuel. Correct as necessary.

j. Check ignition timing. Correct as necessary.

NOISY CONNECTING RODS

a. Check connecting rods for improper alignment and correct as necessary.

b. Check for excessive bearing clearance and correct as necessary.

c. Check for eccentric or out-of-round crankshaft journals and correct as necessary.

d. Check for insufficient oil supply and correct as

necessary.

e. Check for low oil pressure and correct as necessary.

f. Check for connecting rod bolts not tightened correctly and correct as necessary.

NOISY MAIN BEARINGS

a. Check low oil pressure and/or insufficient oil supply and correct as necessary.

b. Check for excessive bearing clearance and correct as necessary.

c. Check for excessive crankshaft end play and correct as necessary.

d. Check for eccentric or out-of-round crankshaft

journals and correct as necessary.

e. Check for excessive belt tension and adjust as necessary.

f. Check for loose torsional damper and replace as necessary.

NOISY VALVE LIFTERS

- a. Check for broken valve springs and replace as necessary.
- b. Check for worn or sticking rocker arms and repair or replace as necessary.
- c. Check for worn or bent push rods and replace as necessary.
- d. Check for valve lifters incorrectly fitted to bore size and correct as necessary.
- e. Check faulty valve lifter plunger or push rod seat and replace lifters as necessary.
- f. Check for plungers excessively worn causing fast leakdown under pressure and replace as necessary.
- g. Check for excessively worn camshaft lobes and replace if necessary.
- h. Check valve lifter oil feed holes plugged causing internal breakdown and correct as necessary.
- i. Check faulty valve lifter check ball. (nicked, flat spot, or out of round) and replace as necessary.
- j. Check rocker arm retaining nut to be installed upside down and correct as necessary.
- k. Check for end of push rod excessively worn or flaked and replace as necessary.

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Condition	Possible Cause	Correction
Engine Will Not Crank	Loose or Corroded Battery Cables	Check connections at battery, engine block and starter solenoid.
	Discharged Batteries	Check generator output as described in Section 6D.
	Starter Inoperative	Refer to Starter Diagnosis as described in Section 6D.
Engine Cranks Slowly - Will Not Start (Minimum Engine Cranking Speed - 100 RPM)	Battery Cable Connections Loose or Corroded	Check connections at battery, engine block and starter.
	Batteries Undercharged	Check charging system as described in Section 6D.
	Wrong Engine Oil	Drain and refill with recommended oil.
Engine Cranks Normally - Will Not Start	Incorrect Starting Procedure	Use recommended starting procedure.
	Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	No Fuel to Nozzles	Loosen injection line at a nozzle. Do not disconnect. Use care to direct fuel away from sources of ignition. Wipe connection to be sure it is dry. Crank 5 seconds. Fuel should flow from injection line. Tighten connection. If fuel does not flow, check fuel solenoid operation as follows: Connect a 12 volt test lamp from wire at injection pump solenoid to ground. Turn ignition to "ON". Lamp should light. If lamp does not light, check wiring to solenoid.
	No Fuel to Injection Pump	Remove line at inlet to injection pump fuel filter. Connect hose from line to metal container. Crank engine. If no fuel is discharged, test the fuel supply pump. If the pump is OK, check the injection pump fuel filter and, if plugged, replace it.
	Plugged Fuel Return System	Disconnect fuel return line at injection pump. Connect a hose from the return line to a metal container. Connect a second hose to the injection pump connection; route it to the metal container. Crank the engine; if engine starts and runs, correct restriction in fuel return system.

Fig. 6A-4--Diesel Diagnosis

Condition	Possible Cause	Correction
Engine Cranks Normally – Will Not Start (Cont'd)	<p>Pump Timing Incorrect</p> <p>Glow Plug Control System Inoperative</p> <p>Glow Plugs Inoperative</p> <p>Internal Engine Problems</p>	<p>Make certain that pump timing mark is aligned with mark on adapter.</p> <p>Disconnect wires from one glow plug on each bank. Use care that disconnected wires do not ground to chassis. Connect a 12 volt test lamp in turn from each glow plug wire to ground. Turn ignition to "ON". Test lamp should light while instrument panel lamp signals "DON'T START".</p> <p>NOTE: Cycle ignition switch to "OFF" between tests to recycle glow plug circuitry. If instrument panel lamp does not signal "DON'T START", engine is warm; glow plug circuitry is not called for; disconnect wire from glow plug circuit thermistor on intake manifold; "DON'T START" lamp and glow plug circuitry will remain "ON" for approximately 2 minutes each time ignition is switched "ON" allowing sufficient time to conduct test.</p> <p>If test lamp does not light as outlined above, refer to Electronics Diagnosis Section.</p> <p>Disconnect wire from each glow plug. With 12 volt test lamp connected to 12 volt source, touch each glow plug terminal.</p> <ol style="list-style-type: none"> a. If test lamp lights, glow plug is operational. b. If test lamp does not light, replace glow plug or plugs. <p>Refer to Engine Section 6A.</p>
Engine Starts But Will Not Continue To Run At Idle	<p>No Fuel in Tank</p> <p>Incorrect or Contaminated Fuel</p> <p>Limited Fuel to Injection Pump</p> <p>Fuel Solenoid Disengaged with Ignition Switch in the "ON" Position</p>	<p>Install correct fuel in tank.</p> <p>Flush fuel system and install correct fuel.</p> <p>Test the fuel supply pump. Replace as necessary.</p> <p>Connect a 12 volt test lamp from wire at injection pump solenoid to ground. Turn ignition to "ON". Lamp should light. Turn ignition to "START". Lamp should light. If lamp does not light in both positions, check wiring to solenoid.</p>

Fig. 6A-5--Diesel Diagnosis

Condition	Possible Cause	Correction
Engine Starts But Will Not Continue To Run At Idle (Cont'd)	Restricted Fuel Return System	Disconnect fuel return line at injection pump. Connect a hose from the return line to a metal container. Connect a second hose to the injection pump connection; route it to the metal container. Start the engine and allow it to idle. If engine idles normally, correct restriction in fuel return system.
	Fast Idle Solenoid Inoperative	With engine cold, start car; solenoid should move to support injection pump lever in "fast idle position" for about 5 seconds. If solenoid does not move, refer to Diesel Electrical Diagnosis Section 6D.
	Low Idle Incorrectly Adjusted	Adjust idle screw to specification.
	Pump Timing Incorrect	Make certain that timing mark, on injection pump, is aligned with mark on adapter.
	Glow Plug Control System Malfunction	Refer to Electrical Diagnosis Section 6D.
	Injection Pump Malfunction	Install replacement pump.
Engine Starts, Idles Rough, Without Abnormal Noise or Smoke	Low Idle Incorrectly Adjusted	Adjust idle screw to specification.
	Injection Line Leaks	Wipe off injection lines and connections. Run engine and check for leaks. Correct leaks.
	Restricted Fuel Return System	Disconnect fuel return line at injection pump. Connect a hose from the return line to a metal container. Connect a second hose to the injection pump connection; route it to the metal container. Start the engine and allow it to idle; if engine idles normally, correct restriction in fuel return system.
	Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	Nozzle(s) Inoperative	With engine running, loosen injection line fitting at each nozzle in turn. Use care to direct fuel away from sources of ignition. Each nozzle should contribute to rough running. If nozzle is found that does not change idle quality, it should be replaced.
Internal Engine Problems	Refer to Engine Section 6A.	

Fig. 6A-6--Diesel Diagnosis

Condition	Possible Cause	Correction
Engine Starts, Idles Rough, Without Abnormal Noise or Smoke (Cont'd)	Internal Fuel Leak at Nozzle(s)	Disconnect fuel return system from nozzles on one bank at a time. With the engine running, observe the normal fuel seepage at the nozzles. Replace any nozzle with excessive fuel leakage.
	Fuel Supply Pump Malfunctions	Test the fuel supply pump. Replace if necessary.
	Uneven Fuel Distribution to Cylinders	Install new or reconditioned nozzles, one at a time, until condition is corrected as indicated by normal idle.
Engine Starts And Idles Rough With Excessive Noise and/or Smoke	Injection Pump Timing Incorrect	Be sure timing mark on injection pump is aligned with mark on adapter.
	Nozzle(s) Inoperative	With engine running, crack injection line at each nozzle, one at a time. Use care to direct fuel away from sources of ignition. Each nozzle should contribute to rough running. If a nozzle is found that does not affect idle quality or changes noise and/or smoke, it should be replaced.
	High Pressure Lines Incorrectly Installed	Check routing of each line. Correct as required.
Engine Misfires But Idles Correctly	Plugged Fuel Filter	Replace filter.
	Incorrect Injection Pump Timing	Be sure that timing mark on injection pump and adapter are aligned.
	Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	Internal Engine Damage	Refer to Engine Section 6A.
Engine Will Not Return To Idle	External Linkage Mis-adjustment or Failure	Reset linkage or replace as required.
	Internal Injection Pump Malfunction	Install replacement injection pump.
Fuel Leaks On Ground - No Engine Malfunction	Loose or Broken Fuel Line or Connection	Examine complete fuel system, including tank, supply, injection and return system. Determine source and cause of leak and repair.
	Internal Injection Pump Failure	Install replacement injection pump.
Significant Loss of Power	Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	Pinched or Otherwise Restricted Return System	Examine system for restriction and correct as required.

Fig. 6A-7--Diesel Diagnosis

Condition	Possible Cause	Correction
Significant Loss of Power (Cont'd)	Plugged Fuel Tank Vent Restricted Supply Plugged Fuel Filter External Compression Leaks Plugged Nozzle(s) Internal Engine Problem	Remove fuel cap. If "hissing" noise is heard, vent is plugged and should be cleaned. Examine fuel supply system to determine cause of restriction. Repair as required. Remove and replace filter. Check for compression leaks at all nozzles and glow plugs, using "Leak-Tec" or equivalent. If leak is found, tighten nozzle clamp or glow plug. If leak persists at a nozzle, remove it and reinstall with a new carbon stop seal and compression seal. Remove nozzles, check for plugging and have repaired or replaced. See Engine Section 6A.
Noise - "Rap" From One or More Cylinders	Air in Fuel System Air in High Pressure Line(s) Nozzle(s) Sticking Open or with Very Low Blowoff Pressure Internal Engine Problem	Check for leaks and correct. Crack line at nozzle(s) and bleed air at each cylinder determined to be causing noise. Use care to direct fuel away from sources of ignition and be sure to carefully retighten lines. Replace the nozzle(s) causing the problem. See Engine Section 6A.
Noise - Significant Overall Combustion Noise Increase With Excessive Black Smoke	Timing Not Set To Specification Internal Engine Problem Injection Pump Housing Pressure Out of Specifications. Internal Injection Pump Problem	Align timing marks on adapter and injection pump. Check for presence of oil in the air crossover. If present, determine cause and correct. See Engine Section 6A for disassembly and inspection procedures. Check housing pressure as described in Section 6A5. If incorrect, replace fuel return line connector assembly. Replace pump.
Noise - Internal or External	Fuel Supply Pump, Alternator, Water Pump, Valve Train, Short Block, Etc.	See appropriate section of Service Manual for inspection, disassembly and repair procedures.

Fig. 6A-8--Diesel Diagnosis

Condition	Possible Cause	Correction
Engine Overheats	Coolant System Leak Oil Cooler System Leak Belt Failure Thermostat Malfunction Head Gasket Failure Internal Engine Problem	Check for leaks and correct as required. Replace. See Engine Section 6 for diagnosis and repair procedures.
Instrument Panel Oil Warning Lamp "ON" at Idle	Oil Cooler or Oil Cooler Line Restricted Internal Engine Problem	Remove restriction in cooler or cooler line. See Engine Section for diagnosis and repair procedures.
Odor or Smoke - Excessive and Not Previously Covered	Same as Gasoline Engines	See Engine Section 6A.
Engine Will Not Shut Off With Key NOTE: With engine at idle, pinch the fuel return line at the injection pump to shut off engine.	Injection Pump Solenoid Does Not Drop Out Injection Pump Solenoid Return Spring Failed	See Electronics Diagnosis Section 6D. If problem is determined to be internal with the injection pump, replace the injection pump. Replace injection pump.

Fig. 6A-9.-Diesel Diagnosis

Section 6A1

Contents

4.1 (D) 250 cu. in. L-6

4.8 (T) 292 cu. in. L-6

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GENERAL DESCRIPTION

CYLINDER BLOCK

The cylinder block is made of cast iron and has 6 cylinders arranged "In-Line". Seven main bearings support the crankshaft which is retained by recessed bearing caps that are machined with the block for proper alignment and clearances. Cylinders are completely encircled by coolant jackets.

CYLINDER HEAD

The cast iron cylinder head provides a compression ratio of 8.1:1. It is cast with individual intake and exhaust ports for each cylinder. Valve guides are integral and rocker arms are retained on individual threaded studs pressed into head. The 4.1(D) heads have integrated inlet manifolds on vehicles in California only. All other L-6 applications use separate inlet manifolds.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron and is supported by seven main bearings. Number seven bearing is the end thrust bearing. Main bearings are lubricated from oil holes which intersect the main oil gallery located on the right side of the block. The cam bearings are also fed oil by intersecting holes with main oil gallery. The lifters are located in the main oil gallery.

A damper assembly, on the forward end of the crankshaft, dampens any engine torsional vibrations. The outer ring of the damper is grooved for the accessory drive belts.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by four bearings and is gear driven. A cast iron crankshaft gear drives the aluminum camshaft gear. Cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with a spherical face on the lifters, causes the valve lifters to rotate.

PISTONS AND CONNECTING RODS

The pistons are made of a cast aluminum alloy using two compression rings and one oil control ring.

Piston pins in the 4.1 (D) engine are offset .060" toward the thrust side (right hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. This also provides for quieter operation. 4.8 (T) engine piston pins are on piston centerline for best durability and reduced friction. Pins are chromium steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just prior to full bearing load.

VALVE TRAIN

A very simple ball pivot-type train is used. Motion is transmitted from the camshaft through the hydraulic lifters and push rods to the rocker arms. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker arm ball is retained by a self locking nut.

HYDRAULIC VALVE LIFTERS

Hydraulic Valve Lifters are used to keep all parts of the valve train in constant contact for quiet operation.

The hydraulic lifter assembly consists of: the lifter body, which rides in the cylinder block boss, a plunger, a push rod seat, a metering valve, a plunger spring, a check ball and spring, a check ball retainer and a push rod seat retainer.

When the lifter is riding on the low point (base circle) of the cam, the plunger spring keeps the plunger and push rod seat in contact with the push rod.

When the lifter body begins to ride up the cam lobe, the check ball traps the oil in the reservoir below the plunger. The plunger and lifter body then rise as a unit, pushing up the push rod and opening the valve. A very small amount of oil will leak out between the plunger and the body.

As the lifter body rides down the other side of the cam, the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the push rod. The ball check valve will then move off its seat and the lifter reservoir will be refilled with oil.

INTAKE MANIFOLD

The intake manifold is of cast iron, single level design for efficient fuel distribution. The 4.1 (D) manifold is an integral unit with the head on all California vehicles only. All other L6 engine applications use separate components. The carburetor pad is centrally located with an early fuel evaporation (EFE) passage running underneath the pad, through which exhaust gases are forced, to promote faster

fuel vaporization when the engine is cold. An exhaust gas recirculation port is also cast into the manifold for the induction of a metered amount of exhaust gases into the air and fuel mixture which has entered through the carburetor.

EXHAUST MANIFOLD

A single four port, underslung, center take down manifold of cast iron is used to direct exhaust gases from the combustion chambers. A heat shield is mounted to the manifold that is used to route heated air to the air cleaner for better fuel vaporization.

ENGINE SERVICE

NOTE: The following information is important in preventing engine damage and in providing reliable engine performance.

When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

It should be kept in mind, while working on the engine, that the 12-volt electrical system is capable of violent and damaging short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected at the battery.

Any time the carburetor or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

Engine Lubrication

Full pressure lubrication, through a full flow oil filter is furnished by a gear-type oil pump. The distributor, driven by a helical gear on the camshaft, drives the oil pump.

Oil drawn by the pick up screen and pipe is pressurized in the pump and routed to the oil filter. If excessive backpressure is encountered at the filter, a bypass valve allows oil flow to the main oil gallery, located along the right side of the block. This rifle drilled gallery supplies oil to the camshaft bearings, the hydraulic lifters and the crankshaft main bearings.

The connecting rod bearings are supplied oil from the crankshaft main bearings by means of cross drilled passages.

The valve train is supplied its lubrication from the valve lifters. Oil within the lifters is pumped up through the top of the lifters through the hollow push rods to the rocker arms. From the head, oil is drained back to the crankcase through oil drain back holes and the push rod holes. (Fig. 6A1-1).

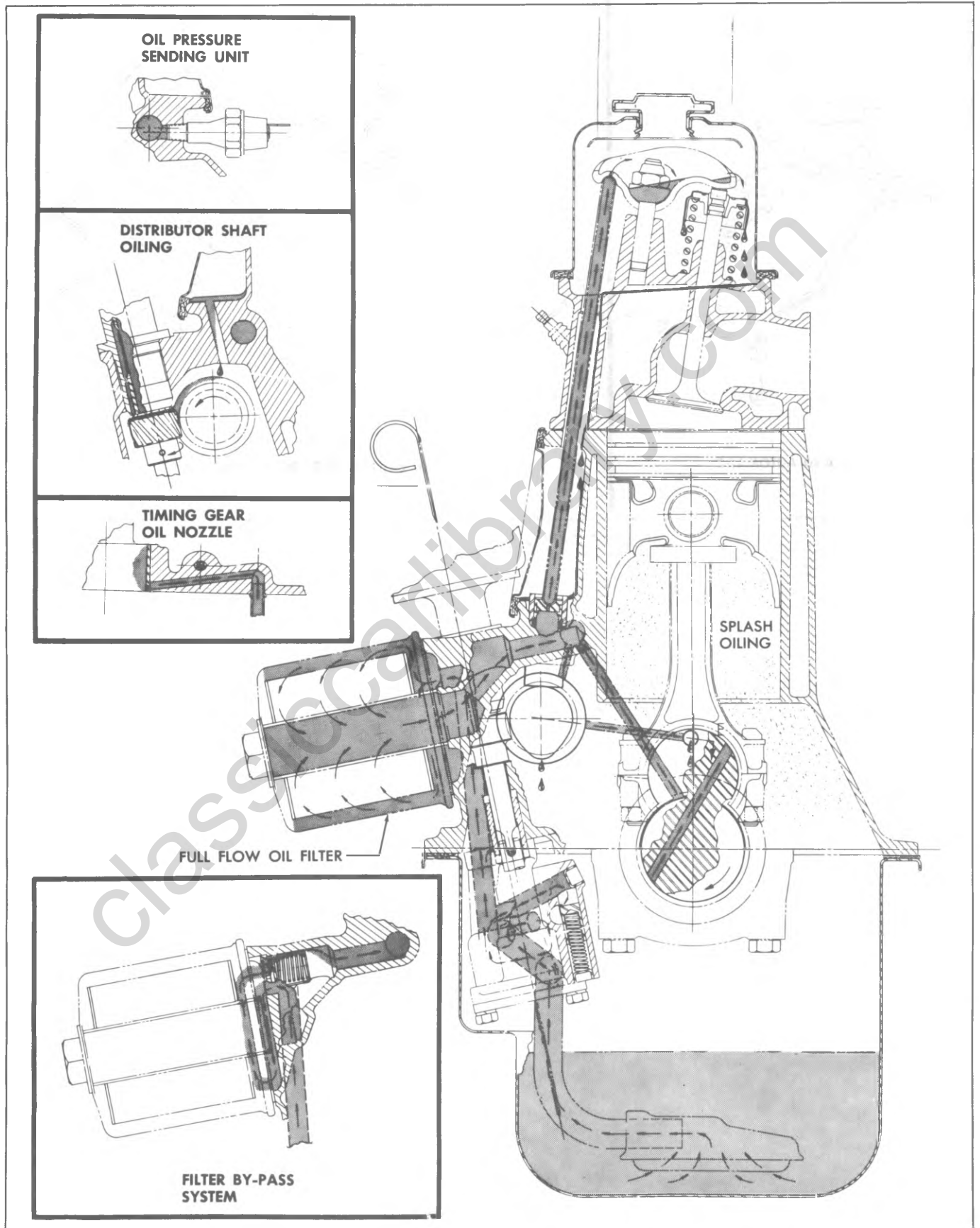


Fig. 6A1-1--In-Line Engine Lubrication

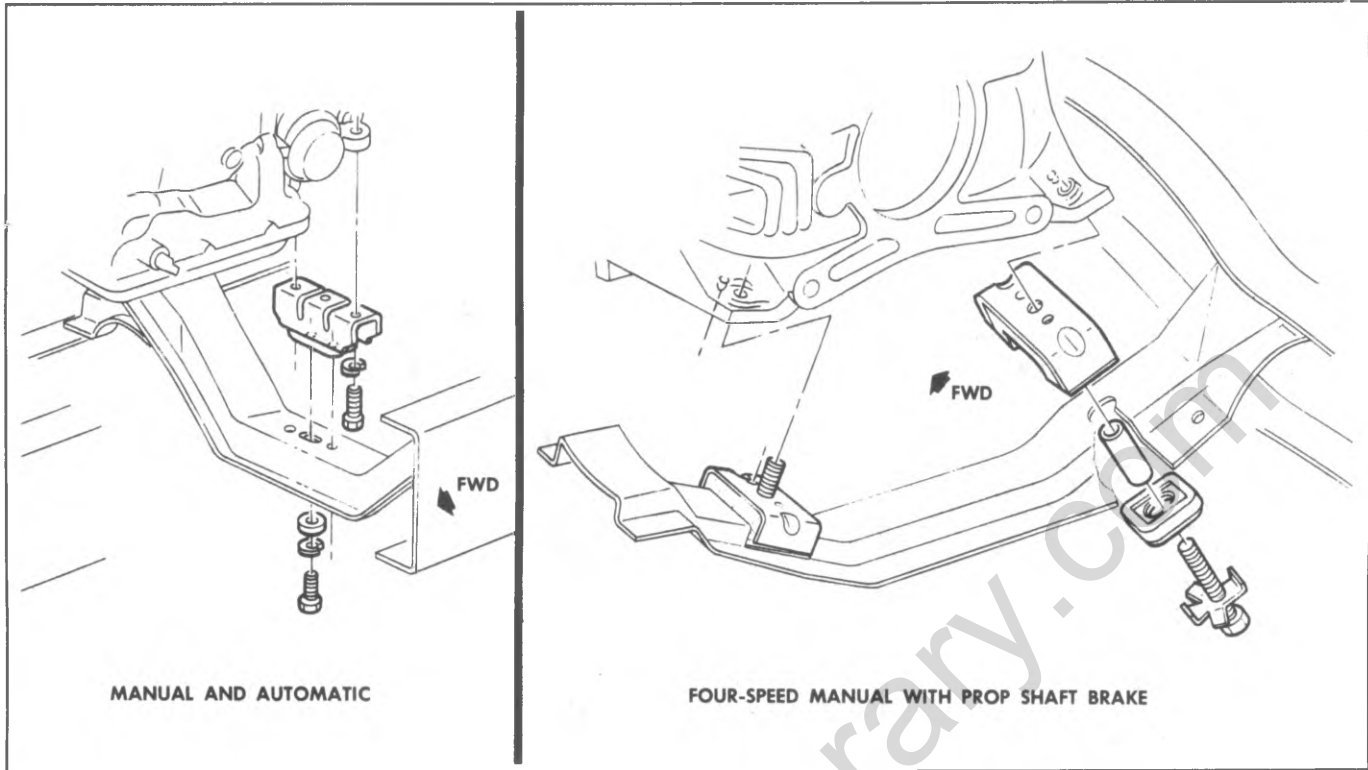


Fig. 6A1-2-"P" Series - Engine Rear Mount

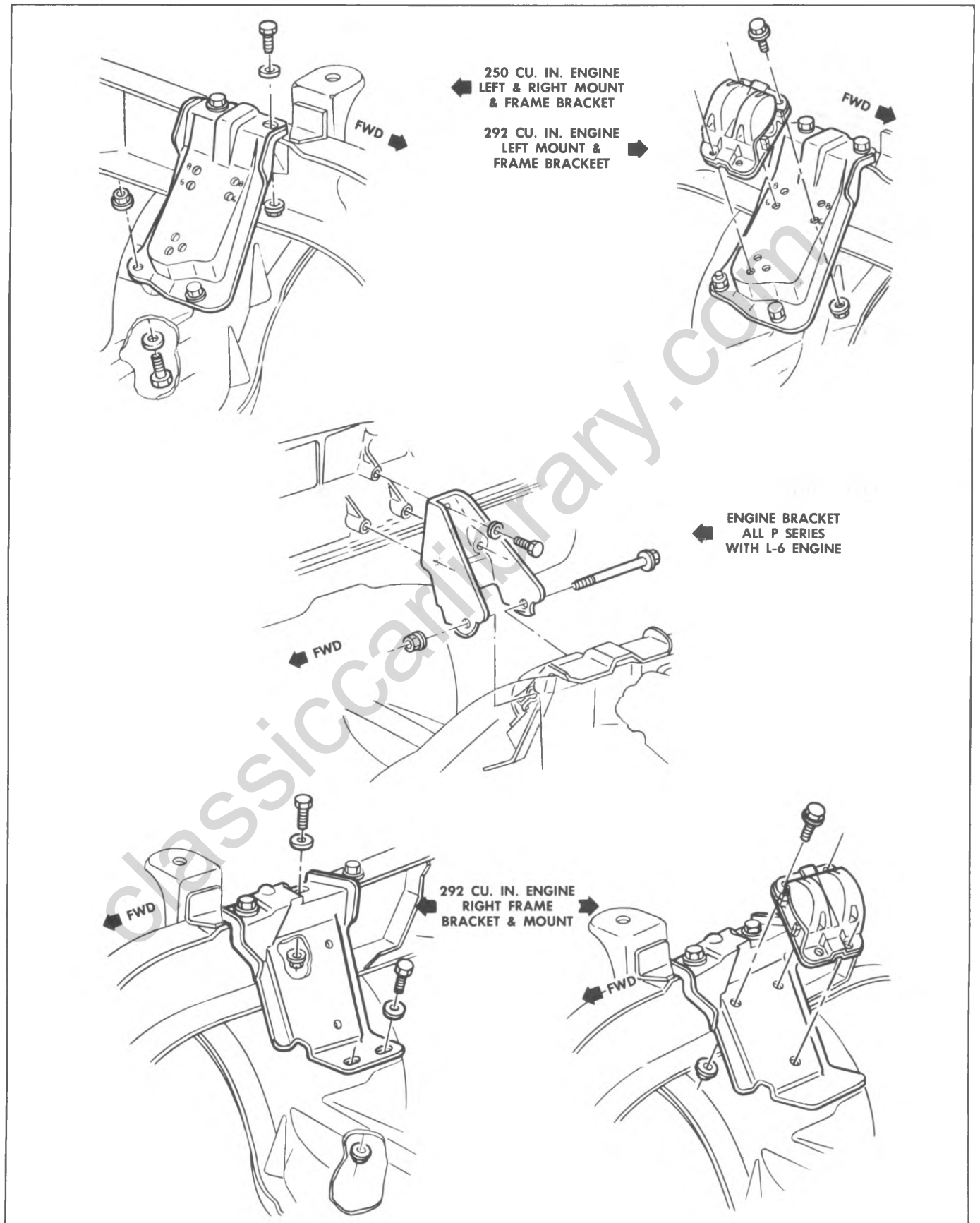


Fig. 6A1-3--"P" Series - Engine Front Mount

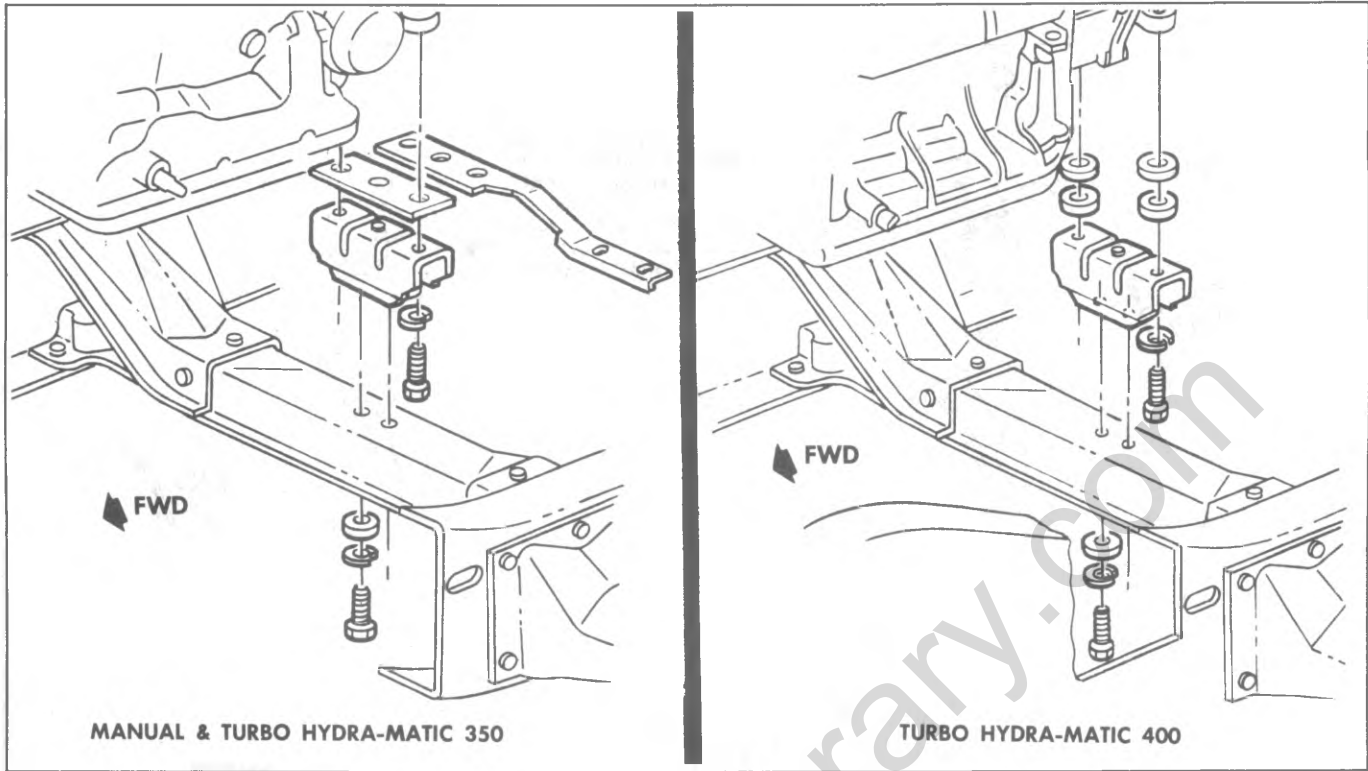


Fig. 6A1-4--"C" Series - Engine Rear Mounts

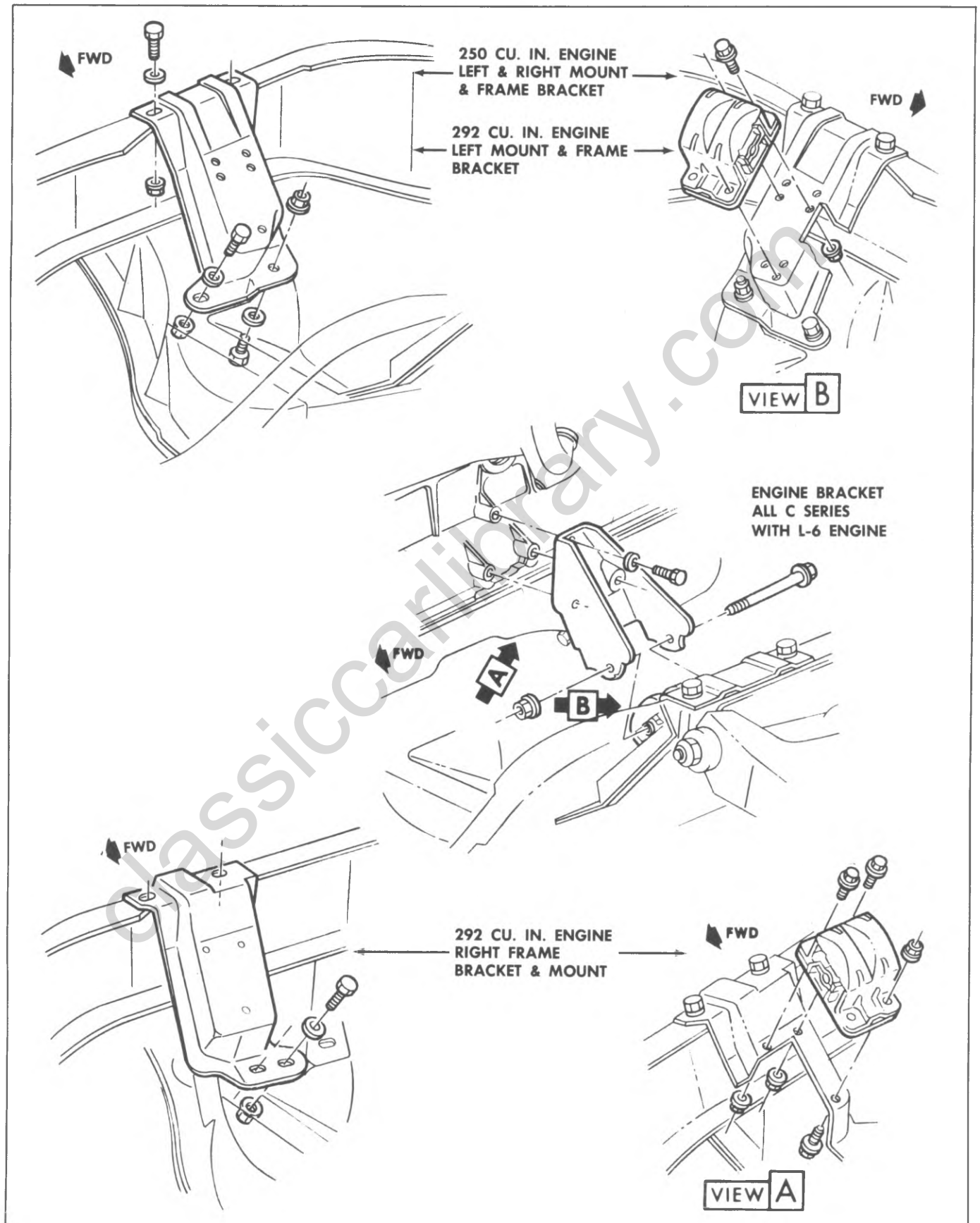


Fig. 6A1-5--"C" Series - Engine Front Mount

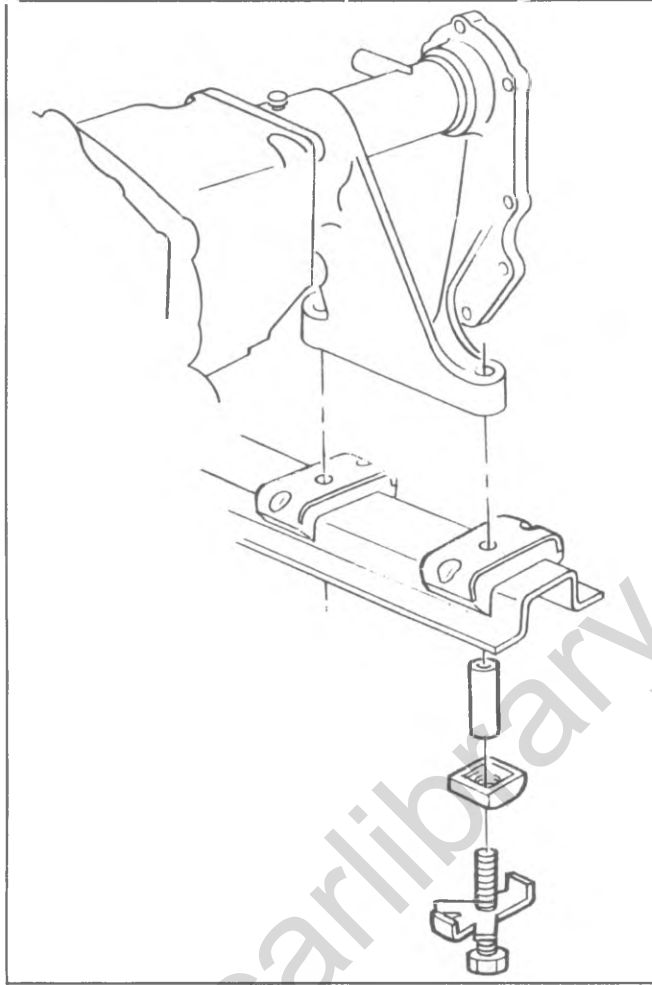
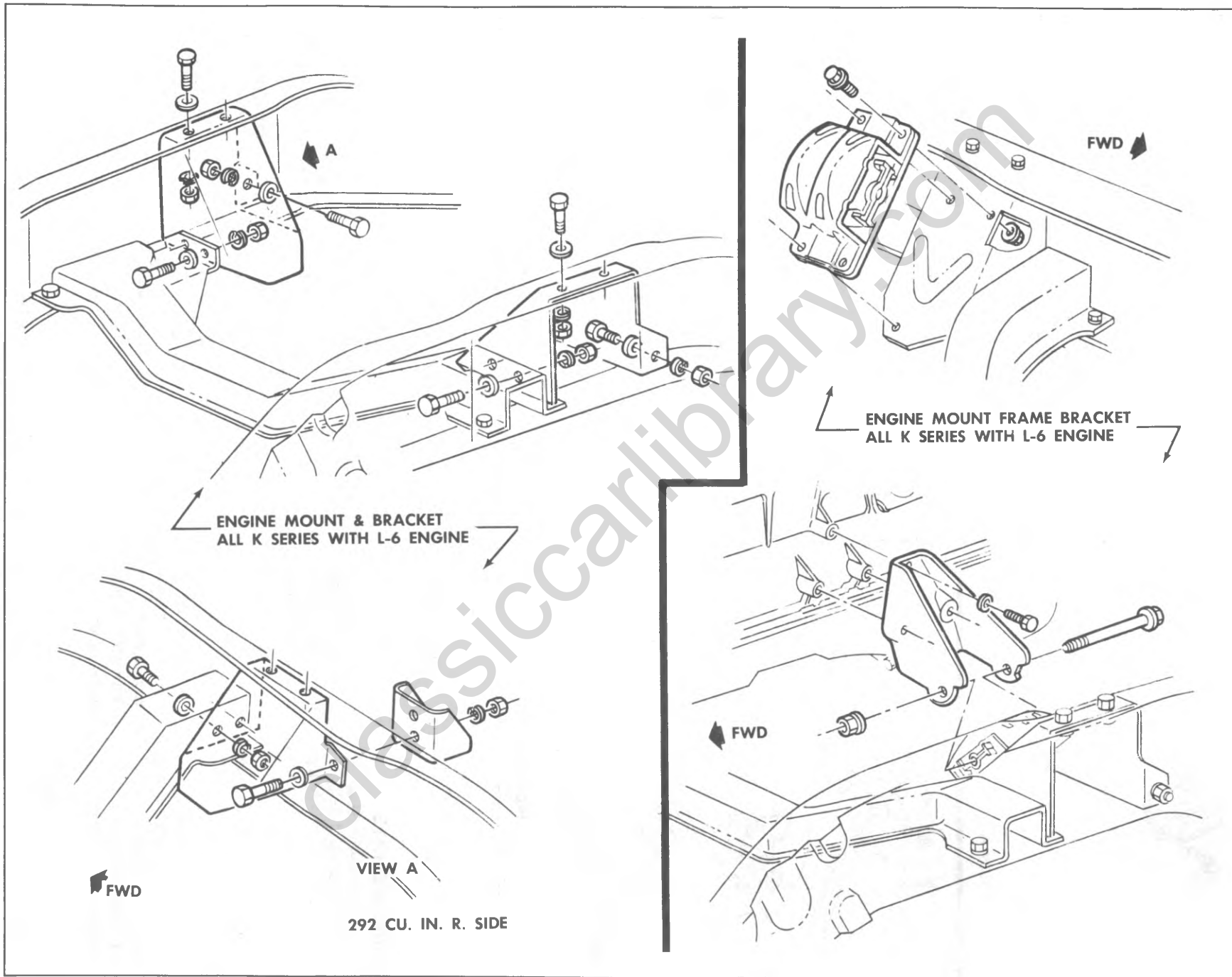


Fig. 6A1-6-"K" Series - Engine Rear Mount

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Fig. 6A1-7-"K" Series - Engine Front Mount



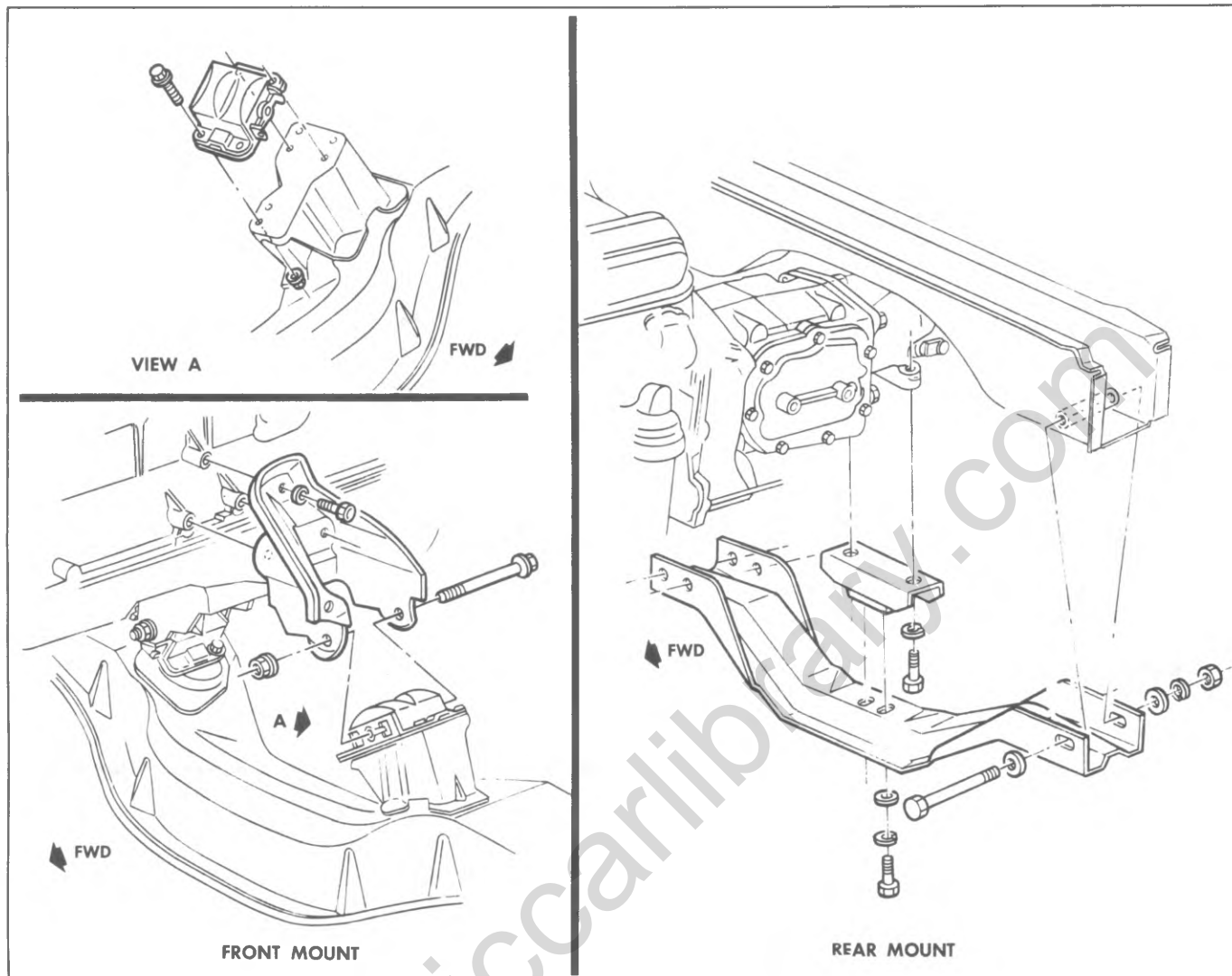


Fig. 6A1-8--"G" Series - Engine Mounts

ON VEHICLE SERVICE

ENGINE MOUNTS

Engine mounts (Fig. 6A1-2 - 6A1-8) are the non-adjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

Checking Engine Mounts

Front Mount

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe both mounts while raising engine. If an engine mount exhibits:

- a. Hard rubber surface covered with heat check cracks;
- b. Rubber separated from a metal plate of the mount;

or

- c. Rubber split through center,

replace the mount. If there is relative movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or

nuts attaching the mount to the engine, frame, or bracket.

Rear Mount

Raise the vehicle on a hoist. Push up and pull down on the transmission tailshaft while observing the transmission mount. If the rubber separates from the metal plate of the mount or if the tailshaft moves up but not down (mount bottomed out) replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the transmission or crossmember.

Front Mount Replacement

1. Remove engine mount through bolt.
2. Raise engine and remove mount to frame bracket attaching bolts. Remove mount.

CAUTION: Raise engine only enough for sufficient clearance. Check for interference between rear of engine and cowl panel.

3. Install new engine mount to frame bracket and

torque attaching bolts to specifications.

4. Install engine mount through bolt and torque to 30 lb. ft. (40 N·m) specifications.

Rear Mount Replacement

1. Support engine weight to relieve rear mounts.
2. Remove crossmember-to-mount bolts.
3. On P Series with manual transmission and propeller shaft parking brake, remove mount attaching bolts from frame outrigger and clutch housing and remove rear mounting cushions.

4. Remove mount-to-transmission bolts, then remove mount.

5. On "P" Series with manual transmission and propeller shaft parking brake, install new mounting cushions and bolts.

6. Install new mount on transmission.

7. While lowering transmission, align and start crossmember-to-mount bolts.

8. Torque bolts to 45 lb. ft. (60 N·m) then bend lock tabs to bolt head as applicable.

MANIFOLD ASSEMBLY - NON-INTEGRATED HEAD

Removal

1. Disconnect battery negative cable at battery.
2. Remove air cleaner.
3. Disconnect both throttle controls at bellcrank and remove throttle return spring.
4. Disconnect fuel and vacuum lines at carburetor.
5. Disconnect crankcase ventilation hose at rocker arm cover.
6. Disconnect vapor hose at canister.
7. Disconnect exhaust pipe at manifold flange.
8. Remove manifold attaching bolts and clamps then remove manifold assembly.
9. Check for cracks in manifold castings.
10. Separate manifolds by removing one bolt and two nuts at center of assembly.
11. Observe gaskets and packing if necessary to diagnose a leakage problem.

Installation

1. Clean gasket surfaces on cylinder head and manifolds.
2. Lay a straight edge along the full length of the exhaust port faces and measure any gaps between the straight edge and the port faces. If at any point a gap of .030 or more exists, it is likely that the manifold has distorted to a point where it will not seat properly. If a good exhaust seal is to be expected, the exhaust manifold must be replaced.
3. Assemble intake and exhaust manifolds using a new gasket by reinstalling the one bolt and two nuts at the center of the manifold to finger tight.
4. Position a new gasket over manifold end studs on the cylinder head.
5. Install manifold assembly bolts, clamps and washers while holding manifold assembly in place by hand.
6. Clean, oil and torque all manifold assembly to cylinder head bolts and nuts to 40 lbs. ft. (55 N·m).
7. Complete torquing the inlet to exhaust manifold bolt and two nuts at the center of the manifold to 45 lb. ft. (61 N·m).

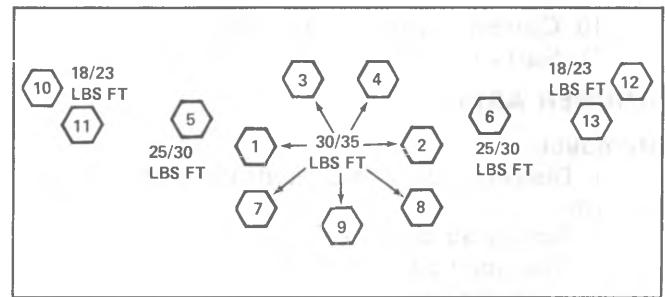


Fig. 6A1-9--Cylinder Head To Exhaust Manifold Tightening Sequence

8. Connect exhaust pipe to manifold using a new packing.

9. Connect crankcase ventilation hose at rocker arm cover.

10. Connect vapor hoses at canister.

11. Connect fuel and vacuum lines a carburetor.

12. Connect throttle controls at bellcrank and install throttle return spring.

13. Install air cleaner, start engine, check for leaks and adjust carburetor idle speed.

EXHAUST MANIFOLD ASSEMBLY - INTEGRATED HEAD

Removal

1. Disconnect negative battery cable.
2. Remove air cleaner.
3. Remove power steering pump and/or A.I.R. pump brackets, if so equipped.
4. Raise vehicle on hoist and disconnect exhaust pipe at manifold and converter bracket at transmission mount. If equipped with manifold converter, disconnect exhaust pipe from converter, remove converter.
5. Lower vehicle.
6. Remove rear heat shield and accelerator cable bracket.
7. Remove exhaust manifold bolts.
8. Remove exhaust manifold, check EFE Valve to see if free and check manifold for cracks.

Installation

NOTE: If a new exhaust manifold is being installed, the E.F.E. valve and actuator and rod assembly must be transferred from the old component.

1. Clean gasket surface and position new gasket on exhaust manifold.
2. Install manifold bolts, while holding manifold assembly in place.
3. Torque all manifold to cylinder head bolts in sequence to torques shown in figure 6A1-9.
4. Install rear heat shield and accelerator cable bracket.
5. Raise vehicle on hoist.
6. Connect exhaust pipe at manifold flange and converter bracket at transmission mount. If equipped with manifold converter, loosely install Manifold Converter, attach exhaust pipe and align exhaust system. Torque attaching bolts to specification.
7. Lower vehicle.
8. Install power steering pump and/or A.I.R. pump and brackets, if so equipped. Tighten drive belt using strand tension gage.
9. Install air cleaner.

10. Connect negative battery cable.
11. Start engine and check for leaks.

ROCKER ARM COVER

Removal

1. Disconnect crankcase ventilation hose(s) at rocker arm cover.
2. Remove air cleaner.
3. Disconnect all wires, fuel and vacuum pipes from rocker arm cover clips.
4. Disconnect air injection hose from check valve of AIR pipe (where so equipped).
5. Remove rocker arm cover by rotating out from under air pipe (where so equipped).

CAUTION: Do not pry rocker arm cover loose. Gaskets adhering to cylinder head and rocker arm cover may be sheared by bumping front end of rocker arm cover rearward with palm of hand or rubber mallet.

Installation

1. Clean gasket surfaces on cylinder head with degreaser. Using RTV, install rocker arm cover and torque bolts to 80 lb. in. (9 N·m).

NOTE: All loose RTV sealer, or pieces causing installation interference must be removed from both cylinder head and cover seal surfaces prior to applying new sealer.

A 1/8" bead of RTV sealer should be placed all around the rocker cover sealing surface of the cylinder head. (When going around attaching bolt holes, always go around the inboard side of the holes). Install cover and torque bolts to 80 lb. in. (9N·m) while RTV is wet (within 10 min.).

2. Connect wires, fuel and vacuum pipes at rocker arm cover clips.
3. Install air cleaner.
4. Connect crankcase ventilation hoses and AIR hoses (where so equipped).

VALVE MECHANISM

Removal

1. Remove rocker arm cover as outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods.

NOTE: Place rocker arms, rocker arm balls and push rods in a rack so that they may be reinstalled in the same location.

Installation and Adjustment

NOTE: Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with "Molykote" or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.
3. Adjust valves when lifter is on base circle of camshaft lobe as follows:
 - a. Mark distributor housing, with chalk, at number one and number six positions (plug wire) then disconnect plug wires at spark plugs and coil and remove distributor cap and plug wire assembly (if not previously done).



Fig. 6A1-10-Valve Adjustment

- b. Crank engine until distributor rotor points to number one cylinder position. The following valves can be adjusted with engine in number one firing position:

Number one cylinder-Exhaust and Intake.

Number two cylinder-Intake

Number three cylinder-Exhaust

Number four cylinder-Intake

Number five cylinder-Exhaust

- c. Back out adjusting nut until lash is felt at the push rod then turn in adjusting nut until all lash is removed. This can be determined by rotating the push rod while turning adjusting nut (Fig. 6A1-10). When play has been removed, turn adjusting nut in one full additional turn (to center lifter plunger).

- d. Crank engine until distributor rotor points to number six position. The following valves can be adjusted with engine in number six firing position:

Number two cylinder-Exhaust

Number three cylinder-Intake

Number four cylinder-Exhaust

Number five cylinder -Intake

Number six cylinder-Intake and Exhaust

4. Install distributor cap and spark plug wire assembly.

5. Install rocker arm cover as outlined.

6. Adjust carburetor idle speed.

VALVE STEM OIL SEAL AND/OR VALVE SPRING

Replacement

1. Remove rocker arm cover as previously outlined.
2. Remove spark plug, rocker arm and push rod on the cylinder(s) to be serviced.
3. Install air line adapter Tool J-23590 to spark plug port and apply compressed air to hold the valves in place.
4. Using Tool J-5892 to compress the valve spring, remove the valve locks, valve cap, valve shield and valve spring and damper (fig. 6A1-11).

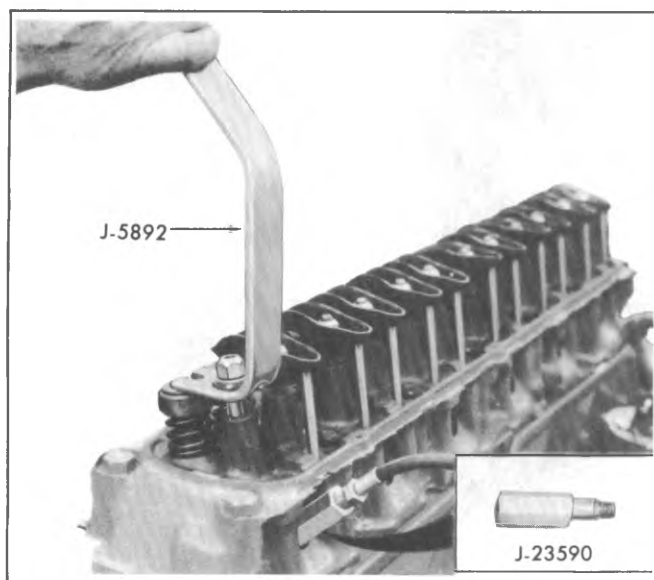


Fig. 6A1-1-1—Compressing Valve Spring

5. Remove the valve stem oil seal.

6. To replace, set the valve spring, valve shield and valve can in place. Compress the spring with Tool J-5892 and install new oil seal in the lower groove of the stem, making sure the seal is flat and not twisted.

NOTE: A light coat of oil on the seal will help prevent twisting.

7. Install the valve locks and release the compressor tool, making sure the locks seat properly in the upper groove of the valve stem.

NOTE: Grease may be used to hold the locks in place while releasing the compressor tool.

8. Using Tool J-23994, apply vacuum to the valve assembly to make sure no air leaks past the seal.

9. Install spark plug, and torque to 15 lb. ft. (20 N·m).

10. Install and adjust valve mechanism as previously outlined.

VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design. Readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts.

Locating Noisy Lifters

Locate a noisy valve lifter by using a piece of garden hose approximately four feet in length. Place one end of the hose near the end of each intake and exhaust valve with the other end of the hose to the ear. In this manner the sound is localized, making it easy to determine which lifter is at fault.

Another method is to place a finger on the face of the valve spring retainer. If the lifter is not functioning properly, a distinct shock will be felt when the valve returns to its seat.

The general types of valve lifter noise are as follows:

1. **Hard Rapping Noise** - Usually caused by the plunger becoming tight in the bore of the lifter body to such an extent that the return spring can no longer push the plunger back up to working position. Probable causes are:

- a. Excessive varnish or carbon deposit causing

abnormal stickiness.

b. Galling or "pickup" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedging between plunger and lifter body.

2. **Moderate Rapping Noise** - Probable causes are:

- a. Excessively high leakdown rate.

- b. Leaky check valve seat.

- c. Improper adjustment.

3. **General Noise Throughout the Valve Train** - This will, in most cases, be caused by either insufficient oil supply or improper adjustment.

4. **Intermittent Clicking** Probable causes are:

- a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.

- b. In rare cases, the ball itself may be out-of-round or have a flat spot.

- c. Improper adjustment.

In most cases where noise exists in one or more lifters, all lifter units should be removed, disassembled, cleaned in a solvent, reassembled, and reinstalled in the engine. If dirt, varnish, carbon, etc., is shown to exist in one unit, it more than likely exists in all the units, thus it would only be a matter of time before all lifters caused trouble.

Removal

1. Remove rocker arm cover and loosen rocker arms sufficiently to remove the push rods. Place push rods in a rack so that they may be returned to their original location.

2. Mark distributor housing, with chalk, at number one and number six position (plug wire) then disconnect plug wires at spark plugs and remove distributor cap and plug wire assembly.

3. Crank engine until distributor rotor points to number one position, then disconnect distributor primary lead at coil and remove distributor.

4. **REMOVE PUSH ROD COVERS.**

5. Remove valve lifters.

NOTE: Place valve lifters in a rack so that they may be installed in the same location.

Disassembly

1. Hold the plunger down with a push rod, and using the blade of a small screw driver, remove the push rod seat retainer.

2. Remove the push rod seat and metering valve (fig. 6A1-12).

3. Remove the plunger, ball check valve assembly and the plunger spring.

4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screw driver (fig. 6A1-13).

Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn, the entire lifter assembly should be replaced. If the lifter body wall is scuffed or worn, inspect the cylinder block lifter bore, if the bottom of the lifter is scuffed or worn inspect the camshaft lobe, if the push rod seat is scuffed or worn inspect the push rod.

An additive containing EP lube, such as EOS, should always be added to crankcase oil for run-in when any new camshaft or lifters are installed. All damaged or worn lifters should be replaced.

NOTE: For proper lifter rotation during engine

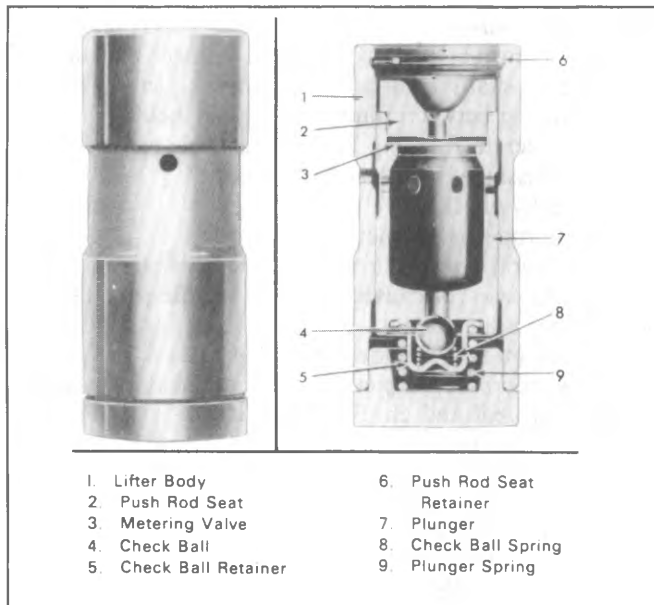


Fig. 6A1-12--Hydraulic Valve Lifter

operation, lifter foot must be convex.

Assembly

1. Place the check ball on small hole in bottom of the plunger.

2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screw driver (fig. 6A1-14).

3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed holes in the lifter body and plunger.

4. Fill the assembly with SAE 10 oil, then insert the end of a 1/8" drift pin into the plunger and press down solid.



Fig. 6A1-14--Installing Ball Check Valve

At this point oil holes in the lifter body and plunger assembly will be aligned (fig. 6A1-15).

CAUTION: Do not attempt to force or pump the plunger.

5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension (fig. 6A1-15).

6. Remove the 1/8" drift pin, refill assembly with SAE 10 oil.

7. Install the metering valve and push rod seat (fig. 6A1-12).

8. Install the push rod seat retainer, press down on the push rod seat and remove the 1/16" drift pin from the oil holes. The lifter is now completely assembled, filled with oil

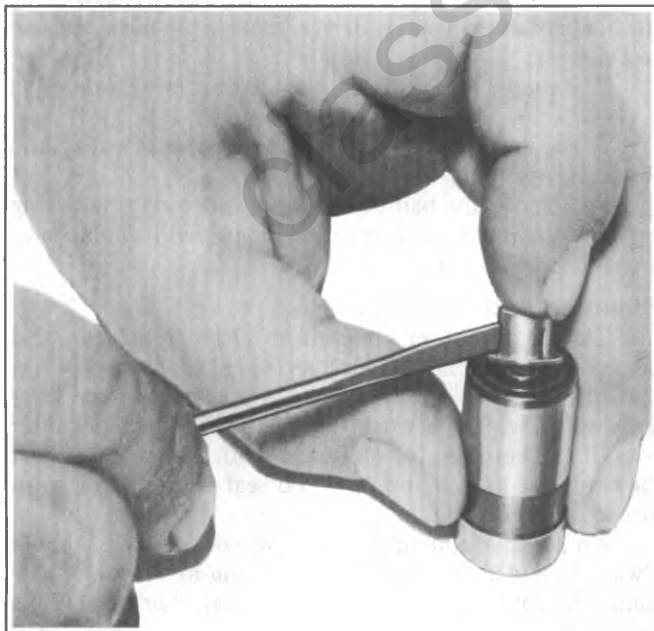


Fig. 6A1-13--Removing Ball Check Valve

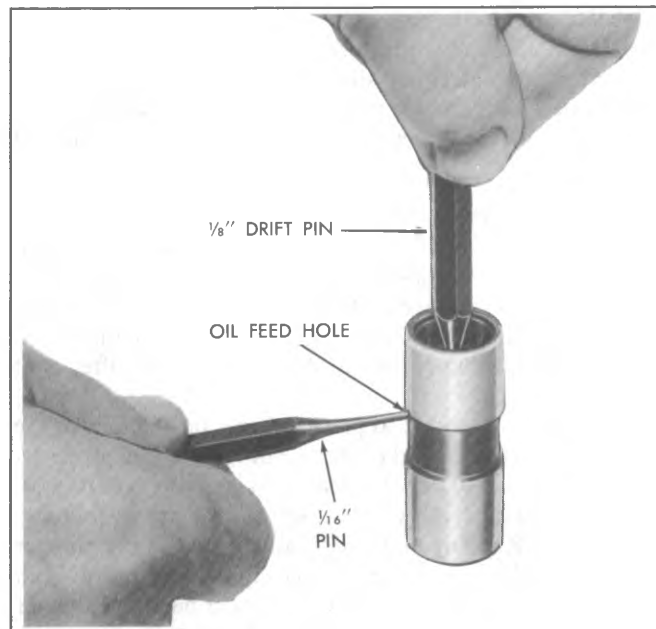


Fig. 6A1-15--Assembling Hydraulic Lifter

and ready for installation.

NOTE: Before installing lifters, coat the bottom of the lifter with "Molykote" or its equivalent.

Installation

1. Install valve lifters.

NOTE: Whenever new valve lifters are being installed, coat foot of valve lifters with "Molykote" or its equivalent. Make sure the lifter foot is convex.

2. Install push rod covers, using new gaskets, and torque bolts to specifications.

3. Install distributor, positioning rotor to number one cylinder position, then connect primary lead at distributor.

4. Install push rods and adjust valve mechanism as outlined.

5. Adjust ignition timing and carburetor idle speed.

CYLINDER HEAD ASSEMBLY

Removal

1. Remove manifold assembly as previously outlined.

2. Remove rocker arm cover and valve mechanism as previously outlined.

3. Drain cooling system (block).

4. Remove fuel and vacuum line from retaining clip at water outlet, then disconnect wires from temperature sending units.

5. Disconnect air injection hose at check valve (if so equipped).

6. Disconnect radiator upper hose at water outlet housing and battery ground strap.

7. Remove cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

Disassembly

1. With the cylinder head removed, use tool J-8062 to compress the valve springs and remove the valve keys. Release the compressor tool and remove rotators or spring caps, oil shedders (if so equipped) springs and spring damper, then remove oil seals and valve spring shims.

2. Remove valves from cylinder head and place them in a rack in their proper sequence so that they can be assembled in their original positions.

Cleaning

1. Clean all deposits from combustion chambers and valve ports using Tool J-8089.

2. Thoroughly clean the valve guides using Tool J-8101.

3. Clean all carbon and sludge from push rods, rocker arms and push rod guides.

4. Clean valve stems and heads on a buffing wheel.

5. Clean carbon deposits from head gasket mating surface.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the water chamber.

2. Inspect the valves for burned heads, cracked faces or damaged stems.

NOTE: Excessive valve stem to bore clearance will cause excessive oil consumption and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine



Fig. 6A1-16--Checking Valve Spring Tension

smoothness.

3. Measure valve stem clearance as follows: Clamp a dial indicator on one side of the cylinder head rocker arm cover gasket rail, locating the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide. With the valve head dropped about 1/16" off the valve seat; move the stem of the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications it will be necessary to ream valve guides for oversize valves as outlined.

4. Check valve spring tension with Tool J-8056 spring tester (fig. 6A1-16).

NOTE: Springs should be compressed to the specified height and checked against the specifications chart. Springs should be replaced if not within 10 lbs. of the specified load (without dampers).

5. Inspect rocker arm studs for wear or damage.

Assembly

1. Insert valves in the proper ports.

2. Set the valve spring shim, valve spring (with damper, if used) valve shield and valve cap or rotator in place (fig. 6A1-17).

3. Compress the spring with Tool J-8062.

4. Install new oil seal in the lower groove of the stem, making sure that the seal is flat and not twisted.

5. Install the valve locks and release the compressor tool, making sure that the locks seat properly in the upper groove of the valve stem.

6. Using Tool J-23994, apply vacuum to the valve assembly to make sure no air leaks past the seal.

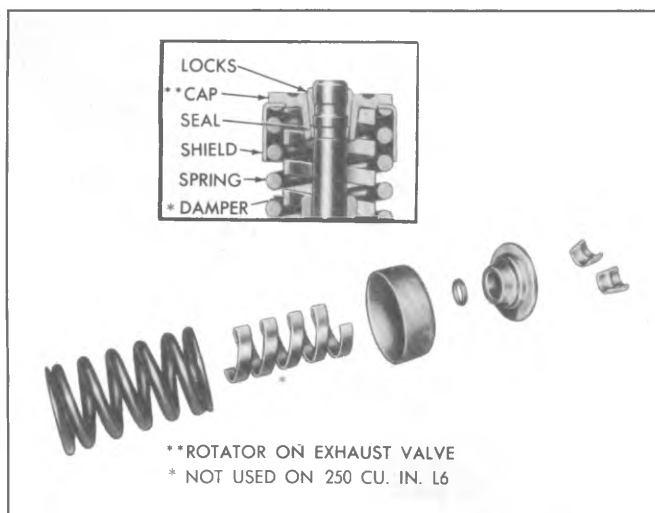


Fig. 6A1-17--Valve Spring Installation

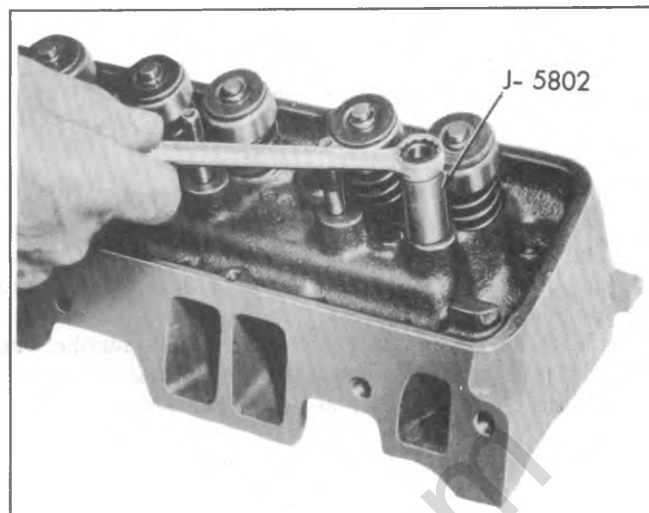


Fig. 6A1-18--Removing Rocker Arm Stud - Typical

Installation

CAUTION: The gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. Cylinder bolt threads in the block and threads on the cylinder head bolt must be cleaned. (Dirt will affect bolt torque.) Do not use gasket sealer on composition steel asbestos gasket.

1. Place the gasket in position over the dowel pins.
 2. Carefully guide cylinder head into place over dowel pins and gasket.
 3. Coat threads of cylinder head bolts with sealing compound and install finger tight.
 4. Tighten cylinder head bolts a little at a time in the sequence shown on the torque sequence chart until 95 lb. ft. (129N·m) torque is reached.
- NOTE:** The left-hand front head bolt torques to 85 lb. ft. (115N·m).
5. Connect radiator upper hose and engine ground strap.
 6. Connect temperature sending unit wires and install fuel and vacuum lines in clip at water outlet.
 7. Fill cooling system.
 8. Install manifold assembly as previously outlined.
 9. Install and adjust valve mechanism as previously outlined.
 10. Install and torque rocker arm cover.
 11. Connect AIR pipe (if so equipped).

ROCKER ARM STUDS

Replacement

Rocker arm studs that have damaged threads or are loose in cylinder heads should be replaced with new studs available in .003" and .013" oversize. Studs may be installed after reaming the holes as follows:

1. Remove old stud by placing Tool J-5802-A over the stud, installing nut and flat washer and removing stud by turning nut (fig. 6A1-18).
2. Ream hole for oversize stud using Tool J-5715 for .003" oversize or Tool J-6036 for .013" oversize (fig. 6A1-19).

CAUTION: Do not attempt to install an oversize stud without reaming stud hole.

3. Coat press-fit area of stud with hypoid axle lubricant. Install new stud, using Tool J-6880 as a guide. Gage should bottom on head (fig. 6A1-20).

VALVE GUIDE BORES

Valves with oversize stems are available (see specifications). To ream the valve guide bores for oversize valves, use Tool Set J-5830.

VALVE SEATS

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for reseating valve seats. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

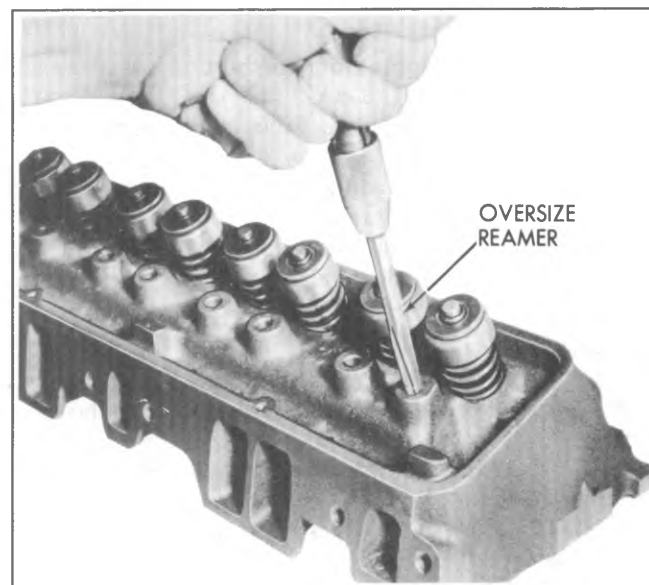


Fig. 6A1-19--Reaming Rocker Arm Stud Bore - Typical

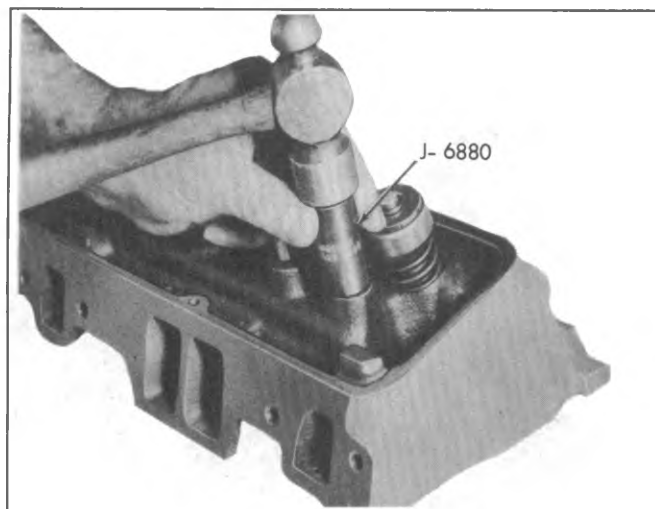


Fig. 6A1-20--Installing Rocker Arm Stud - Typical

Regardless of what type of equipment is used, however, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of pilot in the guide.

Reconditioning

1. Install expanding pilot in the valve guide bore and expand pilot.
2. Place roughing stone or forming stone over pilot and just clean up the valve seat. Use a stone cut to specifications.
3. Remove roughing stone or forming stone from pilot, place finishing stone, cut to specifications, over pilot and cut just enough metal from the seat to provide a smooth finish. Refer to specifications.
4. Narrow down the valve seat to the specified width.
NOTE: This operation is done by grinding the port side with a 30 degree stone to lower seat and a 60 degree stone to raise seat.
5. Remove expanding pilot and clean cylinder head carefully to remove all chips and grindings from above operations.
6. Measure valve seat concentricity.

VALVES

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem on a valve refacing mechanism. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32" thick after grinding, replace the valve.

Several different types of equipment are available for refacing valves. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Reconditioning

1. If necessary, dress the valve refacing machine grinding wheel to make sure it is smooth and true. Set check at angle specified for valve. Refer to specifications.
2. Clamp the valve stem in the chuck of the machine.

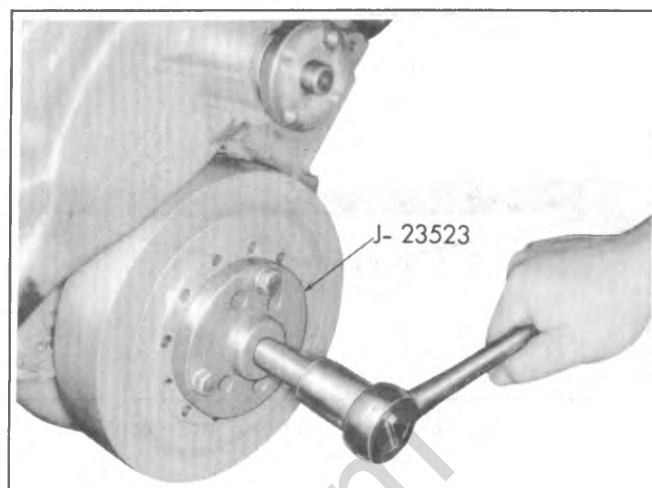


Fig. 6A1-21--Removing Torsional Damper

3. Start the grinder and move the valve head in line with the grinder wheel.

4. Turn the feed screw until the valve head just contacts wheel. Move valve back and forth across the wheel and regulate the feed screw to provide light valve contact.

5. Continue grinding until the valve face is true and smooth all around the valve. If this makes the valve head thin (1/32" min.) the valve must be replaced as the valve will overheat and burn.

6. Remove valve from chuck and place stem in "V" block. Feed valve squarely against grinding wheel to grind any pit from rocker arm end of stem.

NOTE: Only the extreme end of the valve stem is hardened to resist wear. Do not grind end of stem excessively.

7. After cleaning valve face and cylinder head valve seat of grinding particles, make pencil marks about 1/4" apart across the valve face, place the valve in cylinder head and give the valve 1/2 turn in each direction while exerting firm pressure on head of valve.

8. Remove valve and check face carefully. If all pencil marks have not been removed at the point of contact with the valve seat, it will be necessary to repeat the refacing operation and again recheck for proper seating.

9. Grind and check the remaining valves in the same manner.

TORSIONAL DAMPER

Removal

1. Drain radiator and remove.
2. Remove fan belt and (if so equipped) accessory drive pulley and belt.
3. Install Tool J-23523 to damper and turn puller screw to remove damper (fig. 6A1-21). Remove tool.

Installation

1. Coat front cover oil seal contact area of damper with engine oil.

CAUTION: It is necessary to use installer Tool J-22197 to prevent the inertia weight section from walking off the hub during installation of damper.

NOTE: The damper on the 292 L-6 should be pulled on by using special tool J-23523 or equivalent.

2. Attach damper installer Tool J-22197 to damper.

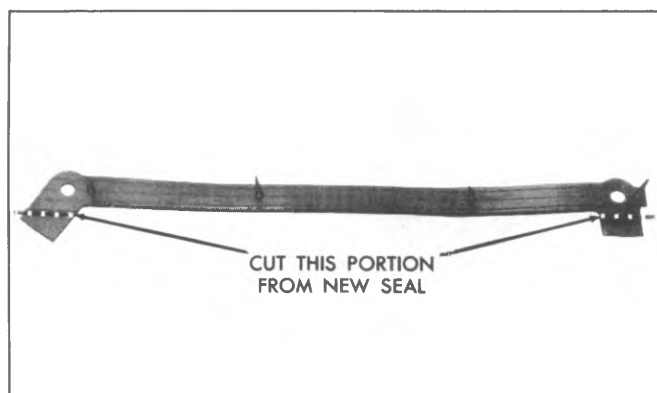


Fig. 6A1-22--Oil Pan Front Seal Modification

Tighten fingers of tool to prevent weight from moving.

3. Position damper on cranksahft and drive into position, using J-5590 until it bottoms against crankshaft gear. Remove installer tool.

4. If so equipped, install accessory drive pulley and belt.

5. Install fan belt and adjust using strand tension gage.

6. Install radiator.

7. Fill cooling system and check for leaks.

CRANKCASE FRONT COVER (TIMING GEAR COVER)

Removal (without removing oil pan)

1. Remove torsional damper as outlined.

2. Remove the two, oil pan-to-front cover attaching screws.

3. Remove the front cover-to-block attaching screws.

4. Pull the cover slightly forward only enough to permit cutting of oil pan front seal.

5. Using a sharp knife or other suitable cutting tool, cut oil pan front seal flush with cylinder block at both sides of cover.

6. Remove front cover and attached portion of oil pan front seal. Remove front cover gasket.

Installation

1. Clean gasket surfaces on block and crankcase front cover.

2. Cut tabs from the new oil pan front seal (fig. 6A1-22) use a sharp instrument to ensure a clean cut.

3. Install seal to front cover, pressing tips into holes provided in cover.

4. Coat the gasket with gasket sealer and place in position on cover.

5. Apply a 1/8 inch bead of silicone rubber sealer part #1051435 (or equivalent) to the joint formed at the oil pan and cylinder block.

6. Install centering Tool J-23042 in crankcase front cover seal.

NOTE: It is important that centering tool be used to align crankcase front cover so that torsional damper installation will not damage seal and so that seal is positioned evenly around balancer.

7. Install crankcase front cover to block. Install and partially tighten the two, oil pan-to-front cover screws.

8. Install the front cover-to-block attaching screws.

9. Remove centering Tool J-23042 and torque all cover attaching screws to 80 lb. in. (9N·m).

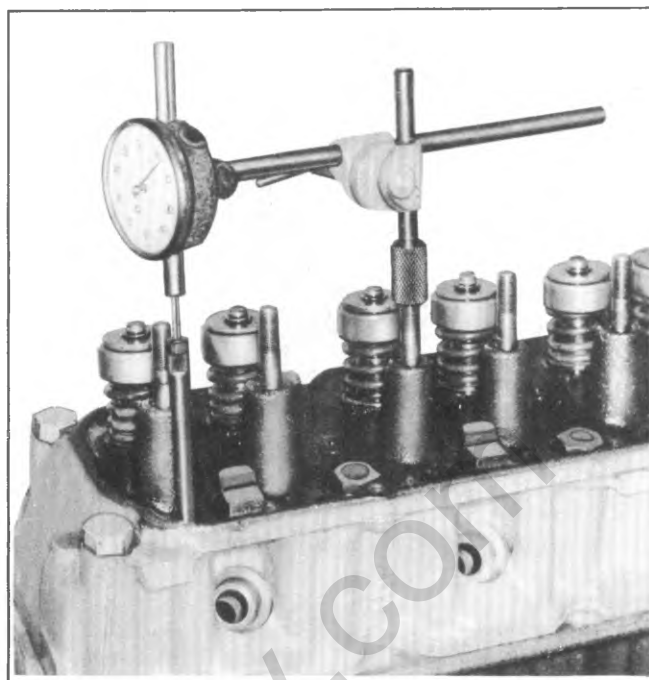


Fig. 6A1-23--Measuring Camshaft Lobe Lift

10. Install torsional damper as outlined.

OIL SEAL (FRONT COVER)

Replacement

With Cover Installed

1. With torsional damper removed, pry old seal out of cover from the front with a large screw driver, being careful not to damage the seal surface on the cover.

2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J-23042.

With Cover Removed

1. With cover removed, pry old seal out of cover from the front with screw driver, being careful not to distort cover.

2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J-23042.

CAUTION: Support cover at sealing area. (Tool J-971 may be used as support.)

CAMSHAFT

Measuring Lobe Lift

NOTE: This procedure is similar to that used for checking valve timing. If improper valve operation is indicated, measure the lift of each push rod in consecutive order and record the readings.

1. Remove valve mechanism as outlined.

2. Position indicator with ball socket adapter (Tool J-8520) on push rod (fig. 6A1-23).

3. Rotate the cranksahft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.

4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is in the fully raised position.

CAUTION: Whenever the engine is cranked remotely at the starter, with a special jumper cable or other means, the "BATT" positive lead must be disconnected from the coil.

5. Compare the total lift recorded from the dial indicator with specifications.
6. Continue to rotate the crankshaft until the indicator reads zero. This will be a check on the accuracy of the original indicator reading.
7. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
8. Install and adjust valve mechanism as outlined.

Removal

1. Remove engine, following procedure on page 6A-40 of this section.
2. Remove lifters as previously outlined.
3. Remove crankcase front cover as previously outlined.
4. Remove fuel pump.
5. Align timing gear marks then remove the two camshaft thrust plate bolts by working through holes in camshaft gear.
6. Remove the camshaft and gear assembly by pulling it out through the front of the block.

NOTE: Support camshaft carefully when removing so as not to damage the camshaft bearings.

Inspection

The camshaft bearing journals should be measured with a micrometer for an out-of-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.

Inspect the camshaft gear and thrust plate for wear or damage. Measure the camshaft end play. This should be .001" to .005".

Gear Replacement

1. If the inspection indicated that the camshaft, gear or thrust plate should be replaced, the gear must be removed from the camshaft. This operation requires the use of camshaft gear remover J-971.
2. Place the camshaft through the gear remover, place end of remover on table of a press and press shaft out of gear.

CAUTION: Thrust plate must be positioned so that woodruff key in shaft does not damage it when the shaft is pressed out of gear. Also support the hub of the gear or the gear will be seriously damaged.

3. To assemble camshaft gear thrust plate and gear spacer ring to camshaft firmly support camshaft at back of front journal in an arbor press.
4. Place gear spacer ring and thrust plate over end of shaft, and install woodruff key in shaft keyway. Install camshaft gear and press it onto the shaft until it bottoms against the gear spacer ring. The end clearance of the thrust plate should be .001" to .005".

Installation

1. Install the camshaft and gear assembly in the engine block, being careful not to damage camshaft bearings or camshaft.
2. Turn crankshaft and camshaft so that the valve timing marks on the gear teeth will line up. Push camshaft

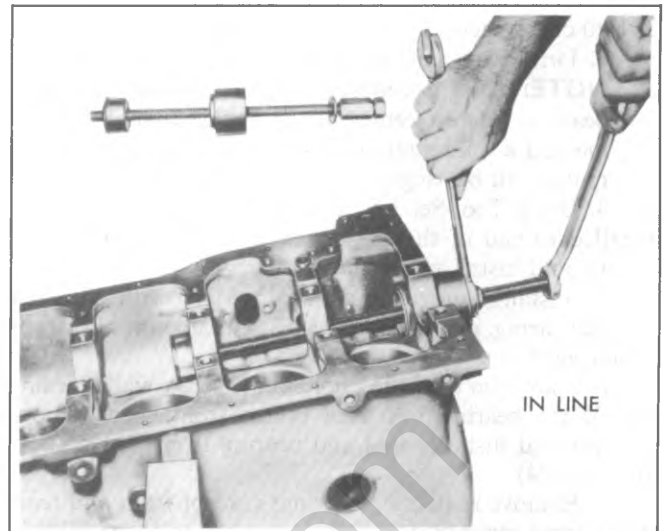


Fig. 6A1-24--Replacing Camshaft Intermediate Bearings

into position. Install camshaft thrust plate-to-block bolts and torque to 80 lb. in. (9N·m).

3. Check camshaft and crankshaft gear run out with a dial indicator. The camshaft gear run out should not exceed .004" and the crankshaft gear run out should not exceed .003".

4. If gear run out is excessive, the gear will have to be removed and any burrs cleaned from the shaft or the gear will have to be replaced.

5. Check the backlash between the timing gear teeth with a dial indicator. The backlash should be not less than .004" nor more than .006" for new parts and not more than .008" for worn parts.

6. Install fuel pump.
7. Install crankcase front cover.
8. Install lifters.
9. Install engine in vehicle.

CAMSHAFT BEARINGS

Removal

1. Remove camshaft as previously outlined.
2. Remove oil pan and oil pump as described on page

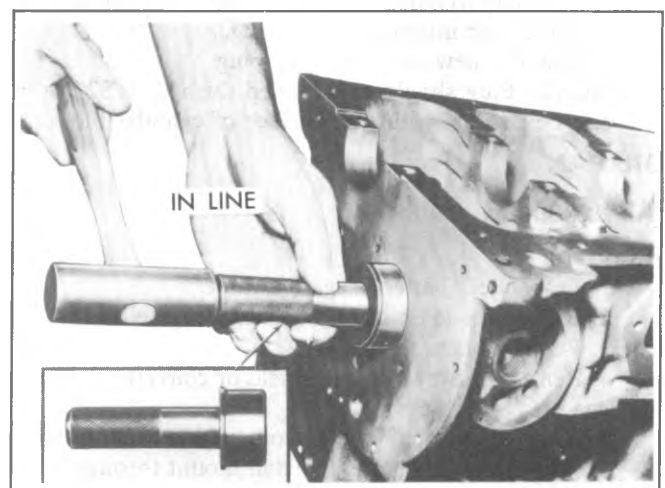


Fig. 6A1-25--Replacing Camshaft Front Bearing

6A1-20 of this section.

3. Drive camshaft rear plug from cylinder block.

NOTE: This procedure is based on removal of the bearings nearest center of the engine first. With this method a minimum amount of turns are necessary to remove all bearings.

4. Using Tool Set J-6098, with nut and thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.

5. Install remover and installer tool with shoulder toward bearing, making sure a sufficient amount of threads are engaged.

6. Using two wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw (fig. 6A1-24).

7. Remove remaining bearings (except front and rear) in the same manner. It will be necessary to index pilot in camshaft rear bearing to remove the rear intermediate bearing.

8. Assemble remover and installer tool on driver handle and remove camshaft front and rear bearings by driving towards center of cylinder block (fig. 6A1-25).

Installation

NOTE: The camshaft front and rear bearings should be installed first. These bearings will act as guides for the pilot and center the remaining bearings being pulled into place.

1. Assemble remover and installer tool on driver handle and install camshaft front and rear bearings by driving towards center of cylinder block (fig. 6A1-25).

2. Using Tool Set J-6098, with nut and thrust washer installed to end of threads, index pilot in camshaft front bearings and install puller screw through pilot.

3. Index camshaft bearing in bore, then install remover and installer tool on puller screw with shoulder toward bearing.

CAUTION: All cam bearing oil holes must be aligned with oil holes in cam bore.

4. Using two wrenches, hold puller screw while turning nut. After bearing has been pulled into bore, remove the remover and installer tool from puller screw and check alignment of oil hole in camshaft bearing.

5. Install remaining bearings in the same manner. It will be necessary to index pilot in the camshaft rear bearing to install the rear intermediate bearing.

6. Install a new camshaft rear plug.

NOTE: Plug should be installed flush to 1/32" deep and be parallel with rear surface of cylinder block.

OIL PAN

(All except 'G' Van)

Removal

1. Disconnect battery negative cable.
2. Raise vehicle on hoist and drain engine oil.
3. Remove starter.
4. Remove flywheel splash shield or converter housing underpan, as applicable.
5. Remove "through" bolts from engine front mounts.
6. Raise front of engine, reinstall mount through bolts and lower engine.
7. Remove oil pan bolts.

8. Remove oil pan.

Installation

1. Thoroughly clean all gasket sealing surfaces.
2. Using a new gasket, install rear seal in rear main bearing cap.
3. Install front seal on crankcase front cover, pressing tips into holes provided in cover.
4. Install side gaskets to engine block, using a gasket sealer with sufficient body to act as a retainer.
5. Install oil pan, torquing the retaining bolts to 80 lb. in. (9N·m).
6. Raise engine sufficiently to allow removal of "through" bolts - lower engine and install mount "through" bolts. Torque bolts to 75 lb. ft. (100 N·m).
7. Install flywheel splash shield or converter housing underpan, as applicable.
8. Install starter.
9. Lower vehicle and fill crankcase with oil.
10. Connect battery negative cable, start engine and check for leaks.

Oil Pan - G-Van

IN-LINE

Removal

1. Disconnect battery negative cable.
 2. Remove engine cover.
 3. Remove air cleaner and studs.
 4. Remove fan finger guard.
 5. Remove radiator upper support brackets.
 6. Raise vehicle on hoist.
- NOTE:** If vehicle is equipped with a standard transmission, perform the following steps before continuing.
- a. Disconnect clutch cross shaft from left front mount bracket.
 - b. Remove transmission to bell housing upper bolt.
 - c. Remove transmission rear mount bolts and install two 7/16" x 3" bolts.
 - d. Raise transmission using jack and install 2" block between mount and crossmember.
7. Remove starter and lay aside.
 8. Drain crankcase.
 9. Remove mount "through" bolts.
 10. Raise engine sufficiently to insert wooden blocks between engine mounts and cross member brackets.
 11. Remove flywheel splash shield or converter cover, as applicable.
 12. Remove oil pan bolts.
 13. Remove oil pan and clean gasket surfaces.

Installation

1. Install new gasket on cleaned gasket surface.
 2. Install oil pan and retaining bolts and torque to specifications.
 3. Install flywheel splash shield or converter cover, as applicable.
 4. Raise engine sufficiently to remove wooden blocks, lower engine and install mount 'through' bolts. Torque bolts to specification.
 5. Install starter.
- NOTE:** If vehicle is equipped with a standard transmission, perform the following steps.
- a. Raise transmission using jack and remove 2" block

from between mount and cross member.

b. Lower transmission on cross member, remove two 7/16" x 3" bolts, install rear mount bolts and torque to specifications.

c. Install transmission to bell housing upper bolt.

d. Connect clutch cross shaft to left front mount bracket.

6. Lower vehicle on hoist.

7. Install radiator upper support brackets.

8. Install fan finger guard.

9. Install air cleaner studs and air cleaner.

10. Install engine cover.

11. Fill crankcase with oil. (See owner's manual).

12. Connect battery negative cable, start engine and check for leaks.

OIL PUMP

Removal

1. Remove oil pan as outlined.

2. Remove two flange mounting bolts, pickup pipe bolt, then remove pump and screen as an assembly.

Disassembly

1. Remove the pump cover attaching screws, the pump cover and the pump cover gasket (fig. 6A1-26).

NOTE: Mark gear teeth so they may be reassembled with the same teeth indexing.

2. Remove the idler gear and the drive gear and shaft from the pump body.

3. Remove the pressure regulator valve retaining pin, pressure regulator valve and related parts.

4. If the pickup screen and pipe assembly need replacing, mount the pump in a soft-jawed vise and extract pipe from pump.

CAUTION: Do not disturb the pickup screen on the pipe. This is serviced as an assembly.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.

2. Inspect the pump body and cover for cracks or excessive wear.

3. Inspect pump gears for damage or excessive wear.

4. Check the drive gear shaft for looseness in the pump body.

5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.

6. Inspect the pickup screen and pipe assembly for damage to screen, pipe or relief grommet.

7. Check the pressure regulator valve for fit.

NOTE: The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.

Assembly

1. If the pickup screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure. Mount the pump in a soft-jawed vice, apply sealer to the end of pipe and tap the pipe in place with a plastic hammer using Tool J-8369.

CAUTION: Be careful of twisting, shearing or collapsing pipe while installing in pump. Pickup screen must be parallel to bottom of oil pan when

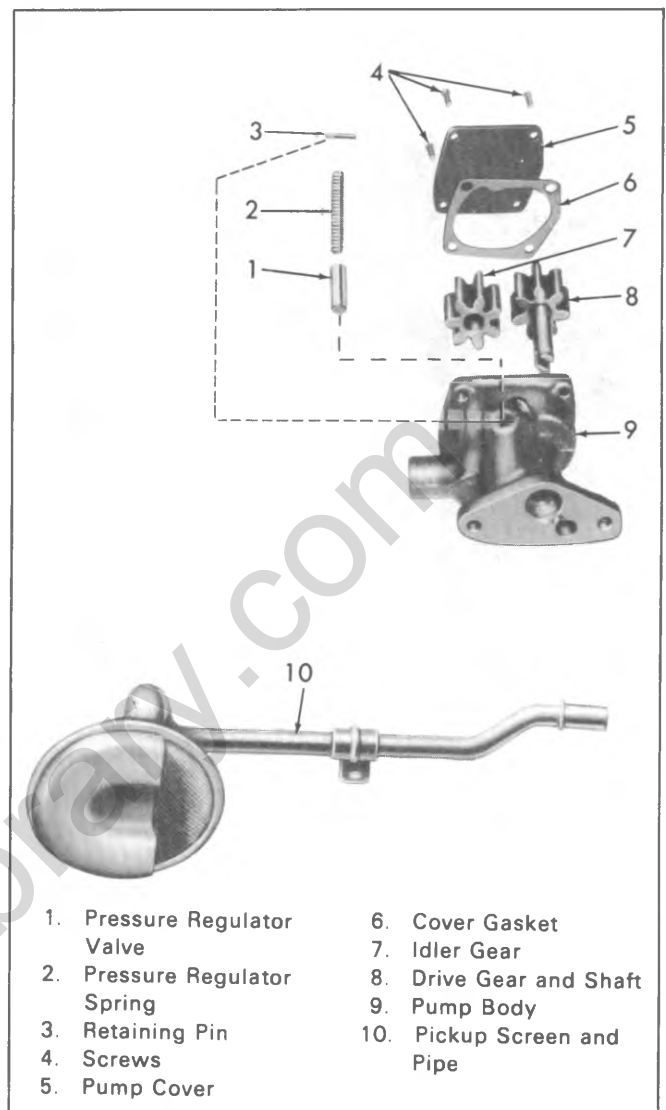


Fig. 6A1-26--Oil Pump

oil pump is installed.

2. Install the pressure regulator valve and related parts.

3. Install the drive gear and shaft in the pump body.

4. Install the idler gear in the pump body with the smooth side of gear towards pump cover opening.

5. Install the pump cover, with new gasket, and torque attaching screws to 70 lb. in. (8N·m).

6. Turn drive shaft by hand to check for smooth operation.

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. **DO NOT FILE RODS OR ROD CAPS.** If clearances are found to be excessive a new bearing will be required. Service bearings are available in standard size and .001" and .002" undersize for use with new and used standard size crankshafts, and in .010" and .020" undersize for use with reconditioned crankshafts.

NOTE: On removing a connecting rod cap, it is possible to find a .009" undersize bearing. These are used in manufacturing for selective fitting.

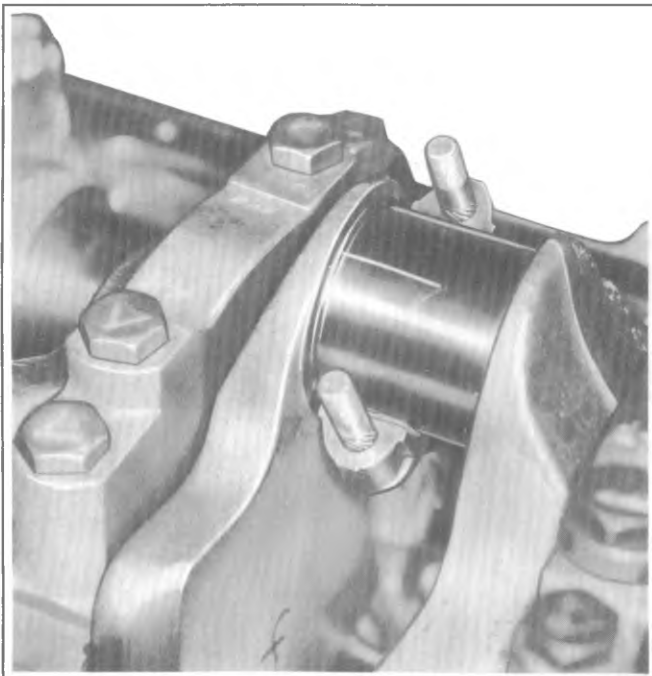


Fig. 6A1-27--Gaging Plastic on Crankpin

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing.
2. Inspect the bearings for evidence of wear or damage. (Bearings showing the above should not be installed.)
3. Wipe both upper and lower bearing shells and crankpin clean of oil.
4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum

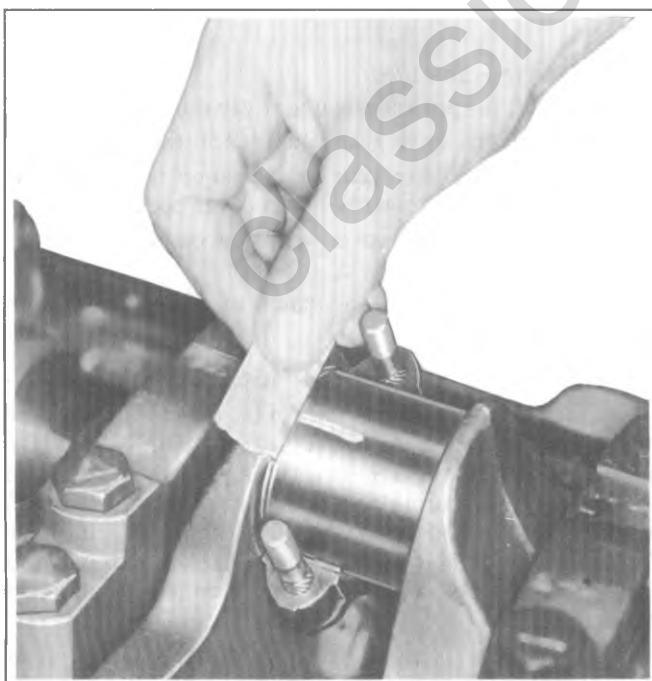


Fig. 6A1-28--Measuring Gaging Plastic

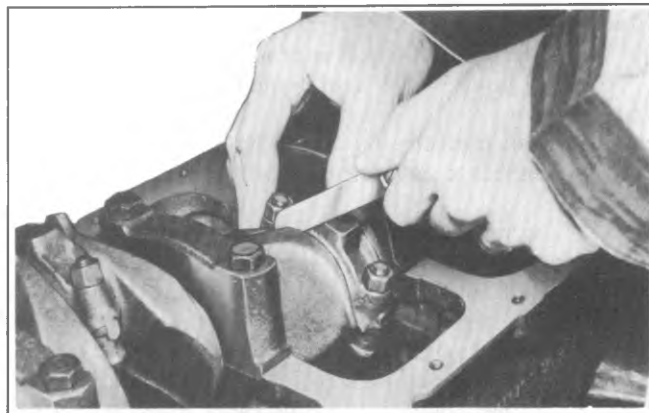


Fig. 6A1-29--Measuring Connecting Rod Side Clearance

diameter of the crankpin to determine new bearing size required.

5. If within specifications measure new or used bearing clearances with Plastigage or its equivalent.

NOTE: If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .001" interference between the bearing and crankpin will result in rapid bearing failure.

- a. Place a piece of gaging plastic the full width of the crankpin as contacted by the bearing (parallel to the crankshaft)(fig. 6A1-27).
- b. Install the bearing in the connecting rod and cap.
- c. Install the bearing cap and evenly torque nuts to 35 lb. ft. (47N·m).

CAUTION: Do not turn the crankshaft with the gaging plastic installed.

- d. Remove the bearing cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point (fig. 6A1-28).

6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance.

NOTE: Be sure to check what size bearing is being removed in order to determine proper replacement size bearing. Undersize is marked on the back of the bearing.

If clearance cannot be brought within specification, the crankpin will have to be ground undersize. If the crankpin is already at maximum undersize, replace crankshaft.

7. Coat the bearing surface with oil, install the rod cap and torque nuts to 35 lb. ft. (47N·m).

8. When all connecting rod bearings have been installed, tap each rod lightly (parallel to the crankpin) to make sure they have clearance.

9. Measure all connecting rod side clearances between the connecting rod cap and side of crankpin (fig. 6A1-29).

CRANKSHAFT MAIN BEARINGS

Main bearings are of the precision insert type and do not utilize shim for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in standard size and .001", .002", .009", .010" and .020" undersize.

Selective fitting of both rod and main bearing inserts

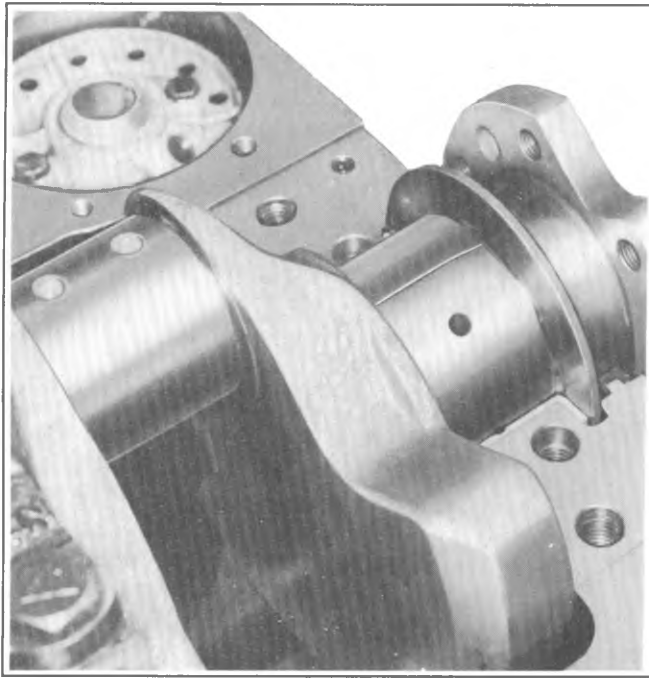


Fig. 6A1-30—Gaging Plastic on Journal – Typical

is necessary in production in order to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a .001" undersize insert which will decrease the clearance .0005" from using a full standard bearing.

When a production crankshaft cannot be precision fitted by this method, it is then ground .009" undersize on **only those main journals that cannot be properly fitted. All journals will not necessarily be ground.** A .009" undersize bearing and .010" undersize bearing will then be used for precision fitting in the same manner as previously described.

NOTE: If, for any reason, main bearings caps are replaced, shimming may be necessary. Laminated shims for each cap are available for service. Shim requirement will be determined by bearing clearance.

Inspection

In general, the lower half of the bearing (except No.1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. **Never replace one half without replacing the other half.**

Checking Clearance

To obtain the most accurate results with "Plastigage", (or its equivalent) a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed. If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft should be supported both front and rear (damper and flywheel) to remove the clearance from the upper bearing. The total clearance can then be measured between

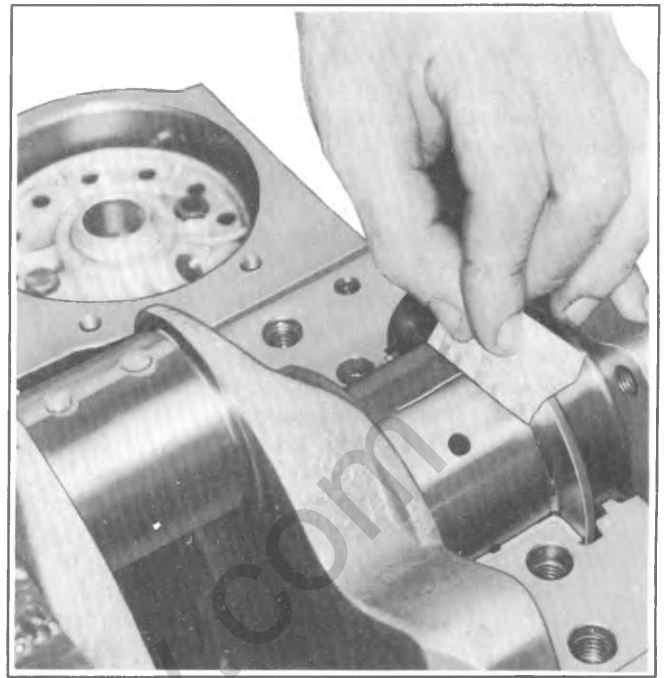


Fig. 6A1-31—Measuring Gaging Plastic – Typical

the lower bearing and journal.

NOTE: To assure the proper seating of the crankshaft all bearing cap bolts must be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing must be wiped clean of oil.

1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal, both bearing shells and bearing cap.
2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal (fig. 6A1-

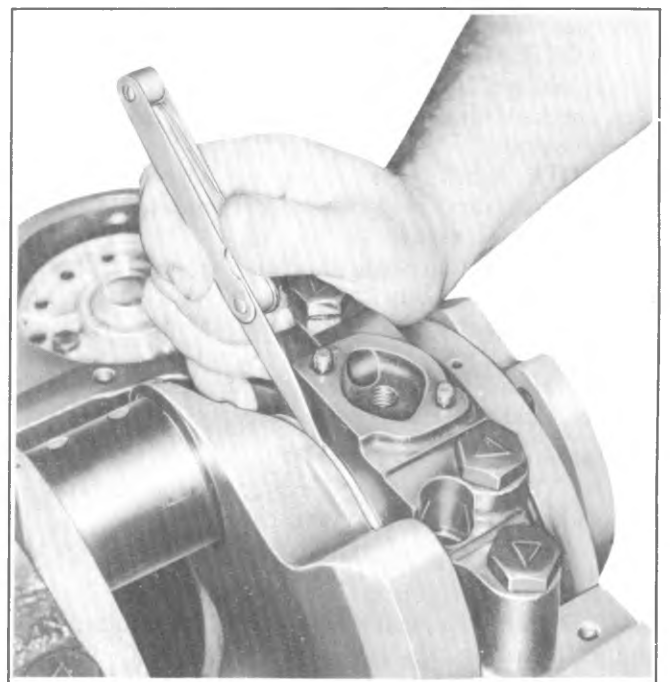


Fig. 6A1-32—Measuring Crankshaft End Play – Typical

30).

CAUTION: Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.

3. Install the bearing cap and evenly torque the retaining bolts to 65 lb. ft. (88N·m).

NOTE: Bearing cap **MUST** be torqued to specification in order to assure proper reading. Variations in torque affect the compression of the plastic gage.

4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.

5. On the edge of gaging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope (fig. 6A1-31).

NOTE: Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (.001" max.), be sure to fit to the maximum diameter of the journal.

If the bearing is fitted to the minimum diameter and the journal is out-of-round .001", interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001" difference.

6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower insert as a unit.

NOTE: If a new bearing cap is being installed and clearance is less than .001", inspect for burrs or nicks; if none are found then install shims as required.

7. A standard, .001" or .002" undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.

NOTE: After selecting new bearing, recheck clearance.

8. Proceed to the next bearing. After all bearings have been checked, rotate the crankshaft to see that there is no excessive drag.

NOTE: When checking No. 1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gage.

9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gage (fig. 6A1-32).

10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

Replacement

NOTE: Main bearings may be replaced with or without removing the crankshaft.

With Crankshaft Removed

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main

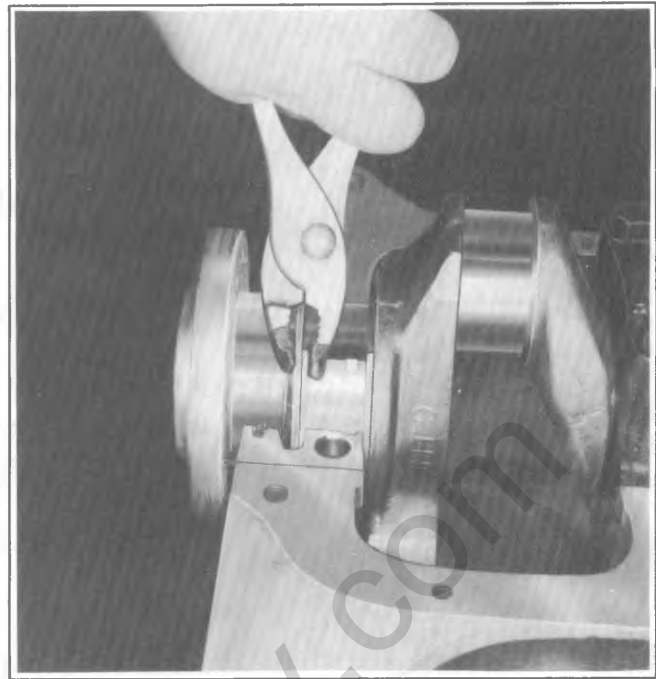


Fig. 6A1-33--Replacing Upper Main Bearing

bearing caps.

4. Install the crankshaft.

Without Crankshaft Removal

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.

2. The rear main journal has no oil hole. Replace the rear main bearing upper half as follows:

a. Use a small drift punch and hammer to start the upper bearing half rotating out of block.

b. Use a pair of pliers (with taped jaws) to hold the bearing thrust surface to the oil slinger and rotate the crankshaft to remove bearing (fig. 6A1-33).

c. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block.

d. Use pliers as in removing to rotate bearing into place. The last 1/4 movement may be done by holding just the slinger with the pliers or tap in place with a drift punch.

3. All other crankshaft journals have oil holes. Replace the main bearing upper half as follows:

a. Install a main bearing removing and installing tool, such as Tool J-8080, in oil hole in crankshaft journal.

NOTE: If such a tool is not available, a cotter pin may be bent as required to do the job.

b. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.

c. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.

4. Oil new lower bearing and install in bearing cap.

5. Install main bearing caps with arrows pointing toward front of engine.

6. Torque all main bearing caps **except the rear main cap** to 65 lb. ft. (88N·m). Torque rear main bearing

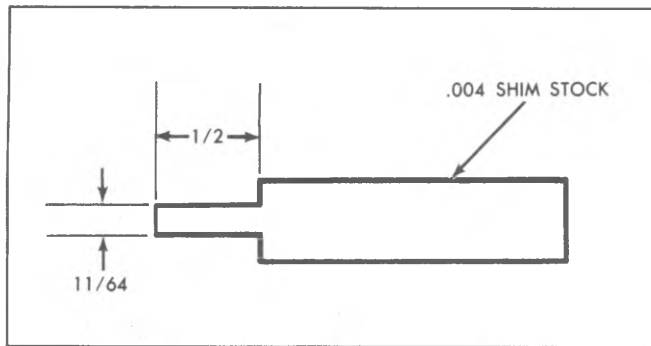


Fig. 6A1-34--Oil Seal Installation Tool

cap to 10-12 lb. ft. (14-16N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque **all** main bearing cap bolts to 65 lb. ft. (88N·m).

OIL SEAL (REAR MAIN)

Replacement

NOTE: Always replace the upper and lower seal as a unit. Install seal with lip facing front of engine.

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft. Extreme care should be exercised when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal. An installation tool (fig. 6A1-34) can be used to protect the seal bead when positioning seal as follows:

1. With the oil pan and oil pump removed, remove the rear main bearing cap.
2. Remove oil seal from the bearing cap by prying from the bottom with a small screw driver (fig. 6A1-35).
3. To remove the upper half of the seal, use a small hammer to tap a brass pin punch on one end of seal until it protrudes far enough to be removed with pliers (fig. 6A1-36).
4. Clean all sealant and foreign material from cylinder case bearing cap and crankshaft, using a nonabrasive cleaner.
5. Inspect components for nicks, scratches, burrs and machining defects at all sealing surfaces, case assembly and crankshaft.

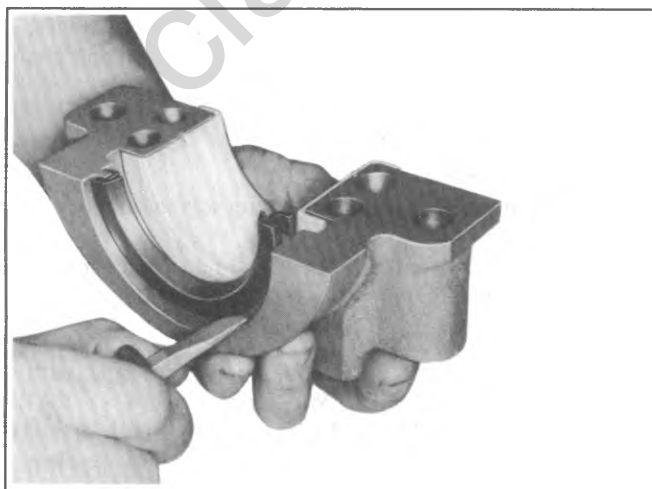


Fig. 6A1-35--Removing Oil Seal Lower Half - Typical

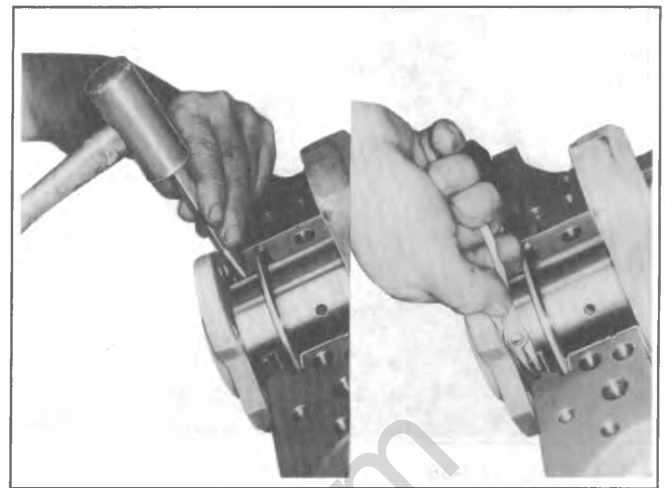


Fig. 6A1-36--Removing Oil Seal Upper Half - Typical

6. Coat seal lips and seal bead with light engine oil - keep oil off seal mating ends.

7. Position tip of tool between crankshaft and seal seat in cylinder case.

8. Position seal between crankshaft and tip of tool so that seal bead contacts tip of tool.

NOTE: Make sure that oil-seal lip is positioned toward front of engine (fig. 6A1-37).

9. Roll seal around crankshaft using tool as a "shoe-horn" to protect seal bead from sharp corner of seal seat surface in cylinder case.

CAUTION: Installation tool must remain in position until seal is properly positioned with both ends flush with block.

10. Remove tool, being careful not to withdraw seal.

11. Install seal half in bearing cap, again using tool as a "shoe-horn", feeding seal into cap using light pressure with thumb and finger.

12. Install bearing cap to case with sealant applied to the cap-to-case interface being careful to keep sealant off the seal split line (fig. 6A1-38).

13. Install the rear main bearing cap (with new seal) and torque to 10-12 lb. ft. (14-16 N·m). Tap end of

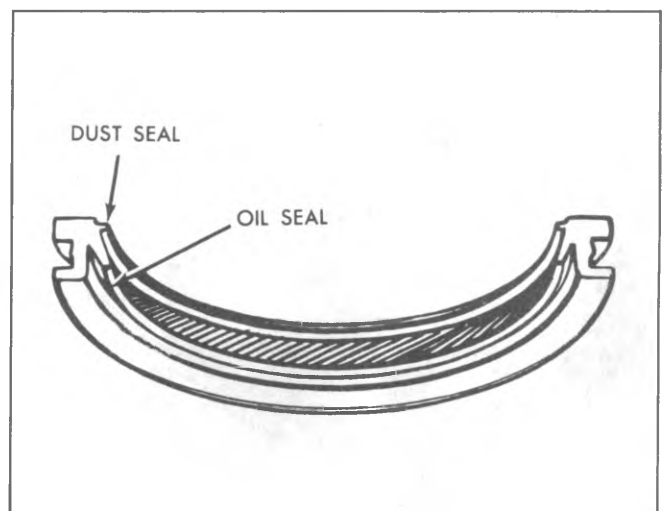


Fig. 6A1-37--Crankshaft Oil Seal - Rear Main

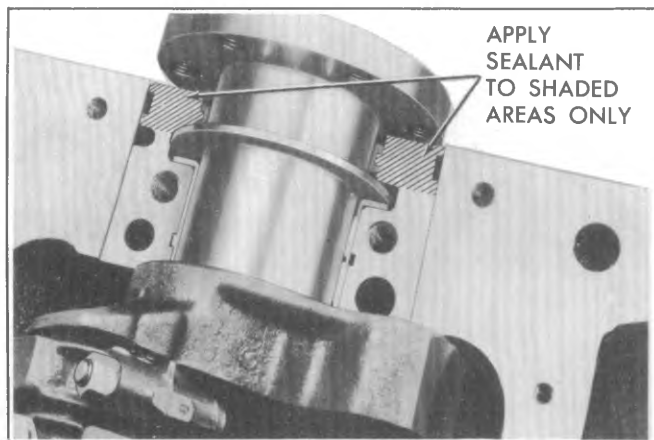


Fig. 6A1-38--Sealing Bearing Cap - Typical

crankshaft first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque bearing cap to 65 lb. ft. (88N·m).

PISTON AND CONNECTING ROD ASSEMBLIES

Removal

1. With oil pan, oil pump and cylinder head removed, use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.

NOTE: Before ridge and/or deposits are removed, turn crankshaft until piston is at the bottom of stroke and place a cloth on top of piston to collect the cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke and remove cloth and cuttings.

2. Inspect connecting rods and connecting rod caps for cylinder identification. If necessary, mark them.

3. Remove connecting rod cap and install Tool J-6305 (11/32") on studs. Push connecting rod and piston assembly

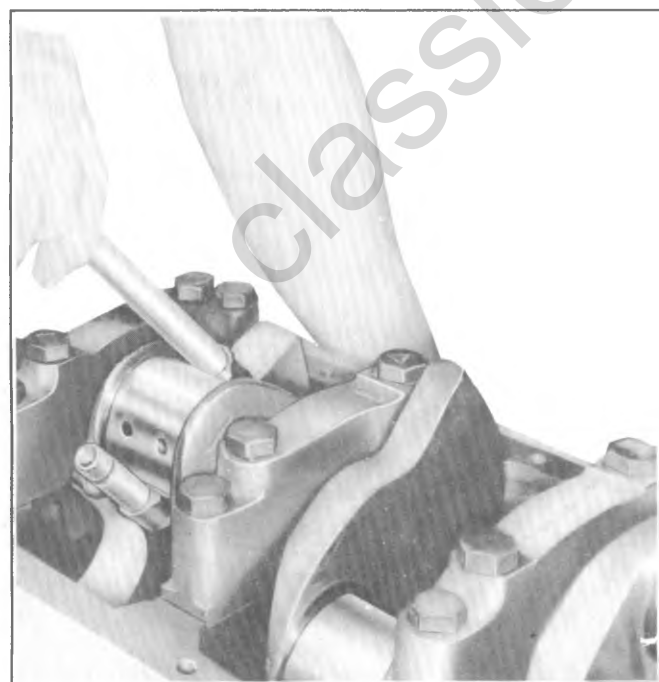


Fig. 6A1-39--Removing Connecting Rod & Piston Assembly

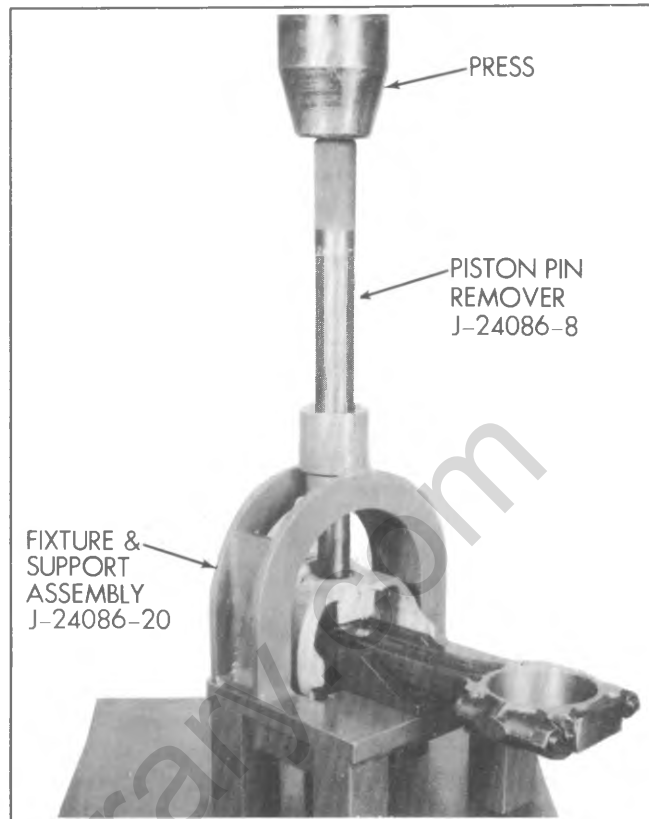


Fig. 6A1-40--Removing Piston Pin

out of top of cylinder block (fig. 6A1-39).

NOTE: It will be necessary to turn the crankshaft slightly to disconnect some of the connecting rod and piston assemblies and push them out of the cylinder.

Disassembly

1. Remove connecting rod bearings from connecting rods and caps.

NOTE: If connecting rod bearings are being reused, place them in a rack so they may be reinstalled in their original rod and cap.

2. Remove piston rings by expanding and sliding them off the pistons. Tools J-8021 (3-7/8") and J-22249 (3-15/16") are available for this purpose.

3. Place connecting rod and piston assembly on tool J-24086. Using an arbor press and piston pin remover, J-24086, press the piston pin out of connecting rod and piston (fig. 6A1-40).

Cleaning and Inspection

Connecting Rods

Wash connecting rods in cleaning solvent and dry with compressed air.

Check for twisted or bent rods and inspect for nicks or cracks. Replace connecting rods that are damaged.

Pistons

Clean varnish from piston skirts and pins with a cleaning solvent. **DO NOT WIRE BRUSH ANY PART OF THE PISTON.** Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy or worn ring lands, scuffed or damaged skirts,

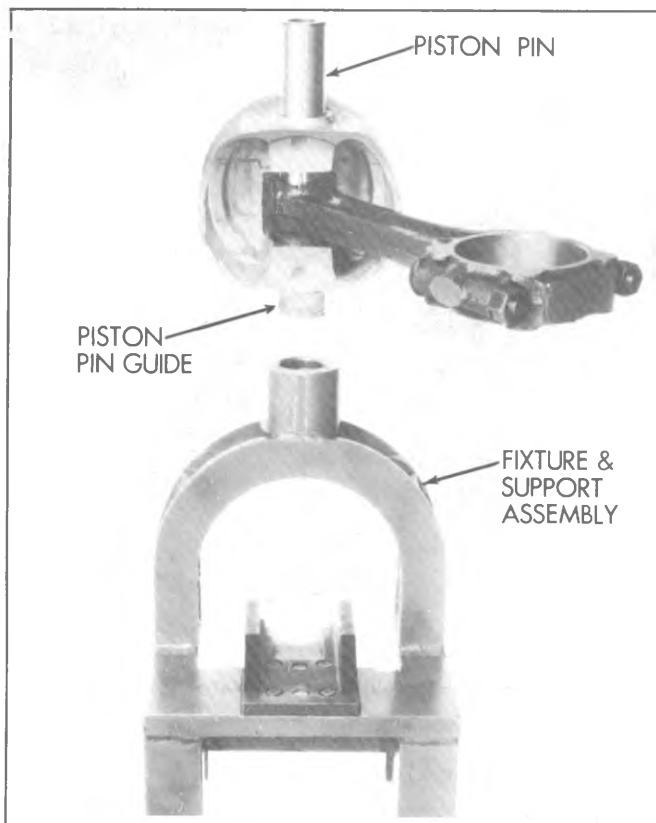


Fig. 6A1-41--Piston Assembly & Fixture & Support Assembly

eroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

Measure piston skirt (across center line of piston pin) and check clearance as outlined under "Piston Selection".

Piston Pins

The piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, the piston and piston pin are a matched set and not serviced separately.

Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when being measured. The piston pin should be measured with a micrometer and the piston pin bore should be measured with a dial bore gage or an inside micrometer. If clearance is in excess of the .001" wear limit, the piston and piston pin assembly should be replaced.

ASSEMBLY

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.
2. Place connecting rod in piston and hold in place with piston pin guide and piston pin. Place connecting rod and piston assembly on fixture and support assembly (fig. 6A1-41).

NOTE: Pin Guide J-24086-7 (Violet) is used to guide pin. Installer setting is G-8.

3. Using piston pin installer, J-24086-9, press the piston pin into the piston and connecting rod (Fig. 6A1-42).

NOTE: The piston pin installer is a variable insertion length tool designed to be applicable to all GM piston

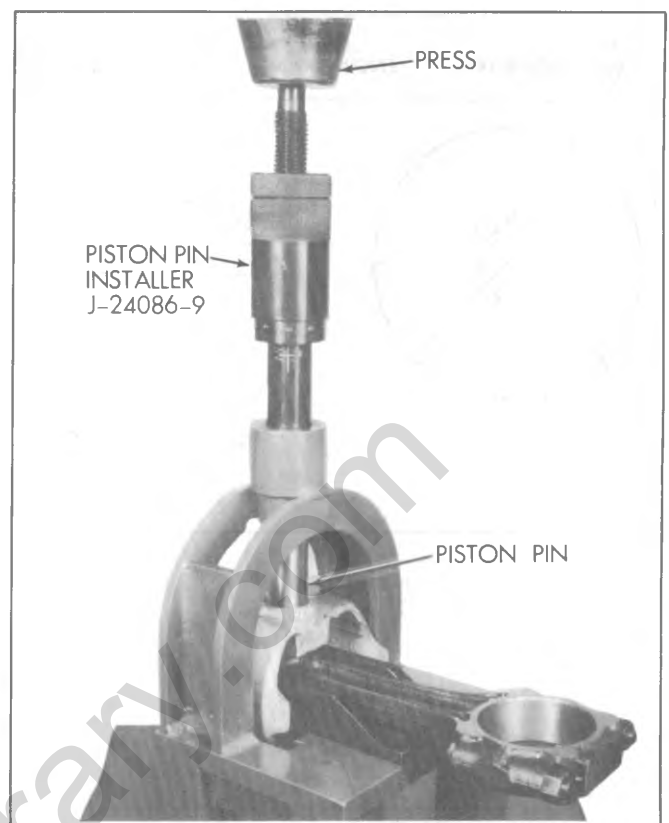


Fig. 6A1-42--Installing Piston Pin

assemblies. The insertion length is varied by rotating the hub on the shaft much like adjusting a micrometer. An alpha-numeric scale is used to determine the desired length for a given piston pin assembly.

CAUTION: After installer hub bottoms on support assembly, do not exceed 5000 psi pressure, as this could cause structural damage to the tool.

4. Remove piston and connecting rod assembly from tool and check piston for freedom of movement on piston pin.

Piston Rings

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the marked side is toward the top of the piston. The top ring is chrome faced, or treated with molybdenum for maximum life.

The oil control rings are of three piece type, consisting of two segments (rails) and a spacer.

1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about 1/4" (above ring travel). Be sure ring is square with cylinder wall.
3. Measure the space or gap between the ends of the ring with a feeler gage.
4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.
5. Fit each compression ring to the cylinder in which it is going to be used.
6. If the pistons have not been cleaned and inspected as previously outlined, do so.

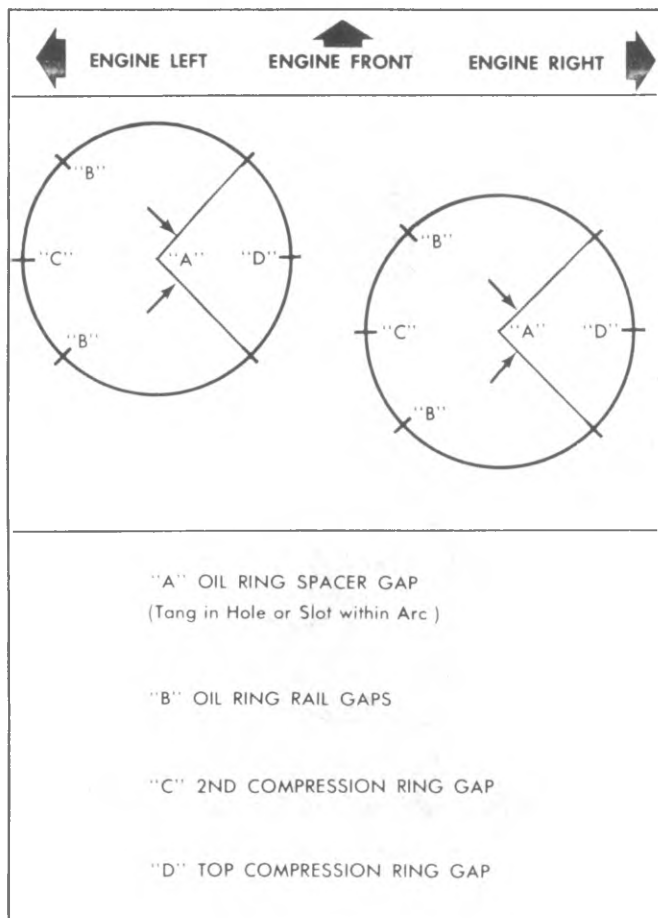


Fig. 6A1-43--Ring Gap Location

7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove to make sure that the ring is free. If binding occurs at any point the cause should be determined, and if caused by ring groove, remove by dressing with a fine cut file. If the binding is caused by a distorted ring, check a new ring.

8. Install piston rings as follows (fig. 6A1-43).

NOTE: Tools J-8021 (3-7/8") and J-22249 (3-15/16") are available for this purpose.

a. Install oil ring spacer in groove and insert anti-rotation tang in oil hole.

b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.

c. Install upper steel oil ring rail with gap properly located.

d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point, the cause should be determined, and if caused by ring groove, remove by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.

e. Install second compression ring expander then ring with gaps properly located.

f. Install top compression ring with gap properly located.

9. Proper clearance of the piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, the clearances between the surfaces of the ring groove should



Fig. 6A1-44--Measuring Ring Groove Clearance

be measured (fig. 6A1-44). (See Specifications.)

Installation

NOTE: Cylinder bores must be clean before piston installation. This may be accomplished with a hot water and detergent wash or with a light honing as necessary. After cleaning, the bores should be swabbed several times with light engine oil and a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.

2. Lightly coat pistons, rings and cylinder walls with light engine oil.

3. With bearing caps removed, install Tool J-6305 (11/32") on connecting rod bolts.

CAUTION: *Be sure ring gaps are properly*

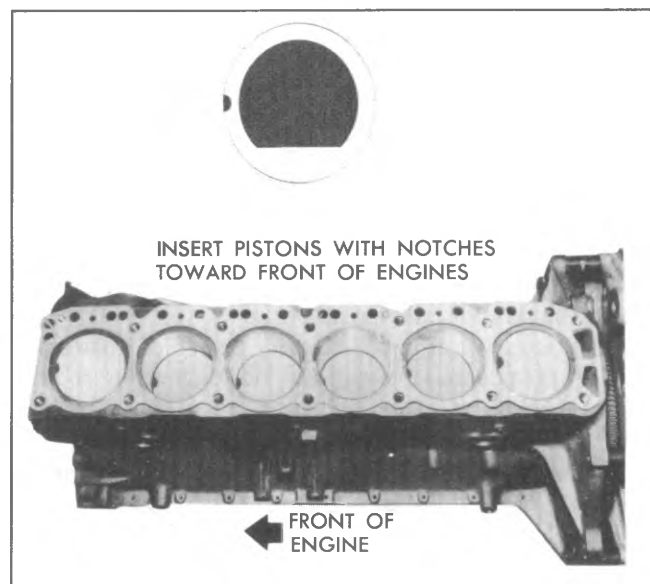


Fig. 6A1-45--Pistons--Installed Position

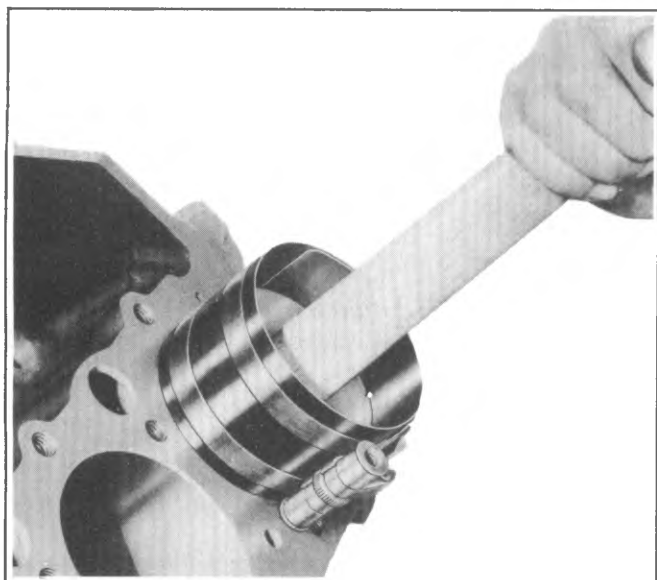


Fig. 6A1-46--Installing Connecting Rod and Piston Assembly

positioned as previously outlined.

4. Install each connecting rod and piston in its respective bore. Pistons must have notches facing front of engine (fig. 6A1-45).

Use Tool J-8037 to compress the rings (fig. 6A1-46). Guide the connecting rod into place on the crankshaft journal with Tool J-6305 (11/32"). Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.

5. Remove J-6305.

6. Install the bearing caps and torque nuts to 35 lb. ft. (47N·m).

NOTE: If bearing replacement is required refer to "Connecting Rod Bearings".

Be sure to install new pistons in the same cylinders for which they were fitted, and used pistons in the same cylinder from which they were removed. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

CYLINDER BLOCK

Cleaning and Inspection

1. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.

2. Remove oil gallery plugs and clean all oil passages.

NOTE: These plugs may be removed with a sharp punch or they may be drilled and pried out.

3. Clean and inspect water passages in the cylinder block.

4. Inspect the cylinder block for cracks in the cylinder walls, water jacket, valve lifter bores and main bearing webs.

5. Measure the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator. Set the gage so that the thrust pin must be forced in about 1/4" to enter gage in cylinder bore. Center gage in cylinder and turn dial to "O". Carefully work gage up and down cylinder to determine taper and turn it

to different points around cylinder wall to determine the out-of-round condition. If cylinders were found to exceed specifications, honing or boring will be necessary.

Oil Filter Bypass Valve

Inspection and Replacement

With the oil filter removed, check the spring and fibre valve for operation. Inspect for a cracked or broken valve. If replacement is necessary, remove valve by prying it out with a screw driver. Install and seat a new valve by tapping it in place, using a 9/16 thin-wall deep socket.

Distributor Lower Bearing

Replacement

The distributor lower bearing is a bronze bushing pressed into the lower side of the engine block. Its upper inside diameter pilots the distributor shaft and the outside diameter extending below the block pilots the oil pump.

The lower bushing will ordinarily require only a clearance or wear check during engine overhaul. When distributor shaft-to-bushing clearance exceeds .0035" the bushing should be replaced as follows:

1. With oil pump and distributor removed install Tool J-9534 into bushing and using a slide hammer, remove the bushing.

2. Clean bushing bore in block and check for burrs or damage.

3. Using Tool J-9535 with driver-bolt in driver handle install driver into new bushing from large inside diameter.

4. Position bushing and driver to block and drive the bushing in position, which is determined by tool bottoming against the block.

5. Remove tool from bushing. It is possible that the bushing with minimum I.D. will collapse enough during installation to slightly seize the installer arbor. If this happens, remove installer tool using slide hammer in driver bolt hole or driver handle.

NOTE: This will not damage the bushing and tool is designed for this purpose, should it occur.

Cylinder Conditioning

The performance of the following operation is contingent upon engine condition at time of repair.

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring.

If the cylinders were found to have less than .005" taper or wear they can be conditioned with a hone and fitted with the high limit standard size piston. A cylinder bore of less than .005" wear or taper may not entirely clean up when fitted to a high limit piston. If it is desired to entirely clean up the bore in these cases, it will be necessary to rebore for an oversize piston. If more than .005" taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.

When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, the cylinder bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

Cylinder Boring

1. Before using any type boring bar, the top of the cylinder block should be filed off to remove any dirt or burrs. This is very important. Otherwise, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.

2. The piston to be fitted should be measured with a micrometer, measuring at the center of the piston skirt and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston and honed to give the specified clearance.

NOTE: Hone cylinders as outlined under "Cylinder Honing and Piston Fitting".

3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

Cylinder Honing

1. When cylinders are to be honed follow the hone manufacturer's recommendations for the use of the hone and cleaning and lubrication during honing.

2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.

3. When finish honing a cylinder bore to fit a piston, the hone should be moved up and down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch pattern of approximately 45 to 65 degrees included angle. The finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.

4. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

CAUTION: Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been honed to correct size as this type piston can be distorted through careless handling.

5. Thoroughly clean the bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil, the bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

Piston Selection

1. Check USED piston to cylinder bore clearance as follows:

a. Measure the "Cylinder Bore Diameter" with a telescope gage (2-12" from top of cylinder bore).

b. Measure the "Piston Diameter" (at skirt across center line of piston pin).

c. Subtract piston diameter from cylinder bore diameter to determine "Piston to Bore Clearance".

d. Locate piston to bore clearance on Piston Selection Chart and determine if piston to bore clearance is in the acceptable range.

2. If used piston is not acceptable, check Piston Size Chart and determine if a new piston can be selected to fit

cylinder bore within the acceptable range.

3. If cylinder bore must be reconditioned, measure new piston diameter (across center line of piston pin) then hone cylinder bore to correct clearance (preferable range).

4. Mark the piston to identify the cylinder for which it was fitted.

FLYWHEEL

Removal

(All Except 4.8 (T) Engines)

1. Remove transmission and/or clutch housing and clutch from engine.

2. Remove flywheel retaining bolts and remove flywheel.

4.8 (T) Engines

1. Remove transmission and/or clutch housing and clutch from engine.

2. Mark relationship of flywheel and crankshaft so that dowel holes can be aligned in their original positions on assembly.

3. Remove engine oil pan and rear main bearing cap.

4. Remove flywheel retaining bolts and drive crankshaft dowels out of flywheel and crankshaft. Rotate crankshaft as necessary so dowels clear cylinder block.

5. Remove flywheel and discard used dowel pins.

Repair

Only repair recommended at flywheel used with conventional clutch is replacement of starter gear in event gear is worn or otherwise damaged.

Use torch to heat the gear around entire circumference, then drive the gear off flywheel, using care not to damage the flywheel.

Uniformly heat the flywheel gear to temperature which will expand gear to permit installation (temperature which will expand gear to permit installation (temperature must not exceed 400°F or 204° C).

As soon as gear has been heated, install on flywheel.

CAUTION: NEVER heat starter gear to Red Hot as this will change metal structure.

Installation

(All Except 4.8 (T) Engines)

1. Clean the mating surfaces of flywheel and crankshaft to make certain there are no burrs.

2. Install flywheel on crankshaft and position to align dowel hole of crankshaft flange and flywheel.

3. Install flywheel retaining bolts and torque to specifications.

4.8 (T) Engine

1. Clean the mating surfaces of flywheel and crankshaft to make certain there are no burrs.

2. Install flywheel on crankshaft and position to align dowel holes of crankshaft flange and flywheel.

3. Install flywheel retaining bolts and torque to specifications.

NOTE: The interference fit dowel pins used on 4.8 (T) engines must be replaced with an oversize dowel pin when installing the flywheel.

4. When installing the original flywheel, ream the dowel pin holes with Tool J-22808-2. When installing a new flywheel, first ream the dowel pin holes with Tool J-22808-2

and then finish reaming them with Tool J-22808-1.

5. Install oversize dowel pins flush with flywheel retaining bolt surface.

6. Install rear main bearing cap and torque bolts to specifications. Install oil pan with new gaskets and seals. Torque oil pan retaining screws to specifications.

ENGINE ASSEMBLY

Removal

1. Remove Hood.
2. Disconnect battery cables at battery.
3. Remove air cleaner.
4. Drain radiator and block.
5. Disconnect radiator and heater hoses and remove radiator and fan shroud.
6. Disconnect wires at:
 - Starter Solenoid
 - Generator
 - Temperature switch
 - Oil Pressure Switch
 - Coil
7. Disconnect:
 - Accelerator linkage at inlet manifold.
 - Fuel line, from tank, at fuel pump.
 - Hoses at fuel vapor storage canister (if applicable).
 - Vacuum line to power brake unit at manifold, if so equipped.
8. Remove power steering pump and lay aside, if so equipped.
9. Raise vehicle on hoist.
10. Drain crankcase.
11. Disconnect exhaust pipe at manifold and, if so equipped, converter bracket at transmission rear mount.
12. Remove starter.
13. Remove flywheel splash shield or converter housing cover as applicable.
14. On vehicles with automatic transmissions, remove converter to flywheel attaching bolt.
15. Remove mount "through" bolts.
16. Remove bell housing bolts.
17. Lower vehicle on hoist.
18. Raise transmission using floor jack.
19. Attach engine lifting devices, raise engine.
20. Remove motor mount to engine brackets.
21. Remove engine assembly.

Installation

1. Position engine assembly in vehicle.
2. Attach motor mount to engine brackets and lower engine in place.
3. Remove engine lifting device.
4. Remove transmission floor jack.
5. Raise vehicle on hoist.
6. Install mount "through" bolts. Torque to specification.
7. Install bell housing bolts. Torque to specifications.
8. On vehicles with automatic transmissions, install converter to flywheel attaching bolts. Torque to specification.
9. Install flywheel splash shield or converter housing cover as applicable. Torque attaching bolts to specifications.
10. Install starter.
11. Connect exhaust pipe at manifold and converter bracket at transmission rear mount.

12. Lower vehicle on hoist.

13. Reinstall power steering pump, if so equipped.

14. Connect:

- Accelerator linkage at inlet manifold.
- Fuel line, from tank, at fuel pump.
- Hoses at fuel vapor storage canister.
- Vacuum line to power brake unit at manifold, if equipped.

15. Connect wires at:

- Starter Solenoid
- Generator
- Temperature Switch
- Oil Pressure Switch
- Coil

16. Install radiator and fan shroud and reconnect radiator and heater hoses.

17. Fill cooling system.

18. Fill crankcase with oil. See owner's manual for specifications.

19. Install air cleaner.

20. Install hood.

21. Connect battery cables.

NOTE: To avoid possible arcing of battery, connect positive battery cable first.

22. Start engine, check for leaks and check timing.

CRANKSHAFT

Removal

1. Remove engine as previously outlined. Remove clutch, if applicable, and flywheel and mount engine on stand.
2. Remove the oil dipstick and oil dipstick tube.
3. Remove the spark plugs.
4. Remove crankshaft pulley and torsional damper.
5. Remove oil pan and oil pump.
6. Remove crankcase front cover.
7. Check the connecting rod caps for cylinder number identification. If necessary, mark them.
8. Remove the connecting rod caps and push the pistons to the top of bores.
9. Remove main bearing caps and lift crankshaft out of cylinder block.
10. Remove rear main bearing oil seal and main bearings from cylinder block and main bearing caps.

Cleaning and Inspection

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure dimensions of main bearing journals and crankpins with a micrometer for out-of-round, taper or undersize. (See Specifications.)
3. Check crankshaft for run-out of supporting at the front and rear main bearings journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator. (See Specifications.)
4. Replace or recondition the crankshaft if out of specifications.

Gear Replacement

Remove crankshaft gear using Tool J-8105 and install using Tool J-5590 (fig. 6A1-47).

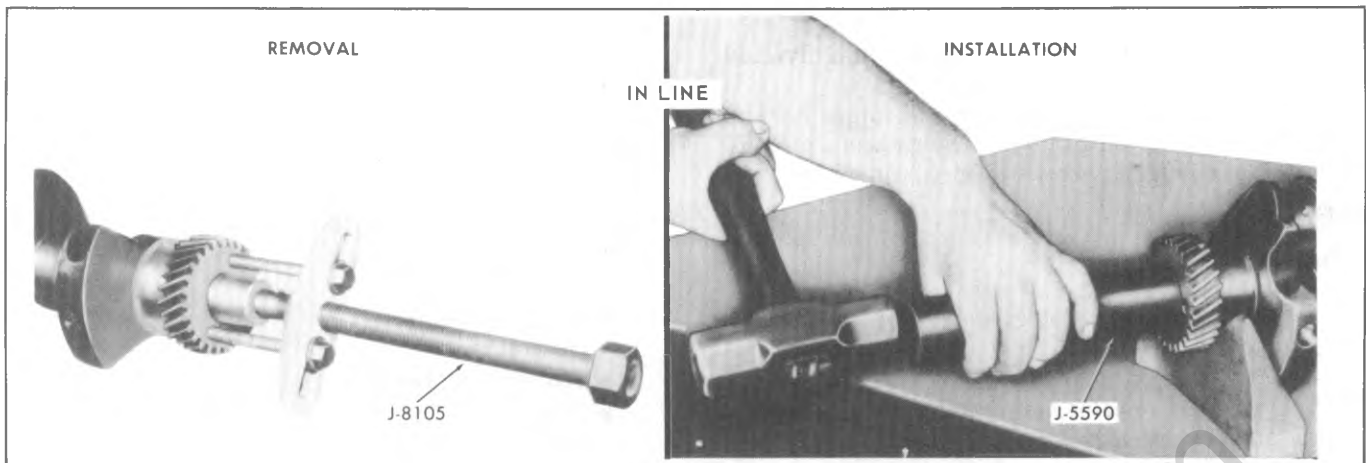


Fig. 6A1-47--Gear Replacement

Installation

1. Install rear main bearing oil seal in cylinder block and rear main bearing cap grooves. Install with lip of seal toward front of engine. Where seal has two lips install lip and helix towards front of engine.

2. Lubricate lips of seal with engine oil. Keep oil off parting line surface.

3. Install main bearings in cylinder block and main bearing caps then lubricate bearing surface with engine oil.

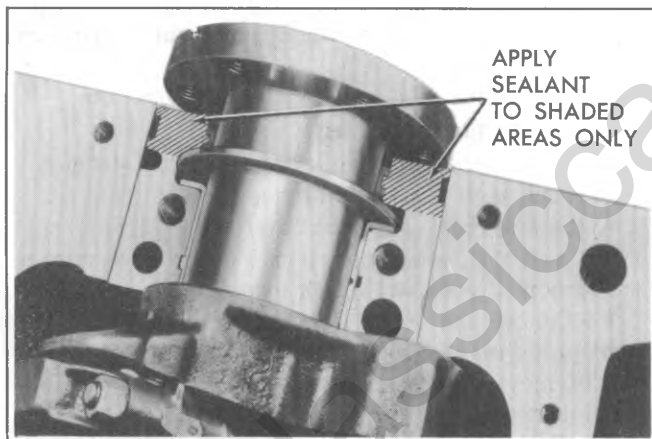


Fig. 6A1-48--Sealing Bearing Cap

4. Install crankshaft, being careful not to damage bearing surfaces.

5. Apply a thin coat of brush-on type oil sealing compound to block mating surface and corresponding surface of cap only (fig. 6A1-48). Do not allow sealer on crankshaft or seal.

6. Install main bearing caps with arrows pointing toward front of engine.

7. Torque all except rear main bearing cap bolts to specifications. Torque rear main bearing cap bolts to 10-12 ft. lbs. then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing cap bolts to specifications.

8. Measure crankshaft end play with a feeler gage. Force crankshaft forward and measure clearance between the front of the rear main bearing and the crankshaft thrust surface.

9. Install flywheel and torque to specifications. A wood block placed between the crankshaft and cylinder block will prevent crankshaft from rotating.

NOTE: Align dowel hole in flywheel with dowel hole in crankshaft. On vehicles equipped with automatic transmissions, install flywheel with the converter attaching pads towards transmission.

GENERAL DATA:

TYPE		IN LINE L-6	
DISPLACEMENT	LITRE (*)	4.1 (D)	4.8 (T)
RPO		LD4	L25
BORE		3.876	
STROKE		3.530	4.120
COMPRESSION RATIO		8.25:1	8.0:1
FIRING ORDER		1-5-3-6-2-4	

CYLINDER BORE:

DIAMETER			3.8745-3.8775
OUT OF ROUND	PRODUCTION		.0005 MAX.
	SERVICE		.002 MAX.
TAPER	PRODUCTION	THRUST SIDE	.0005 MAX.
		RELIEF SIDE	.0005 MAX.
	SERVICE		.001 MAX.

PISTON:

CLEARANCE	PRODUCTION	.0010-.0020	.0026-.0036
	SERVICE	.0030 MAX.	.0045 MAX.

PISTON RING:

C O M P R E S S I O N	GROOVE CLEARANCE	PRODUCTION	TOP	.0012-.0027	.0020-.0040
			2ND	.0012-.0032	.0020-.0040
	SERVICE		HI LIMIT + .001		
	O I L	GAP	PRODUCTION	TOP	.010-.020
2ND				.010-.020	
SERVICE		HI LIMIT + .010			
O I L		GROOVE CLEARANCE	PRODUCTION	.005 MAX.	
	SERVICE			HI LIMIT + .001	
	GAP	PRODUCTION	.015-.055		
			SERVICE		HI LIMIT + .010

* VIN Designation

PISTON PIN

LD4

L25

DIAMETER		.9270-.9273
CLEARANCE	PRODUCTION	.00015-.00025
	SERVICE	.001 MAX.
FIT IN ROD		.0008-.0016 INTERFERENCE

CRANKSHAFT

MAIN JOURNAL	DIAMETER		ALL 2.2979-2.2994	
	TAPER	PRODUCTION	.0002 MAX.	
		SERVICE	.001 MAX.	
	OUT OF ROUND	PRODUCTION	.0002 MAX.	
SERVICE		.001 MAX.		
MAIN BEARING CLEARANCE	PRODUCTION		#1-6 .0010-.0024 #7 .0016-.0035	
	SERVICE		#1-6	.0010-.0025 #7 .0015-.0035
CRANKSHAFT END PLAY			.002-.006	
CRANKPIN	DIAMETER		1.999-2.000	2.099-2.100
	TAPER	PRODUCTION	.0005	
		SERVICE	.001 MAX.	
	OUT OF ROUND	PRODUCTION	.0005	
SERVICE		.001 MAX.		
ROD BEARING CLEARANCE	PRODUCTION		.0010-.0026	
	SERVICE		.0030	
ROD SIDE CLEARANCE			.006-.017	

CAMSHAFT

LOBE LIFT ± .002	INTAKE	.2217
	EXHAUST	.2315
JOURNAL DIAMETER		1.8677-1.8697
CAMSHAFT END PLAY		.003-.008

VALVE SYSTEM

LD4

L25

LIFTER		HYDRAULIC		
ROCKER ARM RATIO		1.75:1		
VALVE LASH	INTAKE	ONE TURN DOWN FROM ZERO LASH		
	EXHAUST			
FACE ANGLE (INT. & EXH.)		45°	46°	
SEAT ANGLE (INT. & EXH.)		46°		
SEAT RUNOUT		.002 MAX.		
SEAT WIDTH	INTAKE	1/32-1/16		
	EXHAUST	1/16-3/32		
STEM CLEARANCE	PRODUCTION	INT.	.0010-.0027	
		EXH.	.0015-.0032	
	SERVICE	HI LIMIT	+ .001 INTAKE + .002 EXHAUST	
VALVE SPRING (OUTER)	FREE LENGTH		1.88	1.90
	PRESSURE LBS. @ IN.	CLOSED	56-64 @ 1.66	78-86 @ 1.66
		OPEN	166-178 @ 1.26	170-180 @ 1.26
	INSTALLED HEIGHT ± 1/32"		1-21/32	1-21/32
DAMPER	FREE LENGTH		NONE	1.94
	APPROX. # OF COILS		NONE	4

TORQUE SPECIFICATIONS

Camshaft Thrust Plate	80 lb. in.
Crankshaft Front Cover	80 lb. in.
Flywheel Housing Cover	80 lb. in.
Oil Pan (To Crankcase) (1/4-20)	80 lb. in.
Oil Pan (To Front Cover)	50 lb. in.
Oil Pump Cover	70 lb. in.
Rocker Arm Cover	45 lb. in.
Connecting Rod Cap	.35 lb. ft.*
Clutch Pressure Plate	.20 lb. ft.*
Oil Pan (To Crankcase) 5/16-18)	.75 lb. in.
Oil Pump	115 lb. in.
Push Rod Cover	50 lb. in.
Water Pump	15 lb. in.
Clutch Pressure Plate	.30 lb. ft. @
Distributor Clamp	.25 lb. ft.
Flywheel Housing	.30 lb. ft.
Manifold (Exhaust)	.30 lb. ft. ¹
Manifold (Exhaust To Inlet)	45 lb. ft. ²
Manifold To Head	40 lb. ft. ²
Thermostat Housing	.30 lb. ft.
Water Outlet	.30 lb. ft.
Connecting Rod Cap	.40 lb. ft. @
Main Bearing Cap	.65 lb. ft.
Flywheel	.60 lb. ft.*
Torsional Damper	.60 lb. ft. @ ¹
Cylinder Head	.95 lb. ft. ¹
Temperature Sending Unit	.20 lb. ft.
Oil Filter	Hand Tight
Oil Pan Drain Plug	.20 lb. ft.
Flywheel	110 lb. ft. @
Spark Plug	17-27 lb. ft.

* 4.1 (D) only

@ 4.8 (T) only

1 Except LH Front Bolt 85 lb. ft.

2 Non-Integral Head

SECTION 6A2

5.0 (U) 305 cu. in. V-8

5.7 (L) 350 cu. in. V-8

6.6 (R) 400 cu. in. V-8

7.4 (S) 454 cu. in. V-8

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GENERAL DESCRIPTION

CYLINDER BLOCK

The cylinder block is made of cast iron and has 8 cylinders arranged in a "V" shape with 4 cylinders in each bank. Five main bearings support the crankshaft which is retained by bearing caps that are machined with the block for proper alignment and clearances. Cylinders are completely encircled by coolant jackets.

CYLINDER HEAD

The cast iron cylinder heads provide a compression ratio of 8.5:1. They are cast with individual intake and exhaust ports for each cylinder. Valve guides are integral, and rocker arms are retained on individual studs.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron, and is supported by five main bearings. Number five bearing is the end thrust bearing.

Main bearings are lubricated from oil holes which intersect the camshaft bearings. The camshaft bearings are fed oil by the main oil gallery which is rifle drilled down the center of the block, above the camshaft. Two additional oil galleries are on either side of the main oil gallery to provide an oil supply for the hydraulic lifters.

A torsional damper on the forward end of the crankshaft dampens any engine torsional vibrations.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by five bearings and is chain driven. A steel crankshaft gear drives the timing chain which in turn drives the camshaft through a bakelite fabric composition gear with steel hub.

Cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with a spherical face on the lifter, causes the valve lifters to rotate.

Camshaft bearings are lubricated through oil holes which intersect the main oil gallery. The main oil gallery is rifle drilled down the center of the block, above the camshaft.

PISTONS AND CONNECTING RODS

The pistons are made of cast aluminum alloy using two compression rings and one oil control ring. Piston pins are offset 1/16" toward the thrust side (right hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins are Chromium steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just prior to full bearing load.

VALVE TRAIN

A very simple ball pivot-type train is used. Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker-arm ball is retained by a nut.

HYDRAULIC VALVE LIFTERS

Hydraulic Valve Lifters are used to keep all parts of the valve train in constant contact.

The hydraulic lifter assembly consists of: the lifter body, which rides in the cylinder block boss, a plunger, a push rod seat, a metering valve, a plunger spring, a check ball and spring, a check ball retainer and a push rod seat retainer.

When the lifter is riding on the low point of the cam, the plunger spring keeps the plunger and push rod seat in contact with the push rod.

When the lifter body begins to ride up the cam lobe, the check ball cuts off the transfer of oil from the reservoir below the plunger. The plunger and lifter body then rise as a unit, pushing up the push rod and opening the valve.

As the lifter body rides down the other side of the cam, the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the push

rod. The ball check valve will then move off its seat and the lifter reservoir will remain full.

INTAKE MANIFOLD

The intake manifold is of cast iron double level design for efficient fuel distribution. The carburetor pad is centrally located with a passage running underneath the pad (E.F.E.) through which exhaust gases are forced to promote faster fuel vaporization when the engine is cold. An EGR port is also cast into the manifold for the mixture of exhaust gases with the fuel air mixture.

EXHUAUST MANIFOLDS

Two cast iron exhaust manifolds are used to direct exhaust gases from the combustion chambers to the exhaust system. The right hand side manifold receives a heat shield that is used to route heated air to the air cleaner for better fuel vaporization.

COMBUSTION CHAMBERS

Combustion Chambers are cast to insure uniform shape for all cylinders. Spark plugs are located between the intake and exhaust valves.

The contoured wedge shape of the combustion chamber minimizes the possibility of detonation, facilitates breathing, and provides swirling turbulence for smooth, complete combustion.

ENGINE LUBRICATION

Full pressure lubrication through a full flow oil filter, is furnished by a gear-type oil pump. The distributor, driven by a helical gear on the camshaft, drives the oil pump. The main oil gallery feeds oil, through drilled passages, to the camshaft and crankshaft to lubricate the bearings. The valve

lifter oil gallery feeds the valve lifters which, through hollow push rods, feed the individually mounted rocker arms (fig. 6A2-1 thru 6A2-3).

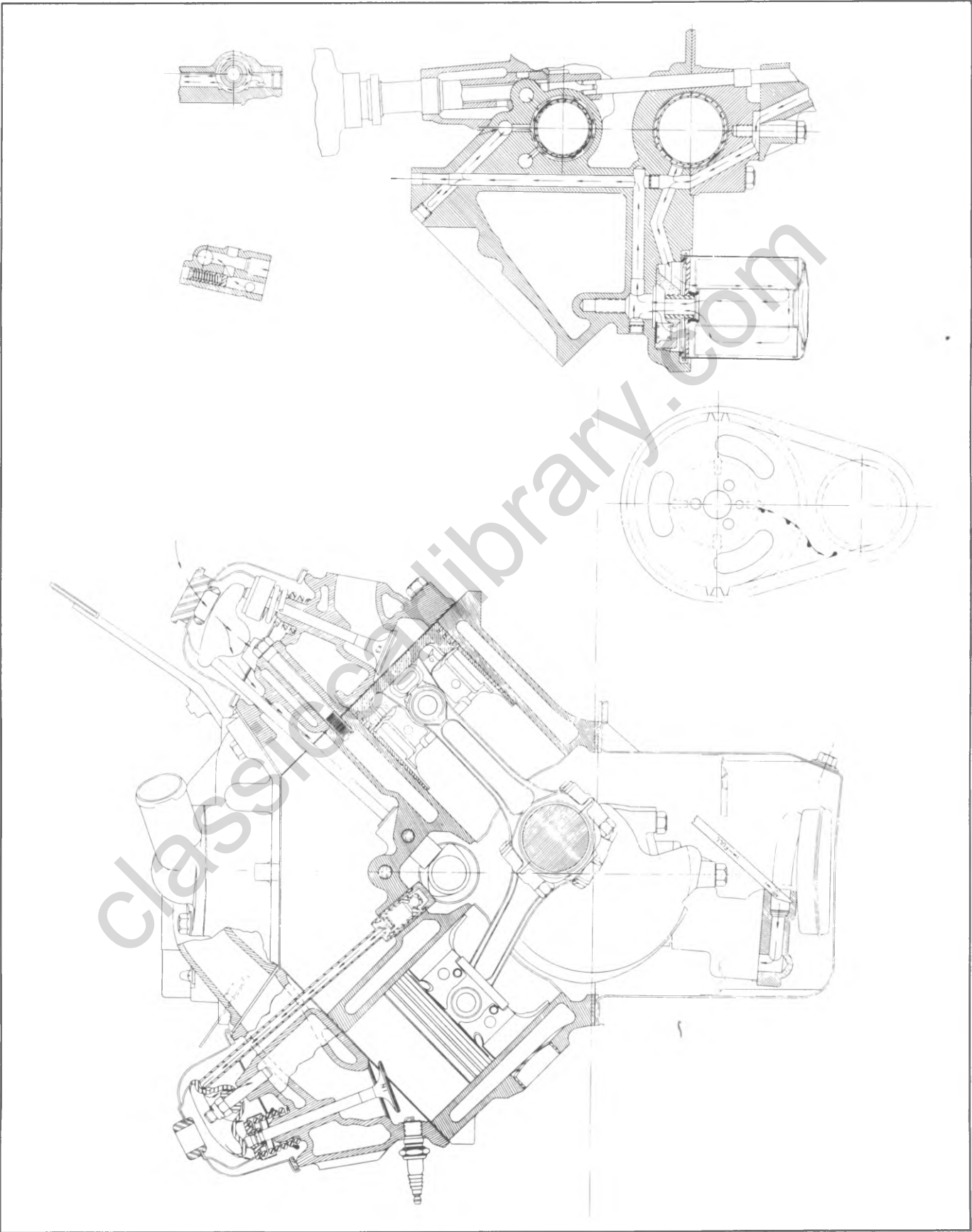


Fig. 6A2-1--"Small V-8" Engine Lubrication

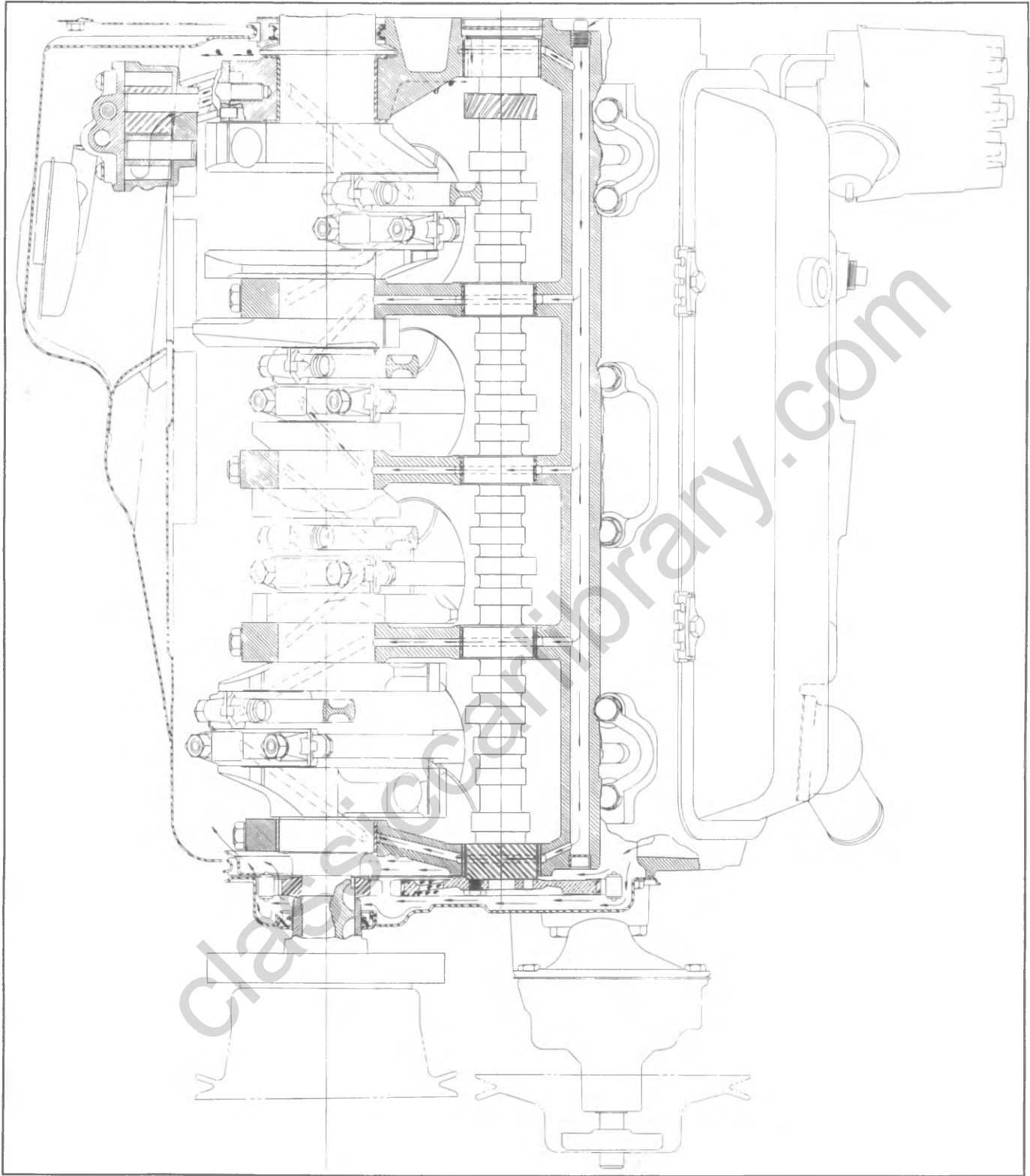


Fig. 6A2-2--"Small V8" Engine Lubrication

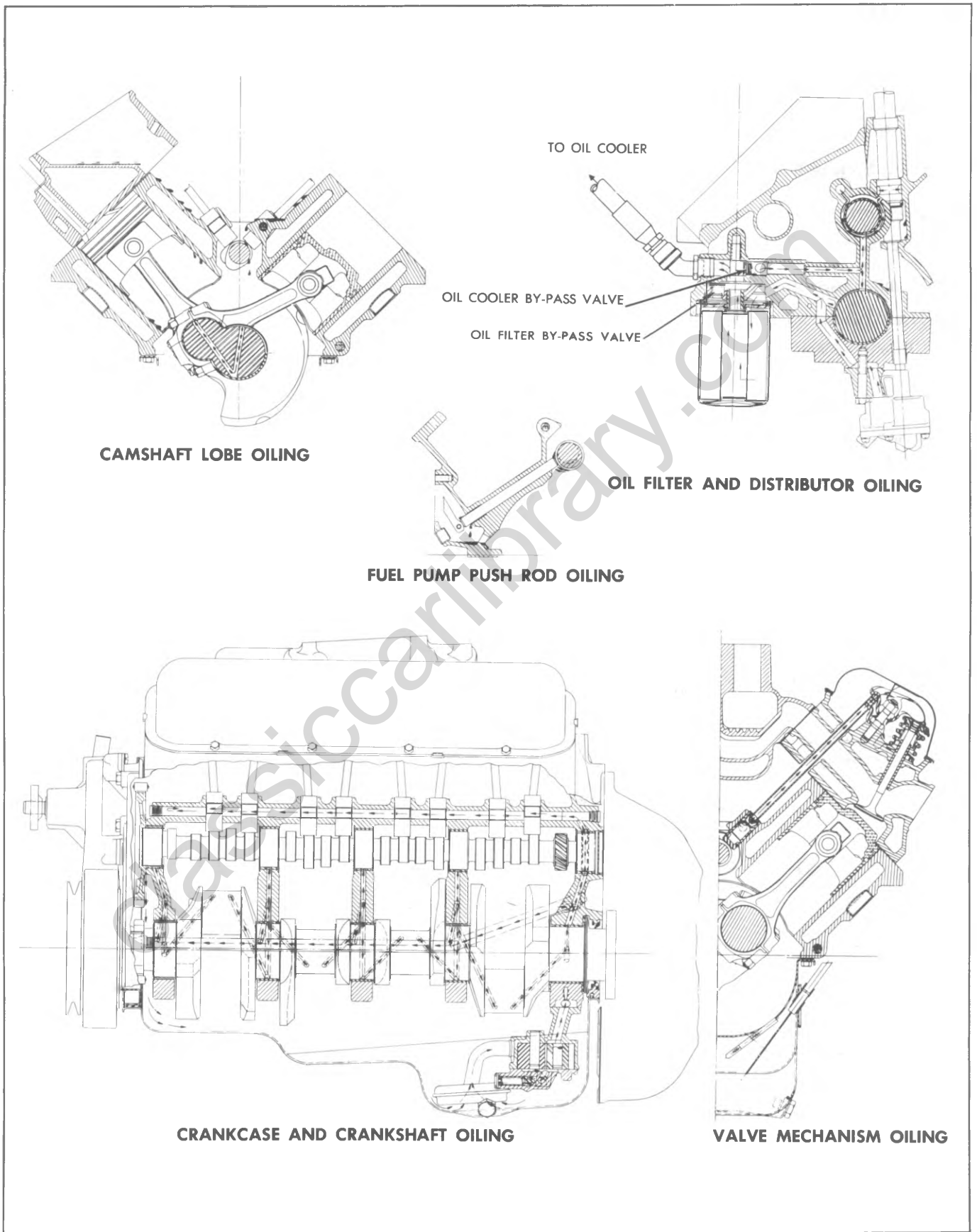


Fig. 6A2-3--"Mark IV" Engine Lubrication

ON VEHICLE SERVICE

ENGINE MOUNTS

Engine mounts (fig. 6A2-4 - 6A2-9) are the non-adjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

Checking Engine Mounts

Front Mount

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe both mounts while raising engine. If an engine mount exhibits:

- Hard rubber surface covered with heat check cracks;
 - Rubber separated from a metal plate of the mount;
- or
- Rubber split through center

Replace the mount. If there is relative movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or nuts attaching the mount to the engine, frame, or bracket.

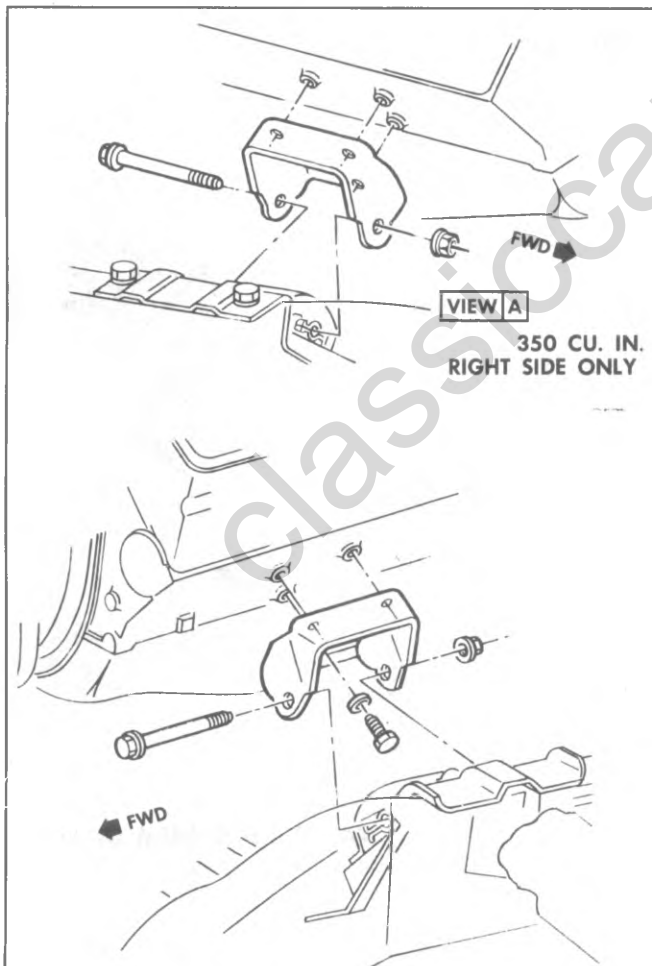


Fig. 6A2-4-"P" Series Engine Mount Bracket

Rear Mount

Raise the vehicle on a hoist. Push up and pull down on the transmission tailshaft while observing the transmission mount. If the rubber separates from the metal plate of the mount or if the tailshaft moves up but not down (mount bottomed out) replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the transmission or crossmember.

Front Mount Replacement

- Remove mount retaining bolt from below frame mounting bracket.
- Raise front of engine and remove mount-to-engine bolts and remove mount.

CAUTION: Raise engine only enough for sufficient clearance. Check for interference between rear of engine and cowl panel.

- Replace mount to engine and lower engine into place.
- Install retaining bolt and torque all bolts to specifications.

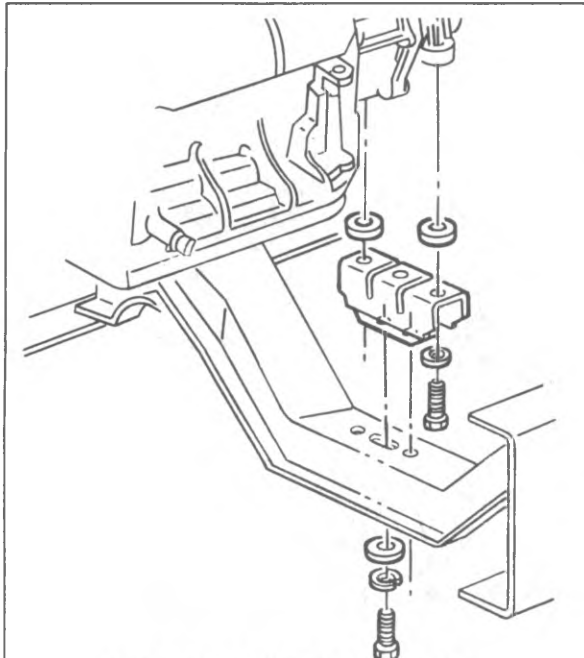
Rear Mount Replacement

- Support engine weight to relieve rear mounts.
- Remove crossmember-to-mount bolts.
- On P Series with manual transmission and propeller shaft parking brake, remove mount attaching bolts from frame outrigger and clutch housing and remove rear mounting cushions.
- Remove mount-to-transmission bolts, then remove mount.
- On P Series with manual transmission and propeller shaft parking brake, install new mounting cushions and bolts.
- Install new mount on transmission.
- While lowering transmission, align and start crossmember-to-mount bolts.
- Torque bolts to specifications then bend lock tabs to bolt head as applicable.

INTAKE MANIFOLD

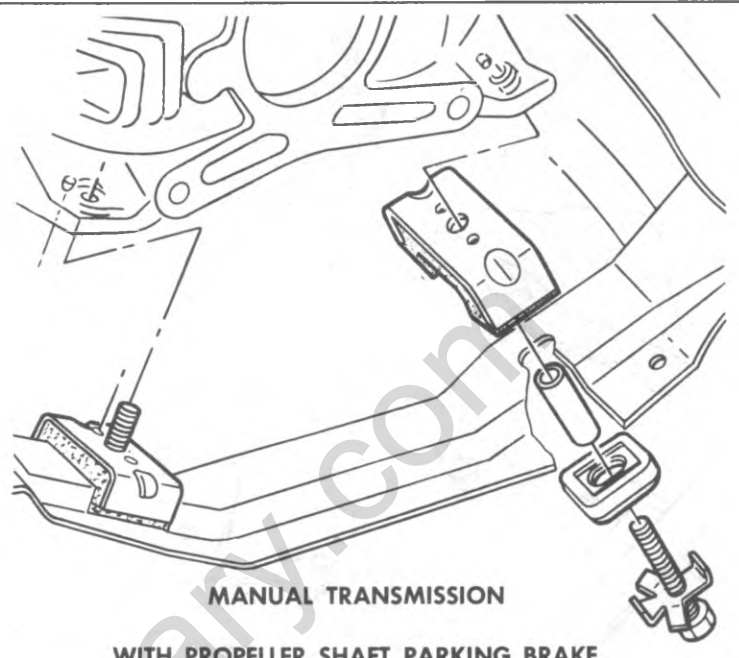
Removal

- Drain radiator and remove air cleaner.
- Disconnect:
 - Battery negative cable at battery.
 - Radiator upper hose and heater hose at manifold.
 - Water pump by-pass at water pump (Mark IV only).
 - Accelerator linkage at carburetor.
 - Fuel line at carburetor.
 - Crankcase ventilation lines.
 - Spark advance hose at distributor.
- Remove distributor cap and mark rotor position with chalk, then remove distributor.
- Remove (as required) air cleaner bracket, air compressor and bracket, accelerator return spring and bracket, and accelerator bellcrank.
- Remove generator upper mounting bracket.
- Remove manifold attaching bolts, then remove manifold and carburetor as an assembly. Discard gaskets and seals.



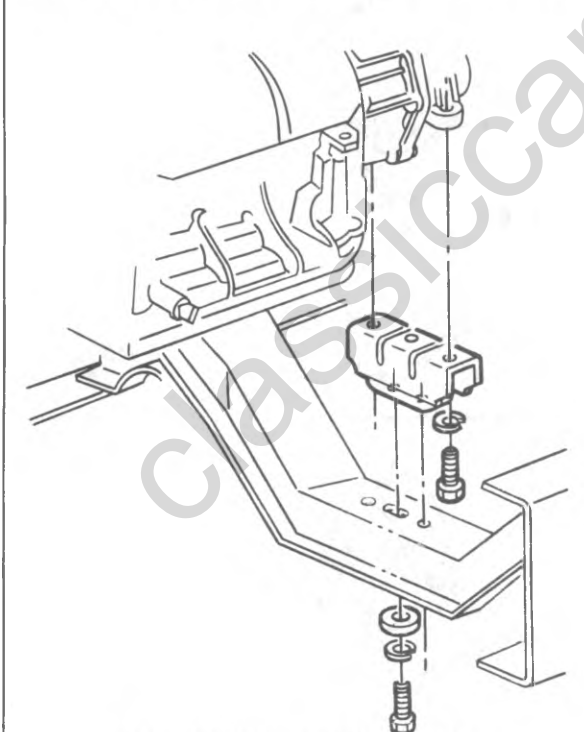
ALL TURBO HYDRA-MATIC 400
(EXCEPT MOBILE HOME CHASSIS)

WITHOUT PROPELLER SHAFT PARKING BRAKE



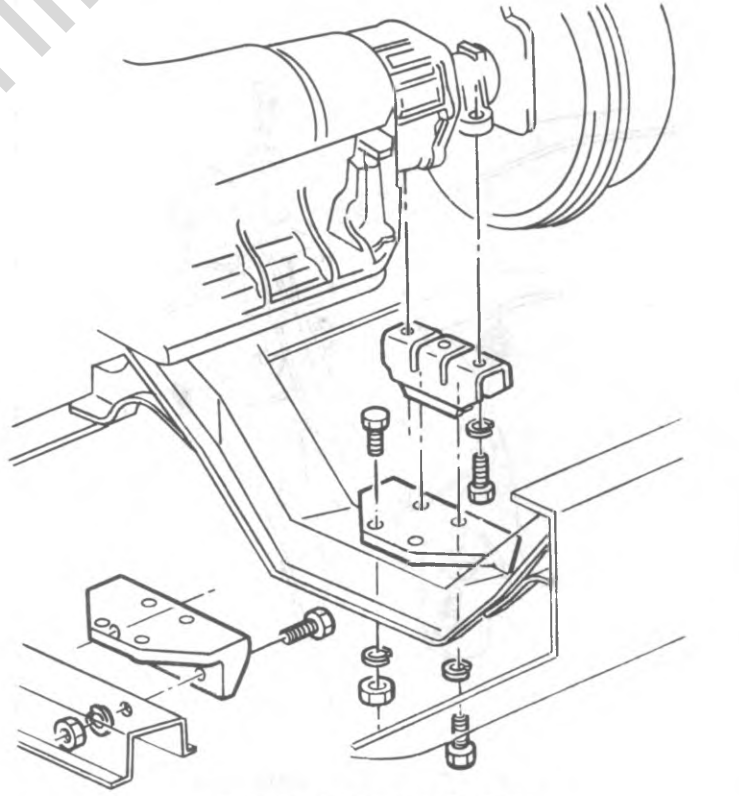
MANUAL TRANSMISSION

WITH PROPELLER SHAFT PARKING BRAKE



ALL MANUAL TRANSMISSION
ALL TURBO HYDRA-MATIC 350
ALL MOBILE HOME CHASSIS

WITHOUT PROPELLER SHAFT PARKING BRAKE



AUTOMATIC TRANSMISSION

WITH PROPELLER SHAFT PARKING BRAKE

Fig. 6A2-5--"P" Series Engine Rear Mount

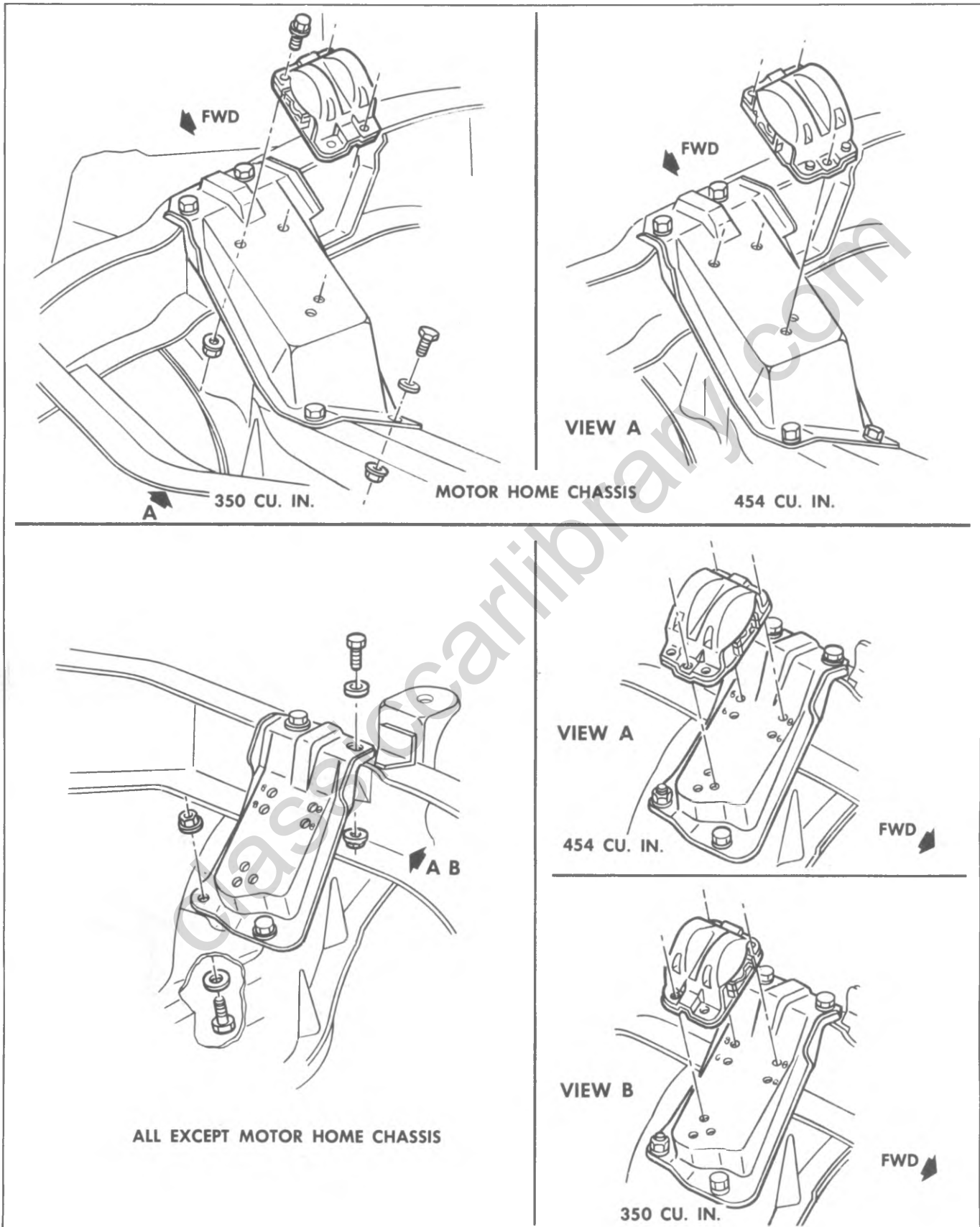


Fig. 6A2-6--"P" Series Engine Front Mount

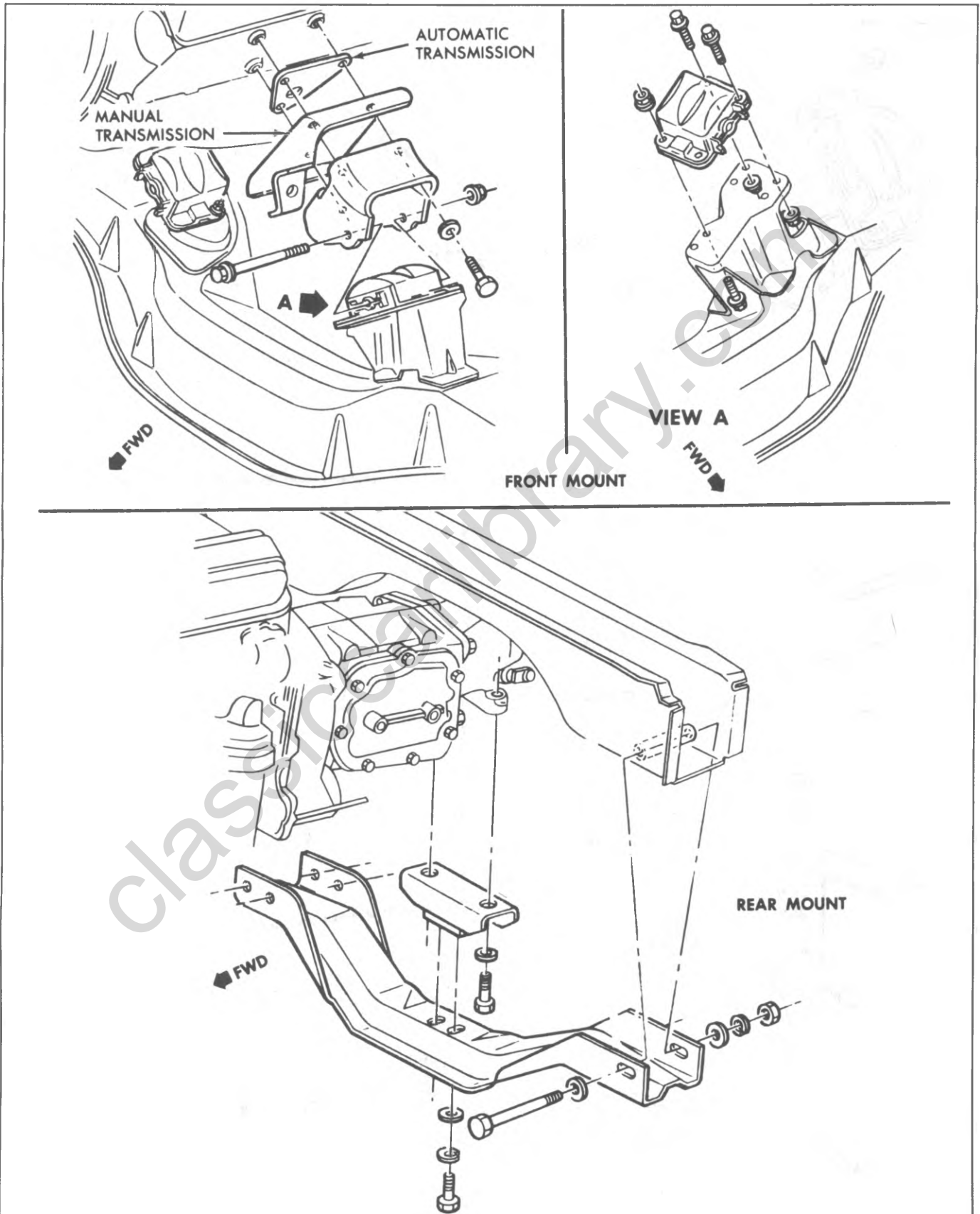


Fig. 6A2-7--"G" Series Engine Mounts

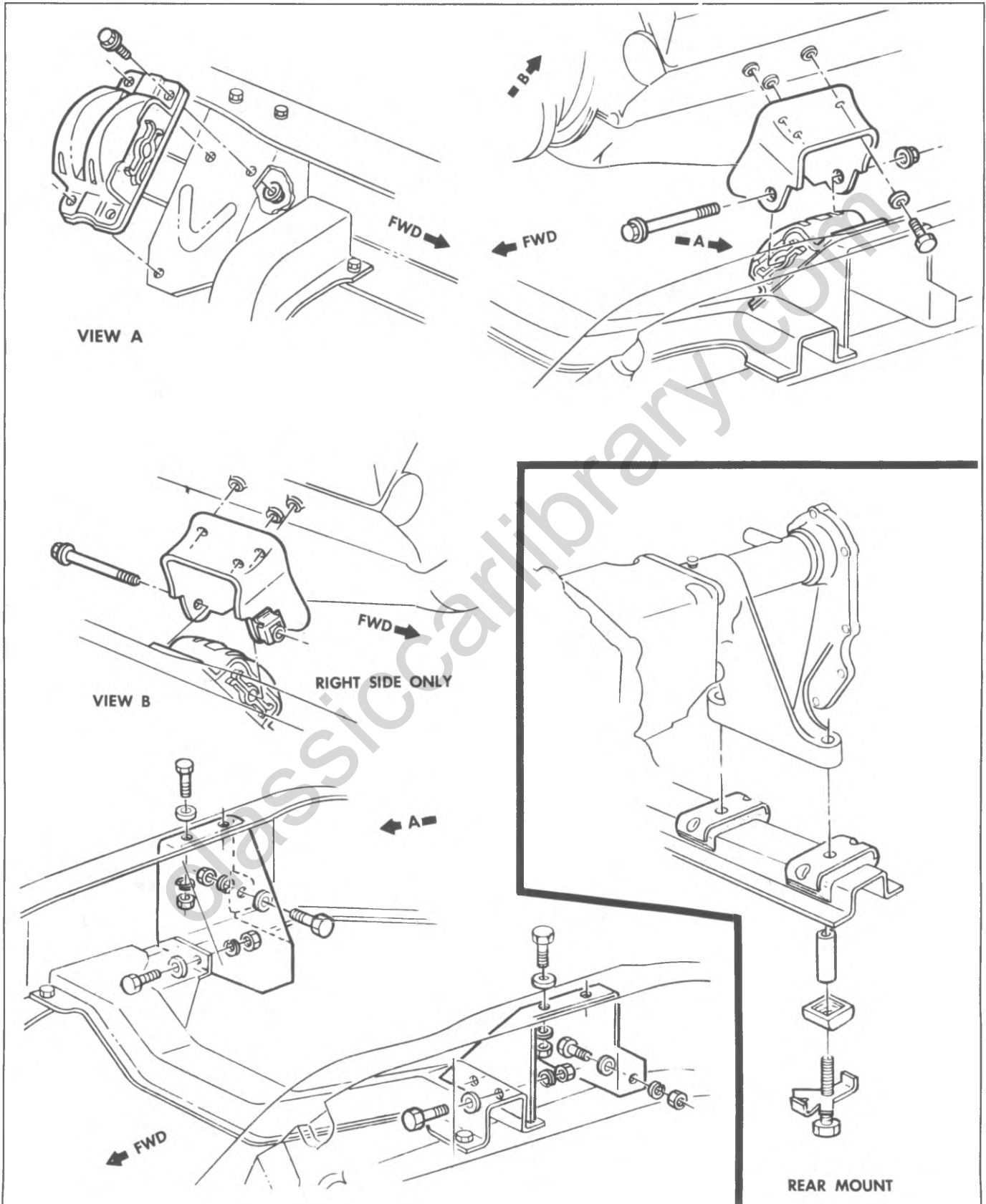


Fig. 6A2-8--"K" Series Engine Mounts

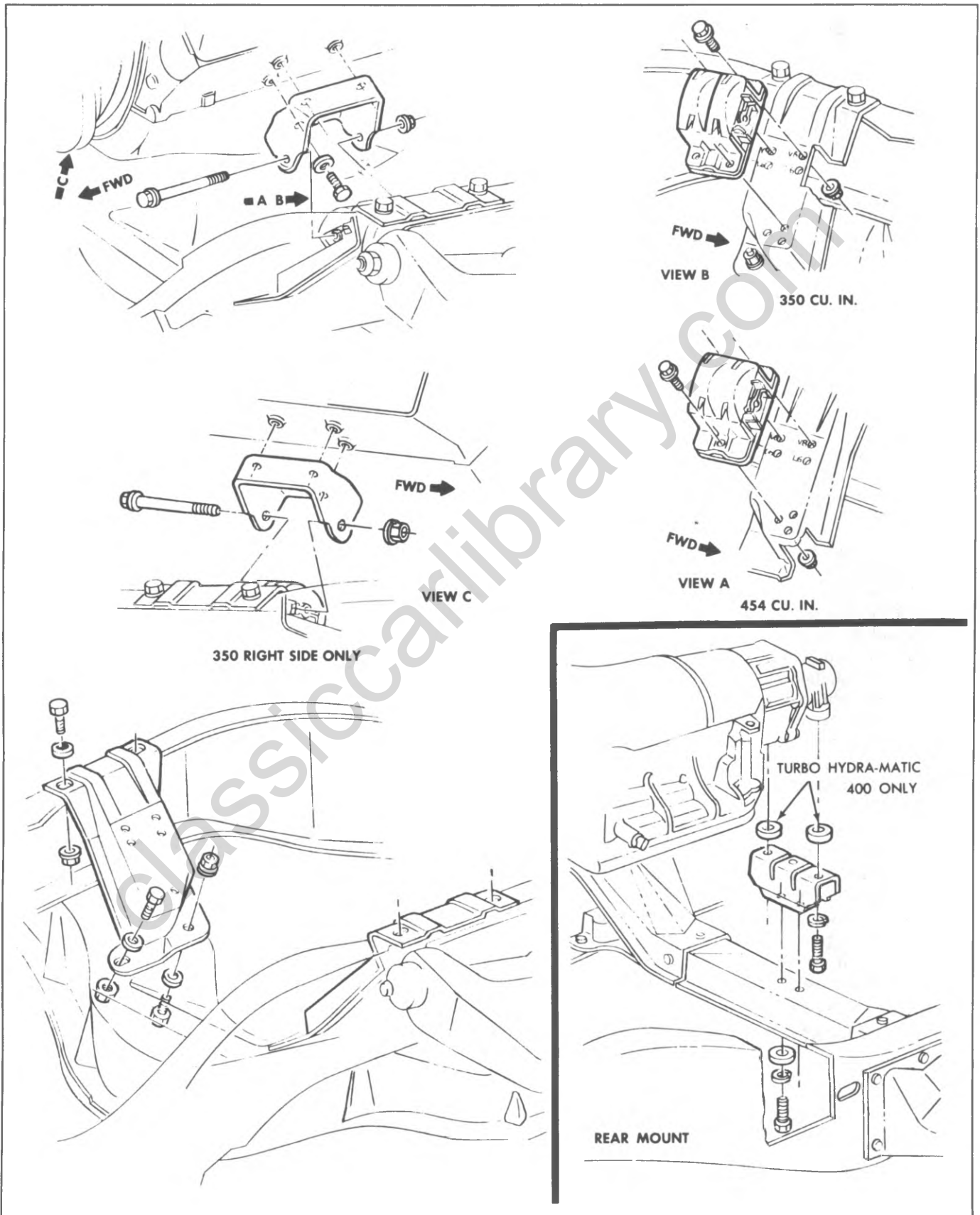


Fig. 6A2-9--"C" Series Engine Mounts

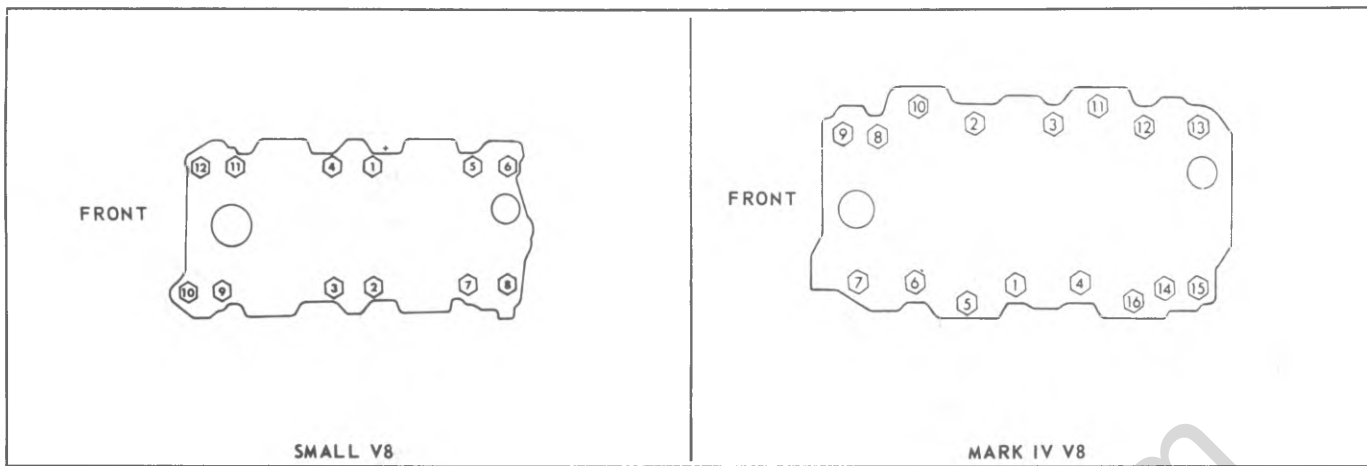


Fig. 6A2-10--Intake Manifold Torque Sequence

7. If manifold is to be replaced, transfer:
 - Carburetor and carburetor attaching bolts.
 - Temperature sending unit.
 - Thermostat with housing (use new gasket).
 - Heater hose and water pump by-pass adapters.
 - EGR Valve (use new gasket) (if applicable).
 - TVS switch (if applicable).
 - Vacuum fitting(s).
 - Choke spring assembly (where applicable).

Installation

1. Clean gasket and seal surfaces on manifold, block, and cylinder heads.
2. Install gaskets on cylinder heads and place a 3/16" bead of RTV on the front and rear ridges of the cylinder case. Extend the bead 1/2" up each cylinder head to seal and retain the manifold side gaskets.
3. Install manifold and torque bolts to specifications in the sequence outlined in fig. 6A2-10.
4. Install (if removed) air cleaner bracket, air compressor and bracket, accelerator bellcrank.
5. Install distributor, positioning rotor at chalk mark, then install distributor cap.
6. Connect:
 - Spark advance hose at distributor.
 - Crankcase ventilation lines.
 - Fuel line at carburetor.
 - Accelerator linkage at carburetor.
 - Water pump by-pass at water pump (Mark IV only).
 - Battery negative cable at battery.
7. Install air cleaner.
8. Fill with coolant, start engine, adjust ignition timing and carburetor idle speed and check for leaks.

EXHAUST MANIFOLD

Removal

1. Remove carburetor heat stove pipe.
2. On Small V8 engine, remove the spark plug wiring heatshields.
3. On Mark IV V8 engine, remove spark plugs.
4. Disconnect exhaust pipe from manifold and hang exhaust pipe from frame with wire.
5. Remove end bolts then remove center bolts and remove manifold.

Installation

NOTE: If installing a new right side manifold, the carburetor heat stove must be transferred from the old unit (fig. 6A2-11 & 6A2-12).

1. Clean mating surfaces on manifold and head, then install manifold in position and install bolts (fingertight).
2. Torque manifold bolts to specifications.
3. Connect exhaust pipe to manifold. Use new gasket or packing.
4. On Mark IV V8 engines, install spark plugs. Torque plugs to specifications.
5. Install carburetor heat stove pipe.
6. On Small V8 engine, install spark plug wiring heatshields.
7. Start engine and check for leaks.

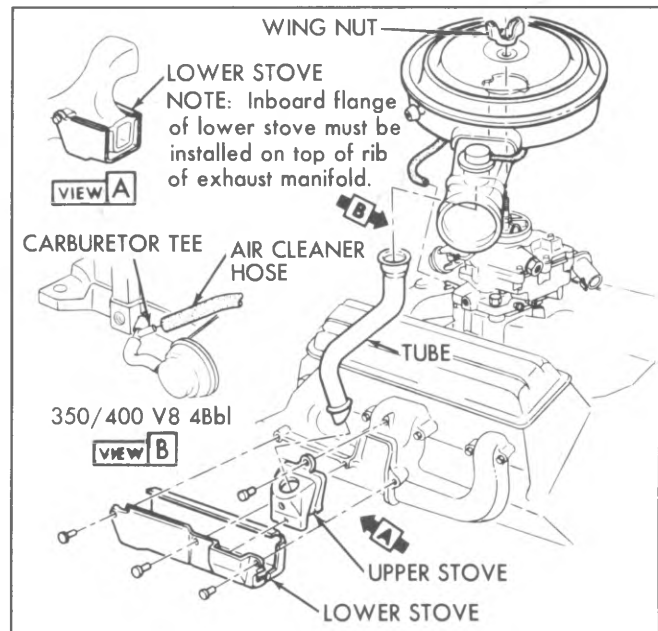


Fig. 6A2-11--Carburetor Heat Stove Assembly--Small V-8

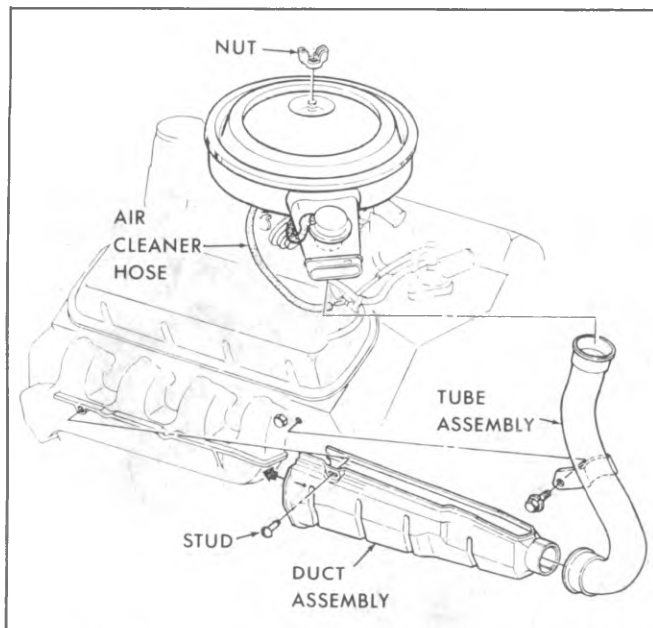


Fig. 6A2-12--Carburetor Heat Stove Assembly--Mark IV

ROCKER ARM COVER

Removal

1. Remove air cleaner.
2. Disconnect crankcase ventilation hoses at rocker arm covers.
3. Disconnect electrical wiring harness from rocker arm clips.
4. Remove carburetor heat stove pipe from right exhaust manifold.
5. If the vehicle is equipped with air conditioning, remove the A/C compressor rear brace on small V-8 (fig. 6A2-13) or upper brace on Mark IV (fig. 6A2-14).

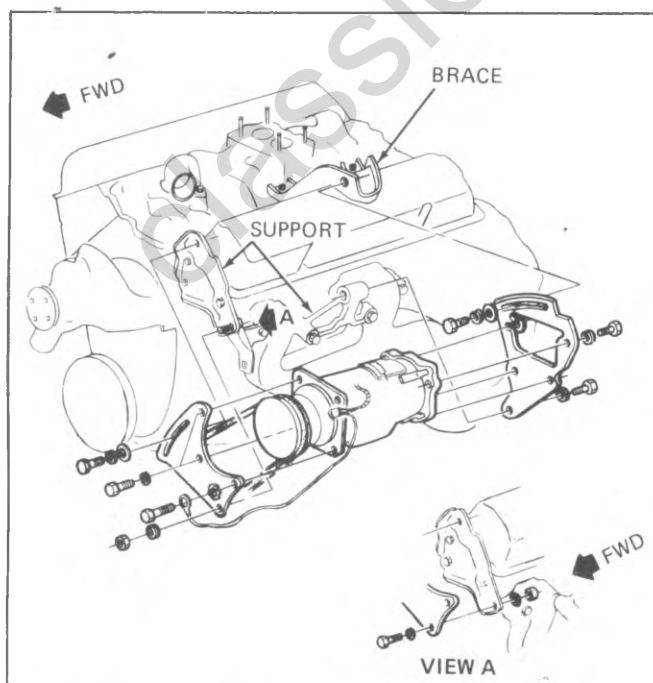


Fig. 6A2-13--A/C Compressor Mounting--Small V-8

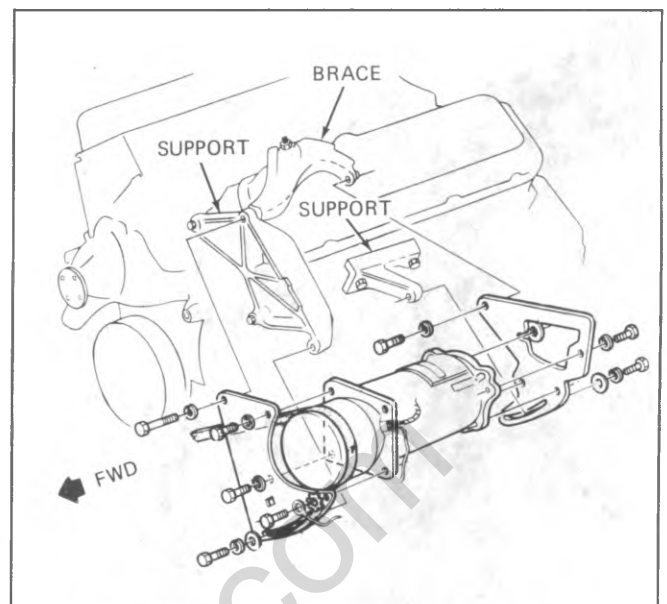


Fig. 6A2-14--A/C Compressor Mounting--Mark IV

6. Remove rocker arm cover to head attaching bolts and remove rocker arm cover.

CAUTION: Do not pry rocker arm cover loose. Gaskets adhering to cylinder head and rocker arm cover may be sheared by bumping front end of rocker arm cover rearward with palm of hand or a rubber mallet.

Installation

1. Clean sealing surface on cylinder head with degreaser then, using RTV, place rocker arm cover on the head, install retaining bolts and torque to specification.

NOTE: All loose RTV sealer, or pieces causing installation interference, must be removed from both cylinder head and cover seal surfaces prior to applying new sealer.

A 1/8" bead of RTV sealer should be placed all around the rocker cover sealing surface of the cylinder head. (When going around the attaching bolt holes, always flow the RTV on the inboard side of the holes). Install cover and torque bolts to specification while RTV is wet (within 10 min.).

2. On A/C equipped vehicles, install the A/C compressor upper brace. Adjust pulley belt to specification.
3. Install carburetor heat stove pipe.
4. Connect electrical wiring harness at clips on rocker arm cover.
5. Connect crankcase ventilation hoses.
6. Install air cleaner, start engine and check for leaks.

VALVE MECHANISM

Removal

1. Remove rocker arm covers as previously outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods.

NOTE: Place rocker arms, rocker arm balls and push rods in a rack so they may be reinstalled in the same locations.

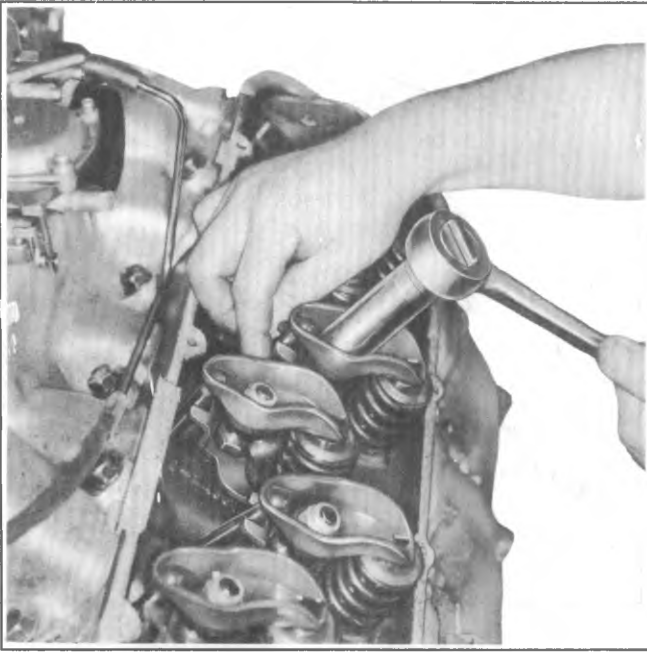


Fig. 6A2-15--Valve Adjustment - Typical

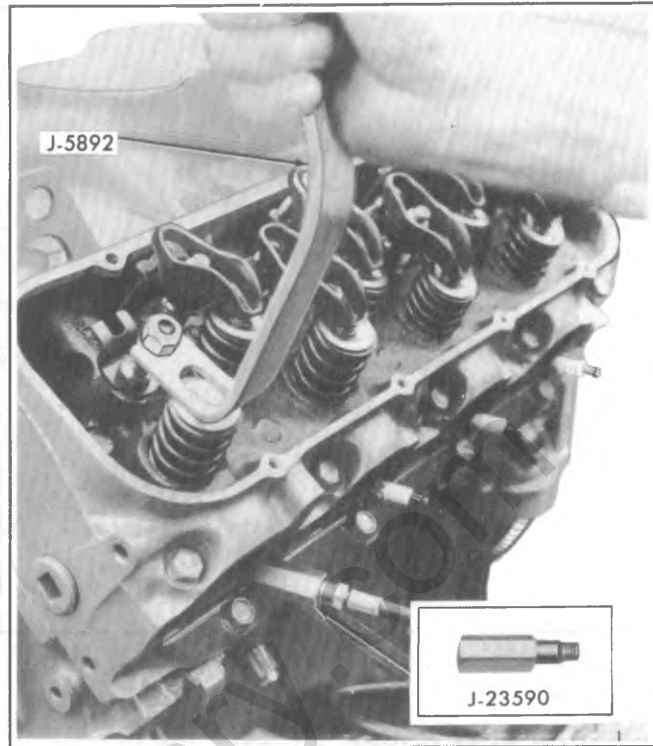


Fig. 6A2-16--Compressing Valve Spring

Installation and Adjustment

NOTE: Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with "Molykote" or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.

2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.

3. Adjust valves when lifter is on base circle of camshaft lobe as follows:

a. Crank engine until mark on torsional damper lines up with center or "O" mark on the timing tab fastened to the crankcase front cover and the engine is in the number 1 firing position. This may be determined by placing fingers on the number 1 valve as the mark on the damper comes near the "O" mark on the crankcase front cover. If the valves are not moving, the engine is in the number 1 firing position. If the valves move as the mark comes up to the timing tab, the engine is in number 6 firing position and should be turned over one more time to reach the number 1 position.

b. With the engine in the number 1 firing position as determined above, the following valves may be adjusted.

- Exhaust--1, 3, 4, 8
- Intake--1, 2, 5, 7

c. Back out adjusting nut until lash is felt at the push rod then turn in adjusting nut until all lash is removed. This can be determined by rotating push rod while turning adjusting nut (fig. 6A2-15). When play has been removed, turn adjusting nut in one full additional turn (to center lifter plunger).

d. Crank the engine one revolution until the pointer "o" mark and torsional damper mark are again in alignment. This is number 6 firing position. With the engine in this position the following valves may be adjusted.

- Exhaust--2, 5, 6, 7
- Intake--3, 4, 6, 8

4. Install rocker arm covers as previously outlined.
5. Start engine and adjust carburetor idle speed.

VALVE STEM OIL SEAL and/or VALVE SPRING

Removal

1. Remove rocker arm cover as previously outlined.
2. Remove spark plug, rocker arm and push rod on the cylinder(s) to be serviced.
3. Install air line adapter Tool J-23590 to spark plug port and apply compressed air to hold the valves in place.
4. Using Tool J-5892 to compress the valve spring, remove the valve locks, valve cap and valve spring and damper (fig. 6A2-16).
5. Remove the valve stem oil seal.

Installation

Small V8 Engines

1. Set the valve spring and damper, valve shield and valve cap in place. Compress the spring with Tool J-5892 and install oil seal in the lower groove of the stem, making sure the seal is flat and not twisted.

NOTE: A light coat of oil on the seal will help prevent twisting.

2. Install the valve locks and release the compressor tool making sure the locks seat properly in the upper groove of the valve stem.

NOTE: Grease may be used to hold the locks in place while releasing the compressor tool.

3. Using tool J-23994, apply vacuum to the valve cap to make sure no air leaks past the seal.
4. Install spark plug, and torque to specification.
5. Install and adjust valve mechanism as previously outlined.

Mark IV V8 Engines

1. Install new valve stem oil seal (coated with oil) in position over valve guide.

NOTE: Seal installation instructions are supplied with each service kit. Install seal following procedures outlined on the supplied instruction sheet.

2. Set the valve spring and damper and valve cap in place.

3. Compress the spring with Tool J-5892 and install the valve locks then release the compressor tool, making sure the locks seat properly in the groove of the valve stem.

NOTE: Grease may be used to hold the locks in place while releasing the compressor tool.

4. Install spark plug, and torque to specifications.

5. Install and adjust valve mechanism as previously outlined.

VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design, readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts.

Locating Noisy Lifters

Locate a noisy valve lifter by using a piece of garden hose approximately four feet in length. Place one end of the hose near the end of each intake and exhaust valve with the other end of the hose to the ear. In this manner, the sound is localized making it easy to determine which lifter is at fault.

Another method is to place a finger on the face of the valve spring retainer. If the lifter is not functioning properly, a distinct shock will be felt when the valve returns to its seat.

The general types of valve lifter noise are as follows:

1. **Hard Rapping Noise**--Usually caused by the plunger becoming tight in the bore of the lifter body to such an extent that the return spring can no longer push the plunger back up to working position. Probable causes are:

a. Excessive varnish or carbon deposit causing abnormal stickiness.

b. Galling or "pick-up" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedging between plunger and lifter body.

2. **Moderate Rapping Noise**--Probable causes are:

a. Excessively high leakdown rate.

b. Leaky check valve seat.

c. Improper adjustment.

3. **General Noise Throughout the Valve Train**--This will, in most cases, be caused by either insufficient oil supply or improper adjustment.

4. **Intermittent Clicking**--Probable causes are:

a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.

b. In rare cases, the ball itself may be out-of-round or have a flat spot.

c. Improper adjustment.

In most cases where noise exists in one or more lifters all lifter units should be removed, disassembled, cleaned in a solvent, reassembled, and reinstalled in the engine. If dirt, corrosion, carbon, etc. is shown to exist in one unit, it more than likely exists in all the units, thus it would only be a matter of time before all lifters caused trouble.

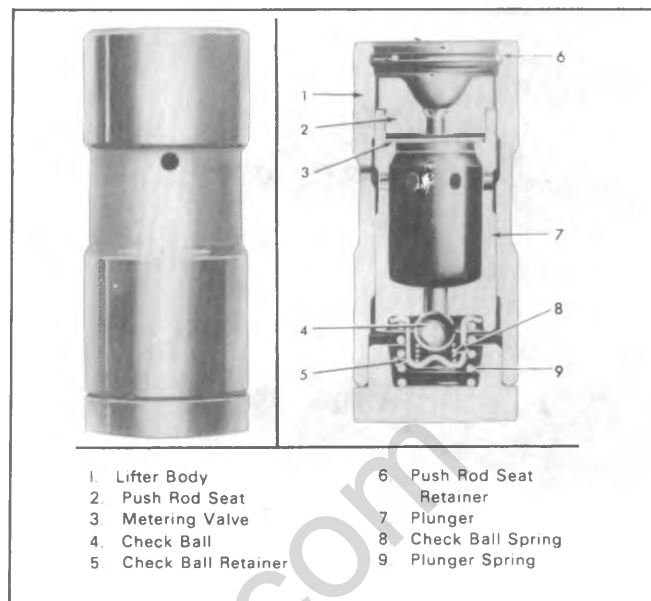


Fig. 6A2-17--Hydraulic Valve Lifter

Removal

1. Remove intake manifold as previously outlined.
2. Remove valve mechanism as previously outlined.
3. Remove valve lifters.

NOTE: Place valve lifters in a rack so that they may be reinstalled in the same location.

Installation

1. Install valve lifters.

NOTE: Whenever new valve lifters are being installed, coat foot of valve lifters with "Molykote" or its equivalent. Make sure lifter foot is convex.

2. Install intake manifold as previously outlined.
3. Install and adjust valve mechanism as outlined.

Disassembly

1. Hold the plunger down with a push rod, and using the blade of a small screw driver, remove the push rod seat retainer.

2. Remove the push rod seat and metering valve (fig. 6A2-17).

3. Remove the plunger, ball check valve assembly and the plunger spring.

4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screw driver (fig. 6A2-18).

Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn, the entire lifter assembly should be replaced. If the lifter body wall is scuffed or worn, inspect the cylinder block lifter bore. If the bottom of the lifter is scuffed or worn, inspect the camshaft lobe. If the push rod seat is scuffed or worn, inspect the push rod. An additive containing EP lube, such as EOS, should always be added to crankcase oil for run-in when any new camshaft or lifters are installed. All damaged or worn lifters should be replaced.

NOTE: For proper lifter rotation during engine operation, lifter foot must be convex.



Fig. 6A2-18--Removing Ball Check Valve

Assembly

1. Place the check ball on small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screw driver (fig. 6A2-19).
3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed holes in the lifter body and plunger.
4. Fill the assembly with SAE 10 oil, then insert the end of a 1/8" drift pin into the plunger and press down solid. At this point, oil holes in the lifter body and plunger



Fig. 6A2-19--Installing Ball Check Valve

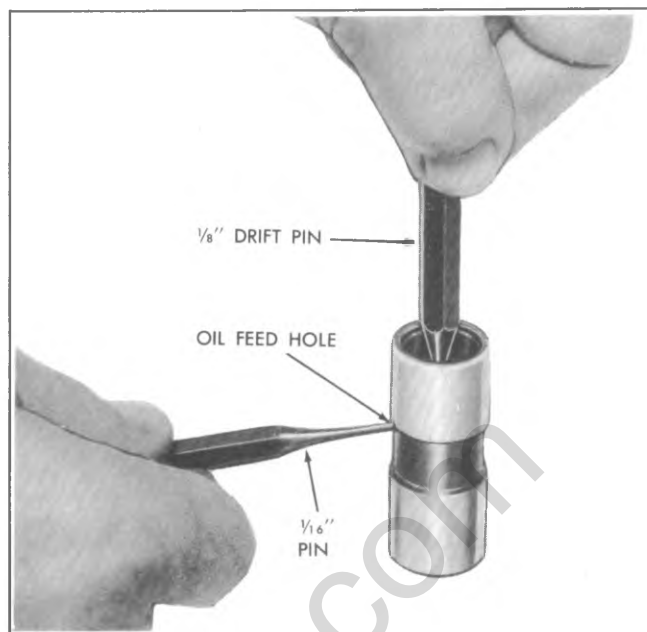


Fig. 6A2-20--Assembling Hydraulic Lifter

assembly will be aligned (fig. 6A2-20).

CAUTION: Do not attempt to force or pump the plunger.

5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension (fig. 6A2-20).
6. Remove the 1/8" drift pin, refill assembly with SAE 10 oil.
7. Install the metering valve and push rod seat (fig. 6A2-17).
8. Install the push rod seat retainer, press down on the push rod seat and remove the 1/16" drift pin from the oil holes. The lifter is now completely assembled, filled with oil and ready for installation.

NOTE: Before installing lifters, coat the bottom of the lifter with "Molykote" or its equivalent.

CYLINDER HEAD ASSEMBLY

Removal

1. Remove intake manifold as previously outlined.
2. Remove generator lower mounting bolt and lay unit aside.
3. Remove exhaust manifolds as previously outlined.
4. If vehicle is equipped with A/C, remove A/C compressor and forward mounting bracket. Lay unit aside.
5. Remove valve mechanism as previously outlined.
6. Drain cylinder block of coolant.
7. Remove cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

Disassembly

1. With cylinder head removed, remove valve rocker arm nuts, balls and rocker arms (if not previously done).
2. Using Tool J-8062, compress the valve springs (fig. 6A2-21) and remove valve keys. Release the compressor tool and remove rotators or spring caps, oil shadders (if so equipped) springs and spring damper, then remove oil seals and valve spring shims.

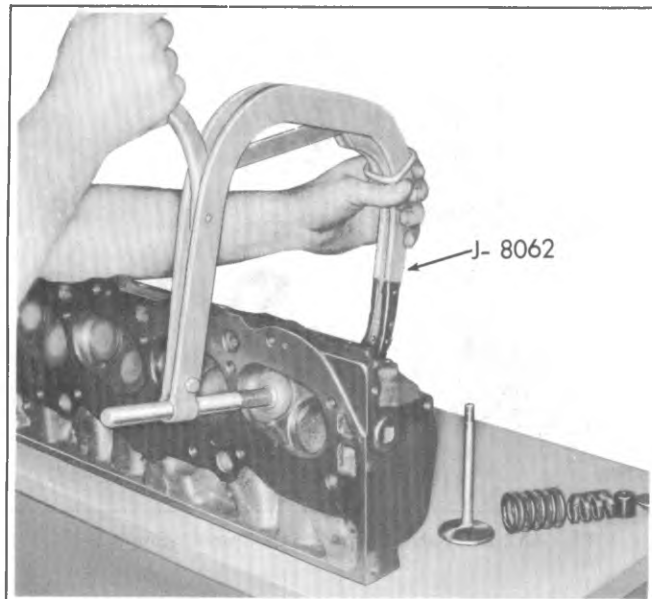


Fig. 6A2-21--Compressing Valve Spring - Typical

3. Remove valves from cylinder head and place them in a rack in their proper sequence so that they can be assembled in their original positions.

Cleaning

1. Clean all carbon from combustion chambers and valve ports using Tool J-8089 (fig. 6A2-22).
2. Thoroughly clean the valve guides using Tool J-8101 (fig. 6A2-23).
3. Clean all carbon and sludge from push rods, rocker arms and push rod guides.
4. Clean valve stems and heads on a buffing wheel.
5. Clean carbon deposits from head gasket mating surface.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the water chamber.
2. Inspect the valves for burned heads, cracked faces

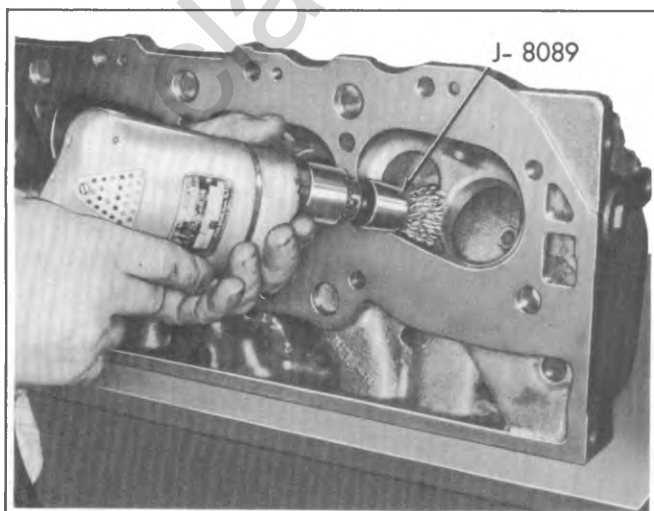


Fig. 6A2-22--Cleaning Combustion Chambers - Typical

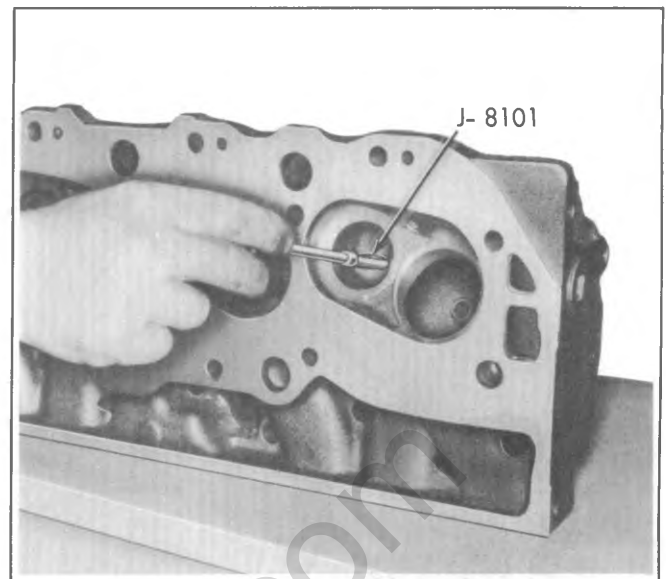


Fig. 6A2-23--Cleaning Valve Guides - Typical

or damaged stems.

NOTE: Excessive valve stem to bore clearance will cause excessive oil consumption and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness.

3. Measure valve stem clearance (fig. 6A2-24) as follows: Clamp a dial indicator on one side of the cylinder head rocker arm cover gasket rail, locating the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide. With the valve head dropped about 1/16" off the valve seat; move the stem of

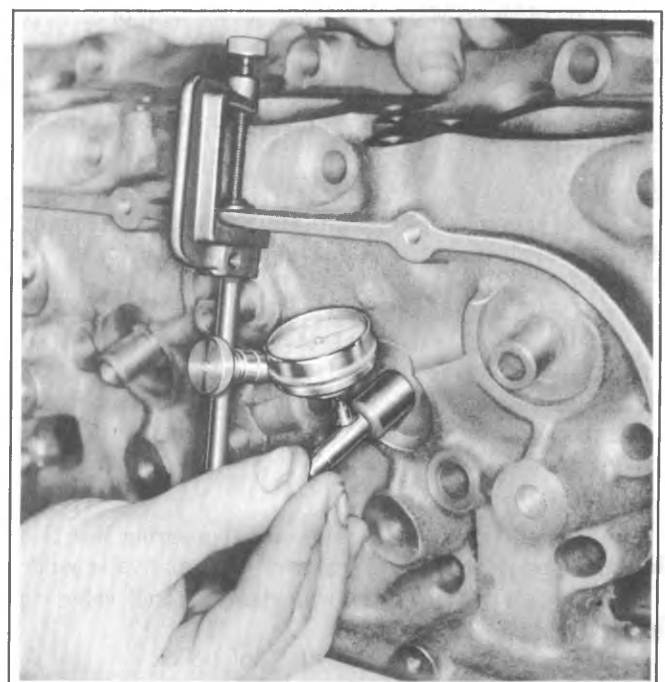


Fig. 6A2-24--Measuring Valve Stem Clearances - Typical



Fig. 6A2-25--Checking Valve Spring Tension

the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications it will be necessary to ream valve guides for oversize valves as outlined.

4. Check valve spring tension with Tool J-8056 spring tester (fig. 6A2-25).

NOTE: Springs should be compressed to the specified height and checked against the specifications chart. Springs should be replaced if not within 10 lbs. of the specified load (without dampers).

5. Inspect rocker arm studs for wear or damage. Inspect push rod guides on Mark IV V8 engines for wear or damage.

Assembly

1. Insert a valve in the proper port.
2. Assemble the valve spring and related parts as follows:

Small V8

- a. Set the valve spring shim, valve spring (with damper if used), oil shedder and valve cap or rotator in place (fig. 6A2-26).

- b. Compress the spring with Tool J-8062.

- c. Install oil seal in the lower groove of the stem, making sure that the seal is flat and not twisted.

- d. Install the valve locks and release the compressor tool, making sure that the locks seat properly in the upper groove of the valve stem.

Mark IV V8

- a. Install valve spring shim on valve spring seat then install a new valve stem oil seal over valve and valve guide.

- b. Set the valve spring (with damper); and valve cap in place (fig. 6A2-27).

- c. Compress the spring with Tool J-8062.

- d. Install the valve locks and release the compressor tool, making sure the locks seat properly in the groove of

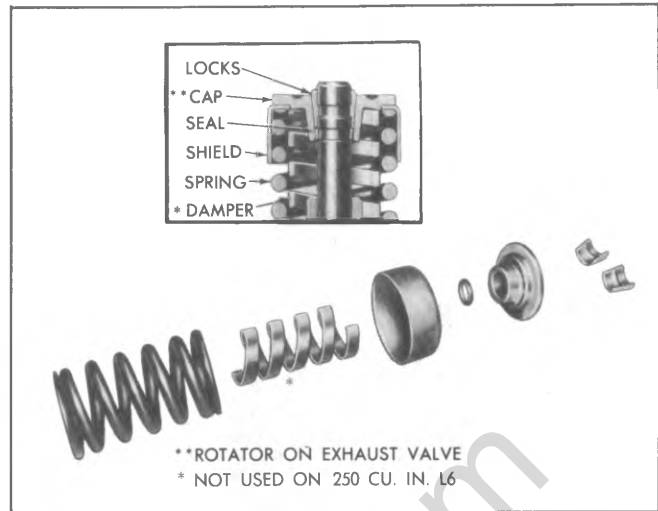


Fig. 6A2-26--Valve Spring Installation - Small V-8

the valve stem.

NOTE: Grease may be used to hold the locks in place, while releasing the compressor tool.

3. Install the remaining valves.

4. On Small V8 engines, check each valve stem oil seal by placing Valve Seal Leak Detector (Tool J-23994) over the end of the valve stem and against the cap. Operate the vacuum pump and make sure no air leaks past the seal (fig. 6A2-28).

5. Check the installed height of the valve springs, using a narrow thin scale. A cutaway scale will help (fig. 6A2-29). Measure from the top of the shim or the spring seat to the top of the valve spring or valve spring shield (fig. 6A2-30). If this is found to exceed the specified height, install a valve spring seat shim approximately 1/16" thick. At no time should the spring be shimmed to give an installed height under the minimum specified.

Installation

CAUTION: The gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. Cylinder bolt threads in the block and threads on the cylinder

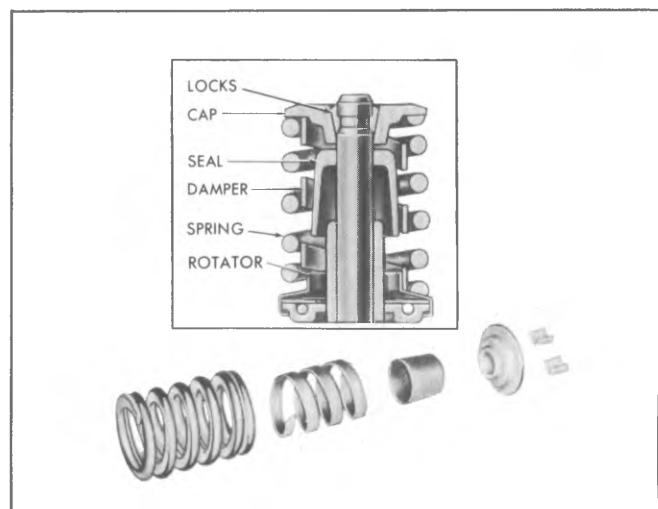


Fig. 6A2-27--Valve Spring Installation - Mark IV

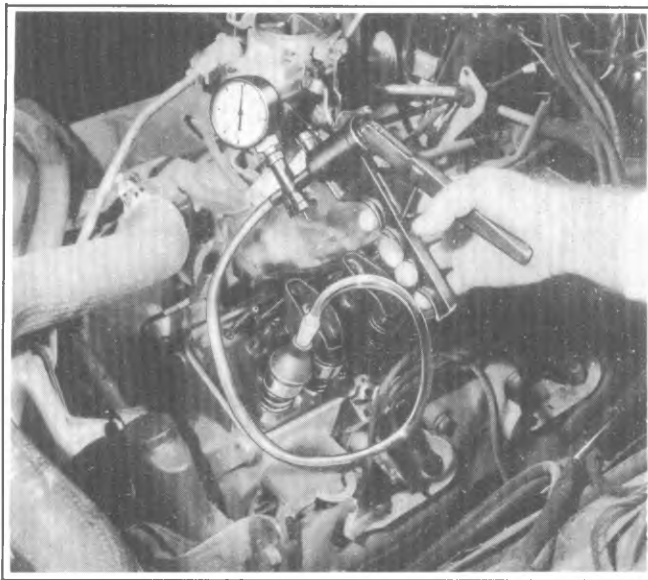


Fig. 6A2-28--Checking Valve Stem Oil Seals - Small V-8

head bolts must be clean. (Dirt will affect bolt torque).

1. On engines using a STEEL gasket, coat both sides of a new gasket with a good sealer. Spread the sealer thin and even. One method of applying the sealer that will assure the proper coat is with the use of a paint roller. Too much sealer may hold the gasket away from the head or block.

CAUTION: Use no sealer on engines using a composition STEEL ASBESTOS gasket.

2. Place the gasket in position over the dowel pins with the bead up.

3. Carefully guide the cylinder head into place over the dowel pins and gasket.

4. Coat threads of cylinder head bolts with sealing compound and install bolts finger tight.

5. Tighten each cylinder head bolt a little at a time in the sequence shown in the torque sequence chart until the specified torque is reached.

6. Install exhaust manifolds as previously outlined.

7. Install intake manifold as previously outlined.

8. Install and adjust valve mechanism as previously outlined.

ROCKER ARM STUDS

Replacement

Mark IV

The push rod guides are related to the cylinder head by the rocker arm studs (fig. 6A2-31). Replace where necessary and torque rocker arm studs to specifications.

NOTE: Coat Threads on cylinder head end of rocker

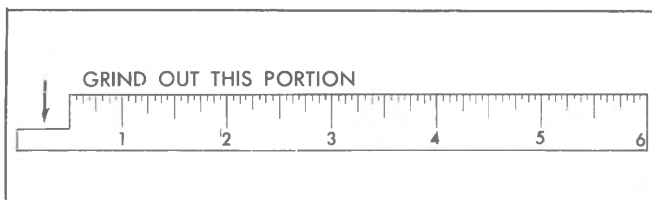


Fig. 6A2-29--Cutaway Scale

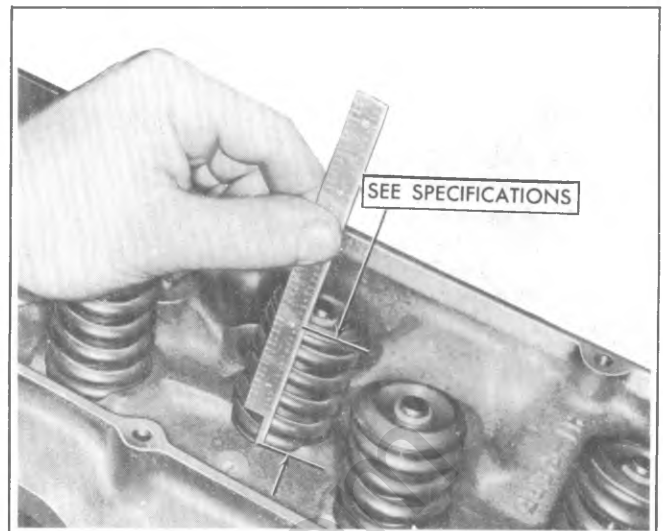


Fig. 6A2-30--Measuring Valve Spring Installed Height

arm studs with sealer before assembly to cylinder head.

Small V8

Rocker arm studs that have damaged threads or are loose in cylinder heads should be replaced with new studs available in .003" and .013" oversize. Studs may be installed after reaming the holes as follows:

1. Remove old stud by placing Tool J-5802-1 over the stud, installing nut and flat washer and removing stud by turning nut (fig. 6A2-32).

2. Ream hole for oversize stud using Tool J-5715 for .003" oversize or Tool J-6036 for .013" oversize (fig. 6A2-33).

CAUTION: Do not attempt to install an oversize stud without reaming stud hole.

3. Coat press-fit area of stud with hypoid axle lubricant.

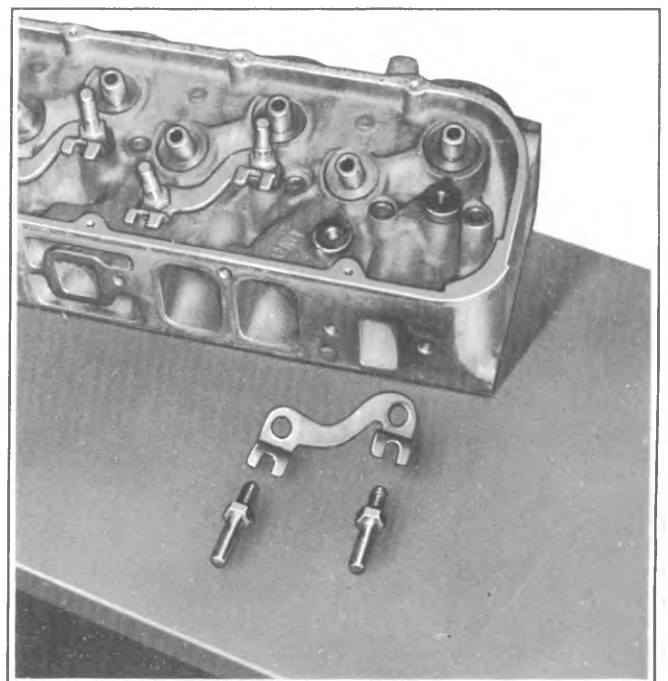


Fig. 6A2-31--Rocker Arm Stud & Push Rod Guide

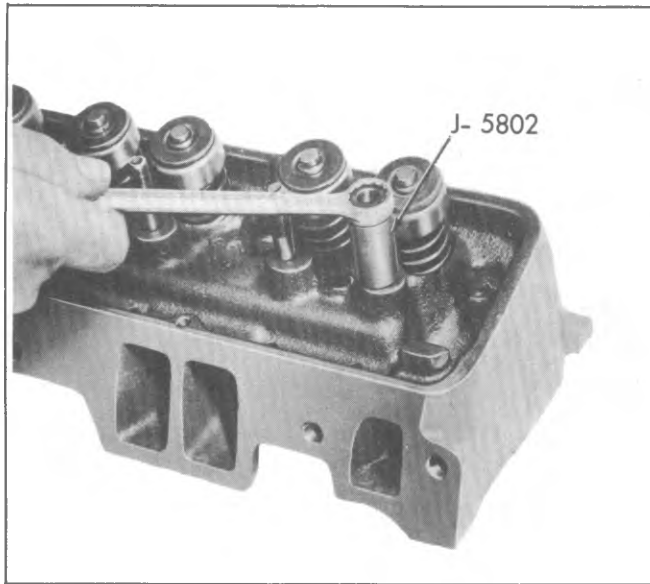


Fig. 6A2-32--Removing Rocker Arm Stud - Small V8

Install new stud, using Tool J-6880 as a guide. Gage should bottom on head (fig. 6A2-34).

VALVE GUIDE BORES

Valves with oversize stems are available (see specifications). To ream the valve guide bores for oversize valves use Tool Set J-5830 for Small V8 or J-7049 for Mark IV V8.

VALVE SEATS

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for

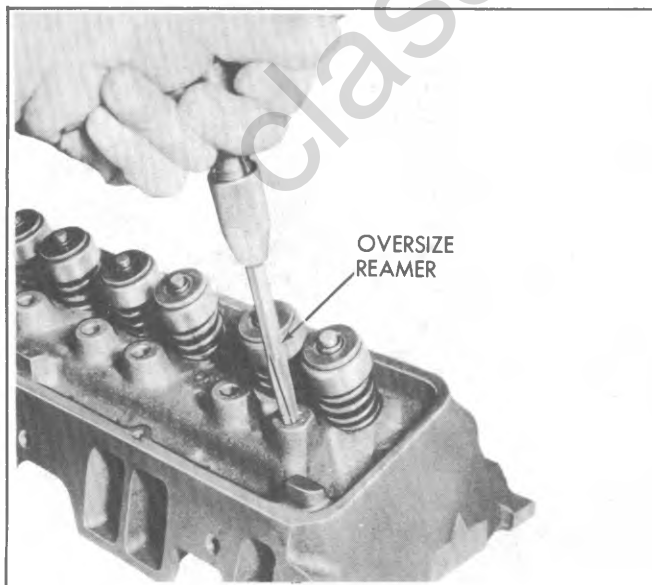


Fig. 6A2-33--Reaming Rocker Arm Stud Bore- Small V8

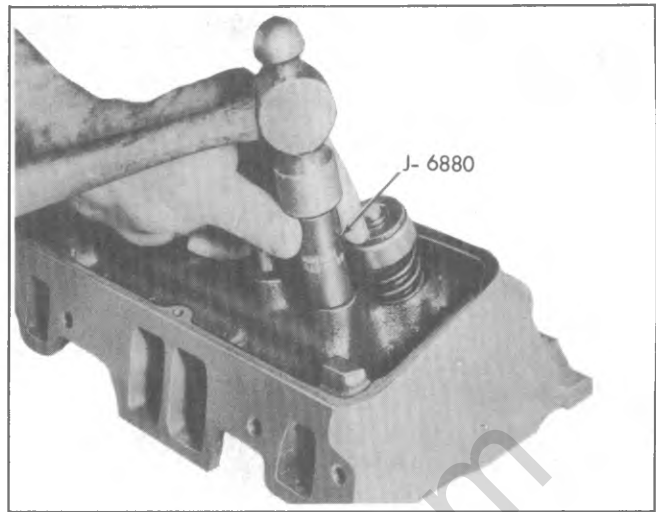


Fig. 6A2-34--Installing Rocker Arm Stud -Small V8

reseating valves seats. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Regardless of what type of equipment is used, however, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of pilot in the guide.

Reconditioning

1. Install expanding pilot in the valve guide bore and expand pilot.
2. Place roughing stone or forming stone over pilot and just clean up the valve seat. Use a stone cut to specifications.
3. Remove roughing stone or forming stone from pilot, place finishing stone, cut to specifications, over pilot and cut just enough metal from the seat to provide a smooth finish. Refer to specifications.

4. Narrow down the valve seat to the specified width.

NOTE: This operation is done by grinding the port side with a 30 degree stone to lower seat and a 60 degree stone to raise seat.

5. Remove expanding pilot and clean cylinder head carefully to remove all chips and grindings from above operations.

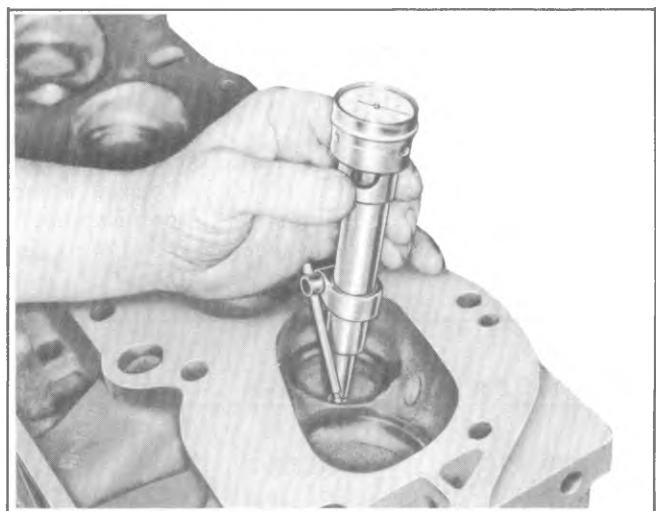


Fig. 6A2-35--Measuring Valve Seat Concentricity - Typical

6. Measure valve seat concentricity (fig. 6A2-35).

NOTE: Valve seats should be concentric to within .002" total indicator reading.

VALVES

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem on a valve refacing mechanism. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32" thick after grinding, replace the valve.

Several different types of equipment are available for refacing valves. The recommendation of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Reconditioning

1. If necessary, dress the valve refacing machine grinding wheel to make sure it is smooth and true. Set chuck at angle specified for valve. Refer to specifications.

2. Clamp the valve stem in the chuck of the machine.

3. Start the grinder and move the valve head in line with the grinder wheel.

4. Turn the feed screw until the valve head just contacts wheel. Move valve back and forth across the wheel and regulate the feed screw to provide light valve contact.

5. Continue grinding until the valve face is true and smooth all around the valve. If this makes the valve head thin (1/32" min.) the valve must be replaced as the valve will overheat and burn.

6. Remove valve from chuck and place stem in "V" block. Feed valve squarely against grinding wheel to grind any pit from rocker arm end of stem.

NOTE: Only the extreme end of the valve stem is hardened to resist wear. Do not grind end of stem excessively.

7. After cleaning valve face and cylinder head valve seat of grinding particles, make pencil marks about 1/4" apart across the valve face, place the valve in cylinder head and give the valve 1/2 turn in each direction while exerting firm pressure on head of valve.

8. Remove valve and check face carefully. If all pencil marks have not been removed at the point of contact with the valve seat, it will be necessary to repeat the refacing operation and again recheck for proper seating.

9. Grind and check the remaining valves in the same manner.

TORSIONAL DAMPER

Removal

1. Remove fan belt, fan and pulley.

2. Remove the fan shroud assembly as outlined in Section 6B.

NOTE: If additional operations (such as camshaft removal) are not being performed, the radiator removal will not be necessary.

3. Remove accessory drive pulley then remove damper retaining bolt.

4. Install Tool J-23523 on damper then, turning puller

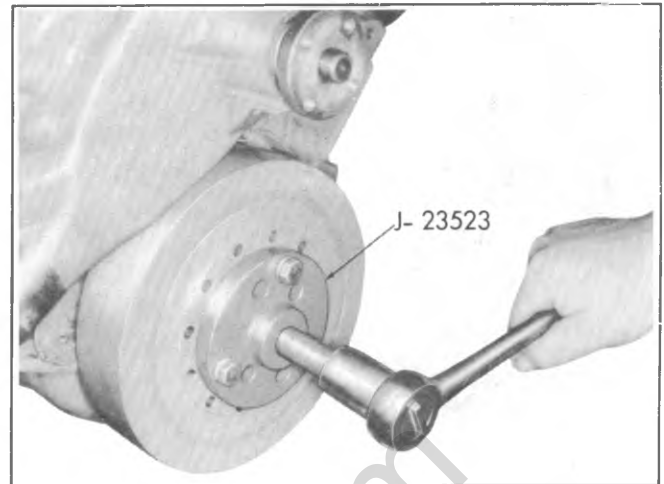


Fig. 6A2-36--Removing Torsional Damper - Typical

screw, remove damper (fig. 6A2-36).

NOTE: Tool J-23523 has holes forming two patterns. A two bolt and a three bolt pattern. The holes for the two bolt pattern must be elongated for use on the Mark IV V8 engines.

Installation

CAUTION: The inertial weight section of the torsional damper is assembled to the hub with a rubber type material. The installation procedures (with proper tool) must be followed or movement of the inertia weight section on the hub will destroy the tuning of the torsional damper.

1. Coat front cover seal contact area (on damper) with engine oil.

2. Place damper in position over key on crankshaft.

3. Pull damper onto crankshaft as follows:

a. Install appropriate threaded end of Tool J-23523 into crankshaft.

CAUTION: Install tool in crankshaft so that at least 1/2" of thread engagement is obtained.

b. Install plate, thrust bearing and nut to complete tool installation.

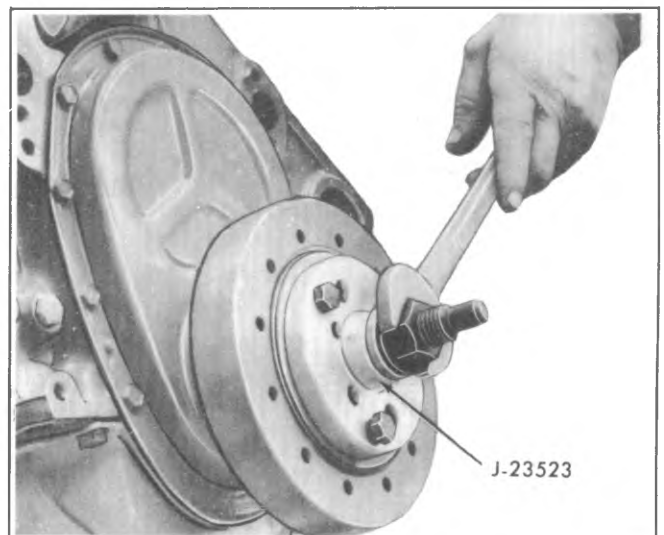


Fig. 6A2-37--Installing Torsional Damper

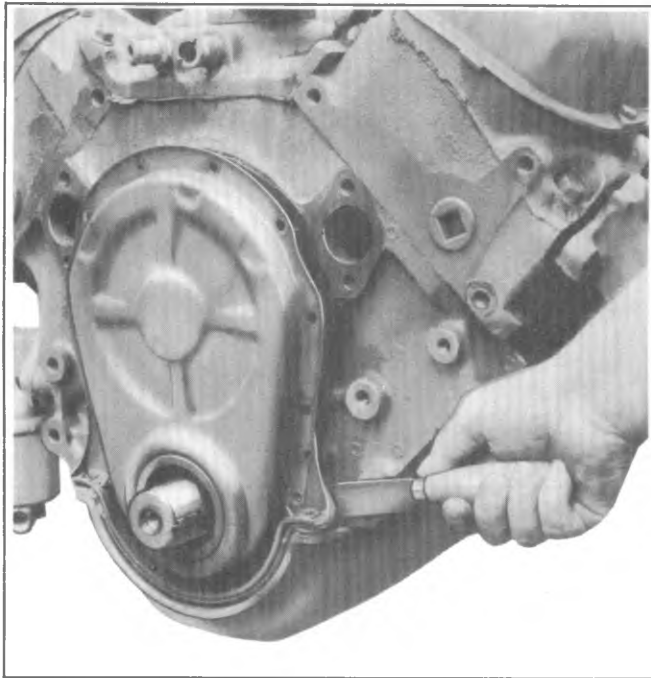


Fig. 6A2-38--Cutting Tabs on Oil Pan Front Seal

c. Pull damper into position as shown in Figure 6A2-37.

d. Remove tool from crankshaft then install damper retaining bolt and torque to specifications.

4. Install accessory drive pulley.

5. Install fan shroud as outlined in Section 6B.

6. Install fan and pulley to water pump hub and tighten securely.

7. Install fan belt and adjust to specifications using strand tension gage.

8. Fill cooling system, start engine and check for leaks.

CRANKCASE FRONT COVER

Removal

Small V8 Engine

1. Remove torsional damper as previously outlined.
2. Remove water pump as outlined in Section 6B.
3. Remove crankcase front cover attaching screws and remove front cover and gasket, then discard gasket.

Mark IV V8 Engine

1. Remove torsional damper and water pump as outlined.
2. Remove the two, oil pan-to-front cover attaching screws.
3. Remove the front cover-to-block attaching screws.
4. Pull the cover slightly forward only enough to permit cutting of oil pan front seal.
5. Using a sharp knife or other suitable cutting tool, cut oil pan front seal flush with cylinder block at both sides of cover (fig. 6A2-38).
6. Remove front cover and attaching portion of oil pan front seal. Remove front cover gasket.

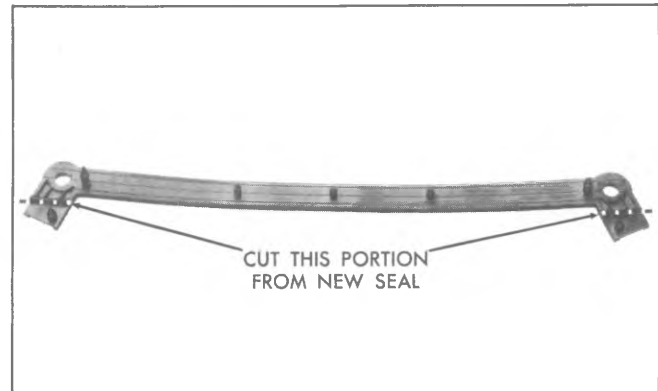


Fig. 6A2-39--Oil Pan Front Seal Modification

Installation

Small V8 Engine

1. Clean gasket surface on block and crankcase front cover.

2. Use a sharp knife or other suitable cutting tool, to remove any excess oil pan gasket material that may be protruding at the oil to engine block junction.

3. Apply a 1/8 inch bead of silicone rubber sealer, part #1051435 (or equivalent) to the joint formed at the oil pan and cylinder block.

4. Coat the cover gasket with gasket sealer and place in position on cover.

5. Install cover-to-oil pan seal, lightly coat bottom of seal with engine oil, and position cover over crankshaft end.

6. Loosely install the cover-to-block, upper attaching screws.

7. Tighten screws alternately and evenly while pressing downward on cover so that dowels in block are aligned with corresponding holes in cover.

NOTE: Position cover so that dowels enter holes in cover without binding. Do not force cover over dowels so that cover flange or holes are distorted.

8. Install remaining cover screws and torque to specifications.

9. Install torsional damper and water pump as previously outlined.

Mark IV V8 Engine

1. Clean gasket surface on block and crankcase front cover.

2. Cut tabs from the new oil pan front seal (fig. 6A2-39). Use a sharp instrument to ensure a clean cut.

3. Install seal to front cover, pressing tips into holes provided in cover.

4. Coat the gasket with gasket sealer and place in position on cover.

5. Apply a 1/8 inch bead of silicone rubber sealer, part #1051435 (or equivalent) to the joint formed at the oil pan and cylinder block (fig. 6A2-40).

6. Position crankcase front cover over crankshaft.

7. Press cover downward against oil pan until cover is aligned and installed over dowel pins on block.

8. Install and partially tighten the two, oil pan-to-front cover attaching screws.

9. Install the front cover-to-block attaching screws.

10. Torque all screws to specifications.

11. Install torsional damper and water pump as

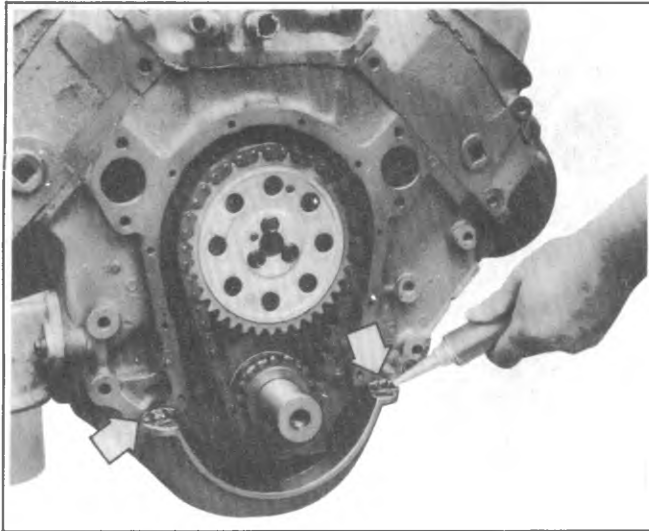


Fig. 6A2-40--Applying Front Cover Sealer

previously outlined.

OIL SEAL (FRONT COVER)

Replacement

With Cover Removed

1. With cover removed, pry oil seal out of cover from the front with a large screw driver.

2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J-23042 on Small V8 engines or Tool J-22102 on Mark IV V8 engines.

CAUTION: Support cover at seal area. (Tool J-971 may be used as support).

With Cover Installed

1. With torsional damper removed, pry seal out of cover from the front with a large screw driver, being careful not to damage the surface on the crankshaft.

2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J-23042 on Small V8 engines or Tool J-22102 on Mark IV V8 engines (fig. 6A2-41).

CAMSHAFT

Measuring Lobe Lift

NOTE: Procedure is similar to that used for checking valve timing. If improper valve operation is indicated, measure the lift of each push rod in consecutive order and record the readings.

1. Remove the valve mechanism as previously outlined.

2. Position indicator with ball socket adapter (Tool J-8520) on push rod (fig. 6A2-42).

NOTE: Make sure push rod is in the lifter socket.

3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.

4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is fully raised position.

CAUTION: Whenever the engine is cranked remotely at the starter, with a special jumper cable or other means, the distributor primary lead must

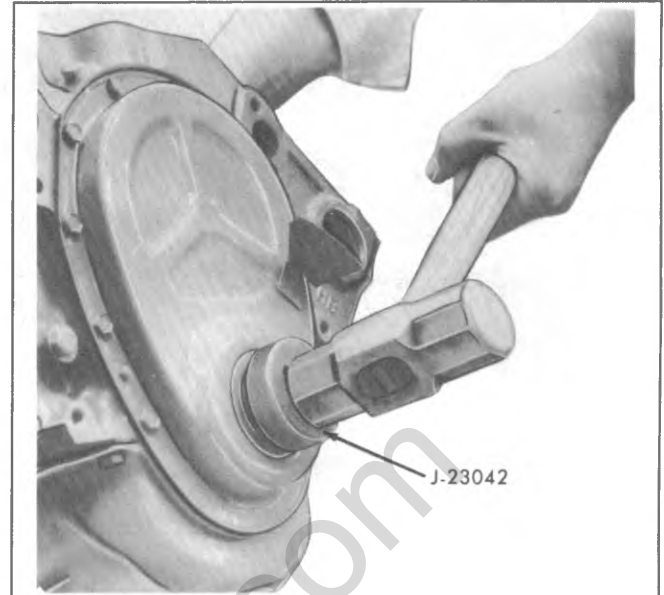


Fig. 6A2-41--Installing Oil Seal

be disconnected from the coil.

5. Compare the total lift recorded from the dial indicator with specifications.

6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.

7. Install and adjust valve mechanism as outlined.

Removal

1. Remove valve lifters as previously outlined.

2. Remove crankcase front cover as previously outlined.

3. Remove grille.

4. Remove fuel pump push rod as outlined in Section 6C.

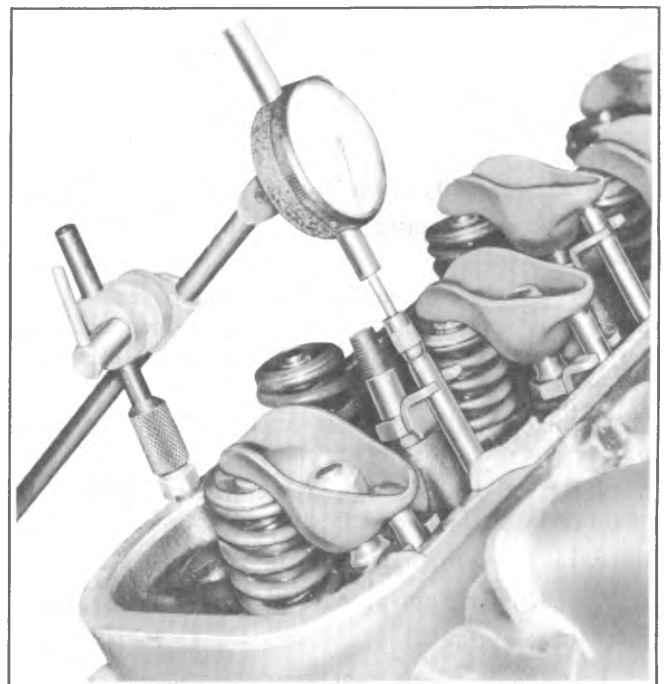


Fig. 6A2-42--Measuring Camshaft Lobe Lift

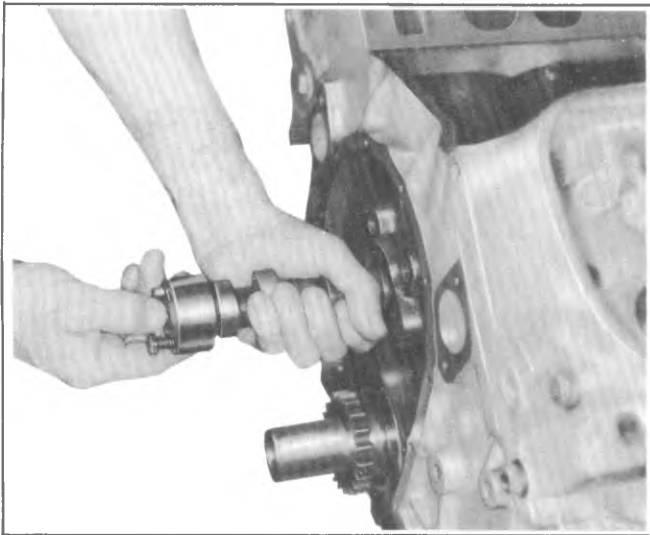


Fig. 6A2-43--Removing Camshaft

5. Complete camshaft removal as follows:

NOTE: Sprocket is a light fit on camshaft. If sprocket does not come off easily a light blow on the lower edge of the sprocket (with a plastic mallet) should dislodge the sprocket.

6. Install two 5/16" x 18 x 4" bolts in camshaft bolt holes then remove camshaft (fig. 6A2-43).

CAUTION: All camshaft journals are the same diameter and care must be used in removing camshaft to avoid damage to bearings.

Inspection

The camshaft bearing journals should be measured with a micrometer for an out-of-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.

Installation

NOTE: Whenever a new camshaft is installed coat camshaft lobes with "Molykote" or its equivalent.

Whenever a new camshaft is installed, replacement of all valve lifters is recommended to insure durability of the camshaft lobes and lifter feet.

1. Lubricate camshaft journals with engine oil and install camshaft.

2. Install timing chain on camshaft sprocket. Hold the sprocket vertically with the chain hanging down and align marks on camshaft and crankshaft sprockets. (Refer to fig. 6A2-44 & 6A2-45).

3. Align dowel in camshaft with dowel hole in camshaft sprocket then install sprocket on camshaft.

4. Draw the camshaft sprocket onto camshaft using the mounting bolts. Torque to specifications.

5. Lubricate timing chain with engine oil.

6. Install fuel pump push rod as outlined in Section 6C.

7. Install grille.

8. Install crankcase front cover as previously outlined.

9. Install valve lifters as previously outlined.

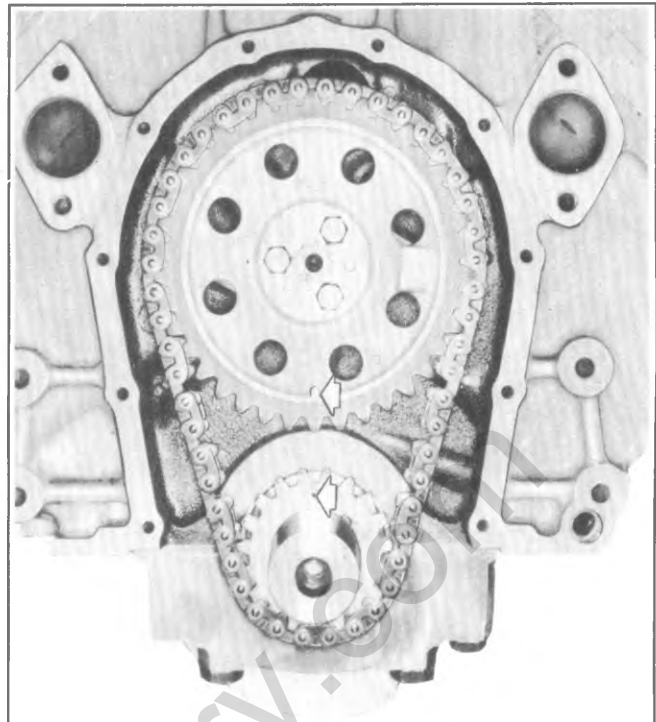


Fig. 6A2-44--Timing Sprocket Alignment Marks

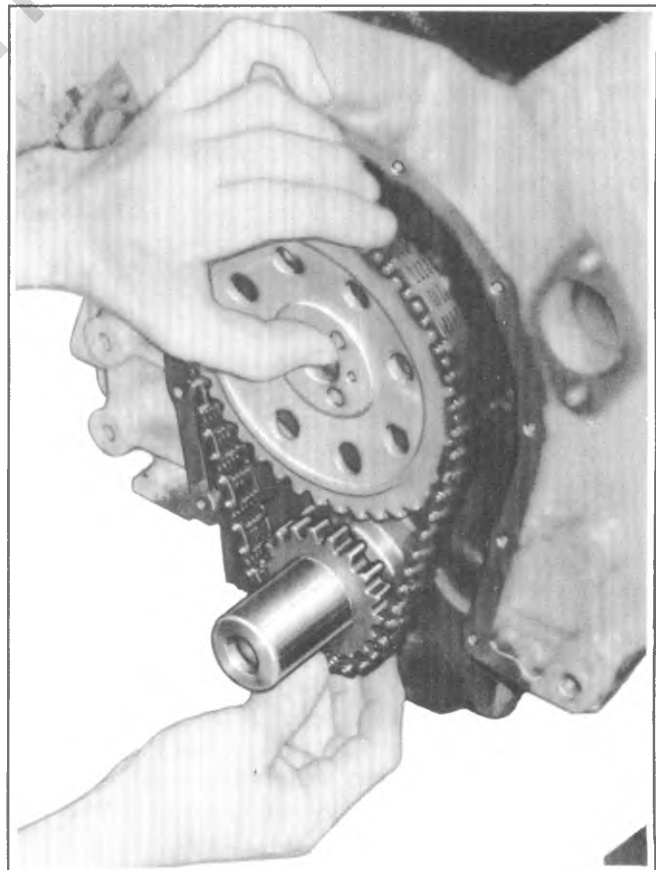


Fig. 6A2-45--Installing Timing Chain

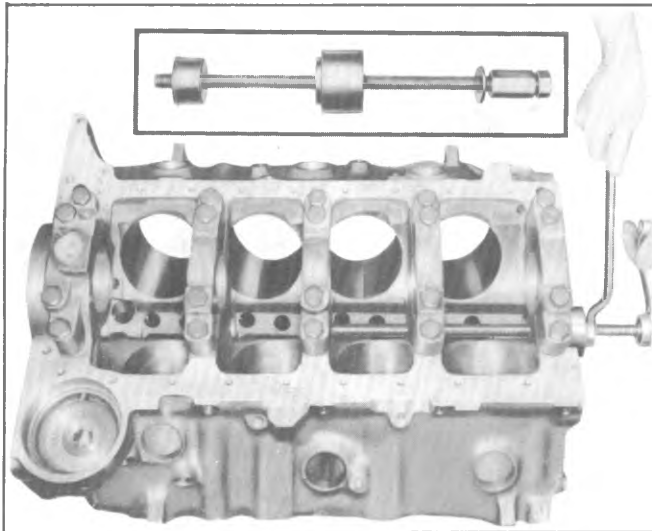


Fig. 6A2-46--Removing Camshaft Bearings

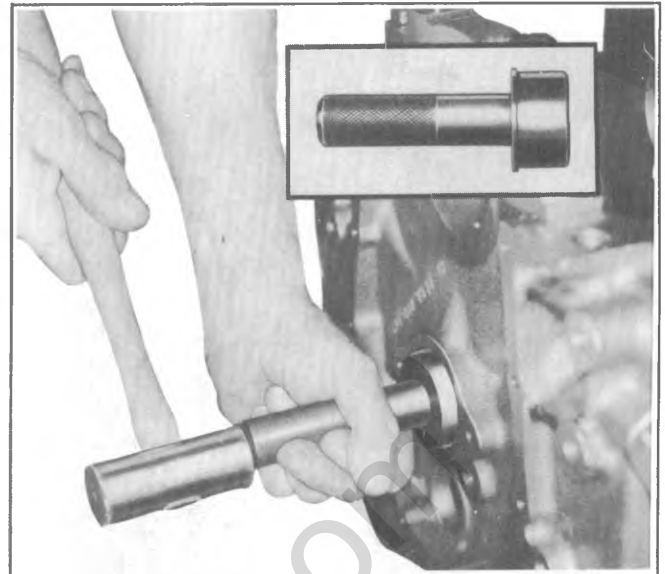


Fig. 6A2-47--Replacing Camshaft Front Bearing

CAMSHAFT BEARINGS

Removal

Camshaft bearings can be replaced while engine is disassembled for overhaul or without complete disassembly of the engine. To replace bearings without complete disassembly remove the camshaft and crankshaft leaving cylinder heads attached and pistons in place. Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Fasten connecting rods against sides of engine so they will not be in the way while replacing camshaft bearings.

1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.

NOTE: This procedure is based on removal of the bearings nearest center of the engine first. With this method a minimum amount of turns are necessary to remove all bearings.

2. Using Tool J-6098 with nut and thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.

3. Install remover and installer tool with shoulder toward bearing, making sure a sufficient amount of threads are engaged.

4. Using two wrenches, hold puller screw while turning nut. After bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw (fig. 6A2-46).

5. Remove remaining bearings (except front and rear) in the same manner. It will be necessary to index pilot in camshaft rear bearing to remove the rear intermediate bearing.

6. Assemble remover and installer tool on driver handle and remove camshaft front and rear bearings by driving towards center of cylinder block (fig. 6A2-47).

Installation

The camshaft front and rear bearings should be installed first. These bearings will act as guides for the pilot and center the remaining bearings being pulled into place.

1. Assemble remover and installer tool on driver handle and install camshaft front and rear bearings by driving towards center of cylinder block (fig. 6A2-47).

2. Using Tool Set J-6098 with nut then thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.

3. Index camshaft bearing in bore (with oil hole aligned as outlined below), then install remover and installer tool on puller screw with shoulder toward bearing.

a. Small V8 Engines--Number one cam bearing oil hole must be positioned so that oil holes are equidistant from 6 o'clock position. Number two through number four bearing oil holes must be positioned at 5 o'clock position (toward left side of engine, and at a position even with bottom of cylinder bore). Number five bearing oil hole must be in 12 o'clock position.

b. Mark IV V8 Engines--Number one through number four cam bearing oil hole must be aligned with oil holes in cam bearing bore. The number five bearing bore is annulus, and cam bearing must be positioned at or near the 6 o'clock position.

4. Using two wrenches, hold puller screw while turning nut. After bearing has been pulled into bore, remove the remover and installer tool from puller screw, and check alignment of oil hole in camshaft bearing.

5. Install remaining bearings in the same manner. It will be necessary to index pilot in the camshaft rear bearing to install the rear intermediate bearing.

6. Install a new camshaft rear plug.

NOTE: Plug should be installed flush to 1/32" deep and be parallel with rear surface of cylinder block.

OIL PAN

Removal (All except 7.4(S) 454)

1. Drain engine oil.
2. Remove oil dip stick and tube.
3. Remove exhaust crossover pipe.
4. On vehicles equipped with automatic transmission, remove converter housing under pan.
5. Remove starter brace and inboard bolt, swing starter aside.
6. Remove oil pan and discard gaskets and seals.

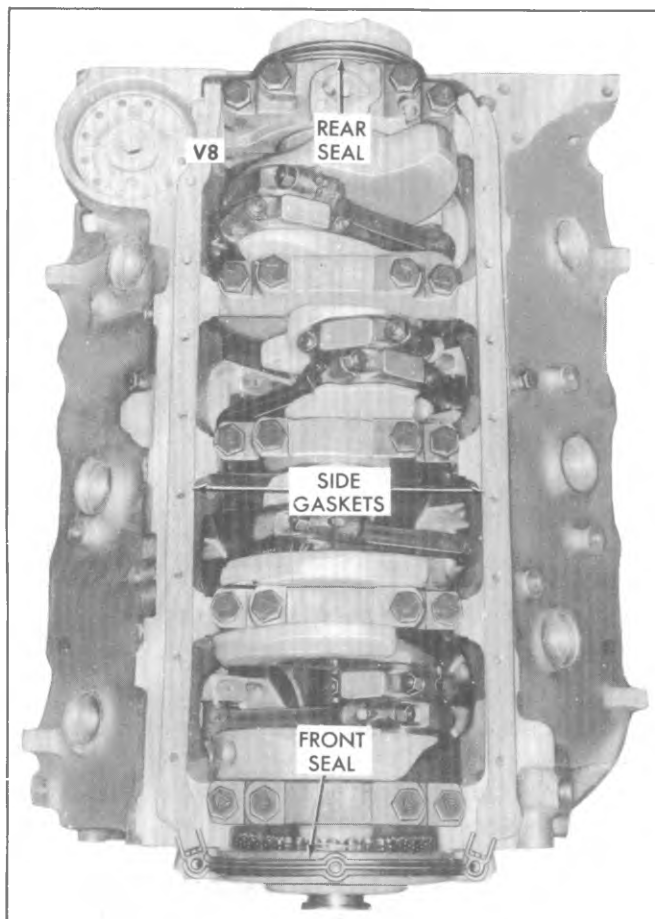


Fig. 6A2-48--Oil Pan Gaskets & Seals

Installation

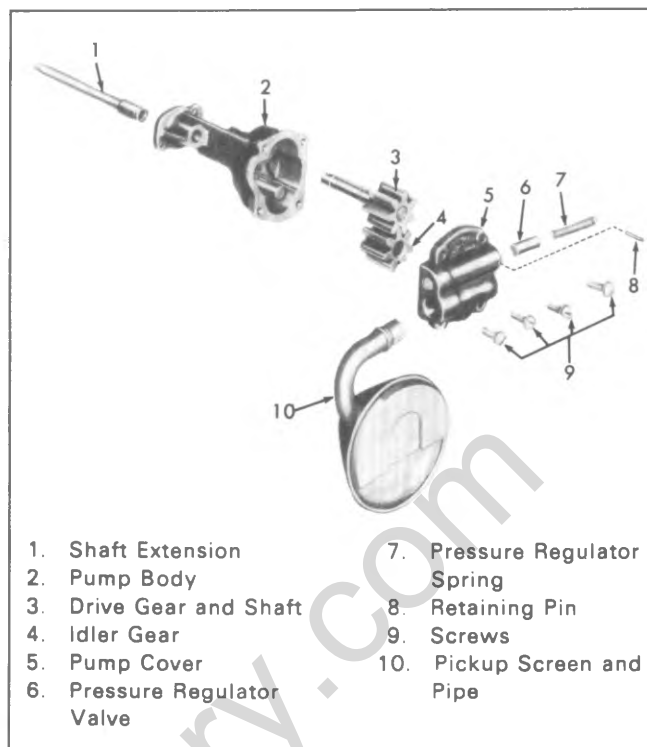
1. Thoroughly clean all gasket and seal surfaces on oil pan, cylinder block, crankcase front cover and rear main bearing cap.
2. Install new oil pan side gaskets on cylinder block using gasket sealer as a retainer. Install new oil pan rear seal in rear main bearing cap groove, with ends butting side gaskets. Install new oil pan front seal in groove in crankcase front cover with ends butting side gaskets (fig. 6A2-48).
3. Install oil pan and torque bolts to specifications.
4. Install starter brace and attaching bolts. Torque bolts to specifications.
5. Install converter housing under pan.
6. Install exhaust crossover pipe.
7. Install oil dip stick tube and dip stick.
8. Fill with oil, start engine and check for leaks.

Removal (7.4(S) 454)

1. Disconnect battery negative cable.
2. Loosen fan shroud.
3. Remove air cleaner.
4. Remove distributor cap.
5. Raise vehicle and drain oil pan.

NOTE: If equipped with manual transmission, remove starter.

6. Remove torque converter cover or clutch cover as applicable.
7. Remove oil filter.
8. On gage equipped vehicles, remove oil pressure line



- | | |
|-----------------------------|------------------------------|
| 1. Shaft Extension | 7. Pressure Regulator Spring |
| 2. Pump Body | 8. Retaining Pin |
| 3. Drive Gear and Shaft | 9. Screws |
| 4. Idler Gear | 10. Pickup Screen and Pipe |
| 5. Pump Cover | |
| 6. Pressure Regulator Valve | |

Fig. 6A2-49--Oil Pump - Small V8

from side of block.

NOTE: Removal of pressure line is important to prevent crushing of line when raising engine.

9. Remove mount through bolts and raise engine.
10. Remove oil pan bolts and drop pan.

Installation

NOTE: If installing new oil pan, transfer dipstick tube from old unit.

1. With clean sealing surfaces on pan and block, place oil pan on block and install oil pan bolts. Torque to 135 lb. in. (15N·m).
2. Lower engine on mounts and install mount through bolts. Torque to 75 lb. ft. (100 N·m).
3. Install oil pressure line, if applicable, and install oil filter.
4. Install torque converter cover or clutch cover, as applicable.

NOTE: If equipped with manual transmission, install starter.

5. Lower vehicle.
6. Install distributor cap and tighten fan shroud.
7. Fill crankcase with oil; see owners manual.
8. Install air cleaner and connect battery negative cable.
9. Start engine and check for leaks.

OIL PUMP

Removal

1. Remove oil pan as previously outlined.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

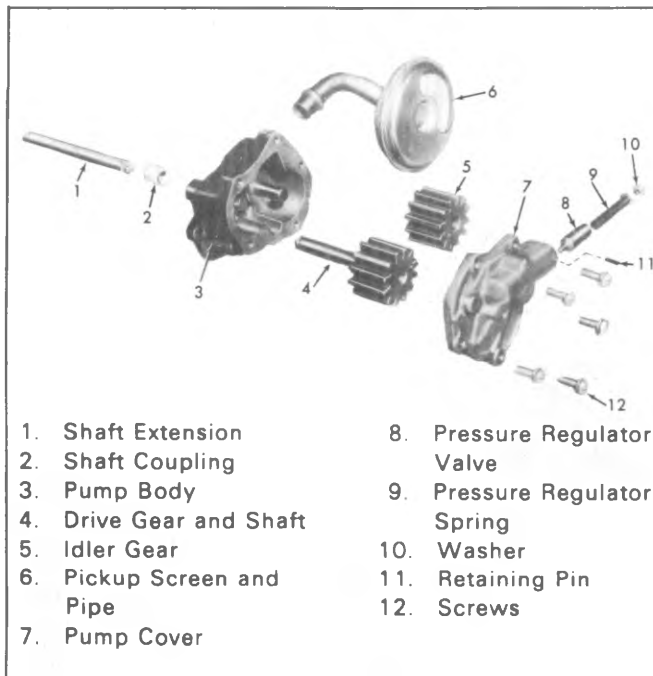


Fig. 6A2-50--Oil Pump - Mark IV

Disassembly (Figures 6A2-49 & 6A2-50)

1. Remove the pump cover attaching screws and the pump cover.

NOTE: Mark gear teeth so they may be reassembled with the same teeth indexing.

2. Remove the idler gear and the drive gear and shaft from the pump body.

3. Remove the pressure regulator valve retaining pin, pressure regulator valve and related parts.

4. If the pickup screen and pipe assembly need replacing, mount the pump in a soft-jawed vise and extract pipe from pump.

CAUTION: Do not disturb the pickup screen on the pipe. This is serviced as an assembly.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.

2. Inspect the pump body and cover for cracks or excessive wear.

3. Inspect pump gears for damage or excessive wear.

4. Check the drive gear shaft for looseness in the pump body.

5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.

6. Inspect the pickup screen and pipe assembly for damage to screen, pipe or relief grommet.

7. Check the pressure regulator valve for fit.

NOTE: The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.

Assembly (Figures 6A2-49 & 6A2-50)

1. If the pickup screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure. Mount the pump in a soft-jawed vise, apply sealer to end

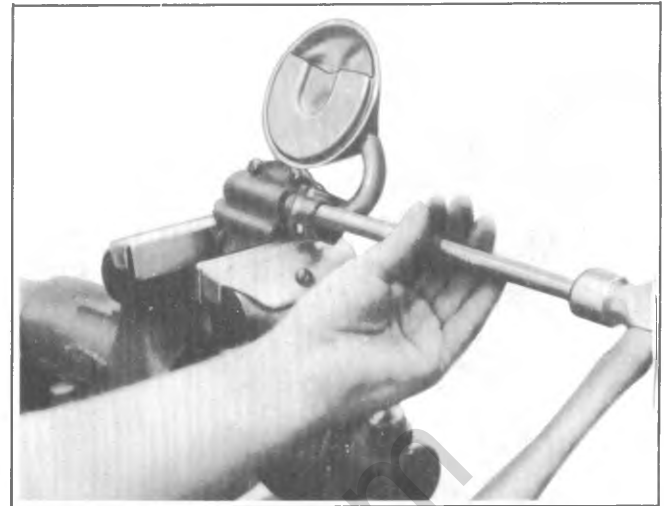


Fig. 6A2-51--Installing Screen - Small V8

of pipe, and using Tool J-8369 for "Small V8" (fig. 6A2-51) or Tool J-22144 for "Mark IV V8" (fig. 6A2-52) tap the pipe in place with a plastic hammer.

CAUTION: Be careful of twisting, shearing or collapsing pipe while installing in pump.

2. Install the pressure regulator valve and related parts.

3. Install the drive gear and shaft in the pump body.

4. Install the idler gear in the pump body with the smooth side of gear towards pump cover opening.

5. Install the pump cover and torque attaching screws to specifications.

6. Turn drive shaft by hand to check for smooth operation.

Installation

1. Assemble pump and extension shaft to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.

2. Install pump to rear bearing cap bolt and torque to specifications.

NOTE: Installed position of oil pump screen is with bottom edge parallel to oil pan rails.

3. Install oil pan previously outlined.

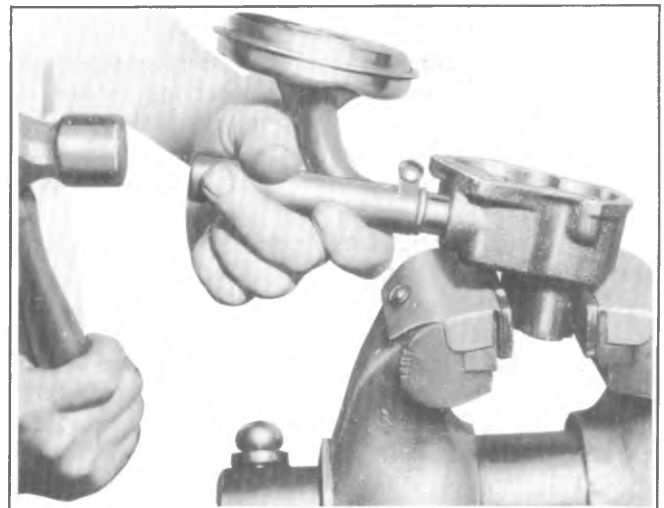


Fig. 6A2-52--Installing Screen - Mark IV

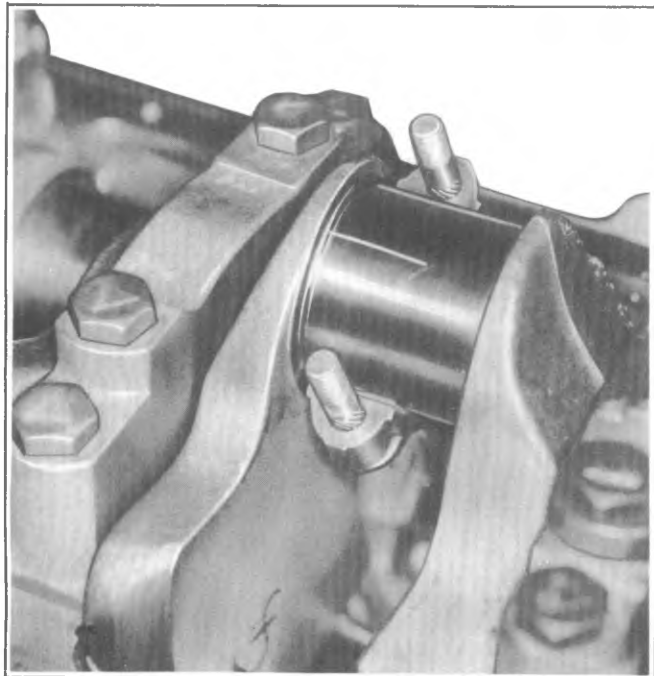


Fig. 6A2-53—Gaging Plastic On Crankpin

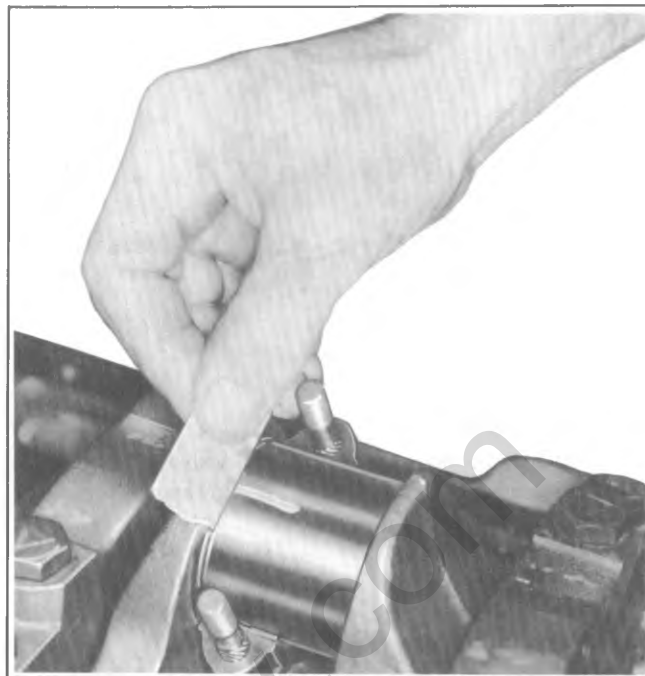


Fig. 6A2-54—Measuring Gaging Plastic

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. **DO NOT FILE RODS OR ROD CAPS.** If clearances are found to be excessive a new bearing will be required. Service bearings are available in standard size and .001" and .002" undersize for use with new and used standard size crankshafts, and in .010" and .020" undersize for use with reconditioned crankshafts.

NOTE: On removing a connecting rod cap, it is possible to find a .009" undersize bearing. These are used in manufacturing for selective fitting.

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing.

2. Inspect the bearing for evidence of wear or damage. (Bearings showing the above should not be installed.)

3. Wipe both upper and lower bearing shells and crankpin clean of oil.

4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.

5. If within specifications measure new or used bearing clearances with Plastigage or its equivalent.

NOTE: If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .001" interference between the bearing and crankpin will result in rapid bearing failure.

a. Place a piece of gaging plastic the full width of the crankpin as contacted by the bearing (parallel to the crankshaft) (fig. 6A2-53).

b. Install the bearing in the connecting rod and cap.
c. Install the bearing cap and evenly torque nuts to specifications.

CAUTION: Do not turn the crankshaft with the gaging plastic installed.

d. Remove the bearing cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point (fig.6A2-54).

6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance.

NOTE: Be sure to check what size bearing is being removed in order to determine proper replacement size bearing.

If clearance cannot be brought to within specifications, the crankpin will have to be ground undersize. If the crankpin is already at maximum undersize, replace crankshaft.

7. Coat the bearing surface with oil, install the rod cap and torque nuts to specifications.

8. When all connecting rod bearings have been installed tap each rod lightly (parallel to the crankpin) to make sure they have clearance.

9. Measure all connecting rod side clearances (see specifications) between connecting rod caps (fig. 6A2-55).

MAIN BEARINGS

Main bearings are of the precision insert type and do not utilize shims for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in standard size and .001", .002", .009", .010" and .020" undersize.

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a .001" undersize insert which will decrease the clearance .0005" from using a full standard bearing.



Fig. 6A2-55--Measuring Connecting Rod Side Clearance

When a production crankshaft cannot be precision fitted by this method, it is then ground .009" undersize **ON ONLY THOSE MAIN JOURNALS THAT CANNOT BE PROPERLY FITTED. ALL JOURNALS WILL NOT NECESSARILY BE GROUND.** A .009" undersize bearing or .010" undersize bearing will then be used for precision fitting in the same manner as previously described.

NOTE: If, for any reason, main bearing caps are replaced, shimming may be necessary. Laminated shims for each cap are available for service. Shim requirement will be determined by bearing clearance.

Inspection

In general, the lower half of the bearing (except No. 1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

Checking Clearance

To obtain the most accurate results with "Plastigage", (or its equivalent) a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed.

If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft should be supported both front and rear (damper and flywheel) to remove the clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

NOTE: To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, preparatory to checking fit of bearings, the

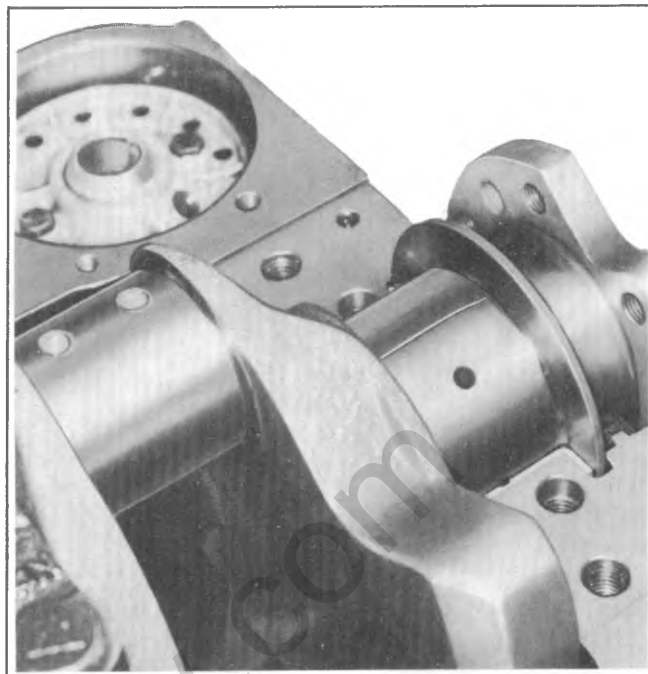


Fig. 6A2-56--Gaging Plastic on Journal

surface of the crankshaft journal and bearing should be wiped clean of oil.

1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.

2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal (fig. 6A2-56).

CAUTION: Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.

3. Install the bearing cap and evenly torque the

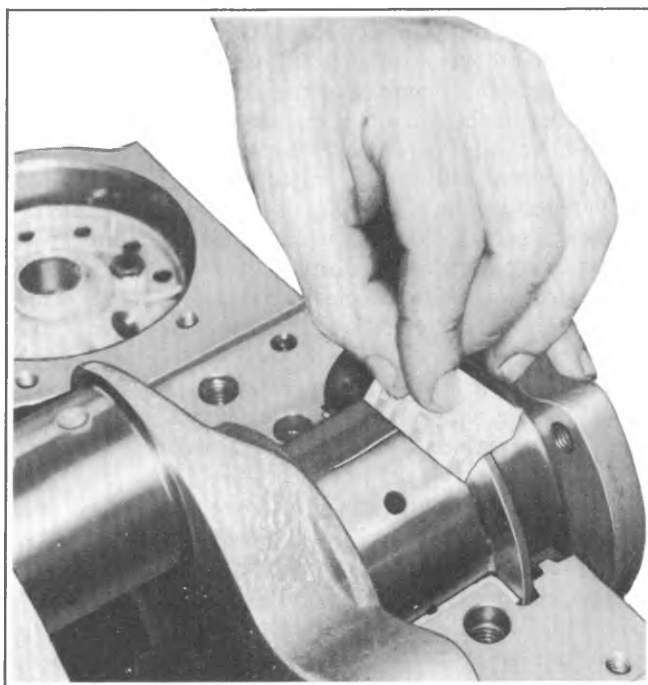


Fig. 6A2-57--Measuring Gaging Plastic

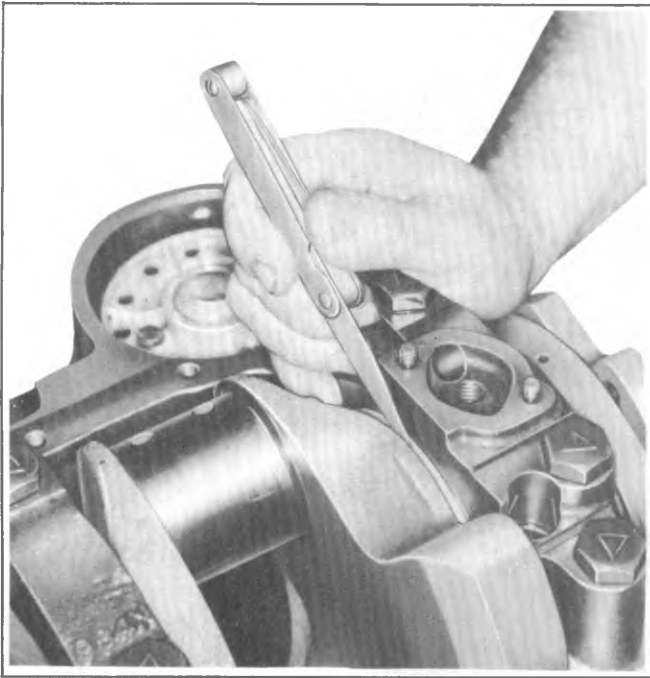


Fig. 6A2-58--Measuring Crankshaft End Play

retaining bolts to specifications.

NOTE: Bearing cap **MUST** be torqued to specifications in order to assure proper reading. Variations in torque affect the compression of the plastic gage.

4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.

5. On the edge of gaging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope (fig. 6A2-57).

NOTE: Normally main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round (.001" max.), be sure to fit to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter and the journal is out-of-round .001", interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001" difference.

6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower inserts as a unit.

NOTE: If a new bearing cap is being installed and clearance is less than .001", inspect for burrs or nicks; if none are found then install shims as required.

7. A standard, .001" or .002" undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.

NOTE: After selecting new bearing, recheck clearance.

8. Proceed to the next bearing. After all bearings have been checked rotate the crankshaft to see that there is no excessive drag.

NOTE: When checking No. 1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gage.

9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gage (fig. 6A2-58).

10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

Replacement

NOTE: Main bearings may be replaced with or without removing the crankshaft.

With Crankshaft Removal

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

Without Crankshaft Removal

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.

2. Install a main bearing removing and installing tool in oil hole in crankshaft journal.

NOTE: If such a tool is not available, a cotter pin may be bent as required to do the job.

3. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.

4. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.

5. Oil new lower bearing and install in bearing cap.

6. Install main bearing cap with arrows pointing toward front of engine.

7. Torque all main bearing caps **EXCEPT THE REAR MAIN CAP** to specifications. Torque rear main bearing cap to 10-12 lb. ft. (14-16N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing caps to specifications.

OIL SEAL (REAR MAIN)

Replacement

NOTE: Always replace the upper and lower seal as a unit. Install seal with lip facing front of engine.

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft. Extreme care should be exercised when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal. An installation tool (fig. 6A2-59) can be used to protect the seal bead when positioning seal as follows:

1. With the oil pan and oil pump removed, remove the rear main bearing cap.

2. Remove oil seal from the bearing cap by prying from the bottom with a small screw driver (fig. 6A2-60).

3. To remove the upper half of the seal, use a small

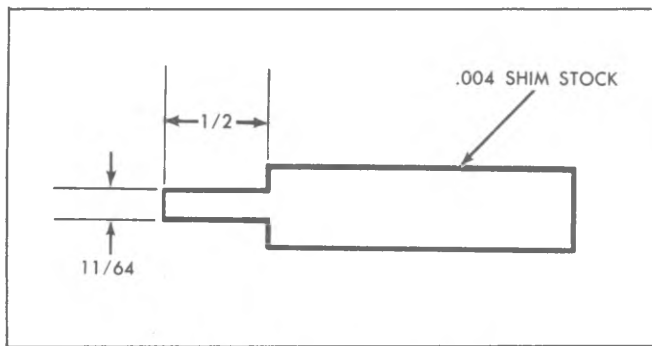


Fig. 6A2-59--Oil Seal Installation Tool

hammer to tap a brass pin punch on one end of seal until it protrudes far enough to be removed with pliers (fig. 6A2-61).

4. Clean all sealant and foreign material from cylinder case bearing cap and crankshaft, using a non-abrasive cleaner.

5. Inspect components for nicks, scratches, burrs and machining defects at all sealing surfaces, case assembly and crankshaft.

6. Coat seal lips and seal bead with light engine oil - keep oil off seal mating ends.

7. Position tip of tool between crankshaft and seal seat in cylinder case.

8. Position seal between crankshaft and tip of tool so that seal bead contacts tip of tool.

NOTE: Make sure that oil-seal lip is positioned toward front of engine (fig. 6A2-62).

9. Roll seal around crankshaft using tool as a "shoe-horn" to protect seal bead from sharp corner of seal seat surface in cylinder case.

CAUTION: Installation tool must remain in position until seal is properly positioned with both ends flush with block.

10. Remove tool, being careful not to withdraw seal.

11. Install seal half in bearing cap, again using tool as a "shoe-horn", feeding seal into cap using light pressure with thumb and finger.

12. Install bearing cap to case with sealant applied to the cap-to-case interface being careful to keep sealant off the

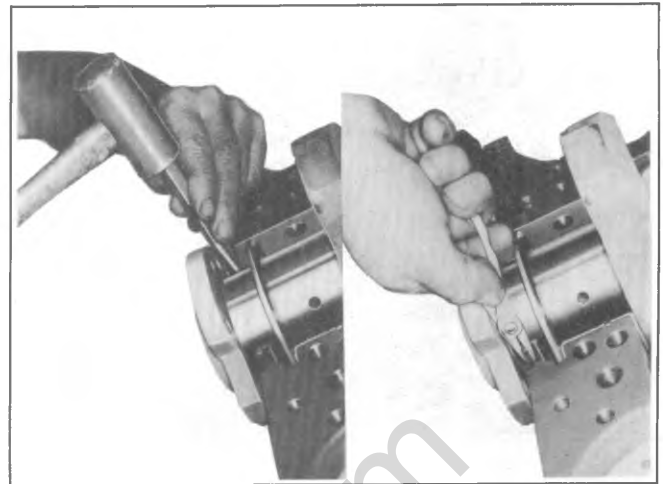


Fig. 6A2-61--Removing Oil Seal - Upper Half

seal split line (fig. 6A2-63).

13. Install the rear main bearing cap (with new seal) and torque to 10-12 lb. ft. (14-16N·m). Tap end of crankshaft first rearward then forward with lead hammer. This will line up thrust surfaces. Retorque bearing cap to specifications.

CONNECTING ROD AND PISTON ASSEMBLIES

Removal

1. With oil pan, oil pump and cylinder head removed, use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.

NOTE: Before ridge and/or deposits are removed, turn crankshaft until piston is at the bottom of stroke and place a cloth on top of piston to collect the cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke and remove cloth and cuttings.

2. Inspect connecting rods and connecting rod caps for cylinder identification. If necessary mark them.

3. Remove connecting rod cap and install Tool J-5239 (3/8") or J-6305 (11/32") on studs. Push connecting rod and piston assembly out of top of cylinder block (fig. 6A2-



Fig. 6A2-60--Removing Oil Seal - Lower Half

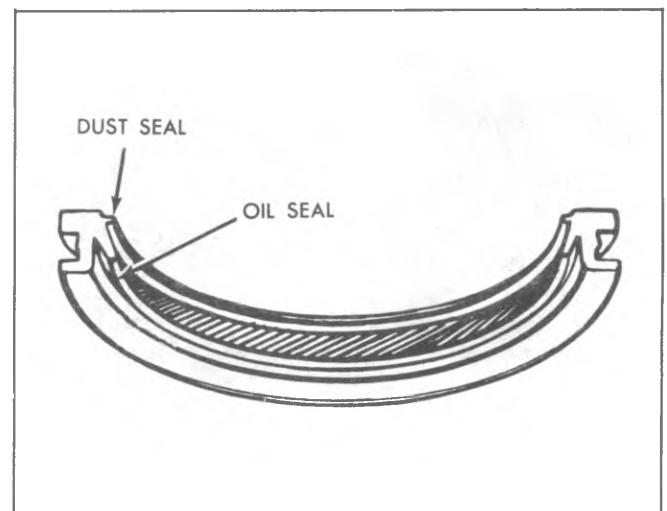


Fig. 6A2-62--Crankshaft Oil Seal - Rear Main

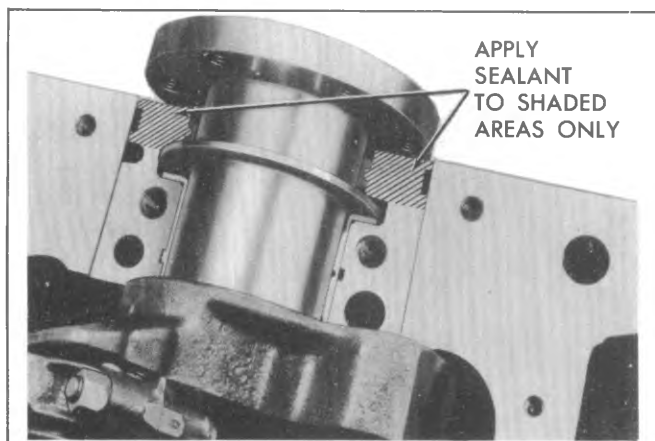


Fig. 6A2-63--Sealing Bearing Cap

64).

NOTE: It will be necessary to turn the crankshaft slightly to disconnect some of the connecting rod and piston assemblies and push them out of the cylinder.

Disassembly

1. Remove connecting rod bearings from connecting rods and caps.

NOTE: If connecting rod bearings are being reused, place them in a rack so they may be reinstalled in their original rod and cap.

2. Remove piston rings by expanding and sliding them off the pistons. Tools J-8020 (3-9/16"), J-8021 (3-7/8"), J8032 (4"), J-22249 (3-15/16"), J-22147 (4-3/32"), and J-22250 (4-1/4") are available for this purpose.

3. Place connecting rod and piston assembly on Tool J-24086-20. Using an arbor press and piston pin remover, J-24086-8, press the piston pin out of connecting rod and piston (fig. 6A2-65).

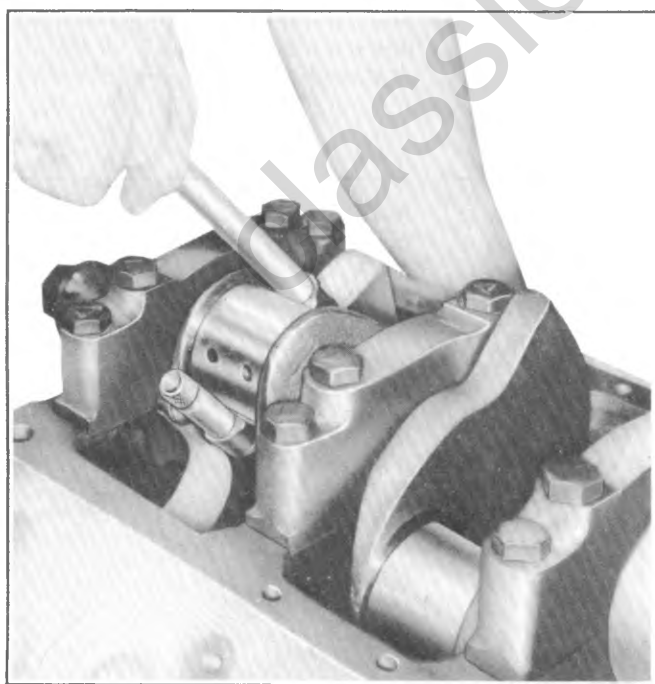


Fig. 6A2-64--Removing Connecting Rod & Piston Assembly

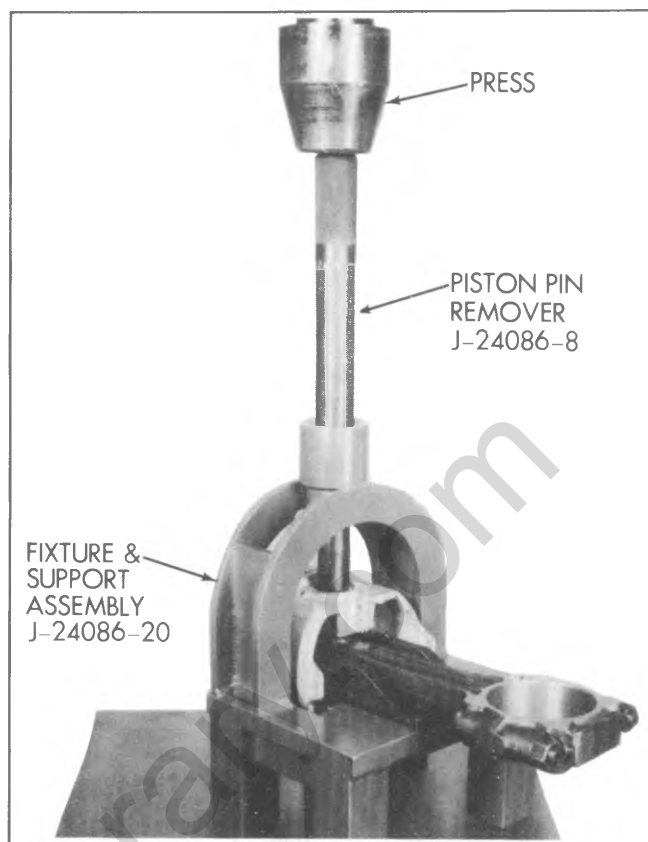


Fig. 6A2-65--Removing Piston Pin

Cleaning and Inspection

Connecting Rods

Wash connecting rods in cleaning solvent and dry with compressed air.

Check for twisted or bent rods and inspect for nicks or cracks. Replace connecting rods that are damaged.

Pistons

Clean varnish from piston skirts and pins with a cleaning solvent. **DO NOT WIRE BRUSH ANY PART OF THE PISTON**. Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy or worn ring lands, scuffed or damaged skirts, eroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

Measure piston skirt (across center line of piston pin) and check clearance as outlined under "Piston Selection".

Piston Pins

The piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, the piston and piston pin are a matched set and not serviced separately.

Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when being measured. The piston pin should be measured with a micrometer and the piston pin bore should be measured with a dial bore gage or an inside micrometer. If clearance is in excess of the .001" wear limit, the piston

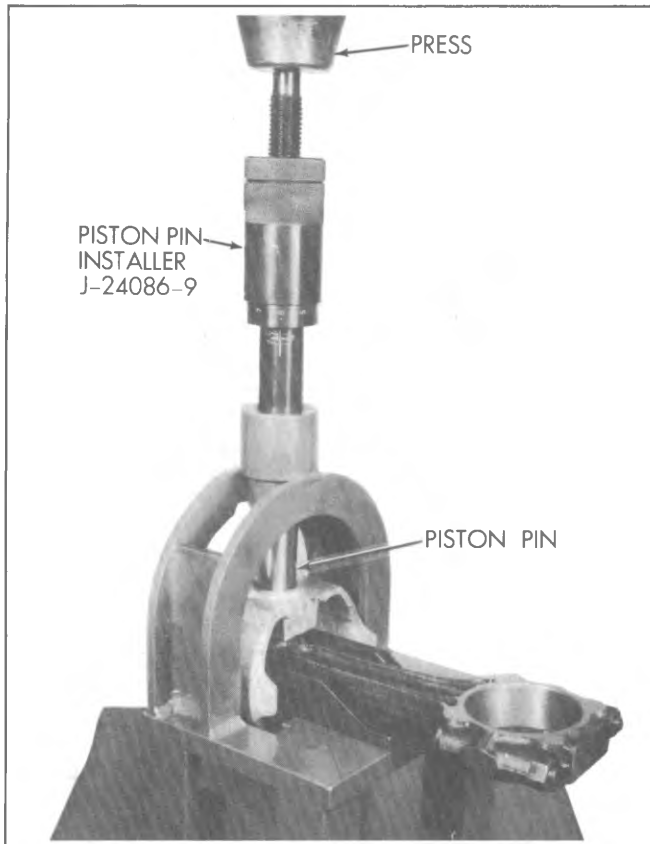


Fig. 6A2-67--Installing Piston Pin

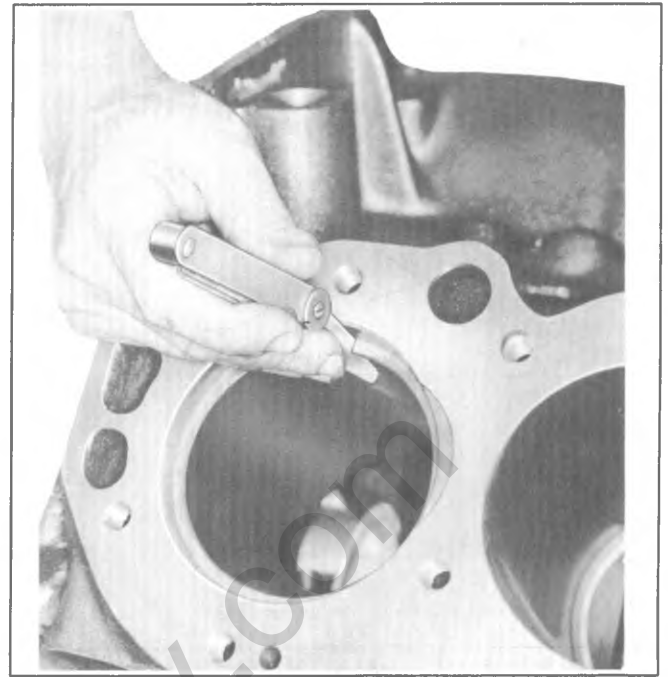


Fig. 6A2-68--Measuring Ring Gap

and piston pin assembly should be replaced.

Assembly

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.

2. Place connecting rod in piston and hold in place with piston pin guide and piston pin. Place assembly on fixture and support assembly.

3. Using piston pin installer, J-24086-9, press the piston pin into the piston and connecting rod (fig. 6A2-67).

NOTE: The piston pin installer is a variable insertion length tool designed to be applicable to all GM Piston assemblies.

The insertion length is varied by rotating the hub on the shaft much like adjusting a micrometer. An alpha-numeric scale is used to determine the desired length for a given piston pin assembly.

CAUTION: After installer hub bottoms on support assembly, do not exceed 5000 psi pressure, as this could cause structural damage to the tool.

4. Remove piston and connecting rod assembly from tool and check piston for freedom of movement on piston pin.

Piston Rings

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the marked side is toward the top of the piston. The top ring is chrome faced, or treated with molybdenum for maximum life.

The oil control rings are of three piece type, consisting of two segments (rails) and a spacer.

1. Select rings comparable in size to the piston being used.

2. Slip the compression ring in the cylinder bore; then



Fig. 6A2-69--Checking Ring in Groove

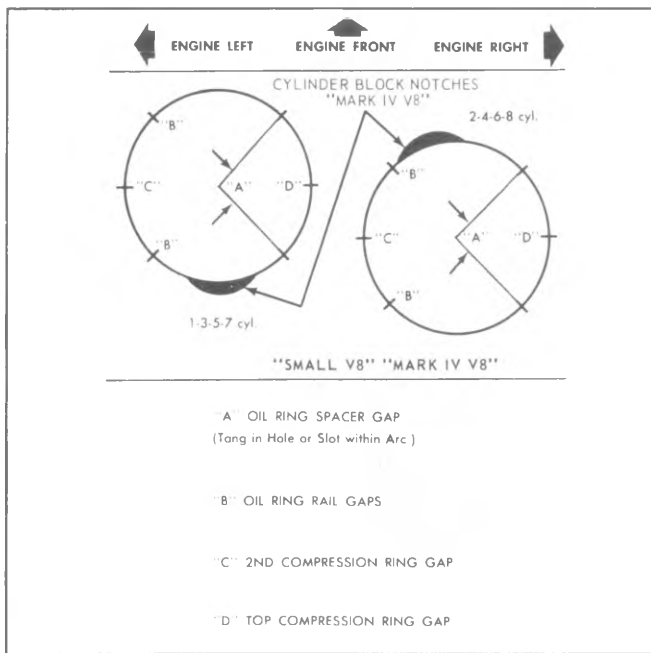


Fig. 6A2-70--Ring Gap Location

press the ring down into the cylinder bore about 1/4 inch (above ring travel). Be sure ring is square with cylinder wall.

3. Measure the space or gap between the ends of the ring with a feeler gage (fig. 6A2-68).

4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.

5. Fit each compression ring to the cylinder in which it is going to be used.

6. If the pistons have not been cleaned and inspected as previously outlined, do so.

7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove (fig. 6A2-69) to make sure that the ring is free. If binding occurs at any point the cause should be determined, and if caused by ring groove, remove by dressing with a fine cut file. If the binding is caused by a distorted ring, check a new ring.

8. Install piston rings as follows (fig. 6A2-70).

NOTE: Tools J-8020 (3-9/16"), J-8021 (3-7/8"), J8032 (4"), J-22249 (3-15/16"), J-22147 (4-3/32"), and J-22250 (4-1/4") are available for this purpose.

a. Install oil ring spacer in groove and insert anti-rotation tang in oil hole.

b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.

c. Install upper steel oil ring rail with gap properly located.

d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point the cause should be determined, and if caused by ring groove, remove by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.

e. Install second compression ring expander then ring with gaps properly located.

f. Install top compression ring with gap properly located.

9. Proper clearance of the piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, the

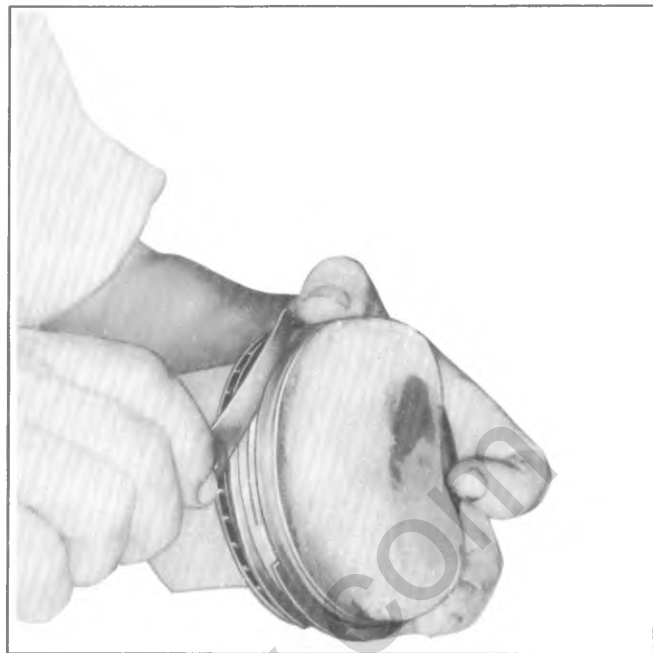


Fig. 6A2-71--Measuring Ring Groove Clearance

clearances between the surfaces of the ring and groove should be measured (fig. 6A2-71). (See Specifications).

Installation

NOTE: Cylinder bores must be clean before piston installation. This may be accomplished with a hot water and detergent wash or with a light honing as necessary. After cleaning, the bores should be swabbed several times with light engine oil and a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.

2. Lightly coat pistons, rings and cylinder walls with light engine oil.

3. With bearing caps removed, install Tool J-5239 (3/8") or J-6305 (11/32") on connecting rod bolts.

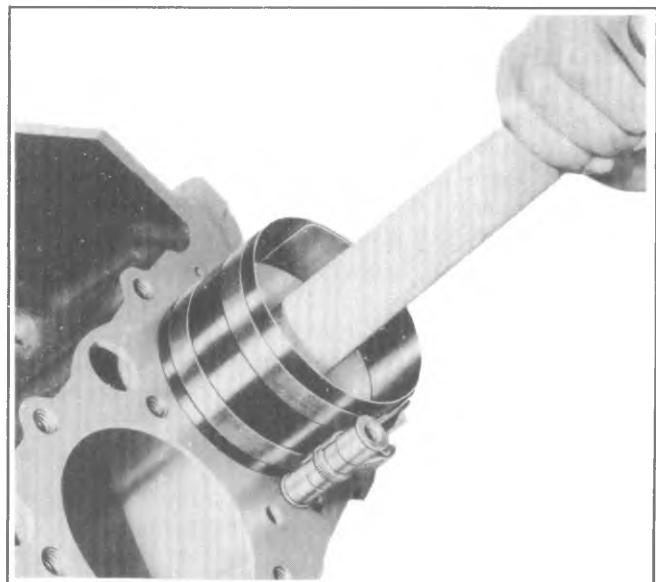


Fig. 6A2-72--Installing Connecting Rod & Piston Assembly

CAUTION: *Be sure ring gaps are properly positioned as previously outlined.*

4. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tang slots on side opposite camshaft. Use Tool J-8037 to compress the rings (fig. 6A2-72). Guide the connecting rod into place on the crankshaft journal with Tool J-5239 (3/8") or J-6305 (11/32"). Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.

5. Remove Tool J-5239 or J-6305.

6. Install the bearing caps and torque nuts to specifications.

NOTE: If bearing replacement is required refer to "Connecting Rod Bearings".

Be sure to install new pistons in the same cylinders for which they were fitted, and used pistons in the same cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at the front of the engine. On V8 engines 1,3,5 and 7 in the left bank and, 2,4, 6 and 8 in the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

CYLINDER BLOCK

Cleaning and Inspection

1. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.

2. Remove oil gallery plugs and clean all oil passages.

NOTE: These plugs may be removed with a sharp punch or they may be drilled and pried out.

3. Clean and inspect water passages in the cylinder block.

4. Inspect the cylinder block for cracks in the cylinder walls, water jacket, valve lifter bores and main bearing webs.

5. Measure the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator. Set the gage so that the thrust pin must be forced in about 1/4" to enter gage in cylinder bore. Center gage in cylinder and turn dial to "0". Carefully work gage up and down cylinder to determine taper and turn it to different points around cylinder wall to determine the out-of-round condition. If cylinders were found to exceed specifications, honing or boring will be necessary.

Conditioning

The performance of the following operation is contingent upon engine condition at time of repair.

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring.

If the cylinders were found to have less than .005" taper or wear, they can be conditioned with a hone and fitted with the high limit standard size piston. A cylinder bore of less than .005" wear or taper may not entirely clean up when fitted to a high limit piston. If it is desired to entirely clean up the bore in these cases, it will be necessary to rebore for

an oversize piston. If more than .005" taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.

When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, the cylinder bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

Boring

1. Before using any type boring bar, the top of the cylinder block should be filed off to remove any dirt or burrs. This is very important. Otherwise, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.

2. The piston to be fitted should be measured with a micrometer, measuring at the center of the piston skirt and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston and honed to give the specified clearance.

NOTE: Hone cylinders as outlined under "Cylinder Honing and Piston Fitting".

3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

Honing

1. When cylinders are to be honed follow the hone manufacturer's recommendations for the use of the hone and cleaning and lubrication during honing.

2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.

3. When finish honing a cylinder bore to fit a piston, the hone should be moved up and down at a sufficient speed to obtain very fine uniform surface finish marks, in a cross-hatch pattern of approximately 45 to 65 degrees included angle. The finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.

4. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

CAUTION: *Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been honed to correct size as this type piston can be distorted through careless handling.*

5. Thoroughly clean the bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil, the bores should be swabbed and then wiped with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

OIL FILTER BYPASS VALVE

Inspection and Replacement

With the oil filter removed, check the spring and fibre valve for operation. Inspect for a cracked or broken valve. If replacement is necessary, the oil filter adapter and bypass valve assembly must be replaced as an assembly. Clean valve

chamber in cylinder block thoroughly. Torque retaining screws to specifications.

Piston Selection

1. Check USED piston to cylinder bore clearance as follows:

a. Measure the "Cylinder Bore Diameter" with a telescope gage (2-1/2" from top of cylinder bore).

b. Measure the "Piston Diameter" (at skirt across center line of piston pin).

c. Subtract piston diameter from cylinder bore diameter to determine "Piston to Bore Clearance".

d. Locate piston to bore clearance on Piston Selection Chart and determine if piston to bore clearance is in the acceptable range.

2. If used piston is not acceptable, check Piston Size Chart and determine if a new piston can be selected to fit cylinder bore within the acceptable range.

3. If cylinder bore must be reconditioned, measure new piston diameter (across center line of piston pin) then hone cylinder bore to correct clearance (preferable range).

4. Mark the piston to identify the cylinder for which it was fitted.

ENGINE ASSEMBLY

Removal

1. Remove hood.
2. Disconnect battery cables at battery.
3. Remove air cleaner.
4. Drain radiator and block.
5. Disconnect radiator and heater hoses and remove radiator and fan shroud.
6. Disconnect wires at:
 - Starter Solenoid
 - Generator
 - Temperature switch
 - Oil Pressure Switch
 - Coil
7. Disconnect:
 - Accelerator linkage at inlet manifold.
 - Fuel line, from tank, at fuel pump.
 - Hoses at fuel vapor storage canister (if applicable).
 - Vacuum line to power brake unit at manifold, if so equipped.
8. Remove power steering pump and lay aside, if so equipped.
9. Raise vehicle on hoist.
10. Drain crankcase.
11. Disconnect exhaust pipe at manifold and, if so equipped, converter bracket at transmission rear mount.
12. Remove starter.
13. Remove flywheel splash shield or converter housing cover as applicable.
14. On vehicles with automatic transmission, remove converter to flywheel attaching bolt.
15. Remove mount "through" bolts.
16. Remove bell housing bolts.
17. Lower vehicle on hoist.
18. Raise transmission using floor jack.
19. Attach engine lifting devices, raise engine.
20. Remove motor mount to engine brackets.
21. Remove engine assembly.

Installation

1. Position engine assembly in vehicle.
 2. Attach motor mount to engine brackets and lower engine in place.
 3. Remove engine lifting device.
 4. Remove transmission floor jack.
 5. Raise vehicle on hoist.
 6. Install mount "through" bolts. Torque to specifications.
 7. Install bell housing bolts. Torque to specifications.
 8. On vehicles with automatic transmissions, install converter to flywheel attaching bolts. Torque to specifications.
 9. Install flywheel splash shield of converter housing cover as applicable. Torque attaching bolts to specifications.
 10. Install starter.
 11. Connect exhaust pipe at manifold and converter bracket at transmission rear mount.
 12. Lower vehicle on hoist.
 13. Reinstall power steering pump, if so equipped.
 14. Connect:
 - Accelerator linkage at inlet manifold.
 - Fuel line, from tank, at fuel pump.
 - Hoses at fuel vapor storage canister.
 - Vacuum line to power brake unit at manifold, if equipped.
 15. Connect wires at:
 - Starter Solenoid
 - Generator
 - Temperature Switch
 - Oil Pressure Switch
 - Coil
 16. Install radiator and fanshroud and reconnect radiator and heater hoses.
 17. Fill cooling system.
 18. Fill crankcase with oil. See owner's manual for specifications.
 19. Install air cleaner.
 20. Install hood.
 21. Connect battery cables.
- NOTE:** To avoid possible arcing of battery, connect positive battery cable first.
22. Start engine, check for leaks and check timing.

CRANKSHAFT

The crankshaft can be removed while the engine is disassembled for overhaul, as previously outlined or without complete disassembly as outlined below.

Removal

1. With the engine removed from the vehicle and the transmission and/or clutch housing removed from the engine, mount engine in stand and clamp securely.
2. Remove the oil dip stick and oil dip stick tube, (if applicable).
3. Remove the starting motor, clutch assembly (if equipped) and flywheel.
4. Remove the spark plugs.
5. Remove crankshaft pulley and torsional damper.
6. Remove oil pan and oil pump.
7. Remove crankcase front cover, and if so equipped, remove timing chain and camshaft sprocket.
8. Check the connecting rod caps for cylinder number identification. If necessary mark them.

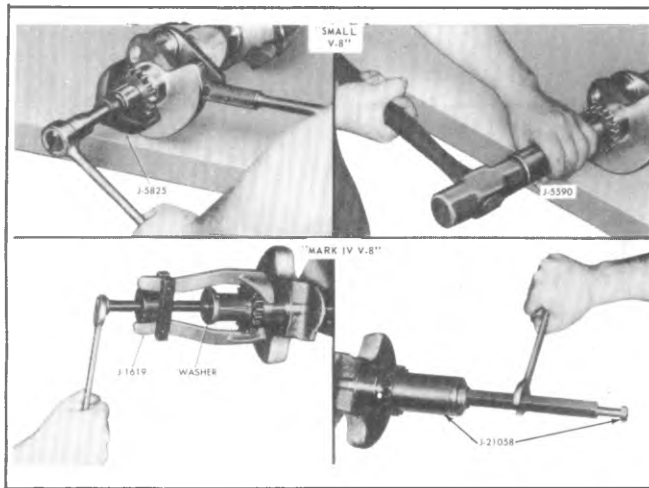


Fig. 6A2-73--Sprocket or Gear Replacement

9. Remove the connecting rod caps and push the pistons to top of bores.

10. Remove main bearing caps and lift crankshaft out of cylinder block.

11. Remove rear main bearing oil seal and main bearings from cylinder block and main bearing caps.

Cleaning and Inspection

1. Wash crankshaft in solvent and dry with compressed air.

2. Measure dimensions of main bearing journals and crankpins with a micrometer for out-of-round, taper or undersize. (See Specifications.)

3. Check crankshaft for run-out by supporting at the front and rear main bearings journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator. (See Specifications.)

4. Replace or recondition the crankshaft if out of specifications.

SPROCKET OR GEAR REPLACEMENT (REFER TO FIG. 6A2-73)

● On "Small V8" engines, remove crankshaft sprocket using Tool J-5825, install using Tool J-5590.

● On Mark IV V8 engines, remove crankshaft sprocket using Tool J-1619, install using Tool J-21058.

Installation

1. Install rear main bearing oil seal in cylinder block and rear main bearing cap grooves. Install with lip of seal toward front of engine. Where seal has two lips install lip with helix towards front of engine.

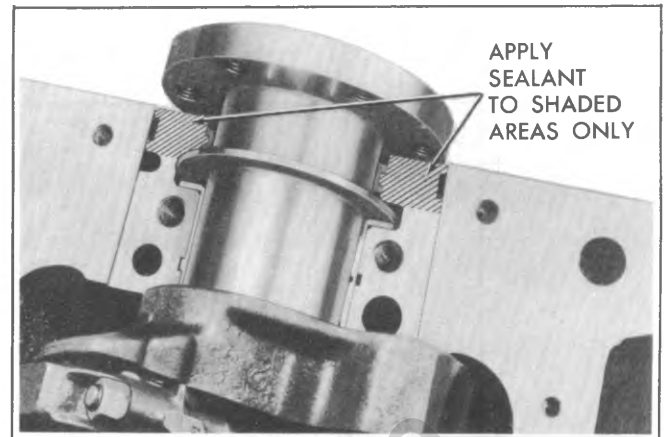


Fig. 6A2-74--Sealing Bearing Cap Block

2. Lubricate lips of seal with engine oil. Keep oil off parting line surface.

3. Install main bearings in cylinder block and main bearing caps then lubricate bearing surface with engine oil.

4. Install crankshaft, being careful not to damage bearing surfaces.

5. Apply a thin coat of brush-on type oil sealing compound to block mating surface and corresponding surface of cap only (fig. 6A2-74). Do not allow sealer on crankshaft or seal.

6. Install main bearing caps with arrows pointing toward front of engine.

7. Torque all except rear main bearing cap bolts to specifications. Torque rear main bearing cap bolts to 10-12 ft. lbs. then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing cap bolts to specifications.

8. Measure crankshaft end play with a feeler gage. Force crankshaft forward and measure clearance between the front of the rear main bearing and the crankshaft thrust surface.

9. Install flywheel and torque to specifications. A wood block placed between the crankshaft and cylinder block will prevent crankshaft from rotating.

NOTE: Align dowel hole in flywheel with dowel hole in crankshaft. On vehicles equipped with automatic transmissions, install flywheel with the converter attaching pads towards transmission.

GENERAL DATA:

TYPE		90° V-8 GASOLINE			
DISPLACEMENT	LITRE (*)	5.0 (U)	5.7 (L)	6.6 (R)	7.4 (S)
RPO		LG9	LS9	LF4	LF8
BORE		3.736	4.000	4.125	4.250
STROKE		3.480		3.750	4.000
COMPRESSION RATIO		8.5:1			
FIRING ORDER		1-8-4-3-6-5-7-2			

CYLINDER BORE:

DIAMETER		3.7350-3.7385	3.9995-4.0025	4.1246-4.1274	4.2495-4.2525
OUT OF ROUND	PRODUCTION	.001 MAX.			
	SERVICE	.002 MAX.			
TAPER	PRODUCTION	THRUST SIDE	.0005 MAX.		
		RELIEF SIDE	.001 MAX.		
	SERVICE	.001 MAX.			

PISTON:

CLEARANCE	PRODUCTION	.0007-.0017	.0014-.0024
	SERVICE	.0027 MAX.	.0035 MAX.

PISTON RING:

COMPRESSION	GROOVE CLEARANCE	PRODUCTION	TOP	.0012-.0032	.0017-.0032
			2ND	.0012-.0032	.0017-.0032
		SERVICE	HI LIMIT PRODUCTION + .001		
	GAP	PRODUCTION	TOP	.010-.020	
			2ND	.010-.025	.010-.020
		SERVICE	HI LIMIT PRODUCTION + .010		
OIL	GROOVE CLEARANCE	PRODUCTION	.002-.007	.005-.0065	
		SERVICE	HI LIMIT PRODUCTION + .001		
	GAP	PRODUCTION	.015-.055		
		SERVICE	HI LIMIT PRODUCTION + .010		

* VIN Designation

PISTON PIN

		LG9	LS9	LF4	LF8
DIAMETER		.9270-.9273			.9895-.9898
CLEARANCE	PRODUCTION	.00025-.00035			
	SERVICE	.001 MAX.			
FIT IN ROD		.0008-.0016 INTERFERENCE			

CRANKSHAFT

MAIN JOURNAL	DIAMETER	#1	2.4484-2.4493	#1-2-3-4	2.7485-2.7494
		#2-3-4	2.4481-2.4490	2.6484-2.6493	2.7481-2.7490
		#5	2.4479-2.4488	2.6479-2.6488	2.7478-2.7488
	TAPER	PRODUCTION	.0002 MAX.		
		SERVICE	.001 MAX.		
	OUT OF ROUND	PRODUCTION	.0002 MAX.		
		SERVICE	.001 MAX.		
MAIN BEARING CLEARANCE	PRODUCTION	#1	.0008-.0020	#1-2-3-4	.0013-.0025
		#2-3-4	.0011-.0023	#5	.0024-.0040
		#5	.0017-.0032	#5	.0025-.0035
	SERVICE	#1	.001-.0015	#2-4	.001-.0025
		#5	.006-.010		
CRANKSHAFT END PLAY		.002-.006		.006-.010	
CRANKPIN	DIAMETER	2.0988-2.0998			2.1985-2.1995
		TAPER	PRODUCTION	.0005	
		SERVICE	.001 MAX.		
	OUT OF ROUND	PRODUCTION	.0005		
	SERVICE	.001 MAX.			
ROD BEARING CLEARANCE	PRODUCTION	.0013-.0035		.0009-.0025	
	SERVICE	.0030			
ROD SIDE CLEARANCE		.008-.014		.013-.023	

CAMSHAFT

LOBE LIFT ± .002	INTAKE	.2484	.2600	.2343
	EXHAUST	.2667	.2733	.2343
JOURNAL DIAMETER		1.8682-1.8692		1.9482-1.9492
CAMSHAFT END PLAY		.004-.012		

SPECIFICATIONS

VALVE SYSTEM			LG9	LS9	LF4	LF8
LIFTER			HYDRAULIC			
ROCKER ARM RATIO			1.50:1		1.70:1	
VALVE LASH	INTAKE	ONE TURN DOWN FROM ZERO LASH				
	EXHAUST					
FACE ANGLE (INT. & EXH.)			45°			
SEAT ANGLE (INT. & EXH.)			46°			
SEAT RUNOUT			.002 MAX.			
SEAT WIDTH	INTAKE	1/32-1/16				
	EXHAUST	1/16-3/32				
STEM CLEARANCE	PRODUCTION	INT.	.0010-.0027			
		EXH.	.0010-.0027		.0012-.0029	
	SERVICE	HI LIMIT - .001 INTAKE - .002 EXHAUST				
VALVE SPRING (OUTER)	FREE LENGTH		2.03		2.12	
	PRESSURE LBS. @ IN.	CLOSED	76-84 @ 1.70 INT. @ 1.61 EXH.			74-86 @ 1.88
		OPEN	194-206 @ 1.25 INT. @ 1.16 EXH.			288-312 @ 1.38
	INSTALLED HEIGHT ± 1/32"		1-23/32 INT.	1-19/32 EXH.		1-7/8
DAMPER	FREE LENGTH		1.86			
	APPROX. # OF COILS		4			

TORQUE SPECIFICATIONS

Crankcase Front Cover	.80 lb. in.
Flywheel Housing Cover	.80 lb. in.
Oil Filter Bypass Valve	.80 lb. in.
Oil Pan (To Crankcase) (1/4-20)	.80 lb. in.*
Oil Pan (To Front Cover)	.55 lb. in.@
Oil Pump Cover	.80 lb. in.
Rocker Arm Cover	.45 lb. in.*
Rocker Arm Cover	.50 lb. in.@
Camshaft Sprocket	.20 lb. ft.
Oil Pan To Crankcase (5/16-18)	.165 lb. in.*
Oil Pan To Crankcase (5/16-18)	.135 lb. in.@
Clutch Pressure Plate	.30 lb. ft.
Distributor Clamp	.25 lb. ft.
Flywheel Housing	.30 lb. ft.
Manifold (Exhaust)	.20 lb. ft. ¹
Manifold (Inlet)	.30 lb. ft.
Water Outlet	.30 lb. ft.
Water Pump	.30 lb. ft.
Connecting Rod Cap	.45 lb. ft.*
Connecting Rod Cap	.50 lb. ft.@
Cylinder Head	.65 lb. ft.*
Cylinder Head	.80 lb. ft.@
Main Bearing Cap	.80 lb. ft.* ²
Oil Pump	.65 lb. ft.
Rocker Arm Stud	.50 lb. ft.@
Flywheel	.60 lb. ft.*
Flywheel	.65 lb. ft.@
Torsional Damper	.60 lb. ft.*
Main Bearing Cap	.110 lb. ft.@
Temperature Sending Unit	.20 lb. ft.
Torsional Damper	.85 lb. ft.@
Oil Filter	.25 lb. ft.
Oil Pan Drain Plug	.20 lb. ft.
Spark Plug	.17-27 lb. ft.

* Small block only

@ Mark IV only

¹ Inside bolts on 5.7 (L) 30 lb. ft.

² Intermediate outer bolts are 70 lb. ft.

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SECTION 6A3

5.7 (Z) 350 Diesel

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GENERAL DESCRIPTION

ENGINE CONSTRUCTION

The engine is a 5.7 Litre V-8 four cycle diesel fuel engine. Cylinder numbers 1, 3, 5 and 7 are on the left bank. Cylinder numbers 2, 4, 6 and 8 are on the right bank. The firing order is 1-8-4-3-6-5-7-2. The major difference between a gasoline engine and the diesel is in the cylinder heads, combustion chamber, fuel distribution system, air intake manifold and method of ignition. The cylinder block, crankshaft, main bearings, rods, pistons and pins are of a heavier construction because of the high compression ratio required to ignite diesel fuel. Diesel ignition occurs because of heat developed in the combustion chamber during compression. This eliminates the need for spark plugs and high voltage ignition.

Intake and exhaust valves in the cylinder heads operate the same as in a gasoline engine, but are of a special design and material for diesel operation. The stainless steel pre-chamber inserts in the cylinder head combustion chambers are serviced separately from the head. With the cylinder head removed they can be pushed out after removing the glow plugs and injection nozzles. Glow plugs are threaded, injection nozzles are retained by a bolt and clamp. The injection nozzles are spring loaded and calibrated to open at a specified fuel pressure.

FUEL SYSTEM (Figs. 6A3-1, 2, 3&4)

The diesel fuel injection pump is mounted on top of the engine. It is gear driven off the camshaft and turns at camshaft speed. It is a high pressure rotary pump that injects a metered amount of fuel to each cylinder at the proper time. The eight high pressure delivery pipes from the pump to the injection nozzle in each cylinder are the same length to prevent any difference in timing, cylinder-to-

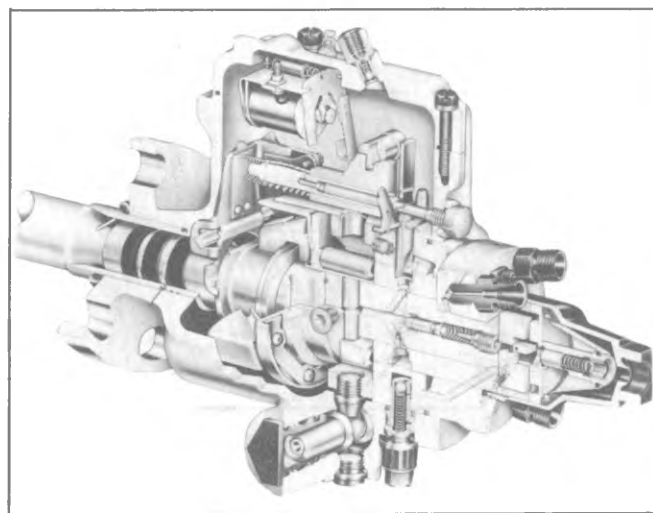


Fig. 6A3-1-Injection Pump-Cutaway

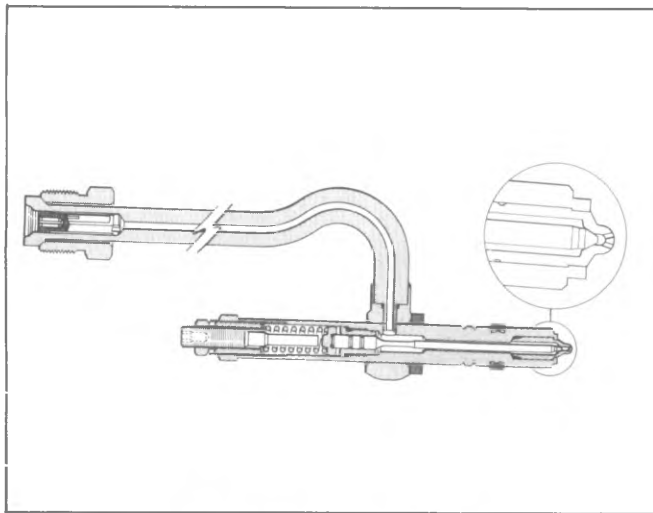


Fig. 6A3-2--Nozzle Cutaway

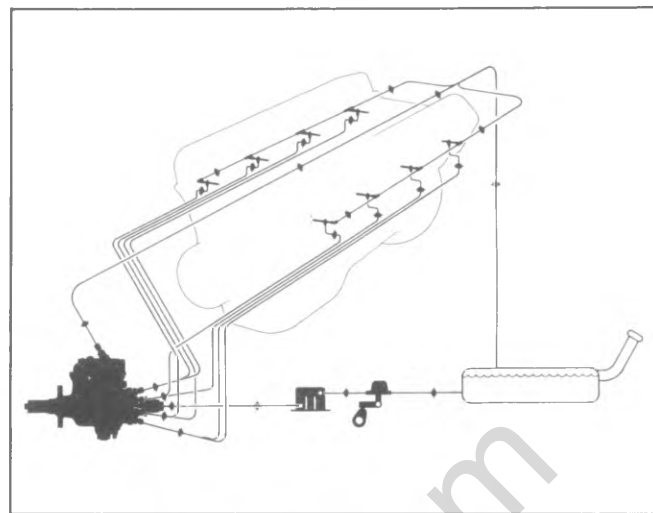


Fig. 6A3-4--System Fuel Circuit

cylinder. The fuel injection pump provides the required timing advance under all operating conditions. Engine RPM is controlled by a rotary fuel metering valve. Pushing down on the accelerator pedal moves the throttle cable to open the metering valve and allow more fuel to be delivered. The injection pump also has a low pressure transfer pump to deliver fuel from the fuel line to the high pressure pump.

The fuel filter is located between the mechanical fuel pump and the injection pump. The diaphragm type mechanical fuel pump is mounted on the right side of the engine and driven by a cam on the crankshaft. The fuel tank is connected by fuel pipes and hoses to the mechanical fuel pump. Excess fuel returns from the fuel injection pump and injection nozzles to the fuel tank through pipes and hoses.

ENGINE LUBRICATION SYSTEM (Fig. 6A3-5)

The engine oil pan forms a reservoir for engine oil to provide lubrication and also hydraulic fluid to operate the valve lifters. Oil pressure for lubrication is furnished by a gear type oil pump that is bolted to the rear main bearing cap and driven by the camshaft gear through a hexagonal drive shaft.

Oil enters the pump through a screened inlet located

near the bottom rear of the oil pan. The pressurized oil from the pump passes through the oil filter located on the right rear side of the engine block. The oil filter vase has a by-pass valve which, in the event of filter restriction, will open at 5.5 to 6.5 psi (38 to 45 kPa). Engine oil is directed to the oil cooler, located in the radiator, then from the cooler to the filter base. The oil then is directed back to the engine oil galleries. A by-pass valve in the filter base allows continuous oil flow to the engine in case of cooler line or cooler restriction. This by-pass valve opens at about 12 psi (83 kPa). Oil then enters the right oil gallery where it is distributed to the five main bearings. The right bank valve lifters receive oil from this gallery from eight feed holes that intersect the gallery.

The five camshaft bearings are lubricated from vertical passages intersecting the main bearing oil passages. At the front main bearing a third passage connects the right main oil gallery to the left gallery which then feeds the left bank of valve lifters.

The injection pump driven gear is lubricated by oil directed through a passage from the top of the front camshaft bearing. An angled passage in the shaft portion

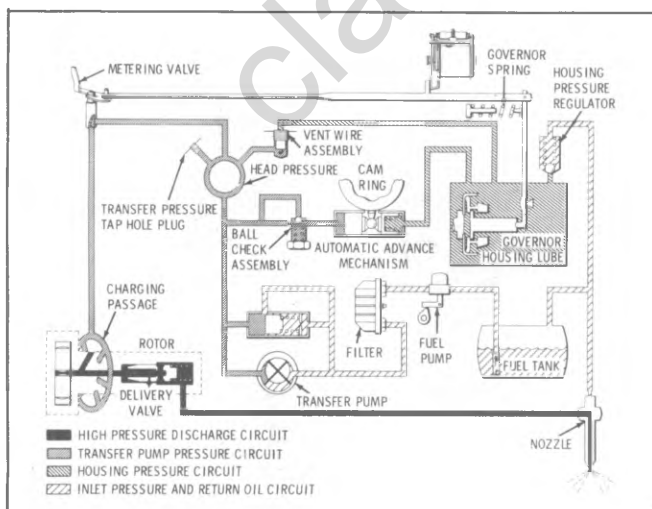


Fig. 6A3-3--Pump Fuel Circuit

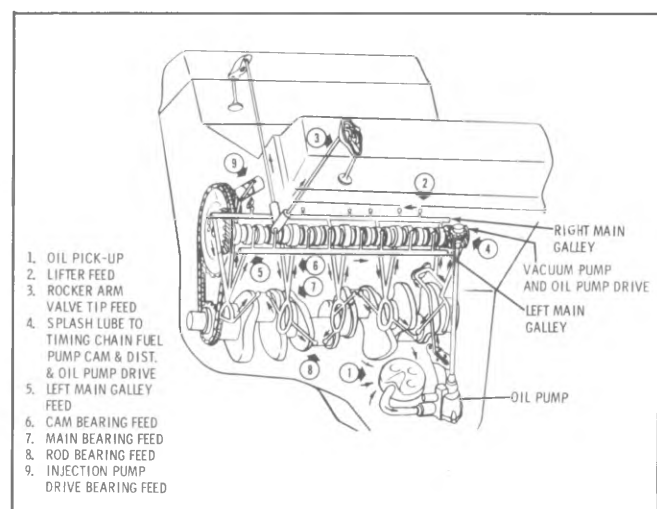


Fig. 6A3-5--Engine Lubrication

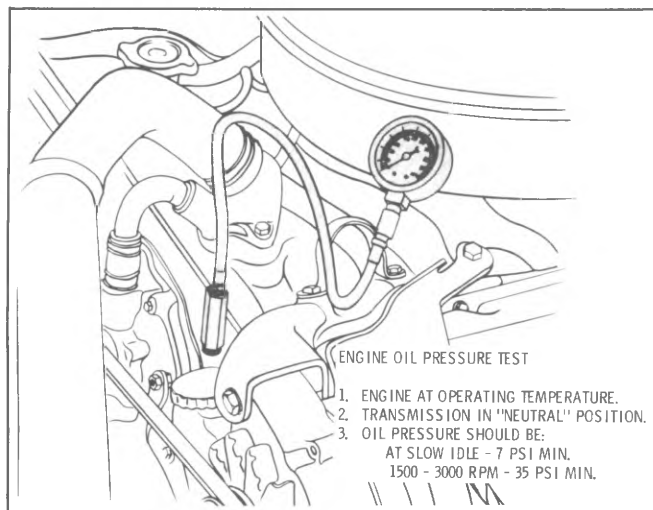


Fig. 6A3-6--Checking Engine Oil Pressure

of the driven gear then directs the oil to the rear driven gear bearing.

The engine oil pressure warning light switch is connected to the front of the left oil gallery. The switch is calibrated to turn on the instrument panel warning light when engine oil pressure is too low. The switch, normally closed, is set to open at 2-6 psi (14 to 41 kPa). The rear oil gallery plug has a .040" orifice to help purge contaminants from the gallery and to lubricate the vacuum pump driven gear.

At the front end of the right gallery, a small orifice sprays oil to lubricate the fuel pump eccentric cam on the crankshaft and the timing chain.

The vacuum pump drive gear is lubricated by oil from the left rear oil gallery.

The rocker arms and valve tips are lubricated by oil furnished through the hydraulic lifters and hollow push-rods. A disc valve in the lifter meters oil to the push rods.

The connecting rod bearings are oiled by constant oil flow from passages drilled through the crankshaft, connecting the main journals to the rod journals. A groove around each main bearing furnishes oil to the drilled crankshaft passages.

Oil returns to the oil pan reservoir from the rocker arms through passages at each end of the cylinder heads. Oil from the valve lifter compartment returns through clearance holes in the lower portion of the compartment

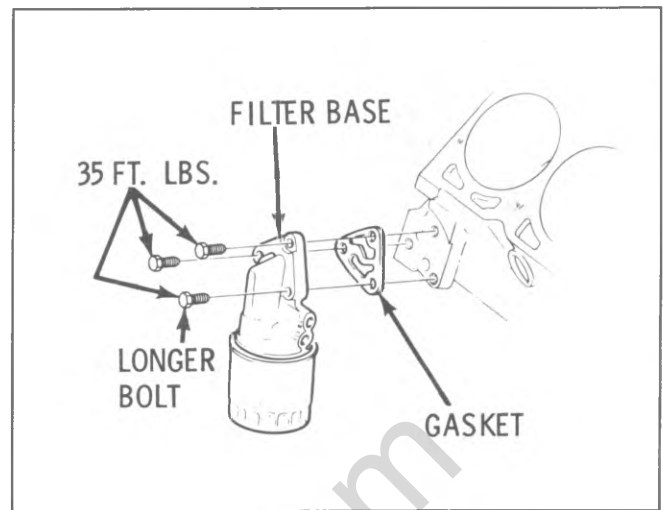


Fig. 6A3-7--Oil Filter Base

near the camshaft. The timing chain compartment drains directly into the oil pan.

NOTE: To check engine oil pressure, See Fig. 6A3-6.

COOLING

Engine cooling is the same as used in gasoline engines except the radiator tank has two oil coolers. One is connected to the transmission, the other one connects into the oil filter base.

ELECTRICAL

Eight glow plugs are used to heat the pre-chamber to aid in starting. They are 12 volt heaters that turn on when the ignition key is turned to the "RUN" position prior to starting the engine. They remain on a short time after starting, then automatically turn off. (The circuit and operation is covered in detail under the subject-Diesel Electrical.) Two 12-volt batteries connected in parallel are required for the higher electrical load due to the glow plugs and starter. The starter is larger and designed to crank the engine at least the 100 RPM required for starting. The two batteries, one on each side in the engine compartment, provide the required capacity and eliminates the need for a single double size special battery. A standard generator supplies charging current to both batteries at the same time. There are no switches or relays in the charging circuit.

ON VEHICLE SERVICE

OIL FILTER BASE (Fig. 6A3-7)

Removal

1. Remove oil cooler lines.
2. Bend exhaust manifold lock tabs away from bolts.
3. Hoist vehicle.
4. Disconnect exhaust system from exhaust manifold.
5. Remove exhaust manifold.
6. Remove oil filter base retaining bolts and remove base.

Installation

If a new oil filter element is installed, add one quart of oil. Clean sealing surfaces and re-bend manifold bolt lock tabs. Start engine, check for leaks and proper oil level. Torque oil filter base attaching bolts to 35 lbs. ft. (47N·m) and exhaust manifold bolts to 25 lbs. ft. (34N·m).

ENGINE MOUNTING

Refer to Fig. 6A3-8.

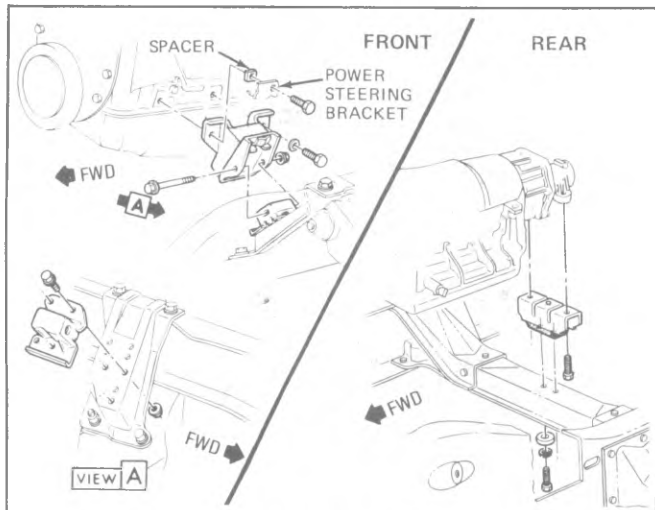


Fig. 6A3-8--Engine Mounts

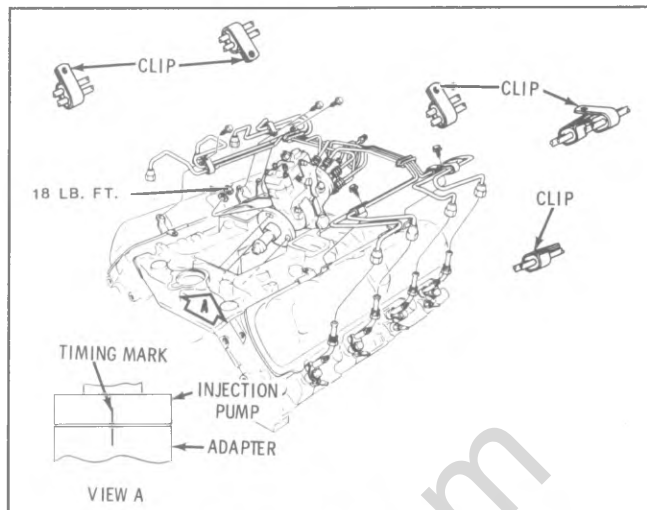


Fig. 6A3-10--Timing Mark & Injection Pump Lines

EXHAUST MANIFOLD

Left Hand Side

Removal and Installation

1. Remove air cleaner and install air crossover screened cover J-26996-1.
2. Remove lower generator bracket.
3. Hoist vehicle.
4. Remove exhaust pipe at manifold flange.
5. Lower vehicle.
6. Remove exhaust manifold from above.

To install, reverse removal procedure. Refer to Fig. 6A3-9 for proper bolt torque.

Right Hand Side

Removal and Installation

1. Hoist vehicle.
2. Disconnect exhaust pipe at manifold flange.
3. Remove exhaust manifold.

To install, reverse removal procedure. See figure 6A3-9 for proper bolt torque.

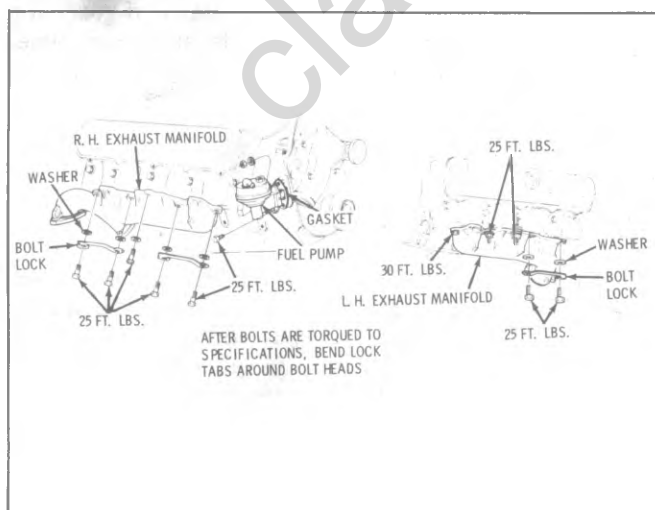


Fig. 6A3-9--Exhaust Manifold Bolts

CHECKING OR ADJUSTING TIMING

Checking (Fig. 6A3-10) ♦

For the engine to be properly timed, the marks on the top of the injection pump adapter and the flange of the injection pump must be aligned.

NOTE: The engine must be off when the timing is reset.

Adjusting

If the marks are not aligned, adjustment is necessary.

1. Loosen the three pump retaining nuts with tool J-26987.
2. Align the mark on the injection pump with the marks on the adapter and tighten nuts. Torque to 35 lbs. ft. (47N·m).

NOTE: Use a 3/4" end wrench on the boss at the front of the injection pump to aid in rotating the pump to align the marks.

3. Adjust throttle rod (See "LINKAGE ADJUSTMENT").

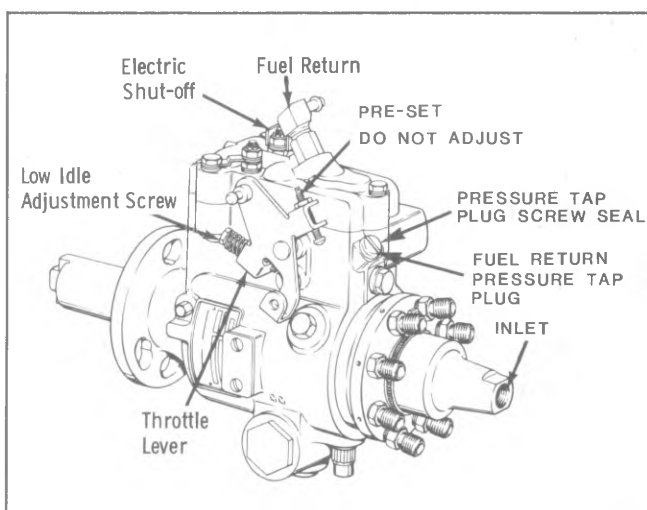


Fig. 6A3-11--Injection Pump Slow Idle Screw

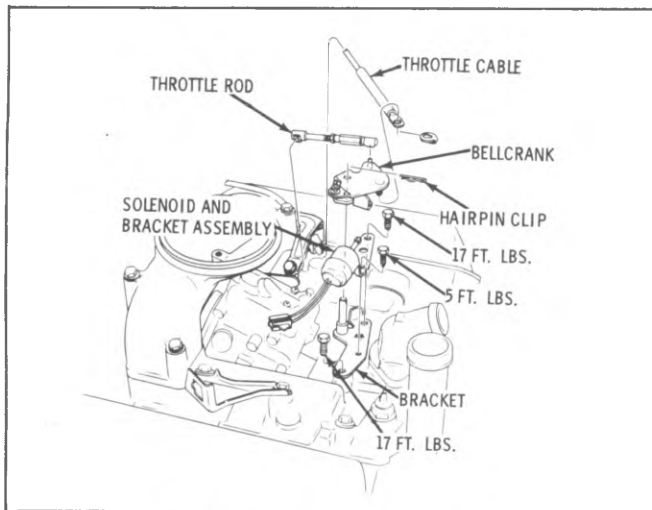


Fig. 6A3-12--Throttle Linkage

LINKAGE ADJUSTMENTS (Figs 6A3-11 and 12)

1. Check timing, adjust if necessary (engine OFF).

2. Throttle rod adjustment: (Engine OFF)

a. With the transmission vacuum regulator valve already installed, loosen the locknut on the throttle rod, then shorten the rod several turns.

b. Rotate the bellcrank to the full throttle stop, then lengthen the throttle rod until the injection pump lever contacts the injection pump full throttle stop. Release the bellcrank.

c. Tighten the throttle rod locknut.

3. Idle adjustment.

NOTE: To check idle speeds, it will be necessary to insert the probe of the magnetic pickup tach. J-26925 in the timing indicator hole.

a. With the driving wheels blocked and the parking brake on, adjust the slow idle screw on the injection pump to 575 RPM (Drive range, A/C OFF).

4. Idle Solenoid Adjustment: (Engine ON).

a. With the driving wheels blocked and the parking brake on, adjust the idle solenoid plunger to 650 RPM, Drive range, A/C ON and compressor wires disconnected.

Transmission Vacuum Regulator Valve

Removal

1. Remove air cleaner and install screened cover J-26996-1.

2. Remove the two hoses from the valve, noting the locations.

3. Remove the two attaching bolts and remove valve.

Installation

1. Disconnect throttle rod and return spring from pump throttle lever.

2. Rotate cam of regulator valve until cam is in W.O.T. position. Using a .090" diameter rod, such as from carburetor gage kit, pin the cam so as to maintain the W.O.T. position.

3. Loosely install the vacuum regulator valve to the pump using the two attaching bolts.

4. Rotate pump throttle lever to the W.O.T. position and hold there.

5. Rotate vacuum regulator valve clockwise until throttle shaft pin contacts cam drive surface.

6. Tighten two attaching bolts to 75 lb. in. (8 N·m).

7. Remove locking rod from valve and release injection pump from W.O.T. position.

8. Connect two vacuum hoses to valve.

9. Connect throttle rod and return spring to throttle lever and check adjustment.

10. Remove screened cover J-26996-1 and install air cleaner.

Checking Injection Pump Housing Fuel Pressure

1. Remove the pressure tap plug.

2. Put the seal from the pressure tap plug on the pressure tap adapter J-28526, then screw the adapter into the pump housing.

3. Attach a low pressure gage to the adapter.

4. Install magnetic pick-up tachometer J-26925.

5. Check the pressure with the engine running at 1000 RPM. The pressure should be 8-12 PSI with not more than 2 PSI fluctuation.

6. If the pressure is incorrect, replace the fuel return line connector assembly.

7. Recheck the pressure. If still incorrect, remove the injection pump for repair.

8. Remove the tachometer, pressure gage and adapter.

9. Put a new pressure tap plug seal on the plug and screw in the plug.

INJECTION PUMP FUEL LINES (Fig. 6A3-10)

NOTE: When lines are to be removed, clean all line fittings thoroughly before loosening. Immediately cap all lines, nozzles and pump fittings to maintain cleanliness.

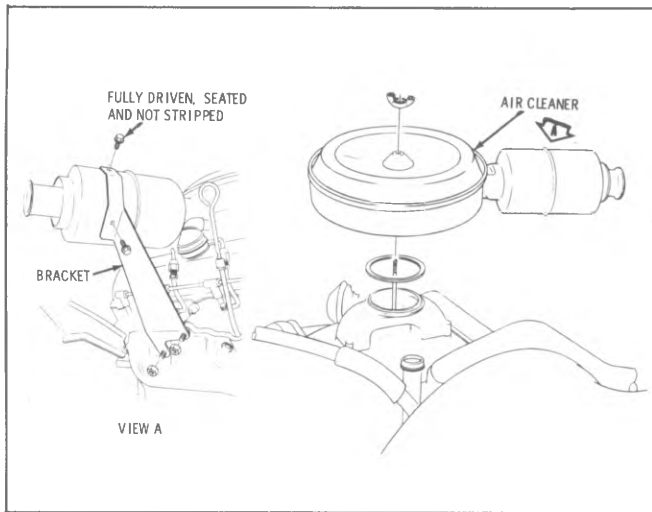


Fig. 6A3-13--Air Cleaner Attachment

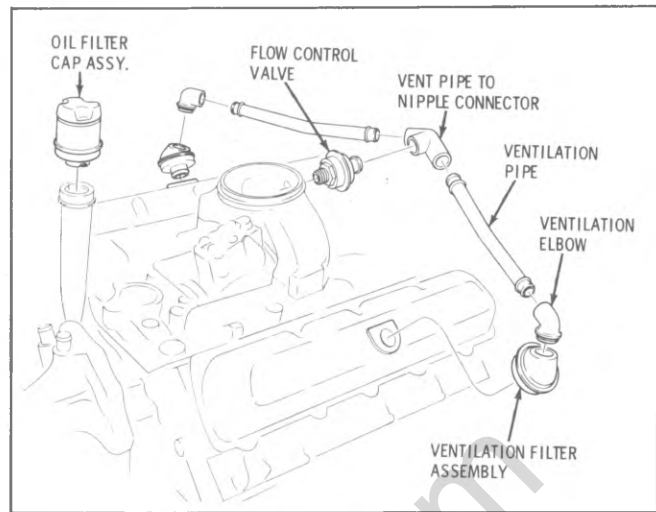


Fig. 6A3-15--Ventilation System

Removal

NOTE: All lines may be removed without removing injection pump. It is not necessary to use a back-up wrench when removing the lines from pump.

1. Remove air cleaner. (Fig. 6A3-13).
2. Remove filters and pipes from valve covers and air crossover.
3. Remove air crossover and cap intake manifold with J-26996-2 screened covers.
4. Remove injection pump line clamps, then remove the injection pump lines and cap open lines, nozzles, and pump fittings.

Installation

1. Install new injection pump line, install loose then torque both ends. Torque pump end to 35 lbs. ft. (47N·m) and nozzle end to 25 lbs. ft. (34 N·m) then install clamps.
- NOTE:** If several lines are to be replaced, start with the bottom lines.
2. Start engine and check for fuel leaks.
3. Remove screened covers J-26996-2 from intake manifold and install air crossover. (Fig. 6A3-14).
4. Connect pipes to flow control valve in air crossover

and ventilation filters in the valve covers. (Fig. 6A3-15).
5. Install air cleaner.

INJECTION PUMP AND LINES

Removal

1. Remove air cleaner.
2. Remove filters and pipes from valve covers and air crossover.
3. Remove air crossover and cap intake manifold with J-26996-2 screened covers.
4. Disconnect throttle rod and return spring. (Figs. 6A3-16 and 6A3-17).
5. Remove bellcrank.
6. Remove throttle cable from intake manifold brackets. Position cable away from engine.
7. Remove lines to fuel filter, then remove fuel filter and bracket. (Fig. 6A3-18).
8. Disconnect fuel line at fuel pump.
9. Disconnect the fuel return line from the injection pump.
10. Using two wrenches, disconnect injection pump lines at the nozzles.

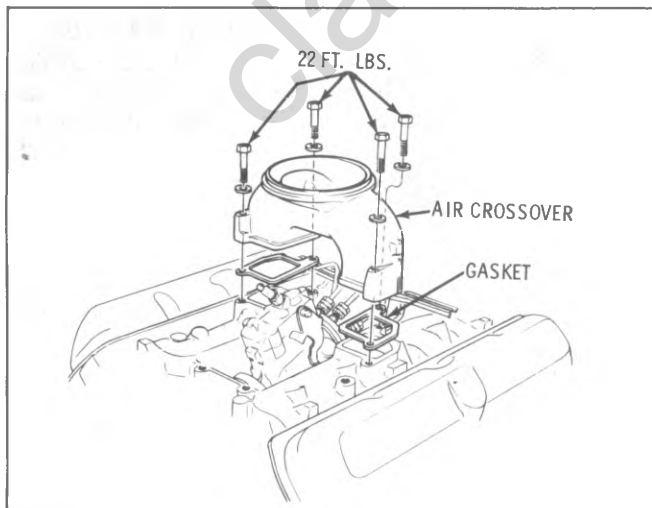


Fig. 6A3-14--Air Crossover

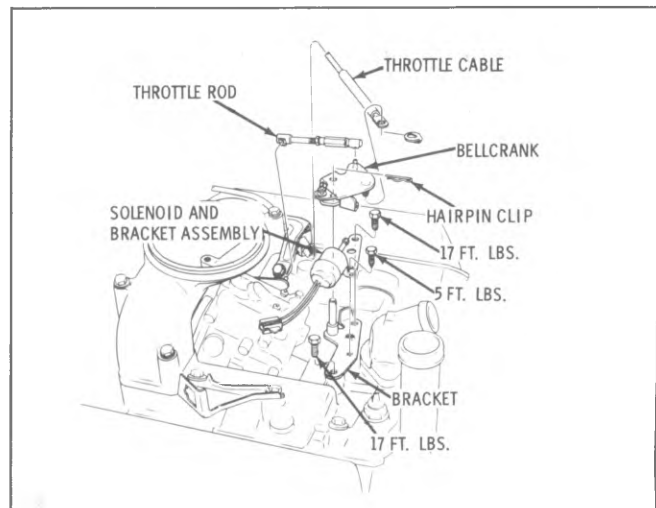


Fig. 6A3-16--Throttle Linkage

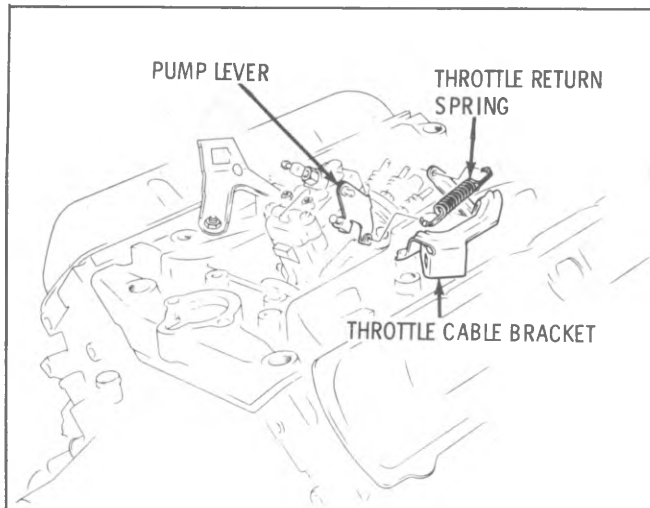


Fig. 6A3-17--Throttle Return Spring

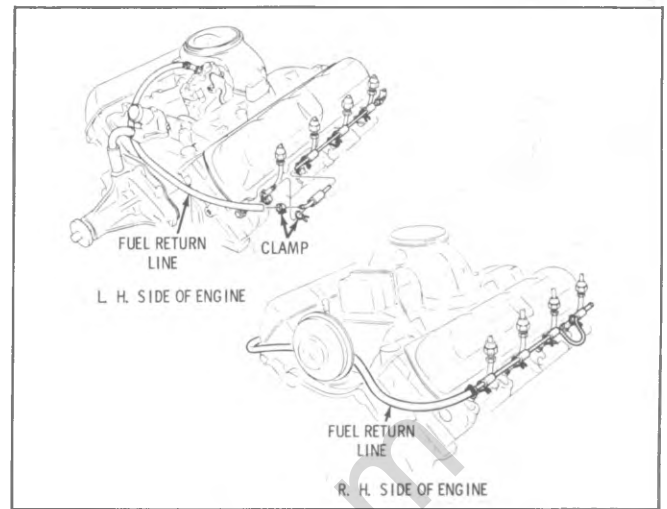


Fig. 6A3-19--Fuel Return Lines

11. Remove 3 nuts retaining injection pump, using tool J-26987.

12. Remove pump and cap all open lines and nozzles.

Installation

1. Remove protective caps then line up offset tang on pump driveshaft with the pump driven gear and install pump.

2. Install 3 nuts and lock washers retaining injection pump, do not tighten. Connect injection pump lines at nozzles, then tighten, using two wrenches. Torque to 25 lbs. ft. (34 N·m).

3. Connect fuel return lines to the injection pump.

4. Align mark on injection pump with line on adapter and tighten nuts. Torque to 18 lbs. ft. (24N·m).

NOTE: Use a 3/4" end wrench on the boss at the front of the injection pump to aid in rotating the pump to align the marks.

5. Adjust the throttle rod. (See LINKAGE ADJUSTMENT).

6. Install fuel line from fuel pump to fuel filter.

7. Install bellcrank and hairpin clip.

8. Install throttle cable to intake manifold and attach

to bellcrank.

9. Connect throttle rod and return spring.

10. Start engine and check for fuel leaks.

11. Remove screened covers J-26996-2 from intake manifold then install air crossover.

12. Install tubes in flow control valve in air crossover and ventilation filters in the valve covers.

13. Install air cleaner.

INJECTION PUMP ADAPTER AND SEAL

Removal

1. Refer to "INJECTION PUMP AND LINES" removal.

2. Remove injection pump adapter.

3. Remove seal from injection pump adapter.

Installation

NOTE: Follow steps 3, 4 5 when only the injection pump seal is being replaced.

1. File mark off from injection pump adapter.

NOTE: DO NOT FILE MARK FROM PUMP.

2. Position engine on No. 1 cylinder T.D.C. Align mark on balancer with zero mark on indicator. Refer to Fig. 6A3-

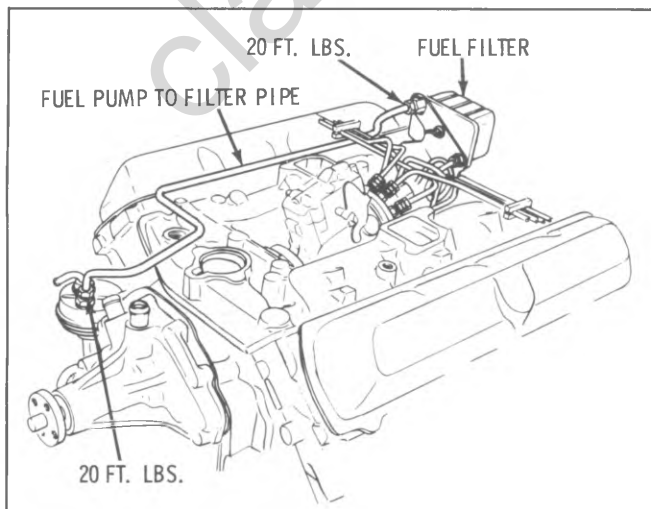


Fig. 6A3-18--Fuel Filter & Lines

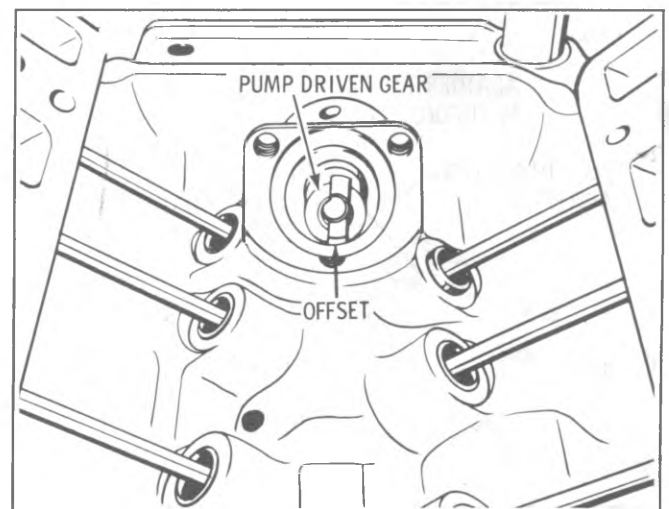


Fig. 6A3-20--Offset on Pump Driven Gear

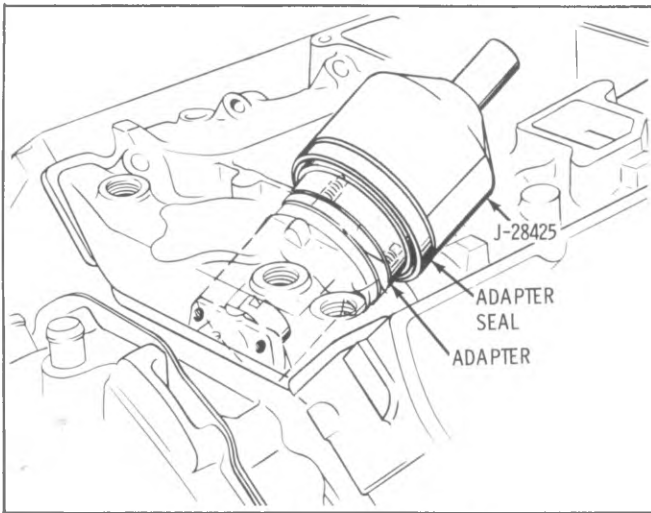


Fig. 6A3-21--Installing Adapter Seal

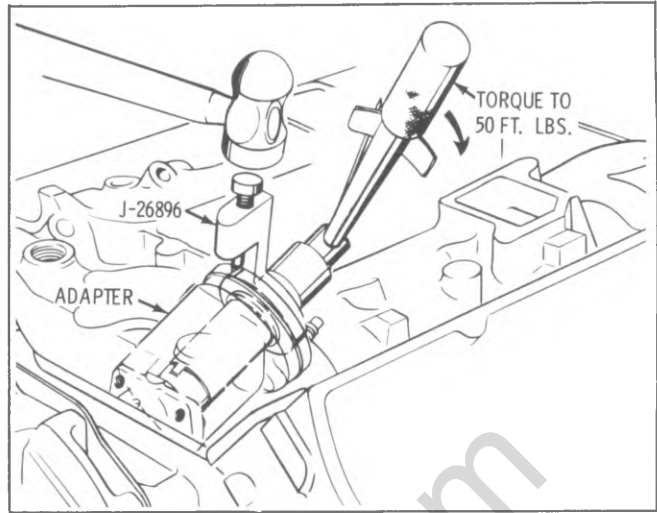


Fig. 6A3-23--Marking Injection Pump Adapter

20 for position of injection pump driven gear. (The index is offset to the right when number one is a T.D.C.).

3. Apply chassis lube to seal area on adapter, tapered edge and seal area in intake manifold then install adapter. Leave loose.

4. Apply chassis lube to I.D. and O.D. of adapter seal and to seal installing tool J-28425. Install seal on tool.

5. Push seal on injection pump adapter with tool J-28425 (fig. 6A3-21).

6. Remove tool and inspect to see if seal is properly positioned.

7. Torque adapter bolts to 25 lbs. ft. (34 N·m) (Fig. 6A3-22).

8. Install Timing Tool, J-26896, into injection pump adapter. Torque Tool toward cylinder No. 1 to 50 lb. ft. (68 N·m). While holding torque, mark injection pump adapter. Remove tool. (See Fig. 6A3-23).

9. Refer to "INJECTION PUMP AND LINES" for installation.

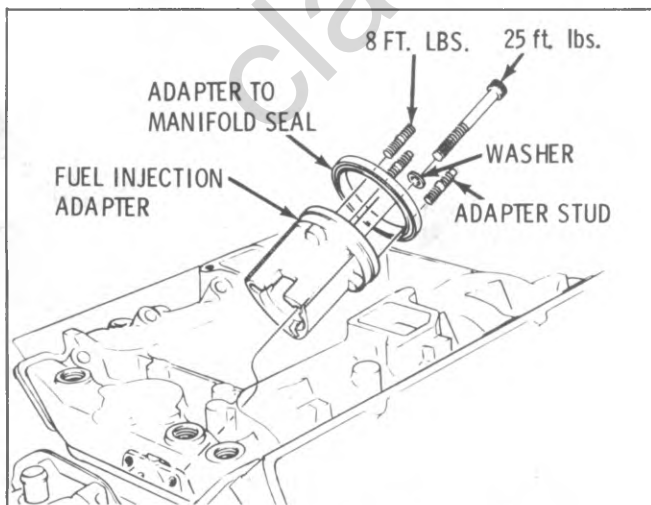


Fig. 6A3-22--Injection Pump Adapter Bolts

VALVE COVER

Removal

1. Refer to "INJECTION PUMP AND LINES" for removal of lines.

2. Remove valve cover to cylinder head attaching screws. Remove accessory mounting brackets as necessary and remove valve cover.

Installation

1. Thoroughly clean the head and valve cover sealing surfaces. Apply #1051435 RTV sealer (or equivalent) to the valve cover. (Fig. 6A3-24).

2. Install valve cover and screws so they are fully seated and not stripped. Install any mounting brackets which were removed. (Fig. 6A3-25).

3. Refer to "INJECTION PUMP AND LINES" for installation of lines.

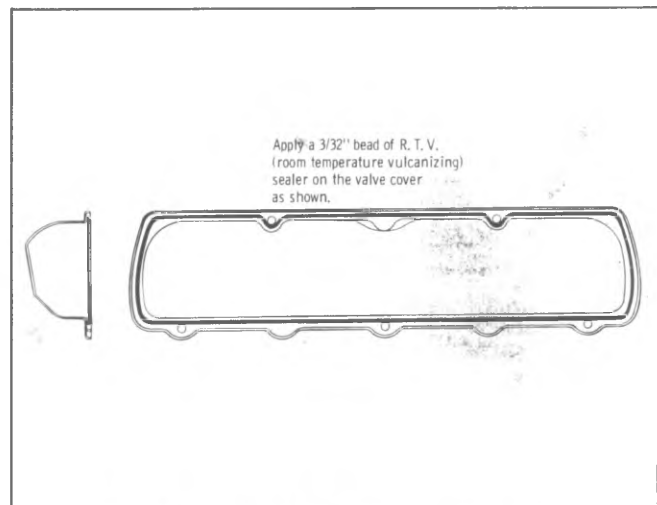


Fig. 6A3-24--Applying Sealer on Valve Cover

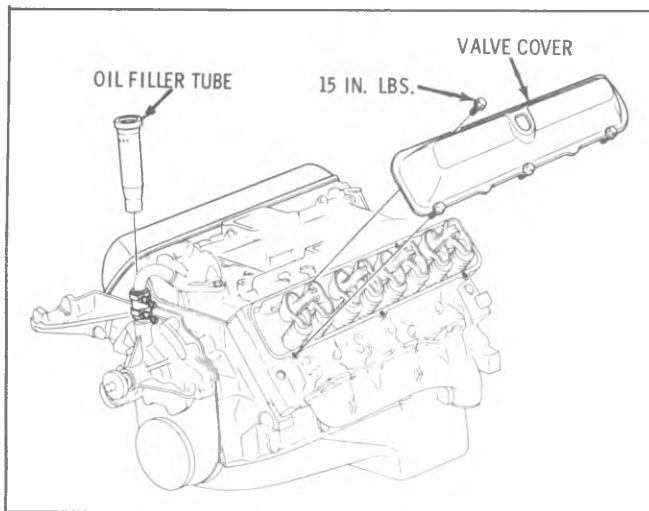


Fig. 6A3-25--Valve Cover

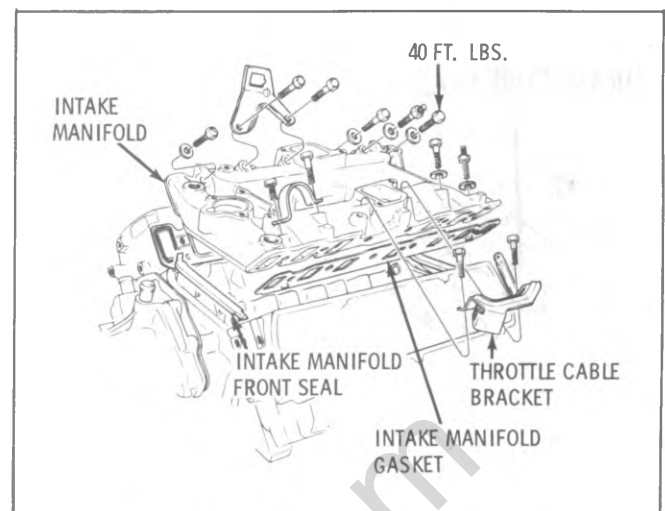


Fig. 6A3-26--Intake Manifold & Gasket

INTAKE MANIFOLD

Removal

1. Remove air cleaner assembly.
 2. Drain radiator, loosen upper bypass hose clamp, remove thermostat housing bolts and remove thermostat housing.
 3. Remove breather pipes from valve covers and air crossover.
 4. Remove air crossover and cap intake manifold with J-26996-2 screened covers.
 5. Disconnect throttle rod and return spring. If equipped with cruise control, remove servo.
 6. Remove hairpin clip at bellcrank and disconnect cables, then remove throttle cable from bracket on the intake manifold and position cable away from engine.
 7. Disconnect wiring as necessary.
 8. Remove generator and/or air conditioning compressor brackets as necessary.
 9. Disconnect fuel line from fuel pump and fuel filter and remove fuel filter and bracket.
 10. Disconnect high pressure lines at nozzles and remove injection pump and cap all open lines and fittings on injection pump, filter and nozzles.
- NOTE: DO NOT BEND INJECTION PUMP LINES.**
11. Disconnect fuel return line from injection pump.
 12. Disconnect vacuum lines at vacuum pump and remove vacuum pump.
 13. Remove drain tube.
 14. Remove intake manifold bolts, then remove intake manifold. Remove adapter seal.
 15. Remove injection pump adapter.
 16. Clean machined surfaces of cylinder head and intake manifold with a putty knife. Use care not to gouge or scratch machined surfaces.

Installation

1. Coat both sides of gasket sealing surface that seal the intake manifold to the head with #1050805 sealer or equivalent and position intake manifold gasket. (Fig. 6A3-26).
2. Install end seals, making sure that ends are positioned under cylinder heads.

3. Position intake manifold on engine.
4. Dip intake manifold bolt in engine oil and torque in sequence shown to 15 lbs. ft. (20 N·m). Then re-torque to 40 lbs. ft. (Fig. 6A3-27).
5. Install drain tube (Fig. 6A3-28).
6. Apply chassis lube to seal area on adapter, taper edge and seal area in intake manifold then install injection pump adapter - leave loose.
7. Apply chassis lube to I.D. and O.D. of adapter seal and to seal installing tool J-28425. Install seal on tool.
8. Push seal on injection pump adapter with tool J-28425 (fig. 6A3-29).
9. Remove tool and inspect to see if properly positioned.
10. Torque adapter bolts to 25 lbs. ft. (34 N·m).
11. Remove caps from injection pump lines. Align offset tang on pump drive shaft with offset in pump driven gear then install injection pump. Connect injection pump lines to nozzles. Align mark on injection pump with mark on adapter.

NOTE: Use a 3/4" end wrench on the boss at the front of the injection pump to aid in rotating the pump to

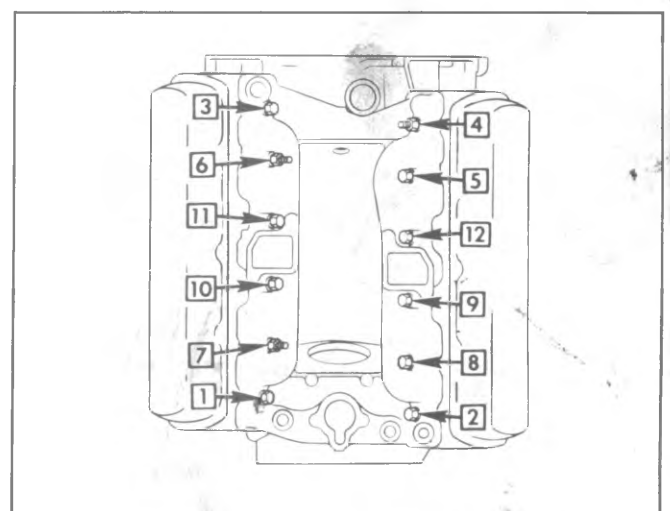


Fig. 6A3-27--Intake Manifold Torque Sequence

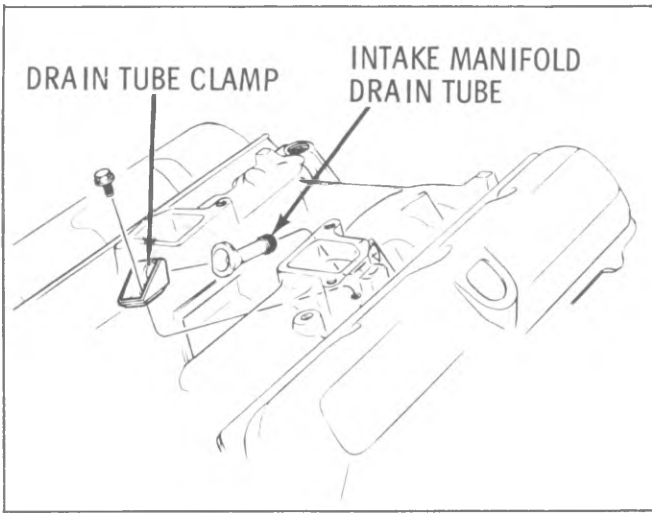


Fig. 6A3-28--Intake Manifold Drain Tube

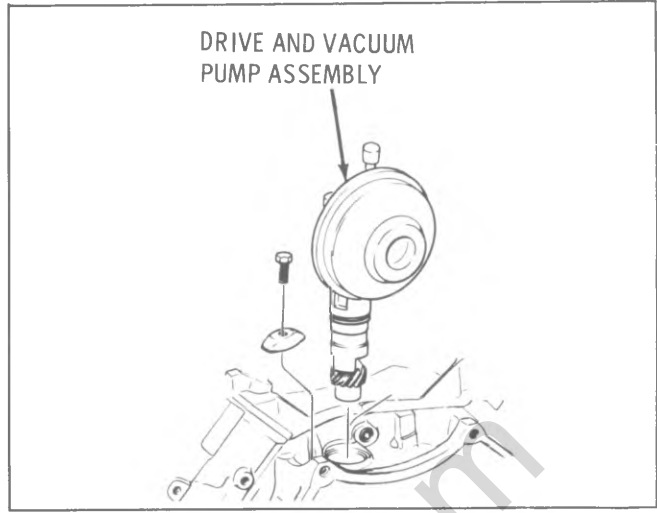


Fig. 6A3-30--Drive & Vacuum Pump

- align the marks.
- 12. Install fuel filter bracket and filter, then connect fuel lines.
- 13. Connect the fuel return line to the injection pump.
- 12. Install vacuum pump and vacuum lines. (Fig. 6A3-30).

CAUTION: Do not operate engine without vacuum pump assembly, as this is the drive for the engine oil pump.

- 15. Connect wiring.
- 16. Install and/or connect generator and air conditioning compressor brackets as necessary.
- 17. Install cable in cable bracket and bellcrank, then install bellcrank to intake manifold.
- 18. Connect throttle rod and return spring.
- 19. Start engine and check for fuel leaks.
- 20. Remove screened covers J-26996-2 from intake manifold.
- 21. Install air crossover.
- 22. Install breather tubes from valve cover filters and flow control valve at the air crossover.
- 23. Connect upper radiator hose and heater hose.

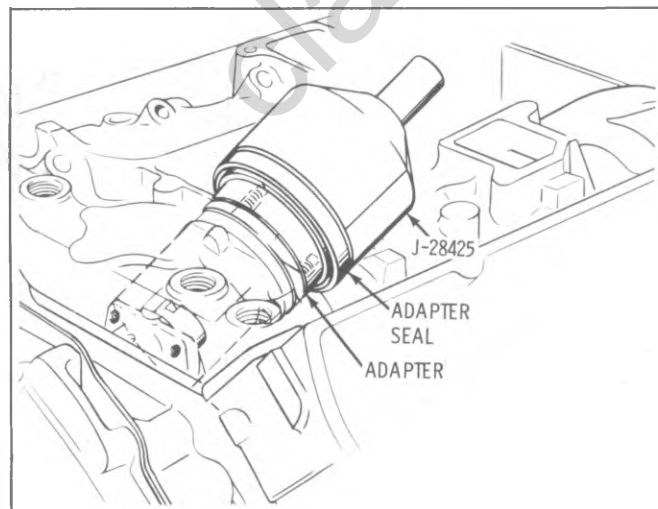


Fig. 6A3-29--Installing Adapter Seal

- 24. Fill cooling system.
- ROCKER ARM ASSEMBLIES (Figs. 6A3-31 & 6A3-32)**
- Removal**
1. Remove air cleaner and install screened cover J-26996-1.
 2. Remove high pressure fuel lines to nozzles.
 3. Remove valve cover.
 4. Remove rocker arm flanged bolts, pivots and rocker arms.
- NOTE:** Remove each set (one set per cylinder) as a

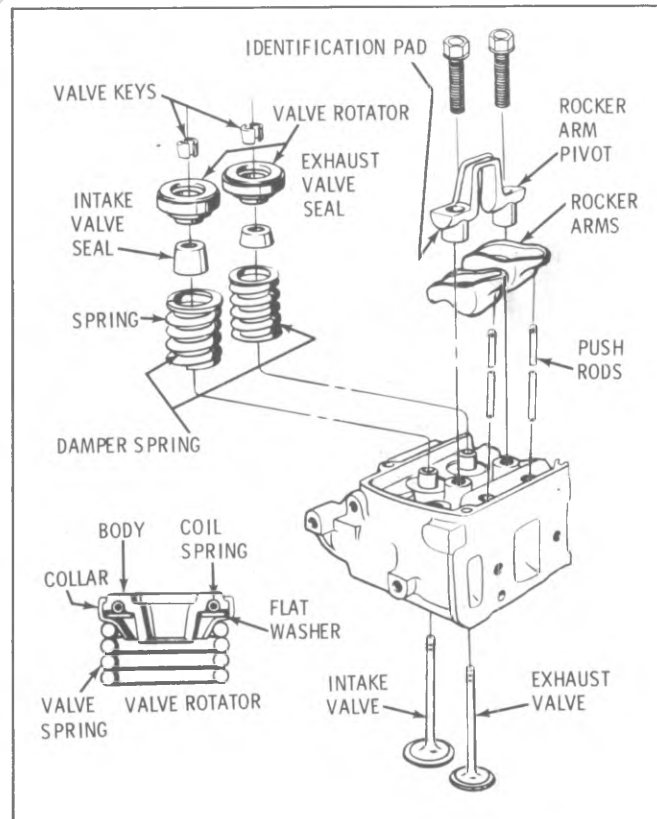


Fig. 6A3-31--Cylinder Head-Exploded View

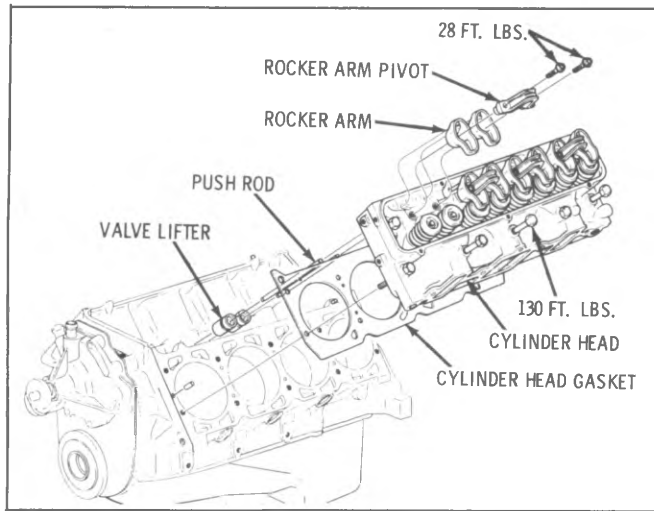


Fig. 6A3-32--Removing Rocker Arms

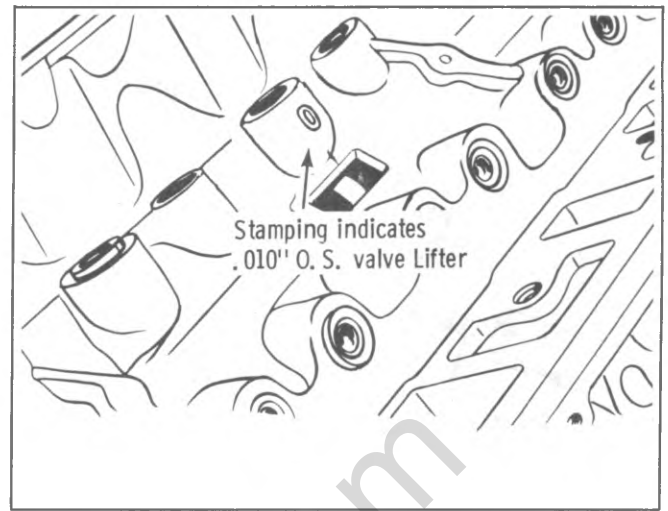


Fig. 6A3-34--O.S. Valve Lifter Identification

unit.

Installation

1. Position a set of rocker arms (for one cylinder) in the proper location.

NOTE: Refer to "Valve Lifter Bleed Down" as lifters must be bled down as possible valve to piston interference, due to close tolerances, could exist.

2. Lubricate wear points with 1050169 lubricant or equivalent and install the pivots.

3. Install the hardened flanged bolts and tighten alternately. Torque bolts to 25 lbs. ft. (34 N·m).

VALVE LIFTERS

Operation

Oil is supplied to the lifter through a hole in the side of the lifter body which indexes with a groove and hole in the lifter plunger. Oil is then metered past the oil metering valve in the lifter, through the push-rods to the rocker arms. (Fig. 6A3-33).

When the lifter begins to ride up the cam lobe, the check valve disc is held against its seat in the plunger by the check valve disc spring which traps the oil in the base

of the lifter body below the plunger. The plunger and lifter body then raise as a unit, pushing up the push-rod to open the valve. The force of the valve spring which is exerted on the plunger through the rocker arm and push-rod causes a slight amount of leakage between the plunger and lifter body. This "leak-down" allows a slow escape of trapped oil in the base of the lifter body. As the lifter rides down the other side of the cam lobe and reaches the base circle or "valve closed" position, the plunger spring quickly moves the plunger back (up) to its original position. This movement causes the check valve disc to open against the check valve disc spring and oil from within the plunger is drawn into the base of the lifter. This restores the lifter to zero lash.

NOTE: Hydraulic valve lifters are not the same as used in gasoline engines.

Removal

NOTE: Valve lifters and push-rods should be kept in order so they can be reinstalled in their original position. Some engines will have both standard and .010" oversize valve lifters. The .010" oversize lifter is etched "0" on the side of the lifter. The cylinder block will also be marked if the oversize lifter is used. (Fig. 6A3-34).

1. Refer to "INTAKE MANIFOLD" for removal.
2. Remove valve covers, rocker arm assemblies and push-rods.
3. Remove valve lifters.

Disassembly

1. Remove the retainer ring with a small screwdriver.
2. Remove push-rod seat and oil metering valve.
3. Remove plunger and plunger spring.
4. Remove check valve retainer from plunger, then remove valve and spring.

Cleaning and Inspection

After lifters are disassembled, all parts should be cleaned in clean solvent. A small particle of foreign material under the check valve will cause malfunctioning of the lifter. Close inspection should be made for nicks, burrs or scoring of parts. If either the body or plunger is defective, replace with a new lifter assembly.

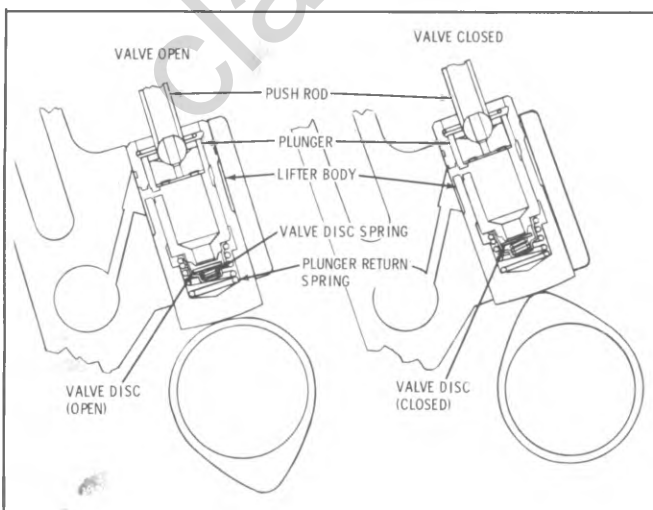


Fig. 6A3-33--Valve Lifter-Cutaway View

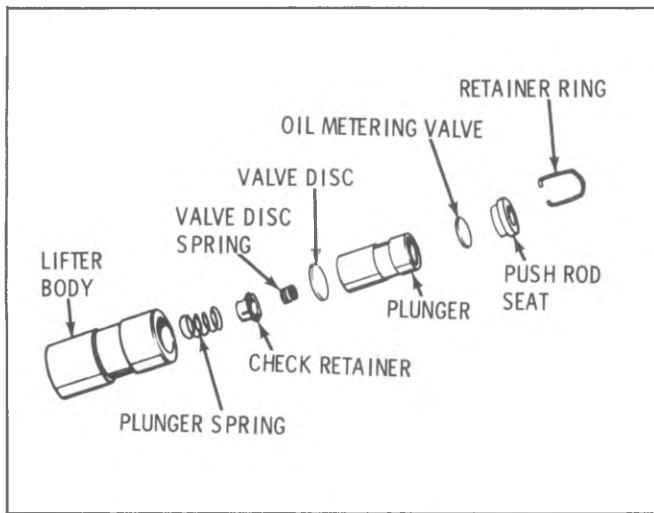


Fig. 6A3-35--Valve Lifter-Exploded View

Whenever lifters are removed, check the lifter foot for abnormal wear as follows:

1. Place a straight edge across the lifter foot.

NOTE: Lifter foot must be clean and dry.

2. While holding the lifter at eye level, check for light between the straight edge and lifter foot.

3. If light indicates a concave surface of the lifter foot, the lifter should be replaced and the camshaft inspected for wear. Wear at the CENTER of the cam base circle is **NORMAL**. The camshaft should be replaced **ONLY** when wear is present across **FULL WIDTH** of cam base circle. Full wear across the nose of the cam is normal.

NOTE: Assembly and Valve Lifter Leak Down Test.

4. Assemble valve disc spring and retainer into plunger. (Fig. 6A3-35). Make sure retainer flange is pressed tight against bottom of recess in plunger.

5. Install plunger spring over check retainer.

6. Hold plunger with spring up and insert into lifter body. Hold plunger vertically to prevent cocking spring.

7. Assemble oil metering valve and push rod seat and seat retaining ring in groove.

NOTE: Lifters must be assembled while submerged in

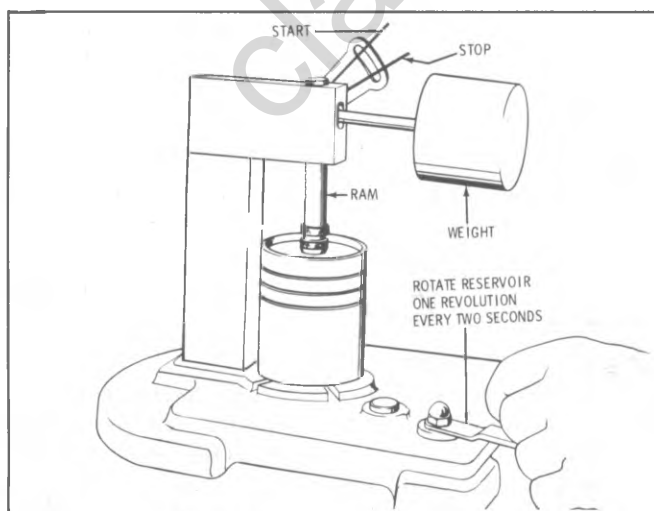


Fig. 6A3-36--Valve Lifter Testing

kerosene or diesel fuel and leak-down tested before placing into service.

8. Fill tester J-5790 with kerosene to 1/2" below top of reservoir.

9. Place assembly into the tester cup, then position oil control valve and push-rod seat onto plunger.

10. Position the 1/4" steel ball on the push-rod seat. Lower tester ram until it contacts the steel ball.

11. Allow ram to move downward by its own weight until air bubbles disappear.

12. Raise ram, then allow to lower. Repeat this procedure several times or until all air is expelled from lifter.

NOTE: Do not attempt to expel air from lifter by pumping on ram.

13. After all air is expelled, allow ram to bleed down lifter until retaining groove is exposed.

14. Install retaining ring.

15. Adjust ram screw so that it contacts the steel ball in the push-rod seat when the pointer is at the start line.

16. Raise arm, then start test by resting ram on steel ball. Rotate reservoir one revolution every two seconds and time the indicator from the start to the stop line. (Fig. 6A3-36). Allowable leak-down rate is 6 seconds minimum for used lifters and 9 to 60 seconds for new lifter.

17. If leak-down tolerance is within specifications, remove test fluid before placing lifter in service.

BLEED DOWN

If the intake manifold has been removed and if any rocker arms have been loosened or removed; it will be necessary to remove those valve lifters, disassemble, drain the engine oil then reassemble the lifters. See "VALVE LIFTER DISASSEMBLY".

If the intake manifold has not been removed but rocker arms have been loosened or removed, valve lifters can be bled down by the following procedure:

1. For cylinders number 3, 5, 7, 2, 4 & 8 turn the crankshaft so the saw slot on the harmonic balancer is a 0° on the timing indicator. For cylinders number 1, 3, 7, 2, 4 & 6 turn the crankshaft so the saw slot on the harmonic balancer is at 4 O'Clock.

2. Tighten the rocker arm pivot bolts to 25 lbs. ft. (34 N·m).

NOTE: It will take up to 45 minutes at each position for the valve lifters to be completely bled down.

CAUTION: Do not rotate the engine until the valve lifters have been bled down, or damage to the valve train could occur.

3. Finish reassembling the engine as the lifters are being bled.

Diagnosis

1. Momentarily Noisy When Car Is Started:

This condition is normal. Oil drains from the lifters which are holding the valves open when the engine is not running. It will take a few seconds for the lifters to fill after the engine is started.

2. Intermittently Noisy On Idle Only, Disappearing When Engine Speed Is Increased:

Intermittent clicking may be an indication of a pitted check valve disc, or it may be caused by dirt.

Correction: Clean the lifter and inspect. If check valve disc is defective, replace lifter.

3. Noisy At Slow Idle Or With Hot Oil, Quiet With

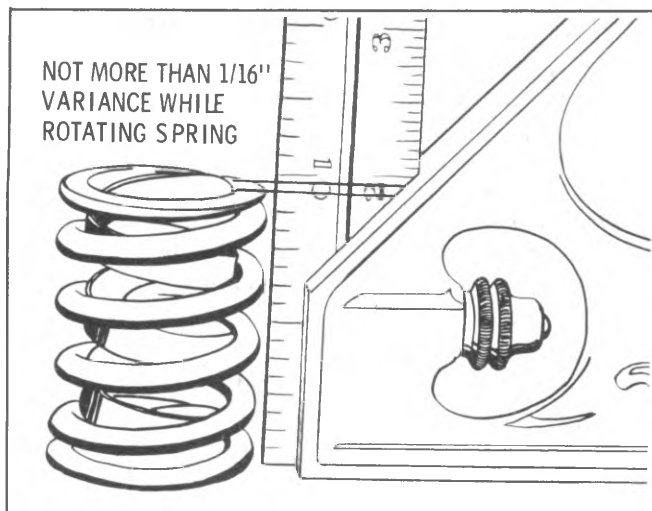


Fig. 6A3-37--Checking Valve Spring

Cold Oil Or As Engine Speed Is Increased:

Leak check the suspected lifters and replace any lifters that do not meet specifications.

4. Noisy At High Car Speeds And Quiet At Low Speeds:

a. High oil level-Oil level above the "Full" mark allows crankshaft counterweights to churn the oil into foam. When foam is pumped into the lifters, they will become noisy since a solid column of oil is required for proper operation.

Correction: Drain oil until proper level is obtained. See PERIODIC MAINTENANCE Section.

b. Low oil level - Oil level below the "Add" mark allows air to the pump at high speeds which results in noisy lifters.

Correction: Fill until proper oil level is obtained. See PERIODIC MAINTENANCE Section.

c. Oil pan bent on bottom or pump screen cocked, replace or repair as necessary.

5. Noisy At Idle Becoming Louder As Engine Speed Is Increased To 1500 rpm:

This noise is not connected with lifter malfunction. It becomes most noticeable in the vehicle at 10 to 15 mph "L" range, or 30 to 35 mph "D" range and is best described as a hashy sound. At slow idle, it may be entirely gone or appear as a light ticking noise in one or more valves. It is caused by one or more of the following:

- Badly worn or scuffed valve tip and rocker arm pad.
- Excessive valve stem to guide clearance.
- Excessive valve seat runout.
- Off square valve spring.
- Excessive valve face runout.
- Valve spring damper clicking on rotator.

To check valve spring and valve guide clearance, remove the valve covers:

a. Occasionally this noise can be eliminated by rotating the valve spring and valve. Crank engine until noisy valve is off its seat. Rotate spring. This will also rotate valve. Repeat until valve becomes quiet. If correction is obtained, check for an off square valve spring. If spring is off square more than 1/16" in free position, replace spring. (Fig. 6A3-37).

b. Check for excessive valve stem to guide clearance. If necessary, correct as required.

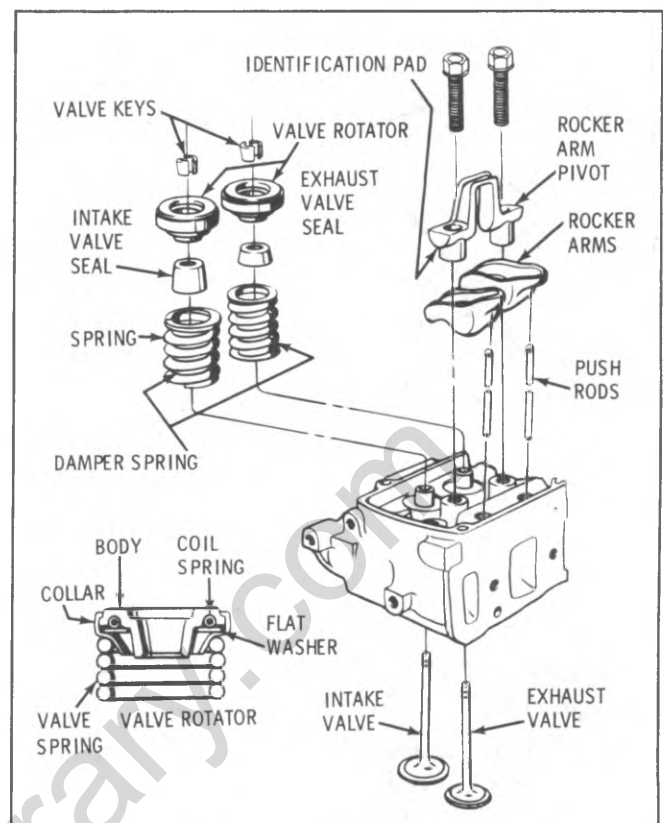


Fig. 6A3-38--Cylinder Head-Exploded View

6. Valves Noisy Regardless Of Engine Speed: This condition can be caused by foreign particles or excessive valve lash.

Check for valve lash by turning engine so the piston in that cylinder is on top dead center of firing stroke. If valve lash is present, the push-rod can be freely moved up and down a certain amount with rocker arm held against valve. If OK, clean suspected valve lifters.

Valve lash indicates one of the following:

- Worn push-rod.
- Worn rocker arm.
- Lifter plunger stuck in down position due to dirt or carbon.
- Defective lifter.

Checking of the above four items:

1. Look at the upper end of push-rod. Excessive wear of the spherical surface indicates one of the following conditions.

a. Improper hardness of the push-rod ball. The push-rod and rocker arm must be replaced.

b. Improper lubrication of the push-rod. The push-rod and rocker arm must be replaced. The oiling system to the push-rod should be checked.

2. If push-rod appears in good condition and has been properly lubricated, replace rocker arm and recheck valve lash.

3. If valve lash exists and push-rod and rocker arm are okay, trouble is in the lifter. Lifter should be replaced.

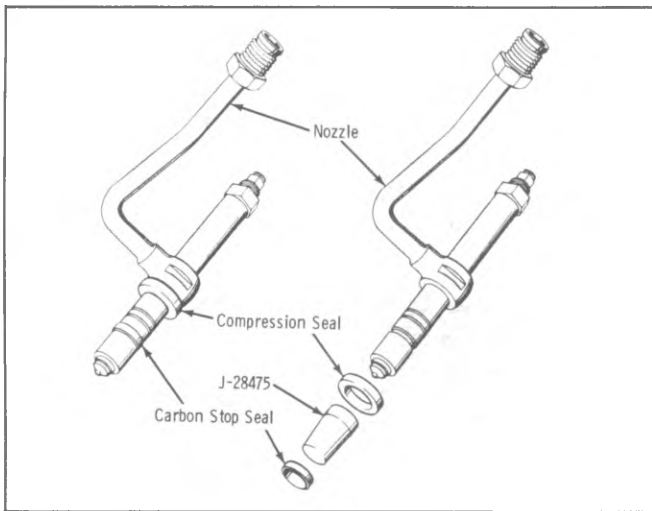


Fig. 6A3-39--Installation of Nozzle Seals

Installation

NOTE: Coat foot of lifter with #562458 lubricant or equivalent.

Prime new lifters by working lifter plunger while submerged in new kerosene or diesel fuel. Lifter could be damaged if dry when starting engine.

1. When a rocker arm is loosened or removed, valve lifter bleed down is required. Refer to "VALVE LIFTER BLEED DOWN". Lifters must be bled down as possible valve to piston interference, due to close tolerances, could exist.
2. Install lifters and push-rods into original position in cylinder block. See note under Removal.
3. Install manifold gaskets and manifold.
4. Position rocker arms, pivots and bolts on cylinder head as shown in Fig. 6A3-38.
5. Install valve covers.
6. Install intake manifold assembly.

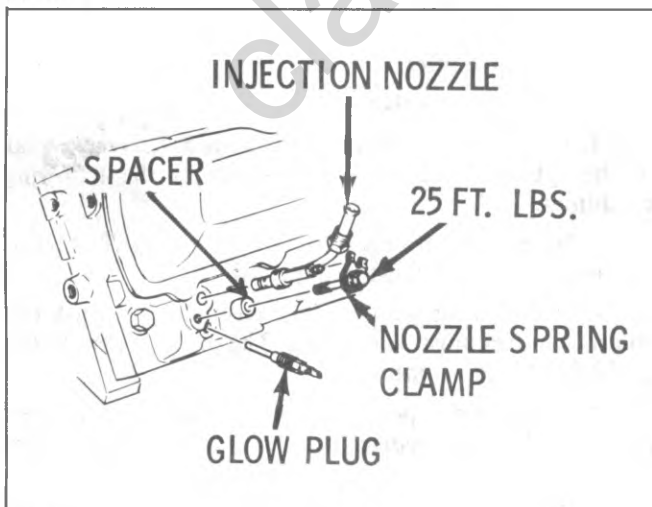


Fig. 6A3-40--Injection Nozzle Installation

INJECTION NOZZLE (WITH LINES REMOVED)

Removal

1. Remove the fuel return line clamps from all nozzles on the bank where a nozzle is to be removed then remove that fuel return line.
2. Remove nozzle spring clamp and spacer then remove nozzle using Tool J-26952.
3. Cap the nozzle inlet line and the tip of the nozzle.
NOTE: Always protect the tip of the nozzle to prevent damage.

Installation

1. If a nozzle is to be reinstalled after removal, a new compression seal and carbon stop seal must be installed after removal of the used seals. See figure 6A3-39 for seal installation.
2. Remove protective caps then install injection nozzle and spring clamp and spacer. Torque bolt to 25 lb. ft. (34 N·m) (Fig. 6A3-40).
3. Install fuel return line.
4. Start engine and check for leaks.

CYLINDER HEAD AND GASKET

Removal

1. Remove intake manifold. See "INTAKE MANIFOLD" for removal.
2. Remove valve cover.
NOTE: Loosen or remove any accessory brackets which interfere.
3. Disconnect glow plug wiring.
4. Remove ground strap from right cylinder head.
5. Remove rocker arm bolts, pivots, rocker arms and push rods.
NOTE: Scribe pivots and keep rocker arms separated so they can be installed in their original locations.
6. Remove fuel return lines from nozzles.
7. Remove exhaust manifold.
8. Remove engine block drain plug on the side of the engine where the cylinder head is being removed.
9. Remove cylinder head bolts and remove cylinder head.
10. If necessary to remove pre-chamber, remove the glow plug or injection nozzle, then tap out with a small blunt drift.

Installation

Head gaskets are a special composition gasket that must be used **WITHOUT** a sealer.

NOTE: No additional sealer can be used when installing the head gaskets as the passage surfaces are sealed when the gaskets are made, using a newly developed method and material. This sealer is accurately printed on the surface of the gasket in the exact quantity required and provides the desired bond between the head and the block. Applying additional sealer would only result in the possibility of leakage.

Install pre-chamber, if removed. The pre-chamber can only be installed in one position. (Fig. 6A3-41). Use a small mallet and install in cylinder head. Install glow plug.

NOTE: Pre-chamber should be .003" to face of head.

Clean cylinder head bolts and dip in engine oil, torque bolts to 100 lbs. ft. (136 N·m) in sequence shown, then re-torque in sequence to 130 lbs. ft. (176 N·m). (Figs. 6A3-42 & 6A3-43).

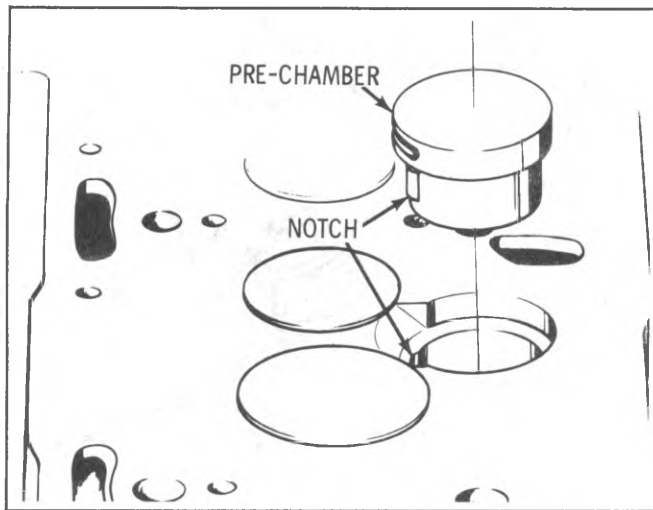


Fig. 6A3-41--Installing Pre-Chamber in Head

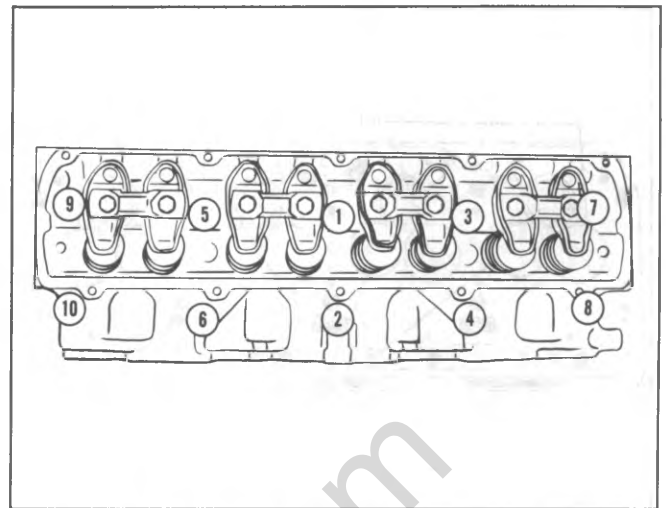


Fig. 6A3-43--Cylinder Head Torque Sequence

NOTE: Torque head bolts before installing rocker arms and pivots.

VALVES AND SPRINGS WITH HEAD REMOVED (Fig. 6A3-44)

Removal

1. Remove valve keys by compressing valve spring with a tool such as J-5892-1.
2. Remove valve spring rotators or retainers and springs.
3. Remove oil seals from valve stems.
4. Remove valves. Keep valves separated so they can be installed in their original locations. (Fig. 6A3-45).

Installation

1. Install valves in their respective guides.
 2. Install new oil seals over valve stem.
- Position seals down as far as possible on valve stem. The seals will correctly position themselves when the engine is started.

NOTE: Inspect seals for cracks after installation.

3. Position valve springs over valve stems.
4. Install valve rotators then compress springs with a

tool such as J-5892-1 and install valve stem keys.

5. Check valve springs and keys to be sure they are properly seated.

6. Install exhaust manifold. Torque bolts and nuts to 25 ft. lbs. (34 N·m). Bend exhaust manifold bolt lock tabs.

Reconditioning

When reconditioning valves and valve seats, clean carbon from cylinder heads and valves using care not to gouge or scratch machined surfaces. A soft wire brush is suitable for this purpose. Whenever valves are replaced or new valves installed, the valve seats must be reconditioned. (Fig. 6A3-46).

Narrow the valve seats to the specified width.

NOTE: This operation is done by grinding the portside with a 30° stone to lower the seat and a 60° stone to raise the seat.

Intake valve seats are induction hardened and must be ground, not cut.

If valve guide bores are worn excessively, they can be reamed oversize. This will require replacement of the valves with oversize valves (stems). The guide bores should be reamed before grinding the valve seats. Valve clearance in guide bore should be .0015" to .0032" (exhaust) or .001" to .0027" for the intake valve.

Measuring Valve Stem Height

Whenever a new valve is installed, or after grinding valves, it will be necessary to measure valve stem height as follows:

Install gage J-25289 as shown in Fig. 6A3-47.

There should be at least .015" clearance on all valves

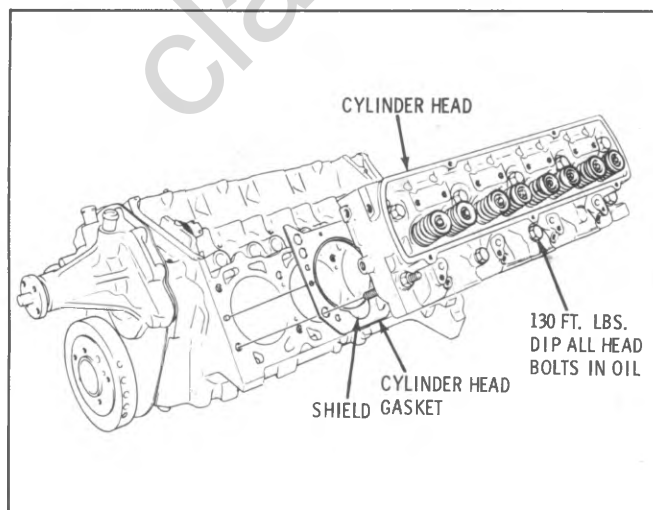


Fig. 6A3-42--Cylinder Head & Gasket

VALVE TRAIN INFORMATION					
TYPE	HEAD DIAMETER	VALVE FACE ANGLE	VALVE SPRING DAMPER	VALVE SEAT INSERT	INDUCTION HARDENED VALVE SEAT
Intake	1.875"	44°	Yes	No	Yes
Exhaust	1.625"	30°	Yes	No	No

Fig. 6A3-44--Valve Train Information Chart

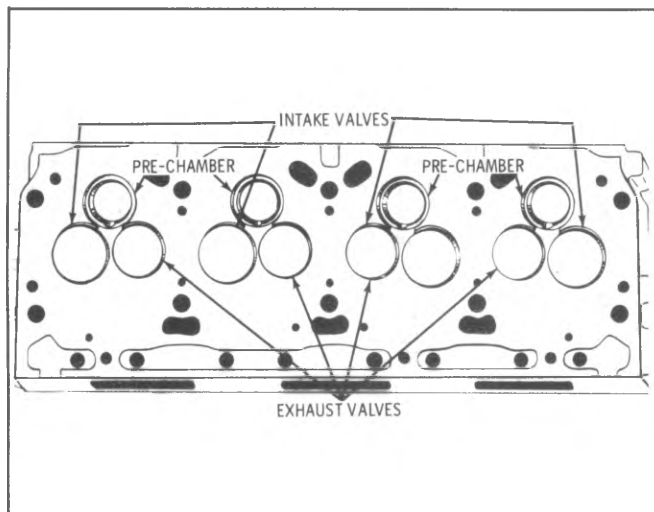


Fig. 6A3-45--Valve Location

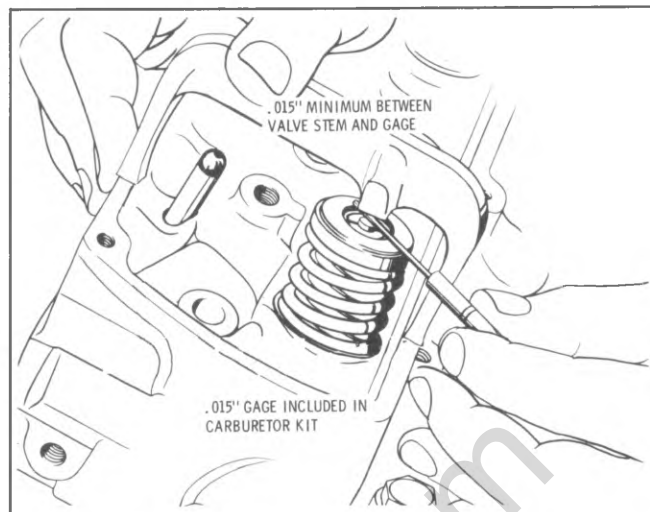


Fig. 6A3-47--Measuring Valve Stem Height

between gage surface and end of valve stem. (Valve stem can be gaged with or without the valve rotator on the valve.) If clearance is less than .015", remove valve and grind tip of valve stems as required on a valve refacing machine, using the "Vee" block attachment to insure a smooth 90° end. Also be certain to break sharp edge on ground valve tip. Observe an original valve to determine chamfer.

After all valve keys have been installed on valves, tap each valve stem end with a mallet to seat valve rotators and keys. Using gage J-25289 as shown in Figs. 6A3-47 and 6A3-48, regage all valves between valve stem and gage (.015" minimum) and valve rotator and gage (.030" minimum). If any valve stem end is less than .005" above rotator, the valve is too short and a new valve must be installed.

EXAMPLE:

Valve Rotator to Gage Clearance— .038"
 Minus Valve Stem to Gage Clearance— .035" - .003"
 This is less than .005" and new valve should be installed.

NOTE: There must be a minimum of .030" clearance between valve rotator and gage. Failure to maintain

this clearance will cause rocker arm and valve rotator interference.

VALVE GUIDE BORE

If the valve guide bores are worn excessively, they can be reamed oversize. The following reamers are available:

- J-5830-1003" Oversize Valve Guide Reamer
- J-6621005" Oversize Valve Guide Reamer
- J5830-7013" Oversize Valve Guide Reamer

If a standard or .003" O.S. valve guide bore is being reamed, use the .003" oversize reamer. For the .005" oversize valve guide bore, use the .005" oversize reamer; use the .013" reamer for the .010" or .013" O.S. valve guide bore. If too large a reamer is used and the spiraling is removed, the valve may not receive the proper lubrication.

Occasionally a valve guide bore will be oversize as manufactured. These are marked on the inboard side of the cylinder heads on the machined surface just above the intake manifold surface. (Fig. 6A3-49). These markings are visible without removing any parts other than the air cleaner assembly. Before removing the cylinder heads to perform service to either the valves or valve guide bores, the cylinder heads should be inspected to determine if these markings

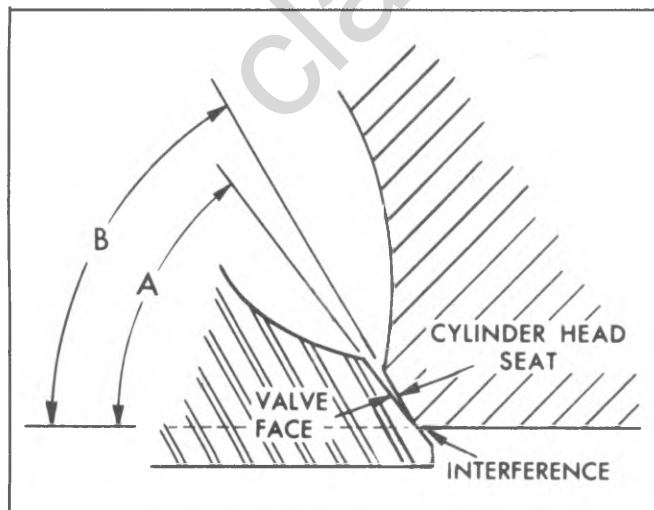


Fig. 6A3-46--Relation of Valve & Seat Angles

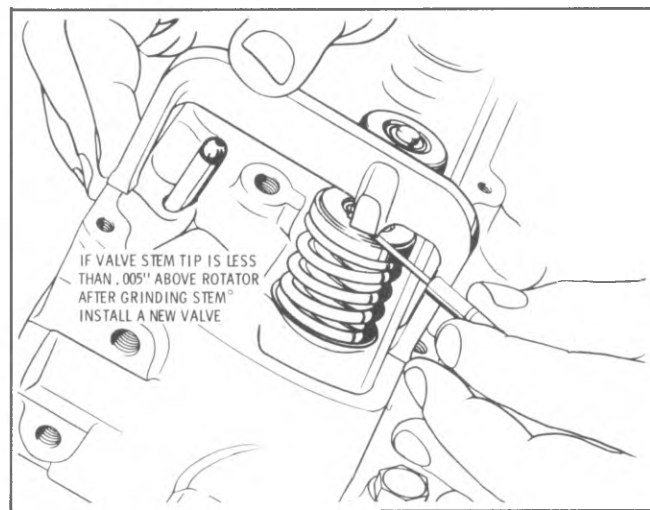


Fig. 6A3-48--Measuring Rotator Height

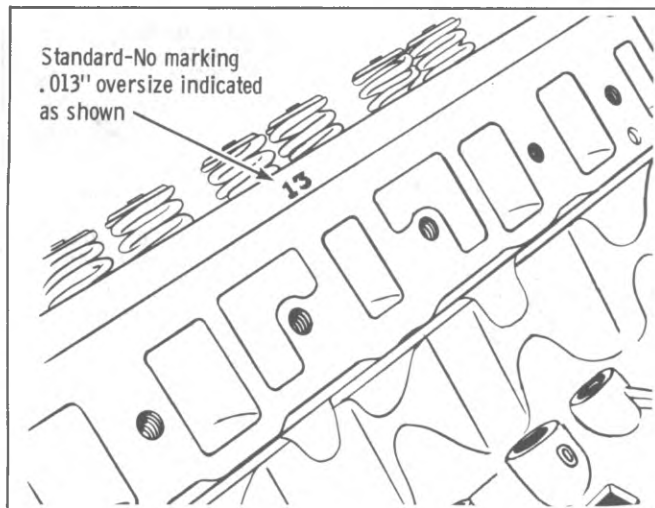


Fig. 6A3-49--Valve Guide Bore Marking

are present. If no markings are present, the guide bores are standard. If oversize markings are present, any valve replacement will require an oversize valve. If the oversize marking is present, only that particular bore would be oversize, not all bores in that cylinder head. Service valves are available in five different stem diameters: Standard, .003" oversize, .005" oversize, .010" oversize, and .013" oversize.

Reaming

Before attempting to ream the valve guide bores they should be cleaned using Tool J-8101 as shown in Fig. 6A3-50.

This procedure to ream valve guide bores is shown in Fig. 6A3-51. Use care to hold reamer straight in valve guide

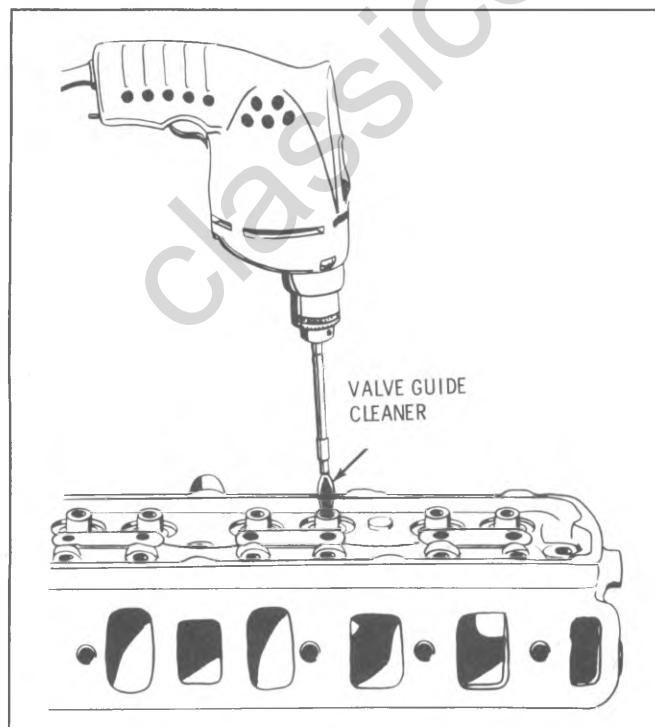


Fig. 6A3-50--Cleaning Valve Guide Bores

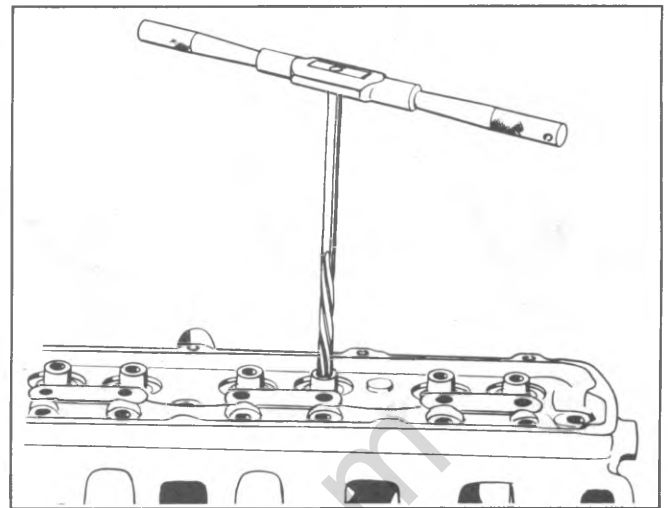


Fig. 6A3-51--Reaming Valve Guide Bores

bore.

REPLACING VALVE SPRING (HEAD ON ENGINE)

To replace a worn or broken valve spring without removing the cylinder head proceed as follows:

Removal

1. Remove rocker arm assemblies.
2. Rotate engine so piston is at top dead center for each cylinder.
3. Install Tool J-5892-1 (Fig. 6A3-52) and compress the valve spring until valve keys are accessible; then remove keys, valve rotators and springs.

NOTE: If valve spring does not compress, tap tool with a mallet to break bind at rotator and keys.

Checking Rotators

The rotators cannot be disassembled and require replacement only when they fail to rotate the valve.

Rotator action can be checked by applying a daub of paint across the top of the body and down the collar. Run engine approximately 1500 rpm. There should appear to be motion between the body and collar; the body will appear

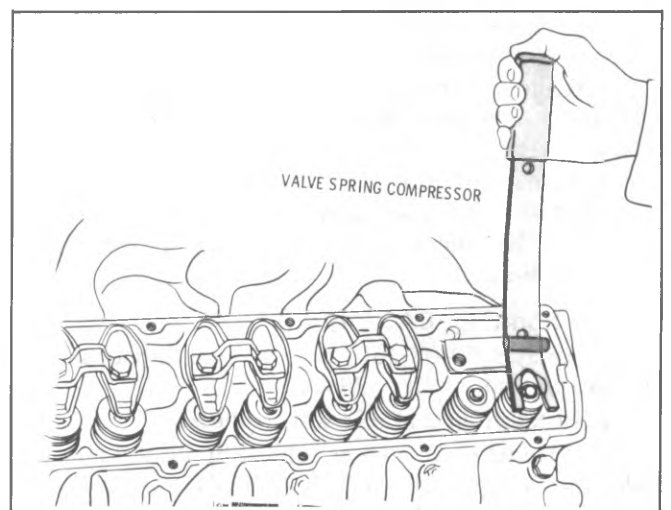


Fig. 6A3-52--Removing Valve Spring

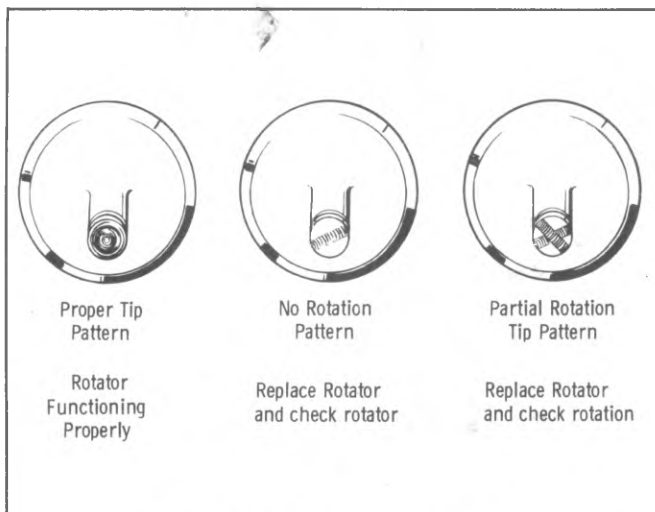


Fig. 6A3-53--Valve Stem Wear

to "walk" around the collar. Rotator action can be either clockwise or counterclockwise. Sometimes on removal and reinstallation, the direction of rotation will change but this does not matter so long as it rotates.

Any time the valves are removed for service the tips should be inspected for improper pattern which could indicate valve rotator malfunction. (Fig. 6A3-53).

Installation

1. Install valve spring and rotator. Using Tool J-5892-1, compress the valve spring until the valve keys can be installed.

2. Install rocker arm assemblies.

3. Bleed valve lifters where rocker arm pivots were loosened. Refer to "VALVE LIFTER BLEED DOWN".

OIL PAN

Removal

1. Remove drive and vacuum pump.
2. Disconnect battery cables.
3. Remove fan shroud attaching screws and pull up from clips.
4. Hoist the vehicle and drain oil.
5. Remove flywheel cover.
6. Remove starter assembly.
7. Remove both mount through bolts then raise engine. LOOSEN right-hand mount and REMOVE left-hand mount.

8. Remove oil pan.

NOTE: If extended work is to be done, the mounts should be reinstalled and the engine lowered to the frame brackets.

Installation (Fig. 6A3-54)

1. Apply 1050805 sealer or equivalent to both sides of pan gaskets and install on block.

2. Install front and rear seals (rubber).

3. Wipe lube, 1050169 or equivalent, on seal area and install pan. Torque bolts to 10 lbs. ft. (14N·m). Reverse the removal procedure. Fill crankcase as explained in the PERIODIC MAINTENANCE Section.

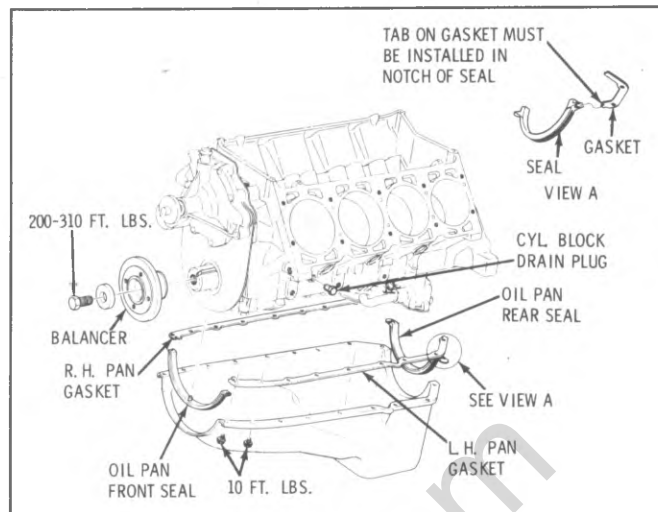


Fig. 6A3-54--Oil Pan Assembly

OIL PUMP

Removal

1. Remove oil pan.
2. Remove the oil pump to rear main bearing cap attaching bolts, then remove pump and drive shaft extension.

Disassembly (Fig. 6A3-55)

1. Remove the oil pump drive shaft extension. **NOTE:** Do not attempt to remove the washers from the drive shaft extension. The drive shaft extension and washers must be serviced as an assembly. (Fig. 6A3-56).
2. Remove the cotter pin, spring and the pressure regulator valve. **NOTE:** Position thumb over pressure regulator bore before removing cotter pin, as the spring is under pressure.
3. Remove the oil pump cover attaching screws and remove the oil pump cover and gasket.
4. Remove the drive gear and idler gear from the pump body.

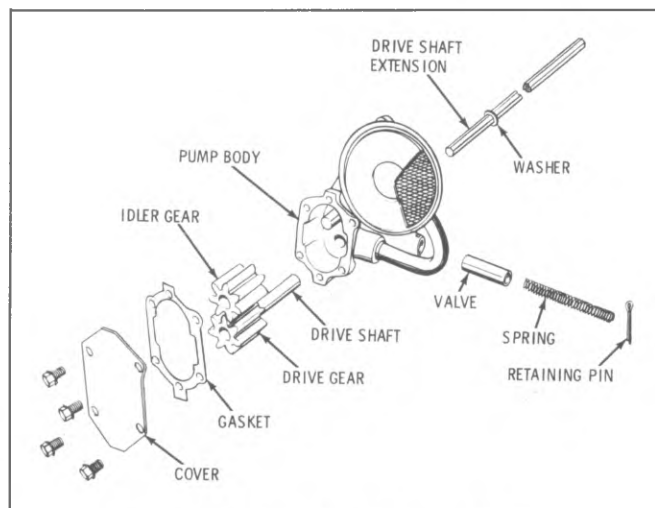


Fig. 6A3-55--Oil Pump-Exploded View

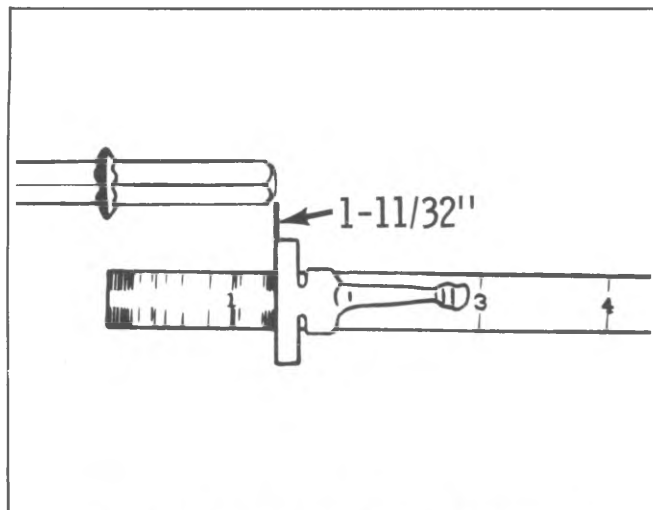


Fig. 6A3-56--Oil Pump Driveshaft Extension

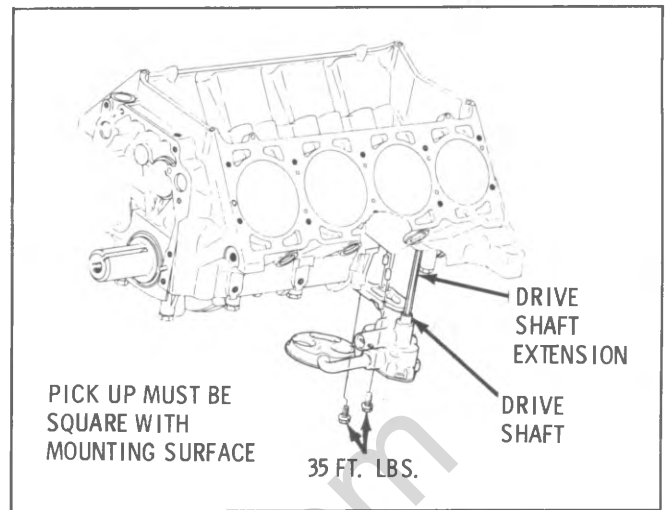


Fig. 6A3-57--Oil Pump Installation

Inspection

Check the gears for scoring or other damage. If they are damaged, new gears should be installed. During assembly, the gear end clearance should be gaged. Proper end clearance is .0005" to .0075". Also check the pressure regulator valve, valve spring and bore for damage. Proper valve to bore clearance is .0025" to .0050". The checking of gear end clearance will be covered in "Assembly". Check the extension shaft at each end for abnormal wear. The shaft is hardened at both ends and identified by a red dye marking.

Assembly

1. Install the gears and shaft in the oil pump body and check the gear end clearance by placing a straight edge over the gears and measure the clearance between the straight edge and the gasket surface. The clearance should be between .0005" to .0075". If the end clearance is to the high limit, check for scores in the cover that would bring the total clearance over the specified amount.

2. Install the cover screws and tighten alternately and evenly. The torque is 8 lbs. ft. (11N·m).

3. Position the pressure regulator valve into the pump cover, closed end first, then install the spring and retaining pin.

NOTE: When assembling the drive shaft extension to the drive shaft, THE END OF THE EXTENSION NEAREST THE WASHERS MUST BE INSERTED INTO THE DRIVE SHAFT.

Installation

1. Insert the drive shaft extension through the opening in the main bearing cap and block until the shaft mates into the vacuum pump driven gear.

2. Position pump onto the rear main bearing cap and install attaching bolts. Torque bolts to 35 lb. ft. (47 N·m) (Fig. 6A3-57).

3. Install the oil pan. Refer to OIL PAN Installation.

CONNECTING ROD AND PISTON

Removal

1. Remove intake manifold, head or heads.
2. Remove oil pan.
3. Remove oil pump assembly.

NOTE: Stamp cylinder number on the machined surfaces of the bolt bosses of the connecting rod and cap for identification when reinstalling. If the pistons are to be removed from the connecting rod, mark cylinder number on piston with a silver pencil or quick drying paint for proper cylinder identification and cap to rod location. The right bank is numbered 2-4-6-8, left bank 1-3-5-7.

Examine the cylinder bore above ring travel. If ridge exists, remove ridge with ridge reamer before attempting to remove the piston and rod assembly.

4. Remove rod bearing cap and bearing.
5. Install guide hose over threads of rod bolts. This to prevent damage to bearing journal and rod bolt threads. (Fig. 6A3-58).
6. Remove rod and piston assembly through the top of the cylinder bore.

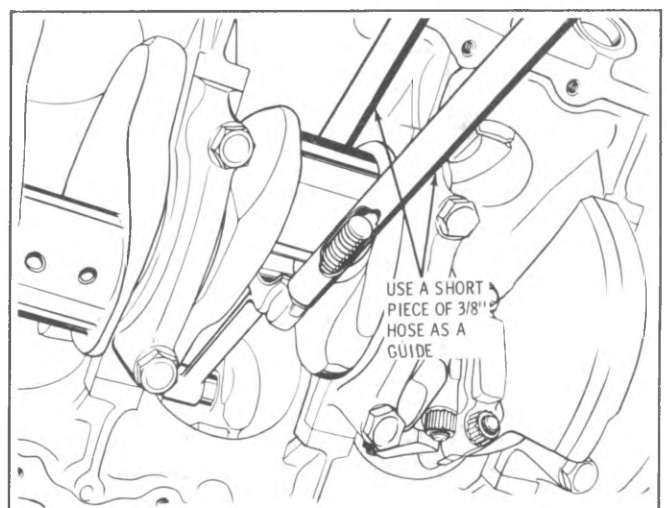


Fig. 6A3-58--Connecting Rod Bolt Guide

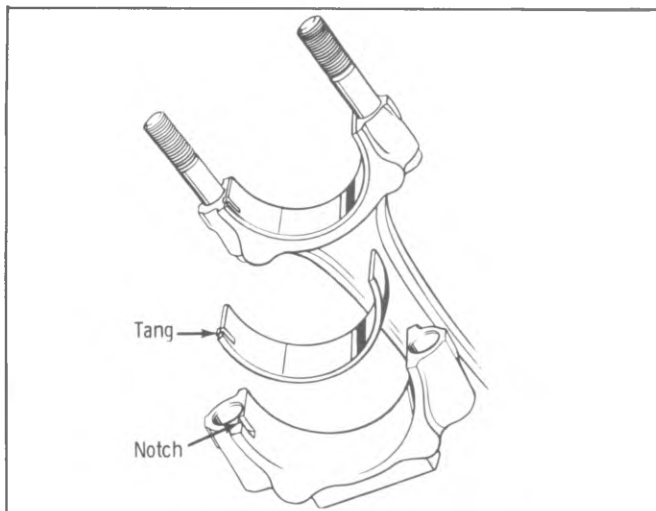


Fig. 6A3-59--Bearing Tang & Notch

7. Remove other rod and piston assemblies in the same manner.

ROD BEARINGS

The connecting rod bearings are designed to have a slight projection above the rod and cap faces to insure a positive contact.

Connecting rod bearings can be replaced without removing the rod and piston assembly from the engine.

1. Remove oil pan.

NOTE: It may be necessary to remove oil pump to provide access to rear connecting rod bearings.

2. With crankpin at the bottom, stamp cylinder number on machined surfaces of connecting rod and cap for identification when reinstalling, then remove caps.

3. Inspect crankpins for roughness and wear. Slight roughness may be removed with a fine grit polishing cloth saturated with engine oil. Burrs may be removed with a fine oil stone by moving the stone on the crankpin circumference. Do not move the stone back and forth across the crankpin. If the crankpins are scored or ridged, the crankshaft must be replaced.

4. The crankpins should be checked for out-of-round



Fig. 6A3-60--Bearing Identification

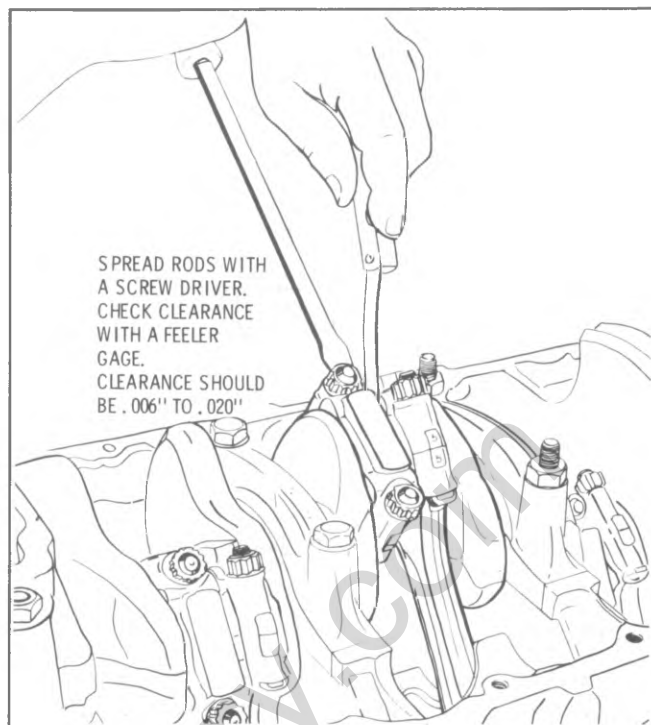


Fig. 6A3-61--Connecting Rod Side Clearance

and correct size with a micrometer. Maximum out-of-round must not exceed .0015".

NOTE: Crankpins will normally be standard size. If any undersized crankshafts are used, all will be .010" U.S. and an "X" will be stamped on the pad at the L.F. upper corner of the block.

5. Clean oil from crankpin bearing cap, connecting rod and outer and inner surface of bearing inserts. Position insert so that tang is properly aligned with notch in rod and cap. (Fig. 6A3-59).

6. Place a piece of plastic gaging material in the center of lower bearing shell.

7. Remove bearing cap and determine bearing clearances by comparing the width of the flattened plastic gaging material at its widest point with the graduation on the container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch. If this clearance is greater than .0035", replace the bearing and recheck clearance with plastic gaging material.

NOTE: Lubricate bearing with engine oil before installation. Repeat Steps 2 through 8 on remaining connecting rod bearings. All rods must be connected to their crankpins when rotating the crankshaft to prevent engine damage.

Bearings are identified as shown in Fig. 6A3-60.

9. Measure the rod side clearance as shown in Fig. 6A3-61. Clearance should be .006" to .020".

ROD ASSEMBLY

If a rod is twisted or bent, a new rod must be installed. **NO ATTEMPT SHOULD BE MADE TO STRAIGHTEN CONNECTING RODS.**

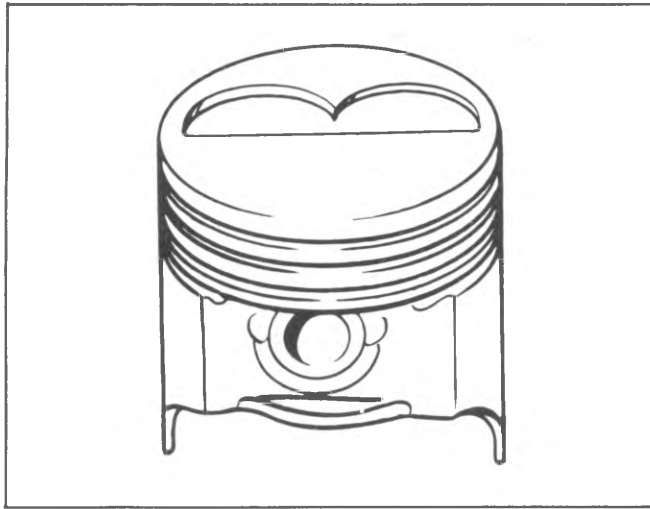


Fig. 6A3-62--Piston Identification

PISTON (Fig. 6A3-62)

Measuring

NOTE: Refer to PISTON INFORMATION CHART FIGURE 6A3-63.

When replacing pistons, the original cylinder size is stamped with a code letter on the block near each cylinder on the cylinder head surface or on the oil pan rail. (Fig. 6A3-64).

When measuring piston for size or taper, measurement must be made on skirt 90° from piston pin hole (with the piston pin removed). (Fig. 6A3-65).

When measuring taper, measure at the centerline of the piston pin hole and at the bottom of the skirt. The largest reading must be at the bottom of the skirt. Allowable taper is .000" to .002".

The piston and cylinder bore must be free of oil and at the same temperature.

NOTE: On some vehicles oversize pistons may be found. These pistons will be .010" oversize.

Each piston should be fitted to its individual cylinder and marked for that cylinder. Piston to bore clearance is .005" to .006".

Checking Cylinder Bore

NOTE: Refer to PISTON INFORMATION Chart Figure 6A3-63.

Cylinder bore size can be measured with inside micrometers or a cylinder gage. Maximum allowable taper of the cylinder bore is .001". The most wear will occur at the top of the ring travel.

Reconditioned cylinder bores should be held to not more than .001" out-of-round and .001" taper.

If the cylinder bores are smooth, the cylinder walls should not be deglazed. If the cylinder walls are scored, the walls may have to be honed before installing new rings. It is important that reconditioned cylinder bores be thoroughly washed with a soap and water solution to remove all traces of abrasive material to eliminate premature wear.

Cleaning Piston

Clean the pistons by scraping carbon off the top of the piston. Deposits in the ring grooves should be removed with a suitable ring groove cleaning tool. It is important that the ring grooves be completely free of deposits.

RINGS (Fig. 6A3-66)

The pistons have three rings (two compression rings and one oil ring). The oil ring consists of two rails and an expander.

Pistons do not have oil drain holes behind rings.

Ring Tolerances

When installing new rings, ring gap and side clearance should be checked as follows:

Piston Ring and Rail Gap

Each ring and rail gap must be measured with the ring or rail positioned squarely and at the bottom of the ring-travel area of the bore. (Fig. 6A3-67).

The end gap measurement should be .015" to .025" for compression rings and .015" to .055" for oil rings.

Side Clearance

Each ring must be checked for side clearance in its respective piston groove by inserting a feeler gage between the ring and its upper land. (Fig. 6A3-68). The piston grooves must be cleaned before checking ring for side clearance. Compression ring clearance is .005" to .007" for top ring, .0018" to .0038" for second ring and .001" to .005" for oil ring.

BORE DIA.	CYL. BORE SELECTION	BORE SIZES	PISTON SELECTION	PISTON SIZE	PISTON DIA.	PISTON TO CYL. BORE CLEARANCE
4.056-4.058 STD.	A	4.0560-4.0565	A	4.0505 - 4.0510	4.0505 - 4.0525 STD.	.0050 to .0060
	B	4.0565-4.0570	B	4.0510 - 4.0515		
	C	4.0570-4.0575	C	4.0515 - 4.0520		
	D	4.0575-4.0580	D	4.0520 - 4.0525		
4.066-4.068 .010 O.S.	J	4.0660-4.0665	J	4.0605 - 4.0610	4.0605 - 4.0625 .010 O.S.	
	K	4.0665-4.0670	K	4.0610 - 4.0615		
	L	4.0670-4.0675	L	4.0615 - 4.0620		
	M	4.0675-4.0680	M	4.0620 - 4.0625		

Fig. 6A3-63--Piston Information Chart

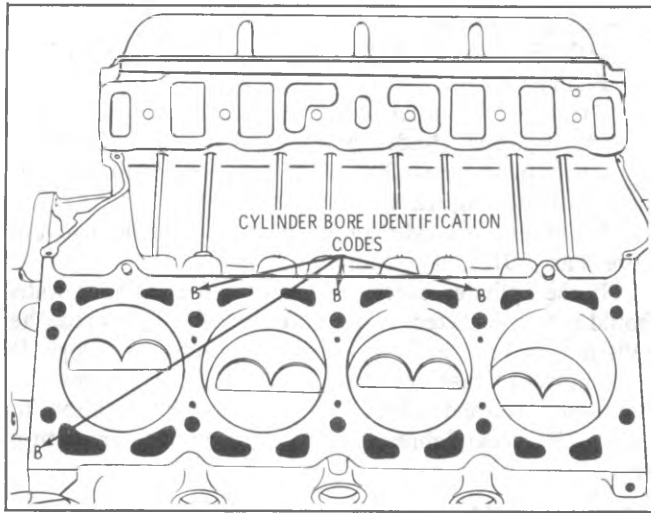


Fig. 6A3-64--Cylinder Bore Marking

NOTE: To check oil ring side clearance, the oil rings must be installed on the piston.

Ring Installation

NOTE: For service ring specifications and detailed installation instructions, refer to the instructions furnished with the parts package.

ROD AND PISTON

Installation

1. Install connecting rod bolt guide hose over rod bolt threads. (Fig. 6A3-69).

2. Apply engine oil to rings and piston, then install piston ring compressing tool on piston. (Fig. 6A3-70).

3. Install each piston and rod in its respective cylinder bore so valve depression in top of piston is towards the inner side of engine. (Fig. 6A3-71).

NOTE: On the forward half of the engine, cylinders 1, 2, 3 and 4, the large valve depression goes to the front. On the rear half of the engine, cylinders 5, 6, 7 and 8, the large valve depression goes to the rear of engine.

4. Lubricate the crankpin with engine oil and install

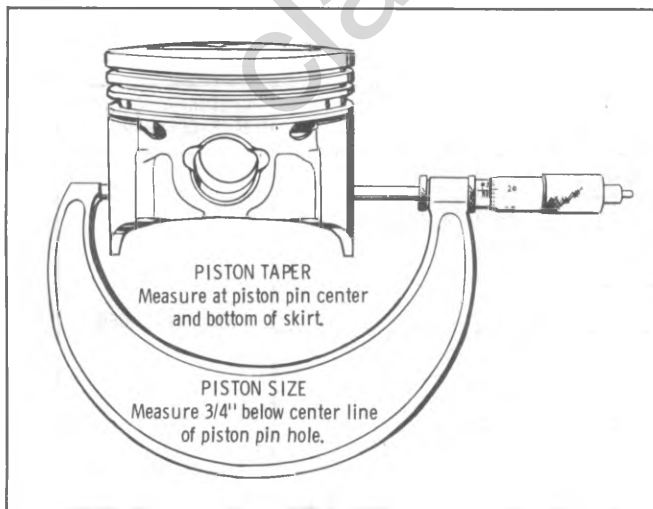


Fig. 6A3-65--Measuring Piston

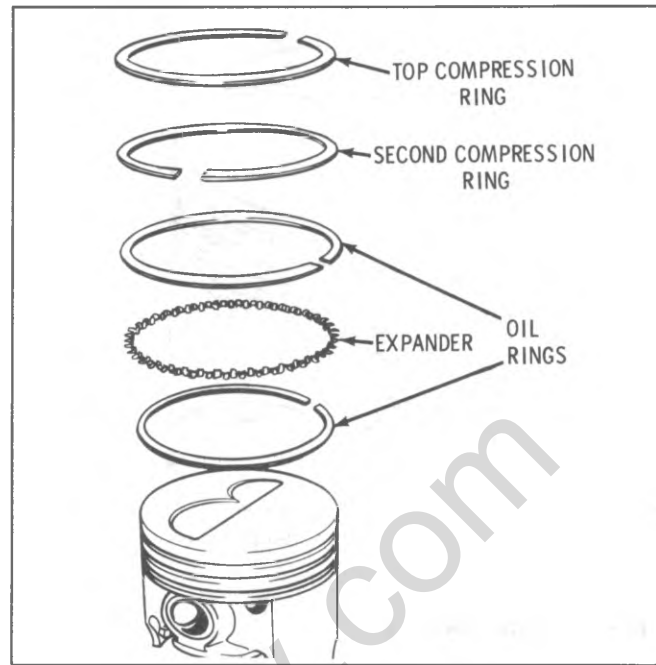


Fig. 6A3-66--Piston Rings

connecting rod bearing and cap, with bearing index tang in rod and cap on same side.

NOTE: When more than one rod and piston is being installed, the connecting rod cap attaching nuts should only be tightened enough to keep each rod in position until all have been installed. This will facilitate installation of remaining piston assemblies.

The clearance between the adjacent rods, when checked with a feeler gage on each crankpin, should be from .006" to .020". (Fig. 6A3-72).

5. Torque rod bolt nuts to 42 lbs. ft. (57 N·m).

PISTON PINS

The piston pin is free floating and the correct fit in the piston is .0003" to .0005" and rod is .0003" to .0013" loose. If the pin to piston clearance is to the high limit (.0005" piston or .0013" rod), the pin can be inserted in the piston or rod with very little hand pressure and will fall through

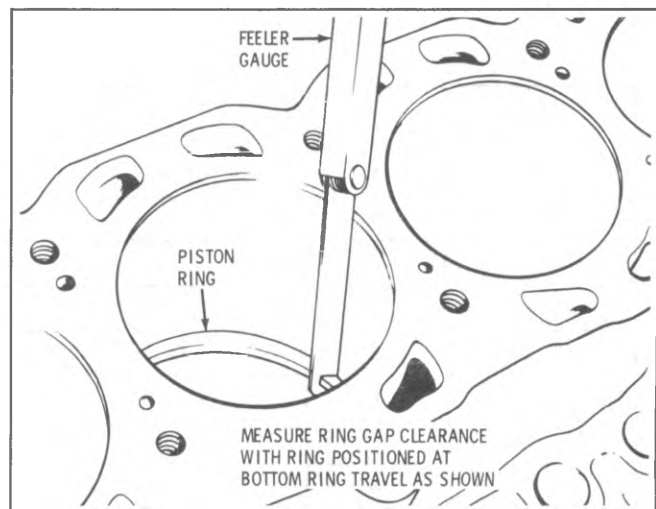


Fig. 6A3-67--Measuring Piston Ring Gap

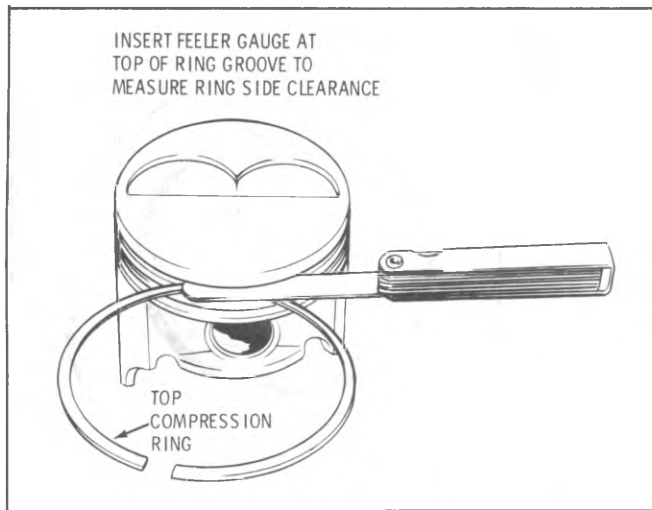


Fig. 6A3-68--Piston Ring Side Clearance

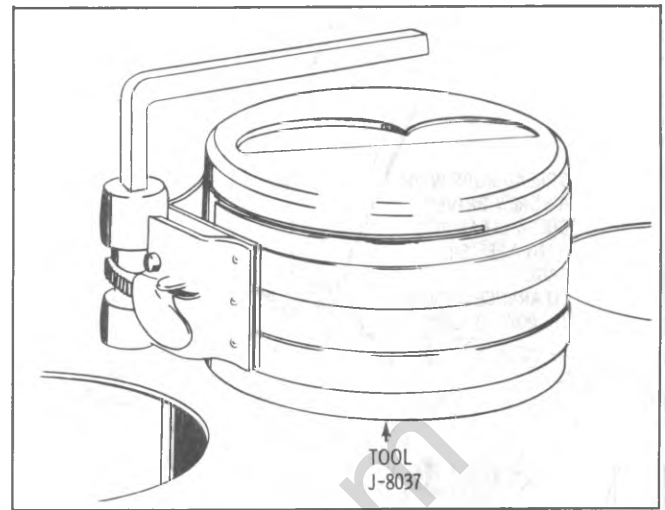


Fig. 6A3-70--Piston Ring Compressor

the piston or rod by its own weight. If the clearance is .0003", the pin will not fall through. It is important that the piston and rod pin hole be clean and free of oil when checking pin fit.

NOTE: The rod may be installed in the piston with either side facing up.

Whenever the replacement of a piston pin is necessary, remove the snap ring retaining the pin. Then remove the pin.

NOTE: It is very important that after installing the piston pin retaining snap rings that the rings be rotated to make sure they are fully seated in their grooves.

CRANKSHAFT PULLEY

Removal

1. Remove belt(s).
2. Hoist vehicle.
3. Remove four pulley bolts and pulley.

Installation

1. Install pulley, and four bolts. Torque to 20 lbs. ft. (27 N·m).
2. Install belt(s). Adjust belts using Tool J-23600.

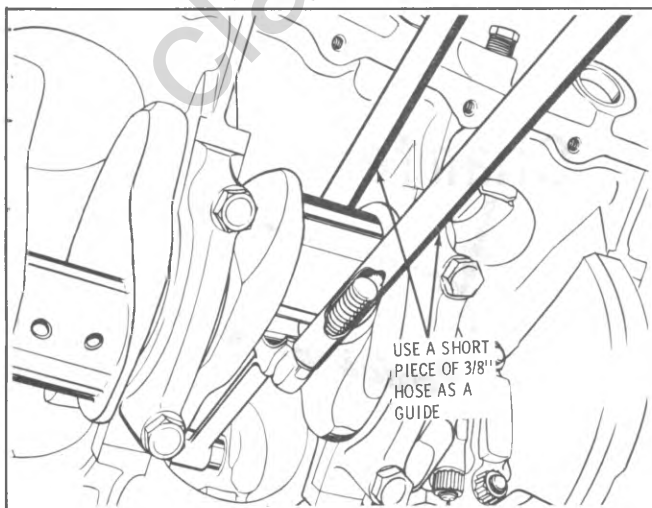


Fig. 6A3-69--Connecting Rod Bolt Guide

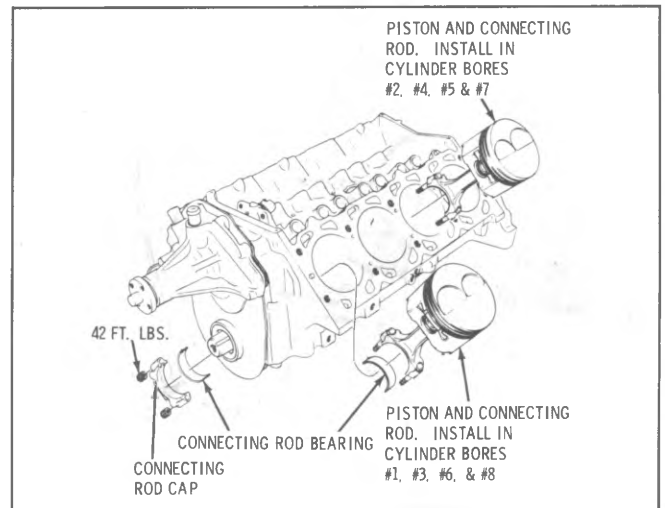


Fig. 6A3-71--Piston Locations in Block

BALANCER

Removal

1. Remove belts and crankshaft pulley.
2. Remove balancer hub bolt and washer.
3. Using balancer puller, remove balancer as shown in Fig. 6A3-73.

CAUTION: Use of any other type puller such as a universal claw type which pulls on the outside of the hub can destroy the harmonic balancer. The outside ring of the balancer is bonded in rubber to the hub; by pulling on the outside, rather than the hub, it is possible to break the bond. The T.D.C. slot is on the outside ring of the balancer; if the bond between the hub and the outside ring is broken, the outside ring could slip which would change the location of the slot mark.

If it is suspected that the bond between the sections of the harmonic balancer has been broken and the slot changed, it can be visually checked as shown in Fig. 6A3-74. The center of the keyway should be approximately 16° from the center of the timing slot. In addition, there are chisel aligning

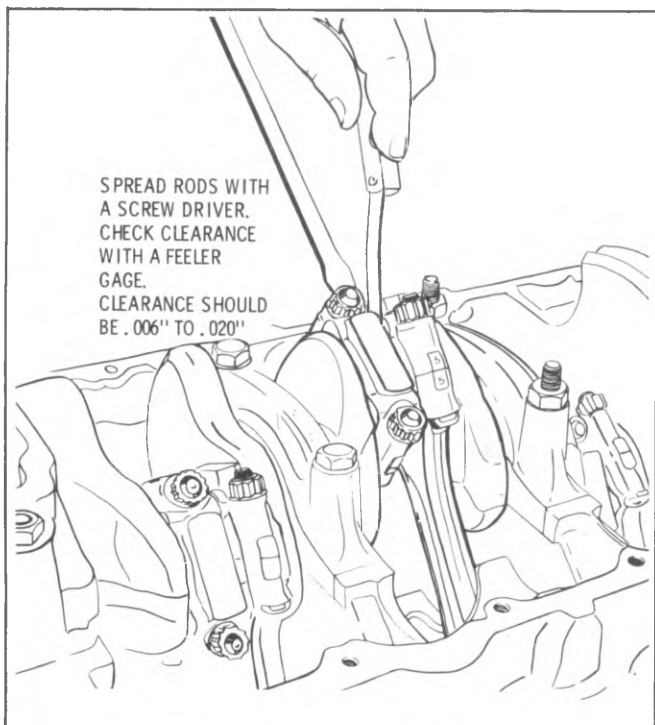


Fig. 6A3-72--Connecting Rod Side Clearance

marks between the weight and hub, marks should be together.

Installation

1. Apply sealer 1050805 or equivalent, to inside diameter of pulley hub and to crankshaft key to prevent possible oil leakage. Coat outside area of crankshaft pulley hub which enters seal with Special Seal Lubricant No. 1050169, or equivalent.

2. Install balancer or crankshaft.

NOTE: Balancer to crankshaft fit is .001" tight to .007" loose.

3. Install washer and bolt. Torque 200-310 lb. ft. (271-420 N·m).

4. Install pulley and belts. Adjust belts using belt

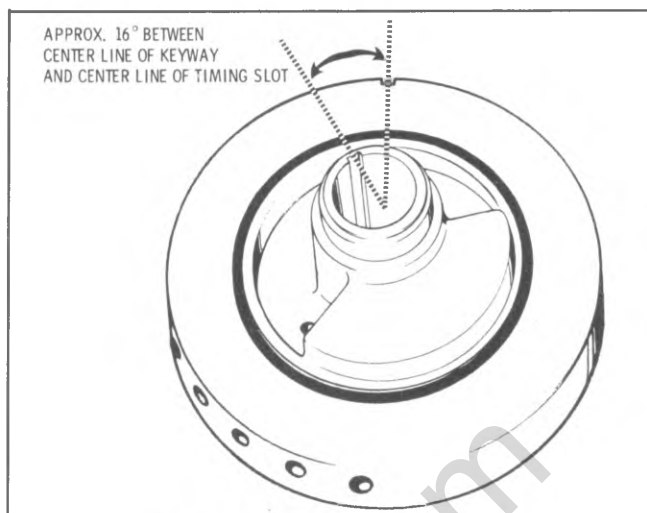


Fig. 6A3-74--Harmonic Balancer

adjusting gage J-23600. Torque pulley bolts to 10 lb. ft. (14N·m).

FRONT COVER

Removal

1. Drain cooling system. Disconnect radiator hoses and bypass hose.

2. Remove all belts, fan and fan pulley, crankshaft pulley and harmonic balancer, and accessory brackets.

3. Remove cover to block attaching bolts and remove cover, timing indicator and water pump assembly.

4. Remove front cover and both dowel pins. It may be necessary to grind a flat on the pins to get a rough surface for gripping.

Installation

1. Grind a chamfer on one end of each dowel pin as shown in Fig. 6A3-75.

2. Cut excess material from front end of oil pan gasket on each side of engine block.

3. Clean block, oil pan and front cover mating surfaces with solvent.

4. Trim about 1/8" from each end of new front pan

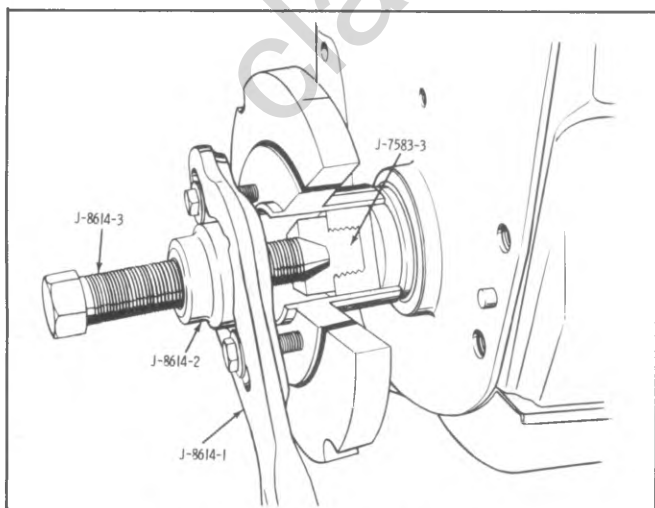


Fig. 6A3-73--Removing Balancer

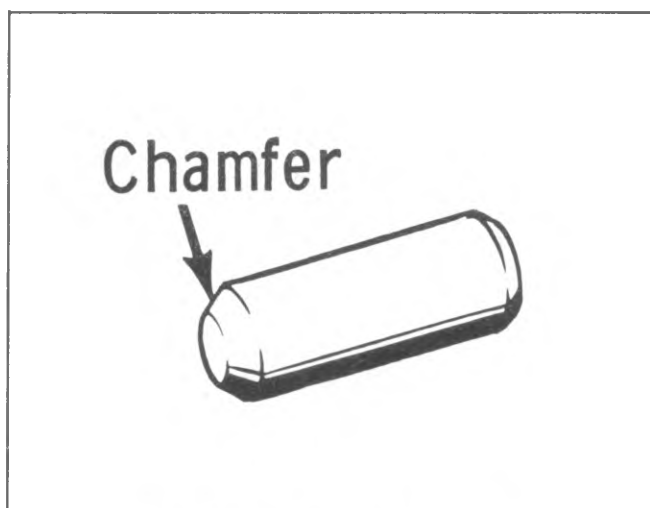


Fig. 6A3-75--Dowel Pin Chamfer

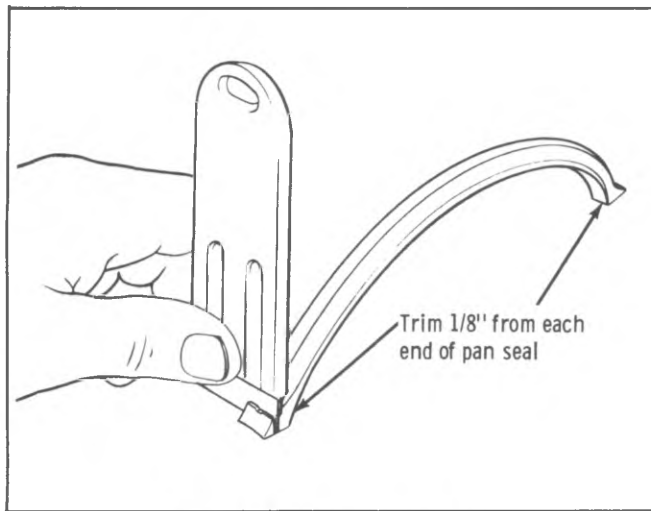


Fig. 6A3-76--Trimming Pan Seal

seal, using a sharp tool as shown in Fig. 6A3-76.

5. Install new front cover gasket on engine block and new front seal on front cover. Apply 1050805 or equivalent sealer to gasket around coolant holes and place on block.

6. Apply R.T.V. sealer at junction of block, pan and front cover as shown in Fig. 6A3-77.

7. Place cover on front of block and press downward to compress seal. Rotate cover left and right and guide pan seal into cavity using a small screwdriver as shown in Fig. 6A3-78.

8. Apply engine oil to bolts (threads and heads).

9. Install two bolts finger tight to hold cover in place.

10. Install two dowel pins (chamfered end first).

11. Install timing indicator and water pump assembly. Then torque bolts evenly as shown in Fig. 6A3-79.

12. Apply lubricant 1050169 or equivalent on balancer seal surface.

13. Install balancer and balancer bolt. Torque from 200-310 lb. ft. (271-420N·m).

14. Install necessary brackets.

15. Connect bypass hose and radiator hoses.

16. Install crankshaft pulley and four attaching bolts.

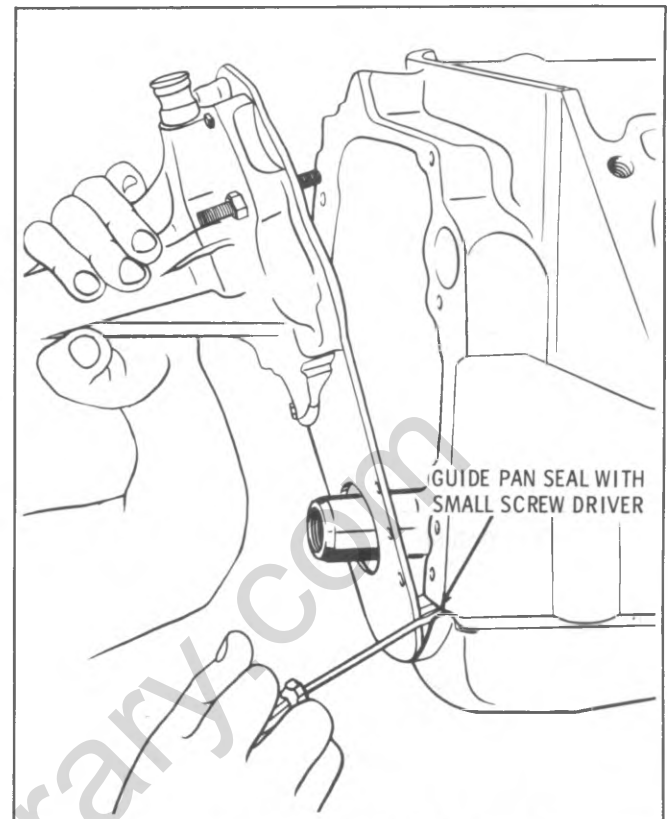


Fig. 6A3-78-- Guide Seal in Pan While Pushing Downward

Torque to 20 lbs. ft. (27 N·m).

17. Install fan pulley, fan and four attaching bolts. Torque bolts to 20 lbs. ft. (27 N·m).

18. Install belts and adjust, using Tool J-23600.

19. Fill radiator.

20. Road test vehicle and check for leaks. Use of spray foot powder or equivalent may aid in detecting leaks.

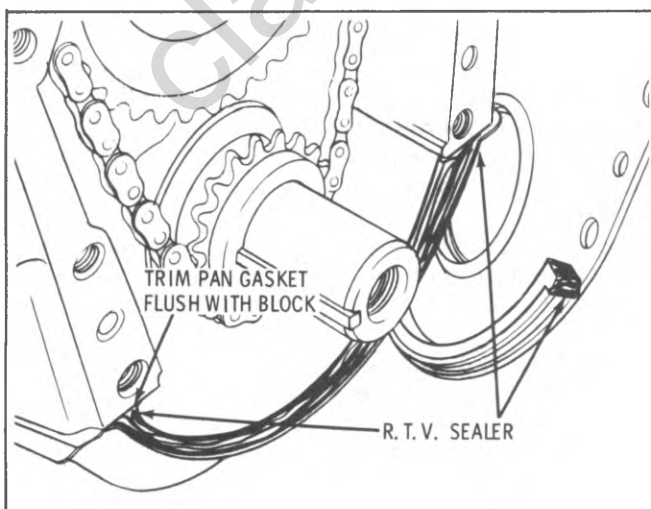


Fig. 6A3-77--Applying RTV & Trimmed Pan Gasket

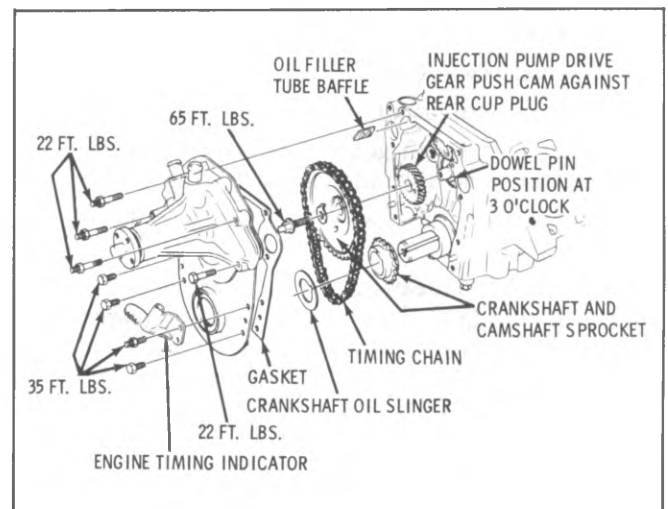


Fig. 6A3-79--Engine Front Cover Bolts

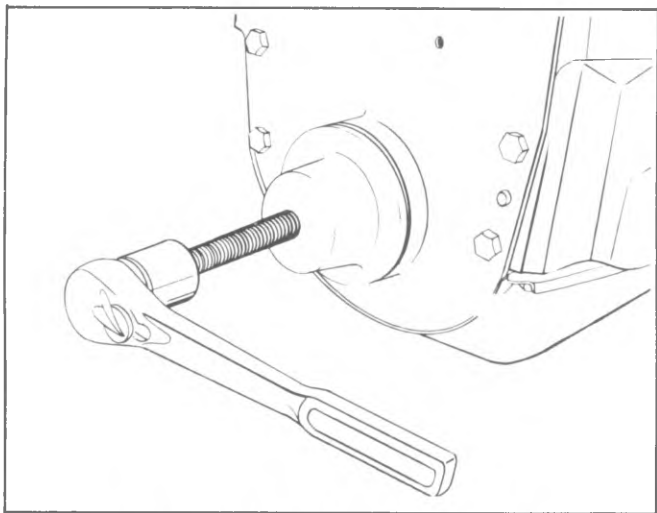


Fig. 6A3-80--Front Oil Seal Installation

OIL SEAL

Removal (Front Cover Installed)

1. Remove the belts.
2. Remove the crankshaft pulley and pulley hub.
3. Remove oil seal.

Installation

1. Apply 1050805 Sealer or equivalent, to outside diameter of seal.
2. Using Tool J-25264 and Screw J-23952, install oil seal as shown in Fig. 6A3-80.
3. Install the pulley hub and crankshaft pulley.
4. Install and adjust belts using Tool J-23600.

TIMING CHAIN AND GEARS

Removal

1. Remove oil slinger, cam gear, crank gear and timing chain.
2. Remove fuel pump eccentric from crankshaft if replacement is necessary.

Installation

1. Install key in crankshaft if removed.
2. If removed, install fuel pump eccentric.
3. Install camshaft gear, crankshaft gear and timing chain together, and align timing marks. (Fig. 6A3-81).
4. Torque camshaft sprocket bolt to 65 lbs. ft. (88 N·m).

NOTE: When the two marks are in alignment, number six is at T.D.C. To obtain T.D.C. for number one cylinder, slowly rotate crankshaft one revolution. This will bring the cam mark to the top, number one then will be in firing position.

5. Install oil slinger.

NOTE: Any time the timing chain and gears are replaced, it will be necessary to retune the engine. Refer to "INJECTION PUMP ADAPTER".

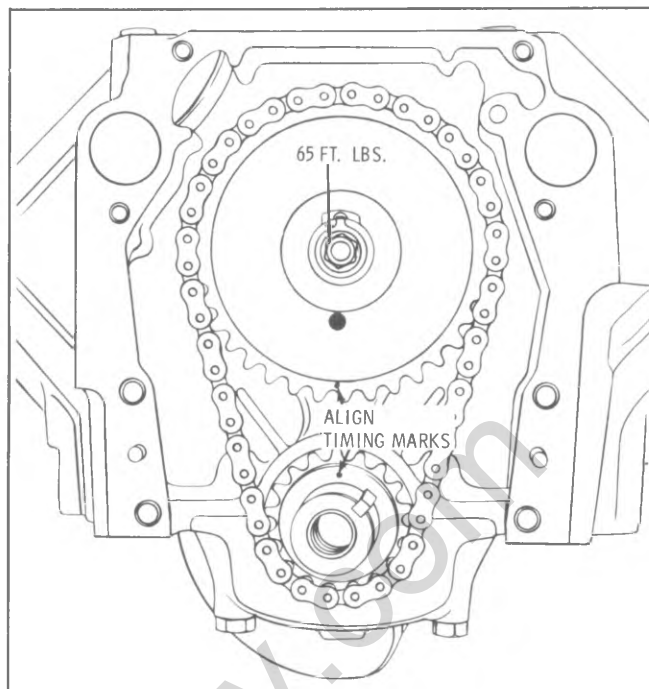


Fig. 6A3-81--Aligning Timing Marks

CAMSHAFT, INJECTION PUMP DRIVE AND DRIVEN GEARS

Removal

1. Disconnect battery.
2. Drain coolant from engine.
3. Remove upper radiator baffle.
4. Disconnect upper radiator hose at water outlet.
5. Disconnect upper radiator hose support clamp.
6. Disconnect cooler lines at radiator.
7. Remove radiator fan shroud.
8. Remove radiator.
9. Remove intake manifold and gasket, front and rear seal. Refer to INTAKE MANIFOLD, Removal and Installation.
10. Remove balancer pulley.
11. Remove balancer attaching bolt.
12. Remove balancer.
13. Remove engine front cover.
14. Remove both valve covers.
15. Remove rocker arms, push rods and valve lifters.
- NOTE:** Parts position should be noted so they will be installed in their original position.
16. If equipped with air conditioning, discharge A/C system, remove condenser attaching bolts and remove condenser.
17. Remove bolt securing camshaft gear and timing chain, then remove timing gears and chain.
18. Position camshaft dowel pin at the 3 o'clock position.
19. With the camshaft held rearward, remove pump drive gear by sliding off the camshaft while rocking the pump driven gear.
20. If necessary to remove pump driven gear, remove injection pump adapter, then remove snap ring and selective washer. Remove the driven gear and spring.
21. Remove camshaft by carefully sliding it out the

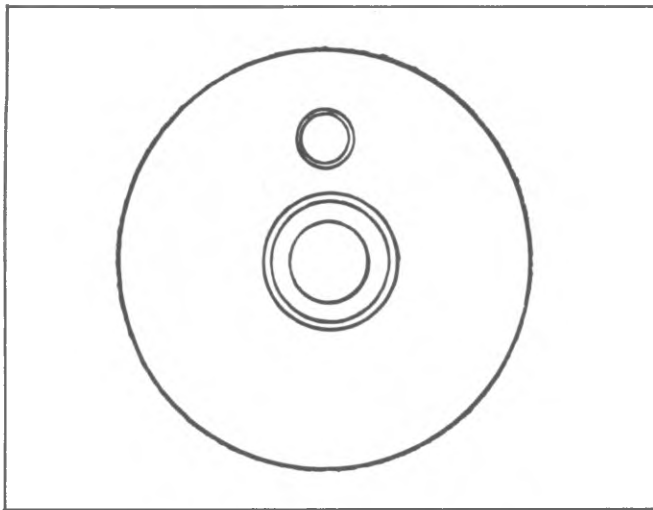


Fig. 6A3-82--Camshaft Identification

front of the engine.

NOTE: Do not force shaft as damage can occur to camshaft bearings. Refer to Fig. 6A3-82 for camshaft identification.

22. If cam bearings are being replaced, it is necessary to remove oil pan. Refer to "OIL PAN REMOVAL".

NOTE: If either the pump drive or driven gears are to be replaced, replace BOTH gears.

SCP1Fig. 6A3-84--Engine Front Cover Bolts

Installation

Any time the injection pump adapter is replaced or if pump drive or driven gears or chain and gears are replaced, it is necessary to retune engine.

Coat camshaft and bearings liberally with #562458 or equivalent before installing. Camshaft gear and crankshaft gear must be aligned as shown in Fig. 6A3-81.

Check the injection pump driven gear bushing, etc.

Install the injection pump driven gear, spring, shim and snap ring. Check the gear end play. If not within .002" to .005", replace the shim to obtain the clearance. (Fig. 6A3-83).

NOTE: Shims are available from .080" to .115" in

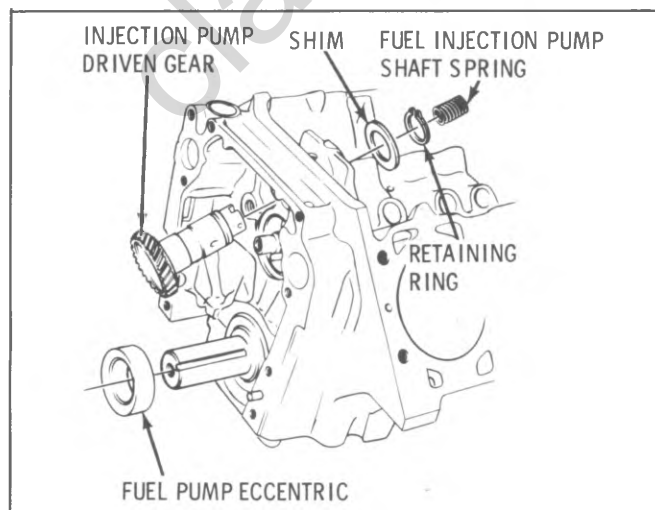


Fig. 6A3-83--Injection Pump Driven Gear Shim

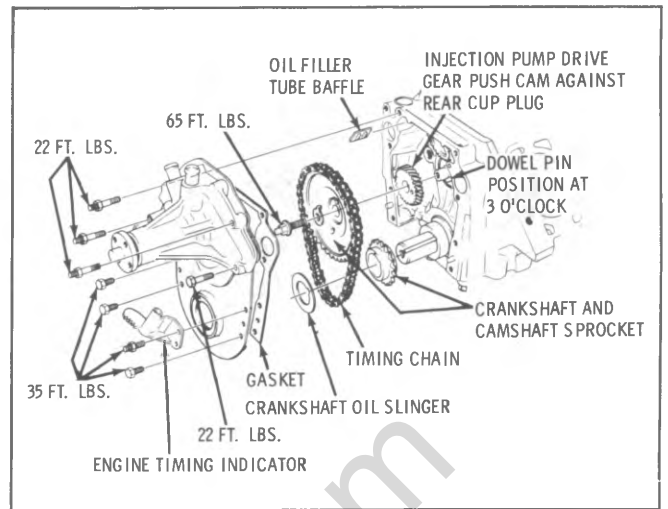


Fig. 6A3-84--Engine Front Cover Bolts

.003" increments.

Position the camshaft dowel pin at 3 o'clock, align the "O" marks on the pump drive and driven gears. Then with the camshaft held in the rearward position, slide the pump drive gear on the camshaft. (Fig. 6A3-84).

Timing indicator attaching stud must be installed and properly torqued before installing power steering pump bracket. Start engine, recharge A/C system, check for possible leaks.

CAMSHAFT AND INJECTION PUMP DRIVEN GEAR BEARINGS

The camshaft bearings must be replaced in complete sets. All bearings must be removed before any can be installed. No. 1 bearing must be removed first, then No. 2, then 3, 4 and 5. When installing the bearings, No. 5 must be installed first, then 4, 3, 2 and 1.

Camshaft Bearing Remover and Installer J-6098-01 is available for this procedure.

This set can be used to remove cam bearings with the engine either in or out of the vehicle.

To replace bearings with engine in vehicle proceed as follows:

Removal

1. Remove engine oil pan and camshaft.
2. Install No. 1 Cam Bearing Remover and Installer on Handle J-8092 and drive out front cam bearing.
3. Place Pilot on Driver and install No. 2 Cam bearing Tool on driver and drive out No. 2 bearing.
4. Remove No. 3, 4 and 5 bearings in the same manner.

NOTE: Each cam bearing is a different diameter and the correct sequence must be used both for removal and installation.

5. To remove the injection pump driven gear bushings, drive both bushings at the same time from the rear to the front of the block using tool J-28439-2 and driver handle J-8092.

Installation

NOTE: To aid aligning bearings with oil passages, place each bearing in the front bore with tapered edge toward block and align the oil hole in the bearing with the center of the oil slot in the bore. Mark bottom of

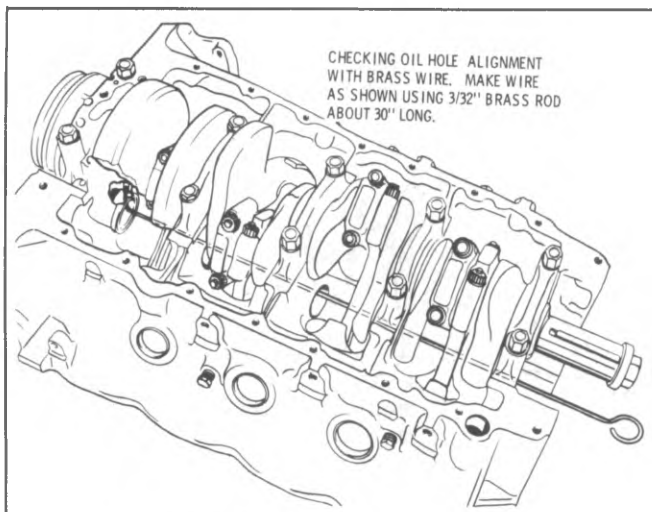


Fig. 6A3-85--Checking No. 5 Oil Hole

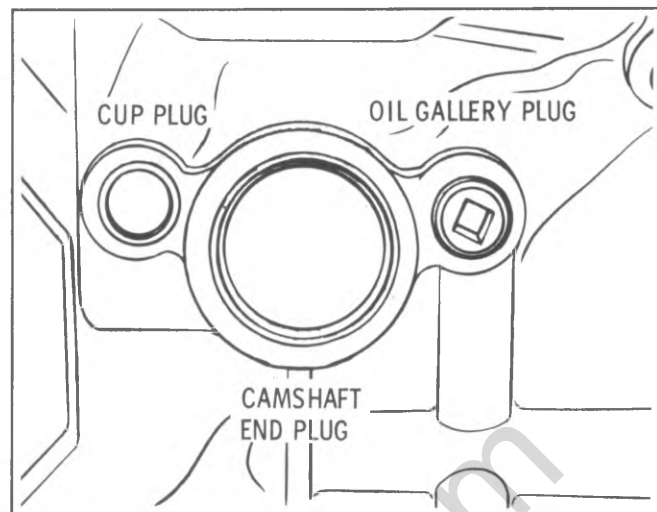


Fig. 6A3-86--Camshaft & Oil Gallery Plugs

bearing. When installing the bearings, the mark will act as a guide.

Slide bearing pilot spacer on bearing pilot. For bearings 5, 4, 3 and 2 put the driver through the pilot, then screw the installer on the driver. Install the bearings as follows:

1. Place new No. 5 bearing on driver and drive bearing in until the last white line on the driver is flush with the front face of the pilot.

2. Use a piece of 3/32" brass rod with a 90° bend at the end to check the oil hole opening as shown in Fig. 6A3-85.

3. Place No. 4 bearing on installer and drive in until the next to last white line on driver is flush with pilot.

4. Follow the same procedure to install No. 3 and No. 2.

5. Place No. 1 bearing on installer. Drive bearing in until it is flush with front face of block.

6. To install the injection pump bushings, align the holes in the bushings with the holes in the block. Install both bushings from the front; driving the rear bushing first, using the long end of tool J-28439-1 and driver handle J-8092. Drive the front bushing with the short end of J-28439-1.

7. Use a piece of 3/32" brass rod with a 90° bend at the end to check all oil hole openings. Wire must enter hole or the bearing will not receive sufficient lubrication. (See Fig. 6A3-85).

8. Install camshaft and engine oil pan.

Camshaft and Oil Gallery Plugs (Fig. 6A3-86).

The left-hand rear oil gallery plug is not shown. It is a threaded plug in the end of the left gallery just rearward of the vacuum pump. A small hole is provided in the plug for vacuum pump lubrication. The cup plug shown provides access to the threaded plug.

The front oil gallery plugs (not shown) are threaded. The plug on the right side has a small hole which provides lubrication for the timing chain and gears.

To find out if the camshaft plug at the rear of the engine is properly installed, place a straight edge across the machined surface of the rear of the block and measure from the straight edge to the lip of the plug. Dimension should be .250" maximum to .160" minimum.

UNIT REPAIR

ENGINE

Removal

1. Drain cooling system.
2. Remove air cleaner and install screened cover J-26996-1.
3. Remove hood from hinges, mark hood for reassembly.
4. Disconnect battery negative cables at batteries and ground wires at inner fender panel. Disconnect engine ground strap.
5. Disconnect radiator hoses, cooler lines, heater hoses, vacuum hoses, power steering pump hoses at power steering gear, air conditioning compressor with brackets and hoses attached, fuel hose from fuel pump and wiring.
6. Remove hairpin clip at bellcrank.
7. Remove throttle cable from intake manifold bracket,

then position cable away from engine.

8. Remove upper radiator support and radiator.
9. Raise vehicle.
10. Disconnect exhaust pipes at manifolds.
11. Remove torque converter cover and three bolts holding converter to flywheel.
12. Remove engine mount through bolts.
13. Remove three bolts, transmission to engine on the right side. Disconnect wires from starter and remove starter.
14. Lower vehicle.
15. Place board on top of jack and slightly raise transmission. Remove three left transmission to engine bolts. Remove engine.
16. If vehicle is to be moved, install converter holding tool J-21654 and support transmission with chain support.

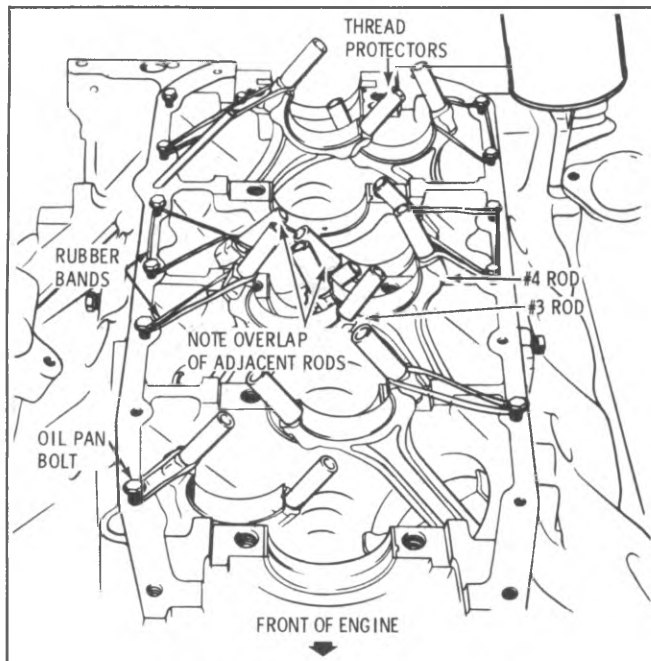


Fig. 6A3-87-Crankshaft Removal

Installation

1. Install engine in place. Locate engine dowels into transmission and position through bolts into mounts and tighten. Install three left transmission to engine bolts. Remove support chains and jack.
2. Raise vehicle. Replace three transmission to engine bolts on the right side. Replace starter and attaching bolts and attach wires.
3. Install three converter to flywheel bolts and torque converter cover bolts to 40 lbs. ft. (54 N·m).
4. Connect exhaust pipes and lower vehicle.
5. Install radiator and upper radiator support.
6. Connect radiator hoses, cooler lines, heater hoses, vacuum hoses, power steering pump hoses at pump, power steering hose bracket to engine, air conditioning compressor, fuel hose to fuel pump and wiring.
7. Position bellcrank and cables to intake manifold. Install bellcrank. Install throttle rod to bellcrank. Connect breather pipes and connect fuel return line to pump.
8. Install air cleaner.
9. Install and align hood with scribe marks.
10. Connect battery cables and ground wires.
11. Add engine oil and coolant.

CRANKSHAFT

Removal (Cylinder Heads On)

1. With engine on stand and oil pan, oil pump and front cover removed, rotate crankshaft to the position where the connecting rod nuts are most accessible. Fig. 6A3-87 shows the engine with the No. 3 and No. 4 rods in the fully extended position.
2. Remove connecting rod caps and install thread protectors. Remove fuel pump eccentric from crankshaft.
3. Remove main bearing caps.
4. Note position of keyway in crankshaft so it can be installed in the same position.
5. Lift crankshaft out of block. Rods will pivot to the

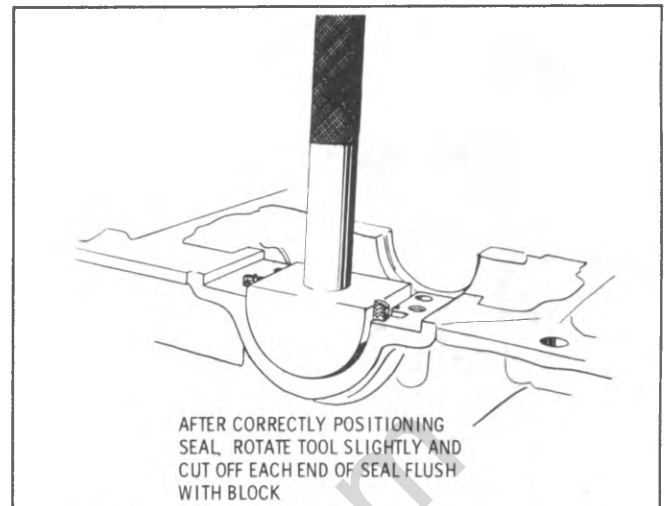


Fig. 6A3-88-Installing Rear Main Oil Seal-Upper Half

center of the engine when the crankshaft is removed. Do not allow pistons to move in their bore during or after crankshaft removal.

Installation

1. Install sufficient oil pan bolts in pan rails to align rods with rubber bands. Align rods so that the inner thread protectors of adjacent rods overlap approximately one inch as shown. Alignment can be adjusted by increasing tension on rubber bands with additional turns around the pan bolts or thread protectors.
 2. Measure the crankshaft journals and crankpins with a micrometer to determine the correct size rod and main bearings to be used.
- NOTE:** Whenever a new or reconditioned crankshaft is installed, new connecting rod bearings and main bearings should be installed.
3. Position crankshaft keyway in the same position as removed and lower into block. The connecting rods will follow the crankpins into the correct position as the crankshaft is lowered.
 4. Remove rubber bands, thread protectors and pan bolts and assemble engine.

Removal (Cylinder Heads Removed)

1. With engine on stand, remove oil pan, front cover, connecting rods, oil pump and fuel pump eccentric from crankshaft.
2. Remove main bearing caps and lift crankshaft out of block.

Installation

1. Measure the crankshaft journals and crankpins with a micrometer to determine the correct size rod and main bearings to be used.
- NOTE:** Whenever a new or reconditioned crankshaft is installed, new connecting rod bearings and main bearings should be installed.
2. Position upper half of main bearings in block and lubricate with engine oil.
 3. Install a new rear main bearing seal. (Fig. 6A3-88).
- NOTE:** Rear bearing must be removed to replace seal.
4. After oil passages in crankshaft have been checked for being open and shaft is clean, place shaft in block.

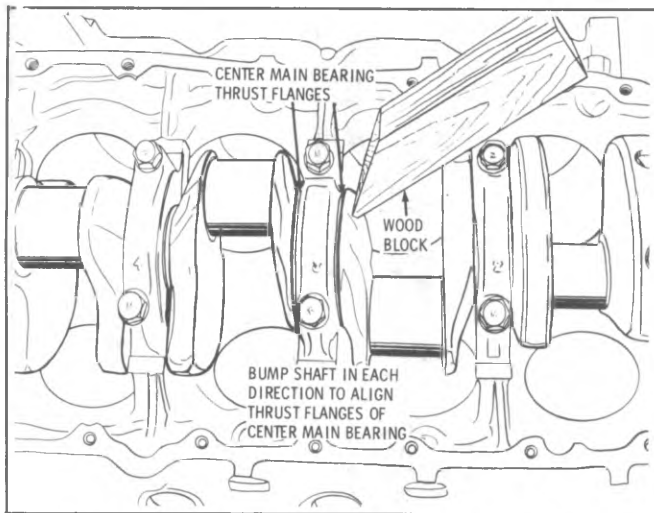


Fig. 6A3-89—Aligning Center Main Bearing Flanges

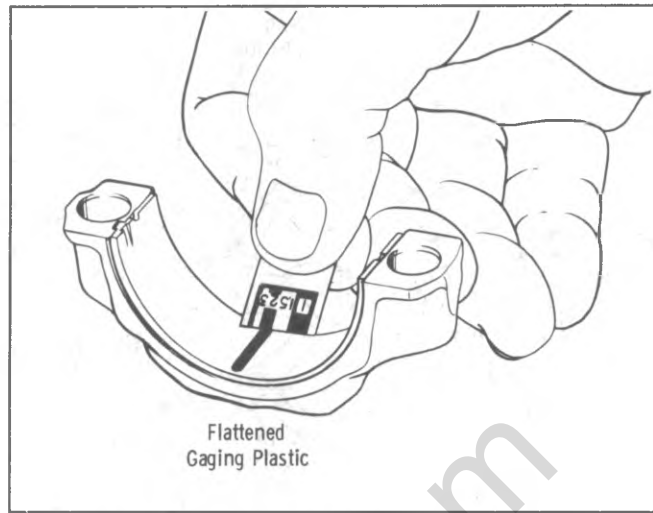


Fig. 6A3-91—Checking Bearing Clearances

Lubricate thrust flanges of the center bearing with 1050169 Lubricant or equivalent. Install caps with lower half of bearing lubricated with engine oil. Lubricate cap bolts with engine oil and install, but do not tighten.

5. With a block of wood (Fig. 6A3-89) bump shaft in each direction to align thrust flanges of center main bearing.

NOTE: After bumping shaft in each direction, wedge the shaft to the front and hold it while torquing No. 3 cap bolts.

6. Torque all main bearing bolts to 120 lbs. ft. (163 N·m). (Fig. 6A3-90).

7. Reassemble engine and install in chassis.

MAIN BEARINGS

Main bearing clearance must not exceed .0035" on all bearings. The .0035" clearance is permissible only if the engine is disassembled for other than a bearing noise condition. If bearings are noisy or if a visual inspection indicates defective bearings, new bearings must be installed within the specifications outlined under MAIN BEARINGS-REPLACE.

Bearings which fall within the .0035" specifications should not be replaced if the bearings show normal wear

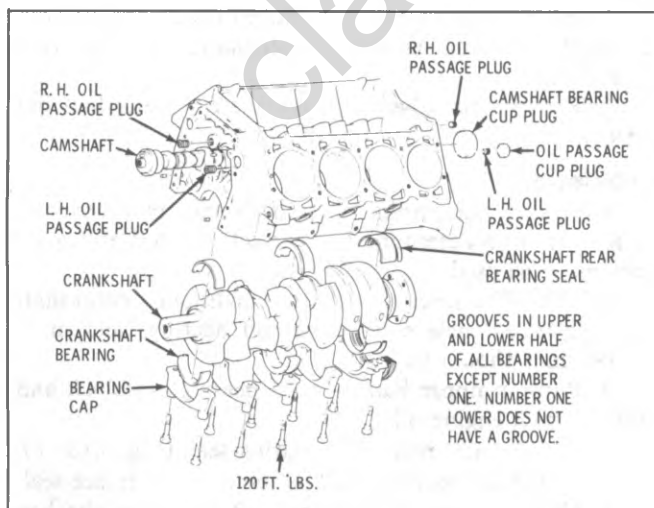


Fig. 6A3-90—Crankshaft-Exploded View

pattern or slight radial grooves.

Checking Bearing Clearances

1. Remove bearing cap and wipe oil from crankshaft journal and outer and inner surfaces of bearing shell.

2. Place a piece of plastic gaging material in the center of bearing.

3. Use a floor jack or other means to hold crankshaft against upper bearing shell. This is necessary to obtain accurate clearance readings when using plastic gaging material.

4. Reinstall bearing cap and bearing. Place engine oil on cap bolts and install. Torque bolts to 120 lbs. ft. (163 N·m).

5. Remove bearing cap and determine bearing clearance by comparing the width of the flattened plastic gaging material at its widest point with graduations on the gaging material container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch. (Fig. 6A3-91). If the clearance is greater than .0035", REPLACE BOTH BEARING SHELLS AS A SET. Recheck clearance after replacing shells. (Refer to MAIN BEARINGS-REPLACE.)

NOTE: Main bearing end thrust clearance should be .0035" to .0135" as checked with a dial indicator.

Main Bearings Replacement

Main bearing clearances must be corrected by the use of selective upper and lower shells. UNDER NO CIRCUMSTANCES should the use of shims behind the shells, to compensate for wear, be attempted.

NOTE: The upper and lower shells must be installed in pairs. Sizes of the bearings are located on the tang. (Fig. 6A3-92). It is possible to have more than one bearing size in the same engine.

To install main bearing shells, proceed as follows:

1. Loosen all main bearing caps.

2. Remove bearing cap and remove lower shell.

3. Insert a flattened cotter pin or roll out pin in the oil passage hole in the crankshaft, then rotate the crankshaft in the direction opposite to cranking rotation. The pin will contact the upper shell and roll it out.

4. The main bearing journals should be checked for roughness and wear. Slight roughness may be removed with

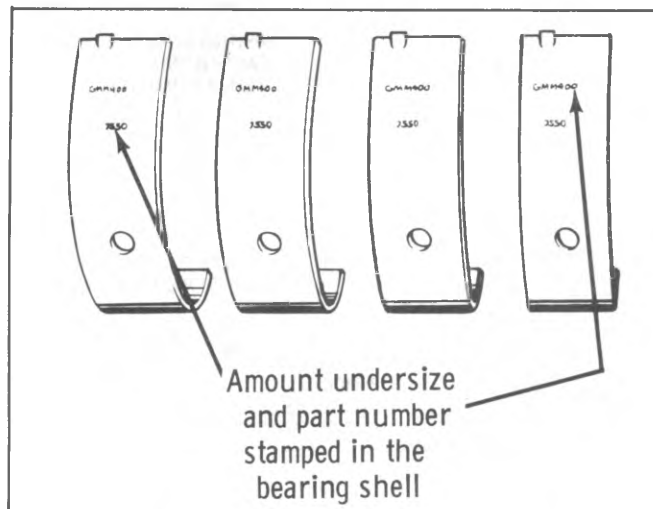


Fig. 6A3-92--Main Bearing Identification

a fine grit polishing cloth saturated with engine oil. Burrs may be removed with a fine oil stone. If the journals are scored or ridged, the crankshaft must be replaced.

NOTE: The journals can be measured for out-of-round with the crankshaft installed by using a crankshaft caliper and inside micrometer or a main bearing micrometer. The upper bearing shell must be removed when measuring the crankshaft journals. Maximum out-of-round of the crankshaft journals must not exceed .0015".

5. Clean crankshaft journals and bearing caps thoroughly before installing new main bearings.

6. Apply Special Lubricant, No. 1050169 or equivalent to the thrust flanges of bearing shells on No. 3 bearing.

7. Place new upper shell on crankshaft journal with locating tang in correct position and rotate shaft to turn it into place using cotter pin or roll out pin as during removal.

8. Place new bearing shell in bearing cap.

9. No. 5 bearing - Install new asbestos oil seal in the rear main bearing cap. (REAR MAIN BEARING OIL SEAL) (Fig. 6A3-93) Install # 1050026 or equivalent sealer on cap as shown.

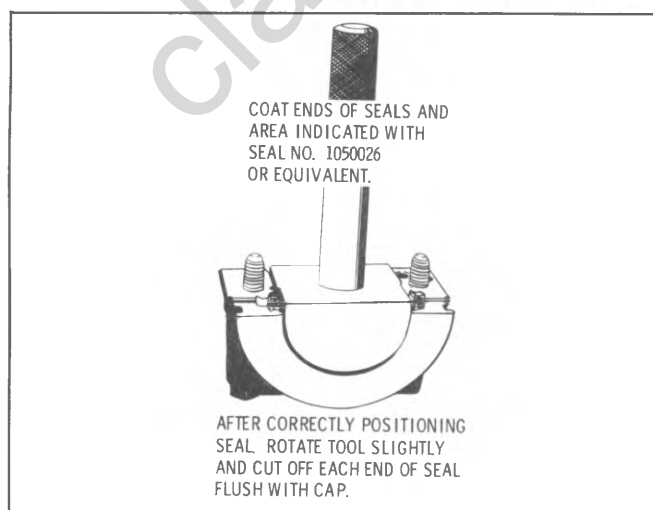


Fig. 6A3-93--Installing Rear Main Oil Seal

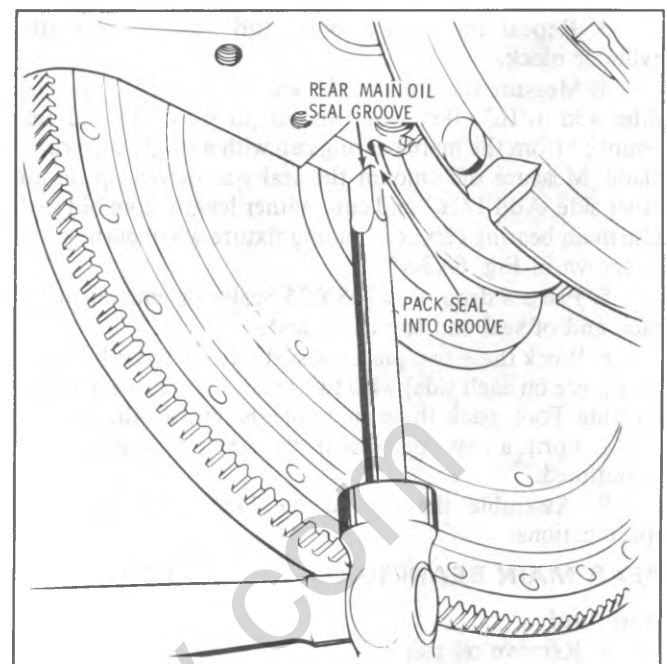


Fig. 6A3-94--Packing Oil Seal

10. Install bearing caps, lubricate bolt threads with engine oil, then install. Torque bolts to 120 lbs. ft. (163 N·m).

REAR MAIN BEARING UPPER OIL SEAL

Repair

Tools have been released to provide a means of correcting engine rear main bearing upper seal leaks without the necessity of removing the crankshaft. The procedure for seal leak correction is listed below.

1. Drain oil and remove oil pan and rear main bearing cap.

2. Insert Packing Tool J-25286 against one end of seal in cylinder block and drive the old seal gently into the groove until it is packed tight. This varies from 1/4" to 3/4", depending on the amount of pack required. (Fig. 6A3-94).

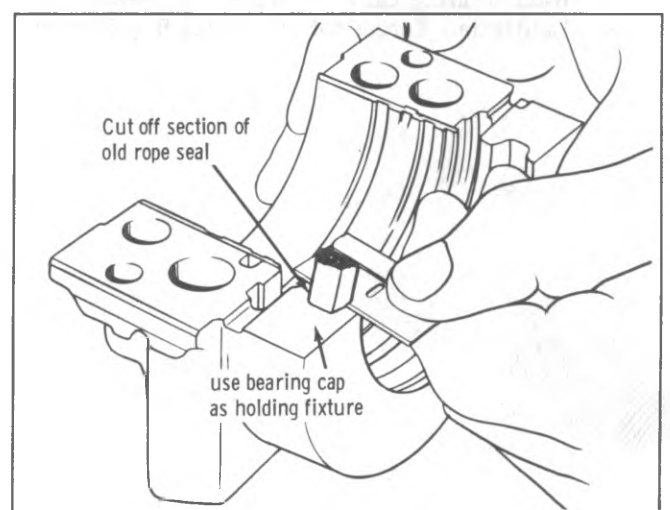


Fig. 6A3-95--Cutting Off Lower Seal Ends

3. Repeat this on the other end of the seal in the cylinder block.

4. Measure the amount the seal was driven up on one side; add $1/16$ " , then cut this length from the old seal removed from the main bearing cap with a single edge razor blade. Measure the amount the seal was driven up on the other side. Add $1/16$ " and cut another length from old seal. Use main bearing cap as a holding fixture when cutting seal as shown in Fig. 6A3-95.

5. Place a drop of #1050026 Sealer or equivalent, on each end of seal and cap as indicated.

6. Work these two pieces of seal into the cylinder block (one piece on each side) with two small screwdrivers. Using Packing Tool, pack these short pieces up into the block.

7. Form a new rope seal in the rear main bearing cap as outlined.

8. Assemble the cap to the block and torque to specifications.

REAR MAIN BEARING LOWER OIL SEAL

Removal

1. Remove oil pan.
2. Remove the rear main bearing cap.
3. Remove rear main bearing insert and old seal.
4. Clean bearing cap and seal grooves and inspect for cracks.

Installation

1. Install seal into bearing cap, packing by hand.
2. Using seal installer, hammer seal into groove.
NOTE: To check if seal is fully seated in the bearing cap, slide the tool away from seal. With tool fully seated in the bearing cap, slide tool against the seal. If undercut area of tool slides over the seal, the seal is fully seated. If tool butts against the seal, the seal must be driven further into the seal groove. Rotate tool before cutting off excess seal packing.
3. With tool slightly rotated, cut seal flush with mating surface. With screwdriver, pack seal end fibers towards center, away from edges. Rotate seal installer when cutting seal to avoid damage to tool.
4. Clean bearing insert and install in bearing cap.
5. Clean crankshaft bearing journal and seal contact. Install sealer on cap as shown.
6. Install bearing caps, lubricate bolt threads with engine oil and install. Torque bolts to 120 lbs. ft. (163 N·m).

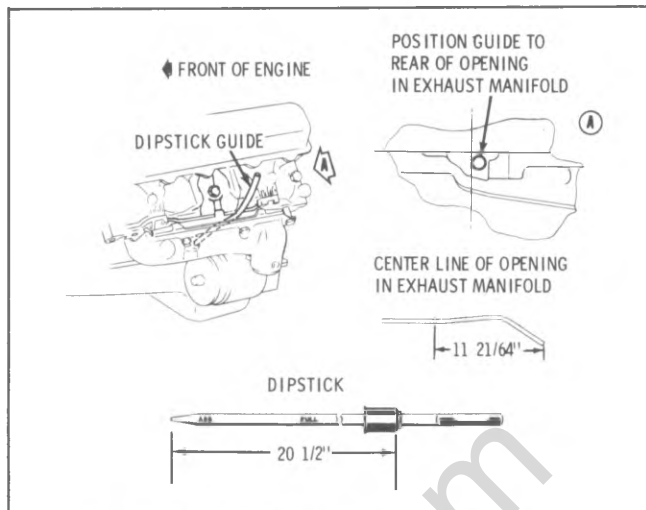


Fig. 6A3-96--Engine Oil Dipstick Identification

7. Install pan with new gaskets.
8. Install lower flex plate cover.

FLEX PLATE

One bolt hole in the flex plate is offset and the flywheel will attach to the crankshaft in only one position. The flex plate ring gear is not replaceable.

ENGINE OIL DIPSTICK AND DIPSTICK GUIDES (Fig. 6A3-96).

Removal

Removal of the dipstick guide will assist in easier removal and installation of the left cylinder head. Before removing the left cylinder head, the guide can be removed using the following procedure:

1. Position the slide hammer from Tool J-2619 on a $1/4$ " diameter 6" long bolt.
2. Insert the threaded end of the bolt into the oil dipstick guide and clamp with a vise grip type pliers.
3. Use slide hammer to tap out tube.

To install, insert a $1/4$ " diameter x $1/2$ " long bolt into the tube and tap on the bolt head to drive tube into the block.

GENERAL DATA:

TYPE		V-8 DIESEL
DISPLACEMENT	LITRE (*)	5.7 (Z)
RPO		LF9
BORE		4.057
STROKE		3.385
COMPRESSION RATIO		22.5:1
FIRING ORDER		1-8-4-3-6-5-7-2

CYLINDER BORE:

DIAMETER		4.056-4.058	
OUT OF ROUND	PRODUCTION		
	SERVICE	N.A.	
TAPER	PRODUCTION	THRUST SIDE	N.A.
		RELIEF SIDE	N.A.
	SERVICE		N.A.

PISTON:

CLEARANCE	PRODUCTION	N.A.
	SERVICE	N.A.

PISTON RING:

COMPRESSION	GROOVE CLEARANCE	PRODUCTION	TOP	.004-.006
			2ND	.0018-.0038
		SERVICE		N.A.
	GAP	PRODUCTION	TOP	.015-.025
			2ND	.015-.025
		SERVICE		N.A.
OIL	GROOVE CLEARANCE	PRODUCTION	N.A.	
		SERVICE	N.A.	
	GAP	PRODUCTION		
		SERVICE	N.A.	

* VIN Designation

PISTON PIN

LF9

DIAMETER		N.A.
CLEARANCE	PRODUCTION	N.A.
	SERVICE	N.A.
FIT IN ROD		.0003-.0013

CRANKSHAFT

MAIN JOURNAL	DIAMETER		ALL 2.9993-3.0003
	TAPER	PRODUCTION	N.A.
		SERVICE	N.A.
	OUT OF ROUND	PRODUCTION	N.A.
SERVICE		N.A.	
MAIN BEARING CLEARANCE	PRODUCTION		#1-2-3-4 .0005-.0021
			#5 .0015-.0031
	SERVICE		N.A.
CRANKSHAFT END PLAY			.0035-.0135
CRANKPIN	DIAMETER		2.1238-2.1248
	TAPER	PRODUCTION	N.A.
		SERVICE	N.A.
	OUT OF ROUND	PRODUCTION	N.A.
SERVICE		N.A.	
ROD BEARING CLEARANCE	PRODUCTION	.0005-.0026	
	SERVICE	N.A.	
ROD SIDE CLEARANCE			.006-.020

CAMSHAFT

LOBE LIFT ± .002	INTAKE	N.A.
	EXHAUST	N.A.
JOURNAL DIAMETER		N.A.
CAMSHAFT END PLAY		.011-.077

TORQUE SPECIFICATIONS

Engine Specifications

VALVE SYSTEM			LF9
LIFTER			HYDRAULIC
ROCKER ARM RATIO			N.A.
VALVE LASH	INTAKE		NON-ADJUSTABLE
	EXHAUST		
FACE ANGLE (INT. & EXH.)			@
SEAT ANGLE (INT. & EXH.)			*
SEAT RUNOUT			.003
SEAT WIDTH	INTAKE		.075-.098
	EXHAUST		.037-.075
STEM CLEARANCE	PRODUCTION	INT.	
		EXH.	.0015-.0032
	SERVICE		N.A.
VALVE SPRING (OUTER)	FREE LENGTH		N.A.
	PRESSURE LBS. @ IN.	CLOSED	76-84 @ 1.670
		OPEN	137-151 @ 1.336
	INSTALLED HEIGHT ± 1/32"		
DAMPER	FREE LENGTH		N.A.
	APPROX. # OF COILS		N.A.

@ — 44° INTAKE — 30° EXHAUST

* — 45° INTAKE — 31° EXHAUST

	lb. ft.	N·m
Injection Pump Attaching Nuts	19	26
Injection Line Nut To Pump	35	47
Injection Pump Adapter Bolts	25	34
Injection Line Nut To Nozzle	25	34
Injection Pump Fuel Filter Inlet Line	20	27
Injection Pump Fuel Filter Outlet Line	10	14
Injection Pump Fuel Inlet Line	20	27
Injection Nozzle Hold-Down Clamp	25	34
Glow Plug	12	16
Crankshaft Bearing Cap Bolts	120	163
Flywheel To Converter	40	54
Flywheel To Crankshaft	60	81
Oil Pump To Bearing Cap Bolts	35	47
Oil Pump Cover To Pump Bolts	8	11
Rocker Arm Pivot Bolt To Head	25	34
Valve Cover Bolts Fully Driven, Seated, Not Stripped		
Oil Pan Bolts	10	14
Oil Pan Drain Plug	30	41
Crankshaft Balancer To Crankshaft Bolt	200-310	271-420
Oil Filter Element To Base	20	27
Oil Filter Assembly To Cylinder Block Bolts	35	47
Oil Cooler Lines To Oil Filter Base	12	16
Oil Cooler Lines To Radiator	25	34
Support/Front Cover To Cylinder Block Bolts 3/8"	35	34
Fan Driven Pulley To Hub Bolts	20	27
Fan Driving Pulley To Balancer Bolts	20	27
Water Pump To Front Cover Bolts	13	18
Water Outlet To Manifold Bolts	20	27
*Intake Manifold To Cylinder Head Bolts	40	54
Exhaust Manifold To Cylinder Head Bolts	25	34
Engine Mount To Cylinder Block Bolts	75	102
Engine Mount To Frame Mount	50	68
Starter To Cylinder Block Bolts	35	47
Starter Brace To Cylinder Block Bolts	25	34
Starter Brace To Starter Bolt	15	20
Vaccum Pump Clamp To Cylinder Block Bolt	17	23
*Cylinder Head Bolts	130	176
Connecting Rod Nuts	42	57
Camshaft Sprocket Bolt	65	88

* Clean and dip entire bolt in engine oil before tightening to obtain a correct torque reading.

SECTION 6B

ENGINE COOLING

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Cylinder Block and Cylinder Head.....	6B-5		

GENERAL DESCRIPTION

All Chevrolet trucks have pressure type engine cooling systems with thermostatic control of coolant circulation. The cooling system is sealed by a pressure type radiator filler cap.

The pressure type radiator filler cap (fig. 6B-1) is designed to operate the cooling system at higher than atmospheric pressure. The higher pressure raises the boiling point of the coolant which increases the efficiency of the radiator.

The radiator filler cap contains a pressure relief valve and a vacuum relief valve. The pressure relief valve is held against its seat by a spring, which when compressed, allows excessive pressure to be relieved out the radiator overflow.

The vacuum valve relieves the vacuum created when the system cools.

The cooling systems water pump is of the centrifugal vane impeller type (figs. 6B-2 and 6B-3). The bearings are permanently lubricated during manufacture and are sealed to prevent the loss of lubricant or the entry of dirt and water. The pump requires no care other than to make certain the

air vent at the top of the housing and the drain holes in the bottom do not become plugged with dirt or grease.

Water pump components are not serviced separately; therefore, in the event of water pump failure, it will be necessary to replace the complete assembly - removal and installation procedures are covered in this section.

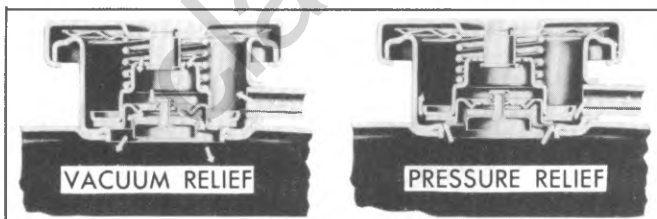


Fig. 6B-1--Radiator Pressure Cap

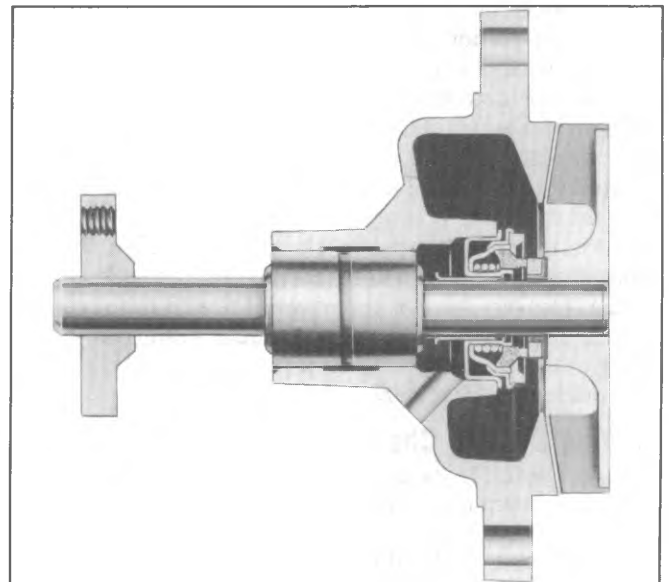


Fig. 6B-2--Water Pump--Typical L-6

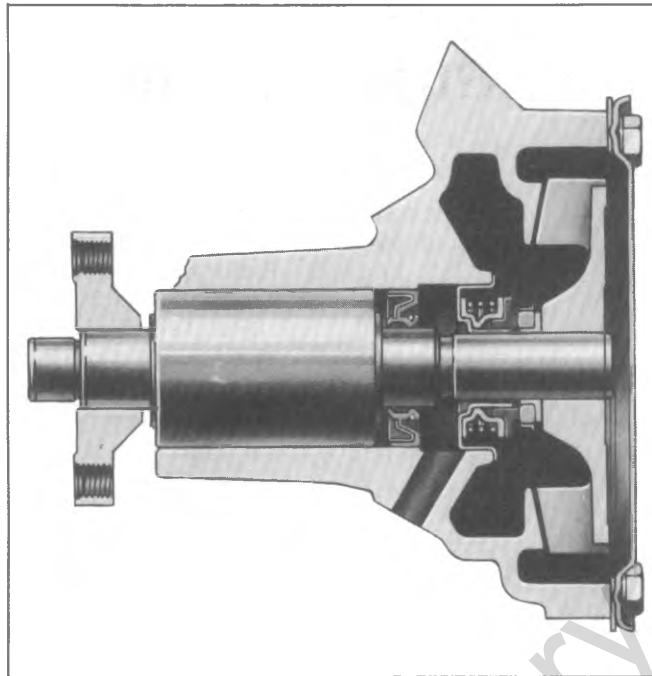


Fig. 6B-3--Water Pump--Typical V8

DIAGNOSIS

If the cooling system requires frequent addition of coolant in order to maintain the proper level, check all units and connections in the cooling system for evidence of leakage. Inspection should be made with cooling system cold. Small leaks which may show dampness or dripping can easily escape detection when the engine is hot, due to the rapid evaporation of coolant. Tell-tale stains of grayish white or rusty color, or dye stains from anti-freeze, at joints in cooling system are almost always sure signs of small leaks even though there appears to be no damage.

Air may be drawn into the cooling system through leakage at the water pump seal or through leaks in the coolant recovery system. Gas may be forced into the cooling system through leakage at the cylinder head gasket even though the leakage is not sufficient to allow water to enter the combustion chamber.

Cooling System Checks

To check for exhaust leaks into the cooling system, drain the system until the coolant level stands just above the top of the cylinder head, then disconnect the radiator upper hose and remove the thermostat and fan belt. Start the engine and quickly accelerate several times. At the same time note any appreciable water rise or the appearance of bubbles which are indicative of exhaust gases leaking into the cooling system.

NOTE: A defective head gasket may allow exhaust gases to leak into the cooling system. This is particularly damaging to the cooling system as the gases combine with the water to form acids which are harmful to the radiator and engine.

Water pump operation may be checked by running the engine while squeezing the radiator upper hose. A pressure surge should be felt. Check for a plugged vent-hole in pump.

Test for restriction in the radiator, by warming the engine up and then turning the engine off and feeling the radiator. The radiator should be hot along the left side and warm along the right side, with an even temperature rise from right to left. Cold spots in the radiator indicate clogged sections.

An operational check of the thermostat can be made by hanging the thermostat on a hook in a 33% glycol solution 25°F (-4°C) above the temperature stamped on the thermostat valve. Submerge the valve completely and agitate the solution thoroughly. Under this condition the valve should open. Remove the thermostat and place in a 33% glycol solution 10°F (-12°C) below temperature indicated on the valve. With valve completely submerged and water agitated thoroughly, the valve should close completely.

Coolant Loss

1. Check for crack in block. Pull engine oil dip-stick to check for water in crankcase.
2. Remove rocker arm covers and check for cracked cylinder head.
3. Remove cylinder heads and check gaskets. While heads are off, check for cracks in heads or block.

Overheating

1. Check to see that the radiator cap seats in radiator filler neck and releases at specified pressure [15 psi (103 kPa)].
2. Check coolant level.
3. Check temperature sending unit and/or gage.
4. Check engine thermostat.
5. Check fan belt for excessive looseness.
6. Check for punctures in radiator, ruptured or

disconnected hoses, loose pressure cap or use of low boiling point antifreeze. These conditions prevent cooling system from maintaining proper pressure.

7. Clean debris from radiator and/or condenser.
8. Check engine operation to make sure tune-up is not needed. Improper timing may cause overheating.
9. Check for driving conditions which may cause overheating. Prolonged idling, start and stop driving in long lines of traffic on hot days, climbing steep grades on hot days, etc. will occasionally cause coolant to boil.
10. Clean cooling system.
11. Remove cylinder heads and check water passages in heads and block for obstructions.

FAN CLUTCH

1. Noise

Fan noise is sometimes evident under the following normal conditions: a. when clutch is engaged for maximum cooling, and b. during first few minutes after start-up until the clutch can re-distribute the silicone fluid back to its normal disengaged operating condition after overnight settling.

However, fan noise or an excessive roar will generally occur continuously under all high engine speed conditions (2500 r.p.m. and up) if the clutch assembly is locked up due to an internal failure. If the fan cannot be rotated by hand or there is a rough grating feel as the fan is turned, the clutch should be replaced.

2. Looseness

Under various temperature conditions, there is a visible lateral movement that can be observed at the tip of the fan blade. This is a normal condition due to the type of bearing used. Approximately 1/4" (6.35mm) maximum lateral movement measured at the fan tip is allowable. This is not cause for replacement.

3. Silicone Fluid Leak

The operation of the unit is generally not affected by small fluid leaks which may occur in the area around the bearing assembly. However, if the degree of leakage appears excessive, proceed to item 4.

4. Engine Overheating

A. Start with a cool engine to ensure complete fan clutch disengagement.

B. If the fan and clutch assembly free-wheels with no drag (revolves over 5 times when spun by hand), the clutch should be replaced. If clutch performs properly with a slight drag go to step C.

NOTE: Testing a fan clutch by holding the small hub with one hand and rotating the aluminum housing in

a clockwise/counterclockwise motion will cause the clutch to free-wheel, which is a normal condition when operated in this manner. This should not be considered a test by which replacement is determined.

C. Use dial type thermometer, J6742-01, or similar type.

NOTE: J6742-01 reads to 180°F (82°C), therefore, allow approximately 3/16" (5mm) pointer movement for each 10°F (-12°C) over 180°F (82°C).

CAUTION: Check for adequate clearance between fan blades and thermometer sensor before starting engine.

Position thermometer so that the thermometer sensor is centered in the space between the fan blades and radiator. This can be achieved by inserting the sensor through one of the existing holes in the fan shroud or fan guard, or by placing between the radiator and the shroud. On some models, it may be necessary to drill a 3/16" (5mm) hole in the fan shroud to insert J6742-01.

D. Cover radiator grille sufficiently to induce a high engine temperature. Start engine and turn on air conditioning if equipped. Maintain a position in front of the vehicle to observe the thermometer reading. With a rod, broom handle, or etc., push on the accelerator linkage to maintain approximately 3000 r.p.m.

E. Observe thermometer reading when clutch engages. It will take approximately 5 to 10 minutes for the temperature to become high enough to allow engagement of the fan clutch. This will be indicated by an increase or roar in fan air noise and by a drop in the thermometer reading of approximately 5 to 15 degrees F (-15 to -9.4°C). If the clutch did not engage between 165-190°F (74-88°C) the unit should be replaced.

NOTE: Be sure fan clutch was disengaged at beginning of test.

CAUTION: Do not continue test past a thermometer reading of 190°F (88°C) to prevent engine overheating.

If no sharp increase in fan noise or temperature drop was observed and the fan noise level was constantly high from start of test to 165°F (74°C), the unit should be replaced.

F. As soon as the clutch engages, remove the radiator grille cover and turn off the air conditioning to assist in engine cooling. The engine should be run at approximately 1500 r.p.m.

G. After several minutes the fan clutch should disengage, as indicated by a reduction in fan speed and roar.

MAINTENANCE AND ADJUSTMENTS

COOLANT LEVEL

With the coolant recovery system, the coolant level is checked by observing the liquid level in the reservoir. The radiator cap need not be removed. The coolant level should

be at the "Cold Full" mark when cooling system cools and coolant is at ambient temperature. After the vehicle has been driven sufficiently to obtain normal operating

temperatures, the level should be at the "Hot Full" mark.

NOTE: Periodically, the radiator cap should be removed to observe the coolant level in the radiator.

WARNING: The radiator coolant level should only be checked when the engine is cool. If the radiator cap is removed from a hot cooling system, serious personal injury may result.

Coolant levels in crossflow radiators with recovery tanks should be maintained to the top of the filler neck.

The recovery tank should be at its appropriate mark when checked.

All cooling systems are pressurized with a 15 psi (103 kPa) pressure cap which permits safe engine operation at coolant temperatures of up to 258°F (126°C).

When the radiator cap is removed or loosened, the system pressure drops to atmospheric, and the heat which had caused water temperature to be higher than 212°F (100°C), will be dissipated by conversion of water to steam. Inasmuch as the steam may form in the engine water passages, it will blow coolant out of the radiator upper hose and tank top, necessitating coolant replacement. Engine operating temperatures higher than the normal boiling point of water are in no way objectionable so long as the coolant level is satisfactory when the engine is cool.

Upon repeated coolant loss, the pressure radiator cap and seat should be checked for sealing ability. Also, the cooling system should be checked for loose hose connections, defective hoses, gasket leaks, etc.

It is the owner's responsibility to keep the freeze protection at a level commensurate with the area in which the vehicle will be operated. Regardless of whether freezing temperatures are or are not expected, cooling system protection should be maintained at least to -20°F (-29°C) to provide adequate corrosion protection and proper temperature indicating light operation. With glycol content less than requirement for -20°F (-29°C), protection, coolant boiling point is less than the temperature indicating light setting. When adding solution due to loss of coolant for any reason or in areas where temperatures lower than -20°F (-29°C) may occur, a sufficient amount of an ethylene glycol base coolant that meets GM Specification 1899-M should be used.

Every two years the cooling system should be serviced by flushing with plain water, then completely refilled with a fresh solution of water and a high-quality, inhibited (permanent-type) glycol base coolant meeting GM Specification 1899-M and providing freezing protection at least to -20°F (-29°C). At this time, also add GM Cooling System Inhibitor and Sealer or equivalent. In addition, Cooling System Inhibitor and Sealer should be added every fall thereafter.

NOTE: ALCOHOL OR METHANOL BASE COOLANTS OR PLAIN WATER ARE NOT RECOMMENDED FOR YOUR ENGINE AT ANY TIME.

Two common causes of corrosion are: (1) air suction—Air may be drawn into the system due to low liquid level in the radiator, leaky water pump or loose hose connections,



Fig. 6B-4--Pressure Checking Radiator Cap

defective pressure cap or leaky overflow hose connection to radiator on recovery bottle; (2) exhaust gas leakage—Exhaust gas may be blown into the cooling system past the cylinder head gasket or through cracks in the cylinder head and block.

Cleaning

A good cleaning solution should be used to loosen the rust and scale before reverse flushing the cooling system. There are a number of cleaning solutions available and the manufacturer's instructions with the particular cleaner being used should always be followed.

WARNING: If you siphon coolant from the radiator, do not use mouth to start siphoning action. The coolant solution is **POISONOUS** and can cause death or serious illness if swallowed.

Reverse Flushing

Reverse flushing should always be accomplished after the system is thoroughly cleaned. Flushing is accomplished through the system in a direction opposite to the normal flow. This action causes the water to get behind the corrosion deposits and force them out.

Radiator

1. Remove the radiator upper and lower hoses and replace the radiator cap.
2. Attach a lead-away hose at the top of the radiator.
3. Attach a new piece of hose to the radiator outlet connection and insert the flushing gun in this hose.
4. Connect the water hose of the flushing gun to a water outlet and the air hose to an air line.

CAUTION: Apply air gradually as a clogged radiator will stand only 20 psi (138 kPa) pressure.

5. Turn on the water and when the radiator is full, turn on the air in short blasts, allowing the radiator to fill between blasts of air.
6. Continue this flushing until the water from the lead-away hose runs clear.

Cylinder Block and Cylinder Head

1. With the thermostat removed, attach a lead-away hose to the water pump inlet and a length of new hose to the water outlet connection at the top of the engine.

NOTE: Disconnect the heater hose and cap connections at engine when reverse flushing engine.

2. Insert the flushing gun in the new hose.

3. Turn on the water and when the engine water jacket is full, turn on the air in short blasts.

4. Continue this flushing until the water from the lead-away hose runs clear.

Heater Core

1. Remove water outlet hose from heater core pipe.

2. Remove inlet hose from engine connection.

3. Insert flushing gun and flush heater core. Care must be taken when applying air pressure to prevent damage to the core.

Fan Belt Adjustment

1. Loosen bolts at generator mounting.

2. Pull generator away from engine until desired tension reading is obtained with a strand tension gage.

3. Tighten all generator bolts securely.

Radiator Cap

The radiator cap should be washed with clean water and pressure checked at regular tune-up intervals. Inspect rubber seal on cap for tears or cracks. Install radiator cap on tester (fig. 6B-4). If the pressure cap will not hold pressure or does not release at the proper pressure, replace the cap.

Thermostat

The thermostat consists of a restriction valve actuated by a thermostatic element. This is mounted in the housing at the cylinder head water outlet above the water pump. Thermostats are designed to open and close at predetermined temperatures and if not operating properly should be removed and tested. (Refer to 'Diagnosis' for testing).

ScP1 Fig. 6B-13--Belt Tension Specifications

DRIVE BELTS (FIG. 6B-5 through 6B-12)

For proper operation of various belt driven components, the belt condition and tension should be checked every 12 months or 15,000 miles (24 135 km).

Frayed or cracked belts should be replaced and tensioned to specifications using a strand tension gage.

Loose belts may place an extremely high impact load on driven component bearings due to the whipping action of the belt.

An over tightened belt places unnecessary loads on the component bearings.

In figure 6B-13, the minimum reading is the lowest allowable setting before the belt must be reset. When readjusting, the adjustment specification should be met.

NOTE: A 'used' belt is one that has been rotated at least one complete revolution on engine pulleys. This begins the 'seating' of the belt and it should never be reset to 'New' belt specifications.

FAN CLUTCH

Removal

1. Remove battery negative cable at battery.

2. Remove radiator upper support or fan shroud upper, as required.

3. Loosen and remove accessory drive belt(s).

4. Remove fan clutch hub to water pump hub attaching bolts or nuts, as applicable, and remove fan clutch assembly.

Installation

NOTE: All mating surfaces (water pump hub and fan clutch hub) should be inspected for smooth mating surfaces and reworked as necessary to eliminate burrs or other imperfections.

1. With pulley on water pump hub, install fan clutch assembly to water pump hub. Torque attaching bolts, or nuts, to 25 lb. ft. (34 N·m).

NOTE: Be sure to align balance marks on both hubs.

2. Secure the fan blade to prevent rotation. (Figure 6B-14).

3. Mount a dial indicator [.001 graduations (.025mm)] to the engine and place the indicator pointer on the fan blade spider. Preferably on the longest band or space on the spider. (See Figure 6B-15).

4. Rotate the water pump pulley in one direction and note the total amount of indicator needle movement. This represents the total radial run-out. Mark the point on the pulley at which the highest reading is obtained.

5. If the total indicator reading is less than .006 inch (.15mm), the assembly is within specification. Install fan belt and adjust.

If the total indicator run-out exceeds .006 inch (.15mm), proceed to Step 6.

6. Divide the total indicator reading in half and obtain this thickness from shim stock [(1/2" x 3/4") (12.7 x 19mm)] and rework per Figure 6B-16. Place this shim pack between the water pump pulley and fan clutch hub at the bolt closest to the point marked on the pulley in Step 3. If the mark on the pulley is between two bolts so that it is difficult to determine which bolt is closest, place two shim packs; one under each bolt on either side of the mark. (See Figure 6B-17).

NOTE: When one shim pack is used, first, torque the bolt over which the shim pack has been placed; second, the bolt opposite the first; and finally, the other two. Torque bolts to 25 lbs. ft. (34 N·m)

When two shim packs are used, each bolt must be torqued partially; then to full torque alternating between opposite bolts; then the other two bolts in the same manner. Torque bolts to 25 lbs. ft (34 N·m).

CAUTION: Excessive run-out may result if the above sequence and torque is not used.

7. Recheck total indicator run-out to verify that run-out is within .006" (.15mm). Install fan belt and adjust.

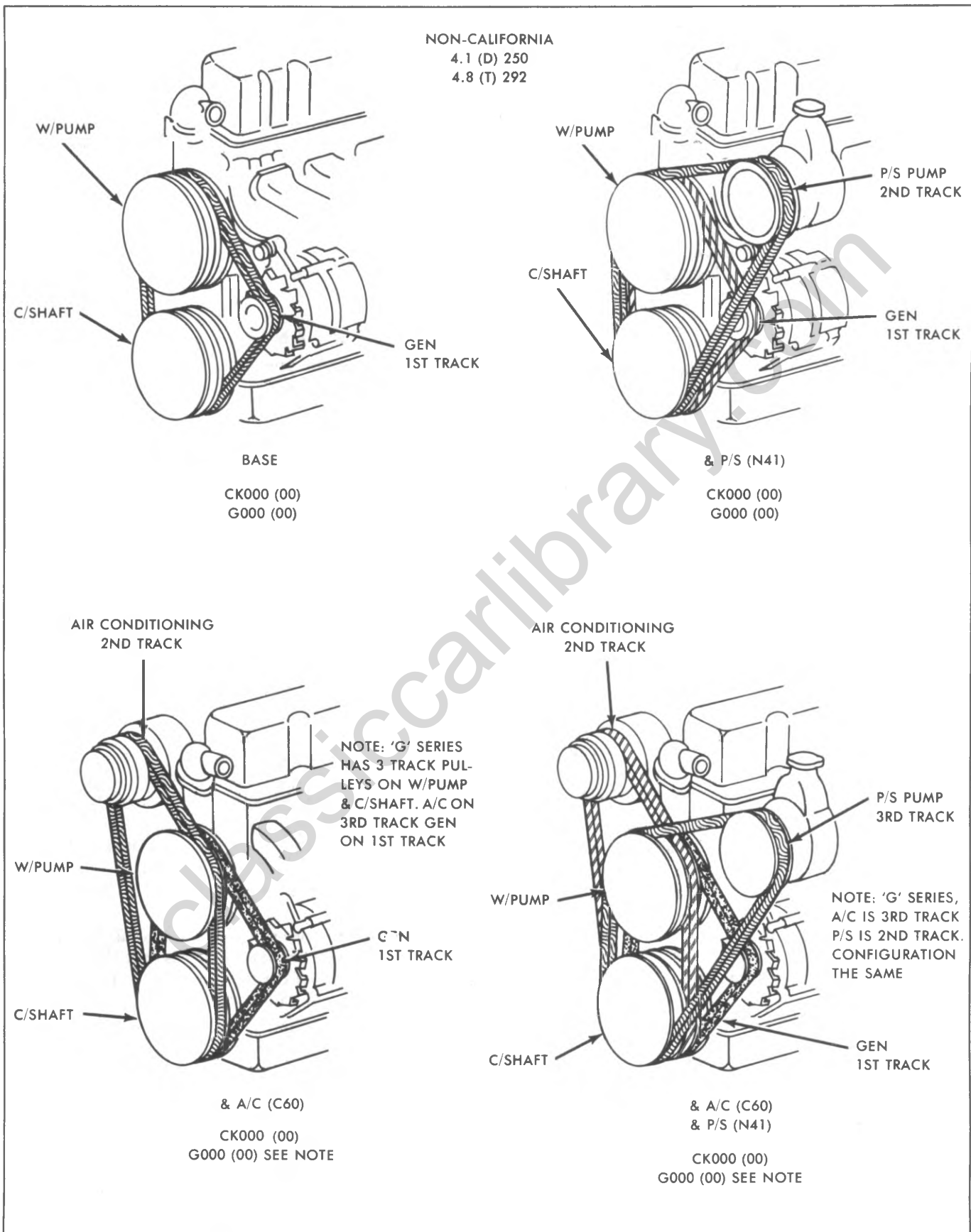


Fig. 6B-5--Non-California--L-6 Belt Routings

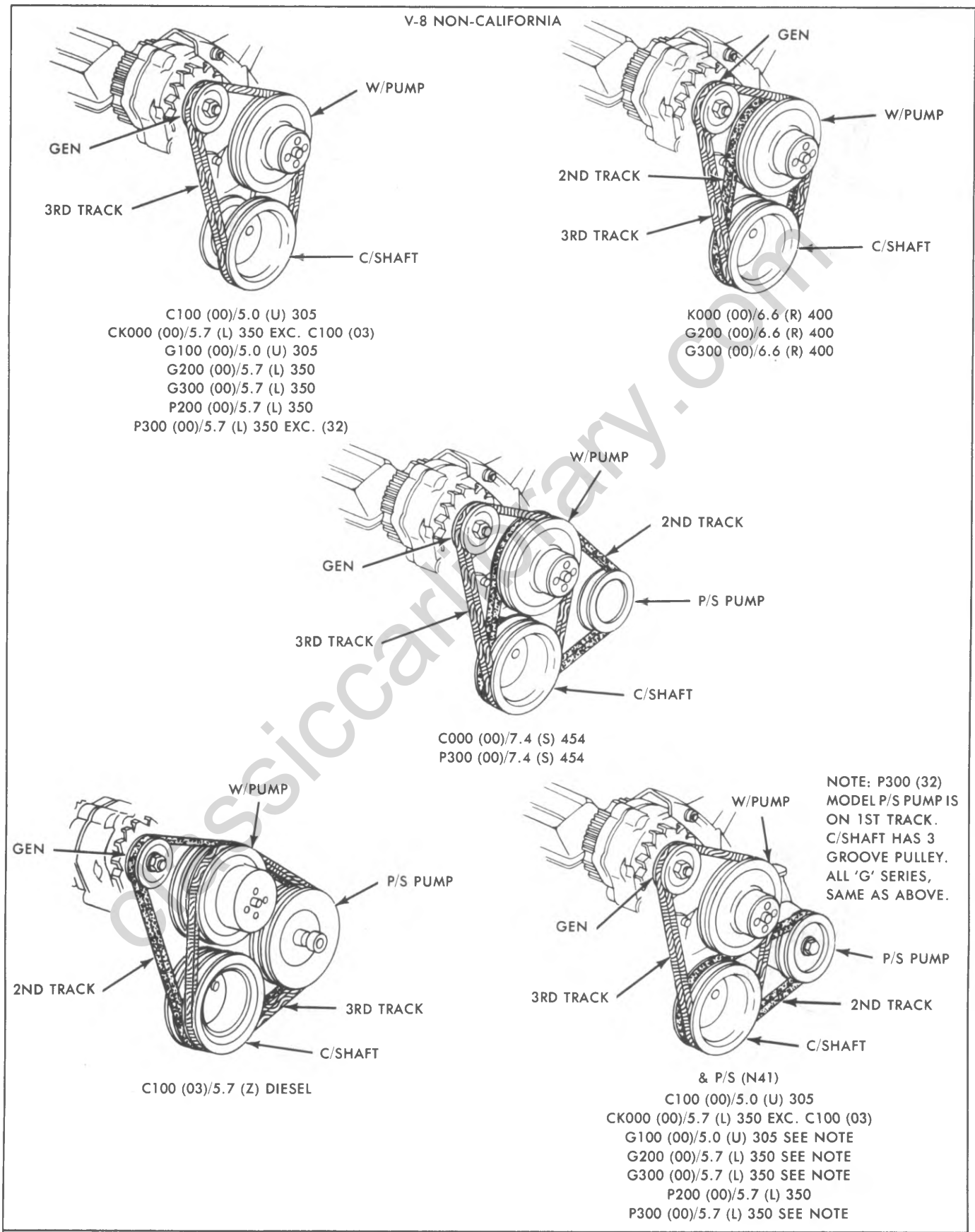
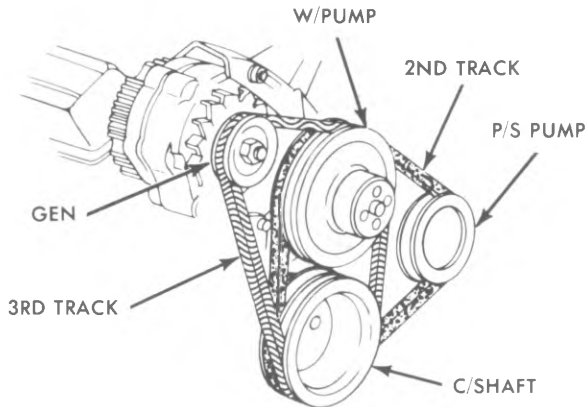
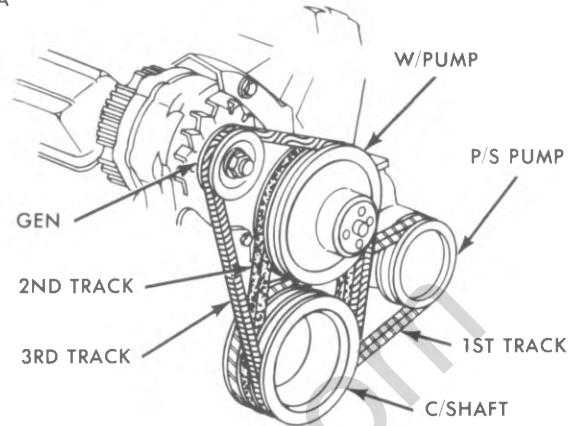


Fig. 6B-6--Non-California--V-8 Belt Routings

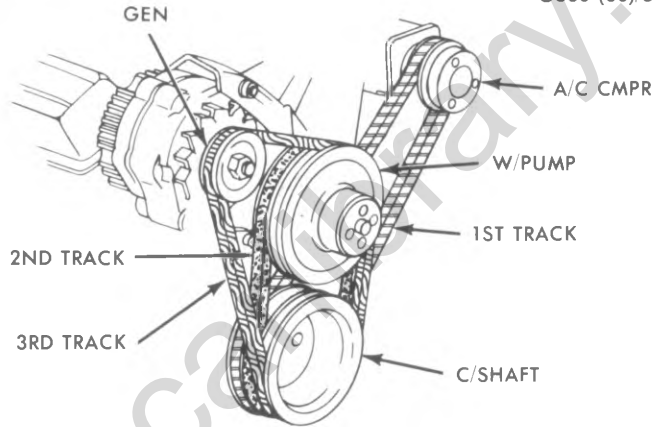
V-8 NON-CALIFORNIA



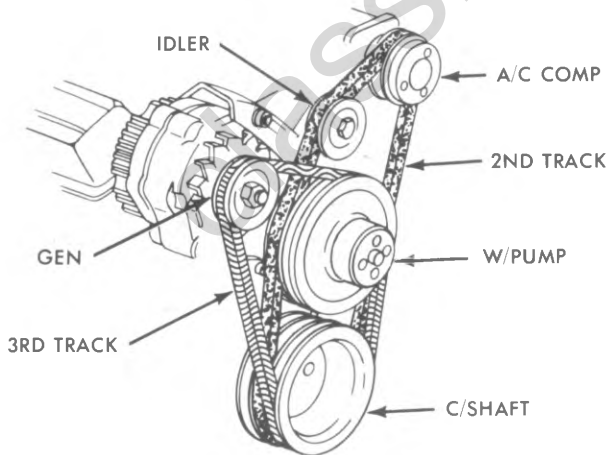
& P/S (N41)
K000 (00)/6.6 (R) 400



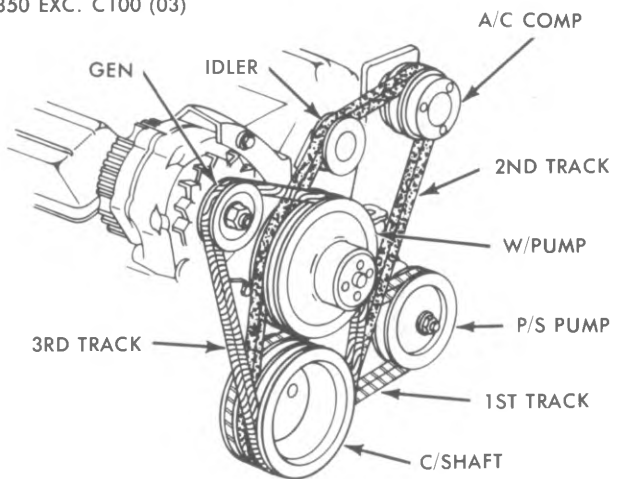
& P/S (N40)
G200 (00)/6.6 (R) 400
G300 (00)/6.6 (R) 400



& A/C (C60)
C100 (00)/5.0 (U) 305
CK000 (00)/5.7 (L) 350 EXC. C100 (03)



& A/C (C60)
G100 (00)/5.0 (U) 305 G310 (05)/6.6 (R) 400
G200 (00)/5.7 (L) 350 G313 (05)/6.6 (R) 400
G300 (00)/5.7 (L) 350 G313 (06)/6.6 (R) 400
G200 (00)/6.6 (R) 400



& A/C (C60)
P300 (32)/5.7 (L) 350

Fig. 6B-7--Non-California--V-8 Belt Routings

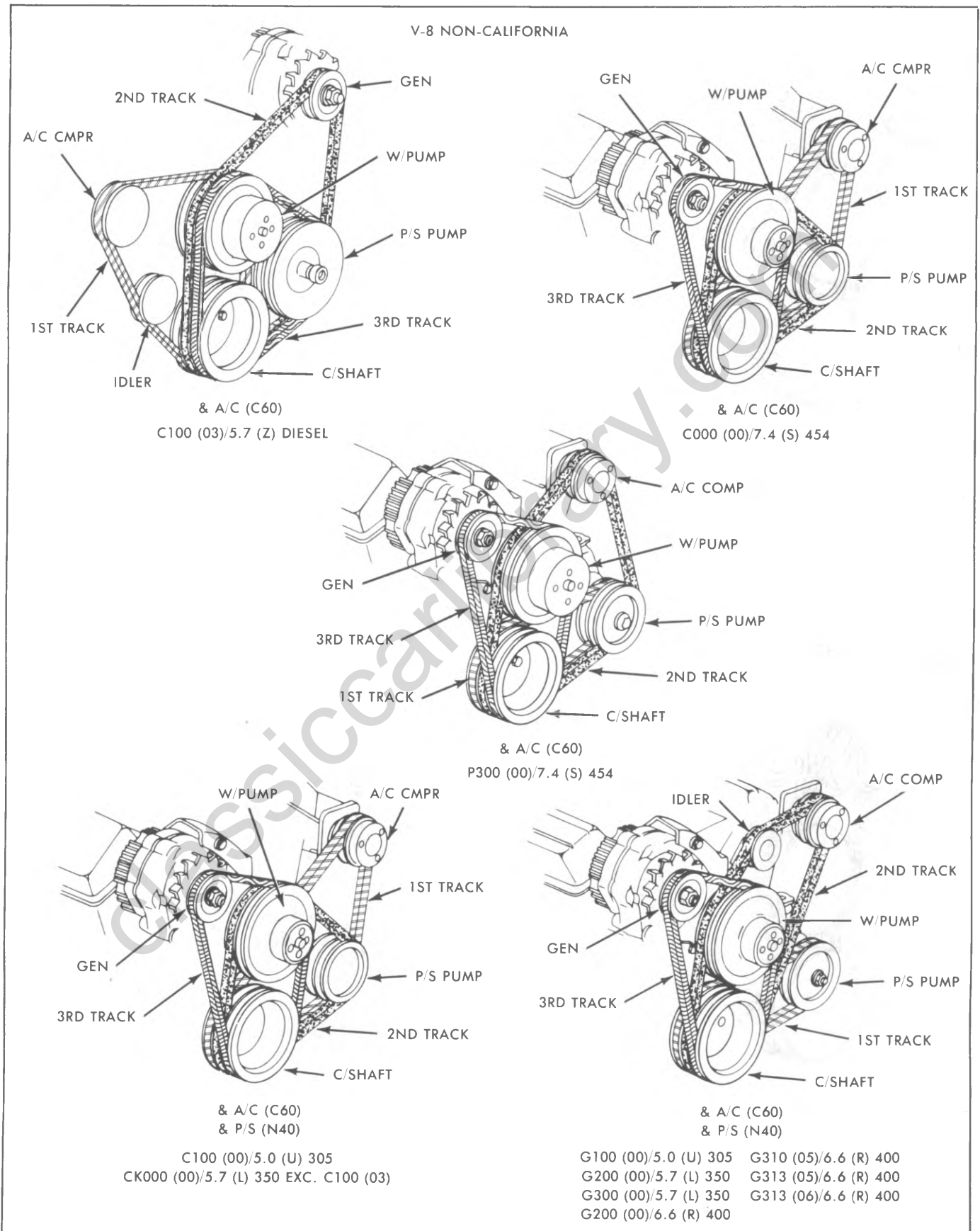
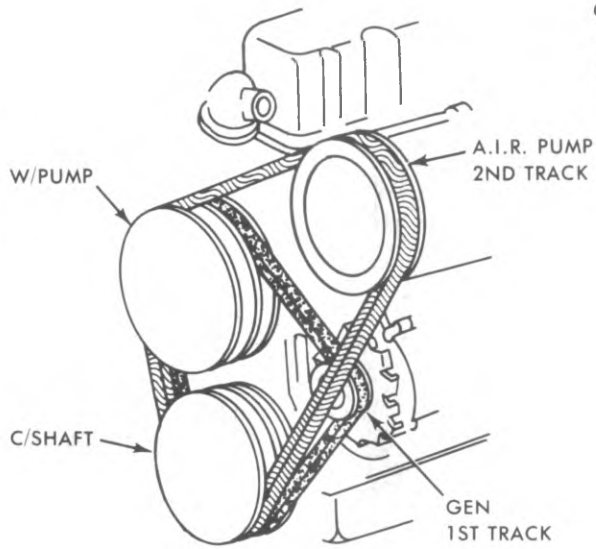
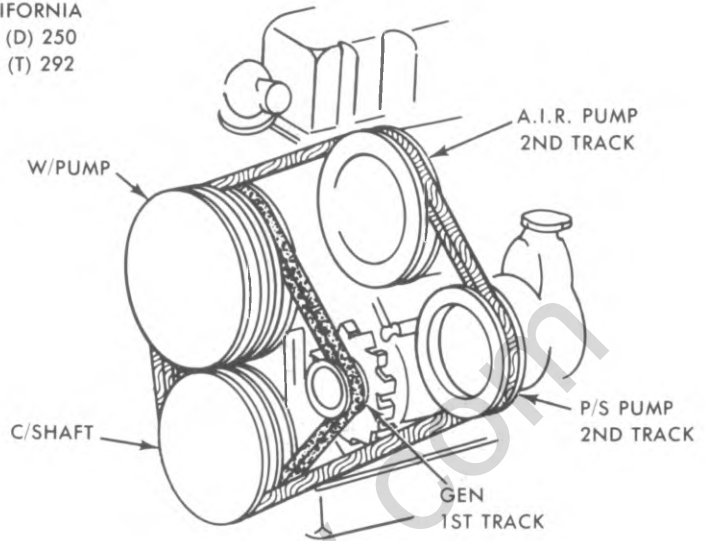


Fig. 6B-8--Non-California--V-8 Belt Routings

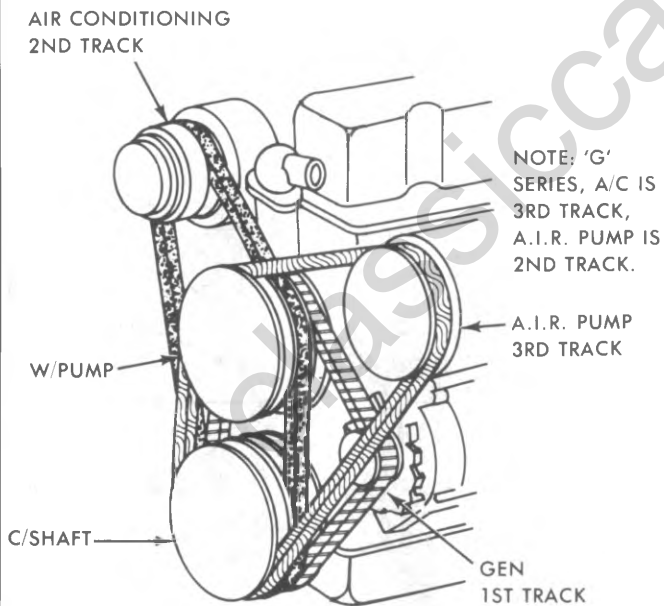
CALIFORNIA
4.1 (D) 250
4.8 (T) 292



BASE
CK000 (00)
G000 (00)

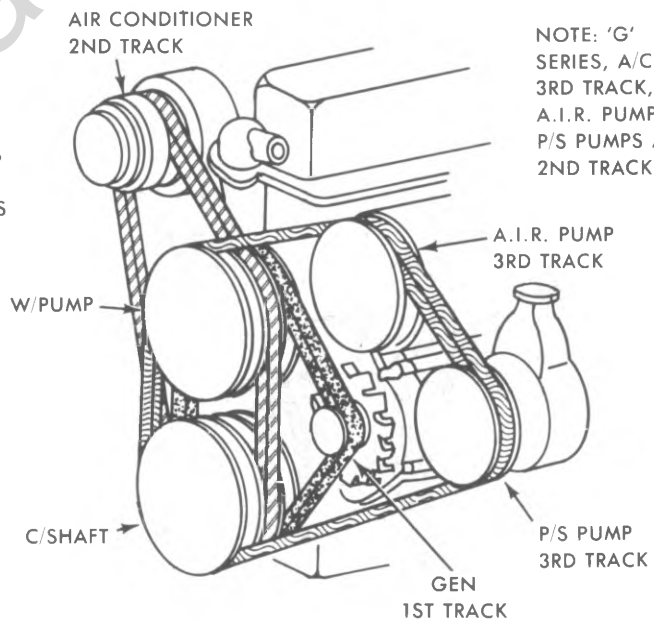


& P/S (N41)
CK000 (00)
G000 (00)



& A/C (C60)
CK000 (00)
G000 (00) SEE NOTE

NOTE: 'G'
SERIES, A/C IS
3RD TRACK,
A.I.R. PUMP IS
2ND TRACK.



& A/C (C60)
& P/S (N41)
CK000 (00)
G000 (00) SEE NOTE

NOTE: 'G'
SERIES, A/C IS
3RD TRACK,
A.I.R. PUMP &
P/S PUMPS ARE
2ND TRACK.

Fig. 6B-9--California--L-6 Belt Routings

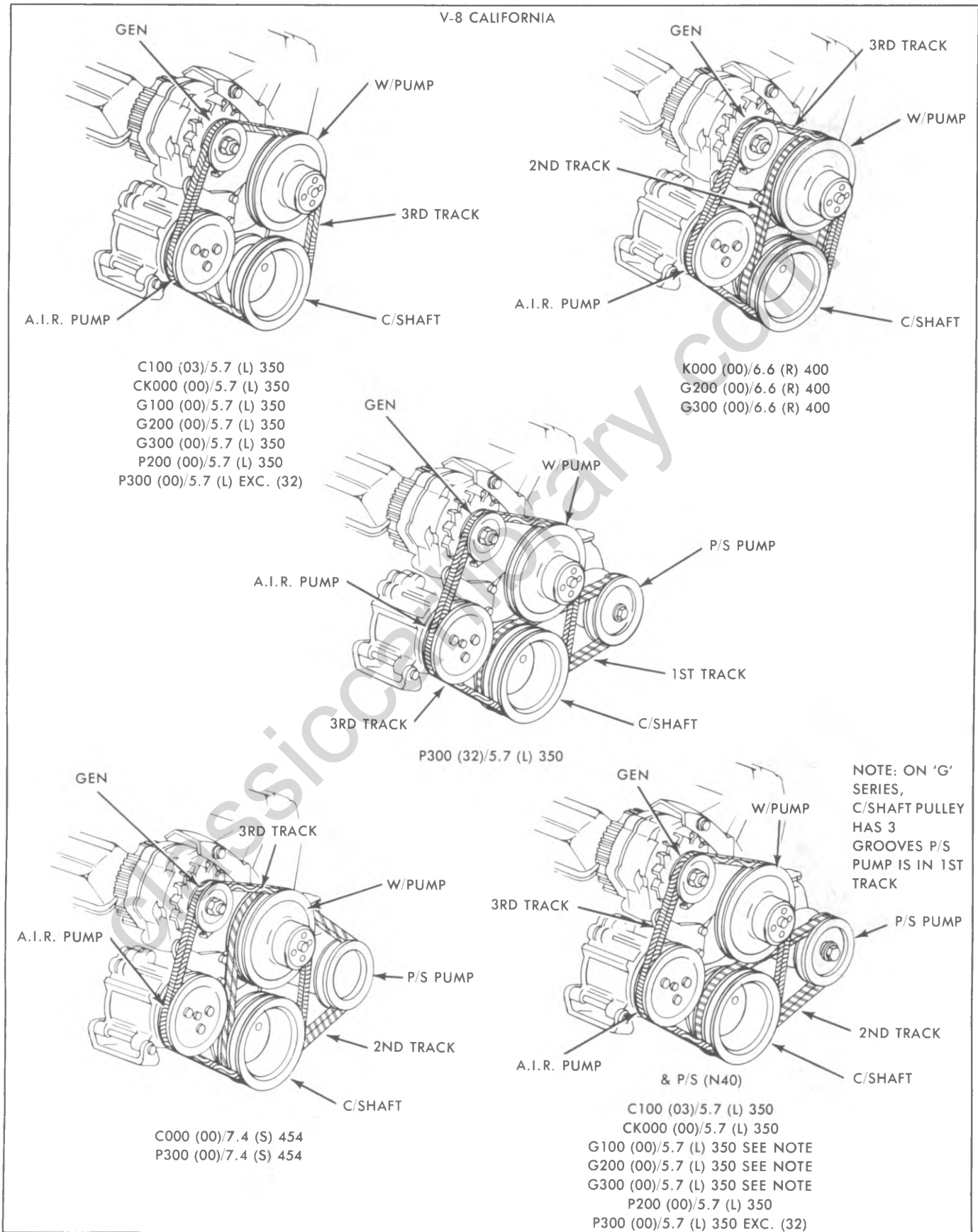
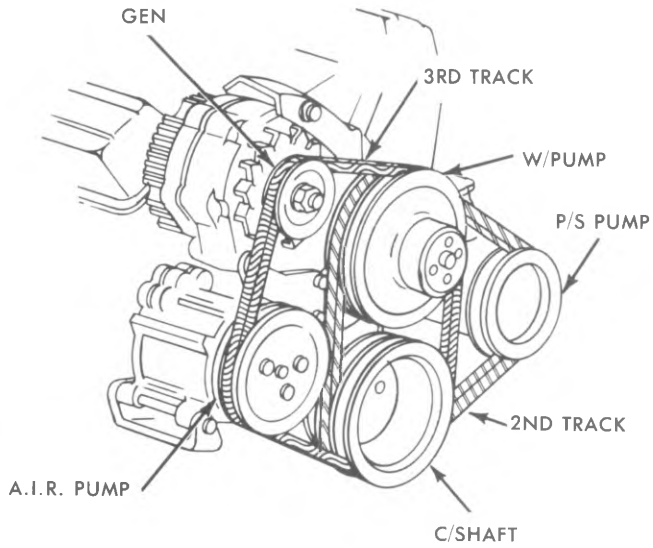
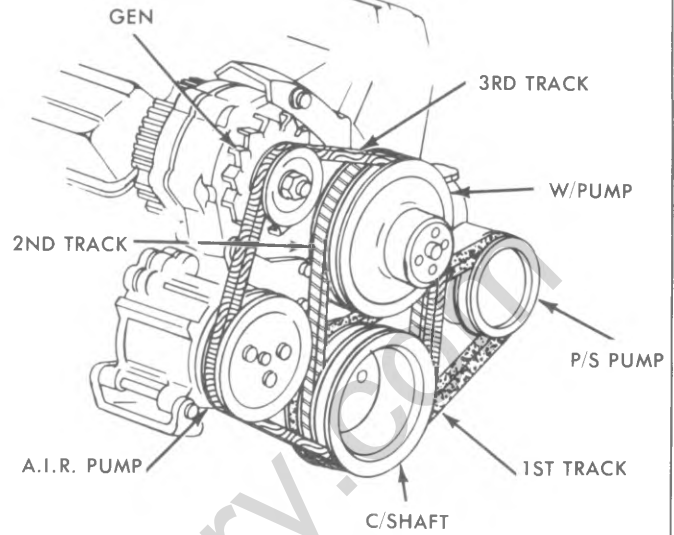


Fig. 6B-10--California--V-8 Belt Routings

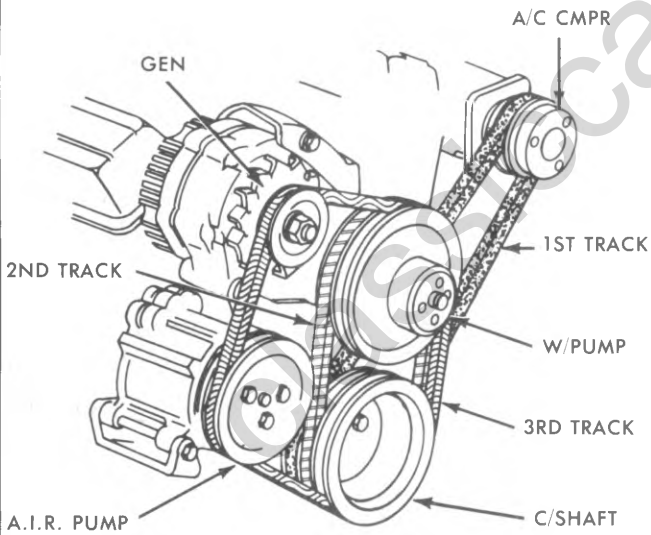
V-8 CALIFORNIA



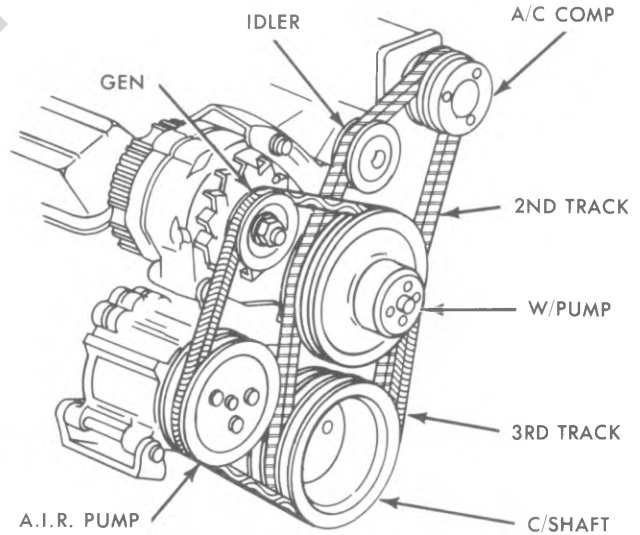
& P/S (N41)
K000 (00)/6.6 (R) 400



& P/S (N40)
G200 (00)/6.6 (R) 400
G300 (00)/6.6 (R) 400



& A/C (C60)
C100 (03)/5.7 (L) 350
CK000 (00)/5.7 (L) 350



& A/C (C60)
G100 (00)/5.7 (L) 350
G200 (00)/5.7 (L) 350
G300 (00)/5.7 (L) 350
G200 (00)/6.6 (R) 400
G310 (05)/6.6 (R) 400
G313 (05)/6.6 (R) 400
G313 (06)/6.6 (R) 400

Fig. 6B-11--California--V-8 Belt Routings

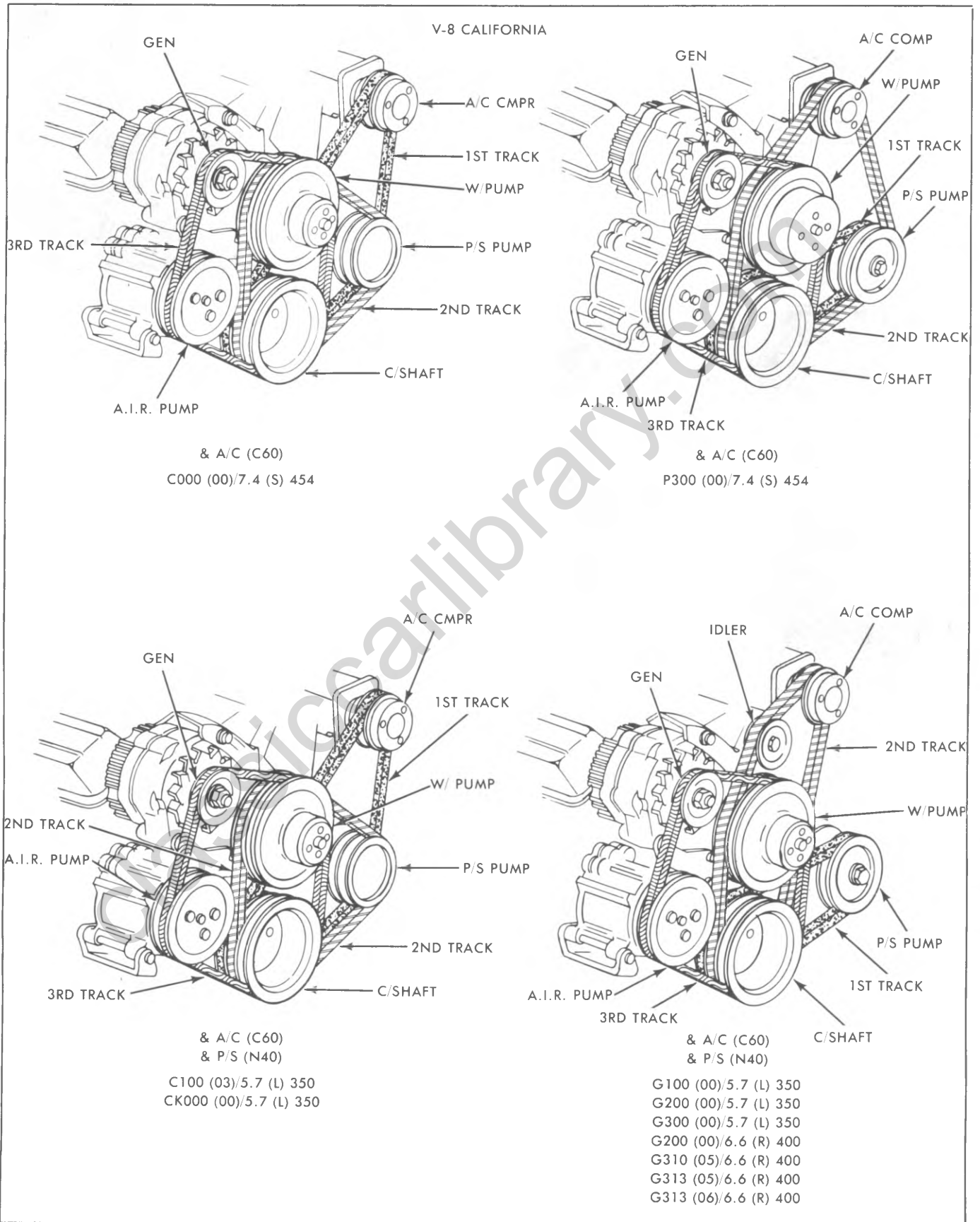


Fig. 6B-12-California-V-8 Belt Routings

6B-14 ENGINE COOLING

TENSION SPECIFICATIONS		
GENERATOR A.I.R. PUMP P/S PUMP	50 LB. MIN.	ADJUST TO 75 ± 5 LBS. USED ADJUST TO 125 ± 5 LBS. NEW
A/C COMPRESSOR	65 LB. MIN.	ADJUST TO 95 ± 5 LBS. USED ADJUST TO 140 ± 5 LBS. NEW

Fig. 6B-13—Belt Tension Specs.

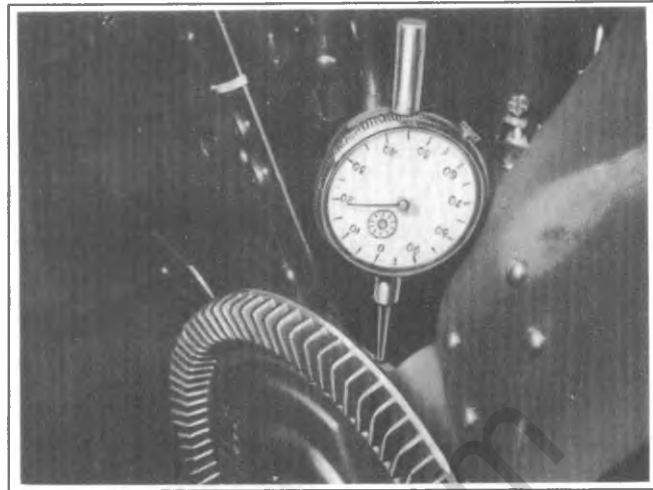
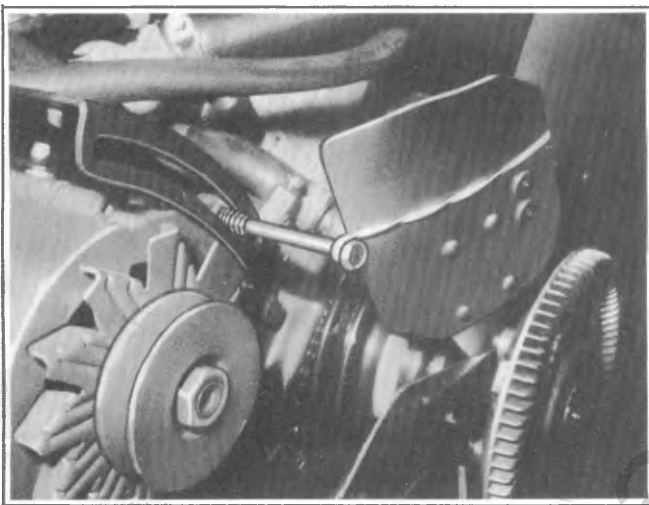


Fig. 6B-15--Checking Run-Out



6B-14--Securing Fan Blade

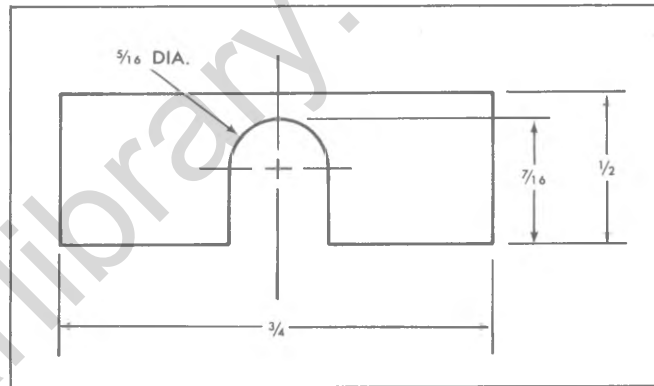


Fig. 6B-16--Shim Fabrication Dimensions

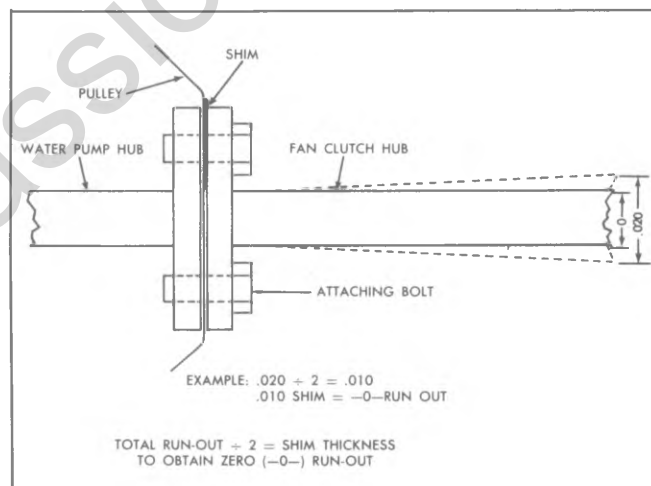


Fig. 6B-17--Determining Shim Placement

SECTION 6C

FUEL SYSTEM

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Fuel Filter	6C-70		
Fuel Pump.....	6C-70		

GENERAL DESCRIPTION

CARBURETOR

All engines are equipped with either a 1-barrel, 2-barrel, or 4-barrel carburetor attached to the intake manifold.

FUEL FILTER

All light duty emissions engines have a pleated paper fuel filter and check valve assembly located in the carburetor inlet.

All vehicles have a woven plastic fuel filter in the fuel tank on the lower end of the pick-up pipe.

FUEL PUMP

The fuel pump is located on the right front of the engine.

EVAPORATIVE CONTROL SYSTEM (ECS)

The Evaporative Control System is a closed system that prevents gasoline vapors in the fuel tank and carburetor from entering the atmosphere.

FUEL TANK AND FEED PIPES

All filler necks with light duty emissions have restrictors to prevent the entry of leaded fuel nozzles.

In all series the tank is vented during filling by an internal baffle inside the filler.

In all series the tank outlet consists of a combination fuel pickup, filter and fuel gage tank unit. The tank unit can be removed by removing a cam ring which retains the unit.

The fuel feed pipes are coated, welded steel tubing. Connections from the tank unit to the line and from the line to the fuel pump are made with synthetic rubber hose attached with spring clamps.

CARBURETION

ALL NEW 1978 VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTIVE AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. FOR THIS REASON, THE FACTORY PROCEDURE FOR SETTING IGNITION TIMING, AND SLOW IDLE MUST BE FOLLOWED EXACTLY WHEN ADJUSTMENTS ARE MADE.

MODEL 1ME CARBURETOR GENERAL DESCRIPTION

The Monojet, carburetor (Fig. 6C-1) is a single bore downdraft carburetor using a triple venture in conjunction with a plain tube nozzle.

Fuel flow through the main metering system is controlled by a main well air bleed and a variable orifice jet. A power enrichment system is used to provide good performance during moderate to heavy acceleration and at higher engine speeds.

The idle system, on all models, incorporates a hot idle compensator (A.T. only) to maintain smooth engine idle during periods of extreme hot engine operation.

The model 1ME incorporates an integral automatic choke system which uses an electrically heated choke coil. The vacuum diaphragm unit is mounted externally on the air horn and connects to the thermostatic coil lever through a connecting line.

The electric choke coil is contained in a choke housing mounted on a bracket attached to the float bowl.

An integral, pleated-paper fuel inlet filter is mounted

in the fuel bowl behind the fuel inlet nut to give maximum filtration of incoming fuel. A check valve on light duty emissions is used in the filter inlet to prevent fuel draining from the fuel system after roll-over.

To improve hot engine starting and meet evaporative emission requirements, fuel vapors from the carburetor bowl are vented to the vapor canister. A tube (location F) is added to the air horn to connect air horn and canister.

Other features of the Monojet carburetor include an aluminum throttle body for decreased weight and improved heat distribution and a thick throttle body to bowl insulator gasket to keep excessive engine heat from the float bowl.

On High Altitude models seals have been added in the float bowl to seal the power piston drive rod and the pump lever to prevent escape of fuel vapors to atmosphere. During unit repair, the seals and retainer, where used, must be removed prior to immersion of the float bowl in carburetor cleaner.

The carburetor model identification is stamped on a vertical portion of the float bowl, adjacent to the fuel inlet nut (Fig. 6C-2).

If replacing the float bowl, follow the manufacturer's instructions contained in the service package so that the identification number can be transferred to the new float bowl.

An electrically operated idle stop solenoid is used on all models.

Dual throttle return springs are used on all carburetors. The throttle lever has a spun-in plastic bushing, this

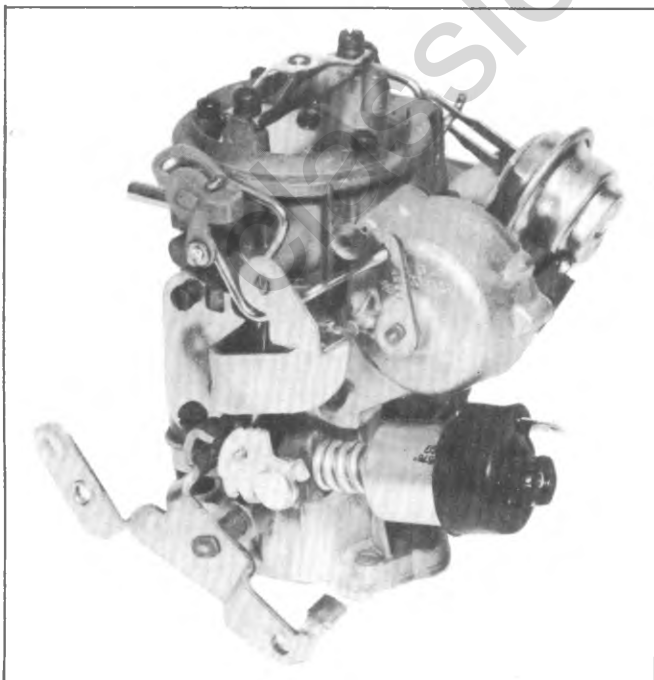


Fig. 6C-1--Model 1ME Carburetor-Rear View

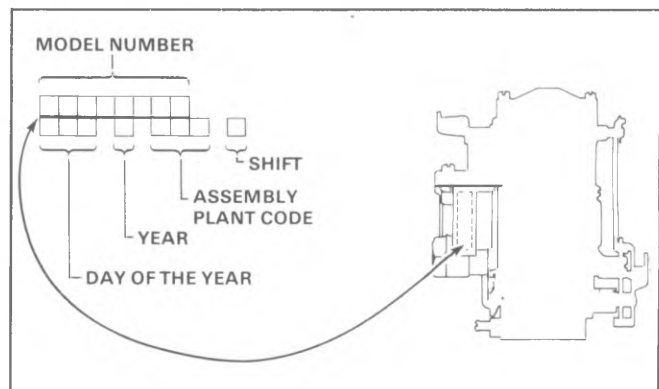


Fig. 6C-2--Model 1ME Carburetor Identification

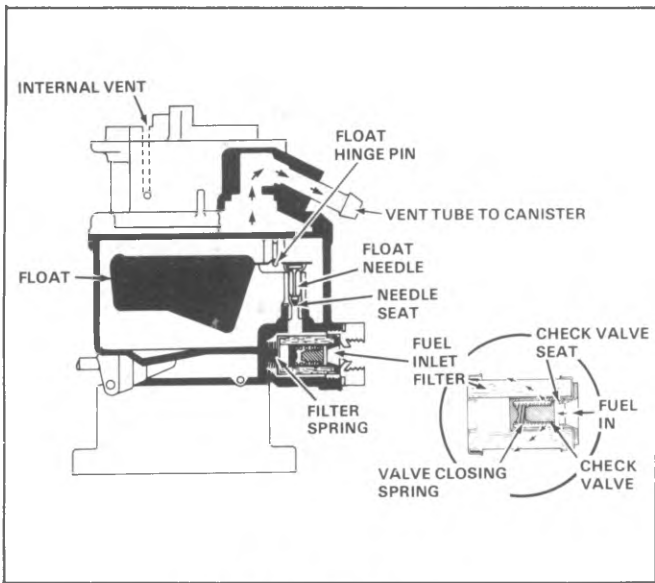


Fig. 6C-3--Float System

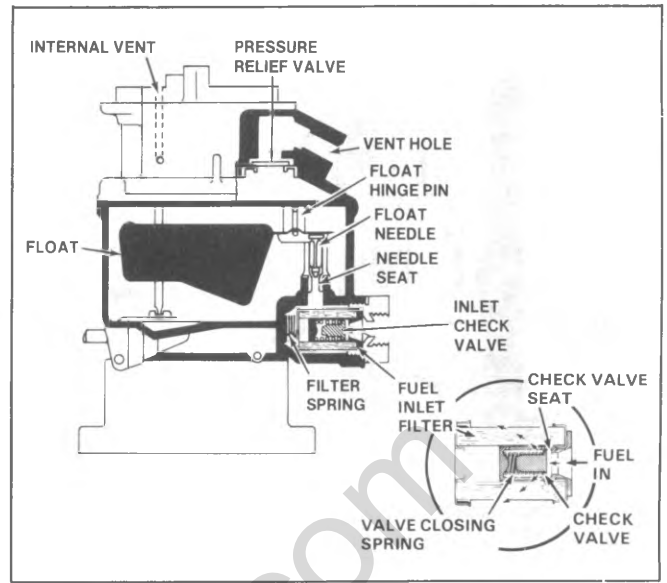


Fig. 6C-4--Float System W/H.D. Emission Except Calif.

is used as the bearing surface for the dual throttle return springs.

NOTE: The spun-in plastic return spring bushing will withstand normal cleaning time in an approved cold immersion type carburetor cleaner. The bushing is not serviced separately and should not be removed from the carburetor throttle lever.

An Exhaust Gas Recirculation system (EGR) is used on light duty emission and heavy duty emission 454 CID Calif. to control oxides of nitrogen. The vacuum supply port necessary to operate the recirculation valve is located in the throttle body and connects through a channel to a tube which is located at the top of the air horn casting. See Idle System (Fig. 6C-5 and 6) for port location and operation.

Six basic systems of operation are used: float, idle, main metering, power enrichment, pump and choke. 6C-3 through 10).

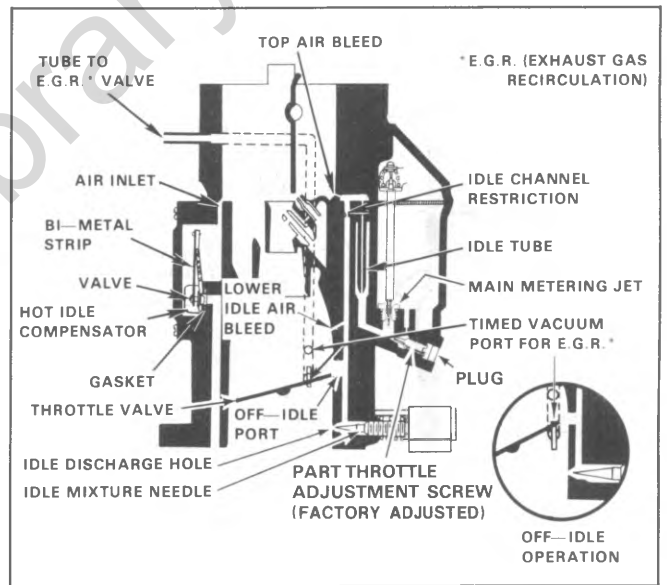


Fig. 6C-5--Idle System

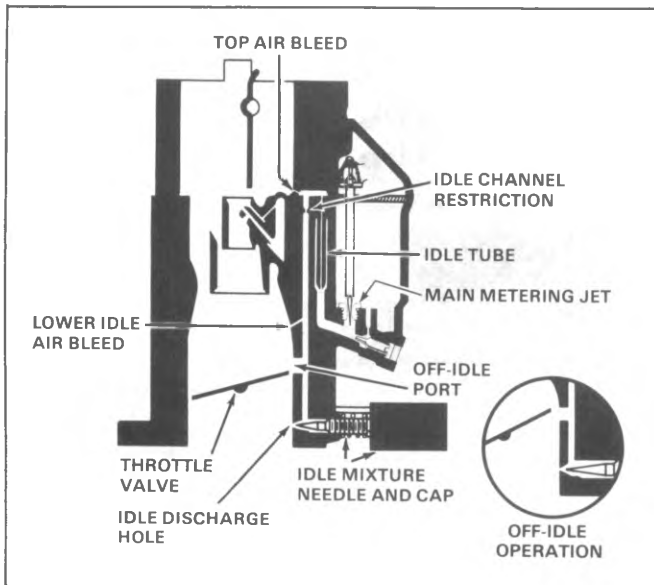


Fig. 6C-6--Idle System W/H.D. Emission

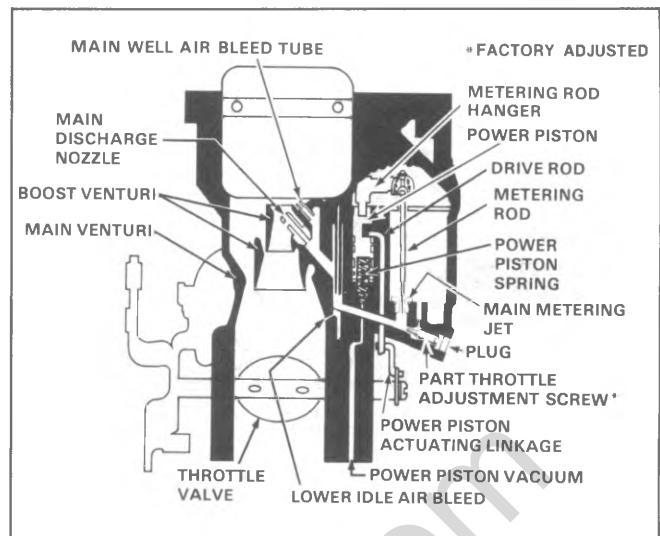


Fig. 6C-8--Power Enrichment System

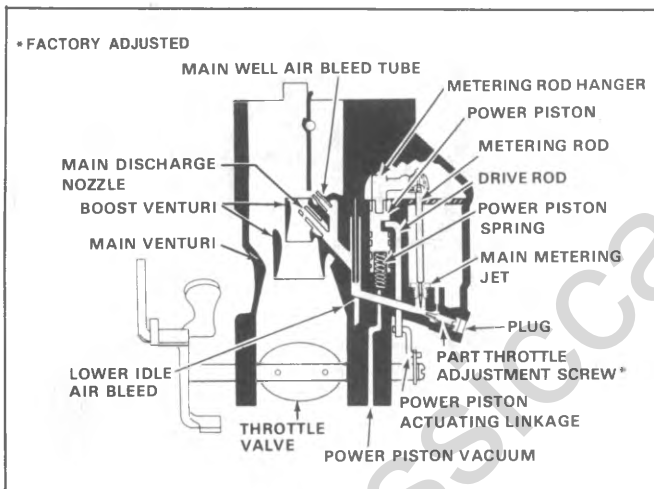


Fig. 6C-7--Main Metering System

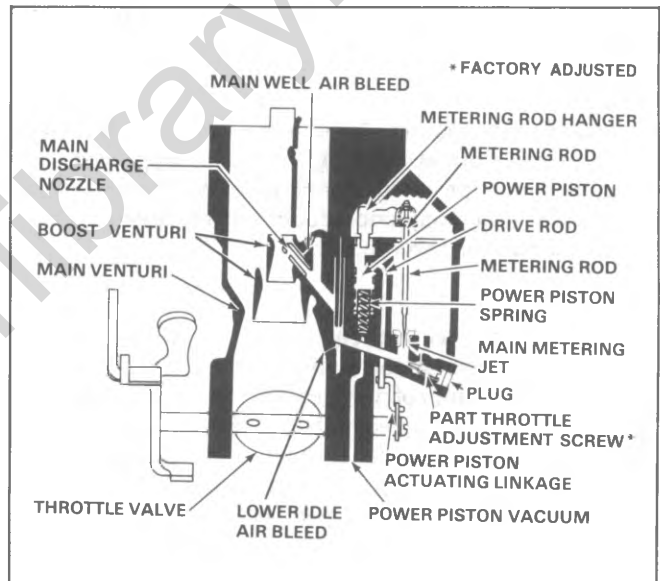


Fig. 6C-9--Power Enrichment System W/H.D. Emission

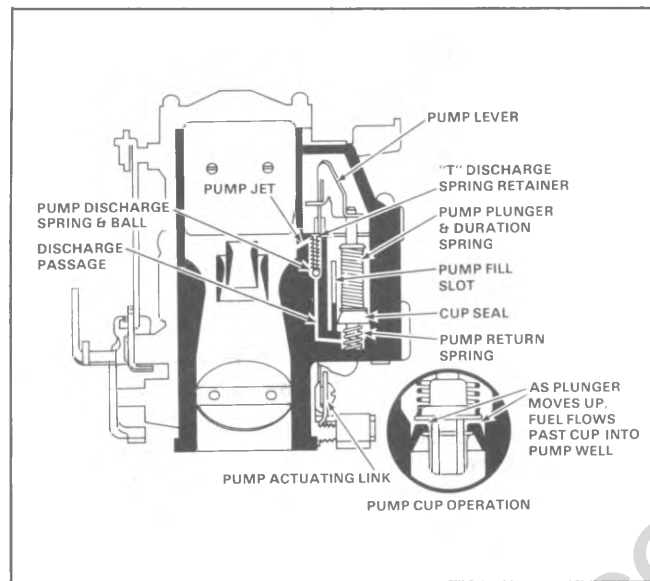


Fig. 6C-10--Pump System

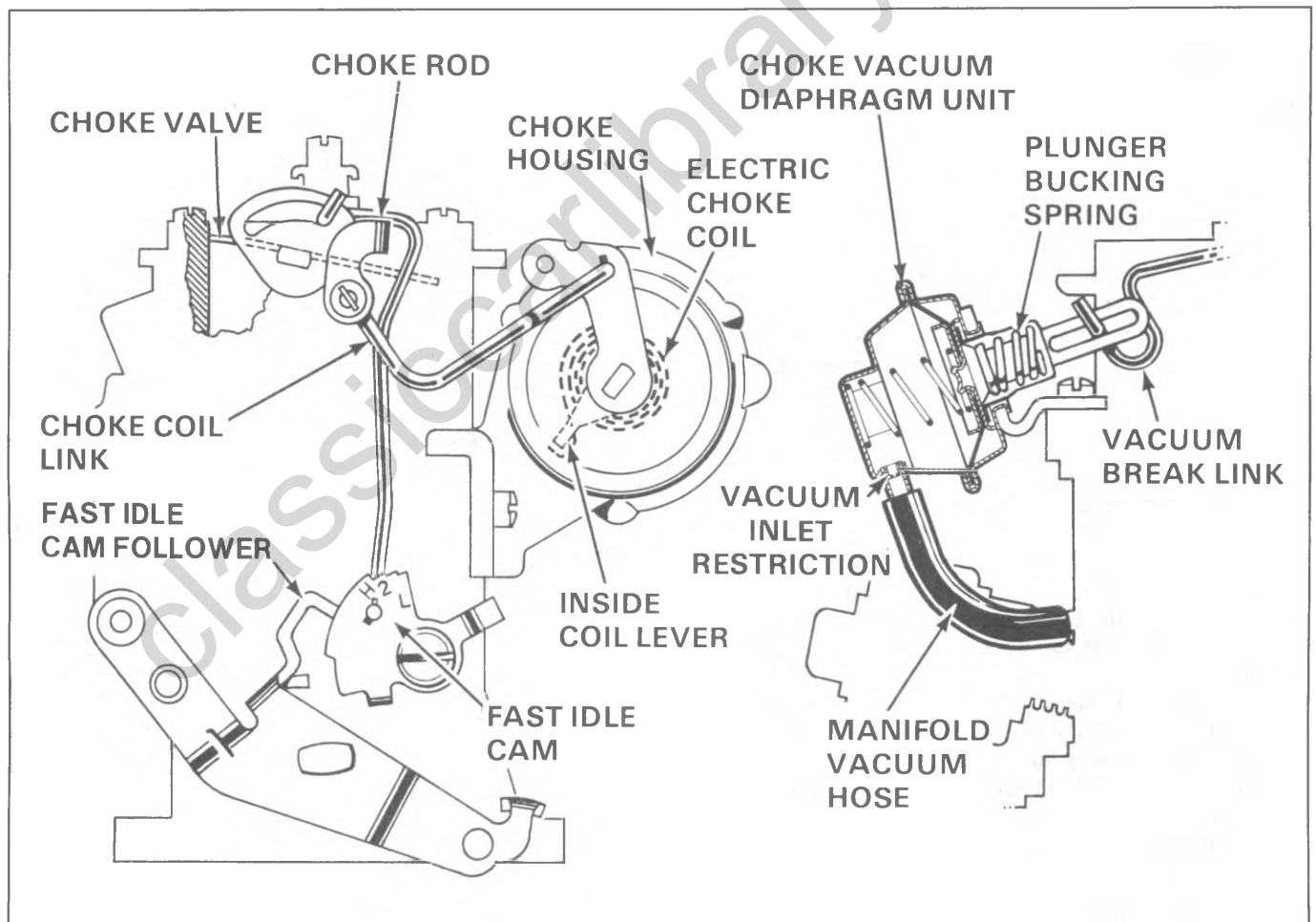


Fig. 6C-11--Choke System

ON-VEHICLE SERVICE

1ME CARBURETOR ADJUSTMENTS

Refer to figure 6C-12 for the following adjustments:

- Float Level
- Metering Rod
- Fast Idle

Refer to figure 6C-13 for the following adjustments:

- Choke Coil Lever
- Automatic Choke
- Choke Rod (Fast Idle Cam)

Choke Checking Procedure

1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links are connected and there are no signs of damage.

2. If choke or linkage binds, sticks, or works sluggishly, clean with Choke Cleaner X-20-A or equivalent. Use cleaner as directed on can. Refer to disassembly instructions for additional direction if cleaning does not correct.

3. Visually inspect carburetor to be certain all vacuum hoses are connected. Inspects hoses for cracks, abrasions, hardness or other signs of deterioration. Replace or correct as necessary.

4. Make sure vacuum break diaphragm shaft is fully extended when engine is off. If shaft is not fully extended, replace vacuum break assembly. Start engine - vacuum break diaphragm shaft should fully retract within 10 seconds. If unit fails to retract, replace vacuum break assembly.

5. Allow choke to cool so that when throttle is opened slightly choke blade fully closes.

NOTE: This check must be performed at an ambient temperature of 60°F to 80°F.

6. Start engine and determine time for choke blade to reach full open position. (Start timer when engine starts).

7. If the choke blade fails to open fully within 3-1/2 minutes proceed with steps 8-9-10 below.

8. Check voltage at the choke heater connection. (Engine must be running). If the voltage is approximately 12-15 volts, replace the electric choke unit.

9. If the voltage is low or zero, check all wires and connections. If the connections at the oil pressure switch are faulty, the oil warning light will be off with the key "on" and engine off. If the fuse is blown, the radio or turn signal indicator will be inoperative. Repair wires or replace fuses as required.

10. If step 9 is good, replace oil pressure switch.

NOTE: No gasket is used between the choke cover and the choke housing due to grounding requirements.

Refer to figure 6C-11 for the following adjustments:

- Vacuum Break
- Unloader
- Idle Speed

Checking Solenoid

1. Turn on ignition, but do not start engine.
2. Open throttle to allow solenoid plunger to extend.
3. Hold throttle lever wide open, feel end of plunger and disconnect wire at solenoid.
4. Plunger should move. Some spring tension should be felt.

5. If plunger did not move, back out 1/8 hex screw (counterclockwise) one full turn and repeat steps 3 and 4.

6. If plunger moves in step 5, connect wire to solenoid and adjust idle speed.

7. If plunger did not move in step 5 insert test lamp (1893 bulb or smaller) between solenoid feed wire and ground.

8. If lamp lights, replace solenoid.

9. If lamp does not light, locate cause of open circuit in solenoid feed wire.

Idle Mixture With Propane Enrichment

A change has been made in some General Motors carburetors to limit the range of idle mixture adjustment on the rich side. In other words, backing out the idle mixture screws will not provide appreciably richer mixture. A new idle mixture adjustment procedure requiring artificial enrichment by addition of propane is necessary for checking and setting idle mixture on these carburetors.

Before suspecting the carburetor as the cause of poor engine performance or rough idle, check ignition system including distributor, timing, spark plugs and wires. Check air cleaner, evaporative emission system, EFE System, PCV system, EGR valve and engine compression. Also inspect intake manifold, vacuum hoses and connections for leaks and check torques of carburetor mounting bolts/nuts. If carburetor bolts are retorqued without carburetor removal retorquer to 12 ft. lbs. maximum.

NOTE: Idle mixture screws have been preset at the factory and capped. Do not remove the caps during normal engine maintenance. Idle mixture should be adjusted only in the case of major carburetor overhaul, throttle body replacement or high idle CO as determined by state or local inspections. Adjusting mixture by other than the following method may violate Federal and/or California or other state or Provincial laws.

1. Set parking brake and block drive wheels. On cars equipped with vacuum parking brake release, disconnect and plug hose at brake.

2. Disconnect and plug hoses as directed on the Emission Control Information Label under the hood.

3. Engine must be at normal operating temperature, choke open and air conditioning off.

4. Connect an accurate tachometer to engine. Set curb idle speed to specification shown on Emission Control Information Label.

5. Disconnect vacuum advance and set timing to specification shown on the Emission Control Information Label. Reconnect vacuum advance.

NOTE: On cars equipped with electronic spark timing, check timing as directed on the Emission Label.

6. Disconnect crankcase ventilation tube from the air cleaner.

7. Using tool J-26911, insert hose with rubber stopper from propane valve into the crankcase ventilator tube opening in the air cleaner.

8. Propane cartridge must be in a vertical position.

9. Slowly open propane control valve until maximum engine speed is reached with the transmission in drive (Neutral for manual shift).

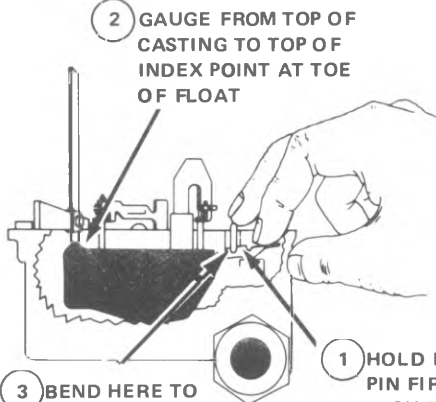
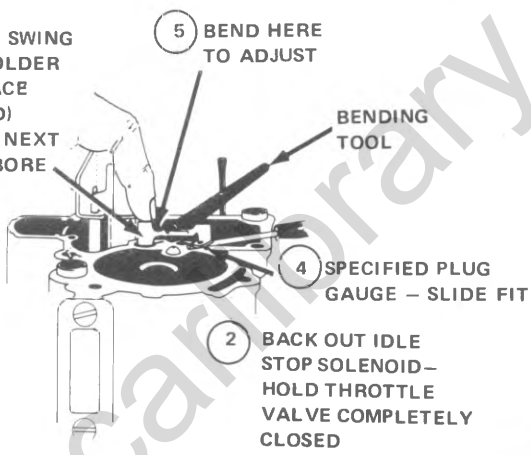
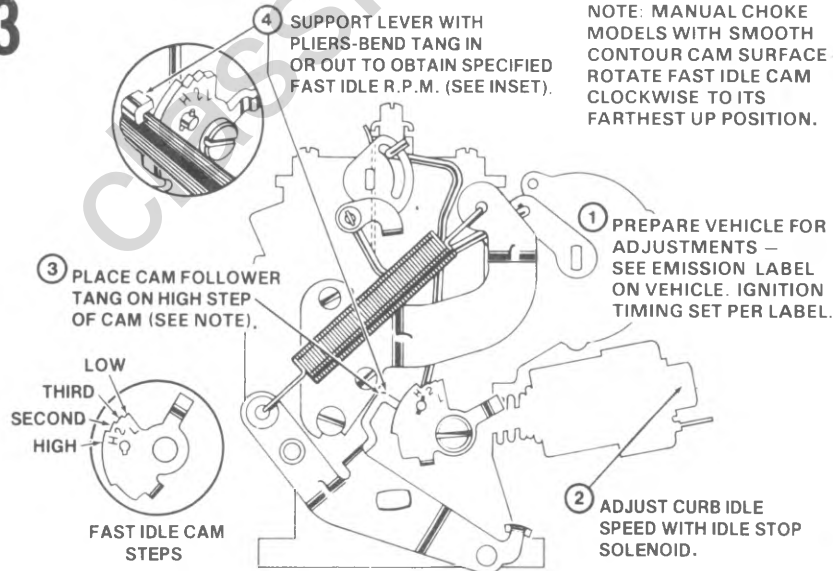
<p>1</p>  <p>2 GAUGE FROM TOP OF CASTING TO TOP OF INDEX POINT AT TOE OF FLOAT</p> <p>3 BEND HERE TO ADJUST FLOAT UP OR DOWN</p> <p>1 HOLD FLOAT RETAINING PIN FIRMLY IN PLACE – PUSH DOWN ON END OF FLOAT ARM, AGAINST TOP OF FLOAT NEEDLE</p> <p>FLOAT LEVEL ADJUSTMENT</p>	<p>CARB. NO.</p> <p>ALL</p>	<p>GAUGE</p> <p>5/16</p>
<p>2</p>  <p>3 HOLD POWER PISTON DOWN AND SWING METERING ROD HOLDER OVER FLAT SURFACE (GASKET REMOVED) OF BOWL CASTING NEXT TO CARBURETOR BORE</p> <p>1 REMOVE METERING ROD BY HOLDING THROTTLE VALVE WIDE OPEN. PUSH DOWNWARD ON METERING ROD AGAINST SPRING TENSION, THEN SLIDE METERING ROD OUT OF SLOT IN HOLDER AND REMOVE FROM MAIN METERING JET.</p> <p>5 BEND HERE TO ADJUST</p> <p>BENDING TOOL</p> <p>4 SPECIFIED PLUG GAUGE – SLIDE FIT</p> <p>2 BACK OUT IDLE STOP SOLENOID – HOLD THROTTLE VALVE COMPLETELY CLOSED</p> <p>METERING ROD ADJUSTMENT</p>	<p>CARB. NO.</p> <p>17058008 17058009 17058308 17058309 17058358 17058359</p> <p>17058006 17058007</p> <p>17058310 17058022 17058312 17058024 17058015 17058081 17058017 17058082 17058021 17058084</p> <p>17058311 17058313</p>	<p>PLUG GAUGE</p> <p>.065</p> <p>.070</p> <p>.080</p> <p>.100</p>
<p>3</p>  <p>4 SUPPORT LEVER WITH PLIERS-BEND TANG IN OR OUT TO OBTAIN SPECIFIED FAST IDLE R.P.M. (SEE INSET).</p> <p>NOTE: MANUAL CHOKE MODELS WITH SMOOTH CONTOUR CAM SURFACE - ROTATE FAST IDLE CAM CLOCKWISE TO ITS FARTHEST UP POSITION.</p> <p>3 PLACE CAM FOLLOWER TANG ON HIGH STEP OF CAM (SEE NOTE).</p> <p>1 PREPARE VEHICLE FOR ADJUSTMENTS – SEE EMISSION LABEL ON VEHICLE. IGNITION TIMING SET PER LABEL.</p> <p>2 ADJUST CURB IDLE SPEED WITH IDLE STOP SOLENOID.</p> <p>LOW THIRD SECOND HIGH FAST IDLE CAM STEPS</p> <p>FAST IDLE ADJUSTMENT</p>	<p>17058021 17058081 17058022 17058082 17058024 17058084</p> <p>17058311 17058313 17058310 17058312 17058015 17058017</p>	<p>2000 RPM (IN PARK OR NEUTRAL)</p> <p>2100 RPM (IN PARK OR NEUTRAL)</p> <p>HEAVY DUTY EMISSIONS 2400 RPM (IN PARK OR NEUTRAL)</p>

Fig. 6C-12--1ME Carburetor Adjustments - 1 of 3

<p>4</p> <p>② HOLD CHOKE VALVE COMPLETELY CLOSED</p> <p>④ BEND LINK TO ADJUST</p> <p>③ .120" PLUG GAUGE MUST PASS THROUGH HOLE IN LEVER AND ENTER HOLE IN CASTING</p> <p>① PLACE FAST IDLE CAM FOLLOWER ON HIGHEST STEP OF FAST IDLE CAM</p> <p>CHOKE COIL LEVER ADJUSTMENT - 1ME</p>	<p>CARB. NO.</p> <p>ALL</p>	<p>PLUG GAUGE</p> <p>.120"</p>
<p>5</p> <p>① LOOSEN THREE RETAINING SCREWS</p> <p>INDEX</p> <p>RICH</p> <p>LEAN</p> <p>③ WITH CHOKE COIL LEVER LOCATED INSIDE COIL TANG (SEE INSET) — SET MARK ON ELECTRIC CHOKE TO SPECIFIED POINT ON CHOKE HOUSING</p> <p>② PLACE FAST IDLE CAM FOLLOWER ON HIGH STEP OF CAM</p> <p>CHOKE HOUSING</p> <p>ELECTRIC CHOKE COIL</p> <p>INSIDE COIL LEVER</p> <p>INSET</p> <p>AUTOMATIC CHOKE ADJUSTMENT - 1ME</p>	<p>CARB. NO.</p> <p>ALL</p>	<p>INDEX MARK</p> <p>INDEX</p>
<p>6</p> <p>③ GAUGE BETWEEN LOWER EDGE OF CHOKE VALVE (AT CENTER) AND INSIDE AIR HORN WALL.</p> <p>② HOLD DOWN ON CHOKE VALVE — ROD IN END OF SLOT.</p> <p>④ BEND ROD AT POINT SHOWN TO ADJUST.</p> <p>① WITH FAST IDLE ADJUSTMENT MADE, FAST IDLE CAM FOLLOWER MUST BE HELD FIRMLY ON SECOND STEP OF FAST IDLE CAM AGAINST HIGHEST STEP.</p> <p>CHOKE ROD (FAST IDLE CAM) ADJUSTMENT</p>	<p>CARB. NO.</p> <p>17058310 17058311 17058312 17058313 17058315 17058317</p> <p>17058021 17058022 17058024 17058081 17058082 17058084</p> <p>17058006 17058007 17058008 17058009 17058308 17058309 17058358 17058359</p>	<p>PLUG GAUGE</p> <p>.190</p> <p>.200</p> <p>.275</p>

Fig. 6C-13-1ME Carburetor Adjustments - 2 of 3

7

NOTE: HOLD GAUGE VERTICAL.

④ PLACE GAUGE BETWEEN LOWER EDGE OF CHOKE VALVE AND INSIDE AIR HORN WALL.

② USE OUTSIDE VACUUM SOURCE TO SEAT DIAPHRAGM.

⑤ BEND LINK TO ADJUST.

③ PUSH DOWN ON CHOKE VALVE (COMPRESS PLUNGER BUCKING SPRING AND SEAT PLUNGER STEM ON MODELS SO EQUIPPED).

① PLACE FAST IDLE CAM FOLLOWER ON HIGHEST STEP OF CAM.

NOTE: ON DELAY FEATURE MODELS, COVER PLUG AND PURGE BLEED HOLE WITH 1" SQUARE PIECE OF MASKING TAPE. REMOVE AFTER ADJUSTMENT.

VACUUM BREAK ADJUSTMENT - 1ME (BOWL SIDE)

CARB. NO.	PLUG GAUGE
17058015 17058017 17058021 17058022 17058024 17058081 17058082 17058084 17058310 17058311 17058312 17058313	.250
17058006 17058007 17058008 17058009 17058308 17058309 17058358 17058359	.275

8

① INSTALL CHOKE COIL IN CHOKE HOUSING AND INDEX PROPERLY (SEE NOTE).

NOTE: IF CHOKE COIL IS WARM, COOL DOWN TO POINT WHERE CHOKE VALVE WILL CLOSE FULLY.

③ GAUGE BETWEEN LOWER EDGE OF CHOKE VALVE AND INSIDE AIR HORN WALL (SEE NOTE).

② HOLD THROTTLE VALVE WIDE OPEN.

④ BEND TANG TO ADJUST (SEE INSET).

UNLOADER ADJUSTMENT - 1ME

CARB. NO.	PLUG GAUGE
17058021 17058022 17058024 17058081 17058082 17058084	.450
17058006 17058007 17058008 17058009 17058308 17058309 17058358 17058359	.520
17058015 17058017 17058310 17058311 17058312 17058313	.600

9

① NOTE: ENGINE MUST BE WARM - CHOKE WIDE OPEN - FAST IDLE CAM FOLLOWER OFF STEPS OF CAM (SEE EMISSION LABEL)

③ TO ADJUST LOW IDLE TURN 1/8" HEX SCREW (SOLENOID NOT ENERGIZED)

② SET CURB IDLE TO SPECIFICATIONS - TURN ASSEMBLY IN OR OUT TO ADJUST R.P.M. (SOLENOID ENERGIZED)

IDLE SPEED ADJUSTMENT

SPECIFICATION

SEE
VEHICLE (ENGINE)
EMISSION CONTROL
INFORMATION LABEL

Fig. 6C-14-1ME Carburetor Adjustments - 3 of 3

NOTE: Too much propane will cause engine speed to drop.

10. Observe propane flow meter to insure propane cartridge is adequately full.

11. With propane flowing, adjust idle speed screw to the enriched RPM (starting point for lean drop setting-see specifications). Readjust propane flow to be certain of maximum engine speed and adjust idle speed again if necessary.

12. Turn off propane. Place transmission in Neutral and run engine at approximately 2,000 RPM for 30 seconds. Put transmission in Drive (Neutral for manual shift).

13. Check idle speed. If it is as shown on the Emission Control Information Label, the idle mixture is correct. In that case proceed with Step #17.

14. If the speed is too low, carefully remove tab from the limiter cap or gently remove cap from screw taking care not to bend the screw head, then back out the screw or screws equally (richen) 1/8 turn at a time until speed on Emissions Label is reached.

If the speed is too high, carefully remove tab from the limiter cap or gently remove cap from screw taking care not to bend the screw head, then turn in the screw or screws equally (leaner) 1/8 turn at a time until speed on Emissions Label is reached.

15. Turn propane on again to check maximum engine idle speed. If speed is different from specification (enriched RPM-starting point for lean drop setting) readjust idle speed screw to enriched RPM with propane flowing.

16. Turn off propane again, clean out engine at 2,000 RPM for 30 seconds in Neutral. Put transmission in Drive (Neutral for manual) re-check idle speed. It should be as shown on the Emissions Control Information Label. If not, repeat the adjustment procedure as in Step #14.

17. If rough idle persists, turn mixture screws in until lightly seated. Back them out equally to the average previous position and rerun propane idle test starting with Step #9.

18. Turn off engine and remove propane tool. Connect crankcase ventilation tube to air cleaner.

CARBURETOR REPLACEMENT (FIG. 6C-15)

Removal

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by presence of dirt, water, or other foreign matter in carburetor. To aid in diagnosing cause, carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check filter.

1. Remove air cleaner.
2. Disconnect fuel and vacuum lines from carburetor.
3. Disconnect electrical connector at choke.
4. Disconnect accelerator linkage.
5. Disconnect solenoid electrical connector.
6. Remove carburetor attaching nuts and remove carburetor and solenoid assembly attachment.
7. Remove insulator gasket.

Installation

It is good shop practice to fill carburetor bowl before installing carburetor. This reduces strain on starting motor and battery and reduces the possibility of backfiring while attempting to start engine. A small supply of fuel will enable

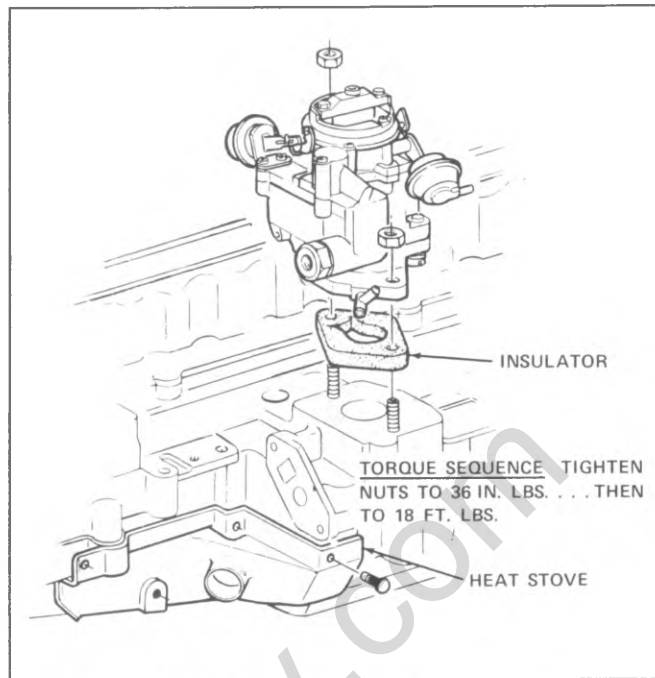


Fig. 6C-15-1ME Carburetor Replacement

carburetor to be filled and the operation of float and intake needle and seat to be checked. Operate throttle lever several times and check discharge from pump jets before installing carburetor.

1. Be certain throttle body and intake manifold sealing surface are clean.
2. Install carburetor insulator.
3. Install carburetor over manifold studs.
4. Install vacuum and fuel lines at carburetor
5. Install attaching nuts and tighten alternately to 16 pounds-feet (21 N·m).
6. Tighten fuel line.
7. Connect accelerator linkage.
8. Connect choke and solenoid electrical connectors.
9. Install air cleaner.
10. Check and adjust idle speed.

SOLENOID REPLACEMENT

An inoperative solenoid should be replaced.

Removal

1. Remove carburetor air cleaner.
2. Disconnect electrical connector at solenoid.
3. Unscrew and remove solenoid from float bowl assembly.

Installation

1. Hold choke valve wide open so that fast idle cam follower clears fast idle cam.
2. Install solenoid and turn in until it contacts lever tang.
3. Connect electrical connector.
4. Install air cleaner.
5. Check and adjust idle speed.

CHOKE COIL REPLACEMENT

Choke mechanism should be checked for free operation. A binding condition may have developed from petroleum gum formation on the choke shaft or from damage. Choke shafts can usually be cleaned without disassembly by using Carbon X(X55) or equivalent.

1. Remove air cleaner and disconnect choke electrical connector.
2. Remove screws attaching choke assembly to housing

and remove choke as an assembly.

3. Install new choke and coil assembly.
4. Install screws and loosely tighten.
5. Adjust choke setting as specified and tighten screws.
6. Connect choke electrical connector.
7. Start engine, check operation of choke and then install air cleaner.

UNIT REPAIR

DISASSEMBLY

Place carburetor on a holding fixture to prevent damage to throttle valve.

Air Horn

Removal

1. Remove choke vacuum break diaphragm hose.
2. Remove vacuum break diaphragm assembly from air horn by removing two attaching screws. These screws have a tapered head and do not use lockwashers. Remove diaphragm plunger stem from diaphragm to choke lever link. (Fig. 6C-16).

CAUTION: *Screw that retains vacuum break lever to choke shaft is installed with thread torque retaining compound. It is not necessary to remove this screw and lever unless choke shaft replacement is required.*

3. Remove fast idle cam attaching screw; then remove fast idle cam (Fig. 6C-17).

Remove choke rod from choke coil lever on end of choke shaft.

4. Remove electric thermostatic coil assembly from choke housing by removing (3) screws and retainers.

5. Choke coil housing need not be removed from float bowl unless replacement is necessary. To remove choke housing, remove three attaching screws from float bowl. Two screws have lockwashers and the one facing the choke

housing has a tapered head for locating choke housing.

6. Remove four remaining air horn to bowl attaching screws and lockwashers (three long and one short screw).

7. Remove air horn by lifting and twisting back towards choke housing so that the choke coil lever link will disengage from the choke coil lever at the choke housing, invert and place on clean bench. Air horn to float bowl gasket can remain on bowl for removal later (Fig. 6C-18).

Disassembly

1. If required, the choke valve and choke shaft can be removed from air horn by removing the screw that retains the vacuum break lever to the choke shaft. Care should be exercised when removing this screw because it is retained in place by thread torque retaining compound. Remove the two attaching screws from the choke valve, then, remove the choke valve and choke shaft from air horn.

NOTE: The choke valve screws are staked in place so it will be necessary to file off staking and re-stake during assembly.

CAUTION: *Do not bend choke shaft when restaking.*

2. No further disassembly of the air horn is necessary.

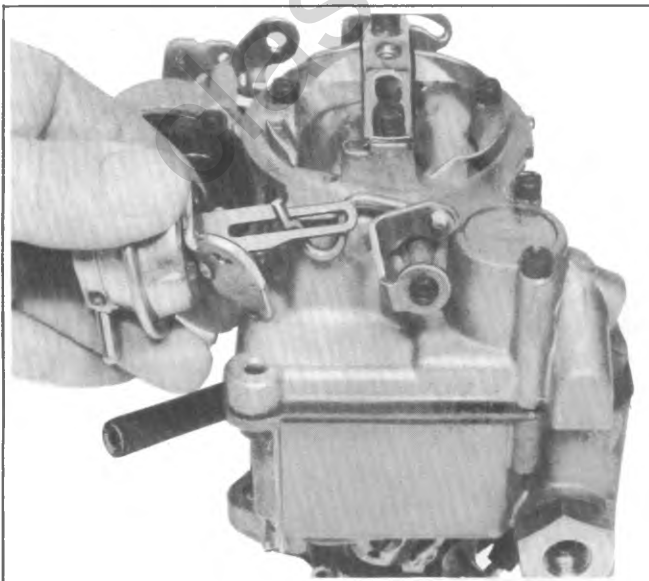


Fig. 6C-16--Vacuum Break Diaphragm

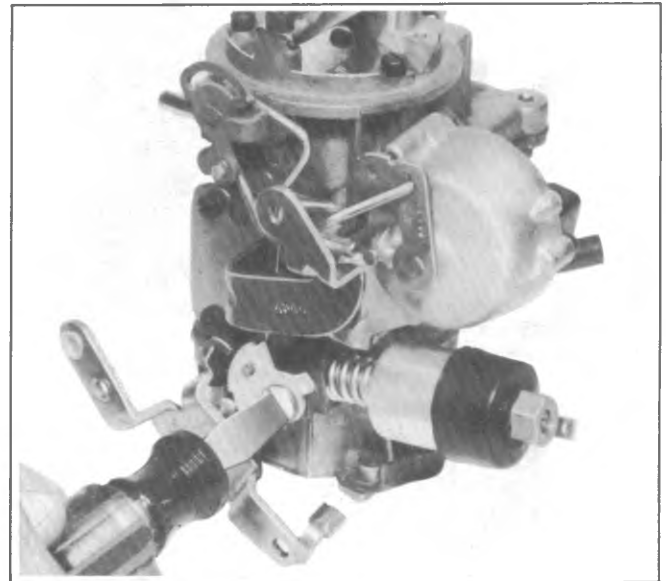


Fig. 6C-17--Fast Idle Cam



Fig. 6C-18--Air Horn Removal

Float Bowl Disassembly

1. Remove air horn to float bowl gasket. Gasket is slit next to metering rod lever so that it can be slid over lever for ease in removal. (Fig. 6C-19).
2. Remove float assembly from float bowl by lifting upward on float hinge pin. Remove hinge pin from float arm.
3. Remove float needle from seat.
4. Disconnect accelerator pump and power piston actuator lever from end of throttle shaft by removing lever

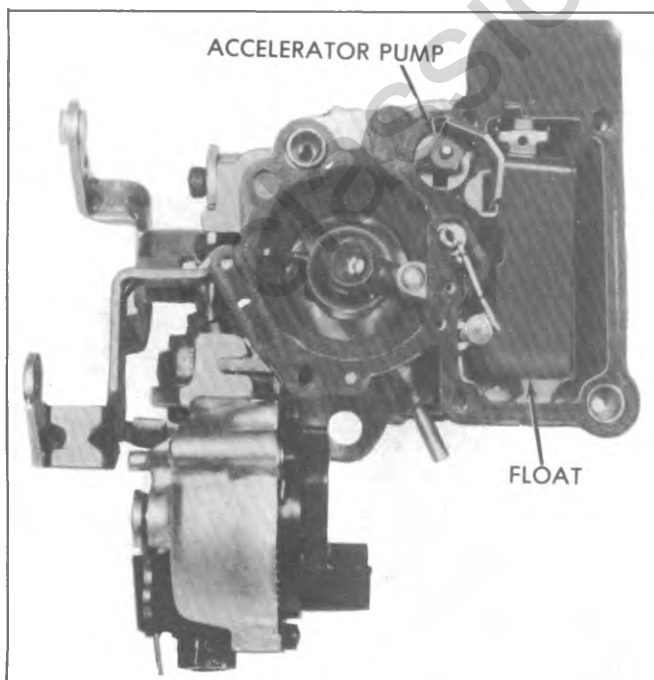


Fig. 6C-19--Float Bowl Disassembly

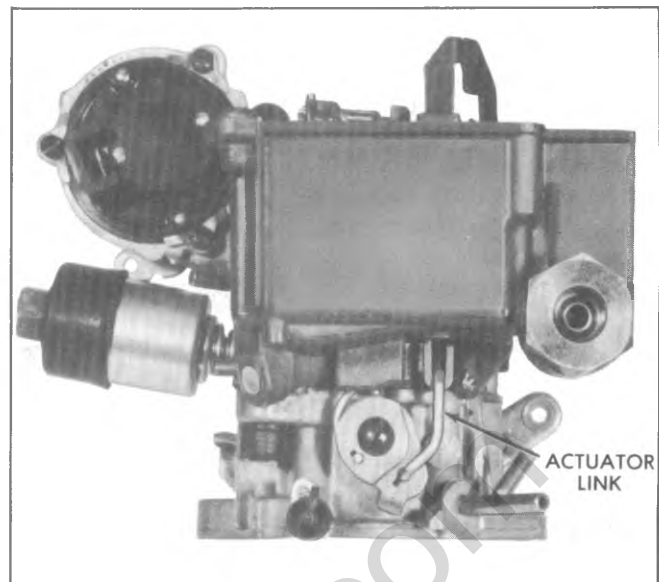


Fig. 6C-20--Pump and Power Piston Actuator Lever

attaching screw (Fig. 6C-20).

5. Hold down on power piston while removing lever. Power piston spring and metering rod assembly may now be removed from float bowl (Fig. 6C-21).
6. Remove lower end of power piston link from actuator lever by rotating until tang on rod slides out of notch in lever.
7. Remove actuator lever from lower end of accelerator pump link in same manner.
8. Push down on accelerator pump and remove actuator link by rotating until tang on rod aligned with slot on pump plunger lever. Remove the link.
9. Remove pump assembly from float bowl (Fig. 6C-22).

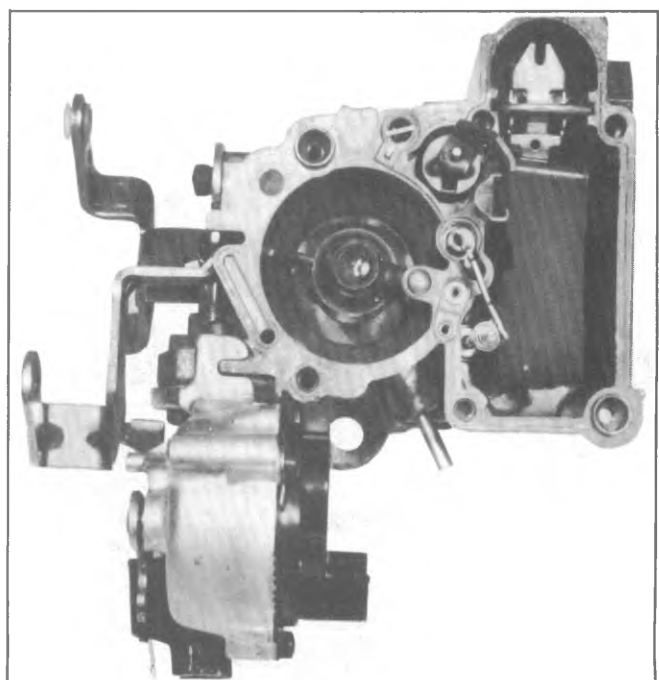


Fig. 6C-21--Float Bowl Assembly

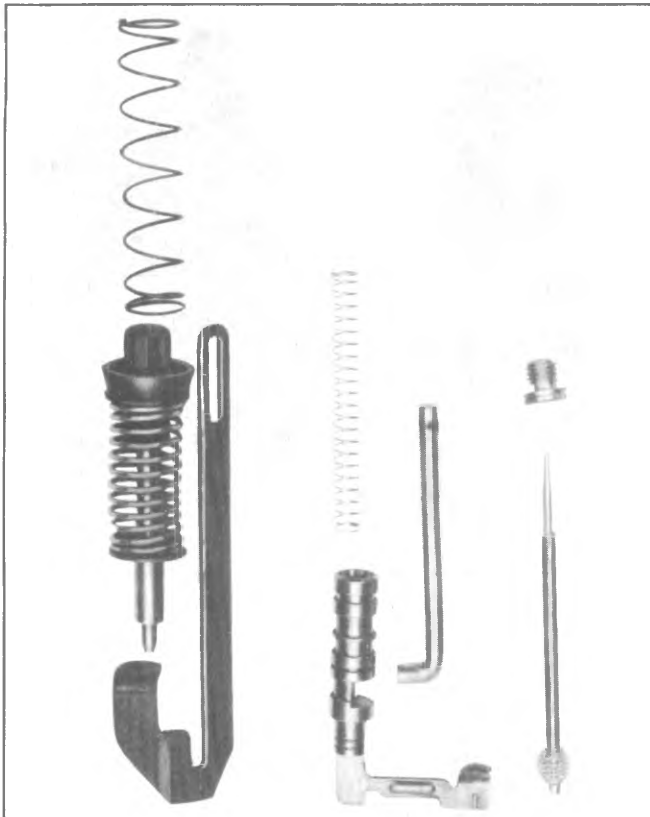


Fig. 6C-22--Metering Rod and Accelerator Pump

10. Remove pump return spring and power piston spring from float bowl (Fig. 6C-22).

11. Remove "T" guide and pump discharge spring using needle nose pliers (Fig. 6C-23).

12. Pump discharge ball and idle tube can be removed at the same time by inverting the bowl.

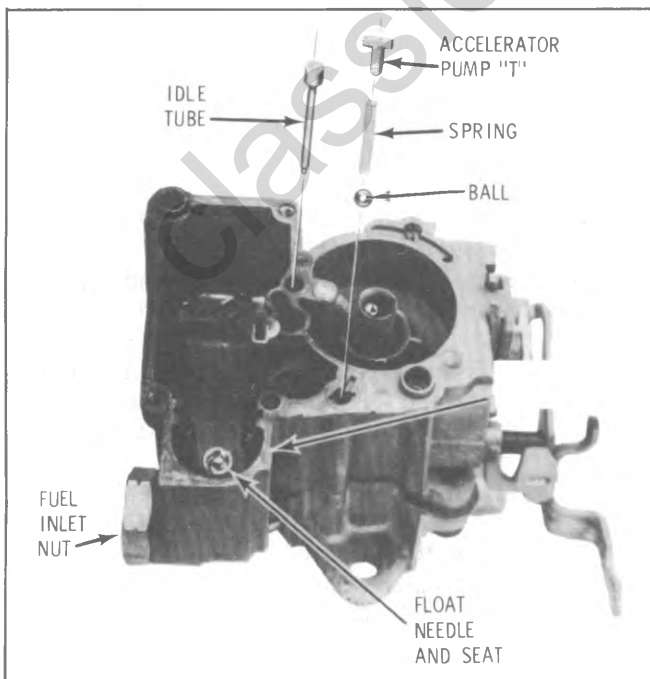


Fig. 6C-23--Pump Discharge "T" Retainer

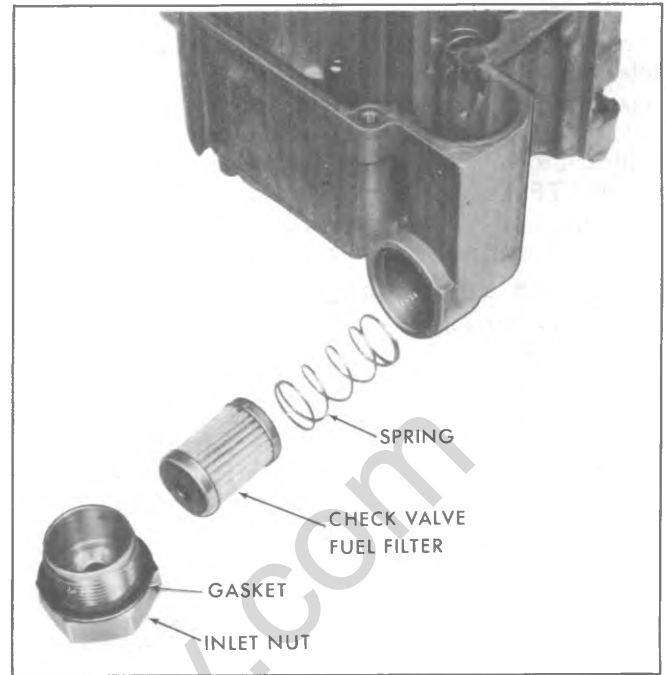


Fig. 6C-24--Fuel Filter and Check Valve

13. Remove main metering jets from bottom of fuel bowl.

14. Remove float needle seat and gasket using Tool J-22769.

15. The idle stop solenoid can be removed at this time if desired.

16. Remove the fuel inlet nut, filter and spring (Fig. 6C-24).

No further disassembly of the float bowl is required.

Throttle Body (Fig. 6C-25)

1. Invert carburetor bowl on bench and remove two throttle body to bowl attaching screws. Throttle body and insulator gasket may now be removed.

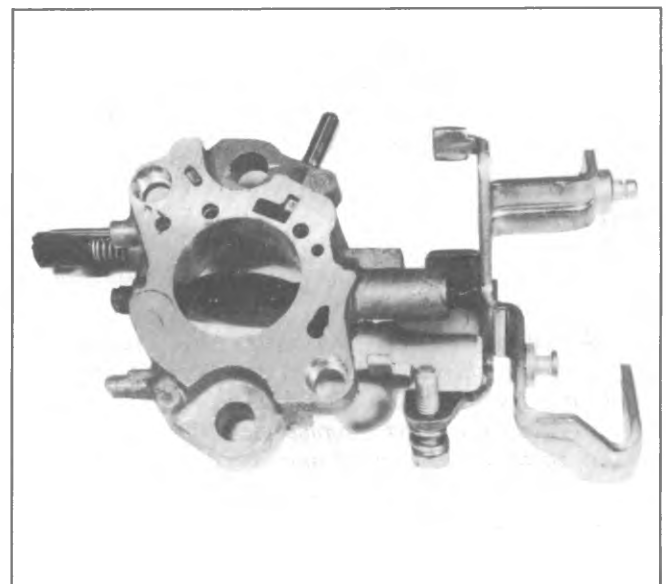


Fig. 6C-25--Throttle Body

2. No further disassembly of the throttle body is necessary unless the idle mixture needle is damaged or the idle channels need cleaning. If necessary to remove the idle mixture needle, cut the tang from the plastic limiter cap. Do not install a replacement cap as a bare mixture screw is sufficient to indicate that the mixture has been readjusted.

NOTE: Due to the close tolerance fit of the throttle valve in the bore of the throttle body, do not remove the throttle valve or shaft.

CLEANING AND INSPECTION

The carburetor should be cleaned in a cold immersion type cleaner.

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner such as Carbon X (X-55) or equivalent.

NOTE: Rubber and plastic parts should not be immersed in carburetor cleaner. However, the air horn which has the plastic relief valve will withstand normal cleaning in carburetor cleaner.

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.

3. Examine float needle and seat assembly for wear. Install a new factory matched set if worn.

4. Inspect upper and lower casting sealing surfaces for damage.

5. Inspect holes in levers for excessive wear or out of round condition. If levers are worn they should be replaced.

6. Examine fast idle cam for excessive wear or damage.

7. Check throttle and choke levers and valve for binds and other damage.

8. Check all springs for distortion or loss in tension; replace as necessary.

NOTE: When carburetor has been disassembled, new gaskets and filter must be used.

CARBURETOR ASSEMBLY

Throttle Body (Fig. 6C-25)

1. If removed, install idle mixture needle and spring into throttle body until lightly seated. Back out two turns as a preliminary adjustment. Final idle mixture adjustment will be made on vehicle.

2. Invert float bowl and install new throttle body to bowl insulator gasket.

3. Install throttle body on bowl gasket so all holes in throttle body are aligned with holes in gasket.

4. Install two throttle body to bowl attaching screws and lockwashers. Tighten even and securely to 20 N·m (15 ft. lbs.).

Float Bowl

1. Install fuel filter spring, filter, and check valve assembly, (if used), inlet nut and gasket rubber seal on check valve faces fuel inlet nut.

CAUTION: *The fuel inlet check valve must be installed (where required) in the filter to meet Motor Vehicle Safety Standards (M.V.S.S.) for roll-over. New service replacement filter include the check valve, where required.*

2. Install idle stop solenoid and spring, if removed. Adjust later for correct idle speed.

3. Install main metering jet into bottom of fuel bowl. Tighten securely.

4. Using wide blade screwdriver install needle seat and

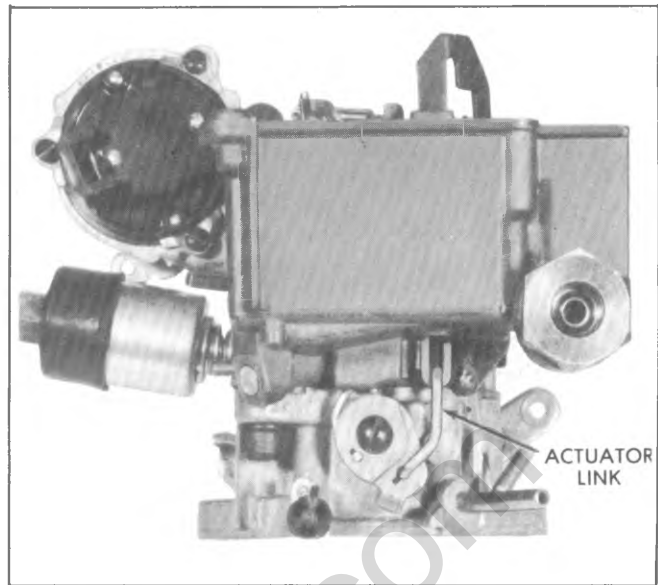


Fig. 6C-26--Pump Drive Link

gasket.

5. Install idle tube flush with bowl casting.

6. Install pump ball, spring and "T" into pump discharge hole (Fig. 6C-10).

7. Drive pump discharge "T" in until flush with bowl casting.

8. Install accelerator pump return spring.

9. Install power piston return spring into piston cavity in the bowl.

10. Install lower end of pump link into actuator lever which fits on throttle shaft. Ends of link point toward carburetor. Bend in link faces fuel inlet nut.

11. Install curved power piston actuator link into throttle actuator lever. End protrudes outward away from throttle bore and has tang which retains link to lever.

12. Install pump plunger assembly into pump well with actuating lever protruding through bottom of bowl casting. Push downward on pump lever and install pump assembly drive link into slot in lower end of shaft. Tang on upper end of link retains link to pump shaft (Fig. 6C-26).

13. Assemble metering rod to holder on power piston. Spring must be on top of arm when assembled correctly. Then install power piston actuating rod (right angle end) into slot in the power piston.

14. Install power piston, metering rod and drive rod assembly into the float bowl. End of drive rod must enter hole in bowl and end of metering rod into jet.

15. Before fastening power piston and pump actuator lever to end of throttle shaft, hold power piston assembly down and slide upper end of curved power piston actuator link into lower end of power piston actuating rod.

16. Install actuating lever on end of throttle shaft by aligning flats or lever with flats on shaft. Install lever retaining screw and tighten securely.

17. Install float needle valve on to float arm hooking pull clip over edge of float arm.

18. Install float hinge pin into float arm. Install float needle into seat and float with hinge pin into float bowl. Hinge pin should be in locating channels in float bowl.

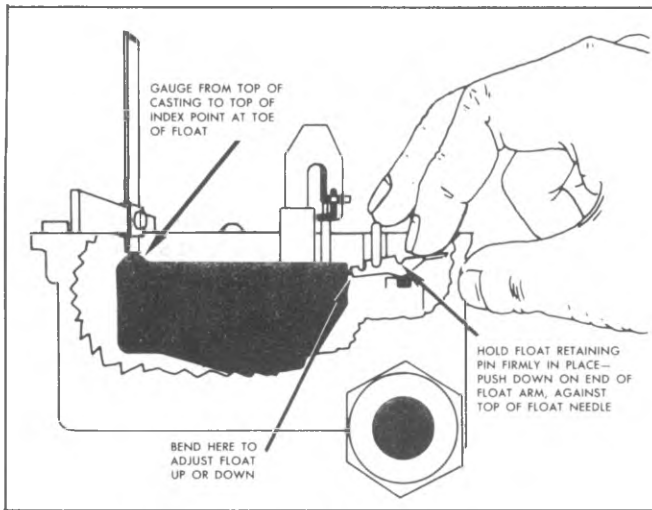


Fig. 6C-27--Float Level Adjustment

Float Level Adjustment (Fig. 6C-27)

1. Hold float retaining pin firmly in place push down on float arm at outer end against top of float needle, as shown.
2. Use adjustable "T" scale and measure distance from top of float at index point on toe to float bowl gasket surface (gasket removed).
3. To adjust, bend float pontoon up or down at float arm junction.

Metering Rod Adjustment (Fig. 6C-28)

1. Open throttle valve, slide metering rod out of holder and remove from main metering jet.
2. To check adjustment, back out 1/8" hex screw on idle stop solenoid and rotate fast idle cam so that cam follower is not contacting steps on cam.
3. With throttle valve completely closed, apply pressure to top of power piston and hold piston down against stop.
4. Holding downward pressure on power piston, swing metering rod holder over flat surface of bowl casting next

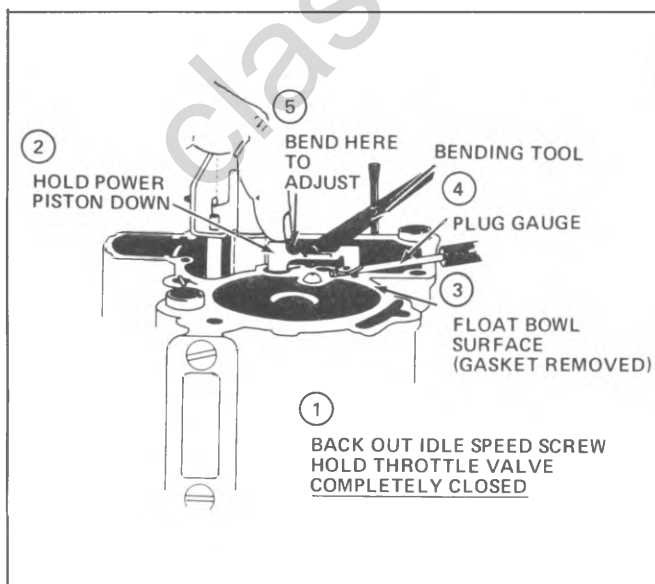


Fig. 6C-28--Metering Rod Adjustment

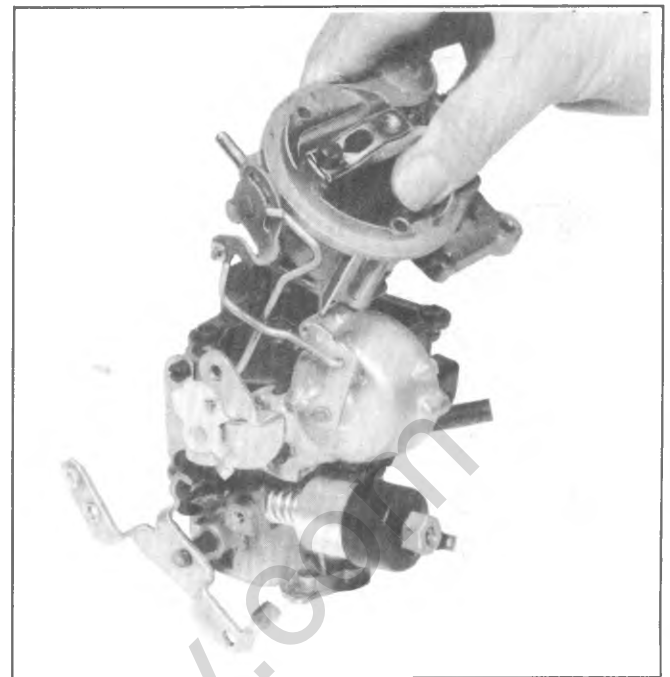


Fig. 6C-29--Installing Air Horn

to carburetor bore.

5. Insert gage between bowl casting and lower surface of metering rod holder. Gage should have a slide fit between both surfaces, as shown.
6. To adjust, carefully bend metering rod holder up or down.
7. Install air horn gasket on float bowl by carefully sliding slit portion of gasket over metering rod holder. Then align gasket with dowels provided on top of bowl casting and press gasket firmly in place.

Air Horn

1. Install choke shaft assembly and choke valve into air horn, if removed. Align choke valve, tighten two retaining screws and stake securely in place.

CAUTION: Apply a torque retaining compound to the vacuum break lever retaining screw and install lever to choke shaft.

2. Install air horn to float bowl by engaging choke coil lever link into notched hole in choke coil lever on choke housing. Then carefully twist and lower air horn onto float bowl. Install three long and one short air horn to float bowl attaching screws and lockwashers (Fig. 6C-29).

3. Install the choke vacuum break diaphragm assembly using two short air horn screws opposite the choke housing, connecting the choke vacuum break diaphragm link to slotted diaphragm plunger stem. The two attaching screws for the choke vacuum break assembly have tapered heads for locating choke diaphragm bracket. Make sure to use these in this location. Tighten all air horn screws evenly and securely using proper tightening sequence (Fig. 6C-30).

4. If removed, install choke housing to float bowl using three attaching screws. Two screws have lockwashers and the other one which face the choke housing has a tapered head for locating choke housing.

5. Install idle cam, and fast idle cam link to upper choke lever assembly. Numbers on fast idle cam face outward.

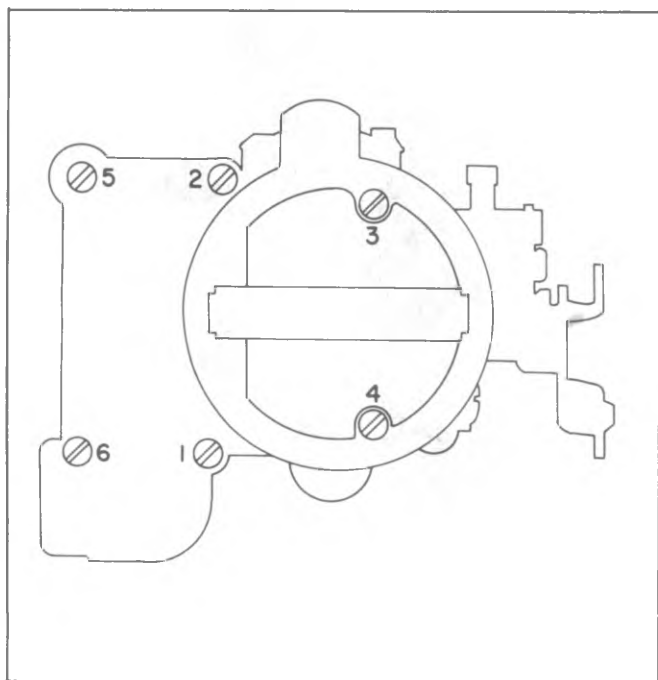


Fig. 6C-30--Tightening Sequence

6. Install electric choke coil assembly on choke housing. Install three retainers and attaching screws. Adjust using choke coil adjustment procedure.

CAUTION: Do not use a gasket between electric coil and housing, as the coil is electrically grounded through housing.

7. Install choke vacuum diaphragm hose to tube on diaphragm and connect to vacuum tube on bowl.

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SPECIFICATIONS

**IDLE MIXTURE WITH PROPANE ENRICHMENT
LIGHT DUTY EMISSIONS**

ENGINE	CURB IDLE	ENRICHED RPM
250 CID MANUAL TRANS. LOW ALTITUDE	SEE: VEHICLE EMISSION CONTROL ON INFORMATION LABEL	900-750 RPM (N)
250 CID AUTOMATIC TRANS. LOW ALT.		620-600 RPM (D)
250 CID MANUAL TRANS HIGH ALTITUDE		900-750 RPM (D)
250 CID AUTOMATIC TRANS. CALIFORNIA		660-600 RPM (D)
250 CID AUTOMATIC TRANS. HIGH ALTITUDE		660-600 RPM (D)
250 CID MANUAL TRANS. CALIFORNIA		850-750 RPM (N)

**IDLE MIXTURE
HEAVY DUTY EMISSIONS**

ENGINE	CURB IDLE	ENRICHED RPM
250 CID	SEE: ENGINE EMISSION CONTROL INFORMA- TION LABEL	SEE: ENGINE EMISSION CONTROL INFORMA- TION LABEL
292 CID		

TORQUE SPECIFICATIONS

1ME CARBURETOR

SCREW	TORQUE (IN. LBS.)	SCREW	TORQUE (IN. LBS.)
AIR HORN TO BOWL	45	FUEL INLET NUT	400
AIR CLEANER BRIDGE	70	FAST IDLE CAM	50
THROTTLE BODY TO BOWL	180	CHOKE LEVER	25
NEEDLE SEAT	45	PUMP LEVER	30*
METERING JET	40		

* Loctite AVV or equivalent

Fig. 6C-31--1ME SPECIFICATIONS

MODEL 2GC/2GV CARBURETOR GENERAL DESCRIPTION

The Model 2GC carburetor (Figs. 6C1-1) is equipped with an integral choke attached to the throttle body assembly.

All light duty truck models use a fuel inlet check valve to shut off fuel flow to the carburetor float bowl to prevent fuel leaks if a vehicle roll-over should occur.

To meet evaporative emission standards and improve hot starting, fuel vapors from the fuel tank and carburetor float bowl are collected in a vapor canister and not vented to atmosphere. The carburetor air horn casting is revised and a tube added (location B) which through a hose, connects directly to a vacuum operated vapor vent valve located in the canister.

All models (except California) use full vacuum for distributor advance obtained through a tube pressed into the float bowl (choke side location "h"). On California models, timed vacuum for distributor advance is supplied through this same tube (location "h").

An Exhaust Gas Recirculation (E.G.R.) system is used to meet emission requirements for oxides of Nitrogen (NOx). In addition, a cup restriction is added in the float bowl behind the Exhaust Gas Recirculation (E.G.R.) vacuum tube (location "j"), to delay E.G.R. valve operation for improved engine performance as the throttle valves are

opened.

A electrically operated solenoid is used on all 2GC models equipped with automatic transmission and air conditioning. The solenoid is used to maintain proper idle speed when the air conditioning is in operation.

Fuel for the pump system is obtained through a hole located in a raised cast-in boss on the floor of the float bowl which prevents the entry of dirt into the accelerator pump fuel inlet passage. The pump plunger head is designed with an expander spring beneath the pump cup to maintain good pump wall contact during pump operation.

The end of the pump plunger stem is upset in manufacturing to provide the "clipless" retaining in feature. The pump plunger assembly may be removed from the inner lever by twisting upset end with small pliers until it breaks. The service pump assembly has a grooved end and is provided with a retaining clip.

The carburetor part number is stamped on the flat section of the float bowl next to the fuel inlet nut. (Fig. 6C1-2). When servicing the carburetor unit, refer to the On-Car Service section for proper procedures and specifications.

Incorporated in the Model 2GC carburetor are six basic systems. They are Float, Idle, Main Metering, Power, Pump and Choke (Figs. 6C1-3 through 10).



Fig. 6C1-1--Model 2GC Carburetor

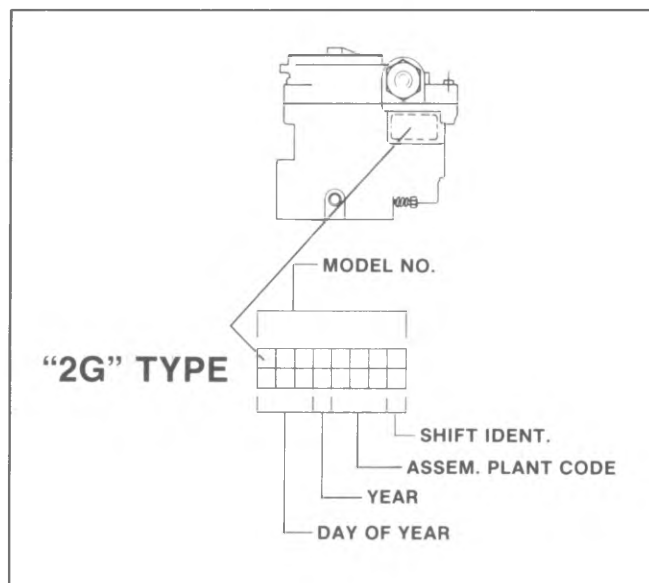


Fig. 6C1-2--Model 2GC Carburetor Identification

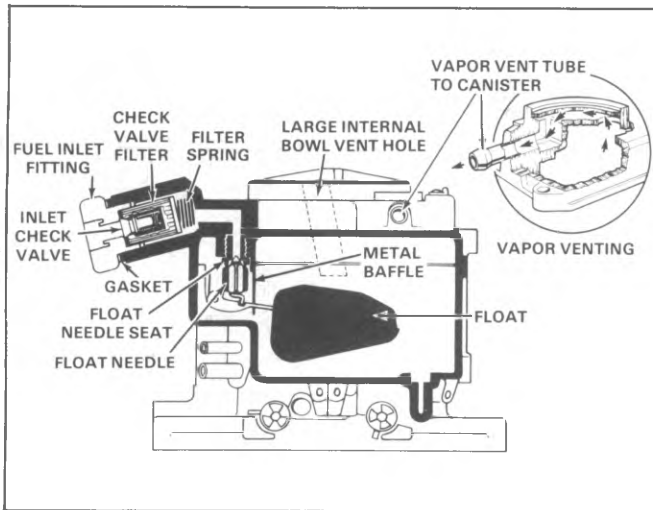


Fig. 6C1-3--Float System

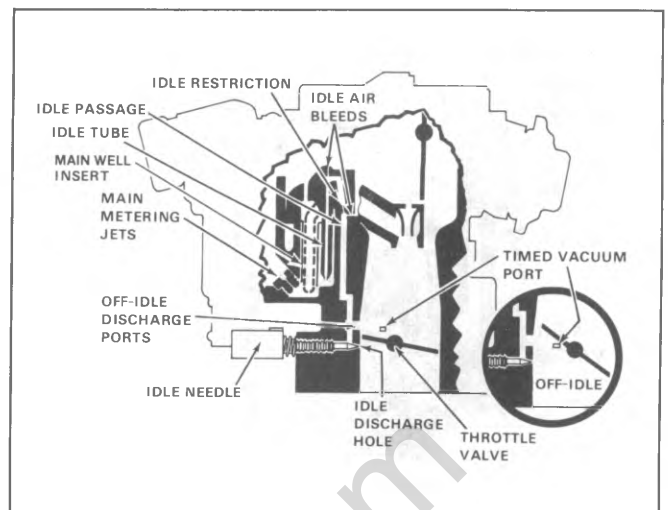


Fig. 6C1-5--Idle System W/H.D. Emission-Except Calif.

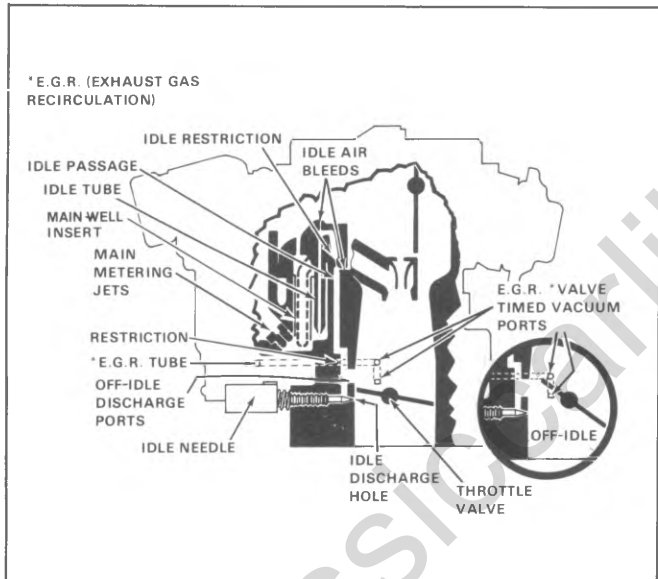


Fig. 6C1-4--Idle System-Except California and H.D. Emission

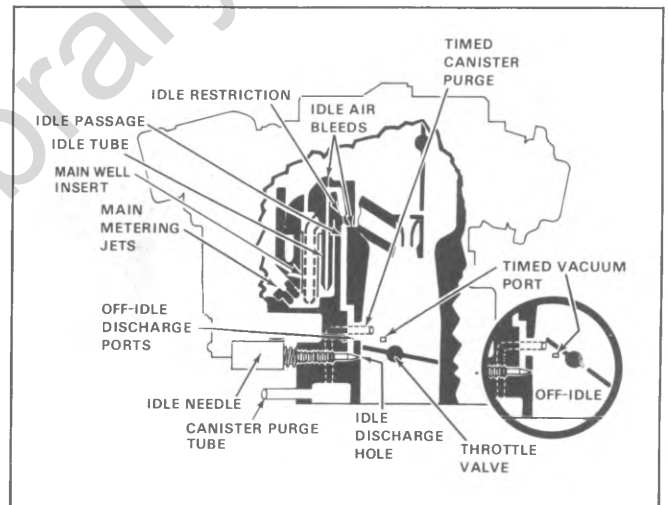


Fig. 6C1-6--Idle System Calif. W/H.D. Emission

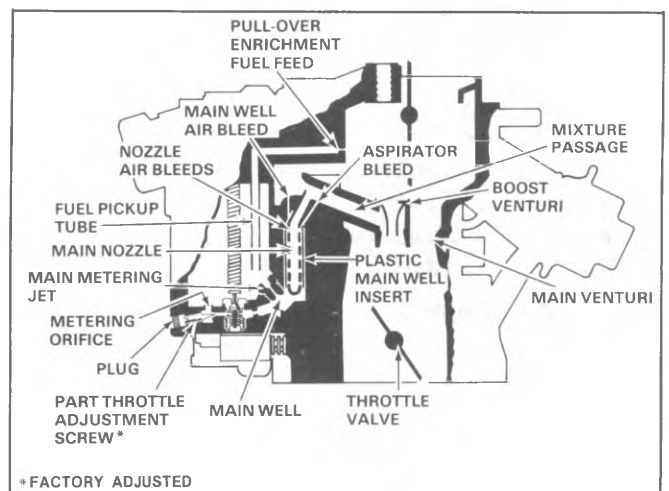


Fig. 6C1-7--Main Metering System

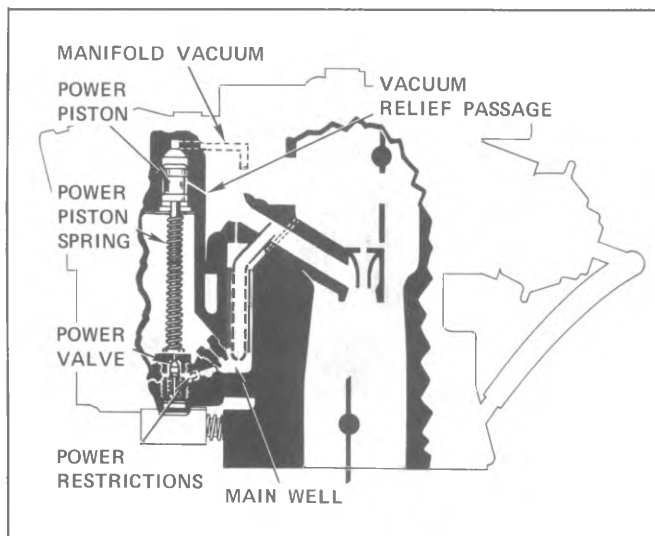


Fig. 6C1-8--Power System

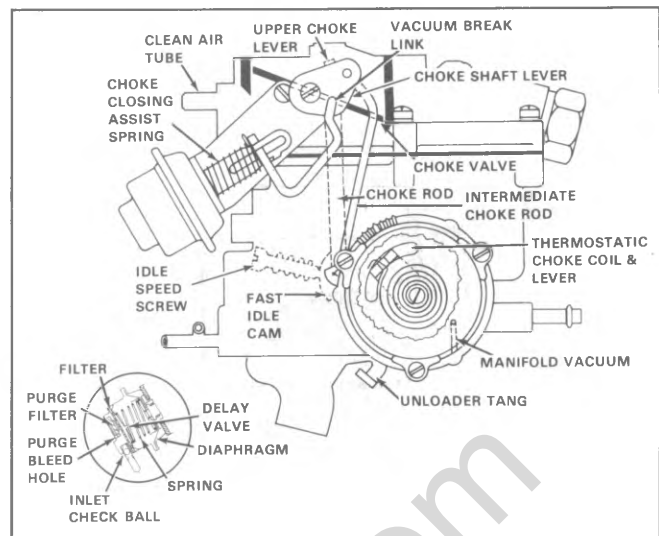


Fig. 6C1-10--Choke System-2GC

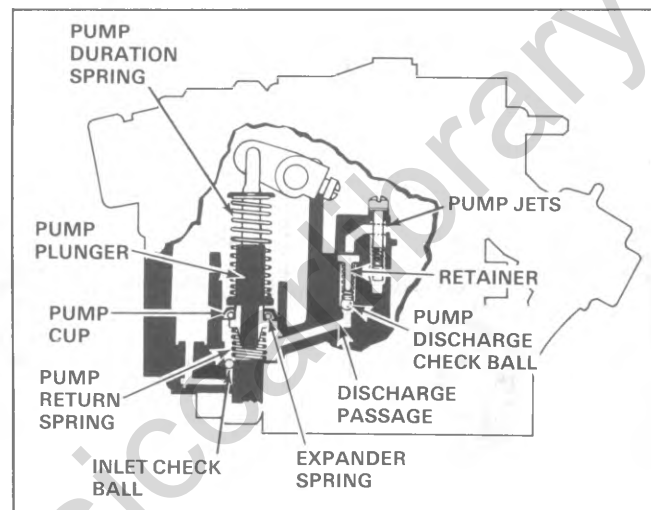


Fig. 6C1-9--Pump System

ON-VEHICLE SERVICE

CARBURETOR ADJUSTMENTS

Refer to figure 6C1-11 for the following adjustments:

- Float Level
- Float Drop
- Pump Rod

Refer to figure 6C1-12 for the following adjustments:

- Choke Coil Lever
- Automatic Choke Coil-2GC
- Choke Coil Rod-2GV

Checking Carburetor Choke

1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links are connected and there are no signs of damage.

2. If choke or linkage binds, sticks, or works sluggishly, clean with Choke Cleaner X-20-A or equivalent. Use cleaner as directed on can. Refer to disassembly instructions

for additional direction if cleaning does not correct.

3. Visually inspect carburetor to be certain all vacuum hoses are connected. Inspect hoses for cracks, abrasions, hardness or other signs of deterioration. Replace or correct as necessary.

4. Make sure vacuum break diaphragm shaft is fully extended when engine is off. If shaft is not fully extended, replace vacuum break assembly. Start engine - Vacuum break diaphragm shaft should fully retract within 10 seconds. If unit fails to retract, replace vacuum break assembly.

Refer to figure 6C1-13 for the following adjustments:

- Choke Rod (Fast Idle Cam)
- Vacuum Break
- Unloader

Refer to figure 6C1-14 for the following adjustments:

- Idle Speed Adjustment-without solenoid.
- Idle Speed Adjustment-with solenoid.

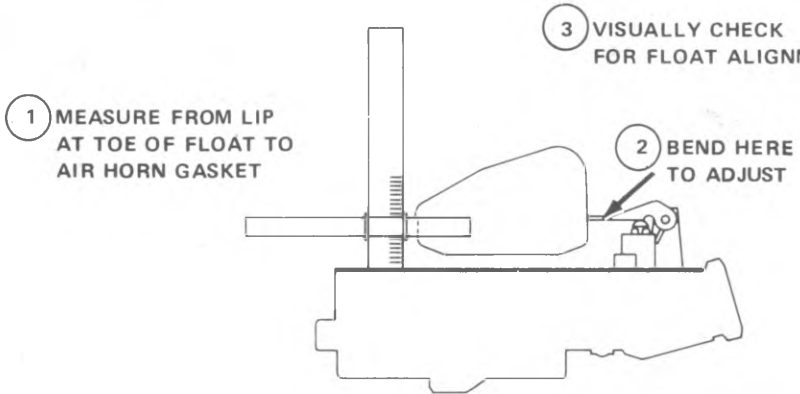
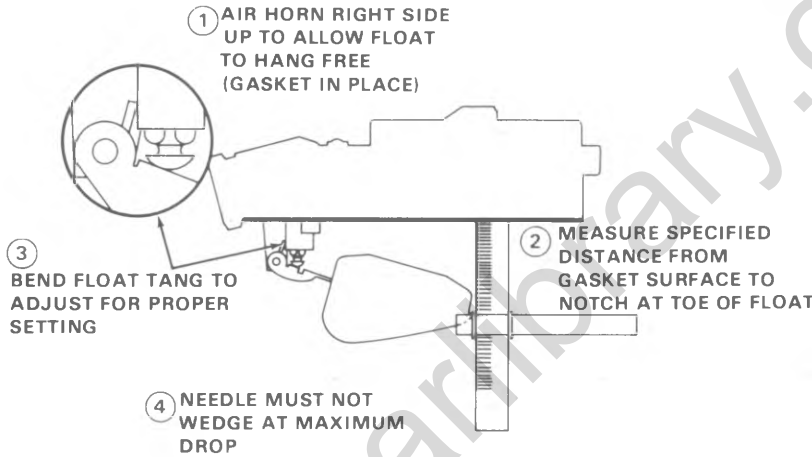
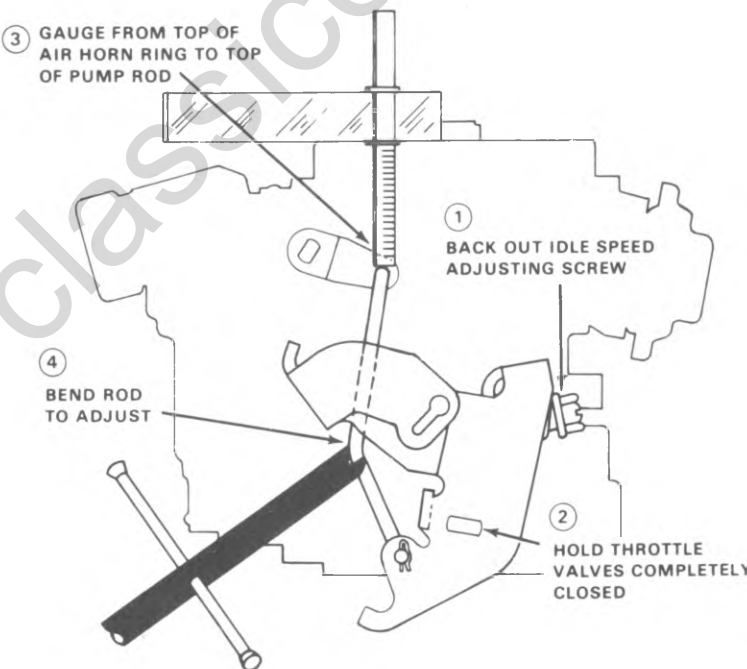
<p>1</p> <p>① MEASURE FROM LIP AT TOE OF FLOAT TO AIR HORN GASKET</p>  <p>② BEND HERE TO ADJUST</p> <p>③ VISUALLY CHECK FOR FLOAT ALIGNMENT</p> <p>FLOAT LEVEL ADJUSTMENT</p>	<p>CARB. NO.</p>	<p>GAUGE</p>
<p>2</p> <p>① AIR HORN RIGHT SIDE UP TO ALLOW FLOAT TO HANG FREE (GASKET IN PLACE)</p>  <p>② MEASURE SPECIFIED DISTANCE FROM GASKET SURFACE TO NOTCH AT TOE OF FLOAT</p> <p>③ BEND FLOAT TANG TO ADJUST FOR PROPER SETTING</p> <p>④ NEEDLE MUST NOT WEDGE AT MAXIMUM DROP</p> <p>FLOAT DROP ADJUSTMENT</p>	<p>CARB. NO.</p>	<p>GAUGE</p>
<p>3</p> <p>③ GAUGE FROM TOP OF AIR HORN RING TO TOP OF PUMP ROD</p>  <p>① BACK OUT IDLE SPEED ADJUSTING SCREW</p> <p>② HOLD THROTTLE VALVES COMPLETELY CLOSED</p> <p>④ BEND ROD TO ADJUST</p> <p>PUMP ROD ADJUSTMENT</p>	<p>CARB. NO.</p>	<p>GAUGE</p>

Fig. 6C1-11--2GC Carburetor Adjustments - 1 of 4

<p>4</p> <p>1 REMOVE THERMOSTATIC COVER COIL ASSEMBLY, AND INSIDE BAFFLE PLATE (IF USED)</p> <p>2 PLACE IDLE SPEED SCREW ON HIGHEST STEP OF FAST IDLE CAM</p> <p>3 CLOSE CHOKE VALVE BY PUSHING UP ON LEVER</p> <p>4 EDGE OF COIL LEVER MUST LINE UP WITH EDGE OF .120" PLUG GAUGE IN HOLE INSIDE CHOKE HOUSING</p> <p>5 BEND ROD HERE TO ADJUST (SEE INSET)</p> <p style="text-align: center;">CHOKE COIL LEVER ADJUSTMENT</p>	<p>CARB. NO.</p> <p>ALL</p>	<p>PLUG GAUGE</p> <p>.120"</p>
<p>5</p> <p>1 SET IDLE SPEED SCREW ON HIGHEST STEP OF CAM</p> <p>2 LOOSEN THREE RETAINING SCREWS (NOTE: TIGHTEN SCREWS AFTER ADJUSTMENT)</p> <p>3 WITH CHOKE VALVE WIDE OPEN (ENGINE COLD) ROTATE COVER AGAINST COIL TENSION UNTIL CHOKE VALVE CLOSURE. SET MARK ON COVER TO SPECIFIED POINT ON CHOKE HOUSING. NOTE: ON MODELS WITH SLOTTED COIL PICK UP LEVER, MAKE SURE COIL TANG IS INSTALLED IN SLOT IN LEVER (SEE INSET).</p> <p style="text-align: center;">AUTOMATIC CHOKE COIL ADJUSTMENT</p>	<p>CARB. NO.</p> <p>ALL</p>	<p>INDEX MARK</p> <p>INDEX</p>
<p>6</p> <p>1 REMOVE UPPER END OF ROD FROM CHOKE LEVER</p> <p>2 HOLD CHOKE VALVE WIDE OPEN</p> <p>3 PUSH DOWNWARD ON ROD TO END OF TRAVEL</p> <p>4 ROD SHOULD FIT IN BOTTOM OF SLOT IN LEVER</p> <p>5 TO ADJUST, BEND LEVER WITH SCREWDRIVER IN SLOT</p> <p>6 CONNECT ROD TO LEVER</p> <p style="text-align: center;">CHOKE COIL ROD ADJUSTMENT - 2GV</p>		
<p>7</p> <p>1 IDLE SPEED SCREW ON 2ND STEP OF FAST IDLE CAM AGAINST HIGH STEP</p> <p>2 GAUGE BETWEEN UPPER EDGE OF CHOKE VALVE AND WALL OF AIR HORN</p> <p>3 BEND TANG TO ADJUST (SEE INSET # 2 OR # 3)</p> <p>L - LOW STEP 2 - 2ND STEP H - HIGH STEP</p> <p>INSET # 1</p> <p>INSET # 2</p> <p>INSET # 3</p> <p style="text-align: center;">CHOKE ROD (FAST IDLE CAM) ADJUSTMENT</p>	<p>CARB. NO.</p> <p>ALL</p>	<p>PLUG GAUGE</p> <p>.260</p>

Fig. 6C1-12--2GC Carburetor Adjustments - 2 of 4

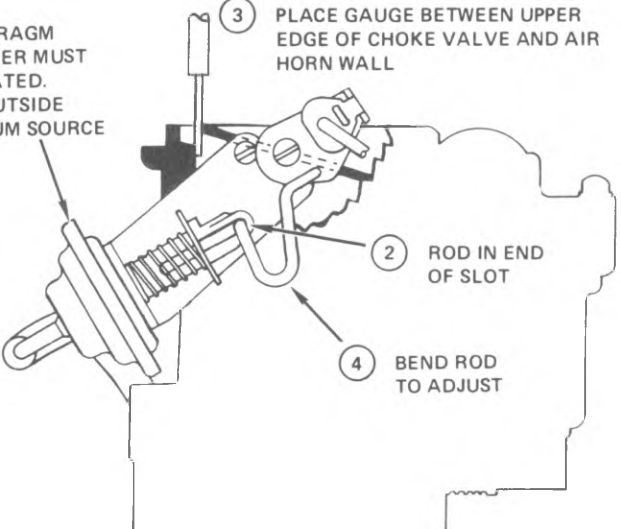
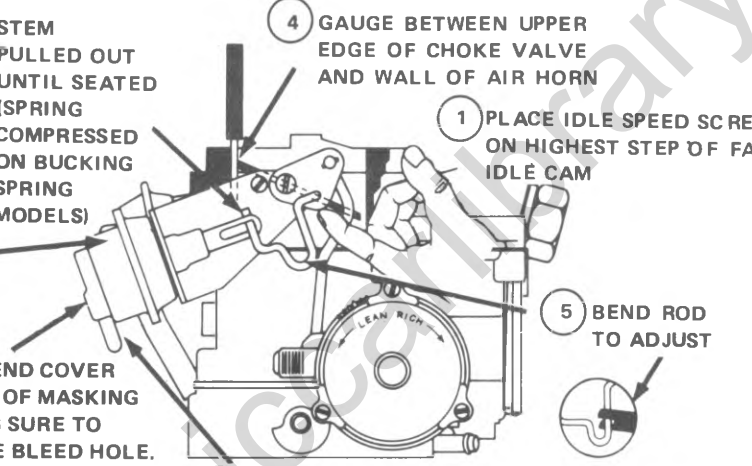
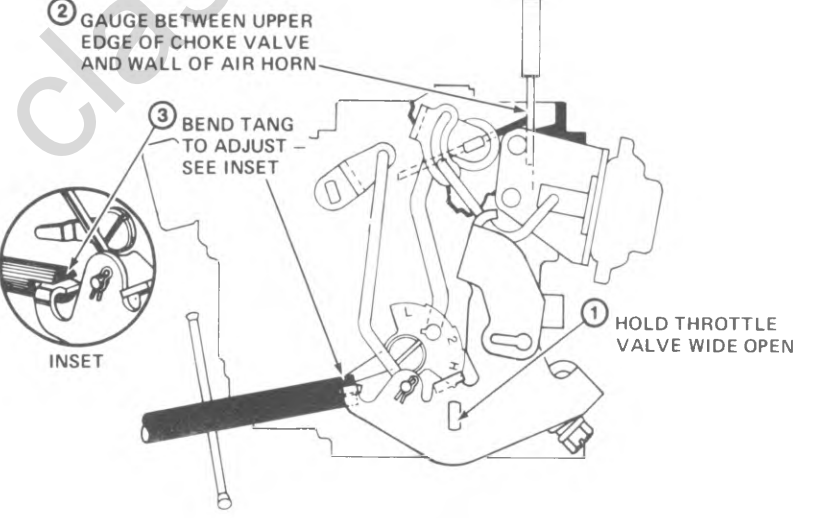
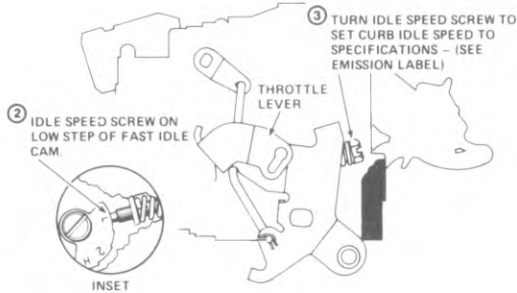
<p>8</p>	<p>① DIAPHRAGM PLUNGER MUST BE SEATED. USE OUTSIDE VACUUM SOURCE</p> <p>③ PLACE GAUGE BETWEEN UPPER EDGE OF CHOKE VALVE AND AIR HORN WALL</p> <p>② ROD IN END OF SLOT</p> <p>④ BEND ROD TO ADJUST</p>  <p>VACUUM BREAK ADJUSTMENT - 2GV</p>	<p>17058127</p>	<p>.190</p>
<p>9</p>	<p>③ STEM PULLED OUT UNTIL SEATED (SPRING COMPRESSED ON BUCKING SPRING MODELS)</p> <p>④ GAUGE BETWEEN UPPER EDGE OF CHOKE VALVE AND WALL OF AIR HORN</p> <p>① PLACE IDLE SPEED SCREW ON HIGHEST STEP OF FAST IDLE CAM</p> <p>⑤ BEND ROD TO ADJUST</p> <p>VACUUM DIAPHRAGM SEATED</p> <p>NOTE: PLUG END COVER WITH A PIECE OF MASKING TAPE MAKING SURE TO COVER PURGE BLEED HOLE. REMOVE TAPE AFTER ADJUSTMENT.</p> <p>② USE OUTSIDE VACUUM SOURCE</p>  <p>VACUUM BREAK ADJUSTMENT (CHOKE SIDE)</p>	<p>CARB. NO.</p> <p>ALL EXCEPT 17058127</p>	<p>PLUG GAUGE</p> <p>.130 RESET TO .160 @ FIRST TUNE UP</p>
<p>10</p>	<p>② GAUGE BETWEEN UPPER EDGE OF CHOKE VALVE AND WALL OF AIR HORN</p> <p>③ BEND TANG TO ADJUST - SEE INSET</p> <p>① HOLD THROTTLE VALVE WIDE OPEN</p>  <p>CHOKE UNLOADER ADJUSTMENT</p>	<p>CARB. NO.</p> <p>ALL</p>	<p>PLUG GAUGE</p> <p>.325</p>

Fig. 6C1-13-2GC Carburetor Adjustments - 3 of 4

11

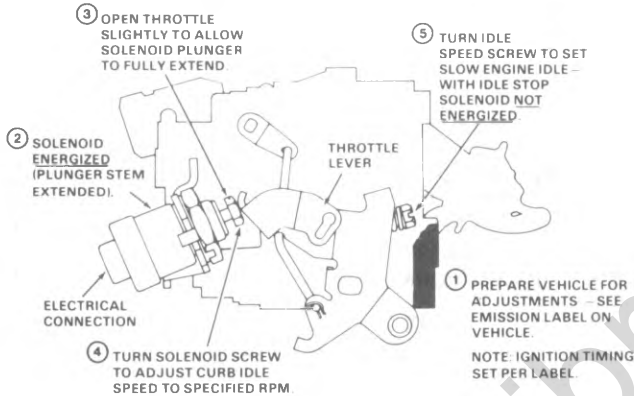
1 PREPARE VEHICLE FOR ADJUSTMENTS - SEE EMISSION LABEL ON VEHICLE. NOTE: IGNITION TIMING SET PER LABEL.



IDLE SPEED ADJUSTMENT - WITHOUT SOLENOID

SEE:
VEHICLE EMISSION
CONTROL INFORMATION
LABEL

12

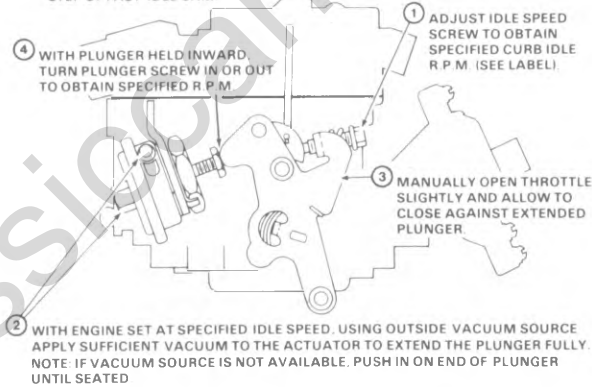


IDLE SPEED ADJUSTMENT - WITH SOLENOID

SEE:
VEHICLE EMISSION
CONTROL INFORMATION
LABEL

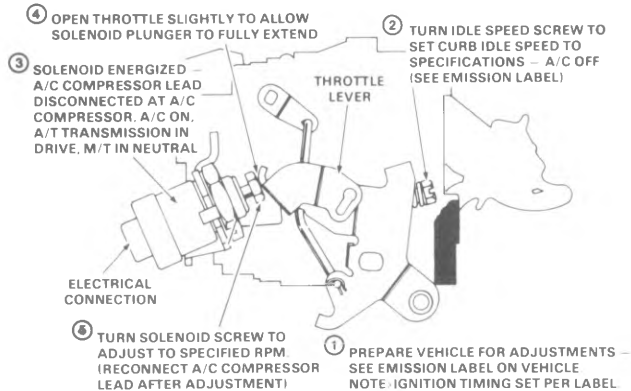
13

NOTE: ENGINE MUST BE WARM. CHOKE WIDE OPEN. IDLE SPEED SCREW ON LOW STEP OF FAST IDLE CAM



THROTTLE LEVER ACTUATOR ADJUSTMENT

14



A/C IDLE SPEED ADJUSTMENT

Fig. 6C1-14--2GC Carburetor Adjustments-4 of 4

Checking Solenoid

1. Turn on ignition, but do not start engine. Turn A/C to "on" position.
2. Open throttle to allow solenoid to extend, close throttle
3. Disconnect lead at solenoid. Solenoid plunger should drop away from throttle lever.
4. Connect solenoid lead. Plunger should move out and contact the throttle lever. Solenoid may not be strong enough to open the throttle, but the plunger should move.
5. If plunger does not move in and out as lead is disconnected and connected, insert test light (1893 bulb or smaller) between the solenoid feed wire and ground.
6. If light lights, replace solenoid.
7. If light does not light, locate cause of open circuit in solenoid feed wire.

Idle Mixture With Propane Enrichment**IDLE MIXTURE ADJUSTMENT****WITH PROPANE ENRICHMENT**

A change has been made in some General Motors carburetors to limit the range of idle mixture adjustment on the rich side. In other words, backing out the idle mixture screws will not provide appreciably richer mixture. A new idle mixture adjustment procedure requiring artificial enrichment by addition of propane is necessary for checking and setting idle mixture on these carburetors.

Before suspecting the carburetor as the cause of poor engine performance or rough idle, check ignition system including distributor, timing, spark plugs and wires. Check air cleaner, evaporative emission system, EFE System, PCV system, EGR valve and engine compression. Also inspect intake manifold, vacuum hoses and connections for leaks and check torques of carburetor mounting bolts/nuts. If carburetor bolts are retorqued without carburetor removal retorque to 12 ft. lbs. maximum.

NOTE: Idle mixture screws have been preset at the factory and capped. Do not remove the caps during normal engine maintenance. Idle mixture should be adjusted only in the case of major carburetor overhaul, throttle body replacement or high idle CO as determined by state or local inspections. Adjusting mixture by other than the following method may violate Federal and/or California or other state or Provincial laws.

1. Set parking brake and block drive wheels. On cars equipped with vacuum parking brake release, disconnect and plug hose at brake.
2. Disconnect and plug hoses as directed on the Emission Control Information Label under the hood.
3. Engine must be at normal operating temperature, choke open and air conditioning off.
4. Connect an accurate tachometer to engine. Set curb idle speed to specification shown on Emission Control Information Label.
5. Disconnect vacuum advance and set timing to specification shown on the Emission Control Information Label. Reconnect vacuum advance.

NOTE: On cars equipped with electronic spark timing, check timing as directed on the Emission Label.

6. Disconnect crankcase ventilation tube from the air cleaner.
7. Using tool J-26911, insert hose with rubber stopper

from propane valve into the crankcase ventilator tube opening in the air cleaner.

8. Propane cartridge must be in a vertical position.
9. Slowly open propane control valve until maximum engine speed is reached with the transmission in drive (Neutral for manual shift).

NOTE: Too much propane will cause engine speed to drop.

10. Observe propane flow meter to insure propane cartridge is adequately full.

11. With propane flowing, adjust idle speed screw to the enriched RPM (starting point for lean drop setting-see specifications). Readjust propane flow to be certain of maximum engine speed and adjust idle speed again if necessary.

12. Turn off propane. Place transmission in Neutral and run engine at approximately 2,000 RPM for 30 seconds. Put transmission in Drive (Neutral for manual shift).

13. Check idle speed. If it is as shown on the Emission Control Information Label, the idle mixture is correct. In that case proceed with Step #17.

14. If the speed is too low, carefully remove tab from the limiter cap or gently remove cap from screw taking care not to bend the screw head, then back out the screw or screws equally (richen) 1/8 turn at a time until speed on Emissions Label is reached.

If the speed is too high, carefully remove tab from the limiter cap or gently remove cap from screw taking care not to bend the screw head, then turn in the screw or screws equally (leaner) 1/8 turn at a time until speed on Emissions Label is reached.

15. Turn propane on again to check maximum engine idle speed. If speed is different from specification (enriched RPM-starting point for lean drop setting) readjust idle speed screw to enriched RPM with propane flowing.

16. Turn off propane again, clean out engine at 2,000 RPM for 30 seconds in Neutral. Put transmission in Drive (Neutral for manual) re-check idle speed. It should be as shown on the Emissions Control Information Label. If not, repeat the adjustment procedure as in Step #14.

17. If rough idle persists, turn mixture screws in until lightly seated. Back them out equally to the average previous position and rerun propane idle test starting with Step #9.

18. Turn off engine and remove propane tool. Connect crankcase ventilation tube to air cleaner.

CARBURETOR REPLACEMENT (FIG.6C1-15)**Removal**

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by presence of dirt, water, or other foreign matter in carburetor. To aid in diagnosis, carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check filter.

1. Remove air cleaner and gasket.
2. Disconnect solenoid wire if equipped.
3. Disconnect fuel and vacuum lines from carburetor.
4. Disconnect fresh air hose and choke hose from choke system.
5. Disconnect accelerator linkage.

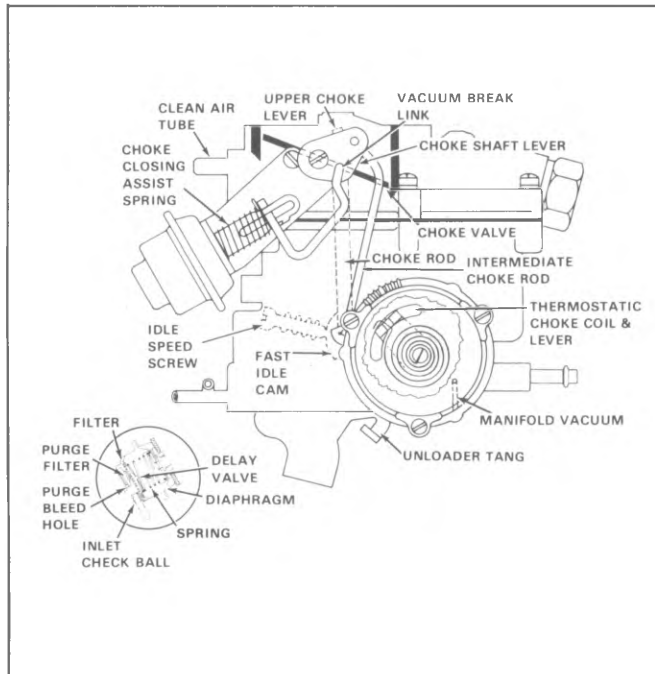


Fig. 6C1-15--Carburetor and Choke Pipes V8, 2Bbl

6. If equipped with automatic transmission, disconnect downshift cable.

7. If equipped with cruise control, disconnect linkage.

8. Remove carburetor attaching bolts and remove carburetor and insulator.

Installation

1. Fill carburetor bowl before installing carburetor.

2. With clean sealing surfaces on carburetor and intake manifold, install new insulator.

3. Position carburetor over insulator and install bolts. Tighten bolts alternately to 145 inch pounds.

4. Connect downshift cable as required.

5. Connect cruise control cable as required.

6. Connect accelerator linkage.

7. Connect choke system.

8. Connect fuel pipe and vacuum hoses.

9. Connect solenoid wire as required.

10. Install air cleaner.

11. Check and adjust idle speed.

UNIT REPAIR

DISASSEMBLY

Place carburetor on a holding fixture to prevent damage to throttle plates.

Solenoid Assembly (If Used)

CAUTION: The electrically operated solenoid should be removed from the float bowl for complete carburetor disassembly and should not be immersed in any type of carburetor cleaner.

To remove the solenoid assembly, bend back the retaining tabs on lockwasher; then remove large nut which retains the stop solenoid to the carburetor bracket. It is not necessary to remove the bracket from the float bowl assembly unless replacement of the bracket is necessary.

Air Horn

1. Remove fuel inlet filter nut and gasket, and remove filter and spring.

2. Disconnect lower end of pump rod from throttle lever by removing spring clip (Fig. 6C1-16).

3. Remove upper end of pump rod from pump lever by rotating rod out of hole in lever (Fig. 6C1-17).

4. Remove the vacuum break diaphragm hose from tube on throttle body and tube on vacuum break diaphragm unit. Then remove the vacuum break diaphragm assembly from air horn by removing two attaching screws. Remove diaphragm and link assembly from lever on end of choke shaft.

5. Remove vacuum break lever from end of choke shaft by removing retaining screw in end of shaft (Fig. 6C1-18). Then, remove the intermediate choke rod from the vacuum break lever and from the lever on the thermostatic coil housing (Fig. 6C1-19).

6. Remove fast idle cam attaching screw from side of

float bowl (Fig. 6C1-20). Remove fast idle cam from end of choke rod by rotating rod out of hole in fast idle cam. The upper end of the choke rod cannot be removed from the choke lever until after the air horn has been removed from the float bowl.

7. Remove eight air horn attaching screws and lockwashers, then lift air horn from float bowl. Rotate

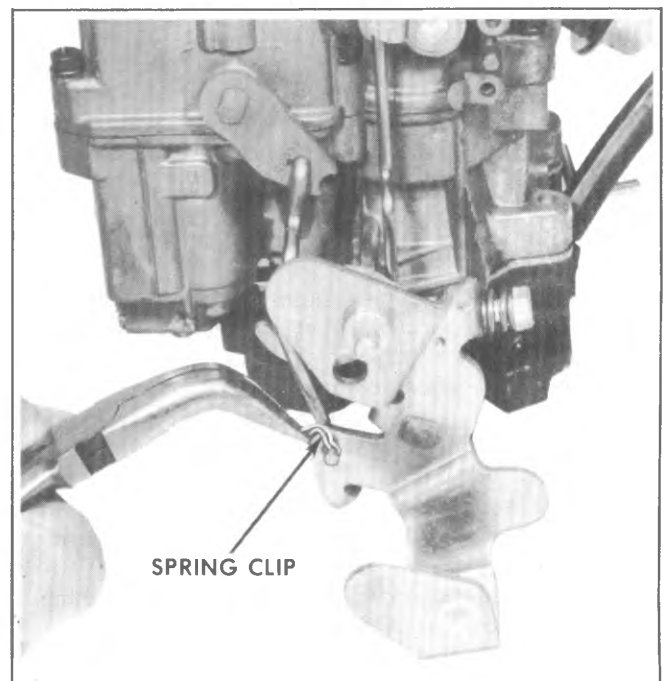


Fig. 6C1-16--Removing Pump Rod Spring Clip

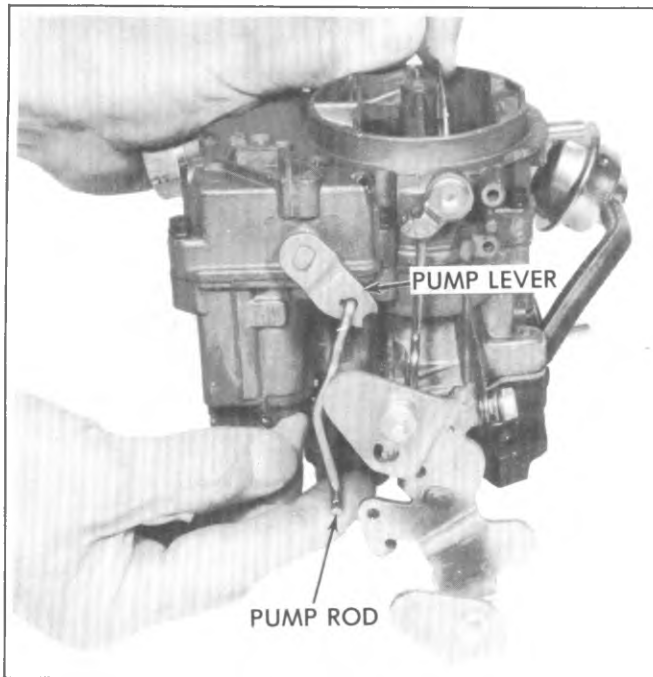


Fig. 6C1-17--Removing Pump Rod

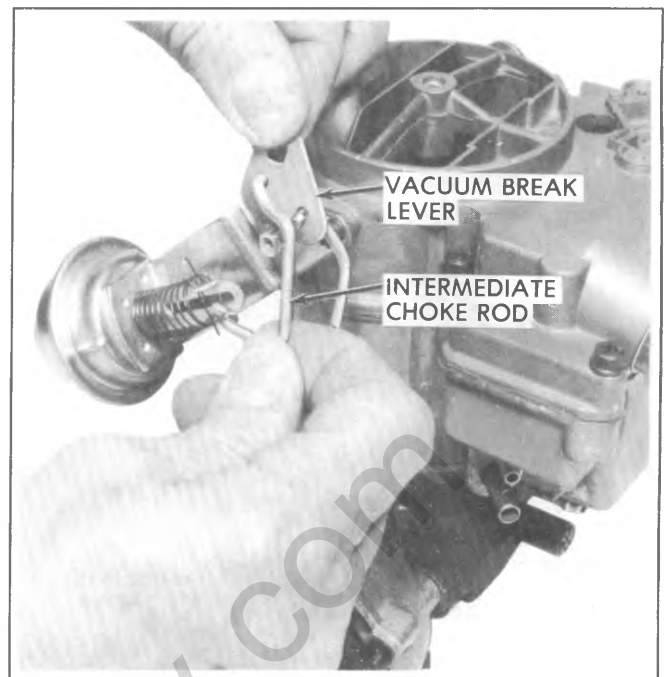


Fig. 6C1-20--Removing Intermediate Choke Rod

choke rod to remove upper end of rod from the choke shaft lever.

8. Place air horn on flat surface. Remove float hinge pin and lift float from air horn. Float needle may now be removed from needle seat or from float assembly (if pull-clip is used).

9. Remove float needle seat and gasket with a wide blade screwdriver.

10. Remove power piston by depressing stem and allowing it to snap free (Fig. 6C1-21). Use care not to bend the power piston stem.

11. Remove the pump plunger assembly and inner pump lever from pump shaft by loosening set screw on inner lever. To remove the pump plunger stem from the inner pump lever it will be necessary to break off the swaged or flattened end of the pump plunger stem. This should not be done unless pump assembly replacement is necessary, such as during overhaul. The service pump assembly uses a grooved pump plunger stem and retaining clip. After removing the inner pump lever and pump assembly, remove the outer pump lever and shaft assembly from air horn. Remove the plastic washer on pump plunger shaft.

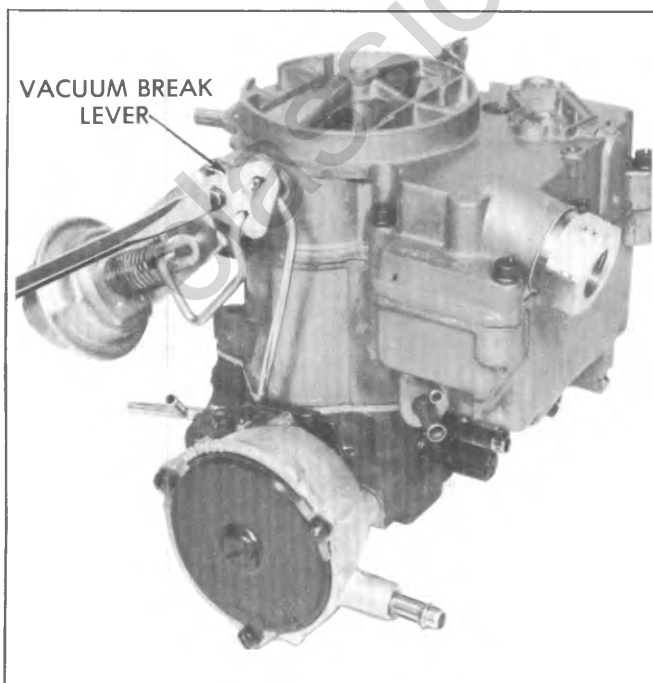


Fig. 6C1-18--Removing Vacuum Break Lever

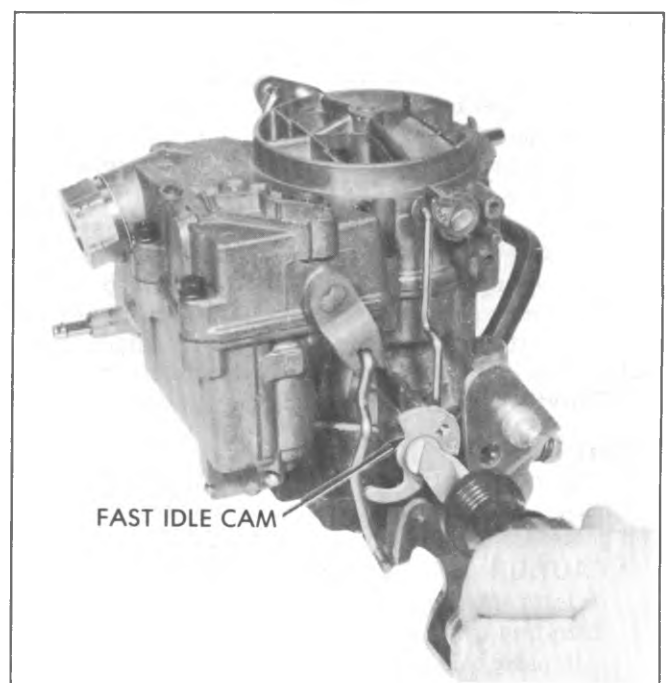


Fig. 6C1-20a--Removing Fast Idle Cam

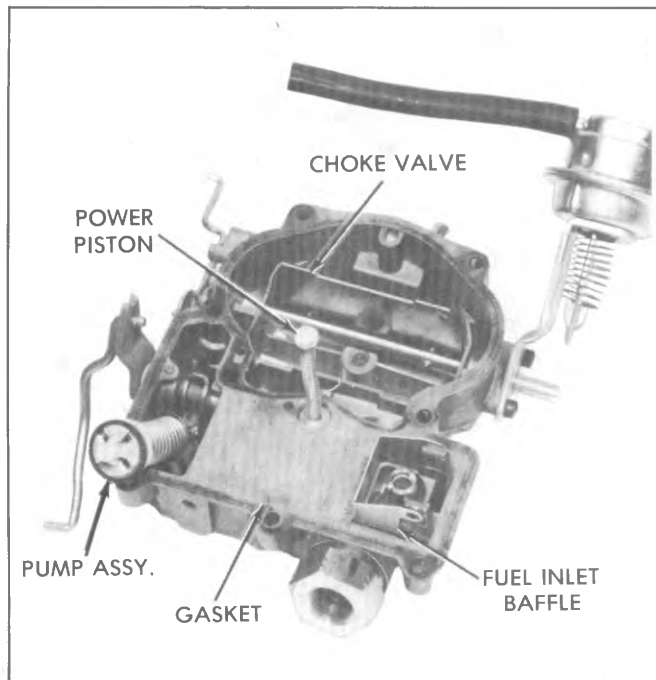


Fig. 6C1-21--Power Piston

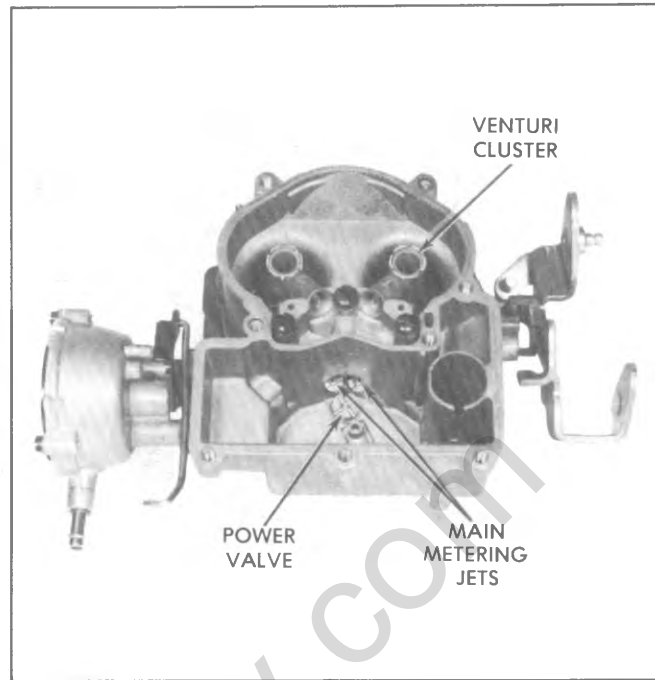


Fig. 6C1-22--Float Bowl

12. Remove air horn gasket from air horn.
13. Remove fuel inlet baffle next to needle seat.
14. Remove two choke valve attaching screws, then remove choke valve. Care should be taken when removing attaching screws so that the choke shaft will not be bent. It may be necessary to file off staked ends on choke valve screws before removing.
15. Remove choke valve shaft from air horn.
16. Remove the fast idle cam rod and lever from the choke shaft.

Float Bowl (Fig. 6C1-22)

1. Remove pump plunger return spring from inside pump well (Fig. 6C1-23). Then remove aluminum check ball from bottom of pump well by inverting bowl.
2. Remove main metering jets, power valve and gasket from inside float bowl.
3. Remove three screws holding venturi cluster to float bowl and remove cluster and gasket. Then remove the plastic main well inserts in the main well cavity (Fig. 6C1-24).
4. Using a pair of long nosed pliers, remove pump discharge spring retainer (Fig. 6C1-25). Then, spring and check ball may also be removed from discharge passage.
5. Invert carburetor and remove three large throttle body to bowl attaching screws and lockwashers (Fig. 6C1-26). Throttle body and gasket may now be removed.

Throttle Body

1. Remove the three choke cover attaching screws and retainers, then remove thermostatic coil and cover assembly and gasket from choke housing (Fig. 6C1-27).

CAUTION: Do not remove cup baffle from beneath thermostatic coil cover because coil distortion may result.

2. Remove baffle plate from inside choke housing (Fig. 6C1-27).

3. Remove the two choke housing attaching screws

from inside choke housing, then remove choke housing and gasket from throttle body casting (Fig. 6C1-27).

4. Remove screw from end of intermediate choke shaft and remove intermediate choke lever from shaft. Remove inner choke coil lever and shaft assembly from choke housing. Remove rubber dust seal from inside choke housing.

5. The idle mixture needles have been adjusted and set at the factory and capped, to prevent excessive adjustment in the field. However, the carburetor has limited idle mixture adjustment. If it is necessary to remove the idle

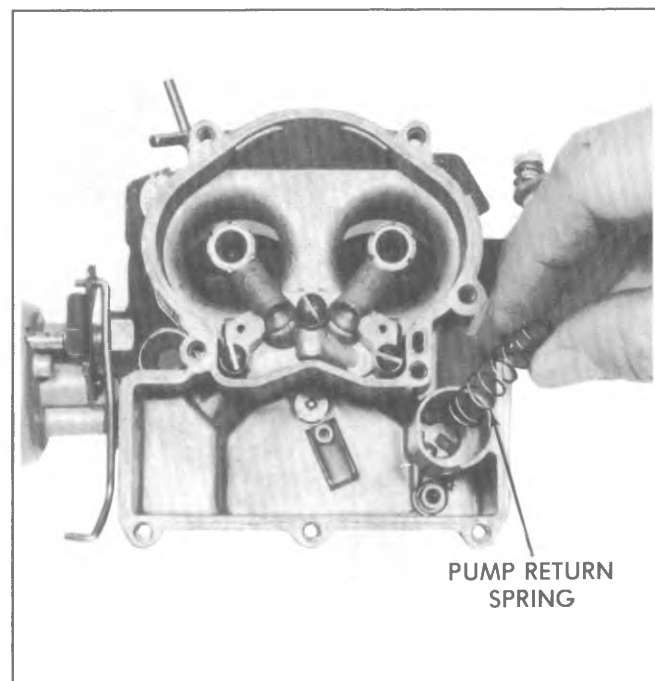


Fig. 6C1-23--Removing Pump Return Spring



Fig. 6C1-24--Venturi Cluster Assembly

mixture needles for cleaning purposes or if they are defective, the following procedure should be used:

Using a pair of side cutter pliers, clip off the limit tang on the limiter cap, and unscrew the idle mixture screw and spring from throttle body. If new idle mixture needles are installed, no plastic limiter caps are required. If the original idle mixture needles had to be removed, install the idle mixture needle and springs into throttle body as described under Assembly. No further disassembly of the throttle body is necessary.

CAUTION: No attempt should be made to remove

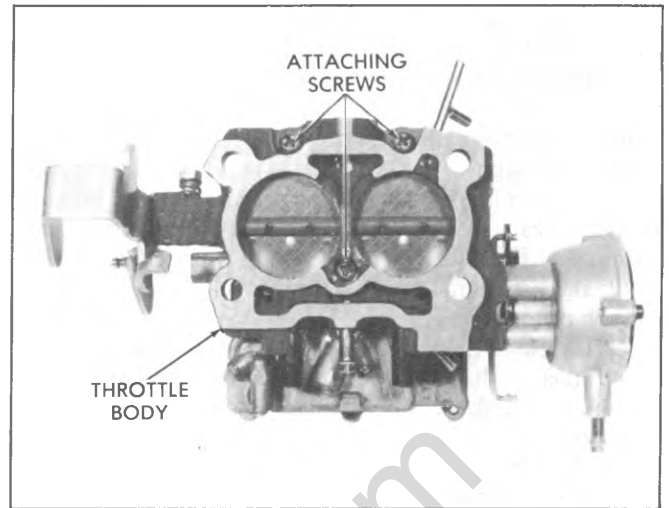


Fig. 6C1-26--Throttle Body Attaching Screws

the throttle valves or shaft as it may be impossible to reassemble the throttle valves correctly in relation to the idle discharge orifices.

CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

CAUTION: The electric solenoid, rubber parts, plastic parts, diaphragms, pump plungers, should not be put in immersion type cleaner as they will swell, harden or distort.

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.

2. Check, repair or replace the following parts if the following problems were encountered.

- a. Flooding

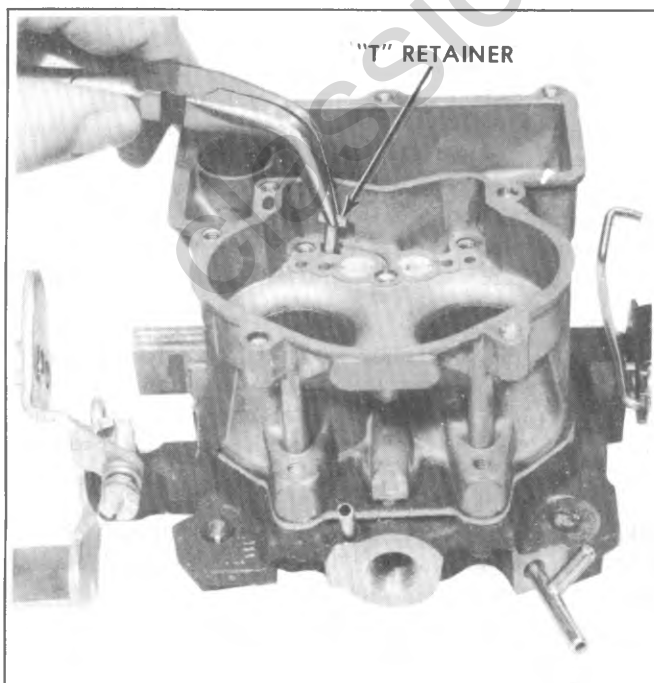


Fig. 6C1-25--Pump Discharge "T" Retainer

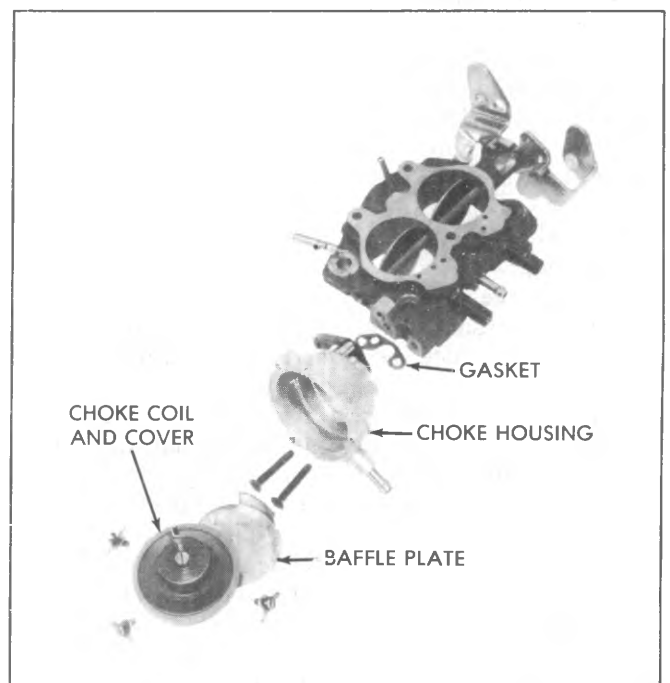


Fig. 6C1-27--Choke Housing Assembly

1. Inspect float needle seat for dirt, deep wear grooves, scores and proper seating.

2. Inspect float, float arm and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

b. Hesitation

1. Inspect pump plunger for cracks, scores or cup, excessive wear. A used pump cup will shrink when dry. Soak in fuel for 8 hours before testing if dried out.

2. Inspect pump duration and return spring for being weak or distorted.

3. Check all pump passages and jets for dirt, improper seating inlet or discharge balls, scores in pump well.

4. Check linkage for excessive wear, repair or replace as necessary.

c. Hard Starting - Poor Cold Operation

1. Check choke valve and linkage for excessive wear, binds or distortion.

2. Inspect choke vacuum diaphragm for leaks.

3. Clean or replace carburetor filter.

4. Inspect needle for sticking, dirt, etc.

5. Examine fast idle cam for wear of damage.

6. Also check items under "flooding".

d. Poor Performance - Poor Gas Mileage

1. Power Piston, power valve, metering rods for dirt, sticking, binding, damaged parts or excessive wear.

2. Clean all fuel and vacuum passages in castings.

e. Rough Idle

1. Inspect idle needle for ridges, burrs or being bent.

2. Inspect gasket mating surfaces on castings for damage to sealing bends, nicks and burrs.

3. Clean all idle fuel passages.

4. Check throttle lever and valves for binds, nicks and other damage.

ASSEMBLY

Throttle Body

1. Install idle speed screw and spring assembly in throttle body if removed.

2. If it was necessary to remove the idle mixture needles, install the idle mixture needles and springs into the throttle body until finger tight and seated. Back out screws four turns as a preliminary idle adjustment.

3. Install new rubber dust seal into cavity inside choke housing. Lip on seal faces towards carburetor after the housing is installed.

4. Install inner choke coil lever and shaft assembly into choke housing.

5. With the choke coil lever and shaft assembly installed into housing, install the intermediate choke lever on flats of intermediate choke shaft and retain with screw. Tighten securely.

6. Install new choke housing to carburetor gasket.

7. Position choke housing on throttle body and retain with two attaching screws. Tighten securely.

8. Before installing the choke cover coil and baffle plate assembly, refer to intermediate choke rod adjustment (Service) to adjust intermediate choke rod so that with the choke valve closed, the lever inside the choke housing lines up with gage.

9. Install choke thermostatic coil and cover assembly with new gaskets and end of coil below plastic tang on the inner choke housing lever. Refer to automatic choke coil

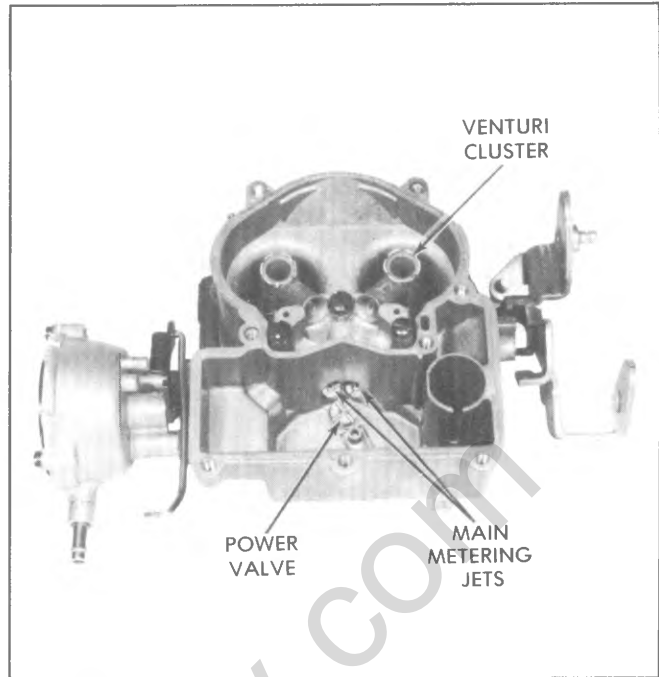


Fig. 6C1-28--Float Bowl Assembly

adjustment (Service) to index cover. Install three choke thermostatic coil retainers and screws. Tighten securely.

10. Place a new gasket on the bottom of the float bowl with holes in gasket aligned with holes in casting, then position the throttle body on gasket and install the three attaching screws. Tighten screws evenly and securely.

Float Bowl (Fig. 6C1-28)

1. Install two main metering jets and vacuum operated power valve into bottom of float bowl. Tighten securely.

2. Drop small aluminum inlet check ball into hole in pump well.

3. Install pump return spring, pressing with finger to center in pump well.

4. Drop steel pump discharge ball into pump discharge hole located beneath the venturi cluster. Ball is 3/16" diameter (do not confuse with aluminum inlet ball). Install pump discharge ball spring and "T" retainer.

5. Install plastic main well inserts into the main fuel wells located beneath the venturi cluster and make sure they are seated in recesses provided. Then install venturi cluster and gasket, tighten three screws evenly and securely. Make certain center screw is fitted with a gasket to prevent pump discharge leakage.

Air Horn

1. Install the upper choke rod lever and collar assembly on to choke shaft. Then install the choke shaft assembly into the air horn from the throttle lever side. Then install the choke valve onto the choke shaft with part number facing upward.

Install the choke valve attaching screws. Center the choke valve before tightening choke valve screws. Tighten choke valve screws and stake lightly in place. Check choke and shaft for freedom of movement.

2. If removed, install the outer pump shaft and lever assembly into air horn casting. Make sure the plastic washer is in place before installing the outer pump shaft and lever assembly.

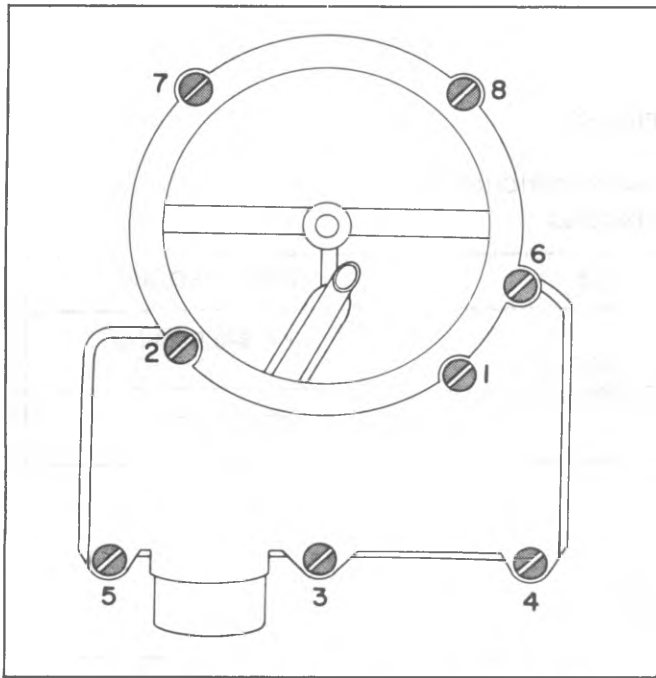


Fig. 6C1-29--Air Horn Tightening Sequence

3. Install the pump plunger to the inner lever and retain with clip provided in the repair kit. End of pump plunger shaft should point inward towards center of carburetor when installed correctly. Then install inner pump lever onto the pump shaft and tighten set screws securely.

4. Position the float needle seat gasket on the needle seat and install seat in the air horn. Tighten securely.

5. Install the power piston assembly into the air horn casting and lightly stake the retaining washer to casting. Make sure the piston travels up and down freely and is not bent.

6. Install fuel inlet baffle next to needle seat. Make sure baffle is seated in grooves in air horn casting.

7. Install air horn gasket onto air horn casting.

8. Install float needle into needle seat. On models with pull clip, install pull clip and needle in slot in float arm. Then install float assembly on air horn and insert hinge pin. Check float action and for free movement of needle in the seat.

9. Check float level and drop adjustments.

10. Install choke rod in upper choke lever and collar assembly rotating rod until tang on end of rod aligns with slot in lever.

Air Horn to Float Bowl

1. Place the air horn assembly on bowl, making certain that the accelerator pump plunger is correctly positioned into pump well and will move freely.

2. Install lockwashers and tighten eight air horn attaching screws evenly and securely according to sequence in Figure 6C1-29.

3. Install filter spring into air horn casting, then install fuel inlet filter and fuel inlet nut and gasket. Tighten nut to 25 pound feet.

CAUTION: *The fuel inlet filter contains a check valve for a vehicle with light duty emission requirements to meet Motor Vehicle Safety Standards. Service replacement filter must contain check valve on these vehicles.*

4. Install fast idle cam to lower end of choke rod (part number or identification faces outward on fast idle cam assembly). Then install the fast idle cam to float bowl retaining with the fast idle cam attaching screw. Tighten securely.

Move linkage up and down to make sure that the cam will fall freely.

5. Install pump rod into upper pump lever by rotating offset end into hole in lever and install lower end of pump rod to throttle lever and retain with a spring clip.

6. Install vacuum break diaphragm assembly onto air horn with two attaching screws and tighten securely.

7. Install lower end of intermediate choke rod into intermediate choke lever on choke housing and connect upper end of rod to vacuum break lever. Install vacuum break diaphragm rod into stem of vacuum break diaphragm and vacuum break lever.

8. Install the vacuum break lever onto end of choke shaft making sure that the lever fits over flats on shaft. Install attaching screw and tighten securely.

9. Connect vacuum break hose to diaphragm unit and vacuum tube on throttle body.

After complete carburetor assembly, check and re-set (if necessary) all choke adjustments and pump rod adjustments.

SPECIFICATIONS

IDLE MIXTURE WITH PROPANE ENRICHMENT
LIGHT DUTY EMISSIONS

ENGINE	CURB IDLE	ENRICHED RPM
350 CID MANUAL TRANS.	SEE: VEHICLE EMISSION CONTROL INFORMATION LABEL	600-640 RPM (N)
305 CID AUTOMATIC TRANS.		500-535 RPM (D)

IDLE MIXTURE
HEAVY DUTY EMISSIONS

ENGINE	CURB IDLE	ENRICHED RPM
305 CID	SEE: ENGINE EMISSION CONTROL INFORMATION LABEL	SEE: ENGINE EMISSION CONTROL INFORMATION LABEL

TORQUE SPECIFICATIONS

2 GC/2 GV CARBURETOR

SCREW	TORQUE (IN. LBS.)
THROTTLE BODY THROTTLE BODY TO BOWL	72
BOWL CLUSTER FAST IDLE CAM METERING JET	46 58 40
CHOKE HOUSING CHOKE LEVER CHOKE HSG. TO THROTTLE BODY CHOKE HOUSING COVER	14 46 26
AIR HORN AIR HORN TO BOWL VACUUM BREAK UNIT CHOKE SHAFT FUEL INLET NUT NEEDLE SEAT	46 26 14 400 45

Fig. 6C1-30--2GC Carburetor Specifications

MODEL M4MC/4MV CARBURETOR

GENERAL DESCRIPTION

The Model M4MC/4MV carburetor (Figs. 6C2-1, 2) are two stage carburetor of downdraft design. The triple venturi system is used on the primary side of the carburetor with 1-3/8 inch throttle valve bores.

The secondary side has two 2-1/4 inch bores. Using the air valve principle in the secondary side, fuel is metered in direct proportion to the air passing through the secondary bores. A baffle is attached to the secondary side of the air horn above the main well bleed tubes to deflect incoming air to improve secondary nozzle operation on heavy acceleration.

A solenoid is used on air conditioned equipped vehicles with automatic transmission and light duty emissions to increase idle speed slightly when the air conditioning is in operation. This allows the engine to idle at the same speed when the air conditioning is in operation, as when it is off.

The float assembly is used along with a windowless type needle seat for better fuel handling in the float bowl. Also, a plastic filler block is used above the float chamber to reduce fuel slosh in this area. A fuel inlet filter check valve is used on light duty emission models to shut off fuel flow to the carburetor float bowl to prevent fuel leaks if a vehicle roll over should occur.

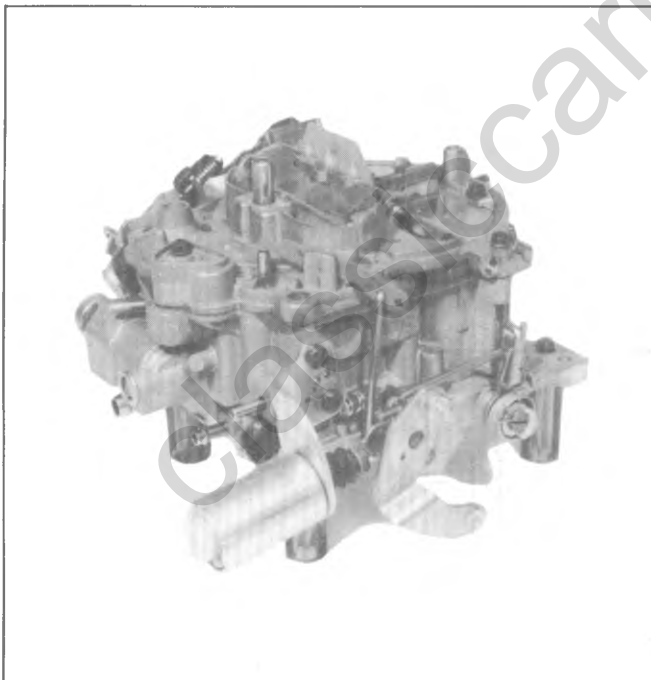


Fig. 6C2-1--Model M4MC Carburetor

The main metering system on all models uses separate main wells to feed each fuel nozzle for improved fuel flow in the venturi system.

A tube (location T) in the air horn, which through a hose connects directly to a vacuum operated vent valve located in the canister. When the engine is not running, the canister vapor vent is open allowing fuel vapors from the carburetor float bowl to pass on into the canister where they are stored until purged.

Adjustable Part Throttle-M4MC

In order to provide a close tolerance adjustment in the main metering system, an adjustment is provided to very accurately set the depth of the metering rods in the main metering jets.

The adjustment feature consists of a pin pressed in the side of the power piston which extends through a slot in the side of the piston well. When the power piston is down (economy position), the side of the pin stops on top of a flat surface on the adjustment screw located in the cavity next to the power piston. The adjustment screw is held from turning by a tension spring beneath the head of the adjustment screw. During production flow test this adjustment screw is turned up or down which, in turn, raises or lowers the power piston and metering rod assembly. This very accurately controls the fuel flow between the rods and jets to meet emission requirements.

CAUTION: *No attempt should be made to change the APT adjustment. If float bowl replacement is required, the new bowl assembly will include an adjustment screw pre-set by the factory.*

An expander (garter) spring beneath the plunger cup on the accelerator pump assembly improves pump fuel delivery.

All M4MC models use the bowl mounted choke housing with thermostatic control assembly.

The choke shaft and some other parts of the choke system are Teflon coated to insure smooth choke operation.

The carburetor part number (Fig. 6C2-3) is stamped on a vertical section of the bowl, near the secondary throttle lever. Refer to the part number on the bowl when servicing this carburetor. When replacing the float bowl assembly, follow the instructions contained in the service package. Stamp or engrave the model number on the new float bowl.

The primary side of the carburetor has six systems of operation. They are float, idle, main metering, power, pump, and choke (Figs. 6C2-4 through 6C2-19). The secondary side has one metering system which supplements the primary main metering system and receives fuel from a common float chamber.

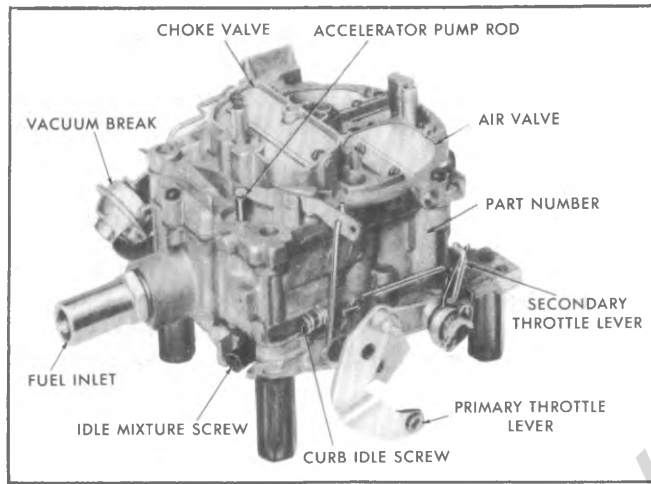


Fig. 6C2-2--Model 4MV Carburetor

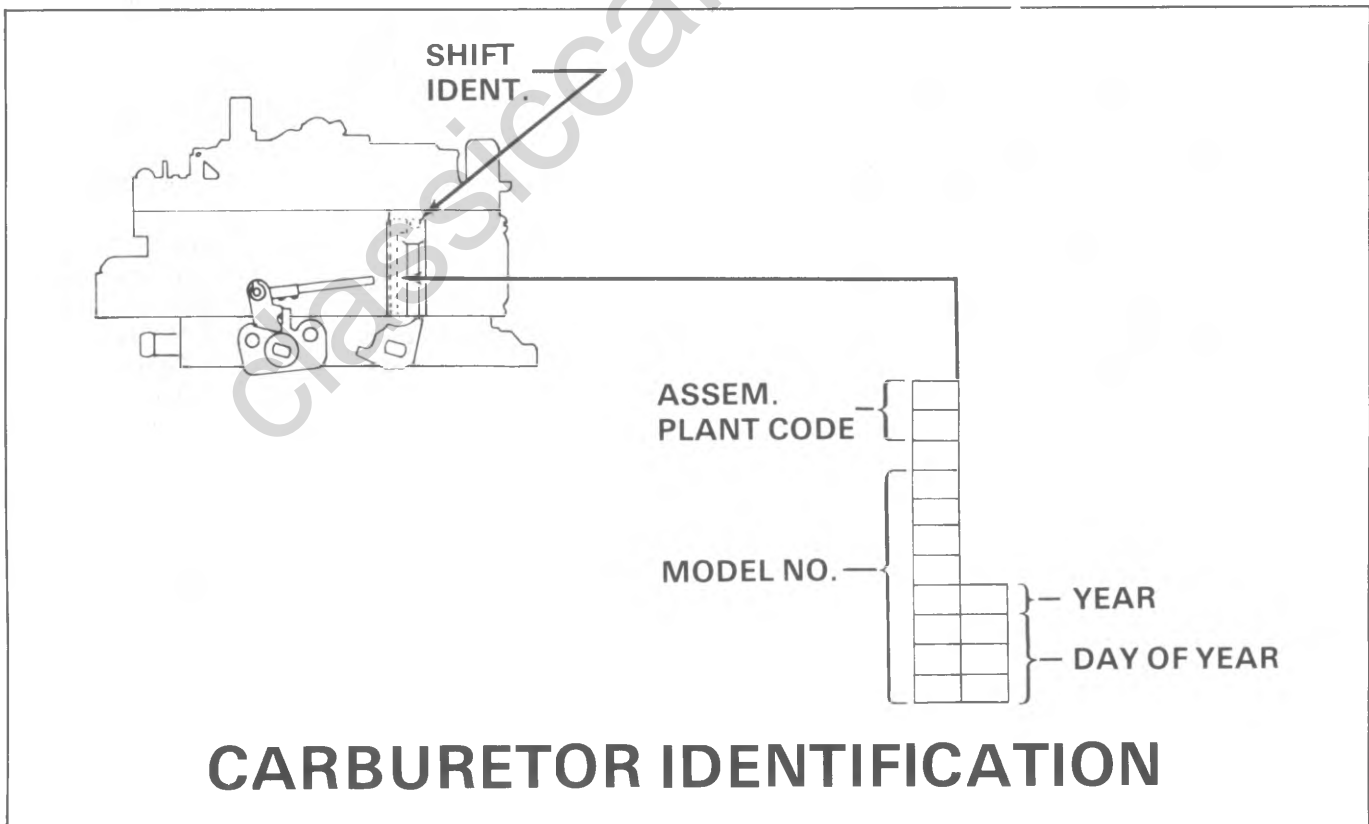


Fig. 6C2-3--Carburetor Identification

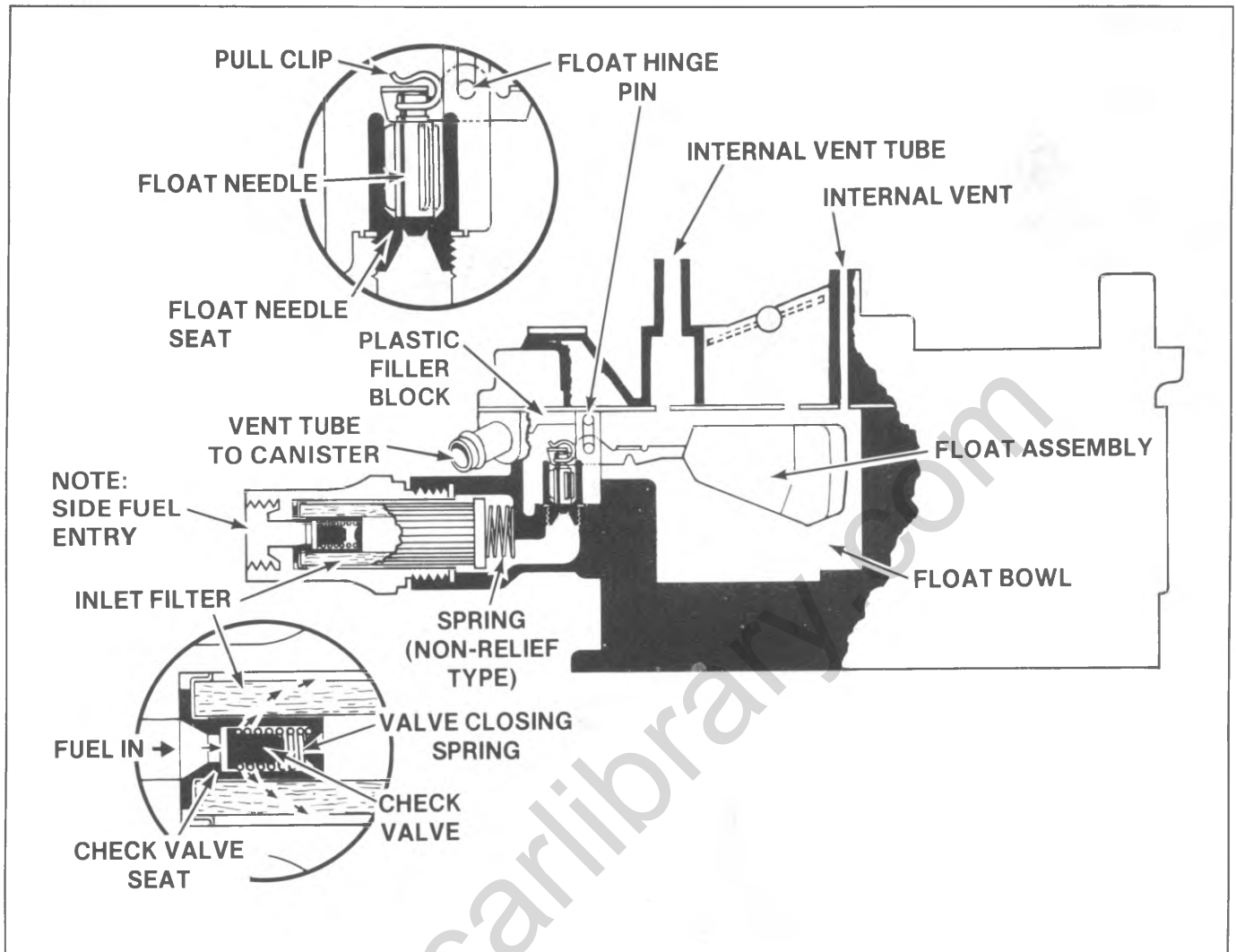


Fig. 6C2-4--Float System

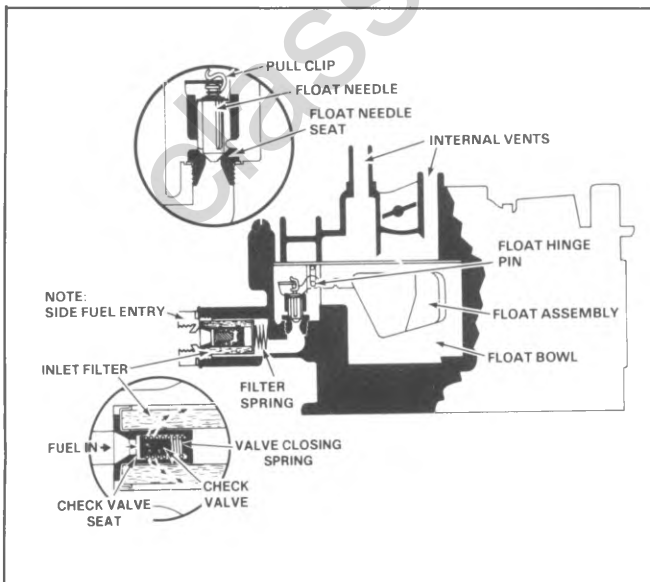


Fig. 6C2-5--Float System 4MV (Except Calif.)

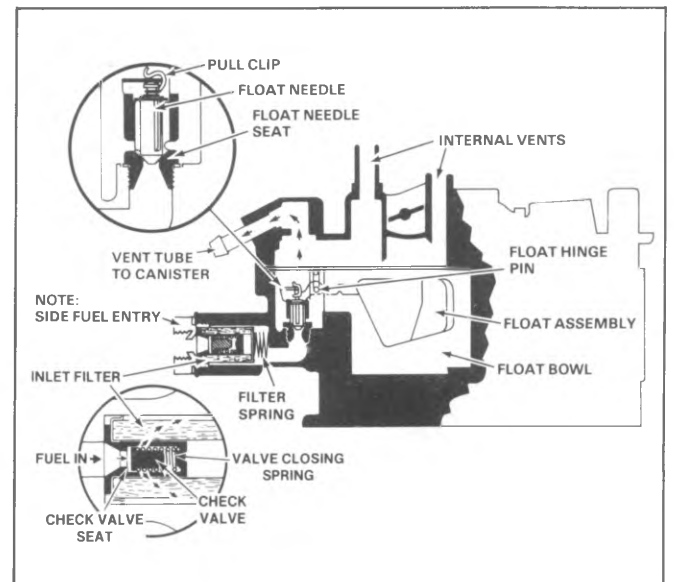


Fig. 6C2-6--Float System 4MV (w/Calif.)

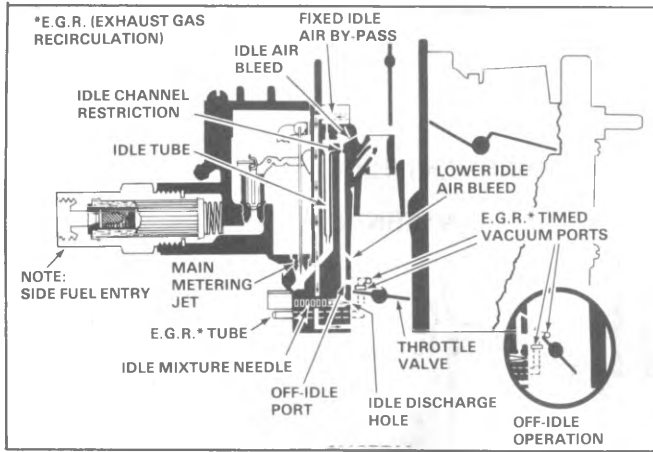


Fig. 6C2-7--Idle System M4MC

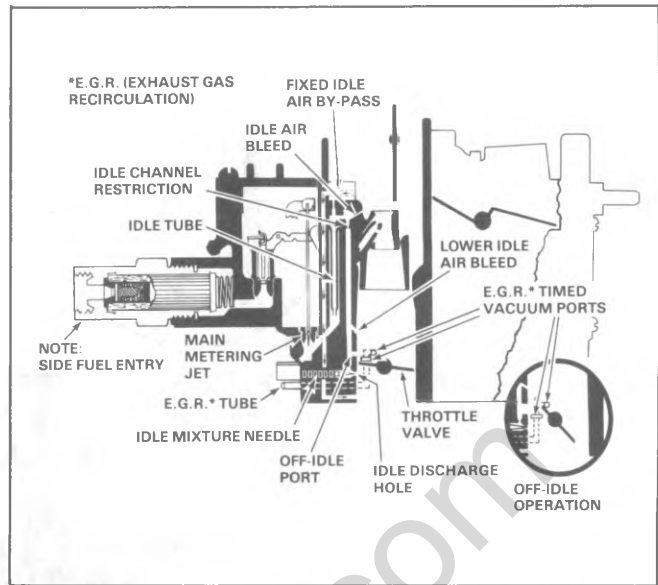


Fig. 6C2-9--Idle System 4MV (Calif.)

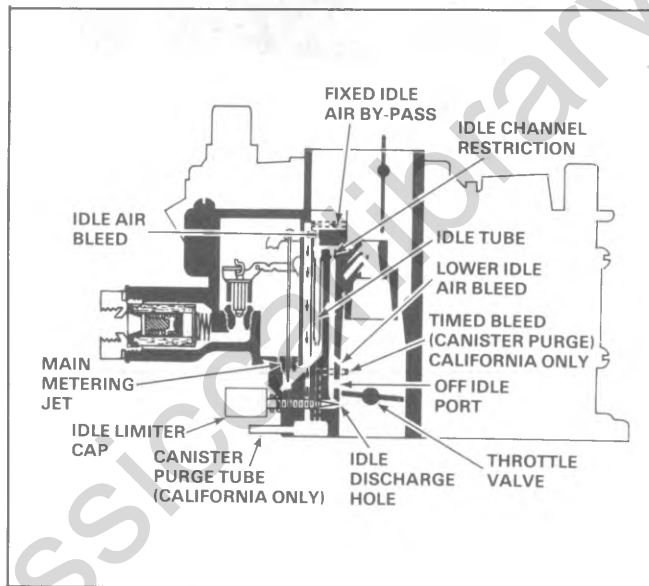


Fig. 6C2-8--Idle System 4MV

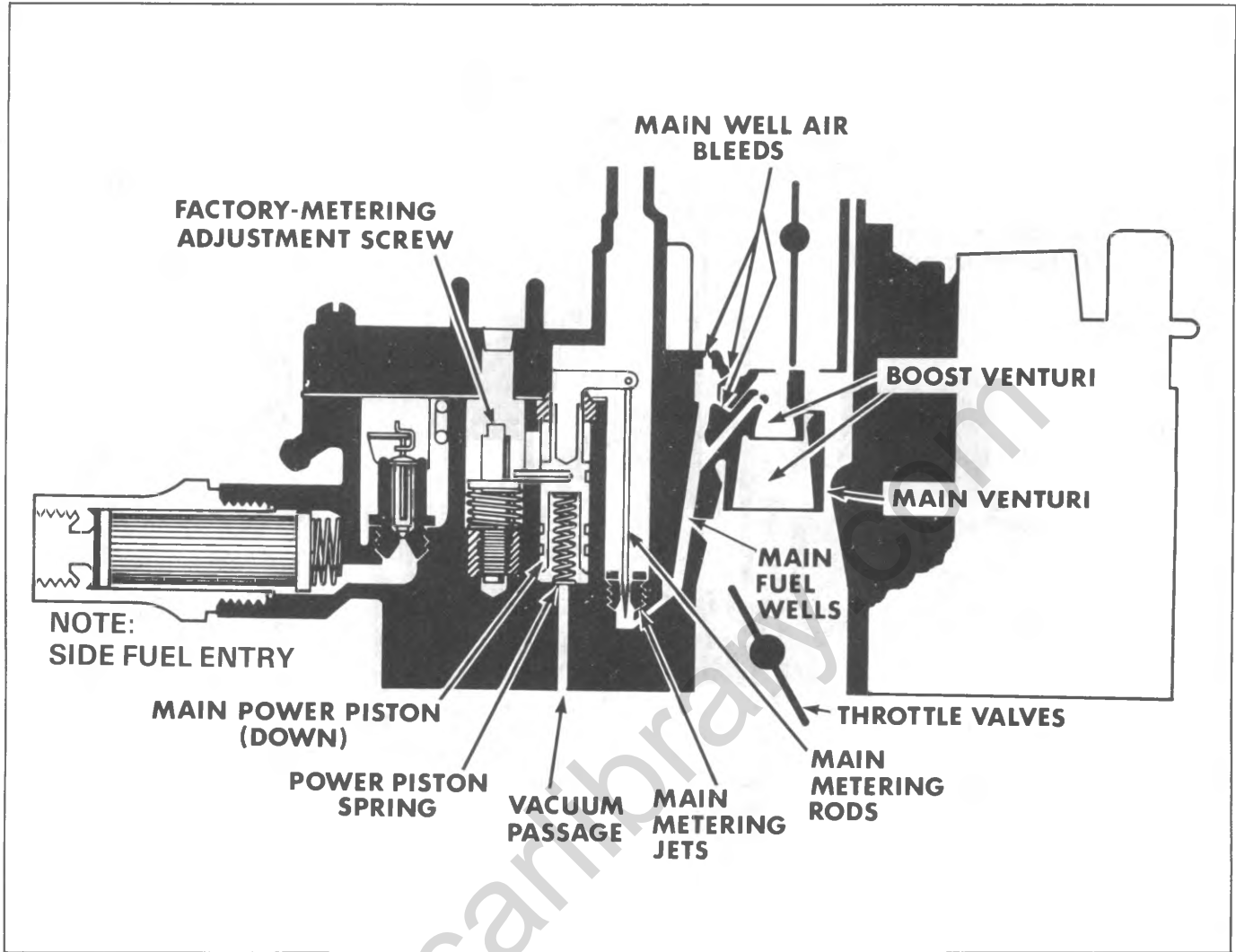


Fig. 6C2-10--Main Metering System-M4MC

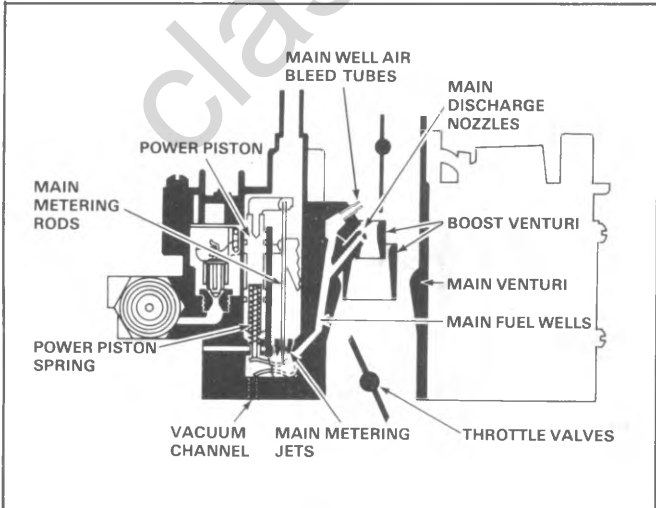


Fig. 6C2-11--Main Metering System-4MV Except Calif.

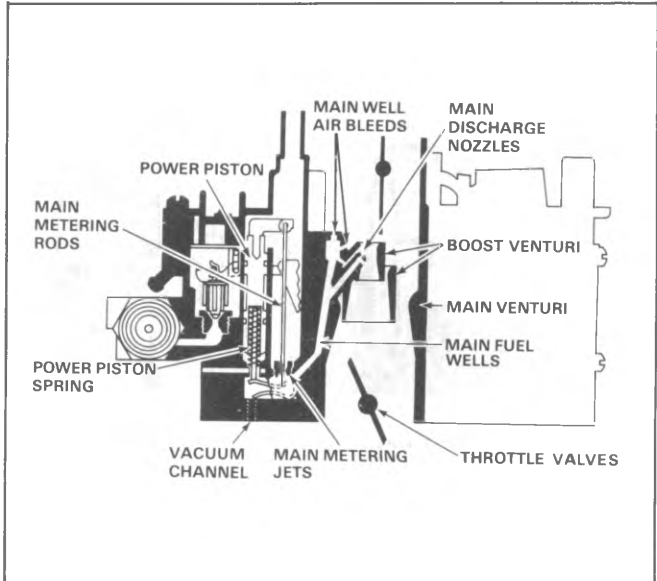


Fig. 6C2-12--Main Metering System Calif. Only

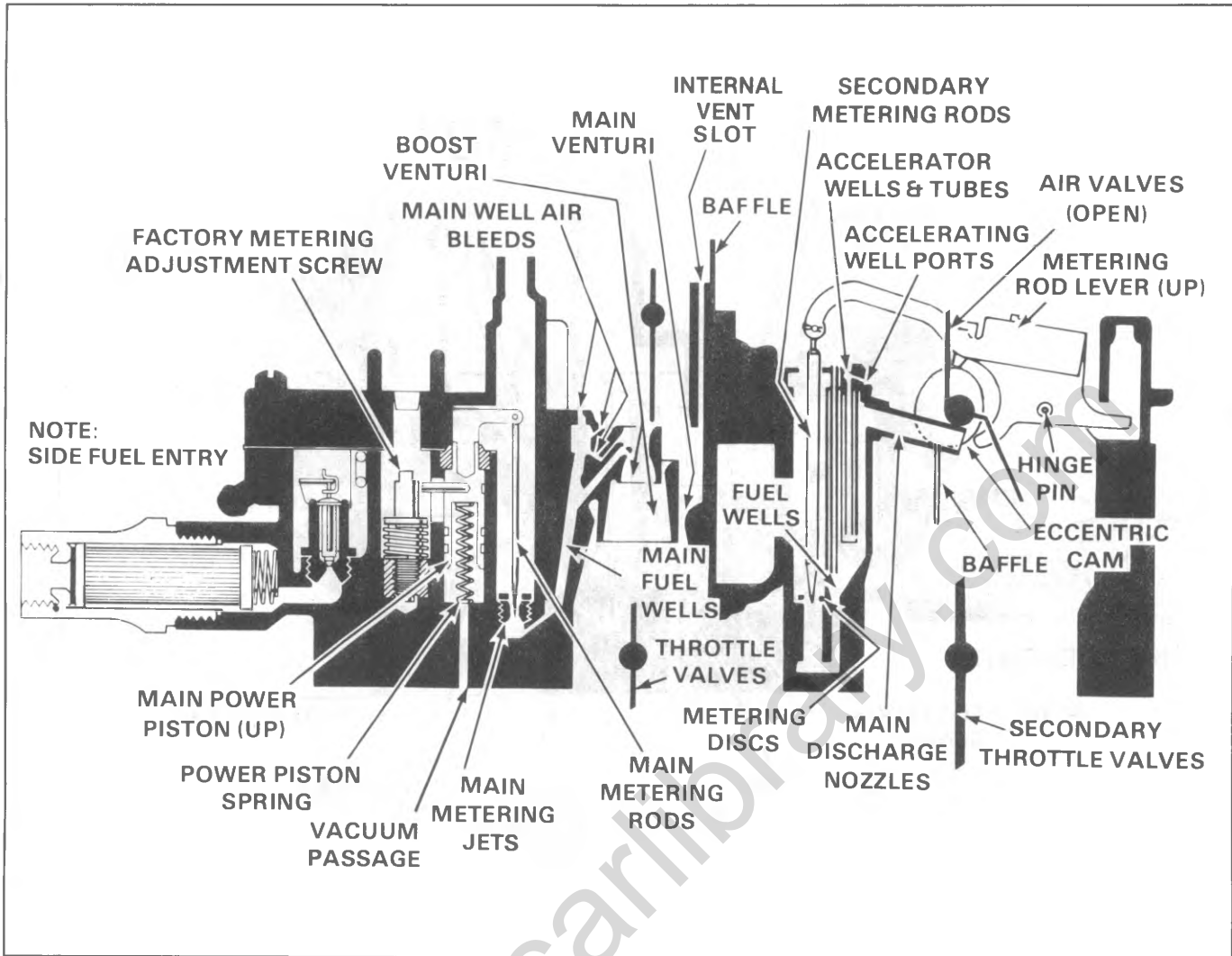


Fig. 6C2-13--Power System-M4MC Except Calif.

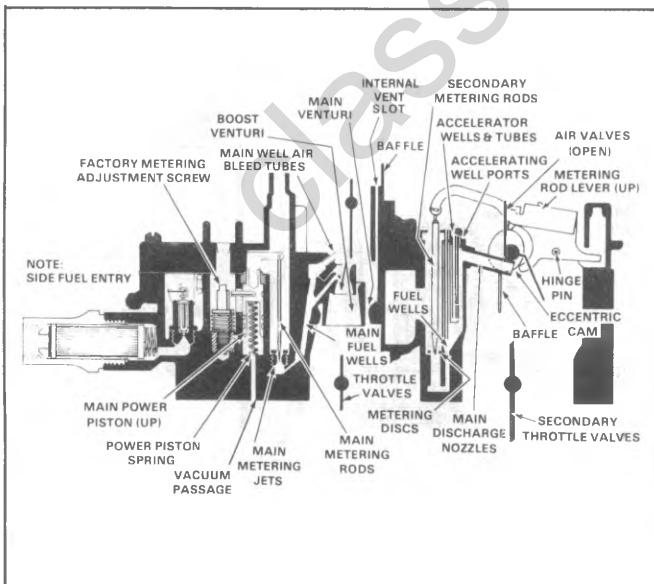


Fig. 6C2-14--Power System M4MC Calif. Only

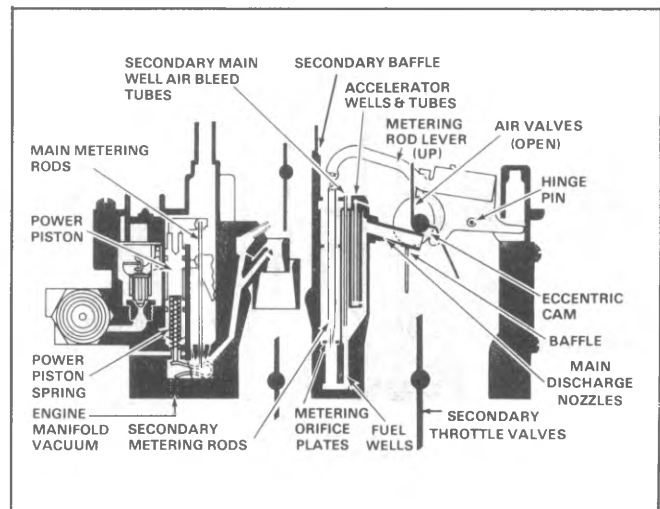


Fig. 6C2-15--Power System-4MV Except Calif.

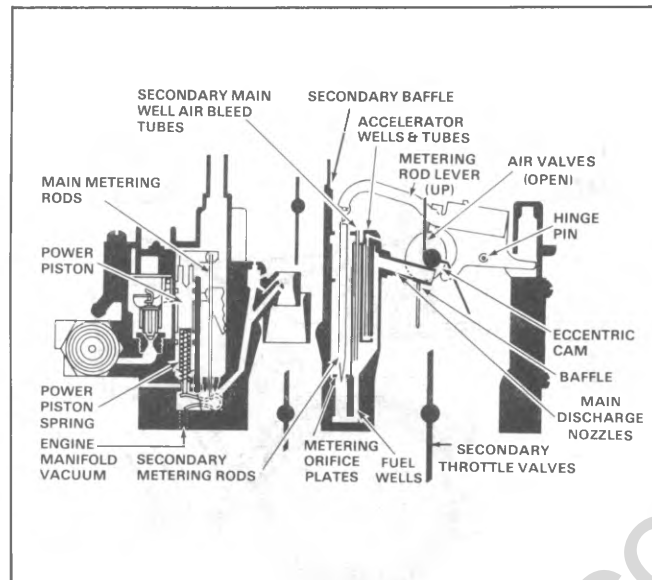


Fig. 6C2-16--Power System 4MV Calif. Only

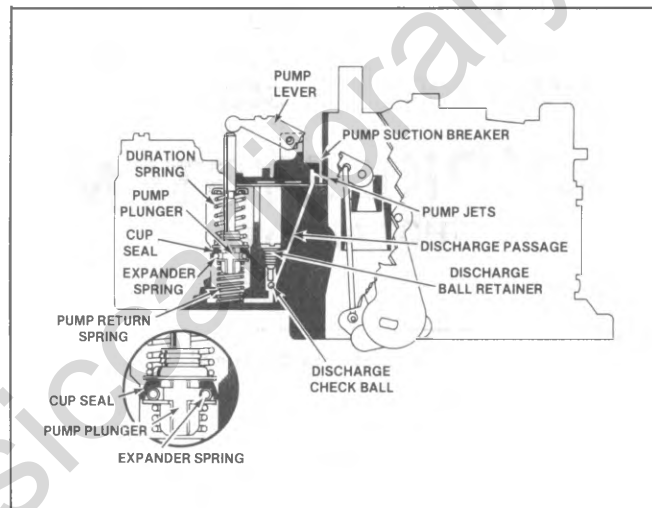


Fig. 6C2-17--Accelerating Pump System-M4MC and 4MV

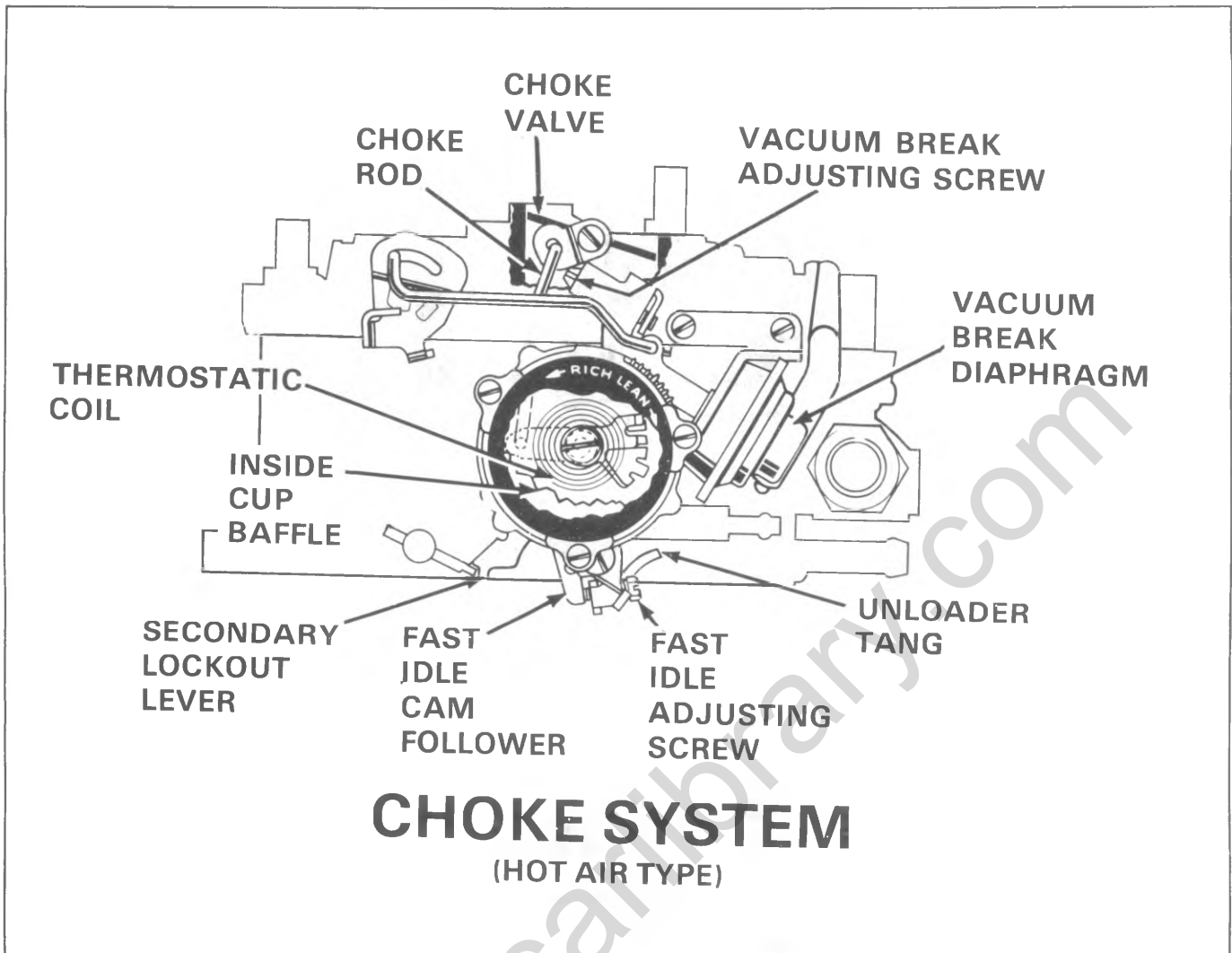


Fig. 6C2-18--Choke System-M4MC

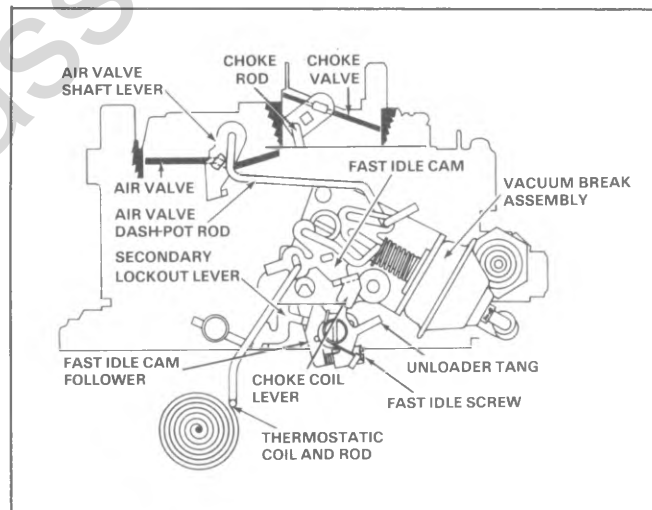


Fig. 6C2-19--Choke System-4MV

ON-VEHICLE SERVICE

M4MC/4MV CARBURETOR ADJUSTMENTS

Refer to figure 6C2-20 for the following adjustments:

- Float
- Pump
- Choke Coil Lever (M4MC)

Refer to figure 6C2-21 for the following adjustments:

- Fast Idle
- Choke Rod (Fast Idle Cam)-M4MC

Refer to figure 6C2-22 for the following adjustments:

- Choke Rod (Fast Idle Cam)-4MV
- Air Valve Rod-M4MC

Refer to figure 6C2-23 for the following adjustments:

- Air Valve Rod-4MV
- Vacuum Break
- Front Vacuum Break

Refer to figure 6C2-24 for the following adjustments:

- Vacuum Break-4MV
- Automatic Choke Coil-M4MC

Refer to figure 6C2-25 for the following adjustments:

- Automatic Choke Coil Rod-4MV

Checking Carburetor Choke

1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links are connected and there are no signs of damage.

2. If choke or linkage binds, sticks or works sluggish, clean with choke cleaner X-20-A or equivalent. Use cleaner as directed on can. Refer to disassembly instructions for additional direction if cleaning does not correct.

3. Visually inspect carburetor to be certain all vacuum hoses are connected. Inspect hoses for cracks, abrasions, hardness or other signs of deterioration. Replace or correct as necessary.

4. Make sure vacuum break diaphragm shaft is fully extended when engine is off. If shaft is not fully extended, replace vacuum break diaphragm shaft should fully retract within 10 seconds. If unit fails to retract, replace vacuum break assembly.

Refer to figure 6C2-26 for the following adjustments:

- Unloader

Refer to figure 6C2-27 for the following adjustments:

- Unloader-4M4
- Secondary Lockout

Refer to figure 6C2-28 for the following adjustments:

- Secondary Closing
- Secondary Opening
- Air Valve Spring

Refer to figure 6C2-29 for the following adjustments:

- Idle Speed-Without Solenoid.
- Idle Speed-With Solenoid.

Checking Solenoid

1. Turn on ignition, but do not start engine.
2. Turn A/C to "on" position.
3. Open throttle to allow solenoid to extend, close throttle.
4. Disconnect lead at solenoid. Solenoid plunger should drop away from throttle lever.
5. Connect solenoid lead. Plunger should move out and contact the throttle lever. Solenoid may not be strong

enough to open the throttle, but the plunger should move.

6. If plunger does not move in and out as lead is disconnected and connected, insert test light (1893 bulb or smaller) between the solenoid feed wire and ground.

7. If light lights, replace solenoid.

8. If light does not light, locate cause of open circuit in solenoid feed wire.

IDLE MIXTURE ADJUSTMENT WITH PROPANE ENRICHMENT

A change has been made in some General Motors carburetors to limit the range of idle mixture adjustment on the rich side. In other words, backing out the idle mixture screws will not provide appreciably richer mixture. A new idle mixture adjustment procedure requiring artificial enrichment by addition of propane is necessary for checking and setting idle mixture on these carburetors.

Before suspecting the carburetor as the cause of poor engine performance or rough idle, check ignition system including distributor, timing, spark plugs and wires. Check air cleaner, evaporative emission system, EFE System, PCV system, EGR valve and engine compression. Also inspect intake manifold, vacuum hoses and connections for leaks and check torques of carburetor mounting bolts/nuts. If carburetor bolts are retorqued without carburetor removal retorque to 12 ft. lbs. maximum.

NOTE: Idle mixture screws have been preset at the factory and capped. Do not remove the caps during normal engine maintenance. Idle mixture should be adjusted only in the case of major carburetor overhaul, throttle body replacement or high idle CO as determined by state or local inspections. Adjusting mixture by other than the following method may violate Federal and/or California or other state or Provincial laws.

1. Set parking brake and block drive wheels. On cars equipped with vacuum parking brake release, disconnect and plug hose at brake.

2. Disconnect and plug hoses as directed on the Emission Control Information Label under the hood.

3. Engine must be at normal operating temperature, choke open and air conditioning off.

4. Connect an accurate tachometer to engine. Set curb idle speed to specification shown on Emission Control Information Label.

5. Disconnect vacuum advance and set timing to specification shown on the Emission Control Information Label. Reconnect vacuum advance.

NOTE: On cars equipped with electronic spark timing, check timing as directed on the Emission Label.

6. Disconnect crankcase ventilation tube from the air cleaner.

7. Using tool J-26911, insert hose with rubber stopper from propane valve into the crankcase ventilator tube opening in the air cleaner.

8. Propane cartridge must be in a vertical position.

9. Slowly open propane control valve until maximum engine speed is reached with the transmission in drive (Neutral for manual shift).

NOTE: Too much propane will cause engine speed to drop.

1

3 GAUGE FROM TOP OF CASTING TO TOP OF FLOAT – GAUGING POINT 3/16" BACK FROM END OF FLOAT AT TOE (SEE INSET)

1 HOLD RETAINER FIRMLY IN PLACE

2 PUSH FLOAT DOWN LIGHTLY AGAINST NEEDLE

4 REMOVE FLOAT AND BEND FLOAT ARM UP OR DOWN TO ADJUST

5 VISUALLY CHECK FLOAT ALIGNMENT AFTER ADJUSTING

FLOAT LEVEL ADJUSTMENT

CARB. NO.	GAUGE
17058201 17058515	15/32
17058213 17058518	
17058215 17058519	
17058229 17058522	
17058503 17058523	
17058506 17058524	
17058508 17058527	
17058509 17058528	
17058510 17058529	
17058513 17058586	
17058514 17058588	
17058212 17058222	7/16
17058218 17058525	
17058219	
17058501 17058520	3/8
17058521	
17058512	13/32

2

3 GAUGE FROM TOP OF CHOKE VALVE WALL, NEXT TO VENT STACK, TO TOP OF PUMP STEM AS SPECIFIED

5 BEND PUMP LEVER TO ADJUST

2 ROD IN SPECIFIED HOLE OF PUMP LEVER

4 SUPPORT LEVER WITH SCREWDRIVER WHILE BENDING LEVER

1 THROTTLE VALVES COMPLETELY CLOSED
NOTE: MAKE SURE FAST IDLE CAM FOLLOWER LEVER IS OFF STEPS ON FAST IDLE CAM

BEND SECONDARY CLOSING TANG AWAY TO CLOSE PRIMARY VALVES. THEN RE-ADJUST

PUMP ADJUSTMENT

CARB. NO.	GAUGE	HOLE LOC.
ALL EXCEPT 17058509 17058510 17058586 17058588	9/32	INNER
17058509 17058510 17058586 17058588		11/32

3

6 BEND CHOKE ROD AT THIS POINT TO ADJUST (SEE INSET).

CHOKE VALVE CLOSED

3 PUSH UP ON THERMOSTATIC COIL TANG (COUNTERCLOCKWISE) UNTIL CHOKE VALVE IS CLOSED.

5 LOWER EDGE OF LEVER SHOULD JUST CONTACT SIDE OF PLUG GAUGE.

4 INSERT SPECIFIED PLUG GAUGE.

1 LOOSEN THREE RETAINING SCREWS AND REMOVE THE THERMOSTATIC COVER AND COIL ASSEMBLY FROM CHOKE HOUSING.

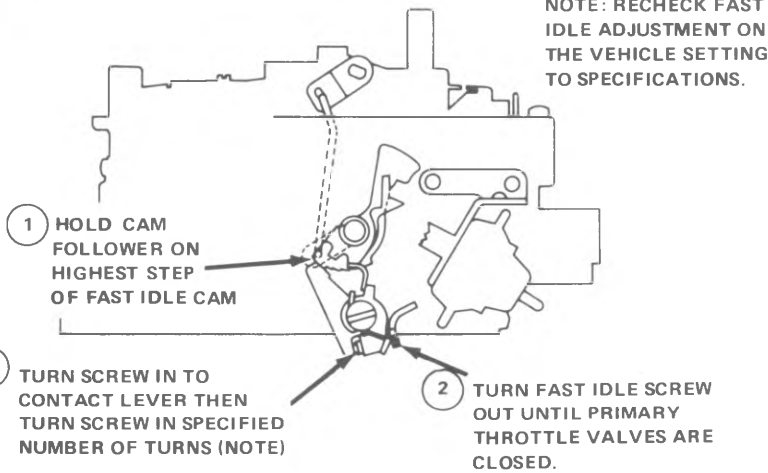
2 PLACE FAST IDLE CAM FOLLOWER ON HIGH STEP OF FAST IDLE CAM.

CHOKE COIL LEVER ADJUSTMENT M4MC

CARB. NO.	PLUG GAUGE
ALL	.120"

Fig. 6C2-20-M4MC/4MV Carburetor Adjustments-1 of 10

4



FAST IDLE ADJUSTMENT (BENCH SETTING)

5

FIGURE 1

1. MAKE FAST IDLE ADJUSTMENT (BENCH OR ON-THE-CAR SETTING).
2. USE CHOKE VALVE MEASURING GAUGE J-26701. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
3. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
4. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
5. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

6. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
7. PLACE CAM FOLLOWER ON SECOND STEP OF CAM NEXT TO HIGH STEP.
8. CLOSE CHOKE BY PUSHING UPWARD ON CHOKE COIL LEVER.
9. TO ADJUST, BEND TANG ON FAST IDLE CAM UNTIL BUBBLE IS CENTERED.
10. REMOVE GAUGE.

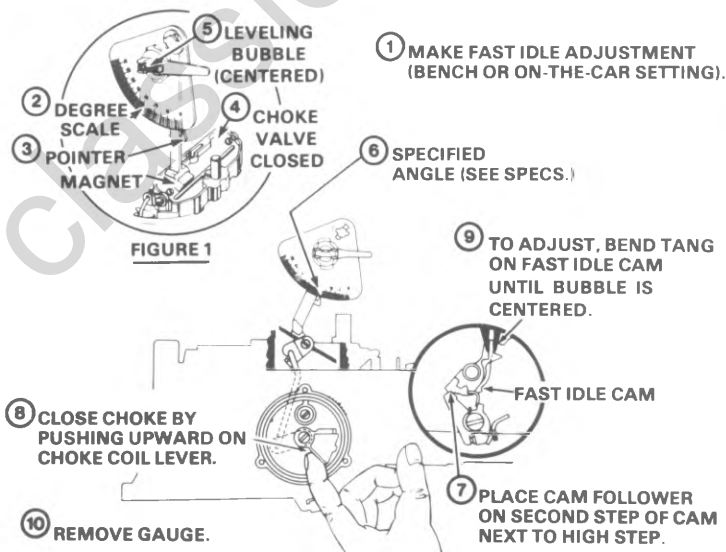


FIGURE 2

CHOKE ROD (FAST IDLE CAM) ADJUSTMENT - ANGLE GAUGE METHOD (M4MC)

CARB. NO.

ANGLE GAUGE

ALL

46°

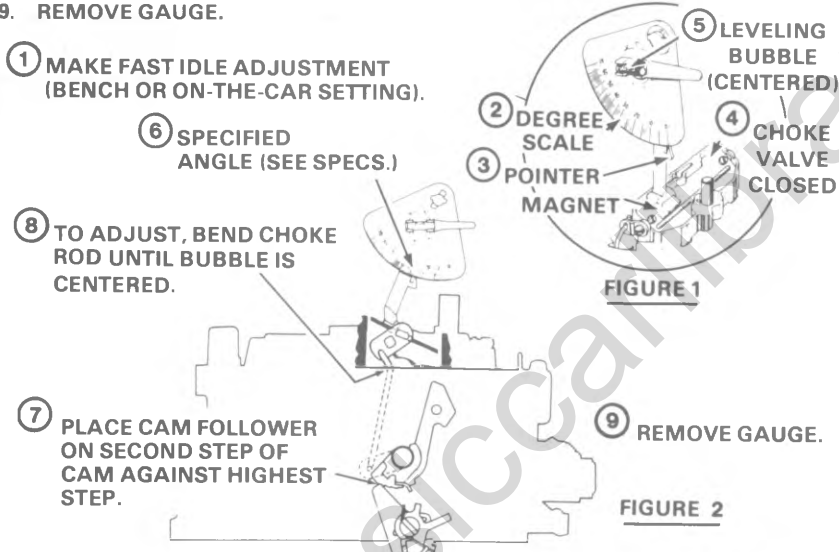
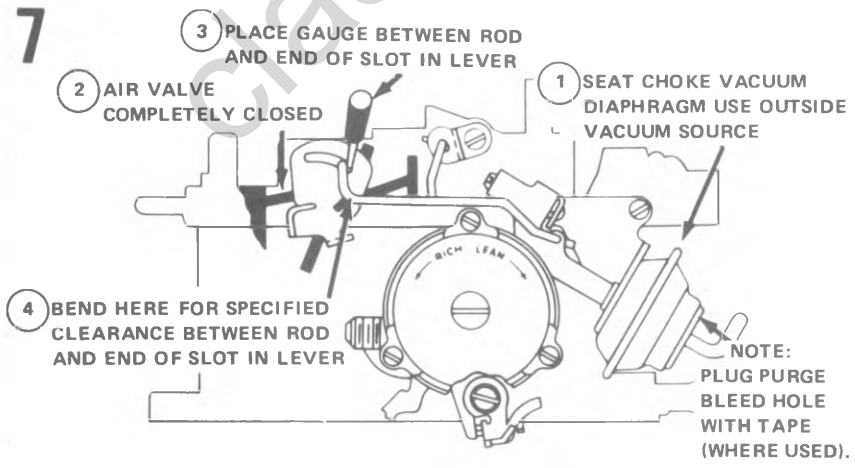
6	CARB. NO.	ANGLE GAUGE
<p>FIGURE 1</p> <ol style="list-style-type: none"> 1. MAKE FAST IDLE ADJUSTMENT (BENCH OR ON-THE-CAR SETTING). 2. USE CHOKE VALVE MEASURING GAUGE J-26701. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE. 3. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER. 4. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE. 5. ROTATE BUBBLE UNTIL IT IS CENTERED. <p>FIGURE 2</p> <ol style="list-style-type: none"> 6. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER. 7. PLACE CAM FOLLOWER ON SECOND STEP OF CAM AGAINST HIGHEST STEP. 8. TO ADJUST, BEND CHOKE ROD UNTIL BUBBLE IS CENTERED. 9. REMOVE GAUGE.  <p>1 MAKE FAST IDLE ADJUSTMENT (BENCH OR ON-THE-CAR SETTING).</p> <p>2 DEGREE SCALE</p> <p>3 POINTER MAGNET</p> <p>4 CHOKE VALVE CLOSED</p> <p>5 LEVELING BUBBLE (CENTERED)</p> <p>6 SPECIFIED ANGLE (SEE SPECS.)</p> <p>7 PLACE CAM FOLLOWER ON SECOND STEP OF CAM AGAINST HIGHEST STEP.</p> <p>8 TO ADJUST, BEND CHOKE ROD UNTIL BUBBLE IS CENTERED.</p> <p>9 REMOVE GAUGE.</p> <p>CHOKE ROD (FAST IDLE CAM) ADJUSTMENT - ANGLE GAUGE METHOD (4MV)</p>	<p>ALL</p>	<p>42°</p>
<p>7</p> <ol style="list-style-type: none"> 1 SEAT CHOKE VACUUM DIAPHRAGM USE OUTSIDE VACUUM SOURCE 2 AIR VALVE COMPLETELY CLOSED 3 PLACE GAUGE BETWEEN ROD AND END OF SLOT IN LEVER 4 BEND HERE FOR SPECIFIED CLEARANCE BETWEEN ROD AND END OF SLOT IN LEVER  <p>NOTE: PLUG PURGE BLEED HOLE WITH TAPE (WHERE USED). REMOVE AFTER ADJUSTMENT</p> <p>AIR VALVE ROD ADJUSTMENT (M4MC)</p>	<p>ALL</p>	<p>.015"</p>

Fig. 6C2-22-M4MC/4MV Carburetor Adjustments-3 of 10

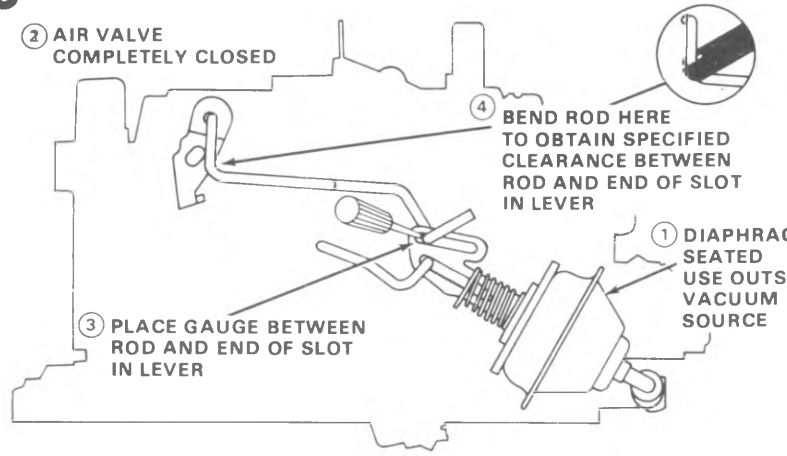
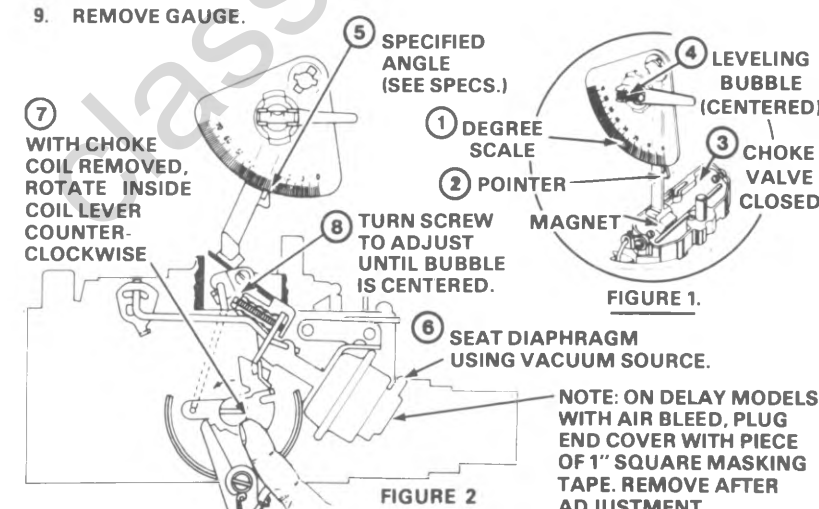
8	CARB. NO.	PLUG GAUGE
 <p style="text-align: center;">AIR VALVE ROD ADJUSTMENT (4MV)</p>	ALL	.015"
9	CARB. NO.	ANGLE GAUGE
<p>FIGURE 1</p> <ol style="list-style-type: none"> USE CHOKE VALVE MEASURING GAUGE J-26701. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE. ROTATE BUBBLE UNTIL IT IS CENTERED. <p>FIGURE 2</p> <ol style="list-style-type: none"> ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER. SEAT CHOKE VACUUM DIAPHRAGM USING VACUUM SOURCE. HOLD CHOKE VALVE TOWARDS CLOSED POSITION, PUSHING COUNTER-CLOCKWISE ON INSIDE COIL LEVER. TO ADJUST, TURN SCREW IN OR OUT UNTIL BUBBLE IS CENTERED. REMOVE GAUGE.  <p style="text-align: center;">FRONT VACUUM BREAK ADJUSTMENT - ANGLE GAUGE METHOD (M4MC)</p>	<p>17058218 17058222</p> <hr style="border-top: 1px dashed black;"/> <p>17058501 17058520 17058521</p> <hr style="border-top: 1px dashed black;"/> <p>17058201 17058219 17058512</p> <hr style="border-top: 1px dashed black;"/> <p>17058503 17058506 17058508 17058509 17058510 17058518 17058519 17058522 17058523 17058524 17058527 17058528 17058586 17058588</p>	<p>27°</p> <hr style="border-top: 1px dashed black;"/> <p>28°</p> <hr style="border-top: 1px dashed black;"/> <p>28.5°</p> <hr style="border-top: 1px dashed black;"/> <p>30°</p>

Fig. 6C2-23--M4MC/4MV Carburetor Adjustments - 4 of 10

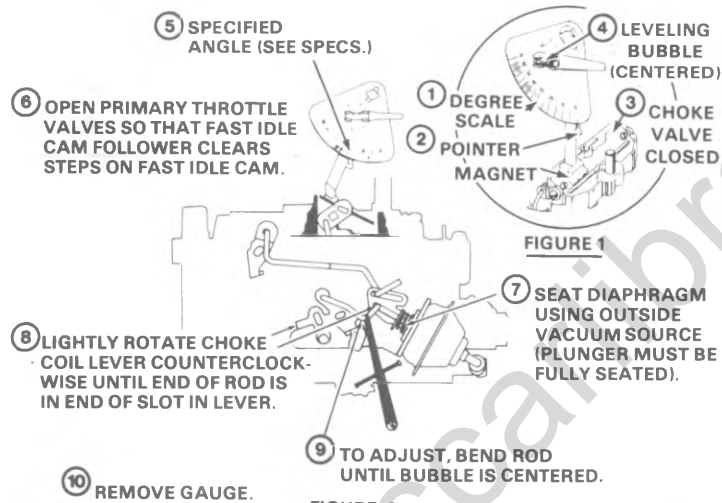
10

FIGURE 1

1. USE CHOKE VALVE MEASURING GAUGE J-26701. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
2. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
3. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
4. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

5. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
6. OPEN PRIMARY THROTTLE VALVES SO THAT FAST IDLE CAM FOLLOWER CLEARS STEPS ON FAST IDLE CAM.
7. SEAT DIAPHRAGM USING OUTSIDE VACUUM SOURCE. (PLUNGER MUST BE FULLY SEATED).
8. LIGHTLY ROTATE CHOKE COIL LEVER COUNTERCLOCKWISE UNTIL END OF ROD IS IN END OF SLOT IN LEVER.
9. TO ADJUST, BEND ROD UNTIL BUBBLE IS CENTERED
10. REMOVE GAUGE.

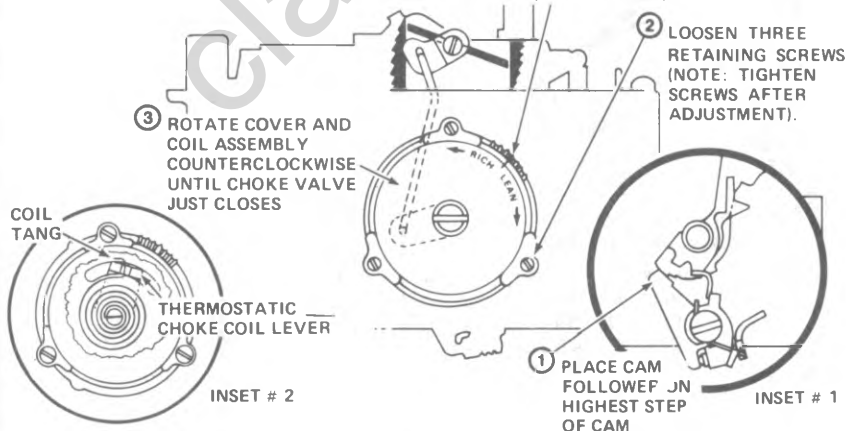


VACUUM BREAK ADJUSTMENT - ANGLE GAUGE METHOD (4MV)

CARB. NO.	ANGLE GAUGE
17058213 17058215 17058229	22°
17058212 17058513 17058514 17058515 17058525	26.5°
17058529	25°

11

4. ALIGN MARK ON COVER WITH SPECIFIED POINT ON HOUSING. NOTE: ON MODELS WITH SLOTTED COIL PICK-UP LEVER, MAKE SURE COIL TANG IS INSTALLED IN SLOT IN LEVER (SEE INSET # 2)



AUTOMATIC CHOKE COIL ADJUSTMENT - (M4MC)

CARB. NO.	INDEX MARK
17058503 17058506 17058508 17058518 17058519 17058522 17058523 17058524 17058527 17058528	1 NOTCH LEAN
17058218 17058222 17058509 17058510 17058586 17058588	2 NOTCHES LEAN
17058201 17058219 17058501 17058520 17058521	3 NOTCHES LEAN
17058512	INDEX

12

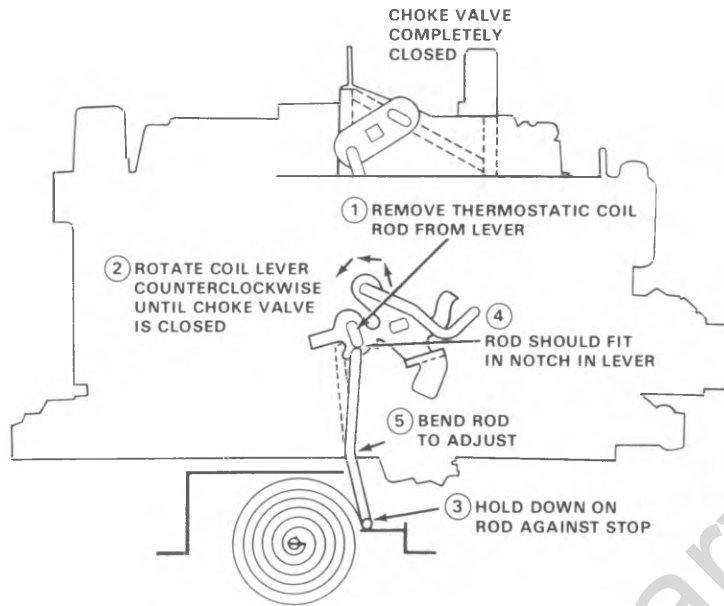
**AUTOMATIC CHOKE COIL ROD ADJUSTMENT (4MV)**

Fig. 6C2-25--M4MC/4MV Carburetor Adjustments - 6 of 10

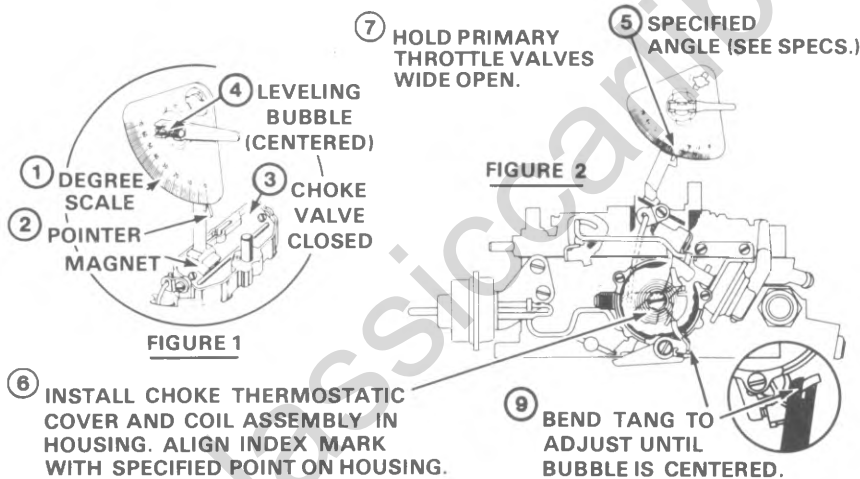
13

FIGURE 1

1. USE CHOKE VALVE MEASURING GAUGE J-26701. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
2. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
3. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
4. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

5. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
6. INSTALL CHOKE THERMOSTATIC COVER AND COIL ASSEMBLY IN HOUSING. ALIGN INDEX MARK WITH SPECIFIED POINT ON HOUSING.
7. HOLD PRIMARY THROTTLE VALVES WIDE OPEN.
8. ON WARM ENGINE, CLOSE CHOKE VALVE BY PUSHING UP ON TANG ON VACUUM BREAK LEVER (HOLD IN POSITION WITH RUBBER BAND).
9. TO ADJUST, BEND TANG ON FAST IDLE LEVER UNTIL BUBBLE IS CENTERED.
10. REMOVE GAUGE.



6. INSTALL CHOKE THERMOSTATIC COVER AND COIL ASSEMBLY IN HOUSING. ALIGN INDEX MARK WITH SPECIFIED POINT ON HOUSING.
8. ON WARM ENGINE, CLOSE CHOKE VALVE BY PUSHING UP ON TANG ON VACUUM BREAK LEVER (HOLD IN POSITION WITH RUBBER BAND).

UNLOADER ADJUSTMENT - ANGLE GAUGE METHOD

CARB. NO. ANGLE GAUGE

17058512 40°

ALL OTHERS 42°

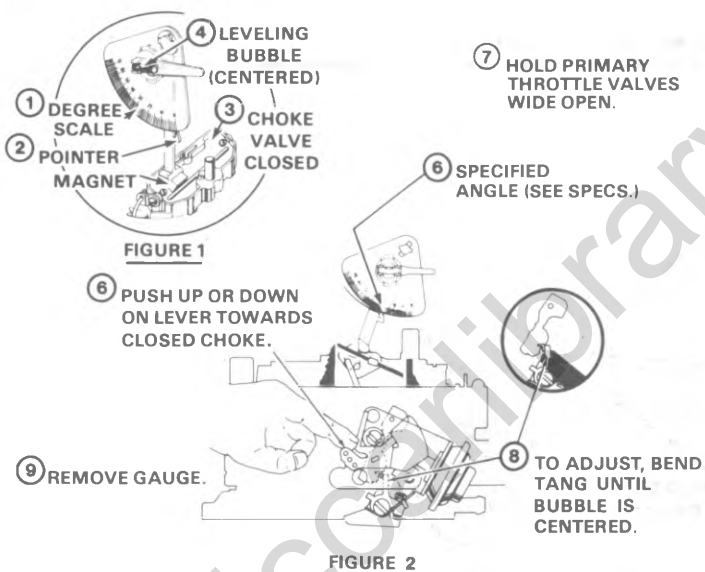
14

FIGURE 1

1. USE CHOKE VALVE MEASURING GAUGE J-26701. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
2. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
3. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
4. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

5. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
6. PUSH UP OR DOWN ON LEVER TOWARDS CLOSED CHOKE.
7. HOLD PRIMARY THROTTLE VALVES WIDE OPEN.
8. TO ADJUST, BEND TANG UNTIL BUBBLE IS CENTERED.
9. REMOVE GAUGE.



UNLOADER ADJUSTMENT - ANGLE GAUGE METHOD (4MV)

CARB. NO.

ANGLE GAUGE

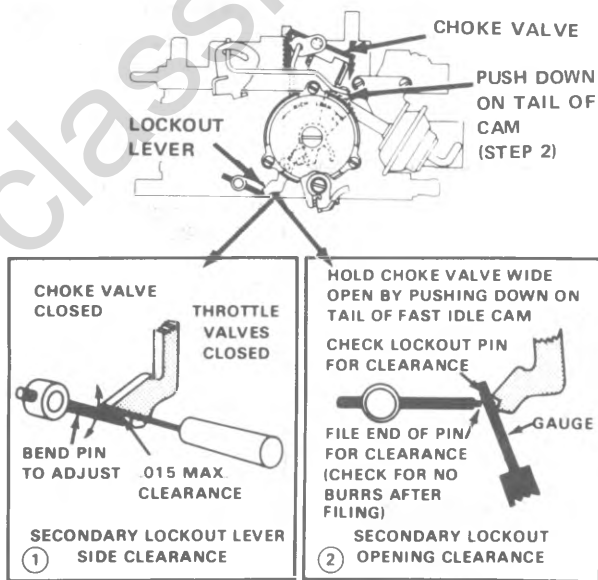
17058213
17058215
17058229

40°

17058212
17058513
17058514
17058515

43°

15



SECONDARY LOCKOUT ADJUSTMENT

CARB. NO.

PLUG GAUGE

ALL

.015"

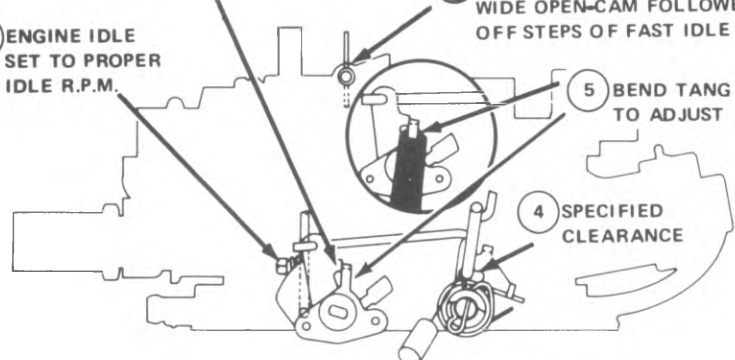
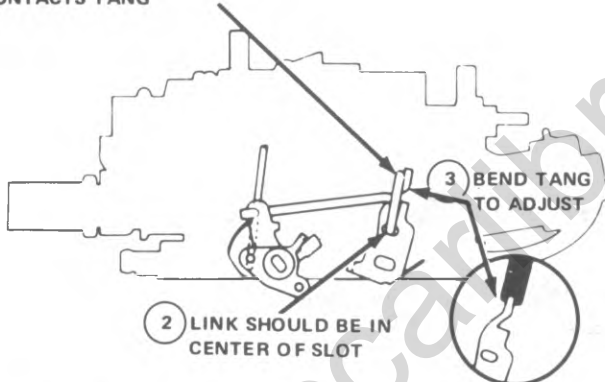
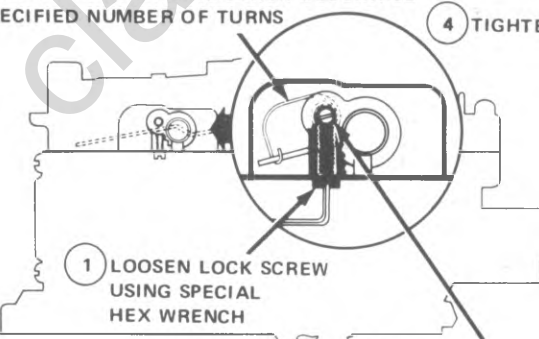
<p>16</p> <p>① ENGINE IDLE SET TO PROPER IDLE R.P.M.</p> <p>② CHOKE VALVE WIDE OPEN-CAM FOLLOWER OFF STEPS OF FAST IDLE CAM</p> <p>③ LEVER AGAINST TANG</p> <p>④ SPECIFIED CLEARANCE</p> <p>⑤ BEND TANG TO ADJUST</p>  <p>SECONDARY CLOSING ADJUSTMENT</p>	<p>CARB. NO.</p> <p>ALL</p>	<p>PLUG GAUGE</p> <p>.020"</p>
<p>17</p> <p>① OPEN PRIMARY THROTTLE UNTIL ACTUATING LINK CONTACTS TANG</p> <p>② LINK SHOULD BE IN CENTER OF SLOT</p> <p>③ BEND TANG TO ADJUST</p>  <p>SECONDARY OPENING ADJUSTMENT</p>		
<p>18</p> <p>① LOOSEN LOCK SCREW USING SPECIAL HEX WRENCH</p> <p>② TURN TENSION ADJUSTING SCREW COUNTERCLOCKWISE UNTIL AIR VALVE OPENS PART WAY</p> <p>③ TURN TENSION ADJUSTING SCREW CLOCKWISE UNTIL AIR VALVE JUST CLOSES. THEN TURN ADJUSTING SCREW CLOCKWISE SPECIFIED NUMBER OF TURNS</p> <p>④ TIGHTEN LOCK SCREW</p>  <p>AIR VALVE SPRING ADJUSTMENT</p>	<p>CARB. NO.</p> <p>ALL EXCEPT 17058525</p> <hr/> <p>17058525</p>	<p>NO TURNS</p> <p>7/8</p> <hr/> <p>3/4</p>

Fig. 6C2-28--M4MC/4MV Carburetor Adjustments-9 of 10

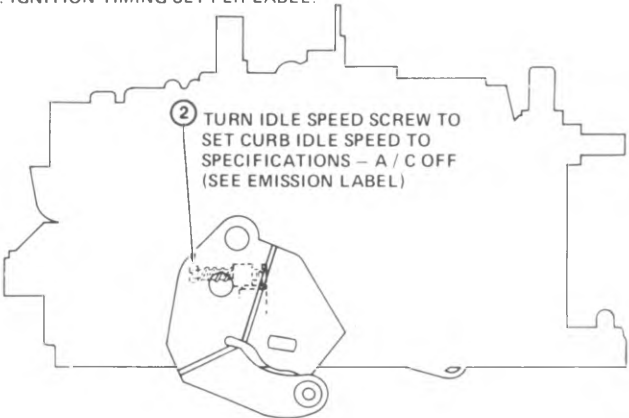
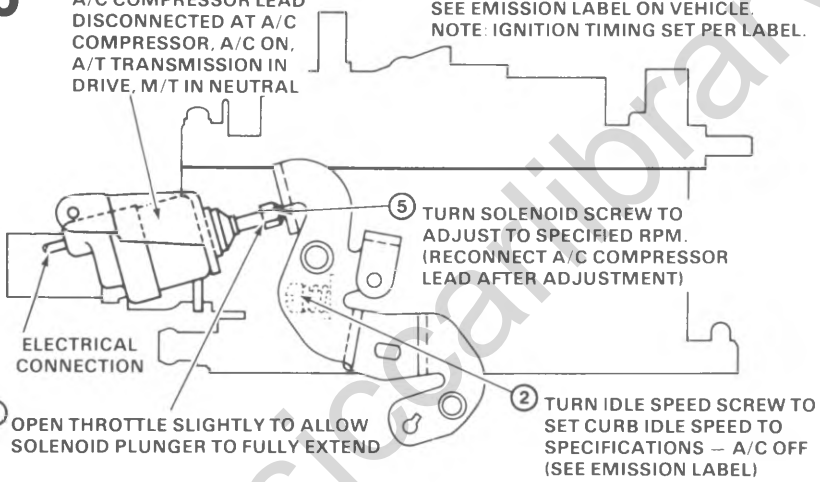
<p>19</p> <p>① PREPARE VEHICLE FOR ADJUSTMENTS – SEE EMISSION LABEL ON VEHICLE. NOTE: IGNITION TIMING SET PER LABEL.</p>  <p>② TURN IDLE SPEED SCREW TO SET CURB IDLE SPEED TO SPECIFICATIONS – A / C OFF (SEE EMISSION LABEL)</p> <p>IDLE SPEED ADJUSTMENT - WITHOUT SOLENOID</p>	<p>SPECIFICATION</p> <p>SEE: VEHICLE (ENGINE) EMISSION CONTROL INFORMATION LABEL</p>
<p>20</p> <p>③ SOLENOID ENERGIZED – A/C COMPRESSOR LEAD DISCONNECTED AT A/C COMPRESSOR, A/C ON, A/T TRANSMISSION IN DRIVE, M/T IN NEUTRAL</p> <p>① PREPARE VEHICLE FOR ADJUSTMENTS – SEE EMISSION LABEL ON VEHICLE. NOTE: IGNITION TIMING SET PER LABEL.</p>  <p>② TURN IDLE SPEED SCREW TO SET CURB IDLE SPEED TO SPECIFICATIONS – A/C OFF (SEE EMISSION LABEL)</p> <p>④ OPEN THROTTLE SLIGHTLY TO ALLOW SOLENOID PLUNGER TO FULLY EXTEND</p> <p>⑤ TURN SOLENOID SCREW TO ADJUST TO SPECIFIED RPM. (RECONNECT A/C COMPRESSOR LEAD AFTER ADJUSTMENT)</p> <p>ELECTRICAL CONNECTION</p> <p>A/C IDLE SPEED ADJUSTMENT - WITH SOLENOID</p>	<p>SPECIFICATION</p> <p>SEE: VEHICLE (ENGINE) EMISSION CONTROL INFORMATION LABEL</p>

Fig. 6C2-29--M4MC/4MV Carburetor Adjustments-10 of 10

**ANGLE DEGREE TO DECIMAL CONVERSION
MODEL M2MC AND M4MC CARBURETOR**

THE RELATION BETWEEN DECIMAL AND ANGLE READINGS IS NOT EXACT DUE TO MANUFACTURING TOLERANCES OF THE COMPONENT PARTS. THIS CHART IS SUPPLIED FOR USE BY THE MECHANIC WHO HAS ACCESS TO PLUG GAUGES ONLY. THE RECOMMENDED TOOL IS AN ANGLE GAUGE FOR ACCURACY AND BEST OVERALL PERFORMANCE AND EMISSIONS.

ANGLE DEGREES	DECIMAL EQUIV. TOP OF VALVE	ANGLE DEGREES	DECIMAL EQUIV. TOP OF VALVE
5	.023	33	.203
6	.028	34	.211
7	.033	35	.220
8	.038	36	.227
9	.043	37	.234
10	.049	38	.243
11	.054	39	.251
12	.060	40	.260
13	.066	41	.269
14	.071	42	.277
15	.077	43	.287
16	.083	44	.295
17	.090	45	.304
18	.096	46	.314
19	.103	47	.322
20	.110	48	.332
21	.117	49	.341
22	.123	50	.350
23	.129	51	.360
24	.136	52	.370
25	.142	53	.379
26	.149	54	.388
27	.157	55	.400
28	.164	56	.408
29	.171	57	.418
30	.179	58	.428
31	.187	59	.439
32	.195	60	.449

**ANGLE DEGREE TO DECIMAL CONVERSION
MODEL 4MV CARBURETOR**

THE RELATION BETWEEN DECIMAL AND ANGLE READINGS IS NOT EXACT DUE TO MANUFACTURING TOLERANCES OF THE COMPONENT PARTS. THIS CHART IS SUPPLIED FOR USE BY THE MECHANIC WHO HAS ACCESS TO PLUG GAUGES ONLY. THE RECOMMENDED TOOL IS AN ANGLE GAUGE FOR ACCURACY AND BEST OVERALL PERFORMANCE AND EMISSIONS.

ANGLE DEGREES	DECIMAL EQUIV. TOP OF VALVE	ANGLE DEGREES	DECIMAL EQUIV. TOP OF VALVE
5	.019	33	.158
6	.022	34	.164
7	.026	35	.171
8	.030	36	.178
9	.034	37	.184
10	.038	38	.190
11	.042	39	.197
12	.047	40	.204
13	.051	41	.211
14	.056	42	.217
15	.060	43	.225
16	.065	44	.231
17	.070	45	.239
18	.075	46	.246
19	.080	47	.253
20	.085	48	.260
21	.090	49	.268
22	.095	50	.275
23	.101	51	.283
24	.106	52	.291
25	.112	53	.299
26	.117	54	.306
27	.123	55	.314
28	.128	56	.322
29	.134	57	.329
30	.140	58	.337
31	.146	59	.345
32	.152	60	.353

10. Observe propane flow meter to insure propane cartridge is adequately full.

11. With propane flowing, adjust idle speed screw to the enriched RPM (starting point for lean drop setting-see specifications). Readjust propane flow to be certain of maximum engine speed and adjust idle speed again if necessary.

12. Turn off propane. Place transmission in Neutral and run engine at approximately 2,000 RPM for 30 seconds. Put transmission in Drive (Neutral for manual shift).

13. Check idle speed. If it is as shown on the Emission Control Information Label, the idle mixture is correct. In that case proceed with Step #17.

14. If the speed is too low, carefully remove tab from the limiter cap or gently remove cap from screw taking care not to bend the screw head, then back out the screw or screws equally (richen) 1/8 turn at a time until speed on Emissions Label is reached.

If the speed is too high, carefully remove tab from the limiter cap or gently remove cap from screw taking care not to bend the screw head, then turn in the screw or screws equally (leaner) 1/8 turn at a time until speed on Emissions Label is reached.

15. Turn propane on again to check maximum engine idle speed. If speed is different from specification (enriched RPM-starting point for lean drop setting) readjust idle speed screw to enriched RPM with propane flowing.

16. Turn off propane again, clean out engine at 2,000 RPM for 30 seconds in Neutral. Put transmission in Drive (Neutral for manual) re-check idle speed. It should be as shown on the Emissions Control Information Label. If not, repeat the adjustment procedure as in Step #14.

17. If rough idle persists, turn mixture screws in until lightly seated. Back them out equally to the average previous position and rerun propane idle test starting with Step #9.

18. Turn off engine and remove propane tool. Connect crankcase ventilation tube to air cleaner.

CARBURETOR REPLACEMENT

Model M4MC (Fig. 6C2-30)

Removal

Flooding, stumble on acceleration and other performance complaints are in many instances, caused by presence of dirt, water, or other foreign matter in carburetor. To aid in diagnosis, carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check filter.

1. Remove air cleaner and gasket.
2. Disconnect wire at solenoid, if equipped.
3. Disconnect fuel pipe and vacuum lines.
4. Disconnect choke system.
5. Disconnect accelerator linkage.
6. If equipped with automatic transmission, disconnect downshift cable.
7. If equipped with cruise control, disconnect linkage.
8. Remove carburetor attaching bolt, carburetor and insulator.

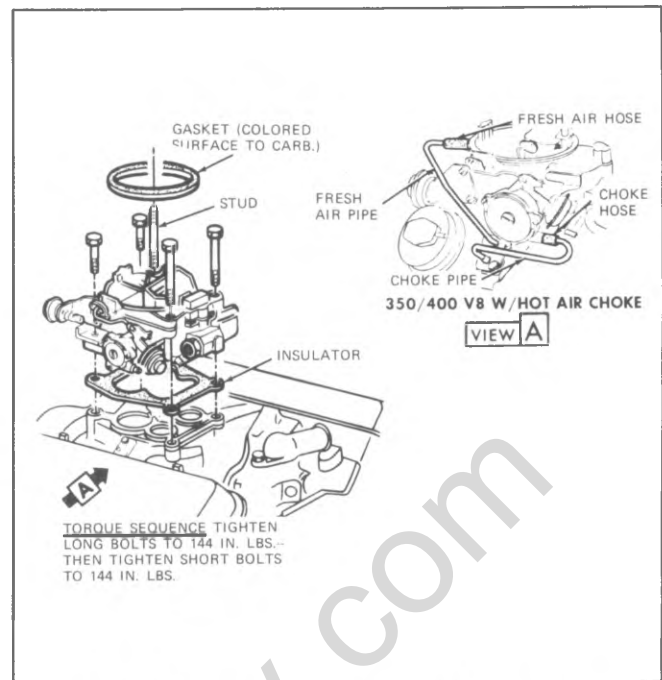


Fig. 6C2-30--Carburetor and Choke Pipes-M4MC

Installation

1. Clean sealing surfaces on intake manifold and carburetor.
2. Fill carburetor bowl before installing carburetor.
3. Install carburetor and new insulator with attaching bolts. Tighten bolts alternately to 144 pound inches.
4. Connect downshift cable as required.
5. Connect cruise control cable as required.
6. Connect accelerator linkage.
7. Connect choke system.
8. Connect fuel pipe and vacuum hoses.
9. Connect solenoid as required.
10. Install air cleaner.
11. Check and adjust idle speed.

Model 4MV (Fig. 6C2-31)

Removal

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by presence of dirt, water, or other foreign matter in carburetor. To aid in diagnosis, carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check filter.

1. Remove air cleaner and gasket.
2. Disconnect fuel and vacuum lines from carburetor.
3. Remove clip from choke linkage.
4. Disconnect accelerator linkage.
5. If equipped with automatic downshift cable, disconnect cable.
6. Remove carburetor attaching bolts and remove carburetor.
7. Remove insulator.

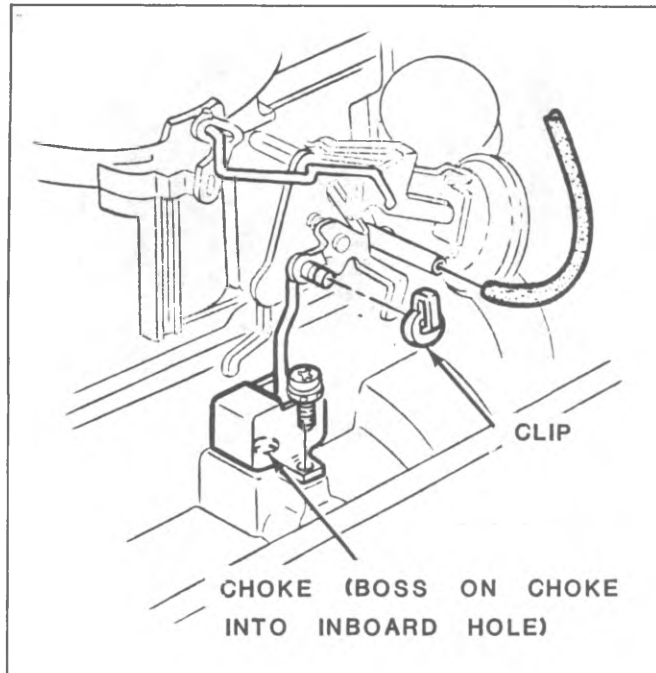


Fig. 6C2-31--Carburetor Choke-4MV

UNIT REPAIR-MODEL M4MC

DISASSEMBLY

Place carburetor on a holding fixture to prevent damage to throttle plates.

Solenoid (If Equipped)

Remove screws securing the solenoid and bracket to float bowl and remove solenoid and bracket assembly.

CAUTION: *The solenoid should not be immersed in any type of carburetor cleaner and should always be removed before complete carburetor overhaul.*

Air Horn

1. Remove upper choke lever from the end of choke shaft by removing retaining screw (Fig. 6C2-32). Then rotate upper choke lever to remove choke rod from slot in lever.

2. Remove choke rod from lower lever inside the float bowl casting by holding lower lever outward with small screwdriver and twisting rod counterclockwise.

3. Remove secondary metering rods by removing the small screw in the top of the metering rod hanger. Lift upward on metering rod hanger until the secondary metering rods are completely out of the air horn. Metering rods may be disassembled from the hanger by rotating ends out of the holes in the end of the hanger. (Fig. 6C2-33).

4. Using special tool J-25322, drive small roll pin (pump lever pivot pin) inward just enough until pump lever can be removed from air horn. Then remove pump lever from pump rod (Fig. 6C2-34).

CAUTION: *Use care in removing small roll pin to prevent damage to pump lever casting bosses in air horn.*

5. Remove nine air horn to bowl attaching screws; two

Installation

1. Clean sealing surfaces on intake manifold and carburetor.
2. Fill carburetor bowl before installing carburetor.
3. Install carburetor and new insulator with attaching bolts. Tighten bolts alternately to 144 pound inches.
4. Connect downshift cable as required.
5. Connect accelerator linkage.
6. Connect choke linkage and install clip.
7. Connect solenoid as required.
8. Install air cleaner.
9. Check and adjust idle speed.

attaching screws are located next to the venturi. (Two long screws, five short screws, and two countersunk screws). (Fig. 6C2-35).

6. Remove air horn from float bowl by lifting straight up. The air horn gasket should remain on the float bowl for removal later (Fig. 6C2-36).

CAUTION: *When removing air horn from float bowl, use care to prevent bending the small tubes protruding from the air horn. These tubes are permanently pressed into the air horn casting. DO NOT REMOVE.*

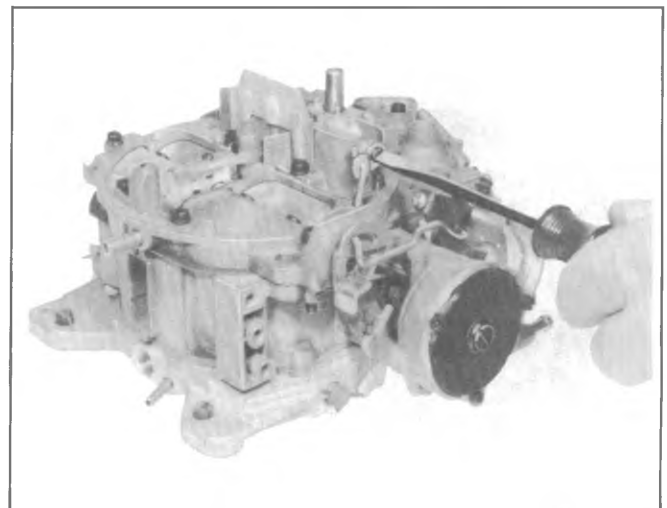


Fig. 6C2-32--Removing Upper Choke Lever

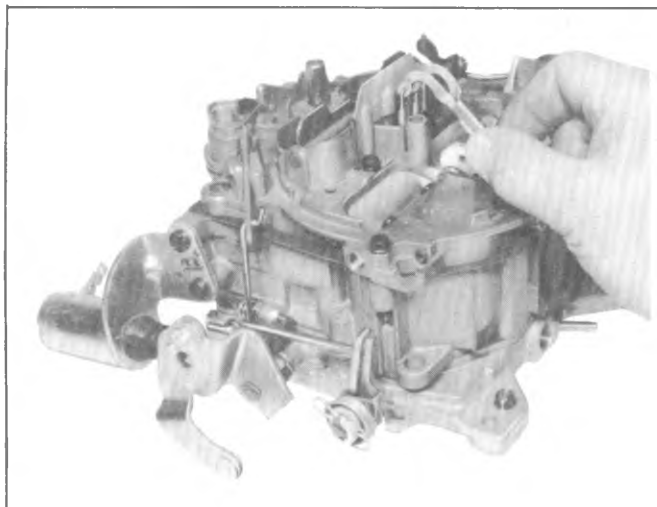


Fig. 6C2-33--Removing Secondary Metering Rods

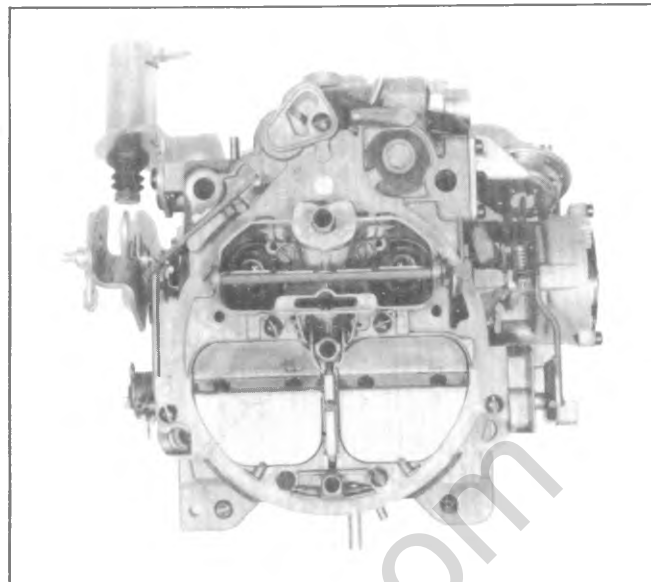


Fig. 6C2-35--Removing Air Horn Screws

Air Horn Disassembly

Remove front vacuum break bracket attaching screws. The diaphragm assembly may now be removed from the air valve dashpot rod and the dashpot rod from the air valve lever (Fig. 6C2-37).

CAUTION: Do not place vacuum break assembly in carburetor cleaner.

Further disassembly of the air horn is not required for cleaning purposes. If part replacement is required, proceed as follows:

1. Remove staking on two choke valve attaching screws, then remove choke valve and shaft from air horn.
2. Air valves and air valve shaft should not be removed.
3. If it is necessary to replace the air valve closing spring or center plastic eccentric cam, a repair kit is available. Instructions for assembly are included in the repair kit.

Float Bowl

1. Remove air horn gasket by lifting out of dowel locating pins and lifting tab of gasket from beneath the power piston hanger, being careful not to distort springs holding the main metering rods (Fig. 6C2-38).



Fig. 6C2-34--Removing Pump Lever

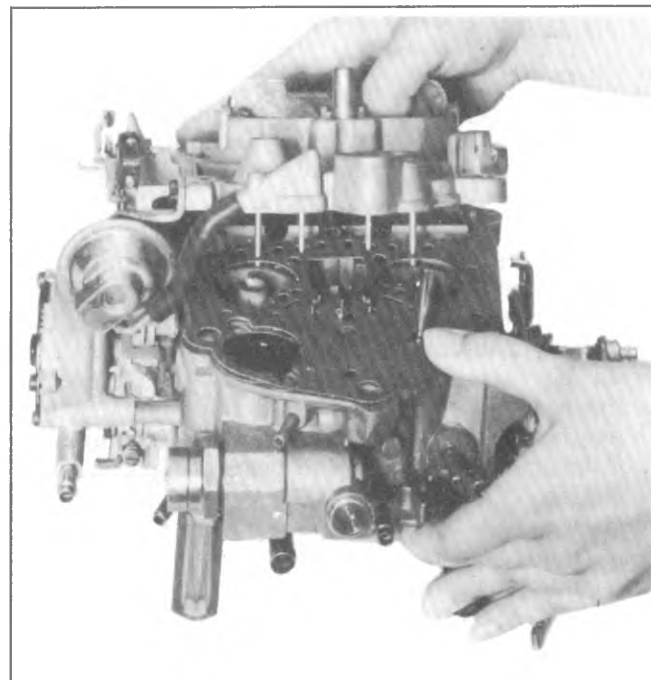


Fig. 6C2-36--Removing Air Horn

2. Remove pump plunger from pump well.
3. Remove pump return spring from pump well.
4. Remove power piston and metering rods by depressing piston stem and allowing it to snap free (Fig. 6C2-39).

The power piston can be easily removed by pressing the piston down and releasing it with a snap. This will cause the power piston spring to snap the piston up against the retainer. This procedure may have to be repeated several times.

CAUTION: Do not remove power piston by using pliers on metering rod hanger.

Remove the power piston spring from the well.

CAUTION: The A.P.T. metering rod adjustment

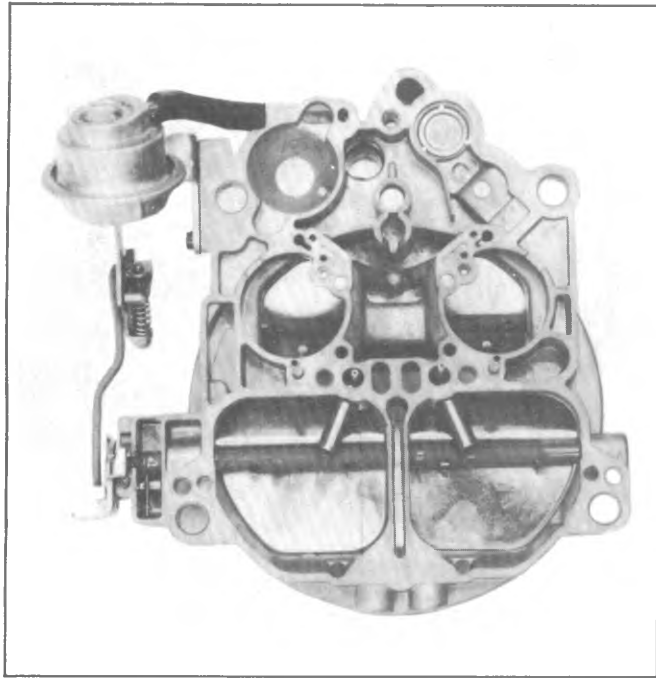


Fig. 6C2-37--Removing Front Vacuum Break

screw is pre-set at the factory and no attempt should be made to change this adjustment in the field. If float bowl replacement is required during service, the new bowl assembly will be supplied with an A.P.T. metering rod screw which will be pre-set as required.

5. Remove metering rods from power piston by disconnecting tension spring from top of each rod, then rotate rod to remove from hanger (Fig. 6C2-40).

CAUTION: Use care when disassembling rods to prevent distortion of tension spring and/or

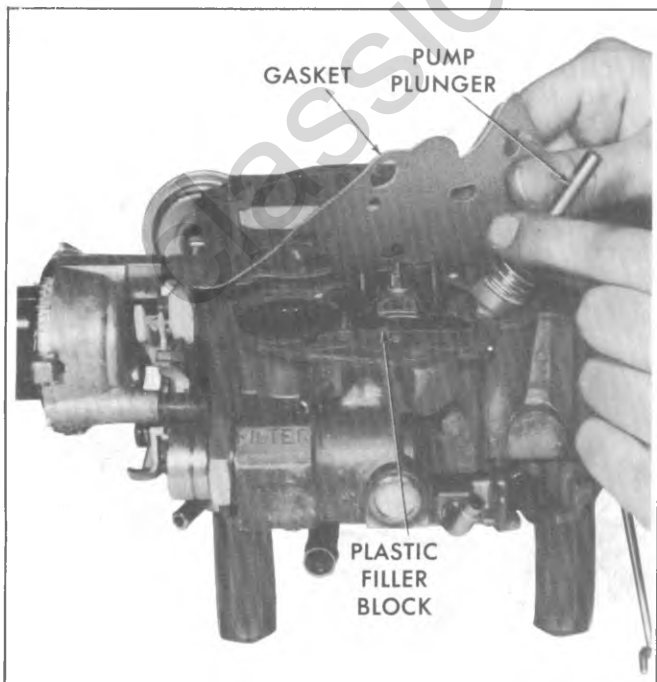


Fig. 6C2-38--Removing Air Horn Gasket and Pump Plunger

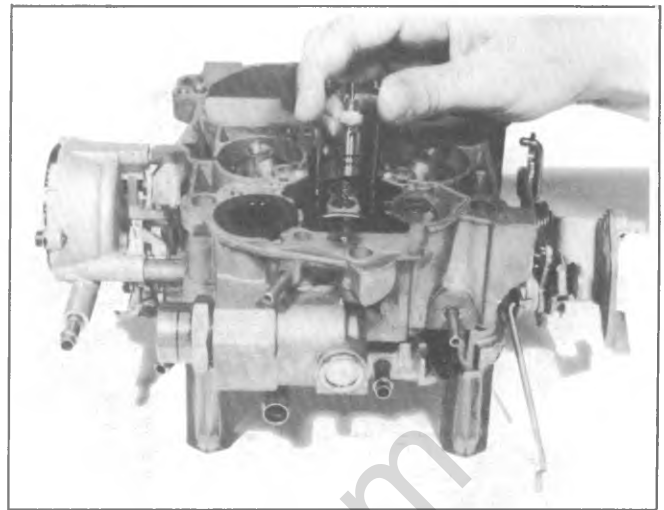


Fig. 6C2-39--Removing Power Piston and Metering Rods

metering rods. Note carefully position of tension spring for later reassembly.

6. Remove plastic filler block over float valve.

7. Remove float assembly and float needle by pulling up on retaining pin. Remove float needle seat and gasket. (Fig. 6C2-41).

8. Remove aneroid cavity insert from float bowl. (Fig. 6C2-42).

9. Remove primary main metering jets (only if necessary) (Fig. 6C2-43).

NOTE: No attempt should be made to remove the secondary metering jet (metering orifice plates). These jets are fixed and, if damaged, bowl replacement is required.

10. Remove pump discharge check ball retainer and check ball.

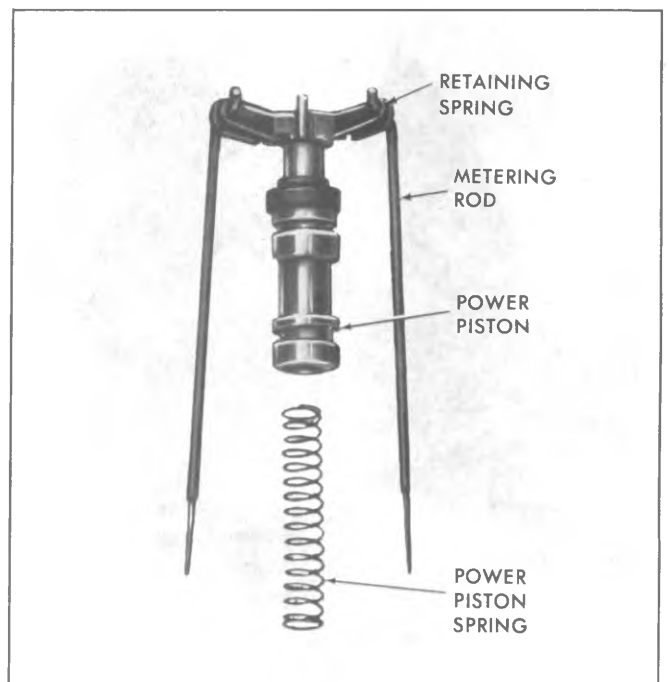


Fig. 6C2-40--Power Piston and Metering Rods

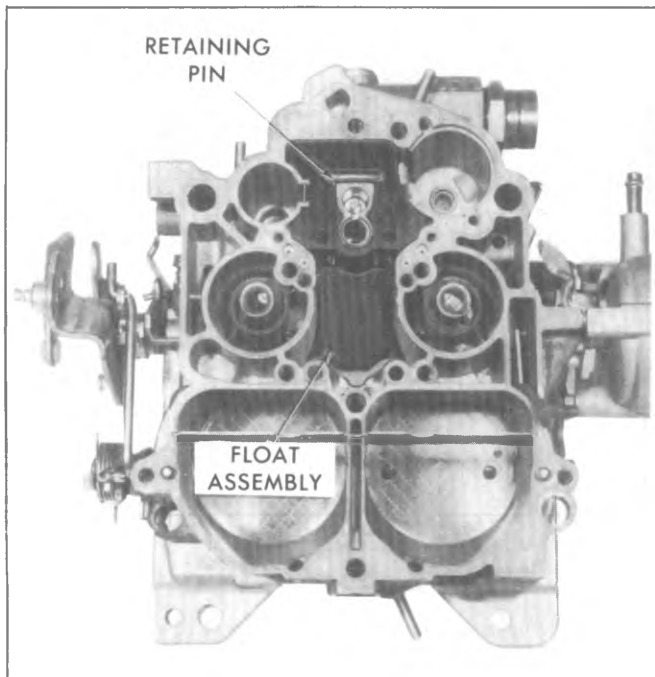


Fig. 6C2-41--Float Assembly

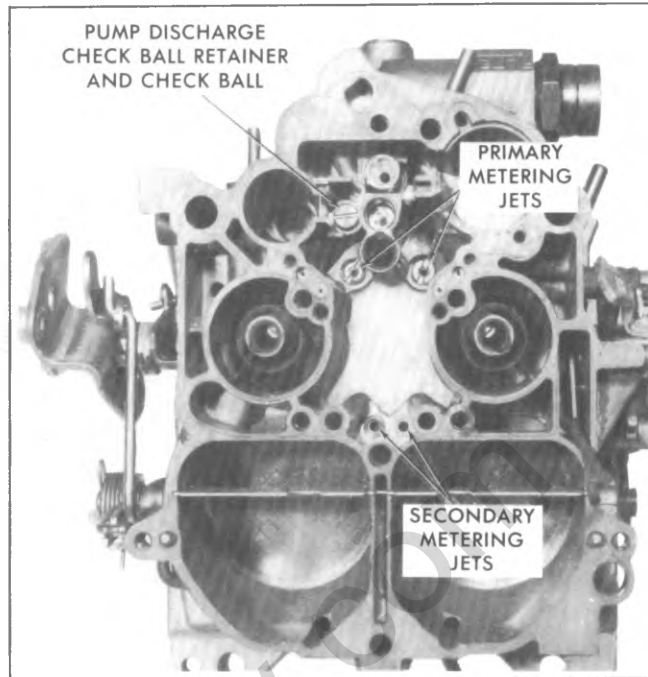


Fig. 6C2-43--Float Bowl Jets

11. Remove secondary air baffle, if replacement is required.
12. Remove pump well fill slot baffle.

Choke

1. Remove three attaching screws and retainers from choke cover and coil assembly. Then pull straight outward and remove cover and coil assembly from choke housing. Remove choke cover gasket, if used.

On M4MC hot air choke model, it is not necessary to remove baffle plate from beneath the thermostatic coil.

Distortion of the thermostatic coil may result if forced off the center retaining post on the choke cover.

2. Remove choke housing assembly from float bowl by removing retaining screw and washer inside the choke housing (Fig. 6C2-44). The complete choke assembly can be removed from the float bowl by sliding outward.

3. Remove secondary throttle valve lock-out lever from float bowl. (Fig. 6C2-45).

4. Remove lower choke lever from inside float bowl cavity by inverting bowl.

5. Remove plastic tube seal from choke housing (Fig. 6C2-45).

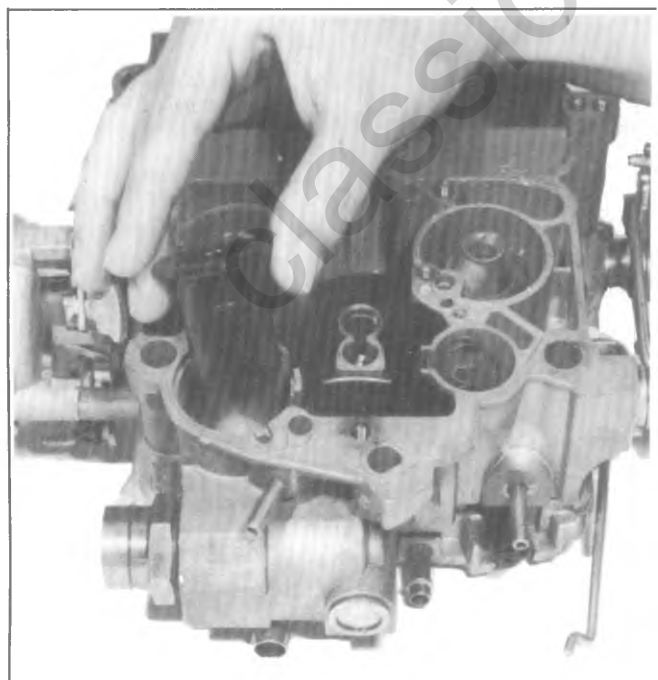


Fig. 6C2-42--Removing Aneroid Cavity Insert

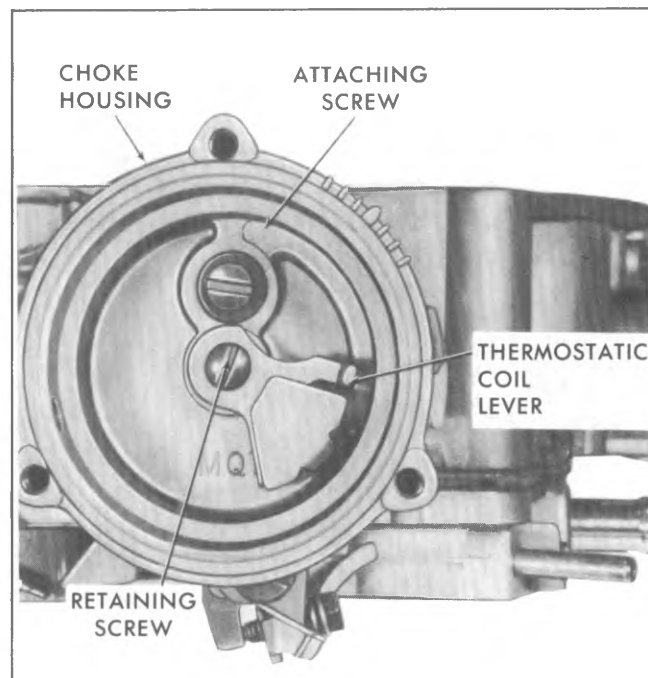


Fig. 6C2-44--Removing Choke Housing

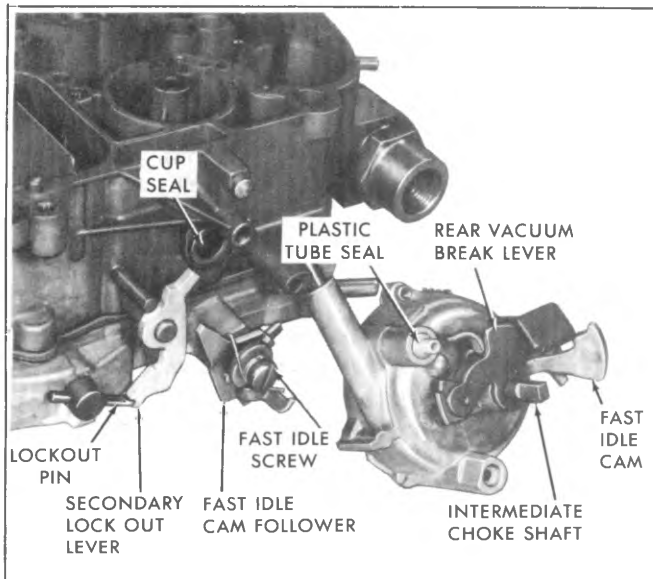


Fig. 6C2-45--Choke Housing Assembly

CAUTION: Plastic tube seal should not be immersed in carburetor cleaner.

6. To disassemble intermediate choke shaft from choke housing, remove coil lever retaining screw at end of shaft inside the choke housing (Fig. 6C2-44). Then remove thermostatic coil lever from flats on intermediate choke shaft. Remove intermediate choke shaft from the choke housing by sliding outward. The fast idle cam can now be removed from the intermediate choke shaft (Fig. 6C2-45).

CAUTION: Remove the cup seal from inside choke housing shaft hole if the housing is to be immersed in carburetor cleaner. Also, remove the cup seal from the float bowl plastic insert for bowl cleaning purposes. **DO NOT ATTEMPT TO REMOVE PLASTIC INSERT**

Float Bowl Disassembly

1. Remove fuel inlet nut, gasket and filter (Fig. 6C2-46).
2. Remove throttle body by removing throttle body to bowl attaching screws (Fig. 6C2-47).
3. Remove throttle body to bowl insulator gasket (Fig. 6C2-48).

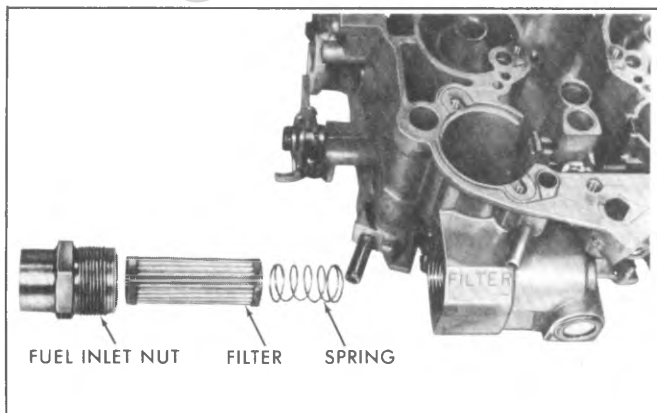


Fig. 6C2-46--Fuel Filter

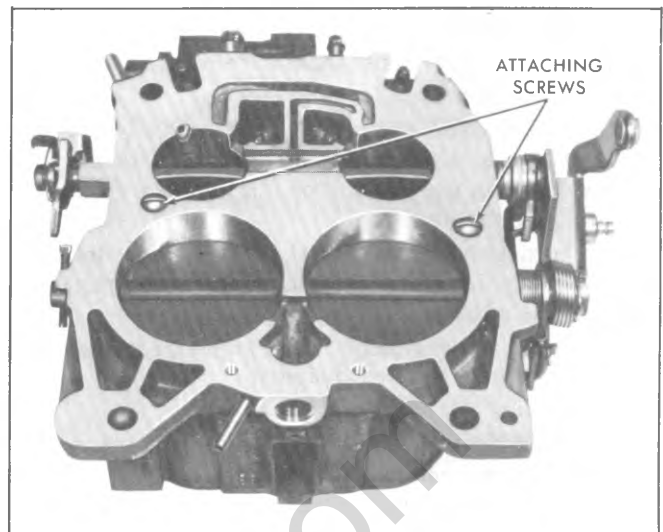


Fig. 6C2-47--Removing Throttle Body

Throttle Body Disassembly

1. Remove pump rod from throttle lever.
2. **DO NOT REMOVE** idle mixture limiter caps, unless it is necessary to replace the mixture needles or normal soaking and air pressure fails to clean the idle passages. If the idle mixture needles are removed, refer to Service Manual for adjustment procedure. If necessary to remove the idle mixture needle, destroy plastic limiter cap. Do not install a replacement cap as a bare mixture screw is sufficient to indicate that the mixture has been re-adjusted.

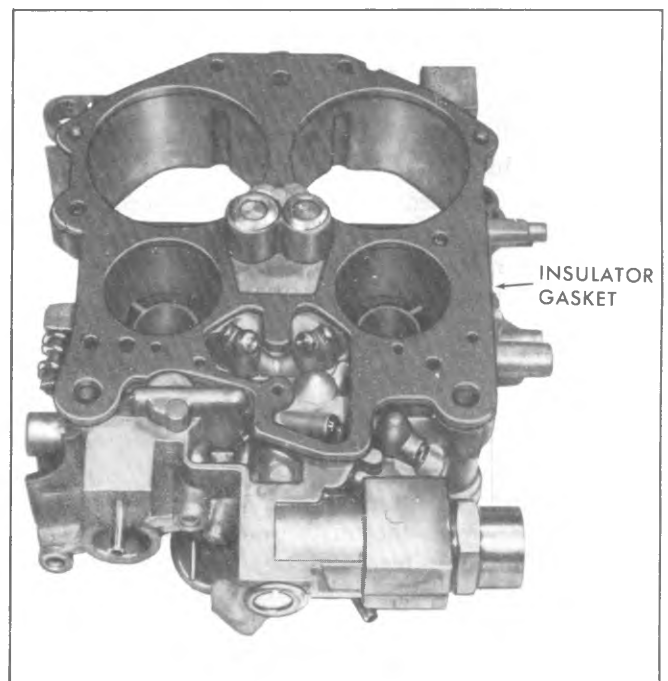


Fig. 6C2-48--Removing Insulator Gasket

CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

CAUTION: *The electric solenoid, rubber parts, plastic parts, diaphragms, pump plungers, should not be put in immersion type cleaner as they will swell, harden or distort.*

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.

2. Check, repair or replace the following parts if the following problems were encountered.

a. Flooding

1. Inspect float needle seat for dirt, deep wear grooves, scores and proper seating.

2. Inspect float, float arm and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

b. Hesitation

1. Inspect pump plunger for cracks, scores or cup, excessive wear. A used pump cup will shrink when dry. Soak in fuel for 8 hours before testing if dried out.

2. Inspect pump duration and return spring for being weak or distorted.

3. Check all pump passages and jets for dirt, improper seating inlet or discharge balls, scores in pump well.

4. Check pump linkage for excessive wear, repair or replace as necessary.

c. Hard Starting - Poor Cold Operation

1. Check choke valve and linkage for excessive wear, binds or distortion.

2. Inspect choke vacuum diaphragm for leaks.

3. Clean or replace carburetor filter.

4. Inspect needle for sticking, dirt etc.

5. Examine fast idle cam for wear or damage.

6. Also check items under "flooding".

d. Poor Performance - Poor Gas Mileage

1. Power Piston, power valve, metering rods for dirt, sticking, binding, damaged parts or excessive wear.

2. Clean all fuel and vacuum passages in castings.

e. Rough Idle

1. Inspect idle needle for ridges, burrs or being bent.

2. Inspect gasket mating surfaces on castings for damage to sealing bends, nicks and burrs.

3. Clean all idle fuel passages.

4. Check throttle lever and valves for binds, nicks and other damage.

ASSEMBLY

Throttle Body

1. If removed, install idle mixture needles and springs until seated. Back out the mixture needles 4 turns as a preliminary idle adjustment. Final adjustment must be made on the engine using the procedures described under slow idle adjustment.

2. Install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point outwards towards throttle lever.

Float Bowl Assembly

1. Install new throttle body to bowl gasket over two locating dowels on bowl.

2. Install throttle body making certain throttle body is properly located over dowels on float bowl, then install throttle body to bowl screws and tighten evenly and securely (Fig. 6C2-47).

3. Place carburetor on proper holding fixture J-8328.

4. Install fuel inlet filter spring, filter, new gasket and inlet nut and tighten nut to 18 pounds feet (Fig. 6C2-46).

CAUTION: *The fuel inlet check valve on a vehicle with light duty emissions must be installed in the filter to meet Motor Vehicle Safety Standards (M.V.S.S.) for roll-over. New service replacement filter includes the check valve.*

NOTE: Ribs on closed end of filter element prevent filter from being installed incorrectly unless forced.

CAUTION: *Tightening beyond specified torque can damage nylon gasket.*

Choke

1. Install new cup seal into plastic insert on side of float bowl for intermediate choke shaft. Lip on cup seal faces outward.

2. Install secondary throttle valve lock-out lever on boss on float bowl with recess in hole in lever facing inward.

3. Install new cup seal into inside choke housing shaft hole. Lips on seal face inward, towards inside of housing.

4. Install fast idle cam onto the intermediate choke shaft (steps on fast idle cam face downward) (Fig. 6C2-45).

5. Carefully install fast idle cam and intermediate choke shaft assembly through seal in choke housing; then install thermostatic coil lever onto flats on intermediate choke shaft. Inside thermostatic choke coil lever is properly aligned when both inside and outside levers face towards fuel inlet. Install inside lever retaining screw into end of intermediate choke shaft. Tighten securely.

6. Using Tool J-23417, install lower choke rod lever into cavity in float bowl. Install plastic tube seal into cavity on choke housing before assembling choke housing to bowl. Install choke housing to bowl sliding intermediate choke shaft into lower choke lever (Fig. 6C2-49).

NOTE: The intermediate choke shaft lever and fast idle cam are in correct relation when the tang on lever is beneath the fast idle cam. Do not install choke cover and coil assembly until inside coil lever is adjusted. Refer to Service Section for adjustment procedures.

Float Bowl

All Models

1. If removed, install air baffle in secondary side of float bowl with notches toward the top. Top edge of baffle must be flush with bowl casting.

2. If removed, install baffle in pump well fill slot.

3. Install pump discharge check ball and retainer in passage next to pump well. Tighten retainer securely.

4. Install primary main metering jets (if removed) (Fig. 6C2-43).

5. Install aneroid cavity insert into float bowl.

6. Install new needle seat assembly, with gasket.

7. To make adjustment easier, bend float arm upward at notch in arm before assembly.

Install needle by sliding float lever under needle pull

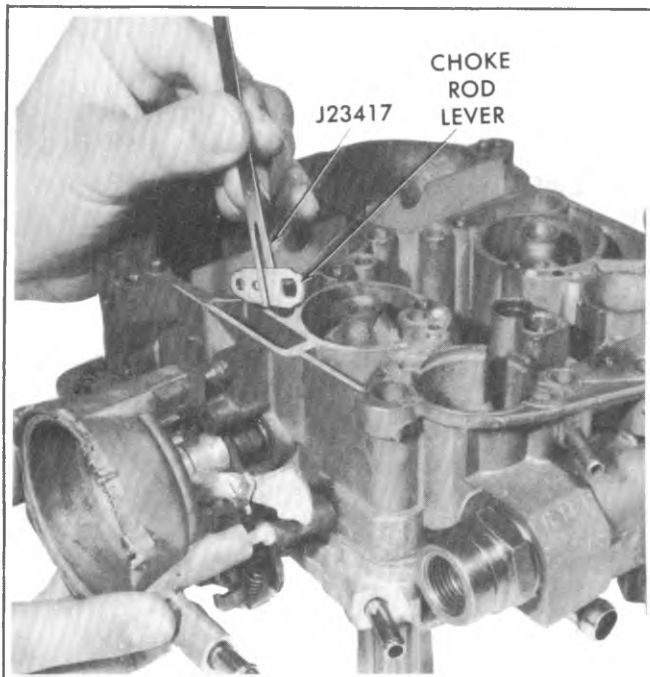


Fig. 6C2-49--Installing Choke Rod Lever

clip--correct installation of the needle pull clip is to hook the clip over the edge of the flat on the float arm facing the float pontoon (Fig. 6C2-50). With float lever in pull clip, hold float assembly at toe and install retaining pin from aneroid cavity side (ends of retaining pin face the accelerating pump well).

CAUTION: Do not install float needle pull clip into holes in float arm.

8. Adjust float level.

Float Level Adjustment (Fig. 6C2-51)

- a. Hold float retainer firmly in place.
- b. Push float down lightly against needle.
- c. With adjustable T-scale, gage from top of float bowl

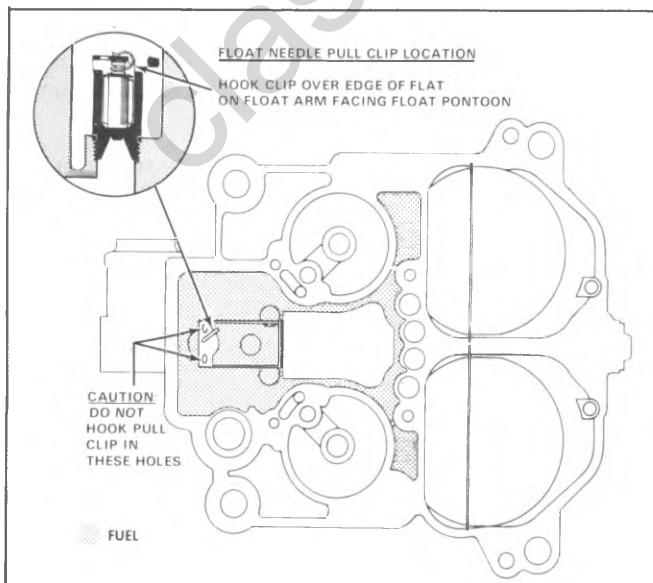


Fig. 6C2-50--Pull Clip Location

casting (air horn gasket removed) to top of float gauging point 3/16" back from end of float at toe.

d. Bend float arm as necessary for proper adjustment by pushing on pontoon. Refer to adjustment chart for specification.

e. Visually check float alignment after adjustment.

9. Install plastic filler block over float needle, pressing downward until properly seated.

10. Install power piston spring in power piston well. If main metering rods were removed from hanger, reinstall making sure tension spring is connected to top of each rod (Fig. 6C2-39). Install power piston assembly in well (aligning pin on piston with slot in well) with metering rods properly positioned in metering jets. Press down firmly on plastic power piston retainer to make sure the retainer is seated in recess in bowl and the top is flush with the top of the bowl casting. If necessary, using a drift punch and small hammer, tap retainer lightly in place.

11. Install pump return spring in pump well.

12. Install air horn gasket by carefully sliding tab of gasket around main metering rods and beneath the power piston hanger. Position gasket over the two dowel pins on the float bowl.

13. Carefully lift one corner of the air horn gasket and install pump plunger in the pump well by pushing the plunger to the bottom of the well against return spring tension. While holding in this position, align pump plunger stem with hole in gasket and press gasket in place.

Air Horn

1. If removed, install choke shaft, choke valve, and two attaching screws. Tighten screws securely and stake lightly in place.

2. Check choke valve for freedom of movement and proper alignment before staking screws in place.

Air Horn to Bowl Installation

1. Holding down on air horn gasket at pump plunger location, carefully lower air horn assembly onto float bowl making sure that the bleed tubes, accelerating well tubes, pull-over enrichment tubes (if used), and pump plunger stem are positioned properly through the holes in the air horn gasket.

CAUTION: Do not force the air horn assembly onto the bowl but rather lightly lower in place.

2. Install two long air horn screws, five short screws, and two countersunk screws into primary venturi area.

Install secondary air baffle beneath screw number 3 and 4.

All air horn screws must be tightened evenly and securely. See Figure 6C2-52 for proper tightening sequence.

3. Install vacuum break diaphragm rod into the slot in lever on the end of the air valve shaft. Then install the other end of rod into hole in the front vacuum break diaphragm plunger. Install front vacuum break control and bracket assembly to air horn using two retaining screws through the bracket. Tighten screws securely.

NOTE: Do not attach vacuum break hose until vacuum break adjustment is completed. Refer to Service Section for adjustment procedure.

4. Connect upper end of pump rod to pump lever by placing rod in specified hole in lever. Align hole in pump lever with hole in air horn casting using J-25322. Using small screwdriver, push pump lever roll pin back through

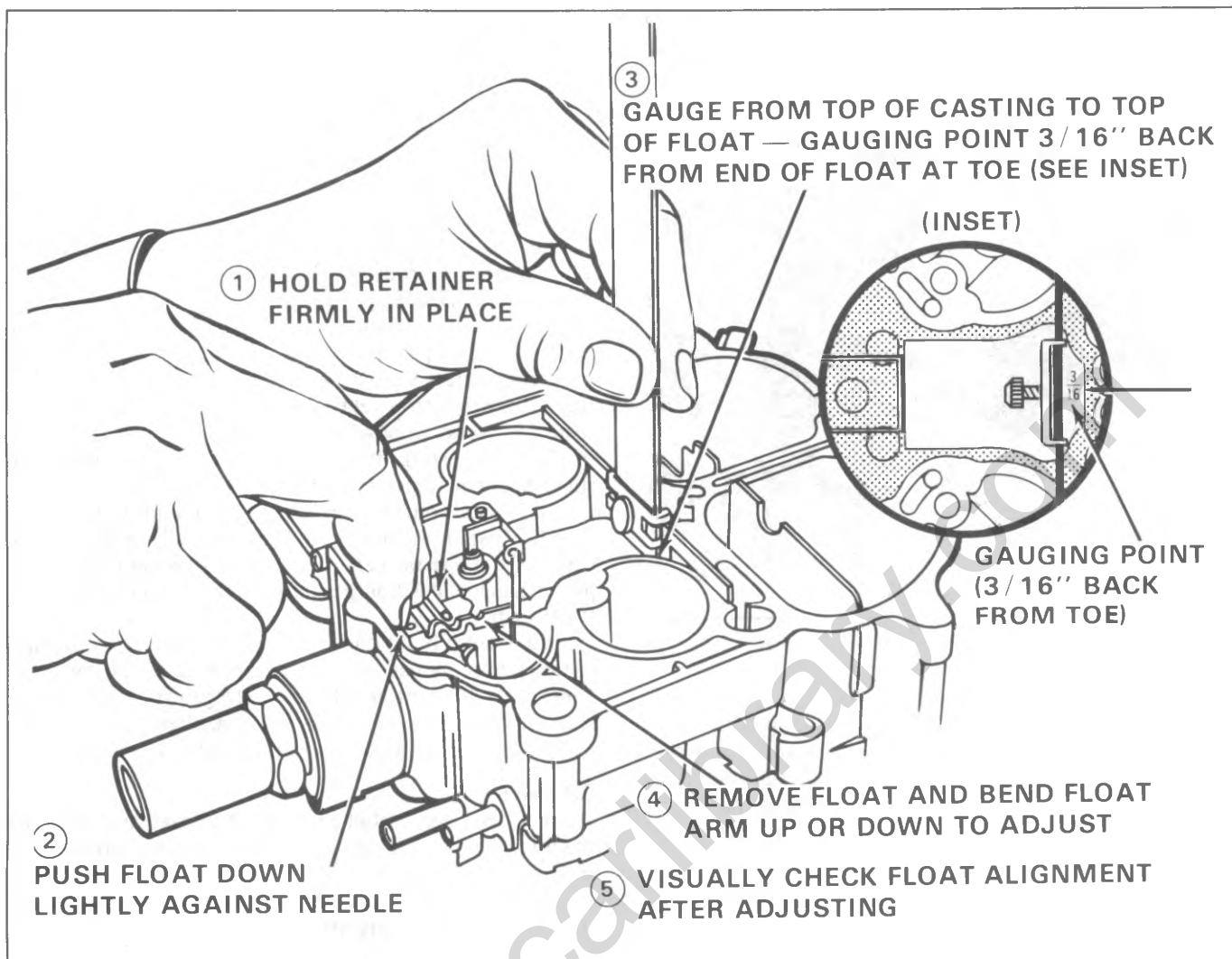


Fig. 6C2-51--Float Level Adjustment

casting until end of pin is flush with casting bosses in air horn (Fig. 6C2-53).

CAUTION: Use care installing the small roll pin to prevent damage to pump lever casting bosses.

5. Install two secondary metering rods into the secondary metering rod hanger (upper end of rods point toward each other). Install secondary metering rod holder, with rods, onto air valve cam follower. Install retaining screw end tighten securely. Work air valves up and down several times to make sure they are free in all positions.

6. Connect check rod into lower choke lever inside bowl cavity; they install choke rod into slot in upper choke lever and retain the choke lever to the end of the choke shaft with attaching screw. Tighten securely. When properly installed, the lever will point to the rear of the carburetor and the number on the lever will face outward (Fig. 6C2-54).

Make sure that the flats on the end of the choke shaft align with flats in the choke lever.

The front and rear vacuum break units, fast idle cam (choke rod), and inside thermostatic choke coil lever must be adjusted properly before installing the choke

thermostatic coil and cover assembly and gasket. Refer to the Adjustment Procedures, in Service Section.

7. After the vacuum break, fast idle cam (choke rod), and inside thermostatic coil lever are adjusted, the thermostatic coil and cover, and gasket on hot air choke model, should be installed and the cover assembly rotated until the choke valve just closes.

On all models (except 454 V8), tang on thermostatic coil must be installed in slot in inside choke coil lever pick-up arm.

Align index point on cover with specified mark on housing as shown on adjustment chart.

Install three choke cover retainers and screws and tighten securely.

8. After making vacuum break adjustment, install vacuum break hose.

9. If used, position and retain solenoid and bracket assembly.

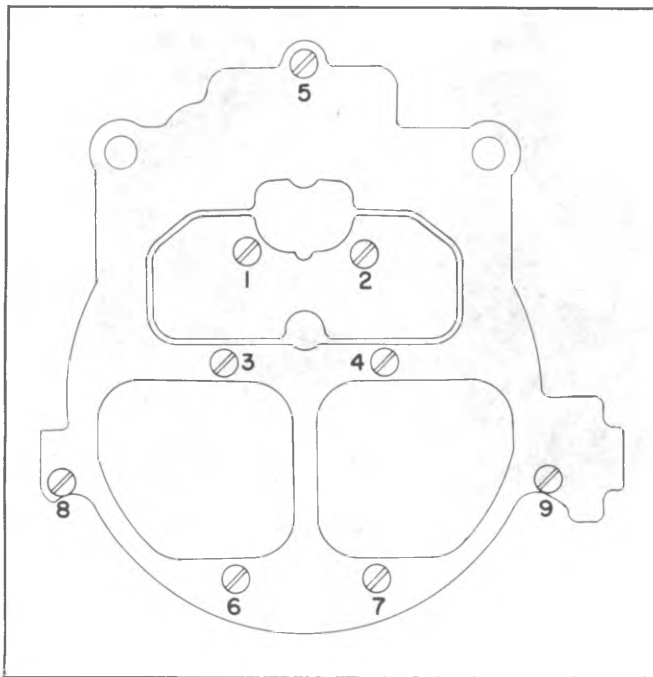


Fig. 6C2-52--Air Horn Screw Tightening Sequence

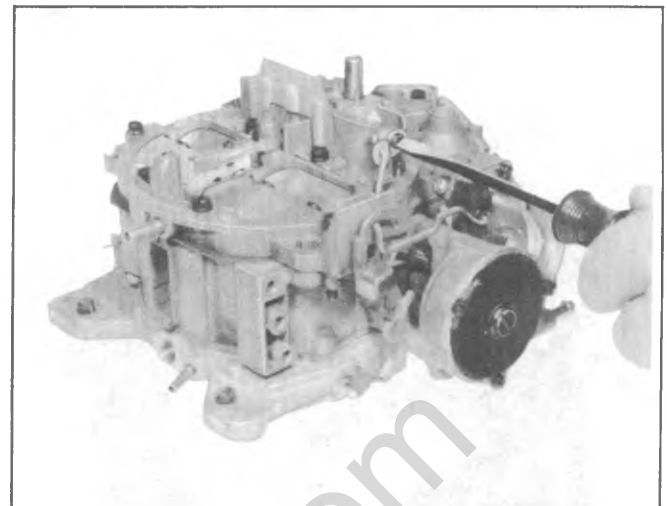


Fig. 6C2-54--Choke Lever and Housing

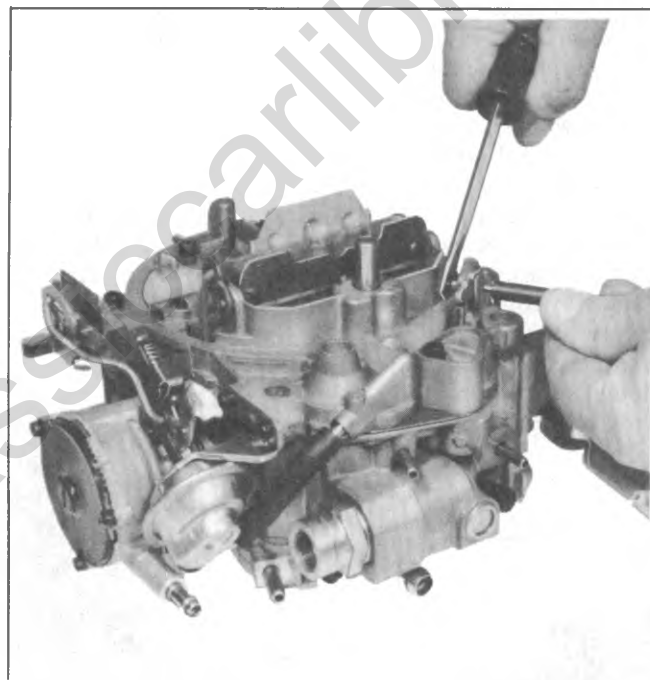


Fig. 6C2-53--Installing Pump Lever Pivot Pin

MODEL 4MV CARBURETOR

DISASSEMBLY

Place carburetor on a holding fixture to prevent damage to throttle plates.

Throttle Return Control Valve (If Equipped)

Remove screws securing the throttle return control

valve and bracket assembly to float bowl and remove control valve and bracket.

CAUTION: *The control valve should not be immersed in any type of carburetor cleaner and should always be removed before complete carburetor overhaul.*

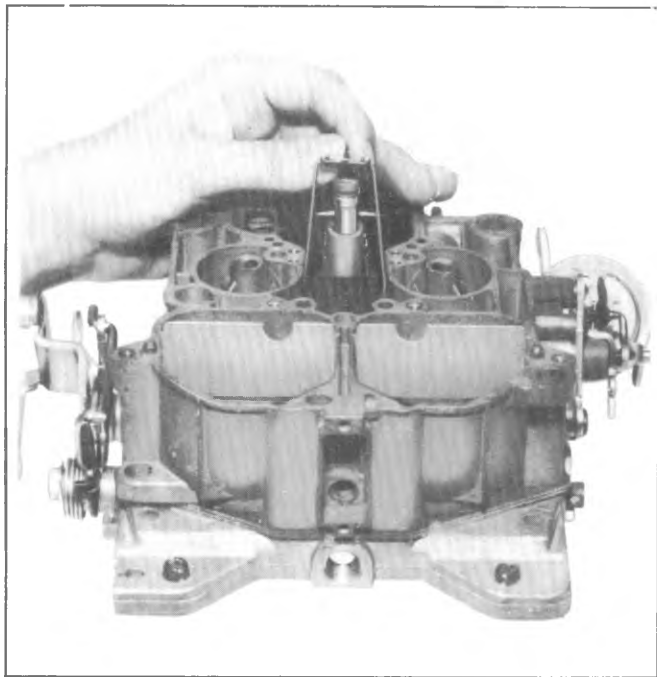


Fig. 6C2-55--Removing Secondary Metering Rods

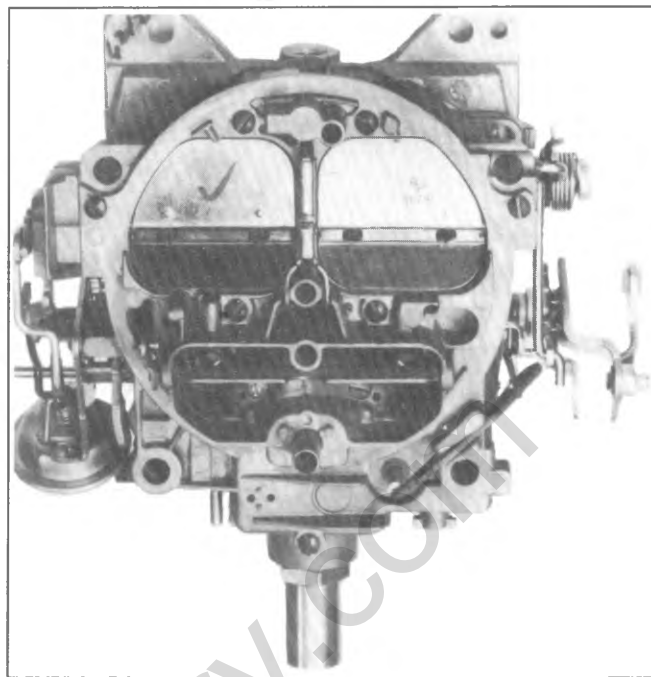


Fig. 6C2-57--Removing Air Horn Screws

Air Horn

1. Remove horseshoe clip from upper end of choke rod. Disconnect choke rod from upper choke shaft lever.

2. Remove choke rod from lower lever inside the float bowl casting by holding lower lever outward with small screwdriver and twisting rod counterclockwise.

3. Remove vacuum hose from vacuum break unit.

4. Remove secondary metering rods by removing the small screw in the top of the metering rod hanger. Lift upward on metering rod hanger until the secondary metering rods are completely out of the air horn. Metering rods may be disassembled from the hanger by rotating ends out of the holes in the end of the hanger (Fig. 6C2-55).

5. Using special tool J-25322, drive small roll pin (pump lever pivot pin) inward just enough until pump lever can be removed from air horn. Then remove pump lever

from pump rod (Fig. 6C2-56).

CAUTION: Use care in removing small roll pin to prevent damage to pump lever casting bases in air horn.

6. Remove nine air horn to bowl attaching screws; two attaching screws are located next to the venturi. (Two long screws, five short screws, and two countersunk screws) (Fig. 6C2-57).

7. Lift air horn off bowl and twist to disengage vacuum break rod from air valve shaft lever. Air horn gasket should remain on bowl for removal later. (Fig. 6C2-58).

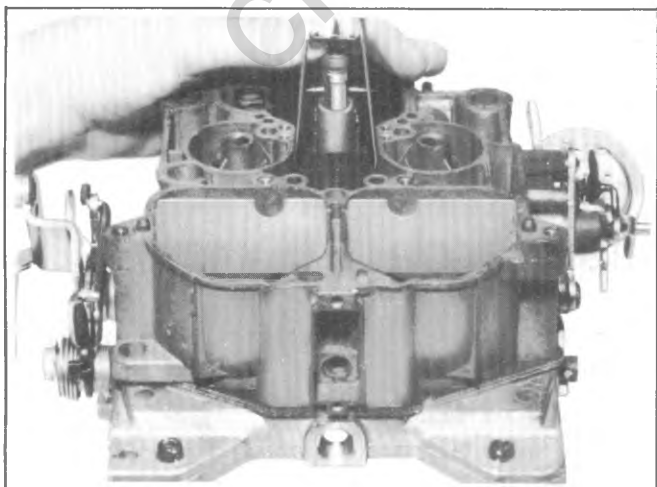


Fig. 6C2-56--Removing Pump Lever

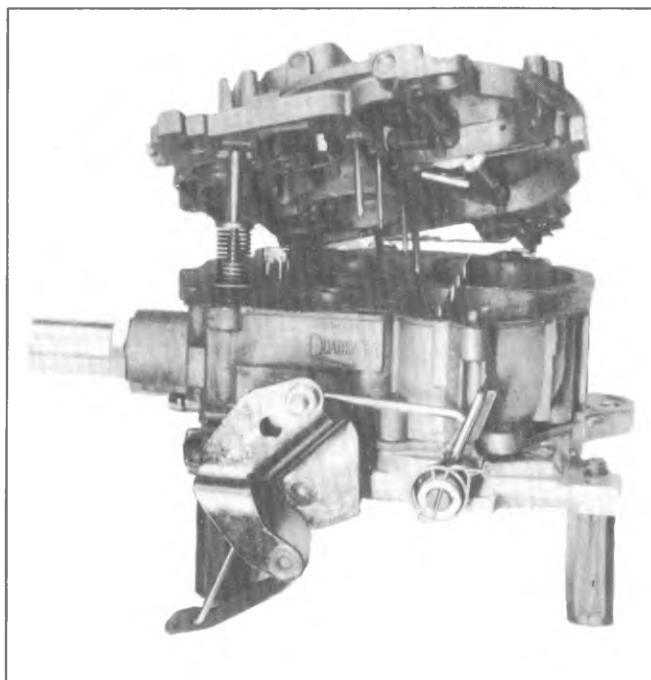


Fig. 6C2-58--Removing Air Horn

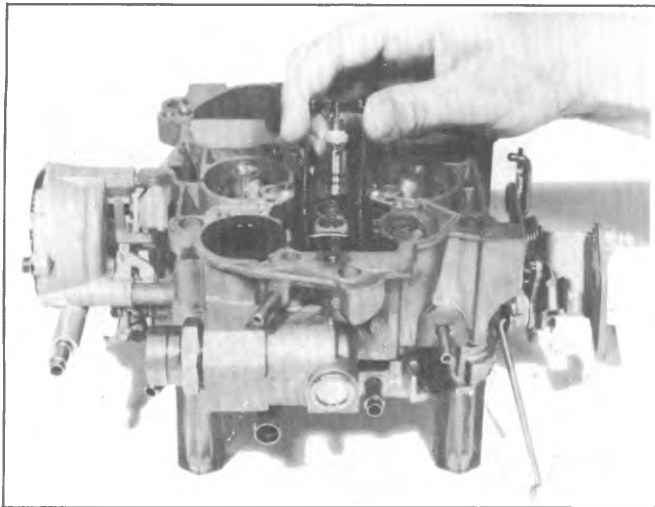


Fig. 6C2-59--Removing Power Piston and Metering Rods

8. Remove vacuum break rod from vacuum break diaphragm plunger.

CAUTION: Care must be taken not to bend the small tubes protruding from air horn. These are permanently pressed into the casting. Do not remove.

Air Horn Disassembly

NOTE: Further disassembly of the air horn is not required for cleaning purposes and is not recommended. If part replacement is required, proceed as follows:

1. Remove staking on two choke valve attaching screws and then remove choke valve and shaft.
2. Remove pump lever roll pin.

CAUTION: Air valves and air valve shaft are calibrated and should not be removed. However, should it be necessary to replace the plastic air valve cam on the air valve shaft, a repair kit is available, which includes the plastic cam, closing spring, pin, screw and instructions.

Float Bowl

1. Remove accelerator pump plunger from pump well.
2. Remove air horn gasket by lifting out of dowel locating pins and lifting tab of gasket from beneath the power piston hanger, being careful not to distort springs holding the main metering rods.
3. Remove pump return spring from pump well.
4. Remove plastic filler block over float valve.
5. Remove power piston and metering rods by depressing piston stem and allowing it to snap free (Fig. 6C2-59).

The power piston can be easily removed by pressing the piston down and releasing it with a snap. This will cause the power piston spring to snap the piston up against the retainer. This procedure may have to be repeated several times.

CAUTION: Do not remove power piston by using pliers on metering rod hanger.

6. Remove metering rods from power piston by disconnecting tension spring from top of each rod, then rotate rod to remove from hanger (Fig. 6C2-60).

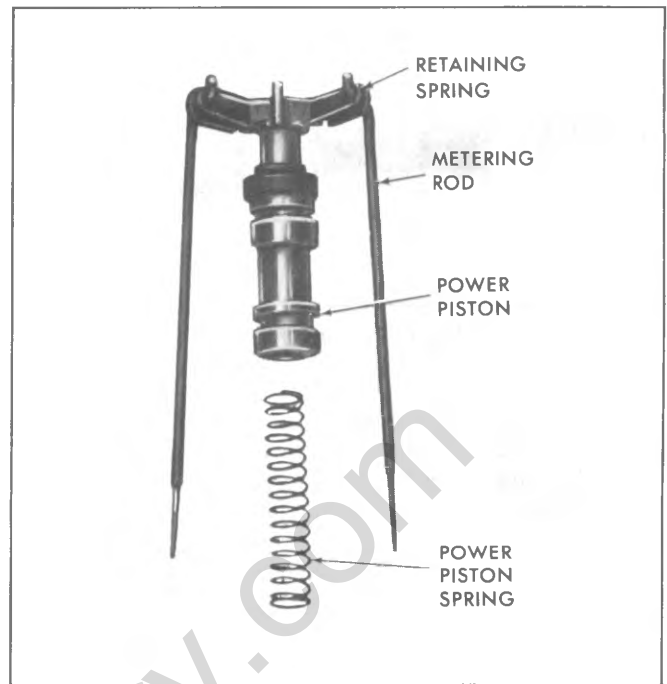


Fig. 6C2-60--Power Piston and Metering Rods

CAUTION: Use care when disassembling rods to prevent distortion of tension spring and/or metering rods. Note carefully position of tension spring for later reassembly.

7. Remove float assembly and inlet needle by pulling up on retaining hinge pin. Do not remove inlet needle seat unless it is damaged, in which case it and fuel needle must be replaced as an assembly. If needle seat is to be removed, use fuel inlet needle seat remover, J-22769.

8. Do not remove primary metering jets, Figure 6C2-61 unless damaged or worn. No attempt should be made to

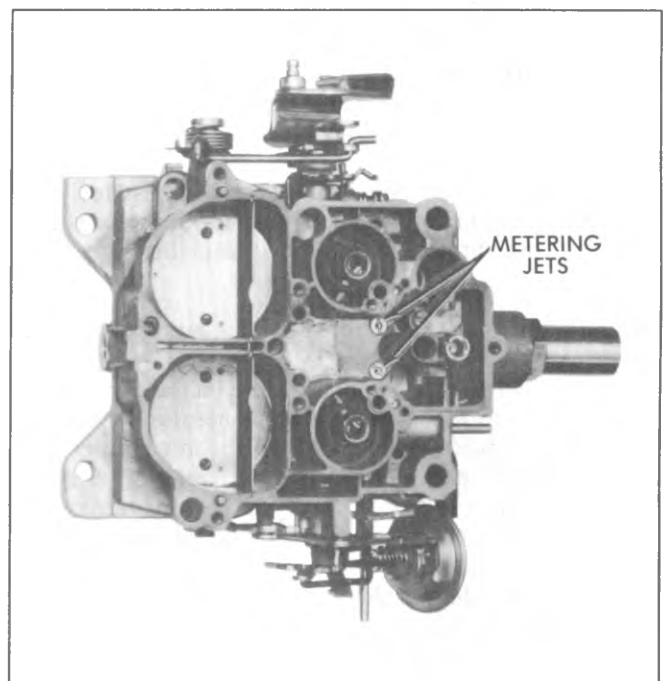


Fig. 6C2-61--Metering Jets

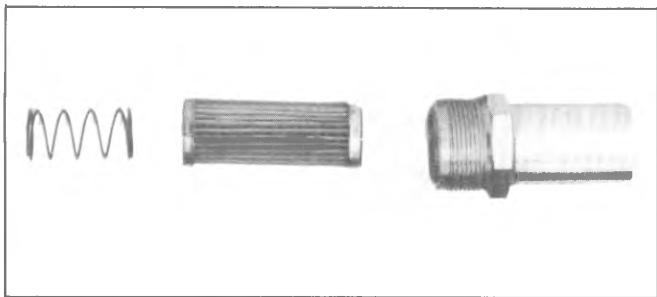


Fig. 6C2-62--Fuel Filter

remove secondary metering plates. If jets are removed but not replaced, they should be installed in the same hole from which they were removed.

9. Remove pump discharge check ball retainer screw and check ball.

10. Remove vacuum hose from vacuum break assembly and from tube connection on bowl if not previously removed.

11. Remove retaining screw from vacuum break assembly and remove assembly from float bowl.

NOTE: If further disassembly of vacuum break mechanism is necessary, spread the retaining ears on bracket next to vacuum break assembly, then remove vacuum break assembly from bracket.

12. Remove secondary throttle valve lock-out lever from float bowl.

13. Remove choke rod actuating lever from inside of float bowl well.

Float Bowl Disassembly

1. Remove fuel inlet nut, gasket, filter and spring (Fig. 6C2-62).

2. Remove secondary air baffle, if replacement is required.

3. Remove primary main metering jets, if necessary.

NOTE: No attempt should be made to remove the A.P.T. metering screws, or secondary metering orifice plates. These items are fixed and, if damaged, float bowl replacement is required.

4. Turn bowl over and remove throttle body assembly by removing two throttle body to bowl attaching screws (Fig. 6C2-63).

NOTE: Be careful when inverting bowl assembly as smallest venturi protrudes beyond the gasket surface.

5. Remove throttle body to bowl insulator gasket.

Throttle Body Disassembly

1. Remove pump rod from throttle lever by rotating rod out of lever.

2. **DO NOT REMOVE** idle mixture limiter caps unless it is necessary to replace the mixture needles or normal soaking and air pressure fails to clean the idle passages. If the idle mixture needles are removed, refer to Service Manual for adjustment procedure. If necessary to remove the idle mixture needle, destroy plastic limiter cap. Do not install a replacement cap as a bare mixture screw is sufficient to indicate that the mixture has been readjusted.

CAUTION: *Extreme care must be taken to avoid damaging throttle valves.*

No further disassembly of the throttle body is required.

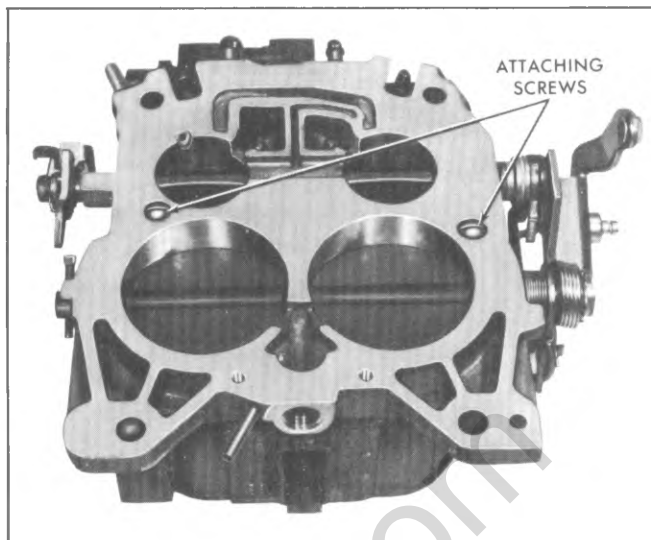


Fig. 6C2-63--Removing Throttle Body

CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

CAUTION: *The electric choke, rubber parts, plastic parts, diaphragms, pump plungers, should not be put in immersion type cleaner as they will swell, harden or distort.*

The plastic cam on the air valve shaft (where used) and bushing in bowl will withstand normal cleaning. Rinse thoroughly after cleaning.

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.

2. Check, repair or replace the following parts if the following problems were encountered.

a. Flooding

1. Inspect float needle seat for dirt, deep wear grooves, scores and proper seating.

2. Inspect float, float arms and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

b. Hesitation

1. Inspect pump plunger for cracks, scores or cup, excessive wear. A used pump cup will shrink when dry. Soak in fuel for 8 hours before testing if dried out.

2. Inspect pump duration and return spring for being weak or distorted.

3. Check all pump passages and jets for dirt, improper seating inlet or discharge balls, scores in pump well.

4. Check pump linkage for excessive wear, repair or replace as necessary.

c. Hard Starting - Poor cold operation

1. Check choke valve and linkage for excessive wear, binds or distortion.

2. Inspect choke vacuum diaphragms for leaks.

3. Clean or replace carburetor filters.

4. Inspect needle for sticking, dirt, etc.

5. Examine fast idle cam for wear or damage.

6. Also check items under "flooding".

d. Poor Performance - Poor Gas Mileage

1. Power piston, power valve, metering rods for dirt, sticking, binding, damaged parts or excessive wear.

2. (If used) Check air valve for binds and damage. If air valve is damaged, the air horn assembly must be replaced. A torsion spring kit is available for repairs to air valve closing spring. A new plastic secondary metering rod cam is included in kit.

3. Clean all fuel and vacuum passages in castings.

e. Rough Idle

1. Inspect idle needle for ridges, burrs or being bent.

2. Inspect gasket mating surfaces on castings for damage to sealing beads, nicks and burrs.

3. Clean all idle fuel passages.

4. Check throttle levers and valves for binds, nicks and other damage.

ASSEMBLY

Throttle Body

1. If removed, install idle mixture needles and springs until seated. Back out the mixture needles 4 turns as a preliminary idle adjustment. Final adjustment must be made on the engine using the procedures described under idle adjustment.

2. Install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point outwards toward throttle lever.

Float Bowl

1. Install new throttle body to bowl gasket over two locating dowels on bowl.

2. Install throttle body making certain throttle body is properly located over dowels on float bowl, then install throttle body to bowl screws and tighten evenly and securely (Fig. 6C2-63).

3. Place carburetor on proper holding fixture J-8328.

4. Install fuel inlet filter spring, filter, new gasket and inlet nut and tighten nut securely (18 ft. lbs.).

CAUTION: *Tightening beyond specified torque can damage nylon gasket.*

5. If vacuum break diaphragm was removed from bracket, slide vacuum break diaphragm between retaining ears and bend ears down slightly to hold securely.

6. Install secondary lock-out lever.

7. Install fast idle cam on vacuum break assembly. Be sure arm of vacuum break lever is located beneath the tail of the fast idle cam.

8. Install vacuum hose to connection on bowl and vacuum break assembly.

NOTE: Do not attach vacuum hose to inlet on vacuum break diaphragm until after vacuum break adjustment is complete. (Refer to Service Manual for adjustment procedure).

9. Connect choke rod (plain end) to choke rod actuating lever, then holding choke rod with grooved end pointing inward - position choke rod actuating lever in well of float bowl and install choke assembly, engaging shaft with hole in actuating lever. Install retaining screw and tighten securely. Remove choke rod from lever for installation later.

10. If removed, install air baffle in secondary side of float bowl with notches toward the top. Top edge of baffle must be flush with bowl casting.

11. Install pump discharge check ball and retainer screw in passage next to pump well. Tighten retainer securely.

12. Install main metering jets. If removed, the jets

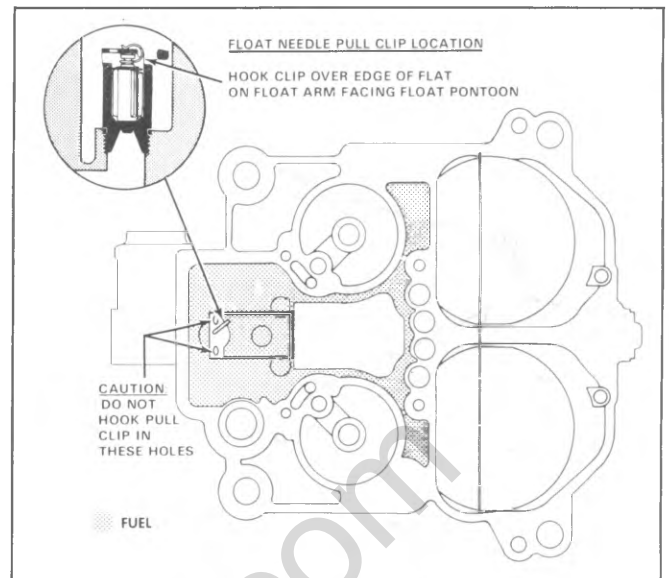


Fig. 6C2-64--Pull Clip Location

should be installed in the same hole from which they were removed.

13. If fuel inlet needle seat was removed, use new needle seat gasket and position new seat on Fuel Inlet Needle Seat Remover and Installer, J-22769. Carefully thread needle seat into float bowl. Tighten securely.

14. To make adjustment easier, bend float arm upward at notch in arm before assembly.

15. Install needle by sliding float lever under needle pull clip---correct installation of the needle pull clip is to hook the clip over the edge of the flat on the float arm facing the float pontoon (Fig. 6C2-64).

With float lever in pull clip, hold float assembly at toe and install retaining hinge pin from A.P.T. metering side (ends of retaining pin face the accelerating pump well).

CAUTION: *Do not install float needle pull clip into holes in float arm. Severe flooding will result.*

16. Adjust Float Level:

FLOAT LEVEL (Fig. 6C2-65)

a. Hold float retainer firmly in place.

b. Push float down lightly against needle.

c. With adjustable T-scale, gage from top of float bowl casting (air horn gasket removed) to top of float - gauging point is 3/16" back from end of float at toe (See inset - Fig. 6C2-65).

d. Bend float arm as necessary for proper adjustment by pushing on pontoon. Refer to Service Manual for specification.

e. Visually check float alignment after adjustment.

17. Install power piston spring in power piston well. If main metering rods were removed from hanger, reinstall making sure tension spring is connected to top of each rod. Install power piston assembly in well with metering rods properly positioned in metering jets. Press down firmly on plastic power piston retainer to make sure the retainer is seated in recess in bowl and the top is flush with the top of the bowl casting. If necessary, using a drift punch and small hammer, top retainer lightly in place.

18. Install plastic filler block over fuel inlet needle, pressing downward until seated properly.

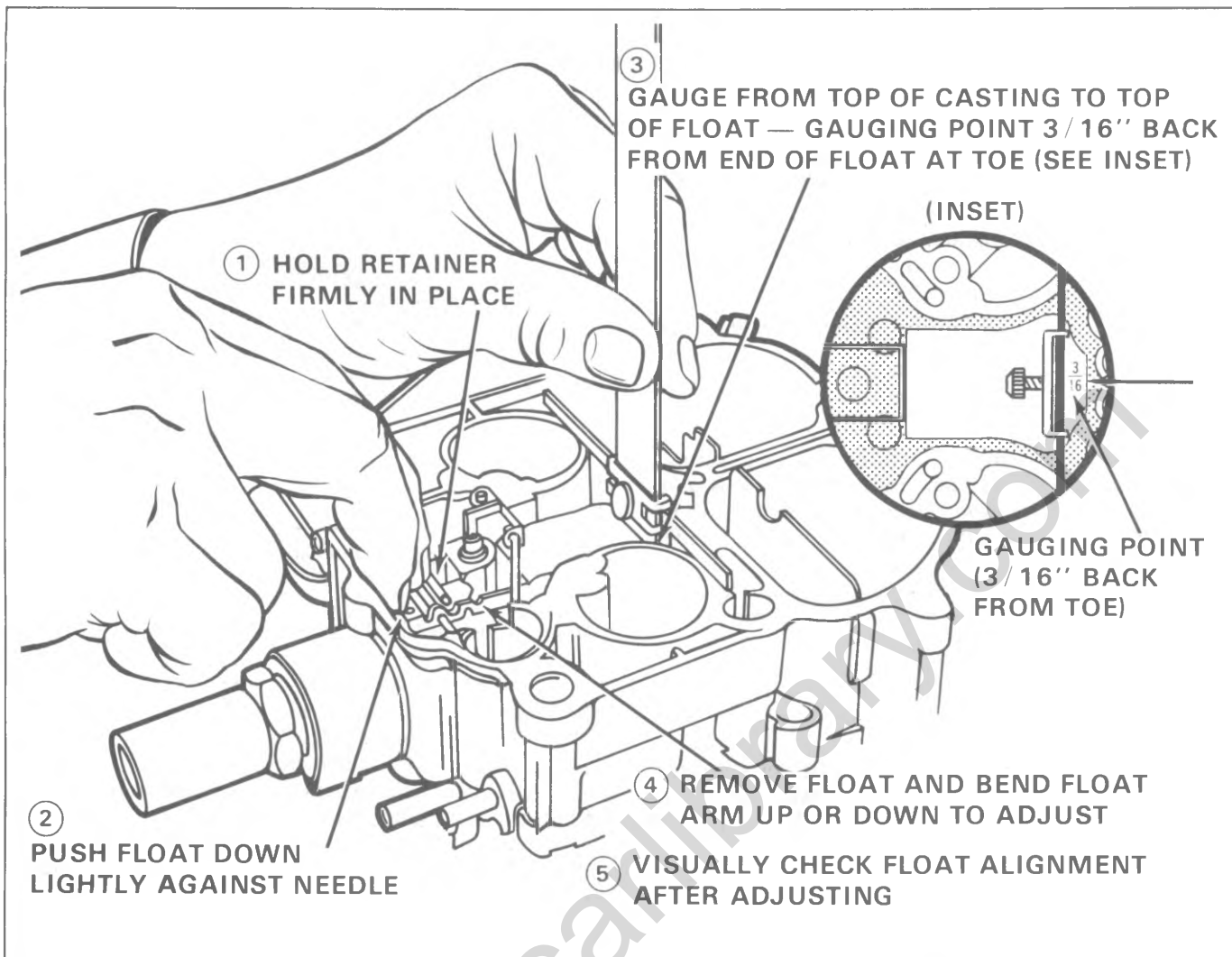


Fig. 6C2-65—Float Level Adjustment

19. Install pump return spring in pump well.

20. Install air horn gasket around primary metering rods and piston. Position gasket over two dowels on secondary side of bowl.

21. Install pump plunger in pump well to complete float bowl assembly.

Air Horn

1. Install the following, if removed: choke shaft, choke valve and two attaching screws. Check for free operation.

The choke valve screws have a special sealing compound to hold them in place. If removed, they should be lightly staked after tightening.

Air Horn to Bowl Assembly

1. Install vacuum break rod into vacuum break diaphragm plunger.

2. Insert vacuum break rod in slot of air valve shaft and twist air horn into position.

3. Lower air horn assembly to bowl carefully, positioning vent tubes and accelerating well tubes through air horn gasket.

CAUTION: Do not force the air horn assembly onto the bowl but rather lightly lower in place.

4. Install two long air horn screws, five short screws, and two countersunk screws into primary venturi area.

All air horn screws must be tightened evenly and securely. See Figure 6C2-52 for proper tightening sequence.

5. Connect choke rod in lower choke lever and retain in upper lever with horseshoe clip.

6. Connect upper end of pump rod to pump lever by placing rod in specified hole in lever. Align hole in pump lever with hole in air horn casting using J-25322. Using small screwdriver, push pump lever roll pin back through casting until end of pin is flush with casting bosses in air horn.

CAUTION: Use care installing the small roll pin to prevent damage to pump lever casting bosses.

7. Install two secondary metering rods into the secondary metering rod hanger (upper end of rods point toward each other). Install secondary metering rod holder, with rods, onto air valve cam follower. Install retaining screw end tighten securely. Work air valves up and down several times to make sure they are free in all positions.

8. If used, position and retain throttle stop vacuum assembly.

**IDLE MIXTURE WITH PROPANE ENRICHMENT
LIGHT DUTY EMISSIONS**

ENGINE	CURB IDLE	ENRICHED RPM
350 CID MANUAL TRANS. LOW ALT.	SEE: VEHICLE EMISSION CONTROL INFORMATION LABEL	700-725 RPM (N)
CALIF. MANUAL TRANS. & CALIF.		700-720 RPM (N)
350 CID AUTOMATIC TRANS. LOW ALT. & CALIF.		500-550 RPM (D)
350 CID AUTOMATIC TRANS. HIGH ALTITUDE		500-550 RPM (D)
454 CID AUTOMATIC TRANS.		550-580 RPM (D)

**IDLE MIXTURE
HEAVY DUTY EMISSIONS**

ENGINE	CURB IDLE	ENRICHED RPM
350 CID EXCEPT CALIFORNIA	SEE: ENGINE EMISSION CONTROL INFORMATION LABEL	SEE: ENGINE EMISSION CONTROL INFORMATION LABEL
350 CID CALIFORNIA		
400 CID		
454 CID EXCEPT CALIFORNIA		
454 CID CALIFORNIA		

TORQUE SPECIFICATIONS

M4MC CARBURETOR

SCREW	TORQUE (IN. LBS.)
THROTTLE BODY THROTTLE BODY TO BOWL	46
CHOKE HOUSING CHOKE LEVER	14
CHOKE HOUSING ATTACHING CHOKE HOUSING COVER	46 26
AIR HORN AIR HORN TO BOWL 10-32 AIR HORN TO BOWL 8-32 AIR HORN TO THROTTLE BODY CHOKE LEVER VACUUM BREAK UNIT FUEL INLET NUT NEEDLE SEAT METERING JET SOLENOID BRACKET	46 26 46 14 26 400 45 40 71

4MV CARBURETOR

SCREW	TORQUE (IN. LBS.)
AIR HORN TO BOWL 10-32 AIR HORN TO BOWL 8-32 AIR HORN TO THROTTLE BODY THROTTLE BODY TO BOWL VACUUM BREAK UNIT SOLENOID BRACKET FUEL INLET NUT METERING JET NEEDLE SEAT	46 26 46 46 26 71 400 40 45

Fig 6C2-66--Specifications-M4MC/4MV Carburetor

FUEL SUPPLY

FUEL FILTER

GENERAL DESCRIPTION

All engine fuel filters are located in the carburetor fuel inlet. These fuel filter elements are of pleated paper. Elements are placed in the inlet hole with the gasket surface outward. A spring holds the element outward, sealing it by compressing a gasket surface against the inlet fitting.

ON-VEHICLE SERVICE

The carburetor inlet fuel filter should be replaced every 15,000 miles or 12 months.

After assembling any filter element in the carburetor, always start the engine and check for leaks in the fuel line and fittings before installing the air cleaner.

Other Filters or Strainers

A woven plastic filter is located on the lower end of the fuel pickup pipe in the gas tank. This filter prevents dirt from entering the fuel line and also stops water unless the filter becomes completely submerged in water. This filter is self cleaning and normally required no maintenance. Fuel stoppage at this point indicates that the gas tank contains an abnormal amount of sediment or water; the tank should therefore be removed and thoroughly cleaned.

Fuel Filter Replacement

Light Duty Emissions

A plugged fuel filter and/or check valve will restrict fuel flow.

1. Disconnect fuel line connection at fuel inlet filter nut.
2. Remove fuel inlet filter nut from carburetor.

3. Remove filter and spring.

4. If removed, install check valve in fuel inlet filter.

CAUTION: *The fuel inlet check valve must be installed in the filter to meet Motor Vehicle Safety Standards (M.V.S.S.) for roll-over. New service replacement filter include the check valve.*

5. Install fuel inlet filter spring, filter, and check valve assembly in carburetor. Check valve end of filter faces toward fuel line.

NOTE: Ribs on closed end of filter element prevent filter from being installed incorrectly unless forced.

6. Install new gasket on fuel inlet filter nut and install nut in carburetor. Tighten nut to 18 pound feet.

CAUTION: *Tightening beyond specified torque can damage gasket.*

7. Install fuel line and tighten connection.

Heavy Duty Emissions

A plugged fuel filter will shut off fuel flow into carburetor.

1. Disconnect fuel line-connection at inlet fuel filter nut.
2. Remove inlet fuel filter nut from carburetor.
3. Remove filter element and spring.
4. Install element spring and filter element in carburetor.
5. Install new gasket on inlet fitting nut and install nut in carburetor and tighten securely.
6. Install fuel line and tighten connector.

FUEL PUMP

GENERAL DESCRIPTION

The fuel pump (Figs. 6C3-1 through 3) is a diaphragm type pump and is actuated by the rocker arm through a link and a push rod.

Some vehicles have a fuel pump which has a metering outlet for a vapor return system. Any vapor which forms is returned to the fuel tank along with hot fuel through a separate line. This greatly reduces any possibility of vapor lock by keeping cool fuel from the tank constantly circulating through the fuel pump.

leaks or restrictions on suction side of mechanical fuel pump will seriously affect pump output.

3. Inspect for leaks at fuel pump diaphragm flange.

4. Disconnect feed pipe near carburetor. Ground distributor terminal of coil with jumper wire so that engine can be cranked without firing. Place suitable container at end of pipe and crank engine a few revolutions. If no gasoline, or only a little flows from pipe, the feed line is clogged or fuel pump is inoperative. Before condemning the fuel pump, disconnect feed line at both ends and blow through it with air hose to make certain that fuel pump is operating within specifications.

Fuel Pump Pressure Test

1. Disconnect gasoline line near carburetor and connect a suitable pressure gage (such as Pressure-Leakdown Tester J-22109).

2. Start engine and check pressure with engine running at slow idle speed. Fuel pump pressure should be as specified at the end of this section. On vehicles equipped with a vapor return system, squeeze off the return hose so that an accurate reading can be obtained.

3. If fuel pump pressure is below minimum, pump must be replaced.

ON-VEHICLE SERVICE

Inspection and Test

If the fuel system is suspected of delivering an improper amount of fuel to the carburetor, it should be inspected and tested in the vehicle, as follows:

Inspection of Fuel System

1. Make certain that there is gasoline in the tank.
2. With the engine running, inspect for leaks at all gasoline feed hose connections from fuel tank to carburetor. Tighten any loose connections. Inspect all hoses for flattening or kinks which would restrict the flow of fuel. Air

Fuel Pump Flow Test

1. Disconnect fuel line from carburetor. Run fuel line into a suitable measuring container.
2. While observing the sweep second hand of a clock or watch, run the engine at idle until there is one pint of fuel in the container. One pint should be pumped in 30 seconds or less.
3. If flow is below minimum, check for restriction in the line.

Diagnosis

Complete diagnosis of all possible causes of the trouble prior to replacement of the fuel pump will save time, expense and possibly prevent a repeat complaint.

Low Pressure Complaint

The only way to check fuel pump pressure is by connecting an accurate pressure gage to the fuel line at carburetor level. Never replace a fuel pump without first making that simple check.

Not Enough Fuel Flow Complaint

When an engine has a "starving-out" condition, many mechanics jump to the conclusion that the fuel pump is not pumping enough fuel. Many times the "starving-out" condition is actually due to a weakness in the ignition system, since these two troubles are very hard to separate. Even when an engine is starving for fuel, the cause is more likely to be a plugged fuel filter or a restricted fuel line than a malfunctioning fuel pump.

Removal

1. Disconnect fuel inlet hose from pump. Disconnect vapor return hose, if so equipped.
2. Disconnect fuel outlet pipe.
3. Remove two 1/2 inch hex head bolts, using a 3/8 inch drive deep socket and a ratchet handle.
4. Remove fuel pump.

Installation

1. Install new fuel pump with new gasket.
2. Install two 1/2 inch hex head bolts, turning them alternately and evenly.
3. Install fuel outlet pipe. If it is difficult to start fitting, time can be saved by disconnecting upper end of pipe from

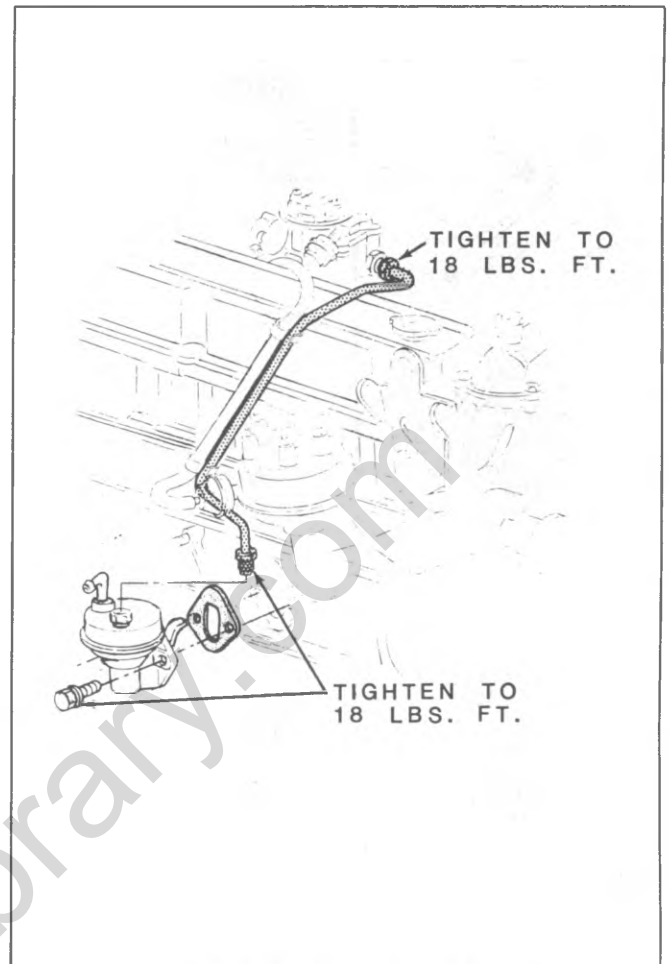


Fig. 6C3-1--Fuel Pump-L6

carburetor. Tighten fitting securely, meanwhile holding fuel pump nut with a wrench. Install and tighten fitting at carburetor, if removed.

4. Install fuel inlet hose. Install vapor return hose, if so equipped.

5. Start engine and check for leaks.

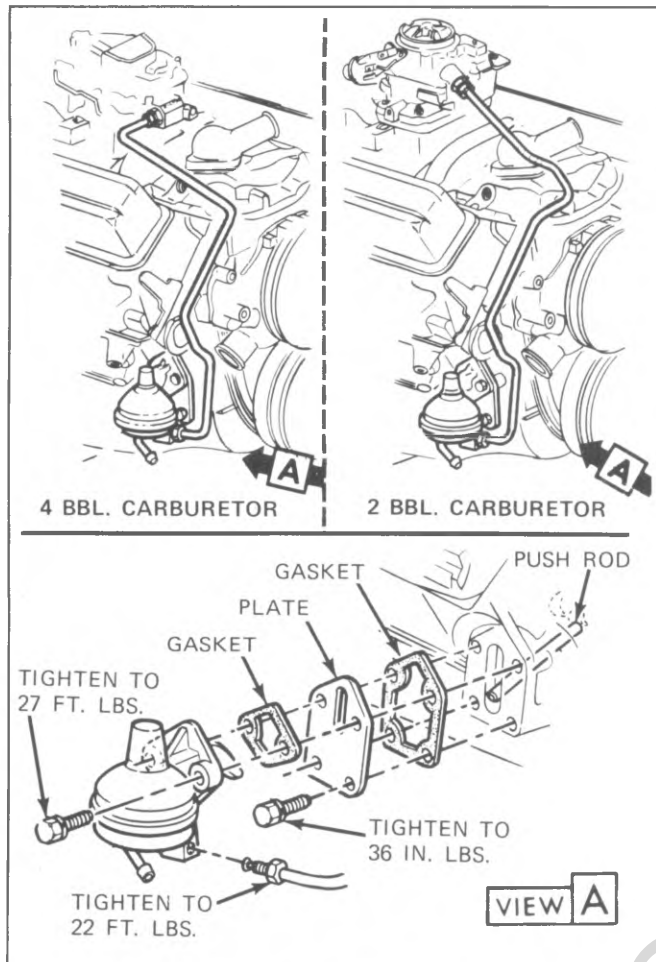


Fig. 6C3-2--Fuel Pump-305/350/400 V8

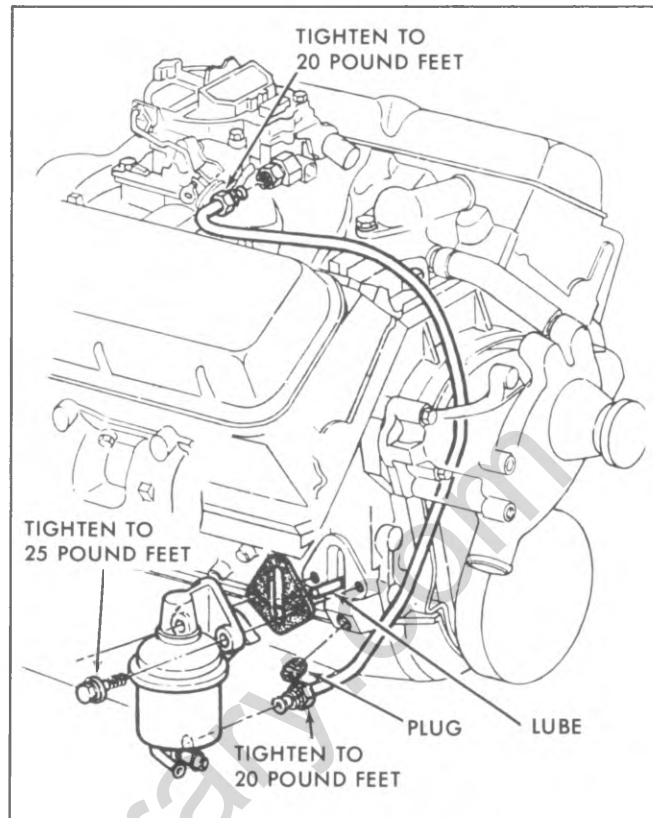


Fig. 6C3-3--Fuel Pump-454 V8

FUEL TANK

ON-VEHICLE SERVICE

Outside Frame Rail Fuel Tank-

Cab and Crewcab (Figs. 6C3-4 and 5)

1. Drain tank.
2. Disconnect fuel lines, meter wire and ground lead.
3. Remove strap supports (lines, vent) and clip.
4. Loosen clamps from filler neck and vent line.
5. Remove strap bolts and lock washers from tank front and rear locations on inside frame rail.
6. Remove tank from frame simultaneously disengaging filler neck hose from filler neck (Fig. 6C3-6).
7. Remove meter assembly from fuel tank using Tool J-24187 (Fig. 6C3-7).
8. Reverse removal procedure to install fuel tank.

Center and Auxiliary Fuel Tank -

CK 10 and 20 (06, 16) (Figs. 6C3-8, 9, 10) Fuel Tank-Van (Fig. 6C3-11)

1. Drain tank.
2. Raise vehicle on hoist.
3. Unclamp upper filler neck and vent tube hose.
4. Unclamp gage unit hoses at frame end.
5. Support tank and remove support straps.

6. Lower tank and disconnect meter wire.

7. Remove tank.

8. Install in the reverse order, using new antisqueak material.

9. Lower vehicle and remove from hoist.

Frame Mounted Fuel Tank - P Model (Figs. 6C3-12, 13, 14)

1. Drain tank.

2. Remove filler neck.

3. Disconnect meter unit fuel line and wiring.

4. Remove bolts attaching tank supports to frame.

5. Remove tank complete with mounting bracket and support straps.

6. Remove tank from brackets and support straps, if necessary.

7. Install in reverse order and replace antisqueak material.

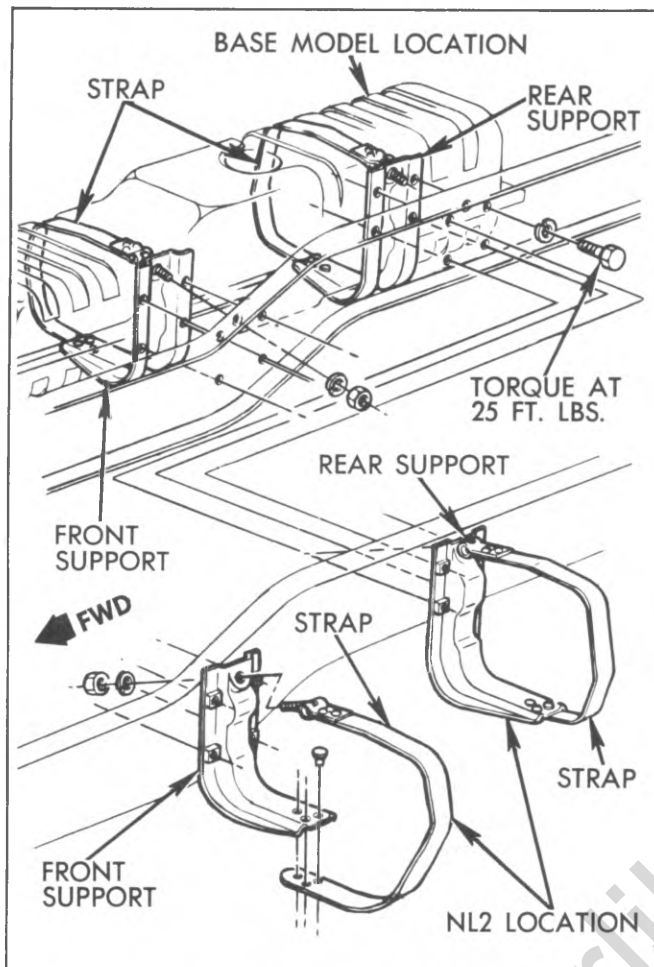


Fig. 6C3-4--Fuel Tank Mounting-Cab and Crewcab

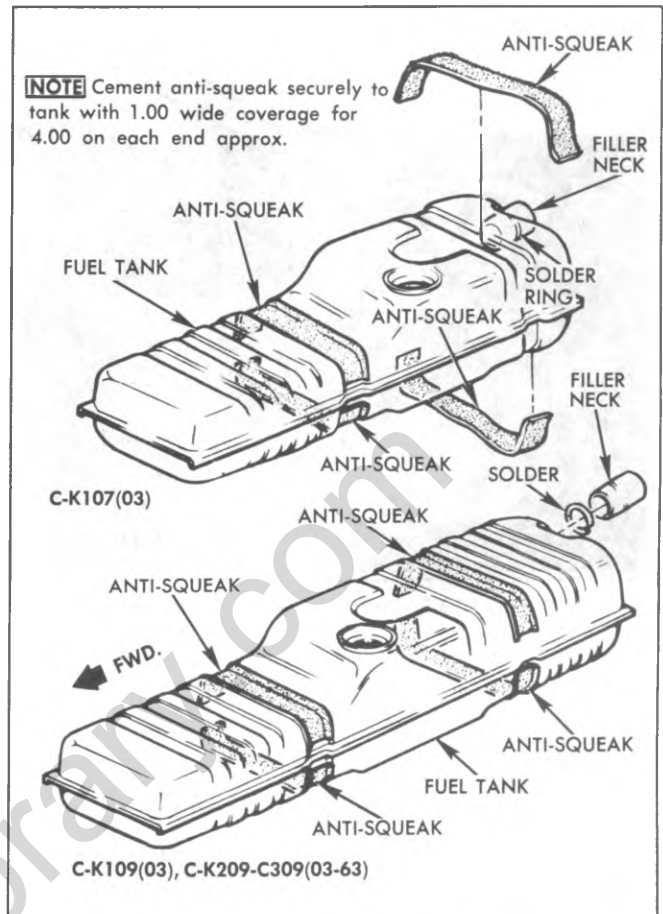


Fig. 6C3-5--Fuel Tank-Cab and Crewcab

7. Purge fuel tank with steam or running hot water for at least five minutes. Pour water out of tank unit hole (rock tank to assure complete removal of water).

CLEANING FUEL SYSTEM

Cleaning

If trouble is due to contaminated fuel or foreign material that has been put into the tank, it can usually be cleaned. If tank is rusted internally, it should be replaced.

1. Disconnect battery negative cable and distributor feed wire.
2. Drain fuel tank.
3. Remove fuel tank.
4. Remove fuel inlet filter at carburetor and inspect for contamination. If filter is plugged replace (leave fuel line disconnected).
5. Locate tank away from heat, flame, or other source of ignition. Remove fuel gage tank unit and inspect condition of filter. If filter is contaminated a new filter should be installed upon reassembly.
6. Complete draining of tank by rocking it and allowing fuel to run out of tank unit hole.

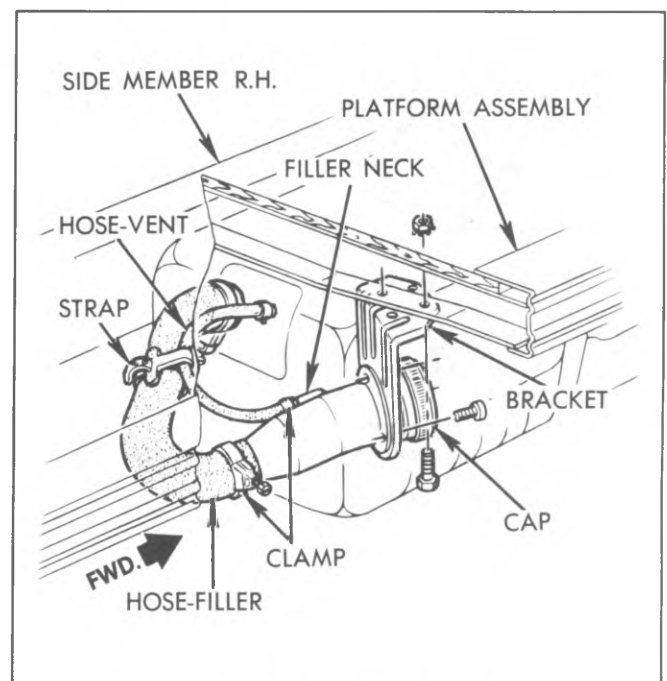


Fig. 6C3-6--Filler Neck-Cab Stake Body

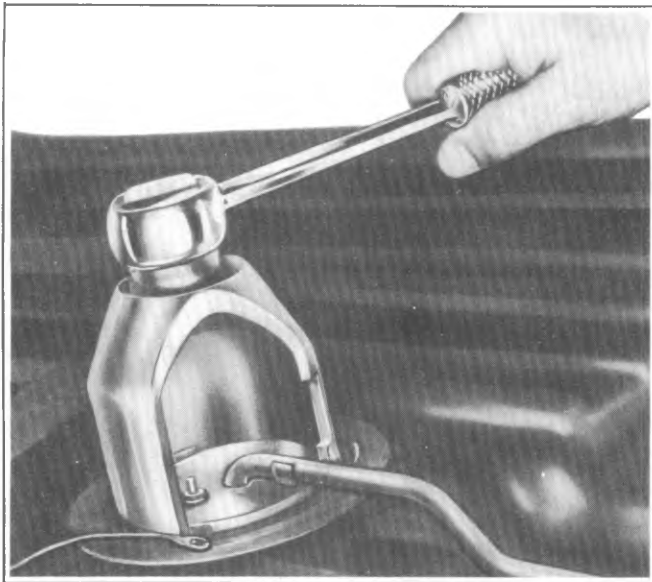


Fig. 6C3-7--Removing Meter Assembly

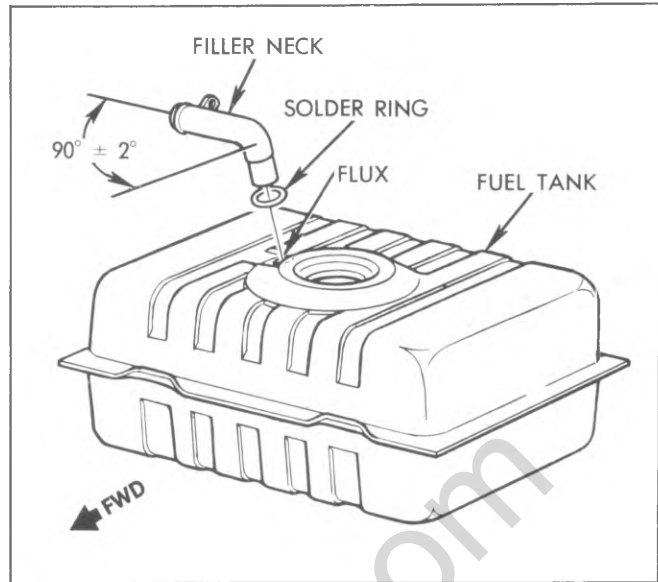


Fig. 6C3-9--Fuel Tank, CK 10-20 (06, 16)

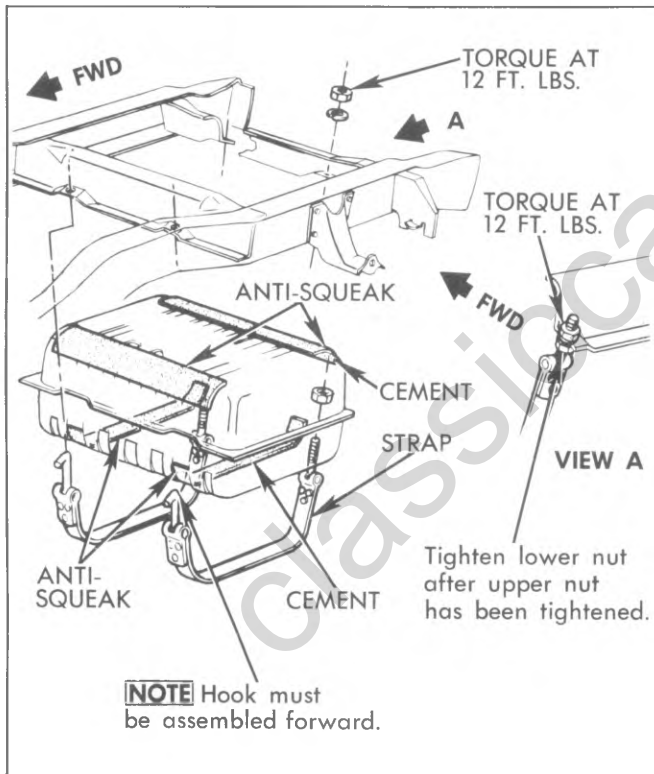


Fig. 6C3-8--Fuel Tank, CK 10-20 (06, 16)

WARNING: This procedure will not remove fuel vapor. Do not attempt any repair on tank or filler neck where heat or flame is required.

8. Disconnect inlet fuel line at pump and use air pressure to clean fuel line and fuel return line (if equipped). Apply air pressure in the direction fuel normally flows through line.

9. Use low air pressure to clean pipes on tank unit.

10. Clean filter on fuel tank unit, if required. Install fuel tank gage unit, (with new gasket) into tank and install tank. Connect tank unit wires and all fuel lines, except pump to carburetor line (see "Removal of Tank" for proper procedure).

11. Connect a hose to fuel line at carburetor; insert other end of hose into a one gallon fuel can.

12. Connect battery cable. Make sure distributor feed wire is disconnected.

13. Put six gallons of clean fuel in tank and operate starter to pump two quarts of fuel into fuel can. This will purge fuel pump.

14. Remove hose and connect fuel line to carburetor.

15. Connect distributor feed wire.

16. Check all connections for leaks.

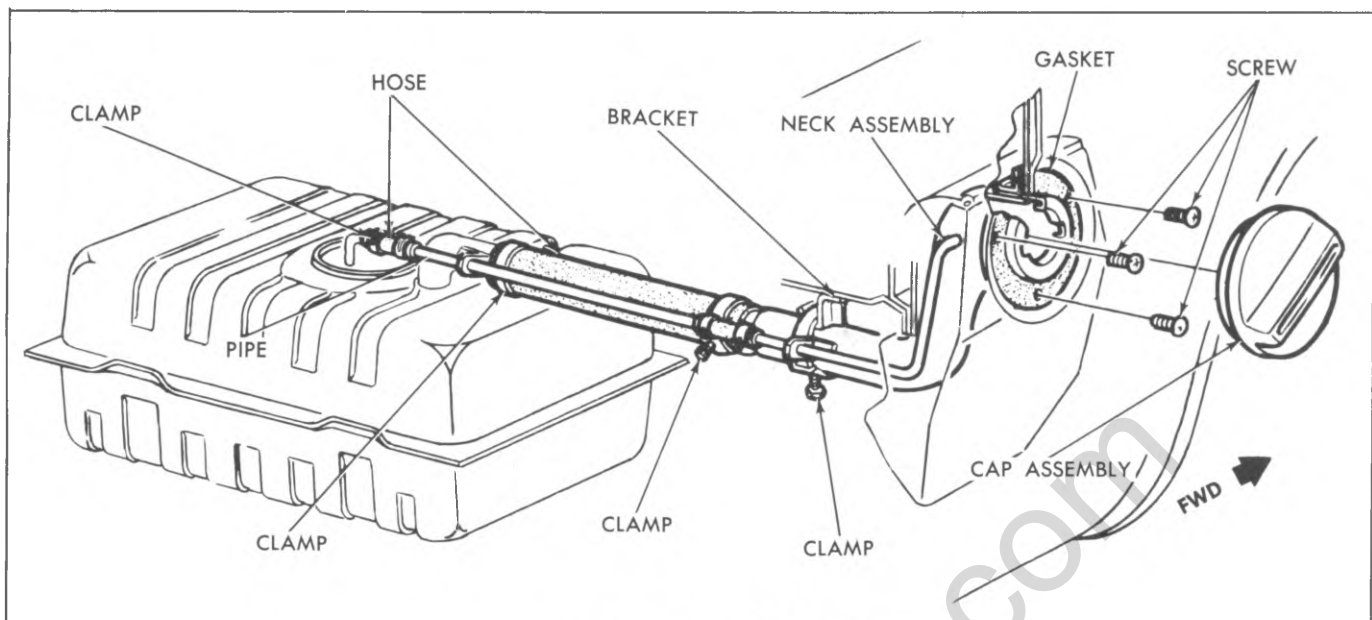


Fig. 6C3-10--Filler Neck, CK10-20 (06, 16)

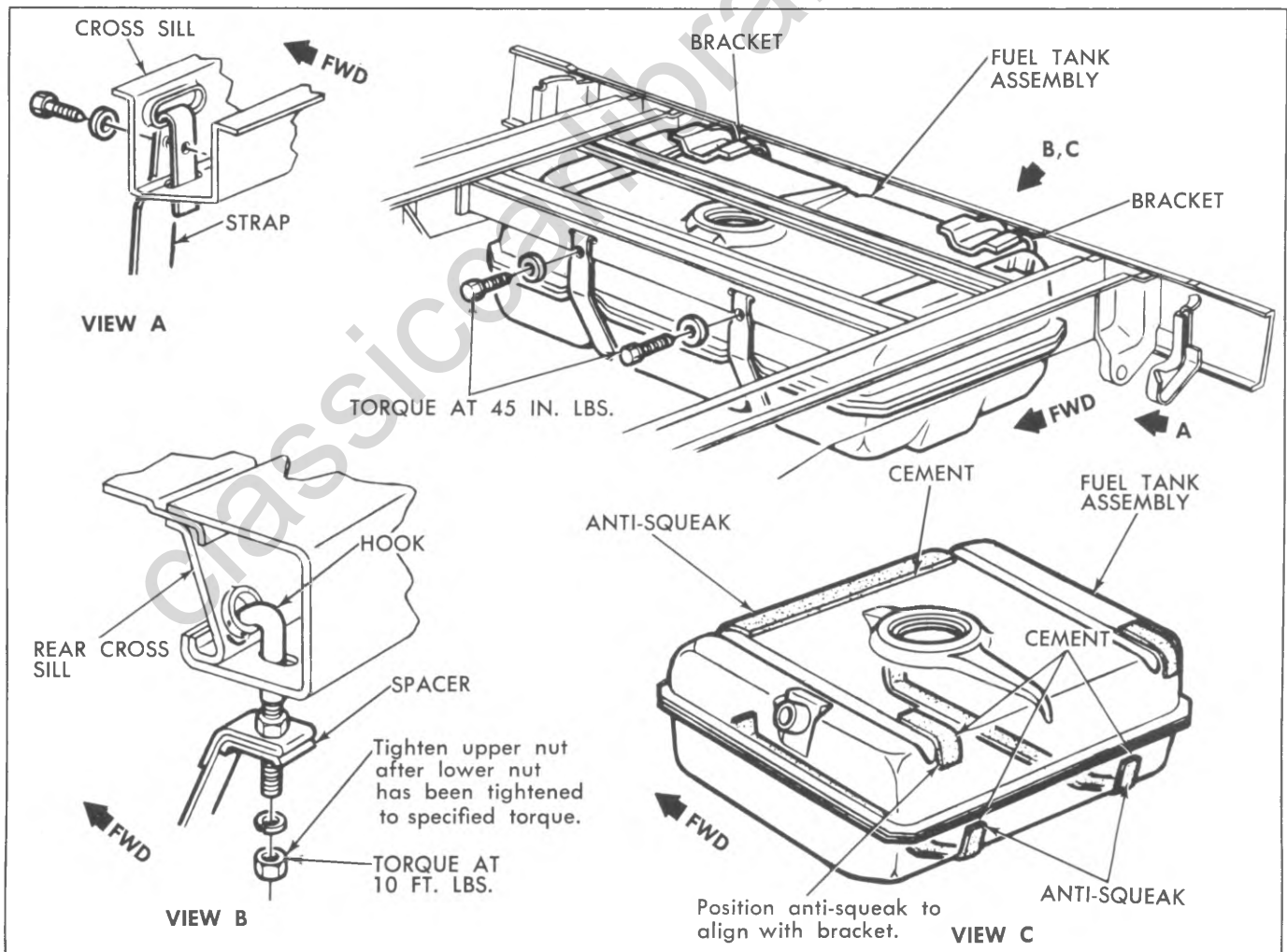


Fig. 6C3-11--Fuel Tank and Mounting - Van

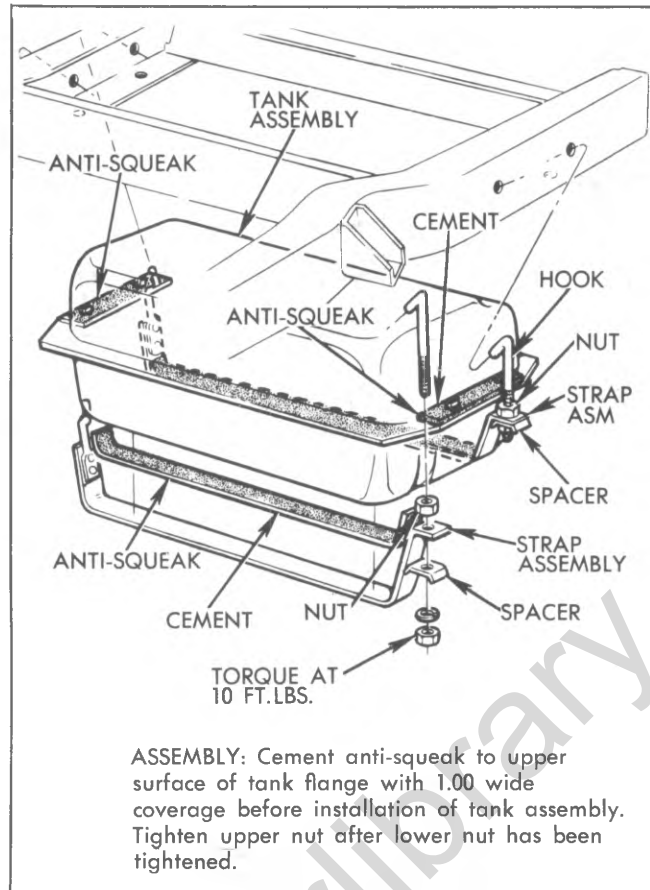


Fig. 6C3-12--Fuel Tank and Mounting - P10

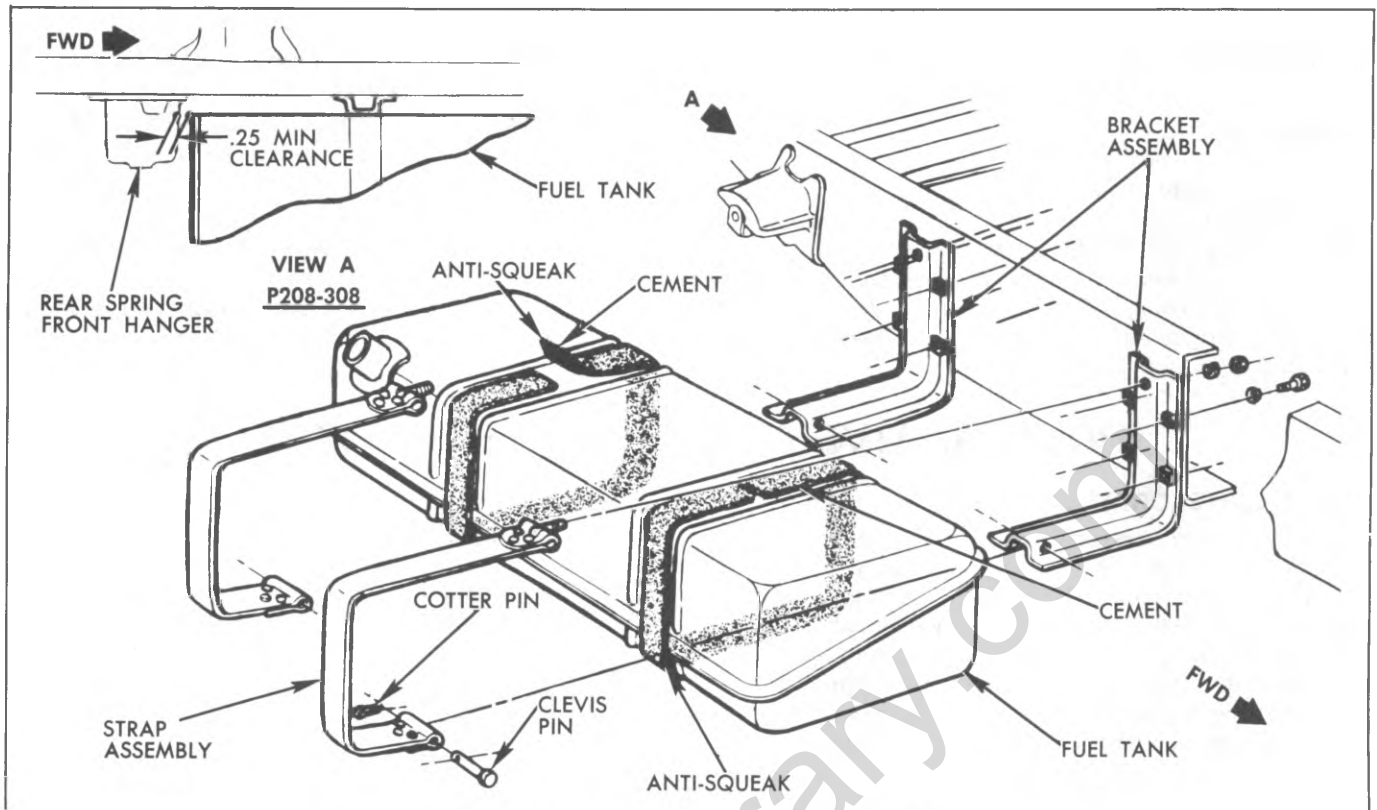


Fig. 6C3-13--Fuel Tank and Mounting - P20, 30

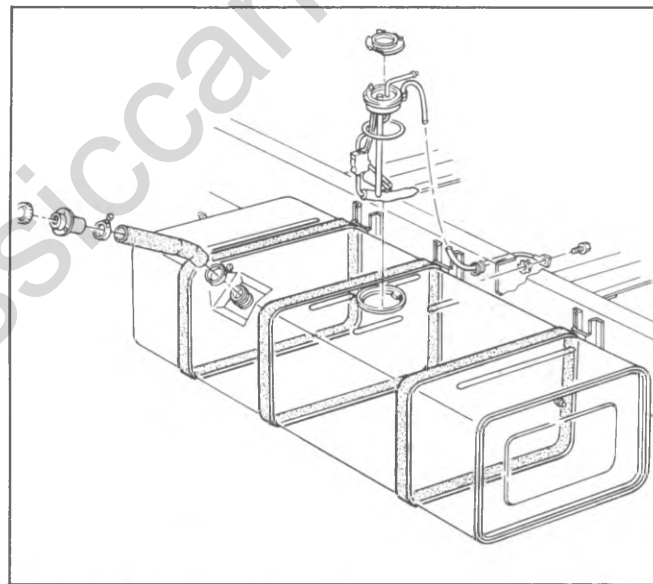


Fig. 6C3-14--Fuel Tank (50 Gal.) Meter and Filler Neck - P30

FUEL FEED AND VAPOR PIPES

GENERAL DESCRIPTION

Fuel feed pipes are secured to the underbody with clamp and screw assemblies. Flexible hoses are located at fuel tank fuel, vapor and return lines and fuel pump. The pipes should be inspected occasionally for leaks, kinks or dents. If evidence of dirt or foreign material is found in

carburetor, fuel pump or pipes, pipe should be disconnected and blown out. Dirt or foreign material may be caused by a damaged or omitted fuel strainer in fuel tank.

ON-VEHICLE SERVICE**Replacement**

If replacement of fuel feed pipe, vapor pipe or return pipe is required, use only double wrap and brazed steel tubing meeting GM Specification 123M or its equivalent. Under no condition use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory fatigue durability to withstand normal vehicle vibrations.

EVAPORATIVE CONTROL SYSTEM (ECS)**GENERAL DESCRIPTION**

All light duty emissions and some heavy duty emission vehicles are equipped with a system designed to prevent escape of fuel vapor to the atmosphere. Vapor generated by evaporation of fuel in the tank, previously exhausted to atmosphere, is transferred by an emission line to the engine compartment. During periods of operation, vapors are fed directly to the engine for consumption. During periods of inoperation, an activated charcoal canister located in the emission line stores any vapor generated for consumption during the next period of operation.

The amount of vapor drawn into the engine at any time is too small to have any effect on fuel economy or engine operation.

With this closed system it is extremely important that only vapors be transferred to the engine. To avoid the possibility of liquid fuel being drawn into the system, these following features are included as part of the total system:

1. A fuel tank overfill protector is provided on all series to assure adequate room for expansion of liquid fuel volume with temperature changes.
2. A one point fuel tank venting system is provided on all series to assure that the tank will be vented under any conceivable vehicle attitude.
3. To protect the tank from mechanical damage in the event of excessive internal or external pressures resulting from the operation of this closed system, a pressure-vacuum relief valve, located in the gas cap, will control the tank internal pressure.

ON-VEHICLE SERVICE

Maintenance requirement is that the oiled fiberglass filter assembled in the bottom of the canister, be replaced every 24 months or 30,000 miles (light duty emissions), 24,000 miles (heavy duty emissions). Under extremely dusty conditions, more frequent attention may be required.

Check operation of bowl vent and purge valve.

Canister and Filter**Removal**

1. Note installed position of hoses on canister.
2. Disconnect hoses from top of canister.
3. Loosen clamps and remove canister.
4. If replacing filter, pull out filter from bottom of canister with your fingers.

Repair

1. Do not use fuel hose for pipe repair within 4 inches of any part of the exhaust system.

2. In repairable areas, cut fuel hose 4 inches longer than the portion of pipe removed. Use only hose stated for fuel usage by the manufacturer.

If more than a 6-inch length of pipe is removed, use a combination of steel pipe and hose so that hose lengths will not be longer than 10 inches.

3. The fuel hose should extend 2 inches on each pipe and be clamped at each end. Pipes must be properly secured to the frame to prevent chafing.

Inspection

1. Check hose connection openings. Assure that they are open.

2. Check operation of purge valve by applying vacuum to the valve. A good valve will hold vacuum.

Installation

1. Install new filter.
2. Install canister and tighten clamp.
3. Connect hoses in same order.

Canister Purge Valve**Disassembly**

1. Disconnect lines at valve.
2. Snap off valve cap (slowly remove cap as diaphragm is under spring tension). Remove diaphragm, spring retainer and spring.
3. Replace parts as necessary. Check orifice openings.

Assembly

1. Install spring, spring retainer, diaphragm and cap.
2. Connect lines to valve.

Checking Purge Valve

1. Remove purge valve control vacuum line. Check for a vacuum signal with engine operating above idle (1500 RPM). If no vacuum signal, perform EGR System Function Check.

2. Apply an external vacuum source to the purge valve control diaphragm. A good valve will hold vacuum.

3. If the valve will not hold vacuum, replace canister.

4. If valve holds vacuum, remove purge line and check for vacuum. If no vacuum, check PCV hoses and system. Repair or replace as necessary.

Checking Bowl Vent Valve

1. Remove the bowl vent vapor hose from the carburetor.

2. Check the open condition of the valve by connecting to a manual vacuum pump. It should not be possible to obtain .5 inch Hg if the valve is open.

3. If a high resistance or plugged system is found, check for a plugged or restricted hose. Hose may be cleared with compressed air. If the hose is clear, remove the canister filler. If the restriction persists, replace the canister.

4. A simple check of the valve closed condition can be obtained with the same procedure as in Step 2, but with the engine operating at operating temperature. Manifold vacuum will be applied to the valve through the control line.

The bowl vent line should exhibit a plugged condition.

5. If the valve is not closed, remove the control vacuum line and check for vacuum. If no vacuum is present, check hose for restriction or vacuum leak. Repair or replace as required. If vacuum is present, replace canister.

Pressure Checking Evaporative Control System

1. Stabilize vehicle by operating until warmed up.
2. Remove tank line at canister and observe for liquid in the line. Hook-up pressure device.
3. Apply 15" H₂O pressure to the fuel vapor line.

A. Observe for excessive loss of pressure.

B. If negligible pressure loss occurs observe for fuel vapor smell or fuel loss at points listed in Diagnostics under Possible Cause.

C. Remove fuel filler cap(s) and observe for pressure in tank(s).

4. Remove fuel cap (LH on dual tank units) and blow on vent line to check for obstructions. (Install LH cap on dual tank units and remove RH cap. Repeat above.)

ACCELERATOR CONTROL

GENERAL

The accelerator control system is cable type. There are no linkage adjustments. A reference between the bottom of accelerator pedal and floor pan should be used only as a check for bent bracket assembly. Check torque references.

Check for correct opening and closing positions by operating accelerator pedal and if any binding is present, check routing of cable.

ACCELERATOR CONTROL CABLE

Refer to figures 6C3-15 through 18 for removal and installation of accelerator control cable.

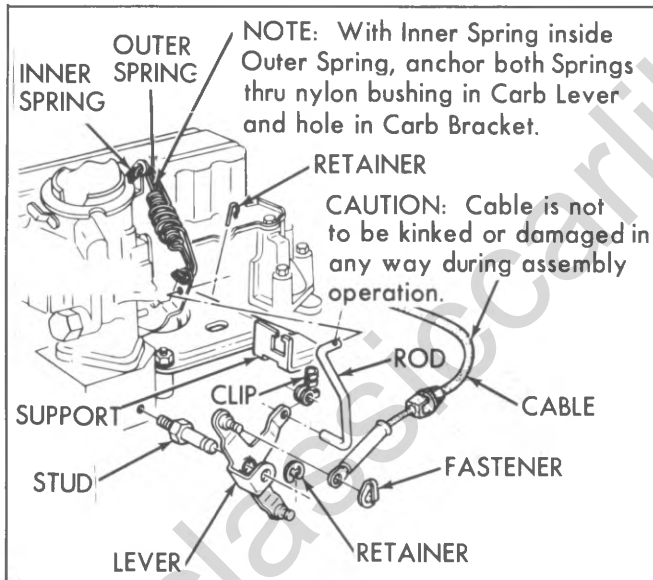


Fig. 6C3-15--Accelerator Controls L6-Light Duty Emissions

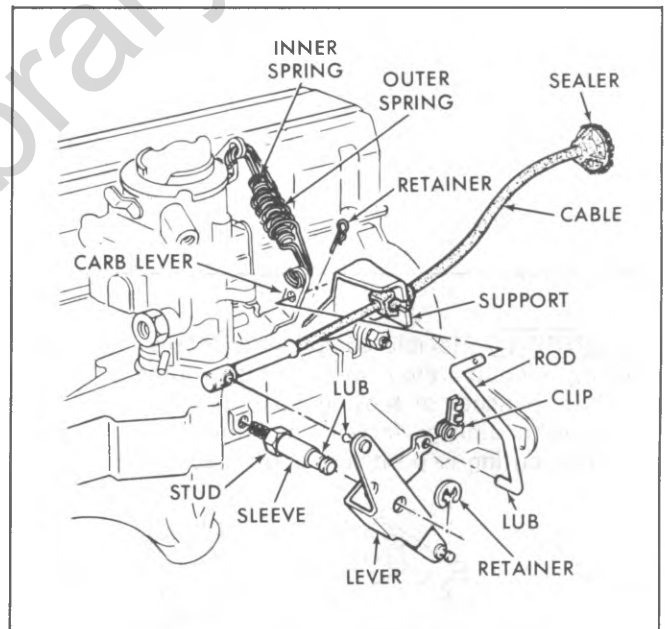


Fig. 6C3-16--Accelerator Controls L6-Heavy Duty Emissions.

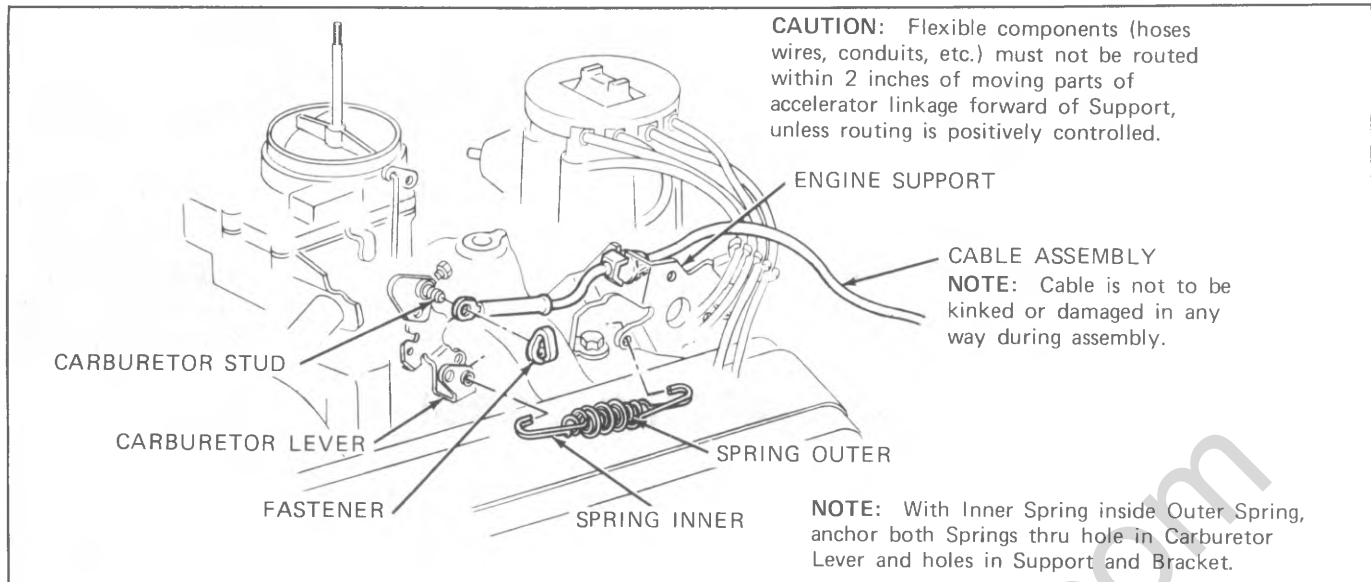


Fig. 6C3-17--Accelerator Controls V8-2Bbl.

ACCELERATOR PEDAL

Refer to figures 6C3-19 through 22 for removal and installation of accelerator pedal.

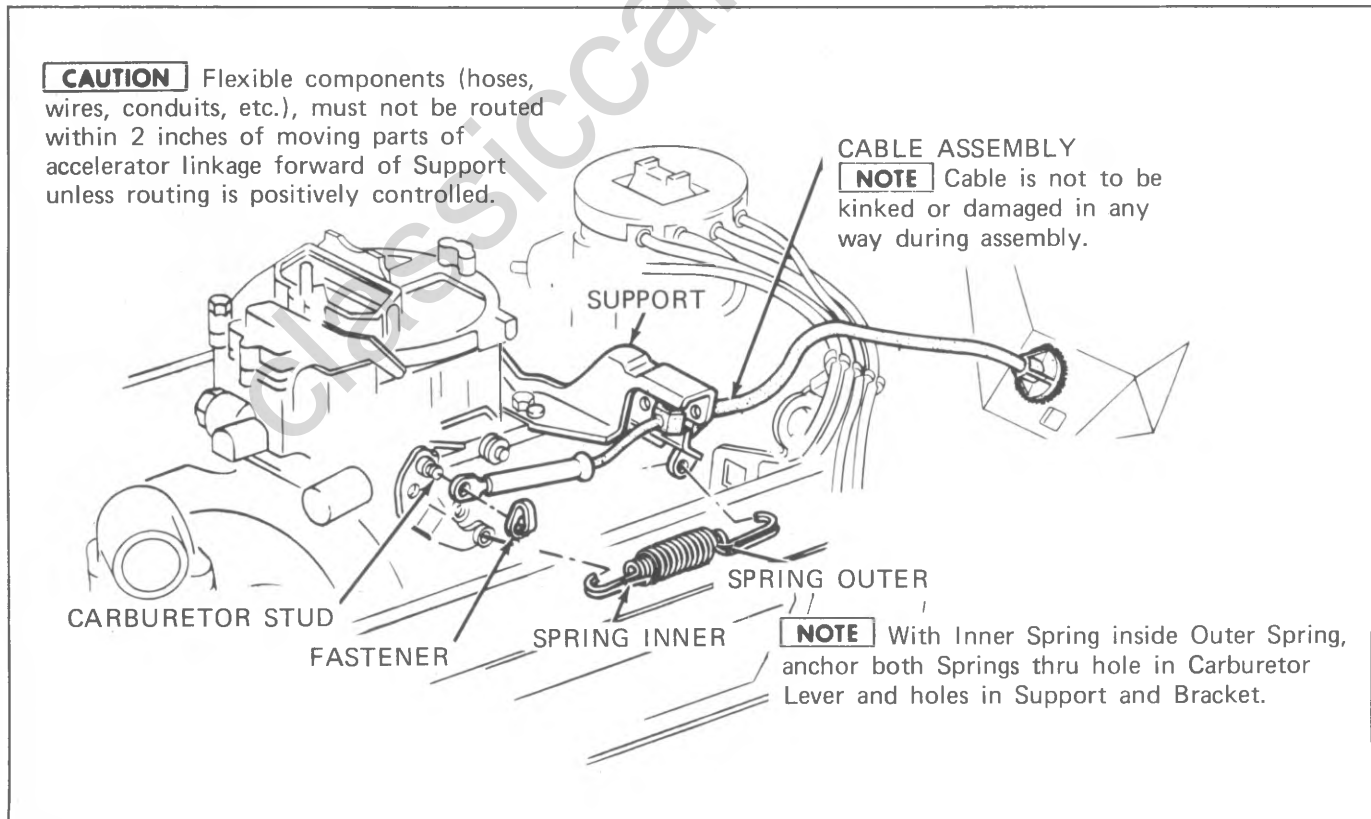


Fig. 6C3-18--Accelerator Controls V8-4Bbl.

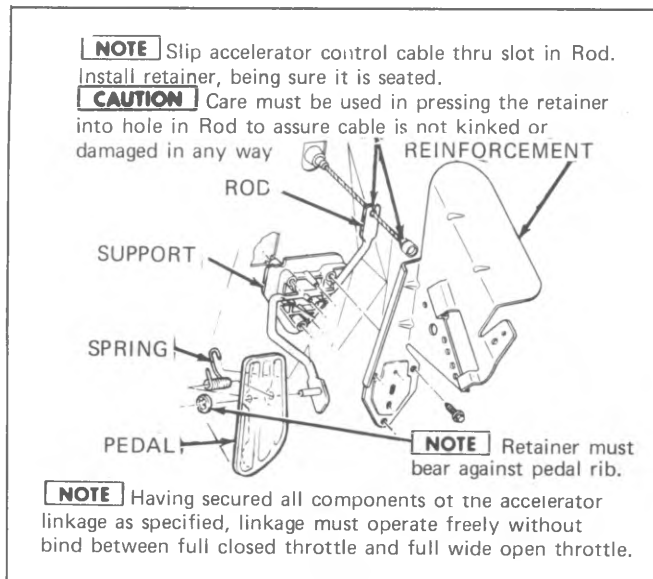


Fig. 6C3-19--Accelerator Pedal-CK

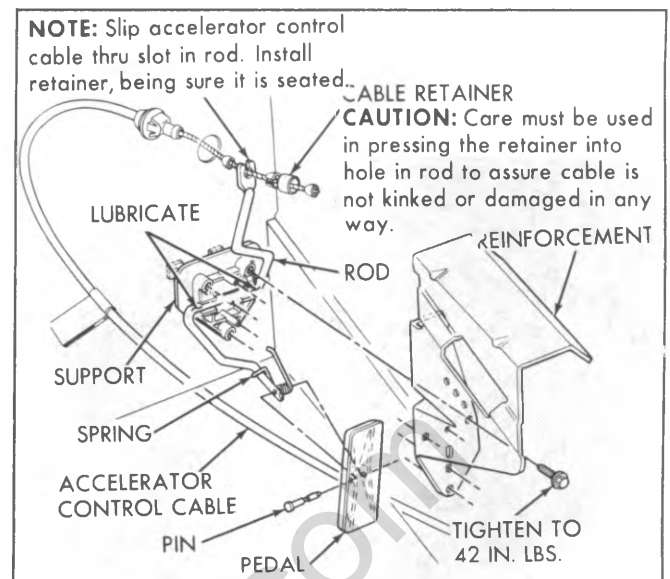


Fig. 6C3-21--Accelerator Pedal-P42

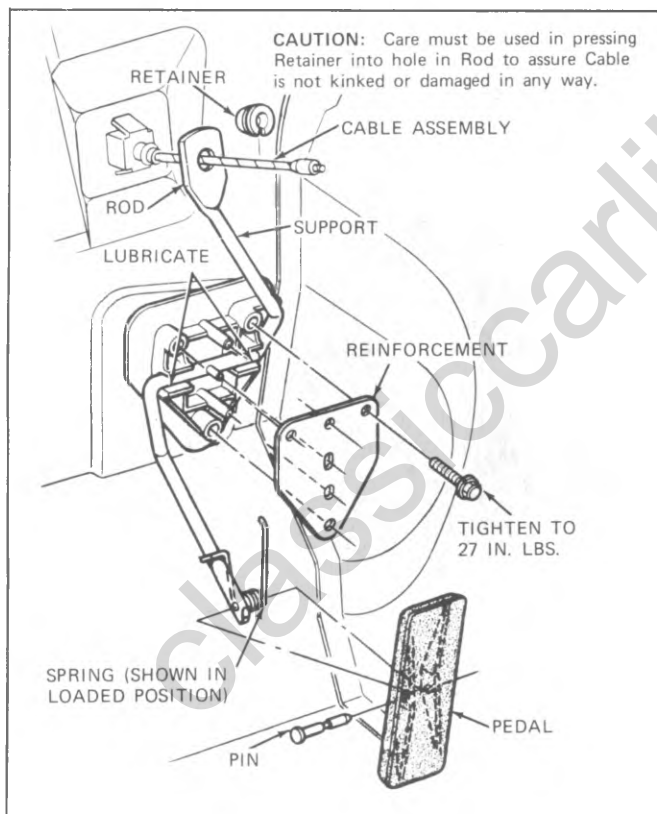


Fig. 6C3-20--Accelerator Pedal-G

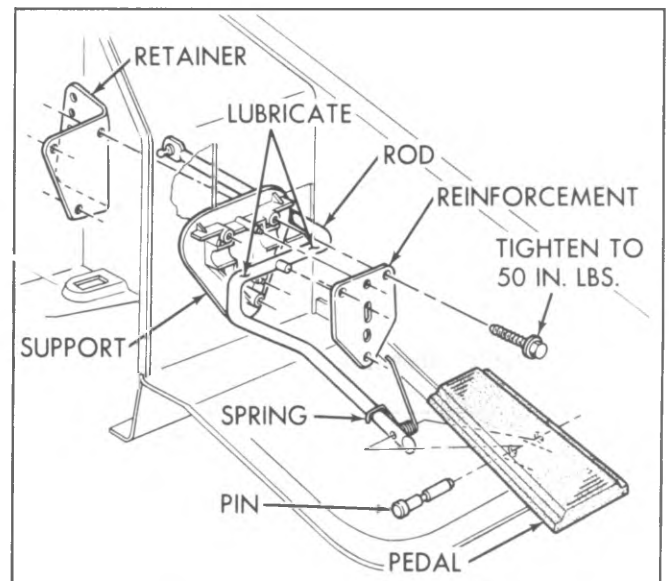
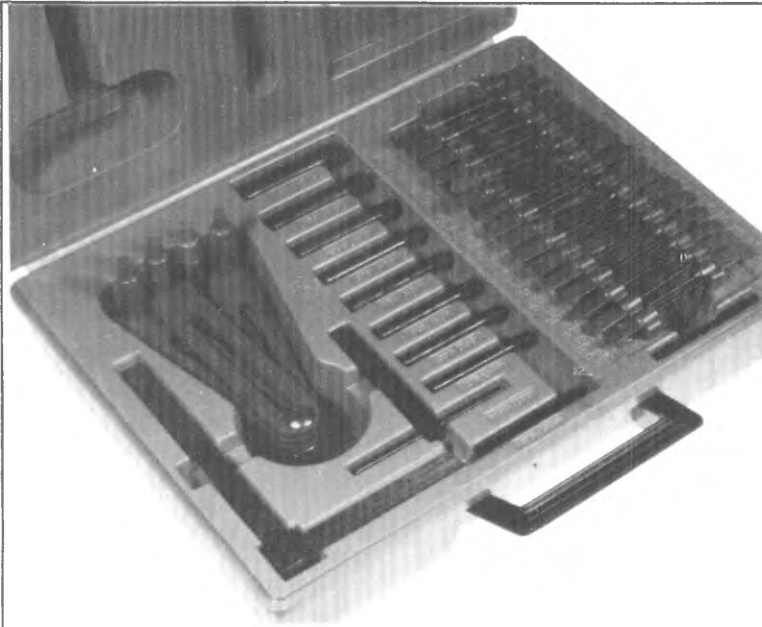


Fig. 6C3-22--Accelerator Pedal-P32

SPECIAL TOOLS



J9789-02 UNIVERSAL CARBURETOR GAUGE SET



J9789-118 CARBURETOR HOLDING STAND



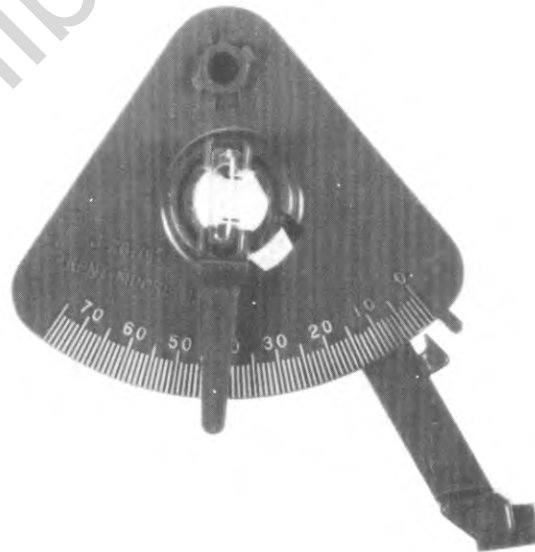
J9789-111 BENDING TOOL



J25322 PUMP LEVER PIN DRIVE PUNCH



J23417 CHOKE LEVER INSTALLING TOOL



J26701 CHOKE VALVE ANGLE GAUGE



J-9789-130 FLOAT GAGE

J-26911 PROPANE ENRICHMENT DEVICE

Fig. 6C3-23--Special Tools

CARBURETOR DIAGNOSIS

The following diagnostic procedures are for carburetor related problems and their effects on car performance. Other systems of the car can also cause similar problems and should be checked when listed on the chart. The problem areas described are:

1. Engine cranks normally. Will not start.
2. Engine starts and stalls.
3. Engine starts hard.
4. Engine idles abnormally and/or stalls.
5. Inconsistent engine idle speeds.
6. Engine diesels (after-run) upon shut off.
7. Engine hesitates on acceleration.
8. Engine has less than normal power at low speeds.
9. Engine has less than normal power on heavy acceleration or at high speed.
10. Engine surges.
11. Poor gas mileage.

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Engine Cranks Normally — Will Not Start.</p>	<p>Improper starting procedure used.</p> <p>Choke valve not operating properly.</p> <p>No fuel in carburetor.</p> <p>Engine flooded. To check for flooding, remove the air cleaner with the engine immediately shut off and look into the carburetor bores. Fuel will be dripping off nozzles.</p>	<p>Check with the customer to determine if proper starting procedure is used, as outlined in the Owner's Manual.</p> <p>Adjust the choke thermostatic coil to specification. Check the choke valve and/or linkage as necessary. Replace parts if defective. If caused by foreign material and gum, clean with suitable non-oil base solvent.</p> <p>NOTE: After any choke system work, check choke vacuum break settings and correct as necessary.</p> <p>Remove fuel line at carburetor. Connect hose to fuel line and run into metal container. Remove the wire from the "bat" terminal of the distributor. Crank over engine — if there is no fuel discharge from the fuel line, test fuel pump as outlined in Section 6. If fuel supply is okay, check the following:</p> <ol style="list-style-type: none"> a. Inspect fuel inlet filter. If plugged, replace. b. If fuel filter is okay, remove air horn and check for a bind in the float mechanism or a sticking inlet needle. If okay, adjust float as specified. <p>Remove the air horn.</p> <p>Check fuel inlet needle and seat for proper seal. If a needle and seat tester is not available, apply vacuum to the needle seat with needle installed. If the needle is leaking, replace.</p> <p>Check float for free movement, bent float hanger or binds in the float arm.</p> <p>If foreign material is in fuel system, clean the system and replace fuel filters as necessary. If excessive foreign material is found, completely disassemble and clean.</p>

CARBURETOR DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Engine Starts — Will Not Keep Running</p>	<p>Fuel pump.</p> <p>Idle speed.</p> <p>Choke heater system malfunctioning (may cause loading).</p> <p>Loose, broken or incorrect vacuum hose routing.</p> <p>Engine does not have enough fast idle speed when cold.</p> <p>Choke vacuum break units are not adjusted to specification or are defective.</p> <p>Choke valve sticking and/or binding.</p> <p>Insufficient fuel in carburetor.</p>	<p>Check fuel pump pressure and volume, replace if necessary. See FUEL SYSTEM DIAGNOSIS, Section 6.</p> <p>Adjust idle to specifications.</p> <p>Check vacuum supply at hot air inlet to choke housing. Should be not less than manifold vacuum minus 3" Hg. with engine running at idle. (Exc. IMV)</p> <p>Check for plugged, restricted, or broken heat tubes.</p> <p>Check routing of all hot air parts.</p> <p>Check condition and routing of all vacuum hoses — correct as necessary.</p> <p>Check for free movement of fast idle cam. Clean and/or realign as necessary.</p> <p>Adjust both vacuum break assemblies to specification. If adjusted okay, check the vacuum break units for proper operation as follows:</p> <p>To check the vacuum break units, apply a constant vacuum source of at least 10" Hg., plungers should slowly move inward and hold vacuum. If not, replace the unit.</p> <p>Always check the fast idle cam adjustment when adjusting vacuum break units.</p> <p>Clean and align linkage or replace if necessary. Readjust all choke settings, see Section 6M, if part replacement or realignment is necessary.</p> <p>Check fuel pump pressure and volume.</p> <p>Check for partially plugged fuel inlet filter. Replace if contaminated.</p> <p>Check the float level adjustment for binding condition. Adjust as specified.</p>
<p>Engine Starts Hard (Cranks Normally)</p>	<p>Loose, broken or incorrect vacuum hose routing.</p> <p>Incorrect starting procedure.</p>	<p>Check condition and routing of all vacuum hoses — correct as necessary. See Section 6E.</p> <p>Check to be sure customer is using the starting procedure outlined in Owner's Manual.</p>

CARBURETOR DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Engine Starts Hard (Cranks Normally) (Continued)</p>	<p>Malfunction in accelerator pump system.</p> <p>Choke valve not closing.</p> <p>Vacuum breaks misadjusted or malfunctioning.</p> <p>Insufficient fuel in bowl.</p> <p>Flooding.</p> <p>Where used, check to see if vent valve is inoperative or misadjusted.</p> <p>Slow engine cranking speed.</p>	<p>Check accelerator pump adjustment and operation.</p> <p>Check pump discharge ball for sticking or leakage.</p> <p>Adjust choke thermostatic coil. Check choke valve and linkage for binds and alignment. Clean and repair or replace as necessary.</p> <p>Check for adjustment and function of vacuum breaks. Correct as necessary.</p> <p>Check fuel pump pressure and volume. Check for partially plugged fuel inlet filter. Replace if dirty. Check float mechanism. Adjust as specified.</p> <p>Check float and needle and seat for proper operation.</p> <p>Check for operation and adjustment of vent valve (if used).</p> <p>Refer to starting circuit diagnosis. Section 6D.</p>
<p>Engine Idles Abnormally (Too fast or too slow)</p>	<p>Incorrect idle speed.</p> <p>Air leaks into carburetor bores beneath throttle valves, manifold leaks, or vacuum hoses disconnected or installed improperly.</p> <p>Clogged or malfunctioning PCV system.</p> <p>Carburetor flooding.</p> <p>Check by using procedure outlined under "Engine Flooded".</p>	<p>Reset idle speed per instructions on underhood label.</p> <p>Check all vacuum hoses and restrictors leading into the manifold or carburetor base for leaks or being disconnected. Install or replace as necessary.</p> <p>Torque carburetor to manifold bolts to 10 ft. lbs. Using a pressure oil can, spray light oil or kerosene around manifold to head surfaces and carburetor throttle body. NOTE: Do not spray at throttle shaft ends. If engine RPM changes, tighten or replace the carburetor or manifold gaskets as necessary.</p> <p>Check PCV system. Clean and/or replace as necessary.</p> <p>Remove air horn and check float adjustments.</p> <p>Check float needle and seat for proper seal. If a needle and seat tester is not available, apply vacuum to the needle seat with needle installed. If the needle is leaking or damaged, replace.</p>

CARBURETOR DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Engine Idles Abnormally (Too fast or too slow) (Continued)</p>	<p>Restricted air cleaner element.</p> <p>Idle system plugged or restricted.</p> <p>Incorrect idle mixture adjustment.</p> <p>Defective idle stop solenoid, idle speed-up solenoid or wiring.</p> <p>Throttle blades or linkage sticking and/or binding.</p>	<p>Check float for free movement. Check for bent float hanger or binds in the float arm.</p> <p>If foreign material is found in the carburetor, clean the fuel system and carburetor. Replace fuel filters as necessary.</p> <p>Replace as necessary.</p> <p>Clean carburetor, see Section 6C1.</p> <p>Readjust per specified procedure. See Section 6C1.</p> <p>Check solenoid and wiring.</p> <p>Check throttle linkage and throttle blades (primary and secondary) for smooth and free operation. Correct problem areas.</p>
<p>Engine Diesels (After Run) upon Shut Off</p>	<p>Loose, broken or improperly routed vacuum hoses.</p> <p>Incorrect idle speed.</p> <p>Malfunction of idle stop solenoid, idle speed-up solenoid or dashpot.</p> <p>Fast idle cam not fully off.</p> <p>Excessively lean condition caused by maladjusted carburetor idle mixture.</p> <p>Ignition timing retarded.</p>	<p>Check condition and routing of all vacuum hoses. Correct as necessary.</p> <p>Reset idle speed per instructions on label in engine compartment.</p> <p>Check for correct operation of idle solenoid. Check for sticky or binding solenoid.</p> <p>Check fast idle cam for freedom of operation. Clean, repair, or adjust as required. Check choke heated air tubes for routing, fittings being tight or tubes plugged. Check choke linkage for binding. Clean and correct as necessary.</p> <p>Adjust carburetor idle mixture as described in Section 6C1.</p> <p>Set to specifications.</p>
<p>Engine Hesitates On Acceleration</p>	<p>Loose, broken or incorrect vacuum hose routing</p> <p>Accelerator pump not adjusted to specification or inoperative.</p> <p>Inoperative accelerator pump system.</p>	<p>Check condition and routing of all vacuum hoses — correct or replace.</p> <p>Adjust accelerator pump, replace.</p> <p>Remove air horn and check pump cup. If cracked, scored or distorted, replace the pump plunger.</p>

CARBURETOR DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Engine Hesitates On Acceleration (Continued)</p>	<p>NOTE: A quick check of the pump system can be made as follows: With the engine off, look into the carburetor bores and observe pump nozzles while quickly opening throttle lever. A full stream of fuel should emit from each pump nozzle.</p> <p>Foreign matter in pump passages.</p> <p>Float level too low.</p> <p>Front vacuum break diaphragm not functioning properly.</p> <p>Air valve malfunction.</p> <p>Power enrichment system not operating correctly.</p> <p>Inoperative air cleaner heated air control.</p> <p>Fuel filter dirty or plugged.</p> <p>Distributor vacuum or mechanical advance malfunctioning.</p> <p>Timing not to specifications.</p> <p>Choke coil misadjusted (cold operation.)</p> <p>EGR valve stuck open.</p>	<p>Check the pump discharge ball for proper seating and location.</p> <p>Clean and blow out with compressed air.</p> <p>Check and reset float level to specification.</p> <p>Check adjustment and operation of vacuum break diaphragm.</p> <p>Check operation of secondary air valve. Check spring tension adjustment.</p> <p>Check for binding or stuck power piston(s) — correct as necessary.</p> <p>Check operation of thermostatic air cleaner system.</p> <p>Replace filter and clean fuel system as necessary.</p> <p>Check for proper operation.</p> <p>Adjust to specifications.</p> <p>Adjust to specifications.</p> <p>Inspect and clean EGR valve.</p>
<p>Engine Has Less Than Normal Power At Normal Accelerations.</p>	<p>Loose, broken or incorrect vacuum hose routing.</p> <p>Clogged or defective PCV system.</p> <p>Choke sticking.</p> <p>Clogged or inoperative power system.</p>	<p>Check condition and routing of all vacuum hoses.</p> <p>Clean or replace as necessary.</p> <p>Check complete choke system for sticking or binding. Clean and realign as necessary. Check adjustment of choke thermostatic coil.</p> <p>Check connections and operation of choke hot air system.</p> <p>Check jets and channels for plugging; clean and blow out passages.</p> <p>Remove air horn and check for free operation of power pistons.</p>

CARBURETOR DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Less Than Normal Power On Heavy Acceleration Or At High Speed (Continued)</p> <p>Engine Surges</p>	Transmission malfunction.	Refer to transmission diagnosis.
	Ignition system malfunction.	Check ignition system. See Section 6D.
	Fuel metering jets restricted.	If the fuel metering jets are restricted and an excessive amount of foreign material is found in the fuel bowl, the carburetor should be completely disassembled and cleaned.
	Fuel pump.	Check fuel pump pressure and volume, inspect lines for leaks and restrictions. See FUEL SYSTEM DIAGNOSIS, Section 6.
	Exhaust system.	Check for restrictions. Correct as required.
	Loose, broken or incorrect vacuum hose routing.	Check condition and routing of all vacuum hoses. Correct as necessary.
	PCV system clogged or malfunctioning.	Check PCV system. Clean or replace as necessary.
	Loose carburetor, EGR or intake manifold bolts and/or leaking gaskets.	Torque carburetor to manifold bolts to 10 ft. lbs. Using a pressure oil can, spray light oil or kerosene around manifold to head mounting surface and carburetor base. If engine RPM changes, tighten or replace the carburetor or manifold gaskets as necessary. Check EGR mounting bolt torque.
	Low or erratic fuel pump pressure.	Check fuel delivery and pressure.
	Contaminated fuel.	Check for contaminants in fuel. Clean system if necessary.
	Fuel filter plugged.	Check and replace as necessary.
	Float level too low.	Check and reset float level to specification.
	Malfunctioning float and/or needle and seat.	Check operation of system. Repair or replace as necessary.
	Power piston stuck or binding.	Check for free movement of power piston(s). Clean and correct as necessary.
<p>Poor Gas Mileage</p>	Fuel jets or passages plugged or restricted.	Clean and blow out with compressed air.
	Ignition system malfunction.	Check ignition system. See Section 6D.
	Exhaust system.	Check for restrictions. Correct as necessary.
	Customer driving habits.	Run mileage test with customer driving if possible. Make sure car has 2000-3000 miles for the "break-in" period.

CARBURETOR DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine starts but will not continue to run or will run but surges and backfires.	Faulty fuel pump.	Perform fuel pump test. Remove and replace fuel pump as required.
Engine will not start	Faulty fuel pump.	Perform diagnostic tests on the fuel pump as described in Section 6B. Remove and replace fuel pump as required.
GASOLINE ODOR	Tank overfilled. Fuel feed or vapor return line leaking. Leak in fuel tank. Disconnected fuel tank vent lines or hoses. Purge lines not connected, improperly routed, plugged or pinched. Faulty fill cap.	Do not "pack" tank. Fill to automatic shut-off. Correct as required. Purge tank and repair or replace tank as required. Connect lines or hoses as required. Check, connect and open lines as required. Install new cap.
COLLAPSED FUEL TANK	Plugged or pinched vent lines or hoses, and defective cap. Canister filter plugged and defective cap.	Check all lines from tank to canister and replace cap. Replace filter in canister and cap.
FUEL TANK RATTLES	Mounting straps loose. Baffle loose. Foreign material in tank. Felt strips improperly located (Station Wagon).	Tighten straps to specifications. Replace fuel tank. Remove tank and clean. Install strips.
FUEL STARVATION	Tank gauge unit filter plugged. Fuel line pinched, plugged or mis-routed. Fuel pump not operating.	Replace filter. Check open or re-route as required. See FUEL PUMP TEST.
Fuel odor	Vapor leak from evaporative system.	Inspect and correct as necessary fuel and evap. hoses and pipes, fuel sender sealing gasket, fuel cap.

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SECTION 6D

ENGINE ELECTRICAL

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ELECTRIC CHOKE HEATER-OIL PRESSURE SWITCH

MK IV V-8 AND 6 CYL ENGINES

All MK IV and 6 cylinder engines have a two-terminal oil pressure switch (sending unit) for controlling current to the electric choke heater. This switch and its associated circuitry provide for the illumination of the "Oil" tell tale lamp in the event of loss of oil pressure or loss of voltage at the choke heater.

The diagram in Figure 6D-1A shows how the dual function is accomplished. The "Bulb Check" feature is same as present system. That is, with ignition switch in "Run" position with engine off. This circuit will also indicate continuity in the choke heater and its connector.

If "Oil" tell tale lamp illuminates with engine running, it could indicate one or more of the following:

1. Loss of oil pressure.
2. Loss of choke heater voltage.
3. Blown GAGE fuse.

ELECTRIC CHOKE HEATER CHECKING PROCEDURE

1. Allow choke to cool so that when throttle is opened slightly, choke blade fully closes.

NOTE: This check must be performed with engine not running and at an ambient temperature of 140°F to 80.6°F (60°C to 27°C).

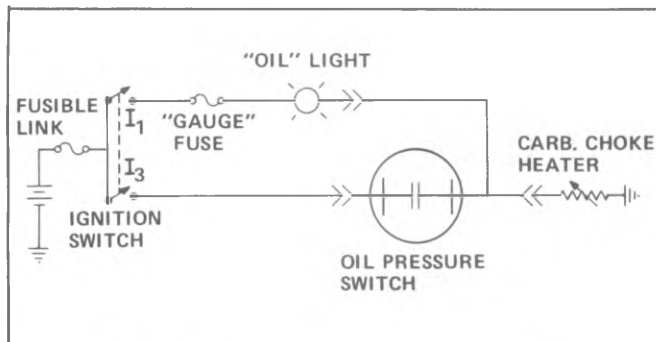


Fig. 6D-1A—Electric Choke Heater Diagram

2. Start engine and determine time for choke blade to

reach full open position. (Start timer when engine starts).

3. If the choke blade fails to open fully within 3.5 minutes, proceed with steps 4-5-6 below.

4. Check voltage at the choke heater connection. (Engine must be running). If the voltage is approximately 12-15 volts, replace the electrical choke unit.

5. If the voltage is low or zero, check all wires and connections. If any connections in the oil pressure switch circuitry are faulty or if the oil pressure switch is failed open, the oil warning light will be on with the engine running. Repair wires or connections as required.

6. If all wiring and connections are good, replace oil pressure switch.

NOTE: No gasket is used between the choke cover and the choke housing because of grounding requirements.

BATTERY

GENERAL DESCRIPTION

All Models have sealed batteries as standard equipment the battery (fig. 6D-1B) is made up of a number of separate elements, each located in an individual cell in a hard rubber case. Each element consists of an assembly of positive plates and negative plates containing dissimilar active materials and kept apart by separators. The elements are immersed in an electrolyte composed of dilute sulfuric acid. Plate straps located on the top of each element connect all the positive plates and all the negative plates into groups. The elements are connected in series electrically by connectors that pass directly through the case partitions between cells. The battery top is a one piece cover. The cell connectors, by passing through the cell partitions, connect the elements along the shortest practical path (fig. 6D-2B). With the

length of the electrical circuit inside the battery reduced to a minimum, the internal voltage drop is decreased resulting in improved performance, particularly during engine cranking at low temperatures.

The terminals of this type battery, passing through the side of the case, are positioned out of the "wet" area surrounding the vent holes. Normal spillage, spewing, condensation, and road splash are not as likely to reach or remain on the vertical sides where the terminals are located. This greatly decreases the cause of terminal corrosion. Also, construction of the terminals is such that the mating cable connector seals the junction and provides a permanently tight and clean connection. Power robbing resistance in the form of corrosion is thereby eliminated at these maintenance-free connections.



Fig. 6D-1B—Freedom Battery

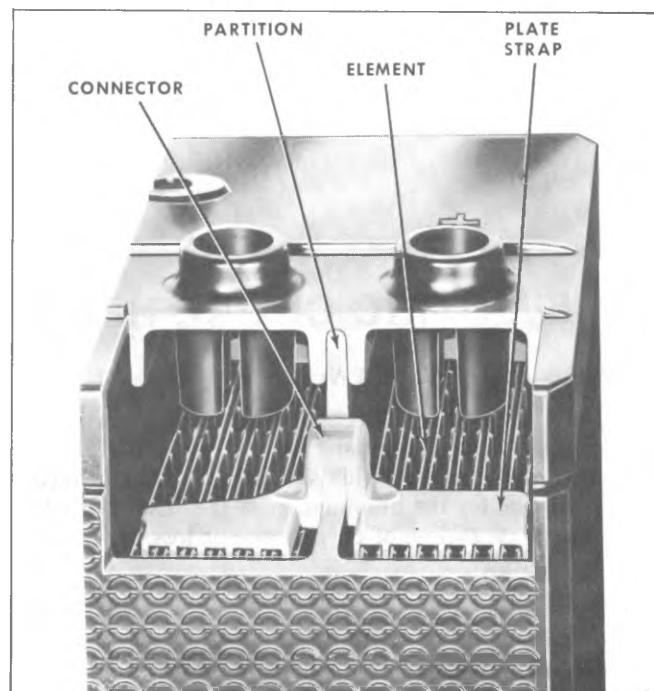


Fig. 6D-2B—Internal View of Battery

The hard, smooth, one piece cover greatly reduces the tendency for corrosion to form on the top of the battery. The cover is bonded to the case forming an air-tight seal between the cover and case.

Electrical energy is released by chemical reactions between the active materials in the two dissimilar plates and the electrolyte whenever the battery is being "discharged." Maximum electrical energy is released only when the cells are being discharged from a state of full charge.

As the cells discharge, chemical changes in the active materials in the plates gradually reduce the potential electrical energy available. "Recharging" the battery with a flow of direct current opposite to that during discharge reverses the chemical changes within the cells and restores them to their active condition and a state of full charge.

The lead-acid storage battery is an electrochemical device for converting chemical energy into electrical energy. It is not a storage tank for electricity as is often believed, but instead, stores electrical energy in chemical form.

Active materials within the battery react chemically to produce a flow of direct current whenever lights, radio, cranking motor, or other current consuming devices are connected to the battery terminal posts. This current is produced by chemical reaction between the active materials of the PLATES and the sulfuric acid of the ELECTROLYTE.

The battery performs three functions in automotive applications:

1. It supplies electrical energy for the cranking motor and for the ignition system as the engine is started.
2. It supplies current for the lights, radio, heater, and other accessories when the electrical demands of these devices exceed the output of the generator.
3. The battery acts as a voltage stabilizer in the electrical system. Satisfactory operation of the vehicle is impossible unless the battery performs each of these functions.

The simplest unit of a lead-acid storage battery is made up of two unlike materials, a positive plate and a negative plate, kept apart by a porous separator. This assembly is called an "ELEMENT" (Fig. 6D-3B).

When this simple element is put in a container filled with a sulphuric acid and water solution called "electrolyte", a two-volt "cell" is formed. Electricity will flow when the plates are connected to an electrical load (Fig. 6D-4B).

An element made by grouping several positive plates together and several negative plates together with separators between them also generates two-volts but can produce more total electrical energy than a simple cell (Fig. 6D-5B).

When six cells are connected in series, a "battery" of cells is formed which produces six times as much electrical pressure as a simple cell, or a total of 12 volts (Fig. 6D-6B).

If the battery continuously supplies current, it becomes run-down or discharged. This is where the generator gets into the act. The generator restores the chemical energy to the battery. This is done by sending current through the battery in a direction opposite to that during discharge. The generator current reverses the chemical actions in the battery and restores it to a charged condition.

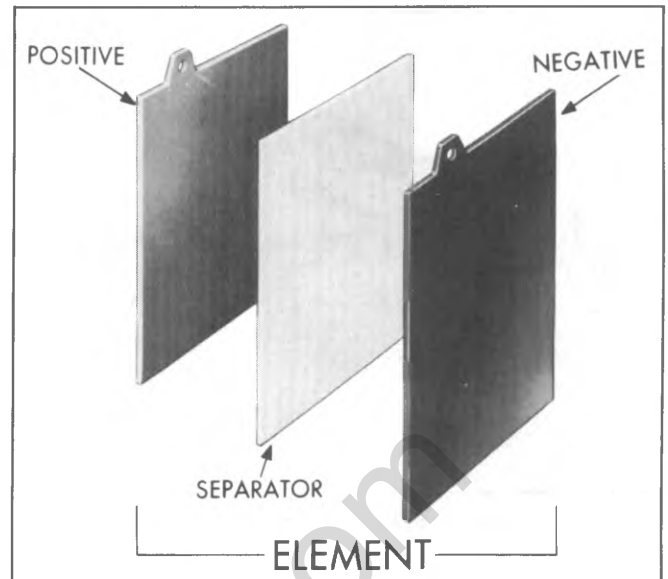


Fig. 6D-3B--Battery Element (Simple)

COMMON CAUSES OF FAILURE

Since the battery is a perishable item which requires periodic servicing, a good maintenance program will insure the longest possible battery life. If the battery tests good but fails to perform satisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of the trouble.

1. Vehicle accessories inadvertently left on overnight to cause a discharge condition.
2. Slow speed driving of short duration, to cause an undercharged condition.
3. A vehicle electrical load exceeding the generator capacity.
4. Defect in the charging system such as high resistance, slipping fan belt, faulty generator or voltage regulator.
5. Battery abuse, including failure to keep the battery

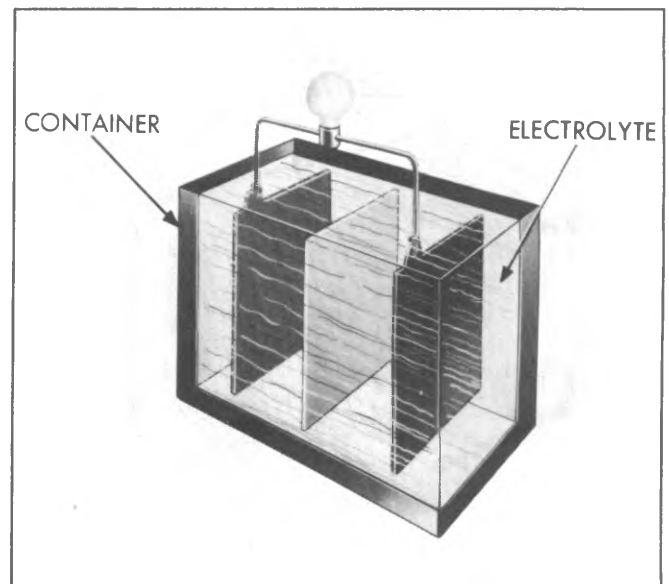


Fig. 6D-4B--Two Volt Battery Cell

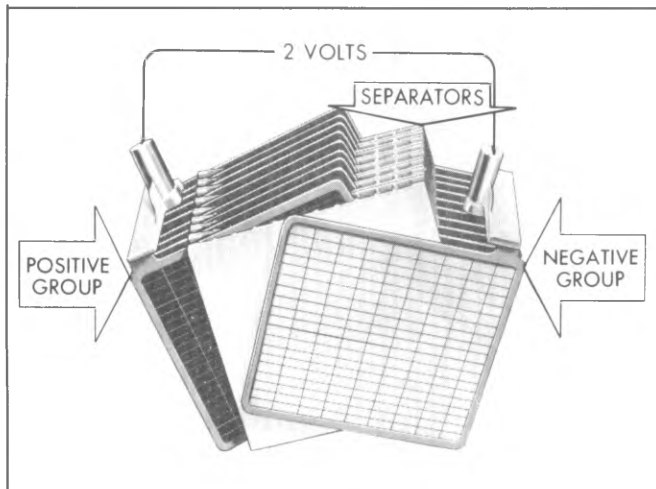


Fig. 6D-5B--Battery Element (Compound)

top clean, cable attaching bolts clean and tight, and improper addition of water to the cells.

CARE OF BATTERY

Battery Storage

A wet charged battery will not maintain its charged condition during storage, and must be recharged periodically. During storage, even though the battery is not in use, a slow reaction takes place between the chemicals inside the battery which causes the battery to lose charge and "wear out" slowly. This reaction is called "self-discharge." The rate at which self-discharge occurs varies directly with temperature of the electrolyte.

Note from Figure 6D-7B that an battery stored in an area at 100°F (38°C) for 60 days has a much lower specific gravity and consequently a lower state of charge than one stored in an area at 60°F (16°C) for the same length of time.

To minimize self-discharge, a wet battery should be stored in as cool a place as possible, provided the electrolyte does not freeze.

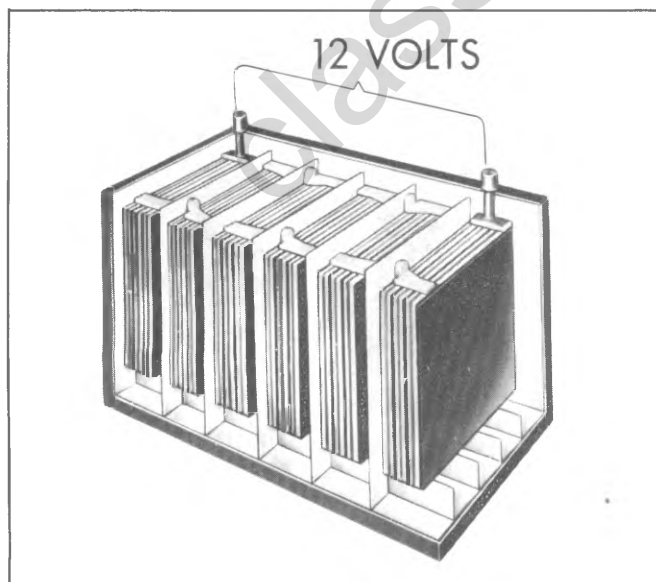


Fig. 6D-6B--Typical 12 Volt Battery Cell Arrangement

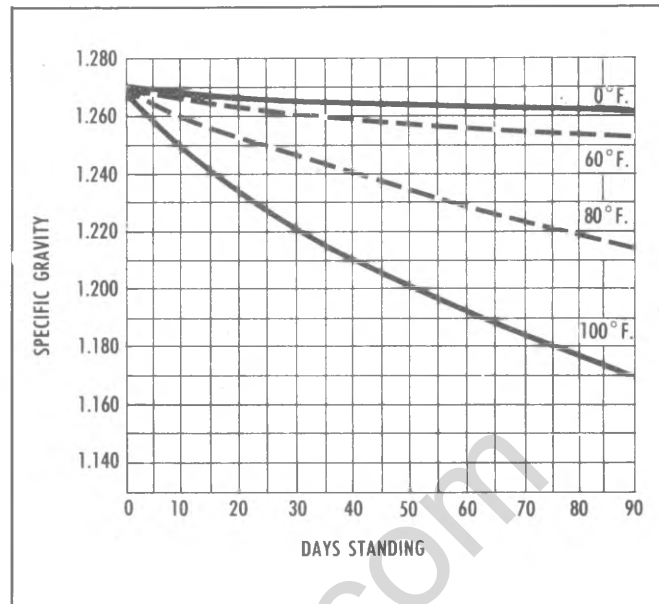


Fig. 6D-7B-- Rate of Self-Discharge

A wet battery which has been allowed to stand idle for a long period of time without recharging may become so badly damaged by the growth of lead sulfate crystals (sulfation) in the plates that it can never be restored to a normal charged condition. An battery in this condition not only loses its capacity but also is subject to changes in its charging characteristics. These changes, due to self-discharge, are often serious enough to prevent satisfactory performance in a vehicle.

Periodic recharging, therefore, is necessary to maintain a wet charged battery in a satisfactory condition while in storage. See paragraph "Charging Wet battery in Storage."

Charging Wet battery in Storage

Before placing a battery on charge, always check the battery hydrometer.

The battery should be brought to a fully charged condition only when darkened indicator with no green dot appears by charging as covered under heading of "Battery Charging."

Trickle charging should not be used to maintain a battery in a charged condition when in storage. The low charge rate method applied every 30 days is the best method of maintaining a wet charged battery in a fully charged condition without damage.

Electrolyte Freezing

The freezing point of electrolyte depends on its specific gravity. The following table gives the freezing temperatures of electrolyte at various specific gravities.

Since freezing may ruin a wet battery, it should be protected against freezing by keeping it in a charged condition. This is true whether the wet battery is in storage or in service.

Carrier and Hold-Down

The battery carrier and hold-down should be clean and free from corrosion before installing the battery. The carrier should be in sound mechanical condition so that it will support the battery securely and keep it level.

To prevent the battery from shaking in its carrier, the

VALUE OF SPECIFIC GRAVITY @ 30°F	FREEZING TEMP. °F °C	VALUE OF SPECIFIC GRAVITY @ 80°F	FREEZING TEMP. °F °C
1.100	18 - 8	1.220	-33 -36
1.120	13 -11	1.240	-50 -46
1.140	8 -13	1.260	-75 -59
1.160	1 -17	1.280	-92 -69
1.180	-6 -21	1.300	-95 -71
1.200	-17 -27		

hold-down bolts should be tight. However, the bolts should not be tightened to the point where the battery case or cover will be placed under a severe strain.

Cleaning

The external condition of the battery should be checked periodically for damage such as cracked cover, case and vent plugs or for the presence of dirt and corrosion. The battery should be kept clean. An accumulation of acid film and dirt may permit current to flow between the terminals, which will slowly discharge the Battery. For best results when cleaning batteries, wash first with a diluted ammonia or a soda solution to neutralize any acid present; then flush with clean water.

BATTERY RATING

A battery generally has two classifications of ratings: (1) a 20 hour reserve capacity rating at 80°F (27°C) and, (2) a cold rating at 0°F (-18°C) which indicates the cranking load capacity. The Ampere/Hour rating formerly found on batteries was based on the 20 hour rating.

amperes for 20 hours while maintaining a specified average individual cell voltage would be classified as a 60 ampere hour battery (e.g. 3 amperes × 20 hours = 60 A.H.) a PWR (Peak Watt Rating) has been developed as a measure of the battery's cold cranking ability. The numerical rating is embossed on each case at the base of the battery. This value is determined by multiplying the maximum current by the maximum voltage. The PWR should not be confused with the ampere hour rating since two batteries with the same ampere hour rating can have quite different watt ratings. For battery replacement, a unit of at least equal power rating must be selected.

SELECTING A REPLACEMENT BATTERY

Long and troublefree service can be more assured when the capacity or wattage rating of the replacement battery is at least equal to the wattage rating of the battery originally engineered for the application by the manufacturer.

The use of an undersize battery may result in poor performance and early failure. Figure 6D-8B shows how battery power shrinks while the need for engine cranking power increases with falling temperatures. Sub-zero temperatures reduce capacity of a fully charged battery to 45% of its normal power and at the same time increase cranking load to 3-1/2 times the normal warm weather load.

Hot weather can also place excessive electrical loads on the battery. Difficulty in starting may occur when

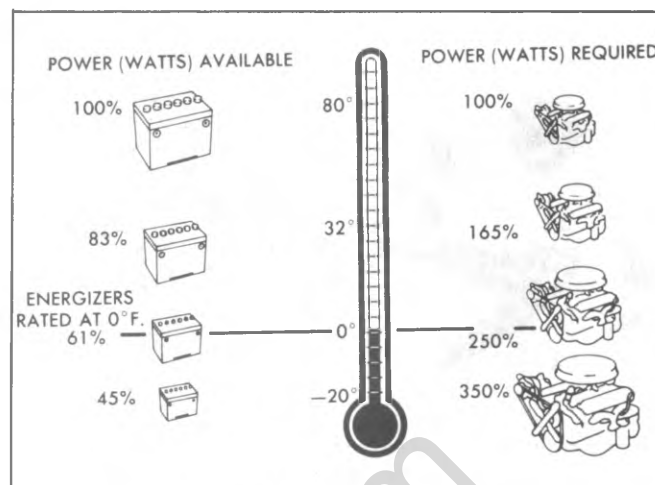


Fig. 6D-8B--Battery Power vs Falling Temperature

cranking is attempted shortly after a hot engine has been turned off or stalls. In fact, modern high compression engines can be as difficult to start under such conditions as on the coldest winter day. Consequently, good performance can be obtained only if the battery has ample capacity to cope with these conditions.

A battery of greater capacity should be considered if the electrical load has been increased through the addition of accessories or if driving conditions are such that the generator cannot keep the battery in a charged condition.

On applications where heavy electrical loads are encountered, a higher output generator that will supply a charge during low speed operation may be required to increase battery life and improve battery performance.

SAFETY PRECAUTIONS

When batteries are being charged, an explosive gas mixture forms in each cell. Part of this gas escapes through the holes in the vent holes and may form an explosive atmosphere around the battery itself if ventilation is poor. This explosive gas may remain in or around the battery for several hours after it has been charged. Sparks or flames can ignite this gas causing an internal explosion which may shatter the battery (Fig. 6D-9B).

The following precautions should be observed to prevent an explosion:

1. Do not smoke near batteries being charged or which have been very recently charged.
2. Do not break live circuits at the terminals of batteries because a spark usually occurs at the point where a live circuit is broken. Care must always be taken when connecting or disconnecting booster leads or cable clamps on fast chargers. Poor connections are a common cause of electrical arcs which cause explosions.

CHARGING PROCEDURES

Battery charging consists of applying a charge rate in amperes for a period of time in hours. Thus, a 10-ampere charge rate for seven hours would be a 70 ampere-hour (A.H.) charging input to the battery. Charging rates in the three to 20 ampere range are generally satisfactory. No particular charge rate (except that charge rate should not exceed 20 amperes) or time can be specified for a battery due to the following factors:

1. The size, or electrical capacity in ampere-hours (A.H.), of the battery.

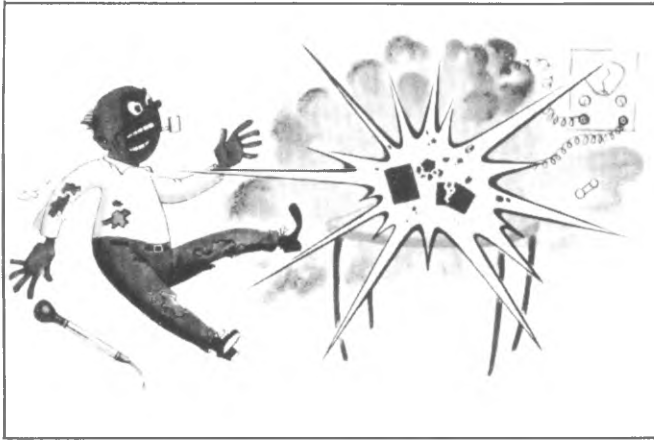


Fig. 6D-9B—Sparks or Flames

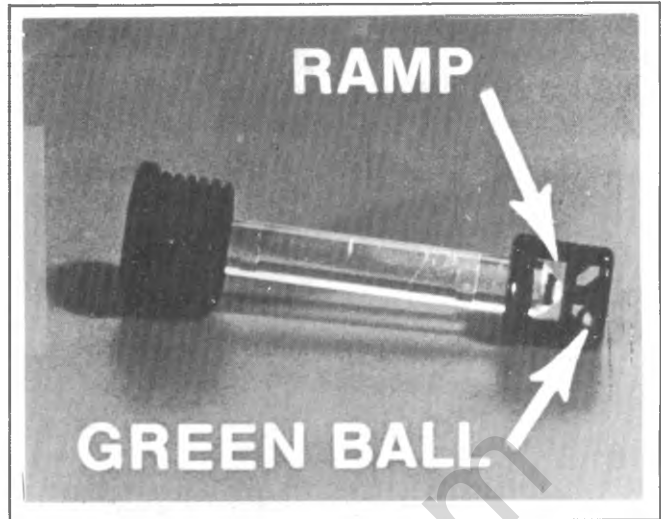


Fig. 6D-10B—Built-In Hydrometer

EXAMPLE: A completely discharged 70 A.H. battery requires almost twice the recharging as a 40 A.H. battery.

2. Temperature of the battery electrolyte.

EXAMPLE: About two hours longer will be needed to charge a 0°F (-18°C) battery than a 80°F (27°C) battery.

3. Battery state-of-charge at the start of the charging period.

EXAMPLE: A completely discharged battery requires twice as much charge in ampere-hours as a one-half charged battery.

4. Battery age and condition.

EXAMPLE: A battery that has been subjected to severe service will require up to 50% more ampere-hour charging input than a relatively new battery.

Built-In Hydrometer

The sealed battery has a built-in temperature compensated hydrometer in the top of the battery. This hydrometer is to be used with the following diagnostic procedure. It is important when observing the hydrometer that the battery have a clean top to see the correct indication. A light may be required in some poorly-lit areas.

Under normal operation, two indications can be observed (see Figure 6D-7):

1. GREEN DOT VISIBLE

Any green appearance is interpreted as a green dot and the battery is ready for testing.

2. DARK; GREEN DOT NOT VISIBLE

If there is a cranking complaint, the battery should be tested as described in the Diagnosis section. The charging and electrical systems should also be checked at this time.

Occasionally, a third condition may appear:

3. CLEAR OR LIGHT YELLOW

On rare occasions, the hydrometer will turn clear or light yellow. Normally, the battery is capable of further service; however, when a cranking complaint has been reported, replace the battery. **DO NOT CHARGE, TEST OR JUMP-START.**

The following procedure should be used for testing batteries:

1. VISUAL INSPECTION

Check for obvious damage, such as cracked or broken case or cover, that could permit loss of electrolyte. If obvious physical damage is noted, replace the battery. Determine cause of damage and correct as needed. If not,

proceed to step 2.

2. HYDROMETER CHECK (Fig. 6D-10B)

a. GREEN DOT VISIBLE

If the hydrometer has a GREEN DOT visible the battery is ready for testing. Proceed to Step 4.

b. DARK; GREEN DOT NOT VISIBLE.

Charge the battery as outlined under Charging Procedure section and proceed to Step 3.

Load Test

Load testing may require use of battery side terminal adapters to insure good connections (see Fig. 6D-11B).

a. Connect a voltmeter and a battery load tester across the battery terminals.

b. Apply 300 ampere load for 15 seconds to remove

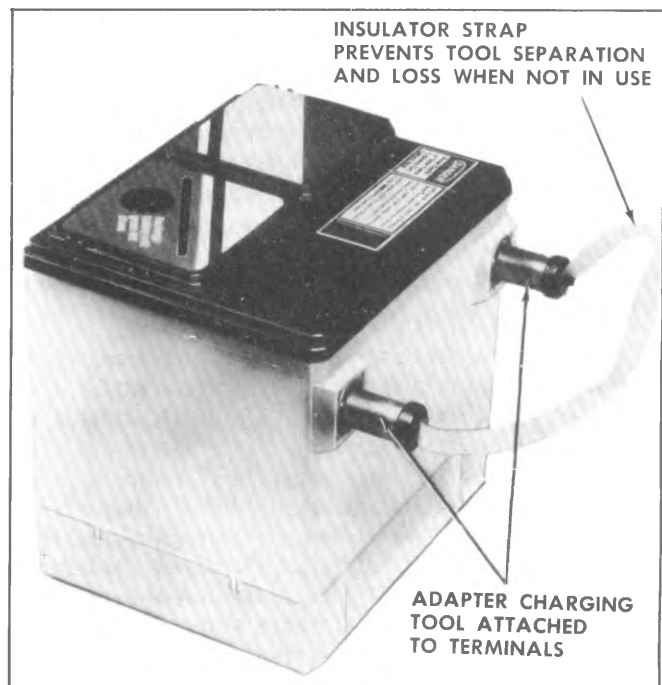


Fig. 6D-11B—Side Terminal Battery Adapters

ON-VEHICLE SERVICE

CHARGING PROCEDURES

When it is necessary to charge a sealed battery, the following safety precautions must be followed:

1. **DO NOT CHARGE** battery if hydrometer is clear or light yellow. Replace battery.

2. If the battery feels hot 125°F (52°C), or if violent gassing or spewing of electrolyte through the vent hole occurs, discontinue charging or reduce charging rate. Charge the battery until the green ball appears. Tipping or shaking the battery may be necessary to make the green ball appear. Temperature of the battery will effect the charging rate, and most charging equipment will not charge at a constant rate. For example, if the charger starts at 30 amperes and drops off to 10 amperes after 1 hour, the average current for that hour was 20 amperes. The actual boost charge was 20 ampere-hours. The sealed battery can be fast charged or slow charged with ordinary chargers in the same manner as conventional batteries. Either method will restore the battery to full charge.

JUMP STARTING IN CASE OF EMERGENCY WITH AUXILIARY (BOOSTER) BATTERY

Do not push or tow this vehicle to start. Damage to the emission system and/or to other parts of the vehicle may result.

Both booster and discharged battery should be treated carefully when using jumper cables. Follow the procedure outlined below, being careful not to cause sparks:

Departures from these conditions or the procedure below could result in:

1. Serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid, or electrical burns; and/or 2. damage to electronic components of either vehicle.

Never expose battery to open flame or electric spark - batteries generate a gas which is flammable and explosive. Remove rings, watches, and other jewelry. Wear approved eye protection. Do not allow battery fluid to contact eyes, skin, fabrics, or painted surfaces - fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly. Be careful that metal tools or jumper cables do not contact the positive battery terminal (or metal in contact with it) and any other metal on the car, because a short circuit could occur. Batteries should always be kept out of the reach of children.

1. Set parking brake and place automatic transmission in **PARK** (neutral for manual transmission.) Turn off lights, heater, and other electrical loads.

2. Check the battery to insure that it is in proper condition to allow safe starting. If it is not, do not attempt jump starting.

a. Check the built-in hydrometer. If it is clear or light yellow, replace the battery, and do not attempt to jump start.

3. Only 12 volt batteries can be used to start this engine.

4. Attach the end of one jumper cable to the positive terminal of the booster battery and the other end of the same cable to the positive terminal of the discharged battery. **DO NOT PERMIT** vehicles to touch each other as this could cause a ground connection and counteract the benefits of this procedure.

5. Attach one end of the remaining negative cable to

BATTERY TYPE	AMPS FOR LOAD TEST
85-5	170
85-4	130
87-5	210

Fig. 6D-12B--Load Test Values

surface charge from the battery. Remove load.

c. Wait 15 seconds to let battery recover and apply specified load. Read voltage after 15 seconds with specified load applied (see Fig. 6D-12B), then disconnect load.

d. If voltage does not drop below the minimum listed in Fig. 6D-13B, the battery is good and should be returned to service. (The battery temperature must be estimated by feel and by the temperature the battery has been exposed to for the preceding few hours.)

e. If voltage drops below the minimum listed, replace the battery.

MINIMUM VOLTAGE	TEMPERATURE	
	°F	°C
9.6	70	21
9.5	60	16
9.4	50	10
9.3	40	4
9.1	30	- 1
8.9	20	- 7
8.7	10	-12
8.5	0	-18

Fig. 6D-13B--Minimum Voltage Drop

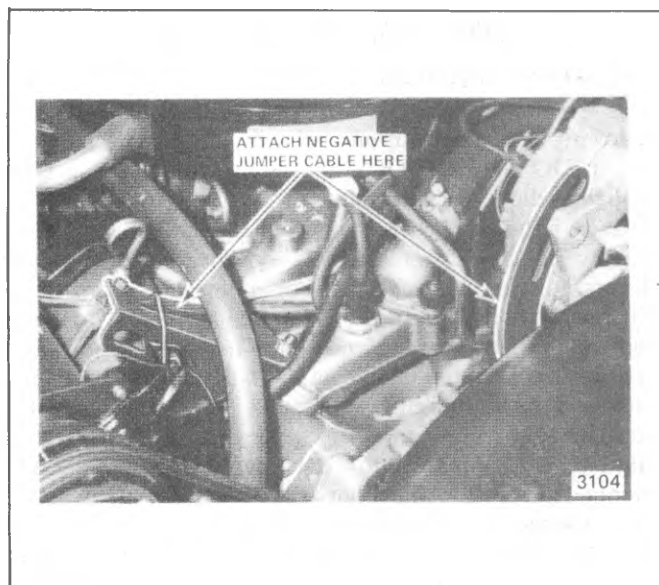


Fig. 6D-14B—Negative Jumper Cable Connection

the negative terminal of the booster battery, and the other end to a solid engine ground (such as A/C compressor or generator mounting bracket) at least 12 inches from the

battery of the vehicle being started (see Fig. 6D-14B) (DO NOT CONNECT DIRECTLY TO THE NEGATIVE TERMINAL OF THE DEAD BATTERY).

6. Start the engine of the vehicle that is providing the jump start and turn off electrical accessories. Then start the engine in the car with the discharged battery.

7. Reverse these directions exactly when removing the jumper cables. The negative cable must be disconnected from the engine that was jump started first.

REMOVE AND REPLACE

When handling a battery, the following safety precautions should be observed:

1. Hydrogen gas is produced by the battery. A flame or spark near the battery may cause the gas to ignite.

2. Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. Any spilled electrolyte should be flushed with large quantities of water and cleaned immediately. To remove or replace a battery, always disconnect the negative cable first, then the positive cable. Torque battery cables at battery to 9 lb. ft. (12 N·m). Two types of battery hold-downs are used. The hold-down rod going across the battery top should be torqued to 25 lb. in. (3.0 N·m), (25 lb. in.), and the clamp which holds the bottom of the battery should be torqued to 6 lb. ft. (8.0 N·m).

THE CHARGING SYSTEM

10-SI SERIES GENERATOR SYSTEM

GENERAL DESCRIPTION

The 10-SI series generator shown in Figure 6D-1C is typical of a variety of models. A solid state regulator having an integrated circuit is built into the end frame. Although models are available with different outputs at idle and different maximum outputs, their basic operating principles are the same.

The generator consists primarily of two end frame assemblies, a rotor assembly and a stator assembly. A typical cross-sectional view is shown in Figure 6D-1C. The rotor assembly is supported in the drive end frame by a ball bearing and in the slip ring end frame by a roller bearing. These rotor bearings contain a supply of lubricant sufficiently adequate to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor and under normal conditions will provide long periods of attention-free service. No periodic adjustments or maintenance are required on the generator assembly.

The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. A rectifier bridge connected to the stator windings contains six diodes, (three positive and three negative) molded into an assembly which is connected to the stator windings. This rectifier bridge changes the stator a.c. voltages to d.c. voltage which appears at the output terminal. The blocking action of the diodes prevent battery discharge back through the generator. Because of this blocking action, the need for a cutout relay in the circuit is eliminated. Generator field

current is supplied through a diode trio which is also connected to the stator windings.

A capacitor, or condenser, mounted in the end frame protects the rectifier bridge and diode from high voltages, and suppresses radio noise.

The typical passenger car integral charging system is made up of two components--a generator with a built-in solid state voltage regulator and battery. These components work together to supply electrical power for ignition, lights, radio, cranking motor, etc. A typical wiring diagram is illustrated in Figure 6D-2C. The basic operating principles are explained as follows.

When the switch is closed, current from the battery flows through the indicator lamp to the generator No. 1 terminal, through resistor R1, diode D1, and the base-emitter of transistor TR1 to ground, and then back to the battery. This turns on transistor TR1, and current flows through the generator field coil and TR1 back to the battery. The indicator lamp then turns on. Resistor R5 carries some of the indicator lamp current and is shown in figure 6D-2C.

With the generator operating, a.c. voltage is generated in the stator windings, and the stator supplies d.c. field current through the diode trio, the field, TR1, and then through the grounded diodes in the rectifier bridge back to the stator. Also, the six diodes in the rectifier bridge change the stator a.c. voltages to a d.c. voltage which appears between ground and the generator "BAT" terminal. As generator speed increases, current is provided for charging

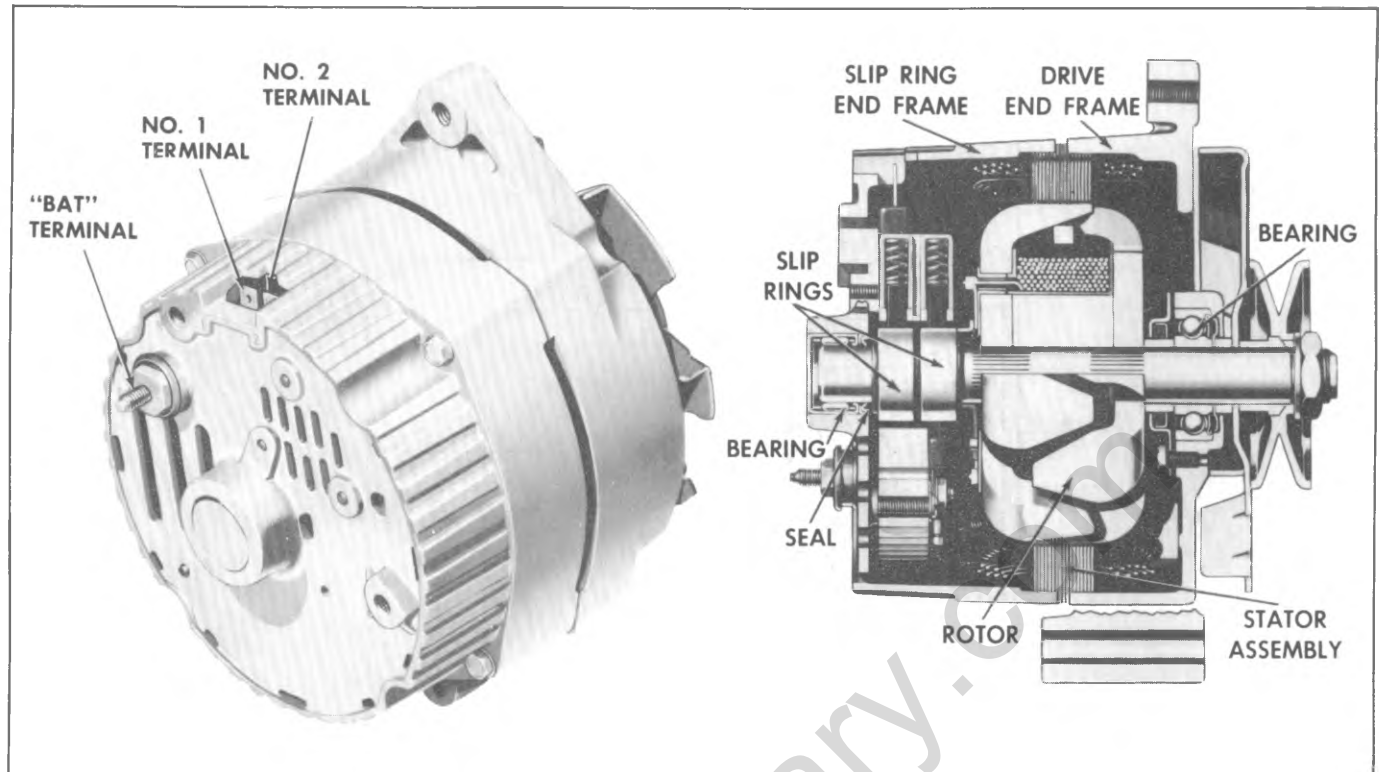


Fig. 6D-1C--10-SI Series Generator

the battery and operating electrical accessories. Also, with the generator operating, the same voltage appears at the "BAT" and No. 1 terminals, and the indicator lamp goes out to indicate the generator is producing voltage.

The No. 2 terminal on the generator is always connected to the battery, but the discharge current is limited to a negligible value by the high resistances of R2 and R3. As the generator speed and voltage increase, the voltage between R2 and R3 increases to the point where zener diode D2 conducts. Transistor TR2 then turns on and TR1 turns off. With TR1 off, the field current and system voltage decrease, and D2 then blocks current flow, causing TR1 to

turn back on. The field current and system voltage increase, and this cycle then repeats many times per second to limit the generator voltage to a pre-set value.

Capacitor C1 smooths out the voltage across R3, resistor R4 prevents excessive current through TR1 at high temperatures, and diode D3 prevents high-induced voltages in the field windings when TR1 turns off.

Resistor R2 is a thermister which causes the regulated voltage to vary with temperature, thus providing optimum voltage for charging the battery.

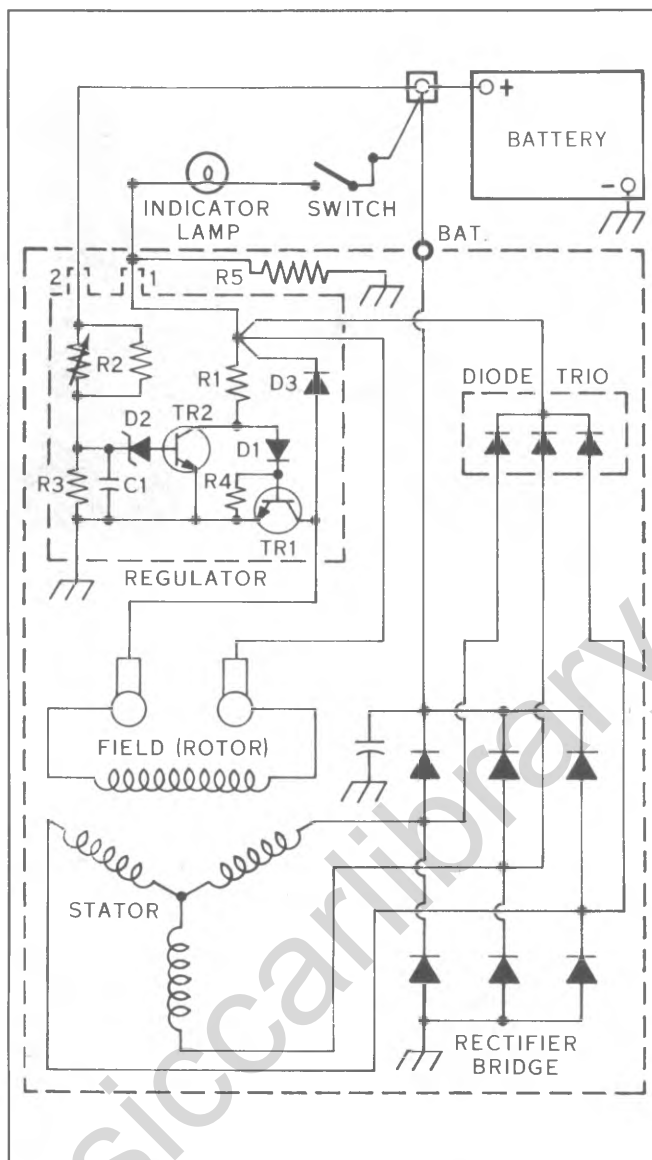


Fig. 6D-2C--Integral Charging System Circuitry

DIAGNOSIS

Most charging system troubles show up as a faulty indicator lamp, an undercharged or an overcharged battery. Since the battery itself may be defective, it should be checked first to determine its condition. Also, in the case of an undercharged battery, check for battery drain caused by grounds or by accessories being left on.

A basic wiring diagram showing lead connections is presented in Figure 6D-3C. The following precautions must be observed when working on the charging circuit. Failure to observe these precautions will result in serious damage to the electrical equipment.

- Do not polarize the generator.
- Do not short across or ground any of the terminals in the charging circuit except as specifically instructed in these procedures.
- Never operate the generator with the output terminal open circuited.

- Make sure the generator and battery are of the same ground polarity.

- When connecting a charger or a booster battery to the vehicle battery, connect negative terminal to negative terminal and positive terminal to positive terminal.

STATIC CHECK

Before making any electrical checks, visually inspect all connections, including slip-on connectors, to make sure they are clean and tight. Inspect all wiring for cracked, frayed or broken insulation. Be sure generator mounting bolts are tight and unit is properly grounded. Check for loose fan belt.

NOTE: In some circuits an ammeter may be used instead of an indicator lamp. In this case, the section pertaining to faulty indicator lamp operation may be omitted from the trouble shooting procedure.

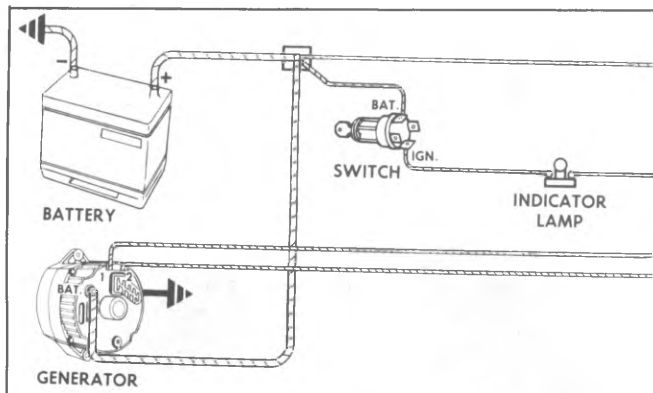


Fig. 6D-3C--Basic Wiring Diagram

INDICATOR LAMP CIRCUIT CHECK

Check the indicator lamp for normal operation as shown below.

If the indicator lamp operates normally, proceed to "Undercharged Battery" or "Overcharged Battery" section. Otherwise, proceed to either one of the following three abnormal conditions.

1. Switch Off, Lamp On— In this case, disconnect the two leads from the generator No. 1 and No. 2 terminals. If the lamp stays on, there is a short between these two leads. If the lamp goes out, replace the rectifier bridge as covered in the "Chassis Overhaul Manual". This condition will cause an undercharged battery.

2. Switch On, Lamp Off, Engine Stopped—This condition can be caused by the defects listed in step 1 above, by reversal of the No. 1 and No. 2 leads at these two terminals, or by an open in the circuit. This condition can cause an undercharged battery. To determine where an open exists, proceed as follows:

a. Check for a blown fuse, or fusible link, a burned out bulb, defective bulb socket, or an open in No. 1 lead circuit between generator and ignition switch.

b. If no defects have been found, proceed to Undercharged Battery section.

3. Switch On, Lamp On, Engine Running—The possible causes of this condition are covered in the "UNDERCHARGED BATTERY" section.

UNDERCHARGED BATTERY CONDITION CHECK

This condition, as evidenced by slow cranking and low specific gravity readings, can be caused by one or more of the following conditions even though the ammeter may be operating normally.

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.

Switch	Lamp	Engine
OFF	OFF	STOPPED
ON	ON	STOPPED
ON	OFF	RUNNING

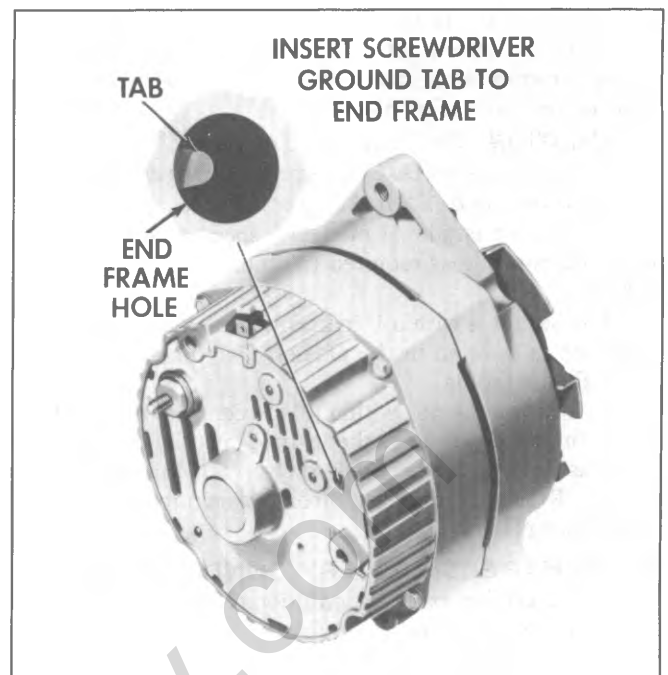


Fig. 6D-4C--Generator End View

2. Check the drive belt for proper tension.
3. Check battery. Test is not valid unless battery is good and fully charged.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the generator and firewall, and the cable clamps and battery posts.
5. With ignition switch "on" connect a voltmeter from generator "BAT" terminal to ground, generator No. 1 terminal to ground and generator No. 2 terminal to ground. A zero reading indicates an open between voltmeter connection and battery.

NOTE: An open No. 2 lead circuit on generators will cause uncontrolled voltage, battery overcharge and possible damage to battery and accessories. Generators supplied for current applications have a built-in feature which avoids overcharge and accessory damage by preventing the generator from turning on if there is an open in the wiring harness connected to the No. 2 generator terminal. Opens in the wiring harness connected between the No. 2 generator terminal and battery may be between the terminals, at the crimp between the harness wire and terminal, or in the wire.

6. If previous Steps 1 through 5 check satisfactorily, check generator as follows:

- a. Disconnect battery ground cable.
- b. Connect an ammeter in the circuit at the "BAT" terminal of the generator.
- c. Reconnect battery ground cable.
- d. Turn on radio, windshield wipers, lights high beam and blower motor high speed. Connect a carbon pile across the battery.
- e. Operate engine at moderate speed as required, and adjust carbon pile as required, to obtain maximum current output.

f. If ampere output is within 10 percent of rated output as stamped on generator frame, generator is not defective;

recheck Steps 1 through 5.

g. If ampere output is not within 10 percent of rated output, ground the field winding by inserting a screwdriver into the test hole (Fig. 6D-4C).

CAUTION: Tab is within 3/4 inch (19mm) of casting surface. Do not force screwdriver deeper than one inch (25mm) into end frame.

h. Operate engine at moderate speed as required, and adjust carbon pile as required to obtain maximum current output.

i. If output is within 10 percent of rated output, replace regulator as covered in the Chassis Overhaul Manual and check field winding.

j. If output is not within 10 percent of rated output, check the field winding, diode trio, rectifier bridge, and stator as covered in the Chassis Overhaul Manual.

k. Remove ammeter from generator and turn accessories off.

OVERCHARGED BATTERY CONDITION CHECK

1. Determine battery condition. Test is not valid if battery is not good and fully charged.

2. Connect a voltmeter from generator No. 2 terminal to ground. If reading is zero, No. 2 lead circuit is open.

3. If battery and No. 2 lead circuit check good, but an obvious overcharge condition exists as evidenced by excessive battery water usage, proceed as follows:

a. Separate end frames as covered in generator "Disassembly" section in the Chassis Overhaul Manual. Check field winding for shorts. If shorted replace rotor and regulator.

b. Connect ohmmeter using lowest range scale from brush lead clip to end frame as shown in Step 1, Figure 6D-5C, then reverse lead connections.

c. If both readings are zero, either the brush lead clip is grounded, or regulator is defective.

d. A grounded brush lead clip can result from omission of insulating washer (Fig. 6D-5C), omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve. If satisfactory, replace regulator as covered in the Chassis Overhaul Manual.

GENERATOR OUTPUT TEST

To check the generator in a test stand, proceed as follows:

1. Make connections as shown in Figure 6D-6C, except leave the carbon pile disconnected. Use a fully charged battery and a 10 ohm resistor rated at six watts or more between the generator No. 1 terminal and the battery.

2. Slowly increase the generator speed and observe the voltage.

3. If the voltage is uncontrolled with speed and increases above 16 volts, check for a grounded brush lead clip as covered under heading of "OVERCHARGED BATTERY", Step 3. If not grounded, replace the regulator.

NOTE: The battery must be fully charged when making this check.

4. Connect the carbon pile as shown.

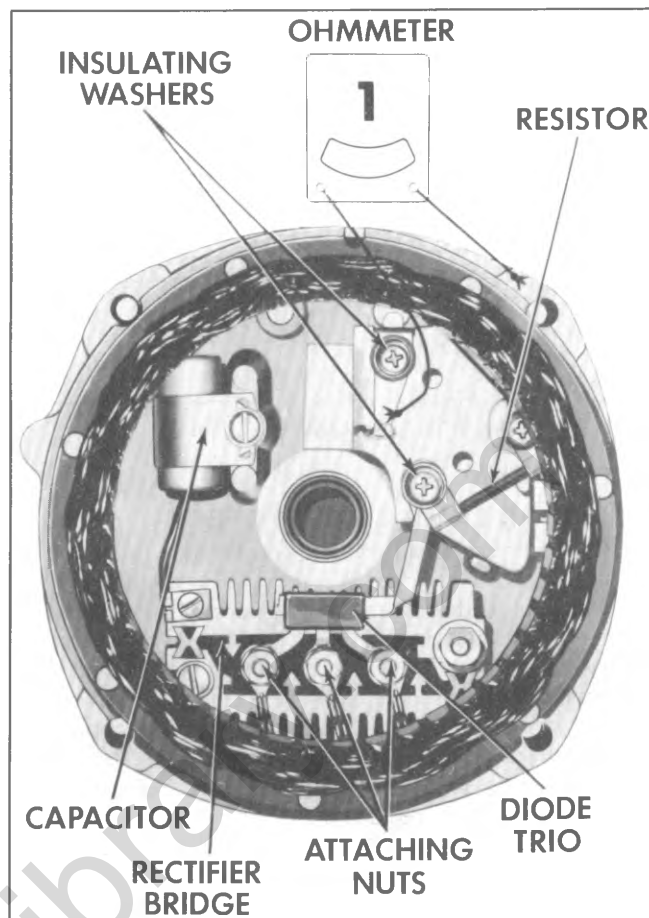


Fig. 6D-5C—Slip Ring End Frame

5. Operate the generator at moderate speed as required and adjust the carbon pile as required to obtain maximum current output.

6. If output is within ten percent of rated output as stamped on generator frame, generator is good.

7. If output is not within ten percent of rated output, ground generator field (Fig. 6D-4C).

8. Operate generator at moderate speed and adjust carbon pile as required to obtain maximum output.

9. If output is within ten percent of rated output, replace regulator as covered in "Regulator Replacement" section.

10. If output is not within ten percent of rated output, check the field winding, diode trio, rectifier bridge and stator as previously covered.

OTHER HARNESS CHECKS

Wires in the charging system may be checked for continuity by use of an ohmmeter or a test light (12 volt). Connect the test so the wire in question is in series in the test circuit.

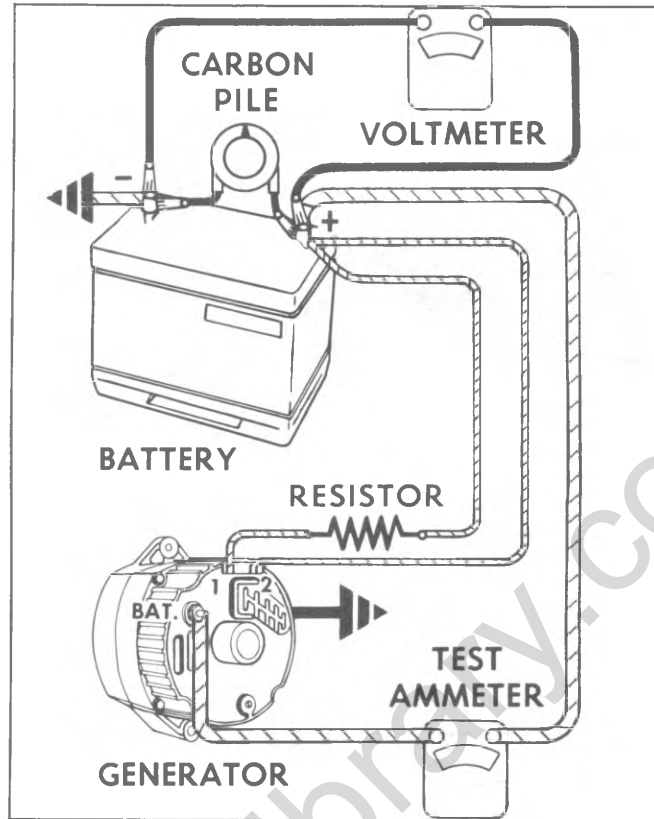
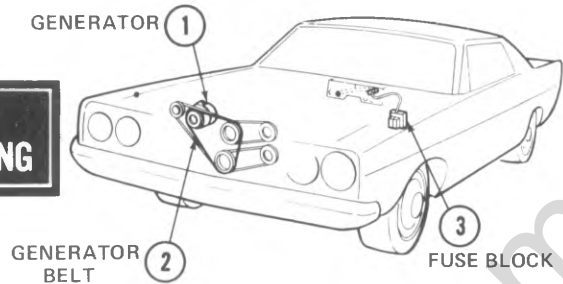


Fig. 6D-6C-Generator Output Test

Chart 1

PROBLEM:
generator light ON engine RUNNING




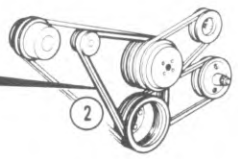



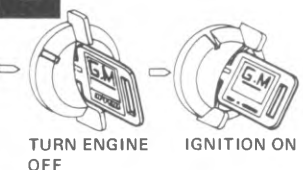

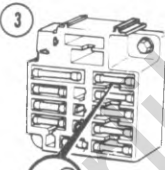





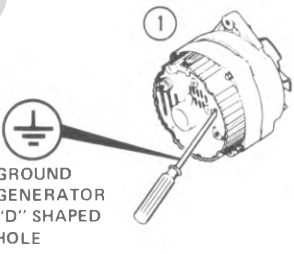


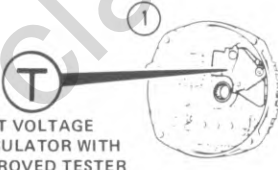



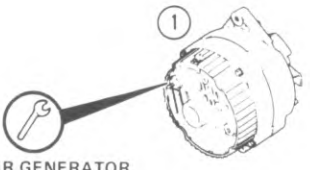

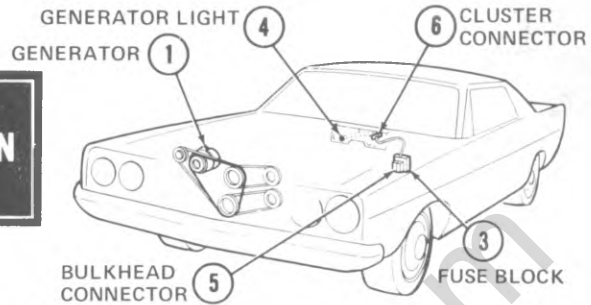



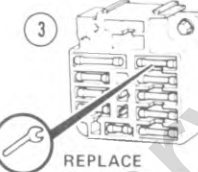








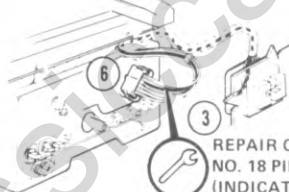



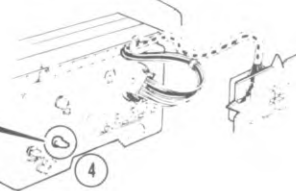








STEP	SEQUENCE	RESULT
<p>1</p>  <p>CHECK GENERATOR BELT</p>	 <p>REPLACE IF NECESSARY ADJUST TENSION TO 80 LBS.</p>  <p>START ENGINE</p>	 STOP  GO TO STEP 2 <p>GENERATOR LIGHT ON (DIM OR BRIGHT)</p>
<p>2</p>  <p>TURN ENGINE OFF IGNITION ON</p>	 <p>CHECK ALL INDICATOR LIGHTS</p>  <p>IF ALL LIGHTS OFF CHECK FOR CAUSE AND REPLACE GAUGES FUSE</p>  <p>START ENGINE</p>	 STOP  GO TO STEP 3 <p>GENERATOR LIGHT ON</p>
<p>3</p>  <p>CONNECT TEST LIGHT TO NO. 1 TERMINAL</p>	 <p>TEST LIGHT 1/2 BRIGHT</p>  <p>GROUND GENERATOR "D" SHAPED HOLE</p>	 GO TO STEP 4  GO TO STEP 5 <p>TEST LIGHT FULLY BRIGHT</p> <p>TEST LIGHT 1/2 BRIGHT</p>
<p>4</p>  <p>TEST VOLTAGE REGULATOR WITH APPROVED TESTER</p>	 GO TO STEP 5  <p>REPLACE VOLTAGE REGULATOR</p>  STOP	
<p>5</p>  <p>REPAIR GENERATOR</p>		 STOP

Chart 2

PROBLEM:
generator light OFF ignition ON
engine NOT RUNNING



STEP	SEQUENCE	RESULT
<p>1</p>  <p>IGNITION ON</p>  <p>CHECK ALL INDICATOR LIGHTS</p>  <p>IF ALL LIGHTS OFF</p>	<p>3</p>  <p>REPLACE GAUGES FUSE</p>  <p>GENERATOR LIGHT ON</p>  <p>GENERATOR LIGHT OFF</p>	<p>STOP</p> <p>IF NEW FUSE BLOWS GO TO STEP 2</p> <p>IF FUSE DOES NOT BLOW GO TO STEP 3</p>
<p>2</p>  <p>CHECK FOR PINCHED OR GROUNDED WIRE IN GAUGES CIRCUITS</p>   <p>REPAIR IF NECESSARY</p>	<p>3</p>  <p>REPLACE GAUGES FUSE</p>  <p>GENERATOR LIGHT ON</p>  <p>GENERATOR LIGHT OFF</p>	<p>STOP</p> <p>GO TO STEP 3</p>
<p>3</p>  <p>REPAIR OPEN IN NO. 18 PINK WIRE (INDICATOR FEED WIRE)</p>	 <p>GENERATOR LIGHT ON</p>  <p>GENERATOR LIGHT OFF</p>	<p>STOP</p> <p>GO TO STEP 4</p>
<p>4</p>  <p>CHECK GENERATOR INDICATOR BULB AND SOCKET ASSY.</p>   <p>REPLACE IF NECESSARY</p>	 <p>GENERATOR LIGHT ON</p>  <p>GENERATOR LIGHT OFF</p>	<p>STOP</p> <p>GO TO STEP 5</p>
<p>5</p> <p>DISCONNECT BROWN/WHITE WIRE</p>  <p>GROUND NO. 1 TERMINAL WIRE</p>  	 <p>GENERATOR LIGHT ON</p>  <p>GENERATOR LIGHT OFF</p>	<p>GO TO STEP 6</p> <p>GO TO STEP 7</p>

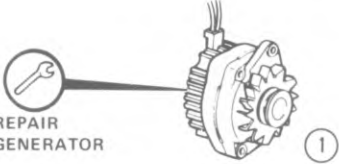

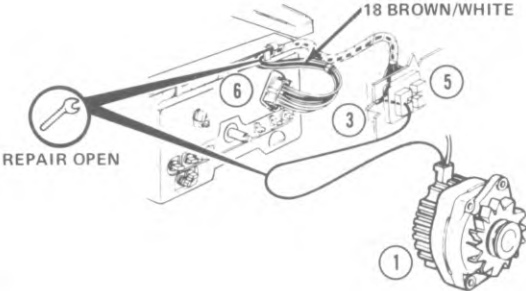

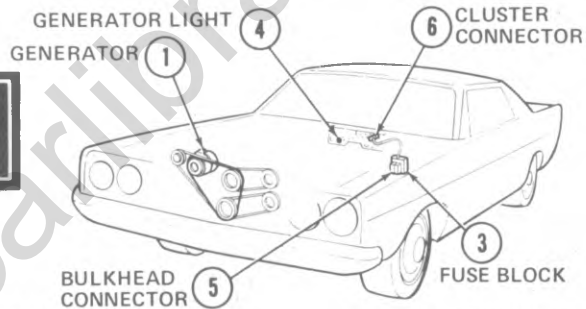
STEP	SEQUENCE	RESULT
6		
7		

Chart 3

PROBLEM:
generator light ON ignition OFF



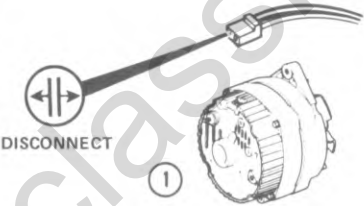
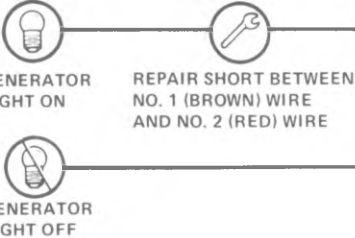


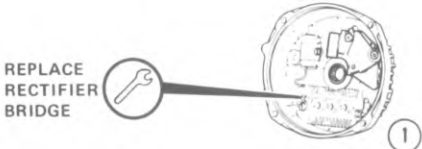

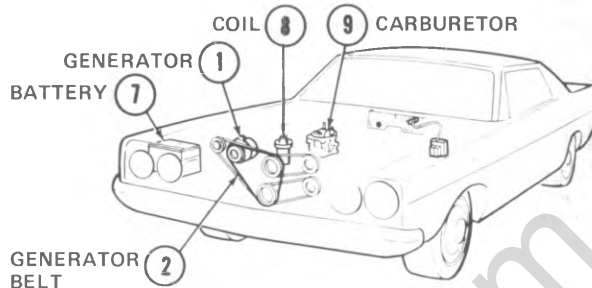
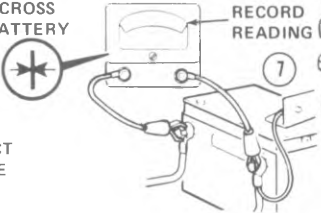

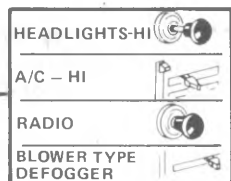
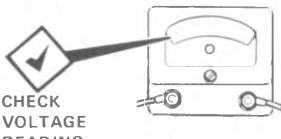

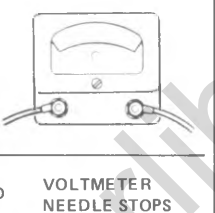

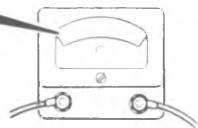

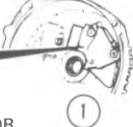
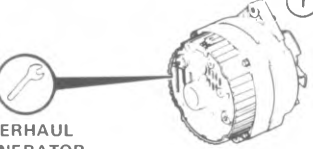
STEP	SEQUENCE	RESULT
1	 	 
2		

Chart 4

PROBLEM:
battery UNDERCHARGED



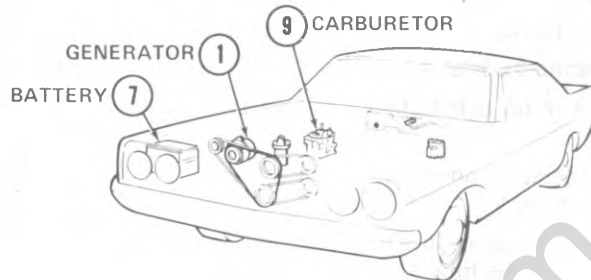
STEP	SEQUENCE	RESULT
<p>1</p> <p>CHECK GENERATOR BELT</p> <p>REPLACE IF NECESSARY ADJUST TENSION TO 80 LBS.</p> <p>MAKE SURE NO ACCESSORIES WERE LEFT ON, IGNITION OFF, DOORS CLOSED, UNDER HOOD LIGHTS DISCONNECTED</p>	<p>DISCONNECT NEGATIVE CABLE</p> <p>CONNECT TEST LIGHT BETWEEN CABLE & BATTERY POST</p>	<p>TEST LIGHT ON → GO TO STEP 2</p> <p>TEST LIGHT OFF → GO TO STEP 3</p> <p>TEST LIGHT OFF - NO DRAIN ON BATTERY</p>
<p>2</p> <p>TAP CABLE AGAINST POST</p> <p>TEST LIGHT ON</p> <p>TRACE & CORRECT CONTINUOUS DRAIN ON BATTERY</p>	<p>TEST LIGHT OFF → STOP</p> <p>TEST LIGHT ON → GO TO STEP 3</p>	
<p>3</p> <p>RECONNECT NEGATIVE CABLE</p> <p>CONNECT JUMPER (-) TERMINAL AND GROUND (ON H.E.I. DISCONNECT FEED WIRE)</p> <p>CONNECT VOLTMETER (+) TERMINAL AND GROUND</p> <p>CRANK ENGINE LONG ENOUGH FOR STABILIZED READING</p>	<p>NEEDLE ABOVE 9.0 VOLTS → GO TO STEP 6</p> <p>NEEDLE BELOW 9.0 VOLTS → GO TO STEP 4</p>	
<p>4</p> <p>CHECK VOLTAGE ACROSS POST WHILE CRANKING</p> <p>IF READING IS WITHIN .5 VOLT OF VOLTAGE AT GEN. → TEST BATTERY USING BATTERY LOAD TEST PROCEDURE</p> <p>IF READING IS NOT WITHIN .5 VOLT OF READING AT GEN. CHECK FOR BATTERY CABLE AND STARTER TO DELCOTRON CIRCUIT RESISTANCE</p>	<p>BATTERY OK CHARGE AS SPECIFIED BY TEST → GO TO STEP 6</p> <p>BATTERY NOT OK → GO TO STEP 5</p>	
<p>5</p> <p>REPLACE BATTERY</p>	<p>GO TO STEP 6</p>	


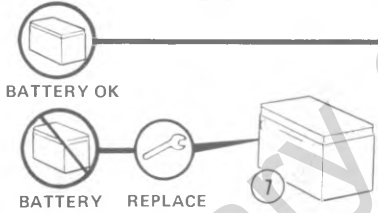

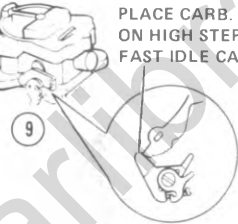
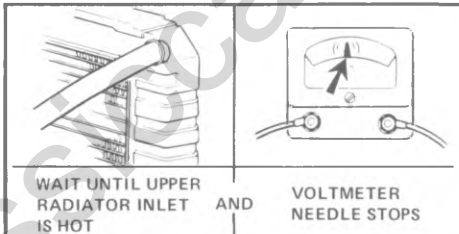

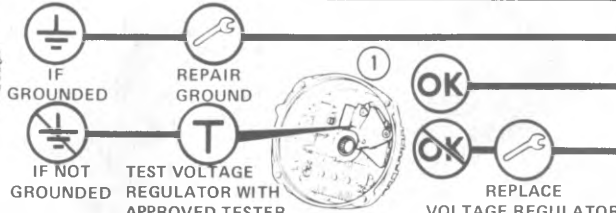

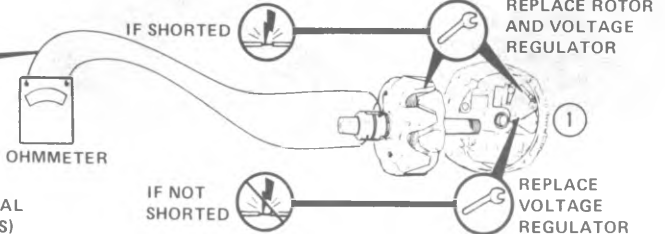
STEP	SEQUENCE	RESULT
<p>6</p>	<p>CONNECT VOLTMETER ACROSS BATTERY</p>  <p>DISCONNECT COIL JUMPER OR RECONNECT HEI FEED WIRE</p> <p>RECORD READING</p> <p>PLACE CARB. ON HIGH STEP FAST IDLE CAM</p>  <p>START ENGINE DO NOT TOUCH ACCELERATOR PEDAL</p>	<p>GO TO STEP 7</p>
<p>7</p>	<p>TURN ON ACCESSORIES</p>  <p>CHECK VOLTAGE READING</p> 	<p>IF VOLTAGE READS LOWER THAN PREVIOUS READING GO TO STEP 9</p> <p>IF VOLTAGE READS HIGHER THAN PREVIOUS READING GO TO STEP 8</p>
<p>8</p>	<p>TURN OFF ACCESSORIES</p>  <p>WAIT UNTIL UPPER RADIATOR INLET IS HOT</p> <p>AND</p> <p>VOLTMETER NEEDLE STOPS</p>  <p>CHECK VOLTAGE READING</p>	<p>IF METER READS UNDER 12.5 GO TO STEP 9</p> <p>IF METER READS OVER 15.5 GO TO STEP 10</p> <p>IF METER READS 12.5 TO 15.5 SEE NOTE STOP</p>
<p>9</p>	<p>GROUND GENERATOR</p>  <p>CHECK VOLTAGE READING</p> 	<p>IF VOLTAGE READS HIGHER THAN PREVIOUS READING GO TO STEP 10</p> <p>IF VOLTAGE READS LOWER THAN PREVIOUS READING GO TO STEP 11</p>
<p>10</p>	<p>TEST VOLTAGE REGULATOR WITH APPROVED TESTER</p>  <p>OK</p> <p>REPLACE VOLTAGE REGULATOR</p> 	<p>GO TO STEP 11</p> <p>STOP</p>
<p>11</p>	<p>OVERHAUL GENERATOR</p> 	<p>STOP</p>

NOTE: IF NOTHING HAS BEEN FOUND RE-EDUCATE OWNER ON EXCESSIVE IDLING, SLOW OR SHORT DISTANCE DRIVING WITH ALL ACCESSORIES ON.

Chart 5

PROBLEM:
battery OVERCHARGED
(uses too much water)



STEP	SEQUENCE	RESULT
<p>1</p>  <p>TEST BATTERY USING BATTERY LOAD TEST PROCEDURE</p>		<p>GO TO STEP 2</p> <p>GO TO STEP 2</p>
<p>2</p>  <p>CONNECT VOLTMETER ACROSS BATTERY</p>	<p>PLACE CARB. ON HIGH STEP FAST IDLE CAM</p>  <p>START ENGINE DO NOT TOUCH ACCELERATOR PEDAL</p>	<p>GO TO STEP 3</p>
<p>3</p> <p>TURN OFF ALL ACCESSORIES</p>	 <p>WAIT UNTIL UPPER RADIATOR INLET IS HOT AND VOLTMETER NEEDLE STOPS</p> <p>CHECK VOLTAGE READING</p>	<p>READING IS 12.5 to 15.5 STOP</p> <p>READING IS NOT 12.5 to 15.5 PERFORM NEXT TWO STEPS 4 & 5</p>
<p>4</p>  <p>CHECK FOR GROUNDED BRUSH LEAD CLIP</p>		<p>GO TO STEP 5</p> <p>GO TO STEP 5</p> <p>GO TO STEP 5</p>
<p>5</p>  <p>CHECK FOR SHORTED FIELD WINDINGS (SEE SERVICE MANUAL FOR SPECIFICATIONS)</p>		<p>STOP</p>

ON-VEHICLE SERVICE

GENERATOR ASSEMBLY

Replacement (Fig. 6D-7C)

1. Disconnect the battery ground cable at battery.
2. Disconnect wiring leads at generator.
3. Remove generator brace bolt, then detach drive belt (belts).
4. Support the generator and remove generator mount bolt and remove from vehicle.
5. Reverse the removal procedure to install then adjust drive belt(s) as outlined in Section 6A of this manual.

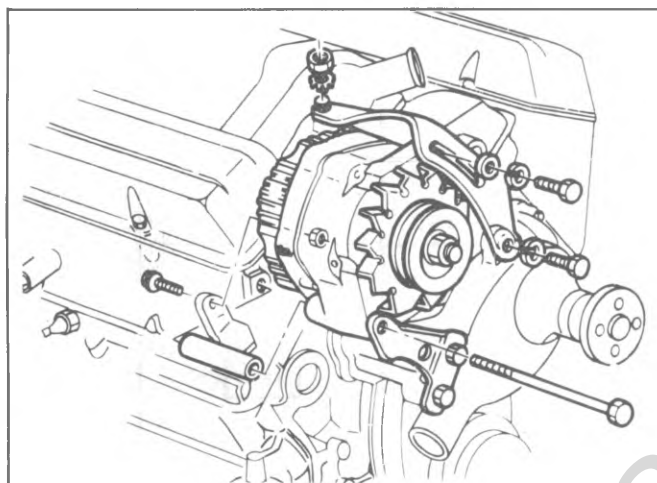


Fig. 6D-7C--Generator Installation Typical

GENERATOR PULLEY

Replacement

1. Place 15/16" box wrench on retaining nut and insert a 5/16" allen wrench into shaft to hold shaft while removing nut (fig. 6D-8C).
2. Remove washer and slide pulley, fan and spacer from shaft.
3. Reverse Steps 1 and 2 to install, use a torque wrench with a crow-foot adapter (instead of box wrench) and torque the nut to 50 ft. lbs. (fig. 6D-9C).

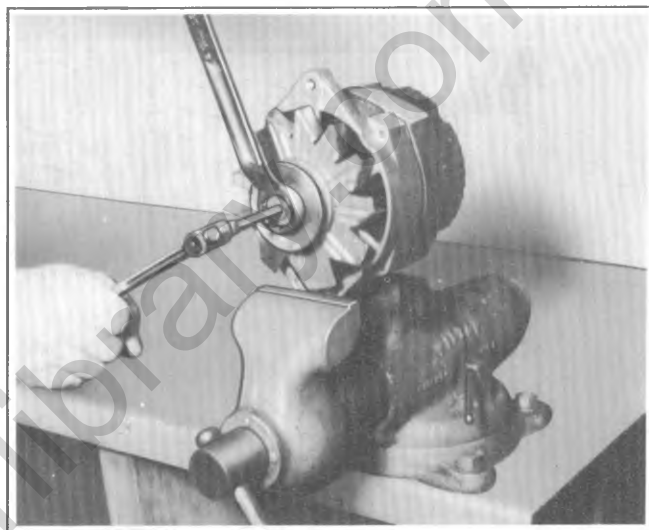


Fig. 6D-8C--Pulley Removal

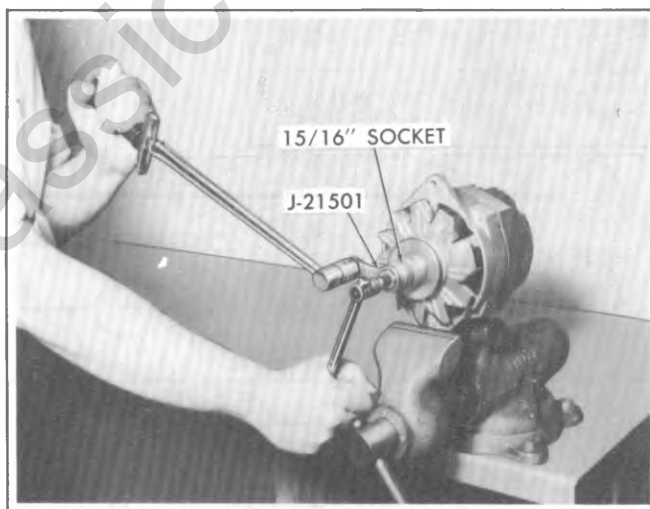


Fig. 6D-9C--Torquing Pulley Nut

UNIT REPAIR

DISASSEMBLY (FIG. 6D-1C)

1. Hold generator in a vise, clamping the mounting flange lengthwise.
2. Remove the four thru-bolts and separate the slip ring end frame and stator assembly from the drive end and rotor assembly by prying apart with a screwdriver at the stator slot.

NOTE: A scribe mark will help locate the parts in the same position during assembly.

3. Place a piece of tape over the slip ring end frame bearing to prevent entry of dirt and other foreign material, and also a piece of tape over the shaft at the slip ring end.

CAUTION: *Brushes may drop onto the rotor shaft and become contaminated with bearing lubricant. Clean brushes prior to installing with a non-toxic cleaner such as trichlorethylene or a soft dry cloth.*

4. Remove the stator lead attaching nuts and separate stator from end frame.

NOTE: At this point, with the two end frames separated the stator disconnected and the rotor removed electrical checks of the rotor, rectifier bridge, stator and diode trio brush lead clip may be made without further disassembly. Refer to the specific checks as outlined in this section.

5. Remove screw attaching diode trio to brush holder assembly and remove diode trio from end frame.

6. Remove the rectifier bridge attaching screw and the "BAT" terminal screw, and disconnect the capacitor lead. Remove rectifier bridge from the end frame.

7. Remove two attaching screws, and remove brush holder and regulator assemblies.

NOTE: Two insulators are assembled over the top of the brush retaining clips and the two screws have special insulating sleeves over the screw body.

8. Remove retaining screw and capacitor from end of frame.

9. Remove slip ring end frame bearing (if necessary). Refer to bearing replacement covered in this section.

10. Remove pulley retaining nut and slide washer, pulley, fan and spacer from shaft.

a. Single groove pulley--place 15/16" box wrench on the shaft nut and insert a 5/16" allen wrench into the shaft end hole to hold the shaft while removing the nut (fig. 6D-8C).

b. Double groove pulley--place a 15/16" socket (with wrench flats on the drive end or use adapter J-21501 and a box wrench on the pulley retaining nut, insert a 5/16" allen wrench through the socket and adapter into hex hole in the shaft to hold the shaft while removing the nut.

11. Remove rotor and spacers from the drive end frame assembly.

12. Remove drive end frame bearing retainer plate screws, plate, gasket, bearing, and slinger from end frame (if necessary).

CLEANING AND INSPECTION

With generator completely disassembled the components should be cleaned and inspected. Be sure testing equipment is in good working order before attempting to check the generator.

1. Wash all metal parts except stator and rotor assemblies.

2. Clean bearings and inspect for sealing, pitting or roughness.

3. Inspect rotor slip rings, they may be cleaned with 400 grain polishing cloth. Rotate rotor for this operation to prevent creating flat spots on slip rings.

4. Slip rings which are out of round may be trued in a lathe to .002" maximum indicator reading. Remove only enough material to make the rings smooth and concentric. Finish with 400 grain polishing cloth and blow dry.

5. Slip rings are not replaceable--excessive damage will require rotor assembly replacement.

6. Inspect brushes for wear. If they are worn halfway, replace. Inspect brush springs for distortion or weakening. If brushes appear satisfactory and move freely in brush holder, springs may be reused.

TESTING

Where specified, conduct the following tests using an ohmmeter with a 1-1/2 volt cell and use the lowest range scale for the readings.

Rotor Field Winding Checks (Fig. 6D-10C)

The rotor may be checked electrically with a 110-volt test lamp or an ohmmeter.

Open Circuit

Connect one test lamp or ohmmeter lead to each slip ring. If the lamp fails to light or if the ohmmeter reading is high, the windings are open.

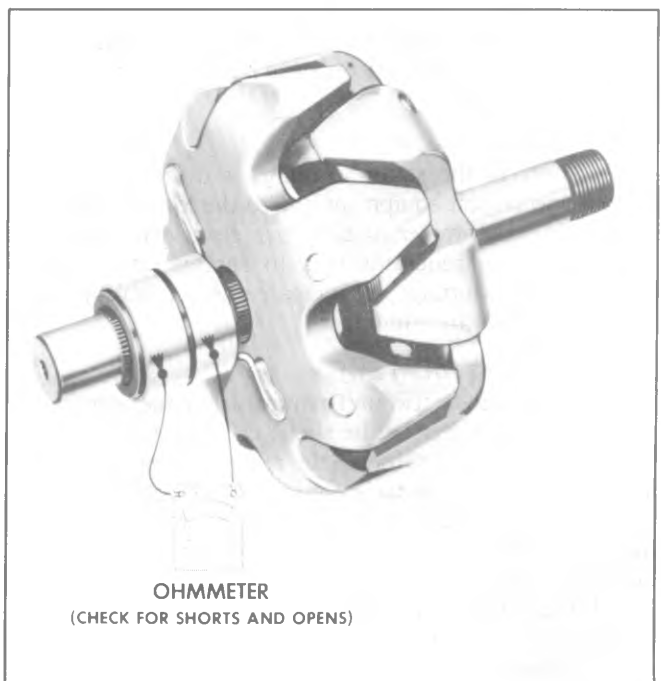


Fig. 6D-10C--Checking Rotor

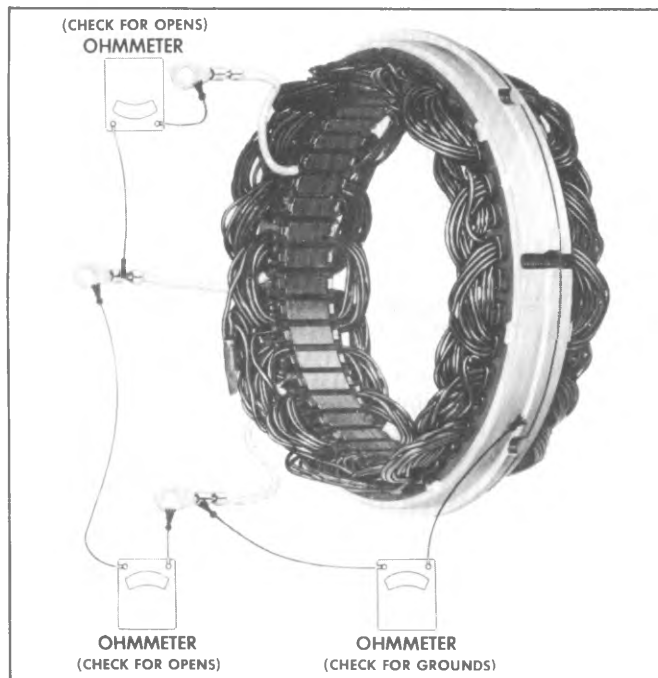


Fig. 6D-11C--Checking Stator

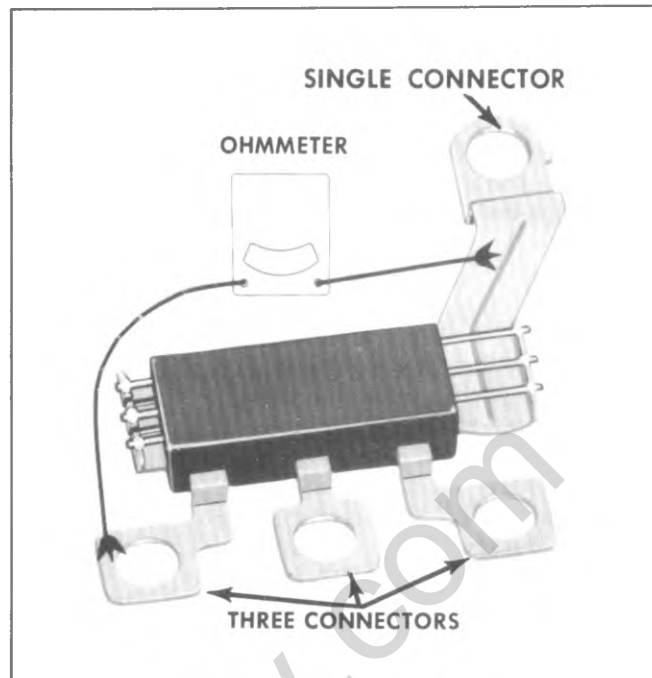


Fig. 6D-12C--Diode Trio Checks

Short Circuit

The windings are checked for shorts by connecting a 12 volt battery and an ammeter in series with the two slip rings. Note the ammeter reading. An ammeter reading above the specified field amperage draw indicates shorted windings. Refer to Specifications at the end of this manual.

Stator Checks (Fig. 6D-11C)

Grounds

Connect a 110-volt test lamp or an ohmmeter from any stator lead to the stator frame. If test lamp lights or if ohmmeter reads low, the windings are grounded.

Open Circuit

If lamp fails to light or if ohmmeter reads high when successively connected between each pair of stator leads, the windings are open.

Short Circuit

A short in the stator windings is difficult to locate without special test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings are indicated. Also, look for heat discoloration on the windings.

Diode Trio (Fig. 6D-12C)

With the diode trio unit remove from the end frame, connect an ohmmeter to the single connect and to one of the three connectors. Observe the reading, then reverse the ohmmeter leads to the same connectors. A good diode trio will give one high and one low reading. If both readings are the same, replace the diode trio. Repeat this test between the single connector and each of the other two connectors.

NOTE: There are two diode trio units differing in appearance used in the generator but they are completely interchangeable.

CAUTION: Do not use high voltage such as 110

volt test lamp to check the diode trio.

Rectifier Bridge Check (Fig. 6D-13C)

Connect an ohmmeter to the grounded heat sink and one of the three terminals. Then reverse the lead connections to the grounded heat sink and same terminal. If both readings are the same, replace the bridge. A good rectifier bridge will give one high and one low reading. Repeat this same test between the grounded heat sink and the other two terminals, and between the insulated heat sink and each of the three terminals. When this is done all six diodes are checked with two readings taken for each diode.

NOTE: The diodes are not replaced individually. The entire rectifier bridge is replaced if one or more diodes are defective.

CAUTION: Do not use high voltage to check the rectifier bridge, such as a 110 volt test lamp.

Voltage Reg./Brush Lead Clip Check (Fig. 6D-5C)

Connect an ohmmeter from the brush lead clip to the end frame as shown in Step 1, Figure 6D-7C. Then reverse lead connections. If both readings are zero, either the brush lead clip is grounded or the regulator is defective.

A grounded brush lead clip can result from omission of the insulating washer, omission of the insulating sleeve on the screw, or a damaged insulating sleeve. Remove the screw and inspect the sleeve. If it is satisfactory, replace the regulator unit.

REPAIRS

Brush Holder and Regulator Replacement (Fig. 6D-5C)

1. If not previously removed, remove the three stator lead attaching nuts, the stator, diode trio brush lead screw and diode trio from the end frame.

2. Remove the remaining two screws from the brush

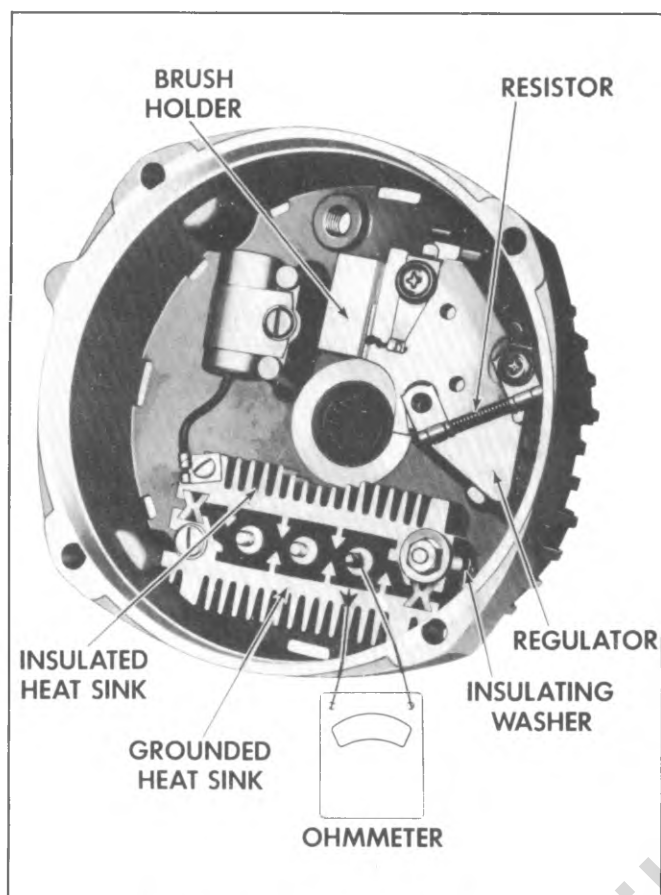


Fig. 6D-13C--Rectifier Bridge Checks

holder and regulator and remove these units from the end frame.

NOTE: The two screws retaining the brush clips have insulating washers over the tops of the brush clips and special insulating sleeves over the screw body above the threads. If they are damaged or missing a ground will result causing uncontrolled or no output.

3. Replace defective unit and reassemble using reverse of removal procedures.

NOTE: The screw nearest regulator terminals does not have an insulating washer, but may or may not have an insulating sleeve.

Slip Ring Servicing

If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the rotor, and hold the polishing cloth against the slip rings until they are clean.

CAUTION: *The rotor must be rotated in order that the slip rings will be cleaned evenly. Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.*

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

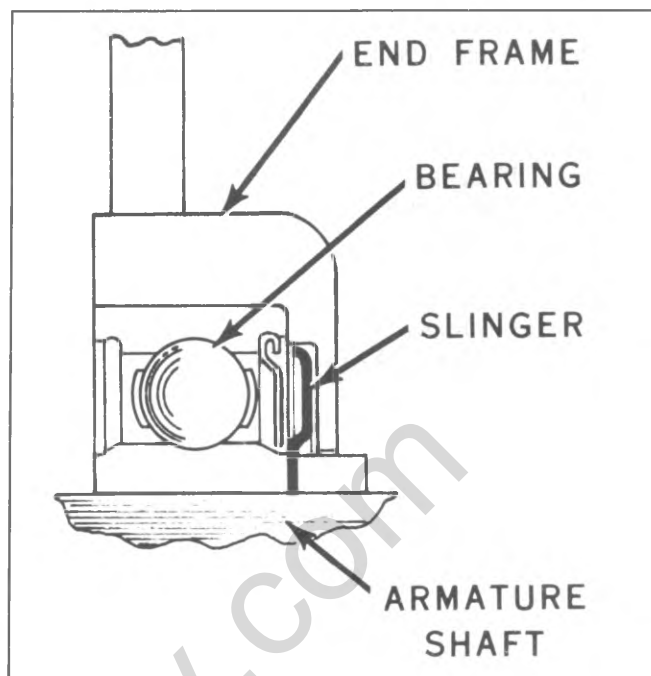


Fig. 6D-14C--Drive End Bearing Cross Section

Drive End Frame--Bearing Replacement/Lubrication

1. The drive end frame bearing can be removed by detaching the retainer plate bolts and separating retainer plate and seal assembly from end frame, and then pressing bearing out using suitable tube or pipe on outer race.

2. Refill bearing one-quarter full with Delco-Remy No. 1948791 grease or equivalent. Do not overfill.

3. Press bearing into end frame using tube or pipe as in Step 1 with bearing and slinger assembled as shown in Figure 6D-8C.

4. Install retainer plate. Use new retainer plate if felt seal is hardened or excessively worn.

NOTE: Stake retainer plate bolts to plate.

Slip Ring End Frame--Bearing Replacement

1. Replace the bearing if the grease supply is exhausted. Make no attempt to re-lubricate and reuse the bearing.

2. Press out from outside of housing, using suitable tool over outer race of bearing.

3. To install, place a flat plate over the bearing and press in from outside of housing until bearing is flush with the outside of the end frame. Support inside of end frame around bearing bore with a suitable tool to prevent distortion. Use extreme care to avoid misalignment.

4. Install new seal whenever bearing is replaced. Lightly coat the seal lip with oil and press seal into the end frame with the seal lip toward the inside of the end frame.

REASSEMBLY

1. Install rotor in drive end frame and attach spacer, fan, pulley, washer, and nut.

2. Using adapter J-21501, insert an allen wrench into hex shaped hole at end of shaft and torque the shaft nut to 40-50 ft. lbs. (fig. 6D-9C).

3. Install capacitor and retaining screw in slip ring end frame.

4. Position brush holder and regulator assemblies in end frame and install two retaining screws.

NOTE: The two screws retaining the brush clips have insulating washers over the top of the brush clips and special insulating sleeves over the screw body above the threads. If the third screw does not have an insulating sleeve, it must not be interchanged with either of the other two screws.

5. Position rectifier bridge to end frame. Install attaching screw and the "BAT" terminal screw. Connect capacitor lead to bridge.

6. Position diode trio on rectifier bridge terminal and

install screw attaching brush lead clip to brush holder.

CAUTION: *Insulating washer on the screw must be assembled over top of the connector.*

7. Position stator in end frame. Connect stator leads to rectifier bridge terminals and install attaching nuts.

8. Position slip ring end frame to drive end frame and install four thru bolts.

NOTE: Remove tooth pick from brush holder at opening in slip ring end frame before operating machine on vehicle.

SPECIAL TOOLS

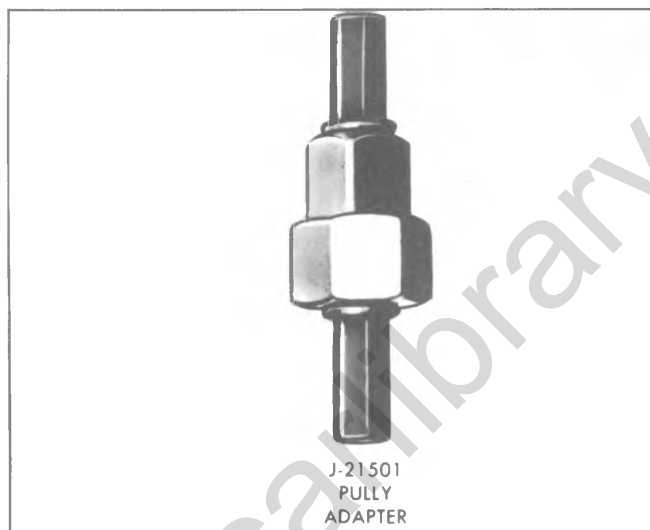


Fig. 6D-15C--Special Tool

IGNITION SYSTEM

DISTRIBUTOR

GENERAL DESCRIPTION

Both the 8 cylinder and 6 cylinder distributors (Fig. 6D-1i) combine all ignition components in one unit. The ignition coil is in the distributor cap and connects directly to the rotor. Operation is the same as a conventional ignition system except the module and pick-up coil of the HEI system replace the contact points of the conventional system.

The High Energy Ignition is a pulse triggered, transistor controlled, inductive discharge ignition system. The magnetic pick-up assembly located inside the distributor contains a permanent magnet, a pole piece with internal teeth, and a pick-up coil. When the teeth of the timer core rotating inside the pole piece line up with teeth of the pole piece, an induced voltage in the pick-up coil signals the all electronic module to open the coil primary circuit. The primary current decreases and a high voltage is induced in the ignition coil secondary winding which is directed through the rotor and high voltage leads to fire the spark

plugs. The capacitor in the distributor is for radio noise suppression.

The module automatically controls the dwell period, stretching it with increasing engine speed. The HEI system also features a longer spark duration, made possible by the higher amount of energy stored in the coil primary. This is desirable for firing lean and EGR diluted mixtures.

Ignition Coil

The ignition coil is built into the distributor cap. The coil is somewhat smaller physically than a conventional coil, but has more primary and secondary windings. It is built more like a true transformer with the windings surrounded by the laminated iron core. A conventional coil has the iron core inside the windings. Although the HEI coil operates in basically the same way as a conventional coil, it is more effective in generating higher secondary voltage when the primary circuit is broken.

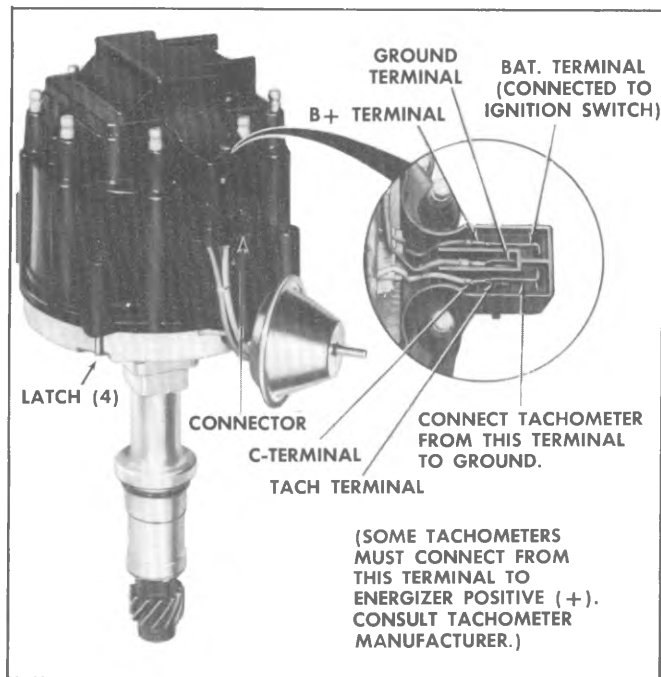


Fig. 6D-1i-8 Cylinder HEI Distributor

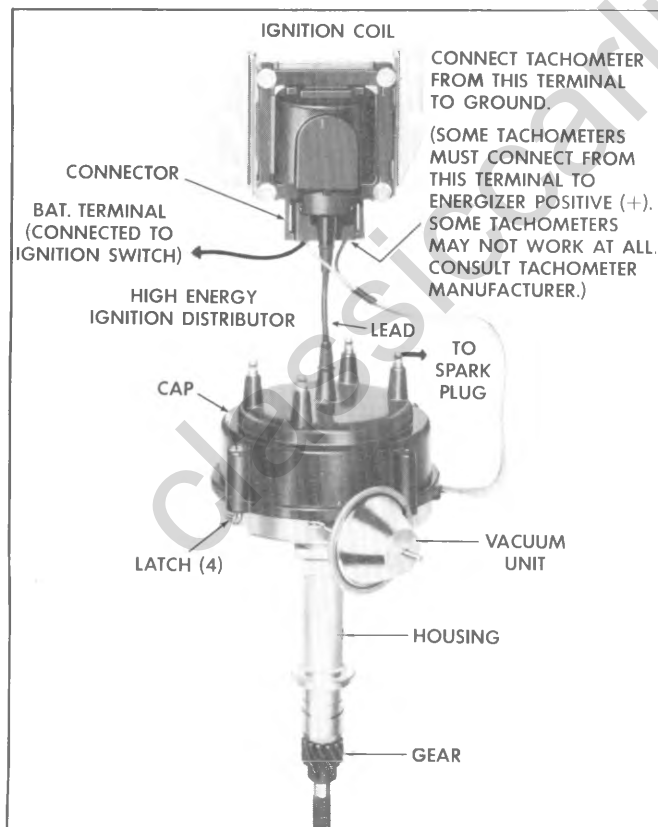


Fig. 6D-2i-6 Cylinder HEI Distributor

Electronic Module

The electronic module is a solid state unit containing five complete circuits which control spark triggering, switching, current limiting, dwell control and distributor pick-up. Dwell angle is controlled by a transistor circuit within the module and is varied in direct relation to engine speed.

Pick-Up Assembly

The pick-up assembly consists of the following:

1. A rotating timer core with external teeth which is turned by the distributor shaft.
2. A stationary pole piece with internal teeth.
3. A pick-up coil and magnet which are located between the pole piece and a bottom plate.

Centrifugal and Vacuum Advance

The centrifugal and vacuum advance mechanisms are basically the same types of units that provide spark advance in the breaker-type system. Centrifugal advance is achieved through the rotation of the timer core in relation to the distributor shaft. Vacuum advance is achieved by attaching the pick-up coil and pole piece to the vacuum advance unit actuating arm.

Wiring (Fig. 6D-3i)

The pick-up coil is connected to transistors in the electronic module. The electronic module is connected to the primary windings in the coil. As the distributor shaft turns the timer core teeth out of alignment with the teeth of the pole piece a voltage is created in the magnetic field of the pick-up coil.

The pick-up coil sends this voltage signal to the electronic module, which determines from RPM when to start current building in the primary windings of the ignition coil.

Each time the timer core teeth align with the pole piece teeth the pick-up coil magnetic field is changed creating a different voltage. The pick-up coil sends this different voltage signal to the electronic module which electronically shuts off the ignition coil primary circuit. This in turn collapses the coil magnetic field, induces high secondary voltage and fires one spark plug.

The electronic module delivers full battery voltage to the ignition coil which is limited to five to six amperes. There is no primary resistance wire in the HEI system. The electronic module triggers the closing and opening of the primary circuit instantaneously with no energy lost due to breaker point arcing or capacitor charging time lag. The capacitor in the HEI unit functions only as a radio noise suppressor.

This instantaneous and efficient circuit triggering enables the HEI system to deliver up to approximately 35,000 volts through the secondary wiring to the spark plugs.

Because of the higher voltage, the HEI system has larger diameter (8 millimeter) spark plug wires with silicone insulation. The silicone wire is gray in color, more heat resistant than standard black wire and less vulnerable to deterioration. Silicone insulation is soft, however, and must not be mishandled.

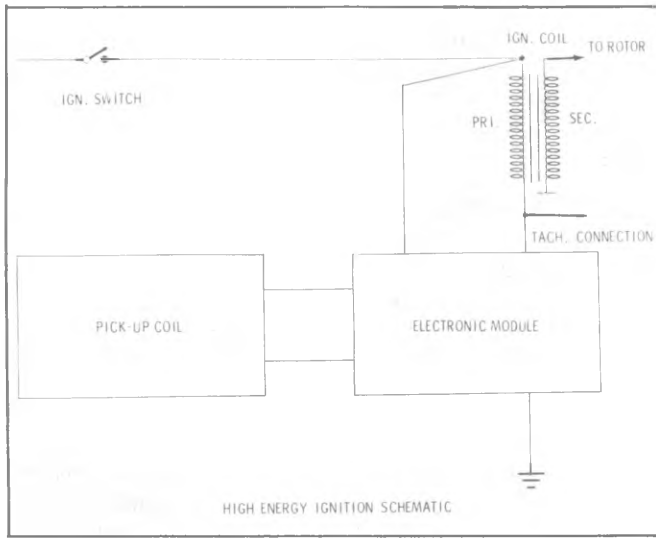


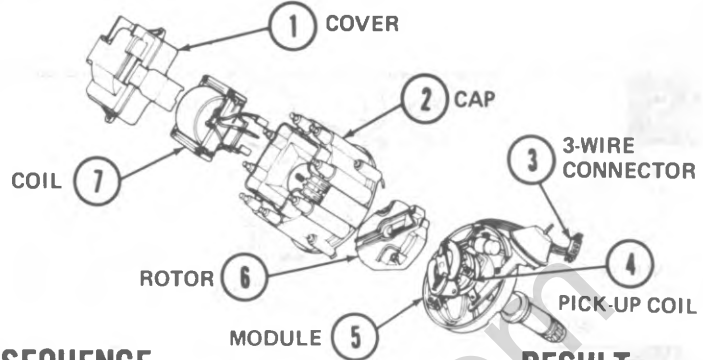
Fig. 6D-3i--High Energy Ignition Basic Wiring

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DIAGNOSIS

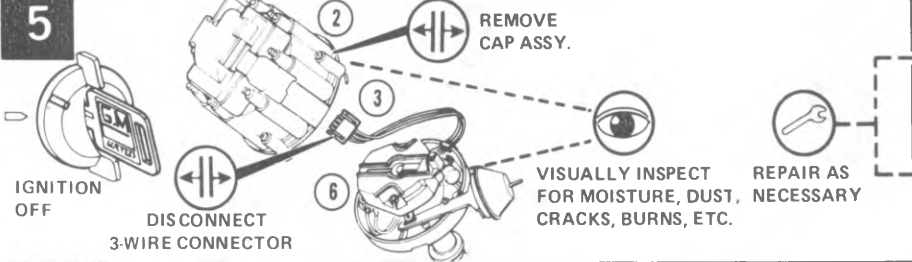
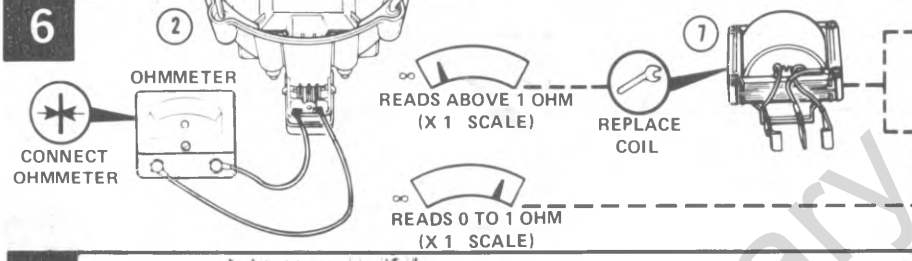
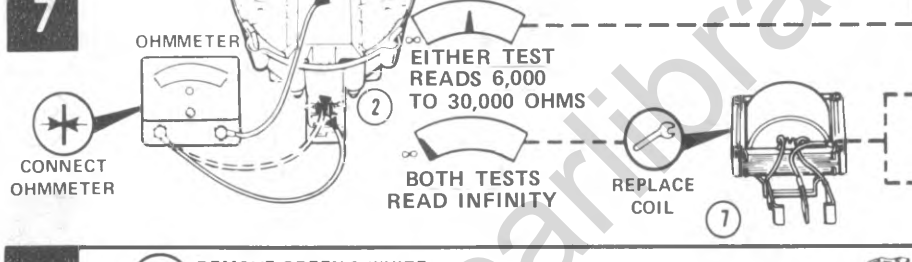
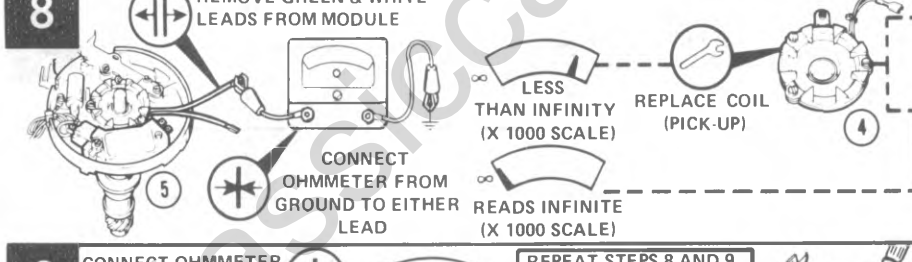
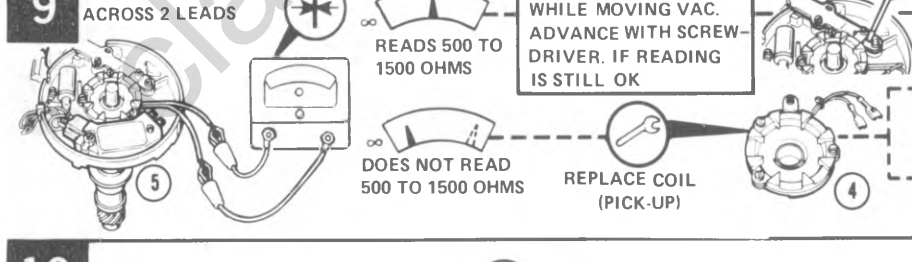
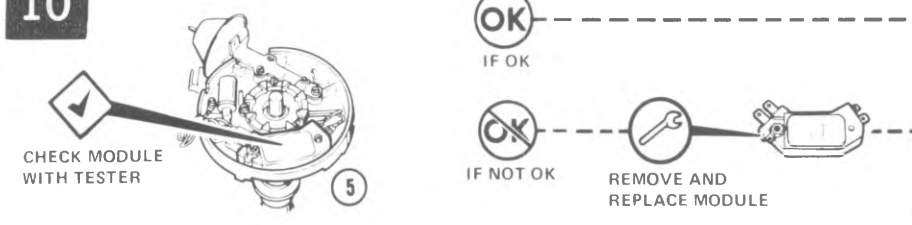
HIGH ENERGY IGNITION SYSTEM V8 engine

PROBLEM:
engine **CRANKS** but
WILL NOT START




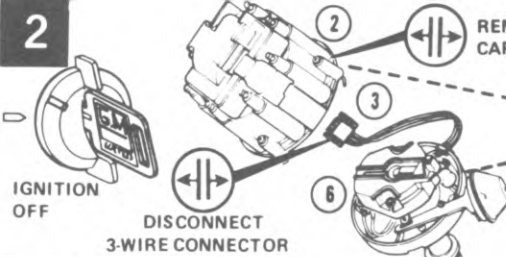
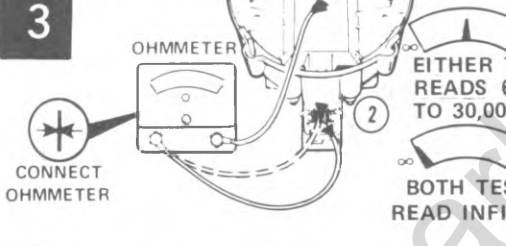
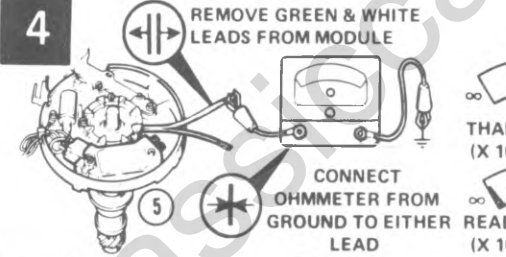
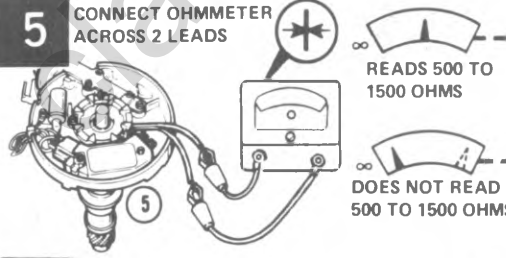
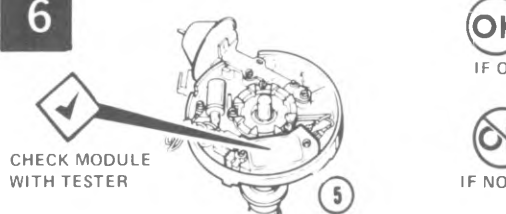
STEP	SEQUENCE	RESULT
<p>1</p>		<p>TEST LIGHT ON 4</p> <p>TEST LIGHT OFF 3</p>
<p>2</p>	<p>TEST LIGHT OFF</p> <p>REPAIR LEAD OR CONNECTOR</p> <p>TEST LIGHT ON</p> <p>TEST LIGHT ON</p>	<p>STARTS STOP</p> <p>NO START 5</p> <p>TEST LIGHT ON 5</p>
<p>3</p>	<p>REPAIR OR REPLACE AS NECESSARY</p> <p>TEST LIGHT ON</p>	<p>STARTS STOP</p> <p>NO START 4</p>
<p>4</p> <p>REMOVE A SPARK PLUG WIRE, INSERT EXTENSION AND PERFORM SPARK TEST</p> <p>USING INSULATED PLIERS HOLD SPARK PLUG WIRE 1/4" AWAY FROM ENG. BLOCK WHILE CRANKING ENGINE</p>		<p>NO SPARK 2</p> <p>SPARK</p> <p>PROBLEM IS NOT IGNITION SYSTEM CHECK</p> <ul style="list-style-type: none"> • FUEL SYSTEM • PLUGS • FLOODED

HIGH ENERGY IGNITION SYSTEM V8 engine

STEP	SEQUENCE	RESULT
5	 <p>IGNITION OFF</p> <p>DISCONNECT 3-WIRE CONNECTOR</p> <p>REMOVE CAP ASSY.</p> <p>VISUALLY INSPECT FOR MOISTURE, DUST, CRACKS, BURNS, ETC.</p> <p>REPAIR AS NECESSARY</p>	<p>STARTS → STOP</p> <p>NO START → 6</p>
6	 <p>CONNECT OHMMETER</p> <p>OHMMETER</p> <p>READS ABOVE 1 OHM (X 1 SCALE)</p> <p>REPLACE COIL</p> <p>READS 0 TO 1 OHM (X 1 SCALE)</p>	<p>STARTS → STOP</p> <p>NO START → 7</p>
7	 <p>CONNECT OHMMETER</p> <p>OHMMETER</p> <p>EITHER TEST READS 6,000 TO 30,000 OHMS</p> <p>BOTH TESTS READ INFINITY</p> <p>REPLACE COIL</p>	<p>STARTS → STOP</p> <p>NO START → 8</p>
8	 <p>REMOVE GREEN & WHITE LEADS FROM MODULE</p> <p>CONNECT OHMMETER FROM GROUND TO EITHER LEAD</p> <p>LESS THAN INFINITY (X 1000 SCALE)</p> <p>REPLACE COIL (PICK-UP)</p> <p>READS INFINITE (X 1000 SCALE)</p>	<p>STARTS → STOP</p> <p>NO START → 9</p>
9	 <p>CONNECT OHMMETER ACROSS 2 LEADS</p> <p>READS 500 TO 1500 OHMS</p> <p>REPEAT STEPS 8 AND 9 WHILE MOVING VAC. ADVANCE WITH SCREWDRIVER. IF READING IS STILL OK</p> <p>DOES NOT READ 500 TO 1500 OHMS</p> <p>REPLACE COIL (PICK-UP)</p>	<p>STARTS → STOP</p> <p>NO START → 10</p>
10	 <p>CHECK MODULE WITH TESTER</p> <p>OK IF OK</p> <p>IF NOT OK REMOVE AND REPLACE MODULE</p>	<p>REPEAT STEPS 5 THRU 9</p> <p>STOP</p>

HIGH ENERGY IGNITION SYSTEM V8 engine

PROBLEM: engine RUNS ROUGH or CUTS OUT

STEP	SEQUENCE	RESULT
1	 <p>CHECK SPARK PLUGS & PLUG WIRES</p> <p>OK</p> <p>REPAIR OR REPLACE</p>	<p>2</p> <p>STOP</p> <p>RUNS SMOOTH</p> <p>2</p> <p>RUNS ROUGH</p>
2	 <p>IGNITION OFF</p> <p>DISCONNECT 3-WIRE CONNECTOR</p> <p>REMOVE CAP ASSY.</p> <p>VISUALLY INSPECT FOR MOISTURE, DUST, CRACKS, BURNS, ETC.</p> <p>REPAIR AS NECESSARY</p>	<p>STOP</p> <p>RUNS SMOOTH</p> <p>3</p> <p>RUNS ROUGH</p>
3	 <p>OHMMETER</p> <p>CONNECT OHMMETER</p> <p>EITHER TEST READS 6,000 TO 30,000 OHMS</p> <p>BOTH TESTS READ INFINITY</p> <p>REPLACE COIL</p>	<p>4</p> <p>STOP</p> <p>RUNS SMOOTH</p> <p>4</p> <p>RUNS ROUGH</p>
4	 <p>REMOVE GREEN & WHITE LEADS FROM MODULE</p> <p>CONNECT OHMMETER FROM GROUND TO EITHER LEAD</p> <p>LESS THAN INFINITY (X 1000 SCALE)</p> <p>REPLACE COIL (PICK-UP)</p> <p>READS INFINITE (X 1000 SCALE)</p>	<p>STOP</p> <p>RUNS SMOOTH</p> <p>6</p> <p>RUNS ROUGH</p> <p>5</p>
5	 <p>CONNECT OHMMETER ACROSS 2 LEADS</p> <p>READS 500 TO 1500 OHMS</p> <p>REPEAT STEPS 4 AND 5 WHILE MOVING VAC. ADVANCE WITH SCREW-DRIVER. IF READING IS STILL OK</p> <p>DOES NOT READ 500 TO 1500 OHMS</p> <p>REPLACE COIL (PICK-UP)</p>	<p>6</p> <p>STOP</p> <p>RUNS SMOOTH</p> <p>6</p> <p>RUNS ROUGH</p>
6	 <p>CHECK MODULE WITH TESTER</p> <p>IF OK</p> <p>IF NOT OK</p> <p>REMOVE AND REPLACE MODULE</p>	<p>REPEAT STEPS 1 THRU 5</p> <p>STOP</p>

ON-VEHICLE SERVICE

MAINTENANCE AND ADJUSTMENTS

Routine Maintenance

The HEI system is designed to be free from routine maintenance. If component part replacement should become necessary, however, several items specific to the HEI system should be noted.

Electronic Module

the electronic module is serviced by complete replacement only. When replacing the module a liberal coating of special silicone grease **MUST** be applied to the metal mounting surface on which the module will be installed. If this grease is not applied the module will not cool properly which can cause the module to malfunction. A tube of this special silicone grease is supplied with each replacement module.

Spark Plug Wires (Figs. 6D-4i, 6D-5i)

The 8 millimeter silicone insulation spark plug wire boots seal more tightly to the spark plugs. Twist the boot about a half turn in either direction to break the seal before pulling on the boot to remove the wire.

WARNING: Do Not remove spark plug wires with the engine running. The higher secondary voltage is capable of jumping an arc of greater distance and could cause an electric shock.

Timing Light Connections

Timing light connections should be made in parallel using an adapter at the distributor number one terminal.

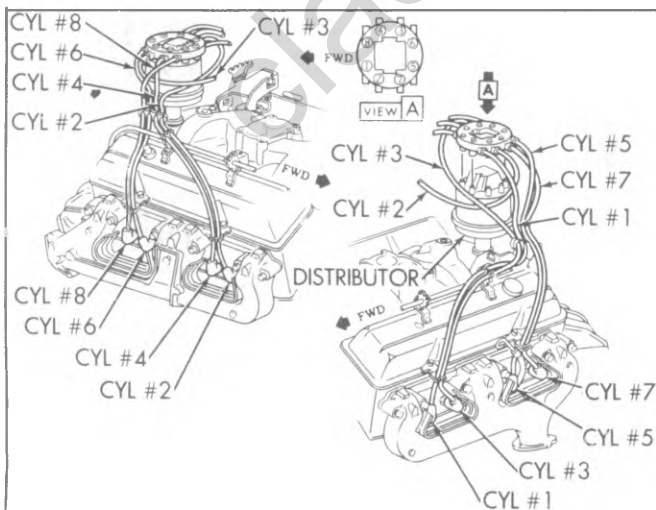


Fig. 6D-4i-8 Cylinder HEI Ignition Wiring

Tachometer Connections

In the distributor cap connector is a "tach" terminal. Connect the tachometer to this terminal and to ground. Some tachometers must connect from the "tach" terminal to the battery positive (+) terminal. Follow tachometer manufacturer's instructions.

CAUTION: Grounding "tach" terminal could damage the HEI electronic module.

Other Test Equipment

Oscilloscopes require special adaptors. Distributor machines require a special amplifier. The equipment manufacturers have instructions and details necessary to modify test equipment for HEI diagnosis.

Vacuum and Centrifugal

Advance Specifications

Vacuum and centrifugal advance specifications are listed in the Specifications Section of this manual.

COMPONENT PART REPLACEMENT

Distributor

Removal

1. Disconnect wiring harness connectors at side of distributor cap.
2. Remove distributor cap and position out of way.
3. Disconnect vacuum advance hose from vacuum advance mechanism.
4. Scribe a mark on the engine in line with rotor. Note approximate position of distributor housing in relation to engine.
5. Remove distributor hold-down nut and clamp.
6. Lift distributor from engine.

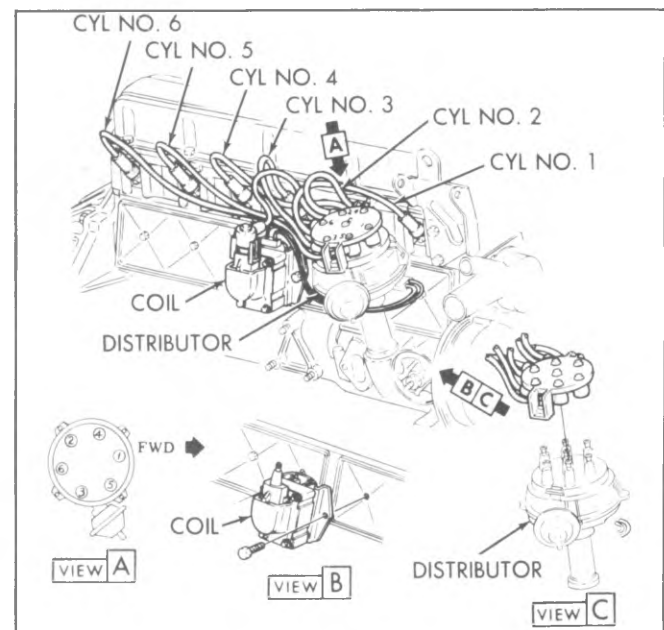


Fig. 6D-5i-6 Cylinder HEI Ignition Wiring

Installation

1. Install distributor using same procedure as for standard distributor.
2. Install distributor hold-down clamp and snugly install nut.
3. Move distributor housing to approximate position relative to engine noted during removal.
4. Position distributor cap to housing with tab in base of cap aligned with notch in housing and secure with four latches.
5. Connect wiring harness connector to terminals on side of distributor cap. Connector will fit only one way.
6. Adjust ignition timing as described in Specification Chart in Section 6E of this manual.

Distributor

Disassembly (Figs. 6D-6i and 6D-8i)

1. Remove distributor as described above.
2. Remove rotor from distributor shaft by removing two screws.
3. Remove two advance springs, weight retainer, and advance weights.
4. Remove two screws holding module to housing and move module to a position where connector may be removed from 'B' and 'C' terminals.
5. Remove wires from "W" and "G" terminals of module.
6. Remove roll pin from drive gear.

CAUTION: *Distributor gear should be supported in such a way that no damage will occur to distributor shaft while removing pin.*
7. Remove gear, shim and tanged washer from distributor shaft. Remove any burrs that may have been caused by removal of pin.
8. Remove distributor shaft from housing.
9. Remove washer from upper end of distributor housing.
10. Remove lock ring at top of housing and remove pole piece and plate assembly and felt washer.

NOTE: No attempt should be made to service the shaft bushings in the housing.
11. Remove vacuum advance mechanism by removing two screws.
12. Disconnect capacitor lead and remove capacitor by removing one screw.
13. Remove wiring harness from distributor housing.

Assembly (Figs. 6D-6i - 6D-9i)

1. Position vacuum advance unit to housing and secure with two screws.
2. Position felt washer over lubricant reservoir at top of housing.
3. Lubricate felt wick with a few drops of motor oil and install replacement pole piece and plate assembly over upper bushing and vacuum advance unit. Make sure the connector or retainer (bow) that holds the white and green electrical leads together is color coded yellow.
4. Install lock ring pole piece and plate assembly.
5. Place distributor shaft (with rotor attached) in distributor housing.
6. On 8 cylinder distributors, install tanged washer, shim and drive gear on distributor shaft.
7. On 6 cylinder distributors, install drive gear on

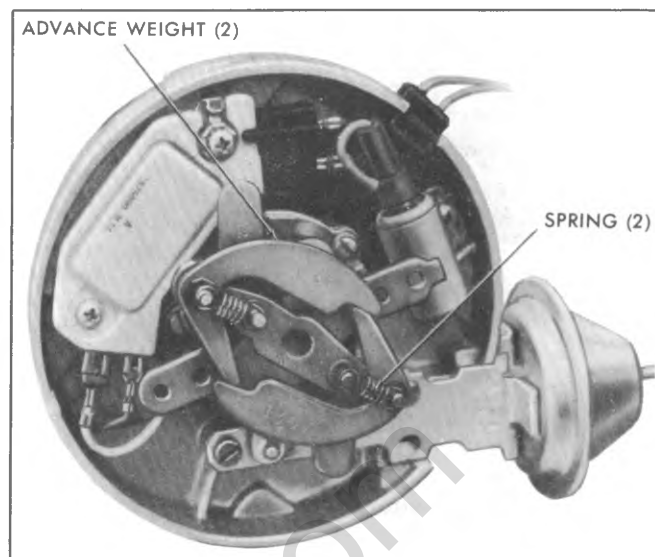


Fig. 6D-6i—Distributor Centrifugal Advance

distributor shaft.

8. Align holes of drive gear with hole of distributor shaft so that locating mark on drive gear is in line with tip of rotor. Support distributor shaft on a wooden block or other suitable object and install roll pin. Make sure distributor is supported in such a way that no damage will occur to distributor shaft while installing roll pin.

9. Check to make sure shaft is not binding by spinning shaft a few times by hand.

10. Position capacitor to housing and loosely install one mounting screw.

11. Install connector to "B" and "C" terminals on module with tab on top.

12. Apply special silicone lubricant liberally to bottom of module and secure with two screws.

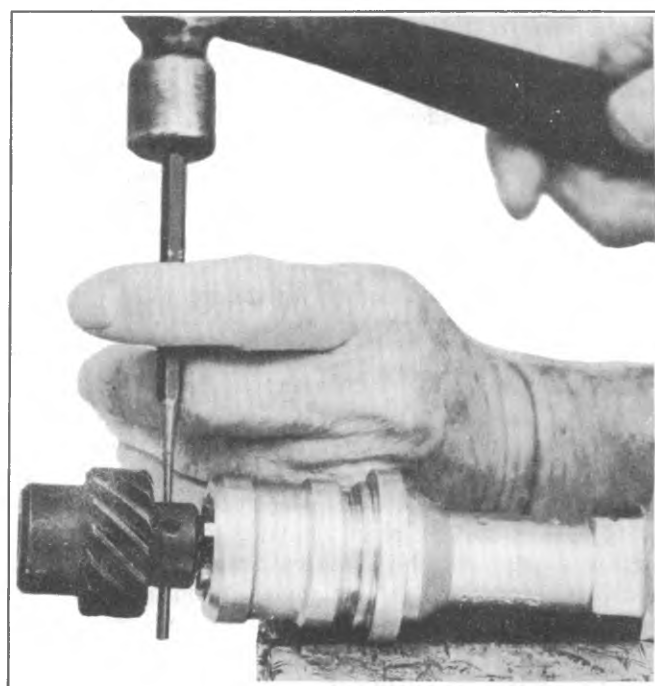


Fig. 6D-7i—Roll Pin Removal

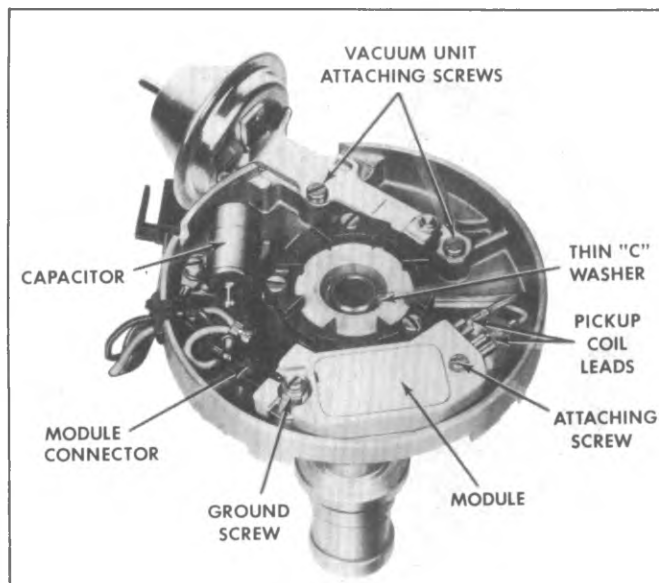


Fig. 6D-8i--Top View of Distributor Housing

13. Position wiring harness with grommet in housing notch.

14. Connect pink wire to capacitor stud, and black wire to capacitor mounting screw. Tighten screw.

15. Connect white wire from pick-up coil to terminal "W" module.

16. Connect green wire from pick-up coil to terminal "G" of module.

17. Install centrifugal advance weights, weight retainer (dimple facing down), and springs.

18. Install rotor and secure with two screws.

CAUTION: *Notch on side of rotor must engage tab on cam weight base.*

19. Install distributor as described above.

Electronic Module

Replacement (Fig. 6D-8i)

The electronic module is serviced by complete replacement only. When replacing the module a liberal coating of special silicone grease **MUST** be applied to the metal mounting surface on which the module will be installed. If this grease is not applied, the module will not cool properly, which can cause the module to malfunction. A tube of this special silicone grease is supplied with each replacement module.

1. Raise hood and remove air cleaner.

2. Release distributor cap and place aside in an out-of-the-way place.

3. Remove two screws and remove rotor from distributor shaft.

4. Remove two screws holding module to housing and move module to a position where electrical connector may be removed from B and C terminals of module.

5. Use needle nose pliers or similar tool to remove pole piece and plate assembly electrical leads from W (White) and G (Green) terminals of module. Do not remove leads by pulling on the wires as damage to the leads may occur.

6. Install replacement module in reverse order of removal. During installation, make sure a liberal amount of special silicone grease is applied to the metal mounting

surface of module to insure proper cooling.

7. Check operation of new module by starting and running vehicle.

Pole Piece and Plate Assembly

Replacement (Figs. 6D-7i - 6D-9i)

The pole piece and plate assembly is serviced by complete replacement only. The three screws securing stationary pole piece and permanent magnet should not be disturbed except under extreme conditions since the pole piece is adjusted by the factory to critical dimensions. During replacement, make sure the replacement pole piece and plate assembly is the correct specified part. One quick method of assuring a correct part is to observe the connector or retainer (bow) that holds the white and green electrical leads together is color coded yellow. The correct pole piece and plate assembly for all 6 and 8 cylinder engines is color coded yellow.

1. Remove distributor as described previously in this section.

2. Support distributor gear on a block of wood or other suitable object (Fig. 6D-7i) and drive roll pin from drive gear. Make sure distributor is supported in such a way that no damage will occur to distributor shaft while removing roll pin.

3. On 8 cylinder distributors, remove drive gear, shim and tanged washer from distributor shaft.

4. On 6 cylinder distributors, remove drive gear from distributor shaft.

5. Remove any burrs that may have been caused by removal of roll pin and remove shaft (with rotor attached) from distributor housing.

6. Use needle nose pliers or similar tool to remove pole piece and plate assembly electrical leads from W (white) and G (Green) terminals of module. Do not remove leads by pulling on the wires as damage to the leads may occur.

7. Remove lock ring from top of pole piece and plate assembly (Fig. 6D-8i) and remove pole piece and plate assembly from distributor housing.

8. Lubricate felt wick with a few drops of motor oil and install replacement pole piece and plate assembly over upper bushing and vacuum advance unit. Make sure the connector or retainer (bow) that holds the white and green electrical leads together is color coded yellow.

9. Install lock ring (Fig. 6D-8i) and then connect green electrical lead of pole piece and plate assembly to G terminal of module. Then connect white lead of pole piece and plate assembly to W terminal of module.

10. Place distributor shaft (with rotor attached) in distributor housing.

11. On 8 cylinder distributors, install tanged washer, shim and drive gear on distributor shaft.

12. On 6 cylinder distributors, install drive gear on distributor shaft.

13. Align holes of drive gear with hole of distributor shaft so that locating mark on drive gear is in line with tip of rotor. Support distributor shaft on a wooden block or other suitable object and install roll pin. Make sure distributor is supported in such a way that no damage will occur to distributor shaft while installing roll pin.

14. Check to make sure shaft is not binding by spinning shaft a few times by hand.

15. Install distributor as described previously in this

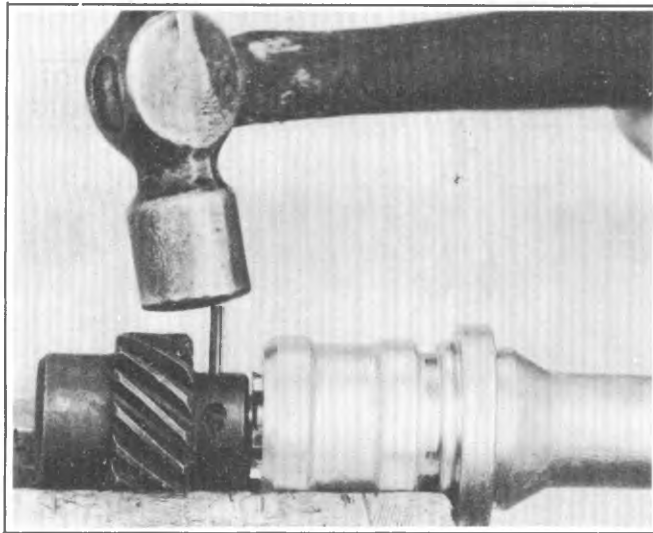


Fig. 6D-9i--Roll Pin Installation

section.

Ignition Coil

Removal (Fig. 6D-10i)

1. Disconnect battery wire and harness connector from distributor cap.
2. Remove three screws securing coil cover to distributor cap.
3. Remove four screws securing ignition coil to distributor cap.
4. Remove ground wire from coil.
5. Push coil leads from under side of connectors and remove coil from distributor cap.

Installation (Fig. 6D-10i)

1. Position coil into distributor cap with terminals over connector at side of cap.
2. Push coil lead wires into connector on side of cap as follows: black (ground) in center; brown next to vacuum advance unit; pink opposite vacuum advance unit.
3. Secure ignition coil with four screws. Place ground wire under coil mounting screw.
4. Install coil cover onto distributor cap and secure with three screws.

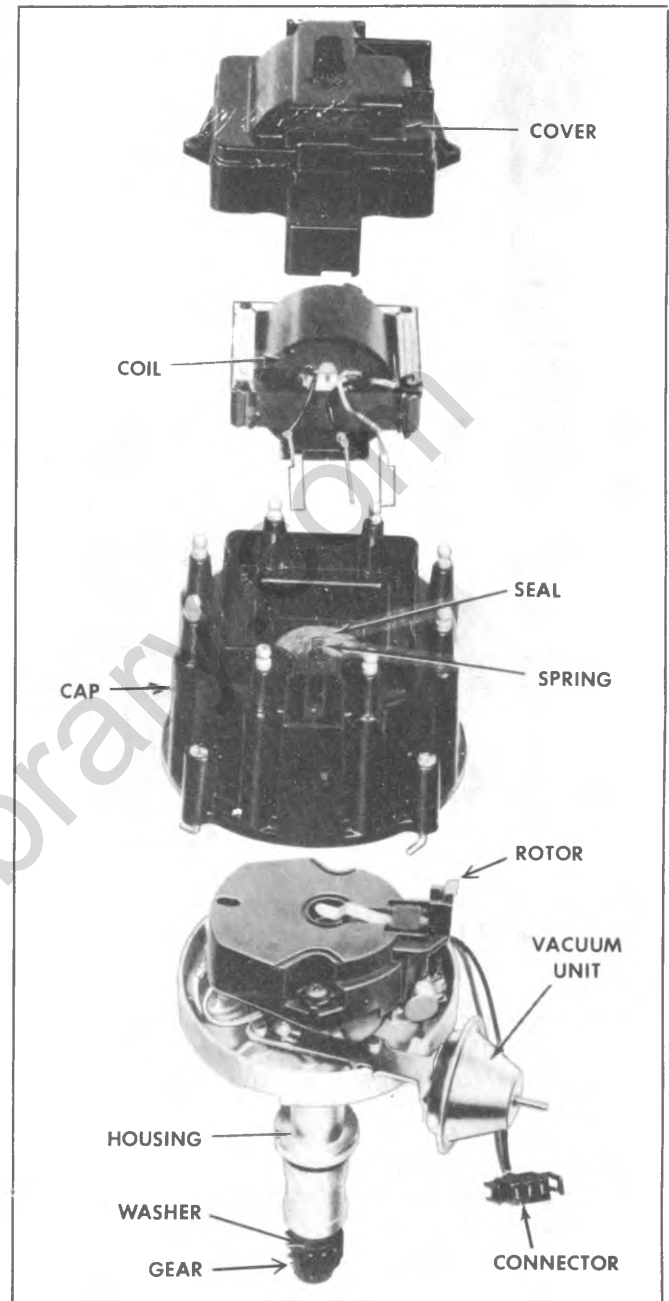


Fig. 6D-10i--Exploded View of 8 Cylinder HEI Distributor

SPARK PLUGS

GENERAL DESCRIPTION

The spark plug (Fig. 6D-11i) consists of a metal shell in which is fastened a porcelain insulator and an electrode extending through the center of the insulator. The metal shell has a short electrode attached to one side and bent in toward the center electrode. There are threads on the metal shell that allow it to be screwed into a tapped hole in the cylinder head. The two electrodes are of special heavy wire, and there is a specified gap between them. The electric spark jumps this gap to ignite the air-fuel mixture in the combustion chamber, passing from the center, or insulated,

electrode. The seals between the metal base, porcelain, and center electrode, as well as the porcelain itself, must be able to withstand the high pressure and temperature created in the combustion chamber during the power stroke.

Some spark plugs have been supplied with a built-in resistor which forms part of the center electrode. The purpose of this resistor is to reduce radio and television interference from the ignition system as well as to reduce spark-plug-electrode erosion caused by excessively long sparking. We have been talking of the high-voltage surge

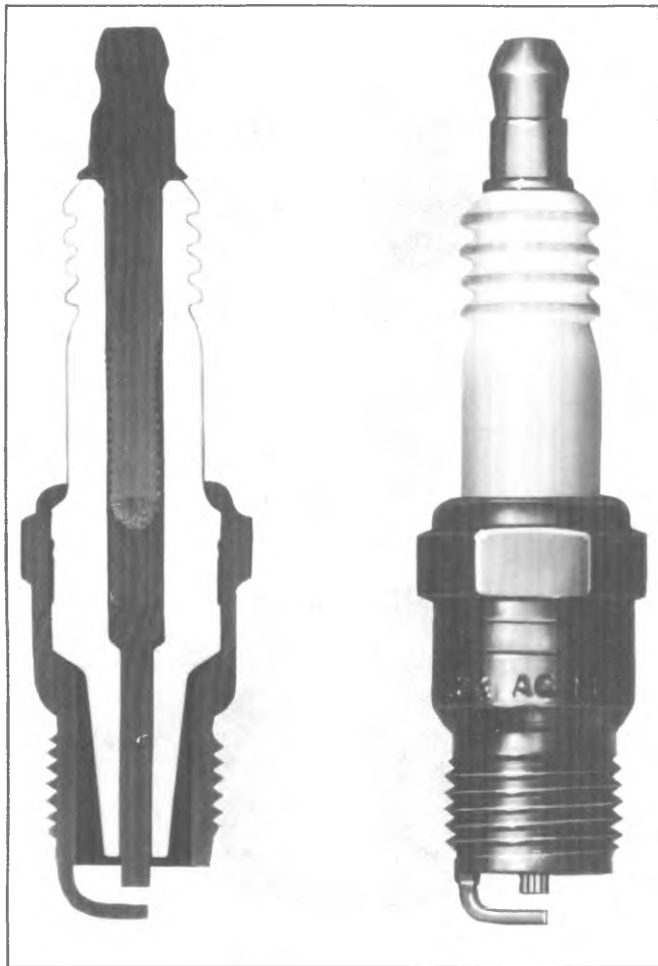


Fig. 6D-11i--Cross-Section of Spark Plug

from the ignition-coil secondary as though it were a single powerful surge that almost instantly caused the spark to jump across the spark plug gap. Actually, the action is more complex than that. There may be a whole series of preliminary surges before a full-fledged spark forms. At the end of the sparking cycle the spark may be quenched and may reform several times. All this takes place in only a few ten-thousandths of a second. The effect is that the ignition wiring acts like a radio transmitting antenna; the surges of high voltage send out impulses that causes radio and television interference. However, the resistors in the spark plugs tend to concentrate the surges in each sparking cycle, reduce their number, and thus reduce the interference and also the erosive effect on the plug electrodes.

Heat Range System

The "heat range" of a spark plug is determined primarily by the length of the lower insulator. The longer this is, the hotter the plug will operate; the shorter it is, the cooler the plug will operate (Fig. 9-12i).

Spark plugs, to give good performance in a particular engine, must operate within a certain temperature range (neither too hot nor too cool). If the spark plug remains too cool: oil, soot, and carbon compounds will deposit on the insulator causing fouling and missing. If the plug runs too hot, electrodes will wear rapidly, and under extreme conditions, premature ignition (pre-ignition) of the fuel mixture may result.

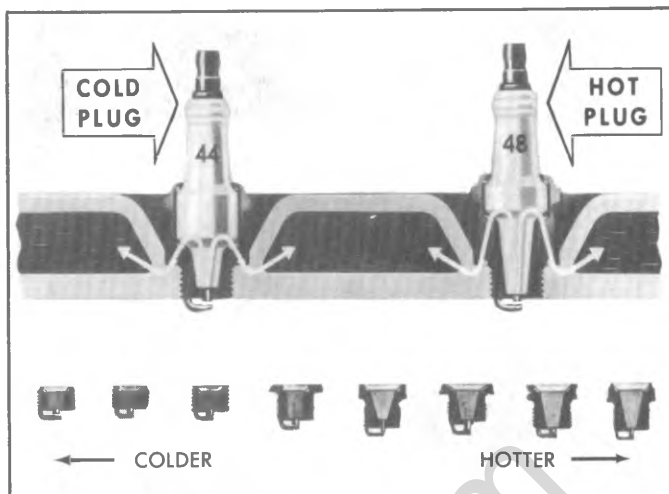


Fig. 6D-12i--Spark Plug Heat Range System

Frequently, the wrong type of spark plugs, one with an improper heat range for the engine, may have been installed when replacing spark plugs originally fitted by the engine manufacturer and such misapplication may lead to poor performance. The heat range system makes it possible to select the type of spark plug that will operate within the correct temperature range for each specific engine.

Where abnormal operating conditions cause chronic carbon or oil fouling of the plugs, the use of a type one number higher (a "hotter" type) than recommended will generally remedy the trouble; and by the same formula, where chronic pre-ignition or rapid electrode wear is experienced, a type with one number lower (a "cooler" type) will generally be found satisfactory.

The last digit of the type number indicates the heat range position of the plug in the heat range system. Read the numbers as you would a thermometer--the higher the last digit, the "hotter" the spark plug will operate in the engine; the lower the last digit, the "cooler" the spark plug will operate.

Spark Plug Reach and Threads

Spark plugs are manufactured in a number of thread sizes and "reaches." Reach is the distance from the gasket seat to the end of the shell. Spark Plugs have a type number on the insulator which designates plug thread size as well as the relative position in the heat range system as previously explained.

DIAGNOSIS

Under normal operating conditions, spark plugs wear out due to the destructive action, under intense heat, of sulphur and lead compounds in the fuel and the bombardment of the electric spark on the electrodes.

It is reasonable to expect over 22,000 miles of useful life from a spark plug. However, operating conditions are an important factor and life expectancy of the spark plug will vary with the type of service in which the engine is used.

The same type of spark plug used in two different engines of the same make and model may frequently show wide variation in appearance. The cause of such differences lies in the condition of the engine, its piston rings, carburetor setting, kind of fuel used, and under what conditions the engine is operated, namely, sustained high

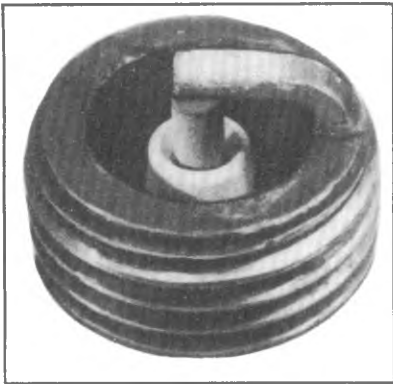
speeds or heavy loads; or continual low speed, stop-and-go driving or light loads.

Spark Plugs are frequently blamed for faulty engine operation which they do not cause. Replacement of old spark plugs by new may temporarily improve poor engine performance because of the lessened demand new plugs make on the ignition system. This cannot permanently cure poor engine performance caused by worn rings or cylinders,

weak coil, worn contact points, faulty carburetion or other engine ills.

On the following pages are pictures of some commonly encountered appearances and causes of spark plug problems.

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Normal Operation



Deposit Fouling "A"



Deposit Fouling "B"



Carbon Fouling

NORMAL OPERATION

Brown to grayish-tan deposits and slight electrode wear indicate correct spark plug heat range and mixed periods of high and low speed driving. **SPARK PLUGS HAVING THIS APPEARANCE MAY BE REINSTALLED. IF MISFIRING PERSISTS, SPARK PLUGS SHOULD BE REPLACED.**

When reinstalling spark plugs, be sure to use new gaskets on spark plugs that utilize engine seat gaskets.

DEPOSIT FOULING—"A"

Red, brown, yellow and white colored coatings which accumulate on the insulator are by-products of combustion and come from the fuel and lubricating oil, both of which today generally contain additives. Most powdery deposits have no adverse effect on spark plug operation; however, they may cause intermittent missing under severe operating conditions, especially at high speeds and heavy load. **SPARK PLUGS HAVING THIS APPEARANCE SHOULD BE REPLACED.**

DEPOSIT FOULING—"B"

Most powdery deposits, as shown in "A", have no adverse effect on the operation of the spark plug as long as they remain in the powdery state. However, under certain conditions of operation, these deposits melt and form a shiny yellow glaze coating on the insulator which, when hot, acts as a good electrical conductor. This allows the current to follow the deposits instead of jumping the gap, thus shorting out the spark plug.

Glazed deposits can be avoided by not applying sudden load, such as wide open throttle acceleration, after sustained periods of low speed and idle operation. **SPARK PLUGS HAVING THIS APPEARANCE SHOULD BE REPLACED.**

CARBON FOULING

Dry, fluffy black carbon deposits may result from overrich carburetion, excessive hand choking, a faulty automatic choke, or a sticking manifold heat valve. A clogged air cleaner can restrict air flow to the carburetor causing rich mixtures. Poor ignition output (faulty breaker points, weak coil or condenser, worn ignition cables) can reduce voltage and cause misfiring. Fouled spark plugs are the result—not the cause—of this problem. **AFTER THE CAUSE HAS BEEN ELIMINATED, SPARK PLUGS HAVING THIS APPEARANCE SHOULD BE REPLACED.**

Excessive idling, slow speeds under light load also can keep spark plug temperatures so low that normal combustion deposits are not burned off. In such a case a hotter type spark plug will better resist carbon deposits.



Detonation

DETONATION

Overadvanced ignition timing, or the use of low octane fuel will result in detonation commonly referred to as engine knock.

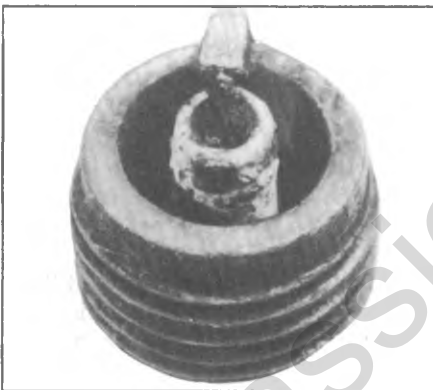
This causes severe shock inside the combustion chamber resulting in damage to the adjacent parts which include spark plugs. A common result of detonation is to have the sidewire of a spark plug torn off.

INSTALL A NEW PLUG OF THE RECOMMENDED HEAT RANGE AFTER PROBLEM HAS BEEN CORRECTED.

Insufficient
Installation Torque**INSUFFICIENT INSTALLATION TORQUE**

Failure to install a spark plug with sufficient torque results in poor contact between the spark plug and the engine seat. The lack of proper heat transfer, resulting from poor seat contact, causes excessive overheating of the spark plug and, in many cases, severe damage as shown.

A NEW SPARK PLUG OF THE RECOMMENDED HEAT RANGE SHOULD BE INSTALLED IN ACCORDANCE WITH AC INSTALLATION INSTRUCTIONS.



Pre-ignition

PRE-IGNITION

Pre-ignition, causing burned or blistered insulator tip and badly eroded electrodes, indicates excessive overheating. Cooling system stoppages or sticking valves can also result in pre-ignition. Lean fuel-air mixtures are an additional cause.

INSTALL A NEW PLUG OF THE RECOMMENDED HEAT RANGE AFTER PROBLEM HAS BEEN CORRECTED.

Sustained high speed, heavy load service can produce high temperatures which will cause pre-ignition and, in this instance a colder spark plug should be used.



Improper Installation

IMPROPER INSTALLATION

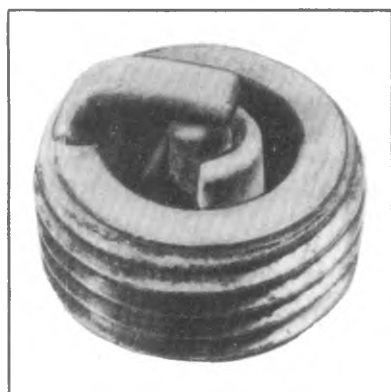
Dirty threads in an engine head will result in the plug seizing before it is actually seated. This results in poor heat transfer and causes the spark plug to overheat.

To insure proper seating of a new spark plug in the head, dirty cylinder head threads should be cleaned with a greased thread chaser of the proper size.

ELIMINATE THE CAUSE AND INSTALL A NEW PLUG OF THE RECOMMENDED HEAT RANGE.



Oil Fouling



Heat Shock Failure

OIL FOULING

Wet, oily deposits with a minor degree of electrode wear may be caused by oil pumping past worn rings. "Break-in" of a new or recently overhauled engine before rings are fully seated may also result in this condition. Other possibilities of introduction of oil into the combustion chamber are a porous vacuum booster pump diaphragm or excessive valve stem guide clearances.

A HOTTER TYPE SPARK PLUG WILL REDUCE OIL DEPOSITS, but too hot a spark plug can cause pre-ignition and, consequently, severe engine damage. An engine overhaul may be necessary in severe cases to obtain satisfactory service.

HEAT SHOCK FAILURE

Heat shock is a common cause of broken and cracked insulator tips. Over-advanced ignition timing and low grade fuel are usually responsible for heat shock failures. Rapid increase in tip temperature under severe operating conditions causes the heat shock and fracture results.

Another common cause of chipped or broken insulator tips is carelessness in regapping by either bending the centerwire to adjust the gap, or allowing the gapping tool to exert pressure against the tip of the center electrode or insulator when bending the side electrode to adjust the gap.

ELIMINATE THE CAUSE AND INSTALL A NEW PLUG OF THE RECOMMENDED HEAT RANGE.

ON-VEHICLE SERVICE

COMPONENT PART REPLACEMENT

Spark Plug

Removal

1. To disconnect wires, pull only on the boot and gently twist boot while pulling away. Pulling on the wire might cause separation of the core of the wire. Remove spark plugs and gaskets using a 5/8" deep socket on the 5/8" hex tapered plugs. Use care in this operation to avoid cracking spark plug insulators.

2. Carefully inspect the insulator and electrodes of all spark plugs. Replace any spark plug which has a cracked or broken insulator. If the insulator is worn away around the center electrode, or the electrodes are burned or worn, the spark plug is worn out and should be discarded.

Cleaning

Spark plugs which have carbon or oxide deposits should be cleaned in a blast type spark plug cleaner. Scraping with a pointed tool will not properly remove the deposits and may damage the insulator. If spark plugs have a wet or oily deposit dip them in a degreasing solvent and then dry thoroughly with dry compressed air. Oily plugs will cause the cleaning compound to pack in the shell.

Carefully follow the instructions of the manufacturer of the cleaner being used, cleaning each plug until the interior of shell and the entire insulator are clean; however, avoid excessive blasting.

Examine interior of plug in good light. Remove any cleaning compound with compressed air. If traces of carbon oxide remain in plug, finish the cleaning with a light blasting operation. Clean firing surfaces of center and side electrodes with several strokes of a fine file.

When spark plugs have been thoroughly cleaned, carefully inspect for cracks or other defects which may not have been visible before cleaning.

Adjusting Spark Plug Gap (Fig. 6D-13i)

Use round wire feeler gages to check the gap between spark plug electrodes of used plugs. Flat feeler gages will not give a correct measurement if the electrodes are worn. Adjust gap by bending the side electrodes only. Adjust gaps to specifications. Setting spark plug gap to other than specification to effect changes in engine performance is not recommended.



Fig. 6D-13i--Checking Spark Plug Gap

Installation of Spark Plugs

When installing spark plugs, make sure that all surfaces on plugs and in cylinder heads are clean. When installing the 5/8" hex tapered seat spark plugs, tighten to 15 lb. ft., using a 5/8" deep socket, an extension and a torque wrench.

CAUTION: *If tapered seat spark plugs are over-tightened, there is a possibility they can crack and be more difficult to remove at the next tune-up.*

DIESEL ENGINE ELECTRICAL SYSTEM AND ELECTRONIC CONTROLS LF9-C SERIES

1978 C10 Series Trucks are available with an optional 5.7 litre-350 cu in. diesel V8. The diesel engine electrical circuitry differs from conventional gasoline engines as follows:

Battery

Two 12 volt sealed top batteries connected in parallel are required for the higher electrical load due to the glow plugs and starter.

Starter

The starter is larger and designed to crank the engine at least the 100 RPM required for starting.

Charging

A Standard generator supplies charging current to both batteries at the same time. There are no switches or relays in the charging circuit.

Ignition

In the diesel engine, air alone is compressed in the cylinder; then after the air has been compressed a charge of fuel is sprayed into the cylinder and ignition occurs due to the heat of compression. Eight glow plugs are used to

preheat the chamber as an aid to starting.

They are 12 volt heaters that turn on when the ignition key is turned to the run position prior to starting the engine. They remain on a short time after starting, then automatically turn off.

Instrumentation

Vehicles with the optional diesel engine require special instrumentation indicators to permit the operator to properly apply the starting procedure. Two lights on the I.P. provide this information on engine starting conditions.

Glow Plugs Light

Indicates that the glow plugs are operating to heat the ignition chambers.

Don't Start Light

"ON" indicates that the chambers are **not** warm enough for engine starting.

Control

Diesel Electronic control and monitoring is accomplished by a control module integral to the engine electrical system. The module monitors start and ignition conditions, coolant temperature, and ignition key position. (If the ignition key is left in the run position 2-5 minutes and lamps turn off, preventing the battery from discharging.) If the engine is running the module will turn off the generator lamp. The module also provides a 2-4 second delay after a no start condition before restart can be accomplished.

System Content Difference

1. Two Batteries.
2. Glow Plugs.
3. Glow Plug Relays.
4. Electronic Controller.
5. Thermistor.
6. Fast Idle Solenoid.
7. "Don't Start" and "Glow Plugs" Lights.
8. Diode In 25 CKT for "Glow Plugs" Light.
9. Temp. Switch for "Glow Plugs" Light.
10. Wiring and Connectors.
11. Fuseable Links.

Diesel Engine Glow plug electronic control circuitry is shown in Figure 6D-2. Chart 6D-1 lists the Module, Relay, and Diode circuits.

System Functions

System functions are illustrated in chart 6D-2.

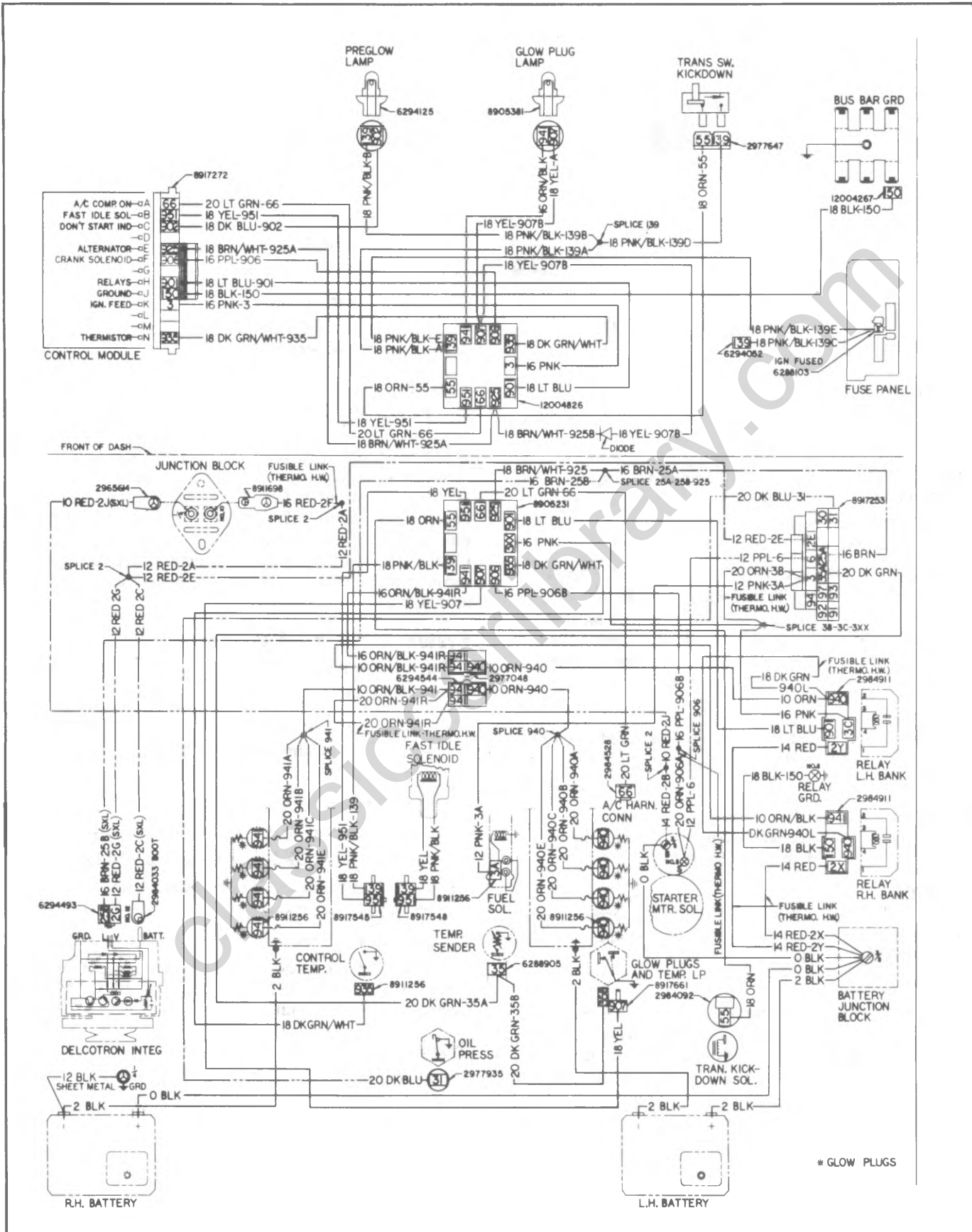


Fig. 6D-2--Diesel Engine Electronic Control

MODULE CIRCUITS

902	LAMP PREGLOW
901	RELAY
951	FAST IDLE
906 A	STARTER SOL
925	GEN OUTPUT
3	IGNITION
150 B	GROUND
935	THERMISTOR
66	A/C CLUTCH FEED

DIODE	907	"GLOW PLUGS" BULB SIDE
	925	GENERATOR SIDE

RELAY CIRCUITS

LEFT BANK RELAY

3 C	COIL FEED
901	COIL CONTROL
2 Y	POWER FEED
940	LEFT BANK GLOW PLUGS FEED & RIGHT BANK RELAY COIL FEED

RIGHT BANK RELAY

940 L	COIL FEED
150	COIL GROUND
2 X	POWER FEED
941	RIGHT BANK GLOW PLUGS FEED

SYSTEM FUNCTIONS

1. GLOW PLUGS "ON" DURING PREGLOW AND AFTER GLOW.
2. GLOW PLUGS "OFF" AFTER AFTER GLOW.
3. GLOW PLUGS LIGHT ON UNTIL ENGINE START.
4. GLOW PLUGS OFF AFTER 5 MINUTES, IF ENGINE NOT STARTED, TO SAVE BATTERY.
5. FAST IDLE ON WITH LOW ENGINE TEMP OR A/C ON AND AFTER EACH IGNITION CYCLE.
6. FEED VOLTAGE TO PUMP SOLENOID.
7. DIODE PROVIDES "OR" FUNCTION FOR GLOW PLUGS TELL-TALE LAMP.
8. ACTIVATE "DON'T START" LIGHT DURING PREGLOW.
9. DEACTIVATE "DON'T START" LIGHT.
10. DEACTIVATE BOTH LIGHTS AFTER START.
11. ACTIVATE "GLOW PLUGS" LIGHT IF GLOW PLUGS ON AT ENGINE TEMPERATURE ABOVE 170°F.
12. PROVIDE DUAL BATTERIES FOR CRANK.

DIAGNOSIS

The series of charts which follow consist of system malfunctions, probable causes and corrective actions, and are to be used as follows:

If the system malfunction is determined to be Number 1 on the Systems Malfunction Chart, the probable cause of this malfunction and the corrective action would follow as number 1 on the respective charts.

SYSTEMS MALFUNCTION CHART

1. Glow plugs not "on" during preglow and afterglow.
2. Preglow, but time period not correct.
3. Preglow okay, but afterglow time period not correct.
4. Glow plugs do not shut "off" after emergency time period expires.
5. Glow plugs "on" at all times. Glow plugs light will be "on".
6. Fast idle "on" with high engine temp and/or A/C off.
7. Fast idle "off" with cold engine temp or A/C "on".
8. Fast idle not on for 5 sec. after each engine start at

all temp. with A/C "off".

9. No voltage at pump solenoid with ignition "on".
10. Voltage at pump solenoid with ignition "off".
11. "Don't start" light not on during preglow, but relays on.
12. "Don't start" light on during any time other than preglow.
13. "Don't start" not recycled "on" after a no start crank.
14. "Glow plugs" light "on" after engine starts. Glow plugs on in normal afterglow period.
15. "Glow plugs" light "on" after engine starts. Glow

plugs "off".

"run" position with engine off.

16. Engine cranks slowly.

17. Glow plugs light not on with ignition switch in

PROBABLE CAUSES CHART

1. Glow Plugs Not "ON" during preglow and afterglow

- _____ A. Open 940 or 941 circuits from relays.
- _____ B. Open 2 circuits from junction block relays.
- _____ C. Bad relay(s).
- _____ D. Open 901 circuit from module to relays.
- _____ E. Open module ground 150 circuit.
- _____ F. Open 3 circuit. to relays.
- _____ G. Faulted 935 circuit to thermistor.
- _____ H. Open 925 circuit to alternator.
- _____ I. Open 3 circuit to module.
- _____ J. Bad module.

2. Preglow but time period not correct .

- _____ A. Open 935 circuit to thermistor.
- _____ B. Faulted 935 circuit to thermistor.
- _____ C. Bad thermistor.
- _____ D. Bad module.

3. Preglow okay, but afterglow time period not correct

- _____ A. Bad module.
- _____ B. Open or faulted 906A to module from starter solenoid.
- _____ C. Open or faulted 925 circuit to module from alternator.

4. Glow Plugs do not shut off after required time period

- _____ A. Bad relays.
- _____ B. Faulted 901 circuit.
- _____ C. Bad module.

5. Glow Plugs on at all times. Glow Plugs light will be on .

- _____ A. Bad solenoid (fast idle).

6. Fast idle "on" with high engine temperature and or A/C off.

- _____ A. Bad solenoid (fast idle).
- _____ B. Faulted 951 circuit to solenoid.
- _____ C. Bad module.
- _____ D. Open 935 circuit to thermistor.
- _____ E. Bad thermistor (open).
- _____ F. Bad A/C controller.

7. Fast idle off with cold engine or A/C "on".

- _____ A. Bad fast idle solenoid.
- _____ B. Open 139 circuit feed to solenoid.
- _____ C. Open 951 circuit to solenoid.
- _____ D. Bad module.
- _____ E. Open module ground 150 circuit.
- _____ F. Faulted 935 circuit to thermistor.
- _____ G. Bad thermistor (faulted).
- _____ H. No module feed, 3 circuit.
- _____ I. No module feed, 3 circuit.
- _____ J. Open or faulted 66 circuit to A/C clutch.
- _____ K. No A/C clutch voltage at feed point.

8. Fast idle not on for 5 sec. after each engine start with A/C off .

- _____ A. Bad module.
- _____ B. Open 906 circuit to starter solenoid.

9. No voltage at pump solenoid with ignition "ON".

- _____ A. Bad ignition switch.
- _____ B. No voltage at ignition switch.

_____ C. Open circuit, 3 circuit, from ignition switch to pump solenoid.

10. **Voltage at pump solenoid with ignition "off" .**

_____ A. Bad ignition switch.

11. **"Don't Start" light not on during preglow, but relays on.**

_____ A. Burned out "Don't Start" light.

_____ B. Open 139 A circuit feed to light.

_____ C. Open 902 circuit feed to light.

_____ D. Bad module.

12. **"Don't Start" light on during any other time than preglow.**

_____ A. Faulted 902 circuit.

_____ B. Bad module.

_____ C. Open 925 circuit to module from alternator.

_____ D. Open "Gen" light.

_____ E. Bad alternator.

13. **"Don't Start" not recycled "on" after a no start crank.**

_____ A. Open 906 A circuit to module.

_____ B. Bad module.

14. **"Glow Plugs" light on after engine starts. Glow Plugs on normally.**

_____ A. Faulted 907 circuit to glow plugs light.

_____ B. Shorted glow plugs temperature switch.

_____ C. Glow plugs temperature switch out of calibration -- too low.

_____ D. Bad generator.

15. **Glow Plugs "light" on after engine starts. Glow Plugs "off".**

_____ A. Shorted diode.

_____ B. Faulted 25 circuit.

16. **Engine Cranks slowly.**

_____ A. Low charge on one or both batteries.

_____ B. Bad connections to batteries.

_____ C. Bad connections at engine cable interface.

17. **Glow Plugs light NOT ON, ignition switch in "run", engine "off".**

_____ A. Glow plugs not "on". See "Probable Causes" item 1 above.

_____ B. Failed diode (open circuit).

_____ C. Burned out glow plugs bulb.

CORRECTIONS CHART

GENERAL

Unless otherwise indicated, testing will be performed with a 12 volt voltmeter. Measurements will be made relative to a good engine ground. Grounding signals should be less than 1.5 volts. 12 volt signals should be 10.5 to 12.5 unless specifically stated.

Measurements will be made with ignition switch in the "on" position within a time period prior to emergency shut down (2 to 5 min.) after ignition is on.

Measure battery voltage with voltmeter before starting diagnostic. Charge batteries if less than 12.4 with ignition off. Also charge batteries if green dot is not visible in either battery.

1.

A. Measure voltages at relays.

● 940 circuits 12V.

● 941 circuit 12V.

● 3 circuit 12 V.

● 2 circuits 12 V.

● 901 circuit 0V.

● 150 circuit 9V.

If: 2, 3 and 901 okay, but 940 or 941 N.G. replace respective relay.

If: 2 or 3 N.G. repair respective open circuit or fuseable link.

If: 901 N.G. measure at module.

If: 150 N.G. (right bank only will not function) - repair "Ground" circuit.

B. Measure 940 and 941 circuits. at glow plugs.

If: N.G. repair open circuits.

C. Measure 901 circuit at module --

If: Okay, repair open to relays.

If: N.G. measure 3 circuit, 150 circuit at module.

- 3 circuit 12V.

- 150 circuit)V.

- If: N.G. repair open circuits.

D. Measure 25 circuit at module.

- 25 circuit less than 3 volts --

If: N.G. repair open circuit to alternator.

e. Using a milliammeter on the 0 to 1 MA range substitute in place of the thermistor in the 935 circuit at the thermistor, it should read between 0.3 to 0.5 MA.

If okay, leave open circuit and recheck 901 circuit. If now okay, check thermistor and replace if bad. If 901 circuit still bad, replace module.

Thermistor can be checked as follows:

At a temperature between 60°F and 80° the thermistor resistance should read between 2000 ohms and 5000 ohms on an ohmmeter.

2.

A. Using a milliammeter on the 0 to 1 MA range substitute in place of thermistor in the 935 circuit. It should read 0.3 to 0.5 MA. If okay, check thermistor for proper resistance to ground. 2000 ohms to 5000 ohms between 60°F and 80°F. If okay, replace module.

3.

A. Check the 906A circuit at the module for 8 to 12 volts when cranking engine and 0 volts with ignition switch in "run" position. Repair open circuit if not okay.

B. In non-gage vehicles, make sure generator lamp is "on" before cranking and "off" after engine starts. In gage vehicles, or if lamp okay in non-gage vehicles, check for 14 to 15 volts at the 925 circuit to module with engine running. If okay, replace module. If N.G., repair open 25 circuit to alternator. If gen. lamp not correct, go to No. 12 D E.

4.

A. Check 901 circuit as follows: monitor with voltmeter for zero signal with ignition on. If no attempt to crank, 901 should transition to 12 volts at 2 to 5 minutes after ignition is on. If okay, then replace relays if 940 and 941 still are at 12 volts.

B. If 901 circuit is not okay, remove module and recheck 901 for 12 volts. If not okay, repair fault on 901 circuit. If okay, replace module.

5.

A. With ignition off, check 940 and 941 circuits, should be 0 volts. If not, check 3 circuit at relays. If not 0 volts, ignition switch is defective or misadjusted. If 3 circuit is 0 volts and 940 and 941 circuits still at 12 volts, replace relays.

6.

A. Remove solenoid connector, replace solenoid if it does not retract.

B. Check 951 circuits. Should be 12 volts. If not, remove module. Recheck 951 circuit. If still not 12 volts, repair fault on 951 circuit.

C. If 951 circuit zero with module plugged in but okay out, apply short to ground at 935 circuit at module and recheck 951 with A/C off. If now okay, repair open 935 circuit or thermistor as in 1E. If not okay check voltage at 66 circuit. If 0 volts, replace module. If 66 circuit no 0 volts with A/C off, repair defective A/C controller switch.

7.

A. Measure voltage at 139 circuit on solenoid. If N.G., repair open 139 circuit. If okay, measure 951 circuit. Should be zero volts. If okay, remove solenoid connector apply 12 volts to one side of solenoid and ground to other side, if not okay, replace solenoid.

B. If 951 not zero volts, recheck at module. If okay, repair open circuit.

C. 951 not zero volts at module, check 3 circuit, 150 circuit, 66 circuit at module. Repair if not as follows:

- 3 12 volts.

- 150 0 volts

- 66 12 volts (A/C on)

- If all okay, replace module.

D. If solenoid okay with A/C on, but N.G. with A/C off and engine cold, check 953 circuit to thermistor as in 1E. If 935 current okay, (0.3 to 0.5 MA.) check thermistor as in 1E. If thermistor okay, replace module. Repair 935 circuit or thermistor for fault if not okay.

E. If 66 circuit no 12 volts with A/C "on", repair open feed to AC feed.

8.

A. If solenoid operation okay in **7A, but N.G. after each start with engine hot and A/C off, check 906A circuit at module with ignition in crank. If 12 volts replace module. If N.G., repair open in 906A circuit.**

9.

A. Check 3A circuit at solenoid. Should be 12 volts with ignition on. If N.G. check 3C circuit at left bank glow plug relay. If okay, repair open in 3A circuit from buckhead connector to solenoid. If N.G. at relay also, check instrument cluster gages or tell-tale lights for operations. If okay, repair open circuit in 3 circuit from ignition switch to bulkhead connector (probably fuseable link).

B. If instrument cluster N.G., check head lamps and if okay, repair open 3 circuit from starter to ignition switch or replace ignition switch, if 2 circuit okay.

C. If 2 circuit okay and ignition okay, check 2 circuit at relays. If N.G., check connections at junction block and battery voltage.

10.

A. Check voltage at pump 3A circuit when ignition switch is turned off.

B. If not zero, check for misadjusted or bad ignition switch. Readjust or replace as necessary.

11.

A. Check relays 940 and 941 circuits during preglow. If N.G., go to step 1. If okay, but "Don't start" light not okay, check bulb and replace if N.G.

B. Check 902 circuit at module. If zero volts, check at bulb. If zero, repair open 139 circuit to bulb socket. If 902 N.G. at bulb, repair open circuit.

C. If relays okay during preglow and 902 circuit not zero during preglow, replace module.

12.

A. Check 902 circuit during start of afterglow. If zero volts, remove module and check bulb. If still on, repair faulted 902 circuit.

B. If bulb goes out with module out, recheck 25 circuit during afterglow at module with engine on. If 14 volts, replace module.

C. If 925 circuit not nominal 14 volts at module with engine running, check 25 circuit at alternator. If 14 volts, repair 925 circuit open to module.

D. If 25 circuit at alternator not 14 volts with engine running, check generator bulb for correct type **168 in non-gage vehicle. In gage vehicles, check for nominal 10 ohms resistance of 25 circuit from generator to ignition switch with switch "off"**.

E. If okay, see: alternator diagnostic in service manual. If bulb or resistor okay but 14 volts not at 25 circuit at alternator, see: alternator diagnostics in service manual.

13.

A. Check the 906A circuit at the module for 8 to 12 volts when cranking. If okay, replace module. If zero, repair open 906A circuit from starter solenoid to module.

14.

A. Disconnect "glow plugs - eng. temp switch" located in left front of intake manifold. If glow plugs lamp goes out (with glow plugs still "on" in normal afterglow period), replace temperature switch. If lamp remains on check for

fault in 907 circuit and repair as required.

B. If lamp remains on with no detectable fault in the 907 circuit, check voltage of the 25 circuit at the alternator as in 12C. Proceed to 12D and E. Note: In non-gage vehicles the "gen" light will remain "on" also.

15.

A. Replace diode in module harness.

16.

A. Check voltage at 2 circuits on relays. If less than 7.5 volts during crank, measure at battery. If okay, check connection at starter. If N.G., at batteries, check connections and retorque to 120 in. lbs. Also check ground leads at engine.

B. If still N.G. disconnect battery to battery cable at one battery, and check each battery per service manual for "freedom" batteries.

17.

A. Check for open glow plugs bulb.

B. If okay, check for open diode or open 907 to 25 circuit to alternator.

ENGINE WIRING

Figures 6D-12 through 6D-15 illustrate diesel engine wiring layouts.

Starter and Generator mounting is illustrated in Figures 6D-16 through 6D-18.

Diesel control module and I.P. controller wiring is shown in Figure 6D-19.

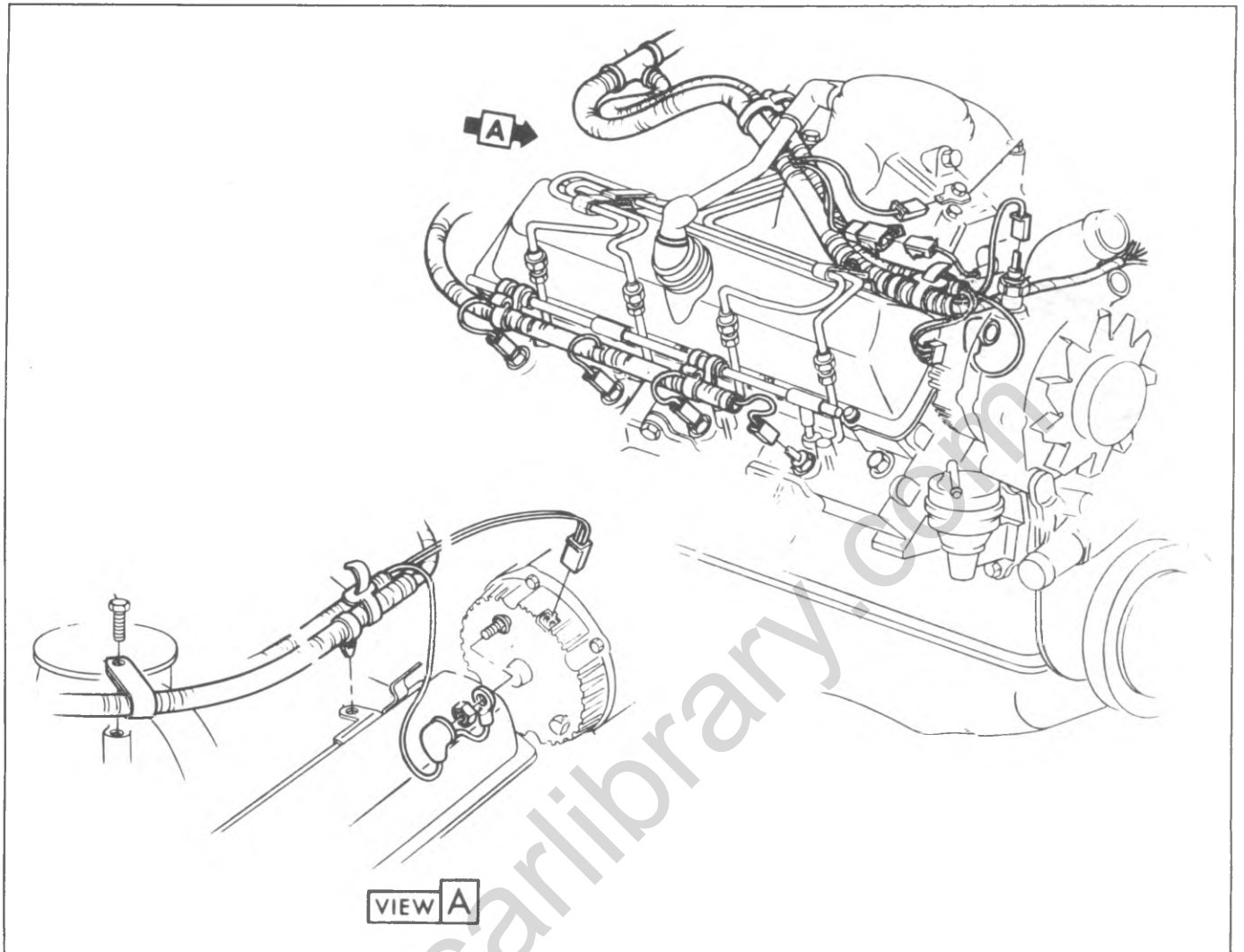


Fig. 6D-12--Diesel Engine Wiring - R.H.

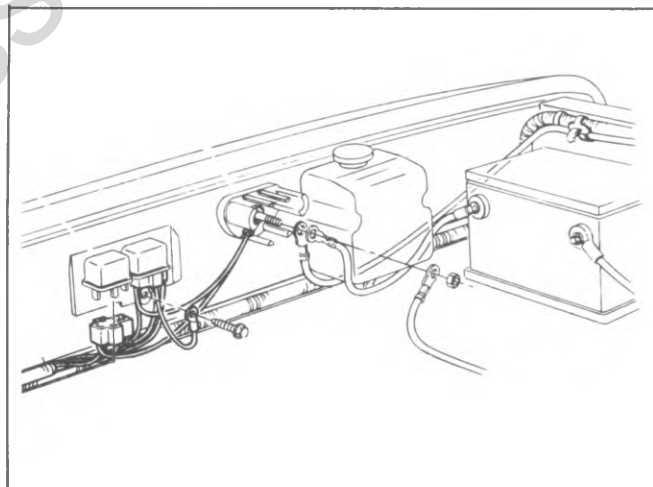


Fig. 6D-13--Diesel Engine Wiring - Relays

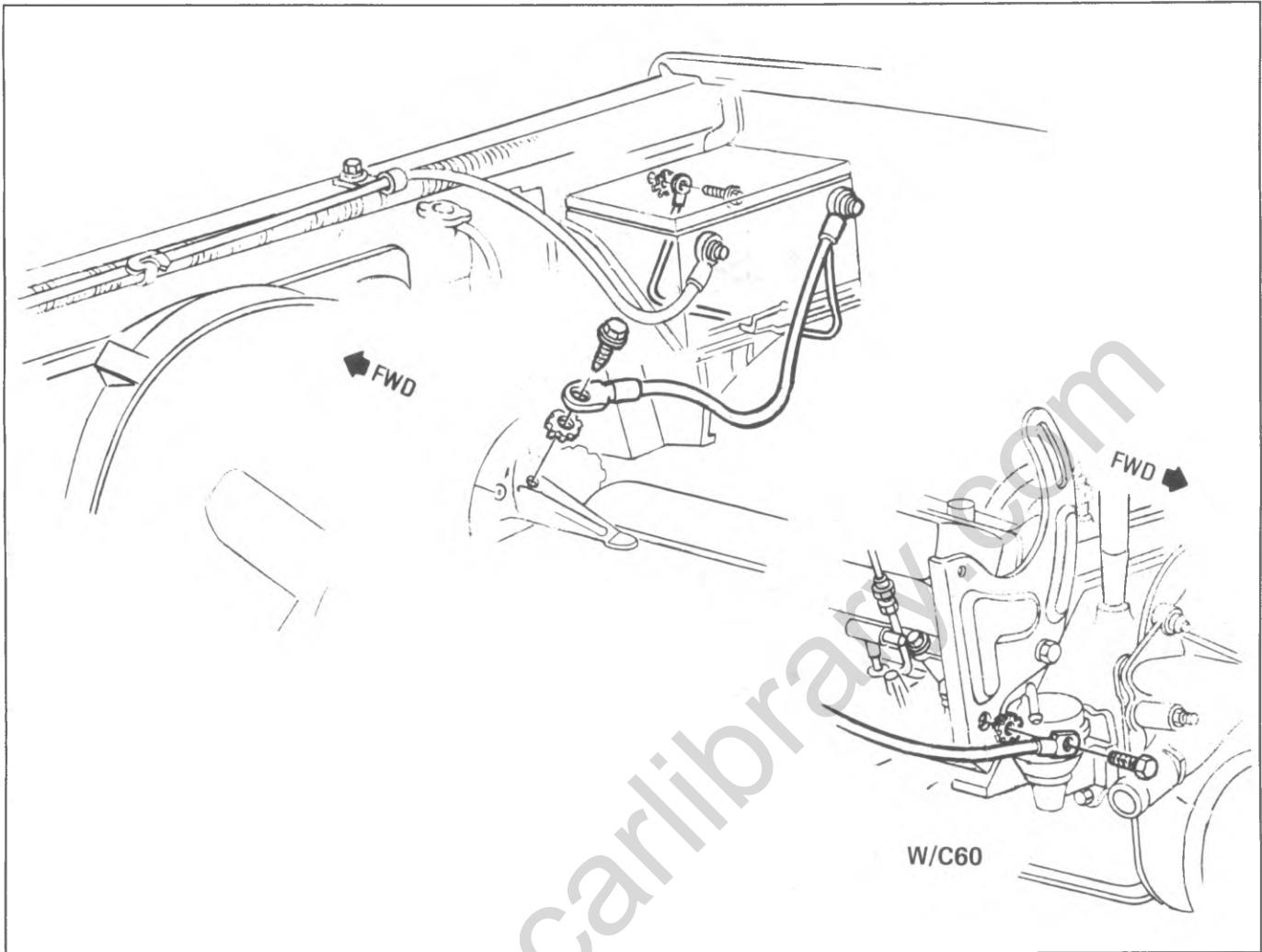


Fig. 6D-14--Diesel Battery Cables

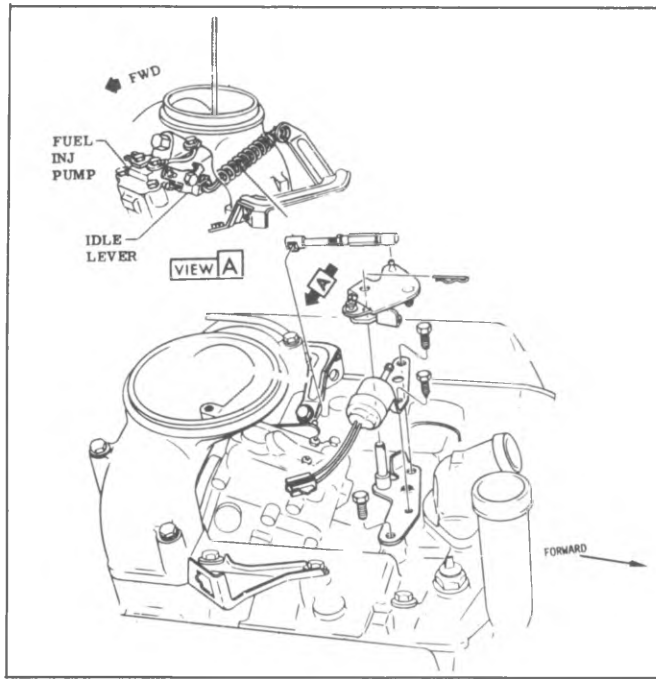


Fig. 6D-15--Diesel Engine - Accelerator Control and Solenoid Assembly

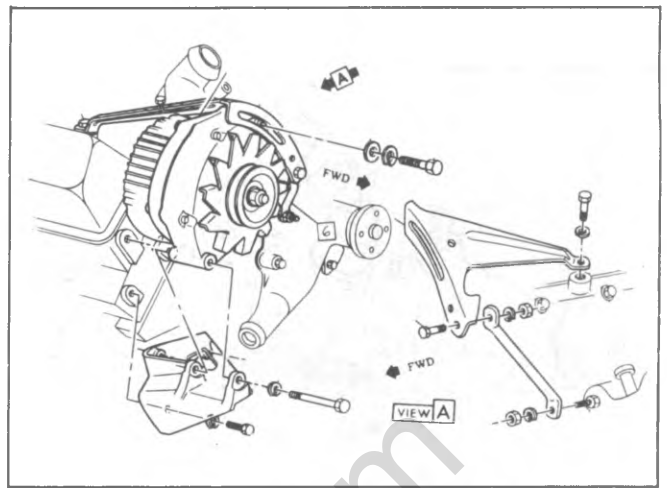


Fig. 6D-17--Generator Mounting - LF9

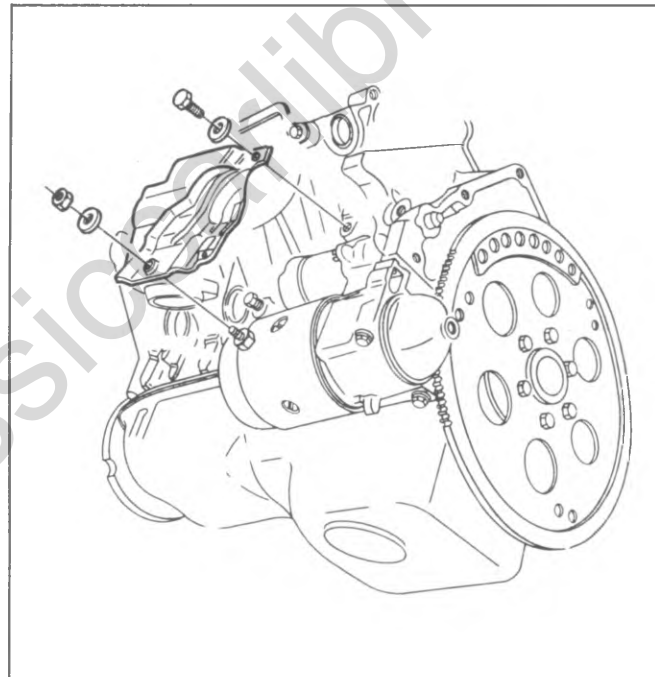


Fig. 6D-16--Diesel Starter Mounting

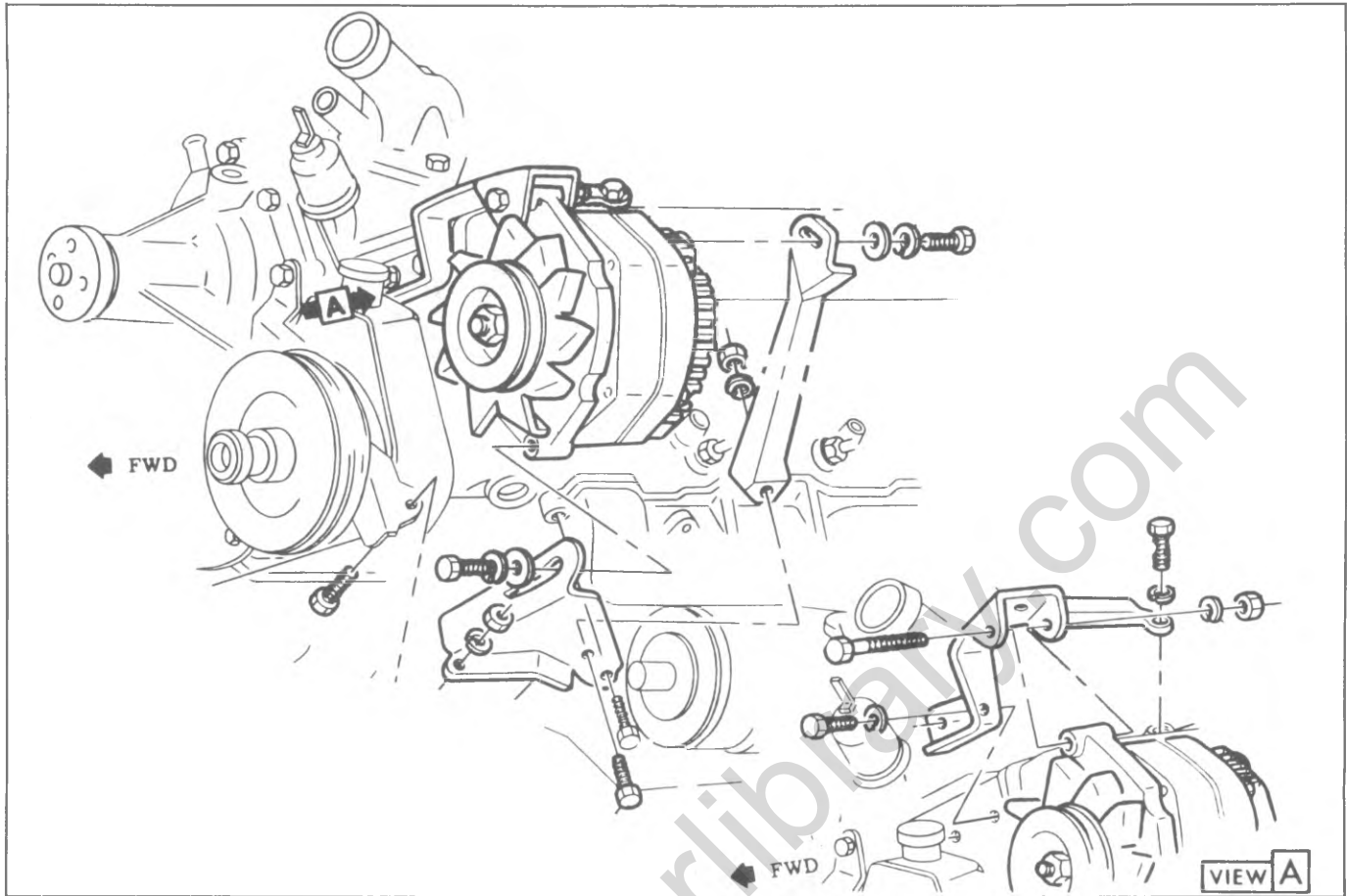


Fig. 6D-18--Generator Mounting - LF9 with A/C

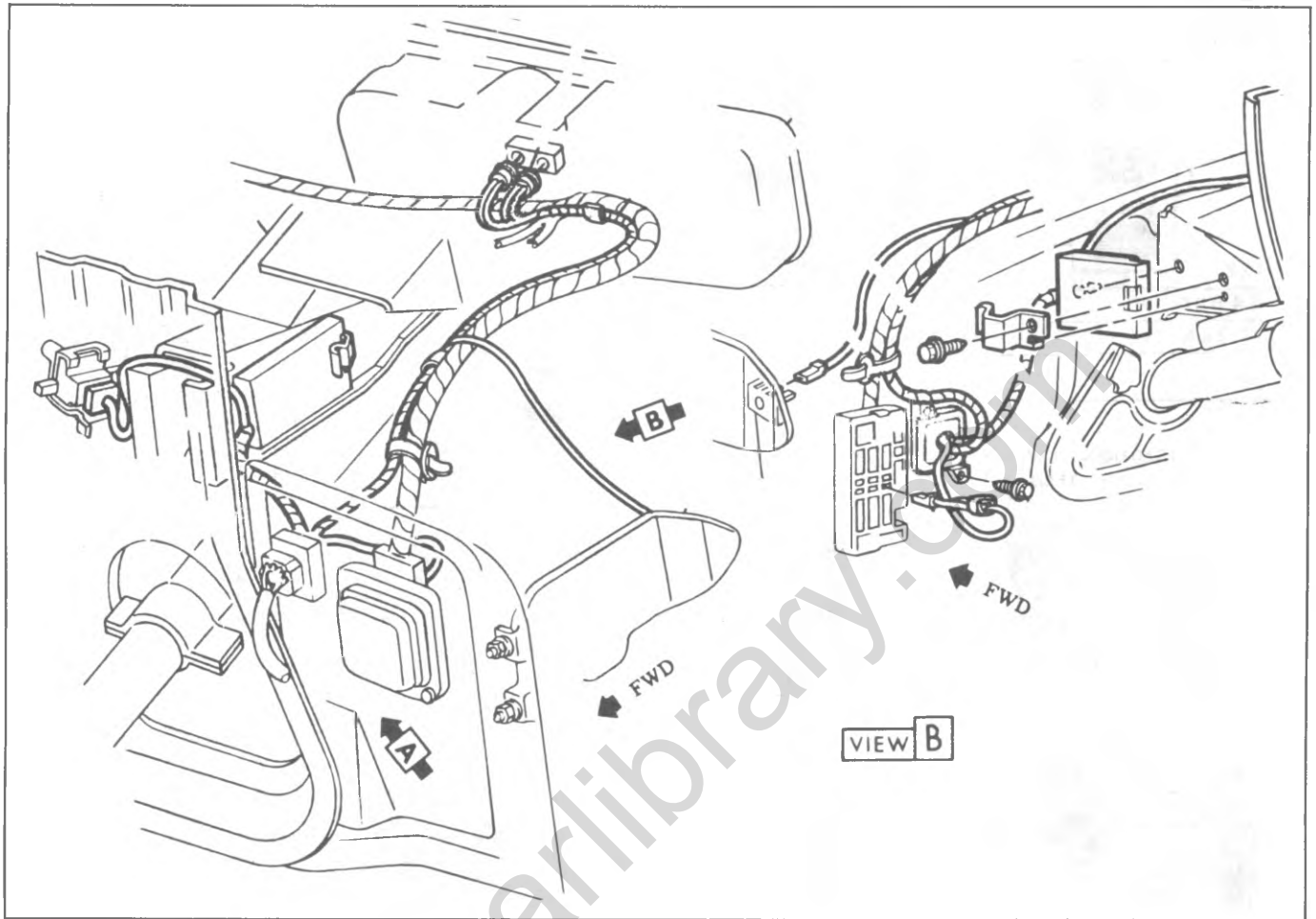


Fig. 6D-19--Diesel Module and I.P. Controller Wiring

IGNITION SWITCH GENERAL DESCRIPTION

The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly. For a complete explanation of the key and lock cylinder, and the actuator rod assembly, refer to the Steering section of this manual.

The ignition switch is key operated through the actuator rod assembly to close the ignition primary circuit and to energize the starting motor solenoid for cranking. The ignition switch used on all cars have five positions: OFF, LOCK, ACCESSORY, RUN and START. OFF is the center position of the key-lock cylinder, and LOCK is the next position to the left. ACCESSORY is located one more detent to the left of LOCK. Turning the key to the right of the OFF position until spring pressure is felt will put the ignition switch in the RUN position, and when turned fully to the right against spring pressure, the switch will be in the START position.

In the RUN position, the ignition primary circuit is activated through a resistance wire. The ignition resistor

wire is used in the ignition running circuit to reduce the voltage to the ignition coil. The resistor wire is bypassed when the engine is being started. The purpose of this is to compensate for the drop in voltage which occurs as the result of the heavy drain on the battery during starting, and to provide a hotter spark for starting.

All ignition switches have five terminals which are connected in different combinations for each of the three operating positions. A brass plate, inside the switch, has three contacts which connect these terminals. Figure 12i shows the positions of the contacts in all positions as viewed from the key side of the switch. There is also a ground pin in the switch which contacts the "ground" terminal when the ignition switch is in the START position. This pin contacts the IGN. terminal when in the OFF position.

Ignition Start and Run Circuit

The ignition switch is fed from the battery to the BAT. terminal of the switch. When the ignition switch is in the OFF position, no current flows through the switch. When the ignition switch is turned to the ACC. position, the BAT.

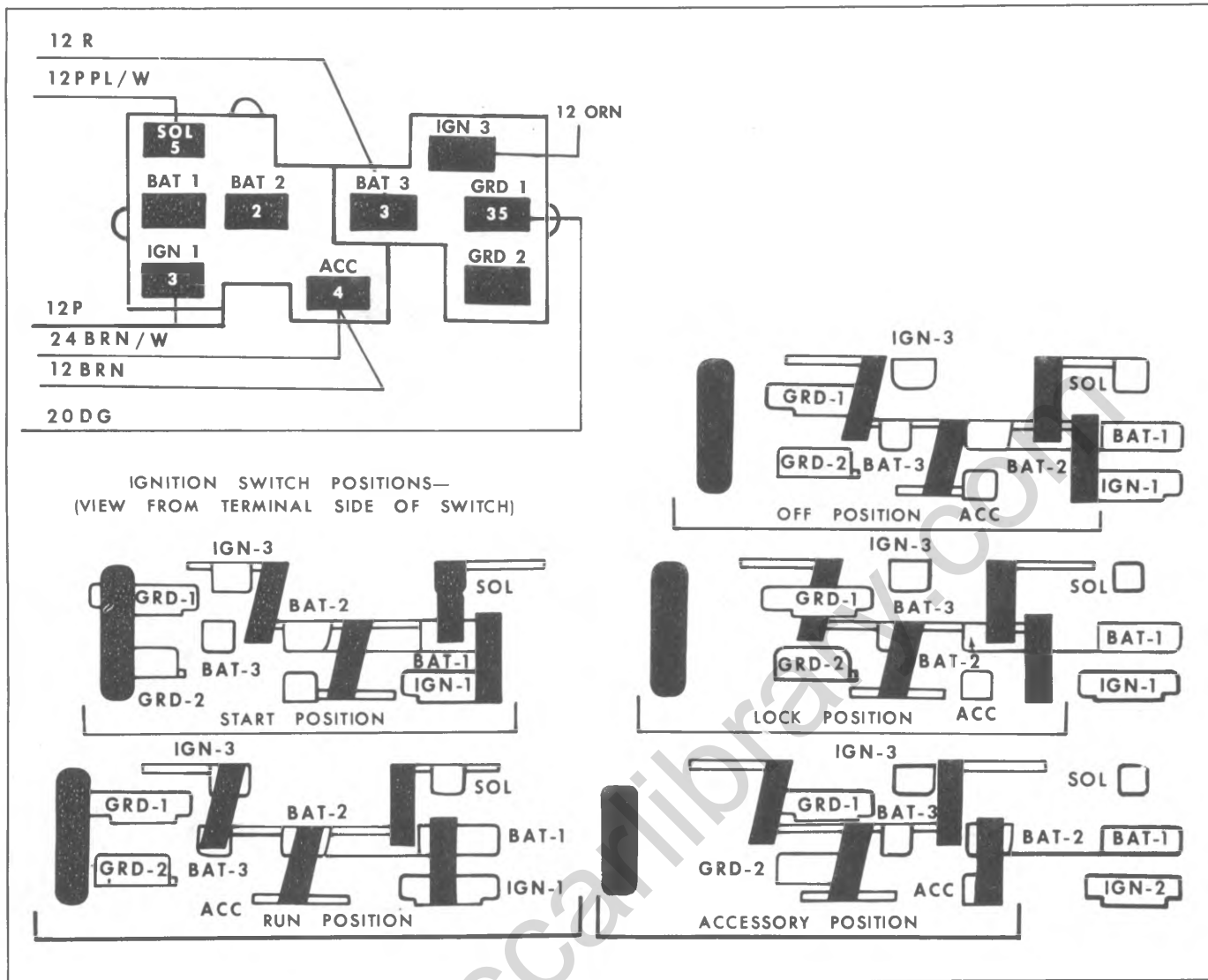


Fig. 6D-14i—Ignition Switch Circuit

terminal is connected to the ACC. terminal. This permits operation of accessories when the engine is not running.

When the ignition switch is turned to the START position, the BAT. terminal is connected to the SOL. and IGN. terminals. When the clutch or automatic transmission neutral start switches are closed, current flows to the starter solenoid. This energizes the solenoid windings. The solenoid has two sets of windings: a "pull-in" winding and a "hold-in" winding. Both windings are used to create the magnetic field to actuate the the solenoid plunger and move the starter pinion into engagement with the flywheel. As the solenoid plunger reaches the end of its travel, it closes a switch which connects battery voltage to the starter motor. With battery voltage applied to both terminals of the "pull-in" windings, the "pull-in" winding is no longer energized, so that only the "hold-in" winding keeps the starter solenoid engaged.

NOTE: The instrument panel warning lights are fed

from the ignition terminal of the ignition switch and have battery voltage applied to them when the ignition switch is in the START and RUN position. These circuits are explained in the Chassis Electrical Section.

When the ignition switch is released from the START to the RUN position, the IGN. terminal is still connected to the BAT. terminal, but the solenoid is no longer energized and so the feed for the coil from the IGN. terminal on the ignition switch, through the ignition resistor wire and to the coil, dropping the battery voltage at the coil to approximately nine volts. With the ignition switch in the RUN position, the BAT. terminal is connected to the IGN. terminal and the ACC. terminal. This permits operation of all accessories and the ignition system.

STARTER SYSTEM

GENERAL DESCRIPTION

The function of the starting system, composed of the starting motor, solenoid and battery, is to crank the engine. The battery supplies the electrical energy, the solenoid completes the circuit to the starting motor, and the motor then does the actual work of cranking the engine.

The starting motor (fig. 6D-1s) consists primarily of the drive mechanism, frame, armature, brushes, and field windings. The starting motor is a pad mounted 12-volt extruded frame type, having four pole shoes and four fields, connected with the armature. The aluminum drive end housing is extended to enclose the entire shift lever and plunger mechanism, protecting them from dirt, splash, and icing. The drive end frame also includes a grease reservoir to provide improved lubrication of the drive end bearing. The flange mounted solenoid switch operates the overrunning clutch drive by means of a linkage to the shaft lever. The Diesel starter utilizes a center bearing. (Figure 6D-1s).

The starting system is made up of the cranking motor with its drive mechanism, the starter motor solenoid and the battery. These units are connected together and work as a team to crank the engine. The simplified diagram (Fig. 6D-2s) shows the electrical components in a typical starting system. Although modern day applications use more circuitry and controls than shown in Figure 6D-1s, the function of the components is always the same--to convert electrical energy from the battery into mechanical energy at the starter motor to crank the engine.

STARTER MOTOR

Construction

A cross-sectional view of a typical starter motor with a solenoid is shown in figure 6D-1s.

The starting motor assembly is made up of field coils placed over pole pieces which are attached to the inside of a heavy iron frame, an armature, an overrunning clutch-type drive mechanism, and a solenoid.

The diesel starter used on CK Series Trucks with diesel engine is illustrated in figure 6D-1s.

The iron frame and pole shoes not only provide a place for the field coils, but also provide a path for the magnetic lines produced by the field coil windings.

Armature

The armature assembly (Fig. 6D-3s), consists of a stack of iron laminations placed over a steel shaft, a commutator assembly and the armature winding. The windings are heavy copper ribbon that are assembled into slots in the iron laminations. The winding ends are soldered or welded to the commutator bars which are electrically insulated from each other and from the iron shaft.

The armature is supported by bushings in the end

frames. A center bearing is used on the 20MT motor. Brushes are supported on the field frame and ride on the commutator bars.

Drive Mechanism

The starting motor drive mechanism (Fig. 6D-4s) is a roll-type overrunning clutch that is assembled onto the armature shaft. Through this drive component power is transmitted from the armature to the engine during the starting cycle.

The overrunning clutch drive contains a pinion which is made to move along the shaft by means of a shift lever to engage the engine ring gear for cranking. A gear reduction is provided between the pinion and ring gear to meet the cranking requirements of the engine. With this gear reduction, the motor operates to crank the engine at speeds required for starting.

The overrunning clutch drive has a shell and sleeve assembly which is splined internally to match the spiral splines on the armature shaft. The pinion is located inside the shell along with spring-loaded rollers that are wedged against the pinion and a taper inside the shell. The springs may be either a helical or accordion type. Four rolls are used. A collar and spring, located over the sleeve, are the other major clutch components.

When the shift lever is operated by the solenoid, it moves the collar endwise along the shaft. The spring pushes the pinion into mesh with the ring gear. If a tooth abutment occurs, the spring compresses until the switch is closed, at which time the armature rotates and the tooth abutment is cleared. The compressed spring then pushes the pinion into mesh and cranking begins.

Torque is transmitted from the shell to the pinion by the rolls which are wedged tightly between the pinion and taper cut into the shell.

When the engine starts, the ring gear drives the pinion faster than the armature and the rolls move away from the taper, allowing the pinion to overrun the shell. The start switch should be opened immediately when the engine starts to avoid prolonged overrun. When the shift lever is moved back by the return spring, the pinion moves out of mesh and the cranking cycle is completed.

SOLENOID

A sectional view of a typical solenoid is shown in Figure 6D-5s. It performs two functions in the starting system. First, it is used to provide a circuit of short length and low resistance between the battery and motor. Since the motor may draw several hundred amperes during operation, heavy cables of short length are needed to reduce the voltage drop in the circuit.

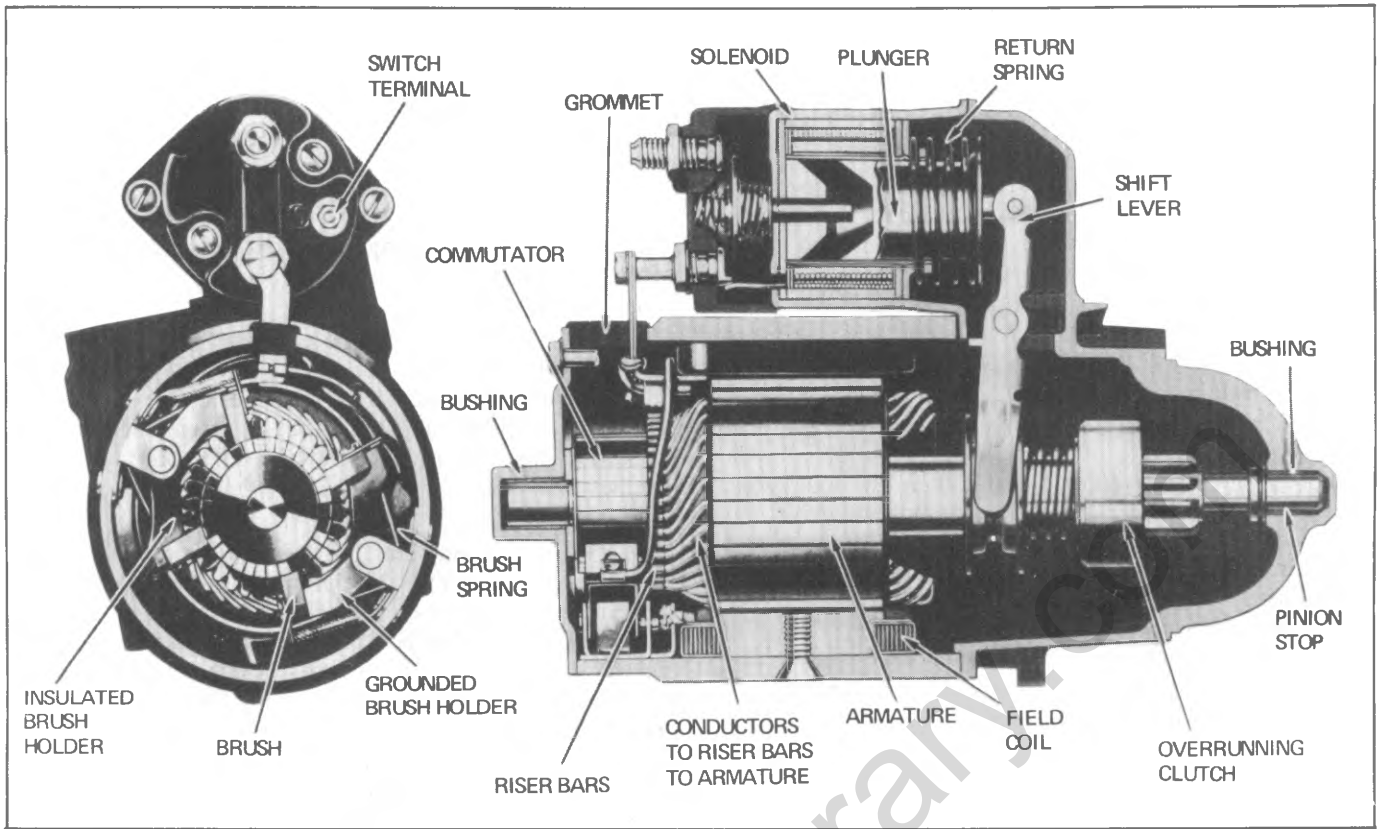


Fig. 6D-1s--Starting Motor Cross Section (Typical)

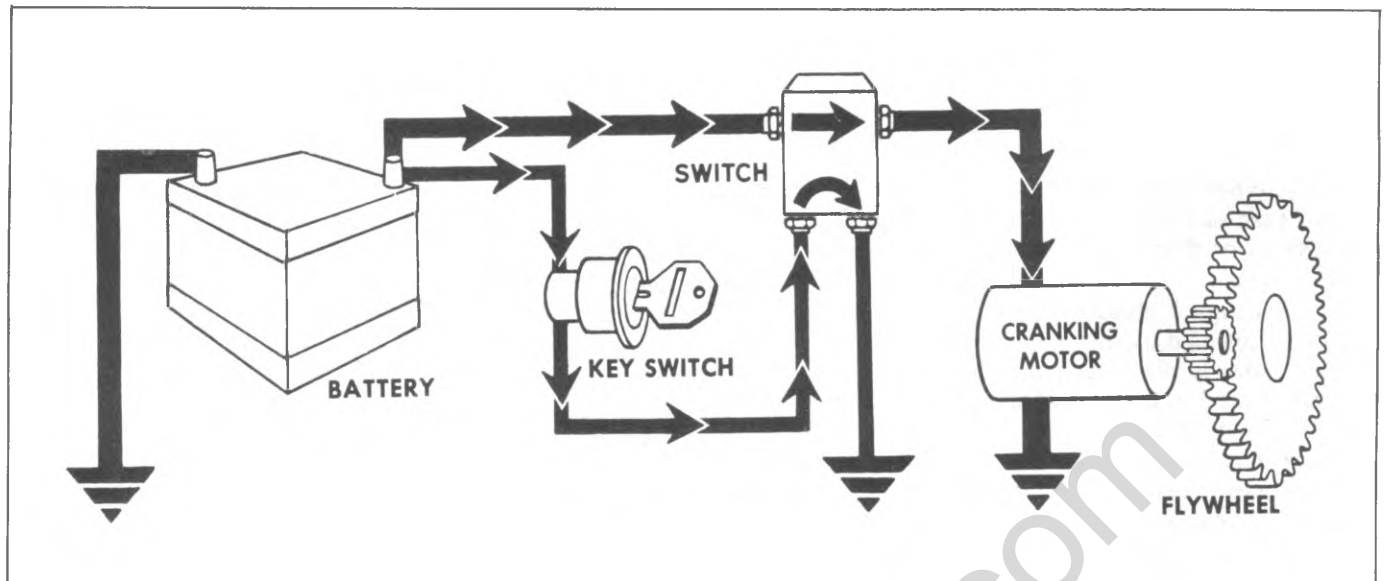


Fig. 6D-2s--Typical Cranking System

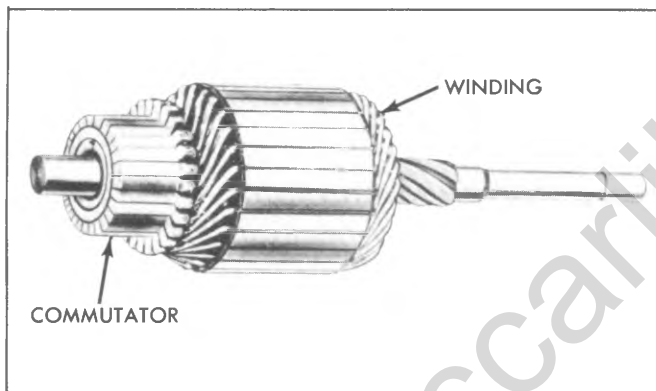


Fig. 6D-3s--Armature Assembly

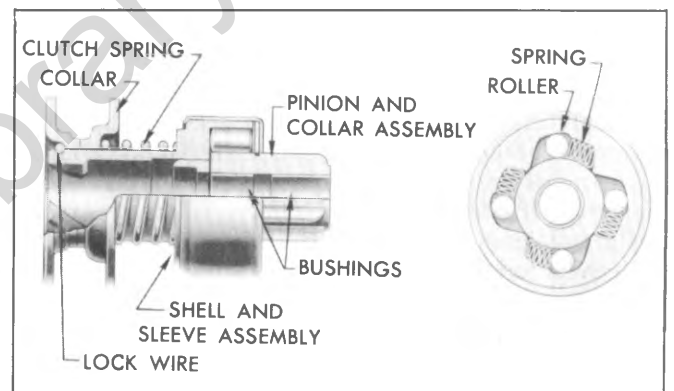


Fig. 6D-4s--Overrunning Clutch Assembly

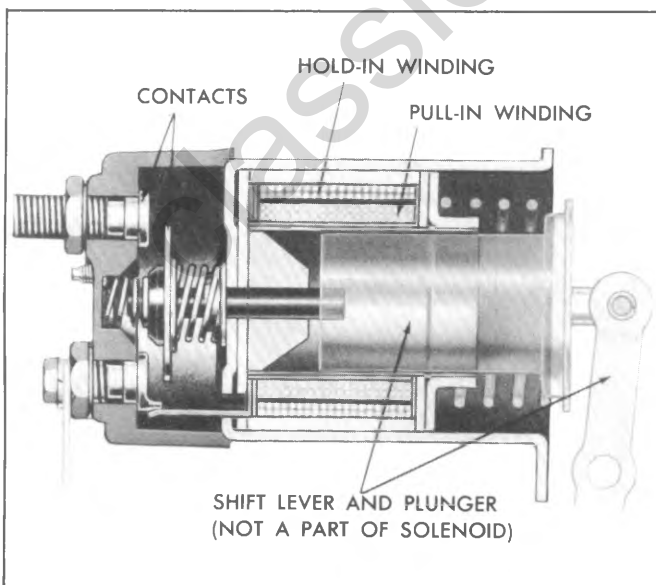


Fig. 6D-5s--Solenoid Cross Section

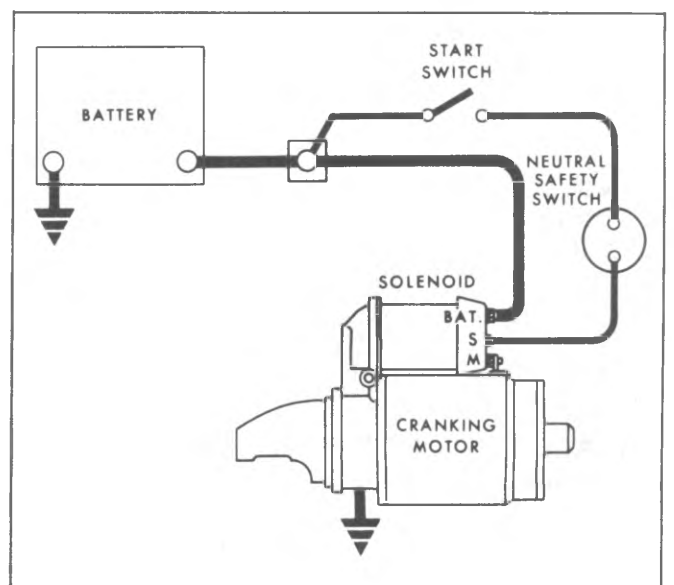


Fig. 6D-6s--Start Switch Circuit (Typical)

DIAGNOSIS

NO CRANKING ACTION

1. Make sure that control lever is neutral (N) or park (P) position or that clutch pedal is depressed on manual transmission.

2. Make quick check of battery and cables. If battery is low, the solenoid usually will produce a clattering noise, because a nearly discharged battery will not sustain the voltage required to hold solenoid plunger in after solenoid switch as been closed.

3. If starter motor spins and drive pinion engages ring gear but does not drive it, overrunning clutch is slipping. Remove motor to replace drive assembly.

4. If starter motor does not operate, note whether solenoid plunger is pulled into solenoid when solenoid circuit is closed. Ordinarily the plunger makes a loud click when it is pulled in. If plunger is pulled in, solenoid circuit is okay and trouble is in solenoid switch, cranking motor, or cranking motor circuit. The starter motor must be removed for repairs to switch or motor.

5. If plunger does not pull into solenoid when ignition switch is turned to "START", the solenoid circuit is open, or solenoid is at fault.

6. To find reason why plunger does not pull into solenoid, connect jumper between solenoid battery terminal and terminal on solenoid switch to which purple wire is connected. If cranking motor operates, solenoid is okay; trouble is in ignition switch, neutral start switch, or in wires and connections between these units.

7. If starter motor still does not operate, remove motor for inspection and test of solenoid switch.

CRANKING SPEED ABNORMALLY LOW

Abnormally low cranking speed may be caused by low battery or defective cables, defective solenoid switch, defective cranking motor, or an internal condition of engine.

1. Make quick check of battery. If low battery is indicated, test battery. If defective cables are indicated, test cables.

NOTE: Check generator belt tension for cause of low battery.

2. If battery and cables are okay, test cranking motor and solenoid switch.

3. If starter motor and solenoid switch test okay, the trouble is due to an internal condition of engine. This may be due to use of engine oil which is too heavy for prevailing temperatures.

VOLTAGE TEST OF STARTING SYSTEM AND SOLENOID SWITCH

The voltage across the starter motor and switch while cranking the engine gives a good indication of any excessive resistance.

NOTE: Engine must be at normal operating temperature when test is made.

1. Inspect battery and cables to make certain that

battery has ample capacity for cranking and ignition.

2. Connect jumper wire to distributor terminal of coil and to ground on engine, so that engine can be cranked without firing.

3. Connect voltmeter positive lead to the motor terminal on solenoid switch; connect voltmeter negative lead to ground (Fig.6D-7s).

4. Turn ignition switch on, crank engine and take voltmeter reading as quickly as possible. If cranking motor turns engine at normal cranking speed with voltmeter reading 9 or more volts, the motor and switch are satisfactory. If cranking speed is below normal and voltmeter reading is 9 volts or greater, the cranking motor is defective.

CAUTION: Do not operate starter motor more than 30 seconds at a time without pausing to allow motor to cool for at least two minutes; otherwise, overheating and damage to motor may result.

5. If starter motor turns engine at low rate of speed with voltmeter reading less than 9 volts, test solenoid switch contacts as follows:

6. With voltmeter switch turned to any scale above 12 volts, connect voltmeter negative lead to the motor terminal of solenoid switch, and connect positive lead to battery terminal of switch (Fig. 6D-8s).

7. Turn ignition switch on and crank engine. Immediately turn voltmeter switch to low scale and take reading as quickly as possible, then turn switch back to higher scale and stop engine.

The voltmeter will read not more than 2/10 volt if switch contacts are satisfactory. If voltmeter reads more than 2/10 volt, switch should be repaired or replaced.

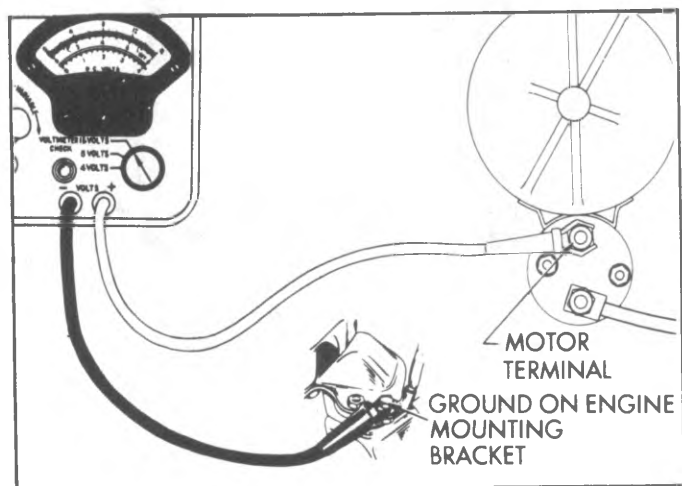


Fig. 6D-7s--Cranking Voltage Test Connections

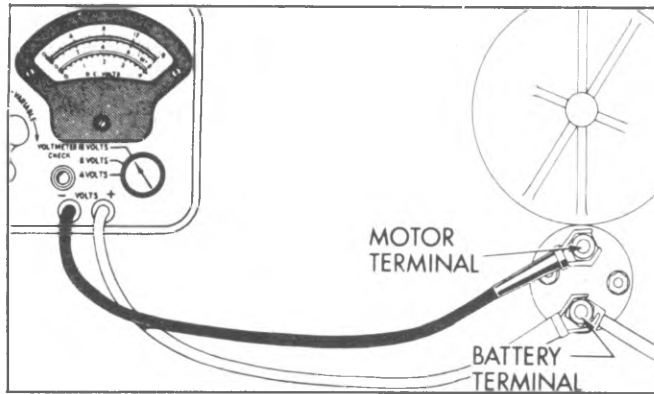


Fig. 6D-8s--Solenoid Switch Contact Test Connections

AMPERAGE TEST OF SOLENOID SWITCH WINDINGS

- (1) Current draw of both windings in parallel.
- (2) Current draw of hold-in winding alone.

1. Remove screw from solenoid motor terminal and bend field leads slightly until clear of terminal. Then ground solenoid motor terminal with a heavy jumper wire (Fig. 6D-9s).

2. Connect a 12-volt battery, a variable resistance, and an ammeter of 100 amperes capacity in series with solenoid "S" terminal. Connect a heavy jumper wire from solenoid base to ground post of battery.

3. Connect a voltmeter between base of solenoid and small solenoid "S" terminal.

4. Slowly adjust resistance until voltmeter reads 10 volts and note ammeter reading. This shows current draw

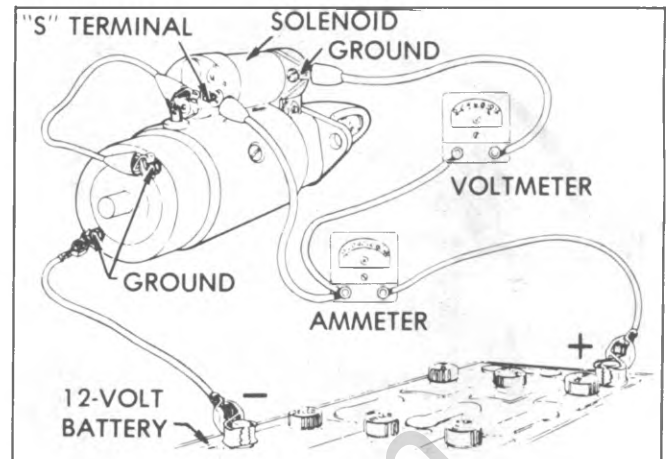


Fig. 6D-9s--Amperage Test of Solenoid

of both windings in parallel. Refer to Delco-Remy bulletin for specifications on the starter being tested.

5. Remove jumper wire from solenoid motor terminal and re-adjust resistance until voltmeter reads 10 volts, then note ammeter reading. This shows current draw of hold-in winding alone. Refer to Delco-Remy bulletin for specifications.

6. If solenoid windings do not test within specifications given, solenoid switch assembly should be replaced.

ON VEHICLE SERVICE

MAINTENANCE AND ADJUSTMENTS

Lubrication

No periodic lubrication of the starting motor or solenoid is required. Since the starting motor and brushes cannot be inspected without disassembling the unit, no service is required on these units between overhaul periods.

COMPONENT PART REPLACEMENT

STARTING MOTOR

Replacement

The following procedure is a general guide for all vehicles and will vary slightly depending on series and model.

1. Disconnect battery ground cable at battery.
2. Raise vehicle to a good working height.
3. Disconnect all wires at solenoid terminals.

NOTE: Reinstall the nuts as each wire is disconnected as thread size is different but may be mixed and stripped.

4. Loosen starter front bracket (nut on V-8 and bolt on L-4) then remove two mount bolts.

NOTE: On V-8 engines incorporating the solenoid heat shield, remove the front bracket upper bolt and detach bracket from starter motor.

5. Remove the front bracket bolt or nut and rotate bracket clear of work area then lower starter from vehicle by lowering front end first -- (hold starter against bell housing and sort of roll end-over-end).

6. Reverse the removal procedure to install. Tighten the mount bolts first, then tighten the brace bolt.

7. Check operation of starter on vehicle.

CHECKING PINION CLEARANCE

Whenever the starter motor is disassembled and reassembled, the pinion clearance should be checked. This is to make sure that proper clearance exists between the pinion and pinion stop retainer when pinion is in cranking position. Lack of clearance would prevent solenoid starter switch from closing properly; too much clearance would cause improper pinion engagement in ring gear.

1. Connect a source of approximately 6 volts (3 battery cells or a 6 volt battery) between the solenoid "S" terminal and ground.

CAUTION: Do not use more than 6 volts or the motor will operate. As a further precaution to

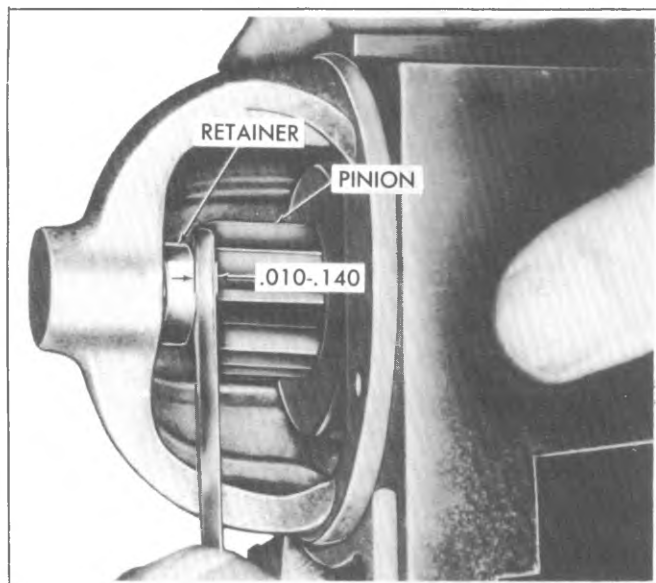


Fig. 6D-10s--Checking Pinion Clearance

prevent motoring, connect a heavy jumper wire from the solenoid motor terminal to ground.

2. After energizing the solenoid, push the pinion away from the stop retainer as far as possible and use feeler gauge to check clearance between pinion and retainer (Fig. 6D-10s).

3. If clearance is not between .010" and .140" it indicates excessive wear of solenoid linkage, shift lever mechanism, or improper assembly of these parts.

NOTE: Pinion clearance cannot be adjusted. If clearance is not correct, motor must be disassembled and checked for the above mentioned defects. Any defective parts must be replaced.

BENCH TEST OF STARTING MOTOR

To obtain full performance data on a cranking motor, or to determine the cause of abnormal operation, the motor should be removed from the engine and be submitted to a no-load test with equipment designed for such tests. A high current carrying variable resistance should be connected into the circuit so that the specified voltage at the starter motor may be obtained, since a small variation in the voltage will produce a marked difference in the current draw.

(a) No-Load Test. Connect the starter motor in series with a 12 volt-battery and an ammeter capable of indicating

several hundred amperes. If an RPM indicator is available, set it up to read armature RPM. Check current draw and armature RPM at the specified voltage.

1. Low no-load speed and high current draw may result from:

(a) Tight, dirty, or worn bearings, bent armature shaft or loose field pole screws which would allow the armature to drag.

(b) Shorted armature. Check armature further on growler.

(c) A grounded armature or field.

Check for grounds by raising the grounded brushes and insulating them from the commutator. If the starter motor has shunt field coils which are grounded to the field frame, disconnect these fields from ground. Then check with a test lamp between the insulated terminal and the frame. If lamp lights, raise other brushes from commutator and check fields separately to determine whether it is the fields or armature that is grounded:

2. Failure to operate with high current draw may result from:

(a) A direct ground in the terminal or fields.

(b) Frozen shaft bearings which prevent the armature from turning.

3. Failure to operate with no current draw may result from:

(a) Open field circuit. Inspect internal connections and trace circuits with test lamp.

(b) Open armature coils. Inspect the commutator for badly burned bars.

(c) Broken or weakened brush springs, worn brushes, high mica on the commutator, or other causes which would prevent good contact between the brushes and commutator. Any of these conditions will cause burned commutator bars.

4. Low no-load speed with low current draw indicates:

(a) An open field winding. Raise and insulate ungrounded brushes from commutator and check fields with test lamp.

(b) High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under item 3 (c).

5. High no-load speed with high current draw indicates shorted fields. There is no easy way to detect shorted fields, since the field resistance is already low. If shorted fields are suspected, replace the fields and check for improvement in performance.

UNIT REPAIR

DISASSEMBLY-EXCEPT 20MT DIESEL (Figs. 6D-1s and 6D-11s)

1. Disconnect the field coil connector(s) from the motor solenoid terminal.

2. Remove through bolts.

3. Remove commutator end frame, field frame assembly and armature assembly from drive housing.

4. Remove overrunning clutch from armature shaft as follows:

a. Slide two piece thrust collar off end of armature shaft.

b. Slide a standard half-inch pipe coupling or other metal cylinder of suitable size (an old pinion of suitable size can be used if available) onto shaft so end of coupling or cylinder butts against edge of retainer (fig. 6D-12s). Tap end

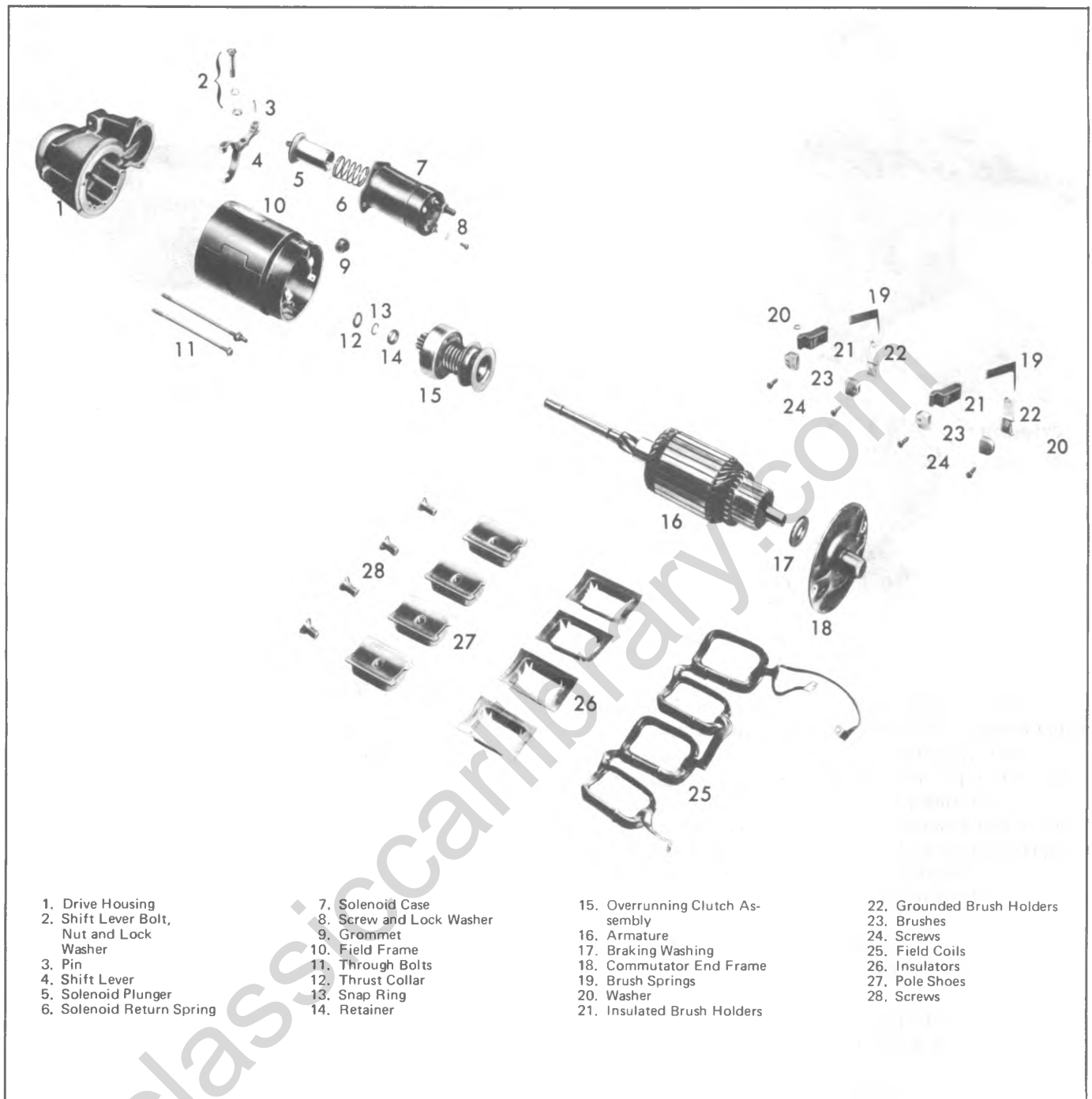


Fig. 6D-11s--Starting Motor Parts Layout

of coupling with hammer, driving retainer towards armature end of snap ring.

c. Remove snap ring from groove in shaft using pliers or other suitable tool. If the snap ring is too badly distorted during removal, it may be necessary to use a new one when reassembling clutch.

d. Slide retainer and clutch from armature shaft.

5. Disassemble brush rigging from field frame.

a. Release "V" spring from slot in brush holder support.

b. Remove support pin.

c. Lift brush holders, brushes and spring upward as a unit.

d. Disconnect leads from each brush.

e. Repeat operation for other set of brushes.

CLEANING AND INSPECTION

With the starting motor completely disassembled except for removal of field coils, the component parts should be cleaned and inspected as described below. Field coils need be removed only where defects in the coils are indicated by the tests described in this section.

1. Clean all starting motor parts, but do not use grease dissolving solvent for cleaning the overrunning clutch, armature, and field coils since such a solvent would

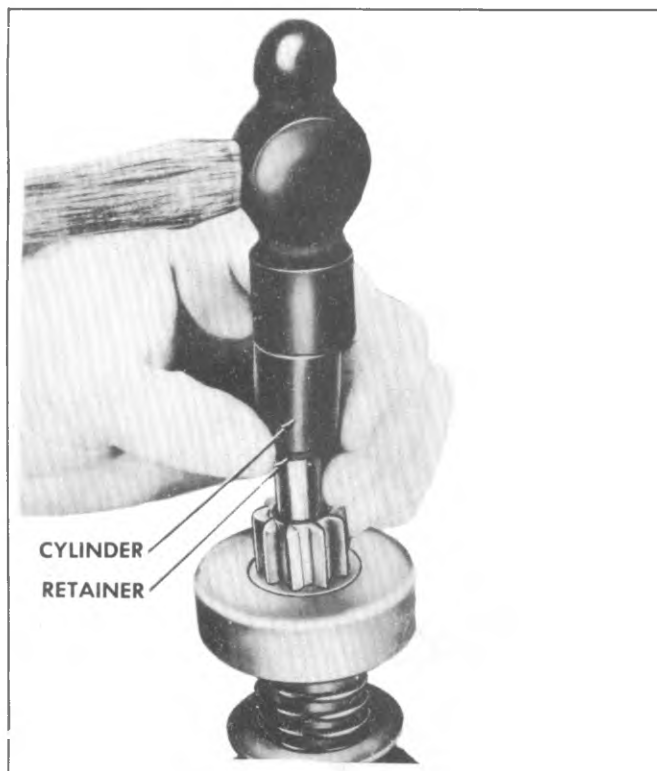


Fig. 6D-12s--Driving Retainer Off Snap Ring

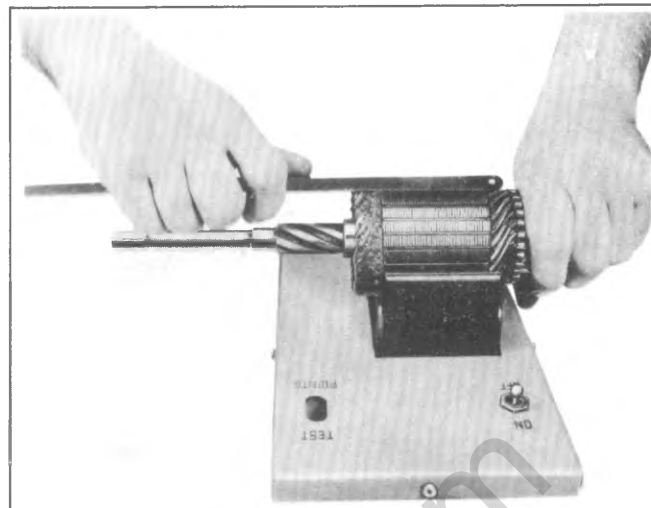


Fig. 6D-13s--Armature Short Circuit Test

dissolve the grease packed in the clutch mechanism and would damage armature and field coil insulation.

2. Test overrunning clutch action. The pinion should turn freely in the overrunning direction and must not slip in the cranking direction. Check pinion teeth to see that they have not been chipped, cracked, or excessively worn. Check the spring for normal tension and drive collar for wear. If necessary, the spring or collar can be replaced by forcing the collar toward the clutch and removing lock ring from end of tube.

3. Check brush holders to see that they are not deformed or bent, but will properly hold brushes against the commutator.

4. Check the condition of the brushes and if pitted or worn to one-half their original length, they should be replaced.

5. Check fit of armature shaft in bushing of drive housing. Shaft should fit snugly in the bushing. If the bushing is worn, it should be replaced. Apply a silicone lubricant to this bushing before reassembly. Avoid excessive lubrication.

6. Check fit of bushing in commutator end frame. If this bushing is damaged or worn excessively, the end frame assembly must be replaced. Apply a silicone lubricant to this bushing before reassembly. Avoid excessive lubrication. Lubricant forced onto the commutator would gum and cause poor commutation with a resulting decrease in cranking motor performance.

CAUTION: Some starter motor models use a molded armature commutator design and no attempt to undercut the insulation should be made or serious damage may result to the commutator.

Undercutting reduces the bonding of the molding material which holds the commutator bars and since the molding material is softer than the copper bars, it is not necessary to undercut the material between the bars of the molded commutator.

7. Inspect armature commutator. If commutator is rough or out of round, it should be turned down and undercut. Inspect the points where the armature conductors join the commutator bars to make sure that it is a good firm connection. A burned commutator bar is usually evidence of a poor connection. See "Turning the Commutator," described under Testing and Repairs.

TESTING AND REPAIRS

Armature Test For Shorts

Check the armature for short circuit by placing on growler and holding hack saw blade over armature core while armature is rotated (fig. 6D-13s). If saw blade vibrates, armature is shorted. Recheck after cleaning between the commutator bars. If saw blade still vibrates, replace the armature.

Armature Test For Ground

Place one lead on the armature core or shaft and the other on the commutator (fig. 6D-14s). If the lamp lights, the armature is grounded and must be replaced.

Field Coil Test For Open Circuit

Place one lead on the insulated brush and the other to the field connector bar (fig. 6D-15s). If the lamp does not light, the field coils are open and will require replacement.

Field Coil Test For Ground

NOTE: Be sure to disconnect the shunt coil before performing this test (when applicable).

Place one lead on the connector bar and the other on the grounded brush (fig. 16s). If the lamp lights, the field coils are grounded.

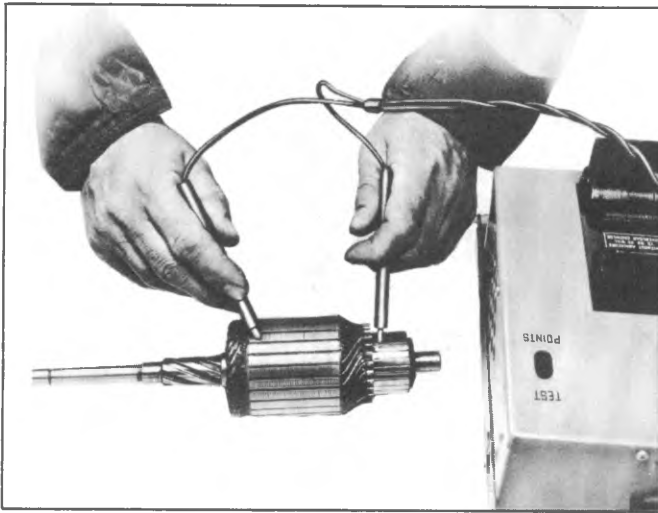


Fig. 6D-14s--Armature Ground Test

Field Coil Replacement

Field coils may be removed from the field frame using a pole shoe screwdriver and a pole shoe spreader. The spreader prevents distortion of the field frame. Careful installation of field coils is necessary to prevent shorting or grounding of the field coils as the pole shoe screws are tightened in place. Formed insulators are used to protect the field leads from grounding to the frame and must be replaced with assembly.

Loose Electrical Connections

When an open soldered connection of the armature to commutator leads is found during inspection, it may be resoldered provided resin flux is used for soldering. Acid flux should never be used on electrical connections.

When inspection shows commutator roughness, it should be cleaned as follows:



Fig. 6D-15s--Field Coil Open Circuit Test

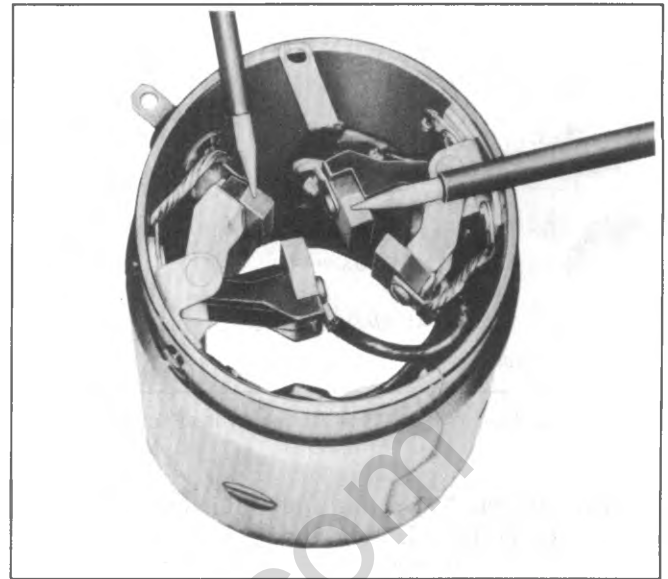


Fig. 6D-16s--Field Coil Ground Test

Turning The Commutator

1. Turn down commutator in a lathe until it is thoroughly cleaned.

CAUTION: Some starter motor models use a molded armature commutator design and no attempt to undercut the insulation should be made or serious damage may result to the commutator. Undercutting reduces the bonding of the molding material which holds the commutator bars and since the molding material is softer than the copper bars, it is not necessary to undercut the material between the bars of the molded commutator.

2. Undercut insulation between commutator bars 1/32". This undercut must be the full width of insulation and flat at the bottom; a triangular groove will not be satisfactory. After undercutting, the slots should be cleaned out carefully to remove any dirt and copper dust.

3. Sand and the commutator lightly with No. 00 sandpaper to remove and slight burrs left from undercutting.

4. Recheck armature on growler for short circuits.

Brush Holder Replacement

If brush holders are damaged, they can be replaced by special service units.

Overrunning Clutch

The overrunning clutch (roll clutch design) used in the various starting motors is (fig. 6D-17s) designed to be serviced as a complete unit.

ASSEMBLY

After all parts have been thoroughly tested and inspected and worn or damaged parts replaced, the starter should be reassembled.

1. Assemble brush rigging to field frame.
 - a. Assemble brushes to brush holders.
 - b. Assemble insulated and grounded brush holder

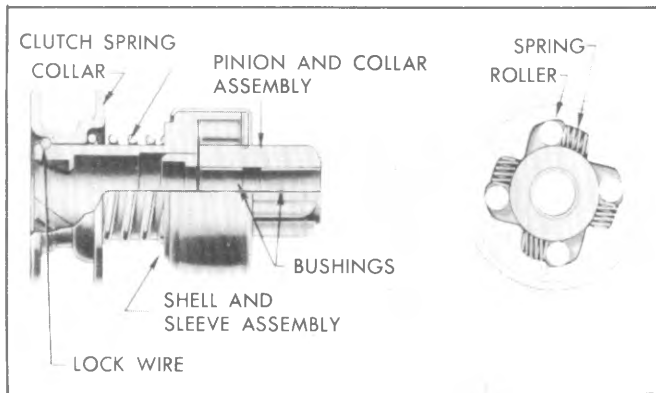


Fig. 6D-17s--Roll Type Clutch Cross-Section

together with the "V" spring and position as unit on the support pin. Push holders and spring to bottom of support and rotate spring to engage the "V" in slot in support.

c. Attach ground wire to grounded brush and field lead wire to insulated brush.

d. Repeat for other set of brushes.

2. Assemble overrunning clutch assembly to armature shaft.

a. Lubricate drive end of armature shaft with silicone lubricant.

b. Slide clutch assembly onto armature shaft with pinion outward.

c. Slide retainer onto shaft with cupped surface facing end of shaft (away from pinion).

d. Stand armature on end of wood surface with commutator down. Position snap ring on upper end of shaft and hold in place with block of wood. Tap wood block with hammer forcing snap ring over end of shaft (fig. 6D-19s). Slide snap ring down into groove.

e. Assemble thrust collar on shaft with shoulder next to snap ring.

f. Place armature flat on work bench, and position retainer and thrust collar next to snap ring. Then using two pair of pliers at the same time (one pair on either side of shaft), grip retainer and thrust collar and squeeze until snap ring is forced into retainer (fig. 6D-19s).

3. Lubricate the drive housing bushing with a silicone lubricant. Make sure thrust collar is in place against snap ring and retainer and slide armature and clutch assembly into place in drive housing engaging shift lever with clutch.

4. Position field frame over armature and apply special sealing compound between frame and solenoid case. Position frame against drive housing using care to prevent damage to the brushes.

5. Lubricate the bushing in the commutator end frame with a silicone lubricant. Place leather brake washer on armature shaft and slide commutator end frame onto shaft.

6. Reconnect the field coil connectors to the "motor" solenoid terminal.

7. After overhaul is completed, perform "Pinion Clearance Check".

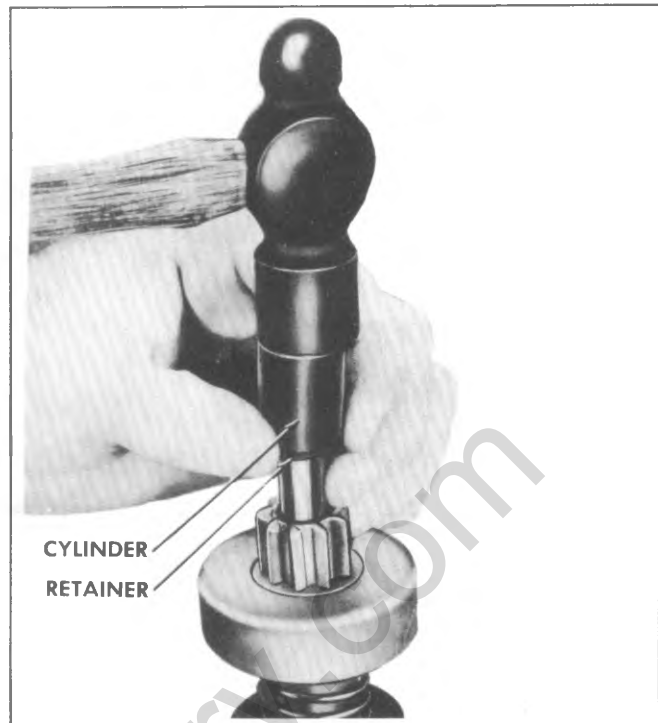


Fig. 6D-18s--Forcing Snap Ring Over Shaft

PINION CLEARANCE CHECK

1. Connect a battery, of the same voltage as the solenoid, from the solenoid switch terminal to the solenoid frame or ground terminal (fig. 6D-20s).

NOTE: Disconnect the motor field coil connector for this test.

2. Momentarily flash a jumper lead from the solenoid motor terminal to the solenoid frame or ground terminal. The pinion will now shift into cranking position and will remain there until the jumper lead is disconnected.

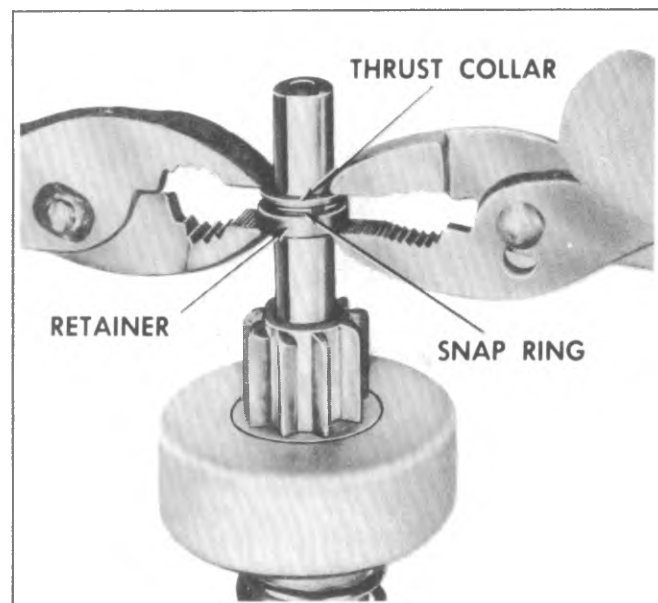


Fig. 6D-19s--Forcing Snap Ring Into Retainer

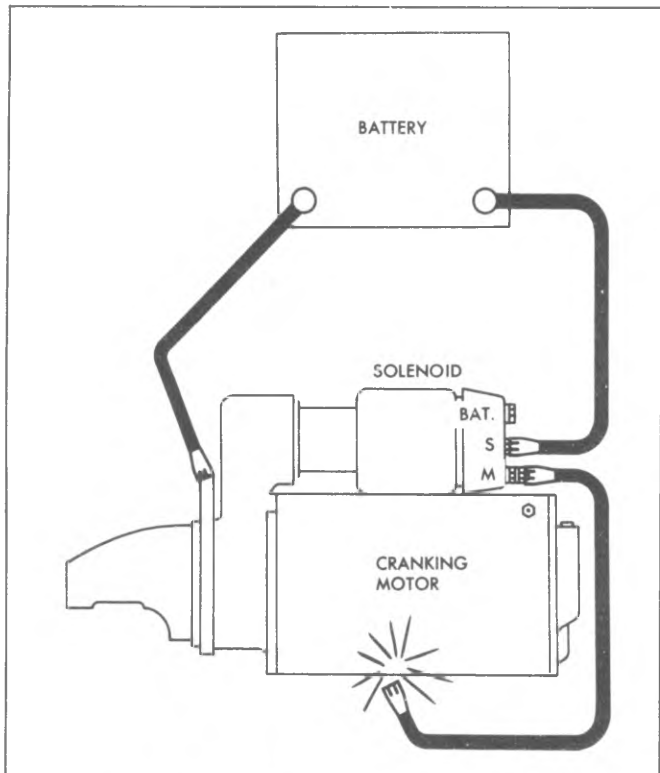


Fig. 6D-20s--Circuit for Checking Pinion Clearance

3. Push the pinion back towards the commutator end to eliminate slack movement.

4. Measure the distance between the pinion and pinion stop (fig. 6D-15s). If clearance is not within specified limits (.010-.140) it may indicate excessive wear of solenoid linkage shift lever yoke buttons or improper assembly of the shift lever mechanism. Worn or defective parts should be replaced.

STARTING SOLENOID

Removal

1. Remove the outer screw and washer from the motor connector strap terminal.
2. Remove the two screws retaining solenoid housing to end frame assembly.
3. Twist solenoid clockwise to remove flange key from keyway slot in housing; then remove solenoid assembly.

Replacement of Contacts (Fig. 6D-21s)

1. With solenoid removed from motor, remove nuts and washers from switch and motor connector strap terminals.
2. Remove the two solenoid end cover retaining screws and washers and remove end cover from solenoid body.
3. Remove nut and washer from battery terminal on end cover and remove battery terminal. Remove resistor by-pass terminal and contactor.
4. Remove motor connector strap terminal and solder new terminal in position.
5. Using a new battery terminal, install terminal washer and retaining nut to end cover. Install by-pass terminal and contactor.
6. Position end cover over switch and motor terminals and install end cover retaining screws. Also install washers and nuts on the solenoid switch and starting motor terminals.
7. Bench test solenoid for proper operation.

Installation

1. With solenoid return spring installed on plunger, position solenoid body to drive housing and turn counterclockwise to engage the flange key in the keyway slot.
2. Install two screws retaining solenoid housing to end frame.
3. Install outer screw and washer securing motor connector strap terminal.

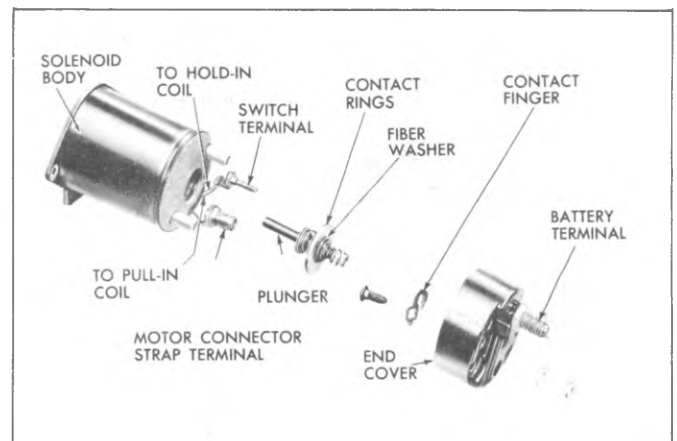


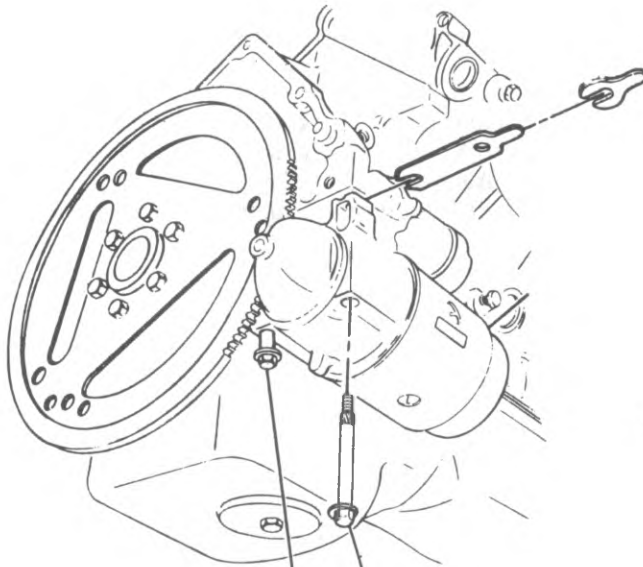
Fig. 6D-21s--Exploded View of Solenoid

STARTER NOISE REPAIR PROCEDURE

Noise during cranking.....use shim **1** on outboard pad, only. Use no more than four shims.

Noise after engine fires.....use shim **2** apply shims one at a time until noise is corrected. Use no more than four shims.

For combinations of the above.....use no more than four shims totally.



NOTE Loosen this bolt when installing **2** shim.

NOTE Remove this bolt to install **2** shim, then reinstall bolt and tighten

NOTE Loosen both bolts when installing **1** shim.

Fig. 6D-22s--Starter Motor Shimming (Exc LF9)

4. Install starter motor as previously described.

STARTERS

Starter motor shimming procedures for CK Series engines (except Diesel) are illustrated in Figure 6D-22s.

STARTER-DIESEL ENGINE (FIG. 6D-23s)**Starter Disassembly (Fig. 6D-23s)**

1. Remove screw from field coil connector and solenoid mounting screws. Rotate solenoid 90° and remove along with plunger return spring.

NOTE: Solenoid may be removed and serviced without further starter disassembly at this time.

2. Remove 2 through bolts, then remove commutator end frame and washer.
3. Remove field frame assembly from drive gear housing. (On diesel starter armature remains in drive end frame.)
4. Remove shift lever pivot bolt.
5. Remove center bearing screws and remove drive gear housing from armature shaft. Shift lever and plunger assembly will now fall away from starter clutch. (Fig. 6D-24s).
6. If necessary to remove overrunning clutch from armature shaft, proceed as follows: (Fig. 25sD-6)
 - a. Remove thrust washer or collar from armature shaft.

- b. Slide a 5/8" deep socket or piece of pipe of suitable size over shaft against retainer as a driving tool. Tap tool to move retainer off snap ring.

- c. Remove snap ring from groove in shaft. If snap ring is distorted, it will be necessary to use a new one on reassembly. (Fig. 6D-26s).

- d. Remove retainer, clutch assembly, (also fiber washer

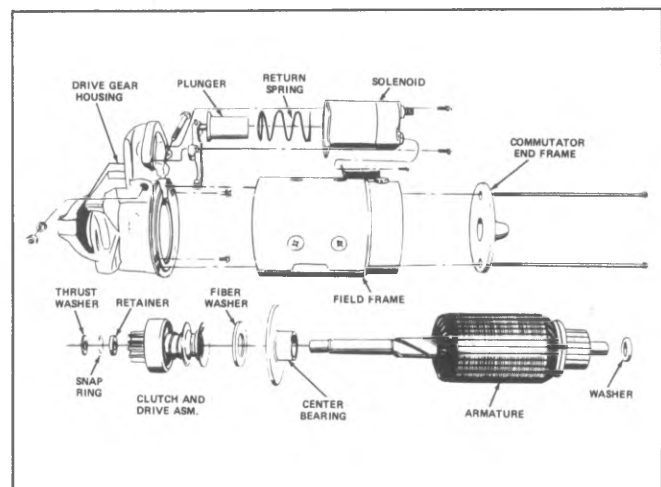


Fig. 6D-23s--Diesel Starter

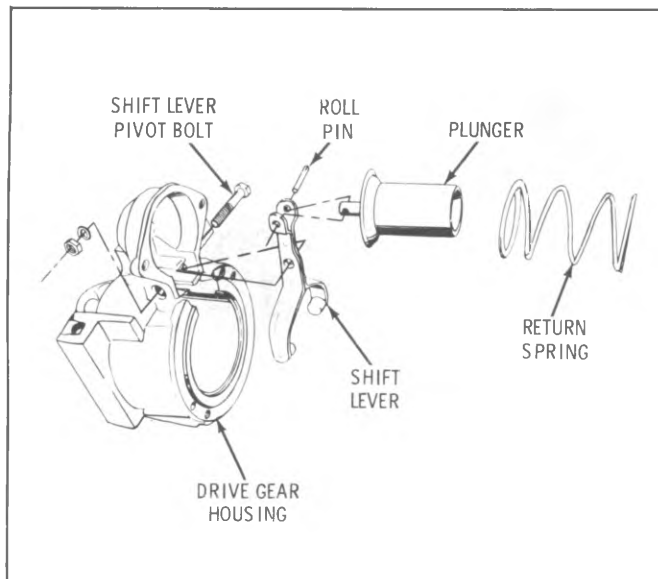


Fig. 6D-24s--Remove Shift Lever

and center bearing on diesel) from armature shaft.

7. The shift lever and plunger may be disassembled at this time by removing the roll pin.

8. If necessary to replace brush holder parts, proceed as follows:

- a. Remove brush holder pivot pin which positions one insulated and one grounded brush. (Fig. 6D-27s).
- b. Remove brush spring.
- c. Replace brushes as necessary.

Cleaning, inspection and Tests

Refer to Section 6D of the 1977 service manual for starter cleaning, inspection and tests.

NOTE: If necessary to remove field coils or pole shoes, care must be taken during reassembly not to break through insulation material on the field coils. Be sure long lip on pole shoes is in direction of armature rotation.

Solenoid Switch

The starter solenoid switch is serviced as an assembly only. The cover can be removed to inspect the contacts and contact disc if necessary. (Fig. 6D-28s).

Starter Assembly

1. Assemble the armature and clutch as follows:

- a. Lubricate drive end of armature shaft with lubricant 1960954 or equivalent.
- b. Install center bearing with bearing toward the armature winding. Then install the fiber washer on the armature shaft. Refer to Fig. 6D-26s.
- c. Slide clutch assembly onto armature shaft with pinion away from armature.
- d. Slide retainer onto shaft with cupped side facing the end of shaft.
- e. Install snap ring into groove on armature shaft.
- f. Install thrust washer on shaft.
- g. Position retainer and thrust washer with snap ring in between. Using two pliers, grip retainer and thrust washer

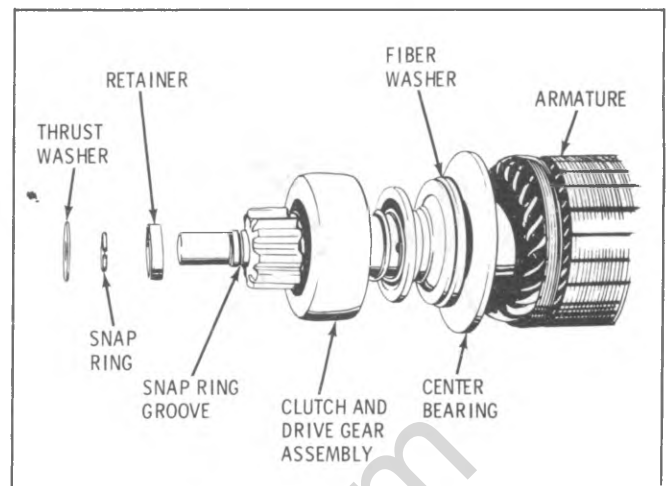


Fig. 6D-25s--Remove Thrust Collar

or collar and squeeze until snap ring is forced into retainer and is held securely in groove in armature shaft. (Fig. 6D-29s).

2. Lubricate drive gear housing bushing with lubricant 1960954 or equivalent.

3. Engage shift lever yoke with clutch and slide complete assembly into drive gear housing.

NOTE: Shift lever may be installed in drive gear housing first.

4. Install the center bearing screws (diesel only) and the shift lever pivot bolt. Tighten securely.

5. Install solenoid assembly on drive gear housing.

6. Apply sealer, No. 1050026 or equivalent to solenoid flange where field frame against drive gear housing on alignment pin using care to prevent damage to brushes.

7. Position field frame against drive gear housing on alignment pin using care to prevent damage to brushes.

8. Lubricate commutator end-frame bushing with lubricant 1960954 or equivalent.

9. Install washer on armature shaft and slide end frame onto shaft, then install and tighten through-bolts.

10. Connect the field coil connector to the solenoid

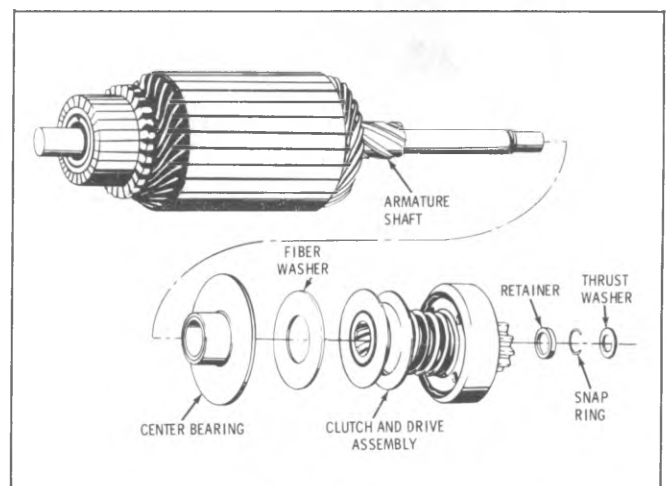


Fig. 6D-26s--Remove Starter Drive

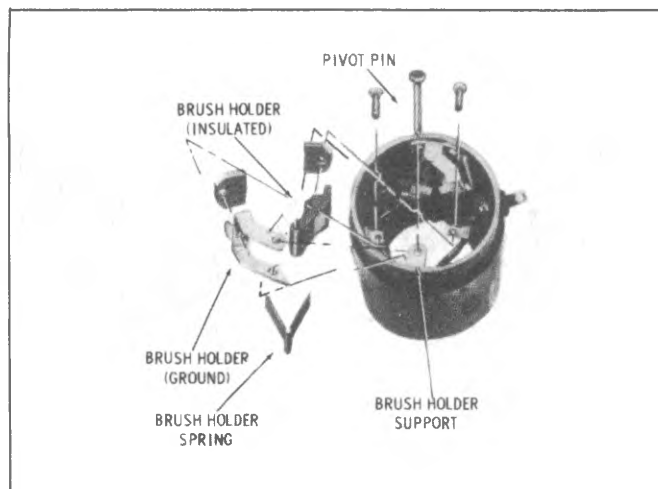


Fig. 6D-27s--Brush Replacement

terminal.

11. Check pinion clearance as outlined under PINION CLEARANCE.

Pinion Clearance

When the starter motor has been disassembled or the solenoid has been replaced, it is necessary to check the pinion clearance. Pinion clearance must be correct to prevent the buttons on the shift lever yoke from rubbing on the clutch collar during cranking.

1. Disconnect the motor field coil connector from the solenoid motor terminal and insulate it carefully.

2. Connect one 12 volt battery lead to the solenoid switch terminal and the other to the starter frame.

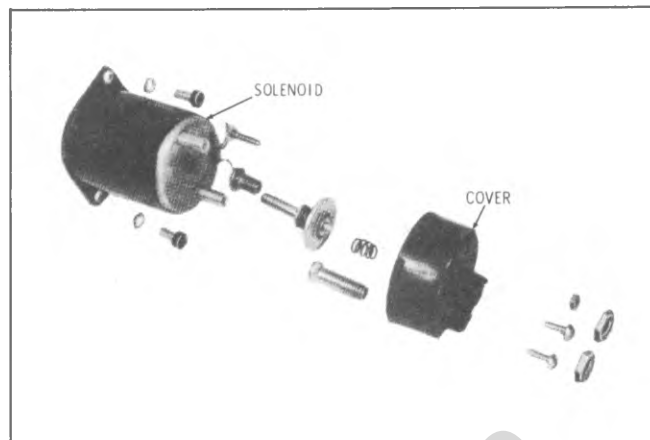


Fig. 6D-28s--Solenoid Switch

3. Flash a jumper lead momentarily from the solenoid motor terminal to the starter frame. This will shift the pinion into cranking position and will remain so until the battery is disconnected.

4. Push the pinion back as far as possible to take up any movement, and check the clearance with a feeler gage. (Fig. 6D-30s). The clearance should be .010" to .140".

Means for adjusting pinion clearance is not provided on the starter motor. If the clearance does not fall within limits, check for improper installation and replace all worn parts.

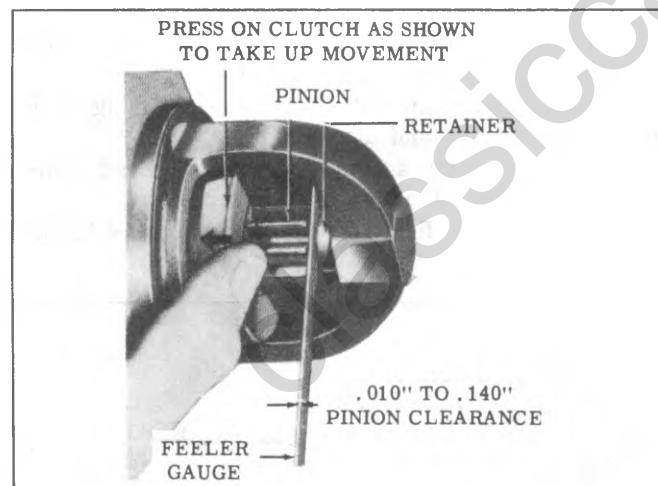


Fig. 6D-30s--Check Pinion Clearance

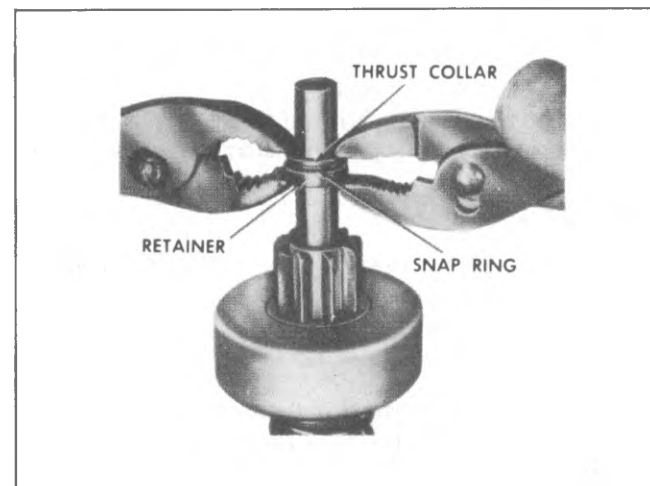


Fig. 6D-29s--Install Snap Ring and Retainer

SPECIFICATIONS

GENERATOR

MODEL NO.	APPLICATION	DELCO REMY SPEC. NO.	FIELD CURRENT AMPS 27°C (80°F) @ 12 VOLTS	COLD OUTPUT* AMPS @ 5000 RMP	RATED HOT OUTPUT** AMPS
1102394 1102491 1102889	All L-6 (Base) (Except G-20, 30 & P-Truck) All C-K-G Truck Base V-8 (Except K31303 & G30003)	4519	4-4.5	33	37
1102485 1102841 1102887	292 L-6 (L25) (Base) (G-20, 30 & P-Truck) All P-Truck Base V-8 (Except P31832)	4521	4-4.5	38	42
1102480 1102486 1102886 1102888	P31832 Truck (Base) All L-6 or V-8 with RPO K76 454 V-8 (FL8) (Base) K31303 & G30003 Truck Base V-8	4522	4-4.5	57	61
1101016 1101028	Optional (COPO)	4525	4-4.5	76	80

*Generator temperature approximately 27°C. (80°F.).

**Ambient temperature 27°C. (80°F.).

Note: The only difference between generators within each group above is the position end frame is rotated.

SPECIFICATIONS

DISTRIBUTOR & SPARK PLUGS

Distributor and spark plug specifications are shown in the Emission Control Chart in Section 6E Specifications.

BATTERY

MODEL NO.	APPLICATION	COLD CRANK RATE @ 0°F (-18°C)	AMPS FOR LOAD TEST	25 AMP. RESERVE CAPACITY (MINUTES)
85-4	250 L-6 (LD4)	275 Amps	130	60
85-5	292 L-6 (L25) 305 V-8 (LG9) 350 V-8 (LS9) 400 V-8 (LF4)	350 Amps	170	80
89-5	454 V-8 (LF8) RPO UA1	465 Amps	230	125
87-5	RPO TP2	430 Amps	210	100

STARTING MOTOR

MODEL NO.	APPLICATION	SPEC. NO.	VOLTS	FREE SPEED AMPERES	RPM
1108778	250 L-6 (LD4) (C & K-10)	3573	9	50-80*	5500-10500
1108779	250 L-6 (LD4) (G-Van)	3573	9	50-80*	5500-10500
1108780	292 L-6 (L25)	2438	9	50-80*	3500-6000
1109056	305 V-8 (LG9) (C & K)	3573	9	50-80*	5500-10500
1109798	305 V-8 (LG9) (G-Van)	3573	9	50-80*	5500-10500
1109052	350 V-8 (LS9)	3563	9	65-95*	7500-10500
1108776	400 V-8 (LF4) 454 V-8 (LF8)	3563	9	65-95*	7500-10500

*Includes Solenoid

SECTION 6E

ENGINE EMISSION CONTROLS

CONTENTS

General Description.....	6E-1
General Description of Emission Control Components.....	6E-1
Early Fuel Evaporation-EFE.....	6E-11
Exhaust Gas Recirculation-EGR.....	6E-14
Positive Crankcase Ventilation System-PCV.....	6E-19
Thermostatic Air Cleaner-TAC.....	6E-19
Air Injection Reactor-AIR.....	6E-25
Throttle Return Control-TRC.....	6E-30
Vacuum Advance Control.....	6E-32
Specifications.....	6E-33

GENERAL DESCRIPTION

The normal operation of the engine results in the release of several compounds to the atmosphere. Federal Government and State of California legislation has placed limitations on the quantities of three compounds which can be emitted. The three controlled compounds are:

- Hydrocarbons - HC
- Carbon Monoxide - CO
- Oxides of Nitrogen - NOx

The emission control section will consist of a general description of emission control components and subsystems, followed by vacuum hose schematics on each engine type, diagnosis and service procedure section.

- The emission control systems include:
- Carburetor Calibration

- Distributor Calibration
- Catalytic Converter (Light Duty Emissions)
- Early Fuel Evaporation (EFE) (Light Duty Emissions)
- Exhaust Gas Recirculation (EGR) (Lt. Duty Emissions 454 Calif. H-Duty Emissions)
- Positive Crankcase Ventilation (PCV)
- Choke Calibration
- Thermostatic Air Cleaner(TAC)
- Evaporation Control System (ECS)

The emission control systems for some engines may use an additional emission control device called Air Injection Reaction (AIR).

GENERAL DESCRIPTION OF EMISSION CONTROL COMPONENTS

CARBURETOR CALIBRATION

While the carburetor's main function is to provide the engine with a combustible air/fuel mixture, the carburetor calibration is critical to maintaining proper emission levels.

The carburetor's idle, off-idle, main metering, power enrichment, and accelerating pump systems are calibrated to provide the best possible combination of engine performance, fuel economy and exhaust emission control. Carburetor adjustments and service must be performed using the recommended procedures to insure engine exhaust emission levels remain within legislated limits.

See Section 6C, Fuel System, for carburetor adjustment specifications and recommended service procedures.

DISTRIBUTOR CALIBRATION

The distributor is an integral part of the engine ignition system and the distributor calibration is an important part of exhaust emission control.

The initial timing centrifugal advance and vacuum advance are calibrated to provide the best engine performance and fuel economy at varying speeds and loads

while remaining within exhaust emission limits. Distributor diagnostics and service procedures are in Section 6D, Engine Electrical.

CATALYTIC CONVERTER

The catalytic converter on a light duty emission vehicle is an emission control device added to the exhaust system to reduce hydrocarbon and carbon monoxide pollutants from the exhaust gas stream. The converter contains material which is coated with a catalytic material containing platinum and palladium.

THE CATALYTIC CONVERTER REQUIRES THE USE OF UNLEADED FUEL ONLY.

Periodic maintenance of the exhaust system is not required; however, if the vehicle is raised for other service, it is advisable to check the general condition of the underfloor catalytic converter, pipes and mufflers.

Refer to Section 6F, Engine Exhaust System, for catalytic converter service procedures and diagnostics.

EARLY FUEL EVAPORATION SYSTEM (EFE)**Light Duty Emissions**

The EFE system is used to provide a source of rapid heat to the engine induction system during cold driveway. Rapid heating is desirable because it provides for quick fuel evaporation and more uniform fuel distribution to aid cold driveability. It also reduces the length of time carburetor choking is required making reductions in exhaust emission levels possible.

EFE systems uses a valve which increases the exhaust gas flow under the intake manifold during cold engine operation. The valve is vacuum operated and is controlled by a thermal vacuum switch (TVS) which applies vacuum when the coolant temperature is below the calibration valve.

Diagnosis and service procedures of the EFE system can be found in this section.

EXHAUST GAS RECIRCULATION SYSTEM (EGR)**Light Duty Emissions and 454-Calif. Heavy Duty Emission.**

The Exhaust Gas Recirculation System meters exhaust gas into induction system for recirculation through the combustion cycle to reduce oxides of nitrogen emissions.

The EGR valve remains closed during periods of engine idle and deceleration to prevent rough idle from excessive exhaust gas dilution in the idle air/fuel mixtures.

All exhaust gas recirculation systems perform the same function, however, differences in operation of system will be covered in the Service Procedure Section.

Diagnosis and service procedure of EGR system can be found in this section.

CLOSED POSITIVE CRANKCASE VENTILATION SYSTEM (PCV)

All engines have closed Positive Crankcase Ventilation System to provide more complete scavenging of crankcase vapors.

An engine which is operated without any crankcase ventilation can be damaged seriously. Therefore, it is important to replace the ventilator valve periodically.

NOTE: If an engine is idling too slow or rough, this may be caused by a clogged ventilator valve or plugged hose; therefore, never adjust the carburetor idle without first checking the PCV valve and hose.

After installing a new PCV valve, readjust engine idle if necessary.

With this system, any blow-by in excess of the system capacity (from a badly-worn engine, sustained heavy load,

etc.) is exhausted into the air cleaner and is drawn into the engine.

Diagnosis and service procedures for the PCV system can be found in this section.

CHOKE SYSTEM

An automatic choke system, maintains proper engine performance during engine warm-up. Modifications to the choke system have been necessary in recent years to meet the lower legislated exhaust emission levels.

THERMOSTATIC AIR CLEANER (TAC)

The Thermostatic Air Cleaner (TAC) is on all engines. The TAC uses a damper assembly in the air cleaner inlet, controlled by a vacuum motor to mix pre-heated and non pre-heated air entering the air cleaner to maintain a controlled air temperature into the carburetor. The vacuum motor is modulated by a temperature sensor in the air cleaner. The pre-heating of the air cleaner inlet air allows leaner carburetor and choke calibrations resulting in lower emission levels, while maintaining good driveability. Diagnostics and service procedures for the thermostatic air cleaner can be found in this section.

AIR INJECTION REACTOR SYSTEM

An air injection reactor (AIR) is used on some engines to provide additional oxygen to continue the combustion process after the exhaust gases leave the combustion chamber. An engine driven pump provides pressurized air which is injected into the exhaust port of the cylinder head or exhaust pipe and then into the exhaust system. The AIR system operates at all times and will bypass air only for a short duration of time during deceleration and at high speeds. The diverter valve performs the bypass function, and the check valve protects the air pump from damage by preventing a back flow of exhaust gas.

Diagnosis and service procedures for air injection reactor system is in this section.

VACUUM CONTROLS

Various types of vacuum controls are used in the emission control system to modify or control the operation of the various emission control components to optimize emission control effectiveness, while minimizing any negative effect on driveability.

Refer to the vacuum hose schematics (Figs. 6E-1 through 6E-18) for usage of these systems.

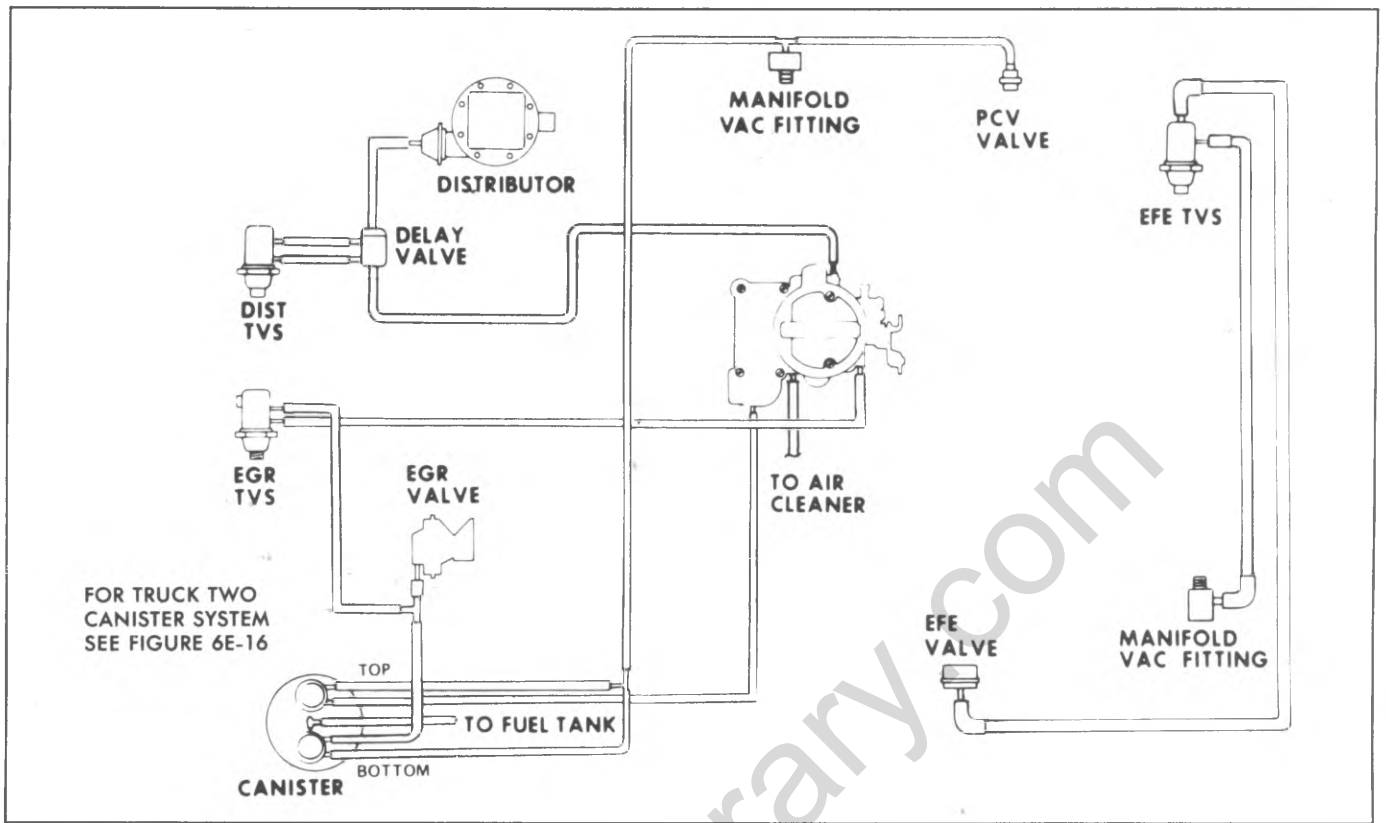


Fig. 6E-1--Vacuum Hose Schematic-L6 250 CID - Except Calif-LD Emissions

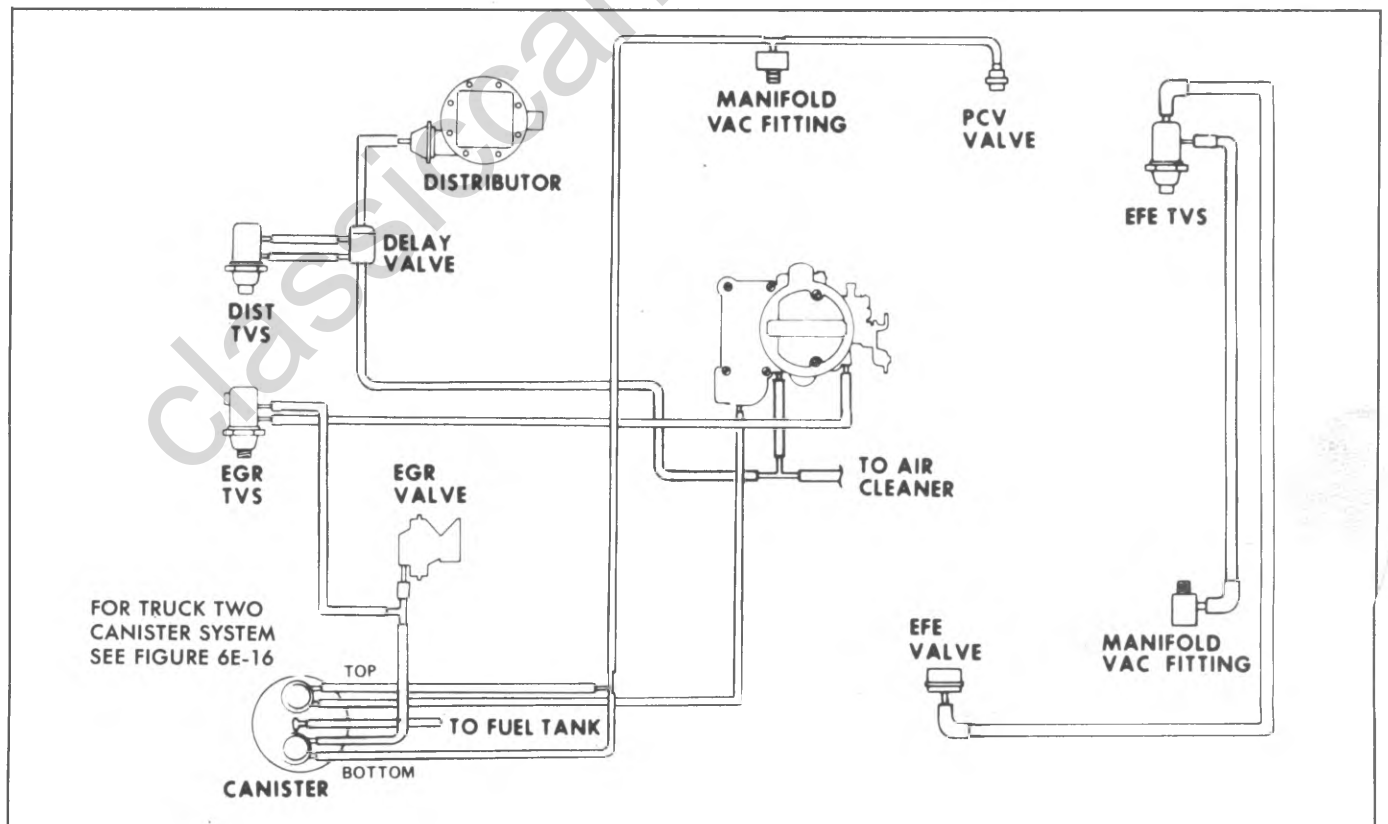


Fig. 6E-2--Vacuum Hose Schematic-L6 250 CID-Calif.-LD Emissions

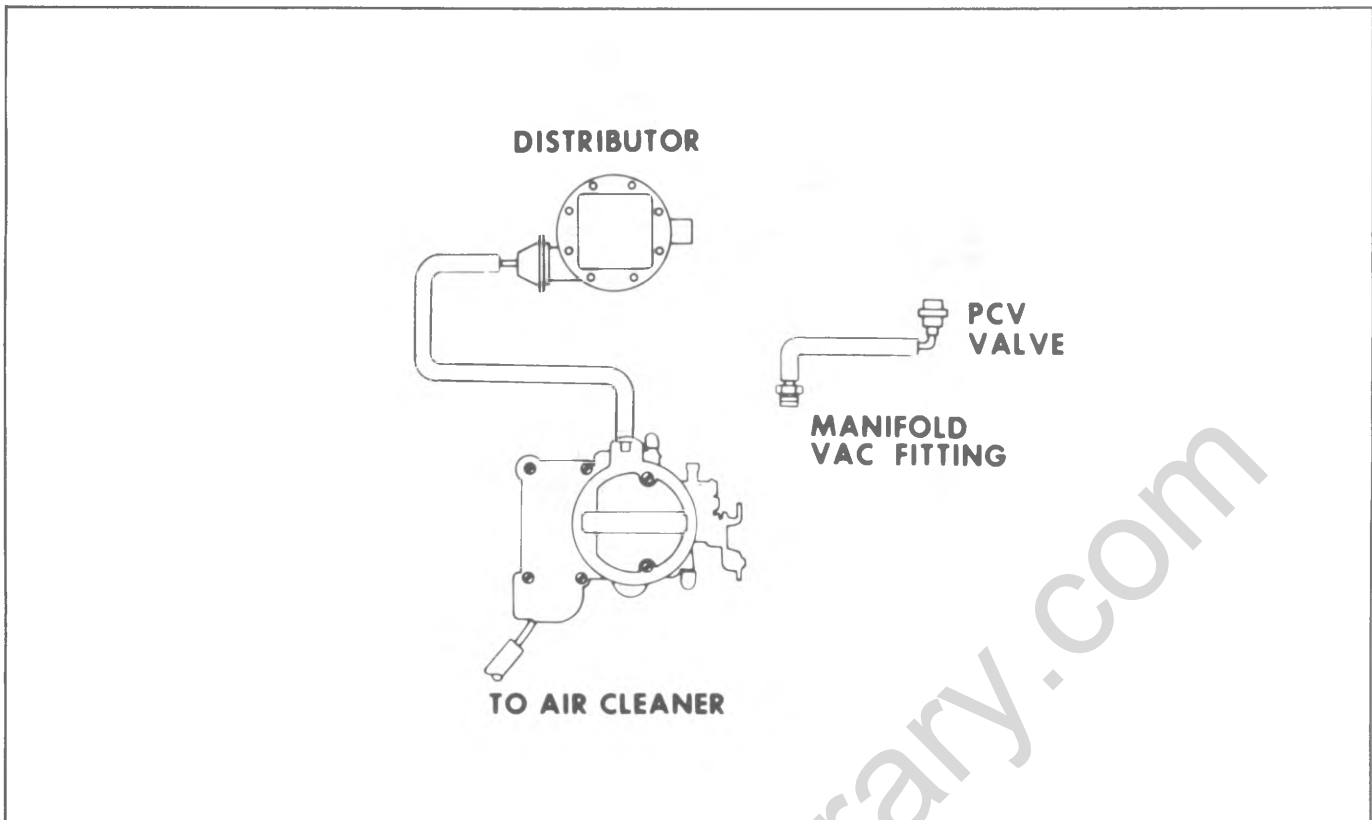


Fig. 6E-3--Vacuum Hose Schematic - L6 250/292 CID-Except Calif. - HD Emissions

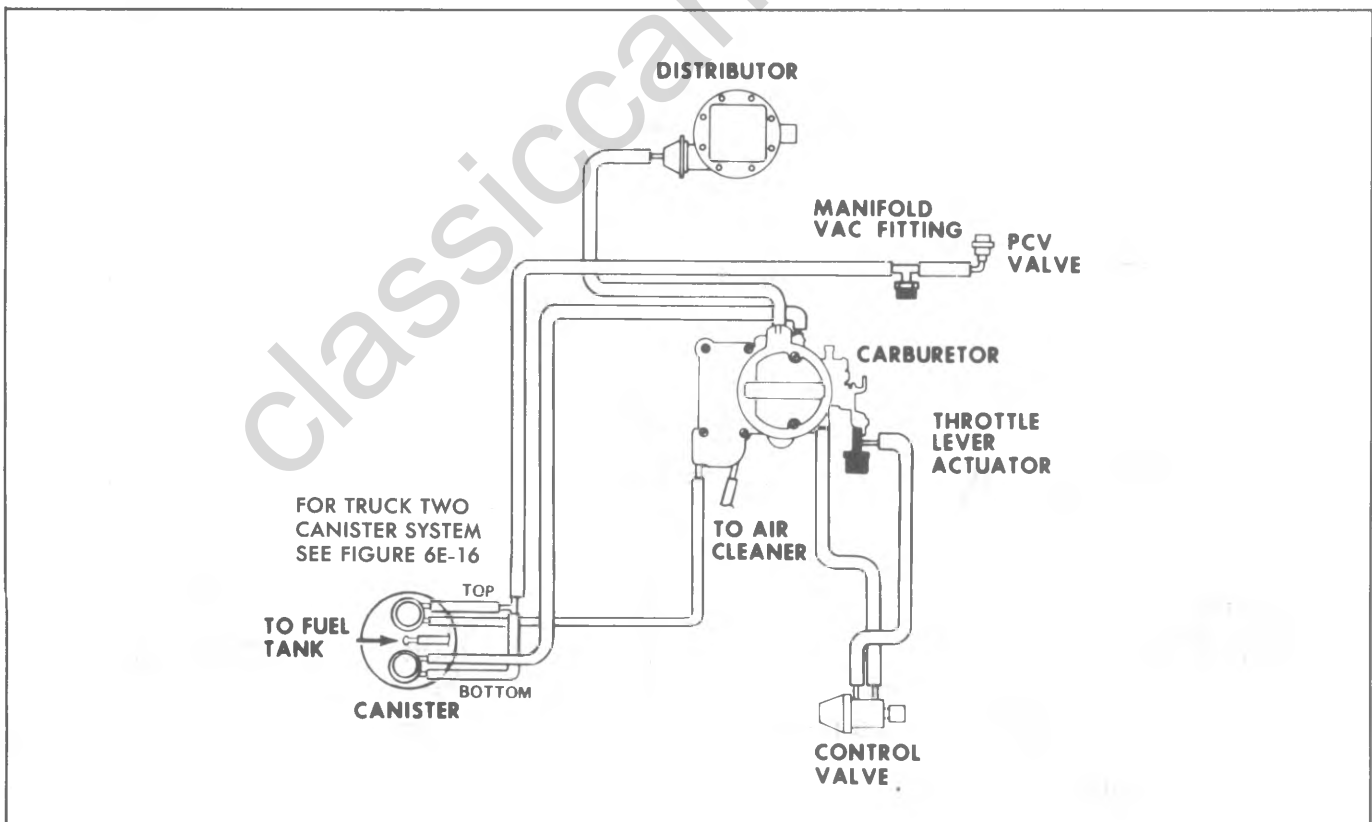


Fig. 6E-4--Vacuum Hose Schematic-L6 292 CID - Calif. - HD Emissions

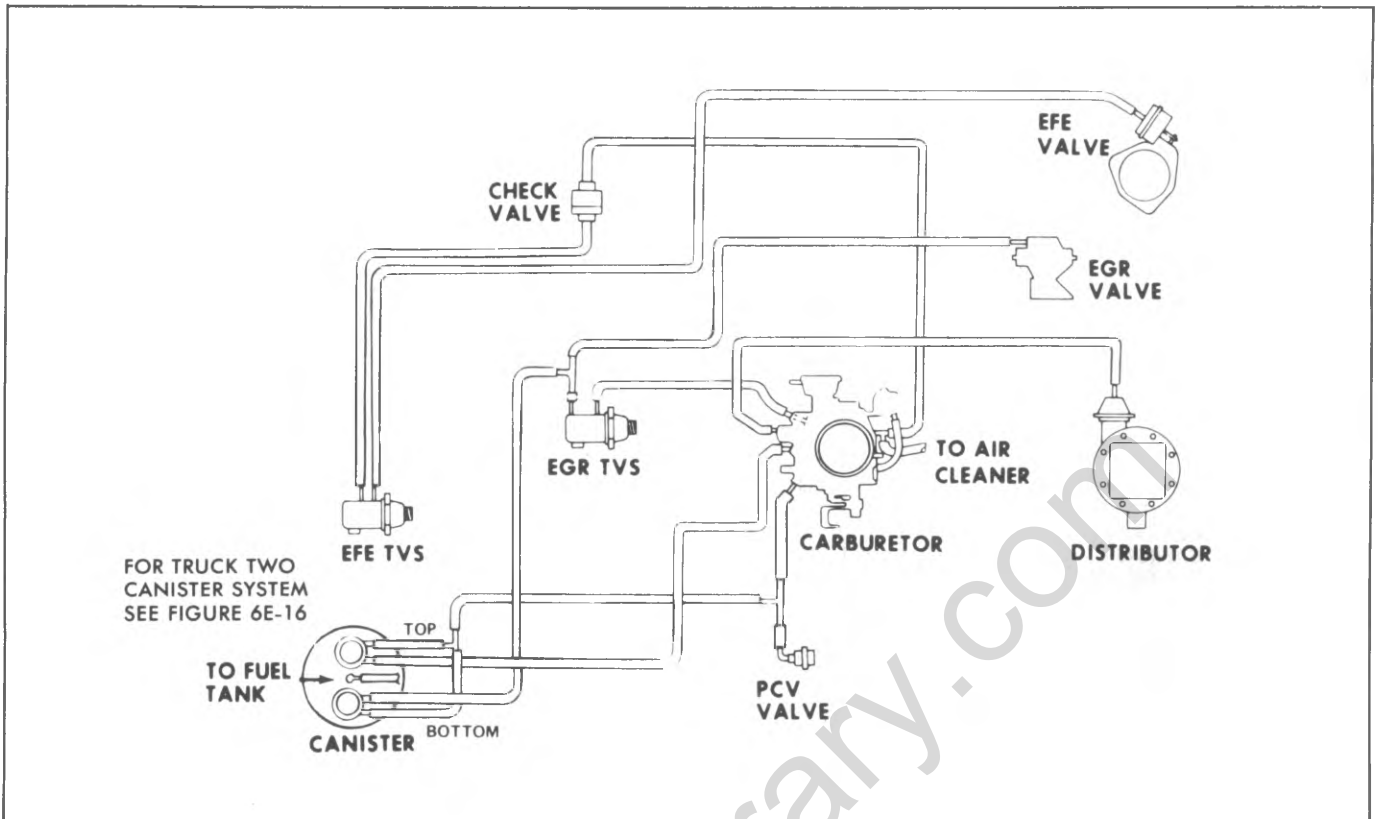


Fig. 6E-5--Vacuum Hose Schematic-V8 305 CID Low Altitude - LD Emissions

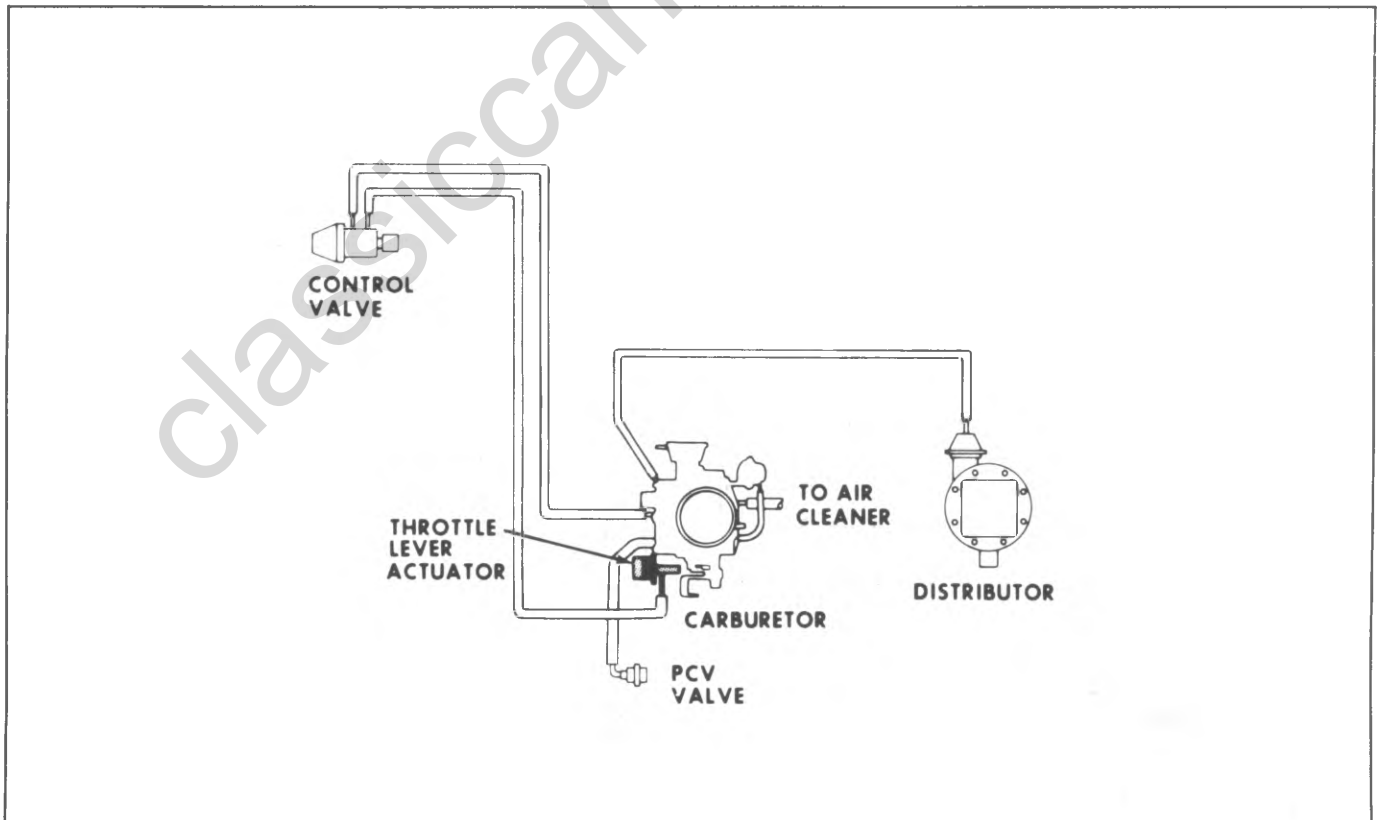


Fig. 6E-6--Vacuum Hose Schematic-V8 305 CID - HD Emissions

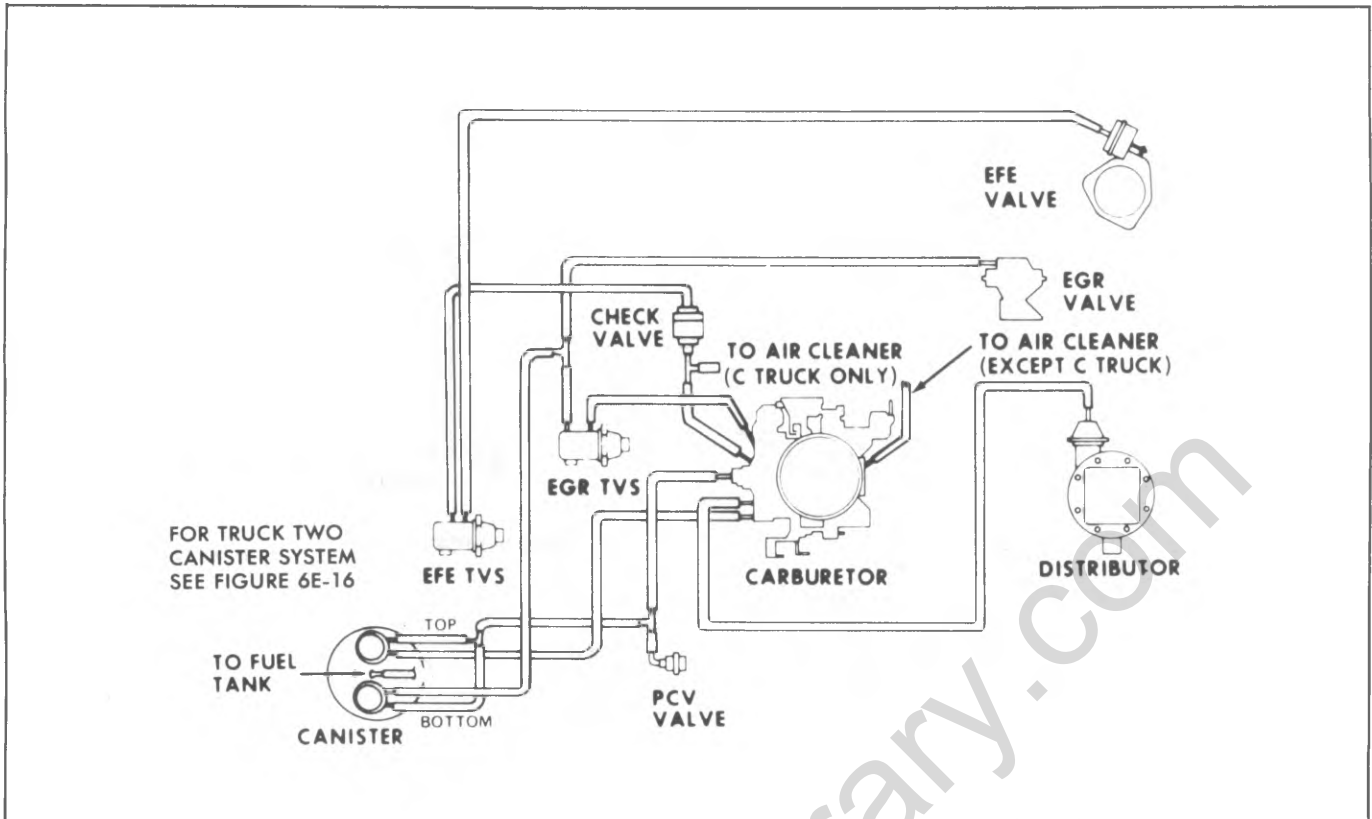


Fig. 6E-7-Vacuum Hose Schematic-V8 350 CID Low Altitude - LD Emissions

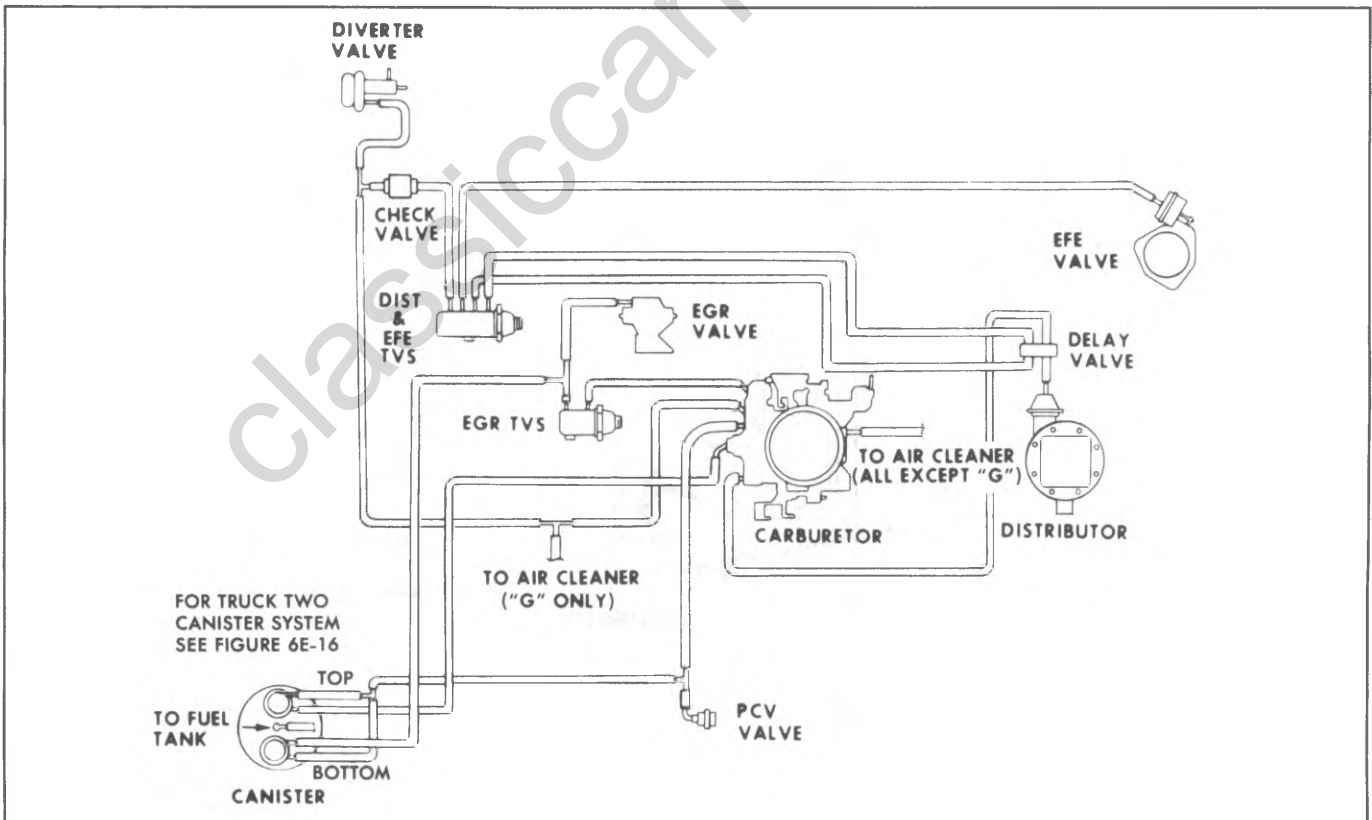


Fig. 6E-8-Vacuum Hose Schematic-V8 350 CID Calif.-LD Emissions

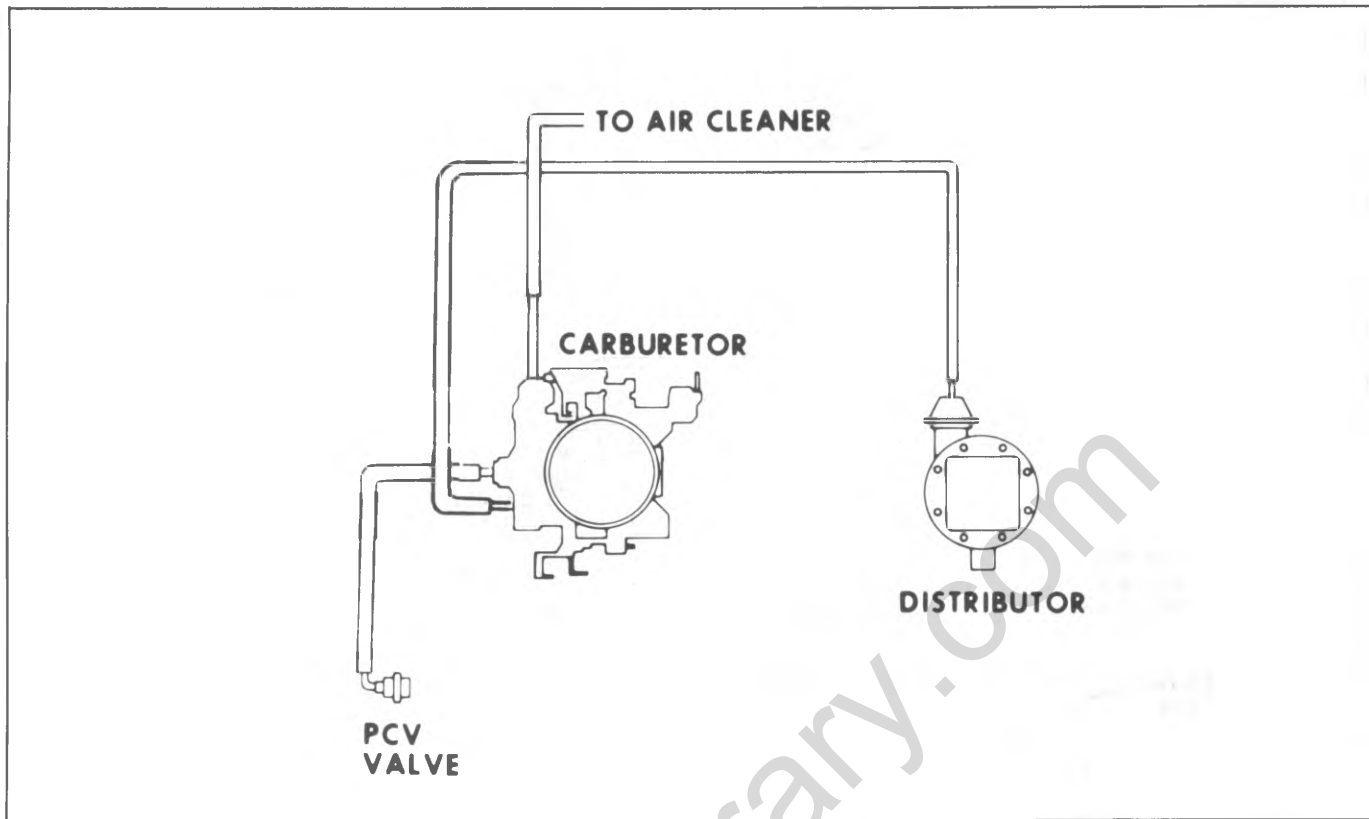


Fig. 6E-9--Vacuum Hose Schematic-V8 350/400 CID (-C60)-LD Emissions

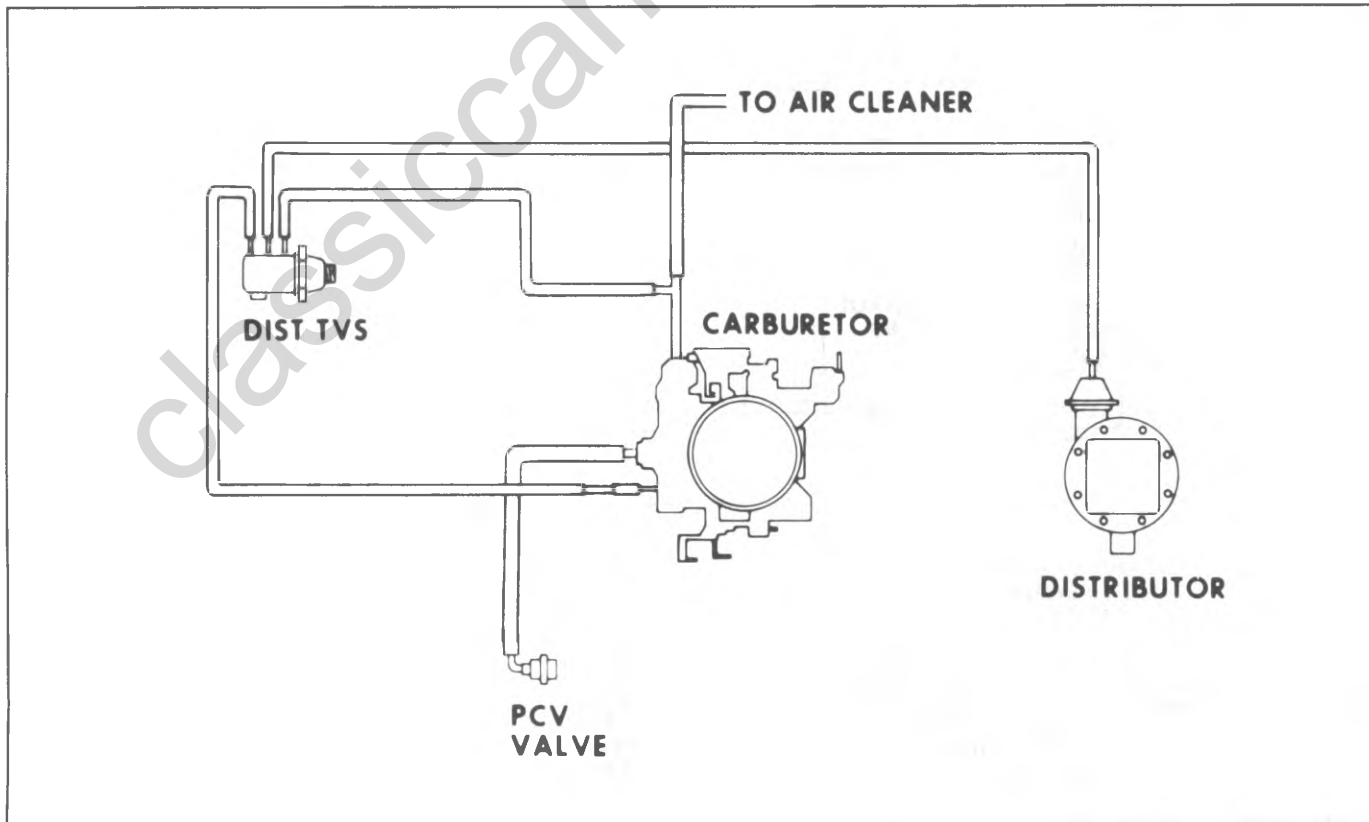


Fig. 6E-10--Vacuum Hose Schematic-V8 350/400 CID (C60)-HD Emissions

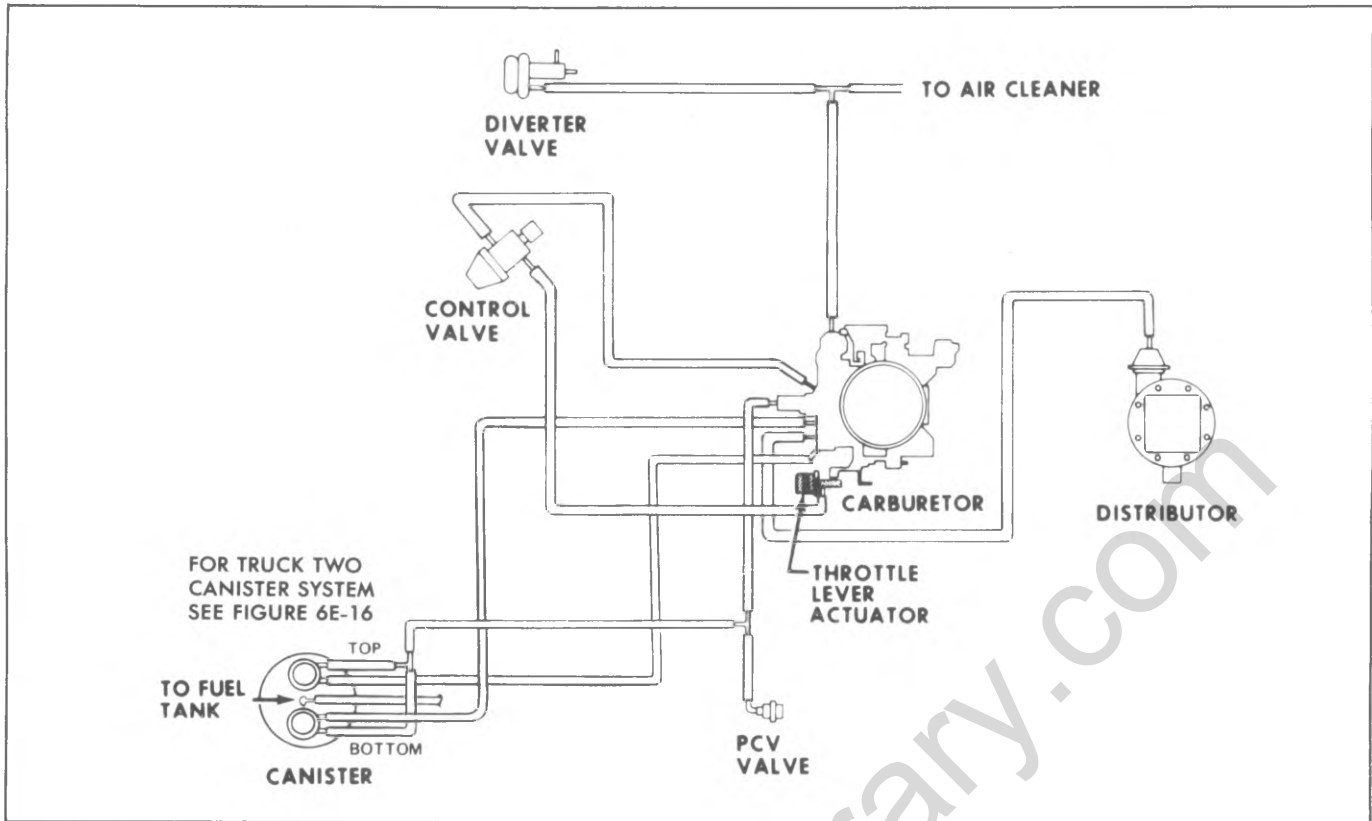


Fig. 6E-11--Vacuum Hose Schematic-V8 350/400 CID Calif. (-C60)-HD Emissions

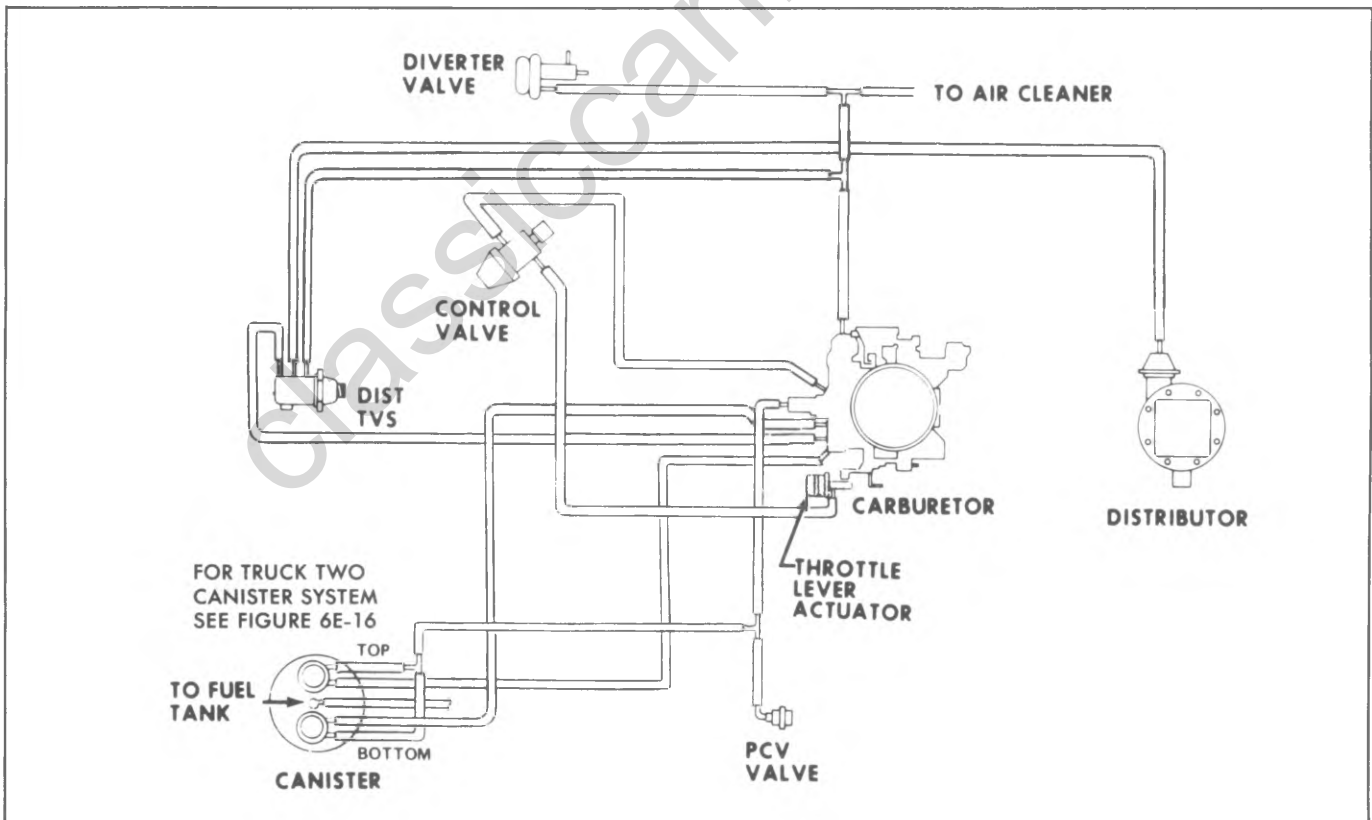


Fig. 6E-12--Vacuum Hose Schematic-V8 350/400 CID Calif. (C60)-HD Emissions

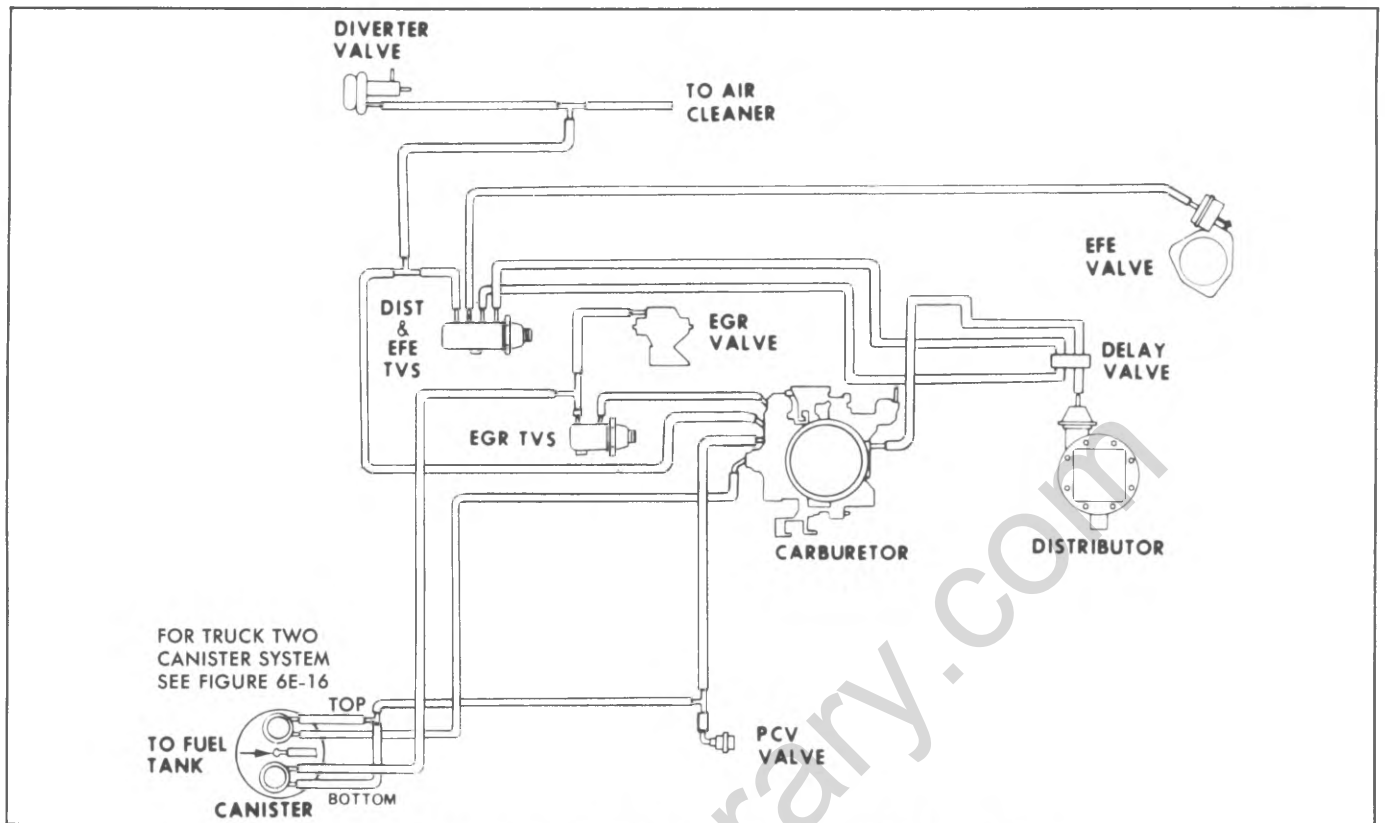


Fig. 6E-13--Vacuum Hose Schematic-V8 454 CID-LD Emissions

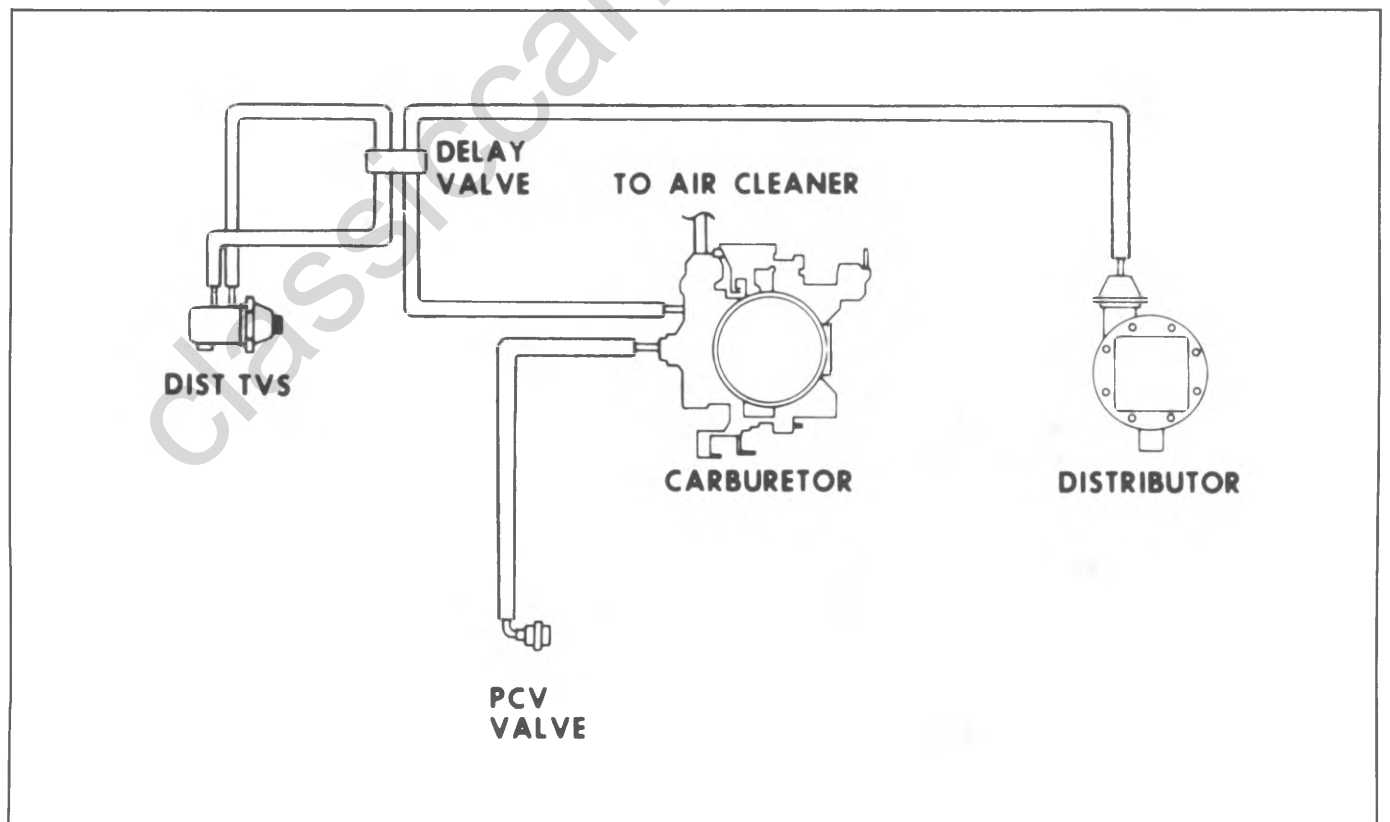


Fig. 6E-14--Vacuum Hose Schematic V8 454 CID Except Calif - HD Emissions

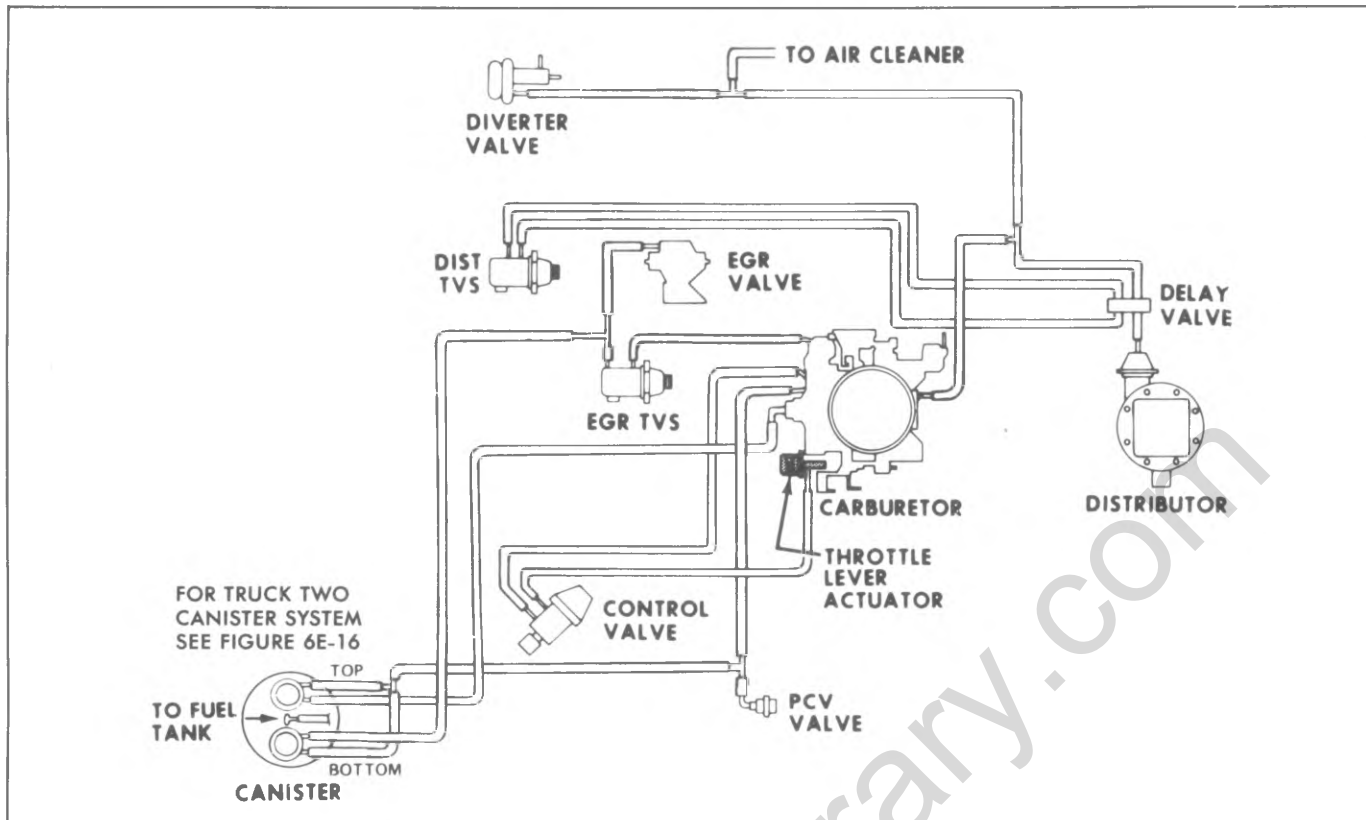


Fig. 6E-15-Vacuum Hose Schematic-V8 454 CID Calif. - HD Emissions

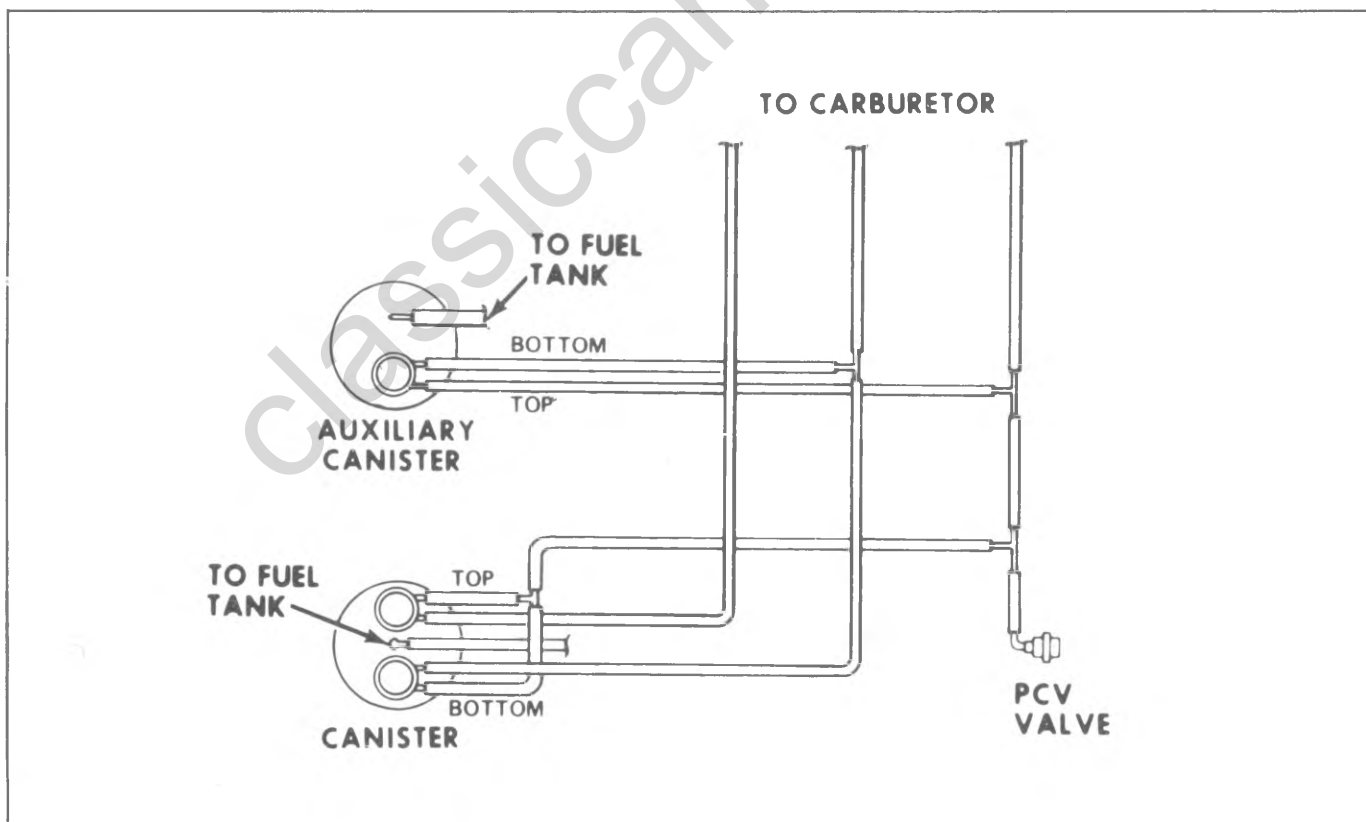


Fig. 6E-16-Vacuum Hose Schematic-Truck Two Canister System

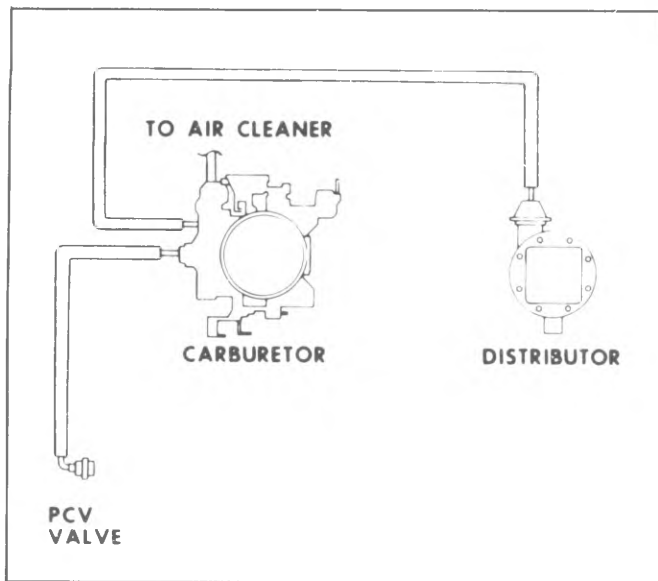


Fig. 6E-17--Vacuum Hose Schematic-V8 454 CID-P Series-HD Emissions

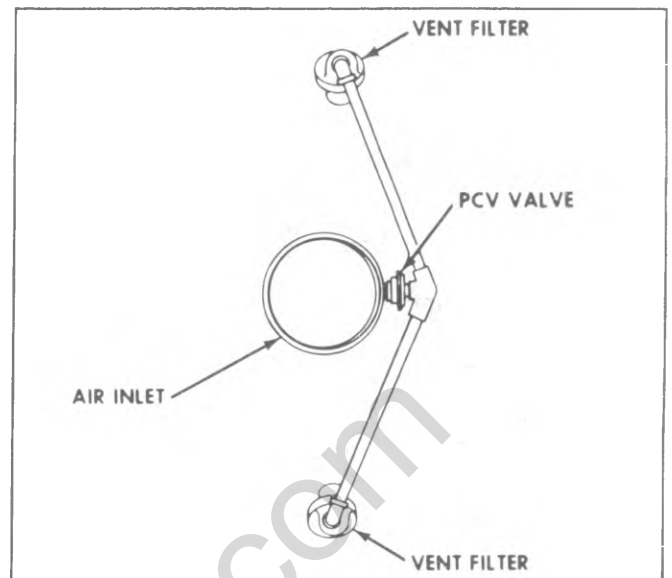


Fig. 6E-18--Hose Schematic-V8 350 CID - Diesel - LD Emissions

ON-VEHICLE SERVICE

EARLY FUEL EVAPORATION (EFE)

GENERAL

INSPECTION

- Visually inspect exhaust heat valve for damage or binding linkage.
- Check that linkage is connected and vacuum hoses are properly routed and connected (Figs. 6E-1 through 19).
- Move exhaust heat valve by hand. If binding or stuck, free with manifold heat valve lubricant, GM Part No. 1050422 or equivalent. If valve cannot be freed, replace valve.

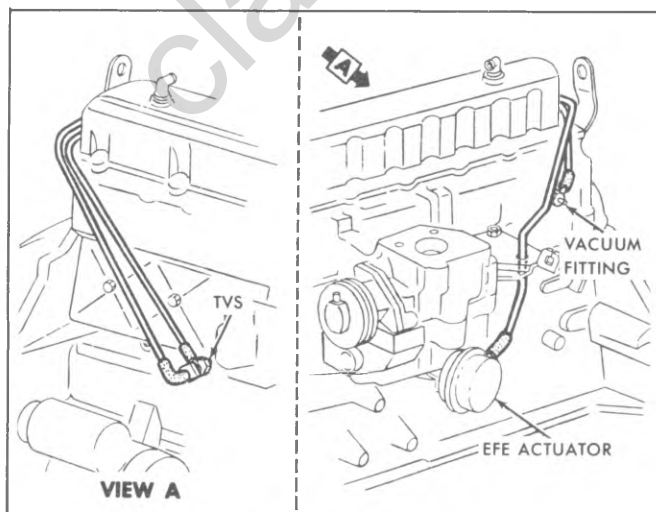


Fig. 6E-19--EFE System-L6

CHECKING EFE SYSTEM

1. With engine cold, position transmission in neutral or park and apply parking brake.
2. Start engine and observe movement of actuator rod and exhaust heat valve. Valve should move to its closed position.
3. If valve does not close, disconnect hose at actuator and check for vacuum.
 - If there is vacuum, replace actuator.
 - If there is no vacuum, disconnect hose at TVS-to-vacuum source.
 - If there is vacuum at hose, replace TVS.
 - If there is no vacuum, check for deteriorated hose and vacuum source to determine lack of vacuum.
4. When coolant reaches 180°F (82°C) (V8), or oil reaches 150°F (66°C) (six cylinder), the exhaust heat valve should move to its open position.
5. If valve does not move, disconnect hose at actuator and check for vacuum.
 - If there is vacuum, replace TVS.
 - If there is no vacuum, replace actuator.

ON-VEHICLE SERVICE

THERMAL VACUUM SWITCH (TVS) - V8

Coolant Temperature

The TVS is located on the engine coolant outlet housing.

Replacement

1. Drain coolant below level of engine coolant outlet housing.
2. Disconnect hoses at TVS ports.
3. Remove TVS.
4. Apply a soft setting sealant uniformly on

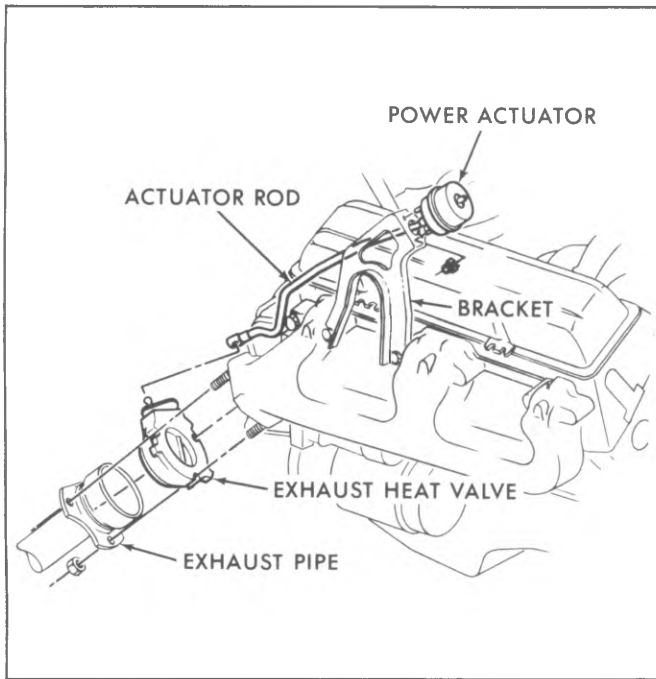


Fig. 6E-20--Actuator and Rod-305/350/400 V8

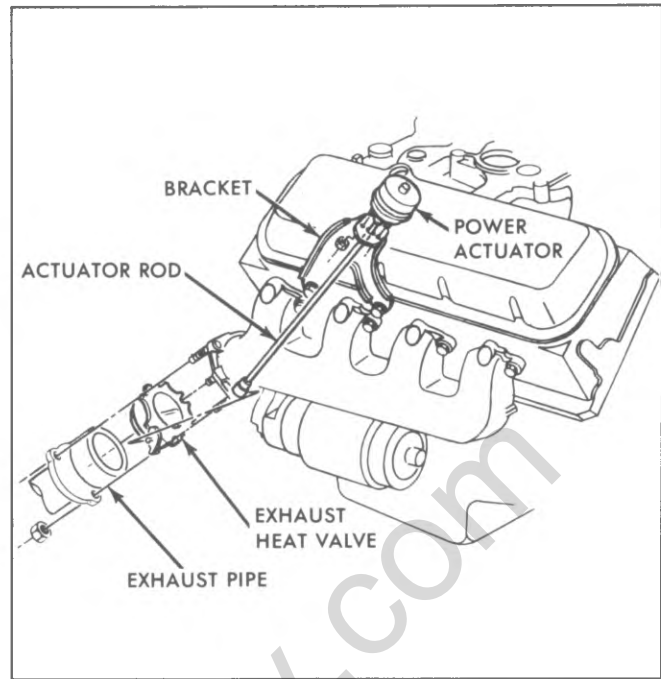


Fig. 6E-21--Actuator and Rod 454 V8

replacement TVS male threads. No sealant should be applied to sensor end of TVS.

5. Install TVS, tighten to 120 pound inches (14.N·m) and then hand torque clockwise as required to align TVS to accommodate hoses.

6. Connect hoses to TVS ports.

7. Add coolant as required.

THERMAL VACUUM SWITCH (TVS) - L6

Oil Temperature

The TVS is located on right hand oil gallery.

Replacement

1. Disconnect hoses at TVS ports.
2. Remove TVS switch.
3. Install TVS switch.
4. Connect hoses to TVS ports.

ACTUATOR AND ROD ASSEMBLY

The actuator and rod assembly is located on a bracket attached to right exhaust manifold on V8 engines (figs. 6E-20 and 6E-21) and on left side attached to exhaust manifold on L6 engine (figs. 6E-22 and 23).

Replacement

1. Disconnect hose from actuator.
2. Remove 2 nuts attaching actuator-to-bracket.
3. Disconnect rod from valve and remove actuator and rod.
4. Install actuator and rod reversing steps 1 and 3. Tighten nuts to 25 pound inches (3 N·m).

EXHAUST HEAT VALVE - V8

Replacement

1. Remove crossover exhaust pipe. Refer to Section 6F for removal and installation.
2. Disconnect rod from valve.
3. Remove valve.
4. Install valve and connect rod.
5. Install crossover exhaust pipe.

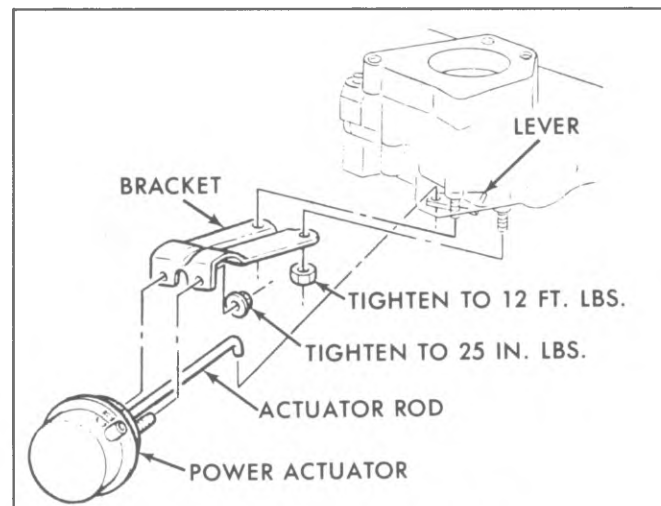


Fig. 6E-22--Actuator and Rod-L6

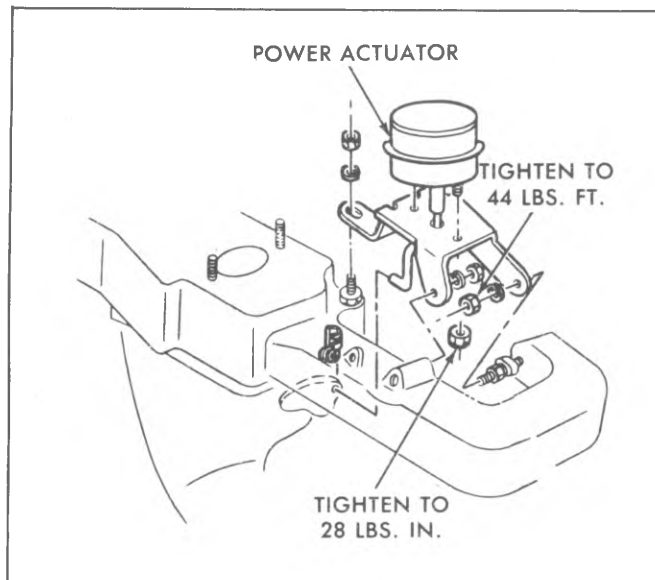


Fig. 6E-23--Power Actuator

EXHAUST HEAT VALVE - L6

Replacement

1. Remove 2 nuts attaching actuator bracket-to-valve and exhaust manifold.
2. Remove bracket and disconnect rod from valve.
3. Remove 2 additional nuts from valve and remove valve.
4. Install valve reversing Steps 1 through 3.

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EXHAUST GAS RECIRCULATION (EGR)

ON-VEHICLE SERVICE

SYSTEM FUNCTIONAL TEST

1. Initial preparation.

a. Remove air cleaner so EGR valve diaphragm movement can be observed or felt.

NOTE: When air cleaner is removed, it is recommended that the choke secondary vacuum break TVS be unclipped and removed from the air cleaner body rather than removing hoses.

b. Plug intake manifold air cleaner vacuum fitting.

c. Connect a tachometer.

d. Warm up engine to operating temperature.

2. Open throttle part way and then release.

3. Observe the EGR diaphragm for movement.

The valve should open slightly when the throttle is opened and close when it is released.

4. Remove EGR hose from EGR valve and plug hose.

5. Place cam follower on second step of fast idle cam and **note speed**.

6. Attach a vacuum hose between air cleaner vacuum fitting and the EGR valve (or use an external source in excess of 11 in. hg. [37kPa]) and **note speed change**. Speed should drop at least 200 RPM with A.T. or at least 150 RPM with M.T.

7. Summary.

a. A successful function test must meet the following:

- EGR diaphragm must move.
- Speed must drop when diaphragm moves.

FUNCTIONAL TEST OF INDIVIDUAL EGR SYSTEM COMPONENT PARTS

1. **EGR VALVE** (Valve can be left on or removed from the engine).

a. Depress the valve diaphragm.

b. With the diaphragm still depressed, plug the vacuum tube and release the diaphragm.

c. Observe diaphragm and/or pintle movement:

● Valve is satisfactory if it takes over 20 seconds for the pintle to seat or for the diaphragm to achieve full travel.

● Valve unsatisfactory and must be replaced if it takes less than 20 seconds for the pintle to seat or for diaphragm to achieve full travel.

GENERAL DESCRIPTION

EGR Valve

The EGR valve (Fig. 6E-24) contains a vacuum diaphragm, which is operated by intake manifold vacuum. The diaphragm vacuum signal supply port is located in the throttle body above the throttle valve, and is exposed to engine manifold vacuum in the off-idle and part throttle to wide open throttle operation. A .030 in. orifice in the valve vacuum tube serves to modulate flow.

BACK PRESSURE EGR VALVE

A back pressure EGR Valve (Fig. 6E-25) is used on all light duty emissions California and High Altitude V8 and L6 engines.

A small diaphragm control valve inside the EGR valve assembly acts as a pressure regulator. The control valve receives an exhaust back pressure signal through the hollow

shaft which exerts a force on the bottom of the control valve diaphragm, opposed by a light spring. A metal deflector plate prevents hot exhaust gases from flowing directly on the diaphragm.

Vacuum is applied to the EGR valve assembly from the carburetor spark port, to assure no exhaust gas recirculation at idle. During off-idle operation, manifold vacuum is applied to the vacuum chamber through a restriction in the signal tube. When engine load is light, and back pressure is low, the control valve is open, allowing air to flow from the 6 bleeds in the diaphragm plate, through the control valve orifice, into the vacuum chamber. The air bleeds off vacuum, decreasing the signal trying to open the EGR valve. Therefore, if back pressure does not close the control valve, sealing off the air flow, there will not be any vacuum built up to open the EGR valve for exhaust gas recirculation.

When power demands are made on the engine, and exhaust gas recirculation is needed, exhaust back pressure increases, closing the control valve, thereby shutting off air flow through the valve. Vacuum builds up in the vacuum chamber until the spring force holding the EGR valve closed is overcome.

Once the EGR valve opens, the exhaust pressure decreases because some of the exhaust gas is flowing into the intake manifold through the EGR passage. In actual operation, the system will reach a balanced condition providing optimum EGR operation.

Any increase in engine load will momentarily increase the exhaust signal, causing the control valve to close, allowing a stronger vacuum signal. The system will then stabilize at a greater EGR flow.

At maximum engine load, when manifold vacuum is nearly zero, momentarily, there will be no EGR operation. This is because of insufficient vacuum to pull the valve open, even though high exhaust back pressure has closed the control valve.

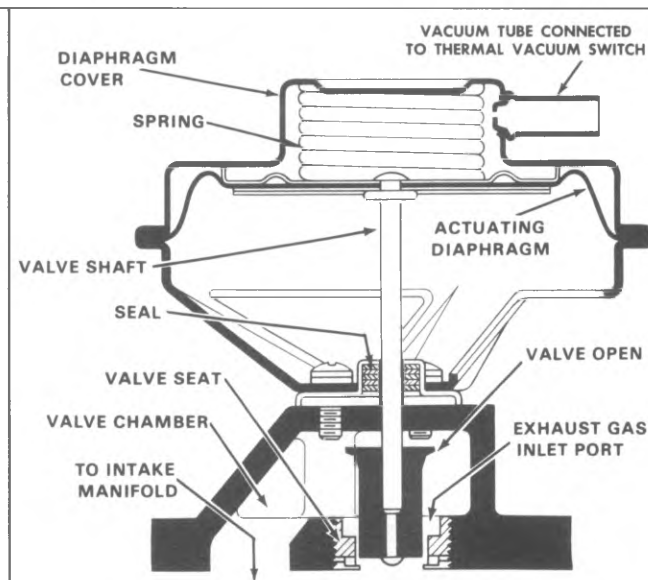


Fig. 6E-24--EGR Valve

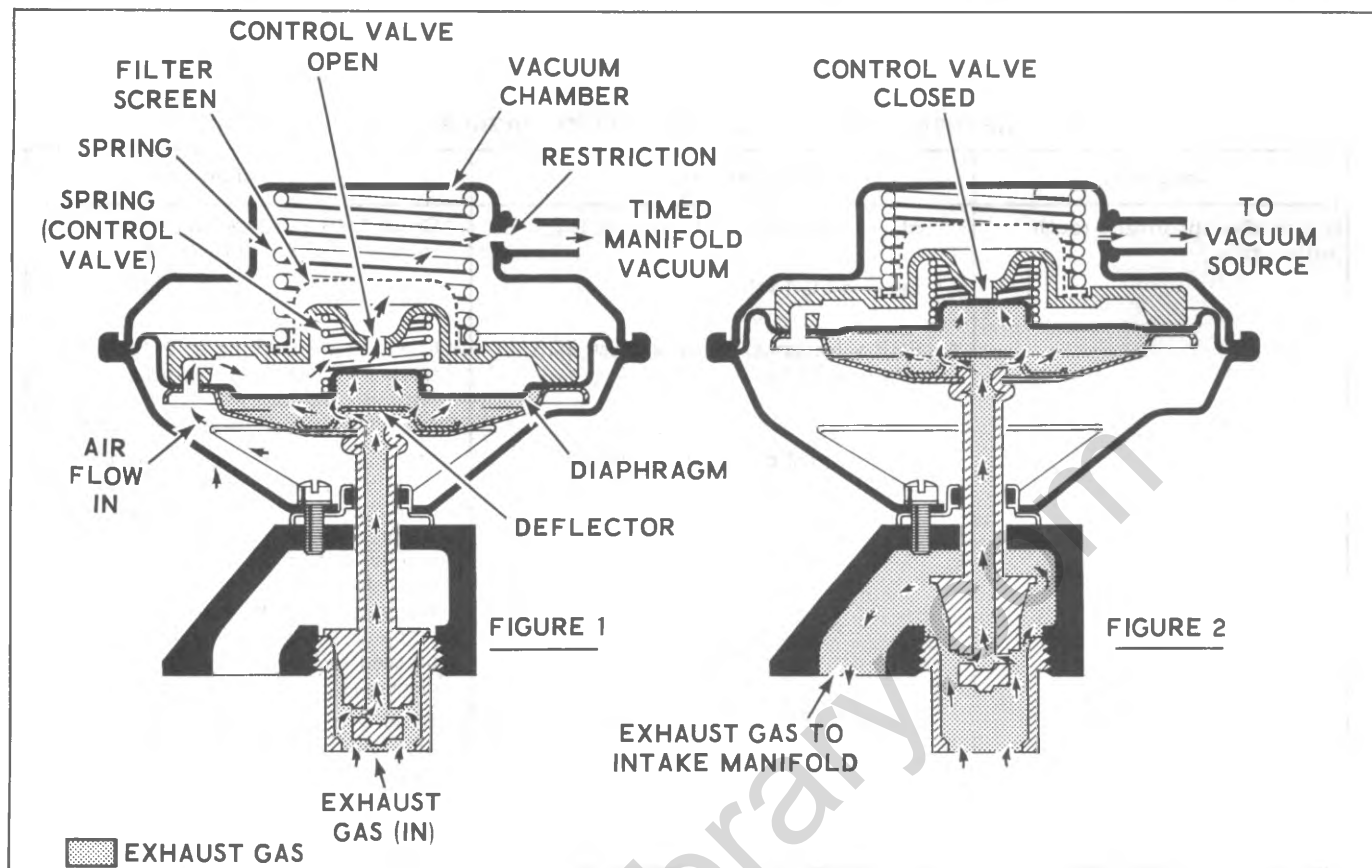


Fig. 6E-25--Back Pressure EGR Valve

Thermal Vacuum Switch

A thermal vacuum switch shuts off vacuum to the EGR valve until coolant temperature is approximately 100°F (38°C) on L6 or 120°F (49°C) on V8.

DIAGNOSIS

Refer to Diagnosis Chart for diagnosis of exhaust gas recirculation system.

ON-VEHICLE SERVICE

Functional Test (on vehicle) - EGR Valve

1. With the engine running, the vehicle in "Park" or "Neutral", set the fast idle cam on second step to hold throttle open (approximately 1400 - 1600 RPM). Engine coolant temperature must be above 120°F (49°C).

2. Place finger beneath EGR valve in a manner to feel movement of diaphragm.

3. Disconnect the vacuum hose and watch for movement of the diaphragm downward (valve closed). This should be accompanied by increase in engine speed.

4. Reconnect the hose. Diaphragm should move upward (valve open). Engine RPM should decrease.

NOTE: A slight vibration of the diaphragm plate assembly may be noticed in back pressure models. This is due to the control valve modulating under light load and does not indicate an undesirable condition nor one requiring correction.

Failure Diagnosis

Diaphragm Doesn't Move:

1. Verify engine speed. Should be approximately 1400 - 1600 RPM.

2. Verify temperature: should be above 120°F (49°C).

3. Check for vacuum at hose. If no vacuum present, find cause for no vacuum. (Plugged or leaking hose or carburetor port, defective EFE/EGR switch).

4. In back pressure models, check control valve operation.

Diaphragm Moves With No Change In Engine RPM

Check manifold EGR passages for blockage.

Function Test (off vehicle) Control Valve (Back Pressure EGR Model Only)

1. Remove vacuum hose.

2. Remove two attaching bolts and EGR valve assembly from intake manifold, discard gasket.

3. Apply external vacuum [10" Hg. (34 kPa) or more] to signal tube. A constant vacuum supply must be used.

4. Valve should not open. If it does, control valve is stuck closed. Clean the valve. (See EGR valve cleaning).

5. With the vacuum still applied, direct a stream of air from a low pressure source into the valve exhaust gas intake.

6. Valve should open completely. If it does not open at all, control valve is stuck open or exhaust passages are plugged. Clean the valve (See EGR valve cleaning).

7. If EGR valve and control valve are both functioning

EXHAUST GAS RECIRCULATION SYSTEM DIAGNOSIS CHART

Condition	Possible Cause	Correction
Engine idles abnormally rough and/or stalls.	<p>EGR valve vacuum hoses misrouted.</p> <p>Leaking EGR valve.</p> <p>EGR valve gasket failed or loose EGR attaching bolts.</p> <p>EGR thermal control valve and/or EGR-TVS.</p> <p>Improper vacuum to EGR valve at idle.</p>	<p>Check EGR valve vacuum hose routing. Correct as required.</p> <p>Check EGR valve for correct operation.</p> <p>Check EGR attaching bolts for tightness. Tighten as required. If not loose, remove EGR valve and inspect gasket. Replace as required.</p> <p>Check vacuum into valve from carburetor EGR port with engine at normal operating temperature and at curb idle speed. Then check the vacuum out of the EGR thermal control valve to EGR valve. If the two vacuum readings are not equal within $\pm 1/2$ in. Hg. (1.7 kPa), then proceed to EGR vacuum control diagnoses. ♦</p> <p>Check vacuum from carburetor EGR port with engine at stabilized operating temperature and at curb idle speed. If vacuum is more than 1.0 in. Hg., refer to carburetor idle diagnosis.</p>
Engine runs rough on light throttle acceleration, poor part load performance and poor fuel economy.	<p>EGR valve vacuum hose misrouted.</p> <p>Failed EGR vacuum control valve.</p> <p>EGR flow unbalanced due to deposit accumulation in EGR passages or under carburetor.</p> <p>Sticky or binding EGR valve.</p> <p>Wrong or no EGR gaskets.</p>	<p>Check EGR valve vacuum hose routing. Correct as required.</p> <p>Same as listing in "Engine Idles Rough" condition.</p> <p>Clean EGR passages of all deposits.</p> <p>Remove EGR valve and inspect. Clean or replace as required.</p> <p>Check and correct as required.</p>

EXHAUST GAS RECIRCULATION SYSTEM DIAGNOSIS CHART (CONT'D.)

Condition	Possible Cause	Correction
(Vehicle with back pressure EGR valve.) Engine stalls on decelerations.	Control valve blocked or air flow restricted. Restriction in EGR vacuum line. Sticking or binding EGR valve.	Check internal control valve function per service procedure. Check EGR vacuum lines for kinks bends, etc. Remove or replace hoses as required. Check EGR vacuum control valve function. Check EGR valve for excessive deposits causing sticky or binding operation. Clean or repair as required. Remove EGR valve and inspect clean or repair as required.
(Vehicle with a back pressure EGR valve.) Part throttle engine detonation.	Control valve blocked or air flow restricted. Insufficient exhaust gas recirculation flow during part throttle accelerations.	Check internal control valve function per service procedure. Check EGR valve hose routing. Check EGR valve operation. Repair or replace as required. Check EGR thermal control valve and/or EGR-TVS as listed in "Engine Idles Rough" section. Replace valve as required. Check EGR passages and valve for excessive deposit. Clean as required.
(Vehicle with a back pressure EGR valve.) (NOTE: Detonation can be caused by several other engine variables. Perform ignition and carburetor related diagnosis.)	Control valve blocked or air flow restricted.	Check internal control valve function per service procedure.
Engine starts but immediately stalls when cold.	EGR valve hoses misrouted. EGR system malfunctioning when engine is cold.	Check EGR valve hose routings. Perform check to determine if the EGR thermal control valve and/or EGR-TVS are operational. Replace as required.
(Vehicle with a back pressure EGR valve.) (NOTE: Stalls after start can also be caused by carburetor problems.)	Control valve blocked or air flow restricted.	Check internal control valve function per service procedure.

properly, clean the mounting surfaces, then using a new gasket, install the valve to the intake manifold. Torque the bolts to 25 ft. lbs. (34 N·m).

8. Connect vacuum hose.

EGR Valve Cleaning

CAUTION: Do not wash valve assembly in solvents or degreaser - permanent damage to valve diaphragm may result. Also, sand blasting of the valve is not recommended since this can affect the operation of the valve.

1. Remove EGR valve and 2 attaching bolts, discarding the gasket.

2. Hold the valve assembly in hand, then tap lightly on the sides and end of the valve, and on the pintle itself using a small wood dowel, with a small plastic hammer to remove the exhaust deposits from the valve seat. Empty loose particles. **DO NOT PUT IN A VISE.**

3. With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.

4. Depress the valve diaphragm and look at the valve seating area through the valve outlet for cleanliness. If valve and/or seat are not completely clean, repeat step 3.

5. Look for exhaust deposits in the valve outlet. Remove deposit build up with a screwdriver.

6. Clean mounting surfaces of intake manifold and valve assembly, then using a new gasket install the valve assembly to the intake manifold. Torque the bolts to 25 ft. lbs. (34 N·m).

7. Connect vacuum hose.

EGR Passage

If inspection of EGR passages in the inlet manifold indicates excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

Replacement

1. Disconnect EGR valve.
2. Remove bolts securing valve to manifold.
3. Remove EGR valve from manifold.
4. Reassemble replacement valve to manifold, using a new gasket.
5. Torque clamp bolt to 13-18 lb. ft.
6. Connect carburetor vacuum signal line to tube at top of valve.

THERMAL VACUUM SWITCH (TVS)

Replacement

1. Disconnect vacuum lines from the thermal vacuum switch.
2. Remove switch from thermostat housing.
3. Apply an approved sealer to threaded portion of switch.
4. Install switch in thermostat housing and torque to 100 lbs. in.
5. Rotate switch head as required to align for proper hose routing.
6. Install vacuum hoses to switch.

Functional Check

Hot

NOTE: This is to be performed as part of the emission maintenance routine at 12,000 miles (19 200 km) or 12 months on heavy duty emission vehicles.

The EGR Thermal Vacuum Delay Switch should be open above coolant temperature 100°F (38°C) on L6 and 120°F (49°C) on V8 permitting the ported vacuum signal to reach the EGR valve above that temperature. Check as follows:

1. Remove EGR valve vacuum hose at EGR valve and connect hose to a vacuum gage.

2. Start engine. With transmission selector lever in Neutral or Park open throttle partially. (Do not overspeed engine.) As throttle is opened, the vacuum gage should respond with an increase in vacuum reading. (Note: Coolant temperature must be above 120°F (49°C) during this test. Allow about 3 minutes at idle to warm up a cold engine. If coolant is below 75°F (24°C) greater time may be required.)

3. If operation is satisfactory, remove gage and reconnect hose to EGR valve.

If gage does not respond to throttle opening, proceed to Step 4.

4. Remove Carb-to-switch hose from switch and connect hose to vacuum gage. Repeat Step 2.

5. If vacuum gage responds to throttle opening, then switch is defective. Remove switch and replace with new part.

If gage does not respond to throttle opening, then check for plugged hose or defective carburetor.

Cold

NOTE: This check may be performed in diagnosing complaint of stall after cold start or poor driveability immediately after cold start.

The EGR thermal vacuum delay switch should be closed below coolant temperature 100°F (38°C) on L6 on 120°F (49°C) on V8, thereby blocking the ported vacuum signal from reaching the EGR valve below that temperature. Check as follows:

1. Drain coolant below level of thermostat housing.
2. Disconnect vacuum lines and remove switch from thermostat housing.

3. Inspect switch to make sure it is in good condition.

4. Connect a vacuum hose to lower nipple of switch, marked "C" or "CARB.". Connect a vacuum gage to upper nipple, marked "E" or "EGR".

5. Place switch in water at 85°F (29°C) and submerge completely for 2 minutes while agitating water thoroughly.

6. Apply 12 in. hg. (-41 kPa) vacuum to hose on lower nipple of switch. Under this condition, the switch should be closed.

NOTE: Leakage of up to 2 in. hg. (-7kPa) of vacuum in 2 minutes is allowable and does not constitute a defective switch.

7. If operation is satisfactory, re-install switch in thermostat housing. If switch is defective, replace with new part.

EGR SYSTEM - INSPECTION AND CLEANING

The following procedure is to be used for the inspection and cleaning of the EGR valve and passages.

Inspection

1. Remove air cleaner.
2. Remove EGR valve from intake manifold.
3. Look for deposits on the valve pintle.
4. Depress the valve diaphragm and inspect for deposits around the valve seating area thru the valve outlet.
5. With the diaphragm still depressed, plug the vacuum tube then release the diaphragm. If the pintle has not closed in 20 seconds, the EGR valve is OK. If the pintle is closed within 20 seconds, the valve must be replaced.
6. The valve requires cleaning if deposits exist.

Cleaning

1. Hold the valve assembly in hand. Then, using a light snapping action with a plastic hammer, tap on the end of the round pintle to remove the exhaust deposits from the valve seat. Empty loose particles.
2. Clean the mounting surface of the EGR valve with a wire wheel or wire brush, and the pintle with a wire brush.
3. Depress the valve diaphragm and check the seating area for cleanliness by looking thru the valve outlet. If pintle or seat are not completely clean, repeat step 1.
4. Inspect the valve outlet for deposits. Remove any

deposit build-up with a screwdriver or other suitable sharp tool.

5. Clean mounting surface on the intake manifold with a wire wheel or wire brush.

NOTE: Do not use solvents for cleaning.

Intake Manifold Passages

1. Remove carburetor.
2. Remove the deposits from the EGR ports by hand turning a drill into the passage. Finish cleaning with a small screwdriver.

CAUTION: Do not use a power drill or file.

3. Brush any small particles down the EGR port and blow compressed air through the port.

NOTE: Do not use solvents for cleaning.

Reassembly

1. Reinstall carburetor using a new gasket and torque hold-down bolts to 10-15 ft. lbs.
2. Reinstall the EGR valve assembly to the intake manifold using a new gasket and torque bolt to 12-17 ft. lbs.
3. Connect fuel line and all vacuum hoses.
4. Warm up engine and reset idle rpm to specification if necessary per Emission Control Information label.
5. Perform functional check of EGR system to ensure correct operation.

POSITIVE CRANKCASE VENTILATION SYSTEM (PCV)

GENERAL DESCRIPTION

Ventilation air is drawn through a filter assembly located in the air cleaner, through a hose, down into the crankcase, up through the ventilator valve, through a hose and into the intake manifold. Intake manifold vacuum draws any fumes from the crankcase to be burned in the engine.

When air flow through the carburetor is high, added air from the Positive Crankcase Ventilation System has no noticeable effect on engine operation; however, at idle speed, air flow through the carburetor is so low that any large amount added by the ventilating system would upset the air-fuel mixture, causing rough idle.

For this reason, a flow control valve is used which

restricts the ventilating system flow whenever intake manifold vacuum is high.

ON-VEHICLE SERVICE

1. Remove PCV valve from intake manifold or rocker arm shaft cover.
2. Run the engine at idle.
3. Place your thumb over end of valve to check for vacuum. If there is no vacuum at valve, check for plugged hoses or valve. Hoses may be cleared with compressed air.
4. Shut off the engine and remove PCV valve. Shake valve and listen for the rattle of check needle in valve. If valve does not rattle, replace valve.

THERMOSTATIC AIR CLEANER (TAC)

INSPECTION

Vacuum Motor Check

1. Check all hoses for proper hook-up. Check for kinked, plugged or damaged hoses.
2. With the engine "OFF", observe damper door position through snorkel opening. If position of snorkel makes observation difficult, use the aid of a mirror. At this point damper door should be in such a position that the heat stove passage is covered (snorkel passage open) (Fig. 6E-26). If not, check for binds in linkage.
3. Apply at least 7 in Hg. of vacuum to the diaphragm assembly through hose disconnected at sensor unit. Damper door should completely close snorkel passage when vacuum

is applied. (Fig. 6E-26). If not, check to see if linkage is hooked up correctly and for a vacuum leak.

4. With vacuum applied, bend or clamp hose to trap vacuum in diaphragm assembly. Damper door should remain in position (closed snorkel passage) (Fig. 6E-24). If it does not, there is a vacuum leak in diaphragm assembly. Replace diaphragm assembly.

Sensor Check (Quick Check of System)

1. Start test with engine cold, air cleaner at a temperature below 79°F (26°C.). If the engine has been in recent use, allow it to cool. (Removing the air cleaner from the engine and placing it on the bench will aid in quickly cooling the sensor.

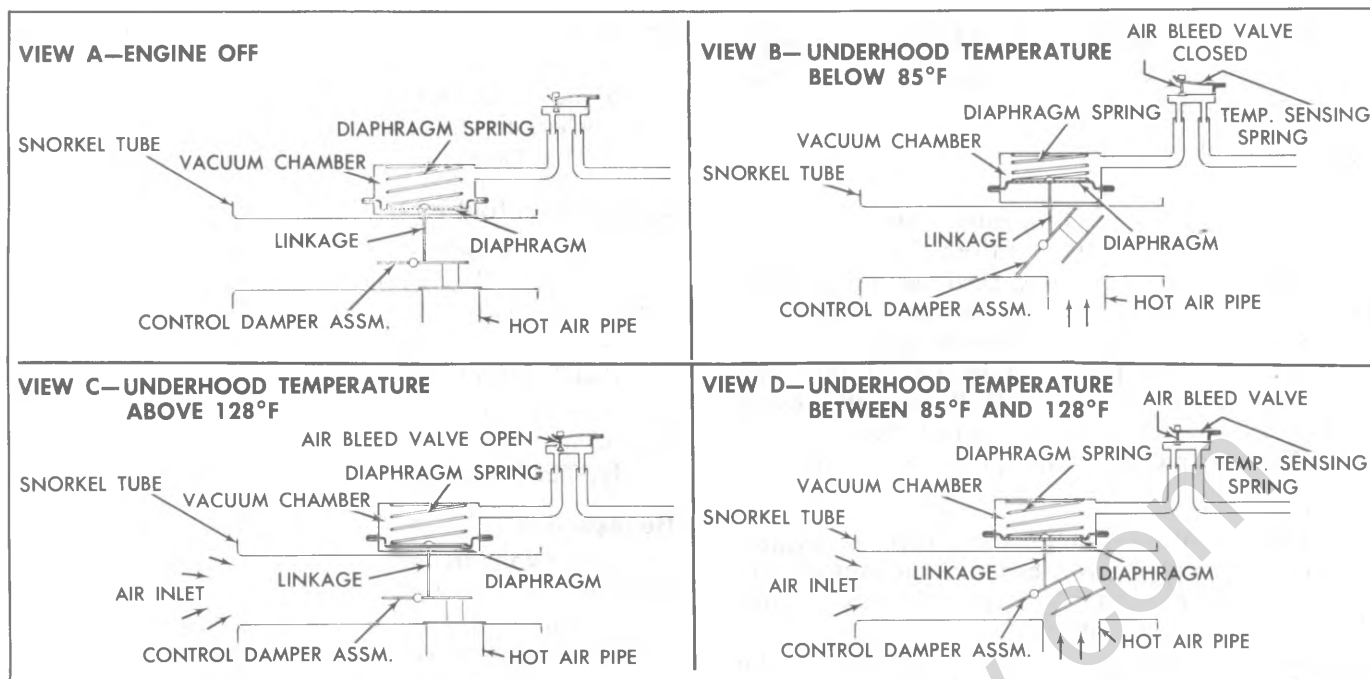


Fig. 6E-26--Air Cleaner Operation

2. Observe the damper door before starting the engine: it should be in the open snorkel position (Fig. 6E-26).

3. Start the engine and allow it to idle. Immediately after starting the engine, the damper door should be in the closed snorkel passage position (Fig. 6E-26).

4. As the engine warms up, the damper door should start to allow outside air and heated air to enter the carburetor inlet.

5. The system is operating normally as described above. If the air cleaner fails to operate as above, or if correct operation of the air cleaner is still in doubt, proceed to the thermometer check (of sensor).

Thermometer Check of Sensor

1. Start test with air cleaner temperature below 79°F. (26°C.). If engine has been run recently, remove air cleaner and place on bench (this will help quickly cool the air cleaner). Remove air cleaner cover and place thermometer as close as possible to the sensor. Let air cleaner cool until thermometer reads below 79°F. (26°C.) about 5 to 10 minutes. Reinstall air cleaner on engine and continue to step 2 below.

2. Start and idle engine. Damper door should move to close the snorkel passage immediately if engine is cool enough. When damper door starts to open the snorkel passage (in a few minutes), remove air cleaner cover and read temperature gage. It must read 115°F. \pm 20°F. (46°C. \pm 7°C).

3. If the damper door does not start to open up the snorkel passage at temperature indicated, temperature sensor is malfunctioning and must be replaced.

ON VEHICLE SERVICE Checking Air Cleaner

1. Inspect system to be sure all hoses and ducts are connected.

2. If engine is warm (above room temperature) remove air cleaner. Permit it to cool to room temperature.

3. Install cooled air cleaner. If air cleaner has cold air intake hose, disconnect it.

4. Start engine. Watch damper valve in air cleaner snorkel.

5. When engine is first started, valve should be closed. As air cleaner warms up, valve should slowly open.

NOTE: In hot weather the room temperature may be too hot for the snorkel valve to close when the engine is started. In this case, cool the temperature sensor in the air cleaner with a cool wet rag.

6. If valve doesn't close when the engine is started, check for vacuum at the diaphragm.

7. If vacuum is present, check for binding in the damper valve and operating link. If damper moves freely, replace diaphragm. (Failure of the diaphragm to close is more likely to result from mechanical bind due to a damaged or corroded snorkel assembly than from a failed diaphragm. This should be checked first, before replacing the diaphragm).

8. If no vacuum is present, check hoses for disconnects, cracks or pinches. Repair or replace as necessary.

9. If hoses are OK, replace temperature sensor in the air cleaner.

Air Cleaner Element Replacement Paper Element

1. Remove air cleaner cover.

2. Remove element.

3. Install new element in air cleaner with either end up.

4. Install air cleaner cover. Do not over-torque wing nut.

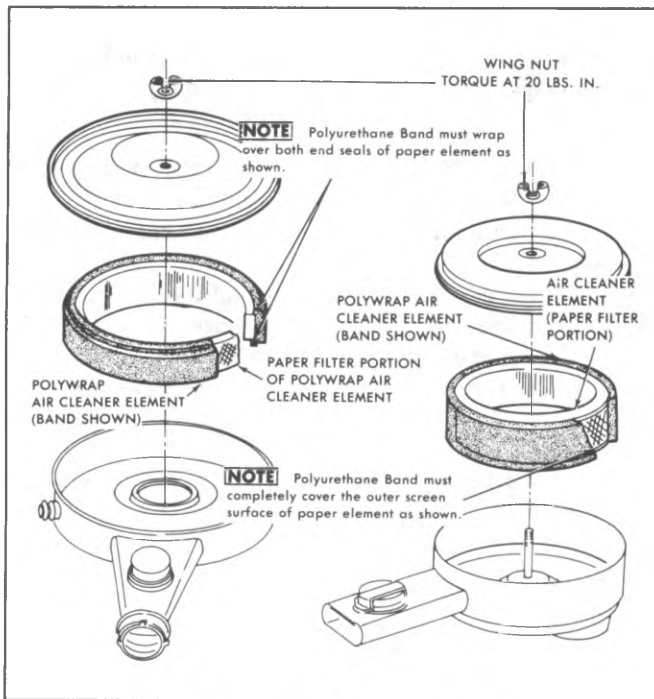


Fig. 6E-27--Polywrap Air Cleaner Element

Polywrap Element

1. Remove air cleaner cover.
2. Remove element.
3. Remove polywrap band from paper element and discard element (Fig. 6E-27).
4. Clean bottom section of air cleaner and inspect cover seal for tears or cracks. Replace seal if damaged.
5. Inspect band for tears and replace if damaged.
6. If band is serviceable, wash in kerosene or mineral spirits and squeeze out excess solvent (Fig. 6E-28).

NOTE: Never use a hot degreaser or any solvent containing acetone or similar solvent; also, never shake, swing or wring the element to remove excess solvent

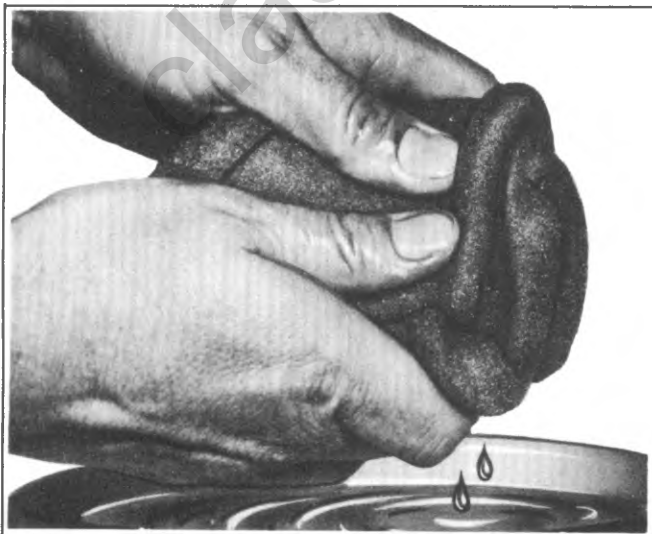


Fig. 6E-28--Cleaning Polywrap Band

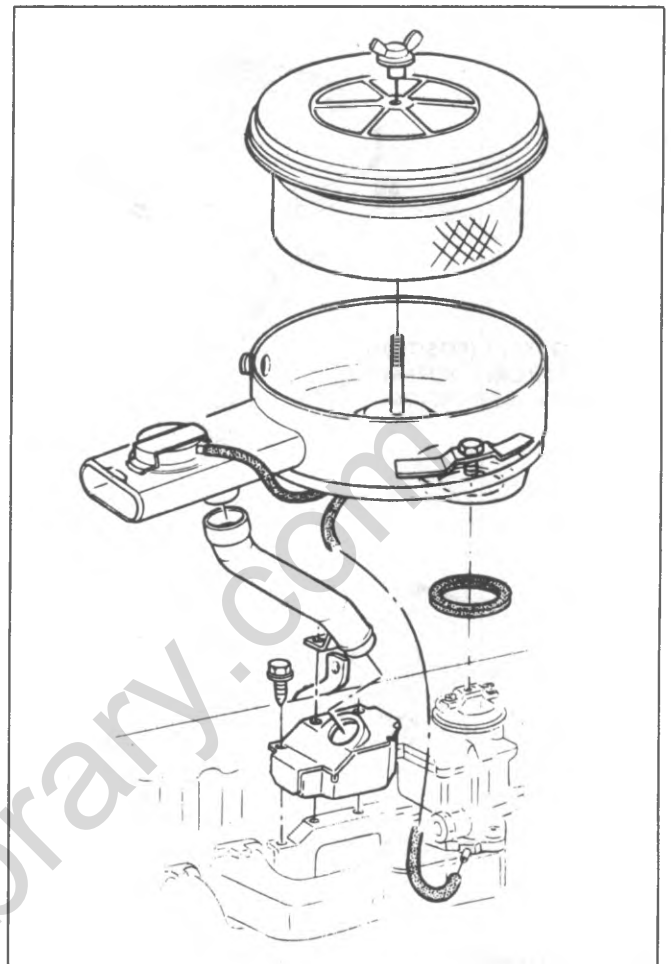


Fig. 6E-29--Air Cleaner-L6

as this may tear the polyurethane material. Instead, "squeeze" the excess solvent from the element.

7. Dip band into light engine oil and squeeze out excess oil.
8. Install band around outer surface of new paper element.
9. Install element in bottom section of air cleaner with either end up.
10. Install air cleaner cover. Do not over-torque wing nuts(s).

Air Cleaner Replacement

Refer to figures 6E-29 and 6E-30 for air cleaner used with in line L6 engine.

Refer to figure 6E-31 for air cleaner used on CK truck with 305/350/400 V8 engine.

Refer to figure 6E-32 for air cleaner used on G truck with V8 engine.

Refer to figure 6E-33 for air cleaner used with 454 V8 engine.

Refer to figure 6E-34 for air cleaner used on P20(42), P30(42) and P30(32) truck with 350 V8 engine and 4MV carburetor.

Refer to figure 6E-35 for air cleaner used on 350 V8 diesel engine.

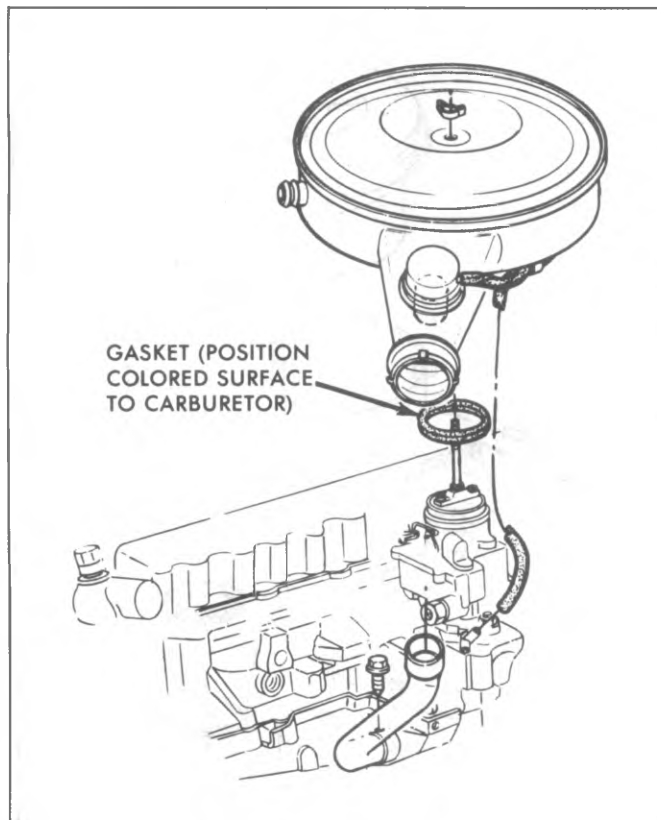


Fig. 6E-30--Air Cleaner-L6

Vacuum Motor

Removal

1. Remove air cleaner.
2. Disconnect vacuum hose from motor.
3. Drill out the two spot welds initially with a 1/6" hole, then enlarge as required to remove the retaining strap. Do not damage the snorkel tube.

4. Remove motor retaining strap.
5. Lift up motor, cocking it to one side to unhook the motor linkage at the control damper assembly.

Installation

1. Drill a 7/64" hole in snorkel tube at center of vacuum motor retaining strap (Fig. 6E-36).
2. Insert vacuum motor linkage into control damper assembly.
3. Use the motor retaining strap and sheet metal screw provided in the motor service package to secure the retaining strap and motor to the snorkel tube.
4. Make sure the screw does not interfere with the operation of the damper assembly. Shorten screw if required.
5. Connect vacuum hose to motor and install air cleaner.

Sensor

Removal

1. Remove air cleaner.
2. Detach hoses at sensor.
3. Pry up tabs on sensor retaining clip (Fig. 6E-37); remove clip and sensor from air cleaner. Note position of sensor for installation.

Installation

1. Install sensor and gasket assembly in original position.
2. Press retainer clip on hose connectors.
3. Connect vacuum hoses and install air cleaner on engine.

Carburetor Air Intake

Refer to figure 6E-38 and 6E-39 for repair or replacement of air intake.

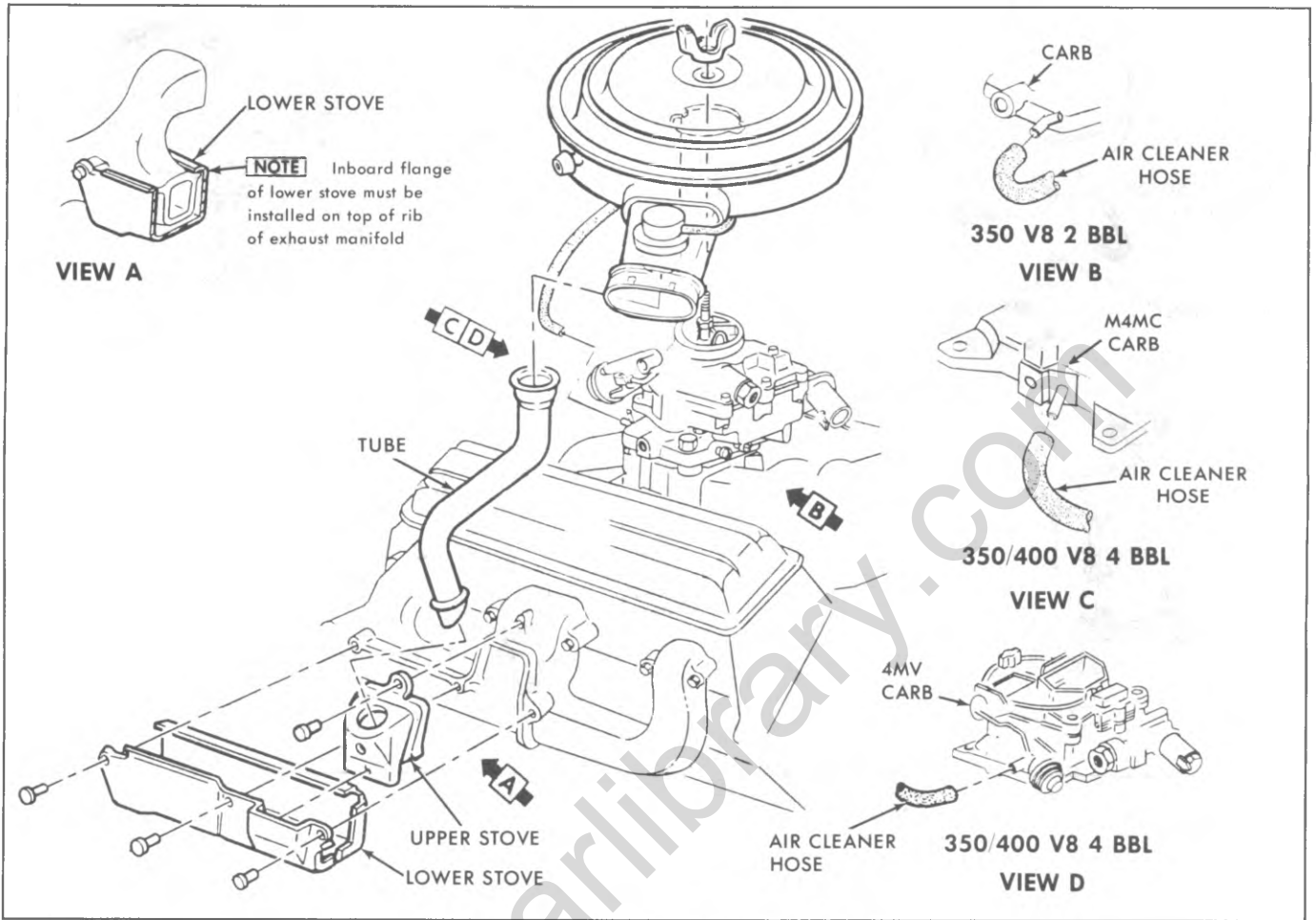


Fig. 6E-31--Air Cleaner-305/350/400 V8 CK

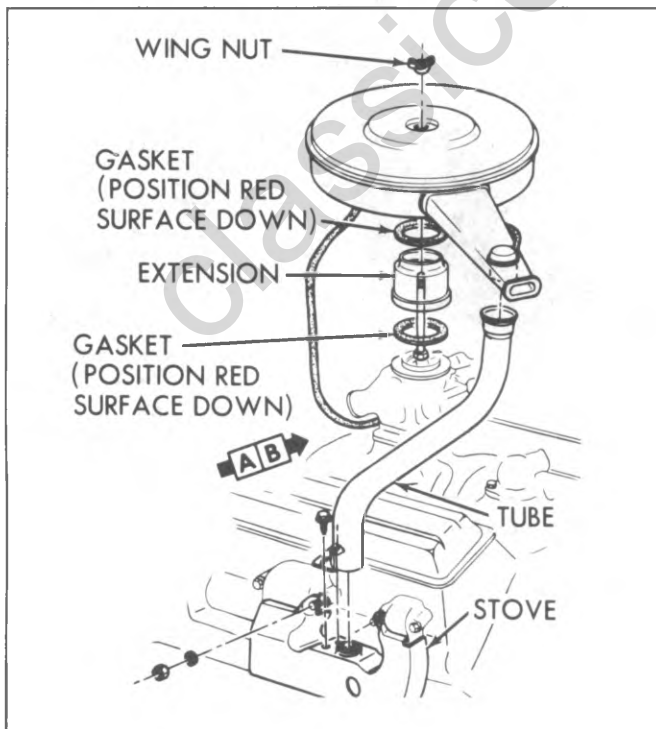


Fig. 6E-32--Air Cleaner-V8 G

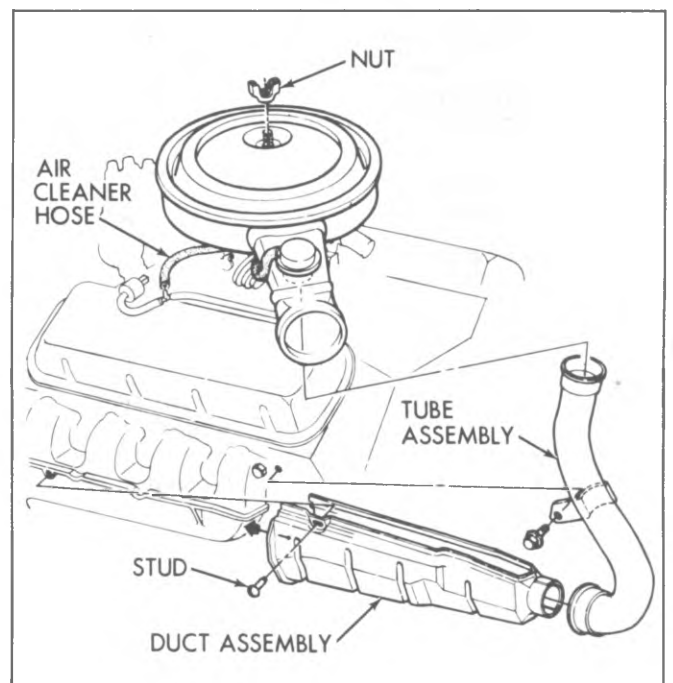


Fig. 6E-33--Air Cleaner-454 V8

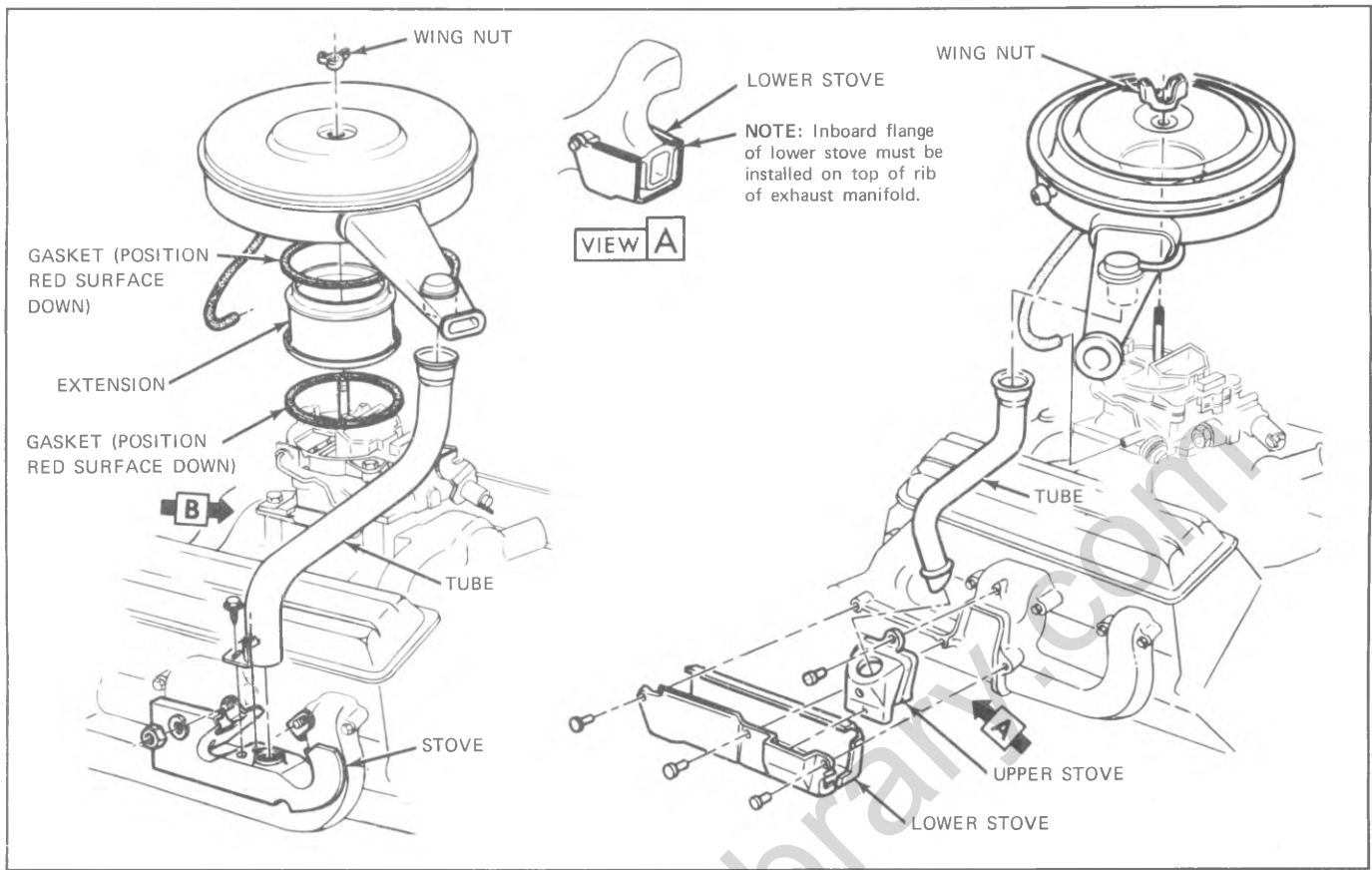


Fig. 6E-34--Air Cleaner-P20(42), P30(42), P30(32)-V8

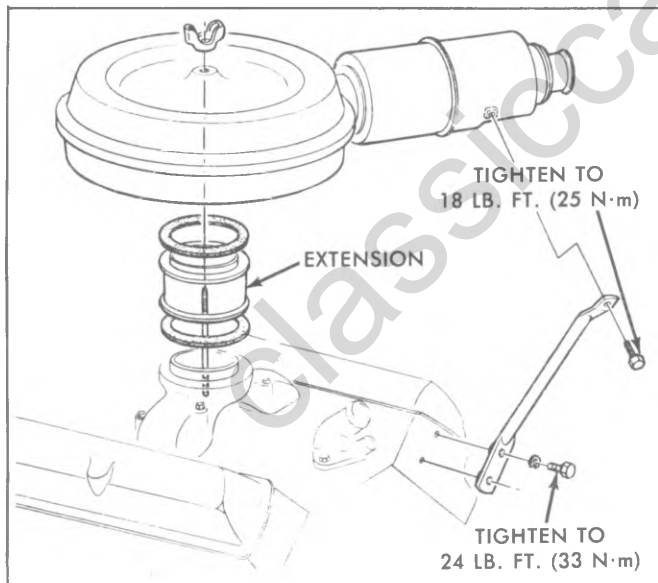


Fig. 6E-35--Air Cleaner-350 V8 Diesel

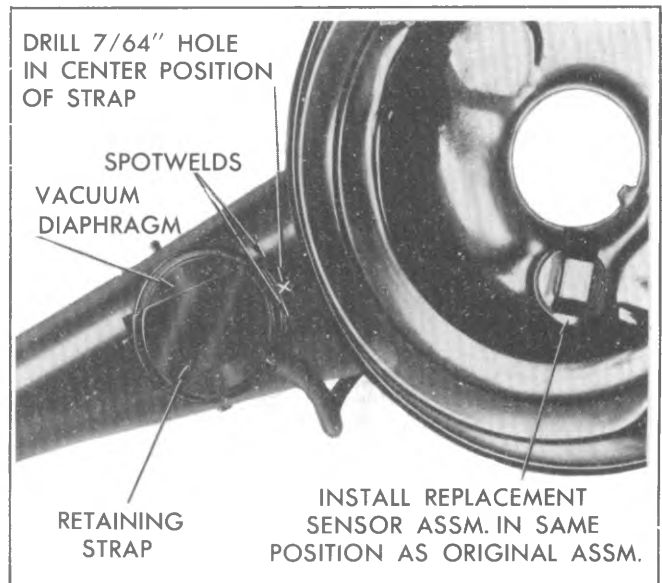


Fig. 6E-36--Vacuum Diaphragm Replacement



Fig. 6E-37--Removing Sensor Unit

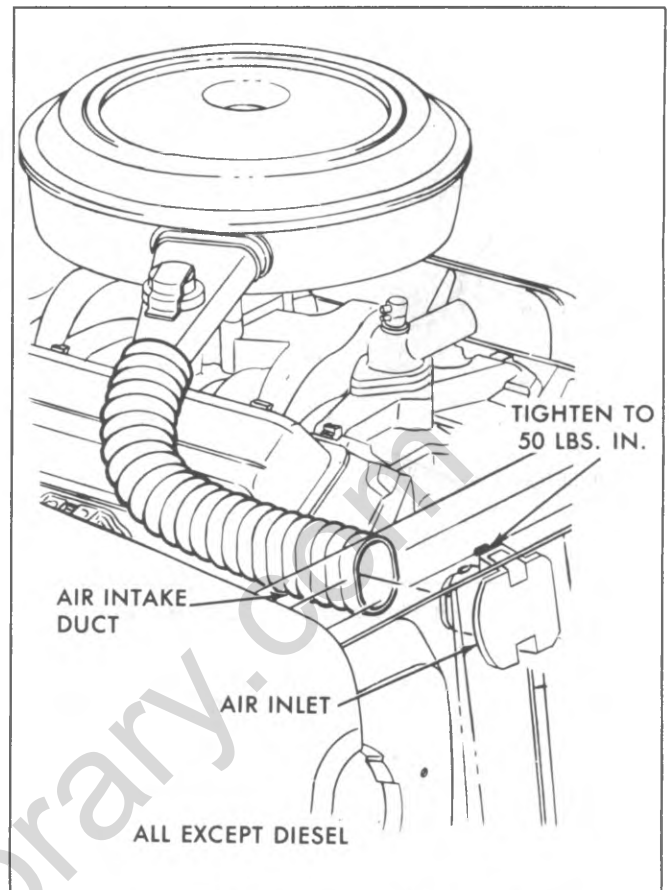


Fig. 6E-39--Carburetor Air Intake - V8

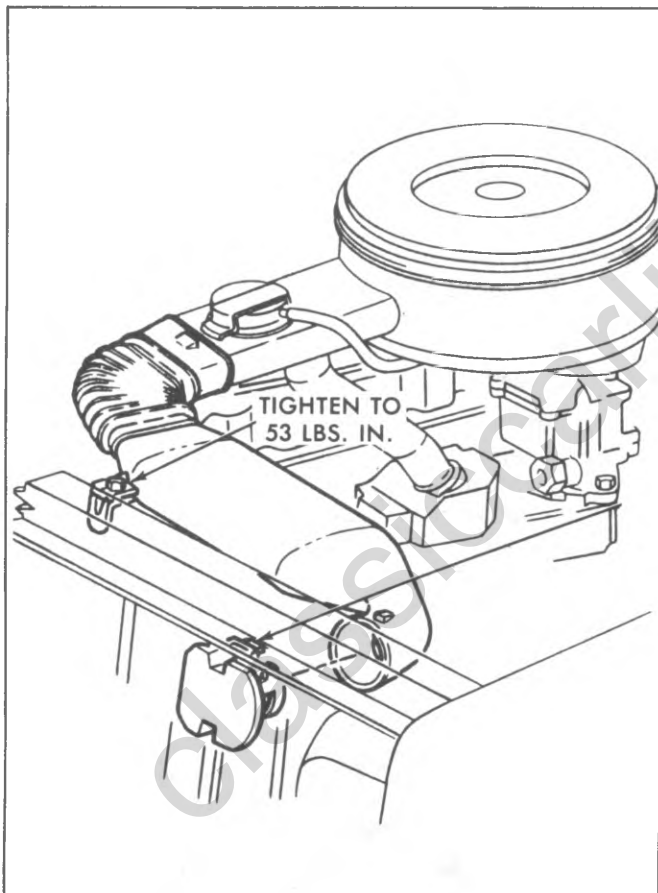


Fig. 6E-38--Carburetor Air Intake-L6

AIR INJECTION REACTOR (AIR) SYSTEM

GENERAL DESCRIPTION

The Air Injection Reactor (A.I.R.) System consists of: an air injection pump (with necessary brackets and drive attachments), air diverter valve, a check valve and air pipe hose necessary to connect diverter valve (Figs. 6E-40 through 42).

The Air Injection Pump (Fig. 6E-43) with an integral filter, compresses the air and injects it through the air manifolds, into the exhaust system in the area of the exhaust valves. The fresh air helps burn the unburned portion of the exhaust gases in the exhaust system, thus minimizing exhaust contamination.

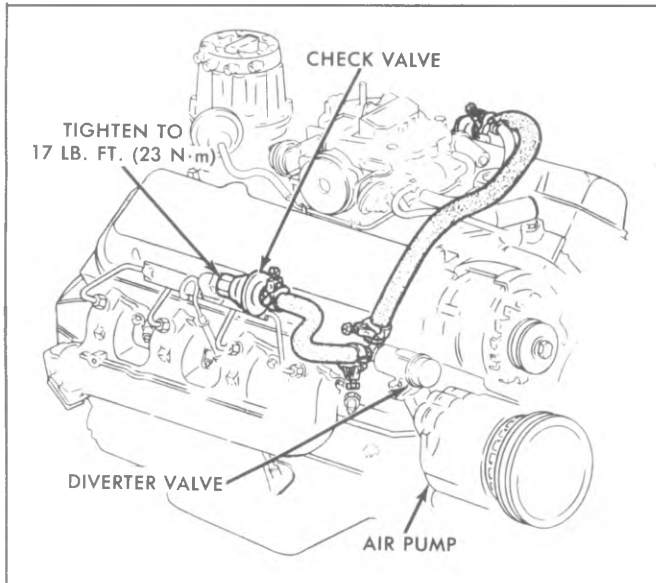


Fig. 6E-40--A.I.R. Pipe Installation-C Series (454)

The diverter valve Fig. 6E-44) when triggered by a sharp increase in manifold vacuum, shuts off the injected air to the exhaust port areas and prevents backfiring during this richer period.

On engine overrun the total air supply is dumped through the muffler on the diverter valve. At high engine speeds the excess air is dumped through the pressure relief valve which is incorporated in the diverter valve.

The check valve (Fig. 6E-40 through 42) prevents exhaust gases from entering and damaging the air injection pump, as back flow can occur even under normal operating conditions.

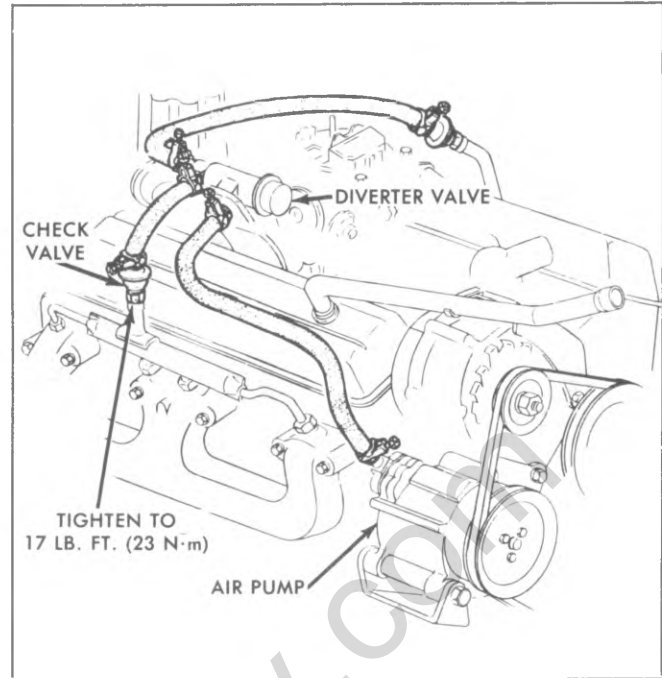


Fig. 6E-42--A.I.R. Pipe Installation-G Series

ON-VEHICLE SERVICE

Drive Belt

Inspection

1. Inspect drive belt for wear, cracks or deterioration and replace if required.
2. Inspect belt tension and adjust if below 70 lbs. using a tension gauge.

Adjustment

Loosen pump mounting bolt and pump adjustment bracket bolt. Move pump until belt is properly tensioned then tighten adjustment bracket bolt and mounting bolt. Use a belt tension gauge to check adjustment.

CAUTION: Do not pry on the pump housing. Distortion of the housing will result in extensive damage to the Air Injection Pump.

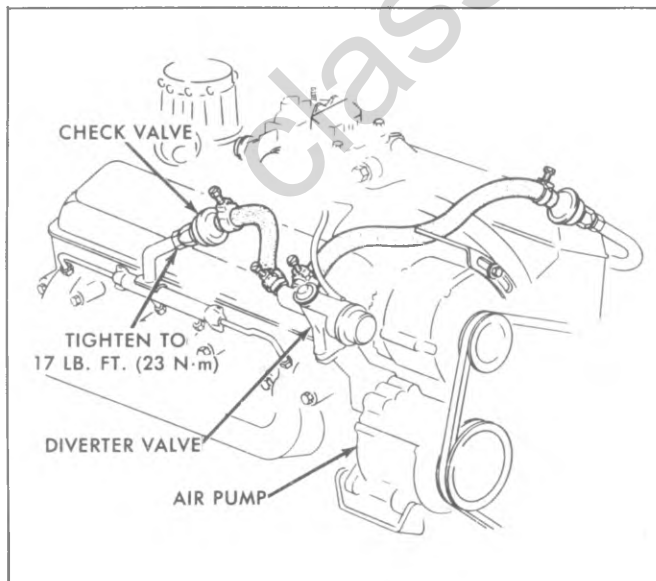


Fig. 6E-41--A.I.R. Pipe Installation - CK Series (350/400)

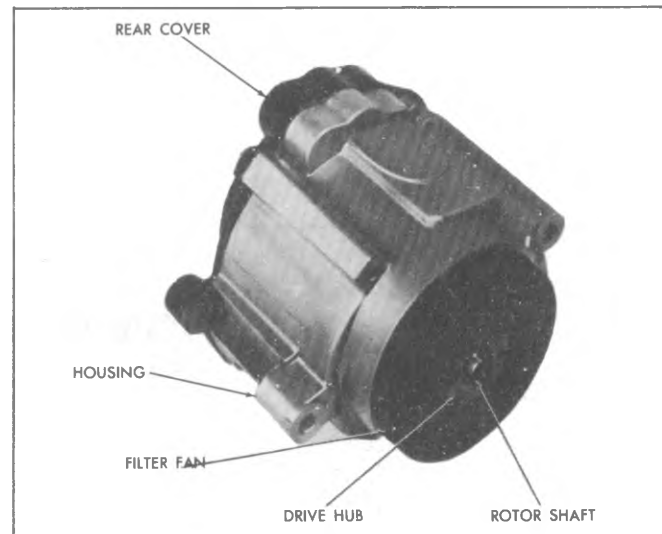


Fig. 6E-43--Air Injection Pump

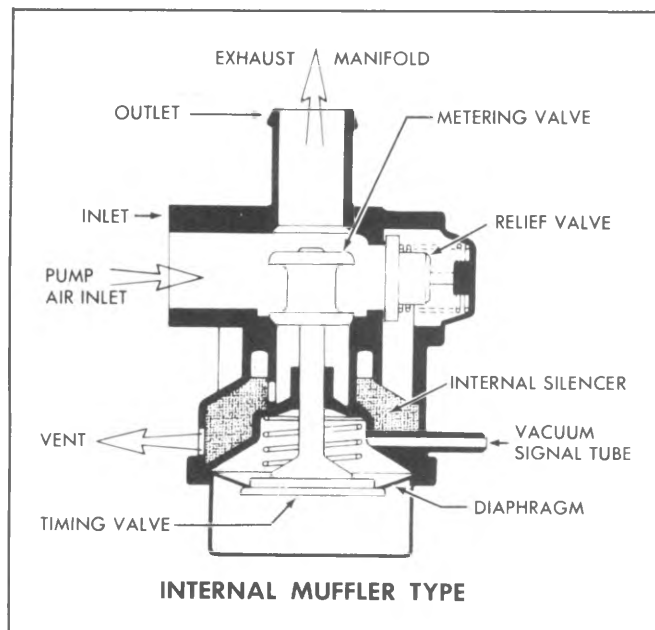


Fig. 6E-44--Diverter Valve

Replace

1. Loosen pump mounting bolt and pump adjustment bracket bolt, then swing pump until drive belt may be removed.
2. Install a new drive belt and adjust as outlined above.

Pump Pulley**Replace**

1. Hold pump pulley from turning by compressing drive belt then loosen pump pulley bolts.
2. Remove drive belt as outlined above then remove pump pulley.

Install

1. Install pump pulley with retaining bolts hand tight. Install and adjust drive belt as outlined above.
2. Hold pump pulley from turning by compressing drive belt then torque pump pulley bolts to 24 lb. ft. (32N·m).
3. Recheck drive belt tension and adjust if required.

Pump Filter**Replace**

1. Remove drive belt and pump pulley as previously outlined.
2. Insert needle nose and pull fan from hub (Fig. 6E-45).

NOTE: Care should be taken to prevent fragments from entering the air intake hole. Do not insert a screwdriver between pump and filter. It is seldom possible to remove the filter without destroying it. Do not attempt to remove the metal hub.

Install

1. Install the new filter by drawing it on with the pulley and pulley bolts (Fig. 6E-46). Do not attempt to install a filter by hammering it on or pressing it on.
2. Draw the filter down evenly by alternately torquing

the bolts. Make certain that the outer edge of the filter slips into the housing. The slight amount of interference with the housing bore is normal.

NOTE: The new filter may squeal upon initial operation until it's O.D. sealing lip has worn in.

Air Hoses and Tubes**Inspection**

1. Inspect all hoses for deterioration or holes.
2. Inspect all tubes for cracks or holes.
3. Check all hose and tube connections.
4. Make repairs or replace parts as needed.
5. Check all tube and hose routing. Interference may cause wear.
6. If leak is suspected on the pressure side of the system or any tubes and/or hoses have been disconnected on the pressure side, the connections should be checked for leaks with soapy water solution.
7. With the pump running, bubbles will form if a leak exists.

Replace

To replace any hose and/or tube, note routing then remove hose(s) and/or tube(s) as required.

Install

1. Install new hose(s) and/or tube(s), routing them as when removed.
2. Tighten all connections.

Check Valve**Inspection**

1. The check valve should be inspected whenever the hose is disconnected from the check valve or whenever check valve failure is suspected. (A pump that had become inoperative and had shown indications of having exhaust gases in the pump would indicate check valve failure.)
2. Blow through the check valve (toward the cylinder head) then attempt to suck back through check valve. Flow should only be in one direction (toward the exhaust manifold). Replace valve which does not function this way.

Replace

Disconnect pump outlet hose at check valve. Remove check valve from pipe assembly, being careful not to bend or twist the assembly.

Diverter Valve and Silencer Assembly**Inspection**

1. Check condition and routing of all lines especially the signal line. All lines must be secure without crimps and not leaking. Replace deteriorated lines.
2. Disconnect signal line at valve. A vacuum signal must be available with engine running.
3. Check diverter valve attaching screws for tightness. Screws should be torqued to 85 lb. in. (10N·m).
4. Defective valves should be replaced (see Functional Test).

Replace

1. Disconnect vacuum signal line. Disconnect valve outlet hose.
2. Remove diverter valve from pump or elbow.

DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
No air supply — accelerate engine to 1500 rpm and observe air flow from hoses. If the flow increases as the rpm's increase, the pump is functioning normally. If not, check possible cause.	<ol style="list-style-type: none"> 1. Loose drive belt. 2. Leaks in supply hose. 3. Leak at fittings. 4. Air expelled through by-pass valve. 4a. Connect a vacuum line directly from engine manifold vacuum to by-pass valve. 4b. Connect vacuum line from engine manifold vacuum source to by-pass valve through vacuum differential valve directly, by passing the differential vacuum delay and separator valve. 5. Check valve inoperative. 6. Pump failure. 	<ol style="list-style-type: none"> 1. Tighten to specifications. 2. Locate leak and repair 3. Tighten or replace clamps. 4a. If this corrects the problem go to step b. If not, replace air by-pass valve. 4b. If this corrects the problem, check differential vacuum, delay and separator valve and vacuum source line for plugging. Replace as required. If it doesn't, replace vacuum differential valve. 5. Disconnect hose and blow through hose toward check valve. If air passes, function is normal. If air can be sucked from check valve, replace check valve. 6. Replace pump.
Excessive pump noise, chirping, rumbling, knocking, loss of engine performance.	<ol style="list-style-type: none"> 1. Leak in hose. 2. Loose hose. 3. Hose touching other engine parts. 4. Vacuum differential valve inoperative. 5. By-pass valve inoperative 6. Pump mounting fasteners loose. 7. Pump failure. 8. Check valve inoperative. 	<ol style="list-style-type: none"> 1. Locate source of leak using soap solution and correct. 2. Reassemble and replace or tighten hose clamp. 3. Adjust hose position. 4. Replace vacuum differential valve. 5. Replace by-pass valve. 6. Tighten mounting screws as specified. 7. Replace pump. 8. Replace check valve.
Excessive belt noise.	<ol style="list-style-type: none"> 1. Loose belt 2. Seized pump 	<ol style="list-style-type: none"> 1. Tighten to spec. 2. Replace pump.
Excessive pump noise. Chirping	<ol style="list-style-type: none"> 1. Insufficient break-in 	<ol style="list-style-type: none"> 1. Run vehicle 10-15 miles at interstate speeds--recheck.
Centrifugal filter fan damaged or broken.	<ol style="list-style-type: none"> 1. Mechanical damage 	<ol style="list-style-type: none"> 1. Replace centrifugal filter fan.
Exhaust tube bent or damaged.	<ol style="list-style-type: none"> 1. Mechanical damage 	<ol style="list-style-type: none"> 1. Replace exhaust tube.
Poor idle or driveability.	<ol style="list-style-type: none"> 1. A defective A.I.R. system cannot cause poor idle or driveability. 	<ol style="list-style-type: none"> 1. Do not replace A.I.R. system.

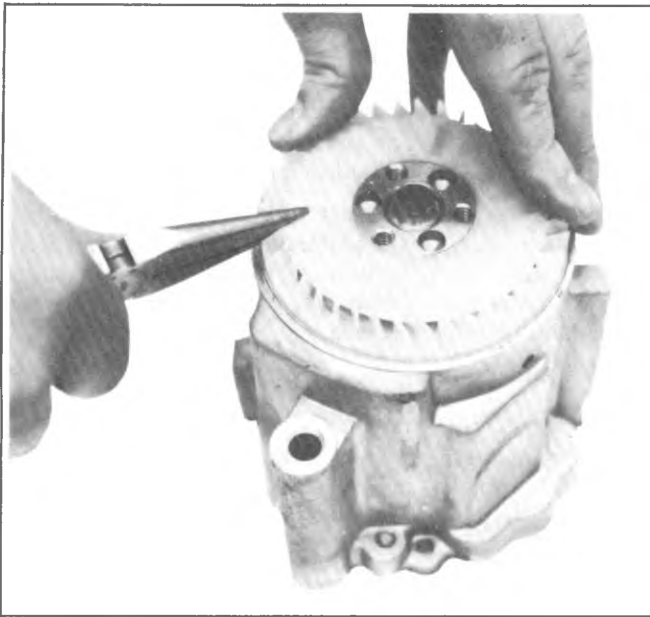


Fig. 6E-45--Removing Centrifugal Filter

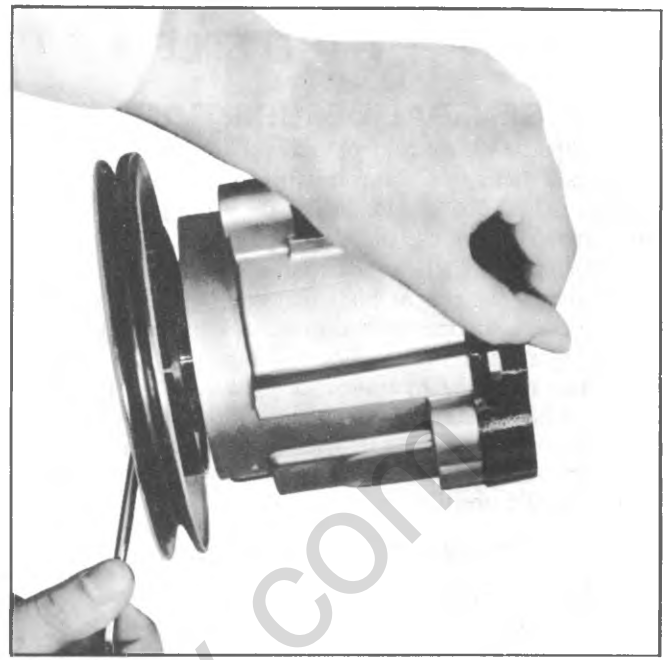


Fig. 6E-46--Installing Centrifugal Filter

Install

1. Install diverter valve to pump or elbow with new gasket. Torque valve attaching screws to 85 lb. in. (9.5N·m).
2. Install outlet and vacuum signal hoses and check system for leaks.

Air Injection Pump

Inspection

Accelerate engine to approximately 1500 RPM and observe air flow from hose(s). If air flow increases as engine is accelerated, pump is operating satisfactorily. If air flow does not increase or is not present, proceed as follows:

1. Check for proper drive belt tension.

2. Check for a leaky pressure relief valve. Air may be heard leaking with the pump running.

NOTE: The AIR System is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the Air Injection Reactor System, operate the engine with the pump drive belt removed. If excessive noise does not exist with the belt removed proceed as follows:

3. Check for a seized Air Injection Pump.

4. Check hoses, tubes and all connections for leaks and proper routing.

CAUTION: *Do not oil AIR pump.*

5. Check diverter valve.

6. Check AIR injection pump for proper mounting and bolt torque.

7. Repair irregularities in these components as necessary.

8. If no irregularities exist and the AIR injection pump noise is still excessive, remove and replace pump.

Replace

1. Disconnect the hoses at the pump.
2. Remove pump pulley as outlined.
3. Remove pump mounting bolts and remove pump.

Install

1. Install pump with mounting bolts loose.
2. Install pump pulley as outlined.
3. Install and adjust belt as outlined.
4. Connect the hoses at the pump.
5. Tighten mounting bolts to 20-35 lb. ft. (27 N·m - 48N·m).

THROTTLE RETURN CONTROL (TRC)

GENERAL DESCRIPTION

A throttle return control system (TRC) is used on 10-30 Series Trucks in California with heavy duty emissions systems. Also, 305 C.I.D. heavy duty emissions (except California) vehicles use the TRC system.

When the vehicle is coasting against the engine, the TRC valve will open at high manifold vacuum levels to allow vacuum to operate the throttle lever actuator. The throttle lever actuator pushes the throttle lever slightly open, thus reducing hydro-carbon emissions during coast down. When manifold vacuum drops below a pre-determined level (TRC valve set point) the control valve closes, the throttle actuator retracts, and the throttle lever returns to idle position.

ON-VEHICLE SERVICE

SYSTEM OPERATION

The TRC valve and actuator system should function to slightly open the throttle at high manifold vacuum overrun conditions (about 21-23 in. hg. [71-78kPa] depending on the particular engine application) and return to the curb idle position at lower manifold vacuums. Failure to function in this manner indicates the TRC valve or actuator is misadjusted, a vacuum leak exists, the valve vent is plugged or there is binding somewhere in the system.

Check hoses for cracking, abrasion, or deterioration and replace as necessary. Check system function for proper operation and adjust as as necessary.

CHECKING AND ADJUSTING SYSTEM

Control Valve (Figs. 6E-47 to 50)

Checking and Adjusting

1. Disconnect valve-to-carburetor hose at the carburetor and connect to an external vacuum source with an accurate vacuum gage inserted near the valve.
2. Apply a minimum of 25 in. Hg. (84 kPa) vacuum

to the control valve vacuum supply fitting and seal off the vacuum supply between the gage and the source. The vacuum gage reading will indicate the valve set point value.

If the gage reading is not within .5 in. Hg. (7kPa) of the specified value for the particular engine being checked, then the valve needs adjustment. If the trapped vacuum drops off faster than .1" Hg. per second, then the valve is leaking and must be replaced.

3. To adjust the valve set point:

- a. Gently pry off the conical plastic cover.
- b. Disengage the jam nuts by holding the larger nut and loosening the smaller nut. Adjust the valve by turning the larger nut in (clockwise) to raise the set point or out (counter-clockwise) to lower the set point value.
- c. Recheck the valve set point per Step 2.
- d. Repeat Steps b and c as necessary to obtain the proper set point value.
 - 292-22.5 in. hg. \pm .5 (maroon)
 - 305-22.5 in. hg. \pm .5 (orange)
 - 350-21.5 in. hg. \pm .5 (black)
 - 400-21.5 in. hg. \pm .5 (black)
 - 454-23.0 in. hg. \pm .6 (green)
- e. Hold the larger adjusting nut and retorque the smaller jam nut to 25-30 in. lbs. (3-3.4 N·m).
- f. Reinstall plastic cover.
- g. If the valve cannot be readjusted, it must be replaced.

Replacement

Disconnect vacuum hoses at control valve. Remove nut, washer and control valve. Reverse procedure to install, then check operation of new control valve.

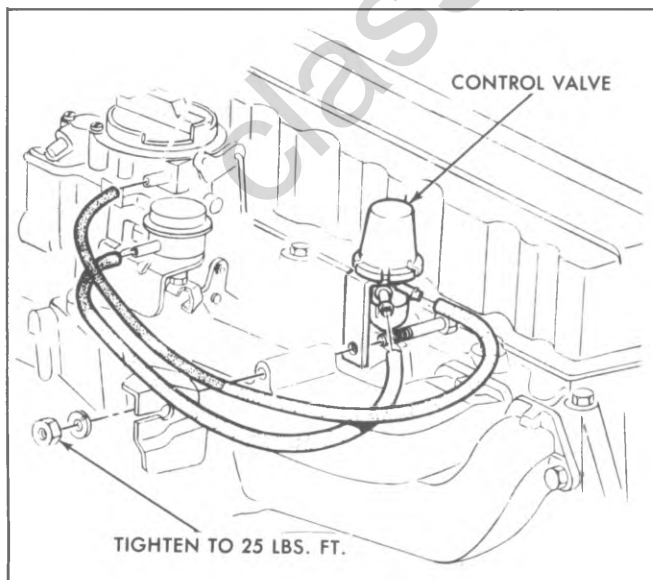


Fig. 6E-47--Control Valve - L6

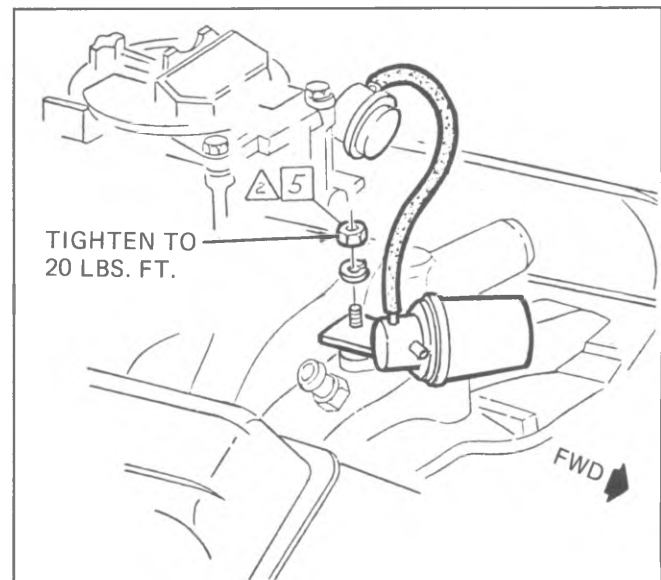


Fig. 6E-48--Control Valve-350/400 V8

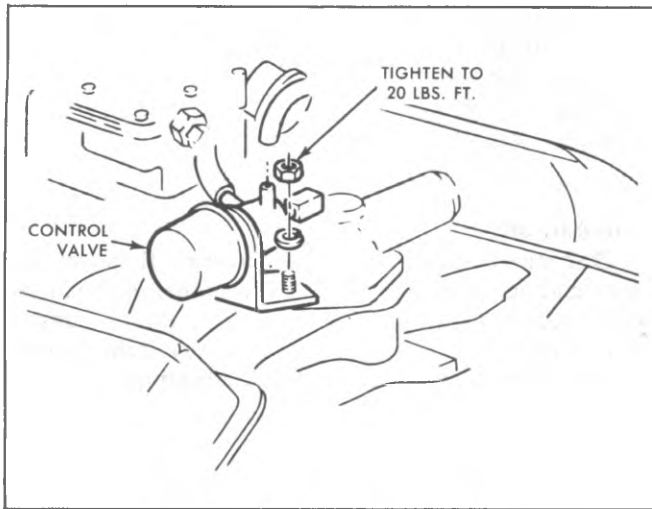


Fig. 6E-49--Control Valve - 305 V8

Throttle Lever Actuator (Fig. 6E-51 and 52)

Check and Adjustment

Throttle Lever Actuator Checking and Adjusting Procedure

1. Disconnect valve-to-actuator hose at valve and connect to an external vacuum source equipped with a vacuum gage near the actuator.

NOTE: If an external vacuum source is not readily available, the actuator may be plumbed directly to manifold vacuum to extend the plunger.

2. Apply 20 in. hg. (68 kPa) vacuum to the actuator and seal off the vacuum source. If the vacuum gage reading drops, then the actuator is leaking and must be replaced.

3. To check the actuator for proper operation:

a. Check the throttle lever, shaft, and linkage to be sure that they operate freely without binding or sticking.

b. Start engine and run until warmed up and idle is stable. Turn air conditioning "off" if so equipped. Note idle

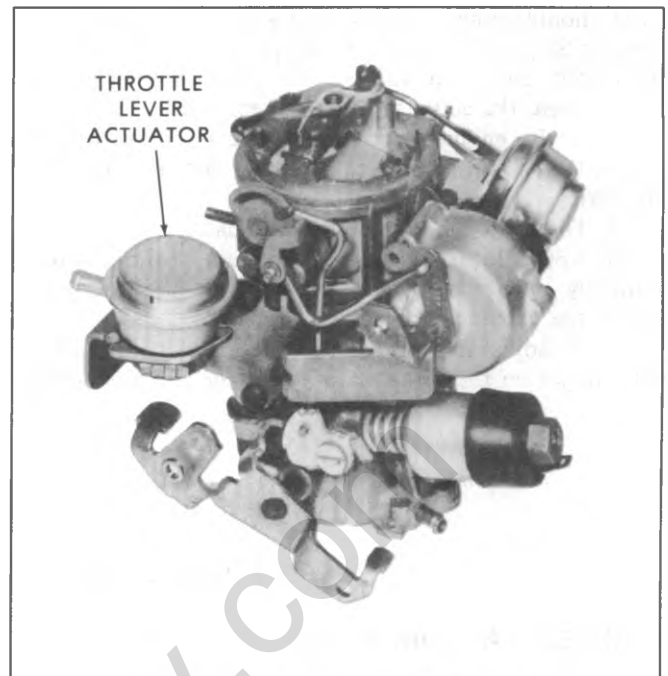


Fig. 6E-51--Throttle Lever Actuator-L6

RPM.

c. Apply 20 in. hg. (68kPa) vacuum to the actuator. Manually open the throttle slightly and allow to close against the extended actuator plunger. Note the engine RPM.

d. Release and reapply 20 in. hg. (68kPa) vacuum to the actuator and note the RPM to which the engine speed increased (do not assist the actuator).

e. If the RPM obtained in Step d is not within 150 RPM of that obtained in c, then the actuator plunger may be binding due to dirt, corrosion, varnish, etc. If binding is indicated and cannot be corrected, then the actuator must be replaced.

f. Release the vacuum from the actuator and the engine

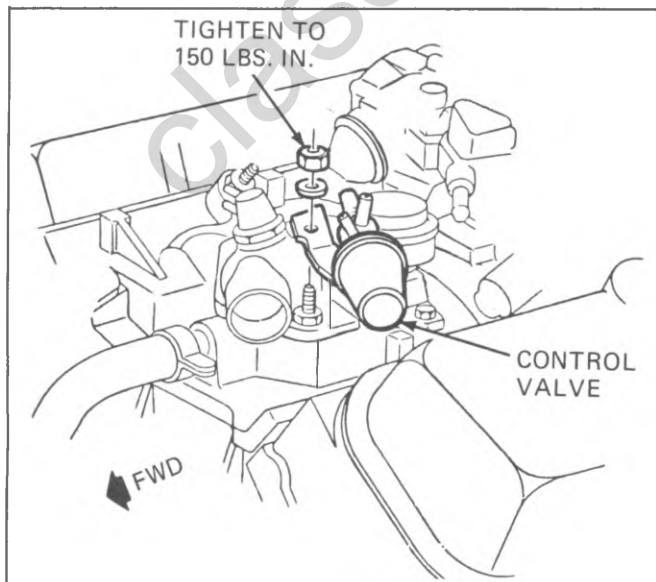


Fig. 6E-50--Control Valve-454 V8

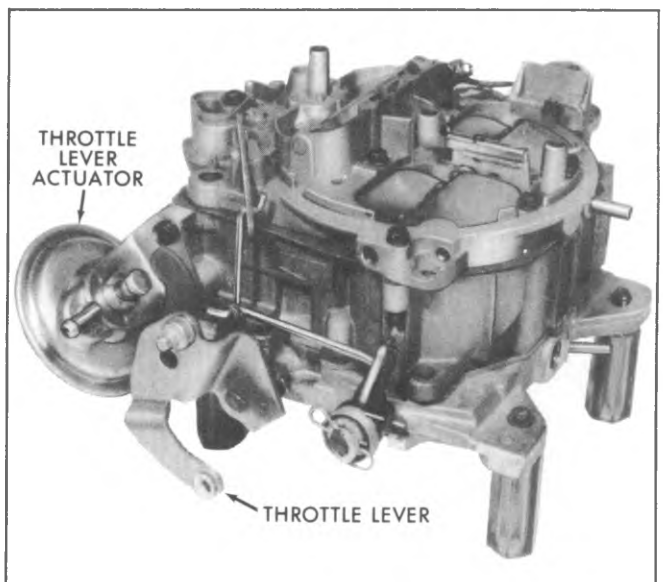


Fig. 6E-52--Throttle Lever Actuator-V8

speed should return to within 50 RPM of the idle speed noted in Step b. If it does not, the plunger may be binding due to dirt, corrosion, varnish, etc. If the problem cannot be corrected, the actuator must be replaced.

g. If the engine RPM noted in c is not within the specified TRC speed range, the TRC actuator must be adjusted.

4. To adjust the throttle lever actuator.

a. Apply 20 in. hg. (68kPa) vacuum to the actuator. Manually open the throttle slightly and allow to close against the extended actuator plunger.

b. To adjust the throttle lever actuator, turn the hex-end plunger on the actuator to obtain the specified speed.

- 292-1600 RPM
- 305-1600 RPM
- 350-1500 RPM
- 400-1500 RPM
- 454-1500 RPM

Replacement

Disconnect vacuum hose at actuator. Remove two screws and actuator (454 only). On all other applications unlock spider washer and loosen large nut to remove actuator from bracket. Reverse procedure to install new unit and refer to 4 above for proper speed adjustment.

VACUUM ADVANCE CONTROL

TRAPPED VACUUM SPARK

General Description

Trapped vacuum spark is on all 454 CID engines with heavy duty emissions. A thermal vacuum switch (TVS) is mounted in the cylinder head sensing engine coolant temperature and a delay valve is between manifold vacuum, distributor and thermal vacuum switch.

When engine temperature is below specified valve, the manifold vacuum signal is routed through the delay valve to the distributor. Ports on TVS are blocked. The delay valve will keep the vacuum to the distributor at vacuum levels higher than manifold depression during vehicle acceleration. A small sintered iron bleed is provided in the delay valve to allow for a leak-down to enable restarts in case of engine stalls.

When engine temperature is above specified valve, the ports on TVS will be open to allow manifold vacuum to the

distributor. The delay valve in the mode of operation acts as a connector.

SPARK CONTROL SWITCH

General Description

Spark control switch system is used on some 350/400 CID engines with heavy duty emission to help protect the engine during an over-heat mode.

When coolant is at normal operating temperature, ported vacuum is directed through a thermal vacuum switch (TVS) to the distributor vacuum advance.

When coolant is above normal operating temperature, full vacuum is directed through the TVS to distributor vacuum advance. This advances the timing and allows the engine to run cooler. At this time, full vacuum is directed to the distributor vacuum advance at idle.

ENGINE PERFORMANCE SPECIFICATION INFORMATION – LD EMISSION LT. DUTY TRUCK

ENGINE AND CODE	IGNITION TIMING B.T.D.C. DEGREES	SPARK PLUG TYPE & GAP	CURB IDLE (RPM)	BASE IDLE (RPM)	FAST IDLE (RPM) (N)	CARBURETOR IDENTIFICATION 17058----	EMISSION CONTROL DEVICES	EGR VALVE MODEL	EMISSION LABEL CODE	DISTRIBUTOR		VACUUM AND MECHANICAL ADVANCE	
										DISTRIBUTOR 1110----	VACUUM MODEL 1973----	VACUUM ADVANCE @ INCHES OF VACUUM (IN CRANK DEGREES)	MECHANICAL ADVANCE (CRANK DEGREES) @ ENGINE RPM
250 CID L-6 ENGINE 1 BBL 1 ME CARBURETOR RPO LD4													
EXC. CALIF. M. T. TAC C10	8° @ 750		750 (N)	425 (N)		021		17060810 17056295 (C109 W/M-4)	XU-XW				
EXC. CALIF. M. T. TAF G10					2000	081	EGR PCV TAC ECS UFC EFE	17060810 (05 Models) 17056295 (06 Models)	XU	717	621		0° @ 1100 14° @ 2300 24° @ 4100
EXC. CALIF. A. T. TAB C10	8° @ 550 NO A/C		550 (D) NO A/C	425 (D)		022 NO A/C 024 A/C			XU-XW				
EXC. CALIF. A. T. TAH G10	8° @ 600 A/C		600 (D) A/C			082 NO A/C 084 A/C		7043042	XU				
CALIFORNIA M. T. TCL C-10-20	8° @ 750	R46TS .035	750 (N)	425 (N)		311			XX-XY	715	619	8° @ 4" Hg 18° @ 12" Hg	0° @ 1000 7° @ 1600 20° @ 4200
CALIFORNIA M. T. TCR G10-20							313			XX			
CALIFORNIA A. T. TCM C10-20	10° @ 600		600 (D)	425 (D)	2100	310	EGR PCV TAC ECS UFC EFE AIR	17056729	XX-XY	719			0° @ 1100 7° @ 2300 16° @ 4200
CALIFORNIA A. T. TCS G10-20-30						312			XX				
HIGH ALT. M.T./C10	8° @ 750		750 (N)	425 (N)		015		17057908	ZW-ZU	715	621		0° @ 1000 7° @ 1600 20° @ 4200
HIGH ALT. M.T./G10						017			ZW				
HIGH ALT. A.T./C10	12° @ 600		600 (D)	425 (D)		015		17057909	ZW-ZU	719			0° @ 1100 7° @ 2300 16° @ 4200
HIGH ALT. A.T./G10						017			ZW				
305 CID V-8 ENGINE 2BBL 2GC CARBURETOR RPO LG9													
EXC. CALIF. M. T. UTR C10 UTT G10	40° @ 600	R45TS .045	600 (N)	-	-	113 NO A/C 123 A/C	EGR, PCV TAC, ECS UFC, EFE	7044019	WB OR WC	1103281	621	0° @ 4" Hg 18° @ 12" Hg	0° @ 1000 10° @ 1700 20° @ 3800
EXC. CALIF. A. T. UTS C10 UTU G10	40° @ 500			500 (D)	-	-	116 NO A/C 118 A/C		17053034		1103338	593	0° @ 5" Hg 24° @ 12" Hg
350 CID (5.7 LITRE) V-8 DIESEL ENGINE RPO LFG													
QA C10 EXC. CAL. TA C10 CAL.	SEE SEC. 6A	NONE	575 (D)		650 (D)	NONE	PCV	NONE	HY HZ	NONE	NONE	NONE	NONE

A. T. AUTOMATIC TRANSMISSION
M. T. MANUAL TRANSMISSION
EGR EXHAUST GAS RECIRCULATION
TAC THERMOSTATIC AIR CLEANER
ECS EVAPORATION CONTROL SYSTEM

UFC UNDER FLOOR CATALYTIC CONVERTER
PCV POSITIVE CRANKCASE VENTILATION
AIR AIR INJECTION REACTOR
SD SPARK DELAY
EFE EARLY FUEL EVAPORATION

ENGINE PERFORMANCE SPECIFICATION INFORMATION – LD EMISSION LT. DUTY TRUCK

ENGINE AND CODE	IGNITION TIMING B.T.D.C. DEGREES	SPARK PLUG TYPE & GAP	CURB IDLE (RPM)	SOLENOID WITH A/C (RPM)	FAST IDLE (RPM) (N)	CARBURETOR IDENTIFICATION 17058----	EMISSION CONTROL DEVICES	EGR VALVE MODEL	EMISSION LABEL CODE	DISTRIBUTOR		VACUUM AND MECHANICAL ADVANCE	
										DISTRIBUTOR 1103----	VACUUM MODEL 1973----	VACUUM ADVANCE @ INCHES OF VACUUM (IN CRANK DEGREES)	MECHANICAL ADVANCE (CRANK DEGREES) @ ENGINE RPM
350 CID V-8 ENGINE 4 BBL M4MC CARBURETOR RPO LS9													
EXC. CALIF. M. T. TJX C10 3 SP.	8° @ 600	R45TS .045	600 (N)	—	1300	201	EGR PCV TAC ECS UFC EFE AIR (CALIFORNIA)	7043133	WD-WF	286	621	0° @ 4" Hg 18° @ 12" Hg	0° @ 1100 12° @ 1600 16° @ 2400 22° @ 4600
EXC. CALIF. M. T. TJY C10 4 SP.								7043139					
EXC. CALIF. M. T. TKF G10 3 SP.								7043133					
EXC. CALIF. A. T. TKA C10	8° @ 500		500 (D)	600 (D)	1600	202 NO A/C 204 A/C		17053034	WD-WF				
EXC. CALIF. A. T. TKH G10						218 NO A/C 222 A/C		WD					
H. ALTITUDE A. T. TYF C10						509 NO A/C 510 A/C		17056494	WH				
H. ALTITUDE A. T. TZC G10	8° @ 700		700 (N)	—	1300	588 NO A/C 586 A/C		17056494	WK				
CALIFORNIA M. T. TYB C10 TYJ C10 TYH C10						503							
CALIFORNIA M. T. TZA G10 TZD G10-20 TZF G20-30						519							
CALIFORNIA A. T. TYD C10 TYK C10	8° @ 500		500 (D)	600 (D)	1600	506 NO A/C 508 A/C		17056730	WK-WM XC-XD				
CALIFORNIA A. T. TZB, TZH G						518 NO A/C 522 A/C			WK				
CALIFORNIA A. T. TZR P20						506			WK-LK				
CALIFORNIA M. T. TZU, TZT CK10-20	8° @ 700	700 (N)	—	1300	503	17056730	WK-WM XA-XB WK	339	626	0° @ 4" Hg 10° @ 8" Hg			
CALIFORNIA A. T. TZW, TZS CK10-20	8° @ 500	500 (D)	600 (D)	1600	506 NO A/C 508 A/C								
400 CID V-8 ENGINE 4 BBL M4MC RPO LF4													
CALIFORNIA A. T. TLX, TLW G20-30	4° @ 500	R45TS .045	500 (D)	600 (D)	1600	523 NO A/C 524 A/C	EGR, PCV TAC, ECS UFC, EFE AIR	17056730	WN-WR XF-XH	301	626	0° @ 4" Hg 10° @ 8" Hg	0° @ 1000 8° @ 1600 19° @ 3450
CALIFORNIA A. T. TLB, TLA K10-20						527 NO A/C 528 A/C							
454 CID V-8 ENGINE 4 BBL M4MC CARBURETOR RPO LF8													
EXC. CALIF. A. T. TSU C10	8° @ 550	R45TS .045	550° (D)	600 (D)	1600	521 NO A/C 520 A/C	EGR, PCV TAC, ECS EFE, AIR UFC	17060843	LN-ZH	240	481	0° @ 6" Hg 20° @ 15" Hg	0° @ 1100 14° @ 2800 20° @ 4200
CALIFORNIA A. T. TRM C20	8° @ 700		700 (N)	—		501		17058605	LR-ZM LS-ZR				
CALIFORNIA A. T. TSS C10-20 TRF C20	8° @ 550		550 (D)	600 (D)		521 NO A/C 520 A/C		17056768	LR-ZM LT-ZT				

A. T. AUTOMATIC TRANSMISSION
M. T. MANUAL TRANSMISSION
EGR EXHAUST GASE RECIRCULATION

TAC THERMOSTATIC AIR CLEANER
ECS EVAPORATION CONTROL SYSTEM
UFC UNDERFLOOR CATALYTIC CONVERTER

PCV POSITIVE CRANKCASE VENTILATION
AIR AIR INJECTION REACTOR
EFE EARLY FUEL EVAPORATION

ENGINE PERFORMANCE SPECIFICATION INFORMATION - HD EMISSION LT. DUTY TRUCK

ENGINE AND CODE	IGNITION TIMING B.T.D.C. DEGREES	SPARK PLUG TYPE & GAP	CURB IDLE (RPM)	BASE IDLE (RPM)	FAST IDLE (RPM) (N)	CARBURETOR IDENTIFICATION 17058----	EMISSION CONTROL DEVICES	EGR VALVE MODEL	EMISSION LABEL CODE	DISTRIBUTOR		VACUUM AND MECHANICAL ADVANCE	
										DISTRIBUTOR 1110----	VACUUM MODEL 1973----	VACUUM ADVANCE @ INCHES OF VACUUM (IN CRANK DEGREES)	MECHANICAL ADVANCE (CRANK DEGREES) @ ENGINE RPM
250 CID L-6 ENGINE 1 BBL 1ME CARBURETOR RPO LD4													
EXC. CALIF. M. T. TAR C10 K10	6° @ 600	R46T .035	600 (N)	450 (N)	2400	007	PCV, TAC	—	ZB	720	520	0° @ 10" Hg 10° @ 13" Hg	0° @ 1100 14° @ 2300 24° @ 4100
EXC. CALIF. A. T. TAM C10 K10						006							
292 CID L-6 ENGINE 1 BBL 1ME CARBURETOR RPO L25													
EXC. CALIF. M. T. THF CKP TUH G	8° @ 600	R44T .035	600 (N)	450 (N)	2400	009	PCV TAC TRC (CALIFORNIA) ECS (CALIFORNIA)	—	ZB	720	520	0° @ 10" Hg 10° @ 13" Hg	0° @ 1100 14° @ 2300 24° @ 4100
EXC. CALIF. A. T. THM CKP20-30 THJ CKP TUF G						008							
CALIFORNIA M. T. THS CKP30						ZD			721	520	0° @ 1100 6° @ 2000 14° @ 2300 24° @ 4100		
CALIFORNIA A. T. THY CK30 P30						309 CK 359 P			308 CK 358 P				
305 CID V-8 ENGINE 2 BBL 2GC CARBURETOR RPO LG9													
										1103----			
EXC. CALIF. M. T. UTW - CK	6° @ 700	R44T .045	700 (N)	—	—	127	PCV TAC TRC	—	ZB	237	516	0° @ 8" Hg 10° @ 13" Hg	0° @ 1000 10° @ 1700 20° @ 3800
EXC. CALIF. A. T. UTX - CK													

A. T. AUTOMATIC TRANSMISSION
M. T. MANUAL TRANSMISSION
TAC THERMOSTATIC AIR CLEANER

ECS EVAPORATION CONTROL SYSTEM
PCV POSITIVE CRANKCASE VENTILATION
TRC THROTTLE RETURN CONTROL

ENGINE PERFORMANCE SPECIFICATION INFORMATION - HD EMISSION

LT. DUTY TRUCK

ENGINE AND CODE	IGNITION TIMING B.T.D.C. DEGREES	SPARK PLUG TYPE & GAP	CURB IDLE (RPM)	BASE IDLE (RPM)	FAST IDLE (RPM) (N)	CARBURETOR IDENTIFICATION 17058 ____	EMISSION CONTROL DEVICES	EGR VALVE MODEL	EMISSION LABEL CODE	DISTRIBUTOR		VACUUM AND MECHANICAL ADVANCE	
										DISTRIBUTOR	VACUUM MODEL	VACUUM ADVANCE @ INCHES OF VACUUM (IN CRANK DEGREES)	MECHANICAL ADVANCE (CRANK DEGREES) @ ENGINE RPM
350 CID V-8 ENGINE 4 BBL 4 MV/M4MC CARBURETOR RPO LS9													
EXC. CALIF. M. T. TWY CK10-20 TKL CK20-30 TYA G20-30 TKM G30 TKT P20-30 TKZ P30						213							
EXC. CALIF. A. T. TWZ CK10-20 TKK CK20-30 TKR G30 TKW P20-30 TYC G20-30 TWW P30	8° @ 700	R44T .045	700 (N)	—	1700	213		—	ZB	1103274	1973482	0° @ 6" Hg 15° @ 12" Hg	0° @ 1200 15° @ 2700 20° @ 4200
EXC. CALIF. A. T. TKX P30 (MOTOR HOME)						215	PCV						
CALIFORNIA M. T. TYL CK30 TXZ P30 TKS P30						513	AIR (CALIFORNIA) STVS (CKG SERIES)						
CALIFORNIA M. T. TZK G30						514	TRC (CALIFORNIA) ECS (CALIFORNIA)						
CALIFORNIA A. T. TYM CK30 TWX P30 TKU P30						513							
CALIFORNIA A. T. TZL G30	2° @ 700	R44TX .060	700 (N)	—	1600	514		—	ZD	1103250	1973516	0° @ 8" Hg 10° @ 13" Hg	0° @ 1150 17° @ 2900 22° @ 4200
CALIFORNIA A. T. TKY P30 (MOTOR HOME)						515							

A. T. AUTOMATIC TRANSMISSION
M. T. MANUAL TRANSMISSION
TAC THERMOSTATIC AIR CLEANER
ECS EVAPORATION CONTROL SYSTEM

PCV POSITIVE CRANKCASE VENTILATION
AIR AIR INJECTION REACTOR
STVS SPARK TVS
TRC THROTTLE RETURN CONTROL

ENGINE PERFORMANCE SPECIFICATION INFORMATION - HD EMISSION

LT. DUTY TRUCK

ENGINE AND CODE	IGNITION TIMING B.T.D.C. DEGREES	SPARK PLUG TYPE & GAP	CURB IDLE (RPM)	BASE IDLE (RPM)	FAST IDLE (RPM) (N)	CARBURETOR IDENTIFICATION 1705----	EMISSION CONTROL DEVICES	EGR VALVE MODEL	EMISSION LABEL CODE	DISTRIBUTOR		VACUUM AND MECHANICAL ADVANCE	
										DISTRIBUTOR 1103 ----	VACUUM MODEL 1973----	VACUUM ADVANCE @ INCHES OF VACUUM (IN CRANK DEGREES)	MECHANICAL ADVANCE (CRANK DEGREES) @ ENGINE RPM
400 CID V-8 ENGINE 4 BBL M4MC CARBURETOR RPO LF4													
EXC. CALIF. A. T. TLZ G20-30 TLJ K20-30 TLK K10-20 TLF-630	4° @ 700	R44T .045	700 (N)	—	1700	8229	PCV TAC STVS	—	ZB	249	482	0° @ 6" Hg 15° @ 12" Hg	0° @ 1000 8° @ 1600 19° @ 3450
CALIFORNIA A. T. TLY G-30	2° @ 700				1600	8525	TRC (CAL- IFORNIA)		ZD	250	516	0° @ 8" Hg 10° @ 13" Hg	0° @ 1150 17° @ 2900 22° @ 4200
CALIFORNIA A. T. TLC K-30					8529	ECS (CAL- IFORNIA)							
454 CID V-8 ENGINE 4MV/M4MC M4MC CARBURETOR RPO LF8													
EXC. CALIF. M. T. TSF C20-30	8° @ 700	R44T .045	700 (N)	—	1700	8212	PCV TAC AIR (CAL- IFORNIA)	—	ZB	238	511	0° @ 10" Hg 15° @ 17" Hg	0° @ 1100 14° @ 2800 20° @ 4200
EXC. CALIF. A. T. TSF C20-30 TST C10-20 TRH P30 (MOTOR HOME) TRK P30-42						EGR (CAL- IFORNIA)	17050064						
CALIFORNIA M. T. TRY C30						EXC FED. 'P' SERIES	17050064		ZD	240	481	0° @ 6" Hg 20° @ 15" Hg	
CALIFORNIA A. T. TSB C30 TRJ P30 (MOTOR HOME)						ECS (CAL- IFORNIA)	17050064						
CALIFORNIA A. T. TRL P30-42													

A. T. AUTOMATIC TRANSMISSION
M. T. MANUAL TRANSMISSION
EGR EXHAUST GAS RECIRCULATION
TAC THERMOSTATIC AIR CLEANER
ECS EVAPORATION CONTROL SYSTEM

UFC UNDERFLOOR CATALYTIC CONVERTER
PCV POSITIVE CRANKCASE VENTILATION
AIR AIR INJECTION REACTOR
TSC THERMAL SPARK CONTROL
TRC THROTTLE RETURN CONTROL

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SECTION 6F

ENGINE EXHAUST SYSTEM

GENERAL DESCRIPTION

For alignment purposes, the muffler outlet flange is notched and mates to a welded tab located on the outside diameter of the tailpipe. The exhaust pipes and muffler use locator tabs for alignment.

Light duty emissions vehicles have an exhaust system with a catalytic converter between the front exhaust pipe and the rear exhaust pipe.

The catalytic converter is an emission control device added to the exhaust system to reduce hydrocarbon and carbon monoxide pollutants from the exhaust gas stream. The converter contains beads which are coated with a catalytic material containing platinum and palladium.

The catalytic converter requires the use of unleaded fuel only.

Periodic maintenance of the exhaust system is not required; however, if the vehicle is raised for other service, it is advisable to check the general condition of the catalytic converter, pipes and mufflers.

CAUTION: *When jacking or lifting vehicle from frame side rails, be certain lift pads do not contact catalytic converter as damage to converter will result.*

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DIAGNOSIS EXHAUST SYSTEM

CONDITION	POSSIBLE CAUSE	CORRECTION
Leaking Exhaust Gases	Leaks at pipe joints.	Tighten U-bolt nuts at leaking joints to 30 foot-pounds.
	Damaged or improperly installed seals or packing.	Replace seals or packing as necessary.
	Loose exhaust pipe heat tube extension connections.	Replace seals or packing as required. Tighten stud nuts or bolts to specifications.
	Burned or rusted out exhaust pipe heat tube extensions.	Replace heat tube extensions as required.
Exhaust Noises	Leaks at manifold or pipe connections.	Tighten clamps at leaking connections to specified torque. Replace gasket or packing as required.
	Burned or blown out muffler.	Replace muffler assembly.
	Burned or rusted out exhaust pipe.	Replace exhaust pipe.
	Exhaust pipe leaking at manifold flange.	Tighten attaching bolts nuts to 17 foot-pounds.
	Exhaust manifold cracked or broken.	Replace manifold.
	Leak between manifold and cylinder head.	Tighten manifold to cylinder head stud nuts or bolts to specifications.
Loss of engine power and/or internal rattles in muffler.	Dislodged turning tubes and or baffles in muffler.	Replace muffler.
Loss of engine power.	Imploding (inner wall collapse) of exhaust pipe (C Truck)	Replace exhaust pipe.

ON-VEHICLE SERVICE

GENERAL

Exhaust System Pipes and Resonators Rearward of the Mufflers Must Be Replaced Whenever A New Muffler Is Installed.

NOTE: When a muffler is replaced use sealing compound at the clamped joint to prevent leaks.

Truck exhaust systems vary according to series and model designation. Series 10-30 trucks use a split-joint design system in which the exhaust pipe-to-muffler are clamped together and muffler-to-tailpipe connections are welded together. All mufflers and tailpipes are welded assemblies (no clamps).

NOTE: All 10-20-30 series exhaust systems are aluminized steel except: (1) "C" Series exhaust pipes and (2) stainless steel exhaust pipes on vehicles equipped with underfloor catalytic converters. Always use correct replacement parts when servicing these systems.

When installing a new exhaust pipe or muffler and tailpipe, on any model, care should be taken to have the correct alignment and relationship of the components to each other. Particular care should be given to the installation of the exhaust pipe and crossover pipe assembly on V-8 engine single exhaust systems. Incorrectly assembled parts of the exhaust system are frequently the cause of annoying noises and rattles due to improper clearances or obstructions to the normal flow of gases. Leave all clamp bolts and muffler bolts loose until all parts are properly aligned and then tighten, working from front to rear.

Exhaust system hangers, hanger brackets, and clamps which are damaged should be replaced to maintain proper exhaust system alignment.

NOTE: When reinstalling exhaust pipe to manifold, always use new packings and nuts. Be sure to clean manifold stud threads with a wire brush when installing the new nuts.

CATALYTIC CONVERTER (FIGS. 6F-1, 2 and 3)

Removal

1. Raise vehicle on hoist.
2. Remove clamps at front and rear of converter.
3. Cut converter pipes at front and rear of converter and remove converter.
4. On C10 models, remove support attaching converter-to-transmission.
5. Remove converter pipe-to-front-exhaust pipe and converter pipe-to-rear exhaust pipe.

Installation

1. With sealer on exhaust pipes, install pipes into converter.
2. On C10 model, loosely connect support attaching converter-to-transmission.
3. Install new "U" bolts and clamps at front and rear of converter.
4. Check all clearance and tighten clamps and support.
5. Lower vehicle and remove from hoist.

Catalyst Removal

If necessary, the catalyst in the converter can be replaced on the vehicle with Tool No. J-25077.

1. Install aspirator J-25077-2 (Fig. 6F-4).

NOTE: Separate hoses should be attached to the aspirator and the vibrator with maximum available pressure. Minimum of 60 psi in each hose.

2. Connect air supply line to aspirator to create a vacuum in the converter to hold beads in place when fill plug is removed.

3. Remove converter fill plug as follows:

a. Threaded plug - Remove with 3/4" hex wrench or Tool J-25077-3.

b. Pressed plug - Drive a small chisel between the converter shell and the fill plug. Use care not to damage converter shell (Fig. 6F-5). Continue to deform fill plug until it can be removed with pliers (Fig. 6F-6).

NOTE: Do not pry fill plug from converter as damage to fill plug sealing surfaces could result.

4. Clamp on vibrator and catalyst container (Fig. 6F-7). Use adapter J-25077-6 if converter was built with pressed plug.

5. Disconnect air supply to aspirator and connect air supply to vibrator. Catalyst will now drain from the converter into the empty container.

6. When all the catalyst has been removed from the converter, disconnect air supply to vibrator and remove container from the converter.

7. Discard used catalyst.

Catalyst Replacement

1. Fill container with approved replacement catalyst.
2. Install fill tube extension to the fixture J-25077-1 (Fig. 6F-8). Use adapter J-25077-6 if converter was built with pressed plug.
3. Connect air supply to aspirator and vibrator.
4. Attach catalyst container to the fixture (6F-9).
5. After the catalyst stops flowing, disconnect air supply to the vibrator.
6. Remove vibrator and check that catalyst has filled converter flush with fill plug hole. Add catalyst if required.
7. Apply an anti-seize compound to the fill plug; install and tighten to 60 pound feet.

If built with a pressed plug, install service fill plug (Fig. 6F-10), as follows: Install the bolt into the bridge and position the bridge into converter opening. Move bolt and bridge back and forth to dislodge catalyst beads until bridge is positioned (Fig. 6F-11).

8. Remove bolt from bridge then position the washer and fill plug, dished side out, over the bolt.

9. While holding the fill plug and washer against the bolt head (Fig. 6F-12), thread the bolt 4 of 5 turns into the bridge. Release the fill plug and the aspirator will pull the fill plug into position.

NOTE: If fill plug is allowed to seat against the converter before installing bolt, the threaded hole in the bridge will fill with beads and it will be very difficult to start the bolt.

10. After making sure fill plug is correctly seated, tighten the bolt and torque to 28 ft. lbs. (Fig. 6F-13).

11. Disconnect air supply to aspirator and remove.

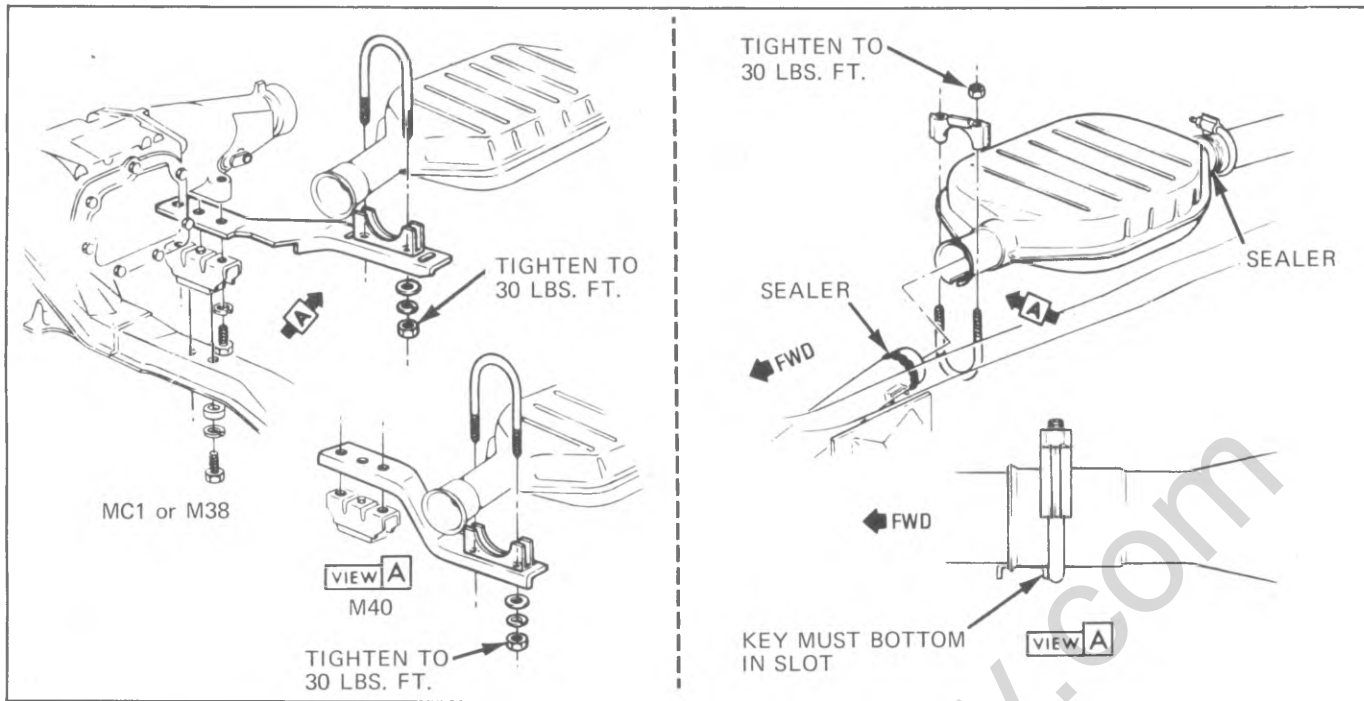


Fig. 6F-1--Catalytic Converter - CK Series

12. Start vehicle and check for leaks.

Bottom Cover

If, for any reason, the bottom cover of the converter is torn or severely damaged, it can be replaced with a repair kit.

Bottom Cover Replacement

1. Remove bottom cover by cutting close to the bottom outside edge (Figs. 6F-14 and 15). Do not remove the fill plug. The depth of the cut must be very shallow to prevent damage to the inner shell of the converter.

2. Remove insulation (Fig. 6F-16).

3. Inspect inner shell of the converter for damage. If there is damage in the inner shell, the converter assembly

must be replaced (Fig. 6F-17).

4. Place new insulation in the replacement cover. Apply sealing compound, all around the cover after the insulation is in position. Apply extra sealer at the front and rear opening for the pipes (Fig. 6F-18).

5. Install replacement cover on converter (Fig. 6F-18).

6. Install cover retaining channels on both sides of the converter (Fig. 6F-19).

7. Attach 2 clamps over retaining channels at each end of the converter (Fig. 6F-20).

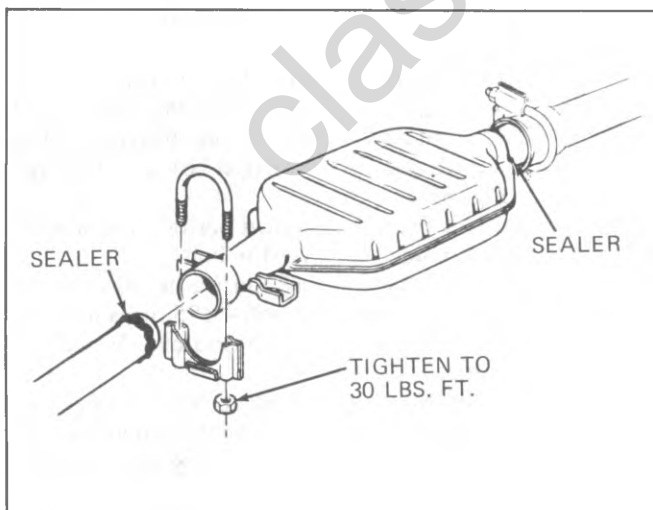


Fig. 6F-2--Catalytic Converter - G Series

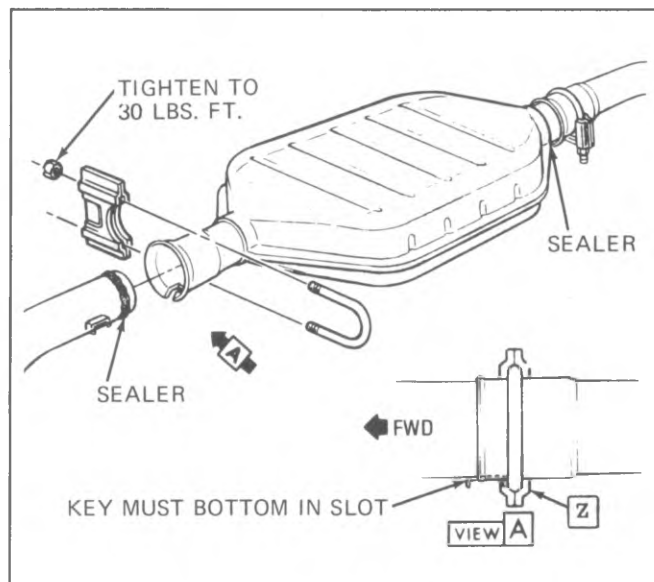


Fig. 6F-3--Catalytic Converter - P Series

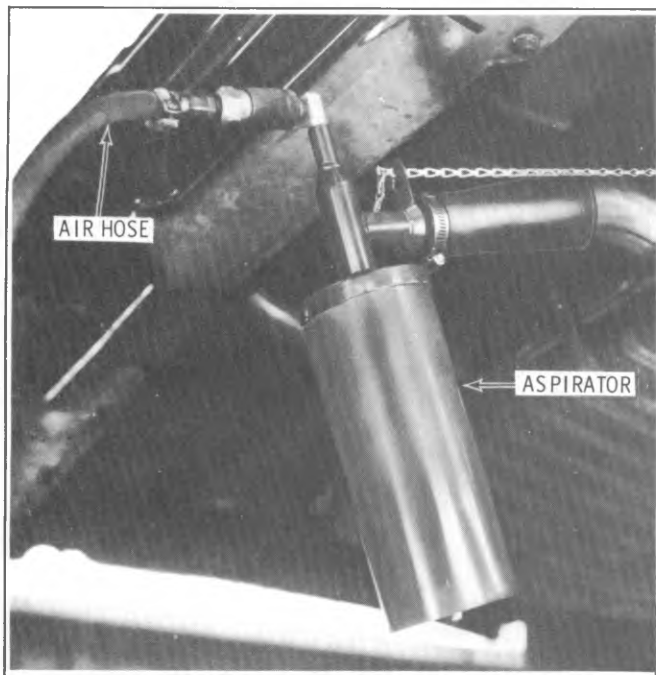


Fig. 6F-4--Installing Aspirator

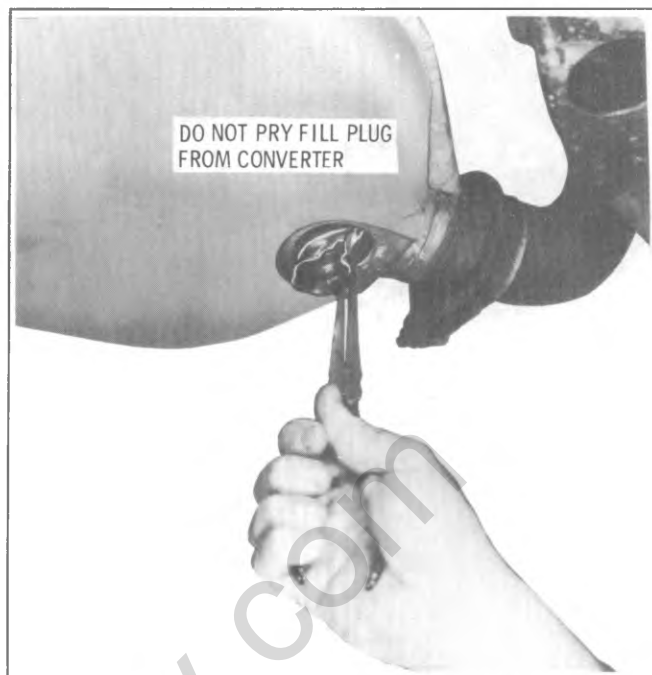


Fig. 6F-6--Removing Pressed Plug With Pliers



Fig. 6F-5--Removing Pressed Plug

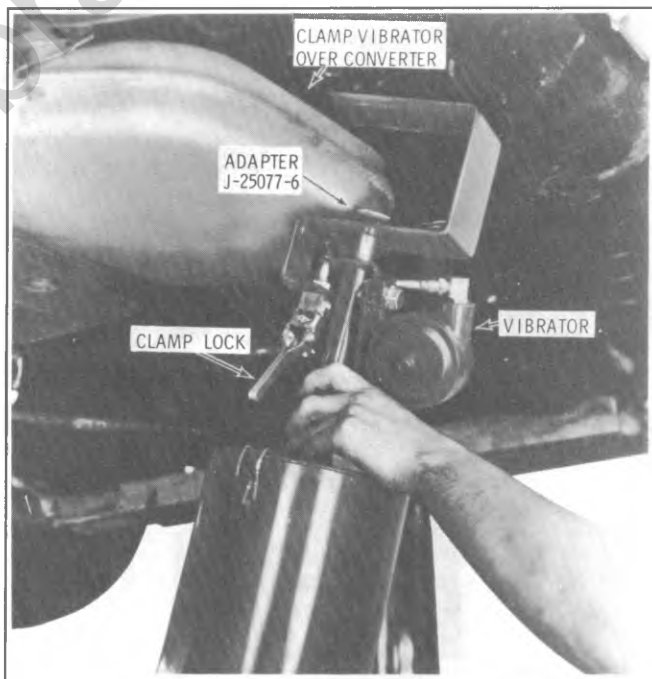


Fig. 6F-7--Installing Vibrator and Adapter

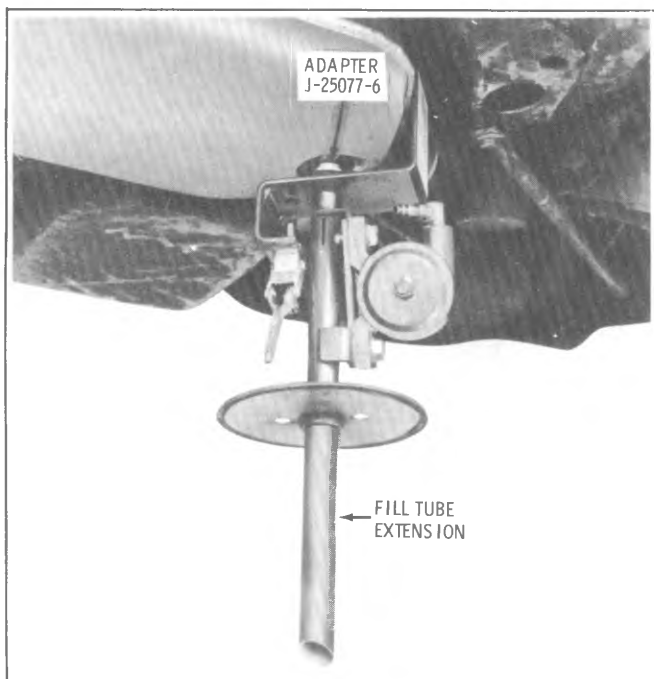


Fig. 6F-8--Installing Fill Tube Extension

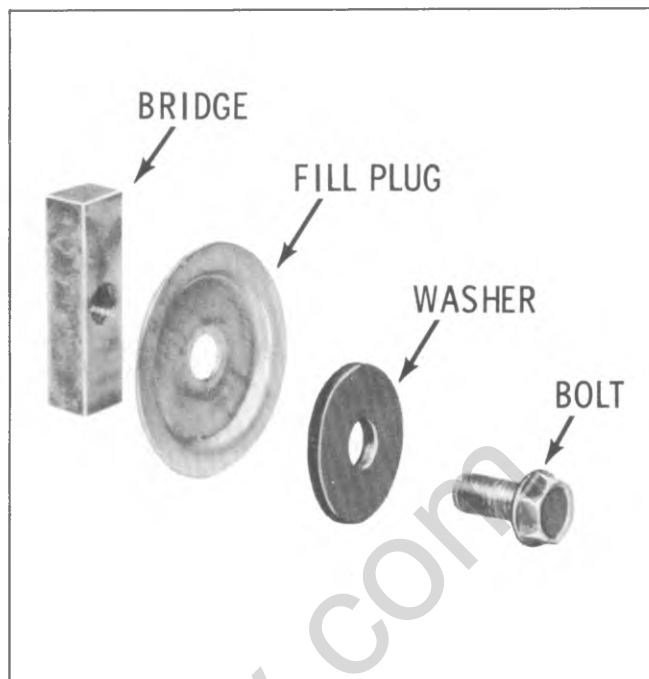


Fig. 6F-10--Service Fill Plug

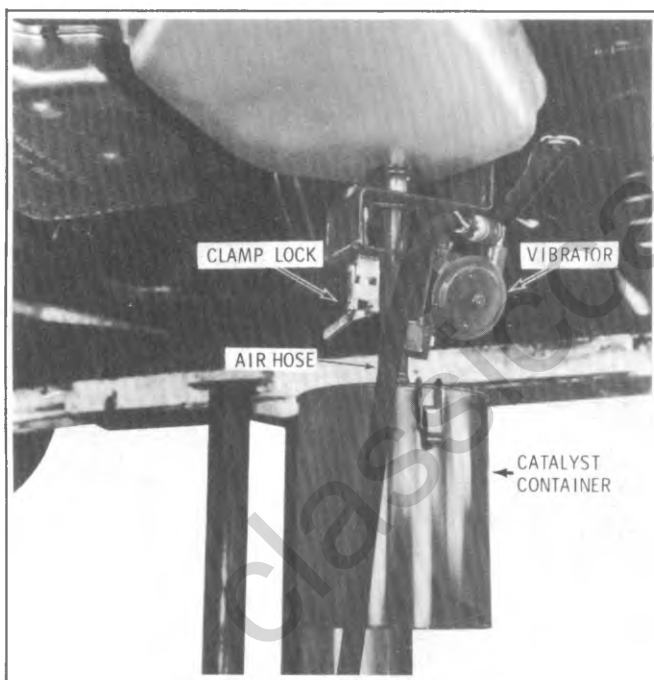


Fig. 6F-9--Installing Catalyst Container

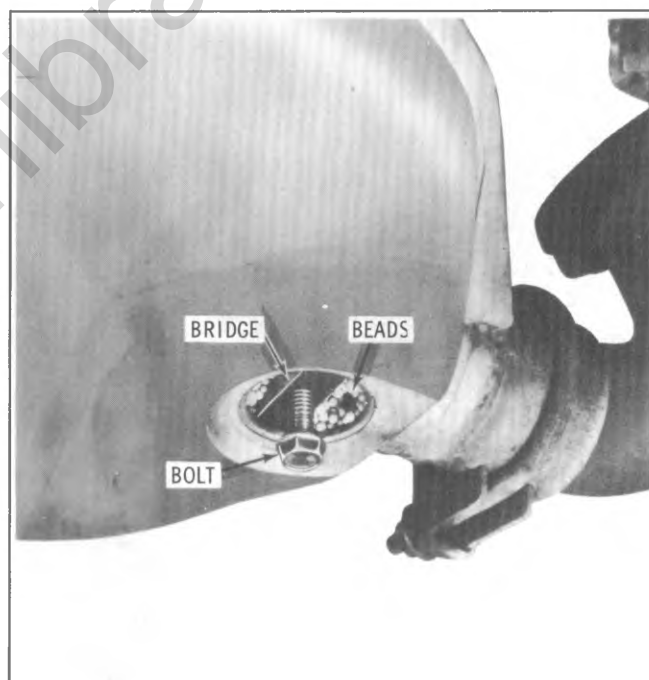


Fig. 6F-11--Positioning Fill Plug Bridge

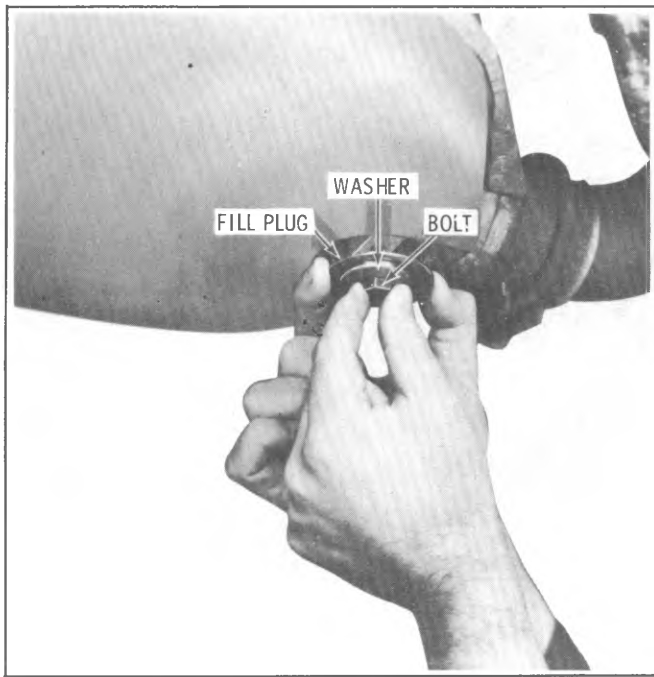


Fig. 6F-12--Installing Fill Plug

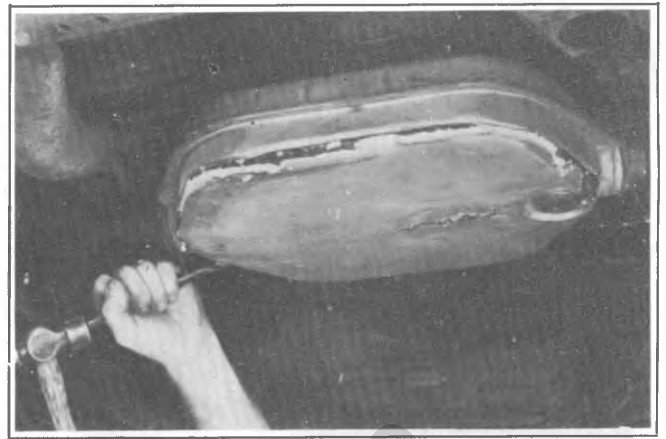


Fig. 6F-14--Removing Bottom Cover

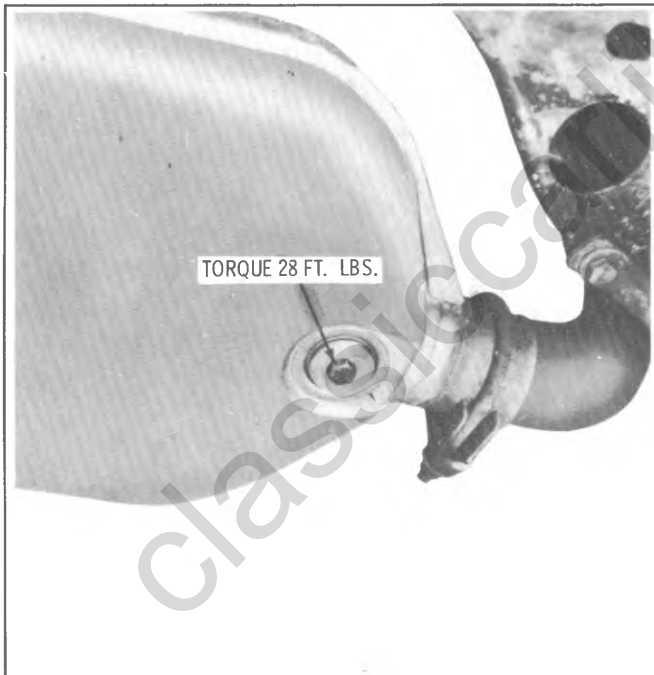


Fig. 6F-13--Fill Plug - Installed View

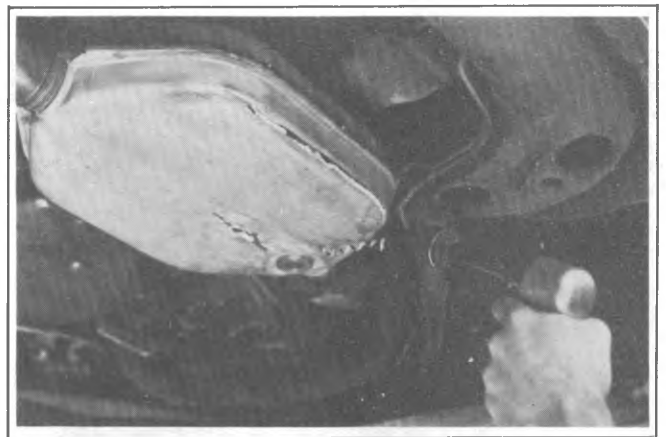


Fig. 6F-15--Removing Bottom Cover

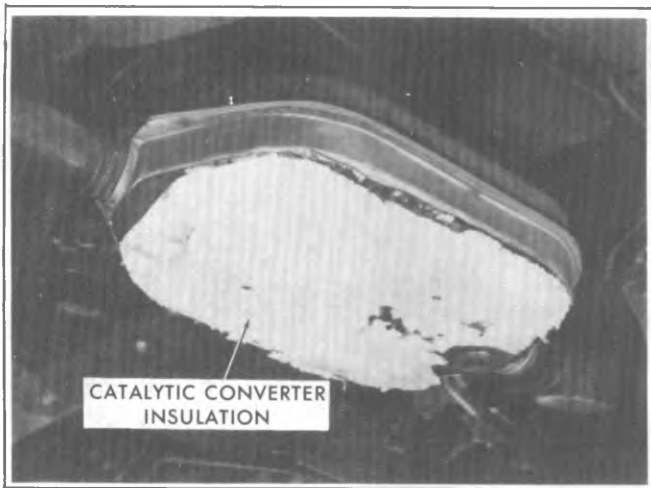


Fig. 6F-16--Catalytic Converter Insulation

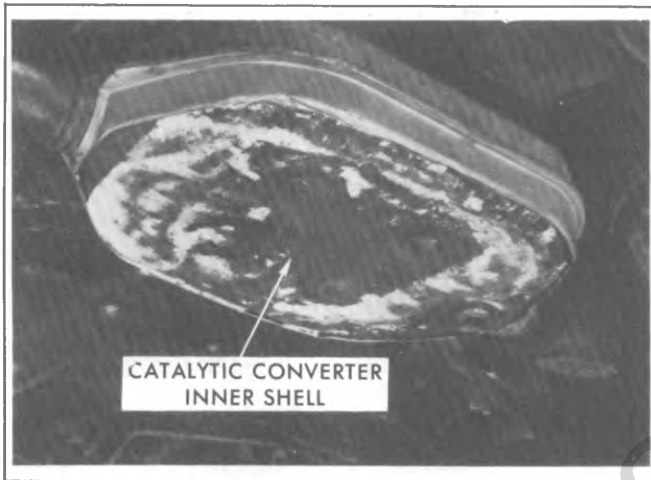


Fig. 6F-17--Catalytic Converter Inner Shell

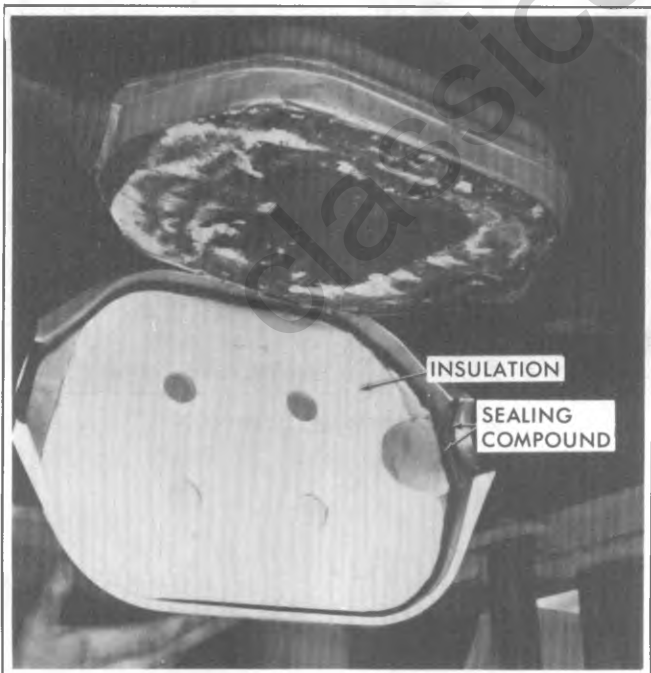


Fig. 6F-18--Installing Bottom Cover Replacement

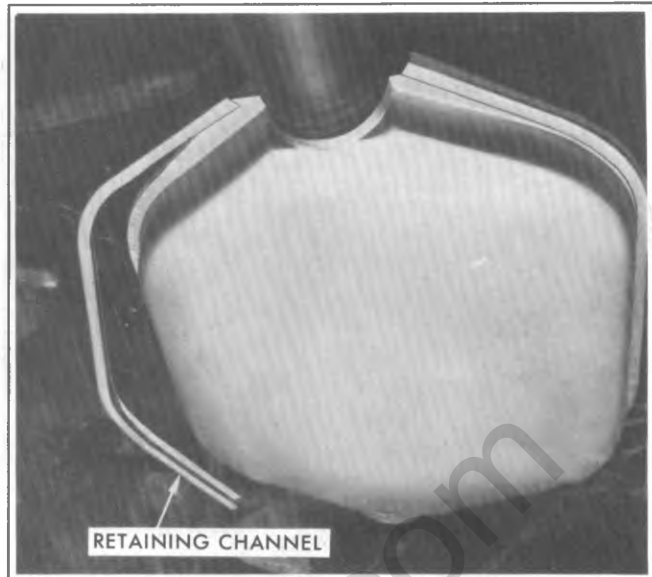


Fig. 6F-19--Installing Bottom Cover Retaining Channels

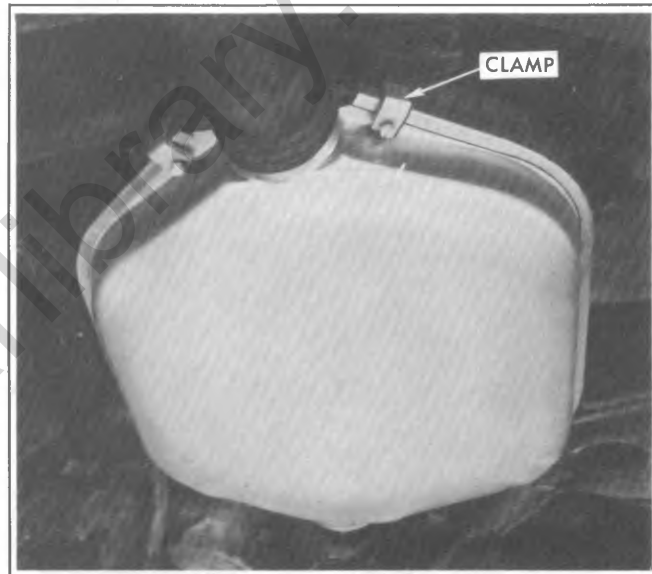


Fig. 6F-20--Installing Bottom Cover Clamps

SPECIAL TOOLS



Fig. 6F-21--Special Tools

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SECTION 7A

AUTOMATIC TRANSMISSION

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CBC 350 TRANSMISSION

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GENERAL DESCRIPTION

The CBC 350 transmission is a fully automatic unit consisting primarily of a 3-element hydraulic torque converter and two planetary gear sets. Four multiple-disc clutches, two roller clutches, and an intermediate overrun band provide the friction elements required to obtain the desired function of the two planetary gear sets.

The 3-element torque converter consists of a pump, turbine and a stator assembly. The stator is mounted on a one way roller clutch which will allow the stator to turn clockwise, but not counterclockwise. References to clockwise and counterclockwise are determined by looking toward rear of vehicle.

The torque converter is of welded construction and is serviced as a complete assembly. The unit is filled with oil and is attached to the engine crankshaft by a flywheel, thus always rotates at engine speed. The converter pump is an integral part of the converter housing, therefore, the pump blades, rotating at engine speed, set the oil within the converter into motion and direct it to the turbine, causing the turbine to rotate.

As the oil passes throughout the turbine it is traveling in such a direction that if it were not redirected by the stator it would hit the rear of the converter pump blades and

impede its pumping action. So at low turbine speeds, oil is redirected by the stator to the converter pump in such a manner that it actually assists the converter pump to deliver power, or multiply engine torque.

As turbine speed increases, the direction of oil leaving the turbine changes and flows against the rear side of the stator vanes in a clockwise direction. Since the stator is now impeding the smooth flow of oil, its roller clutch releases and it revolves freely on its shaft. Once the stator becomes inactive, there is no further multiplication of engine torque within the converter.

At this point, the converter is merely acting as a fluid coupling as both the converter pump and turbine are being driven at approximately the same speed.

A hydraulic system pressurized by a gear type pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to the transmission are:

- Manual Linkage - To select the desired operating range.

- Engine Vacuum - To operate the vacuum modulator.

- Cable Control - To operate the detent valve.

A vacuum modulator is used to automatically sense

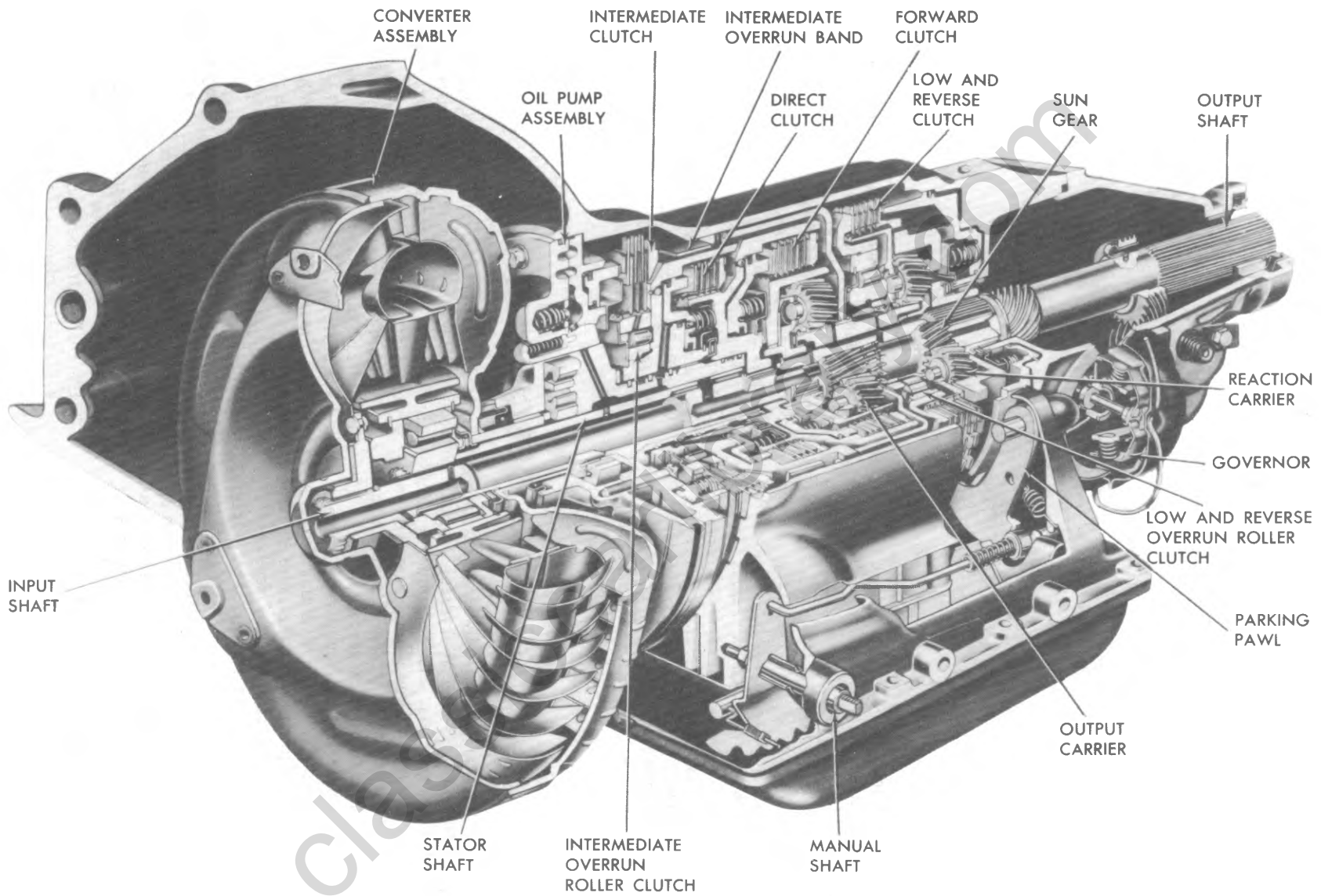


Fig. 7A-1-CBC 350, Cross-Section View

any change in the torque input to the transmission. The vacuum modulator transmits this signal to the pressure regulator, which controls line pressure, so that all torque requirements of the transmission are met and smooth shifts are obtained at all throttle openings.

The detent valve is activated by a cable that is connected to the accelerator lever assembly. When the

throttle is half open, the valve is actuated causing throttle downshift at speeds below 50 mph, (80 km/h). When the throttle is fully open the detent valve is actuated causing the transmission to downshift from 3-1 at speeds below 40 mph (65 km/h) and 3-2 below 75 mph (120 km/h).

MAINTENANCE AND ADJUSTMENTS

TRANSMISSION FLUID

Fluid Level and Capacity

The fluid level indicator is located in filler tube at right rear of engine. To bring the fluid level from the ADD mark to the FULL mark requires one pint of fluid. Fluid level should be checked at every engine oil change.

Fluid level should be to the FULL mark with the transmission fluid at normal operating temperature of 200°F (93°C). With warm fluid at room temperature of 70°F (21°C), the level will be 1/4 inch below the ADD mark on the dipstick. The normal operating temperature is obtained only after at least 15 miles of highway type driving or the equivalent of city driving.

Approximately 3 litres (6 pints) of fluid are required to refill the transmission after the oil pan has been drained. The fluid capacity of the CBC 350 transmission and converter assembly is approximately 10 litres (20 pints) but **correct level is determined by the mark on the dipstick rather than by amount added.** Use only DEXRON® or DEXRON® II automatic transmission fluid or its equivalent.

NOTE: An early change to a darker color from the usual red color and/or a strong odor that is usually associated with overheated transmission fluid is normal, and is not a positive sign of required maintenance or transmission failure.

Checking Procedure and Adding Fluid

To determine proper fluid level at normal operating temperature, proceed as follows:

1. Position vehicle on a level surface, place selector lever in park (P), apply parking brake and have engine

running at normal idle.

2. Remove fluid level indicator, wipe it clean and reinstall fully until cap seats.

3. Remove indicator and reading of fluid level should be at full "F" mark.

4. If additional fluid is required, add DEXRON® or DEXRON® II automatic transmission fluid or its equivalent to "F" mark on indicator.

If the vehicle cannot be driven sufficiently to bring the transmission to operating temperature and it becomes necessary to check the fluid level, the transmission may be checked at room temperature of 70°F (21°C) as follows:

1. Position selector lever in park (P), apply parking brake and start engine. **DO NOT RACE ENGINE.** Move selector lever through each range.

2. Immediately check fluid level with selector lever in Park, engine running and vehicle on LEVEL surface.

Fluid level on indicator should be 1/4 inch below the "ADD" mark.

3. If additional fluid is required, add enough fluid to bring level to 1/4" below the ADD mark on the dipstick. If transmission fluid level is correctly established at 70°F, (21°C), it will appear at the FULL mark on the dipstick when the transmission reaches its normal operating temperature of 200°F, (93°C).

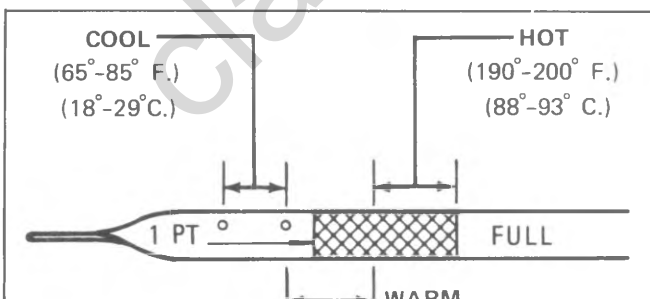
CAUTION: *DO NOT OVERFILL, as foaming and loss of fluid through the vent pipe might occur as fluid heats up.*

If fluid is too low, especially when cold, complete loss of drive may result which can cause transmission failure.

Draining and Refilling Transmission Oil Pan

The oil pan should be drained and the strainer cleaned at the intervals detailed in section O-B of this manual, and fresh fluid added to obtain the proper level on indicator. Section O-B also details intervals for vehicles subjected to heavy city traffic during hot weather, or in commercial use, or when the engine is regularly idled for prolonged periods or when vehicle is used for towing.

Drain fluid immediately after operation before it has had an opportunity to cool.



NOTE: DO NOT OVERFILL. IT TAKES ONLY ONE PINT TO RAISE LEVEL FROM ADD TO FULL WITH A HOT TRANSMISSION.

Fig. 7A-2--Dipstick

WARNING: Transmission fluid temperature can exceed 350°F, (177°C).

1. Raise vehicle.
2. Support transmission with suitable jack at the transmission.
3. With fluid receptacle placed under transmission oil pan, remove oil pan attaching bolts from front and side of pan.

7A-4 AUTOMATIC TRANSMISSION

4. Loosen rear pan attaching bolts approximately four (4) turns.

5. Carefully pry transmission oil pan loose with screwdriver, allowing fluid to drain.

6. Remove remaining screws and remove oil pan and gasket. Discard gasket.

7. Drain fluid from oil pan. Clean pan with solvent and dry thoroughly with clean compressed air.

8. Remove two (2) strainer-to-valve body screws, strainer and gasket. Discard gasket.

9. Thoroughly clean strainer assembly in solvent and dry throughly with clean compressed air.

10. Install new strainer-to-valve body gasket, strainer and two (2) screws.

11. Install new gasket on oil pan and install oil pan. Tighten its thirteen (13) attaching bolt and washer assemblies to 12 pound-feet torque.

12. Lower vehicle. Add approximately 3 litres (6 pints) of DEXRON® or DEXRON®II automatic transmission fluid or its equivalent through filler tube.

13. With selector lever in PARK position, apply hand brake, start engine and let idle (carburetor off fast idle step). **DO NOT RACE ENGINE.**

14. Move selector lever through each range and, with selector lever in PARK range, check the fluid level.

15. Add additional fluid to bring level to 1/4" below the ADD mark on the dipstick.

CAUTION: Do not overfill. Foaming can result if overfilled.

Adding Fluid to Fill Dry Transmission and Converter Assembly

In cases of transmission overhaul, when a complete fill of approximately 10 litres (20 pints) is required, proceed as follows:

1. Add a sufficient quantity of transmission fluid through filler tube to raise the level to the lower portion of the dipstick.

2. With manual control lever in park (P) position, start engine and place on cold idle cam. **DO NOT RACE ENGINE.** Move manual control lever through each range.

3. Immediately check fluid level with selector lever in park (P), engine running and vehicle on LEVEL surface and add additional fluid to bring level to 1/4" below the "ADD" mark on the dipstick. Do not overfill.

CHECKING TRANSMISSION MOUNT

Raise vehicle on a hoist. Push up and pull down on transmission tailshaft while observing transmission mount. If rubber separates from metal plate of mount or if tailshaft moves up but not down (mount bottomed out) replace mount. If there is relative movement between a metal plate of mount and its attaching point, tighten screws or nuts attaching mount to transmission or crossmember.

SHIFT CONTROLS

Column Shift Linkage - CK and P Series

(Figs. 7A-3 and 7A-4)

1. The shift tube and lever assembly must be free in the mast jacket. See Section 3B for alignment of steering column assembly if necessary.

2. To check for proper shift linkage adjustment, lift the transmission selector lever towards the steering wheel.

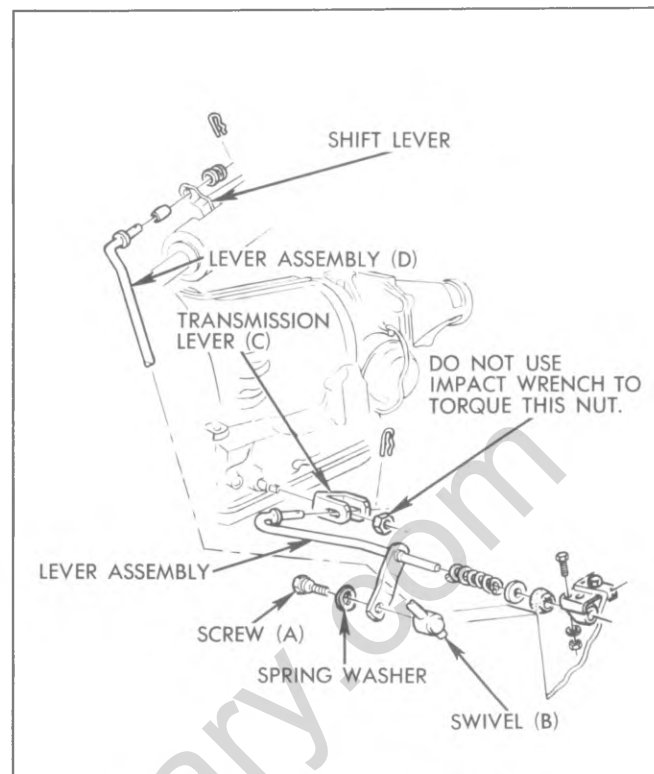


Fig. 7A-3—Column Shift Linkage - CK Series

Allow the selector lever to be positioned in drive (D) by the transmission detent.

NOTE: Do not use the indicator pointer as a reference to position the selector lever. When performing linkage adjustment, pointer is adjusted last.

3. Release the selector lever. The lever should be inhibited from engaging low range unless the lever is lifted.

4. Lift the selector lever towards the steering wheel, and allow the lever to be positioned in neutral (N) by the

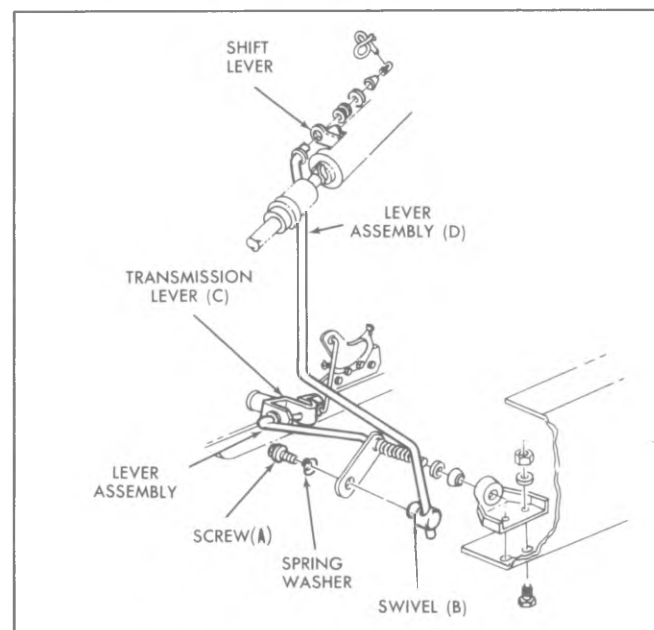


Fig. 7A-4—Column Shift Linkage-P Series

transmission detent.

5. Release the selector lever. The lever should now be inhibited from engaging reverse range unless the lever is lifted.

6. A properly adjusted linkage will prevent the selector lever from moving beyond both the neutral detent, and the drive detent unless the lever is lifted to pass over the mechanical stop in the steering column.

7. If adjustment is required, remove screw (A) and spring washer from swivel (B).

8. Set transmission lever (C) in Neutral position by moving lever counterclockwise to L1 detent and then clockwise three (3) detent positions to Neutral.

9. Position transmission selector lever in Neutral position as determined by the mechanical stop in steering column assembly.

NOTE: Do not use the indicator pointer as a reference to position the selector lever. When performing linkage adjustment, pointer is adjusted last.

10. Assemble swivel, spring washer and screw to lever assembly (D) and tighten screw to 20 pound feet.

11. Readjust indicator needle if necessary to agree with the transmission detent positions. See Section 9.

12. Readjust neutral start switch if necessary to provide the correct relationship to the transmission detent positions. See Section 8.

13. Check operation (CK Series):

a. With key in "Run" position and transmission in "Reverse" be sure that key cannot be removed and that steering wheel is not locked.

b. With key in "Lock" position and shift lever in "Park", be sure that key can be removed, that steering wheel is locked, and that transmission remains in "Park" when steering column is locked.

CAUTION: Any inaccuracies in the above adjustments may result in premature failure of the transmission due to operation without controls in full detent. Such operation results in reduced oil pressure and in turn partial engagement of the affected clutches. Partial engagement of the clutches with sufficient pressure to cause apparent normal operation of the vehicle will result in failure of the clutches or other internal parts after only a few miles of operation.

Column Shift Linkage - G Series

(Fig. 7A-5)

1. The shift tube and lever assembly must be free in the mast jacket.

2. Set transmission lever (C) in "neutral" position by one of the following optional methods.

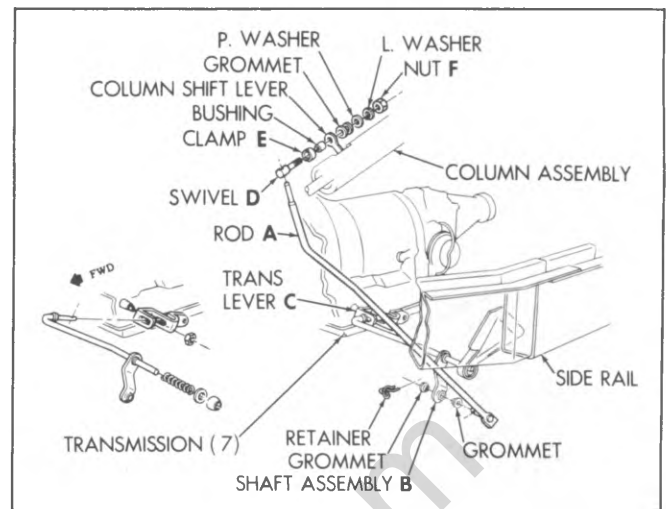


Fig. 7A-5--Column Shift Linkage-G Series

NOTE: Obtain "neutral" position by moving transmission lever (C) counter-clockwise to "L1" detent, then clockwise three detent positions to "neutral" or obtain "neutral" position by moving transmission lever (C) clockwise to the "park" detent then counter-clockwise two detents to "neutral".

3. Set the column shift lever in "neutral" position. This is obtained by rotating shift lever until it locks into mechanical stop in the column assembly.

NOTE: Do not use indicator pointer as a reference to position the shift lever.

4. Attach rod (A) to shaft assembly (B) as shown (Fig. 7A-5).

5. Slide swivel (D) and clamp (E) onto rod (A) align the column shift lever and loosely attach as shown.

6. Hold column lever against "neutral" stop "park" position side.

7. Tighten nut (F) to 18 foot pounds.

8. Readjust indicator needle if necessary to agree with the transmission detent positions.

9. Readjust neutral start switch if necessary to provide the correct relationship to the transmission detent positions.

CAUTION: Any inaccuracies in the above adjustments may result in premature failure of the transmission due to operation without controls in full detent. Such operation results in reduced oil pressure and in turn partial engagement of the affected clutches. Partial engagement of the clutches with sufficient pressure to cause apparent normal operation of the vehicle will result in failure of the clutches or other internal parts after only a few miles of operation.

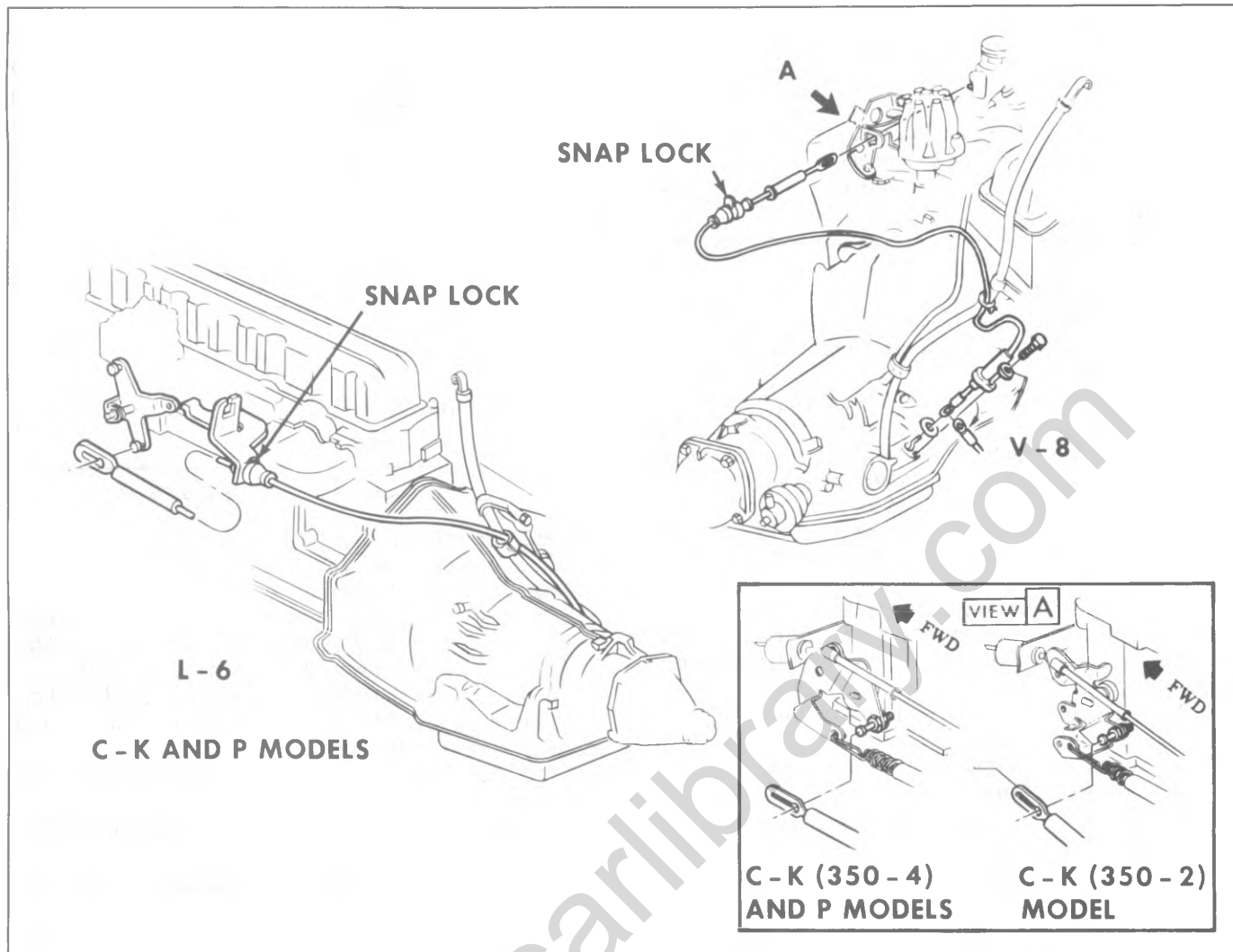


Fig. 7A-6--Detent Downshift Cable - C, K and P Series

DETENT DOWNSHIFT CABLE

(Figs. 7A-6 and 7A-7)

Removal

1. Push up on bottom of snap-lock and release lock and detent downshift cable.
2. Disconnect cable from carburetor lever.
3. Compress locking tabs and disconnect snap-lock assembly from bracket.
4. Remove clamp around filler tube, remove screw and washer securing cable to transmission and disconnect detent downshift cable.

Installation

1. Install new seal on detent downshift cable. Lubricate seal with transmission fluid.
2. Connect transmission end of detent downshift cable and secure to transmission case with bolt and washer tightened to 75 inch pounds.

3. Route cable in front of filler tube and install clamp around filler tube, modulator pipe and detent downshift cable. Locate clamp approximately 2 inches above filler tube bracket.

4. Pass cable through bracket and engage locking tabs of snap-lock on bracket.

5. Connect cable to carburetor lever.

Adjustment

With snap-lock disengaged, position carburetor to wide open throttle (W.O.T.) position and push snap-lock downward until top is flush with rest of cable.

NEUTRAL START SWITCH

The adjustment of the neutral start switch is described in Section 8, Electrical.

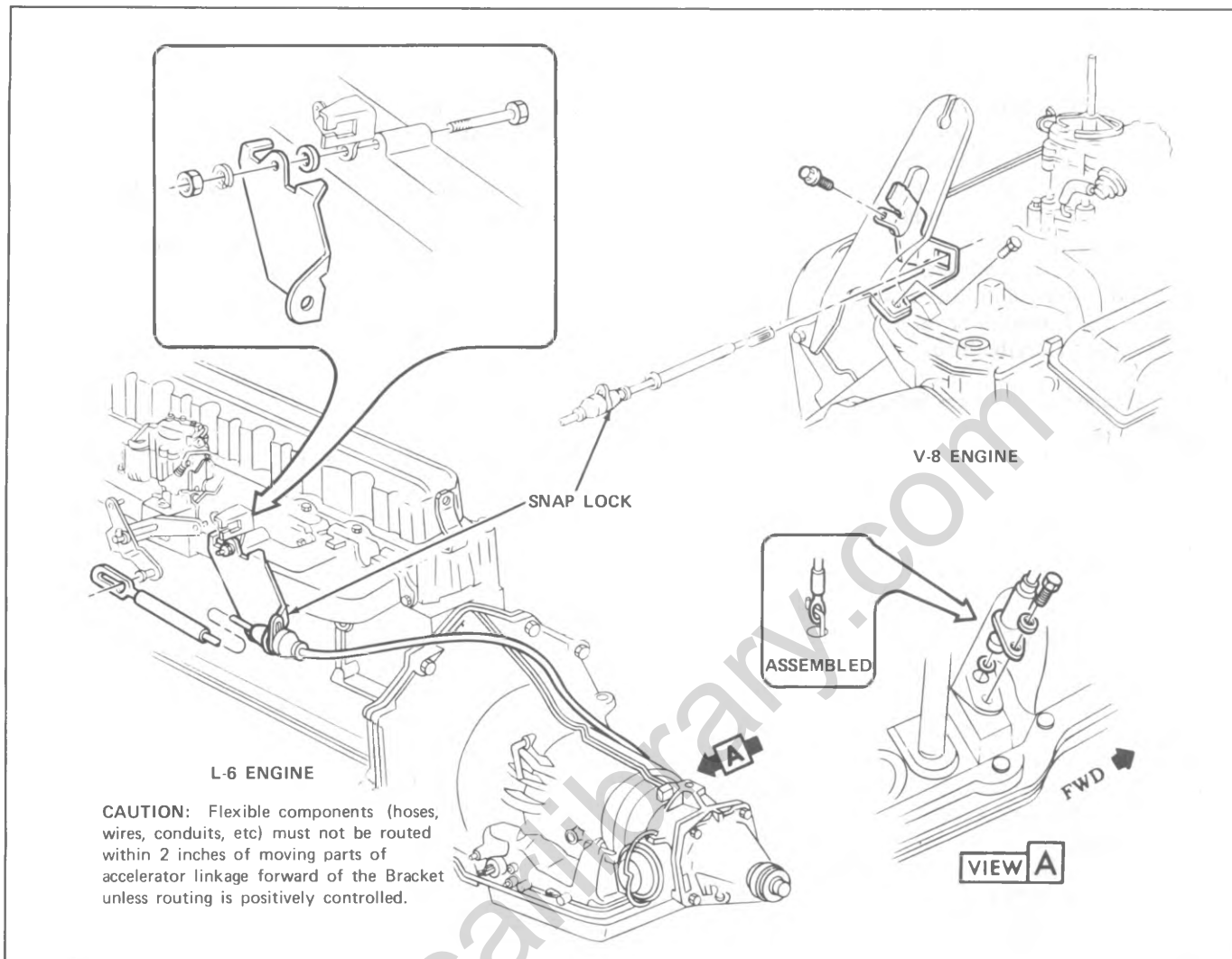


Fig. 7A-7--Detent Downshift Cable - G Series

DIAGNOSIS

SEQUENCE FOR DIAGNOSIS

1. Check and correct fluid level.
2. Check detent cable adjustment.
3. Check and correct vacuum line and fittings.
4. Check and correct manual linkage.
5. Road test vehicle.
 - a. Install oil pressure gage.
 - b. Road test using all selective ranges, noting when discrepancies in operation or oil pressure occur.
 - c. Attempt to isolate the unit or circuit involved in the malfunction.
 - d. If engine performances indicates an engine tune-up is required, this should be performed before road testing is completed or transmission correction attempted. Poor engine performance can result in rough shifting or other malfunctions.

FLUID CHECKING PROCEDURES

Refer to Maintenance and Adjustment Section for fluid checking procedures.

FLUID LEAK DIAGNOSIS

Determining Source of Leak

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases, the source of the leak can be deceiving due to "wind flow" around the engine and transmission.

The suspected area should be wiped clean of all oil before inspecting for the source of the leak.

The use of a "Black Light" to locate the point at which the oil is leaking is helpful. Comparing the oil from the leak to that on the engine or transmission dipstick, when viewed by black light, will determine the source of the leak - engine or transmission.

Oil leaks around the engine and transmission are generally carried toward the rear of the vehicle by air stream. For example, a transmission oil filler tube to case leak will sometimes appear as a leak at the rear of the transmission. In determining the source of a leak, proceed as follows:

1. Degrease underside of transmission.
2. Road test to get unit at operating temperature.
3. Inspect for leak with engine running.
4. With engine off, check for oil leaks due to the raised oil level caused by drain back.

Possible Points of Oil Leak

1. Transmission Oil Pan Leak.
 - a. Attaching bolts not correctly torqued.
 - b. Improperly installed or damaged pan gasket.
 - c. Oil pan gasket mounting face not flat.
2. Extension Housing.
 - a. Attaching bolts not correctly torqued.
 - b. Rear seal assembly damaged or improperly installed.
 - c. Square seal, extension to case, damaged or improperly installed.
 - d. Porous casting. See subparagraph C.
3. Case Leak.
 - a. Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine.
 - b. Modulator assembly "O" ring seal damaged or

improperly installed.

- c. Detent cable connector "O" ring seal damaged or improperly installed.
 - d. Governor cover not tight, gasket damaged or leak between case face and gasket.
 - e. Speedometer gear "O" ring damaged.
 - f. Manual shaft seal damaged or improperly installed.
 - g. Line pressure tap plug loose.
 - h. Vent pipe (refer to item 5).
 - i. Porous casting. See Subparagraph C.
4. Leak at Front of Transmission.
 - a. Front pump seal leaks.
 1. Seal lip cut. Check converter hub, etc.
 2. Bushing moved and damaged, Oil return hole plugged.
 3. No oil return hole.
 - b. Front pump attaching bolts loose or bolt washer type seals damaged or missing.
 - c. Front pump housing "O" ring damaged or cut.
 - d. Converter leak in weld area.
 - e. Porous casting (pump).
 5. Oil Comes Out Vent Pipe.
 - a. Transmission over-filled.
 - b. Water in oil.
 - c. Foreign material between pump and case or between pump cover and body.
 - d. Case - porous near converter bosses. Front pump cover or housing oil channels shy or stock near breather. See Subparagraph C.
 - e. Pump to case gasket mis-positioned.

FLUID PRESSURE CHECK

While vehicle is stationary (service brake on), engine speed set to 1200 rpm, transmission oil pressure gage attached as shown in Fig. 7A-10B, and vacuum modulator tube **disconnected**, the transmission line pressure tap should read 167 psi in drive, 166 psi in L1 or L2, and 254 psi in reverse.

While vehicle is stationary (service brake on), engine speed set to maintain 12 inches hg. absolute manifold pressure, transmission oil pressure gage attached, and vacuum modulator tube **connected**, the transmission line pressure tap should read 85 psi in drive, 105 psi in L1 or L2, and 129 psi in reverse.

CASE POROSITY REPAIR

External oil leaks caused by case porosity can be successfully repaired with the transmission in the vehicle by using the following recommended procedures:

1. Road test and bring the transmission to operating temperature, approximately 180 degrees F.
2. Raise vehicle on a hoist or jack stand, engine running, and locate source of oil leak. Check for oil leaks in Low, Drive, and Reverse.
3. Shut engine off and thoroughly clean area to be repaired with a suitable cleaning solvent and a brush - air dry.

A clean, dry soldering acid brush can be used to clean the area and also to apply the epoxy cement.

4. Using instructions of the manufacturer, mix a sufficient amount of epoxy to make the repair. Make certain

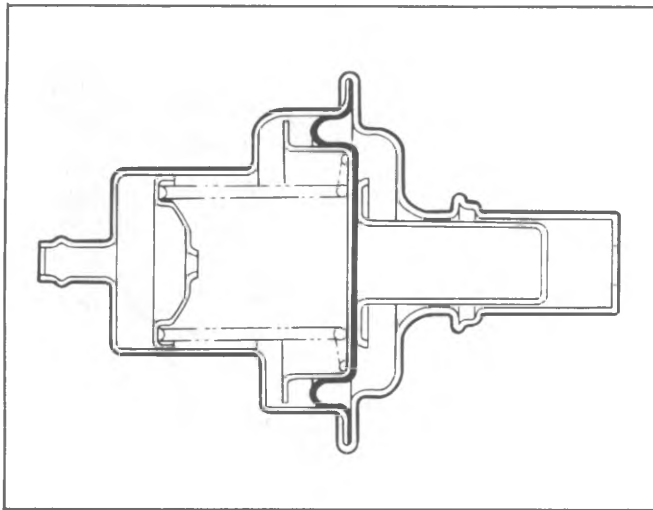


Fig. 7A-8--Vacuum Modulator Assembly

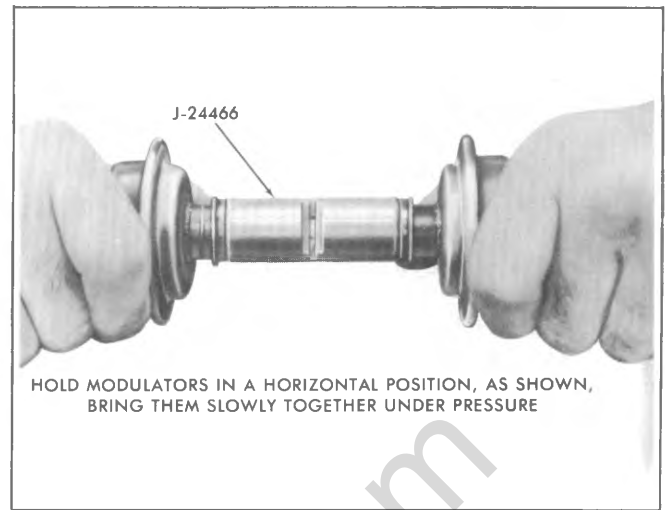


Fig. 7A-9--Spring Tension Comparison

the area to be repaired is fully covered.

5. Allow cement to cure for 3 hours before starting engine.

6. Road test and check for leaks.

VACUUM MODULATOR DIAGNOSIS

A defective vacuum modulator can cause one or more of the following complaints.

1. Harsh upshifts and downshifts.
2. Delayed upshifts.
3. Soft upshifts and downshifts.
4. Slips in low, drive and reverse.
5. Transmission overheating.
6. Engine burning transmission oil.

If any one of the above complaints are encountered, the modulator must be checked.

Vacuum Diaphragm Leak Check

Insert a pipe cleaner into the vacuum connector pipe as far as possible and check for the presence of transmission oil. If oil is found, replace the modulator.

Gasoline or water vapor may settle in the vacuum side of the modulator. If this is found without the presence of oil, the modulator is serviceable and should not be changed.

Atmospheric Leak Check

Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, the crimped upper to lower housing seam (Fig. 7A-8). Using a short piece of rubber tubing, apply air pressure to the vacuum pipe by blowing into the tube and observe for leak bubbles. If bubbles appear, replace the modulator.

NOTE: Do not use any method other than human lung power for applying air pressure, as pressures over 6 psi may damage the modulator.

Spring Tension Comparison Check

Using tool J-24466, as shown in Figure 7A-9, compare the load of a known good modulator with the assembly in question.

- a. Install the modulator that is known to be acceptable on either end of the tool.
- b. Install the modulator in question on the opposite end of the tool.

c. Holding the modulators in a horizontal position, bring them together under pressure until either modulator sleeve just touches the tool. The indicator in the gage will show white if the modulator is acceptable. A non-conforming modulator will cause the indicator to shift, thus showing blue. If white does not appear, the modulator in question should be replaced.

Sleeve Alignment Check

Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the cam. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

Once the modulator assembly passes all of the above tests, it is an acceptable part and may be re-used.

TRANSMISSION CLUTCH PLATES DIAGNOSIS

1. Lined Drive Plates.

a. Dry plates with compressed air and inspect the lined surface for:

1. pitting and flaking
2. wear
3. glazing
4. cracking
5. charring
6. chips or metal particles imbedded in lining.

If a lined drive plate exhibits any of the above conditions, replacement is required. Do not diagnose drive plates by color.

2. Steel Driven Plates

Wipe plates dry and check for heat discoloration. If the surface is smooth and an even color smear is indicated, the plate should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plate must be replaced.

3. Clutch Release Springs

Evidence of extreme heat or burning in the area of the clutch may have caused the springs to take a heat set and would justify replacement of the springs.

CAUSES OF BURNED CLUTCH PLATES

1. FORWARD CLUTCH

- a. Check ball in clutch housing damaged, stuck or missing.
- b. Clutch piston cracked, seals damaged or missing.

- c. Low line pressure.
- d. Pump cover oil seal rings missing, broken or undersize; ring groove oversize.
- e. Case valve body face not flat or porosity between channels.

2. INTERMEDIATE CLUTCH

- a. Intermediate clutch piston seals damaged or missing.
- b. Low line pressure.
- c. Case valve body face not flat or porosity between channels.

3. DIRECT CLUTCH

- a. Restricted orifice in vacuum line to modulator (poor vacuum response).
- b. Check ball in direct clutch piston damaged, stuck or missing.
- c. Defective modulator bellows.
- d. Clutch piston seals damaged or missing.
- e. Case valve body face not flat or porosity between channels.

- f. Clutch installed backwards.

NOTE: Burned clutch plates can be caused by incorrect usage of clutch plates. Also, anti-freeze in transmission fluid can cause severe damage, such as large pieces of composition clutch plate material peeling off.

GOVERNOR PRESSURE CHECK

1. Install line Pressure Gage, to tap location shown in Fig. 7A-10.
2. Disconnect vacuum line to modulator.
3. With car on hoist (rear wheels, off ground), foot off brake, in drive, check line pressure at 1000 RPM.
4. Slowly increase engine RPM to 3000 RPM and determine if a line pressure drop occurs (7 PSI or more).
5. If no pressure drop occurs:
 - a. Inspect Governor
 1. Stuck valve.
 2. Free Weights.
 3. Restricted orifice in governor valve.
 - b. Governor Feed System
 1. Check screen in control valve assembly.
 2. Check for restrictions in feed line.
 3. Scored governor bore.

MANUAL LINKAGE

Manual linkage adjustment and the associated neutral safety switch are important from a safety standpoint. The neutral safety switch should be adjusted so that the engine will start in the Park and Neutral positions only.

With the selector lever in the Park position, the parking pawl should freely engage and prevent the vehicle from rolling. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

ROAD TEST

Drive Range

Position selector lever in DRIVE RANGE and accelerate the vehicle from 0 MPH (0 km/h). A 1-2 and 2-3 shift should occur at all throttle openings. (The shift points will vary with the throttle opening). As the vehicle decreases in speed to 0 MPH (0 km/h), the 3-2 and 2-1 shifts should occur.

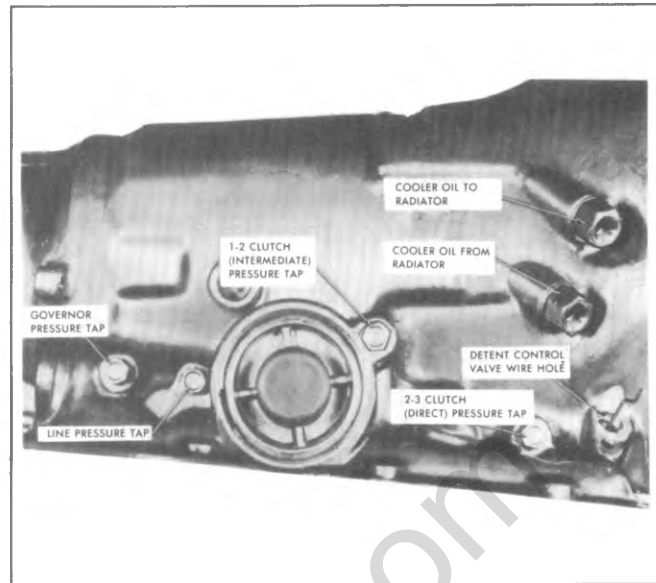


Fig. 7A-10--Pressure Tap Locations

Low L2 Range

Position the selector lever in L2 RANGE and accelerate the vehicle from 0 MPH (0 km/h). A 1-2 shift should occur at all throttle openings. (No. 2-3 shift can be obtained in this range). The 1-2 shift point will vary with throttle opening. As the vehicle decreases in speed to 0 MPH (0 km/h), a 2-1 shift should occur.

The 1-2 shift in INTERMEDIATE RANGE is somewhat firmer than in DRIVE RANGE. This is normal.

Low L1 Range

Position the selector lever in L1 RANGE and accelerate the vehicle from 0 MPH (0 km/h). No upshift should occur in this range.

2ND Gear - Overrun Braking: (L2)

Position the selector lever in DRIVE RANGE, and with the vehicle speed at approximately 35 MPH (60 km/h), move the selector lever to L2 RANGE. The transmission should downshift to 2nd. An increase in engine RPM and an engine braking effect should be noticed. Line pressure should change from approximately 100 PSI to approximately 125 PSI in 2nd.

1ST Gear - Overrun Braking: (L1)

Position the selector lever in L2 RANGE at approximately 30 to 50 MPH (50 to 80 km/h), with throttle closed, move the selector lever to L1. A 2-1 downshift should occur in the speed range of approximately 45 to 30 MPH (70 to 50 km/h), depending on axle ratio and valve body calibration. The 2-1 downshift at closed throttle will be accompanied by increased engine RPM and an engine braking effect should be noticed. Line pressure should be approximately 150 PSI. Stop vehicle.

Reverse Range: (R)

Position the selector lever in REVERSE POSITION and check for reverse operation.

TROUBLE DIAGNOSIS, BY CONDITION

Refer to Fig. 7A-12, Diagnosis Chart, to determine a possible cause of a transmission problem.

Additional diagnosis of a malfunction is as follows:

No Drive in Drive Range

(Install pressure gage)

- Low Oil Level - correct level and check for external leaks or defective vacuum modulator (leaking diaphragm will evacuate oil from unit).

- Manual Linkage - misadjusted, correct alignment to manual lever shift quadrant is essential.

- Low Oil Pressure - refer to LOW LINE PRESSURE below.

- Forward Clutch:

- a. Forward clutch does not apply - piston cracked; seals missing or damaged; clutch plates burned (see BURNED CLUTCH PLATES below).

- b. Pump feed circuit-to-forward clutch oil seal rings missing or broken on pump cover; leak in feed circuits; pump-to-case gasket mispositioned or damaged; clutch drum ball check stuck or missing.

- Low and Reverse Roller Clutch Assembly - broken spring, damaged cage or installed backwards.

High or Low Oil Pressure

(Refer to OIL PRESSURE CHECKS)

High Line Pressure

- Vacuum Leak:

- a. Vacuum line disconnected.

- b. Leak in line from engine to modulator.

- c. Improper engine vacuum.

- d. Leak in vacuum-operated accessory (hoses, vacuum advance, etc.).

- Modulator:

- a. Stuck modulator valve.

- b. Water in modulator.

- c. Damaged, not operating properly.

- Detent System - detent valve or cable stuck in detent position.

- Valve Body:

- a. Pressure regulator and/or boost valve stuck.

- b. Boost valve sleeve broken or defective.

- c. Incorrect pressure regulator valve spring.

- d. 2-3 shift control valve and sleeve installed in pressure regulator bore.

- e. Pressure regulator exhaust hole not drilled or blocked.

Low Line Pressure

- Low transmission oil level.

- Defective vacuum modulator assembly.

- Strainer Assembly:

- a. Blocked or restricted.

- b. Gasket omitted or damaged.

- Oil Pump:

- a. Gear clearance, damaged, worn, gear installed backwards:

- b. Pump-to-case gasket mispositioned.

- c. Defective pump body and/or cover.

- d. Bottom seal ring on pump cover hub omitted or damaged.

- e. Priming valve in pump omitted.

- Valve Body:

- a. Pressure regulator or boost valve stuck.

- b. Pressure regulator valve spring, too weak.

- c. #1 rubber ball omitted.

- d. Loose valve body bolts.

- e. Valve body spacer plate support omitted.

- f. Reverse and modulator booster valve stuck.

- Internal Circuit Leaks:

- a. Forward clutch leak (pressure low in Drive range, pressure normal in Neutral and Reverse).

1. Check pump oil seal rings.

2. Check forward clutch seals.

- b. Direct clutch leak (pressure low in Reverse, pressure normal in other ranges).

1. Check direct clutch outer seal.

2. Check 1-2 accumulator and 2-3 accumulator pistons and rings for damage or missing.

- c. Intermediate servo piston seal ring broken or omitted.

- Case Assembly - check ball missing from cored passage in case face.

No Pressure

- Flashing blocking suction cavity in case.

- Priming valve in pump omitted.

- Front pump drive gear lugs sheared off.

- Vacuum modulator valve omitted.

- Pump to case gasket incorrectly installed.

No Upshift

- Governor valve stuck (chips).

- 1-2 shift control or shift valve stuck.

- Nylon gear of governor assembly mutilated or broken.

- Governor locating pin in case loose.

- 1-2 accumulator piston ring omitted or broken.

- Incorrect intermediate clutch pack.

- Intermediate piston seals omitted or damaged.

- Governor inner weights jammed.

Low Downshifts 3-2 and 2-1 (full detent)

- Detent regulator valve stuck.

- Detent regulator valve spring seat omitted.

- Shift control or shift valves sticking.

- Detent linkage not hooked up.

- Incorrect vacuum setting.

- Defective governor.

- Modulator valve sticking.

High Downshifts 3-2 and 2-1 (full detent)

- Detent regulator valve sticking or stuck.

- Defective governor assembly.

- Shift control and shift valves sticking.

No Drive in Drive Range

- Forward clutch apply holes in pump hub not drilled.

- Clutch apply hole in forward clutch drum not drilled.

- Lip seals of forward clutch piston omitted or damaged.

- Steel relief ball in forward clutch drum omitted or not sealing.

- Incorrect pressure plate (excessive clearance).

- Rear roller clutch slipping or installed backwards.

- Damaged shifter shaft (transmission not in drive range).

- Input ring gear omitted.

- Manual valve incorrectly installed.

No Drive in Reverse Range

- Reverse clutch pack snap ring omitted.
- Direct clutch apply holes in pump hub not drilled.
- Direct clutch apply oil seal rings omitted or broken.
- Reverse apply holes in case not drilled or blocked.
- Incorrect clutch pack.
- Manual valve incorrectly installed.

Low Lube Pressures

- Bushings omitted in front of stator shaft I.D.

1-2 Shift - Full Throttle Only

- Detent Valve - sticking or linkage misadjusted.
- Vacuum Leak - vacuum line or fittings leaking.
- Control Valve Assembly:
 - a. Valve body gaskets - leaking, damaged or incorrectly installed.
 - b. Detent valve train stuck.
 - c. 1-2 valve stuck closed (in downshifted position).
- Case Assembly - refer to case porosity repair.

First Speed Only - No 1-2 Shift

- Detent (downshift) cable - binding.
- Governor Assembly:
 - a. Governor valve sticking.
 - b. Driven gear loose, damaged or worn (check for pin in case and length of pin showing; also, check output shaft drive gear for nicks or rough finish if driven gear shows damage).
- Control Valve Assembly:
 - a. Valve body gaskets - leaking, damaged or incorrectly installed.
 - b. Governor feed channels blocked.
 - c. 1-2 shift valve train stuck closed (in downshifted position).
- Intermediate Clutch:
 - a. Clutch piston seals - missing, improperly installed or cut.
 - b. Intermediate roller clutch - broken spring or damaged cage.
- Case:
 - a. Porosity between channels.
 - b. Governor feed channel blocked; governor bore scored or worn, allowing cross pressure leak.

First and Second Speeds Only - No 2-3 Shift

- Control Valve Assembly:
 - a. Valve body gaskets - leaking, damaged or incorrectly installed.
 - b. 2-3 shift valve train stuck closed (in downshifted position).
- Direct Clutch:
 - a. Pump hub - direct clutch oil seal rings - broken or missing.
 - b. Clutch piston seals - missing, improperly assembled or cut.
 - c. Clutch plates burned (see BURNED CLUTCH PLATES below).

No First Speed - Starts in Second Speed

(Locks up in L1 Range)

Intermediate Clutch:

1. Too many plates in intermediate clutch pack.
2. Incorrect intermediate clutch piston.

Drive in Neutral

- Manual Linkage - misadjusted, (correct alignment in manual lever shift quadrant is essential).
- Internal Linkage - manual valve disconnected or end broken.
- Oil Pump - line pressure leaking into forward clutch apply passage.
- Forward Clutch - incorrect clutch plate usage or burned clutches (see BURNED CLUTCH PLATES below).

No Motion in Reverse or Slips in Reverse

(Install pressure gage)

- Low Oil Level - add oil.
- Manual Linkage - misadjusted (correct alignment in manual lever shift quadrant is essential).
- Low Oil Pressure - refer to LOW LINE PRESSURE above.
- Control Valve Assembly:
 - a. Valve body gaskets - leaking, damaged or incorrectly installed.
 - b. 2-3 shift valve train stuck open (in upshifted position).
- Intermediate Servo - piston or pin stuck so intermediate overrun band is applied.
- Low and Reverse Clutch - piston outer seal damaged or missing.
- Direct Clutch:
 - a. Outer seal damaged or missing.
 - b. Clutch plates burned (see BURNED CLUTCH PLATES below).
- Forward Clutch - clutch does not release (will cause DRIVE in NEUTRAL).

Slips in All Ranges or Slips on Start

(Install pressure gage)

- Low Oil Level - add oil.
- Low Oil Pressure - refer to LOW LINE PRESSURE above.
- Forward clutch:
 - a. Clutch plates burned (see BURNED CLUTCH PLATES below).
 - b. Pump cover oil seal rings broken or worn.
- Case - cross leaks or porosity.

Slipping 1-2 Shift

(Install pressure gage)

- Low Oil Level - add oil.
- Low Oil Pressure - refer to LOW LINE PRESSURE above.
- 2-3 Accumulator - oil ring damaged or missing.
- 1-2 Accumulator - oil ring damaged, missing or case bore damaged.
- Pump-to-Case Gasket - mispositioned or damaged.
- Intermediate Clutch:
 - a. Piston seals damaged or missing.
 - b. Clutch plates burned (See BURNED CLUTCH PLATES below).

- Case - porosity between channels.

Slipping 2-3 Shift

(Install pressure gage)

- Low Oil Level - add oil.
- Low Oil Pressure - refer to LOW LINE PRESSURE above.

● Direct Clutch:

a. Piston seals leaks, damaged or missing.

b. Clutch plates burned (see BURNED CLUTCH PLATES below).

c. Inspect for proper number and type of clutch plates.

- Case - refer to case porosity repair.

Rough 1-2 Shift

(Install pressure gage)

● High Oil Pressure - refer to HIGH LINE PRESSURE above.

● 1-2 Accumulator:

a. Oil rings damaged.

b. Piston stuck.

c. Broken or missing spring.

d. Bore damaged.

● Intermediate Clutch - check for burned and number (type) of plates.

● Case:

a. Check for correct number and location of check balls.

b. Porosity between channels.

Rough 2-3 Shift

(Install pressure gage)

● High Oil Pressure - refer to HIGH LINE PRESSURE above.

● 2-3 Accumulator:

a. Oil ring damaged.

b. Piston stuck.

c. Broken or missing spring.

d. Piston bore damaged.

No Engine Braking in L2

(Install pressure gage)

● Low Oil Pressure - pressure regulator and/or boost valve stuck.

● Intermediate Servo and 2-3 Accumulator:

a. Servo or accumulator oil rings or bores leaking or damaged.

b. Servo piston stuck or cocked.

● Intermediate Overrun Band - intermediate overrun band broken or burned (look for cause), not engaged or servo pin.

No Engine Braking in L1

(Install pressure gage)

● Low Oil Pressure - pressure regulator and/or boost valves stuck.

● Manual Low Control Valve Assembly - stuck.

● Low and Reverse Clutch - piston inner seal damaged or missing.

No Part Throttle Downshift

(Install pressure gage)

● Oil Pressure - vacuum modulator assembly, modulator valve or pressure regulator valve train (other malfunctions may also be noticed).

● Detent Valve and Linkage - sticks, disconnected or broken.

- 2-3 shift valve - stuck.

No Detent (Wide Open Throttle)

Downshift

● Detent cable or retainer not adjusted properly.

● Detent cable disconnected at transmission or throttle linkage.

● Valve Body:

a. Detent valve sticks.

b. Detent regulator valve sticks.

c. Incorrect spacer plate or gasket.

High or Low Shift Points

(Install pressure gage)

● Oil Pressure:

a. Engine Vacuum - check at transmission end of modulator pipe.

b. Check vacuum line connections at engine and transmission.

c. Vacuum modulator assembly and valve and pressure regulator valve train.

● Governor:

a. Valve sticking.

b. Feed holes restricted or leaking.

● Detent Valve and Linkage - stuck open (will cause high shift points).

● Control Valve Assembly:

a. 1-2 shift valve train sticking.

b. 2-3 shift valve train sticking.

● Case - refer to case porosity repair.

Won't Hold in Park

● Manual Linkage - misadjusted (correct alignment in manual lever shift quadrant is essential).

● Internal Linkage:

a. Inner lever and actuating rod assembly - defective or improperly installed.

b. Parking pawl - broken or inoperative.

c. Parking lock bracket loose, burred or rough edges or incorrectly installed.

d. Parking pawl disengaging spring missing, broken or incorrectly hooked.

Transmission Noisy

CAUTION: Before checking transmission for noise, make certain that the noise is not coming from the water pump, alternator, power steering, etc. These components can be isolated by removing the proper belt and running the engine not more than two minutes at one time.

Park, Neutral and all Driving Ranges

● Pump Cavitation:

a. Low oil level.

b. Plugged or restricted strainer.

c. Strainer-to-valve body gasket damaged.

d. Porosity in valve body intake area.

e. Water in oil.

f. Porosity or voids at transmission case (pump face) intake port.

g. Pump-to-case gasket off location.

● Pump Assembly:

	INTERMEDIATE CLUTCH	INTER. OVERRUN ROLLER CLUTCH	INTERMEDIATE BAND	DIRECT CLUTCH	FORWARD CLUTCH	LOW/REV. CLUTCH	LOW AND ROLLER CLUTCH
NEUTRAL	OFF	Ineffective	OFF	OFF	OFF	OFF	Ineffective
DRIVE, First Gear	OFF	Ineffective	OFF	OFF	ON	OFF	Locked
DRIVE, Second Gear	ON	Locked	OFF	OFF	ON	OFF	Free-Wheeling
DRIVE, Third Gear	ON	Free-Wheeling	OFF	ON	ON	OFF	Free-Wheeling
L ₁	OFF	Ineffective	OFF	OFF	ON	ON	Locked
L ₂	ON	Locked	ON	OFF	ON	OFF	Free-Wheeling
REVERSE	OFF	Ineffective	OFF	ON	OFF	ON	Ineffective

Fig. 7A-11--CBC 350 Clutch Apply Chart

- a. Gears damaged.
- b. Driving gear assembled backwards.
- c. Crescent interference.
- d. Oil seal rings damaged or worn.
- Converter:
 - a. Loose flexplate-to-converter bolts.
 - b. Converter damage.
 - c. Water in oil (causes whine).

First, Second and/or Reverse Gear

Planetary Gear Set:

1. Gears or thrust bearings damaged.
2. Input or output ring gear damaged.

During Acceleration - Any Gear

- Transmission or cooler lines grounded to underbody.
- Motor mounts loose or broken.

Squeal at Low Vehicle Speed

Speedometer driven gear shaft seal - requires lubrication or replacement.

TURBO HYDRAMATIC 350 44

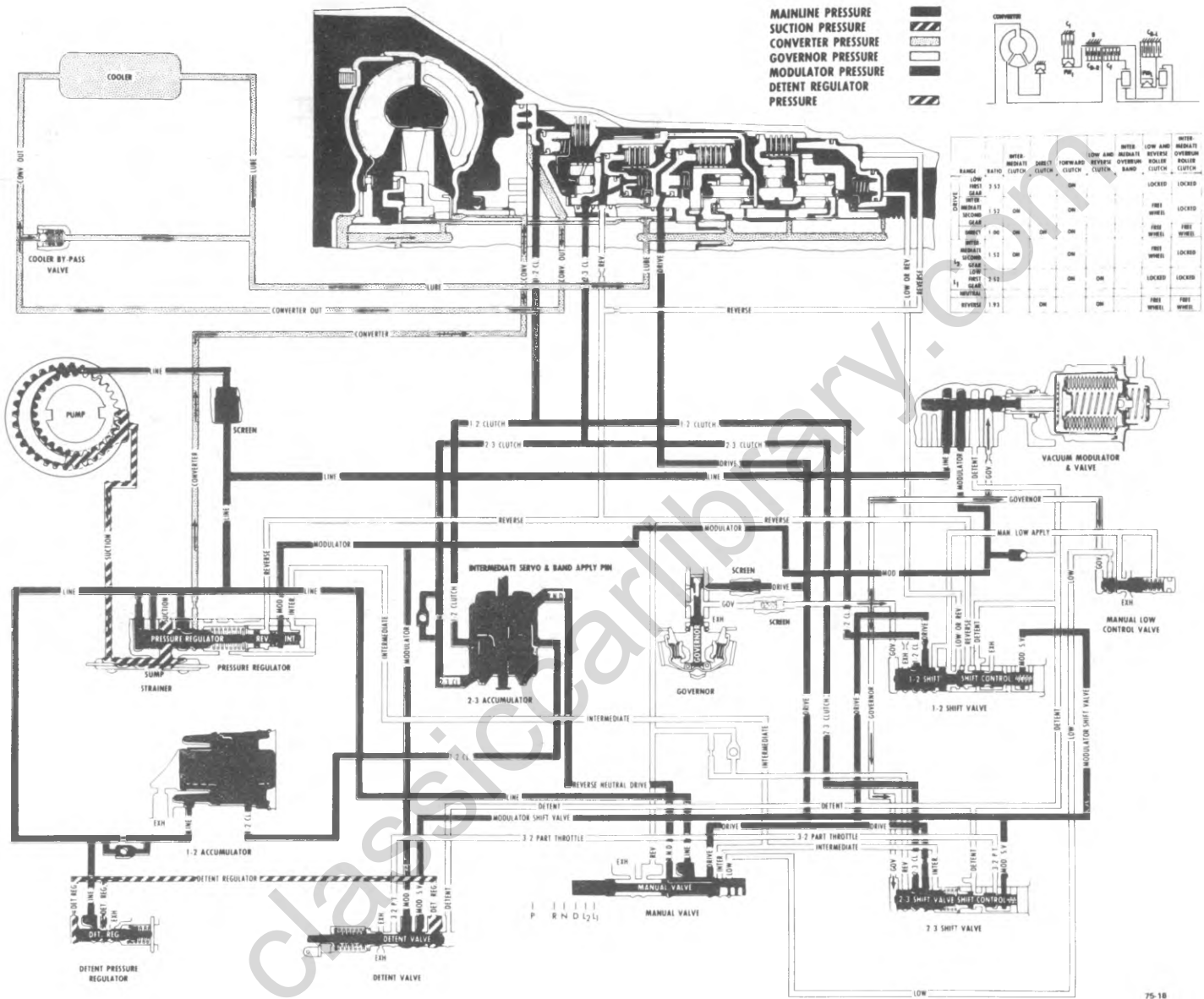


Fig. 7A-13-CBC 350 Hydraulic Circuit

SERVICE OPERATIONS

TRANSMISSION REPLACEMENT

(All Except K Model)

NOTE: If necessary, the catalytic converter may have to be disconnected to provide adequate clearance for transmission removal. This procedure will include removal of the converter support bracket.

1. Before raising the vehicle, disconnect the negative battery cable detent downshift cable at carburetor and release the parking brake.
2. Raise vehicle on hoist.
3. Remove propeller shaft.
4. Disconnect speedometer cable, detent downshift cable, modulator vacuum line and oil cooler pipes at transmission.
5. Disconnect shift control linkage.
6. Support transmission with suitable transmission jack.
7. Disconnect rear mount from frame crossmember.
8. Remove two bolts at each end of frame crossmember. Remove crossmember.
9. Remove converter under pan.
10. Remove converter-to-flexplate bolts, as seen in Figure 7A-14.
11. Lower transmission until jack is barely supporting it.
12. Remove transmission to engine mounting bolts and remove oil filler tube at transmission.
13. Raise transmission to its normal position, support engine with jack and slide transmission rearward from engine and lower it away from vehicle.

CAUTION: Use suitable converter holding tool when lowering transmission or keep rear of transmission lower than front so as not to lose

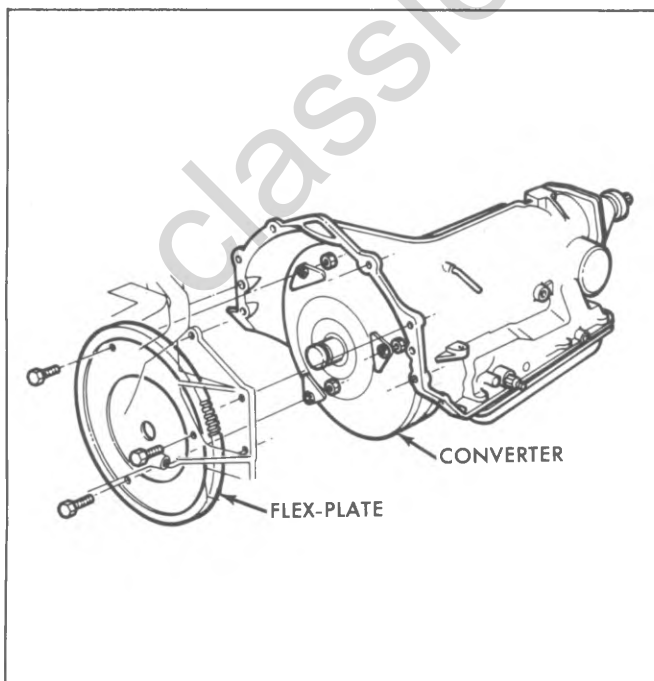


Fig. 7A-14--Typical Transmission Mounting

converter.

The installation of the transmission is the reverse of the removal with the following added step. Before installing the flex plate-to-converter bolts, make certain that the attaching lugs on the converter are flush with the flex plate and the converter rotates freely by hand in this position. Then, hand start all three bolts and tighten finger tight before torquing to specifications. This will insure proper converter alignment.

After installation of transmission, lower vehicle and remove vehicle from hoist. Check linkage for proper adjustment.

Check transmission fluid level.

TRANSMISSION REPLACEMENT

(K Model)

1. Disconnect battery cable.
2. Remove transmission dipstick.
3. Disconnect detent downshift cable at carburetor.
4. Remove transfer case shift lever knob and boot.
5. Raise vehicle on hoist.
6. Remove flexplate cover.
7. Remove torque converter to flexplate attaching bolts. See Figure 7A-14. Secure the converter.
8. Disconnect transmission shift linkage and speedometer cable.
9. Remove engine crossunder pipe to manifold bolts.
10. Disconnect vacuum modulator line, line to filler tube clip and detent downshift cable to filler tube strap.
11. Disconnect detent downshift cable at the transmission.
12. Disconnect transmission oil cooler lines at the transmission.
13. Remove transfer case adapter to crossmember bolts.

When applicable, disconnect engine-to-transmission support strut rod from transmission. See Figure 7A-22.

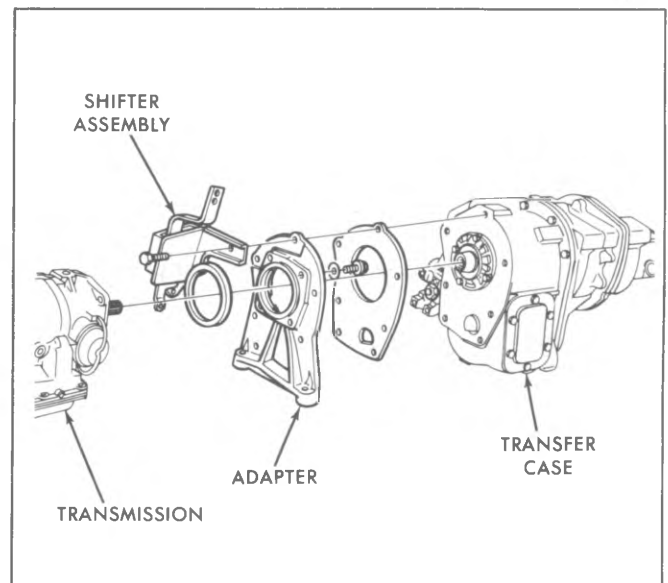


Fig. 7A-15--Typical Transfer Case-To-Transmission Mounting

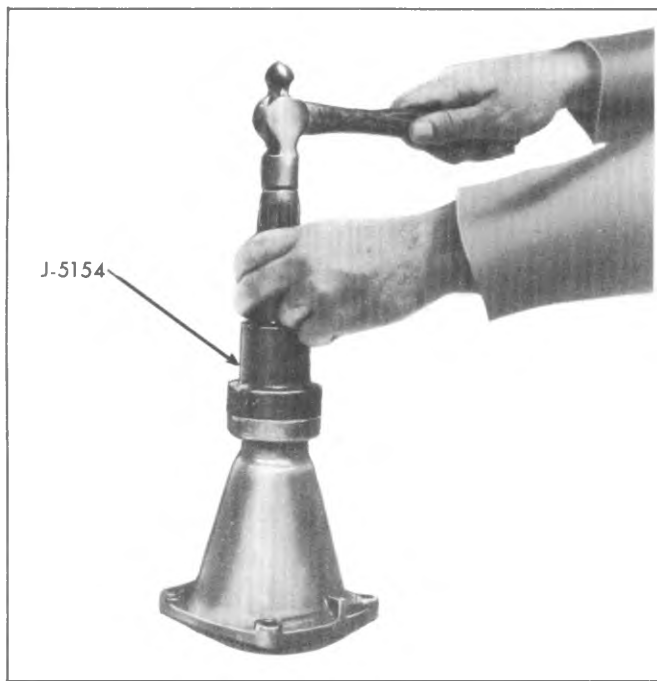


Fig. 7A-16--Installing Oil Seal into Extension Housing

14. Raise engine as necessary.
15. Remove crossmember bolts and remove crossmember.
16. Remove exhaust system hanger bolts.
17. Disconnect rear propeller shaft at transfer case.
18. Disconnect parking brake cable.
19. Disconnect exhaust system. (Tie aside.)
20. Disconnect front propeller shaft at front axle. (Tie aside.)
21. Support transmission and transfer case with jack (use safety chains).
22. Remove transfer case to frame bracket bolts.
23. Remove transmission to engine bolts, remove transmission and transfer case.
24. Disconnect transfer case-to-transmission strut rod. Remove transfer case from transmission (includes: new "O" ring seal). See Figure 7A-15.
25. Move transmission to bench fixture.
26. Drain transmission.
27. Remove torque converter.
28. Remove and discard front pump seal.
29. Refill transfer case. Reverse removal procedure to install.

EXTENSION HOUSING OIL SEAL

Removal

1. Remove propeller shaft.
2. Pry out lip oil seal with screwdriver or small chisel.

Installation

1. Drive a new oil seal into place with Installer J-21426, as seen in Figure 7A-16.
2. Install propeller shaft and adjust fluid level.

SPEEDOMETER DRIVEN GEAR

Removal

1. Disconnect speedometer cable.
2. Remove retainer bolt, retainer, speedometer driven gear and O-ring seal.

Installation

Installation of speedometer driven gear is the reverse of REMOVAL. Install new O-ring seal (if required) and adjust the fluid level.

SPEEDOMETER DRIVE GEAR

Removal

1. Raise vehicle and support transmission with suitable transmission jack.
2. Remove propeller shaft.
3. Disconnect speedometer cable.
4. Disconnect transmission rear mount from frame crossmember.
5. Remove two bolts at each end of frame cross member and remove crossmember.
6. Remove extension housing.
7. Install Special Tools J-21427-01 and J-8105 on output shaft and remove speedometer drive gear. Remove retaining clip.

Installation

1. Place speedometer drive gear retaining clip into hole in output shaft.
2. Align slot in speedometer drive gear with retaining clip and install.
3. Install extension housing and tighten attaching bolts to 25 pound feet.
4. Connect speedometer cable.
5. Install crossmember to frame and transmission.
6. Install propeller shaft.
7. Remove transmission jack and lower vehicle.

MANUAL SHAFT, RANGE SELECTOR INNER LEVER AND PARKING LINKAGE ASSEMBLIES

Removal

1. Referring to draining procedures, drain transmission fluid from oil pan.
 2. After oil pan and strainer have been removed, remove valve body assembly. Discard gaskets.
 3. Remove manual shaft-to-case retainer and unthread jam nut holding range selector inner lever to manual shaft. See Figure 7A-17.
 4. Remove jam nut and remove manual shaft from range selector inner lever and case.
- NOTE:** Do not remove manual shaft lip oil seal unless replacement is required.
5. Remove parking pawl actuating rod and range selector inner lever from case.
 6. Remove bolts and parking lock bracket.
 7. Remove parking pawl disengaging spring and, if necessary to replace park pawl or shaft, clean up bore in case and remove parking pawl shaft retaining plug, park pawl shaft and pawl.

Installation

Installation of parking linkage, selector lever and manual shaft is the reverse of REMOVAL. Install new plug (if required), new lip oil seal (if required) and new gaskets.

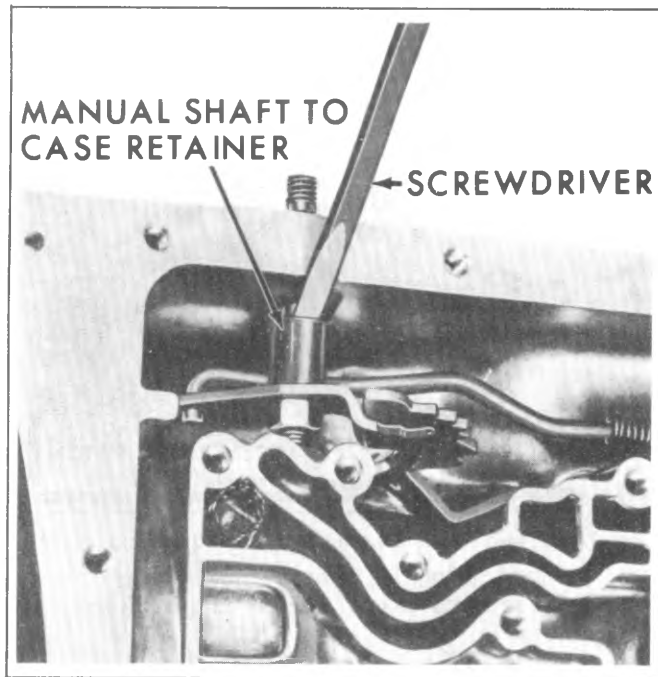


Fig. 7A-17--Removing Manual Shaft-to-Case Retainer

Adjust the fluid level.

NOTE: Before installing the propeller shaft, liberally lubricate splines of the transmission yoke with a Lithium soap base lubricant. The lubricant should seep from the vent hole (rear cap of yoke) when installing yoke on transmission output shaft. It is essential that the vent hole is not obstructed.



Fig. 7A-18--Governor Cover and O-Ring Seal

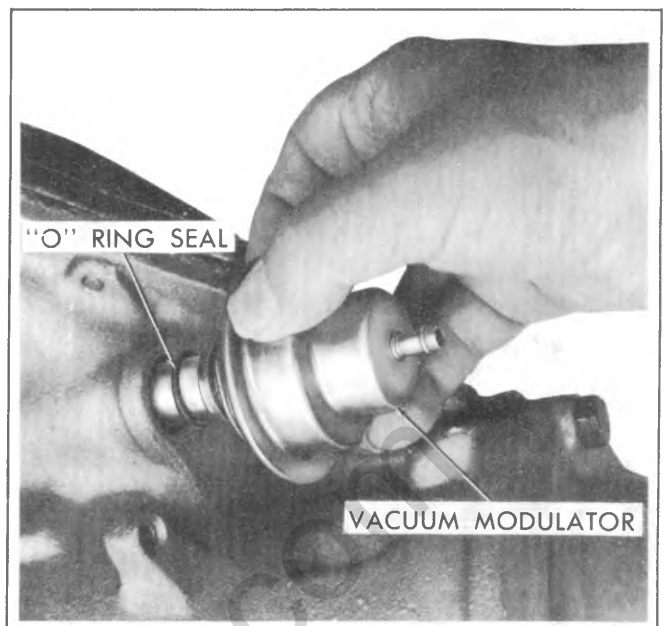


Fig. 7A-19--Removing Vacuum Modulator

GOVERNOR Removal

1. Raise vehicle and disconnect speedometer cable at transmission.
2. Remove governor cover retainer and governor cover, as seen in Figure 7A-18.

NOTE: Be careful not to damage cover and "O" ring seal.

3. Remove governor. Inspect weights and valve for freeness.

Installation

1. Install governor.
 2. Install governor cover using a brass drift around the outside flange of the cover.
- NOTE:** Do not distort cover on installation. Be sure "O" ring seal is not cut or damaged.
3. Install retainer.
 4. Connect speedometer cable, lower vehicle and check transmission fluid level.

VACUUM MODULATOR AND MODULATOR VALVE ASSEMBLY

Removal

1. Disconnect vacuum hose from vacuum modulator stem and remove vacuum modulator attaching screw and retainer.
2. Remove modulator assembly and its O-ring seal from case. See Figure 7A-19.
3. Remove modulator valve from case.

Installation

Installation of the modulator and modulator valve is the reverse of REMOVAL. Install a new O-ring seal and adjust the fluid level.

4. Remove tool and install oil pan bolts.

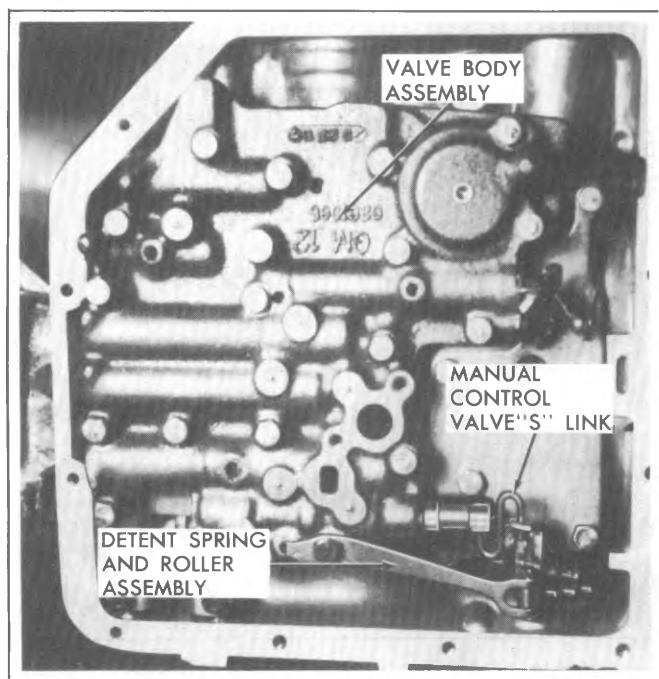


Fig. 7A-20—Detent Spring/Valve Body

VALVE BODY ASSEMBLY

Removal

1. Referring to draining procedures, drain transmission fluid from oil pan.
2. After oil pan and strainer, have been removed, discard gaskets.
3. Remove detent spring and roller assembly from valve body and remove valve body-to-case bolts. See Figure 7A-20.
4. Remove valve body assembly while disconnecting manual control valve link from range selector inner lever and removing detent control valve link from the detent actuating lever.
5. Remove manual valve and link assembly from valve body assembly.

Installation

Installation of the valve body assembly is the reverse of REMOVAL. Install new gaskets to strainer and oil pan and adjust the fluid level.

1-2 ACCUMULATOR

Removal

1. Remove two transmission oil pan bolts below the 1-2 accumulator cover. Install J-23069 in place of bolts removed.
2. Press in on cover and remove retaining ring.
3. Remove cover "O" ring seal, spring and 1-2 accumulator, as seen in Figure 7A-21.

Install

1. Install 1-2 accumulator piston.

NOTE: Rotating piston slightly when installing will help to get rings started in bore.

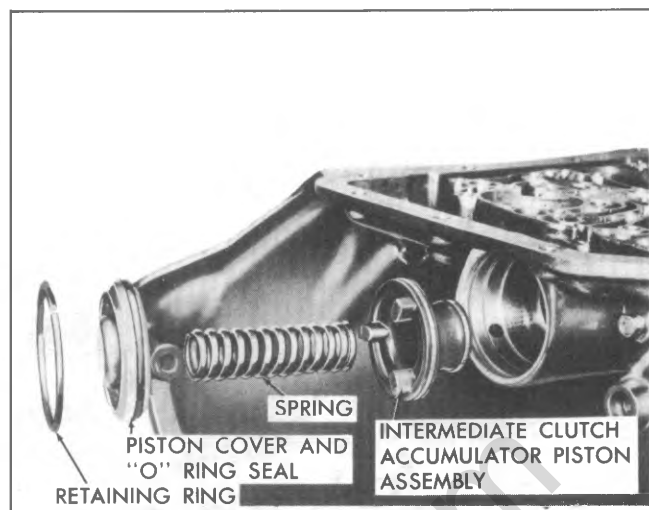


Fig. 7A-21—Intermediate Clutch Accumulator Components

2. Position spring, "O" ring seal and cover in place.
3. Press in on cover with J-23069 and install retaining ring.
4. Remove tool and install oil pan bolts.

SUPPORT STRUT ROD

Replacement

The transmission support strut rod attachment is shown in Figure 7A-22. Remove the two bolts when replacing the strut rod. When removing the transmission, it is only necessary to remove the bolt at the transmission end of the strut rod.

OIL COOLER PIPES

If replacement of transmission steel tubing cooler pipes is required, use only double wrapped and brazed steel tubing meeting GM specification 123M or its equivalent. Under no condition use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory fatigue durability to withstand normal vehicle vibrations.

Steel tubing should be flared using the upset (double lap) flare method which is detailed in Section 5.

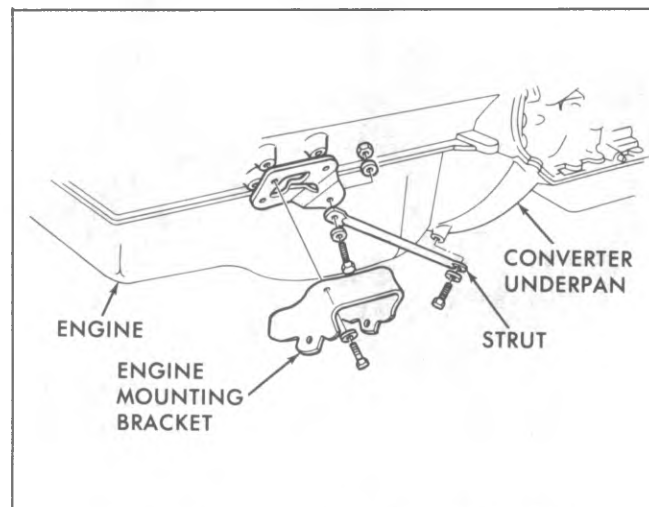


Fig. 7A-22—Transmission Support Strut Rod

THM 400 TRANSMISSION

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GENERAL DESCRIPTION

The THM 400 transmission is a fully automatic unit consisting primarily of a 3-element hydraulic torque converter and a compound planetary gear set. Three multiple-disc clutches, one gear unit, one roller clutch, and two bands provide the friction elements required to obtain the desired function of the compound planetary gear set.

The torque converter couples the engine to the planetary gears through oil and provides hydraulic torque multiplication when required. The compound planetary gear set produces three forward speeds and reverse.

The 3-element torque converter consists of a pump or driving member, a turbine or driven member, and a stator assembly. The stator is mounted on a one-way roller clutch which will allow the stator to turn clockwise but not counter-clockwise.

The torque converter housing is filled with oil and is attached to the engine crankshaft by a flex plate and always rotates at engine speed. The converter pump is an integral part of the converter housing, therefore the pump blades, rotating at engine speed, set the oil within the converter into motion and direct it to the turbine, causing the turbine to rotate.

As the oil passes through the turbine it is traveling in such a direction that if it were not re-directed by the stator it would hit the rear of the converter pump blades and impede its pumping action. So at low turbine speeds, the oil is re-directed by the stator to the converter pump in such a manner that it actually assists the converter pump to deliver power or multiply engine torque.

As turbine speed increases, the direction of the oil leaving the turbine changes and flows against the rear side of the stator vanes in a clockwise direction. Since the stator is now impeding the smooth flow of oil, its roller clutch releases and it revolves freely on its shaft. Once the stator becomes inactive, there is no further multiplication of engine torque within the converter. At this point, the converter is merely acting as a fluid coupling as both the converter pump and turbine are being driven at approximately the same speed - or at one-to-one ratio.

A hydraulic system pressurized by a gear type pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to transmission are:

Manual Linkage - To select the desired operating range.

Engine Vacuum - To operate a vacuum modulator unit.

12 Volt Electrical - To operate an electrical detent solenoid.

A vacuum modulator is used to automatically sense any change in the torque input to the transmission. The vacuum modulator transmits this signal to the pressure regulator for line pressure control, to the 1-2 accumulator valve, and to the shift valves so that all torque requirements of the transmission are met and smooth shifts are obtained at all throttle openings.

The detent solenoid is activated by an electric switch on the carburetor. When the throttle is fully opened, the switch on the carburetor is closed, activating the detent solenoid and causing the transmission to downshift for passing speeds.

The selector quadrant has six selector positions: P, R, N, D, L2, L1.

P. PARK position positively locks the output shaft to the transmission case by means of a locking pawl to prevent the vehicle from rolling in either direction (not on CL model). The engine may be started in Park position.

R. REVERSE enables the vehicle to be operated in a reverse direction.

N. Neutral position enables the engine to be started and run without driving the vehicle.

D. DRIVE Range is used for all normal driving conditions and maximum economy. Drive Range has three gear ratios, from the starting ratio to direct drive. Detent downshifts are available by depressing the accelerator to the floor.

L2. L2 Range has the same starting ration as Drive Range, but prevents the transmission from shifting ration when extra performance is desired. L2 Range can also be

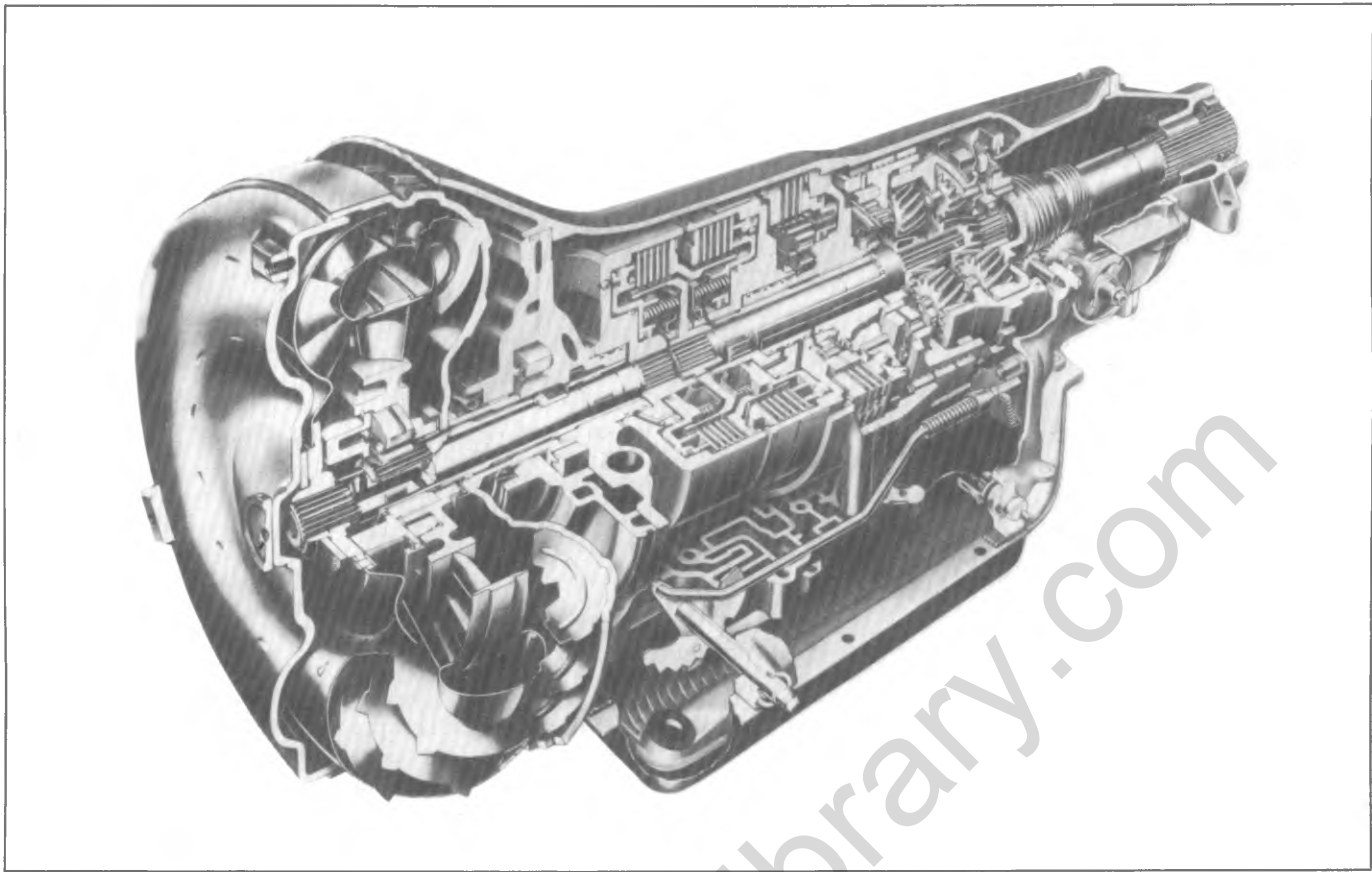


Fig. 7A-30--THM 400, Cross-Section View

used for engine braking. L2 Range can be selected at any vehicle speed, and the transmission will shift to second gear and remain in second until the vehicle speed or the throttle are changed to obtain first gear operation in the same manner as in D Range.

L1. L1 Range can be selected at any vehicle speed, and the transmission will shift to second gear and remain in

second until vehicle is reduced to approximately 40 MPH, depending on axle ratio. L1 Range position prevents the transmission from shifting out of first gear.

NOTE: It is very important that any communication concerning the THM 400 always contain the transmission code and vehicle identification number.

MAINTENANCE AND ADJUSTMENTS

CHECKING TRANSMISSION MOUNT

Raise the vehicle on a hoist. Push up and pull down on the transmission extension while observing the transmission mount. If the rubber separates from the metal plate of the mount or if the extension moves up but not down (mount bottomed out), replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the transmission or crossmember.

TRANSMISSION FLUID

Fluid Level and Capacity

The fluid level indicator is located in the filler tube at the right rear of the engine. To bring the fluid level from the ADD mark to the FULL mark requires one pint of fluid. Fluid level should be checked at every engine oil change.

Fluid level should be to the FULL mark with the transmission fluid at normal operating temperature of 180°F, (82°C). With warm fluid at room temperature of 70°F

(21°C), the level will be 3/8 inch below the ADD mark on the dipstick. The normal operating temperature is obtained only after at least 15 miles of highway type driving or the equivalent of city driving.

Approximately 9 pints of fluid are required to refill transmission after oil pan has been drained. The fluid capacity of the THM 400 transmission and converter assembly is approximately 22 pints but **correct level is determined by mark on the dipstick rather than by amount added.** Use only DEXRON® or DEXRON® II automatic transmission fluid or its equivalent.

NOTE: An early change to a darker color from the usual red color and/or a strong odor that is usually associated with overheated transmission fluid is normal, and is not a positive sign of required maintenance or transmission failure.

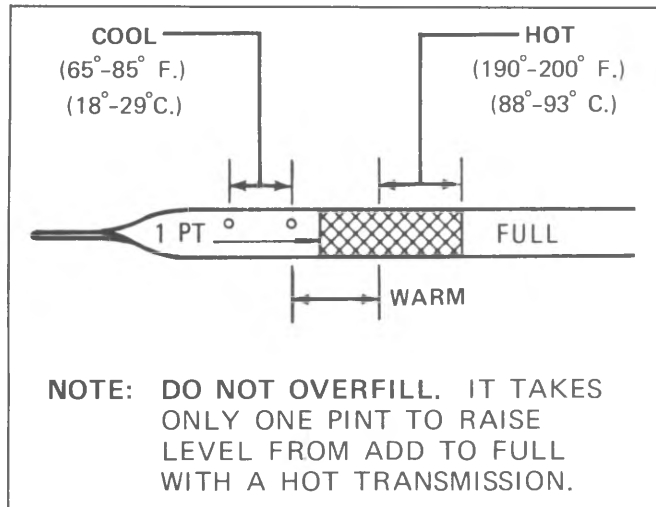


Fig. 7A-31--Dipstick Markings

Checking Procedure and Adding Fluid

To determine proper fluid level at normal operating temperature of 180°F (82°C), proceed as follows:

1. Position vehicle on a level surface, place selector lever in park (P), apply parking brake and have engine running at normal idle.
2. Remove fluid level indicator, wipe it clean and reinstall fully until cap seats.
3. Remove indicator and reading of fluid level should be at full "F" mark.
4. If additional fluid is required, add DEXRON® or DEXRON® II automatic transmission fluid or its equivalent to "F" mark on indicator.

If the vehicle cannot be driven sufficiently to bring the transmission to operating temperature and it becomes necessary to check the fluid level, the transmission may be checked at room temperature of 70°F (21°C) as follows:

1. Position selector lever in park (P), apply parking brake and start engine. **DO NOT RACE ENGINE.** Move selector lever through each range.
2. Immediately check fluid level with selector lever in Park, engine running and vehicle on LEVEL surface. Fluid level on indicator should be 3/8 inch below the "ADD" mark.

3. If additional fluid is required, add enough fluid to bring level to 3/8 inch below the ADD mark on the dipstick. If transmission fluid level is correctly established at 70°F (21°C), it will appear at the FULL mark on the dipstick when the transmission reaches its normal operating temperature of 180°F (82°C).

CAUTION: DO NOT OVERFILL, as foaming and loss of fluid through the vent pipe might occur as fluid heats up.

If fluid is too low, especially when cold, complete loss of drive may result which can cause transmission failure.

Draining and Refilling Transmission Oil Pan

The oil pan should be drained and filter replaced and fresh fluid added to obtain the proper level on indicator, at the intervals detailed in section O-B of this manual. For vehicles subjected to heavy city traffic during hot weather, or in commercial use, when the engine is regularly idled for prolonged periods or when vehicle is used for towing, oil

pan should be drained and filter replaced more frequently. See section O-B.

Drain fluid immediately after operation before it has had an opportunity to cool.

WARNING: Transmission fluid temperature can exceed 350°F (177°C).

1. Raise vehicle and support transmission with suitable jack at transmission.
 2. With fluid receptacle placed under transmission oil pan, remove oil pan attaching bolts from front and side of pan.
 3. Loosen rear pan attaching bolts approximately four (4) turns.
 4. Carefully pry transmission oil pan loose with screwdriver, allowing fluid to drain.
 5. Remove remaining screws and remove oil pan and gasket. Discard gasket.
 6. Drain fluid from oil pan. Clean pan with solvent and dry thoroughly with clean compressed air.
 7. Remove oil filter retainer bolt, oil filter assembly, O-ring seal from intake pipe and discard the filter and O-ring seal.
 8. Install new O-ring seal on intake pipe and install new filter on pipe assembly.
 9. With O-ring seal on intake pipe, install pipe and filter assembly, attaching filter to the control valve assembly with its retainer bolt, torquing to 10 pound feet.
 10. Install new strainer-to-valve body gasket, strainer and two (2) screws.
 11. Install new gasket on oil pan and install oil pan. Tighten its thirteen (13) attaching bolt and washer assemblies to 12 pound-feet.
 12. Lower vehicle add approximately 5 pints U.S. measure (4 pints Imperial measure) of DEXRON® or DEXRON® II automatic transmission fluid or its equivalent through filler tube.
 13. With selector lever in PARK position, apply hand brake, start engine and let idle (carburetor off fast idle step). **DO NOT RACE ENGINE.**
 14. Move selector lever through each range and, with selector lever in PARK range, check the fluid level.
 15. Add additional fluid to bring level to 1/4" below the ADD mark on the dipstick.
- CAUTION: Do not overfill. Foaming can result if overfilled.**

Adding Fluid to Fill Dry Transmission and Converter Assembly

In cases of transmission overhaul, when a complete fill is required, including converter (approximately 22 pints), proceed as follows:

1. Add 9 pints of transmission fluid through filler tube.
2. With manual control lever in park (P) position, start engine and place on cold idle cam. **DO NOT RACE ENGINE.** Move manual control lever through each range.
3. Immediately check fluid level with selector lever in park (P), engine running and vehicle on LEVEL surface and add additional fluid to bring level to 3/8-inch below the "ADD" mark on the dipstick. Do not overfill.

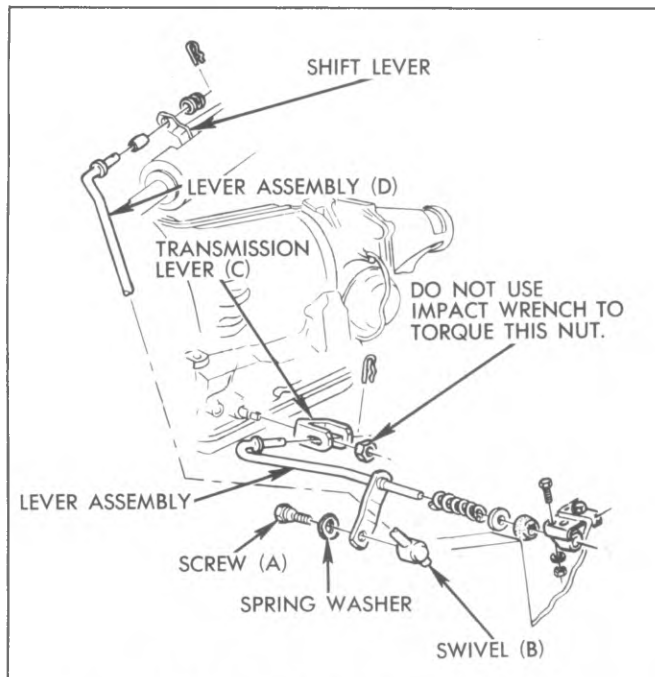


Fig. 7A-32--Column Shift Linkage - CK Series

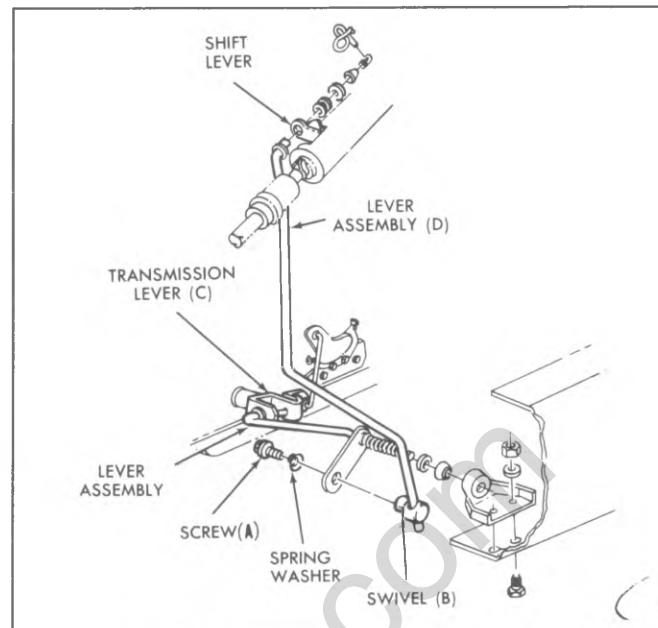


Fig. 7A-33--Column Shift Linkage - P Series

SHIFT CONTROLS

Column Shift Linkage - CK and P Series

(Figs. 7A-32 and 7A-33)

1. The shift tube and lever assembly must be free in the mast jacket. See Section 3B for alignment of steering column assembly if necessary.

2. To check for proper shift linkage adjustment, lift the transmission selector lever towards the steering wheel. Allow the selector lever to be positioned in drive (D) by the transmission detent.

NOTE: Do not use indicator pointer as a reference to position the selector lever. When performing linkage adjustment, pointer is adjusted last.

3. Release the selector lever. The lever should be inhibited from engaging low range unless the lever is lifted.

4. Lift the selector lever towards the steering wheel and allow the lever to be positioned in neutral (N) by the transmission detent.

5. Release the selector lever. The lever should now be inhibited from engaging reverse range unless the lever is lifted.

6. A properly adjusted linkage will prevent the selector from moving beyond both the neutral detent, and the drive detent unless the lever is lifted to pass over the mechanical stop in the steering column.

7. If adjustment is required, remove screw (A) and spring washer from swivel (B).

8. Set transmission lever (C) in Neutral position by moving lever counter-clockwise to L1 detent and then clockwise three (3) detent positions to Neutral.

9. Position transmission selector lever in Neutral position as determined by the mechanical stop in steering column assembly.

NOTE: Do not use the indicator pointer as a reference to position the selector lever. When performing linkage adjustment, pointer is adjusted last.

10. Assemble swivel, spring washer and screw to lever assembly (D) and tighten screw to 20 pound feet.

11. Readjust indicator needle if necessary to agree with the transmission detent positions. See Section 3B.

12. Readjust neutral start switch if necessary to provide the correct relationship to the transmission detent positions. See Section 8.

13. Check operation (CK Series):

a. With key in "Run" position and transmission in "Reverse" be sure that key cannot be removed and that steering wheel is not locked.

b. With key in "Lock" position and shift lever in "Park", be sure that key can be removed, that steering wheel is locked, and that transmission remains in "Park" when steering column is locked.

CAUTION: Any inaccuracies in the above adjustments may result in premature failure of the transmission due to operation without controls in full detent. Such operation results in reduced oil pressure and in turn partial engagement of the affected clutches. Partial engagement of the clutches with sufficient pressure to cause apparent normal operation of the vehicle will result in failure of the clutches or other internal parts after only a few miles of operation.

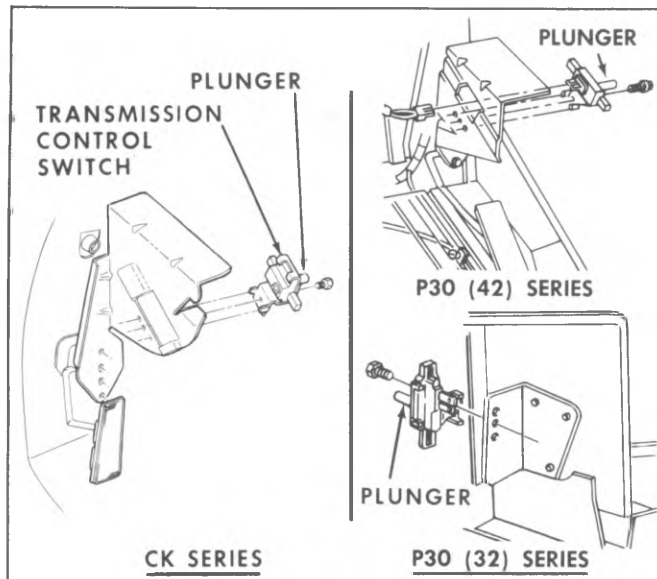


Fig. 7A-34--Detent Downshift Switch

DETENT DOWNSHIFT SWITCH

1. Install switch as shown in Figure 7A-34.
2. After installing the switch, press the switch plunger as far forward as possible. This presets the switch for adjustment. The switch will then adjust itself with the first wide open throttle application of the accelerator pedal.

NEUTRAL START BACKUP LAMP SWITCH ADJUSTMENT

The neutral start backup lamp switch must be adjusted so that the car will start in the park or neutral position, but will not start in the other positions. For replacement and adjustment refer to Section 8 of this manual.

VACUUM REGULATOR VALVE-ADJUSTMENT

When the THM 400 is used with a diesel engine, the vacuum source for operation of the vacuum modulator is through a vacuum regulator valve. This valve is mounted on the high pressure fuel pump, and should be adjusted as detailed in Section 6A3 of this manual.

DIAGNOSIS

SEQUENCE FOR DIAGNOSIS

1. Check and correct oil level.
2. Check detent switch.
3. Check and correct vacuum line and fittings.
4. Check and correct manual linkage.
5. Install oil pressure gage.
6. Road test car.
 - a. Road test using all selective ranges, noting when discrepancies in operation or oil pressure occur.
 - b. Attempt to isolate the unit or circuit involved in the malfunction.
 - c. If engine performance indicates an engine tune up is required, this should be performed before road testing is completed or transmission correction attempted. Poor engine performance can result in rough shifting or other malfunctions.

FLUID CHECKING PROCEDURES

Refer to Maintenance and Adjustment section for fluid checking procedure.

FLUID LEAK DIAGNOSIS

Determining Source of Oil Leak

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases, the source of the leak can be deceiving due to "wind flow" around the engine and transmission.

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a "Black Light" to locate the point at which the oil is leaking is helpful. Comparing the oil from the leak to that on the engine or transmission dipstick, when viewed by black light, will determine the source of the leak - engine or transmission.

Oil leaks around the engine and transmission are

generally carried toward the rear of the car by the air stream. For example, a transmission oil fill pipe to case leak will sometimes appear as a leak at the rear of the transmission. In determining the source of a leak, proceed as follows:

1. Degrease underside of transmission.
2. Road test to get unit at operating temperature. (180 degrees F.)
3. Inspect for leak with engine running.
4. With engine off, check for oil leaks due to the raised oil level caused by drain back.

Possible Points of Oil Leak

1. Transmission Oil Pan Leak
 - a. Attaching bolts not correctly torqued.
 - b. Improperly installed or damaged pan gasket.
 - c. Oil pan gasket mounting face not flat.
2. Case Extension
 - a. Attaching bolts not correctly torqued.
 - b. Rear seal assembly damaged or improperly installed.
 - c. Extension to case, gasket damage or improperly installed.
 - d. Porous casting. See paragraph C.
 - e. Output shaft "O" ring damaged.
3. Case Leak
 - a. Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine "loading" one side of "O" ring.
 - b. Modulator assembly "O" ring seal damaged or improperly installed.
 - c. Electrical connector "O" ring seal damaged or improperly installed.
 - d. Governor cover bolts not torqued, gasket damaged or leak between case face and gasket.
 - e. Speedometer gear "O" ring damaged.
 - f. Manual shaft lip seal damaged or improperly installed.

		Minimum	Maximum
L2-2nd Gear - Steady road load at approximately 25 mph		145 psi	155 psi
Gear	Selector Lever Position	Minimum	Maximum
1st	Drive		
2nd	("Zero" throttle to full throttle.)	60	150
3rd			
3rd	Drive Range, Zero Throttle at 30 mph	60	
Reverse	Rev. (Zero to full throttle)	95	260

Fig. 7A-35--Fluid Pressure Check - Road or Normal Operating Conditions

- g. Parking pawl shaft cup plug damaged, improperly installed.
- h. Line pressure band release tap plug loose.
- i. Vent pipe (refer to item 5).
- j. Porous casting. See subparagraph C.
- 4. Leak at Front of Transmission
 - a. Front pump seal leaks.
 - 1. Seal lip cut. Check converter hub for nicks, etc.
 - 2. Bushing moved forward and damaged.
 - 3. Garter spring missing from seal.
 - b. Front pump attaching bolts loose or bolt seals damaged or missing.
 - c. Front pump housing "O" ring damaged or cut.
 - d. Converter leak in weld area.
 - e. Porous casting (pump).
- 5. Oil Comes Out Vent Pipe
 - a. Transmission over-filled.
 - b. Water in oil.
 - c. Foreign matter between pump and case or between pump cover and body.
 - d. Case - porous, front pump cover mounting face shy of stock near breather. See subparagraph C.
 - e. Pump to case gasket mispositioned.
 - f. Incorrect dipstick.
 - g. Cut "O" ring or grommet on filter.
 - h. Pump - shy of stock on mounting faces, porous casting, breather hole plugged in pump cover.

FLUID PRESSURE CHECK

Road or Normal Operating Conditions

While road testing (with the transmission oil pressure gage attached and the vacuum modulator tube **connected** , the transmission pressure should check approximately as shown on Figure 7A-35.

Vehicle Stationary - Engine at 1200 RPM

With the transmission oil pressure gage attached and the vacuum modulator tube **disconnected** , the transmission pressures should check approximately as shown in Fig. 7A-36.

Vehicle Stationary - Engine at 1000 RPM

With the transmission oil pressure gage attached and the vacuum modulator tube **connected** for normal modulator operation, the transmission pressure should check approximately as shown in Fig. 7A-37.

NOTE: Pressures are not significantly affected by altitude or barometric pressure when the vacuum modulator tube is connected.

Case Porosity Repair

External leaks caused by case porosity have successfully been repaired with the transmission in the vehicle by using the following recommended procedures:

1. Road test and bring the transmission to operating temperature, approximately 180 degrees.
2. Raise vehicle on hoist or jack stand, engine running and locate source of oil leak. Check for leak in all operating positions. Use of a mirror is helpful in finding leaks.
3. Shut engine off and thoroughly clean area to be repaired with a cleaning solvent and a brush air dry.
4. Using instructions of the manufacturer, mix a sufficient amount of epoxy to make repair. Observe cautions of manufacturer in handling.
5. While the transmission case is still HOT apply the epoxy to the area to be repaired. A clean, dry soldering acid brush can be used to clean the area and also to apply the epoxy cement. Make certain the area to be repaired is fully covered.
6. Allow cement to cure for three hours before starting engine.
7. Road test and check for leaks.

VACUUM MODULATOR DIAGNOSIS

A defective vacuum modulator can be determined by performing the following procedures.

Vacuum Diaphragm Leak Check

Insert a pipe cleaner into the vacuum connector pipe as far as possible and check for the presence of transmission oil. If oil is found, replace the modulator.

Gasoline or water vapor may settle in the vacuum side of the modulator. If this is found without the presence of oil, the modulator should not be changed.

Atmospheric Leak Check

Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, the crimped upper to lower housing seam, and the threaded screw seal (Fig. 7A-38). Using a short piece of rubber tubing apply air pressure to the vacuum pipe by blowing into the tube and observe for

Drive, Neutral, Park	L ₁ or L ₂	Reverse
150	150	233

Fig. 7A-36--Fluid Pressure Check - Vehicle Stationary, Vacuum Tube Disconnected

<u>Drive, Neutral, Park</u>	<u>L1 or L2</u>	<u>Reverse</u>
60	150	107

Fig. 7A-37--Fluid Pressure Check - Vehicle Stationary, Vacuum Tube Connected

leak bubbles. If bubbles appear, replace the modulator.

NOTE: Do not use any method other than human lung power for applying air pressure, as pressures over 6 psi may damage the modulator.

Bellows Comparison Check

Using a comparison gage, as shown in Figure 7A-39, compare the load of a known good modulator with the assembly in question.

a. Install the modulator that is known to be acceptable on either end of the gage (Fig. 7A-40).

b. Install the modulator in question on the opposite end of the gage. (Fig. 7A-41).

c. Holding the modulators in a horizontal position, bring them together under pressure until either modulator sleeve end just touches the line in the center of the gage (Fig. 7A-42). The gap between the opposite modulator sleeve end and the gage line should then be 1/16" or less. If the distance is greater than this amount, the modulator in question should be replaced.

Sleeve Alignment Check

Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the can. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

Once the modulator assembly passes all of the above tests, it is an acceptable part and should be re-used.

MANUAL LINKAGE

Manual linkage adjustment and the associated neutral safety switch are important from a safety standpoint. The neutral safety switch should be adjusted so that the engine will start in the Park and Neutral positions only.

With the selector lever in the Park position, the parking pawl should freely engage and prevent the vehicle from

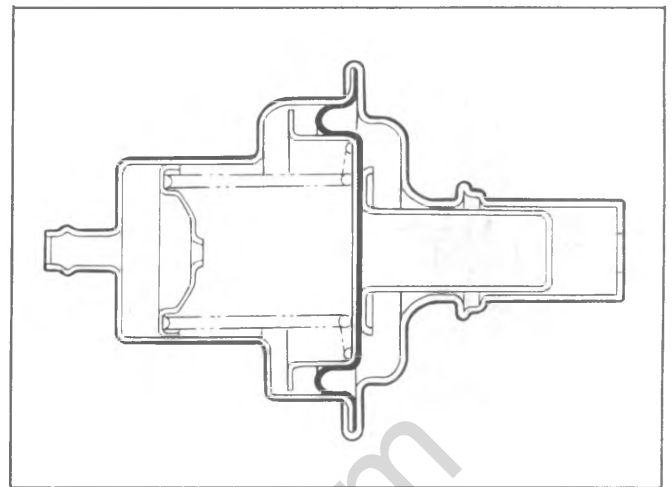


Fig. 7A-39--Bellows Comparison Gage

rolling. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

TROUBLE DIAGNOSIS, BY CONDITION

NOTE: On vehicles with diesel engine, the vacuum source for the vacuum modulator is the Vacuum Regulator Valve. When diagnosing shift complaints on these vehicles, it is important to assure that the vacuum pump is providing 22 inches of vacuum to this valve. Also check the throttle linkage adjustment as outlined in Section 6A3 of this manual.

No Drive in Drive Range

(Install pressure gage)

- Low oil level - check for external leaks or defective vacuum modulator (leaking diaphragm will evacuate oil from unit).

- Manual linkage maladjusted (correct alignment in manual lever shift quadrant is essential); manual valve disconnected from manual lever pin.

- Low oil pressure - refer to **LOW LINE PRESSURE** below.

- Forward clutch:

- a. Clutch does not apply - piston cracked; seals missing,

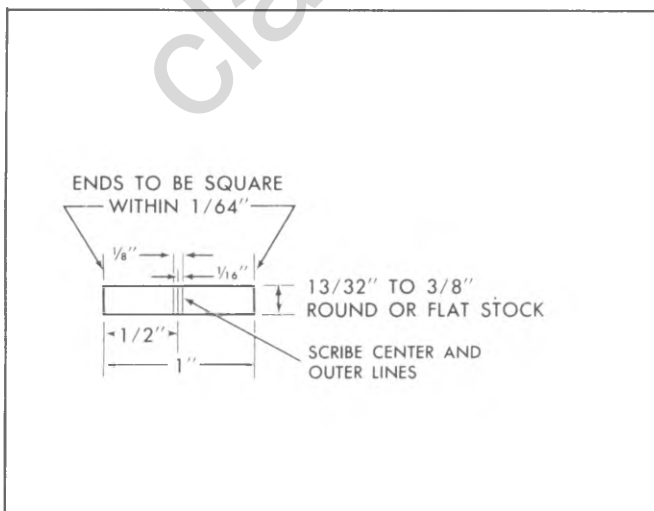


Fig. 7A-38--Vacuum Modulator

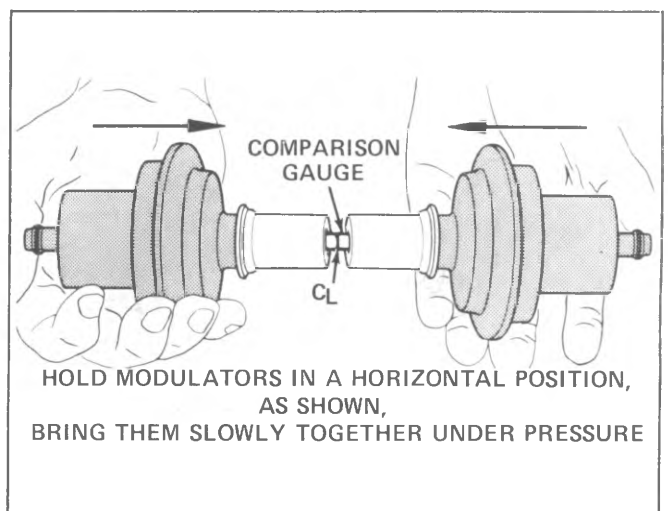


Fig. 7A-40--Holding Modulators in Horizontal Position

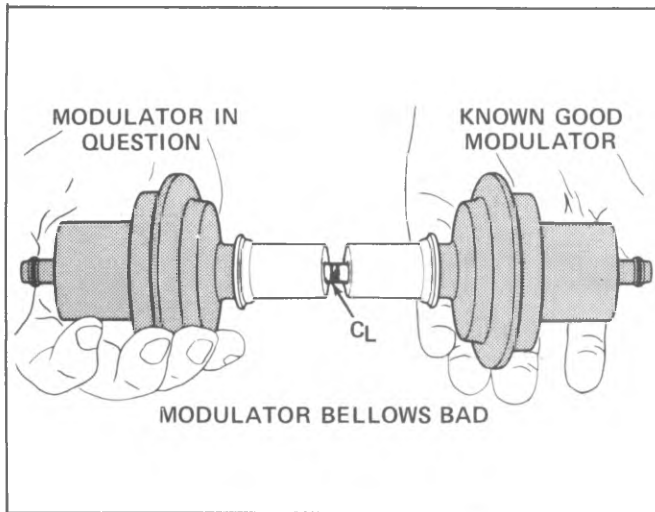


Fig. 7A-41--Modulator Bellows - Bad

damaged; clutch plates burnt (see **BURNED CLUTCH PLATES** below).

b. Pump feed circuit-to-forward clutch oil seal rings missing or broken on pump cover; leak or restriction in feed circuits; pump-to-case gasket mispositioned or damaged. Clutch drum ball check stuck or missing.

● Roller Clutch - broken springs, damaged cage or installed backwards.

High or Low Oil Pressure

(Refer to **FLUID PRESSURE CHECKS**)

High Line Pressure

● Vacuum Leak:

- Vacuum line disconnected.
- Leak on line from engine to modulator.
- Improper engine vacuum.
- Leak in vacuum-operated accessory (hoses, vacuum advance, etc.).

● Modulator:

- Stuck modulator valve.
- Water in modulator.
- Damaged, not operating properly.

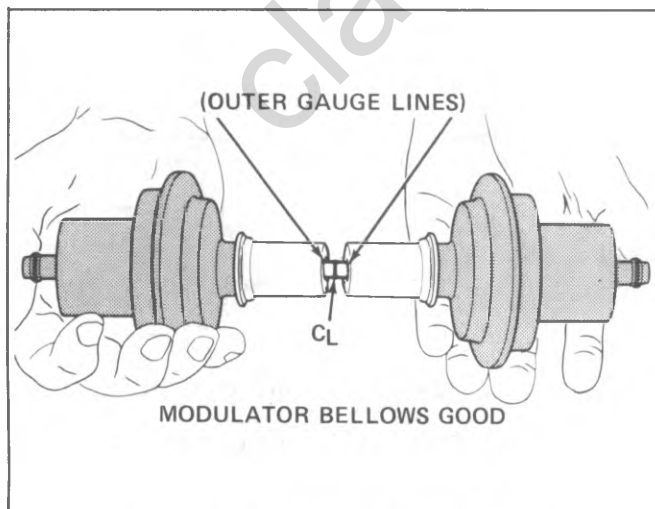


Fig. 7A-42--Modulator Bellows (Good)

● Detent System:

- Detent switch actuated (plunger stuck) or shorted.
- Detent wiring shorted.
- Detent solenoid stuck open.
- Detent feed orifice in spacer plate blocked or restricted.

e. Detent solenoid loose.

f. Detent valve bore plug damaged.

g. Detent regulator valve pin short.

● Oil Pump:

- Pressure regulator and/or boost valve stuck.
- Incorrect pressure regulator valve spring.
- Too many pressure regulator valve spacers.
- Pressure boost valve installed backwards or defective.

e. Pressure boost bushing broken or defective.

f. Pump casting bad.

Low Line Pressure

● Low transmission oil level.

● Defective vacuum modulator assembly.

● Filter Assembly:

- Blocked or restricted.
- "O" Ring seal on intake pipe and/or grommet omitted or damaged.

c. Split or leaking intake pipe.

d. Wrong filter assembly.

● Oil Pump:

- Pressure regulator and/or boost valve stuck.
- Pressure regulator valve spring too weak.
- Not enough spacers in pressure regulator.
- Gear clearance, damaged, worn, drive gear installed backwards.

e. Pump-to-case gasket mispositioned.

f. Defective or mismatched pump body/pump cover.

● Internal Circuit Leaks:

a. Forward clutch leak (pressure low in Drive range - pressure normal in Neutral and Reverse).

1. Check pump oil seal rings.

2. Check forward clutch seals.

b. Direct clutch leak (pressure low in Reverse, pressure normal in all other ranges).

1. Check center support oil seal rings.

2. Check direct clutch outer seal.

3. Check rear servo and front accumulator pistons and rings for damage or missing.

6. Case Assembly:

a. Porosity in intake bore area.

b. Check case for intermediate clutch cup plug leak or blown out.

c. L1-reverse check ball mispositioned or missing (this will cause no reverse and no overrun braking in L1 range).

1-2 Shift-Full Throttle Only

● Detent switch sticking or defective (may stick in cold or wet weather). Can be detected by pulling connection at transmission and obtaining normal upshifts.

● Detent solenoid:

a. Loose.

b. Gasket leaking.

c. Sticks open.

● Control valve:

a. Valve body gaskets - leaking, damaged, incorrectly installed.

- b. Detent valve train stuck.
- c. 3-2 valve stuck.
- Case - porosity.

First Speed Only, No 1-2 Shift

- Governor:
 - a. Valve sticking.
 - b. Driven gear loose, damaged or worn (check for pin in case and length of pin showing); also check output shaft drive gear for nicks or rough finish if driven gear shows damage.
- Control valve:
 - a. 1-2 shift valve train stuck closed.
 - b. Governor feed channels blocked, leaking, pipes out of position, governor screen plugged.
 - c. Valve body gaskets leaking, damaged, incorrectly installed.
- Case:
 - a. Intermediate clutch cup plug leaking or blown out.
 - b. Porosity between channels.
 - c. Governor feed channel blocked; governor bore scored or worn, allowing cross pressure leak.
- Intermediate clutch:
 - a. Case center support - oil rings missing, broken, defective; orifice plug missing.
 - b. Clutch piston seals missing, improperly assembled, cut.

First and Second Speeds Only, No 2-3 Shift

- Detent solenoid - stuck open (detent shifts only - the 2-3 shift would occur at very high speeds, being interpreted as no 2-3 shift).
- Detent switch.
- Control valve:
 - a. 2-3 valve train stuck.
 - b. Valve body gaskets leaking, damaged, incorrectly installed.
- Direct clutch:
 - a. Center support oil rings missing, broken, defective.
 - b. Clutch piston seals missing, improperly assembled, cut; piston ball check stuck or missing.

Drive in Neutral

- Manual linkage maladjusted.
- Internal Linkage:
 - a. Manual valve disconnected or end broken.
 - b. Inside detent lever pin broken.
- Pump Assembly - transmission lube pressure leaking into forward clutch apply passage.
- Forward Clutch:
 - a. Burned plates - check cause.
 - b. Clutch doesn't release - will also cause no drive in Reverse.

No Drive in Reverse or Slips in Reverse

- (Install pressure gage)
- Low fluid level.
- Manual linkage maladjusted.
- Oil pressure - refer to LOW LINE PRESSURE above.
- Control valve:
 - a. Valve body gaskets leaking, damaged, incorrectly installed (Other malfunctions may also be indicated).
 - b. Low reverse ball check missing from case (this will also cause no overrun braking in L1 Range).

c. 2-3 valve train stuck open (this will also cause 1-3 upshift in Drive range).

d. Reverse feed passage restricted; also check case passages.

- Rear servo and accumulator:
 - a. Servo piston seal ring damaged or missing.
 - b. Short band apply pin (this may also cause no overrun braking or slips in overrun braking - L1 range). Refer to INSTALLATION OF REAR SERVO ASSEMBLY for pin selection procedure.
 - c. Defective rear servo piston or bore.
- Reverse or low band burnt, loose lining; apply pin or anchor pins not engaged; band broken.
- Direct clutch:
 - a. Outer seal damaged or missing.
 - b. Clutch plates burnt (see BURNED CLUTCH PLATES below).
 - Forward clutch - clutch does not release (will also cause Drive in Neutral).
 - Center support - oil seal rings or grooves damaged or worn.

Slips in all Ranges, Slips on Start

(Install pressure gage)

- Low fluid level.
- Oil pressure - refer to LOW LINE PRESSURE above.
- Case - cross leaks, porosity.
- Forward and direct clutches slipping (if burnt, see BURNED CLUTCH PLATE below); oil seal rings on pump cover broken or worn.

Slips 1-2 Shift

(Install pressure gage)

- Low fluid level.
- Oil pressure - refer to LOW LINE PRESSURE above.
- Front accumulator piston oil ring damaged or missing.
- Control valve:
 - a. 1-2 accumulator valve train sticking.
 - b. Porosity in valve body or case.
 - c. Valve body attaching bolts not properly torqued.
- Rear accumulator oil ring missing or damaged; case bore damaged.
- Pump-to-case gasket mispositioned.
- Case:
 - a. Intermediate clutch cup plug leaks excessively.
 - b. Porosity between channels.
 - c. Raised ridge around case center support bolt (does not allow control valve assembly to seat properly).
- Intermediate clutch:
 - a. Piston seals missing or damaged; clutch plates burnt (see BURNED CLUTCH PLATES below).
 - b. Center support - leak in feed circuit (oil rings damaged or grooves defective), excessive leak between tower and bushing, orifice bleed plug hole (.020 dia.) blocked, center support bolt not seated properly in case.

Rough 1-2 Shift

(Install pressure gage)

- Oil pressure - refer to HIGH LINE PRESSURE above.
- Control valve:

- a. 1-2 accumulator valve train.
- b. Valve body-to-case bolts loose.
- c. Wrong gaskets or off location, damaged.
 - Case:
 - a. Intermediate clutch ball missing or not sealing.
 - b. Porosity between channels.
 - Rear servo accumulator:
 - a. Oil rings damaged.
 - b. Piston stuck.
 - c. Broken or missing spring.
 - d. Bore damaged.
- Intermediate clutch - clutch plates burnt (see BURNED CLUTCH PLATES below).

Slips 2-3 Shift

(Install pressure gage)

- Low fluid level.
- Oil pressure - refer to LOW LINE PRESSURE above.
 - Control valve - accumulator piston pin (leak at swedge end).
 - Case porosity.
 - Direct clutch:
 - a. Piston seals leaking or ball check leaks.
 - b. Center support oil seal rings damaged; excessive leak between tower and bushing.

Rough 2-3 Shift

(Install pressure gage)

- Oil Pressure - refer to HIGH LINE PRESSURE above.
 - Front servo accumulator:
 - a. Front accumulator spring missing, broken.
 - b. Accumulator piston stuck.
 - Direct clutch - air check for leak to outer area of clutch piston or center piston seal.
 - Damaged center support.

No Engine Braking in L2 Range - 2nd Gear

- Front servo accumulator:
 - a. Servo or accumulator oil rings or bores leaking.
 - b. Servo piston cocked or stuck.
- Front band broken, burnt (check for cause), not engaged on anchor pin and/or servo pin.

No Engine Braking in L1 Range - 1st Gear

- Case assembly - L1-reverse check ball mispositioned or missing from case; case damaged at L1-reverse check ball area.
 - Rear servo:
 - a. Oil seal ring, bore or piston damaged; leaking apply pressure.
 - b. Rear band apply pin short, improperly assembled.
 - Rear band broken, burnt (check for cause), not engaged on anchor pins or servo pin.

NOTE: Items above will also cause slips in Reverse or no Reverse.

No Part Throttle Downshift

(Install pressure gage)

- Oil pressure - refer to HIGH OR LOW OIL PRESSURE above.
 - Control valve - 3-2 valve stuck spring missing or broken.

No Detent Downshifts

- Detent switch adjustments, connection (switch plunger activated approx. 7/8" at full throttle opening).
 - Solenoid inoperative, connections.
 - Control valve-detent valve train sticking.

Low or High Shift Points

(Install pressure gage)

- Oil Pressure - refer to HIGH OR LOW OIL PRESSURE above.
 - Governor:
 - a. Valve sticking.
 - b. Feed holes restricted or leaking; pipes damaged or mispositioned.
 - c. Feed line screen plugged.
 - Detent switch.
 - Detent solenoid stuck open, loose, etc. (will cause late shifts).
 - Control valve:
 - a. Detent valve train.
 - b. 3-2 valve train (detent upshifts possible).
 - c. 1-2 shift valve train - 1-2 regulator valve stuck (this would cause a constant 1-2 shift point, regardless of throttle opening).
 - d. Spacer plate gaskets mispositioned; spacer plate orifice holes missing or blocked.
 - Case porosity; intermediate clutch cup plug leaking, missing.

Won't Hold in Park

- Manual linkage maladjusted.
- Internal linkage:
 - a. Parking brake lever and actuator defective (check for chamfer on actuator rod sleeve).
 - b. Parking pawl broken.
 - c. Parking pawl bracket loose, burned, rough edges or incorrectly installed.
 - d. Parking pawl return spring missing, broken or incorrectly hooked.

Transmission Noisy

CAUTION: Before checking transmission for what is believed to be "transmission noise", make sure that the noise is not from the water pump, alternator, power steering, etc. These components can be isolated by removing the proper belt and running the engine no more than two minutes at one time.

Park, Neutral and all Driving Ranges

- Pump Cavitation:
 - a. Oil level low.
 - b. Plugged or restricted filter.
 - c. Intake pipe "O" ring damaged.
 - d. Intake pipe split, porosity in case intake pipe bore.
 - e. Water in oil.
 - f. Porosity or voids at transmission case (pump face) intake port.
 - g. Pump-to-case gasket off location.
- Pump Assembly:
 - a. Gears damaged or defective; driving gear installed backwards.
 - b. Crescent interference.
 - c. Oil seal rings damaged or worn.
- Converter:

- a. Loose flexplate-to-converter bolts.
- b. Damaged converter.

First, Second and/or Reverse Gears

Planetary Gear Set:

- a. Gears or thrust bearings damaged.
- b. Front internal gear ring damaged.

During Acceleration - Any Gear

- Transmission or cooler lines grounded to underbody.
- Motor mounts loose or broken.

Squeal at Low Vehicle Speed

Speedometer driven gear shaft seal - requires lubrication or replacement.

Burned Clutch Plates

- Forward clutch:
 - a. Check ball in clutch drum damaged, stuck or missing.
 - b. Clutch piston cracked, seals damaged or missing.
 - c. Low line pressure (see LOW LINE PRESSURE above).
 - d. Manual valve mispositioned (may also cause front band failure).
 - e. Restricted oil feed to forward clutch (clutch housing to inner and outer areas not drilled, restricted, porosity in pump, etc.).
 - f. Transmission case valve body face not flat or porosity between channels.
 - g. Manual valve bent and center land not ground properly.
 - h. Pump cover oil seal rings missing, broken or undersize, ring groove oversize.
- Intermediate Clutch:
 - a. Constant bleed orifice in center support missing.
 - b. Rear accumulator piston oil ring damaged or missing.

c. 1-2 accumulator valve stuck in control valve assembly.

- d. Intermediate clutch piston seals damaged or missing.
- e. Center support bolt loose.
- f. Low line pressure (see LOW LINE PRESSURE above).
- g. Intermediate clutch cup plug in case missing.
- h. Transmission case valve body face not flat or porosity between channels.
- i. Manual valve bent and center land not ground properly.

● Direct Clutch:

- a. Restricted orifice in vacuum line to modulator (poor vacuum response).
- b. Check ball in clutch piston damaged, stuck or missing.
- c. Defective modulator bellows.
- d. Center support bolt loose (bolt may be tight in support but not holding support tight to the case).
- e. Center support oil rings or grooves damaged or missing.
- f. Clutch piston cracked, seals damaged or missing.
- g. Front and rear servo pistons and/or seals damaged.
- h. 3-2 valve, 3-2 valve spring or 3-2 spacer pin installed in wrong location in 3-2 valve train bore.
- i. Manual valve bent and center land not ground properly.
- j. Transmission case valve body not flat or porosity between channels.
- k. Intermediate roller clutch installed backwards.
- In addition, burned clutch plates can be caused by incorrect usage of clutch plates. Also, anti-freeze in transmission fluid can cause severe damaged, such as large pieces of clutch plate material peeling off.

	FORWARD CLUTCH	DIRECT CLUTCH	FRONT BAND	INTERMEDIATE CLUTCH	INTERMEDIATE ROLLER CLUTCH	LOW ROLLER CLUTCH	REAR BAND
NEUTRAL	OFF	OFF	OFF	OFF	Ineffective	Ineffective	OFF
DRIVE, First Gear	ON	OFF	OFF	OFF	Ineffective	Effective	OFF
DRIVE, Second Gear	ON	OFF	OFF	ON	Effective	Ineffective	OFF
DRIVE, Third Gear	ON	ON	OFF	ON	Ineffective	Ineffective	OFF
L ₁	ON	OFF	OFF	OFF	Ineffective	Effective	ON
L ₂	ON	OFF	ON	ON	Effective	Ineffective	OFF
REVERSE	OFF	ON	OFF	OFF	Ineffective	Ineffective	ON

Fig. 7A-43--THM 400 Clutch Apply Chart

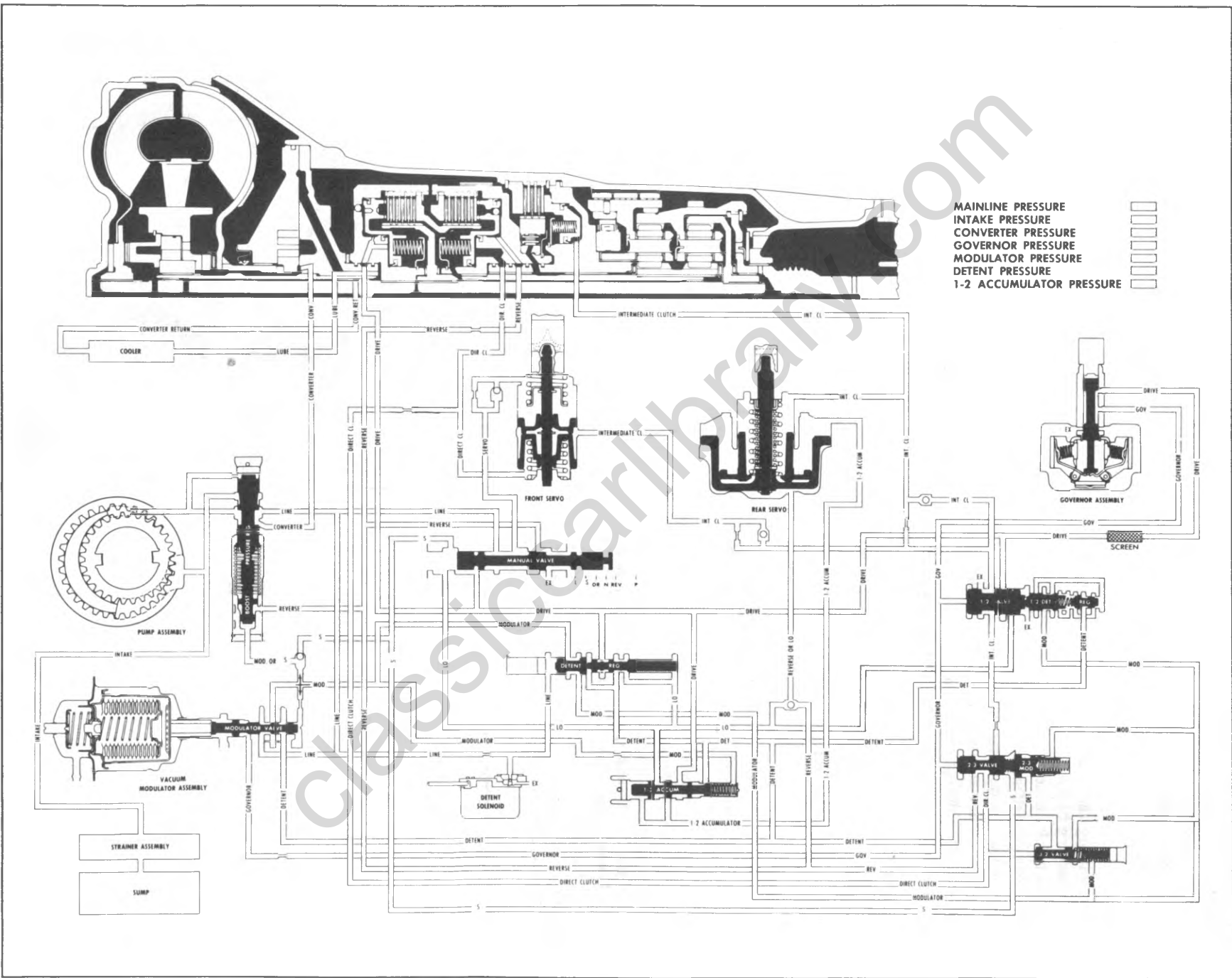


Fig. 7A-44--THM 400 Hydraulic Circuit

SERVICE OPERATIONS

TRANSMISSION REPLACEMENT

NOTE: If necessary, the catalytic converter may have to be disconnected to provide adequate clearance for transmission removal. This procedure will include removal of the converter support bracket.

Removal

Before raising the truck, disconnect the battery and release the parking brake.

1. Raise truck on hoist.
2. Remove propeller shaft.
3. Disconnect speedometer cable, electrical lead to case connector, vacuum line at modulator, and oil cooler pipes.
4. Disconnect shift control linkage.
5. Support transmission with suitable transmission jack.
6. Disconnect rear mount from frame crossmember.
7. Remove two bolts at each end of the frame crossmember and remove crossmember.
8. Remove converter under pan.
9. Remove converter-to-flex plate bolts. See Figure 7A-45.
10. Loosen exhaust pipe to manifold bolts approximately 1/4 inch, and lower transmission until jack is barely supporting it.
11. Remove transmission to engine mounting bolts and remove oil filler tube at transmission.
12. Raise transmission to its normal position, support engine with jack and slide transmission rearward from engine and lower it away from vehicle.
13. Use converter holding Tool J-5384 when lowering transmission or keep rear of transmission lower than front so as not to lose converter.

Installation

The installation of the transmission is the reverse of the removal with the following additional steps.

1. Before installing the flex plate to converter bolts, make certain that the weld nuts on the converter are flush with the flex plate and the converter rotates freely by hand in this position. Then, hand start all bolts and tighten finger tight before torquing to specification. This will insure proper converter alignment.
2. Install transmission support crossmember to transmission and frame with taper on support sloping toward rear.
3. After installation of transmission, check linkage for proper adjustment.
4. Remove truck from hoist.

REAR EXTENSION OIL SEAL

Removal

1. Remove propeller shaft.
2. Pry seal out with screw driver.

Installation

1. For all models except CL, use Tool J-21359 to drive seal in place. For CL models, use J-24057.
2. Re-install propeller shaft.

GOVERNOR

Removal

1. Remove governor cover attaching screws, cover, and gasket, as seen in Figure 7A-46.
2. Discard gasket.
3. Withdraw governor assembly from case.

Installation

Installation of the governor assembly is the reverse of the removal. Use a new gasket under the governor cover. Adjust fluid level.

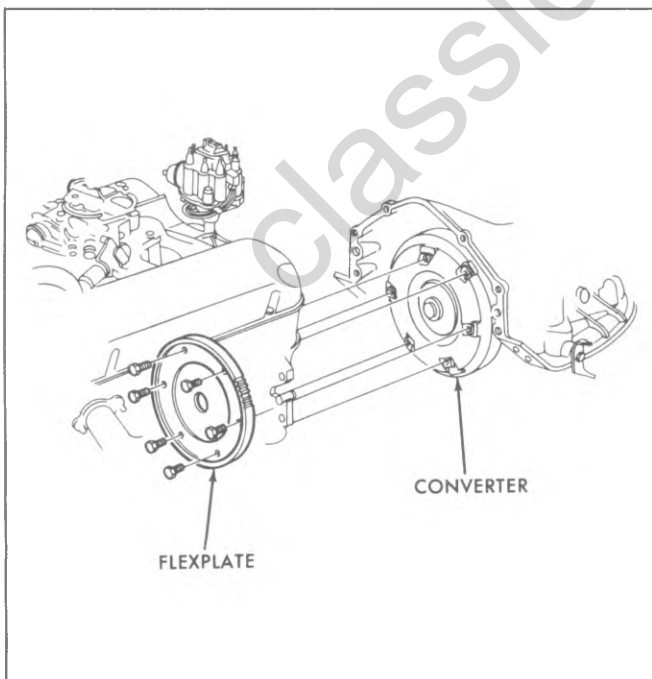


Fig. 7A-45--Typical Transmission Mounting

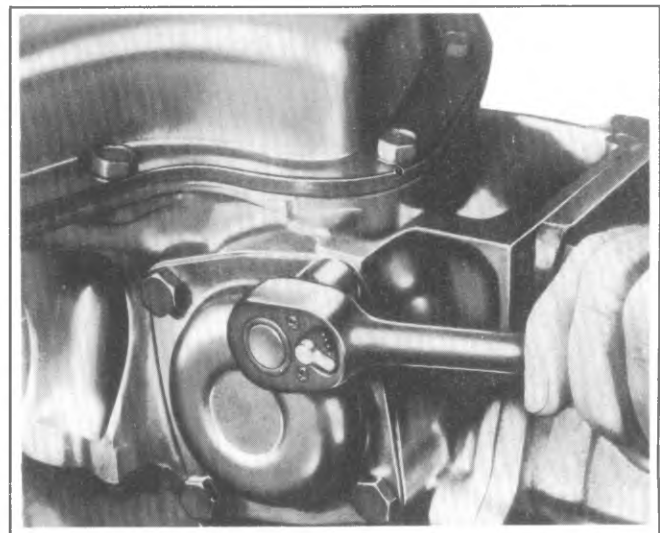


Fig. 7A-46--Removing Governor Attaching Screws

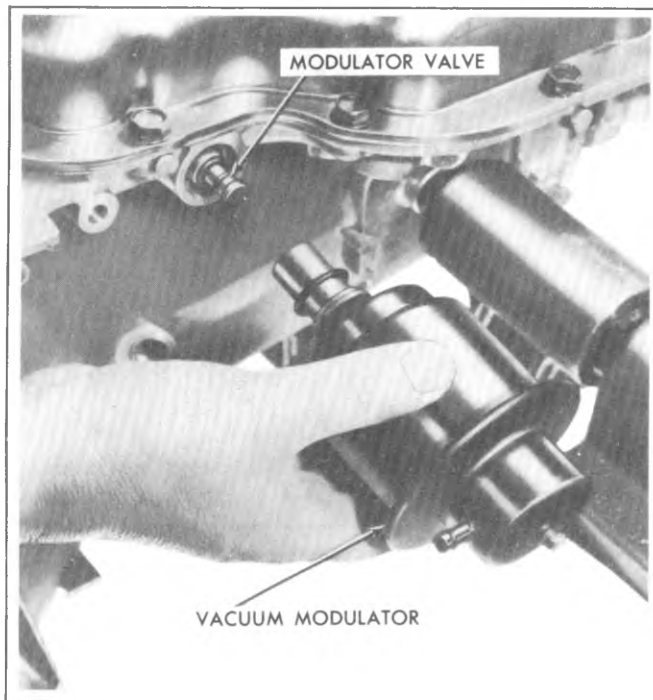


Fig. 7A-47--Removing Vacuum Modulator and Valve

MODULATOR AND MODULATOR VALVE

Removal

1. Remove modulator assembly attaching screw and retainer.
2. Remove modulator assembly from case. Discard "O" ring seal.
3. Remove modulator valve from case. See Figure 7A-47.

Installation

Installation of the modulator assembly and modulator valve is the reverse of the removal. Use a new "O" ring seal on the modulator assembly.

Adjust fluid level.

PARKING LINKAGE-10, 20 SERIES

Removal

1. Remove bottom pan and oil filter.
2. Unthread jam nut holding detent lever to manual shaft.
3. Remove manual shaft retaining pin from case.
4. Remove manual shaft and jam nut from case, as shown in Figure 7A-48.

NOTE: Do not remove manual shaft seal unless replacement is required.

5. Remove parking actuator rod and detent lever assembly.

6. Remove parking pawl bracket attaching screws and bracket.

7. Remove parking pawl return spring.

NOTE: The following steps should be completed unless part replacement is required.

8. Remove parking pawl shaft retainer.
9. Remove parking pawl shaft, cup plug parking pawl shaft, and parking pawl.

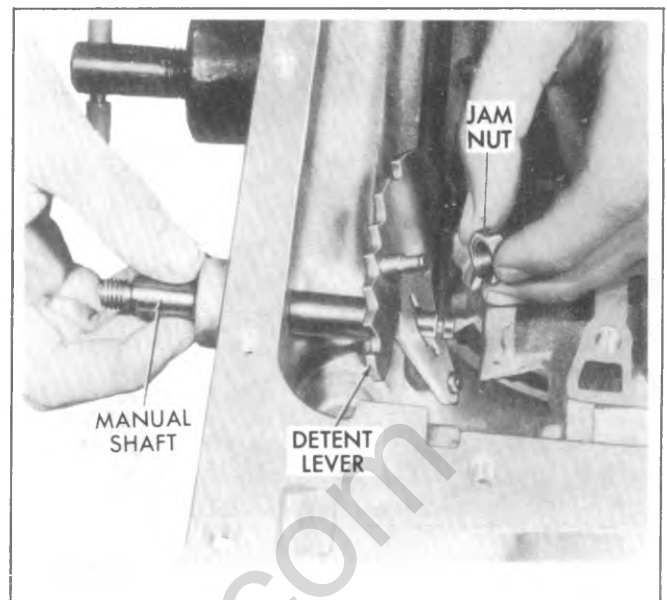


Fig. 7A-48--Removing Jam Nut from Manual Shaft

Installation

Installation of the parking linkage is the reverse of the removal. Use new seal and cup plug, if removed, and new bottom pan gasket.

CONTROL VALVE BODY

Removal

1. Remove bottom pan and filter.
2. Disconnect lead wire from pressure switch assembly.
3. Remove control valve body attaching screws and detent roller spring assembly.

NOTE: Do not remove solenoid attaching screws.

CAUTION: If the transmission is in the vehicle, the front servo parts may drop out as the control valve assembly is removed.

4. Remove control valve body assembly and governor pipes. If care is taken in removing control valve body the six (6) check balls will stay in place above the spacer plate. See Figure 7A-49.

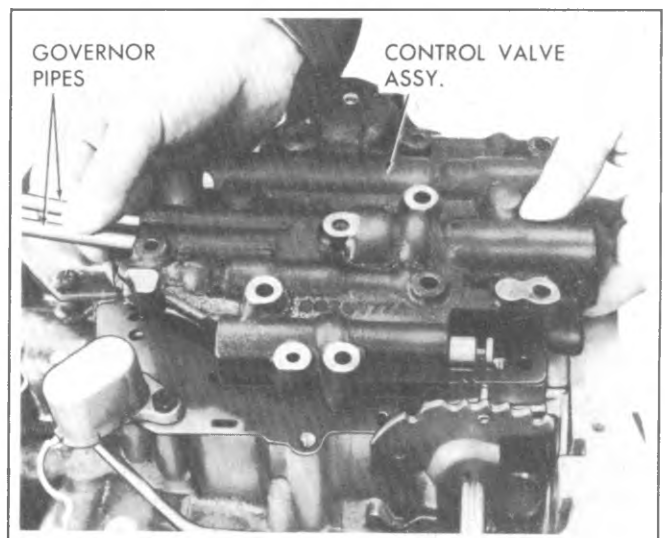


Fig. 7A-49--Removing Control Valve and Governor Pipes

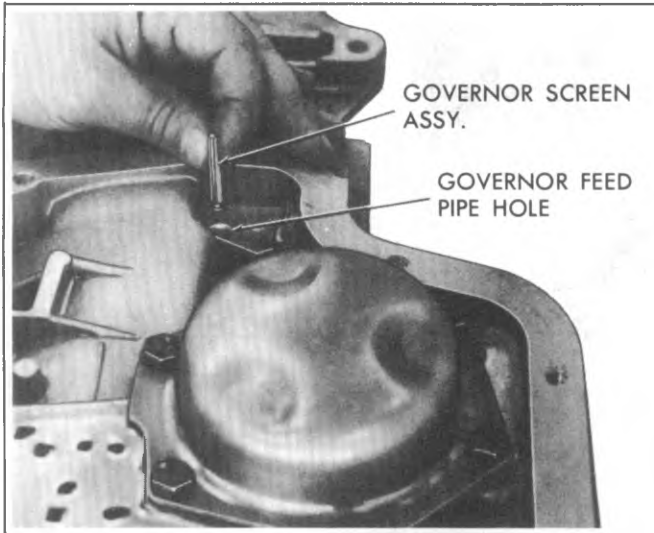


Fig. 7A-50--Governor Screen Position

5. Remove the governor screen assembly from end of governor feed pipe or from the governor feed pipe hole in the case (Fig. 7A-50). Clean governor screen in clean solvent and air dry.

CAUTION: Do not drop manual valve.

6. Remove the governor pipes and manual valve from control valve body.

Installation

Installation of control valve body is in reverse of removal. See Overhaul Manual. Adjust fluid level.

PRESSURE REGULATOR VALVE

Removal

1. Remove bottom pan and filter.
2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring, using J-5403 pliers.
3. Remove regulator boost valve bushing and valve.
4. Remove pressure regulator spring.
5. Remove spring retainer, washer spacer(s) if present, and regulator valve.

Installation

NOTE: A solid type pressure regulator valve must only be used in a pump cover with a squared-off pressure regulator boss (See Figure 7A-51). A pressure regulator valve with oil holes and orifice cup plug may be used to service either type pump.

Installation of the pressure regulator valve is the reverse of the removal. Install new gasket on oil pan and adjust fluid level.

SUPPORT STRUT ROD

Replacement

The transmission strut rod attachment is shown in Figure 7A-52. Remove the two bolts when replacing the strut rod. When removing the transmission, it is only necessary to remove the bolt at the transmission end of the strut rod.

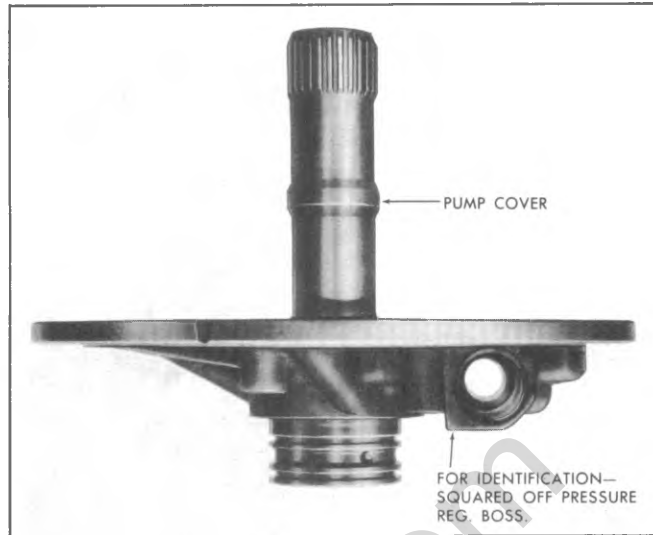


Fig. 7A-51--Pressure Regulator Valve

OIL COOLER PIPES

If replacement of transmission steel tubing cooler pipes is required, use only double wrapped and brazed steel tubing meeting GM specification 123M or its equivalent. Under no condition use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory fatigue durability to withstand normal vehicle vibrations.

Steel tubing should be flared using the upset (double lap) flare method which is detailed in Section 5.

OTHER SERVICE OPERATIONS

The following operations when done as single operations and not as part of a general overhaul should, as a practical matter, be performed with the transmission in the vehicle. Refer to the "Transmission Disassembly and Reassembly" section of the Overhaul Manual for service procedures.

1. Oil filler pipe and "O" ring seal.
2. Oil pan and gasket.
3. Down shift solenoid or connector.
4. Valve body spacer plate, gasket and check balls.
5. Front accumulator piston.

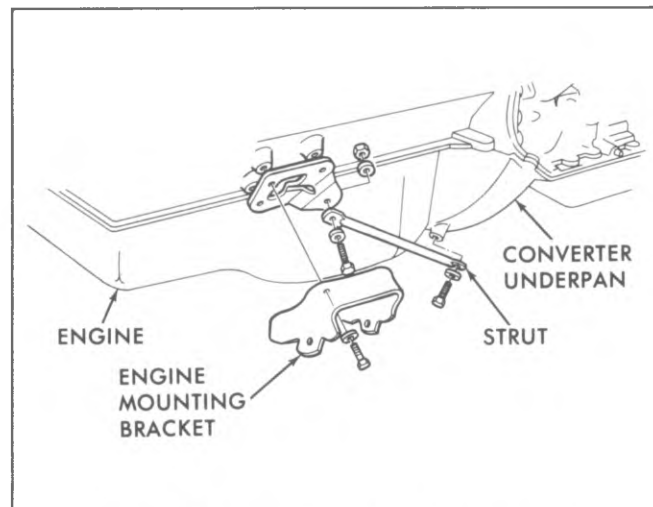


Fig. 7A-52--Transmission Support Strut Rod

6. Rear servo and rear accumulator assembly.
7. Rear band apply checking with Tool J-21370.
8. Front servo assembly.
9. Speedo driven gear.
10. Case extension or gasket.
11. Filter and "O" ring.
12. Pressure switch assembly.

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SPECIFICATIONS

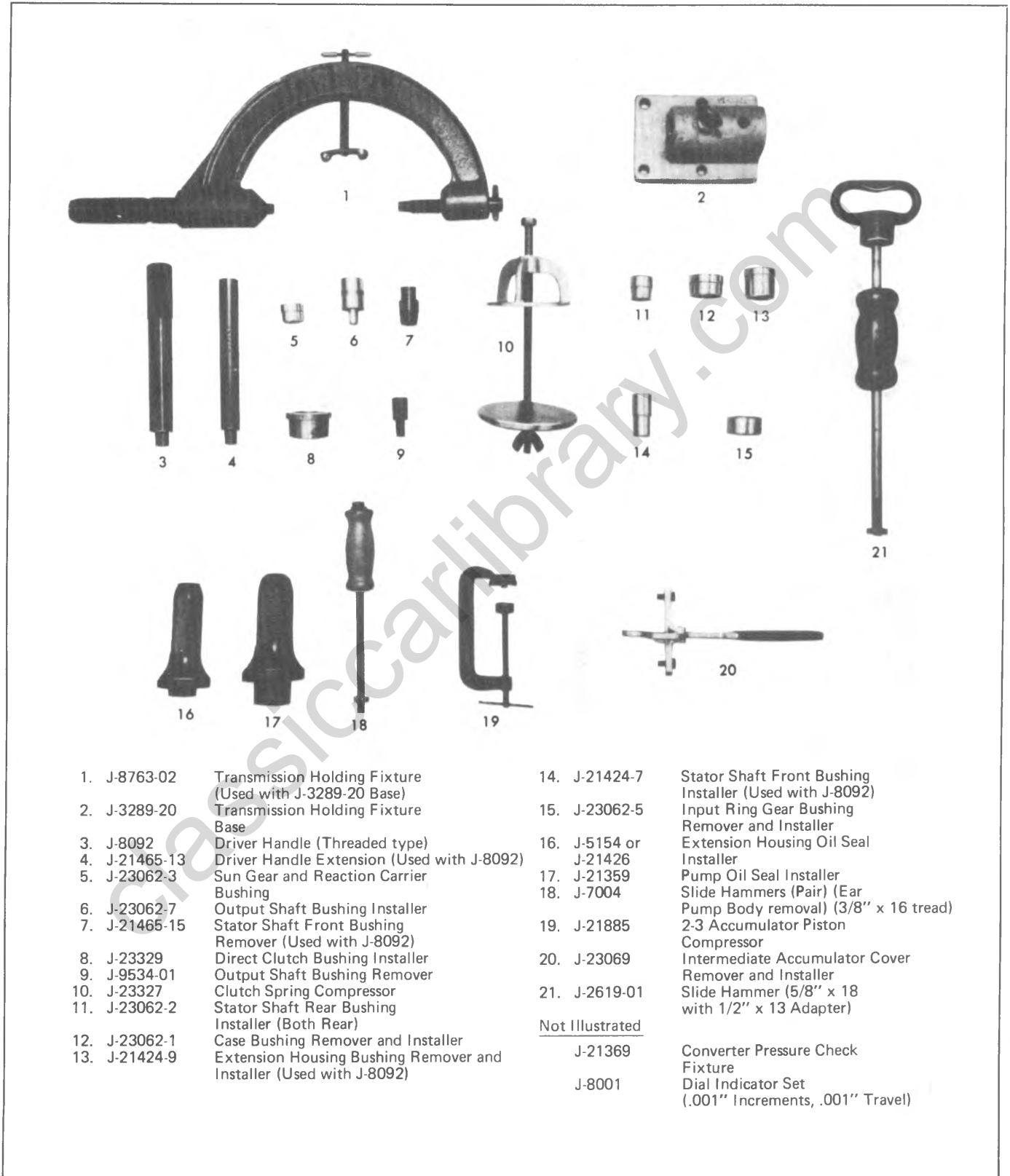
CBC 350

Pump Cover to Pump Body	17 ft. lbs.
Pump Assembly to Case	18-1/2 ft. lbs.
Valve Body and Support Plate	130 in. lbs.
Parking Lock Bracket	29 ft. lbs.
Oil Suction Screen	40 in. lbs.
Oil Pan to Case	130 in. lbs.
Extension to Case	25 ft. lbs.
Modulator Retainer to Case	130 in. lbs.
Inner Selector Lever to Shaft	25 ft. lbs.
Detent Valve Actuating Bracket	52 in. lbs.
Converter to Flywheel Bolts	35 ft. lbs.
Under Pan to Transmission Case	110 in. lbs.
Transmission Case to Engine	35 ft. lbs.
Oil Cooler Pipe Connectors to Transmission	
Case or Radiator	125 in. lbs.
Oil Cooler Pipe to Connectors	10 ft. lbs.
Detent Cable to Transmission	75 in. lbs.
Detent Cable to Carb.	112 in. lbs.

THM 400

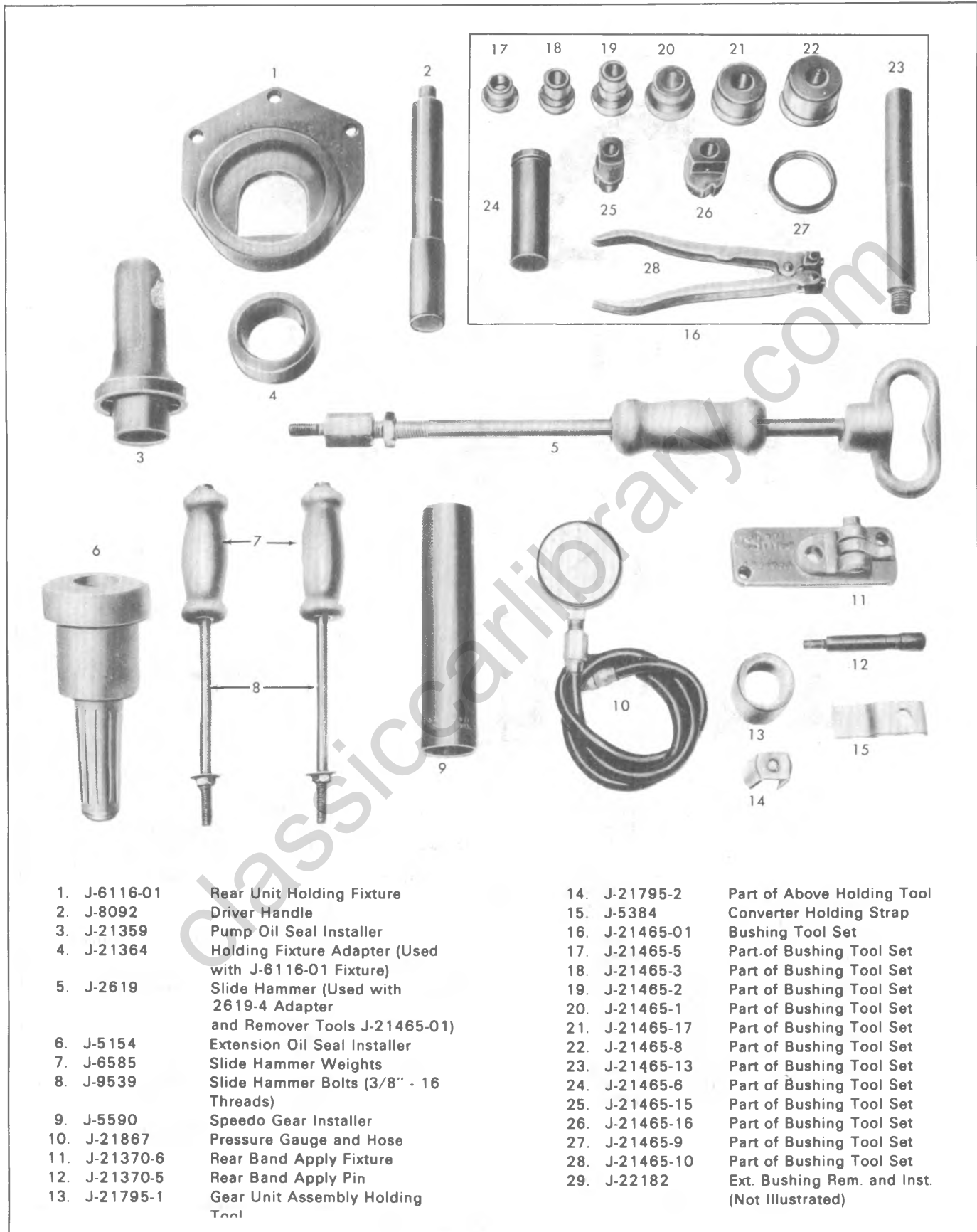
Pump Cover Bolts	18 ft. lbs.
Parking Pawl Bracket Bolts	18 ft. lbs.
Center Support Bolt	23 ft. lbs.
Pump to Case Attaching Bolts	18 ft. lbs.
Extension Housing to Case Attaching Bolts	23 ft. lbs.
Rear Servo Cover Bolts	18 ft. lbs.
Detent Solenoid Bolts	7 ft. lbs.
Control Valve Body Bolts	8 ft. lbs.
Bottom Pan Attaching Screws	12 ft. lbs.
Modulator Retainer Bolt	18 ft. lbs.
Governor Cover Bolts	18 ft. lbs.
Manual Lever to Manual Shaft Nut	8 ft. lbs.
Manual Shaft to Inside Detent Lever	18 ft. lbs.
Linkage Swivel Clamp Nut	43 ft. lbs.
Converter Dust Shield Screws	93 ft. lbs.
Transmission to Engine Mounting Bolts	35 ft. lbs.
Converter to Flywheel Bolts	35 ft. lbs.
Rear Mount to Transmission Bolts	40 ft. lbs.
Rear Mount to Crossmember Bolt	40 ft. lbs.
Crossmember Mounting Bolts	25 ft. lbs.
Oil Cooler Line	10 ft. lbs.
Line Pressure Take-Off Plug	13 ft. lbs.
Strainer Retainer Bolt	10 ft. lbs.
Oil Cooler Pipe Connectors to Transmission	
Case or Radiator	125 in. lbs.
Oil Cooler Pipe to Connector	10 in. lbs.
Downshift Switch to Bracket	22 in. lbs.

SPECIAL TOOLS



- | | | | | | |
|-----|------------|--|-----|------------------------|--|
| 1. | J-8763-02 | Transmission Holding Fixture (Used with J-3289-20 Base) | 14. | J-21424-7 | Stator Shaft Front Bushing Installer (Used with J-8092) |
| 2. | J-3289-20 | Transmission Holding Fixture Base | 15. | J-23062-5 | Input Ring Gear Bushing Remover and Installer |
| 3. | J-8092 | Driver Handle (Threaded type) | 16. | J-5154 or J-21426 | Extension Housing Oil Seal Installer |
| 4. | J-21465-13 | Driver Handle Extension (Used with J-8092) | 17. | J-21359 | Pump Oil Seal Installer |
| 5. | J-23062-3 | Sun Gear and Reaction Carrier Bushing | 18. | J-7004 | Slide Hammers (Pair) (Ear Pump Body removal) (3/8" x 16 tread) |
| 6. | J-23062-7 | Output Shaft Bushing Installer | 19. | J-21885 | 2-3 Accumulator Piston Compressor |
| 7. | J-21465-15 | Stator Shaft Front Bushing Remover (Used with J-8092) | 20. | J-23069 | Intermediate Accumulator Cover Remover and Installer |
| 8. | J-23329 | Direct Clutch Bushing Installer | 21. | J-2619-01 | Slide Hammer (5/8" x 18 with 1/2" x 13 Adapter) |
| 9. | J-9534-01 | Output Shaft Bushing Remover | | <u>Not Illustrated</u> | |
| 10. | J-23327 | Clutch Spring Compressor | | J-21369 | Converter Pressure Check Fixture |
| 11. | J-23062-2 | Stator Shaft Rear Bushing Installer (Both Rear) | | J-8001 | Dial Indicator Set (.001" Increments, .001" Travel) |
| 12. | J-23062-1 | Case Bushing Remover and Installer | | | |
| 13. | J-21424-9 | Extension Housing Bushing Remover and Installer (Used with J-8092) | | | |

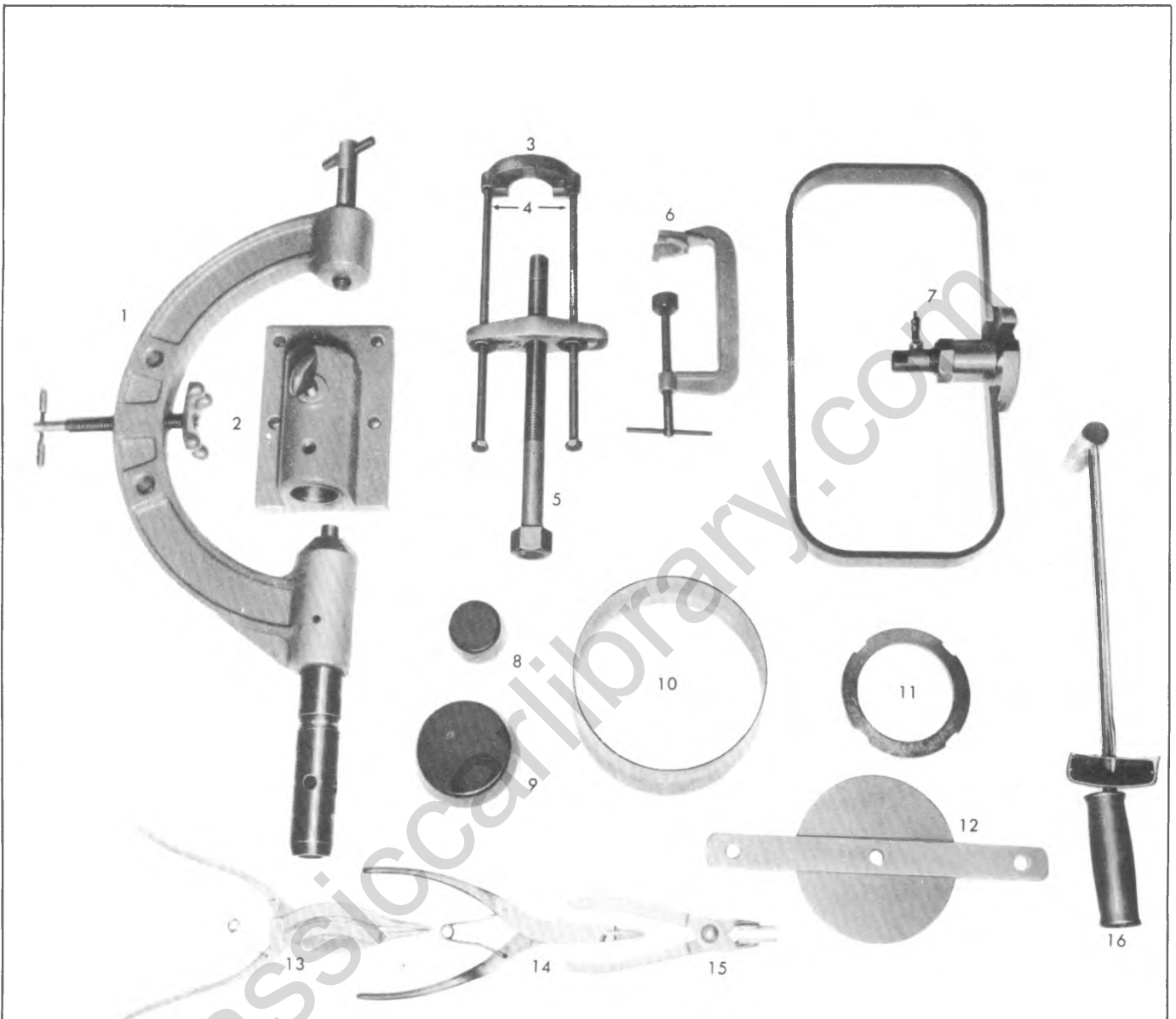
Fig. 7A-1ST--CBC 350 Special Tools



- 1. J-6116-01 Rear Unit Holding Fixture
- 2. J-8092 Driver Handle
- 3. J-21359 Pump Oil Seal Installer
- 4. J-21364 Holding Fixture Adapter (Used with J-6116-01 Fixture)
- 5. J-2619 Slide Hammer (Used with 2619-4 Adapter and Remover Tools J-21465-01)
- 6. J-5154 Extension Oil Seal Installer
- 7. J-6585 Slide Hammer Weights
- 8. J-9539 Slide Hammer Bolts (3/8" - 16 Threads)
- 9. J-5590 Speedo Gear Installer
- 10. J-21867 Pressure Gauge and Hose
- 11. J-21370-6 Rear Band Apply Fixture
- 12. J-21370-5 Rear Band Apply Pin
- 13. J-21795-1 Gear Unit Assembly Holding Tool

- 14. J-21795-2 Part of Above Holding Tool
- 15. J-5384 Converter Holding Strap
- 16. J-21465-01 Bushing Tool Set
- 17. J-21465-5 Part of Bushing Tool Set
- 18. J-21465-3 Part of Bushing Tool Set
- 19. J-21465-2 Part of Bushing Tool Set
- 20. J-21465-1 Part of Bushing Tool Set
- 21. J-21465-17 Part of Bushing Tool Set
- 22. J-21465-8 Part of Bushing Tool Set
- 23. J-21465-13 Part of Bushing Tool Set
- 24. J-21465-6 Part of Bushing Tool Set
- 25. J-21465-15 Part of Bushing Tool Set
- 26. J-21465-16 Part of Bushing Tool Set
- 27. J-21465-9 Part of Bushing Tool Set
- 28. J-21465-10 Part of Bushing Tool Set
- 29. J-22182 Ext. Bushing Rem. and Inst. (Not Illustrated)

Fig. 7A-2ST--THM 400 Special Tools



- | | | | |
|---------------|--|-----------------|---|
| 1. J-8763 | Transmission Holding Fixture | 11. J-21664 | Clutch Spring Compressor Adapter Ring |
| 2. J-3289-14 | Holding Fixture Base | 12. J-4670 | Clutch Spring Compressor |
| 3. J-21427-1 | Speedo Gear Remover | 13. J-8059 | Snap Ring Pliers |
| 4. J-9539 | Side Hammer Bolts (3/8" - 16 Threads) | 14. J-5586 | Snap Ring Pliers |
| 5. J-8105 | Speedo Gear Remover Puller | 15. J-5403 | Snap Ring Pliers |
| 6. J-22269-01 | Accumulator Piston Remover and Installer | 16. J-1313 | Torque Wrench 0-140 Ft. Lbs. |
| 7. J-21369 | Converter Pressure Check Fixture | Not Illustrated | Pressure Regulator |
| 8. J-21362 | Seal Protector - Forward and Direct Clutch - Inner | J-24684 | Valve Compressor |
| 9. J-21363 | Seal Protector - Intermediate Clutch - Inner | J-24675 | Accumulator Piston Adapter (Used with J-22269-01) |
| 10. J-21409 | Seal Protector - Forward Clutch - Outer | | |

Fig. 7A-3ST-THM 400 Special Tools

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SECTION 7B

MANUAL TRANSMISSION

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GENERAL DESCRIPTION

THREE-SPEED TRANSMISSIONS

3-Speed 76mm

3-Speed 77mm

NOTE: Manual transmissions are designated according to A) the number of forward gears, and B) the measured distance between centerlines of the mainshaft and the countergear.

The three speed synchromesh transmissions (Figs. 7B-1 through 7B-3) are representative of a constant-mesh transmission design. Fundamental components of these units are the case, which houses the gears and shaft; the shift control mechanism and the various shafts and gears. The input shaft has an integral main drive gear and rotates with the clutch driven plate; that is, the shaft rotates all the time the clutch is engaged and the engine is running. The input shaft is supported in the case by a ball bearing and at the front end by an oil impregnated bushing mounted in the engine crankshaft. The drive gear is in constant mesh with the countershaft drive gear. Since all gears in the countershaft cluster are integral to the shaft, they also rotate at the time the clutch is engaged. The countergear is carried on roller bearings at both ends and thrust is absorbed by thrust washers located between the countergear and thrust bosses in the case. The transmission mainshaft is held in line with the input shaft by a pilot bearing at its front end, which allows it to rotate or come to rest independently of the input shaft. In the 76 mm unit, the mainshaft is carried at the rear by a ball bearing mounted in the front face of the extension housing. In the 77 mm unit, the mainshaft is carried at the rear by a ball bearing mounted in the rear face of the case.

Helical gears are incorporated throughout, except for reverse gear in the 77 mm transmission. The mainshaft gears are free to rotate independently on the mainshaft and are in constant mesh with the countershaft gears. The reverse idler gear is carried on a bushing, finish bored in place, and thrust is taken on the thrust bosses of the case.

The transmissions are fully synchronized in all forward speeds; however, reverse gear is not. The synchronizer assemblies consist of a hub, sleeve, two key springs and three

synchronizer keys. The synchronizer hubs are splined to the mainshaft and retained by snap rings. These assemblies permit gears to be selected without clashing, by synchronizing the speeds of mating parts before they engage.

In the 76 mm unit, the driven gear, second speed gear, first speed gear and reverse gear are rigidly connected to the countergear. In the 77 mm transmission, only the driven gear, second speed gear and first speed gear are rigidly connected to the countergear. The engine driven clutch gear drives the countergear through a constant mesh countershaft driven gear. The countergear rotates in a direction opposite, or counter, to the rotation of the clutch gear. Forward speed gears on the countergear remain in constant mesh with two nonsliding mainshaft gears giving first and second speed. Third speed is a direct drive with the clutch gear engaged directly to the mainshaft. Forward gears are engaged through two sliding synchronizer sleeves mounted on the mainshaft. Engagement of the constant mesh mainshaft gears to the mainshaft is accomplished through blocker ring-type synchronizers.

FOUR-SPEED TRANSMISSION

4-Speed 117mm

The 117mm, Model CH 465 truck transmission (Figs. 7B-4 and 7B-5) uses a constant mesh first gear that engages with the second speed synchronizer sleeve. Second, third and fourth gears are synchronized. The clutch gear is supported by a heavy duty ball bearing. The forward end of the mainshaft is supported by a loose collar-type bearing inside the clutch gear, while therear is carried on a ball bearing in the case. End play is taken up by the rear flange retaining nut. The countergear is supported at the rear by a single row ball bearing which takes the thrust load, and by a roller bearing at the front. Incorporated in the cover is a ball pin type interlock which prevents simultaneous engagement of two gears. As one rod is moved, it pushes a ball out that engages the other two rods to prevent their movement.

Gearshift levers on manual transmissions are located

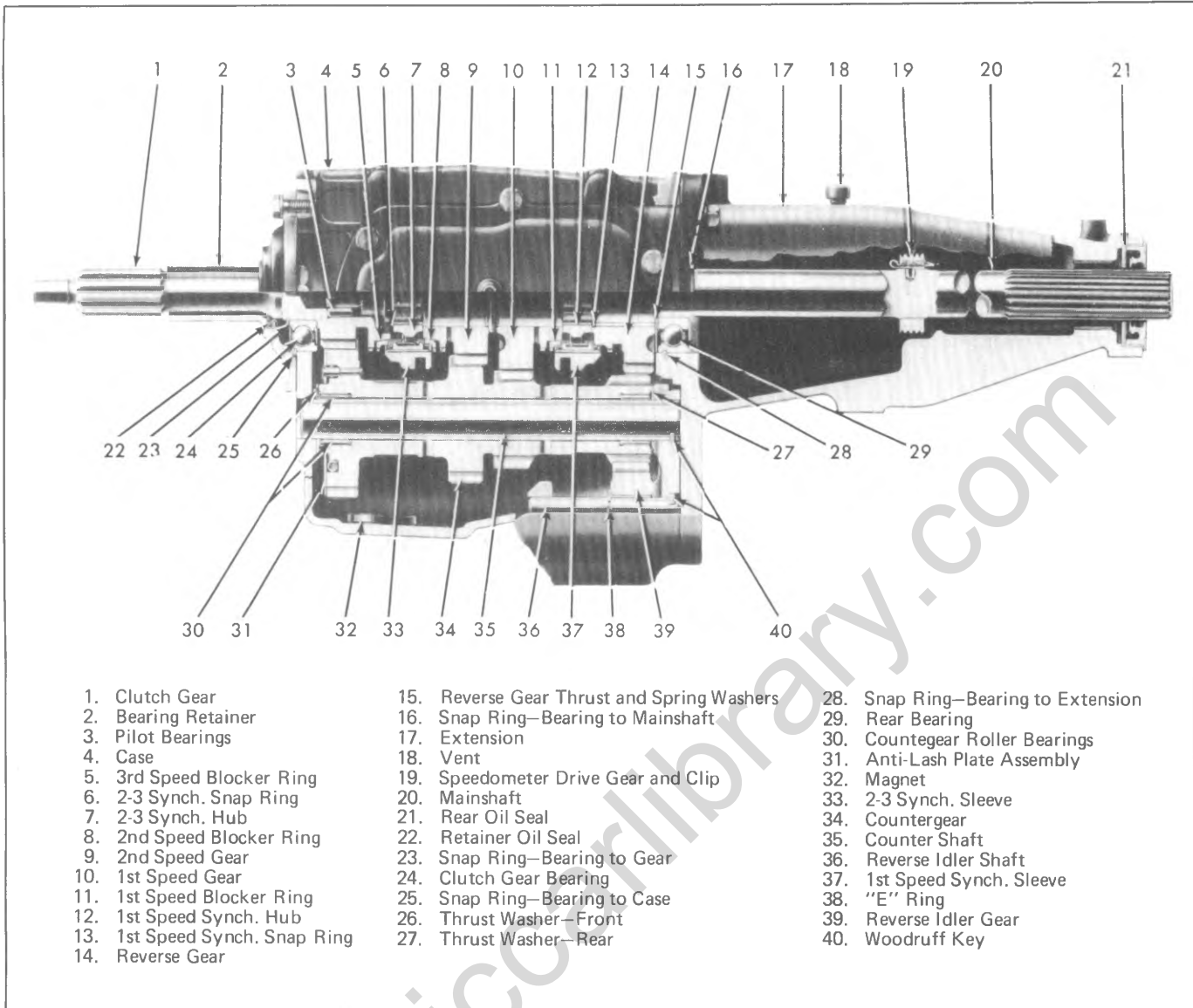
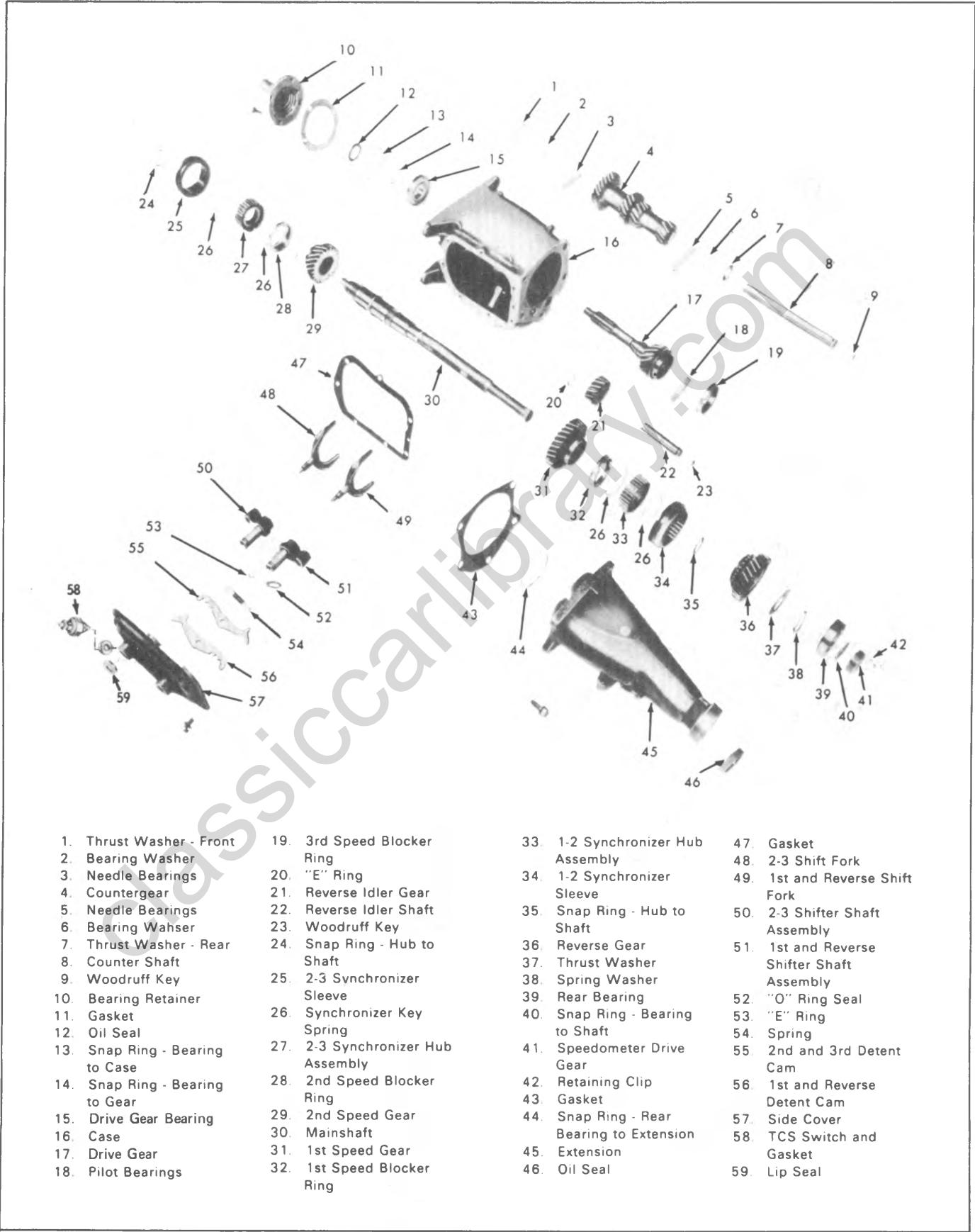


Fig. 7B-1--3-Speed 76mm, Cross-Section

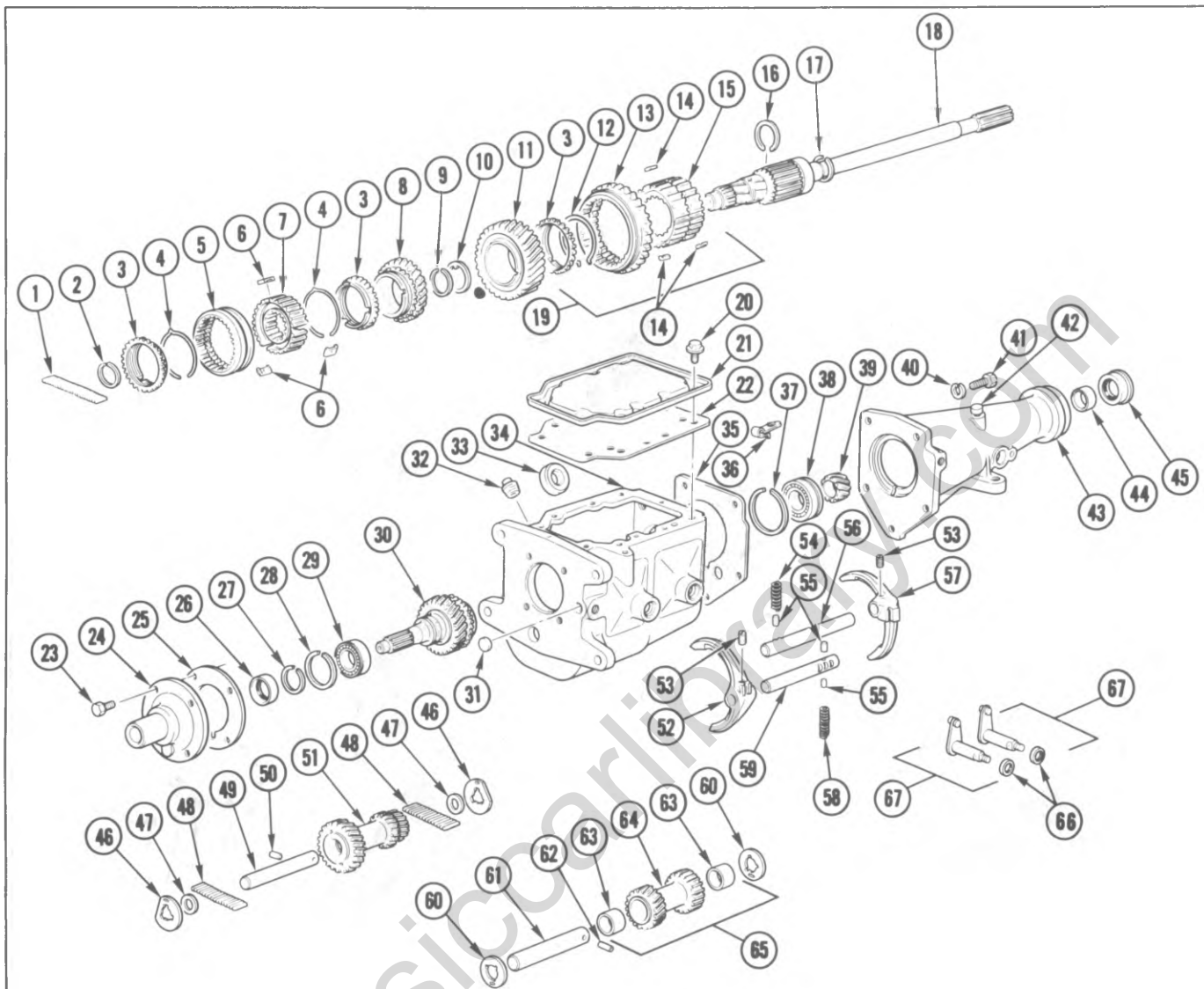
either on the steering column or on the floorboard. Regardless of location, the lever performs two operations: It selects the gear assembly to be moved, and moves it either forward or backward into the desired gear position. The transmission action is the same whether a floor-type shift

lever or a steering column shift lever is used. When the shift lever is moved, the movement is carried by linkage to the transmission.



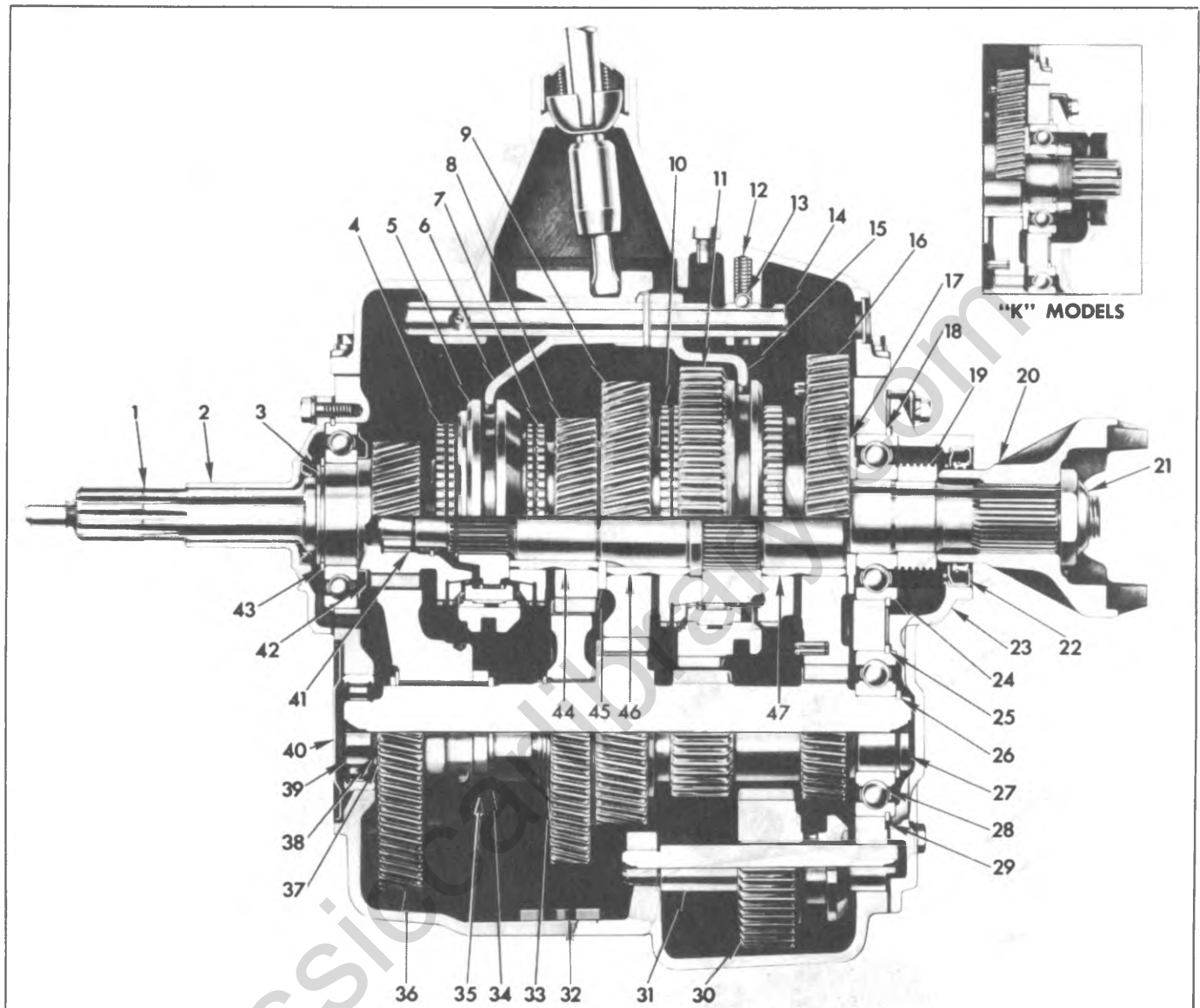
- | | | | |
|---------------------------------|-----------------------------------|---|--|
| 1. Thrust Washer - Front | 19. 3rd Speed Blocker Ring | 33. 1-2 Synchronizer Hub Assembly | 47. Gasket |
| 2. Bearing Washer | 20. "E" Ring | 34. 1-2 Synchronizer Sleeve | 48. 2-3 Shift Fork |
| 3. Needle Bearings | 21. Reverse Idler Gear | 35. Snap Ring - Hub to Shaft | 49. 1st and Reverse Shift Fork |
| 4. Countergear | 22. Reverse Idler Shaft | 36. Reverse Gear | 50. 2-3 Shifter Shaft Assembly |
| 5. Needle Bearings | 23. Woodruff Key | 37. Thrust Washer | 51. 1st and Reverse Shifter Shaft Assembly |
| 6. Bearing Wahser | 24. Snap Ring - Hub to Shaft | 38. Spring Washer | 52. "O" Ring Seal |
| 7. Thrust Washer - Rear | 25. 2-3 Synchronizer Sleeve | 39. Rear Bearing | 53. "E" Ring |
| 8. Counter Shaft | 26. Synchronizer Key Spring | 40. Snap Ring - Bearing to Shaft | 54. Spring |
| 9. Woodruff Key | 27. 2-3 Synchronizer Hub Assembly | 41. Speedometer Drive Gear | 55. 2nd and 3rd Detent Cam |
| 10. Bearing Retainer | 28. 2nd Speed Blocker Ring | 42. Retaining Clip | 56. 1st and Reverse Detent Cam |
| 11. Gasket | 29. 2nd Speed Gear | 43. Gasket | 57. Side Cover |
| 12. Oil Seal | 30. Mainshaft | 44. Snap Ring - Rear Bearing to Extension | 58. TCS Switch and Gasket |
| 13. Snap Ring - Bearing to Case | 31. 1st Speed Gear | 45. Extension | 59. Lip Seal |
| 14. Snap Ring - Bearing to Gear | 32. 1st Speed Blocker Ring | 46. Oil Seal | |

Fig. 7B-2--3-Speed 76mm, Exploded View



- | | |
|--|---|
| 1. MAINSHAFT ROLLER BEARINGS | 35. EXTENSION HOUSING TO CASE GASKET |
| 2. 2ND & 3RD SYNCHRONIZER RETAINING RING | 36. SPEEDOMETER DRIVER GEAR RETAINING CLIP |
| 3. SYNCHRONIZER BLOCKER RINGS | 37. TRANSMISSION REAR BEARING LOCK RING |
| 4. 2ND & 3RD SYNCHRONIZER SPRING | 38. MAINSHAFT BEARING ASSEMBLY |
| 5. 2ND & 3RD SYNCHRONIZER SLEEVE | 39. SPEEDOMETER DRIVE GEAR |
| 6. 2ND & 3RD SYNCHRONIZER KEYS | 40. EXTENSION TO CASE WASHER |
| 7. 2ND & 3RD SYNCHRONIZER HUB | 41. EXTENSION TO CASE BOLT |
| 8. SECOND SPEED GEAR | 42. TRANSMISSION EXTENSION VENTILATOR ASSEMBLY |
| 9. 1ST SPEED GEAR RETAINING RING | 43. EXTENSION HOUSING ASSEMBLY |
| 10. 1ST SPEED GEAR TABBED WASHER | 44. EXTENSION HOUSING BUSHING |
| 11. 1ST SPEED GEAR | 45. EXTENSION HOUSING OIL SEAL ASSEMBLY |
| 12. REVERSE SYNCHRONIZER SPRING | 46. COUNTERGEAR THRUST WASHER |
| 13. 1ST & REVERSE SYNCHRONIZER SLEEVE & GEAR | 47. COUNTERGEAR SPACER |
| 14. REVERSE SYNCHRONIZER KEYS | 48. COUNTERGEAR ROLLET BEARINGS |
| 15. 1ST & REVERSE SYNCHRONIZER HUB | 49. COUNTERGEAR SHAFT |
| 16. 1ST & REVERSE SYNCHRONIZER RETAINING RING | 50. COUNTERGEAR SPRING PIN |
| 17. REAR BEARING RETAINING RING | 51. COUNTERGEAR |
| 18. TRANSMISSION MAINSHAFT | 52. 2ND & 3RD SHIFTER FORK |
| 19. REVERSE-SYNCHRONIZER ASSEMBLY | 53. SHIFTER LOCKING SCREW |
| 20. ACCESS COVER BOLTS | 54. 1ST & 2ND SHIFTER INTERLOCK SPRING |
| 21. ACCESS COVER | 55. SHIFTER INTERLOCK PIN |
| 22. ACCESS COVER GASKET | 56. 1ST & REVERSE SHIFTER RAIL |
| 23. BEARING RETAINER - TO CASE BOLTS | 57. 1ST & REVERSE SHIFTER FORK |
| 24. BEARING RETAINER - CLUTCH GEAR | 58. 2ND & 3RD SHIFTER INTERLOCK SPRING |
| 25. GASKET - CLUTCH GEAR BEARING RETAINER | 59. 2ND & 3RD SHIFTER RAIL |
| 26. SEAL ASSEMBLY - CLUTCH GEAR BEARING RETAINER | 60. REVERSE IDLER GEAR THRUST WASHER |
| 27. CLUTCH GEAR BEARING RETAINING RING | 61. REVERSE IDLER GEAR SHAFT |
| 28. CLUTCH GEAR BEARING LOCK RING | 62. SPRING PIN IDLER GEAR SHAFT |
| 29. CLUTCH GEAR BEARING ASSEMBLY | 63. REVERSE IDLER GEAR BUSHING |
| 30. CLUTCH GEAR | 64. REVERSE IDLER GEAR |
| 31. EXPANSION PLUG | 65. REVERSE IDLER GEAR ASSEMBLY |
| 32. FILLER PLUG | 66. SEAL TRANSMISSION SHIFTER |
| 33. TRANSMISSION CASE MAGNET | 67. TRANSMISSION SHIFTER SHAFT & LEVER ASSEMBLY |
| 34. CASE | |

Fig. 7B-3--3-Speed 77mm, Exploded View



- | | | | |
|--|------------------------------------|-------------------------------|--------------------------------|
| 1. Main Drive Gear | 11. Reverse Driven Gear | 24. Mainshaft Rear Bearing | 37. Thrust Washer |
| 2. Drive Gear Bearing Retainer | 12. Poppet Spring | 25. Rear Bearing Snap Ring | 38. Snap Ring |
| 3. Snap Ring-Outer | 13. Poppet Ball | 26. Snap Ring | 39. Front Countershaft Bearing |
| 4. 3rd and 4th Synchronizer Ring | 14. Shift Rail | 27. Countershaft | 40. Countergear Front Cover |
| 5. 3rd and 4th Synchronizer Collar | 15. 1st and 2nd Shift Fork | 28. Countershaft Rear Bearing | 41. Pilot Bearing Rollers |
| 6. 3rd and 4th Shift Fork | 16. 1st Speed Gear | 29. Bearing Snap Ring | 42. Clutch Gear Oil Slinger |
| 7. 3rd and 4th Speed Synchronizer Ring | 17. Thrust Washer | 30. Reverse Idler Gear | 43. Snap Ring |
| 8. 3rd Speed Gear | 18. Bearing Snap Ring | 31. Reverse Idler Shaft | 44. 3rd Speed Gear Bushing |
| 9. 2nd Speed Gear | 19. Speedometer Drive Gear | 32. Case Magnet | 45. Thrust Washer |
| 10. 1st and 2nd Synchronizer Assembly | 20. Output Yoke | 33. Snap Ring | 46. 2nd Speed Gear Bushing |
| | 21. Flange Nut | 34. Snap Ring | 47. 1st Speed Gear Bushing |
| | 22. Rear Bearing Retainer Oil Seal | 35. Spacer | |
| | 23. Rear Bearing Retainer | 36. Countergear | |

Fig. 7B-4-4-Speed, 117mm, Cross-Section

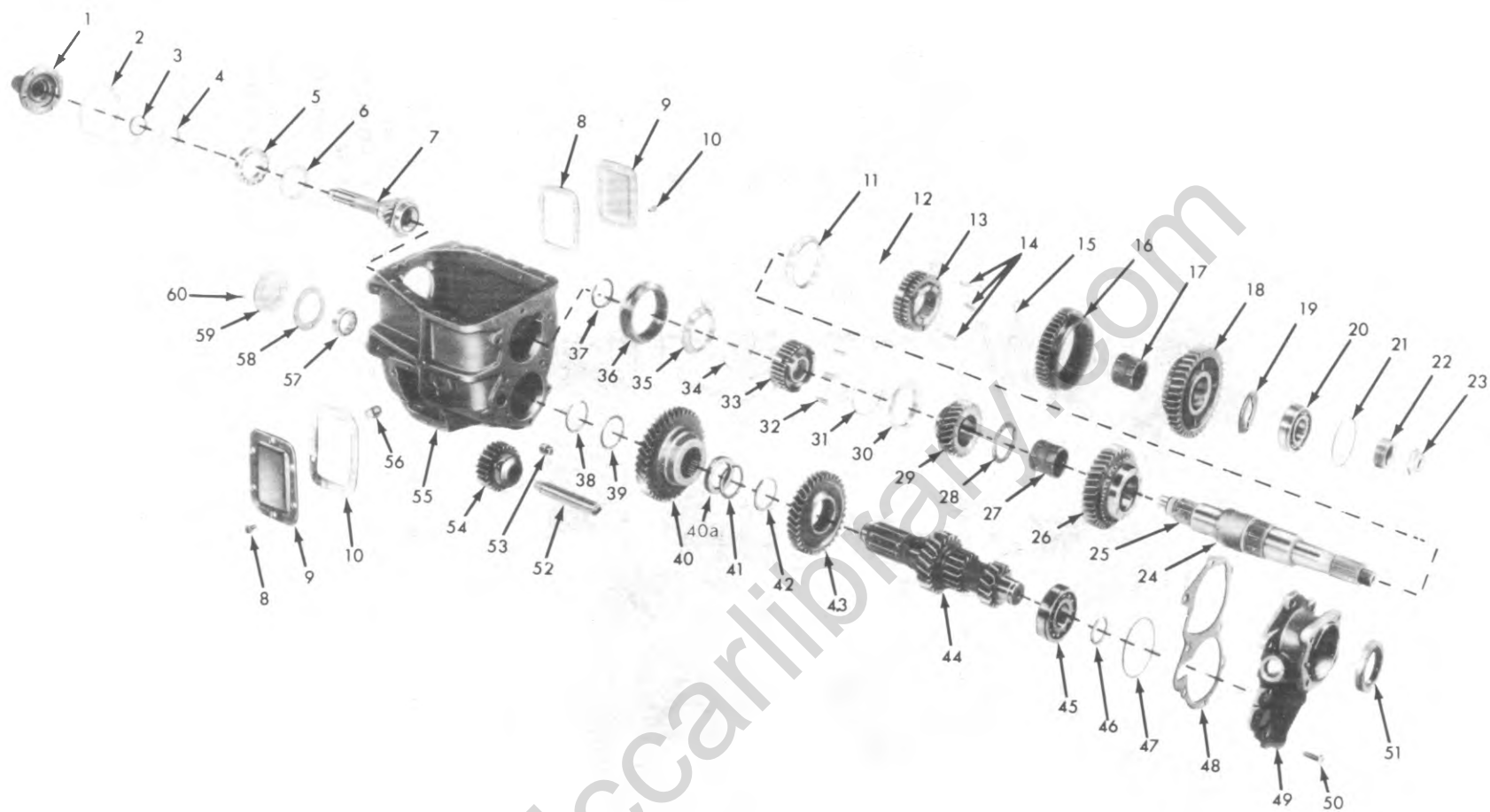


Fig. 7B-5-4-Speed 117mm, Exploded View

- | | | | | |
|----------------------------------|------------------------------------|---------------------------------------|------------------------------|-------------------------------|
| 1. Drive Gear Bearing Retainer | 13. 1st-2nd Speed Synchronizer Hub | 26. 2nd Speed Gear | 37. Snap Ring | 48. Rear Retainer Gasket |
| 2. Retainer Gasket | 14. Synchronizer Keys | 27. 3rd Gear Bushing | 38. Snap Ring | 49. Rear Retainer |
| 3. Lip Seal | 15. Synchronizer Spring | 28. Thrust Washer | 39. Thrust Washer | 50. Retainer Bolts |
| 4. Snap Ring | 16. Reverse Driven Gear | 29. 3rd Speed Gear | 40. Clutch Countergear | 51. Retainer Lip Seal |
| 5. Drive Gear Bearing | 17. 1st Gear Bushing | 30. 3rd Speed Blocker Ring | 40a. Spacer | 52. Reverse Idler Shaft |
| 6. Oil Slinger | 18. 1st Gear Thrust Washer | 31. Synchronizer Spring | 41. Snap Ring | 53. Drain Plug |
| 7. Drive Gear and Pilot Bearings | 19. Rear Main Bearing | 32. Synchronizer Keys | 42. Snap Ring | 54. Reverse Idler Gear |
| 8. Power Take-Off Cover Gasket | 20. Speedometer Gear | 33. 3rd-4th Synchronizer Hub | 43. 3rd Speed Countergear | 55. Case |
| 9. Power Take-Off Cover | 21. Bearing Snap Ring | 34. Synchronizer Spring | 44. Countergear Shaft | 56. Fill Plug |
| 10. Retaining Screws | 22. Speedometer Gear | 35. 3rd-4th Speed Blocker Ring | 45. Countergear Rear Bearing | 57. Countergear Front Bearing |
| 11. 1st-2nd Speed Blocker Ring | 23. Rear Mainshaft Lock Nut | 36. 3rd-4th Speed Synchronizer Sleeve | 46. Snap Ring | 58. Gasket |
| 12. Synchronizer Spring | 24. 2nd Speed Bushing (On Shaft) | | 47. Bearing Outer Snap Ring | 59. Front Cover |
| | 25. Mainshaft | | | 60. Cover Screws |

MAINTENANCE AND ADJUSTMENTS

TRANSMISSION LINKAGE ADJUSTMENT

3-Speed Column Shift

(Figs. 7B-6, 7B-7, and 7B-8)

In cases where gearshift linkage has been disconnected or removed, proper adjustment sequence is important.

1. Set both shifter levers in neutral position. Install control rods to both second and third shifter lever and first and reverse shifter lever.

2. Align both shifter tube levers on mast jacket in the neutral position. Install gauge (3/16 to 7/32 in.) in holes of levers so that gearshift control lever is in neutral position.

3. Connect control rods to tube levers making sure clamps are properly adjusted so that tube levers and transmission shifter levers remain in their neutral positions while tightening.

4. Remove gauge and move selector lever through all positions to check adjustment and insure over-travel in all positions.

NOTE: If mast jacket lower dash clamp has been disturbed at its mounting on dash, its adjustment to the steering mainshaft should be checked as outlined in Section 3B of this manual.

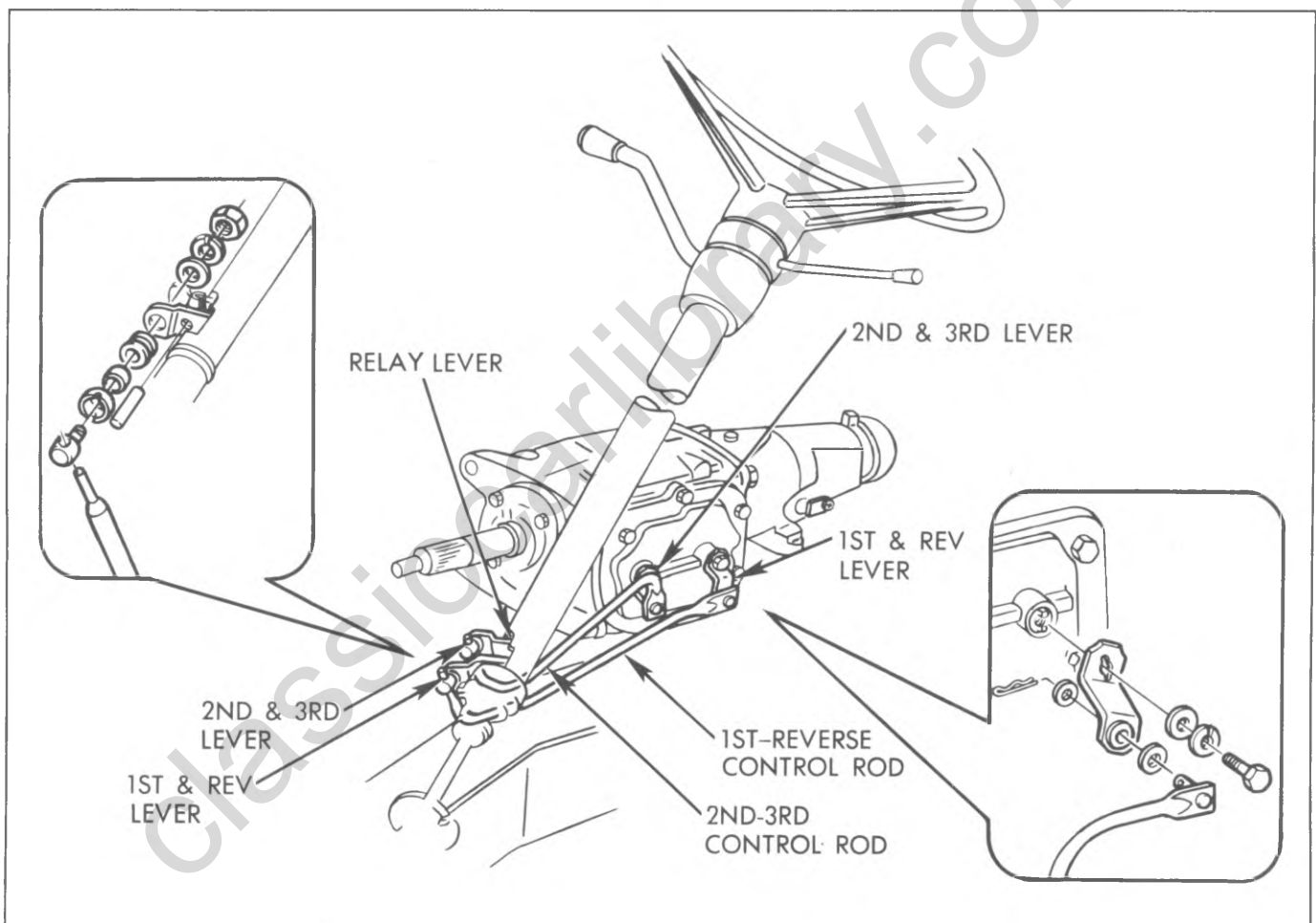


Fig. 7B-6--G-Truck Column Shift Linkage

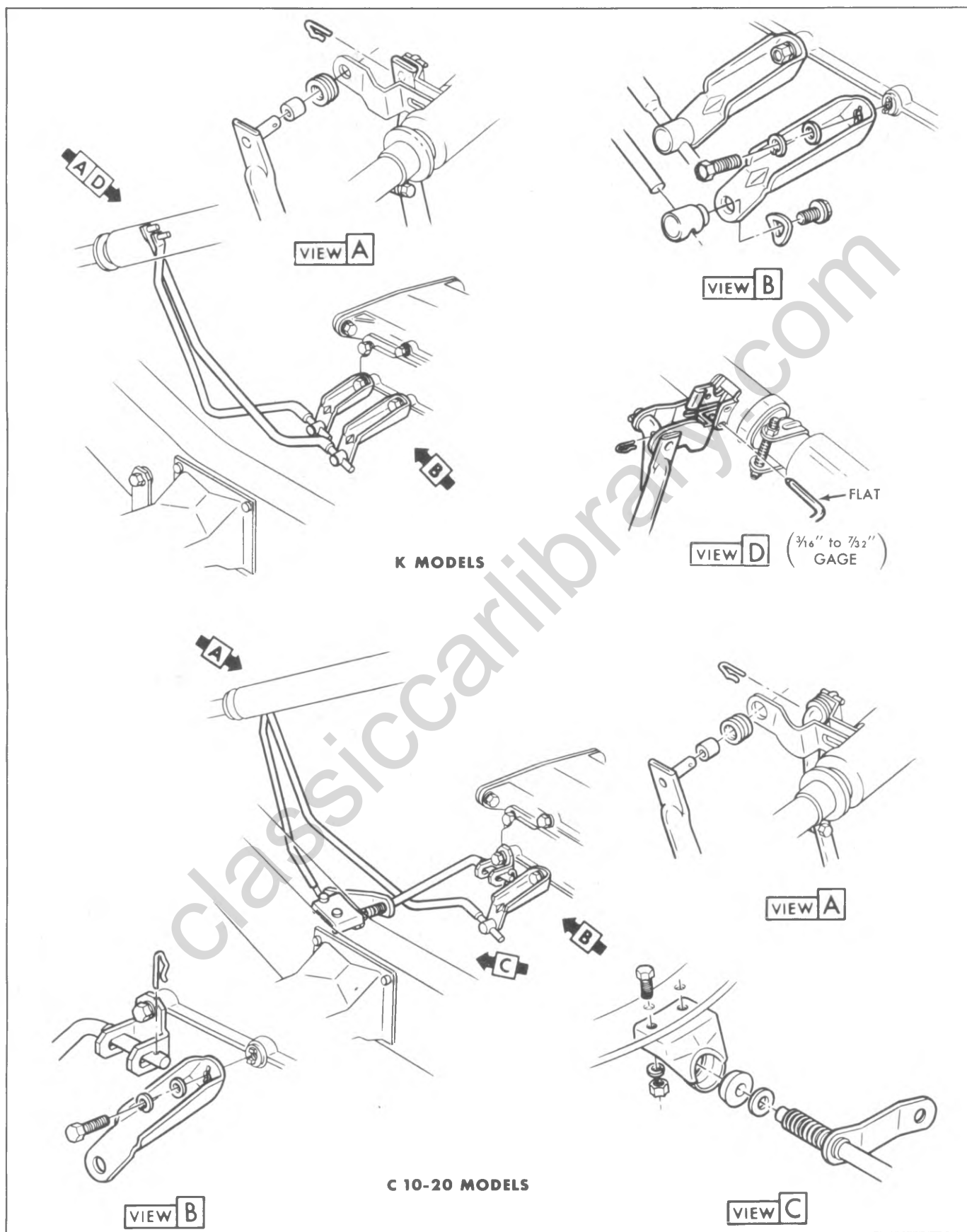


Fig. 7B-7--C and K-Truck Column Shift Linkage

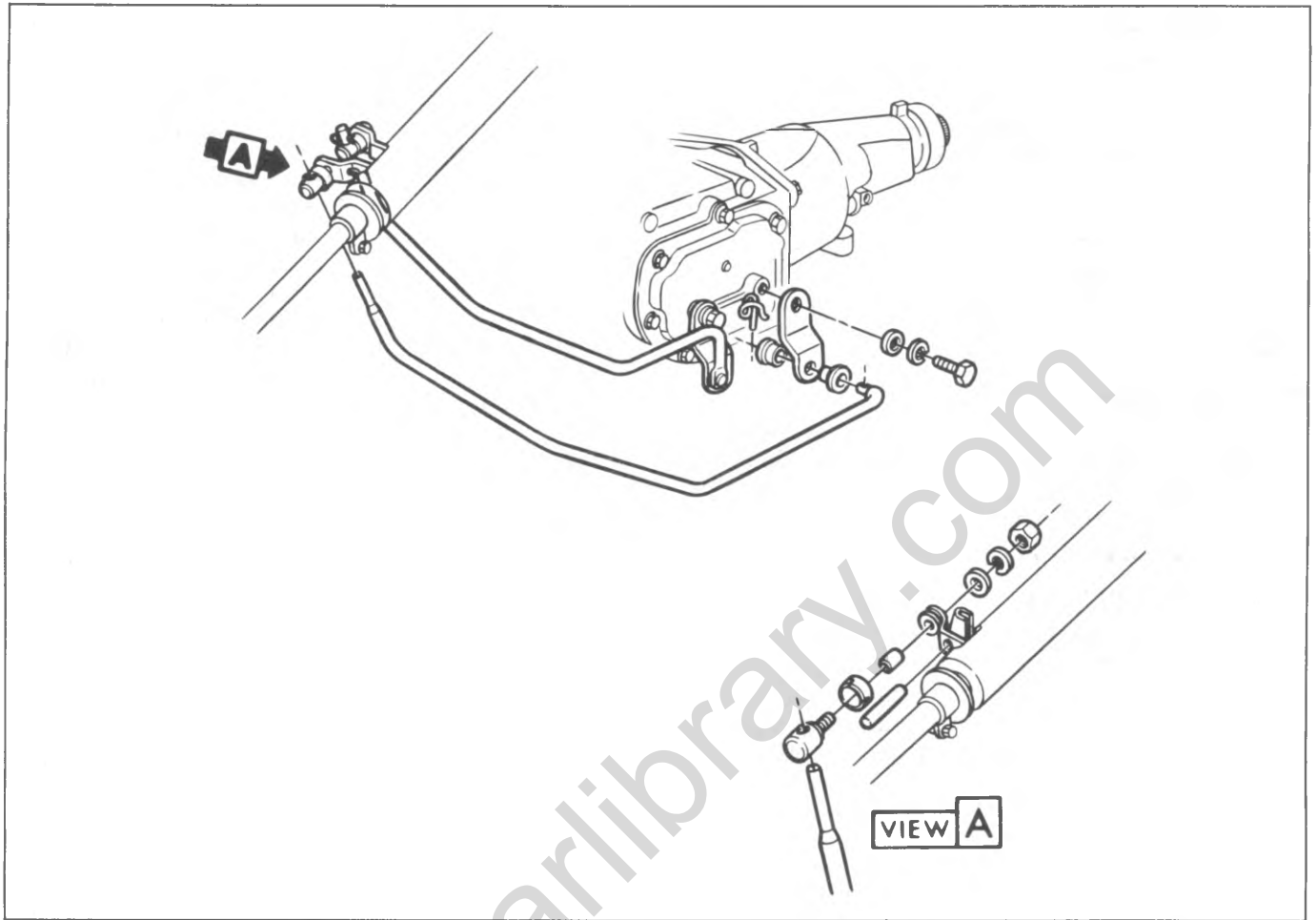


Fig. 7B-8-P-Truck Column Shift Linkage

DIAGNOSIS

Preliminary Inspection

Before attempting to repair the clutch, transmission or related linkages for any reason other than an obvious failure, the problem and probable cause should be identified. A large percentage of clutch and manual transmission problems are manifested by shifting difficulties such as high shift effort, gear clash and grinding or transmission blockout. When any of these problems occur a careful analysis of these difficulties should be accomplished, and the following checks and adjustments performed in the presented sequence before removing the clutch or transmission for repairs.

CLUTCH ADJUSTMENT

Clutch Free Pedal Travel

1. The clutch free pedal travel adjustment should be made as outlined in ■ Section 7C.
2. Check clutch linkage for lost motion caused by loose or worn swivels, deflection of mounting brackets or damaged conrod shaft.

Clutch Spin Down Time

1. Run the engine at a normal idle with transmission in neutral and clutch engaged.
2. Disengage the clutch, wait nine seconds and shift the transmission to reverse. No grinding noise should be heard. A grinding noise indicates incorrect clutch adjustment, lost motion clutch misalignment, or internal problems such as failed dampers, facings, cushion springs, diaphragm spring fingers, pressure plate drive straps, etc.

SHIFT LINKAGE ADJUSTMENT

Steering Column Shift Control

1. Remove the shift control rods from the column levers.
2. Check shift effort at the shift control lever knob. (Effort should not exceed 2 lbs. with transmission linkage removed.)
3. If binding is felt, refer to the adjustment procedure for the steering column lower bearing in Section 3B.
4. Lubricate all rod and swivel connections and recheck shift effort after installation.
5. If shift linkage is free from binding, the column levers should be checked for end play. A .005" feeler gauge

SHIFT TORQUE Inch-Pounds	3-SPD — 76mm
	50

Fig. 7B-9--Shift Torque Chart

should fit between the levers and control lever.

6. Connect control rods and check steering column control levers for alignment. In neutral, the column control lever tangs should line up with the slot in the main control lever.

Floor Shift Control

All swivels, rods and mountings should be checked for lost motion and repaired or replaced as necessary. Transmission control levers should be checked for wear and repaired or replaced as necessary.

TRANSMISSION SHIFT EFFORT

Transmission Shift Effort Checking Procedures

1. Remove the shift rods at the transmission and align the sleeve, blocker ring and gear by shifting into the offending gear and then back into neutral.

2. Check the torque required to shift into gear with an inch pound torque wrench on the shift lever attaching bolt. If more than the specified torque (Fig. 7B-11) is required, the transmission shift lever should be checked for rust or dirt binding the lever.

3. Clean levers, lubricate and recheck the torque value.

NOTE: If at this point in the procedure, it is found that high shift effort or blockout still exists, an anti-chatter lubricant (positraction additive) should be used. The lubricant is available in plastic bottle and can be squirted into the transmission through the filler plug.

Transmission Internal Problems Related to Shift Effort

When the above procedures have been checked and the problem still exists, the transmission will have to be removed and disassembled for further diagnosis. There are three basic types of transmission internal problems reflected by shifting effort.

1. Hard Shifting - The effort to shift is excessive, but

the gears engage. The lever moves with excessive effort throughout the entire travel range. If the static shift effort is high, (clutch depressed, engine not running) the synchronizer sleeve and hubs should be checked for a tight fit. With the three synchronizer keys removed, the sleeve should be loose on the hub. If the hub and sleeve are not a loose fit, replace the synchronizer assembly.

2. Blockout - The lever moves freely until the synchronizer is engaged. Synchronization should be heard to take place, but the gear will not engage. When it does engage, a double bump is generally felt in the lever. The synchronized blocker ring can be damaged by excessive force on gear cones that are finished improperly. The blocker ring material may stick to the synchronizer gear cone causing it to be a yellowish brass color, in streaks, which results in hard shifts when present. The gear cone should be a bright silver color. Polish the gear cone with 400 grit paper to a bright silver when this condition is present. The blocker rings should be replaced if the thread is damaged or worn.

3. Clash - Gear clash is a sound which sometimes occurs when the sleeve and gear chamfers contact each other in the unsynchronized state. The characteristics of clash are a grating or loud buzzing sound from the transmission. The shift lever load will be lower, but a vibration should be felt. The noise (clash) can be for a short instant or long enough to keep the gear from being engaged. This condition should not be confused with hard shifting or reported as such. Hard shifting and clash are directly opposite conditions. When the clash is slight, the load will build up on the shift lever and then fall off rapidly followed by the grating sound.

If the transmission has been clashing, the sleeve ends should be examined for chipping and burrs. If the sleeves are damaged, the synchronizer assemblies and blocker rings should be replaced. Synchronizer sleeve ends should have an angular surface. The surfaces should be even from side to side and the radii indicated should be very small. Any chipping will require synchronizer replacement.

Check the synchronizer load. When the keys are installed, the spring ends on one side of the hub should be hooked in one key and the spring on the opposite side of the synchronizer should not be hooked on the same key. A definite load should be felt when the sleeve is moved on the hubs with the keys and springs in proper position.

SHIFTING DIFFICULTY DIAGNOSIS

CONDITION	PROBABLE CAUSE	CORRECTION
High Shift Effort-Column Shift (Effort exceeds 2 ft. lbs. at lever knob with transmission linkage disconnected.)	Binding of column levers	Adjust column mechanism per Section 3B Steering of the Chassis Service Manual
		Clean and lubricate all rod and swivel connections.
	Lever end play exceeds .005 in.	Adjust levers
	Misalignment of column control levers.	Adjust levers
Gear Clash and binding	Improper linkage Adjustment	Adjust Shift linkage
Lost motion	Loose or worn swivels and grommets. Deflection of Mounting Brackets. Loose shift levers. Damaged Cordon Shaft	Replace defective parts

Fig. 7B-10--Shifting Difficulty Diagnosis Chart

MANUAL TRANSMISSION DIAGNOSIS

CONDITION	PROBABLE CAUSE	CORRECTION
Slips out of High Gear	<ul style="list-style-type: none"> a. Transmission loose on clutch housing b. Shift rods interfere with engine mounts or clutch throw-out lever c. Shift linkage does not work freely; binds d. Damaged mainshaft pilot bearing e. Main drive gear retainer broken or loose f. Dirt between transmission case and clutch housing g. Misalignment of transmission h. Stiff shift lever seal i. Pilot bearing loose in crankshaft j. Worn or improperly adjusted linkage 	<ul style="list-style-type: none"> a. Tighten mounting bolts b. Replace or bend levers and rods to eliminate interference c. Adjust and free up shift linkage d. Replace pilot bearing e. Tighten or replace main drive gear f. Clean mating surfaces g. Refer to TRANSMISSION ALIGNMENT h. Replace seal i. See Section 6 for brg. fits j. Adjust or replace linkage as required
Noisy in All Gears	<ul style="list-style-type: none"> a. Insufficient lubricant b. Worn countergear bearings c. Worn or damaged main drive gear and countergear d. Damaged main drive gear or main shaft bearings e. Worn or damaged countergear anti-lash plate 	<ul style="list-style-type: none"> a. Fill to correct level b. Replace countergear bearings and shaft c. Replace worn or damaged gears d. Replace damaged bearings or main drive gear e. Replace countergear
Noisy in High Gear	<ul style="list-style-type: none"> a. Damaged main drive gear bearing b. Damaged mainshaft bearing c. Damaged high speed gear synchronizer 	<ul style="list-style-type: none"> a. Replace damaged bearing b. Replace damaged bearing c. Replace synchronizer
Noisy in Neutral with Engine Running	<ul style="list-style-type: none"> a. Damaged main drive gear bearing b. Damaged or loose mainshaft pilot bearing c. Worn or damaged countergear anti-lash plate d. Worn countergear bearings 	<ul style="list-style-type: none"> a. Replace damaged bearing b. Replace pilot bearings. See Section 6 for bearing fits c. Replace countergear d. Replace countergear bearings and shaft
Noisy in all Reduction Gears	<ul style="list-style-type: none"> a. Insufficient lubricant b. Worn or damaged main drive gear or countergear 	<ul style="list-style-type: none"> a. Fill to correct level b. Replace faulty or damaged gears
Noisy in Second Only	<ul style="list-style-type: none"> a. Damaged or worn second-speed constant mesh gears b. Worn or damaged countergear rear bearings c. Damaged or worn second-speed synchronizer 	<ul style="list-style-type: none"> a. Replace damaged gears b. Replace countergear bearings and shaft c. Replace synchronizer
Noisy in Third Only (Four Speed)	<ul style="list-style-type: none"> a. Damaged or worn third-speed constant mesh gears b. Worn or damaged countergear bearings 	<ul style="list-style-type: none"> a. Replace damaged gears b. Replace damaged countergear bearings and shaft

Fig. 7B-11—Manual Transmission Diagnosis Chart A

MANUAL TRANSMISSION DIAGNOSIS (CONT'D.)

CONDITION	PROBABLE CAUSE	CORRECTION
Noisy in Reverse Only	a. Worn or damaged reverse idler gear or idler bushing b. Worn or damaged reverse gear on mainshaft c. Damaged or worn reverse countergear d. Damaged Shift mechanism	a. Replace reverse idler gear assembly b. Replace reverse gear c. Replace countergear assembly d. Inspect linkage and adjust or replace damaged parts
Excessive Backlash in all Reduction Gears	a. Worn countergear bearings b. Excessive end play in countergear	a. Replace bearings b. Replace countergear thrust washers
Main Drive Gear Bearing Retainer Burned or Scored by Input Shaft	a. Loose or damaged mainshaft pilot bearing b. Misalignment of transmission	a. Replace bearing. See Section 6 for bearing fit b. Align transmission
Leaks Lubricant	a. Excessive amount of lubricant in transmission b. Loose or broken main drive gear bearing retainer c. Main drive gear bearing retainer gasket damaged d. Side cover loose or gasket damaged e. Rear bearing retainer oil seal leaks f. Countershaft loose in case g. Shift lever seals leak	a. Drain to correct level b. Tighten or replace retainer c. Replace gasket d. Tighten cover or replace gasket e. Replace seal f. Replace case g. Replace seal

Fig. 7B-12--Manual Transmission Diagnosis Chart B

COMPONENT PARTS REPLACEMENT

TRANSMISSION REPLACEMENT

3-Speed and 4-Speed Transmission Removal

(Except K Series)

1. Raise vehicle on suitable hoist and drain lubricant from transmission.
2. Disconnect speedometer cable.
3. Remove shift controls from transmission.

NOTE: On vehicle equipped with 4-Speed transmission, remove the gearshift lever using Tool J-8109 as shown in Figure 7B-14. Press down firmly and rotate tool counterclockwise to release gearshift lever.

Place clean lint-free cloth or other suitable covering over opening on transmission to prevent entry of dirt or foreign material.

4. Disconnect parking brake lever and controls (when

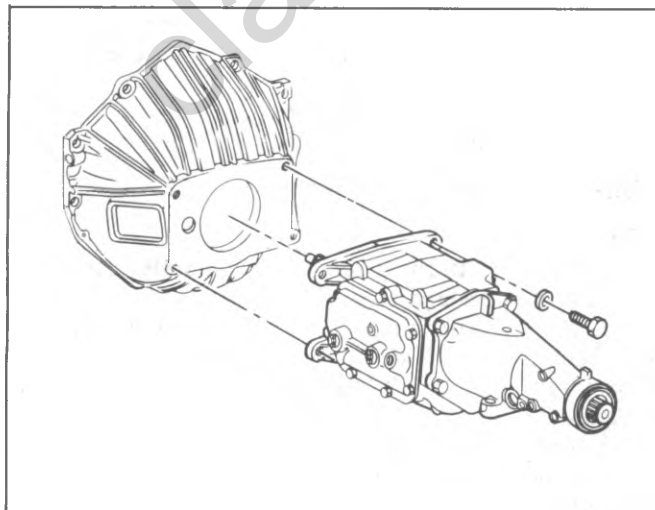


Fig. 7B-13--Typical Transmission Mounting

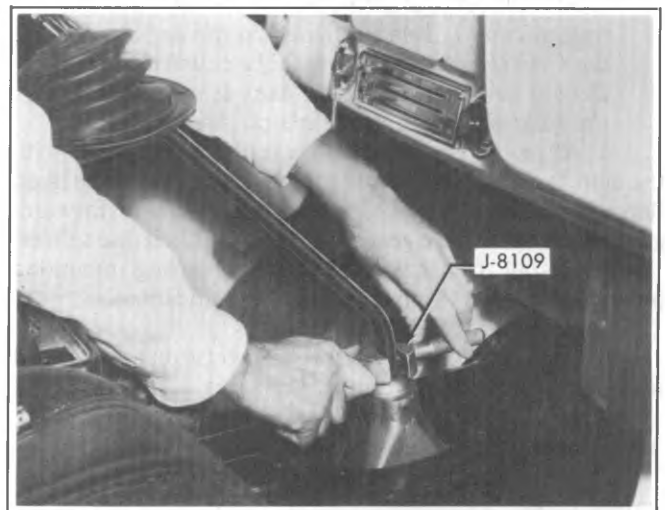


Fig. 7B-14--Removing Gearshift Lever

used) and back up lamp switch wire.

5. Disconnect propeller shaft from transmission as described in Section 4-A.

6. Position a suitable dolly or jack under the vehicle and adjust to carry the weight of the transmission.

7. Visually inspect to determine if other equipment, lines or brackets must be removed to permit removal of the transmission. Remove crossmember.

CAUTION: *Be sure to support the clutch release bearing and support assembly during removal of the transmission main drive gear from the flywheel housing. This will prevent the release bearing from falling out of the flywheel housing when the transmission is removed.*

8. Remove transmission-to-clutch housing mounting bolts.

CAUTION: *When removing the transmission, do not allow the weight of the transmission to hang on the clutch disc hub, as the disc may become distorted, seriously affecting clutch operation.*

9. Move the transmission assembly straight away from the engine, using care to keep the transmission main drive gear shaft in alignment with the clutch disc hub. See Fig. 7B-13.

10. When the transmission is free from the engine, lower the transmission and move from under the vehicle.

11. If desired, a careful check of clutch components should be made after the transmission has been removed. If the clutch requires repair, refer to Section 7C before transmission is reinstalled in the vehicle.

3-Speed and 4-Speed Transmission Installation (Except K Series)

1. Apply a light coating of high temperature grease to the main drive gear bearing retainer and splined portion of transmission main drive gear shaft to assure free movement of clutch and transmission components during assembly.

CAUTION: *Do not apply an excessive amount of grease in the above areas, as under normal operation this grease could be thrown onto clutch facings resulting in clutch problems.*

2. Shift the transmission into high gear. Mount transmission on dolly or jack and move into position under the vehicle.

CAUTION: *Avoid springing the clutch when the transmission is being installed to the engine. Do not force the transmission into the clutch disc hub. Do not let the transmission hang unsupported in the splined portion of the clutch disc.*

3. Align the transmission main drive gear shaft with the clutch disc hub by rotating the transmission companion flange or output yoke. Move the transmission forward, guiding the main drive gear shaft into the clutch disc splines.

4. Install transmission-to-clutch housing mounting bolts and washers. Tighten bolts to specifications.

5. Install crossmember.

6. Connect propeller shaft to transmission as described in Section 4A. Remove transmission jack.

7. Connect parking brake lever and control (if used). Adjust brakes as outlined in Section 5.

8. Reconnect speedometer cable to adapter at transmission.

9. Reinstall shift controls on transmission.

NOTE: On vehicles equipped with a 3-speed transmission, reconnect shift levers to transmission side cover. On vehicles equipped with a 4-Speed, 117mm transmission, install gearshift lever using Tool J-8109 as shown in Figure 7B-14. Press down firmly and rotate clockwise to install gearshift lever. Install transmission floor pan cover and floor mat.

10. If other equipment (exhaust pipe, support brackets, etc.) was removed, reinstall these parts.

11. Refill transmission with lubricant recommended in Section 0-B of this manual.

12. If necessary, adjust clutch or transmission control linkage to achieve proper transmission operation.

3-Speed Transmission - "K" Series

Removal and Installation

1. Raise vehicle on hoist.

2. Drain transfer case and transmission. Disconnect the speedometer cable from speedometer driven gear fitting.

3. Disconnect propeller shaft front U-joint yoke at case, and tie up out of way.

4. Remove bolt holding the shift lever control assembly to the adapter assembly. Remove shift lever rod from transfer case shift rail connector link. Push assembly to one side and tie up out of way.

5. Remove the bolts attaching the strut to the right-hand side of the transfer case and also to the engine rear face. Remove the strut.

6. Support transfer case in a suitable cradle. Remove bolts attaching transfer case to adapter, and remove the transfer case.

7. Disconnect shift control rods from the shifter levers at the transmission.

8. Support rear portion of engine. Remove two (2) adapter mount bolts.

9. Remove the 2 top transmission to clutch housing cap screws and insert 2 transmission guide pins, Tool J-1126 in these holes.

10. Remove the 2 lower transmission-to-clutch housing cap screws.

11. Slide the transmission and adapter assembly straight back on guide pins until the clutch gear is free of splines in the clutch disc.

NOTE: The use of the 2 guide pins during this operation will support the transmission and prevent damage to the clutch disc through springing.

12. Remove the transmission and adapter as an assembly from under the body.

13. Remove adapter from transmission.

14. To install, reverse removal procedure.

4-Speed Transmission Removal

K Series

1. Remove attaching screws from transfer case shift lever boot retainer and remove retainer.

2. Remove attaching screws from transmission shift lever boot retainer. Slide boot and retainer up lever and remove transmission shift lever using Tool J-8109 as shown in Figure 7B-14.

3. Remove floor mat or carpeting from compartment.

4. If necessary, remove center floor outlet from heater distributor duct. If equipped with a center console, remove console before proceeding to next step.

5. Remove transmission floor cover attaching screws and cover. Rotate cover approximately 90° to clear transfer case shift lever while lifting cover from vehicle.
6. Disconnect shift lever rod assembly from transfer case shift rail connecting link.
7. Remove shift lever attaching bolt and shift lever control from adapter.
8. Raise and support vehicle on hoist. Support engine with suitable floor stand. Drain transfer case and transmission assemblies.
9. Disconnect speedometer cable from transfer case.
10. Disconnect prop shaft at rear of transfer case and tie up away from work area.
11. Disconnect front prop shaft from transfer case and tie up away from work area.
12. Open lock tabs and remove transmission mount-to-frame crossmember bolts.
13. Support transmission and transfer case assembly with suitable floor stand.
14. Remove frame to crossmember bolts and remove crossmember from vehicle. Rotate crossmember to clear frame rails.
15. On V-8 engine models, remove exhaust crossover pipe.
16. Remove transmission to clutch housing attaching bolts.

NOTE: Remove upper bolts first and install transmission guide pins J-1126. Use of the guide pins will prevent damage to the clutch assembly.

17. Slide transmission rearward until main drive gear clears the clutch assembly and lower assembly from vehicle.

4-Speed Transmission Installation

K Series

1. Position transmission, with transfer case attached, to the clutch housing. Install bolts attaching transmission to clutch housing.
 2. On V-8 models, install exhaust crossover pipe.
 3. Position frame crossmember and install retaining bolts. Install bolts retaining adapter assembly to crossmember and transfer case to frame rail bracket. Torque all bolts to specification.
 4. Torque front and rear transfer case yoke lock nuts to specifications.
 5. Install front and rear propshafts to transfer case output yokes.
 6. Connect the speedometer cable.
 7. Fill transmission and transfer case to proper level with lubricant specified in Section 0-B.
 8. Install transfer case shift lever assembly and attaching bolt. Connect shift lever rod to shift rail connector link.
 9. Install transmission floor cover and attaching bolts.
 10. Install heater distributor duct center outlet.
- NOTE:** On models with center console, install console and retaining bolts.
11. Install floor mat, transfer case shift lever retainer and attaching screws.
 12. Install transmission shift lever, boot and retainer.

TRANSMISSION ALIGNMENT

In some instances where excessive gear whine or high gear hop out, particularly at 50 MPH (80 km/h) and up, are encountered, and after all other probable causes have been checked, an alignment check of the transmission and clutch housing may be helpful.

A special tool, on which a dial indicator is mounted, is necessary to check the transmission case rear bore alignment. This tool may be made from a new or good used clutch gear which has a good bearing surface on the crankshaft pilot end and at the front main bearing location.

The splines on the clutch gear shaft and the teeth on the clutch gear should be ground off so the shaft may be rotated in a clutch disc hub without interference when assembled in the car. Weld a piece of 1/4" rod in the mainshaft pilot bore long enough to extend out the case rear bore. Assemble a good bearing on the clutch gear shaft and secure it with the clutch gear bearing snap ring. Attach a suitable dial indicator to the rod.

1. Remove the transmission from the vehicle and completely disassemble, except for the reverse idler gear.

NOTE: In any case where the clutch gear pilot or pilot bearing is excessively loose or worn, the pilot bearing should be replaced before checking the transmission case rear bore alignment by the dial indicator method.

2. Carefully install the special tool with the dial indicator in the transmission case with the face of the indicator to the rear of the case and with the tracing finger contacting the I.D. of the case rear bore. Secure in place with a clutch gear bearing retainer.

3. Assemble the transmission case to the clutch housing and tighten the four transmission mounting bolts securely.

NOTE: Be sure to clean off any paint or other foreign material on the mating faces of the clutch housing and transmission as any foreign material on these faces will change alignment; also, check carefully for dings or burrs on these mating surfaces and remove carefully as necessary.

4. Dial indicate the transmission case rear bore and record the indicator readings in the 12, 3, 6 and 9 o'clock positions.

NOTE: It is best to start the reading at the 3, 6, 9 or 12 o'clock position closest to the point where the indicator plunger reaches its maximum outward travel. Set the dial indicator at "0" at this location and then record the 3, 6, 9 and 12 o'clock readings in rotation.

5. Install temporary slotted shims between the transmission case and the clutch housing in the quantities and at the bolt locations as necessary to bring misalignment at the transmission case rear bore to a maximum of .005" indicator reading in either the vertical or horizontal direction.

EXAMPLE: If the maximum indicator reading is at the 12 o'clock position, put shims on the two bottom bolts.

6. After the position and quantity of shims has been determined and recorded the transmission case may be removed.

NOTE: The clutch housing should then be stamped, showing the position where shims are to be installed and the thickness of shims at each location.

7. Inspect the external clutching teeth of the clutch gear and second speed gear. Inspect the second and third speed clutch internal clutching teeth. If the teeth are worn or

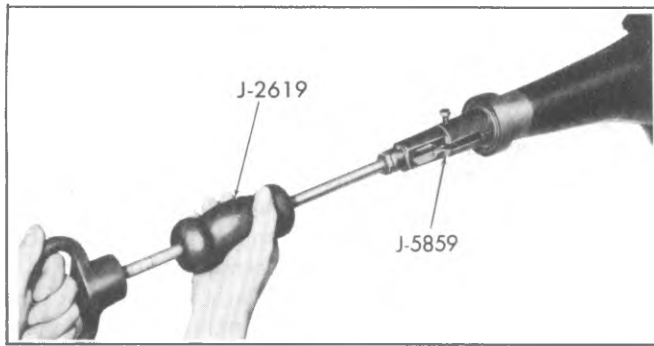


Fig. 7B-15--Removing Rear Oil Seal

tapered, even slightly, the gears should be replaced. Reassemble the transmission.

8. Install the transmission assembly to the clutch housing, using the correct number of shims at the proper locations as previously determined. Shims are available by unit part number with each unit consisting of the following shims:

- 4--.002" shims Identification--two corners cut off.
- 2--.005" shims Identification--one corner cut off.
- 1--.010" shims Identification--all corners square.

NOTE: These special shims have a tab on one end for ease of installation. Do not slot the shims for the permanent installation.

REAR OIL SEAL REPLACEMENT

1. Drain lubricant from transmission.
2. Disconnect propeller shaft from transmission as described in Section 4A.
3. On 3-speed transmissions, perform the following replacement procedures:
 - a. Remove slip joint yoke from rear of transmission mainshaft.
 - b. Pry seal out of extension housing or remove oil seal using oil seal remover (J-5859) and slide hammer (J-2619) as shown in Figure 7B-15.
 - c. Coat outer diameter of new oil seal with sealing cement. Install new oil seal using extension housing oil seal installer (J-5154).
 - d. Install slip joint yoke on rear of transmission mainshaft.
4. On 4-speed transmissions, perform the following:
 - a. Remove parking brake from rear of transmission as described in Section 5, if so equipped.
 - b. Disconnect speedometer cable and remove speedometer driven gear from mainshaft rear bearing retainer.
 - c. Using flange or yoke holding tool, remove the output yoke or companion flange nut. Pull output yoke or companion flange nut off the mainshaft.
 - d. Support transmission while removing mounting bolts and bearing retainer. Remove mainshaft rear bearing retainer and gasket. Discard gasket.
 - e. Remove oil seal from rear bearing cap. Discard oil seal.
 - f. Coat outer diameter of new oil seal with sealing cement. Install oil seal in rear bearing cup using a suitable installer. Drive seal flush with outside of rear bearing cap, being careful not to damage seal. Use Installer J-22834 with Adapter J-22834-1 as required, as shown in Fig. 7B-16.

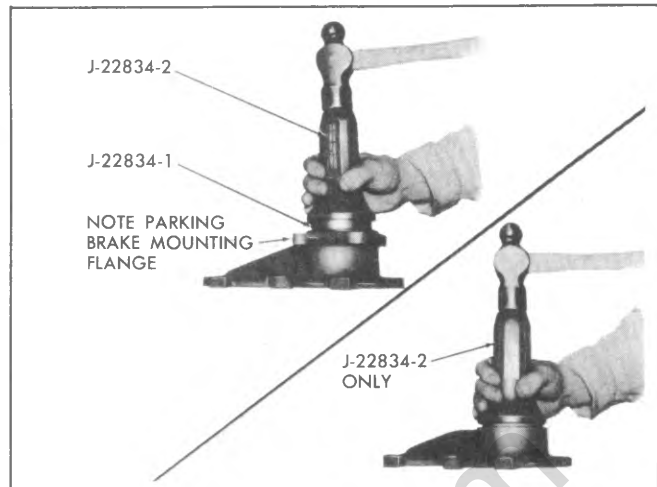


Fig. 7B-16--Replacing Rear Bearing Retainer Oil Seal

g. Clean all gasket surfaces, then install the rear bearing cap with a new gasket on the transmission. Tighten cap screws firmly.

h. Install output yoke or companion flange on mainshaft. Using a flange or yoke holding tool install retaining nut. Torque the retaining nut to specification.

i. Install speedometer driven gear, then connect speedometer cable.

5. Reconnect propeller shaft to transmission as described in Section 4A.

6. Refill transmission with lubricant recommended in Section 0-B.

SPEEDOMETER DRIVEN GEAR REPLACEMENT

1. Disconnect speedometer cable on 3-speed units, then remove lock plate to housing bolt and lock washer and remove lock plate. Insert screw driver in lock plate slot in fitting and pry fitting, gear and shaft from housing. Pry "O" ring from groove in fitting.
2. Install new "O" ring in groove in fitting, coat "O" ring and driven gear shaft with transmission lubricant and insert shaft.
3. Hold the assembly so slot in fitting is toward lock plate boss on housing and install in housing. Push fitting into housing until lock plate can be inserted in groove and attached to housing.

TRANSMISSION SIDE COVER

Replacement/Repair (Fig. 7B-17)

1. Disconnect control rods from levers, back-up lamp wiring and TCS switch.
2. Shift transmission into neutral detent positions before removing cover. Remove cover assembly from transmission case carefully and allow oil to drain.
3. Remove the outer shifter levers.
4. Remove both shift forks from shifter shaft assemblies. Remove both shifter shaft assemblies from cover. Seals around shifter shaft may now be pried out if replacement is required because of damage.
5. Remove detent cam spring and pivot retainer "C" ring. Remove both detent cams.
6. With detent spring tang projecting up over the 2nd and 3rd shifter shaft cover opening, install the first and reverse detent cam onto the detent cam pivot pin. With the

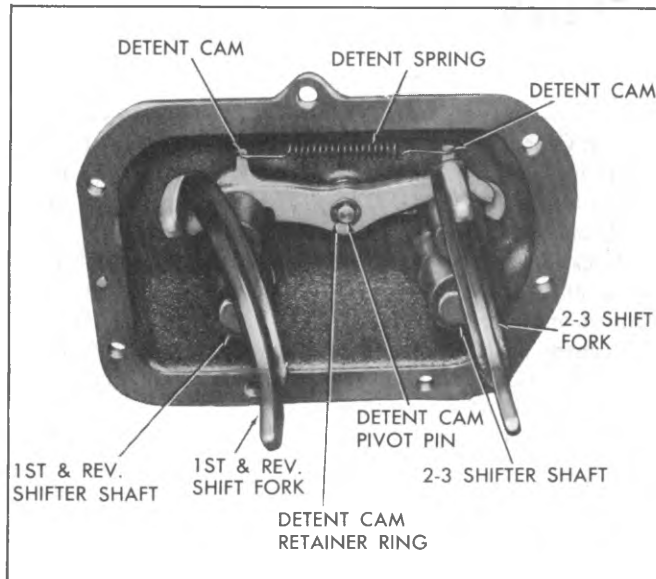


Fig. 7B-17--Transmission Side Cover Assembly

detent spring tang projecting up over the first and reverse shifter shaft cover hole install the 2nd and 3rd detent cam.

7. Install detent cam retaining "C" ring to pivot shaft, and hook spring into detent cam notches.

8. Install both shifter shaft assemblies in cover being

careful not to damage seals. Install both shift forks to shifter shaft assemblies, lifting up on detent cam to allow forks to fully seat into position.

9. Install outer shifter levers, flat washers, lock washers and bolts.

10. Shift shifter levers into neutral detent (center) position and slide cover into place making sure the shift forks are aligned with their respective mainshaft clutch sliding sleeves.

11. Install cover attaching bolts and tighten evenly to specified torque. Install TCS switch and connect wiring.

12. Remove filler plug and add lubricant specified in Section 0-B to level of filler plug hole.

TRANSMISSION FLOOR SHIFT CONTROL LEVER REPLACEMENT

1. On K-Series models, remove transfer case shift lever boot retainer attaching screws and retainer from compartment floor.

2. Remove floor covering from vehicle.

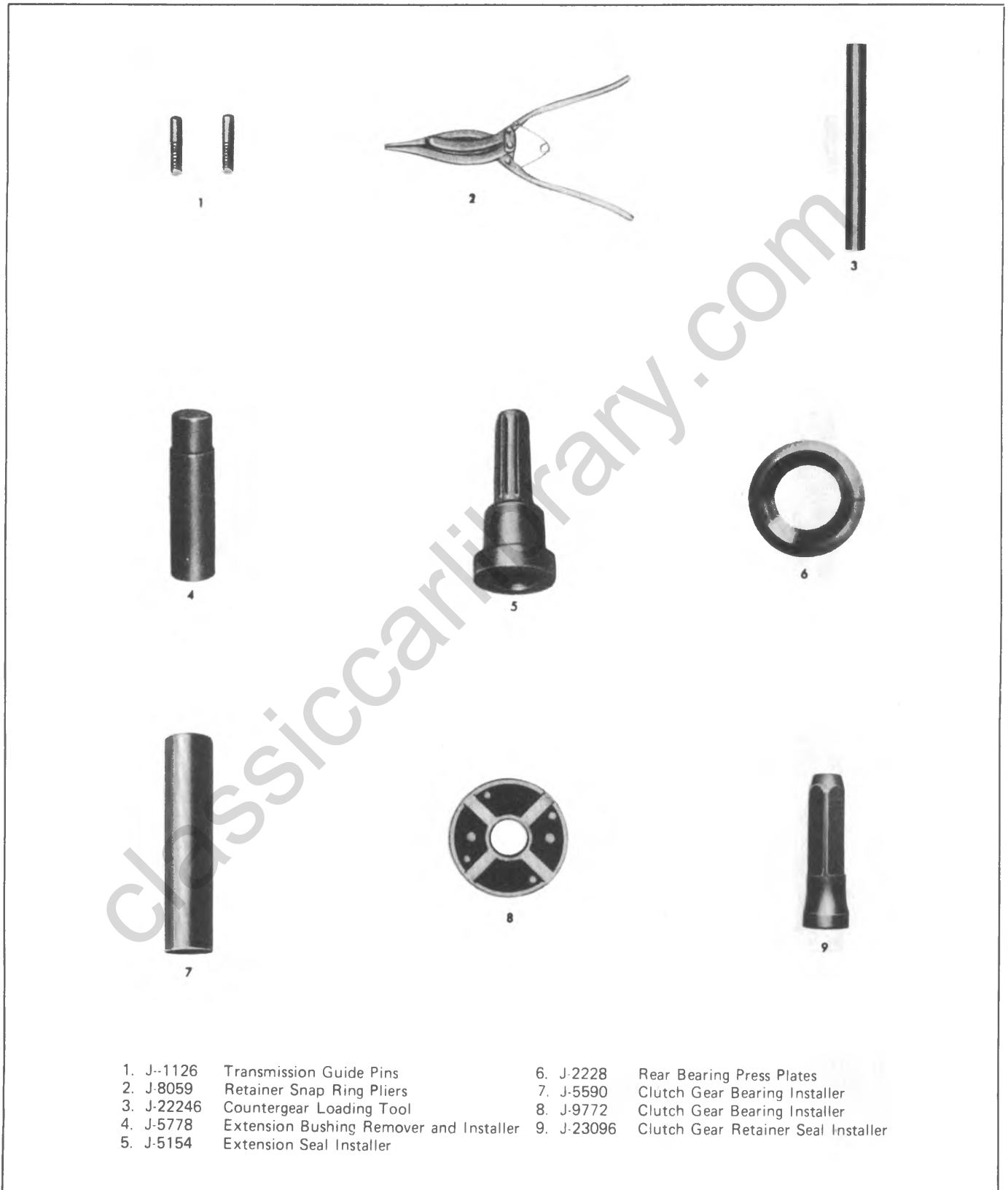
3. Remove transmission shift lever boot retainer attaching screws.

4. Slide boot and retainer up on shift lever and remove the transmission shift lever using Tool J-8109 as shown in Figure 7B-14.

5. To install, reverse removal procedure Steps 1-4.

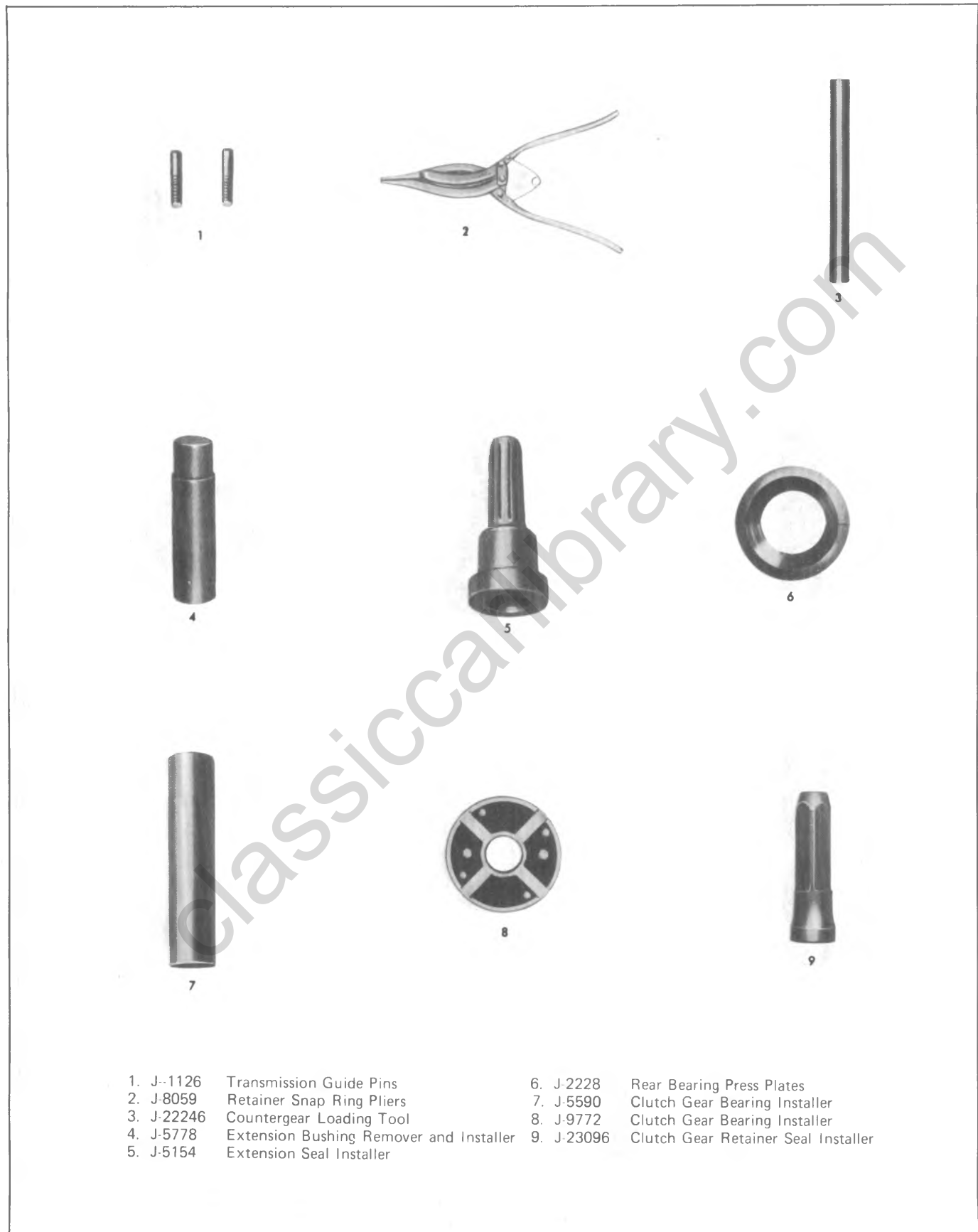
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SPECIAL TOOLS



- | | | | |
|------------|---|------------|-------------------------------------|
| 1. J--1126 | Transmission Guide Pins | 6. J-2228 | Rear Bearing Press Plates |
| 2. J-8059 | Retainer Snap Ring Pliers | 7. J-5590 | Clutch Gear Bearing Installer |
| 3. J-22246 | Countergear Loading Tool | 8. J-9772 | Clutch Gear Bearing Installer |
| 4. J-5778 | Extension Bushing Remover and Installer | 9. J-23096 | Clutch Gear Retainer Seal Installer |
| 5. J-5154 | Extension Seal Installer | | |

Fig. 7B-1ST-3-Speed Special Tools



- | | | | |
|------------|---|------------|-------------------------------------|
| 1. J-1126 | Transmission Guide Pins | 6. J-2228 | Rear Bearing Press Plates |
| 2. J-8059 | Retainer Snap Ring Pliers | 7. J-5590 | Clutch Gear Bearing Installer |
| 3. J-22246 | Countergear Loading Tool | 8. J-9772 | Clutch Gear Bearing Installer |
| 4. J-5778 | Extension Bushing Remover and Installer | 9. J-23096 | Clutch Gear Retainer Seal Installer |
| 5. J-5154 | Extension Seal Installer | | |

Fig. 7B-2ST--4-Speed Special Tools

SECTION 7C

CLUTCH

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GENERAL DESCRIPTION

CLUTCH SYSTEMS

DIAPHRAGM SPRING CLUTCH

Principal Components

The principal parts of a diaphragm-type clutch system are: the driving members, attached to the engine and turning with it; the driven members attached to the transmission and turning with it; the operating members which include

the spring or springs and the linkage required to apply and release the pressure which holds the driving and driven members in contact with each other. Figure 7C-1 shows a clutch cutaway so operating members can be seen.

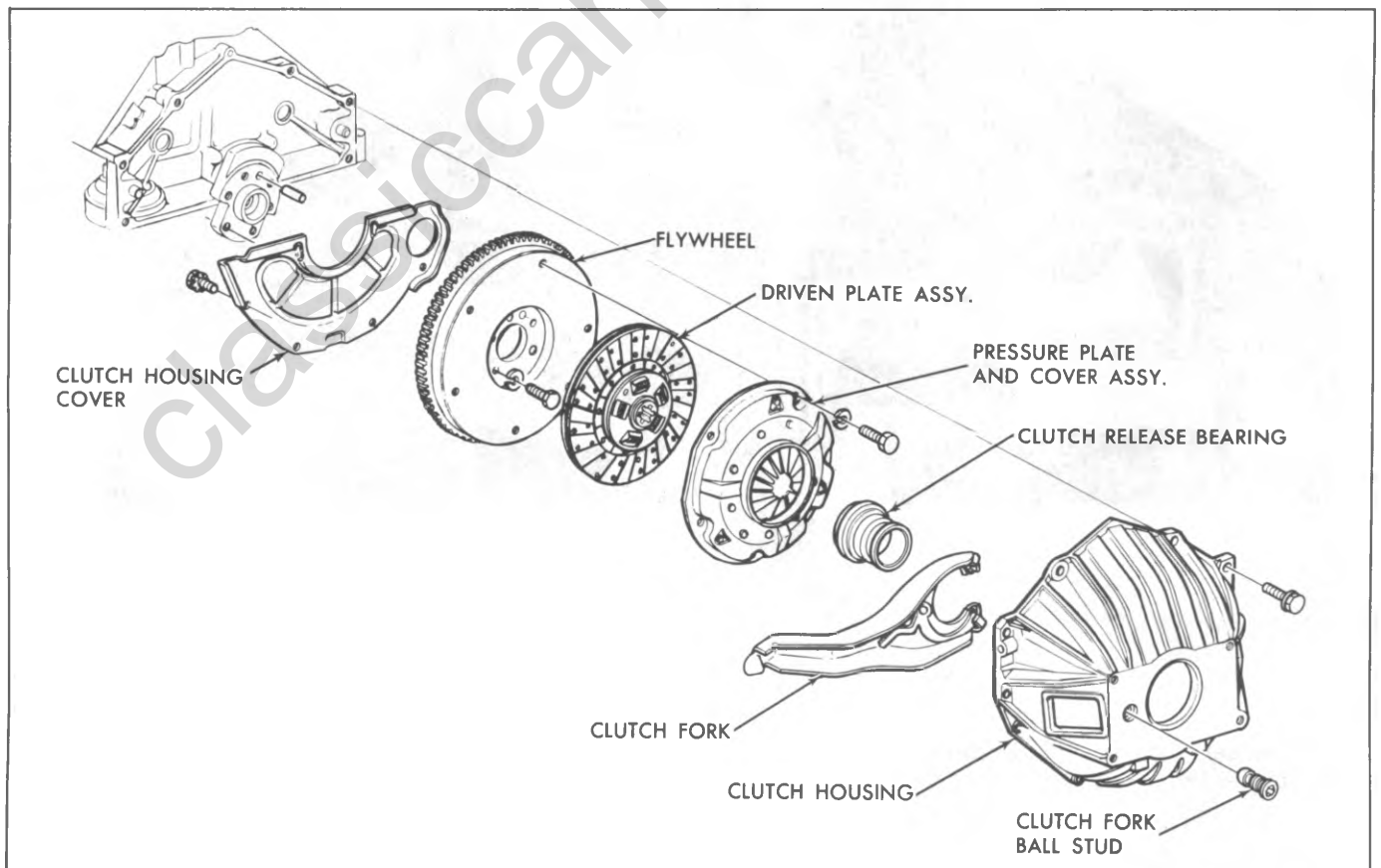
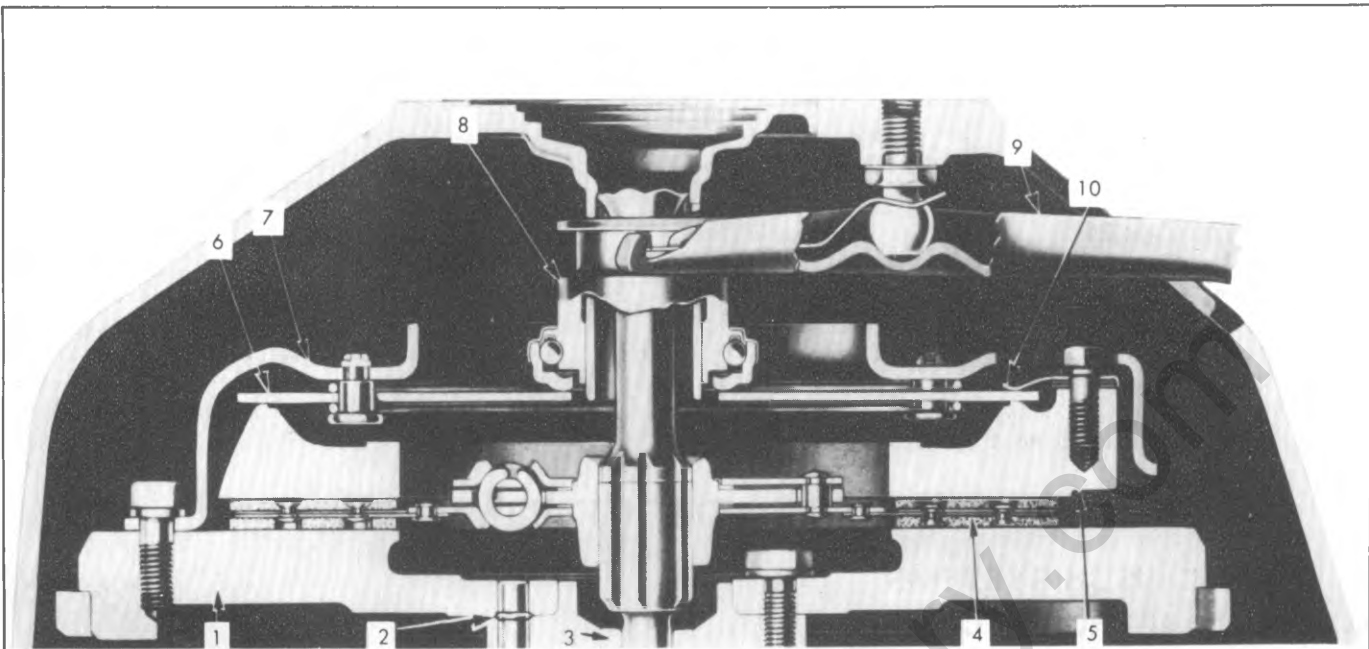
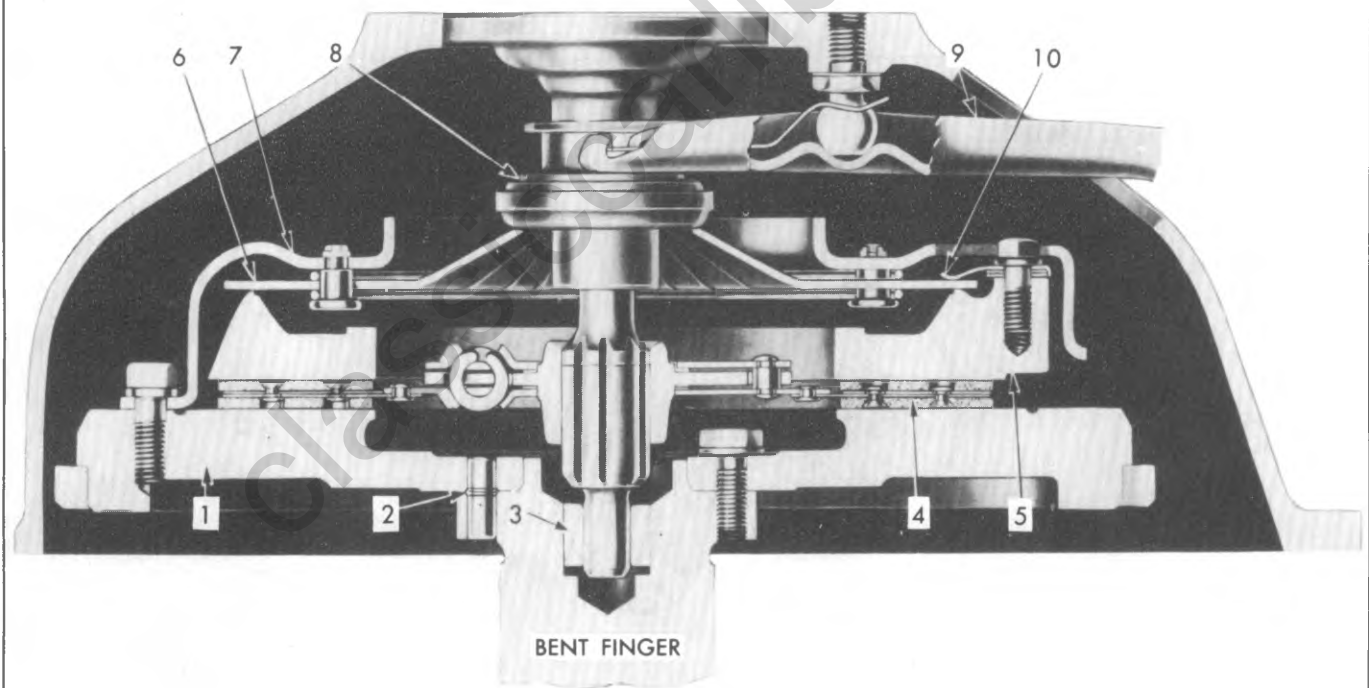


Fig. 7C-1—Clutch System Components



FLAT FINGER



BENT FINGER

- | | | | | |
|---------------|------------------|---------------------|---------------------------|-----------------------|
| 1. Flywheel | 3. Pilot Bushing | 5. Pressure Plate | 7. Cover | 9. Fork |
| 2. Dowel-hole | 4. Driven Disc | 6. Diaphragm Spring | 8. Clutch Release Bearing | 10. Retracting Spring |

Fig. 7C-2--Cross-Section View of Diaphragm-Type

Driving Members

The driving members of a clutch usually consist of two iron plates or flat surfaces machined to a smooth finish. Iron is desirable because it contains enough graphite to provide some lubrication when the driving member is slipping during engagement. One of these surfaces is usually the rear face of the engine flywheel, and the other is a comparatively heavy flat ring with one side machined. This part is known as the pressure plate. It is fitted into a steel cover, which also contains some of the operating members, and is bolted to the flywheel.

Driven Members

The driven member is the clutch disc with a splined hub which is free to slide lengthwise along the splines of the clutch shaft, but which drives the shaft through these same splines. Grooves on both sides of the clutch disc lining prevent sticking of the plate to the flywheel and pressure plate. Suitable frictional facings are attached to each side of the clutch disc by means of brass rivets. These facings must be heat resistant since friction produces heat. The most commonly used facings are made of cotton and asbestos fibers woven or molded together and impregnated with resin or similar binding agents. Very often, copper wires are woven, or pressed into material to give it additional strength.

In order to make clutch engagement as smooth as possible and eliminate chatter, the steel segments attached to the splined hub are slightly waved, which causes the contact pressure on the facings to rise gradually as the waved springs flatten out.

The clutch disc is provided with a flexible center to absorb the torsional vibration of the crankshaft which would be transmitted to the power train unless it were eliminated. The flexible center takes the form of steel compression springs placed between the hub and the steel plate. The springs permit the disc to rotate slightly with relation to its hub until the springs are compressed and relative motion stops. Then the disc can rotate slightly backward as the springs decompress. This slight backward and forward rotation permitted by the springs allows the clutch shaft to rotate at a more uniform rate than the crankshaft, thereby eliminating some of the torsional vibration from the crankshaft and preventing the vibration from being carried back through the transmission.

Operating Members

The driving and driven members are held in contact by spring pressure. This pressure may be exerted by a one-piece conical or diaphragm spring. In the diaphragm design clutch, the clutch release bearing moves forward against the spring fingers forcing the diaphragm spring to pivot around the pivot ring, dishing the fingers toward the flywheel. The outer circumference of the spring now lifts the pressure plate away from the driven disc, through a series of retracting springs placed around the outer circumference of the pressure plate.

NOTE: Two variations of the diaphragm spring design are the flat finger type and the bent finger type (Fig. 7C-2). The integral release fingers in the bent finger design are bent back to gain a centrifugal boost to aid quick re-engagement at high engine speeds.

The clutch release bearing is a ball-thrust bearing contained in the clutch housing, mounted on a sleeve

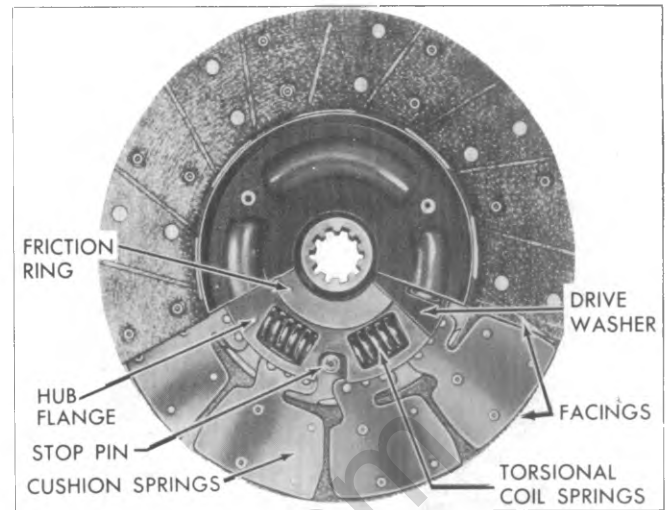


Fig. 7C-3--Clutch Disc

attached to the front of the transmission case. The release bearing is moved by the clutch fork to contact the release levers and move the pressure plate to the rear, thus separating the clutch driving members from the driven member when the clutch pedal is depressed by the driver. A return spring preloads clutch linkage, removing looseness due to wear, keeping the bearing clear of the spring fingers. The clutch free pedal travel, therefore, will increase with linkage wear and decrease with driven disc wear. The free travel felt at the clutchpedal is release bearing lash.

NOTE: The clutch release bearing used with the bent finger design is of shorter length than the release bearing used with the flat finger design clutch. Do not interchange the two bearings. The longer bearing, if used with the bent finger spring clutch, could cause inability to obtain proper free pedal travel resulting in slippage and rapid wear.

Clutch Spring Operation

In diaphragm spring type clutches, a diaphragm spring is used instead of coil springs. It is a conical piece of spring steel punched to give it greater flexibility. The diaphragm is positioned between the cover and the pressure plate so that the diaphragm spring is nearly flat when the clutch is in the engaged position. The action of this type of spring is similar to that of the bottom of an ordinary oil can. The pressure of the outer rim of the spring on the pressure plate decreases as the flat position is passed. The outer rim of the diaphragm is secured to the pressure plate and is pivoted on rings approximately 1 inch in from the outer edge so that the application of the pressure at the inner section will cause the outer rim to move away from the flywheel and draw the pressure plate away from the clutch disc, releasing or disengaging the clutch. When the pressure is released from the inner section, the oil-can action of the diaphragm causes the inner section to move out, and the movement of the outer rim forces the pressure plate against the clutch disc, thus engaging the clutch.

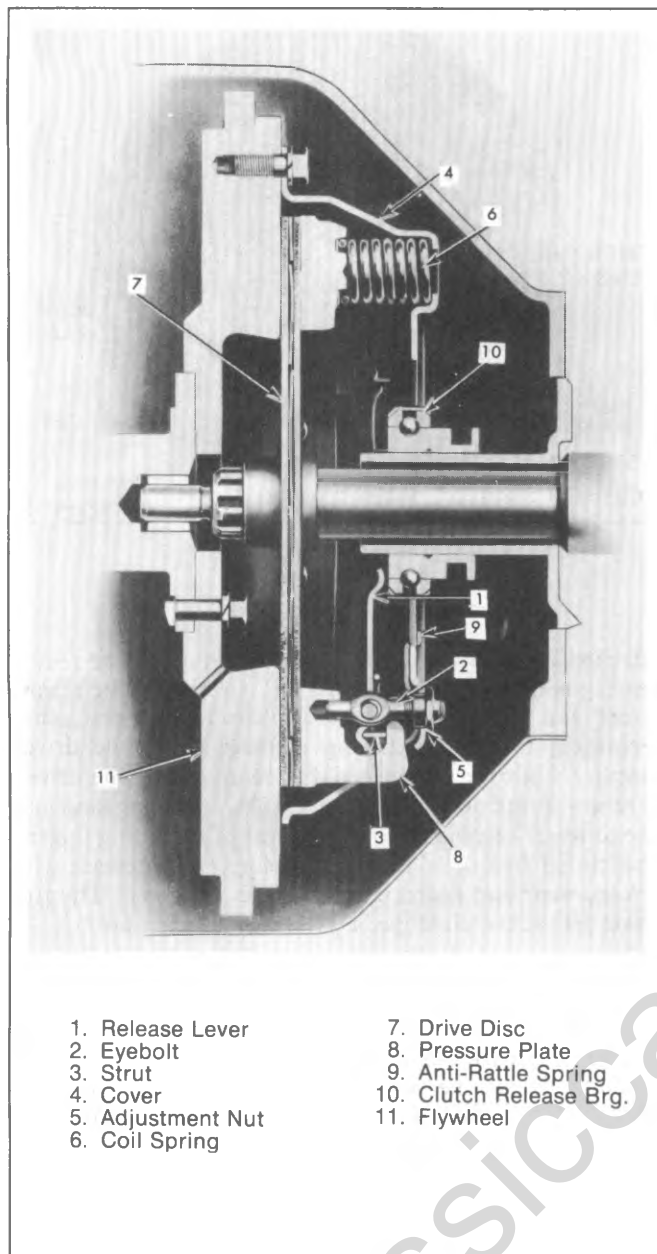


Fig. 7C-4--Cross-Section View of Coil Spring Type

COIL SPRING CLUTCH

The coil spring single plate clutch (Fig. 7C-4) is a dry disc type and no adjustment for wear is provided in the clutch itself. An individual adjustment is provided for locating each lever in manufacturing but the adjusting nut is locked in place and should never be disturbed, unless the clutch assembly is dismantled for replacement of parts.

When the clutch pedal is depressed the release bearing is moved toward the flywheel and contacts the inner ends of the release levers, (item 1 in Fig. 7C-5). Each release lever is pivoted on a floating pin which remains stationary in the lever and rolls across a short flat portion of the enlarged hole in the eyebolt (item 2). The outer end of each release lever engages the pressure plate lug by means of a strut (3), which provides knife-edge contact between the outer end of the lever and the lug. The outer ends of the eyebolts extend through holes in the stamped cover (4), and are fitted with

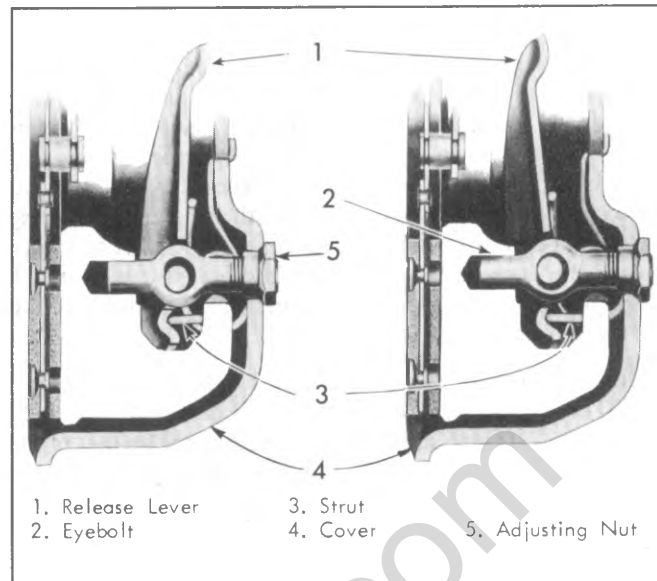


Fig. 7C-5--Release Lever, Coil Spring Type

adjusting nuts (5) to correctly position the levers.

When the clutch system is fully engaged, the clutch disc is firmly clamped between the flywheel and the pressure plate by the pressure of the springs. When the driver disengages the clutch by depressing the pedal, the release fork is moved on its pivot, and the pressure is applied to the release bearing. The rotating race of the release bearing presses against the clutch release levers and moves them on their pivot pins. The outer ends of the release levers, being fastened to the cover, move the pressure plate to the rear, compressing the clutch springs and allowing driving members to rotate independently of the driven member. The release fork moves only on its pivot, which contacts the clutch fork ball stud. All parts of the clutch system, except the clutch release bearing and collar, rotate with the flywheel when the clutch is engaged.

When the clutch is disengaged, the release bearing rotates with the flywheel, but the driven plate and the clutch shaft rotate as dictated by the transmission gear range and vehicle speed.

CLUTCH CONTROLS

The clutch operating controls for C-K trucks (Fig. 7C-6) are a mechanical type consisting of a pendant type pedal, return spring, pedal push rod, cross-shaft, fork push rod, routed vertically, inside the cab, from the pedal lever down through two boots on the toe pan, to the cross-shaft lever. When the clutch pedal is depressed, the pedal push rod moves rotating the cross-shaft, pushing the fork push rod rearward, and pivoting the clutch fork to move the release bearing against the clutch release fingers and releasing the clutch.

The clutch operating controls for "G" and "P" models are a mechanical type similar to the C-K models. On "G" models (Fig. 7C-7) a pedal pull rod is routed vertically from the clutch pedal lever down through the toe-panel to the cross shaft. When the pedal is depressed, the pedal pull rod moves, rotating the cross shaft, pushing the clutch fork rod rearward and pivoting the clutch fork. This action moves the release bearing against the clutch release fingers, releasing the clutch.

"P" model controls (Fig. 7C-8) have an upper pull rod connected from the clutch pedal shaft to a bell crank and a lower pull rod from the bell crank to the cross shaft. When the pedal is depressed, the pull rods are moved

rotating the cross shaft and pushing the clutch fork rearward, thus subsequently activating the clutch release mechanism.

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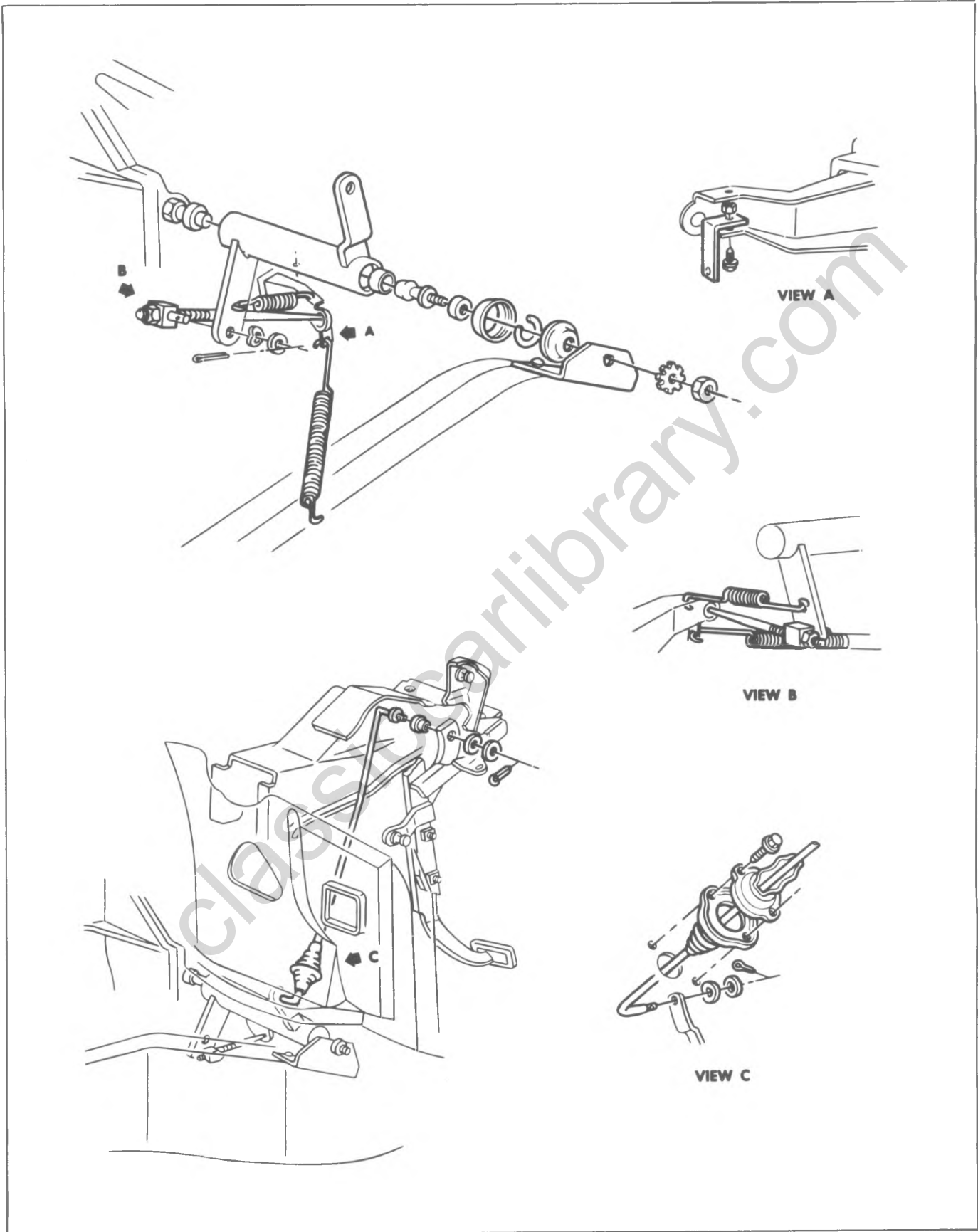


Fig. 7C-6--C-K Clutch Controls

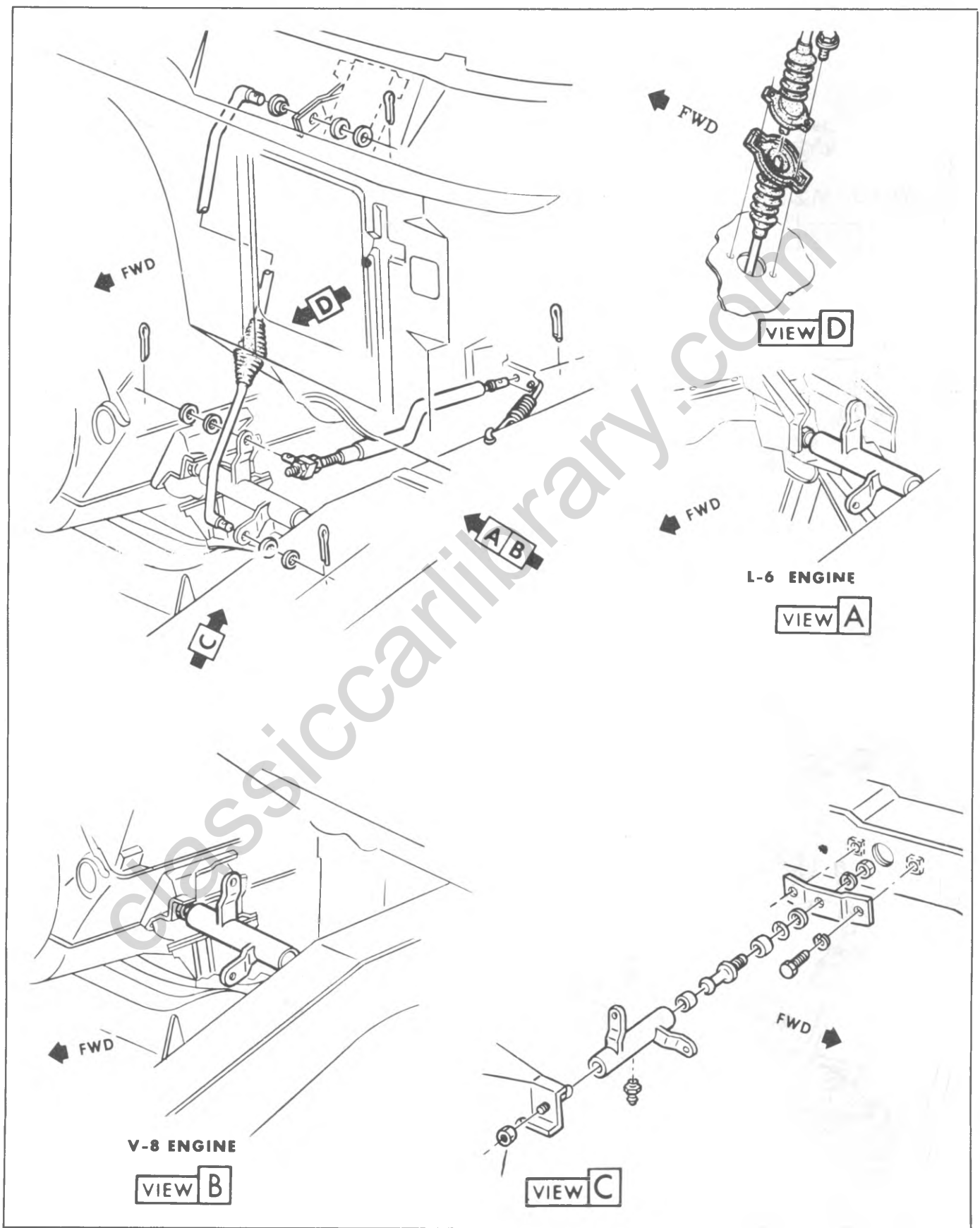


Fig. 7C-7-G-Truck Clutch Controls

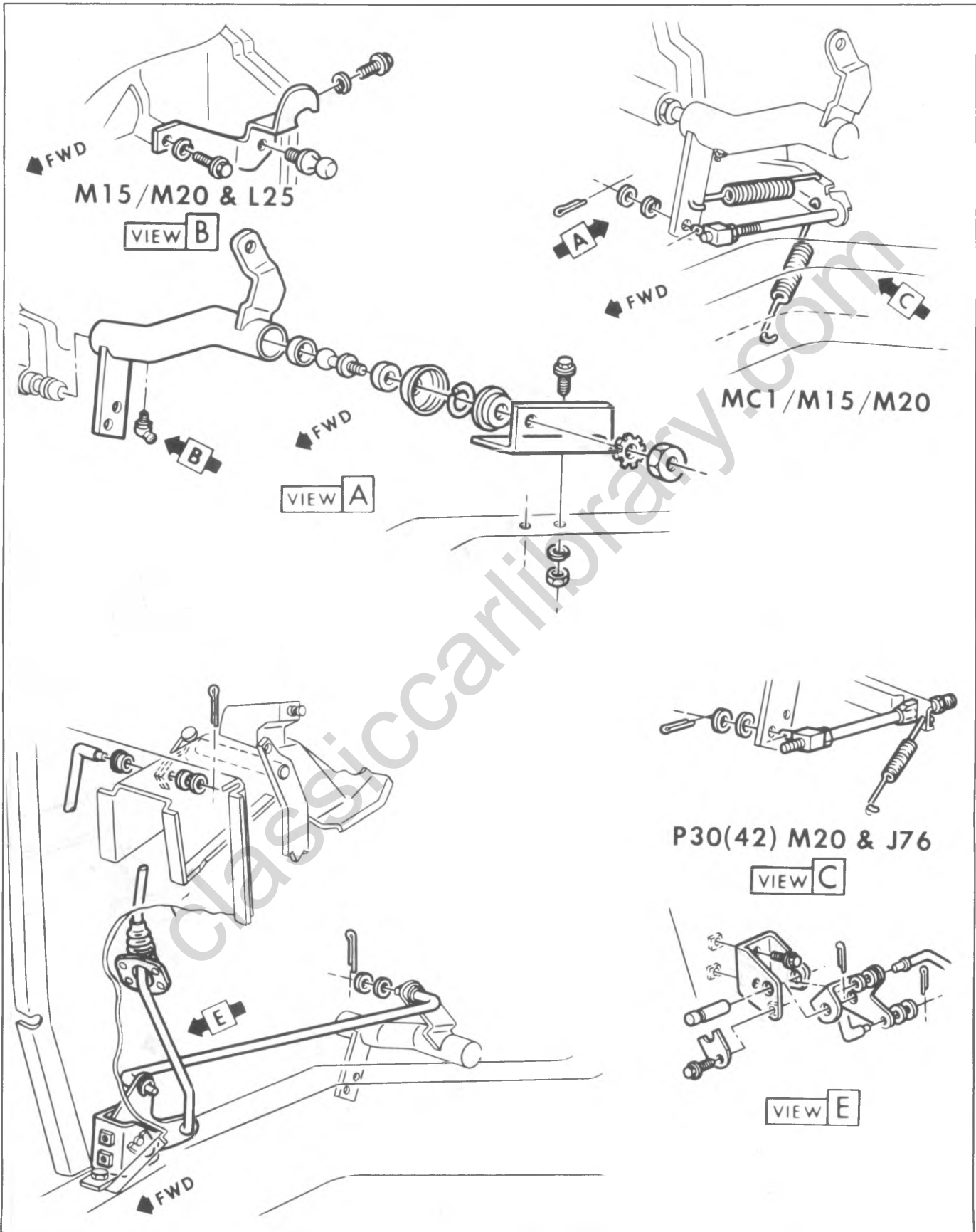


Fig. 7C-8--P-Truck Clutch Controls

MAINTENANCE AND ADJUSTMENTS

CLUTCH LINKAGE INSPECTION

There are several things which affect good clutch operations. Therefore, it is necessary, before performing any major clutch operations, to make preliminary inspections to determine whether trouble is actually in the clutch.

Check the clutch linkage to be sure the clutch releases fully as follows:

1. With engine running, hold the clutch pedal approximately 1/2" from floor mat and move shift lever between first and reverse several times. If this can be done smoothly, the clutch is fully releasing. If shift is not smooth, clutch is not fully releasing and adjustment is necessary.

2. Check clutch pedal bushings for sticking or excessive wear.

3. Check fork for proper installation on ball stud. Lack of lubrication on fork can cause fork to be pulled off the ball.

4. Check for bent, cracked or damaged cross shaft levers or support bracket.

5. Loose or damaged engine mounts may allow the engine to shift its position causing a bind on clutch linkage at the cross shaft. Check to be sure there is some clearance between cross shaft, both mount brackets, and ball studs.

6. Check clutch release bearing end clearance between spring fingers and front bearing retainer on the transmission. If no clearance exists, fork may be improperly installed on ball stud or clutch disc may be worn out.

CLUTCH FREE PEDAL TRAVEL ADJUSTMENT

Only one adjustment is necessary to compensate for all normal clutch wear. The clutch pedal should have free travel (measured at clutch pedal pad) before the release bearing engages the clutch diaphragm spring or levers. Lash is required to prevent clutch slippage which would occur if the bearing was held against the fingers or to prevent the bearing from running continually. A clutch that has been slipping prior to free play adjustment may still slip right after the new adjustment due to previous heat damage.

C, K and P Models (Except P30 W/J76)

1. Disconnect return spring at clutch fork.

2. Rotate clutch lever and shaft assembly until clutch pedal is firmly against rubber bumper on brake pedal bracket.

3. Push outer end of clutch fork rearward until release bearing lightly contacts pressure plate fingers or levers.

4. Loosen lock nut and adjust rod length so that swivel slips freely into gauge hole. Increase pushrod length until all lash is removed from system.

5. Remove swivel from gauge hole and insert into lower hole on lever. Install two washers and cotter pin. Tighten lock nut being careful not to change rod length.

6. Reinstall return spring and check pedal free travel. Pedal travel should be 1 3/8" to 1 5/8" on "C-K" models and 1 1/4" to 1 1/2" on "P" models.

P-30 Models W/J76 (Fig. 7C-10)

1. Disconnect clutch fork return spring.

2. Loosen nut "G" at swivel.

3. Move the clutch fork rod against fork to eliminate all clearance between release bearing and clutch fingers.

4. Rotate shaft lever until clutch pedal contacts the bumper mounted on the brake pedal bracket.

5. Rotate the fork rod until a clearance of approximately 1/4" to 5/16" (.29) is obtained between the shoulder on the fork rod and the adjustment nut.

6. Tighten nut "G" against swivel and install clutch return spring.

7. Check free pedal clearance at pedal. Pedal clearance should be 1 3/8" to 1 5/8". Readjust as required.

G-Models (Fig. 7C-11)

1. Disconnect clutch fork return spring at fork.

2. Loosen nut "A" and back off from swivel approximately 1/2 inch.

3. Hold clutch fork push rod against fork to move release bearing against clutch fingers (push rod will slide through swivel at cross-shaft).

4. Adjust nut "B" to obtain approximately 1/4" clearance between nut "B" and swivel.

5. Release push rod, connect return spring and tighten nut "A" to lock swivel against nut "B".

6. Check free pedal clearance at pedal (1 1/4" to 1 1/2" is proper clearance). Readjust if necessary.

INSUFFICIENT CLUTCH RELEASE

Where complaints of first or reverse gear clash due to insufficient clutch release are encountered, the following may be helpful. Cut off the existing clutch pedal stop bumper to a height of 3/8". Since shortening the bumper increases the lash and not the usable stroke, the lash must be reduced to specifications in order to gain the additional stroke benefit.

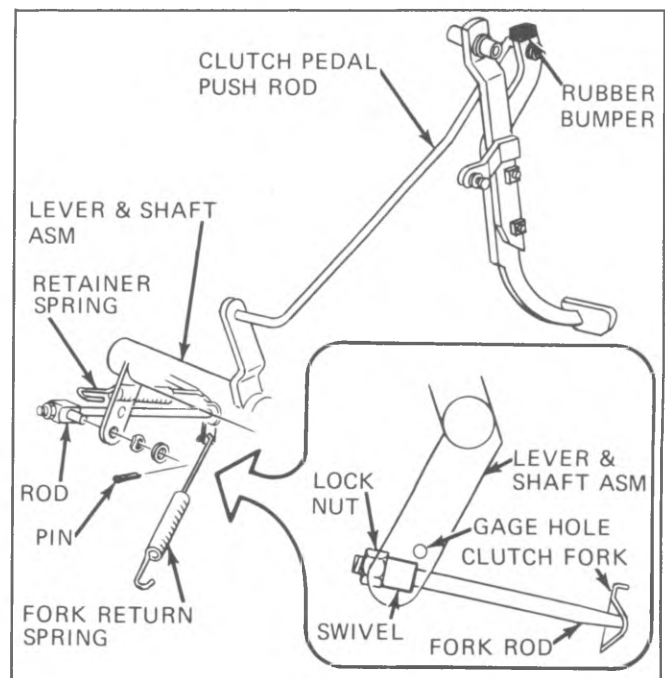


Fig. 7C-9--CK-Free Pedal Travel

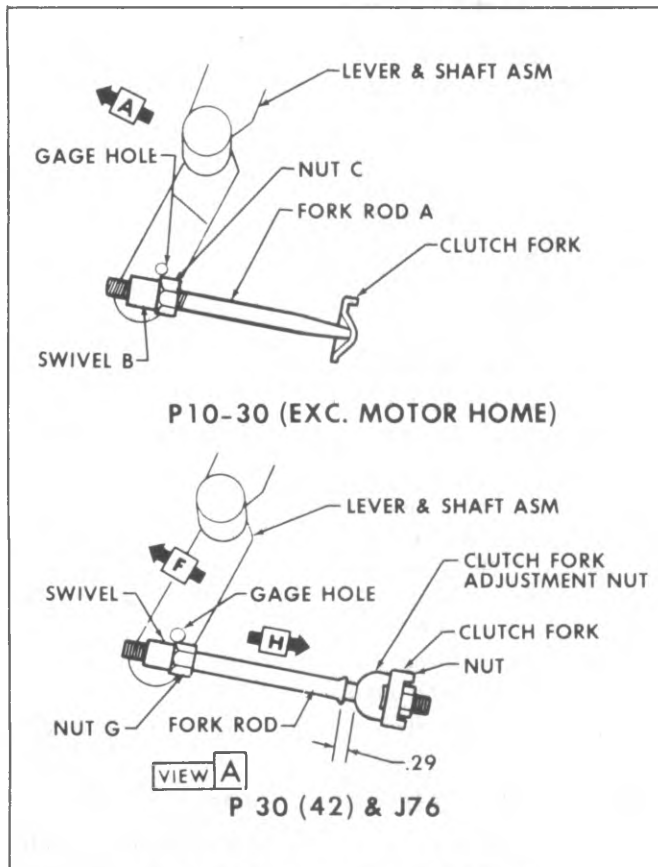


Fig. 7C-10--P-Truck Free Pedal Travel

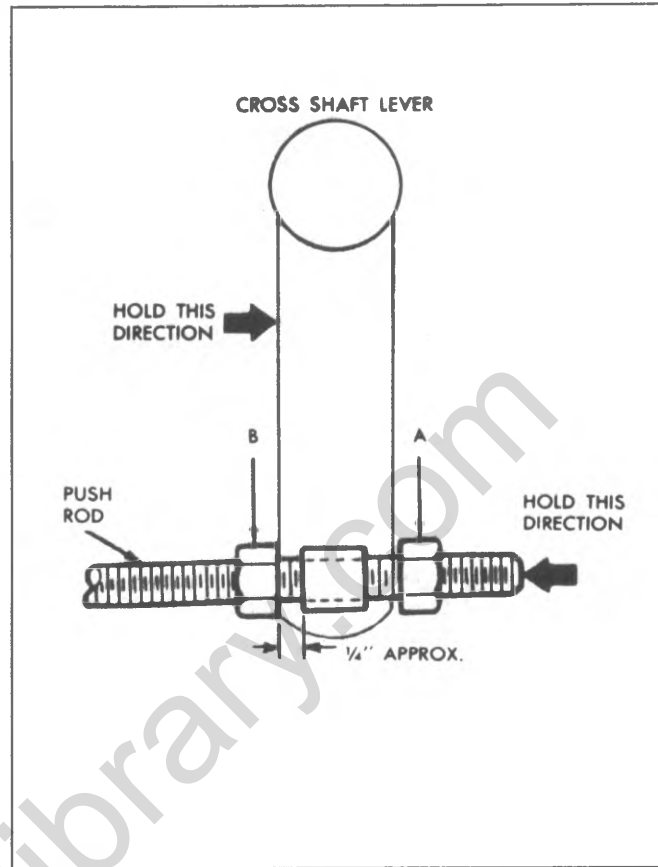


Fig. 7C-11--G-Truck Free Pedal Travel

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CLUTCH TROUBLE DIAGNOSIS

CONDITION	PROBABLE CAUSE	CORRECTION
Fails to Release (Pedal pressed to floor-shift lever does not move freely in and out of reverse gear)	<ul style="list-style-type: none"> a. Improper linkage Adjustment b. Improper pedal travel c. Loose linkage d. Faulty pilot bearing e. Faulty driven disc f. Fork off ball stud g. Clutch disc hub binding on clutch gear spline h. Clutch disc warped or bent 	<ul style="list-style-type: none"> a. Adjust Linkage b. Trim bumper stop and adjust linkage c. Replace as necessary d. Replace bearing e. Replace disc f. Install properly and* lubricate fingers at release bearing with wheel bearing grease. g. Repair or replace clutch gear and/or disc. h. Replace disc (run-out should not exceed .020"). <p>*Very lightly lubricate fingers</p>
Slipping	<ul style="list-style-type: none"> a. Improper Adjustment (no lash) b. Oil Soaked driven disc c. Worn facing or facing torn from disc. d. Warped pressure plate or flywheel e. Weak diaphragm spring f. Driven plate not seated in g. Driven plate overheated 	<ul style="list-style-type: none"> a. Adjust linkage to spec. b. Install new disc and correct leak at its source c. Replace disc d. Replace pressure plate or flywheel e. Replace pressure plate (Be sure lash is checked before replacing plate.) f. Make 30 to 40 normal starts CAUTION: Do Not Overheat g. Allow to cool – check lash
Grabbing (Chattering)	<ul style="list-style-type: none"> a. Oil on facing. Burned or glazed facings. b. Worn splines on clutch gear. c. Loose engine mountings. d. Warped pressure plate or flywheel. e. Burned or smeared resin on flywheel or pressure plate. 	<ul style="list-style-type: none"> a. Install new disc and correct leak. b. Replace transmission clutch gear. c. Tighten or replace mountings. d. Replace pressure plate or flywheel. e. Sand off if superficial, replace burned or heat checked parts.
Rattling-Transmission Click	<ul style="list-style-type: none"> a. Weak retracting springs. b. Clutch fork loose on ball stud or in bearing groove. c. Oil in driven plate damper. d. Driven plate damper spring failure. 	<ul style="list-style-type: none"> a. Replace pressure plate. b. Check ball stud and retaining. c. Replace driven disc. d. Replace driven disc.
Release Bearing Noise with Clutch Fully Engaged	<ul style="list-style-type: none"> a. Improper adjustment. No Lash. b. Release bearing binding on transmission bearing retainer. c. Insufficient tension between clutch fork spring and ball stud. d. Fork improperly installed. e. Weak linkage return spring. 	<ul style="list-style-type: none"> a. Adjust linkage. b. Clean, relubricate, check for burrs, nicks, etc. c. Replace fork. d. Install properly. e. Replace spring.
Noisy	<ul style="list-style-type: none"> a. Worn release bearing. b. Fork off ball stud (heavy clicking). c. Pilot Bearing loose in crankshaft. 	<ul style="list-style-type: none"> a. Replace bearing. b. Install properly and lubricate fork fingers at bearing. c. See Section 6 for bearing fits.
Pedal Stays on Floor When Disengaged	<ul style="list-style-type: none"> a. Bind in linkage or release bearing. b. Springs weak in pressure plate. c. Springs being over traveled. 	<ul style="list-style-type: none"> a. Lubricate and free up linkage and release bearing. b. Replace pressure plate. c. Adjust linkage to get proper lash, be sure proper pedal stop (bumper) is installed.
Hard Pedal Effort	<ul style="list-style-type: none"> a. Bind in linkage. b. Driven plate worn. 	<ul style="list-style-type: none"> a. Lubricate and free up linkage. b. Replace driven plate.

Fig. 7C-12--Clutch Diagnosis Chart

COMPONENT PARTS REPLACEMENT

PRELIMINARY INSPECTION

There are many things which affect good clutch operation. Therefore, it is necessary, before performing any major clutch operations, to make a preliminary inspection to determine whether or not the trouble is actually in the clutch.

1. Check the clutch pedal and make sure that the pedal has proper free travel, as described in "Maintenance and Adjustments".
2. Check the clutch pedal bushing for wear and for sticking on the shaft or loose mountings.
3. Lubricate the pedal linkage.
4. Tighten all front and rear engine mounting bolts.

CLUTCH DISC AND PRESSURE PLATE (DIAPHRAGM TYPE)

Removal from Vehicle

1. Remove transmission as outlined in Section 7B.
2. Disconnect clutch fork push rod and pull back spring.
3. Remove clutch and flywheel housing.
4. Remove clutch fork by pressing it away from its ball mounting with a screwdriver, until the fork snaps loose from the ball or remove ball stud from rear of clutch housing. Remove release bearing from clutch fork.

NOTE: The retainer may be removed from the fork by prying out with a small screwdriver.

5. Install Tool J-5824 or a used clutch drive gear to support the clutch assembly during removal.

NOTE: Before removing clutch from flywheel, mark the flywheel, clutch cover and one pressure plate lug, so that these parts may be assembled in their same relative positions, as they were balanced as an assembly.

6. Loosen the clutch attaching bolts one turn at a time to prevent distortion of clutch cover until diaphragm spring is released.

7. Remove clutch pilot tool and remove clutch assembly from vehicle.

NOTE: The flywheel should be inspected for cracks, heat checking, flatness and other defects.

Installation to Vehicle

1. Install the pressure plate in the cover assembly lining up the notch mark on pressure plate with notch mark on flange of cover.

2. Install pressure plate retracting springs, lockwashers and drive strap to pressure plate bolts. Tighten to 11 ft. lbs. torque. The clutch is now ready to be installed.

3. Hand crank the engine until "X" mark on flywheel is at the bottom.

4. Install clutch disc, pressure plate and cover assembly and support them with Tool J-5824 or a used clutch drive gear.

5. Turn clutch assembly until "X" mark or painted white letter on clutch cover flange lines up with "X" mark on flywheel.

6. Install attaching bolts and tighten each one a turn at a time to prevent distorting the cover as the spring pressure is taken up.

7. Remove clutch pilot tool.

8. Pack clutch fork ball seat with a small amount of high melting point grease. On "P" models with J76, install a new retainer in the groove of the clutch fork if the old retainer is worn or damaged.

NOTE: Install retainer with high side up, away from bottom of the ball socket and with open end of retainer on the horizontal.

CAUTION: Be careful not to use too much lubricant. Excessive lubricant may get on clutch fingers and cause slippage.

9. Replace clutch fork ball if removed from the clutch housing and snap clutch fork onto the ball.

10. Pack lubricant in the recess on the inside of the release bearing collar and coat the clutch fork groove with a small amount of graphite grease, as shown in Figure 7C-13.

11. Install release bearing assembly to the clutch fork. Install clutch and flywheel housing to engine.

12. Assemble transmission as outlined in Section 7B.

13. Align push rod to clutch fork and attach return spring to clutch fork.

14. Adjust clutch linkage as described in "Maintenance and Adjustments."

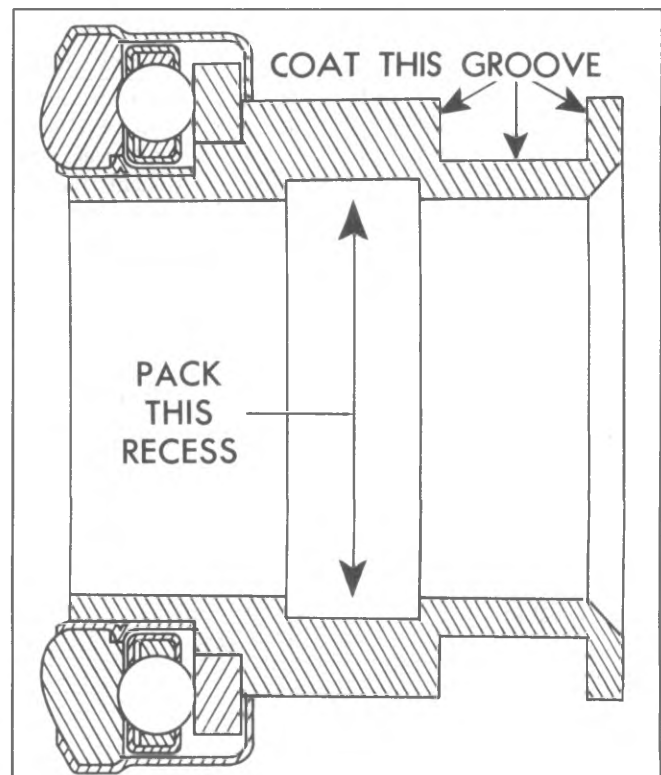


Fig. 7C-13--Lubrication Points on Clutch Release Bearing

CLUTCH DISC AND PRESSURE PLATE (COIL SPRING TYPE)

Removal From Vehicle

1. Remove transmission as outlined in Section 7B.
2. Disconnect clutch fork push rod and pull back spring.
3. Remove clutch and flywheel housing.
4. Remove clutch fork by pressing it away from its ball mounting with a screwdriver, until the fork snaps loose from the ball or remove ball stud from rear of clutch housing. Remove release bearing from clutch fork.

NOTE: The retainer may be removed from the fork by prying out with a small screwdriver.

5. Install Tool J-5824 or a used clutch drive gear to support the clutch assembly during removal.

NOTE: Before removing clutch from flywheel, mark the flywheel, clutch cover and one pressure plate lug, so that these parts may be assembled in their same relative positions, as they were balanced as an assembly.

6. Loosen the holding screws a turn or two at a time to avoid bending rim of cover. It is advantageous to place wood or metal spacers (approximately 3/8 thick) between the clutch levers and the cover to hold the levers down as the holding screws are removed or when clutch is removed from engine. When removing driven plate be sure to mark flywheel side.

7. Remove clutch pilot tool and remove clutch assembly from vehicle.

NOTE: Inspect flywheel for heat defects, cracks, flatness, or other defects.

Installation To Vehicle

1. Assemble driven plate and clutch cover assembly to flywheel in accordance with marking on driven plate for flywheel side. Use Tool J-5824 or a dummy shaft to support assembly.

2. Line up the clutch assembly with "X" mark or painted white letter with "X" mark on flywheel, before tightening cover holding screws.

3. Tighten holding screws, a turn at a time, before removing dummy shaft.

4. Remove clutch pilot tool.

5. Pack clutch fork ball seat with a small amount of high melting point grease and install a new retainer in the groove of the clutch fork if the old retainer is worn or damaged.

NOTE: Install retainer with high side up, away from bottom of the ball socket and with open end of retainer on the horizontal.

CAUTION: Be careful not to use too much lubricant. Excessive lubricant may get on clutch fingers and cause slippage.

6. Replace clutch fork ball if removed from the clutch housing and snap clutch fork onto the ball.

7. Pack lubricant in the recess on the inside of the release bearing collar and coat the clutch fork groove with a small amount of graphite grease, as shown in Figure 7C-13.

8. Install release bearing assembly to the clutch fork. Install clutch and flywheel housing to engine.

9. Assemble transmission as outlined in Section 7B.

10. Align push rod to clutch fork and attach return

spring to clutch fork.

11. Adjust clutch linkage as described in "Maintenance and Adjustments."

CLUTCH PEDAL ARM, PUSH ROD OR BUSHING REPLACEMENT (Fig. 7C-14)

C-K Models

Removal

1. Disconnect battery negative ground cable at the battery terminal.

2. Disconnect clutch push rod at the cross shaft under the vehicle.

3. Remove steering column covers. Remove screws retaining push rod boots to bulkhead.

4. Remove air conditioning duct from lower left side of instrument cluster if so equipped. (Refer to Section 1A).

CAUTION: Maintain pressure on lower arm.

When lower attaching bolt is removed upper section will snap upward.

5. Disconnect clutch neutral start switch from pedal arm.

6. Remove bolts attaching lower section of clutch pedal arm to the upper arm.

7. Remove lower arm and push rod from vehicle.

8. Remove pedal return spring.

9. Remove pedal pivot shaft retaining nut and pivot shaft. Insert a dummy shaft or rod through the support to hold the brake pedal components in place.

10. Remove the clutch pedal assembly from the support assembly.

11. Remove pedal bushings and spacer from pedal arm. Check pedal bumper for wear and replace as required.

Installation

1. Install new bushings and spacer in pedal arm. Components should be lubricated prior to assembly.

2. Position clutch pedal upper arm in support bracket and install pivot bolt through support and pedal arms.

NOTE: Bolt must be installed in direction shown in Figure 7C-14 in order to clear return spring.

3. Install pivot bolt retaining nut and torque to specifications.

4. Install pull back spring to support and pedal arm.

NOTE: If previously removed connect pedal push rod to clutch pedal arm.

5. Position lower pedal arm to upper arm and install upper attaching bolt. Push down on pedal and install lower bolt. Torque to specifications.

6. Install clutch neutral start switch.

7. Install air conditioning duct.

8. Install steering column covers. Install screws retaining push rod boots to bulk head.

9. Check operation of clutch assembly and adjust clutch as required.

G and P Models (Fig. 7C-14)

Removal

1. Apply parking brake firmly. Disconnect neutral start switch from pedal arm.

2. Remove bolt at clutch pedal push rod lever, then remove lever from pedal shaft.

3. Hold pedal pad with one hand and slide clutch pedal and shaft assembly outboard enough to clear pedal stop.

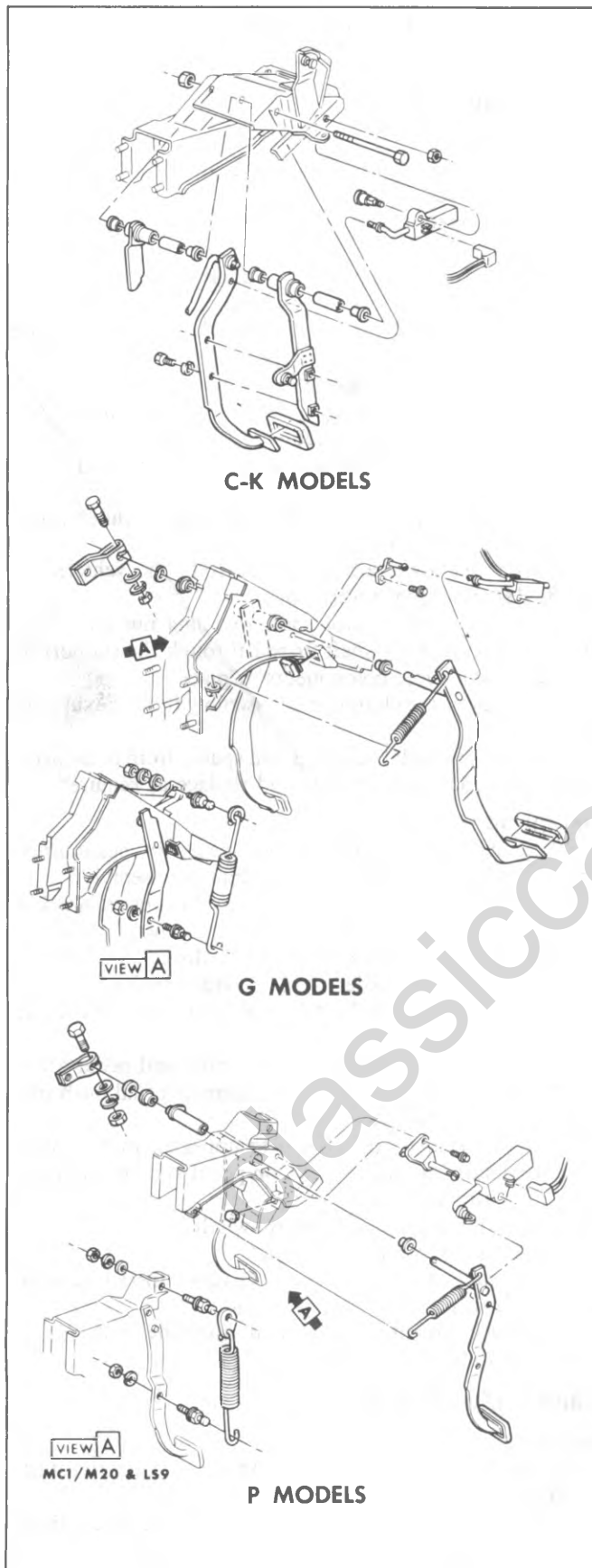


Fig. 7C-14--Clutch Pedal Mounting Attachment

Insert a dummy shaft or rod through support and brake pedal assembly to hold components in place while removing clutch pedal shaft. Allow return spring (or center spring) to pull pedal up high enough to unhook spring from pedal arm.

4. Remove pedal and shaft assembly from support bracket.

Inspection

1. Check clutch pedal bushings for excessive wear and replace as necessary.
2. Check clutch pedal shaft for wear and alignment. Straighten or replace as necessary.

Installation

NOTE: Use new shaft bushing if needed. Lubricate with petrolatum.

1. Slide one pedal shaft bushing over shaft, install shaft in support enough to still clear pedal bumper stop, hook pedal return (or overcenter) spring to pedal, then rotate pedal forward of bumper stop; slide shaft into position in support and release pedal against bumper stop.
2. Install clutch pedal shaft bushing over pedal shaft end and into place in sleeve.
3. Assemble pedal push rod lever over pedal shaft and install bolts, washers, and nut.
4. Connect neutral start switch to pedal arm.
5. Adjust clutch pedal free travel as needed.

CLUTCH CROSS-SHAFT REPLACEMENT

(Figs. 7C-6, 7C-7, 7C-8)

1. Disconnect clutch fork return spring at fork.
2. Disconnect pedal push rod at cross-shaft lever and allow clutch fork push rod to hang free from lower lever.
3. On C-K models, remove ball stud retaining nut, at frame end and slide shaft toward engine. Then lift cross-shaft up to clear bracket and remove shaft from the engine ball stud. On G models, remove frame bracket retaining bolts, then remove shaft from engine ball stud.
4. Remove clutch fork push rod from cross-shaft lever.
5. Reverse removal procedure to install.

SPECIAL TOOLS

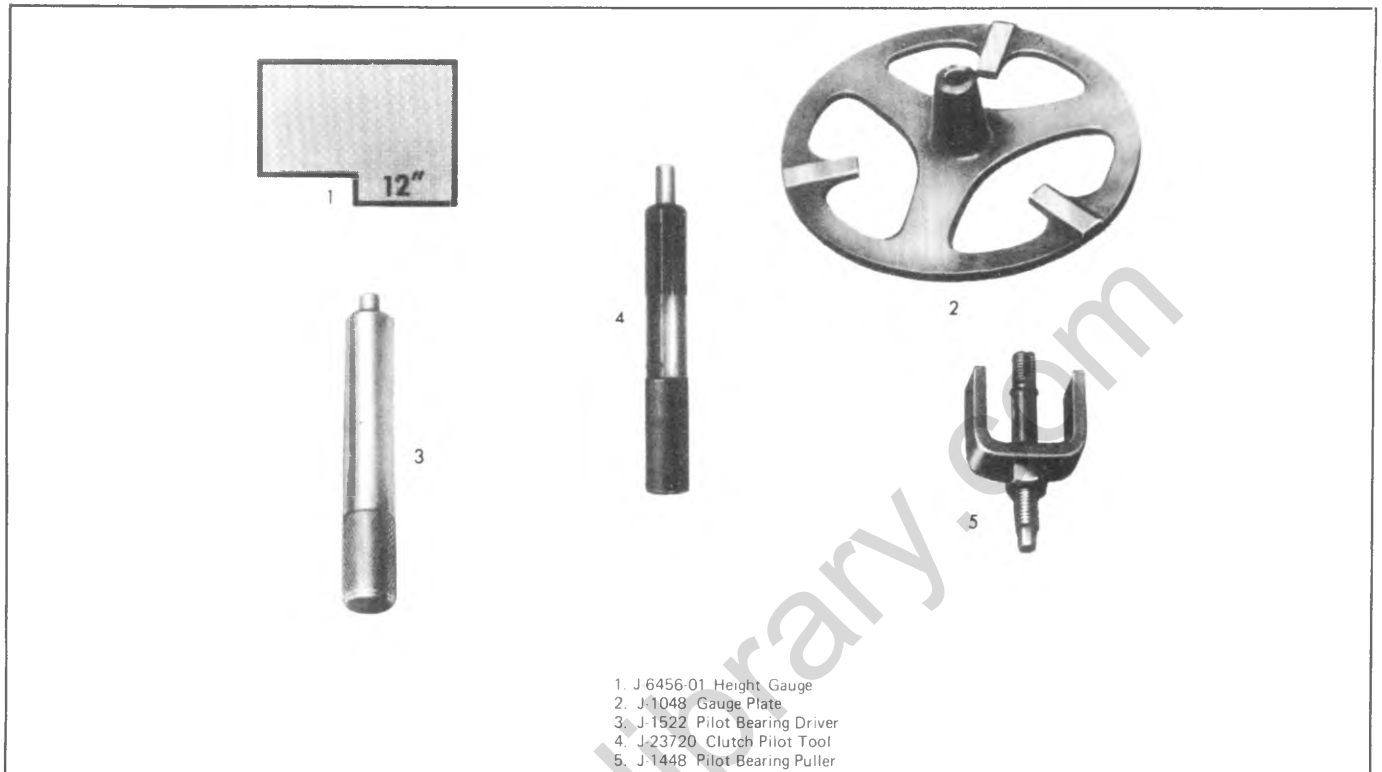


Fig. 7C-ST-Clutch Special Tools

SECTION 7D

TRANSFER CASE

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GENERAL DESCRIPTION

TRANSFER CASES

A transfer case mounts behind the transmission, as seen in Fig. 7D-1, and allows drive torque to be transmitted in a proportional split to both the front axle and the rear axle, resulting in four-wheel drive. The shift control lever for the transfer case is floor-mounted in the passenger compartment. Depending on the type of transfer case and the shift lever position, various combinations of rear wheel drive, four wheel drive, high traction (gear reduction) or direct drive may be selected.

Model 205, Part-Time

The model 205 transfer case shown in Fig. 7D-2 is a two-speed unit which can be used for either two-wheel or four-wheel drive. Direct drive (1:1 ratio) is available in two modes, 2H for two-wheel drive, or 4H for four-wheel drive. Gear reduction (1.96:1 ratio) is used in the 4L position. This unit uses constant mesh helical gears to connect the input shaft, idler gear and two output gears, thus allowing gear selection to match driving conditions. The front input shaft gear (Item #27) is in constant mesh with the idler gear (#44) and, through the idler gear, with the front output gears (#59 and #67) and the rear output gear (#17). Sliding clutches (#26, #64) allow for selective gear engagement resulting in High or Lo range, and two-wheel or four-wheel drive. Ball bearings support the input shaft,

rear output shaft and front output shaft. Tapered roller bearings are used on the idler shaft. When driving in a four-wheel mode (4L or 4H) the hubs on the front wheels must be turned to the "Locked" position.

Model 203, Full-Time

The model 203 transfer case shown in Figs. 7D-3 and 7D-4 provides full-time four wheel drive. It consists of two basic sections; the range box which provides selection of Hi range for direct drive (1:1 ratio), or Lo range for gear reduction (2:1 ratio); and the transfer case section which provides for drive to the front and rear axles. A differential unit provides differential action between the two axles; however, the unit can be locked by the driver (Hi-Loc or Lo-Loc) to provide equal rotation to both axles.

Main components of the Model 203 transfer case are the range box (Item #9) with its input gear (#13), idler gear (#32) and output gears (#40); the chain housing (#46) with its input shaft (#38), drive sprocket (#64), drive chain (#65) and front output shaft (#60); and the differential (#75), differential housing (#82), rear output shaft (#77) and housing (#84).

Torque output is controlled by the position of the shift control lever.

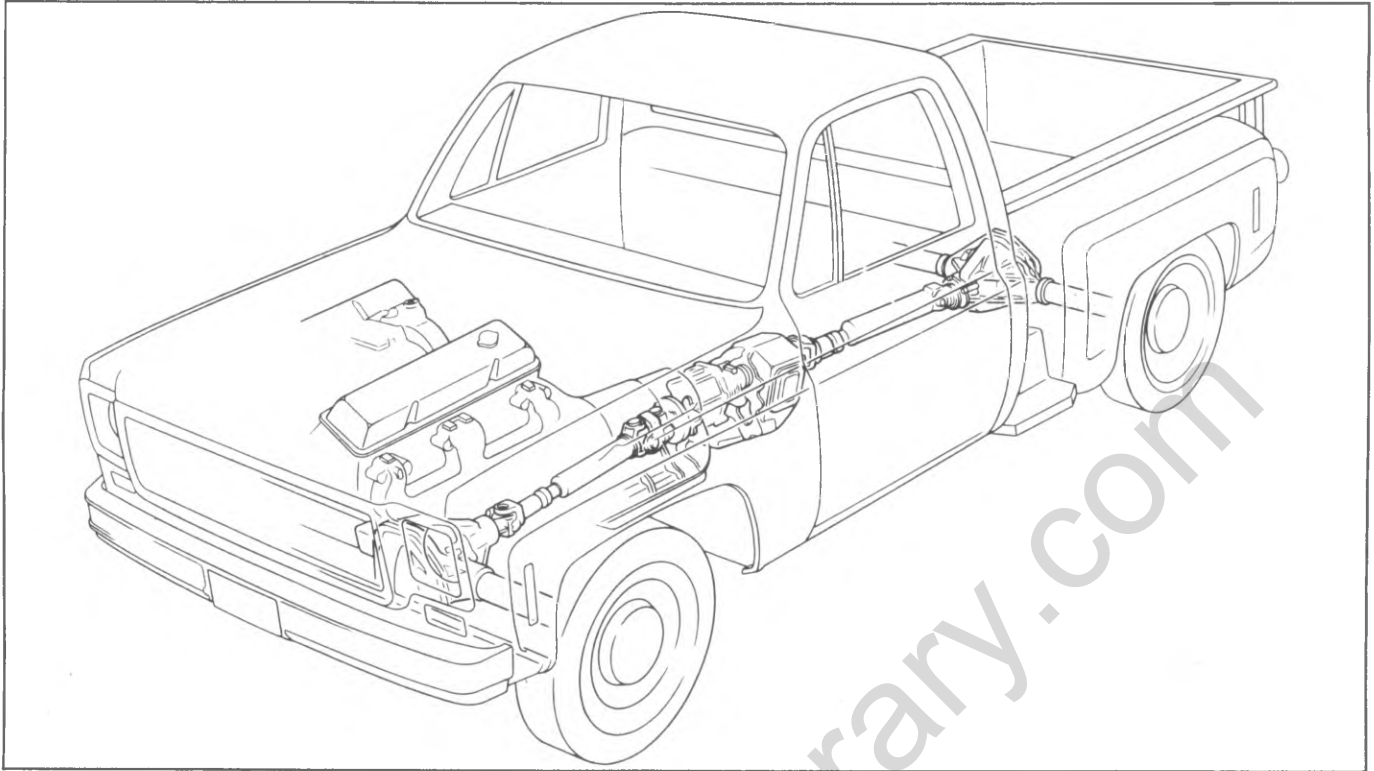
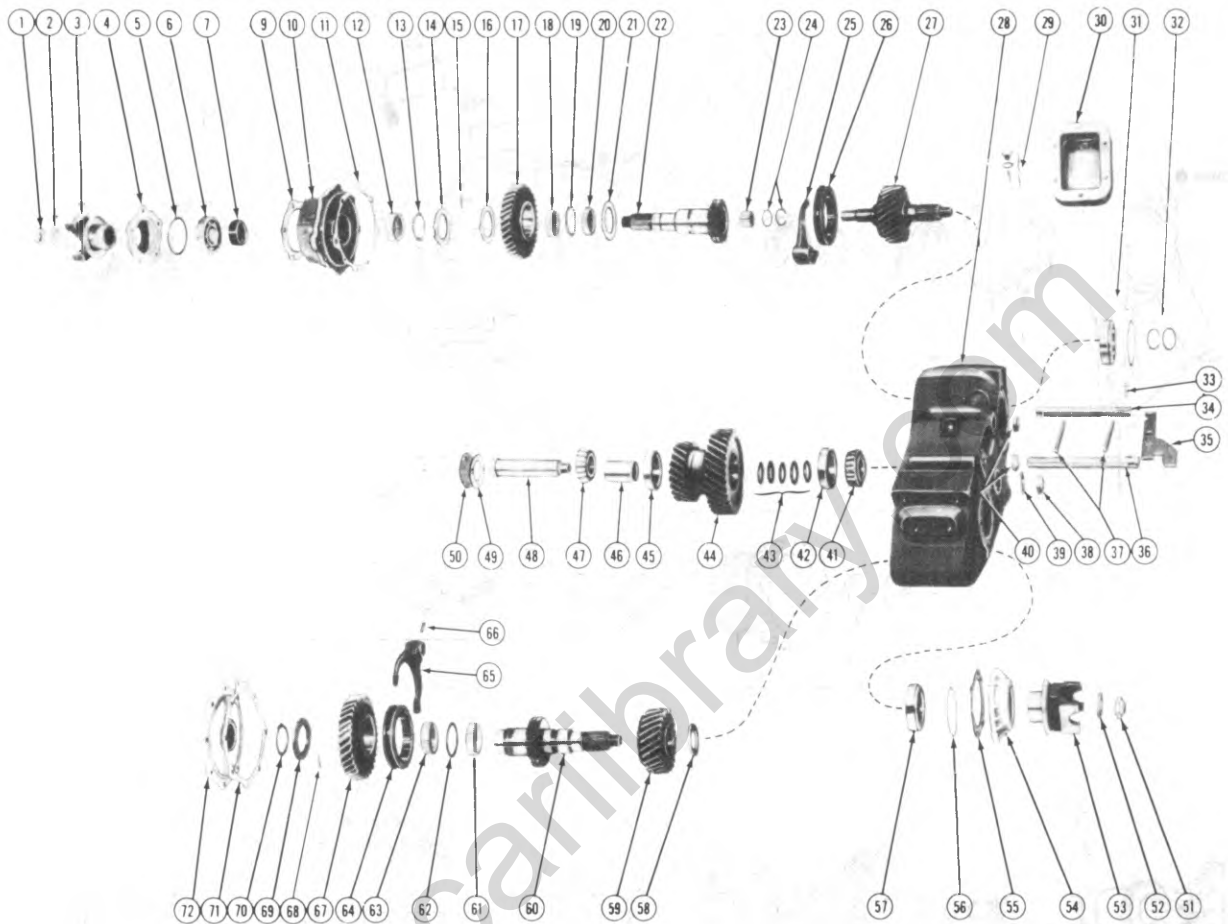


Fig. 7D-1--Transfer Case, Typical Functional View



- | | | | | | |
|----|------------------------------------|----|-----------------------------------|----|----------------------------|
| 1 | Rear Output Shaft Locknut | 26 | Sliding Clutch | 49 | Cover Gasket |
| 2 | Washer | 27 | Input Shaft | 50 | Rear Cover |
| 3 | Yoke | 28 | Transfer Case | 51 | Front Output Shaft Locknut |
| 4 | Bearing Retainer and Seal Assembly | 29 | Poppet Plug Spring and Ball | 52 | Washer |
| 5 | Snap Ring | 30 | P.T.O. Gasket and Cover | 53 | Yoke |
| 6 | Bearing | 31 | Input Shaft Bearing and Snap Ring | 54 | Bearing Retainer and Seat |
| 7 | Speedometer Gear | 32 | Snap Ring and Rubber "O" Ring | 55 | Gasket |
| 9 | Gasket | 33 | Shift Link Clevis Pin | 56 | Snap Ring |
| 10 | Housing | 34 | Range Shift Rail | 57 | Front Bearing |
| 11 | Gasket | 35 | Shift Rail Connector Link | 58 | Thrust Washer |
| 12 | Bearing | 36 | Front Wheel Drive Shift Rail | 59 | Front Wheel High Gear |
| 13 | Snap Ring | 37 | Interlock Pins | 60 | Front Output Shaft |
| 14 | Thrust Washer | 38 | Rear Idler Lock Nut | 61 | Needle Bearings |
| 15 | Thrust Washer Lock Pin | 39 | Washer | 62 | Spacer |
| 16 | Thrust Washer (Tanged) | 40 | Shift Rail Seals | 63 | Needle Bearing |
| 17 | Low Speed Gear | 41 | Idler Shaft Bearing | 64 | Sliding Clutch Gear |
| 18 | Needle Bearings | 42 | Bearing Cup | 65 | Shift Fork |
| 19 | Spacer | 43 | Shims | 66 | Roll Pin |
| 20 | Needle Bearings | 44 | Idler Gear | 67 | Front Output Low Gear |
| 21 | Tanged Washer | 45 | Bearing Cup | 68 | Thrust Washer Lock Pin |
| 22 | Rear Output Shaft | 46 | Spacer | 69 | Thrust Washer |
| 23 | Needle Bearings | 47 | Idler Shaft Bearing | 70 | Snap Ring |
| 24 | Washer and Retainer | 48 | Idler Shaft | 71 | Rear Cover Gasket |
| 25 | Shift Fork | | | 72 | Rear Cover and Bearing |

Fig. 7D-2--Model 205 Transfer Case, Exploded View

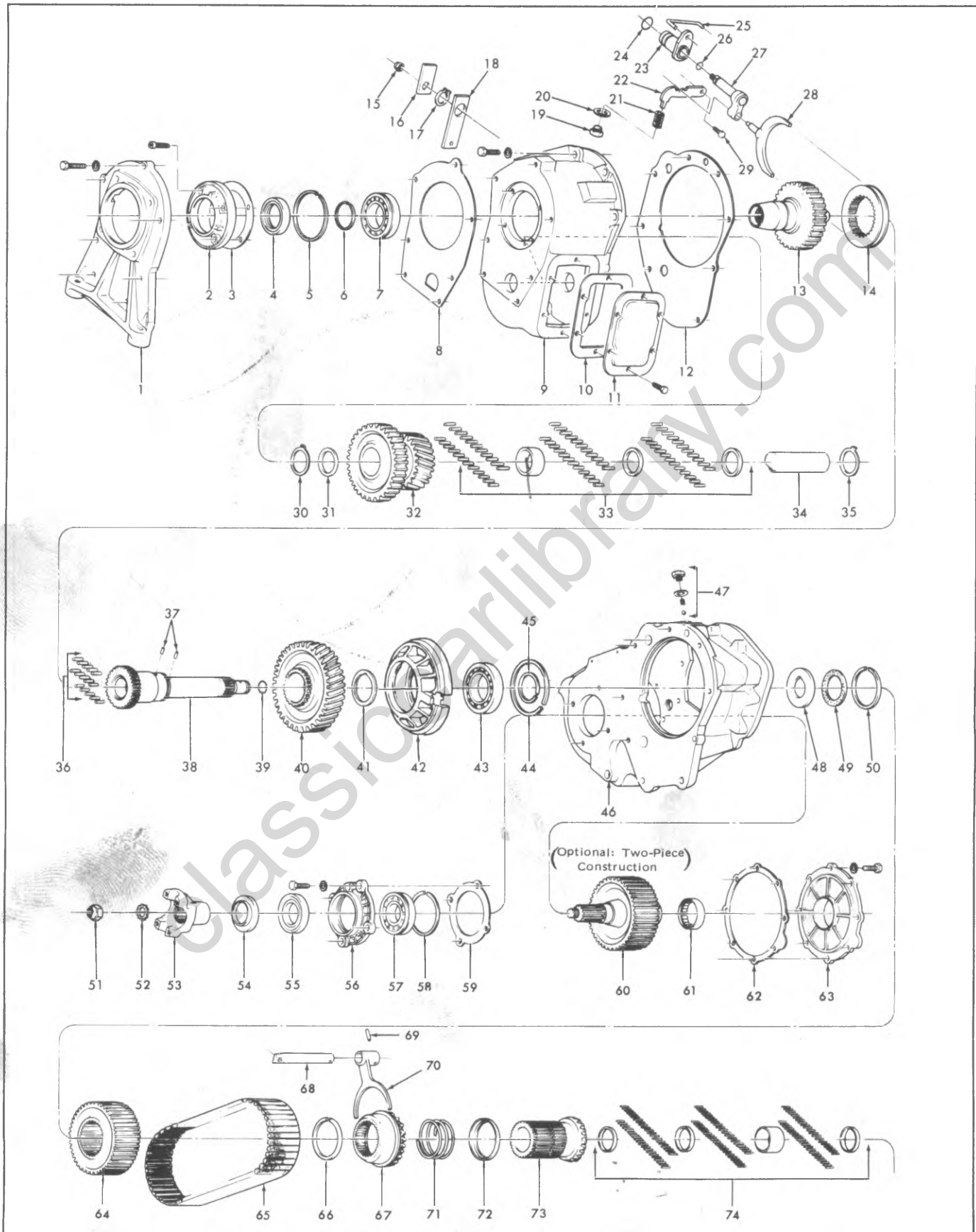


Fig. 7D-3-Model 203 Transfer Case Exploded View A

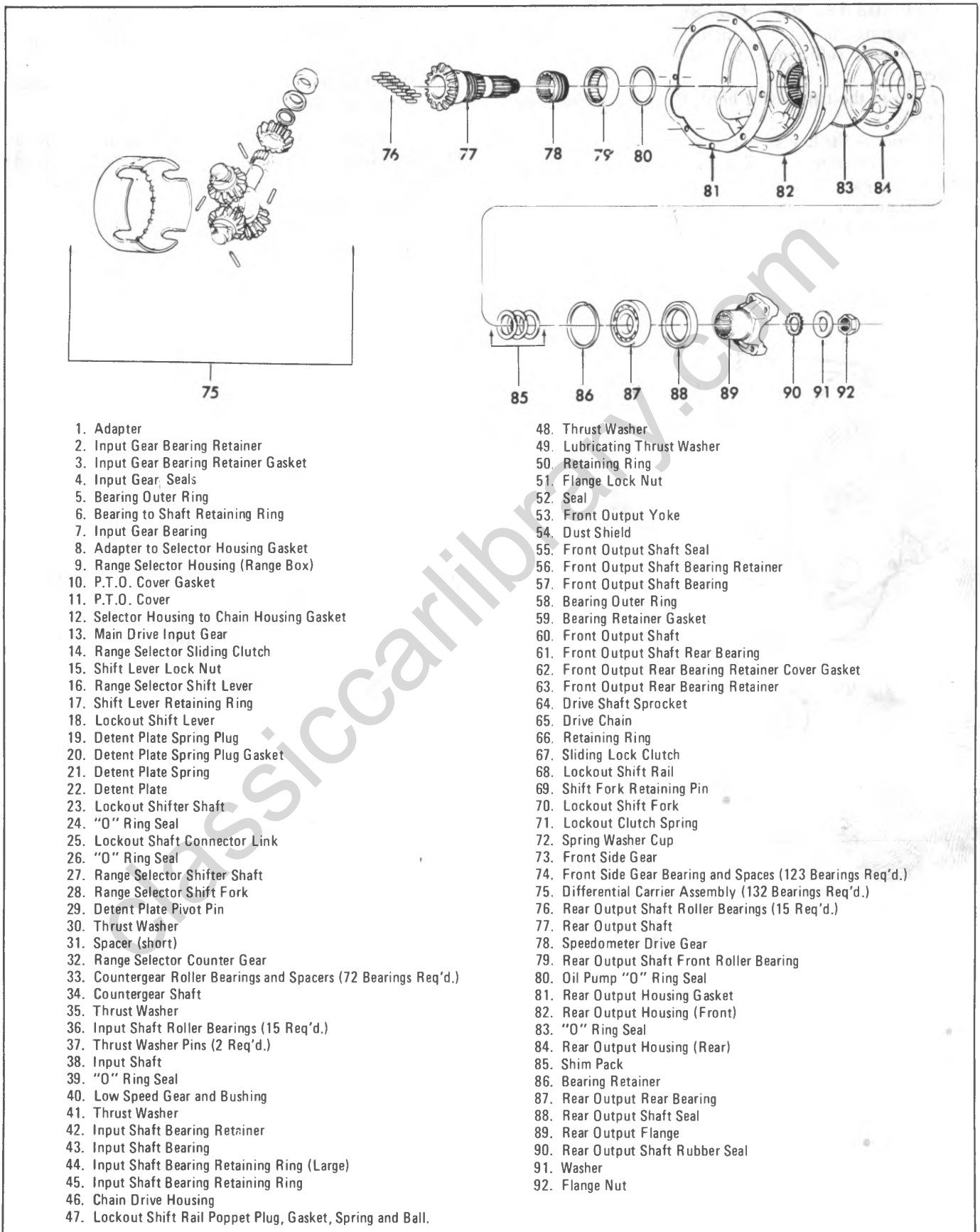


Fig. 7D-4-Model 203 Transfer Case Exploded View B

MAINTENANCE AND ADJUSTMENTS

MODEL 203 TRANSFER CASE-OIL CHANGE

1. Operate truck on road surface to agitate the transfer case lubricant sufficiently to reach normal operating temperatures.

2. Raise the truck on a hoist. Remove the lubricant filler plug.

3. Remove the lowest bolt from the front output shaft rear bearing retainer, and allow the lubricant to drain. See Item A in Figure 7D-5.

4. Remove six bolts retaining the P.T.O. cover, then remove the cover while allowing lubricant to drain. See item B.

5. Remove speedo driven gear at location C.

6. Use a suction gun at locations B and C to remove as much lubricant as possible.

7. Install speedo driven gear, P.T.O. cover, and lowest bolt into bearing retainer.

8. Add approximately seven pints of engine oil through the filler plug opening. Check the fluid level and add sufficient oil to raise the level to one-half inch below the filler plug opening. Replace the plug. Wipe the surfaces of the case and the skid plate to remove excess oil.

9. Lower the truck to the floor.

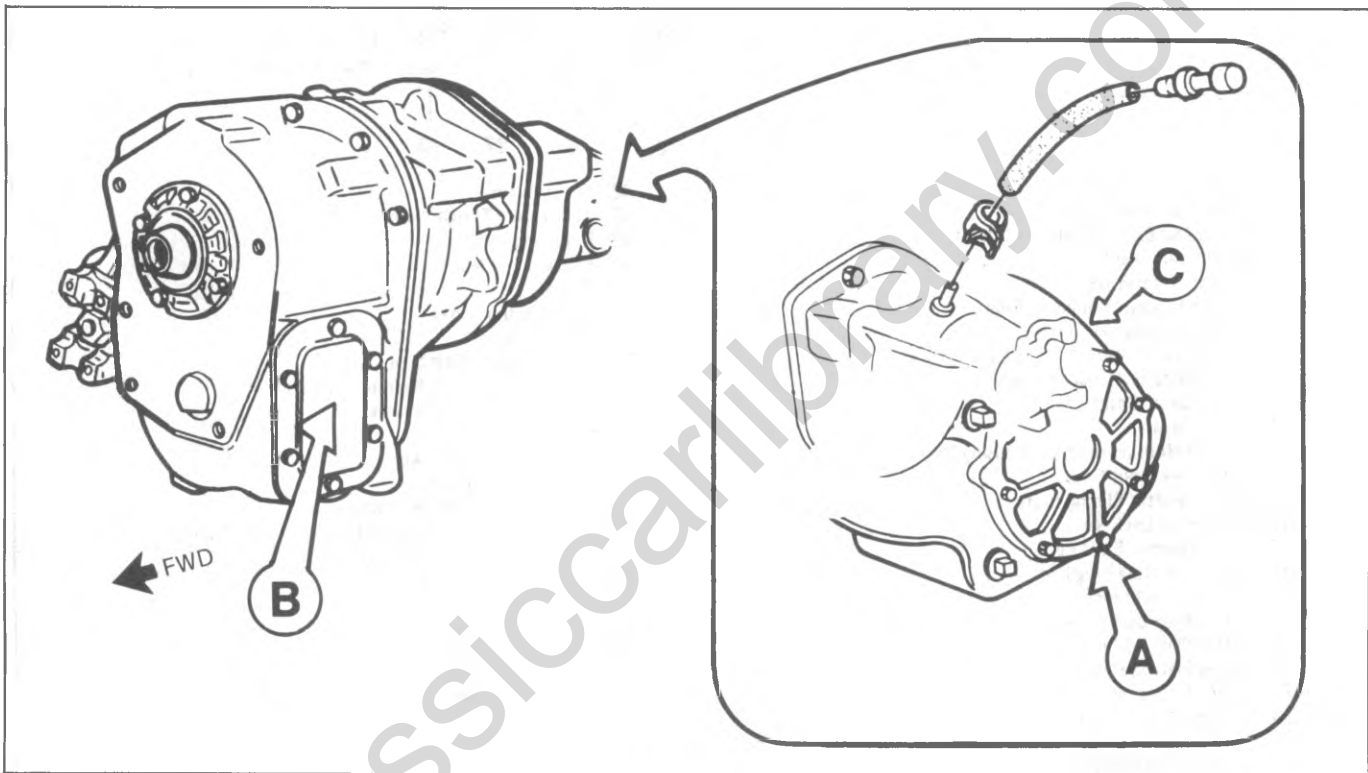


Fig. 7D-5--Model 203 Transfer Case, Oil Change Location View

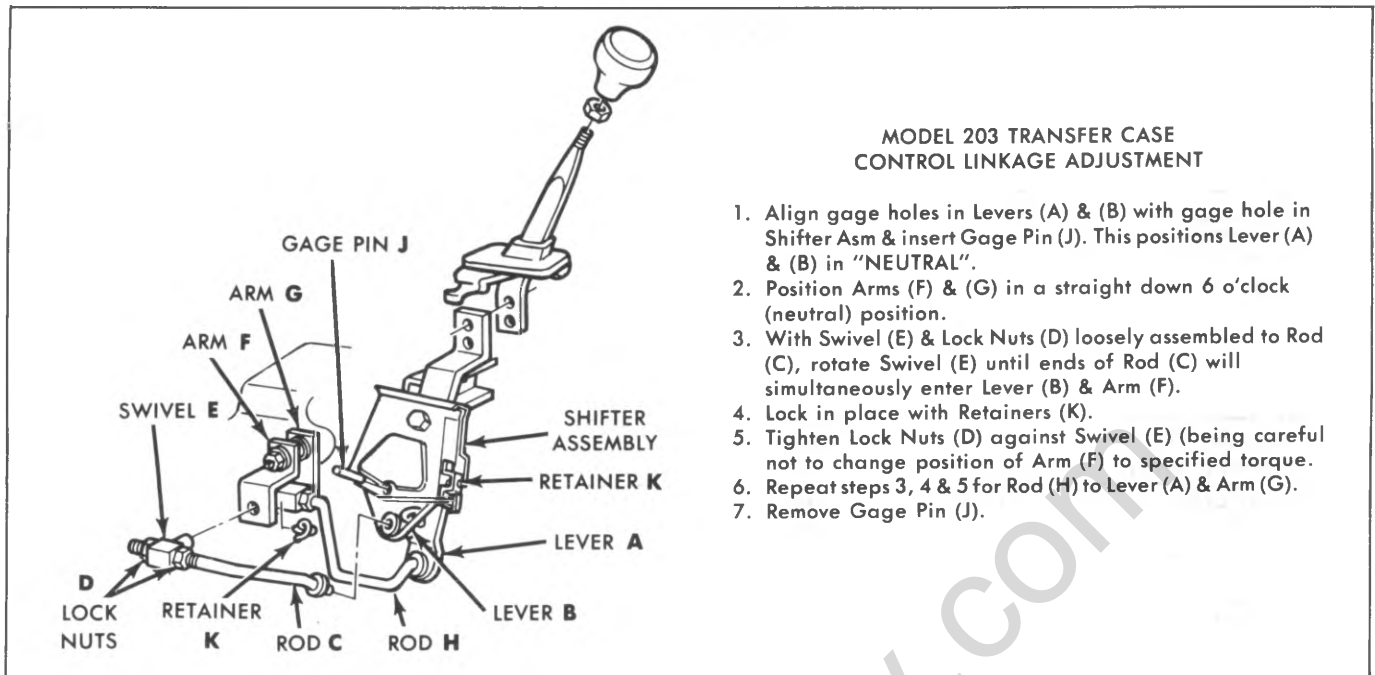


Fig. 7D-6--Model 203 Linkage

LINKAGE ADJUSTMENT AND INSPECTION

The control linkages for transfer cases are shown in Figs. 7D-6 and 7D-7. Adjustment procedures for Model 203 are shown in Fig. 7D-6.

Periodically inspect the linkage system for freedom of operation, proper engagement, loose attaching bolts foreign material, etc. Adjust, clean and tighten as necessary.

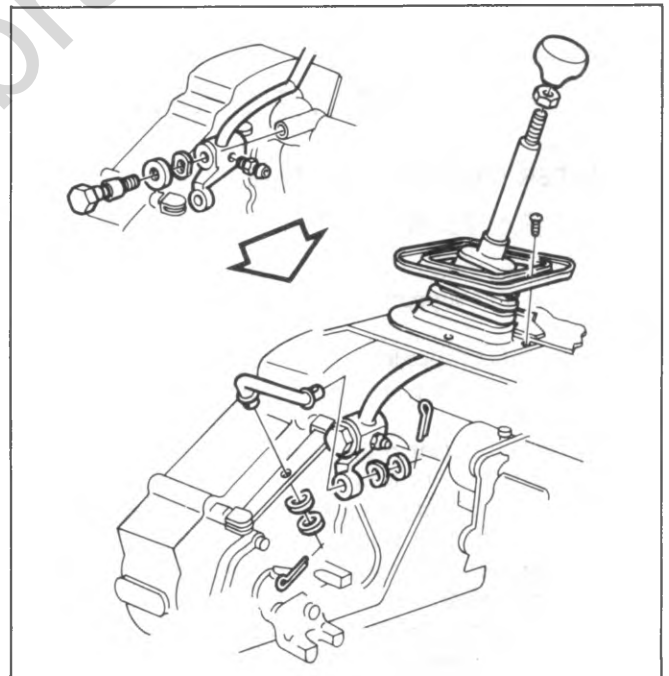


Fig. 7D-7--Model 205 Linkage

DIAGNOSIS

COMPLAINT	POSSIBLE CAUSES	REMEDIES
Excessive Noise	<ol style="list-style-type: none"> 1. Lubricant level-low 2. Worn or damaged bearings 3. Worn or damaged chain 4. Misalignment of drive shafts or universal joints 5. Yoke bolts loose 6. Loose adapter bolts 	<ol style="list-style-type: none"> 1. Fill as required 2. Replace 3. Replace 4. Align 5. Torque to specs. 6. Torque to specs.
Shifter Lever Difficult to Move	<ol style="list-style-type: none"> 1. Dirt/contamination on linkage 2. Binding inside transfer case 	<ol style="list-style-type: none"> 1. Clean and lubricate 2. Repair as required
Shifter Lever Disengages from Position	<ol style="list-style-type: none"> 1. Linkage misadjusted/loose 2. Gears worn or damaged 3. Shift rod bent 4. Missing detent ball or spring 	<ol style="list-style-type: none"> 1. Readjust/tighten 2. Replace 3. Replace 4. Replace
Lubricant Leaking	<ol style="list-style-type: none"> 1. Excessive lubricant in case 2. Leaking seals or gaskets 3. Loose bolts 4. Scored yoke in seal contact area 	<ol style="list-style-type: none"> 1. Adjust level 2. Replace 3. Tighten 4. Refinish or replace

Fig. 7D-8--Transfer Case Diagnosis

COMPONENT PARTS REPLACEMENT

TRANSFER CASE REPLACEMENT

Removal (Fig. 7D-9)

1. Raise and support vehicle on hoist. Drain transfer case.
2. Disconnect speedometer cable.
3. Remove skid plate and crossmember supports as necessary.
4. Disconnect rear prop shaft from transfer case and tie up away from work area.
5. Disconnect front prop shaft from transfer case and tie up shaft away from work area.
6. Disconnect shift lever rod from shift rail link. Model 203, disconnect shift levers at transfer case.
7. Support transfer case and remove bolts attaching transfer case to transmission adapter.
8. Move transfer case to rear until input shaft clears adapter and lower assembly from vehicle.

Installation

1. Support transfer case in suitable stand and position

case to transmission adapter. Install bolts attaching case to adapter and torque to 45 ft. lbs.

2. Remove stand.
3. Install connecting rod to shift rail link or connect shift levers to transfer case, as applicable. On Model 203 case, be sure that nylon spacer (Item #19, Fig. 7D-3) is in place before installing levers.
4. Connect front prop shaft to transfer case front output flange or yoke.
5. Connect rear prop shaft to transfer case rear output yoke.
6. Install crossmember support and skid plate, if removed.
7. Connect speedometer cable.
8. Fill transfer case to proper level with lubricant specified in section 0-B.
9. Lower and remove vehicle from hoist.

CAUTION: Check and tighten all bolts to specified torques.

NOTE: Before connecting prop shafts to companion flanges, be sure locknuts are torqued to specifications.

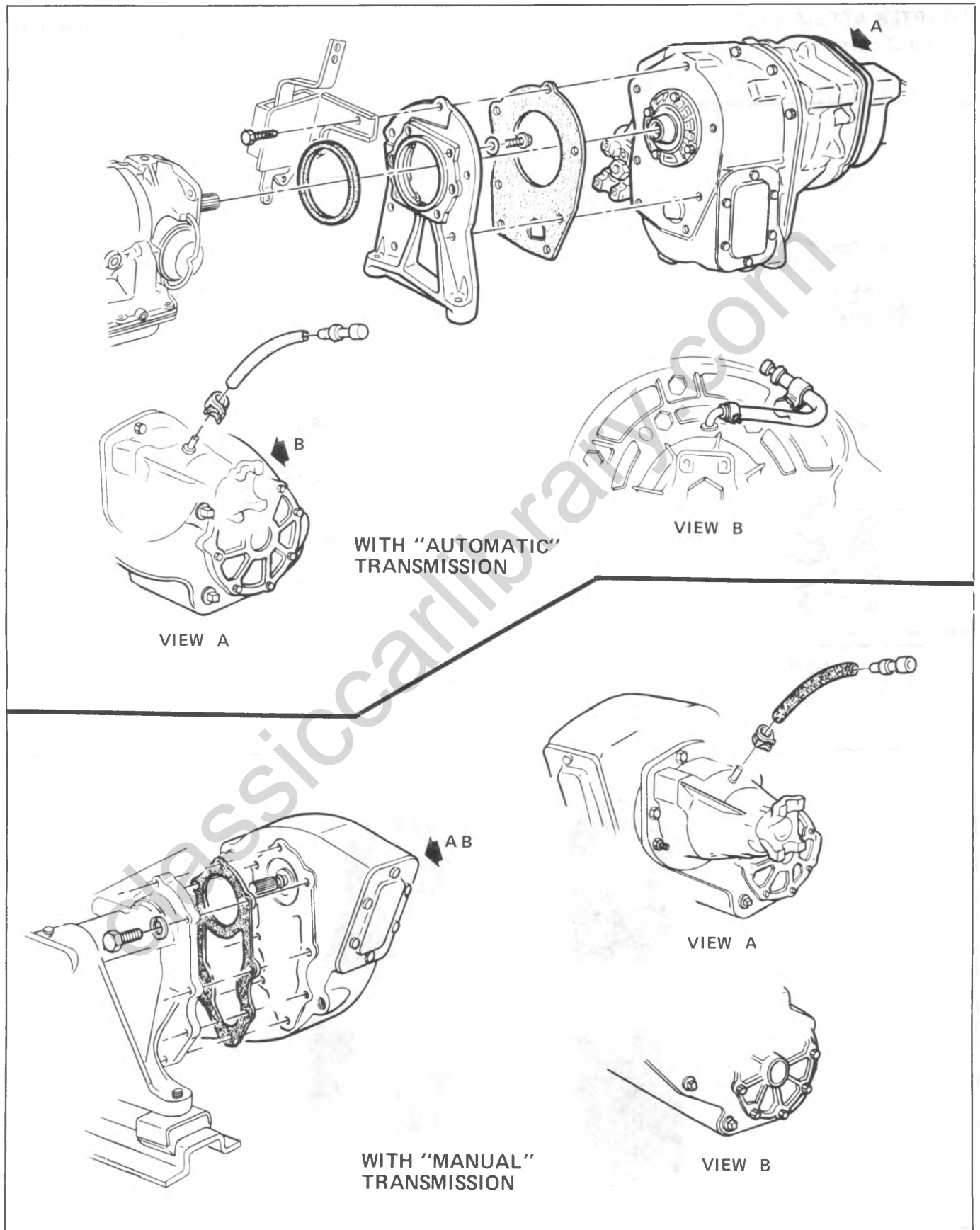


Fig. 7D-9--Transfer Case Attachment-Typical

SKID PLATE

STRUT ROD

ADAPTER ASSEMBLIES

Attachment of the above items is shown in Figures 7D-

10, 7D-11, 7D-12. Refer to these figures when removing or replacing these components.

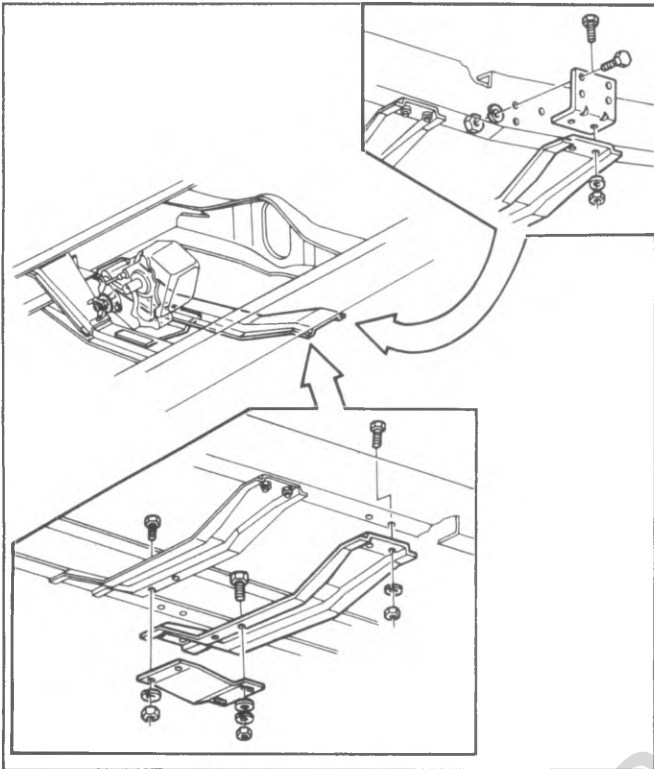


Fig. 7D-10--Skid Plates

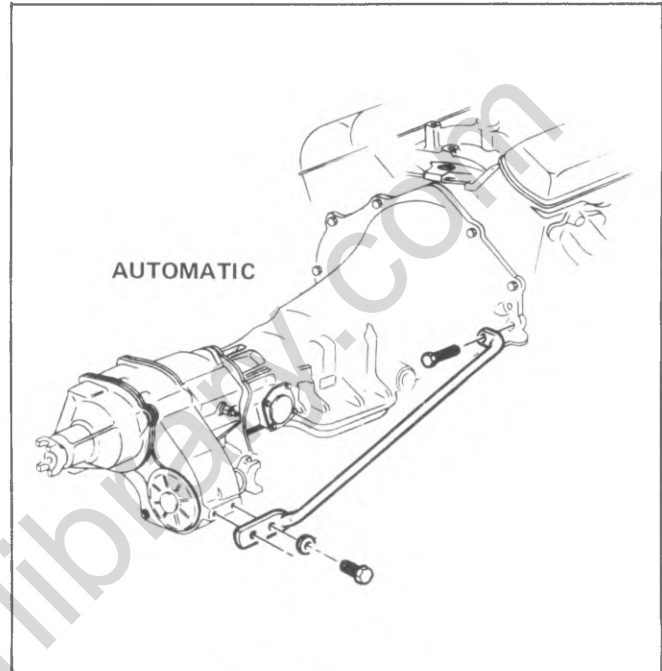


Fig. 7D-11--Strut Rods

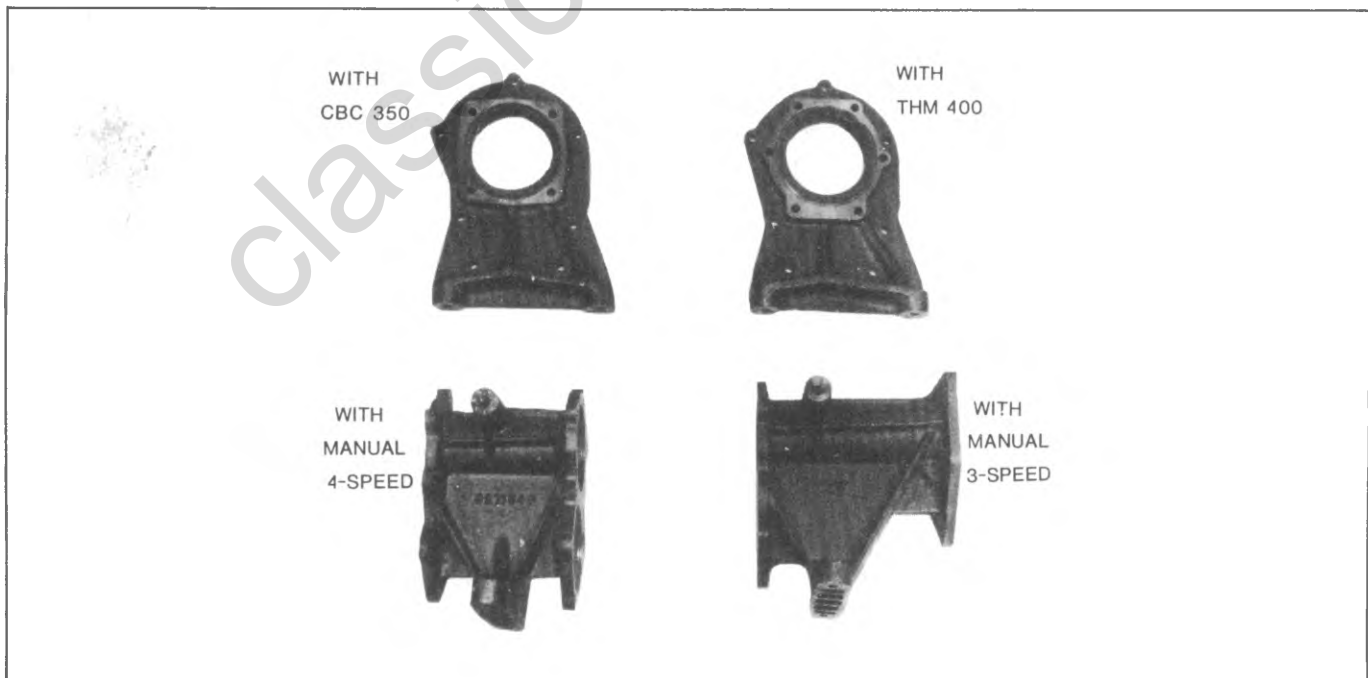


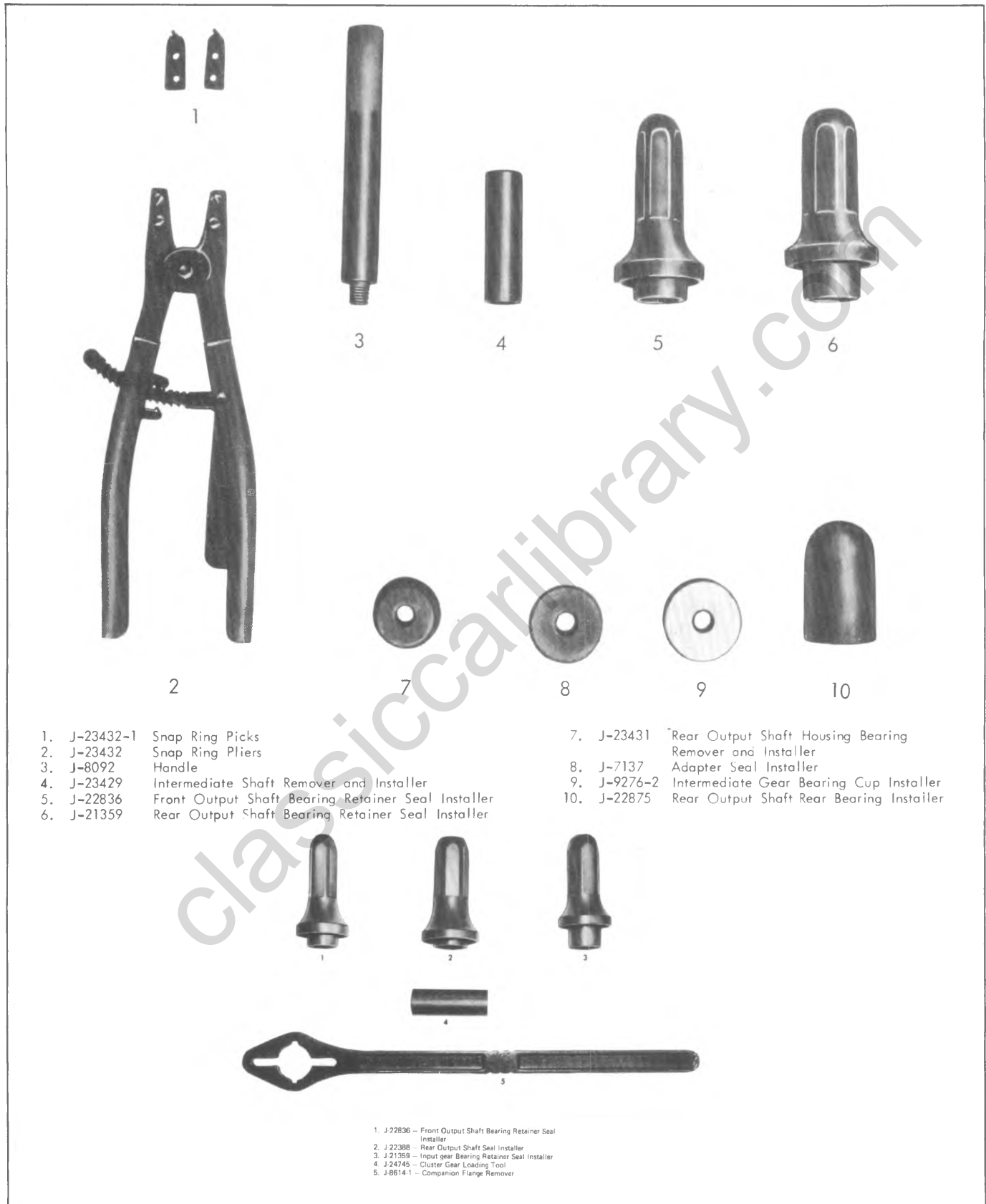
Fig. 7D-12--Adapter Assemblies

SPECIFICATIONS

NEW PROCESS TRANSFER CASE MODEL 205

Idler Shaft Lock Nut	200 ft. lbs.
Idler Shaft Cover Bolts	18 ft. lbs.
Front Output Shaft Front Bearing	
Retainer Bolts	30 ft. lbs.
Front Output Shaft Yoke Lock Nut	200 ft. lbs.
Rear Output Shaft Bearing Retainer Bolts	30 ft. lbs.
Rear Output Shaft Housing Bolts	30 ft. lbs.
Rear Output Shaft Yoke Lock Nut	150 ft. lbs.
P.T.O. Cover Bolts	15 ft. lbs.
Front Output Shaft Rear Bearing	
Retainer Bolts	30 ft. lbs.
Drain and Filler Plugs	30 ft. lbs.
Transfer Case to Frame Bolts	130 ft. lbs.
Transfer Case to Adapter Bolts	25 ft. lbs.
Adapter Mount Bolts	25 ft. lbs.
Transfer Case Bracket to Frame Nuts (Upper)	30 ft. lbs.
Transfer Case Bracket to Frame Nuts (Lower)	65 ft. lbs.
Adapter to Transmission Bolts - (Manual	
Transmission)	22 ft. lbs.
Adapter to Transmission Bolts - (Automatic	
Transmission)	35 ft. lbs.
Transfer Case Control Mounting Bolt	100 ft. lbs.

SPECIAL TOOLS



- 1. J-23432-1 Snap Ring Picks
- 2. J-23432 Snap Ring Pliers
- 3. J-8092 Handle
- 4. J-23429 Intermediate Shaft Remover and Installer
- 5. J-22836 Front Output Shaft Bearing Retainer Seal Installer
- 6. J-21359 Rear Output Shaft Bearing Retainer Seal Installer

- 7. J-23431 Rear Output Shaft Housing Bearing Remover and Installer
- 8. J-7137 Adapter Seal Installer
- 9. J-9276-2 Intermediate Gear Bearing Cup Installer
- 10. J-22875 Rear Output Shaft Rear Bearing Installer

- 1. J-22836 - Front Output Shaft Bearing Retainer Seal Installer
- 2. J-22388 - Rear Output Shaft Seal Installer
- 3. J-21359 - Input gear Bearing Retainer Seal Installer
- 4. J-24745 - Cluster Gear Loading Tool
- 5. J-8614-1 - Companion Flange Remover

Fig. 7D-ST-Special Tools

SECTION 8

ELECTRICAL-BODY AND CHASSIS

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LIGHTING SYSTEM

GENERAL DESCRIPTION

The lighting system includes the main light switch; stop light, dimmer and backing lamp switches; head and parking lamps; stop, tail, side marker, clearance and identification lamps; instrument illumination, directional signal and indicator lamps and the necessary wiring to complete the various circuits.

A bulkhead fuse panel (fig. 8-1) provides convenient power taps and fuse clips for the appropriate circuits. The engine wiring harness and forward lamp harness connectors are bolted to the fuse panel.

All wiring systems not protected by a fuse or circuit breaker incorporate a fusible link which provides increased overload protection. The starting motor circuit is the exception.

Composite wiring diagrams are available in a separate manual. The standardized color code is common to all wiring harnesses. The wire covering color designates a particular circuit usage.

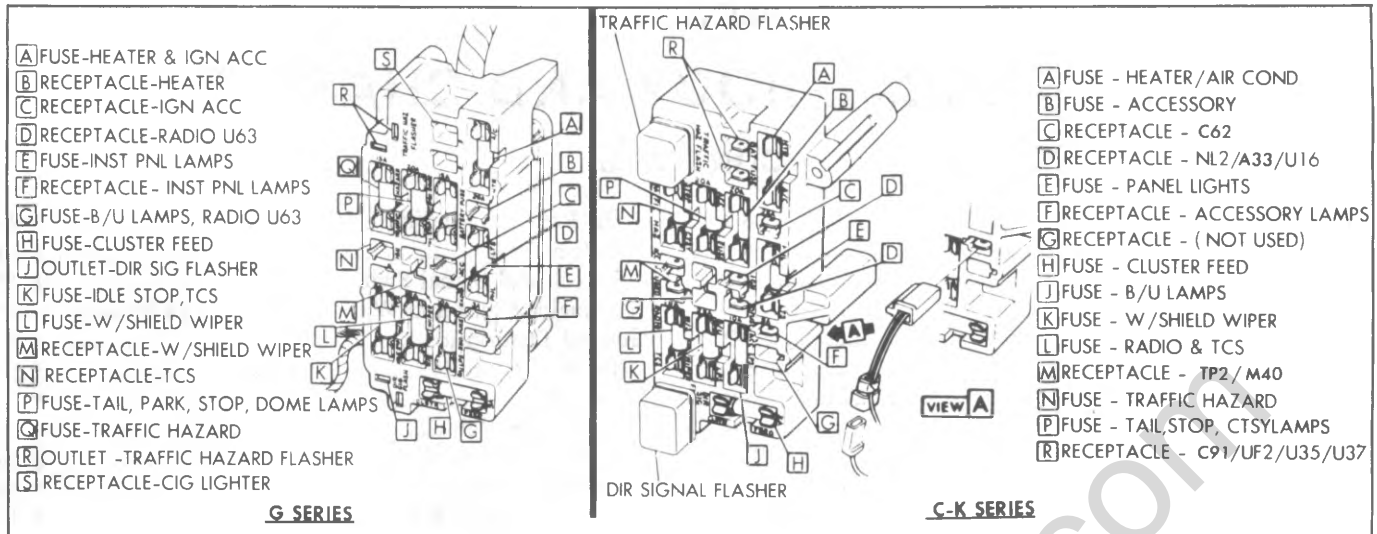


Fig. 8-1--Fuse Panel

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DIAGNOSIS

HEADLAMP DIAGNOSIS

Condition	Possible Cause	Correction
One headlamp inoperative or intermittent	1. Loose connection	1. Secure connections to sealed beam including ground. (Black Wire)
	2. Defective Sealed Beam	2. Replace sealed beam
One or more headlights are dim.	1. Open ground connection at headlight	1. Repair black wire connection between sealed beam and body ground.
	2. Black ground wire mislocated in headlight connector (type 2 sealed beam)	2. Relocate black wire in connector
One or more headlights short life	1. Voltage regulator misadjusted	1. Readjust regulator to specifications.
All headlights inoperative or intermittent	1. Loose connection	1. Check and secure connections at dimmer switch and light switch.
	2. Defective dimmer switch	2. Check voltage at dimmer switch with test lamp. If test lamp bulb lights only at light blue wire terminal, replace dimmer switch.
	3. Open wiring - light switch to dimmer switch	3. Check light blue wire with test lamp. If bulb lights at light switch light blue wire terminal but not at dimmer switch, repair open wire.
	4. Open wiring - light switch to battery	4. Check red wire terminal at light switch with test lamp. If lamp does not light, repair open red wire circuit to battery. (possible open fusible link)
	5. Shorted ground circuit	5. If, after a few minutes operation, headlights flicker "ON" and "OFF" and or a thumping noise can be heard from the light switch (circuit breaker opening and closing), repair short to ground in circuit between light switch and headlights. After repairing short, check for headlight flickering after one minute operation. If flickering occurs, the circuit breaker has been damaged and light switch must be replaced.
	6. Defective light switch	6. Check red and white wire terminals at light switch with test lamp. If bulb lights at red wire terminal but not at light blue terminal, replace light switch.

Upper or lower beam will not light or intermittent

1. Open connection or defective dimmer switch
2. Short circuit to ground

1. Check dimmer switch terminals with test lamp. If bulb lights at light blue or tan wire terminals, repair open wiring between dimmer switch and headlights. If bulb will not light at one of these terminals, replace dimmer switch.
2. Follow diagnosis above (All headlights inoperative or intermittent)

SIDE MARKER LAMP DIAGNOSIS

Condition	Possible Cause	Correction
One lamp inoperative	<ol style="list-style-type: none"> 1. Turn signal bulb burnt out (Front lamp) 2. Side marker bulb burnt out 3. Loose connection or open in wiring 	<ol style="list-style-type: none"> 1. Switch turn signals on. If signal bulb does not light, replace bulb. (Bulb filament provides ground path for marker lamp bulb through the light blue or dark blue/white strip wires). 2. Replace bulb. 3. Using test lamp, check brown wire terminal at bulb socket. If test lamp lights, repair open ground circuit. If lamp does not light, repair open brown wire circuit.
Front or rear lamps inoperative	<ol style="list-style-type: none"> 1. Loose connection or open ground connection 2. Multiple bulbs burnt out 	<ol style="list-style-type: none"> 1. If associated tail or park lamps do not operate, secure all connectors in brown wire circuit. If park and turn lamps operate, repair open ground connections. 2. Replace burnt out bulbs.
All lamps inoperative	<ol style="list-style-type: none"> 1. Blown fuse 2. Loose connection 3. Open in wiring 	<ol style="list-style-type: none"> 1. If park and tail lamps do not operate, replace blown fuse. If new fuse blows, check for short to ground between fuse panel and lamps. 2. Secure connector to light switch. 3. Check tail light fuse with test lamp. If test lamp lights, repair open wiring between fuse and light switch. If not, repair open wiring between fuse and battery. (Possible open fusible link).

4. Defective light switch

4. Check light switch with test lamp. If test lamp lights at terminal No. 5 but not at terminal No. 4, replace light switch.

TAIL, PARK AND LICENSE LAMP DIAGNOSIS

Condition	Possible Cause	Correction
One side inoperative	1. Bulb burnt out	1. Replace bulb
	2. Open ground connection at bulb socket or ground wire terminal	2. Jumper bulb base socket connection to ground. If lamp lights, repair open ground circuit.
Both sides inoperative	1. Tail lamp fuse blown	1. Replace fuse. If new fuse blows, repair short to ground in brown wire circuit between fuse panel through light switch to lamps.
	2. Loose connection	2. Secure connector at light switch.
	3. Open wiring	3. Using test light, check circuit on both sides of fuse. If lamp does not light on either side, repair open circuit between fuse panel and battery. (possible open fusible link). If test lamp lights at light switch brown wire terminal, repair open wiring between light switch and lamps.
	4. Multiple bulb burnout	4. If test lamp lights at lamp socket brown wire terminal, replace bulbs.
	5. Defective light switch	5. If test lamp lights at light switch terminal No. 4 (Brown/white wire) but not at terminal No. 5 (Brown wire), replace defective light switch.

TURN SIGNAL AND HAZARD WARNING LAMP

Condition	Possible Cause	Correction
Turn signals inoperative one side	1. Bulb(s) burnt out (Flasher cannot be heard)	1. Turn hazard warning system on. If one or more bulbs are inoperative replace necessary bulbs.
	2. Open wiring or ground connection	2. Turn Hazard warning system on. If one or more bulbs are inoperative, use test lamp and check circuit at lamp socket. If test lamp lights, repair open ground connection. If not, repair open wiring between bulb socket and turn signal switch.
	3. Improper bulb or defective turn signal switch.	3. Turn hazard warning system on. If all front and rear lamps operate, check for improper bulb (1034 instead of 1157). If bulbs are OK, replace defective turn signal switch.
	4. Short to ground. (Flasher can be heard, no bulbs operate)	4. Locate and repair short to ground by disconnecting front and rear circuits separately.
Turn signals inoperative	1. Blown turn signal fuse	1. Turn hazard warning system on. If all lamps operate, replace blown fuse. If new fuse blows, repair short to ground between fuse and lamps.
	2. Defective flasher (Located behind instrument panel near steering column)	2. If turn signal fuse is OK and hazard warning system will operate lamps, replace defective turn signal flasher.
	3. Loose connection	3. Secure steering column connector. If necessary, check purple wire terminals in connector with test lamp. If test lamp lights only on one side of connector, clean or tighten connector contacts.

Hazard warning lamps inoperative

1. Blown stop-hazard fuse

1. Switch turn signals on. If lamps operate, replace stop-hazard fuse if blown. If new fuse blows, repair short to ground. (Could be in stop light circuit).

2. Defective hazard warning flasher. (Located on fuse panel).

2. If stop-hazard fuse is OK, switch turn signals on. If lamps operate, replace defective hazard flasher.

3. Open in wiring or defective turn signal switch.

3. Using test lamp, check brown wire in turn signal steering column connector. If lamp does not light on either side of connector, repair open circuit between flasher and connector. If lamp lights only on feed side of connector, clean connector contacts. If lamp lights on both sides of connector, replace defective turn signal switch assembly.

BACK-UP LAMP

Condition	Possible Cause	Correction
One lamp inoperative or intermittent	1. Loose or burnt out bulb	1. Secure or replace bulb.
	2. Loose connection	2. Tighten connectors.
	3. Open ground connections	3. Repair bulb ground circuit.
Both lamps inoperative or intermittent.	1. Neutral start switch misadjusted (Open when shift lever is in reverse position)	1. Readjust neutral start switch.
	2. Loose connection or open circuit	2. Secure all connectors. If OK, check continuity of circuit from fuse to lamps with test lamp. If lamp does not light on either side of fuse, correct open circuit from battery to fuse.
	3. Blown fuse	3. Replace fuse. If new fuse blows, repair short to ground in circuit from fuse through neutral start switch to back-up lamps.
	4. Defective neutral start switch	4. With ignition on, check switch terminals in back-up position with test lamp. If lamp lights at pink wire terminal but not at light green wire terminal, replace neutral start switch.
	5. Defective ignition switch	5. If test lamp lights at ignition switch battery terminal but not at output terminal, replace ignition switch.

Lamp will not turn off	1. Neutral start switch misadjusted (closed when shift lever is not in reverse position)	1. Readjust neutral start switch
STOP LIGHTS		
Condition	Possible Cause	Correction
One bulb inoperative	1. Bulb burnt out.	1. Replace bulb.
One side inoperative	1. Loose connection, open wiring or defective bulbs 2. Defective directional signal switch or cancelling cam	1. Turn on directional signal. If lamp does not operate, check bulbs. If bulbs are OK, secure all connections. If lamp still does not operate, use test lamp and check for open wiring. 2. If lamp will operate by turning directional signal on, the switch is not centering properly during cancelling operation. Replace defective cancelling cam or directional signal switch.
All inoperative	1. Stop-hazard fuse blown 2. Stop-switch misadjusted or defective	1. Replace fuse. If new fuse blows, repair short to ground in circuit between fuse and lamps. 2. With brake pedal depressed, check white wire terminal in steering column connector with test lamp. If lamp does not light, check stop switch for proper adjustment. If adjustment is OK, replace stop switch.
Will not turn off	1. Stop switch misadjusted or defective.	1. Readjust switch. If switch still malfunctions, replace.

ON-VEHICLE SERVICE

MAINTENANCE AND ADJUSTMENTS

Maintenance of the lighting units and wiring system consists of an occasional check to see that all wiring connections are tight and clean, that the lighting units are securely mounted to provide good ground and that the headlamps are properly adjusted. Loose or corroded connections may cause a discharged battery, difficult starting, dim lights, and possible damage to the generator. Wire harnesses must be replaced if insulation becomes burned, cracked, or deteriorated. Whenever it is necessary to splice a wire or repair one that is broken, always use solder to bond the splice. Always use rosin flux solder on electrical connections. Use insulating tape to cover all splices or bare wires.

When replacing wires, it is important that the correct size be used. Never replace a wire with one of a smaller size. Fusible links in the wiring are four gauge sizes smaller than the cable it is designed to protect. The links are marked on the insulation with wire gauge size because of the heavy insulation which makes the link appear a heavier gauge than it actually is.

Each harness and wire must be held securely in place by clips or other holding devices to prevent chafing or wearing away the insulation due to vibration.

By referring to the wiring diagram manual, circuits may be tested for continuous circuit or shorts with a conventional test lamp or low reading voltmeter.

HEADLAMP ADJUSTMENT (Fig. 8-2)

The headlamps must be properly aimed to obtain maximum road illumination. When using mechanical headlamp aimers, follow manufacturers instructions.

The headlamps must be checked for proper aim whenever a sealed beam unit is replaced and after repairs of the front end sheet metal assembly.

Regardless of the method used for checking headlamp aim, the truck must be at normal weight, that is with gas, oil, water and spare tire. Tires must be inflated to specified pressures.

Some states have special requirements for headlamp

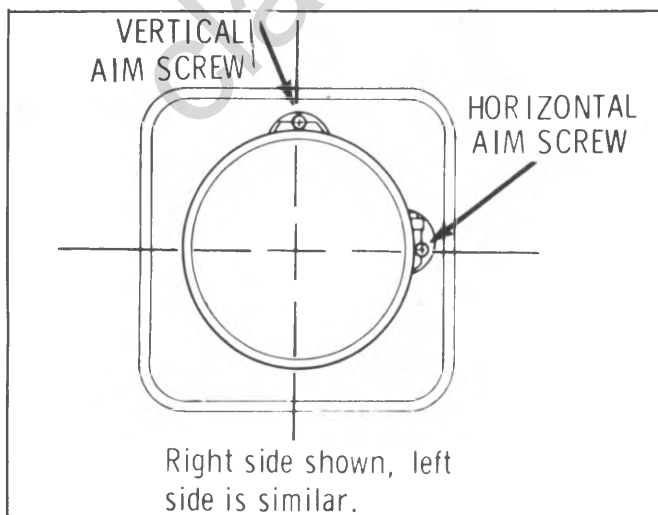


Fig. 8-2--Headlamp Adjustments (Typical)

aiming adjustment and these requirements must be known and followed.

Horizontal and vertical aiming of each sealed beam is provided by two adjusting screws visible through the bezel which move the mounting ring against the tension of the coil spring (fig. 8-2).

There is no adjustment for focus since the sealed beam unit is set for focus during manufacturing assembly.

COMPONENT PART REPLACEMENT

SEALED BEAM UNIT

Replacement (Figs. 8-3 and 8-4)

1. Remove bezel retaining screws and bezel.
2. Remove retaining ring.

NOTE: Do not disturb adjusting screw setting.

3. Disconnect wiring harness connector located at rear of unit in engine compartment and remove sealed beam unit.

4. Attach wiring harness connector to unit.

5. Position new sealed beam unit in mounting ring and install retaining ring.

NOTE: The number molded into lens face must be at top.

6. Install retaining ring then check operation of unit and install bezel.

PARKING LAMP BULB

Replacement (Figs. 8-3 and 8-4)

1. Remove lens retaining screws and remove lens from the housing.

2. Replace bulb and check lamp operation.

3. Install lens and retaining screws.

PARKING LAMP HOUSING

C-K Models

Replacement (Fig. 8-3)

1. Remove parking lamp lens screws and remove the lens.

2. Remove lamp housing retaining screws and pull housing forward.

3. Disconnect parking lamp wiring harness from housing by rotating bulb socket counterclockwise.

4. Connect wiring harness to new housing by inserting

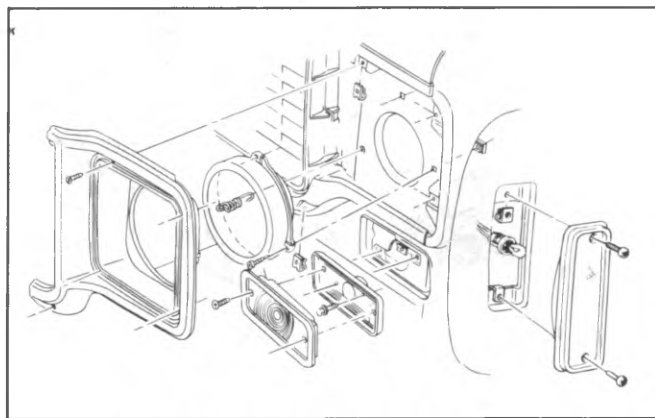


Fig. 8-3--Front Lighting (C-K Models)

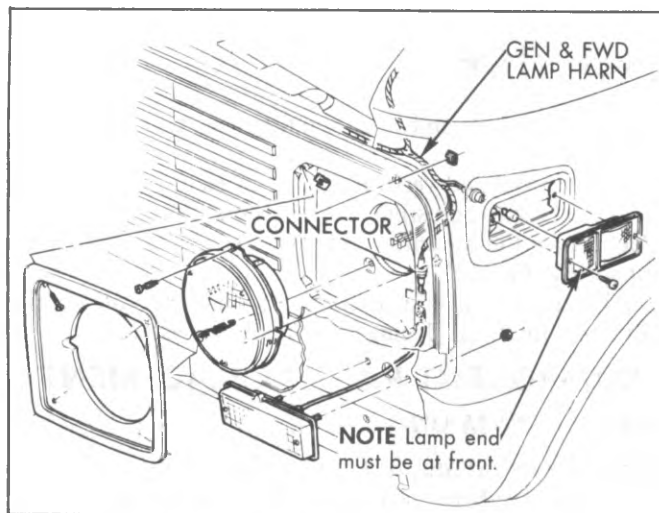


Fig. 8-4--Front Lighting (G Models)

bulb socket into housing and rotating clockwise.

5. Install bulb if removed during disassembly. Install lens and retaining screws.

G Models

Replacement (Fig. 8-4)

Right Side

1. Remove both headlamp bezels.
2. Remove both parking lamp lens.
3. Remove grille.
4. Remove battery and battery box.
5. Disconnect wiring harness at connector.
6. Remove housing stud nuts and remove housing with pigtail.
7. To install, reverse removal steps.

Left Side

1. Remove two screws and parking lamp lens.
2. Disconnect wiring harness at connector.

3. Remove housing stud nuts and remove housing with pigtail.
4. To install, reverse removal steps.

FRONT SIDE MARKER LAMP BULB AND/OR HOUSING

All Models

Replacement

NOTE: For housing replacement follow procedure for the right side bulb replacement below.

1. **Left Side** - Raise hood.

Right Side - Remove lamp assembly retaining screws and pull outward on assembly.

2. Twist wiring harness socket 90° counterclockwise and remove harness and bulb from housing.

3. Replace bulb and check lamp operation.

4. Insert bulb into housing, press in on harness socket and twist 90° clockwise. Check that socket is securely attached.

5. **Left Side** - Lower hood.

Right Side - Install housing in opening and install retaining screws.

REAR SIDE MARKER LAMP BULB AND/OR HOUSING

C-K 03 models with E62 and G Models

Replacement

Same as Right Front Side Marker Lamp Bulb and/or Housing Replacement - All Vehicles.

NOTE: Bulb on G Models without interior trim may be removed from inside the vehicle.

C-K 14, 03 and 63 with E63, and 06 Models

Replacement

1. Remove lens to housing four screws.
2. Replace bulb and check operation.
3. Position lens and install four attaching screws.

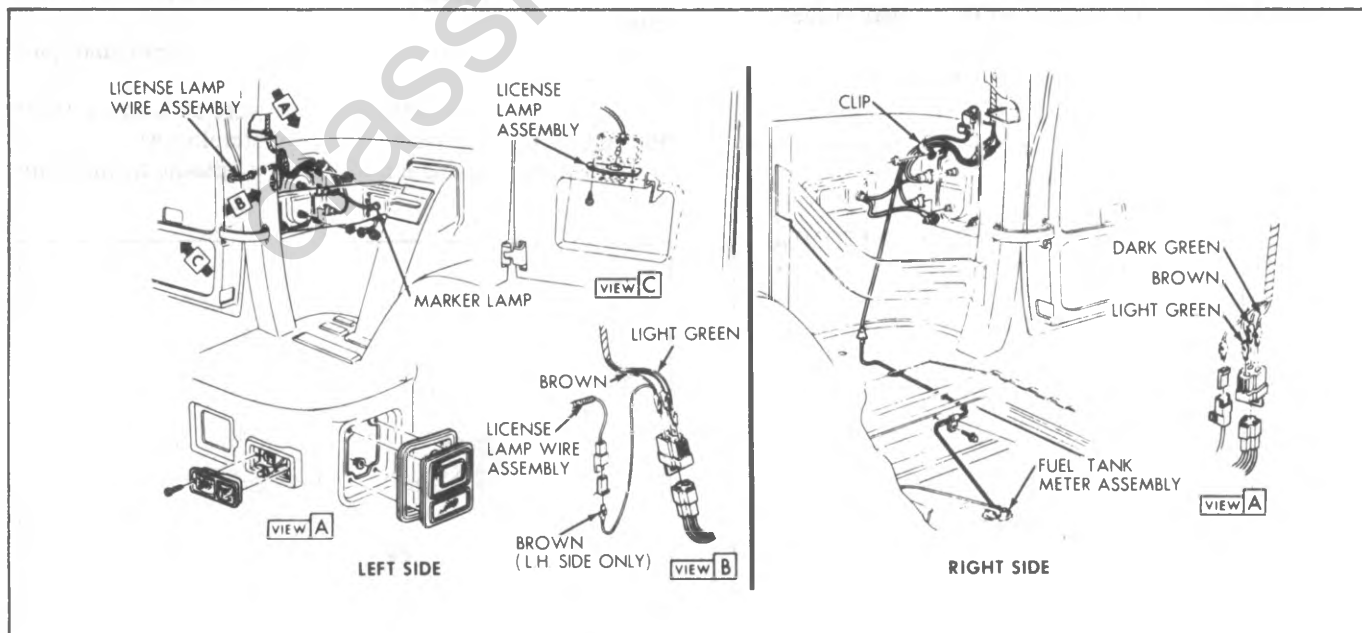


Fig. 8-5--Rear Lighting (G Models)

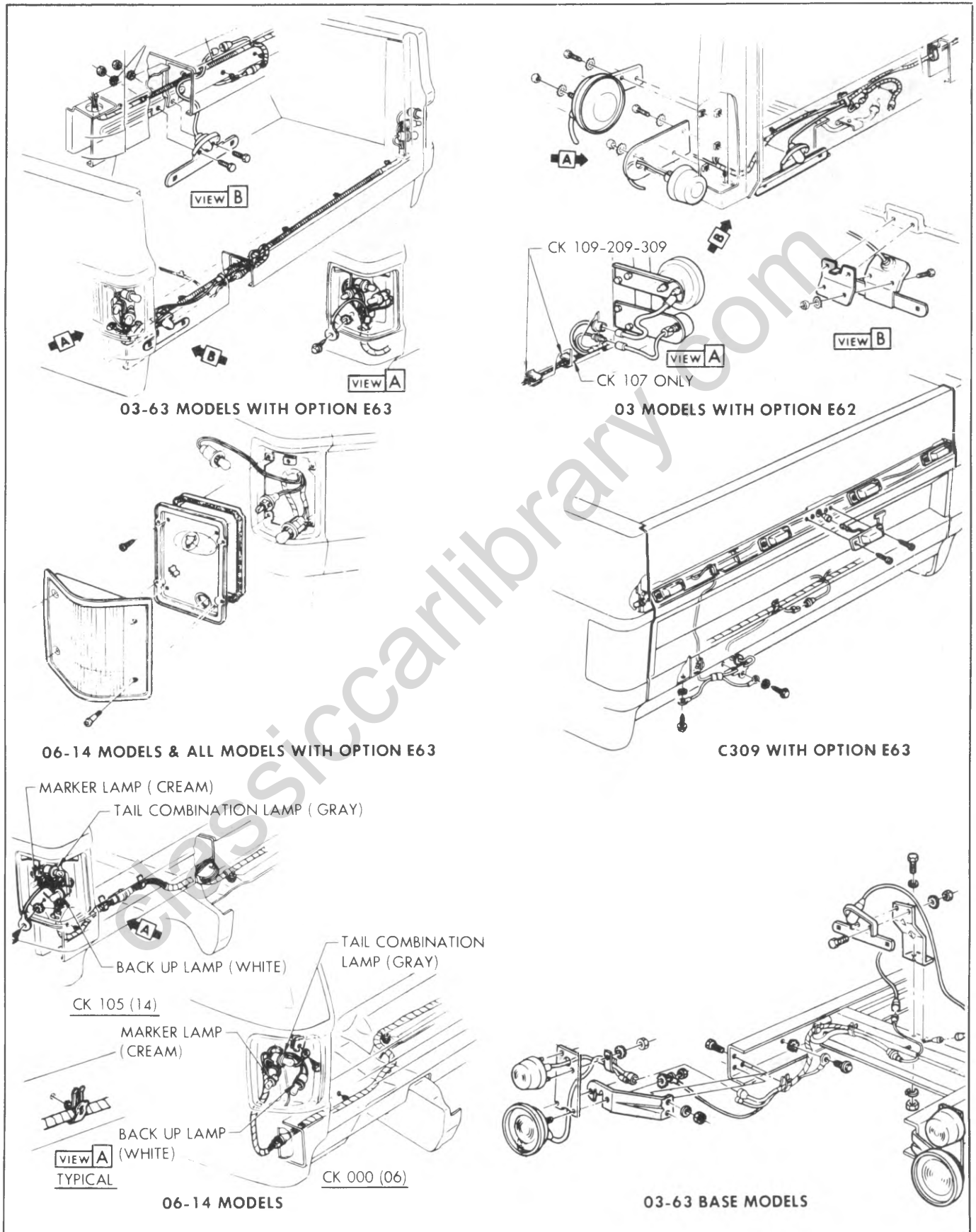


Fig. 8-6--Rear Lighting (C-K Models Except with E56 or E62)

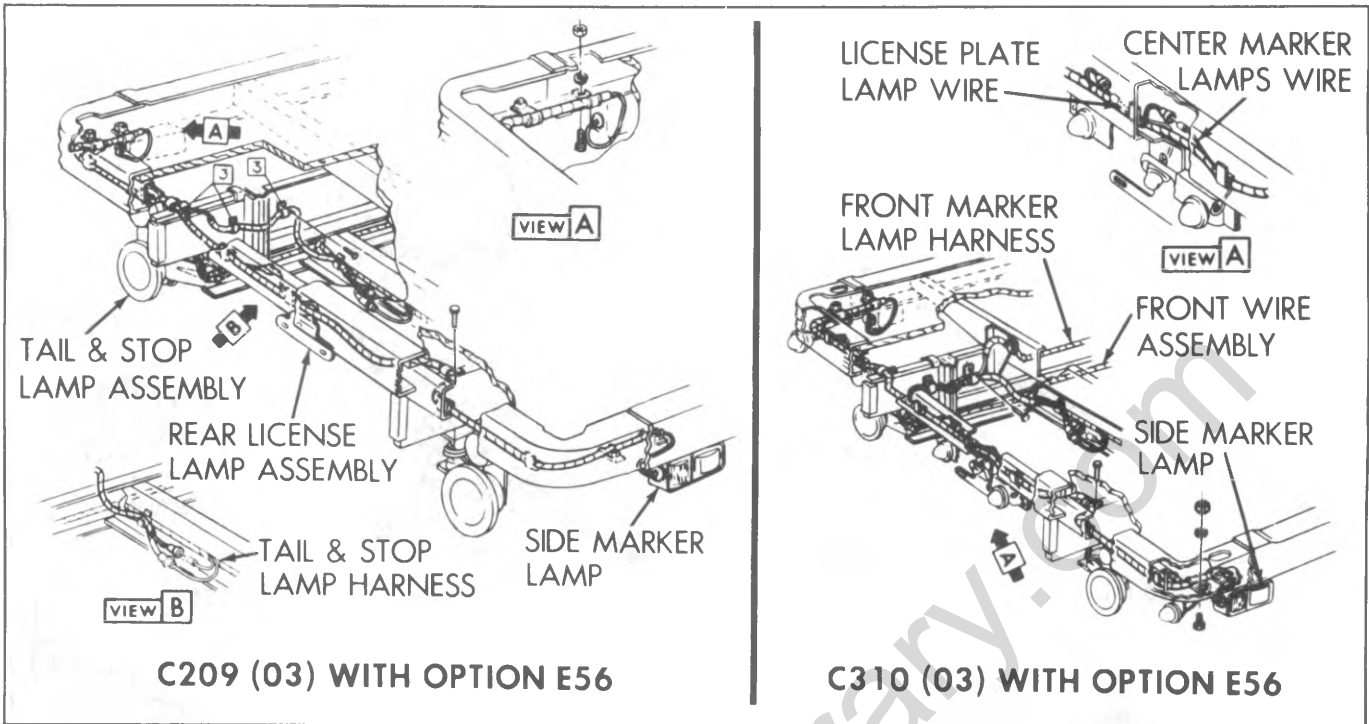


Fig. 8-7--Rear Lighting (C-K Platform and Stake Rack Models)

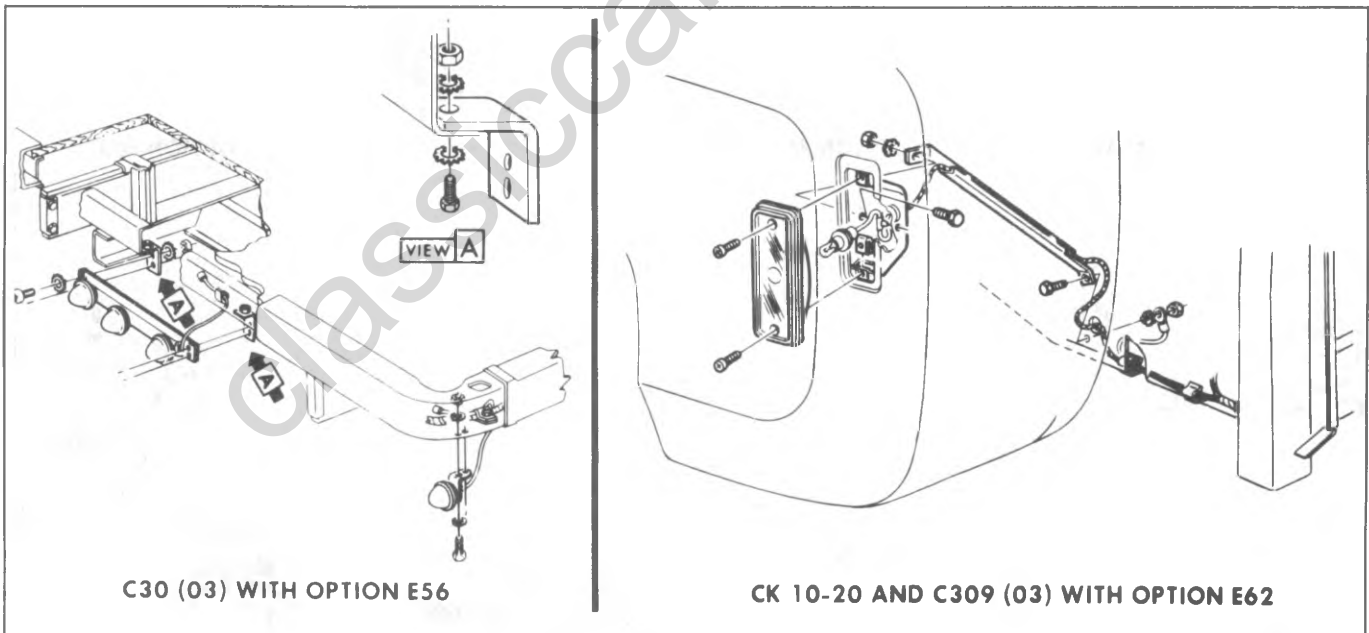


Fig. 8-8--Rear Lighting (C30 03 Models with E56 and C-K Models with E62)

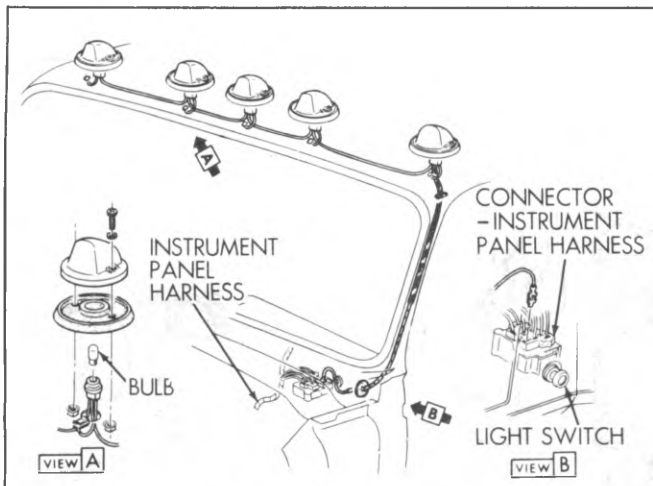


Fig. 8-9--Clearance Lamps

Platform and Stake Rack Models (E56)

Exploded view of the different rear lighting arrangements are shown in Figures 8-7 and 8-8. The bulbs may be replaced by removing the lamp lens attaching screws and lamp lens. The lamp housings may be replaced by removing housing attaching nuts or screws, or by removing nuts and bolts from bracket.

TAIL, STOP AND BACKUP LAMP BULBS

Replacement

1. Remove lens to housing attaching screws.
2. Replace bulb and check operation.
3. Position lens and install attaching screws.

TAIL, STOP AND BACKUP LAMP HOUSING

C-K 14, 03 and 63 w/E63 and 06 Models

All G Models

Replacement

1. Remove lens to housing attaching screws.
2. Remove bulbs from sockets.
3. Remove housing attaching screws (nuts on G Models).
4. Rotate wiring harness sockets counterclockwise and remove housing.
5. To install, reverse Steps 1-4 above.

DIRECTIONAL SIGNAL LAMPS

Directional signal lamps are an integral part of parking and tail lamp assemblies. Refer to the applicable lamp or bulb replacement procedures covered previously.

CLEARANCE, LICENSE PLATE AND IDENTIFICATION LAMPS

Refer to Figures 8-7 through 8-10 for clearance, license plate and identification lamp installations.

LIGHT SWITCH

C-K Models (Fig. 8-11)

Replacement

1. Disconnect battery ground cable.
2. Reaching up behind instrument cluster, depress shaft

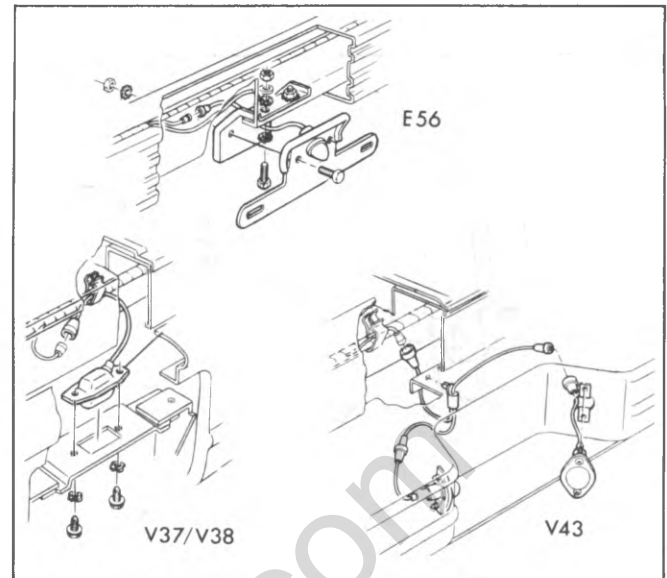


Fig. 8-10--License Plate Lamps (C-K Models)

retaining button and remove switch knob and rod.

3. Remove instrument cluster bezel screws on left end. Pull out on bezel and hold switch nut with a wrench.

4. Disconnect multiple wiring connectors at switch terminals.

5. Remove switch by rotating while holding switch nut.

6. To install, reverse Steps 1-5 above.

G Models (Fig. 8-11)

Replacement

1. Disconnect battery ground cable.
2. Reaching up behind instrument panel, depress shaft retaining button and remove switch knob-shaft.
3. From front of instrument panel remove switch retaining nut.
4. Push switch from panel opening and remove multiple electrical connector at switch terminals.
5. To install, reverse Steps 1-4, making sure grounding ring is installed on switch.

HEADLAMP BEAM SELECTOR SWITCH

Replacement

1. Fold back upper left corner of the floor mat and remove two screws retaining switch to the floor pan.
2. Disconnect wiring connector from switch terminals.
3. Connect wiring to replacement switch and check operation.
4. Position switch to floor pan and install retaining screws.
5. Replace floor mat.

STOPLAMP SWITCH

See Section 5 (Brakes) of this manual for adjustment and replacement procedures.

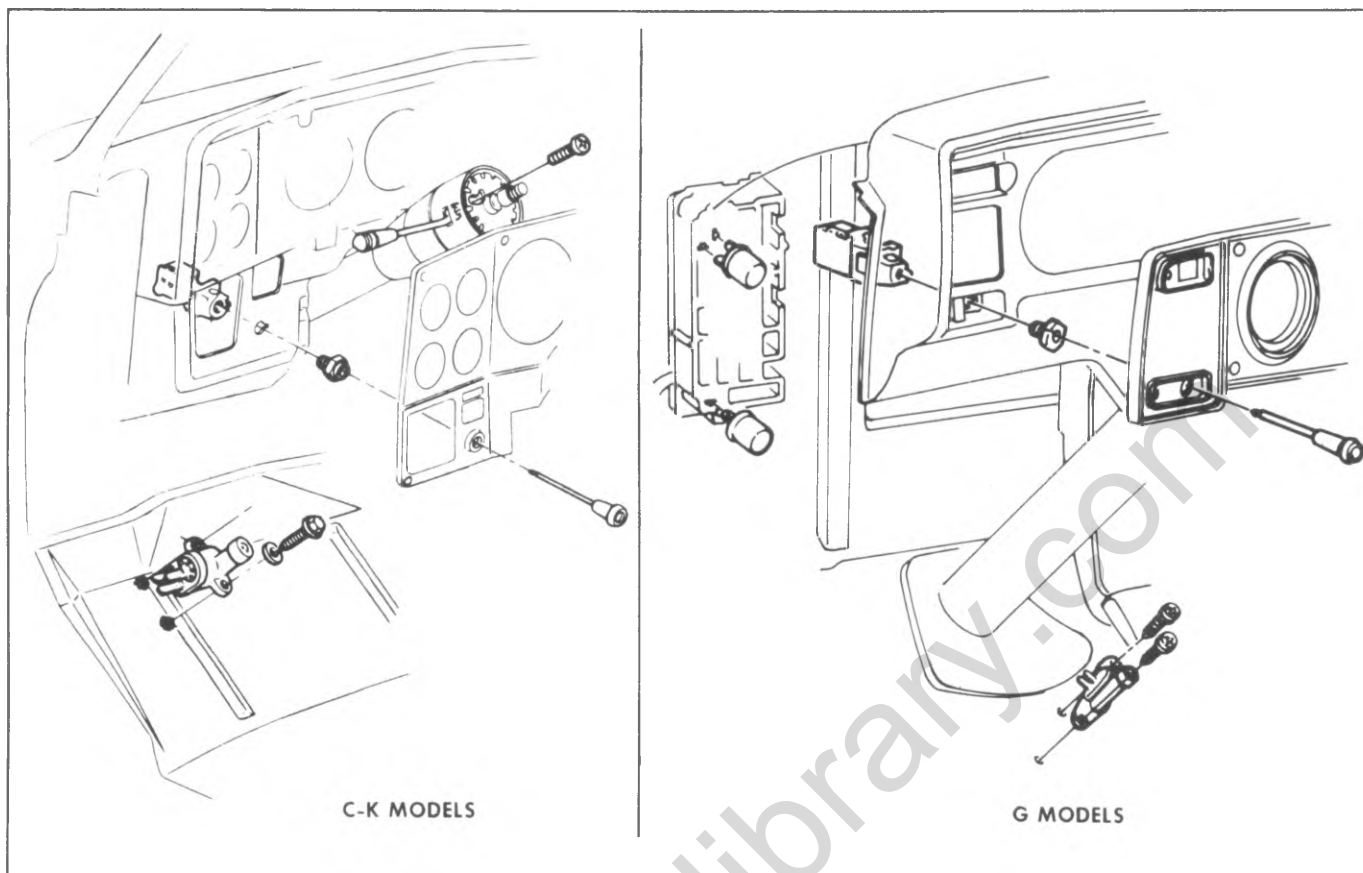


Fig. 8-11—Light and Headlamp Beam Selector Switches

INSTRUMENTS, GAGES AND CONTROLS

GENERAL DESCRIPTION

All instruments and gages are installed in the instrument cluster. Instruments and gages can be serviced in the vehicle (C-K Models); however, the entire cluster must be removed from the vehicle for servicing of the instruments and gages (G Models). Illuminating and indicator lamps may be replaced without removing the cluster from the vehicle. Bulbs are installed in plastic

holders which lock into the cluster housing.

Regular maintenance is not required on the instrument cluster or its components other than maintaining clean, tight electrical connections, replacing defective parts and keeping the speedometer cable properly lubricated.

DIAGNOSIS

OIL PRESSURE INDICATOR

Condition	Possible Cause	Correction
Light not lit, ignition on and engine not running.	1. Bulb burned out.	1. Replace bulb.
	2. Open in light circuit.	2. Locate and correct open.
	3. Defective oil pressure switch.	3. Replace oil pressure switch.
Light on, engine running above idle speed.	1. Grounded wiring between light and switch.	1. Locate and repair ground.
	2. Defective oil pressure switch.	2. Replace oil pressure switch.
	3. Low oil pressure.	3. Locate cause of low oil pressure and correct.

COOLANT TEMPERATURE INDICATOR

Condition	Possible Cause	Correction
"HOT" indicator; light not lit when cranking engine.	1. Bulb burned out.	1. Replace bulb.
	2. Open in light circuit.	2. Locate and correct open.
	3. Defective ignition switch.	3. Replace ignition switch.
Light on, engine running.	1. Wiring grounded between light and switch.	1. Locate and correct grounded wiring.
	2. Defective temperature switch.	2. Replace temperature switch.
	3. Defective ignition switch.	3. Replace ignition switch.
	4. Coolant temperature above 258 degrees F.	4. Locate and correct cause of high coolant temperature.

HORNS WILL NOT OPERATE

Cause	Correction
Loose connections in circuit.	Check and tighten connections. Be sure to check ground straps.
Defective horn switch.	Replace defective parts.
Defective horn relay.	Replace relay.
Defects within horn.	Replace horn.

HORNS HAVE POOR TONE

Cause	Correction
Low available voltage at horn.	Check battery and charging circuit.
Defects within horn.	Although horn should blow at any voltage above 7.0 volts, a weak or poor tone may occur at operating voltages below 11.0 volts. If horn has weak or poor tone at operating voltage of 11.0 volts or higher, remove horn and replace.

HORNS OPERATE INTERMITTENTLY

Cause	Correction
Loose or intermittent connections in horn relay or horn circuit.	Check and tighten connections.
Defective horn switch.	Replace switch.
Defective relay.	Replace relay.
Defects within horn.	Replace horn.

HORNS BLOW CONSTANTLY

Cause	Correction
Sticking horn relay.	Replace relay.
Horn relay energized by grounded or shorted wiring.	Check and adjust wiring.
Horn button can be grounded by sticking closed.	Adjust or replace damaged parts.

SPEEDOMETER

Cause	Correction
Noisy speedometer cable.	1. Loosen over-tightened casing nuts and snap-on at speedometer head.
Pointer and odometer inoperative.	2. Replace housing and core.
Inaccurate reading.	Replace broken cable.
Kinked cable.	1. Check tire size.
Defective speedometer head.	2. Check for correct speedometer driven gear.
Casing connector loose on speedometer case.	Replace cable. Reroute casing so that bends have no less than 6" radius.
	Replace or have repaired at authorized service station.
	Tighten connector.

GAS GAUGE

DASH UNIT NEVER READS FULL

1. Connect Gas Gauge Tester J-22344 to tank unit feed wire and observe dash unit.

Dash Unit Reads Okay

1. Reconnect tank unit feed wire to tank unit.
2. Completely fill fuel tank.
3. Note dash unit pointer with engine running.
4. If pointer still does not go to full, disconnect feed wire to tank unit.
5. With ohmmeter check resistance of tank unit. Should read 88 to 92 ohm with a full tank.
6. If low resistance, check tank mounting area for damage.

Gauge Does Not Read Full

1. Check cluster fuse.
2. Check for proper connections at: Dash unit to printed circuit. I.P. harness to printed circuit.
3. If dash unit is okay, check for opens in printed circuit or shorts due to pinched wires in the body harness.
4. Remove dash unit and check.

DASH UNIT DEAD BETWEEN
EMPTY AND FULL WITH IGNITION ON
(SAME PLACE AT ALL TIMES)

1. Disconnect tank unit feed wire. With voltmeter, check feed wire voltage. Should read 3-4 volts.

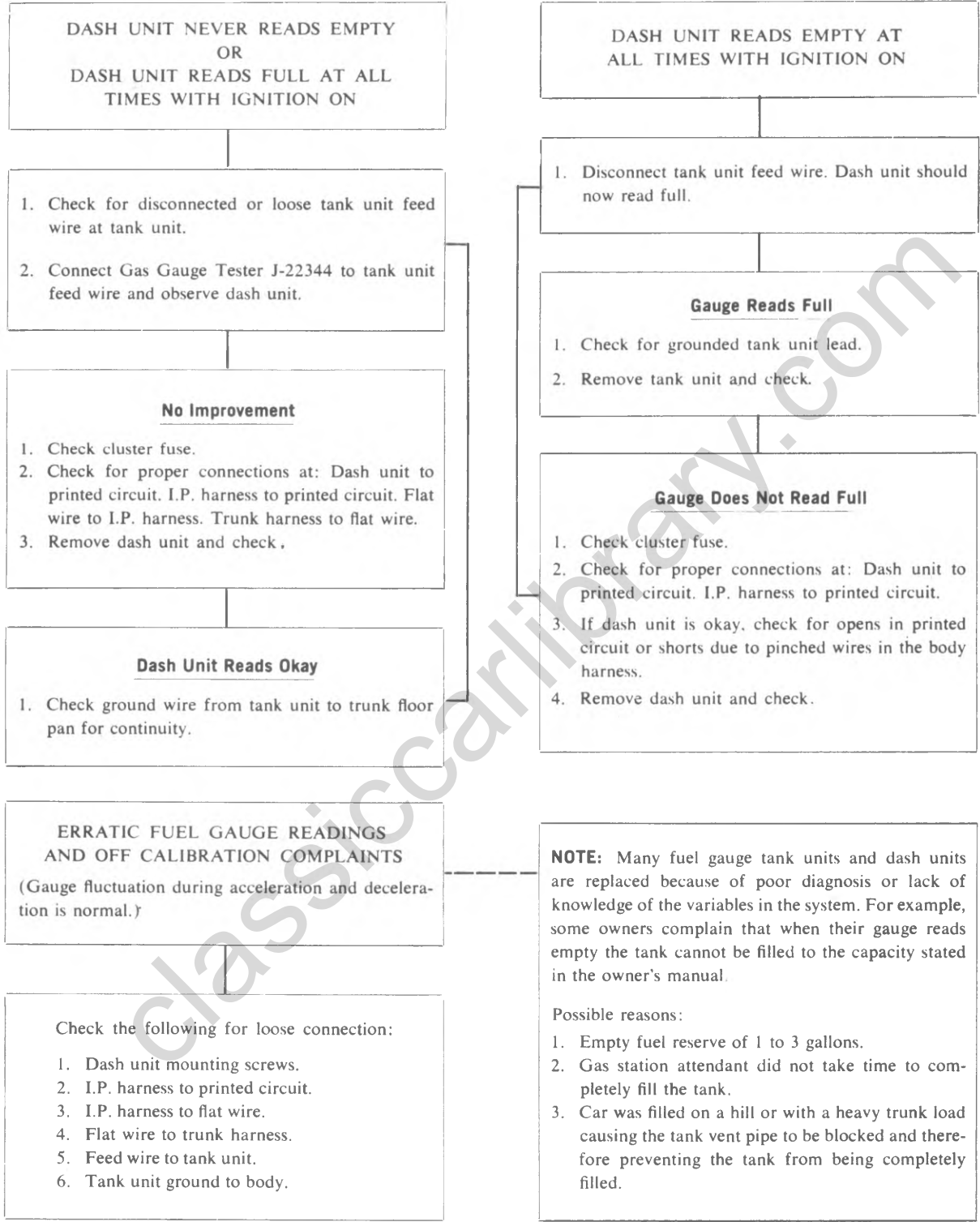
No Voltage

1. Indicates open circuit on hot side of dash unit.
 - a. Check cluster fuse.
 - b. Check for proper connection at: Dash unit to printed circuit. I.P. harness to printed circuit.
2. If circuits are okay, remove dash unit and check.

Voltage

1. Connect gas gauge checker to tank unit feed wire and observe dash unit.
2. If still dead, remove dash unit and check.

NOTE: The dash unit may be any place with the ignition off.



CHARGING SYSTEM INDICATOR

Condition	Possible Cause	Correction
Light on, ignition off.	1. Shorted positive diode.	1. Locate and replace shorted diode.
Light not on, ignition on and engine not running.	1. Bulb burned out.	1. Replace bulb.
	2. Open in light circuit.	2. Locate and correct open.
	3. Open in field.	3. Replace rotor.
Light on, engine running above idle speed.	1. No generator output.	1. Check and correct cause of no output.
	2. Shorted negative diode.	2. Locate and replace shorted diode.
	3. Loose or broken generator belt.	3. Tighten or replace and tighten generator belt.

ON-VEHICLE SERVICE

COMPONENT PART REPLACEMENT

NEUTRAL START SWITCH

C-K Models (Fig. 8-12)

Replacement and Adjustment

1. Disconnect battery ground cable.
 2. Disconnect electrical harness at switch.
 3. Remove switch mounting screws and remove switch.
 4. Position shift lever in neutral gate notch.
 5. Insert .096" (2.4mm) gage pin to depth of 3/8 inch (9.5mm) into switch gage hole. switch assembly is fixed in neutral position with internal plastic shear pin.
 6. Assemble the switch to column by inserting the switch carrier tang in the shift tube slot and fasten in position by assembling mounting screws to retainers.
- NOTE:** If retainer strips out it must be replaced.
7. Remove .096" gage pin.
 8. Move shift lever out of neutral gate notch to park gate position to shear switch internal plastic pin.
 9. Return shift lever to neutral gate notch.
 10. Switch (2.0mm) gage hole will freely admit .080" gage pin to a depth of 3/8 inch (9.5mm).
 11. If pin will not freely enter gage hole, switch must be reset as below.
 12. Connect battery ground cable and electrical harness.

Reset Installation Procedure

1. Place shift lever in neutral gate notch.
2. Loosen attaching screws.
3. Rotate switch on column and insert .096" (2.4mm) gage pin to depth of 3/8 inch (9.5mm).
4. Tighten attaching screws.
5. Repeat installation procedure Steps 7 through 12 above.

G-P Models

Replacement (Fig. 8-12)

1. Raise vehicle on a hoist.
 2. Disconnect the switch harness from the switch.
 3. Remove switch mounting bolts and remove switch.
 4. Assemble new switch loosely to mounting bracket.
 5. Align .093/.097" (2.3/2.4mm) hole in Lever (B) with hole in Switch Assembly. Insert Pin (A) to hold in NEUTRAL position.
 6. Set Transmission Lever (C) in NEUTRAL position by the following method.
- NOTE:** Obtain NEUTRAL by moving Transmission Lever counterclockwise to L1 detent, then clockwise three detents to the NEUTRAL detent position.
7. Install Rod into Transmission Lever and Switch Lever. Secure with clips.
 8. Tighten switch attaching screws.
 9. Lower vehicle from hoist and carefully check switch

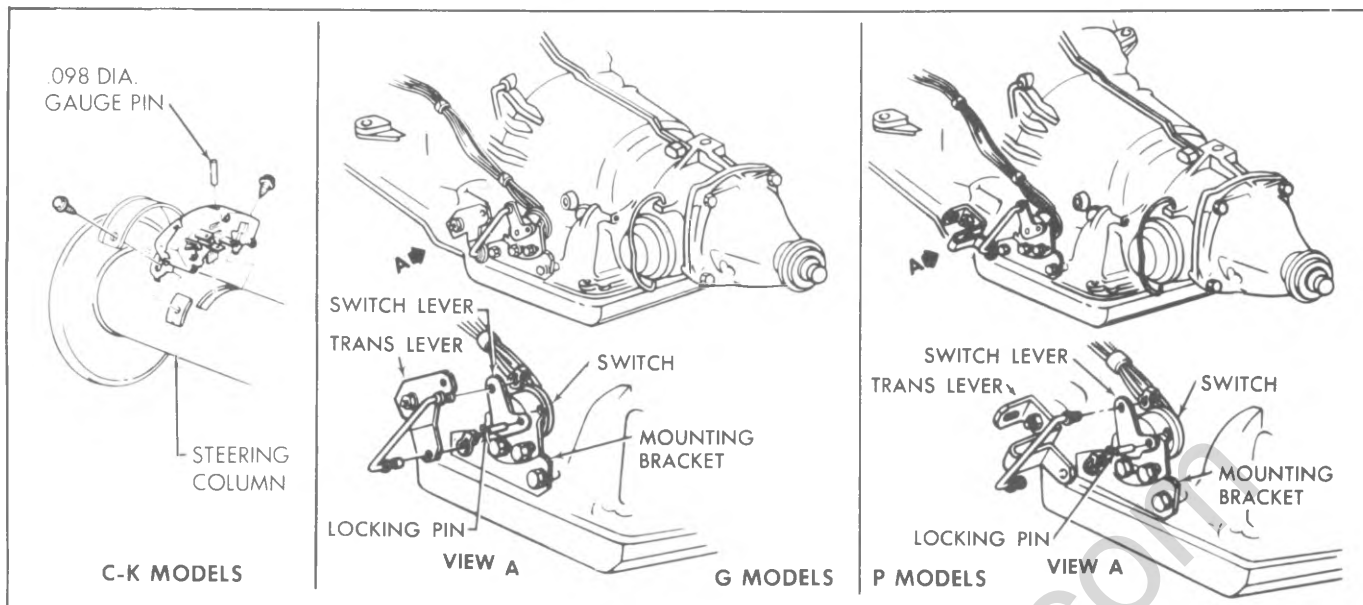


Fig. 8-12--Neutral Start Switch Replacement - Typical

operation.

BACKING LAMP SWITCH

See "Neutral Start Switch" for automatic transmission models.

Column Mounted Switch (Manual Transmission)

Replacement

1. Disconnect battery ground cable.
2. Disconnect switch wiring harness.
3. Remove column mounting screws and remove switch.
4. Assemble the switch to the column. Fasten in position by installing mounting screws.
5. Install battery ground cable.
6. Check operation to make sure back-up lights come on in reverse gear only.

Transmission Mounted Switch

Replacement

1. Raise vehicle on a hoist.
2. Disconnect switch wiring harness.
3. Remove switch from transmission.
4. To install a new switch, reverse Steps 1-3 above.

WINDSHIELD WASHER/WIPER SWITCH

C-K Models

Replacement

1. Disconnect battery ground cable.
2. Remove instrument panel bezel screws and bezel.
3. Remove switch attaching screws.
4. Pull out on switch assembly and disconnect electrical harness - remove switch.
5. To install, reverse Steps 1-4 above. Check switch operation before reinstalling instrument panel bezel.

G Models

Replacement

1. Disconnect battery ground cable.
2. Reach up behind left side of instrument panel, and:
 - a. Remove plug connector from rear of switch.
 - b. Remove (3) mounting screws securing bezel and ground wires to switch.
3. Replace switch, installing ground wire and connector. Check operation of switch, first observing washer solvent level.

IGNITION SWITCH

C-K Models

See Section 3B - Steering, for ignition switch replacement procedure.

G Models

Replacement (Fig. 8-13)

1. Disconnect battery ground cable.
2. Remove lock cylinder by positioning switch in "ACC" position and inserting stiff wire in small hole in cylinder face. Push in on wire to depress plunger and continue to turn key counterclockwise until lock cylinder can be removed.
3. Remove metallic ignition switch nut.
4. Pull ignition switch out from behind instrument panel and remove "theft resistant" connector. Use a screwdriver to unsnap locking tangs on connector from their position on switch.
5. Snap connector into place on new ignition switch.
6. Place switch into position from behind instrument panel, first adding grounding ring then install ignition switch nut.
7. Install lock cylinder, key inserted.
8. Install battery ground cable.

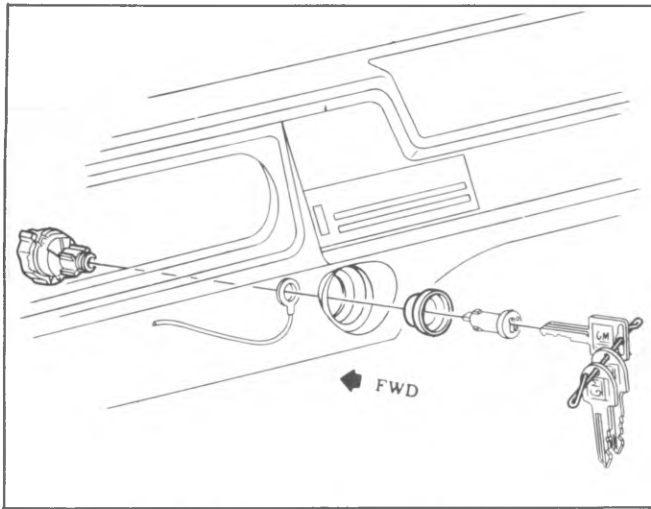


Fig. 8-13--Ignition Switch (G Models)

INSTRUMENT CLUSTER

C-K Models

Replacement (Fig. 8-14)

1. Disconnect battery ground cable.
2. Remove headlamp switch control knob.
3. Remove radio control knobs.
4. Remove eight screws and remove instrument bezel.
5. Reach up under instrument cluster and disconnect speedometer by first depressing tang on rear of speedometer head, then pulling cable free from head as tang is depressed.
6. Disconnect oil pressure gage line at fitting in engine compartment.
7. Pull instrument cluster out just far enough to disconnect line from oil pressure gage.
8. Remove cluster to bench for further disassembly (laminated printed circuit, speedometer head, gages).
9. Install cluster in reverse order of removal.

G Models

Replacement (Fig. 8-15)

1. Disconnect battery ground cable.
2. Reach up under instrument cluster and disconnect speedometer cable by first depressing tang on rear of speedometer head, then pulling cable free from head as tang is depressed.
3. Unplug instrument panel harness connector from printed circuit.
4. Disconnect oil pressure line from gage if so equipped.
5. Remove two nuts attaching instrument cluster studs to lower opening in instrument panel.
6. Pull top of cluster away from instrument panel and lift out bottom of cluster.
7. Remove cluster to bench for further disassembly (laminated printed circuit, speedometer head, gages).
8. Install cluster in reverse order of removal, noting that clips at top of cluster slip into instrument panel opening after bottom of cluster is installed.

INDICATOR AND ILLUMINATING BULBS

All Models

Replacement (Figs. 8-14 and 8-15)

1. Reach up under instrument panel and turn bulb holder counterclockwise to remove from cluster housing.
2. Pull bulb straight out to remove from holder.
3. Install replacement bulb in holder, press inward to lock in place.
4. Insert holder into housing, with lugs on holder entering notches in case, and turn clockwise to lock holder against printed circuit.

LAMINATED (PRINTED) CIRCUIT

All Models

Replacement

1. Remove instrument cluster assembly as previously described in this section.
2. Remove all instrument cluster lamp bulb assemblies.
3. Remove laminated circuit retaining screws.

NOTE: These screws serve as a ground for the circuit and must be reinstalled to provide the proper ground.
4. **G Models** - Remove fuel, temperature and ammeter terminal nuts retaining laminated circuit to rear of cluster.
5. Lift laminated circuit from cluster cover.
6. To install, reverse Steps 1-5 and check electrical operation of all affected components.

SPEEDOMETER

NOTE: Servicing of the speedometer assembly should only be performed by trained technicians having the proper test equipment.

C-K Models

Replacement

1. Disconnect battery ground cable.
2. Remove headlamp switch control knob.
3. Remove radio control knobs and clock adjuster stem.
4. Remove instrument cluster bezel and steering column cover.
5. Remove instrument cluster lens.
6. Remove transmission PRNDL indicator and case front cover.
7. Remove speedometer to cluster screws and speedometer assembly.
8. To install, reverse removal procedure. Check speedometer operation.

G Models

Replacement

1. Remove instrument cluster as previously described in this section.
2. Remove four screws retaining cluster rear cover containing speedometer.
3. Remove two hex head screws and rubber grommets securing speedometer assembly to cluster cover.
4. To install, reverse removal procedure and check operation of speedometer assembly.

CAUTION: Use care to prevent kinking the speedometer cable during removal and installation.

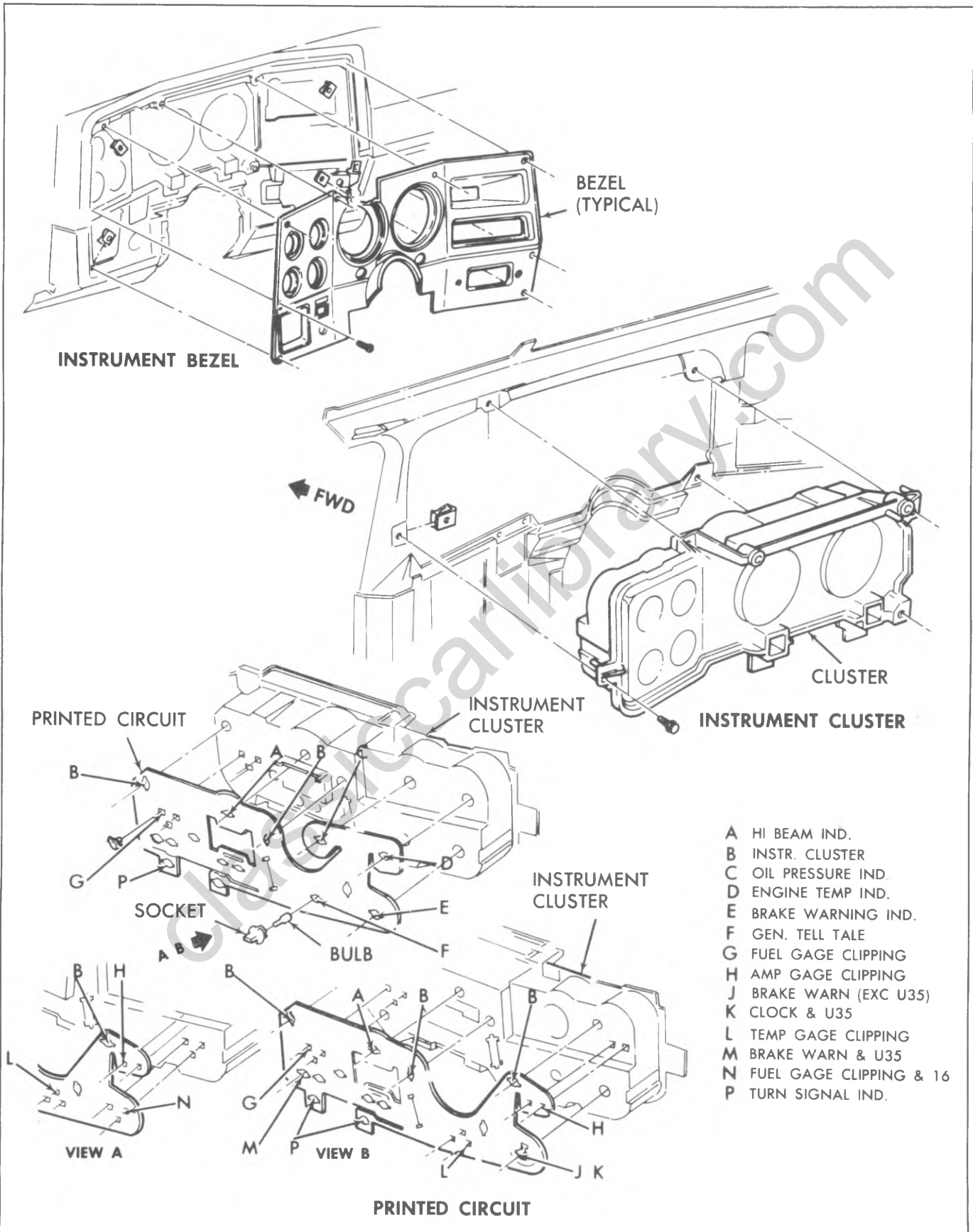


Fig. 8-14--Instrument Cluster Assembly (C-K Models)

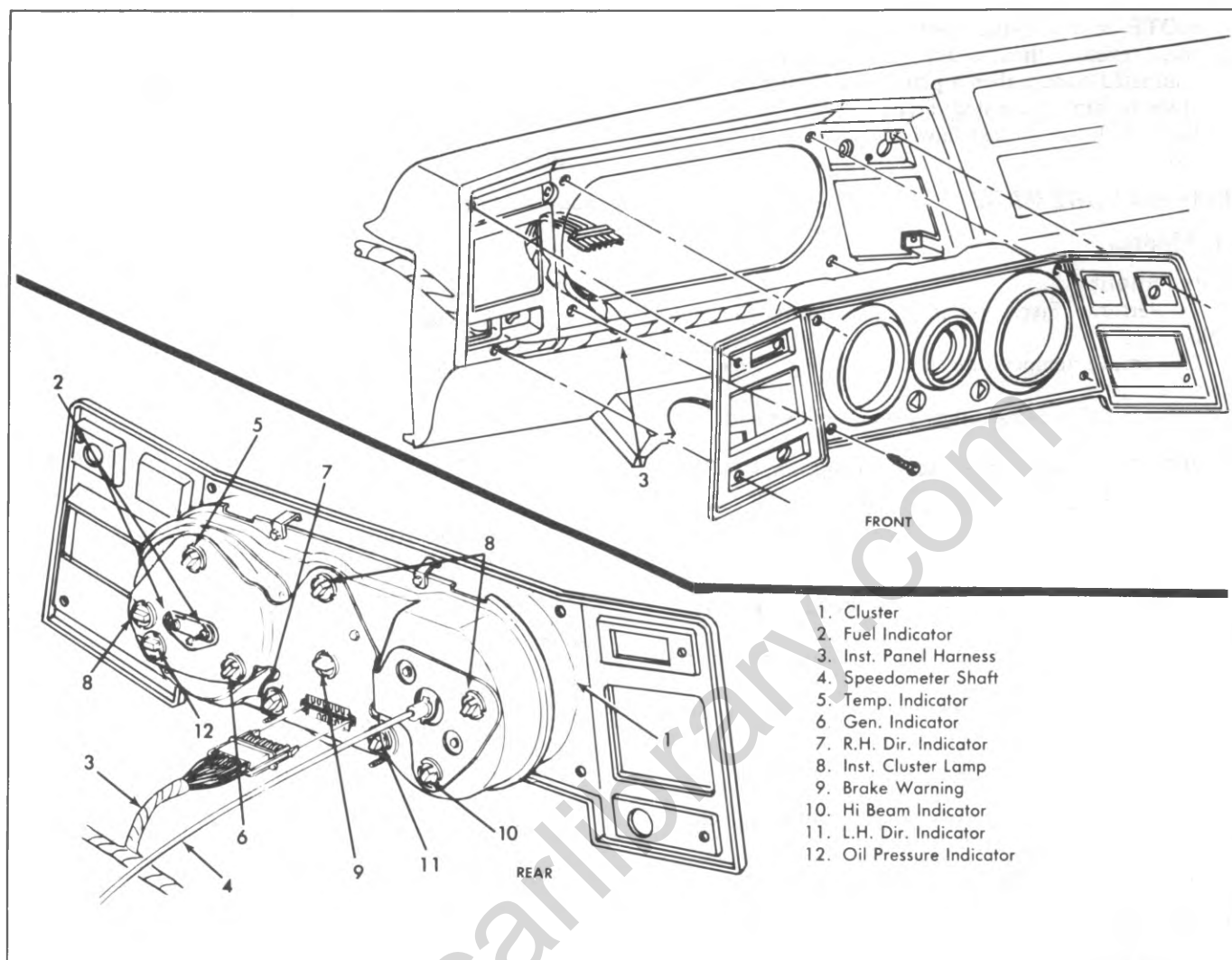


Fig. 8-15--Instrument Cluster Assembly (G Models)

SPEEDOMETER CABLE CORE

All Vehicles

Replacement

1. Disconnect battery ground cable.
2. Disconnect speedometer cable from speedometer head by reaching up under instrument panel, depressing spring clip and pulling cable from head.
3. Remove old core by pulling it out at end of speedometer cable casing.

NOTE: If old cable core is broken it will be necessary to remove lower piece from transmission end of casing.

4. Lubricate entire length of cable core with speedometer cable lubricant.
5. To install, reverse Steps 1-3 above.

CAUTION: Use care to prevent kinking speedometer cable core during installation.

FUEL GAGE

C-K Models

Replacement

1. Perform Steps 1-5 of "Instrument Cluster - Replacement".
2. Remove fuel gage attaching screws and remove the gage.
3. To install, reverse Steps 1-2 above. Check gage operation.

G Models

Replacement

1. Remove instrument cluster assembly as previously described.
2. Remove instrument cluster bulb holders, ground screws, nuts and washers retaining laminated circuit to fuel gage rear cover.
3. Remove three screws retaining fuel gage rear cluster cover.
4. Lift gage away from laminated circuit and rear cluster cover.
5. To install, reverse Steps 1-4 and check operation of fuel gage.

NOTE: Mount insulator strip on fuel gage studs first, then resistor, then a nut on each stud, next the laminated circuit, then a plain washer on each of two studs holding laminated circuit and finally a nut on back of the studs that have a washer and laminated circuit.

TEMPERATURE GAGE

C-K Models

Replacement

1. Perform Steps 1-5 of "Instrument Cluster - Replacement".

2. Remove temperature gage attaching screws and remove the gage.

3. To install, reverse Steps 1 and 2 above and check gage operation.

NOTE: Be sure gage studs engage clips holding laminated circuit to back of cluster housing.

G Models

Replacement

1. Remove instrument cluster assembly as previously described in this section.

2. Remove terminal nuts retaining laminated circuit to gage unit.

3. Remove attaching screws, cover and gage assembly from cluster housing.

4. Remove terminal attaching nuts and gage unit from cover plate.

5. To install, reverse removal procedure and check operation of gage.

TEMPERATURE SENDING UNIT

All Models

Replacement

WARNING: Do not remove cap with engine hot, allow vehicle to cool off first.

1. Relieve cooling system pressure by loosening radiator cap to first stop. Tighten cap after pressure is relieved.

2. Disconnect sending unit wiring harness.

3. Remove sending unit from the engine.

4. Install new sending unit and connect electrical harness.

5. Check coolant level and unit operation.

NOTE: Coolant must have at least 0°F (-18°C) freeze protection for sending unit to function properly.

OIL PRESSURE GAGE

C-K Models

Replacement

1. Perform Steps 1-5 of Instrument Cluster - Replacement" procedure.

2. Reach up under the instrument panel and place a cloth under the line to gage connection. Remove line to gage nut.

3. Remove gage to cluster attaching screws and remove gage.

4. To install, reverse Steps 1-3 above and check gage operation.

G Models

Replacement

1. Remove instrument cluster as previously described in this section.

NOTE: Oil pressure line connection may leak oil when opened; wrap with cloth.

2. Remove bulb holders, grounding screws and lift laminated circuit aside as necessary.

3. Remove instrument cluster cover to separate oil pressure gage from cluster.

4. Remove pipe fitting and retaining nut from gage being replaced then remove gage from cluster DO NOT KINK PIPE.

5. To install replacement oil pressure gage, reverse Steps 1-4, then observe operation of gage.

OIL PRESSURE SENDING UNIT

All Models

Replacement

1. Disconnect wiring harness connector from sending unit terminal located in block above starter on L-6 engines, at left front of distributor on V-8 (except 454 V-8) or rear left side of block (454 V-8) engines.

2. Remove sending unit using Tool J21757. Replace with new unit and check operation.

VOLTMETER

C-K Models

Replacement

1. Perform Steps 1-5 of "Instrument Cluster - Replacement" procedure.

2. Remove gage to instrument panel screws and remove meter.

3. To install, reverse Steps 1 and 2 above and check meter operation.

NOTE: Be sure meter studs engage clips holding printed circuit to back of cluster housing.

G Models

Replacement

1. Remove instrument cluster assembly as previously described in this section.

2. Remove terminal nuts retaining laminated circuit to meter.

3. Lay back laminated circuit portion after removing grounding screws and bulb holders.

4. Remove attaching screws, cover and meter from cluster housing.

5. Remove terminal attaching nuts and meter from cover plate.

6. To install, reverse Steps 1-5 and check operation of meter.

DIRECTIONAL SIGNAL SWITCH

The directional signal switch is a self-contained unit which incorporates the hazard warning switch and the lane changing signal.

The hazard warning circuit is activated by a push-pull switch which is located on the right side of the steering column, opposite the directional signal lever. The switch knob must be pulled to cancel circuit.

The lane changing circuit is activated by holding the directional signal lever in the first detent position; there is no lock in or cancelling device in this position.

See Section 3B "Steering" for all servicing procedures.

WINDSHIELD WIPER AND WASHER

C-K-G MODELS

GENERAL DESCRIPTION

GENERAL DESCRIPTION

The Delco permanent magnet type wiper is a completely new design for 1978. The motor parts-field magnets, armature, drive gear etc. are enclosed in a two piece sheet metal housing. For purposes of explanation the housing halves are referred to as upper and lower housings. The two housings are attached to each other by ten extrusions which are staked over. Figure 8-1.

As shown in Figure 8-1, the washer pump parts are assembled on the outside surface of the upper half of the sheet metal housing. Thus, the washer pump becomes an integral part of the wiper motor assembly.

The wiper motor is protected by an automatic reset type circuit breaker located on the motor brush holder assembly. A fuse located in the fuse block protects the vehicle wiring.

The wiper motor can be operated only when the ignition switch is in the "run" or "accessory" position.

Referring to figure 8-1 note that there are seven terminals which are numbered.

The function of each terminal is covered in the explanation that follows.

NOTE: Wipers are equipped with locking type connectors for attaching vehicle wiring and care should be used when disconnecting wiring from wiper.

As shown in figure 8-2, the wiper motor has three brushes which are referred to as "common", "Lo speed" and "Hi speed". When the ignition switch is "ON", 12 V(

via no. 1 terminal. The Lo and Hi speed brushes are connected to motor terminals two and three.

LO AND HI SPEED CIRCUITS

Moving the dash switch to the "Lo" or "Hi" speed position completes the respective brush circuit to ground at the dash switch and wiper motor runs at that speed.

WASHER PUMP OPERATION

The washer pump is an integral part of the wiper motor and cannot be replaced as a separate assembly as was possible with previous motors.

SHUTTING OFF THE WIPER

This explanation covers that portion of wiper operation when the owner first turns the wiper "off" at the dash switch and the wiper blades have not reached their normal park position, (approximately 1 1/2-2" above the lower windshield molding).

In order to have the blades stop in their normal park position and the wiper motor shut off properly, the motor operates in "Lo" speed. This is accomplished as follows: with the dash switch in the "OFF" position, the Lo speed brush circuit is completed to ground at the dash switch through a park switch located in the gear housing (Terminals 4 and 5). The park switch contacts are normally closed and this permits the wiper to continue to run.

When the blades reach their park position, a cam on the gear opens the normally closed park switch contacts shutting off the wiper.

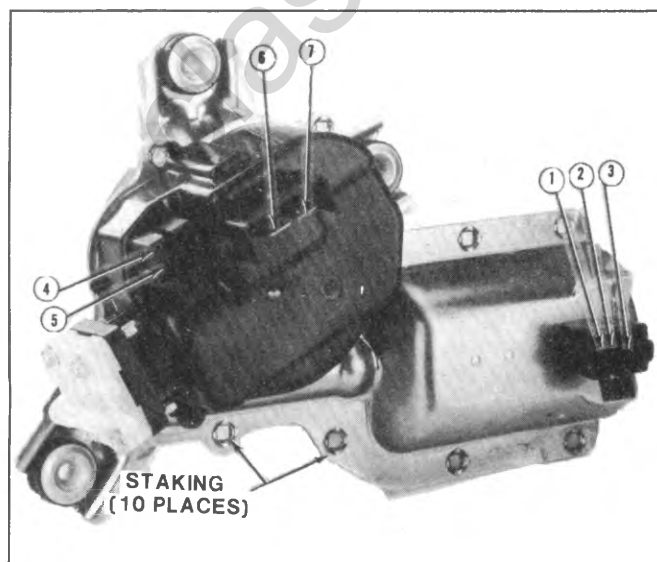


Fig. 8-1--Wiper Motor Housing

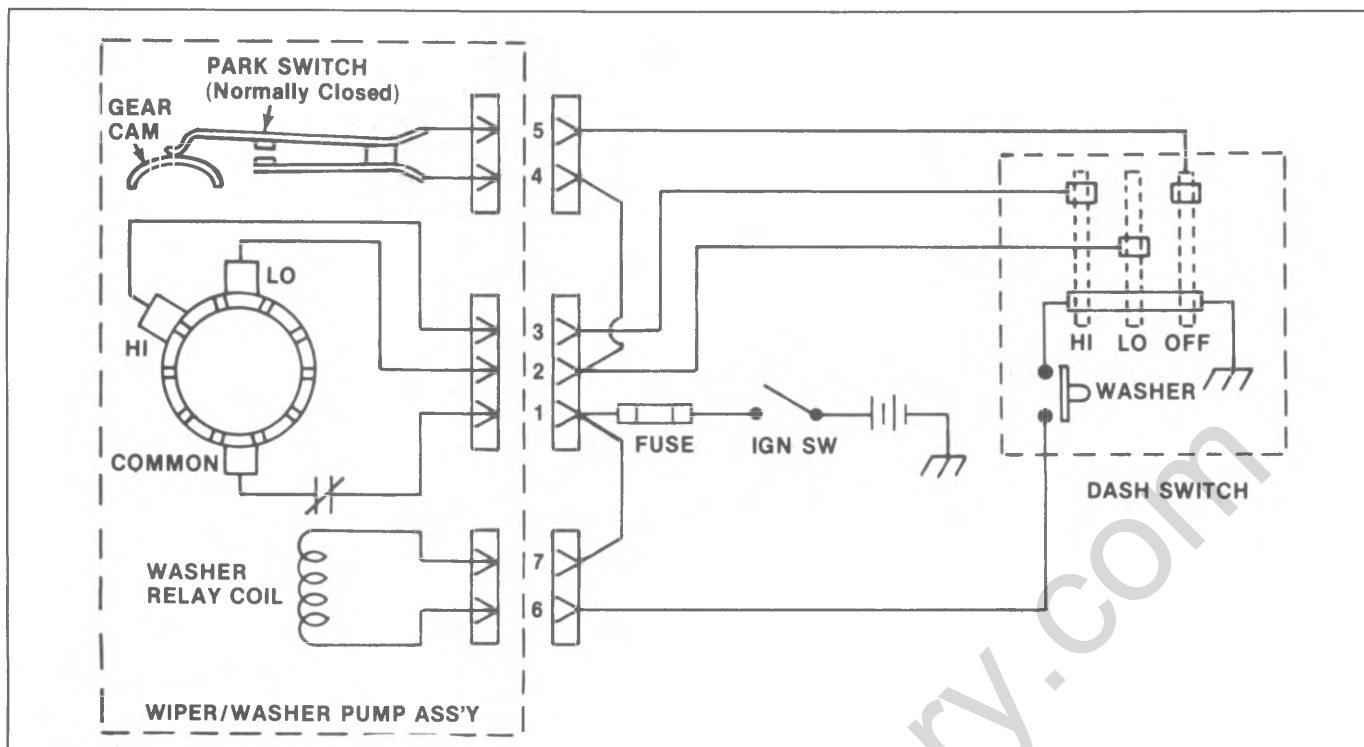


Fig. 8-2--Wiper Motor Schematic

WASHER PUMP CIRCUIT

Actuating the washer portion of the dash switch completes the washer pump magnet coil circuit to ground and mechanically moves the wiper motor switch to the Lo speed position. This dual function starts the wiper motor and washer operation simultaneously. When the wash cycle (10 squirts at full pressure) is completed, the wiper will continue to run until the owner returns the switch to the "off" position.

WASHER PUMP OPERATION

Pumping Mechanism

The basic pump consists of a spring loaded piston enclosed in a plastic cylinder housing. Attached to the piston and extending out of cylinder housing is an actuator plate. Attached to the end of the cylinder housing is a valve assembly consisting of two exhaust check valves and one intake check valve. Figure 8-3.

Note the cam follower pin that extends through an elongated opening in the piston actuator plate. When the wiper motor is running, a 4 lobe cam, which is part of the wiper gear, moves the cam follower back and forth.

Pump Idling (No Pumping Action)

Refer to Fig. 8-4 and note that a tang on the piston actuator plate is resting against a ramp on the lower surface of the ratchet gear. This, in effect, holds the piston actuator plate in a lock-out position. With actuator plate in this position and the wiper running, the cam-follower pin merely moves back and forth in the elongated slot of the piston actuator plate and no pumping action can occur.

The ratchet gear, which, if rotated, would move the ramp away from the tang of the actuator plate releasing the pump action, is prevented from rotating as follows: The relay assembly, consisting of a coil and armature, is

constructed in such a way that the ratchet gear pawl extends through an opening in the relay armature (Fig. 8-5), preventing it from engaging the ratchet gear teeth.

Starting the Pump

Actuating the washer button to obtain windshield washer pump operation starts the wiper motor and energizes the relay. When relay is energized, the relay armature is pulled toward the coil, allowing the ratchet gear pawl to drop out of the relay armature opening and engage the teeth of the ratchet gear.

The ratchet pawl, which is actuated by the same cam-follower pin that moves the piston actuating plate, begins to rotate the ratchet gear. Rotating the ratchet gear one tooth moves the ratchet wheel ramp away from the tang of the piston actuating plate (Fig. 8-4), permitting the piston spring to expand which in turn forces the piston toward the valve assembly resulting in the first exhaust stroke. This sequence then repeats through the remaining cycles.

Intake Stroke

When the cam-follower moves in the direction indicated by the arrow in Fig. 8-6, the cam-follower pin, which extends through the piston actuating plate, pulls the actuator plate away from the valve assembly compressing the piston spring. As the piston moves away from the valve assembly, a vacuum is created in the cylinder which opens the intake valve, drawing washer solution into the cylinder (Fig. 8-6).

Exhaust Stroke

As the 4-lobe cam continues to rotate, the cam follower moves in the opposite direction described in the intake stroke. This permits the piston spring to expand which in turn pushes the piston toward the valve assembly creating pressure between the piston and valve assembly. This

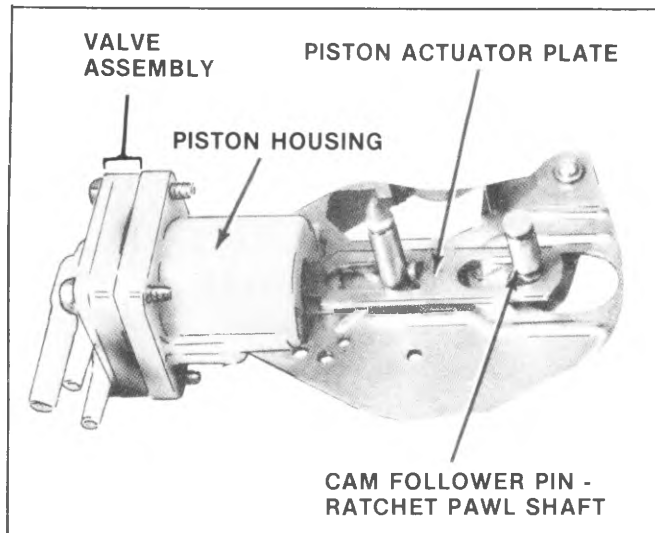


Fig. 8-3--Washer Valve Assembly

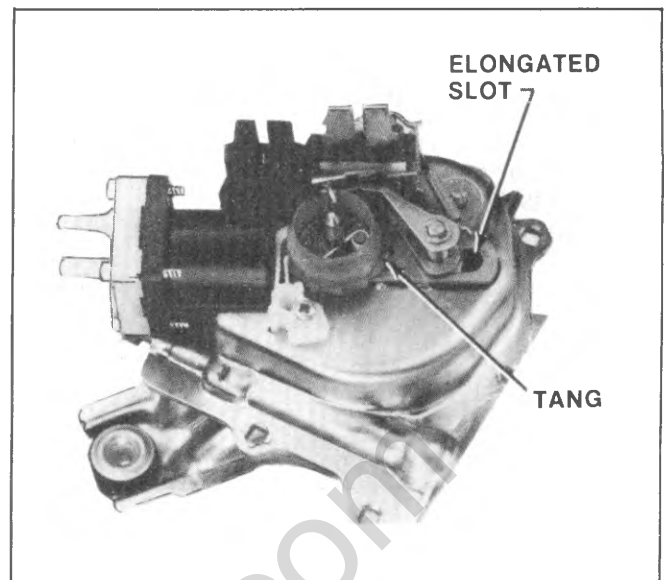


Fig. 8-4--Ratchet Gear Pawl

pressure "build-up" forces the two exhaust valves open compelling the washer solution to flow to the nozzles. See Fig. 8-7.

NOTE: For purposes of explanation, only one exhaust valve opening is shown in Fig. 8-7.

The intake and exhaust stroke cycle will occur four times for each revolution of the wiper drive gear while the washer pump is operating.

Stopping the Pump (Completion of the Wash Cycle)

The pumping operation is terminated automatically when the ratchet gear has rotated a full 360° and the 12th cycle is completed. This is accomplished as follows.

As the ratchet gear approaches the completion of its 360° travel, two functions occur simultaneously:

1. A leg on the relay armature rides up a ramp located on the outer surface of the ratchet gear. When the leg reaches the top of the ramp, it moves over the top edge of the ratchet gear. This action allows the ratchet gear pawl to re-enter the armature opening preventing further rotation of the ratchet gear until the next time the relay coil is energized from the washer button. (Refer to Fig. 8-7 for position of armature leg while pump is idling.)

2. The tang on the piston actuating plate is resting once more against the ramp on the lower side of the ratchet gear

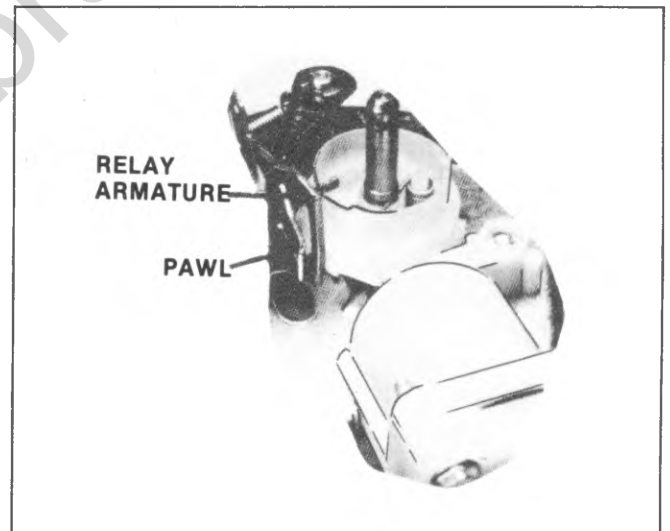


Fig. 8-5--Relay Armature

(Fig. 8-4).

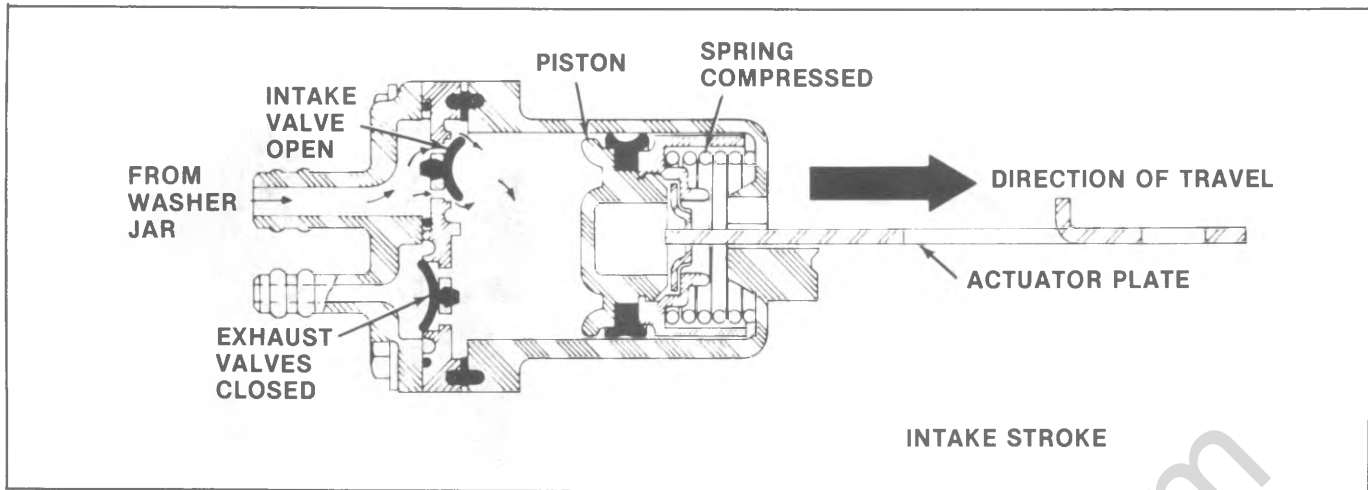


Fig. 8-6--Pump Operation

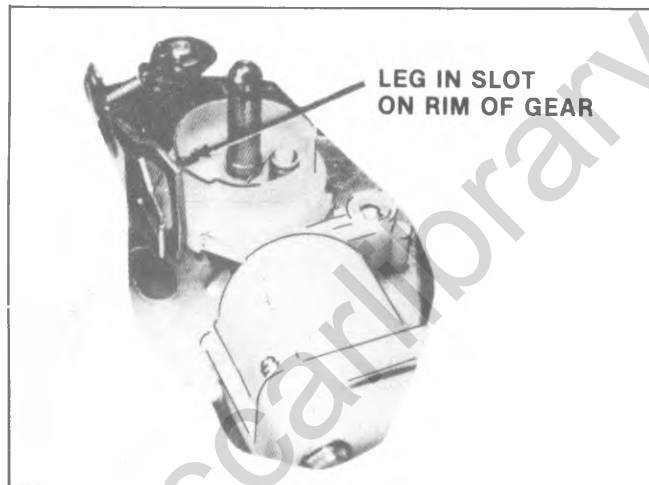


Fig. 8-7--Armature Leg Position

DIAGNOSIS

WIPER - ON VEHICLE

Troubleshooting with wiper installed on the vehicle consists of two basic steps: (A) Preliminary inspection and (B) Operating wiper independent of vehicle wiring and dash switch.

Preliminary Inspection Procedure

- A. Preliminary Inspection - Check the following items:
1. Body wiring securely connected to wiper unit and dash switch.
 2. Wiper ground connection to vehicle chassis.
 3. Dash switch is mounted securely.
 4. Fuse.

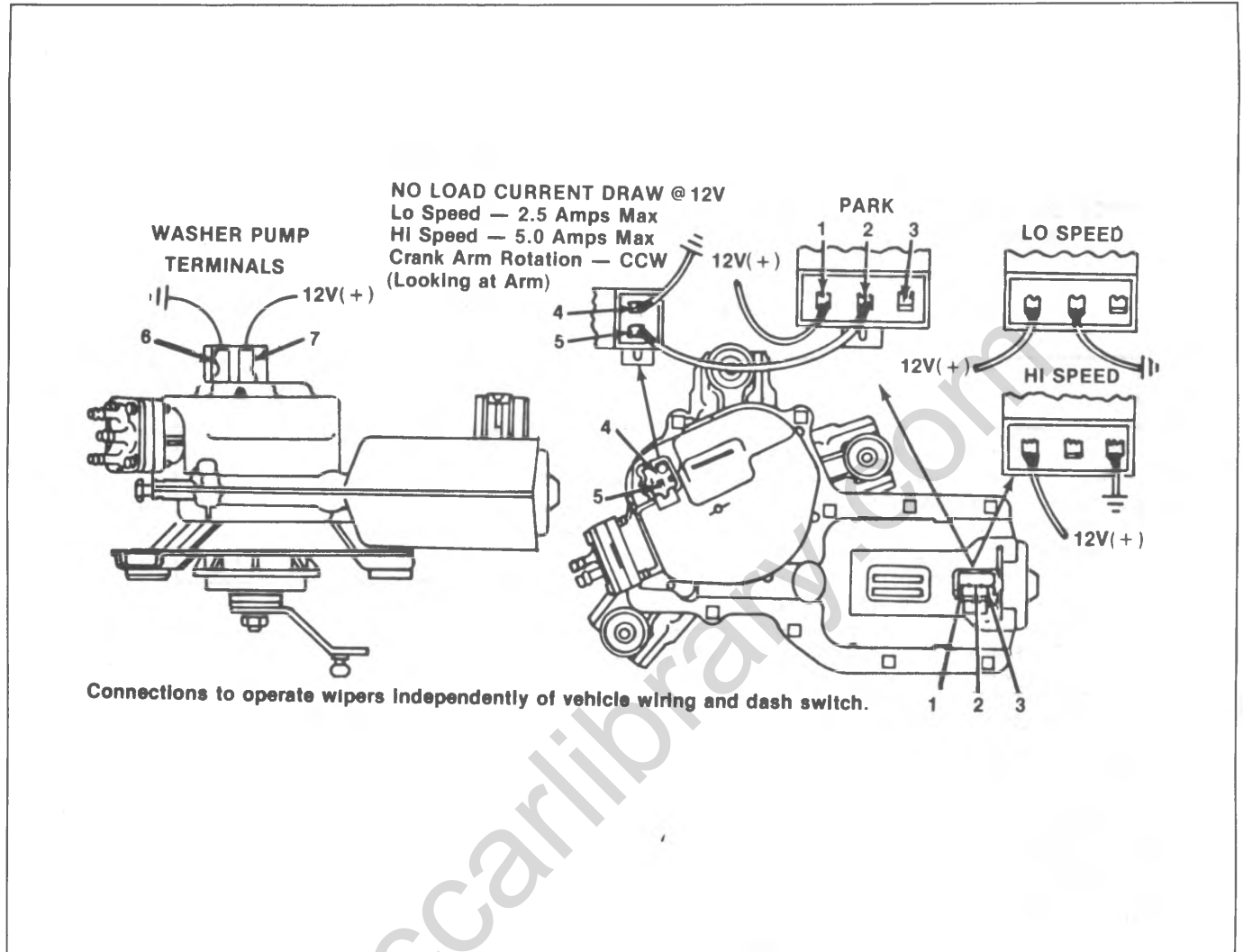


Fig. 8-8--Wiper Motor Diagnosis Diagram

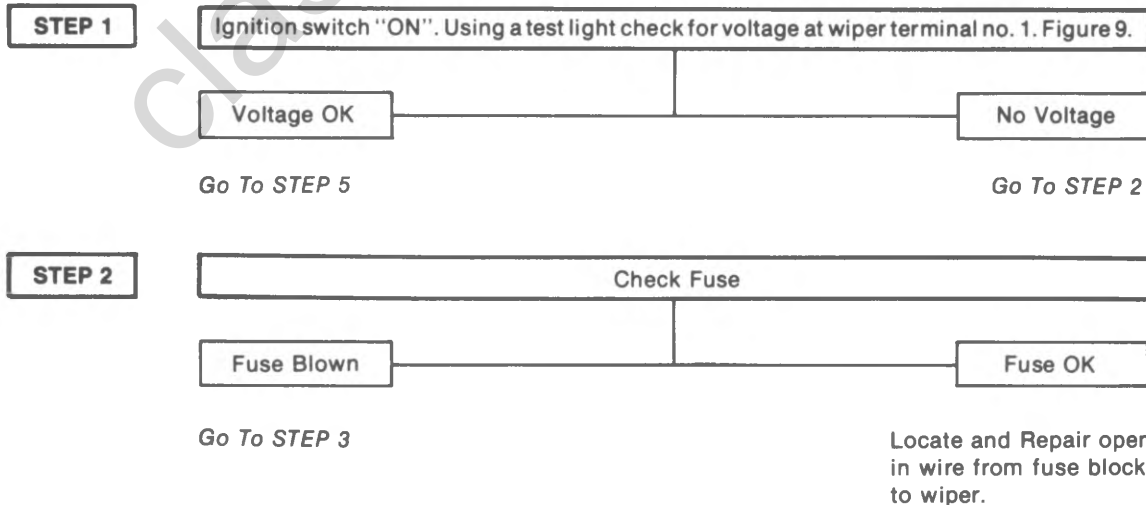
WIPER MOTOR/WASHER PUMP DIAGNOSIS

NOTE: Detached wiper/washer assemblies may be operated as shown in Figure 9 to determine possible problems.

DIAGNOSIS CHART

SYMPTOM	PROCEDURE NO.	PAGE
1) Wiper Inoperative - Both Lo and Hi	1	7
2) Lo speed only - inoperative in Hi	2	8
3) Hi speed only - inoperative in Lo	3	9
4) One speed - same in both Lo and Hi	4	9
5) Blades stop at random positions when wiper is turned off. (Do Not Return to Park Position)	5	9
6) Wiper will not shut off	6	10
7) Intermittent operation	7	10
8) Wiper motor runs but blades don't move	8	11
9) Washer pump inoperative	9	11
10) Washer won't shut off	10	13

PROCEDURE I (Wiper Inoperative)



Procedure 1 (cont.)

STEP 3

Remove blown fuse and connect an ammeter 0-30 amp. across fuse block terminals. Operate wiper motor and observe if current draw exceeds capacity of original fuse.

Current Draw High

Current Draw OK

Go To STEP 4

Replace fuse and recheck system

STEP 4

Disconnect wiring from wiper motor; replace fuse and actuate wiper dash switch several times. Recheck fuse. Ignition switch ON.

Fuse Blown

Fuse OK

Locate and repair shorted or grounded condition in wiring

Problem is in motor refer to "wiper repair" page

STEP 5

Ignition switch "ON". Leave wiring connected to wiper motor. Connect jumper wire from terminal no. 2 to ground. Figure

Wiper Runs

Wiper Inop.

Check dash switch ground wire connection. If OK, replace dash switch.

Problem is in motor refer to "wiper repair" Page

PROCEDURE 2 (Lo Speed Only) (Inop in Hi)

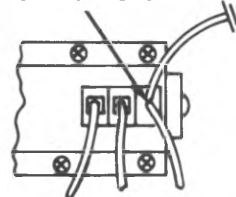
STEP 1

Ignition switch "ON". Leave wiring connected to wiper. Connect jumper wire from terminal no. 3 to ground. **Dash switch in "Hi" speed position!!**

Wiper Runs in Hi

Problem is an open wire from terminal no. 3 to dash switch. or Dash Switch.

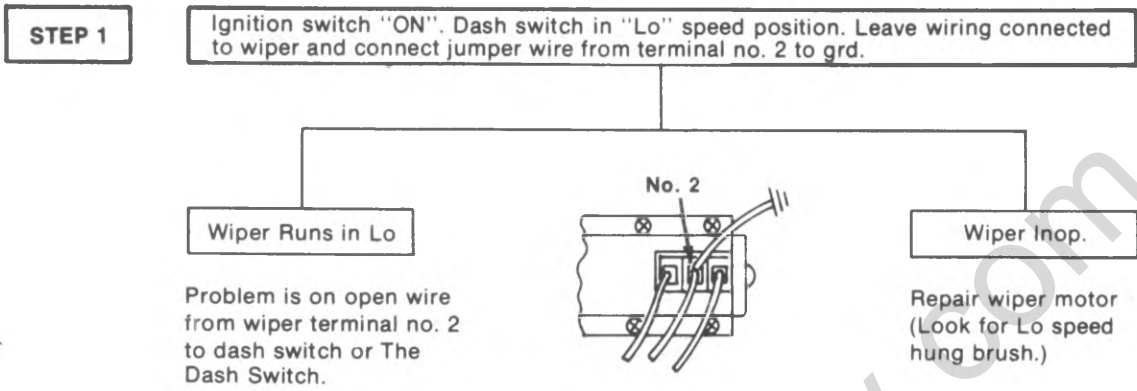
Terminal No. 3



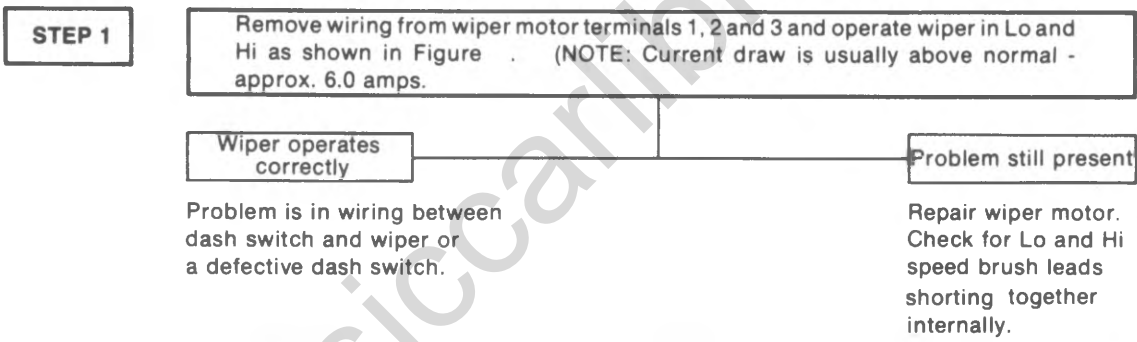
Wiper Inop.

Repair wiper motor. (Look for Hi speed hung brush)

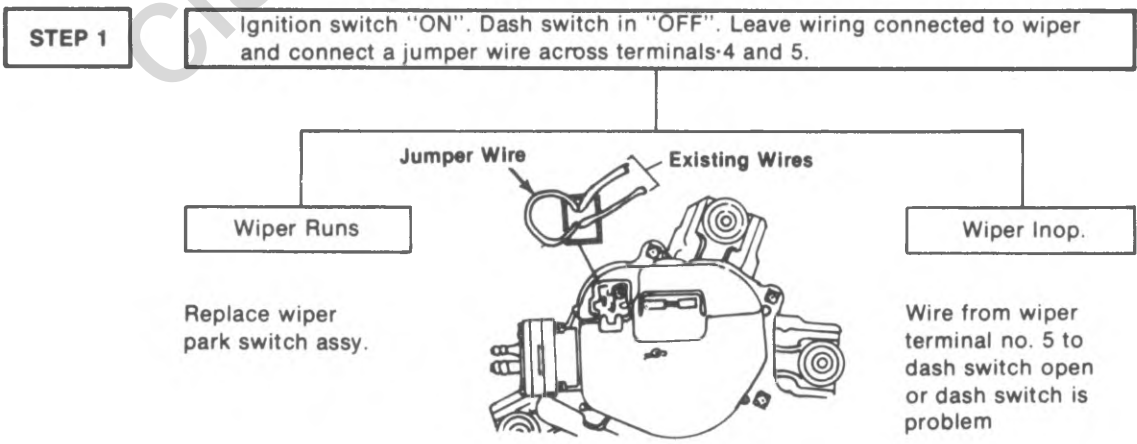
PROCEDURE 3 ("Hi" Speed Only) (Inop in Lo)



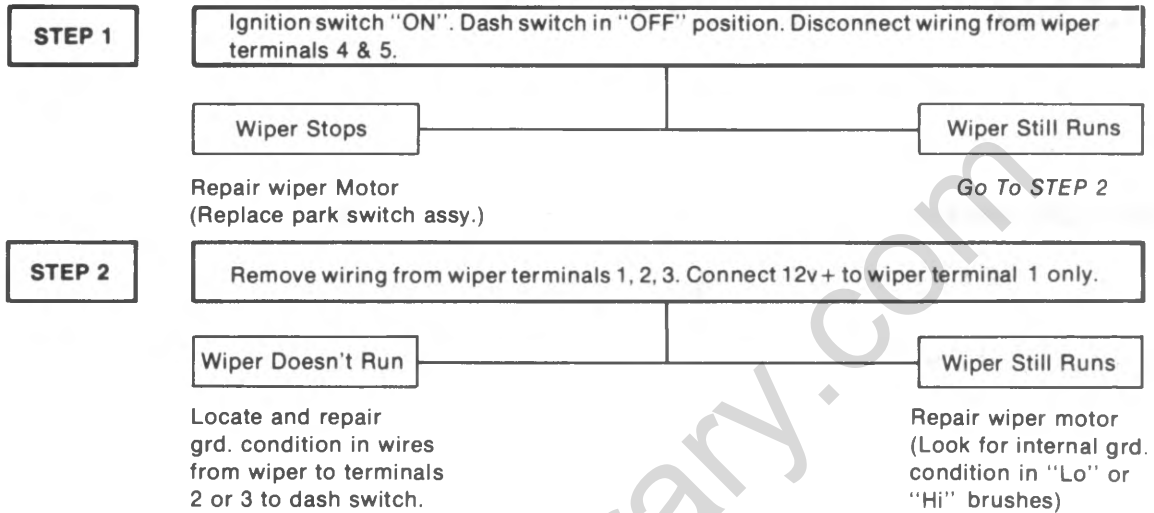
PROCEDURE 4 (One speed - same in both Lo and Hi).



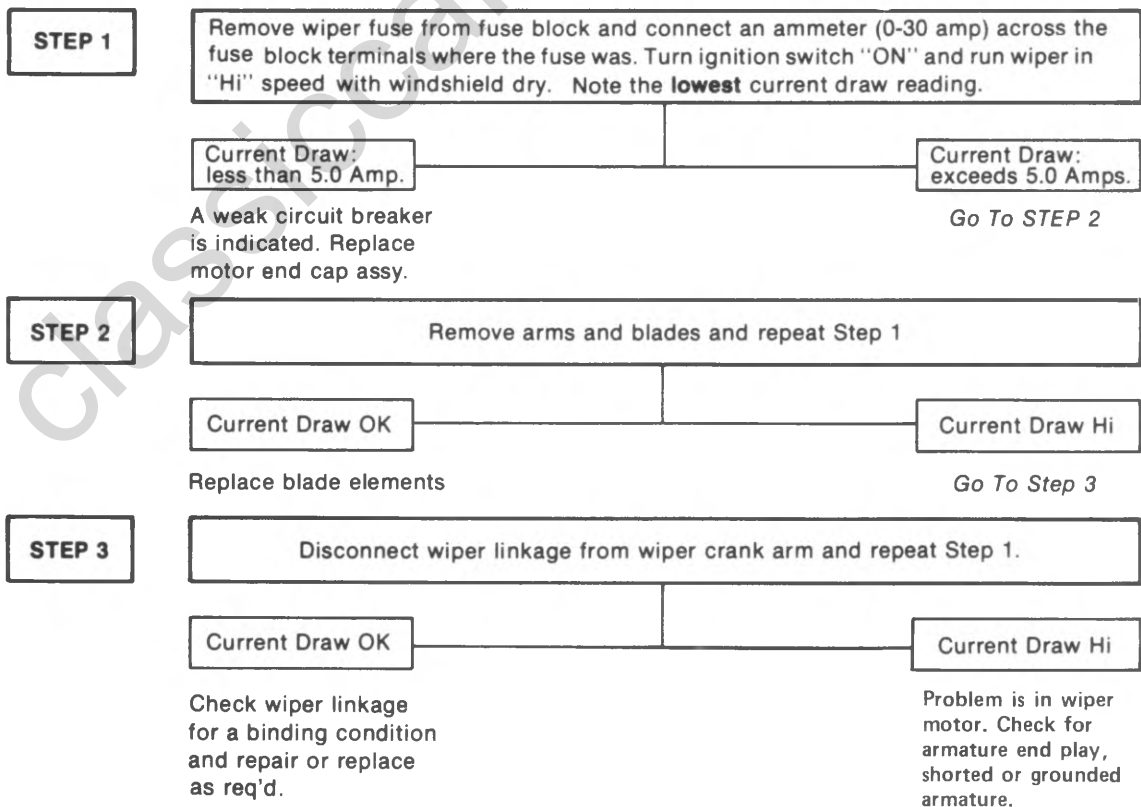
PROCEDURE 5 (Wiper shuts off but blades don't return to park position)



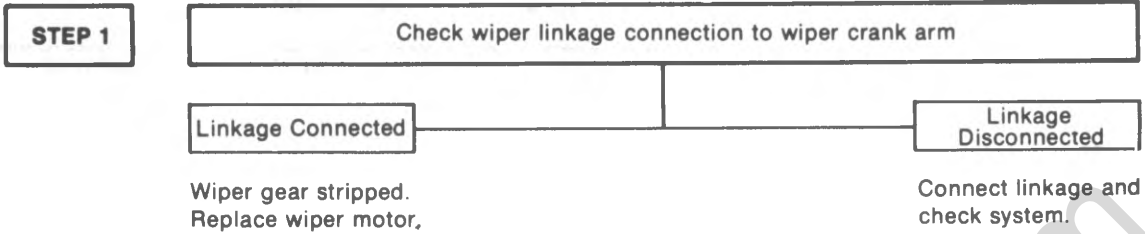
PROCEDURE 6 (Wiper will not shut off)



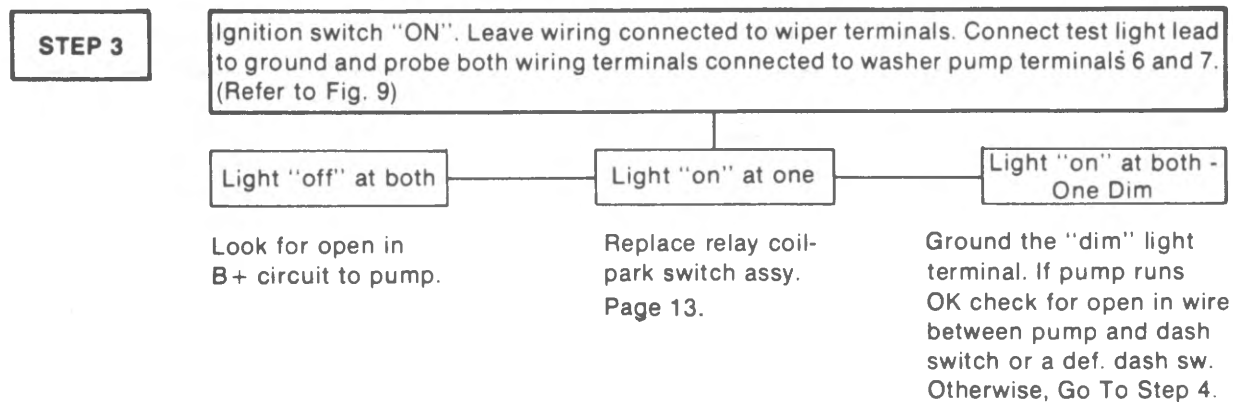
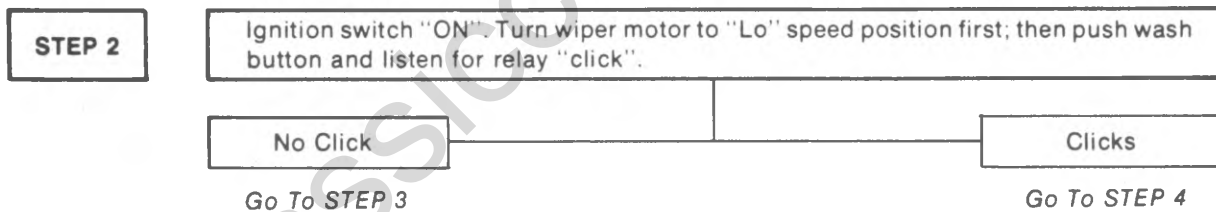
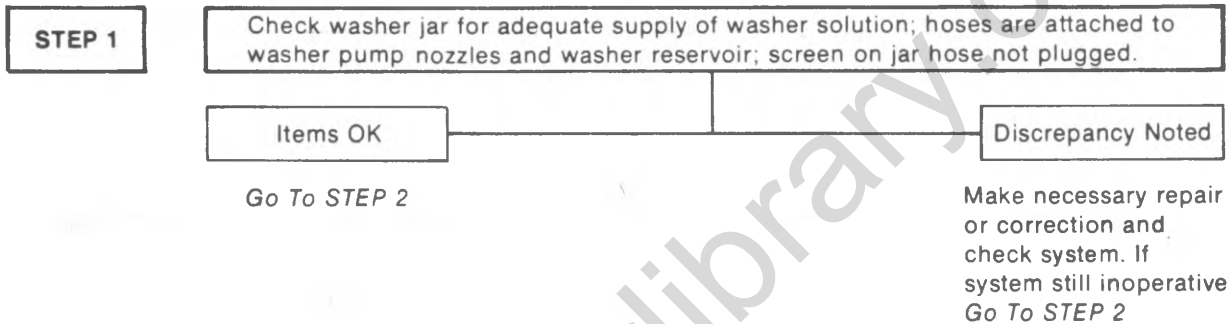
PROCEDURE 7 (Intermittent Operation) (Wiper has both speeds)



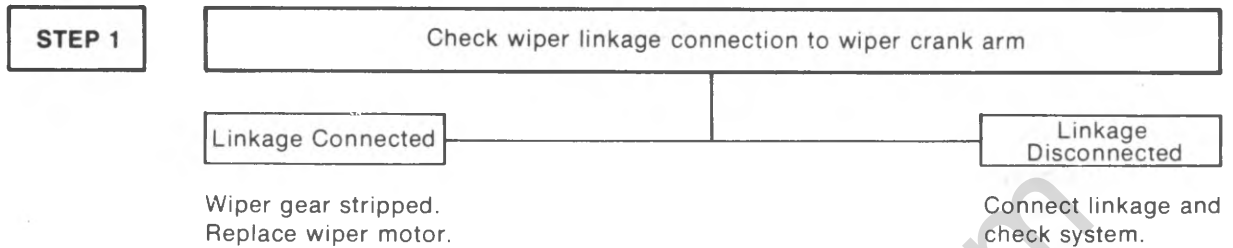
PROCEDURE 8 (Wiper Runs But Blades Don't Move)



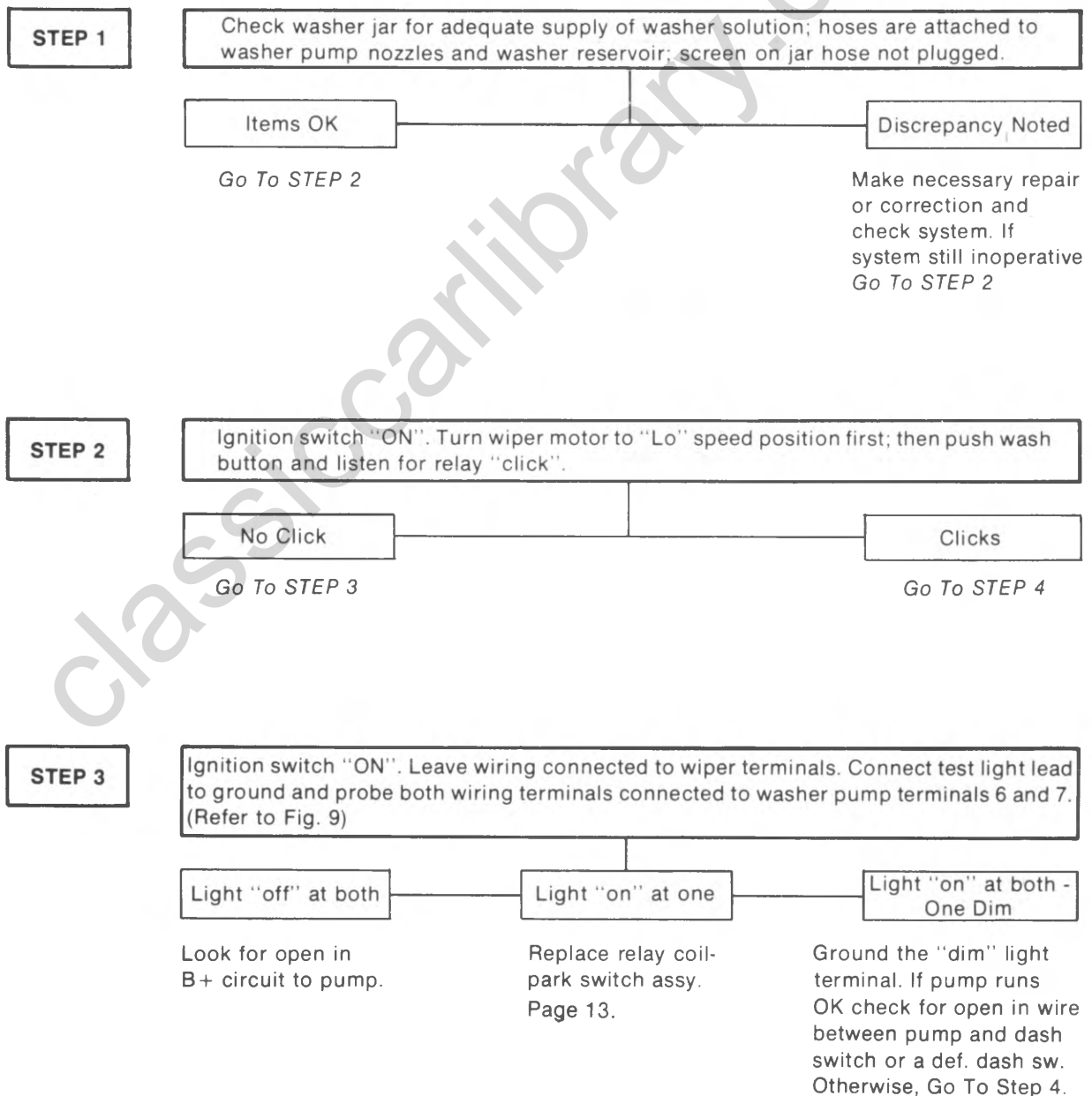
PROCEDURE 9 (Washer Pump Inoperative)



PROCEDURE 8 (Wiper Runs But Blades Don't Move)



PROCEDURE 9 (Washer Pump Inoperative)



PROCEDURE 10 (Washer Pumps Continuously)

STEP 1

Have wiper running and disconnect wiring from washer pump terminals 6 and 7. Observe if pump completes wash cycle and stops pumping.

Pump stops

Check for grounded wire between pump terminal and dash switch or a defective dash sw.

Pump keeps running

Go To STEP 2

STEP 2

Disconnect wiring from wiper unit; remove washer pump cover and re-connect wiring to wiper-washer. Turn on wiper and check the following items.

- a) Ratchet gear dog spring engaging ratchet gear teeth.
- b) Weak spring tooth on ratchet gear.
- c) Ratchet gear tooth damaged
- d) Cam-follower damaged.

Replace item(s) as required.

DELAY WIPER SYSTEM OPERATION AND DIAGNOSIS

Light duty trucks use a separate control assembly to operate the windshield wipers over a variable delay of 1 to 20 seconds. The control assembly plugs into the selector switch at two different connectors. One of these connectors has a piggy-back connector that connects to the regular wiper harness. There is also a lead from the control that plugs into the accessory cavity of the fuse panel. Moving the control knob of the selector switch to the extreme left position and holding it there, will result in a MIST mode. The mist mode feature provides momentary low speed wiper operation as long as the control knob is held in position. This position is spring loaded and will only remain activated as long as the knob is held in position. Upon releasing the control knob, it will automatically return to OFF position. By positioning the control knob in the first detent right of OFF, the selector switch is in the DELAY mode. Rotation of the control knob while in the delay mode regulates the delay period between the time it takes the wiper to make one sweep and momentarily stop.

Shifting the control knob right to next detent position will put the wipers in a LOW speed wiper mode. By moving the control again to the right (right most detent) will activate the HIGH speed wiper mode.

Depressing the control knob, in any mode, will result

in washer fluid being squirted on the windshield.

Depressing the control knob on light duty trucks for one or two seconds will send a measured amount of fluid onto the windshield and then the washer will shut off. If the wiper control knob is any position other than HIGH, the wipers will continue to operate at low speed until they are manually turned OFF.

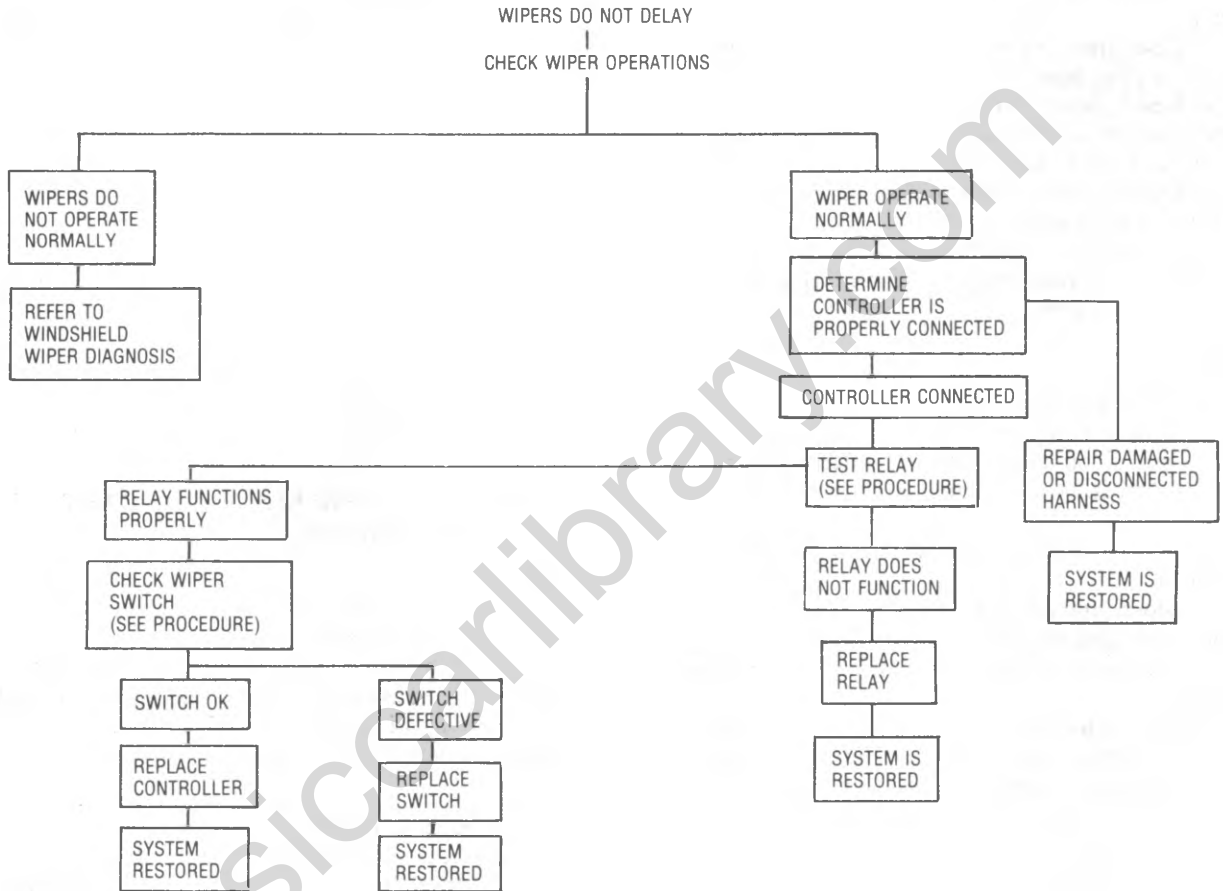
In the HIGH mode, depressing the knob results in washer fluid being dispensed with the wipers operating at the high speed mode.

Selector Switch Checking Procedure

If the wiper washer selector switch is suspected of being faulty, it can be checked with an ohmmeter as indicated in Chart 8-1. Before performing any continuity check disconnect both harness connectors from switch to controller.

Next, place selector switch in mode desired and perform a continuity check between the individual leads as indicated in the chart. If there is a meter reading at each check but no indication of shorts, the switch can be assumed to be good.

Diagnosis



Selector Switch Checking Procedure

If the wiper/washer selector switch is suspected of being faulty, it can be checked with an ohm meter as indicated in table below. Before performing any continuity check on selector switch, disconnect both harness connectors from switch to controller. Next, place selector switch in mode desired and perform a continuity check between the individual leads as indicated in table below, Figure 15. If there is a meter reading at each check but no indication of shorts, switch can be assumed to be good.

	Mist	Off	Delay	Delay Control (Rotate Control full clockwise)	LO	HI	Wash (Off Mode — press in on control)
Dark Blue							X
Light Blue	X				X	X	X
Green	X	X			X	X	X
Black	X	X	X		X	X	X
Black Wht Str	X	X	X		X		X
Orange				X			
White				X			

ON-VEHICLE SERVICE

COMPONENT PART REPLACEMENT

WIPER MOTOR

C-K Models

Replacement (Fig. 8-9)

1. Make sure wiper motor is in Park position.
 2. Open hood and disconnect ground cable from battery.
 3. Disconnect electrical harness at wiper motor and hoses at washer pump.
 4. Reach down through access hole in plenum and loosen wiper drive rod attaching screws. Remove drive rod from wiper motor crank arm.
 5. Remove wiper motor to dash panel attaching screws and remove the motor assembly.
 6. To install, reverse Steps 1-5 above.
- NOTE:** Lubricate wiper motor crank arm pivot prior to reinstallation.

G Models

Replacement (Fig. 8-10)

1. Make sure wiper motor is in Park position.
2. Open hood and disconnect battery ground cable.
3. Remove wiper arms from wiper transmission linkage.
4. Remove remaining screws securing cowl panel cover and lift off.
5. Loosen nuts holding transmission linkage to wiper motor crank arm and lift linkage off arm.
6. Disconnect power feed to wiper motor at multiple connector.
7. Remove left dash defroster outlet from flex hose and push hose aside for access to wiper motor screws.
8. Remove one screw securing left hand heater duct to engine cover shroud and slip heater duct down and out.
9. Protect carpet, then remove windshield washer hoses from washer pump.
10. Remove three screws securing wiper motor to cowl

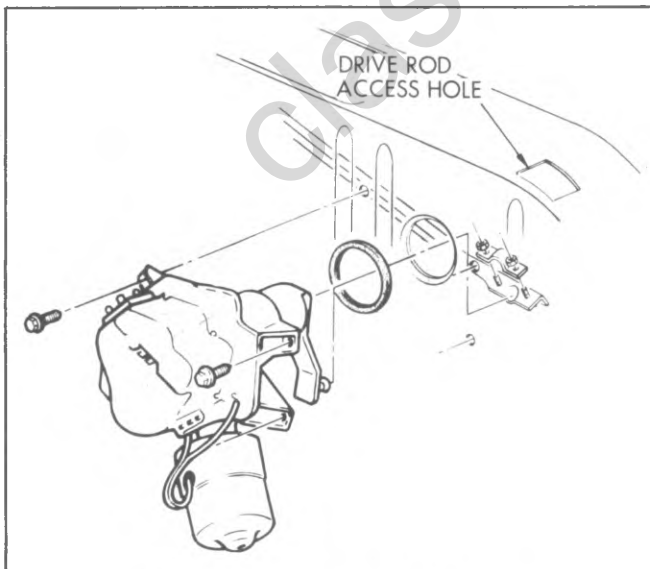


Fig. 8-9-Wiper Motor (C-K Models)

and lift wiper motor out from under dash for further disassembly on bench.

11. To install, reverse Steps 1-10 above.

NOTE: Install wiper in the PARK position. Lube wiper motor crank arm pivot prior to installation.

UNIT REPAIR

WIPER MOTOR

Repairs to the motor/gear box section of the wiper are limited to the switch, armature, and cap and brush holder assy., plus the external parts such as the crank arm, spacer/seal (plastic) and output shaft seal.

PARK SWITCH

This is part of the washer pump relay coil assembly. Refer to figure 8-11.

Removal

1. Disconnect wiring from wiper assembly and remove washer pump cover.
2. Remove pawl spring.
3. Push in retainer tab to release relay coil-park switch assembly from washer frame.
4. To re-assemble, reverse steps 1 thru 3 and check wiper operation, figure 8-11.

ARMATURE ASSEMBLY END CAP-BRUSH HOLDER ASSEMBLY

Replacement

1. Bend retainer tabs as required to provide clearance for removing end cap assembly. Figure 8-12.
2. To assist in pushing the end of the motor housing, rotate crank arm clock-wise (looking at crankarm).
3. Pull end cap assembly off the armature shaft and pull armature out of wiper housing.

Replace

1. Release brush spring tension figure 8-13 and slide brushes back in their respective brush holders.
 2. Assemble armature in end cap assembly and reposition brush spring legs behind their respective tabs, figure 8-14.
 3. To maintain the end cap in its assembled position on armature shaft during re-assembly of armature in the wiper housing proceed as follows: Using small wire such as tag wire, tie armature to end cap assembly as shown in figure 8-15.
 4. Guide armature worm shaft through the housing bearing.
- NOTE:** : The strong magnetic field will pull armature toward one of the magnets. It will be necessary to overcome the magnetic force to start shaft into the bearing.
5. Guide terminal housing of end cap into the slot area of the wiper housing.
 6. Remove wire used to attach armature to end cap. This should be done before end cap enters the housing.

7. After wire is removed, rotate crank arm slightly to permit armature worm shaft to engage gear teeth. The end cap assembly can then be pushed into the housing until it bottoms against the end of the housing.

8. Bend the 4 tabs as required to secure the end cap

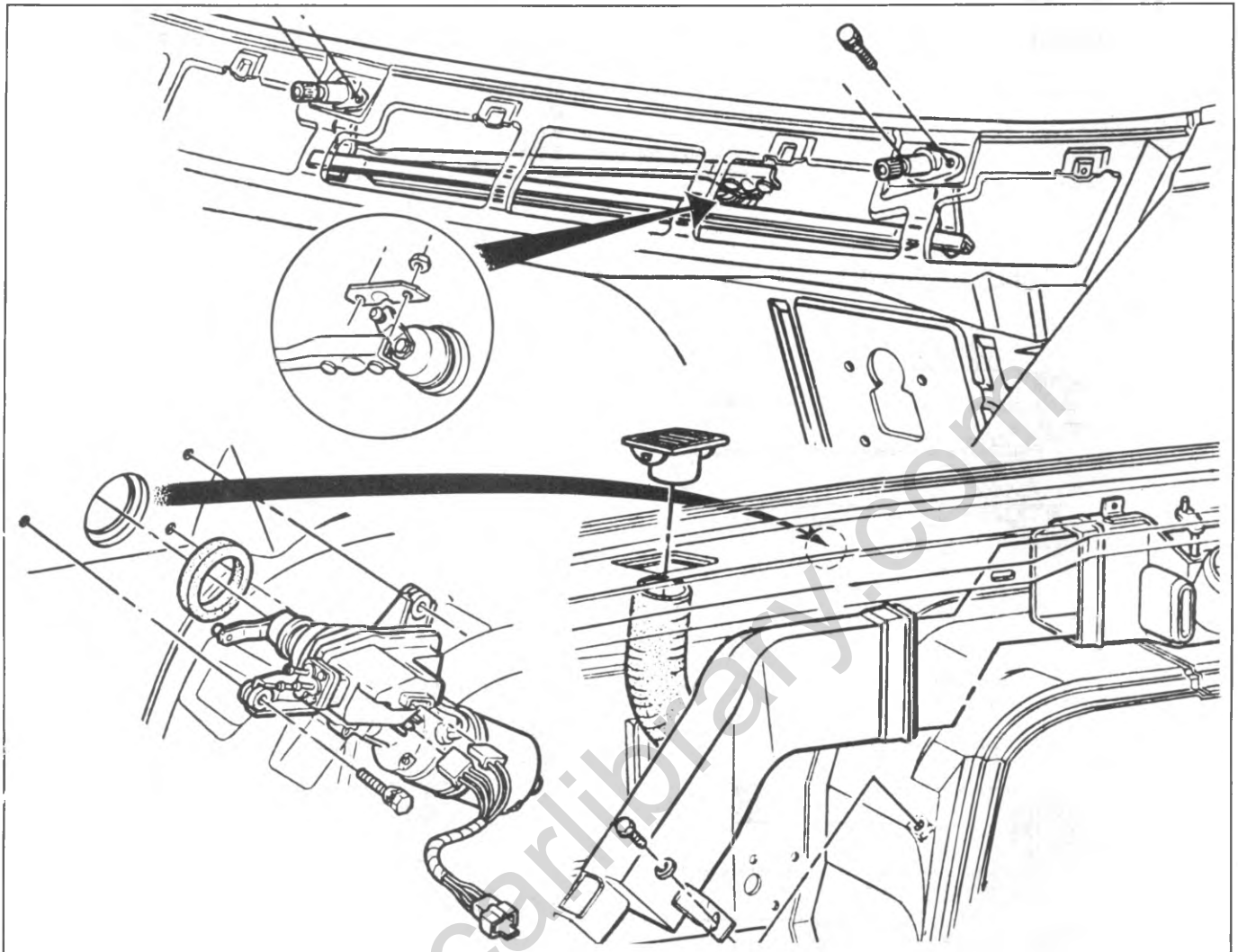


Fig. 8-10--Wiper Motor (G Models)

in position figure 8-11.

9. Check wiper operation.

CRANK ARM, SPACER, SEAL Refer to Figure 8-10

Replacement

1. Remove crank arm retaining nut, crank arm, shaft seal and spacer in the order indicated.

NOTE: When re-assembling the shaft seal, be sure flat side is toward crank arm.

2. When re-assembling the crank arm, be sure wiper motor is in park (refer to figure 8-12), and assemble crank arm on shaft in position shown in Figure 8-12.

WASHER PUMP

Relay Coil

This is part of park switch assembly. Refer to "Park switch" for disassembly-assembly procedure.

Ratchet Pawl

Refer to Figure 8-18.

1. Disconnect pawl spring.
2. Remove "e" type retainer ring and slip pawl off of shaft.

Dog Spring: Refer to Figure 8-18

1. Remove screw that attaches dog spring to washer frame.

Ratchet Gear: Refer to Figure 8-18

1. Remove dog spring and ratchet pawl.
2. Move leg of retainer spring out of shaft groove and slide ratchet gear off shaft. Be careful not to lose retainer spring.
3. To re-assemble gear, reverse steps 1 and 2 but read note.

NOTE: In order to push gear on shaft until it bottoms, move ratchet pawl shaft in a direction away from the gear. This will allow gear collar to slide past the tab on the piston actuator plate. (Refer to Figure 8-4.)

Piston and Housing Assy:

Refer to Figure 8-19.

1. Remove ratchet pawl, dog spring and ratchet gear.
2. Pull piston housing away from frame until the mounting grooves clear the frame. During this step the piston spring is being compressed.
3. Remove valve assembly as required.
4. To re-assemble, reverse steps 1 thru 3.

CONNECTIONS TO OPERATE WIPERS INDEPENDENTLY OF VEHICLE WIRING AND DASH SWITCH.

NO LOAD CURRENT DRAW @ 12V

Lo Speed — 2.5 Amps Max
 HI Speed — 5.0 Amps Max
 Crank Arm Rotation — CCW
 (Looking at Arm)

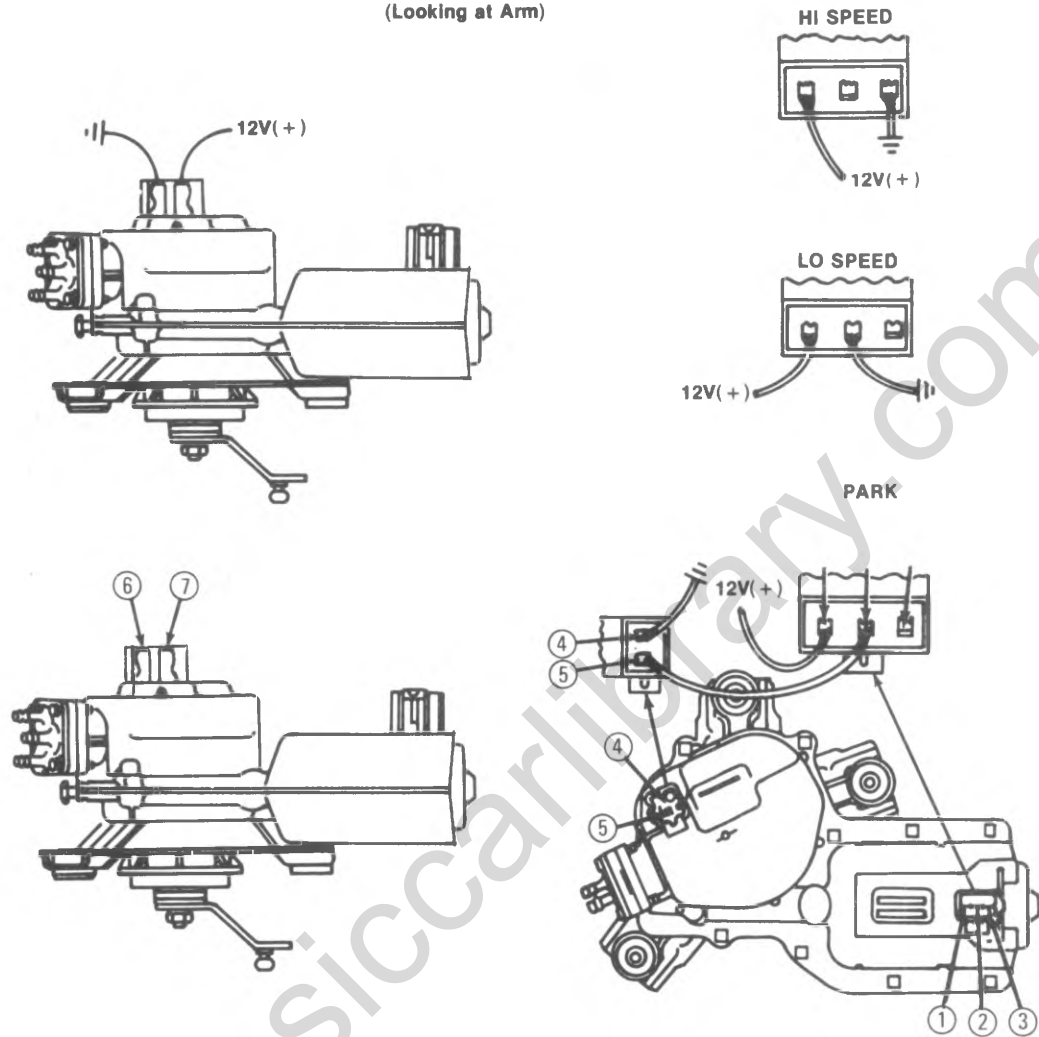


Fig. 8-11--Checking Motor Operation

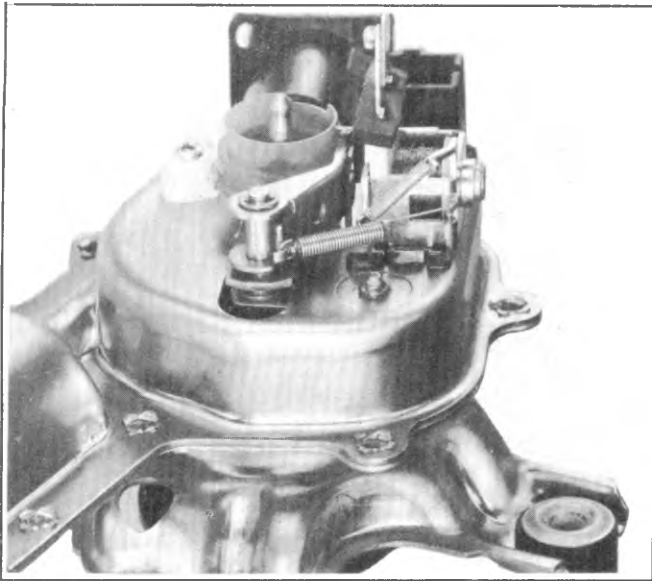


Fig. 8-12--Relay Coil Assembly

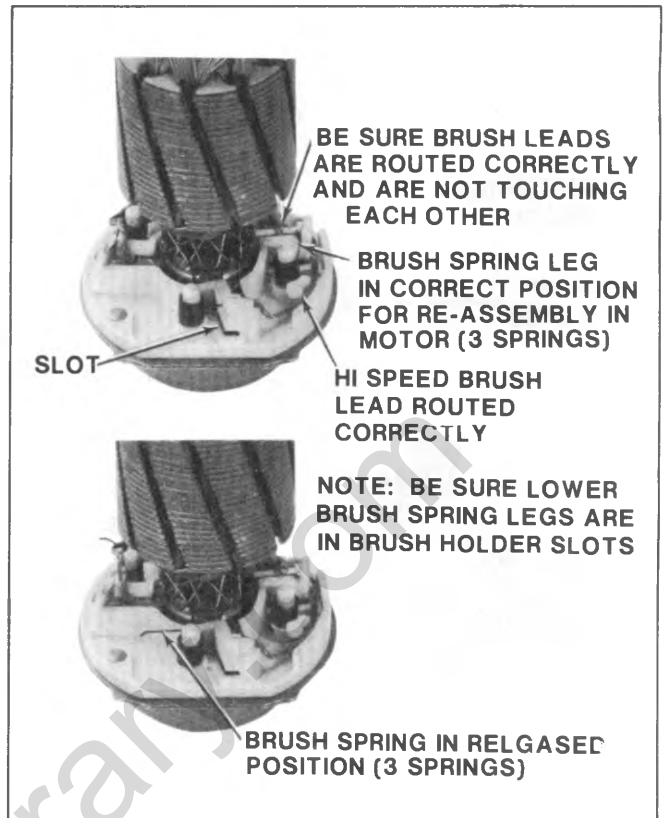


Fig. 8-14--Brush Spring--Brush Spring-Released Position

Valve Assembly: Refer to Figure 8-18.

1. Remove the four (4) attaching screws and remove valve assembly and gasket ring.
2. During re-assembly, be sure seal is properly installed in piston housing and valve assembly grooves.

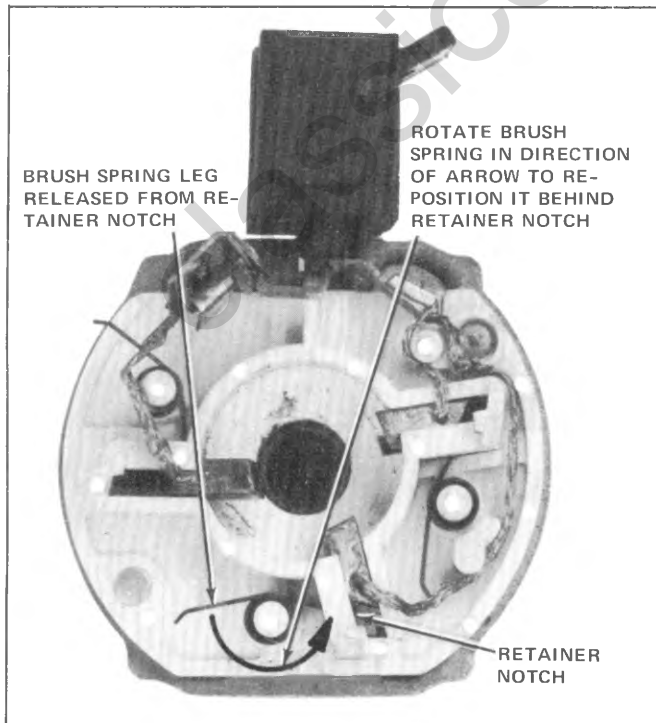


Fig. 8-13--Releasing Brush Spring Tension

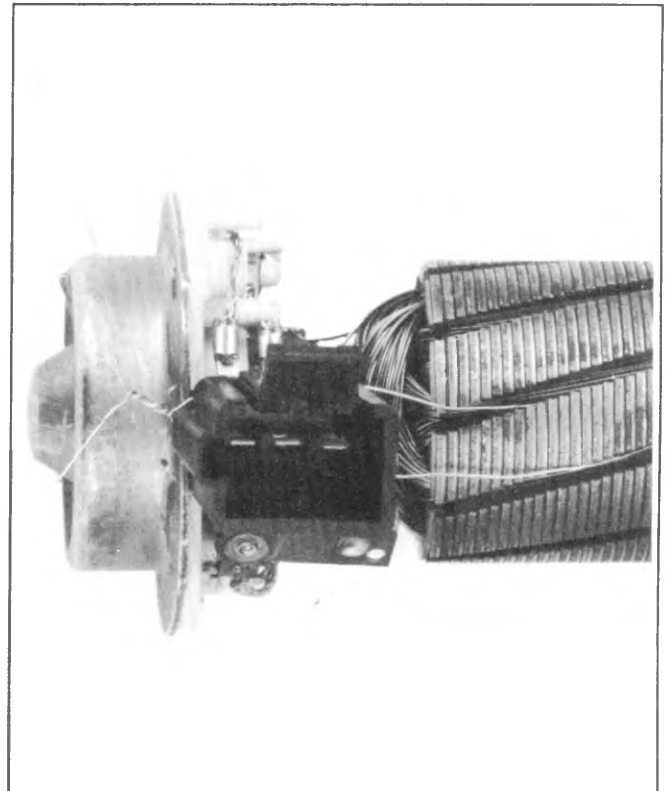


Fig. 8-15--End Cap Assembly

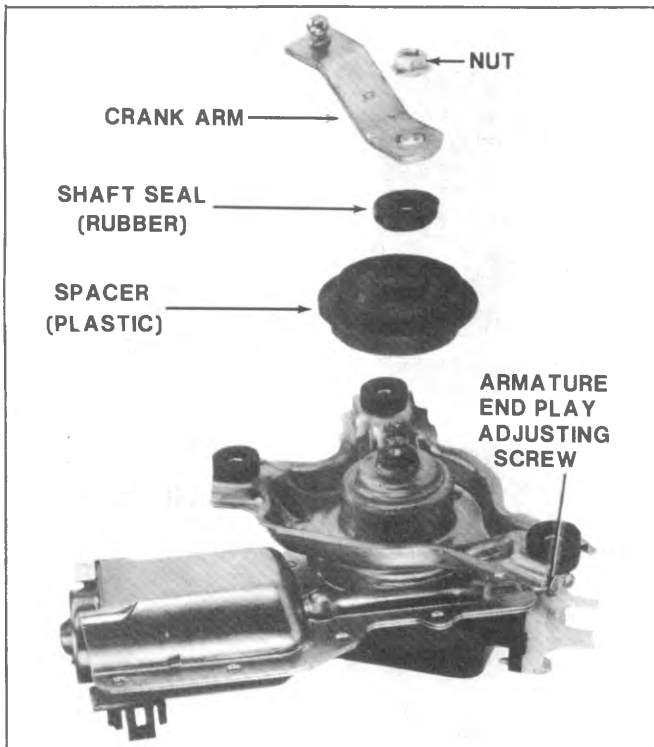


Fig. 8-16--Crank Arm Spacer Seal

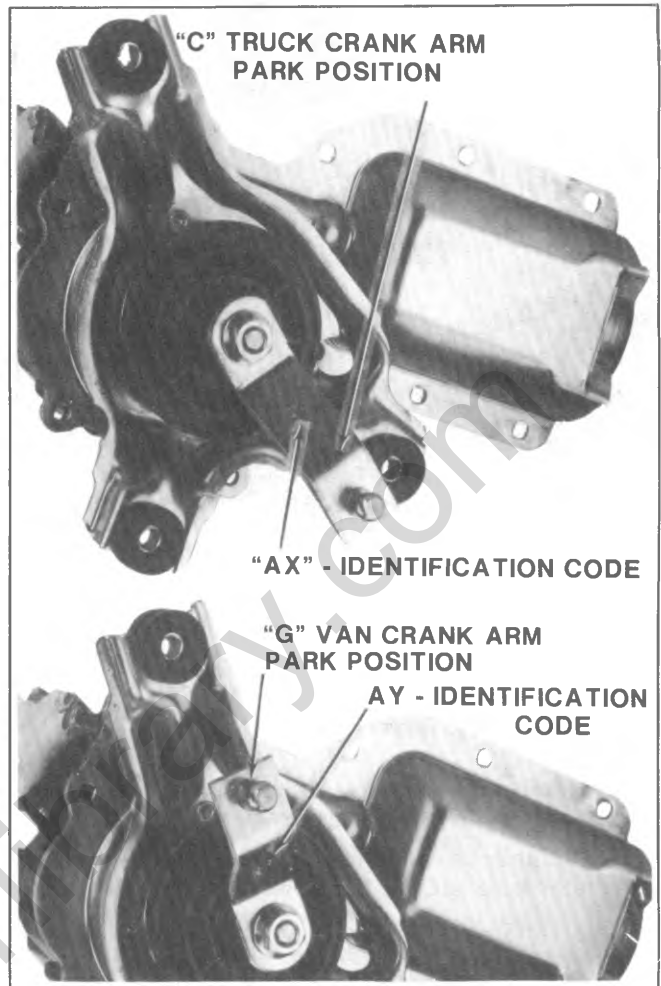


Fig. 8-17--Crank Arm Park Position

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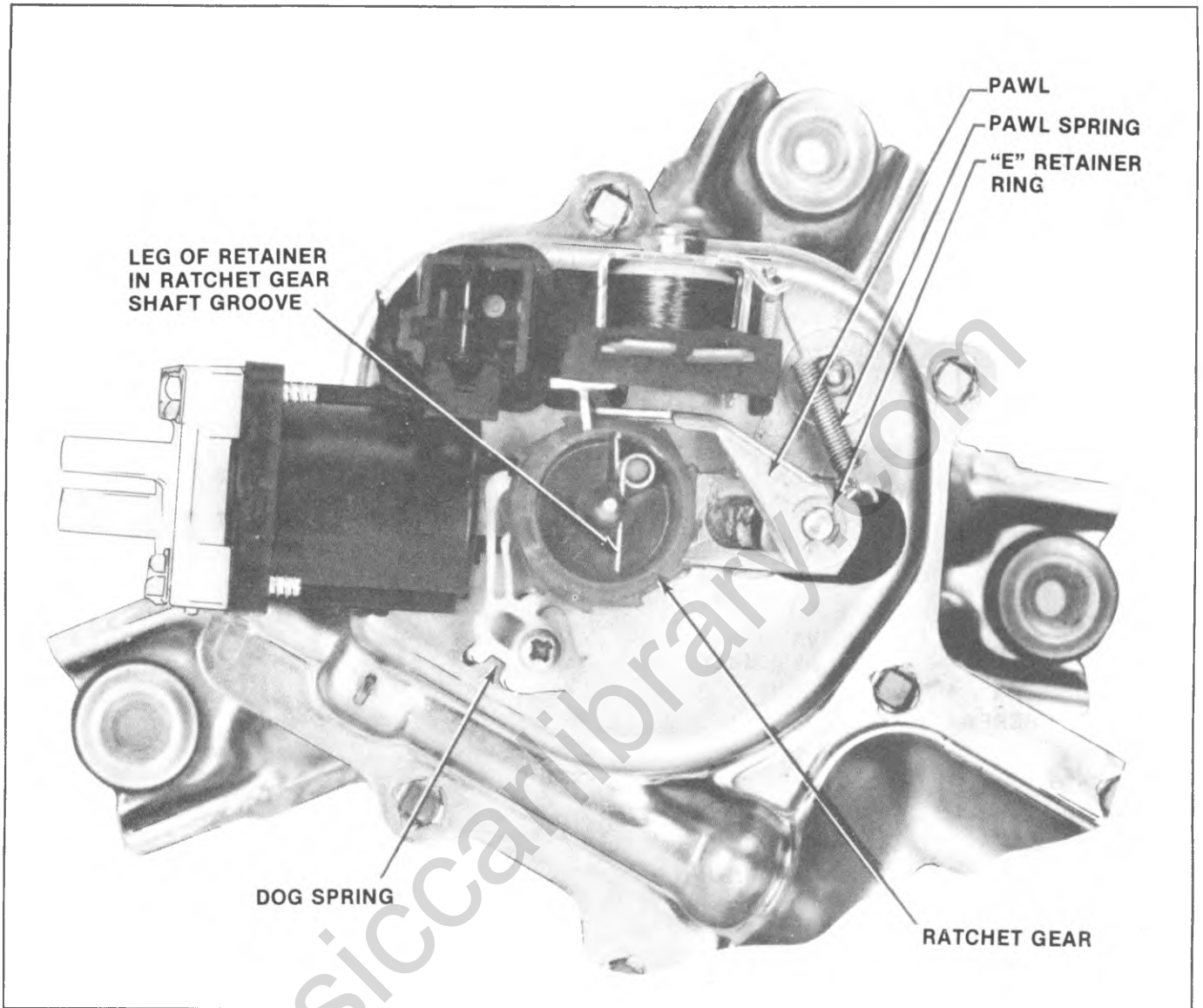


Fig. 8-18--Washer Pump Assembly

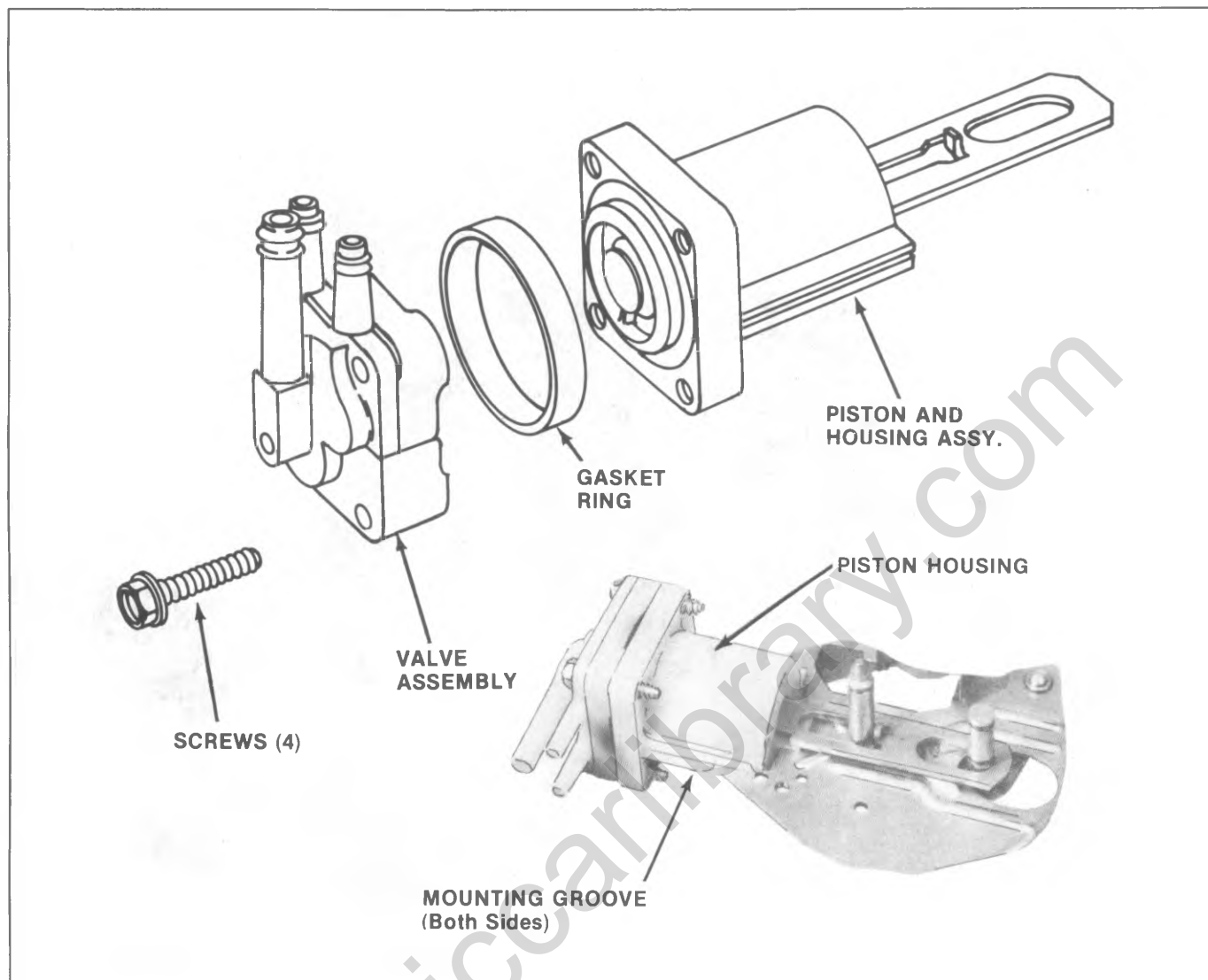


Fig. 8-19--Washer Pump Exploded View

WINDSHIELD WIPER AND WASHER P MODELS GENERAL DESCRIPTION

The system consists of a compound wound rectangular-shaped motor attached to a gear box containing a parking switch in addition to the gear train. The gear train consists of a motor armature helical gearshaft which drives an intermediate gear and pinion assembly. The pinion gear of the intermediate gear and pinion drives an output gear and shaft assembly.

Turning the wiper switch to the LO speed position completes the circuits from the wiper terminals 1 and 3 to ground. Current then flows from the battery via wiper terminal No. 2 through the series field and divides; (1) part passes through the armature to ground via wiper terminal No. 1 to the wiper switch and (2) the second part passes through the shunt field to ground through wiper terminal

No. 3 to the wiper switch (fig. 8-20).

NOTE: The wiper switch must be securely grounded to body metal.

Moving the wiper switch to the HI speed position opens the shunt field circuit to ground at the switch. However, the shunt field is connected to a 20 ohm resistor which is connected across wiper terminals 1 and 3. The shunt field current then flows via terminal No. 3 through the resistor to terminal No. 1 to the switch, to ground (fig. 8-21).

The parking circuit covers that portion of wiper operation when the wiper switch is turned "off" and the wiper blades have not reached the park position.

When the wiper blades are not in the normal park position, the parking switch contacts are still closed. The

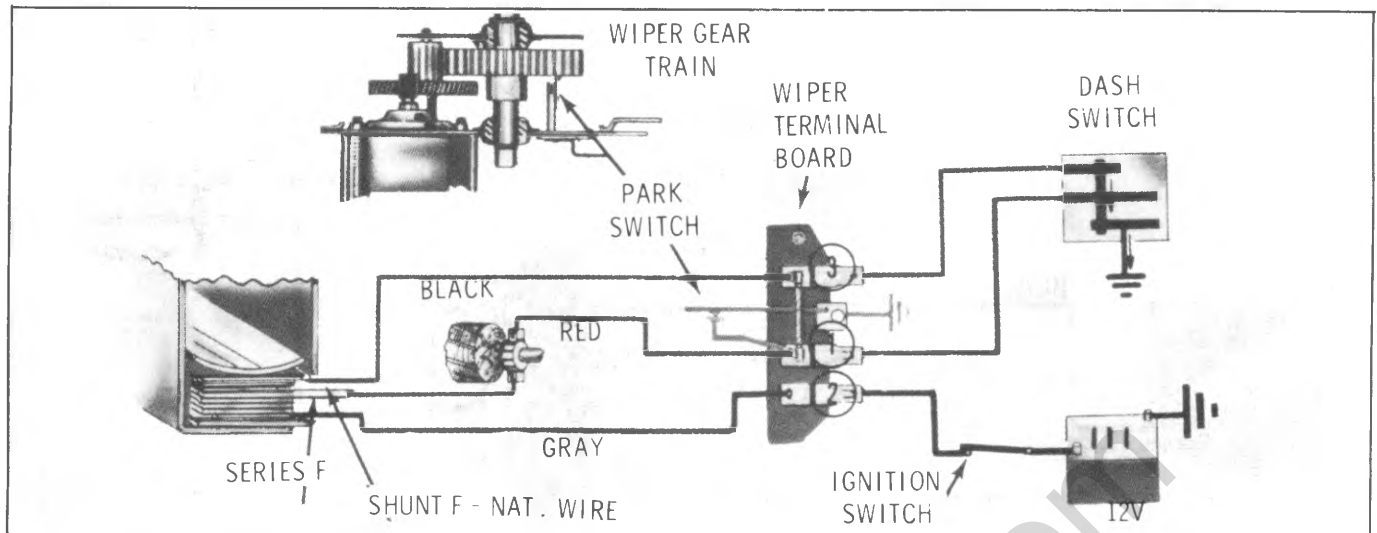


Fig. 8-20--LO Speed Circuit

wiper will continue to operate until the wiper output gear is turned to a position where its cam opens the park switch. Referring to Figure 8-22, it can be seen that the wiper motor circuits are completed to ground through the parking switch.

NOTE: The wiper motor must be securely grounded to body metal.

The shunt field circuit is completed from terminal No. 3 via the switch to terminal No. 1 through the parking switch to ground. The series field and armature circuit is

also completed from terminal No. 1 through the parking switch to ground.

NOTE: The shunt field is connected direct to ground, by-passing the resistor. This results in LO speed operation during the parking operation.

When the output gear cam opens the park switch contacts, the wiper is OFF.

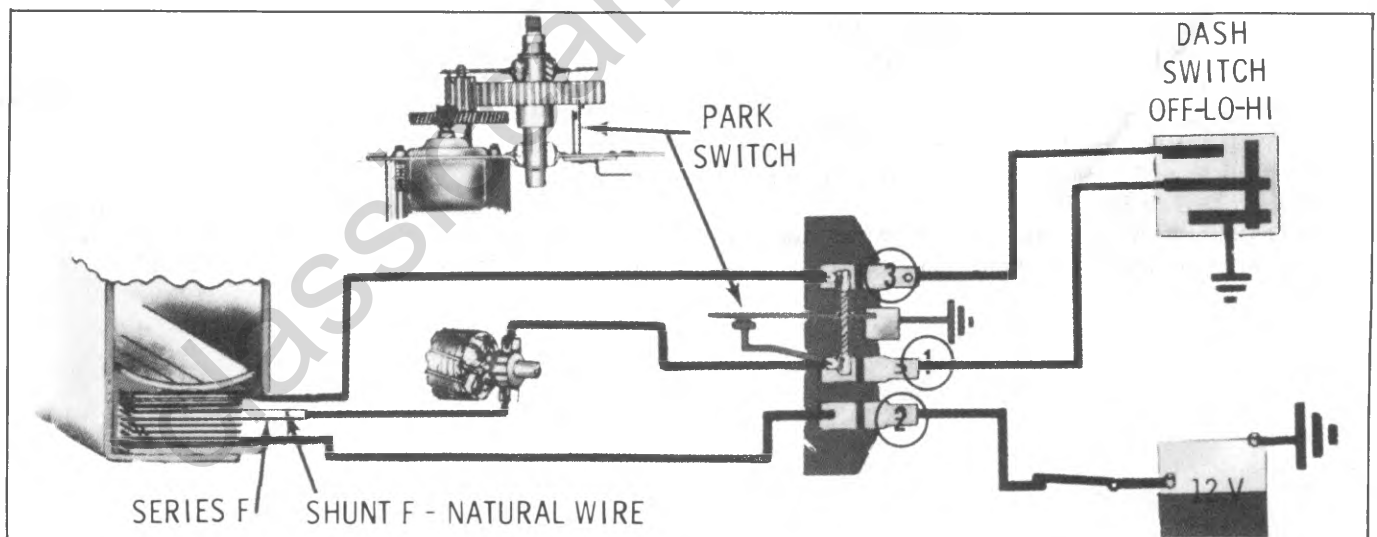


Fig. 8-21--HI Speed Circuit

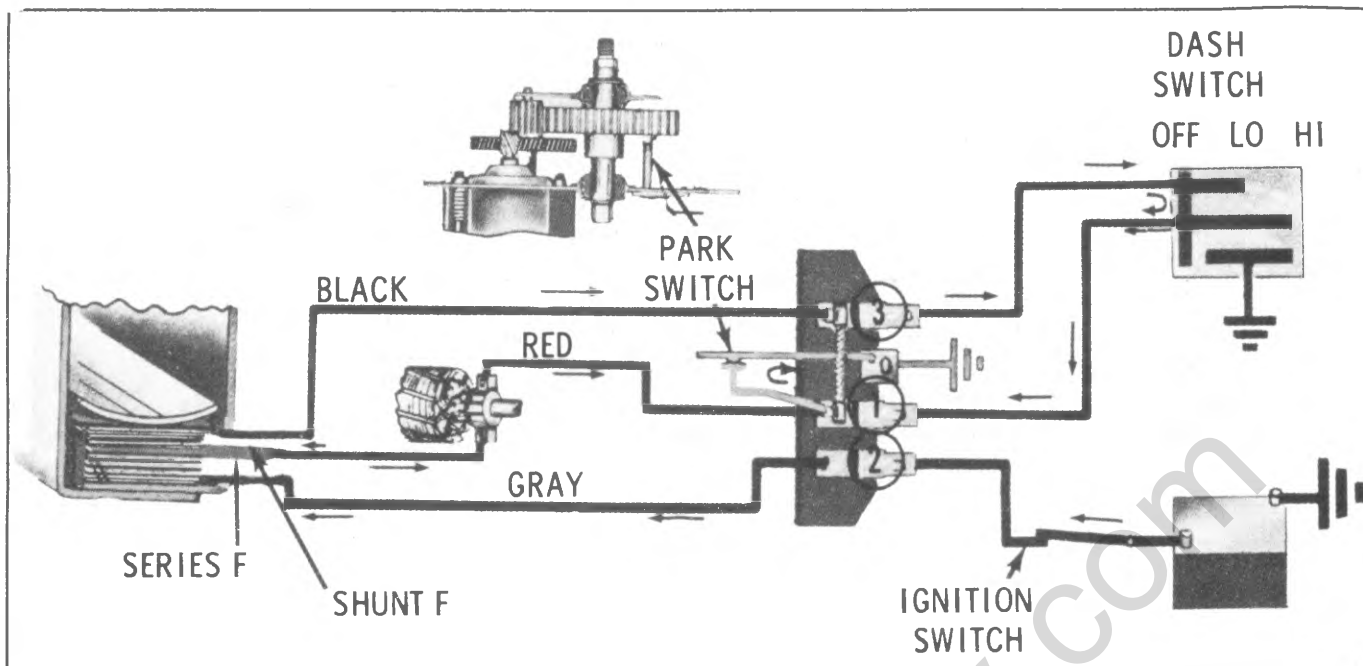


Fig. 8-22--PARKING Circuit

DIAGNOSIS

WIPER - ON VEHICLE

1. Inspect for the following items:

a. Wiring harness is securely connected to wiper and switch.

b. Wiper motor is securely grounded to body.

c. Wiper switch is securely mounted and grounded.

d. Check fuse.

2. If items in Step 1 check out, try operating wiper in both "LO" and "HI" speeds, then turn wiper off (blades should return to park position). If wiper fails to operate correctly, proceed to Step 3.

3. Disconnect wiring harness from wiper and try operating wiper as shown in Figure 8-23.

a. If wiper operates correctly independently of switch and vehicle wiring, refer to the DIAGNOSIS CHART - WIPER ON VEHICLE.

b. If wiper still fails to operate correctly in Step 3, disconnect wiper linkage from motor crankarm and try operating wiper again. If wiper operates correctly independently of linkage, check linkage for cause of wiper malfunction.

c. If wiper fails to operate correctly independently of linkage, remove wiper motor from vehicle and refer to DIAGNOSIS CHART-WIPER OFF VEHICLE.

DIAGNOSIS - WIPER ON VEHICLE

NOTE: Ignition switch must be "on" for all electrical tests.

CONDITION	APPARENT CAUSE	CORRECTION
1. Wiper Inoperative or intermittent	<p>A. Blown fuse</p> <p>B. Open circuit in feed wire (No. 2 terminal on wiper motor)</p> <p>C. Loose mounting of wiper switch</p> <p>D. Defective wiper switch</p> <p>E. Open circuit in wire to wiper switch (No. 1 terminal on wiper motor)</p>	<p>A. Locate short circuit and repair. Replace fuse.</p> <p>B. Locate broken wire and repair</p> <p>C. Tighten switch mounting</p> <p>D. Replace switch</p> <p>E. Locate broken wire and repair</p>
<p>2. Wiper will not shut off:</p> <p>A. Wiper has both "Lo" and "Hi" speeds</p> <p>B. Wiper has "Lo" speed only</p> <p>C. Wiper has "Hi" speed only</p>	<p>A. Grounded Wire (No. 1 terminal on wiper motor) to wiper switch</p> <p>A. Defective wiper switch</p> <p>B. Grounded wire (No. 3 terminal on wiper motor) to wiper switch</p> <p>A. Defective wiper switch</p> <p>B. Open circuit in wire (No. 3 terminal on wiper motor) to wiper switch</p>	<p>A. Locate short circuit and repair</p> <p>A. Replace wiper switch</p> <p>B. Locate and repair short circuit</p> <p>A. Replace wiper switch</p> <p>B. Locate and repair broken wire</p>
3. Wiper has "Hi" speed only	A. Open circuit in wire (No. 3 terminal on wiper motor) to wiper switch	A. Locate broken wire and repair
4. Wiper has "Lo" speed only	<p>A. Grounded wire (No. 3 terminal on wiper motor) to wiper switch</p> <p>B. Defective wiper switch</p>	<p>A. Locate short circuit and repair</p> <p>B. Replace wiper switch</p>
5. Blades do not return to full park position	A. Loose wiper ground strap connection	A. Tighten strap connection

DIAGNOSIS - WIPER OFF VEHICLE

CONDITION	APPARENT CAUSE	CORRECTION
1. Wiper Inoperative or Intermittent	A. Broken or damaged gear train (only if inoperative) B. Poor solder connections at terminal board C. Loose splice joints at brush plate D. Brushes binding in brush holder E. Open circuit in armature	A. Replace gears as required B. Resolder wires at terminals C. Recrimp or solder splice joints D. Clean holder or replace brush, spring or brush plate assembly. E. Replace armature
2. Wiper will not shut-off: A. Wiper has normal "Hi" and "Lo" speed B. Wiper has "Lo" speed only C. Wiper has "Hi" speed only	A. Defective park switch B. Grounded red lead wire A. Grounded shunt field coil B. Grounded black wire A. Open circuit in shunt field coil B. Open circuit in black wire	A. Replace terminal board assembly B. Repair short circuit in red wire A. Replace frame and field assembly B. Repair short circuit in black wire A. Replace frame and field assembly B. Repair broken wire or poor solder connection
3. Wiper shuts off - but not in park position	A. Park switch defective or contacts dirty	A. Replace terminal board assembly or clean contacts
4. "Hi" speed too fast	A. Resistor defective	A. Replace terminal board assembly

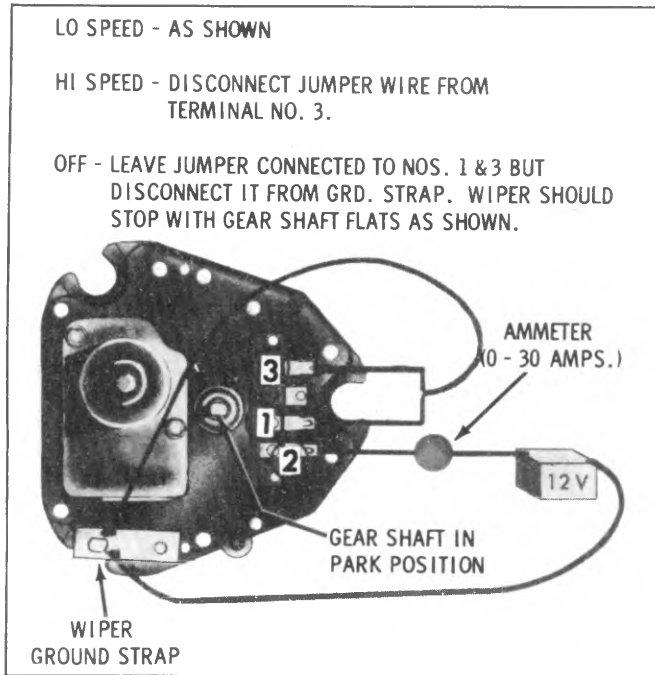


Fig. 8-23--Jumper Wire Connections

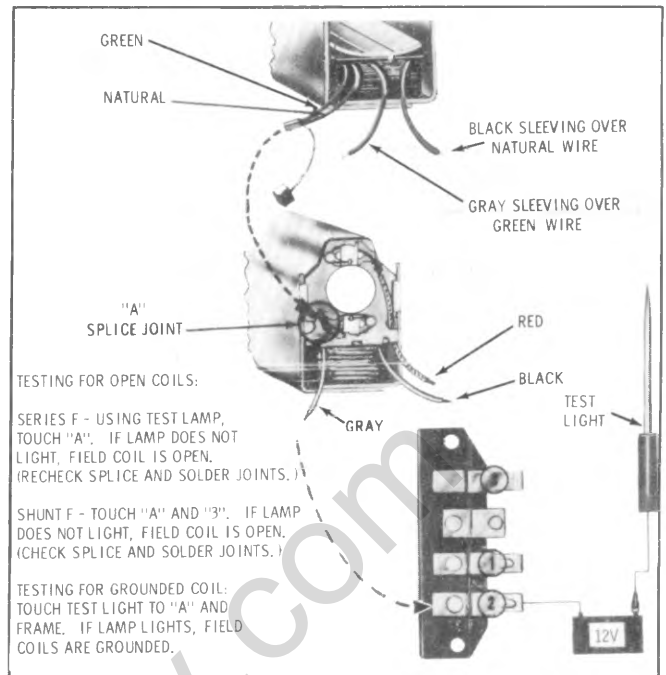


Fig. 8-25--Testing Field Coils

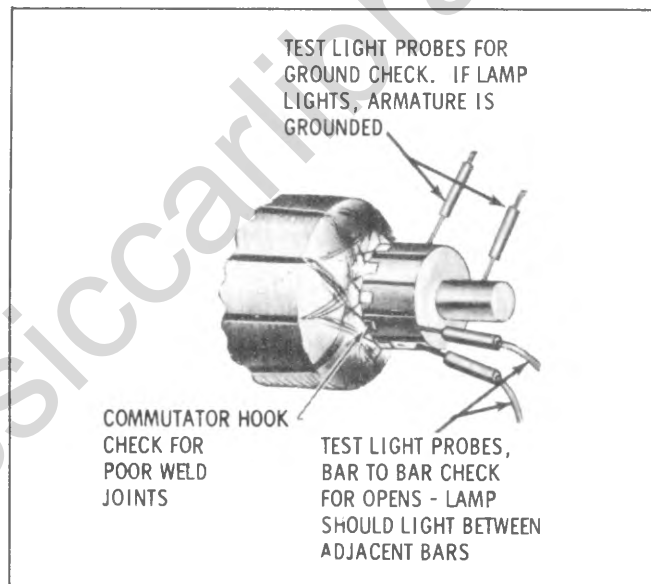


Fig. 8-24--Checking Armature

DIAGNOSIS - WASHER SYSTEM

CONDITION	APPARENT CAUSE	CORRECTION
1. Washers inoperative	<p>A. Inadequate quantity of washer solution</p> <p>B. Hoses damaged or loose</p> <p>C. Plugged screen at end of jar cover hose</p> <p>D. Loose electrical connection to washer pump or wiper switch</p> <p>E. Open circuit in feed wire to ratchet relay coil</p> <p>F. Wiper switch defective</p> <p>G. Ratchet relay coil defective</p> <p>H. Washer nozzles plugged</p> <p>I. Ratchet wheel tooth missing</p> <p>J. Ratchet pawl spring missing</p> <p>K. Defective pump valve assembly</p>	<p>A. Add washer solution</p> <p>B. Cut short length off end of hose to insure air tight connection or replace hose</p> <p>C. Clean screen</p> <p>D. Check electrical connections and repair if necessary</p> <p>E. Locate open circuit and repair</p> <p>F. Replace wiper switch</p> <p>G. Replace ratchet relay</p> <p>H. Clean washer nozzles</p> <p>I. Replace ratchet wheel</p> <p>J. Replace ratchet pawl spring</p> <p>K. Replace pump valve assembly</p>
2. Washer pumps continuously when wipers are operating	<p>A. Grounded wire from ratchet relay to switch</p> <p>B. Wiper switch defective</p> <p>C. Ratchet wheel tooth missing</p> <p>D. Ratchet wheel dog broken or not contacting ratchet wheel teeth</p> <p>E. Lock-out tang broken or bent on piston actuating plate</p>	<p>A. Locate grounded wire and repair</p> <p>B. Replace wiper switch</p> <p>C. Replace ratchet wheel</p> <p>D. Replace or repair ratchet wheel dog</p> <p>E. Replace piston actuating plate</p>

ON-VEHICLE SERVICE

WIPER MOTOR

Wiper motor replacement procedures are not included here since installation is performed by the individual body manufacturers; however, disassembly of the unit will be covered.

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UNIT REPAIR

WIPER MOTOR

Disassembly (Fig. 8-26)

Gear Box

1. Remove the two washer pump mounting screws and lift pump off washer.

2. Remove washer pump drive cam as required (figs. 8-29 and 8-30). The cam is pressed on the shaft but can be wedged off by using two screwdrivers between cam and plate.

3. Clamp crank arm in a vise and remove crank arm retaining nut.

CAUTION: Failure to clamp crank arm may result in stripping of wiper gears.

4. Remove crank arm, seal cap, retaining ring, and end-play washers.

NOTE: Seal cap should be cleaned and repacked with a waterproof grease before reassembly.

5. Drill out gear box cover retaining rivets, remove cover from gear train.

NOTE: Screws, nuts and lockwashers for reassembling cover to wiper are contained in the service repair package.

6. Remove output gear and shaft assembly, then slide intermediate gear and pinion assembly off shaft.

7. If necessary, remove terminal board and park switch assembly as follows:

a. Unsolder motor leads from terminals. Code motor leads.

b. Drill out rivets securing terminal board and park switch ground strap to mounting plate.

NOTE: Screws, nuts and washers for attaching a replacement terminal board park switch assembly are included with the replacement assembly.

Motor

1. Follow Steps 1 through 7b under gear box disassembly.

2. Remove motor through bolts, tap motor frame lightly, and remove motor from mounting plate.

3. Remove brush spring tension (fig. 8-26), slide armature and end plate from motor frame. Pull end plate from armature.

NOTE: Thrust plug located between armature shaft and end plate.

4. Remove end play adjusting washers from armature, noting arrangement for proper reinstallation.

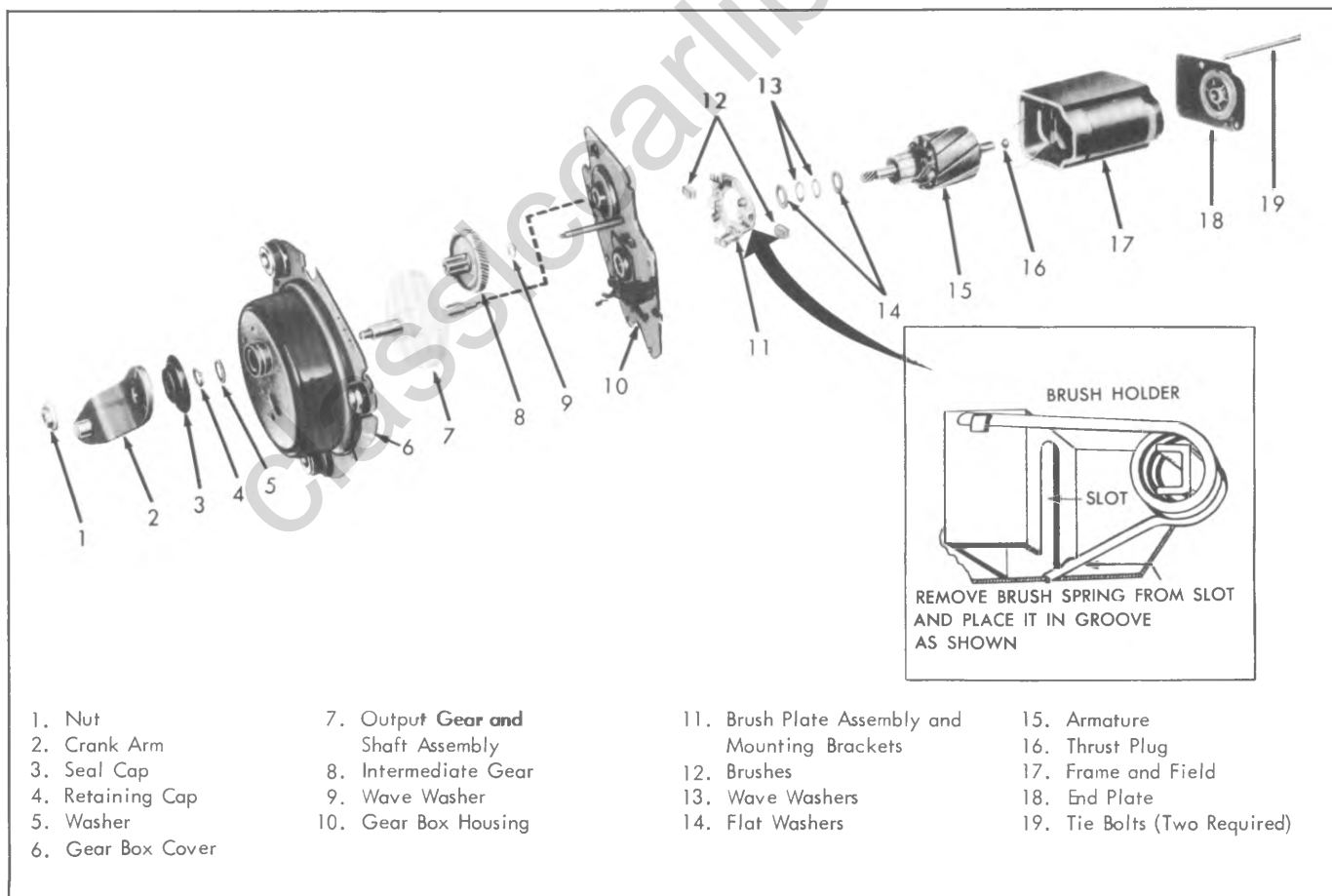


Fig. 8-26--Wiper Motor and Gear Box Assembly

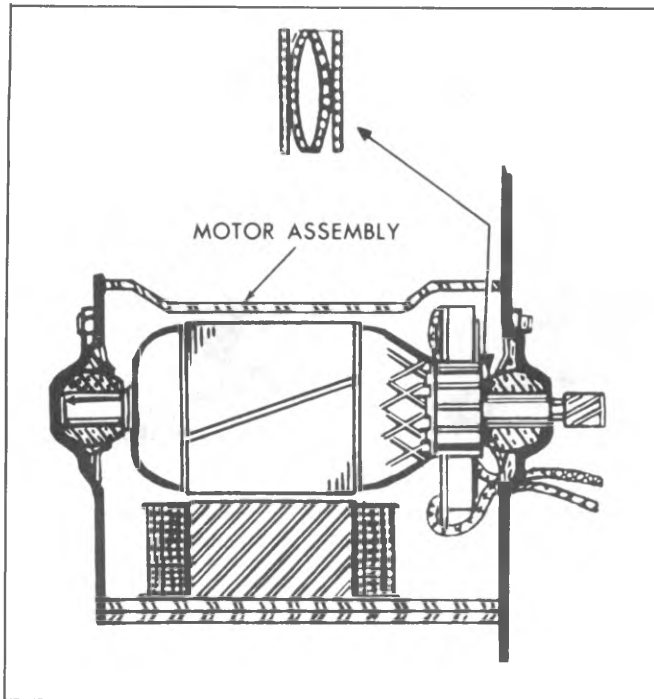


Fig. 8-27--End Play Wave Washer Installation

Inspection

Check and inspect all parts for wear; replace as necessary. All parts can be replaced individually except motor frame and field, which is serviced as an assembly. Service kits also provide screws, nuts and washers to replace gear cover and terminal board rivets.

Assembly

Refer to Figure 8-26 for exploded view of motor and gear train.

Motor

Reassemble motor using reverse of disassembly procedure.

NOTE: Armature end play is controlled by end play washers. See Figure 8-27 for proper assembly of end play washers. Lubricate armature shaft bushings with light machine oil.

Gear Box

1. Assemble gear box using reverse of disassembly procedure.

NOTE: Lubricate gear teeth with Delco Cam and Ball Bearing lubricant (or equivalent). Be sure cover is properly located over dowel pins and be sure to reinstall ground strap.

2. Place wiper in park position and install crank arm on output shaft, rotate crank so alignment marks line up with those on cover (fig. 8-28).

3. Replace retaining nut, place crank arm in vise, tighten retaining nut.

WINDSHIELD WASHER

The positive displacement washer pump used on the two-speed non-depressed park wipers (fig. 8-29) use a pump mechanism consisting of a piston, piston spring and valve arrangement driven by a (4) lobe cam, and follower assembly (fig. 8-31). The cam is attached to one shaft of the

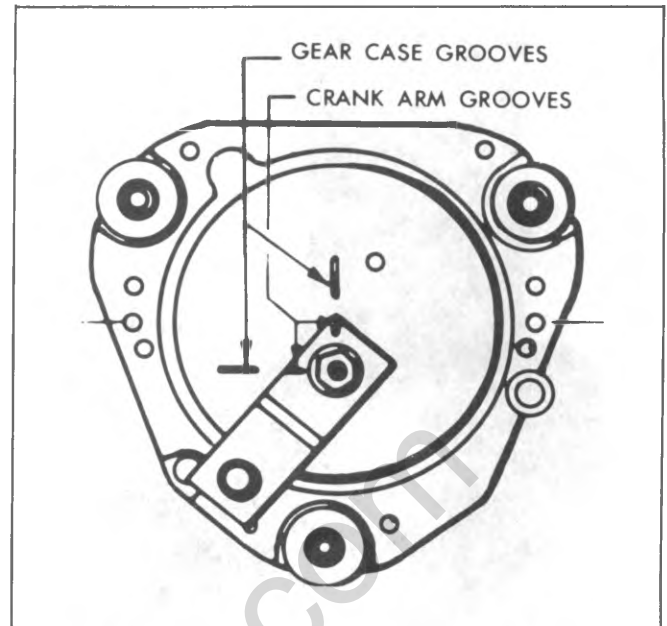


Fig. 8-28--Wiper Motor Crank Arm in Park Position

wiper motor output gear (fig. 8-30). Programming is accomplished electrically and mechanically by a relay assembly and ratchet wheel arrangement.

Replacement

1. Disconnect battery ground cable.
2. Remove two pump mounting bolts.
3. Remove washer pump assembly.
4. To install reverse Steps 1-3 above.

CAUTION: Install washer multiplug harness connector with battery lead on terminal with no tang (fig. 8-29). Incorrect installation of connector will result in direct ground and destroy wiper

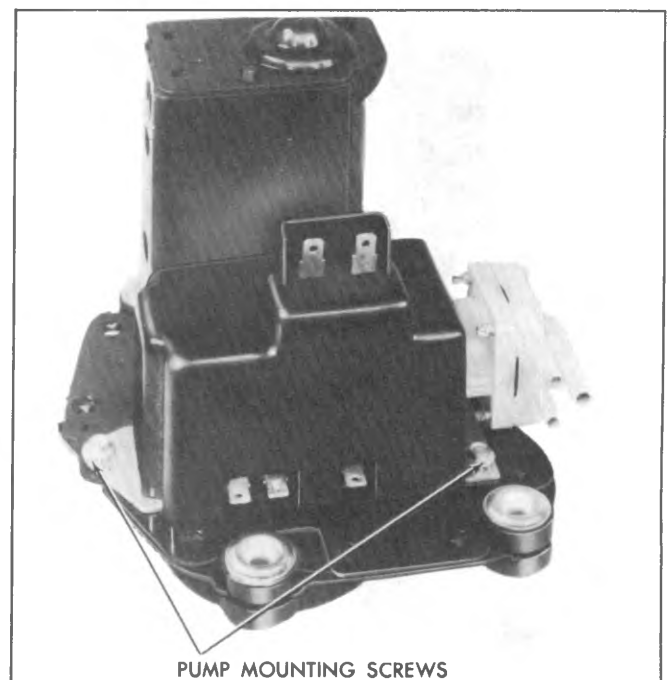


Fig. 8-29--Washer Pump Attaching Screws

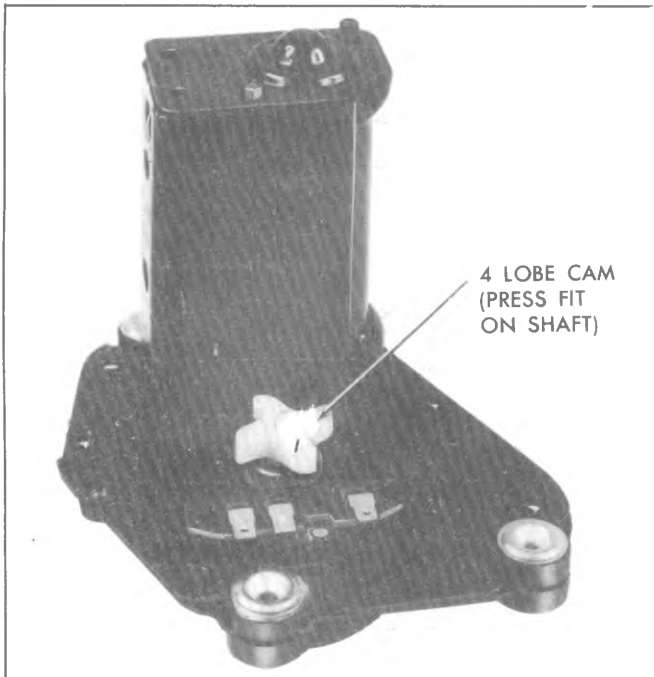


Fig. 8-30--Washer Pump Drive Cam

motor fuse.

Disassembly-Assembly (Figures 8-32-8-35)

1. Remove washer pump cover by squeezing.
2. Solenoid assembly - ratchet dog.
 - a. Remove ratchet dog retaining screw. Hold spring loaded solenoid plunger in position and carefully lift solenoid assembly and ratchet dog off frame of pump.
 - b. Separate ratchet dog from solenoid mounting plate as required.
3. Ratchet pawl.



Fig. 8-31--Washer Pump Drive Cam and Actuator

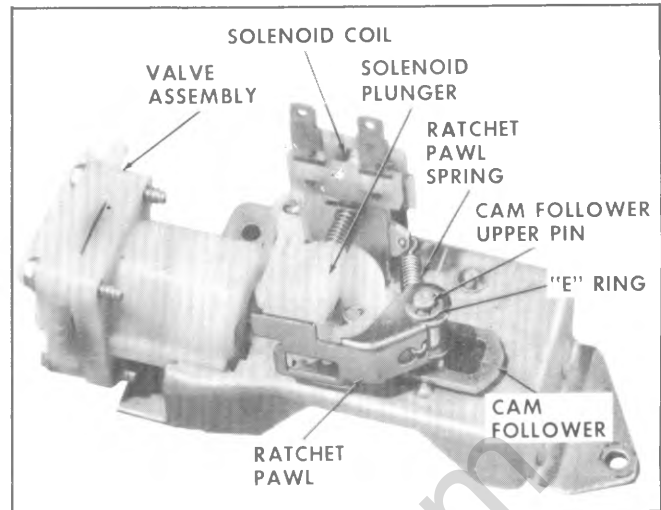


Fig. 8-32--Washer Pump Mechanism

- a. Disconnect ratchet pawl spring.
- b. Remove ratchet pawl retaining ring and slide ratchet pawl off cam follower shaft.
4. Ratchet wheel.
 - a. Follow Step 1 under solenoid - ratchet dog disassembly.
 - b. Move ratchet wheel spring out of shaft groove and slide ratchet wheel off its shaft.
5. Pump and actuator plate assembly.
 - a. Remove solenoid assembly - ratchet pawl and ratchet wheel as outlined in their respective procedures.
 - b. To separate pump and pump actuator plate from frame, pull pump housing in direction of the arrow until grooves in housing clear the frame. Then remove actuator plate from ratchet wheel and cam follower shafts.
6. Valve assembly.

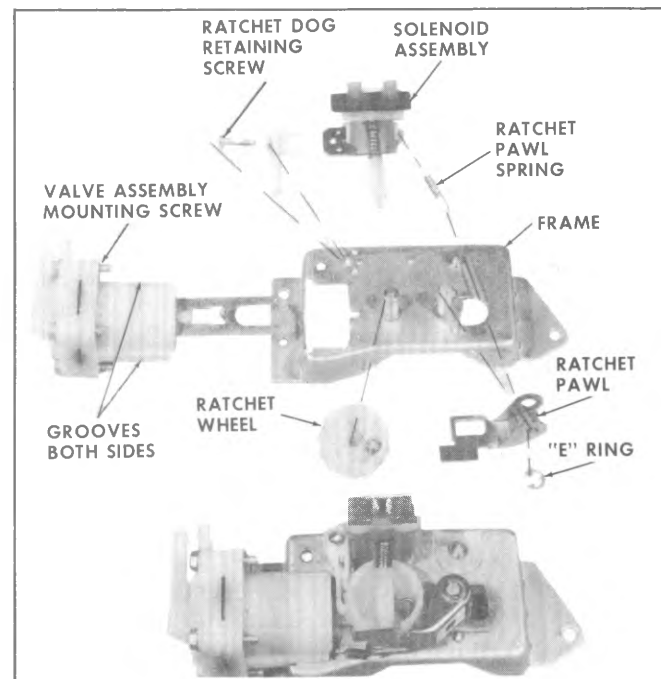


Fig. 8-33--Washer Pump-Exploded View

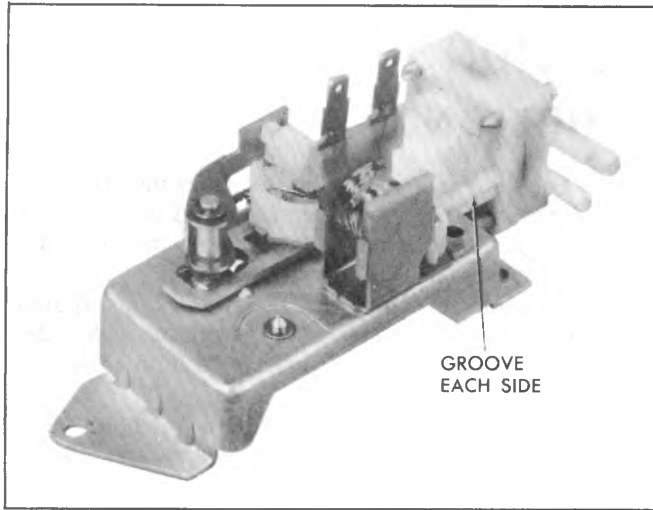


Fig. 8-34--Releasing Pump From Lockout Position

a. Remove four screws that attach the valve assembly to pump housing.

CAUTION: During assembly, be sure gasket between housing and valve plate is properly positioned in housing and valve plate grooves. Also be sure triple "O" ring is properly installed between valve body and pipe assembly.

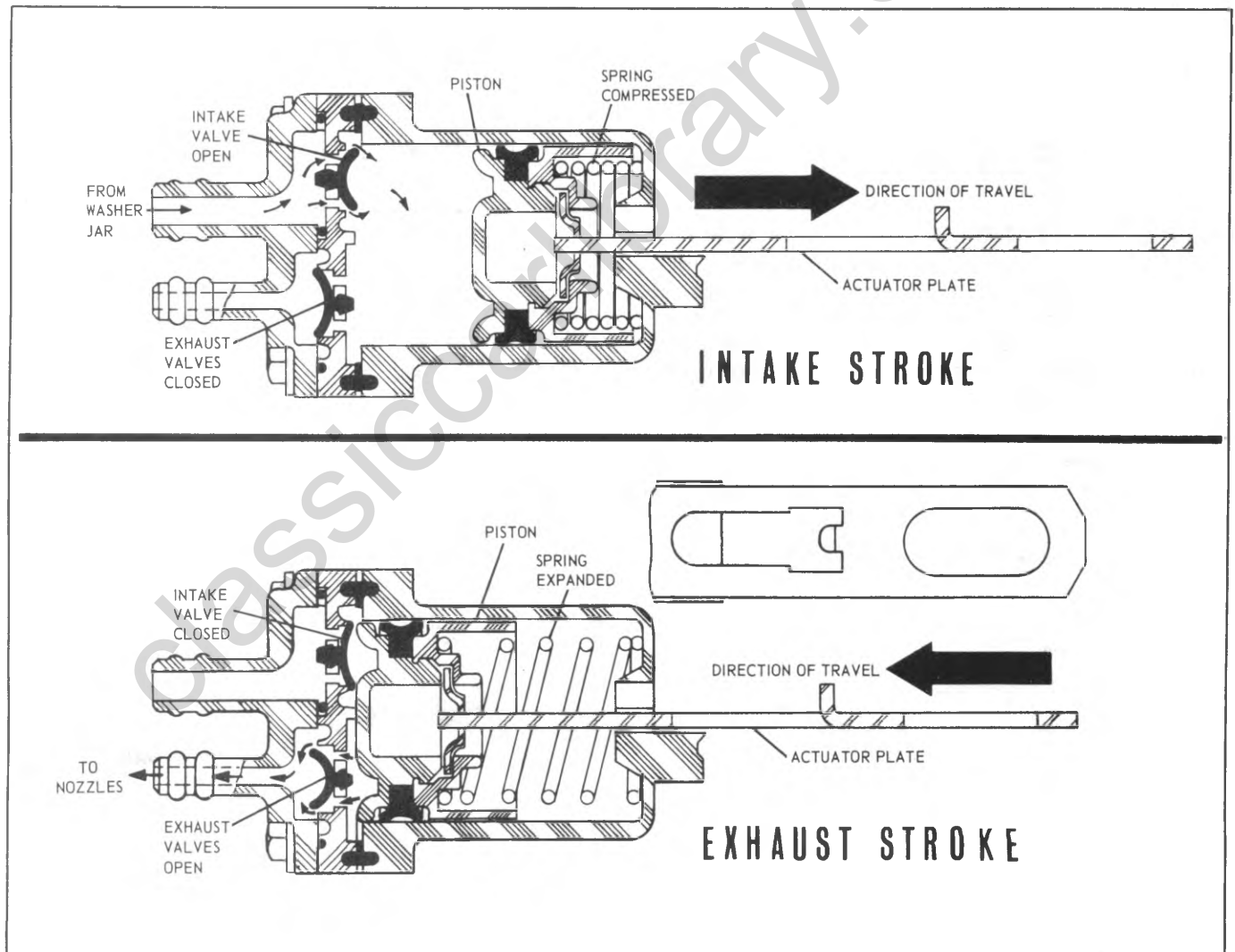


Fig. 8-35--Cross Section of Windshield Washer Pump Valve

CIRCUIT PROTECTION

GENERAL DESCRIPTION

All electrical circuits are protected against excessive loads which might occur due to shorts or overloads in the wiring system. Such protection is provided by either a circuit breaker, fuse or fusible link. Each of these protective devices are explained below.

CIRCUIT BREAKER (Fig. 8-36)

A circuit breaker is a protective device designed to open the circuit when a current load is in excess of rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excess current will open the circuit breaker and cause it to cycle if it automatically resets, thus, indicating there is something wrong in the system. The circuit breaker will continue to cycle until the trouble is found and corrected. Excessive cycling of the breaker will eventually damage the breaker contacts to the point that replacement of the breaker is necessary.

FUSE (Fig. 8-36)

A common method of protection is to use a fuse in the circuit. Whenever there is an excessive current through the circuit, the fusible element will melt and open the circuit. The disadvantage of using a fuse instead of a circuit breaker is the fuse in a one-time protection and replacement is required.

FUSIBLE LINK (FIG. 8-37)

In addition to circuit breakers and fuses, the wiring harness incorporates fusible links to protect the wiring. Links are used rather than a fuse in wiring circuits that are not normally fused, such as the ignition circuit. Chevrolet wiring fusible links are color coded red in the charging and load circuits to match color coding of the circuit they

protect. Each link is four gage sizes smaller than the cable it is designed to protect and are marked on the insulation with wire gage size because the heavy insulation makes the link appear a heavier gage than it actually is.

Engine compartment wiring harnesses incorporate several fusible links. The same size wire with special hypalon insulation must be used when replacing a fusible link.

The links are:

1. A molded splice at the starter solenoid "Bat" terminal, 14 gage red wire. Servicing requires splicing in a new link.

2. A 16 gage red fusible link is located at junction block to protect all unfused wiring of 12 gage or larger. The link is molded into the bulkhead connector.

3. The generator warning light and field circuitry (16 gage wire) is protected by a fusible link (20 gage red wire) used in the "battery feed to voltage regulator #3 terminal". The link is installed as a molded splice in the circuit at the junction block. Service by splicing in a new 20 gage wire.

DIAGNOSIS

Failures in a circuit are usually caused by short or open circuits. Open circuits are usually caused by breaks in the wiring, faulty connections or mechanical failure in a component such as a switch or circuit breaker. Short circuits are usually caused by wires from different components of the circuit contacting one another or by a wire or component grounding to the metal of the body due to a screw driven through the wires, insulation cut through by a sharp metal edge, etc.

The following information may aid in locating and correcting a failure in the body wiring electrical system.

1. If a major portion of the electrical circuit becomes inoperative simultaneously, the failure may be due to improper connections between the front and rear harness, or between the front harness and the chassis wiring connector on top of fuse block.

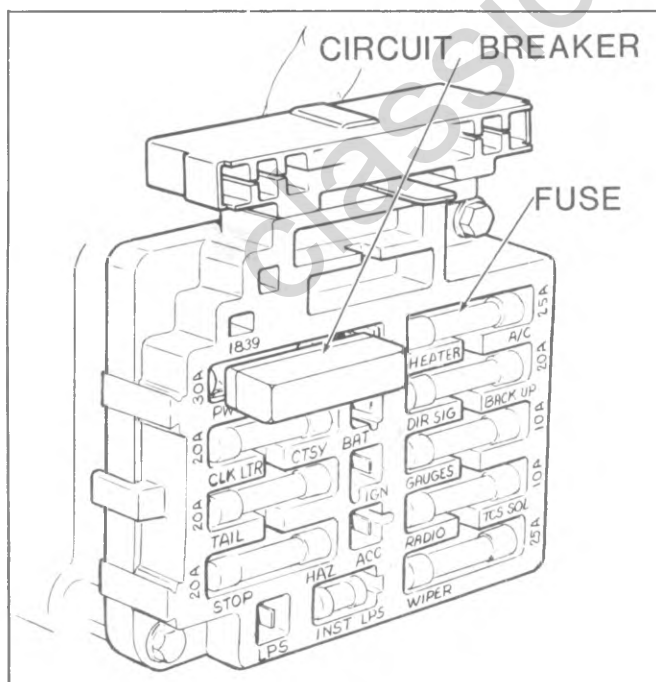


Fig. 8-36--Fuse and Circuit Breaker

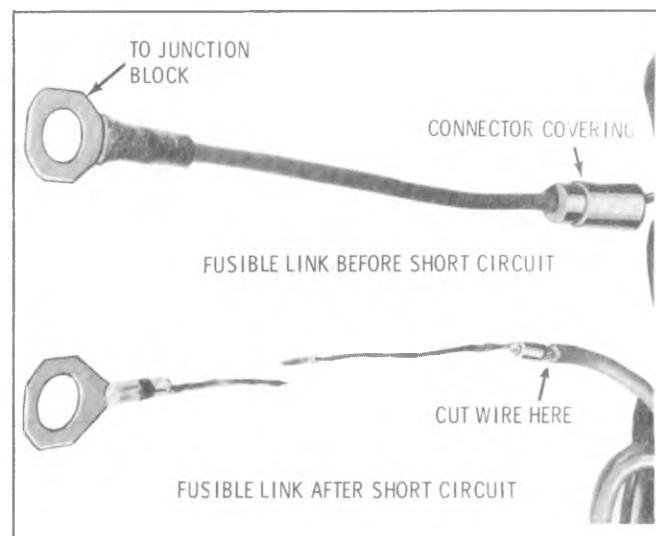


Fig. 8-37--Fusible Link

2. If only one of the circuits is inoperative, the failure is due to an open circuit or short in the affected circuit. Short circuits usually result in blown fuses or in the case of power equipment circuits, in the circuit breaker opening the circuit. If the fuse is not blown and the circuit affected is a lamp circuit, check the bulb before proceeding with any checking procedures.

3. The dome lamp and courtesy lamp circuits are

ON-VEHICLE SERVICE

COMPONENT PART REPLACEMENT

Fusible Link Replacement (Fig. 8-38)

A new fusible link can be installed, after the short circuit is located and repaired, as follows:

1. Disconnect battery ground cable.
2. Disconnect fusible link from junction block or starter solenoid.
3. Cut harness directly behind connector to remove damaged fusible link (fig. 8-37).
4. Strip harness wire approximately 1/2".
5. Position clip around new fusible link and harness wire, crimp so that all wires are securely fastened.
6. Solder connection using rosin core solder. Use sufficient heat to obtain a good solder joint.
7. Tape all exposed wires with plastic electrical tape to prevent corrosion and shorting.
8. Connect fusible link to junction block or starter solenoid.
9. Connect battery ground cable.

HEADLAMPS WARNING BUZZER

Replacement (Fig. 8-39)

1. Disconnect electrical connector from LPS (Lamps) socket of fuse panel.
2. Disconnect electrical connector from IGN (Ignition) socket of fuse panel.
3. Disconnect electrical connector to instrument panel harness.
4. Remove strap securing buzzer to instrument panel

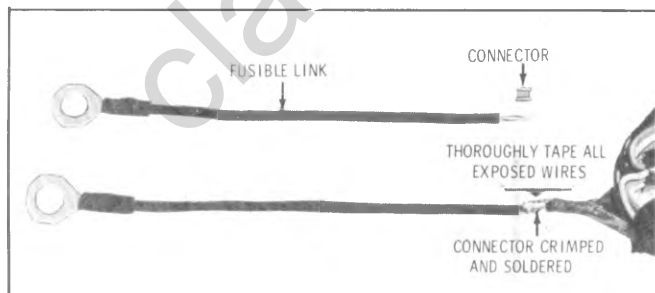


Fig. 8-38--Fusible Link Replacement

designed so that the switches are in the "ground" side of the circuit. If a condition is encountered where the lamps remain "on" even though the jamb or courtesy lamp switches are not actuated, the failure is probably due to defective switches, or to the wire leading to the switches being grounded to the metal body.

harness.

5. Install replacement headlamp warning buzzer in reverse sequence of removal.

SEAT BELT WARNING SYSTEM

All C-K type light duty trucks have a non-sequential timer controlled seat belt warning system. This system has an instrument panel warning light that will illuminate every time the ignition switch is turned on, whether or not the driver's seat belt is buckled, but will automatically go off after 4-8 seconds. The buzzer is also controlled by the 4-8 second timer, but will operate only if the driver has not buckled-up prior to turning on the ignition. If no attempt is made to buckle-up after turning on the ignition, the buzzer will also shut-off automatically after 4-8 seconds.

A trouble shooting diagnostic chart and wiring schematic are shown in Figures 8-40 and 8-41.

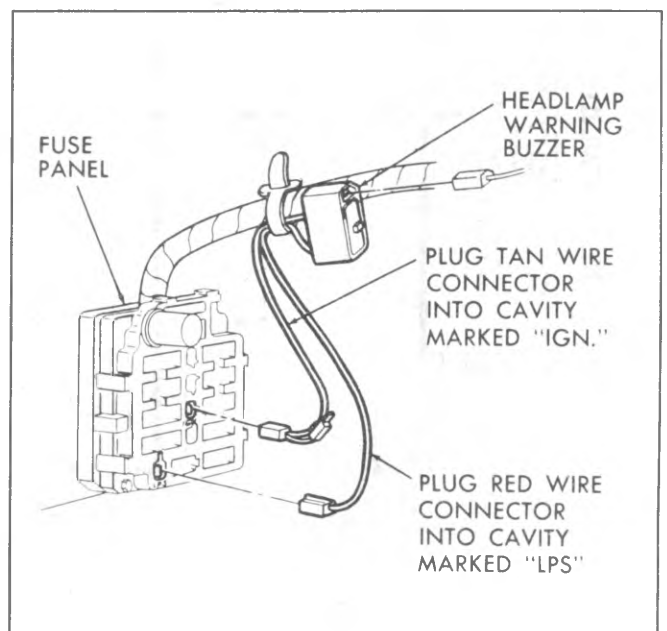


Fig. 8-39--Headlamp Warning Buzzer

SEAT BELT REMINDER LIGHT/BUZZER DIAGNOSIS

NOTE: WHEN DIAGNOSING A WARNING SYSTEM FAILURE AND THE SYSTEM AUTOMATICALLY SHUTS OFF BECAUSE OF THE 4-8 SECOND TIMER, A MINIMUM OF 3 MINUTES MUST BE ALLOWED BETWEEN THE DIAGNOSTIC STEPS TO ALLOW THE TIMER TO RESET (KEY IN OFF POSITION DURING THIS PERIOD).

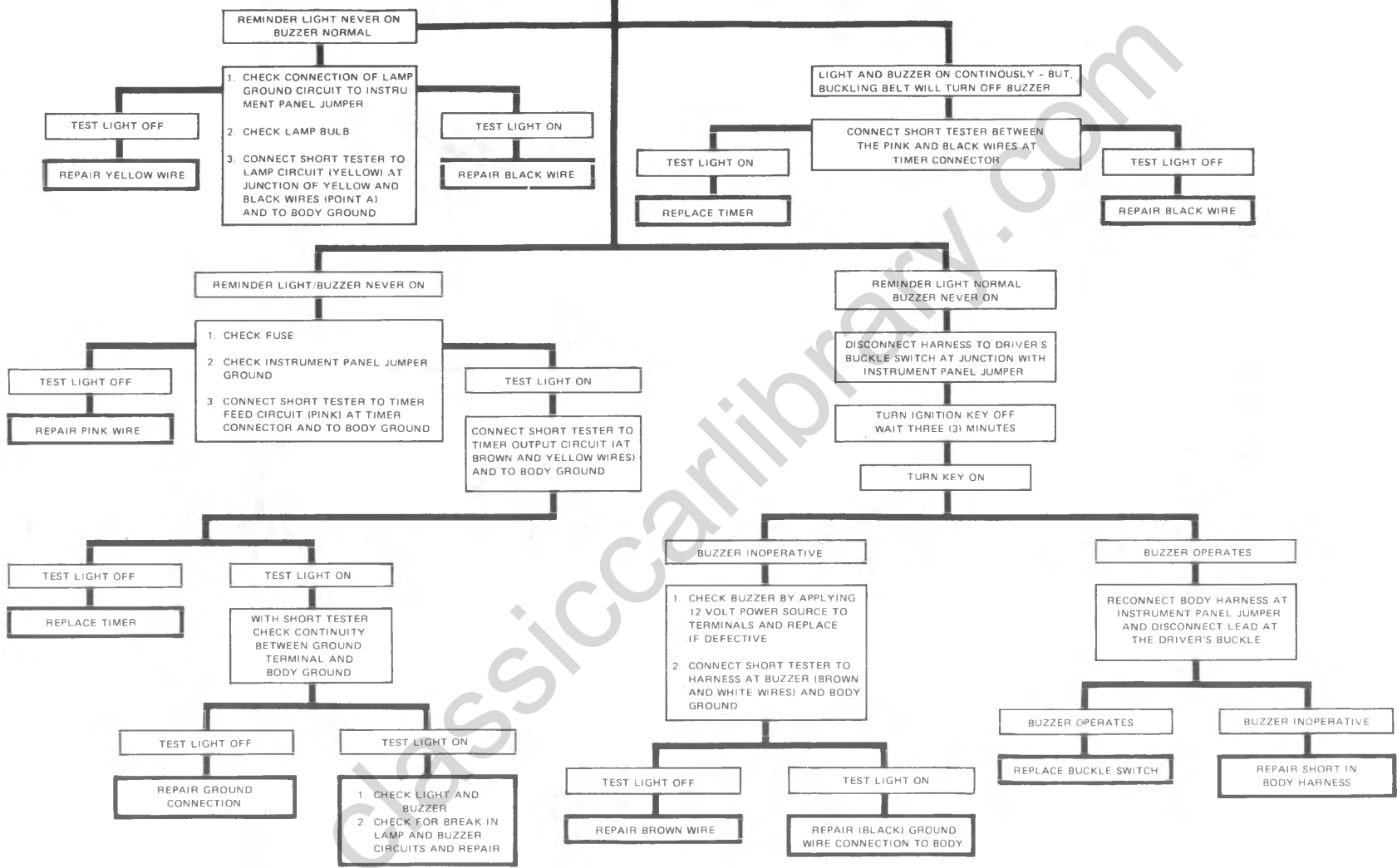


Fig. 8-40-Seat Belt Reminder System Diagnosis

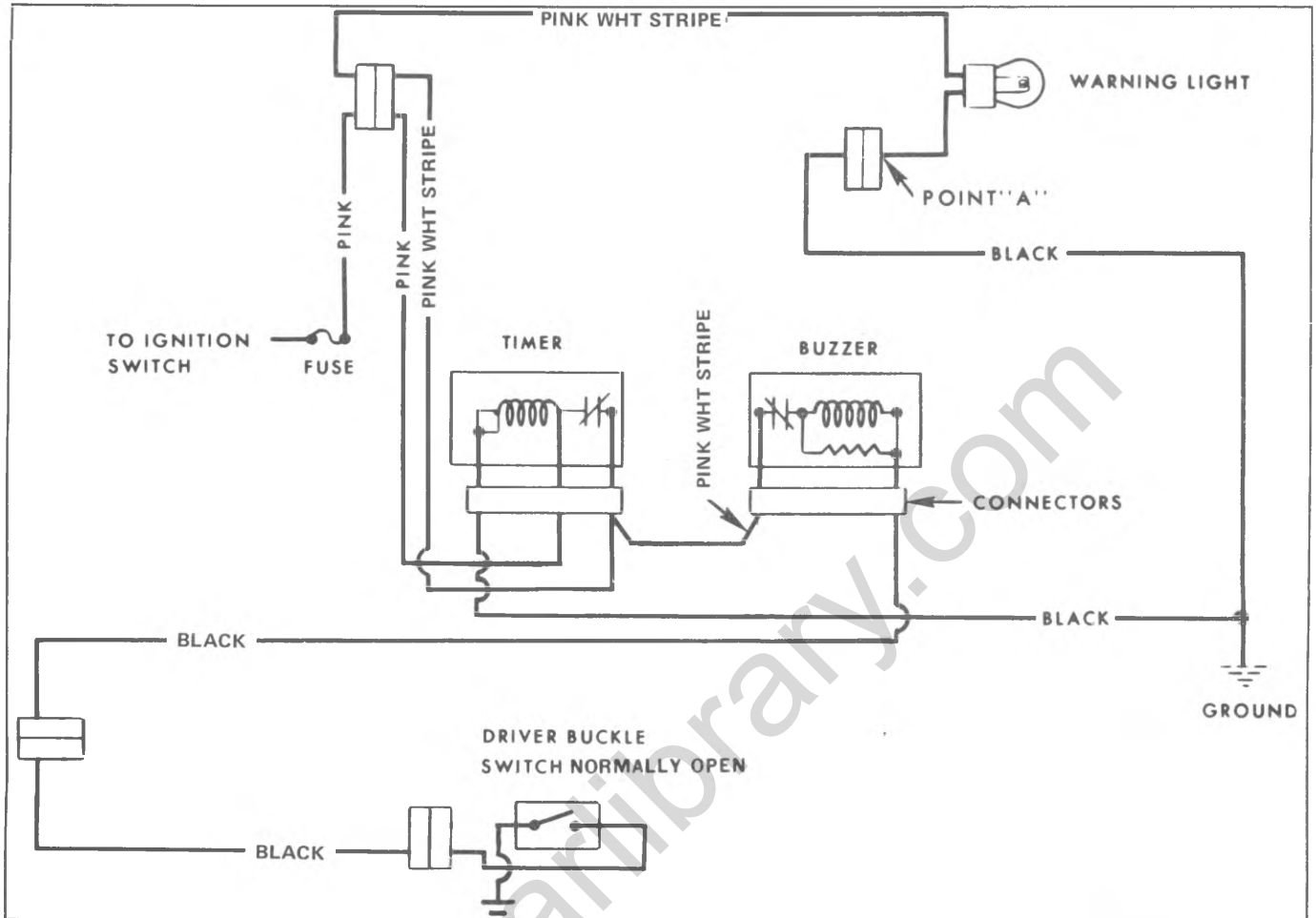


Fig. 8-41—Seat Belt Reminder System Schematic

SPECIFICATIONS

FUSES — CIRCUIT BREAKERS

The wiring circuits are protected from short circuits by a combination of fuses, circuit breakers, and fusible thermal links in the wiring itself. This greatly reduces the hazard of electrically caused fires in the vehicles.

The headlamp circuits are protected by a circuit breaker in the light switch. An electrical overload on the breaker will cause the lamps to go on and off, or in some cases to remain off.

In addition to a fuse, the windshield wiper motor is also protected by a circuit breaker. If the motor overheats, due to overloading caused by heavy snow, etc., the wipers will remain stopped until the motor cools.

Fuses located in the Junction Block beneath the dash on the drivers side are:

C-K TRUCK

Heater, Front A/C, Generator Warning Lamp	20 Amp
Idle Stop Solenoid, Aux. Battery, Radio, Time Delay Relay, Emission Control Solenoid, Transmission Downshift (M40)	15 Amp
Cigarette Lighter, Clock, Dome Lamp, Cargo Lamp	20 Amp
Fuel Gauge, Brake Warning Lamp, Temperature Warning Lamp, Oil Pressure Warning Lamp	4 Amp
Courtesy Lamp, Roof Marker Lamp, License Plate Lamp, Parking Lamp, Side Marker Lamp, Tail Lamp, Clearance Lamp	20 Amp
Directional Signal Indicator Lamp, Stop Lamp, Traffic Hazard	15 Amp
Instrument Cluster Lamp, Heater Dial Lamp, Radio Dial Lamp, Cruise Control Lamp, Windshield Wiper Switch Lamp	4 Amp
Windshield Wiper/Washer	25 Amp
Cruise Control, Rear Window Aux., Fuel Tank, Tachometer, Back-up Lamp, Directional Signal Indicator Lamp, Directional Signal Lamp, Headlamp Buzzer	15 Amp

P TRUCK

Heater†, Air Conditioning†	25 Amp
Instrument Cluster Lamp, Windshield Wiper Switch Lamp	3 Amp
Directional Signal Indicator Lamp, Stop Lamp, Traffic Hazard	15 Amp
Fuel Gauge, Brake Warning Lamp	3 Amp
License Plate Lamp, Parking Lamp, Side Marker Lamp, Tail Lamp, Clearance Lamp, Identification Lamp	15 Amp
Windshield Washer/Wiper	25 Amp
Cigarette Lighter†, Clock†, Courtesy†, Dome Lamp†	15 Amp
Auxiliary Battery†, Back-up Lamp, Radio	15 Amp

Idle Stop Solenoid, Cruise Control†, Directional Signal Lamp, Time Delay Relay, Emission Control Solenoid, Transmission Downshift (M40)	10 Amp
---	--------

In-line fuses are located in the auxiliary heater circuits (C-K-P models) and underhood lamp, front and rear A/C circuits (C-K models)

†When incorporated by body builder

Do not use fuses of higher amperage than those recommended above

The following wiring harnesses are protected by a "fusible link" which is a special wire incorporated in the circuit headlamp hi-beam indicator, horn, air conditioning high blower, ignition circuits (C-K-P models) starter solenoid (pull-in and hold) circuit (C-K models). Should an electrical overload occur, this wire will fail and prevent damage to the major harness.

G TRUCK

Heater, A/C	25 Amp
Idle Stop Solenoid, Cruise Control, Directional Signal Lamp, Directional Signal Indicator Lamp, Transmission Downshift (M-40)	10 Amp
Cigarette Lighter, Dome Lamp, Spot Lamp ...	15 Amp
Fuel Gauge, Brake Warning Lamp, Temperature Warning Lamp, Generator Warning Lamp, Oil Pressure Warning Lamp	3 Amp
Stop Lamp, Traffic Hazard	15 Amp
Auxiliary Battery, Backing Lamp, Radio Dial Lamp, Radio	15 Amp
Instrument Cluster Lamp, Heater Dial Lamp, Transmission Control Lamp with Tilt Wheel, Cruise Control Lamp, W/S Wiper Switch Lamp, Headlamp Buzzer	3 Amp
License Lamp, Parking Lamp, Side Marker Lamp, Tail Lamp	15 Amp
Windshield Wiper	25 Amp

An in-line fuse is located in the Ammeter and the auxiliary heater circuits.

Do not use fuses of higher amperage rating than those recommended above

The following wiring harnesses are protected by a "fusible link" which is a special wire incorporated in the circuit, ignition, horn and headlamp hi-beam indicator circuits, air conditioning high blower. Should an electrical overload occur, this wire will fail and prevent damage to the major harness.

CIRCUIT BREAKERS

DEVICE OR CIRCUIT PROTECTED	MODELS	AMPERES	LOCATION
Headlamp and parking lamp circuit	C-K-P-G	15	Light switch
Tailgate window motor	C-K	30	Dash (forward side)
Rear A/C (C69 overhead)	G	35	Dash (forward side)

LAMP BULB DATA C-K-P TRUCK

USED IN	QUANTITY	TRADE#	POWER
Dome Lamps:			
Cab	1	1004	15 CP
Utility & Suburban	1	211-2	12 CP
Oil Pressure indicator lamp ¹	1	168	3 CP
Generator indicator lamp ¹	1	168	3 CP
Instrument cluster lamps ²	5	168	3 CP
Headlamp beam indicator lamp	1	168	3 CP
Lamp assembly — tail & stop lamp	2	1157	3-32 CP
License Lamp ⁴	1	67	4 CP
Directional signal (front park lamps) ⁶	2	1157	3-32 CP
Head Lamps	2	6014	50-60 W
Temperature indicator lamp	1	168	3 CP
Directional signal indicator lamp	2	168	3 CP
Clearance and marker lamps	4	168	3 CP
Roof marker lamps ⁵	5	194	2 CP
Brake warning indicator	1	168	3 CP
Transmission control (auto)	1	1445	0.7 CP
Backing lamp (exc. motor home)	2	1156	32 CP
Backing lamp (motor home)	2	1295	50 CP
Heater or A/C	1	161	1 CP
Corner marker lamps (platform)	7	67	4 CP
Cargo lamp (C-K cab)	1	1142	21 CP
Radio dial lamp — AM	1	1816	3 CP
—AM/FM	1	216	1 CP
Cruise control lamp	1	53	1 CP
Courtesy lamp	1	1003	15 CP
Windshield wiper switch	1	161	1 CP
Clock	1	168	3 CP
Rear identification ⁷	10	1895	2 CP
Underhood lamp	1	93	15 CP
Seat belt warning	1	168	3 CP
Cargo/dome lamp	2	211-2	12 CP
Four wheel drive indicator	1	168	3 CP

¹ On CA, KA 10-35 instrument clusters only.

² 3 lamps used on instrument cluster on P models or C-K w/o gauges.

³ Double filament sealed beam 60W high beam, 50W low beam.

⁴ 2 lamps used with step bumper and P models.

⁵ 4 required on P models.

⁶ 1157 NA, 2.2-24 CP on C-K models.

⁷ Wideside Pickup.

LAMP BULB DATA G TRUCK

USED IN	QUANTITY	TRADE#	POWER
Dome lamps	2	211-2	12 CP
Oil pressure indicator lamp	1	168	3 CP
Generator indicator lamp	1	168	3 CP
Instrument cluster lamps	3	168	3 CP
Headlamp beam indicator lamp	1	168	3 CP
Park, directional signal lamps	2	1157	3-32 CP
Tail, stop lamps	2	1157	3-32 CP
License lamp	1	67	4 CP
Head lamps ¹	2	6014	50-60 W
Temperature indicator lamp	1	168	3 CP
Directional signal indicator lamp	2	168	3 CP
Marker lamps	4	168	3 CP
Brake warning indicator lamp	1	168	3 CP
Back-up lamp	2	1156	32 CP
Radio dial lamp	1	1893	2 CP
Heater or A/C control	1	194	2 CP
Transmission control w/tilt wheel	1	1445	0.7 CP
Cruise control	1	53	1 CP
W/S wiper switch lamp	1	161	1 CP

¹ Double filament sealed beam 60W high beam, 50W low beam.

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SECTION 9

ACCESSORIES

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CRUISE MASTER

GENERAL DESCRIPTION

The Cruise Master is a speed control system which employs engine manifold vacuum to control the throttle power unit. The power unit moves the throttle, when speed adjustment is necessary, by receiving a varying amount of controlled vacuum from the transducer. The speedometer cable (from the transmission) drives the transducer, and a cable (from the transducer) drives the instrument panel speedometer. The engagement of the transducer is controlled by an engagement switch located at the end of the turn signal lever. Two brake release switches are provided: an electric switch disengages the transducer and a vacuum valve decreases the vacuum in the power unit to quickly return the throttle to idle position.

The purpose of the Cruise Master system is to allow the driver to maintain a constant highway speed without the necessity of continually applying foot pressure to the accelerator pedal. Speed changes are easily made and override features allow the vehicle to be stopped, slowed or accelerated as desired.

Engaging the Cruise System

The driver accelerates to the desired cruise speed and partially depresses and releases the cruise control engagement switch button located at the end of the directional signal lever. The cruise system takes over speed control, and within engine limitation, maintains this speed regardless of changes in terrain.

The Engagement Switch button performs these functions:

1. Above 30 mph (50 km/h), when partially depressed and released, it engages the cruise system.

2. When depressed fully and held there, it disengages the system.

3. When released slowly from the fully depressed position, it will engage the system at the existing speed and cruise at that speed (above 30 mph or 50 km/h).

NOTE: See Fig. 9-1C "Engage Switch Operation".

Speed Changes

Override -The accelerator pedal may be depressed at any time to override the cruise system. Release of the accelerator pedal will return the vehicle to the previous cruise speed.

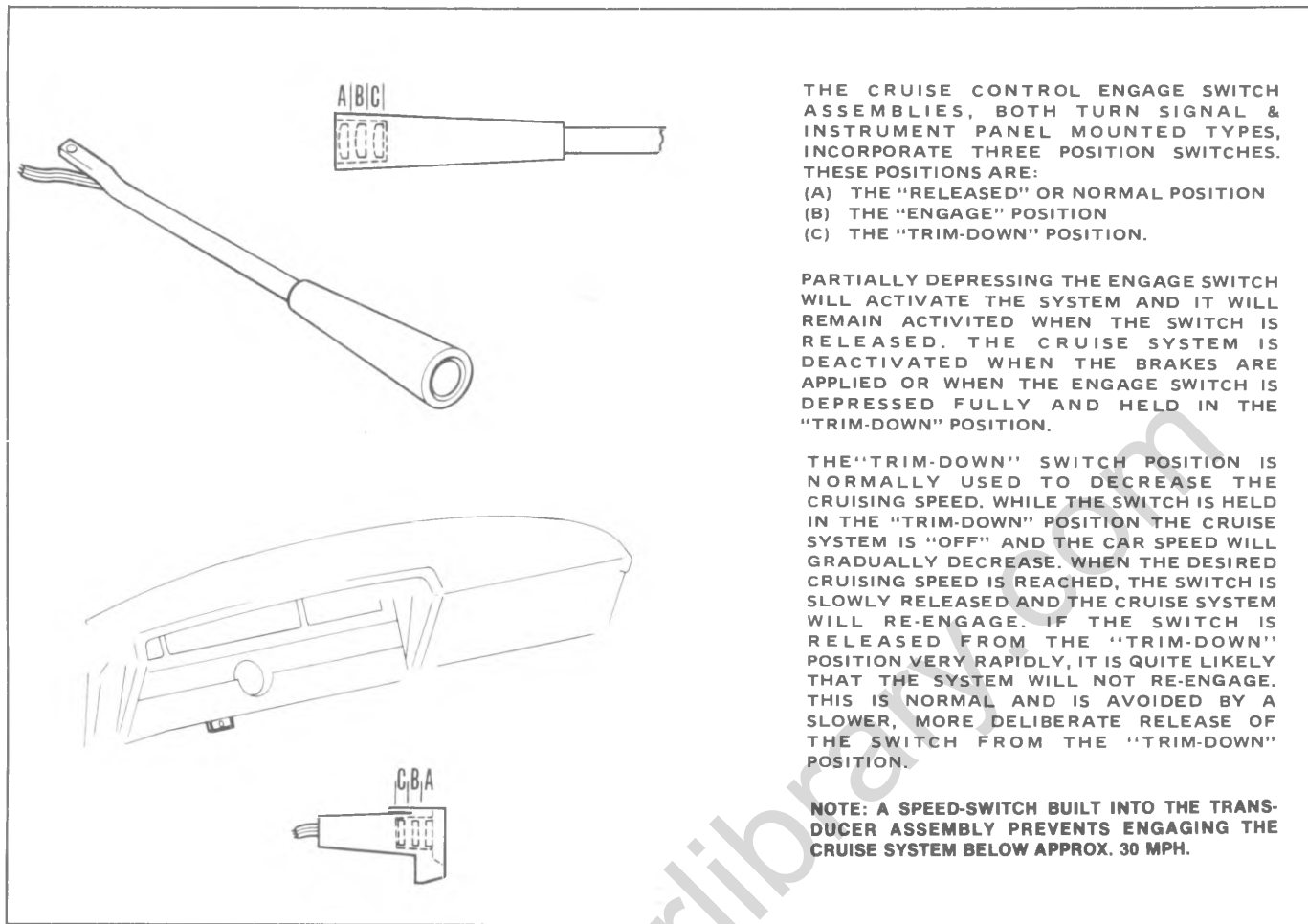
To Cruise At A Higher Speed -Depress the accelerator pedal to reach the new desired speed. Then, fully depress and slowly release the cruise control engagement switch button. The system re-engages at the higher speed when the button is slowly released.

To Cruise At A Lower Speed -Disengage the system by depressing the engagement switch button fully and holding it there until the vehicle has decelerated to the new desired speed; then release the button slowly. The system re-engages at the lower speed when the button is slowly released.

Cruise Master Units

1. The Engagement Switch, which is located at the end of the directional signal lever, is used to control the system and for upward and downward speed adjustments.

2. The Transducer (fig. 9-2C) is mounted in the speedometer cable line. It is a combination speed sensing device and control unit. When engaged, it senses vehicle



THE CRUISE CONTROL ENGAGE SWITCH ASSEMBLIES, BOTH TURN SIGNAL & INSTRUMENT PANEL MOUNTED TYPES, INCORPORATE THREE POSITION SWITCHES. THESE POSITIONS ARE:

- (A) THE "RELEASED" OR NORMAL POSITION
- (B) THE "ENGAGE" POSITION
- (C) THE "TRIM-DOWN" POSITION.

PARTIALLY DEPRESSING THE ENGAGE SWITCH WILL ACTIVATE THE SYSTEM AND IT WILL REMAIN ACTIVATED WHEN THE SWITCH IS RELEASED. THE CRUISE SYSTEM IS DEACTIVATED WHEN THE BRAKES ARE APPLIED OR WHEN THE ENGAGE SWITCH IS DEPRESSED FULLY AND HELD IN THE "TRIM-DOWN" POSITION.

THE "TRIM-DOWN" SWITCH POSITION IS NORMALLY USED TO DECREASE THE CRUISING SPEED. WHILE THE SWITCH IS HELD IN THE "TRIM-DOWN" POSITION THE CRUISE SYSTEM IS "OFF" AND THE CAR SPEED WILL GRADUALLY DECREASE. WHEN THE DESIRED CRUISING SPEED IS REACHED, THE SWITCH IS SLOWLY RELEASED AND THE CRUISE SYSTEM WILL RE-ENGAGE. IF THE SWITCH IS RELEASED FROM THE "TRIM-DOWN" POSITION VERY RAPIDLY, IT IS QUITE LIKELY THAT THE SYSTEM WILL NOT RE-ENGAGE. THIS IS NORMAL AND IS AVOIDED BY A SLOWER, MORE DELIBERATE RELEASE OF THE SWITCH FROM THE "TRIM-DOWN" POSITION.

NOTE: A SPEED-SWITCH BUILT INTO THE TRANSDUCER ASSEMBLY PREVENTS ENGAGING THE CRUISE SYSTEM BELOW APPROX. 30 MPH.

Fig. 9-1C--Cruise Master Engagement Switches

speed and positions the Power Unit to maintain the selected speed.

3. The Power Unit is bracket mounted to the engine on all models. It opens or closes the throttle as dictated by the Transducer.

4. The Cruise Brake Release Switch, which is mounted on the brake pedal bracket, disengages the system electrically when the brake pedal is depressed.

5. The Cruise Brake Release Valve, which is mounted on the brake pedal bracket, disengages the system pneumatically when the brake pedal is depressed.

6. The Cable and Casing Assemblies drive the transducer and speedometer.

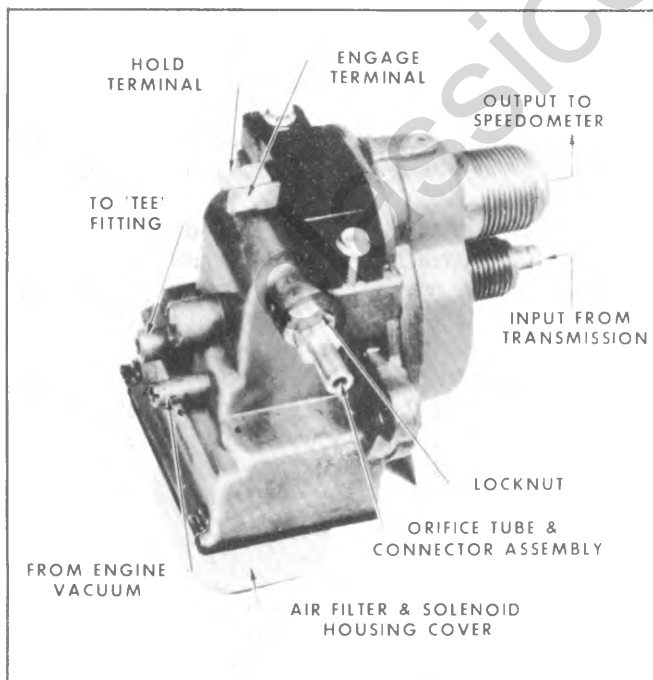


Fig. 9-2C--Transducer

DIAGNOSIS

ELECTRICAL SYSTEM TROUBLESHOOTING

1. Check fuse and connector.
2. Check electric brake switch as follows:
 - a. Unplug connector at switch.
 - b. Connect ohmmeter across cruise master contacts on brake switch. The ohmmeter must indicate no continuity when the pedal is depressed and continuity when pedal is released. The cruise release brake switch (electric) is adjusted as is the standard stop light brake switch.
 - c. Replace electric brake switch if needed.
3. Check clutch release switch (manual transmission only) same as electric release switch above.

Engagement Switch Test

Check engagement switch and connecting wiring as follows: Unplug engagement switch connector (brown, blue, black) at electrical wiring harness connector then perform the following tests (fig. 9-3C).

Test#1—Connect ohmmeter between terminal #1 (brown wire) and terminal#2 (blue wire). Continuity shall be maintained until switch is depressed all the way in.

Test#2—Connect ohmmeter between terminal#1 (brown wire) and terminal#3 (black wire). No continuity shall be shown; however, when the button is partially depressed, continuity shall be indicated. When the button is pressed all the way down, no continuity shall be shown.

Test#3—Connect ohmmeter between terminal#2 (blue wire) and terminal#3 (black wire). Button released, no continuity; however, when the button is depressed partially and fully, continuity shall be shown.

Harness Test (Fig. 9-3C)

1. Disconnect engage switch wire harness connector from the main harness connector (red, brown/white, and white wires).
2. Connect ohmmeter between point C (brown/white stripe wire in main wire harness) and ground. Make sure the Transducer is well grounded to the chassis. The ohmmeter should read between 42 and 49 ohms. If a resistance either above or below the value indicated is

shown, then disconnect the connector from the Transducer and measure the resistance of the brown/white stripe wire from point C to D. It should measure 40 ohms ± 2 ohms.

3. If a resistance either above or below the value indicated is shown, the main wiring harness should be replaced.

NOTE: When disconnecting or reconnecting the main wiring harness connector from the Transducer, care should be exercised so as not to damage the blade connectors or the wiring harness. The disconnect may be facilitated by prying carefully on the plastic connector with a small screwdriver.

4. Measuring the solenoid coil circuit resistance between point E (Hold Terminal) and ground, the ideal resistance should be between 5 and 6 ohms. A reading of less than 4 ohms indicates shorting in the coil circuit. A reading of more than 7 ohms indicates excessive resistance in the coil circuit. Either extremity indicates replacement of the Transducer assembly. The main harness wiring from point F to G (white wire) should also be checked for continuity.

POWER UNIT AND VACUUM SYSTEM TEST

To determine the condition of the diaphragm, remove hose from the Power Unit and apply 14 inches of vacuum to the tube opening and hold in for one minute. The vacuum shall not leak down more than 5 inches of vacuum in one minute. If leakage is detected, replace the Power Unit. To utilize engine as a vacuum source, proceed as follows:

1. Disconnect Power Unit linkage at carburetor and vacuum hose from the Power Unit, then connect engine vacuum directly to the Power Unit fitting.
2. Note position of Power Unit diaphragm.
3. Start engine--the diaphragm should pull in.
4. Clamp off engine vacuum supply line and check for leakage.

The cruise release brake valve (vacuum) and connecting hoses can likewise be checked using a vacuum pump.

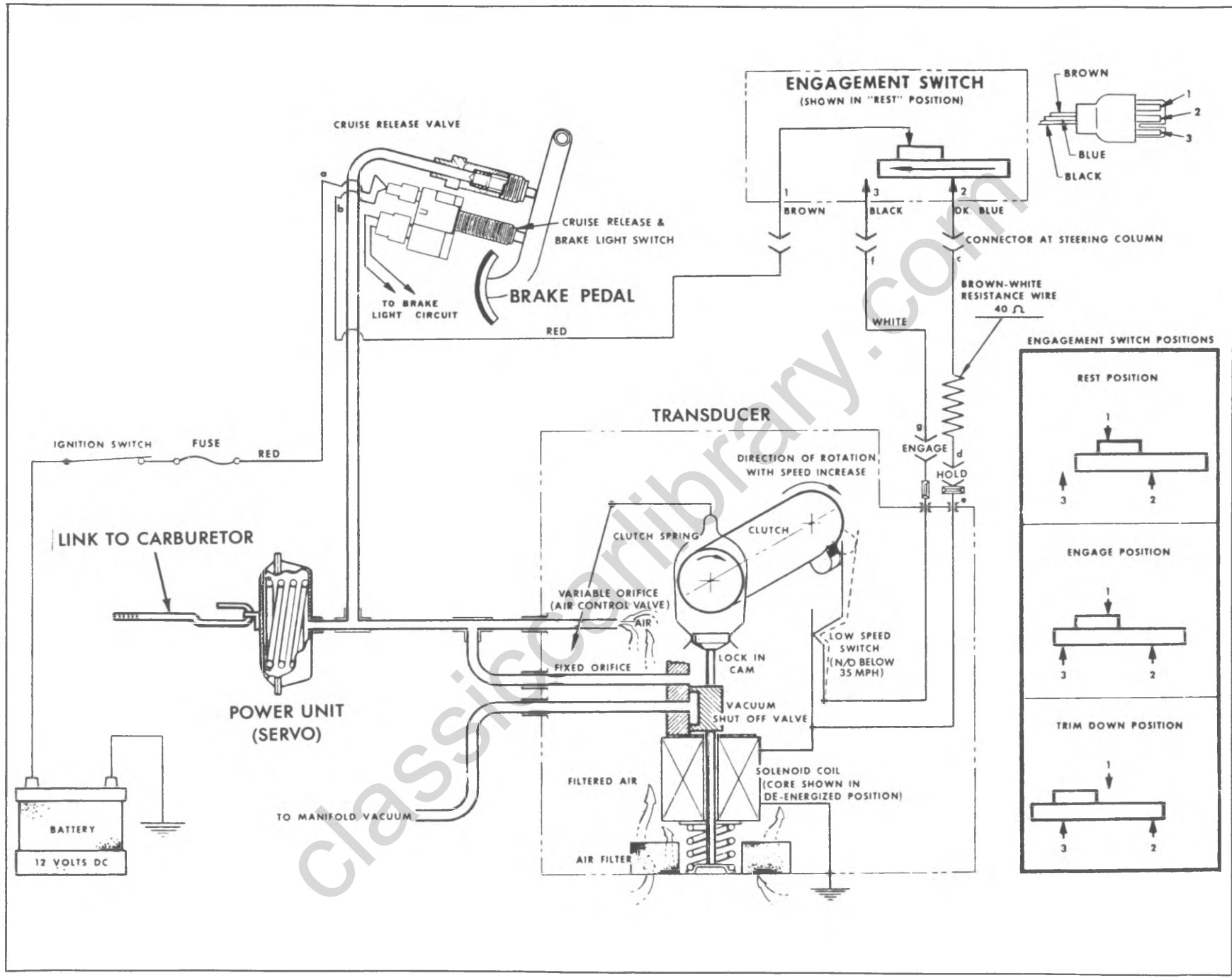
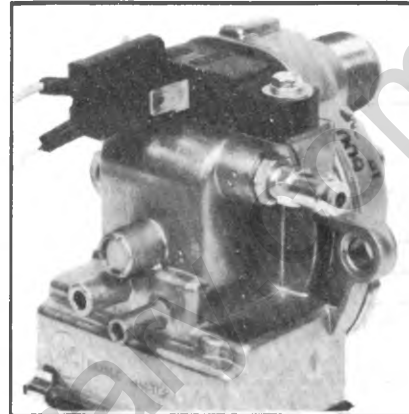
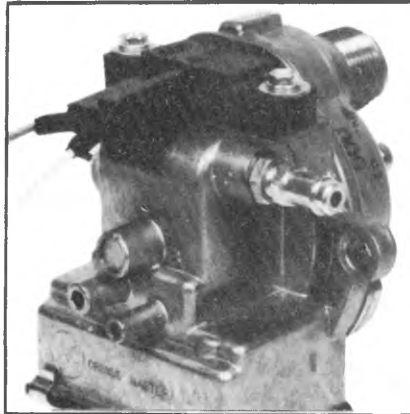


Fig. 9-3C—Electro-Pneumatic Schematic

CHEVROLET CRUISE MASTER TROUBLESHOOTING

CHECK I FOR SYSTEMS WITH ERRATIC CRUISE PERFORMANCE

CHECK II FOR INOPERATIVE SYSTEMS MAKE ALL TESTS WITH TRANSMISSION SELECTOR IN "PARK" & PARKING BRAKE ON EXCEPT WHERE INDICATED OTHERWISE. RECONNECT ANY DISCONNECTED HOSES AND/OR ELECTRICAL CONNECTORS IN PROPER MANNER AT THE COMPLETION OF TEST.



CHECK I

1. CHECK POWER UNIT ADJUSTMENT - SEE SERVICE ADJUSTMENT PROCEDURE
2. CHECK FOR PINCHED, KINKED, PLUGGED, OR DAMAGED VACUUM HOSES. ALSO CHECK VACUUM FITTINGS.
3. CHECK SPEEDOMETER CABLE ROUTING. IT MUST NOT BE KINKED OR HAVE TOO SHARP A TURNING RADIUS (NOT LESS THAN 6" RADIUS). CHECK DRIVE CABLE FOR DISTORTED OR BENT TIPS. FERRULES MUST BE SNUG.
4. CHECK FOR A BINDING THROTTLE LINKAGE CONDITION.
5. CHECK ADJUSTMENT OF BRAKE RELEASE SWITCH & VACUUM RELEASE VALVE. (SEE SERVICE & ADJUSTMENTS)
6. CHECK FOR PROPER OPERATING PROCEDURE OF THE ENGAGE SWITCH.
7. IF STEPS 1 THROUGH 6 DO NOT SOLVE THE PROBLEM PROCEED WITH CHECK II.

SPECIAL NOTE PERTAINING TO ENGAGEMENT-CRUISE SPEED ZEROING.

IF THE CAR CRUISES BELOW ENGAGEMENT SPEED, SCREW THE ORIFICE TUBE OUTWARD. IF THE CAR CRUISES ABOVE THE ENGAGEMENT SPEED, SCREW THE ORIFICE TUBE INWARD. EACH 1/4 TURN WILL CHANGE THE CAR SPEED APPROXIMATELY ONE MPH. ENGAGEMENT ACCURACY TESTING TO BE DONE AT 60 MPH. SNUG UP LOCK NUT AFTER EACH ADJUSTMENT.

CAUTION: DO NOT REMOVE ORIFICE TUBE FROM CASTING.

CHECK II

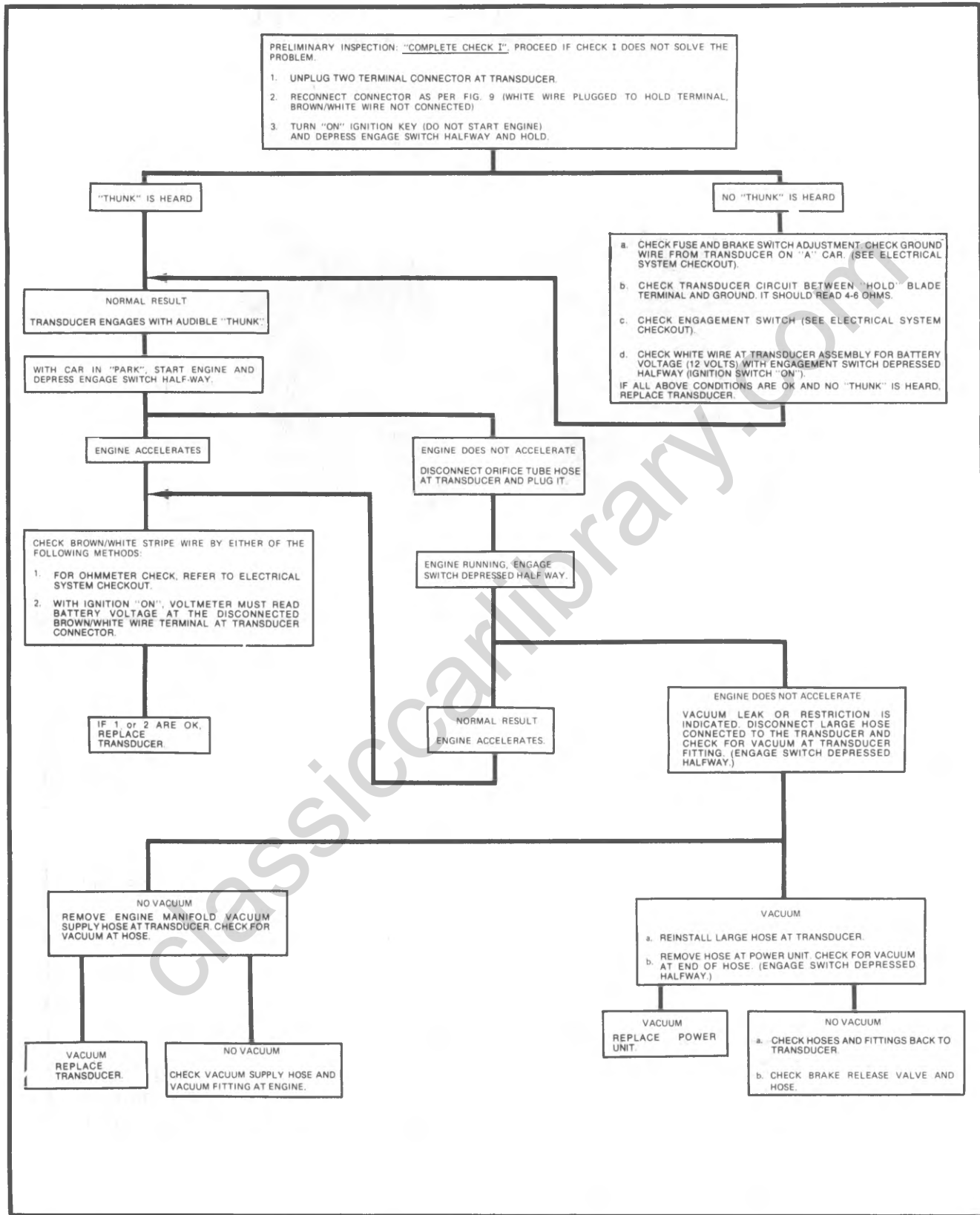


Fig. 9-5C--System Diagnosis Chart No.2

ON-CAR SERVICE

MAINTENANCE AND ADJUSTMENTS

The components of the Cruise-Master System are designed to be replaced should they become inoperative. The Transducer is calibrated in such a manner during manufacturing that overhaul operations are impractical. However, one adjustment may be made to the Transducer to correct speed drop or increase at the time of engagement.

TRANSDUCER (Figs. 9-6C and 9-7C)

One transducer adjustment is possible - Engagement Cruising Speed Zeroing (to remove any difference between engagement and cruising speed). No transducer adjustment should be made, however, until the Power Unit linkage adjustment has been checked and vacuum hoses are checked for leaks, kinks, or other restrictions.

If the vehicle cruises at a speed a few mph above or below the engagement speed, this error can be corrected with a simple adjustment of the orifice tube in the transducer (Fig. 9-2C).

CAUTION: *Never remove orifice tube from casting. It cannot be reinstalled once it has been removed.*

1. To check cruise speed error, engage Cruise-Master at 55 mph (90 km/h).
2. If vehicle cruises **below** engagement speed, screw orifice tube **outward**.
3. If vehicle cruises **above** engagement speed, screw orifice tube **inward**.

NOTE: Each 1/4 turn of the orifice tube will change cruise speed approximately one mph (one km/h). Snug-up lock nut after each adjustment.

If a Transducer is found to be defective and not simply out-of-adjustment, it must be replaced. During replacement, check the hoses which connect to the Transducer and replace any which are cracked or deteriorated.

POWER UNIT

Adjustment (Fig. 9-6C and 9-7C)

1. Before adjusting the Power Unit linkage, make sure ignition is OFF and fast idle cam is OFF and that the throttle is completely closed.
2. With rod hooked through tab on power unit, adjust length by turning link onto rod until dimension shown in Figures 9-6C and 9-7C is obtained.
3. Install link and link retainer.

NOTE: If the Servo Unit is found to be defective, replacement is required. Note the condition of the hoses and replace any which are cracked or deteriorated.

BRAKE RELEASE SWITCHES (Figs. 9-6C and 9-7C)

Electric

The Cruise Master brake release switch electrical contacts must be switched open when the brake pedal is depressed .38" to .64", measured at the brake pedal.

An inoperative switch must be replaced. Switch replacement procedure is similar to standard brake lamp switch replacement.

Vacuum

The vacuum valve plunger must clear the brake pedal arm when the brake pedal is depressed 1.17"-1.36" (except Hydro-Boost), 1.23" to 1.49" (Hydro-Boost), measured at the pedal (fig. 9-7C).

An inoperative (sticking, plugged, or leaking) vacuum valve must be replaced. Vacuum valve replacement is similar to brake lamp switch replacement. Be certain that the hose to the valve is connected firmly and is not cracked or deteriorated.

COLUMN MOUNTED ENGAGEMENT SWITCH

The engagement switch is serviced only by replacement of the turn signal lever assembly.

COMPONENT PART REPLACEMENT

TRANSDUCER

Replacement

1. Disconnect battery ground cable.
2. Disconnect speedometer cables at transducer.
3. Disconnect vacuum and wiring harness at transducer body.
4. Remove transducer to bracket screws and remove regulator.
5. To install, reverse Steps 1-4 above.

POWER UNIT

Replacement

1. Disconnect battery ground cable.
2. Disconnect vacuum line at power unit.
3. Remove power unit link retainer at accelerator lever stud.
4. Remove rod and link from power unit.
5. Remove power unit to bracket nut and washer and remove power unit assembly.
6. To install, reverse Steps 1-5 above.
7. Adjust the power unit as outlined in this section.

COLUMN MOUNTED ENGAGEMENT SWITCH

Removal

1. Disconnect the battery ground cable.
2. Disconnect cruise master engagement switch wiring harness plug on steering column.
3. Remove plastic protector from cruise master wiring harness on column.
4. Remove turn signal lever (see Section 3B of this Manual).
5. Connect a 15" piece of piano wire to cruise master wiring harness plug for installation before easing turn signal lever assembly up and out of the column.

Installation

1. Attach new engagement switch harness plug to piano wire routed through column.
2. Pull connector and wire gently down column to prevent scraping wire insulation.
3. Install turn signal lever (see Section 3B of this Manual).
4. Slide plastic wiring protector over harness and up column.
5. Connect cruise master wiring harness on column.
6. Connect battery ground cable.

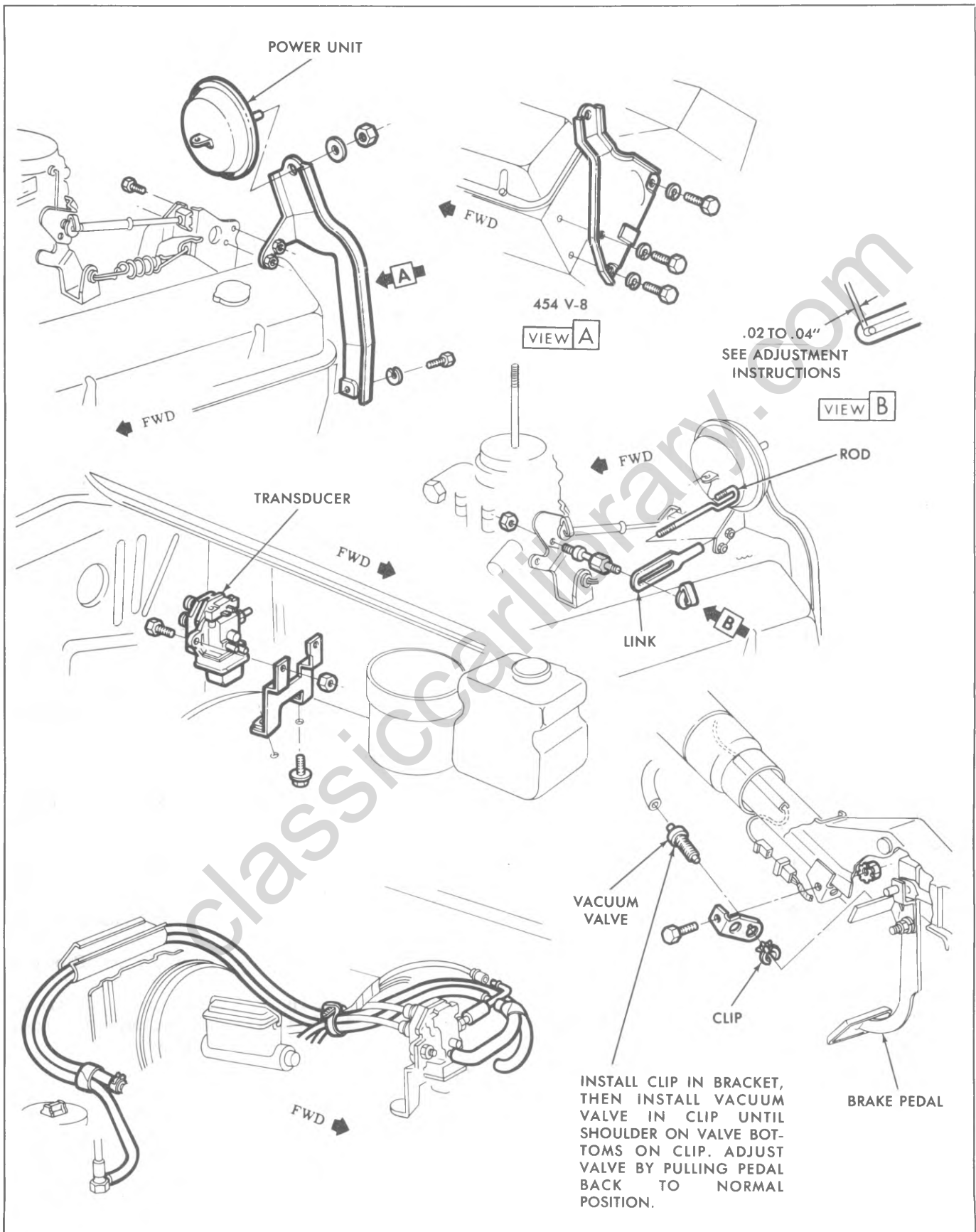


Fig. 9-6C--Cruise Master Installation--C-K Models

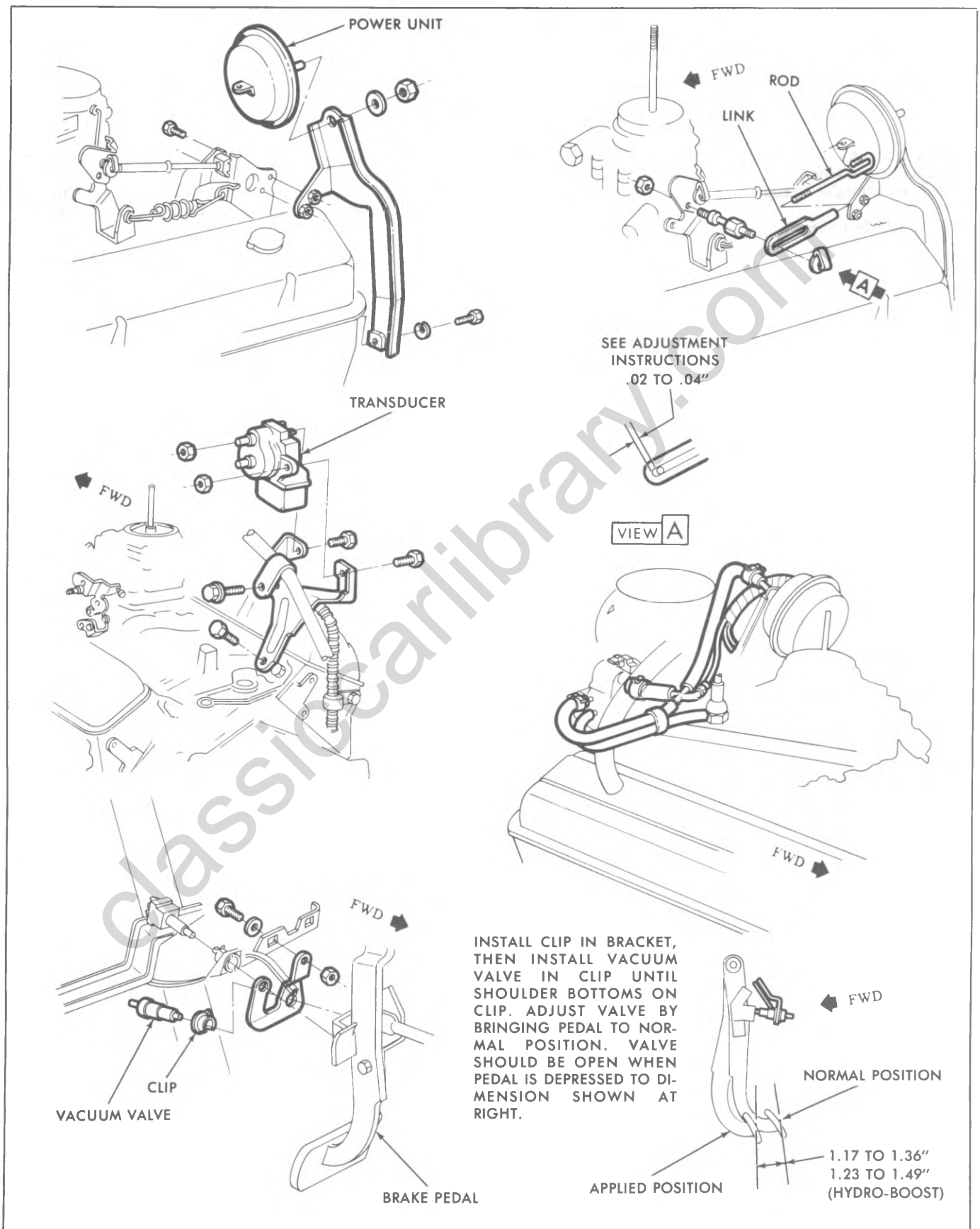


Fig. 9-7C--Cruise Master Installation--G Models

SPECIFICATIONS

CRUISE-MASTER

Solenoid Resistance	5 ohms \pm 1/4 ohm
Solenoid Wire Resistance	40 ohms
Maximum allowable Vacuum Leakage rate for Servo unit	5 inches of Vacuum Per Minute
	Not Greater than 1 inch of Vacuum per 10 seconds
Operational Test Speed	55 MPH

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RADIO

GENERAL DESCRIPTION

Radio options available for installation on light duty trucks are indicated in the option chart (fig. 9-1R).

C-K Model trucks incorporate a windshield antenna. The antenna lead snaps onto the center of the windshield,

inside the vehicle. G Model antennas are mounted externally on the right front fender.

RADIO OPTIONS AND DESCRIPTION	MODELS		
	C	K	G
U63 AM	X	X	X
U69 AM/FM	X	X	X
U58 AM/FM Stereo	—	—	X
UM2 AM/FM Stereo-Tape	—	—	X
U76 Antenna — Windshield	X	X	—
U80 Speakers — Auxiliary	X	X	X

Fig. 9-1R--Radio Option Chart

DIAGNOSIS

The radio trouble diagnosis guide is intended as an aid in locating minor faults which can be corrected without a specialized knowledge of radio and without special radio test equipment. If the suggestions given here do not affect a correction, further testing should be done only by a trained radio technician having proper test equipment.

RADIO STATIONS MIX TOGETHER

Trim radio as described earlier in this section. However, if two or more signals are picked up at the same time, there is no known way to separate them.

RADIO NOISE-STATIC

Refer to Fig. 9-2R for radio suppression on the vehicle.

Trimming radio as outlined in this section may reduce some noises on AM.

Check capacitor grounds and all ground straps for clean tight connections.

Spark plug wires must be in good condition and resistance type plugs used. See Diagnosis Charts.

WEAK RADIO SIGNAL

Test windshield antenna as described under "Antenna Testing" in this section.

DISTORTED TONE

Turn on radio, adjust for high volume and maximum bass. Check speaker by substituting a good speaker.

No Distortion -Replace speaker.

Distortion -Defective receiver-remove for servicing.

EIGHT-TRACK STEREO TAPE PLAYER

The tape player trouble diagnosis guide is intended as an aid in locating minor faults which can be corrected without a specialized knowledge of electronics and without special test equipment. If the suggestions given here do not effect a correction, further testing should be done only by a trained radio technician having proper test equipment. It should first be determined if the owner's tape and not the player is at fault. Substituting a known good tape cartridge for the owner's is a simple check.

NOTE: Because tape player service problems are generally corrected by a radio repair shop, there is a tendency for many technicians to remove a set when a problem is reported. Removal of the tape player can frequently be avoided if the diagnosis chart is used to eliminate problems which can be easily fixed or which are not caused by a faulty player.

In diagnosing radio/tape problems the main point to remember is that you now have both a radio and a tape player to diagnose as part of the stereo system. By inserting test tape, J-22683-01, you can quickly determine whether the tape speed is proper. Since only the pre-amps and audio are common to both radio and tape, by listening for distortion with the tape playing and comparing it to the radio signal, you can further isolate the problem to either radio or tape; See the Diagnosis Chart.

TESTING WINDSHIELD ANTENNA (Fig. 9-3R)

All C-K model trucks with factory installed radios are equipped with windshield antennas. To positively identify antenna failure and eliminate the possibility of unnecessary windshield replacement, Windshield Antenna Tester J-

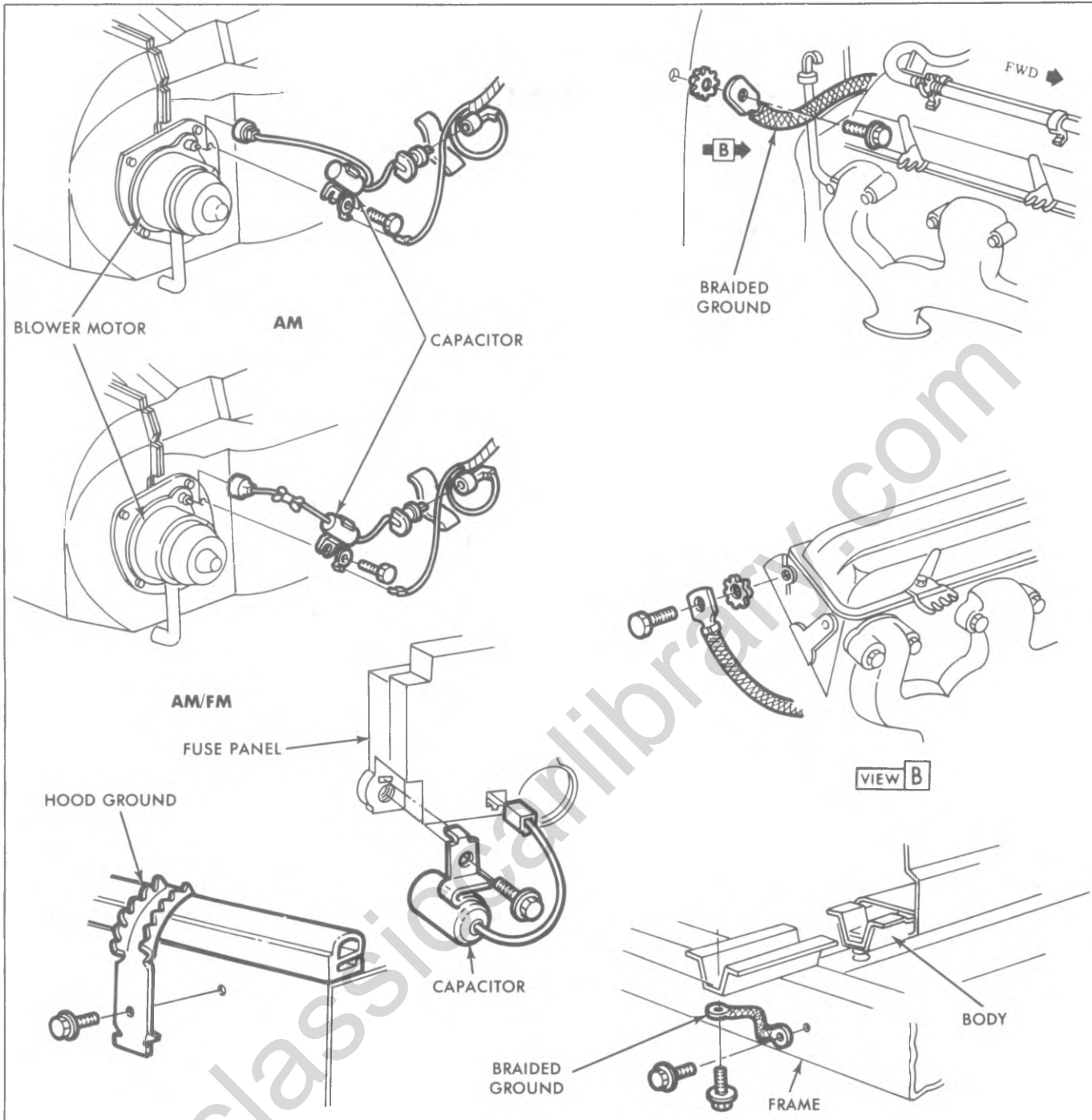


Fig. 9-2R--Radio Static Suppression

23520 should be used to determine continuity of the thin antenna wire.

When antenna failure is suspected, the following checks should be made before replacing the windshield.

1. Check Tester J-23520 for operation on any vehicle radio antenna that is operating normally to test for a weak or dead battery.

2. Check all antenna connectings to insure that antenna is electrically coupled to the radio.

3. Turn ignition switch to accessory position, turn radio "ON", select AM band if receiver is AM/FM and tune radio to an off station position.

4. Hold tester to antenna beginning at the upper corner of antenna:

CAUTION: The plastic Shield must be on tester at all times to avoid scratching windshield.

a. If a shrill sound is emitted through the speaker when both antenna wires are tested, antenna is operational.

b. If no sound is emitted through one or both antenna wires, move tester along the wire toward center of windshield and down toward radio.

c. If a shrill sound is picked up, find exact location where the noise begins, this is the area of the defect. Replace windshield.

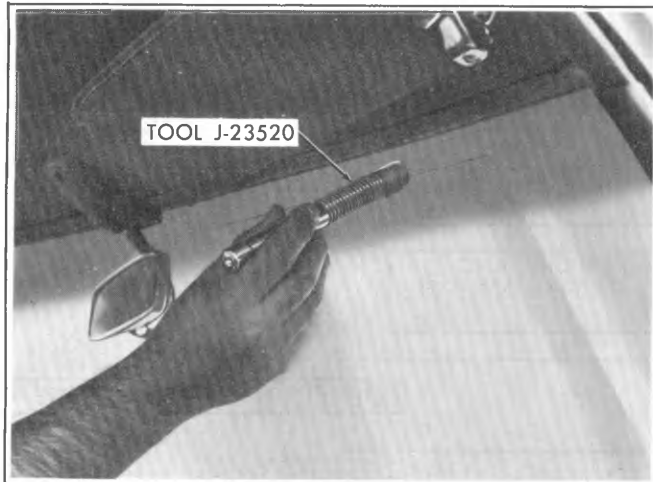


Fig. 9-3R--Testing Windshield Antenna (Typical)

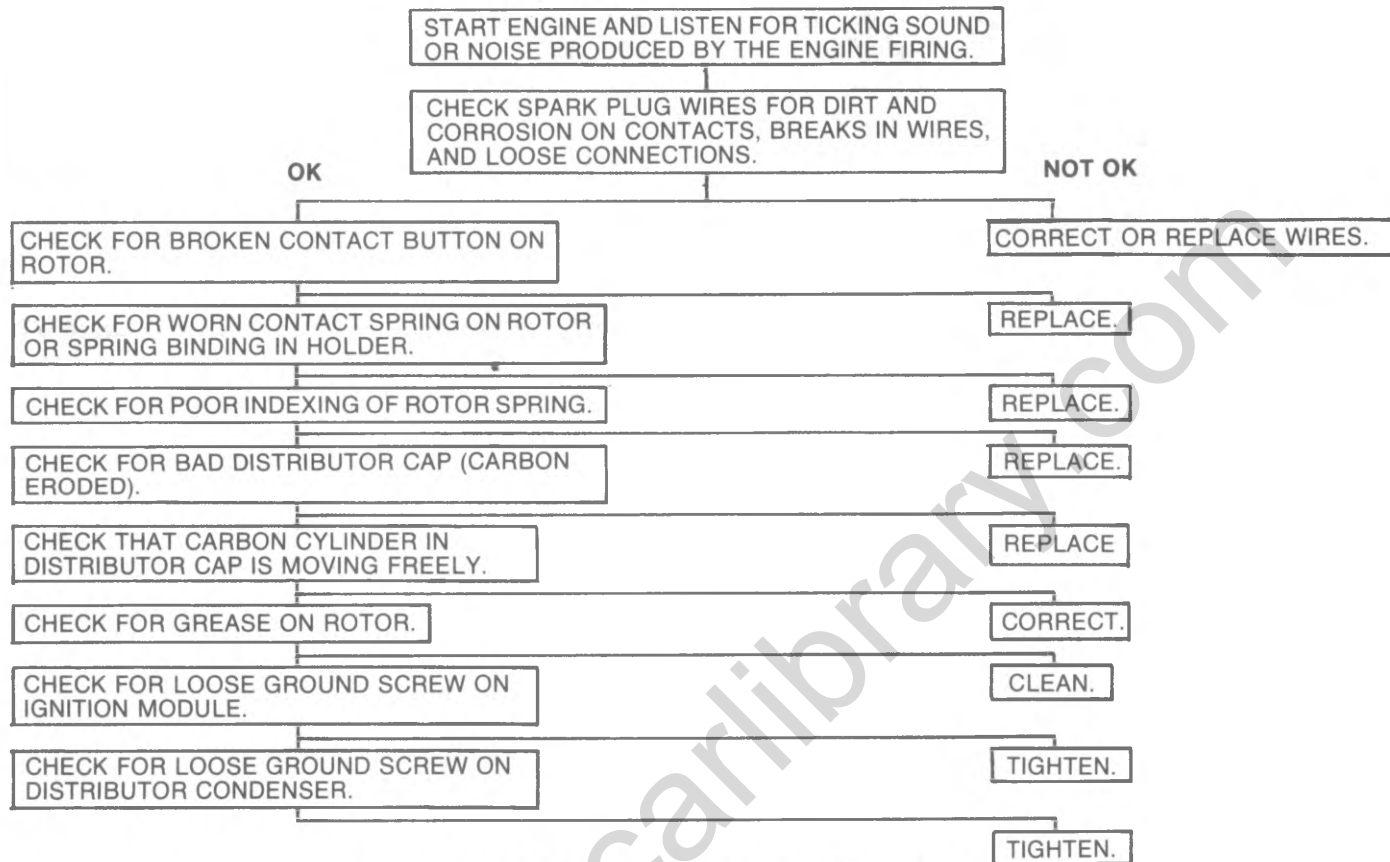
d. If no noise is heard over entire length of antenna, unplug antenna lead at radio and touch tester to antenna socket in radio.

e. If radio now makes a shrill sound, check connectors and antenna lead for possible defect before replacing windshield.

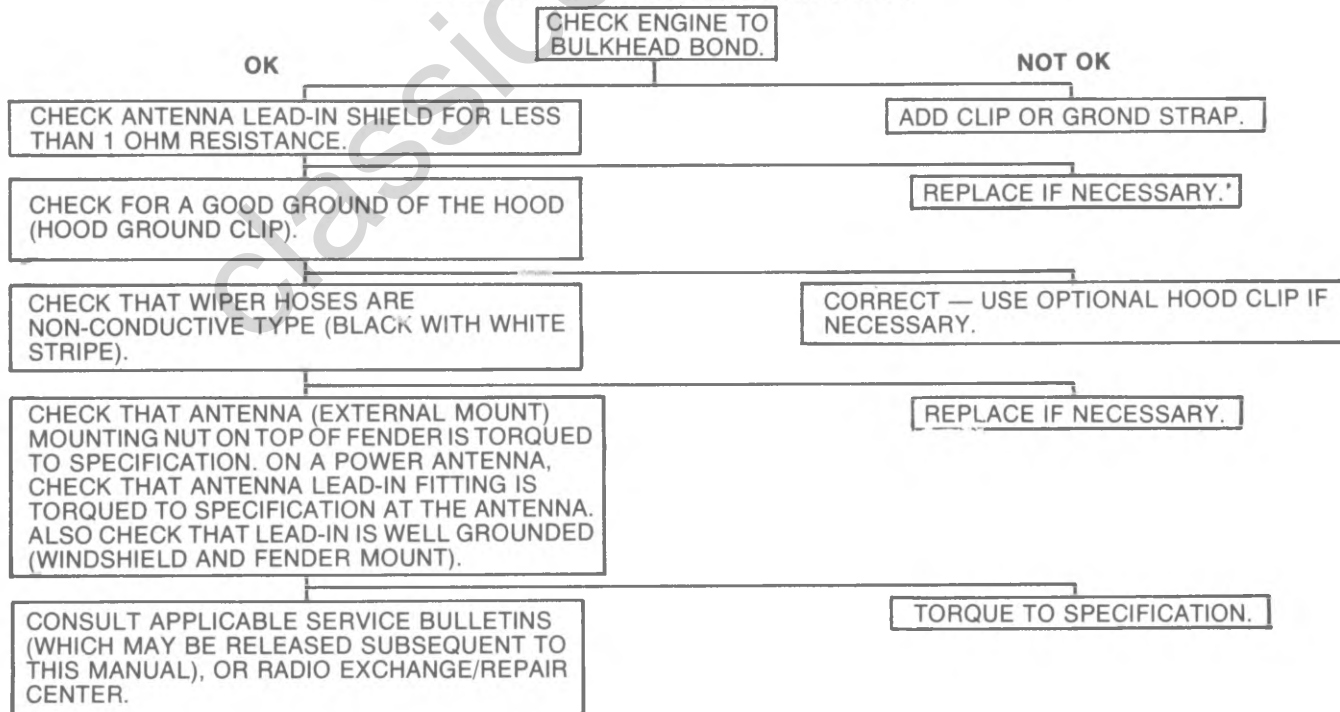
f. If no noise is emitted, radio, speaker, or fuse is defective.

NOTE: Make sure that antenna tester is turned off after completing antenna test.

RADIO NOISE DIAGNOSIS IMPROPERLY OPERATING IGNITION SYSTEM (HEI)



LACK OF SHIELDING/GROUNDING



RADIO NOISE — BLOWER MOTOR

TURN ON BLOWER MOTOR. NOISE APPEARS AS STATIC WHICH FOLLOWS BLOWER MOTOR SPEED (USUALLY ON FM).

CHECK IF A .25 MFD COAXIAL FEED-THROUGH CAPACITOR IS INSTALLED ON THE BLOWER MOTOR LEAD.

INSTALLED

NOT INSTALLED

SUBSTITUTE A .25 MFD COAXIAL CAPACITOR. (REFER TO "MAINTENANCE AND ADJUSTMENTS")

INSTALL A .25 MFD COAXIAL CAPACITOR. (REFER TO "MAINTENANCE AND ADJUSTMENTS")

NO NOISE

NOISE

NO NOISE

REPLACE CAPACITOR.

REPLACE BLOWER MOTOR.

STOP.

TAPE ONLY

TAPE DEAD

TAPE WEAK

CHECK PLAYER FOR OBSTRUCTION THROUGH DOOR.

INSPECT & CLEAN, MOVING PARTS AND HEAD*

NO OBSTRUCTION

OBSTRUCTION

TAPE NOT OK

TAPE OK

SUBSTITUTE KNOWN GOOD TAPE CARTRIDGE

REMOVE OBSTRUCTION

SUBSTITUTE WITH KNOWN GOOD TAPE CARTRIDGE.

STOP

DEAD

WORKS

SUBSTITUTE TAPE NOT OK

SUBSTITUTE TAPE OK

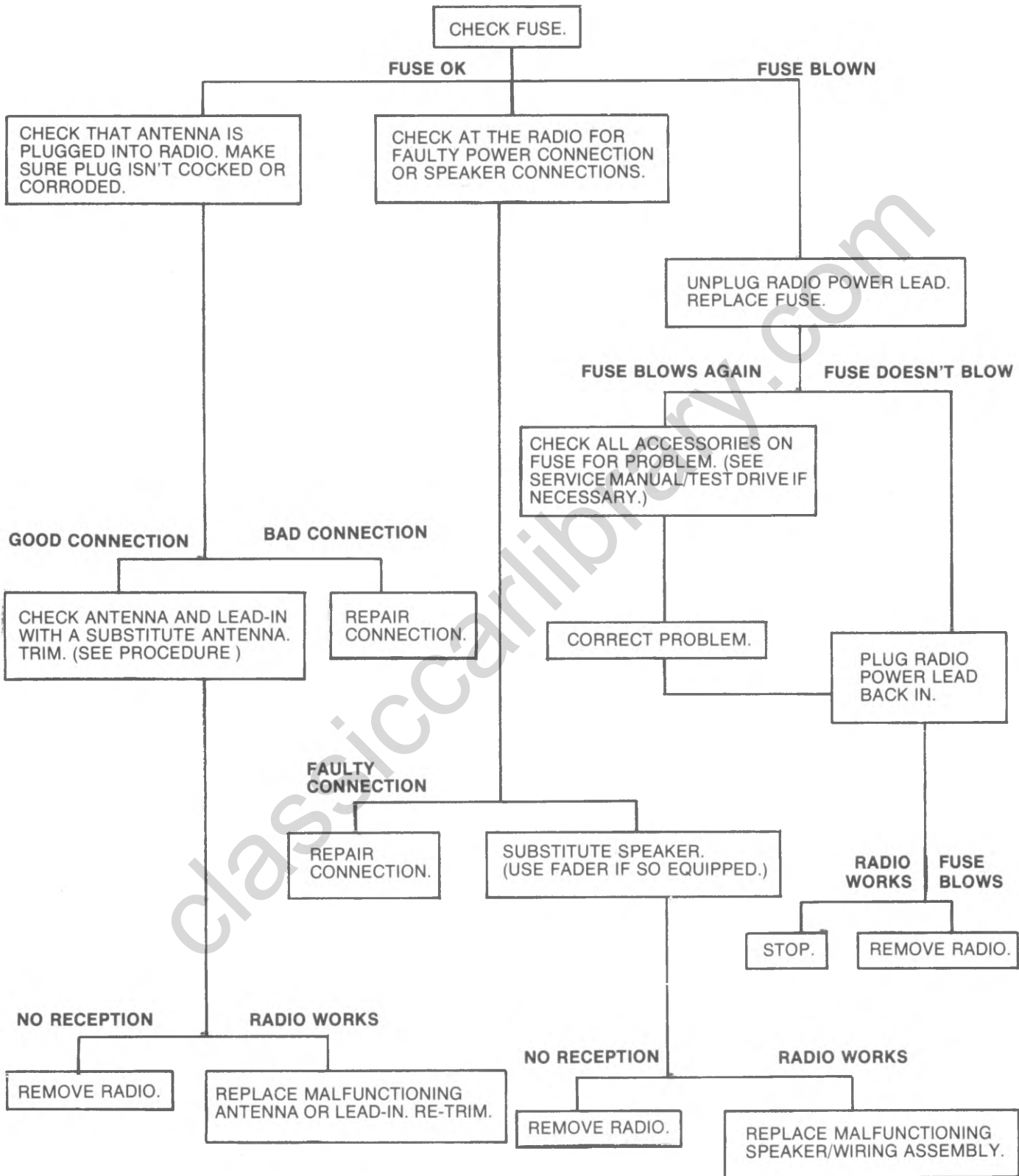
REMOVE PLAYER

INFORM CUSTOMER TO USE GOOD QUALITY TAPES

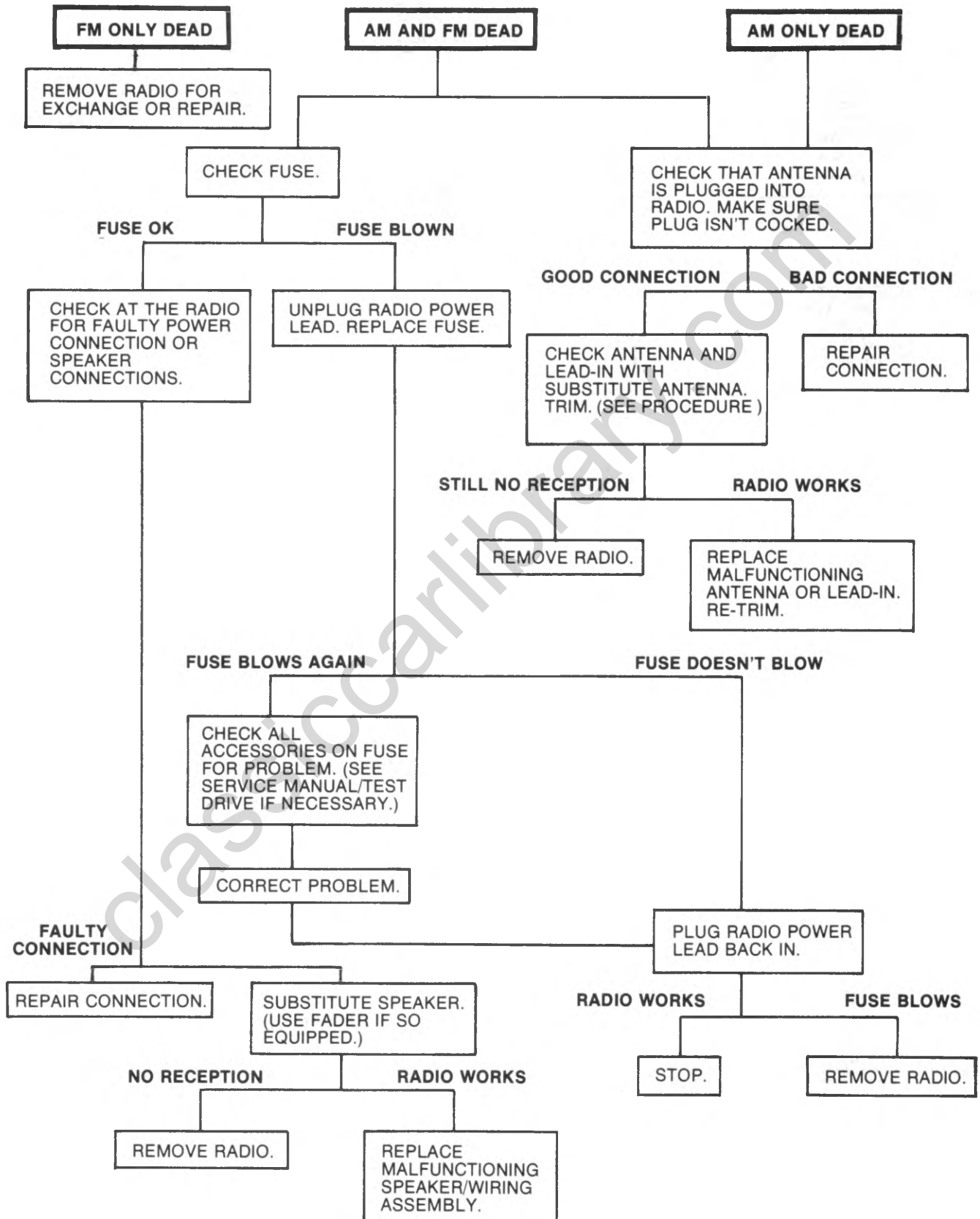
REMOVE UNIT

INFORM CUSTOMER TO USE GOOD QUALITY TAPE

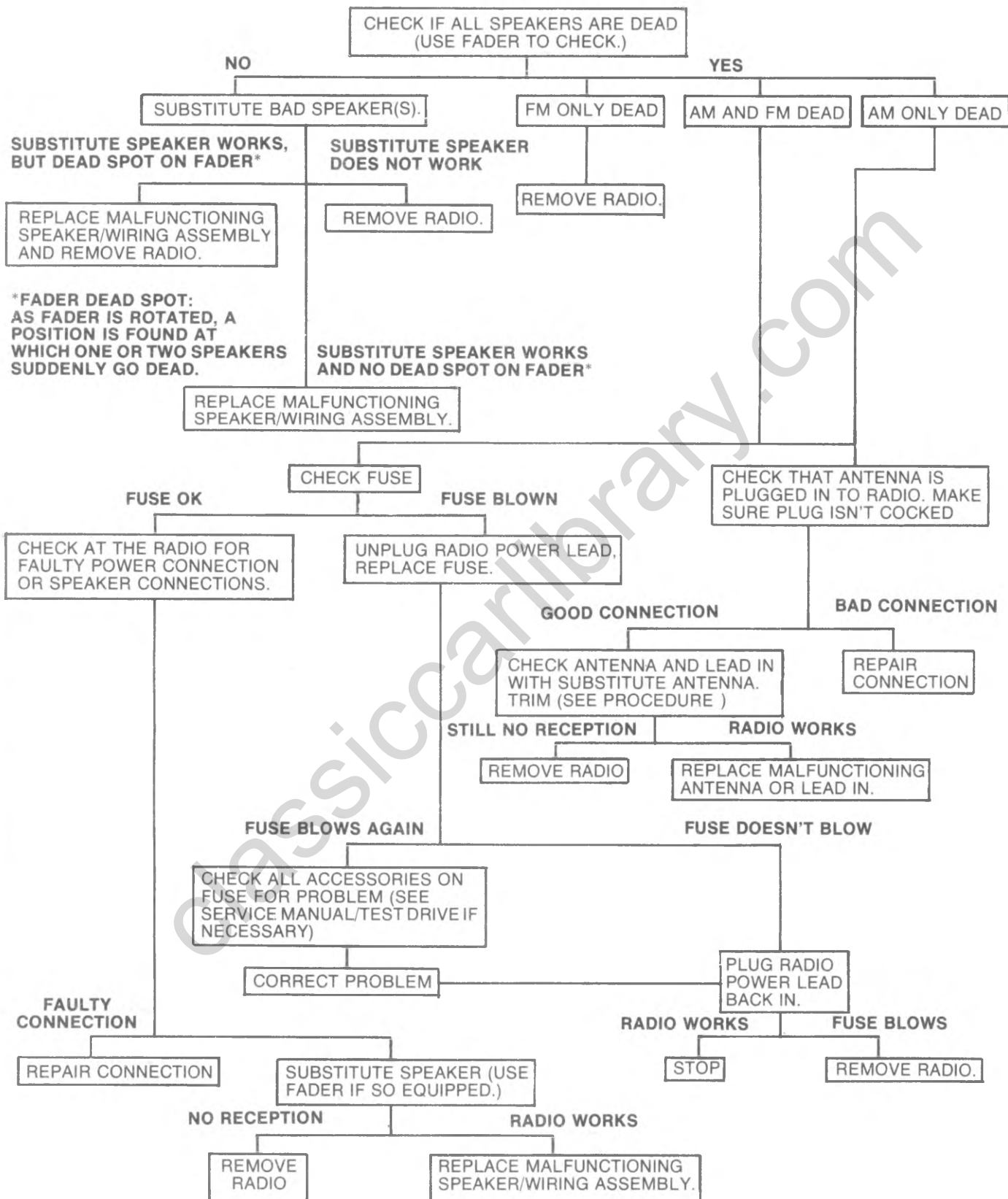
DEAD RADIO — AM RADIO



DEAD RADIO — AM/FM RADIO



DEAD RADIO — AM/FM STEREO



ON-CAR SERVICE

MAINTENANCE AND ADJUSTMENTS

TAPE PLAYER MAINTENANCE

The only required maintenance on tape players is periodic cleaning of the tape player head and capstan. This service should be performed every 100 hours of operation. Since you can reach them through the tape door, you can leave the tape player in the truck.

To clean the head and capstan, use a cotton swab dipped in ordinary rubbing alcohol. Wipe the head and capstan as shown in Figure 9-4R.

No lubricants should be used since they will cause the player to operate improperly, especially at extreme temperatures.

Do not bring any magnetized tools near the tape head. If the head becomes magnetized, every cartridge played in the player will be degraded.

To operate the tape player, completely insert a cartridge into the unit. This turns the tape player on, automatically removes power from the radio, and switches the speakers from the radio to the tape player. This feature prevents accidental damage to the radio should the owner attempt to operate it while the tape player is in use.

After the tape player is in operation, the front panel controls of the player are then adjusted for the most pleasant stereo listening.

The tape player is equipped with a cartridge locking arm to hold the cartridge in a rigid position against the capstan drive for minimum wow and flutter. As the cartridge is withdrawn from the player, the on/off switch at the other side of the cartridge is not completely disengaged when the cartridge lock arm reaches a detent point on the cartridge. Always withdraw the cartridge just beyond the detent point for normal operation from the

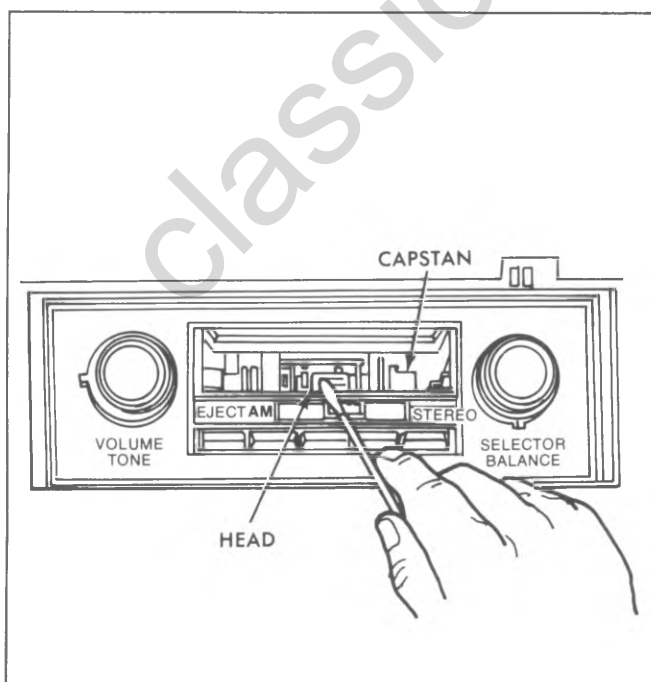


Fig. 9-4R—Cleaning Tape Player Head

radio.

Tape cartridges should be handled carefully and should be kept clean and out of direct sunlight. A cartridge should not be left inserted fully in the player. This may cause permanent damage to the cartridge.

RADIO INSTALLATION PRECAUTIONS

Listed below are common causes of inoperative radio receivers or poor reception on the AM scale upon reinstallation after repair.

- Radio speakers not connected--this could cause the output transistor to burn out in the receiver.
- Antenna lead not plugged into the receiver or windshield.
- Antenna trimmer not peaked.

TRIMMING RADIO

If diagnosis indicates the radio receiver must be trimmed, perform the following procedure:

1. Remove tuner control knob and bezel (right hand knob).
2. Place ignition key in the "ACC" position.
3. Turn volume control to maximum volume.
4. Tune radio to a weak station (near 1400 KC) on the AM scale.
5. Adjust antenna trimmer screw ($\pm 2^\circ$ screw rotation) until maximum volume is received (fig. 9-5R).
6. Turn radio volume off.
7. Replace tuner control bezel and knob.
8. Turn ignition to "lock".

COMPONENT PART REPLACEMENT

RADIO RECEIVER

C-K Models

Replacement (Fig. 9-6R)

1. Disconnect battery ground cable.
2. Pull off radio control knobs and remove knob bezels. Remove nuts and washers from control shafts using a deep well socket.
3. **AM Radio** -Remove the radio support bracket stud

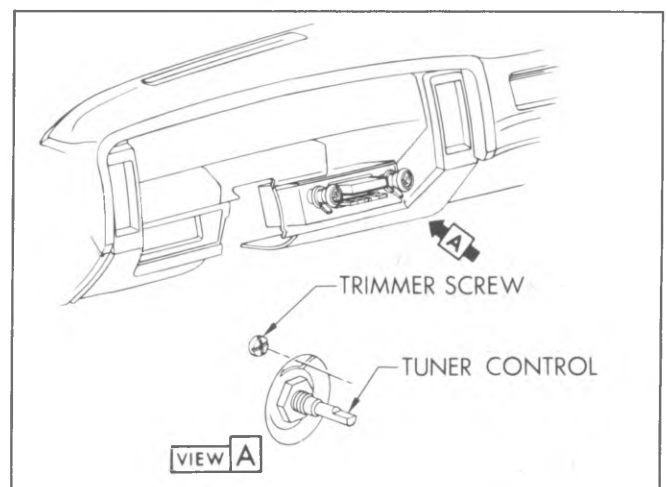


Fig. 9-5R—Trimming Radio

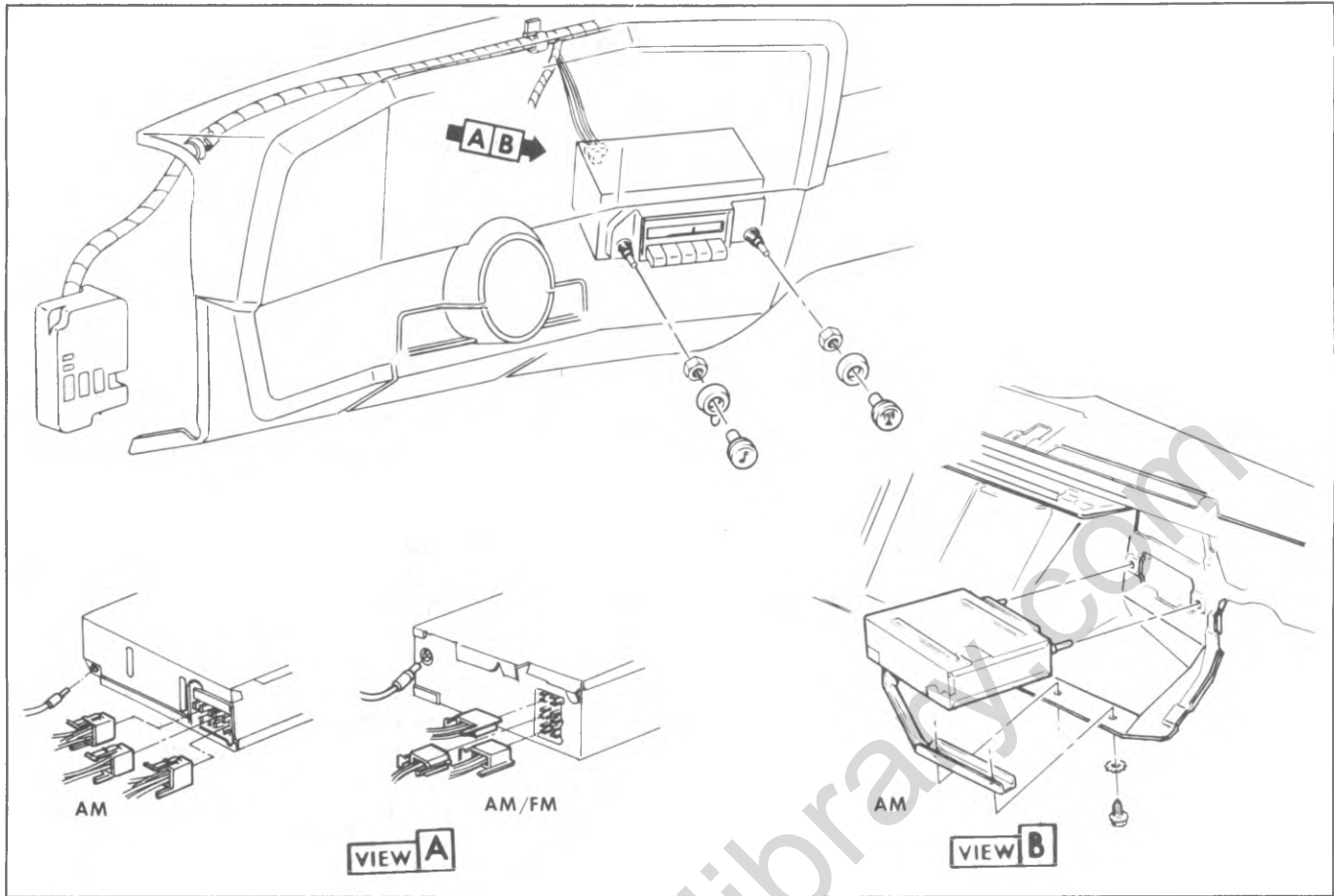


Fig. 9-6R--Radio Receiver (C-K Models)

nut and lockwasher.

AM/FM Radio -Remove radio support bracket to instrument panel screws.

4. Lift up on the rear edge of radio. Then push radio forward until control shafts clear instrument panel. Lower control far enough to disconnect electrical harness.

5. Disconnect power feed, speaker and antenna lead wires and remove radio.

6. To install, reverse Steps 1-5 above.

G Models

Replacement (Fig. 9-7R)

1. Disconnect battery ground cable.
2. Remove engine cover.
3. Remove air cleaner cover and element.
4. Remove radio control knobs and retaining nuts.
5. Remove rear mounting bracket.
6. Push radio forward in vehicle and then lower assembly and disconnect electrical harnesses and antenna lead.
7. Remove radio receiver from vehicle.
8. To install, reverse Steps 1-7 above.
9. Check operation.

CAUTION: Always attach speaker wiring harness before applying power to the radio to prevent receiver damage.

RADIO DIAL BULB

AM and AM/FM radio dial bulbs can be replaced with the radio in the truck. Tape player radios must be removed from the vehicle for dial bulb replacement.

Replacement (All Models)

AM Radio

1. Slide radio dial lens upward, approximately 1/8 inch.
2. Tip bottom edge of lens outward (toward technician) and remove lens.
3. Pull out bulb section and remove bulb.
4. Install new bulb into socket and then reinstall bulb section.
5. Reinstall dial lens.

AM-FM And Stero Radio

1. Slide radio dial lens upward approximately 1/8 inch.
2. Tip bottom edge of lens outward (toward technician) and remove lens.
3. Remove rear dial plate screw. Place dial pointer at 16 and remove plate.
4. Remove bulb.
5. To install, reverse steps 1-4 above.

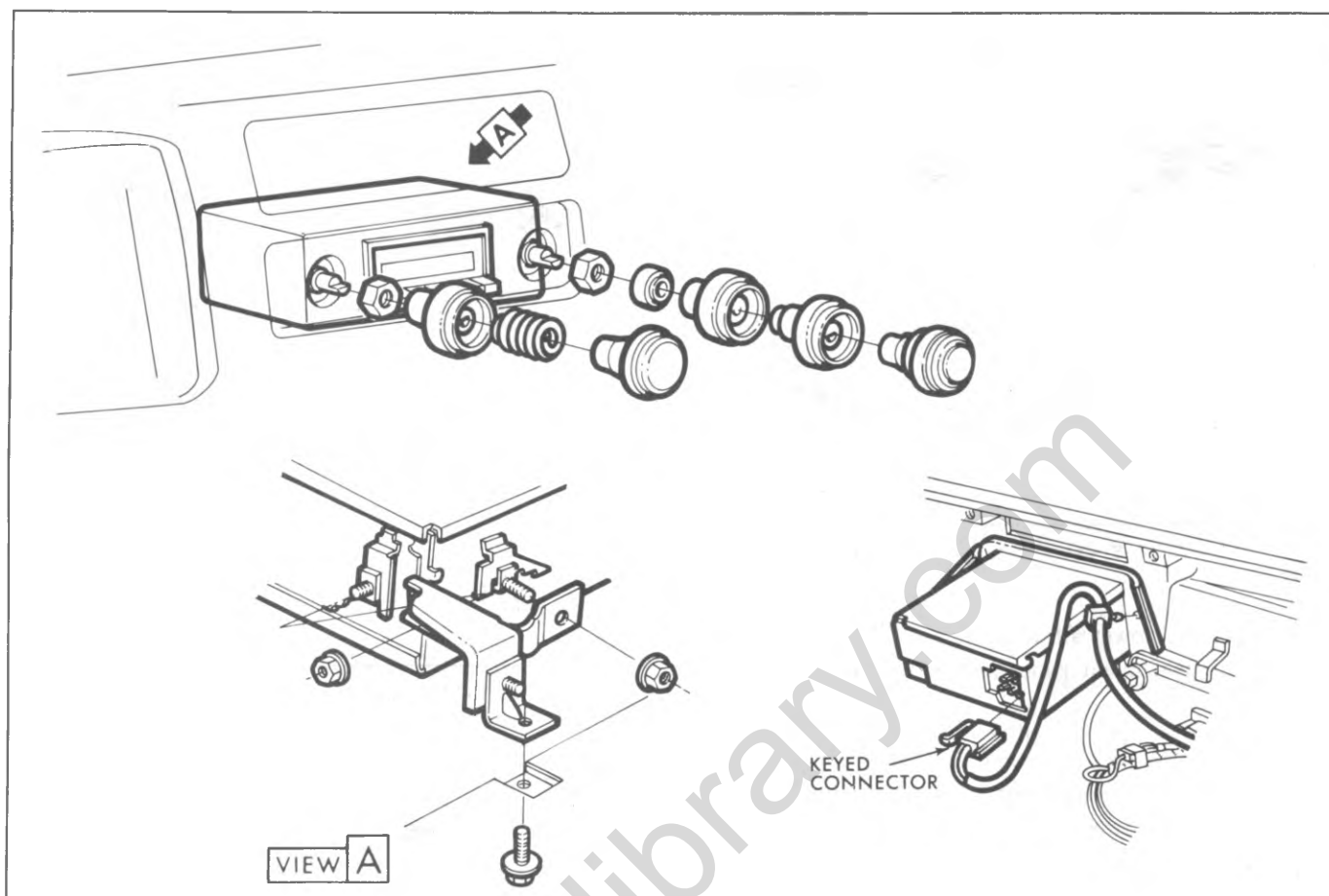


Fig. 9-7R--Radio Receiver Installation--G Models

Tape Player Radio

1. Remove radio from vehicle.
2. Remove radio top cover.
3. Remove bulb.
4. To install, reverse steps 1-3 above.

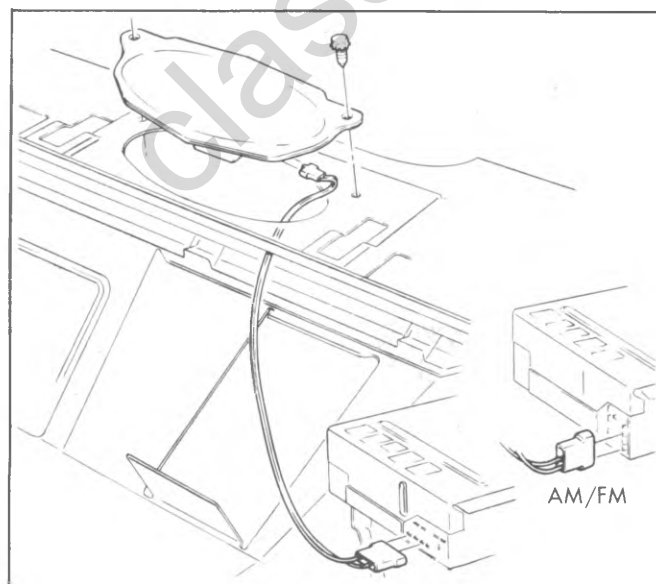


Fig. 9-8R--Radio Front Speaker (C-K Models)

FRONT SPEAKER**C-K Models****Replacement (Fig. 9-8R)**

1. Disconnect battery ground cable.
2. Remove instrument cluster bezel upper four screws.
3. Remove instrument panel pad screws and remove pad.
4. Remove speaker to dash panel screws.
5. Lift up on speaker, disconnect speaker wiring harness and then remove speaker.
6. To install, reverse Steps 1-5 above.

G Models**Replacement (Fig. 9-9R)****G Models--Left Side**

1. Disconnect battery ground cable.
2. Remove instrument panel bezel.
3. Remove instrument cluster.
4. Remove speaker attaching screws, disconnect wiring harness and remove speaker.
5. To install, reverse Steps 1-4 above.
6. Check operation.

G Models--Right Side

1. Disconnect battery ground cable.
2. Remove engine cover.
3. Remove steering column brace bolts.
4. Remove radio support bracket bolt and instrument

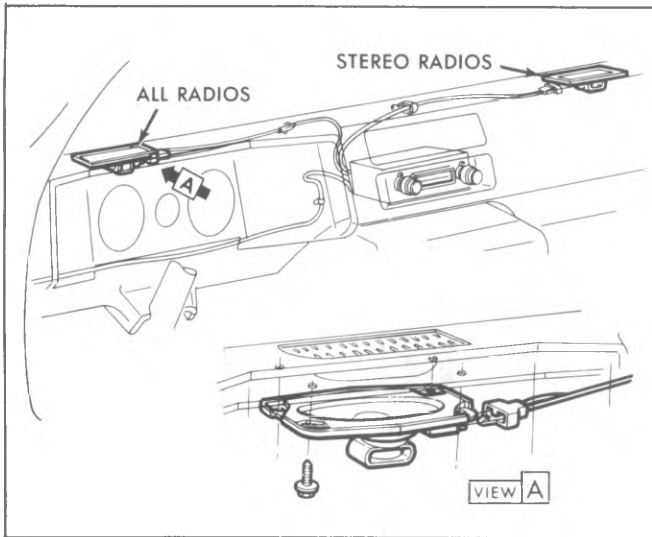


Fig. 9-9R--Speaker Installation--G Models

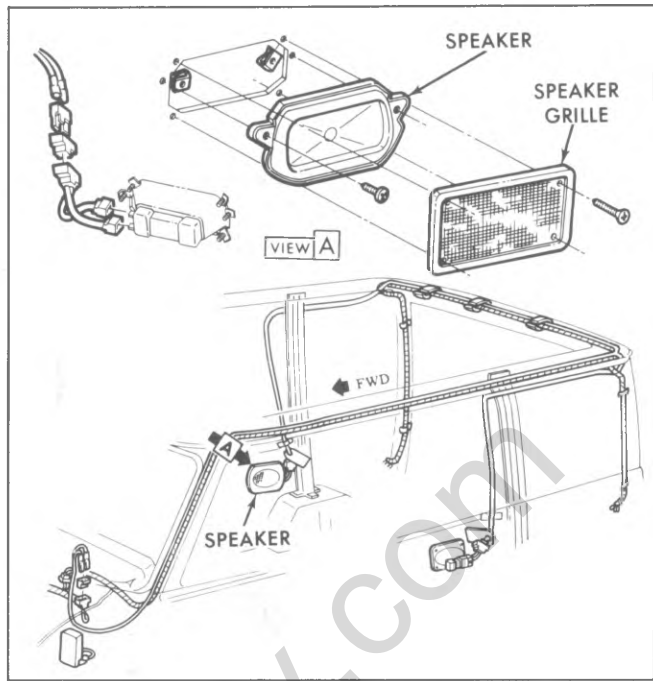


Fig. 9-11R--Rear Speaker (G (05) Truck)

panel upper and lower attaching screws.

5. Pull instrument panel assembly rearward to gain access to speaker.

6. Remove speaker attaching screws, disconnect speaker wiring harness and remove speaker.

7. To install, reverse Steps 1-6 above.

8. Check operation.

REAR SPEAKER

C-K Models

Replacement (Fig. 9-10R)

1. Remove four screws securing speaker grille to trim panel and remove grille.

2. Disconnect electrical connector from speaker.

3. Remove two screws securing speaker to trim panel and remove speaker.

NOTE: On 109 and 209 (06) models, there is a gasket between speaker and trim panel.

4. Install replacement speaker in reverse order of removal.

G Models

Replacement (Figs. 9-11R and 9-12R)

1. Remove the four most forward lower screws securing right rear trim panel. Pull trim panel outward slightly for access to speaker.

2. Disconnect electrical connector from speaker.

3. Remove four nuts securing speaker to grille studs and remove speaker.

4. Install replacement speaker in reverse order of removal.

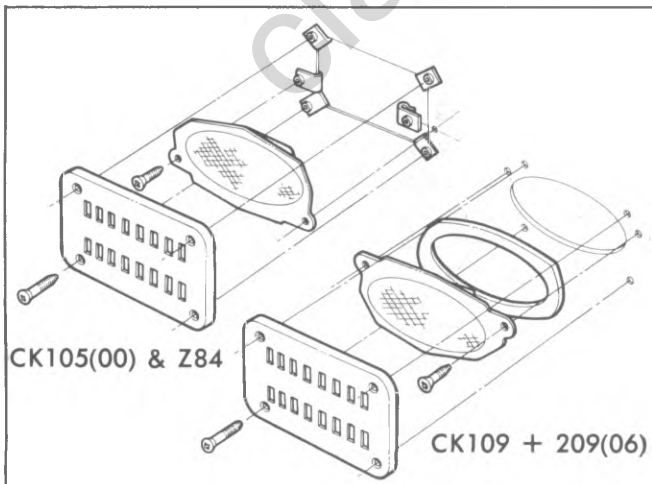


Fig. 9-10R--Rear Speaker (C-K Models)

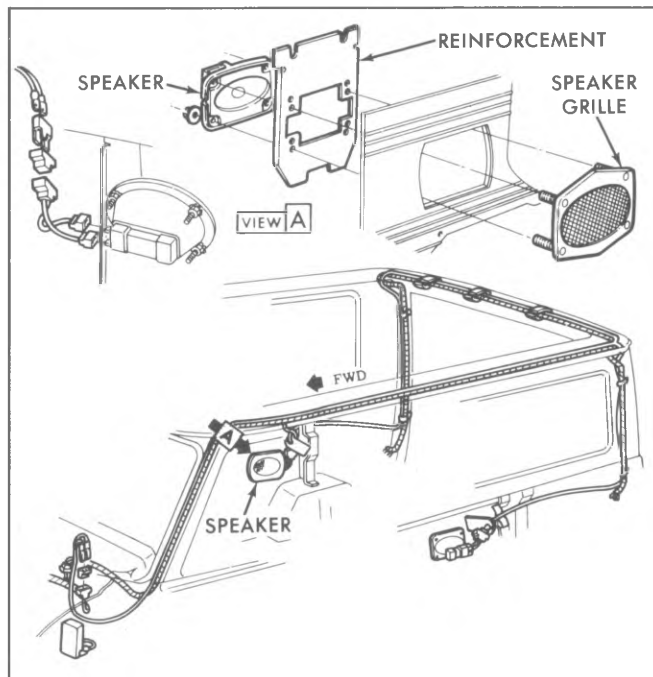


Fig. 9-12R--Rear Speaker (G (06) Truck)

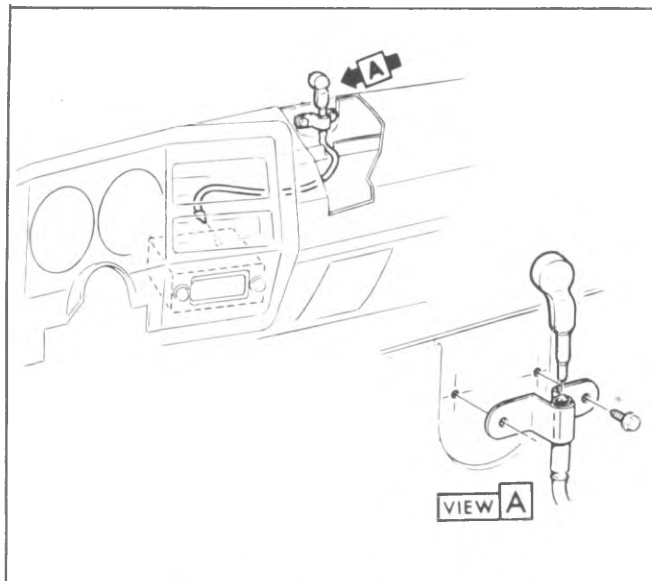


Fig. 9-13R--Antenna Lead (C-K Models)

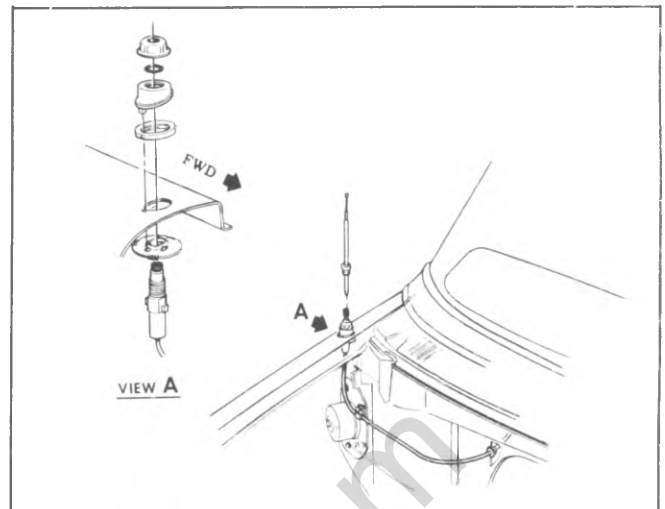


Fig. 9-14R--Antenna Installation (G Models)

ANTENNA

C-K Models (Fig. 9-13R)

Antenna Replacement

Refer to Section 2 of this manual "Windshield Replacement" procedure.

Cable Replacement

1. Disconnect battery ground cable.
2. Unsnap antenna cable from windshield.
3. Remove bracket to dash panel screws.
4. Disconnect cable at rear of radio receiver and remove cable assembly.

G Models (Fig. 9-14R)

Antenna Replacement

1. Unscrew mast nut. Prevent the cable assembly from turning by using two separate wrenches. Remove rod and mast assembly.

2. To install, insert rod and mast assembly into cable assembly and tighten mast nut. Prevent cable assembly from turning by using a second wrench.

Cable Assembly Replacement

1. Disconnect battery ground cable.
2. Remove antenna assembly as described above.
3. Remove cable body nut and then remove seal, bezel, gasket and ring ground.
4. Perform Steps 2-8 of "Radio Receiver Removal".
5. Disconnect cable at rear of receiver.
6. Insert new cable through the dash panel (from the forward side).
7. Reverse Steps 1-5 above to complete installation.

NOTE: Be sure cable grommet is properly positioned in dash panel.

SPECIAL TOOLS

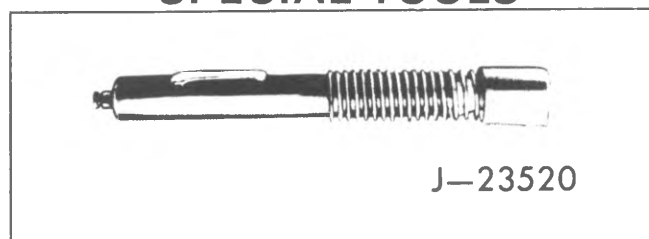
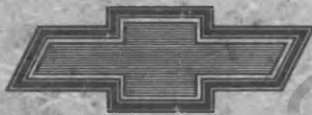


Fig. 9-15R--Windshield Antenna Tester (J-23520)



CHEVROLET

SERVICE