

CHEVROLET

1974

CHEVROLET

**PASSENGER
CARS
AND
LIGHT DUTY
TRUCKS**

**OVERHAUL
MANUAL**

ST 333-74

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IMPORTANT SAFETY NOTICE

Proper service and repair is important to the safe, reliable operation of all motor vehicles. The service procedures recommended by Chevrolet and described in this service manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended.

It is important to note that some warnings against the use of specific service methods that can damage the vehicle or render it unsafe are stated in this service manual. It is also important to understand these warnings are not exhaustive. Chevrolet could not possibly know, evaluate and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, Chevrolet has not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Chevrolet must first satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects.

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1974

OVERHAUL MANUAL

covering

CHEVROLET, CHEVELLE, MONTE CARLO, NOVA, CAMARO, CORVETTE

and

LIGHT DUTY (SERIES 10-30)

CHEVROLET TRUCKS

FOREWORD

This manual includes procedures involved in disassembly and assembly of major components of 1974 Chevrolet, Chevelle, Monte Carlo, Nova, Camaro, Corvette and Light Duty Trucks. Information on theory of operation, diagnosis, maintenance and adjustments, minor service operations, and removal and installation for these components is contained in either the 1974 Passenger Car or Light Duty Truck Service Manuals.

The Section Index on this 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, are found at the end of major sections, while Specifications covering vehicle components are presented at the rear of the manual.

This manual should be kept in a handy place for ready reference. If properly used, it will enable the technician to better service 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.

CHEVROLET MOTOR DIVISION

General Motors Corporation
DETROIT, MICHIGAN

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AIR CONDITIONING COMPRESSOR

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For all practical purposes all vehicles make use of the same air conditioning compressor. Actual differences between compressors are found in their mounting brackets, pulleys, connector assemblies and compressor capacities, none of which affect the following Overhaul Procedures.

MINOR REPAIR PROCEDURES

The following operations to the Hub and Drive Plate, Pulley and Bearing, and Coil Housing are covered as "Minor" because they may be performed without first purging the system or removing the compressor from the vehicle. The shaft seal assembly, pressure relief valve and superheat switch, may also be serviced without removing the compressor from the vehicle but these operations are covered later in this section as "Major Repair Procedures" because the system must first be purged of refrigerant.

Illustrations used in describing these operations show the compressor removed from the vehicle to more clearly illustrate the various operations.

Hub and Drive Plate

Removal

1. If disassembly is being performed on a bench, mount Holding Fixture J-9396 in a vise and attach the compressor to the fixture.
2. Using Clutch Hub Holding Tool J-9403 and Socket J-9399, remove the locknut from the shaft (fig. 2). Discard locknut.
3. Tool J-9401 may now be used to remove the hub and drive plate assembly (fig. 3).

NOTE: Carefully snug tool into place with wrench to insure engagement with threads.

4. Use Snap Ring Pliers J-5403 to remove the retainer ring (Item 39, fig. 1). Then remove the hub spacer.

Inspection

If the frictional surface shows signs of damage due to

excessive heat, the hub and drive plate and the pulley should be replaced. Check further for the underlying cause of the damage, i.e. low coil voltage or binding of the compressor internal mechanism.

Installation

NOTE: When hub and drive plate assembly is ready for installation, clean its frictional face with a suitable cleaner.

1. Insert the square hub and drive plate key into the keyway in the drive shaft allowing it to project approximately 3/16" out of the end of the keyway (fig. 4).
2. Line up the key in the shaft with the keyway in the hub.
3. Using Tool J-9480 and Washer J-9480-2 (fig. 5), install the hub and drive plate assembly. Pull the assembly onto the shaft until there is approximately 3/32" space between the frictional surfaces of the drive plate and pulley. (A ZERO thrust race is approximately 3/32" thick and may be used to roughly gauge this operation.)

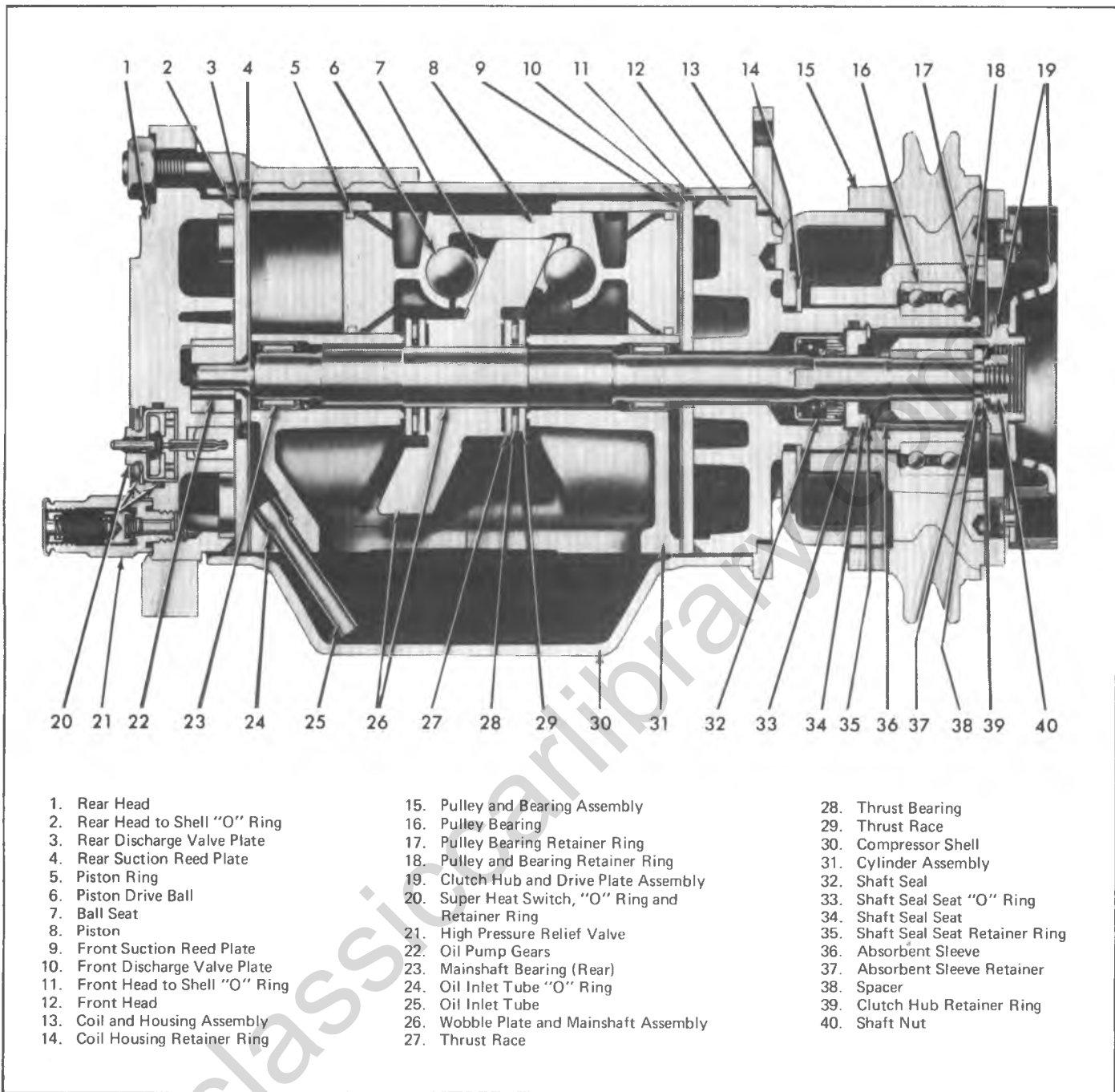
NOTE: Use Tool J-9403 to hold hub and drive plate if necessary.

4. Install the hub spacer washer and, using Snap Ring Pliers J-5403, install the retainer ring (Item 39, fig. 1), convex side of ring facing washer.
5. Use Tools J-9399 and J-9403 to install a new locknut. Tighten the nut to 14-26 ft. lbs. torque. Air gap between the frictional faces should now be .022" to .057".

NOTE: The shoulder or circular projection on the locknut must face towards retainer ring.

6. The pulley should now rotate freely.

CAUTION: Never pound or drive the hub and drive plate into position. Always use the proper tools when removing or replacing clutch parts. Failure to do so may result in serious internal



- | | | |
|----------------------------------|---|-----------------------------------|
| 1. Rear Head | 15. Pulley and Bearing Assembly | 28. Thrust Bearing |
| 2. Rear Head to Shell "O" Ring | 16. Pulley Bearing | 29. Thrust Race |
| 3. Rear Discharge Valve Plate | 17. Pulley Bearing Retainer Ring | 30. Compressor Shell |
| 4. Rear Suction Reed Plate | 18. Pulley and Bearing Retainer Ring | 31. Cylinder Assembly |
| 5. Piston Ring | 19. Clutch Hub and Drive Plate Assembly | 32. Shaft Seal |
| 6. Piston Drive Ball | 20. Super Heat Switch, "O" Ring and Retainer Ring | 33. Shaft Seal Seat "O" Ring |
| 7. Ball Seat | 21. High Pressure Relief Valve | 34. Shaft Seal Seat |
| 8. Piston | 22. Oil Pump Gears | 35. Shaft Seal Seat Retainer Ring |
| 9. Front Suction Reed Plate | 23. Mainshaft Bearing (Rear) | 36. Absorbent Sleeve |
| 10. Front Discharge Valve Plate | 24. Oil Inlet Tube "O" Ring | 37. Absorbent Sleeve Retainer |
| 11. Front Head to Shell "O" Ring | 25. Oil Inlet Tube | 38. Spacer |
| 12. Front Head | 26. Wobble Plate and Mainshaft Assembly | 39. Clutch Hub Retainer Ring |
| 13. Coil and Housing Assembly | 27. Thrust Race | 40. Shaft Nut |
| 14. Coil Housing Retainer Ring | | |

Fig. 1--Six Cylinder Compressor--Cross Sectional View

compressor damage and seal leakage due to shift of crankshaft.

7. Operate the refrigeration system and rapidly cycle the clutch (by turning the air conditioning off and on at least 20 times at approximately one second intervals) to seat the mating parts of the clutch.

Pulley and Bearing Assembly

Removal

1. Remove the hub and drive plate assembly.

2. Using Snap Ring Pliers J-6435, remove the pulley and bearing retainer ring (fig. 6).
3. Remove shaft key.
4. Place Puller Pilot J-9395 over the compressor shaft and pull off the pulley assembly using J-8433 pulley puller (fig. 7).

Inspection

Check the appearance of the pulley and bearing assembly. If the frictional surface of the pulley shows



Fig. 2--Removing Shaft Locknut

signs of excessive grooving due to slippage, both the pulley and the clutch hub and drive plate assembly should be replaced. The frictional surfaces of the pulley and bearing assembly should be cleaned with a suitable solvent before reinstallation.

Bearing Replacement

1. With the pulley and bearing assembly removed from the compressor, use a sharp pointed instrument to remove the wire retainer ring.

CAUTION: *If the bearing is to be reused be careful not to slip and damage the seal.*

2. From the rear of the pulley, press or drive bearing out of pulley using Tool J-9398 and Handle J-8092.
3. From the front of the pulley and using Tool J-9481 with Handle J-8092, press or drive the new bearing into the pulley.

Installation

1. Using Tool J-9481, press or drive the pulley and bearing assembly onto the compressor neck. The pulley should now rotate freely.
2. Install retainer ring using Snap Ring Pliers J-6435.
3. Install the wire bearing retainer ring.
4. Replace the hub and drive plate assembly. Use proper tools. **DO NOT** drive or pound on the hub assembly.

Coil Housing Assembly

Removal

1. Remove the hub and drive plate assembly, the pulley and bearing assembly, and electrical connector.
2. Scribe the location of the coil housing to the



Fig. 3--Removing Hub and Drive Plate Assembly



Fig. 4--Drive Plate Key Installed in Keyway

compressor body. This operation is to insure that the electrical terminals will be reassembled in the same position.

3. Using Snap Ring Pliers J-6435, remove the coil housing retainer ring (fig. 8).
4. Remove the coil housing assembly.

Inspection

Check coil for loose connectors or cracked insulation. Amperage should not be more than 3.2 amps at 12 volts D.C. at room temperature.

Installation

1. Rotate the coil housing to the correct position as indicated by the scribe marks and the location of the electrical terminals and fit into place (fig. 9).
2. Use Snap Ring Pliers J-6435 to install retainer ring.

NOTE: Install flat surface of the retainer ring facing the coil housing.

3. Replace the pulley and bearing assembly and the hub and drive plate assembly. **DO NOT** drive or pound on the hub assembly.
4. If the compressor is installed in the vehicle, connect the electrical connections.



Fig. 5--Installing Hub and Drive Plate Assembly



Fig. 6--Removing Pulley and Bearing Assembly Retainer Ring



Fig. 7--Removing Pulley

MAJOR REPAIR PROCEDURES

The following service procedures are considered major since the refrigeration system must be completely purged of refrigerant before proceeding and/or because major internal operating and sealing components of the compressor are being disassembled and serviced. A clean workbench, preferably covered with a sheet of clean paper, orderliness in the work area and a place for all parts being removed and replaced is of great importance as is the use of the proper, clean service tools. Any attempt to use make-shift or inadequate equipment may result in damage and/or improper compressor operation.

These procedures are based on the use of the proper service tools and the condition that an adequate stock of service parts is available. Service parts stock should include the following:

1. Major interior mechanism assembly--ready for installation in shell as is.
2. Service cylinder assembly--front and rear halves with main bearings in place and halves dowel pinned together.
3. Piston drive balls.
4. Ball seats--total of 10 sizes, including the ZERO seat.
5. Thrust races--total of 14 sizes, including the ZERO race.
6. Pistons--low and high compression.
7. Piston rings.
8. Main shaft bearings.

9. Thrust bearings.
10. Compressor shaft and wobble plate.
11. Suction reed valves.
12. Discharge valve plate--front and rear.
13. Compressor front head.
14. Compressor rear head.
15. Pulley and pulley bearing.
16. Clutch hub and drive plate assembly.
17. Seal kit--service--contains all seals and "O" rings.(a)
18. Shaft seal kit.(a)
19. Nuts--head to shell, and shaft.(a)
20. Retainer rings--all necessary sizes.
21. Cylinder locator (dowel) pins.



Fig. 8--Removing Coil Housing Retainer Ring

22. Valve and head locator (dowel) pins.
23. Service discharge crossover tube kit.

(a) To be used each time a compressor is rebuilt.

All parts required for servicing are protected by a preservation process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the mechanism assembly just as they are removed from the service package.

Piston ball seats and shaft thrust races will be identified on the parts themselves to denote their size and dimension.

Shaft Seal Assembly

When replacing the shaft seal assembly, even if the compressor remains on the vehicle during the operation, it will be necessary to purge the system of refrigerant as outlined in the Service Manual.

Removal

1. After first purging the system of refrigerant, remove the clutch hub and drive plate, and the shaft key.
2. Pry out the sleeve retainer and remove the absorbent sleeve. Remove the seal seat retaining ring using Snap Ring Pliers J-5403.
3. Thoroughly clean the area of the compressor neck surrounding the shaft, the exposed portion of the seal seat, and the shaft itself of any dirt or foreign material before removing the seal seat.



Fig. 9--Installing Coil Housing

4. Place Tool J-22974 over the end of the shaft to prevent chipping the ceramic seat. Fully engage the knurled tangs of Tool J-23128 into the recessed portion of the seal seat by turning the handle clockwise. Lift the seat from the compressor with a rotary motion (fig. 11).

CAUTION: *DO NOT* tighten the handle with a wrench or pliers; however, the handle must be hand tightened securely to remove the seat.

5. With Tool J-22974 still over the end of the shaft, engage the tabs on the seal assembly with the tangs on Tool J-9392 by twisting the tool clockwise while pressing the tool down. Then lift the seal assembly out.
6. Remove the seal seat "O" ring from the compressor neck using Tool J-9553 (fig. 11).
7. Recheck the shaft and inside of the compressor neck for dirt or foreign material and be sure these areas are perfectly clean before installing new parts.

Inspection

Seals should not be reused. Always use a new seal kit on rebuild. Be extremely careful that the face of the seal to be installed is not scratched or damaged in any way. Make sure that the seal seat and seal are free of lint and dirt that could damage the seal surface.

1-6 AIR CONDITIONING COMPRESSOR

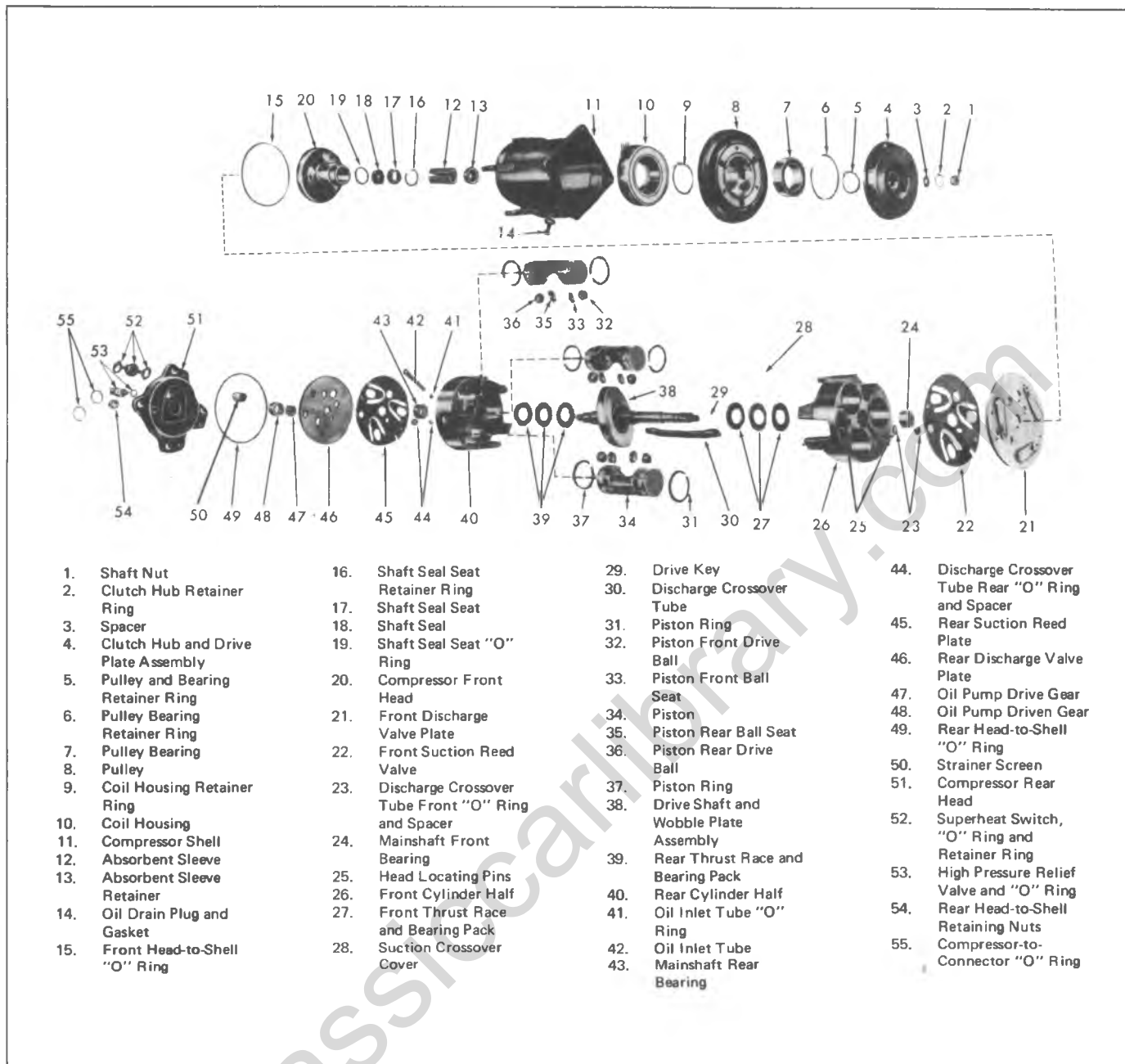


Fig. 10--Six Cylinder Compressor--Exploded View

Apparent seal leaks are sometimes the result of mispositioning of the wobble plate on the compressor shaft caused by improper procedures during pulley removal, pounding or dropping on the compressor shaft or collision impact. Check as shown in Figure 12. If measurement is greater than shown, replace the shaft and wobble plate assembly.

Installation

1. Coat the new shaft seal seat "O" ring with clean Frigidaire 525 viscosity refrigeration oil (or equivalent) and install in the compressor neck groove using Tool J-21508 (fig. 13).

NOTE: Refrigeration oil has been specially

dehydrated and therefore has a great affinity for the moisture in the atmosphere. NEVER leave the refrigeration oil bottle uncapped for more than a few moments or oil contamination will result.

2. Coat the "O" ring and seal face of the new shaft seal assembly with clean refrigeration oil and carefully engage the seal assembly onto the locking tangs of Tool J-9392 (fig. 13). Place shaft Seal Protector J-22974 over the end of the shaft and slide the seal down the shaft, turning the tool clockwise and applying light pressure until the seal assembly engages the flats on the shaft and is seated in place. Rotate the tool counter-clockwise

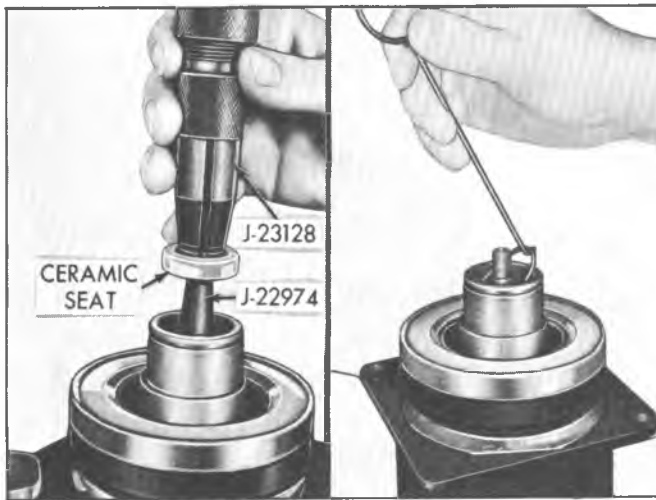


Fig. 11--Removing Seal Seat and "O" Ring

slightly (to release it from the seal) and remove Tool J-9392.

3. Coat the seal face of the new seal seat with clean refrigeration oil. Grip the seal seat with Tool J-23128 and push into place with a rotary motion, so as not to disturb the "O" ring and to also effect a seal with this "O" ring. Remove Tool J-23128.
4. Install the new seal seat retainer ring with Tool J-5403, with the flat face against the seal seat. Press on the retainer ring until it snaps into place. Remove Tool J-22974 from the end of the shaft.
5. Leak test the compressor as described under "Leak Testing the Compressor" in this section. Correct any leaks found.
6. Install the new absorbent sleeve by rolling the material into a cylinder, overlapping the ends, and slipping the sleeve into the compressor neck with the overlap toward the top of the compressor. With a small screw driver or similar instrument, carefully spread the sleeve until the ends of the sleeve butt at the top vertical centerline.
7. Position the new metal sleeve retainer so that its flange face will be against the front end of the sleeve. Tool J-9395 may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place (retainer recessed approximately $1/32$ " from the face of the compressor neck).
8. Reinstall the clutch hub and drive plate assembly.

Compressor Rear Head and Internal Mechanism

Service operations to the rear head or internal mechanism of the compressor should be performed with the compressor removed from the vehicle to insure that the necessary degree of cleanliness may be maintained. Clean hands, clean tools and a clean bench, preferably covered with clean paper, are of extreme importance.

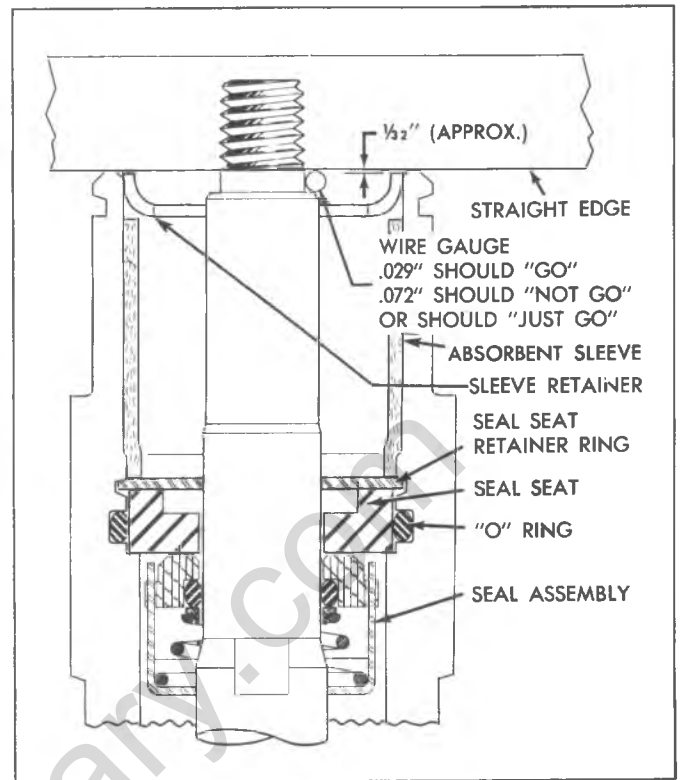


Fig. 12--Checking for Wobble Plate Position on Shaft

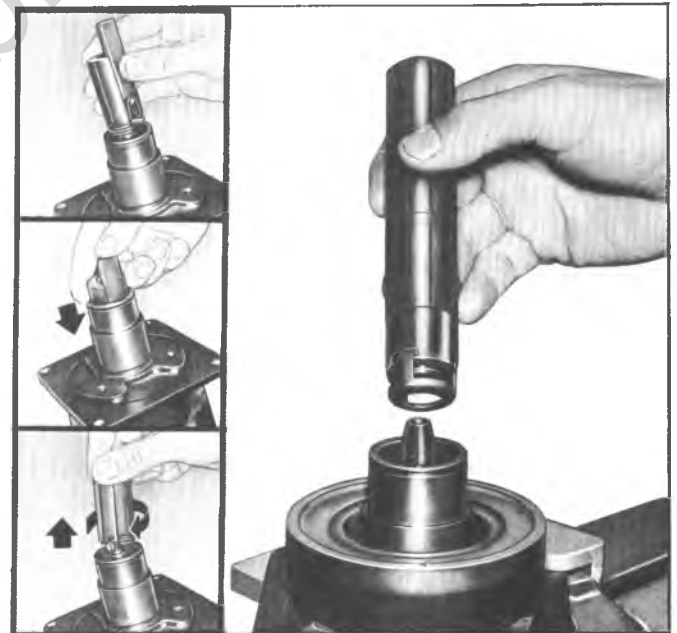


Fig. 13--Replacing Seal and "O" Ring

Pressure Relief Valve

When a faulty pressure relief valve, located in the rear head casting, is encountered, the valve assembly should be removed after purging the system and a new valve and gasket installed. The entire system should then be evacuated and recharged.

1-8 AIR CONDITIONING COMPRESSOR

Superheat Switch

If it becomes necessary to replace the superheat switch, located in the rear head casting, the switch assembly should be removed only after purging the system. After the switch has been replaced and a new "O" ring seal installed, the system should be evacuated and recharged.

Rear Head, Oil Pump and Valve Assemblies Removal

1. Remove the compressor from the vehicle, drain compressor oil into a clean container, clean the exterior of the compressor case and rear head casting with a suitable solvent and mount the compressor, rear head up, in Holding Fixture J-9396 which should then be mounted securely in a vise.
2. Remove the four nuts from the shell studs.
3. Remove the rear head. Examine the sealing surface of the casting webs. If this surface is damaged by nicks or scratches, the head should be replaced.
4. Examine the suction screen in the rear head for any damage or contamination. Clean or replace the screen as necessary.
5. Remove and examine the oil pump gears. If either of the gears shows any wear or damage, replace both gears.

NOTE: Keep the ends of the two oil pump gears matched and replace the same end toward the discharge plate upon reassembly.

6. Remove the rear head-to-shell "O" ring and discard.
7. With two screw drivers, carefully pry up on the rear discharge valve plate assembly (fig. 14). Check for broken reeds or damaged seats and replace entire assembly if such is found.

CAUTION: Excessive force during this operation may loosen valve reed retainer rivets.

8. Carefully lift off the rear suction reed valve. Valve must be replaced if any damage is evident.

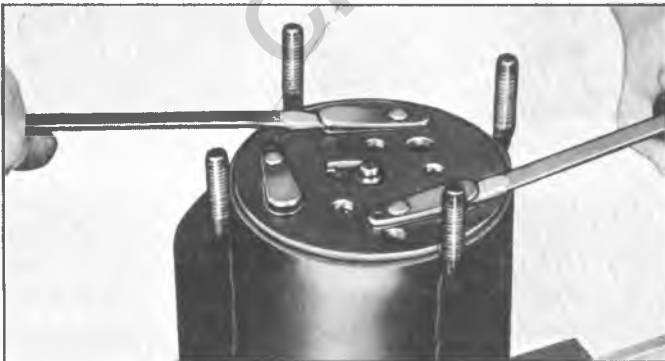


Fig. 14-Removing Rear Discharge Valve Plate



Fig. 15-Proper Oil Pump Gear Positioning

Installation

1. Carefully replace the suction reed valve and the rear discharge plate over the dowel pins and ports in the cylinder assembly. Proper positioning of the reed plate may be determined by lining up the proper opening in the plate with the discharge crossover tube opening.
2. Position the rear head casting to align with the dowel pins. The two lower mounting pads will be in alignment with the oil sump in the shell. Rotate the cylinder assembly back and forth by hand, if necessary, to permit this alignment. Remove the rear head from this trial assembly.
3. Install the inner oil pump gear over the "D" flat on the shaft and place the outer oil pump gear over the inner gear. Position the outer gear as follows:
 - a. Observe the position of the oil sump in the shell.
 - b. Locate the approximate centerline of this sump.
 - c. Facing the centerline of the sump and viewing from the sump side (bottom) of the compressor, move the OUTER gear toward the right (side having the oil drain fitting) until it is at approximately 90 degrees (3 o'clock position) from the centerline of the oil sump (fig. 15).
4. Coat the head-to-shell "O" ring with clean refrigeration oil and generously lubricate the area around the outer edge of the valve plate where the "O" ring will be placed. Oil also the oil pump

gears, valve reeds and the area where the head casting web sealing surface will contact the valve plate.

5. Install the head-to-shell "O" ring.
6. Be sure that the suction screen is properly positioned in the rear head, then assemble the rear head to the compressor shell being careful not to damage the sealing surface of the head casting webs.

CAUTION: Be sure head does not bind against oil pump gears when being installed.

7. Install new nuts to the threaded shell studs and tighten to 19-25 ft. lbs. torque.
8. Leak test the compressor as outlined under "Leak Testing the Compressor" in this section.
9. Install compressor in the vehicle.

Major Internal Mechanism

The clutch hub and drive plate assembly, drive key, pulley, and coil housing and shaft seal should be removed before proceeding with the following compressor disassembly.

Removal from Shell

1. Remove the rear head, discharge plate and suction reed valve from the compressor as outlined under "Rear Head and Reed Valve Assemblies."
2. Remove the oil inlet tube and "O" ring with Tool J-5139 as shown in Figure 16.
3. Carefully lay the compressor shell on its side and slide out interior mechanism and front head assembly. DO NOT hammer or use undue force to remove the mechanism; however, gentle taps on the head casting may aid in removing the assembly.

CAUTION: DO NOT hammer or tap on the compressor shaft.

4. Remove front head casting, front discharge valve plate and suction reed valve from the mechanism. Examine parts for damage and replace if necessary. Check particularly for damage to the sealing surfaces of the front head casting webs.
5. Examine the mechanism for any obvious damage.
6. Remove the suction crossover cover (fig. 17).
7. If desired, the mechanism may be assembled in Checking Cage J-9397 and operated on a motor test stand, or by some other suitable means, to observe sound level and general operation. Tighten cage nuts evenly to 14-16 ft. lbs. torque.
8. Remove mechanism from the cage.

Disassembly

If the mechanism has sustained major damage, due possibly to loss of refrigerant and/or oil, it may be necessary to replace it with a complete service interior

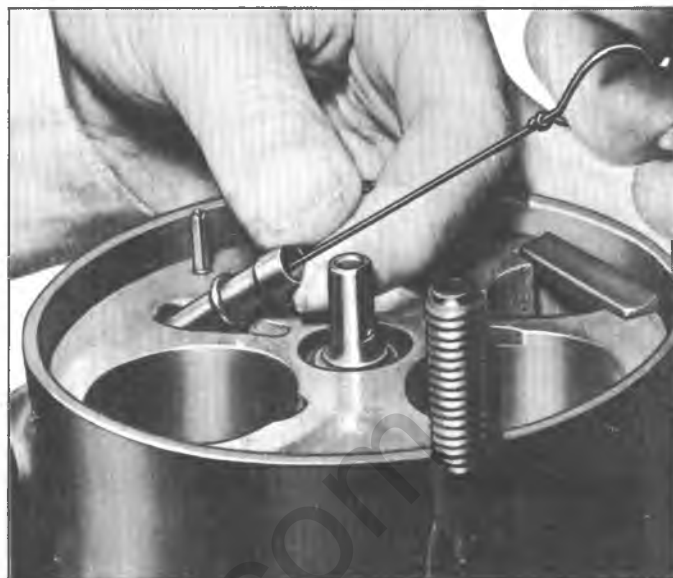


Fig. 16--Removing Oil Inlet Tube and "O" Ring

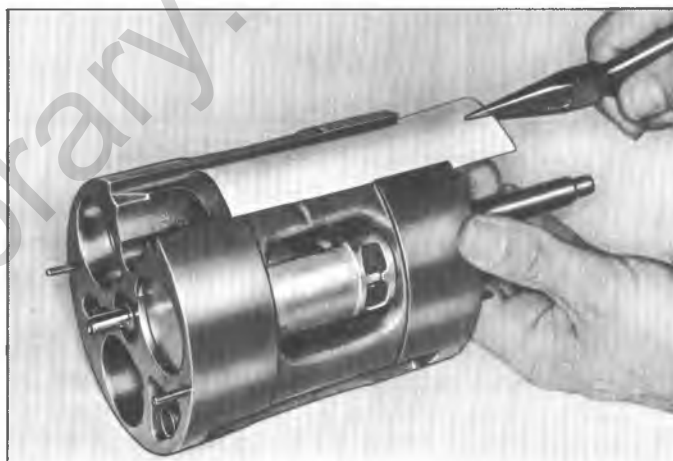


Fig. 17--Removing Suction Crossover Cover

mechanism assembly rather than to replace individual parts. If further disassembly is considered worthwhile, proceed as follows:

1. Before disassembling the cylinder and mechanism, number the pistons and cylinder locations so that all parts may be replaced in their original location. Pistons and cylinder bores may be identified by numbering them 1, 2 and 3 with a pencil.
2. Use an old discharge tube to drive discharge tube out of cylinder (fig. 18): Drive from REAR of cylinder.
3. Drive the cylinder halves apart and free from the dowel pins and discharge crossover tube using a fiber block and mallet (fig. 19). Discard the discharge crossover tube.

NOTE: Before driving cylinder halves apart, position wobble plate toward front of compressor in area of crossover tube.



Fig. 18--Unseating Discharge Crossover Tube

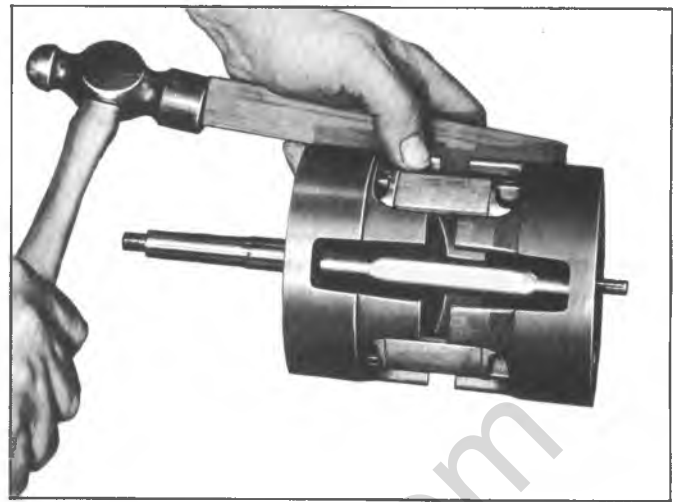


Fig. 19--Separating Cylinder Halves

4. Carefully remove the rear half of the cylinder from the pistons and set the front cylinder half, with the piston, shaft and wobble plate, in Compressing Fixture J-9397.

5. Push up on the shaft and, one assembly at a time, remove pistons, rings, seats and balls placing all parts in Tray J-9402 in the compartment associated with the proper end of the piston. Discard all piston ball seats.

NOTE: The front of the piston may be identified by a notch in the casting web (fig. 20). The piston compartments in Tray J-9402 have a boss at this notch location to indicate the front.

6. Remove and inspect all piston rings. Replace all broken or damaged rings. Damaged pistons must also be replaced.

7. Examine piston balls. Replace if they show burning or excessive wear.

8. Remove the rear combination of thrust races and bearing from the shaft and discard all three pieces.

9. Remove the shaft and wobble plate assembly from the front half of the cylinder.

10. Remove the front combination of thrust washers and bearing and discard all three pieces.

11. Examine all surfaces of the wobble plate and, if satisfactory, reuse. If it shows signs of wear, replace the shaft and wobble plate as an assembly. Use care

not to move wobble plate on the shaft. This is factory set.

12. Examine the front and rear cylinder halves and replace if cylinder bores are deeply scored or damaged.

13. Wash all parts to be reused in a suitable cleaner. Blow dry all parts.

14. If cylinder main bearings are to be replaced, they may be removed and reinstalled at this time using Tool J-9432. Drive against the lettered end of the bearings and from the outside of the cylinder. Bearing must be not more than 1/8" below surface.

Gauging Procedure

The gauging operations which follow have been worked out on a simple basis to establish and provide necessary running clearances. Two gauging procedures are necessary.

The first gauging operation is made to choose the proper size ball seats to provide, at each piston, a .0005" to .0010" total preload between the seats and the wobble plate at the tightest place through the 360 degree rotation of the wobble plate. The bronze ball seats are

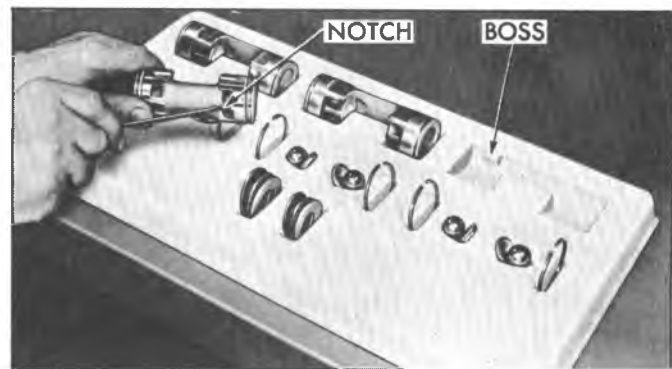


Fig. 20--Notch Identifying Front End of Piston

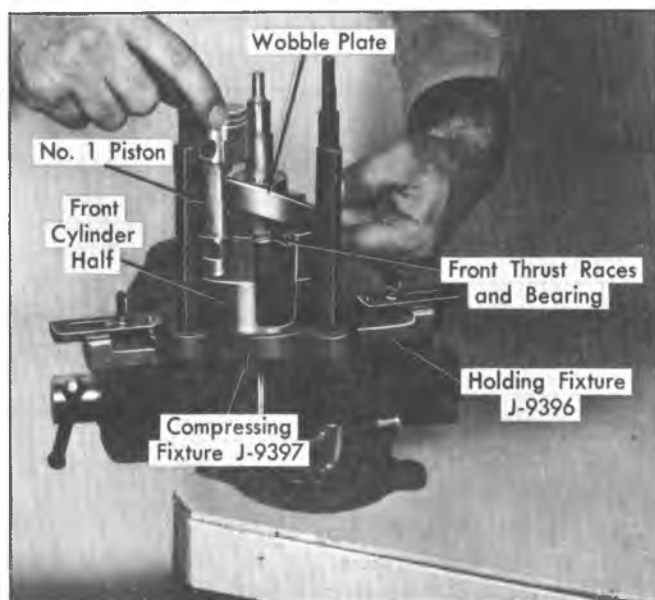


Fig. 21--Installing Piston, Front Ball and Seat and Rear Ball

provided in .0005" variations including a basic ZERO seat.

The second gauging operation, performed at the rear shaft thrust bearing and race pack, is designed to obtain .0005" to .0015" preload between the hub surfaces of the wobble plate and the front and rear hubs of the cylinder. A total of 14 steel thrust races, including a basic ZERO race, are provided in increments of .0005" thickness to provide the required fit. Proper selection of thrust races and ball seats is of extreme importance.

1. Secure from service parts stock:
 - Four-ZERO thrust races
 - Three-ZERO ball seats
 - Two-New thrust bearings
2. Assemble a ZERO thrust race, a new needle thrust bearing and another ZERO thrust race, in that order, to the front end of the shaft (A dab of clean petroleum jelly will hold the bearing-race pack together and in place on the shaft). Lubricate front and rear faces of the wobble plate with clean refrigeration oil.
3. With the front half of the cylinder assembly resting on Tool J-9397, insert the shaft threaded end through the front main bearing until the thrust race assembly rests on the front cylinder hub.
4. Assemble a ZERO thrust race, a new needle bearing and a second ZERO thrust race in that order, to the rear of the shaft.
5. Apply a light smear of clean petroleum jelly to the ball pockets of each of the three pistons.
6. Place the balls in the piston pockets. The petroleum jelly will hold the balls in place.
7. Apply a light smear of petroleum jelly to the cavity

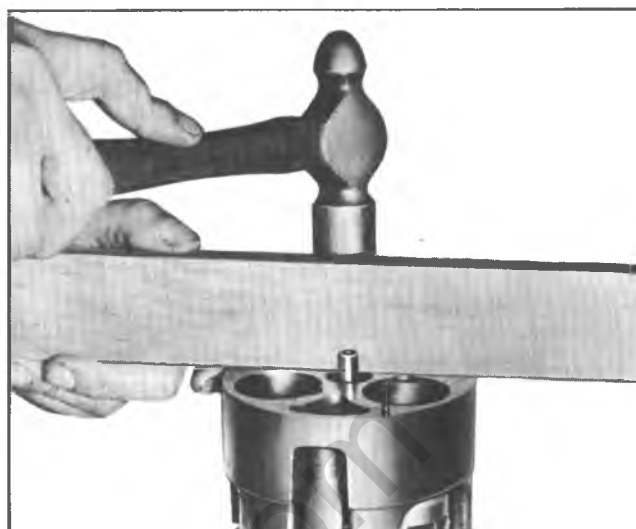


Fig. 22--Assembling Cylinder Halves

of three new ZERO ball seats and place one seat over each front piston ball. There should now be a ball and seat in the front ball pocket of each piston and a ball only in the rear ball pocket.

NOTE: Do not assemble any of the piston rings at this time.

8. Rotate the shaft and wobble plate until the high point of the wobble plate is directly over the cylinder bore previously designated as No. 1. Lift up slightly on the shaft and wobble plate assembly, insert the front (notched) end of the No. 1 piston into the cylinder bore, and at the same time, place the front ball and seat and the rear ball only over the wobble plate (fig. 21). Hold front thrust bearing pack tight against wobble plate hub while lifting shaft.
9. Repeat this operation with pistons No. 2 and No. 3.
10. Align the rear head casting with bores, suction passage, discharge crossover holes, and dowel pins. Tap into place, using a plastic block and mallet (fig. 22).
11. Place the cylinder assembly in the checking cage with the front of the compressor shaft pointing up, positioning the discharge tube opening between the cage bolts. This will provide access for the feeler gauge. Assemble the cage and tighten all nuts evenly to 14-16 ft. lbs. torque.
12. Use a leaf type feeler gauge and a suitable spring scale to check clearance between the REAR ball and the wobble plate (fig. 23) of the No. 1 piston. Use a suitable combination of feeler gauge leaves until 4 to 8 oz. of force is required to pull gauge from between the ball and the plate.

NOTE: Use undamaged feeler gauges generously lubricated with clean refrigeration oil. Support the spring scale so that only the

1-12 AIR CONDITIONING COMPRESSOR

actual force required to pull the feeler gauge free is measured.

Rotate the shaft approximately 120 degrees and again check with a feeler gauge between the parts. Rotate the shaft another 120 degrees and make a third check. From this total of three feeler gauge checks, use the **MINIMUM** reading to select a numbered seat to correspond to the feeler gauge reading (i.e., if minimum reading was .019, use a No. 19 seat. If reading was .0195, use a No. 19-1/2 seat). Place this seat in the parts tray in the

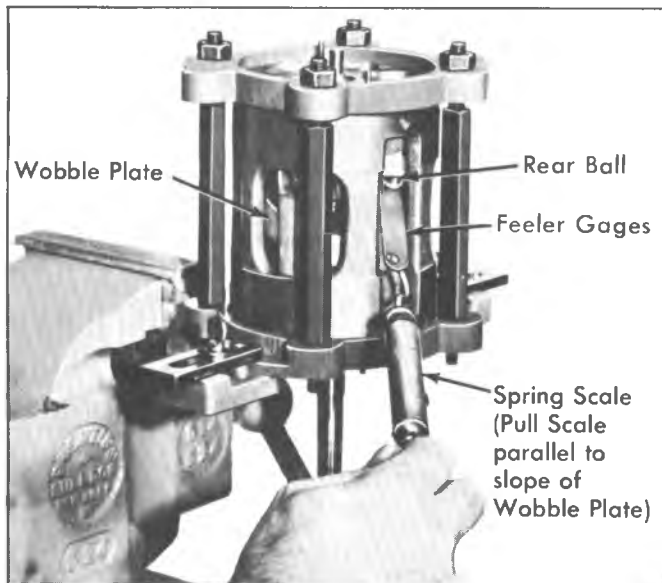


Fig. 23--Checking Clearance Between Rear Ball and Wobble Plate

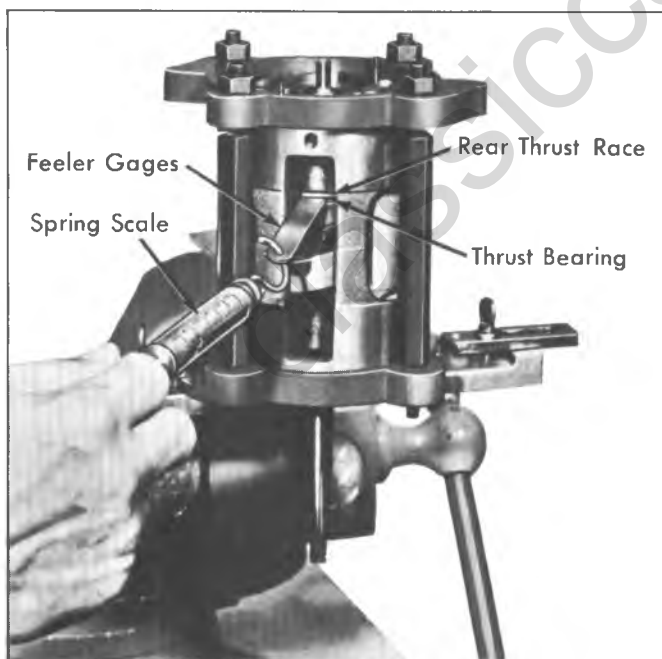


Fig. 24--Checking Clearance Between Rear Thrust Bearing and Outer Thrust Race

compartment corresponding to the rear ball position of the No. 1 piston.

13. Repeat the operation described in Step 12 for pistons No. 2 and No. 3.
14. The next gauging operation is to determine the space between the **REAR** thrust bearing and the upper (outer) rear thrust race. Use a suitable combination of feeler gauge leaves so that 4 to 8 oz. of force is required to pull gauge free (fig. 24). Select a numbered thrust race to correspond to this feeler gauge reading and place this race in parts tray in the rear thrust race compartment.
15. Loosen the nuts and ring from the checking cage.
16. Drive the cylinder halves apart, using a fiber block and mallet.
17. Carefully remove the rear half of the cylinder and set the front half (including the pistons, shaft and wobble plate assembly) on Fixture J-9397.
18. Carefully remove one piston at a time from the wobble plate and the front half of the cylinder. Transfer each piston, ball and seat to its proper place in the parts tray along with the numbered rear seat chosen in Steps 12 and 13 above.
19. Remove the rear outer (upper) **ZERO** thrust race from the compressor shaft and replace it with the numbered thrust race (determined in Step 14 above) from parts tray.

CAUTION: When the balls and seat are removed from the piston, be sure that they are placed in the proper parts tray pocket so as not to lose the relationship of the balls and seats to the proper end of the piston.

NOTE: This **ZERO** thrust race may be put aside for reuse in future gauging and/or rebuild operations.

20. The gauging operations are now complete.

Assembly

After properly performing the gauging procedure and choosing the correct ball seats and thrust races as outlined under "Gauging Procedures," the cylinder assembly may be reassembled. Be sure to install all new seals and "O" rings. All are included in the compressor seal service kit.

Assembly procedure is as follows:

1. Support the front half of the cylinder assembly on Fixture J-9397 and install the shaft and wobble plate, threaded end down, with its front bearing race pack (**ZERO** race, bearing and **ZERO** race) and its rear bearing race pack (**ZERO** race, bearing, numbered race) if this was not already done at the end of the "Gauging Procedure."
2. Assemble a piston ring, scraper groove toward the center of the piston, to each end of the three pistons.

3. Apply a light smear of petroleum jelly to the numbered ball seats chosen in the gauging procedure and install all balls and seats (if removed in Step 18 of the gauging procedure) in their proper place in the piston.
4. Rotate the wobble plate so that the high point is above cylinder bore No. 1. Carefully assemble piston No. 1, complete with ball and ZERO seat on the front and ball and numbered seat on the rear, over the wobble plate. Hold front thrust bearing pack tight against wobble plate hub while lifting hub. Compress and enter the piston ring into the front cylinder half.
5. Repeat this operation for pistons No. 2 and No. 3.
6. Assemble one end of a service discharge crossover tube into the hole in the front cylinder half.
7. Rotate the shaft to position the pistons in a stair-step arrangement, then carefully place the rear cylinder half over the shaft and start the pistons into the cylinder bores.
8. Compress the piston ring on each piston to permit its entrance into the cylinder.
9. When all three pistons and rings are in their respective cylinders, align the end of the discharge crossover tube with the hole in the rear half of the cylinder.

NOTE: Be sure the flattened portion of this tube faces the inside of the compressor to allow for wobble plate clearance.

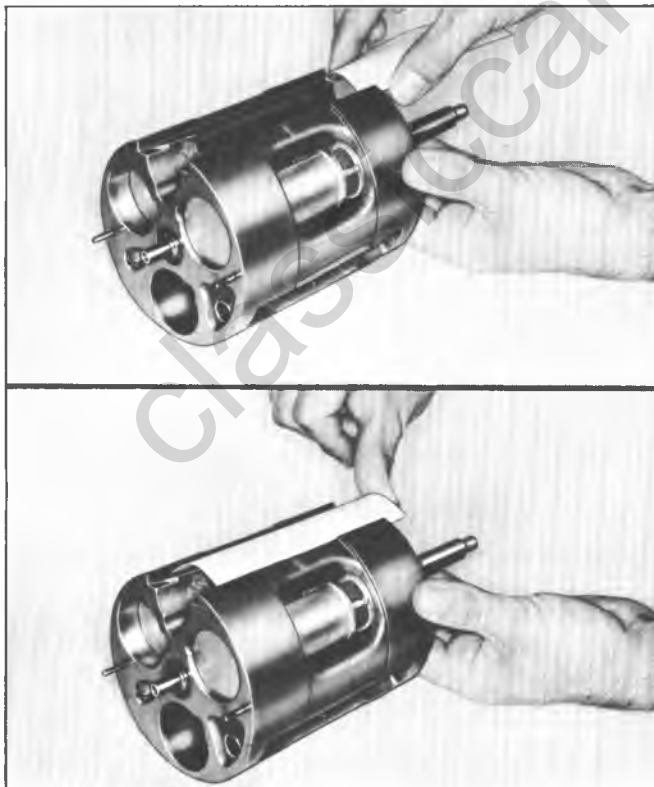


Fig. 25--Installing Suction Crossover Cover

10. When all parts are in proper alignment, tap with a fiber block and mallet to seat the rear half of the cylinder over the locating dowel pins. If necessary, clamp the cylinder in Fixture J-9397 to complete drawing the cylinder halves together.
11. Generously lubricate all moving parts with clean refrigeration oil and check for free rotation of the parts.

NOTE: It may be desirable to clamp the cylinder assembly in compressing Fixture J-9397 and check on the motor test stand for proper operation before proceeding further. If any improper operation is observed, the mechanism should be regauged to insure proper operation. Complete the assembly procedure when correct operation is obtained.

12. Replace the suction crossover cover as shown in Figure 25. Compress the cover (as shown) to start it into the slot, and then press it in until flush on both ends.

Installation Into Shell

1. Support the cylinder on Fixture J-21352 with the threaded end of the shaft up.
2. Assemble the two dowel pins in the front cylinder if they are not already in place.

NOTE: A rod drilled 1/4 in. deep to the O.D. of the dowel pins will aid in installing.

3. Install the discharge crossover tube front "O" ring and spacer (fig. 26).
4. Aligning the dowel pin holes, discharge crossover and oil return slot, assemble the suction reed valve to the front end of the cylinder.
5. Assemble the front discharge valve plate, aligning the holes with the dowel pins and proper opening in the head.

NOTE: The front discharge plate has a

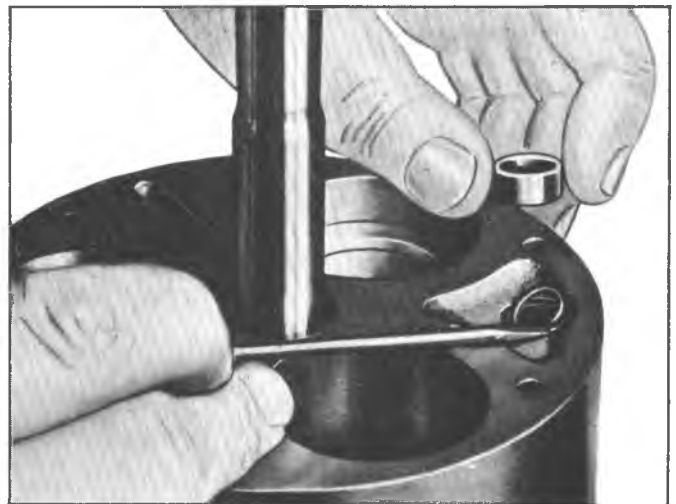


Fig. 26--Installing Discharge Crossover Tube Front "O" Ring and Spacer



Fig. 27--Installing Shell Over Internal Mechanism

larger diameter hole in the center than the rear discharge plate.

6. Check the sealing surface of the compressor front head casting webs and replace the entire casting if there is any evidence of damage. Discard the "O" ring.
7. Coat the valve plate with clean refrigeration oil. Rotate the front head casting until it is properly positioned over the discharge reed retainers and dowel pins, then set it in place (being careful not to damage the sealing surfaces) and seat it over dowels with light mallet taps.

NOTE: Dowel pin and hole location can be marked with pencil to aid in locating proper position.

8. Apply clean refrigeration oil to a new "O" ring and "O" ring groove at the lower edge of the front head casting and carefully assemble the "O" ring in the groove.
9. Coat the inside machined surfaces of the compressor shell with refrigeration oil.

10. Locate the oil intake tube hole in the rear discharge plate. Line up the oil sump with this hole location and slide the shell down over the mechanism while supporting the mechanism on Fixture J-21352 (fig. 27).

NOTE: Raise the front head slightly to facilitate shell installation and to reduce the possibility of damaging the "O" ring.

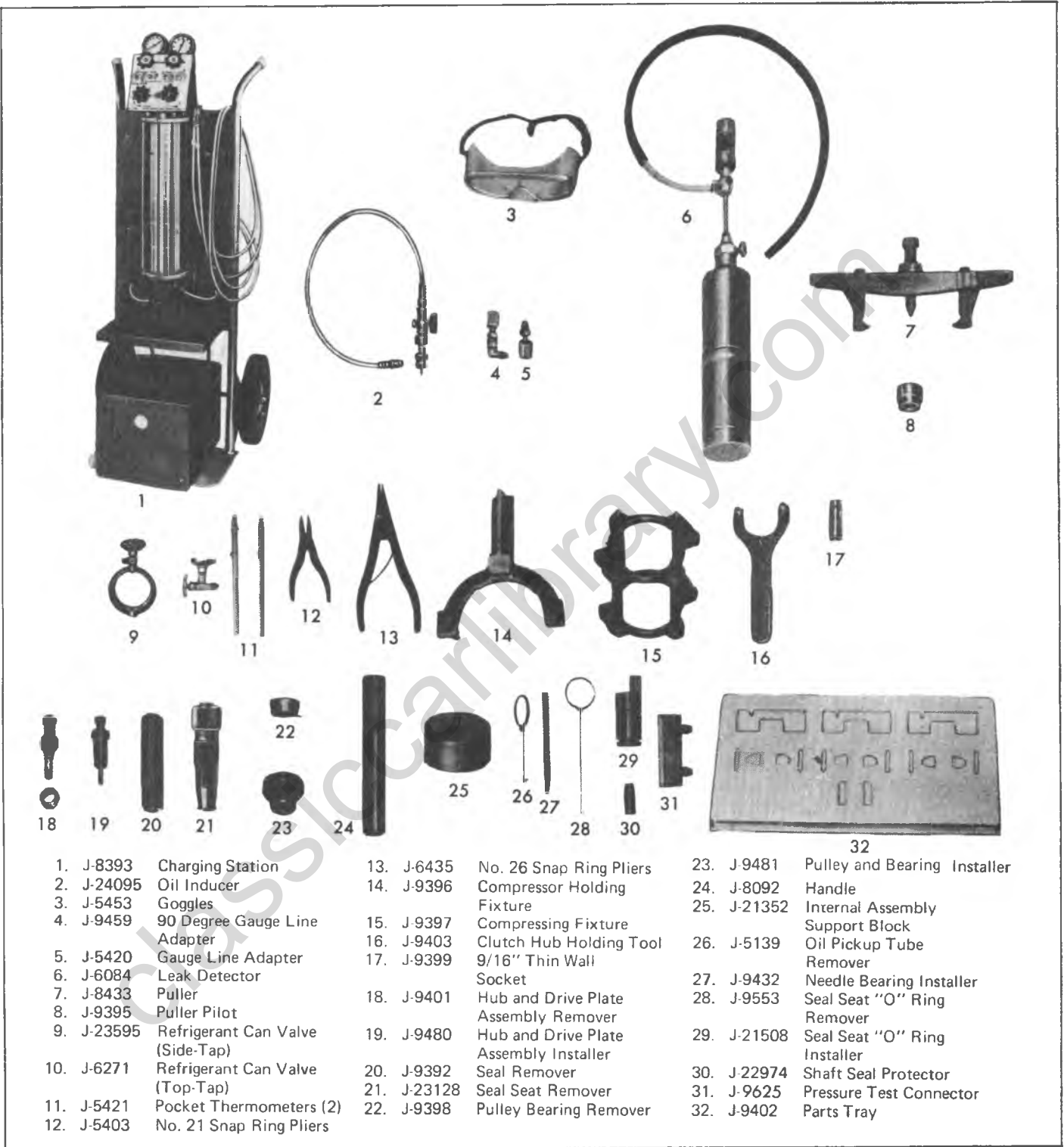
11. Place Compressor Support Bracket J-9396 in a vise and, carefully inverting the compressor shell with the mechanism inside, mount the front compressor flange on the support bracket.
12. Place a new "O" ring in the oil intake tube hole applying clean refrigeration oil to the oil intake tube hole and the "O" ring. Rotating the compressor mechanism to line up with the hole in the compressor oil sump baffle, install the pickup tube. Be sure that the "O" ring and intake tube are properly seated.
13. Assemble the dowel pins into the rear cylinder.
14. Install the discharge crossover tube rear "O" ring and spacer.
15. Replace the rear suction reed valve, rear discharge valve plate, oil pump gears, rear head and head nuts as outlined previously under "Rear Head and Reed Assemblies--Installation."
16. Install a new shaft seal assembly kit as outlined under "Shaft Seal Assembly--Installation."
17. Reinstall the coil housing, pulley and bearing assembly and hub and drive plate assembly as outlined earlier in this section.

Leak Testing The Compressor

Whenever service operations are performed on the compressor shaft seal assembly or on the interior mechanism, use the following procedure to leak test the reassembled compressor:

1. Install "O" rings and Cover Plate J-9625 over the suction and discharge ports of the compressor head.
2. Check and add oil to the compressor as outlined under "Checking Compressor Oil Charge" in the Service Manual.
3. Temporarily install the shaft nut. With the compressor in the horizontal operating position (oil sump down), rotate the compressor shaft several times in the normal direction of rotation.
4. Hook up a Refrigerant-12 container and charging line (using Adapter J-5420) to cover plate fitting over the suction port, charge the compressor up to can pressure, and leak test compressor with a leak detector.
5. Turn off the refrigerant container valve. Transfer gauge line and adapter to cover plate fitting over the discharge port and repeat the procedure outlined in Step 4.
6. Correct any leaks present.

SPECIAL TOOLS



- | | | | | | |
|------------|----------------------------------|-------------|--|-------------|---------------------------------|
| 1. J-8393 | Charging Station | 13. J-6435 | No. 26 Snap Ring Pliers | 23. J-9481 | Pulley and Bearing Installer |
| 2. J-24095 | Oil Inducer | 14. J-9396 | Compressor Holding Fixture | 24. J-8092 | Handle |
| 3. J-5453 | Goggles | 15. J-9397 | Compressing Fixture | 25. J-21352 | Internal Assembly Support Block |
| 4. J-9459 | 90 Degree Gauge Line Adapter | 16. J-9403 | Clutch Hub Holding Tool | 26. J-5139 | Oil Pickup Tube Remover |
| 5. J-5420 | Gauge Line Adapter | 17. J-9399 | 9/16" Thin Wall Socket | 27. J-9432 | Needle Bearing Installer |
| 6. J-6084 | Leak Detector | 18. J-9401 | Hub and Drive Plate Assembly Remover | 28. J-9553 | Seal Seat "O" Ring Remover |
| 7. J-8433 | Puller | 19. J-9480 | Hub and Drive Plate Assembly Installer | 29. J-21508 | Seal Seat "O" Ring Installer |
| 8. J-9395 | Puller Pilot | 20. J-9392 | Seal Remover | 30. J-22974 | Shaft Seal Protector |
| 9. J-23595 | Refrigerant Can Valve (Side-Tap) | 21. J-23128 | Seal Seat Remover | 31. J-9625 | Pressure Test Connector |
| 10. J-6271 | Refrigerant Can Valve (Top-Tap) | 22. J-9398 | Pulley Bearing Remover | 32. J-9402 | Parts Tray |
| 11. J-5421 | Pocket Thermometers (2) | | | | |
| 12. J-5403 | No. 21 Snap Ring Pliers | | | | |

Fig. 28--Air Conditioning Special Tools

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SECTION 3

FRONT AXLE DIFFERENTIAL (4-WHEEL DRIVE)

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FRONT AXLE DIFFERENTIAL

Differential Case

Removal (Fig. 1)

1. If front axle assembly is removed from vehicle, mount assembly in suitable holding fixture and remove axle shafts as outlined in Axle Shaft Removal, Section 3, Truck Service Manual.
2. Remove cover attaching bolts and lock washers and the metal tag secured by one of the attaching bolts. Remove cover and gasket.

NOTE: The tag shows the number of teeth on pinion and drive gear.

3. Remove differential side bearing caps, making sure they are marked for reassembly in the same position.
4. Position Spreader Tool J-5231-01 so the two dowels on tool fit into recesses in carrier, install two hold down bolts and install a dial indicator at one end of opening in carrier to indicate width of opening.
5. Expand spreader tool to spread carrier a maximum of .020".

CAUTION: Do not attempt to remove differential without using the spreader tool. Do not expand carrier more than .020 in. or it may be damaged and take a permanent set.

6. Remove dial indicator and, using a pry bar, lift out differential assembly. Remove and tag bearing cups so they may be reinstalled in their original positions. Relieve pressure on spreader tool and remove tool.

Oil Seal Replacement

The axle shaft inner oil seals are located just outboard of

the differential bearings. They can be replaced only after the differential is removed from the carrier.

Disassembly

1. Remove bearing cups from differential case and identify for reassembly.
2. Remove bearing cones from case, using puller J-22888 and correct plug (fig. 4) and remove shims from case. Identify all parts so they may be reassembled in their original location.

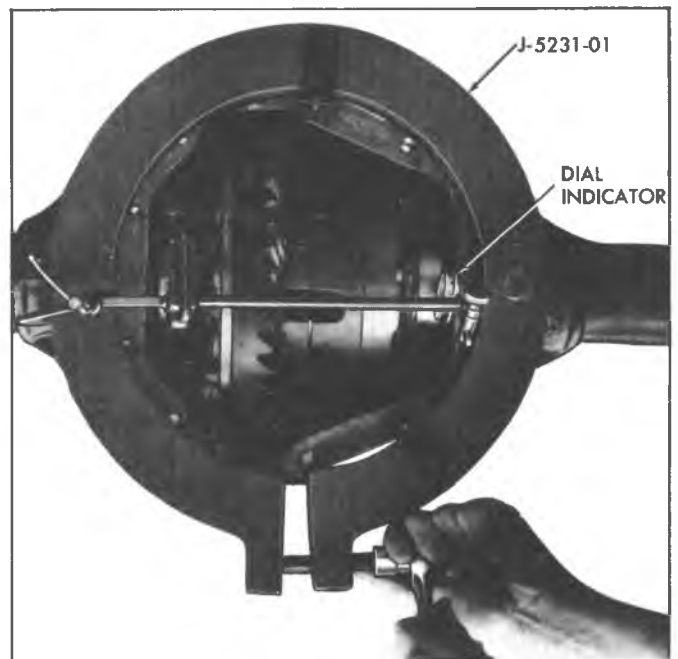


Fig. 1—Spreading Case with J-5231-01

3-2 FRONT AXLE DIFFERENTIAL

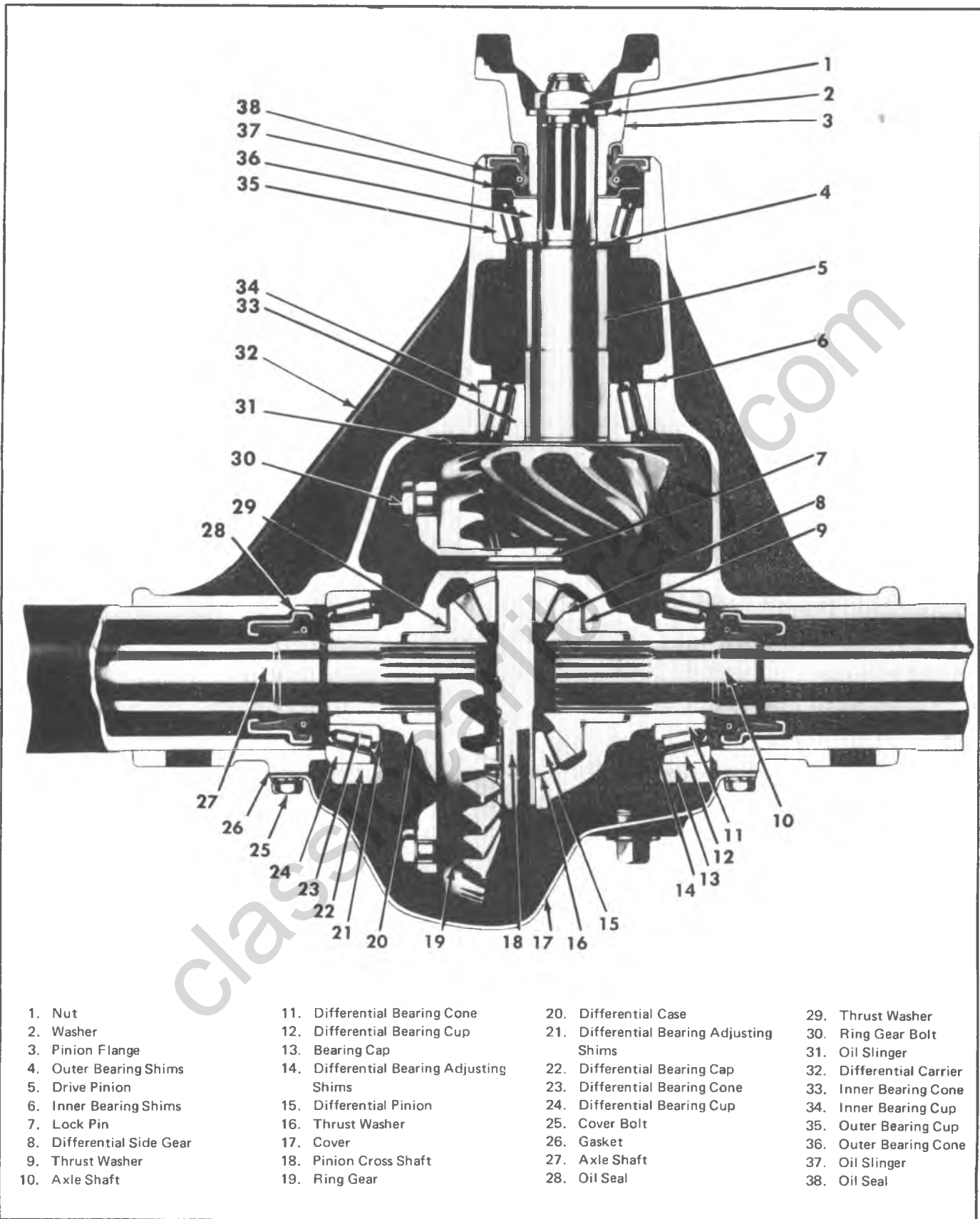
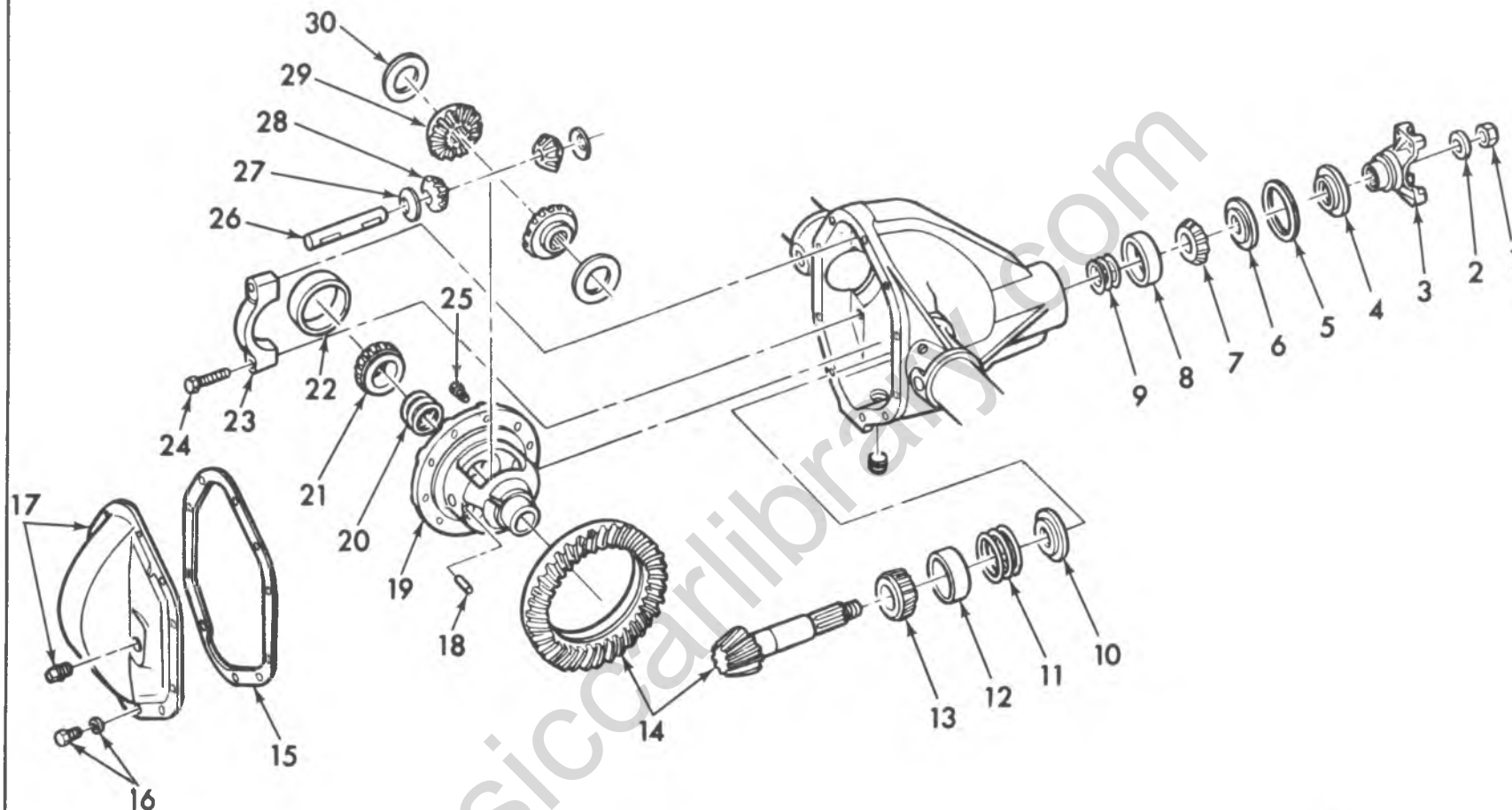


Fig. 2—Front Axle Differential Assembly

Fig. 3—Differential—Exploded View



- | | | | |
|---|------------------------------------|--|-------------------------------------|
| 1. Nut | 11. Shims (Inner Pinion Bearing) | 17. Cover and Plug | 24. Bolt (Differential Bearing Cap) |
| 2. Washer | 12. Cup (Inner Pinion Bearing) | 18. Lock Pin (Pinion Shaft) | 25. Bolt (Ring Gear) |
| 3. Companion Flange | 13. Cone and Roller (Inner Pinion) | 19. Differential Case | 26. Pinion Shaft |
| 4. Pinion Oil Seal | 14. Ring and Pinion | 20. Shims (Differential Adjusting) | 27. Thrust Washer (Pinion) |
| 5. Gasket | 15. Gasket (Housing Cover) | 21. Cone and Roller (Differential Bearing) | 28. Pinion |
| 6. Outer Pinion Oil Slinger | 16. Screw and Washer (Cover) | 22. Cup (Differential Bearing) | 29. Side Gear |
| 7 and 8. Cone and Roller (Outer Pinion Bearing) | | 23. Cap (Differential Bearing) | 30. Thrust Washer (Side Gear) |
| 9. Shims (Outer Pinion Bearing) | | | |
| 10. Inner Pinion Oil Slinger | | | |

3-4 FRONT AXLE DIFFERENTIAL

3. Drive the pinion shaft lock pin out of case.
4. Remove ring gear bolts from case and separate ring gear from case.
5. Remove pinion shaft, pinions, side gears and thrust washers from case.

DRIVE PINION

Removal

1. Using Holding Bar J-8614-1, attached to pinion shaft flange, remove self-locking nut and washer from pinion shaft.
2. Install Tool J-8614-2, and 3 into holding bar as shown in Figure 5 and remove flange from drive pinion. Remove drive pinion from carrier.
3. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket,

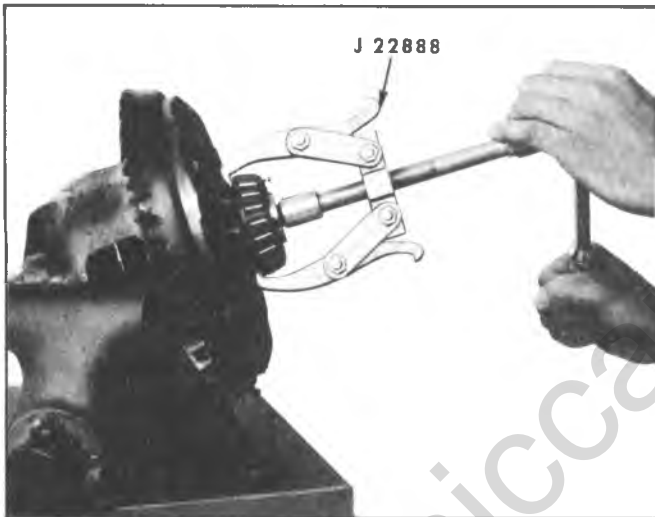


Fig. 4—Removing Side Bearings

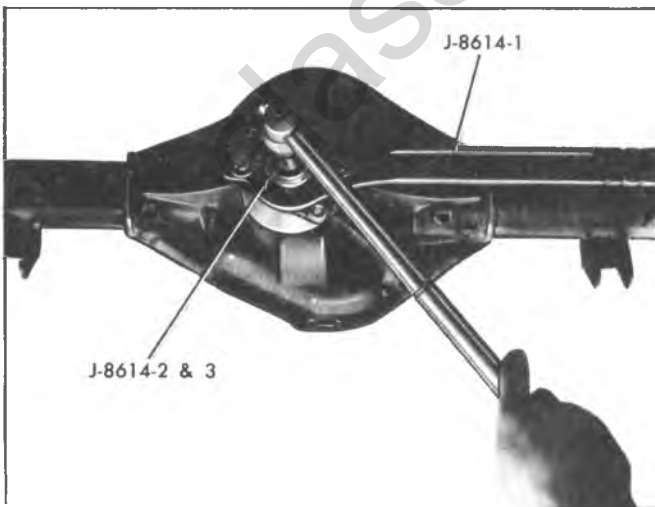


Fig. 5—Removing Pinion Flange

outer pinion cone and roller and shim pack. Tag shim pack for reassembly.

4. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.
5. Remove inner pinion cone and roller using Tool J-22912, installed as shown in Figure 6, and press pinion from bearing.

Inspection

1. Clean all gears and bearings in cleaning solvent and inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear. On pinion bearing rollers, inspect large end of rollers for wear. This is where wear is most evident on tapered roller bearings.

NOTE: The pinion bearings are of the tapered type, and the natural wear pattern is a frosted condition with occasional slight scratches on races or rollers. This does not indicate a defective bearing.

2. Inspect pinion splines and flange splines for evidence of excessive wear.
3. Inspect ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case for cracks or scores or side gears, thrust washers, and pinion thrust faces.
5. Check fit of differential side gears in case.
6. Check fit of side gears and axle shaft splines.
7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.



Fig. 6—Removing Inner Pinion Bearing Cone and Roller

DIFFERENTIAL CASE

Reassembly

1. Position differential side gears and new thrust washers in differential case.
2. Position differential pinions and new thrust washers in differential case. Align pinions with holes in differential case.
3. Install pinion shaft in differential case. Align hole in shaft with hole in case, then install lock pin. Peen hole to prevent pin dropping out of case.
4. Position ring gear to case, then install cap screws. Tighten cap screws evenly and alternately to specifications (See Specification Section).
5. With an arbor press, press differential side bearings onto case using Tool J-22175. Do not install shims at this time.
6. Place differential case in carrier and install bearing caps. Care should be taken to install caps in original position. Use mark placed on caps and carrier at removal. Tighten caps just enough to keep bearing caps in place.
7. Install dial indicator on carrier with indicator button contacting back of ring gear (Fig. 7). Rotate differential case and check for runout. If runout is greater than .002", the assembly should be removed and the ring gear removed from the case. Again install differential case and check runout at differential case flange.
8. Should runout of case flange be greater than .002", the defect is probably due to bearings or differential case, and should be corrected before proceeding further.
9. Position two screwdrivers between bearing cup and carrier on opposite side of ring gear (away from dial indicator side). Pull on screwdrivers and force differential case as far as possible toward the dial

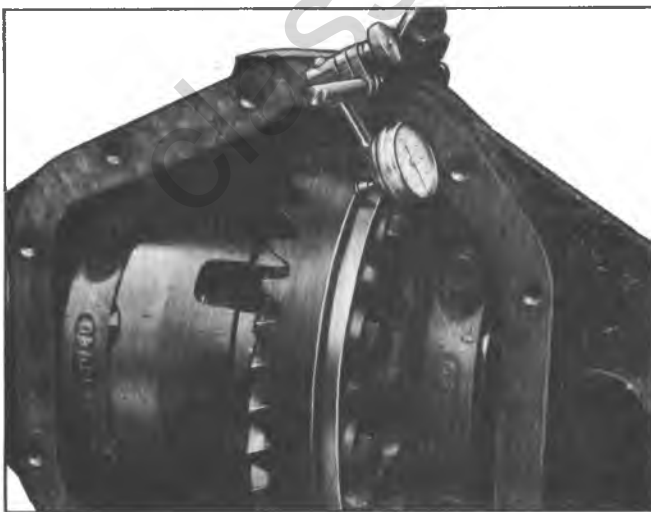


Fig. 7--Checking Runout

indicator. Rock the ring gear to set the bearings. With force still applied, set indicator at "0".

10. Reposition screwdrivers between bearing cup and carrier on ring gear side. Pull on screwdrivers and force differential case as far as possible toward center of carrier. Repeat several times until the same reading is obtained. Record the indicator reading. This will be the total amount of shims needed (less preload) for setting backlash later during assembly.
11. Remove differential from carrier.

DRIVE PINION

Installation and Adjustment of Depth and Preload

Ring gears and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring before proceeding with assembly.

On the button end of each pinion there is etched a plus (+) number, a minus (-) number, or a zero (0) number, which indicates the best running position for each particular gear set. This dimension is controlled by the shimming behind the inner bearing cup. Whenever baffles or oil slingers are used, they become a part of the adjusting shim pack.

For example: If a pinion is etched +3, this pinion would require .003" less shims than a pinion etched "0". This means by removing shims, the mounting distance of the pinion is increased by .003" which is just what a +3 etching indicates. Or if a pinion is etched -3 we would want to add .003" more shims than would be required if the pinions were etched "0". By adding .003" shims, the mounting distance of the pinion was decreased .003" which is just what a -3 etching indicated.

If the old ring and pinion set is to be reused, measure the old shim pack and build a new shim pack to this same dimension. If baffle is in the axle assembly, it is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005" and .010".

NOTE: If baffle or slinger is bent or mutilated, it should be replaced.

Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the plus or minus etching on both the old and new pinion, and adjust the thickness of the old shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads (+2) and the new pinion is (-2), add .004" shims to the original shim pack.

1. Determine proper inner shim pack (for setting pinion depth) by using chart (fig. 8).

3-6 FRONT AXLE DIFFERENTIAL

Old Pinion Marking	New Pinion Marking								
	- 4	- 3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4
+ 4	+ 0.008	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0
+ 3	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001
+ 2	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002
+ 1	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003
0	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004
- 1	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005
- 2	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006
- 3	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007
- 4	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007	- 0.008

Fig. 8—Drive Pinion Shim Chart

2. Install inner shim pack and oil slinger in inner cup bore and drive inner cup into position using Tool J-21059 used with J-8092.
3. To the outer shim pack (for setting preload) add or remove an equal amount as was added or removed from the inner shim pack.
4. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092.
5. Press inner pinion bearing cone and roller onto pinion shaft using Installer J-9772 on arbor press as shown in Figure 9.
6. Install drive pinion and inner bearing cone and roller assembly in differential carrier.
7. Install shims and outer pinion cone and roller on pinion shaft using Tool J-5590 and companion flange to press bearing onto pinion (Fig. 10).
8. Install flange holding bar and install washer and nut on pinion shaft. Torque nut to 255 ft. lbs.
9. Remove holding bar and with an inch pound torque

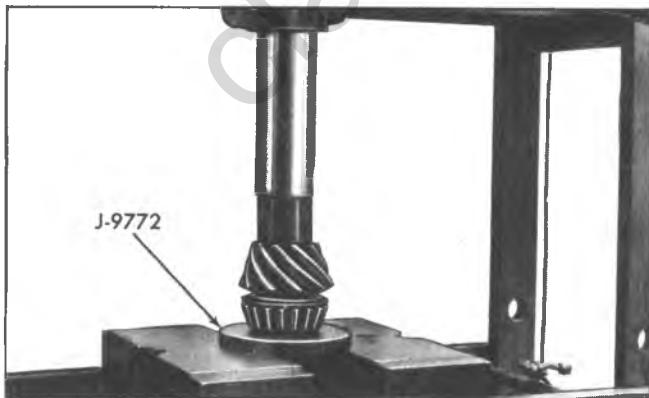


Fig. 9—Installing Inner Pinion Cone and Roller

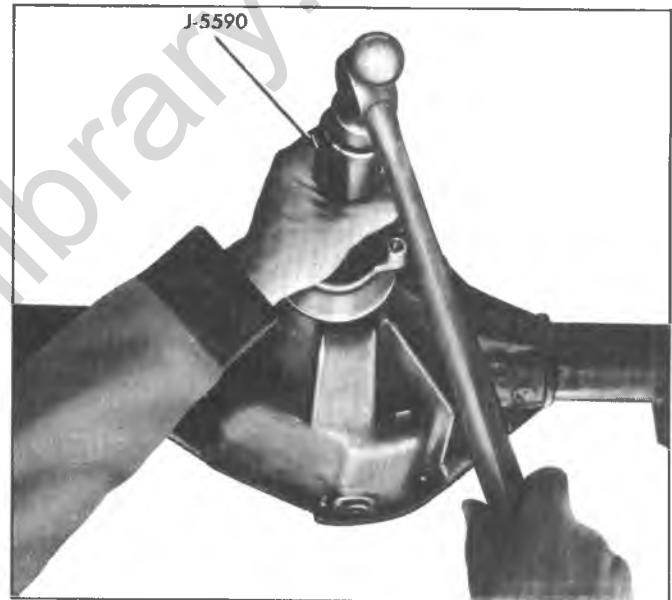


Fig. 10—Installing Pinion Flange

wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.

NOTE: Torque reading to start shaft turning must be disregarded.

10. If torque requirements (preload) are not to specifications, adjust shim pack as necessary. Increase the outer shim pack to reduce rotation torque. Decrease shim pack to increase rotating torque.
11. Remove nut, washer and flange from pinion shaft.
12. Install oil slinger, gasket and using Tool J-22804 install oil seal.

13. Install flange, washer and nut. Torque nut to specifications.

DIFFERENTIAL CASE

Preload and Adjustment

1. Place differential assembly (with pinion assembled) into housing. Install bearing caps in their proper position and tighten screws just enough to hold the bearing cups in place.
2. Install dial indicator on carrier with indicator button contacting back of ring gear (Fig. 7).
3. Place two screwdrivers between bearing cup and housing on ring gear side of case, and pry ring gear into mesh with pinion gear as far as it will go. Rock ring gear to allow bearings to seat and gears to mesh. With force still applied, set indicator to "0".
4. Reposition screw drivers on opposite side of ring gear and pry ring gear as far as it will go. Now take an indicator reading. Repeat until the same reading is obtained every time. This reading will be the necessary amount of shims between the differential case and differential bearing on the ring gear side. Remove differential bearing from the ring gear side and assemble proper amount of shims. Reassemble bearing.
5. Remove the differential bearing from the opposite side of ring gear. To determine the amount of shims needed here, use the following method.
 - a. Subtract the size of shim pack just installed on ring gear side of case from the reading obtained and recorded in step 10 of Differential Case—Reassembly.
 - b. To this figure, add an additional .015" shims to compensate for preload and backlash.

Example: If reading in step 10 of Differential Case—Reassembly was .085", and the shims installed on ring gear side of case was .055", the correct amount of shim will be $.085" - .055" + .015" = .045"$.
6. Install shims as indicated in step 5, (which will give the proper bearing preload and backlash) and install side bearing.

Installation

1. Spread differential carrier, using spreader as shown in Figure 1.
2. Install differential bearing cups in their correct locations then install differential case into carrier.
3. Install differential bearing caps in the correct location as indicated by marks made at disassembly. Install cap screws finger tight. Rotate differential assembly and rap on case with a soft-faced hammer to ensure proper seating of case in carrier.
4. Remove spreader and torque cap bolts to specifications.

5. Install dial indicator and check ring gear backlash at four equally spaced points around the ring gear. Backlash must be held to .004" to .009" and must not vary more than .002" between positions checked.
6. Whenever backlash is not within limits, differential bearing shim pack should be corrected to bring backlash within limits.
7. Check gear tooth contact, using red lead method, as described in "Gear Tooth Contact Pattern Check".
8. After a successful pattern check, install housing cover using a new gasket. Torque bolts to specifications.
9. Install axle shafts and install axle assembly into vehicle (See Service Manual).
10. Fill with recommended lubricant, lower vehicle to floor and road test vehicle.

GEAR TOOTH CONTACT PATTERN CHECK

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 11.

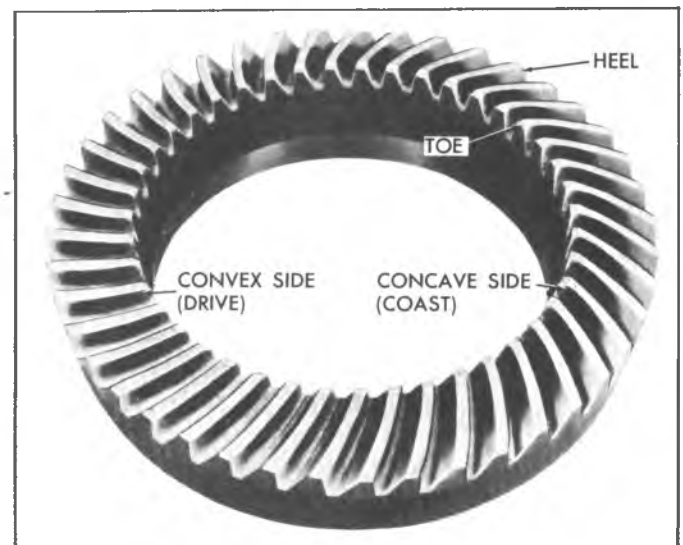


Fig. 11—Gear Tooth Nomenclature

3-8 FRONT AXLE DIFFERENTIAL

Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten bearing cap bolts to 55 lb. ft.
4. Apply a load until a torque of 40-50 lb. ft. is required to turn the pinion.

NOTE: A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with Figure 12.

Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern. These are backlash and position of drive pinion in carrier. The effects of bearing preloads are not readily apparent on hand loaded teeth pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

NOTE: It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

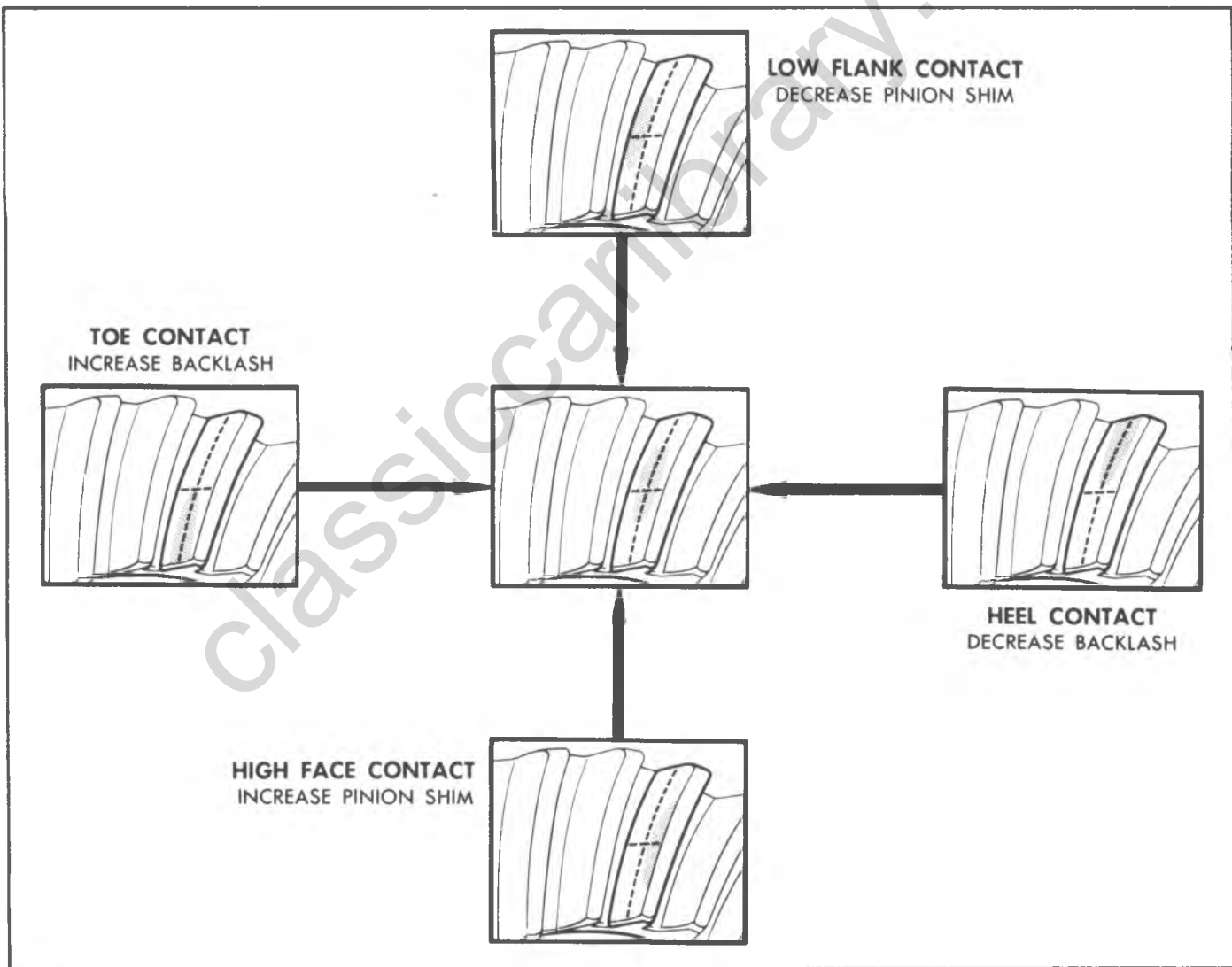


Fig. 12—Gear Tooth Contact Pattern

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease

backlash, decrease right shim and increase left shim an equal amount.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

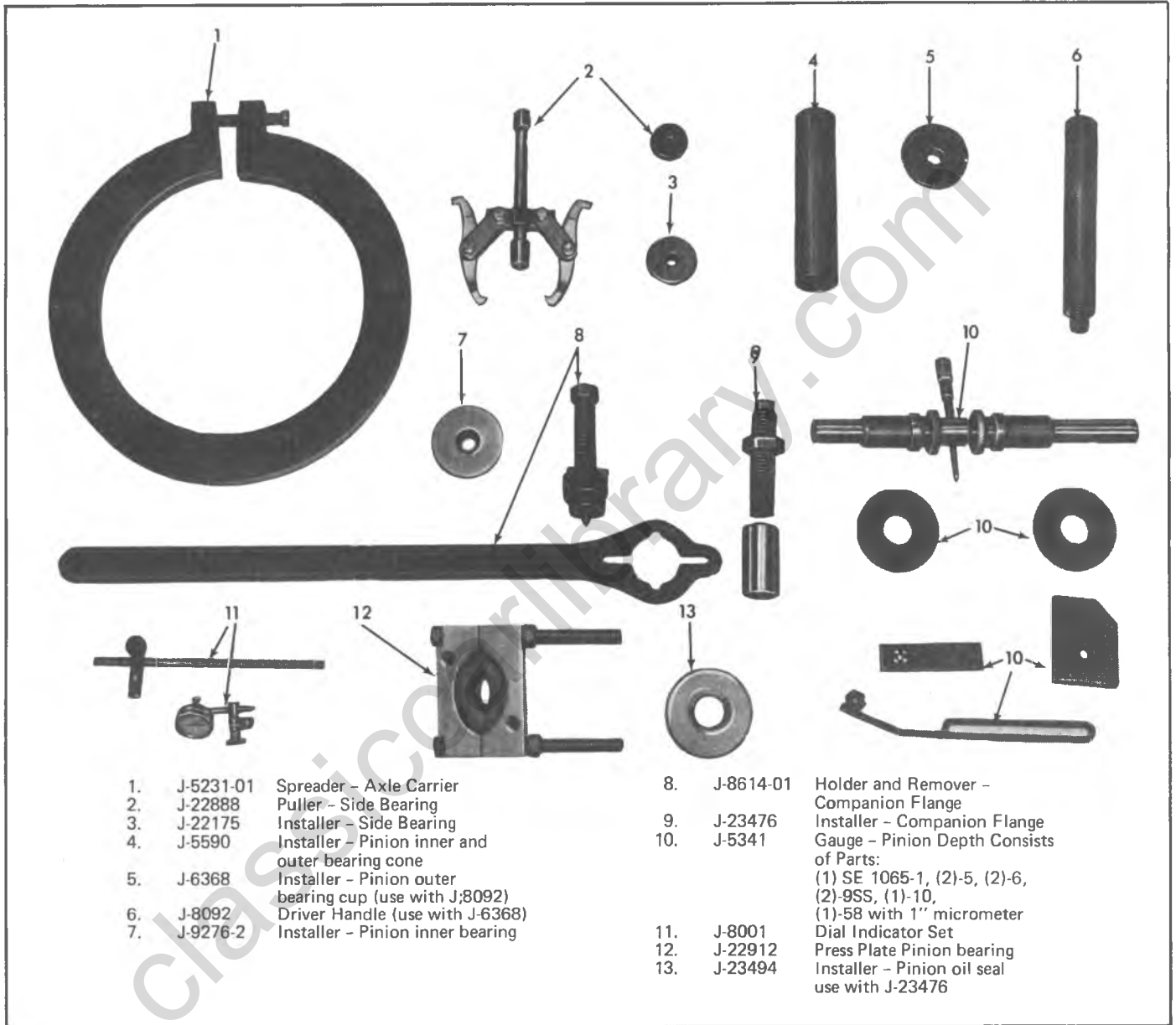


Fig. 13—Special Tools

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SECTION 4

REAR AXLE DIFFERENTIAL CARRIER

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SERVICE INFORMATION

AXLE IDENTIFICATION

It is important to know which axle is being serviced, in order to use the correct overhaul procedure. The manufacturing code number on Passenger Car axles may be found on the axle tube close to the carrier. It is the third letter of the axle code.

For example, if an axle had this axle number: HKP 218 DW, the manufacturer could be determined from the third letter, P. Truck axles are identified in this section by ring gear size. The following chart lists pertinent information needed on Passenger Car and Series 10-30 Truck axles.

SOURCE	CODE	RING GEAR SIZE	MODEL	SOURCE	TIRE/CAPACITY	RING GEAR SIZE		
CHEVROLET	G C	8 1/2"	C10	Chevrolet	Salisbury/3750#	8 7/8		
			K10	Chevrolet	Salisbury/3750#	8 7/8		
	P10		Chevrolet	Salisbury/3500#	8 7/8			
	G10		Chevrolet	Salisbury/3100	8 7/8			
BUICK	B		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			
McKINNON	K	8 7/8"		G20	Chevrolet	Salisbury/3500	8 7/8	
				C30 (Except Dual Wheel Camper)	Chevrolet	Salisbury/7500#	10 1/2	
C30 (Dual Wheel Camper)	Dana			Salisbury/7500	10 1/2			
P30	Chevrolet			Salisbury/7500	10 1/2			
PONTIAC	P		8 7/8"	P30 (With H22/H23)	Chevrolet	Banjo/11,000#	12 1/4	
				G30	Chevrolet	Salisbury/7500#	10 1/2	
McKINNON	M			8 7/8"	G30 (Kutaway Van)	Dana	Salisbury/6200#	9 3/4

Fig. 0-1—Axle Usage Chart

4-2 REAR AXLE DIFFERENTIAL CARRIER

ALTERNATE PINION DEPTH SETTING PROCEDURE

A new pinion depth coding system facilitates the use of Pinion Setting Gauge J-21777-01, as outlined in later portions of this section. The coding system is used on passenger car differentials with 8-1/2 inch and 8-7/8 ring gears, on Corvette, and on truck models with 8-7/8 inch ring gears.

However, if J-21777-01 is **not** used in determining pinion depth shim requirements, the following tools and procedures are recommended. Only the steps of the procedures that differ from the J-21777-01 method are mentioned.

8-1/2" Ring Gear—Passenger Car

1. Set up the tools as shown in figure 0-2.
2. Preload the dial indicator one half revolution, with the plunger off the gauge plate, and tighten in this position.
3. Rest the plunger on the low gauging surface, marked Y.
4. "Zero" the indicator on the highest spot of the gauging surface.

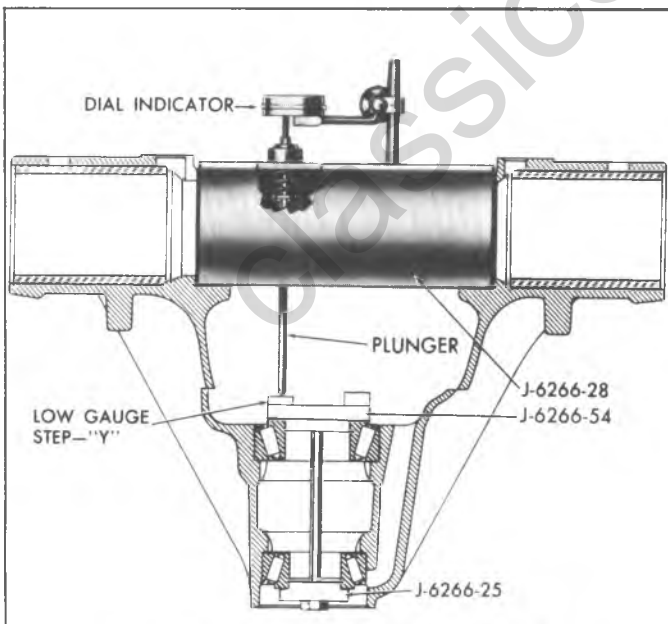


Fig. 0-2—Pinion Gauging Tools—8 1/2" Ring Gear

5. Swing the plunger off the plate and read the dial indicator. This reading is the required shim thickness for a nominal pinion.
6. If a pinion is coded +2, +1, -1, or -2, alter the shim thickness that many thousandths of an inch.

For example, if the indicator reading was .028, and the pinion code is -1, the required shim would be $.028 - .001 = .027$ inch.

Corvette

8-7/8" Ring Gear—Truck

1. Set up the tools as shown in figures 0-4, and 0-5.
2. "Zero" the dial indicator **off** the gauge plate.
3. Swing the plunger across the plate until the highest reading is obtained. Record the result.
4. Combine the pinion code number with "45", which represents a nominal pinion. From that number, subtract the dial indicator reading. The result is the required shim thickness.

For example, if the reading was .016, and the pinion code was +2, the correct shim could be determined as follows: $45 + 2 = 47$; $.047 - .016 = .031$ inch.

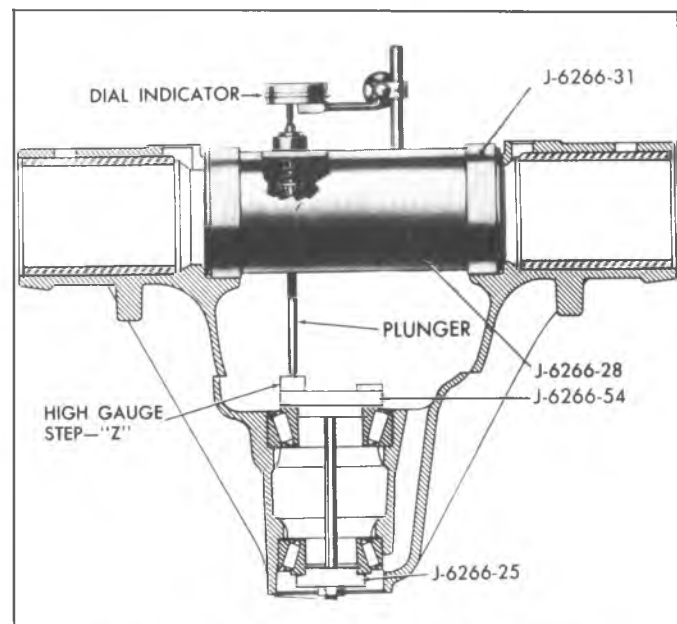


Fig. 0-3—Pinion Gauging Tools—8 7/8" Passenger

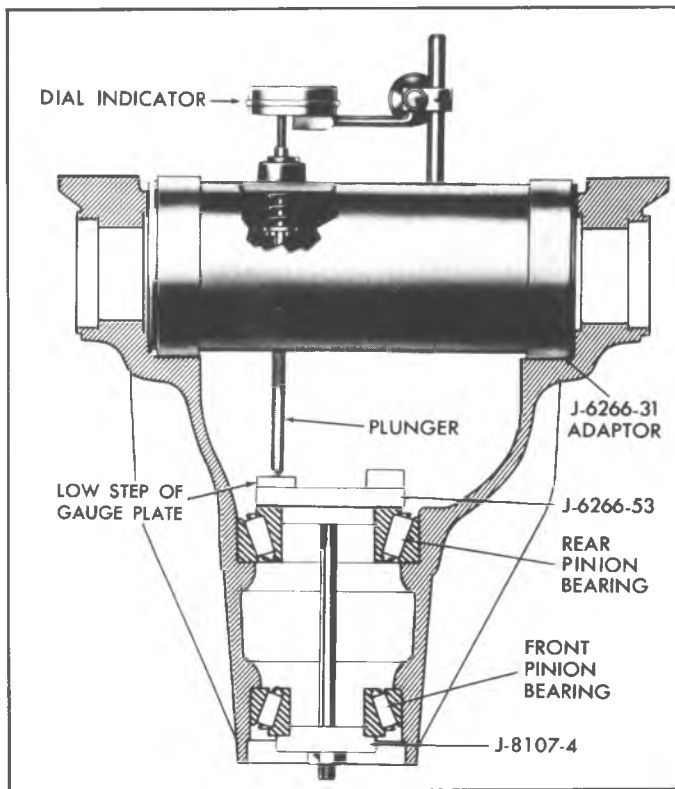


Fig. 0-4—Pinion Gauging Tools—Corvette

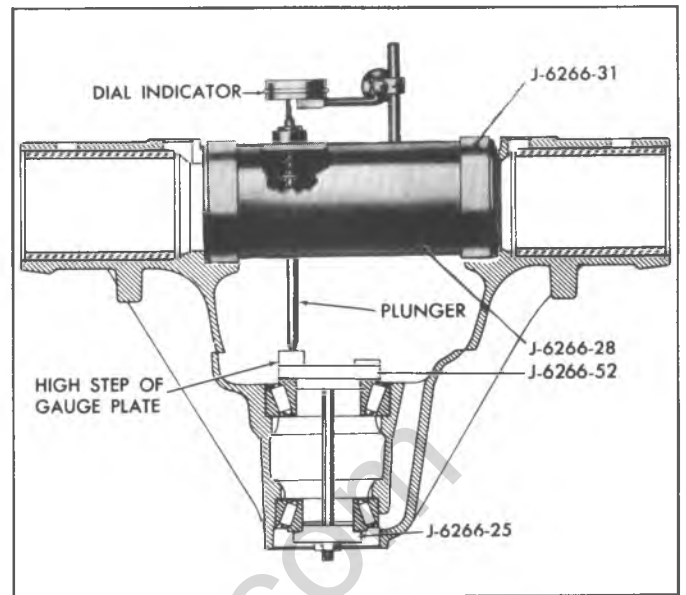


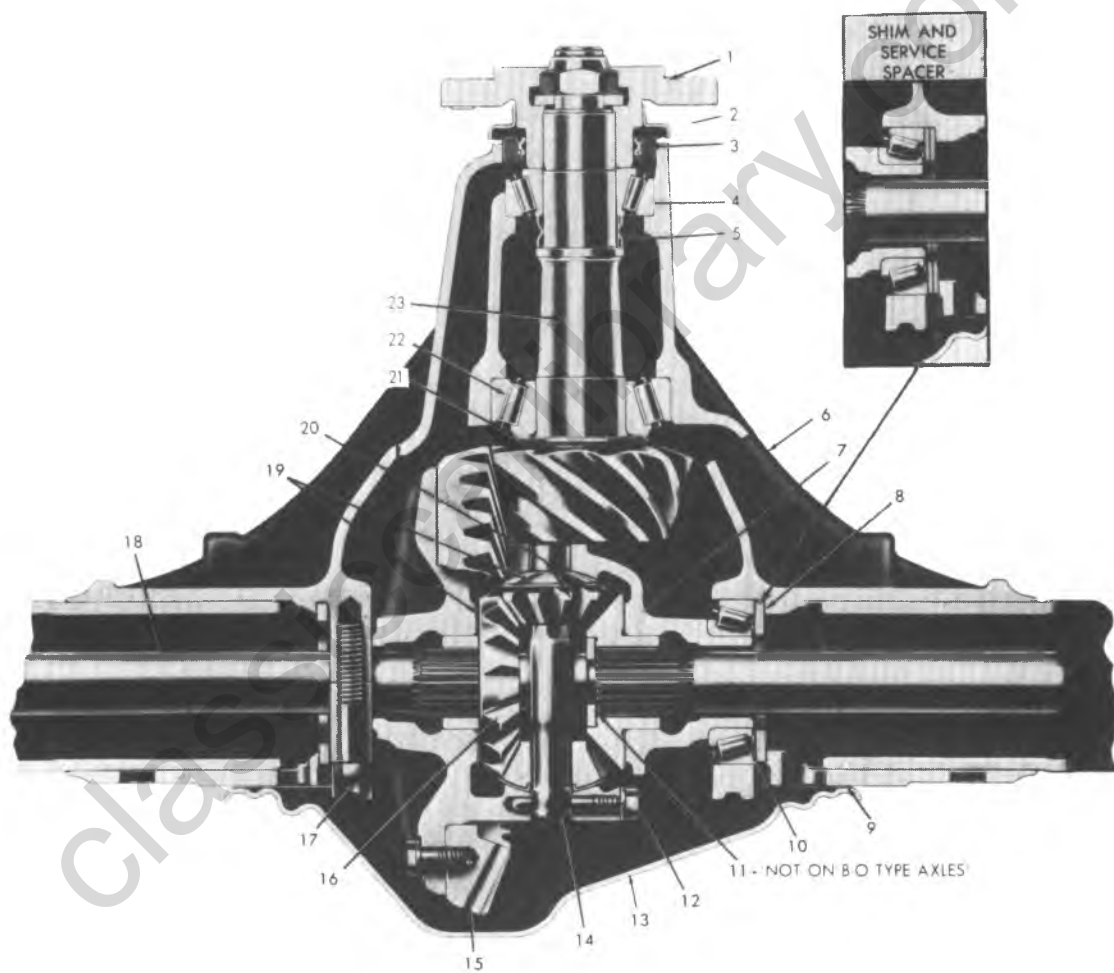
Fig. 0-5—Pinion Gauging Tools—8 7/8" Truck

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PASSENGER CAR DIFFERENTIAL 8-1/2" RING GEAR

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Differential Case	Drive Pinion	Checks and Adjustments
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- | | | | |
|--------------------------|-----------------------------|------------------|-------------------------|
| 1. Companion Flange | 7. Differential Case | 13. Cover | 19. Thrust Washer |
| 2. Deflector | 8. Shim | 14. Pinion Shaft | 20. Differential Pinion |
| 3. Pinion Oil Seal | 9. Gasket | 15. Ring Gear | 21. Shim |
| 4. Pinion Front Bearing | 10. Differential Bearing | 16. Side Gear | 22. Pinion Rear Bearing |
| 5. Pinion Bearing Spacer | 11. "C" Lock | 17. Bearing Cap | 23. Drive Pinion |
| 6. Differential Carrier | 12. Pinion Shaft Lock Screw | 18. Axle Shaft | |

Fig. 1A—Cross-Section of Typical Differential with 8 1/2" Ring Gear

DIFFERENTIAL CASE

Removal and Disassembly

NOTE: Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described under "Checks and Adjustments". This will indicate gear or bearing wear or an error in backlash or pinion depth setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, they may be reinstalled at original lash to avoid changing gear tooth contact.

1. Remove screw that retains differential pinion shaft, and remove pinion shaft.
2. Remove rear axle shafts as outlined in Service Manual.
3. Roll out the differential pinions and thrust washers; then remove side gears and thrust washers. Mark the pinions and side gears so they can be reassembled in their original positions.
4. Mark side bearing caps for installation in same position during reassembly. Loosen bolts holding differential side bearing caps to housing.

CAUTION: Do not attempt to pry caps off as this may damage machined face of caps.

5. Using a pry bar as shown in figure 2A, pry differential case out of carrier. Exercise caution in prying on carrier so that gasket sealing surface is not damaged. If the bearings are preloaded, the case will suddenly fall free when it is pried past a certain point; therefore, make sure case is properly supported to prevent damage. The bearing cups may be loosely installed, as shown in figure 2A, to prevent case from falling.
6. Place right and left bearing outer races and shims in sets with marked bearing caps so that they can be reinstalled in their original positions.

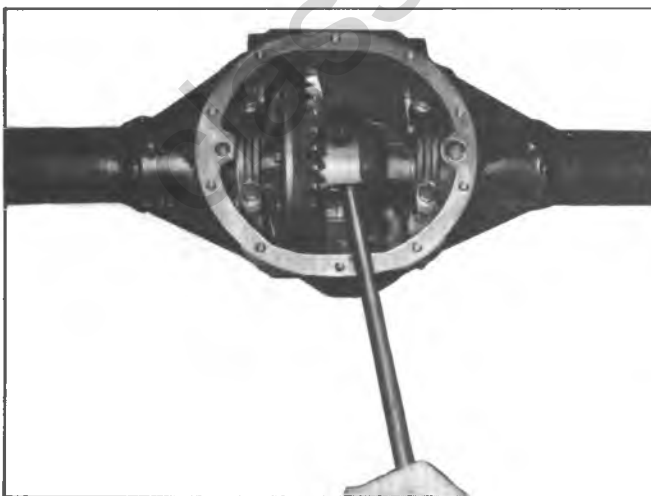


Fig. 2A Differential Case Removal

Inspection

1. Clean all parts in cleaning solvent; inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear.
2. Inspect axle shaft and side gear for evidence of excessive wear.
3. Inspect hypoid ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case, pinions, side gears, thrust washers and pinion shaft for cracks scoring, spalling or excessive wear.
5. Check fit of differential side gears in case.

Differential Bearing Replacement

1. Install Tool J-22888 and Adapter Plug J-8107-2, as shown in figure 3A. Make sure that the puller legs are fitted securely in case notches, against inner race.
2. Tighten puller screw to remove bearing.
3. Place new bearing onto hub, with the thick side of the inner race toward the case. Drive the bearing into place, using J-22761 as shown in figure 4A.
4. Before bearing installation on opposite hub, support differential case on Adapter Plug J-8107-2. This allows differential case to rest on adapter plug instead of bearing cage. Install other bearing as done in Step 3.

Ring Gear or Differential Case Replacement

1. Remove the ring gear screws (L.H. thread) and, using a soft drift and a hammer, tap ring gear off the case.

NOTE: Do not attempt to pry ring gear from case. To do so may damage machined surfaces.

2. Remove any nicks or imbedded dirt from case

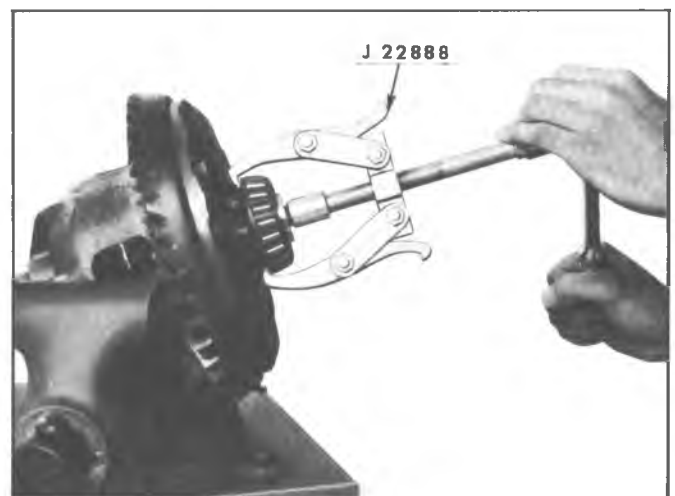


Fig. 3A—Differential Side Bearing Removal

4-6 REAR AXLE DIFFERENTIAL CARRIER

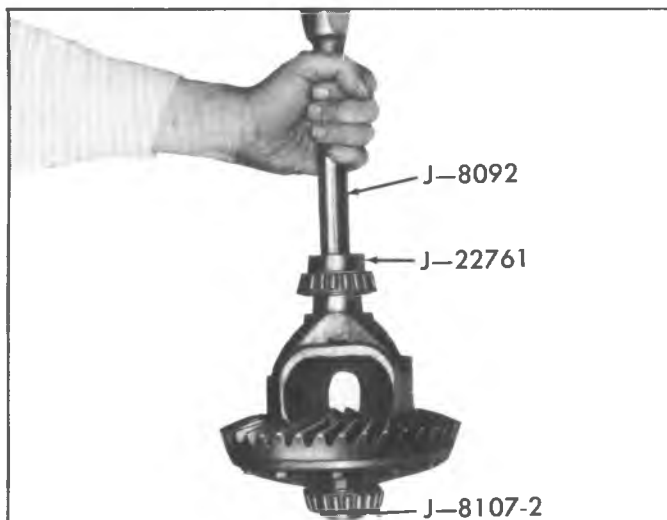


Fig. 4A—Differential Bearing Installation

flange surface which mates with ring gear. Clean all surfaces.

3. Liberally coat the differential case pilot with hypoid lubricant. Pre-align ring gear and differential case bolt holes and press against adaptor plug J-8107-2 to initially start ring gear on case pilot, as shown in figure 5A.
4. Start all ring gear bolts during initial assembly to maintain bolt hole alignment. Draw up all bolts evenly, using a criss-cross pattern to avoid cocking the gear on the case.
5. Insure that gear is seated firmly against the case, then torque all bolts to 90 lb. ft.

Reassembly

1. Install thrust washers and side gears into case. If

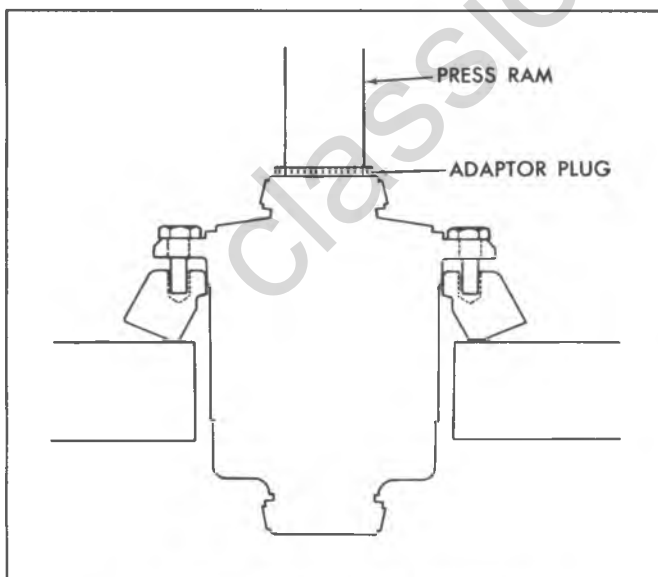


Fig. 5A—Ring Gear-to-Case Installation

original parts are being reused, replace in original positions.

2. Position pinions and thrust washers through loading hole in case 180° apart so that they engage side gears.
3. Rotate gears until the differential pinion bores and the case shaft holes are aligned.
4. Install pinion shaft and lock screw. It is not necessary to torque lock screw until axle shafts are installed.
5. Differential may be installed in carrier now, or after service is performed on the drive pinion.

Installation and Adjustment

1. Check condition of bearing, bearing cups, cup seat in carrier and carrier caps to make sure that they are free from nicks, burrs and foreign material.
2. Lubricate bearings with axle lubricant; position cups on proper bearing, then install differential assembly in carrier and support the assembly to prevent it from falling.
3. Install strap J-22779-6 on left bearing by tightening bearing bolts alternately and evenly to snug fit.
4. With the ring gear tight against the pinion gear (.000" to .001" backlash), insert gauging Tool J-22779 between the left bearing cup and carrier housing. See Figure 6A.
5. While oscillating tool, turn adjusting nut clockwise until a noticeable drag is produced.
6. Tighten lock bolt on side of tool.
7. Between the right bearing and carrier, install Service Spacer A (.170"), Service Shim B and Feeler Gauge C. Thickness of Feeler Gauge must be sufficient to produce a slight "drag" when moved between carrier and Service Shim.

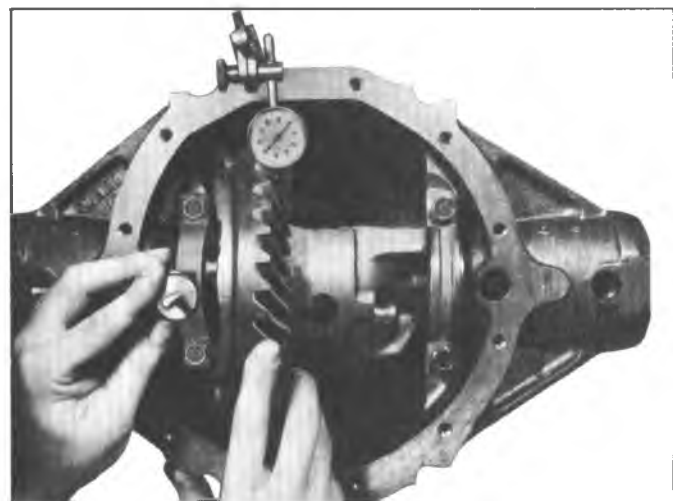


Fig. 6A—Installing Gauging Tool

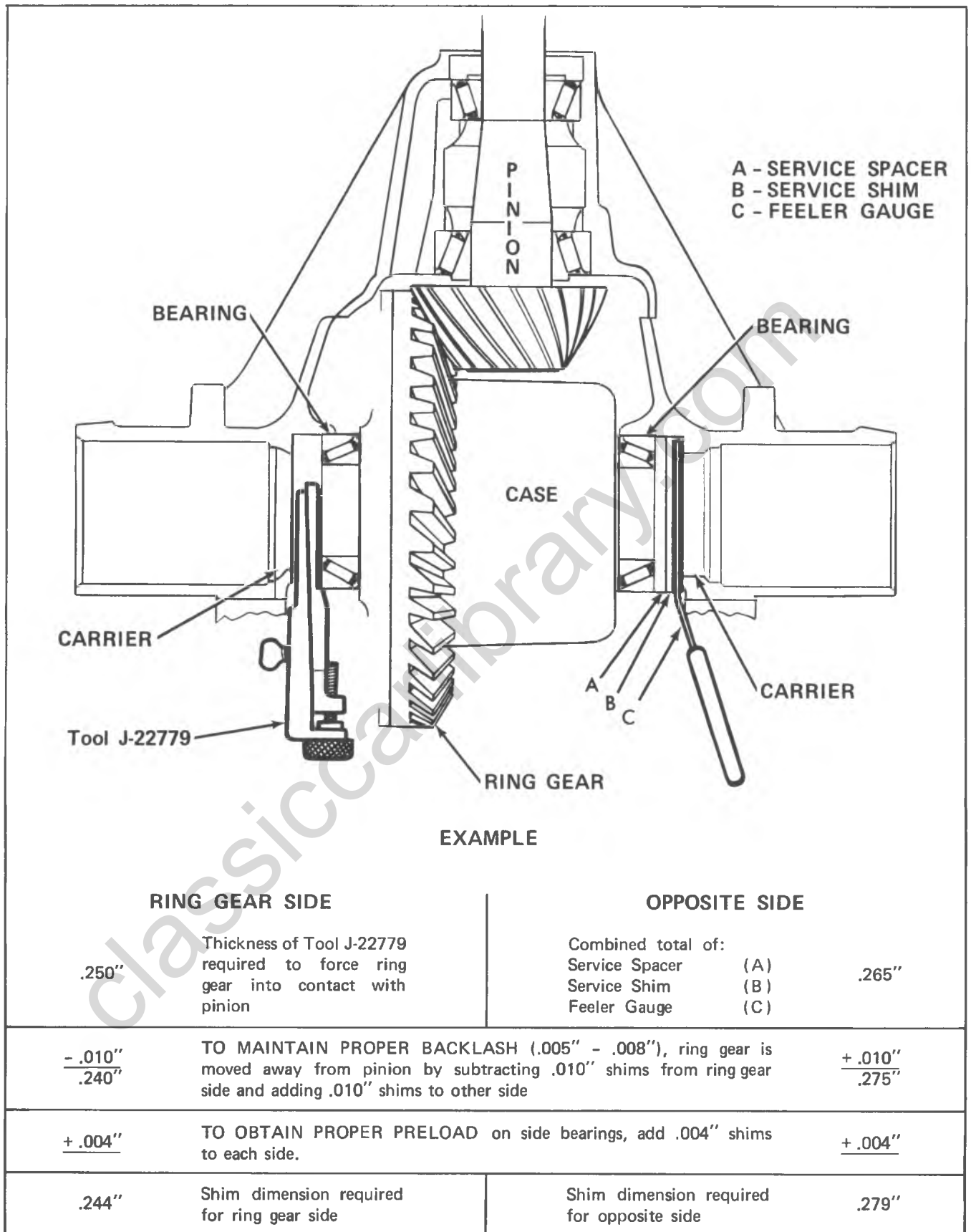


Fig. 7A—Determining Side Bearing Shim Requirements

4-8 REAR AXLE DIFFERENTIAL CARRIER

8. Now measure the above dimensions as shown in Fig. 7A.
 - a. Using a micrometer as in Figure 8A, measure the thickness of J-22779 in a minimum of three places and average these readings. Record the result.
 - b. Add together the dimensions of the Service Shim, Service Spacer and Feeler Gauge. Record the result.
9. Use the sample procedure in Figure 7A to determine the proper thickness for each shim pack.
10. Install left shim first, then wedge right shim between bearing cup and spacer (position shim so that chamfered side is outward or next to spacer). If shim does not have sufficient chamfer or lead around O.D. to allow easy installation without scraping spacer, file or grind chamfer before installing.
11. If difficulty is encountered in installing shim, partially remove case and slide case and shim into position. Tap shim into position, using a soft faced hammer, while rotating differential case with free hand. See Figure 9A.
12. Install bearing caps in original position and torque to 60 ft. lbs.

NOTE: At this point, the differential side bearings are properly preloaded. If any adjustments are required in later procedures, make sure that preload remains established as in step 9. If backlash is changed, be sure that **total** thickness of two shim packs does not change.

13. Mount a dial indicator on the carrier and check the backlash between the ring gear and pinion, as shown in Figure 10A. The backlash should be within the range of 0.005"-0.008". Check gear lash

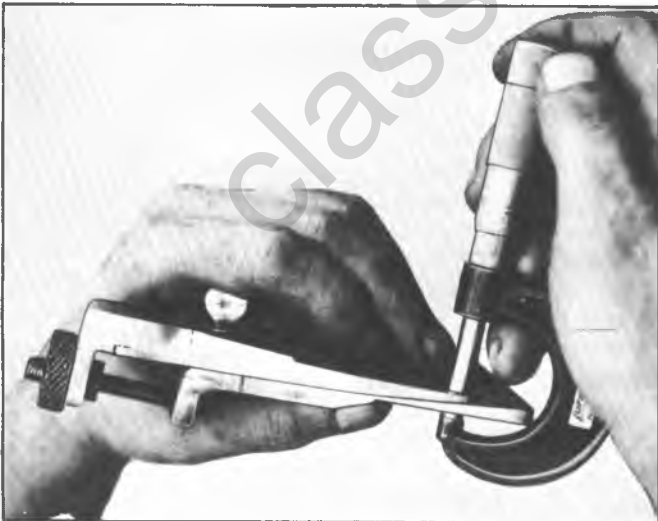


Fig. 8A—Measuring Gauge Thickness

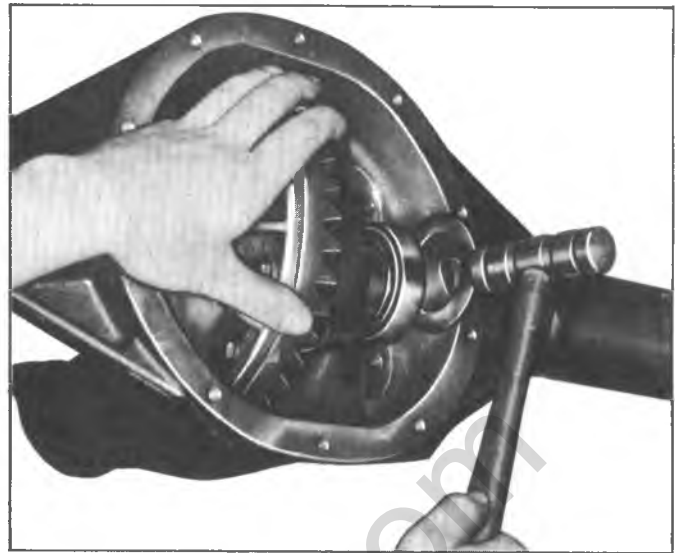


Fig. 9A—Installing Differential Shim

at four different equally spaced positions around the gear. Variation in readings should not exceed .002".

NOTE: Position the dial indicator so that indicator button is perpendicular to tooth angle and in line with gear rotation.

14. If variation in backlash readings exceeds .002", measure ring gear and case runout as shown in Figure 11A. Gear runout should not exceed .003"; should runout exceed this limit check ring gear and case for deformation and/or foreign matter between case and gear.
15. If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of other shim the same amount. Total shim thickness must be maintained at all times to maintain proper preload.
16. Backlash changes approximately .002" for each

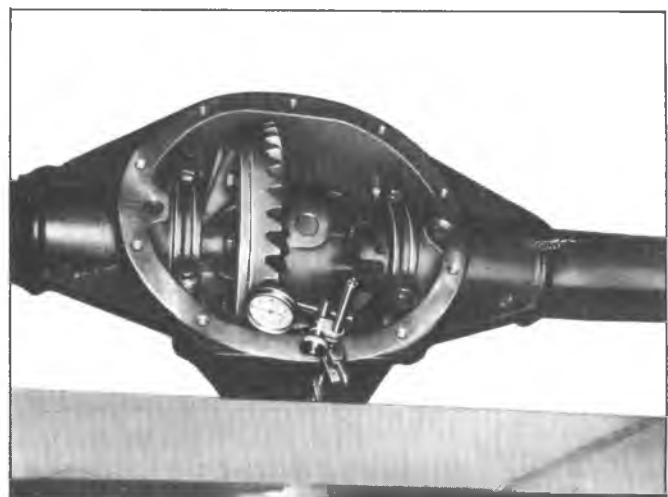


Fig. 10A—Checking Ring Gear Backlash

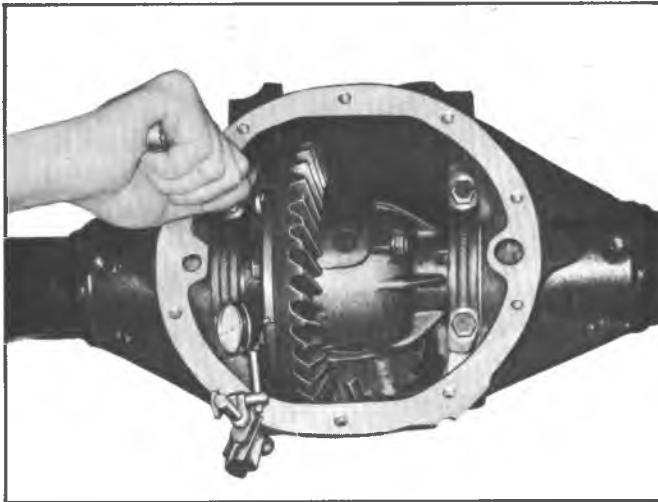


Fig. 11A—Checking Ring Gear Run-Out

.003" change in shim dimensions. If backlash exceeds .008", increase the shim thickness on ring gear side, while decreasing shim thickness on opposite side **an equal amount**. If backlash is less than .005", decrease the shim thickness on ring gear side, while increasing shim thickness on opposite side **an equal amount**.

DRIVE PINION

Removal

1. Remove differential as previously outlined.
2. Check torque required to rotate drive pinion as described under "Drive Pinion - Installation and Adjustment". If there is no torque reading, check for looseness of pinion assembly by shaking (push-pull) the companion flange. Looseness indicates the need for bearing replacement.
3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 12A. Position J-8614-11 on flange so that the four notches are toward the flange.
4. Remove pinion nut and washer.
5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 13A.
6. To remove the drive pinion, first thread the original pinion nut half way on the pinion, for thread protection.
7. Place the differential cover temporarily back onto the housing, using two screws. This will prevent the pinion from falling to the floor during removal.
8. Tap the end of the pinion nut with a large hammer and a soft drift, as shown in figure 14A.

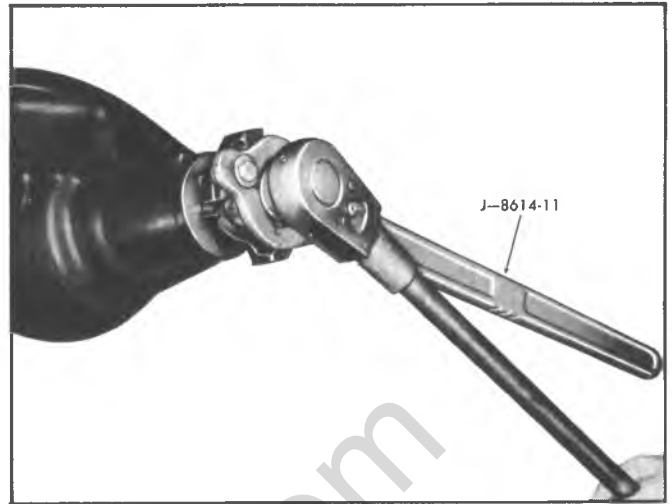


Fig. 12A—Drive Pinion Nut Removal

NOTE: Care must be taken not to damage pinion bearings while removing pinion from carrier. Inspect bearings and cups for damage and replace if needed.

9. Remove the pinion oil seal and the front pinion bearing. Remove the cover and retrieve the drive pinion from the housing. Discard the pinion oil seal, nut and collapsible spacer. Use a new seal, nut and spacer on reassembly.

Bearing Removal and Cup Replacement

1. If front pinion bearing is to be replaced, drive outer race from carrier using a drift in slots provided for this purpose. Tap alternately on opposite sides of bearing cup to avoid cocking.
2. If rear pinion bearing is to be replaced, drive outer race from carrier using a drift in slots provided for this purpose.

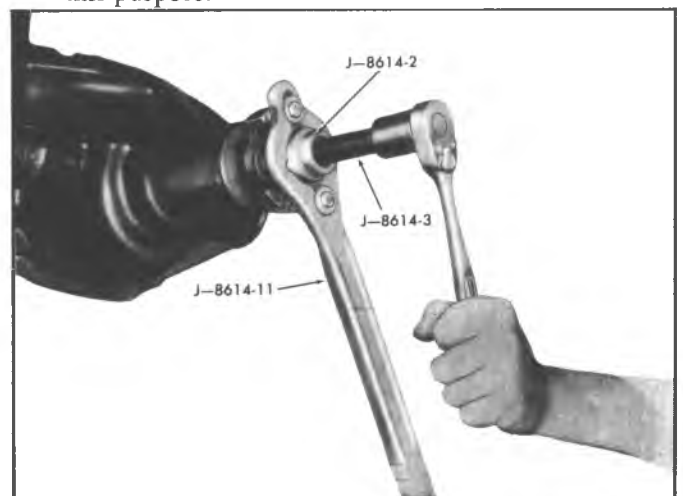


Fig. 13A—Drive Pinion Flange Removal

4-10 REAR AXLE DIFFERENTIAL CARRIER

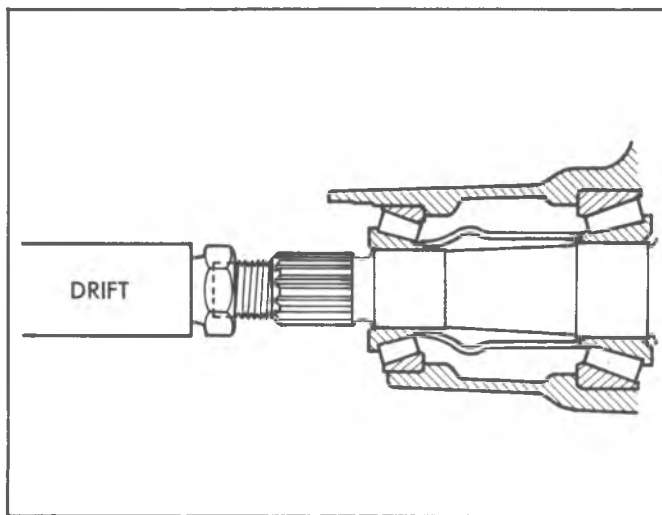


Fig. 14A—Removing Drive Pinion

3. Remove rear pinion bearing from pinion shaft using Press Plate J-22912. See Figure 15A.

Tighten nuts on tool until plates are under the bearing inner race. Then, set tool on press. Make sure the plates straddle opening on press. Do not position bolts across opening. To do so may bend the bolts when pressure is applied. Press bearing from pinion. Record thickness of shim removed from between bearing and pinion head.

4. Inspect carrier pinion bearing bores and shoulders for nicks. Remove as necessary. Clean the bores and the installation tools.
5. Lubricate both outer cups with liberal amounts of hypoid lubricant.
6. Install the rear cup, with the large end against the bore shoulder, using Installer J-8608 as shown in figure 16A.
7. Install the front cup, with the large end against the



Fig. 15A—Removing Drive Pinion Rear Bearing.

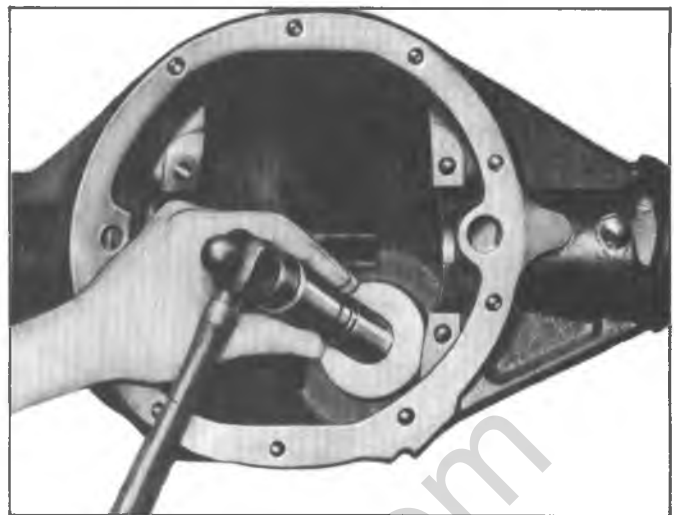


Fig. 16A—Installing Pinion Rear Bearing Cup

bore shoulder, using Installer J-7137 as shown in figure 17A.

8. Check both bores to make sure cups are fully seated.

Setting Pinion Depth and Installing Pinion Bearings

NOTE: If the original ring gear and pinion and the pinion rear bearing assembly are to be reinstalled, the original shim thickness may be used.

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or "nominal" setting due to allowable variation in

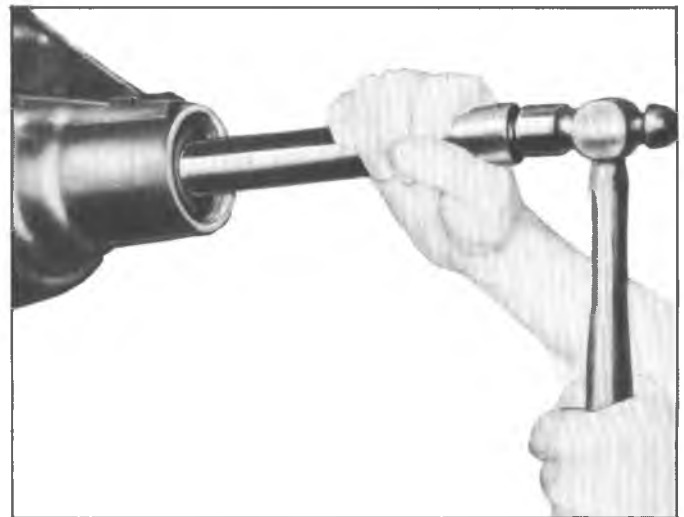


Fig. 17A—Installing Pinion Front Bearing Cup

machining the parts. When a pinion is found having a plus or minus reading recorded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.

In order to compensate for all of the allowable machining variables, a procedure of gaging the carrier and shimming the pinion has been developed. After gaging a carrier, the assembler must install the appropriate shim between the drive pinion shoulder and rear bearing so that pinion depth can be adjusted to the required position for best tooth contact in each axle assembly.

Proper pinion depth is determined with Pinion Setting Gauge J-21777-01.

1. Clean the housing assembly and all gauge parts to insure accurate measurements.
2. Lubricate front and rear pinion bearings which will be used in final assembly and position them in their respective races in the carrier.
3. With cloverleaf gauge plate J-21777-29 mounted on preload stud J-21777-43, insert stud through rear bearing and pilot J-21777-35, and through front bearing and pilot J-21777-42. Install the hex nut until snug and rotate the bearings to make sure they are properly seated. See figure 18A for illustration of proper positioning.
4. Hold the preload stud stationary with a wrench on the flats and tighten hex nut until 20 in. lbs. of torque are required to rotate the bearings as shown in figure 19A.
5. Mount the side bearing discs J-21777-45 on the ends of arbor J-21777-1, using the step of the disc that corresponds to the base of the carrier.
6. Place the arbor and plunger assembly into the carrier, being sure the side bearing discs are seated properly.

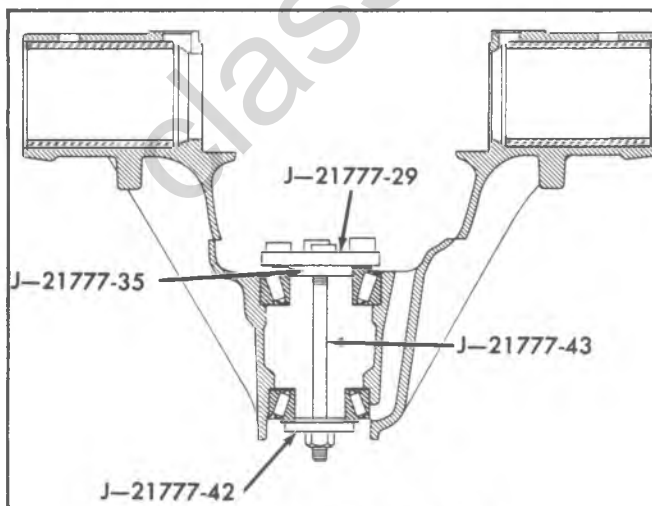


Fig. 18A—Gauge Plate Installed

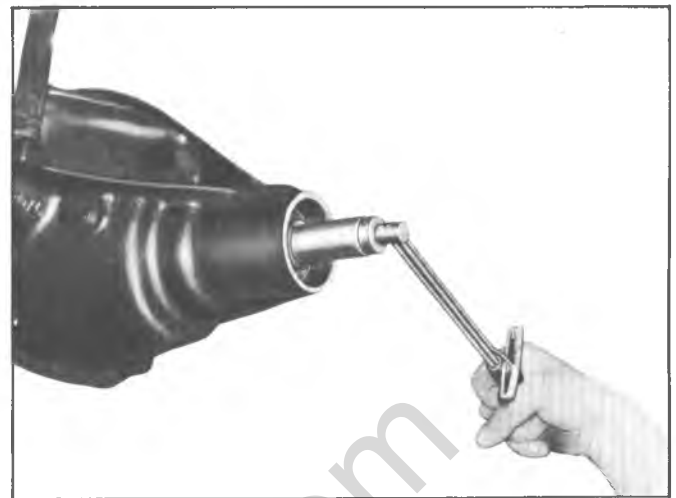


Fig. 19A—Measuring Rotating Torque

7. Install the bearing caps finger tight to prevent the discs from moving.
8. Position dial indicator J-8001 on the mounting post of the arbor with the contact button resting on the top surface of the plunger.
9. Preload the dial indicator one half revolution and tighten in this position.
10. Select the button on the gauge plate that corresponds to the ring gear size and rotate the plate until the plunger rests directly upon that button.
11. Rock the plunger rod slowly back and forth across the button until the dial indicator reads the greatest deflection. At this point, set the dial indicator to zero. Tools will now be positioned as shown in figure 20A.
12. Repeat the rocking action of the plunger several times to verify the setting.

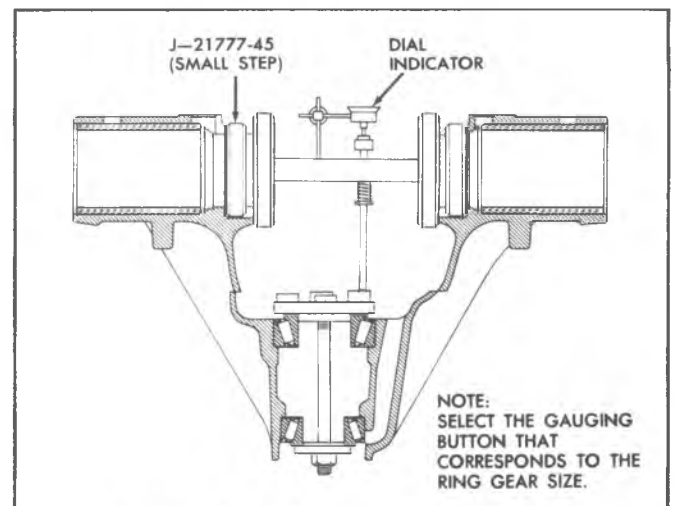


Fig. 20A—Depth Gauge Installed in Position

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13. Once the zero reading is obtained, swing the plunger until it is removed from the gauging plate button.

The dial indicator will now read the required pinion shim thickness for a "nominal" pinion. Record this size.

14. Check the rear face of the drive pinion being installed for a pinion code number. This number indicates the necessary alteration of the pinion shim thickness as determined in step 13.

a. If the pinion is stamped with a plus (+) number, **add** that many thousandths to the indicator reading. For example, if indicator reading is .019, and pinion is marked (+2), the correct depth shim for installation will be $.019 + .002 = .021$ inch.

b. If the pinion has no plus (+) or minus (-) number, use the indicator reading as the correct shim thickness.

c. If the pinion is stamped with a minus (-) number, **subtract** that many thousandths from the indicator reading. For example, if the indicator reading is .031, and pinion is marked (-3), the correct depth shim for installation will be $.031 - .003 = .028$ inch.

15. Remove bearing caps and depth gauging tools from carrier.

16. Position the shim selected in step 14 on the pinion shaft against pinion head.

17. Lubricate the rear pinion bearing with liberal amounts of hypoid lubricant and install rear bearing onto pinion, using J-8609 as shown in figure 21A.

Installation and Adjustment

1. Lubricate the front bearing with liberal amounts of hypoid lubricant, and place into outer cup.

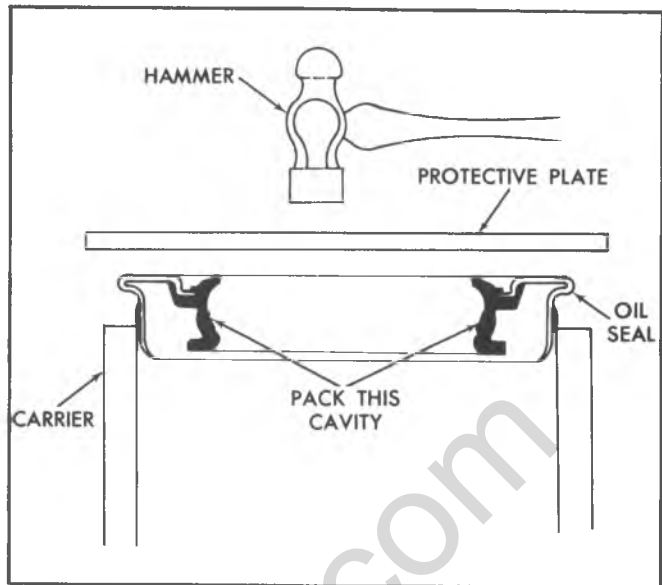


Fig. 22A—Installing Pinion Oil Seal

2. Place a new pinion oil seal into position in carrier bore. Tap lightly with a protective plate and a hammer until seal flange seats against carrier, as shown in figure 22A.
3. Coat lips of pinion oil seal and seal surface of pinion flange with gear lube.
4. Install a new pinion bearing spacer onto the drive pinion.
5. Remove nut and sleeve from Companion Flange Installer J-9458. Screw J-9458 onto drive pinion and insert assembly into housing.
6. Position companion flange onto drive pinion. Install sleeve and nut onto J-9458.
7. Install Companion Flange Holding Tool J-8614-11. See Figure 23A.
8. Tighten nut on Tool J-9458 which draws drive

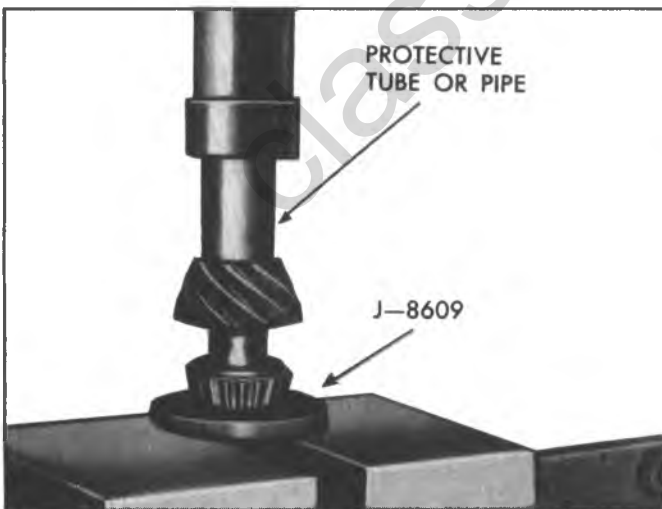


Fig. 21A—Drive Pinion Rear Bearing Installation

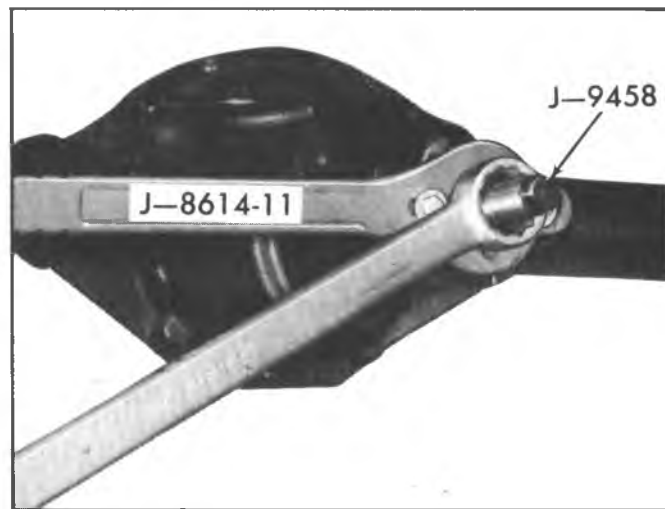


Fig. 23A—Drive Pinion Flange Installation

pinion through front bearing and companion flange. Tighten only until end play is removed from drive pinion then remove Tool J-9458.

NOTE: When no further end play is detectable, and when Holder J-8614-11 will no longer pivot freely as pinion is rotated, bearing preload specifications are being neared. Further tightening should be done only after nut and washer installation and preload has been checked with a torque wrench.

9. Lubricate cavity between end of pinion splines and pinion flange with a non-hardening sealer (such as Permatex Type A or equivalent) and install washer. Lubricate new nut threads with a liberal amount of hypoid lubricant, and install on pinion snugly.
10. Check preload by using an inch pound torque wrench such as J-5853 as shown in Figure 24A.

NOTE: After torque has been checked, final tightening should be done very cautiously. For example, if when checking, torque was found to be 5 inch pounds, additional tightening of the pinion nut as little as 1/8 turn can add 5 additional inch pounds drag. Therefore, the pinion nut should be further tightened only a little at a time and torque should be checked after each slight amount of tightening. Exceeding torque specifications may compress the collapsible spacer too far and require its replacement.

11. While observing the preceding caution, carefully set preload drag at 20-25 in. lb. on new bearings or 10-15 in. lb. on reused bearings.
12. Rotate pinion several times to assure that bearings have been seated. Check preload again. If drag has been reduced by rotating pinion, re-set preload to specification.



Fig. 24A—Measuring Rotating Torque

CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 11 of "Drive Pinion-Installation and Adjustment".

Side Bearing Preload is set to specifications in step 9 of "Differential Case-Installation and Adjustment".

Following service to the Differential Case or to the Drive Pinion and Ring Gear, a Gear Tooth Contact Pattern Check **must** be made to verify the accuracy of the work in setting the pinion depth and the ring gear-to-pinion backlash.

Gear Tooth Contact Pattern Check

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 25A.

Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound (yellow lead chromate or equivalent) and apply this mixture sparingly to

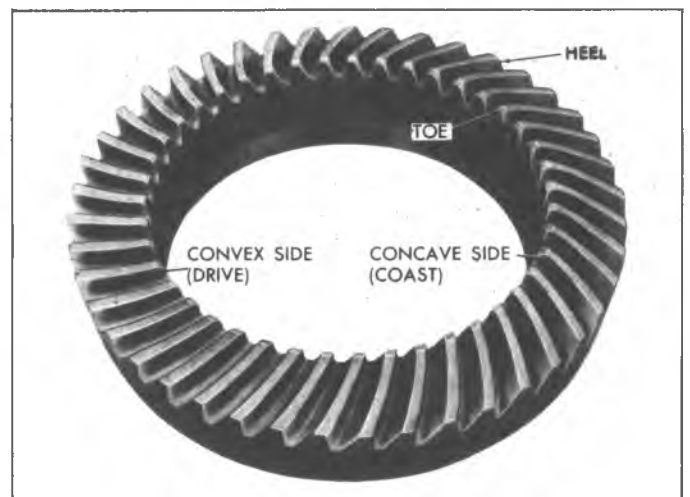


Fig. 25A—Gear Tooth Nomenclature

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all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.

3. Tighten bearing cap bolts to 55 lb. ft.
4. Expand brake shoes until a torque of 20-30 lb. ft. is required to turn the pinion.

NOTE: A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with Figure 26A.

Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern. These adjustments are backlash and

position of drive pinion in carrier. The effects of bearing preloads are not readily apparent on hand loaded teeth pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

NOTE: It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion.

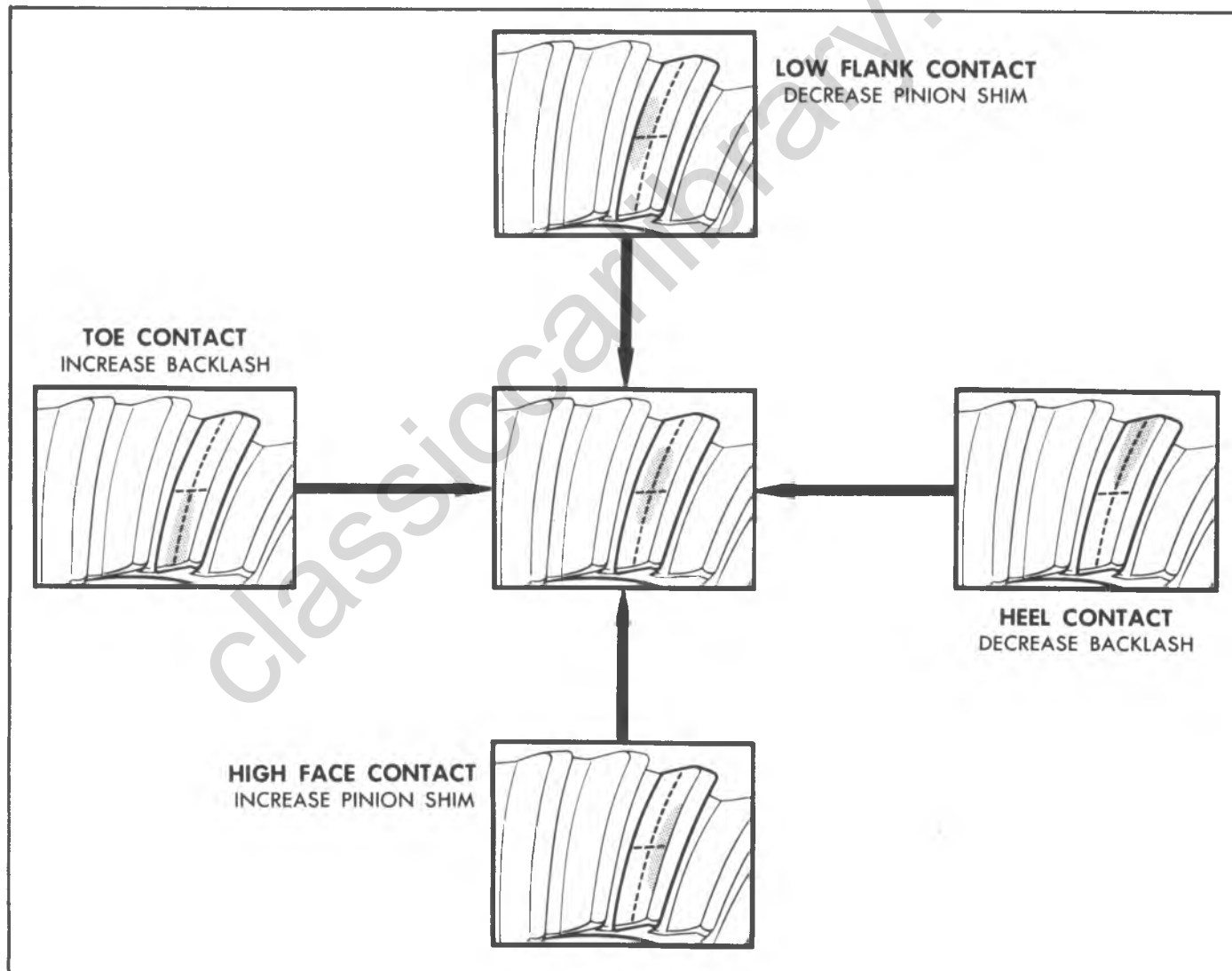


Fig. 26A—Gear Teeth Contact Pattern Check

(The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease backlash, decrease right shim and increase left shim an equal amount.

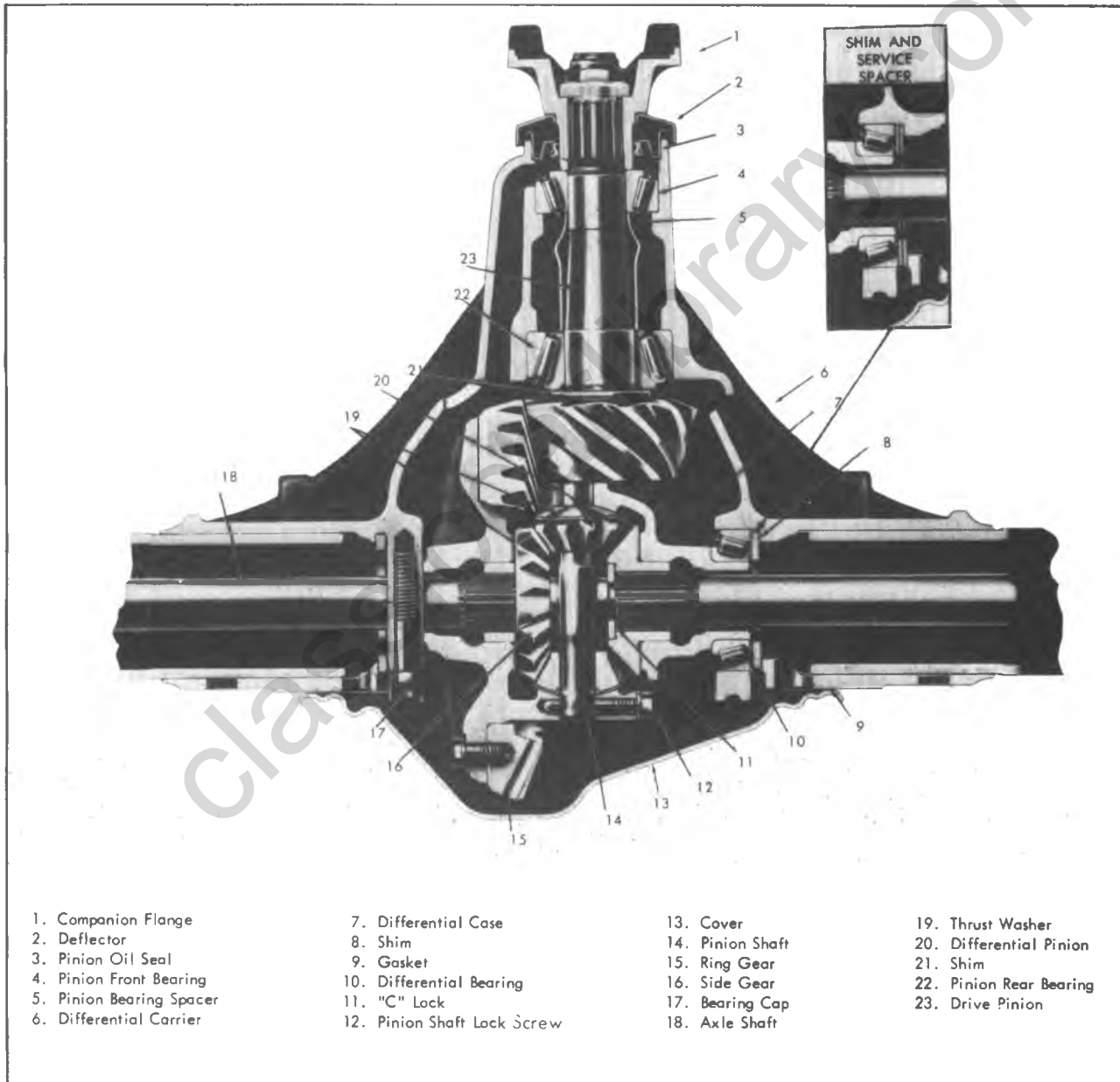
The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

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PASSENGER CAR AND SERIES 10 TRUCK DIFFERENTIAL 8-7/8" RING GEAR

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|--------------------------|-----------------------------|------------------|-------------------------|
| 1. Companion Flange | 7. Differential Case | 13. Cover | 19. Thrust Washer |
| 2. Deflector | 8. Shim | 14. Pinion Shaft | 20. Differential Pinion |
| 3. Pinion Oil Seal | 9. Gasket | 15. Ring Gear | 21. Shim |
| 4. Pinion Front Bearing | 10. Differential Bearing | 16. Side Gear | 22. Pinion Rear Bearing |
| 5. Pinion Bearing Spacer | 11. "C" Lock | 17. Bearing Cap | 23. Drive Pinion |
| 6. Differential Carrier | 12. Pinion Shaft Lock Screw | 18. Axle Shaft | |

Fig. 1B—Cross Section of Differential with 8 7/8" Ring Gear

DIFFERENTIAL CASE

Removal and Disassembly

NOTE: Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described under "Checks and Adjustments". This will indicate gear or bearing wear or an error in backlash or pinion depth setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, they may be reinstalled at original lash to avoid changing gear tooth contact.

1. Remove screw that retains differential pinion shaft, and remove pinion shaft.
2. Remove rear axle shafts as outlined in the Service Manual.
3. Roll out the differential pinions and thrust washers, then remove side gears and thrust washers. Mark pinions and side gears so that they can be reassembled in original position.
4. Mark the bearing caps and housing for reassembly in same position. Loosen bearing cap bolts. Tap surface of bearing caps to loosen.

CAUTION: Do not attempt to pry caps off as this may damage machined face of caps.

5. Using a pry bar as shown in Figure 2B, pry differential case out of carrier. Exercise caution in prying on carrier so that gasket sealing surface is not damaged. If the bearings are preloaded, the case will suddenly fall free when it is pried past a certain point; therefore, make sure case is properly supported to prevent damage. The bearing caps may be loosely installed, as shown in Figure 2B, to prevent case from falling.
6. Place left and right bearing cups with bearing caps so that they may be reinstalled in original positions. Place shims with appropriate cups.



Fig. 2B—Differential Case Removal

Inspection

1. Clean all parts in cleaning solvent; inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear.
2. Inspect axle shaft and side gear splines for evidence of excessive wear.
3. Inspect hypoid ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case, pinions, side gears, thrust washers and pinion shaft for cracks, scoring, spalling or excessive wear.
5. Check fit of differential side gears in case.

Differential Bearing Replacement

1. Install Tool J-22888 and Adapter Plug J-8107-4, assuring puller legs are fitted securely in notches in case and against bearing cone, as shown in figure 3B.
2. Tighten puller screw to remove bearing.
3. Place new bearing on hub with thick side of inner race toward case and drive into place, using J-22175 and Driver Handle J-8092, as shown in figure 4B.
4. Before bearing installation on opposite hub, support differential case on Adapter Plug J-8107-4. This allows differential case to rest on adapter instead of bearing cage. See Figure 4B. Install remaining bearing as instructed in Step 3.

Ring Gear or Differential Case Replacement

1. Remove the ring gear bolts (L.H. thread on passenger car applications) and, using a soft drift and a hammer, tap ring gear off the case.

NOTE: Do not attempt to pry ring gear from case. To do so may damage machined surfaces.

2. Remove any nicks or imbedded dirt from case

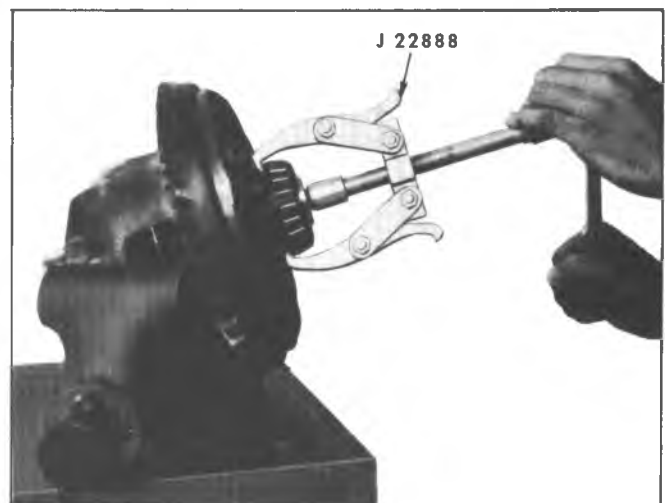


Fig. 3B—Differential Bearing Removal

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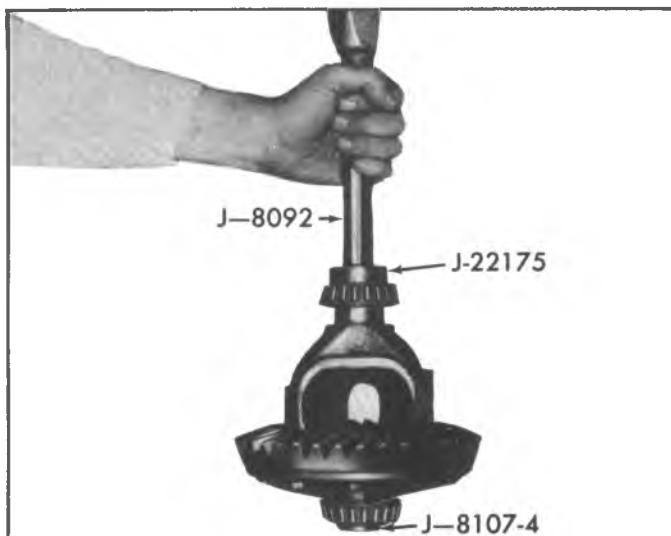


Fig. 4B—Differential Bearing Installation

flange surface which mates with ring gear. Clean all surfaces.

3. Liberally coat the differential case pilot with hypoid lubricant. Pre-align ring gear and differential case bolt holes, and press on adaptor plug J-8107-4 to initially start ring gear on case pilot, as shown in figure 5B.
4. Start all ring gear bolts during initial assembly to maintain bolt hole alignment. Draw up all bolts evenly, using a criss-cross pattern to avoid cocking the gear on the case.
5. Insure that the gear is seated firmly against the case, then torque the bolts to 90 ft. lbs. for passenger cars, and 60 ft. lbs. for truck models.

Reassembly

1. Install thrust washers and side gears into case. If original parts are being reused, replace in original positions.

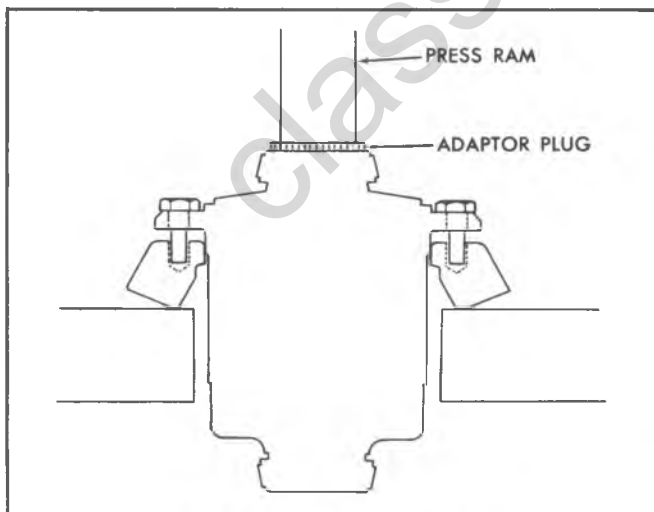


Fig. 5B—Ring Gear-to-Case Installation

2. Position pinions and thrust washers through loading hole in case 180° apart so they engage side gears.
3. Rotate gears until the differential pinion bores and the case shaft holes are aligned.
4. Install pinion shaft and lock screw. It is not necessary to torque lock screw until axle shafts are installed.
5. Differential may be installed in carrier now, or after service is performed on the drive pinion.

Installation and Adjustment

1. Check condition of bearing, bearing cups, cup seat in carrier and carrier caps to make sure that they are free from nicks, burrs and foreign material.
2. Lubricate bearings with axle lubricant; position cups on proper bearing, then install differential assembly in carrier and support the assembly to prevent it from falling.
3. Install strap J-22779-6 on left bearing by tightening bearing bolts alternately and evenly to snug fit.
4. With the ring gear tight against the pinion gear (.000" to .001" backlash) insert gauging Tool J-22779 between the left bearing cup and carrier housing as shown in Figure 6B.
5. While oscillating tool, turn adjusting nut clockwise until a noticeable drag is produced.
6. Tighten lock bolt on side of tool.
7. Between the right bearing and carrier, install Service Spacer A (.170"), Service Shim B and Feeler Gauge C. Thickness of Feeler Gauge must be sufficient to produce a slight "drag" when moved between carrier and Service Shim.
8. Now measure the above dimensions as shown in Fig. 7B.
 - a. Using a micrometer as in Figure 8B measure the thickness of J-22779 in a minimum of three

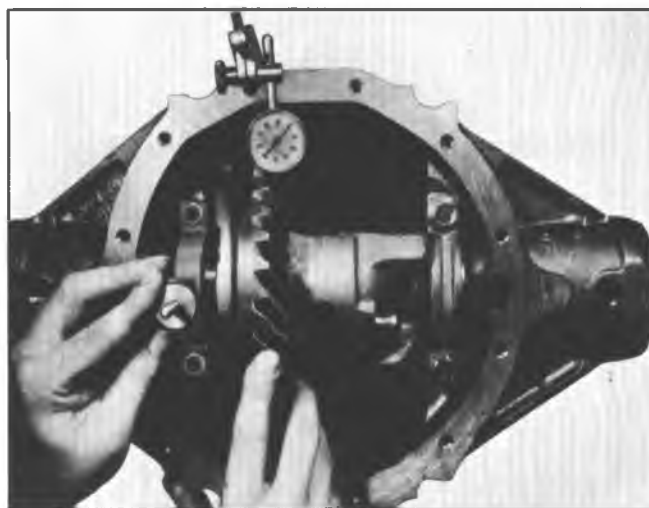


Fig. 6B—Installing Gauging Tool

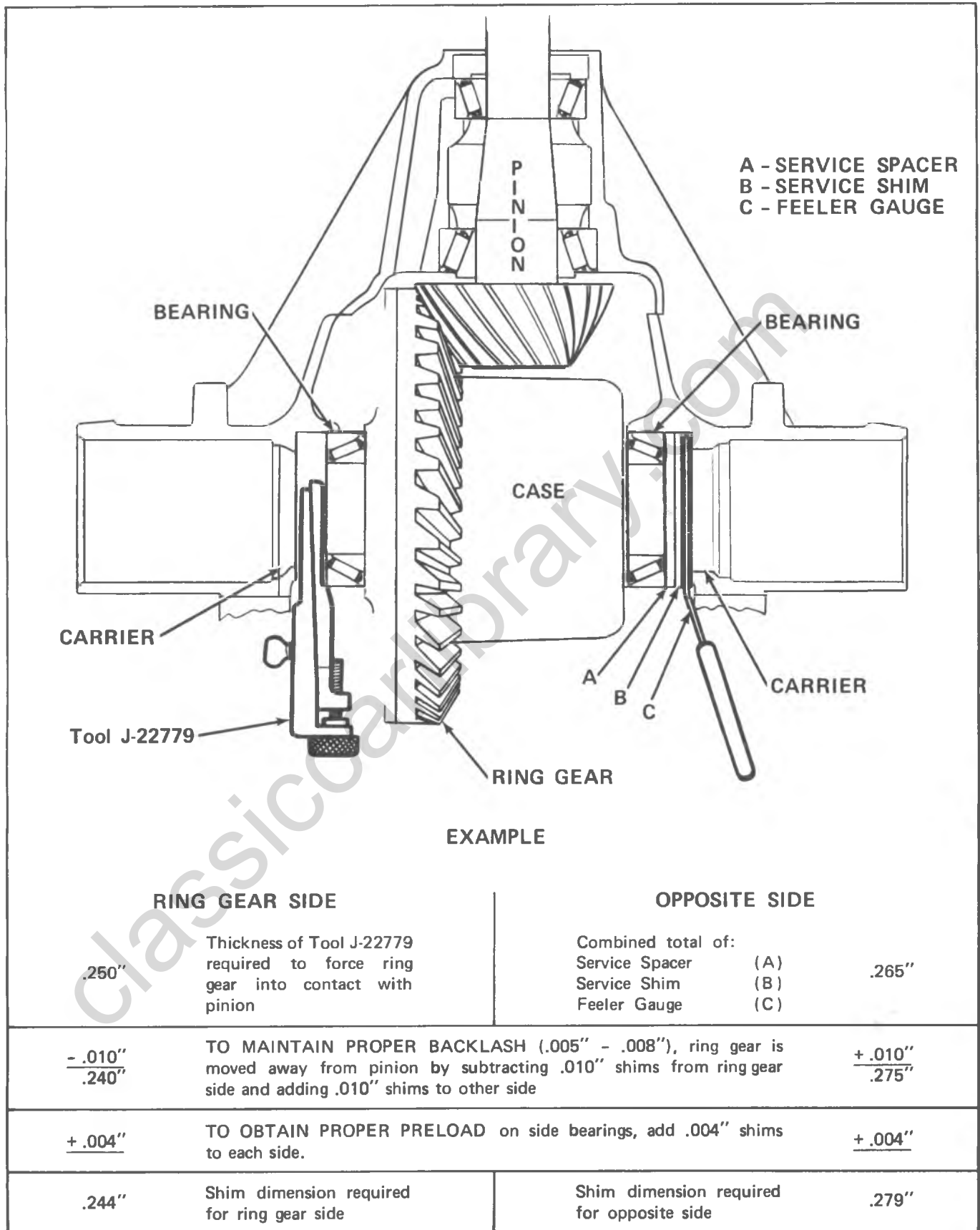


Fig. 7B—Determining Side Bearing Shim Requirements

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places and average these readings. Record the result.

- b. Add together the dimensions of the Service Shim, Service Spacer and Feeler Gauge. Record the result.
9. Use the sample procedure in Figure 7B to determine the proper thickness for each shim pack.

NOTE: Production preloading of the differential bearings is accomplished by the use of cast iron preload shim. These shims cannot be used when rebuilding the carrier as they may break when tapped into place.

10. Install left shim first, then wedge right shim between bearing cup and spacer. Position shim so that chamfered side is outward or next to spacer. If shim does not have sufficient chamfer or lead around O.D. to allow easy installation without scraping spacer, file or grind chamfer before installing.
11. If difficulty is encountered in installing shim, partially remove case and slide case and shim into position. Tap shim into position, using a soft faced hammer, while rotating differential case with free hand as shown in Figure 9B.
12. Install bearing caps in original position and torque to 60 ft. lbs.

NOTE: At this point, the differential side bearings are properly preloaded. If any adjustments are required in later procedures, make sure the preload remains as established in step 9. If backlash is changed in later steps, be sure the **total** thickness of the two shim packs does not change.

13. Mount a dial indicator on the carrier and check the backlash between the ring gear and pinion, as shown in Figure 10B. The backlash should be within the range of 0.005"-0.008". Check gear lash

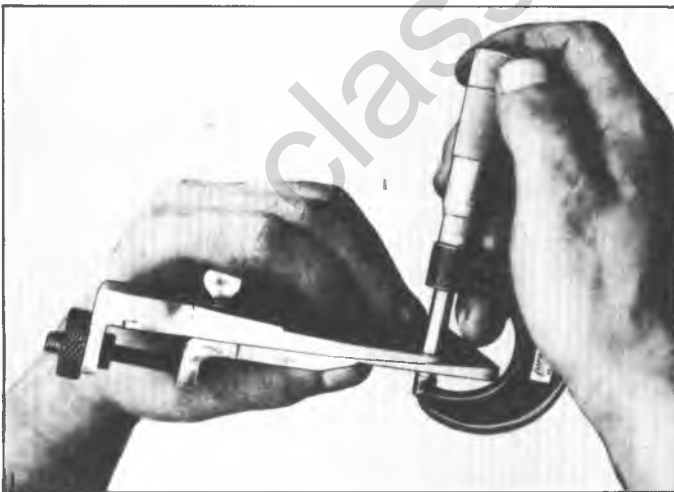


Fig. 8B—Measuring Gauge Plate Thickness



Fig. 9B—Installing Differential Shim

at four different equally spaced positions around the gear. Variation in readings should not exceed .002".

NOTE: Position the dial indicator so that indicator button is perpendicular to tooth angle and in line with gear rotation.

14. If variation in backlash readings exceeds .002"; measure ring gear and case runout as shown in Figure 11B. Gear runout should not exceed .003"; should runout exceed this limit, check ring gear and case for deformation and/or foreign matter between case and gear.
15. If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of other shim **the same amount**. Total shim thickness must be maintained at all times to maintain proper preload.
16. Backlash changes approximately .002" for each .003" change in shim dimensions.

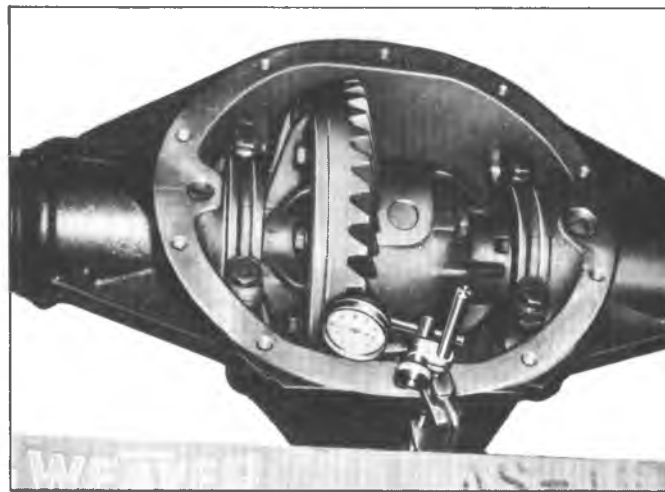


Fig. 10B—Checking Ring Gear Backlash

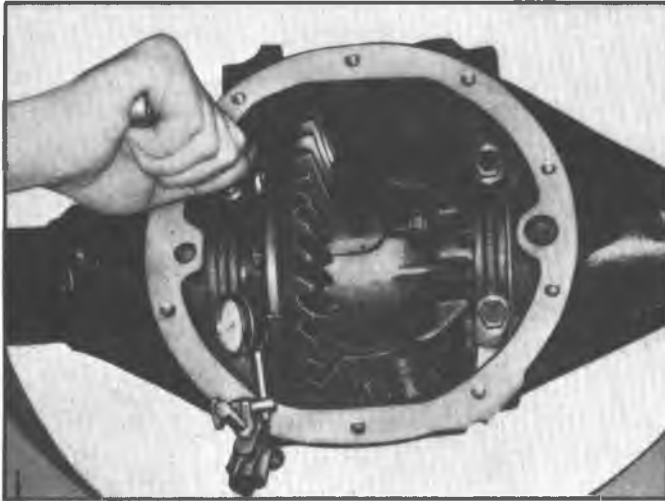


Fig. 11B—Checking Ring Gear Runout

If backlash exceeds .008", increase the shim thickness on the ring gear side, while decreasing the shim thickness on the opposite side **an equal amount**. If backlash is less than .005", decrease the shim thickness on the ring gear side, while increasing the shim thickness on the opposite side **an equal amount**.

DRIVE PINION

Removal

1. Remove differential as previously outlined.
2. Check torque required to rotate drive pinion, as described under "Drive Pinion - Installation and Adjustment". If there is no preload reading, check for looseness of pinion assembly by shaking (push-pull) the companion flange. Looseness indicates the need for bearing replacement.
3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 12B. Position J-8614-11 on flange so that the four notches are toward the flange.
4. Remove pinion nut and washer.
5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 13B.
6. To remove the drive pinion, first thread the original pinion nut half way on the pinion, for thread protection.
7. Place the differential cover temporarily back onto the housing, using two screws. This will prevent the pinion from falling to the floor during removal.
8. Tap the end of the pinion nut with a large hammer and a soft drift, as shown in figure 14B.



Fig. 12B—Drive Pinion Nut Removal

NOTE: Care must be taken not to damage pinion bearings while removing pinion from carrier. Inspect bearings and cups for damage and replace if needed.

9. Remove the pinion oil seal and the front pinion bearing. Remove the cover and retrieve the drive pinion from the housing. Discard the pinion oil seal, nut, and collapsible spacer. Use a new oil seal, nut and spacer on reassembly.

Bearing Removal and Cup Replacement

1. If front pinion bearing is to be replaced, drive outer race from carrier using a drift in slots provided for this purpose. Tap alternately on opposite sides of the bearing cup to avoid cocking.
2. If rear pinion bearing is to be replaced, drive outer race from carrier using a drift in slots provided for this purpose.

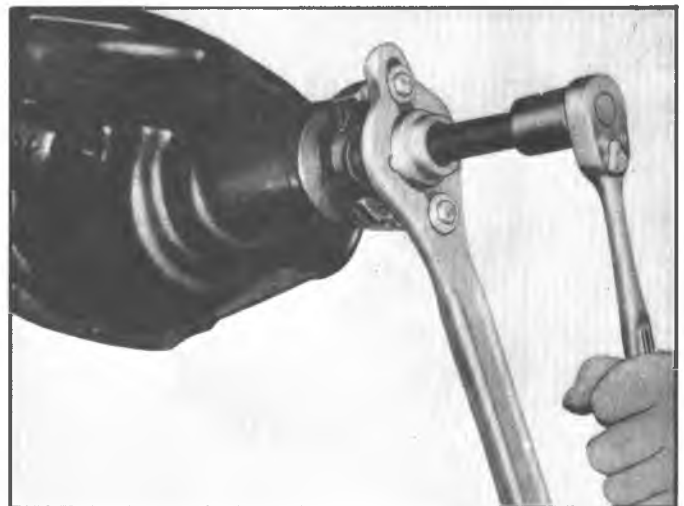


Fig. 13B—Drive Pinion Flange Removal

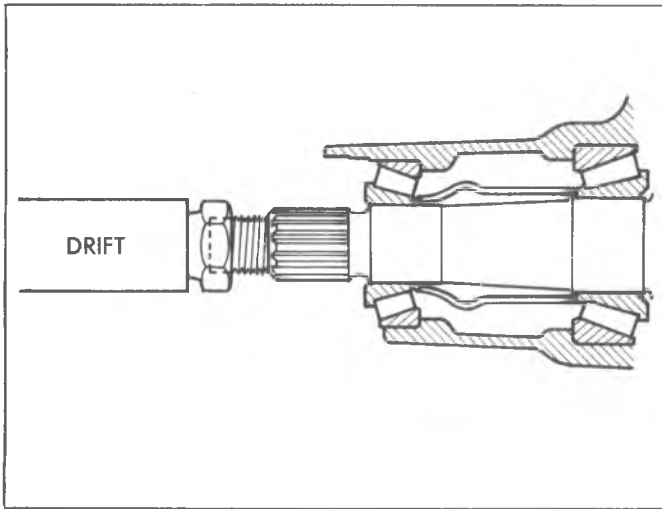


Fig. 14B—Removing Drive Pinion

3. Remove rear pinion bearing from pinion shaft using Press Plate J-22912, as shown in figure 15B.

Tighten nuts on tool until plates are under the bearing inner race. Then set the tool on a press. Make sure the plates straddle the opening on the press. Do not position bolts across the opening. To do so may bend the bolts when pressure is applied. Press bearing from pinion. Record the thickness of shim removed from between bearing and pinion head.

4. Inspect carrier pinion bearing bores and shoulders for nicks. Remove as necessary. Clean the bores and the installation tools.
5. Lubricate both bearing cups with liberal amounts of hypoid lubricant.
6. Install the rear cup, with the large end against the bore shoulder, using Installer J-0270-14 for Truck models, and J-9745 for Passenger Car, as shown in figure 16B.

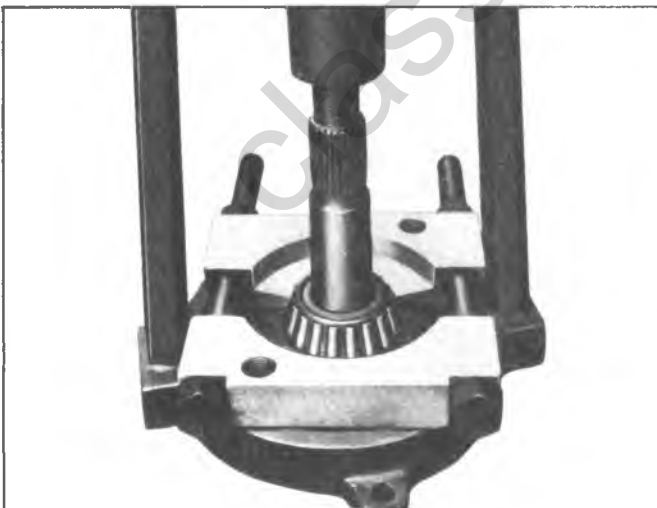


Fig. 15B—Removing Drive Pinion Rear Bearing

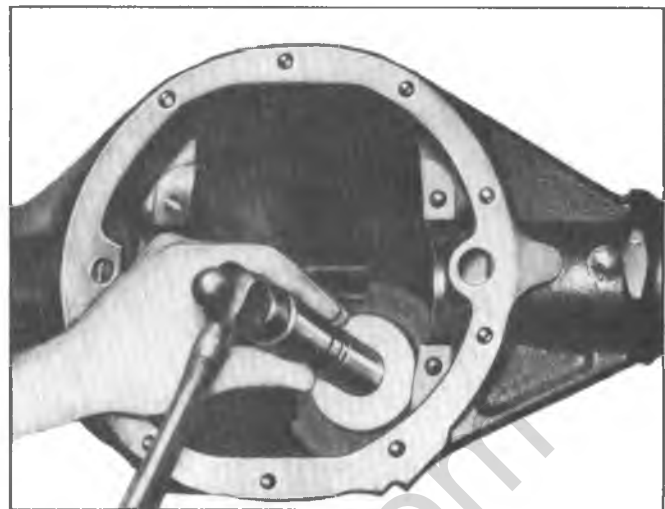


Fig. 16B—Installing Pinion Rear Bearing Cup

7. Install the front cup, with the large end against the bore shoulder, using Installer J-7137 as shown in figure 17B.
8. Check both bores to make sure cups are fully seated.

Setting Pinion Depth and Installing Pinion Bearings

NOTE: If the original ring gear and pinion and the pinion rear bearing assembly are to be reinstalled, the original shim thickness may be used.

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or

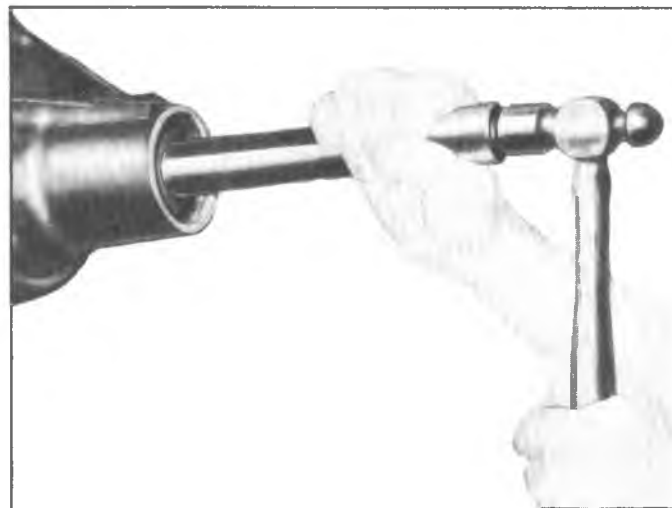


Fig. 17B—Installing Pinion Front Bearing Cup

"nominal" setting due to allowable variation in machining the parts. When a pinion is found having a plus or minus reading recorded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.

In order to compensate for all of the allowable machining variables, a procedure of gaging the carrier and shimming the pinion has been developed. After gaging a carrier, the assembler must install the appropriate shim between the drive pinion shoulder and rear bearing so that pinion depth can be adjusted to the required position for best tooth contact in each axle assembly.

Proper pinion depth is determined with Pinion Setting Gauge J-21777-01.

1. Clean the housing assembly and all gauge parts to insure accurate measurements.
2. Lubricate front and rear pinion bearings which will be used in final assembly and position them in their respective races in the carrier.
3.
 - a. **For Passenger Car** use cloverleaf gauge plate J-21779-29 mounted on preload stud J-21777-43.
 - b. **For Truck Models** use cloverleaf gauge plate J-21779-36 mounted on preload stud J-21777-43.
 - c. For all models, insert stud through rear bearing and pilot J-21777-35, and through front bearing and pilot J-21777-42. Install the hex nut until snug and rotate the bearings to make sure they are properly seated. See figures 18B and 19B for illustration of proper positioning.
4. Hold the preload stud stationary with a wrench on the flats and tighten hex nut. Tighten until 20 in. lbs. of torque are required to rotate the bearings, as shown in figure 20B.
5. Mount the side bearing discs J-21777-45 on the

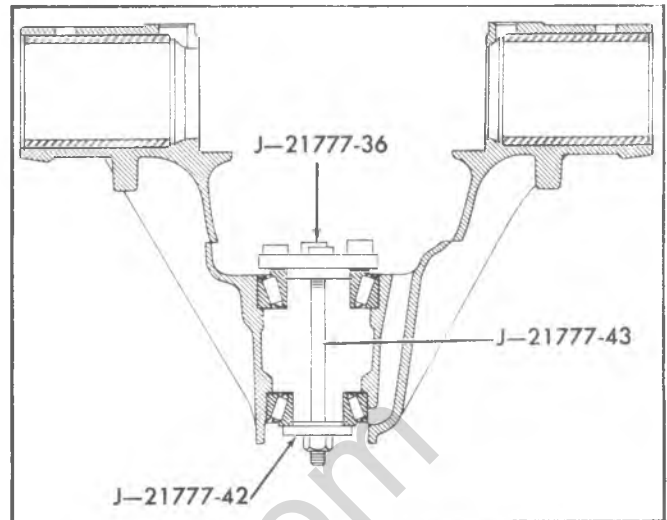


Fig. 19B—Gauge Plate Installed—Truck

6. Place the arbor and plunger assembly into the carrier, being sure the side bearing discs are seated properly.
7. Install the bearing caps finger tight to hold the discs from movement.
8. Position dial indicator J-8001 on the mounting post of the arbor with the contact button resting on the top surface of the plunger.
9. Preload the dial indicator one-half revolution, and tighten in this position.
10. Select the button on the gauge plate that corresponds to the ring gear size and rotate the plate until the plunger rests directly upon that button.
11. Rock the plunger rod slowly back and forth across the button until the dial indicator reads the greatest

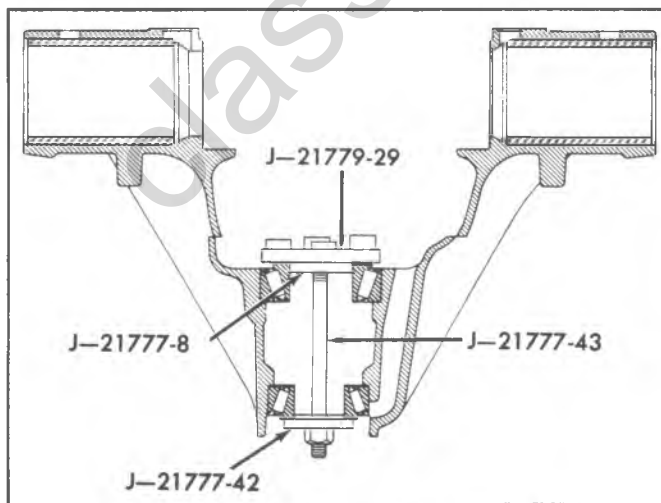


Fig. 18B—Gauge Plate Installed—Passenger Car

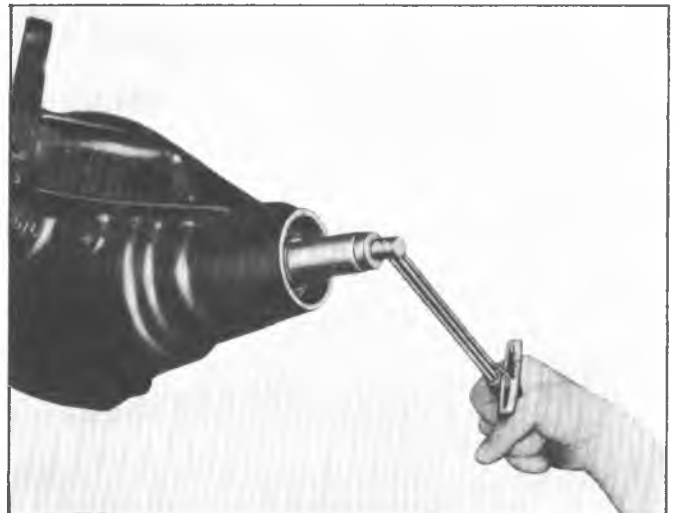


Fig. 20B—Measuring Rotating Torque

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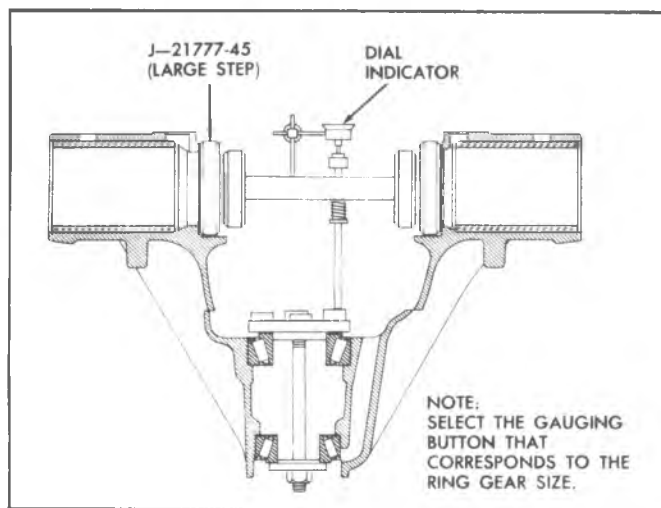


Fig. 21B—Gauging Tools Installed in Carrier—
Passenger Car

deflection. At this point, set the dial indicator to zero. Tools will now be positioned as shown in figures 21B and 22B.

12. Repeat the rocking action of the plunger several times to verify the setting.
13. Once the zero reading is obtained, swing the plunger until it is removed from the gauging plate button.

The dial indicator will now read the required pinion shim thickness for a "nominal" pinion. Record this figure.

14. Check the rear face of the drive pinion being installed for a pinion code number. This number indicates the necessary alteration of the pinion shim thickness as determined in step 13.
 - a. If the pinion is stamped with a plus (+) number, **add** that many thousandths to the

indicator reading. For example, if indicator reading is .019, and pinion is marked (+2), the correct depth shim for installation will be $.019 + .002 = .021$ inch.

- b. If the pinion has no plus (+) or minus(-) number, use the indicator reading as the correct shim thickness.
- c. If the pinion is stamped with a minus (-) number, **subtract** that many thousandths from the indicator reading. For example, if the indicator reading is .031, and pinion is marked (-3), the correct depth shim for installation will be $.031 - .003 = .028$ inch.

15. Remove bearing caps and depth gauging tools from carrier.
16. Position the shim selected in step 14 on the pinion shaft against pinion head.
17. Lubricate the rear pinion bearing with liberal amounts of hypoid lubricant and install rear bearing. Use J-6547 as shown in figure 23B for passenger car models. Use J-5590 for truck models, as shown in figure 24B.

Installation and Adjustment

1. Lubricate the front bearing with liberal amounts of hypoid lubricant, and place into outer cup.
2. **For Passenger Car** place a new pinion oil seal into position in carrier bore. Tap lightly with a protective plate and a hammer until seal flange seats against carrier, as shown in figure 25B.
3. **For Truck Models** position seal in bore and place gauge plate J-22804-2 over seal and against flange. Gauge plate insures proper seating of seal in carrier bore. See figure 26B. Use J-23911 to press seal into bore until gauge plate is flush with the

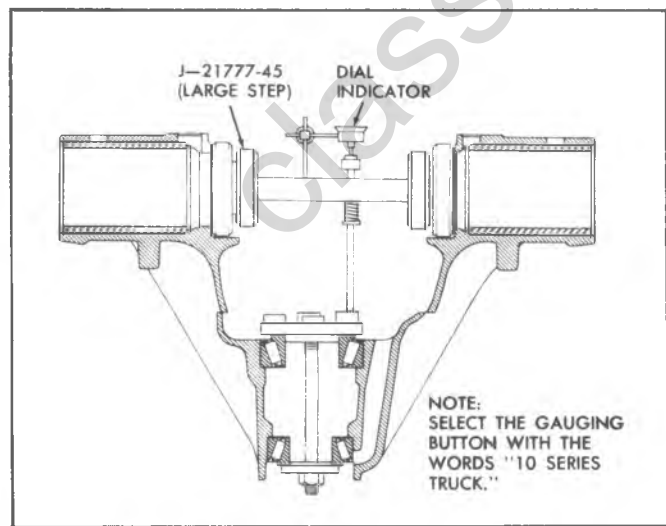


Fig. 22B—Gauging Tools Installed in Carrier—Truck

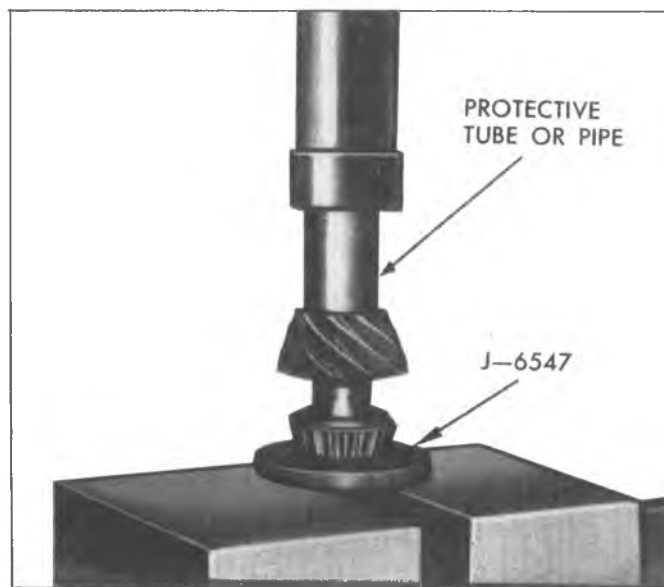


Fig. 23B—Installing Rear Bearing—Passenger Car

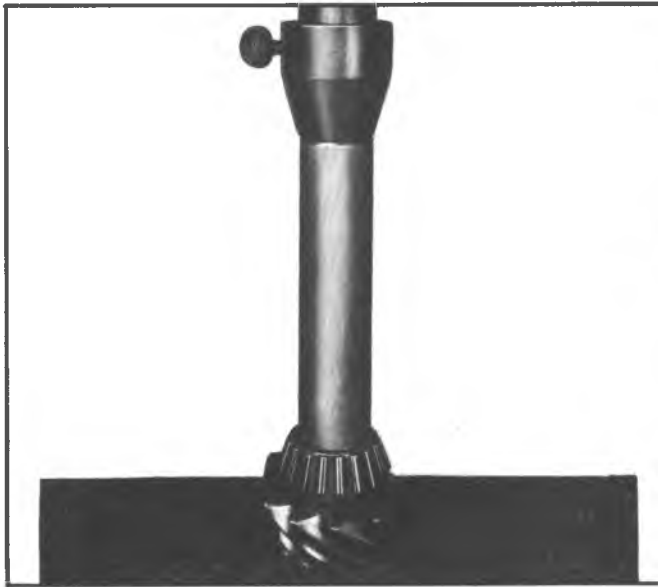


Fig. 24B—Installing Rear Bearing—Truck

carrier shoulder and seal flange. Turn gauge plate 180°; seal must be square in carrier to seal properly.

4. Coat lips of pinion oil seal and seal surface of pinion flange with hypoid lubricant.
5. Install a new pinion bearing spacer onto drive pinion.
6. **For Passenger Car**, position companion flange onto drive pinion, using J-9458 and companion flange Holding Tool J-8614-11, as shown in figure 26B. Tool J-9458-1 is threaded onto pinion shaft, and nut tightened against J-9458-2 to pull flange onto shaft. Remove J-9458 after flange is seated.
7. **For Truck models**, place drive pinion into position, and mount a suitable thick washer or sheet metal plate over the pinion stem. Install the original

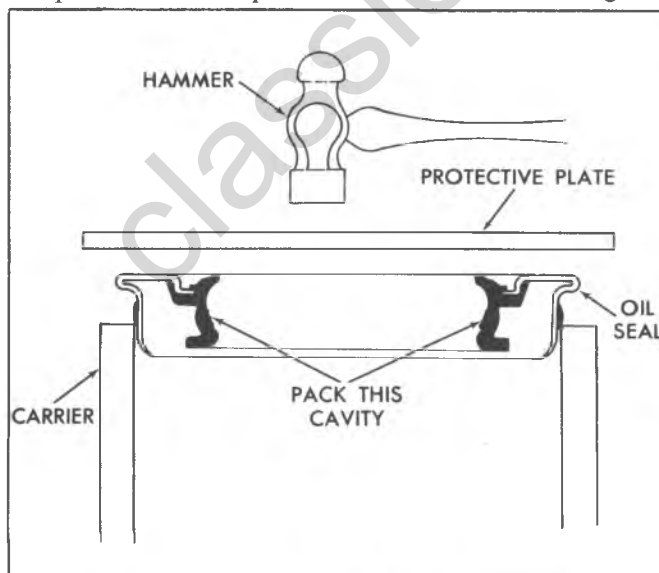


Fig. 25B—Installing Pinion Oil Seal—Passenger Car

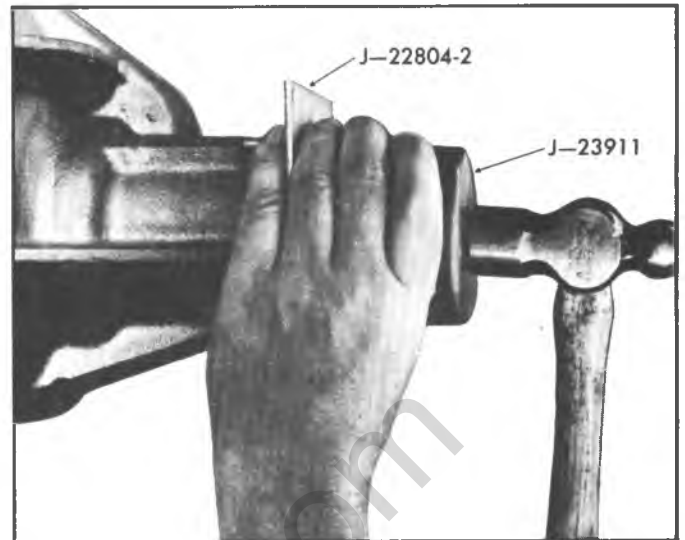


Fig. 26B—Installing Pinion Oil Seal—Truck

pinion nut and tighten sufficiently to draw pinion through the front bearing far enough to leave threads exposed when the companion flange is placed into position. Remove the washer and install the companion flange, using J-8614-11.

For all models, tighten nut until all end play is removed from drive pinion.

NOTE: When no further end play is detectable, and when Holder J-8614-11 will no longer pivot freely as pinion is rotated, preload specifications are being neared. Further tightening should be done only after nut and washer installation and preload has been checked.

9. While observing the preceding caution, carefully set preload drag at 20-25 inch pounds on new bearings,

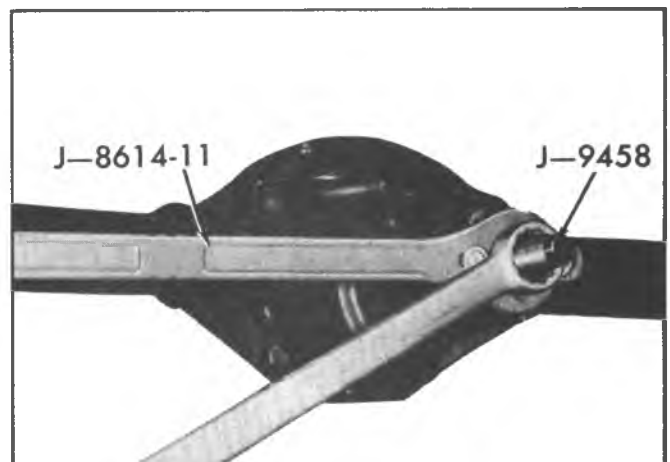


Fig. 27B—Installing Companion Flange—Passenger Car

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or 10-15 inch pounds on reused bearings. Use an inch-pound torque wrench such as J-5853, as shown in figure 28B, to measure the rotating torque.

NOTE: After torque has been checked, final tightening should be done very cautiously. For example, if when checking, torque was found to be 5 inch-pounds, additional tightening of the pinion nut as little as 1/8 turn can add 5 additional inch pounds drag. Therefore, the pinion nut should be further tightened only a little at a time and torque should be checked after each slight amount of tightening. Exceeding torque specifications may compress the collapsible spacer too far and require its replacement.

10. Rotate the pinion several times to assure that bearings have been seated. Check preload again. If drag has been reduced, re-set preload to specifications.

CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 8 of "Drive Pinion-Installation and Adjustment".

Side Bearing Preload is set to specifications in step 9 of "Differential Case-Installation and Adjustment".

Following service to the Differential Case or to the Drive Pinion and Ring Gear, a Gear Tooth Contact Pattern Check **must** be made to verify the accuracy of the work in setting the pinion depth and the ring gear-to-pinion backlash.

Gear Tooth Contact Pattern Check

Prior to final assembly of the differential, a Gear Tooth



Fig. 28B—Measuring Rotating Torque

Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

GEAR TOOTH NOMENCLATURE

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 29B.

Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring-gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten bearing cap bolts to 55 lb. ft.
4. Expand brake shoes until a torque of 20-30 lb. ft. is required to turn the pinion.

NOTE: A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with Figure 30B.

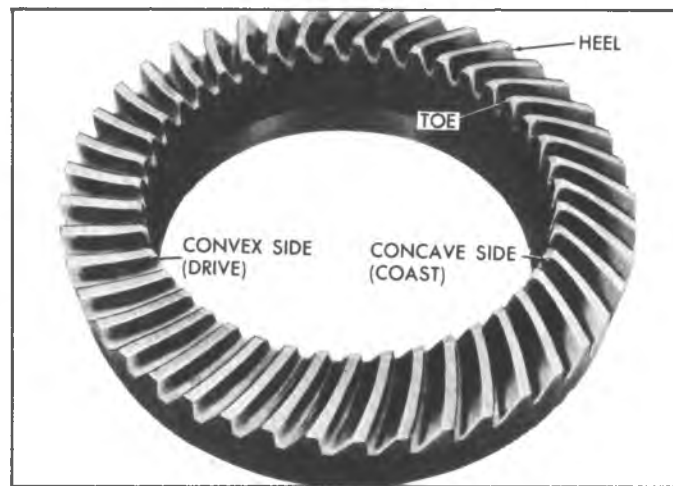


Fig. 29B—Gear Tooth Nomenclature

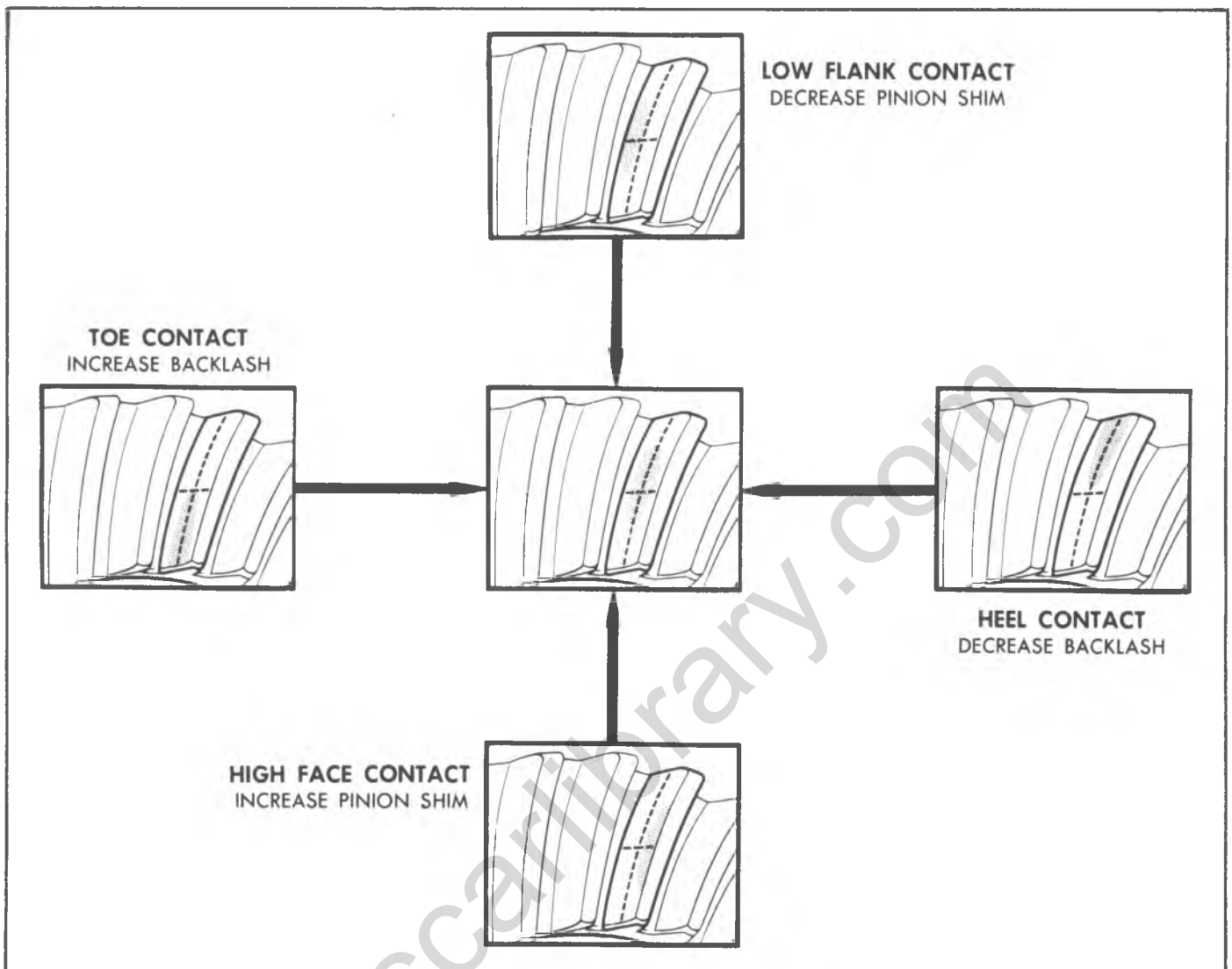


Fig. 30B—Gear Tooth Contact Pattern Check

Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern. These are backlash and position of drive pinion in carrier. The effects of bearing preloads are not readily apparent on hand loaded teeth pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

NOTE: It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing

tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

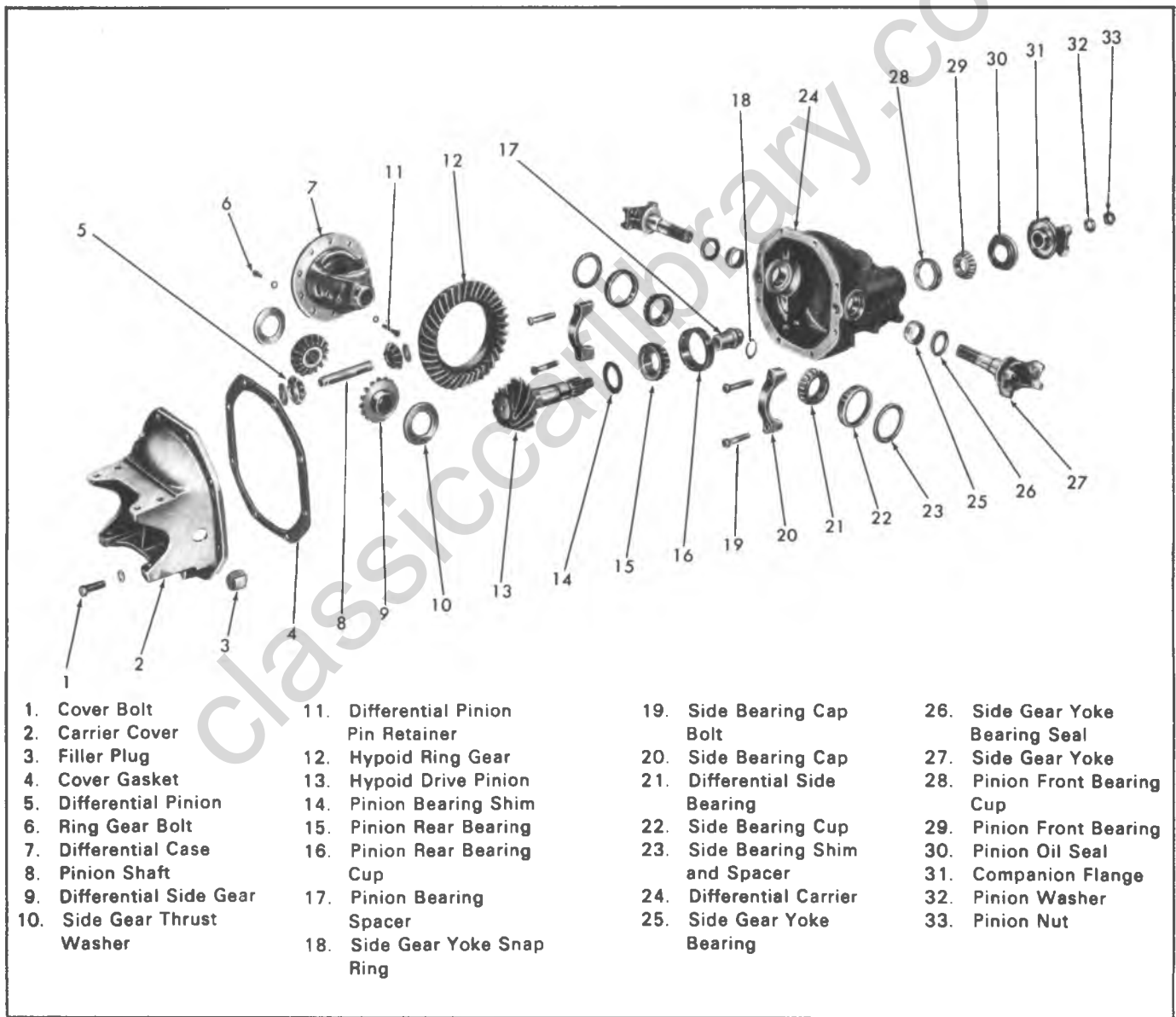
Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease backlash, decrease right shim and increase left shim an equal amount.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

CORVETTE DIFFERENTIAL

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Installation and Adjustment 4-30		



- | | | | |
|------------------------|--------------------------------------|----------------------------------|---------------------------------|
| 1. Cover Bolt | 11. Differential Pinion Pin Retainer | 19. Side Bearing Cap Bolt | 26. Side Gear Yoke Bearing Seal |
| 2. Carrier Cover | 12. Hypoid Ring Gear | 20. Side Bearing Cap | 27. Side Gear Yoke |
| 3. Filler Plug | 13. Hypoid Drive Pinion | 21. Differential Side Bearing | 28. Pinion Front Bearing Cup |
| 4. Cover Gasket | 14. Pinion Bearing Shim | 22. Side Bearing Cup | 29. Pinion Front Bearing |
| 5. Differential Pinion | 15. Pinion Rear Bearing | 23. Side Bearing Shim and Spacer | 30. Pinion Oil Seal |
| 6. Ring Gear Bolt | 16. Pinion Rear Bearing Cup | 24. Differential Carrier | 31. Companion Flange |
| 7. Differential Case | 17. Pinion Bearing Spacer | 25. Side Gear Yoke Bearing | 32. Pinion Washer |
| 8. Pinion Shaft | 18. Side Gear Yoke Snap Ring | | 33. Pinion Nut |

Fig. 1C—Carrier Assembly—Exploded View

DIFFERENTIAL CASE

Removal and Disassembly

1. Clamp carrier in Holding Fixture J-3289.
2. Remove snap rings securing side gear yokes and pull yokes out of carrier. See Figure 1C.
3. Mark differential bearing caps for reassembly in same relative location and remove caps.
4. Pull differential assembly out of carrier, taking care not to damage machined mounting surface on carrier. See Figure 2C. Remove differential bearing shims and mark for future reference.
5. To disassemble, and reassemble, follow procedures outlined in "Positraction Differential Unit" section.

Inspection

1. Clean all gears and bearings in cleaning solvent and blow dry.
2. Inspect gears for scoring, pitting or cracks.
3. Inspect bearings for spalling, pitting or scoring. Discard all parts that show excessive wear or failure.
4. Inspect side gear driveshaft yokes closely for spline wear or yoke cracking. If equipment is available, use magnetic penetrant method to check for minute fractures in yokes or gears.

Differential Bearing Replacement

1. Place Puller J-22888 over differential bearing using Adapter Plug J-8107-4 in side gear bore. Tighten puller screw to remove bearing as in Figure 3C.
2. Install new bearing on hub using Installer J-22175. See Figure 4C.
3. Before bearing installation on opposite hub, support differential case on Adapter Plug J-8107-4. This allows differential case to rest on plug instead

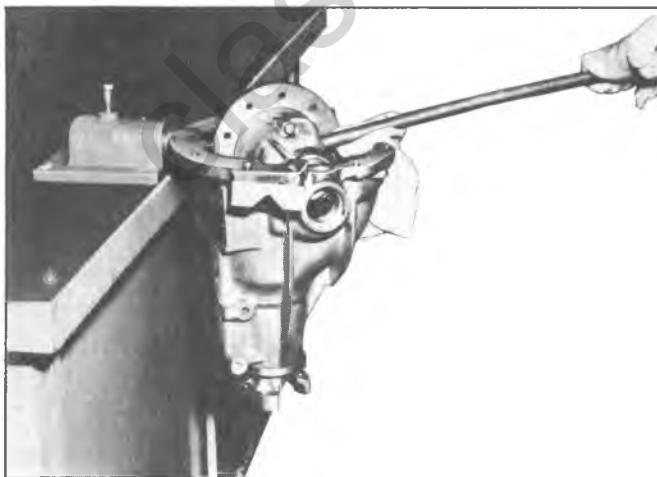


Fig. 2C—Removing Differential Case

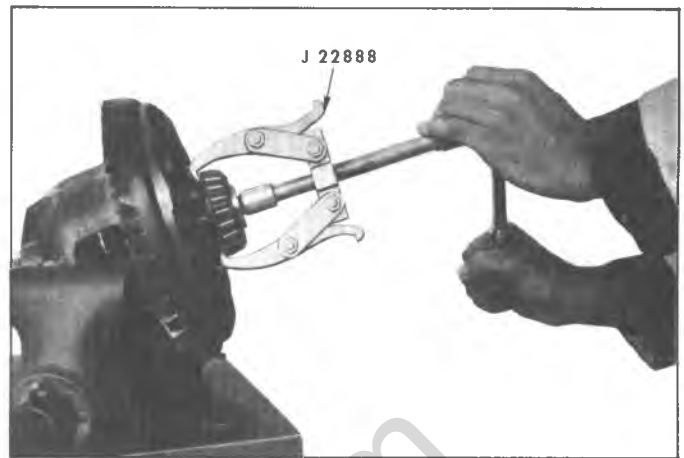


Fig. 3C—Removing Differential Bearing

of bearing cage. See Figure 4C. Install remaining bearing.

Ring Gear or Differential Case Replacement

1. Remove ring gear bolts and tap ring gear off differential case.
2. Install guide pins fabricated from 3/8-24 x 1 1/2" bolts with heads removed and ends slotted as shown in Figure 5C.
3. Clean ring gear mounting surface and mounting flange on case. Place ring gear on pilot case diameter.

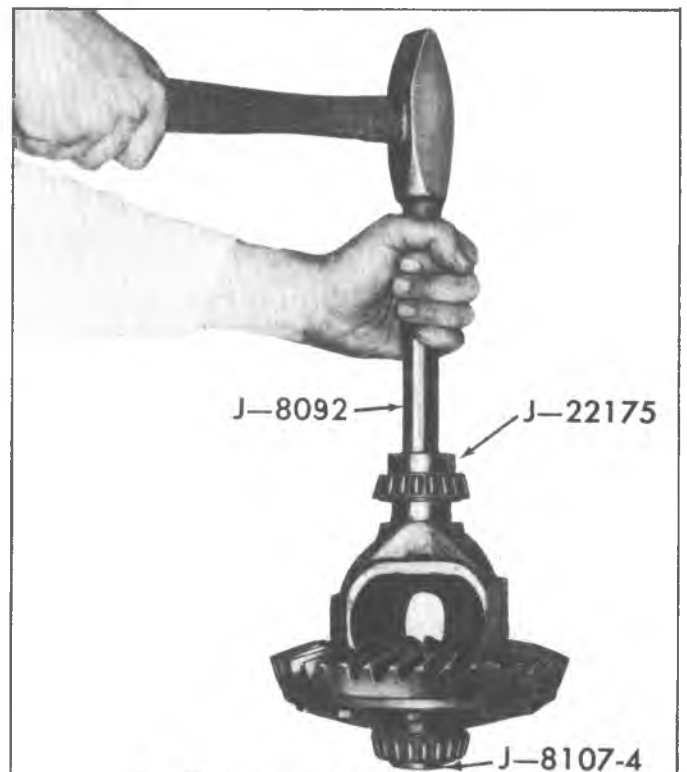


Fig. 4C—Differential Bearing Installation

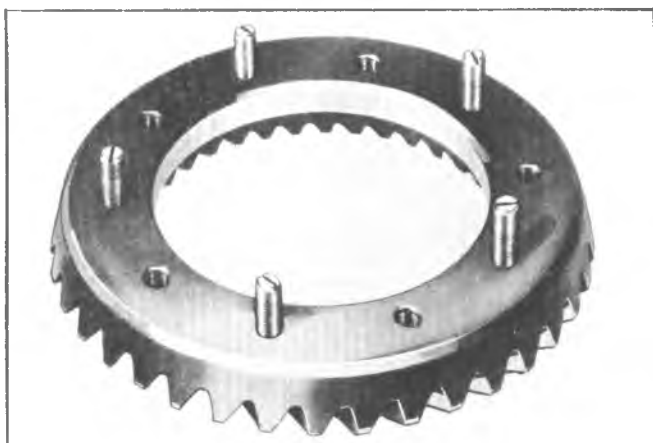


Fig. 5C—Ring Gear Guide Pins Installed

4. Install every other ring gear bolt and draw ring gear up evenly until gear is seated against flange.
5. Remove guide pins and install remaining ring gear bolts. Torque bolts to specifications.

Side Gear Yoke Bearing and/or Seal Replacement

1. Place new yoke bearings on Installer J-9773 and install bearing into carrier bore using Handle J-7079-2. See Figure 6C. Drive bearing until it is fully seated.
2. Place a new seal on Installer J-9774 and install into seal bore outboard of bearing as in Figure 7C.



Fig. 6C—Installing Side Gear Yoke Bearings

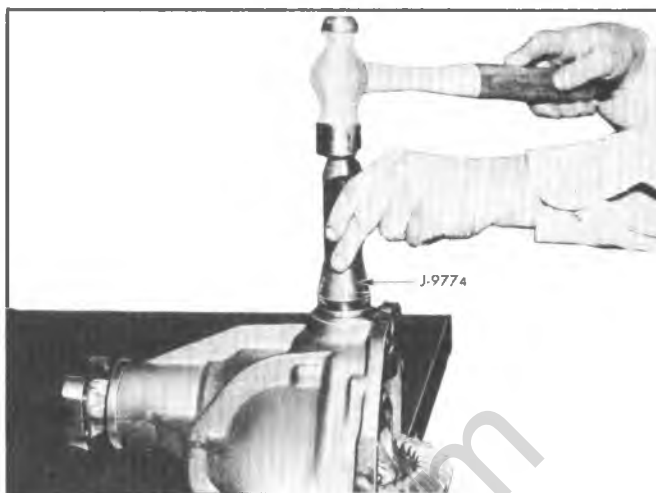


Fig. 7C—Installing Side Gear Yoke Seal

Installation and Adjustment

1. Check condition of bearing cups, cup seat in carrier and carrier caps to make sure they are free from nicks, burrs and foreign material.
2. Lubricate bearings with axle lubricant. Position cups on proper bearings then install differential assembly in carrier as shown in Figure 8C. Install right bearing cap, tightening the bolts to a snug fit.
3. Service spacers are available in one thickness only—.170" plus or minus .001". Steel service shims are used with the service spacer. See following Shim Chart for shim availability and identification.

NOTE: Production preloading of the differential bearings is accomplished by the use of cast iron shims. These shims cannot be used when rebuilding the carrier as they may break when tapped into place.

4. Install strap J-22779-6 on left bearing by tightening bearing bolts alternately and evenly to a snug fit.



Fig. 8C—Installing Differential Assembly

Shim Thickness	Shim Identification	
	Notches	
	I.D.	O.D.
.040	0	0
.042	4	1
.044	4	2
.046	4	3
.048	4	4
.050	5	0
.052	5	1
.054	5	2
.056	5	3
.058	5	4
.060	6	0
.062	6	1
.064	0	2
.066	0	3
.068	0	4
.070	1	0
.072	1	1
.074	1	2
.076	1	3
.078	1	4
.080	2	0
.082	2	1
.084	2	2
.086	2	3
.088	2	4
.090	3	0
.092	3	1
.094	3	2
.096	3	3
.098	3	4
.100	4	0

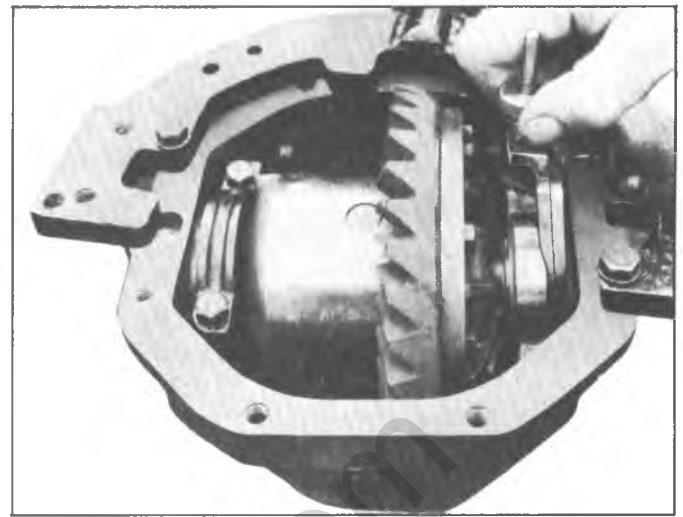


Fig. 9C—Measuring Differential Shim Requirement

5. With the ring gear tight against the pinion gear (.000" to .001" backlash), insert gauging Tool J-22779 between the left bearing cup and carrier housing. See Figure 9C. Turn adjusting nut clockwise while oscillating the tool until a noticeable drag is produced.
6. Tighten lock bolt on side of the tool, then remove tool.
7. Using a micrometer, measure the thickness of the gauging plates in a minimum of three places as shown in Figure 10C. Average these readings and record the result.
8. Turn the ring gear 90 degrees and repeat Steps 5, 6 and 7.
9. The required thickness of the service shim is determined by subtracting the thickness of the service spacer from the **higher** of the two averaged readings obtained in Steps 7 and 8.

EXAMPLE:

Gauge thickness (higher reading)254"
 Service spacer..... minus .170"
 Service shim size (left side)......084"

10. Install the selected shim between the service spacer and bearing. Remove strap J-22779-6 and install left bearing cap. Torque bearing cap bolts to specifications.
11. Remove right-hand bearing cap and install Tool J-22779 between right bearing cup and carrier housing.
12. Turn adjusting nut clockwise while oscillating tool until a noticeable drag is produced (bearing outer race rotates with tool). Remove tool and measure the thickness of the gauging plate in a minimum of three places. Average these readings and record the results.
13. Turn the ring gear 90 degrees and repeat Steps 11 and 12.
14. The required thickness of the service shim is determined as in Step 9; however, an additional .008" must be added to obtain proper side bearing preload.



Fig. 10C—Measuring Gauge Plate Thickness



Fig. 11C—Installing Differential Shim

EXAMPLE:

Gauge thickness (higher reading)226"
 Service spacer used..... minus .170"
 Difference056"
 For preload..... add .008"
 Service shim size064"

NOTE: Service shims are available in increments of .002 in.—if the shim measurement falls between the available shims, select a shim thinner by .001 inch.

15. Install the selected shim between the service spacer and bearing, using a soft face hammer. See Figure 11C.
16. Install the right bearing cap and torque both bearing caps to specifications.
17. Mount a dial indicator on the carrier and check backlash between the ring gear and pinion, as shown in Figure 12C. Backlash should be within the range of .003" to .010" with a reading of .005" to

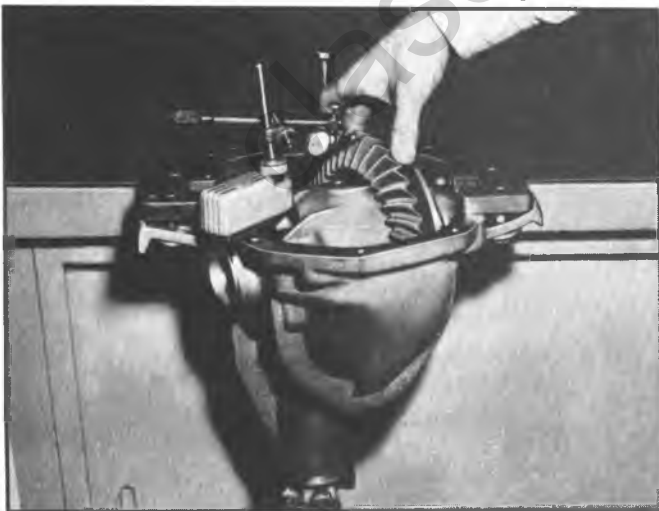


Fig. 12C—Checking Backlash

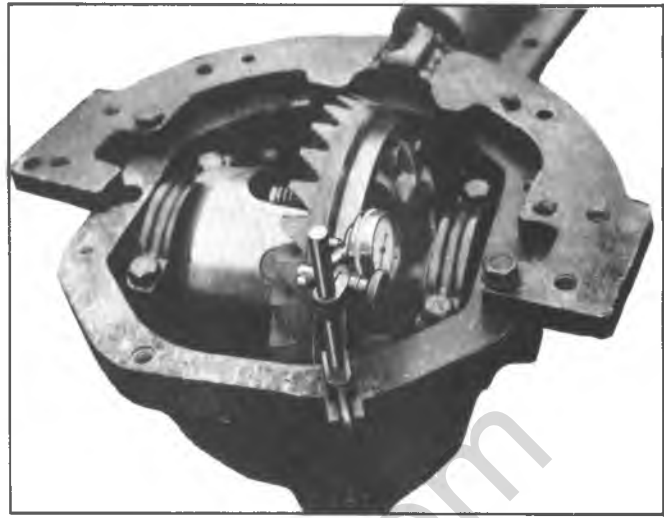


Fig. 13C—Checking Ring Gear Runout

.008" preferred. Check reading at four equally spaced positions around the ring gear. Variation in reading should not exceed .003".

NOTE: Position the dial indicator so that indicator button is perpendicular to tooth angle and in line with gear rotation.

18. If variation in backlash exceeds .003", measure ring gear and case runout as shown in Figure 13C. Gear runout should not exceed .003"; should runout exceed this limit, check ring gear and case for deformation and/or foreign matter between case and gear.
19. If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of the other shim the same amount. Total shim thickness must be maintained to maintain proper preload.

EXAMPLE: By decreasing shim on the right side .003" and increasing shim thickness on the left side by .003", backlash will decrease by .002".

DRIVE PINION

Removal

1. Remove differential case as previously outlined.
2. Check pinion bearing preload as described under "Drive Pinion - Installation and Adjustment". If there is no preload reading, check for looseness of pinion assembly by shaking the companion flange. Looseness indicates the need for bearing replacement.
3. Turn holding fixture over and install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 14C. Position J-8614-11 on flange so that the four notches are toward the flange.

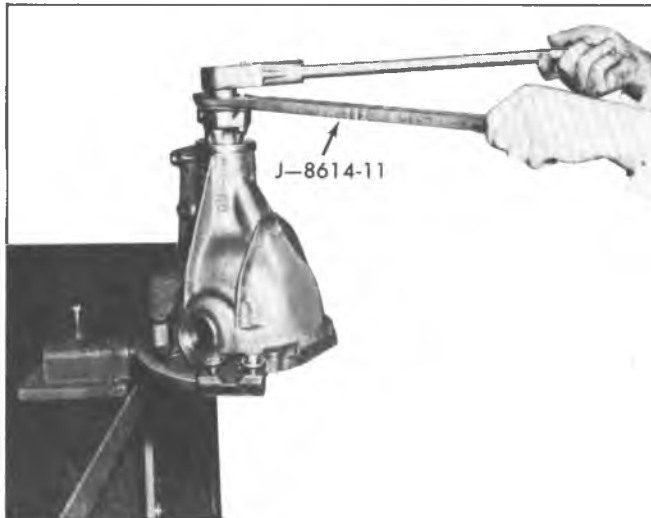


Fig. 14C—Removing Companion Flange Nut

4. Remove pinion nut and washer. Discard pinion nut and use a new one upon reassembly.
5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 15C.
6. With companion flange removed, drive pinion and rear bearing assembly can be removed from carrier.
7. Pry companion flange seal out of carrier using screw driver and discard seal. Remove pinion front bearing assembly.
8. Pry differential side gear yoke seals out of carrier and discard seals. Using a piece of 1 3/4" O.D. pipe of suitable length, tap yoke bearings out of bore.

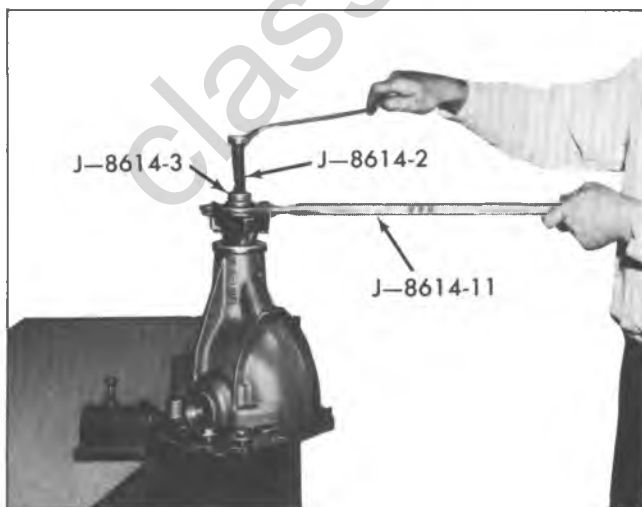


Fig. 15C—Removing Companion Flange

Inspection

1. Clean all gears and bearings in cleaning solvent and blow dry.

NOTE: Do not spin bearings during drying process. The extremely fast spinning and lack of lubrication may quickly result in the failure of an otherwise reusable bearing.

2. Inspect gears for scoring, pitting or cracks.
3. Inspect bearings for spalling, pitting or scoring. Discard all parts that show excessive wear or failure.

Pinion and/or Bearing Replacement

1. If necessary to replace pinion bearings, tap old cups out of carrier using a brass drift. See Figure 16C. Tap alternately on opposite sides of cup to prevent cups from cocking in carrier. Inspect cup seats and bore for any nicks or burrs and remove as necessary before installing new bearing cups.
2. Select front and rear pinion bearings and drive cups into carrier using Drive Handle J-8092 and Cup Installers J-8608 for the rear cup and J-7137 for front cup. See Figures 17C and 18C. Seat cups securely and squarely against shoulders in carrier.
3. Remove pinion rear bearing using Press Plates J-9771 in Holder J-0358-1 as shown in Figure 19C. Remove and discard shim between bearing and gear head.

Setting Pinion Depth

NOTE: If the original ring gear and pinion and the pinion rear bearing assembly are to be reinstalled, the original shim thickness may be used.

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the

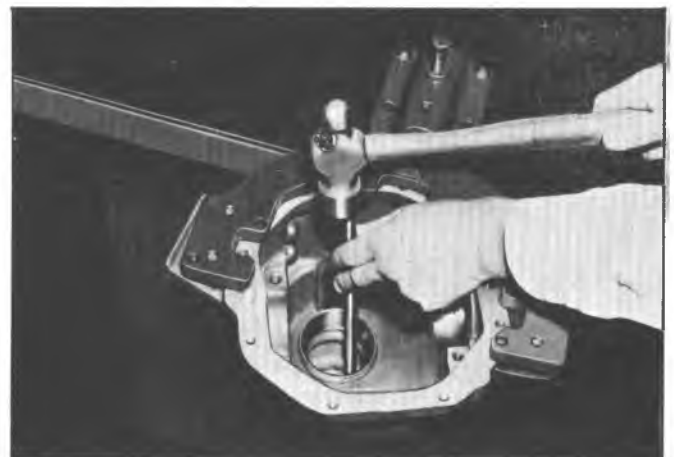


Fig. 16C—Removing Pinion Bearing Cup

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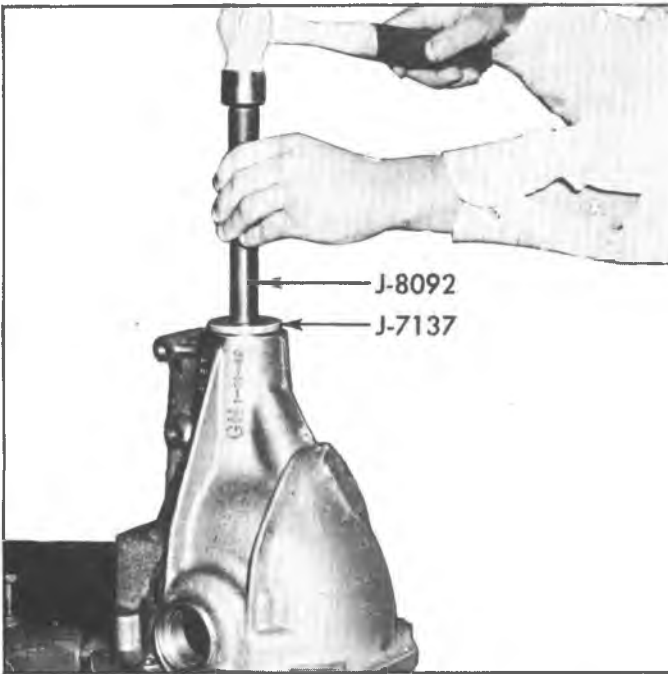


Fig. 17C—Installing Pinion Front Bearing Cup

centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or "nominal" setting due to allowable variation in machining the parts. When a pinion is found having a plus or minus reading recorded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.



Fig. 18C—Installing Pinion Rear Bearing Cup

In order to compensate for all of the allowable machining variables, a procedure of gaging the carrier and shimming the pinion has been developed. After gaging a carrier, the assembler must install the appropriate shim between the drive pinion shoulder and the rear bearing so that pinion depth can be adjusted to the required position for best tooth contact in each axle assembly.

Proper pinion depth is determined with pinion setting Gauge J-21777-01.

1. Clean the housing assembly and all gauge parts to insure accuracy of measurements.
2. Lubricate the front and rear pinion bearings which will be used in final assembly and position them in their respective races in the carrier.
3. With cloverleaf gauge plate J-21777-36 mounted on preload stud J-21777-43, insert stud through rear bearing and pilot J-21777-35, and through front bearing and pilot J-21777-42. Install the hex nut until snug and rotate the bearings to make sure they are properly seated. See figure 20C for illustration of proper positioning.
4. Hold the preload stud stationary with a wrench on the flats and tighten hex nut until 20 in. lbs. of torque are required to rotate the bearings, as shown in figure 21C.
5. Mount the side bearing discs J-21777-45 on the ends of arbor J-21777-1, using the step of the disc that corresponds to the bore of the carrier.
6. Place the arbor and plunger assembly into the carrier, being sure the side bearing discs are seated properly.
7. Install the bearing caps finger tight to hold the discs from movement.
8. Position dial indicator J-8001 on the mounting post of the arbor with the contact button resting on the top surface of the plunger.

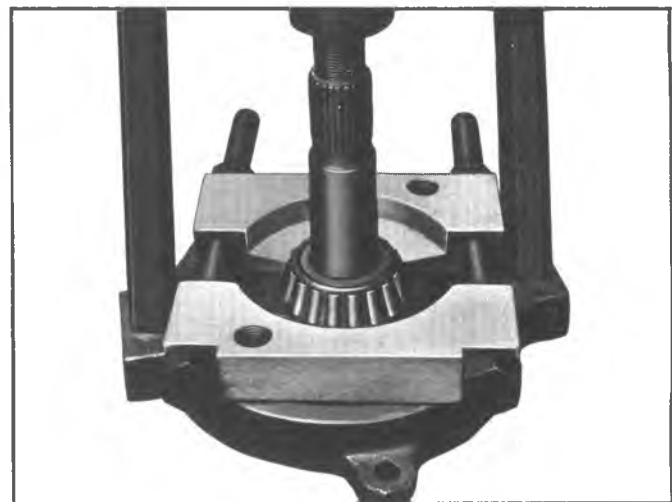


Fig. 19C—Removing Pinion Rear Bearing

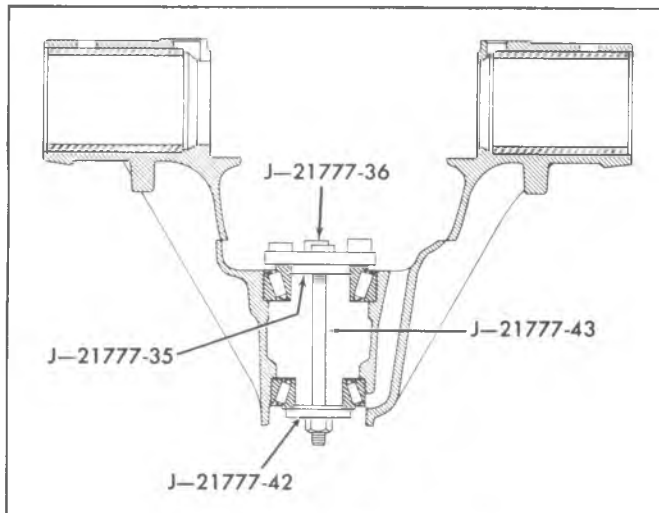


Fig. 20C—Gauge Plate Installed

9. Preload the dial indicator one half revolution, and tighten in this position.
10. Select the button on the gauge plate that corresponds to the ring gear size and rotate the plate until the plunger rests directly upon that button.
11. Rock the plunger rod slowly back and forth across the button until the dial indicator reads the greatest deflection. At this point, set the dial indicator to zero. Tools will now be positioned as shown in figure 22C.
12. Repeat the rocking action of the plunger several times to verify the setting.
13. Once the zero reading is obtained, swing the plunger until it is removed from the gauging plate button.

The dial indicator will now read the required pinion shim thickness for a "nominal" pinion.

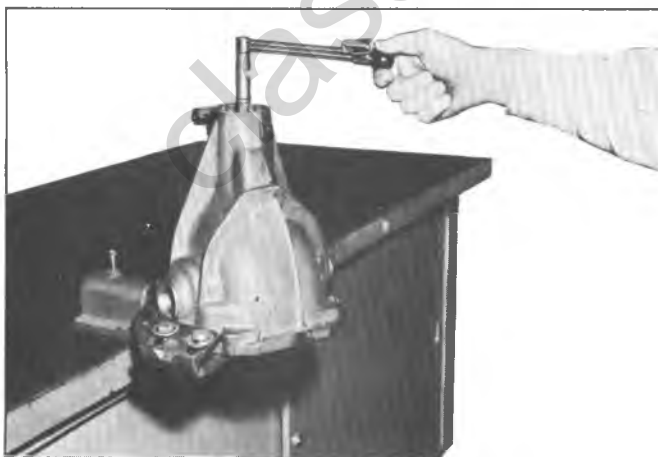


Fig. 21C—Measuring Rotating Torque

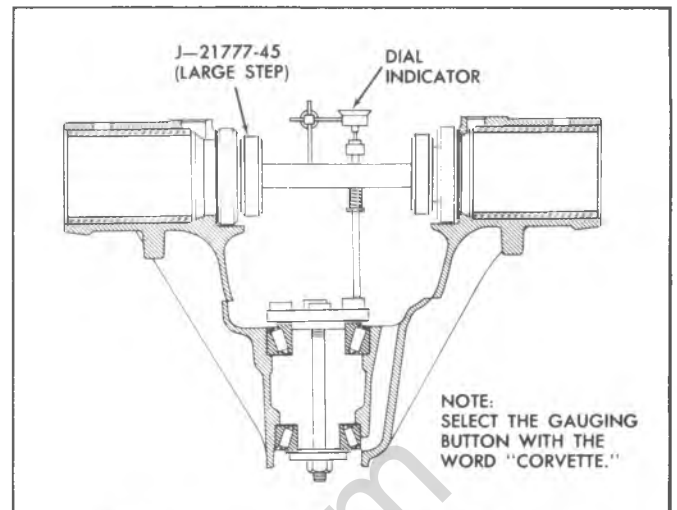


Fig. 22C—Pinion Depth Gauging Tools Installed

14. Check the rear face of the pinion being installed for a pinion code number. This number indicates the necessary alteration of the pinion shim thickness as determined in step 13.
 - a. If the pinion is stamped with a plus (+) number, **add** that many thousandths to the indicator reading. For example, if indicator reading is .019, and pinion is marked (+2), the correct depth shim for installation will be $.019 + .002 = .021$ inch.
 - b. If the pinion has no plus (+) or minus (-) number, use the indicator reading as the correct shim thickness.
 - c. If the pinion is stamped with a minus (-) number, **subtract** that many thousandths from the indicator reading. For example, if the indicator reading is .031, and pinion is marked (-3), the correct depth shim for installation will be $.031 - .003 = .028$ inch.
15. Remove bearing caps and depth gauging tools from carrier.
16. Position the shim selected in step 14 on the pinion shaft against the pinion head.
17. Install the rear bearing on drive pinion, using J-8609 as shown in figure 23C.

Installation and Adjustment

1. Lubricate pinion bearings and outer races and place drive pinion in carrier.
2. Place a new pinion bearing spacer over pinion so it seats on inner race of rear bearing.
3. Slide pinion front bearing cone and roller assembly over pinion shaft so it seats against spacer.
4. Pack the cavity between the seal lips of the pinion flange oil seal with a lithium-base extreme pressure lubricant.
5. Place oil seal in carrier bore and tap into position

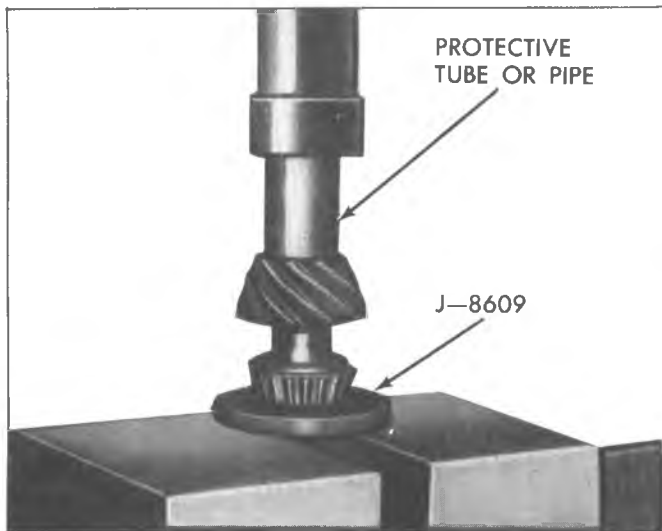


Fig. 23C—Installing Pinion Rear Bearing

with a hammer and drift, until oil seal flange seats against the carrier.

6. Install companion flange using Holder J-8614-11 and Installer J-5780. See Figure 24C.
7. Pack the cavity between end of pinion splines and pinion flange with a nonhardening sealer (such as Permatex Type A or equivalent) prior to installing washer and nut on pinion.
8. Install a new nut on pinion shaft. Tighten nut to remove end play—continue alternately tightening in small increments, and checking preload with torque wrench J-5853 and adapter J-5810 until torque required to rotate pinion is 20-30 in. lbs. for new bearings and seal, or 5-15 in. lbs. when used parts are reinstalled. See Figure 25C.

CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments

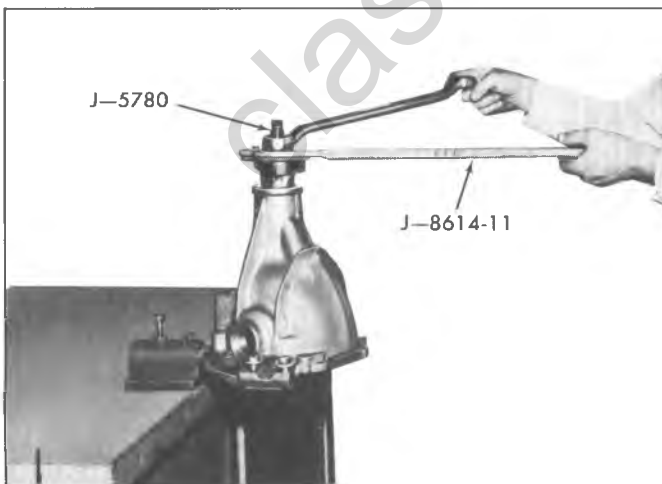


Fig. 24C—Installing Companion Flange

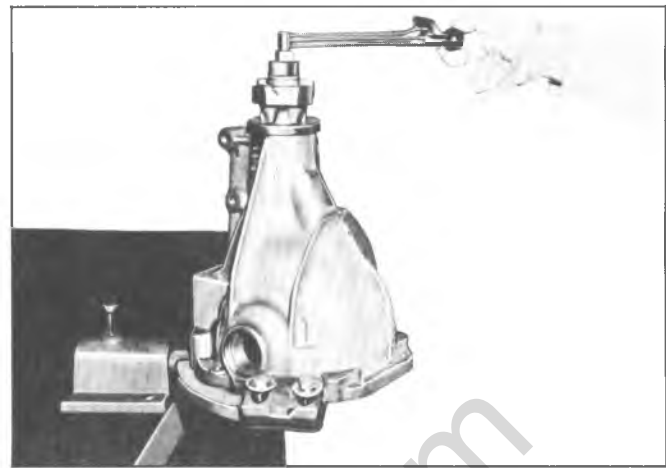


Fig. 25C—Measuring Rotating Torque

are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 8 of "Drive Pinion—Installation and Adjustment."

Side Bearing Preload is set to specifications in step 14 of "Differential Case—Installation and Adjustment."

Following service to the Differential Case or to the Drive Pinion and Ring Gear, a Gear Tooth Contact Pattern Check **must** be made to verify the accuracy of the work in setting the pinion depth and the Ring Gear-to-Pinion backlash.

Gear Tooth Contact Pattern Check

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 26C.

Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten bearing cap bolts to 55 lb. ft.

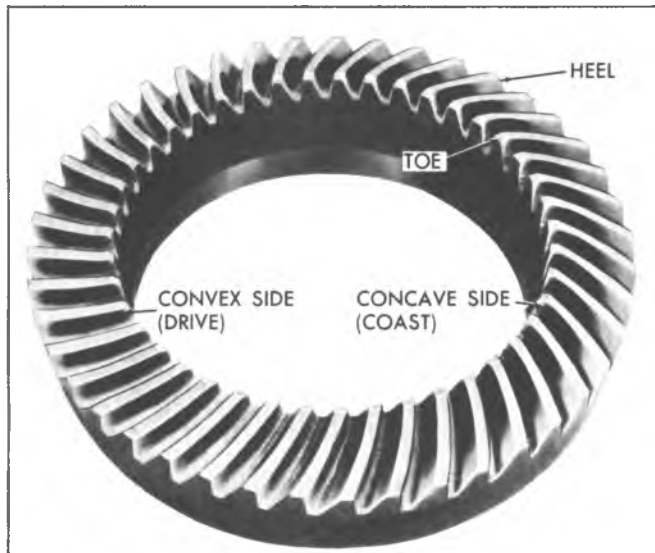


Fig. 26C—Gear Tooth Nomenclature

4. Expand brake shoes until a torque of 20-30 lb. ft. is required to turn the pinion.

NOTE: A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with Figure 27C.

Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern. These are backlash and position of drive pinion in carrier. The effects of bearing preloads are not readily apparent on hand loaded teeth pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

NOTE: It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease backlash, decrease right shim and increase left shim an equal amount.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

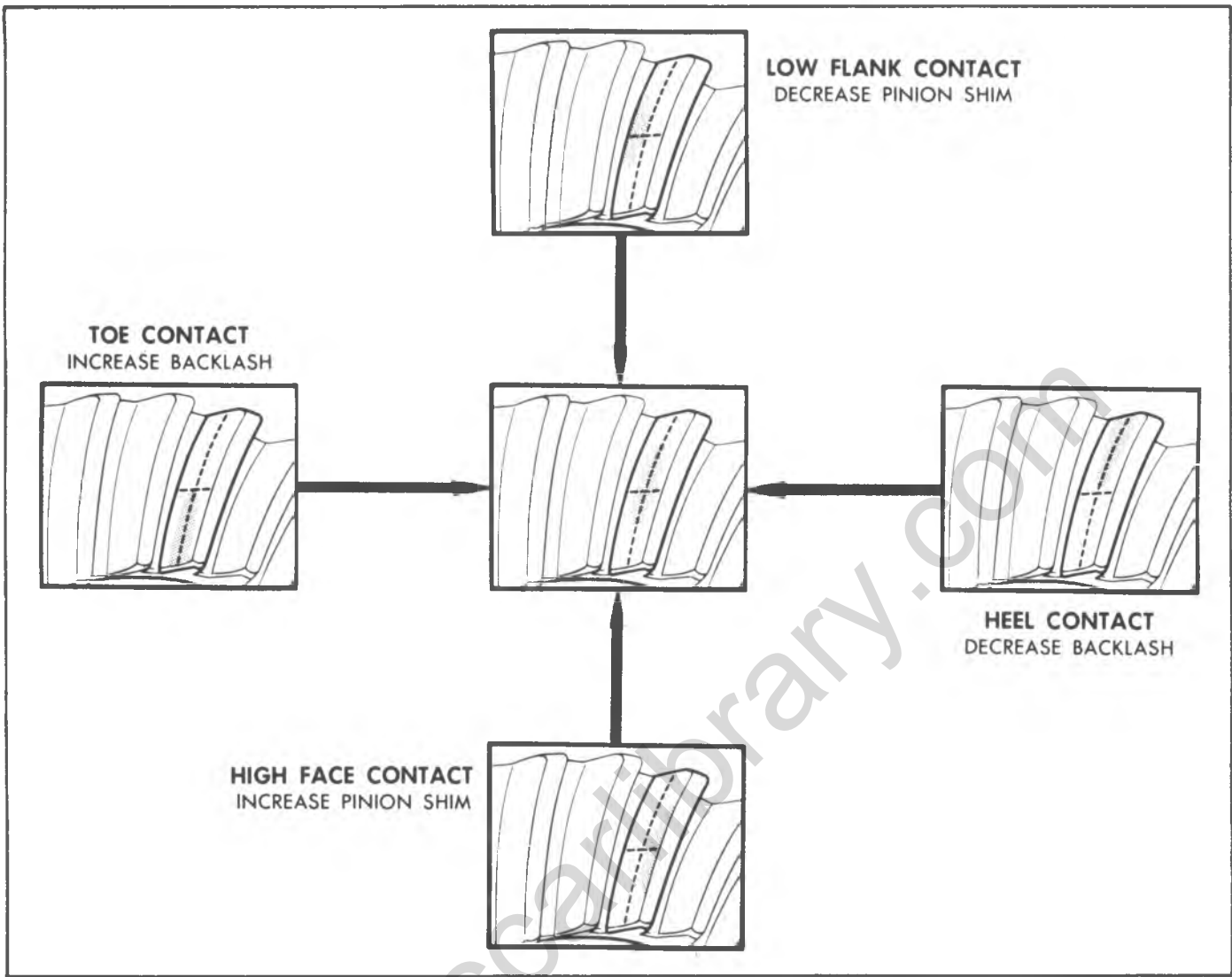


Fig. 27C—Gear Tooth Contact Pattern

LIMITED SLIP DIFFERENTIAL UNITS

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GENERAL DESCRIPTION

Vehicles with 8 1/2" ring gear or 8 7/8" ring gear axles use three optional limited slip differentials, namely Chevrolet, Eaton and Borg Warner. Corvette uses only the Eaton unit.

The Borg Warner unit is not repairable except for differential side bearings and must be replaced with either a Chevrolet or an Eaton Positraction differential unit, if service is necessary. See figure 1D.

All truck 10 1/2" ring gear axles produced by Chevrolet use an optional Eaton Positive Locking differential that is serviced as an assembly only. Truck 10 1/2" ring gear axles produced by Dana use only the optional Dana Power-Lok, shown in figure 17D.

Overhaul procedures for limited slip axles are the same as for standard axles, except for the following operations.

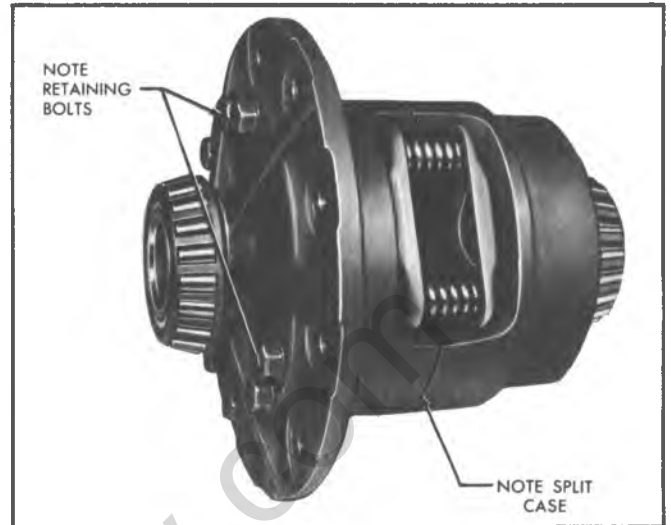


Fig. 1D—Borg Warner Positraction Identification

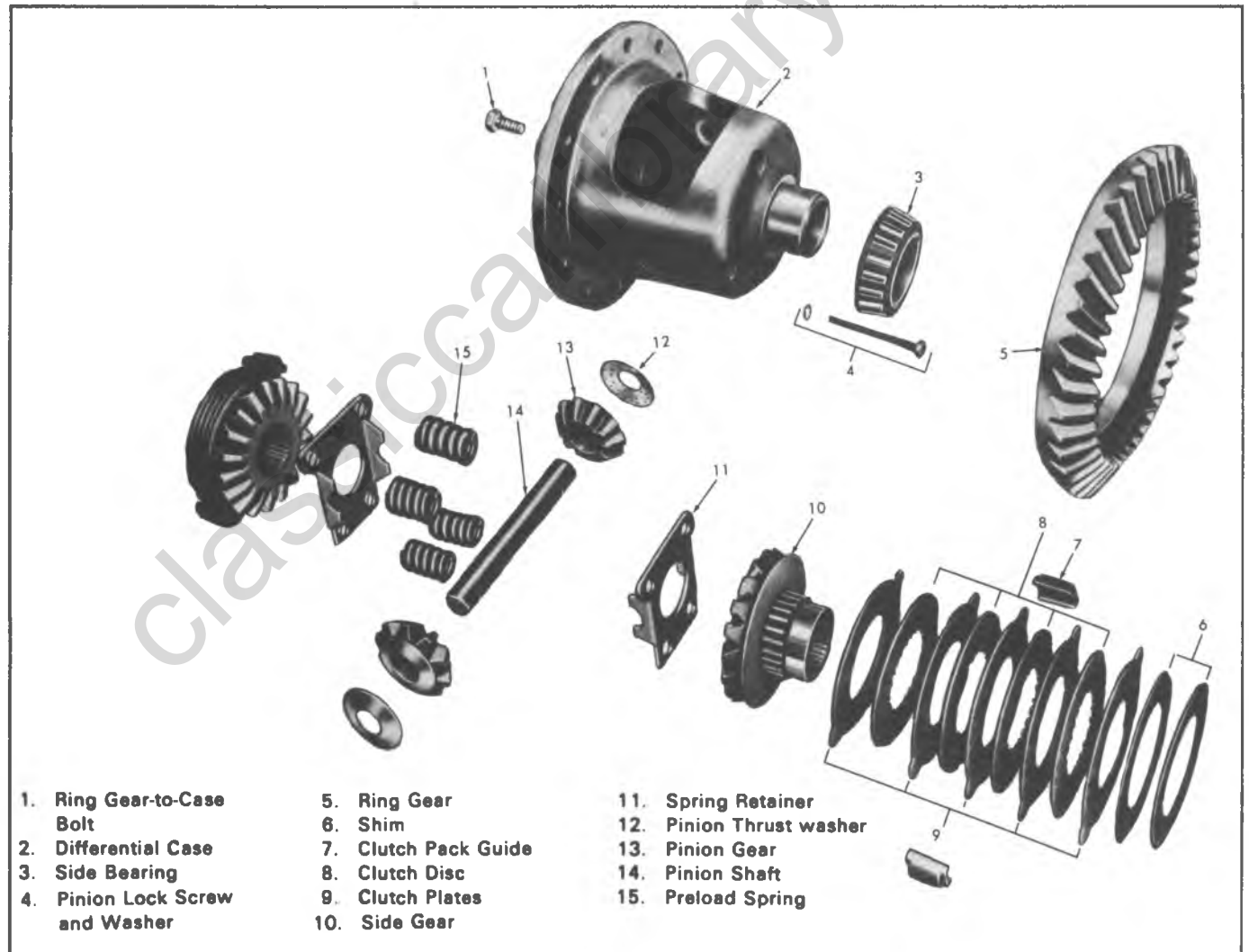


Fig. 2D—Eaton Positraction Exploded View

EATON POSITRACTION—FIGURE 2D

Disassembly

1. Remove ring gear and side bearings following the procedures established for the conventional differential unit.
2. **For all models except Corvette**, remove the preload spring retainer and springs by tapping on the spring retainer through the observation hole in the case. See Figure 3D. Drive the spring retainer from the case sufficiently to allow insertion of a 1/4 inch bolt in each of the two front springs. Secure each bolt with a nut as in Figure 4D.

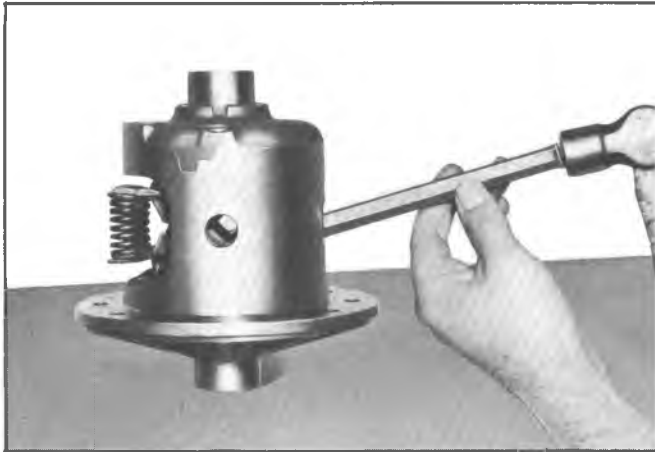


Fig. 3D—Removing Preload Spring Pack (Typical)

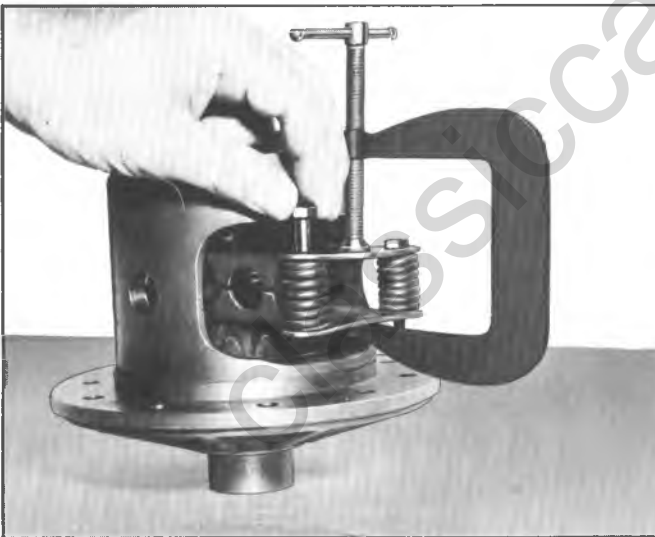


Fig. 4D—Installing Bolts to Retain Springs

3. **On Corvette** it will be necessary to raise the spring retainers slightly to clear the shoulder on the side gears. Install Tool J-22311 to clutch pack so that slotted ends are equally engaged at front and rear of spring retainer. See Figure 5D.



Fig. 5D—Removing Preload Spring Pack (Corvette)

4. After installing the retaining bolts continue to drive spring retainer from the case until enough of the retainer is exposed to permit installation of bar stock and "C" clamp as shown in Figure 6D. Center the bar stock over the axle shaft hole in the spring retainer, then compress "C" clamp sufficiently to permit withdrawal of spring pack.



Fig. 6D— C-Clamp and Bar Stock Installed for Spring Removal

5. Position spring pack in vise and remove 1/4 inch bolts. Alternately relieve "C" clamp pressure and vise pressure until spring compression is relieved. See Figure 7D.

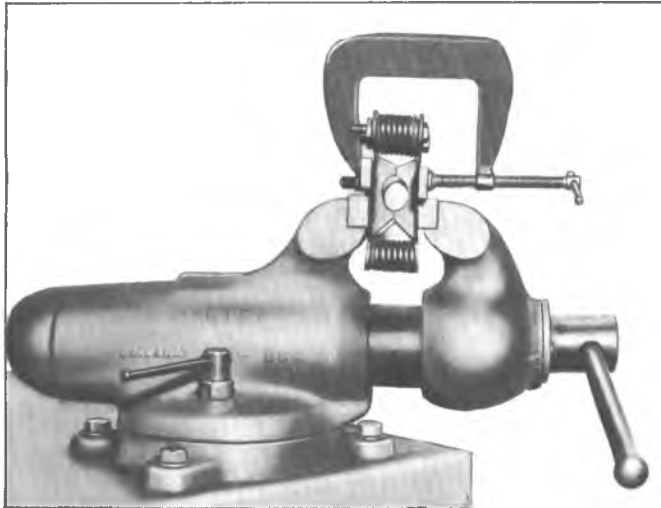


Fig. 7D—Removing Preload Springs from Pack

6. **For Truck Models** roll out the differential pinions and thrust washers.

For Passenger models pinion gears can be removed by rotating them in one direction only. Using Figure 8D as a reference, rotate differential case clockwise to remove the first gear, then rotate case counter-clockwise to remove the second gear. To remove second gear, it may be necessary to assist pinion gear upon its seat by prying on gear through observation holes on case. Mark pinions and side gears for reassembly in original position.

7. Remove side gear, clutch pack, shims and guides from case. Tap the assembly from the case, using a brass drift as shown in Figure 9D. Repeat removal on opposite gear.

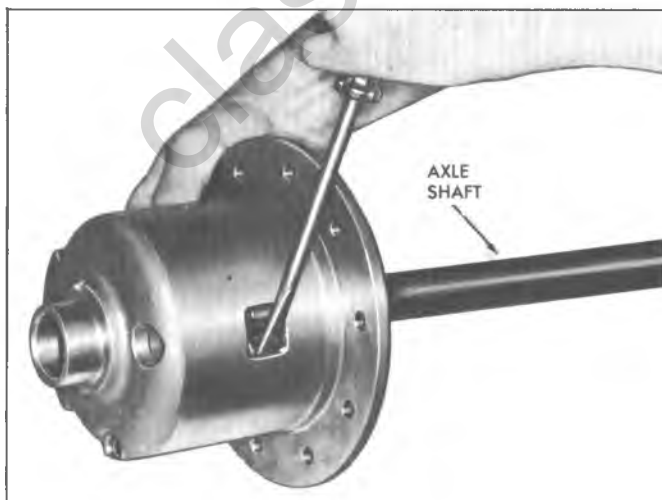


Fig. 8D—Removing Differential Pinion Gears



Fig. 9D—Removing Side Gear

8. Separate clutch pack assembly from side gear. Retain clutch pack assembly with original side gear.

Inspection

1. Check clutch plates and discs for excessive wear and signs of overheating.
 NOTE: Clutch plates and discs are not serviced separately. If replacement is required, clutch pack must be replaced as an assembly.
2. Inspect preload springs for distortion and other defects.
3. Compress springs and determine if they are capable of properly preloading the clutch pack, replace springs that are weak or questionable.
4. Examine spring retainer for alignment between the retainer halves and for excessive wear at spring seats.

Reassembly

1. Lubricate clutch plates and discs with special positraction lubricant.
2. Alternately position clutch plate and clutch disc on side gear, beginning and ending with clutch plate, until assembly of clutch pack is complete. See Figure 10D.
3. Install clutch pack guides on the clutch plate lugs. Make sure that the clutch disc lugs engage with side gear teeth.
4. Select shims of equal thickness as those removed from the case, or if old shims are suitable, reinstall them over the side gear hub.
5. Lubricate and assemble opposite side gear as above.
6. Install one side gear, clutch pack assembly and shim(s) in the differential case.

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Fig. 10D—Assembling Clutch Pack

7. Position pinion gears and thrust washers on side gears. Install pinion shaft through case and gears.
8. Install dial indicator in case so that contact button rests against pinion gear as shown in Figure 11D.
9. Compress clutch pack, using a screwdriver as shown in Figure 11D. Move the pinion gear to obtain tooth clearance.
10. Tooth clearance should be .001" to .008". If required, change shims to obtain proper tooth clearance.
11. Remove side gear assembly and repeat tooth clearance procedure for other side gear on opposite side of case.
12. Remove pinion shaft, gears and thrust washers.
13. Install remaining side gear, clutch pack assembly and shims in case.
14. Install pinion gears and thrust washers. Installation of pinion gears can be performed by reversing the pinion gear removal procedure.

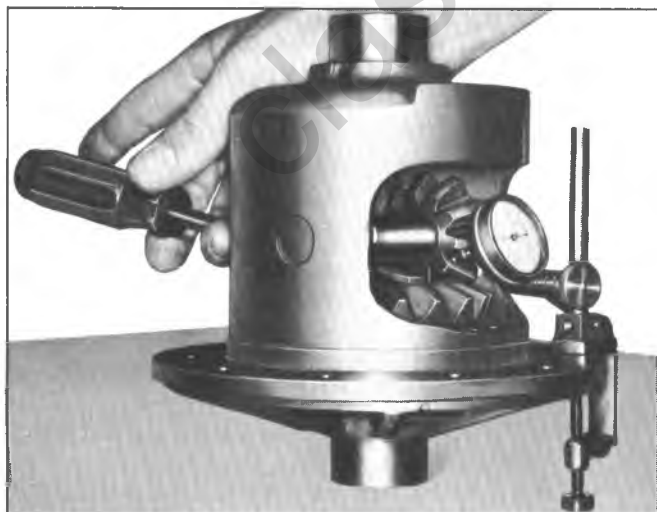


Fig. 11D—Measuring Pinion Gear Tooth Clearance

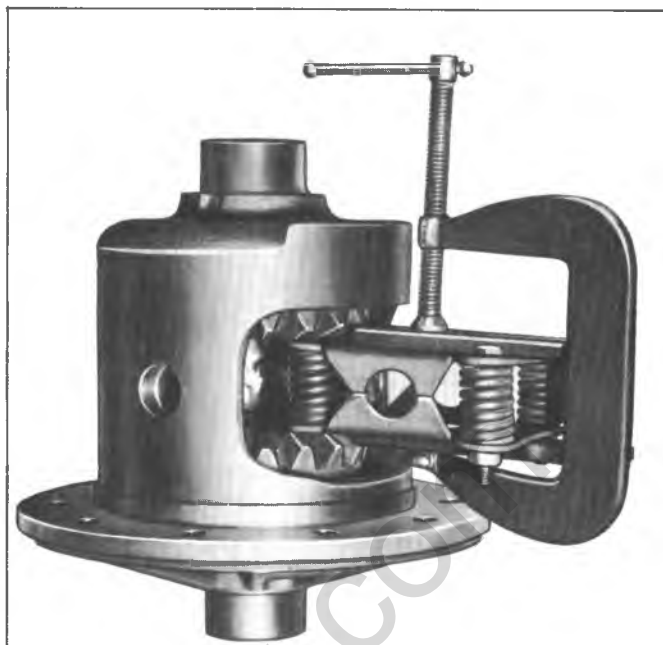


Fig. 12D—Spring Pack Compressed for Installation

15. **For all except Corvette** assemble springs in spring retainer and clamp assembly in vise. Install "C" clamp and bar stock on spring retainer then install a 1/4 inch bolt and nut in each front spring. See Figure 12D.
16. Position spring pack between side gears and remove bar stock and "C" clamp.
17. **On Corvette** install Tool J-22311 to compress clutch pack, secure pack with 1/4" bolts as shown in Figure 13D. Partially install pack then remove bolts and complete pack installation. Remove tool.
18. Drive spring pack into side gears sufficiently to retain front springs, then remove 1/4 inch bolts from springs. Drive spring pack into position. See Figure 14D.
19. Install the pinion shaft and lock screw to retain side gears until axle shafts are installed.

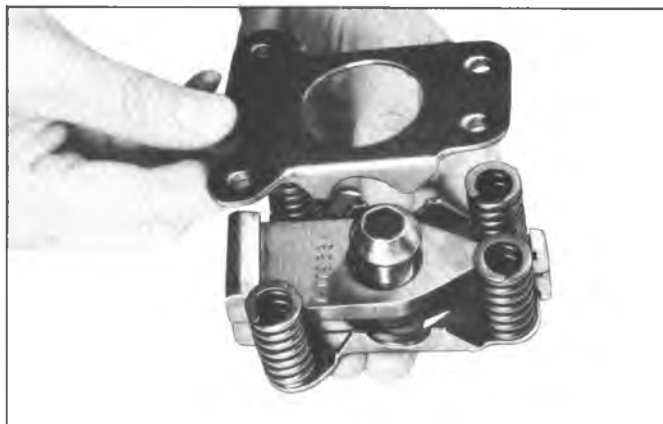


Fig. 13D—Installing Spring Pack Compression Tool (Corvette)

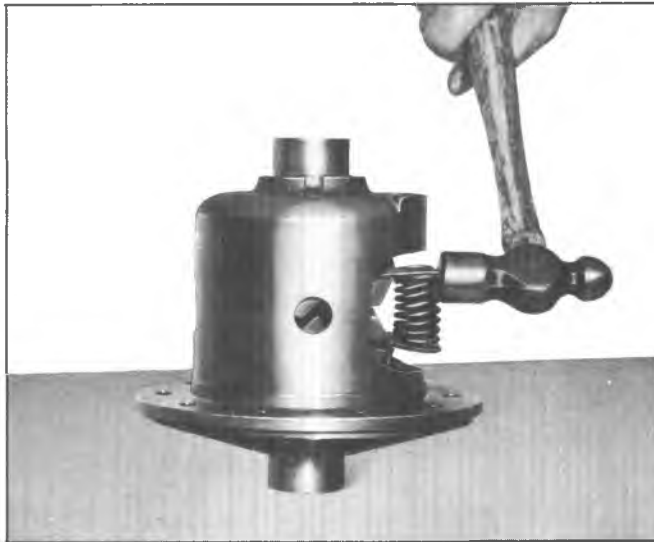


Fig. 14D—Installing Spring Pack

20. Check alignment of spring retainer with side gears. Slight movement of the spring pack can be made if necessary.
21. Install side bearings and ring gear to case using procedure outlined for the conventional differential.
22. Place differential in carrier and adjust bearings and backlash as outlined for the conventional differential.
23. Check operation of unit as follows:
 - a. Raise rear of vehicle until rear wheels are off the ground, and remove one wheel and tire assembly.
 - b. Attach Adapter J-5748 to axle shaft flange and install a 1/2-13 bolt into adapter, shown in Figure 15D.
 - c. With wheel and tire assembly still on vehicle held firmly to prevent turning, measure torque required to rotate opposite axle shaft with a 0-150 lb. torque wrench attached to J-5748. Torque required to rotate axle shaft should be no less than 40 ft-lbs.

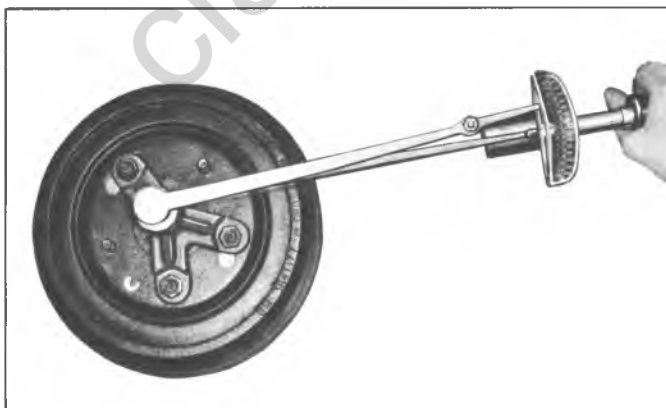


Fig. 15D—Measuring Positraction Rotating Torque

CHEVROLET POSITRACTION—FIGURE 16D

A Chevrolet produced Positraction differential unit is used optionally in 8 1/2 inch ring gear axles. Individual components of this positraction unit are not interchangeable with other design units.

Disassembly

1. Remove ring gear and side bearings following the procedures established for the conventional differential unit. Remove pinion shaft.
2. Using a wide, blunt instrument such as a drift or block of wood, drive the preload spring from the case.
3. Support an axle shaft in a vise, and slide the case into the shaft; then turn the case to remove both pinions and thrust washers.

NOTE: The pinion shaft may be partially installed to aid in rotating the case.

4. Remove the case from the axle shaft and remove both side gears, clutch packs and shims. Mark the gears, clutch packs and shims for reinstallation in same positions.

Inspection

Check the clutch plates and discs for wear and signs of overheating. Check the condition of the preload spring. Check the gear teeth for signs of wear. Replace parts as needed. Clean all parts to be used for assembly.

NOTE: The force required to compress the preload spring to 1-5/16 inches should be 300 lbs. \pm 30 lbs.

Reassembly

1. Lubricate the clutch discs and plates with positraction lubricant.
2. Alternately position clutch plates and discs on a side gear, beginning and ending with a clutch plate.
3. Position the side gear, clutch pack and original shim into the case.
4. Install both pinion gears and thrust washers into the case, and install pinion shaft.
5. Place the case onto an axle shaft supported in a vise.
6. Insert a screwdriver between the pinion shaft and the face of the side gear. Force the screwdriver in until the clutch pack is compressed.
7. Check the backlash between side gear and pinion gears. If backlash does not fall into the range of .005" to .008", adjust the shim dimension as required. Increasing shim thickness will decrease backlash; to increase backlash, decrease the thickness of the shim.

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NOTE: Service shims are available from .070" to .122" in increments of .004".

8. Remove the pinion shaft, pinion gears, side gear, clutch pack and shim from the case.
9. Install the opposite gear, clutch pack and original shim into the opposite side of the case. Place both pinion gears, and thrust washers into position, and install the pinion shaft.
10. Follow the procedure in steps 5, 6 and 7 to determine the proper shim dimension.
11. When the proper shims have been determined to achieve .005" to .008" backlash between both pinion gears and both side gears, install shims, clutch packs and side gears into case.

12. Mount the case onto the axle shaft locked in a vise. Place both pinions and thrust washers into position—180° apart—and carefully "roll in" by turning the case on the shaft.

NOTE: A large "C" clamp may be used to apply slight compression against pinion gears to aid the "rolling in" procedure.

13. Tap the preload spring into place with a hammer.
14. Install the pinion shaft and lock screw.
15. Install the side bearings and ring gear using the procedure outlined for conventional units.
16. Place the differential unit in the carrier and adjust ring gear and pinion backlash, and gear tooth pattern.

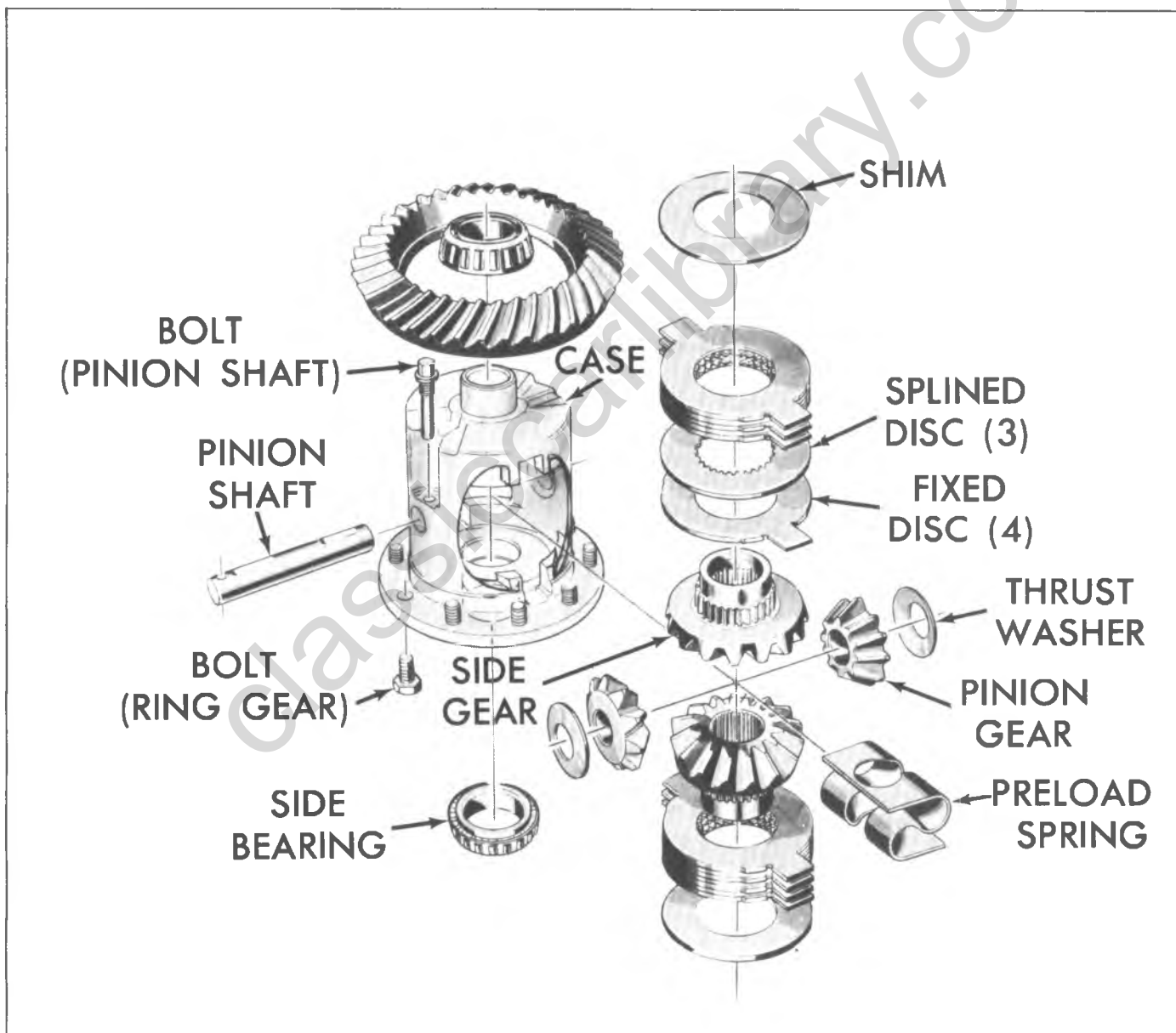


Fig. 16D—Chevrolet Positraction—Exploded

POWER-LOK DIFFERENTIAL

The Power-Lok differential shown in Figure 17D is a unit which is installed as optional equipment in place of the standard differential. The locking differential permits the major driving force to be transmitted to the wheel with better traction. This means that the vehicle can be operated on ice, snow, sand or under other adverse conditions with a minimum amount of slippage through one wheel.

Disassembly

1. Remove differential bearing cups and tag for reassembly reference.
2. Remove differential bearing cones, using Puller Tool J-22888.
3. Tag each bearing cone and shim for reassembly reference, as they should be replaced in their original locations.
4. Scribe mark on both halves of differential so they can be reassembled in their original locations.
5. Remove eight bolts attaching two halves of case together.
6. Separate plain half of differential case from flanged half.

7. Remove five plates and discs from side gear ring.

NOTE: A series of clutch plates and dished (Belleville) friction plates on each side of differential side gears transmits drive from differential case to axle shafts. Carefully observe the order in which the plates are used, since they must be replaced in the same order. Refer to Figure 17D.

8. Remove side gear ring and side gear.
9. Remove two cross shafts and pinion gears.
10. Remove side gear, side gear ring, and five plates and discs from the opposite side. Observe the order in which the plates are used.

Inspection

1. Inspect cross shafts and pinions for scoring, wear, pitting, etc. If the center lands of either cross shaft show signs of wear, examine ends of axle shafts to determine if the axle shaft is rubbing against cross shaft. This rubbing condition may cause a whine or howl that is similar to a pinion bearing noise, at 40 to 50 MPH. This condition can be corrected by grinding 1/32" off the end of the axle shaft.

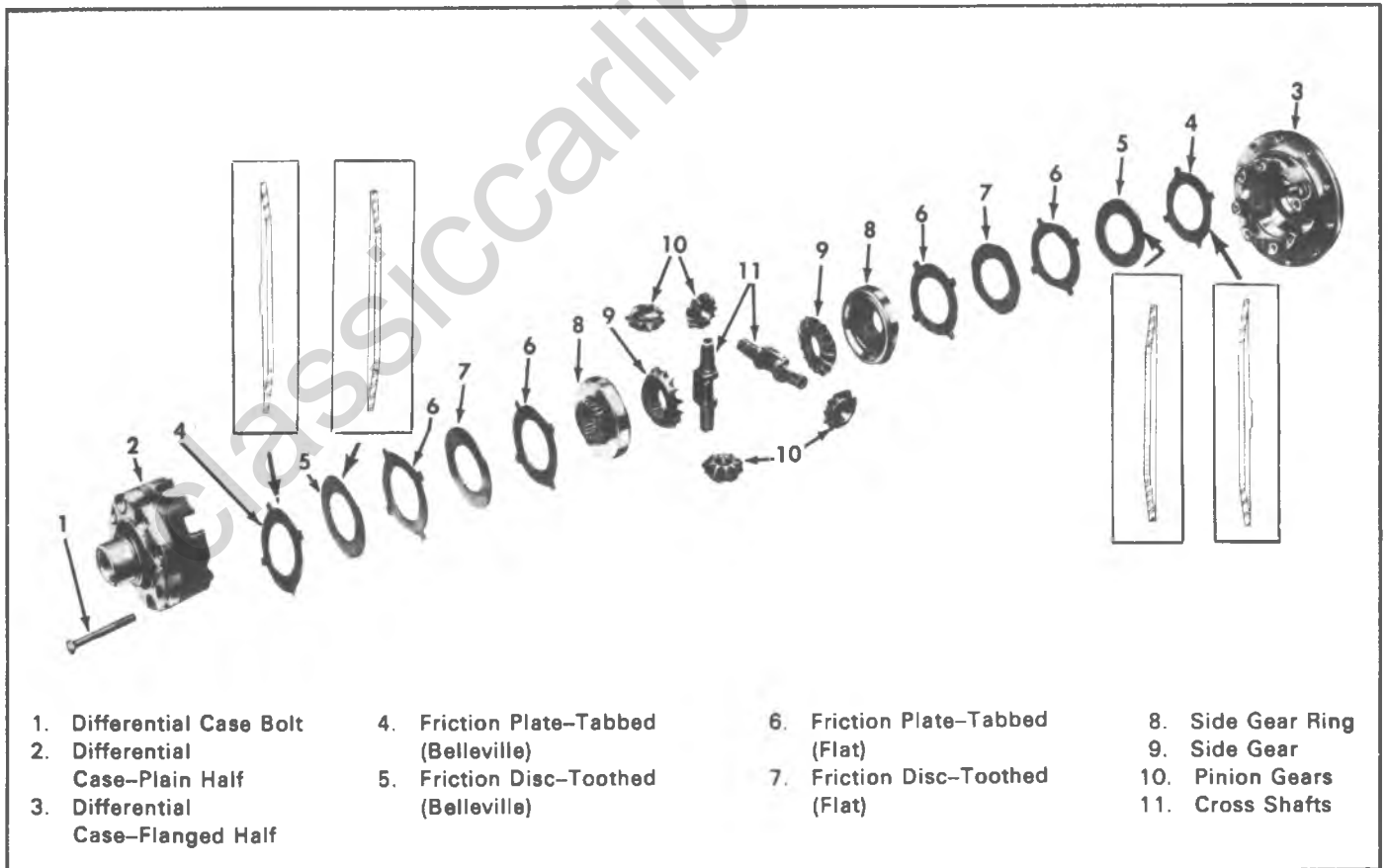


Fig. 17D—Power-Lok Differential

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2. Inspect clutch discs and plates for wear, cracked, or distorted condition. Refer to "Specifications" section.
3. Inspect side gear rings, side gears, and differential cases for worn, cracked, or distorted condition that would render these parts unfit for further services.

Assembly

During assembly operations, all parts should be kept clean and free of dirt or other foreign material. As each part is assembled in its proper position, it is necessary that it be lightly coated with the correct lubricant.

1. Place tabbed Belleville friction plate (4) in flanged differential case, being extremely careful that convex (bulged) side is toward the side gear. See Figure 17D.
2. Assemble remaining plates and discs to splines of side gear ring, being sure they are assembled in the same order of removal. The convex (bulged) side of the Belleville friction disc (5) should be toward the side gear and it should nest into the Belleville friction plate (4).
3. Place assembled side gear ring with plates and discs in flanged half of differential case.
4. Install side gear and cross shafts with pinions.
5. In the order listed install the following: (1) side gear, (2) side gear ring, (3) flat plate with tabs, (4) flat disc with teeth, (5) flat plate with tabs, (6) Belleville disc with convex (bulged) side up, or toward side gear, (7) Belleville plate, with convex (bulged) side up, or side toward gear.
6. Position plain half of differential case over previously assembled parts with scribe markings on both halves of case in alignment.
7. Install differential case bolts, but do not tighten at this time.

8. Before tightening bolts, use axle shafts and align splines of the side gear and side gear ring, on each side. Tighten bolts evenly and alternately. Remove axle shafts.
9. Observe if Power-Lok components have been assembled properly. Each pinion cross shaft can be tight on its ramp or if there is clearance it should be only a few thousandths, and it should be equal at all four cross shaft ends.

Testing Procedure

The Power-Lok can be effectively tested for correct operation by placing one rear wheel on good dry pavement and the other on ice, snow, mud, gravel, grease, etc.

It can easily be determined whether or not the non-slipping wheel is providing pulling power. The procedure should then be repeated with the opposite wheels on the dry and slippery surfaces.

The above testing procedure is a rough test that can be made by the owner of the vehicle. However, if it is suspected that the unit is not operating properly, it can be checked by the following procedure.

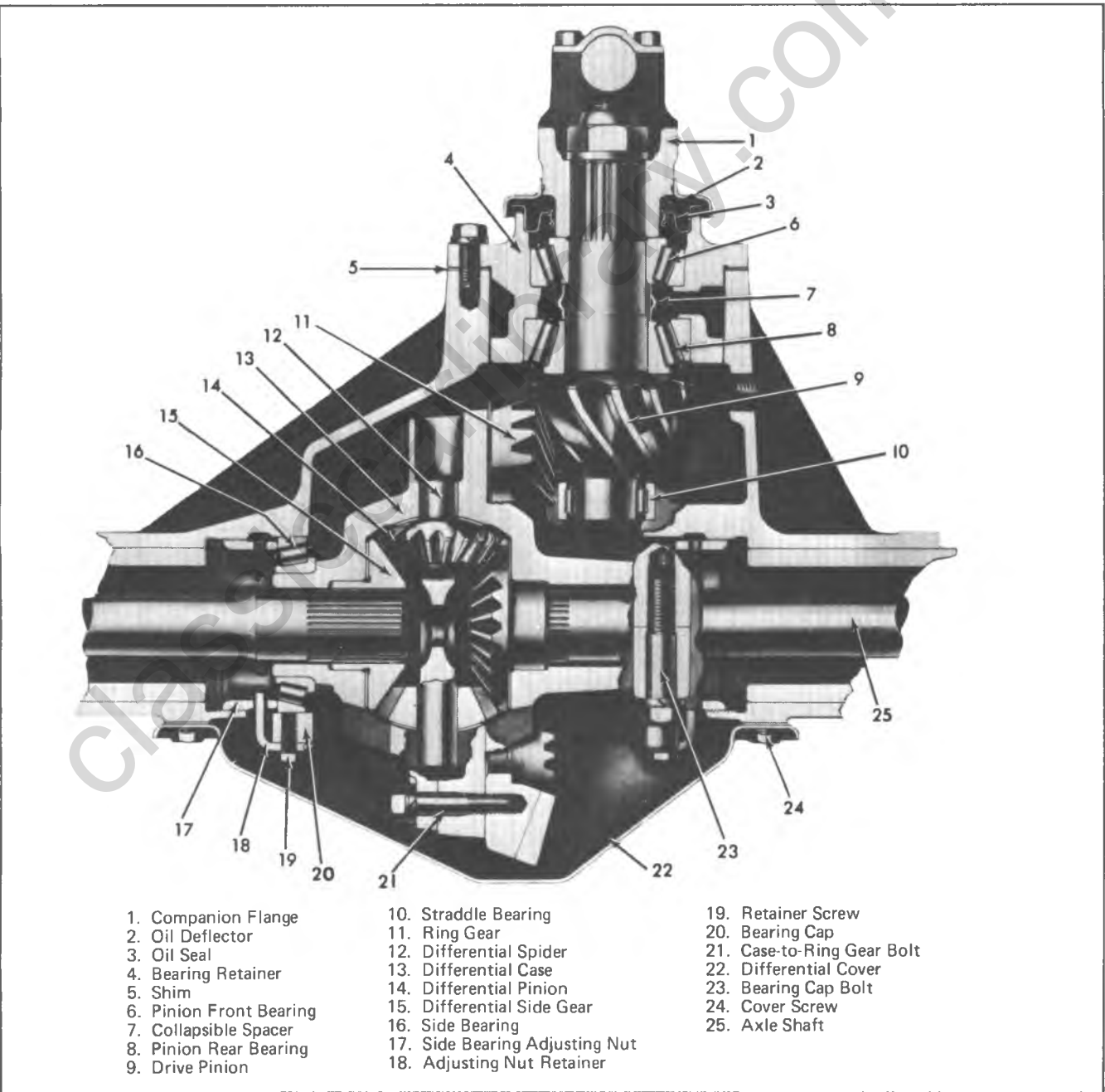
Be sure the transmission is in neutral. Raise one wheel off the floor and place a block in the front and rear of the opposite wheel. Remove the hub cap and install a special tool across two wheel studs. Apply a torque wrench to special tool. Disregard breakaway torque and observe only the torque required to continuously turn the wheel smoothly.

If the torque reading is less than 40 foot-pounds or more than 200 ft. lb., the unit should be disassembled and the necessary repairs made.

CHEVROLET SERIES 20-30 TRUCK DIFFERENTIAL 10-1/2" RING GEAR

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- | | | |
|-------------------------|--------------------------------|----------------------------|
| 1. Companion Flange | 10. Straddle Bearing | 19. Retainer Screw |
| 2. Oil Deflector | 11. Ring Gear | 20. Bearing Cap |
| 3. Oil Seal | 12. Differential Spider | 21. Case-to-Ring Gear Bolt |
| 4. Bearing Retainer | 13. Differential Case | 22. Differential Cover |
| 5. Shim | 14. Differential Pinion | 23. Bearing Cap Bolt |
| 6. Pinion Front Bearing | 15. Differential Side Gear | 24. Cover Screw |
| 7. Collapsible Spacer | 16. Side Bearing | 25. Axle Shaft |
| 8. Pinion Rear Bearing | 17. Side Bearing Adjusting Nut | |
| 9. Drive Pinion | 18. Adjusting Nut Retainer | |

Fig. 1E—Cross Section of Chevrolet Truck Differential with 10 1/2" Ring Gear

DIFFERENTIAL CASE

Removal

1. Mount axle assembly in a bench vise or holding fixture.
2. Remove cover bolts and cover, as seen in figure 2E, and allow lubricant to drain into pan.
3. Remove axle shafts as outlined in Truck Service Manual.

NOTE: Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described in Step 9 of "Differential Case—Installation." This will indicate gear or bearing wear or an error in backlash or pinion depth setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, then may be reinstalled at original lash to avoid changing gear tooth contact.

4. Remove adjusting nut lock retainers from bearing caps.
5. Mark bearing caps for reinstallation in the same position, and remove caps.
6. Loosen side bearing adjusting nuts, using J-24429 as shown in figure 3E.
7. Remove differential from carrier.

Side Bearing Replacement

1. Install bearing puller J-8107 onto one side bearing, with puller screw centered on pilot plug as shown in figure 4E. Be sure to install puller fingers into notches of case, in order to pull on inner race only.
2. Tighten puller screw, while rotating bearing to insure that bearing cage is not being distorted.
3. Remove the other bearing in the same manner.

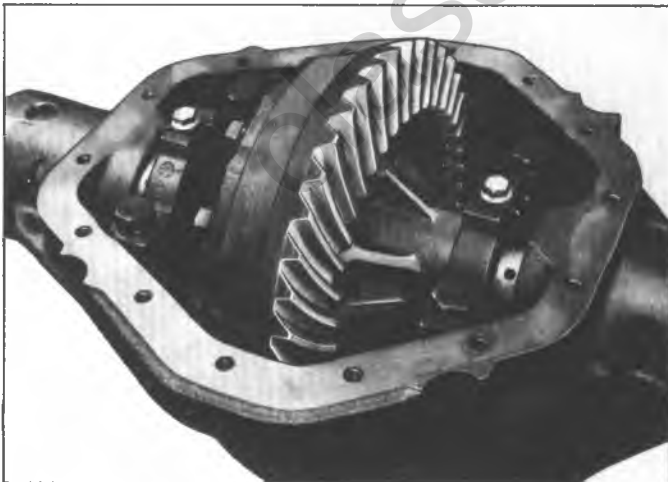


Fig. 2E—Cover Removed from Carrier

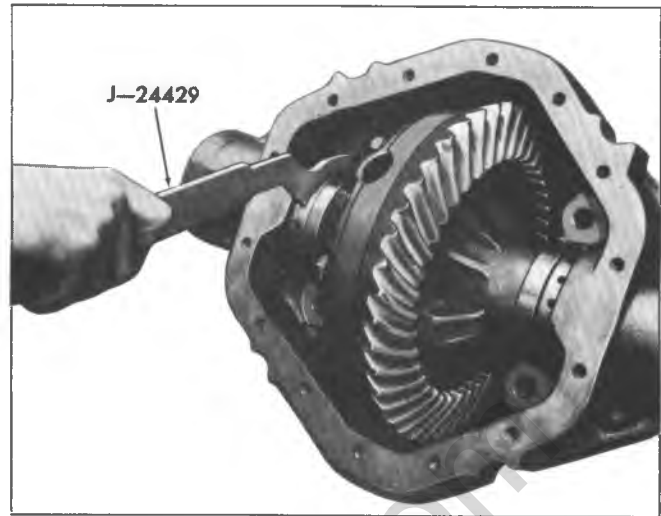


Fig. 3E—Loosening Adjusting Nuts



Fig. 4E—Differential Bearing Removal

4. Inspect bearings and hub for nicks, burrs or evidence of abnormal wear.
5. To install bearings, place bearing onto hub, and use driver handle J-8092 and bearing installer J-24430 to drive bearing onto hub until it seats against the shoulder.
6. When installing the second bearing, support case on pilot plug as shown in figure 5E to prevent damage to first bearing installed.

Ring Gear Replacement

1. Remove the ring gear bolts and lock washers, and use a soft faced hammer to tap the ring gear from the case.
2. Place new ring gear into position on case and install lock washers and bolts.
3. Torque bolts alternately to specifications.

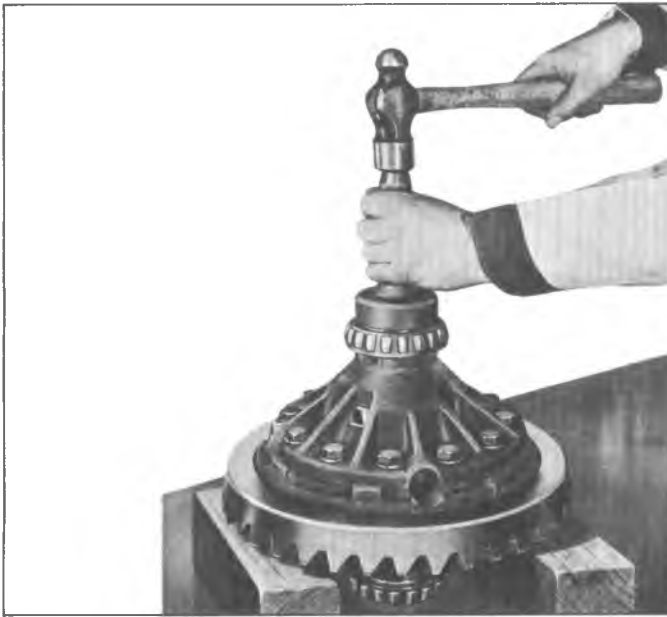


Fig. 5E—Differential Bearing Installation

Disassembly of Case

1. Mark the case and cover halves with a scribe line for reassembly in the same position.
2. With ring gear removed, separate case and cover.
3. Remove the internal parts and keep separated so they may be installed in the same relative positions.

Inspection

1. Inspect the differential gears, pinions, thrust washers, spider and all mating surfaces for evidence of abnormal wear.
2. Clean all parts thoroughly in suitable solvent.
3. Replace parts as necessary.

Reassembly of Differential

1. Lubricate internal parts with hypoid gear lubricant.
2. Place differential pinions and thrust washers onto spider.
3. Assemble differential gears and washers to case and cover.
4. Assemble differential case and cover making sure scribe marks align.
5. Install ring gear and attaching bolts and lockwashers, and torque alternately to specifications.
6. The differential may be installed into the carrier at this point, or may be installed after servicing the drive pinion.

Installation and Adjustment

1. Place bearing cups over side bearings and lift the differential assembly into the carrier. Install bearing caps, making sure marked caps are installed in original positions. Secure the cap bolts snugly.

2. Loosen the right side adjusting nut and tighten the left side nut, using J-24429 as shown in figure 3E, until the ring gear contacts the drive pinion. Do not force the gears into contact so as to bind them. At this point, zero lash is obtained.
3. Back off the left adjusting nut approximately two slots. Install locking fingers into holes and fasten fingers to bearing cap.
4. Tighten right adjusting nut firmly to force the case into solid contact with the left adjusting nut.
5. Loosen right adjusting nut until it is free from its bearing, then retighten until it contacts the bearing.
6. Tighten right adjusting nut approximately two slots if used bearings are being installed, or three slots if new bearings are being installed.
7. Install locking retainer into holes and attach fingers to bearing cap.
8. Torque bearing cap bolts to specification.

NOTE: At this point the differential bearings are properly preloaded. If any additional adjustments are required in the following procedures make sure that the preload remains as established. If one adjusting nut is loosened the other nut must be tightened **an equal amount** to maintain this preload.

9. Mount a dial indicator on the housing and measure the backlash between the ring gear and pinion. Backlash should be from .003" to .012" with .005" to .008" preferred. Refer to figure 6E.

NOTE: If backlash is more than .012" loosen the right adjusting nut one slot and tighten left adjusting nut one slot. If backlash is less than .003" loosen the left adjusting nut one slot and tighten the right adjusting nut one slot.

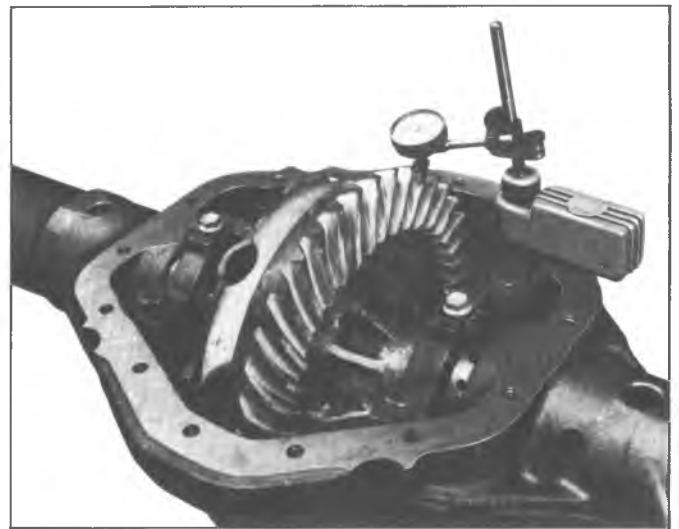


Fig. 6E—Measuring Backlash

DRIVE PINION ASSEMBLY

Removal

1. Remove differential as previously outlined.
2. Check pinion bearing preload as described under "Drive Pinion - Reassembly". Record the result. If there is no preload reading, check for looseness of pinion assembly by shaking the companion flange. Looseness indicates the need for bearing replacement.
3. Remove the pinion bearing retainer bolts from the housing as shown in figure 7E.
4. Remove the pinion and bearing retainer assembly. It may be necessary to rap on the pilot end of the pinion to assist the assembly from the carrier.
5. Record the thickness of the shims removed from between the bearing retainer flange and the carrier housing.

Disassembly

1. Clamp the pinion assembly in vise.
2. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 8E. Position J-8614-11 on flange so that the four notches are toward the flange.
3. Use a suitable sized socket to remove the pinion nut and washer. Discard the pinion nut and use a new one upon reassembly.
4. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 9E.
5. Support the bearing retainer as shown in figure 10E and press out the drive pinion. Do not allow drive pinion to fall onto the floor.



Fig. 7E—Removing Retainer Bolts

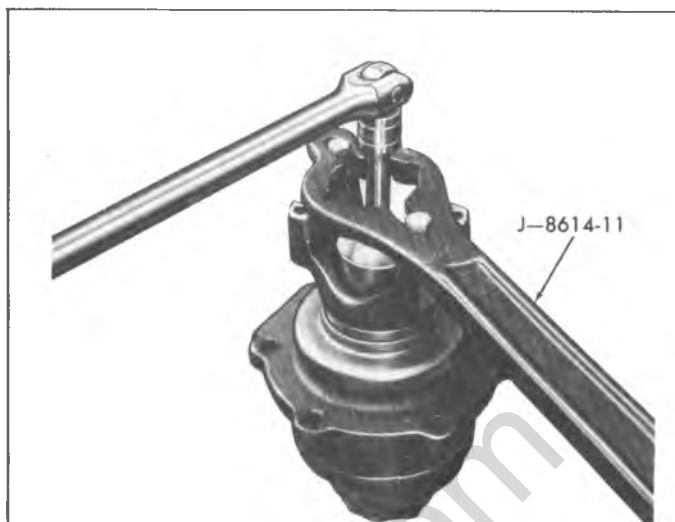


Fig. 8E—Removing Pinion Nut

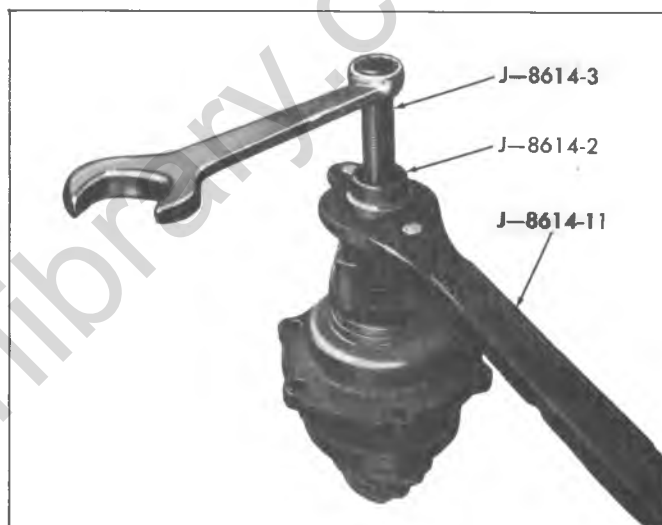


Fig. 9E—Removing Flange

6. Separate the pinion flange, the oil seal, the front bearing and the bearing retainer. The oil seal may have to be driven from the bearing retainer if it is being replaced.
7. Drive the pinion front and rear bearing cups from the bearing retainer, using a drift.
8. To remove the rear bearing, use J-22912 as shown in figure 11E.
9. Drive the pinion straddle bearing from the carrier housing, using a drift as shown in figure 12E.

Inspection

1. Clean all parts in a suitable solvent and dry with air.
2. Inspect the drive pinion for chipped, cracked or excessively worn teeth and inspect the splines for wear.
3. Inspect the bearings for worn or pitted rollers or races. Inspect the pinion flange splines for wear.

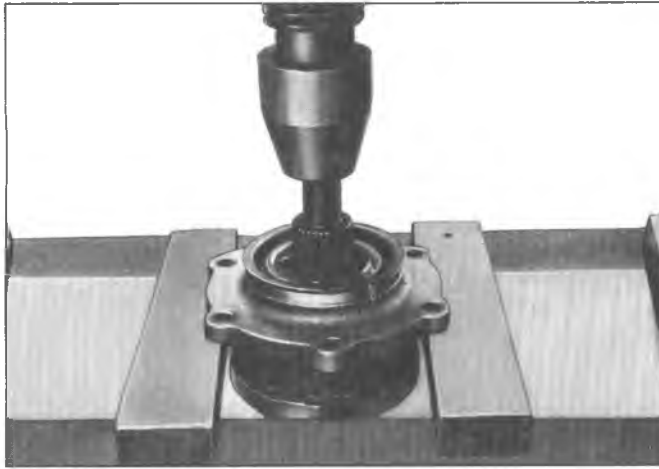


Fig. 10E—Pressing Drive Pinion from Bearing Retainer

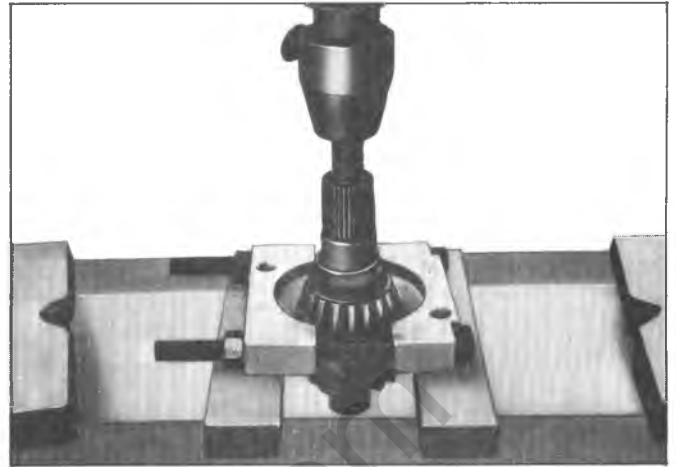


Fig. 11E—Removing Pinion Rear Bearing

4. Inspect the bearing retainer for cracks, imperfections, corrosion, pits and grooves.
5. Replace parts as required.

Reassembly

1. Lubricate all parts with hypoid lubricant.
2. Press pinion rear bearing onto drive pinion as shown in figure 13E, using J-24433.
3. Install the front and rear pinion bearing cups into the bearing retainer, using driver handle J-8092 on J-8608 for the front cup, and on J-24432 for the rear cup.
4. Install the pinion straddle bearing into the carrier housing, using driver handle J-8092 and installer J-23322, as shown in figure 14E.
5. Place bearing retainer, with cups in position, onto

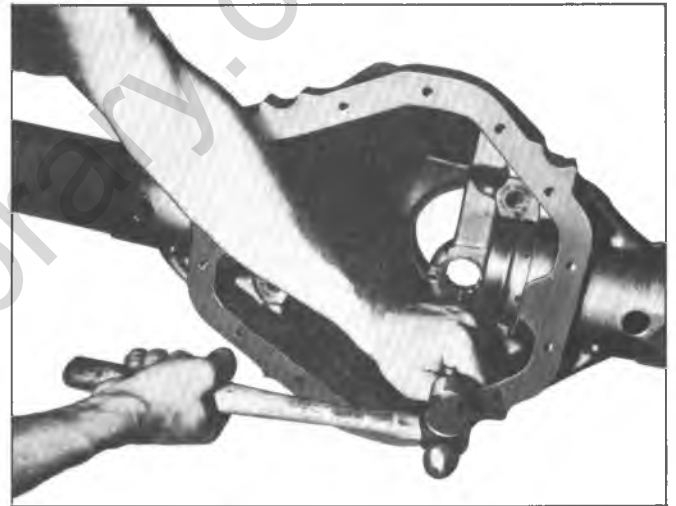


Fig. 12E—Removing Straddle Bearing

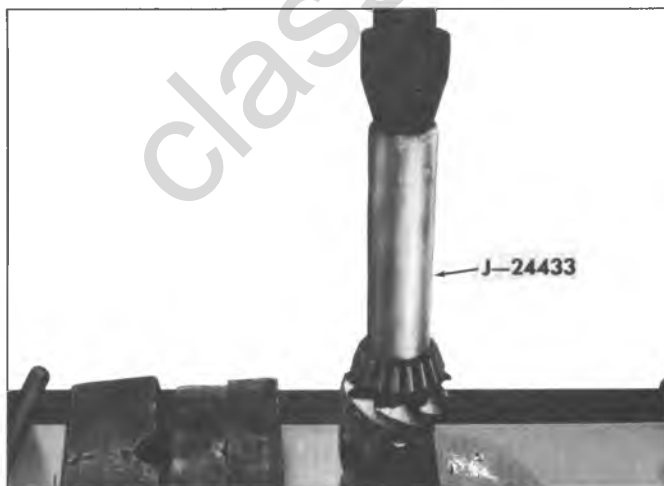


Fig. 13E—Installing Pinion Rear Bearing



Fig. 14E—Installing Straddle Bearing

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the drive pinion. Install a new collapsible spacer into position.

6. Press front bearing onto drive pinion.
7. Lubricate the oil seal lips with a lithium-base extreme pressure lubricant, and install the seal in the retainer bore. Use J-24434 with driver handle J-8092. Press the seal into the bore until it seats against internal shoulder.
8. Install pinion flange and oil deflector onto the splines, then install lock washer and new pinion nut.
9. Clamp the pinion flange into a vise. Install J-8614-11 as in figure 8E. Tighten the nut to achieve proper bearing preload.
 - a. Proper preload is attained when rotational torque required to rotate the pinion is 25-35 in. lbs. for new bearings, or 5-15 in. lbs. for used bearings.
 - b. Tighten pinion nut to approximately 350 ft. lbs., then take a torque reading as shown in figure 15E, using J-5853.
 - c. Continue tightening pinion nut in small increments until proper preload is attained.

CAUTION: *Over-tightening of pinion nut may collapse spacer too much, requiring its replacement.*

Installation and Adjustment

1. Examine the head of the drive pinion for a pinion depth code number.
2. Compare the depth code number with the number on the original pinion. Use the following chart to select the proper shim for preliminary setting of pinion depth.
3. Refer to the thickness of the shim recorded earlier in Pinion Removal procedures. Increase or decrease

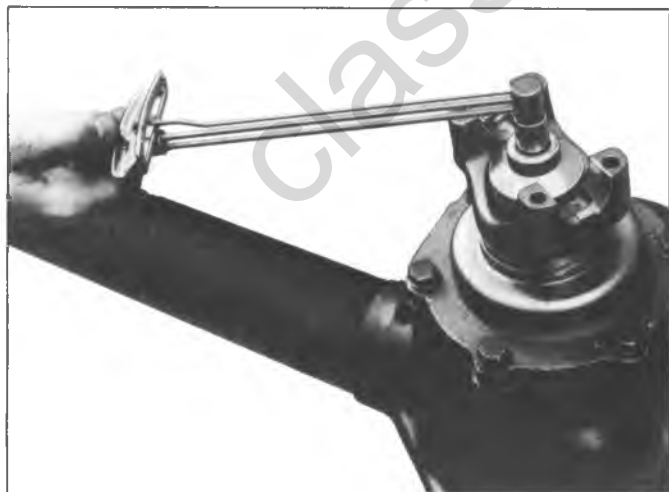


Fig. 15E—Measuring Rotating Torque

		CODE NUMBER ON ORIGINAL PINION				
		+2	+1	0	-1	-2
CODE NUMBER ON SERVICE PINION	+2	-	ADD .001	ADD .002	ADD .003	ADD .004
	+1	SUBT. .001	-	ADD .001	ADD .002	ADD .003
	0	SUBT. .002	SUBT. .001	-	ADD .001	ADD .002
	-1	SUBT. .003	SUBT. .002	SUBT. .001	-	ADD .001
	-2	SUBT. .004	SUBT. .003	SUBT. .002	SUBT. .001	-

Fig. 16E—Pinion Depth Codes

the shim dimension as indicated by the chart in figure 16E.

- a. For example, if original shim measured .014 inch, original code was -1 and new code is +2, the correct shim would be .014 inch plus .003 = .017 inch.
 - b. If original shim was .012 inch, original code +2, and new code is -2, the correct shim would be .012 minus .004 = .008 inch.
4. Place the pinion shim as determined in step 3 onto the carrier housing, making sure the bolt holes align with those of carrier, and that the mating surfaces are clean and free from foreign material.
 5. Place the pinion retainer assembly into position, and align bolt holes to carrier. Install retaining bolts and tighten in a crosswise manner. Torque to specifications.
 6. Following drive pinion service, a Contact Pattern Check must be made.

CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 9 of "Drive Pinion Reassembly".

Side Bearing Preload is set to specifications in step 6 of "Differential Case—Installation and Adjustment".

Following service to the Differential assembly or to the Drive Pinion, the Pinion Depth and the Ring-Gear-to-Pinion Backlash **must** be checked, using a Gear Tooth Contact Pattern Check as outlined below.

Gear Tooth Contact Pattern Check

Prior to final assembly of the differential, a Gear Tooth

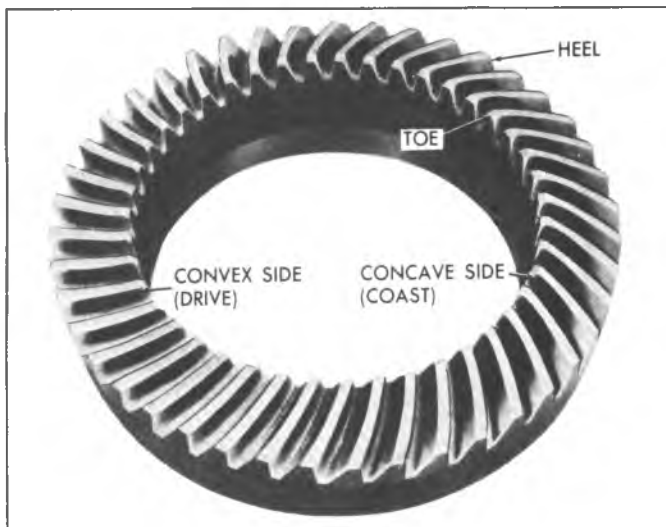


Fig. 17E—Gear Tooth Nomenclature

Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 17E.

Pattern Check

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound (yellow lead chromate or equivalent) and apply this mixture to ring gear

teeth. When properly applied, the area of tooth contact will be clearly visible after load is applied.

3. Tighten bearing cap bolts to specifications.
4. Apply load to gears by expanding brake shoes or by wrapping a heavy rag around the companion flange to resist rotation.

NOTE: A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with figure 18E. Make adjustments as outlined below.
6. The important thing to achieve in the pattern check and subsequent adjustments is to locate the contact pattern centrally on the face of the ring gear teeth.

Pinion Depth Adjustment

1. The pinion depth shim may be replaced as necessary to place the drive pinion at the correct depth. See figure 18E.
2. Depth shims are available from .006 inch to .024 inch, in increments of .001 inch.

Backlash Adjustment

1. Remove locking retainers from side bearing adjusting nuts.
2. Move adjusting nuts **an equal amount** in or out to achieve proper backlash.
 - a. To increase backlash, loosen the left adjusting nut and tighten the right adjusting nut **an equal amount**.
 - b. To decrease backlash, loosen the right adjusting nut and tighten the left adjusting nut **an equal amount**.

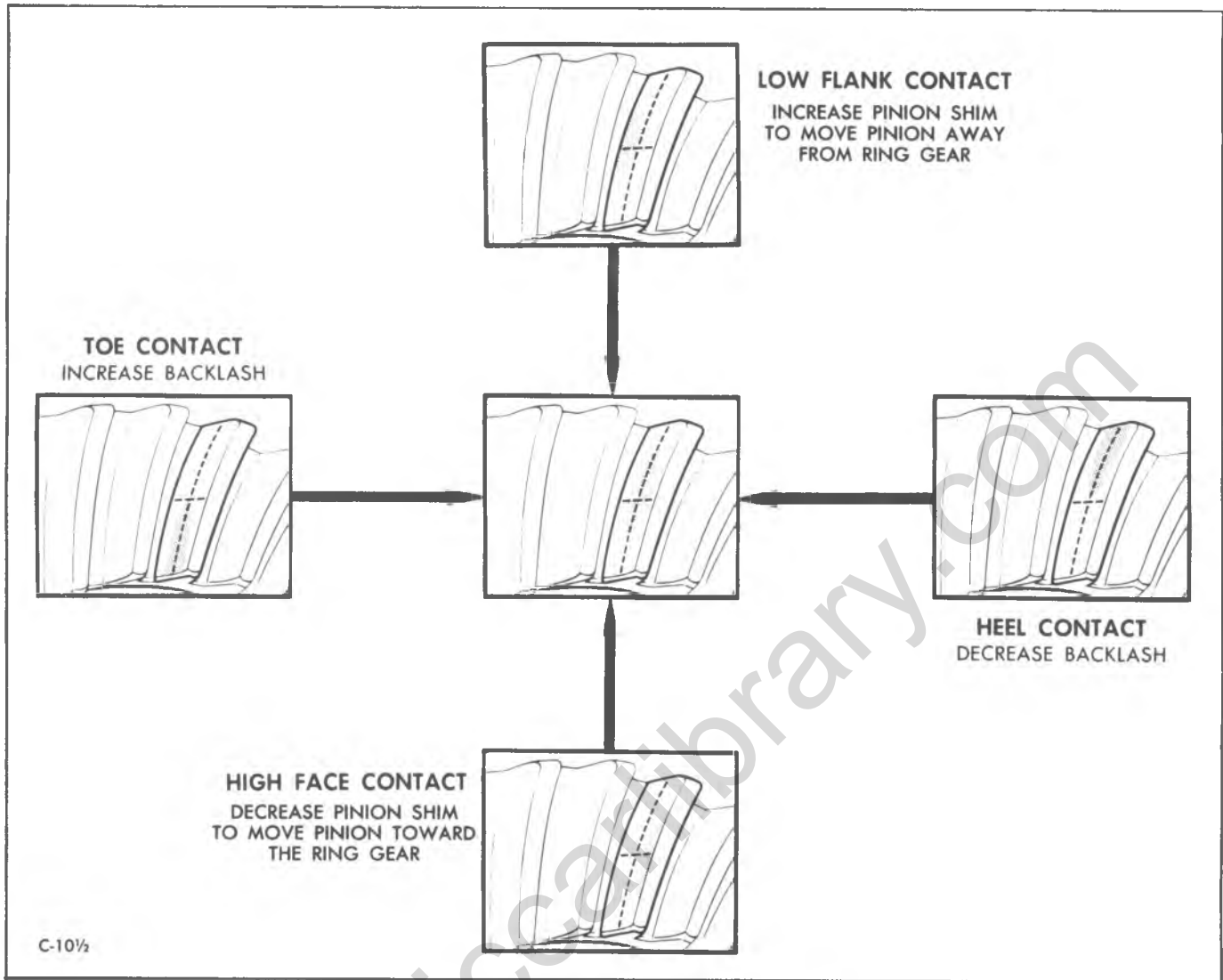


Fig. 18E—Gear Teeth Contact Pattern Check

DANA DIFFERENTIALS

10-1/2" RING GEAR

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GENERAL DESCRIPTION

This Dana Spicer axle is similar in design to other Salisbury type axles with the following exceptions:

1. In order to remove the differential case, the carrier must be spread.

2. The drive pinion assembly incorporates an inner and outer bearing shim pack. The inner shim is used to maintain proper pinion depth. The outer shim is used to maintain proper preload on the pinion bearings.

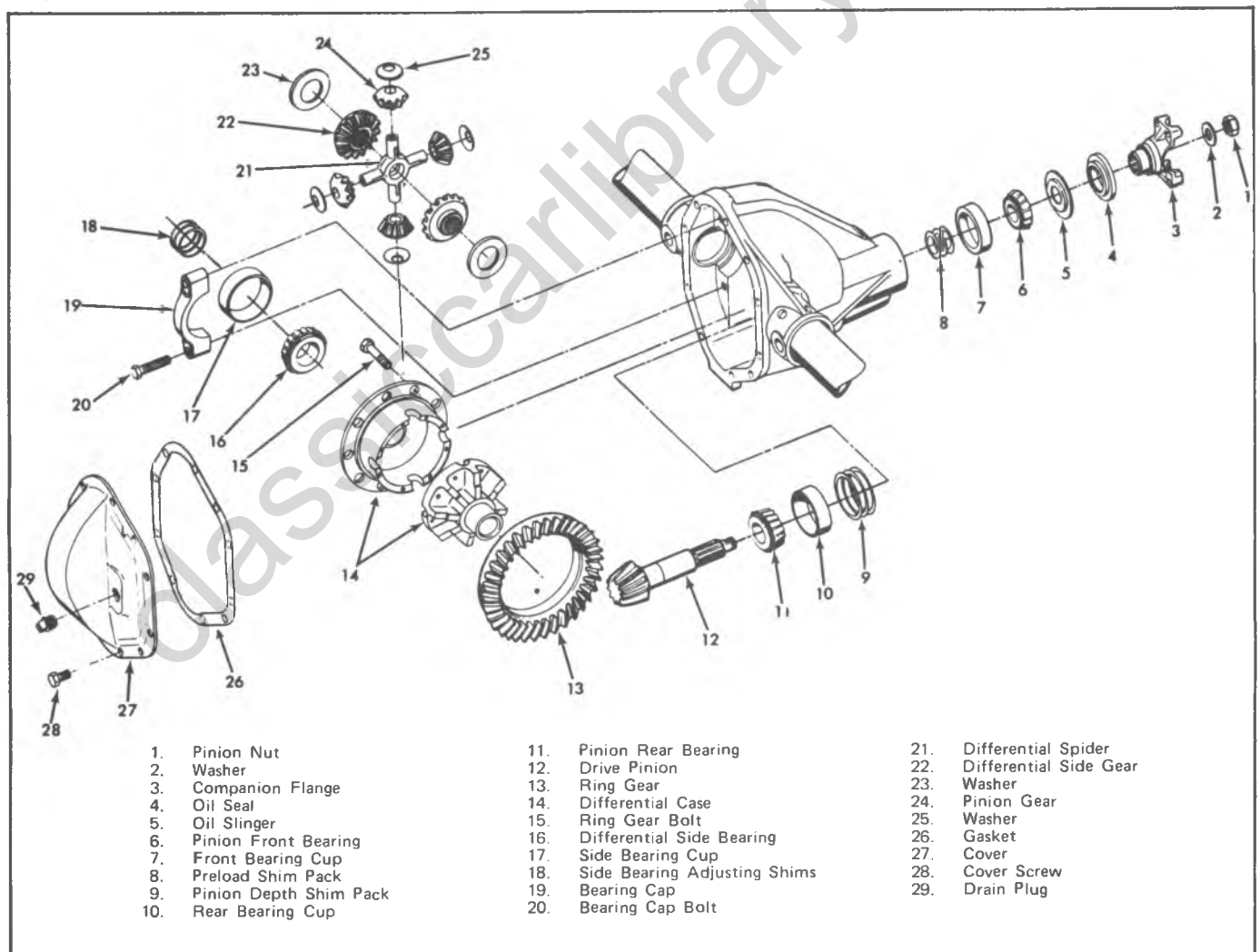


Fig. 1F — Dana Differential with 10 1/2" Ring Gear

DIFFERENTIAL CASE

Removal

1. Place vehicle on hoist with rear axle hanging free.
2. Remove wheel and tire assemblies.
3. The axle shafts are full-floating type with flanged outer end of shaft attached to wheel hub by studs and nuts. Wheel is supported by tapered roller bearings at outer end of axle housing.
 - a. Remove axle shaft to hub attaching nuts.
 - b. Rap on axle shaft to loosen shaft from hub and remove shafts.
4. Remove plug in carrier and drain lubricant.
5. Remove cap screws and lock washers attaching cover to carrier. Remove cover and gasket.
6. Mark one side of carrier and matching cap for reassembly in the same position. Remove bearing caps.
7. Using spreader tool J-24385, and a dial indicator as shown in figure 2F, spread carrier a maximum of .015 inch.

CAUTION: Do not exceed this dimension, as carrier may be permanently damaged.

8. Remove the dial indicator and use a prybar to remove the differential case from the carrier. Record the dimensions and location of the side bearing shims. Remove the spreader tool.

Disassembly

1. Remove differential side bearings by placing J-22912 under bearings and supporting plates on a press bed. Apply force to pilot plug J-8107-3 to drive the case from the bearing.

NOTE: Use care not to damage case hubs with tool J-22912.

2. Remove the ring gear bolts and the ring gear. Tap

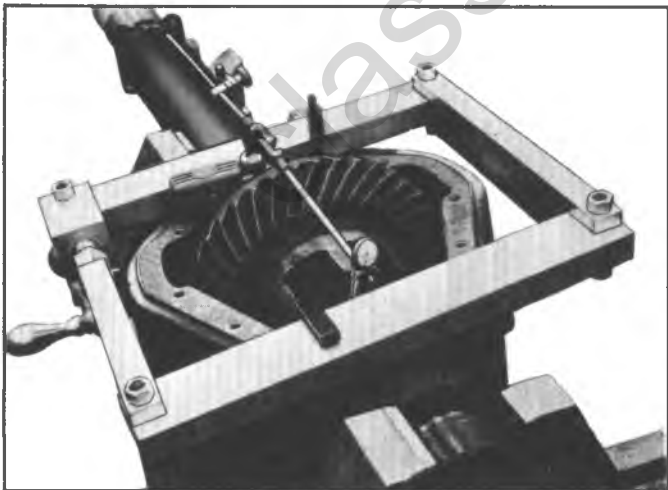


Fig. 2F—Spreading the Carrier

the ring gear with a soft-faced hammer to free it from the case.

3. Scribe both case halves for reassembly in same position.
4. Remove bolts holding case halves together, as shown in figure 3F.
5. Tap lightly on top half of case to free it from the bottom half. Remove top half of case.
6. Lift out all internal parts.

Inspection

1. Clean all gears and bearings in solvent. Inspect cups, races and rollers for scoring, chipping or evidence of excessive wear.
2. Inspect ring gear teeth and machined surfaces. Examine fit of internal gears.
3. Inspect pinion cross-shaft.
4. Replace parts as required.



Fig. 3F—Separating Case Halves

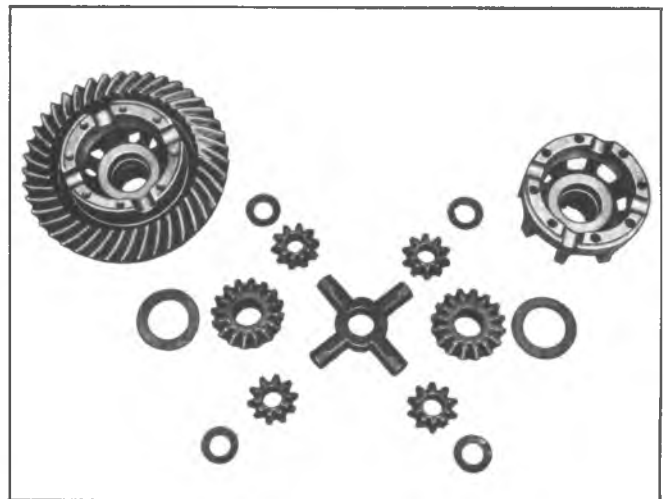


Fig. 4F—Internal Parts Inspection

DRIVE PINION

Removal and Disassembly

1. Remove differential as previously outlined.
2. Check pinion bearing preload as described under "Drive Pinion - Installation and Adjustment." If there is no preload reading, check for looseness of pinion assembly by shaking the companion flange. Looseness indicates the need for bearing replacement.
3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 5F. Position J-8614-11 on flange so that the four notches are toward the flange.
4. Remove pinion nut and washer. Discard pinion nut and use a new one upon reassembly.
5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 6F.
6. Remove drive pinion from carrier. It may be necessary to tap on the pinion with a soft faced hammer.
7. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.
8. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.
9. Remove rear pinion bearing using J-22912, and an arbor press.



Fig. 5F—Removing Pinion Nut

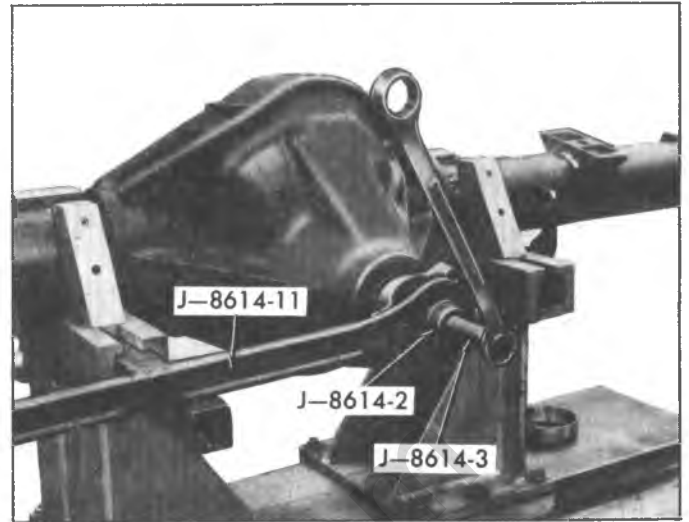


Fig. 6F—Removing Companion Flange

Inspection

1. Clean all gears and bearings in cleaning solvent and inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear. On pinion bearing rollers, inspect large end of rollers for wear. This is where wear is most evident on tapered roller bearings.
2. Inspect pinion splines and flange splines for evidence of excessive wear.
3. Inspect ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case for cracks or scores or side gears, thrust washers, and pinion thrust faces.
5. Check fit of differential side gears in case.
6. Check fit of side gears and axle shaft splines.
7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.

DIFFERENTIAL CASE

Reassembly

1. Assemble new washers to side gears. Apply a small amount of hypoid lubricant on the side gear hubs.
2. Assemble pinion gears and new washers onto cross shaft.
3. Place side gears, pinion gears, cross shaft and washers into flanged half of case.
4. Assemble top half of case to bottom half, making sure scribe marks are aligned.
5. Assemble body bolts finger tight. Then tighten bolts alternately to specifications.
6. Install ring gear to differential case.
7. Install ring gear-to-case bolts finger tight, then tighten alternately to specifications.
8. Place side bearing into position and install, using

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tools J-8092 and bearing installer J-24383 as shown in figure 7F.

9. Install bearing on opposite side in the same manner. Be sure to support differential case on pilot plug J-8107-3.

SHIM REQUIREMENTS—GAUGING PROCEDURES

Side Bearing Shims

1. With the pinion removed from the carrier, place the bearing cups over the side bearings, and install the differential case into the carrier.
2. Place the shim which was originally installed on the ring gear side into its original position.
3. Install the bearing caps lightly in their marked positions. Tighten the caps just enough to keep the bearings in place.
4. Mount a dial indicator on the carrier with the tip of the indicator on the back face of the ring gear.
5. Position two screwdrivers between the bearing shim and carrier on the ring gear side of the case. Pull on the screwdrivers and force the differential case as far as possible away from the dial indicator.
6. With force still applied, set the indicator dial to "zero", being sure the probe is still in contact with the ring gear.
7. Reposition the screwdrivers to the opposite side of the differential case as shown in figure 8F.
8. Pull on the screwdrivers and force the differential case back toward the dial indicator. Repeat several times until the same indicator reading is obtained.
9. To the dial indicator reading, add the thickness of the shim. Record the result, as this figure will be used during determination of side bearing shim requirements.



Fig. 7F—Installing Side Bearing



Fig. 8F—Screwdrivers Against Case

Pinion Shims

Ring gears and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring gear before proceeding with assembly.

On the rear face of each pinion there is etched a plus (+) number, a minus(-) number, or a zero (0) number, which indicates the best running position for each particular gear set. This dimension is controlled by the shimming behind the inner bearing cup. Whenever baffles or oil slingers are used, they become a part of the adjusting shim pack.

For example: if a pinion is etched +3, this pinion would require .003" less shims than a pinion etched "0". This means by removing shims, the mounting distance of the pinion is increased by .003" which is just what a +3 etching indicates. Or if a pinion is etched -3 we would want to add .003" more shims than would be required if the pinions were etched "0". By adding .003" shims, the mounting distance of the pinion was decreased .003" which is just what a -3 etching indicated. Refer to figure 10F.

If the old ring and pinion set is to be reused, measure the old shim pack and build a new shim pack to this same dimension. If baffle is in the axle assembly, it is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005" and .010".

NOTE: If baffle or slinger is bent or mutilated, it should be replaced.

Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the plus or minus etching on both the old and new pinion, and adjust the

Old Pinion Marking	New Pinion Marking								
	- 4	- 3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4
+ 4	+ 0.008	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0
+ 3	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001
+ 2	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002
+ 1	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003
0	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004
- 1	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005
- 2	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006
- 3	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007
- 4	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007	- 0.008

Fig. 9F—Dana Pinion Code Chart



Fig. 10F—Pinion Code Location

thickness of the old shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads (+2) and the new pinion is (-2), add .004" shims to the original shim pack.

DRIVE PINION

Assembly and Installation

1. Determine the correct pinion depth shim by using the chart in figure 9F.
2. Install the pinion depth shim in rear cup bore.
3. Install rear bearing cup by using driver handle J-8092 and installer J-24381.
4. To the outer shim pack (for setting preload) add or

remove an equal amount as was added or removed from the inner shim pack.

5. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092.
6. Press rear pinion bearing onto pinion shaft, using installer J-24433.
7. Install drive pinion and bearing into the differential carrier.
8. Install preload shims and front pinion bearing. Do not install oil seal at this time.
9. Install flange and holding bar J-8614-11 as shown in "Drive Pinion—Removal".
10. Install washer and nut onto pinion shaft. Torque nut to 250 lbs. ft.
11. Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.

NOTE: Torque reading to start shaft turning must be disregarded.

12. If torque requirements (preload) are not to specifications, adjust shim pack as necessary.
 - a. To increase preload, decrease the thickness of preload shims.
 - b. To decrease preload, increase the thickness of preload shims.
13. When bearing preload meets specifications, remove nut, washer and flange from pinion shaft.
14. Install new pinion oil seal into housing as shown in figure 11F, using J-24384.
15. Install flange, washer and nut. Using holder bar J-8614-11, torque nut to 250 lbs. ft.



Fig. 11F—Installing Pinion Oil Seal

DIFFERENTIAL CASE

Installation and Adjustment

1. Place the differential case, with side bearings and cups installed, into position in the carrier.
2. Select the smallest of the original shims as a "gauging" shim and place it between the bearing cup and the carrier on the ring gear side of the case.
3. Install bearing caps and bearing screws finger tight. Make sure bearing caps are in correct marked position.
4. Mount a dial indicator on the ring gear side of the carrier, with the indicator probe in contact with the back face of the ring gear.
5. Position two screwdrivers between the bearing cup and the carrier on the side opposite the ring gear.
6. Pull on the screwdrivers and force the differential case as far as possible toward the indicator. With force still applied, set the dial indicator to zero.
7. Reposition the screwdrivers on the ring gear side of the case. Force the ring gear into mesh with the drive pinion and observe the dial indicator. Repeat this operation several times until the same reading is obtained.
8. Add the indicator reading to the "gauging" shim thickness to determine the correct shim dimension for installation on the ring gear side of the case.

For example, if the gauging shim was .155 inch, and the indicator reading in step 7 was .017 inch, the correct shim would be $.155 + .017 = .172$ inch.

9. Remove the "gauging" shim and install the correct size shim into position between the bearing cup and the carrier on the ring gear side of the case.
10. To determine the correct dimension for the remaining shim, first refer to the dimension obtained in step 8 of "Gauging Procedures—Side

Bearing Shims". From that figure, subtract the size of the shim installed in step 9 above; then add .006 inch for preload and backlash.

For example, if the reading in step 18 was .329 inch, and the shim just installed on the ring gear side of the case was .172 inch, the correct shim dimension would be $.329 - .172 = .157 + .006 = .163$ inch.

11. Spread the differential carrier as shown in figure 2F.
12. Assemble the shim determined in step 10 into place between the bearing cup and the carrier.
13. Remove the spreader and the dial indicator.
14. Install the bearing caps in marked positions and torque cap screws to specifications.
15. Install dial indicator and check ring gear backlash at four equally spaced points around the ring gear. Backlash must be held to .004" to .009" and must not vary more than .002" between positions checked.
16. Whenever backlash is not within limits, differential bearing shim pack should be corrected to bring backlash within limits.
 - a. Low backlash is corrected by decreasing the shim on the ring gear side and increasing the opposite side shim **an equal amount**
 - b. High backlash is corrected by increasing the shim on the ring gear side and decreasing the opposite side shim **an equal amount**
17. Check gear tooth contact, using yellow lead method, as described in "Gear Tooth Contact Pattern Check".
18. Using a new gasket, install housing cover and torque bolts to specifications.
19. Reinstall the rear universal joint, and torque "U" bolt nuts to specifications.
20. Install axles into carrier and axle flange over hub studs.
21. Torque hub stud nuts to specifications.
22. Fill differential with lubricant.
23. Install wheel and tire assembly.

CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 12 of "Drive Pinion—Assembly and Installation". Side Bearing Preload is set to specifications in step 10 of "Differential Case—Installation and Adjustment". Following service to the Differential Case or to the Drive Pinion and Ring Gear, a Gear Tooth Contact Pattern Check **must** be made, to verify the accuracy of the work

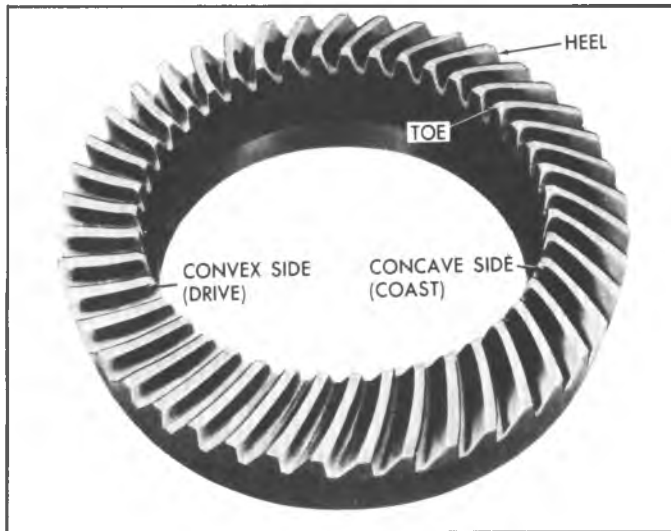


Fig. 12F—Gear Tooth Nomenclature

GEAR TOOTH CONTACT PATTERN CHECK

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 12F.

Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.

in setting the pinion depth and the ring gear-to-pinion backlash.

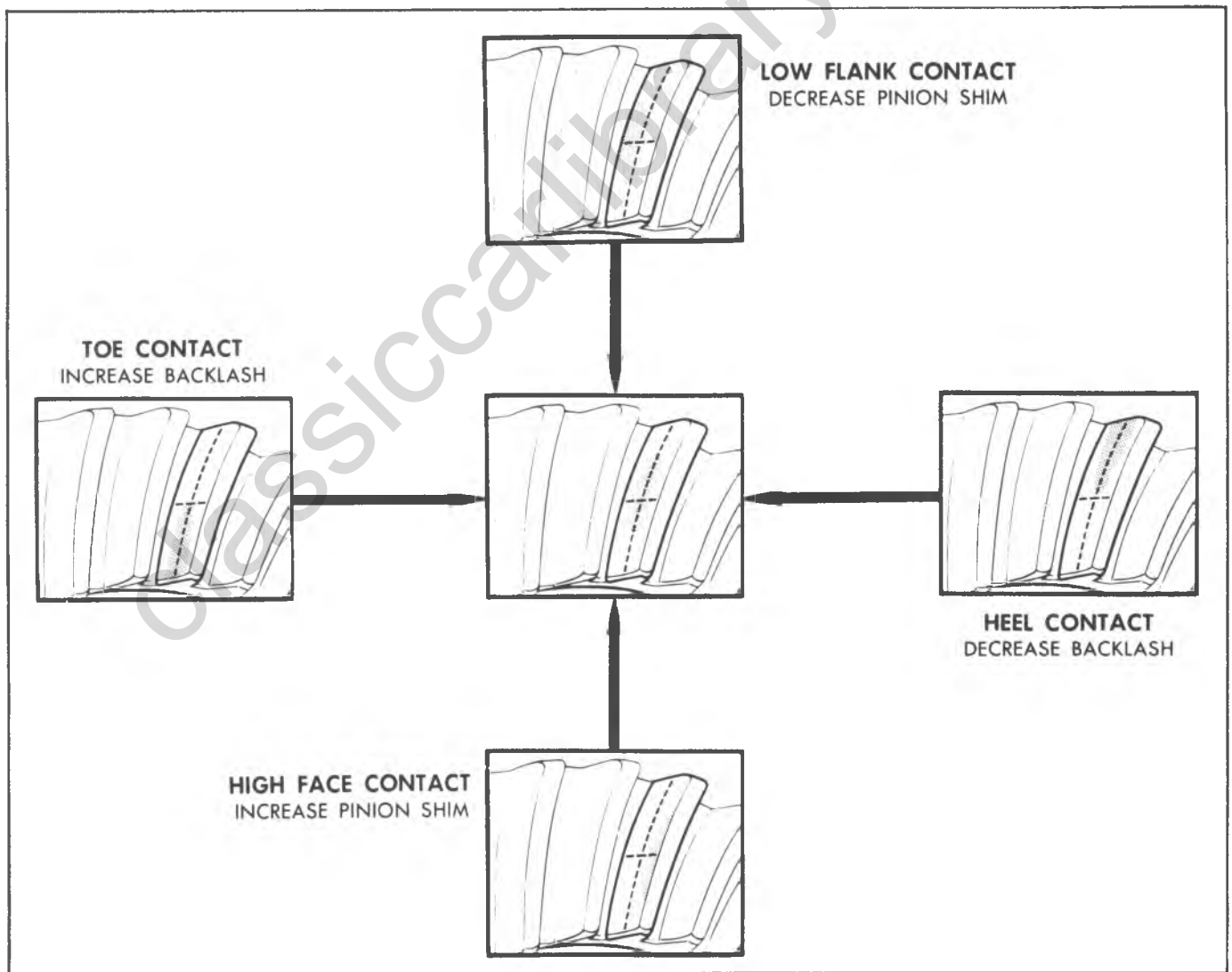


Fig. 13F—Gear Teeth Contact Pattern Check

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2. Use gear marking compound (yellow lead chromate or equivalent) and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten bearing cap bolts to specifications.
4. Apply load to gears by expanding brake shoes or by wrapping a heavy rag around the companion flange to resist rotation.

NOTE: A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with figure 13F. Make adjustments as necessary.
6. The important thing to achieve in the pattern check and subsequent adjustments is to locate the contact pattern centrally on the face of the ring gear teeth.

Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern. These adjustments are backlash and position of drive pinion in carrier. The effects of bearing preloads are not readily apparent on hand loaded teeth pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

NOTE: It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness of the inner shim, located between the rear bearing cup and the carrier housing. Increasing the shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease backlash, decrease right shim and increase left shim an equal amount.

DANA 9-3/4" RING GEAR

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GENERAL DESCRIPTION

This Dana Spicer axle is similar in design to other Salisbury type axles with the following exceptions:

1. The differential side bearing shims are located between the side bearing cone and roller assembly and the differential case. See figure 14F. These bearings are of the tapered roller design and are preloaded. In order to remove the differential case the carrier must be spread.
2. The pinion assembly incorporates an inner and outer bearing shim. The inner shim is used to maintain proper pinion depth. The outer shim is used to maintain proper preload on the pinion bearing.

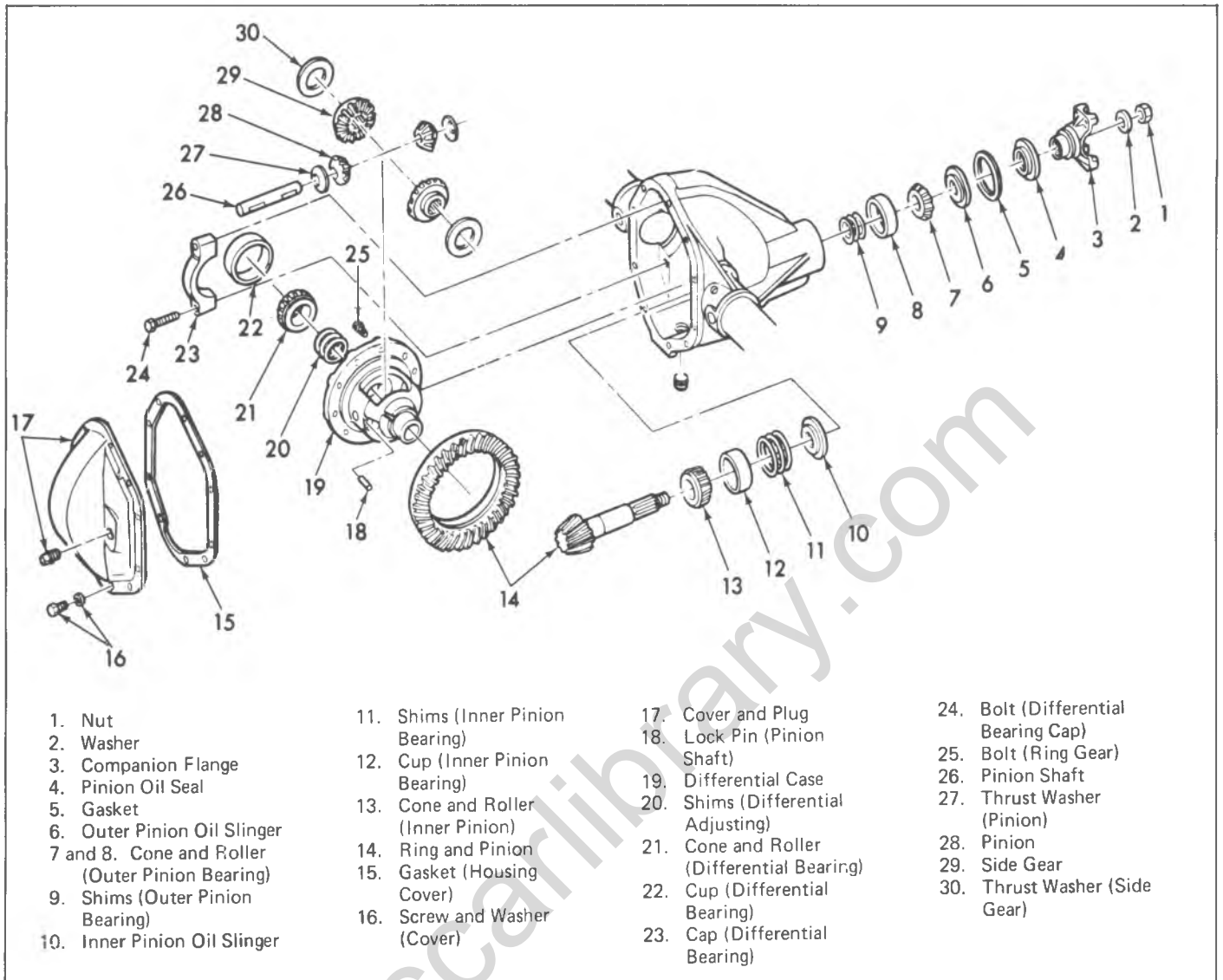


Fig. 14F—Dana Differential With 9-3/4" Ring Gear—Exploded View

DIFFERENTIAL CASE

Removal

1. Place vehicle on hoist with rear axle hanging free.
2. Remove wheel and tire assemblies.
3. The axle shafts are full-floating type with flanged outer end of shaft attached to wheel hub by studs and nuts. Wheel is supported by tapered roller bearings at outer end of axle housing.
 - a. Remove axle shaft to hub attaching nuts.
 - b. Rap on axle shaft to loosen shaft from hub and remove shafts.
4. Remove plug in carrier and drain lubricant.
5. Remove cap screws and lock washers attaching cover to carrier. Remove cover and gasket.
6. Mark one side of carrier and matching cap for reassembly. Remove cap screws attaching bearing caps to carrier.

7. Using spreader Tool J-24385 and dial indicator as shown in figure 15F, spread carrier a maximum of .020".

CAUTION: Do not exceed this dimension as carrier may be permanently damaged.

8. Remove dial indicator and with the use of a pry bar remove differential case from carrier. Remove spreader.

Disassembly

1. Remove differential bearing cups and identify with a tag for reassembly.
2. Place differential in vise and drive out pinion shaft lock pin.
3. Remove differential bearing cone and roller using Puller J-22888, with Plug J-8107-3, as in figure 16F. Tag cone and rollers for assembly.

NOTE: If ring gear and pinion are to be reassembled, note position of shims and replace accordingly.

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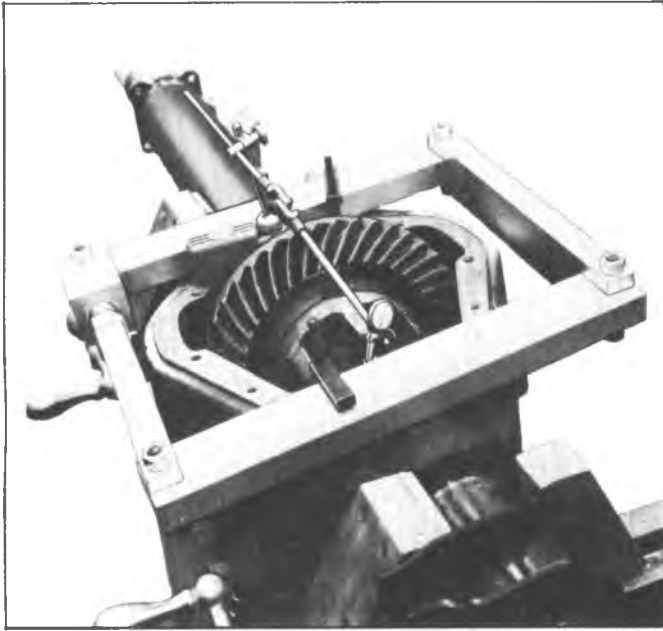


Fig. 15F—Tool J-24385 Mounted on Carrier

4. Remove spacer, pinion shaft, pinions, side gears and thrust washers from differential case.
5. Remove screws attaching ring gear to differential case. Remove gear.

DRIVE PINION

Removal

1. Separate rear universal joint, tape trunnion bearings to joint, position propeller shaft to one side and tie propeller shaft to frame side rail.
2. Using Holding Bar J-8614-11, attached to pinion shaft flange, remove self-locking nut and washer from pinion shaft.

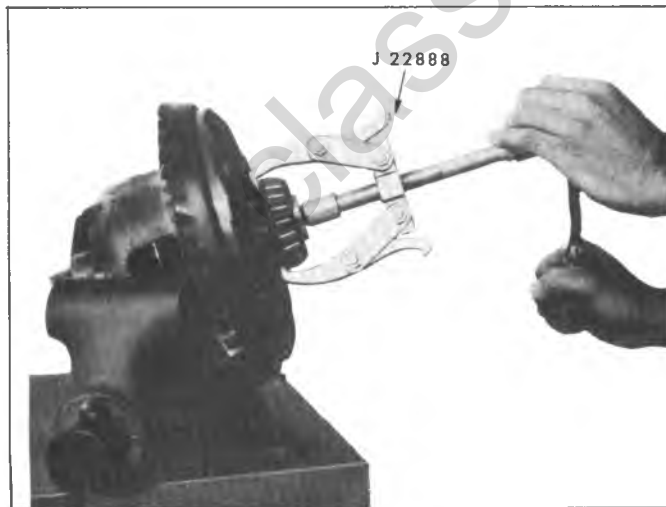


Fig. 16F—Removing Differential Side Bearings

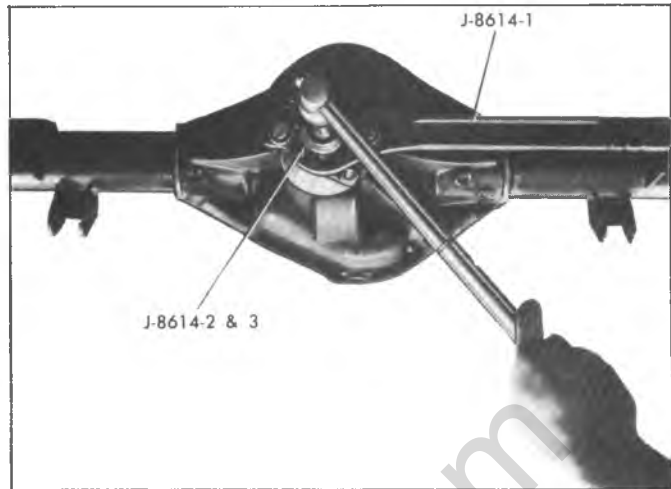


Fig. 17F—Removing Pinion Flange

3. Install Tool J-8614-2, and 3 into holding bar as shown in figure 17F and remove flange from drive pinion. Remove drive pinion from carrier.
4. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.
5. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.
6. Remove inner pinion cone and roller using Tool J-22912, installed as shown in figure 18F, and press pinion from bearing.

Inspection

1. Clean all gears and bearings in cleaning solvent and inspect all bearing cups, races and rollers for

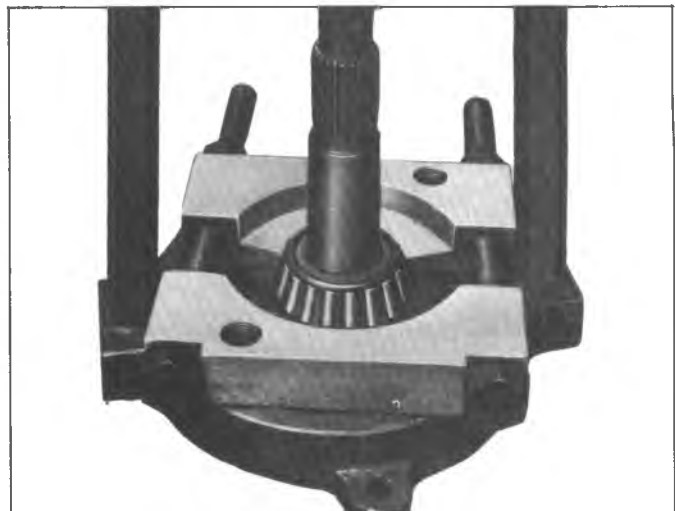


Fig. 18F—Removing Inner Pinion Bearing Cone and Roller

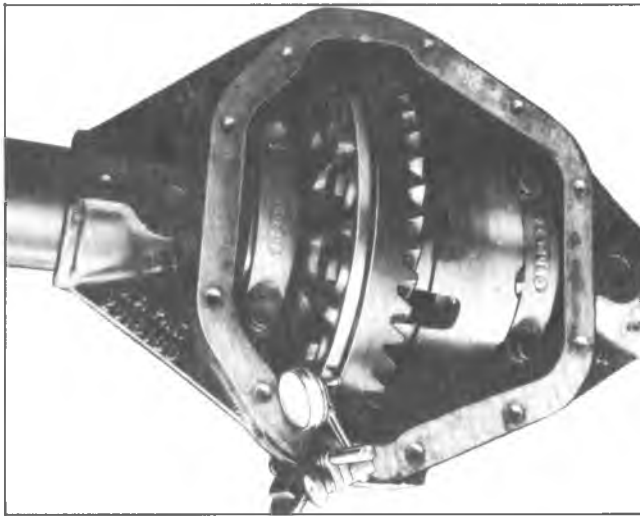


Fig. 19F—Checking Runout

scoring, chipping or evidence of excessive wear. On pinion bearing rollers, inspect large end of rollers for wear. This is where wear is most evident on tapered roller bearings.

NOTE: The pinion bearings are of the tapered type, and the natural wear pattern is a frosted condition with occasional slight scratches on races or rollers. This does not indicate a defective bearing.

2. Inspect pinion splines and flange splines for evidence of excessive wear.
3. Inspect ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case for cracks or scores. Inspect side gears, thrust washers, and pinion thrust faces.
5. Check fit of differential side gears in case.
6. Check fit of side gears and axle shaft splines.
7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.

DIFFERENTIAL CASE

Reassembly

1. Position differential side gears and new thrust washers in differential case.
2. Position differential pinions and new thrust washers in differential case. Align pinions with holes in differential case.
3. Install pinion shaft in differential case. Align hole in shaft with hole in case, then install lock pin. Peen hole to prevent pin dropping out of case.
4. Position ring gear to case, then install cap screws. Tighten cap screws evenly and alternately to specifications.
5. With an arbor press, press differential side bearings onto case using Tool J-21051. Do not install shims at this time.

6. Place differential case in carrier and install bearing caps. Care should be taken to install caps in original position. Use mark placed on caps and carrier at removal. Tighten caps just enough to keep bearing caps in place.
7. Install dial indicator on carrier with indicator button contacting back of ring gear, as in figure 19F. Rotate differential case and check for runout. If runout is greater than .002", the assembly should be removed and the ring gear removed from the case. Again install differential case and check runout at differential case flange.
8. Should runout of case flange be greater than .002", the defect is probably due to bearings or differential case, and should be corrected before proceeding further.
9. Position two screwdrivers between bearing cup and carrier on opposite side of ring gear (away from dial indicator side). Pull on screwdrivers and force differential case as far as possible toward the dial indicator. Rock the ring gear to set the bearings. With force still applied, set indicator at "O".
10. Reposition screwdrivers between bearing cup and carrier on ring gear side. Pull on screwdrivers and force differential case as far as possible toward center of carrier. Record the indicator reading. This will be the total amount of shims needed (less preload) for setting backlash later during assembly.
11. Remove differential from carrier.

DRIVE PINION

Installation and Adjustment of Depth and Preload

Ring gears and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring before proceeding with assembly.

On the button end of each pinion there is etched a plus (+) number, a minus (−) number, or a zero (0) number, which indicates the best running position for each particular gear set. This dimension is controlled by the shimming behind the inner bearing cup. Whenever baffles or oil slingers are used, they become a part of the adjusting shim pack.

For example: If a pinion is etched +3, this pinion would require .003" less shims than a pinion etched "O". This means by removing shims, the mounting distance of the pinion is increased by .003" which is just what a +3 etching indicates. Or if a pinion is etched −3 we would want to add .003" more shims than would be required if the pinions were etched "O". By adding .003" shims, the mounting distance of the pinion was decreased .003" which is just what a −3 etching indicated. See figure 20F.

If the old ring and pinion set is to be reused, measure the old shim pack and build a new shim pack to this

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Old Pinion Marking	New Pinion Marking								
	- 4	- 3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4
+ 4	+ 0.008	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0
+ 3	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001
+ 2	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002
+ 1	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003
0	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004
- 1	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005
- 2	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006
- 3	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007
- 4	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007	- 0.008

Fig. 21F—Dana Pinion Code Chart

same dimension. If baffle is in the axle assembly, it is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005" and .010".

NOTE: If baffle or slinger is bent or mutilated, it should be replaced.

Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the plus or minus etching on both the old and new pinion, and adjust the thickness of the old shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads (+2) and the new pinion is (-2), add .004" shims to the original shim pack.

1. Determine proper inner shim pack (for setting pinion depth) by using chart in figure 21F.
2. Install inner shim pack and oil slinger in inner cup bore and drive inner cup into position using Tool J-21059 used with J-8092.
3. To the outer shim pack (for setting preload) add or remove an equal amount as was added or removed from the inner shim pack.
4. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092 as shown in figure 22F.
5. Press inner pinion bearing cone and roller onto pinion shaft using Installer J-9772 on arbor press as shown in figure 23F.
6. Install drive pinion and inner bearing cone and roller assembly in differential carrier.
7. Install shims and outer pinion cone and roller on



Fig. 20F—Marking From Nominal on Pinion

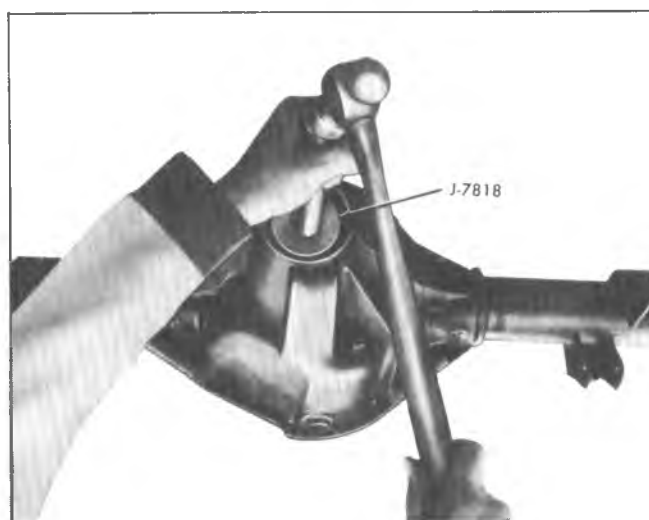


Fig. 22F—Installing Outer Pinion Bearing Cup

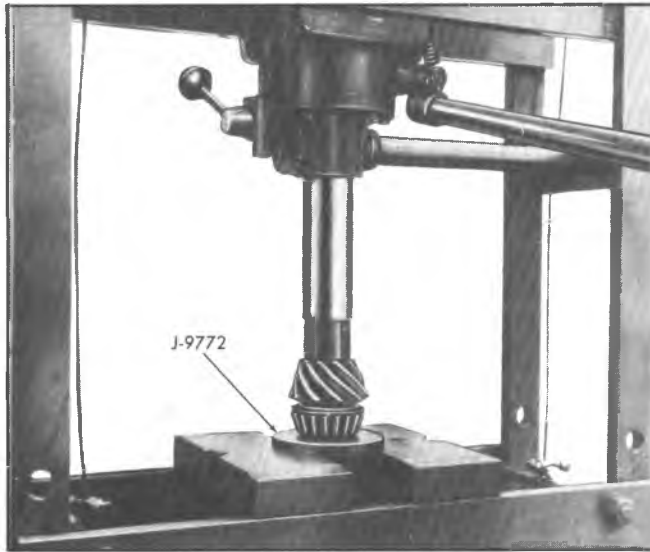


Fig. 23F—Installing Inner Pinion Cone and Roller

pinion shaft using Tool J-5590 and companion flange to press bearing onto pinion, as in figure 24F.

8. Install flange holding bar and install washer and nut on pinion shaft. Torque nut to 255 ft. lbs.
 9. Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.
- NOTE: Torque reading to start shaft turning must be disregarded.
10. If torque requirements (preload) are not to specifications, adjust shim pack as necessary. Increase the outer shim pack to reduce rotation torque. Decrease shim pack to increase rotating torque.
 11. Remove nut, washer and flange from pinion shaft.
 12. Install oil slinger, gasket and using Tool J-22804 install oil seal.



Fig. 24F—Installing Pinion Flange

13. Install flange, washer and nut. Torque nut to specifications.

DIFFERENTIAL CASE

Preload and Adjustment

1. Place differential assembly (with pinion assembled) into housing. Install bearing caps in their proper position and tighten screws just enough to hold the bearing cups in place.
2. Install dial indicator on carrier with indicator button contacting back of ring gear, as in figure 19F.
3. Place two screwdrivers between bearing cup and housing on ring gear side of case, and pry ring gear into mesh with pinion gear as far as it will go. Rock ring gear to allow bearings to seat and gears to mesh. With force still applied, set indicator to "O".
4. Reposition screw drivers on opposite side of ring gear and pry ring gear as far as it will go. Now take an indicator reading. Repeat until the same reading is obtained every time. This reading will be the necessary amount of shims between the differential case and differential bearing on the ring gear side. Remove differential bearing from the ring gear side and assemble proper amount of shims. Reassemble bearing.
5. Remove the differential bearing from the opposite side of ring gear. To determine the amount of shims needed here, use the following method.
 - a. Subtract the size of shim pack just installed on ring gear side of case from the reading obtained and recorded in step 10 of Differential Case—Reassembly.
 - b. To this figure, add an additional .015" shims to compensate for preload and backlash.

Example: If reading in step 10 of Differential Case—Reassembly was .085", and the shims installed on ring gear side of case was .055", the correct amount of shim will be $.085" - .055" + .015" = .045"$.
6. Install shims as indicated in step 5, (which will give the proper bearing preload and backlash) and install side bearing.

Installation

1. Spread differential carrier, using spreader as shown in figure 15F.
2. Install differential bearing outer races in their correct location, then install differential case into carrier.
3. Install differential bearing caps in the correct location as indicated by marks made at disassembly. Install cap screws finger tight. Rotate differential assembly and rap on case with a soft faced hammer to ensure proper seating of case in carrier.
4. Remove spreader and torque cap bolts to specifications.

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5. Install dial indicator and check ring gear backlash at four equally spaced points around the ring gear. Backlash must be held to .004" to .009" and must not vary more than .002" between positions checked.
6. Whenever backlash is not within limits, differential bearing shim pack should be corrected to bring backlash within limits.
7. Check gear tooth contact, using yellow lead method, as described earlier in "Dana 10-1/2" Ring Gear" section, under "Gear Tooth Contact Pattern Check". Refer to figure 25F.
8. Using a new gasket, install housing cover and torque bolts to specifications.
9. Reinstall the rear universal joint, and torque "U" bolt nuts to specifications.
10. Install axles into carrier and axle flange over hub studs. Torque hub stud nuts to specifications.
11. Fill differential with lubricant.
12. Install wheel and tire assembly.

CAUTION: See Caution on page 1 of this section regarding the fasteners referred to in the above steps.

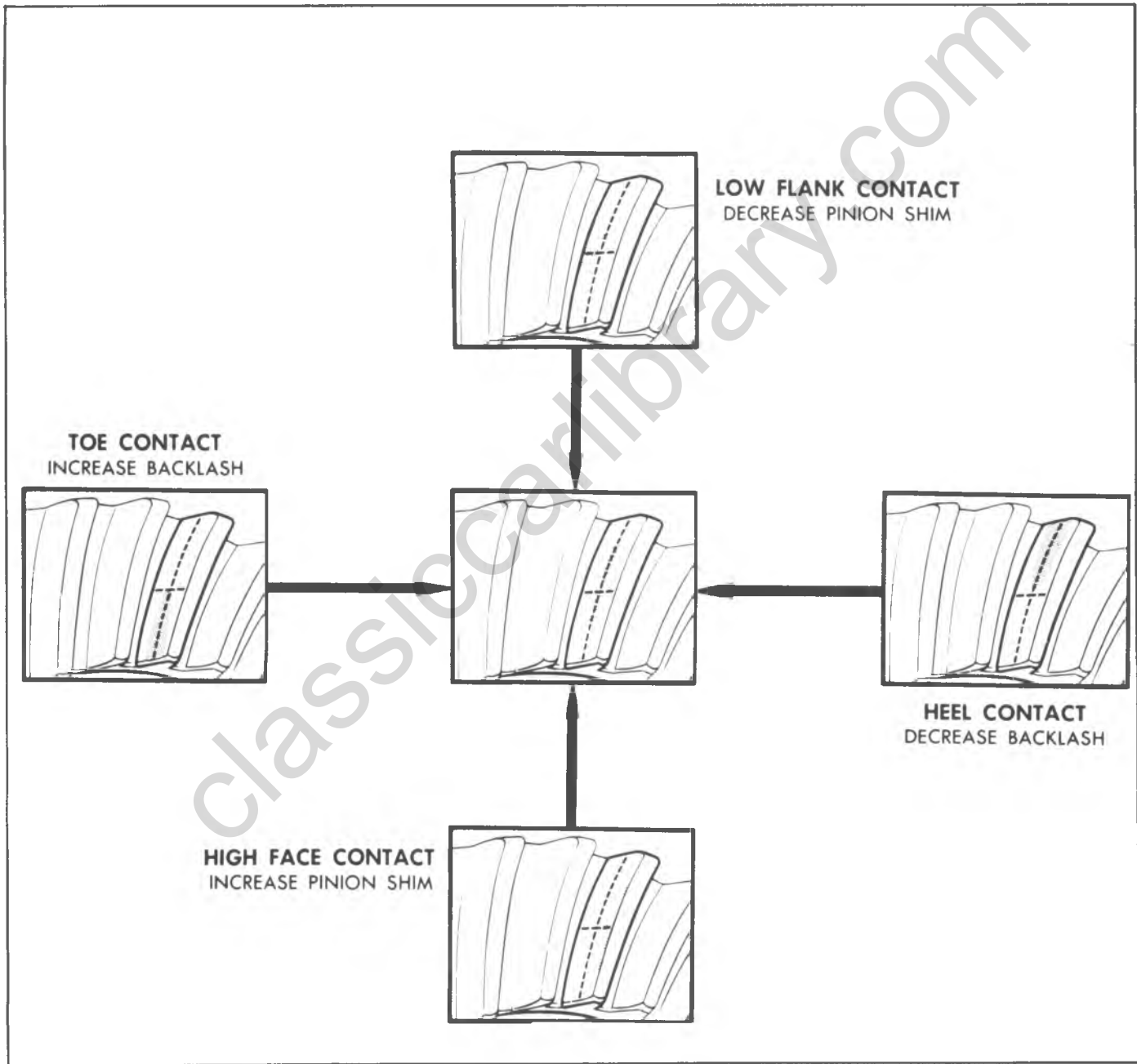


Fig. 25F—Gear Teeth Contact Pattern Check

CHEVROLET TRUCK DIFFERENTIAL

12-1/4" RING GEAR

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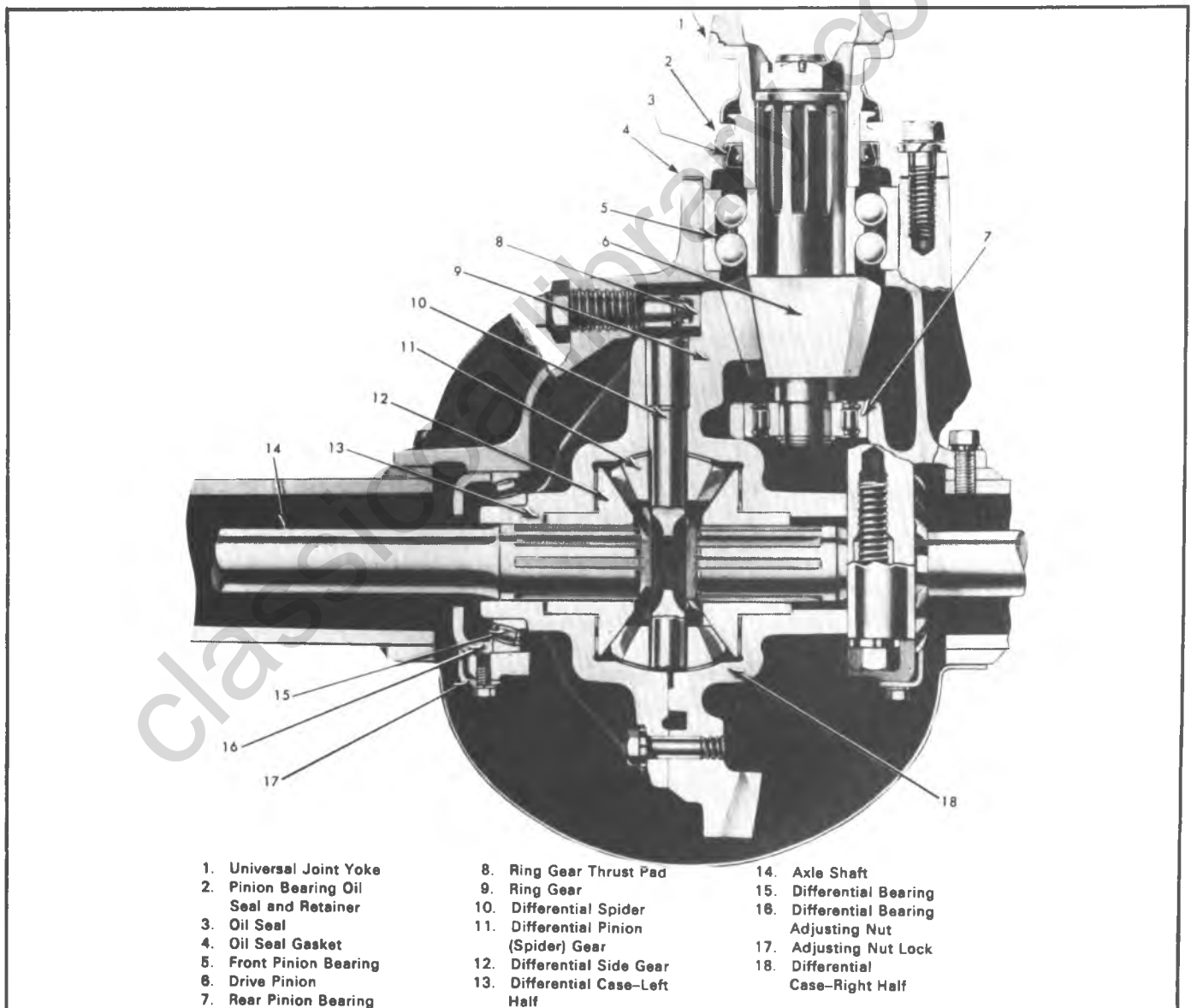


Fig. 1G—Cross Section of Truck Differential with 12 1/4" Ring Gear

CASE AND DRIVE PINION

Removal

1. Drain lubricant from differential, remove axle shaft as outlined in Truck Service Manual. See "Axle Shaft Removal".
2. Remove two trunnion bearing "U" bolts from the rear yoke and split the rear universal joint.
NOTE: The bearings can be left on the trunnion and held in place with tape.
3. Swing propeller shaft to one side and tie to the frame side rail.
4. Remove bolts and lock washers which retain the carrier assembly to the axle housing. Support the differential housing with a floor jack and roll it from under truck.

Disassembly

1. Mount carrier assembly in a bench vise or holding fixture.
2. Loosen ring gear thrust pad locknut and remove thrust pad.
3. Remove differential adjusting nut locks and bearing cap bolts and lock washers.
4. Mark bearing caps and carrier for reassembly in same position. Remove bearing caps and adjusting nuts by tapping on bosses of caps with a soft faced hammer until caps are free from dowels.

CAUTION: Do not attempt to pry cap off as this may damage machined face of cap.

5. Remove differential and ring gear assembly from the carrier.

CAUTION: Exercise care that differential bearing outer races are not dropped while removing assembly from carrier.

6. Remove the bolts which attach the pinion bearing retainer to the carrier.
7. Remove the pinion and bearing assembly from the carrier.

NOTE: It may be necessary to drive this unit from carrier. Use brass drift against pilot end of pinion.

Repairs

Pinion Disassembly

1. Clamp pinion drive flange in bench vise.
2. Remove cotter pin, nut and washer from end of pinion.
3. Remove drive flange and bearing retainer assembly from pinion.
4. Drive oil seal from retainer. Discard seal as new parts should be used at assembly.
5. Remove pinion rear bearing snap ring and press

bearing from pinion, using Tool J-1453, as shown in figure 2G.

6. Position drive pinion in an arbor press so that the bearing is supported by two pieces of flat steel stock as shown in Figure 3G. Place flat stock parallel to each other and against pinion so as to pick up a large area of bearing outer race. Press pinion from bearing making sure pinion is supported to prevent damage when removed from bearing.

Pinion Inspection

1. Wash all parts in cleaning solvent.
2. Inspect pinion for scored, cracked, chipped or worn teeth.
3. Inspect splines on pinion shaft for excessive wear.
4. Inspect pinion bearing assemblies for roughness, defects or excessive wear.

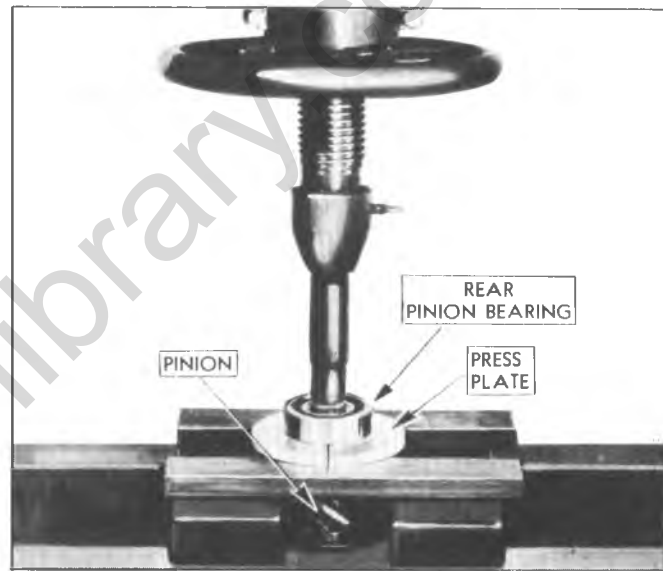


Fig. 2G—Pinion Rear Bearing Removal

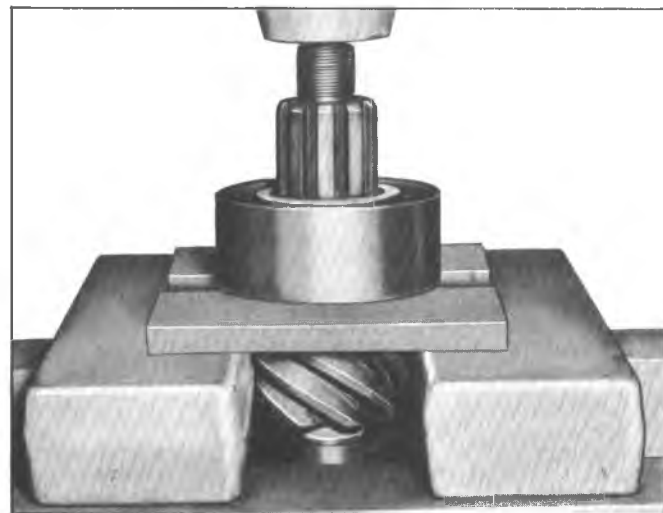


Fig. 3G—Drive Pinion Front Bearing Removal

Pinion Reassembly

1. Pack the cavity between the pinion oil seal lips with a lithium-base EP lubricant to provide initial lubrication and to aid in inserting pinion flange.
2. Press the oil seal into the retainer. Position seal lips toward the pinion bearing, using Tool J-22281 as shown in Figure 4G.
3. Install the pinion rear bearing assembly on pinion shaft making sure that chamfered side of inner race seats against shoulder on pinion shaft. Then install pinion bearing lock ring using Tool J-1364 as shown in Figure 5G.
4. To install pinion front bearing, position the one-piece double row ball bearing on pinion shaft, so that extended portion of inner race is toward pinion head. Then, using a suitable length of 2 inch pipe, press bearing onto shaft until it seats against the pinion head.

CAUTION: When pressing bearing on pinion,

exercise care to prevent damage to ground surface of pilot.

5. Slide oil seal retainer on pinion shaft, then tap drive flange onto pinion splines.
6. Clamp drive flange in a bench vise and install flange washer and nut. Torque nut to specifications and install cotter pin without backing off on nut.

Differential Disassembly

1. Check differential case to make sure that the two halves are marked so they may be reassembled in same relation. See Figure 6G.
2. Remove bolts holding case and cover together.
NOTE: Ring gear is mounted on the case.
3. Separate cover from case and remove differential side gears and thrust washers, pinion gears with thrust washers and differential spider.

Differential Inspection

1. Wash all parts thoroughly in cleaning solvent.
2. Inspect ring gear for chipped, scored or worn teeth.
3. Check radial clearance between differential side gears and differential case, also fit of differential pinions on spider.
4. Inspect spider arms for wear and distortion.
5. Inspect splines and teeth of differential side gears and pinions for chipping or excessive wear.
6. Check thrust washers for wear and replace if even slight wear is indicated.
7. Check differential side bearings and cups for broken races, discoloration or roughness.
8. Inspect differential case for cracks or distortion.

Ring Gear Replacement

1. Remove ring gear from case by tapping the back of the gear with a soft faced hammer.



Fig. 4G—Pinion Oil Seal Installation

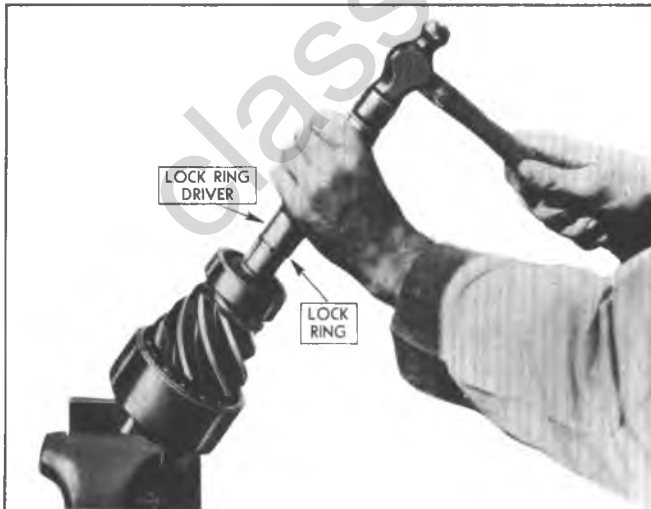


Fig. 5G—Pinion Rear Bearing Lock Ring Installation

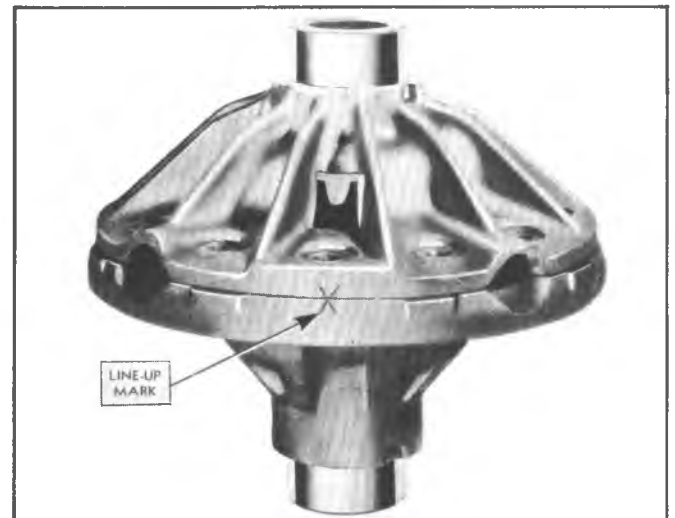


Fig. 6G—Differential Case Line-Up Marks

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2. Inspect ring gear pilot case flange and back of ring gear for dirt or burrs.
3. Install two guide pins (made from cap screws with heads cut off and ends slotted) to new gear diametrically opposite each other.
4. Start guide pins through case flange and tap ring gear on case.

Differential Bearing Replacement

1. Install Tool J-8107 making sure puller legs are fitted securely in notches in case and tighten retaining yoke as shown in Figure 7G.
2. Tighten puller screw to remove bearing.
3. Place new bearing on hub with thick side of inner race toward case and install bearing using J-1488 as shown in Figure 8G.

NOTE: The side bearing tool is counterbored

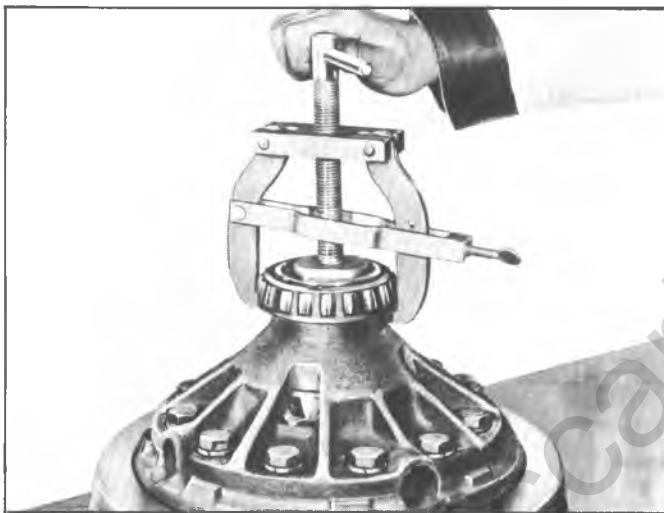


Fig. 7G—Differential Bearing Removal

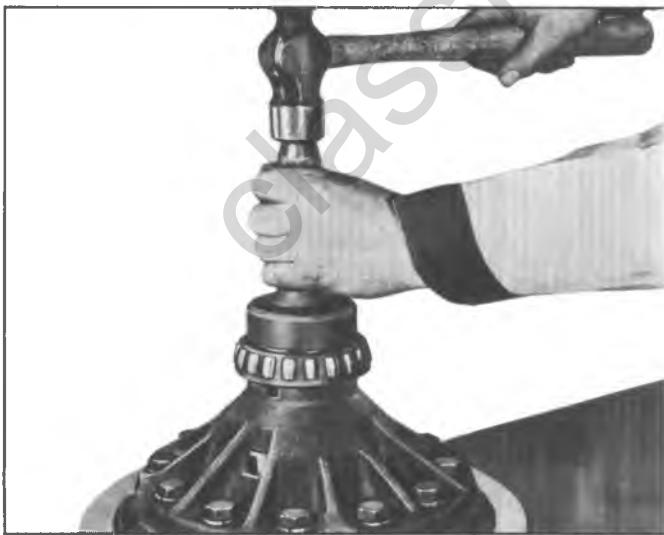


Fig. 8G—Differential Bearing Installation

and has pilot to assure proper installation and seating of bearing.

Differential Reassembly

1. Lubricate differential side gears, pinions and thrust washers.
2. Place differential pinions and thrust washers on spider.
3. Assemble side gears and pinions and thrust washers to left half of differential case.
4. Assemble right half of case to left half being sure to line up marks on the two halves.
5. Install differential-to-ring gear bolts and lock washers and tighten evenly until ring gear is flush with case flange.
6. Remove two guide pins and install remaining two bolts. Torque all bolts alternately and evenly to specifications.

Reassembly

1. Place new pinion bearing retainer gasket on the retainer and install pinion assembly in carrier.

NOTE: The pinion assembly should be pressed into the carrier to prevent the possibility of damaging the shims.

2. Install pinion bearing retainer bolts and lock washers and torque bolts to specifications.
3. Lubricate differential bearing rollers with engine oil and place outer races over them.
4. Install differential assembly in carrier and install adjusting nuts.

CAUTION: Carefully slide adjusting nuts alongside the bearings so that threads on nuts fit into threads in carrier.

5. Install differential bearing caps making sure the marks on the caps line up with the marks on the carrier.
6. Install bearing cap bolts and lock washers and tighten until lock washers just flatten out.

Backlash and Preload Adjustment

1. With differential bearing cap bolts loosened just enough to permit turning the bearing adjustment nuts with Tool J-0972, remove all lash between ring gear and pinion. See Figure 9G.
2. Back off left hand adjusting nut one to two notches to a locking position.
3. Tighten right hand adjusting nut firmly to force differential in solid contact with left hand adjusting nut.
4. Back off right hand adjusting nut until free of bearing; then retighten snugly against bearing.
5. Tighten right hand nut from one to two additional notches to a locking position.

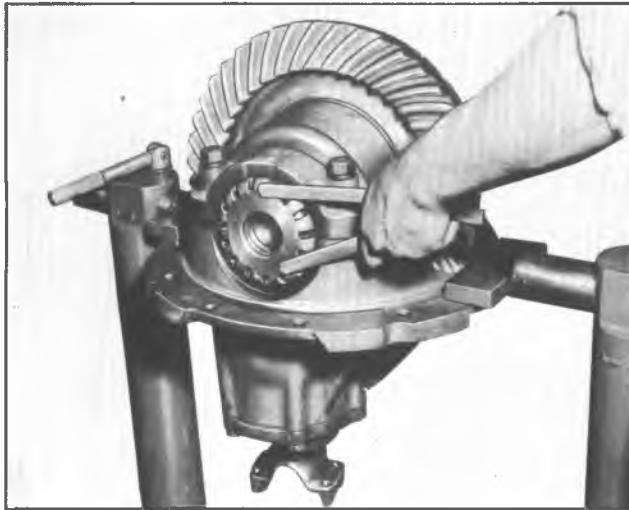


Fig. 9G—Backlash and Preload Adjustment

NOTE: This method of adjustment provides for proper preload of bearings.

6. Mount a dial indicator on the carrier and check the backlash between ring gear and pinion as shown in Figure 10G. Backlash should be from .003" to .012" (.005" to .008" preferred).

NOTE: If backlash is more than .012 inch, loosen the right hand adjusting nut one notch and tighten left hand adjusting nut one notch. If backlash is less than .003 in. loosen the left hand adjusting nut one notch and tighten right hand nut one notch.

7. Tighten bearing cap bolts to specifications.
8. Install side bearing adjusting nut locks and torque to specifications.



Fig. 10G—Checking Backlash

Ring Gear Thrust Pad Adjustment

1. Inspect bronze tip of thrust pad and if worn install a new one.
2. Install thrust pad and tighten screw until bronze tip engages back face of ring gear while rotating gear.
3. Back off screw one-twelfth (1/12) turn and tighten locknut to specifications. See Figure 11G.

NOTE: Make sure screw does not turn during locking process. This adjustment provides .005 in. to .007 in. clearance between thrust pad and ring gear face.

Installation

1. Clean out axle housing and cover and place new gasket over axle housing.
2. Assemble differential carrier to axle housing, install lockwashers and bolts and tighten securely.
3. Replace axle housing inspection cover, if removed, using new gasket.
4. Assemble rear universal joint.

CAUTION: This propeller shaft to pinion flange 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.

5. Install axle shafts as outlined in applicable axle installation procedure in Service Manual.
6. Fill axle with lubricant to a level even with bottom of filler hole. See Section 0 in the Truck Service Manual for proper lubricant.

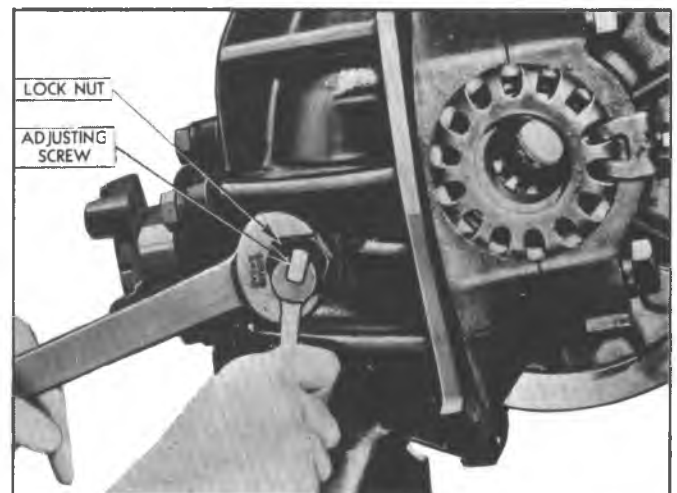
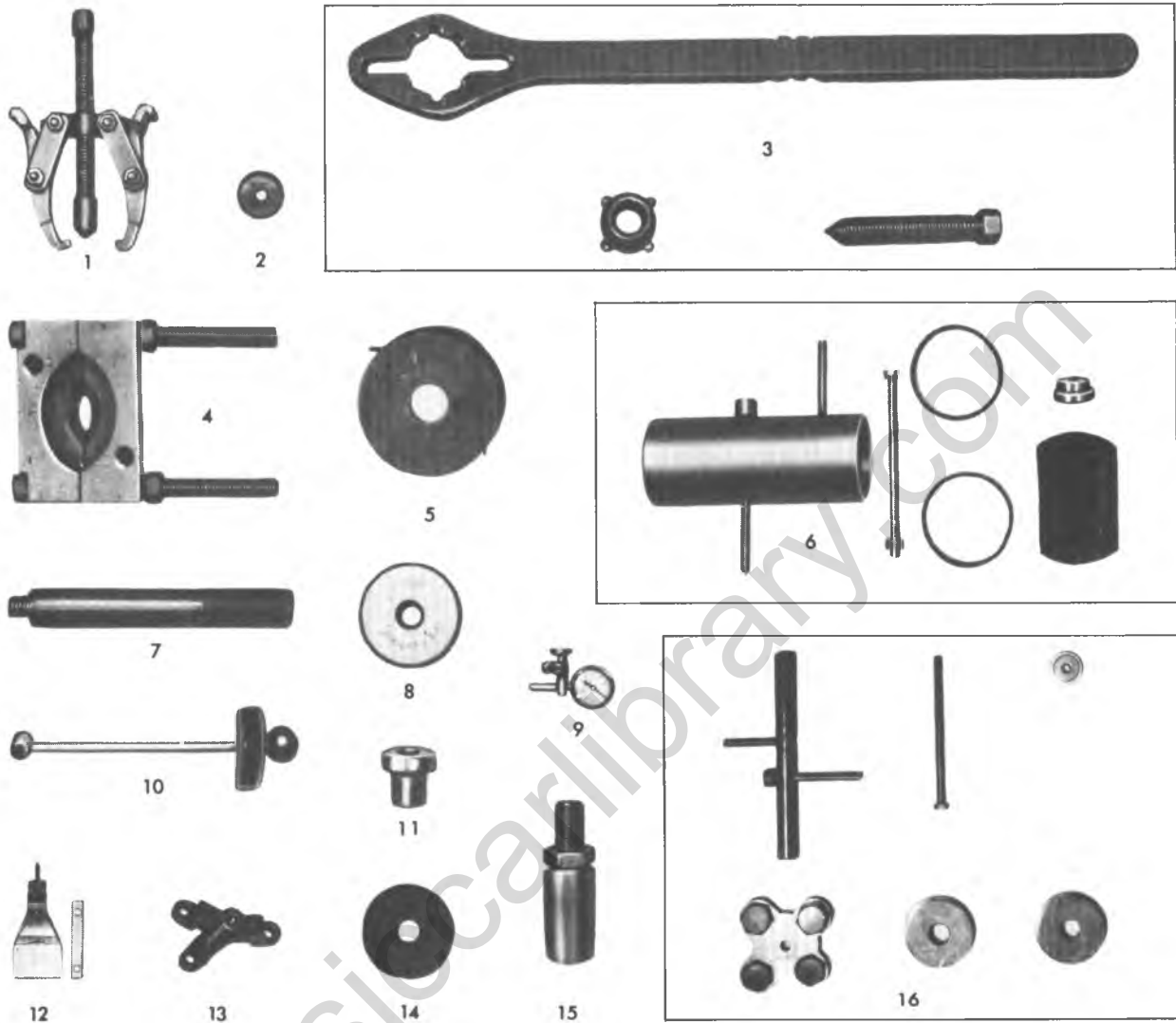


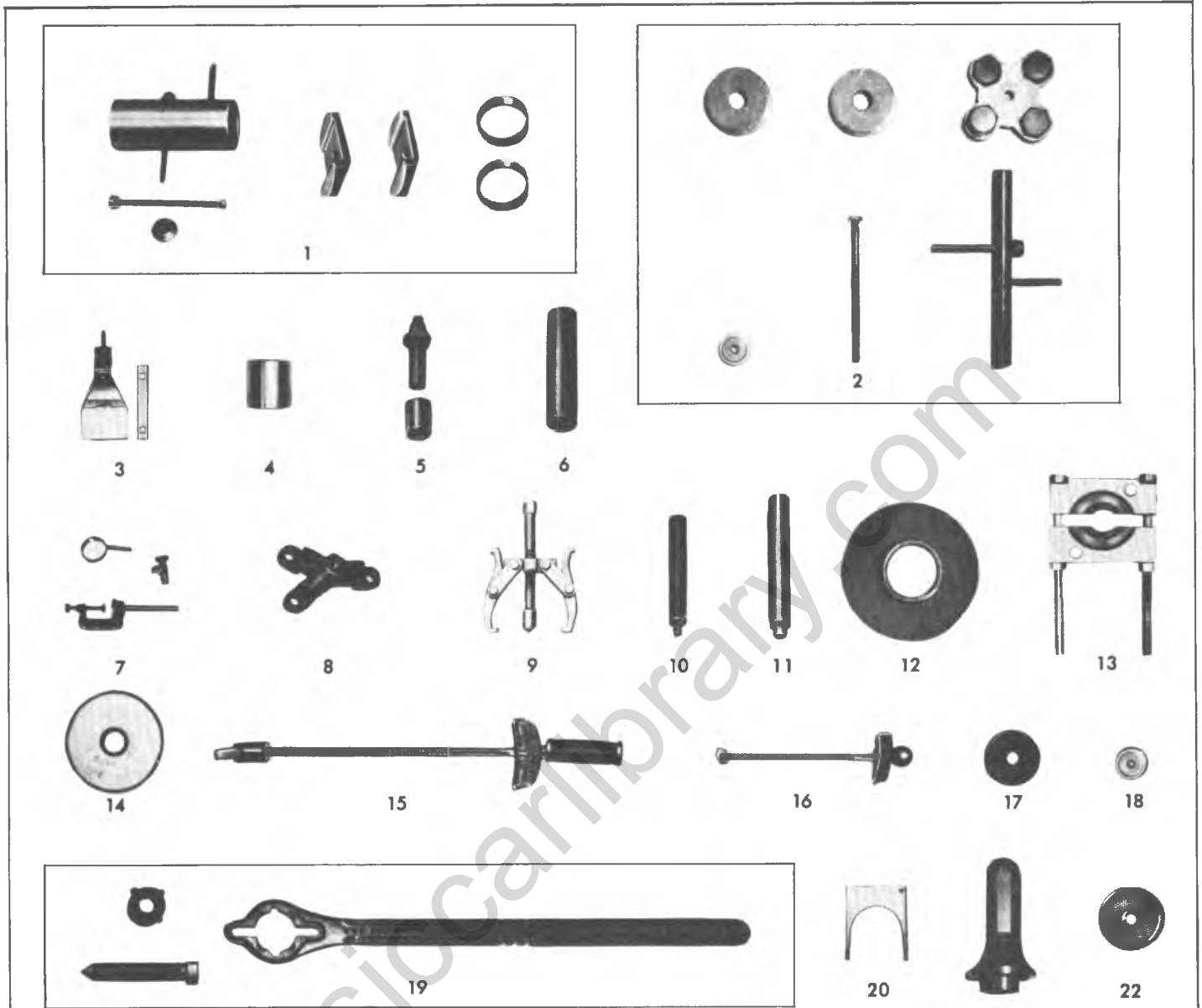
Fig. 11G—Ring Gear Thrust Pad Adjustment

SPECIAL TOOLS



- | | | | |
|-------------|---|-------------|---|
| 1. J-22888 | Differential Side Bearing Remover | 9. J-8001 | Dial Indicator |
| 2. J-8107-2 | Adapter Plug | 10. J-5853 | In. Lbs. Torque Wrench |
| 3. J-8614 | Companion Flange Remover | 11. J-22761 | Differential Side Bearing Installer |
| | J-8614-11 Holder | 12. J-22779 | Side Bearing Shim Gauge |
| | J-8614-2 Screw | | J-22779 Strap |
| | J-86141 Nut | 13. J-5748 | Positraction Torque Measuring Adapter |
| 4. J-22912 | Press Plate | 14. J-8608 | Drive Pinion Rear Bearing Cup Installer |
| 5. J-8609 | Pinion Rear Bearing Installer | 15. J-9458 | Companion Flange Installer |
| 6. J-6266 | Pinion Depth Gauge | 16. J-21777 | Pinion Setting Gauge |
| | J-6266-31 Ring Adapters | | J-21777-45 Side Discs |
| | J-6266-54 Gauge Plate | | J-21777-1 Arbor |
| | J-6266-25 Front Pinion Bearing Plug | | J-21777-29 Gauge Plate |
| 7. J-8092 | Drive Handle | | J-21777-42 Front Bearing Plug |
| 8. J-7137 | Drive Pinion Front Bearing Cup Installer
(Used with J-8092 Drive Handle) | | J-21777-43 Stud |

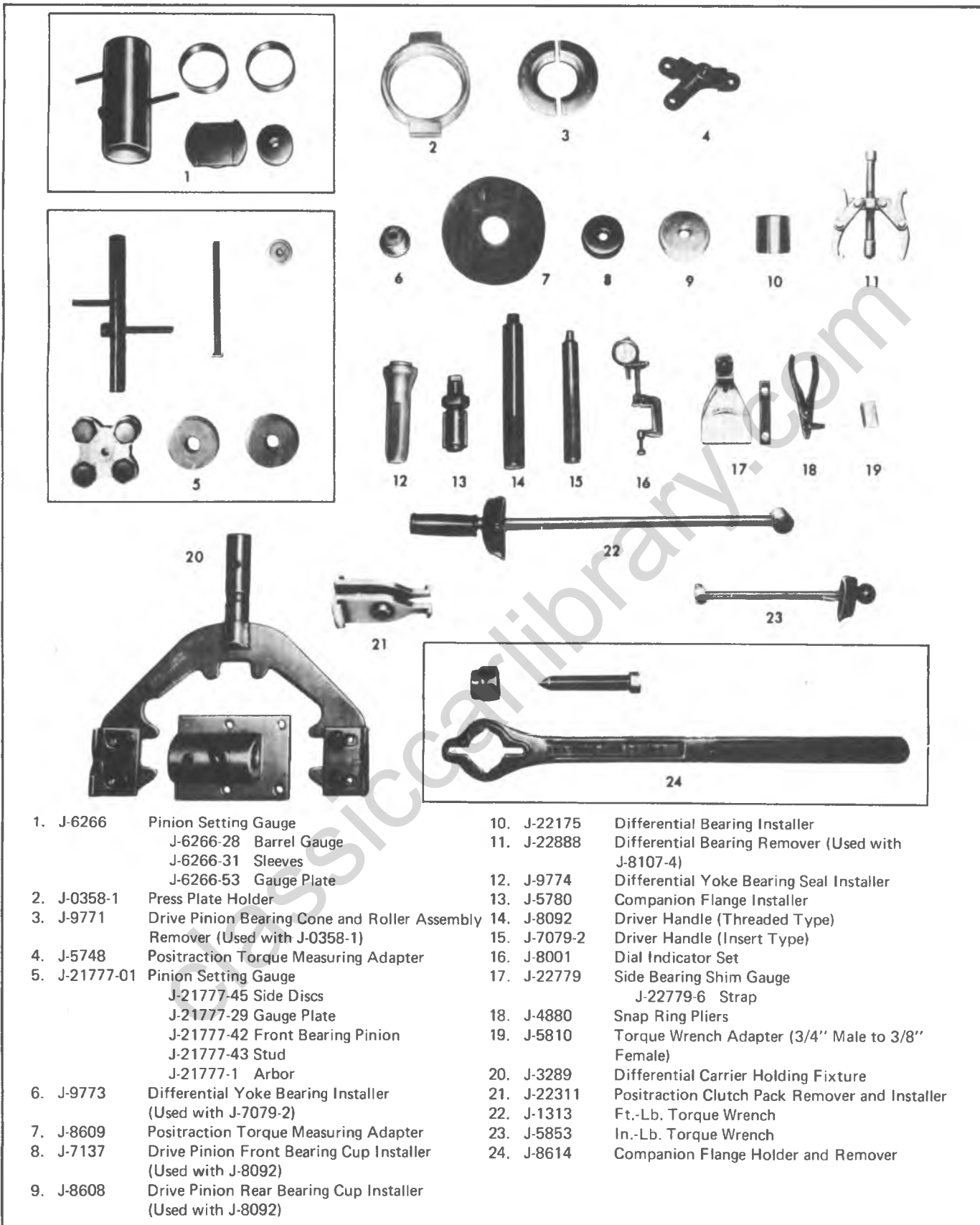
Fig. 1T—Special Tools—8 1/2" Ring Gear Differentials



- | | |
|--|--|
| <p>1. J-6266 Pinion Setting Gauge
 J-6266-28 Barrel Adapter
 J-6266-25 Plug
 J-6266-52 Gauge Plate
 J-6266-53 Gauge Plate
 J-6266-31 Adapter Rings</p> <p>2. J-21777-01 Pinion Setting Gauge
 J-21777-1 Arbor
 J-21777-45 Side Discs
 J-21777-29 Gauge Plate
 J-21777-42 Front Bearing Plug
 J-21777-43 Stud</p> <p>3. J-22779 Side Bearing Shim Gauge
 J-22779 Strap</p> <p>4. J-22175 Side Bearing Installer</p> <p>5. J-9458 Companion Flange Installer - Passenger Car</p> <p>6. J-5590 Pinion Rear Bearing Cup Installer - Truck Axle</p> <p>7. J-8001 Dial Indicator Set</p> | <p>8. J-5748 Positraction Torque Measuring Adapter</p> <p>9. J-22888 Differential Bearing Remover</p> <p>10. J-7079-2 Driver Handle (Insert Type)</p> <p>11. J-8092 Driver Handle (Threaded Type)</p> <p>12. J-6547 Pinion Rear Bearing Installer - Passenger Car</p> <p>13. J-22912 Press Plate</p> <p>14. J-9745 Pinion Rear Bearing Cup Installer</p> <p>15. J-1313 0-150 Ft. Lbs. Torque Wrench</p> <p>16. J-5853 In. Lbs. Torque Wrench</p> <p>17. J-7137 Pinion Front Bearing Cup Installer (Used with J-8092)</p> <p>18. J-8107-4 Differential Bearing Remover - Installer (Used with J-9537 and J-22779)</p> <p>19. J-8614 Companion Flange Holder</p> <p>20. J-22804-1 Pinion Seal Gauge Plate - Truck Only</p> <p>21. J-23911 Pinion Oil Seal Installer - Truck</p> <p>22. J-0270-14 Pinion Rear Bearing Cup Installer Truck Axle (Used with J-8092)</p> |
|--|--|

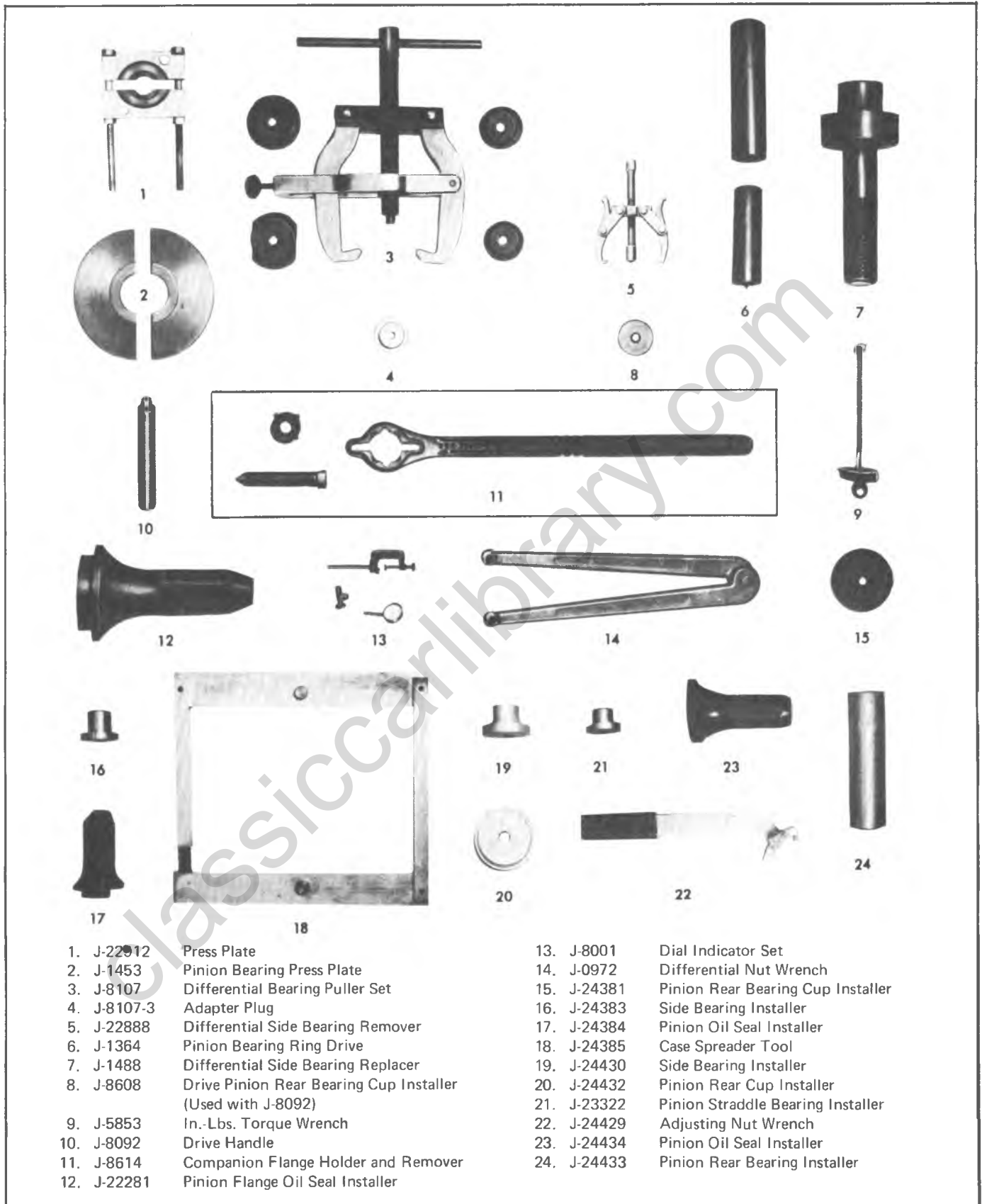
Fig. 2T—Special Tools—8 7/8" Ring Gear Differentials

4-76 REAR AXLE DIFFERENTIAL CARRIER



- | | | | |
|---------------|--|--------------|---|
| 1. J-6266 | Pinion Setting Gauge
J-6266-28 Barrel Gauge
J-6266-31 Sleeves
J-6266-53 Gauge Plate | 10. J-22175 | Differential Bearing Installer |
| 2. J-0358-1 | Press Plate Holder | 11. J-22888 | Differential Bearing Remover (Used with J-8107-4) |
| 3. J-9771 | Drive Pinion Bearing Cone and Roller Assembly Remover (Used with J-0358-1) | 12. J-9774 | Differential Yoke Bearing Seal Installer |
| 4. J-5748 | Positraction Torque Measuring Adapter | 13. J-5780 | Companion Flange Installer |
| 5. J-21777-01 | Pinion Setting Gauge
J-21777-45 Side Discs
J-21777-29 Gauge Plate
J-21777-42 Front Bearing Pinion
J-21777-43 Stud
J-21777-1 Arbor | 14. J-8092 | Driver Handle (Threaded Type) |
| 6. J-9773 | Differential Yoke Bearing Installer (Used with J-7079-2) | 15. J-7079-2 | Driver Handle (Insert Type) |
| 7. J-8609 | Positraction Torque Measuring Adapter | 16. J-8001 | Dial Indicator Set |
| 8. J-7137 | Drive Pinion Front Bearing Cup Installer (Used with J-8092) | 17. J-22779 | Side Bearing Shim Gauge
J-22779-6 Strap |
| 9. J-8608 | Drive Pinion Rear Bearing Cup Installer (Used with J-8092) | 18. J-4880 | Snap Ring Pliers |
| | | 19. J-5810 | Torque Wrench Adapter (3/4" Male to 3/8" Female) |
| | | 20. J-3289 | Differential Carrier Holding Fixture |
| | | 21. J-22311 | Positraction Clutch Pack Remover and Installer |
| | | 22. J-1313 | Ft.-Lb. Torque Wrench |
| | | 23. J-5853 | In.-Lb. Torque Wrench |
| | | 24. J-8614 | Companion Flange Holder and Remover |

Fig. 3T—Special Tools—Corvette Differentials



- | | | | |
|-------------|---|-------------|-----------------------------------|
| 1. J-22912 | Press Plate | 13. J-8001 | Dial Indicator Set |
| 2. J-1453 | Pinion Bearing Press Plate | 14. J-0972 | Differential Nut Wrench |
| 3. J-8107 | Differential Bearing Puller Set | 15. J-24381 | Pinion Rear Bearing Cup Installer |
| 4. J-8107-3 | Adapter Plug | 16. J-24383 | Side Bearing Installer |
| 5. J-22888 | Differential Side Bearing Remover | 17. J-24384 | Pinion Oil Seal Installer |
| 6. J-1364 | Pinion Bearing Ring Drive | 18. J-24385 | Case Spreader Tool |
| 7. J-1488 | Differential Side Bearing Replacer | 19. J-24430 | Side Bearing Installer |
| 8. J-8608 | Drive Pinion Rear Bearing Cup Installer
(Used with J-8092) | 20. J-24432 | Pinion Rear Cup Installer |
| 9. J-5853 | In.-Lbs. Torque Wrench | 21. J-23322 | Pinion Straddle Bearing Installer |
| 10. J-8092 | Drive Handle | 22. J-24429 | Adjusting Nut Wrench |
| 11. J-8614 | Companion Flange Holder and Remover | 23. J-24434 | Pinion Oil Seal Installer |
| 12. J-22281 | Pinion Flange Oil Seal Installer | 24. J-24433 | Pinion Rear Bearing Installer |

Fig. 4T—Special Tools—10-1/2" and 12-1/4" Ring Gear Truck Differentials

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SECTION 5

BRAKES

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.*

CONTENTS OF THIS SECTION

Power Brake Cylinder Single Diaphragm (Delco Moraine) .	5-1
Power Brake Cylinder Dual Diaphragm (Delco Moraine) .	5-10
Power Brake Cylinder Single Diaphragm (Bendix)	5-19
Power Brake Cylinder Dual Diaphragm (Bendix).....	5-24
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DELCO-MORaine POWER BRAKE CYLINDER SINGLE DIAPHRAGM--DASH MOUNTED

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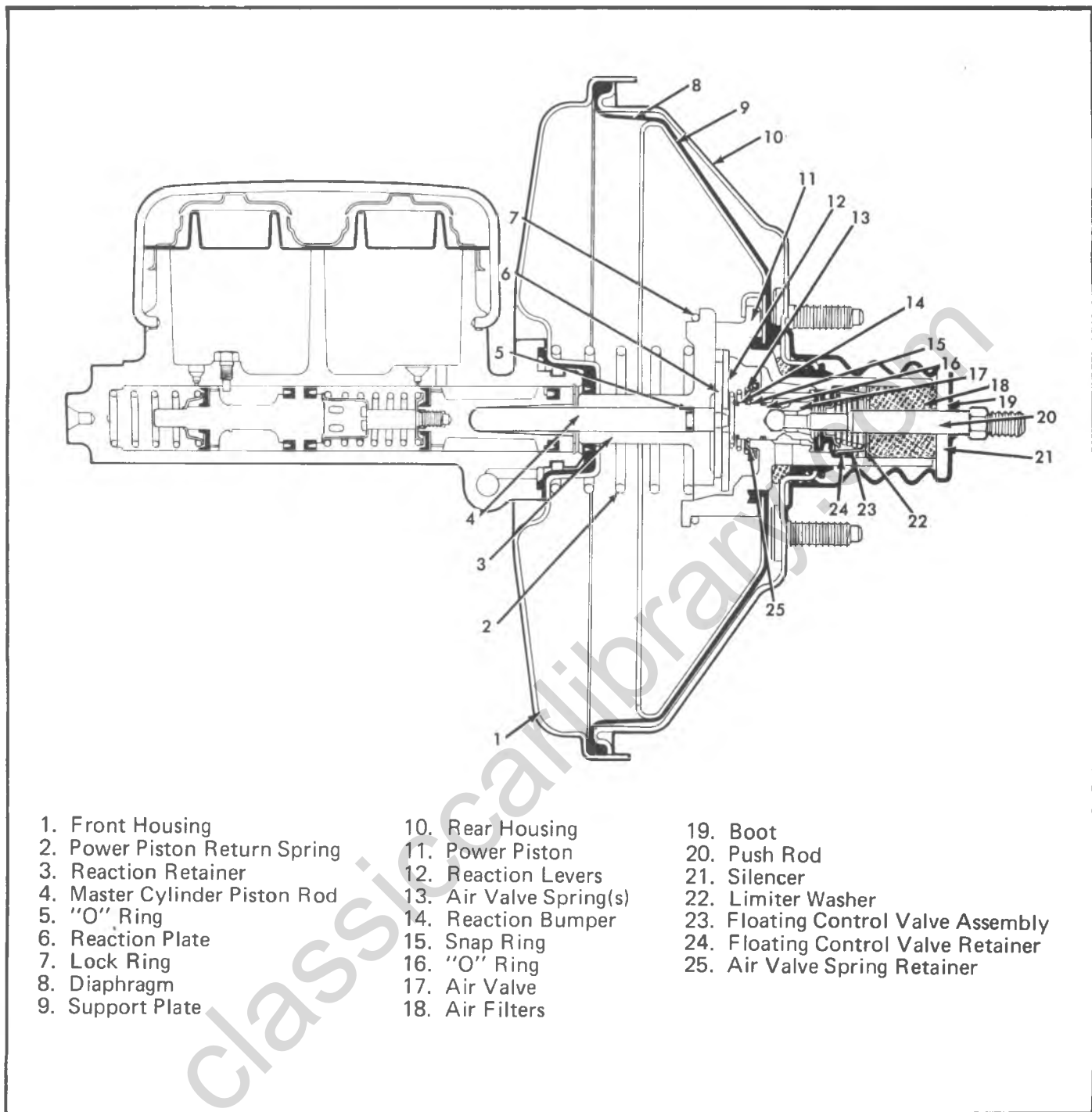
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OVERHAUL OPERATIONS

Disassembly

The following procedure applies to the power section of the power brake unit only (fig. 1A). For service of the master cylinder refer to applicable portion in the "Service" manual.

1. Scribe across outer edge of both housings and across mounting bracket flanges to provide a guide mark for reassembly.
2. Remove master cylinder attaching nuts and set master cylinder aside.
3. Attach base of Tool J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs. Clamp base in bench vise with power section up (fig. 2A).
4. Separate front and rear housings as follows:
 - a. **Straight Mounting Bracket (Fig. 3A)** - Place Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs.
 - b. **Tilt Mounting Bracket (Chevelle)** - Secure Spanner Wrench J-9504 to bracket with three



- | | | |
|-------------------------------|-------------------------|-------------------------------------|
| 1. Front Housing | 10. Rear Housing | 19. Boot |
| 2. Power Piston Return Spring | 11. Power Piston | 20. Push Rod |
| 3. Reaction Retainer | 12. Reaction Levers | 21. Silencer |
| 4. Master Cylinder Piston Rod | 13. Air Valve Spring(s) | 22. Limiter Washer |
| 5. "O" Ring | 14. Reaction Bumper | 23. Floating Control Valve Assembly |
| 6. Reaction Plate | 15. Snap Ring | 24. Floating Control Valve Retainer |
| 7. Lock Ring | 16. "O" Ring | 25. Air Valve Spring Retainer |
| 8. Diaphragm | 17. Air Valve | |
| 9. Support Plate | 18. Air Filters | |

Fig. 1A--Delco-Moraine Vacuum Power Cylinder (Nova shown as Typical)

bolts and nuts. Draw nuts down tight to eliminate damage to bracket.

- c. **Tilt Mounting Bracket Except Chevelle (Fig. 4A)**
- Place Tool J-22893 inside tilted mounting bracket. Place Spanner Wrench J-9504 on top of J-22893 and tighten nuts and washers securing spanner wrench.

WARNING: When separating housings, maintain pressure on rear housing as it is under spring tension.

- d. Press down on Spanner Wrench J-9504 and rotate the rear housing counterclockwise to

separate the two housings. If the rear housing cannot be readily loosened, tap the rear housing lightly with a plastic hammer.

- Remove Tools J-9504 and J-22893 from rear housing (tilted mounting bracket type); Tool J-9504 on regular type.

CAUTION: Care must be exercised not to damage or loosen studs in housing. Also, take care that no pressure is brought to bear on plastic power piston.

- Lift the rear housing assembly from the unit.

Rear Housing Group (Fig. 5A)

- Clevis Type Push Rod** - loosen the clevis locknut and then remove the clevis and locknut.
- Remove the boot from the neck of the power piston.

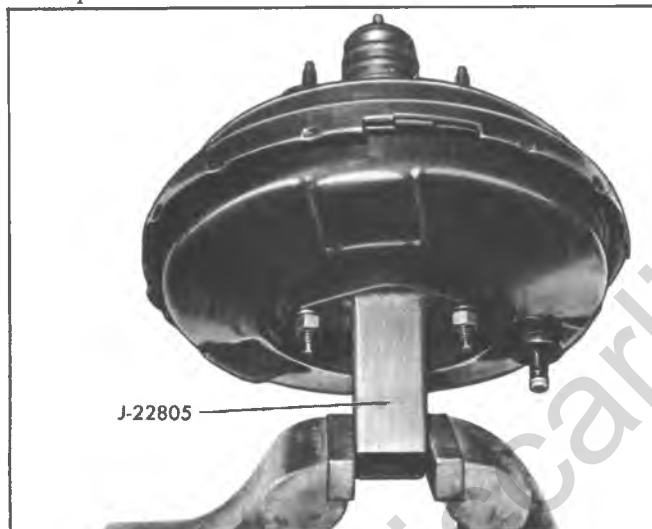


Fig. 2A--Holding Power Cylinder Using Tool J-22805



Fig. 3A--Separating Housings with Tools J-9504 and J-22805

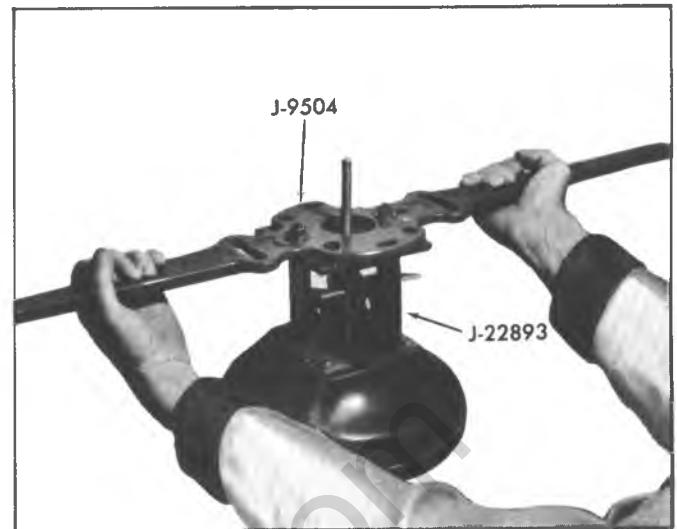


Fig. 4A--Separating Tilt Bracket Type Housings with Tools J-9504 and J-22893

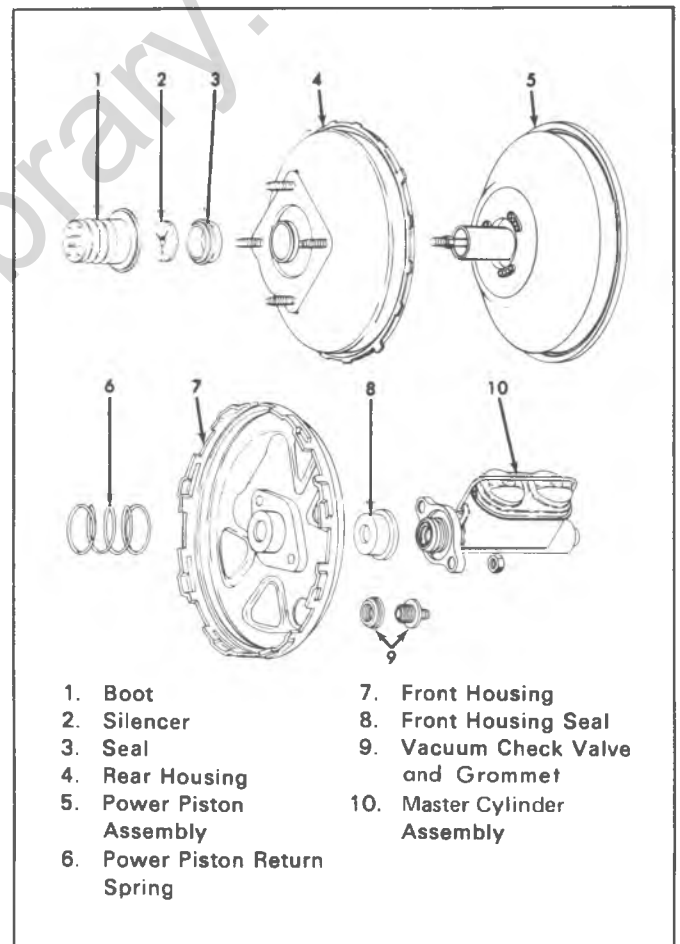


Fig. 5A--Delco-Moraine Power Unit

- Remove the silencer retaining clip from the push rod and remove silencer.
- Separate the power piston assembly from the rear housing.

5-4 BRAKES

- Remove the power piston seal from the rear housing.

Power Piston Group (Fig. 6A)

CAUTION: Care should be used in handling the diaphragm of the power piston assembly. The diaphragm should be protected from grease, oil, foreign matter and from nicks, scratches and gouges.

- Remove the air filter from the neck of the power piston.
- Remove the lock ring from the power piston by prying one of the ends out from under the large divided locking lug, and then pull it out from under the remaining two small lugs.
- Remove the reaction retainer, piston rod, reaction plate, three reaction levers, air valve spring(s), small reaction bumper, and air valve spring retainer.
- Place square shank of Tool J-21524 in a vise and position the assembly down on the tool so that the three lugs on the tool fit into the three notches in the power piston.
- Pull the diaphragm edges away from the support

plate and grip the steel support plate by hand, press down and rotate counterclockwise to separate the plate from the power piston (fig. 7A).

- Remove the diaphragm from the support plate and lay both parts aside.
- Position the power piston in a vise padded with shop-towels, with the tube down (fig. 8A).
- Using Snap Ring Pliers J-4880, remove the snap ring from the air valve.
- Place the power piston (tube down) in an arbor press. Using a rod not exceeding 1/2" in diameter, press the air valve assembly from the power piston (fig. 9A).
- Push the master cylinder piston rod from the reaction retainer and remove the "O" ring from the rod.

CAUTION: The air valve-floating control valve-push rod assembly is serviced as a complete

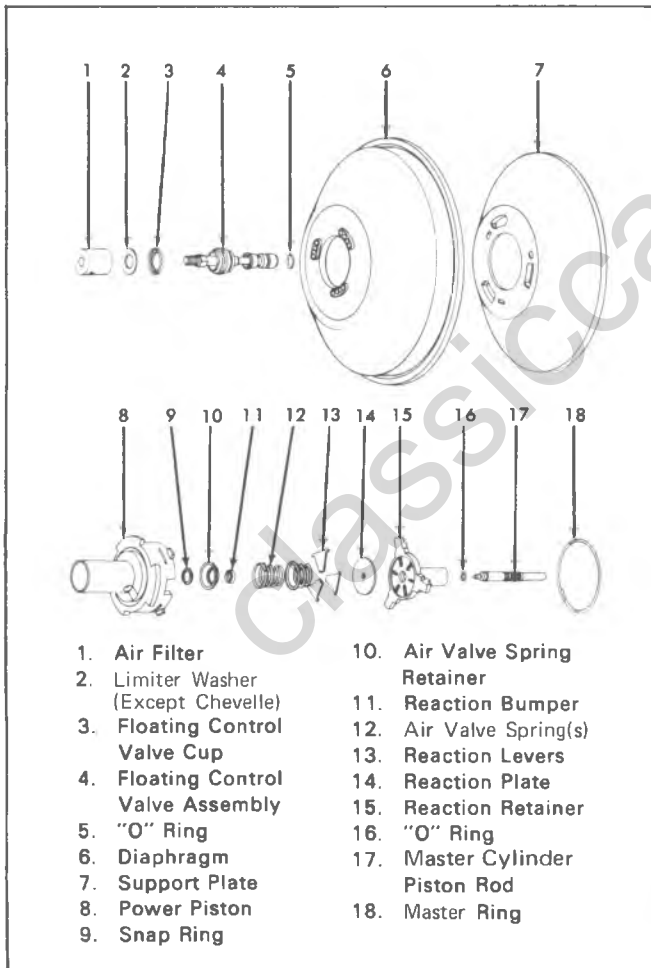


Fig. 6A--Power Piston and Components



Fig. 7A--Separating Power Piston from Support Plate



Fig. 8A--Removing Air Valve Snap Ring



Fig. 9A--Removing Air Valve Assembly from Power Piston

unit. A new assembly should always be used whenever it is removed from the power piston.

Front Housing Group

1. Remove the power piston return spring from the front housing.
2. Remove the seal from the front housing.
3. Remove and discard the vacuum check valve and grommet.
4. If the front housing is to be replaced, remove Holding Tool J-22805 from the front housing.

Cleaning

Use denatured alcohol to clean all metal, plastic and rubber parts of the power cylinder. Immerse parts in cleaning fluid and use a hair brush to remove foreign matter. Blow out all passages, orifices and valve holes. AIR DRY and place cleaned parts on clean paper or lint-free cloth. If slight rust is found on inside surface of power cylinder housing, polish clean with crocus cloth or fine emery cloth, then follow with a thorough cleaning as outlined above.

CAUTION: Use of gasoline, kerosene, anti-freeze alcohol or any other cleaner with even a trace of mineral oil will damage rubber parts. Be particularly careful during reassembly that no grease or mineral oil comes in contact with these rubber parts.

Inspection

Wipe cleaning fluid from all parts and carefully inspect each part for damage and wear. Inspect rubber parts for

cuts, nicks and distortion. These rubber parts are the key to control of air flow and should account for the majority of troubles traceable to leakage. If there is any question whatever as to serviceability of any part, replace it.

Refer to "Inspection Chart" for more detailed instructions.

Assembly (Figs. 1A, 5A, and 6A)

CAUTION: Be sure to keep parts clean until reassembly. Re-wash at reassembly if there is any occasion to doubt cleanliness - such as parts dropped or left exposed for eight hours or longer.

If there is any suspicion of contamination or any evidence of corrosion, completely flush the car hydraulic brake system in accordance with the "Service" manual.

Lubricate rubber parts, plastic and metal friction points with Delco Silicone Lube #5459912 (or equivalent).

Front Housing Group

1. Install a new vacuum check valve and grommet.
2. Place new front housing seal in the center of the front housing so that the flat surface of the cup lies against the bottom of depression in the housing.
3. If a new housing is being installed, assemble Holding Fixture J-22805 to the front face of the housing.

Power Piston Group

1. Install a NEW "O" ring in the groove on the master cylinder piston rod. Apply a thin film of Delco Silicone Lube #5459912 (or equivalent) to the "O" ring.
2. Insert master cylinder piston rod through the reaction retainer with round end of rod at tube end of retainer.
3. Place the square shank of Tool J-21524 in a vise and position power piston on tool with the three lugs fitting into the notches of the power piston.
4. Install a NEW "O" ring on the NEW air valve assembly, in the second groove from the push rod forward end.

NOTE: A NEW air valve-floating control valve-push rod assembly should always be used whenever it is removed from the power piston.

5. Coat the NEW floating control valve large O.D. and the "O" ring with a thin film of Delco Silicone Lube #5459912 (or equivalent).
6. Press the assembly (air valve first) to its seat in the power piston tube.

INSPECTION CHART

Part	Inspect For	Corrective Action
Power Piston and Support Plate and Reaction Retainer	1. Cracks, distortion, chipping, damaged lever seats, pitted or rough holes.	1. Clean up or replace.
	2. Worn seal surfaces (tubes).	2. Replace
	3. Rough or uneven floating valve seat.	3. Replace
	4. Open passages and flow holes.	4. Clean
Reaction Levers or Plates	1. Cracks, distortion, tears and heavy wear.	1. Replace
Floating Control Valve	1. Deterioration of rubber or warped valve face.	1. Replace
Air Valve - Push Rod Assembly	1. Air valve: scratches, dents, distortion, or corrosion of I.D. or O.D. All seats to be smooth and free of nicks and dents.	1. Do not repair - Replace.
	2. Push rod must move freely in air valve, but must not pull out.	2. If worn, replace air valve - push rod assembly.
Front and Rear Housings	1. Scratches, scores, pits, dents, or other damage affecting rolling or sealing of diaphragm or other seals.	1. Replace, unless easily repaired
	2. Cracks, damage at ears, damaged threads on studs.	2. Replace, unless easily repaired
	3. Bent or nicked locking lugs.	3. Replace, unless easily repaired
	4. Loose studs.	4. Replace or repair.
Air Filters and Silencer	1. Dirty	1. Replace

7. Install a new floating control valve retainer over the push rod, (flat side toward the floating control valve).
8. Start the floating control valve and retainer into the power piston tube.
9. Seat retainer in the power piston tube by pressing it in place with Tool J-21601; scribe line on tool should line up with top edge of power piston tube (fig. 10A).
10. Install the push rod limiter washer (except Chevelle) over the push rod and then the air filter element.
11. Assemble power piston diaphragm support plate from side of support plate opposite locking tangs. The raised flange of diaphragm is pressed through hole in center of support plate.

NOTE: Make sure the support plate is in the groove in the center flange of the diaphragm.

12. Pull diaphragm away from O.D. of support plate so that support plate can be gripped with hands.
13. With power piston still positioned on holding tool in vise, coat bead of diaphragm that contacts power piston with Delco Silicone Lube #5459912 (or equivalent).
14. Holding support plate by metal, with locking tangs down, place support plate and diaphragm assembly over tube of power piston. The flange of the diaphragm will fit into groove on power piston (fig. 11A).
15. Place this assembly, tube down, in a padded vise, (Do Not Clamp).



Fig. 10A--Installing Air Valve and Retainer



Fig. 11A--Installing Power Piston to Support Plate

16. Install snap ring in groove of air valve with Snap Ring Pliers J-4880 (fig. 8A).
17. Install the air valve spring retainer to seat on the snap ring.
18. Install the reaction bumper into the groove in the end of the air valve.
19. Position the air valve return spring, large end down, on the spring retainer.
20. The three reaction levers are now placed into position with ears on wide end in slots in power piston. The narrow ends will rest on top of air valve return spring.
21. Position reaction plate (with numbered side up) on top of reaction levers. Press down on plate until large ends of reaction levers pop up so plate rests flat on levers. Be sure reaction plate is centered.
22. Master cylinder piston rod and reaction retainer assembly is now assembled to the power piston.
23. With round end of piston rod up, and with reaction retainer held toward top of piston rod, place small end of piston rod in hole in center of reaction plate. Line up ears on reaction retainer with notches in power piston and push reaction retainer down until ears seat in notches (fig. 12A).
24. Secure with lock ring making sure ends of lock ring are set in place on the large divided lug of the power piston, one end on each side of lug (fig. 13A).
25. Install air filter over end of push rod and seat into neck of power piston.



Fig. 12A-Installing Reaction Retainer on Power Piston

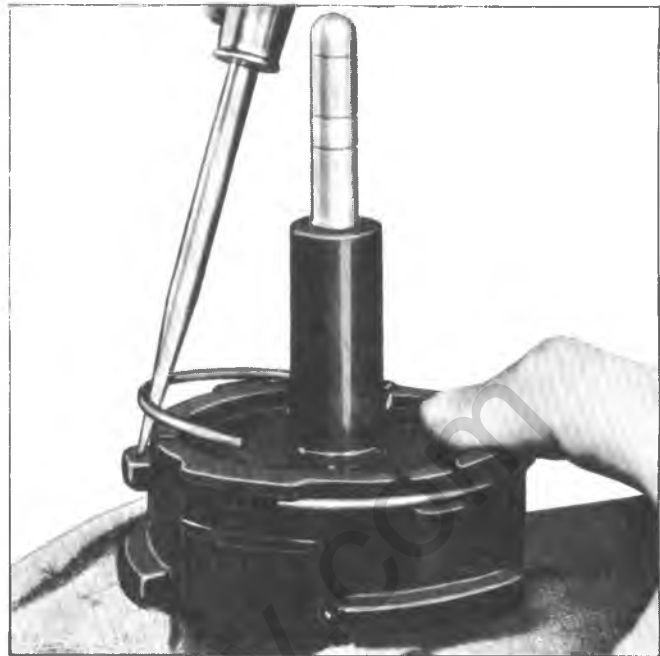


Fig. 13A-Installing Retainer Lock Ring

Rear Housing Group

1. Install a NEW seal in the center of the rear housing (large flange of seal on stud side of housing). Lubricate the inside of the seal with Delco Silicone Lube #5459912 (or equivalent).
NOTE: Make sure flange on rear housing is engaged in groove of seal.
2. Apply a thin coat of Delco Silicone Lube #5459912 (or equivalent) to the power piston tube and assemble the power piston to the rear housing.
3. Place the felt silencer onto the push rod and install silencer retainer clip in groove on push rod.
4. Place push rod boot in place on power piston tube.
5. **Clevis Type Push Rod** - Assemble the locknut and clevis to the push rod.

Final Assembly

1. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damaging of studs. Clamp base in a vise. Place power piston return spring over the insert in the front housing.
2. Lubricate the ID of the support plate seal, the reaction retainer tube and the beaded edge of the diaphragm with Delco Silicone Lube #5459912 (or equivalent).
3. Place the rear housing assembly over the front housing assembly and align the scribe marks of the

two housings so they will match when in locked position.

4. Assemble front and rear housings as follows:

- a. **Straight Mounting Bracket** - Place Spanner Wrench J-9504 over studs on rear housing, and attach with nuts and washers--draw nuts down tight to eliminate bending or damaging of studs.
- b. **Tilt Mounting Bracket (Chevelle)** - Secure Spanner Wrench J-9504 to bracket with three bolts and nuts. Draw nuts down tight to eliminate damage to the bracket.
- c. **Tilt Mounting Bracket (Except Chevelle)** - Position Tool J-22893 inside tilted mounting bracket. Place Spanner Wrench J-9504 on top of J-22893 and tighten nuts and washers to bolts provided, securing Spanner Wrench.
- d. Press down on spanner wrench and twist rear housing clockwise in relation to front housing until fully locked.

NOTE: If unit is not easily locked, hold housings together and apply vacuum to check valve in front housing. Do not put pressure on power piston extension.

5. Remove Spanner Wrench J-9504. Remove unit from vise and remove Holding Fixture J-22805 from the front housing.

Gauging

NOTE: The unit as received does not incorporate an adjustable piston rod; however, checking with the gauge is a good practice if only to determine that all components have been assembled correctly.

If for any reason the piston rod was replaced, the service piston rod is adjustable, and gauging is a necessity

1. Place power unit in a vise so that master cylinder push rod is up.
2. **Deep Socket Master Cylinder Primary Piston** - Place Tool J-7723-01 over the piston rod so that it fits between the studs on front housing. Gauge should be parallel to studs resting on surface of housing. The cutout portion of the gauge should never be lower than the end of the piston rod, and the gap should never be more than .010 inch (fig. 14A).

NOTE: If push rod height adjustment gauge is not available, the required dimensions for fabrication are given in Figure 15A.

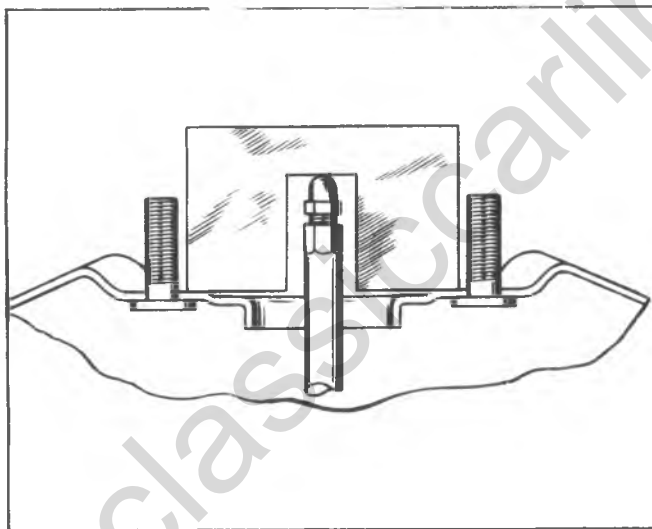


Fig. 14A - Adjustment of Piston Rod

Any variation beyond these two limits would require replacement of the piston rod with the service adjustable piston rod, and adjusting the screw in the end of the rod to match the height of the gauge.

3. **Shallow Socket Master Cylinder Primary Piston** - Place Gauge J-22647 over the piston rod in a position which will allow the gauge to be slipped to the left or right without contacting the studs (fig. 14B). The center section of the gauge has two levels. The piston rod should always contact the longer section (lower level) of the gauge. The piston rod should never contact the shorter section (higher level) of the gauge. Move gauge from side to side to check piston rod height.
- Any variation beyond these two limits indicates incorrect assembly, need for adjustment or requires replacement of the piston rod with the service adjustable piston rod, and adjusting the screw in the end of the rod to match the height of the gauge.
4. Install the master cylinder assembly on the front housing, positioning the cylinder on the mounting studs so that the top of the master cylinder reservoir is toward the scribe marks on the housings.
5. Install nuts on the studs and torque to 25 ft. lbs.

CAUTION: See "Caution" on Page 1 of this section

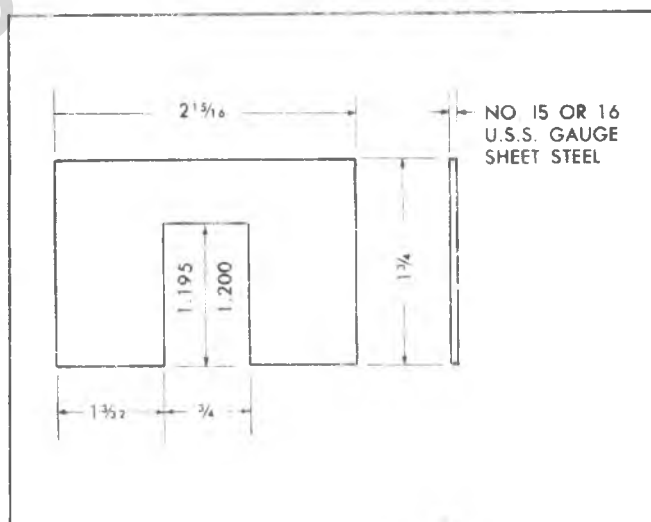


Fig. 15A - Piston Rod Gauge

DELCO MORAINÉ POWER BRAKE CYLINDER

DUAL DIAPHRAGM--DASH MOUNTED

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OVERHAUL OPERATIONS

Disassembly (Fig. 1B)

NOTE: Scribe a mark on the top center of the front and rear housings in line with master cylinder reservoir cover to facilitate reassembly.

- Remove the two locknuts which hold the master cylinder to the front housing, and remove the master cylinder from the mounting studs.
- Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate damage to studs. Clamp base in a bench vise with the power section up (fig. 2B).
- Separate front and rear housings as follows:
 - Straight Mounting Bracket (Fig. 2B)** - Place Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs.
 - Tilt Mounting Bracket (Chevelle)** - Secure Spanner Wrench J-9504 to bracket with three bolts and nuts. Draw nuts down tight to eliminate damage to bracket.
 - Tilt Mounting Bracket Except Chevelle (Fig. 4A)** - Place Tool J-22893 inside tilted mounting bracket. Place Spanner Wrench J-9504 on top of J-22893 and tighten nuts and washers, securing spanner wrench.

WARNING: When separating housings, maintain pressure on rear housing as it is under spring tension.

- Press down on Spanner Wrench J-9504 and rotate the rear housing counterclockwise to separate the two housings. If the rear housing cannot be readily loosened, tap the rear housing lightly with a plastic hammer.
- Remove Tools J-9504 and J-22893 from rear housing (tilted mounting bracket type), Tool J-9504 on regular type.

CAUTION: Care must be exercised not to damage or loosen studs in housing. Also, take care that no pressure is brought to bear on plastic power piston.

- Lift the rear housing assembly from the unit.

Front Housing Group

- Remove the power piston return spring. The retainer plate may come out with the power piston return spring. Remove and discard the vacuum check valve and grommet from the front housing.
- Remove the front housing seal.

Rear Housing Group

- Remove the push rod clevis and locknut, if so equipped.
- Remove the boot retainer and boot from the rear housing. Remove the felt silencer from inside the boot.
- Remove the power piston group from the rear housing and remove the seal from the center opening of the rear housing.

Power Piston Group

- Lift the bead on the O.D. of the secondary diaphragm and remove the diaphragm support ring (fig. 3B).
- If not already disengaged, remove the retainer plate from the secondary piston. Remove the piston rod retainer and piston rod from the secondary piston.
- Mount double-ended Tool J-23101 (with large diameter end up) in a vise. Position the secondary power piston so that the two radial slots in the piston fit over the ears (tang) of the tool (fig. 4B).
- Fold back primary diaphragm from the O.D. of the primary support plate. Grip the edge of the support plate and rotate counterclockwise to unscrew the

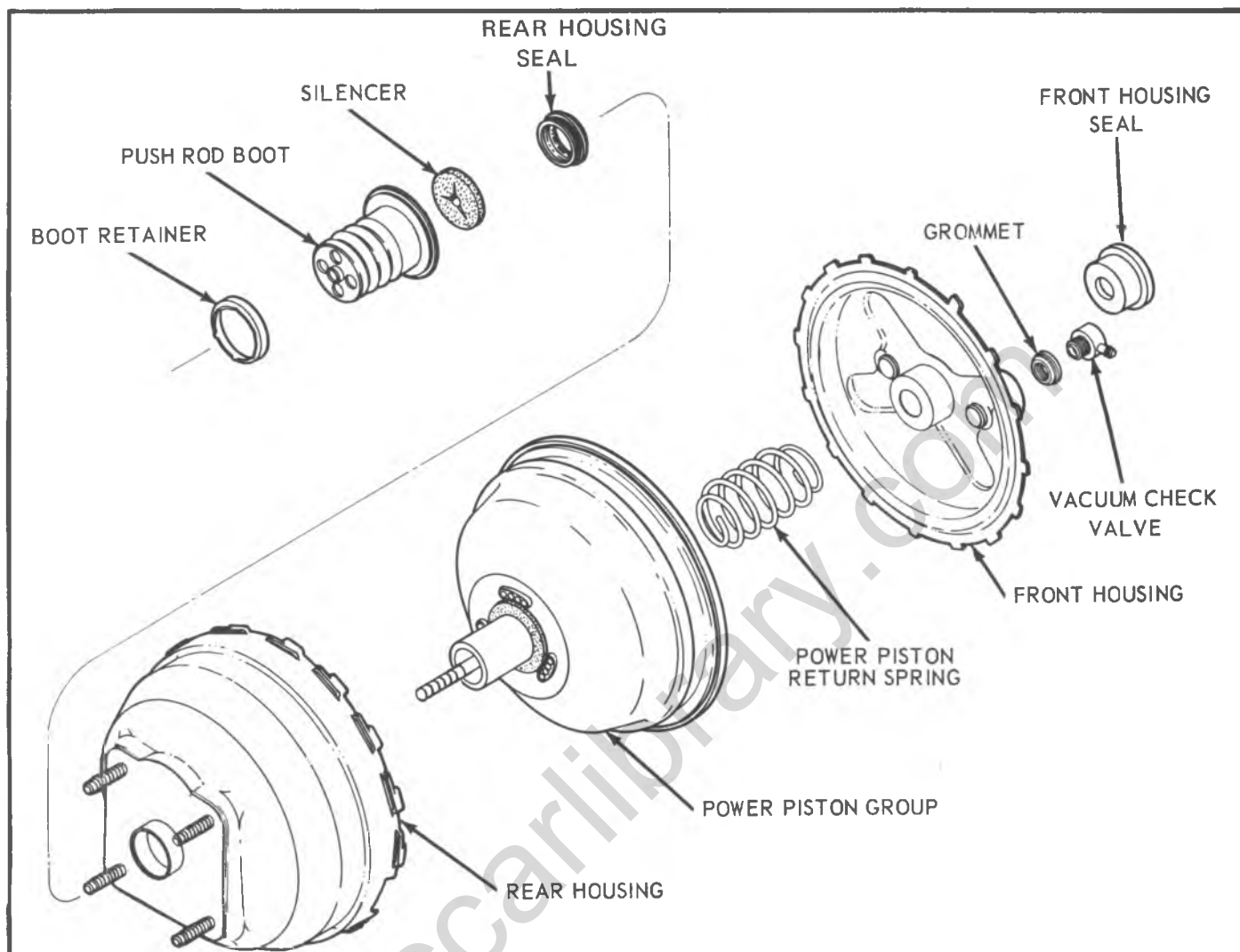


Fig. 1B--Exploded View of Major Assemblies

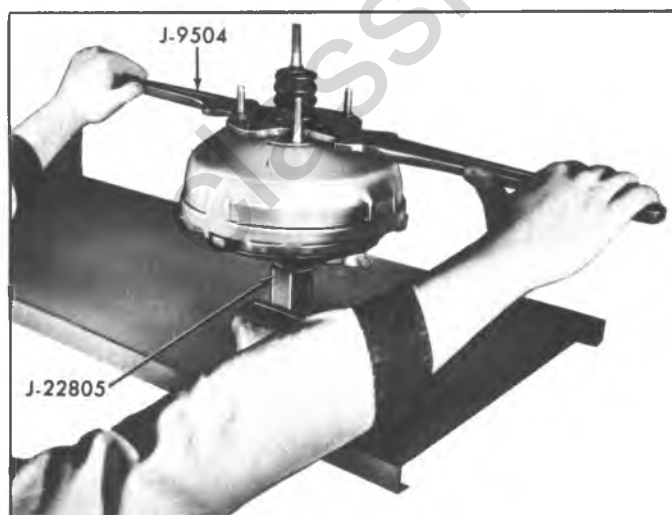


Fig. 2B--Unlocking Front and Rear Housings

primary power piston from the secondary power piston.

NOTE: It is possible that the primary support plate will unlock from the primary piston before the primary piston unscrews from the secondary piston. If this happens, continue to turn the primary support plate counterclockwise. Tabs (stops) on the primary support plate will temporarily lock the primary support plate to the primary power piston and permit continued counterclockwise rotation to unscrew the primary power piston from the secondary power piston (fig. 5B).

5. Remove the housing divider from the secondary power piston. Remove the secondary power piston bearing from the housing divider.
6. The secondary power piston should still be positioned on Tool J- 23101. Fold back secondary diaphragm from O.D. of secondary support plate. Grip the edges of the support plate and rotate

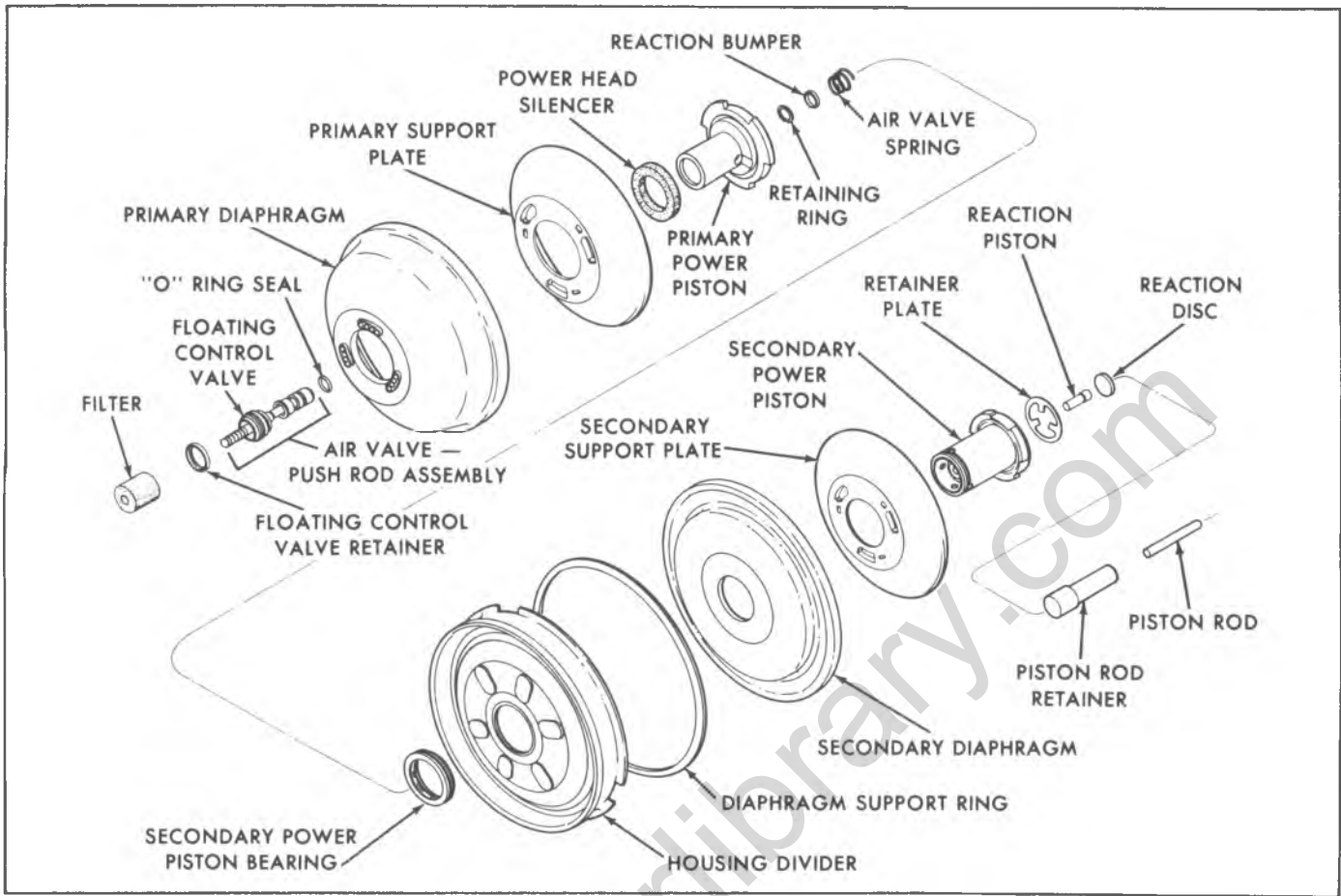


Fig. 3B--Power Piston Group

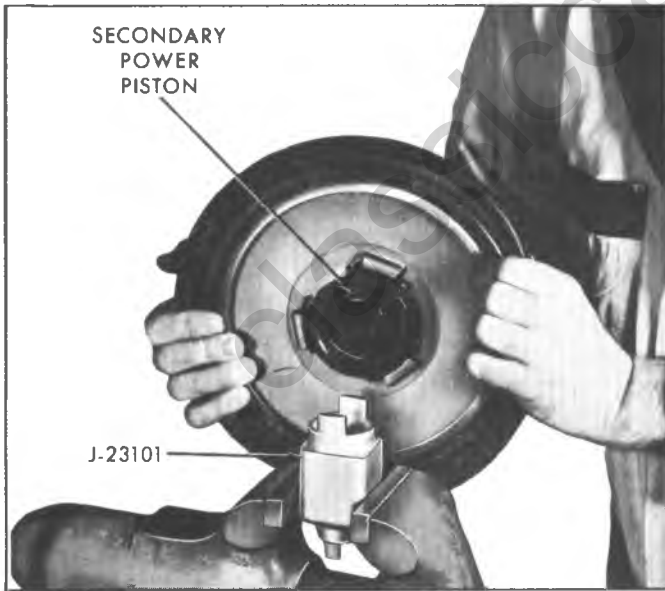


Fig. 4B--Positioning Secondary Power Piston in Tool J-23101 (Large Dia. End Up)

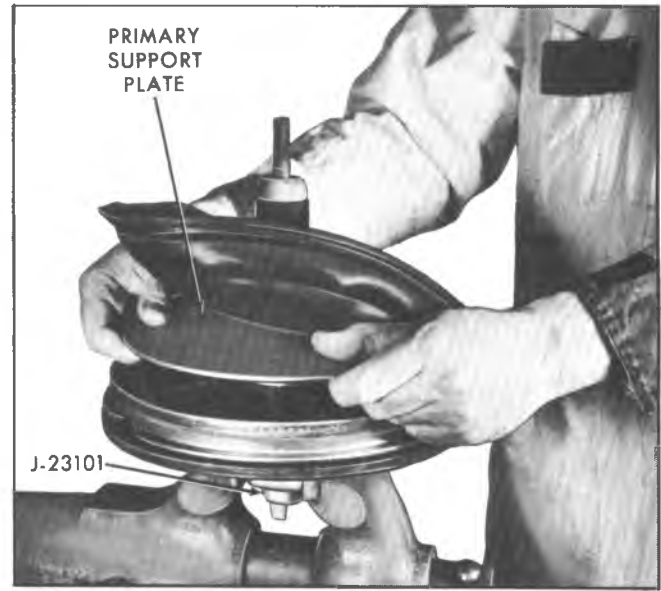


Fig. 5B--Locking or Unlocking Primary and Secondary Power Pistons

clockwise to unlock the secondary support plate from the secondary power piston (fig. 6B).

7. Remove the secondary diaphragm from the secondary support plate.

8. Remove the reaction piston and reaction disc from the center of the secondary power piston by pushing down on the end of the reaction piston with a small object, such as a pencil, wooden dowel or metal rod (fig. 7B).
9. Remove the air valve spring from the end of the air valve (if it didn't come off during disassembly of the power piston).
10. Mount Tool J-23101 in a vise (with small diameter end up). Position the primary power piston so that the two radial slots in the piston fit over the ears (tang) of the tool (fig. 8B).
11. Fold back primary diaphragm from the support plate. Grip the edge of the support plate and rotate in a counterclockwise direction to unlock the primary support plate from the primary power piston (fig. 9B).
12. Remove the primary diaphragm from the primary support plate.
13. Remove the air filter from the tubular section of the primary power piston.
14. Remove the power head silencer from the neck of the power piston tube.
15. Remove the rubber reaction bumper from the end of the air valve.
16. Using Snap Ring Pliers J-4880, remove the retaining ring from the air valve (fig. 10B).
17. Remove the air valve-push rod assembly from the tube end of the primary power piston. The following removal method is recommended:
Place the primary power piston in an arbor press, and press the air valve push rod assembly out the bottom of the power piston tube with a rod not exceeding 1/2" in diameter.
18. Removal of the air valve push rod assembly will disassemble the control valve retainer.
19. Remove the "O" ring seal from the air valve.

Cleaning

Use denatured alcohol to clean all metal, plastic and rubber parts of the power cylinder. Immerse parts in cleaning fluid and use a hair brush to remove foreign matter. Blow out all passages, orifices and valve holes. **AIR DRY** and place cleaned parts on clean paper or lint-free cloth. If slight rust is found on inside surface of power cylinder housing, polish clean with crocus cloth or fine emery cloth, then follow with a thorough cleaning as outlined above.

CAUTION: Use of gasoline, kerosene, anti-freeze alcohol or any other cleaner with even a trace of mineral oil, will damage rubber parts.

Inspection

Wipe cleaning fluid from all parts and carefully inspect each part for damage and wear. Inspect rubber parts for

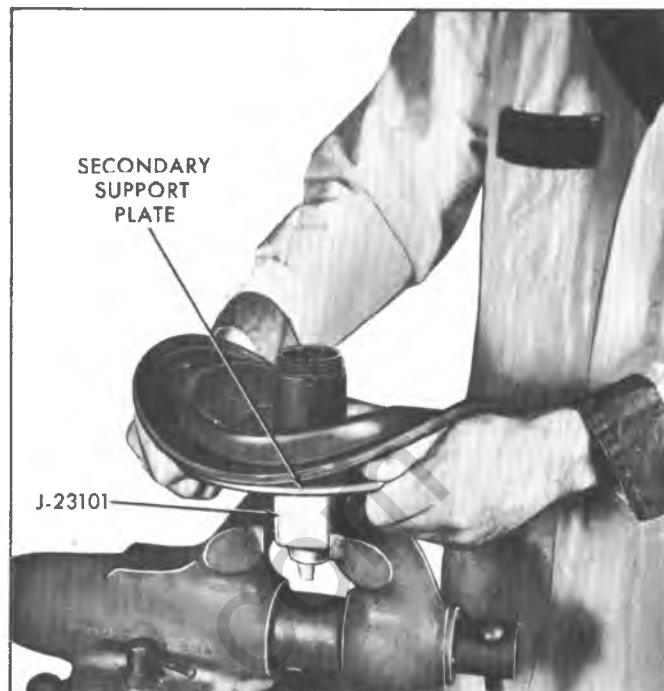


Fig. 6B--Locking or Unlocking Secondary Support Plate and Secondary Power Piston

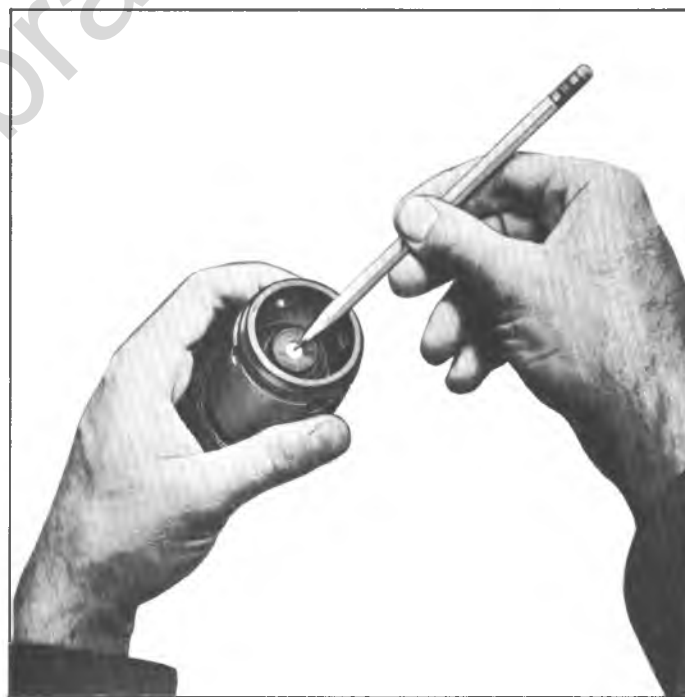


Fig. 7B--Removing Reaction Piston and Reaction Disc From Secondary Power Piston

cuts, nicks and distortion. These rubber parts are the key to control of air flow and should account for the majority of troubles traceable to leakage. If there is any question whatever as to serviceability of any part, replace it.



Fig. 8B--Positioning Primary Power Piston in Tool J-23101 (Small Dia. End Up)



Fig. 10B--Removing Retaining Ring From Air Valve

If there is any suspicion of contamination or any evidence of corrosion, completely flush the car hydraulic brake system in accordance with the Service Manual.

Lubricate rubber, plastic and metal friction points with Delco Silicone Lube #5459912 (or equivalent).

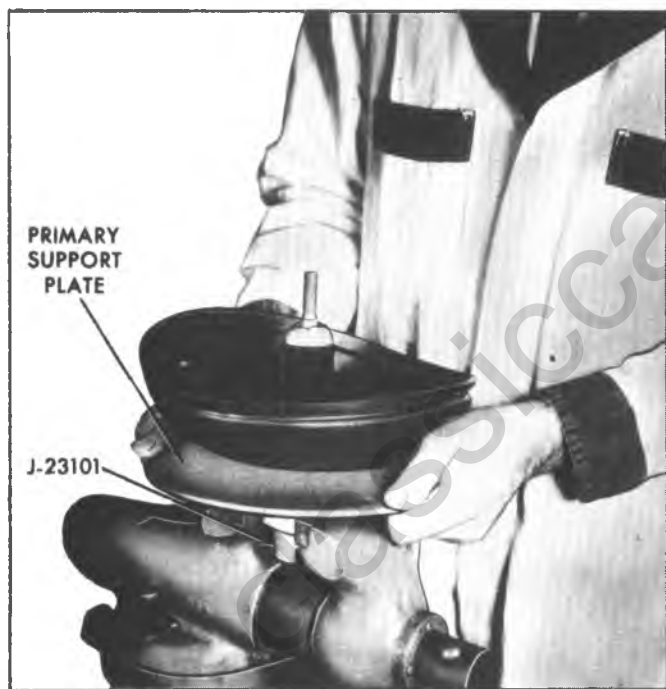


Fig. 9B--Locking or Unlocking Primary Support Plate From Primary Power Piston

Refer to "Inspection Chart" for more detailed instructions.

Assembly

CAUTION: *Be sure to keep parts clean until reassembly. Re-wash at reassembly if there is any occasion to doubt cleanliness - such as parts dropped or left exposed for eight hours or longer.*

Front Housing Group

1. Replace vacuum check valve using a new grommet if old one is cracked or damaged.
2. Place new front housing seal in housing so flat surface of cup lies against bottom of depression in housing.

Power Piston Group

1. Lubricate the I.D. and O.D. of the "O" ring seal with Delco Silicone Lube #5459912 (or equivalent) and place on the air valve.
2. Wipe a thin film of Delco Silicone Lube #5459912 (or equivalent) on the large and small O.D. of the floating control valve.

NOTE: If the floating control valve needs replacement, it will be necessary to replace the complete air valve-push rod assembly. Since the floating control valve is a component part of this assembly and cannot be disassembled from the push rod.

INSPECTION CHART

Part	Inspect For	Corrective Action
Power Pistons and Support Plates	1. Damaged threads.	1. Replace
	2. Cracks, distortion, chipping, pitted or rough holes, worn seal surfaces (tubes).	2. Clean up or replace.
Piston Rod Retainer	1. Cracks, distortion, chipping.	1. Replace
Air Valve—Push Rod Assembly	1. Air Valve scratches, dents, distortion, or corrosion of I.D. or O.D. All seats to be smooth and free of nicks and dents.	1. Do not repair—Replace.
	2. Push rod must move freely in air valve, but must not pull out.	2. If worn, replace air valve push rod assembly.
	3. Deterioration of rubber or warped valve face in floating control valve.	3. Replace
Spring Retainers	1. Check for cracks, deformation.	1. Replace
Front and Rear Housings	1. Scratches, scores, pits, dents, or other damage affecting rolling or sealing diaphragm or other seals.	1. Replace, unless easily repaired.
	2. Cracks, damaged threads on studs, broken studs.	2. Replace, unless easily repaired.
	3. Bent or nicked locking lugs.	3. Replace, unless easily repaired.
	4. Loose studs.	4. Replace or repair.
Filter and Silencers	1. Dirty	1. Replace

5-16 BRAKES

- Place the air valve end of the air valve push rod assembly into the tube of the primary power piston. Manually press the air valve push rod assembly so that the floating control valve bottoms on the tube section of the primary power piston. Installer Tool J-23175 can be used to manually press the floating control valve to its seat.
- Place the I.D. of the floating control valve retainer on the O.D. of floating control valve Retainer Installer J-23175. Place over the push rod so that the closed side of the retainer seats on the floating control valve (fig. 11B). With Installer J-23175, manually press the retainer and floating control valve assembly to seat in the primary power piston tube (fig. 12B).
- The filter element can now be stretched over the push rod and pressed into the primary power piston tube.
- Using Snap Ring Pliers J-4880, place the retaining ring into the groove in the air valve (fig. 10B).
- Position the rubber reaction bumper on the end of the air valve.

CAUTION: Tolerances of those component parts affecting output of the tandem power brake are very important.

- Apply a light film of Delco Silicone Lube #5459912 (or equivalent) to the O.D. of the rubber reaction disc.
- Place the rubber reaction disc in the large cavity of the secondary power piston and push the disc down to seat on the reaction piston.

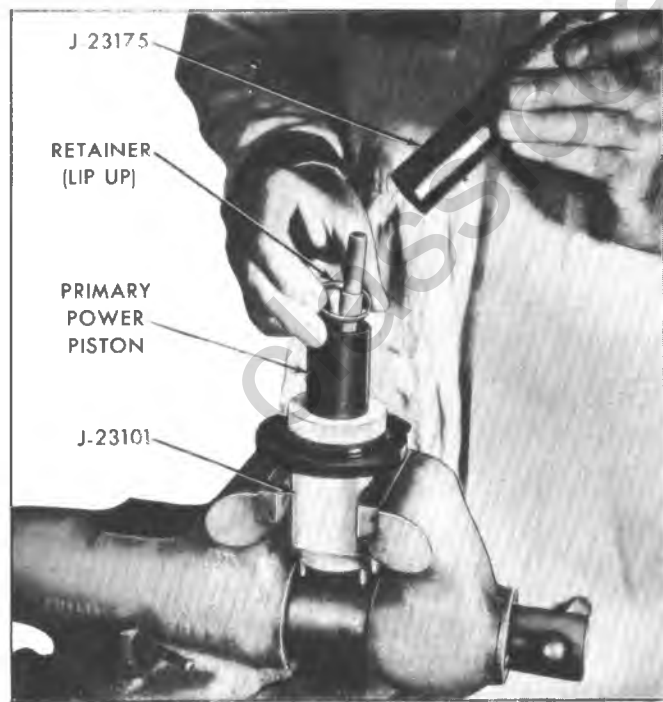


Fig. 11B--Installing Floating Control Valve Retainer with Installer J-23175



Fig. 12B--Seating Floating Control Valve Assembly with Installer J-23175

- Unlock the secondary power piston from the primary power piston.
- Assemble the primary diaphragm to the primary support plate from the side of the support plate opposite the locking tangs. Press the raised flange on the I.D. of the diaphragm through the center hole of the support plate. Be sure that the edge of the support plate center hole fits into the groove in the raised flange of the diaphragm. Lubricate the diaphragm I.D. and the raised surface of the flange (that fits into a groove in the primary power piston) with a light coat of Delco Silicone Lube #5459912 (or equivalent).
- Mount Tool J-23101 (small diameter end up) in a vise. Position the primary power piston so that the two radial slots in the piston fit over the ears (tang) of the tool (fig. 8B).
- Fold the primary diaphragm away from the O.D. of the primary support plate.
- Holding the edges of the support plate, with the locking tangs down, place the primary support plate and diaphragm assembly over the tube of the primary power piston. The flange on the I.D. of the primary diaphragm will fit into a groove in the primary power piston.
- Grip the edges of the primary support plate, press down, and rotate clockwise until the tabs on the primary power piston contact the stops on the support plate (fig. 9B).
- Place the power head silencer on the tube of the

primary power piston so that the holes at the base of the tube are covered.

17. Apply Delco Silicone Lube #5459912 (or equivalent) to the O.D. of the primary power piston tube.
18. Remove the primary piston assembly from Tool J-23101 and lay it aside.
19. Assemble the secondary diaphragm to the secondary support plate from the side of the support plate opposite the locking tangs. Press the raised flange on the I.D. of the diaphragm through the center hole of the support plate. Be sure that the edge of the support plate center hole fits into the groove in the raised flange of the diaphragm. Apply a thin coat of Delco Silicone Lube #5459912 (or equivalent) to the I.D. of the secondary diaphragm and the raised surface of the flange (that fits into a groove in the secondary power piston).
20. Mount Tool J-23101 (with large diameter end up) in a vise. Position the secondary power piston so that the radial slots in the piston fit over the ears (tang) of the tool. Apply a light coat of Delco Silicone Lube #5459912 (or equivalent) to the tube of the secondary power piston (fig. 4B).
21. Fold the secondary diaphragm away from the O.D. of the secondary plate.
22. Holding the edges of the support plate with the locking tangs down, place the secondary diaphragm and support plate assembly over the tube of the secondary power piston. The flange on the I.D. of the secondary diaphragm will fit into the groove in the secondary piston.
23. Grip the edges of the secondary support plate, press down, and rotate counterclockwise until the tabs on the secondary power piston contact the stops on the support plate. Fold the secondary diaphragm back into position on the secondary support plate. Leave the secondary power piston assembly on Tool J-23101 in the vise (fig. 6B).
24. Apply a light coat of talcum powder or Delco Silicone Lube #5459912 (or equivalent) to the bead on the O.D. of the secondary diaphragm. This will facilitate reassembly of front and rear housings.
25. Place the secondary diaphragm support ring on the secondary power piston assembly so that it rests on the edge of the diaphragm.
26. Hold the housing divider so that the formed over flange (that holds the primary diaphragm) of the divider faces down. Place the secondary bearing in the I.D. of the divider so that the extended lip of the bearing faces up.
27. Lubricate the I.D. of the secondary bearing with Delco Silicone Lube #5459912 (or equivalent).
28. Position secondary Bearing Protector Tool J-23188 on the threaded end of the secondary power piston (fig. 13B).
29. Hold the housing divider so that the six oblong protrusions on the middle of the divider are facing up. Press the divider down over the tool and onto the secondary power piston tube where it will rest against the diaphragm support ring. Remove Tool J-23188 from secondary power piston; however, do not remove the secondary power piston sub-assembly from Tool J-23101.
30. Pick up the primary power piston assembly and fold the primary diaphragm away from the O.D. of the primary support plate.
31. Position the small end of the air valve return spring on the air valve so that it contacts the air valve retaining ring.
32. Position the primary power piston on the tubular portion of the secondary power piston, making sure that the air valve return spring seats down over the raised center section of the secondary piston.
33. Grip the edge of the primary support plate, press down, and start the threads on the secondary power piston into the threaded portion of the primary power piston by rotating in clockwise direction (fig. 5B).
34. Continue to tighten the primary power piston until it is securely attached (approximately 5-15 ft. lbs.) to the secondary power piston.
35. Fold the primary diaphragm back into position on the primary support plate and pull the diaphragm O.D. over the formed flange of the housing divider. Check that the bead on the diaphragm is seated evenly around the complete circumference.

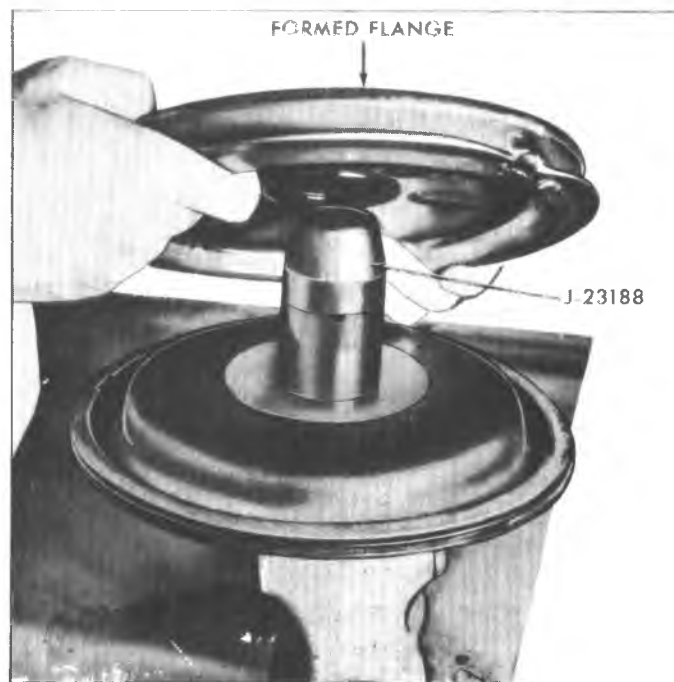


Fig. 13B--Positioning Housing Divider Over Secondary Bearing Protector Tool J-23188

36. Wipe a thin film of Delco Silicone Lube #5459912 (or equivalent) on the O.D. of the piston rod retainer. Insert the master cylinder piston rod retainer into the cavity in the secondary power piston so that the flat end bottoms against the rubber reaction disc in the bottom of the cavity.

Rear Housing Group

1. Coat the I.D. of the rear housing seal with Delco Silicone Lube #5459912 (or equivalent).
2. Place the NEW seal in the rear housing center hole so that the formed flange of the housing center hole fits into the groove of the seal. The thin lip of the seal will protrude to the outside of the housing.

Final Assembly

1. Mount Holding Fixture J-22805 in a vise and position the front housing on the tool so that the housing studs fit in the holes provided in the tool.
2. Position the power piston return spring over the inset in the front housing.
3. Assemble the power piston group to the rear housing by pressing the tube of the primary piston through the rear housing bearing. Press down until the housing divider seats in the rear housing and the primary power piston bottoms against the housing.
4. Place the piston rod retainer plate on the end of the power piston return spring in the front housing.
5. Hold the rear housing assembly (with mounting studs up) over the front housing (make sure that the piston rod retainer does not dislodge from the secondary power piston during this operation). Position the rear housing so that when the tangs on the edge of the front housing are locked in the slots on the edge of the front housing, the scribe marks on the top of the housings will be in line.
6. Lower the rear housing assembly onto the front housing. Check that the piston rod retainer goes through the center of the retainer plate on the power piston return spring. The retainer plate and power piston spring must seat in the depression in the face of the secondary power piston. Check that the bead on the O.D. of the secondary diaphragm is positioned between the edges of the housings.

7. Assemble front and rear housings as follows:
 - a. **Straight Mounting Bracket** - Place Spanner Wrench J-9504 over studs on rear housing, and attach with nuts and washers--draw nuts down tight to eliminate bending or damaging of studs.
 - b. **Tilt Mounting Bracket (Chevelle)** - Secure Spanner Wrench J-9504 to bracket with three bolts and nuts. Draw nuts down tight to eliminate damage to bracket.
 - c. **Tilt Mounting Bracket Except Chevelle** - Position Tool J-22893 inside tilted mounting

bracket. Place Spanner Wrench J-9504 on top of J-22893 and tighten nuts and washers to bolts provided, securing Spanner Wrench.

- d. Press down on spanner wrench and twist rear housing clockwise in relation to front housing until fully locked.

NOTE: If unit is not easily locked, hold housings together and apply vacuum to check valve in front housing. Do not put pressure on power piston extension.

8. Remove Tool J-9504 and, if used, Tool J-22893 from the rear housing.
9. Place the silencer in the closed end of the power head boot. Stretch the boot over the push rod and over the flange in the center of the rear housing. Install the boot retainer over the boot.
10. Remove the power head assembly from Holding Fixture J-22805 and remove Fixture J-22805 from the vise.
11. Install the push rod clevis and locknut, if so equipped.

Gauging

1. Place the power head assembly in a padded vise (front housing up). Do not clamp tight!
2. Insert the master cylinder piston rod, flat end first, into the piston rod retainer.
3. Press down on the master cylinder piston rod (with approximately a 40-50 pound load) to be sure it is properly seated.

NOTE: Remove the front housing seal to assure that no vacuum is in the power head while gauging.

4. Place Gauge J-22647 over the piston rod in a position which will allow the gauge to be slipped to the left or right without contacting the studs (fig. 14B).

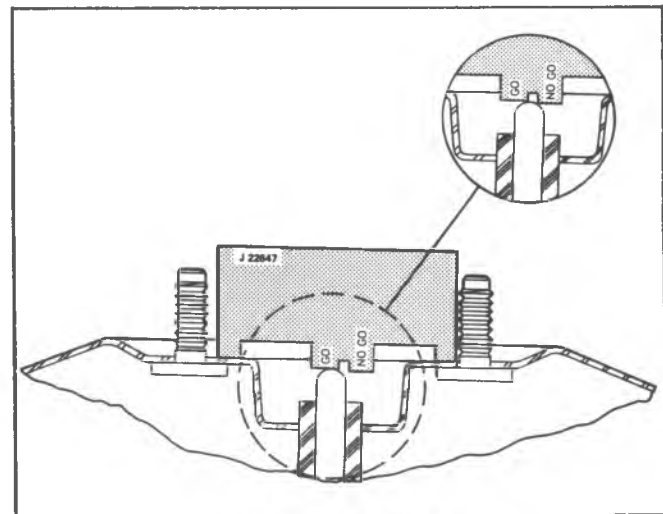


Fig. 14B--Gauging Piston Rod

5. The center section of the gauge has two levels. The piston rod should always contact the longer section (lower level) of the gauge. The piston rod should never contact the shorter section (higher level) of the gauge. Move gauge from side to side to check piston rod height.
6. Any variation beyond these two limits indicates an incorrect piston rod. Since the piston rod is non-adjustable, a new adjustable piston rod must be installed.
7. Wipe a thin film of Delco Silicone Lube #5459912 (or equivalent) on the I.D. of the front housing seal and position seal in the depression in the housing.
8. Install the master cylinder assembly on the front housing, positioning the cylinder on the mounting studs so that the top of the master cylinder reservoir is toward the scribe marks on the housings.
9. Install nuts on the studs and torque to 25 ft. lbs.

CAUTION: See "Caution" on Page 1 of this section.

BENDIX POWER BRAKE CYLINDER SINGLE DIAPHRAGM--DASH MOUNTED

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OVERHAUL OPERATIONS

Disassembly (Figs. 1C and 2C)

The following procedure applies to the power section of the power brake unit only. For service of the master cylinder, refer to applicable portion of "Standard Brakes" in the "Service" manual.

1. Scribe across outer edge of both housings and, if used, across mounting bracket flanges to provide a guide mark for reassembly.
2. Remove master cylinder attaching nuts and set master cylinder aside.
3. Remove the front housing seal (fig. 2C); pulling the piston rod from the front housing will also remove the seal assembly. Remove the piston rod.
4. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs. Clamp base in bench vise with power section up (fig. 2A).

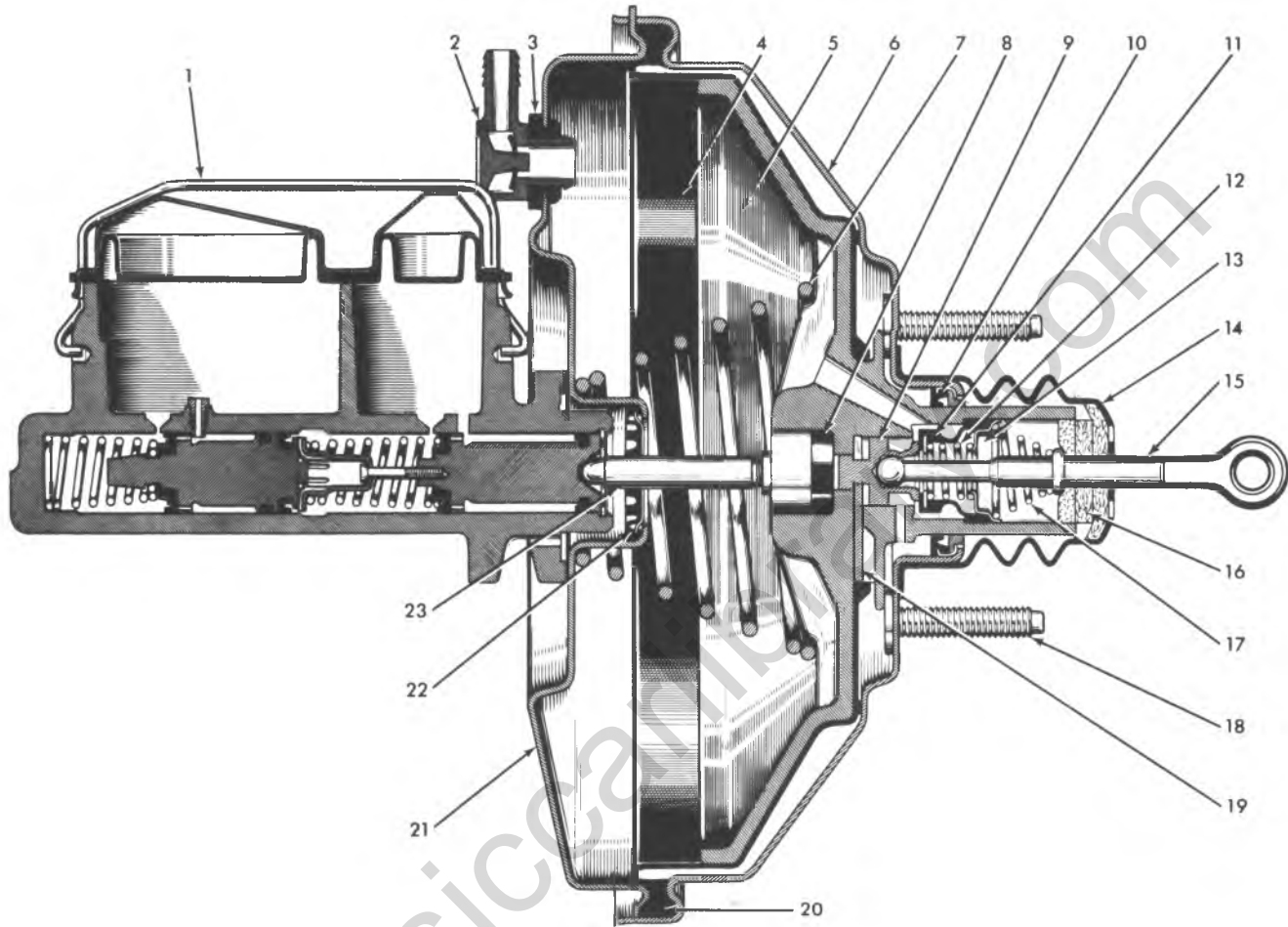
CAUTION: Be sure to align tool so that the check valve in the front housing is not damaged.
5. Loosen locknut and remove push rod clevis and locknut, if so equipped.
6. Remove the mounting bracket from the rear housing, if so equipped.
7. Remove the dust boot retainer, dust boot and silencer from the diaphragm plate extension.

8. The edge of the rear housing contains twelve lances. Four of these lances (one in each quadrant) are deeper than the other lances (fig. 3C). The metal that forms the four deep lances must be partially straightened so that the lances will clear the cutouts in the front housing. If the metal tabs that form the deep lances crack or break during straightening, the housing must be replaced.
9. Place Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs (fig. 3A).

WARNING: When separating housings, maintain pressure on rear housing as it is under spring tension.

10. Press down on Spanner Wrench J-9504 and rotate the rear housing clockwise to separate the two housings. If the rear housing cannot be readily loosened, tap the rear housing lightly with plastic hammer.
11. Remove Tool J-9504 from the rear housing.

CAUTION: Care must be exercised not to damage or loosen studs in the rear housing. Also, take care that no pressure is brought to bear on plastic diaphragm plate tension.
12. Lift the rear housing assembly from the unit.



- 1. Master Cylinder
- 2. Vacuum Check Valve
- 3. Grommet
- 4. Diaphragm
- 5. Diaphragm Plate
- 6. Rear Housing
- 7. Diaphragm Spring
- 8. Reaction Disc

- 9. Air Valve
- 10. Front Housing Seal
- 11. Poppet Valve
- 12. Poppet Valve Spring
- 13. Poppet Retainer
- 14. Dust Boot
- 15. Valve Push Rod
- 16. Filter and Silencers

- 17. Valve Return Spring
- 18. Mounting Stud
- 19. Air Valve Lock Plate
- 20. Diaphragm Lip
- 21. Front Housing
- 22. Front Housing Seal
- 23. Piston Rod

Fig. 1C--Bendix Single Diaphragm Unit (Typical)

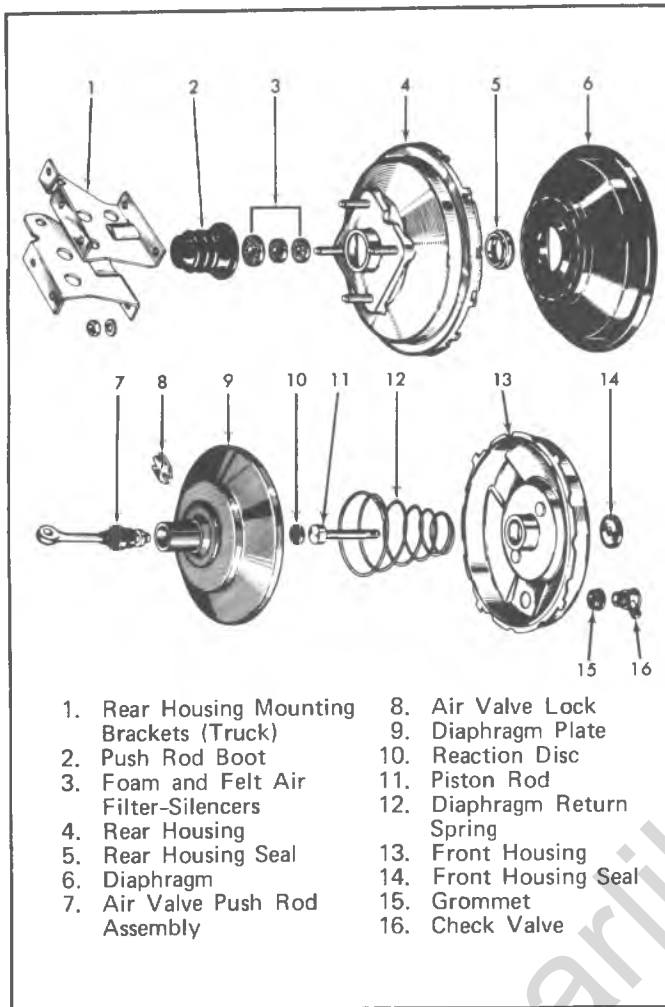


Fig. 2C-Bendix Power Cylinder Components (Typical)

Rear Housing Group

1. Remove the air filter element from location within the diaphragm plate extension.

CAUTION: To prevent chipping of the plastic diaphragm plate, exercise extreme caution when removing the air filter retainer. Use a small screwdriver or other suitable tool, and pry at several peripheral locations until the retainer is freed.

2. Separate the diaphragm plate assembly from the rear housing and lay the rear housing aside.
3. Disassemble diaphragm plate assembly (fig. 2C).
 - a. Remove rolling diaphragm from the groove in the diaphragm plate hub.

CAUTION: Care should be used in handling the diaphragm of the diaphragm plate assembly. The diaphragm should be protected from grease, oil, foreign matter and from nicks, scratches and gouges.

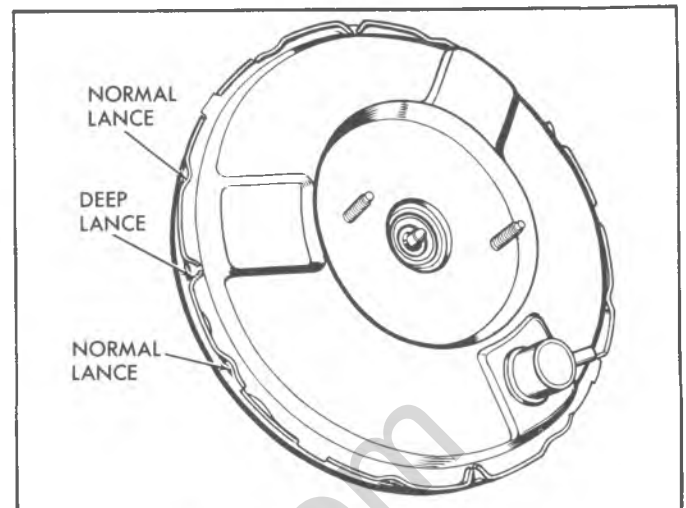


Fig. 3C-Lances in Rear Housing

- b. Hold the diaphragm plate so that the push rod is in its normal (horizontal) installed position, depress the push rod slightly (approximately 1/16 inch), and rotate piston so the air valve lock will fall from its location in the diaphragm plate hub. Remove the air valve push rod assembly from the diaphragm plate. Remove the reaction disc from its location in the diaphragm plate bore (insert the piston rod or other suitable tool through diaphragm plate extension and push disc from its seat). Exercise care so as not to chip surface of passages in the diaphragm plate.

NOTE: Perform Step 4 only if seal is defective and a new seal is available. Do not reuse seal once it has been removed from the unit.

4. Support outer surface of rear housing on blocks of wood or other suitable material (stud side up) and drive out seal with a punch or a thin blade screwdriver. Discard seal.

Front Housing Group

1. Remove check valve from grommet and then remove grommet from front housing; discard valve and grommet.
2. Remove front housing and holding fixture from vise; then remove holding fixture from front housing.

Cleaning

Use denatured alcohol to clean all metal, plastic and rubber parts of the power cylinder. Immerse parts in cleaning solvent and use a hair brush to remove foreign matter. Blow out all passages, orifices and valve holes. AIR DRY and place cleaned parts on clean paper or lint-free cloth. If slight rust is found on inside surface of power cylinder housing, polish clean with crocus cloth or fine emery cloth, then follow with a thorough cleaning as outlined above.

CAUTION: The use of gasoline, kerosene, antifreeze, alcohol or any other cleaner, with even a trace of mineral oil, will damage rubber parts. Be particularly careful during reassembly that no grease or mineral oil comes in contact with these rubber parts.

Inspection

Wipe cleaning fluid from all parts and carefully inspect each part for damage and wear. Inspect rubber parts for cuts, nicks and distortion. These rubber parts are the key to control of air flow and should account for the majority of troubles traceable to leakage. If there is any question whatever as to serviceability of any part, replace it.

Refer to "Inspection Chart" for more detailed instructions.

Assembly (Figs. 1C and 2C)

CAUTION: Be sure to keep parts clean until reassembly. Re-wash at reassembly if there is any occasion to doubt cleanliness - such as parts dropped or left exposed for eight hours or longer.

If there is any suspicion of contamination or any evidence of corrosion, completely flush the car hydraulic brake system in accordance with the Chassis Service Manual.

Lubricate rubber parts, all plastic and metal friction points with Delco Silicone Lube #5459912, or equivalent.

Front Housing Group

1. Install new check valve grommet in front housing with beveled edge of grommet inside of housing. Dip new check valve in clean denatured alcohol and install in grommet--check valve stem is to be outside of housing.
2. Position and secure Holding Fixture J-22805 (fig. 2A) to mounting studs, and place tool and front housing in a vise. Be sure to align tool so that check valve is not damaged.

NOTE: If either or both of the housings are replaced, make sure alignment marks are transferred to the new housing.

Rear Housing Group

1. Place rear housing on a block of wood, stud side down, and position housing seal in center hole. Use Tool J-22677 (fig. 4C) to seat seal in recess of rear housing. Tool bottoms against housing when seal is in place.
2. Assemble diaphragm plate assembly (see fig. 2C).
 - a. Apply Delco Silicone Lube #5459912 (or equivalent) to outside diameter of diaphragm plate and extension, to bearing surfaces of air valve and to outer edge of valve poppet. Insert

air valve and push rod assembly in extension of diaphragm plate.

NOTE: The air valve, poppet valve and push rod are serviced as an assembly; a complete unit must be installed if there is damage to any of the component parts.

- b. Depress the push rod slightly and install the air valve lock. Make sure the lock indexes and retains the air valve.
- c. Install the rolling diaphragm in the groove of diaphragm plate.
- d. Apply Delco Silicone Lube #5459912 (or equivalent) to surface of reaction disc and position disc in center bore of diaphragm plate. Use piston rod to seat disc in bore. Make sure disc is fully seated before removing piston rod.

NOTE: If reaction disc is not fully seated, it will result in an erroneous push rod height adjustment.

3. Apply Delco Silicone Lube #5459912 (or equivalent) to I.D. of rear housing seal and diaphragm bead contact surface of rear housing. Install diaphragm plate assembly in rear housing.
4. Place air filter element over push rod and into diaphragm plate extension. Install filter retainer.

Final Assembly

1. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs. Clamp base in bench vise with power section up (fig. 2A).

CAUTION: Be sure to align tool so that the check valve in the front housing is not damaged.

2. Place Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs.
3. Place diaphragm plate return spring in front housing and position rear housing assembly on front housing (small end of spring downward). Position rear housing so that when housings are locked, scribe marks on front and rear housings will be in alignment.
4. Press down on Spanner Wrench J-9504 and rotate the rear housing counterclockwise to assemble the two housings (fig. 3A).

CAUTION: Bend lances in on the rear housing. If the tangs crack or break during this operation it will be necessary to replace that half of the housing.

5. Remove Tool J-9504 from the rear shell.
6. Install air silencers over push rod end and then install push rod boot. Install boot retainer.

INSPECTION TABLE

Part	Inspect For	Corrective Action
Diaphragm Support Plate	1. Cracks, distortion, chipping, damaged seats, pitted or rough holes.	1. Clean up or replace.
	2. Worn seal surfaces (tubes).	2. Replace
	3. Rough or uneven valve seat.	3. Replace
	4. Open passages and flow holes.	4. Clean
Poppet Valve	1. Deterioration of rubber or warped valve face.	1. Replace
Air Valve - Push Rod Assembly	1. Air valve: scratches, dents, distortion, or corrosion of I.D. or O.D. All seats to be smooth and free of nicks and dents.	1. Do not repair - replace.
	2. Push rod must move freely in air valve, but must not pull out.	2. If worn, replace air valve - push rod assembly.
Front and Rear Housings	1. Scratches, scores, pits, dents, or other damage affecting rolling or sealing of diaphragm or other seals.	1. Replace, unless easily repaired.
	2. Cracks, damage at ears. damaged threads on studs.	2. Replace, unless easily repaired.
	3. Bent or nicked locking lugs.	3. Replace, unless easily repaired.
	4. Loose studs.	4. Replace or repair.
Air Filters and Silencer	1. Dirty	1. Replace



Fig. 4C--Installing Rear Housing Seal

7. **Clevis Type Push Rod**- Install locknut and push rod clevis.
8. Install mounting bracket to the rear shell, if so equipped.

CAUTION: See "Caution" on Page 1 of this section.

9. Remove power cylinder from vise and remove Holding Fixture J-22805.
10. Apply Delco Silicone Lube #5459912 (or equivalent) sparingly to the piston rod, keeping lubricant away from rounded end of rod. Guide piston rod into center bore of the diaphragm plate until it is fully seated against reaction disc.
11. Install front housing seal. Press and seal into front housing until seal is bottomed in recess of housing.
12. Install master cylinder to power cylinder. Install attaching nuts and torque to 25 ft. lbs.

CAUTION: See "Caution" on Page 1 of this section.

NOTE: The piston rod is non-adjustable and therefore no gauging procedures are included.

BENDIX POWER BRAKE CYLINDER DUAL DIAPHRAGM--DASH MOUNTED

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OVERHAUL OPERATIONS

Disassembly (Figs. 1D and 2D)

1. Scribe across the flanges of front and rear housings, in line with master cylinder cover, to provide a guide mark for reassembly.
2. Remove two (2) master cylinder attaching nuts and remove the master cylinder.
3. Remove the front housing seal (fig. 1D); pulling the piston rod from the front housing will also remove the seal. Separate the piston rod and seal.
4. Remove vacuum check valve from front housing by pulling straight out on valve. Then remove rubber grommet from front housing. Discard both valve and grommet.

5. **Clevis Type Push Rod**- Loosen locknut and remove clevis and locknut from push rod.
6. Unseat dust boot from flange of rear housing and remove boot and silencer from assembly.
7. Using a thin-bladed screw driver carefully pry silencer retainer off hub of rear diaphragm plate, being careful not to chip plastic.
8. Squirt denatured alcohol down the push rod to lubricate rubber grommet in the air valve.
9. Install end of air valve push rod in vise, leaving enough clearance to position two (2) open end wrenches between the vise and retainer on hub of rear plate.

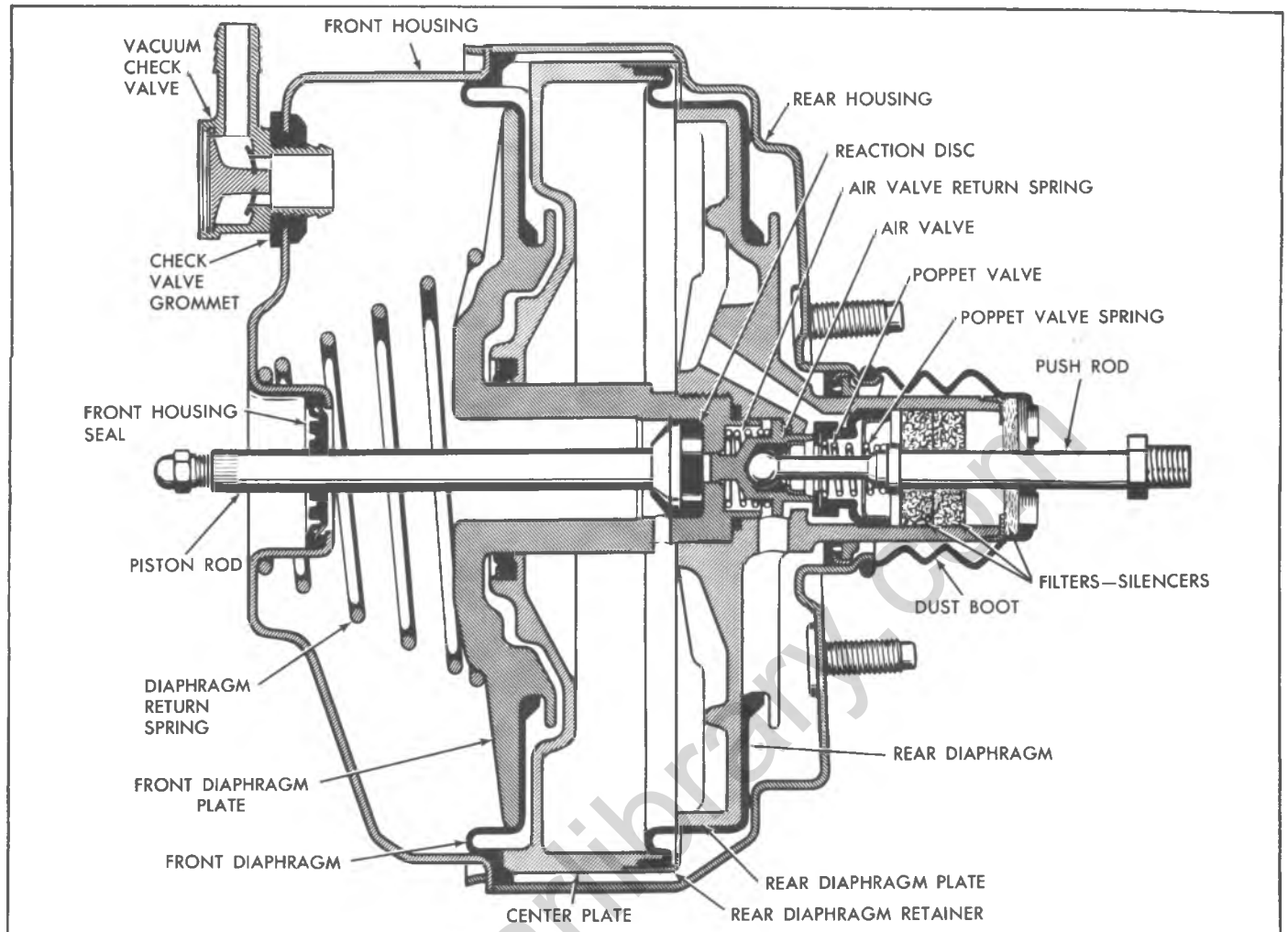


Fig. 1D-Bendix Dual Diaphragm Cross Section

10. Using the wrench nearest the vise as a pry, force the air valve off the ball end of the push rod. DO NOT damage the plastic hub or allow vacuum cylinder to fall to the floor (fig. 3D).
11. Slide air filter and air silencer from ball end of push rod.
12. Remove poppet valve spring, poppet retainer and valve poppet from hub of rear diaphragm plate (fig. 4D).
13. The edge of the rear housing contains twelve (12) lances. Four (4) of these lances (one in each quadrant) are deeper than the other lances. The metal that forms the four (4) deep lances must be partially straightened so that the lances will clear the cutouts in the front housing. If the metal tabs that form the deep lances break during straightening, the housing must be replaced (fig. 5D).
14. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs.
15. Place power unit with Holding Fixture J-22805 in an arbor press with rear housing up and secure to plate of press by a suitable means of holding Tool J-22805 (fig. 6D). By using a 1-1/2" open end wrench on Tool J-22805 and allowing unit to turn against back of arbor press, press will hold unit from turning.
16. Place Spanner Wrench J-9504 over studs on rear shell (fig. 6D). Use three washers and nuts to attach wrench to housing. Use a suitable piece of pipe of approximately two inches I.D. and approximately three inches in length. Place over plastic diaphragm plate hub. Place a piece of flat stock steel over end of pipe and press rear housing down far enough to relieve tension of diaphragm rubber lip and spring.
17. Rotate spanner bar counterclockwise and unlock shells.

WARNING: The diaphragm return spring is compressed in the power section and expands as the pressure on the housings is removed. If the housings do not separate when the screw has been turned slightly to reduce the pressure, tap the housings with a rubber hammer to break the bond.

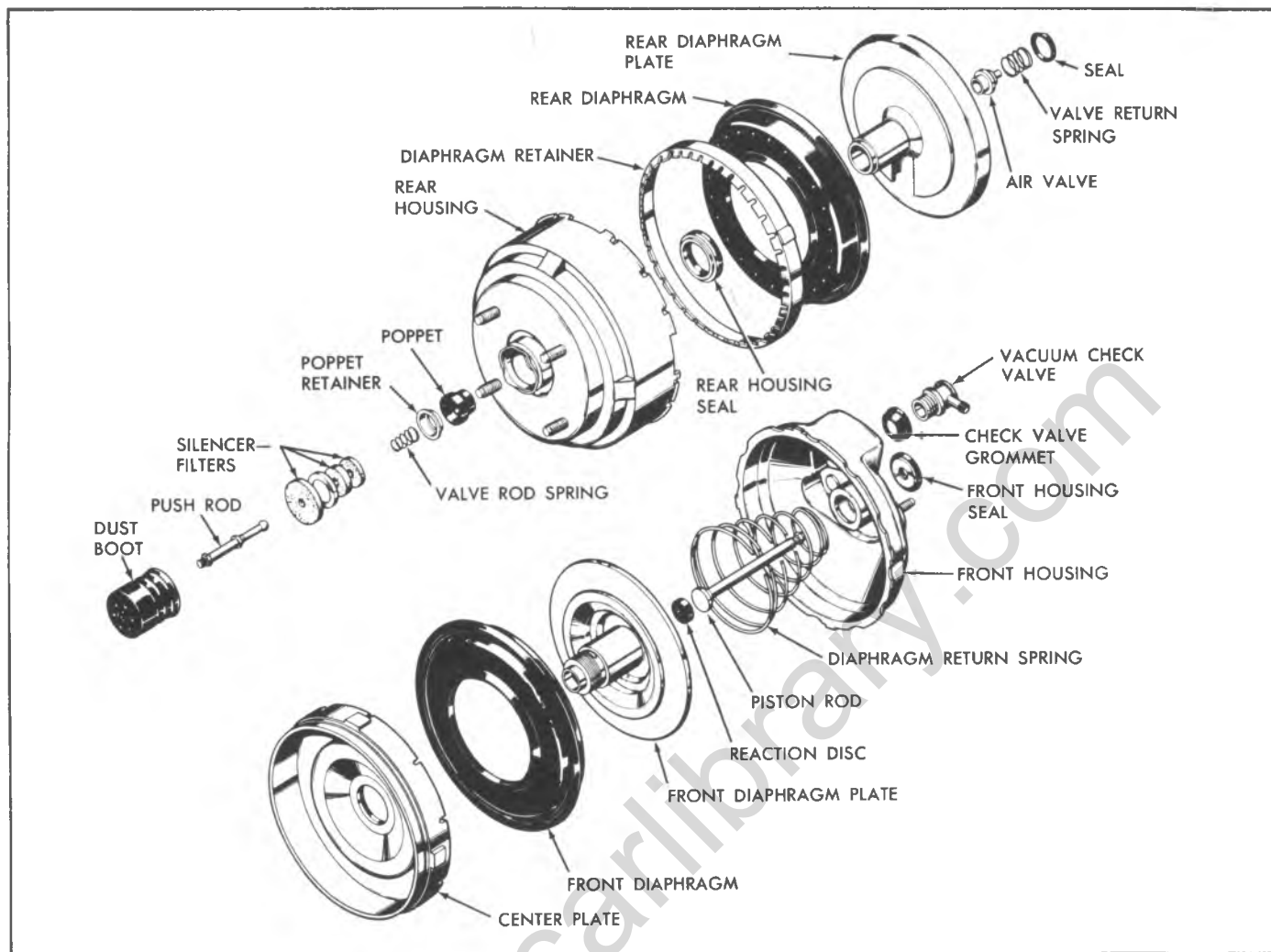


Fig. 2D-Bendix Dual Diaphragm Components

18. Release press and remove diaphragm return spring.
19. Remove three nuts and washers from Spanner Wrench and separate wrench and rear housing.
20. Remove Holding Fixture J-22805 from front housing.
21. Work edges of front diaphragm from under lances of rear housing and remove complete vacuum assembly from rear housing, using care not to damage rear housing seal. Bosses on center plate must be aligned with cutouts in rear housing to remove the assembly.
22. Wet the rear diaphragm retainer with denatured alcohol and remove the retainer using fingers only.
23. Clamp Tool J-22839 in a vise. Place the diaphragm and plate assembly on the tool with the tool seated in the hex opening in the front plate.
24. Twist the rear diaphragm plate counterclockwise, using hand leverage on the outer edge of the plate.
25. After the two (2) plates have been loosened, remove the plates from Tool J-22839 and place on a bench with the front plate down. Unscrew the rear plate completely and carefully lift it off the front plate hub, grasping the air valve and valve return spring as the parts are separated.
26. Remove the square ring seal from the shoulder of the front diaphragm plate hub.
27. Remove the reaction disc from inside the front diaphragm plate hub. Carefully slide the center plate off the hub of the front plate.

NOTE: Vacuum seal may stay in front or center diaphragm plate. If seal assembly is defective, center plate and seal assembly must be replaced as an assembly.

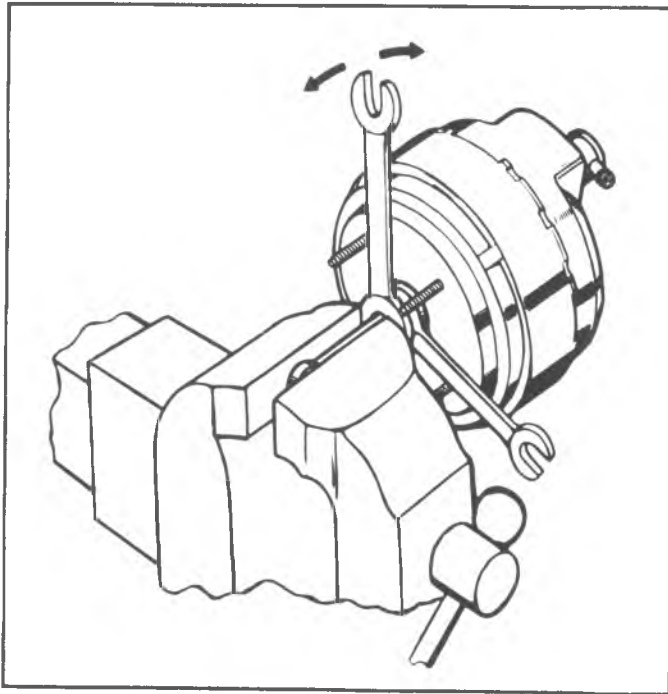


Fig. 3D--Removing Push Rod

28. Remove the diaphragms from the plates.
29. If rear housing seal requires replacement, use a blunt punch or 1-1/4" socket to drive seal from housing.

Cleaning

Use denatured alcohol to clean all metal, plastic and rubber parts of the power cylinder. Immerse parts in cleaning fluid and use a hair brush to remove foreign matter. Blow out all passages, orifices and valve holes. AIR DRY and place cleaned parts on clean paper or lint-free cloth. If slight rust is found on inside surface of power cylinder housing, polish clean with crocus cloth or fine emery cloth, then follow with a thorough cleaning as outlined above.

CAUTION: Use of gasoline, kerosene, anti-freeze alcohol or any other cleaner with even a trace of mineral oil, will damage rubber parts.

Inspection

Wipe cleaning fluid from all parts and carefully inspect each part for damage and wear. Inspect rubber parts for cuts, nicks and distortion. These rubber parts are the key to control of air flow and should account for the majority of troubles traceable to leakage. If there is any question whatever as to serviceability of any part, replace it.

Refer to "Inspection Chart" for more detailed installations.

Assembly

CAUTION: Be sure to keep parts clean until reassembly. Re-wash at reassembly if there is any occasion to doubt cleanliness - such as

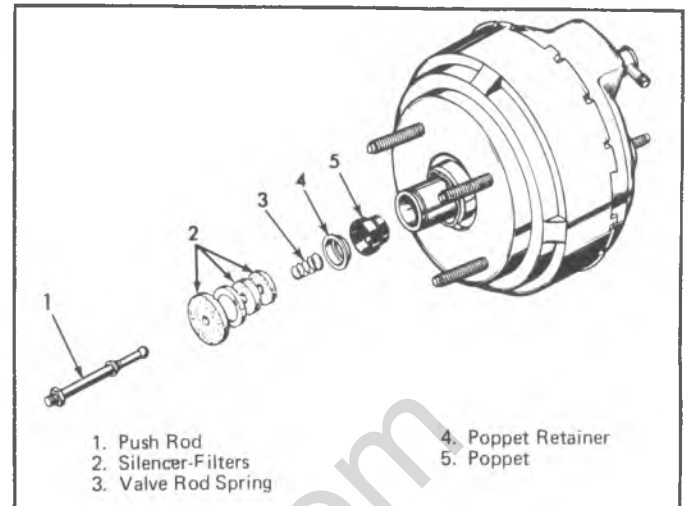


Fig. 4D--Removing Valve Operating Rod, Retainer, Filters and Poppet

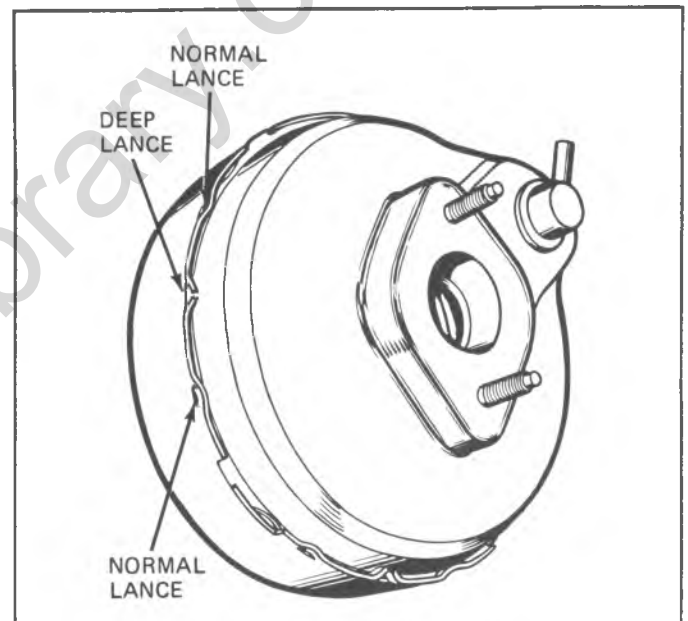


Fig. 5D--Lances in Rear Housing

parts dropped or left exposed for eight hours or longer.

If there is any suspicion of contamination or any evidence of corrosion, completely flush the car hydraulic brake system in accordance with the Service Manual.

Lubricate rubber, plastic and metal friction points with Delco Silicone Lube #5459912 (or equivalent).

1. If the rear housing seal was removed, press the new seal into this cavity in the rear housing using Tool J-22677 (fig. 7D). The flat rubber surface of the seal should be 5/16" below the flat, inside surface of the rear housing.

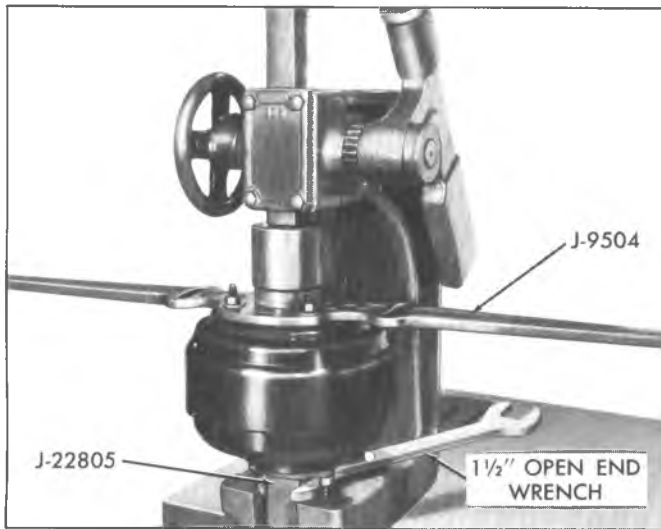


Fig. 6D--Holding and Separating Housings Using J-22805 and J-9504 in Arbor Press

2. Install reaction disc in hub of front plate with small tip side first. Use rounded rod to seat disc.
3. Mount Tool J-22839 in vise.
4. Install front diaphragm on front plate. Long fold of diaphragm must be facing down.
5. Install Tool J-22733 over threads on front plate hub (fig. 8D).
6. Apply a light film of Delco Silicone Lube #5459912 (or equivalent) to front plate hub and to seal in center plate, then guide center plate, seal first, onto the front plate hub, being careful not to damage center plate seal. Remove Seal Protector J-22733.
7. Apply a light coat of Delco Silicone Lube #5459912 (or equivalent) to front and rear bearing surfaces of air valve, being careful not to apply lubricant to rubber grommet inside valve. Install square ring seal on shoulder of front plate hub. Install air valve return spring and valve in base of front plate hub (fig. 9D).
8. Set rear plate over hub of front plate, and using hands only, screw plate on hub, making sure that valve and spring are properly aligned. Check travel of valve plunger with index finger - valve should be free. Be sure plates are tight but do not overtorque.
9. Assemble rear diaphragm to rear plate and place lip of diaphragm in groove in rear plate. Install diaphragm retainer over rear diaphragm and lip of center plate. Using fingers, press retainer until it seats on shoulder of center plate (fig. 10D).
10. Apply talcum powder to inside wall of rear housing and Delco Silicone Lube #5459912 to the scalloped cutouts of front housing and to seal in rear housing. Assemble diaphragm and plate assembly into rear housing by carefully guiding rear plate hub through seal in rear housing. Bosses on center plate must be aligned between lances in rear housing for reassembly. Work outer rim of front diaphragm into rear housing with screwdriver blade so that it is under lances in housing.
11. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs.
12. Secure front housing and Holding Fixture J-22805 on arbor press plate by a suitable means (fig. 6D).
13. Place Spanner Wrench J-9504 over studs on rear housing. Use three washers and nuts to attach wrench to housing. Place a suitable piece of pipe (approximately two inch I.D. and approximately three inches in length) over plastic diaphragm plate hub. Place a piece of flat stock steel over end of pipe.
14. Install diaphragm return spring so that small end of spring is against front housing.
15. Lubricate outer rim of front diaphragm with Delco Silicone Lube #5459912 (or equivalent).
16. Apply liberal coat of Delco Silicone Lube #5459912 (or equivalent) to cut-out trim surface of front housing that will engage front diaphragm.
17. Place rear housing over front housing, lining up scribe marks on front housing so that front housing is slightly counterclockwise of scribe mark on rear housing.
18. Compress housings in the arbor press until diaphragm edge is fully compressed with tangs on front housing against slots on rear housing.
19. Rotate spanner wrench clockwise until tangs on front housing butt against rear housing stops.

CAUTION: Bend lanced areas "in" on the housing to secure in place. If the tangs break during this operation, it will be necessary to replace that half of the housing.
20. Remove three nuts and lock washers securing rear housing to spanner wrench.
21. Remove Holding Fixture J-22805 from front housing by removing two nuts and washers.
22. Wet poppet valve with denatured alcohol and assemble in rear plate hub, small end first. Wet poppet retainer with denatured alcohol and assemble with shoulder inside poppet. Assemble retainer, filters and silencer over ridge on push rod and return spring over ball end of push rod. Wet grommet in air valve with denatured alcohol and guide air valve push rod into air valve. Tap end of push rod with plastic hammer to lock ball in grommet. Press filters and silencers into hub and install retainer on hub.
23. Assemble silencer in dust boot, wet dust boot opening with denatured alcohol and assemble over operating valve rod and over flange of rear housing.

INSPECTION CHART

Part	Inspect For	Corrective Action
Diaphragm Support Plates	1. Cracks, distortion, chipping, damaged lever seats, pitted or rough holes.	1. Clean up or replace.
	2. Worn seal surfaces (tubes).	2. Replace
	3. Rough or uneven valve seat.	3. Replace
	4. Open passages and flow holes.	4. Clean
Poppet Valve	1. Deterioration of rubber or warped valve face.	1. Replace
Air Valve - Push Rod Assembly	1. Air valve: scratches, dents, distortion, or corrosion of I.D. or O.D. All seats to be smooth and free of nicks and dents.	1. Do not repair - replace.
	2. Push rod must move freely in air valve, but must not pull out.	2. If worn, replace air valve - push rod assembly.
Front and Rear Housings	1. Scratches, scores, pits, dents, or other damage affecting rolling or sealing of diaphragm or other seals.	1. Replace, unless easily repaired.
	2. Cracks, damage at ears, damaged threads on studs.	2. Replace, unless easily repaired.
	3. Bent or nicked locking lugs.	3. Replace, unless easily repaired.
	4. Loose studs.	4. Replace or repair.
Air Filters and Silencer	1. Dirty	1. Replace.

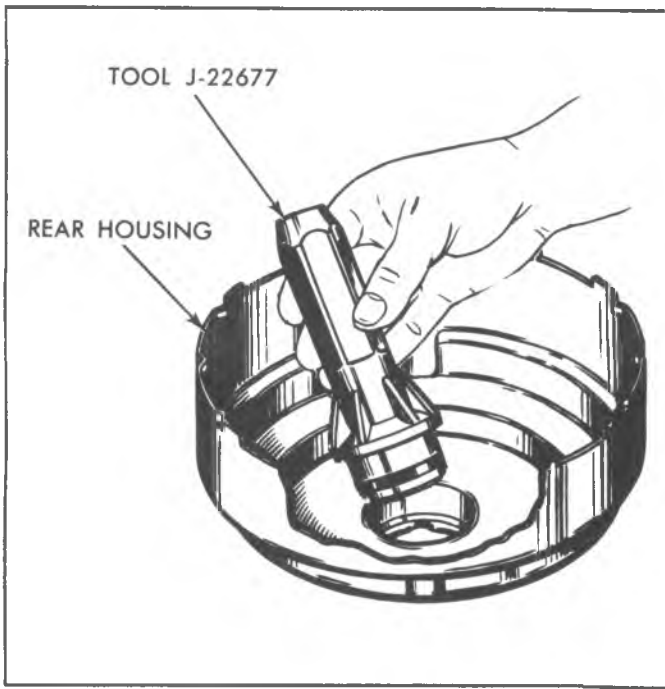


Fig. 7D--Installing Rear Housing Seal with Installer J-22677

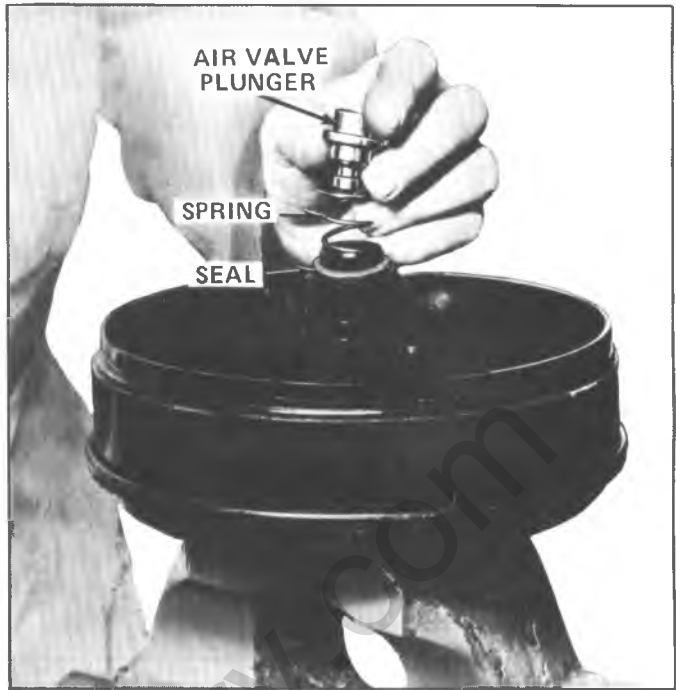


Fig. 9D--Installing Air Valve Assembly

24. **Clevis Type Push Rod** - Assemble locknut and clevis to push rod end.
25. Dip new check valve grommet in denatured alcohol and install into front housing, beveled side first.
26. Dip end of new vacuum check valve in denatured alcohol and install valve through grommet.
27. Apply Delco Silicone Lube #5459912 (or equivalent) to piston end of piston rod and insert in cavity in front plate. Twist rod to eliminate air bubbles at reaction disc. Assemble seal over piston rod and press into recess in front housing.

CAUTION: The piston rod is designed with a self-locking adjustment screw to provide the correct relationship between vacuum piston and master cylinder piston. The adjustment is important as it provides for the compensating port being kept open while unit is in released position. Adjustment screw is set to the correct height when assembled, and under normal service, will not require further adjustment. After unit has been disassembled however, the height should be checked as follows.

Piston Rod Gauging

If adjustment is necessary, grasp piston rod with pliers at

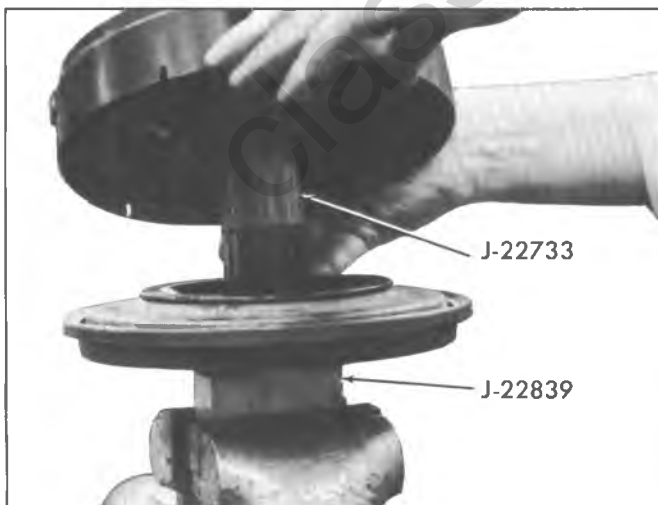


Fig. 8D--Seal Protector J-22733 Installed

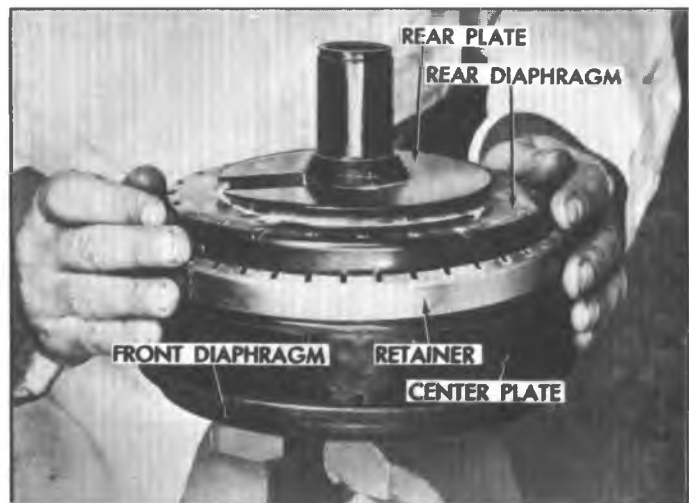


Fig. 10D--Installing Rear Diaphragm Retainer

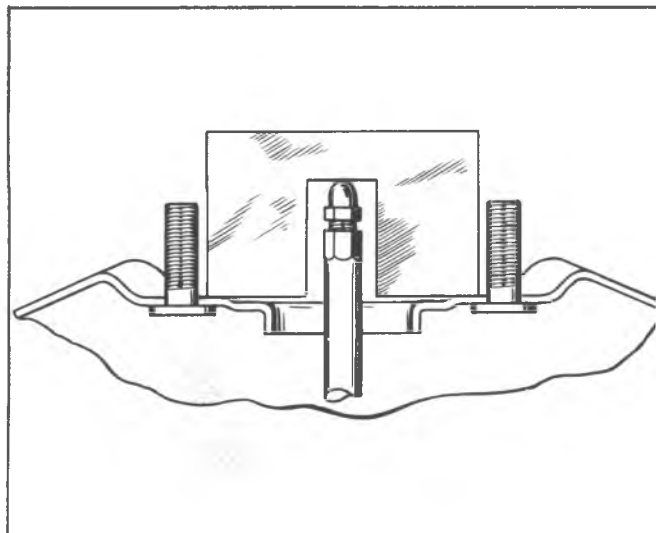


Fig. 11D--Adjustment of Piston Rod

serrated end and turn adjusting screw either in or out as required.

1. Place top of Piston Rod Height Gauge J-21183 (Corvette) over piston rod with legs of gauge resting on front housing as in Figure 11D. Top of screw should touch gauge.

NOTE: If piston rod height adjustment gauge

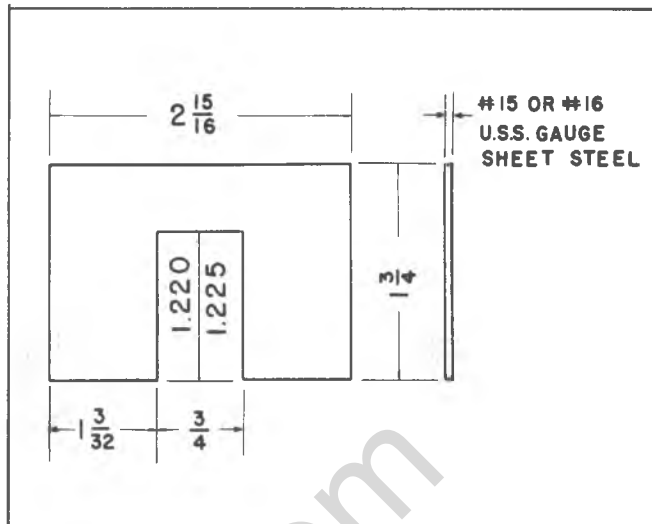


Fig. 12D--Piston Rod Gauge

is not available, the required dimensions for fabrication are given in Figure 12D for Corvette.

2. Install backing plate on rear housing and thread clip nut on stud marked during disassembly.
3. Assemble master cylinder to front housing and tighten nuts to 25 ft. lbs. torque.

CAUTION: See "Caution" on Page 1 of this section.

BENDIX

HYDRAULIC BRAKE BOOSTER (HYDRO-BOOST)

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OVERHAUL OPERATIONS

The Bendix Hydraulic Brake Booster utilizes the hydraulic pressure supplied by the power steering pump to provide power assist for brake applications (fig. 1E). The dual master cylinder is mounted to the output push rod end of the booster.

The procedures below include removal of the linkage bracket even though it is not necessary to remove the bracket for overhaul of the internal assembly.

Disassembly (Fig. 2E)

1. Secure the booster in a vise (bracket end up) and use a hammer and chisel to cut the bracket nut that secures the linkage bracket to the power section (cut the nut at the open slot in the threaded portion of the housing). Be careful to avoid damage to the threads on the booster hub. Spread the nut and remove it from the power section. Then remove the linkage bracket.
2. Remove the pedal rod boot by pulling it off over the pedal rod eyelet.
3. Place Tool J-24569 around the pedal rod and resting on the input rod end as shown in Figure 3E.
4. Place a punch (or similar tool) through the pedal rod from the lower side of Tool J-24569. Push the punch on through to rest on the higher side of the tool. Lift up on the punch to shear the pedal rod retainer; remove the pedal rod.
5. Remove the remnants of the rubber grommet from the groove near the end of the pedal rod and from the groove inside the input rod end.
6. Disengage the tabs of the spring retainer from the ledge inside the opening near the master cylinder mounting flange of the booster. Remove the

retainer and the piston return spring from the opening.

7. Pull straight out on the output push rod to remove the push rod and push rod retainer from inside the booster piston.
8. Press in on spool plug, and insert a small punch into the hole on top of the housing (fig. 4E). This unseats one side of the spool plug snap ring from its groove in the bore. Then remove the snap ring from the bore.
9. Use pliers to remove the spool plug from the bore. Remove the "O" ring seal from the plug; discard the "O" ring. Remove the spool spring from the bore.
10. Place the booster cover in a vise equipped with soft jawed devices, and remove the five screws that secure the booster housing to the cover.

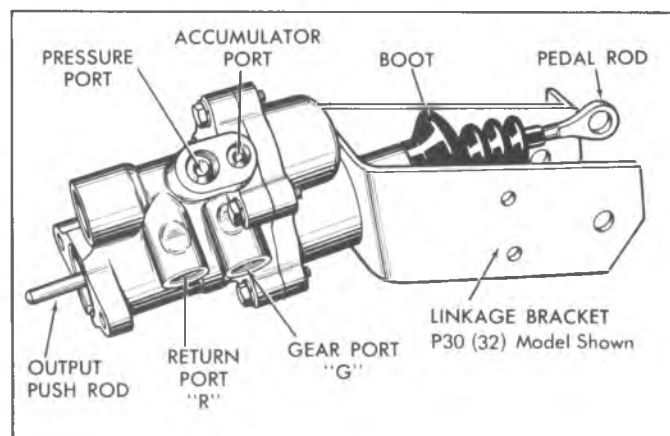


Fig. 1E--Bendix Hydro-Boost Brake Booster (Typical)

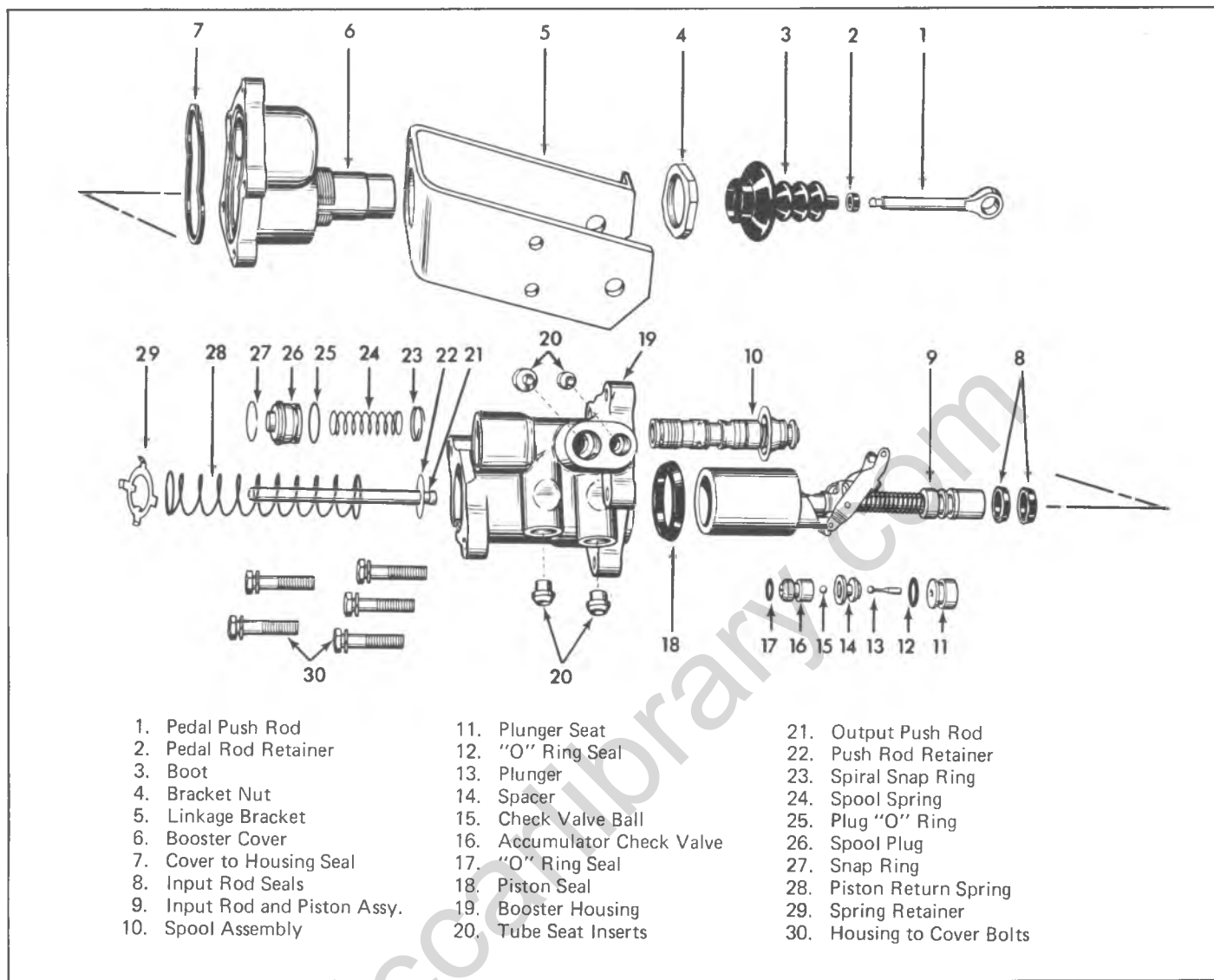


Fig. 2E--Power Booster Components (Typical)

11. Remove the booster assembly from the vise and while holding the unit over a pan, separate the cover from the housing. Remove the large seal ring from the groove in the cover; discard the seal.
 12. Press in on the end of the spool assembly, and use Snap Ring Removal Tool J-24549 (Fig. 5E) to remove the spiral type snap ring from the groove near the forward end of the spool. The tool is used to engage one coil of the snap ring and then rotated to remove the remaining snap ring coils from the groove in the spool; discard the snap ring.
- NOTE:** Removal is best accomplished by applying pressure against the opposite side of the snap ring with a small screwdriver while the coil is being engaged with Tool J-24549.
13. Remove the input rod and piston assembly, and the spool assembly from the booster housing.
 14. Remove the input rod seals from the input rod end, and the piston seal from the piston bore in the housing; discard the seals.
 15. Remove the plunger, seat, spacer and ball from the accumulator valve bore in the flange of the booster housing. Remove the "O" ring from the seat; discard the "O" ring.
 16. Thread a screw extractor into the opening in the check valve in the bottom of the accumulator valve bore, and remove the check valve from the bottom of the bore. Discard the check valve and "O" ring.

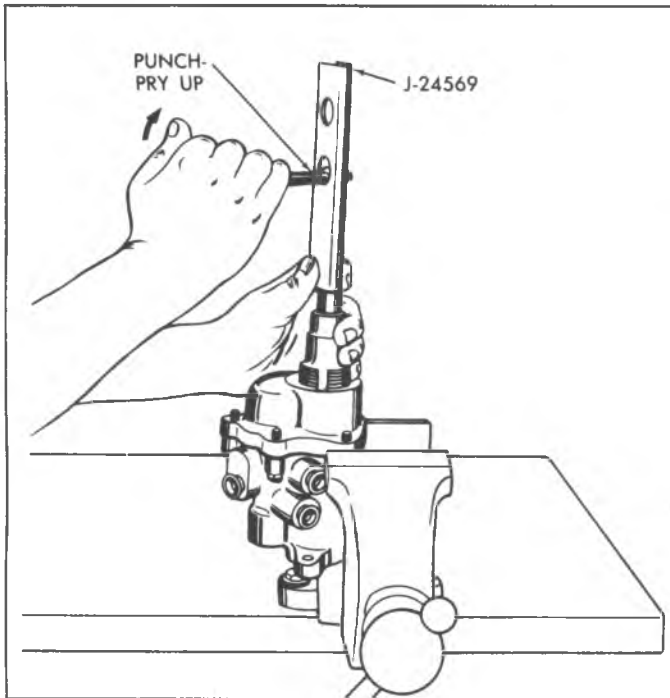


Fig. 3E--Removing Booster Pedal Rod

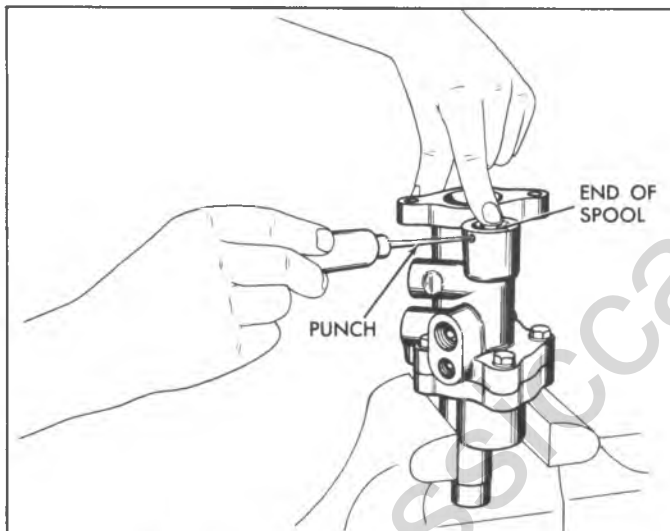


Fig. 4E--Removing Spool Plug from Booster

NOTE: Using a screw extractor damages the seat in the check valve. A new check valve, "O" ring and ball must be installed whenever the check valve is removed from the accumulator valve bore.

17. Use a 1/4" or a 5/16" spiral flute type screw extractor to remove the tube seats from the booster ports.

Cleaning and Inspection

1. Clean all metal parts in a suitable solvent. Be careful to avoid losing small parts.

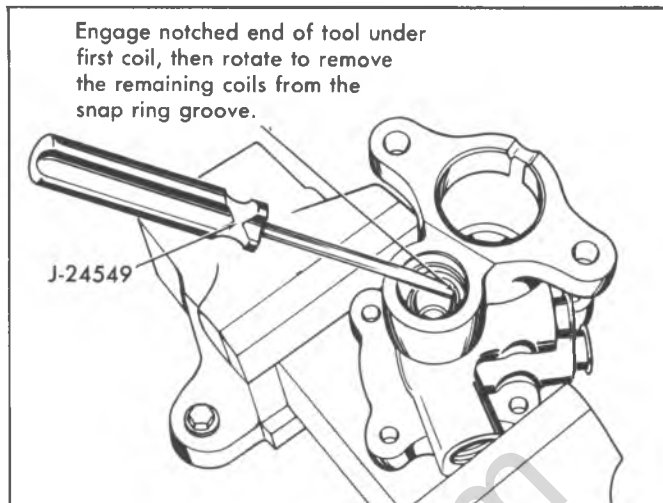


Fig. 5E--Removing Spiral Snap Ring

2. Inspect the valve spool and the valve spool bore in the booster housing for corrosion, nicks, scoring or other damage. Discoloration of the spool or bore, particularly in the grooves, is not harmful and is no cause for concern.
3. If the valve spool or the valve spool bore has nicks or scoring that can be felt with a fingernail, particularly on the lands, the spool and housing should be replaced as an assembly.

NOTE: The clearance between the valve spool and the spool bore of the housing assembly is important. Because of this, the valve spool and the housing assembly make up a selective assembly (the valve spool is selected to match the spool bore), and the spool and housing can only be replaced as an assembly.

4. Inspect the input rod and piston assembly for corrosion, nicks, scoring or excessive wear. If the piston is damaged, the input rod and piston assembly should be replaced.
5. Inspect the piston bore in the booster housing for corrosion, nicks, scoring or other damage. If the bore is damaged, the valve spool and housing should be replaced as an assembly.

Assembly

CAUTION: *Be sure to keep parts clean until reassembly. Re-wash at reassembly if there is any occasion to doubt cleanliness - such as parts dropped or left exposed for eight hours or longer.*

Lubricate all seals and metal friction points with power steering fluid.

Whenever the booster is disassembled, all seals, tube inserts, spiral snap ring, check valve and ball should be replaced. All of these parts are included in a seal kit.

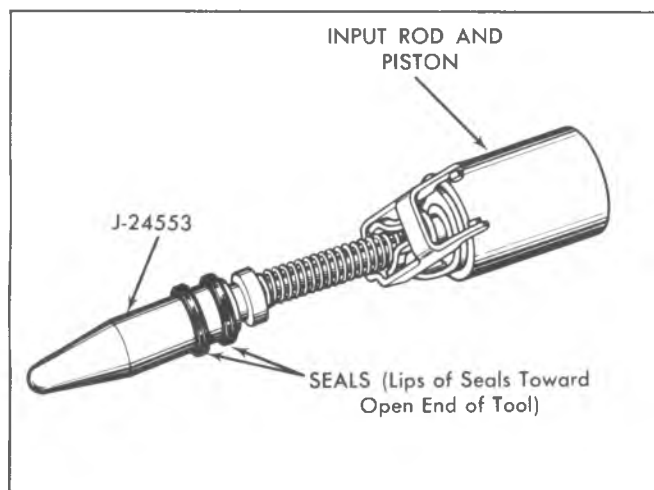


Fig. 6E--Installing Input Rod Seals

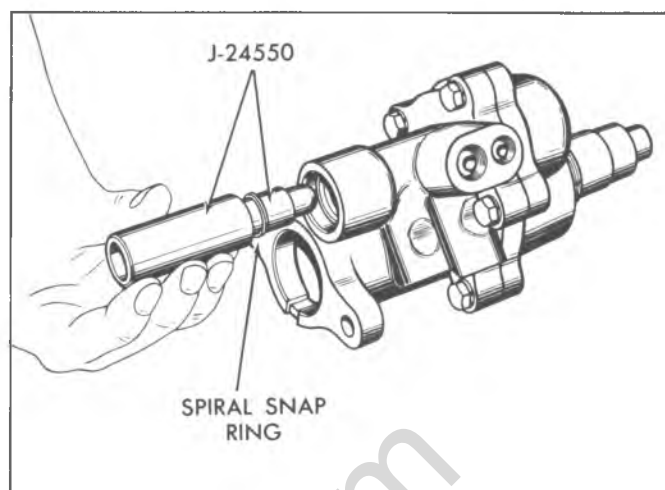


Fig. 8E--Installing Spiral Snap Ring

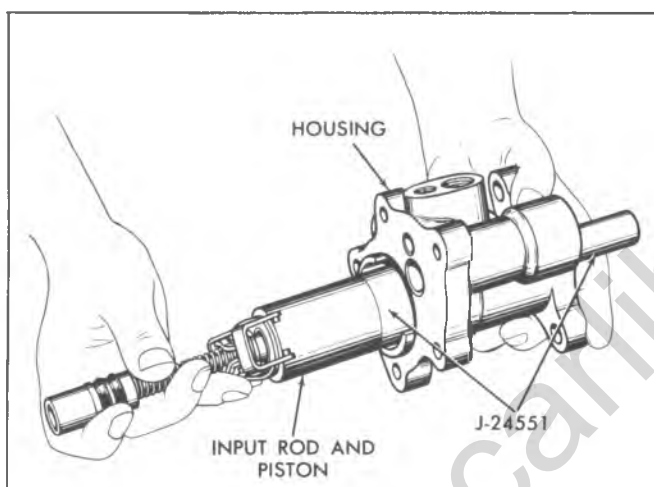


Fig. 7E--Installing Input Rod and Piston Assembly into Booster

1. Position a **NEW** tube seat in each booster port and screw a spare tube nut in each port to press the seat down into the port. Do not tighten the tube nuts in the port as this may deface the seats.
2. Remove the spare tube nuts and check for aluminum chips in the ports. Be sure that any foreign matter is removed.
3. Coat the piston bore and the piston seal with clean power steering fluid, and assemble the **NEW** seal in the bore. The lip of the seal must be toward the rear (away from the master cylinder mounting flange). Be sure the seal is fully seated in the housing.
4. Lubricate the input rod end, **NEW** input rod seals and Seal Installer Tool J-24553 with clean power steering fluid. Slide the seals on the tool with the lip

of the cups toward the open end of the tool (fig. 6E).

5. Slide the tool over the input rod end and down to the second groove; then slide the forward seal off the tool and into the groove. Assemble the other seal in the first groove. Be sure that both seals are fully seated.
6. Lubricate the piston and Piston Installing Tool J-24551 with clean power steering fluid. Insert the large end of the tool into the piston (fig. 7E), and slide the tool and piston into the piston bore and through the piston seal.
7. Assemble the **NEW** "O" ring onto the **NEW** accumulator check valve, and dip the assembly in clean power steering fluid. Insert the check valve into the accumulator valve recess in the housing flange.
8. Assemble the new ball and spacer in the same recess.
9. Assemble the **NEW** "O" ring onto the charging valve plunger seat and insert the plunger into the seat. Dip the assembly in clean power steering fluid, and insert it into the charging valve recess.
10. Dip the spool assembly in clean power steering fluid, and insert the assembly into the spool bore in the housing. Be sure that the pivot pins on the upper end of the input rod lever assembly are engaged in the groove in the sleeve. Remove Tool J-24551 from the piston assembly.
11. Separate the two parts of Snap Ring Installing Tool J-24550 and place the **NEW** spiral type spool retaining ring on the tool as shown in Figure 8E. Insert the rounded end of the tool into the spool. Then while pressing on the rear of the spool, slide the retaining ring off the tool and into the groove near the forward end of the spool by pressing in on the tool sleeve. Check to be sure that the retaining ring is fully seated.

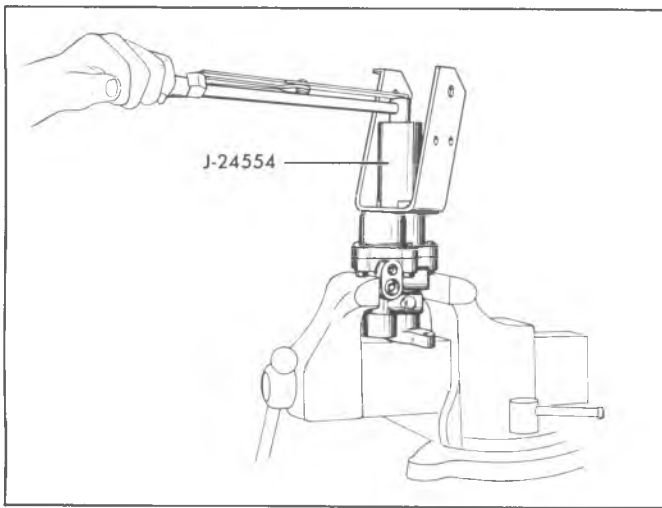


Fig. 9E--Installing Linkage Bracket Nut (Typical)

12. Position a **NEW** housing seal in the groove in the housing cover. Then join the booster housing and cover and secure with five screws. Tighten the screws to 18-26 ft. lbs.

CAUTION: See "Caution" on Page 1 of this section.

13. Assemble a **NEW** "O" ring seal on the spool plug. Insert the spool spring and the spool plug in the forward end of the spool bore. Press in on plug and assemble the plug snap ring in the groove in the bore.
14. Position the linkage bracket on the booster. The tab on the inside diameter of the large hole in the bracket should fit into a slot in the threaded portion of the booster hub.
15. Install the **NEW** bracket nut with the staking groove outward on the threaded hub of the booster. Using Tool J-24554 and a torque wrench (fig. 9E), tighten the nut to 95-120 ft. lbs.

CAUTION: See "Caution" on Page 1 of this section.

16. Use a hammer and a small punch inserted into the staking groove of the nut, at the slot in the booster hub (fig. 10E), to stake the nut in place. Be sure that the outer thread of the nut is upset.
17. Assemble a **NEW** boot on the pedal rod. Then assemble a **NEW** grommet in the groove near the end of the pedal rod.
18. Moisten the grommet with water (to ease assembly), and insert the grommet end of the pedal rod into the input rod end of the booster housing. Push on the end of the pedal rod to seat the grommet in the groove inside the housing.

NOTE: When the grommet is fully seated, the pedal rod will rotate freely with no binding.

19. Slide the boot on the pedal rod and assemble the large end of the boot on the hub of the power section.

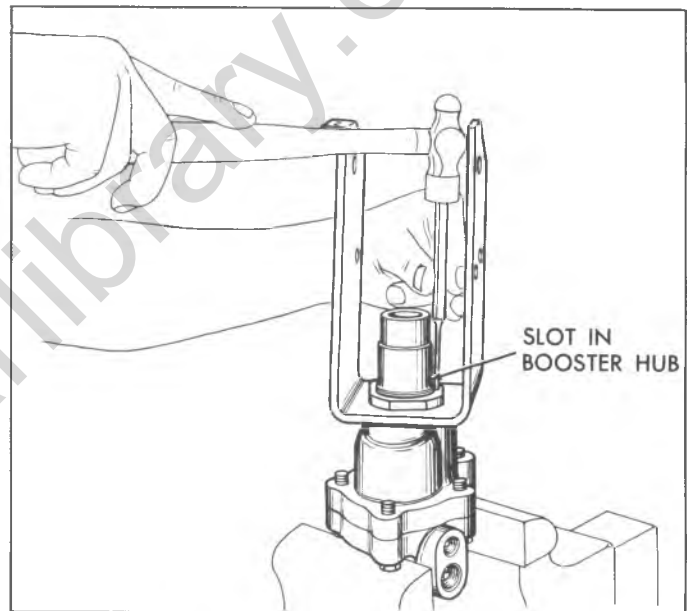


Fig. 10E--Staking Linkage Bracket Nut (Typical)

Special Tools



- | | | | |
|--------------|------------------------------------|-------------|-------------------------------|
| 1. J-4880 | Snap Ring Pliers | 12. J-22893 | Booster Separating Adapter |
| 2. J-7723-01 | Height Gauge | 13. J-23101 | Power Piston Holding Tool |
| 3. J-21183 | Height Gauge | 14. J-23175 | Control Valve Installer |
| 4. J-21524 | Power Piston Remover and Installer | 15. J-23188 | Secondary Bearing Protector |
| 5. J-21601 | Power Brake Retainer and Installer | 16. J-24549 | Spiral Snap Ring Remover |
| 6. J-22657 | Bushing Retainer Socket | 17. J-24550 | Spiral Snap Ring Installer |
| 7. J-22647 | Height Gauge | 18. J-24551 | Piston Installer |
| 8. J-22677 | Power Cylinder Seal Installer | 19. J-24553 | Input Rod Seal Installer |
| 9. J-22733 | Seal Installer and Protector | 20. J-24554 | Socket |
| 10. J-22805 | Power Cylinder Holding Fixture. | 21. J-24569 | Pedal Push Rod Remover |
| 11. J-22839 | Front Plate Holding Fixture | 22. J-9504 | Power Cylinder Spanner Wrench |

Fig. 11E--Special Tools

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SECTION 6

ENGINE

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INTRODUCTION

This section, covering all gasoline engines, has been condensed using only typical illustrations and procedures (except where specific illustrations and procedures will help clarify the operation). The similarity of engines, engine parts and engine sub-assemblies and the resulting similarity of procedures required to service these units should aid the technician in servicing the many engines.

Many operations outlined in this section, when done as

single operations and not part of a general overhaul, should be performed with the engine in the vehicle.

In order to avoid repetition and to identify the engines involved in a particular procedure, the 350- and 400- cu. in. V8 engines are identified as "Small V8's". The 454-cu. in. V8 engines are identified as "Mark IV V8's".

GENERAL DESCRIPTION

IN-LINE ENGINES

Cylinders are numbered front to rear. Firing order is 1-5-3-6-2-4 for the L6 engines. Crankshaft rotation as viewed from the rear is counter-clockwise.

The L6 crankshaft has seven main bearings and the camshaft has four bearings.

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 main oil gallery also feeds the valve lifters which, through hollow push rods, feed the individually mounted rocker arms (fig. 1).

V8 ENGINES

Cylinders are numbered front to rear, 1-3-5-7 on the left bank and 2-4-6-8 on the right bank. Firing order is, 1-8-4-3-6-5-7-2. Crankshaft rotation as viewed from the rear is counter-clockwise.

The crankshaft has five main bearings and the camshaft has five bearings.

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. 2 and 3).

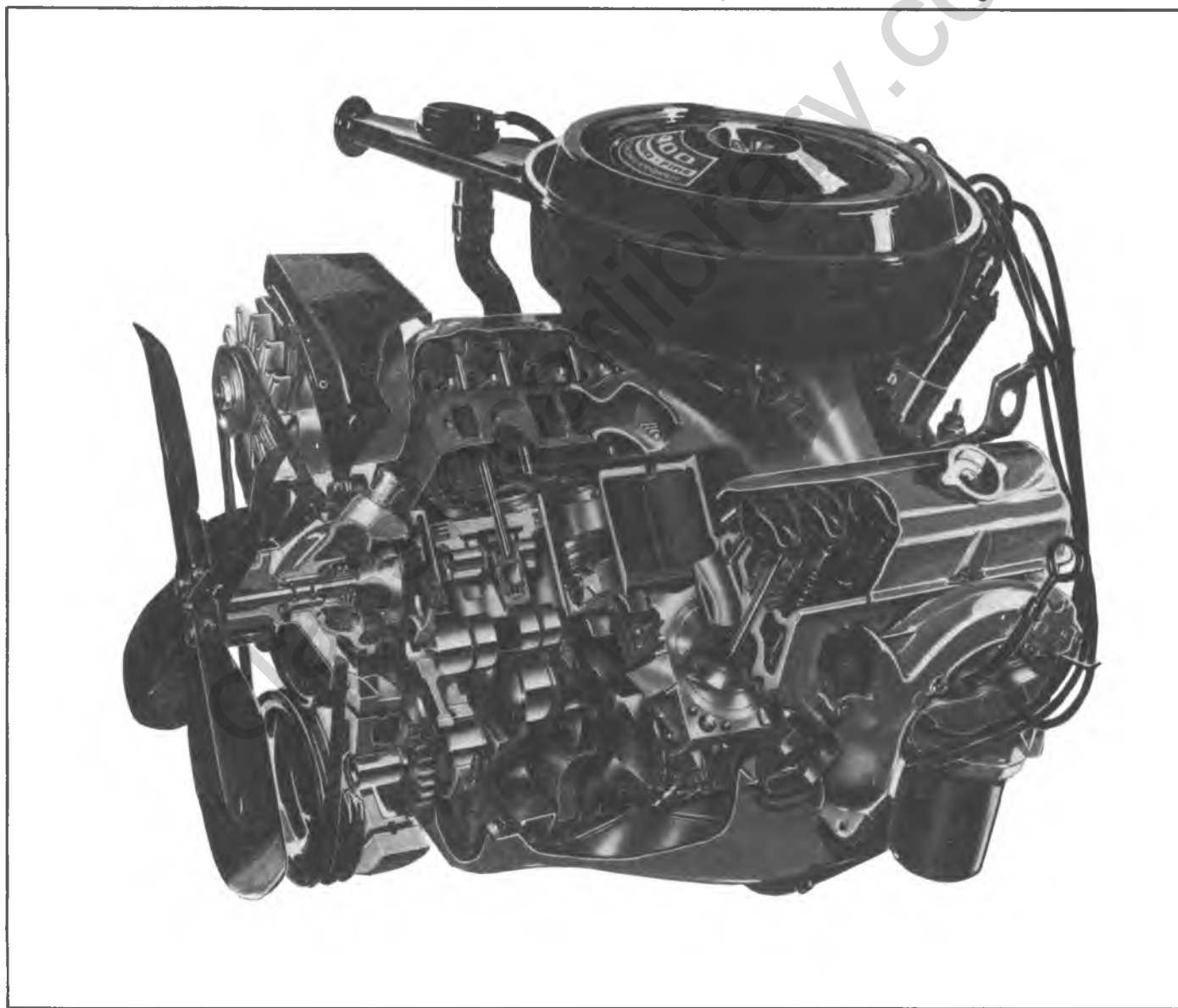


Fig. i—V8 Engine (Typical)

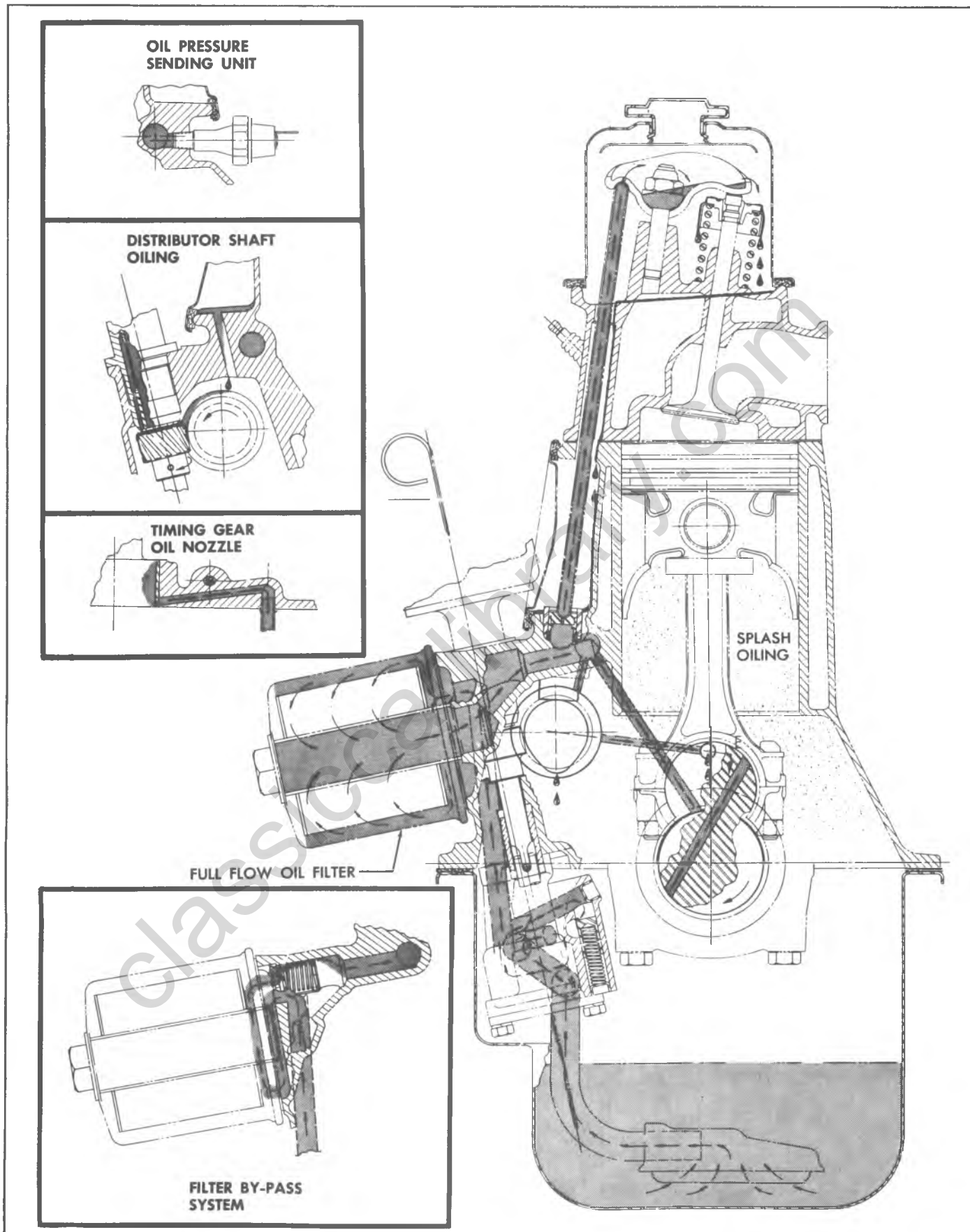


Fig. 1—In-Line Engine Lubrication

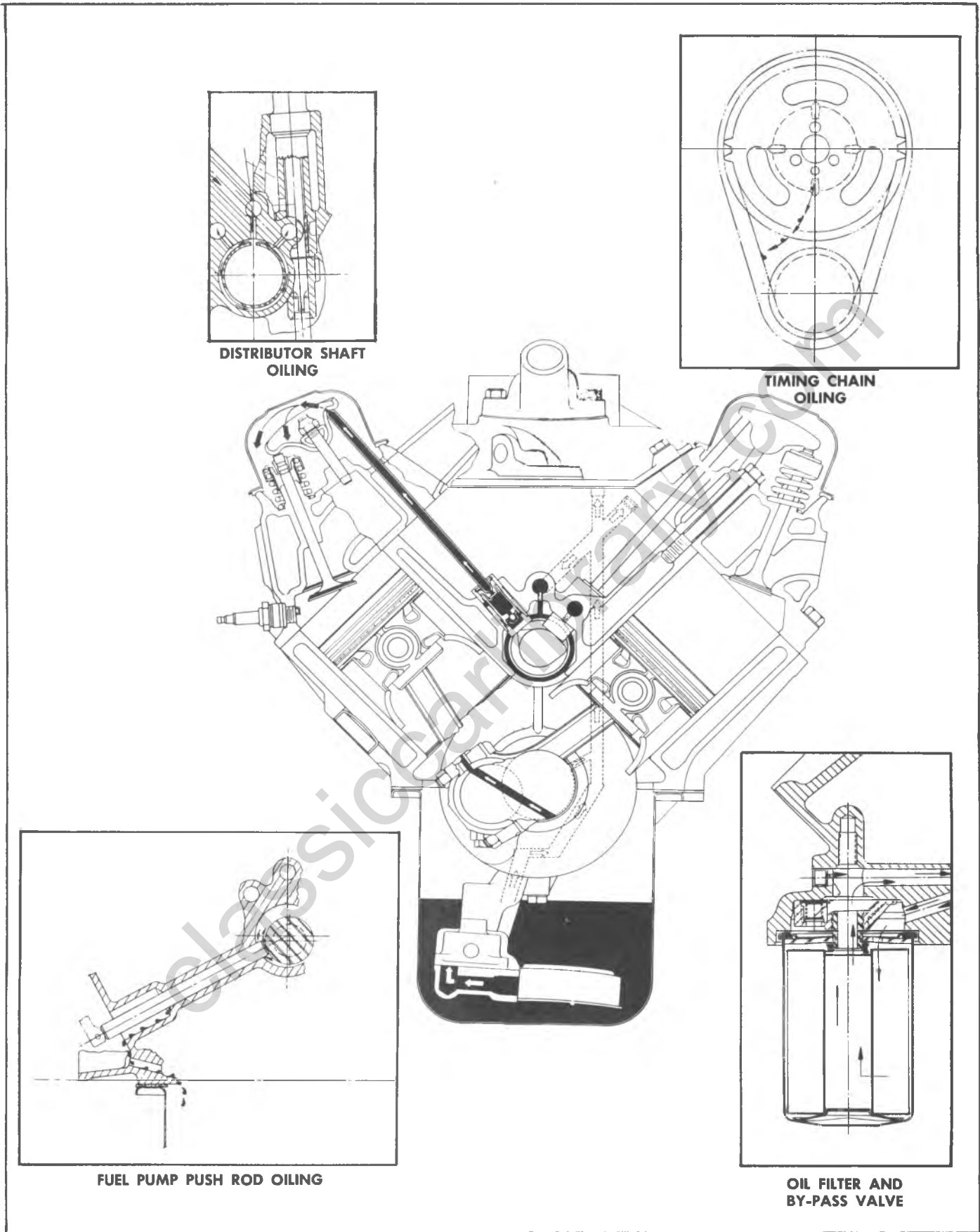


Fig. 2- "Small V8" Engine Lubrication

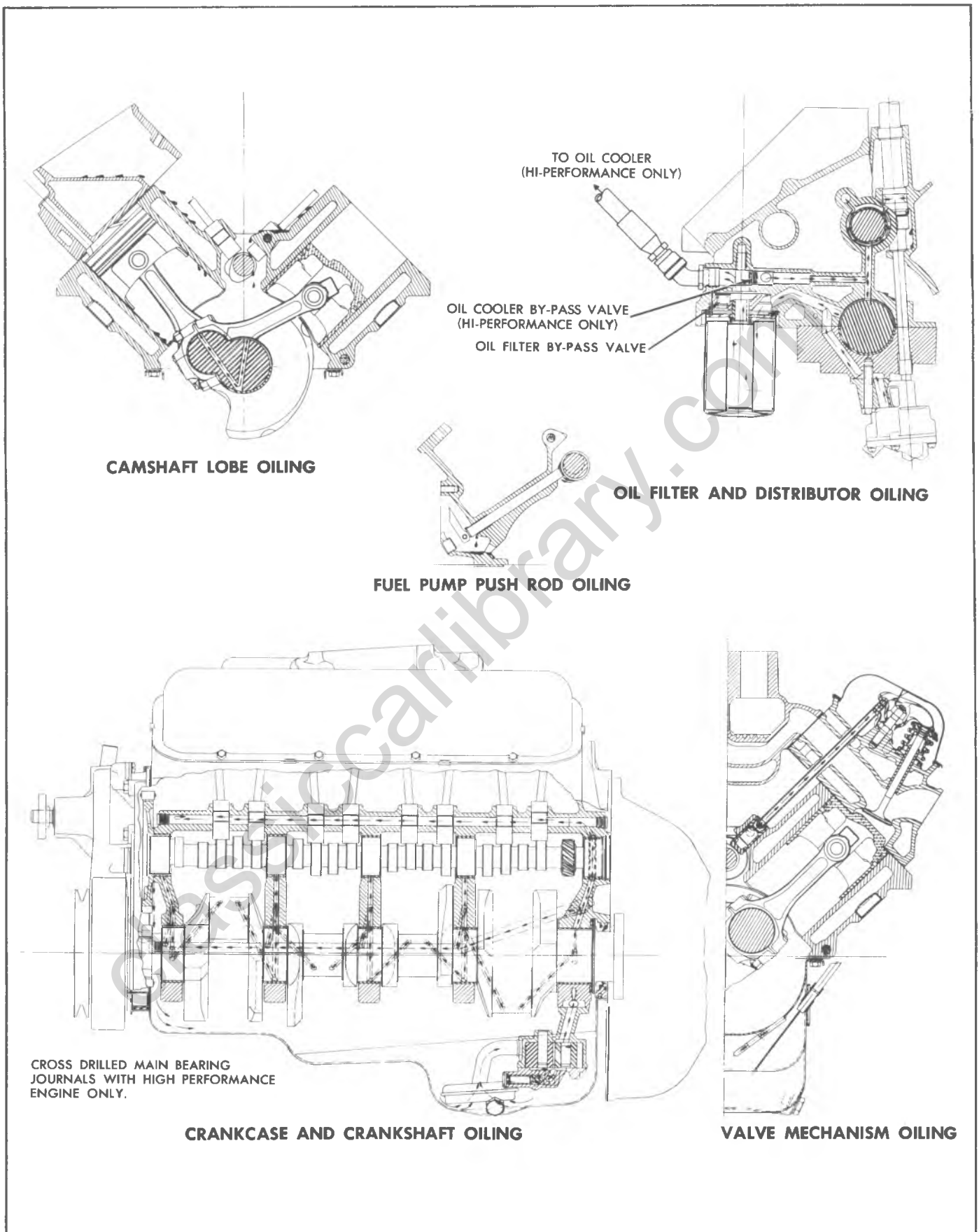


Fig. 3—"Mark IV V8" Engine Lubrication

REPAIR PROCEDURES

ENGINE ASSEMBLIES

Disassembly

NOTE: For partial disassembly of the engine refer to the applicable "Chassis Service Manual" under the part or sub-assembly to be serviced. For complete disassembly of the engine (into sub-assemblies) follow the outline below.

1. With the engine mounted on an engine stand (transmission and/or clutch housing removed from the engine), remove the following sub-assemblies (if applicable). Refer to the appropriate section of the applicable "Chassis Service Manual."
 - Air Injection Reactor System (with brackets).
 - Delcotron (with brackets).
 - Accessory Drive Pulley(s) (and belts).
 - Water Pump (and by pass hose).
 - Fuel Pump (and fuel pump push rod on V8 engines).
 - Distributor Cap (with spark plug wires).
 - Carburetor (and fuel lines).
 - Oil Filter.
 - Starter.
 - Clutch Pressure Plate and Disc.
 - Ground Strap.
 - Oil Dip Stick and Oil Dip Stick Tube.
2. Remove intake and exhaust manifolds.
3. On In-Line engines, remove push rod covers.
4. Loosen valve rocker arm nuts until rocker arms can be pivoted, then remove push rods and valve lifters. Place push rods and valve lifters in a rack so they may be installed in the same location during engine assembly.
5. Remove the cylinder head(s).
6. Using Tool J-23523, remove the torsional damper.
7. Remove the oil pan.
8. Remove crankcase front cover.
9. On the performance engines, remove the oil baffle.
10. Remove oil pump and screen assembly. On V8 engines, remove the extension shaft.
11. Check connecting rods and caps for cylinder number identification and if necessary, mark them. Check cylinder bores for ridge and if necessary, remove ridge.
12. Remove connecting rod caps and using connecting rod guide set, Tool J-5239 (3/8") or J-6305 (11/32"), push connecting rod and piston assemblies out of block.

NOTE: It will be necessary to turn the crankshaft to disconnect and remove some of the connecting rod and piston assemblies.

13. Remove the camshaft as follows:

CAUTION: Use care in removing camshaft to avoid damaging bearings.

WITH TIMING CHAIN (V8)

---Remove camshaft sprocket bolts then remove camshaft sprocket and timing chain.

NOTE: Sprocket is a light press fit on camshaft. To dislodge, tap lightly on lower edge of camshaft sprocket with a plastic hammer.

---Install two 5/16-18 bolts in camshaft sprocket bolt holes and carefully remove camshaft.

WITH TIMING GEAR (In-Line)

---Remove camshaft thrust plate screws (through holes in camshaft gear), then remove camshaft and gear as an assembly.

14. Remove the flywheel.

NOTE: Refer to Truck Chassis Service Manual for removal and installation procedures of 292 cu. in. engine flywheel.

15. Remove main bearing caps and lift crankshaft out of cylinder block.
16. Remove rear main bearing oil seal from cylinder block and rear main bearing cap.
17. Discard all gaskets and seals removed during engine disassembly.

NOTE: For further disassembly, cleaning and inspection refer to the part or sub-assembly to be serviced.

Assembly

NOTE: For inspection, repair, assembly or replacement of any engine part or sub-assembly refer to this section under the part or sub-assembly being serviced. Use new gaskets and seals on engine assembly.

1. Install the crankshaft as follows:
 - a. 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.
 - b. Lubricate lips of seal with engine oil. Keep oil off parting line surface.
 - c. Install main bearings in cylinder block and main bearing caps then lubricate bearing surface with engine oil.

- d. Install crankshaft, being careful not to damage bearing surfaces.
 - e. Apply a thin coat of brush-on type oil sealing compound to block mating surface and corresponding surface of cap only (fig. 4). Do not allow sealer on crankshaft or seal.
 - f. Install main bearing caps with arrows pointing toward front of engine.
 - g. 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.
 - h. Measure crankshaft end play with a feeler gauge. Force crankshaft forward and measure clearance between the front of the rear main bearing and the crankshaft thrust surface. Refer to Figure 42.
2. 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.

3. Install the camshaft as follows:

NOTE: Whenever a new camshaft or new lifters are installed, lubricate camshaft lobes and foot of lifters with "Molykote" or its equivalent.

WITH TIMING CHAIN (V8)

- a. Install two 5/16-18 bolts in camshaft bolt holes, then lubricate camshaft journals with engine oil

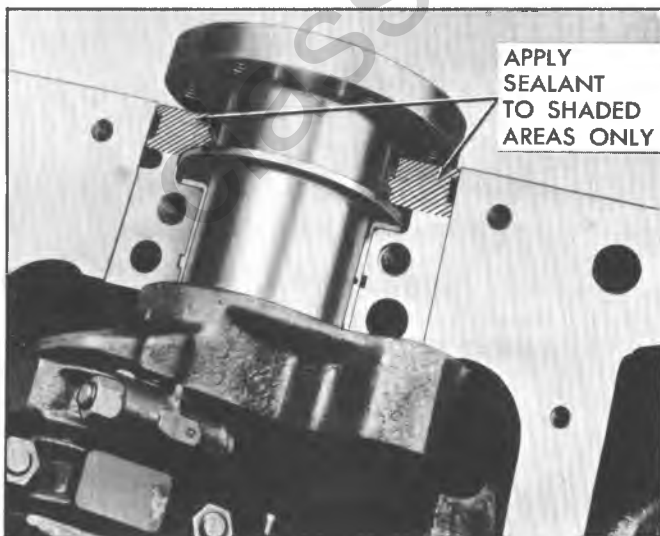


Fig. 4—Sealing Bearing Cap and Block

and install camshaft, being careful not to damage bearings (fig. 5). Remove the two 5/16-18 bolts.

- b. Install timing chain on camshaft sprocket then align marks on camshaft and crankshaft sprockets and connect chain to crankshaft sprocket. Align dowel on camshaft with dowel hole in camshaft sprocket and install sprocket on camshaft (fig. 6).

CAUTION: Do not hammer camshaft sprocket onto camshaft. This may loosen camshaft rear expansion plug.

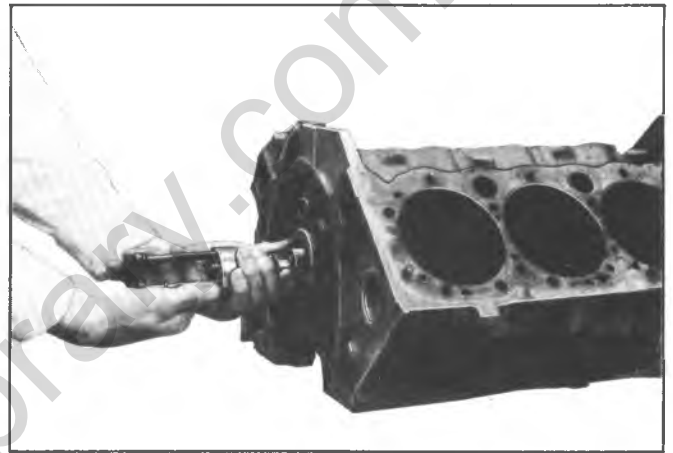


Fig. 5—Installing Camshaft

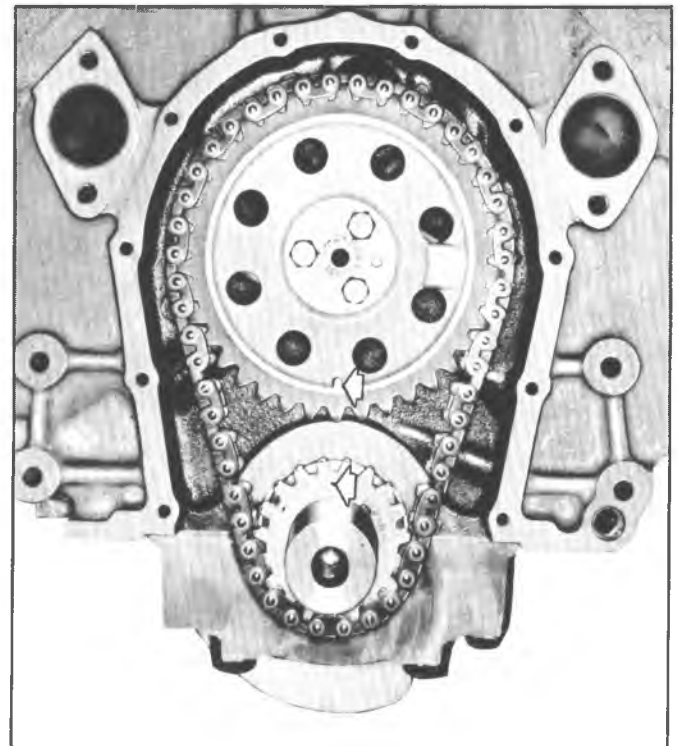


Fig. 6—Timing Sprocket Alignment Marks

6-8 ENGINE

- c. Draw camshaft sprocket onto camshaft, using the mounting bolts. Torque bolts to specifications.
- d. Lubricate timing chain with engine oil.

WITH TIMING GEAR (In Line)

- a. Lubricate camshaft journals with engine oil, then rotating crankshaft and camshaft so that marks on gears will line up, install camshaft and gear assembly being careful not to damage bearings (fig. 7).
 - b. Check camshaft and crankshaft gear run out with a dial indicator (fig 8). The camshaft gear run out should not exceed .004", and the crankshaft gear run out should not exceed .003".
 - c. Check the backlash between the timing gear teeth with a dial indicator (fig. 9). The backlash should be not less than .004" nor more than .006".
 - d. Lubricate timing gears with engine oil.
4. Install connecting rod and piston assemblies as follows:
- a. Install connecting rod bearings in connecting rods and connecting rod caps then lubricate bearings, pistons, piston rings, connecting rod bolts and cylinder walls lightly with engine oil.
 - b. Install connecting rod guide set Tool J-5239 (3/8") or Tool J-6305 (11/32") on connecting rod bolt and using Tool J-8037 to compress the rings, install number one connecting rod and piston assembly in its respective bore. Use a hammer handle and light blows. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the bore.

CAUTION: Be sure ring gaps are properly

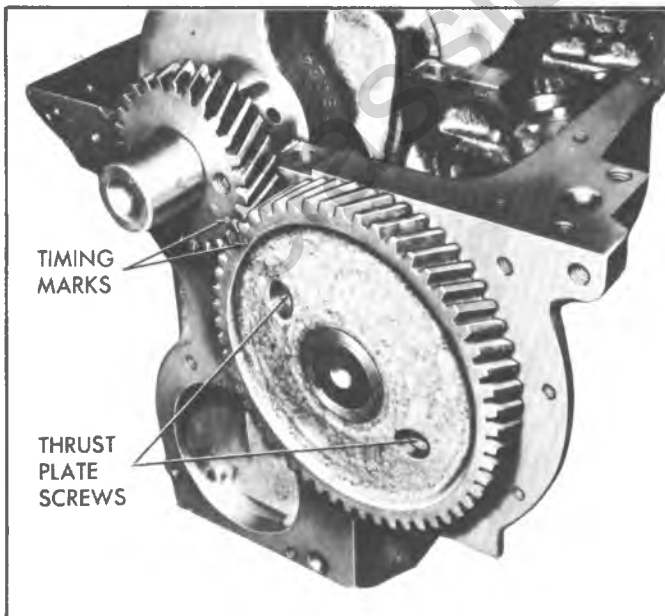


Fig. 7—Timing Gear Alignment Marks

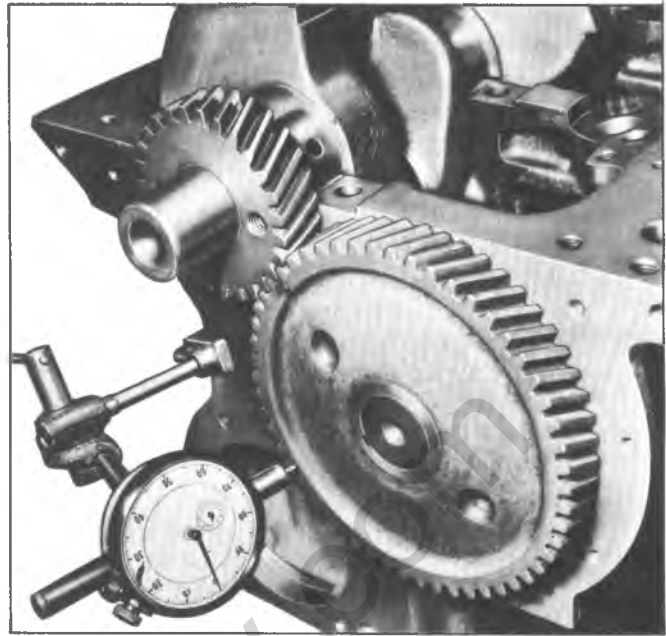


Fig. 8—Checking Timing Gear Runout

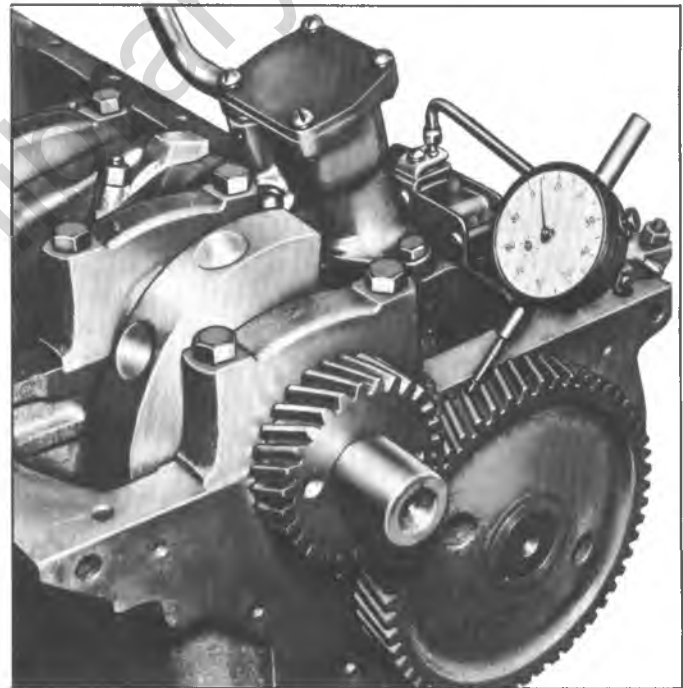


Fig. 9—Checking Timing Gear Backlash

positioned on piston and piston is properly positioned in cylinder block. Refer to Figures 57, 59 and 60.

- c. Remove connecting rod guide set then install connecting rod cap and torque nuts to specifications. Repeat Step b and c for the remaining connecting rod and piston assemblies.
- d. Measure connecting rod side clearance (see specifications). Measure between connecting rod cap and side of crankpin on In Line engines

and between connecting rod caps on V8 engines. Refer to Figures 46 and 47.

5. Install oil pump and screen assembly (and extension shaft on V8 engines). On hi-performance engines, install the oil baffle.
6. Install the crankcase front cover as follows:

IN-LINE ENGINES

- a. Lubricate seal lip with engine oil then install crankcase front cover aligning Tool J-23042 in seal (fig. 10).
- b. Place crankcase front cover gasket in position on cover, then install crankcase front cover on cylinder block and torque bolts to specifications. Remove tool.

V8 ENGINES

- a. Place crankcase front cover gasket in position over dowel pins on cylinder block.
 - b. Lubricate seal lip with engine oil then place crankcase front cover in position over dowel pins and torque bolts to specifications.
7. Install the oil pan as follows:
 - a. Install side gaskets on cylinder block. Apply sealer at the intersection of side gaskets and both end seals.
 - b. Install oil pan rear seal, in groove in rear main bearing cap, with ends butting side gaskets.
 - c. Install oil pan front seal, in crankcase front cover, with ends butting side gaskets.
 - d. Install oil pan and torque bolts to specifications.
 8. Install torsional damper as follows:

CAUTION: The inertia 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.

DRIVE ON TYPE (Without Retaining Bolt)



Fig. 10--Centering Tool in Cover (In-Line)

- a. Coat front cover seal area (on damper) with engine oil.
 - b. Attach damper Installer Tool J-22197 to damper. Tighten fingers of tool to prevent weight from moving (fig. 11).
 - c. Position damper on crankshaft and drive into position using J- 5590 until it bottoms against crankshaft gear or sprocket (fig. 11). Remove installer tool.
- a. Coat front cover seal contact area (on damper) with engine oil.
 - b. Place damper in position over key on crankshaft.
 - c. Using Tool J-23523 pull damper onto crankshaft (fig. 12).

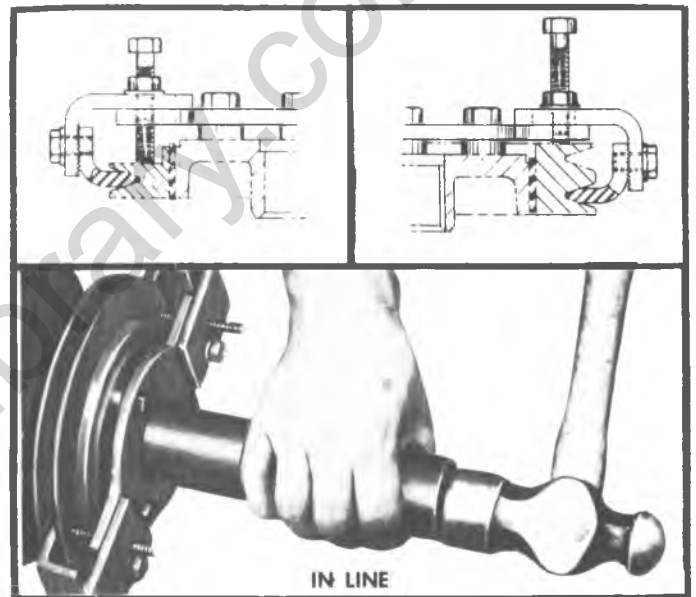


Fig. 11--Installing Torsional Damper (Drive on Type)

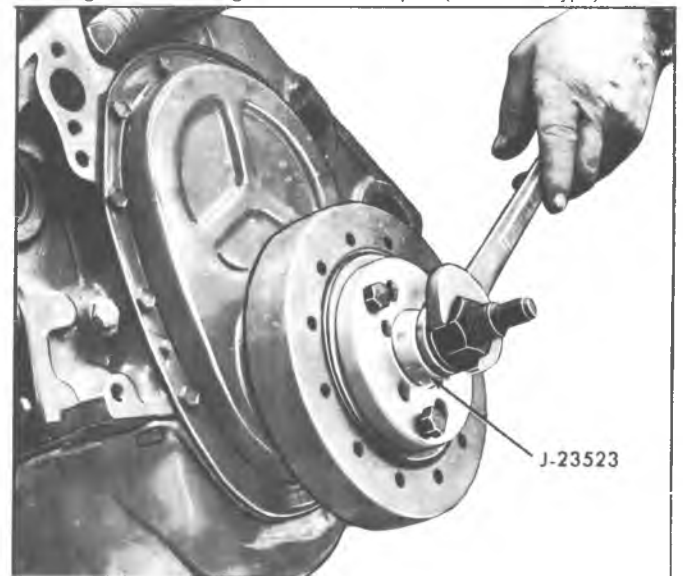


Fig. 12--Installing Torsional Damper (Pull on Type)

6-10 ENGINE

CAUTION: Install bolt in crankshaft with sufficient thread engagement (min. 1/2").

- d. Remove tool from crankshaft.
 - e. Install damper retaining bolt and torque to specifications.
9. Install cylinder head(s) as follows:

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 bolts must be cleaned. (Dirt will effect bolt torque).

- a. On engines using a STEEL gasket, coat both sides of gasket with sealer, spread the sealer thin and even. Too much sealer may hold the beads of the gasket away from the head or block. One method of applying the sealer that will assure the proper coat is with the use of a paint roller.

CAUTION: Use no sealer on engines using a composition STEEL ASBESTOS gasket.

- b. Place the gasket in position over the dowel pins, with the bead up.
 - c. Carefully guide cylinder head into place over dowel pins and gasket.
 - d. Coat threads of cylinder head bolts with sealing compound and install finger tight.
 - e. Tighten cylinder head bolts a little at a time in torque sequence shown in Figure 76 until the specified torque is reached. (See Engine Torques.)
10. Install valve lifters and push rods. Install in the same location from which removed during engine disassembly.

NOTE: Whenever new valve lifters and/or rocker arms and balls are being installed coat foot of valve lifters and surfaces of rocker arms and balls with "MOLYKOTE" or its equivalent.

11. Install valve rocker arms, rocker arm balls and nuts and tighten rocker arm nuts until all push rod end play is taken up.
12. On In-Line engines, install push rod covers.
13. Install intake and exhaust manifolds. Torque to specifications in the sequence outlined under "Torque Specifications" Figure 77.
14. Install the following sub-assemblies (if applicable) as outlined in the applicable "Chassis Service Manual".

---Oil Dip Stick Tube and Oil Dip Stick

---Ground Strap

---Clutch Pressure Plate and Disc

---Starter

---Oil Filter (new)

---Carburetor and Fuel Lines

---Distributor Cap (with spark plug wires)

---Fuel Pump (and fuel pump push rod on V8 engines)

---Water Pump (and by pass hose)

---Accessory Drive Pulley(s) (and belts)

---Delcotron (with brackets)

---Air Injection Reactor System (with brackets)

15. Adjust all belts as necessary.
16. Adjust valves as outlined under Valve Mechanism, Installation and Adjustment in the applicable "Chassis Service Manual".
17. Attach engine lift at engine lift brackets.

CYLINDER HEAD ASSEMBLIES

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. 13) and remove valve keys. Release the compressor tool and remove rotators or spring caps, spring shields (if so equipped) springs and spring damper, then remove oil seals and valve spring shims.
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. 14).

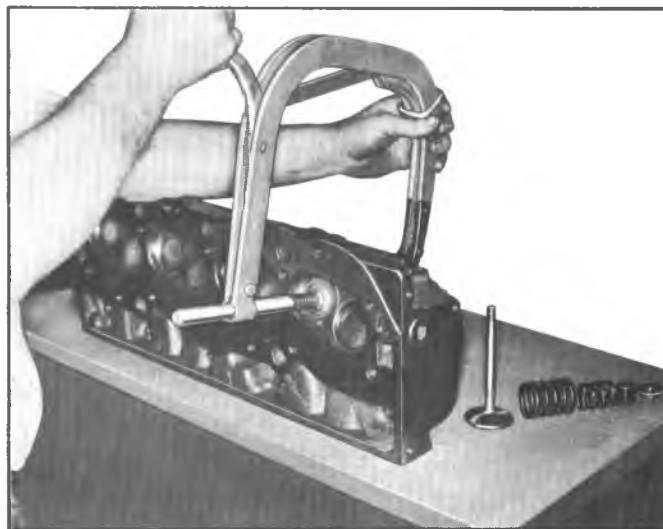


Fig. 13—Compressing Valve Spring

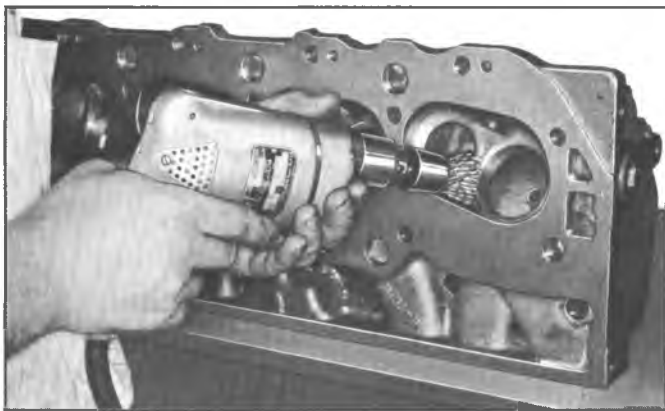


Fig. 14—Cleaning Combustion Chambers

2. Thoroughly clean the valve guides using Tool J-8101 (fig. 15).
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 smoothness.

3. Measure valve stem clearance (fig. 16) as follows: Clamp a dial indicator on one side of the cylinder head rocker arm cover gasket rail, locating the

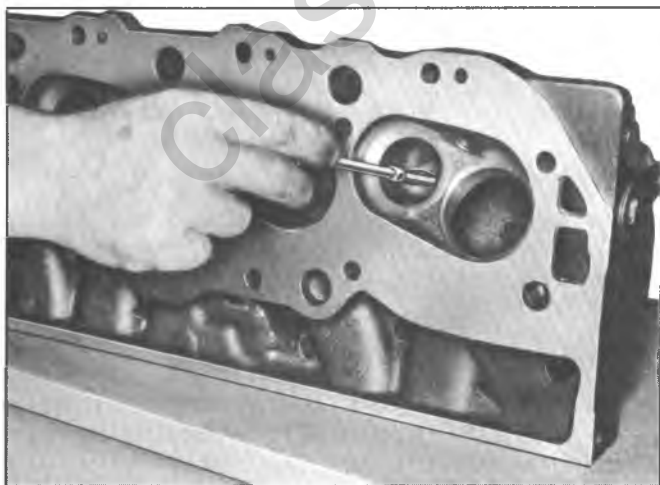


Fig. 15—Cleaning Valve Guides

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. 17).

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.

Repairs

Rocker Arm Studs and Push Rod Guides

Mark IV and 350 cu. in. High Performance

The push rod guides are related to the cylinder head by the rocker arm studs (fig. 18). Replace where necessary and torque rocker arm studs to specifications.

NOTE: Coat Threads on cylinder head end of rocker arm studs with sealer before assembling to cylinder head.

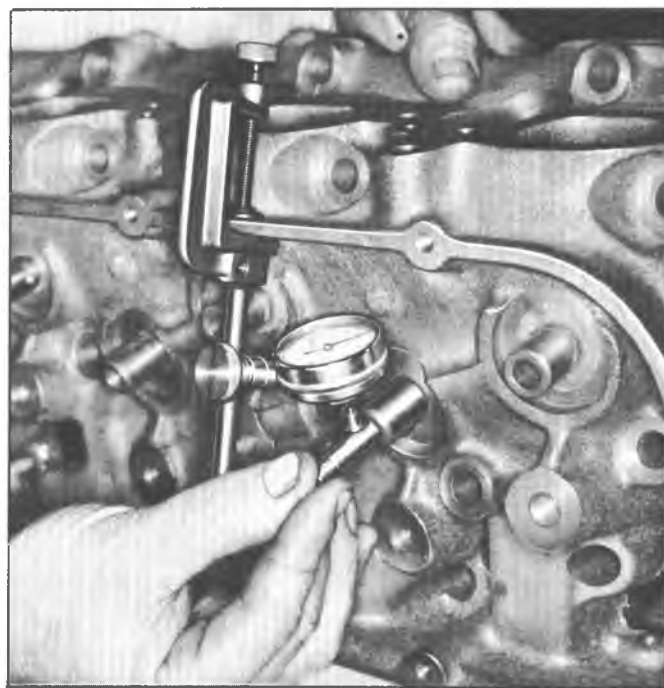


Fig. 16—Measuring Valve Stem Clearance



Fig. 17—Checking Valve Spring Tension

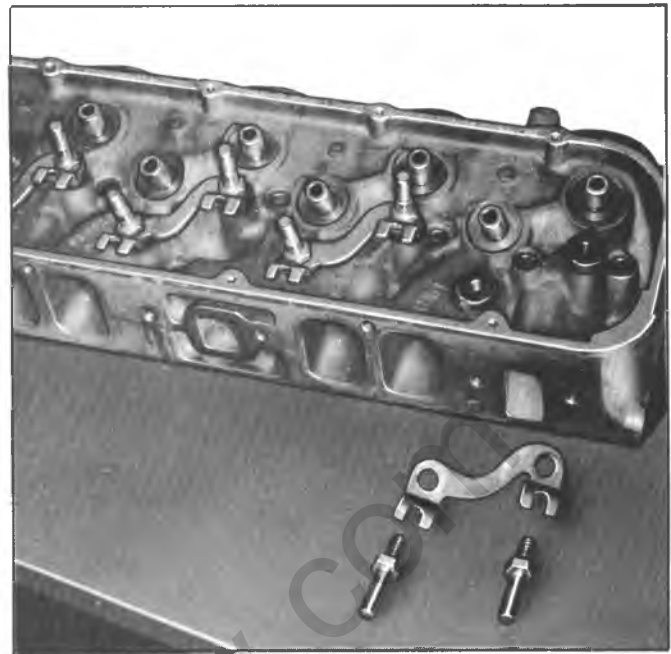


Fig. 18—Rocker Arm Stud and Push Rod Guide

In-Line and 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. 19).
2. Ream hole for oversize stud using Tool J-5715 for .003" oversize or Tool J-6036 for .013" oversize (fig. 20).

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. Gauge should bottom on head (fig. 21).

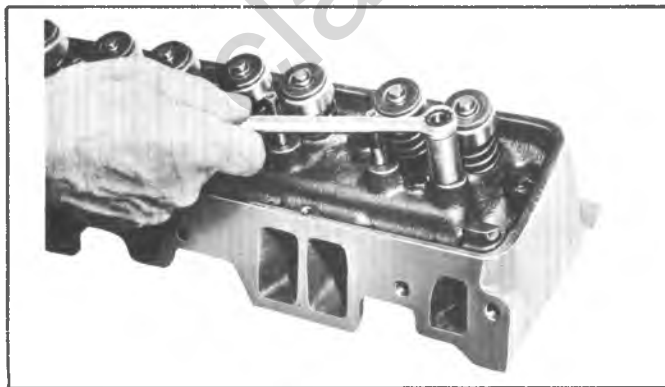


Fig. 19—Removing Rocker Arm Stud (In-Line and "Small V8")

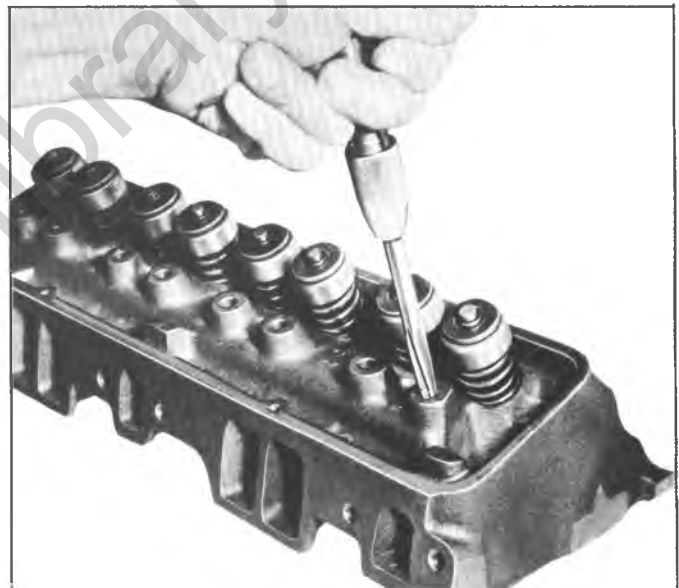


Fig. 20—Reaming Rocker Arm Stud Bore (In-Line and "Small V8")

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 (In-Line and "Small V8") or J-7049 (Mark IV V8) (fig. 22).

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

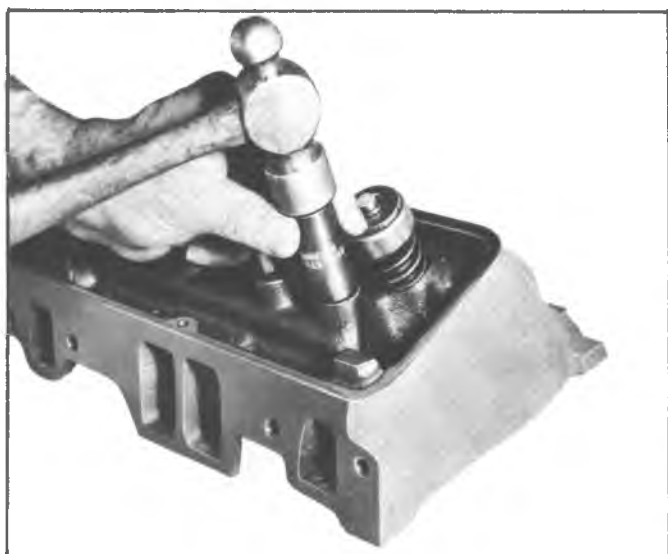


Fig. 21—Installing Rocker Arm Stud (In-Line and "Small V8")

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 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.

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 and Figure 23.
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 (fig. 24).

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



Fig. 22—Reaming Valve Guide

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.

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 and Figure 23.
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

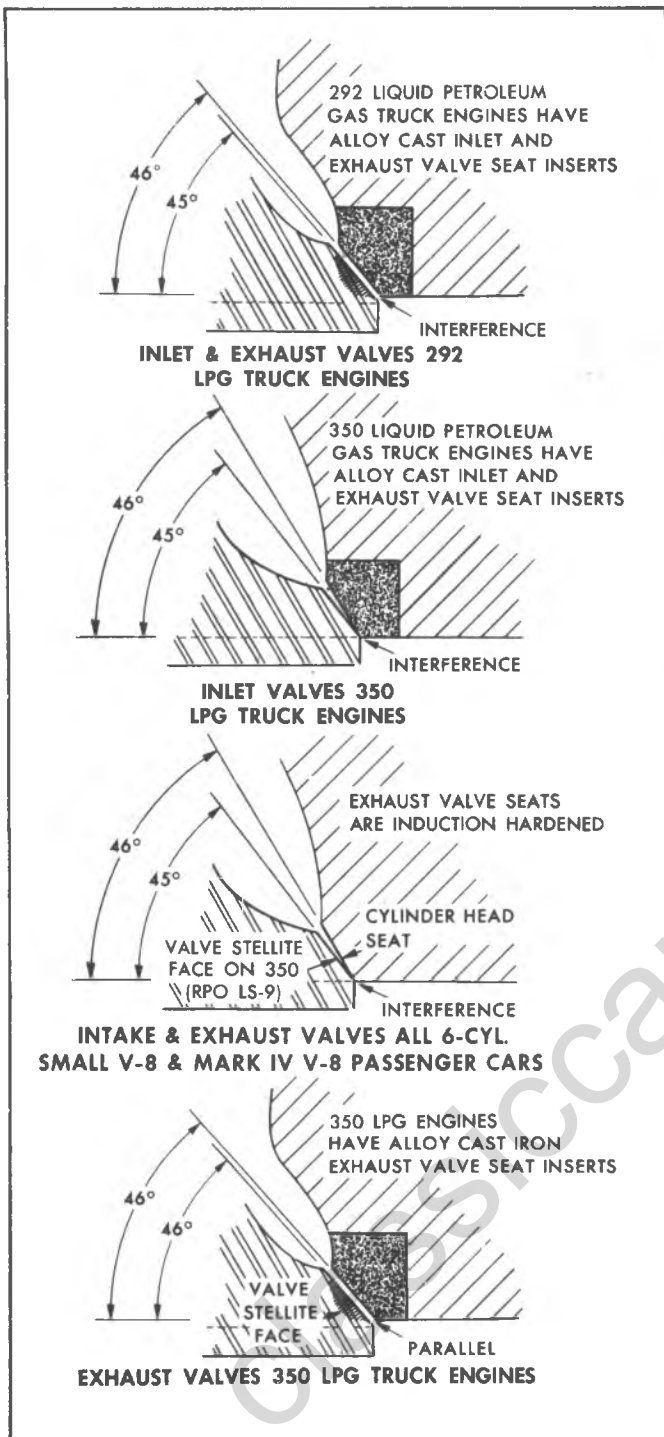


Fig. 23—Relation of Valve and Seat Angles

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



Fig. 24—Measuring Valve Seat Concentricity

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.

Assembly

1. Insert a valve in the proper port.
2. Assemble the valve spring and related parts as follows:

In-Line and "Small V8"

CAUTION: On engines using exhaust valve rotators, make sure that the proper (shorter) springs are used on exhaust valves.

- a. Set the valve spring shim, valve spring (with damper if used), valve shield and valve cap or rotator in place (fig. 25).
- 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. 26).

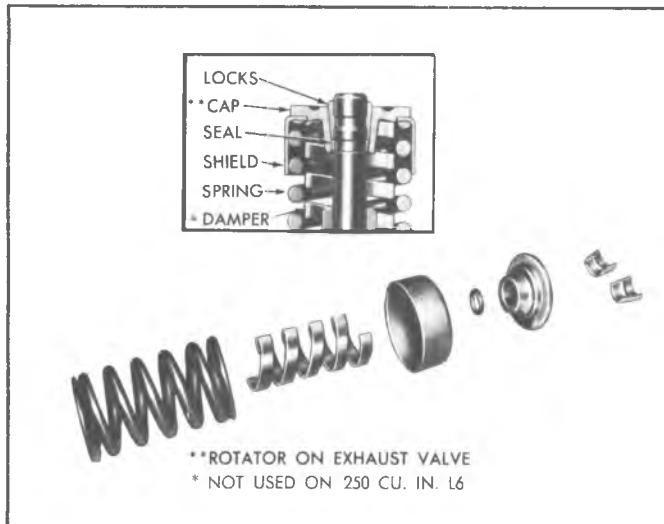


Fig. 25—Valve Spring Installation (In-Line and "Small V8")

- 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 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 In-Line and "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. 27).
5. Check the installed height of the valve springs, using a narrow thin scale. A cutaway scale will help (fig. 28). Measure from the top of the shim or the

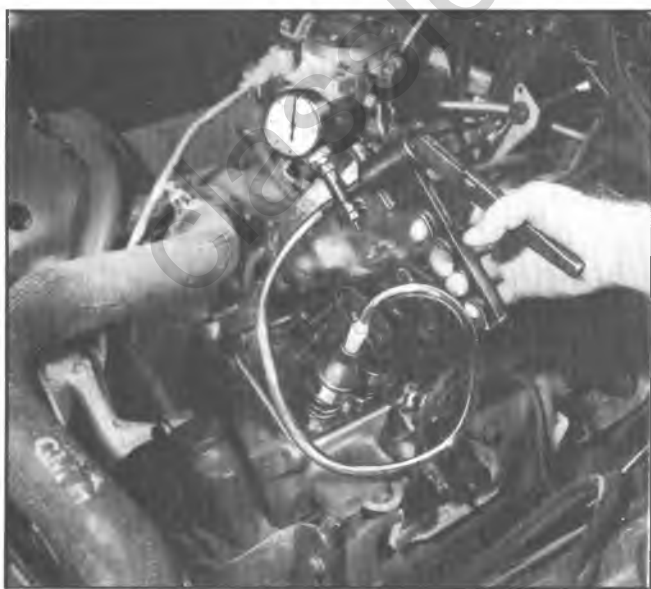


Fig. 27—Checking Valve Stem Oil Seals

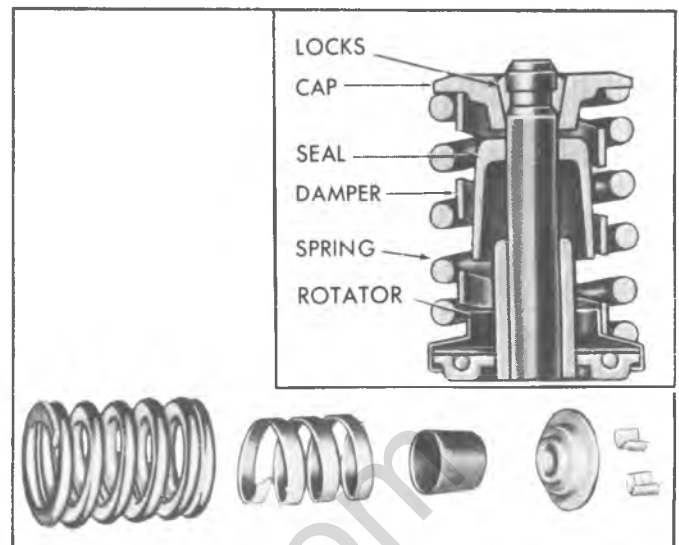


Fig. 26—Exhaust Valve Spring Installation ("Mark IV V8")

spring seat to the top of the valve spring or valve spring shield (fig. 29). 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.

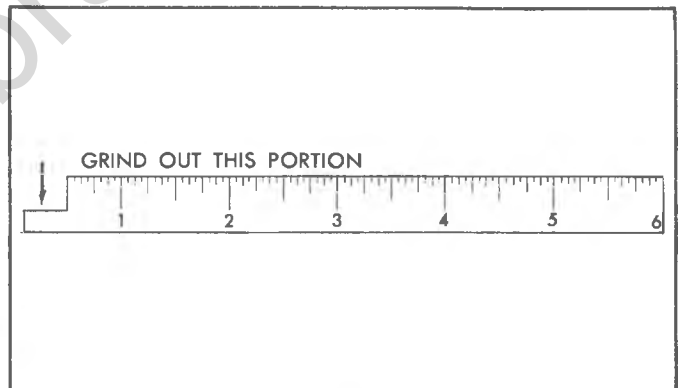


Fig. 28—Cutaway Scale

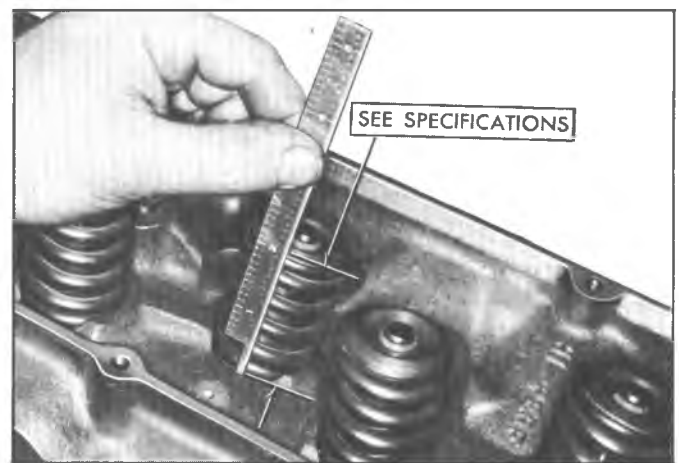


Fig. 29—Measuring Valve Spring Installed Height

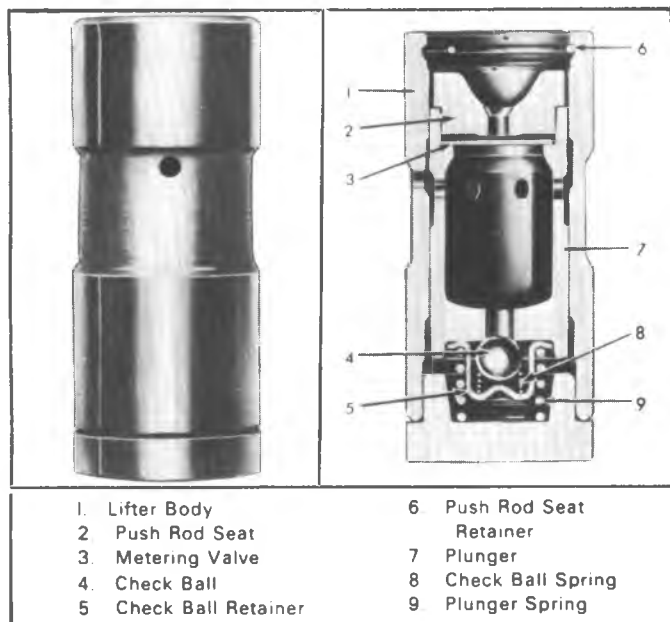


Fig. 30—Hydraulic Valve Lifter

VALVE LIFTERS

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. 30).
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. 31).

Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn



Fig. 31—Removing Ball Check Valve

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.

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. 32).
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 assembly will be aligned (fig. 33).

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. 33).
6. Remove the 1/8" drift pin, refill assembly with SAE 10 oil.



Fig. 32—Installing Ball Check Valve

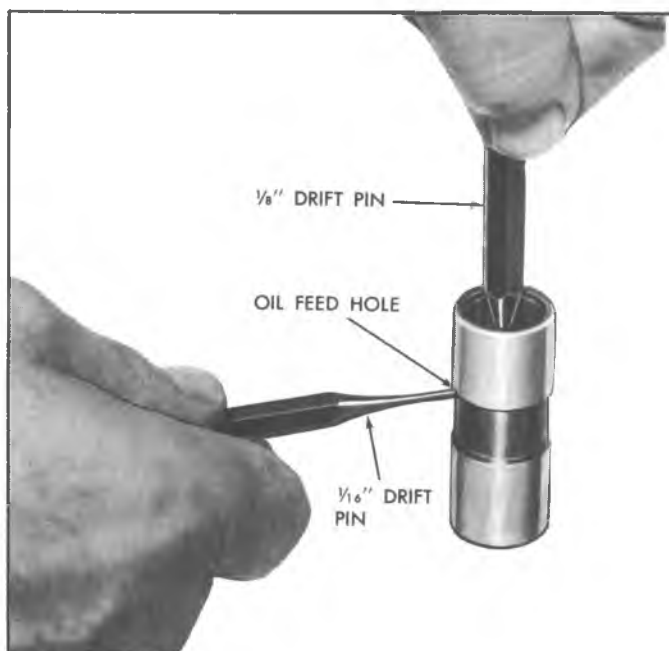


Fig. 33—Assembling Hydraulic Lifter

7. Install the metering valve and push rod seat (fig. 30).
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.

OIL PUMP

The oil pump consists of two gears and a pressure regulator valve enclosed in a two-piece housing. The oil pump is driven by the distributor shaft which is driven by a helical gear on the camshaft.

A baffle is incorporated on the pickup screen to eliminate pressure loss due to sudden surging stops.

Disassembly

REFER TO FIGURES 34, 35, AND 36

1. Remove the pump cover attaching screws, the pump cover and on In-Line engines the pump cover gasket.

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.

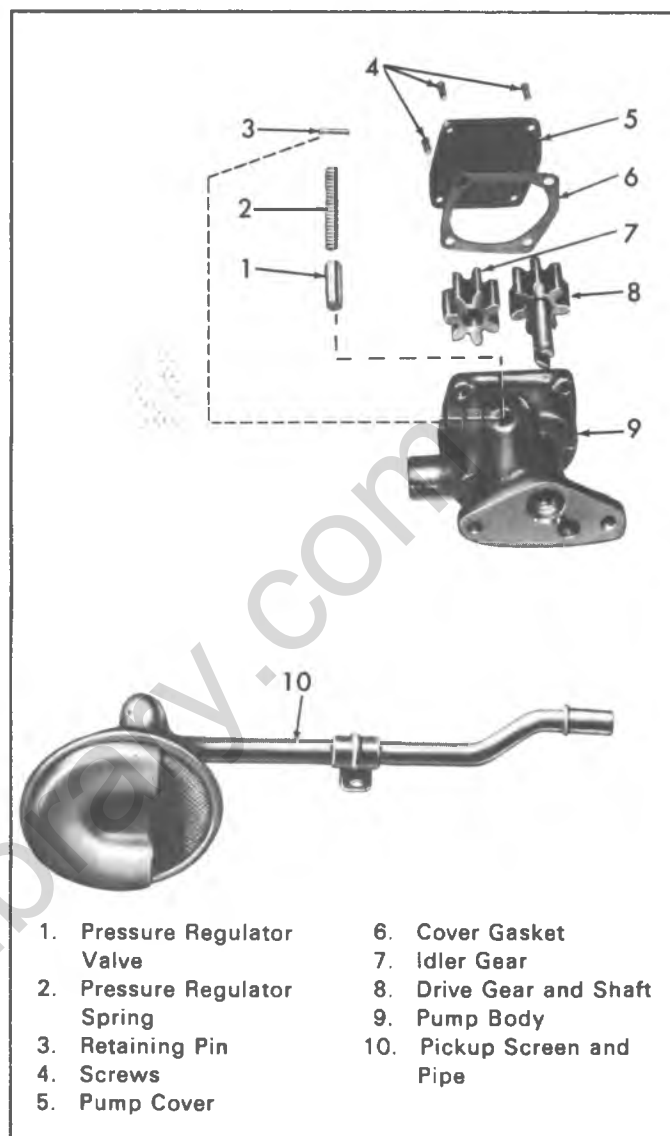


Fig. 34—Oil Pump (L6 Engine)

- | | |
|------------------------------|----------------------------|
| 1. Pressure Regulator Valve | 6. Cover Gasket |
| 2. Pressure Regulator Spring | 7. Idler Gear |
| 3. Retaining Pin | 8. Drive Gear and Shaft |
| 4. Screws | 9. Pump Body |
| 5. Pump Cover | 10. Pickup Screen and Pipe |

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

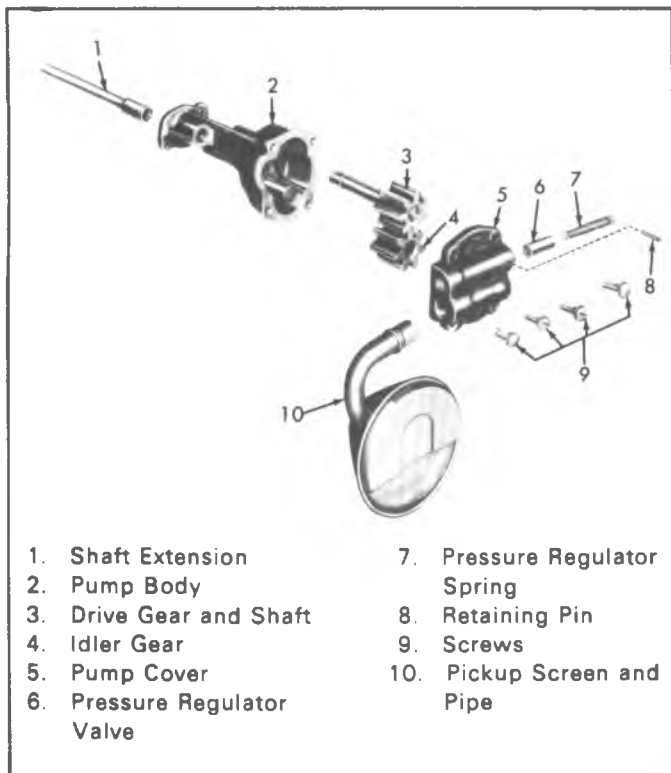


Fig 35—Oil Pump ("Small V8")

serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.

Assembly

REFER TO FIGURES 34, 35 and 36

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 of pipe, and using Tool J-8369 for "Small V8" (fig. 37) or Tool J-22144 for "Mark IV V8" (fig. 38) tap the pipe in place with a plastic hammer.

CAUTION: Be careful of twisting, shearing or

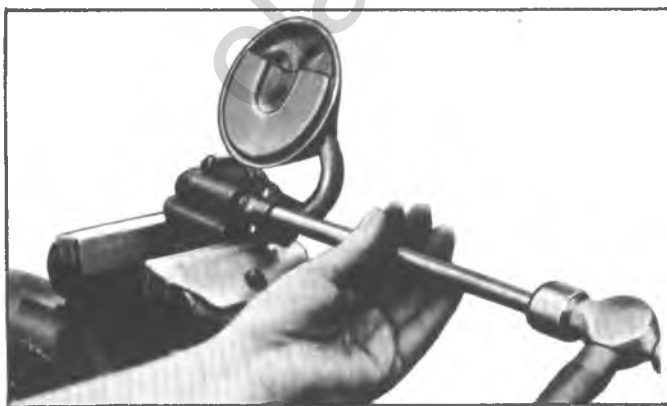


Fig. 37—Installing Screen ("Small V8")

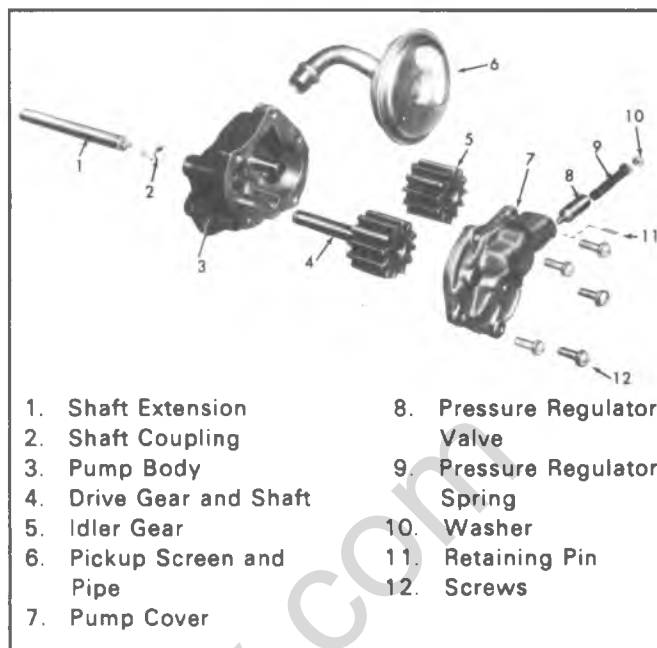


Fig. 36—Oil Pump ("Mark IV V8")

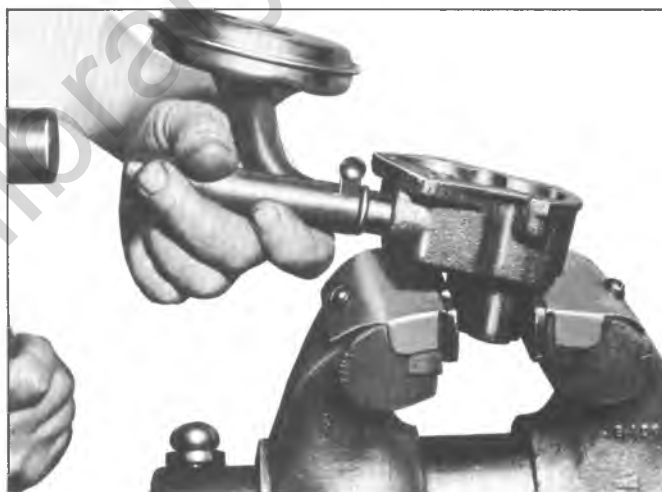


Fig. 38—Installing Screen ("Mark IV V8")

collapsing pipe while installing in pump. Pickup screen on In-Line engines must be parallel to bottom of oil pan when 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 on In-Line engines) and torque attaching screws to specifications.
6. Turn drive shaft by hand to check for smooth operation.

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. Bearings are available in standard size and .001", .002", .009", .010", .020" and .030" 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.

When a production crankshaft cannot be precision fitted by this method, it is then ground .009" undersize **on main journals only**. A .009" undersize bearing and .010" undersize bearing may be used for precision fitting in the same manner as previously described. Any engine fitted with a .009" undersize crankshaft will be identified by the following markings.

- ".009" will be stamped on the crankshaft counterweight forward of the center main journal.
- A figure "9" will be stamped on the block at the left front oil pan rail.

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 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 gauging plastic the full width of the bearing (parallel to the crankshaft) on the journal (fig. 39).

CAUTION: Do not rotate the crankshaft while the gauging plastic is between the bearing and journal.

3. Install the bearing cap and evenly torque the retaining bolts to specifications.
4. Remove bearing cap. The flattened gauging plastic will be found adhering to either the bearing shell or journal.
5. On the edge of gauging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gauging plastic, measure its compressed width (at the widest point) with the graduations on the gauging plastic envelope (fig. 40).

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



Fig. 39—Gauging Plastic on Journal



Fig. 40—Measuring Gauging Plastic

.001", interference between the bearing and journal will result in rapid bearing failure. If the flattened gauging 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 gauging 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.
8. Proceed to the next bearing. After all bearings have been checked rotate the crankshaft to see that there is no excessive drag.
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 gauge (fig. 41).
10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

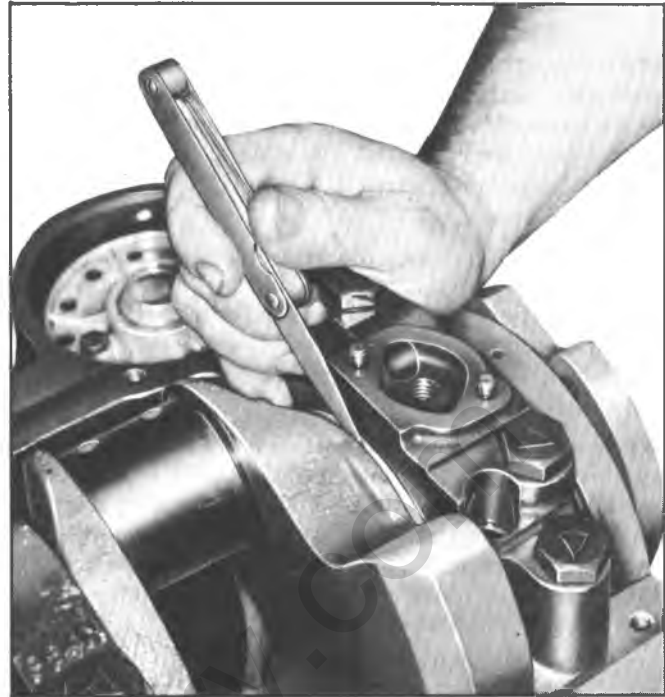


Fig. 41—Measuring Crankshaft End Play

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. On the In-Line engine crankshaft, 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 42).
 - 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



Fig. 42—Replacing Upper Main Bearing (In-Line)

holding just the slinger with the pliers or tap in place with a drift punch.

3. All other crankshaft journals (In-Line and V8) have oil holes. Replace the main bearing upper half as follows:
 - a. 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.

 - 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 cap with arrows pointing toward front of engine.
6. Torque main bearing cap bolts to specifications.

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. 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.

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 the bearings 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 gauging plastic the full width of the crankpin as contacted by the bearing (parallel to the crankshaft) (fig. 43).
- 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 gauging plastic installed.

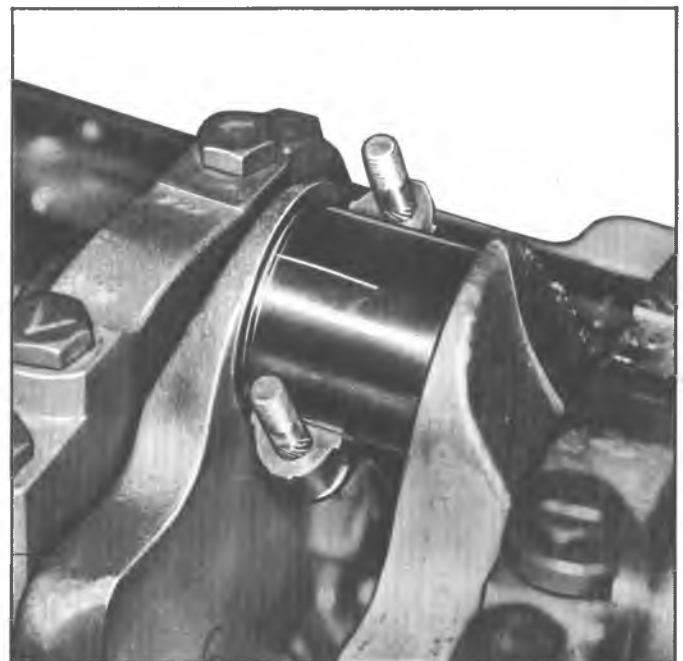


Fig. 43—Gauging Plastic on Crankpin

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- d. Remove the bearing cap and using the scale on the gauging plastic envelope, measure the gauging plastic width at the widest point (fig. 44).
6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance.
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 the connecting rod cap and side of crankpin on In-Line engines (fig. 45) or between connecting rod caps on V8 engines (fig. 46).

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.

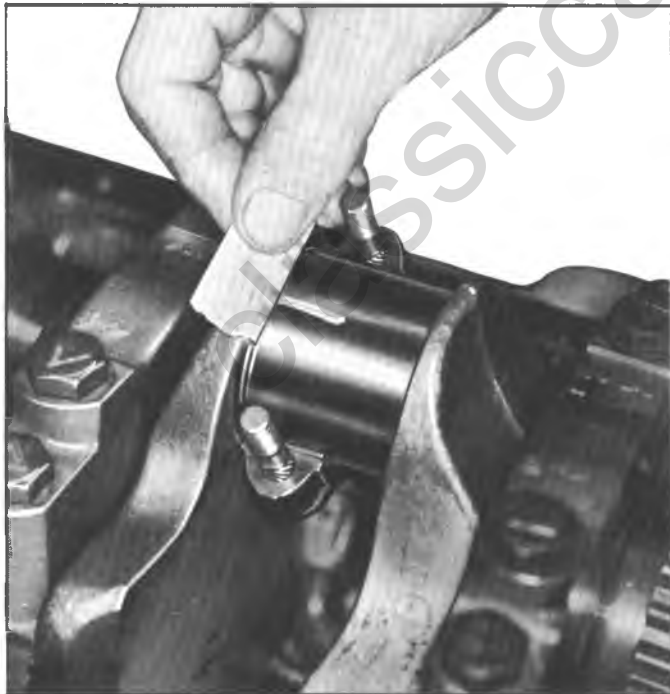


Fig. 44—Measuring Gauging Plastic



Fig. 45—Measuring Connecting Rod Side Clearance (In-Line)



Fig. 46—Measuring Connecting Rod Side Clearance (V8)

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. 47).

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

If bosses on pistons (fig. 48) do not allow piston support Tool J-9510-1 to seat squarely on the piston for press

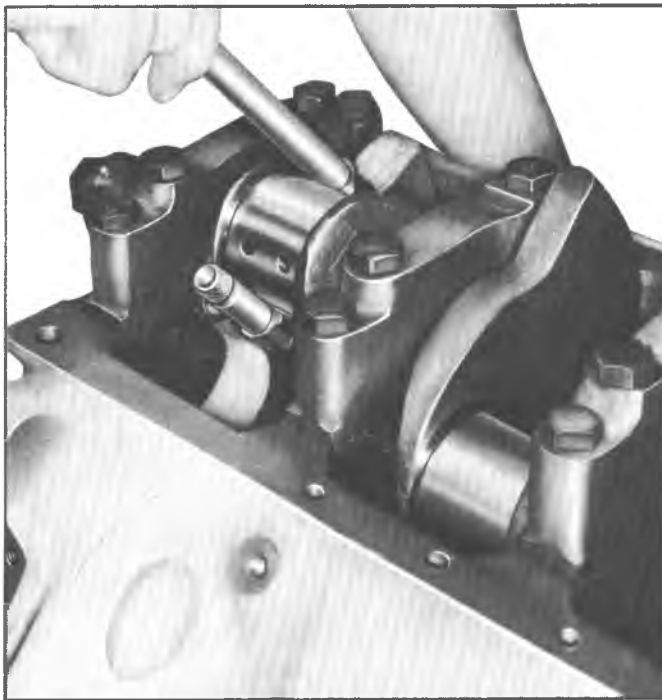


Fig. 47—Removing Connecting Rod and Piston Assemblies

operations, modifications to the tool are necessary. To allow adequate clearance for these bosses, turn or grind the upper portion of the tool to the dimensions shown in Figure 49.

Modification of the tool as described does not affect tool application on other pistons.

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"), J-8032 (4"), J-22249 (3-15/16"), J-22147

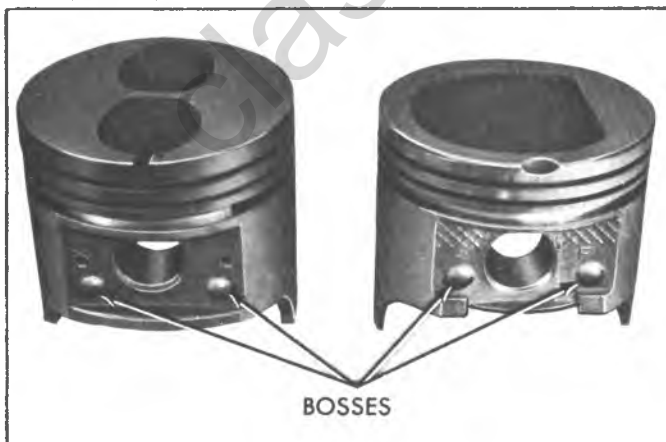


Fig. 48—Piston Bosses

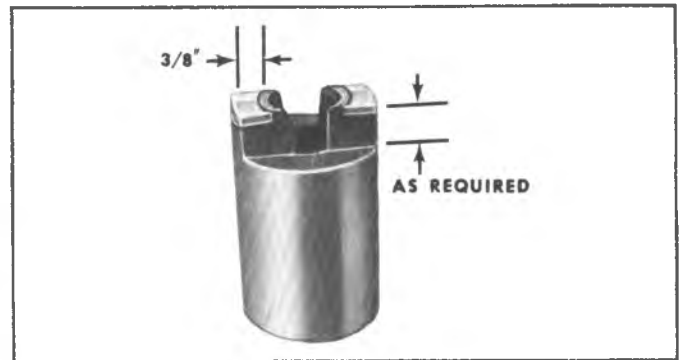


Fig. 49—Piston Support Tool Rework

(4-3/32"), and J-22250 (4-1/4") are available for this purpose.

3. Using Tool J-9500 for In-Line and "Small V8" (fig. 50) or Tool J-6994 for "Mark IV V8" (fig. 51), place connecting rod and piston assembly in an arbor press with piston on Support then using Remover, press piston pin out of connecting rod and piston.
4. Remove assembly from arbor press and remove tools, piston pin, connecting rod and piston.

Cleaning and Inspection

Connecting Rods

Wash connecting rods in cleaning solvent and dry with compressed air.

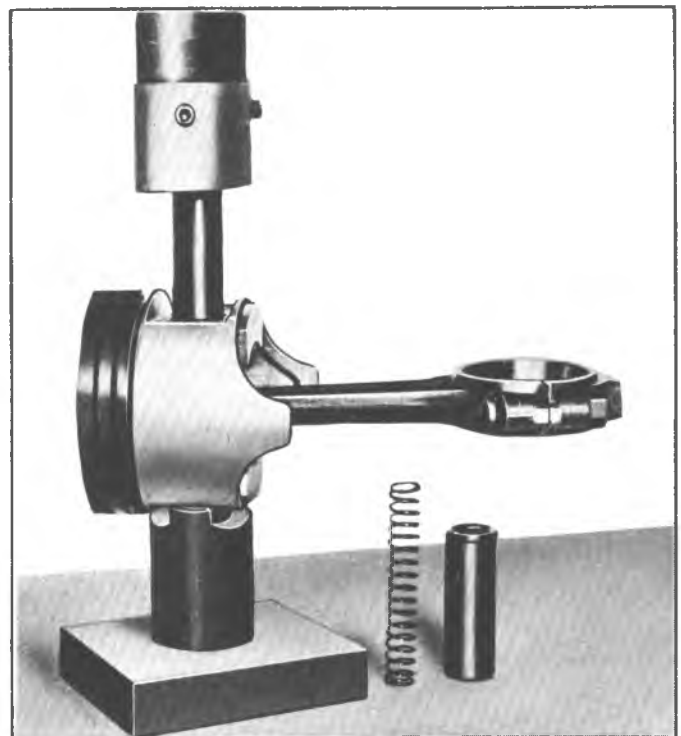


Fig. 50—Removing Piston Pin (In-Line and "Small V8")

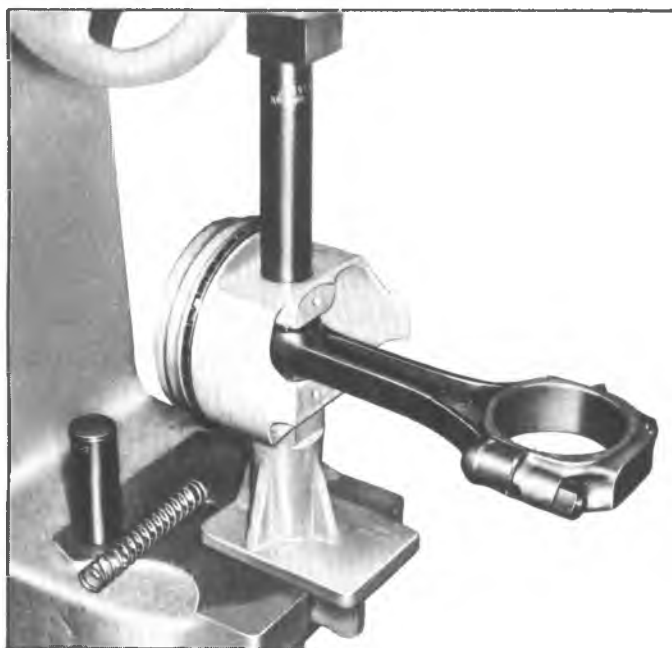


Fig. 51—Removing Piston Pin ("Mark IV V8")

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 gauge 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. Using Tool J-9510 for In-Line and "Small V8" (fig. 52) or Tool J-6994 for "Mark IV V8" (fig. 53) place Support with spring and pilot in place on an arbor press.
3. Position piston on connecting rod with appropriate side of piston (fig. 55) and connecting rod bearing tangs aligned (fig. 52 or 53).
4. Place piston on support, indexing pilot through piston and rod.
5. Place Installer on piston pin, start piston pin into piston and press on installer until pilot bottoms in support.
6. Remove installer from connecting rod and piston assembly and check piston for freedom of movement on piston pin.

Piston Rings

All compression rings are marked on the upper side of

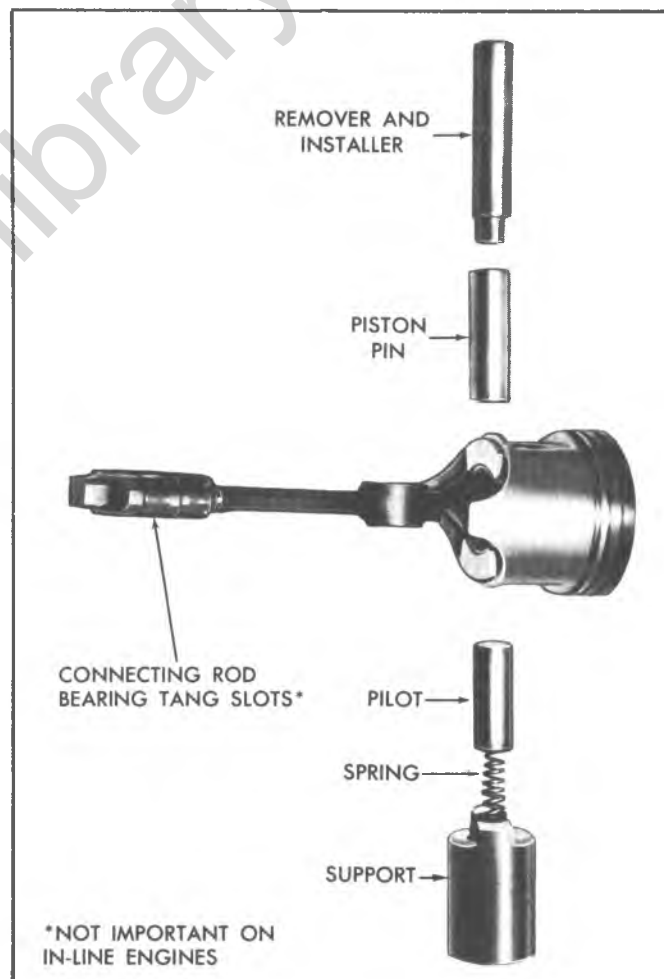


Fig. 52—Piston Pin and Tool Layout (In-Line and "Small V8")

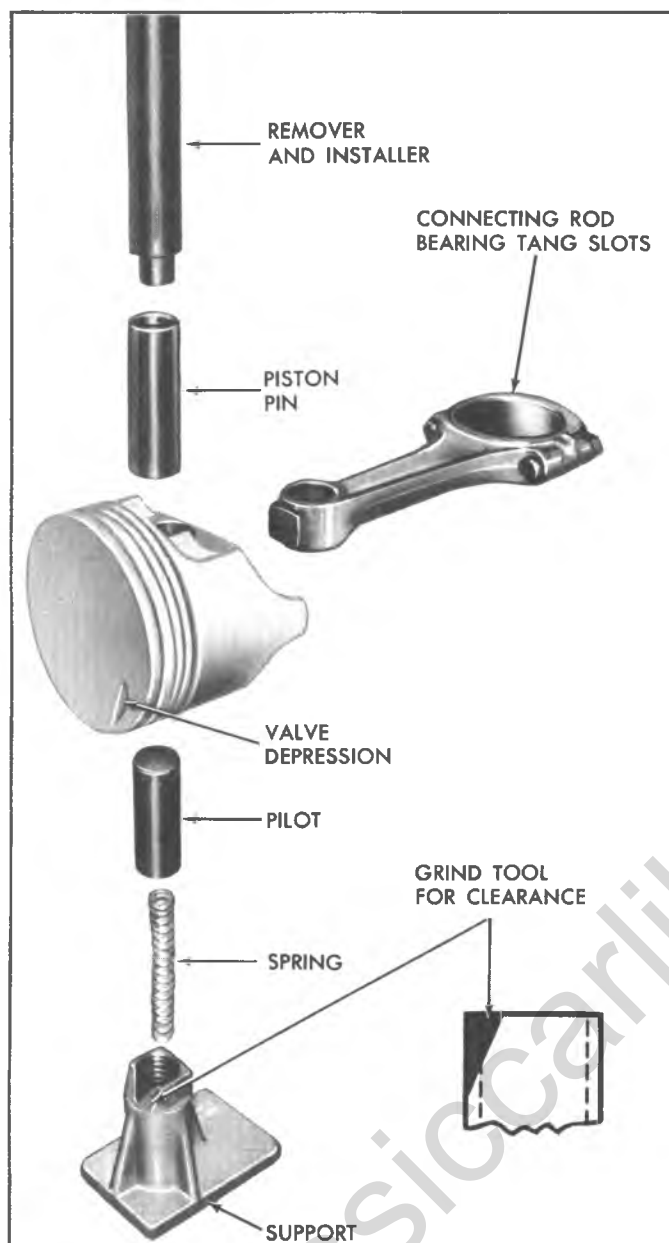


Fig. 53—Piston Pin and Tool Layout ("Mark IV V8")

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 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 gauge (fig. 55).
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. 56) 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. 57).

NOTE: Tools J-8020 (3-9/16"), J-8021 (3-7/8"), J-8032 (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, except on 250 cu. in. engine, 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 and groove should be measured (fig. 58). (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.

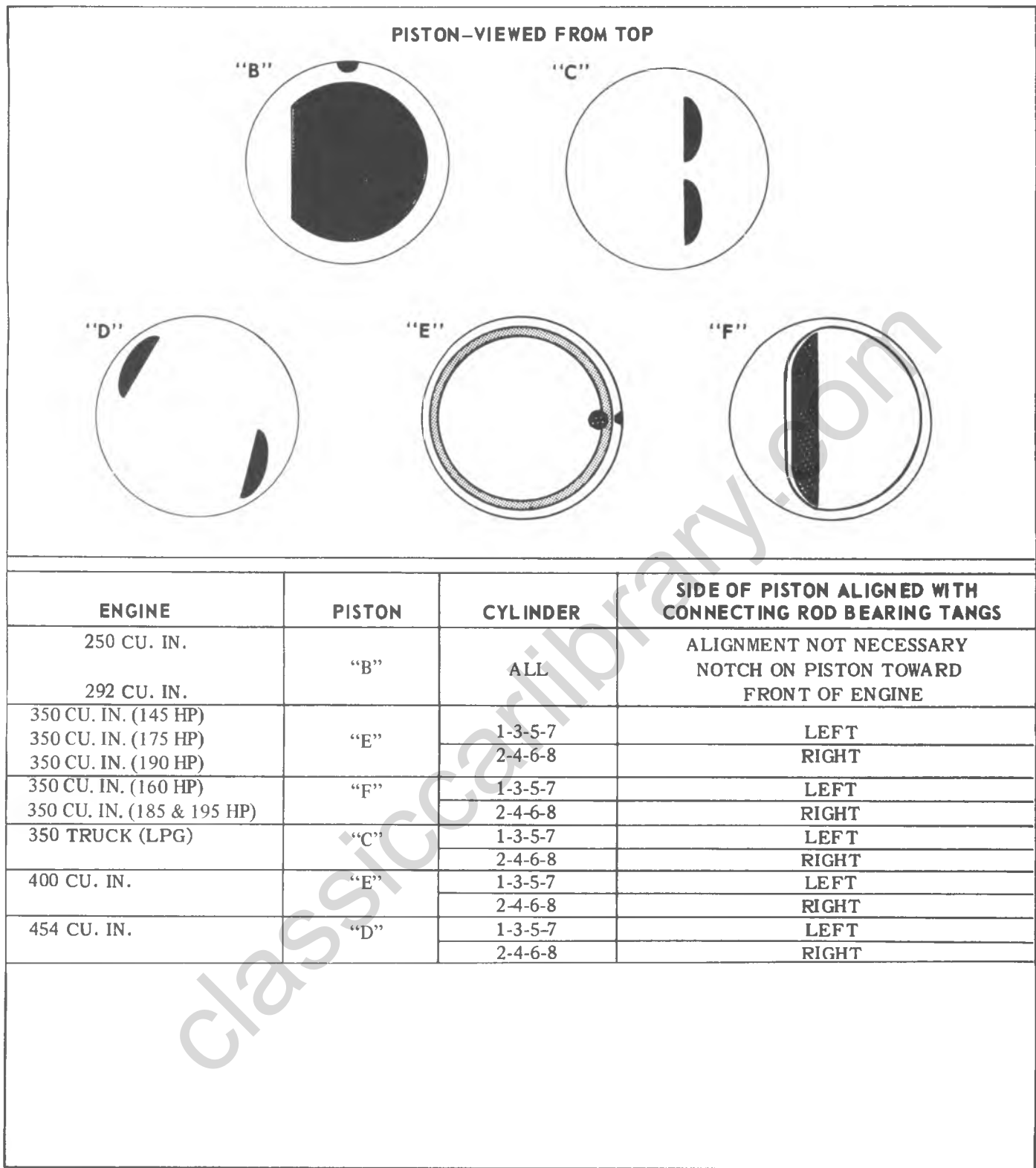


Fig. 54—Connecting Rod and Piston Relationship

3. With bearing caps removed, install Tool J-5239 (3/8") or J-6305 (11/32") on connecting rod bolts.

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 on V8 engines (fig. 59). In-Line engine pistons must have piston notch facing front of engine (fig. 60). Use

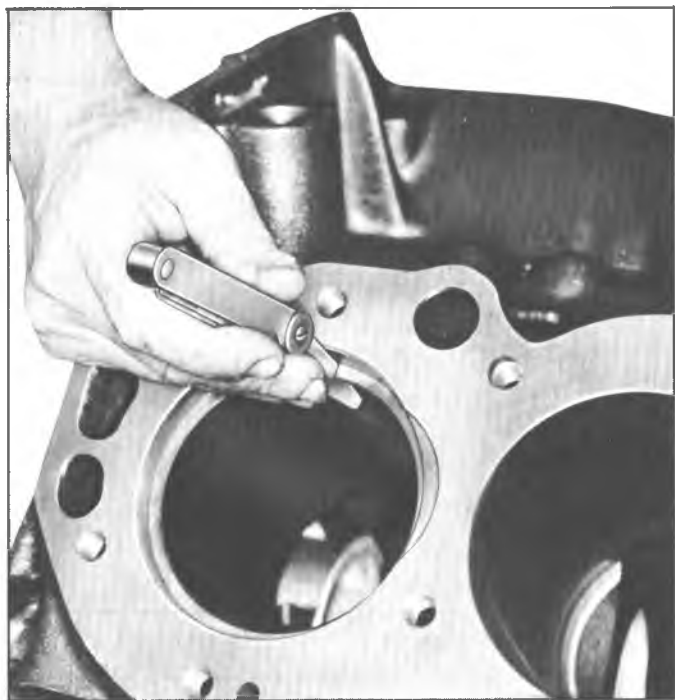


Fig. 55—Measuring Ring Gap

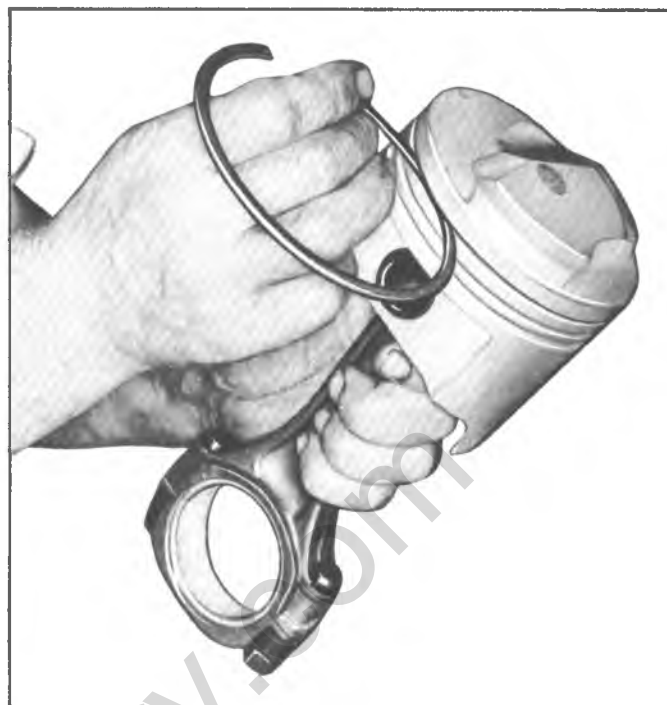


Fig. 56—Checking Ring In Groove

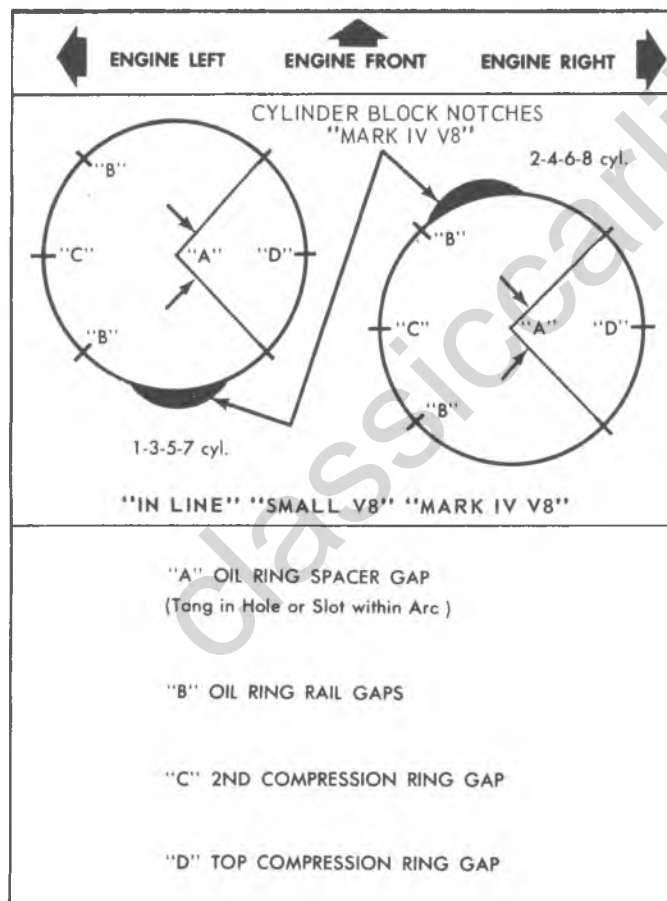


Fig. 57—Ring Gap Location



Fig. 58—Measuring Ring Groove Clearance

Tool J-8037 to compress the rings (fig. 61). 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.

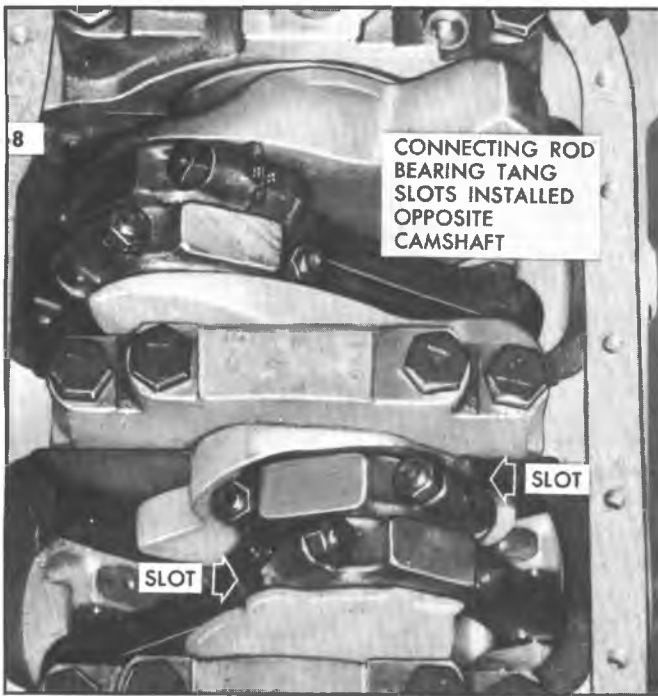


Fig. 59—Connecting Rods—Installed Position V8

6. Install the bearing caps and torque nuts to specification.

NOTE: If bearing replacement is required refer to "Connecting Rod Bearings".

NOTE: 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.

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 overhaul stand and clamp securely.
2. Remove the oil dip stick and oil dip stick tube, (if applicable).

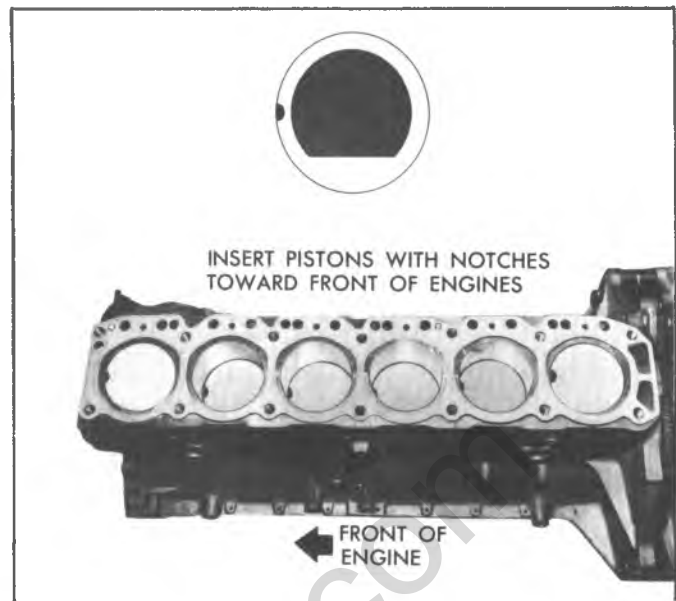


Fig. 60—Pistons—Installed Position (In-Line)

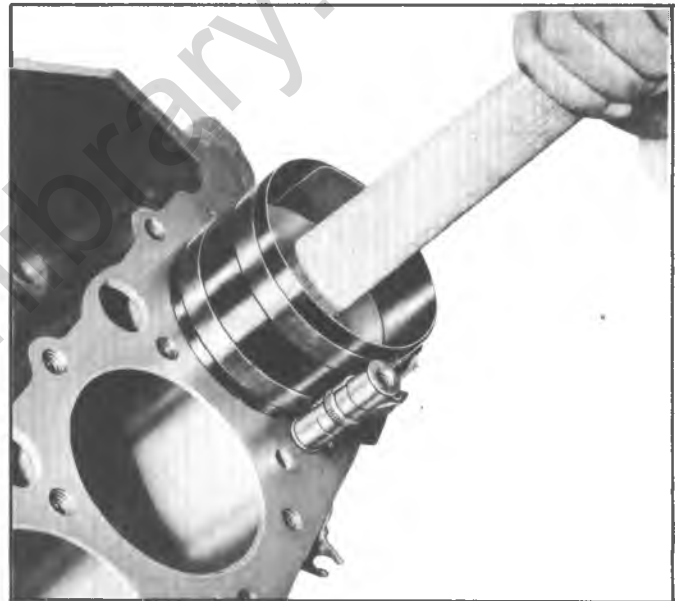


Fig. 61—Installing Connecting Rod and Piston Assemblies

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.
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. 62)

- On In-Line engines, remove crankshaft gear using Tool J- 8105, install using Tool J-5590.
- 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

For installation of crankshaft, refer to the applicable steps under "Engine Assembly" previously outlined.

If a new crankshaft is being installed on a 292 cu. in. engine, the flywheel dowel pin hole must be reamed as outlined in Truck Chassis Service Manual.

CAMSHAFT

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.

The camshaft should also be checked for alignment. The best method is by use of "V" blocks and a dial indicator (fig. 64). The dial indicator will indicate the exact amount the camshaft is out of true. If it is out more than .0015" dial indicator reading, the camshaft should be replaced.

On In-Line engines inspect the camshaft gear and thrust plate for wear or damage. Measure the camshaft end play. This should be .001" to .005" (fig. 64).

Oil Nozzle Replacement (In Line)

1. Remove nozzle with pliers (fig. 65).

2. Drive new nozzle in place (oil hole in vertical position) using a suitable light plastic or rubber hammer.

Camshaft Gear Replacement (In Line)

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 (fig. 66).

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" (fig. 64).

CAMSHAFT BEARINGS

Inspection

With the camshaft removed, inspect the bearings for evidence of wear or damage. (Bearings showing the above should be replaced.)

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 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.
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

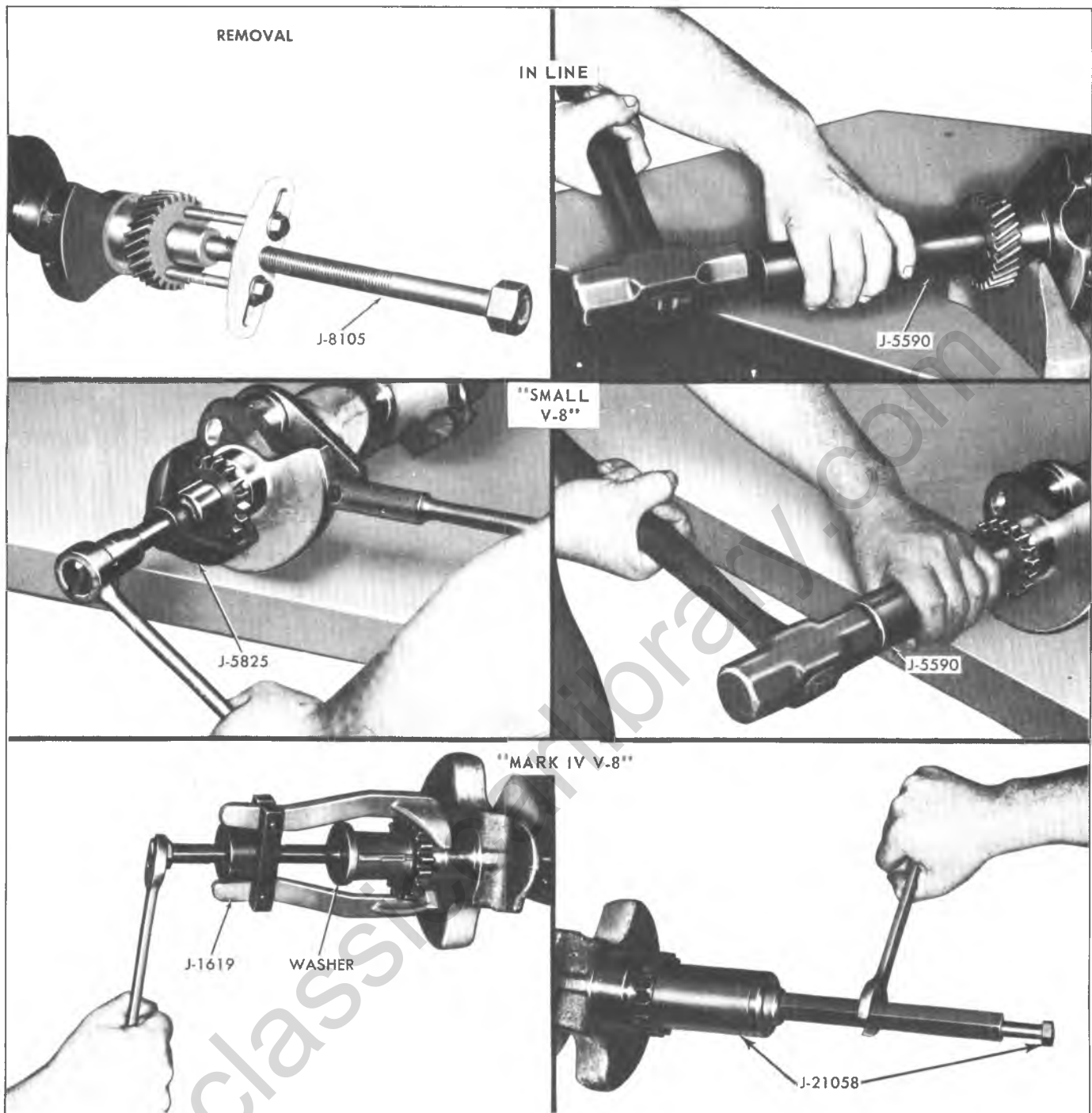


Fig. 62—Sprocket or Gear Replacement

nut. When bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw (fig. 67).

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. 68).

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. 68).

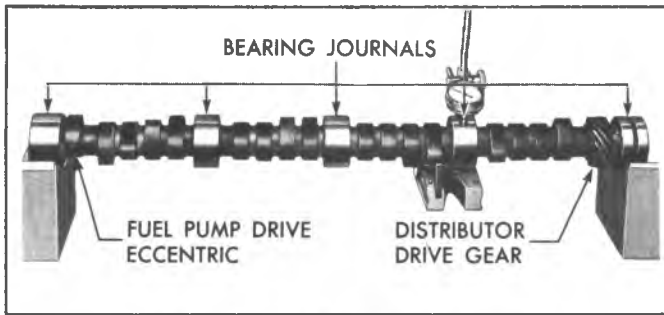


Fig. 63—Checking Camshaft Alignment

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. In Line Engines--All cam bearing oil holes must be aligned with oil hole in cam bore.
 - b. 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.
 - c. 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 (fig. 67).
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.

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

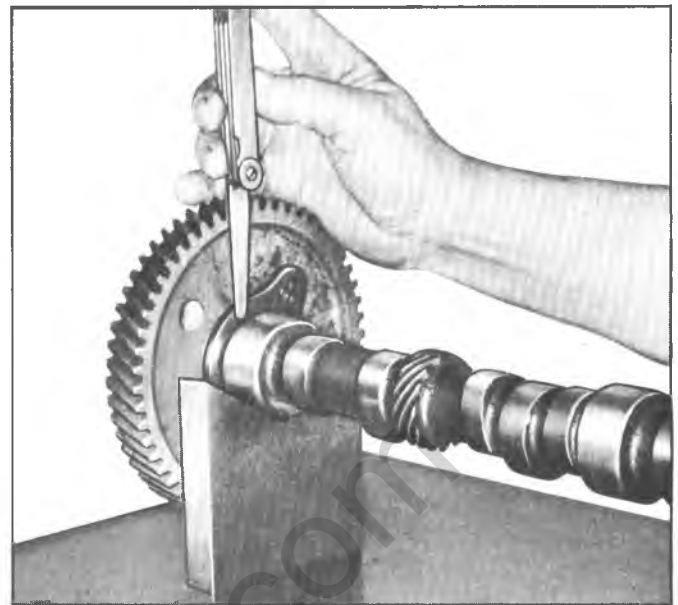


Fig. 64—Measuring Camshaft End Play

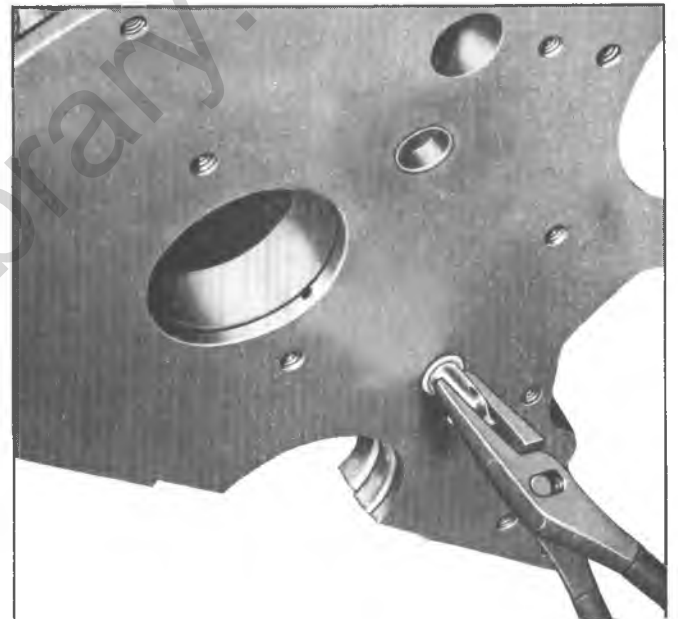


Fig. 65—Oil Nozzle Replacement (In-Line)

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 gauge so that the thrust pin must be forced in about 1/4" to enter gauge in cylinder bore. Center gauge in cylinder and turn dial to "0". Carefully work gauge up and

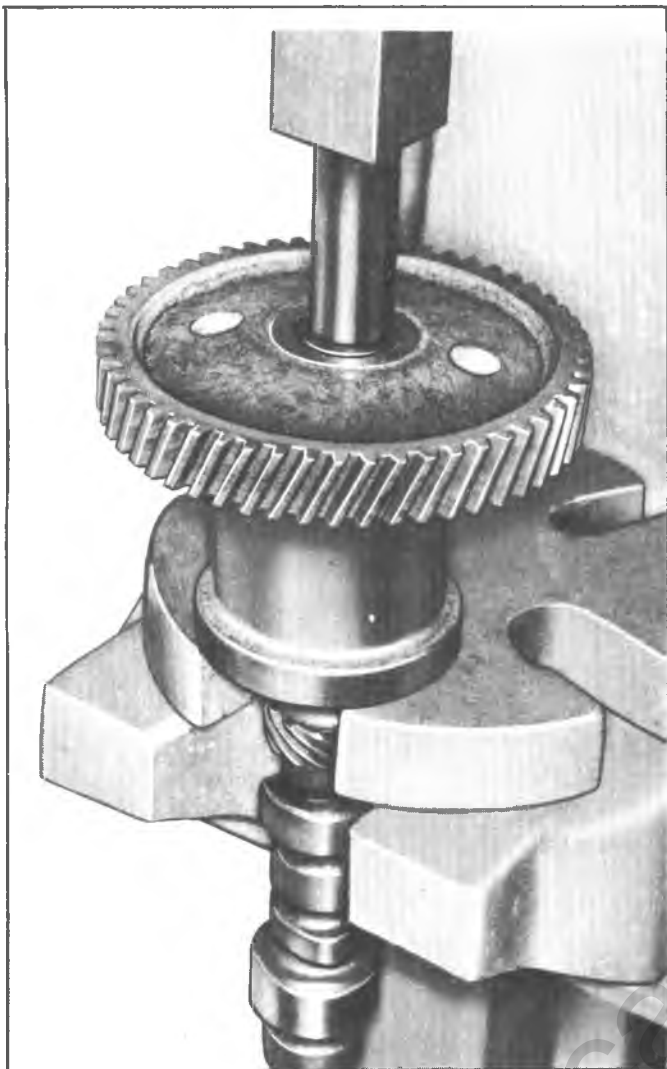


Fig. 66—Removing Camshaft Gear

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 (fig. 69).

Oil Filter Bypass Valve Inspection and Replacement

In-Line Engines

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 (fig. 70).

V8 Engines

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

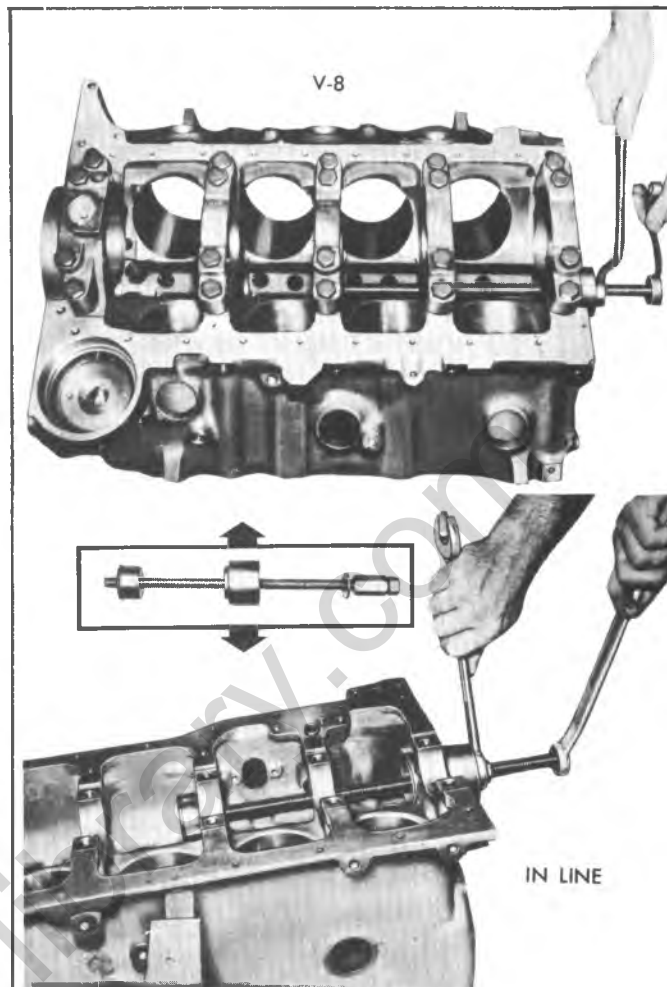


Fig. 67—Replacing Camshaft Center Bearing

assembly. Clean valve chamber in cylinder block thoroughly. Torque retaining screws to specifications (fig. 71).

Distributor Lower Bearing Replacement (In-Line)

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 (fig. 72).
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.

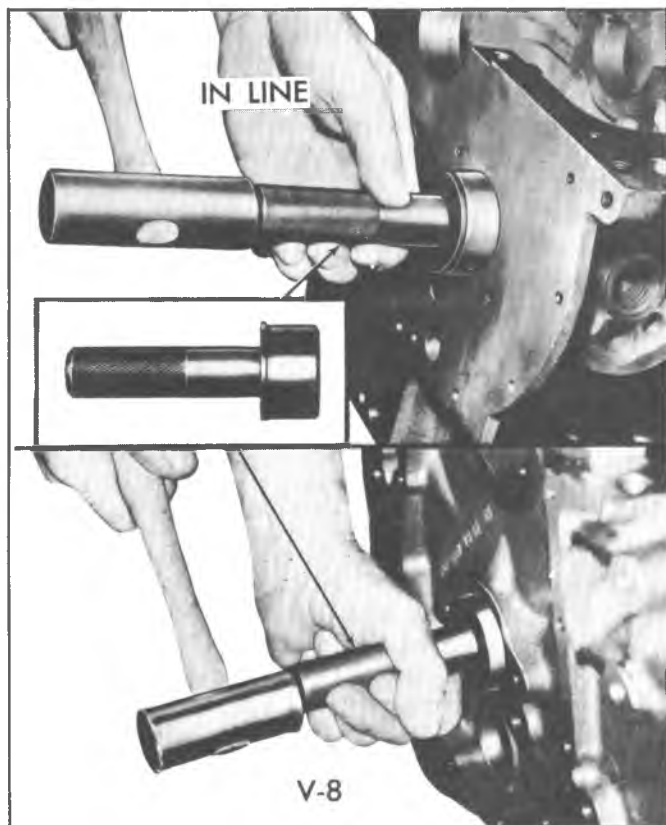


Fig. 68—Replacing Camshaft Front Bearing

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.

REPAIRS

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



Fig. 69—Measuring Cylinder Bore

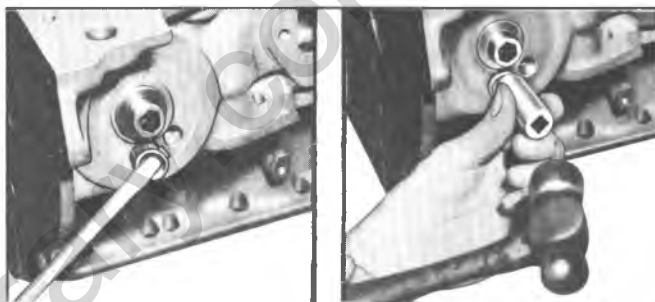


Fig. 70—Oil Filter By-Pass Valve (In-Line)

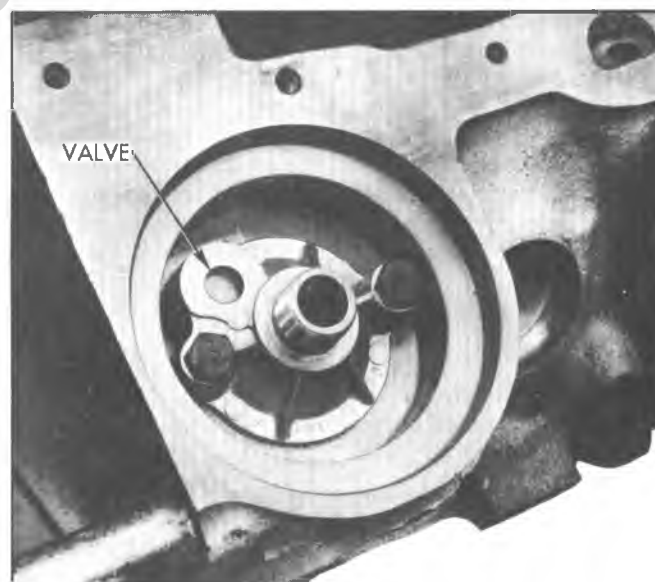


Fig. 71—Oil Filter By-Pass Valve (V8)

.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

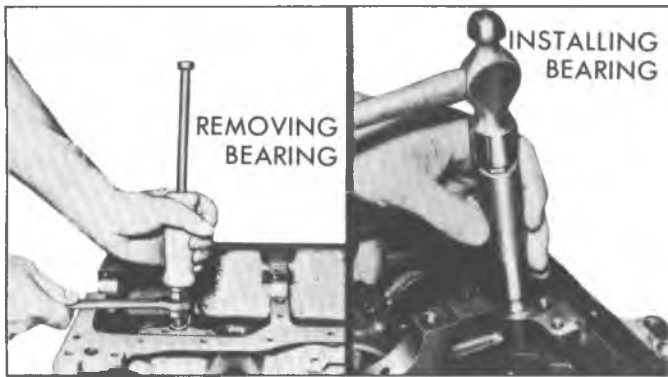


Fig. 72—Replacing Distributor Bearing

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 (fig. 73).
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 gauge (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



Fig. 73—Cylinder Finish Marks

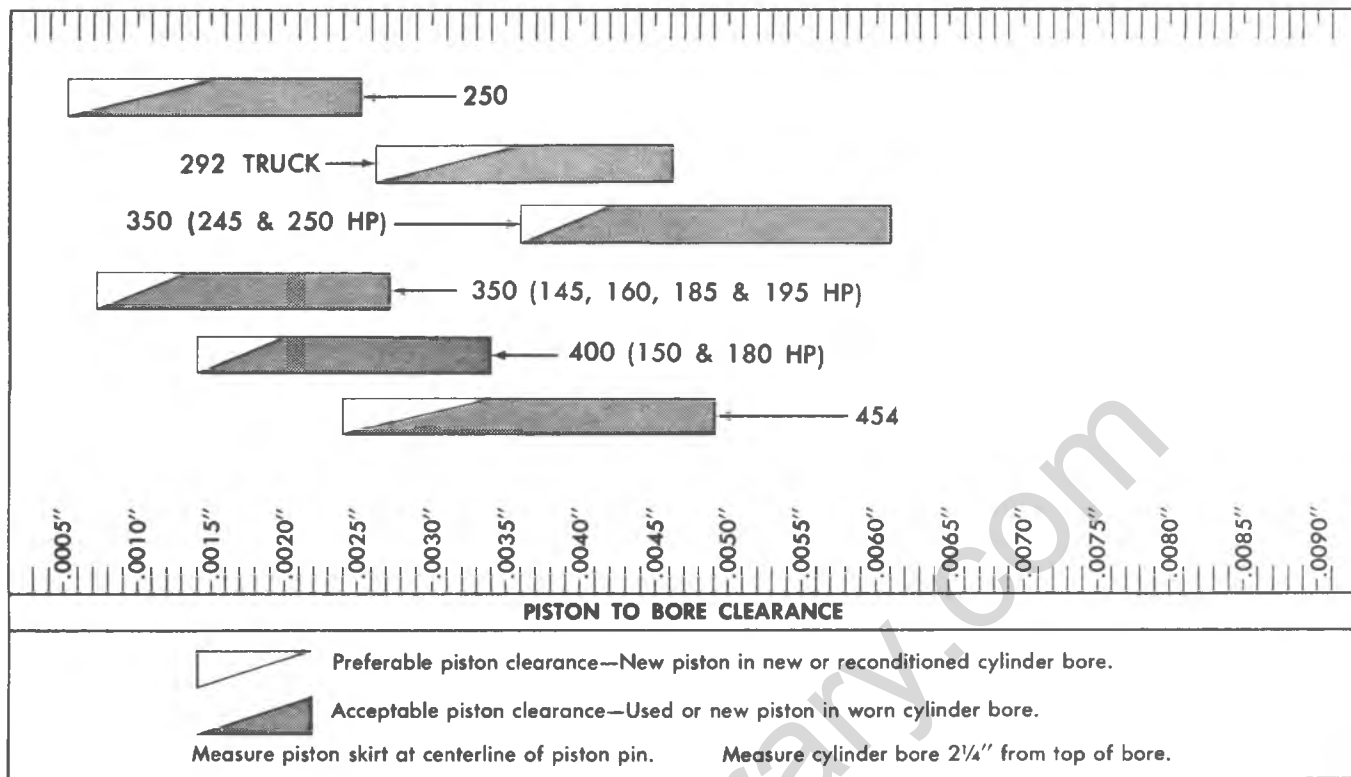


Fig. 74—Piston Selection Chart

Selection Chart (fig. 74) and determine if piston to bore clearance is in the acceptable range.

2. If used piston is not acceptable, check Piston Size Chart (fig. 75) 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 (DISPLACEMENT)	PISTONS AVAILABLE		
	STD.	OVERSIZE	
		.001"	.030"
250	3.8750	3.8760	3.9035
	3.8760	3.8770	3.9055
292	3.8730	3.8740	3.9038
	3.8740	3.8750	3.9062
350 (Exc. 245 & 250 HP)	3.9998	4.0008	4.0283
	4.0008	4.0018	4.0303
350 (245 & 250 HP)	3.9959	3.9969	4.0252
	3.9969	3.9979	4.0272
400	4.1241	4.1251	4.1526
	4.1251	4.1261	4.1546
454	4.2481	4.2491	4.2775
	4.2491	4.2501	4.2795

Fig. 75—Piston Size Chart

TORQUE SPECIFICATIONS

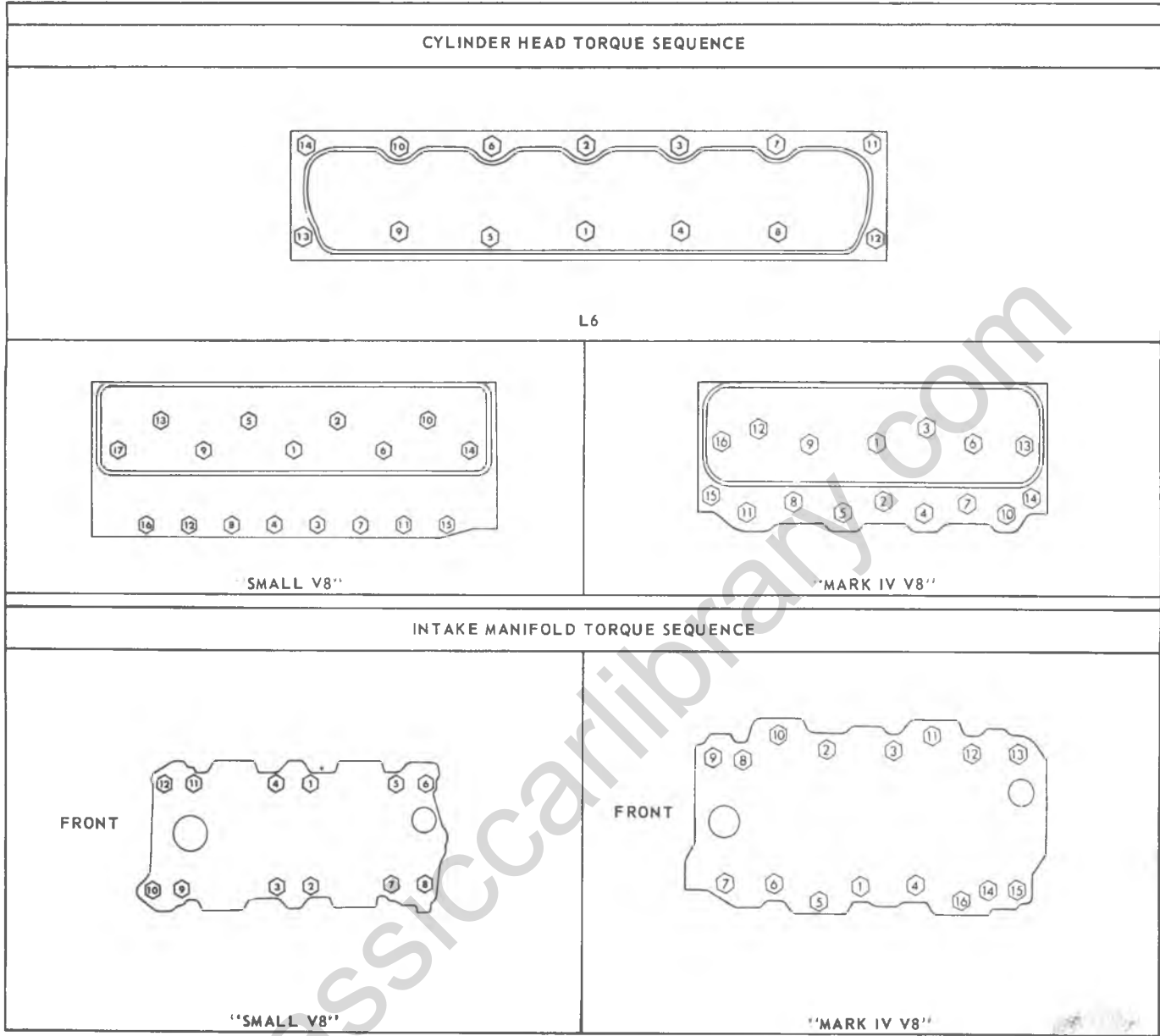


Fig. 76—Torque Specifications

SPECIAL TOOLS

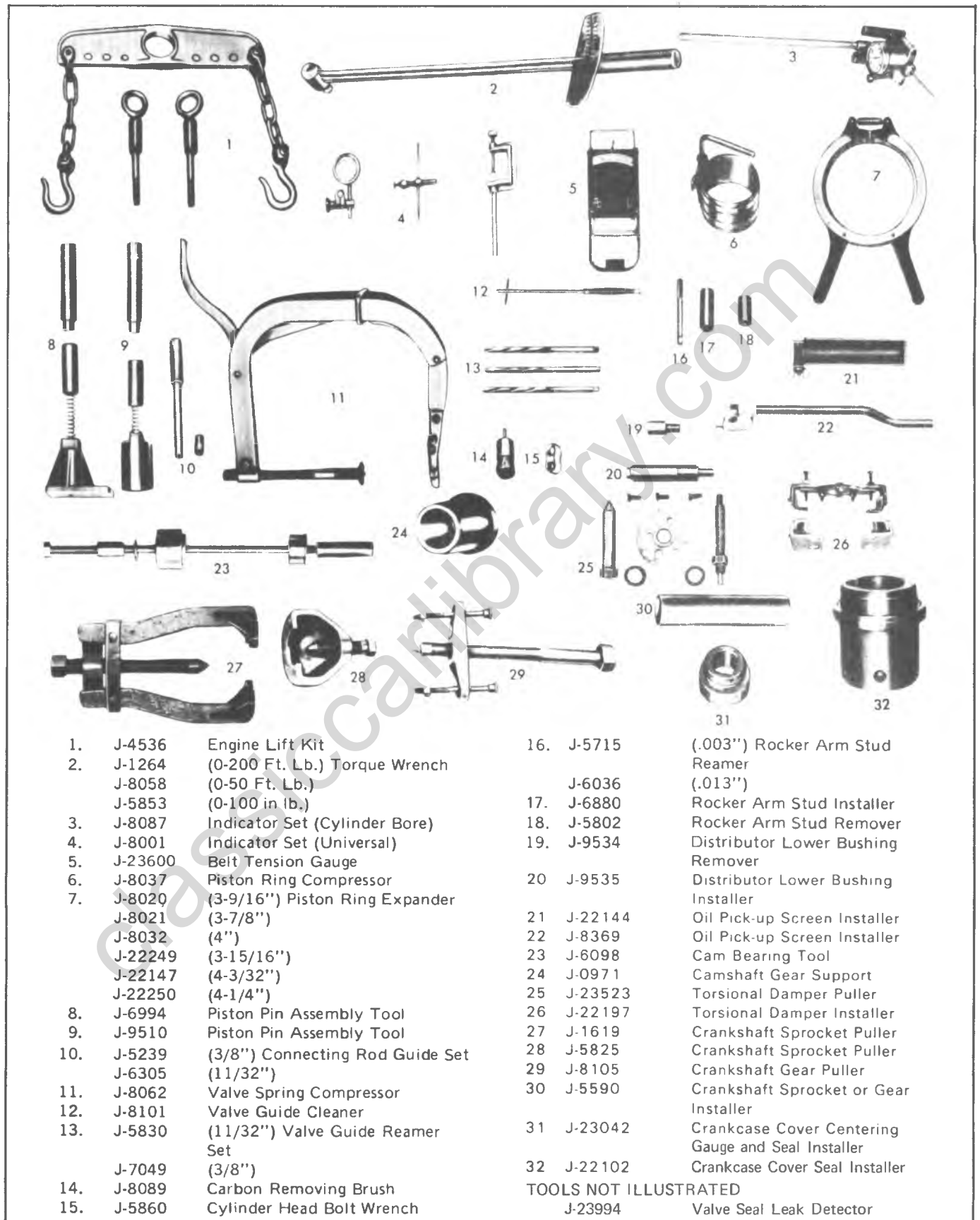


Fig. 77—Engine Special Tools

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SECTION 6M

CARBURETORS

CONTENTS OF THIS SECTION

NOTE: Also refer to the Emission Control Systems'' Booklet for required maintenance and warranty information.

Introduction.....6M-1	Rochester 4MV (Quadrajets).....6M-14
Rochester M and MV (Monojet).....6M-1	Special Tools6M-20
Rochester 2GV (SAE 1 1/2)6M-8	

INTRODUCTION

(SEE ROCHESTER CARBURETORS IDENTIFICATION, FIG. M1)

Various carburetors, designed to meet the particular requirements of engines, transmission and vehicles, are used on passenger vehicles and although carburetors may look alike they are not always interchangeable. Refer to carburetor part number and/or specifications.

This section, divided into sub-sections by carburetor

model, covers the repair procedures for the various carburetors, assembly and disassembly procedures and internal carburetor adjustment. Although illustrations showing bench operations are used, most single operations, when not part of a general overhaul, should be performed (if practical) with the carburetor on the engine. Typical illustrations and procedures are used except where specific illustrations or procedures are necessary to clarify the operation.

ROCHESTER M AND MV (MONOJET)

INDEX

General Description.....6M-1	Assembly and Adjustments.....6M-5
Disassembly.....6M-3	Throttle Body.....6M-5
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Float Bowl6M-3	Adjust Float Level.....6M-7
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GENERAL DESCRIPTION

The model MV (Fig. M2, M3, M4 and M5) carburetor used with 6 cylinder engine is a single bore, down draft unit using a triple venturi in conjunction with a plain tube nozzle. The main venturi is 1 5/16'' in diameter and the throttle bore is 1 11/16''.

Fuel flow through the main metering system is controlled by 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 with passenger car automatic transmission incorporates a hot idle compensator to maintain smooth engine idle during periods of extreme hot engine operation.

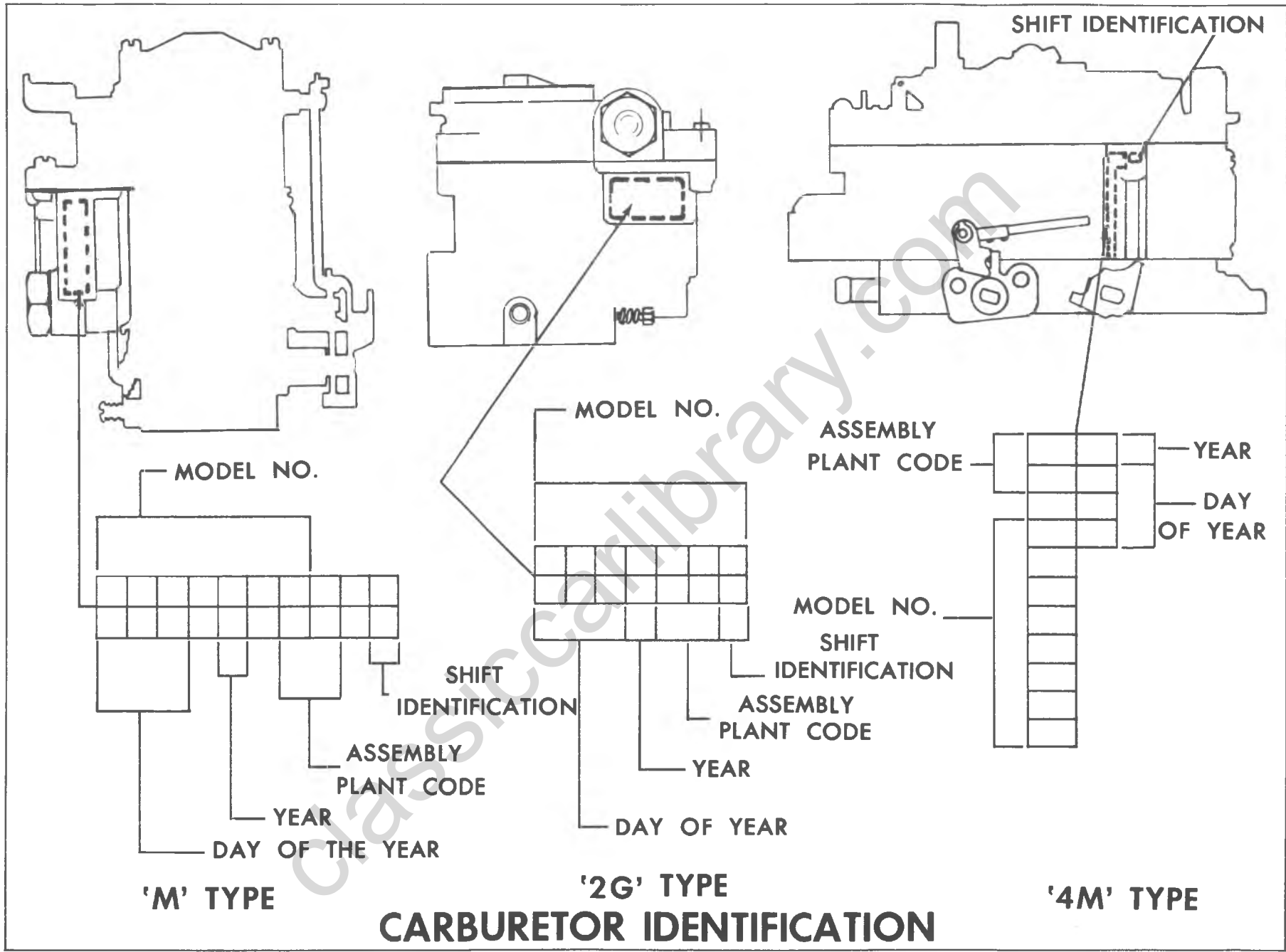
The model MV carburetor has an automatic choke system. The vacuum diaphragm unit connects to the

choke valve lever through a connecting link. The choke coil is mounted on the manifold and is connected to the choke valve lever by a rod.

An internal fuel inlet filter is mounted in the fuel bowl behind the fuel inlet nut to give maximum filtration of incoming fuel.

An electrically operated idle stop solenoid is attached to the carburetor float bowl casting and replaces the curb idle speed screw. The idle stop solenoid, energized when the ignition is turned on, controls the engine curb idle speed.

The carburetor part number is stamped on a vertical section of the float bowl, next to the fuel inlet nut. When replacing the float bowl assembly, follow the manufacturer's instructions contained in the service package so



CARBURETOR IDENTIFICATION

Fig. M1--Rochester Carburetors Identification

that the part number can be transferred to the new float bowl.

The idle mixture screw will have a limiter cap installed with a 1/2 to 3/4 turn lean adjustment provided on the vehicle. The mixture screw will be pre-set at the factory and capped, and no further adjustment should be required except during cleaning and overhaul.

An overhaul idle mixture adjustment procedure is

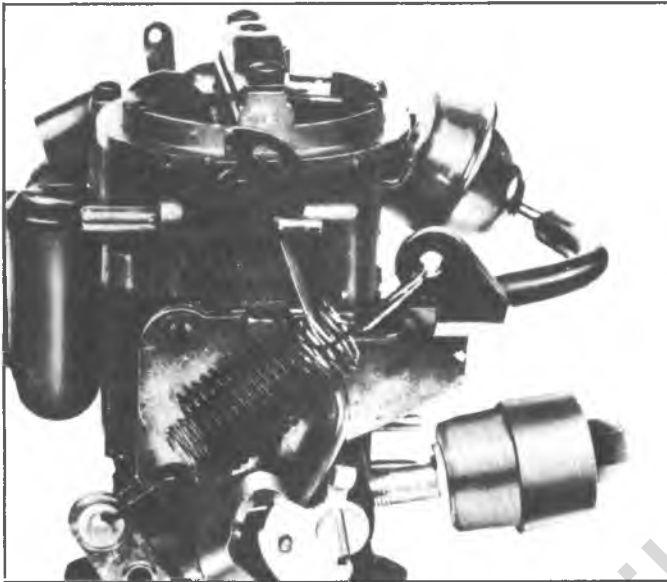


Fig. M2--Rochester Monojet Carburetor - L/D
Emission Carburetor
Shown (Typical)

provided, should the idle mixture needle need replacement or the mixture channels cleaned during the overhaul process. A new idle mixture needle limiter cap is **NO LONGER** provided in the overhaul kit. The absence of a stop on the cap is evidence that the idle mixture has been readjusted due to service work.

DISASSEMBLY OF CARBURETOR

Air Horn

1. If desired, the choke valve, and choke shaft can be removed from air horn by first removing the thermostatic coil lever from the end of choke shaft by removing attaching screw.

Remove the two choke valve attaching screws; then remove the choke valve and choke shaft from air horn.

NOTE: The choke valve screws are held in place by Loctite so it will be necessary to restake or use Thread Lock No. 7041970 or equivalent during assembly.

2. No further disassembly of the air horn is necessary. The pressure relief valve disc need not be removed from the top of the air horn for cleaning purposes.

Float Bowl

1. Remove air horn to float bowl gasket. Gasket is slit next to metering rod hanger so that it can be easily removed.
2. Remove float assembly from float bowl by lifting upward on float hinge pin. Remove hinge pin from float arm.

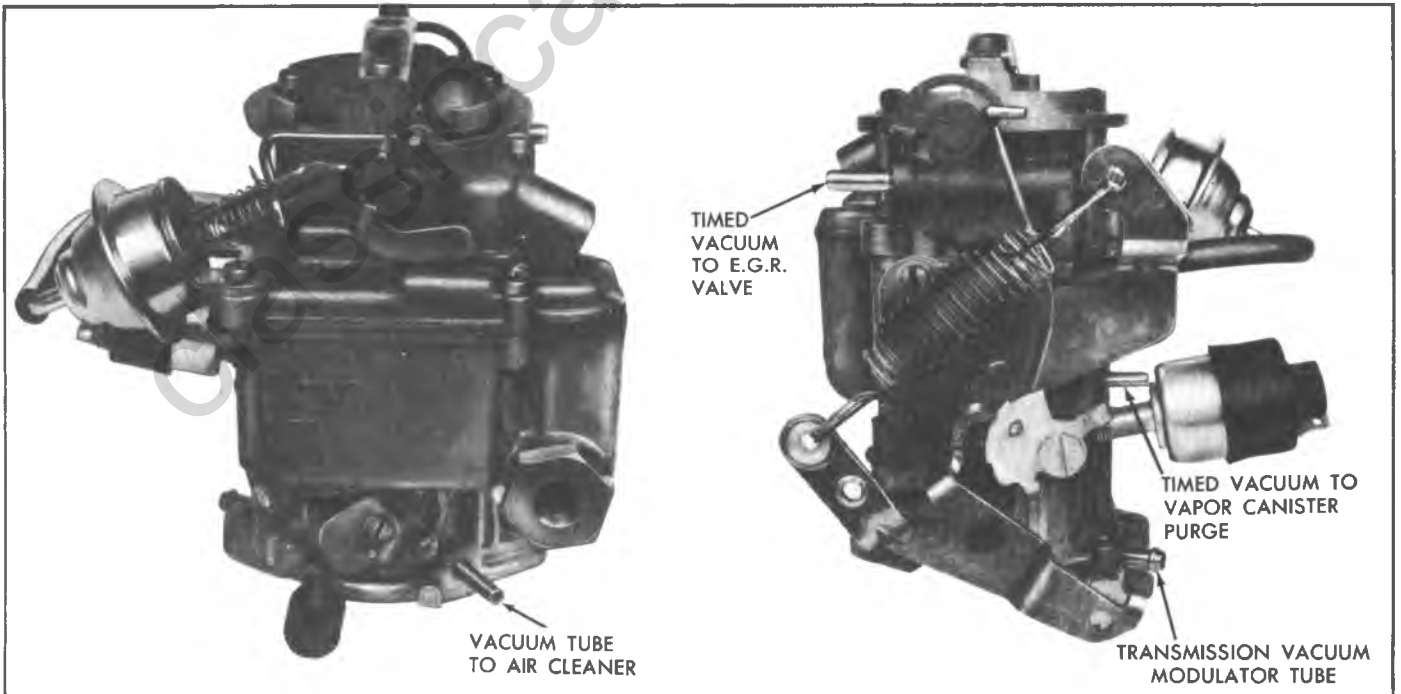


Fig. M3--Model MV (1bbl.) Passenger Car (Automatic) Carburetor

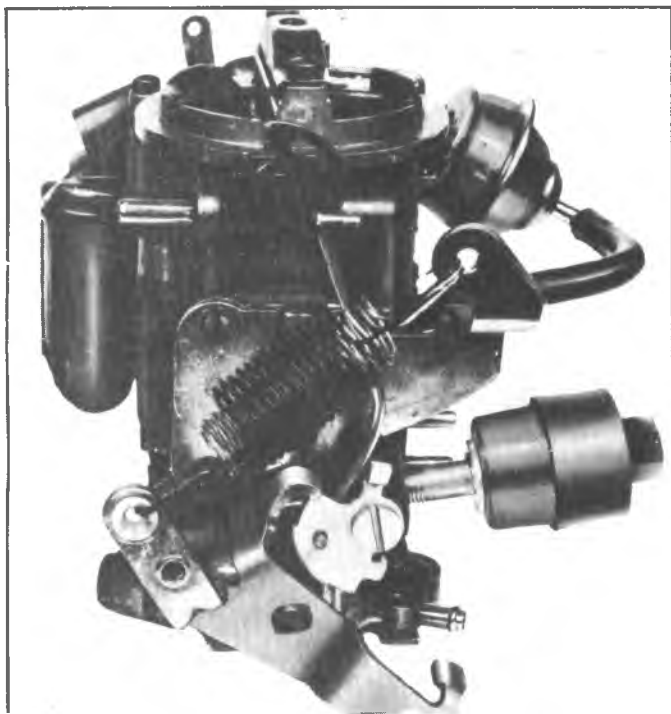


Fig. M4—Model MV (1 bbl) Passenger Car (Manual) Carburetor

3. Remove float needle, float needle seat and gasket. Use caution in removing needle seat to prevent damage.
4. Remove fuel inlet nut, gasket, paper filter element and pressure relief spring.
5. Using long nosed pliers, remove "T" pump discharge spring retainer. Pump discharge spring and ball may be removed by inverting bowl.
6. The idle tube can be removed at same time by inverting bowl.
7. To remove accelerating pump plunger and metering rod--power piston drive assemblies, perform following operation:
 - a. Remove actuating lever on throttle shaft by removing attaching screw at end of shaft.
 - b. Remove upper end of drive link from power piston rod.
 - c. Rotate drive link from keyhole in actuating lever.
 - d. Remove actuating lever from pump link by rotating off tang on rod.
 - e. Remove upper end of pump link by rotating from keyhole in pump slide.
8. The power piston--metering rod assembly and drive rod can now be lifted from float bowl.
9. Remove power piston spring from power piston cavity.
10. Remove pump plunger assembly from float bowl.
11. Remove pump return spring from pump well.

12. Remove main metering jet from bottom of fuel bowl.
13. Remove three screws from throttle return spring bracket. Then remove bracket, hot idle compensator and gasket from recess in bowl beneath compensator.
14. Idle adjustment screw and fast idle cam can be removed at this time if desired. No further disassembly of the float bowl is required.

Throttle Body Removal and Disassembly

1. Invert carburetor bowl on bench and remove two throttle body to bowl attaching screws. Throttle body and insulator gasket may now be removed from float bowl.

NOTE: Do not tamper with the idle mixture needle with a limiter cap unless performing an overhaul or due to needle damage. This has been set to test requirements by the manufacturer.

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, destroy the stop tang on the plastic limiter cap.
3. Remove the idle mixture needle and spring, if required.

NOTE: Due to the close tolerance fit of throttle valve in the bore of the throttle body, do not remove the 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.

CAUTION: Any rubber parts, plastic parts, including float, diaphragms, pump plunger, electric parts and solenoids should not be immersed in carburetor cleaner.
2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.
3. Inspect idle mixture needle for damage.
4. Examine float needle and seat assembly for wear. Install a new factory matched set if worn.
5. Inspect upper and lower casting sealing surfaces for damage.
6. Inspect holes in levers for excessive wear or out of round condition. If levers or rods are worn they should be replaced.
7. Examine fast idle cam for excessive wear or damage.
8. Check throttle and choke levers and valves for binds and other damage.

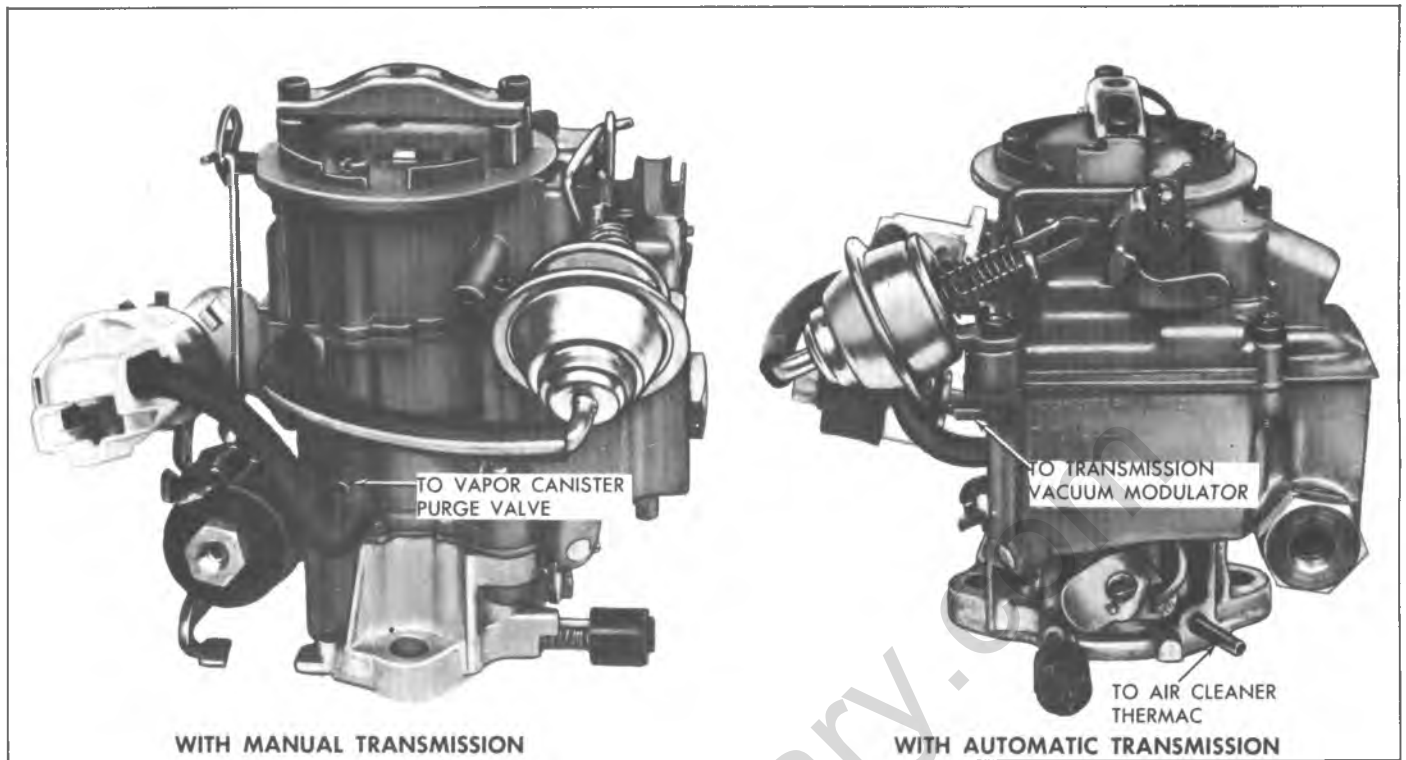


Fig. M5—Model MV (1 bbl) Passenger Car

9. Replace filter element.
10. Check all springs for distortion or loss in tension, replace as necessary.

CARBURETOR ASSEMBLY

Throttle Body

After completing assembly of the carburetor, and when installed in the vehicle, adjust the mixture screw to achieve the idle speed and idle mixture settings as specified in specifications and under Service Manual procedures.

1. If removed, install idle mixture needle and spring until lightly seated. Back out four turns as a preliminary idle adjustment.
2. Invert float bowl and install new throttle body to bowl insulator gasket.
3. Install throttle body on bowl gasket so that all holes in throttle body are aligned with holes in gasket.
4. Install two throttle body to bowl attaching screws. Tighten evenly and securely (12 to 15 foot lbs. of torque). The throttle body to bowl screws do not use lock washers as they have an interference fit designed into the thread for holding proper torque.

Float Bowl

1. Install fast idle cam to boss on float bowl, attaching

- with fast idle cam screw. Tighten securely. Part number on cam faces outward.
2. Install round seal into recess in idle compensator cavity in float bowl.
3. Install idle compensator assembly with two (2) attaching screws. Tighten securely.
4. Install throttle return spring bracket with (3) attaching screws. Tighten securely.
5. Install pump return spring into pump well. Make sure spring is properly seated in bottom of well.
6. Install pump plunger assembly into pump well with slide protruding through bottom of bowl casting. Push downward on pump slide and install pump drive link into hole in lower end of shaft. Ends of drive link point towards carburetor bore. Tang on upper end of link retains link to pump slide.
7. Install power piston and pump actuating lever to lower end of link. Projection on this lever points downward.
8. Install power piston spring into power piston cavity.
9. Install end of power piston actuating rod into groove on side of power piston. Then install power piston metering rod assembly and actuating rod into float bowl. End of metering rod must enter jet orifice.
10. Install drive link into keyhole in actuating lever.
11. Hold complete assembly downward in bowl, then install upper end of power piston drive link into hole in lower end of power piston actuating rod.

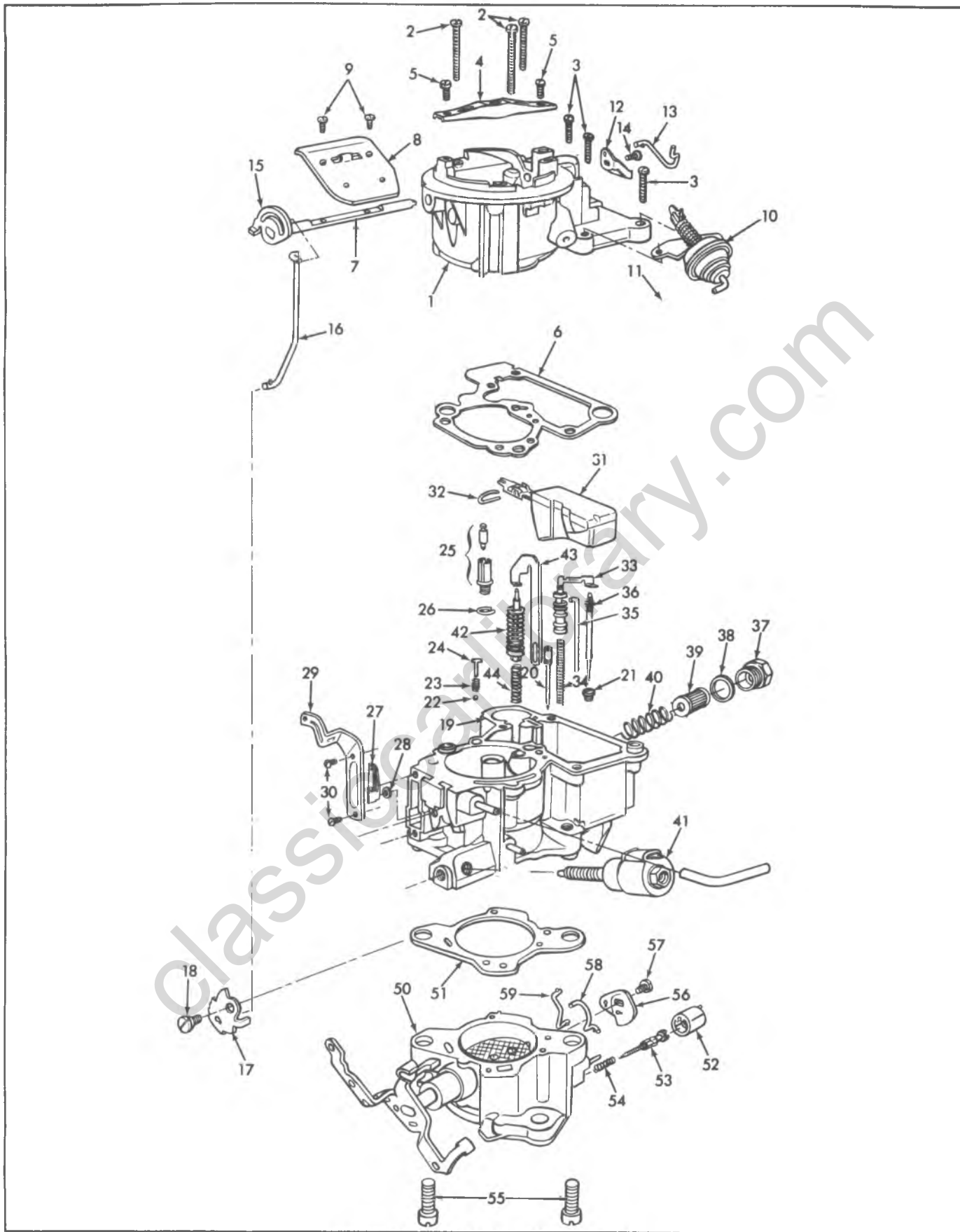


Fig. M6--Monojet--(See Fig. M7 for legend)

- | | | | |
|-----------------------------------|-------------------------------|--------------------------------------|-----------------------------------|
| 1. Air Horn Assembly | 16. Choke Rod | 30. Screw—Cover | 50. Throttle Body Assembly |
| 2. Screw—Air Horn—Long | 17. Cam—Fast Idle | 31. Float Assembly | 51. Gasket—Throttle Body |
| 3. Screw—Air Horn—Short | 18. Screw—Cam Attaching | 32. Hinge Pin—Float | 52. Idle Needle Limiter Cap |
| 4. Bracket—Air Cleaner Stud | 19. Float Bowl Assembly | 33. Power Piston Assembly | 53. Idle Needle |
| 5. Screw—Bracket Attaching | 20. Idle Tube Assembly | 34. Spring—Power Piston | 54. Spring—Idle Needle |
| 6. Gasket—Air Horn | 21. Jet—Main Metering | 35. Rod—Power Piston | 55. Screw—Throttle Body |
| 7. Choke Shaft and Lever Assembly | 22. Ball—Pump Discharge | 36. Metering Rod and Spring Assembly | 56. Lever—Pump and Power Rods—New |
| 8. Choke Valve | 23. Spring—Pump Discharge | 37. Filter Nut—Fuel Inlet | 57. Screw—Lever Attaching |
| 9. Screw—Choke Valve | 24. Guide—Pump Discharge | 38. Gasket—Filter Nut | 58. Link—Power Piston Rod |
| 10. Choke Vacuum Break, Unit | 25. Needle and Seat Assembly | 39. Filter—Fuel Inlet | 59. Link—Pump Lever |
| 11. Vacuum Break Hose | 26. Gasket—Needle Seat | 40. Spring—Fuel Filter | |
| 12. Vacuum Break Lever | 27. Idle Compensator Assembly | 41. Idle Stop Solenoid | |
| 13. Vacuum Break Link | 28. Gasket—Idle Compensator | 42. Pump Assembly | |
| 14. Vacuum Break Lever Screw | 29. Cover—Idle Compensator | 43. Lever—Pump Actuating | |
| 15. Choke Lever | | 44. Spring—Pump Return | |

Fig. M7—Legend for Monojet (Fig. M3)

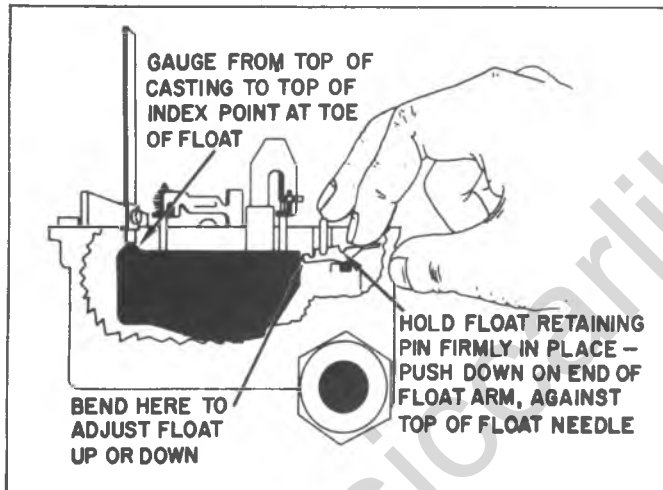


Fig. M8--Float Level Adjustment

Align "D" hole in actuating lever with flats on throttle shaft and install lever on end of throttle shaft. Install retaining screw in end of throttle shaft and tighten securely.

NOTE: Before installing air horn, check operation of entire drive mechanism, metering rod and accelerator pump to ensure free operation from closed to wide open throttle.

12. Install idle tube into cavity in float bowl.
13. Install pump discharge ball, spring and spring retainer. Make sure spring retainer is flush with top of bowl casting.
14. Install fuel filter relief spring, fuel inlet filter, filter nut and gasket. Tighten securely. Open end of filter should face hole in fuel inlet nut.

15. Install float needle seat and gasket. Tighten securely and carefully to avoid damage to seat.
16. Install float needle valve into needle seat.
17. Insert straight portion of float hinge pin into float arm. Install float and hinge pin into float bowl.

Float Level Adjustment (Fig. M8)

1. Hold float retainer firmly in place and push down on float arm at outer end.
2. With adjustable T--scale, measure distance from top of float at index point on toe, to float bowl gasket surface (gasket removed).
3. Bend float pontoon up or down at float arm junction to adjust.

Metering Rod Adjustment (Fig. M9)

1. To check adjustment back out the allen screw in the Idle Stop Solenoid to ensure closed throttle valve. Rotate fast idle cam so that fast idle cam follower is not contacting steps on cam. (Remove cam if necessary.)
2. With throttle valve completely closed, apply pressure to hanger directly above power piston and hold piston down against its stop (See Fig. M9).
3. Holding downward pressure on power piston, swing metering rod holder over flat surface of bowl casting until metering rod rests lightly against inside edge of bowl.
4. Use specified plug gauge and insert between bowl casting and lower surface of metering rod holder against metering rod. Gauge should have a slide fit between both surfaces, as shown.

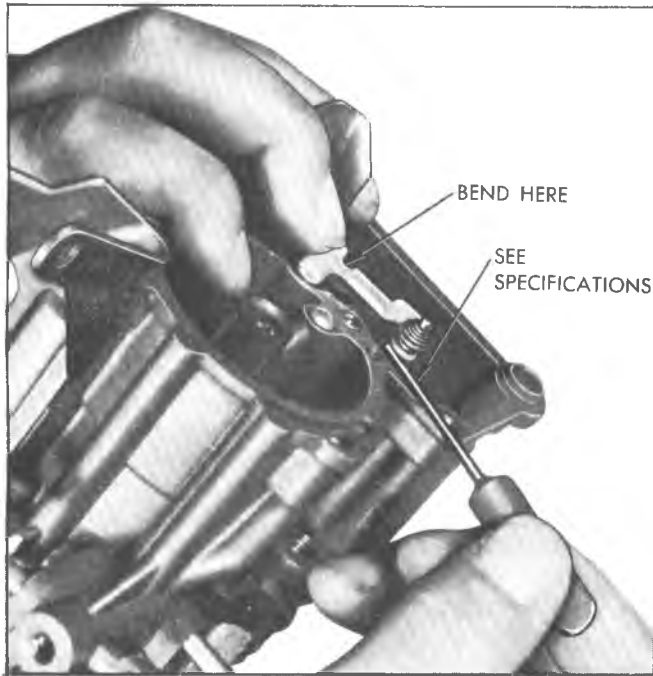


Fig. M9--Metering Rod Adjustment

5. To adjust, carefully bend metering rod holder up or down at point shown.
6. 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— Assemble and Install

1. Install choke shaft assembly and choke valve into air horn, if removed. Align choke valve, tighten two retaining screws and stake securely or use Thread Lock No. 7041970 or equivalent.
2. Install air horn to float bowl by lowering gently on to float bowl until seated. Install three long and three short air horn to float bowl attaching screws.

NOTE: Install the choke vacuum break diaphragm assembly under the two short air horn screws next to the thermostatic coil lever. Connect the choke vacuum break diaphragm link to the thermostatic coil lever

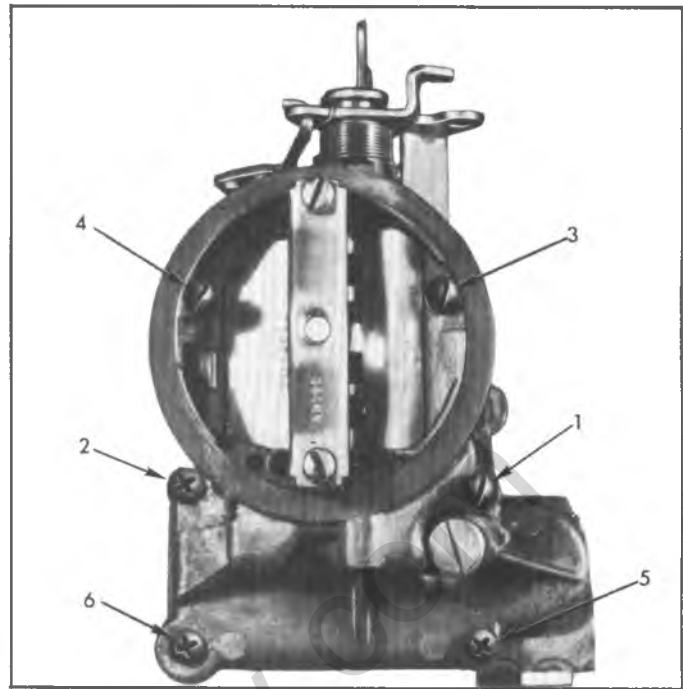


Fig. M10--Tightening Sequence--Air Horn

3. Install the choke vacuum break diaphragm hose to the nipple on vacuum break diaphragm and tube on air horn.
4. Assemble choke rod into the slot in the upper choke lever. End of rod points away from air horn casting when installed properly.
5. Install lower end of choke rod into fast idle cam. Steps on fast idle cam should face fast idle tang on throttle lever. Install fast idle cam to boss on float bowl with attaching screw. Tighten securely.
6. Install electrically operated idle stop solenoid into boss on float bowl.

IMPORTANT: After carburetor overhaul, throttle body part replacement, mixture needle part replacement, or needle removal, the procedures in Section 6M, 1974 Chassis Service Manual, under Idle Mixture Adjustment must be followed.

ROCHESTER 2GV (SAE 1 1/2)

INDEX

Disassembly.....	6M-9
Assembly.....	6M-12

GENERAL DESCRIPTION

MODEL 2GV (1-1/2") 2 BARREL (LARGE)

DISASSEMBLY

Removal of the Idle Stop Solenoid Assembly.

CAUTION: Do not immerse the solenoid in any type of carburetor cleaner.

Air Horn (Figure V2)

1. On 2GV models, remove choke coil lever retaining screw from end of choke shaft and remove choke coil lever from choke vacuum diaphragm rod.
2. Remove the choke vacuum break diaphragm rod from the vacuum diaphragm plunger by rotating off-set end of rod out of slot in diaphragm plunger.
3. Remove choke vacuum diaphragm supply hose from tube on throttle body, then remove vacuum diaphragm assembly by removing two retaining screws.
4. Place carburetor on a proper holding fixture being careful not to damage the throttle valve or components. Then remove the fuel inlet filter nut, filter, spring, and filter nut gasket.

NOTE: The paper fuel inlet filter has its own sealing gasket so there is no extra gasket required between the filter element and fuel inlet nut.
5. Remove pump rod retaining clip from throttle lever end of rod, and remove rod from throttle lever, depress pump and rotate the pump rod out of upper pump lever.
6. Using a wide bladed screwdriver, remove the fast

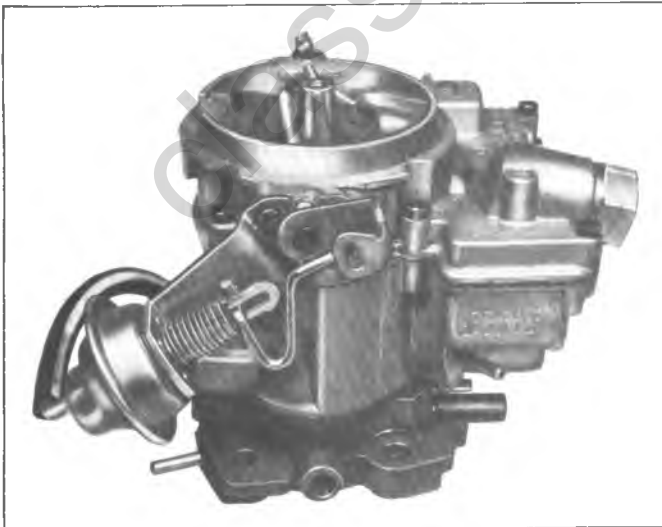


Fig. V1--Rochester 2GV-2BBL. (1 1/2") Carburetor

idle cam attaching screw-- rotate cam and remove cam from rod.

7. Place choke valve in wide open position, rotate choke rod towards pump lever and remove the choke rod from upper choke lever on choke shaft.
8. Remove air horn to bowl attaching screws and choke cable bracket on 2G models. Tap air horn lightly to loosen from bowl and lift air horn from float bowl.
9. Place air horn top-down on a flat surface and remove float hinge pin, float, air horn gasket, splash shield and float needle.
10. Using a wide bladed screwdriver, remove the float needle seat and gasket.
11. Remove power piston by depressing shaft and allowing spring to snap sharply several times thus forcing piston from casting.
12. Remove screw retaining pump inner lever to outer lever and withdraw lever and plastic washer from air horn. Place plunger in gasoline or kerosene to prevent rubber from drying out.

CAUTION: Do not bend arm on inner pump lever to remove the pump assembly from the inner pump lever. To remove the pump assembly from the inner pump lever, rotate the pump plunger stem out of the hole in lever. If the inner lever is bent to remove the pump assembly it will cause binding of the assembly which could hold the throttle open.
13. If choke shaft or valve needs replacement, remove two choke valve screws:
 - a. On 2GV Models, remove choke valve, and slide shaft and kick lever from air horn.
 - b. On 2G Models, disconnect choke spring from lever, and remove shaft and lever assembly from air horn.
 - c. On 2G Models, remove retaining ring from annular groove in casting, then remove choke lever and swivel and spring.

Float Bowl and Throttle Body (Figure V3)

1. Remove the pump plunger return spring from pump well. Where used. Remove the aluminum inlet check ball from the bottom of the pump well. The pump inlet check ball is aluminum and smaller than the steel pump discharge check ball. Do not interchange as failure of the pump system will result.
2. Remove main metering jets and power valve and gasket.
3. Remove three screws on top of cluster after which cluster and gasket may be removed.

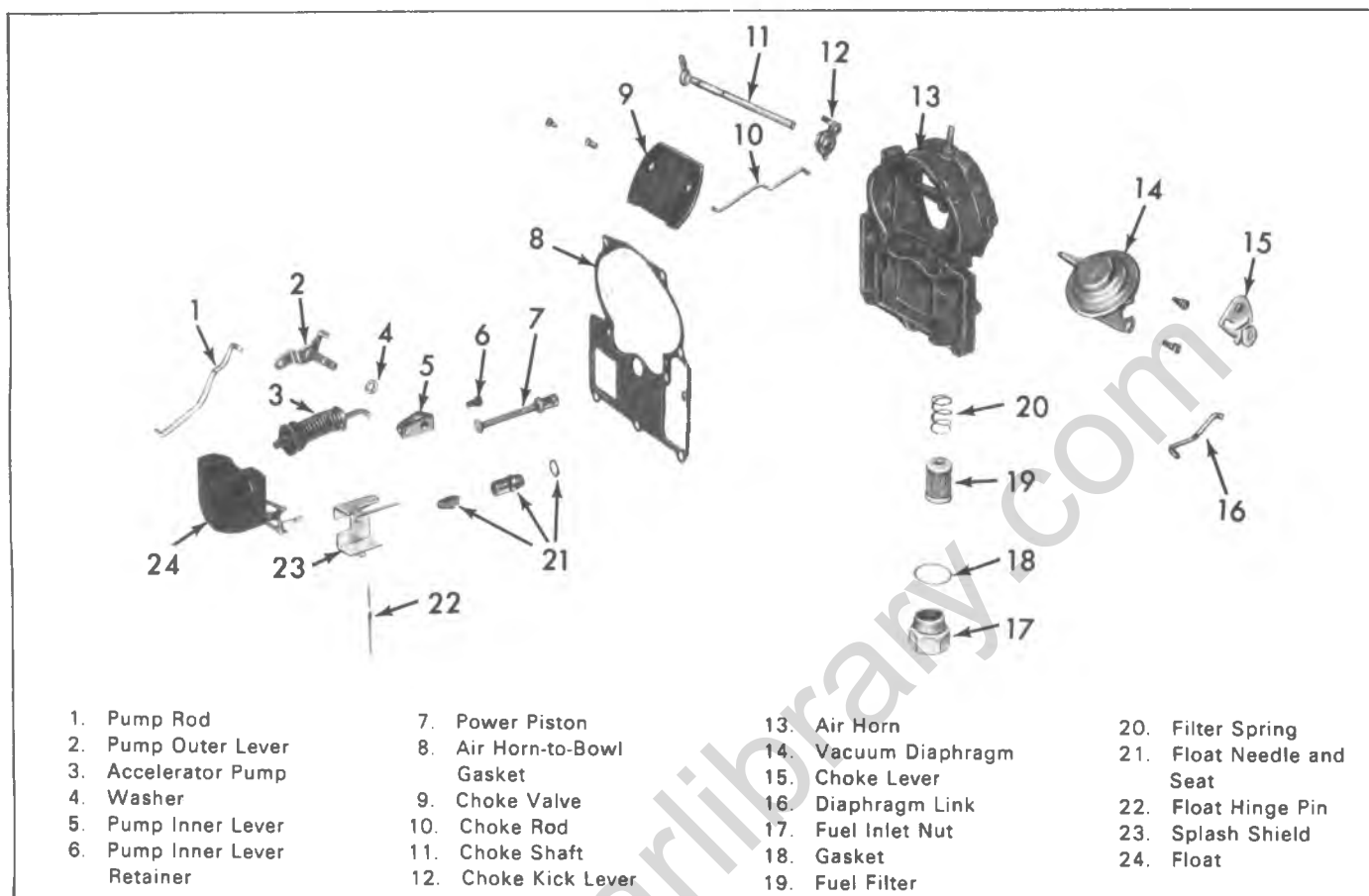


Fig. V2-Air Horn Disassembled

NOTE: The cluster center screw has one fiber washer. The two outer screws have lock washers. Also, the center screw is not threaded the full length of the body -- smaller diameter is required for pump jet discharge.

- Using a pair of long nose pliers, remove the pump discharge spring retainer (Figure V4). Then the pump discharge spring and check ball may also be removed.
- After removing the venturi cluster assembly and gasket, remove the plastic main well inserts from the main wells by using a pair of needle nosed pliers. Be careful not to distort the plastic main well inserts.
- Invert carburetor and remove three large throttle body to bowl attaching screws. Throttle body and gasket may now be removed.

NOTE: Do not tamper with the idle mixture needle with a limiter cap unless performing an overhaul or due to needle damage. This

has been set to test requirements by the manufacturer.

- Further disassembly of the throttle body is not recommended. If the idle mixture needles are damaged, or need replacement or the idle mixture channels have to be cleaned, the plastic limiter cap should be broken away from mixture screws.
- IMPORTANT:** Before removing idle mixture needle, be certain to count number of turns to bottom this old idle mixture needle. This is required so that when it is necessary to install a new needle, you may bottom the new needle and then back off the same number of turns it took to bottom the old needle.
- Remove idle mixture needle and spring, if required.

Cleaning and Inspection

CAUTION: Any rubber parts, plastic parts (including float assembly), diaphragms, pump plungers, electric parts and solenoids, should not be immersed in carburetor cleaner.

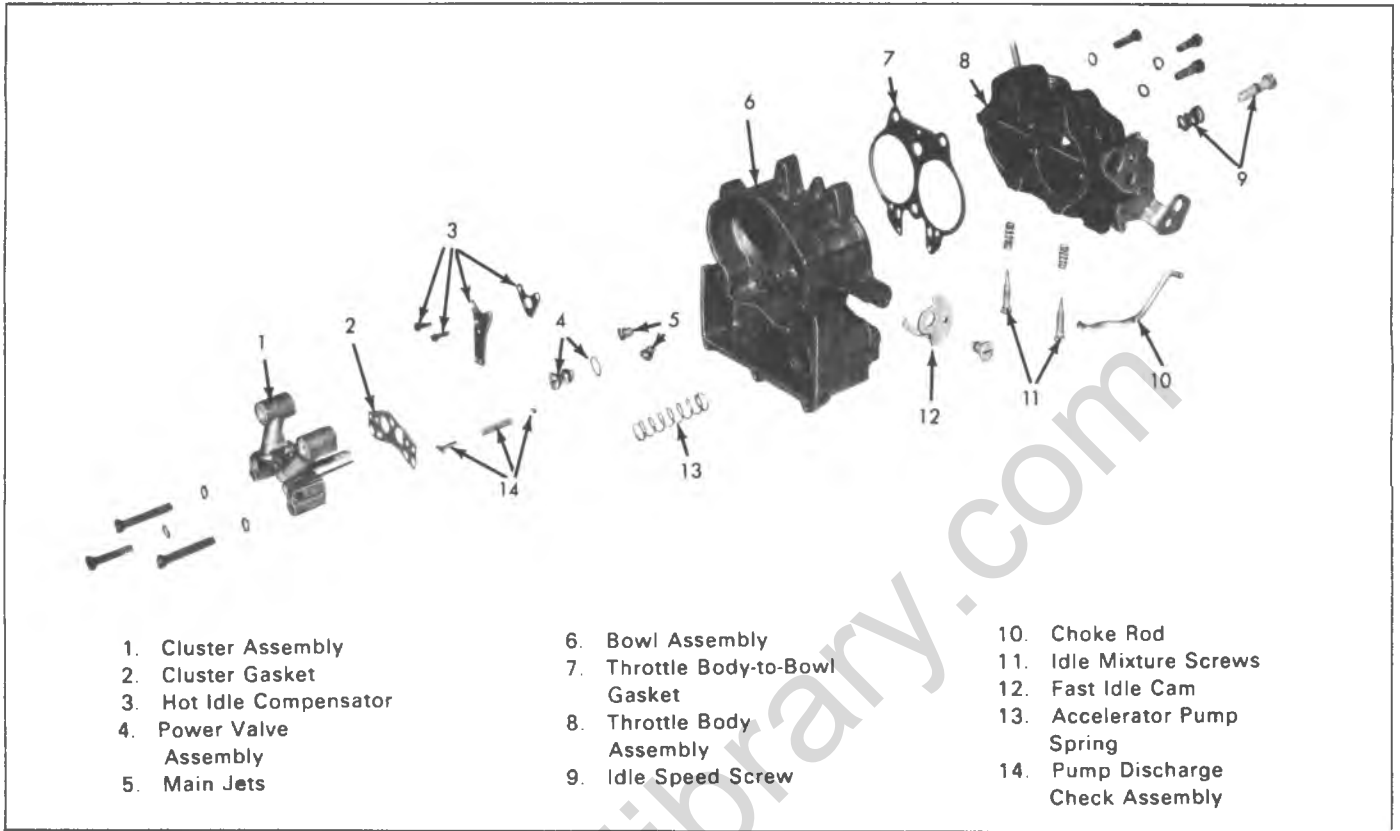


Fig. V3--Bowl and Throttle Body Disassembled

The carburetor should be cleaned in a cold immersion type cleaner.

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner.

CAUTION: Any rubber parts, plastic parts, diaphragms, pump plungers, electric parts and solenoids, should not be immersed in carburetor cleaner.

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.
3. Inspect idle mixture needle for damage.
4. Examine float needle and seat assembly for wear. Install a new factory matched set if worn.
5. Inspect upper and lower casting sealing surfaces for damage.
6. Inspect holes in levers for excessive wear or out of round condition. If levers or rods are worn they should be replaced.
7. Examine fast idle cam for excessive wear or damage.
8. Check throttle and choke levers and valves or binds and other damage.
9. Replace filter element.

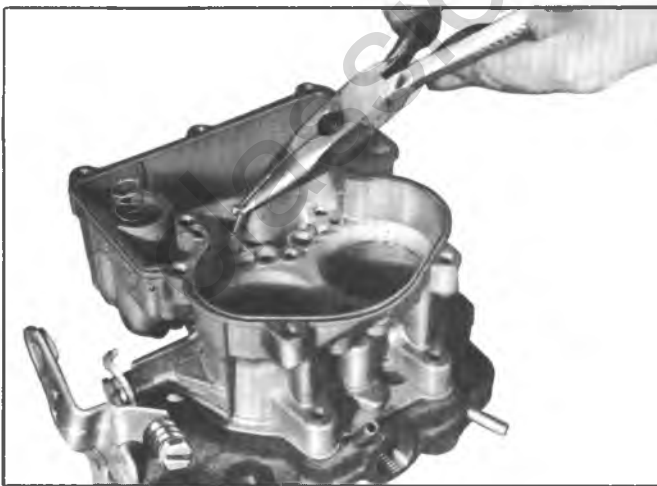


Fig. V4--Removing Pump Discharge Spring Retainer

6M-12 CARBURETORS

10. Check all springs for distortion or loss in tension, replace as necessary.

ASSEMBLY AND ADJUSTMENTS

Assembly of Float Bowl and Throttle Body

1. If removed, install the idle mixture adjusting needles and springs into throttle body until finger tight. Back out screws four turns as a preliminary idle adjustment.

New Part Replacement

If a new throttle body is being replaced, install and bottom the new idle mixture needle and back off four turns.

After completing assembly of the carburetor, and when installed in the vehicle, adjust the mixture screw to achieve the idle speed and idle mixture settings as outlined under "Idle Mixture Adjustments" in Section 6M, Chassis Service Manual.

NOTE: Adjust the idle mixture with the carburetor installed on the engine, per instructions in the Service Manual.

The idle mixture needle should be set by backing off the new mixture needle the same number of turns, after bottoming, as was required to bottom the original needle which was pre-set and sealed by the manufacturer before it left the factory. (See "Note" in disassembly procedures).

CAUTION: Do not force the idle mixture needle against the seat or damage will result.

2. Invert the float bowl, and place new throttle body gasket in position over locating dowels and attach throttle body to bowl with three attaching screws.

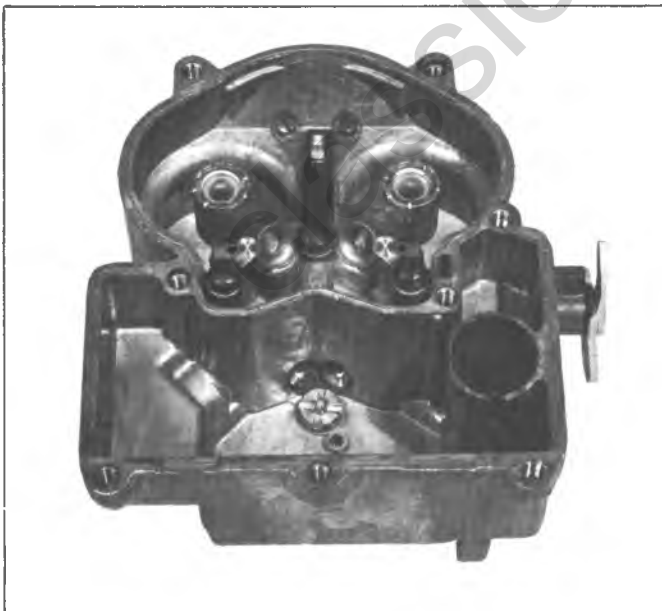


Fig. V5--Bowl Assembly--Parts Location

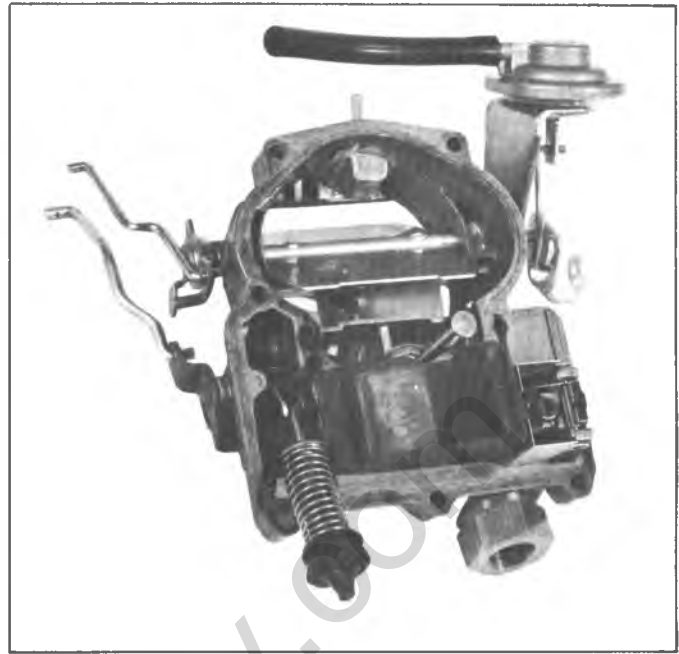


Fig. V6--Air Horn Assembly--Parts Location

Tighten screws evenly and securely.

3. Drop steel pump discharge ball into pump discharge cavity. Ball is 3/16" diameter steel. Install pump discharge spring and retainer.

NOTE: The top of retainer should be flush with top of float bowl casting beneath venturi cluster.

4. Install plastic main well inserts into main well. Top of insert should be flush with top of casting.
5. Install small aluminum ball into the bottom of pump well inlet channel and make sure the ball is seated in channel. Install the pump return spring into pump well, apply finger pressure to center it in the pump well over the inlet check ball. Figure V5 shows the float bowl and throttle body at this stage of assembly.
6. Install hot idle compensator assembly and gasket (where used) and tighten screws evenly.

Assembly of Air Horn (Figure V6)

1. On 2GV Models, install choke kick lever on choke shaft with tang on kick lever towards lever on shaft.
2. On 2GV Models, install choke shaft into up ended air horn--insert shaft left to right.
3. On 2G Models, install torsion spring and choke lever and swivel assembly on air horn. Install retain annular ring in groove.
4. Center choke valve on choke shaft with letters "RP" facing upward. Install choke valve screws and tighten securely. Stake screws to eliminate any

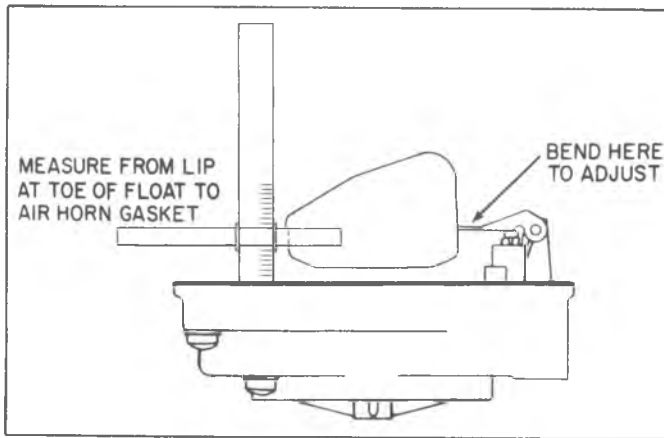


Fig. V7--Float Level Adjustment

possibility of their coming loose. (On 2G Models, connect torsion spring to idle cam lever).

5. Install accelerator pump plunger and rod to pump inner lever--end of plunger rod points inward.
6. Position accelerator pump outer lever (with plastic washer) partially through air horn and align flats on inner lever and outer lever shaft install and secure levers with retaining screw.
7. Install power piston in vacuum cavity. Make sure that piston travels freely in cavity. Lightly stake retainer in place.
8. Install float needle seat gasket into casting, then install needle seat and tighten securely with a wide bladed screwdriver. Position float needle into seat.
9. Install splash shield to float retainer legs.
10. Install air horn-to-bowl gasket making sure gasket is indexed with locating dowel.
11. Position cut out in float toward power piston and align float with legs, then install retainer pin through splash shield and float.
12. Install fuel filter spring, fuel filter, fuel inlet nut gasket, and fuel inlet nut. Tighten fuel inlet nut securely.
13. Install vacuum break diaphragm onto air horn with

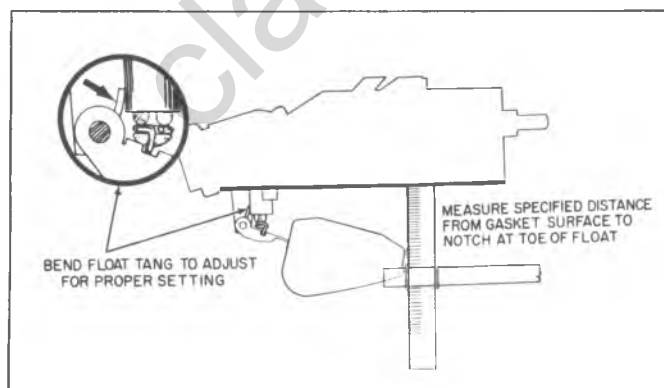


Fig. V8--Float Drop Adjustment

part number on diaphragm bracket facing away from casting or outward. Position vacuum break diaphragm rod into slot in diaphragm plunger and attached to choke coil lever. Then install the choke coil lever on flats on the end of choke shaft; tang on choke coil lever faces outward. Install choke coil lever retaining screw and tighten securely.

Float Level Adjustment

With air horn inverted, gasket in place and needle seated measure distance from lip at toe of float to air horn gasket. Adjust float to specifications by bending the float arm at point shown (fig. V7).

Float Drop Adjustment

With air horn right side up so that float can hang free, measure distance from lip at toe of float air horn gasket. Adjust float drop to specifications by bending tang (Fig. V8) at the rear of the float hanger.

Assembly of Air Horn to Float Bowl

1. Place air horn on bowl, making certain that accelerator pump plunger is properly positioned and that it will move freely. Raise air horn, index power piston with spring, and lower it straight down to insure proper installation.
2. Install and tighten air horn screws evenly and securely in sequence shown in Figure V9. The number one screw is the long screw.

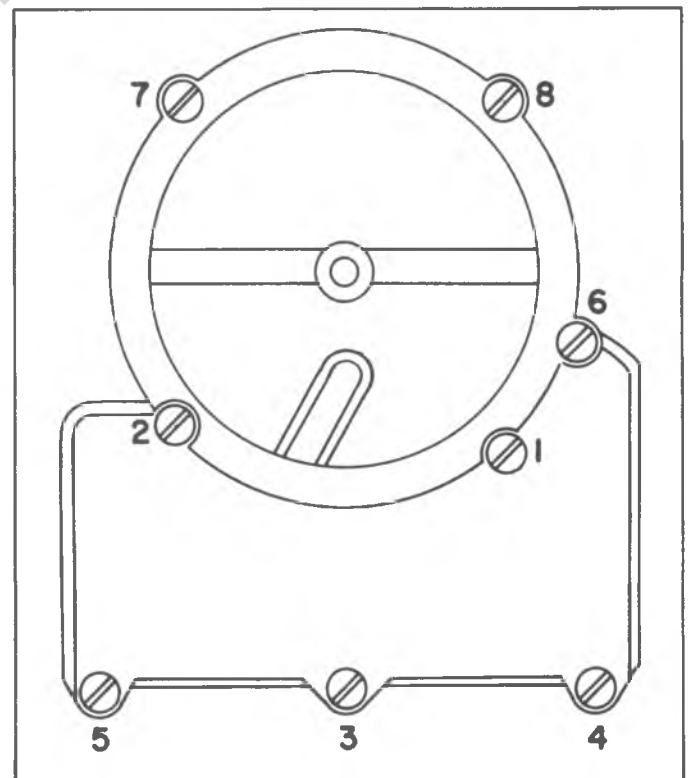


Fig. V9--Air Horn Tightening Sequence

6M-14 CARBURETORS

NOTE: The choke cable retaining bracket is retained by number seven and eight screws.

3. Install fast idle rod in choke kick lever, then install opposite end into fast idle cam. Rotate rod and cam and secure cam to bowl with the shouldered bolt-letters "RP" on fast idle cam face outward.

NOTE: The rod offset end connects to fast idle cam.

4. Install accelerator pump rod and secure at throttle lever with "hair pin" type clip.
5. Connect vacuum diaphragm at fitting on throttle body.

Installation of Idle Stop Solenoid on Float Bowl

1. Install idle stop solenoid into bracket on float bowl. Then install large lock washer and large retaining nut and tighten securely.

2. Bend retaining ears on lockwasher over flats on nut so that nut is locked securely in place.

NOTE: Adjustment of the idle stop solenoid should be made with the carburetor unit on the engine. See "Idle Adjustment Procedures" on the decal in the engine compartment.

Adjust Accelerator Pump Rod

Back out idle stop screw and idle stop solenoid plunger screw so that the throttle valves are completely closed in bores. Place the adjustable "T" scale gauge on top of air horn ring. Bend the pump rod at lower angle to obtain specified dimension to the top of the pump rod.

IMPORTANT: After carburetor overhaul, throttle body part replacement, mixture needle part replacement, or limiter cap and needle removal, the procedures in Section 6M, 1974 Chassis Service Manual, under "Idle Mixture Adjustments", must be followed.

ROCHESTER 4MV (QUADRAJET)

INDEX

Disassembly	6M-14
Assembly and Adjustment	6M-17

MODEL 4MV - 4 BARREL

DISASSEMBLY

NOTE: Place carburetor on proper holding fixture. Care should be used so as not to damage the throttle valves as they are a precision fit.

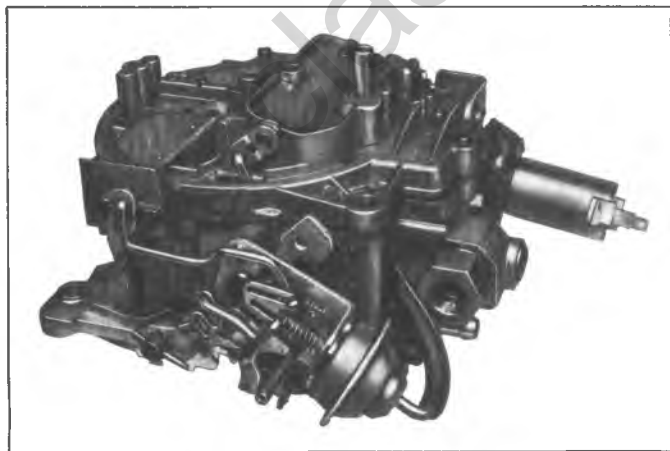


Fig. Q1--Rochester 4MV (Quadrajets) Carburetor

Removal of the Idle Stop Solenoid Assembly

CAUTION: Do not immerse the Idle Stop Solenoid assembly in any type of carburetor cleaner.

Air Horn Removal

1. Remove larger Idle Stop Solenoid bracket retaining screw from float bowl. Do not remove the bracket from air horn assembly.
2. Remove clip from upper end of choke rod, disconnect choke rod, disconnect choke rod from upper choke shaft lever and remove choke rod from lower lever in bowl.
3. Remove roll pin at pump lever pivot by driving pivot inward with proper fitting punch. Then remove pump lever from air horn and upper end of pump rod by rotating lever from rod.
4. Remove nine (9) air horn to float bowl attaching screws. Two attaching screws are located next to the primary venturi. (Two long screws, five short screws, two counter-sunk screws).
5. Remove small screw at top of secondary metering rod hanger.

6. Remove metering rod hanger and secondary rods as an assembly.
7. Remove air horn by lifting straight up. Air horn gasket should remain on bowl for removal later.

CAUTION: Care must be taken not to bend the main well air bleed tubes or accelerating well tubes protruding from the air horn. These are permanently pressed into the casting. Do not remove.

Air Horn Disassembly (Figure Q2)

NOTE: Further disassembly of the air horn is not required for cleaning purposes.

If part replacement is required, proceed as follows:

1. Remove choke valve attaching screws, then remove choke valve and shaft (Figure Q2).

CAUTION: Air valves and air valve shaft are calibrated and should not be removed.

There is an air valve shaft spring repair kit which includes the plastic cam, torsion spring, spring and retaining screw. If replacement is necessary, instructions are provided in kit.

Float Bowl Disassembly (Fig. Q3)

1. Remove pump plunger from pump well.
2. Remove air horn gasket from dowels on secondary side of bowl, then remove gasket from around power piston and primary metering rods.
3. Remove pump return spring from pump well.
4. Remove plastic filler over float valve.

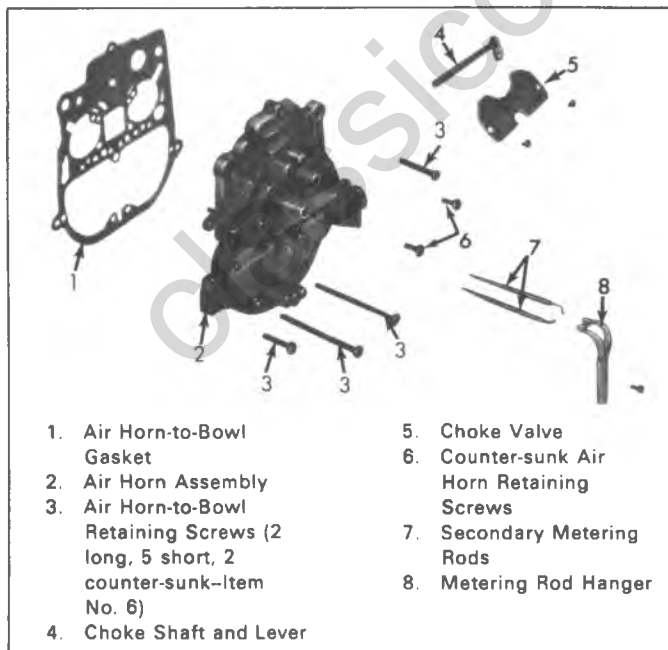


Fig. Q-2--Air Horn Exploded View

5. Remove power piston by pressing the piston down and releasing it. Remove power spring from well.

NOTE: Never remove power piston with pliers, if unable to remove, repeat step 5.

NOTE: The power piston assembly is held in place for ease in assembly of the air horn, by a plastic retainer at top of power piston bore.

6. Remove metering rods from power piston by disconnecting tension spring from top of each rod then rotating rod to remove from hanger.
 7. Remove float assembly by pulling up slightly on retaining pin until pin can be removed by sliding toward pump well. After pin is removed, slide float assembly toward front of bowl to disengage needle pull clip being careful not to distort pull clip.
 8. Remove pull clip and fuel inlet needle.
 9. Remove fuel inlet needle seat with wide blade screw driver. Remove needle seat gasket and discard.
 10. Remove primary metering jets. No attempt should be made to remove secondary metering discs.
 11. Remove pump discharge check ball retainer and check ball.
 12. Remove baffle from secondary side of bowl.
 13. Remove retaining screw from choke assembly on side of float bowl and remove assembly from bowl; then remove secondary lockout lever from cast boss on bowl.
 14. Remove fast idle cam from choke assembly.
- CAUTION:** Do not place vacuum break assembly in carburetor cleaner.
15. Remove intermediate choke rod and actuating lever from inside of float bowl well.
 16. Remove fuel inlet filter nut gasket, filter and spring.
 17. Remove throttle body by removing throttle body to bowl attaching screws.
 18. Remove throttle body to bowl insulator gasket.

Throttle Body Disassembly (Figure Q4)

NOTE: Do not tamper with the idle mixture needle and limiter cap unless performing an overhaul or needle damage has been experienced. This has been set to test requirements by the manufacturer.

1. Remove pump rod from throttle lever by rotating rod out of primary lever.
2. No further disassembly of the throttle body is necessary unless the idle mixture needles are damaged or the idle channels need cleaning. If necessary to remove the idle mixture needles, destroy plastic limiter caps as new ones are provided in the overhaul kit.

IMPORTANT: Before removing idle mixture needle, be certain to count number of turns

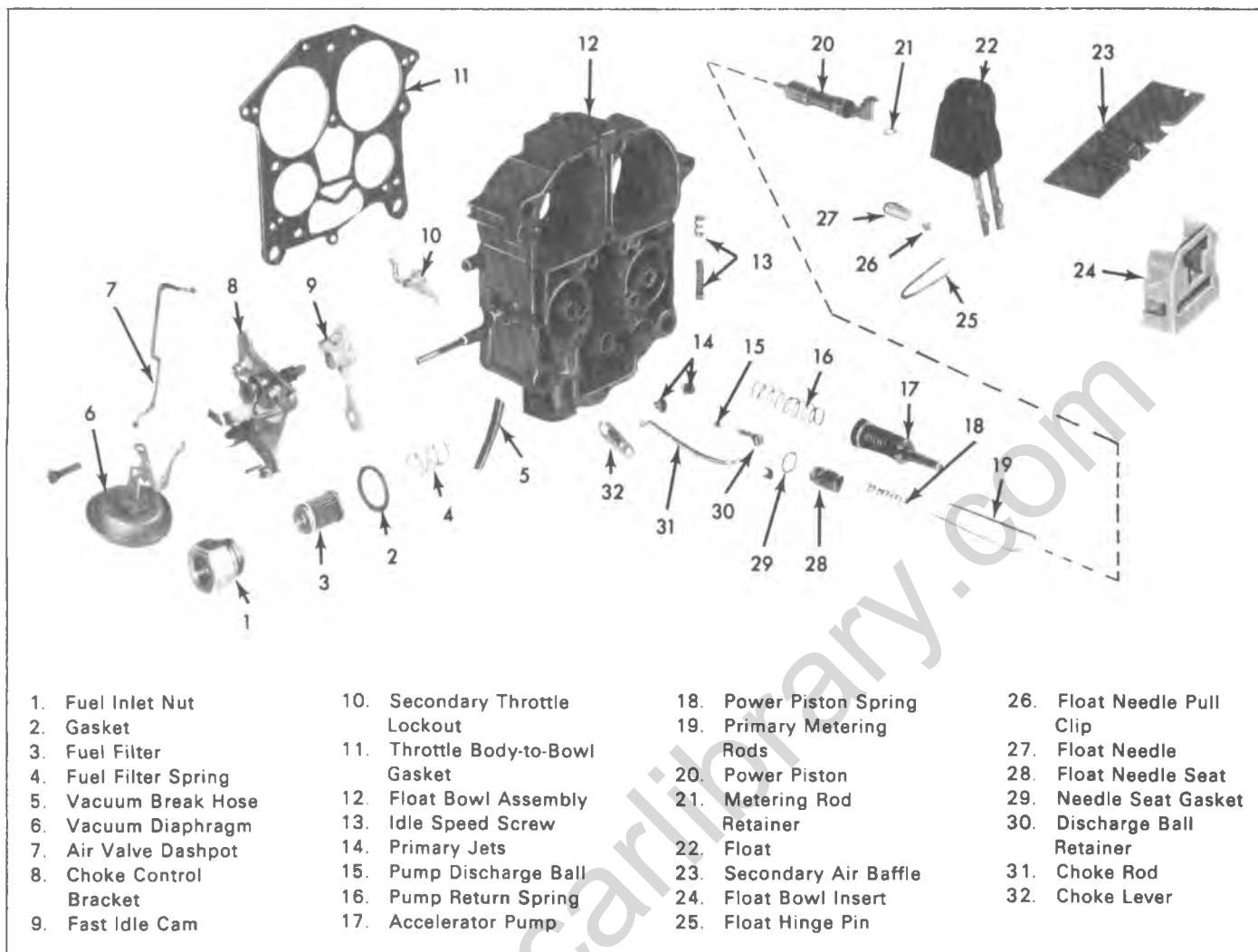


Fig. Q3-Float Bowl Exploded View

to bottom this old idle mixture needle. This is required so that when it is necessary to install a new needle, you may bottom the new needle and then back off the same number of turns it took to bottom the old needle.

Remove idle mixture needle and spring, if required.

NOTE: No further disassembly of the throttle body is required.

CAUTION: Extreme care must be taken to avoid damaging secondary throttle valves.

Cleaning and Inspection

CAUTION: Do not immerse the Idle Stop Solenoid in any type of carburetor cleaner or solvent.

The carburetor should be cleaned in a cold immersion type cleaner.

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner.

CAUTION: Any rubber parts, plastic parts, diaphragms, pump plungers, electric parts and solenoids, should not be immersed in carburetor cleaner.

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.
3. Inspect idle mixture needle for damage.
4. Examine float needle and seat assembly for wear. Install a new factory matched set if worn.
5. Inspect upper and lower casting sealing surfaces for damage.
6. Inspect holes in levers for excessive wear or out of round condition. If levers or rods are worn they should be replaced.
7. Examine fast idle cam for excessive wear or damage.
8. Check throttle and choke levers and valves or binds and other damage.
9. Replace filter element.

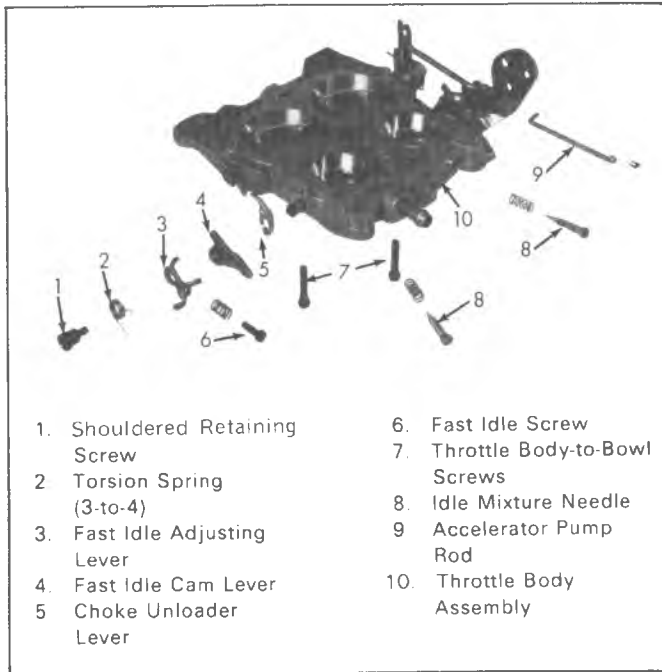


Fig. Q4--Throttle Body Exploded View

10. Check all springs for distortion or loss in tension, replace as necessary.

ASSEMBLY AND ADJUSTMENTS

New Part Replacement

If a new throttle body is being replaced, install and bottom the new idle mixture needle and back off four turns.

After completing assembly of the carburetor, and when installed in the vehicle, adjust the mixture screw to achieve the idle speed and idle mixture settings as specified in specifications and outlined in Section 6M in the Service Manual under Idle Mixture Adjustments.

Throttle Body Assembly

1. If removed, install the idle mixture needles and springs until lightly seated. Back out idle mixture needles four turns as a preliminary idle adjustment.

NOTE: Instructions for adjustment are included in the service manual.

NOTE: Back off the new mixture needle the same number of turns, after bottoming, as was required to bottom the original needle which was pre-set and sealed by the manufacturer before it left the factory. (See "Note" in disassembly procedures).

2. Install pump rod in hole of throttle lever by rotating rod into lever.

Float Bowl Assembly

1. Install new throttle body to bowl insulator gasket

being certain the gasket is properly installed 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. Place carburetor on proper holding fixture.
3. Install fuel inlet filter spring, filter, new gasket and inlet nut and tighten nut securely.
4. Install fast idle cam on choke shaft with cam pick-up lever on underside of cam.
5. Connect choke rod to choke rod actuating lever (plain end) 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 (fig. Q5). Install retaining screw and tighten securely. Remove choke rod from lever for installation later.
6. Install vacuum hose to tube connection on bowl and vacuum break assembly.
7. Install air deflector in secondary side of bowl with notches towards top.
8. Install pump discharge check ball and retainer in passage next to pump well.
9. Install primary main metering jets.
10. Install fuel inlet needle seat and gasket. Use wide blade screw driver to avoid distortion. Install fuel inlet needle.

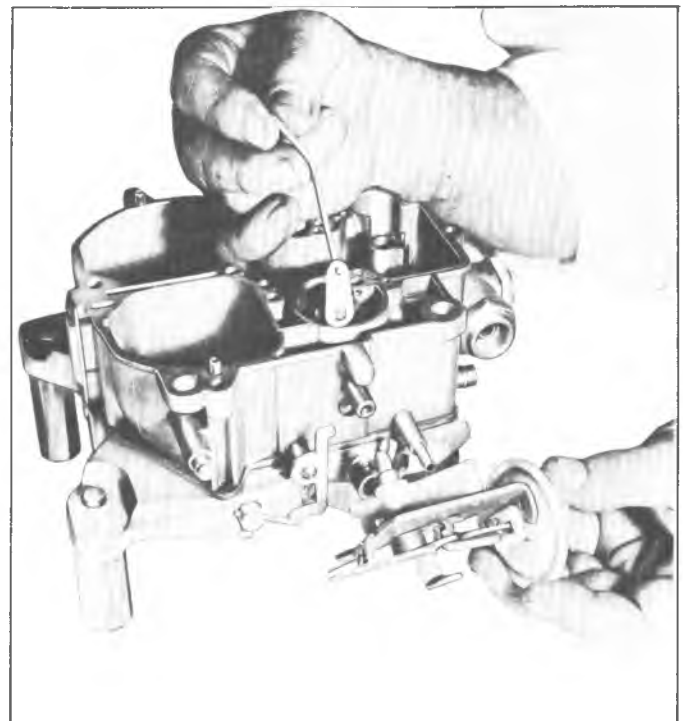


Fig. Q5--Installing Choke Bracket Assembly

6M-18 CARBURETORS

11. Install pull clip on needle. Pull clip is properly positioned with open end towards front of bowl.
12. Install float by sliding float lever under pull clip from front to back. With float lever in pull clip, hold float assembly at toe and install retaining pin from pump well side. Be careful not to distort pull clip (Do NOT install pull clip thru hole in float arm.)
13. **Float level adjustment (fig. Q6).**
 - a. With an adjustable T-scale, measure from top of float bowl gasket surface (gasket removed) to top of float at toe (located gauging point 3/16" back from toe).

NOTE: Make sure retaining pin is held firmly in place and tang of float needle is seated on float needle.

 - b. Bend float up or down for proper adjustment.
14. Install power piston spring in power piston well. If primary main metering rods were removed from hanger reinstall making sure that tension spring is connected to top of each metering rod. Install power piston assembly in well with metering rods properly positioned in metering jets. Press down firmly on power piston retainer to insure engagement of retaining clip.
15. Install plastic filler over float needle, pressing downward until seated properly.
16. Install pump return spring in pump well.
17. Install air horn gasket around primary metering rods and piston. Position gasket over two dowels on secondary side of bowl. Press power piston down firmly to assure correct alignment engagement of pin.
18. Install pump plunger in pump well.

Air Horn Assembly

1. Install choke shaft, choke valve and two attaching

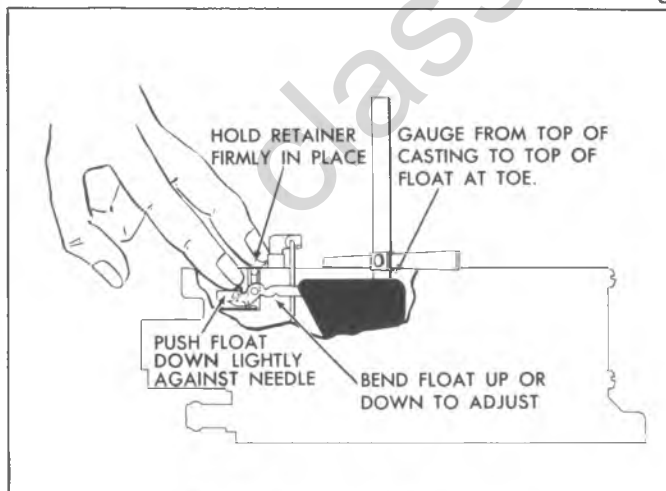


Fig. Q6--Float Level Adjustment

screws, if removed. Make sure that the two choke valve screws are lightly staked in place.

Air Horn to Float Bowl Installation

1. Place air horn assembly on bowl, carefully positioning vent tubes and accelerating well tubes to air horn gasket. Do not force air horn assembly on to float bowl as distortion of the vent tubes may result.
2. Install two long air horn screws, five short screws and two countersunk screws in primary venturi area. All screws must be tightened evenly and securely (Figure Q7).
3. Connect pump lever to upper pump rod by rotating lever into rod. (Pump rod should be in inner hole). Then install pump lever into air horn casting and push pump lever pin back through casting until flush with casting.
4. Connect choke rod into lower choke lever in float bowl cavity and retain in upper lever with retaining clip.
5. Install air valve to dashpot rod into air valve shaft lever hole and into the slot in the dashpot plunger; then position dashpot into retaining bracket. Crimp over ears on retaining bracket and connect the vacuum hose from the unit to tube on float bowl.
6. Install secondary metering rod and hanger. Rod should be positioned with upper ends through hanger holes and towards each other. (Figure Q8). Install hanger retainer screw and tighten securely.

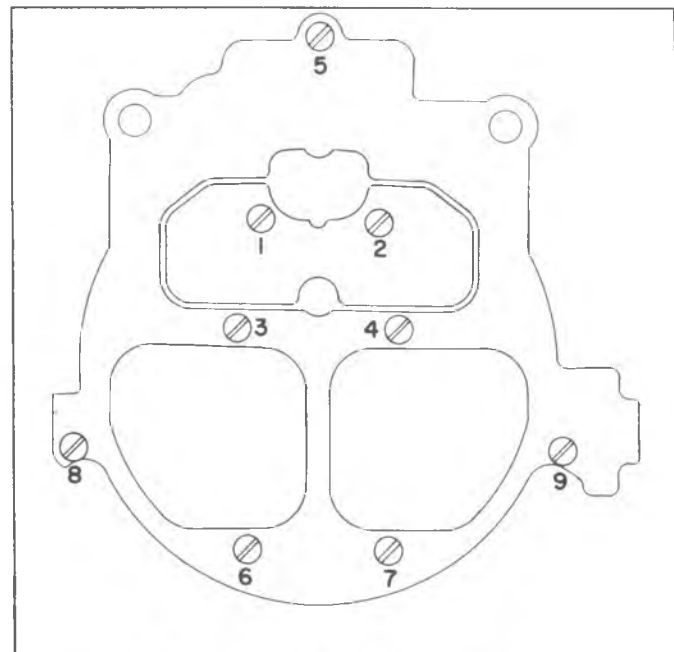


Fig. Q7--Air Horn Tightening Sequence

Installation of the Electrically Operated Idle Stop Solenoid

NOTE: After carburetor overhaul, throttle body part replacement, mixture needle part replacement, or needle removal for any reason, the procedures in Section 6M, 1974 Chassis Service Manual, under "Idle Mixture Adjustments", must be followed.

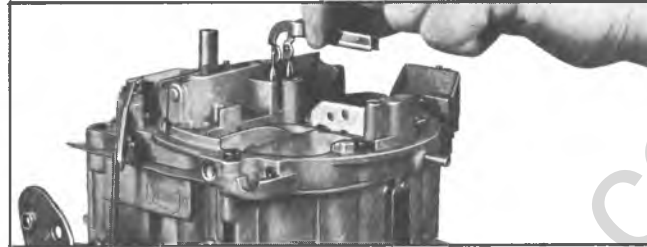


Fig. Q8--Installing Secondary Metering Rods

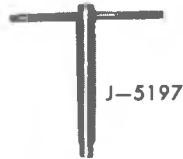
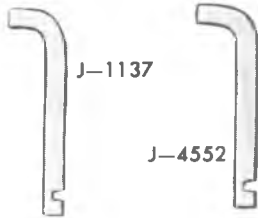
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SPECIAL TOOLS



J-22973

J-9789



BENDING TOOLS

J-8328



1. J-1137 Choke Rod Bending
2. J-4552 Choke Rod Bending (1 2 bbl.)
3. J-5197 Unloader Bending
4. J-8328 Carburetor Holding Tool

5. J-9789 Universal Carburetor Kit
7. J-22973 Ther-Mac Thermometer

Fig. Q9-Engine Fuel Special Tools

SECTION 6Y

ENGINE ELECTRICAL

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STARTING MOTOR

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Armature Test for Ground.....	6Y-3	Brush Holder Replacement.....	6Y-5
Armature Test for Shorts.....	6Y-3	Overrunning Clutch.....	6Y-5
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Field Coil Test for Ground.....	6Y-4	Pinion Clearance.....	6Y-6

DISASSEMBLY (Figs. 1S and 2S)

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:

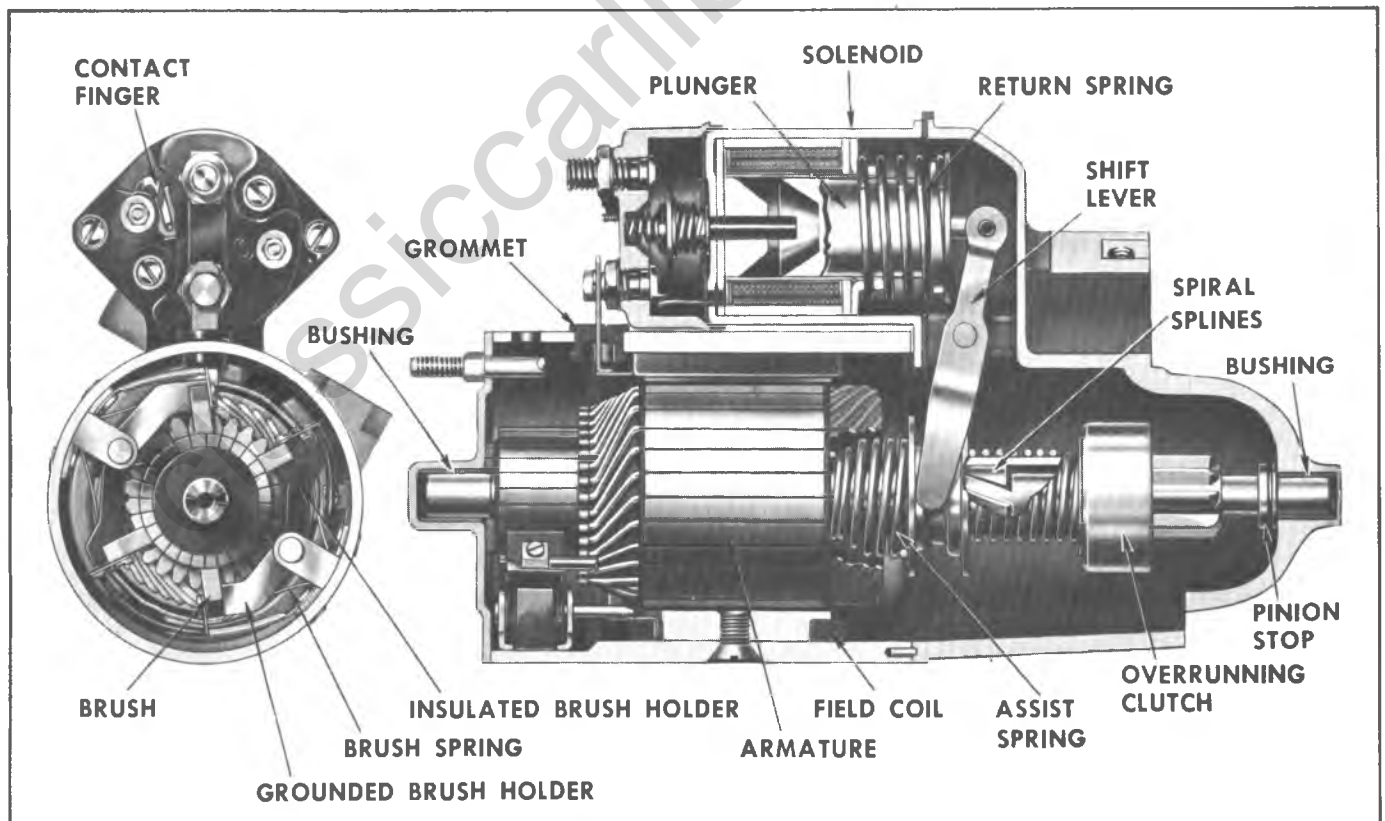


Fig. 1S--Starting Motor Cross Section

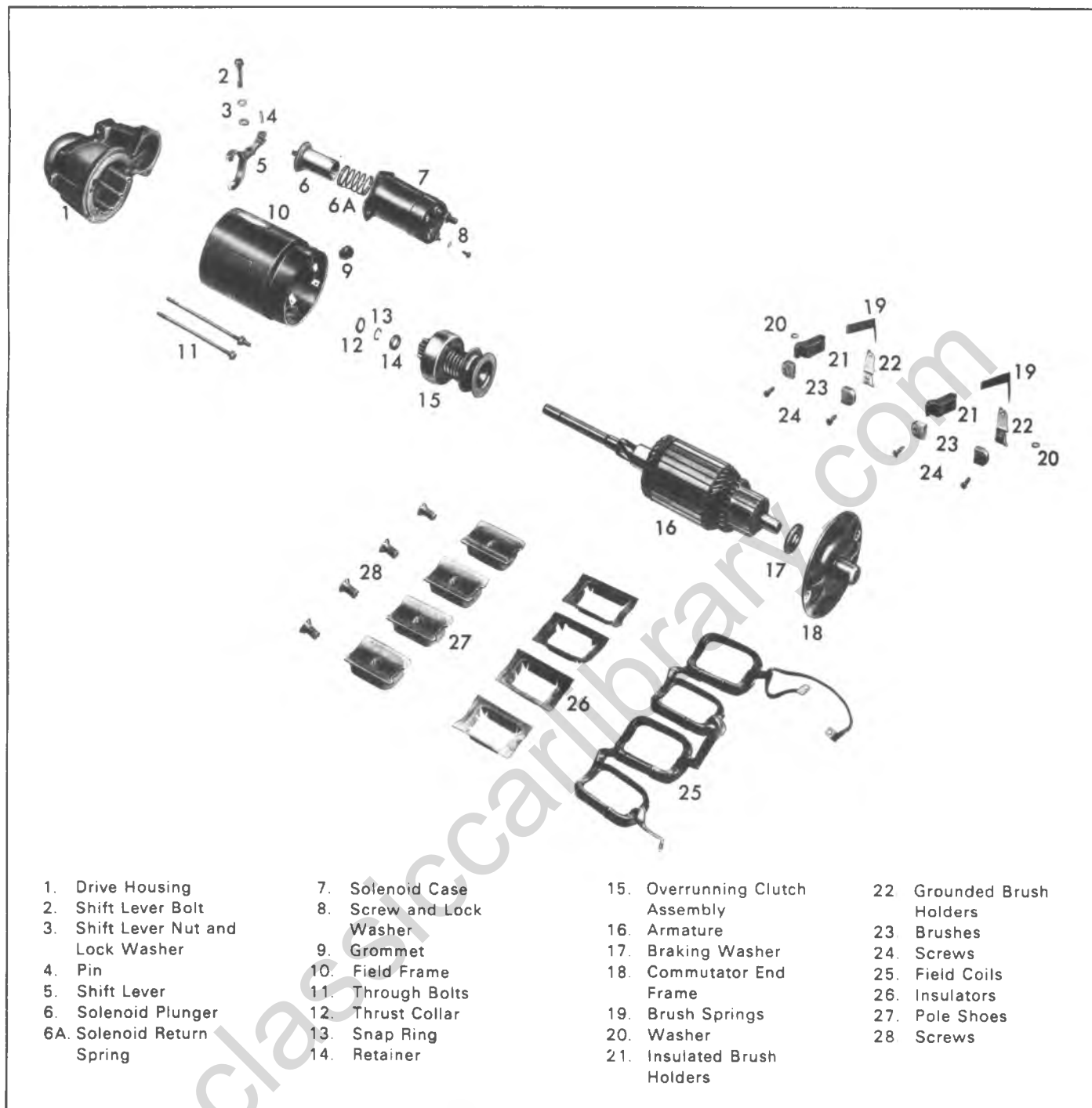


Fig. 2S-Starting Motor Parts Layout

- 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. 3S). Tap end 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.

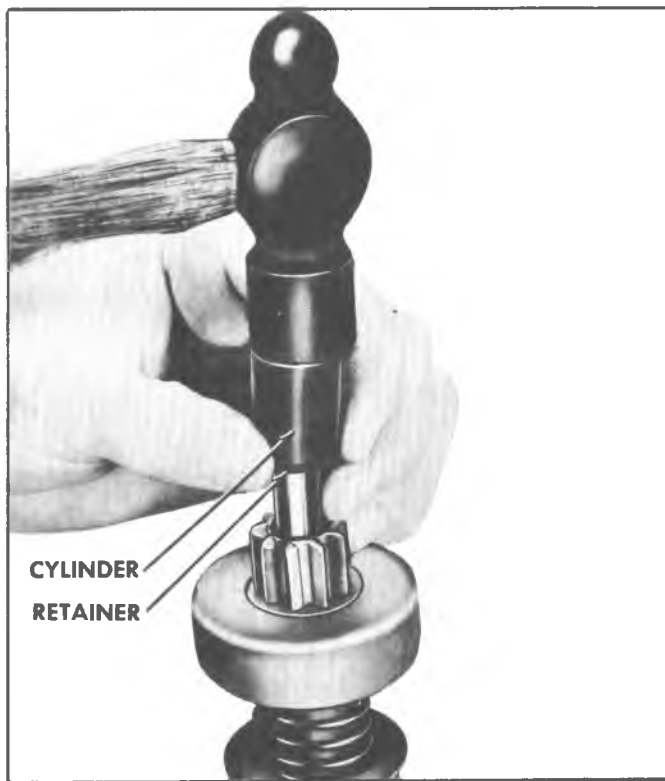


Fig. 3S-Driving Retainer Off Snap Ring

- 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 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. 4S). 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. 5S). 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. 6S). If the lamp does not light, the field coils are open and will require replacement.

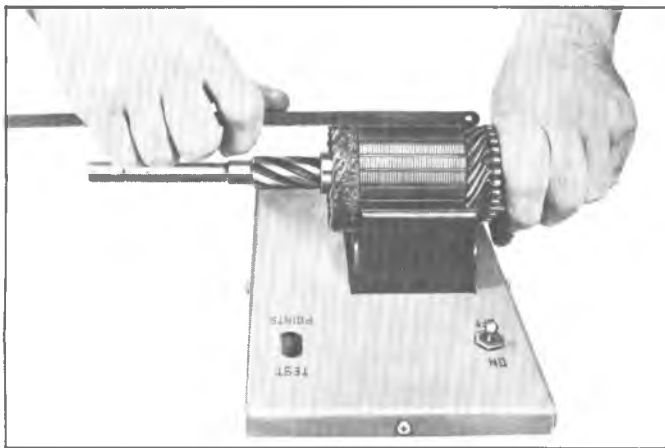


Fig. 4S--Armature Short Circuit Test

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. 7S). If the lamp lights, the field coils are grounded.

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:

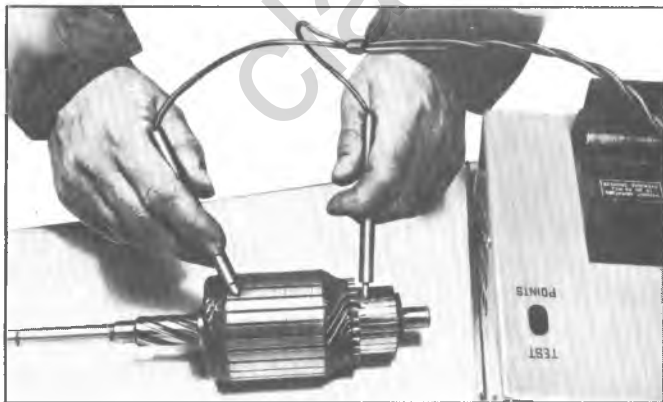


Fig. 5S--Armature Ground Test



Fig. 6S--Field Coil Open Circuit Test



Fig. 7S--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. 8S) 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 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.

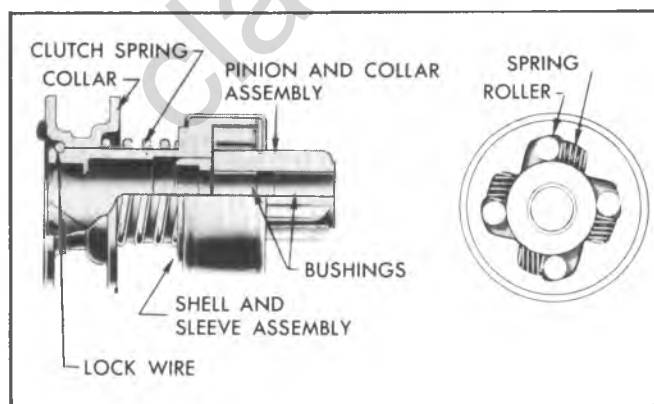


Fig. 8S--Roll Type Clutch Cross-Section

- 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. 9S). 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. 10S).
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

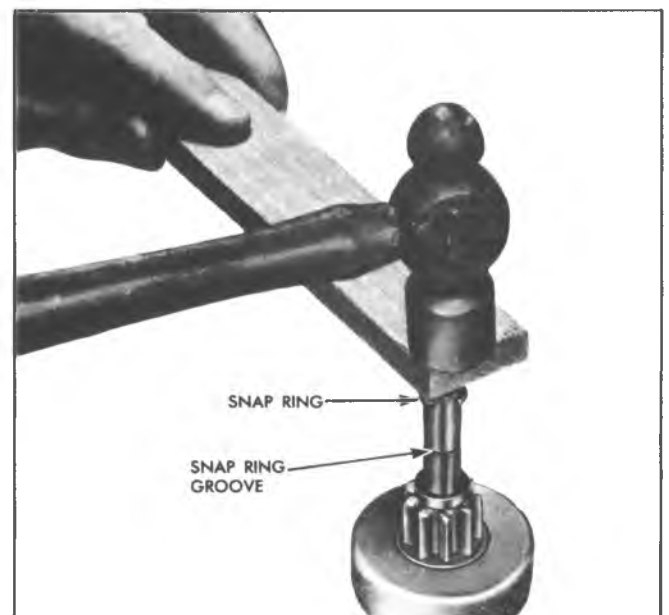


Fig. 9S--Forcing Snap Ring Over Shaft

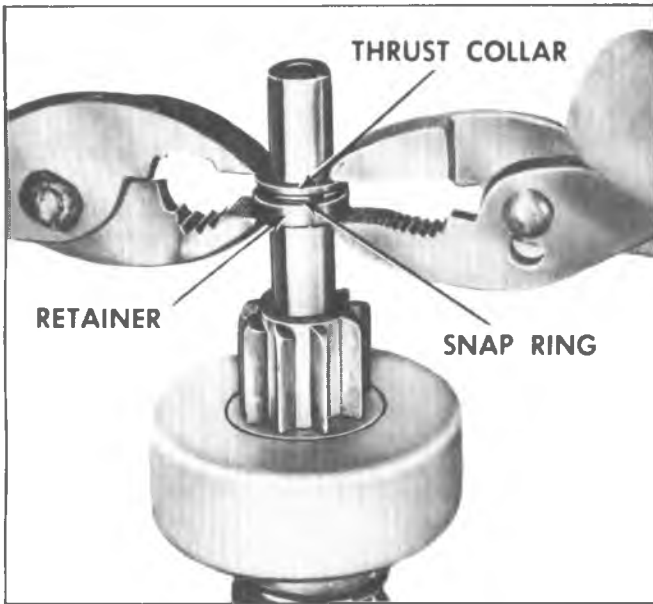


Fig. 10S-Forcing Snap Ring Into Retainer

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".

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. 11S).

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 battery is disconnected.
3. Push the pinion back towards the commutator end to eliminate slack movement.
4. Measure the distance between the pinion and pinion stop (fig. 12S). 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.

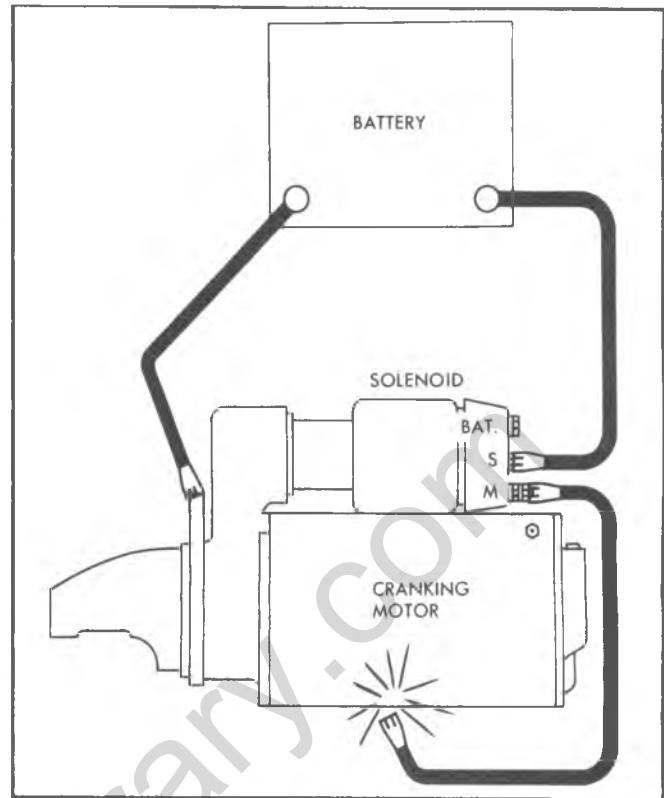


Fig. 11S-Circuit for Checking Pinion Clearance

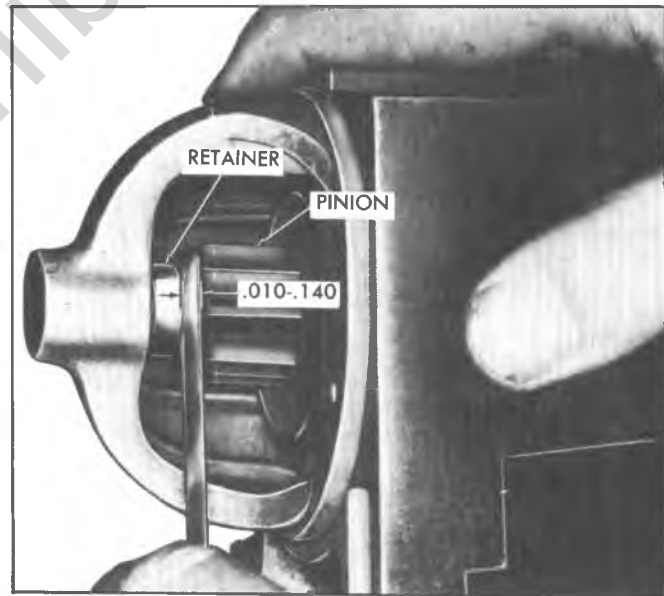


Fig. 12S-Checking Pinion Clearance

STARTING SOLENOID

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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. 13S)

1. With solenoid removed from motor, remove nuts and washers from switch and motor connector strap terminals.

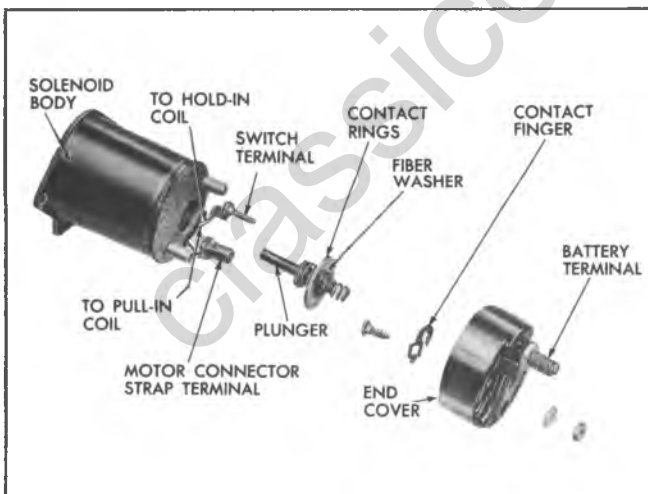


Fig. 13S-Exploded View of Solenoid

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.
4. Install starter motor as previously described.

10-SI SERIES 100 TYPE DELCOTRON

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DISASSEMBLY (fig. 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

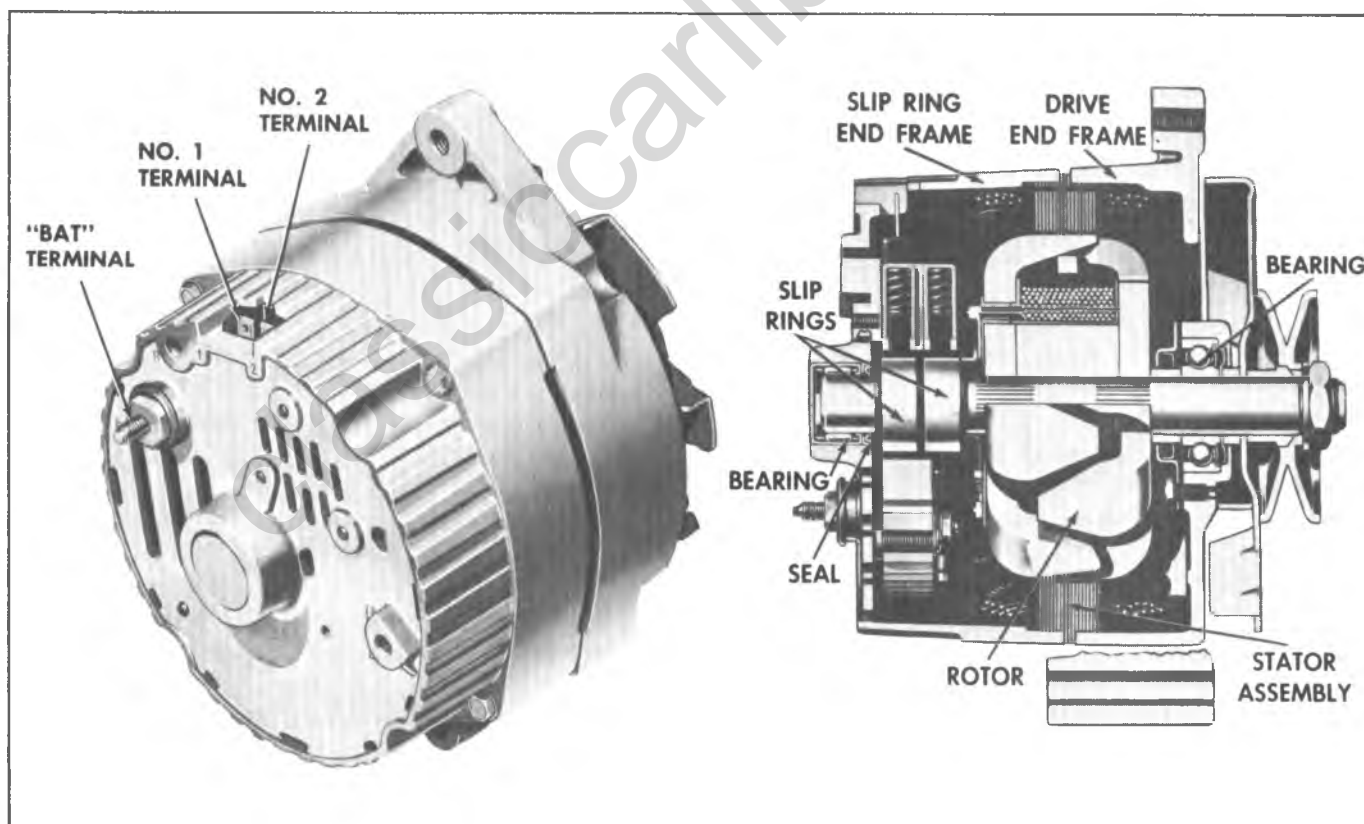


Fig. 1C-10-SI Series Delcotron

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 (fig. 7C).

NOTE: Diode trio may be checked for a grounded brush lead clip at this point. Refer to diode trio checks.

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 (fig. 6C).
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. 2C).
 - 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).

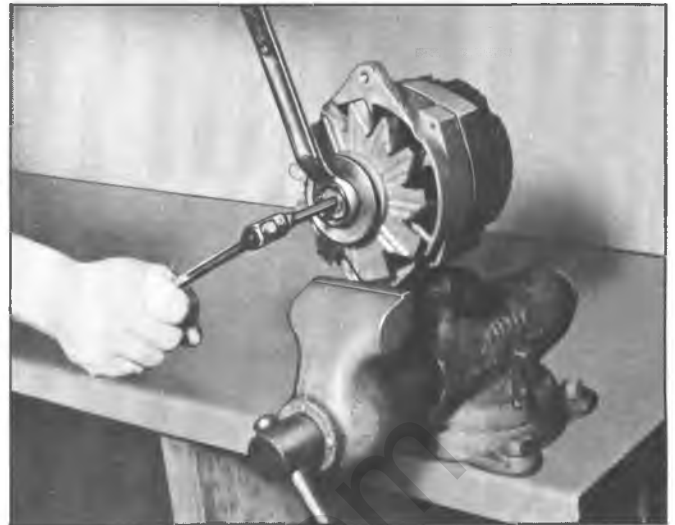


Fig. 2C-Removing Pulley

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. 3C)

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

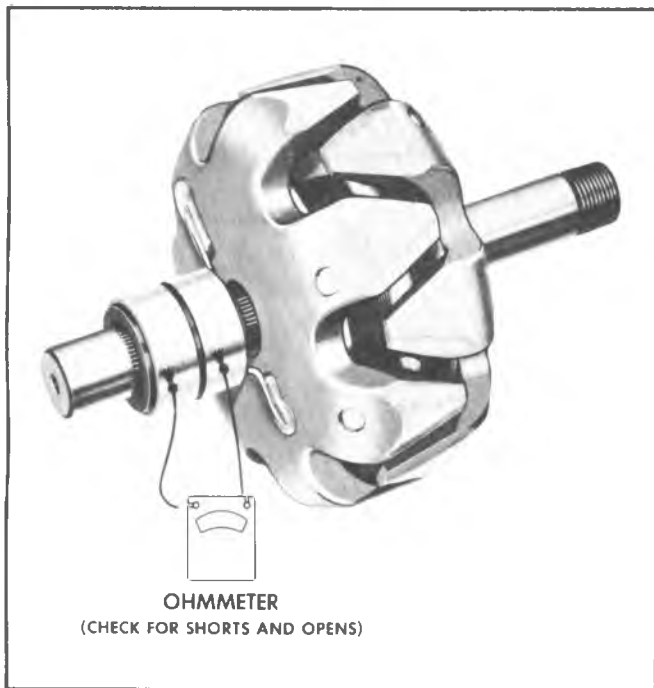


Fig. 3C-Checking Rotor

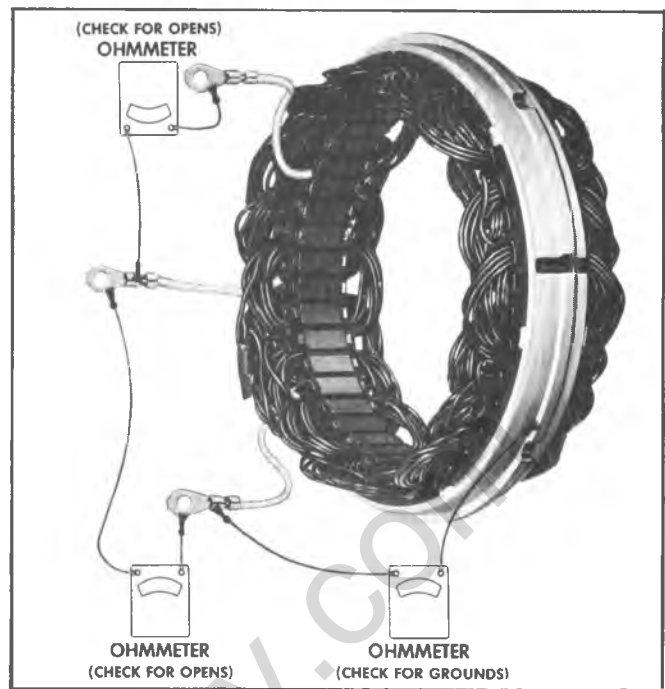


Fig. 4C-Checking Stator

ring. If the lamp fails to light or if the ohmmeter reading is high, the windings are open.

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. 4C)

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. 5C)

With the diode trio unit remove from the end frame, connect an ohmmeter to the single connect and to one of

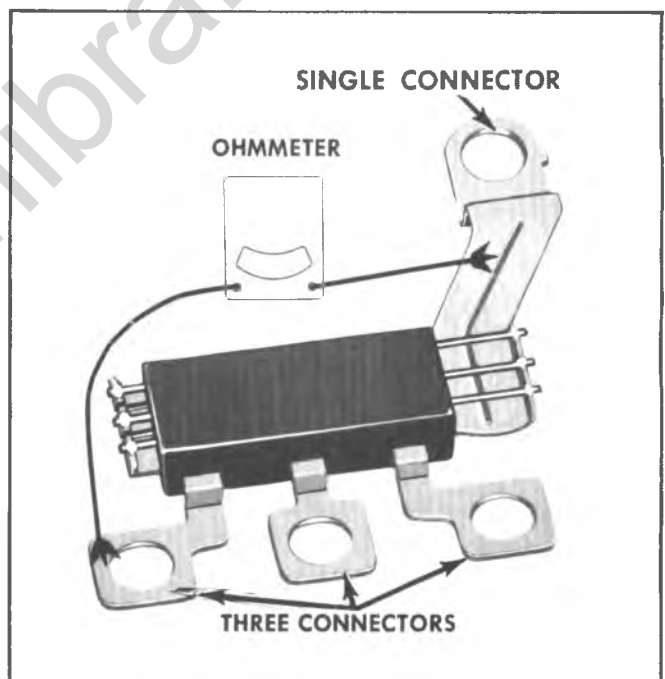


Fig. 5C-Diode Trio Checks

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.

The diode trio may also be checked for a grounded brush lead while still installed in the end frame. Connect an ohmmeter from the brush lead clip to the end frame as shown in Step 2, Figure 7C, then reverse the lead connection. If both readings are zero, check for a grounded brush lead clip caused by omission of the insulating washer, of the insulating sleeve over the screw, or damaged insulating sleeve. Remove the screw to inspect the sleeve. If sleeve or screw are not grounded, replace regulator.

CAUTION: Do not use high voltage such as 110 volt test lamp to check the diode trio.

Rectifier Bridge Check (fig. 6C)

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

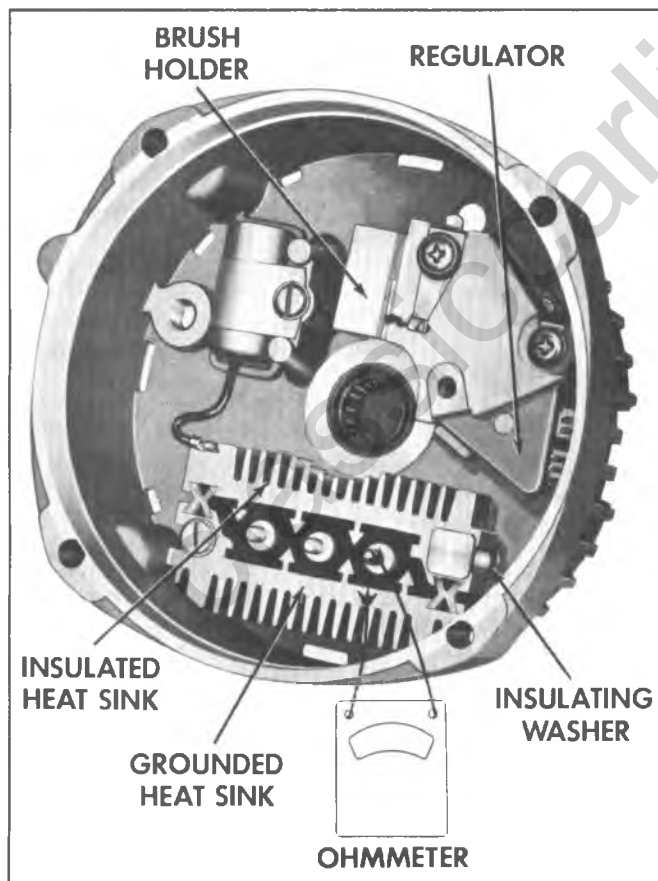


Fig. 6C-Rectifier Bridge Checks

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. 7C)

Connect an ohmmeter from the brush lead clip to the end frame as shown in Step 1, Figure 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.

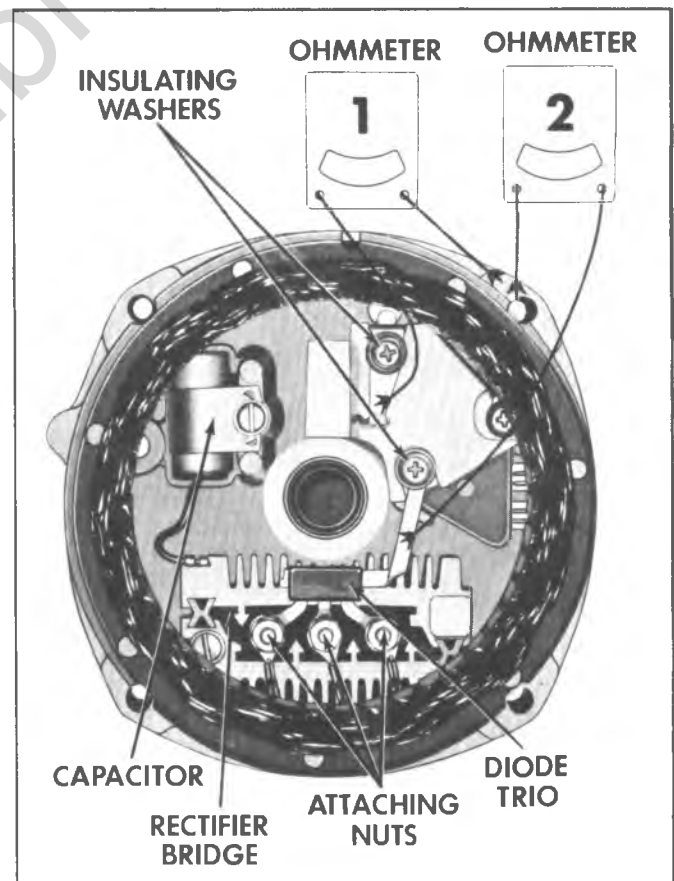


Fig. 7C-Brush Lead Clip Checks

REPAIRS

Brush Holder and Regulator Replacement (fig. 7C)

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 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.

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 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

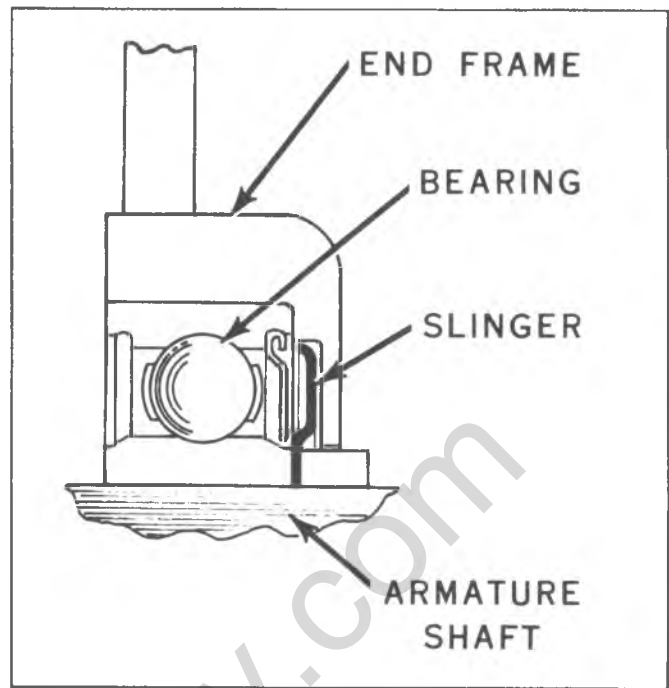


Fig. 8C--Drive End Bearing Cross Section

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. 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

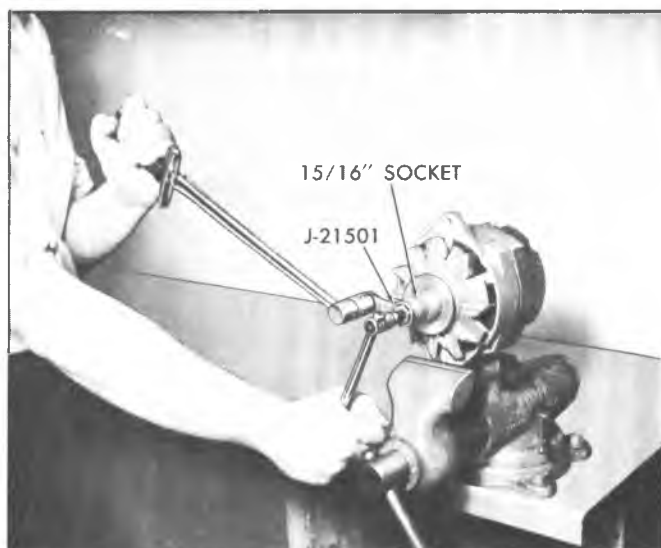


Fig. 9C-Installing Pulley Nut

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

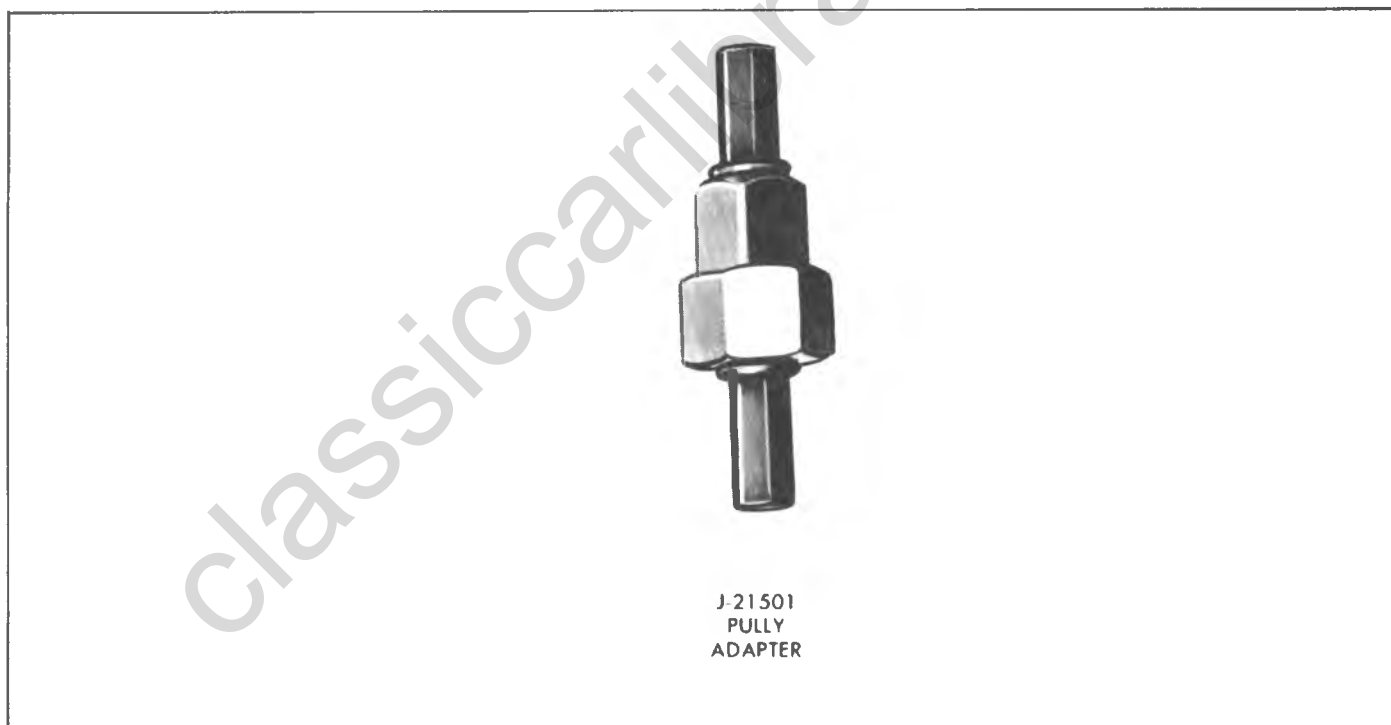


Fig. 10C—Special Tool

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SECTION 7A

AUTOMATIC TRANSMISSION

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TURBO HYDRA-MATIC 250 TRANSMISSION

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TRANSMISSION DISASSEMBLY AND REASSEMBLY

DISASSEMBLY

1. Install Holding Fixture J-8763-02 on transmission and place into Holding Tool base J-3289-20 with converter facing up (fig. 2N).

NOTE: Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the case should be thoroughly

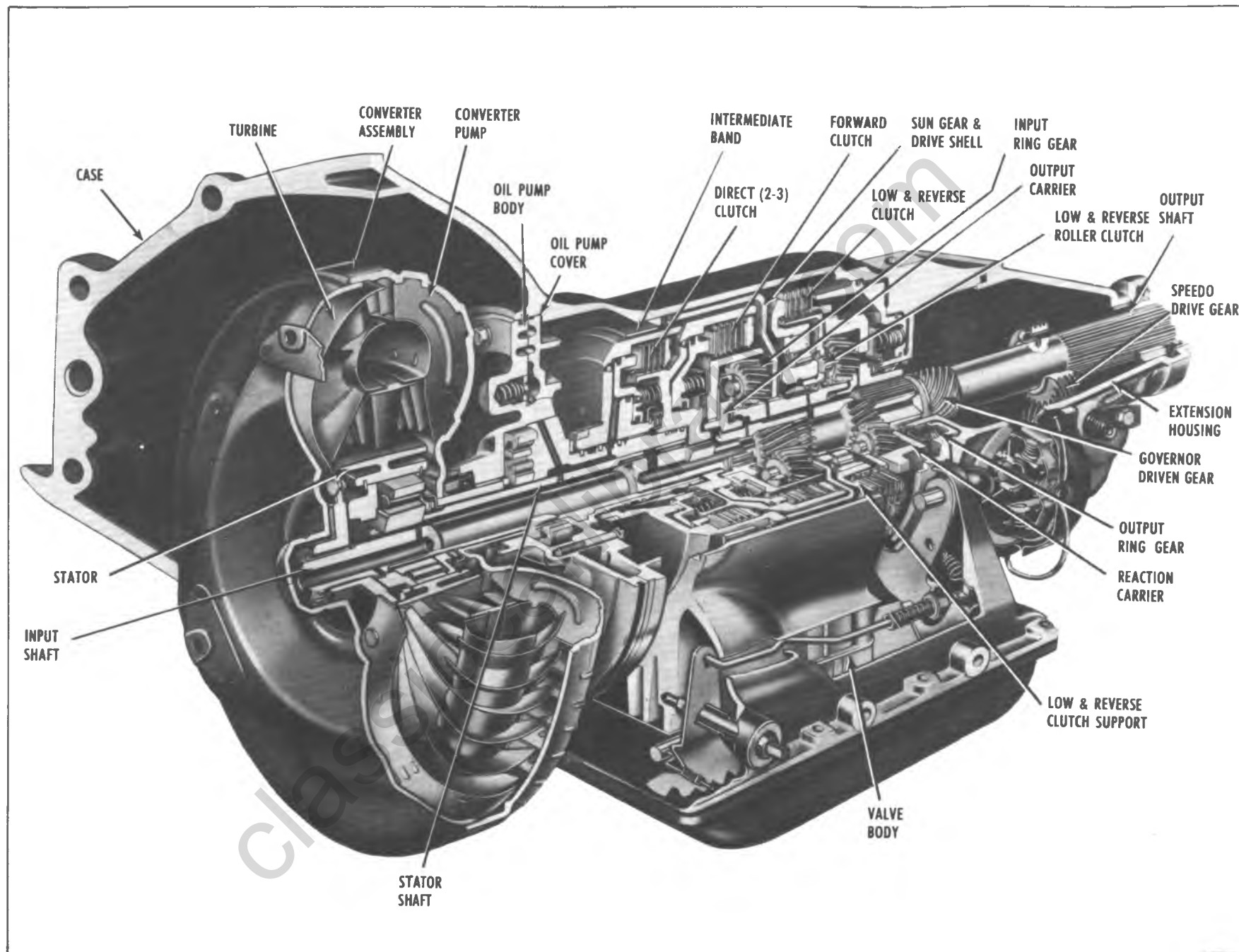


Fig. 1N-Turbo Hydra-Matic 250 Sectioned View

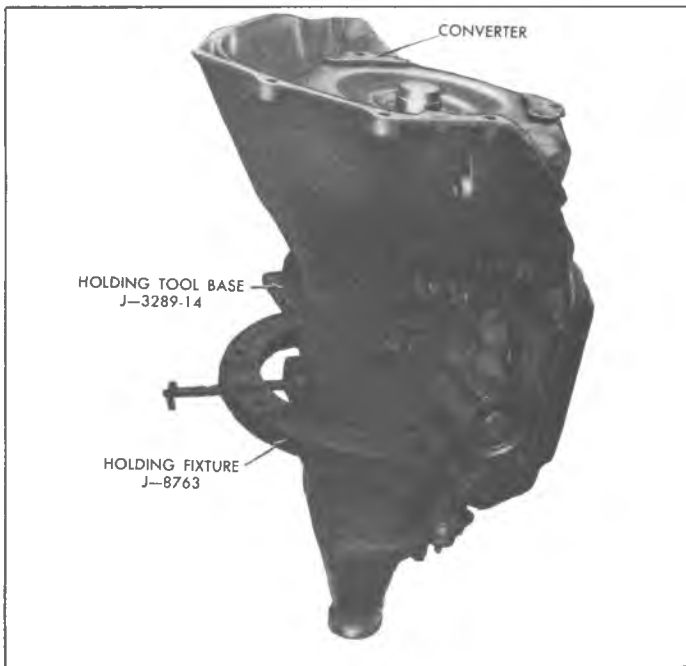


Fig. 2N--Transmission in Holding Fixture

cleaned to prevent the possibility of dirt entering the transmission internal mechanism. During disassembly, all parts should be thoroughly cleaned in cleaning fluid and then air dried. Wiping cloths or rags should not be used to dry parts.

CAUTION: Do not use solvents which could damage rubber seals or clutch facings.

2. With transmission in holding fixture remove torque converter assembly.
3. Remove vacuum modulator assembly attaching bolt and retainer.
4. Remove vacuum modulator assembly, "O" ring

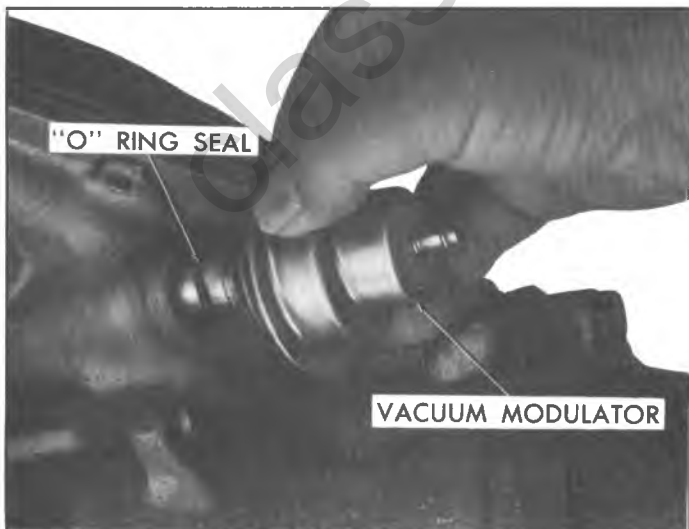


Fig. 3N--Removing Vacuum Modulator Assembly

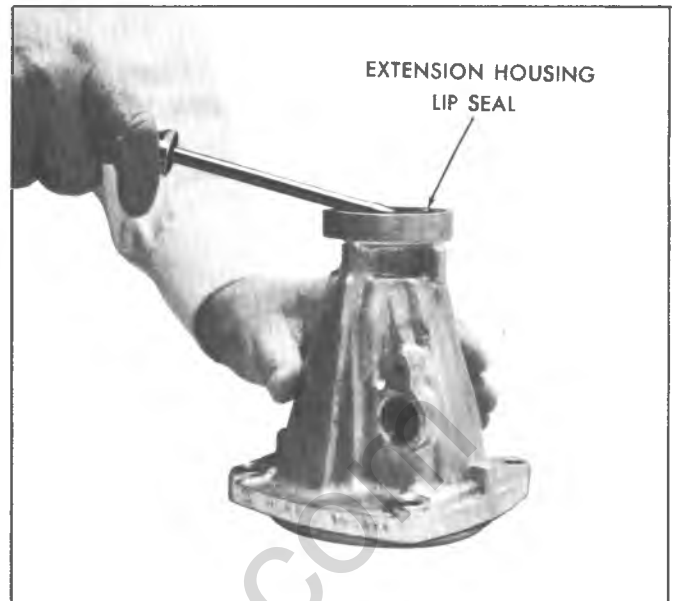


Fig. 4N--Removing Extension Housing Lip Seal

seal, and modulator valve from case (fig. 3N). Discard "O" ring.

REMOVAL OF EXTENSION, SPEEDOMETER DRIVEN GEAR, GOVERNOR, OIL PAN AND SCREEN

1. Remove four housing to case attaching bolts.
2. Remove extension housing from case and remove square cut "O" ring seal from extension housing.

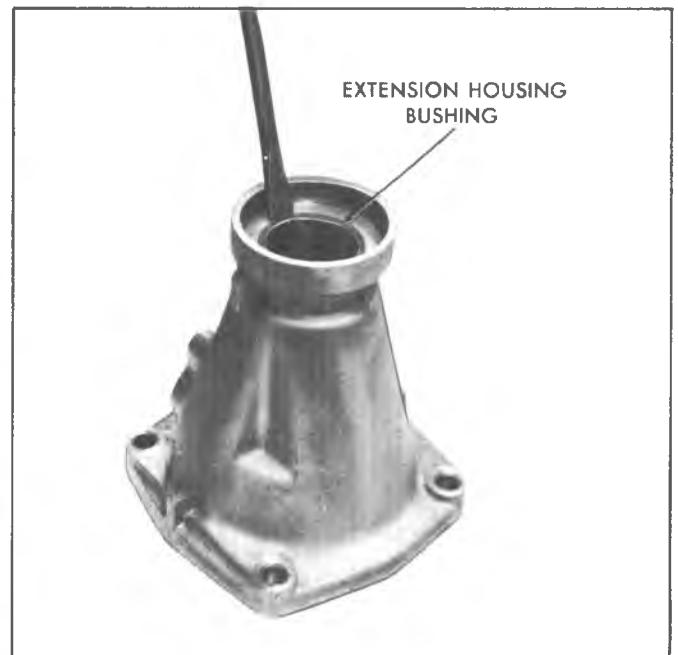


Fig. 5N--Removing Extension Housing Bushing

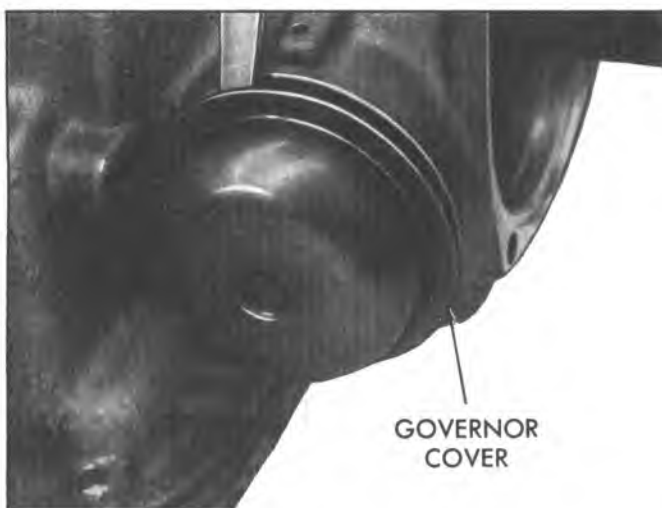


Fig. 6N--Removing Governor Cover



Fig. 8N--Removing Governor from Case

3. Remove extension housing lip seal using screw driver (fig. 4N).
4. If extension housing bushing is to be replaced, collapse bushing (fig. 5N) and refer to Figure 94N for installation.
5. Install speedometer drive gear remover tool J-21427-01 and J- 9539 bolts with J-8105 or suitable puller on output shaft and remove speedometer drive gear. Remove retaining clip.
6. Remove governor cover retainer with a screwdriver.
7. Using a screwdriver and hammer, gently tap along governor cover lip (fig. 6N), remove governor cover and "O" ring seal (fig. 7N). Discard seal.

CAUTION: Do not attempt to pry the screwdriver between the case and governor cover as this could cause damage to the case.

8. Withdraw governor assembly from case (fig. 8N) and check governor bore and governor sleeve for scoring.
9. Remove oil pan attaching screws (fig. 9N), oil pan, and gasket. Discard gasket.



Fig. 7N--Governor Cover and "O" Ring Seal

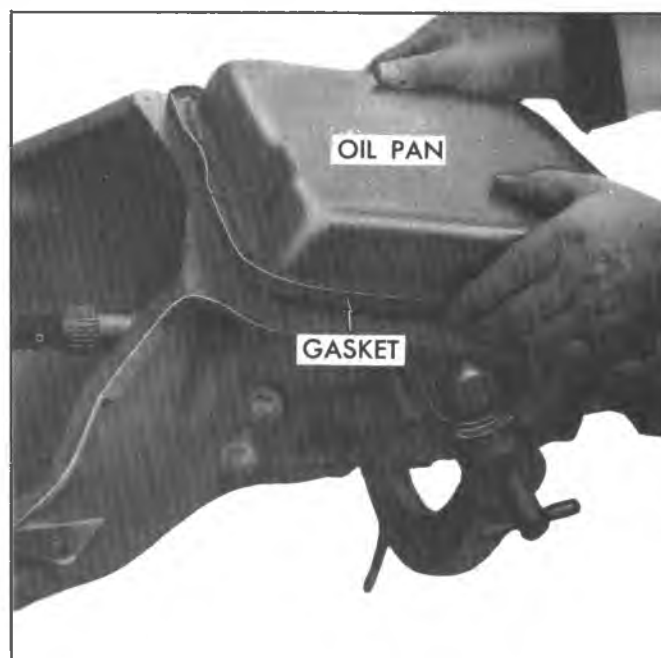


Fig. 9N--Removing Transmission Oil Pan

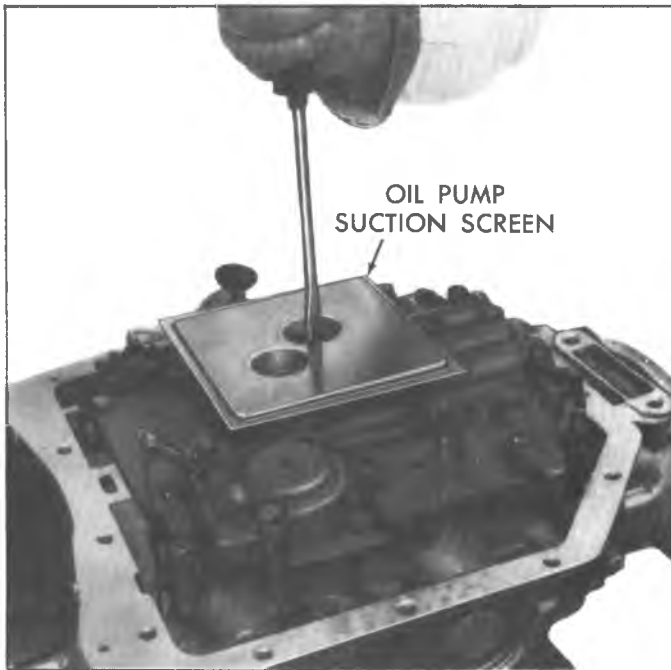


Fig. 10N--Removing Oil Pump Suction Screen (Strainer) from Valve Body

10. Remove oil pump suction screen (strainer) to valve body attaching screws (fig. 10N).
11. Remove oil pump screen (strainer) and gasket from valve body.

REMOVAL OF VALVE BODY AND LINKAGE

1. Remove detent spring and roller assembly from valve body. Remove valve body to case attaching bolts (fig. 11N).

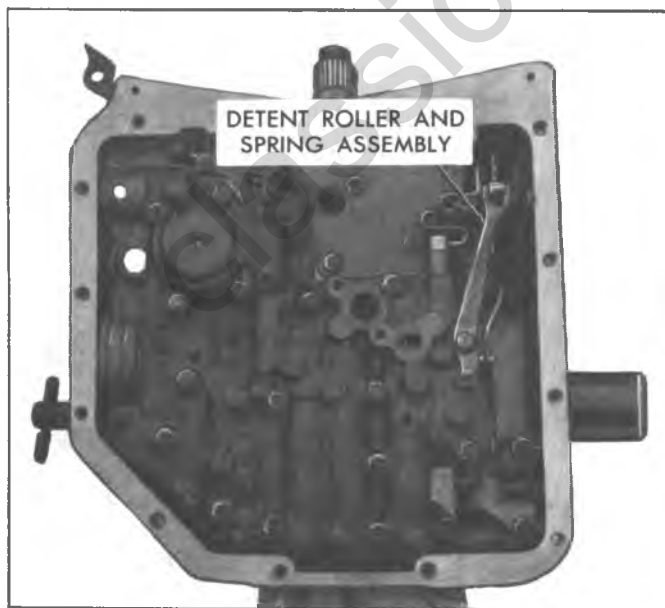


Fig. 11N--Detent Spring and Roller Assembly

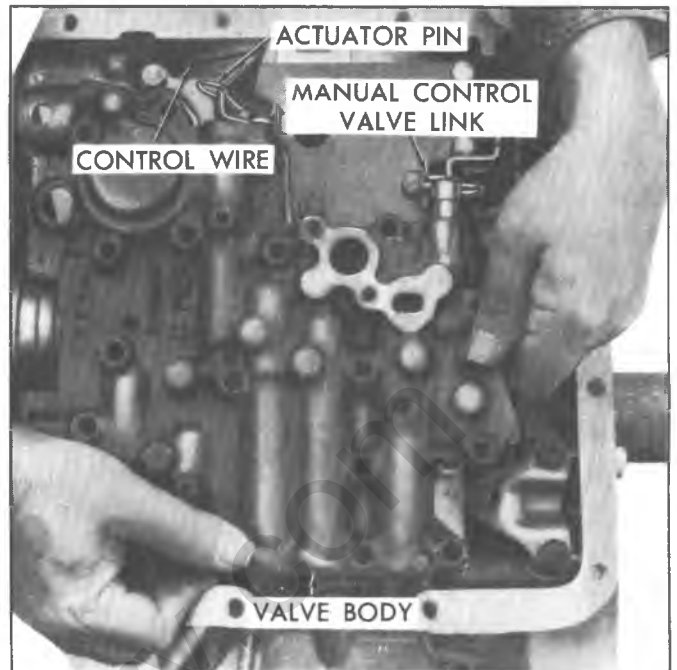


Fig. 12N--Removing Manual Control Valve Link, Valve Body and Detent Actuating Lever

2. Remove actuator pin from detent actuator valve lever and remove control wire (fig. 12N).
3. Remove manual control valve link from range selector inner lever and remove valve body (fig. 12N). Refer to page 7A-15 for valve body disassembly, inspection and assembly.
4. Remove intermediate servo return spring (fig. 13N).
5. Remove transfer plate support bolts. Remove transfer support plate (fig. 13N).



Fig. 13N--Removing Transfer Support Plate and Intermediate Servo Return Spring

7A-6 AUTOMATIC TRANSMISSION

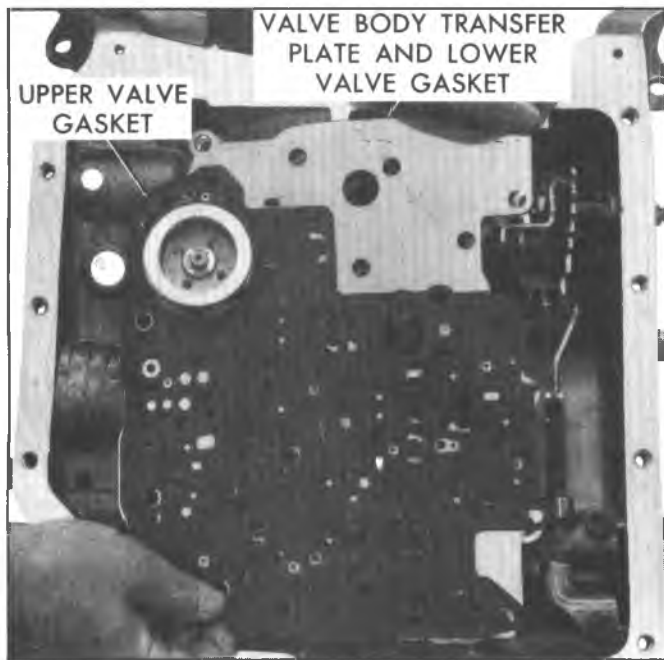


Fig. 14N--Removing Valve Body Transfer Plate and Gasket

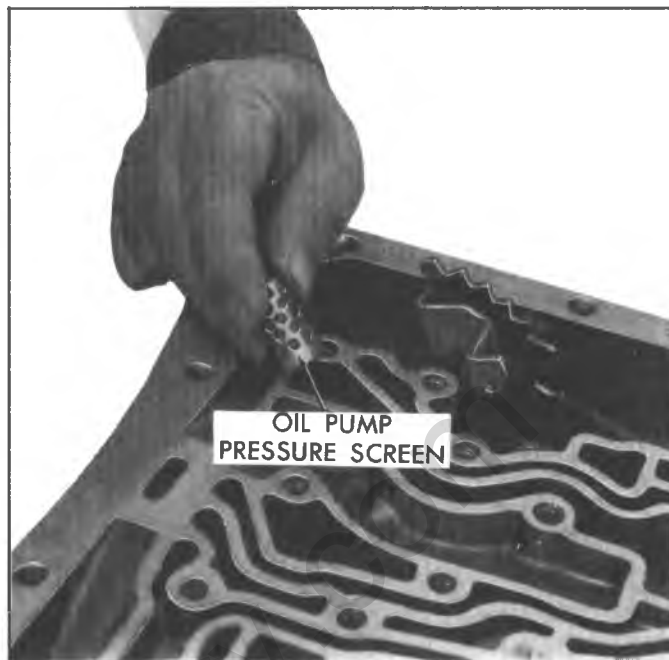


Fig. 16N--Removing Oil Pump Pressure Screen

6. Remove upper gasket, valve body transfer plate and lower valve gasket (fig. 14N).
7. Remove four (4) check balls from correct passages in case face (fig. 15N).

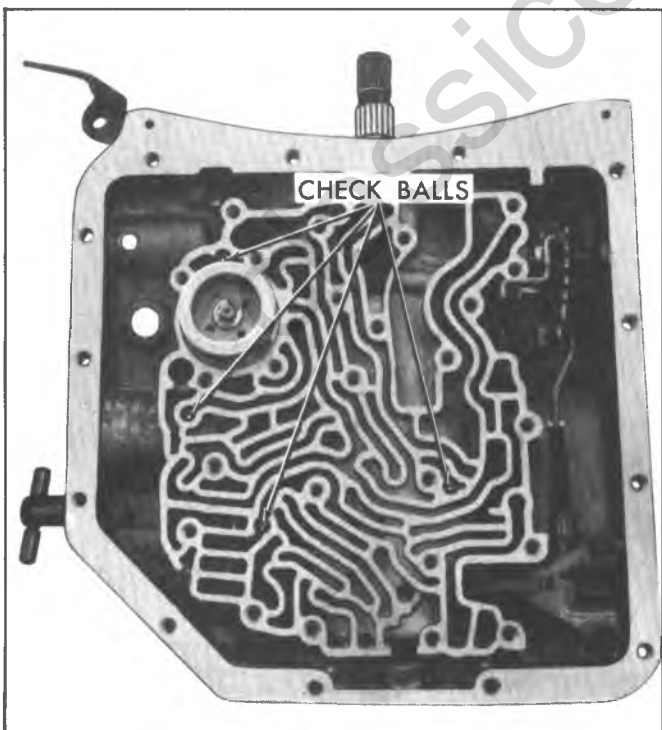


Fig. 15N--Check Ball Four (4) Locations

8. Remove oil pump pressure screen from oil pump pressure hole in case (fig. 16N).
9. Remove governor feed screen from governor feed hole (drive oil) in case (fig. 17N).



Fig. 17N--Removing Governor Feed Screen

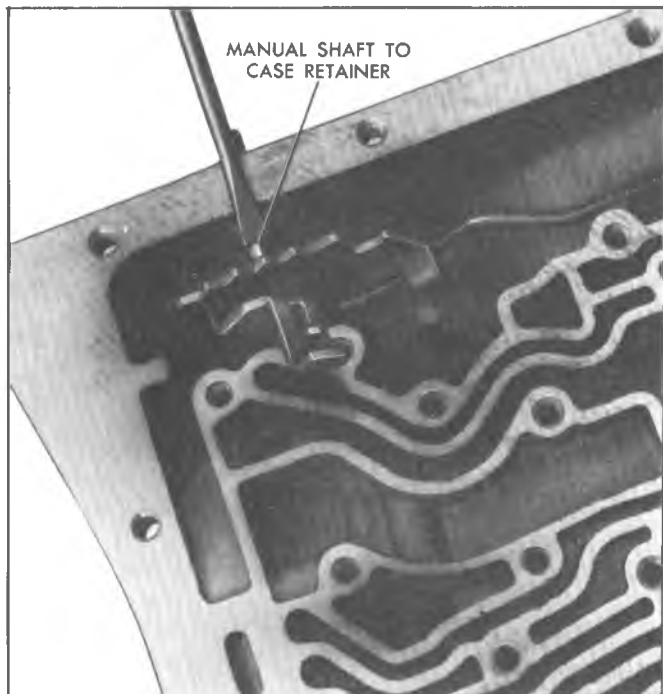


Fig. 18N--Removing Manual Shaft to Case Retainer

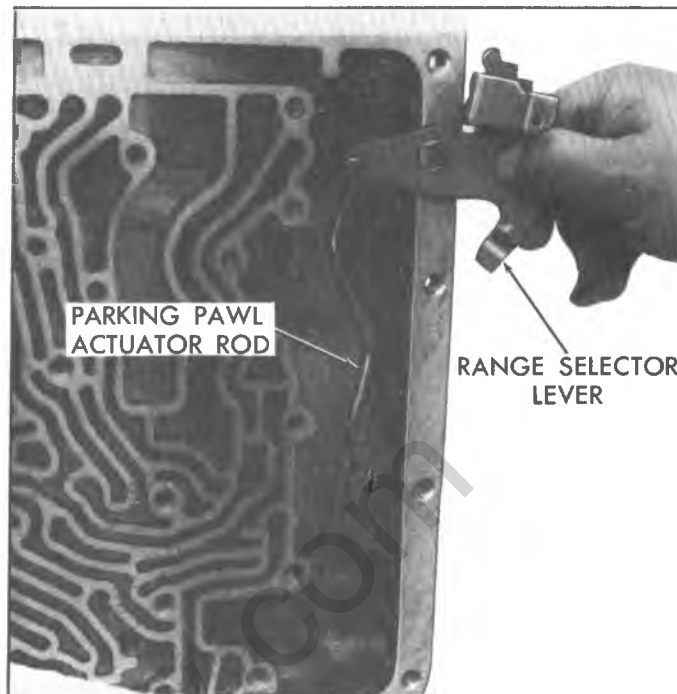


Fig. 20N--Removing Range Selector Lever and Parking Pawl Actuator Rod from Case

10. Remove manual shaft to case retainer with screwdriver (fig. 18N).
11. Loosen nut holding range selector inner lever to manual shaft (fig. 19N). Pull on manual shaft and remove nut. Remove manual shaft.
12. Remove range selector lever and parking pawl actuator rod from case. Disassemble inner lever from parking pawl actuator rod (fig. 20N).
13. Remove manual shaft to case lip seal (fig. 21N), if replacement is required.



Fig. 19N--Loosening Nut Holding Range Selector Lever to Manual Shaft

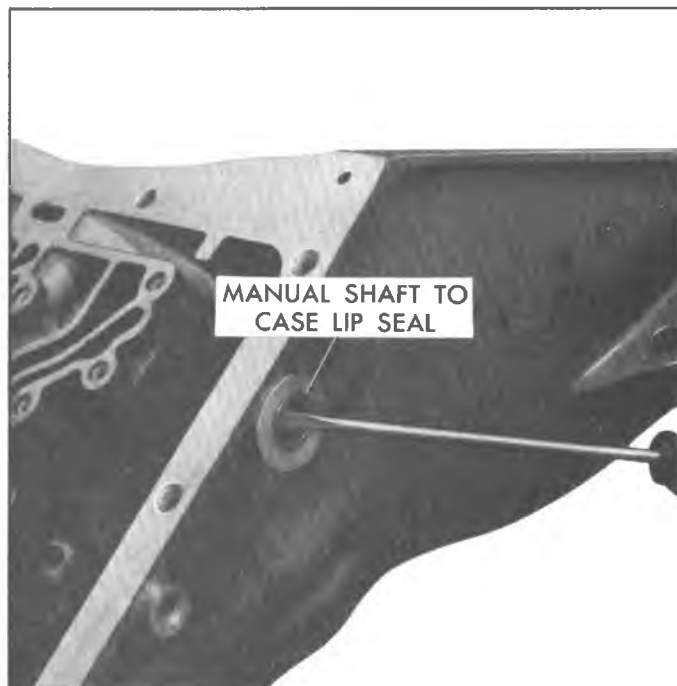


Fig. 21N--Removing Manual Shaft to Case Lip Seal

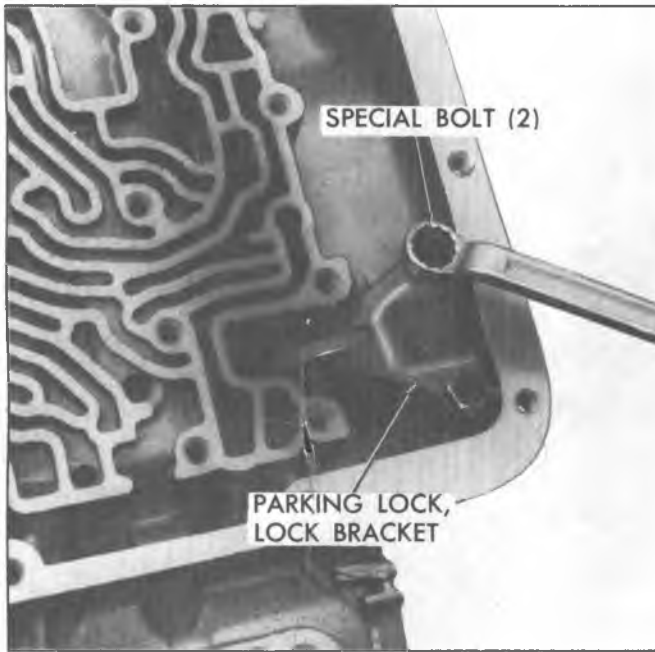


Fig. 22N--Removing Park Lock, Lock Bracket



Fig. 24N--Parking Pawl Shaft Retaining Plug, Parking Pawl Shaft and Parking Pawl

14. Remove attaching special bolts and parking lock; lock bracket (fig. 22N).

15. Remove parking pawl disengaging spring (fig. 23N).

16. Remove parking pawl shaft retaining plug, parking pawl shaft, and parking pawl (fig. 24N) if replacement is required.

NOTE: The parking pawl shafts retaining plug may be removed by using a bolt extractor.

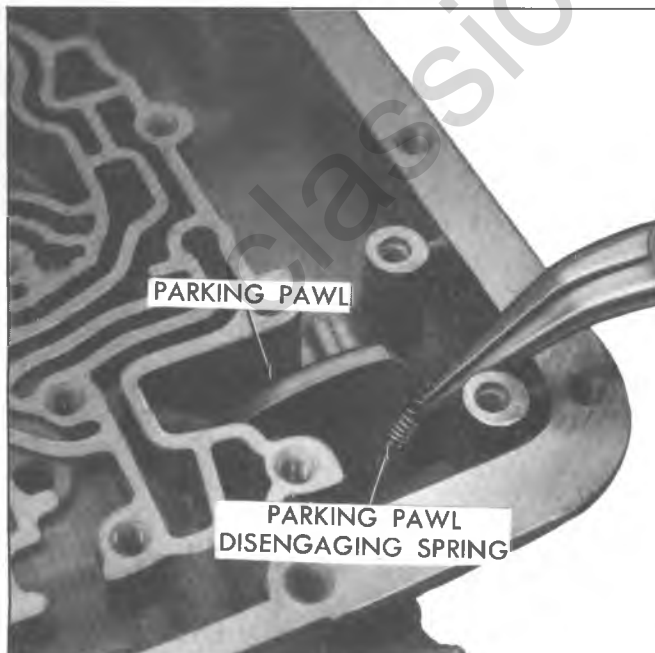


Fig. 23N--Removing Parking Pawl Disengaging Spring

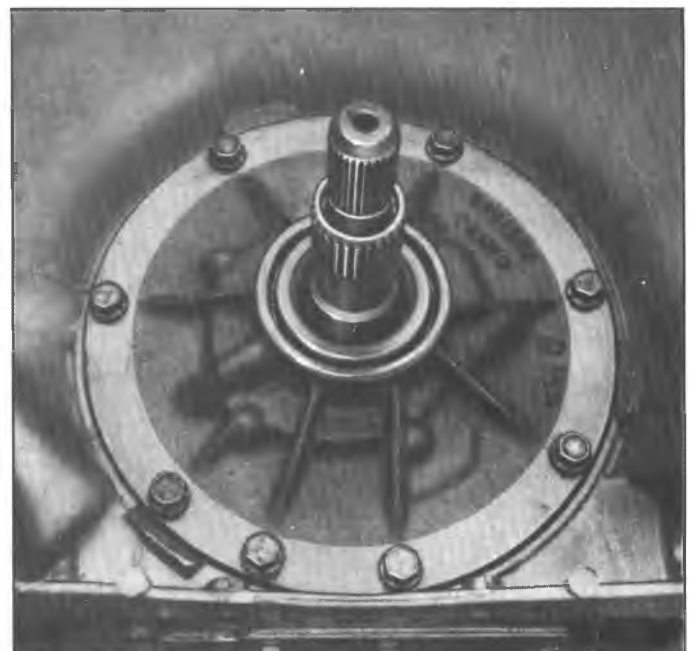


Fig. 25N--Pump Attaching Bolts



Fig. 26N--Removing Pump from Case

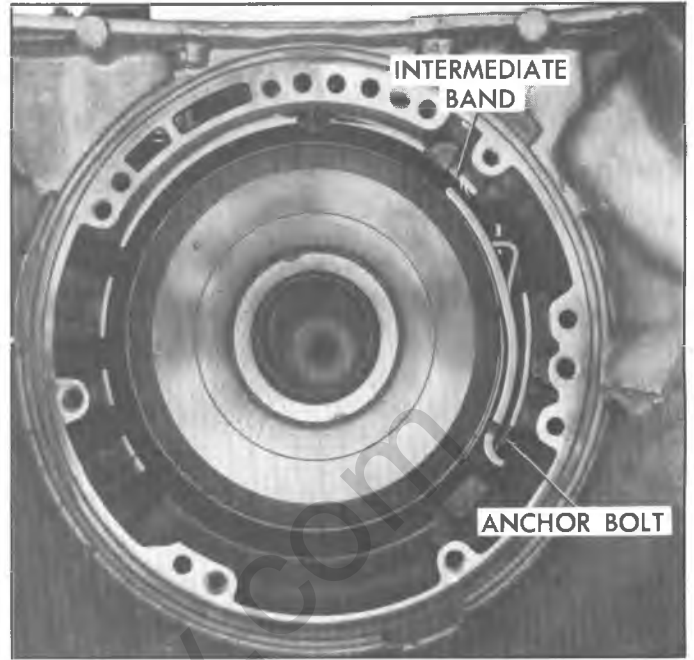


Fig. 28N--Intermediate Band

REMOVAL OF OIL PUMP AND INTERNAL CASE COMPONENTS

1. Remove eight (8) pump attaching bolts with washer type seals (fig. 25N).
2. Install two (2) threaded slide hammers J-7004 into threaded holes in pump body and remove pump assembly from case (fig. 26N). Discard pump gasket.

Refer to pages 7A-16 thru 7A-18 for disassembly and reassembly of the oil pump.

3. Loosen nut and intermediate band anchor bolt (Fig. 27N).
4. Remove intermediate band (fig. 28N).
5. Remove intermediate servo (fig. 29N) and disassembly as shown in figure 30N.



Fig. 27N--Intermediate Band Anchor Bolt

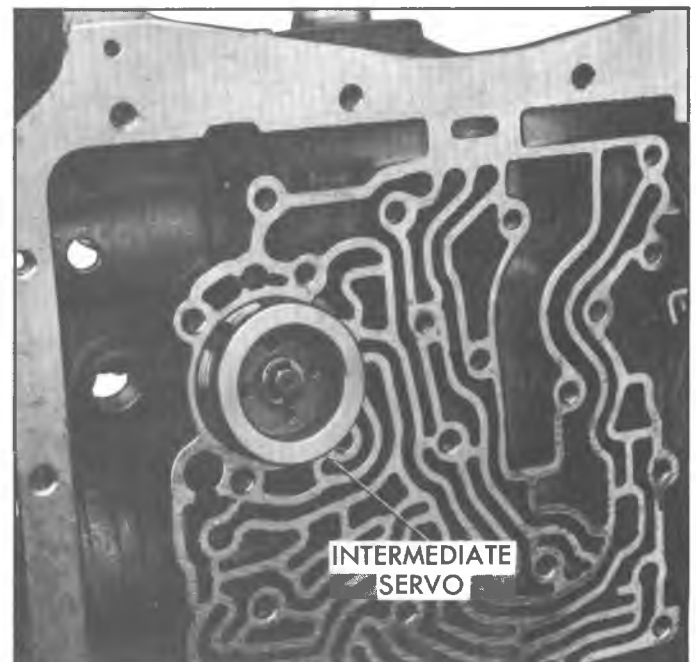


Fig. 29N--Removing Intermediate Servo

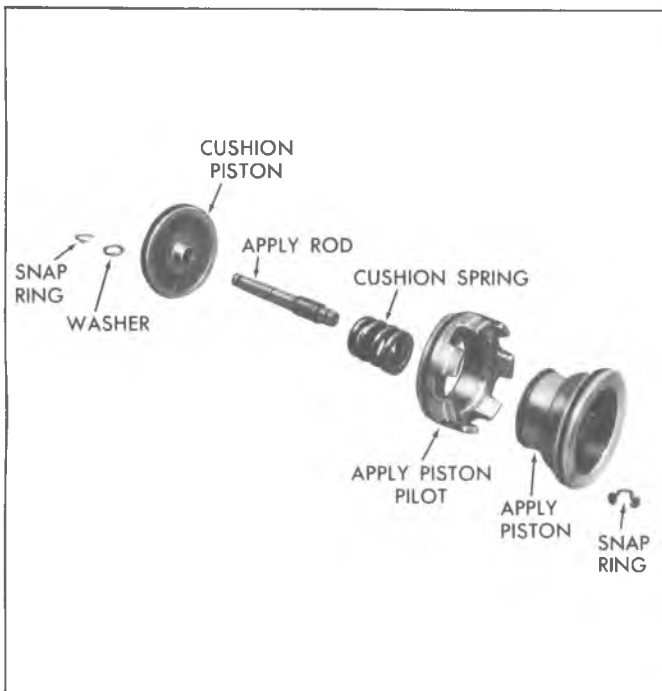


Fig. 30N--Intermediate Servo

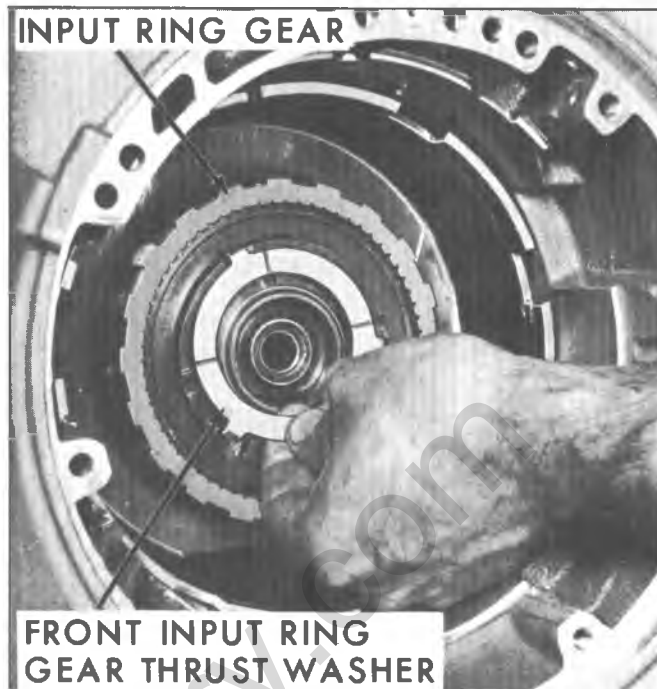


Fig. 32N--Removing Input Ring Gear Front Thrust Washer

6. Remove direct and forward clutch assemblies, from case (fig. 31N). Refer to pages 7A-19 and 7A-22 for disassembly and reassembly of the direct and forward clutches.

7. Remove input ring gear front thrust washer (fig. 32N).

NOTE: Washer has 3 tangs.

8. Remove input ring gear to output shaft snap ring (fig. 33N).



Fig. 31N--Removing Direct and Forward Clutch Assemblies

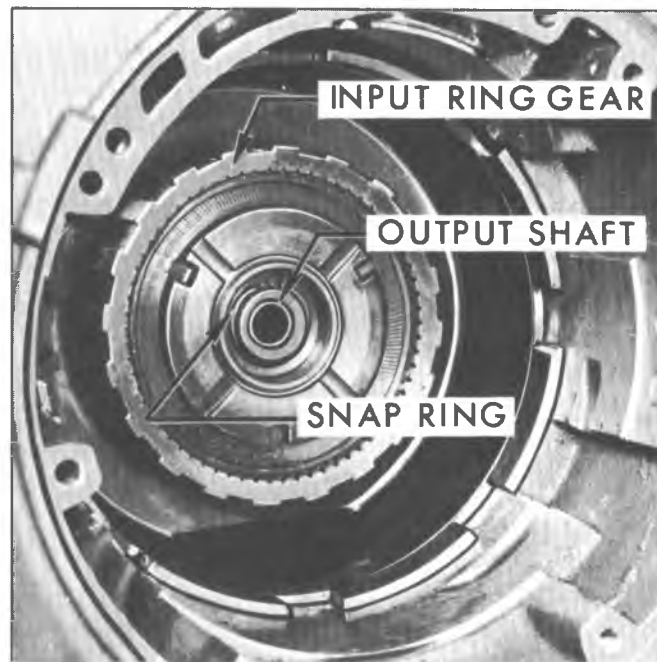


Fig. 33N--Removing Input Ring Gear to Output Shaft Snap Ring

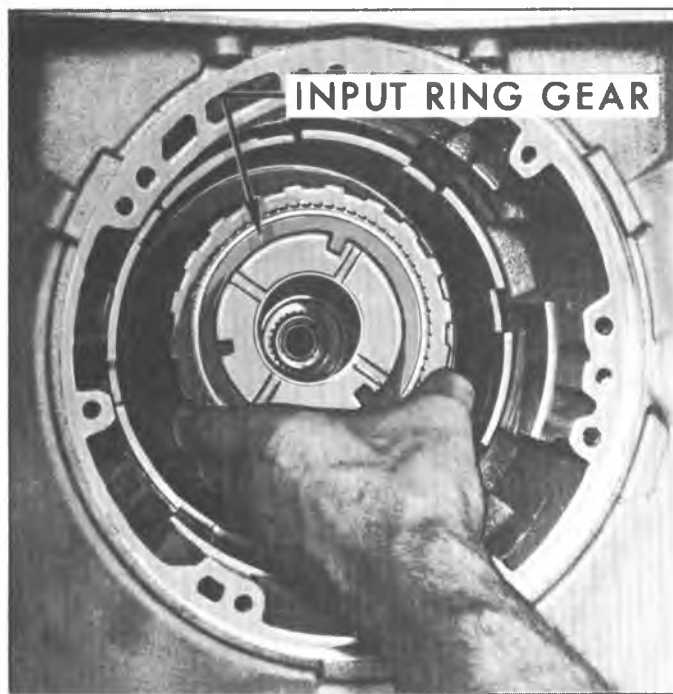


Fig. 34N--Removing Input Ring Gear

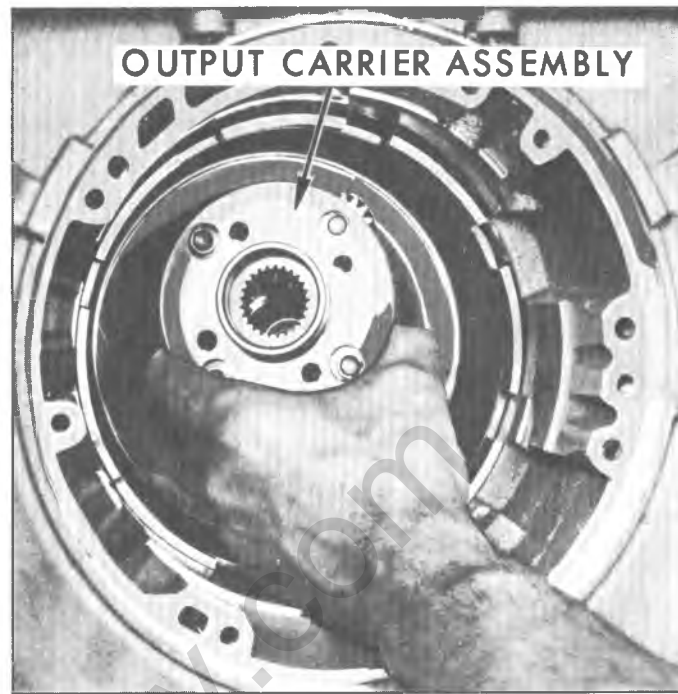


Fig. 36N--Removing Output Carrier Assembly

9. Remove input ring gear (fig. 34N).
10. Remove input ring gear rear (output carrier) thrust washer (fig. 35N).
11. Remove output carrier assembly (fig. 36N).
12. Remove sun gear drive shell assembly (fig. 37N).

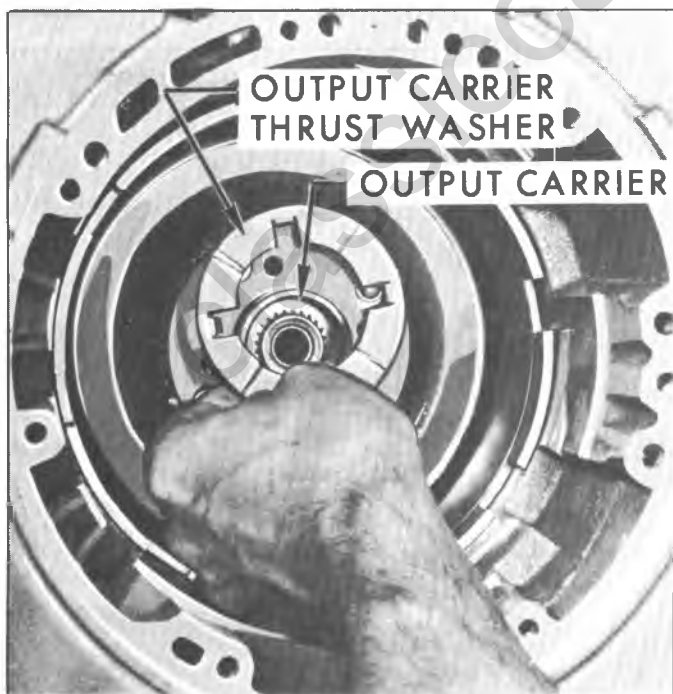


Fig. 35N--Removing Input Ring Gear Rear Thrust Washer

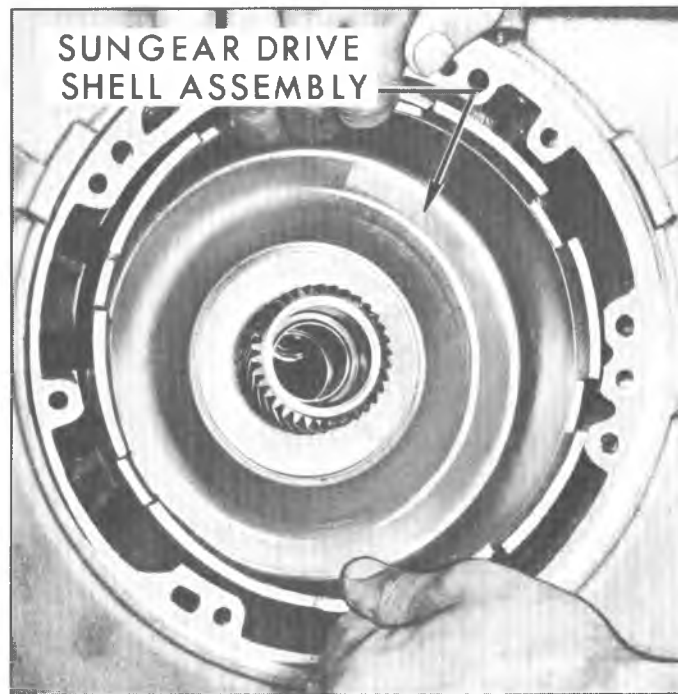


Fig. 37N--Removing Sun Gear Drive Shell

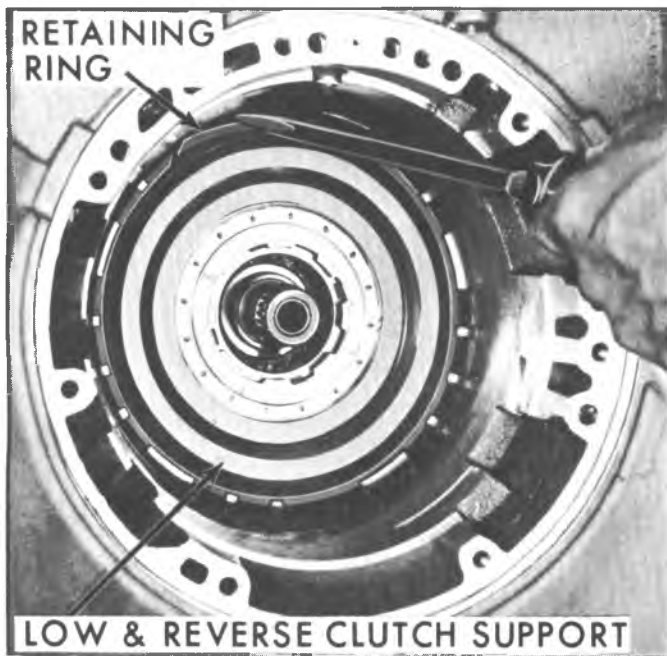


Fig. 38N--Removing Low and Reverse Clutch Support Retaining Ring

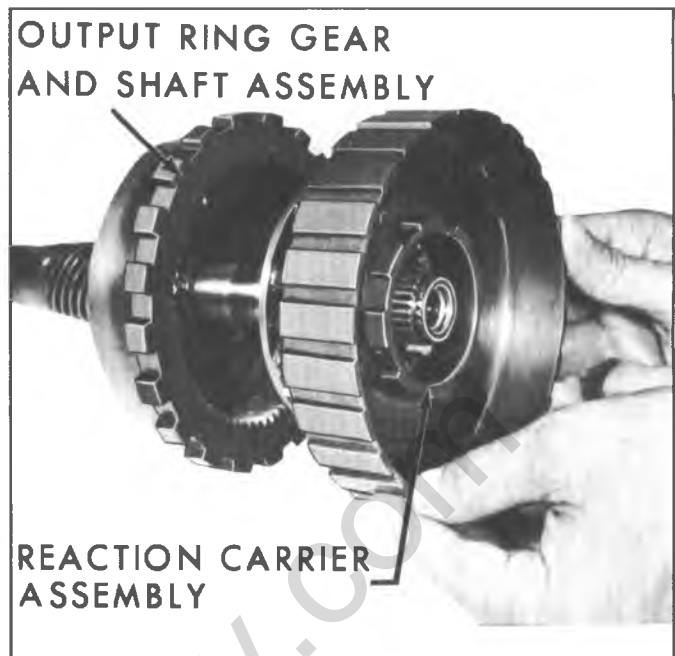


Fig. 40N--Removing Reaction Carrier Assembly

13. Remove low and reverse roller clutch support to case retaining ring (fig. 38N).
14. Remove low and reverse clutch support and race assembly and anti-clunk spring.
15. Remove low and reverse clutch faced plates and steel reaction plates (fig. 39N).
16. Remove reaction carrier assembly from output ring gear and shaft assembly (fig. 40N).
17. Remove output ring gear and shaft assembly from case (fig. 41N).

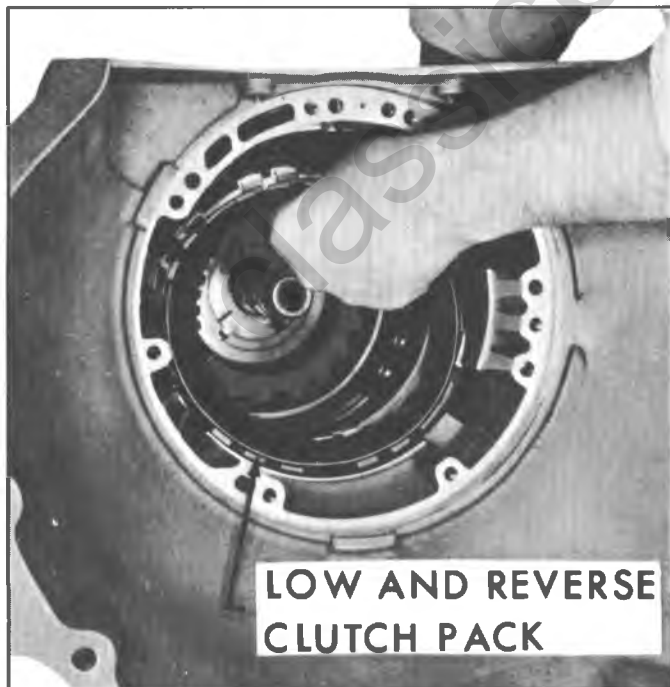


Fig. 39N--Removing Low and Reverse Clutch Pack

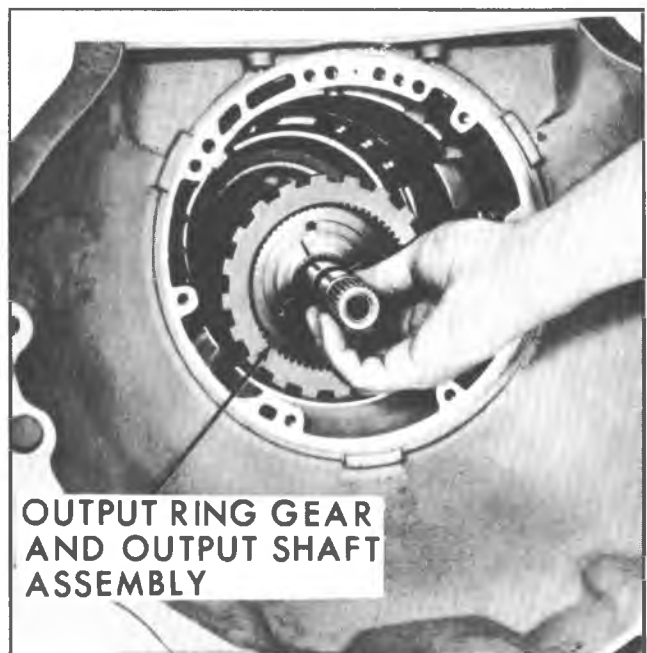


Fig. 41N--Removing Output Ring Gear and Shaft Assembly

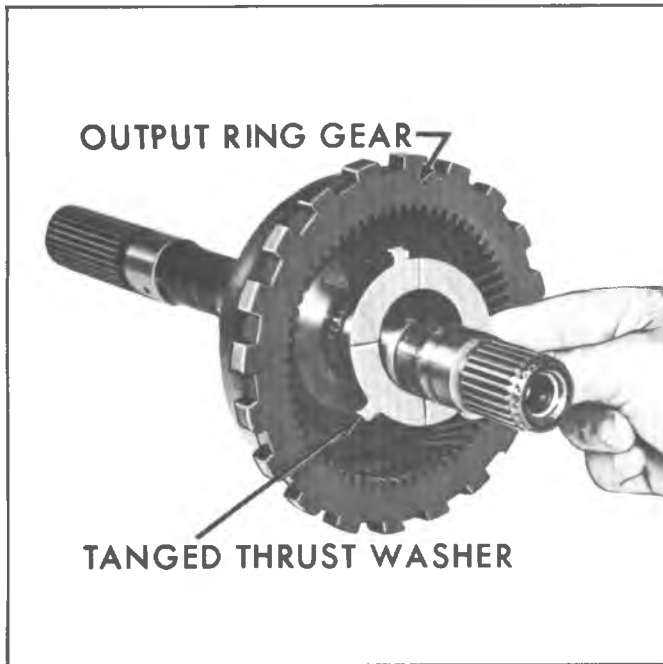


Fig. 42N--Removing Output Ring Gear Tanged Thrust Washer

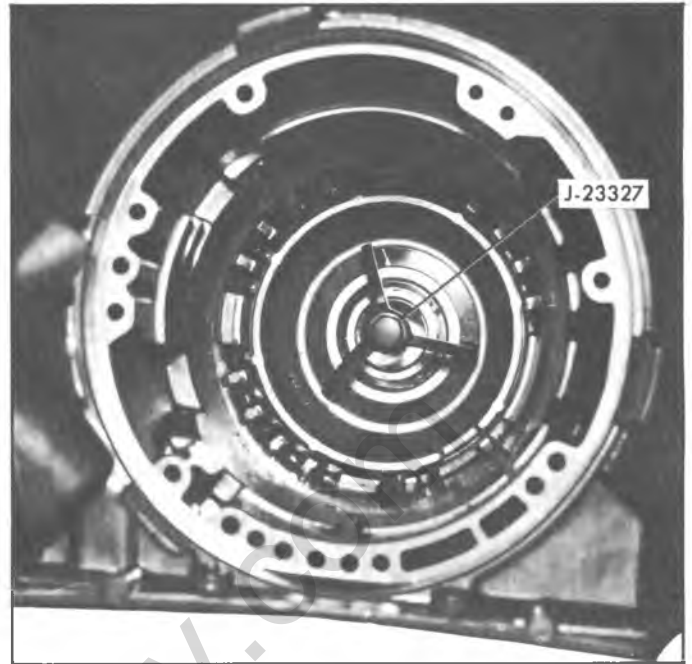


Fig. 44N--Compressing Low and Reverse Clutch Piston Spring Retainer

18. Remove reaction carrier to output ring gear tanged (front) thrust washer (fig. 42N).
19. Remove output ring gear to case needle bearing assembly (fig. 43N).
20. Compress low and reverse clutch piston spring retainer using tool J-23327 (fig. 44N) and remove piston retaining ring and spring retainer.
21. Remove seventeen (17) piston springs from piston (fig. 45N).



Fig. 43N--Removing Output Ring Gear to Case Needle Bearing Assembly

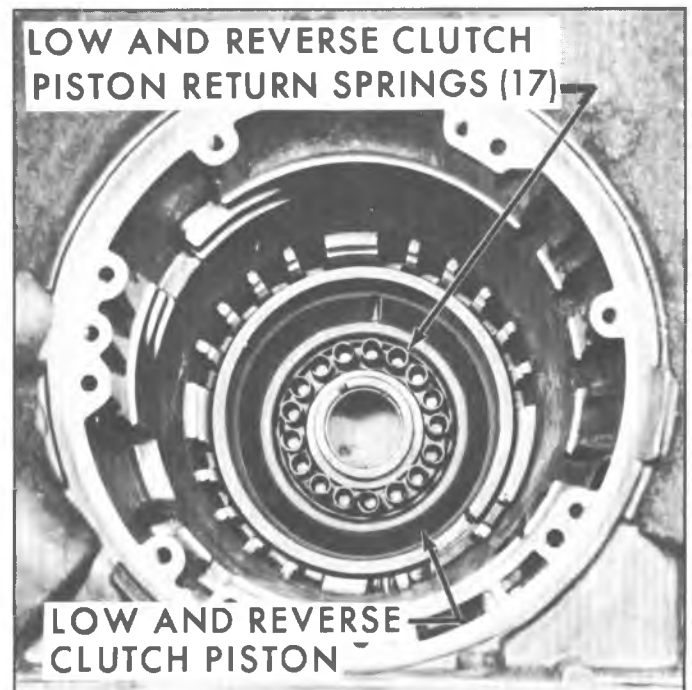


Fig. 45N--Low and Reverse Clutch Piston Springs and Piston

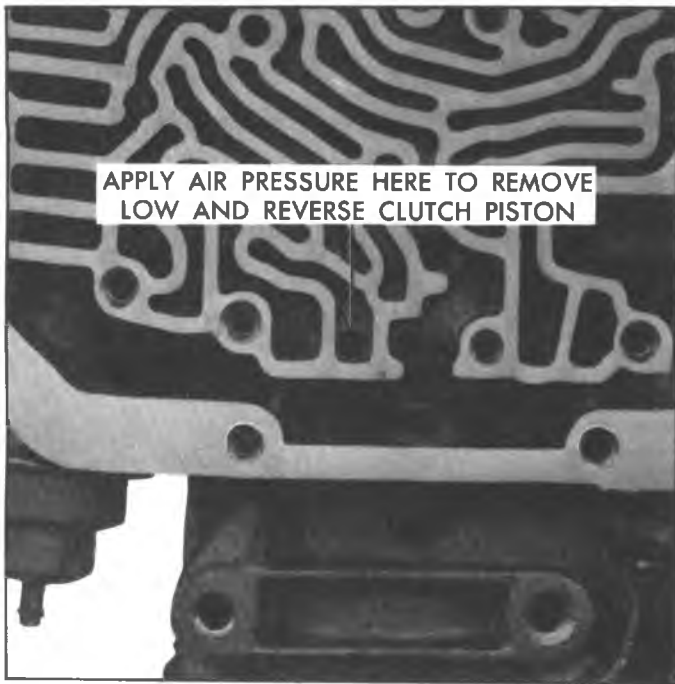


Fig. 46N--Removing Low and Reverse Clutch Piston

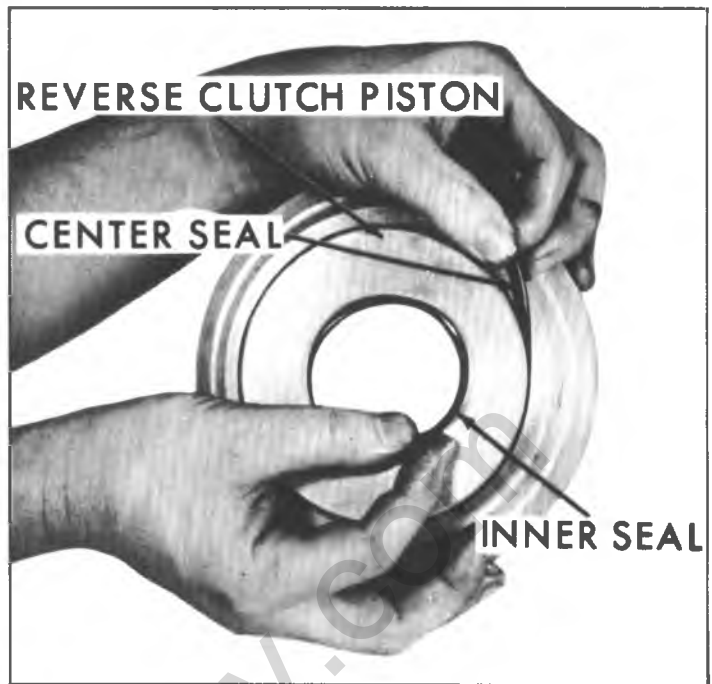


Fig. 48N--Removing Low and Reverse Clutch Piston Center and Inner Seal

22. Remove low and reverse clutch piston assembly by applying compressed air in passage shown on Figure 46N.
23. Remove low and reverse clutch piston outer seal (fig. 47N).

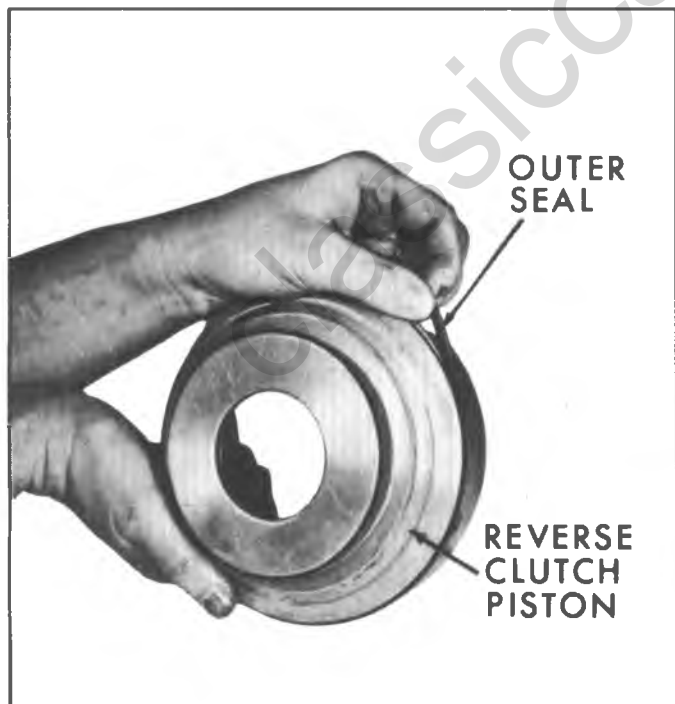


Fig. 47N--Removing Low and Reverse Clutch Piston Outer Seal

24. Remove low and reverse clutch piston center and inner seal (fig. 48N).
25. Install tool J-23069 to compress 1-2 accumulator piston cover and remove retaining ring (fig. 49N).
26. Remove 1-2 accumulator piston cover and remove "O" ring seal from case.
27. Remove 1-2 accumulator piston spring.

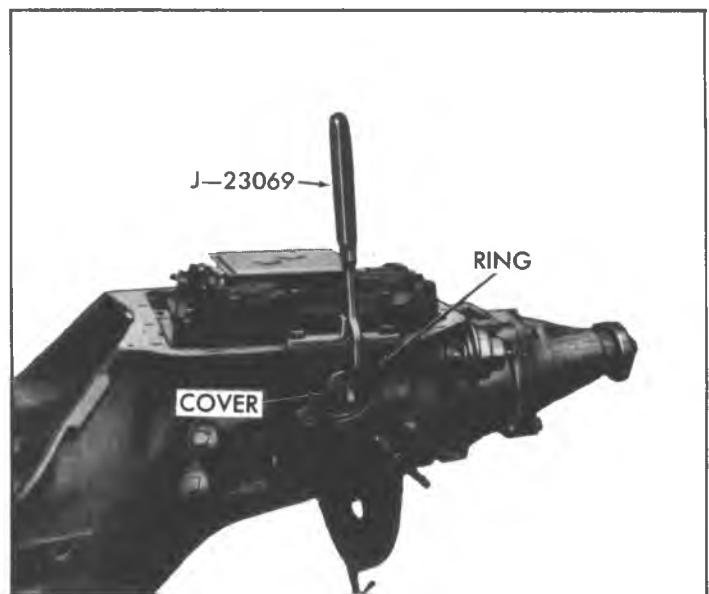


Fig. 49N--Removing 1-2 Accumulator Piston Cover Retaining Ring

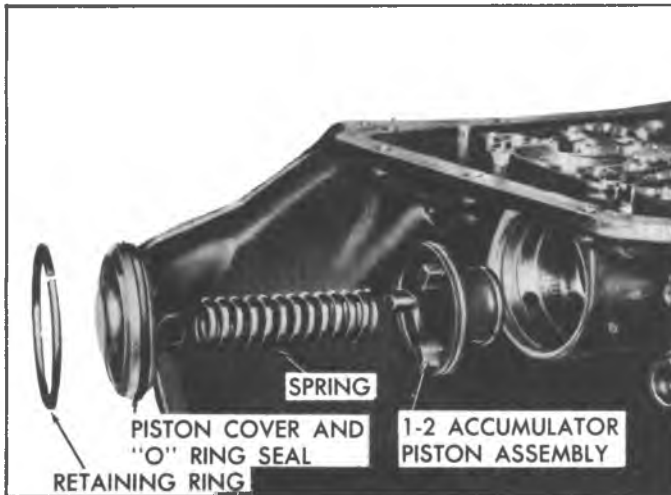


Fig. 50N--1-2 Accumulator Components

28. Remove 1-2 accumulator piston assembly. (fig. 50N).
29. Also, remove inner and outer hook type oil seal rings if required.

VALVE BODY DISASSEMBLY, INSPECTION, AND REASSEMBLY (FIG. 51N)

Disassembly

1. Position valve body assembly with cored face up

and direct clutch accumulator piston pocket positioned as shown in Figure 51N.

2. Remove manual valve from lower left hand bore.
3. From lower right hand bore remove the pressure regulator valve train retaining pin, boost valve sleeve, intermediate boost valve, reverse and modulator boost valve, pressure regulator valve spring, and the pressure regulator valve.
4. From the next bore, remove the 2-3 shift valve train retaining pin, sleeve, control valve spring, 2-3 shift control valve, shift valve spring, and the 2-3 shift valve.
5. From the next bore, remove the 1-2 shift valve train retaining pin, sleeve, shift control valve spring, 1-2 shift control valve, and the 1-2 shift valve.
6. From the next bore, remove retaining pin, plug, manual low control valve spring, and the manual low control valve.
7. From the next bore, remove the retaining pin, spring, seat, and the detent regulator valve.
8. From bore on opposite side, remove detent actuating lever bracket bolt, bracket, stop, spring retainer, seat, outer spring, inner spring, washer and detent valve.

Inspection

1. Inspect all valves for scoring, cracks and free movement in their respective bores.

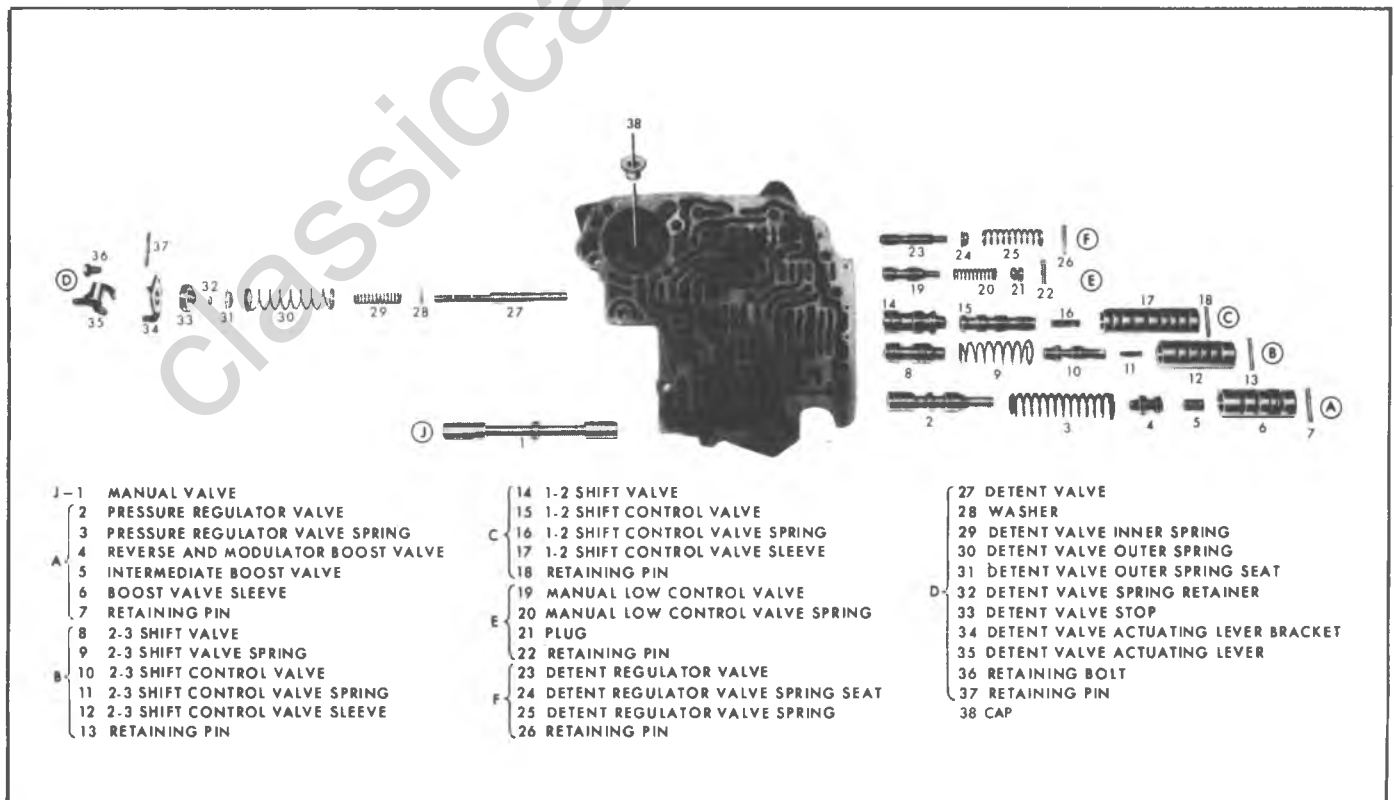


Fig. 51N--Valve Body--Exploded View

7A-16 AUTOMATIC TRANSMISSION

2. Inspect valve body for cracks, scored bores, interconnected oil passages and flatness of mounting face.
3. Check all springs for distortion or collapsed coils.

Reassembly

1. Install the detent valve, washer, outer spring, inner spring, spring seat, and spring retainer. Install detent valve stop and detent valve actuating bracket. Torque bolt to 52 inch-pounds.
2. Install the pressure regulator valve, spring, reverse and modulator boost valve, intermediate boost valve, boost valve sleeve and retaining pin.
3. In the next bore up, install 2-3 shift valve, shift valve spring, 2-3 shift control valve, shift control valve spring, shift control valve sleeve and retaining pin.
4. In the next bore up, install the 1-2 shift valve, 1-2 shift control valve, control valve spring, control valve sleeve and retaining pin.
5. In the next bore up, install the manual low control valve, spring, plug and retaining pin.
6. In the top right hand bore, install the detent regulator valve, spring seat, spring and retaining pin.

OIL PUMP (FIG. 52N)

Disassembly

1. Place pump cover and stator shaft assembly

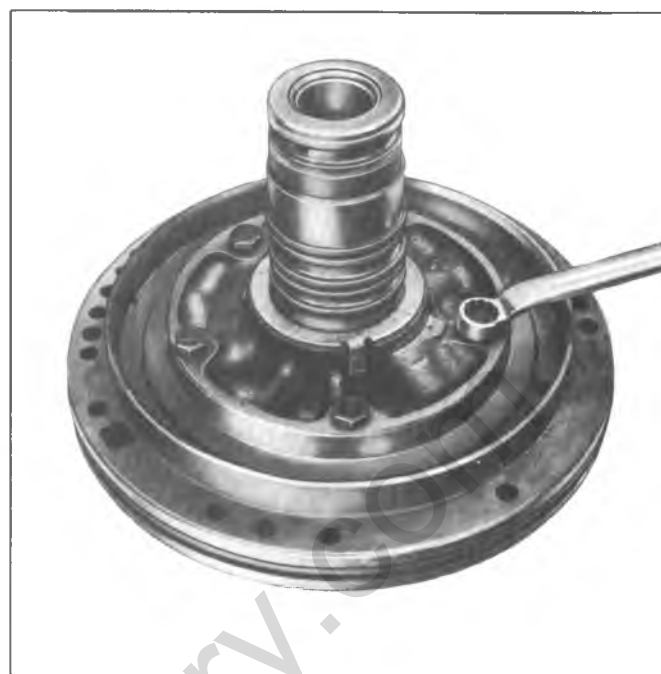


Fig. 53N--Removing Pump Cover to Pump Body Bolts

through hole in bench.

2. Remove pump cover to body attaching bolts 5/16 x 18-1 1/2 (fig. 53N).
3. Remove two (2) forward clutch housing to pump hub hook type oil seal rings and three (3) direct

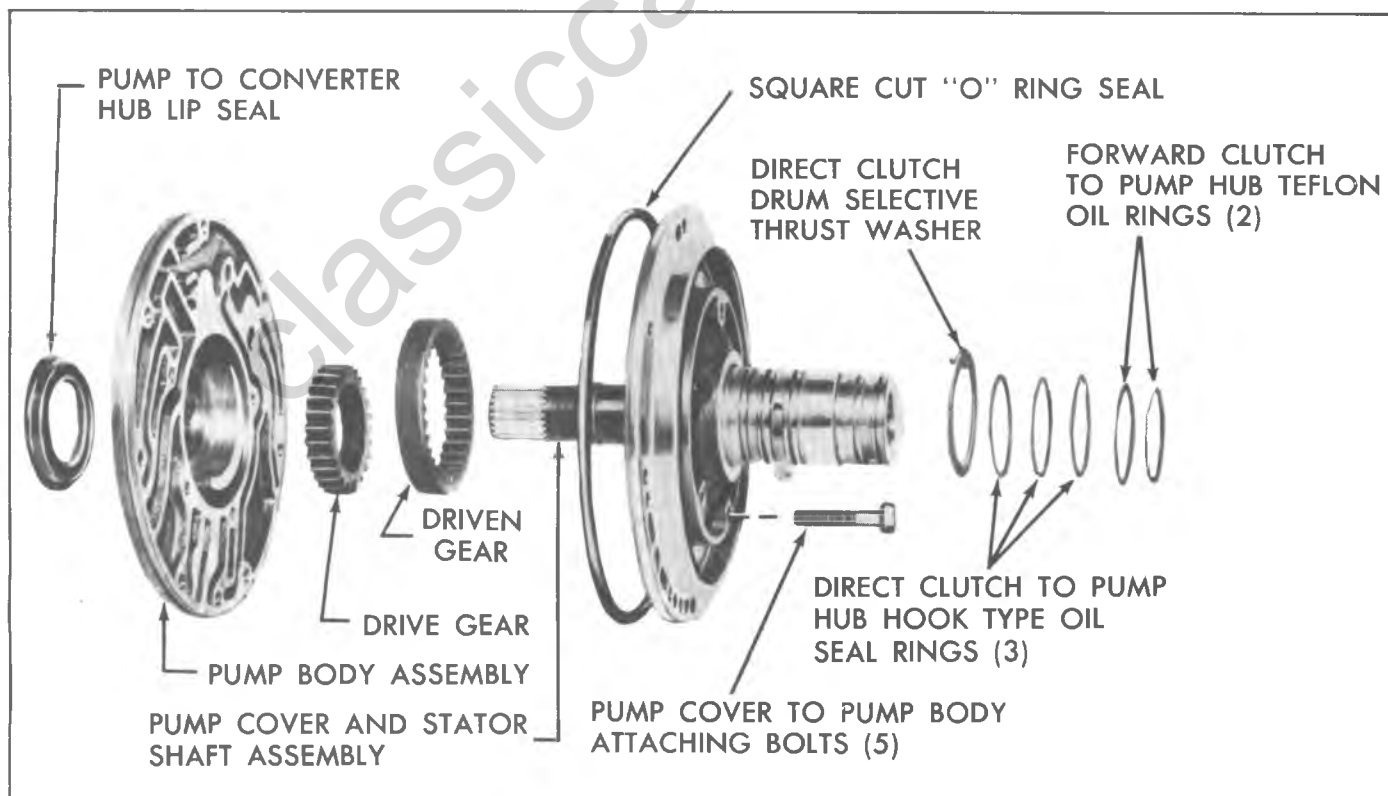


Fig. 52N--Pump Assembly--Exploded View



Fig. 54N--Pump Hub Oil Seal Rings

clutch drum to pump hub hook type oil rings (fig. 54N).

4. Remove pump cover to direct clutch drum housing selective thrust washer (fig. 54N).
5. Remove pump cover and stator shaft assembly from pump body (fig. 55N).
6. Remove pump drive gear and driven gear.
7. Remove pump outside diameter to case (square cut) "O" ring seal. Discard seal.

Inspection

1. Wash all parts in cleaning solvent and blow out all

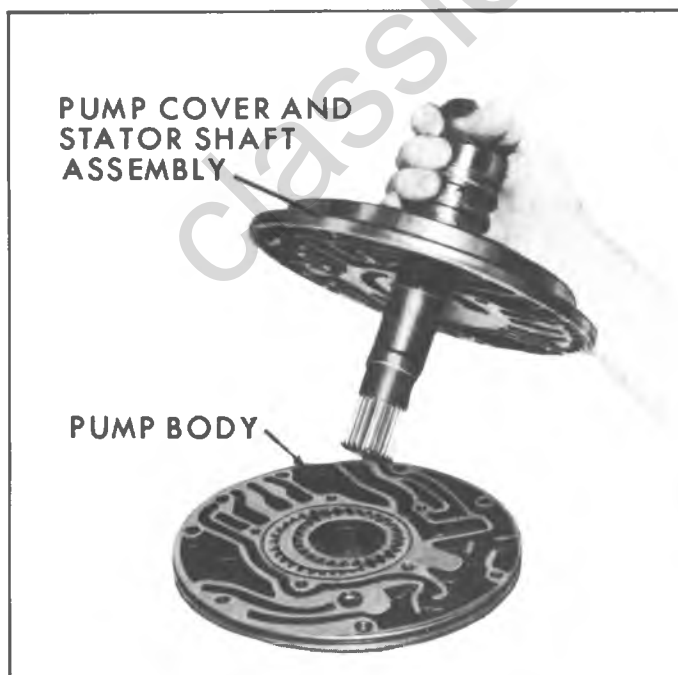


Fig. 55N--Separating Pump Cover from Pump Body



Fig. 56N--Checking Pump Body to Gear Face Clearance

oil passages. **DO NOT USE RAGS TO DRY PARTS.**

CAUTION: *Some solvents may be harmful to rubber seals.*

2. Inspect pump gears for nicks or damage.
3. Inspect body and cover faces for nicks or scoring. Inspect cover hub O.D. for nicks or burrs which might damage clutch drum bushing journal.
4. Inspect body bushing for galling or scoring. Check clearance between body bushing and converter pump hub. Maximum clearance is .005". If the bushing is damaged, the oil pump body should be replaced.
5. Inspect converter housing hub O.D. for nicks or

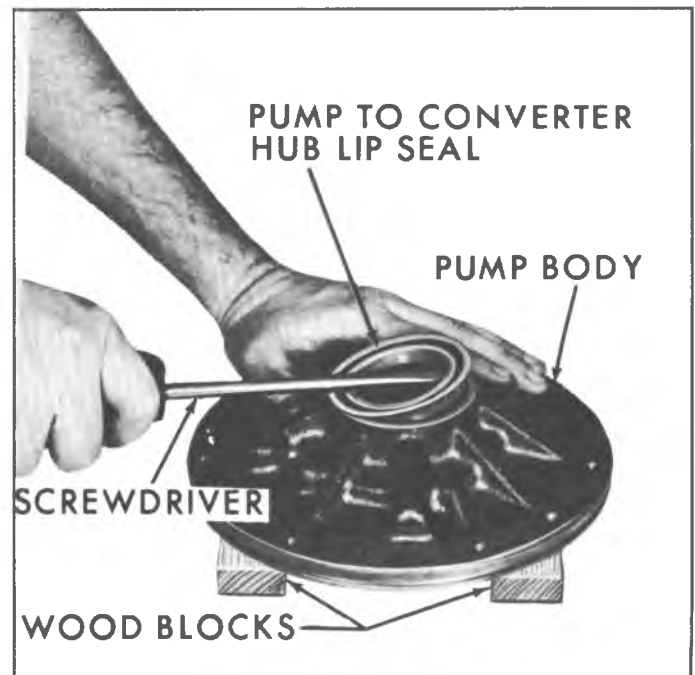


Fig. 57N--Removing Pump to Converter Hub Lip Seal

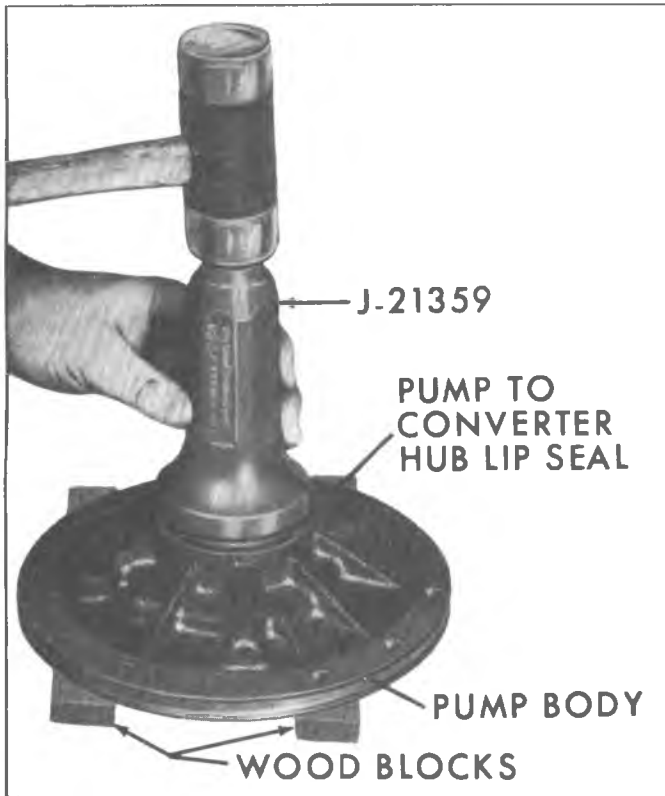


Fig. 58N--Installing Hub Lip Seal

burrs which might damage pump seal or bushing. Repair or replace as necessary.

6. If hub lip seal is damaged or is leaking (and the pump body is otherwise suitable for reuse), replace seal.

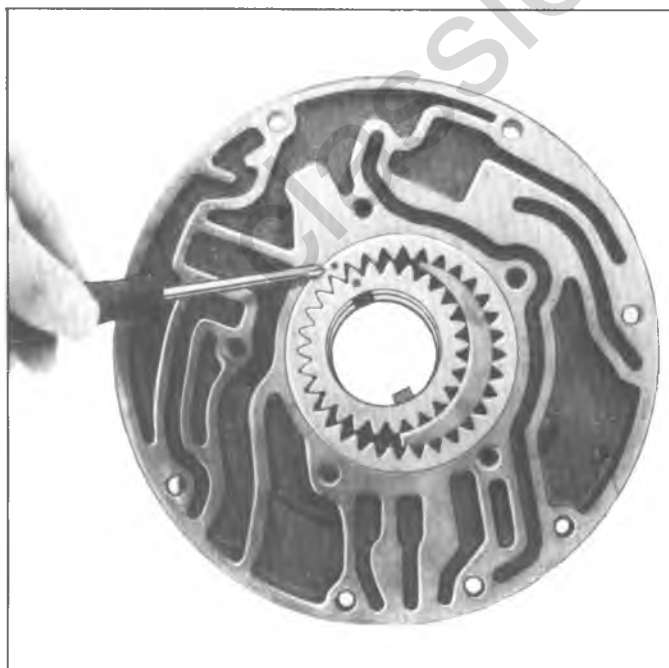


Fig. 59N--Installing Pump Drive and Driven Gears

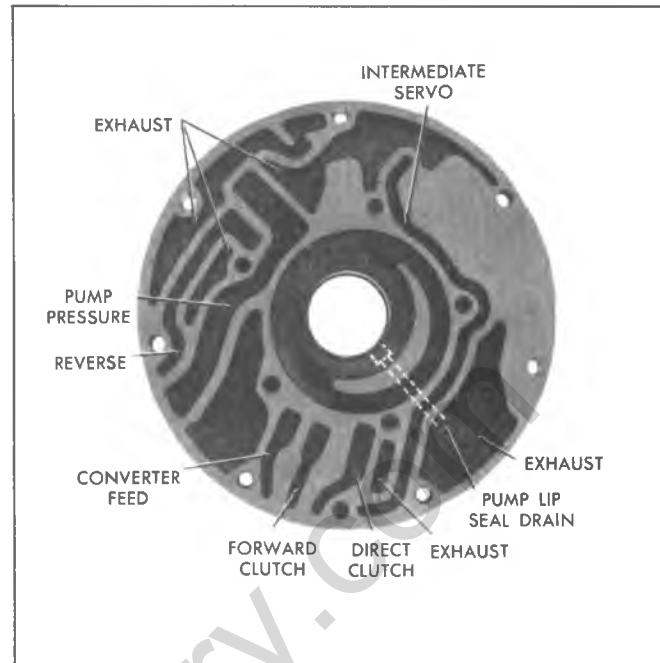


Fig. 60N--Pump Body Oil Passages

7. With parts clean and dry, install pump gears in pump body and check pump body face to gear face clearance. Clearance should be .0005"-.0015" (fig. 56N).

Reassembly

1. Replace hub lip seal if defective (figs. 57N and 58N).
2. Place pump body on wood blocks and pry out defective seal. Coat outer diameter of new seal with

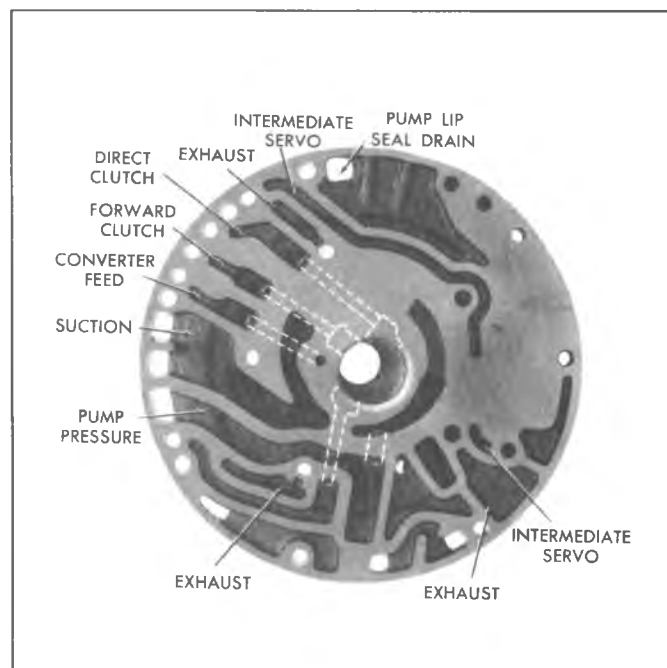


Fig. 61N--Pump Cover Oil Passages

a non-hardening sealer and install seal using seal installer J-21359 to seat seal fully in counterbore.

3. Install pump drive gear and driven gear (fig. 59N).
4. Install direct clutch drum housing to pump cover selective thrust washer over pump cover delivery sleeve.
5. Install three (3) direct clutch to pump hub hook type oil seal rings. Install two (2) forward clutch to pump hub hook type oil seal rings.

CAUTION: Check pump cover and body oil passages to make sure they are not restricted (figs. 60N and 61N).



Fig. 63N--Removing Direct Clutch Pressure Plate

6. Install pump outside diameter to case (square cut) "O" ring seal.
7. Align pump body to cover, and install five (5) attaching bolt. Tighten bolts to 18 pound-feet.

DIRECT CLUTCH (FIG. 62N)

Disassembly

1. Remove direct clutch pressure plate to clutch drum retaining ring and pressure plate (Fig. 63N).

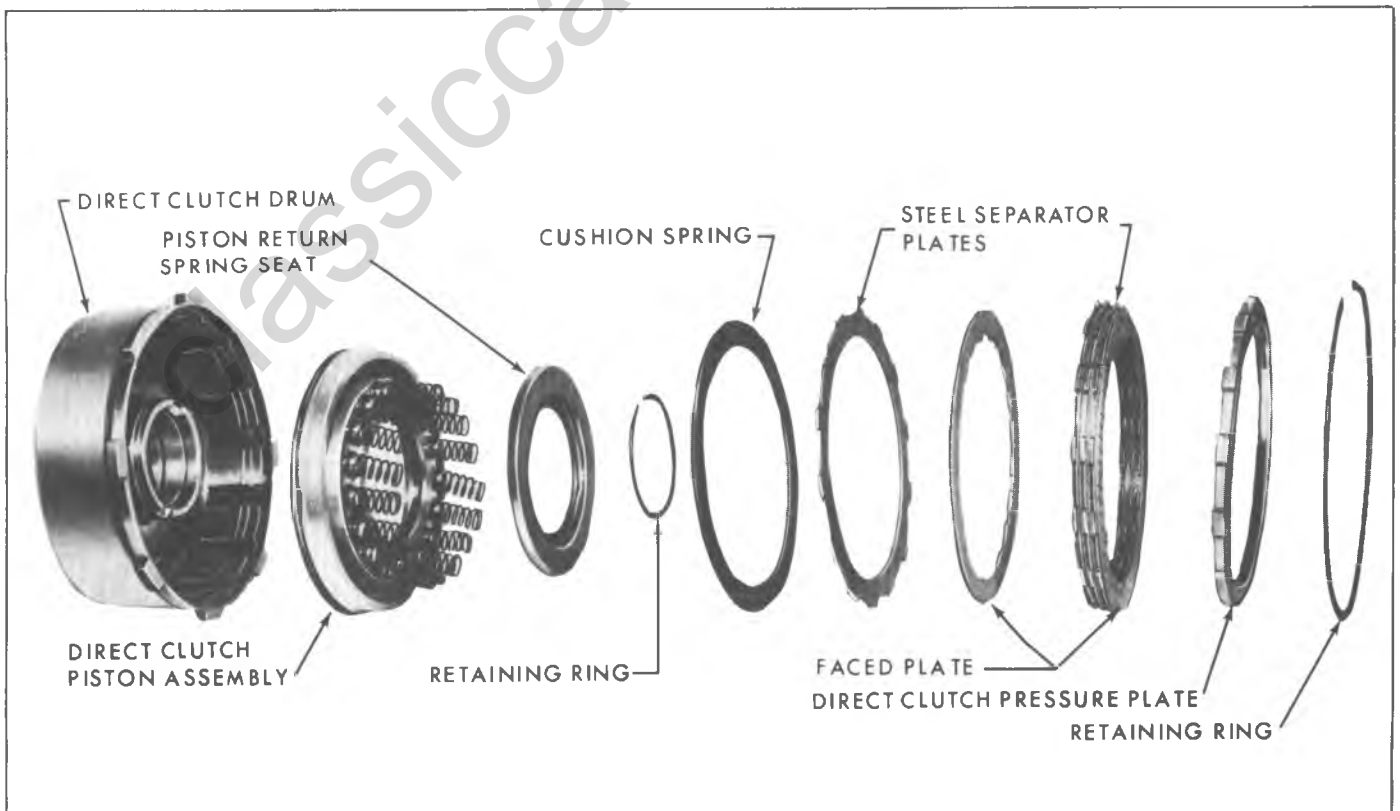


Fig. 62N--Direct Clutch Assembly--Exploded View

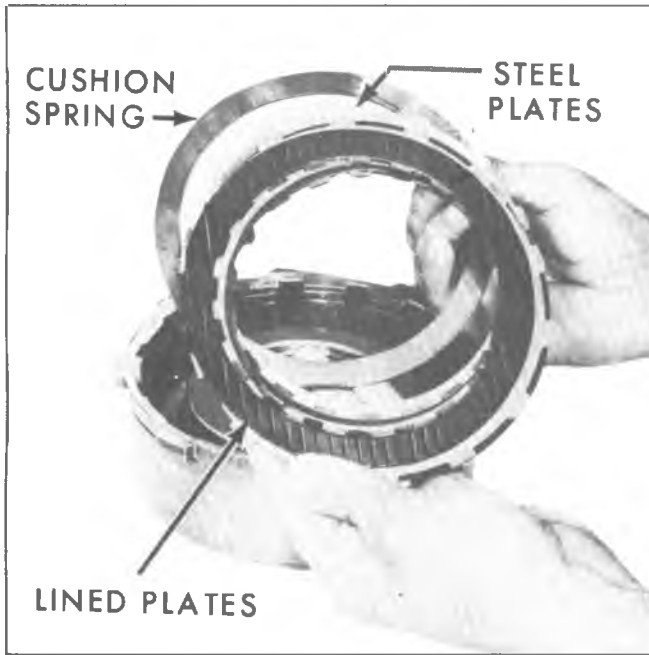


Fig. 64N--Removing Lined Plates and Steel Plates



Fig. 66N--Removing Direct Clutch Outer and Inner Seals

2. Remove three lined drive plates, three steel driven plates and cushion spring (fig. 64N).
3. Using compressor tool J-23327, remove direct clutch piston return spring seat retaining ring, spring seat and seventeen (17) clutch return coil springs (fig. 65N).
4. Remove direct clutch piston.
5. Remove direct clutch piston outer seal and inner seal (fig. 66N).
6. Remove direct clutch piston center seal from drum (fig. 67N).



Fig. 65N--Compressing Direct Clutch Spring Seat

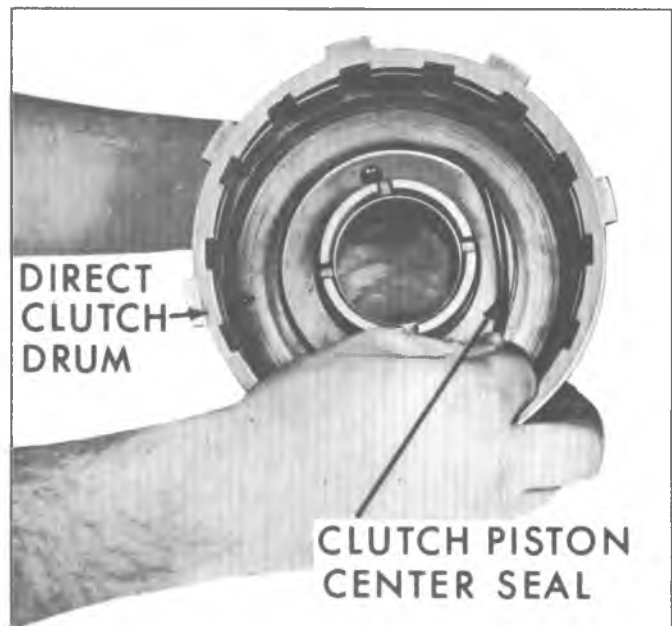


Fig. 67N--Removing Direct Clutch Piston Center Seal



Fig. 68N--Installing Direct Clutch Piston



Fig. 69N--Installing Direct Clutch Springs, Spring Seat and Retaining Ring

Inspection

1. Inspect drive and driven clutch plates for signs of burning, scoring or wear.
2. Inspect seventeen (17) springs for collapsed coils or signs of distortion.
3. Inspect piston for cracks.

4. Inspect clutch housing for wear, scoring, open oil passages and free operation of ball check.

Reassembly

1. Install new direct clutch piston outer seal and inner seals.

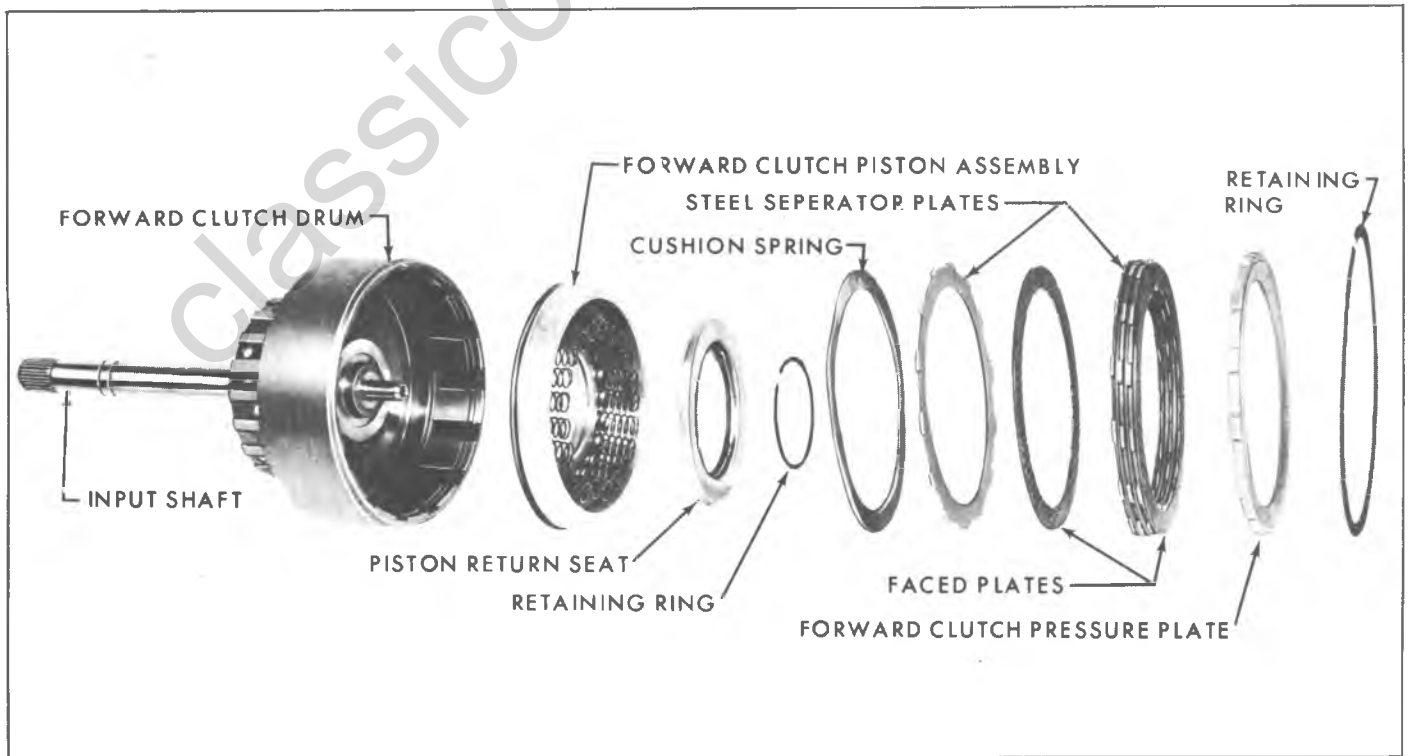


Fig. 70N--Forward Clutch Assembly--Exploded View

7A-22 AUTOMATIC TRANSMISSION

2. Install new direct clutch piston center seal on drum with lip facing upward.
3. Install direct clutch piston into housing with aid of a feeler gauge or a piece of .020" piano wire crimped into copper tubing (fig. 68N).
4. Install seventeen (17) clutch return coil springs.
5. Install piston return spring seat. Compress spring seat with tool J-23327 and install retaining ring (fig. 69N).
6. Lubricate with transmission fluid and install cushion spring, lined plates and steel plates, start with cushion spring alternating steel and lined plates.
7. Install direct clutch pressure plate and retaining ring.

FORWARD CLUTCH (FIG. 70N)

Disassembly

1. Remove direct clutch drum to forward clutch housing needle roller bearing (fig. 71N).
2. Remove forward clutch retaining ring and pressure plate (fig. 72N).
3. Remove four face drive plates, four steel driven plates and cushion spring (fig. 73N).
4. Using tool J-23327, compress piston return seat and remove retaining ring (fig. 74N).

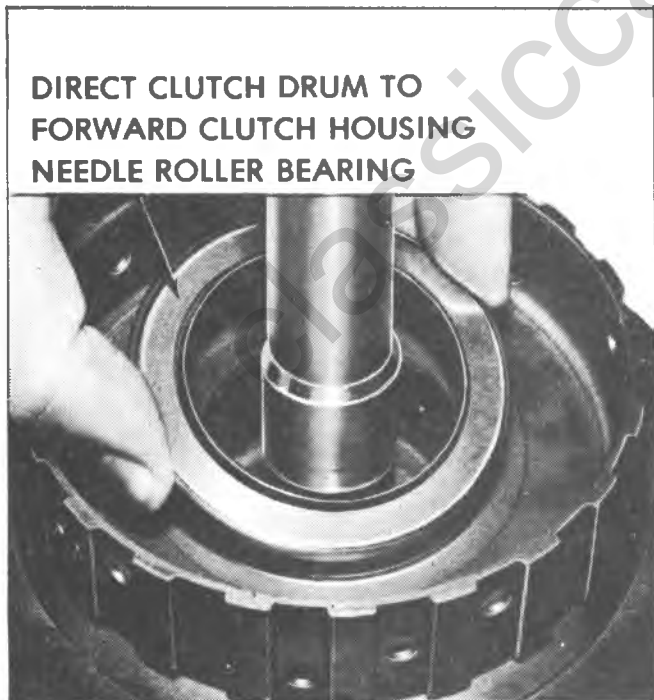


Fig. 71N--Direct Clutch Drum to Forward Clutch Housing Needle Roller Bearing

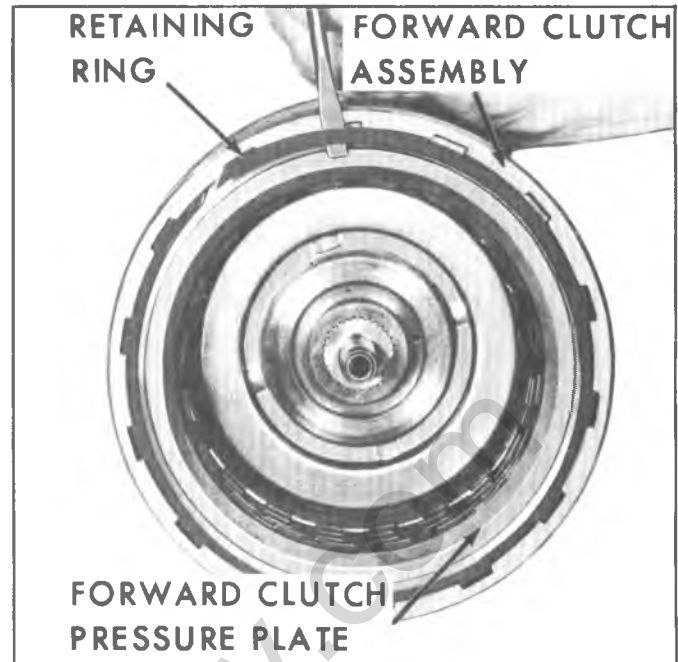


Fig. 72N--Removing Forward Clutch Retaining Ring and Pressure Plate

5. Remove piston return seat and twenty-one (21) clutch return springs.
6. Remove forward clutch piston assembly.
7. Remove the forward clutch inner and outer piston seals (fig. 75N).

Inspection

1. Inspect drive and driven clutch plates for signs of burning, scoring or wear.

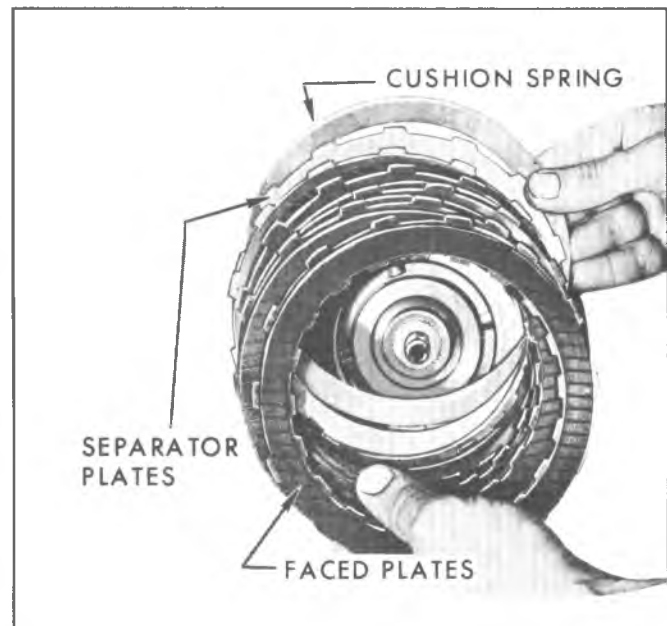


Fig. 73N--Removing Forward Clutch, Clutch Separator and Face Plates and Cushion Spring

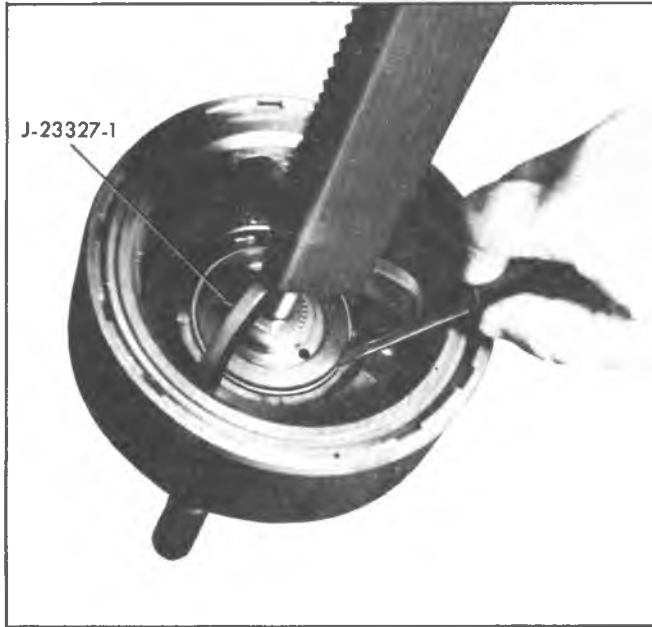


Fig. 74N--Compressing Forward Clutch Piston Return Seat

2. Inspect twenty one (21) springs for collapsed coils or signs of distortion.
3. Inspect piston for cracks.
4. Inspect clutch housing for wear, scoring, open oil passages and free operation of exhaust check ball (fig. 76N).
5. Inspect input shaft.
 - a. Inspect for open lubrication passages at each end.

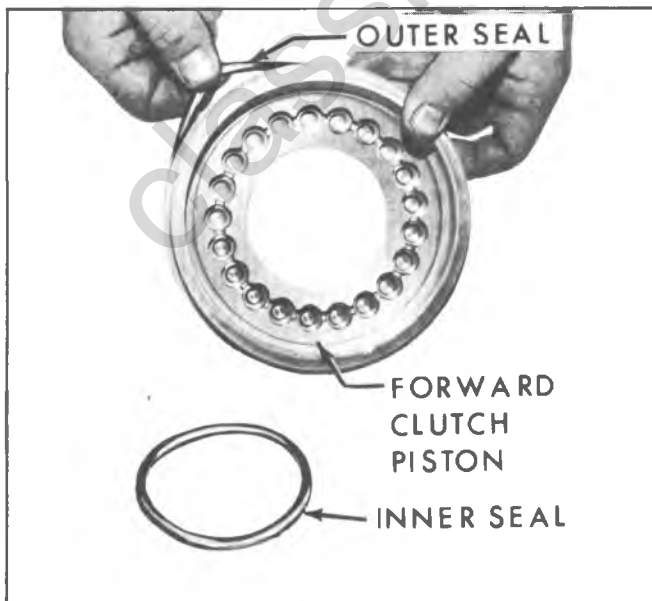


Fig. 75N--Removing Forward Clutch Piston Inner and Outer Seals

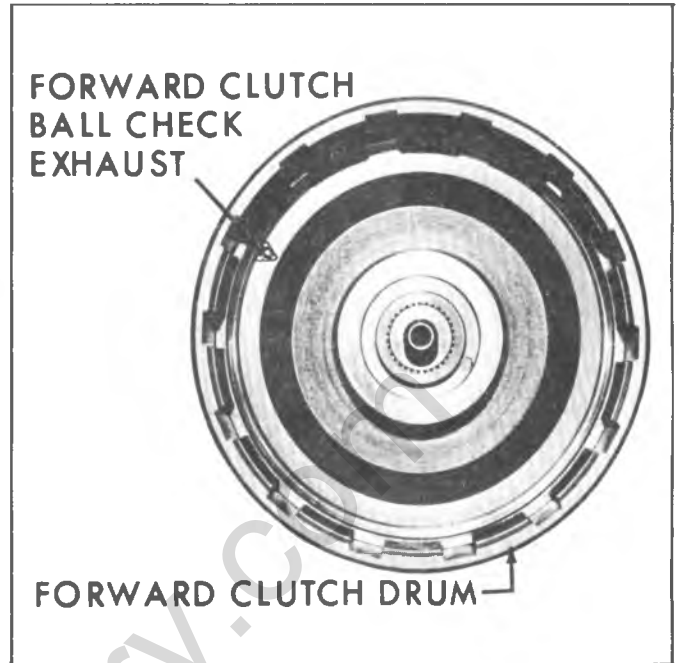


Fig. 76N--Forward Clutch Exhaust Check Ball

- b. Inspect splines for damage.
- c. Inspect ground bushing journals for damage.
- d. Inspect shaft for cracks or distortion.

NOTE: Input shaft and clutch housing are serviced separately.

Reassembly

1. Install new forward clutch inner piston seal and outer piston seal.

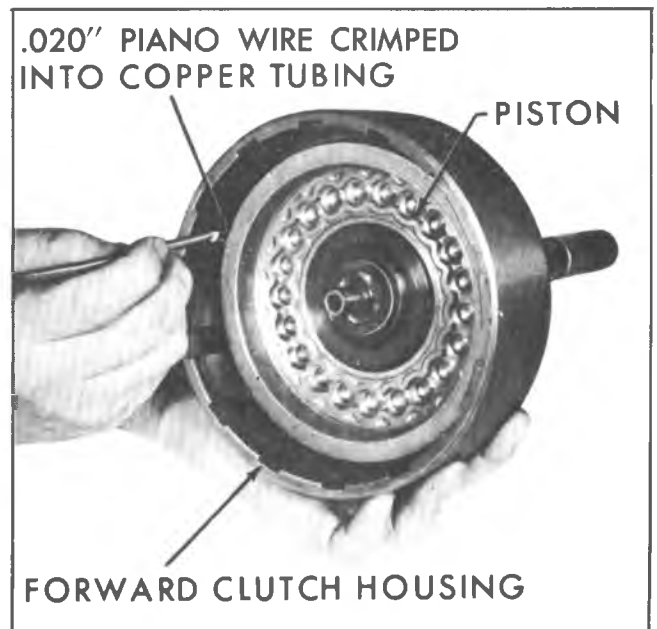


Fig. 77N--Installing Forward Clutch Piston

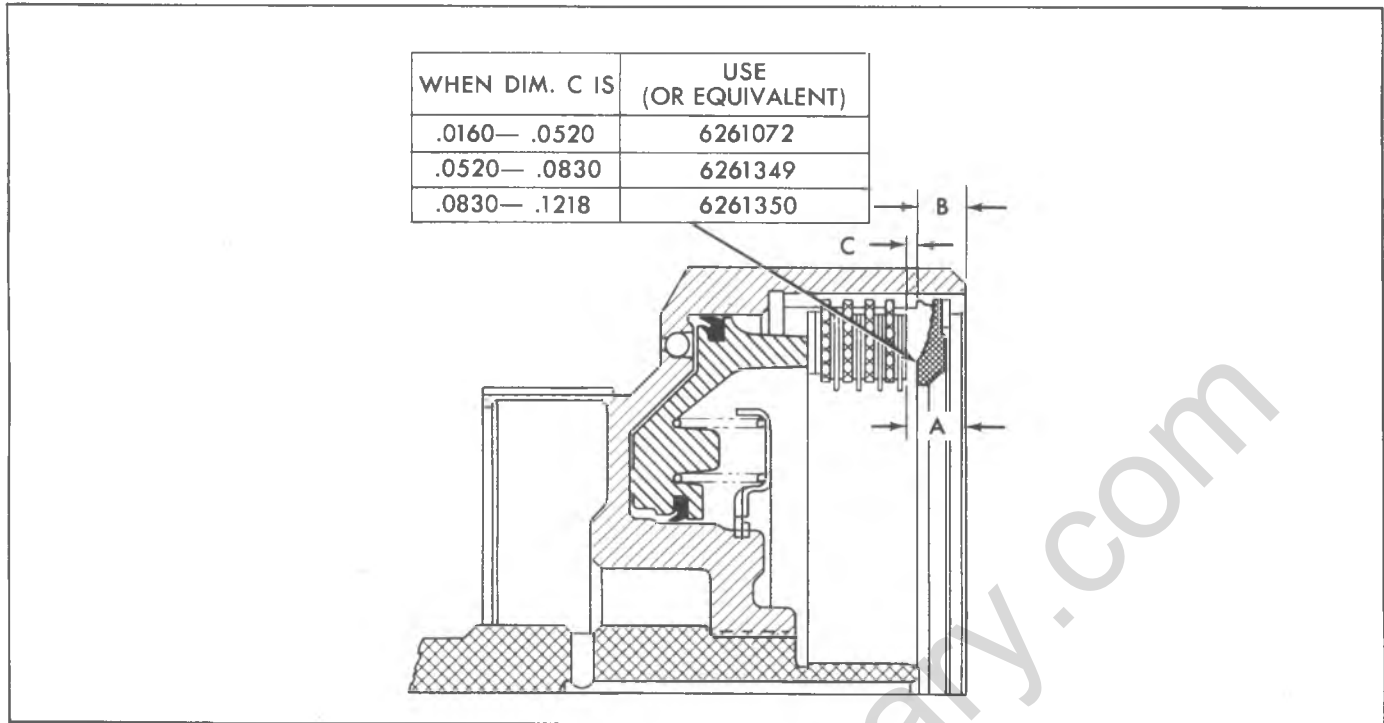


Fig. 78N--Determining Selective Fit for Forward Clutch Pressure Plate

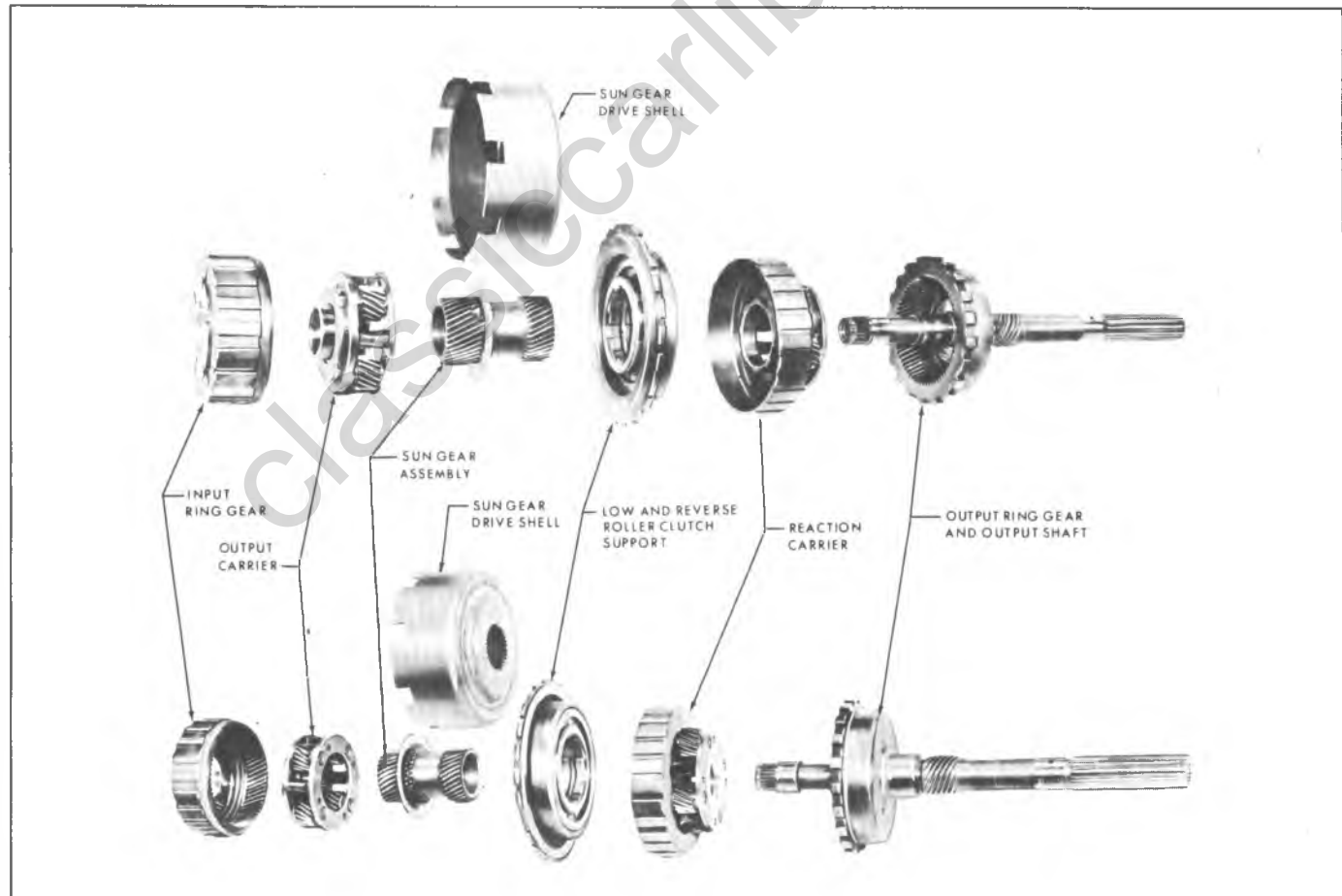


Fig. 79N--Planetary Gear Train--Exploded View

2. Install the forward clutch piston assembly with the aid of a feeler gauge or a piece of .020" piano wire crimped into copper tubing (fig. 77N).
3. Install twenty-one (21) clutch return coil springs.
4. Install spring retainer. Compress spring retainer and install retaining ring using tool J-23327-1 as shown on Figure 74N.
5. Lubricate with transmission fluid and install cushion spring face plates and steel separator plates, starting with the cushion spring and alternating steel and faced.
6. Install forward clutch pressure plate (selective fit) and retaining ring. Using chart on Figure 78N to select correct pressure plate (dimension C), measure distance from the top of clutch pack to the top of clutch drum (dimension A). Measure distance from the lower edge of the notch on the inner surface of the drum to the end of the drum (dimension B). Subtract B from A to get dimension C.

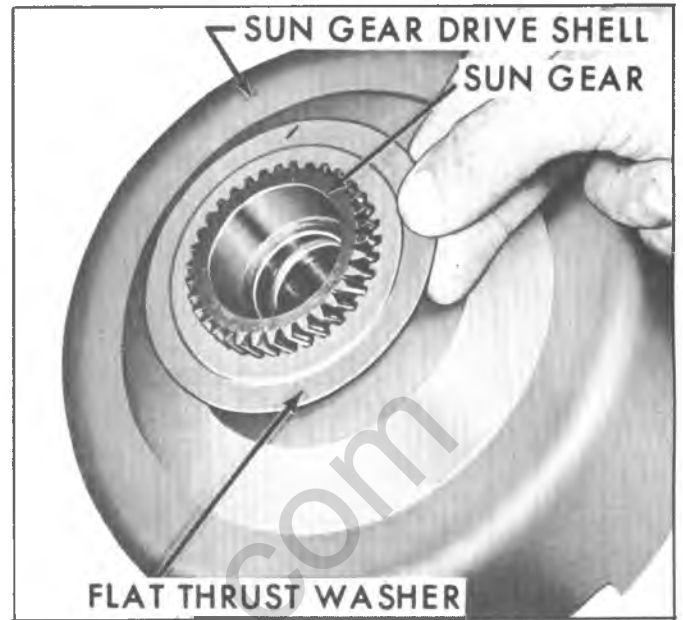


Fig. 81N--Removing Sun Gear to Drive Shell Rear Steel Thrust Washer

SUN GEAR AND SUN GEAR DRIVE SHELL (FIG. 79N)

Disassembly

1. Remove sun gear to sun gear drive shell rear retaining ring (fig. 80N).
2. Remove sun gear to drive shell flat rear steel thrust washer (fig. 81N).
3. Remove sun gear assembly from drive shell.
4. Remove sun gear to drive shell front retaining ring (fig. 82N). Discard retaining ring.

5. If bushing is to be replaced, refer to Figure 94N.

Inspection

Check gear and sun gear shell for damage or wear.

Assembly

1. Install new sun gear to drive shell front retaining ring.



Fig. 80N--Removing Sun Gear Drive Shell Rear Retaining Ring



Fig. 82N--Removing Sun Gear to Drive Shell Front Steel Thrust Washer

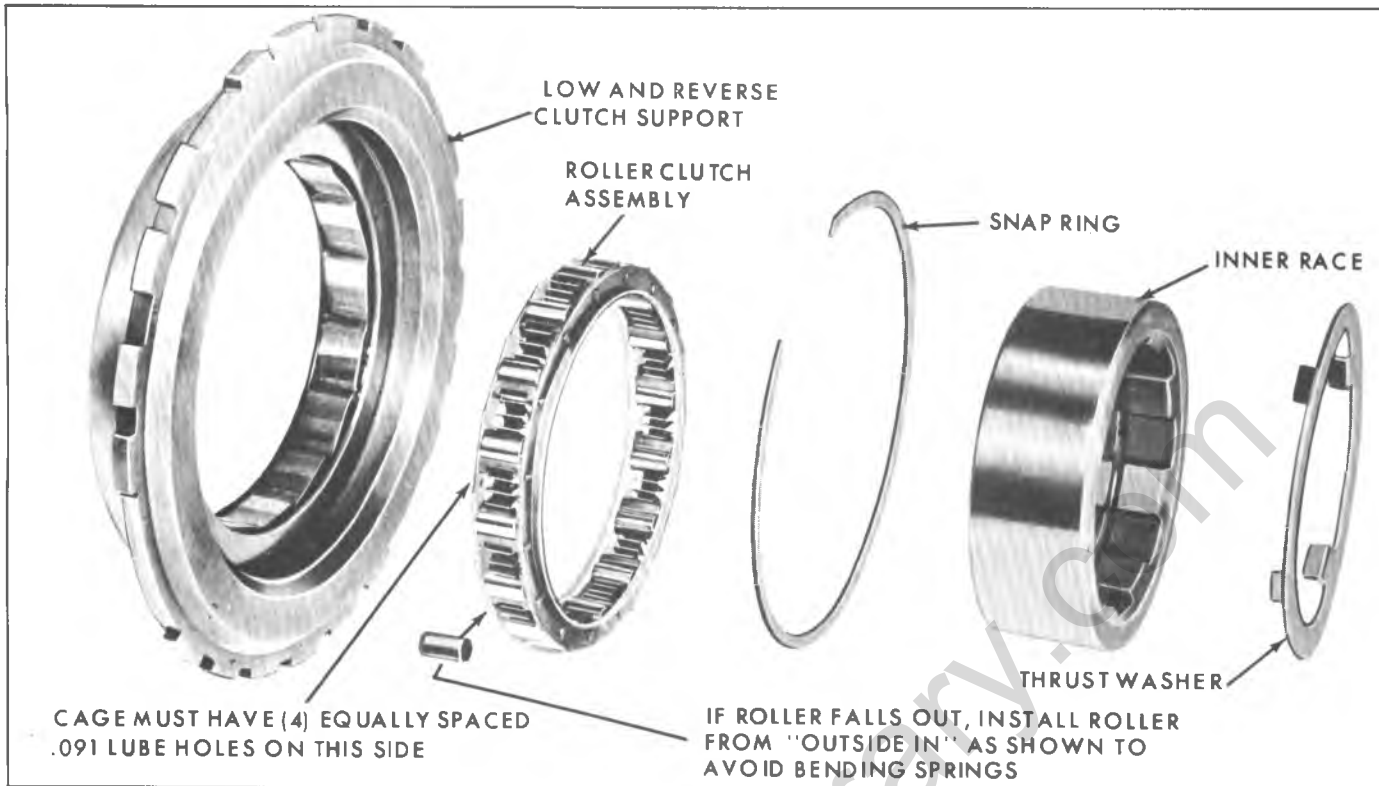


Fig. 83N--Low and Reverse Clutch Assembly--Exploded View

2. Install sun gear assembly into drive shell.
3. Install sun gear to drive shell flat steel thrust washer.
4. Install new sun gear to sun gear drive shell retaining ring.

NOTE: Do not stress front and rear retaining rings at installation.

LOW AND REVERSE ROLLER CLUTCH SUPPORT (FIG. 83N)

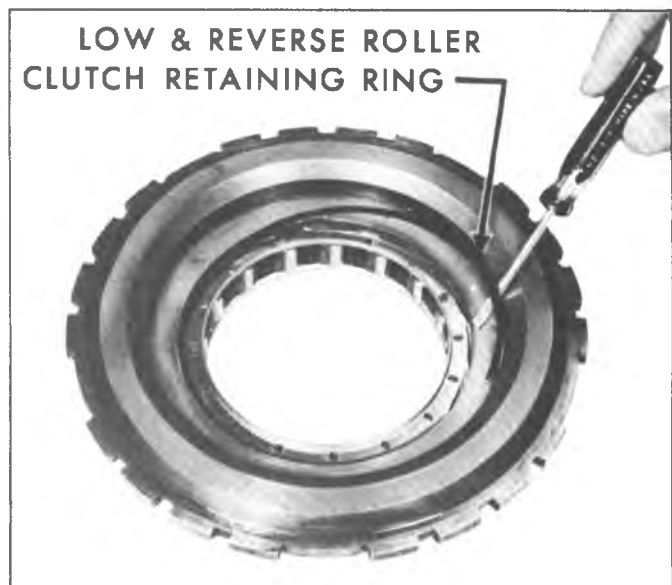
Disassembly

1. Remove low and reverse clutch to sun gear shell thrust washer.



LOW AND REVERSE OVERRUN CLUTCH RACE

Fig. 84N--Removing Overrun Clutch Inner Race



LOW & REVERSE ROLLER CLUTCH RETAINING RING

Fig. 85N--Removing Overrun Roller Clutch Retaining Ring

2. Remove low and reverse overrun clutch inner race from support (fig. 84N).
3. Remove low and reverse clutch roller clutch retaining ring (fig. 85N).
4. Remove low and reverse roller clutch assembly (fig. 86N).

Inspection

1. Inspect roller clutch inner and outer race for scratches and indentations.
2. Inspect rollers for wear and roller springs for distortion.

Assembly

1. Install low and reverse roller clutch assembly to inner race with oil holes toward rear of transmission.
2. Install low and reverse overrun clutch outer race.
3. Install low and reverse clutch to cam retaining ring.

NOTE: Low and reverse overrun clutch inner race should free wheel in the clockwise direction only.

GOVERNOR ASSEMBLY

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is serviced as a complete assembly. The driven gear can be serviced separately.

It is necessary to disassemble governor assembly in order to replace driven gear. Disassembly may also be

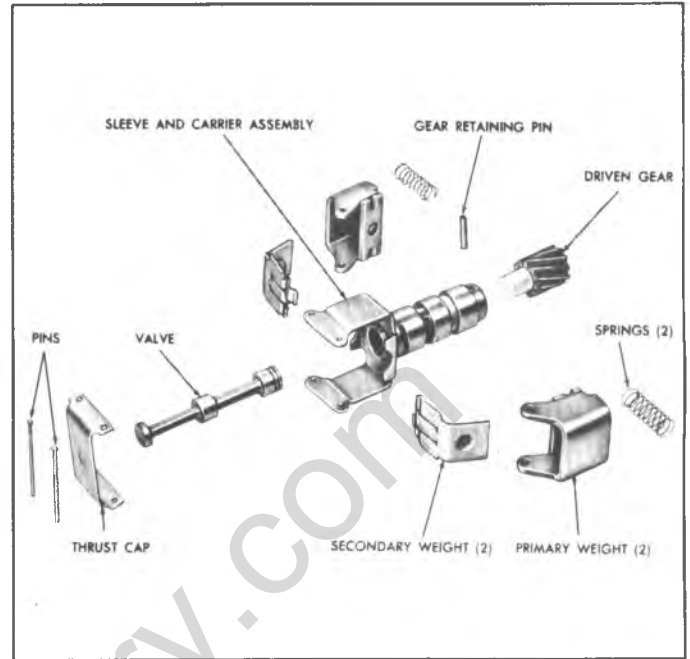


Fig. 87N--Governor Assembly--Exploded View Typical

necessary due to improper operation. In such cases, proceed as follows:

Disassembly

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights, and springs. Governor weights are interchangeable from side to side and need not be identified (fig. 87N).
2. Remove governor valve from governor sleeve. Be careful not to damage valve.
3. Perform following inspections and replace governor driven gear, if necessary.

Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring or galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs, or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect governor weight springs for distortion or damage.
9. Check governor weights for free operation in their retainers.



Fig. 86N--Removing Overrun Roller Clutch Assembly

10. Check valve opening at entry and exhaust (.020 inch minimum).

Governor Driven Gear Replacement

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

1. Drive out governor gear retaining split pin using small punch.
2. Support governor on 3/16 inch plates installed in exhaust slots of governor sleeve, place in arbor press, and with a long punch, press gear out of sleeve.
3. Carefully clean governor sleeve of chips that remain from original gear installation.
4. Support governor on 3/16 inch plates installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.
5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90 degrees from existing hole, center punch and then, while supporting governor in press, drill new hole through sleeve and gear using a standard (1/8 inch) drill.
6. Install split retaining pin.
7. Wash governor assembly thoroughly to remove any chips that may have collected.

Assembly

1. Install governor valve in bore of sleeve, large land end first.
2. Install governor weights and springs, and thrust cap on governor sleeve.
3. Align pin holes in thrust cap, governor weight assemblies and governor sleeve, and install new pins. Crimp both ends of pins to prevent them from falling out.
4. Check governor weight assemblies for free operation on pins.
5. Check governor valve for free movement in governor sleeve.

BUSHING REPLACEMENT

Extension Housing Bushing

Remove extension housing bushing from housing using tool J-21424-9 with drive handle J-8092. Install extension housing bushing in housing flush to .010 below seal counter bore surface using tool J-21424-9 with drive handle J-8092 (fig. 88N).

Output Shaft Bushing

With output shaft properly supported, remove bushing using remover J-9534-01 and slide hammer J-7004 (fig. 89N). Using tool J-23062-7, install bushing until tool bottoms on output shaft.

Case Bushing

With case properly supported, drive out bushing from rear of case using tool J-23062-1 and drive handle J-8092. Using tool J-23062-1 and drive handle J-8092 with extension J-21465-13, install bushing from interior of case to 3/16" from front surface with split in bushing located at governor pilot upper bore wall area.

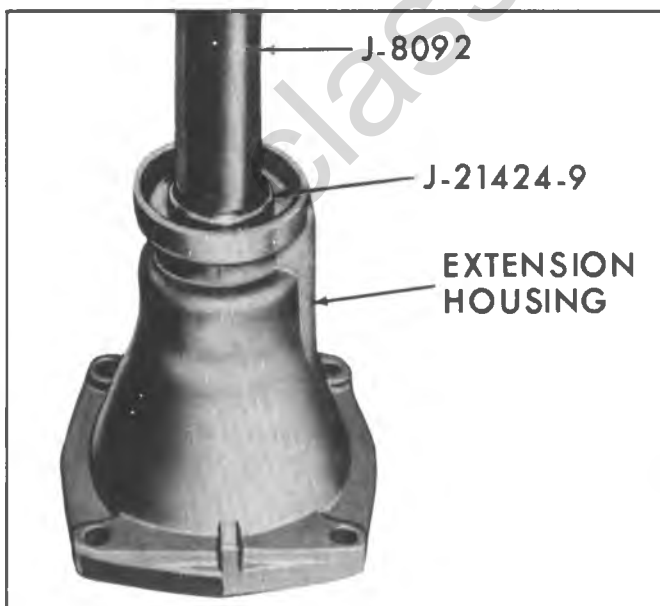


Fig. 88N--Installing Extension Housing Bushing

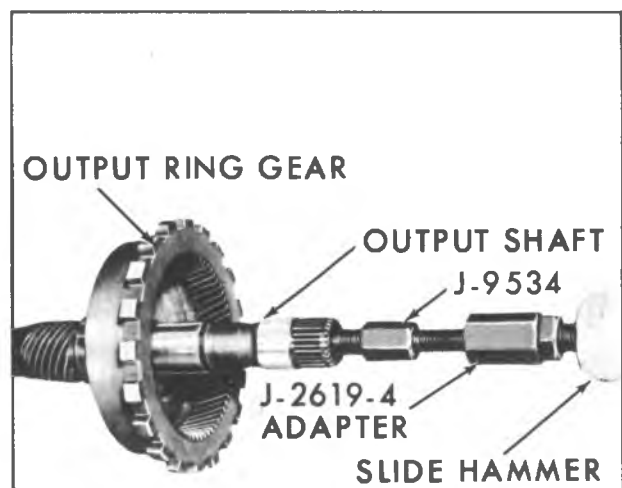


Fig. 89N--Removing Output Shaft Bushing

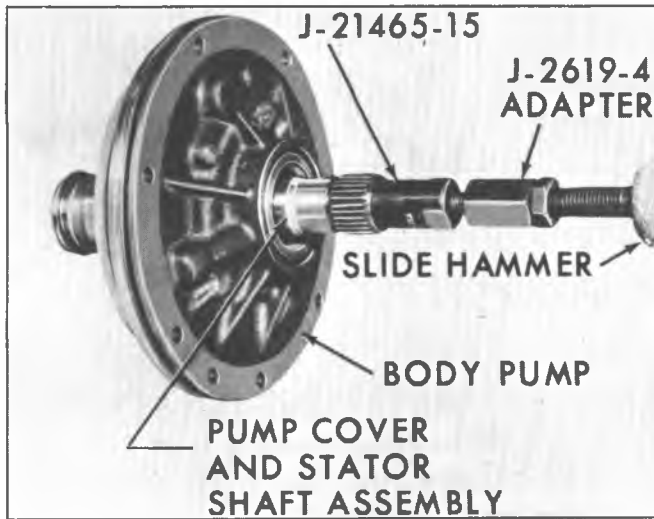


Fig. 90N--Removing Stator Shaft Front Bushing

Stator Shaft Front Bushing

With stator shaft properly supported, remove front bushing using tool J-21465-16 and slide hammer with adapter J-2619-01 (fig. 90N). Using tool J-21242-7 and drive handle J-8092, install bushing to .250" from face (fig. 91N).

Stator Shaft Rear Bushing

With stator shaft properly supported, remove front bushing (fig. 92N). Place tool J-21424-7 and drive handle J-8092 with extension J-21465-13 through front of stator shaft and drive out two (2) rear bushings. Using tool J-23062-2 and extension J-21465-13, install inner bushing to approximately 1-5/32" below front face and outer bushing 3/32" below front face (fig. 98N). Install new front bushing (fig. 91N).

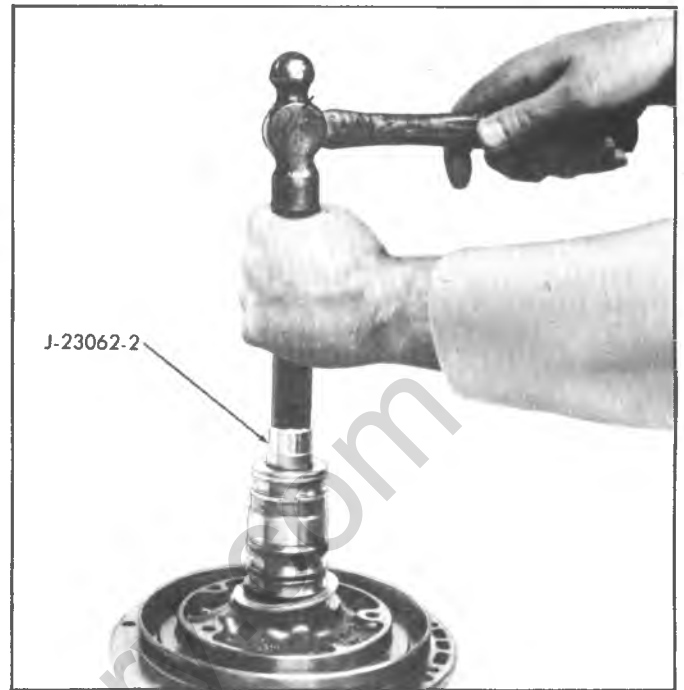


Fig. 92N--Installing Inner and Outer Stator Shaft Bushing

Input Ring Gear Bushing

With input ring gear properly supported, remove bushing using tool J-23062-5 and drive handle J-8092. Using tool J-23062-5 and drive handle J-8092, install bushing to approximately 1/16" below rear face inside gear end (fig. 93N).

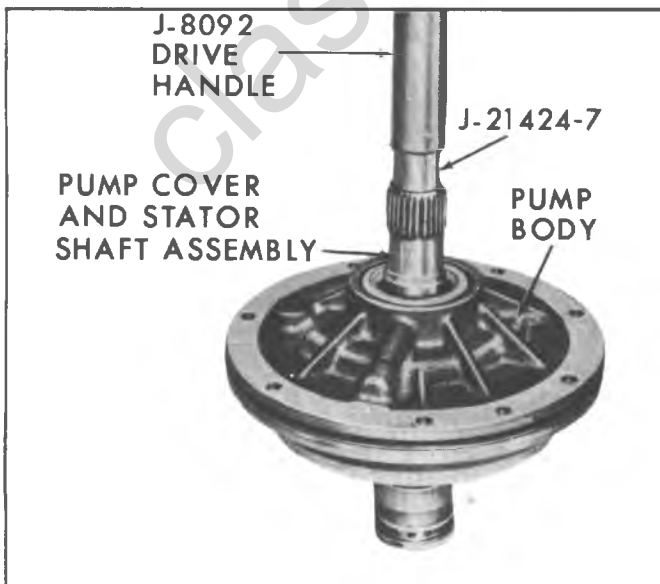


Fig. 91N--Installing Stator Shaft Front Bushing

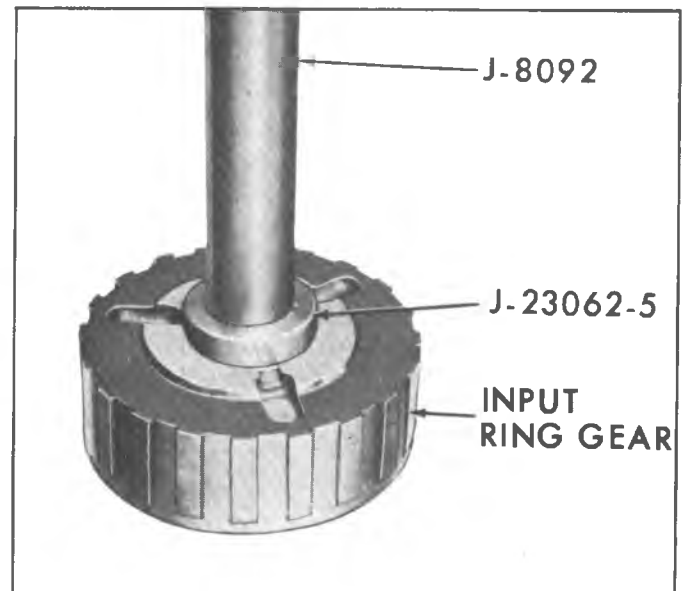


Fig. 93N--Installing Input Ring Gear Support Bushing

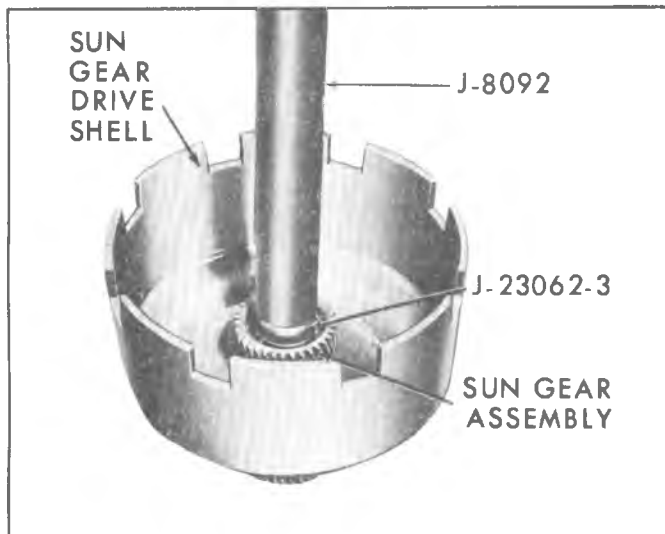


Fig. 94N--Installing Sun Gear Bushings

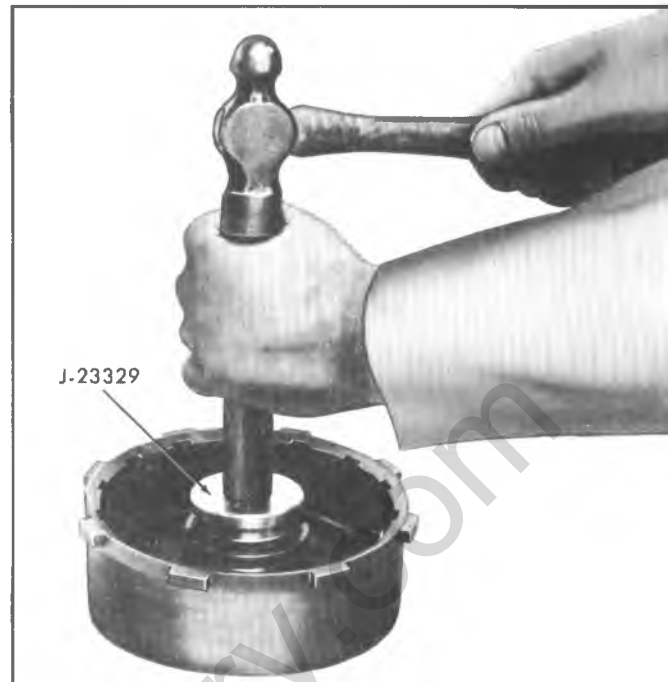


Fig. 96N--Installing Direct Clutch Drum Bushing

Sun Gear Bushing

With sun gear properly supported, remove two (2) sun gear bushing using tool J-23062-3 and drive handle J-8092 with extension J-21465-13. Using tool J-23062-3 and drive handle J-8092, install sun gear bushings to .010" below surface at either end (fig. 94N).

Reaction Carrier Bushing

With reaction carrier properly supported, remove bushing using tool J-23062-3 and drive handle J-8092. Using tool J-23062-3 and drive handle J-8092, install bushing flush to or .010" below inside face.

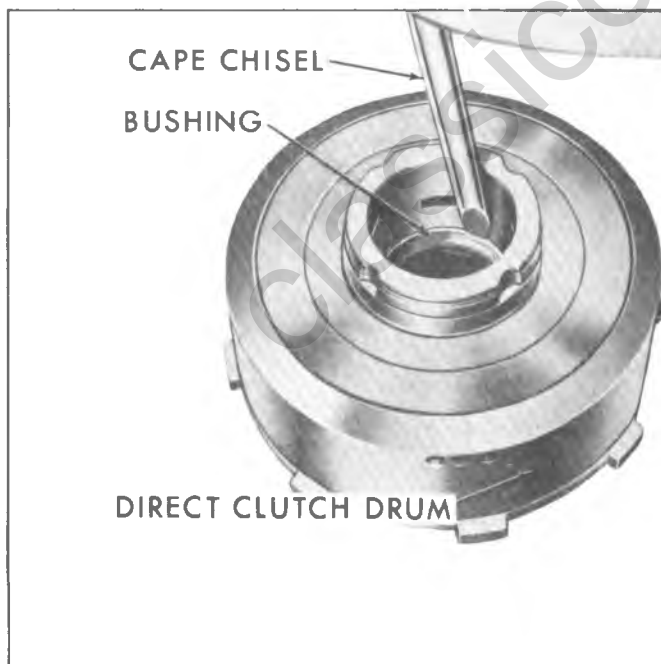


Fig. 95N--Removing Direct Clutch Drum Bushing

Direct Clutch Bushing

With direct clutch drum properly supported, remove bushing (fig. 95N). Using tool J-23329 and drive handle J-8092, install direct clutch drum bushing (fig. 96N).

TRANSMISSION ASSEMBLY

When servicing transmission, use only transmission fluid or petroleum jelly as lubricants to retain bearings or races during assembly. Lubricate all bearings, seal rings and clutch plates prior to assembly.

Transmission Internal Components

1. Install low and reverse clutch piston assembly with notch in piston installed adjacent to parking pawl.
2. Install seventeen (17) piston return (coil) springs.
3. Install spring retainer and retaining ring. Using tool J-23327, compress return seat so spring retainer retaining ring may be installed. Install output ring gear rear thrust bearing in case.
4. Install output ring gear on output shaft.

5. Install reaction carrier to output ring gear front thrust washer (3 tangs) into output ring gear support.
6. Install output shaft assembly into case.
7. Install reaction carrier assembly into output ring gear and shaft assembly.
8. Lubricate and install low reverse clutch steel reaction plates and face plates, starting with a steel plate and alternating with face plates. Install low and reverse clutch support retainer (anti-clunk) spring.

NOTE: Notch in steel separator plates should be placed toward bottom of case.

9. Install low and reverse clutch support assembly with position of notch with low and reverse clutch support retainer (anti-clunk) spring as shown on Figure 97N.

IMPORTANT: Make certain the splines on inner race of the roller clutch align with splines on reaction carrier.

10. Install low and reverse roller clutch inner race to sun gear shell thrust washer.
11. Install low and reverse clutch support to case snap ring with anti-clunk spring between gap.
12. Install rear thrust washer and sun gear drive shell assembly.
13. Install output carrier assembly.
14. Install input ring gear rear thrust washer.
15. Install input ring gear.

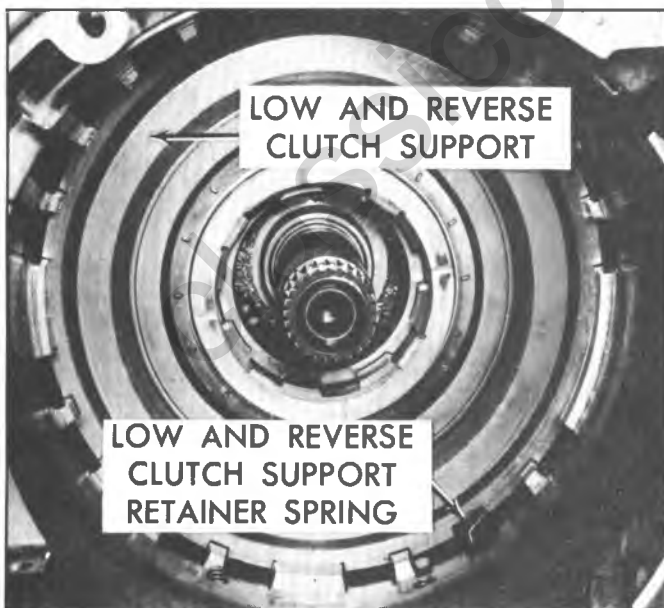


Fig. 97N--Installing Low and Reverse Clutch Support Assembly

16. Install new input ring gear to output shaft snap ring.
17. Install input gear front thrust washer.
18. Install direct clutch assembly, and special thrust washer to forward clutch assembly.

CAUTION: Do not over stress snap ring.

19. Install direct and forward clutch assemblies into case.

CAUTION: Make certain forward clutch face plates are positioned over input ring gear and the tangs on direct clutch housing are installed into slots on the sun gear drive shell.

20. Install intermediate servo.
21. Install intermediate band. Make sure band ends are properly located on adjusting screw and servo rod ends. Turn adjusting screw into case until end of screw has picked up slot in band lug.
22. To check for proper thickness of selective fit thrust washer between the oil pump cover and direct clutch assembly, proceed as follows:
 - a. Install selective fit thrust washer, (fig. 98N) oil pump gasket and using guide studs from J-3387 set install oil pump. Install two pump to case bolts.
 - b. Position transmission so that output shaft points down. Install a dial indicator as shown in Figure 99N. Zero the indicator.
 - c. Lift up on the transmission output shaft and observe the total indicator movement.

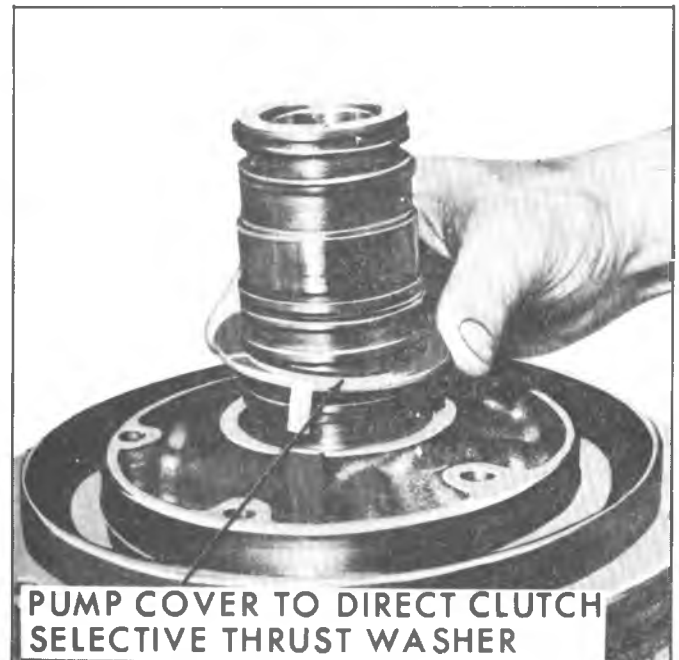


Fig. 98N--Pump Cover to Direct Clutch Selective Thrust Washer

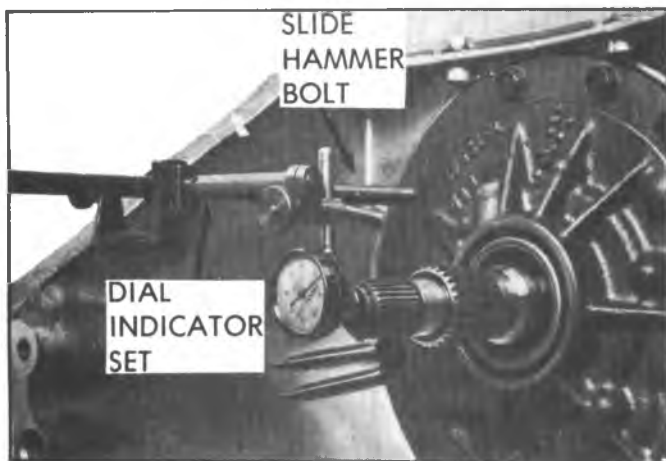


Fig. 99N--Checking End Play for Proper Thrust Washer Selection

- d. The indicator should read .032" to .064". If the reading is within limits, the proper selective fit washer is being used. If the reading is not within limits, it will be necessary to remove the pump and change to a thicker or thinner selective fit thrust washer, as required to obtain the specified clearance. Repeat the above checking procedure.

NOTE: Selective fit thrust washers are available in thicknesses of .065"-.067", .082"-.084" and .099"-.101".

23. Install new pump assembly to case gasket.
24. Install new pump assembly square cut oil seal ring.
25. Install guide pins into case.
26. Install pump assembly into case. Install attaching bolts with new washer type seals.

IMPORTANT: If the input shaft can not be rotated as the pump is being pulled into place, the direct and forward clutch housings have not been properly installed to index the faced plates with their respective parts. This condition must be corrected before the pump is pulled into place. After pump assembly is completely installed, adjust intermediate band. Tighten adjusting screw to 30 inch-pounds and then back-off 3 complete turns. While holding screw in position, tighten locknut to 15 foot-pounds.

Speedometer Drive Gear and Extension

1. Place speedometer drive gear retaining clip into hole in output shaft.
2. Heat a new speedometer drive gear using a heat lamp or suitable heat method.
3. Align slot in speedometer drive gear with retaining clip and install.

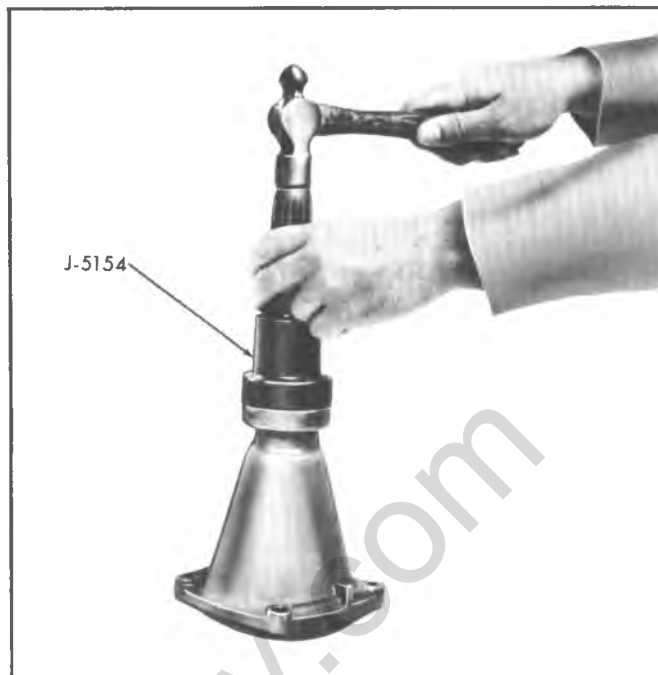


Fig. 100N--Installing Extension Housing Seal

4. Install extension housing to case square cut "O" ring seal.
5. Attach extension housing to case using attaching bolts. Torque to 25 foot pounds.
6. If necessary, install a new extension housing seal using seal installer J-5154 or J-21426 (fig. 100N).

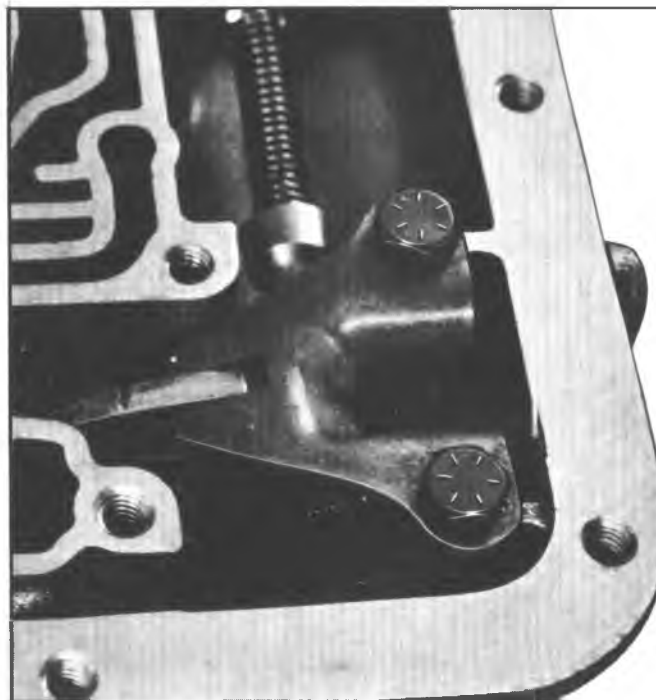


Fig. 101N--Park Lock Bracket Special Bolt Identification

Manual Linkage

1. If necessary, install a new manual shaft to case lip seal using 3/4" diameter rod, seat seal in case.
2. Install parking pawl, tooth toward the inside of case, into case.
3. Install parking pawl shaft into case and through parking pawl.
4. Install parking pawl shaft retainer plug. Drive into case using a 3/8" dia. rod, until retainer plug is .130" to .170" below face of case, then stake in three places.
5. Install parking pawl disengaging spring, square end hooked on pawl.
6. Install park lock bracket using two special bolts (GM 300M, 6 mark on head or equivalent) and torque bolts to 29 foot pounds (fig. 101N).
7. Install range selector inner lever to parking pawl actuator rod.
8. Install actuating rod under the park lock bracket and parking pawl.
9. Install manual shaft through case and range selector inner lever.
10. Install retaining nut on manual shaft. Torque to 30 foot pounds.
11. Install manual shaft to case spacer clip.

Valve Body, Oil Pan and Gasket

1. Install oil pump pressure screen and governor feed screen.
2. Install four (4) check balls into proper transmission case pockets (fig. 15N).
3. Install valve body transfer plate lower valve and gasket.
4. Install upper valve gasket.
5. Install intermediate servo return spring.

6. Install valve body. Connect manual control valve link to range selector inner lever. Torque bolts in random sequence to 130 inch pounds.
 7. Install transfer support plate and torque bolts to 130 inch pounds.
 8. Connect detent control valve wire to detent valve actuating lever, then attach lever to valve body.
 9. Install detent roller and spring assembly to valve body.
 10. Align lube holes in suction screen with those in valve body and install screen assembly gasket and screen.
- . pounds in succession until bolts maintain torque specification.

NOTE: If a new oil pan is being installed, transfer production code number on right side of old pan to new pan.

Governor and Vacuum Modulator

1. Install governor assembly, cover and seal and retainer wire.
2. Install vacuum modulator valve.
3. Install vacuum modulator and retainer clip. Torque bolt to 130 inch pounds.

NOTE: Position retainer with tangs pointing toward modulator.

1-2 Accumulator (Refer to Figures 49N and 50N)

1. Install 1-2 accumulator piston assembly.
2. Install 1-2 accumulator spring.
3. Install new "O" ring seal in groove in case before installing cover.
4. Install 1-2 accumulator cover and retaining ring using tool J- 23069.

TURBO HYDRA-MATIC 350 TRANSMISSION

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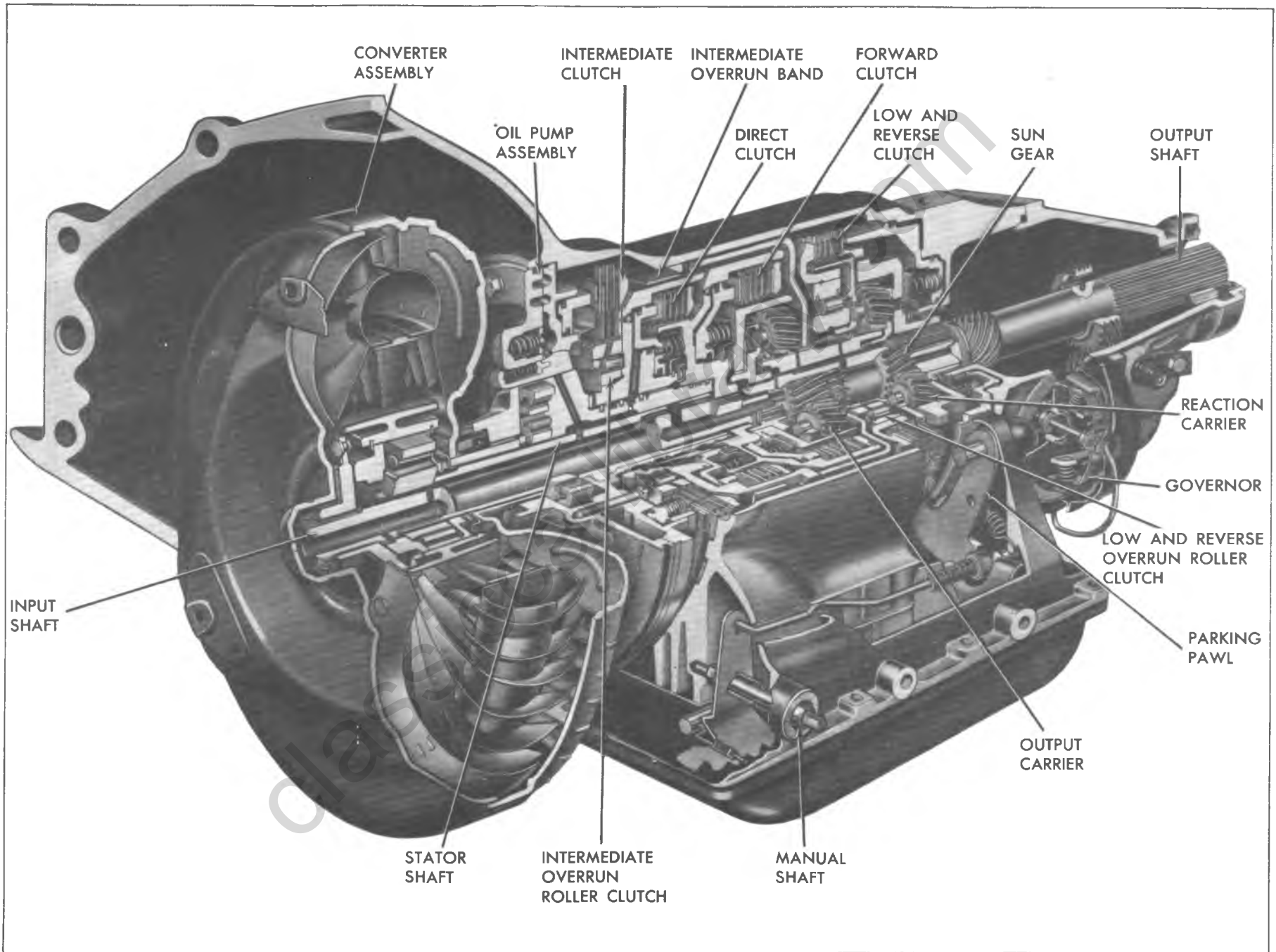


Fig. 1M--Turbo Hydra-Matic 350 Sectioned View

TRANSMISSION DISASSEMBLY AND REASSEMBLY

DISASSEMBLY

1. Install Holding Fixture J-8763-02 on transmission and place into Holding Tool base J-3289-20 with converter facing up (fig. 2M).

NOTE: Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the case should be thoroughly cleaned to prevent the possibility of dirt entering the transmission internal mechanism. During disassembly, all parts should be thoroughly cleaned in cleaning fluid and then air dried. Wiping cloths or rags should not be used to dry parts.

CAUTION: Do not use solvents which could damage rubber seals or clutch facings.

2. With transmission in holding fixture remove torque converter assembly.
3. Remove vacuum modulator assembly attaching bolt and retainer.
4. Remove vacuum modulator assembly, "O" ring seal, and modulator valve from case (fig. 3M). Discard "O" ring.

REMOVAL OF EXTENSION, SPEEDOMETER DRIVEN GEAR, GOVERNOR, OIL PAN AND SCREEN

1. Remove four housing to case attaching bolts.

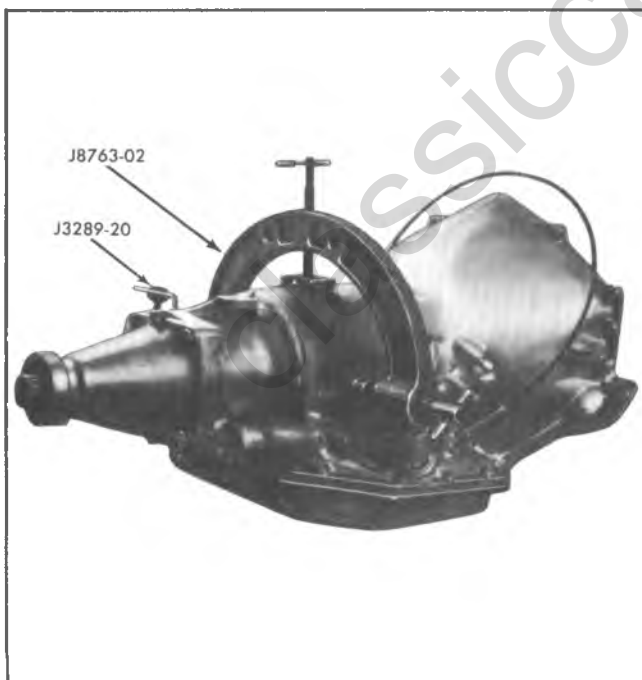


Fig. 2M--Transmission in Holding Fixture

2. Remove extension housing from case and remove square cut "O" ring seal from extension housing.
3. Remove extension housing lip seal using screw driver (fig. 4M).
4. If extension housing bushing is to be replaced, collapse bushing (fig. 5M) and refer to Figure 94M for installation.
5. Install speedometer drive gear remover tool J-21427-01 and J- 9539 bolts with J-8105 or suitable

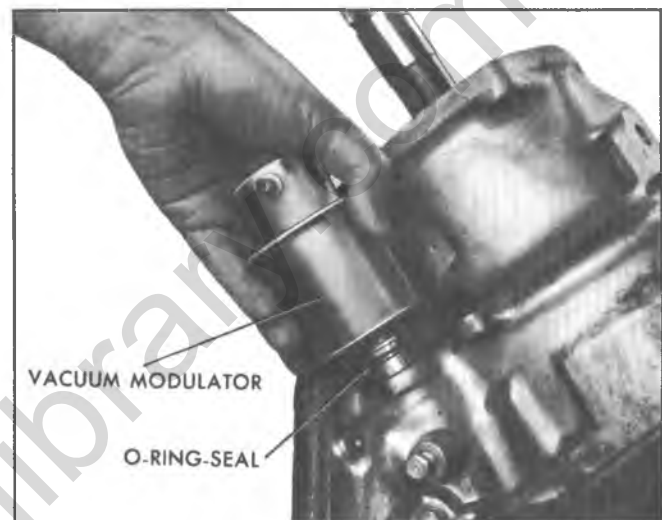


Fig. 3M--Removing Vacuum Modulator Assembly

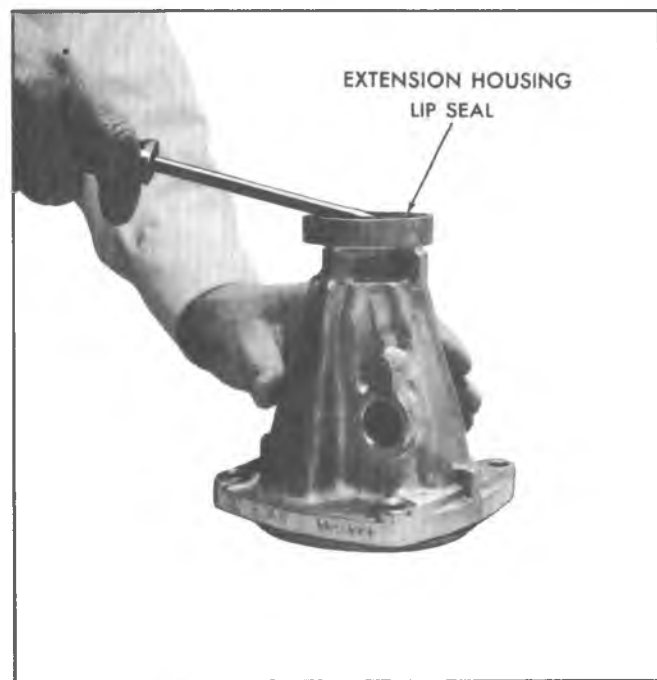


Fig. 4M--Removing Extension Housing Lip Seal

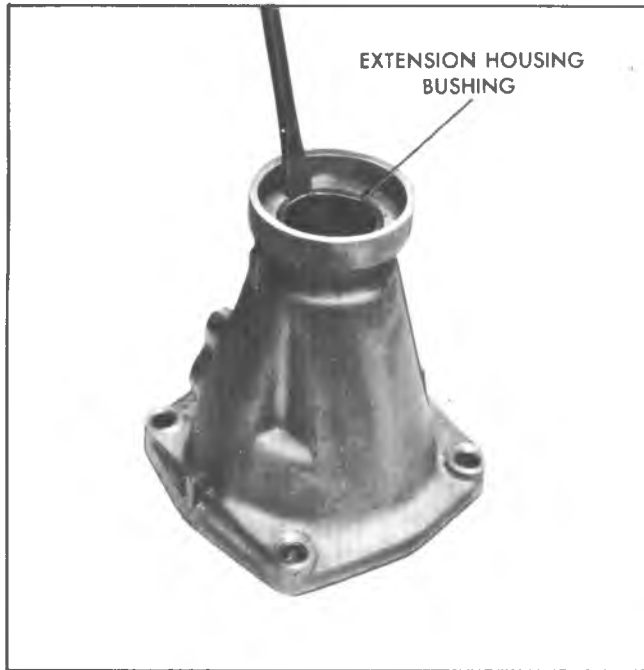


Fig. 5M--Removing Extension Housing Bushing



Fig. 7M-Governor Cover and "O" Ring Seal

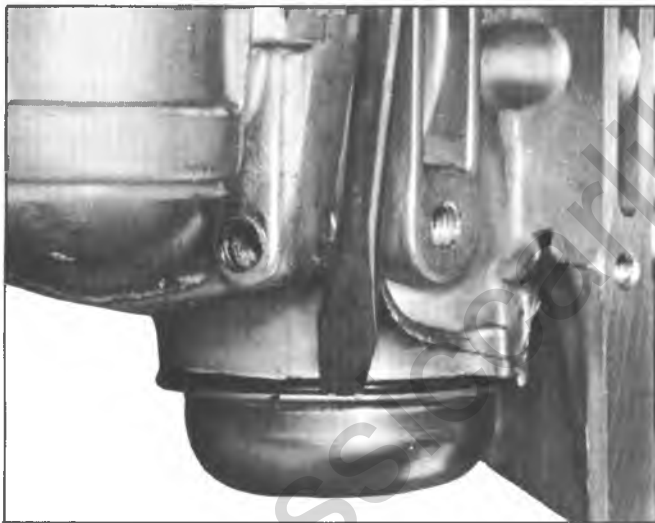


Fig. 6M--Removing Governor Cover

puller on output shaft and remove speedometer drive gear. Remove retaining clip.

6. Remove governor cover retainer with a screwdriver.
7. Using a screwdriver and hammer, gently tap along governor cover lip (fig. 6M), remove governor cover and "O" ring seal (fig. 7M). Discard seal.

CAUTION: Do not attempt to pry the screwdriver between the case and governor cover as this could cause damage to the case.

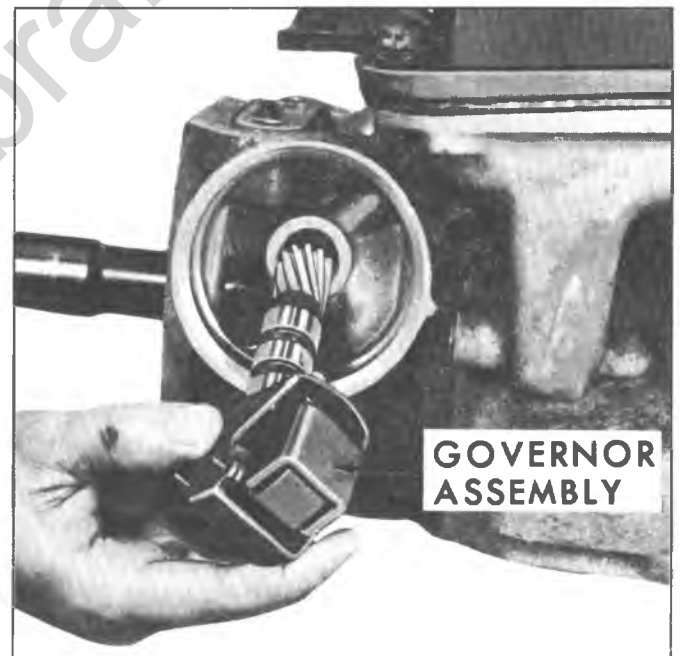


Fig. 8M--Removing Governor from Case

8. Withdraw governor assembly from case (fig. 8M) and check governor bore and governor sleeve for scoring.



Fig. 9M--Removing Transmission Oil Pan

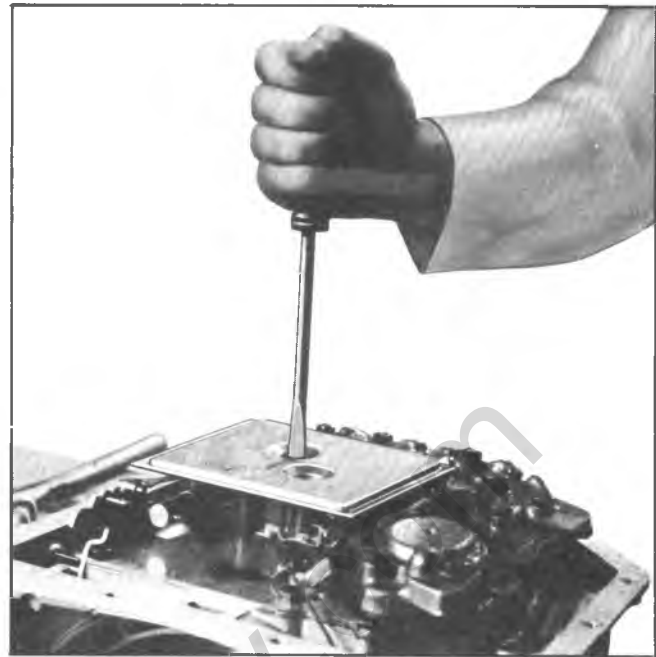


Fig. 10M--Removing Oil Pump Suction Screen (Strainer) from Valve Body

9. Remove oil pan attaching screws (fig. 9M), oil pan, and gasket. Discard gasket.
10. Remove oil pump suction screen (strainer) to valve body attaching screws (fig. 10M).
11. Remove oil pump screen (strainer) and gasket from valve body.

REMOVAL OF VALVE BODY AND LINKAGE

1. Remove detent spring and roller assembly from valve body. Remove valve body to case attaching bolts (fig. 11M).
2. Remove manual control valve link from range selector inner lever. Remove detent control valve link from detent actuating lever (fig. 12M). Refer to page 7A-37 for valve body disassembly.
3. Remove transfer plate support bolts. Remove transfer support plate (fig. 13M).
4. Remove upper gasket, valve body transfer (spacer) plate and valve body transfer (spacer) plate to case gasket (fig. 14M).
5. Remove four (4) check balls from correct passages in case face (fig. 15M).
6. Remove oil pump pressure screen from oil pump pressure hole in case (fig. 16M).

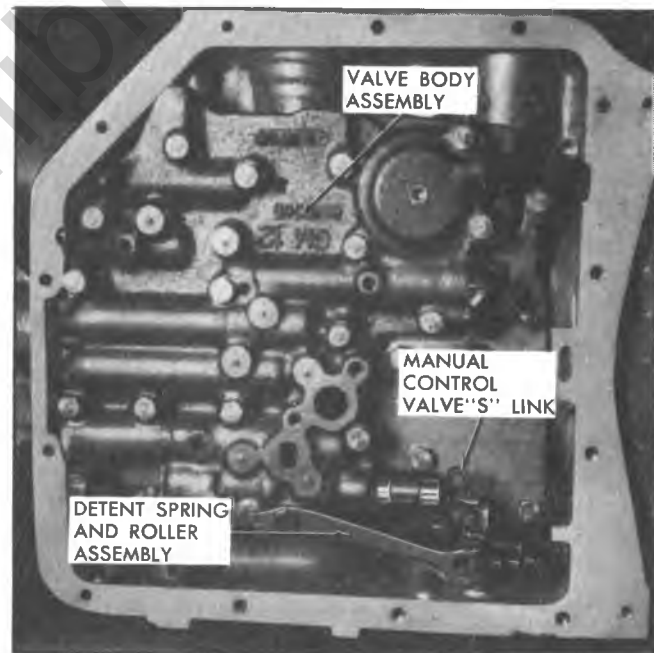


Fig. 11M--Detent Spring and Roller Assembly



Fig. 12M--Removing Manual Control Valve Link, Valve Body and Detent Actuating Lever

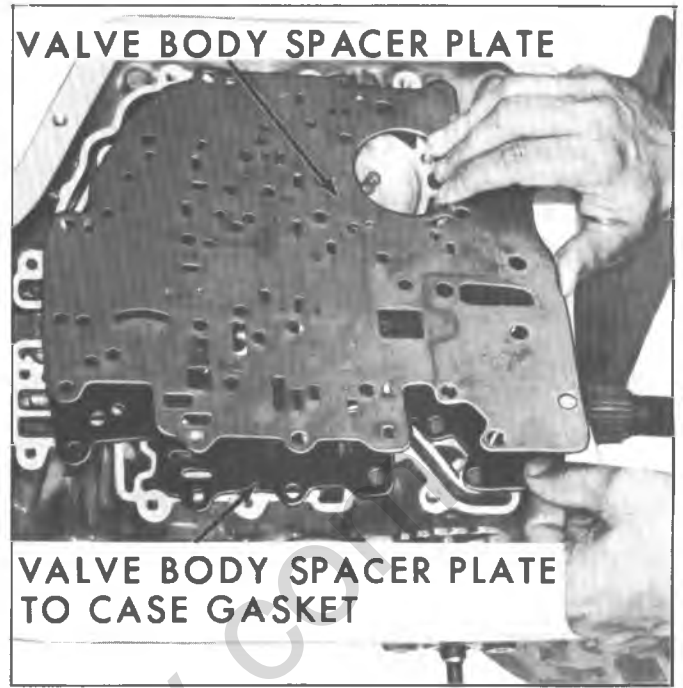


Fig. 14M--Removing Valve Body Transfer (Spacer) Plate and Gasket

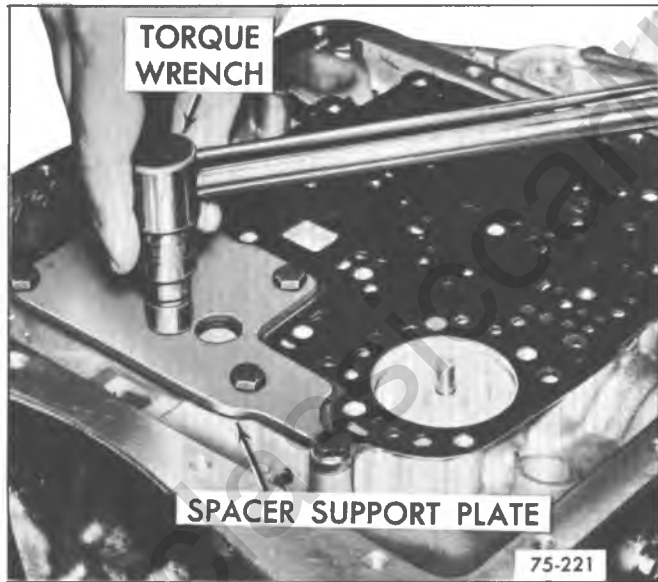


Fig. 13M--Removing Transfer (Spacer) Support Plate

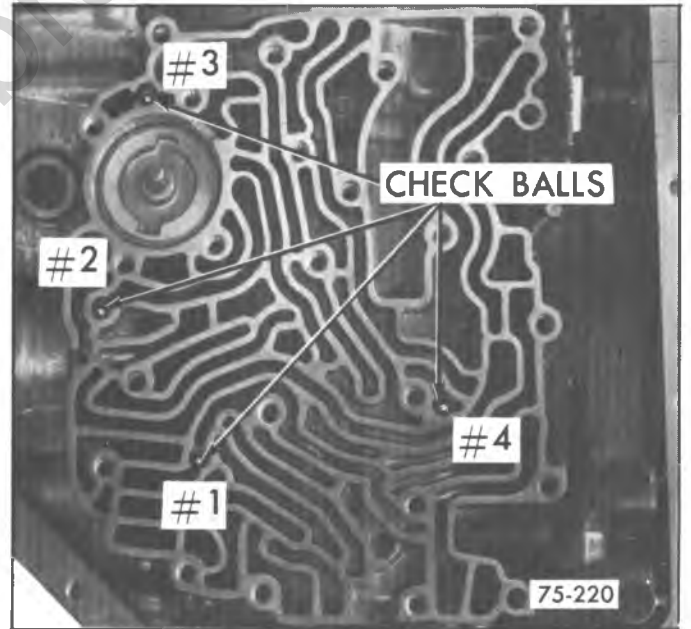


Fig. 15M--Check Ball Four (4) Locations

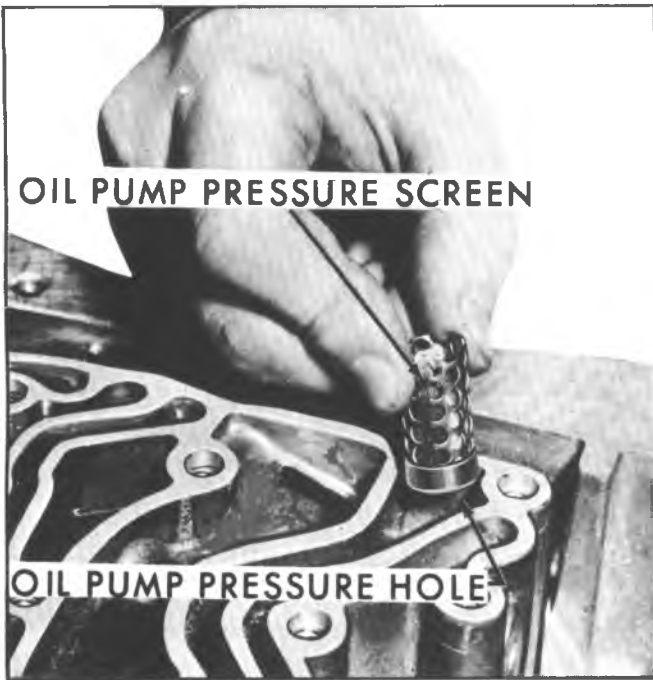


Fig. 16M--Removing Oil Pump Pressure Screen

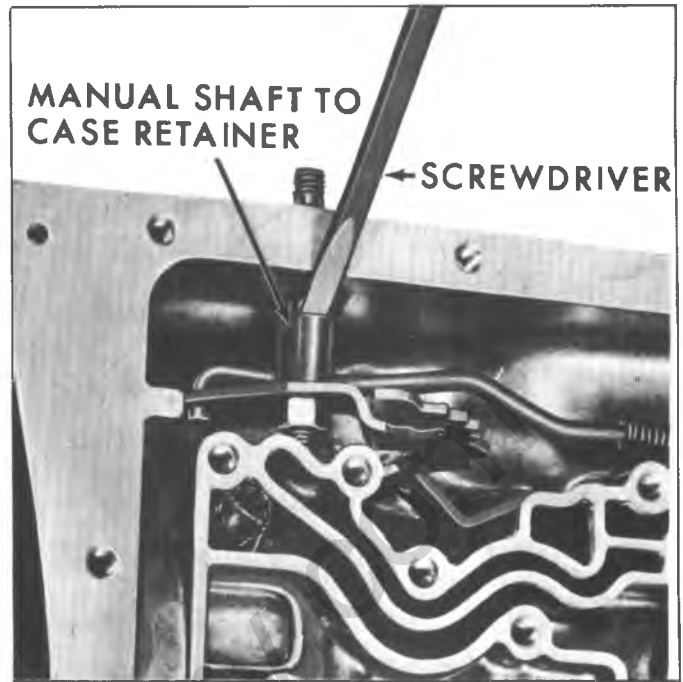


Fig. 18M--Removing Manual Shaft to Case Retainer

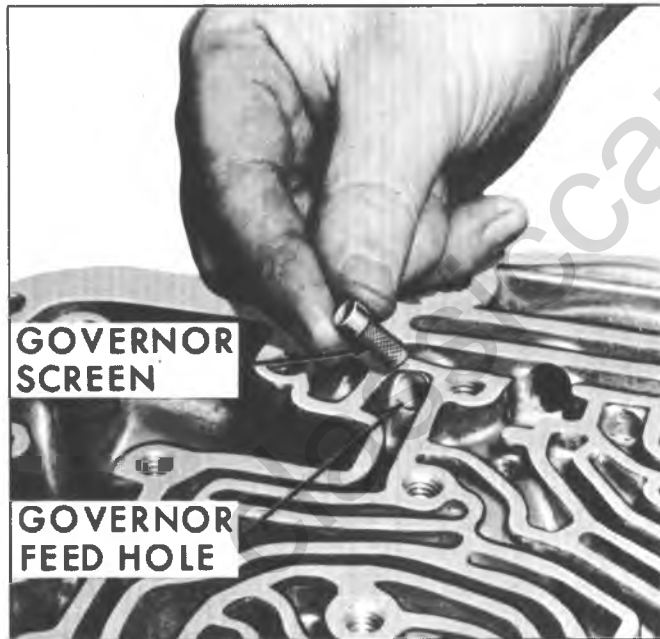


Fig. 17M--Removing Governor Feed Screen

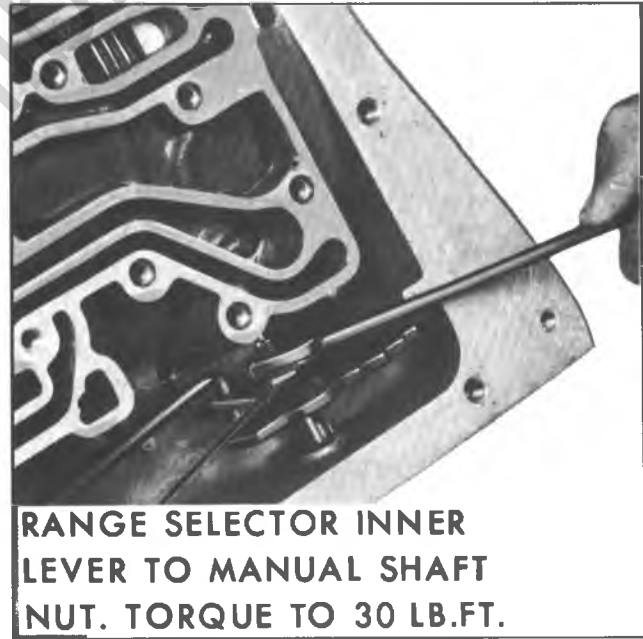


Fig. 19M--Loosening Nut Holding Range Selector Inner Lever to Manual Shaft

7. Remove governor feed screen from governor feed hole (drive oil) in case (fig. 17M).
NOTE: On JA and JH models, there are two governor feed screens.
8. Remove manual shaft to case retainer with screwdriver (fig. 18M).

9. Loosen nut holding range selector inner lever to manual shaft (fig. 19M).
10. Remove range selector inner lever from manual shaft. Remove manual shaft from case. Remove inner lever and parking pawl actuator rod from case. Disassemble inner lever from parking pawl actuator rod (fig. 20M).

11. Remove manual shaft to case lip seal (fig. 21M).
12. Remove parking lock; lock bracket (fig. 22M). (Special Bolts).
13. Remove parking pawl disengaging spring (fig. 23M).



Fig. 20M--Removing Manual Shaft and Inner Lever and Parking Pawl Actuator Rod from Case

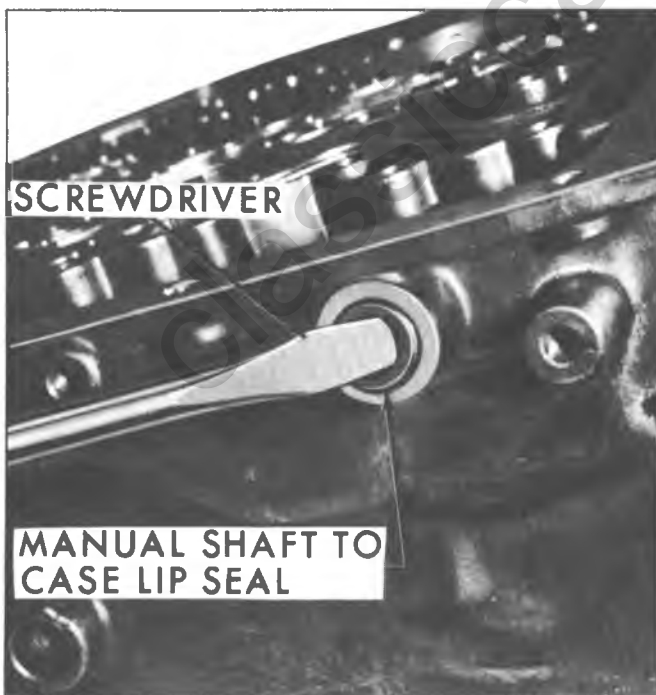


Fig. 21M--Removing Manual Shaft to Case Lip Seal

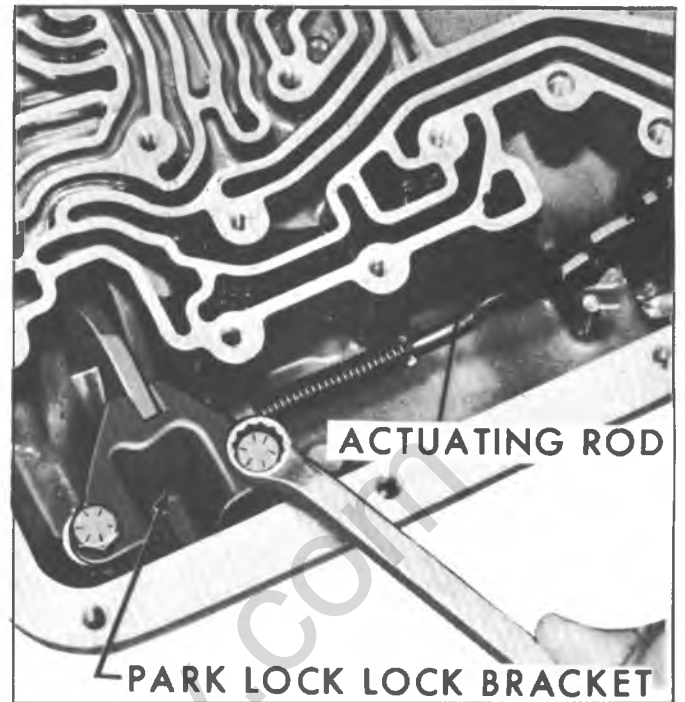


Fig. 22M--Removing Park Lock, Lock Bracket

14. Remove parking pawl shaft retaining plug, parking pawl shaft, and parking pawl (fig. 24M) if replacement is required.

NOTE: The parking pawl shafts retaining plug may be removed by using a bolt extractor.



Fig. 23M--Removing Parking Pawl Disengaging Spring

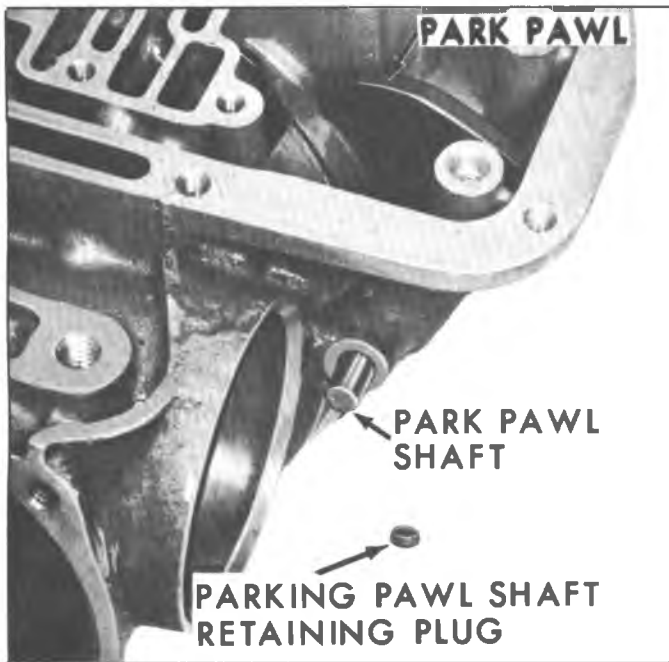


Fig. 24M--Parking Pawl Shaft Retaining Plug, Parking Pawl Shaft and Parking Pawl

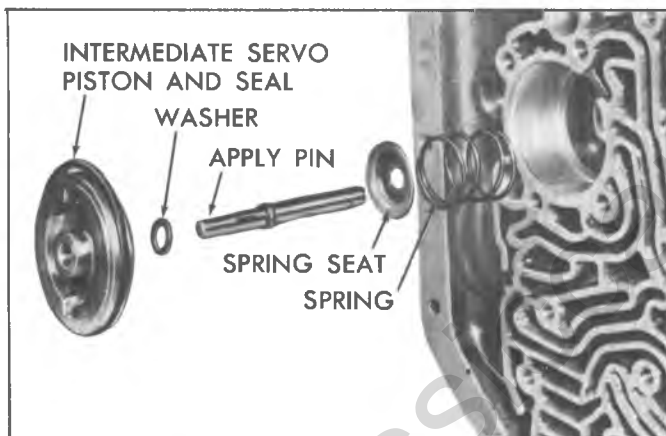


Fig. 25M--Intermediate Servo Piston and Related Parts



Fig. 26M--Removing Pump Attaching Bolts

15. Remove intermediate servo piston and seal ring. Remove washer, spring seat and apply pin (fig. 25M).

REMOVAL OF OIL PUMP AND INTERNAL CASE COMPONENTS

1. Remove eight (8) pump attaching bolts with washer type seals (fig. 26M).
2. Install two (2) threaded slide hammers J-7004 into threaded holes in pump body and remove pump assembly from case (fig. 27M). Discard pump gasket.



Fig. 27M--Removing Pump from Case



Fig. 28M--Removing Intermediate Clutch Cushion Spring

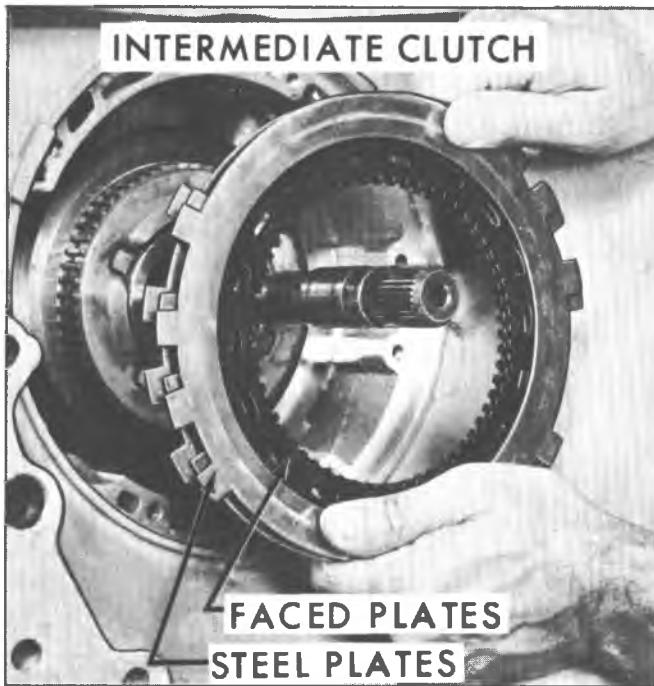


Fig. 29M--Removing Intermediate Clutch Plates



Fig. 31M--Removing Intermediate Overrun Brake Band

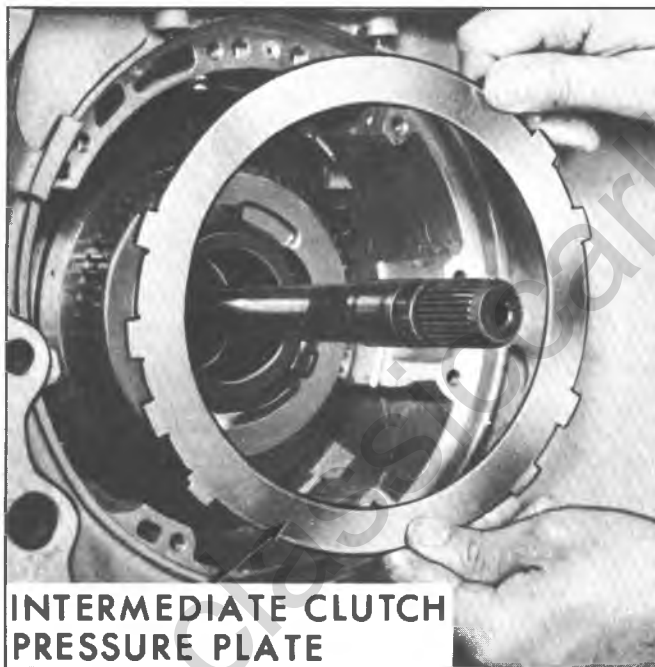


Fig. 30M--Removing Intermediate Clutch Pressure Plate

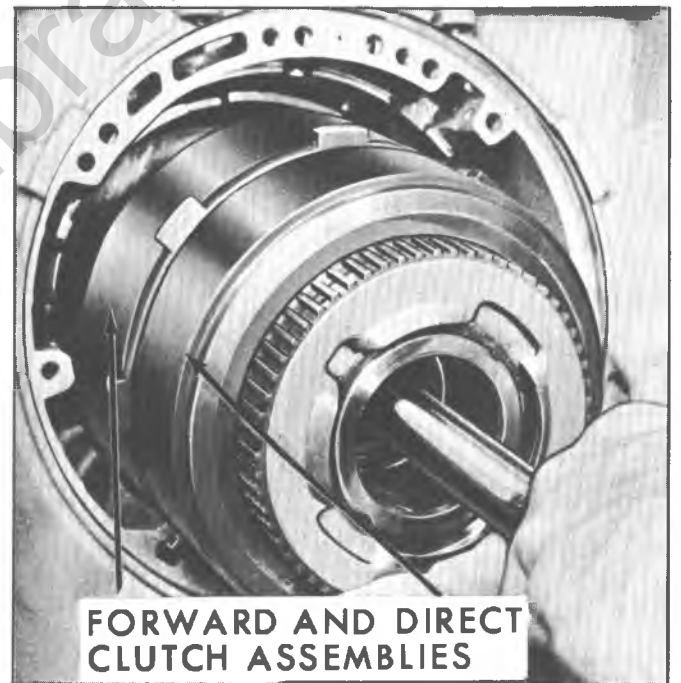


Fig. 32M--Removing Direct and Forward Clutch Assemblies

3. Remove intermediate clutch cushion spring (fig. 28M).
4. Remove intermediate clutch drive plates and steel reaction plates (fig. 29M).
5. Remove intermediate clutch pressure plate (fig. 30M).
6. Remove intermediate overrun brake band (fig. 31M).
7. Remove direct and forward clutch assemblies from case (fig. 32M).

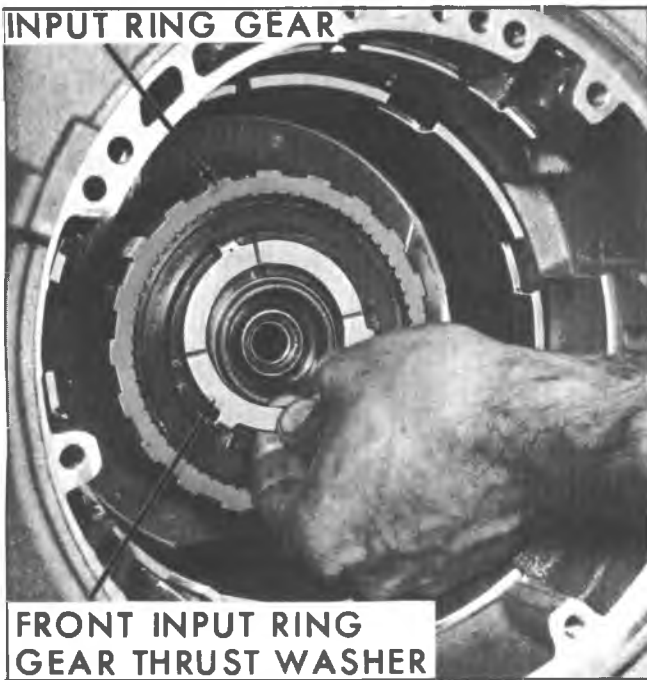


Fig. 33M--Removing Input Ring Gear Front Thrust Washer

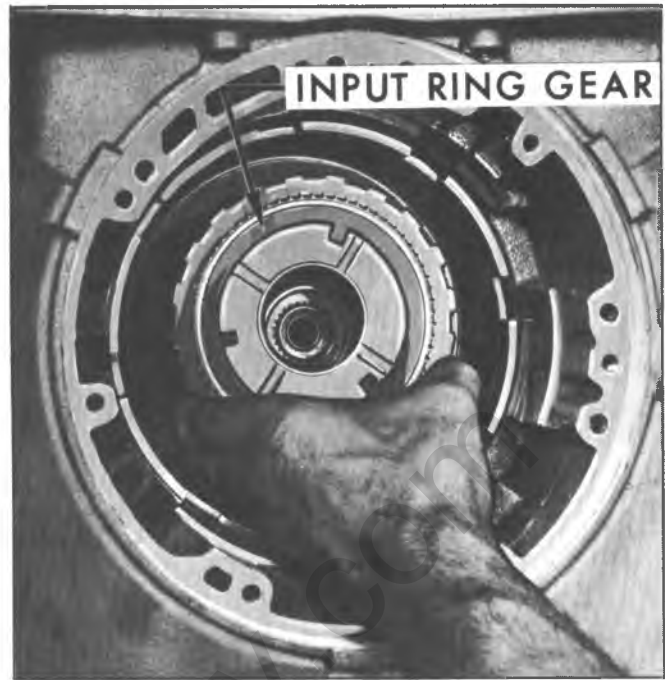


Fig. 35M--Removing Input Ring Gear

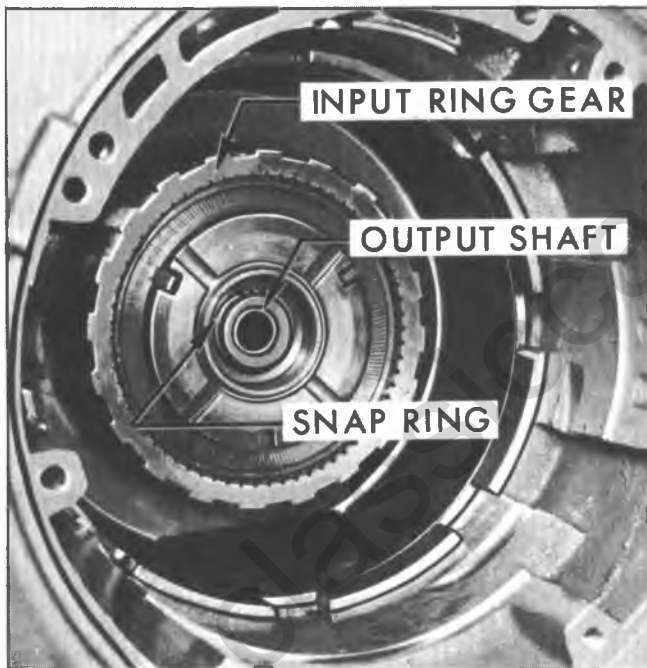


Fig. 34M--Removing Input Ring Gear to Output Shaft Snap Ring

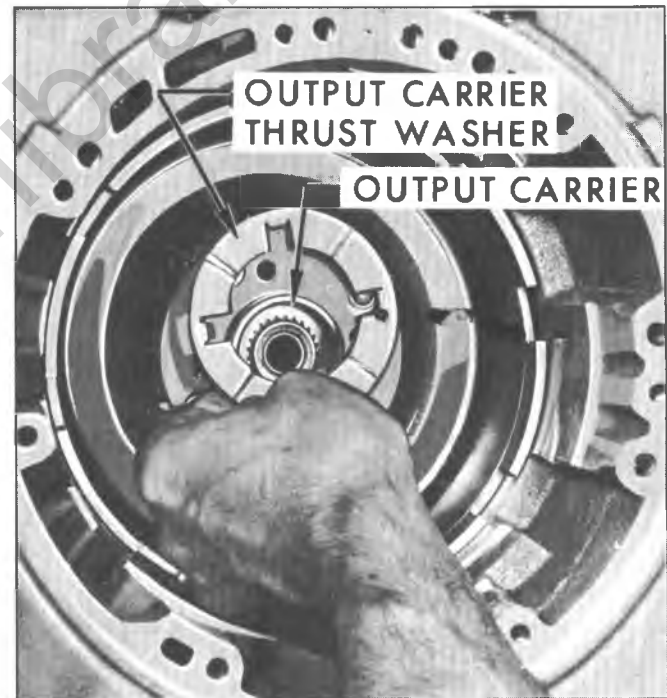


Fig. 36M--Removing Input Ring Gear Rear Thrust Washer

8. Remove input ring gear front thrust washer (fig. 33M).
NOTE: Washer has 3 tangs.
9. Remove input ring gear to output shaft snap ring (fig. 34M).

10. Remove input ring gear (fig. 35M).
11. Remove input ring gear rear (output carrier) thrust washer (fig. 36M).

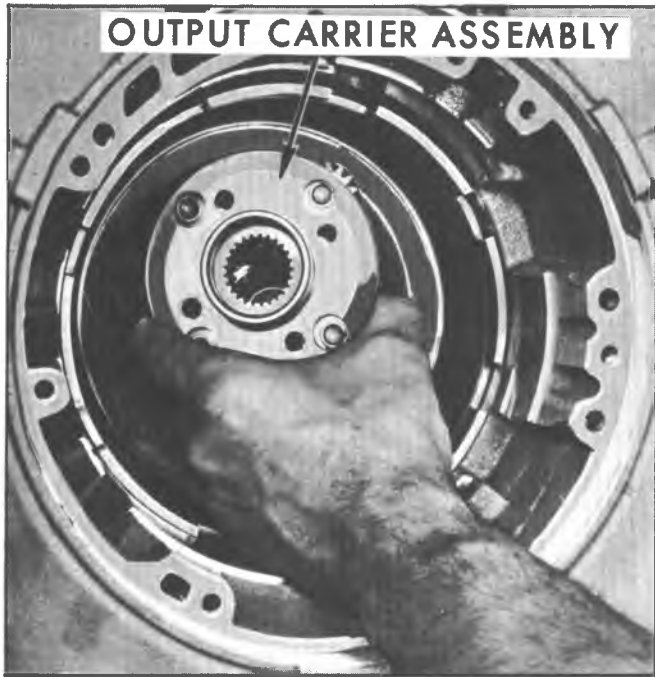


Fig. 37M--Removing Output Carrier Assembly

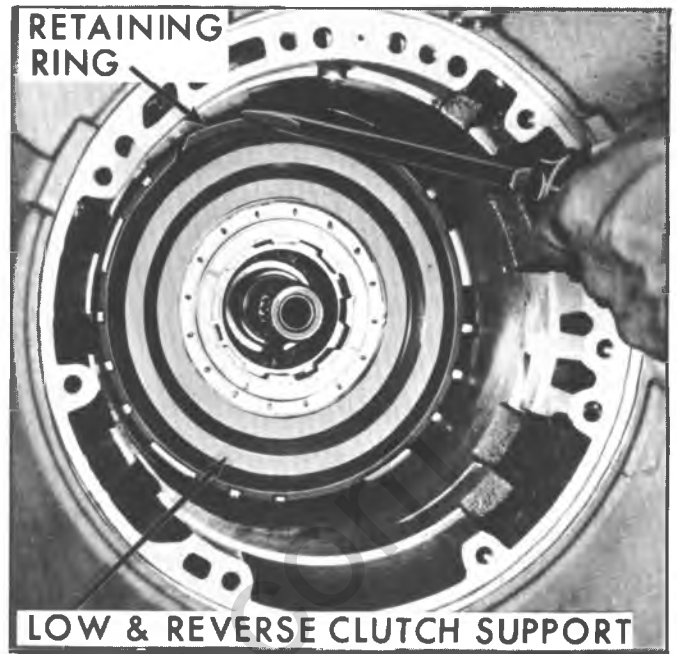


Fig. 39M--Removing Low and Reverse Clutch Support Retaining Ring



Fig. 38M--Removing Sun Gear Drive Shell

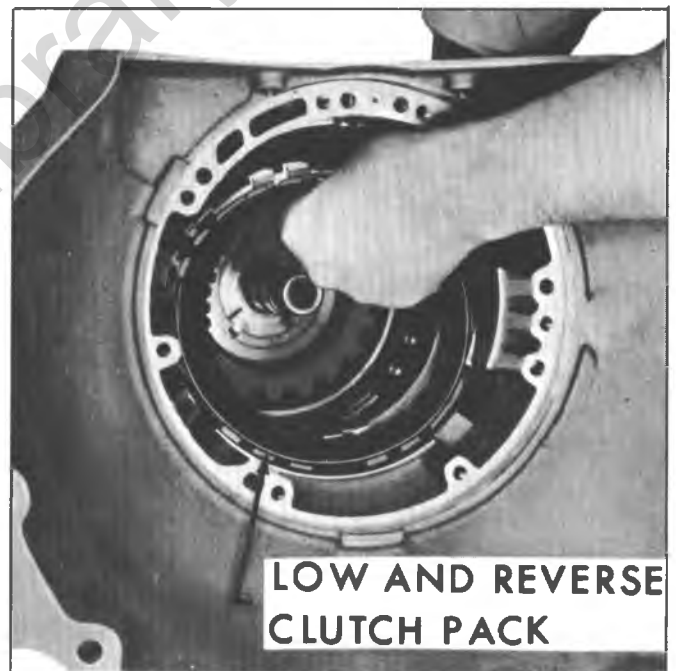


Fig. 40M--Removing Low and Reverse Clutch Pack

12. Remove output carrier assembly (fig. 37M).
13. Remove sun gear drive shell assembly (fig. 38M).
14. Remove low and reverse roller clutch support to case retaining ring (fig. 39M).

15. Remove low and reverse clutch support and race assembly and anti-clunk spring.
16. Remove low and reverse clutch faced plates and steel reaction plates (fig. 40M).

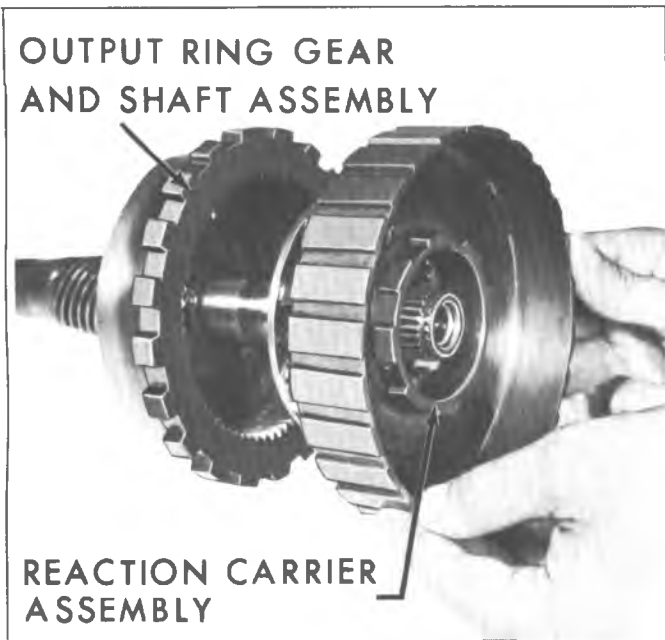


Fig. 41M--Removing Reaction Carrier Assembly

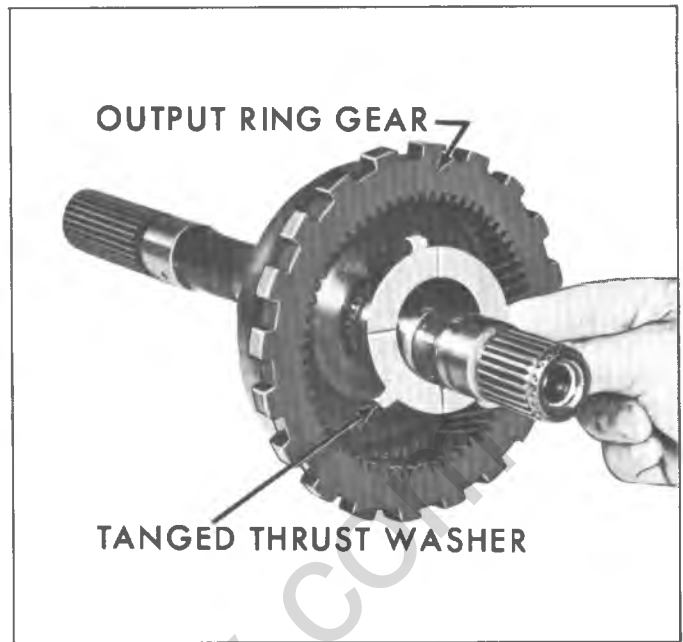


Fig. 43M--Removing Output Ring Gear Tanged Thrust Washer

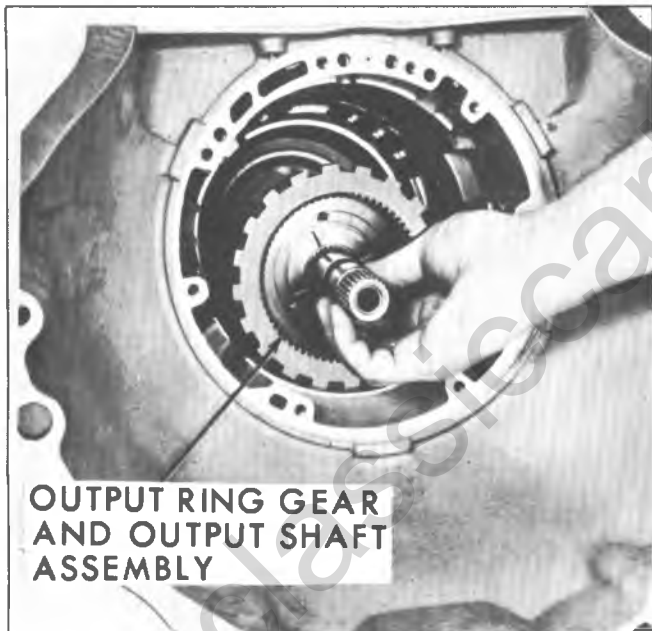


Fig. 42M--Removing Output Ring Gear and Shaft Assembly

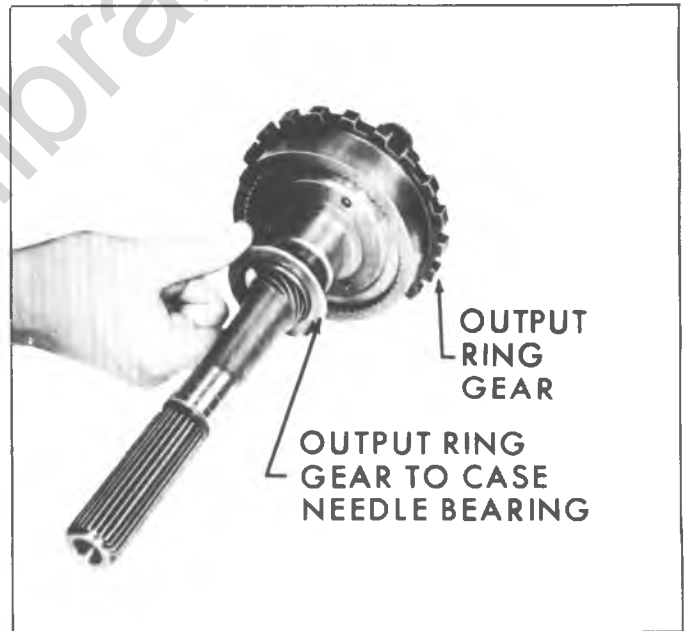


Fig. 44M--Removing Output Ring Gear to Case Needle Bearing Assembly

17. Remove reaction carrier assembly from output ring gear and shaft assembly (fig. 41M).
18. Remove output ring gear and shaft assembly from case (fig. 42M).

NOTE: On Trucks, also remove grease pack sleeves from output shaft before taking shaft from case.

19. Remove reaction carrier to output ring gear tanged (front) thrust washer (fig. 43M).
20. Remove output ring gear to case needle bearing assembly (fig. 44M).

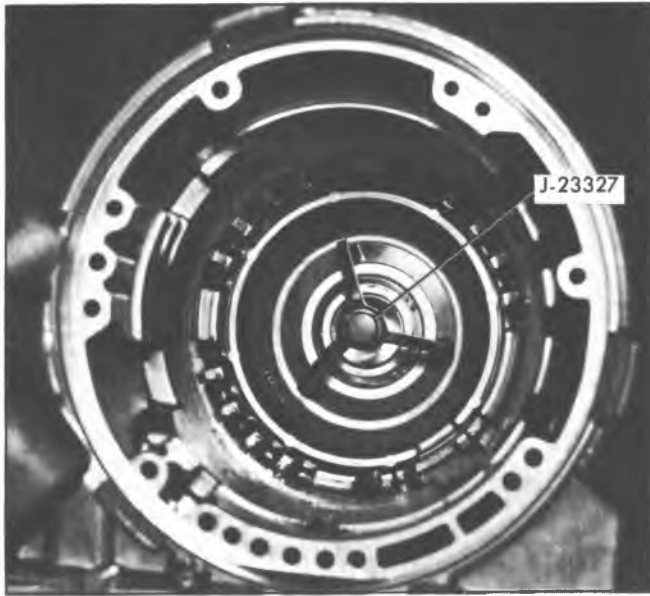


Fig. 45M--Compressing Low and Reverse Clutch Piston Spring Retainer

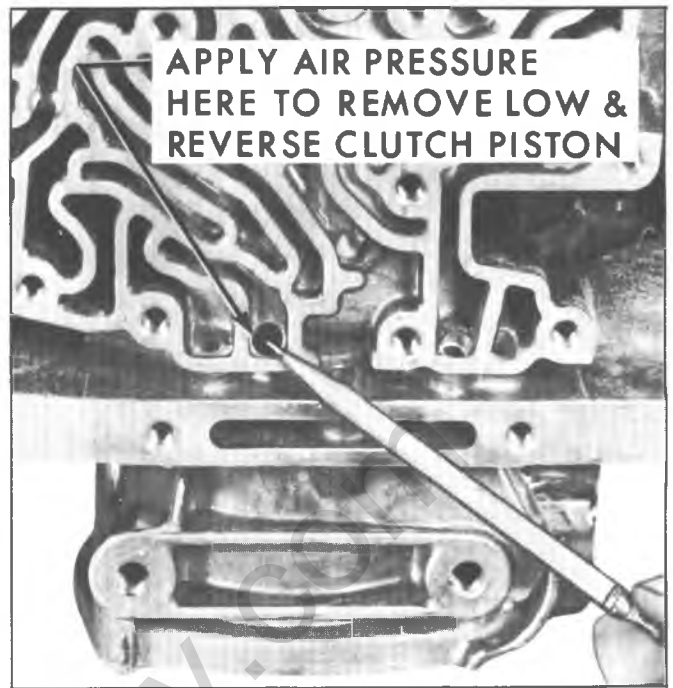


Fig. 47M--Removing Low and Reverse Clutch Piston

21. Compress low and reverse clutch piston spring retainer using tool J-23327 (fig. 45M) and remove piston retaining ring and spring retainer.
22. Remove seventeen (17) piston springs from piston (fig. 46M).

23. Remove low and reverse clutch piston assembly by applying compressed air in passage shown on Figure 47M.
24. Remove low and reverse clutch piston outer seal (fig. 48M).

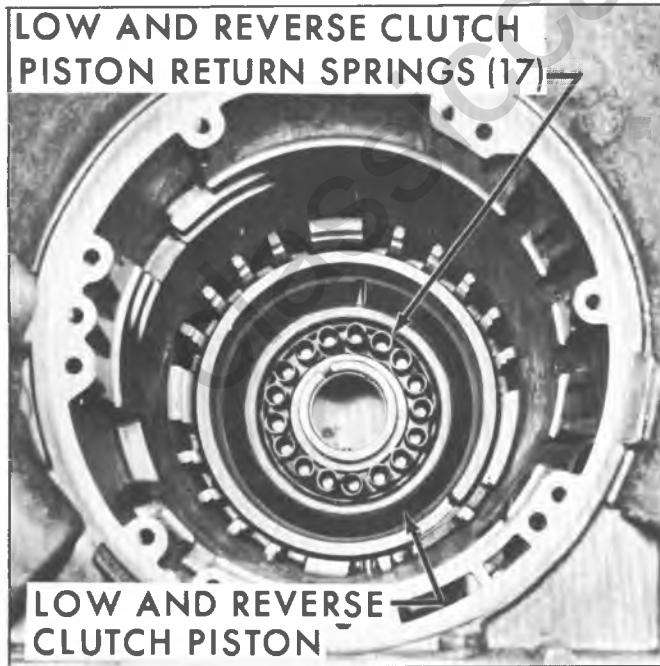


Fig. 46M--Low and Reverse Clutch Piston Springs and Piston

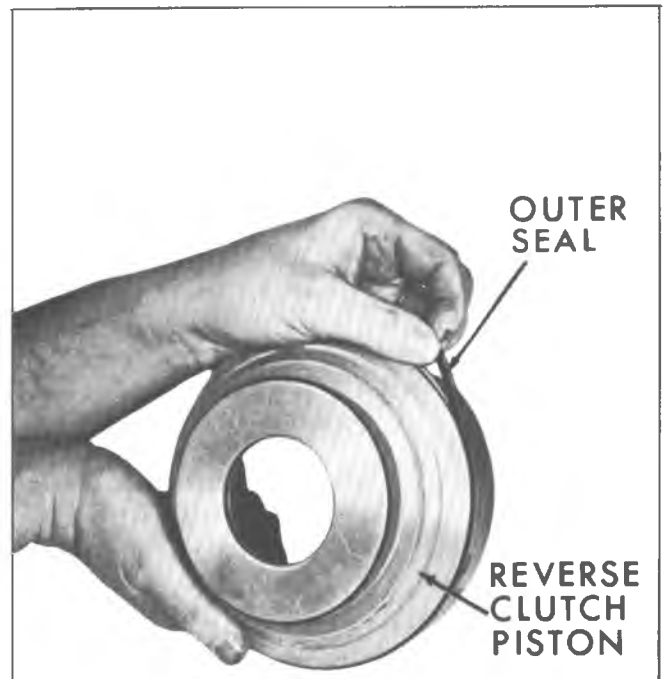


Fig. 48M--Removing Low and Reverse Clutch Piston Outer Seal

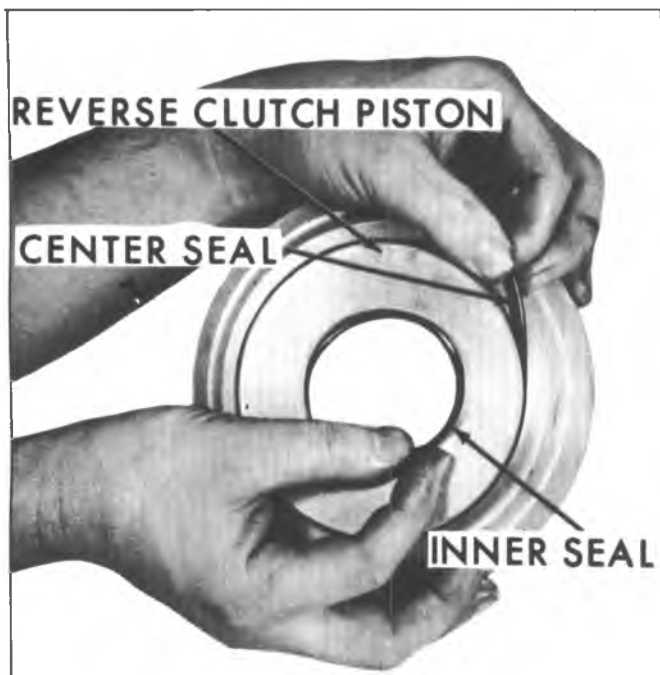


Fig. 49M--Removing Low and Reverse Clutch Piston Center and Inner Seal

25. Remove low and reverse clutch piston center and inner seal (fig. 49M).
26. Install tool J-23069 to compress intermediate clutch accumulator piston cover and remove retaining ring (fig. 50M).
27. Remove intermediate clutch accumulator piston cover and remove "O" ring seal from case.
28. Remove intermediate clutch accumulator piston spring.
29. Remove intermediate clutch accumulator piston assembly. (fig. 51M).
30. Also, remove inner and outer hook type oil seal rings if required.

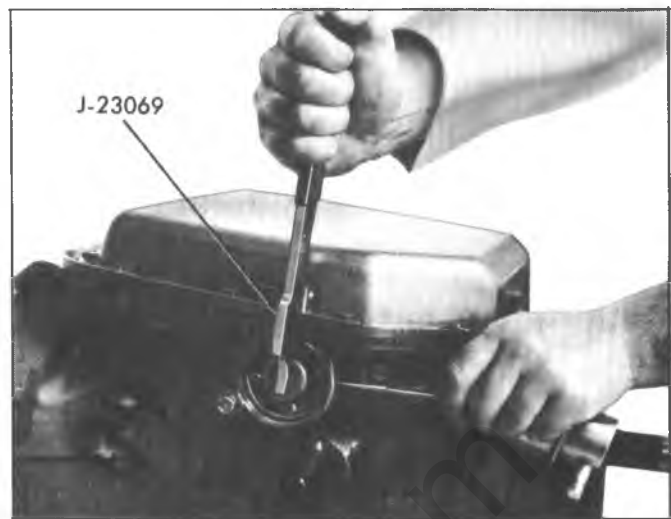


Fig. 50M--Removing Accumulator Piston Cover Retaining Ring

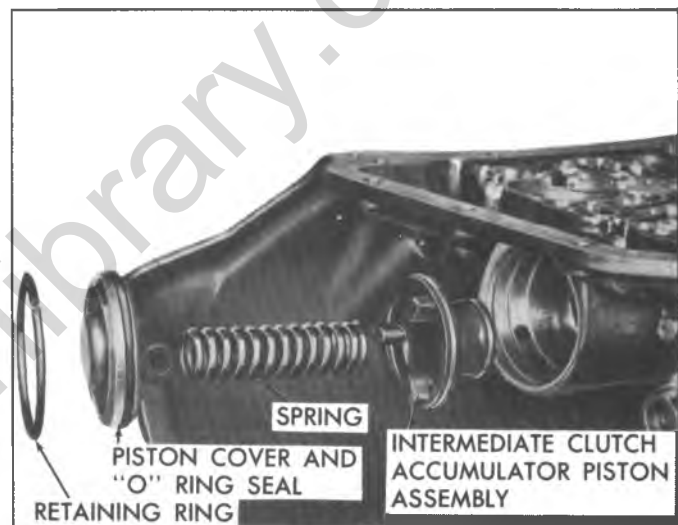


Fig. 51M--Intermediate Clutch Accumulator Components



Fig. 52M—Removing Direct Clutch Accumulator Piston Retaining "E" Ring

VALVE BODY DISASSEMBLY, INSPECTION, AND REASSEMBLY (FIG. 53M)

Disassembly

1. Position valve body assembly with cored face up and direct clutch accumulator piston pocket positioned as shown in Figure 53M.
2. Remove manual valve from lower left hand bore.
3. From lower right hand bore remove the pressure regulator valve train retaining pin, boost valve sleeve, intermediate boost valve, reverse and modulator boost valve, pressure regulator valve spring, and the pressure regulator valve.
4. From the next bore, remove the 2-3 shift valve train retaining pin, sleeve, control valve spring, 2-3 shift control valve, shift valve spring, and the 2-3 shift valve.
5. From the next bore, remove the 1-2 shift valve train retaining pin, sleeve, shift control valve spring, 1-2 shift control valve, and the 1-2 shift valve.
6. From the next bore, remove retaining pin, plug, manual low control valve spring, and the manual low control valve.
7. From the next bore, remove the retaining pin, spring, seat, and the detent regulator valve.
8. Install Tools J-22269 and J-24675 on direct clutch accumulator piston and compress piston only enough to remove retaining "E" ring (fig. 52M).

CAUTION: *Piston may be damaged if piston is over compressed.*

9. Remove direct clutch accumulator piston, and metal oil seal ring, and spring.
10. From the next bore down from the direct clutch accumulator, remove the detent actuating lever bracket bolt, bracket, actuating lever and retaining pin, stop, spring retainer, seat, outer spring, inner spring, washer and detent valve.

Inspection

1. Inspect all valves for scoring, cracks and free movement in their respective bores.
2. Inspect valve body for cracks, scored bores, interconnected oil passages and flatness of mounting face.
3. Check all springs for distortion or collapsed coils.

Reassembly

1. Install direct clutch accumulator piston spring and piston into valve body.
2. Install special tools J-22269 and 24675 and compress spring and piston only enough to install retaining ring.

NOTE: Align piston and oil seal ring when entering bore.

3. Install the detent valve, washer, outer spring, inner spring, spring seat, and spring retainer. Install detent valve stop and detent valve actuating bracket. Torque bolt to 52 in. lbs. Assemble detent actuating lever with retaining pin.
4. Install the pressure regulator valve, spring, reverse and modulator boost valve, intermediate boost valve, boost valve sleeve and retaining pin.
5. In the next bore up, install 2-3 shift valve, shift valve spring, 2-3 shift control valve, shift control valve spring, shift control valve sleeve and retaining pin.
6. In the next bore up, install the 1-2 shift valve, 1-2 shift control valve, control valve spring, control valve sleeve and retaining pin.
7. In the next bore up, install the manual low control valve, spring, plug and retaining pin.
8. In the top right hand bore, install the detent regulator valve, spring seat, spring and retaining pin.

OIL PUMP (FIG. 54M)

Disassembly

1. Place pump cover and stator shaft assembly through hole in bench.

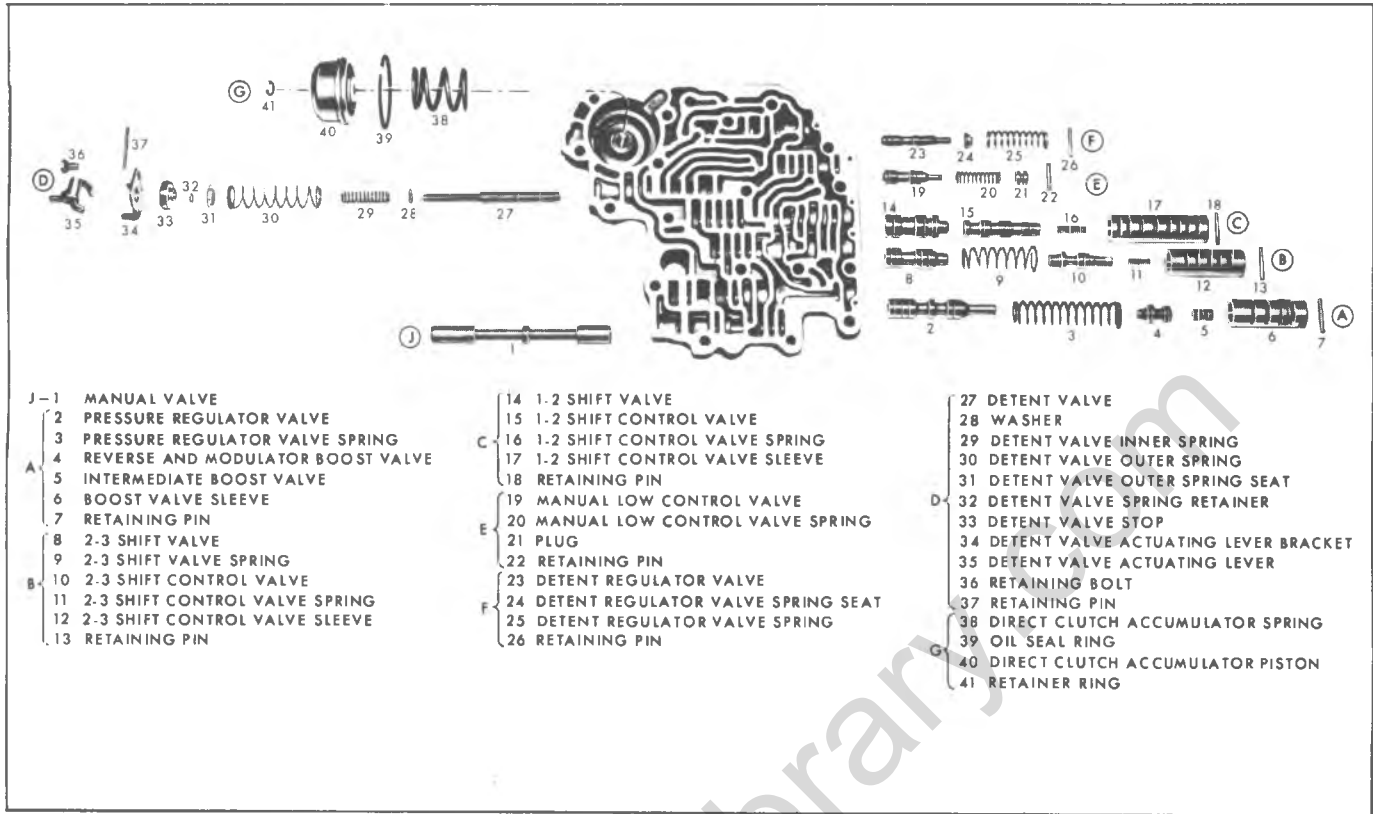


Fig. 53M--Valve Body--Exploded View

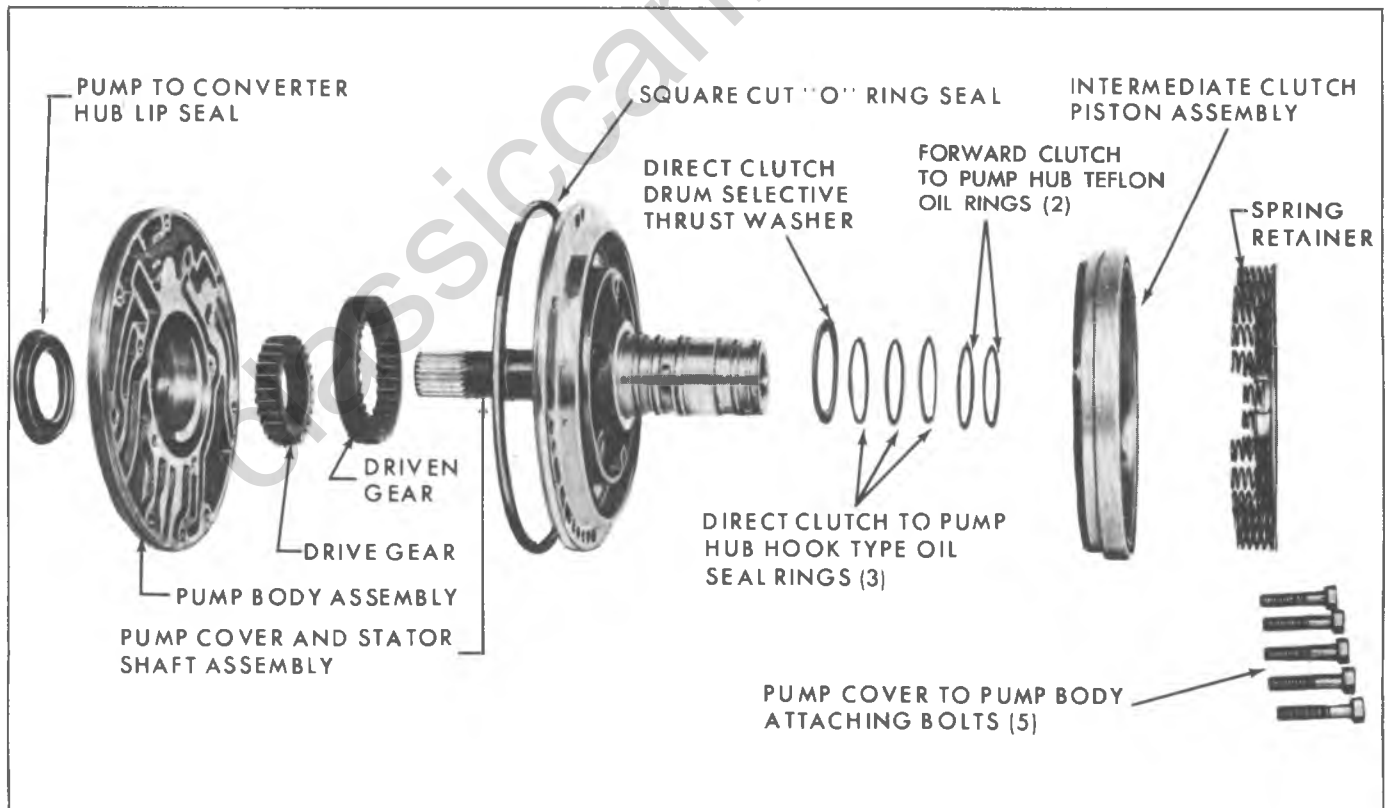


Fig. 54M--Pump Assembly--Exploded View

2. Remove pump cover to body attaching bolts 5/16 x 18-1 1/2 (fig. 55M).
3. Remove intermediate clutch spring retainer, twenty(20) intermediate clutch return springs and the intermediate clutch piston assembly (fig. 56M).

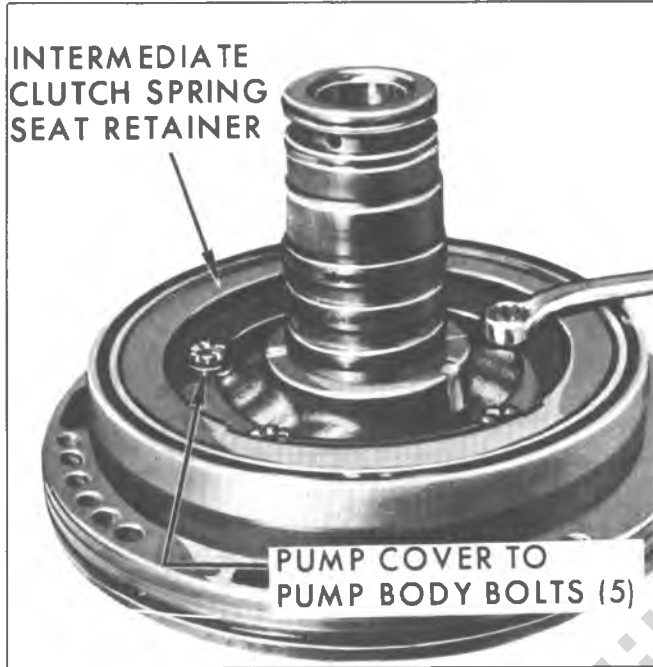


Fig. 55M--Removing Pump Cover to Pump Body Bolts

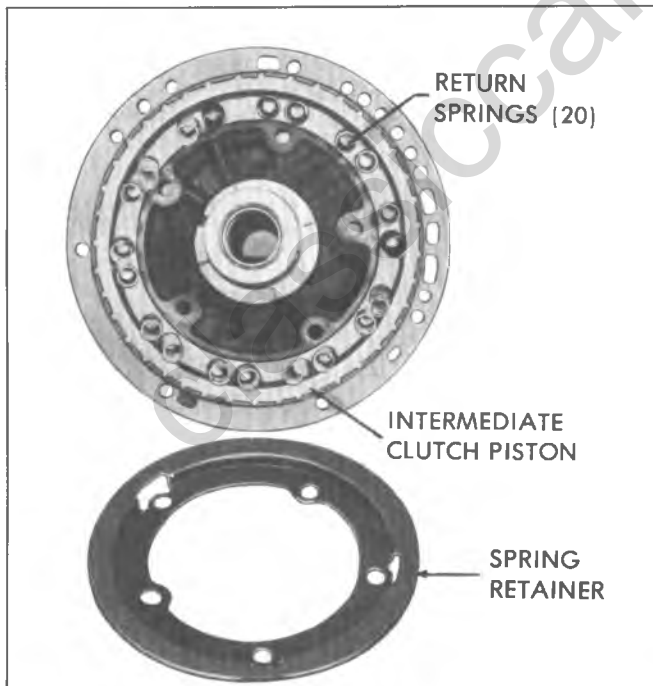


Fig. 56M--Intermediate Clutch Spring Retainer, Return Springs and Piston

4. Remove intermediate clutch piston inner and outer seals (fig. 57M).
5. Remove two (2) forward clutch housing to pump hub hook type oil seal rings and three (3) direct clutch drum to pump hub hook type oil rings (fig. 58M).

NOTE: Forward clutch oil seal rings are teflon on JA and JH models.

6. Remove pump cover to direct clutch drum housing selective thrust washer (fig. 58M).

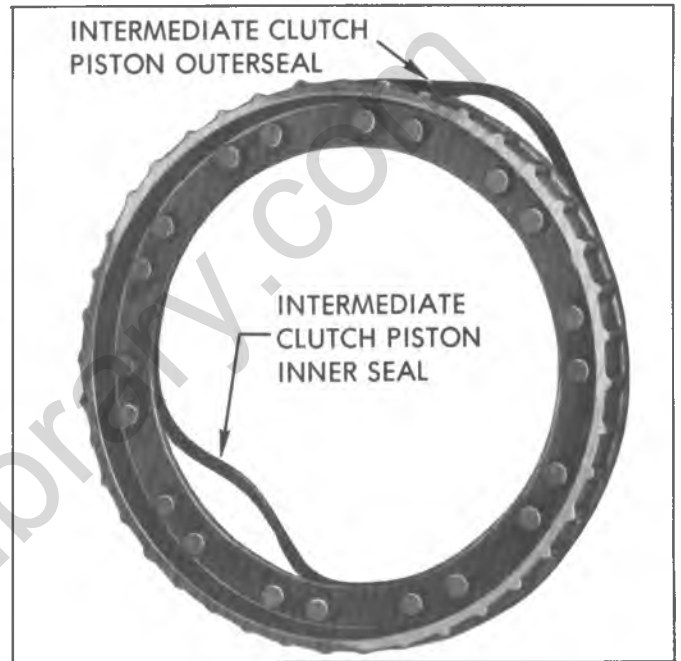


Fig. 57M--Removing Intermediate Clutch Piston Inner and Outer Seal



Fig. 58M--Pump Hub Oil Seal Rings

NOTE: A needle bearing is used on C series Truck instead of a thrust washer.

7. Remove pump cover and stator shaft assembly from pump body (fig. 59M).
8. Remove pump drive gear and driven gear.
9. Remove pump outside diameter to case (square cut) "O" ring seal. Discard seal.

Inspection

1. Wash all parts in cleaning solvent and blow out all oil passages. DO NOT USE RAGS TO DRY PARTS.

CAUTION: Some solvents may be harmful to rubber seals.

2. Inspect pump gears for nicks or damage.
3. Inspect body and cover faces for nicks or scoring. Inspect cover hub O.D. for nicks or burrs which might damage clutch drum bushing journal.
4. Inspect body bushing for galling or scoring. Check clearance between body bushing and converter pump hub. Maximum clearance is .005". If the bushing is damaged, the oil pump body should be replaced.
5. Inspect converter housing hub O.D. for nicks or burrs which might damage pump seal or bushing. Repair or replace as necessary.
6. If hub lip seal is damaged or is leaking (and the pump body is otherwise suitable for reuse), replace seal.
7. With parts clean and dry, install pump gears in

pump body and check pump body face to gear face clearance. Clearance should be .0005"- .0015" (fig. 60M).

Reassembly

1. Replace hub lip seal if defective (figs. 61M and 62M).
2. Place pump body on wood blocks and pry out defective seal. Coat outer diameter of new seal with a non-hardening sealer and install seal using seal installer J-21359 to seat seal fully in counterbore.
3. Install pump drive gear and driven gear (fig. 63M).



Fig. 60M--Checking Pump Body to Gear Face Clearance

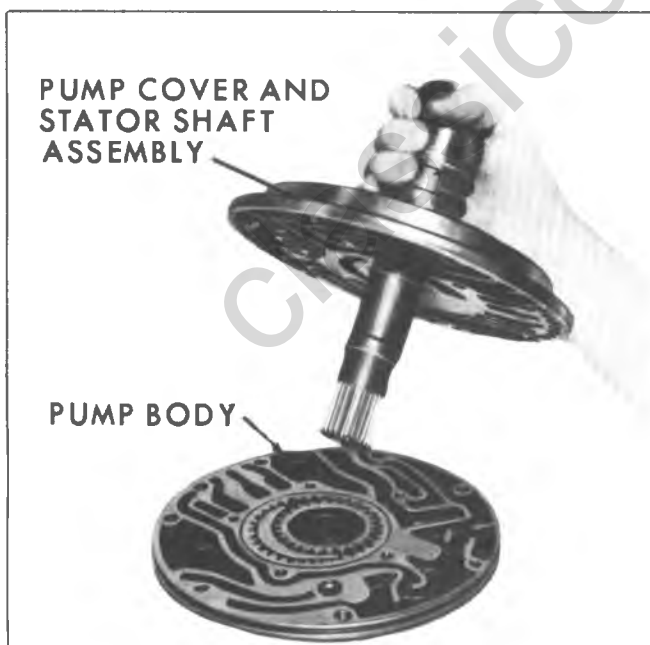


Fig. 59M--Separating Pump Cover from Pump Body

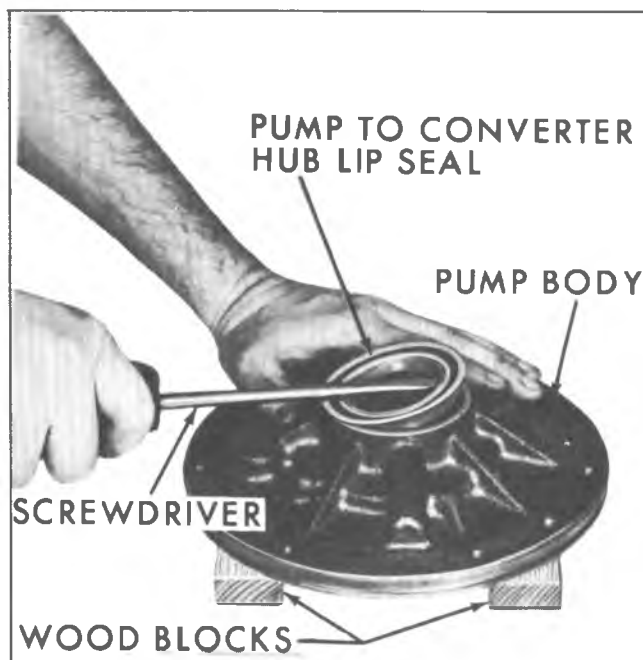


Fig. 61M--Removing Pump to Converter Hub Lip Seal

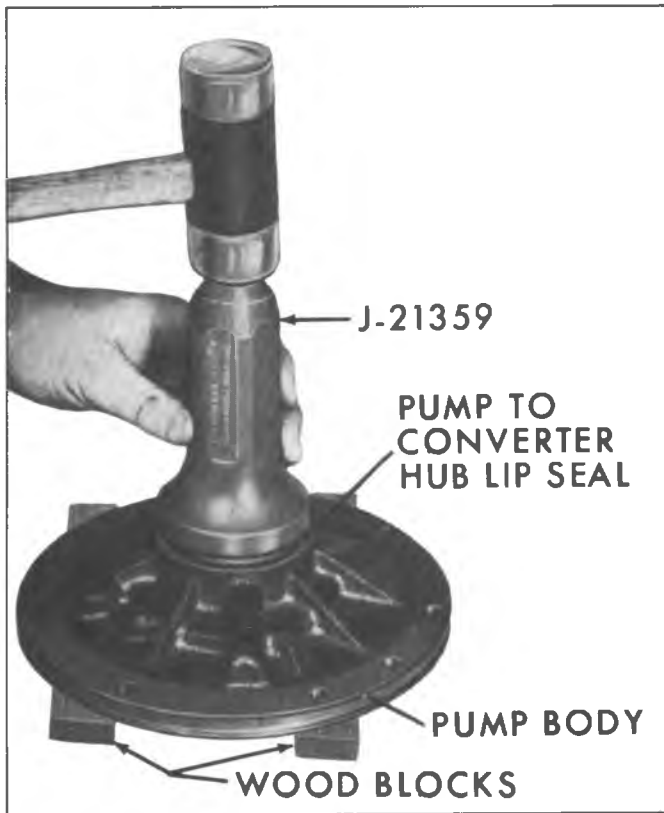


Fig. 62M--Installing Hub Lip Seal

4. Install direct clutch drum housing to pump cover selective thrust washer over pump cover delivery sleeve.
5. Install three (3) direct clutch to pump hub hook



Fig. 63M--Installing Pump Drive and Driven Gears

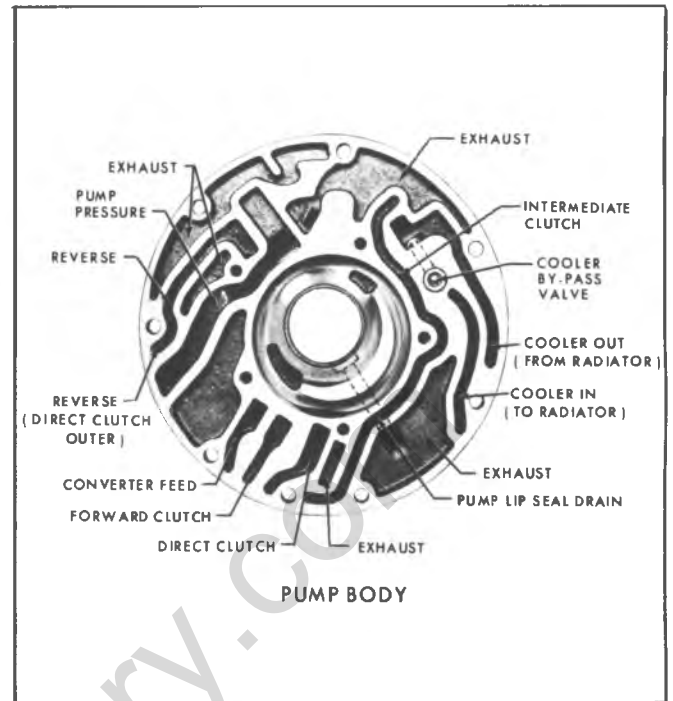


Fig. 64M--Pump Body Oil Passages

type oil seal rings. Install two (2) forward clutch to pump hub hook type oil seal rings.

CAUTION: Check pump cover and body oil passages to make sure they are not restricted (figs. 64M and 65M).

6. Install intermediate clutch piston inner seal and outer seal on piston.
7. Install pump outside diameter to case (square cut) "O" ring seal.
8. Install intermediate clutch piston assembly into pump cover being careful not to damage seals.
9. Install spring retainer with attached clutch return springs, align pump body to cover, and install five (5) attaching bolt. Tighten bolts to 18 pound-feet.
10. Align pump body to cover and start bolts.

DIRECT CLUTCH AND INTERMEDIATE OVERRUN ROLLER CLUTCH (FIG. 66M)

Disassembly

1. Remove intermediate overrun clutch drum front retaining ring and retainer (fig. 67M).
2. Remove intermediate clutch overrun outer race (fig. 67M).
3. Remove intermediate overrun roller clutch assembly (fig. 68M).

NOTE: Intermediate overrun roller clutch

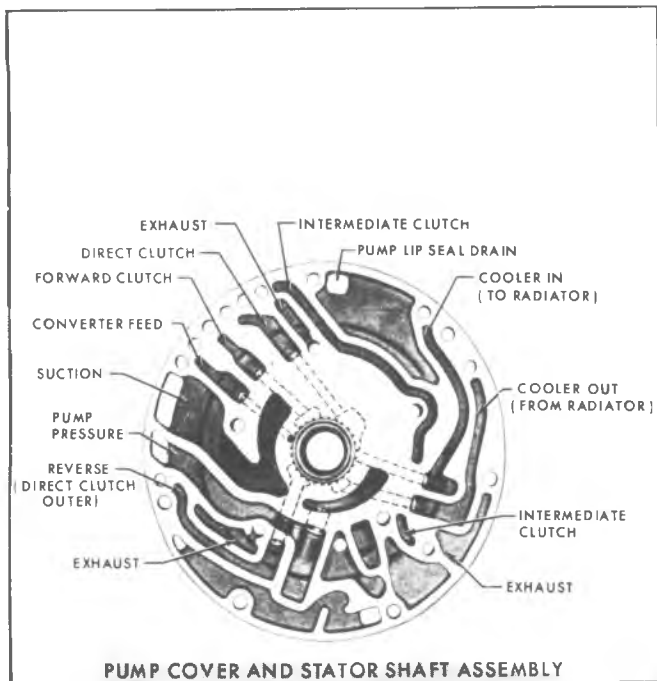


Fig. 65M--Pump Cover Oil Passages

inner race is a press fit. Do not remove unless replacement is necessary.

4. Remove direct clutch drum to forward clutch housing needle roller bearing (fig. 69M).
5. Remove direct clutch pressure plate to clutch drum.

retaining ring and pressure plate (fig. 70M).

6. Remove drive plates and steel driven plates (fig. 71M).
 7. Using compressor tool J-23327, remove direct clutch piston return spring seat retaining ring, spring seat and seventeen (17) clutch return coil springs (fig. 72M).
- NOTE:** On JA and JH models, return coil springs are attached to retaining ring.
8. Remove direct clutch piston.
 9. Remove direct clutch piston outer seal and inner seal (fig. 73M).
 10. Remove direct clutch piston center seal from drum (fig. 74M).

Inspection

1. Inspect drive and driven clutch plates for signs of burning, scoring or wear.
2. Inspect seventeen (17) springs for collapsed coils or signs of distortion.
3. Inspect piston for cracks.
4. Inspect clutch housing for wear, scoring, open oil passages and free operation of ball check.
5. Inspect roller clutch inner and outer race for scratches or indentations.
6. Inspect roller cage for wear and roller springs for distortion.

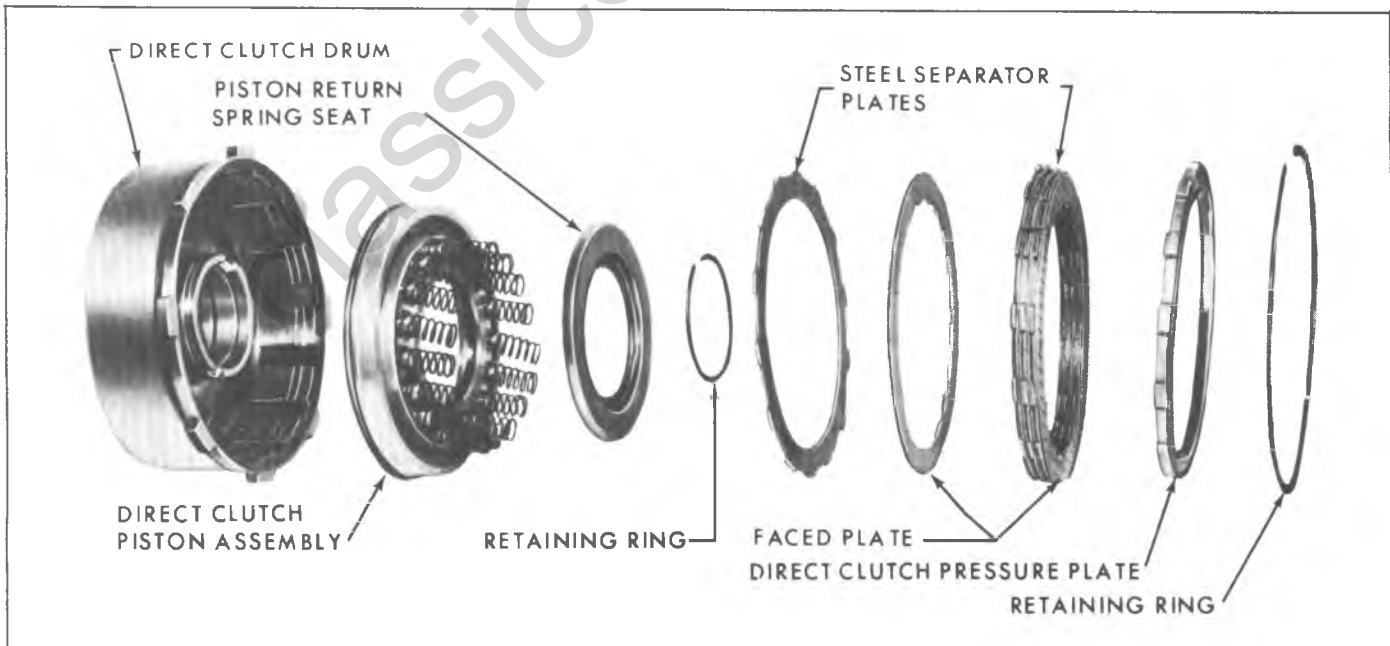


Fig. 66M--Direct Clutch Assembly--Exploded View

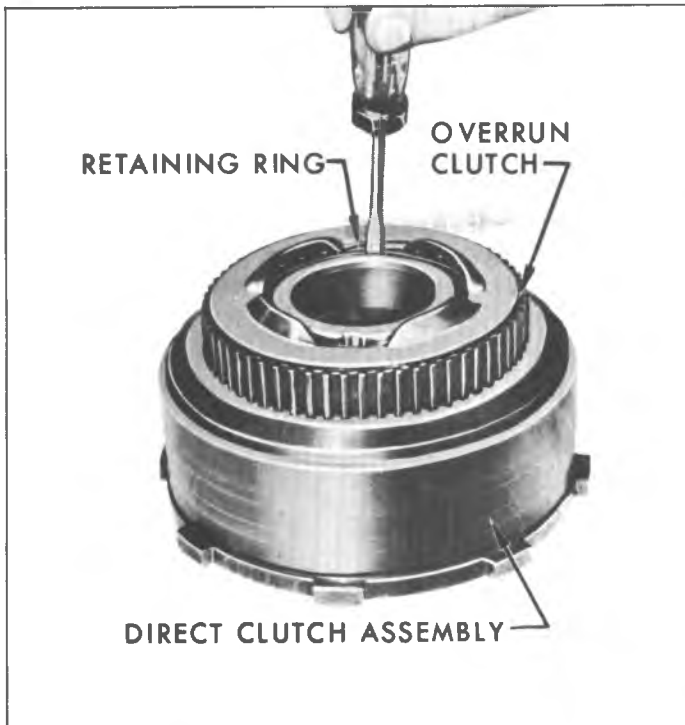


Fig. 67M--Removing Overrun Clutch Retaining Ring and Retainer



Fig. 69M--Direct Clutch Drum to Forward Clutch Housing Needle Roller Bearing

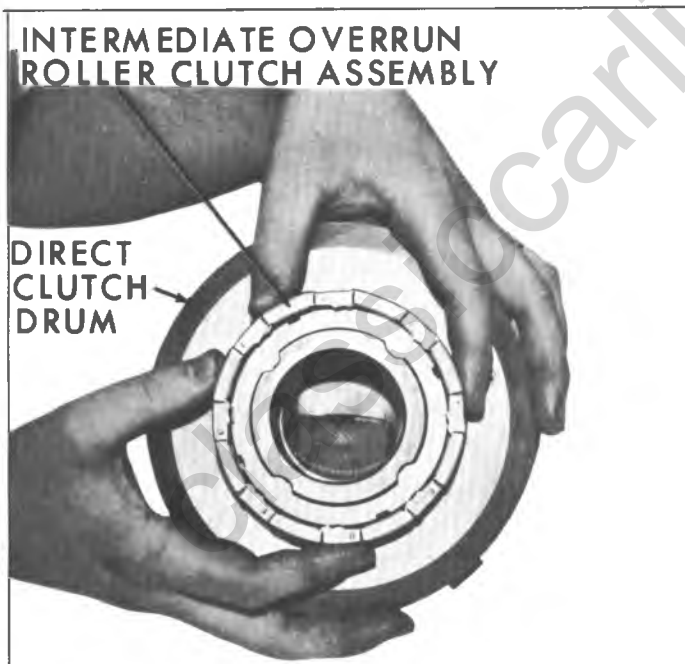


Fig. 68M--Removing Intermediate Overrun Roller Clutch

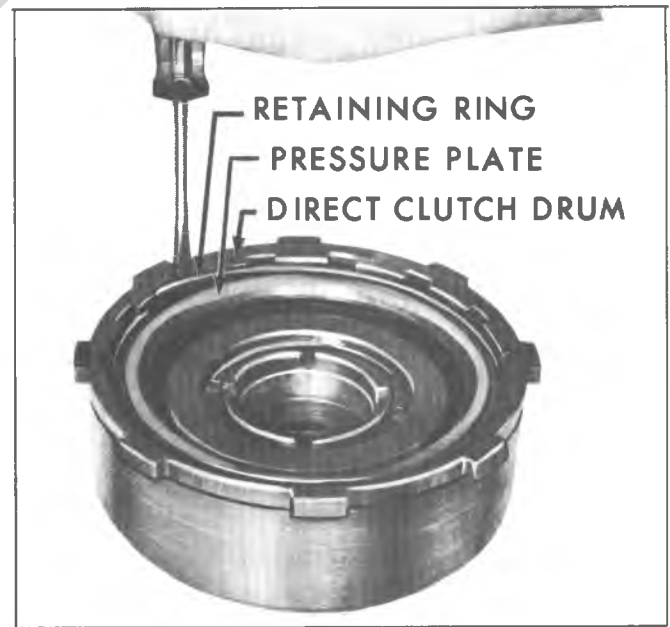


Fig. 70M--Removing Direct Clutch Pressure Plate

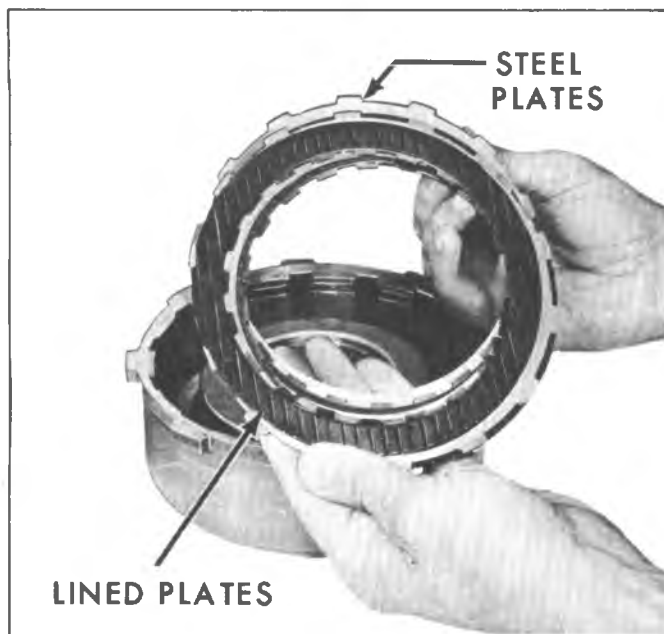


Fig. 71M-Removing Face Plates and Steel Separator Plates

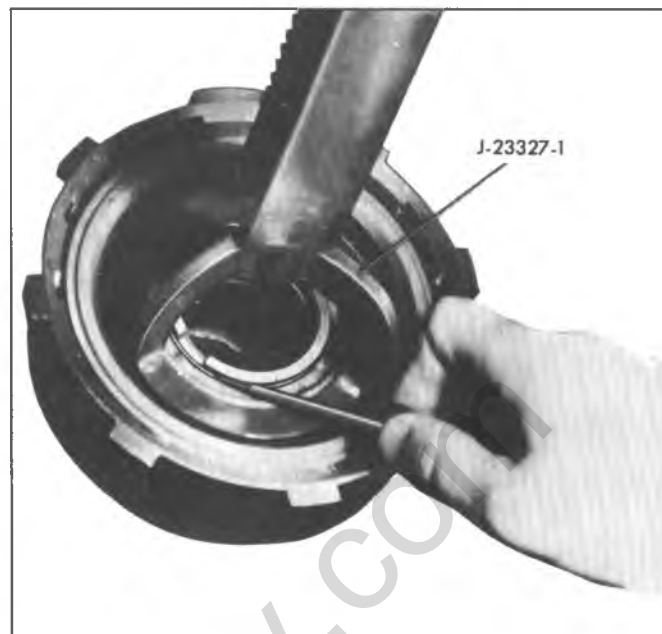


Fig. 72M-Compressing Direct Clutch Spring Seat

Reassembly

1. Install new direct clutch piston outer seal and inner seals.
2. Install new direct clutch piston center seal on drum with lip facing upward.
3. Install direct clutch piston into housing with aid of a feeler gauge or a piece of .020" piano wire crimped into copper tubing (fig. 75M).
4. Install seventeen (17) clutch return coil springs.
5. Install piston return spring seat. Compress spring seat with tool J-23327 and install retaining ring (fig. 76M).
6. Lubricate with transmission fluid and install face plates and steel separator plates, alternating steel and faced plates.
7. Install direct clutch pressure plate and retaining ring.
8. Install intermediate overrun roller clutch assembly with four (4) holes toward front of transmission.

CAUTION: If roller falls out during assembly operation, reinstall roller from inside to outside cage direction to avoid bending spring.

9. Install intermediate clutch overrun outer race.

NOTE: When outer race is installed, it should free wheel in counterclockwise direction only.

10. Install intermediate overrun clutch retainer and retainer ring as shown on Figure 67M.

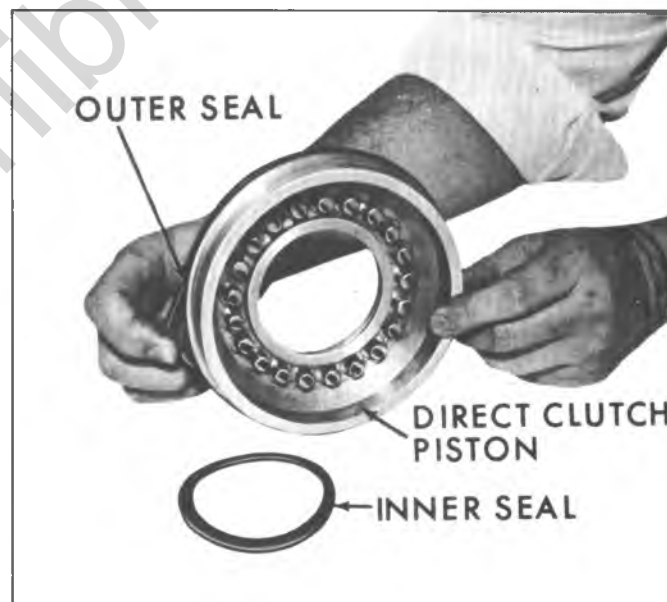


Fig. 73M-Removing Direct Clutch Outer and Inner Seals

FORWARD CLUTCH (FIG. 77M)

Disassembly

1. Remove forward clutch retaining ring and pressure plate (fig. 78M).



Fig. 74M--Removing Direct Clutch Piston Center Seal



Fig. 76M--Installing Direct Clutch Springs, Spring Seat and Retaining Ring

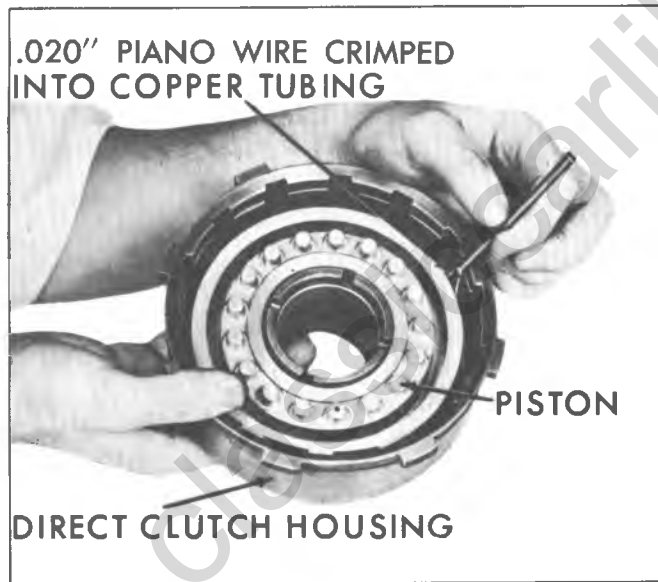


Fig. 75M--Installing Direct Clutch Piston

2. Remove face plates, steel separator plates and cushion spring (fig. 79M).
3. Using tool J-23327, compress piston return seat and remove retaining ring (fig. 80M).
4. Remove piston return seat and twenty-one (21) clutch return springs.

NOTE: On JA and JH models, return springs are attached to return seat.

CLUTCH ASSEMBLIES

CLUTCH	DRIVE PLATE	DRIVEN PLATES	CUSHION SPRING
FORWARD			
L-6, 307 V-8	4	4	1
350 V-8, 400 2-bbl. TAXI AND TRUCK	5	5	1
INTERMEDIATE			
L-6, 307 V-8	2	2	1
350 V-8, 400 2-bbl. TAXI AND TRUCK	3	3	1
DIRECT			
L-6, 307 V-8	3	3	NONE
350 V-8, 400 2-bbl. TAXI AND TRUCK	4	4	NONE
REVERSE			
L-6, 307 V-8	4	4	NONE
350 V-8, 400 2-bbl. TAXI AND TRUCK	5	5	NONE

5. Remove forward clutch piston assembly.
6. Remove the forward clutch inner and outer piston seals (fig. 81M).

Inspection

1. Inspect drive and driven clutch plates for signs of burning, scoring or wear.
2. Inspect twenty one (21) springs for collapsed coils or signs of distortion.
3. Inspect piston for cracks.
4. Inspect clutch housing for wear, scoring, open oil passages and free operation of exhaust check ball (fig. 82M).

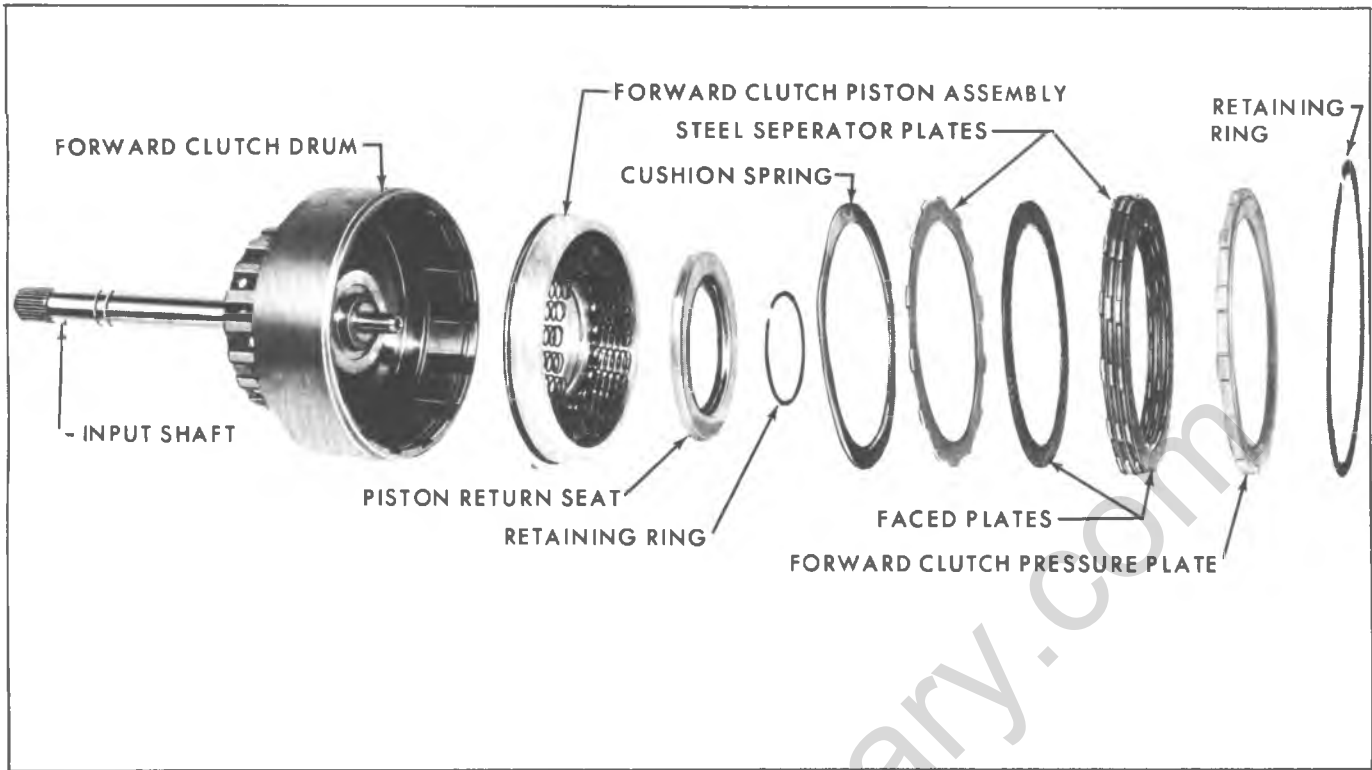


Fig. 77M--Forward Clutch Assembly--Exploded View

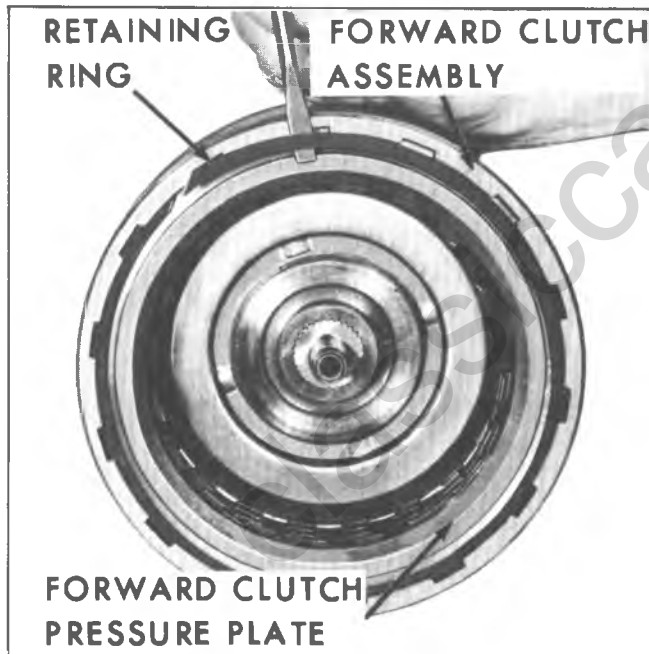


Fig. 78M--Removing Forward Clutch Retaining Ring and Pressure Plate

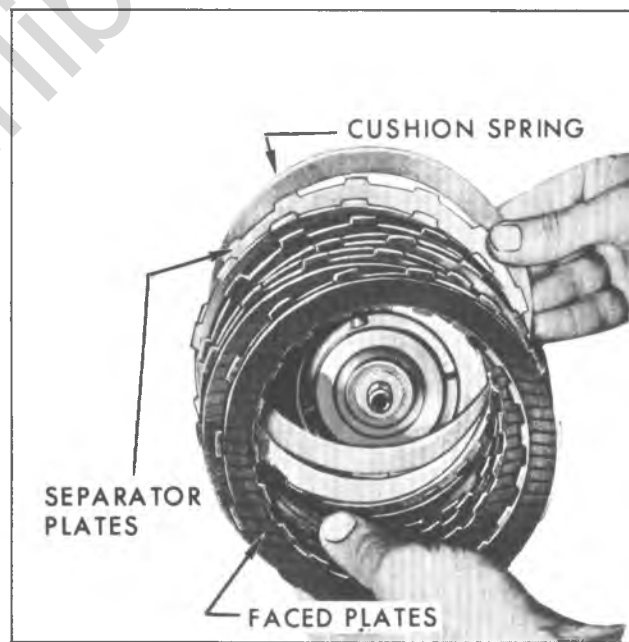


Fig. 79M--Removing Forward Clutch, Clutch Pack

5. Inspect input shaft.
 - a. Inspect for open lubrication passages at each end.
 - b. Inspect splines for damage.

- c. Inspect ground bushing journals for damage.
- d. Inspect shaft for cracks or distortion.

NOTE: Input shaft and clutch housing are serviced separately.

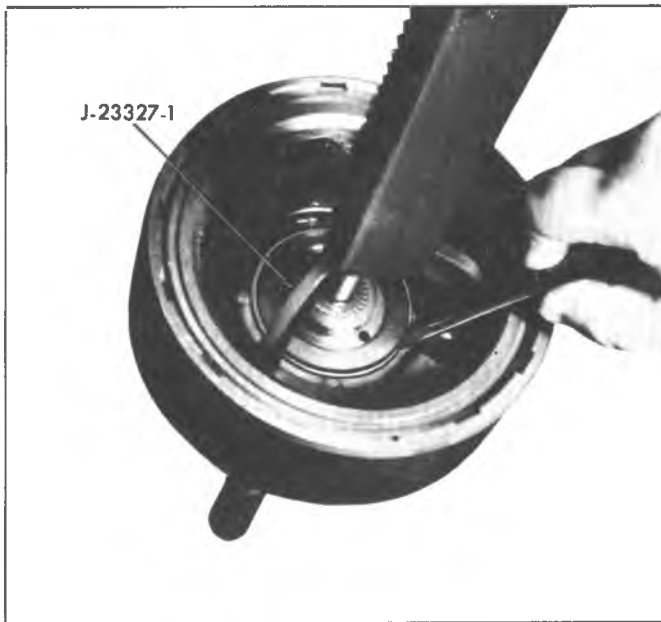


Fig. 80M--Compressing Forward Clutch Piston Return Seat

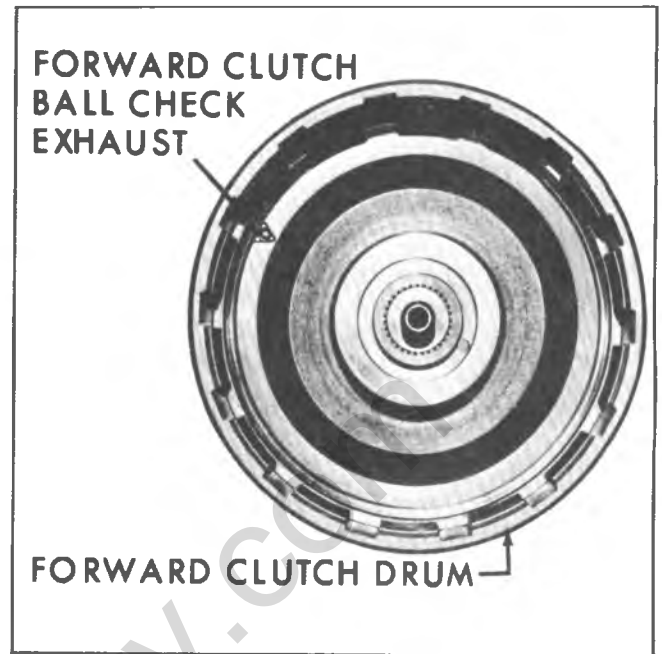


Fig. 82M--Forward Clutch Exhaust Check Ball

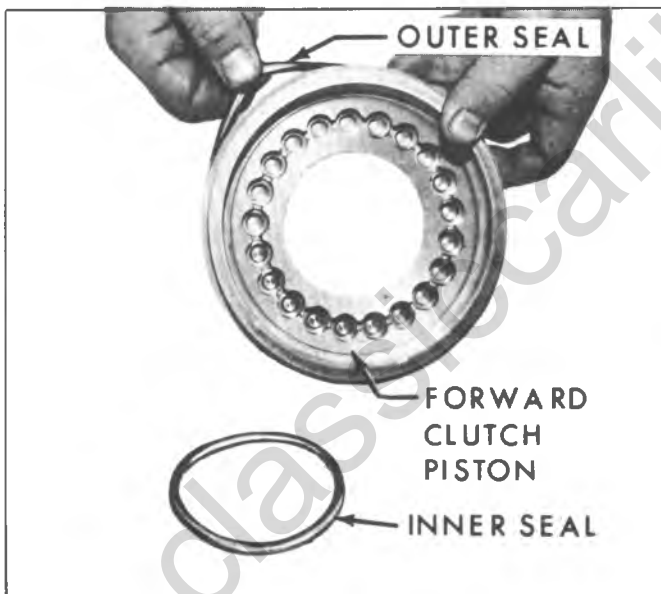


Fig. 81M--Removing Forward Clutch Piston Inner and Outer Seals

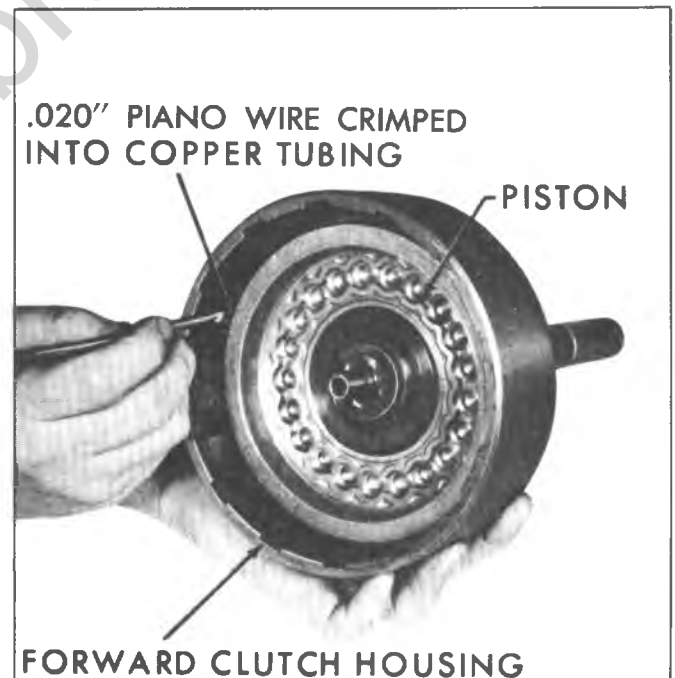


Fig. 83M--Installing Forward Clutch Piston

Reassembly

1. Install new forward clutch inner piston seal and outer piston seal.
2. Install the forward clutch piston assembly with the aid of a feeler gauge or a piece of .020" piano wire crimped into copper tubing (fig. 83M).
3. Install twenty-one (21) clutch return coil springs.
4. Install spring retainer. Compress spring retainer and install retaining ring using tool J-23327-1 as shown on Figure 80M.
5. Lubricate with transmission fluid and install cushion spring face plates and steel separator plates, starting with the cushion spring and alternating steel and faced.

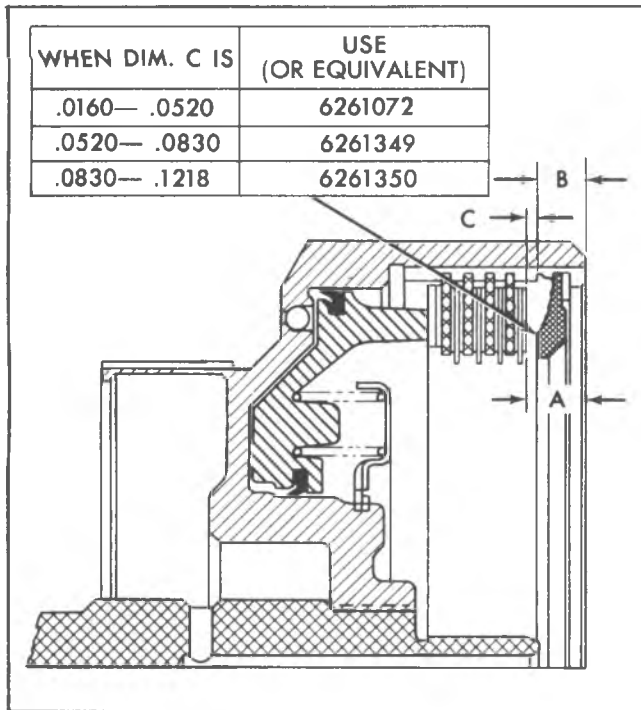


Fig. 84M--Determining Selective Fit for Forward Clutch Pressure Plate

6. Install forward clutch pressure plate (selective fit) and retaining ring. Using chart on Figure 84M to select correct pressure plate (dimension C), measure distance from the top of clutch pack to the top of clutch drum (dimension A). Measure distance from

the lower edge of the notch on the inner surface of the drum to the end of the drum (dimension B). Subtract B from A to get dimension C.

SUN GEAR AND SUN GEAR DRIVE SHELL (FIG. 85M)

Disassembly

1. Remove sun gear to sun gear drive shell rear retaining ring (fig. 86M).
2. Remove sun gear to drive shell flat rear steel thrust washer (fig. 87M).
3. Remove sun gear assembly from drive shell.
4. Remove sun gear to drive shell front retaining ring (fig. 88M). Discard retaining ring.
5. If bushing is to be replaced, refer to Figure 100M.

Inspection

Check gear and sun gear shell for damage or wear.

Assembly

1. Install new sun gear to drive shell front retaining ring.
2. Install sun gear assembly into drive shell.
3. Install sun gear to drive shell flat steel thrust washer.
4. Install new sun gear to sun gear drive shell retaining ring.

NOTE: Do not stress front and rear retaining rings at installation.

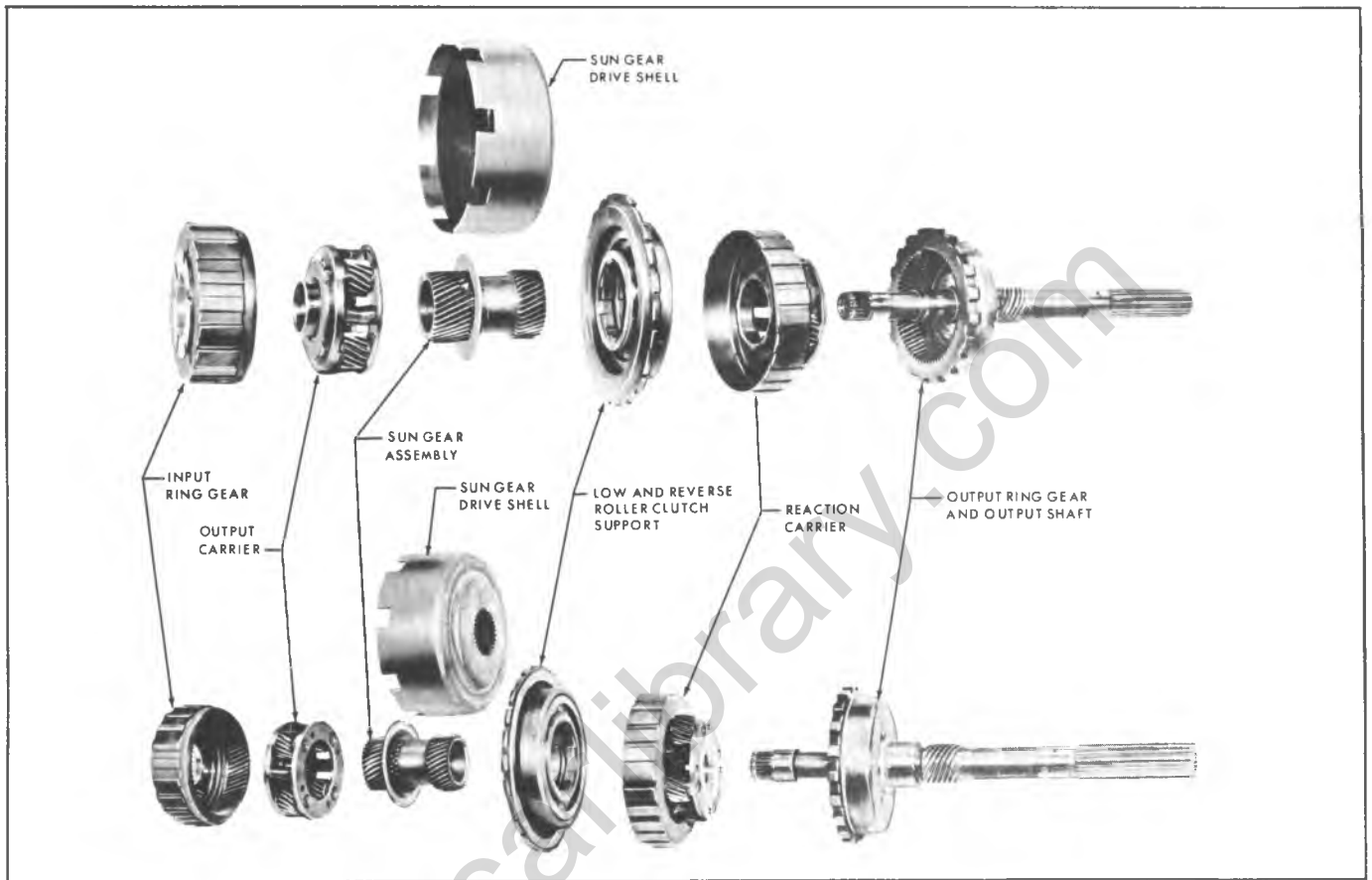


Fig. 85M--Planetary Gear Train--Exploded View

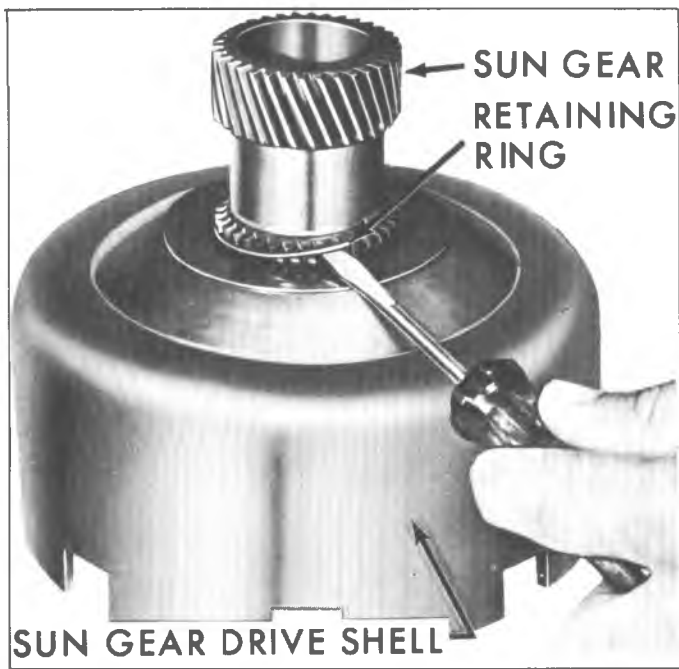


Fig. 86M-Removing Sun Gear Drive Shell Rear Retaining Ring

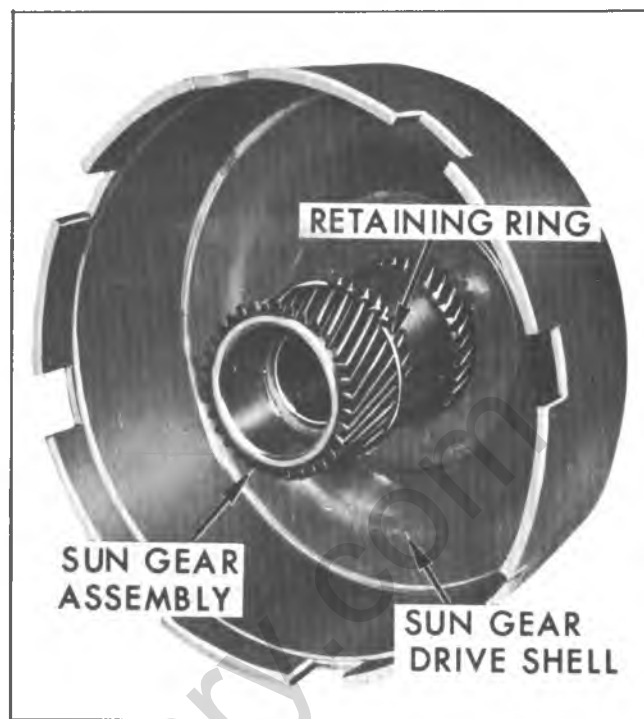


Fig. 88M-Removing Sun Gear to Drive Shell Front Steel Thrust Washer

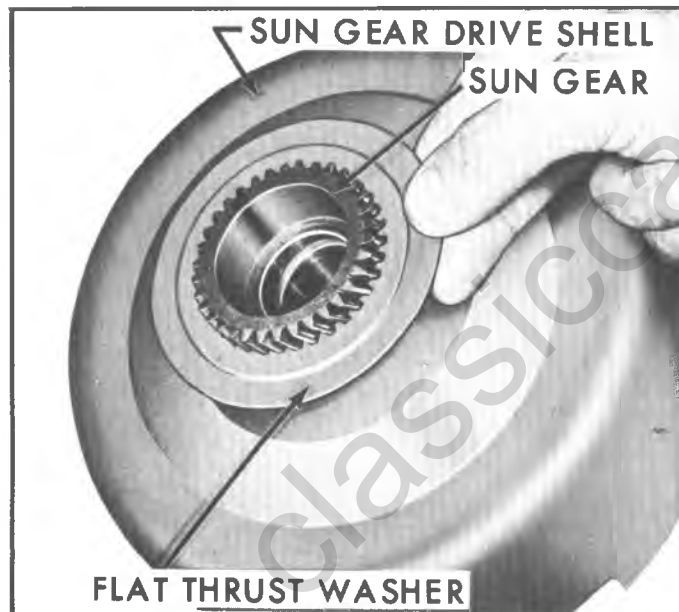


Fig. 87M-Removing Sun Gear to Drive Shell Rear Steel Thrust Washer

LOW AND REVERSE ROLLER CLUTCH SUPPORT (FIG. 89M)

Disassembly

1. Remove low and reverse clutch to sun gear shell thrust washer.
2. Remove low and reverse overrun clutch inner race from support (fig. 90M).
3. Remove low and reverse clutch roller clutch retaining ring (fig. 91M).

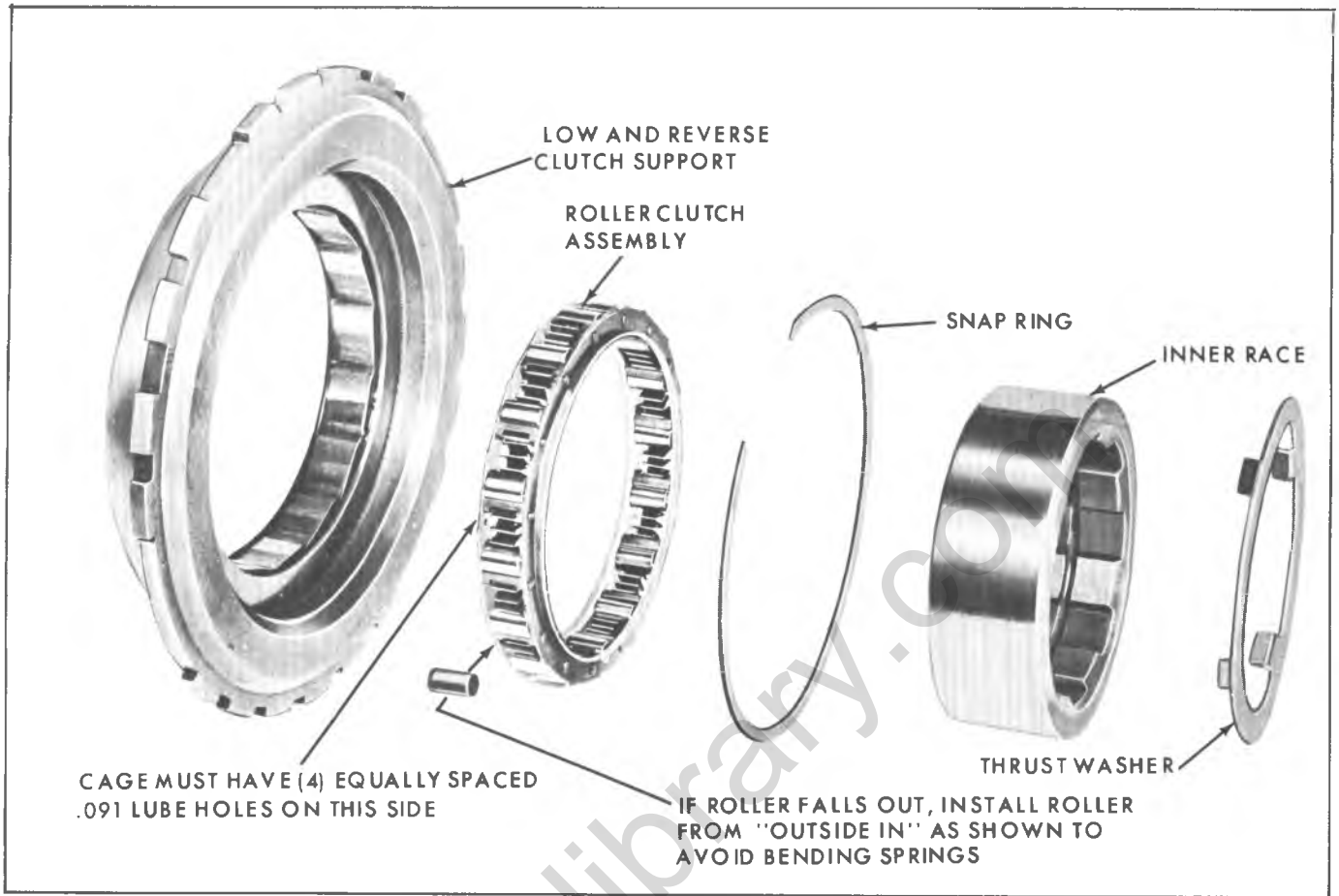


Fig. 89M--Low and Reverse Clutch Assembly--Exploded View

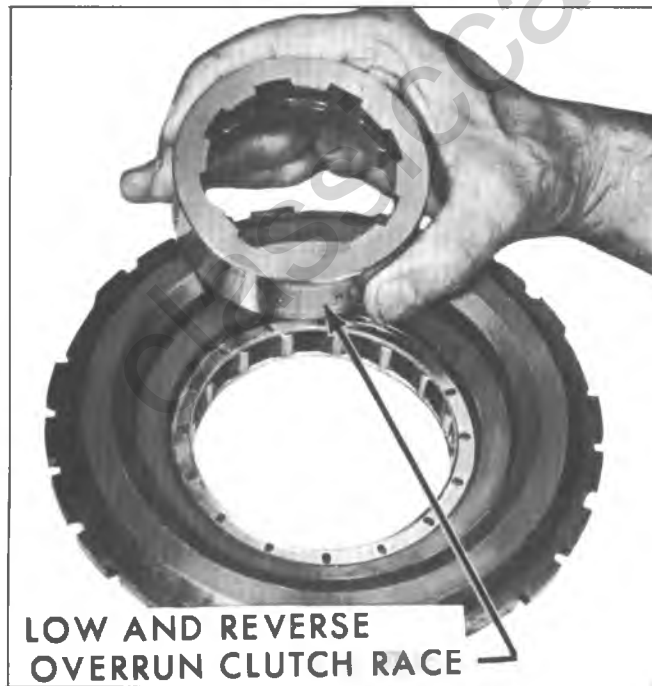


Fig. 90M--Removing Overrun Clutch Inner Race

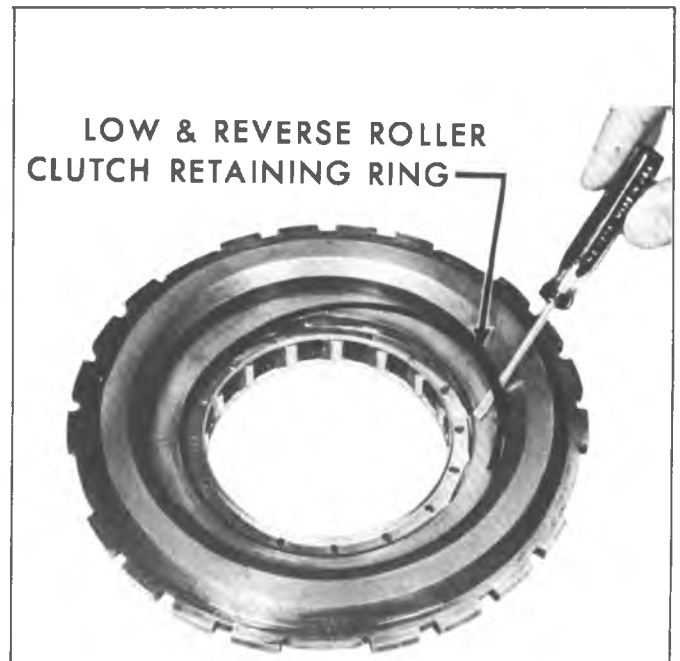


Fig. 91M--Removing Overrun Roller Clutch Retaining Ring

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4. Remove low and reverse roller clutch assembly (fig. 92M).

Inspection

1. Inspect roller clutch inner and outer race for scratches and indentations.
2. Inspect rollers for wear and roller springs for distortion.

Assembly

1. Install low and reverse roller clutch assembly to inner race with oil holes toward rear of transmission.
2. Install low and reverse overrun clutch outer race.
3. Install low and reverse clutch to cam retaining ring.

NOTE: Low and reverse overrun clutch inner race should free wheel in the clockwise direction only.

GOVERNOR ASSEMBLY

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is serviced as a complete assembly. The driven gear can be serviced separately.

It is necessary to disassemble governor assembly in order to replace driven gear. Disassembly may also be necessary due to improper operation. In such cases, proceed as follows:



Fig. 92M--Removing Overrun Roller Clutch Assembly

Disassembly

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights, and springs. Governor weights are interchangeable from side to side and need not be identified (fig. 93M).
2. Remove governor valve from governor sleeve. Be careful not to damage valve.
3. Perform following inspections and replace governor driven gear, if necessary.

Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring or galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs, or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect governor weight springs for distortion or damage.
9. Check governor weights for free operation in their retainers.

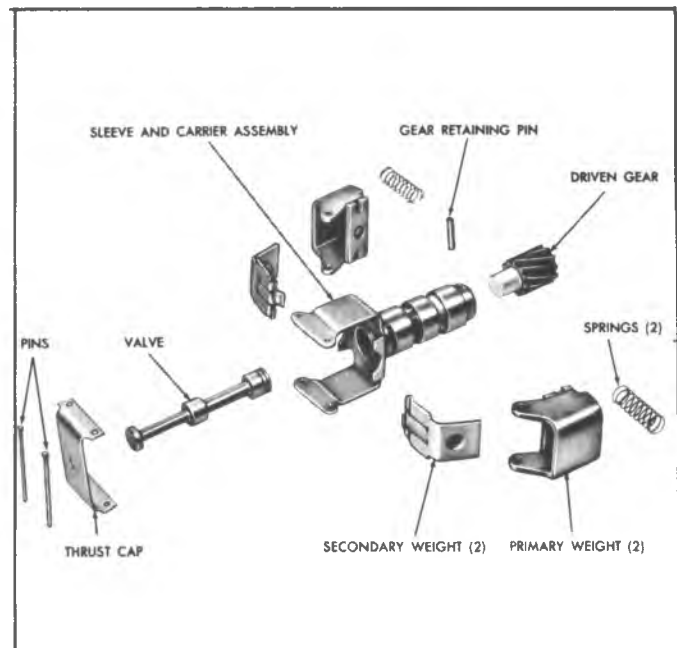


Fig. 93M--Governor Assembly--Exploded View Typical

10. Check valve opening at entry and exhaust (.020 inch minimum).

Governor Driven Gear Replacement

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

1. Drive out governor gear retaining split pin using small punch.
2. Support governor on 3/16 inch plates installed in exhaust slots of governor sleeve, place in arbor press, and with a long punch, press gear out of sleeve.
3. Carefully clean governor sleeve of chips that remain from original gear installation.
4. Support governor on 3/16 inch plates installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.
5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90 degrees from existing hole, center punch and then, while supporting governor in press, drill new hole through sleeve and gear using a standard (1/8 inch) drill.
6. Install split retaining pin.
7. Wash governor assembly thoroughly to remove any chips that may have collected.

Assembly

1. Install governor valve in bore of sleeve, large land end first.
2. Install governor weights and springs, and thrust cap on governor sleeve.
3. Align pin holes in thrust cap, governor weight assemblies and governor sleeve, and install new pins. Crimp both ends of pins to prevent them from falling out.
4. Check governor weight assemblies for free operation on pins.
5. Check governor valve for free movement in governor sleeve.

BUSHING REPLACEMENT

Extension Housing Bushing

Remove extension housing bushing from housing using tool J-21424-9 with drive handle J-8092. Install extension housing bushing in housing flush to .010 below seal counter bore surface using tool J-21424-9 with drive handle J-8092 (fig. 94M).

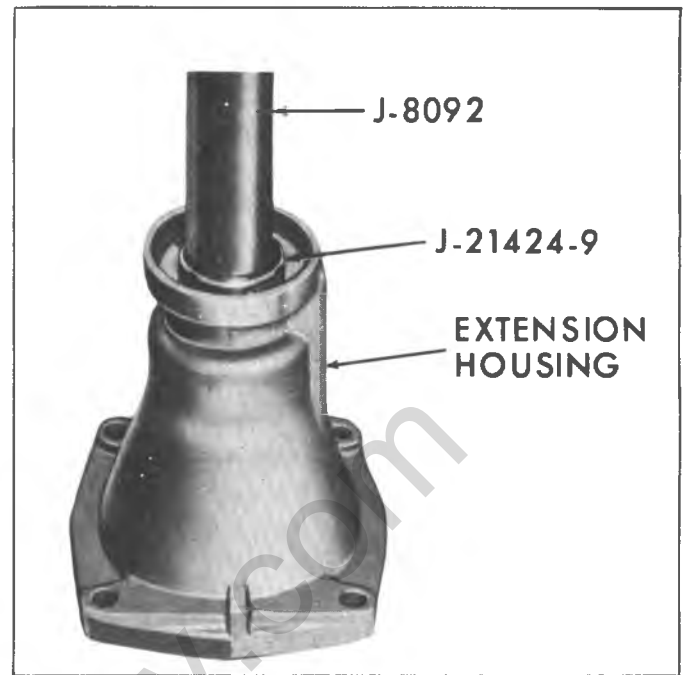


Fig. 94M--Installing Extension Housing Bushing

Output Shaft Bushing

With output shaft properly supported, remove bushing using remover J-9534-01 and slide hammer J-7004 (fig. 95M). Using tool J-23062-7, install bushing until tool bottoms on output shaft.

Case Bushing

With case properly supported, drive out bushing from rear of case using tool J-23062-1 and drive handle J-8092. Using tool J-23062-1 and drive handle J-8092 with extension J-21465-13, install bushing from interior of case to 3/16" from front surface with split in bushing located at governor pilot upper bore wall area.

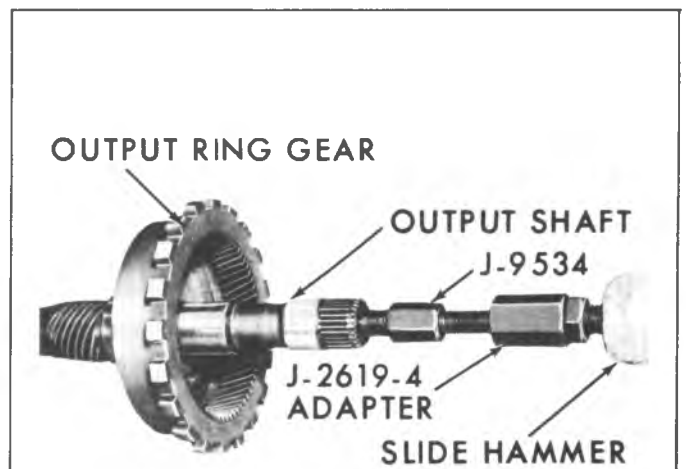


Fig. 95M--Removing Output Shaft Bushing

Stator Shaft Front Bushing

With stator shaft properly supported, remove front bushing using tool J-21465-16 and slide hammer with adapter J-2619-01 (fig. 96M). Using tool J-21242-7 and drive handle J-8092, install bushing to .250" from face (fig. 97M).

Stator Shaft Rear Bushing

With stator shaft properly supported, remove front bushing (fig. 98M). Place tool J-21424-7 and drive handle J-8092 with extension J-21465-13 through front of stator shaft and drive out two (2) rear bushings. Using tool J-23062-2 and extension J-21465-13, install inner bushing to approximately 1-5/32" below front face and

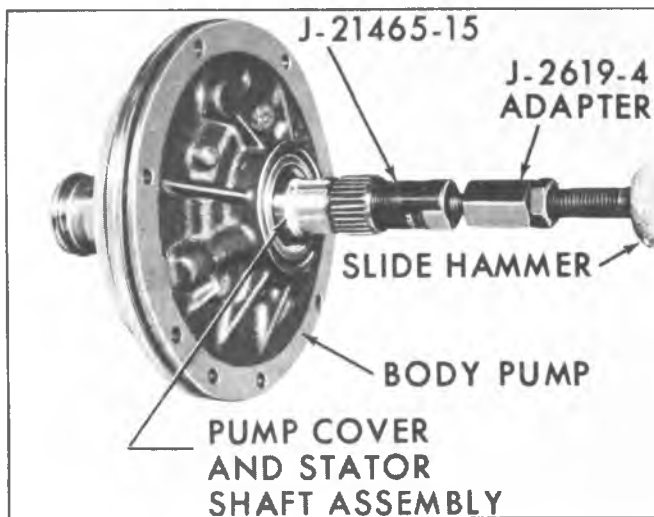


Fig. 96M--Removing Stator Shaft Front Bushing

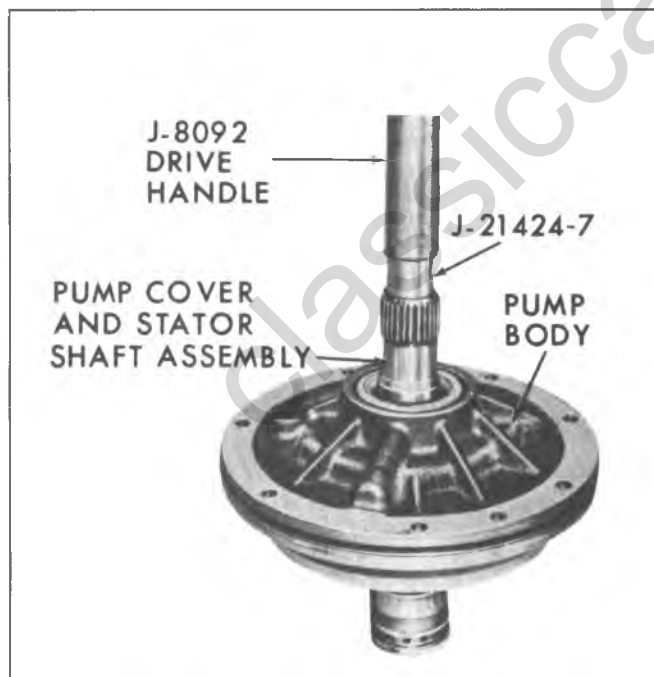


Fig. 97M--Installing Stator Shaft Front Bushing

outer bushing 3/32" below front face (fig. 98M). Install new front bushing (fig. 97M).

Input Ring Gear Bushing

With input ring gear properly supported, remove bushing using tool J-23062-5 and drive handle J-8092. Using tool J-23062-5 and drive handle J-8092, install bushing to approximately 1/16" below rear face inside gear end (fig. 99M).

Sun Gear Bushing

With sun gear properly supported, remove two (2) sun gear bushing using tool J-23062-3 and drive handle J-8092 with extension J-21465-13. Using tool J-23062-3 and drive handle J-8092, install sun gear bushings to .010" below surface at either end (fig. 100M).

Reaction Carrier Bushing

With reaction carrier properly supported, remove bushing using tool J-23062-3 and drive handle J-8092. Using tool J-23062-3 and drive handle J-8092, install bushing flush to or .010" below inside face.

Direct Clutch Bushing

With direct clutch drum properly supported, remove bushing (fig. 101). Using tool J-23329 and drive handle J-8092, install direct clutch drum bushing (fig. 102M).

TRANSMISSION ASSEMBLY

When servicing transmission, use only transmission oil or petroleum jelly as lubricants to retain bearings or

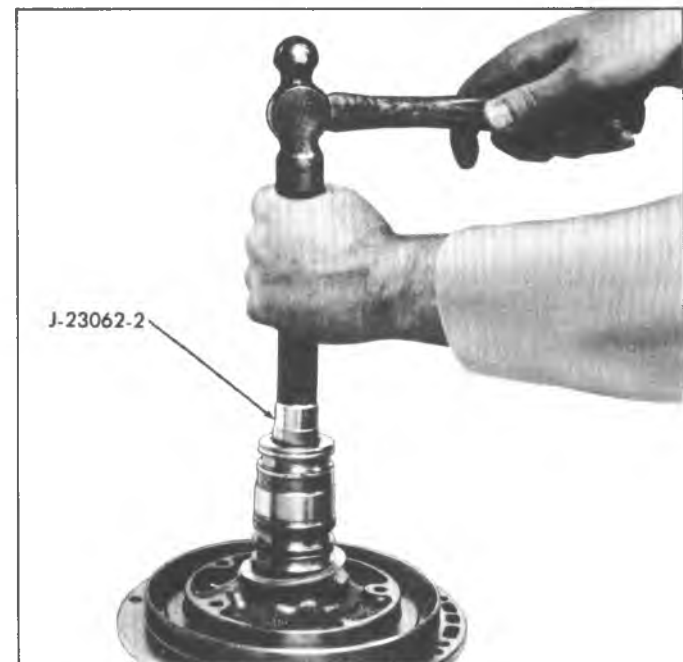


Fig. 98M--Installing Inner and Outer Stator Shaft Bushing

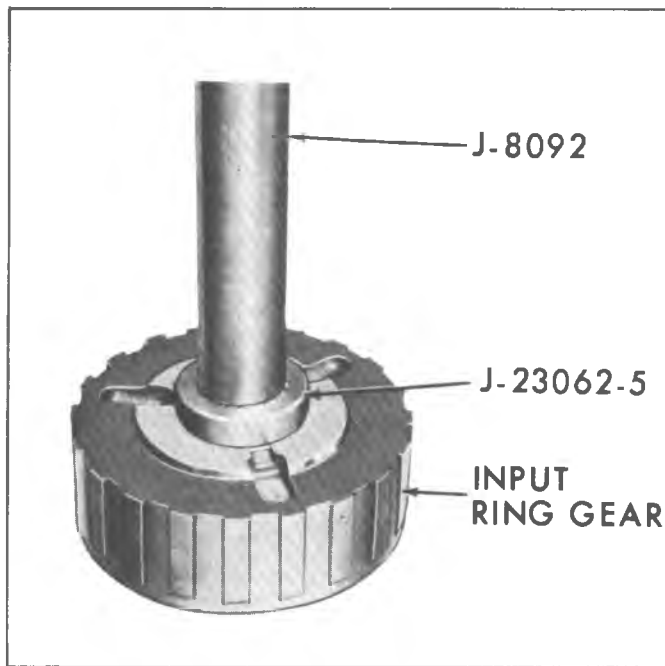


Fig. 99M--Installing Input Ring Gear Support Bushing

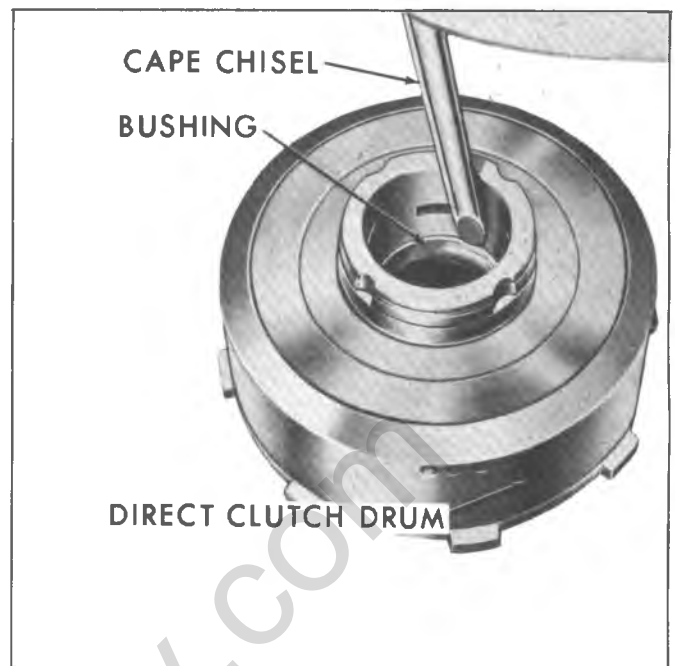


Fig. 101M--Removing Direct Clutch Drum Bushing

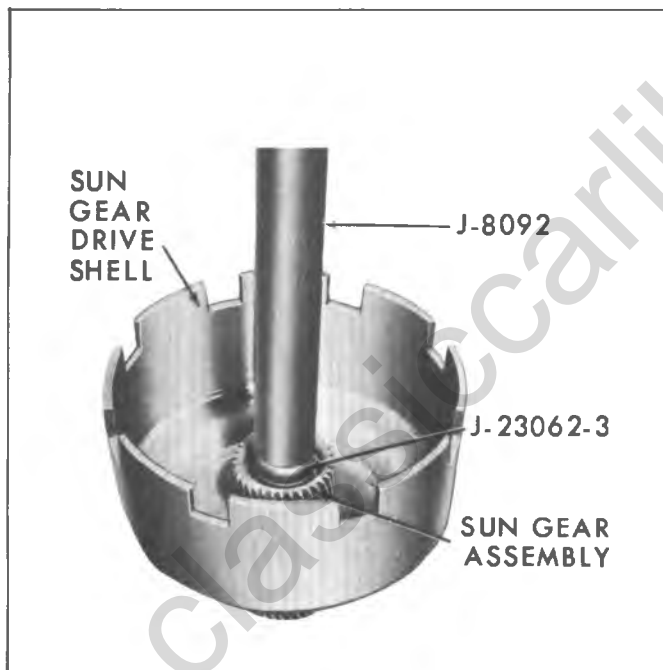


Fig. 100M--Installing Sun Gear Bushings

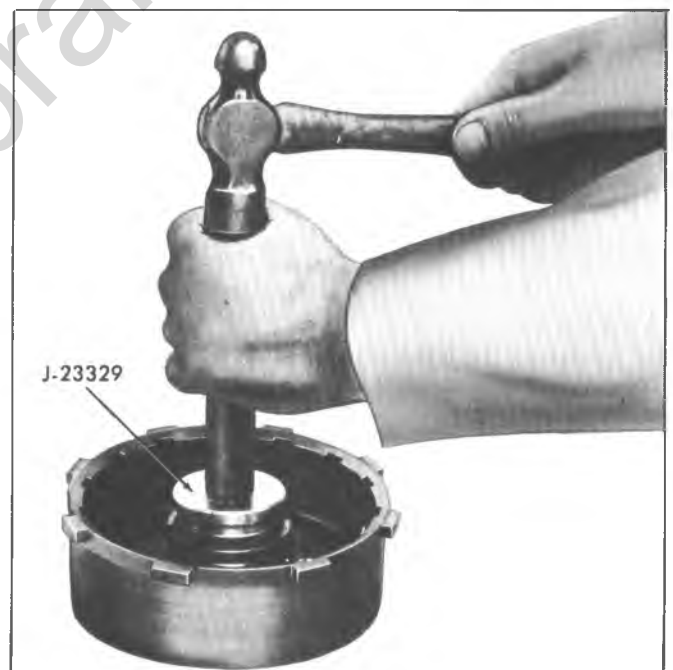


Fig. 102M--Installing Direct Clutch Drum Bushing

aces during assembly. Lubricate all bearings, seal rings and clutch plates prior to assembly.

Transmission Internal Components

1. Install low and reverse clutch piston assembly with notch in piston installed adjacent to parking pawl.
2. Install seventeen (17) piston return (coil) springs.
3. Install spring retainer and retaining ring. Using

tool J-23327, compress return seat so spring retainer retaining ring may be installed. Install output ring gear rear thrust bearing in case.

4. Install output ring gear on output shaft.
5. Install reaction carrier to output ring gear front thrust washer (3 tangs) into output ring gear support.
6. Install output shaft assembly into case.

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7. Install reaction carrier assembly into output ring gear and shaft assembly.
8. Oil and install low reverse clutch steel reaction plates and face plates, starting with a steel plate and alternating with face plates. Install low and reverse clutch support retainer (anti-clunk) spring.

NOTE: Notch in steel separator plates should be placed toward bottom of case.

9. Install low and reverse clutch support assembly with position of notch with low and reverse clutch support retainer (anti-clunk) spring as shown on Figure 103M.

IMPORTANT: Make certain the splines on inner race of the roller clutch align with splines on reaction carrier.

10. Install low and reverse roller clutch inner race to sun gear shell thrust washer.
11. Install low and reverse clutch support to case snap ring with anti-clunk spring between gap.
12. Install rear thrust washer and sun gear drive shell assembly.
13. Install output carrier assembly.
14. Install input ring gear rear thrust washer.
15. Install input ring gear.
16. Install new input ring gear to output shaft snap ring.

CAUTION: Do not over stress snap ring.

Install input gear front thrust washer.

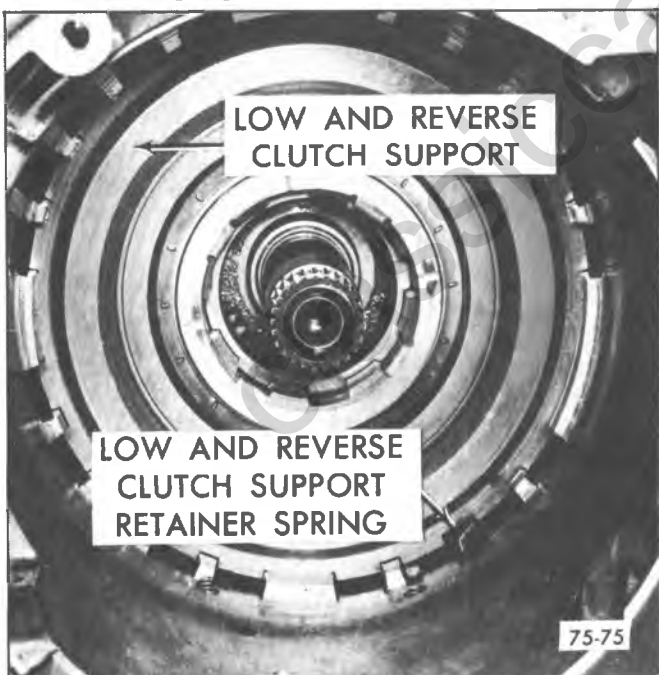


Fig. 103M--Installing Low and Reverse Clutch Support Assembly

18. Install direct clutch assembly, and special thrust washer to forward clutch assembly.
19. Install clutch assemblies into case.

CAUTION: Make certain forward clutch face plates are positioned over input ring gear and the tangs on direct clutch housing are installed into slots on the sun gear drive shell.

20. Install intermediate clutch overrun brake band.
21. Install intermediate clutch pressure plate.
22. Oil and install face and steel intermediate clutch plates, starting with a face plate and alternating steel and face.

NOTE: Notch in steel reaction plates is installed toward selector lever inner bracket.

23. Install intermediate clutch cushion spring.

Pump To Direct Clutch Thrust Washer Selection Procedure

24. To check for proper thickness of selective fit thrust washer between the oil pump cover and direct clutch assembly, proceed as follows:
 - a. Install selective fit thrust washer, (fig. 104M) oil pump gasket and using guide studs from J-3387 set install oil pump. Install two pump to case bolts.
 - b. Move transmission so that output shaft points down. Mount a dial indicator so that plunger of indicator is resting on end of the input shaft. J-5492 may be used to support the dial indicator as shown in Figure 105M. Zero the indicator.



Fig. 104M--Pump Cover to Direct Clutch Selective Thrust Washer

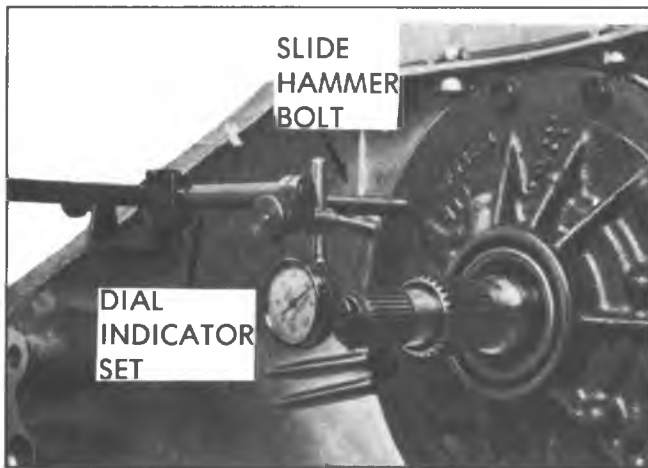


Fig. 105M--Checking End Play for Proper Thrust Washer Selection

- c. Push up on the transmission output shaft and observe the total indicator movement.
- d. The indicator should read .032" to .064". If the reading is within limits, the proper selective fit washer is being used. If the reading is not within limits, it will be necessary to remove the pump and change to a thicker or thinner selective fit thrust washer, as required to obtain the specified clearance. Repeat the above checking procedure.

NOTE: Selective fit thrust washers are available in thicknesses of .066", .083" and .100".

25. Install new pump assembly in case gasket.
26. Install new pump assembly to case square cut oil seal ring.
27. Install guide pins into case.
28. Install pump assembly into case. Install attaching bolts with new washer type seals.

IMPORTANT: If the input shaft can not be rotated as the pump is being pulled into place, the direct and forward clutch housings have not been properly installed to index the faced plates with their respective parts. This condition must be corrected before the pump is pulled into place.

Speedometer Drive Gear and Extension

1. Place speedometer drive gear retaining clip into hole in output shaft.
2. Heat a new speedometer drive gear using a heat lamp or suitable heat method.
3. Align slot in speedometer drive gear with retaining clip and install.
4. Install extension housing to case square cut "O" ring seal.

5. Attach extension housing to case using attaching bolts. Torque to 25 ft. lb.
6. If necessary, install a new extension housing seal, using seal installer J-5154 or J-21426 (fig. 106M).

Manual Linkage

1. If necessary, install a new manual shaft to case lip seal using 3/4" diameter rod, seat seal in case.
2. Install parking pawl, tooth toward the inside of case, into case.
3. Install parking pawl shaft into case and through parking pawl.
4. Install parking pawl shaft retainer plug. Drive into case using a 3/8" dia. rod, until retainer plug is .130" to .170" below face of case, then stake in three places.
5. Install parking pawl disengaging spring, square end hooked on pawl.
6. Install park lock bracket, torque bolts to 29 ft. lb. (fig. 107).

CAUTION: 290 M Bolts -- 6 marks on head.

7. Install range selector inner lever to parking pawl actuator rod.
8. Install actuating rod under the park lock bracket and parking pawl.
9. Install manual shaft through case and range selector inner lever.
10. Install retaining nut on manual shaft. Torque to 30 ft. lbs.
11. Install manual shaft to case spacer clip.

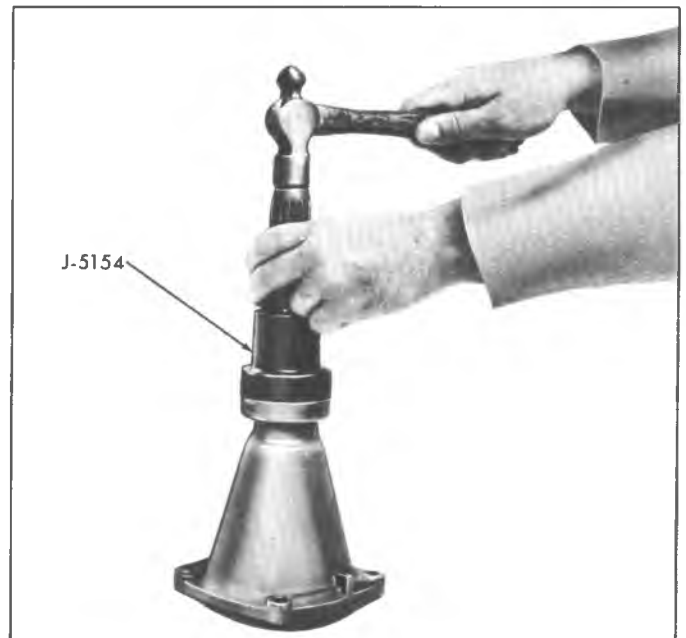


Fig. 106M--Installing Extension Housing Seal

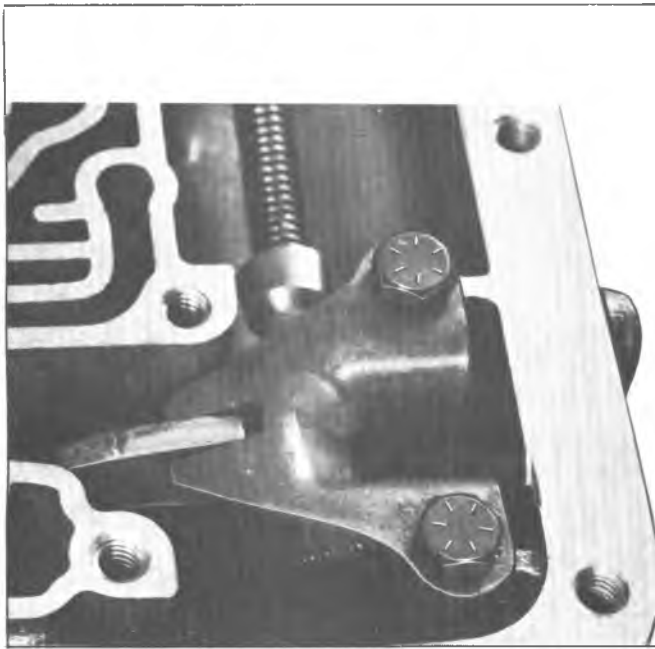


Fig. 107M--Park Lock Bracket Special Bolt Identification

Intermediate Servo Piston, Valve Body, Oil Pan and Gasket

1. Install intermediate servo piston, apply pin, spring and spring seat.
2. Install intermediate servo piston and metal oil seal ring.
3. Install four (4) check balls into proper transmission case pockets (fig. 16M).
4. Install oil pump pressure screen and governor feed screen.
5. Install valve body transfer plate and gasket assembly.
6. Install valve body to transfer plate gasket.
7. Install valve body. Connect manual control valve link to range selector inner lever. Torque bolts in random sequence to 130 inch pounds.
8. Install spacer support plate, torque bolts to 130 inch pounds.

9. Connect detent control valve wire to detent valve actuating lever, then attach lever to valve body.
10. Install detent roller and spring assembly to valve body.
11. Align lube holes in strainer with those in valve body and install strainer assembly gasket and strainer.
12. Install oil pan using a new gasket. Tighten bolts to 130 inch pounds in succession until bolts maintain torque specification.

NOTE: If a new oil pan is being installed, transfer production code number is on right side of old pan to new pan. On JA and JH models, production code number is on governor cover.

Governor and Vacuum Modulator

1. Install governor assembly, cover and seal and retainer wire.
2. Install vacuum modulator valve.
3. Install vacuum modulator and retainer clip. Torque bolt to 130 inch pounds.

NOTE: Position retainer with tangs pointing toward modulator.

Intermediate Clutch Accumulator (Refer to Figures 51M and 52M)

1. Install intermediate clutch accumulator piston assembly.
2. Install intermediate clutch accumulator spring.
3. Install new "O" ring seal in groove in case before installing cover.
4. Install intermediate clutch accumulator cover and retaining ring using tool J-23069.

TURBO HYDRA-MATIC 375/400/475 TRANSMISSION

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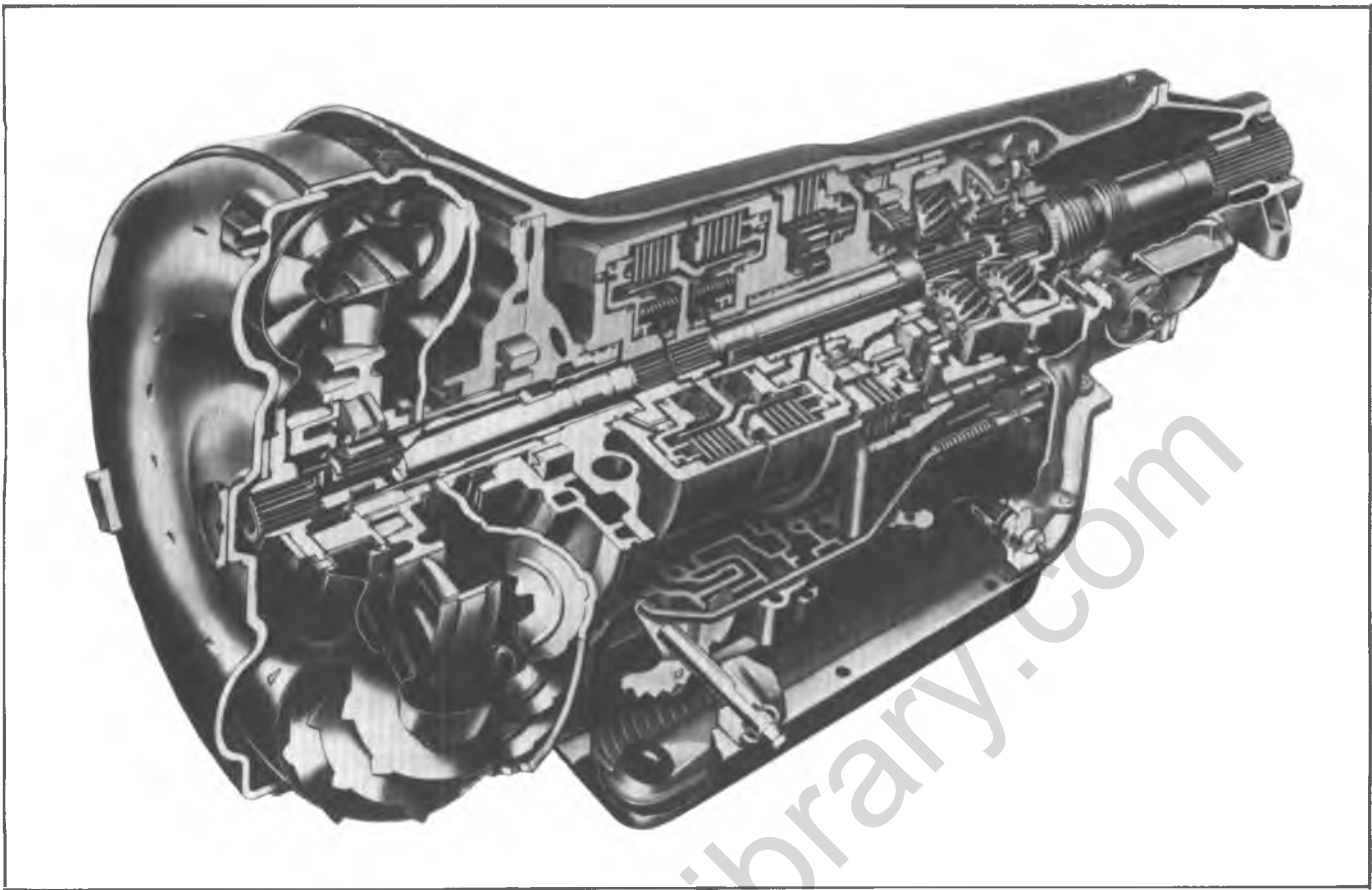


Fig. 1T--Side Cross Section--Typical

TRANSMISSION DISASSEMBLY AND ASSEMBLY

DISASSEMBLY OF MAJOR UNITS

1. With transmission in cradle on portable jack, remove converter assembly by pulling straight out.

NOTE: Converter contains a large amount of oil.

2. Install holding Fixture J-8763-01 on transmission so that modulator assembly will be located on side of holding fixture nearest bench (fig. 2T).

NOTE: Do not over-torque holding screw. This will bind center support.

3. Install fixture and transmission into holding Tool Base J- 3289-14 with bottom pan facing up (fig. 2T).
4. Remove modulator assembly attaching screw and retainer (fig. 3T).
5. Remove vacuum modulator assembly and "O" ring seal from case (fig. 4T). Discard "O" ring.
6. Remove modulator valve from transmission case (fig. 4T).

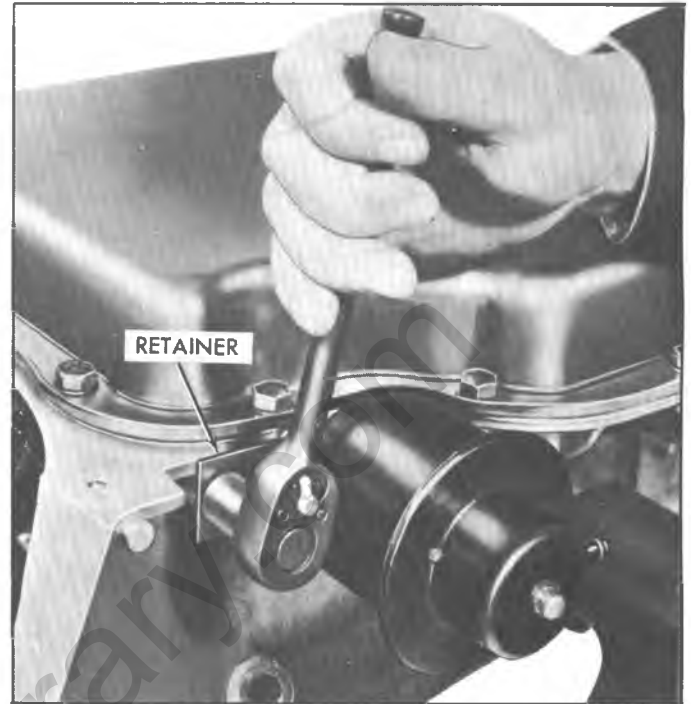


Fig. 3T--Removing Modulator Retainer



Fig. 2T--Transmission in Holding Fixture

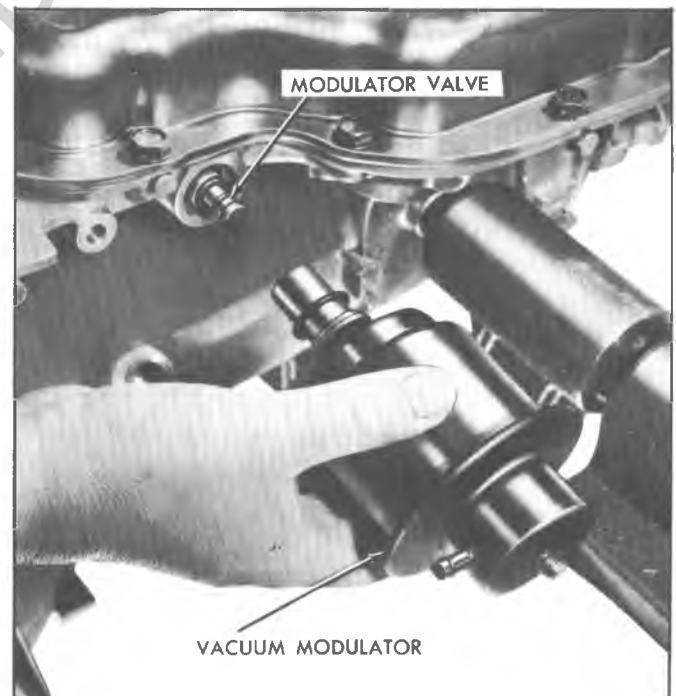


Fig. 4T--Removing Vacuum Modulator and Valve

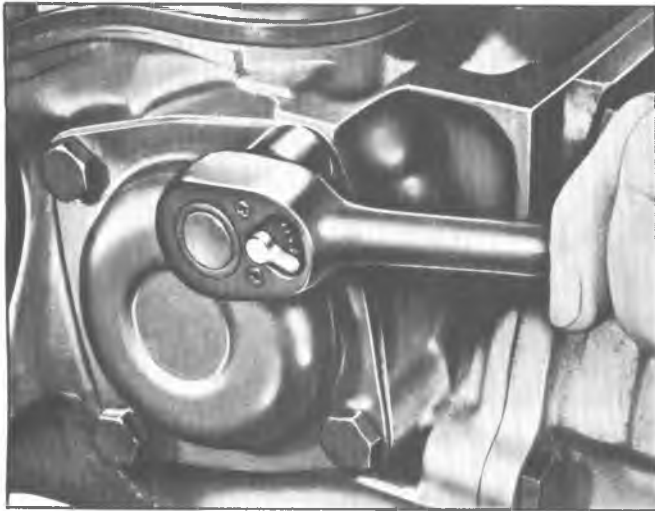


Fig. 5T--Removing Governor Cover Attaching Screws

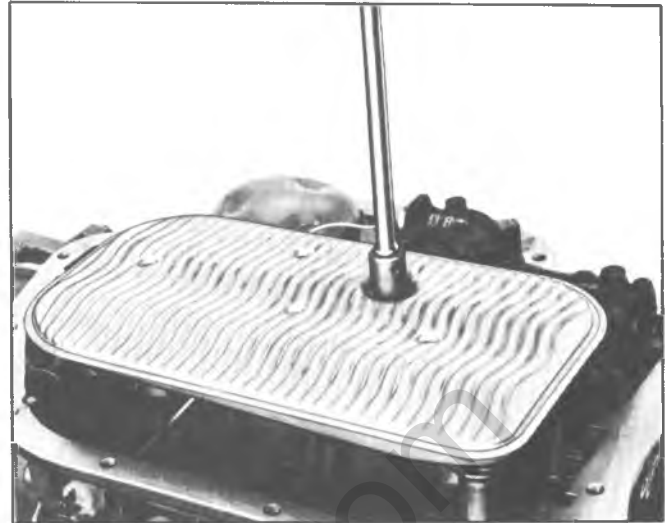


Fig. 7T--Removing Filter Retainer Bolt

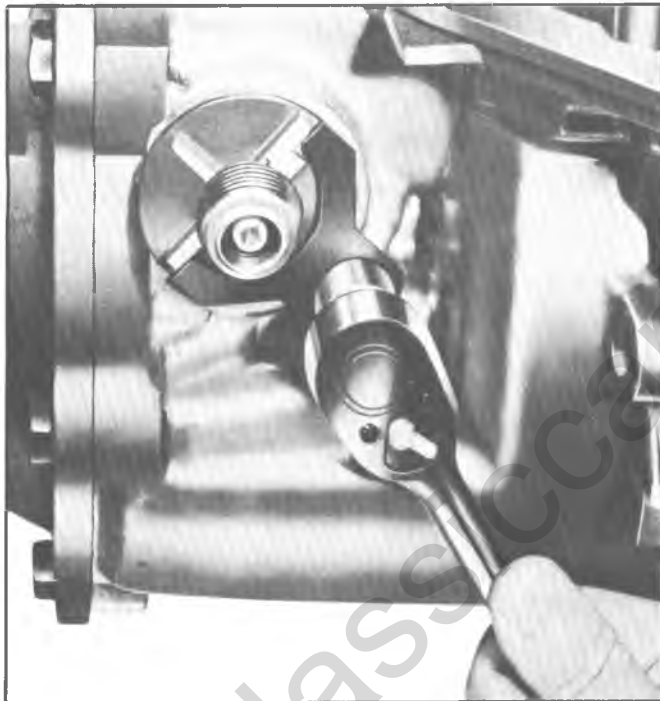


Fig. 6T--Removing Speedometer Driven Gear Retainer

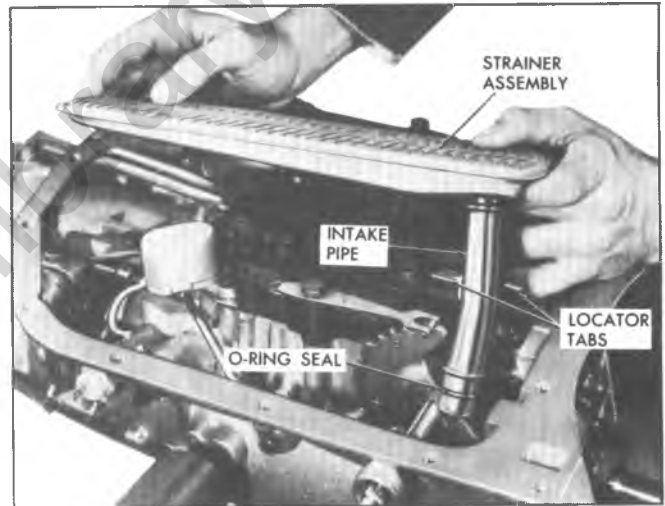


Fig. 8T--Removing Filter Assembly and "O" Ring

Removal of Governor Speedometer Driven Gear, Pan, Filter and Intake Pipe

1. Remove attaching screws, governor cover and gasket (fig. 5T). Discard gasket.
2. Withdraw governor assembly from case.

3. Remove speedometer driven gear attaching screw and retainer (fig. 6T).
4. Withdraw speedometer driven gear assembly from case.
5. Remove bottom pan attaching screws, bottom pan and bottom pan gasket. Discard gasket.
6. Remove the filter retainer bolt (fig. 7T).
7. Remove filter and intake pipe assembly from case (fig. 8T) and discard filter.
8. Remove intake pipe to case "O" ring seal from intake pipe or case and discard.

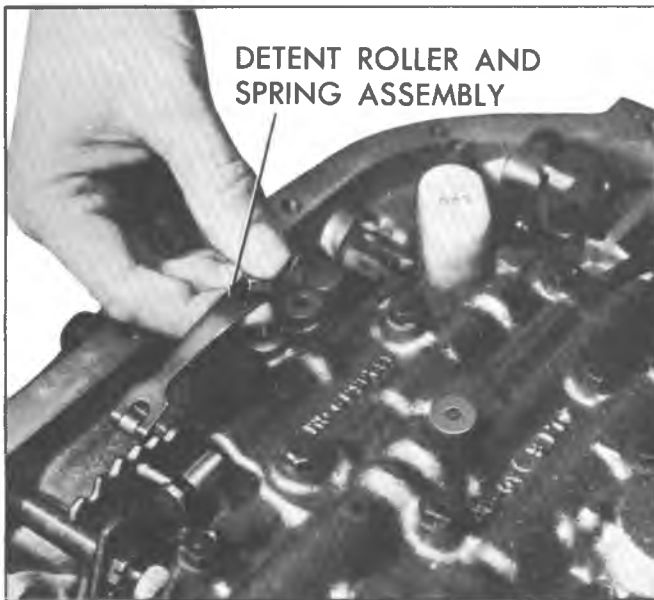


Fig. 9T--Removing Detent Roller and Spring Assembly

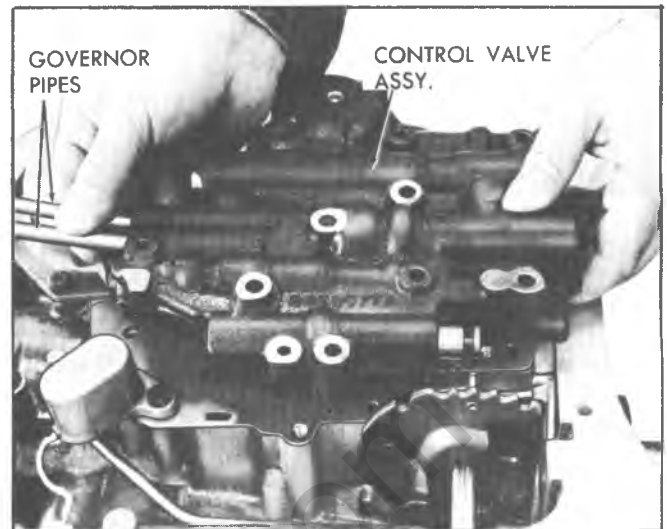


Fig. 10T--Removing Control Valve Assembly and Governor Pipes from Case

Removal of Control Valve Assembly, Solenoid Connector, Governor Pipes, Governor Screen Assembly, and Detent Spring Assembly

1. Remove control valve body attaching screws and detent roller and spring assembly (fig. 9T).

NOTE: Do not remove solenoid attaching screws.

CAUTION: If transmission is in the vehicle, the front servo parts may drop out as the control valve assembly is removed.

2. Remove control valve assembly and governor pipes (fig. 10T).

CAUTION: Do not drop manual valve.

3. Remove governor screen assembly from governor feed pipe hole in the case or from end of governor feed pipe (fig. 10T-A). Clean governor screen in clean solvent and air dry.

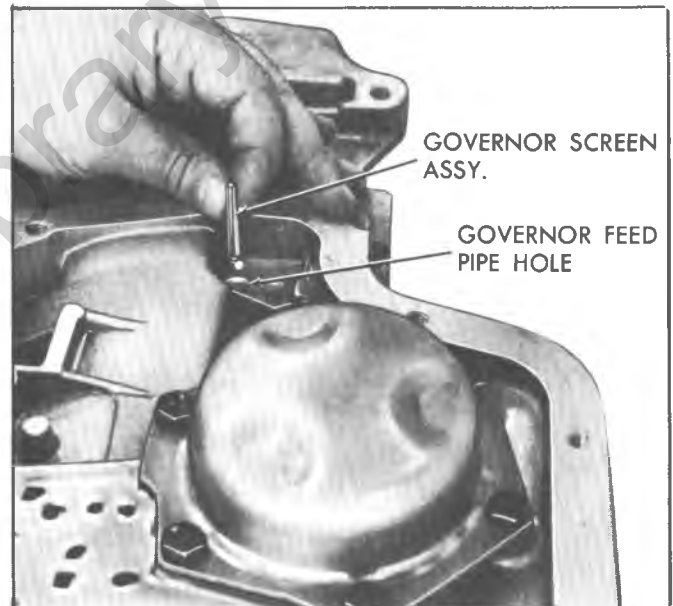


Fig. 10T-A--Removing Governor Screen Assembly

4. Remove governor pipes from control valve assembly.
5. Disconnect solenoid lead wire from connector terminal (fig. 10T- B).

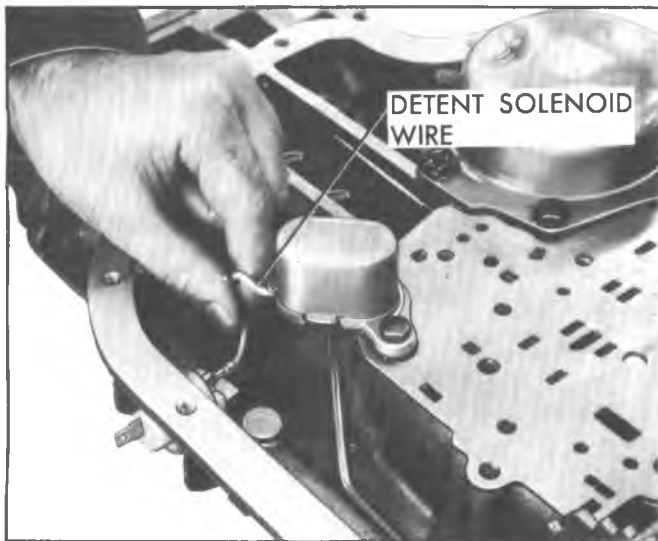


Fig. 10T-B--Disconnecting Detent Solenoid Wire

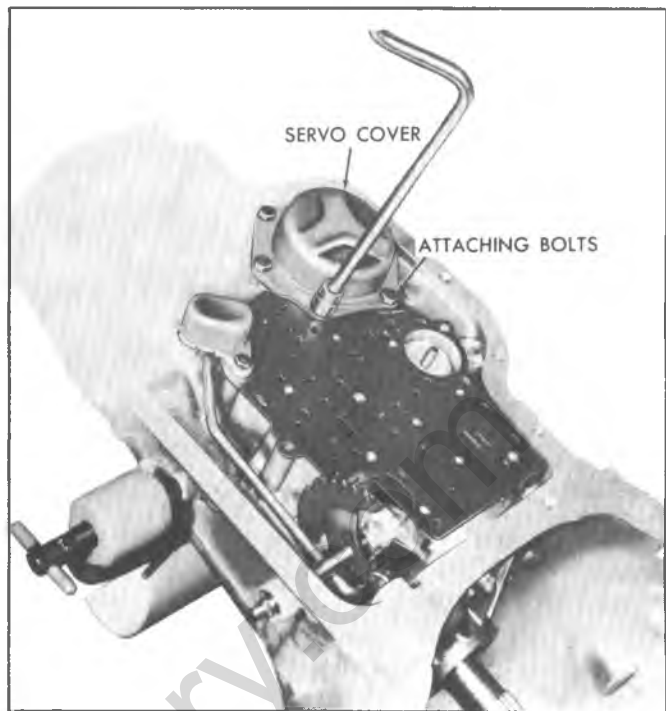


Fig. 11T--Removing Rear Servo Cover Attaching Bolts

Removal of Rear Servo, Valve Body Spacer, Gasket and Front Servo

1. Remove rear servo cover attaching screws, servo cover and gasket. Discard gasket (fig. 11T).
1. Remove rear servo assembly from case (fig. 12T).
3. Remove rear servo accumulator spring.
4. Make band apply pin selection check to determine possible cause of malfunction (fig. 13T).

Rear Band Apply Pin Selection

- a. Attach band apply pin selection Gauge J-21370-5 and J-21370-6 to transmission case with attaching screws checking to make certain the gauge pin does not bind in servo pin hole (fig. 13T).
- b. Apply 25 ft. lb. torque and select proper pin to be used during assembly of transmission.

Selecting proper length pin is equivalent to adjusting band. The band lug end of each selective apply pin bears indentation in the form of one, two or three rings.

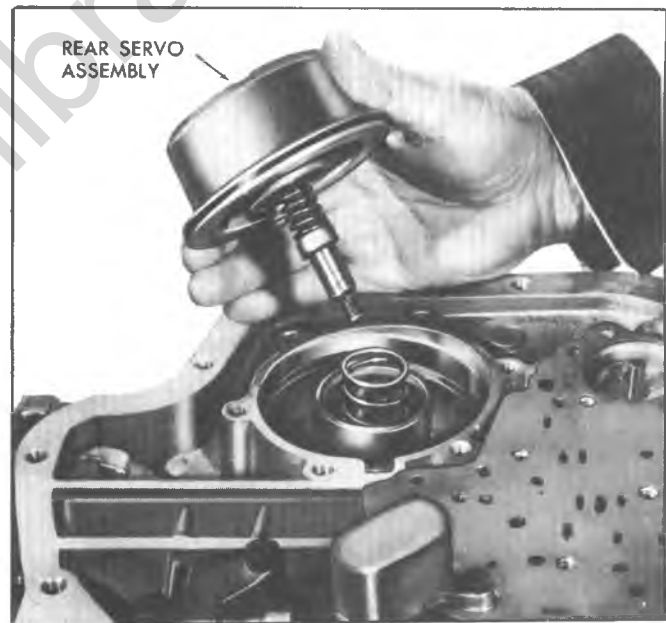


Fig. 12T--Removing Rear Servo Assembly

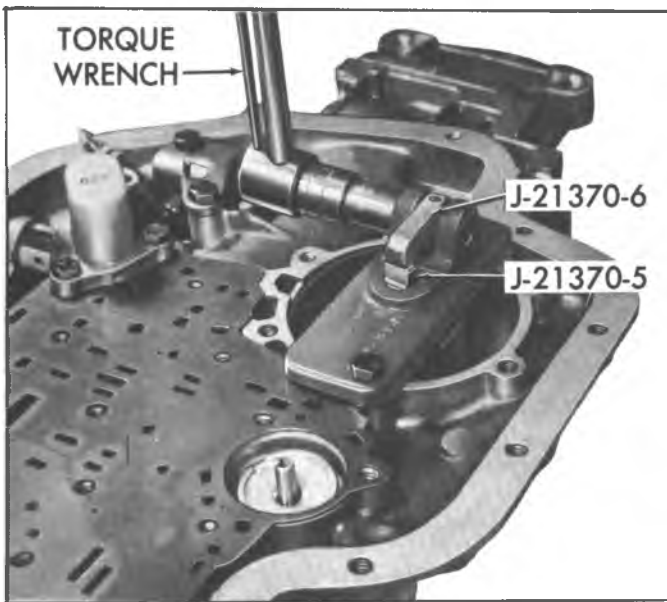


Fig. 13T--Checking Rear Band Apply Pin

- c. If both steps of J-21370-5 are below the gauge surface, the long pin, identified by 3 rings, should be used.
- d. If the gauge surface is between the steps, the medium pin, identified by 2 rings, should be used.
- e. If both steps are above the gauge surface, the short pin, identified by 1 ring, should be used.

NOTE: If the transmission is in the vehicle, be careful when the detent solenoid is removed as it prevents the spacer plate and gasket and check balls from dropping down.

5. Remove detent solenoid attaching screws, detent solenoid and gasket (fig. 14T).
6. Withdraw electrical connector and "O" ring seal (fig. 15T).
7. Remove control valve assembly spacer plate and gasket.
8. Remove six (6) check balls from cored passages in transmission case.

NOTE: Mark location of balls for aid in reassembly.

9. Remove front servo piston, retainer ring, washer, pin, spring retainer and spring from transmission case (fig. 16T).



Fig. 14T--Removing Detent Solenoid and Gasket

Remove Manual Linkage

NOTE: If necessary, remove manual linkage as follows:

1. Unthread jam nut holding detent lever to manual shaft.
2. Remove manual shaft retaining pin from case (fig. 17T).
3. Remove manual shaft and jam nut from case (fig.



Fig. 15T--Removing Electrical Connector and "O" Ring Seal

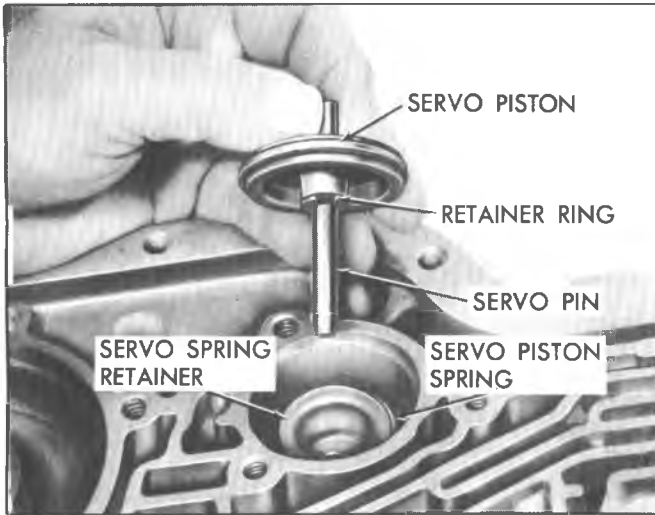


Fig. 16T--Removing Front Servo Piston, Retainer Ring, and Pin

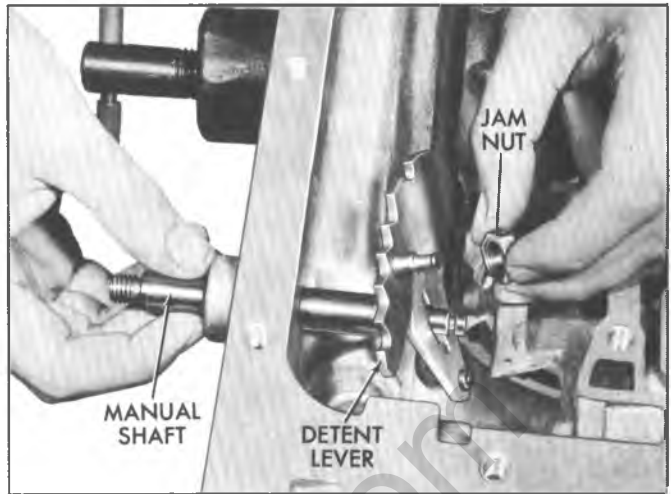


Fig. 18T--Removing Detent Lever and Jam Nut from Manual Shaft

18T). Do not lose jam nut as it becomes free from manual shaft.

4. Remove parking actuator rod and detent lever assembly.
5. Remove attaching screws and parking bracket (fig. 19T).

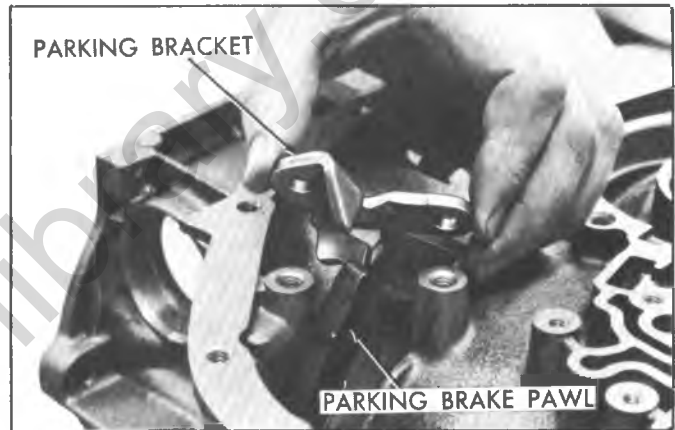


Fig. 19T--Removing Parking Bracket

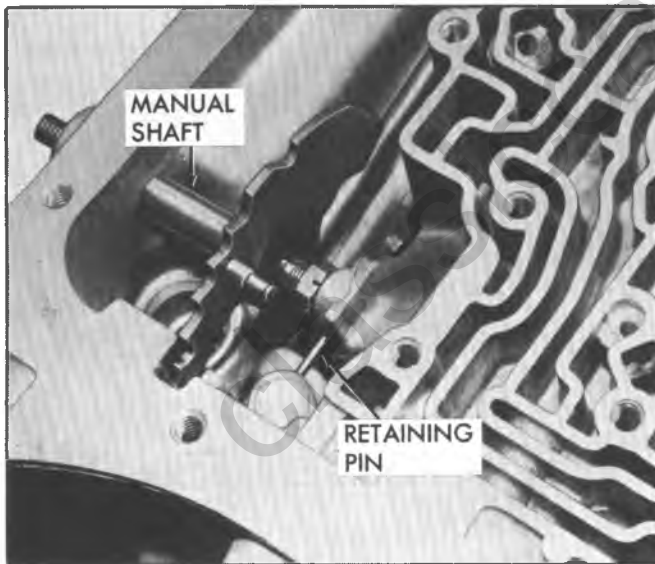


Fig. 17T--Removing Manual Shaft Retaining Pin from Case

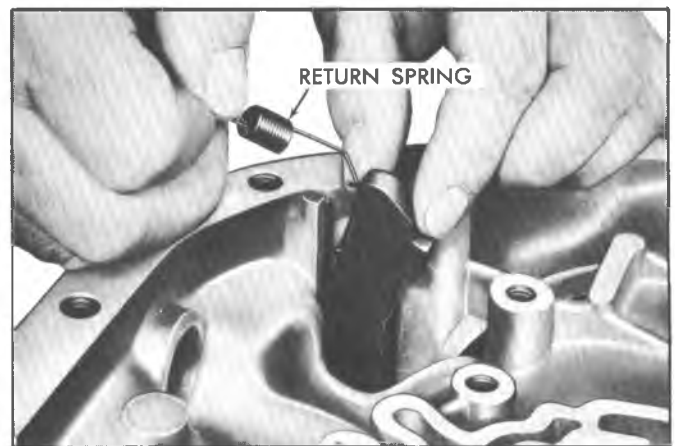


Fig. 20T--Removing Parking Pawl Return Spring

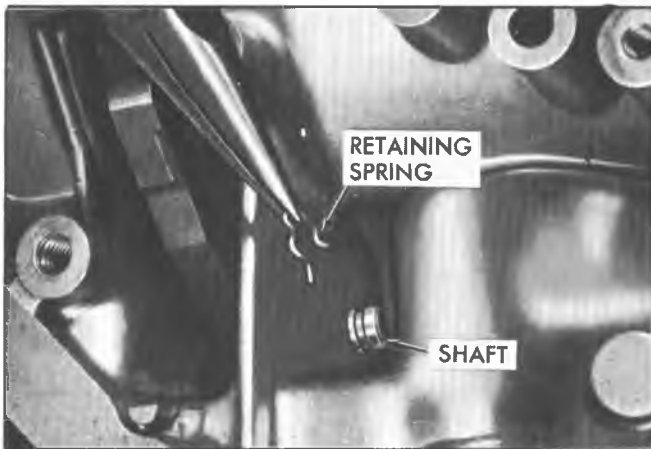


Fig. 21T--Removing Parking Shaft Retaining Spring

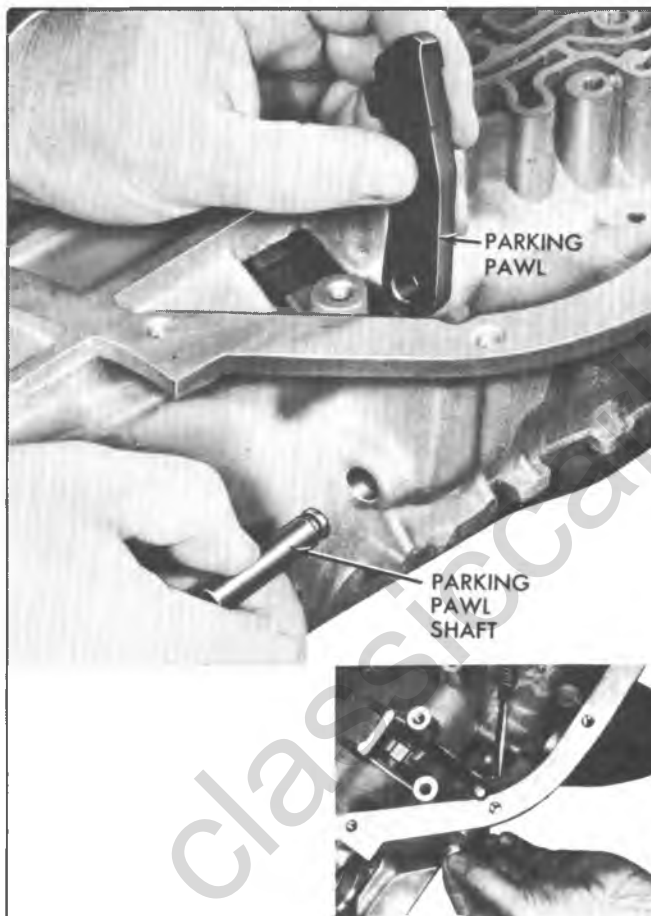


Fig. 22T--Removing Parking Pawl, Shaft and Cup Plug

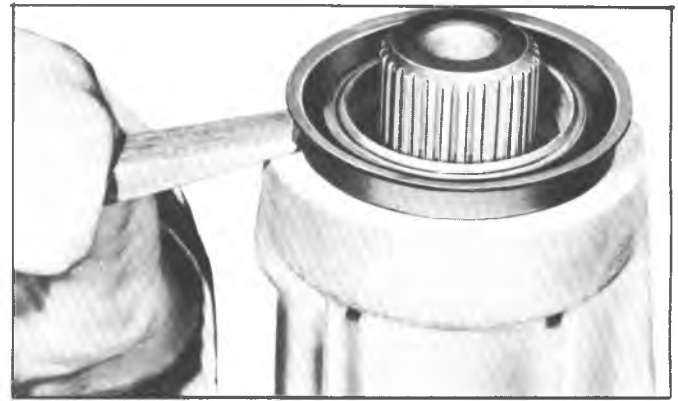


Fig. 23T--Removing Rear Oil Seal from Case Extension

6. Remove parking pawl return spring (fig. 20T).
NOTE: The following steps are to be completed only if 1 or more of the parts involved require replacement.
7. Remove parking pawl shaft retainer (fig. 21T).
8. Remove parking pawl shaft cup plug by inserting a screwdriver, between the parking pawl shaft and the case rib, and prying outwards (fig. 22T).
9. Remove parking pawl shaft and parking pawl (fig. 22T).

Removal of Rear Oil Seal and Case Extension

1. If necessary to replace, pry rear oil seal from case extension (fig. 23T).
2. Remove case extension to case attaching bolts.
3. Remove case extension to case gasket (fig. 24T).
4. Make front unit end play check as follows (fig. 25T):
 - a. Remove one front pump attaching bolt, and bolt washer. (See Figure 25T for location).
 - b. Install a 3/8"-16 threaded slide hammer bolt or J-9539, into bolt hole.
 - c. Mount a dial indicator on rod and index indicator to register with end of turbine shaft.

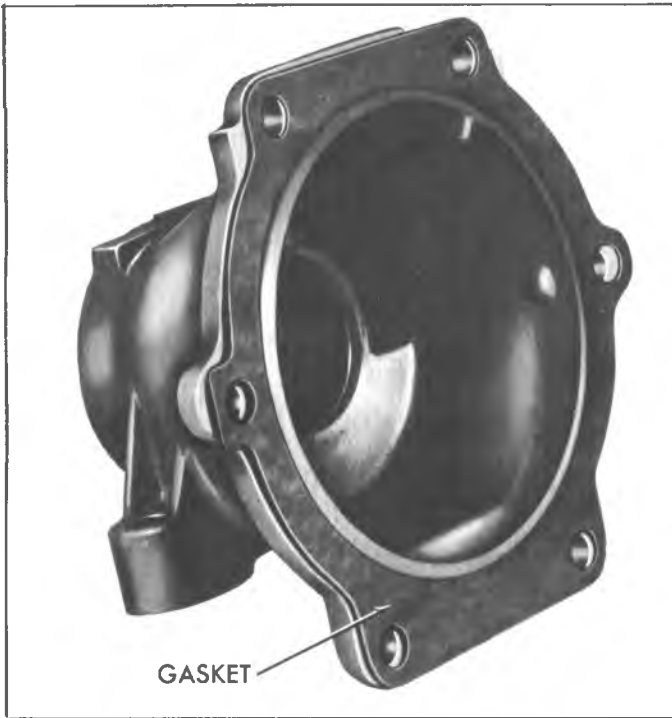


Fig. 24T--Case Extension and Gasket

- d. Push on turbine shaft rearward.
- e. Push output shaft forward.
- f. Set dial indicator to Zero.
- g. Pull turbine shaft forward.

Read resulting travel or end play. Should be .003"-.024".

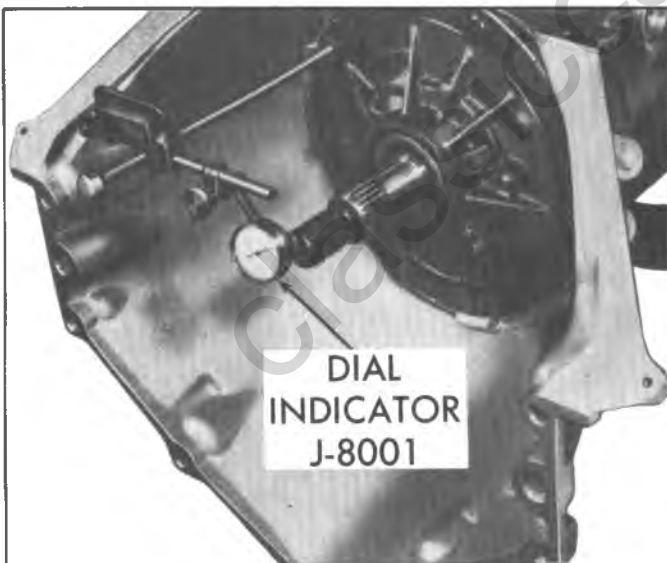


Fig. 25T--Checking Front Unit End Play

Selective washer controlling this end play is the washer located between pump cover and forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select proper washer from the following chart:

FRONT END WASHER THICKNESS

Thickness	Color
.060 - .064	Yellow
.071 - .075	Blue
.082 - .086	Red
.093 - .097	Brown
.104 - .108	Green
.115 - .119	Black
.126 - .130	Purple

NOTE: An oil soaked washer may tend to discolor, so it will be necessary to measure washer for its actual thickness.



Fig. 26T--Removing Front Seal

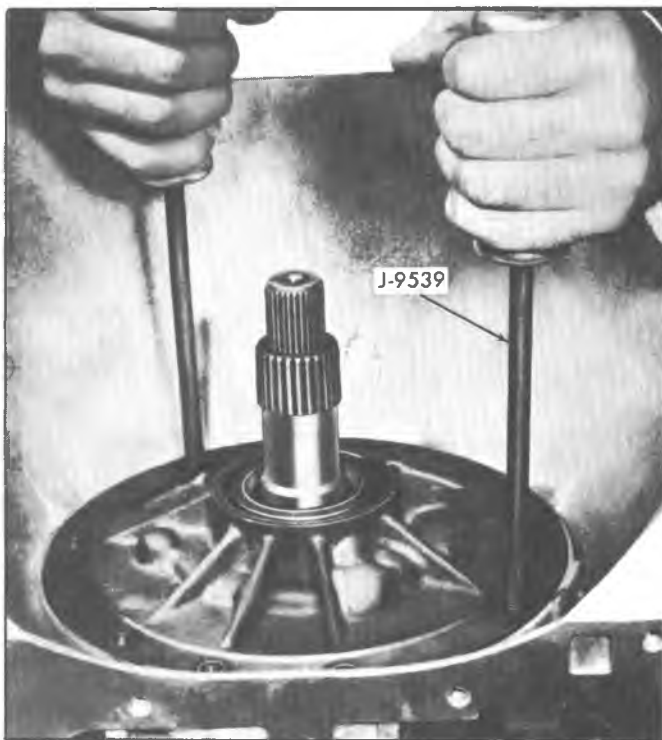


Fig. 27T--Removing Pump Assembly

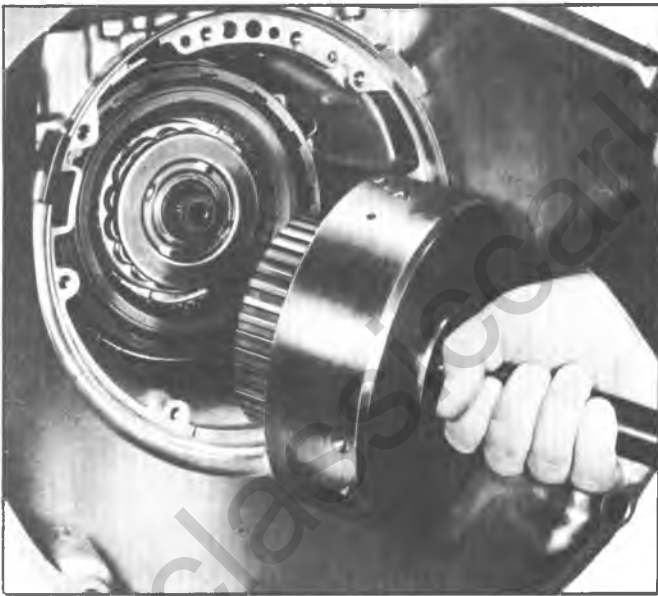


Fig. 28T--Removing Forward Clutch Assembly and Turbine Shaft

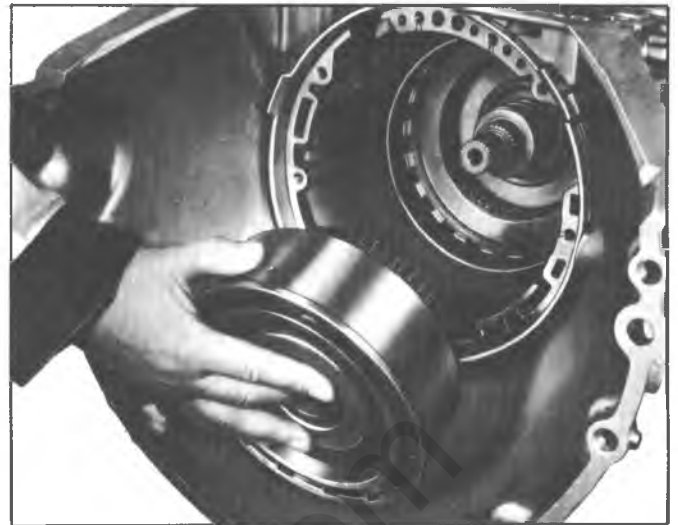


Fig. 29T--Removing Direct Clutch Assembly

Oil Pump and Internal Case Components

Removal

1. If necessary to replace, pry front seal from pump (fig. 26T).
2. Remove pump attaching bolts.
3. Install two 3/8"-16 threaded slide hammer bolts, J-9539 with weights J-6585-01, into bolt holes in pump body and remove pump assembly from case (fig. 27T). (See illustration for location of threaded holes.)
4. Remove and discard pump to case seal and gasket.
5. Remove forward clutch assembly and turbine shaft from transmission (fig. 28T).
6. Remove forward clutch hub to direct clutch housing thrust washer, if it did not come out with forward clutch housing assembly.
7. Remove direct clutch assembly (fig. 29T).

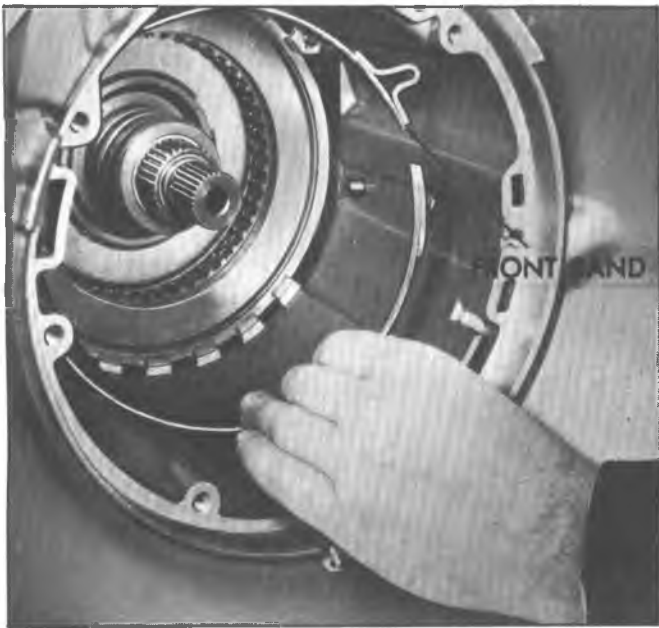


Fig. 30T--Removing Front Band

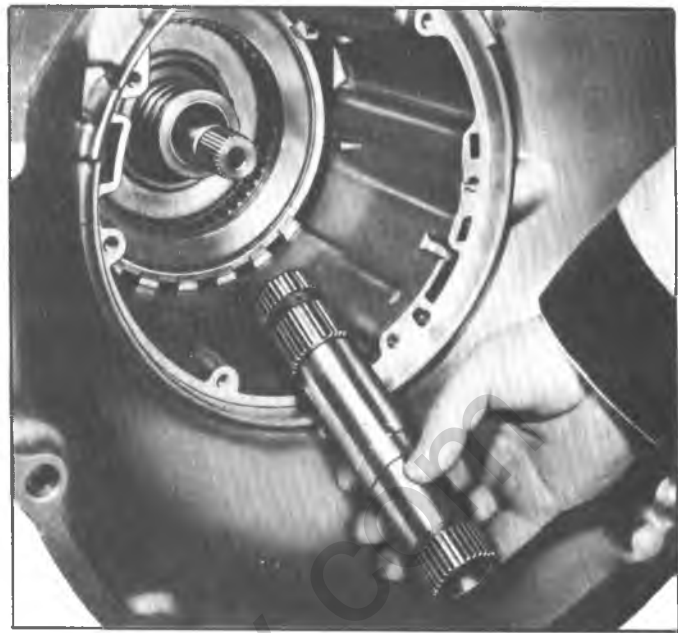


Fig. 31T--Removing Sun Gear Shaft

8. Remove front band assembly (fig. 30T).
9. Remove sun gear shaft (fig. 31T).

Check Rear End Play as Follows (Fig. 32T)

- a. Install J-9539 or a 3/8"-16 threaded bolt into an extension housing attaching bolt hole (fig. 32T).
- b. Mount a dial indicator on bolt and index with end of output shaft.
- c. Move output shaft in and out to read end play. End play should be from .007"-.019". Selective washer controlling this end play is a steel washer having 3 lugs that is located between output shaft thrust washer and rear face of transmission case.

If a different washer thickness is required to bring end play within specification, it can be selected from the following chart.

10. Remove center support to case bolt (fig. 33T), using a 3/8" 12-point thin wall deep socket.
11. Remove intermediate clutch backing plate to case snap ring.

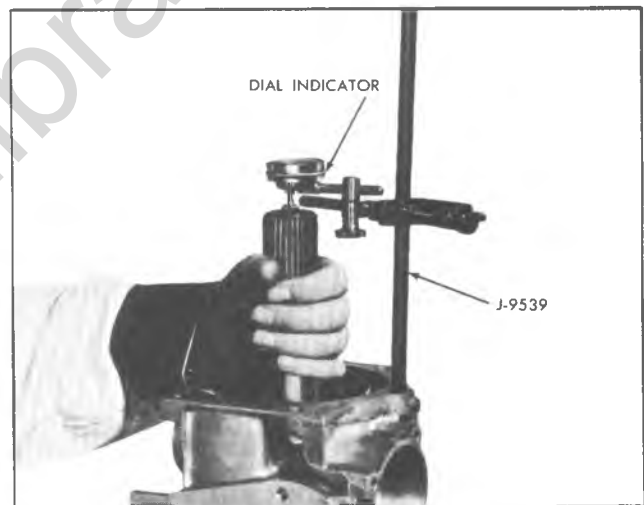


Fig. 32T--Checking Rear Unit End Play

REAR END WASHER THICKNESS

Thickness	Identification
.074 - .078	None 1
.082 - .086	1 Tab Side 2
.090 - .094	2 Tab Side 3
.098 - .102	1 Tab O.D. 4
.106 - .110	2 Tabs O.D. 5
.114 - .118	3 Tabs O.D. 6



Fig. 33T--Removing Center Support Bolt

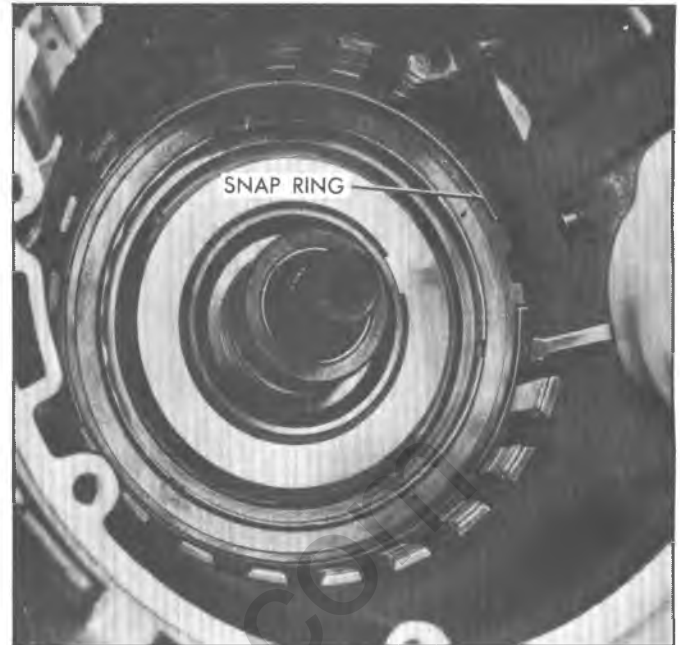


Fig. 35T--Removing Center Support to Case Retaining Snap Ring

12. Remove intermediate clutch backing plate, three (3) composition, and three (3) steel clutch plates (fig. 34T).
13. Remove intermediate clutch plates.
 - a. (All except CY Model) Remove three (3) composition, three (3) steel clutch plates and one waved steel plate.
 - b. (CY Model) Remove two (2) composition and three (3) steel clutch plates.
14. Remove center support to case retaining snap ring (fig. 35T).
15. Remove entire gear unit assembly by lifting with gear assembly installing and removing Holding Tool J-21795 with J-9539 slide hammer (fig. 36T).

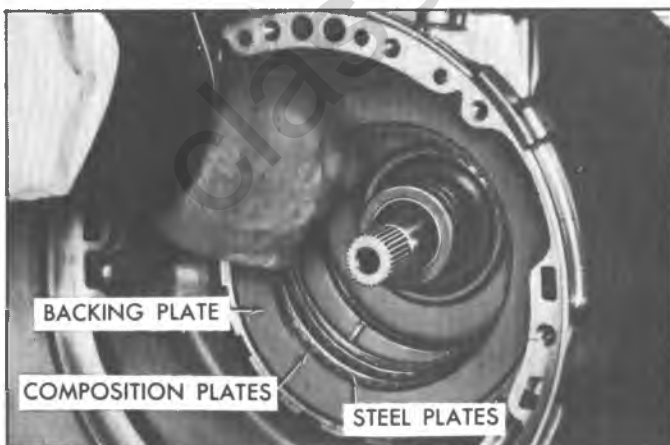


Fig. 34T--Removing Intermediate Backing Plate and Clutch Plates

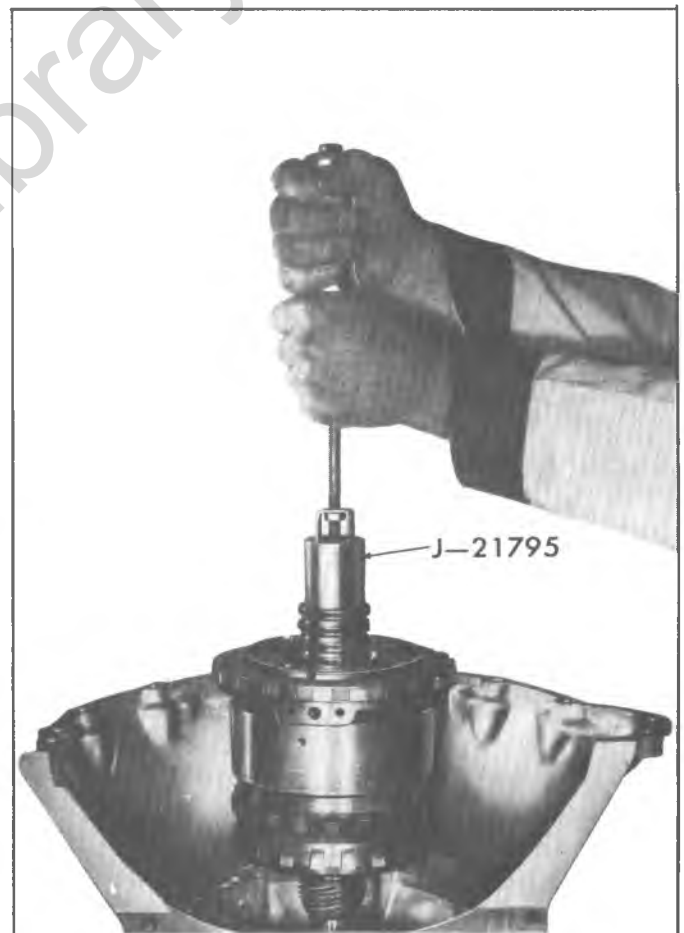


Fig. 36T--Removing Center Support and Gear Unit from Case



Fig. 37T-Removing Selective Washer

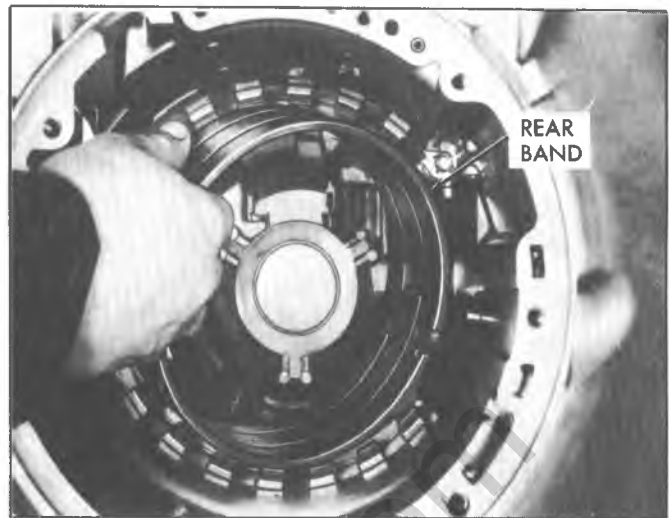


Fig. 38T-Removing Rear Band

16. Remove shaft to case thrust washer from rear of output shaft or inside case.
17. Place gear unit assembly, with output shaft facing down through hole in work bench.
18. Remove rear unit selective washer from transmission case (fig. 37T).
19. Remove center support to case spacer (fig. 37T-A).
20. Remove rear band assembly (fig. 38T).



Fig. 37T-A-Removing Center Support to Case Spacer

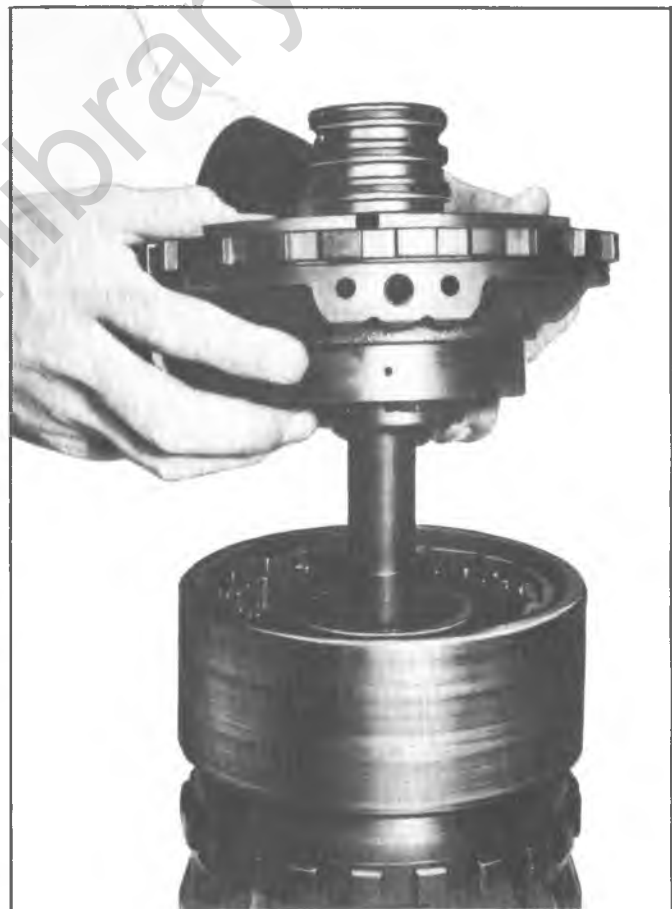


Fig. 39T-Removing Center Support Assembly

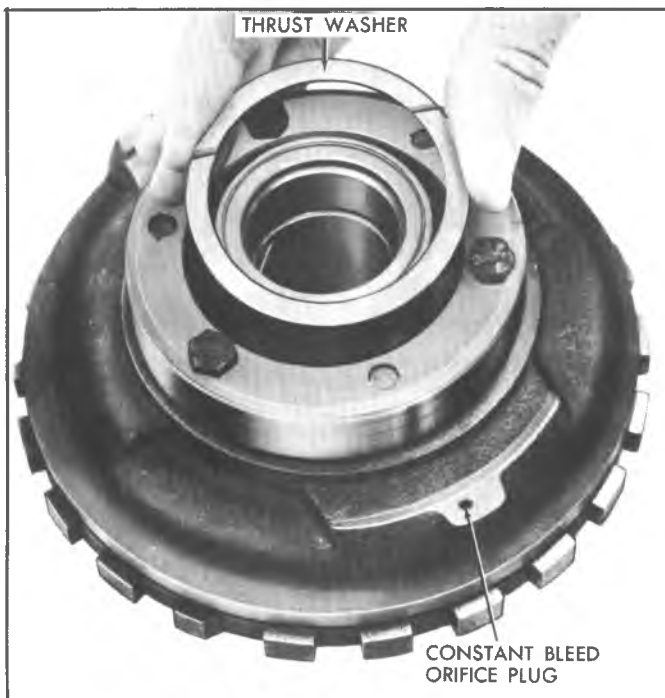


Fig. 40T--Removing Center Support Thrust Washer

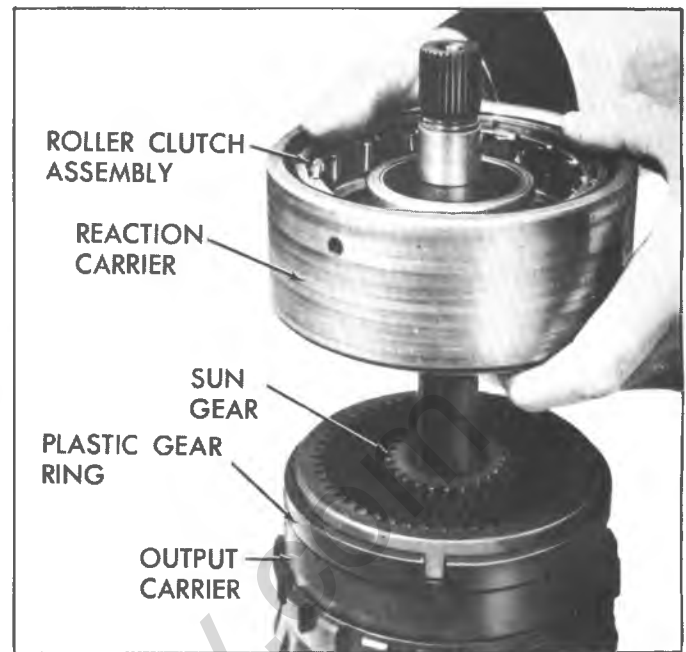


Fig. 41T--Removing Reaction Carrier and Roller Clutch from Output Carrier

Disassembly of Gear Unit Assembly

NOTE: CL Model (spur gears) disassembly procedure is identical as illustrated.

1. Remove center support assembly (fig. 39T).
2. Remove center support to reaction carrier thrust washer (fig. 40T).
3. Remove center support to sun gear races and thrust bearing.

NOTE: One race may have been removed with center support.

4. Remove reaction carrier and roller clutch assembly (fig. 41T). Lift roller clutch assembly out of carrier.
5. Remove front internal gear ring from output carrier assembly.

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Fig. 42T--Removing Sun Gear

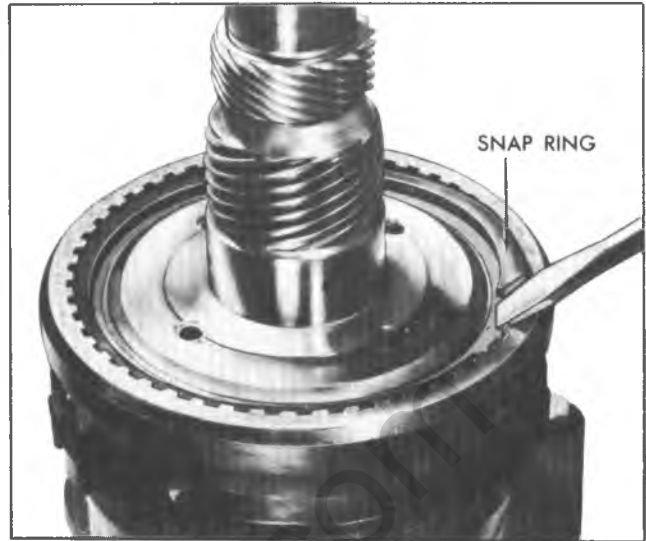


Fig. 43T--Removing Output Shaft to Carrier Snap Ring

6. Remove sun gear (fig. 42T).
7. Remove reaction carrier to output carrier thrust washer.
8. Turn assembly over and place main shaft through hole in work bench.
9. Remove "O" ring from output shaft of models that use an "O" ring.
10. Remove output shaft to output carrier snap ring (fig. 43T).

11. Remove output shaft.
12. Remove output shaft to rear internal gear thrust bearing and two (2) races.
13. Remove rear internal gear and mainshaft (fig. 44T).

NOTE: Do not drop bearings.

14. Remove rear internal gear to sun gear thrust bearing and two (2) races.
15. If necessary, remove rear internal gear to mainshaft snap ring, to remove mainshaft (fig. 45T).



Fig. 44T--Removing Rear Internal Gear and Mainshaft

Speedometer Drive Gear Replacement

If removal and installation or replacement of the speedometer drive gear is necessary, proceed as follows:

Nylon Speedometer Drive Gear

1. Depress clip and slide speedometer drive gear off output shaft (Fig. 46T).
2. To install, place clip (square end toward flange of shaft) into hole in output shaft (fig. 47T). Align slot in speedometer drive gear with clip and install gear.

NOTE: The nylon speedometer drive gear is installed at the factory only. ALL service replacement speedometer drive gears are STEEL. When replacing the nylon speedometer drive gear with a steel gear, discard the retaining clip and refer to Step "2" of steel speedometer drive gear installation.

Steel Speedometer Drive Gear

1. Install speedometer drive gear remover Tool J-21427-01 and J- 9539 bolts with J-8105 or suitable puller on output shaft, and remove speedometer drive gear (fig. 47T-A).
2. Install new steel speedometer drive gear and drive to location (5-43/64" below end of output shaft for all models except "CA" and "CR") (11 29/64 below end of output shaft for models "CA" and "CR") using J-5590 (fig. 47T-B).

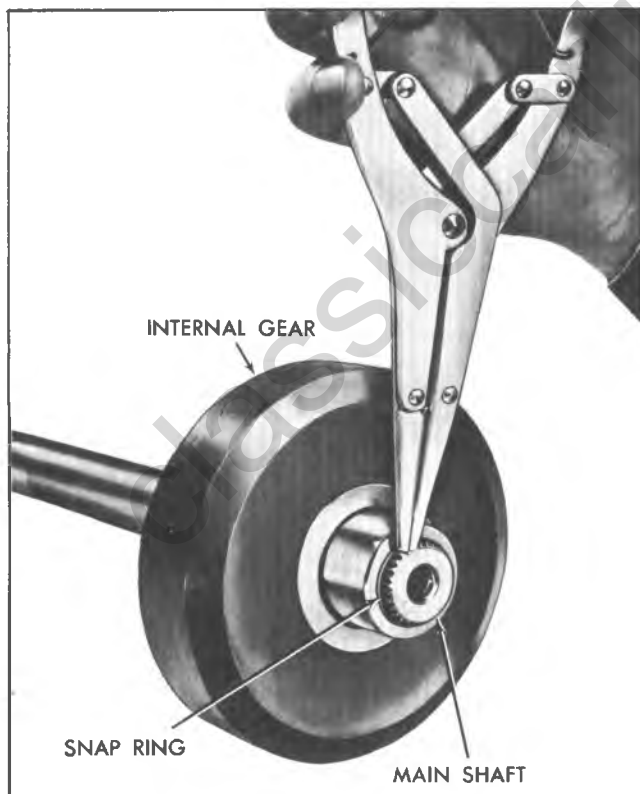


Fig. 45T—Removing Rear Internal Gear to Main Shaft Snap Ring

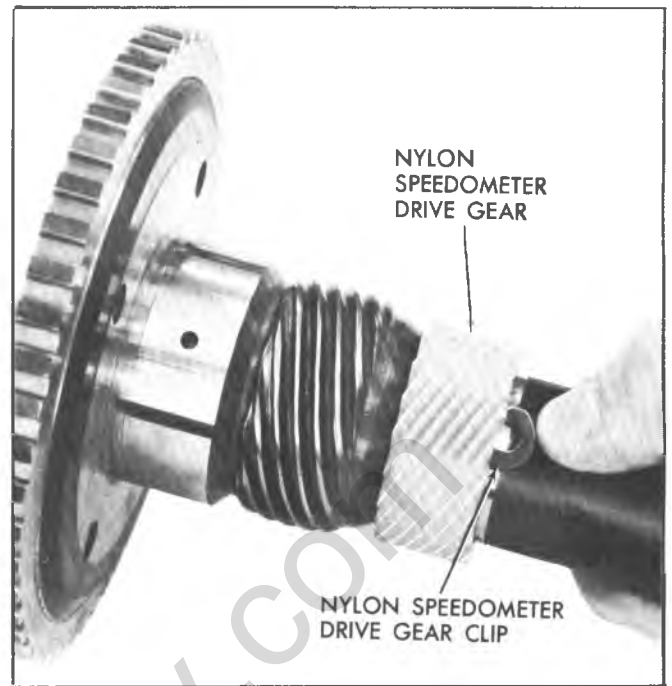


Fig. 46T—Removing Speedometer Drive Gear

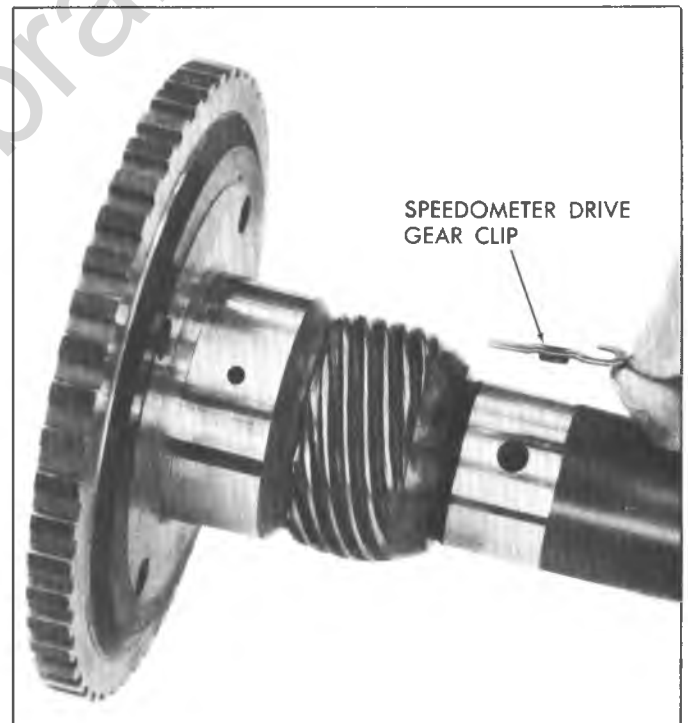


Fig. 47T—Installing Speedometer Drive Gear Clip

GOVERNOR ASSEMBLY

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is

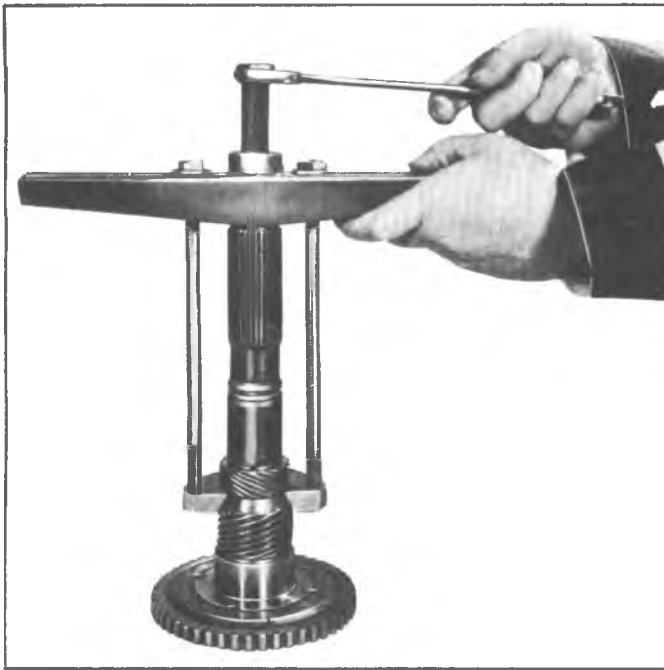


Fig. 47T-A--Removing Steel Speedometer Drive Gear

serviced as a complete assembly. However, the driven gear can also be serviced separately.

It is necessary to disassemble governor assembly in order to replace driven gear. Disassembly may also be necessary due to foreign material causing improper operation. In such cases, proceed as follows:

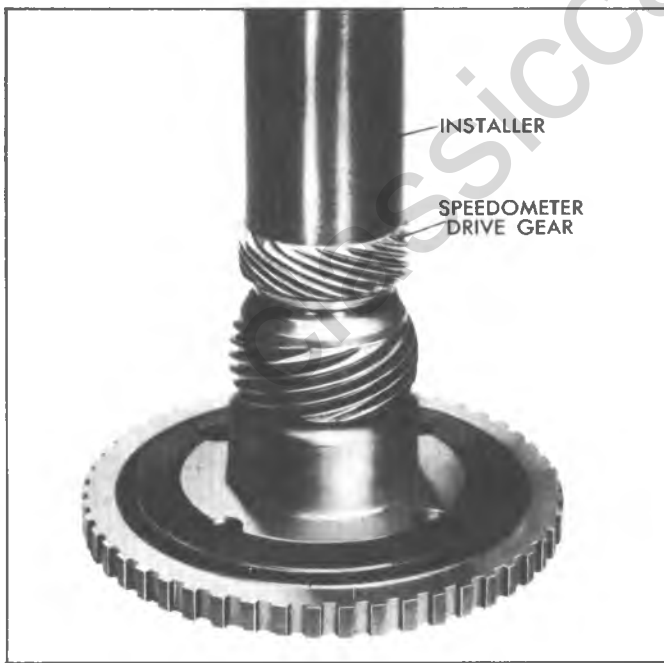


Fig. 47T-B--Installing Steel Speedometer Drive Gear

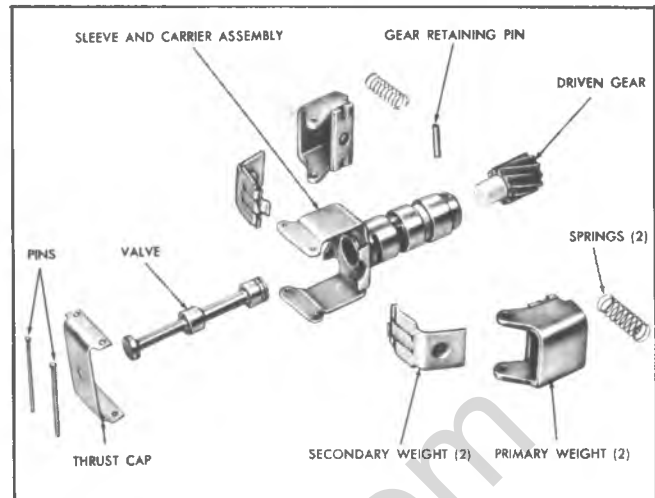


Fig. 48T-Governor--Exploded

Disassembly

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights, and springs. Governor weights are interchangeable from side to side and need not be identified. (Fig. 48T).
2. Remove governor valve from governor sleeve. Be careful not to damage valve.
3. Perform following inspections and replace governor driven gear, if necessary.

Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring or galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs, or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect governor weight springs for distortion or damage.
9. Check governor weights for free operation in their retainers.
10. Check valve opening at entry (.020" minimum) with a feeler gage, holding governor as shown with governor weights extended completely outward (fig. 48T-A).
11. Check valve opening at exhaust (.020" minimum) with a feeler gauge, holding governor as shown

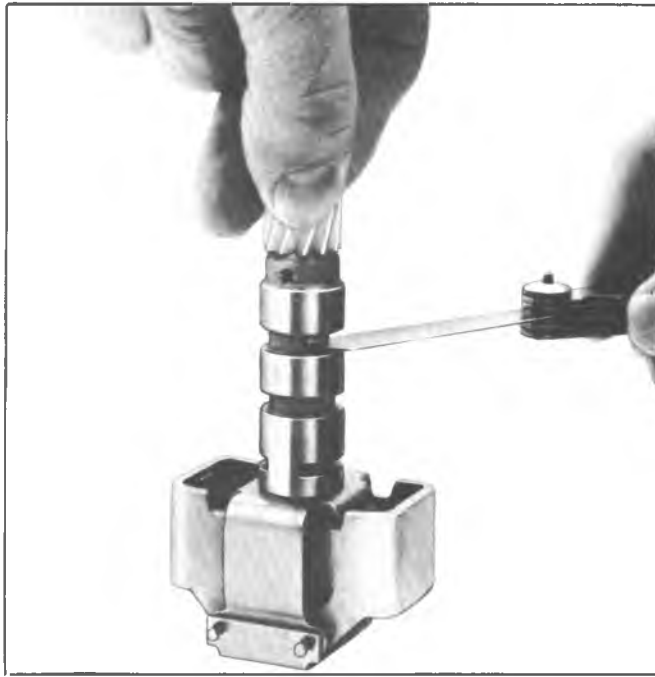


Fig. 48T-A--Checking Valve Opening With Weights Outward

with governor weights completely inward (fig. 48T-B).

Governor Driven Gear Replacement

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven



Fig. 48T-B--Checking Valve Opening With Weight Inward

gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

1. Drive out governor gear retaining split pin using small punch (fig. 49T).
2. Support governor on 7/64 inch plates installed in exhaust slots of governor sleeve, place in arbor press, and with a long punch, press gear out of sleeve.
3. Carefully clean governor sleeve of chips that remain from original gear installation.
4. Support governor on 7/64 inch plates installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.
5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90 degrees from existing hole, center punch and then, while supporting governor in press, drill new hole through sleeve and gear using a standard (1/8 inch) drill.
6. Install split retaining pin.
7. Wash governor assembly thoroughly to remove any chips that may have collected.

Assembly

1. Install governor valve in bore of governor sleeve, large end first.
2. Install governor weights and springs, and thrust cap on governor sleeve.
3. Align pin holes in thrust cap, governor weight

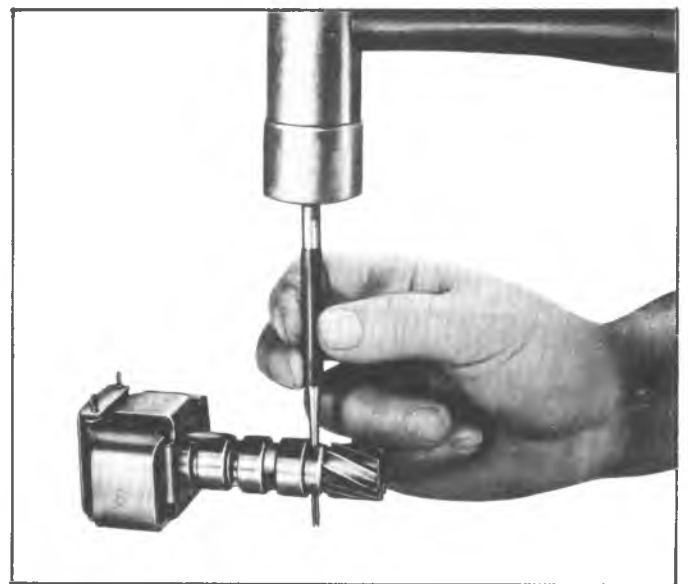


Fig. 49T--Removing Governor Gear Retaining Pin

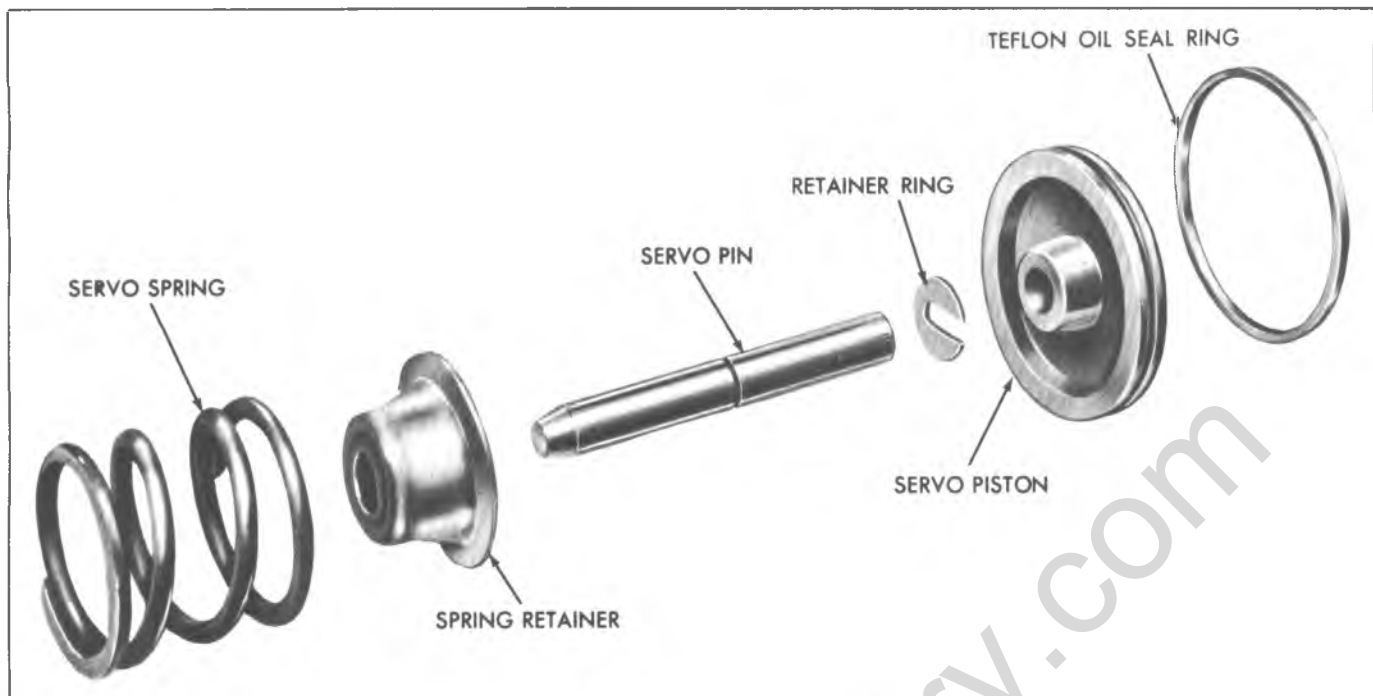


Fig. 50T--Front Servo Assembly--Exploded View

assemblies and governor sleeve, and install new pins. Crimp both ends of pins to prevent them from falling out.

4. Check governor weight assemblies for free operation on pins.

4. Remove washer, spring, and spring retainer.

5. Check governor valve for free movement in governor sleeve.

Front Servo Parts Inspection

NOTE: See figure 50T. Do not remove the teflon oil seal ring from the front servo piston unless the oil seal ring requires replacement. For service, the oil seal ring is aluminum.

1. Inspect servo pin for damage.
2. Inspect piston and oil ring for damage.
3. Check fit of servo pin in piston and case bore.

Inspection

NOTE: See figure 52T. Do not remove the teflon oil seal rings from the rear accumulator piston, unless the oil seal rings require



Fig. 50T-A--Removing Rear Accumulator Piston from Rear Servo Piston

Rear Servo Assembly

Disassembly

1. Remove rear accumulator piston from rear servo piston (fig. 50T-A).
2. Remove "E" ring retaining rear servo piston to servo pin (fig. 51T).
3. Remove rear servo piston and seal from servo pin (fig. 52T). (Exploded view.)

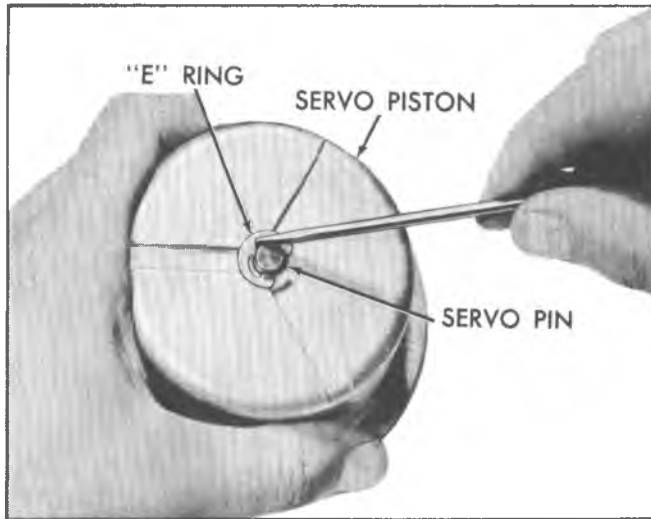


Fig. 51T--Removing Retaining "E" Ring from Rear Servo Pin

replacement. If the teflon inner oil seal ring (small diameter) requires replacement, for service, use the aluminum oil seal ring Part Number 8623671 or equivalent.

The rear accumulator piston, large diameter ring groove depth, is machined shallower to take the large teflon oil seal ring. If this ring requires replacement use only the teflon oil seal ring, Part Number 8627153 or equivalent.

1. Inspect freedom of accumulator rings in pinston grooves.
2. Inspect fit of servo pin in servo piston in case bore.
3. Inspect servo pin for scores or cracks.
4. Inspect accumulator and servo pistons for scoring, cracks or porosity.

Assembly

1. Install spring retainer cup side down, spring and washer on servo pin.
2. Install servo pin, retainer, spring and washer, into bore of servo piston and secure with "E" ring.
3. Install oil seal ring on servo piston, if removed.
4. Install outer and inner oil rings on accumulator piston, if removed, and assemble into bore of servo piston.

CONTROL VALVE, DISASSEMBLY, INSPECTION AND RE-ASSEMBLY (Fig. 55T)

Disassembly

1. Position control valve assembly with cored face up and accumulator pocket nearest operator.
2. Remove manual valve from upper bore.
3. Install Special Tools J-22269 and J-24675, on accumulator piston and remove retaining ring (fig. 53T).

4. Remove front accumulator piston and spring (fig. 54T).
5. On the right side adjacent to the manual valve, remove the 1-2 valve train as follows:
 - a. (Model CY) Remove retaining pin, 1-2 modulator bushing, 1-2 valve spring, 1-2 modulator valve and 1-2 shift valve.
 - b. (Models CA, CF, CJ, CR, CL, CM, CK, CZ and CS) Remove retaining pin, 1-2 modulator bushing, 1-2 regulator valve, 1-2 regulator spring, 1-2 detent valve, and 1-2 shift valve.
6. From next bore down, remove retaining pin, 2-3 shift valve spring, modulator valve bushing, 2-3 modulator valve, 3-2 intermediate spring, and 2-3 shift valve.
7. From next bore down remove retaining pin, bore plug, spring, spacer, and 3-2 valve.
8. At other end of assembly, top bore, remove retaining pin and bore plug, detent valve, detent regulator valve, spring and spacer.
9. From the next bore down, remove the 1-2 accumulator valve train as follows:
 - a. (Models CA and CS) Remove the grooved retaining pin, bore plug, 1-2 accumulator valve and spring.
 - b. (Models CR, CK and CL) Remove the grooved retaining pin, bore plug, 1-2 accumulator valve.
 - c. (Models CF, CJ, CM, CZ and CY) Remove the grooved retaining pin, bore plug, 1-2 accumulator secondary spring and 1-2 accumulator valve.

Inspection

NOTE: See figure 54T. Do not remove the teflon oil seal ring from the front accumulator piston unless the oil seal ring requires replacement. For service, the oil seal ring is cast iron.

1. Inspect all valves for scoring, cracks and free movement in their respective bores.
2. Inspect bushings for cracks, scratches or distroction.
3. Inspect body for cracks, or scored bores.
4. Check all springs for distortion or collapsed coils.
5. Inspect accumulator piston and oil seal ring for damage.

Reassembly

1. Install front accumulator spring and piston into valve body.
2. Install Special Tools J-22269 and J-24675 and compress spring and piston and secure with retaining "E" ring.
3. Install the 1-2 accumulator valve train into the lower left hand bore as follows:
 - a. (Model CM) Install the 1-2 accumulator spring and 1-2 accumulator valve, stem end out, into

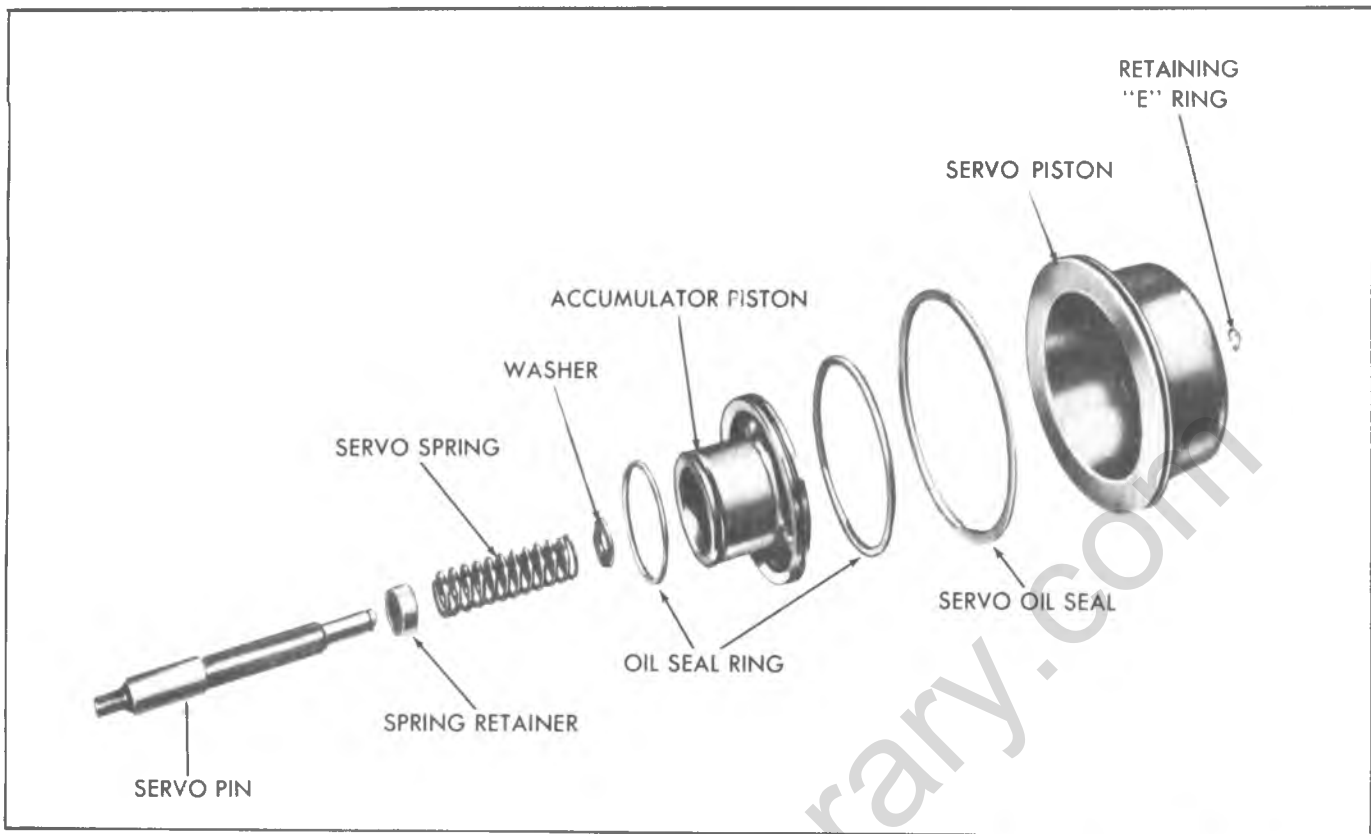


Fig. 52T—Rear Servo and Accumulator Assembly—Exploded View



Fig. 53T—Installing Compressor Tool to Front Accumulator Piston

bore. Place the bore plug into valve bore and install grooved retaining pin from the cast surface side of the valve body, with the grooves entering the pin hole last. Tap pin with a hammer until flush with cast surface.

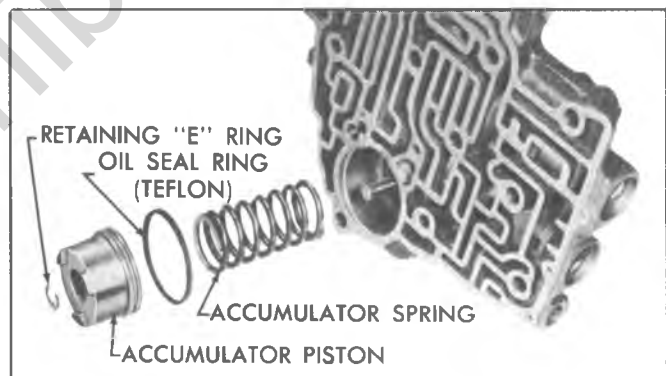


Fig. 54T—Front Accumulator Assembly - Exploded View

- b. (Models CR, CK and CL) Install 1-2 accumulator valve stem end out, into bore. Place bore plug into valve bore and install grooved retaining pin from cast surface side of the valve body, with the groove entering the pin holes last. Tap pin with a hammer until flush with case surface.
- c. (Models CA, CF, CJ, CM, CZ and CY) Install the 1-2 accumulator valve, stem end out, and 1-2 accumulator secondary spring. Install the bore plug and compress spring until grooved retaining pin can be inserted from the cast surface side of the valve body. Install retaining pin with the grooved end entering the pin hole last and

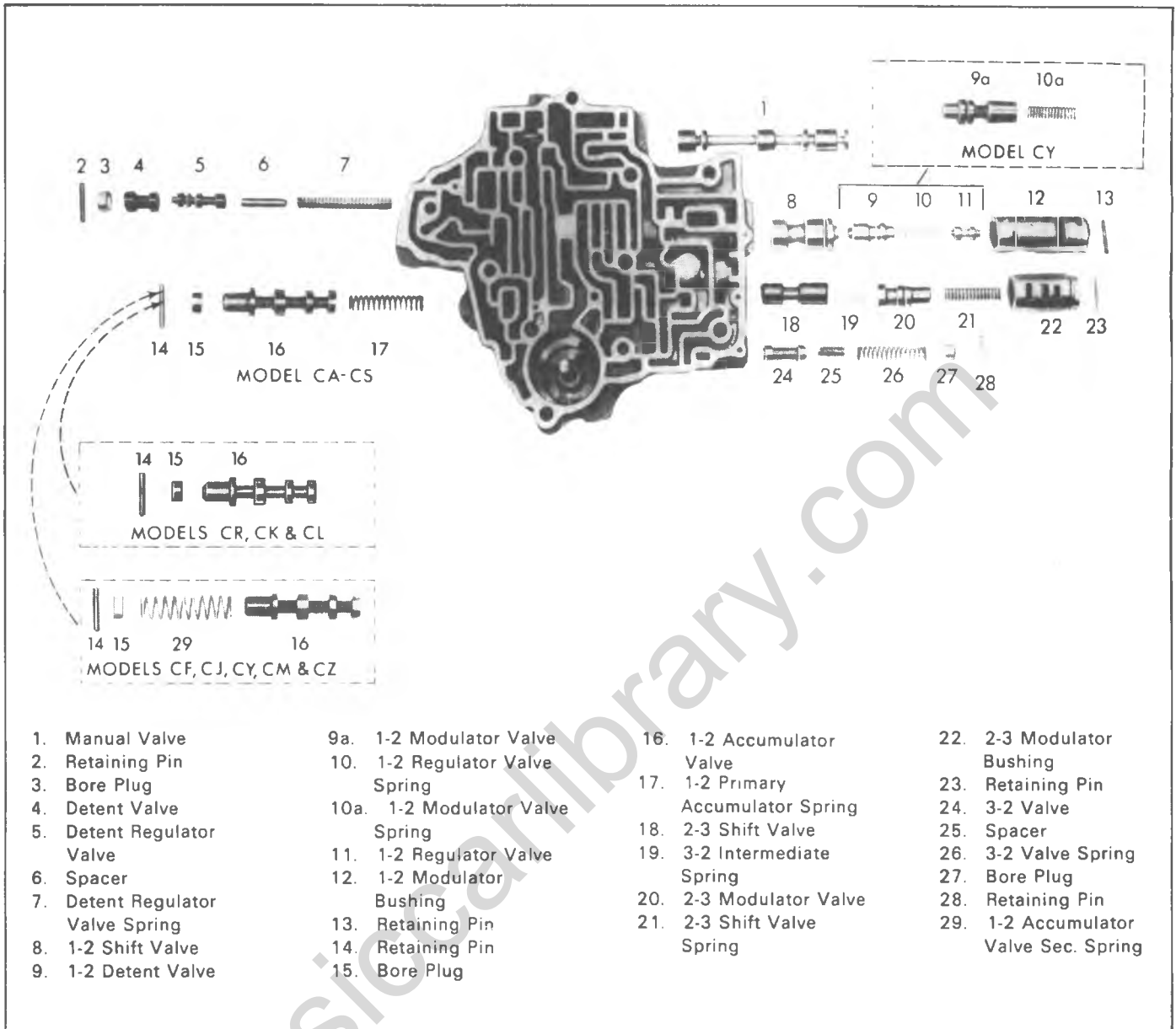


Fig. 55T--Control Valve Assembly--Exploded View

- | | | | |
|----------------------------------|---------------------------------|------------------------------------|---------------------------------------|
| 1. Manual Valve | 9a. 1-2 Modulator Valve | 16. 1-2 Accumulator Valve | 22. 2-3 Modulator Bushing |
| 2. Retaining Pin | 10. 1-2 Regulator Valve Spring | 17. 1-2 Primary Accumulator Spring | 23. Retaining Pin |
| 3. Bore Plug | 10a. 1-2 Modulator Valve Spring | 18. 2-3 Shift Valve | 24. 3-2 Valve |
| 4. Detent Valve | 11. 1-2 Regulator Valve Bushing | 19. 3-2 Intermediate Spring | 25. Spacer |
| 5. Detent Regulator Valve | 12. 1-2 Modulator Retaining Pin | 20. 2-3 Modulator Valve | 26. 3-2 Valve Spring |
| 6. Spacer | 13. Retaining Pin | 21. 2-3 Shift Valve Spring | 27. Bore Plug |
| 7. Detent Regulator Valve Spring | 14. Retaining Pin | | 28. Retaining Pin |
| 8. 1-2 Shift Valve | 15. Bore Plug | | 29. 1-2 Accumulator Valve Sec. Spring |
| 9. 1-2 Detent Valve | | | |
-
4. In next bore up, install detent spring and spacer. Compress spring and secure with small screwdriver (fig. 56T).
 5. Install detent regulator valve, wide land first.
 6. Install detent valve, narrow land first.
 7. Install bore plug (hole out), depress spring by pressing in on plug, install retaining pin, and remove screwdriver.
 8. In lower right hand bore, install 3-2 valve.
 9. Install 3-2 spring, spacer, bore plug (hole out) and retaining pin.
 10. In next bore up, install the 2-3 shift valve, open end out, into the bore and install 3-2 intermediate spring.
 11. Install 2-3 modulator valve into bushing and install both parts into valve body bore.
 12. Install 2-3 valve spring and retaining pin.
 13. In next bore up, install 1-2 valve, stem end out.
 14. a. (Model CY) Install the 1-2 valve spring and 1-2 modulator valve into the 1-2 modulator bushing, aligning the spring in the bore of the modulator valve. Install parts into the valve body bore.
 b. (Models CA, CM, CF, CJ, CK, CR, CS, CL and CZ) Install the 1-2 regulator valve, regulator spring, and 1-2 detent valve open hole first into the 1-2 modulator bushing, aligning the spring

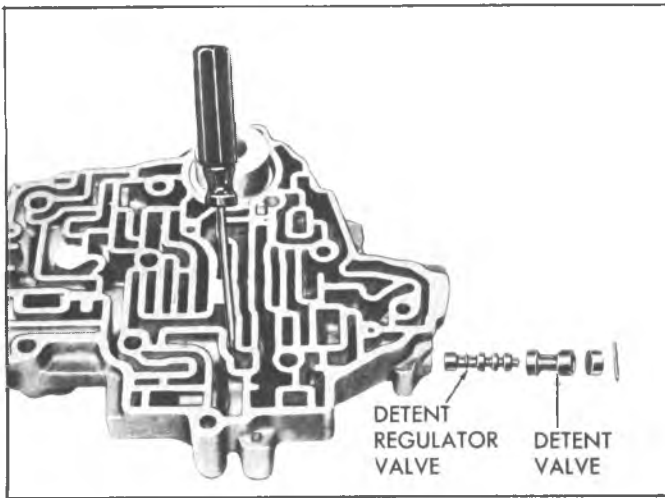


Fig. 56T--Installing Detent Regulator Valve and Detent Valve

in the bore of the detent valve. Install the parts in the valve body bore.

15. Compress bushing against spring and install retaining pin.
16. Install manual valve with detent pin groove to the right.

Oil Pump Disassembly, Inspection and Assembly

Disassembly

1. Place oil pump assembly in hole in bench or holding fixture, J-6116 with J-21364 adapter.

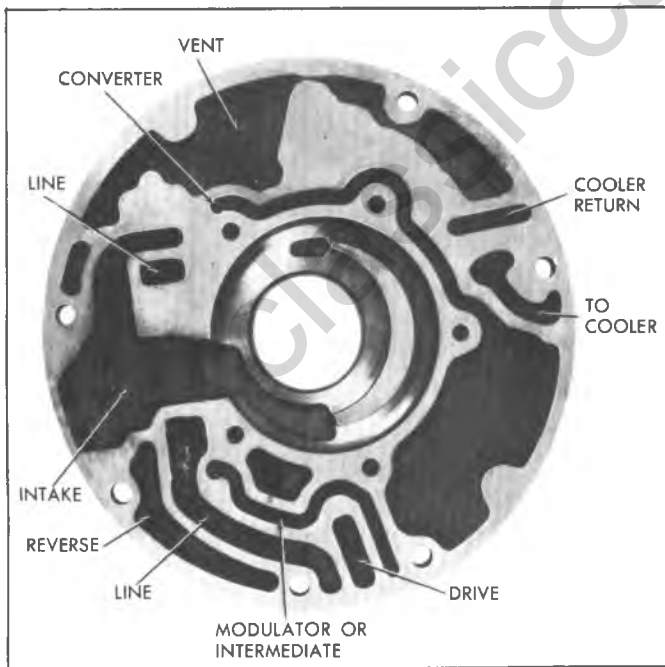


Fig. 57T--Pump Body Oil Passages

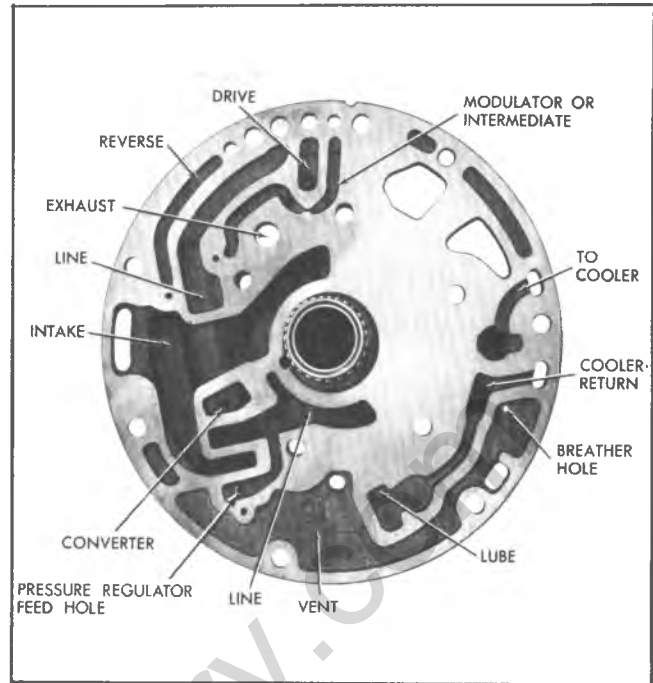


Fig. 58T--Pump Cover Oil Passages

2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring, using J-5403 pliers (fig. 60T).
3. Remove regulator boost valve bushing and valve.
4. Remove pressure regulator spring.
5. Remove regulator valve, spring retainer and spacer(s), if present (fig. 61T).
6. Remove pump cover to body attaching bolts.
7. Remove pump cover from body.
8. Remove retaining pin and bore plug from pressure regulator bore (fig. 62T).
9. Remove hook type oil rings from pump cover.
10. Remove pump to forward clutch housing selective washer.
11. Mark drive and driven gears for reassembly in same position and remove from the pump body. See figure 63T.

Inspection of Pump Body and Pump Cover

NOTE: A solid type pressure regulator valve must only be used in a pump cover with a squared off pressure regulator boss. See figure 64T. A pressure regulator valve with oil holes and orifice cup plug may be used to service either type pump cover.

1. Inspect drive and driven gear pocket and crescent for scoring, galling or other damage.

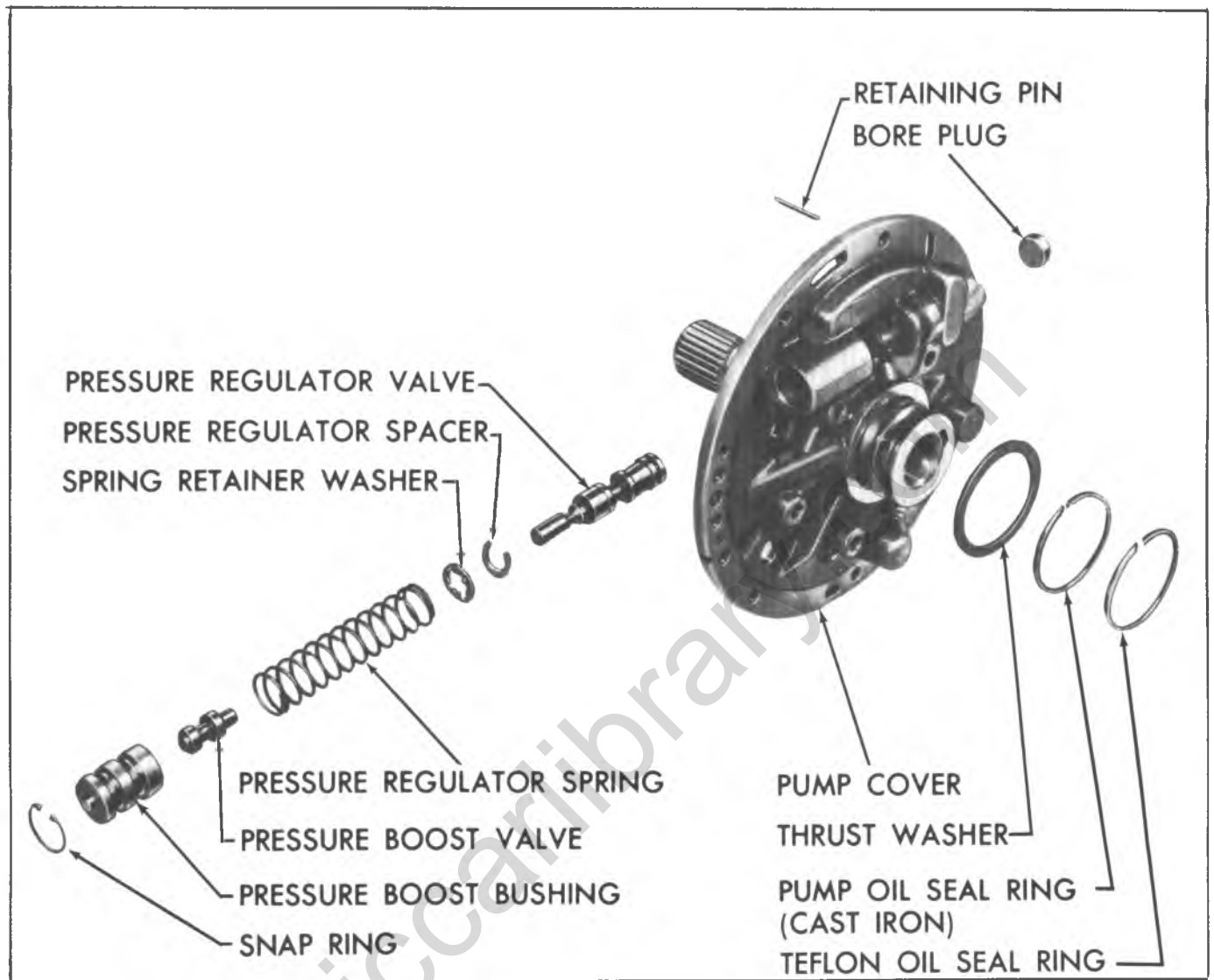


Fig. 59T--Pump Cover--Exploded View

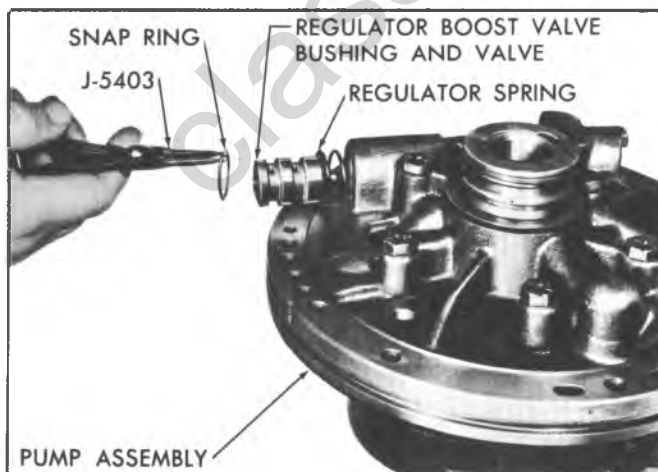


Fig. 60T--Removing Pump Regulator Valve Snap Ring

2. Place pump gears in pump body and check pump body face to gear face clearance (should be .0008" - .0035")(fig. 65T).
3. Check face of pump body for scores or nicks.
4. Check oil passages (fig. 57T).
5. Check for damaged cover bolt attaching threads.
6. Check for overall flatness of pump body face.
7. Check bushing for scores or nicks. If replacement is necessary, proceed as follows:
 - a. Using Tool J-21465-17 and driver Handle J-8092 remove bushing.
 - b. From front side of pump, using J-21465-17 and driver Handle J-8092 install new bushing flush to .010" below gear pocket face.
8. Inspect pump attaching bolt seals for damage, replace if necessary.
9. Inspect pump cover face for overall flatness.

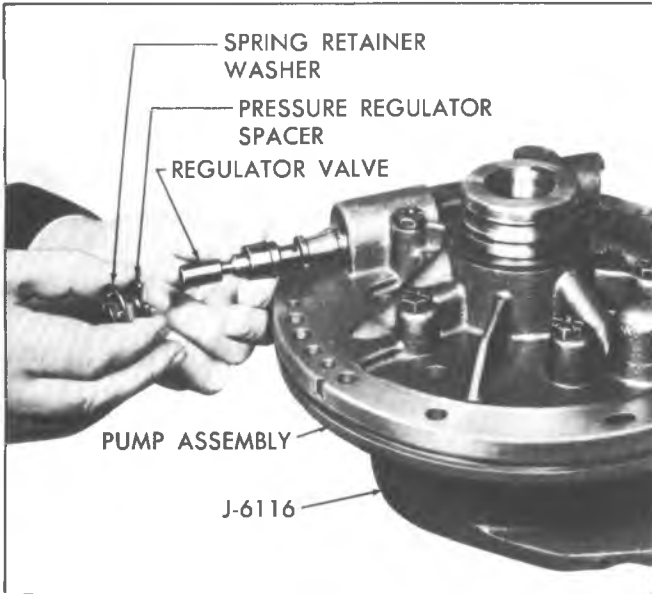


Fig. 61T--Removing Pressure Regulator Valve

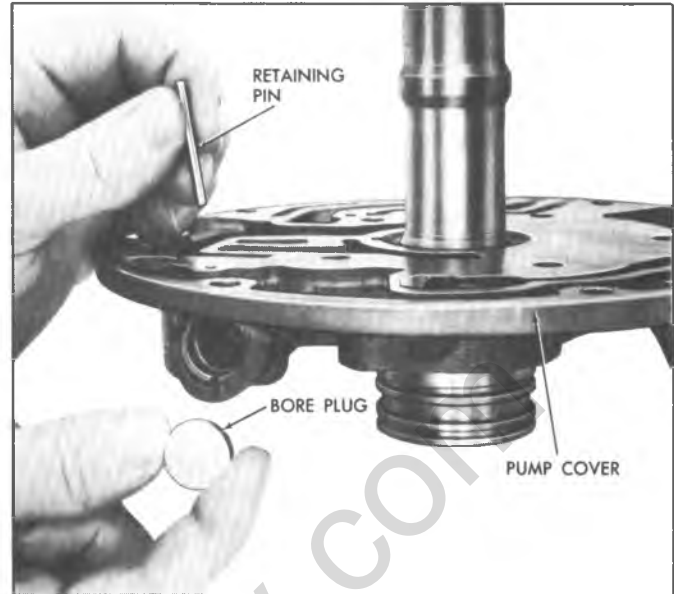


Fig. 62T--Installing Pressure Regulator Retaining Pin and Bore Plug

10. Check for scores or chips in pressure regulator bore.
11. Check that all passages are open and not interconnected (fig. 58T).
12. Check for scoring or damage at pump gear face.
13. Inspect stator shaft for damaged splines, or scored bushings. If replacement of bushing is necessary proceed as follows:

Front

- a. With pump cover and stator shaft properly supported, using Tool J-21465-15, with slide hammer tool J-2619, and adapter Tool J-2619-4 remove bushing.
- b. Using Tool J-21465-3 with Driver Handle J-8092 press or drive replacement bushing into place until tool bottoms.

Rear

- c. With pump and stator shaft properly supported, using Tool J-21465-15, with slide hammer Tool J-2619 and adapter tool J-2619-4, remove bushing.
- d. Using Tool J-21465-2 with Driver Handle J-8092, pressor drive replacement bushing into place until tool bottoms.

14. Inspect oil ring grooves for damage or wear.
15. Inspect selective washer thrust face for wear or damage.
16. Inspect pressure regulator and boost valve for free operation in their respective bores.
17. Inspect pump cover for open 1/8" breather hole (fig. 58T).

Assembly

1. Install drive and driven pump gears with alignment

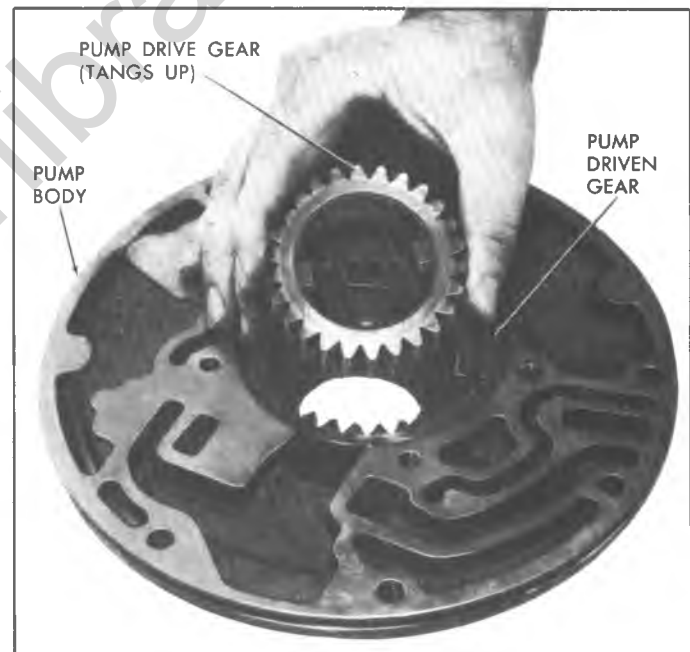


Fig. 63T--Installing Pump Drive Gear

marks up into pump body (fig. 63T) drive gear tangs up.

2. Protect stator shaft and install pump cover in vise.
3. Install spacer(s) if used, retainer and spring, into pressure regulator bore (fig. 59T).
4. Install pressure regulator valve from opposite end of bore, stem end first.
5. Install boost valve into bushing, stem end out, and install both parts into pump cover by compressing bushing against spring.

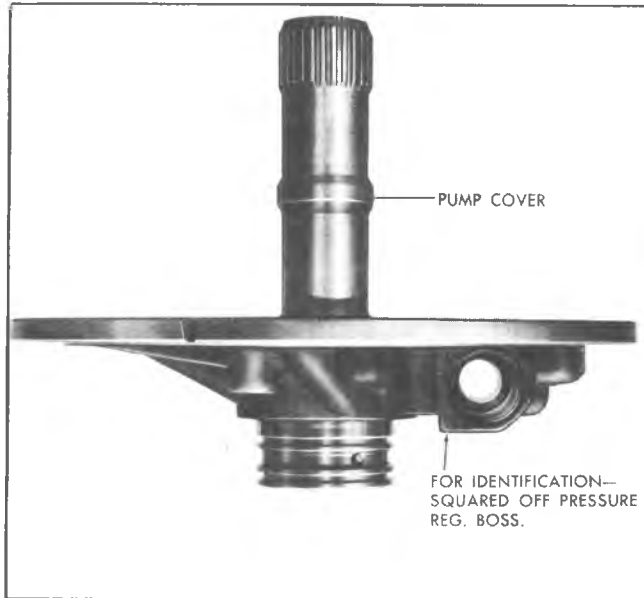


Fig. 64T-Pressure Regulator Valve Identification



Fig. 65T-Checking Pump Body Face to Gear Face Clearance

6. Install retaining snap ring.
7. Install pressure regulator valve bore plug and retaining pin into opposite end of bore.
8. Install previously selected front unit selective thrust washer over pump cover delivery sleeve.
9. Install two (2) hook type oil seal rings.
10. Assemble pump cover to pump body with attaching bolts (fig. 65TA).
NOTE: Leave bolts one turn loose at this time.
11. To align the pump body and cover, place the pump assembly, less rubber seal ring, upside down into the pump bore of the case (fig. 66T).
12. Tighten pump cover bolts to 18 foot pounds. Remove pump assembly from case bore.
13. Install pump to case "O" ring seal.

FORWARD CLUTCH DISASSEMBLY, INSPECTION AND ASSEMBLY

Disassembly

1. Place forward clutch assembly with turbine shaft through hole in bench or Holding Fixture J-6116, and remove forward clutch housing to direct clutch hub snap ring (fig. 67T).
2. Remove direct clutch hub.
3. Remove forward clutch hub and thrust washers (fig. 68T).
4. Remove five (5) radial grooved composition and five (5) steel clutch plates.
5. If necessary place forward clutch and turbine shaft in arbor press and remove turbine shaft (fig. 69T).

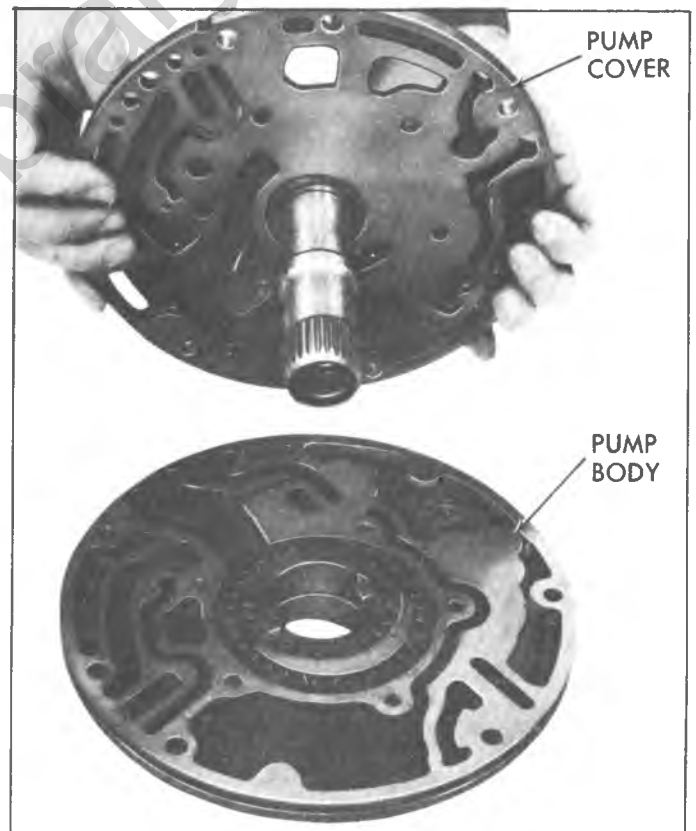


Fig. 65TA-Aligning Pump, Cover to Pump Body

6. Using J-4670 clutch spring compressor in arbor press with Adapter J-21664, compress spring retainer and remove snap ring (fig. 70T).
7. Remove spring retainer and sixteen (16) clutch release springs.

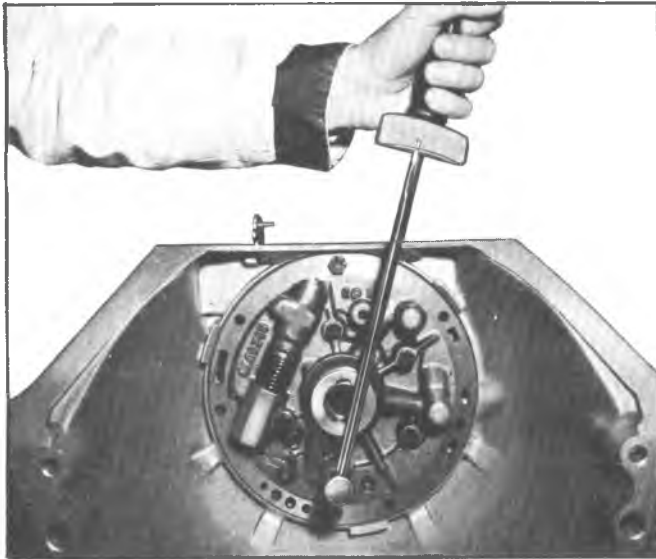


Fig. 66T--Installing Pump Cover to Pump Body

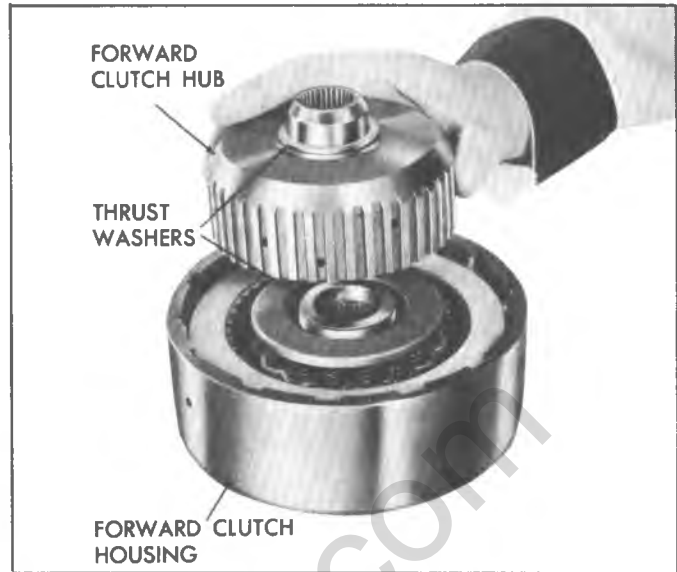


Fig. 68T--Removing Forward Clutch Hub and Thrust Washers

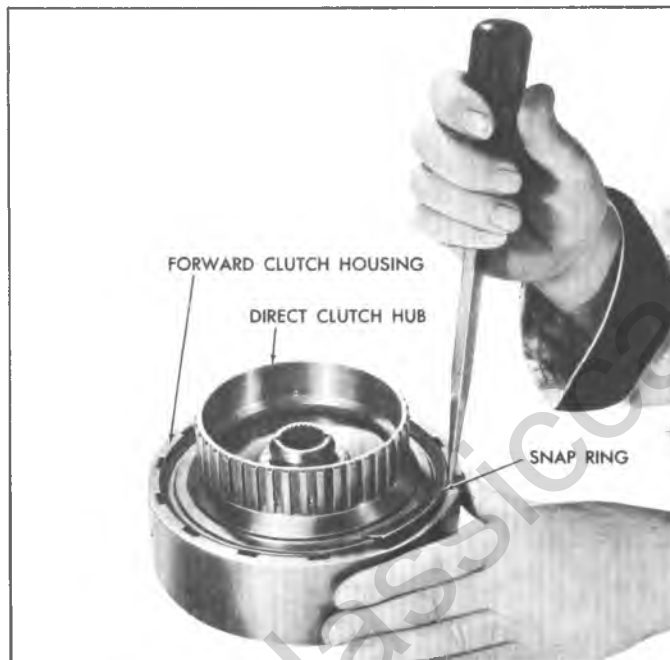


Fig. 67T--Removing Forward Clutch Housing to Direct Clutch Hub Snap Ring

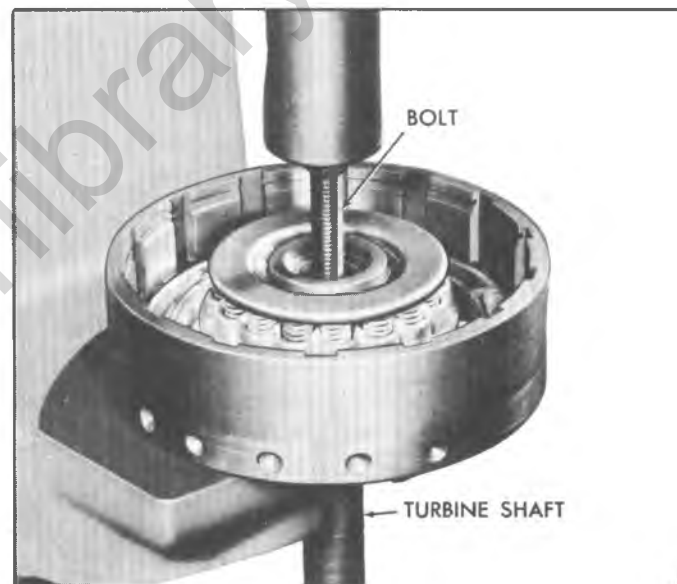


Fig. 69T--Removing Turbine Shaft from Forward Clutch Housing

NOTE: Keep springs separate from direct clutch release springs.

8. Remove forward clutch piston.
9. Remove inner and outer clutch piston seals (fig. 71T).
10. Remove center piston seal from forward clutch housing (fig. 72T).

Inspection

1. Inspect composition-faced and steel clutch plates

for signs of burning, scoring or wear.

2. Inspect sixteen (16) springs for collapsed coils or signs of distortion.
3. Inspect clutch hubs for worn splines, proper lubrication holes or scored thrust faces.
4. Inspect piston for cracks.
5. Inspect clutch housing for wear, scoring, open oil passages and free operation of ball check.
6. Inspect turbine shaft.
 - a. Inspect for open lubrication passages at each end.



Fig. 70T--Removing Forward Clutch Spring Retaining Snap Ring

- b. Inspect splines for damage.
- c. Inspect ground bushing journals for damage.
- d. Inspect shaft for cracks or distortion.

NOTE: Turbine shaft and clutch housing are serviced separately. Shaft may be removed from housing by using a suitable size socket in an arbor press (fig. 69T).

Assembly (fig. 72T)

NOTE: The Turbo Hydra-Matic forward and direct clutch pistons have identical inside and outside diameters. It is possible to reverse the pistons during reassembly, therefore, care should be exercised to make certain the proper piston be installed in the clutch assemblies. As shown in Figure 89T, the direct clutch piston can be identified by the check ball.

- 1. Place new inner and outer oil seals on clutch piston, lips face away from spring pockets (fig. 71T).
- 2. Place a new center seal on clutch housing, lip faces up (fig. 72T).

NOTE: Apply automatic transmission oil to all seals and clutch plates.

- 3. Place seal protector Tool J-21362, over clutch hub and install outer clutch piston seal Protector J-21409, into clutch drum and install piston, rotating piston on drum until seated (fig. 74T).



Fig. 71T--Removing Forward Clutch Piston Outer Seal



Fig. 72T--Removing Forward Clutch Center Seal

- 4. Install sixteen (16) clutch release springs into pockets in piston.
- 5. Place spring retainer and snap ring on springs.
- 6. Compress springs in arbor press, using clutch compressor Tools J- 4670 and J-21664, install snap ring.
- 7. If removed, install turbine shaft in forward clutch housing, using arbor press.
- 8. Install forward clutch hub washers on forward clutch hub. Retain with petrolatum.
- 9. Place forward clutch hub into forward clutch housing.
- 10. Oil and install five (5) radial grooved composition and four (4) flat steel and one (1) waved steel clutch plate (plate with "U" notches) starting with waved steel and alternating composition and steel clutch plates (fig. 75T).

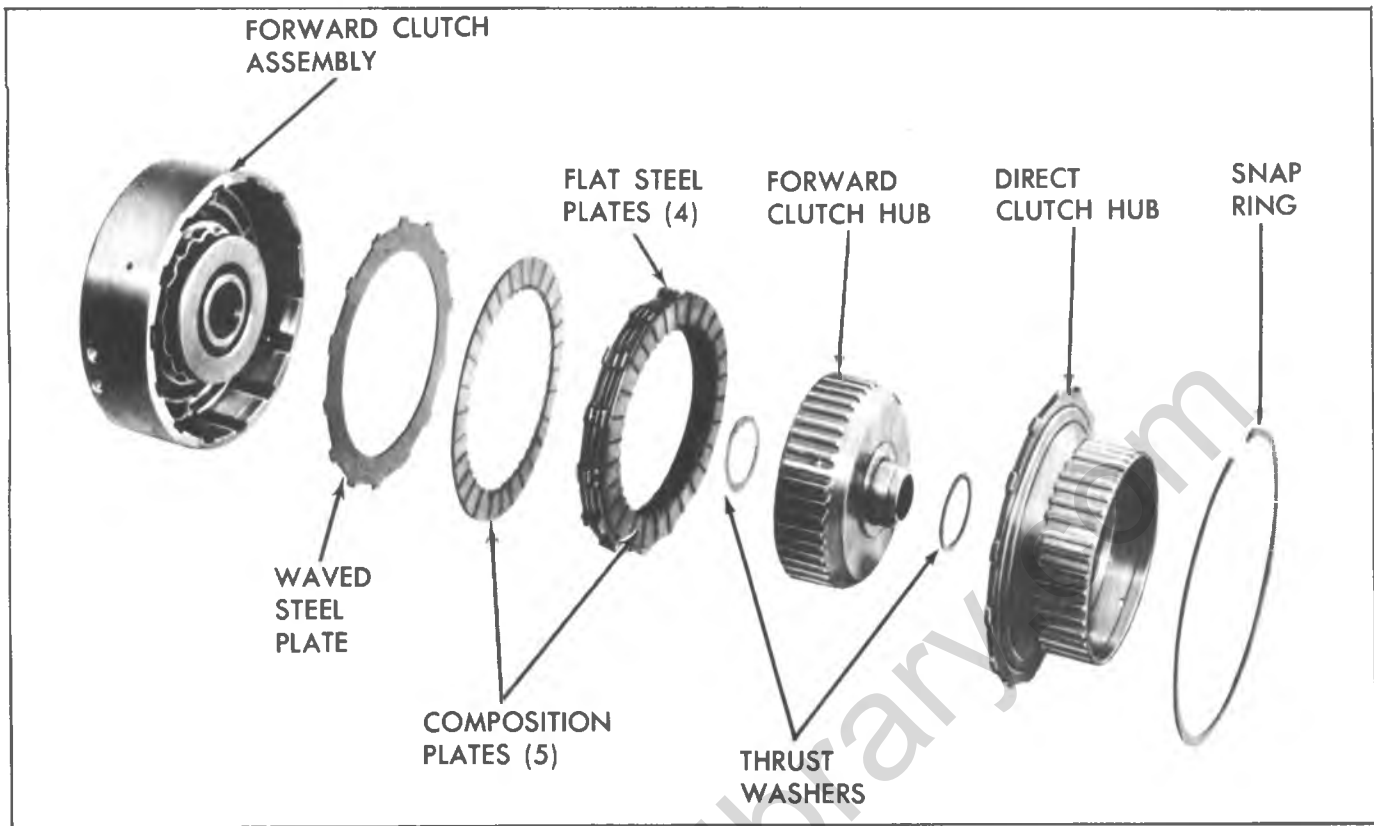


Fig. 73T--Forward Clutch Assembly--Exploded View

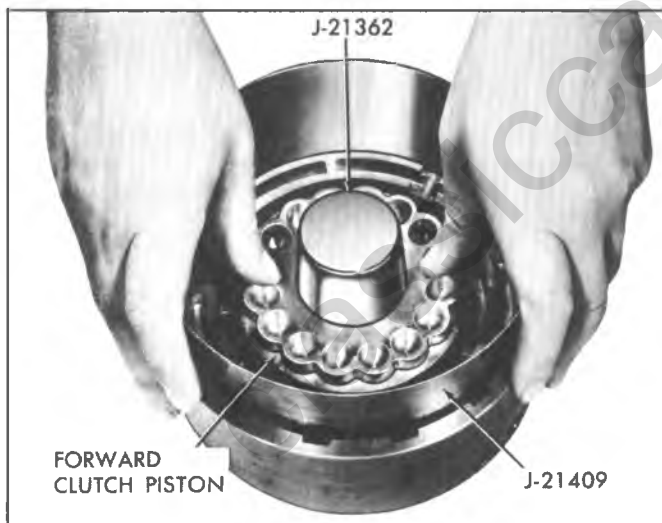


Fig. 74T--Installing Forward Clutch Piston

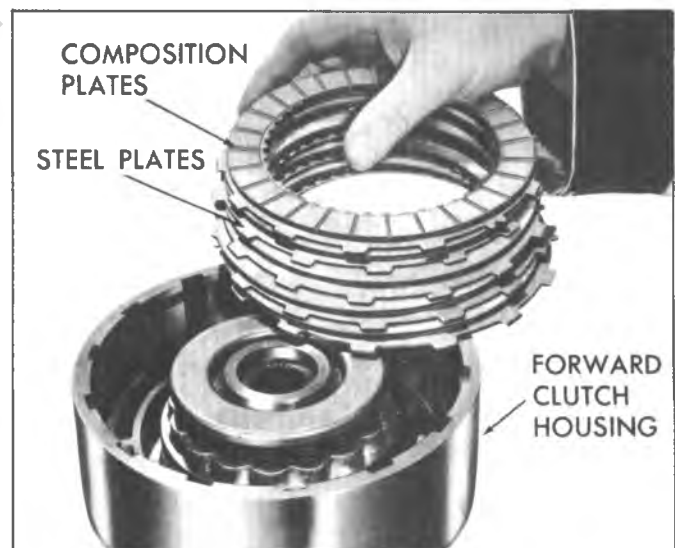


Fig. 75T--Installing Forward Clutch Composition and Steel Plates



Fig. 76T--Installing Forward Clutch Housing to Direct Clutch Hub Snap Ring

CAUTION: Do not confuse the flat steel clutch plate (plate with "V" notch) with the waved steel clutch plate (plate with "U" notch).

NOTE: Radially grooved composition clutch plates are installed at the factory only. All service composition plates have the smooth surface configuration.



Fig. 77T--Air Checking Forward Clutch Assembly

11. Install direct clutch hub and retaining snap ring (fig. 76T).
12. Place forward clutch housing on pump delivery sleeve and air check clutch operation (fig. 77T).

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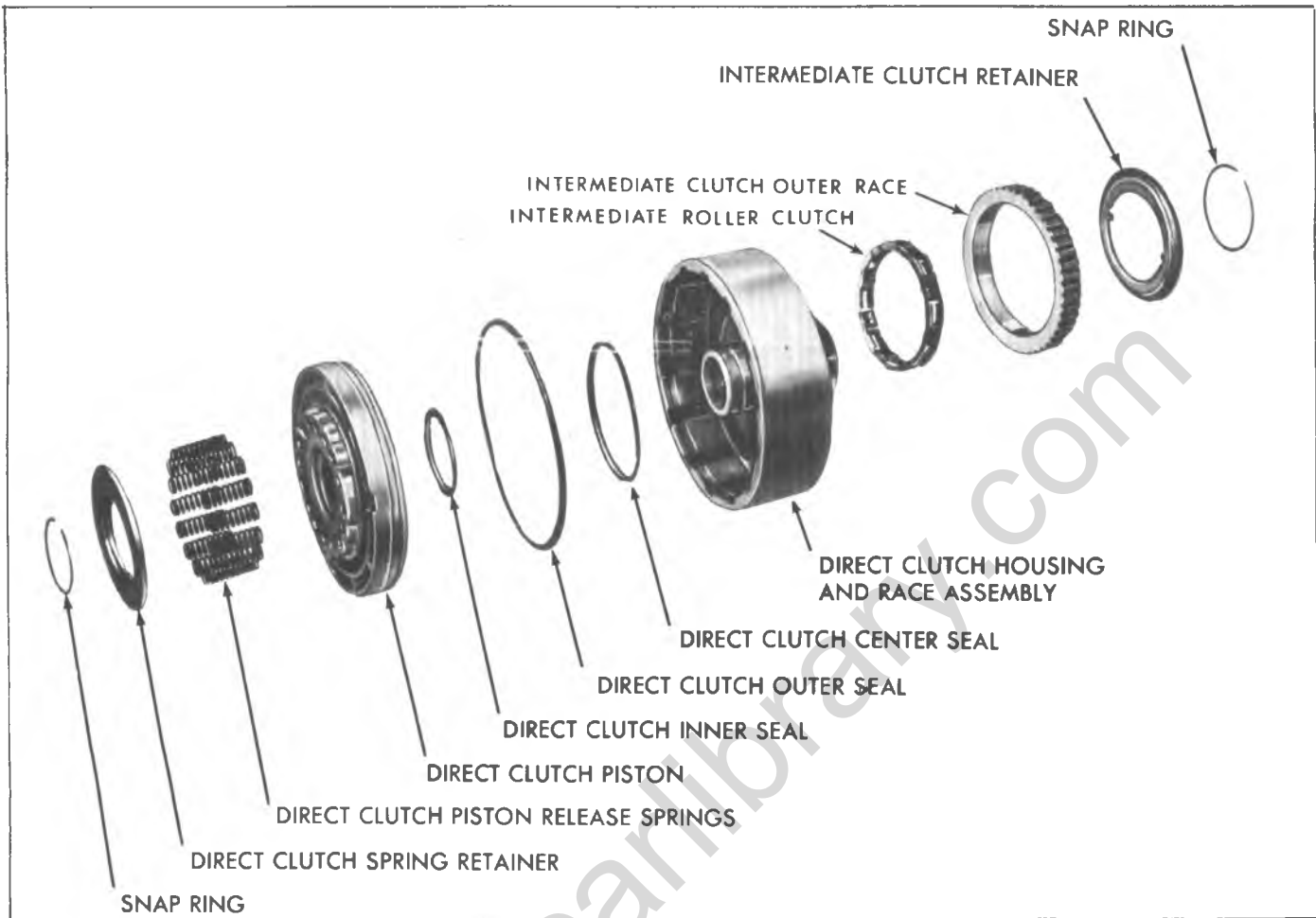


Fig. 78T--Direct Clutch and Intermediate Roller Assembly

DIRECT CLUTCH AND INTERMEDIATE ROLLER, DISASSEMBLY, INSPECTION AND ASSEMBLY

Disassembly

1. Remove intermediate roller assembly retainer snap ring and retainer (fig. 79T).
2. Remove roller outer race and roller assembly.
3. Turn unit over and remove backing plate to direct clutch housing snap ring (fig. 80T).
4. Remove direct clutch backing plate, composition plates, steel clutch plates and waved steel plate.

NOTE: No waved steel plate used in CY model.

5. Using clutch compressor Tool J-4670 and J-21664, compress spring retainer in arbor press and remove snap ring (fig. 81T).

6. Remove retainer and fourteen (14) piston release springs.

NOTE: Keep springs separate from forward clutch release springs.

7. Remove direct clutch piston (fig. 82T).
8. Remove outer seal from piston.
9. Remove inner seal from piston.
10. Remove center piston seal from direct clutch housing.

Inspection

1. Inspect roller assembly for popped or loose rollers.
2. Inspect inner cam and outer race for scratches or wear.
3. Inspect clutch housing for cracks, wear, proper opening of oil passages or wear on clutch plate drive lugs.

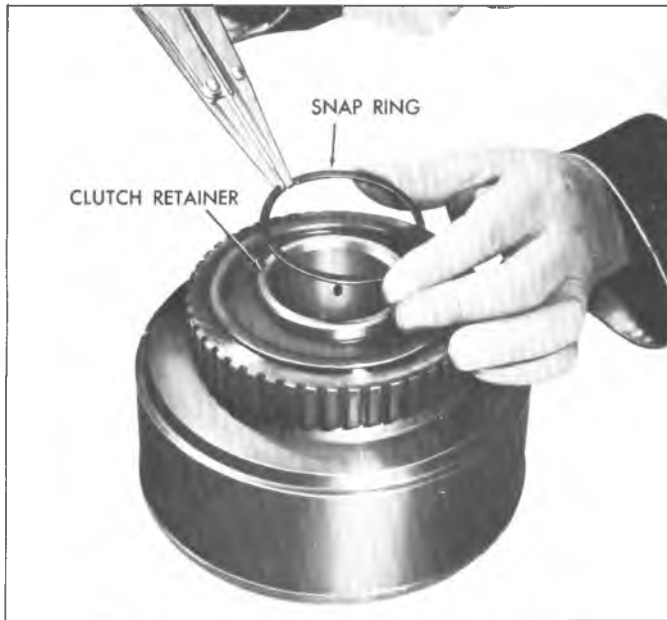


Fig. 79T--Removing Intermediate Clutch Retainer Snap Ring



Fig. 81T--Removing or Installing Direct Clutch Snap Ring

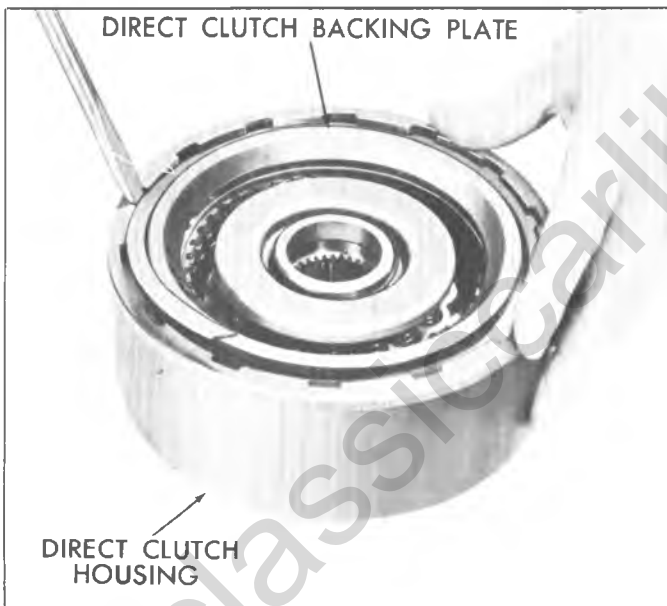


Fig. 80T--Removing Direct Clutch Backing Plate Snap Ring

4. Inspect composition-faces and steel clutch plates for sign of wear or burning.
5. Inspect backing plate for scratches or other damage.
6. Inspect clutch piston for cracks and free operation of ball check.

Assembly

NOTE: The Turbo Hydra-Matic forward and direct clutch pistons have identical inside and outside diameters. It is possible to reverse the



Fig. 82T--Removing Direct Clutch Piston Assembly

pistons during reassembly, therefore, care should be exercised to make certain the proper piston be installed in the clutch assemblies. As shown in Figure 89T, the direct clutch piston can be identified by the check ball. On CY model, the direct clutch piston has 2 check balls.

1. Install a new inner clutch piston seal on piston with lip facing away from spring pockets (fig. 84T).
2. Install a new outer clutch piston seal with lip facing away from spring pockets (fig. 85T).
3. Install a new center seal on clutch housing with lip of seal facing up (fig. 86T).

NOTE: Apply automatic transmission oil to all seals and clutch plates.

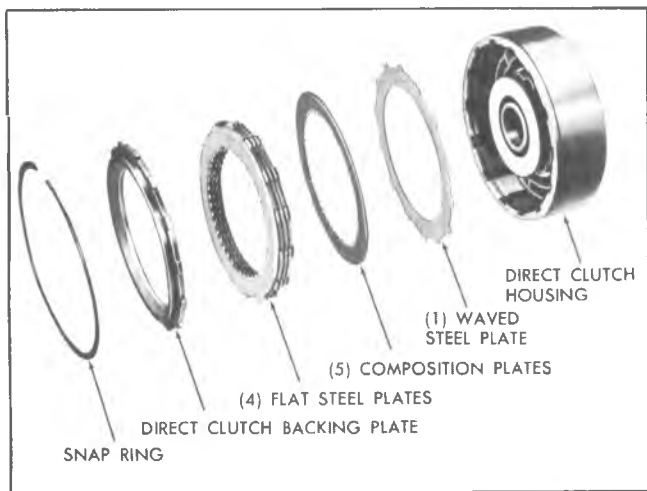


Fig. 83T--Direct Clutch Assembly Exploded

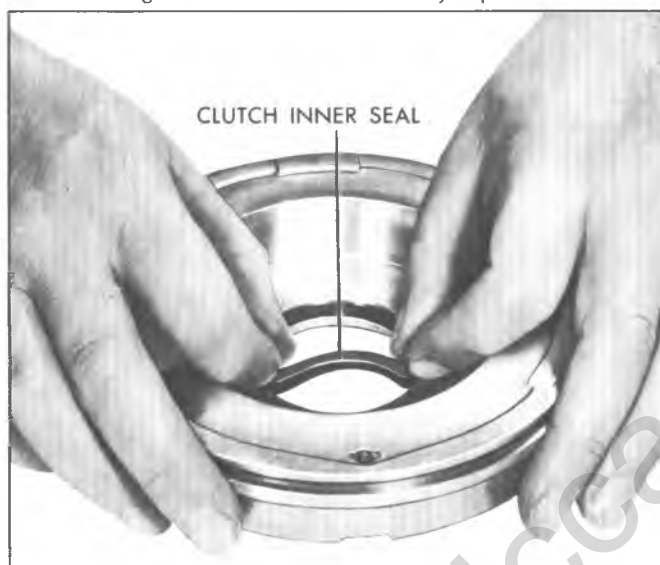


Fig. 84T--Installing Direct Clutch Inner Seal

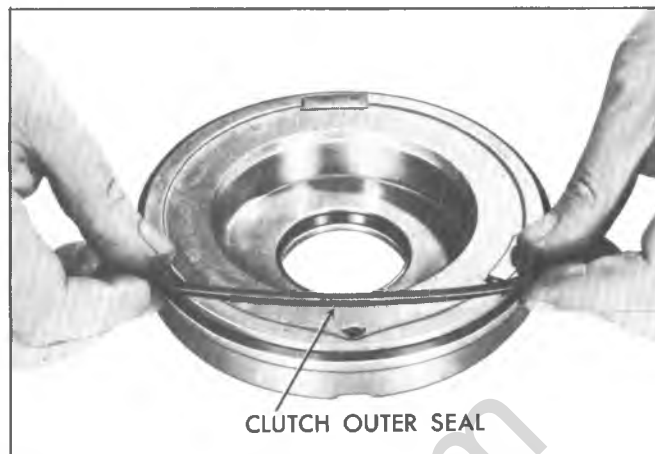


Fig. 85T--Installing Direct Clutch Outer Seal

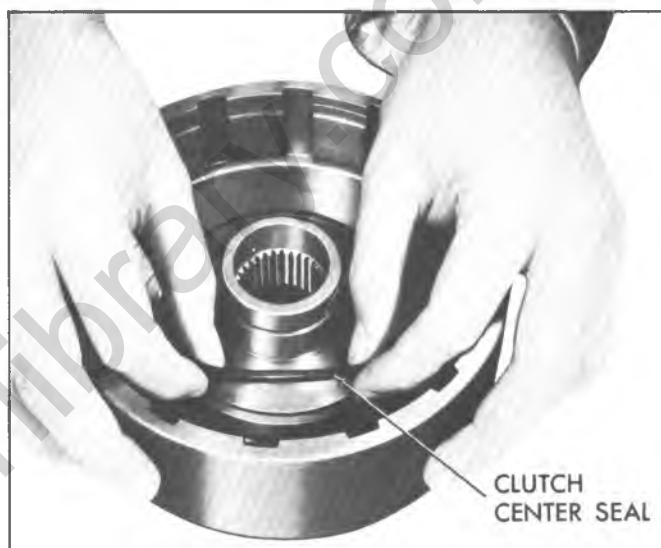


Fig. 86T--Installing Direct Clutch Center Seal

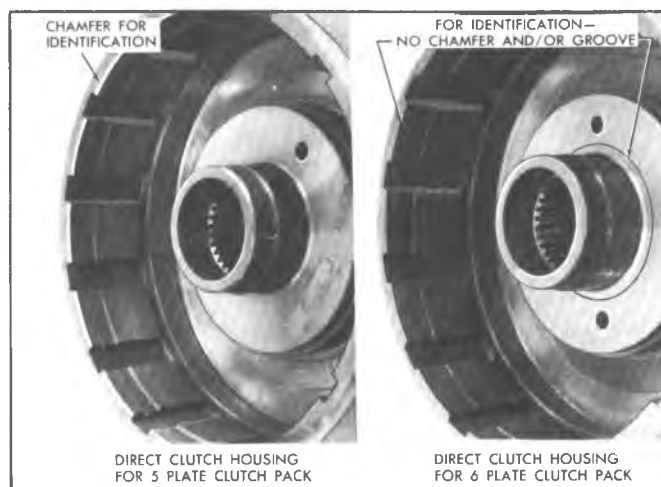


Fig. 87T--Direct Clutch Housing Identification

4. Place seal protectors, Tools J-21362 Inner, J-21409 Outer, over hub and clutch housing and install clutch piston, with a rotating motion (fig. 88T).
5. Install sixteen (16) springs into piston.
6. Place spring retainer and snap ring on retainer.
7. Using an arbor press and Tool J-4670, with J-21664, compress springs and install snap ring (fig. 82T):
8. Install direct clutch plates.

- a. (Models CA, CL, CJ, CK and CM) oil and install five (5) composition, four (4) flat steel plates and one (1) waved steel plate ("U" Notch), starting with the waved plate and

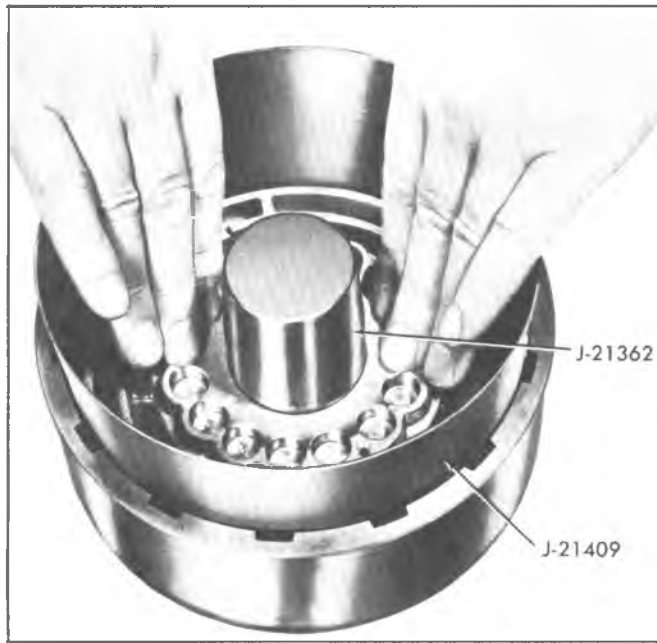


Fig. 88T--Installing Direct Clutch Piston

alternating composition and flat steel clutch plates (fig. 90T).

- b. (Model CY) oil and install six (6) composition and six (6) flat steel plates, starting with a flat steel plate and alternating composition and flat steel clutch plates.
- c. (Models CF, CR, CG and CS) oil and install six (6) composition, five (5) flat steel plates and one (1) waved steel plate ("U" Notch), starting with the waved plate and alternating composition and flat steel clutch plates.

NOTE: Do not use radial grooved composition plates here.

- 8. Install clutch backing plate.
- 9. Install backing plate retaining snap ring (fig. 91T).

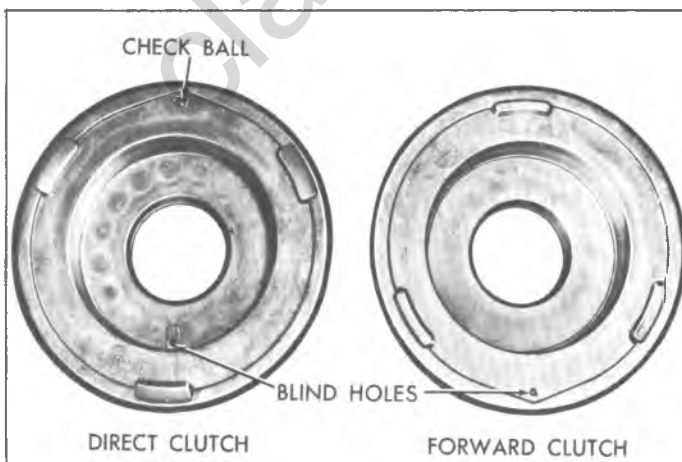


Fig. 89T--Forward and Direct Clutch Piston Identification

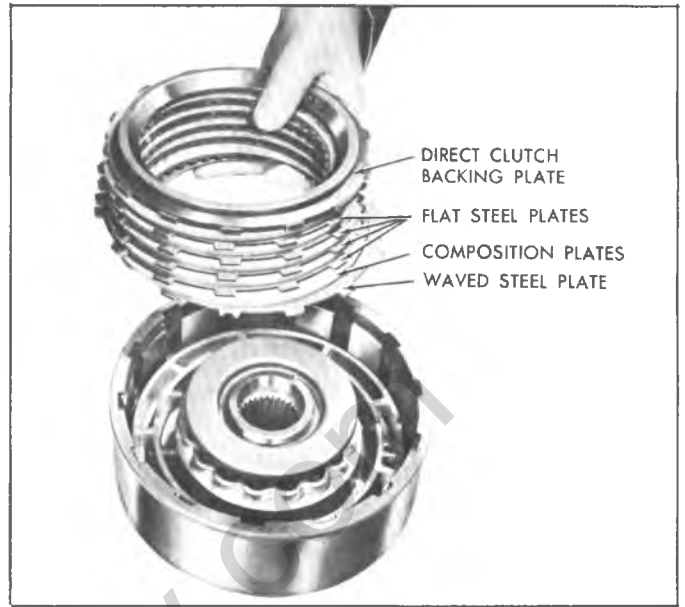


Fig. 90T--Install Direct Clutch Backing Plate, Composition Plates, and Steel Plates

NOTE: Install rollers that may have come out of the roller cage by compressing the energizing spring with forefinger and inserting the roller from the outer side.

- 10. Turn unit over and install the intermediate clutch roller assembly onto the intermediate clutch inner cam (fig. 92T).
- 11. Install the intermediate clutch outer race with a clock wise turning motion (fig. 92TA).

NOTE: Roller clutch is not released for CY model.

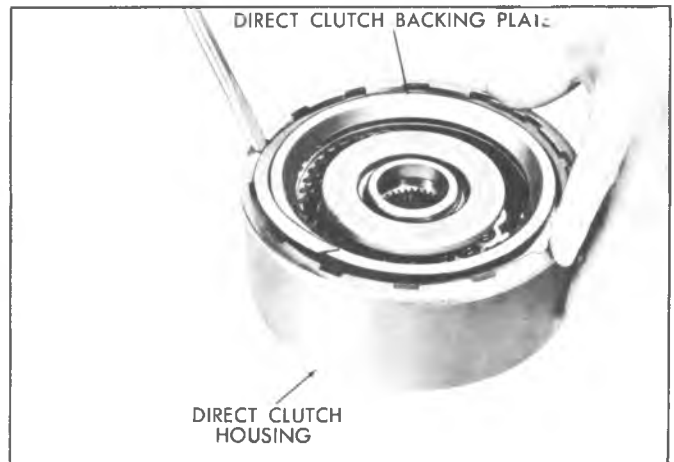


Fig. 91T--Installing Direct Clutch Housing to Backing Plate Snap Ring

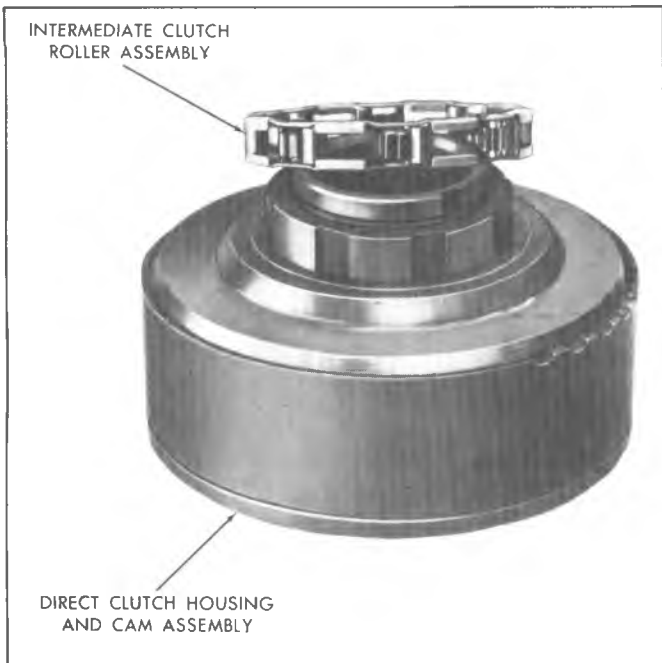


Fig. 92T--Installing Intermediate Clutch Roller Assembly

NOTE: Outer race should not turn counterclockwise after installation. (See Figure 93T).

12. Install intermediate clutch retainer and snap ring (fig. 94T and 95T).
14. Place direct clutch assembly over center support and air check operation of direct clutch (fig. 96T).

NOTE: If air is applied through reverse passage, (right oil feed hole) it will escape from direct clutch passage (left oil feed hole). This is considered normal. Apply air through left oil feed hole to actuate piston and move direct clutch.

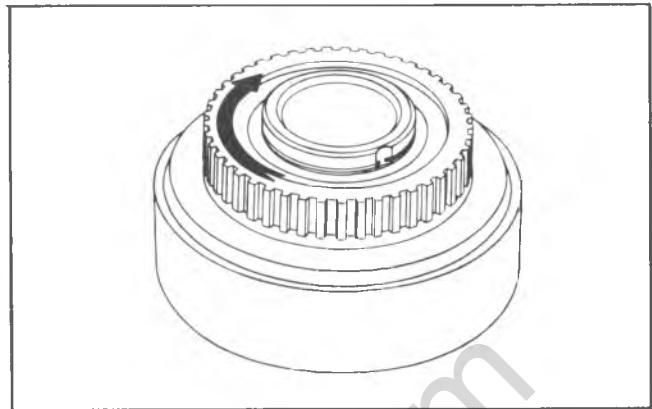


Fig. 93T--Intermediate Roller Clutch Rotation



Fig. 94T--Installing Intermediate Clutch Retainer

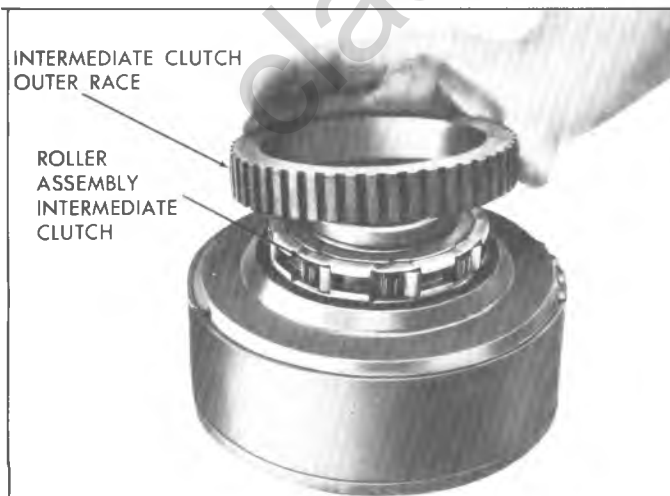


Fig. 92TA--Installing Intermediate Clutch Outer Race to Direct Clutch

DISASSEMBLY, INSPECTION AND RE-ASSEMBLY OF CENTER SUPPORT

Disassembly

1. Remove four (4) teflon oil seal rings from the center support (fig. 97T).
2. Compress spring retainer and remove snap ring (fig. 98T).
3. Remove spring retainer (Fig. 98TA) and three (3) clutch release springs (Fig. 98TB).
4. Remove intermediate clutch spring guide (Fig. 98TC).



Fig. 95T--Installing Intermediate Clutch Retainer Snap Ring

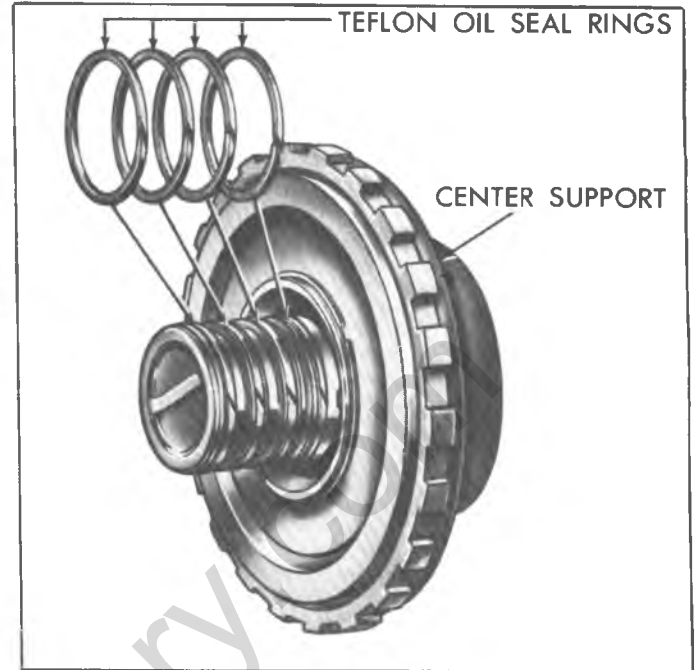


Fig. 97T--Center Support and Oil Seal Rings

5. Remove intermediate clutch piston (Fig. 98TD).
6. Remove inner and outer piston seal.

CAUTION: Do not remove three (3) screws retaining roller clutch inner race to center support.

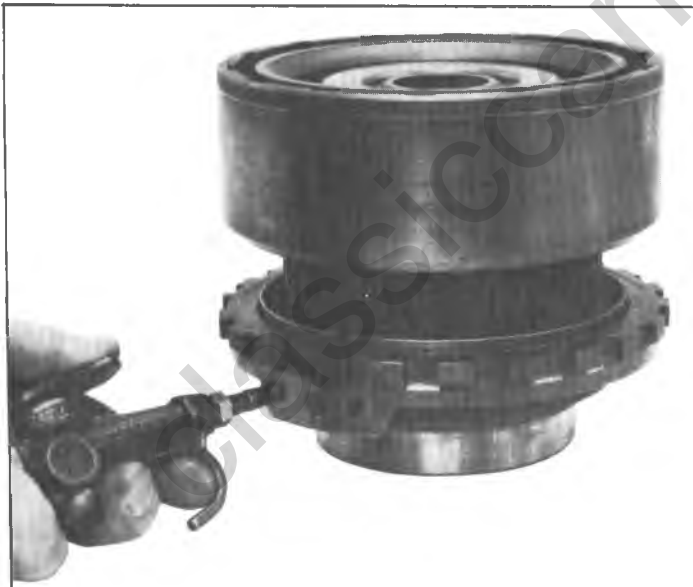


Fig. 96T--Air Checking Direct Clutch Assembly

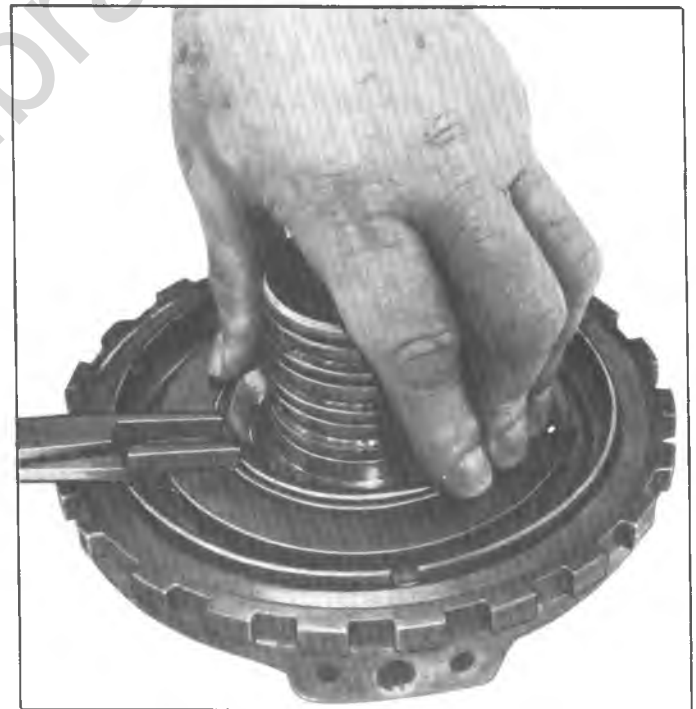


Fig. 98T--Removing Intermediate Clutch Piston Snap Ring

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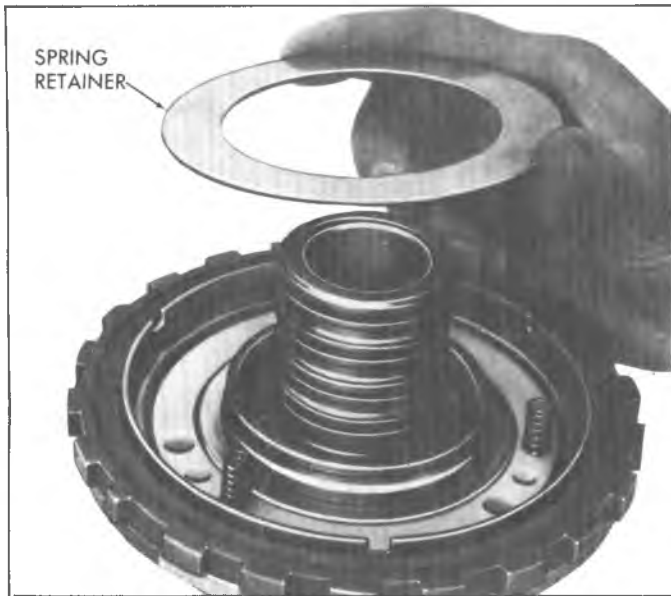


Fig. 98TA—Removing Spring Retainer

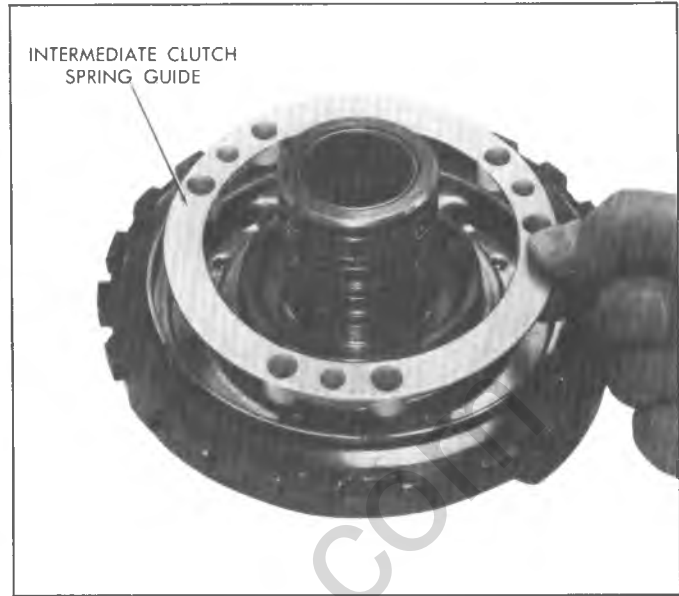


Fig. 98TC—Removing Intermediate Clutch Spring Guide



Fig. 98TB—Removing Clutch Release Springs

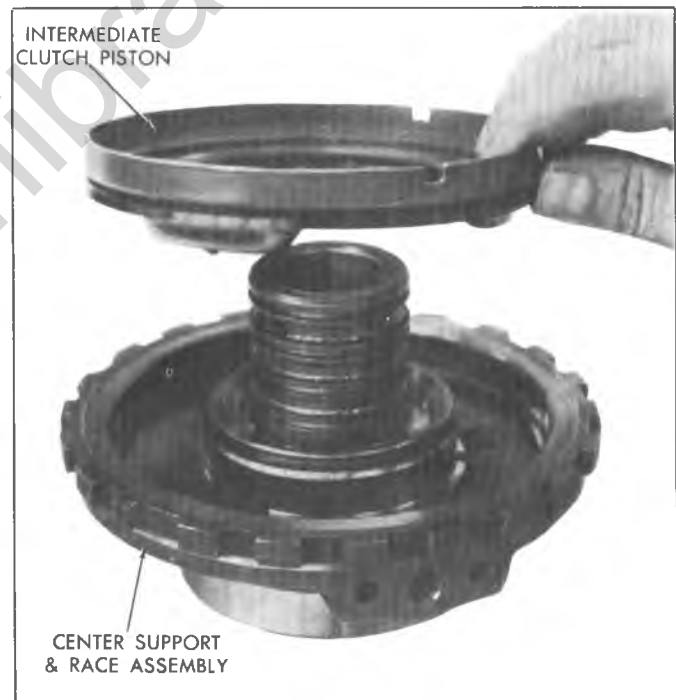


Fig. 98TD—Removing Intermediate Clutch Piston

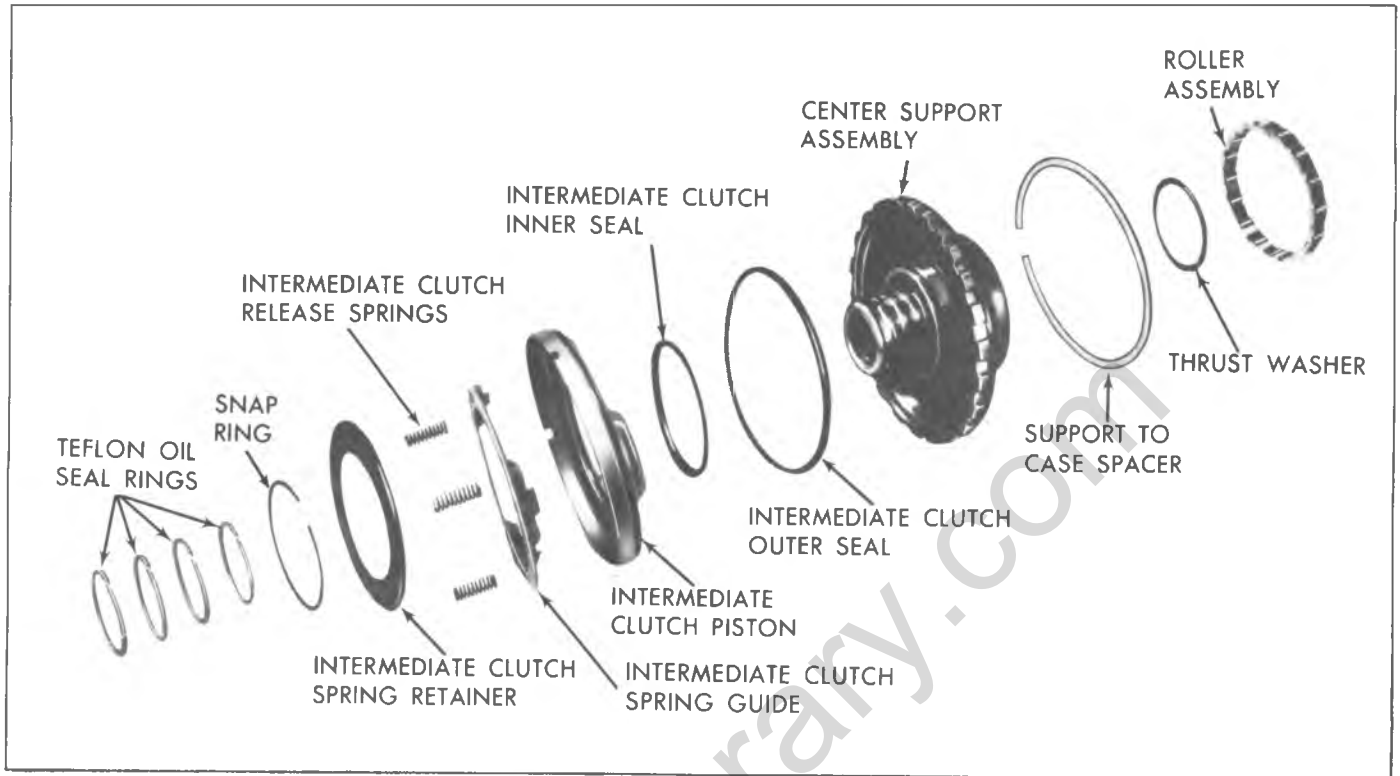


Fig. 99T--Center Support Assembly--Exploded View

Inspection

1. Inspect roller clutch inner race for scratches or indentations. Be sure lubrication hole is open. Be sure constant bleed plug orifice, (approx. .020 dia.), is open (fig. 40T).
2. Inspect bushing for scoring, wear or galling. If replacement is necessary, proceed as follows:
 - a. Using Tool J-21465-6 with Driver Handle J-8092 remove bushing.
 - b. From front side of center support, align elongated slot in the bushing with drilled hole in the oil delivery sleeve closest to the piston. Using Tool J-21465-6 and Driver Handle J-8092, drive bushing squarely into the bore until the bushing is flush to .010" below top of oil delivery sleeve.
3. Check oil ring grooves and teflon oil rings for damage.

NOTE: All service center support oil seal rings are hook type cast iron.
4. Air check oil passages to be sure they are not interconnected.
5. Inspect piston sealing surfaces for scratches.
6. Inspect piston seal grooves for nicks or other damage.

7. Inspect piston for cracks.
8. Inspect release springs for distortion.
9. Inspect support to case for burrs or raised edges. If present, remove with a stone or fine sandpaper.

Assembly

1. Lubricate and install new inner and outer seals on piston with lip of seal facing away from spring pocket (fig. 100T and 101T).
2. Install inner seal protector, Tool J-21363, on center support hub, install piston, indexing spring pockets of piston into cored areas of the center support (fig. 102T).
3. Install intermediate clutch spring guide (Fig. 102TA).
4. Install three (3) release springs into holes of spring guide. Space equally during assembly (Fig. 102TB).
5. Place spring retainer and snap ring over springs.
6. Compress springs and install snap ring (fig. 103T).
6. Install three (3) hook type cast iron oil seal rings on the center support if the teflon ring was not removed. If the teflon ring was removed, install four (4) hook type cast iron oil seal rings.
7. Air check operation of intermediate clutch piston (fig. 104T).

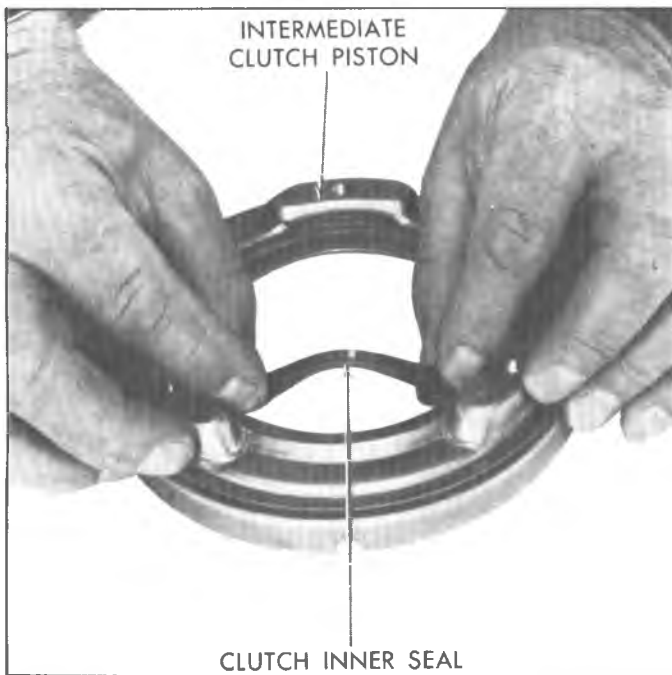


Fig. 100T--Installing Intermediate Clutch Inner Seal

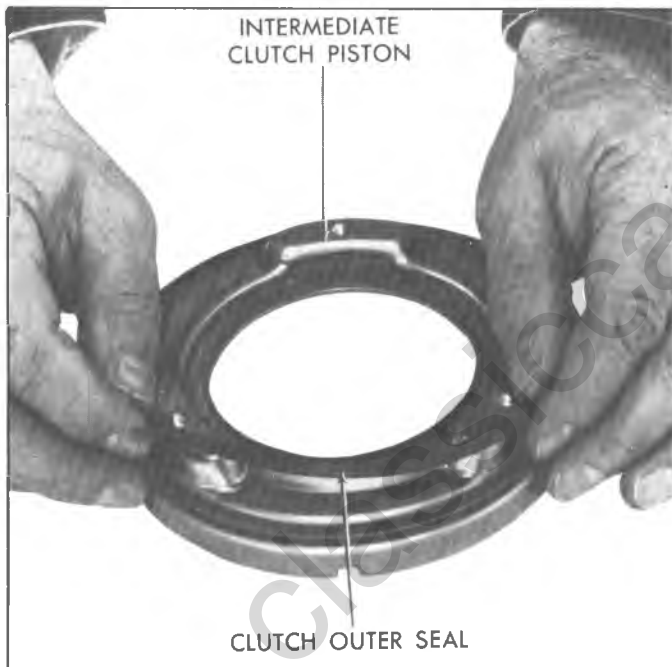


Fig. 101T--Installing Intermediate Clutch Outer Seal

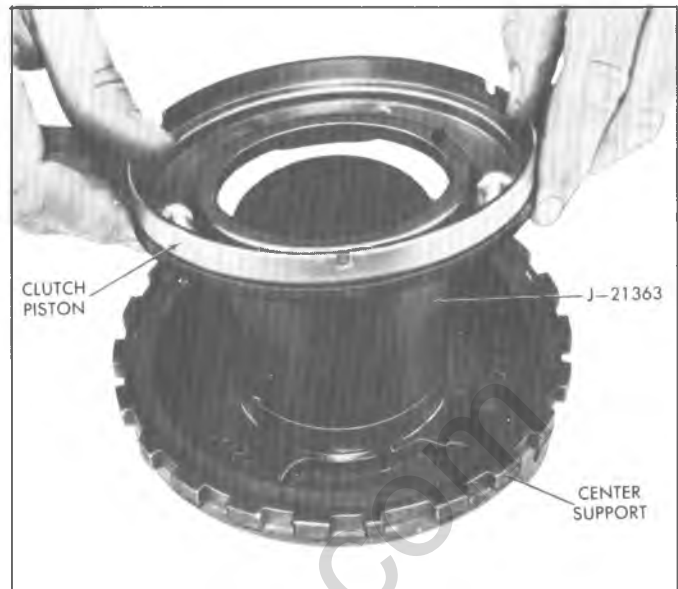


Fig. 102T--Installing Intermediate Clutch Piston

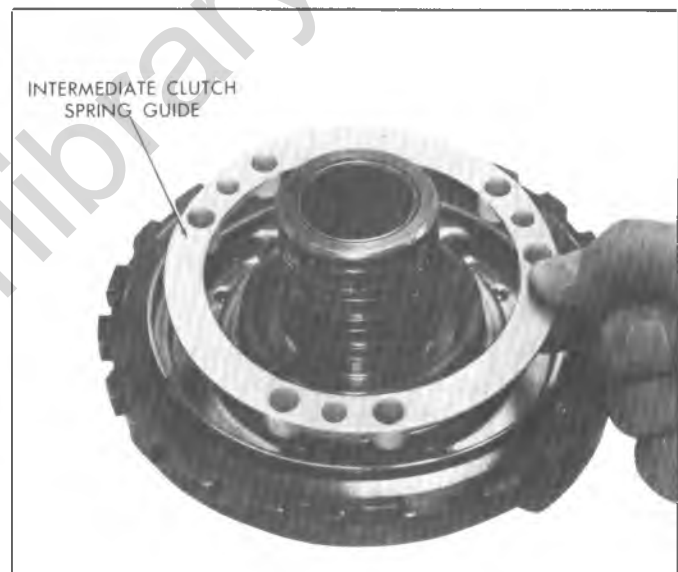


Fig. 102TA--Installing Intermediate Clutch Spring Guide

Inspection of Reaction Carrier, Roller Clutch, and Output Carrier Assembly

1. Inspect band surface on reaction carrier for signs of burning or scoring.
2. Inspect roller clutch outer race for scoring or wear.
3. Inspect thrust washer surfaces for signs of scoring or wear.

4. Inspect bushing for damage. If bushing is damaged, reaction carrier must be replaced.
5. Inspect reaction carrier pinions for damage, rough bearings, or excessive tilt.
6. Check pinion end play. Pinion end play should be .009"-.024" (fig. 105T).
7. Inspect roller clutch for damaged rollers.
8. Inspect roller clutch cage and springs for damage.
9. Inspect front internal gear (output carrier) for damaged teeth.

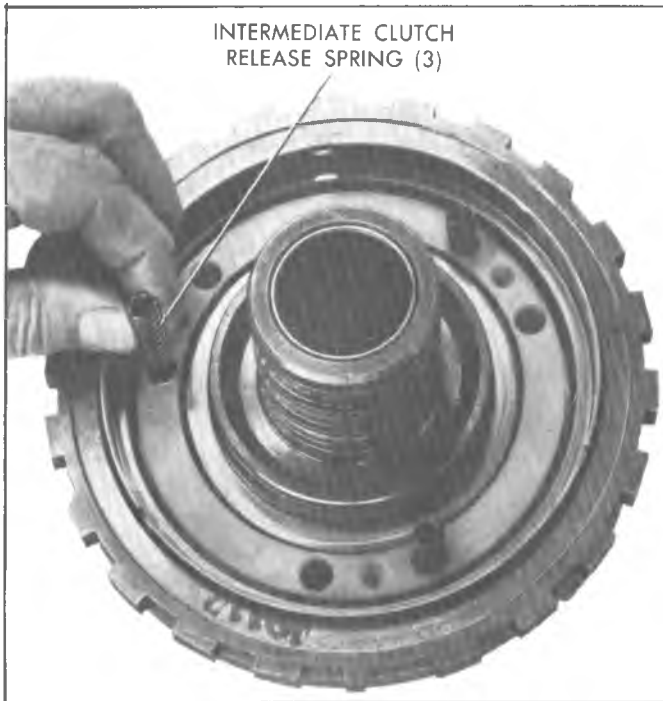


Fig. 102TB—Installing Intermediate Clutch Release Springs



Fig. 104T—Air Checking Intermediate Clutch Piston

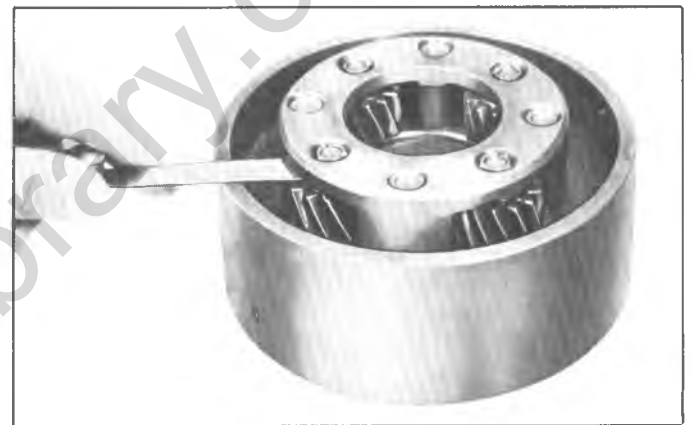


Fig. 105T—Checking Pinions End Play



Fig. 103T—Installing Intermediate Clutch Piston Snap Ring

10. Inspect output carrier pinions for damage, rough bearings or excessive tilt.
11. Check pinion end play. Pinion end play should be .009"-.024" (fig. 106T).
12. Inspect parking pawl lugs for cracks or damage.
13. Inspect output locating splines for damage.

14. Inspect front internal gear ring for flaking (fig. 42T).

Pinion Replacement Procedure

1. Support carrier assembly on its front face.
2. Using a 1/2 inch diameter drill, remove stake marks from the end of the pinion pin, or pins, to be replaced. This will reduce the probability of cracking the carrier when pinion pins are pressed out. Do not allow drill to remove any stock from the carrier.
3. Using a tapered punch, drive or press pinion pins out of carrier (fig. 107T).
4. Remove pinions, thrust washers and roller needle bearing.
5. Inspect pinion pocket thrust faces for burrs and remove if present.
6. Install eighteen (18) needle bearings into each pinion using petrolatum to hold bearings in place. Use pinion pin as guide (fig. 108T).
7. Place a bronze and steel washer on each side of

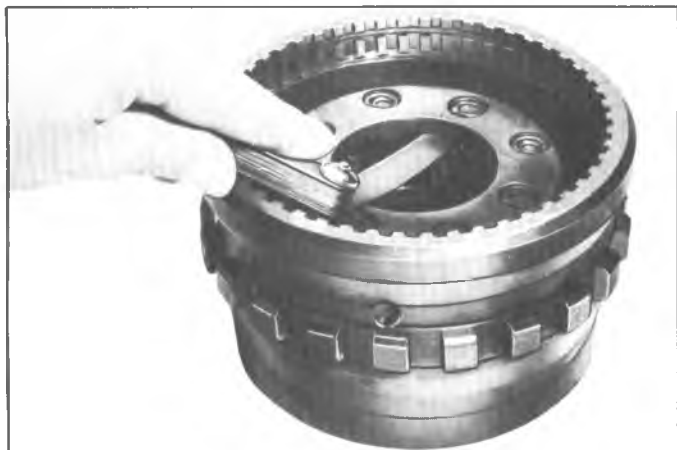


Fig. 106T-Checking Output Carrier Pinion End Play

pinion so steel washer is against pinion, hold them in place with petrolatum.

8. Place pinion assembly in position in carrier and install a pilot shaft through rear face of assembly to hold parts in place.
9. Drive a new pinion pin into place while rotating pinion from front, being sure that headed end is flush or below face of carrier (fig. 109T).
10. Place a large punch in a bench vise to be used as an anvil while staking opposite end of pinion pin in three places. Both ends of pinion pins must lie below face of carrier or interference may occur.

OUTPUT SHAFT, REAR INTERNAL GEAR, SUN GEAR AND SHAFT

Output Shaft

1. Inspect bushing for wear or galling. If replacement is necessary, proceed as follows:
 - a. Thread Tool J-21465-16 into bushing and using Slide Hammer J-2619, remove bushing.

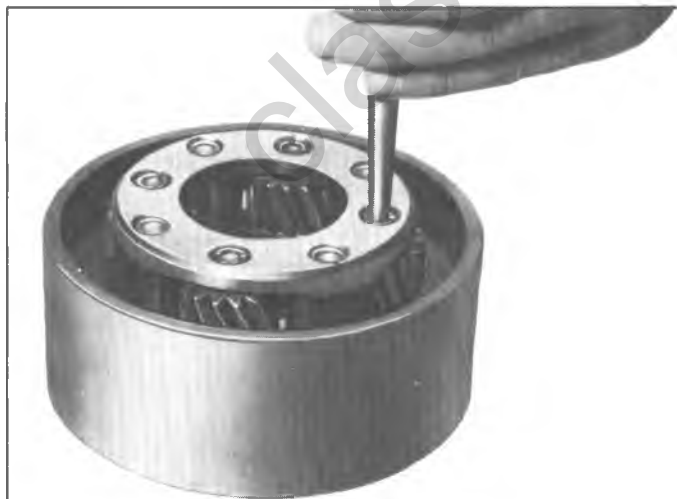


Fig. 107T-Removing Planet Pinion Pin

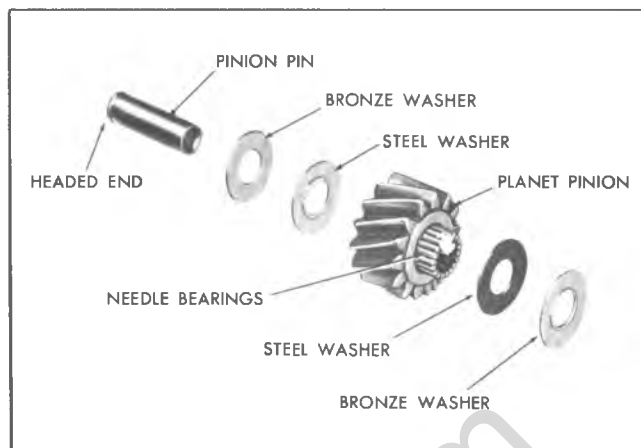


Fig. 108T-Planet Pinion Assembly-Exploded View



Fig. 109T-Installing Planet Pinion Pin

- b. Using Tool J-21465-1 with drive handle J-8092, install bushing into place until tool bottoms.
2. Inspect bearing and thrust washer surfaces for damage.
3. Inspect governor drive gear for rough or damaged teeth.
4. Inspect splines for damage.
5. Inspect orificed cup plug in lubrication passage.
6. Inspect drive lugs for damage.

Inspection of Rear Internal Gear

1. Inspect gear teeth for damage or wear.
2. Inspect splines for damage.
3. Inspect gear for cracks.

Inspection of Sun Gear

1. Inspect gear teeth for damage or wear.
2. Inspect splines for damage.
3. Be sure oil lubrication hole is open.

Inspection of Sun Gear Shaft

1. Inspect shaft for cracks or splits.

2. Inspect splines for damage.
3. Inspect bushings for scoring or galling. If necessary to replace, proceed as follows:

SUN GEAR SHAFT BUSHING-FRONT AND REAR

Remove

With sun gear shaft properly supported, using Tool J-21465-15, with slide hammer and Adapter J-2619, remove bushing.

Replace

Using Tool J-21465-5 with Driver Handle J-8092 press or drive replacement bushing into place until tool bottoms.

INSPECTION OF MAIN SHAFT

1. Inspect shaft for cracks or distortion.
2. Inspect splines for damage.
3. Inspect ground bushing journals for damage.
4. Inspect snap ring groove for damage.
5. Make sure that lubrication holes are open.

NOTE: If replacement of mainshaft is required, make sure that the orifice cup plug in the service mainshaft is removed.

INSPECTION OF FRONT AND REAR BANDS, SUPPORT TO CASE SPACER

1. Inspect lining for cracks, flaking, burring, or looseness.
2. Inspect bands for cracks or distortion.
3. Inspect end for damage at anchor lugs or apply lugs.

INSPECTION OF CASE EXTENSION - ALL EXCEPT CL MODEL

1. Inspect bushing for excessive wear or damage. If replacement is necessary, remove rear seal and with extension housing properly supported, remove bushing as follows:
 - a. (All except CM and CL Models) Using tool J-22419, with Driver Handle J-8092, drive or press replacement bushing into place, flush to .010 below oil seal counter bore area. Stake bushing, using tool J-21465-10. Stake marks to be in bushing lubrication grooves.
 - b. (CM Model) Using Tool J-8400-19 (or J-9640) with Driver Handle J-8092, drive or press replacement bushing into place flush to .010 below oil seal counter bore area. Stake bushing, using tool J-21465-10 (or J-8400-22). Stake marks to be in bushing lubrication grooves.
2. Inspect gasket mounting face for damage.

3. Inspect housing for cracks or porosity.
4. Be sure rear seal drain back port is not obstructed.

INSPECTION OF CASE EXTENSION - CL MODEL

1. Inspect seal (case extension to case) groove for damage.
2. Inspect for cracks, or porosity.
3. Inspect dowel pin in rear face for damage.
4. Inspect oil seal for damage. If replacement is required, proceed as follows:
 - a. Pry oil seal from extension.
 - b. Apply non-hardening sealer to outside of new oil seal, and install oil seal into case extension using tool (J-24057) (see fig. 140T).
5. Inspect ball bearing assemblies. If they are damaged, or if they require cleaning, proceed as follows:
 - a. Remove rear seal.
 - b. Remove snap ring.
 - c. Remove ball bearings and bearing spacer, using a brass rod on the outside race of bearing. An arbor press can be used if tool to press bearing out is located on outer race of bearing.

CAUTION: DO NOT locate against inner race or balls.

 - d. Install ball bearing assembly and spacer, bearing first.
 - e. Install ball bearing assembly and snap ring.
 - f. Install new rear oil seal.

INSPECTION OF MODULATOR AND VALVE

1. Inspect modulator assembly for any signs of bending or distortion (fig. 110T).
2. Inspect "O" ring seal seat for damage.

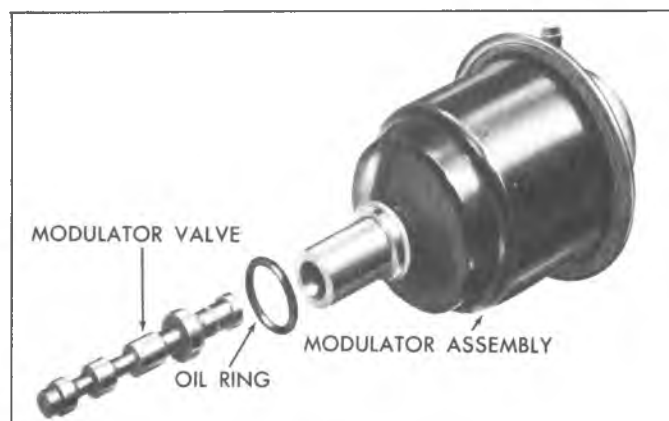


Fig. 110T-Modulator Assembly and Valve

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3. Apply suction to vacuum tube and check for diaphragm leaks.
4. Check modulator bellows as outlined in Section 7 of Service Manual (modulator plunger is under pressure - 16 lbs.). If bellows is damaged plunger will have very little pressure.
5. Inspect modulator valve for nicks or damage.
6. Check freeness of valve operation in case bore.

INSPECTION OF MANUAL AND PARKING LINKAGE

1. Inspect parking actuator rod for cracks, or broken spring retainer lugs (fig. 111T).
2. Inspect actuator spring for damage.
3. Inspect actuator for free fit on actuator rod.
4. Inspect parking pawl for cracks or wear.
5. Inspect manual shaft for damaged threads, rough oil surface or loose lever.
6. Inspect inside detent lever for cracks or a loose pin.

7. Inspect parking pawl shaft if removed for damaged retainer groove.
8. Inspect parking pawl return spring for deformed coils or end.
9. Inspect parking bracket for cracks or wear.
10. Inspect detent roller and spring assembly.

INSPECTION OF CASE ASSEMBLY (FIGS. 112T AND 113T)

CAUTION: *If the case assembly requires replacement, make sure the center support-to-case spacer is removed from the old case and reinstalled in the new case.*

1. Inspect case assembly for cracks, porosity or inter-connected passages.
2. Check for good retention of band anchor pins.
3. Inspect all threaded holes for thread damage.
4. Inspect intermediate clutch driven plate lugs for damage or brinelling.

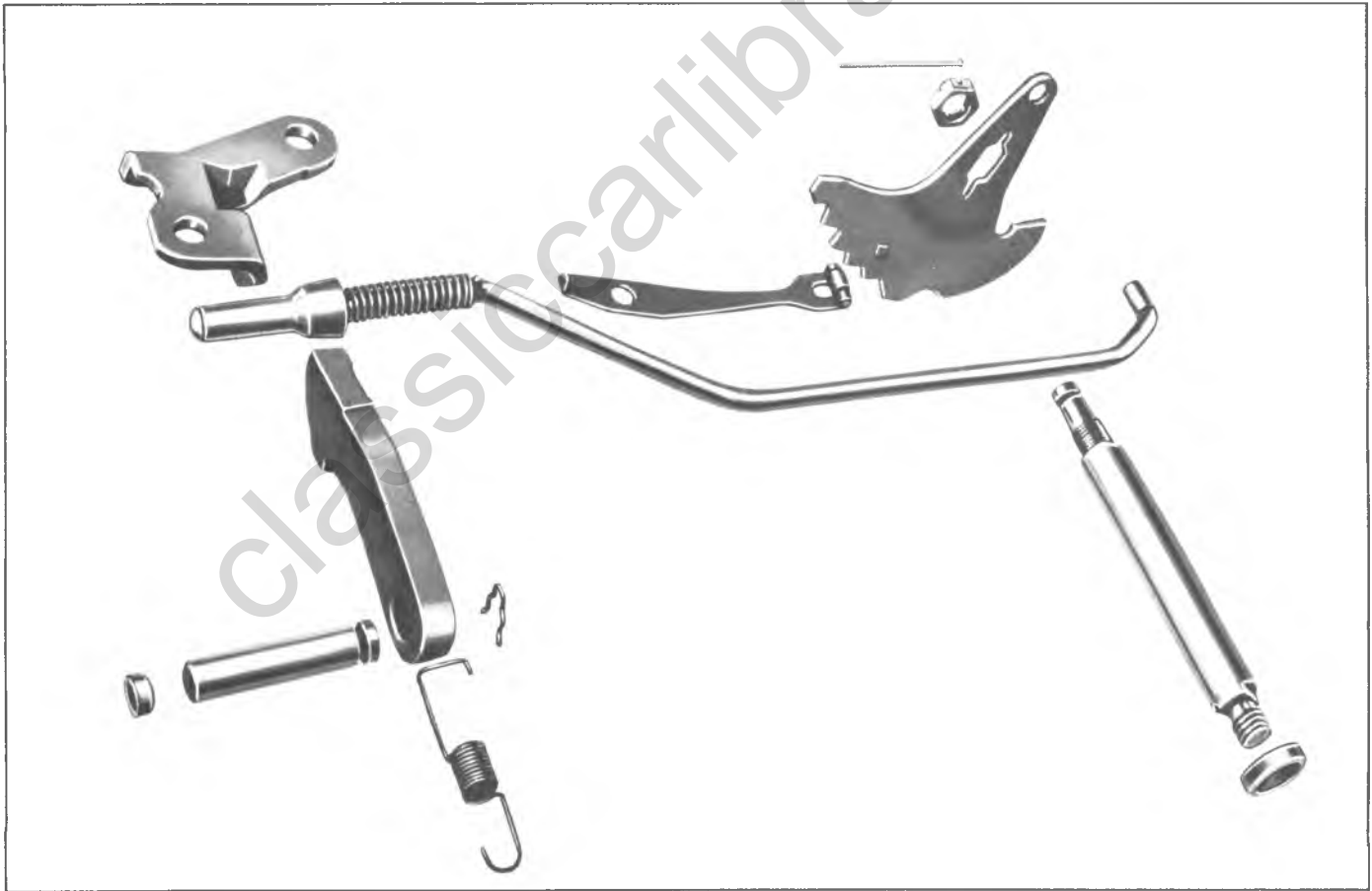


Fig. 111T--Manual and Parking Linkage--Exploded View

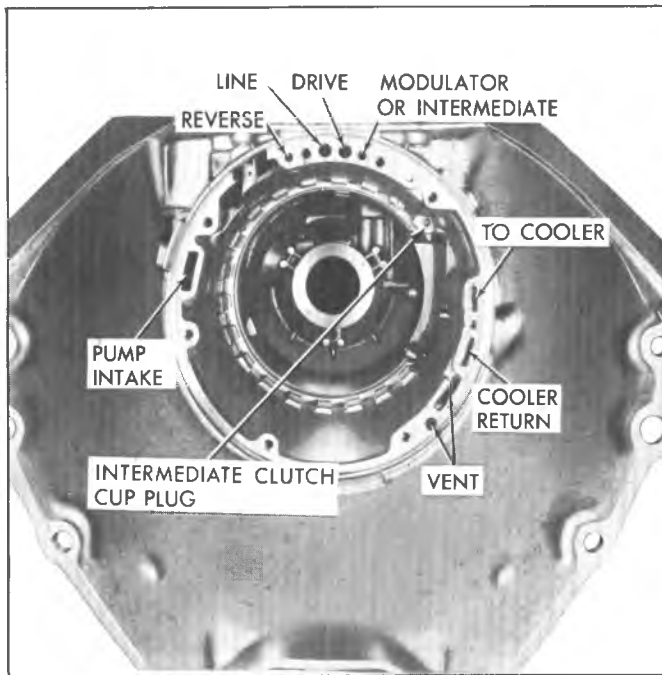


Fig. 112T--Case-Front View Passage Identification

5. Inspect snap ring grooves for damage.
6. Inspect bore for governor assembly for scratches or scoring.
7. Inspect modulator valve bore for scoring or damage.
8. Inspect cup plug inside case for good staking and sealing.
9. Inspect case bushing. If necessary to replace, proceed as follows:

Case Bushing

Remove

With case properly supported, using tool J-21465-8, with Driver Handle J-8092, remove bushing.

Replace

Using tool J-21465-8 adaptor ring J-21465-9, Driver Handle J-8092, and extension J-21465-13, with lube passage facing front of transmission case, drive replacement bushing into case until .040 to .055 above selective washer face. Stake bushing with tool J-21465-10. Stake marks to be in bushing lubrication grooves.

INSPECTION OF CONVERTER

1. Check converter for leaks as follows (fig. 114T):
 - a. Install Tool J-21369 and tighten.
 - b. Apply 80 psi air pressure to tool.
 - c. Submerge in water and check for leaks.
2. Check converter hub surfaces for signs of scoring or wear.

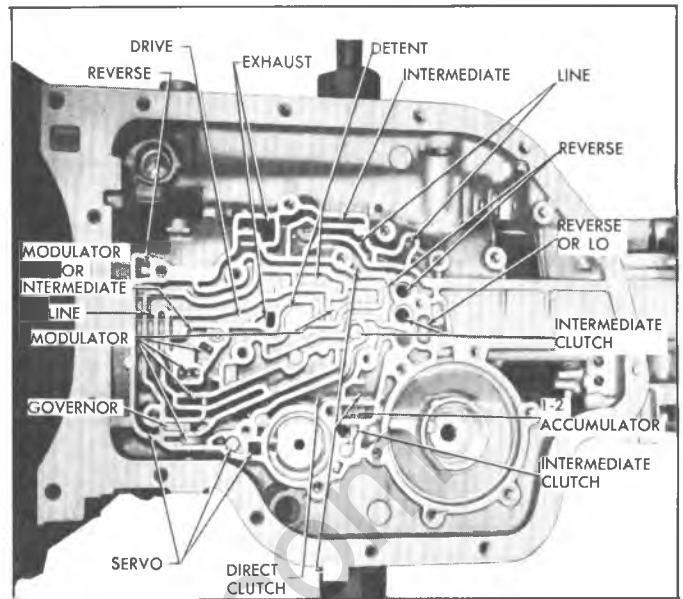


Fig. 113T--Inspect Transmission Case



Fig. 114T--Air Checking Converter

Converter End Clearance Check (Figs. 114T-A and 114T-B)

1. Fully release collet end of Tool J-21371-8.
2. Install collet end of Tool J-21371-8 into converter hub until it bottoms; then tighten cap nut to 5 lb. ft. (fig. 114T-A).
3. Install Tool J-21371-3 and tighten hex nut to 3 lb. ft. (fig. 114T-B).
4. Install Dial Indicator J-8001 and set it at "zero",

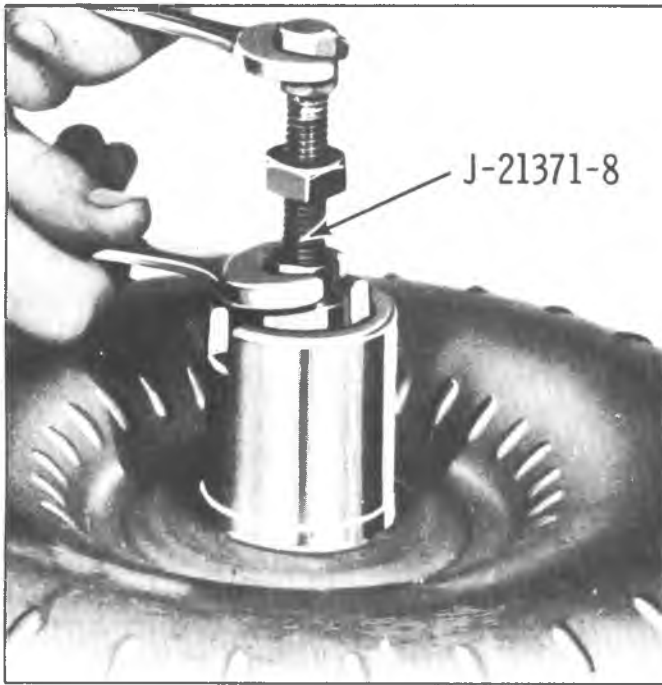


Fig. 114T-A--Loosening Collet on Tool J-21571-8

while its plunger rests on the cap nut of Tool J-21371-8.

5. Loosen hex nut while holding cap nut stationary. With the hex nut loosened and holding Tool J-21371-3 firmly against the converter hub, the reading obtained on the dial indicator will be the converter end clearance. End clearance should be less than .050". If the end clearance is .050" or greater, the converter must be replaced.

ASSEMBLY OF REAR UNIT

1. Install rear internal gear on end of main shaft.
2. Install rear internal gear retaining snap ring (fig. 116T).
3. Install sun gear to internal gear thrust races and bearings against inner face of rear internal gear as follows, and retain with petrolatum.
 - a. Place large race against internal gear with outer flange facing forward or up (fig. 117T).

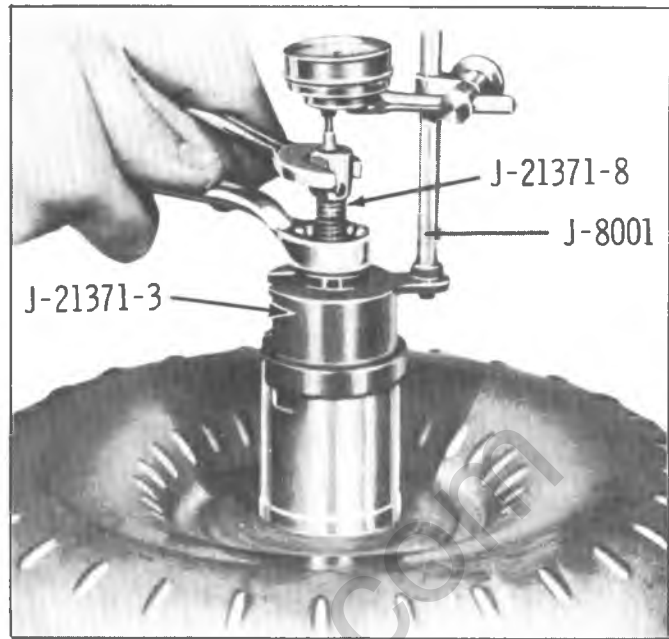


Fig. 114T-B--Checking Converter End Clearance

- b. Place thrust bearing against race.
- c. Place small race against bearing with inner flange facing into bearing or down.
4. Install output carrier over mainshaft so that pinions mesh with rear internal gear.
5. Place above portion of "build-up" through hole in bench so that mainshaft hangs downward.
6. Install rear internal gear to output shaft thrust races and bearings as follows and retain with petrolatum (fig. 118T).
 - a. Place small diameter race against internal gear with center flange facing up.
 - b. Place bearing on race.
 - c. Place second race on bearing with outer flange cupped over bearing.
7. Install output shaft into output carrier assembly (fig. 119T).
8. Install output shaft to output carrier snap ring.

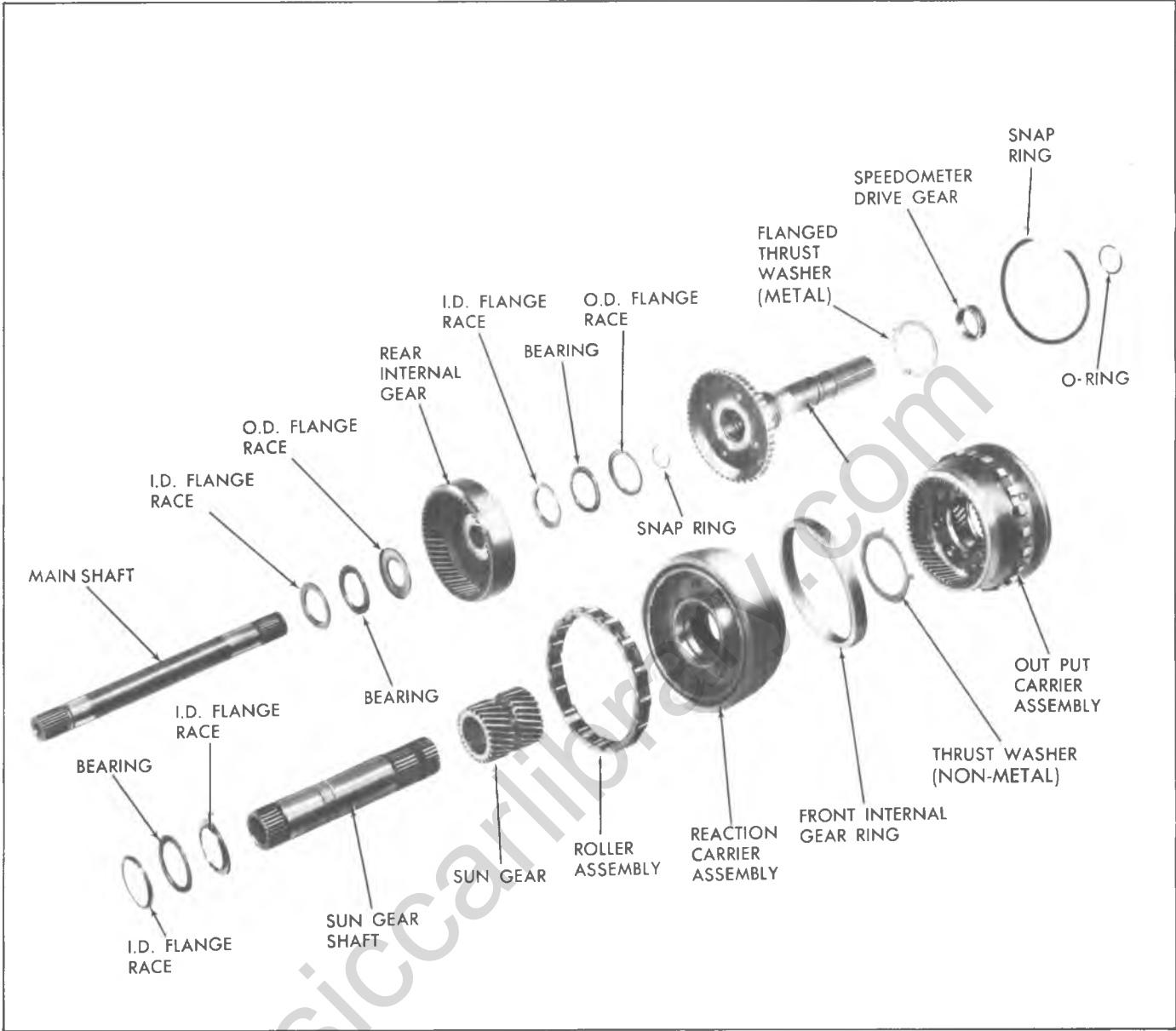


Fig. 115T-Gear Unit Assembly-Exploded View

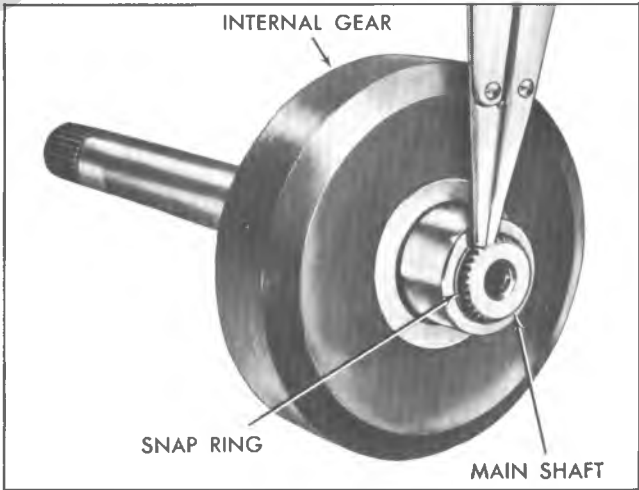


Fig. 116T--Installing Rear Internal Gear Snap Ring

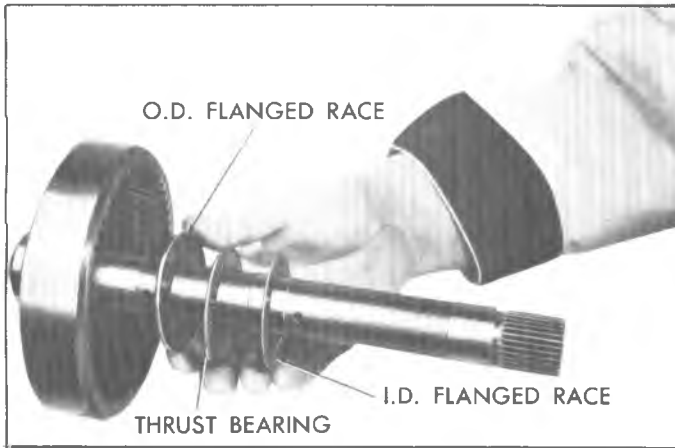


Fig. 117T--Installing Rear Internal Gear to Sun Gear Bearing and Races

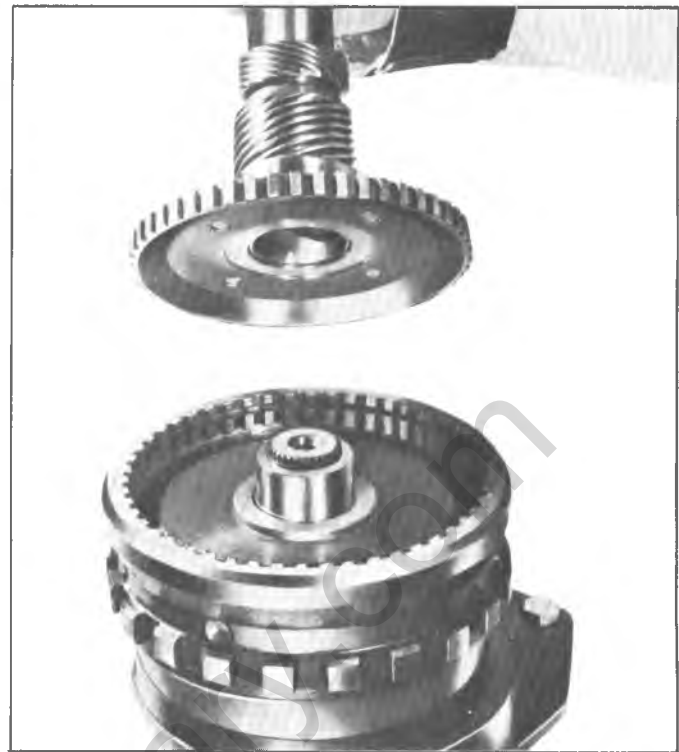


Fig. 119T--Installing Output Shaft

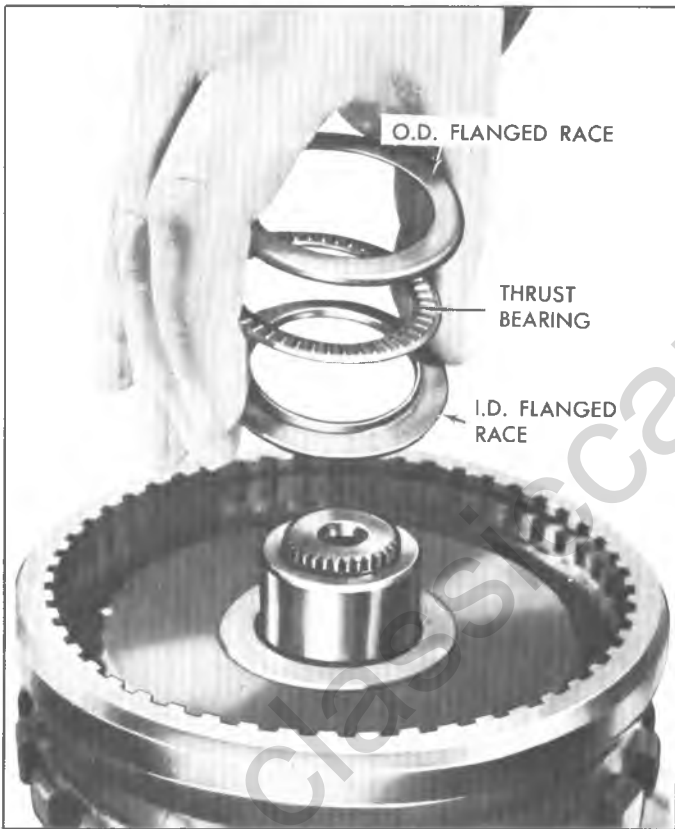


Fig. 118T--Installing Rear Internal Gear to Output Shaft Bearing and Races

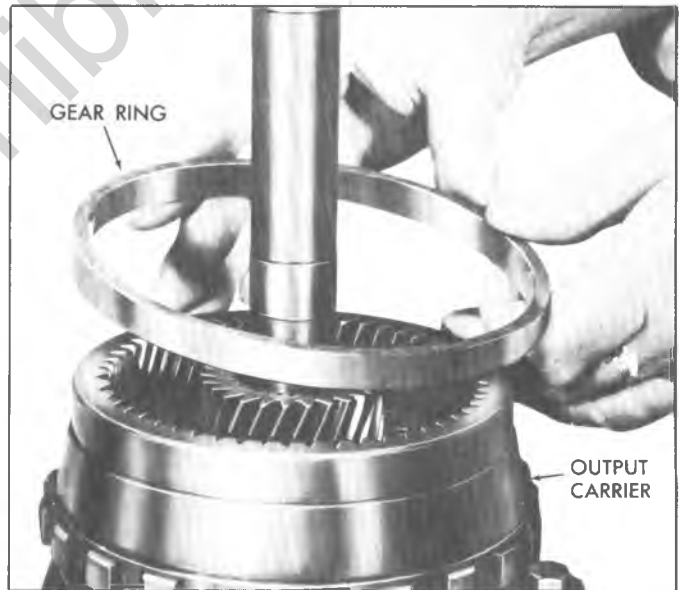


Fig. 120T--Installing Front Internal Gear Ring to Output Carrier



Fig. 121T--Installing Reaction Carrier

9. Install "O" ring on output shaft of models that use an "O" ring.
10. Turn assembly over and support so that output shaft hangs downward.
11. Install reaction carrier to output carrier thrust washer with tabs facing down in pockets of output carrier and retain with petrolatum.
12. Install sun gear I.D. splines with chamfer down.
13. Install front internal gear ring over output carrier (fig. 120T).
14. Install sun gear shaft with long splined end down.
15. Install reaction carrier (fig. 121T).

NOTE: When a new output carrier and/or reaction carrier is being installed and if the front internal gear ring prevents assembly of the carriers, replace the front internal gear rings with the SERVICE ring.

16. Install center support to sun gear thrust races and bearings as follows: (Retain with petrolatum).
 - a. Install large race, center flange up over sun gear shaft.
 - b. Install thrust bearing against race.
 - c. Install second race, center flange up (fig. 122T).

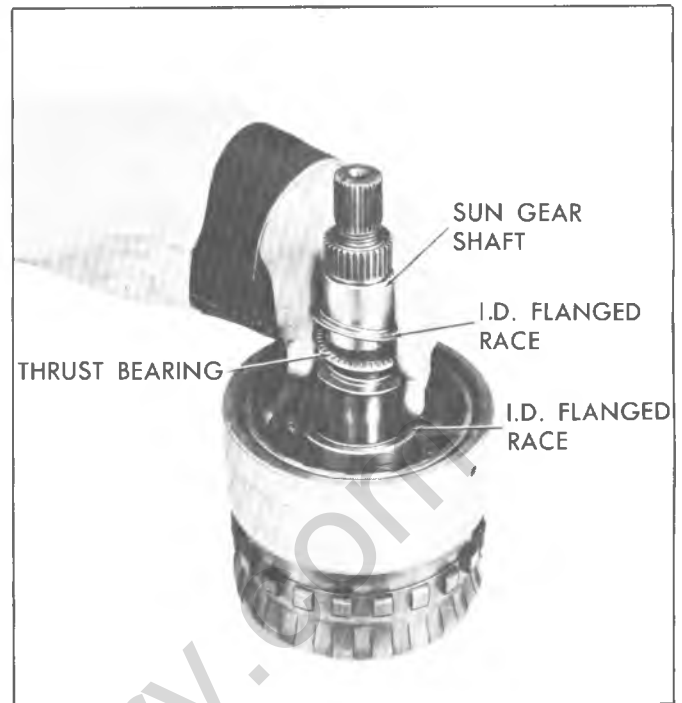


Fig. 122T--Installing Center Support to Sun Gear Thrust Bearing and Races

17. Install rollers that may have come out of the roller clutch cage, by compressing the energizing spring with forefinger and inserting roller from the outer edge (fig. 123T).
18. Install roller clutch assembly (fig. 124T) into reaction carrier.
19. Install center support to reaction carrier thrust washer into recess in center support. Retain with petrolatum (fig. 40T).
20. Install center support into roller clutch in reaction carrier (fig. 125T).

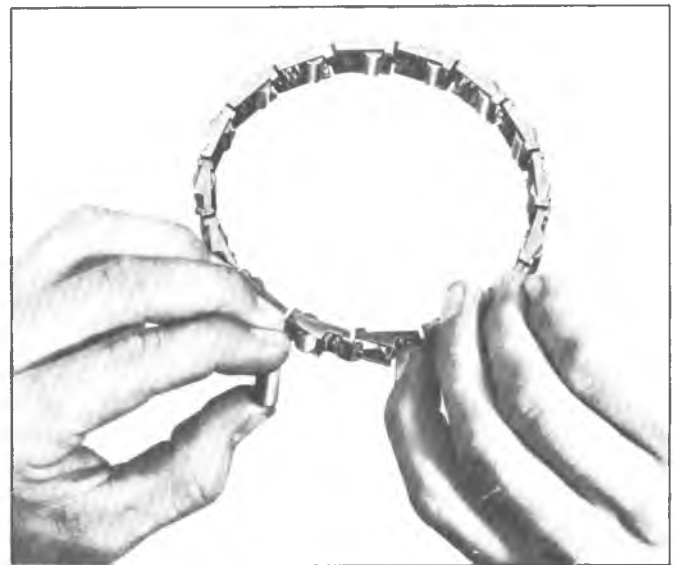


Fig. 123T--Installing Roller into Roller Clutch Cage

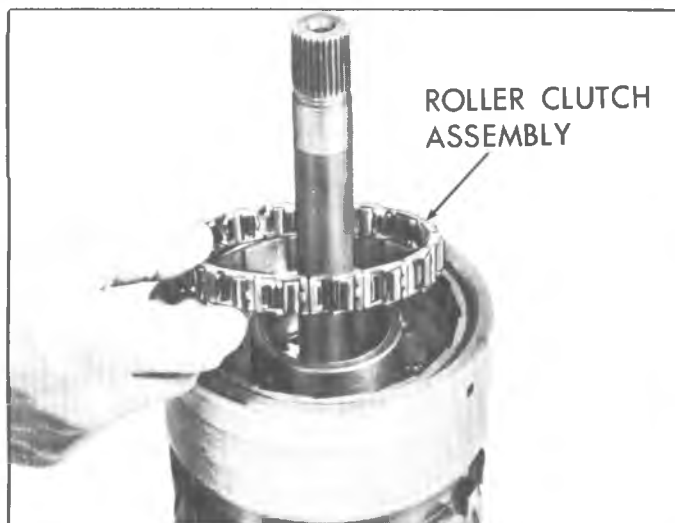


Fig. 124T--Installing Roller Clutch to Reaction Carrier

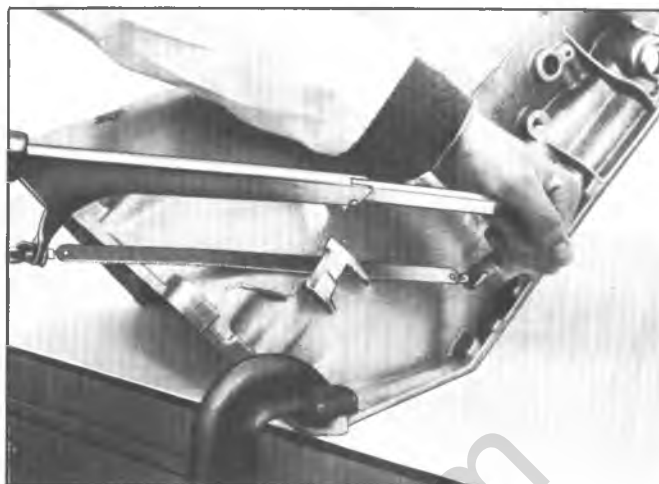


Fig. 126T-A--Modification of Service Case for Corvette Models

NOTE: With reaction carrier held, center support should only turn counter-clockwise after installation.

21. Install J-21795 on gear unit assembly to hold units in place.
22. Install output shaft to case thrust washer tabs in pockets (fig. 126T), and retain with petrolatum.

CASE MODIFICATION--CORVETTE

NOTE: Due to the configuration of the body floor pan, it is necessary to modify the standard Service Case when used as a replacement part for the Corvette.

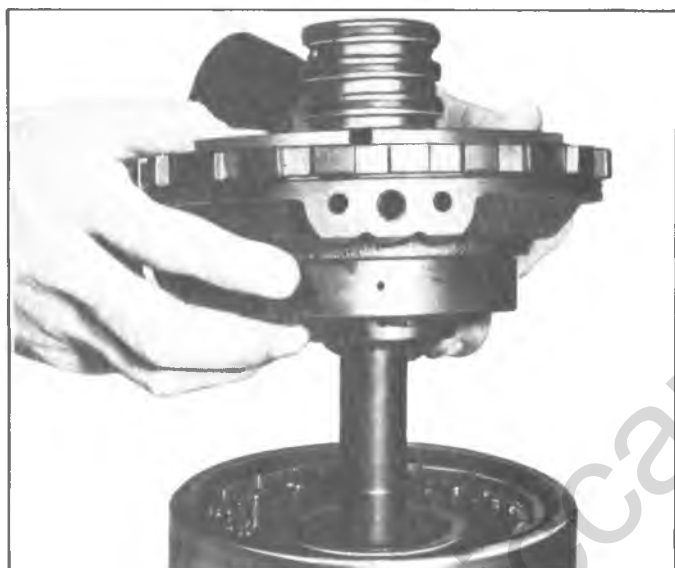


Fig. 125T--Installing Center Support to Reaction Carrier



Fig. 126T--Installing Case to Output Shaft Thrust Washer



Fig. 127T--Installing Parking Pawl Shaft Cup Plug

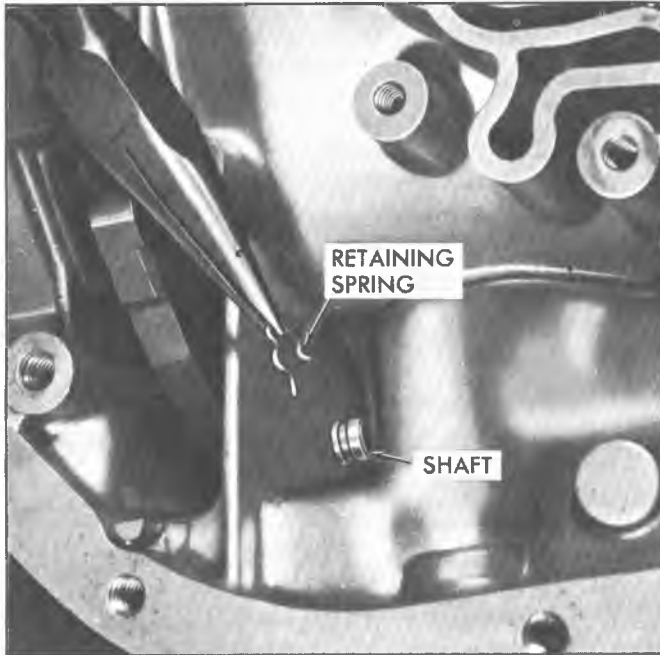


Fig. 128T--Installing Parking Shaft Retaining Spring

Using a "C" Clamp, clamp the transmission case firmly to a suitable bench, with the converter under pan attaching face down, as shown in Figure 126T-A, (do not damage machined surface of the case).

Using a hacksaw, remove the two front manufacturing lugs (one on each side), as close to the wall of the case as possible, using caution not to cut into the wall of the case.

ASSEMBLY OF UNITS TO TRANSMISSION CASE

NOTE: The first three steps can be omitted if the parts involved were not removed on disassembly.

1. Install parking pawl tooth toward inside of case, and parking pawl shaft (fig. 127T).
2. Install parking pawl shaft retainer clip (fig. 128T).



Fig. 129T--Installing Rear Band

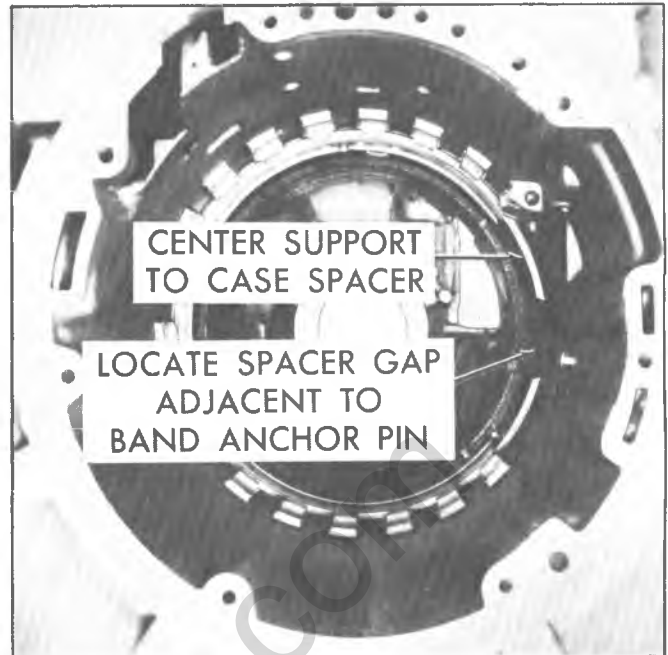


Fig. 129T-A--Installing Center Support to Case Spacer

3. Install parking pawl shaft cup plug and drive into the case, using a 3/8 dia. rod, until the parking pawl shaft bottoms on the case rib (fig. 127T).
4. Install parking pawl return spring, square end hooked on pawl and other end on case.
5. Install parking bracket with guides over parking pawl using two attaching bolts, torque to 18 ft. lbs.
6. Install rear band assembly so that two lugs index with two anchor pins. Check to make sure band is seated on lugs (fig. 129T).
7. Install the center support to case spacer against the shoulder at the bottom of case splines and the gap located adjacent to the band anchor pin (fig. 129T-A).

CAUTION: Do not confuse this spacer (.040" thick and both sides flat) with either the center support to case snap ring (one side beveled) or the intermediate clutch backing plate to case snap ring (.093" thick and both sides flat).

8. Install proper rear selective washer (proper washer determined by previous end play check) into slots provided inside rear of transmission case.
9. Install complete gear unit assembly into case, using Tool J-21795 (fig. 130T).
10. Install center support to case retaining snap ring with bevel side up (flat surface against the center support) and locating gap adjacent to band anchor pin. Make certain ring is properly seated in case (fig. 131T).
11. Install case to center support bolt by placing the center support locating tool into the case direct

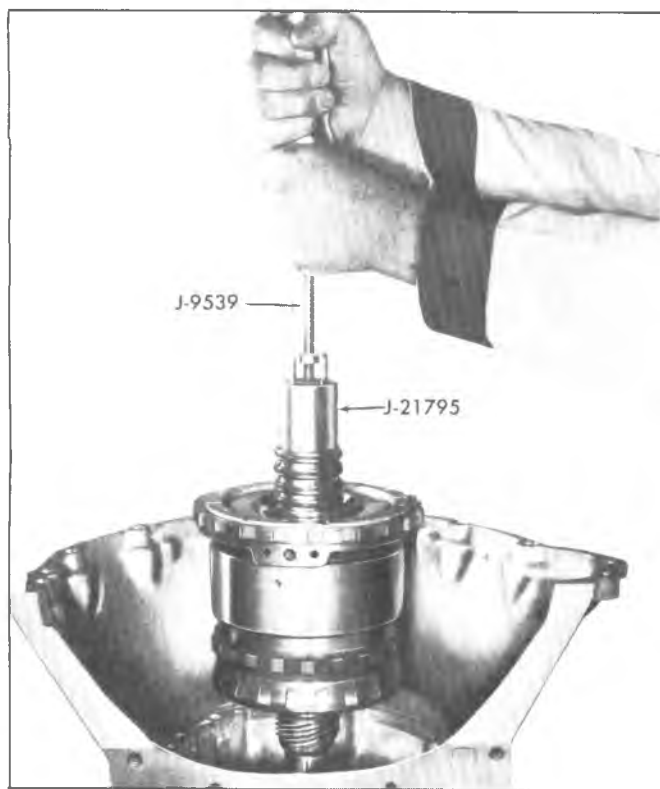


Fig. 130T--Installing Center Support and Gear Unit

clutch passage, with the handle of the tool pointing to the right as viewed from the front of the transmission and parallel to the bell housing mounting face. Apply pressure downward on the tool handle which will tend to rotate the center support counterclockwise as viewed from the front of the transmission. While holding the center support firmly, counterclockwise against the case splines, torque the case to center support bolt to 20-25 ft. lbs., using a 3/8" 12-point thin wall deep socket (fig. 131T-A).

CAUTION: When using the locating tool, care should be taken not to raise burrs on the case valve body mounting face.

12. Install intermediate clutch plates.

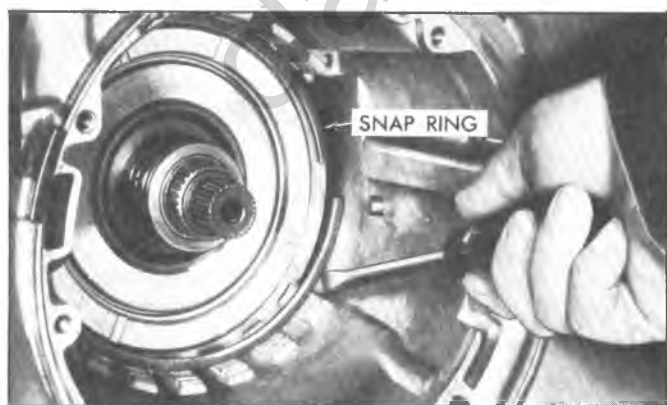


Fig. 131T--Installing Center Support to Case Snap Ring

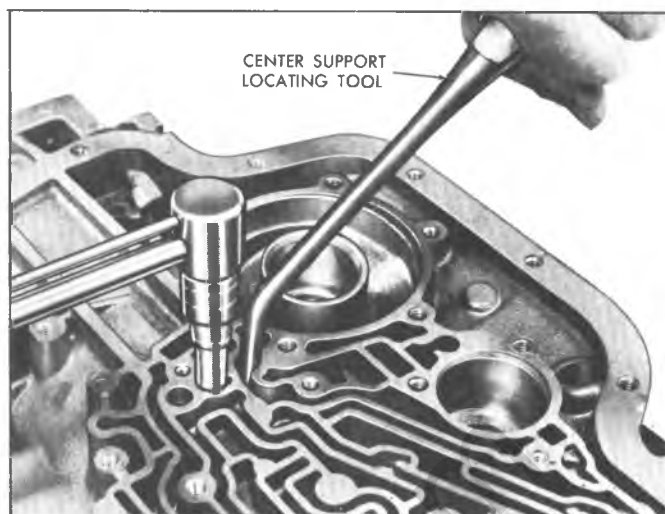


Fig. 131T-A--Installing Center Support Bolt

- a. (All except CY Model) Oil and install three (3) steel and three (3) composition clutch plates. Start with the waved steel plate and alternate composition and steel clutch plates (fig. 132T).
 - b. (CY Model) Oil and install two (2) steel and three (3) composition plates. Alternate composition and steel clutch plates (fig. 132T).
13. Install intermediate clutch backing plate, ridge up (Fig. 132T).
 14. Install intermediate clutch backing plate to case snap ring, locating gap opposite band anchor pin.
NOTE: Both sides of this snap ring are flat, and it is .093" thick.
 15. Check rear end play as follows:
 - a. Install a 3/8"-16 bolt or J-9539, into an extension housing attaching bolt hole (fig. 32T).
 - b. Mount a dial indicator on a rod and index with end of output shaft.

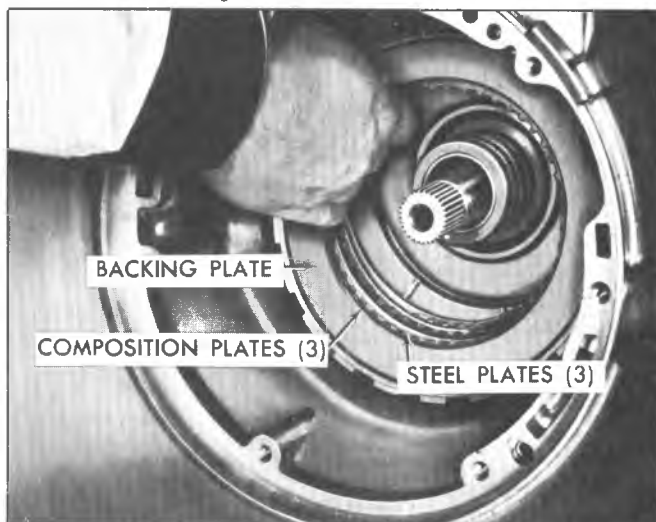


Fig. 132T--Installing Intermediate Backing Plate and Clutch Plates

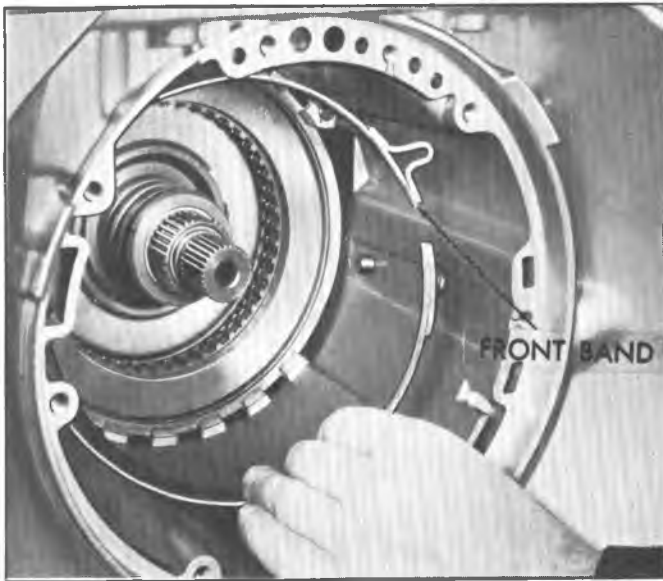


Fig. 133T--Installing Front Band

- c. Move output shaft in and out to read end play. End play should be from .007"-.019". The selective washer controlling this end play is a steel washer having 3 lugs that is located between thrust washer and rear face of transmission case.

If a different washer thickness is required to bring end play within specifications, it can be selected from the following chart:

- 16. Install front band with anchor hole placed over band anchor pin and apply lug facing servo hole (fig. 133T).

Install Manual Linkage

- a. Install a new manual shaft seal into transmission case using a 3/4 diameter rod to seat seal.
- b. If removed, insert actuator rod into manual detent lever from side opposite pin.
- c. Install actuator rod plunger under parking bracket over parking pawl.
- d. Install manual shaft through case and detent lever (fig. 134T).
- e. Install detent jam nut on manual shaft, and tighten to 18 ft. lbs. (fig. 135T).
- f. Install retaining pin indexing with groove in manual shaft. Rotate transmission to vertical position and remove J-21795.

REAR END WASHER THICKNESS

Thickness	Identification Notches and/or Numeral
.074 - .078	None.....1
.082 - .086	1 Tab Side2
.090 - .094	2 Tab Side3
.098 - .102	1 Tab O.D.....4
.106 - .110	2 Tabs O.D.5
.114 - .118	3 Tabs O.D.6

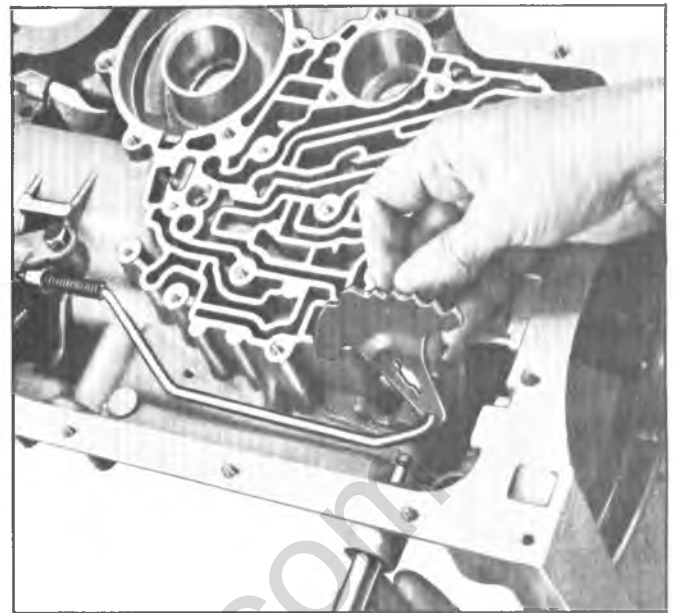


Fig. 134T--Installing Manual Shaft to Case

- 17. With converter end of transmission up, carefully install direct clutch and intermediate roller assembly. It will be necessary to shake and slightly twist housing to allow roller outer race to index with composition plates. Housing hub will bottom on sun gear shaft (fig. 136T).

NOTE: First visually line up the intermediate clutch drive lugs, one above the other to help engagement of housing hub splines. It also may be helpful to remove the direct clutch plates while installing housing.

- 18. Install forward clutch hub to direct clutch housing

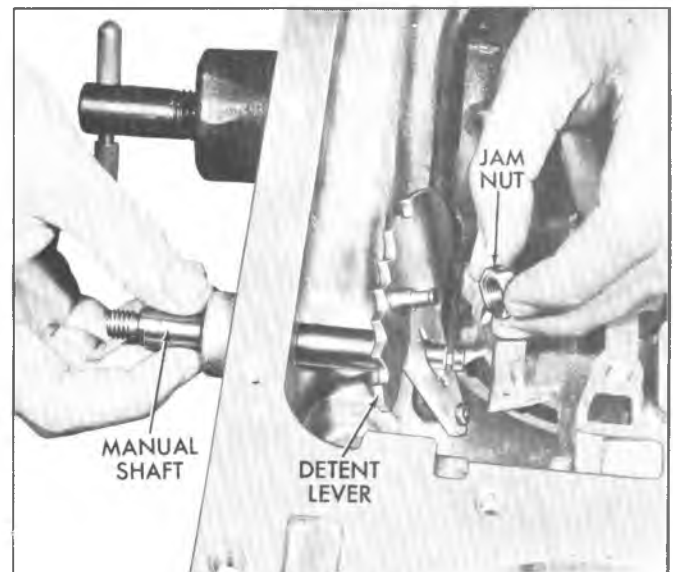


Fig. 135T--Installing Detent Lever and Jam Nut to Manual Shaft

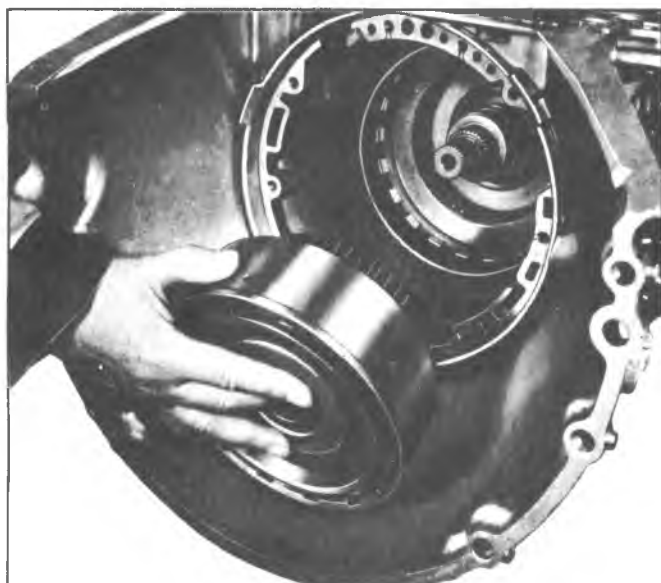


Fig. 136T--Installing Direct Clutch Assembly

thrust washer on forward clutch hub. Retain with petrolatum.

19. Install forward clutch assembly and turbine shaft; indexing direct clutch hub so end of mainshaft will bottom on end of forward clutch hub. When forward clutch is seated it will be approximately 1-1/4" from pump face in case (fig. 137T).
20. Install front pump assembly and gasket.

NOTE: If turbine shaft cannot be rotated as pump is being pulled into place, forward or direct clutch housing have not been properly installed to index with all clutch plates. This condition must be corrected before pump is pulled fully into place.

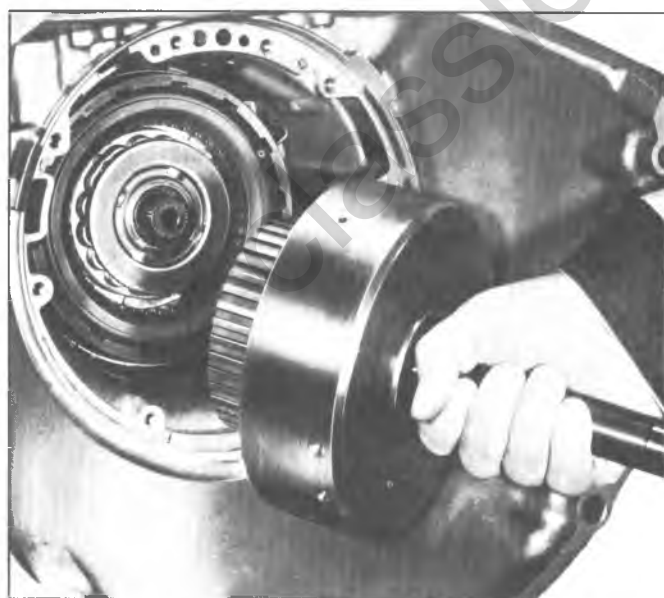


Fig. 137T--Installing Forward Clutch Assembly and Turbine Shaft

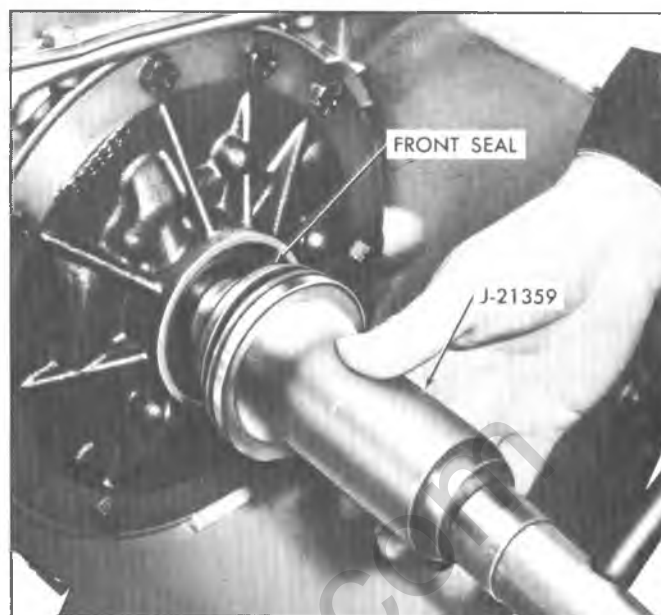


Fig. 138T--Installing Pump Seal

FRONT END WASHER THICKNESS

Thickness	Color
.060 - .064	Yellow
.071 - .075	Blue
.082 - .086	Red
.093 - .097	Brown
.104 - .108	Green
.115 - .119	Black
.126 - .130	Purple

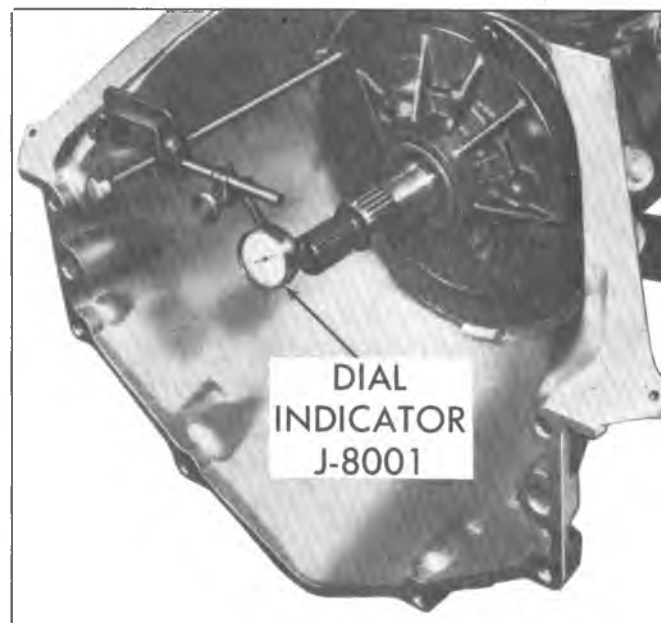


Fig. 139T--Checking Front Unit End Play

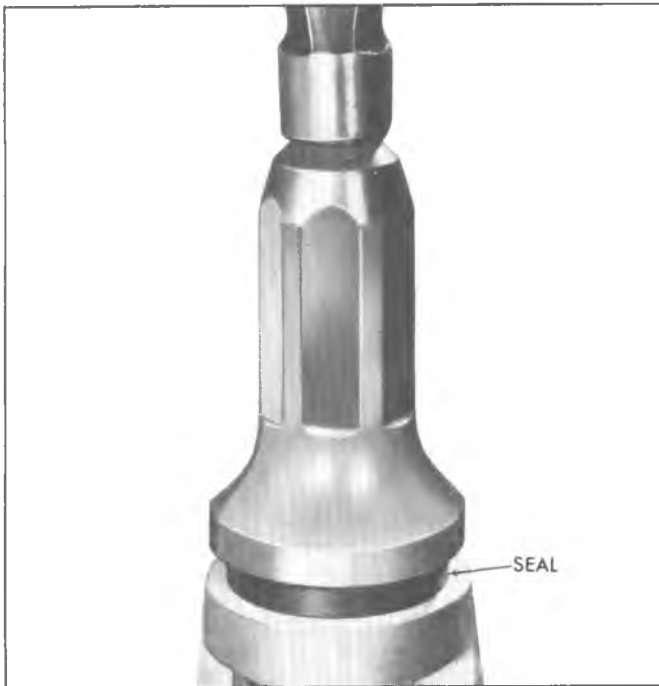


Fig. 140T--Installing Extension Oil Seal (Typical)

21. Install all but one pump attaching bolts and seals. Torque to 18 ft. lbs. (See Figure 139T for location of omitted bolt.)
22. If necessary to install a new front seal, use a non-hardening sealer on outside of seal body; and using Tool J-21359, drive seal in place (fig. 138T).
23. Check front unit end play as follows (fig. 139T).
 - a. Install a 3/8"-16 threaded bolt or a Slide Hammer Bolt J-9539 into bolt hole in pump.
 - b. Mount a dial indicator on rod and index indicator to register with end of turbine shaft.
 - c. Push turbine shaft rearward.
 - d. Push output shaft forward.
 - e. Set dial indicator to zero.
 - f. Pull turbine shaft forward.

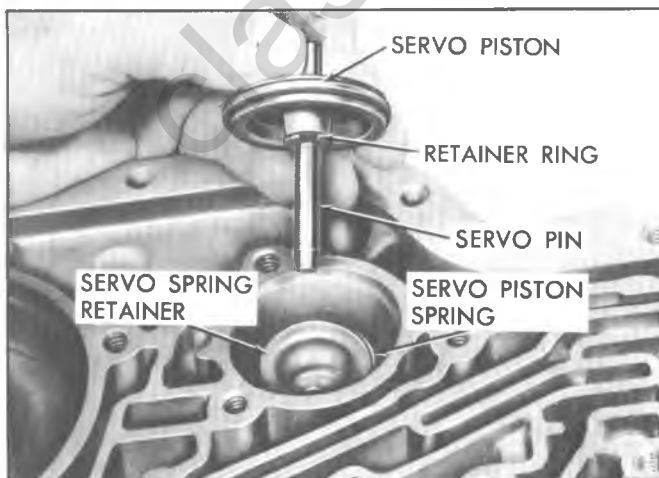


Fig. 141T--Installing Front Servo Piston, Washer, and Pin

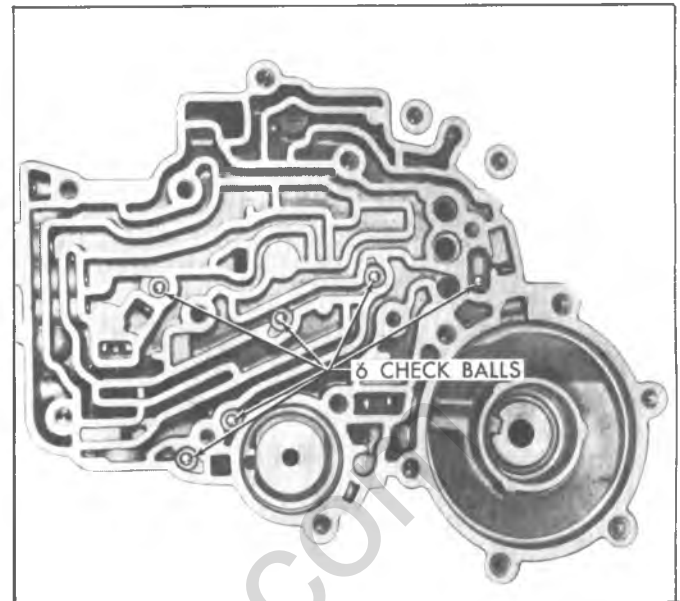


Fig. 142T--Location of Check Balls

Read resulting travel or end play which should be .003"-.024". Selective washer controlling this end play is located between pump cover and forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select proper washer from the chart below:

NOTE: An oil soaked washer may tend to discolor. It will be necessary to measure washer for its actual thickness.

24. Install remaining front pump attaching bolt and seal. Torque 18 ft. lbs.

REAR EXTENSION ASSEMBLY

1. Install new extension housing to case gasket on extension housing.
2. Attach extension housing to case using attaching bolts. Torque bolts to 20-25 ft. lbs.
3. If necessary, install a new seal as follows:
 - a. (All except CM and CL Models) use a non-hardening sealer on outside of seal body; and using Tool J-21359, drive seal in place (fig. 140T).
 - b. (Model CM and CL) use a non-hardening sealer on outside of seal body; and using Tool J-21464 (CM) or J-24057 (CL), drive seal in place (fig. 140T).

Installation of Check Balls, Control Valve Spacer Plate and Gasket, Detent Solenoid, Front Servo Assembly, and Electrical Connector

1. Install two control valve assembly attaching bolts with heads cut off as guide pins as shown in figure 151T.

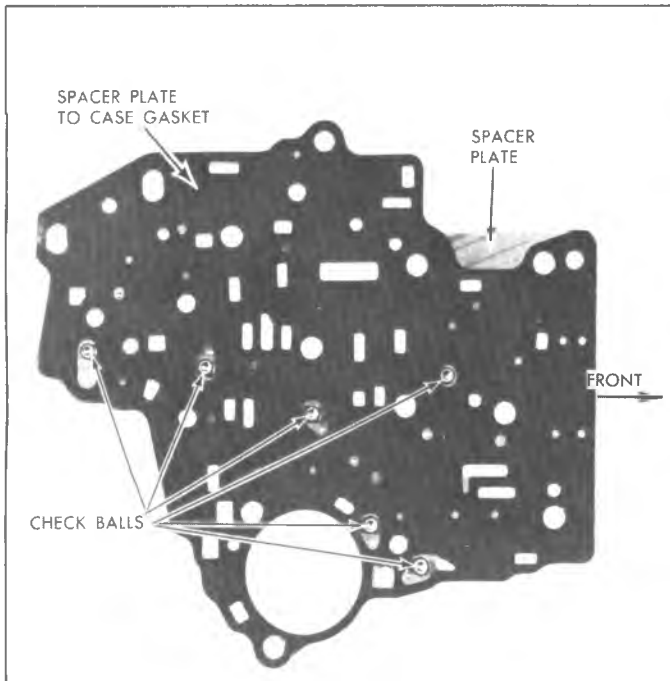


Fig. 142T-A--Location of Check Balls--In Vehicle Installation

2. Install six (6) check balls into ball seat pockets in transmission case. Figure 142T.

NOTE: If transmission is in the vehicle, install check balls into ball seat pockets on spacer plate (fig. 142T-A).

3. Install control valve spacer plate-to-case gasket (gasket with extension for detent solenoid). Figure 143T.
4. Install control valve spacer plate and control valve to spacer plate gasket.

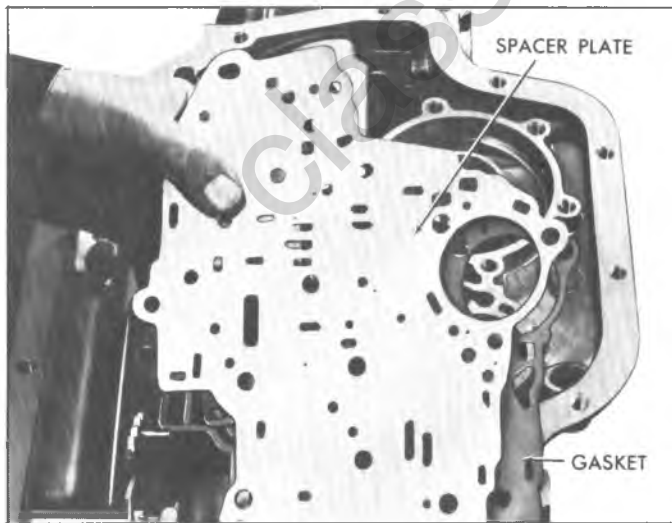


Fig. 143T--Installing Control Valve Assembly Spacer Plate and Gasket

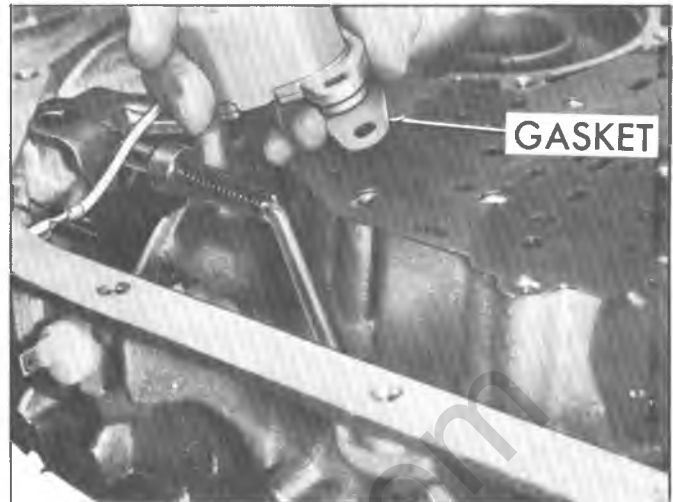


Fig. 144T--Installing Detent Solenoid and Gasket

5. Install detent solenoid gasket.
6. Install detent solenoid assembly with connector facing outer edge of case (fig. 144T). Do not tighten bolts at this time.
7. Install front servo spring and spring retainer into transmission case.
8. Install retainer pins in front servo pin groove and install pin into case so that tapered end contacts band. Make certain retainer ring is installed in servo pin groove.
9. Install seal ring on servo piston, if removed, and install on servo pin with flat side of piston positioned toward bottom pan. Figure 141T.

NOTE: The teflon ring allows the front servo piston to slide very freely in the case. The free fit of the ring in the bore is a normal characteristic and does not indicate leakage during operation. The teflon ring should only be replaced if it shows damage or if evidence of leakage during operation exists.

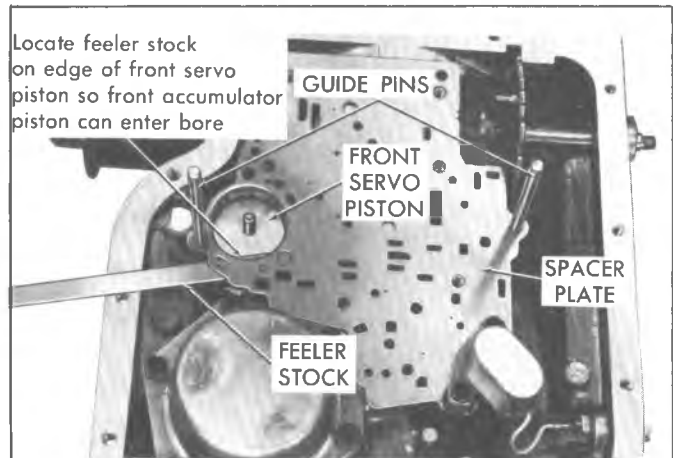


Fig. 144T-A--Front Servo Group--In Vehicle Installation

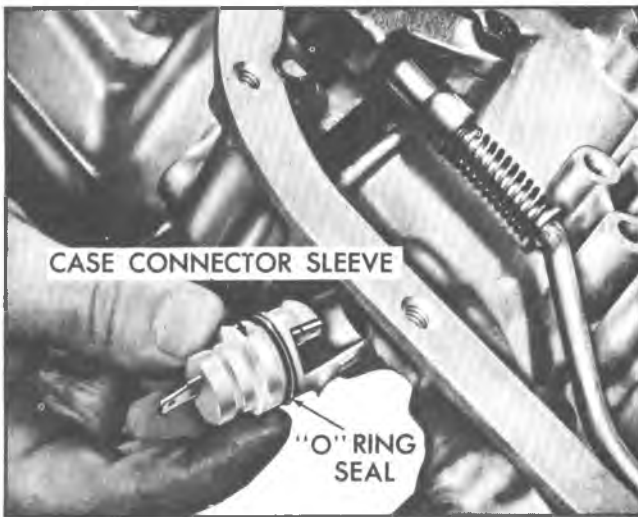


Fig. 145T--Installing Electrical Connector and "O" Ring Seal

NOTE: If transmission is in the vehicle, assemble front servo group as shown in figure 50T and install this group of parts into front servo bore in case and hold. Slip a length of straight, clean feeler gauge or shim stock (about .020") between spacer plate and front servo piston to temporarily retain front servo group. Figure 144T-A.

10. Install "O" ring seal on electrical connector.
11. Lubricate and install electrical connector with lock tabs facing into case, positioning locator tab in notch on side of case (fig. 145T).
12. Install detent wire to electrical connector (fig. 10TB).

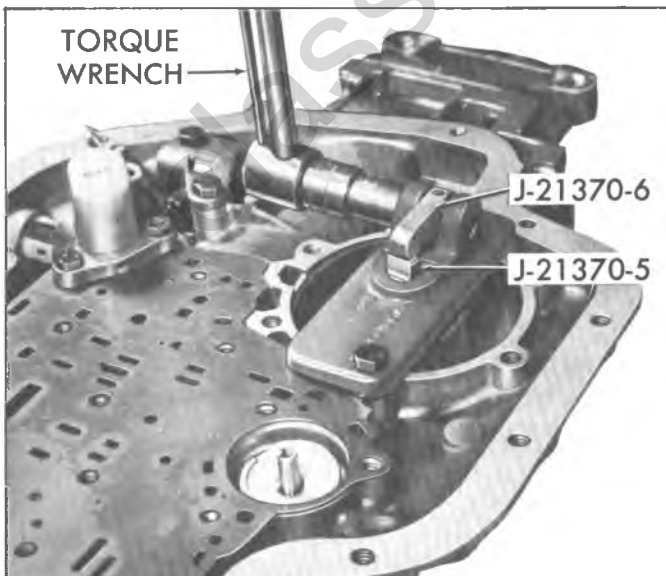


Fig. 146T--Checking Rear Band Pin



Fig. 147T--Installing Rear Accumulator Spring

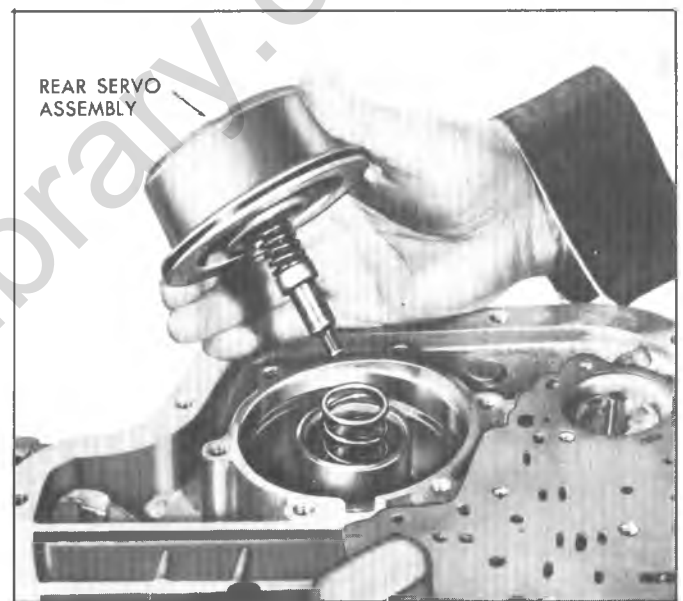


Fig. 148T--Installing Rear Servo Assembly

Installation of Rear Servo Assembly

1. Check rear servo band apply pin. (Fig. 146T).
 - a. Attach band apply pin selection Gauge J-21370-6 and J-21370-5 to transmission case (lever pivot pin to rear) with attaching screws. Attach tool attaching screws finger tight and check freeness of selective pin. Torque attaching screws to 15 ft. lbs. and recheck pin to make certain it does not bind.
 - b. Apply 25 ft. lb. torque and select proper servo pin to be used from scale on tool.

Selecting proper length pin is equivalent to adjusting band. The band lug end of each selective apply pin bears identification in the form of one, two, or three rings.

There are three selective pins identified as follows:

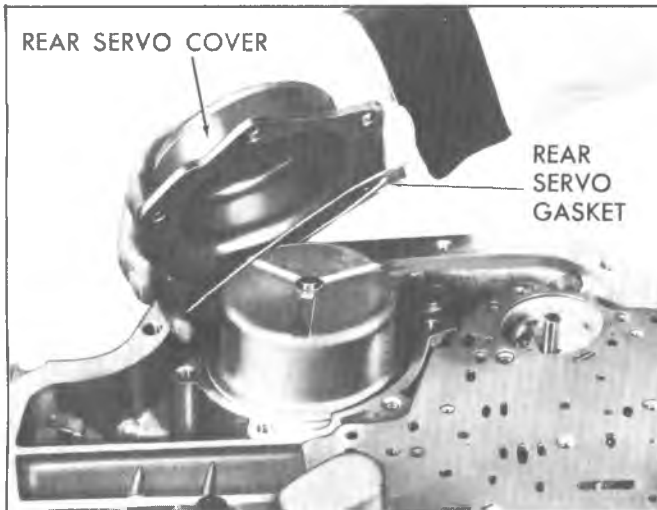


Fig. 149T--Installing Rear Servo Cover and Gasket

1. If both steps are below the gauge surface, the long pin, identified by 3 rings, should be used.
2. If the gauge surface is between the steps, the medium pin, identified by 2 rings, should be used.
3. If both steps are above the gauge surface, the short pin, identified by 1 ring, should be used.
2. Install rear accumulator spring into case (fig. 147T).
3. Lubricate and install rear servo assembly into case (fig. 148T).
4. Install rear servo gasket and cover (fig. 149T).
5. Install attaching screws. Torque bolts to 15-20 ft. lbs.

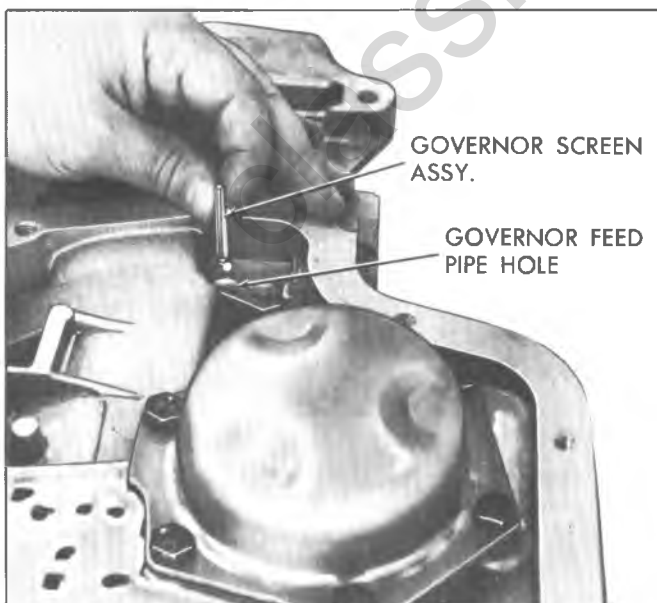


Fig. 150T--Installing Governor Screen Assembly

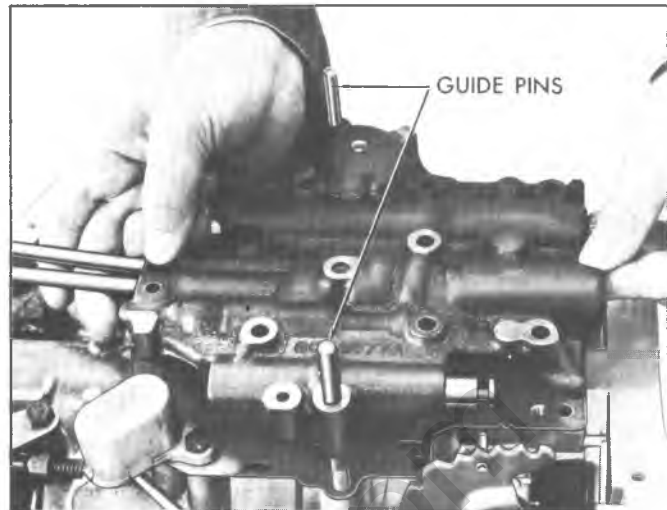


Fig. 151T--Installing Control Valve Assembly and Governor Pipes

INSTALLATION OF CONTROL VALVE ASSEMBLY, GOVERNOR PIPES AND GOVERNOR SCREEN ASSEMBLY

1. Install governor pipes on control valve assembly. Governor pipes are interchangeable.
2. Install governor screen assembly, open end first, into governor feed pipe hole in case (hole nearest the center of the transmission) (Fig. 150T).

NOTE: If transmission is in vehicle, before installing the control valve assembly and governor pipes as outlined in Step 3 below, insert the governor screen, closed end first, into governor feed pipe. (This pipe locates in the governor feed pipe hole in the case nearest the center of the transmission). SEE figure 150T.
3. Install control valve assembly and governor pipes on transmission, while carefully aligning the governor feed pipe over the governor screen (fig. 151T). Make certain gasket and spacer do not become mispositioned.

NOTE: Check manual valve to make sure it is indexed properly with pin on detent lever and check governor pipes to make certain they are properly seated in case holes.

4. Start control valve assembly attaching bolts.

NOTE: If transmission is in the vehicle, remove feeler stock before tightening any control valve bolts.

5. Remove guide pins and install detent roller and spring assembly and remaining bolts (fig. 152T).

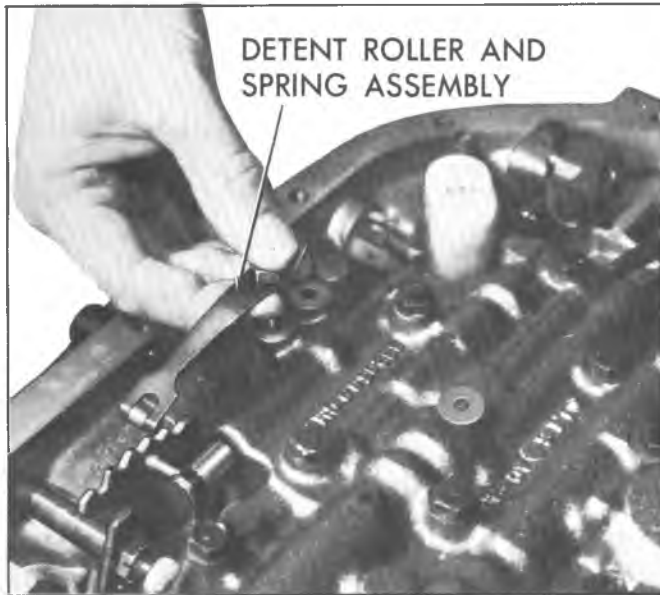


Fig. 152T--Installing Detent Roller and Spring Assembly

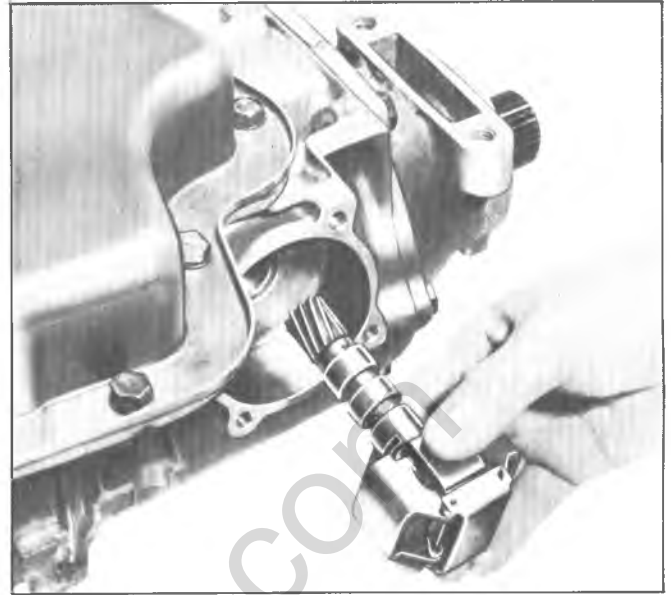


Fig. 154T--Installing Governor Assembly

INSTALLATION OF FILTER AND INTAKE PIPE

1. Install case to intake pipe "O" ring seal on intake pipe and assemble into filter assembly.
2. Install filter and intake pipe assembly (fig. 8T).

NOTE: It is recommended that the filter be replaced, rather than cleaned, whenever the transmission is disassembled.

3. Install filter retainer bolt (fig. 7T).
4. Install new bottom pan gasket and bottom pan, with attaching screws. Torque to 12 ft. lbs.

INSTALLATION OF MODULATOR VALVE AND VACUUM MODULATOR

1. Install modulator valve into case, stem end out (fig. 153T).
2. Install "O" ring seal on vacuum modulator.

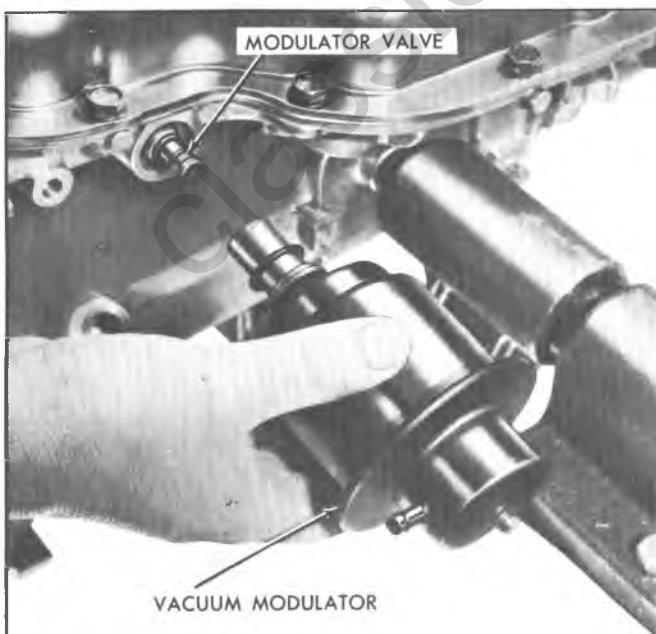


Fig. 153T--Installing Vacuum Modulator and Valve



Fig. 155T--Installing Speedometer Driven Gear and Sleeve

7A-130 AUTOMATIC TRANSMISSION

3. Install vacuum modulator into case.
4. Install modulator retainer and attaching bolt. Torque bolt 18 ft. lbs.

INSTALLATION OF GOVERNOR ASSEMBLY

1. Install governor assembly into case (fig. 154T).
2. Attach governor cover and gasket with four (4) attaching bolts. Torque bolts to 18 ft. lbs.

INSTALLATION OF SPEEDOMETER DRIVEN GEAR ASSEMBLY

1. Install speedometer driven gear assembly (fig. 155T).

2. Install speedometer driven gear retainer and attaching bolt.

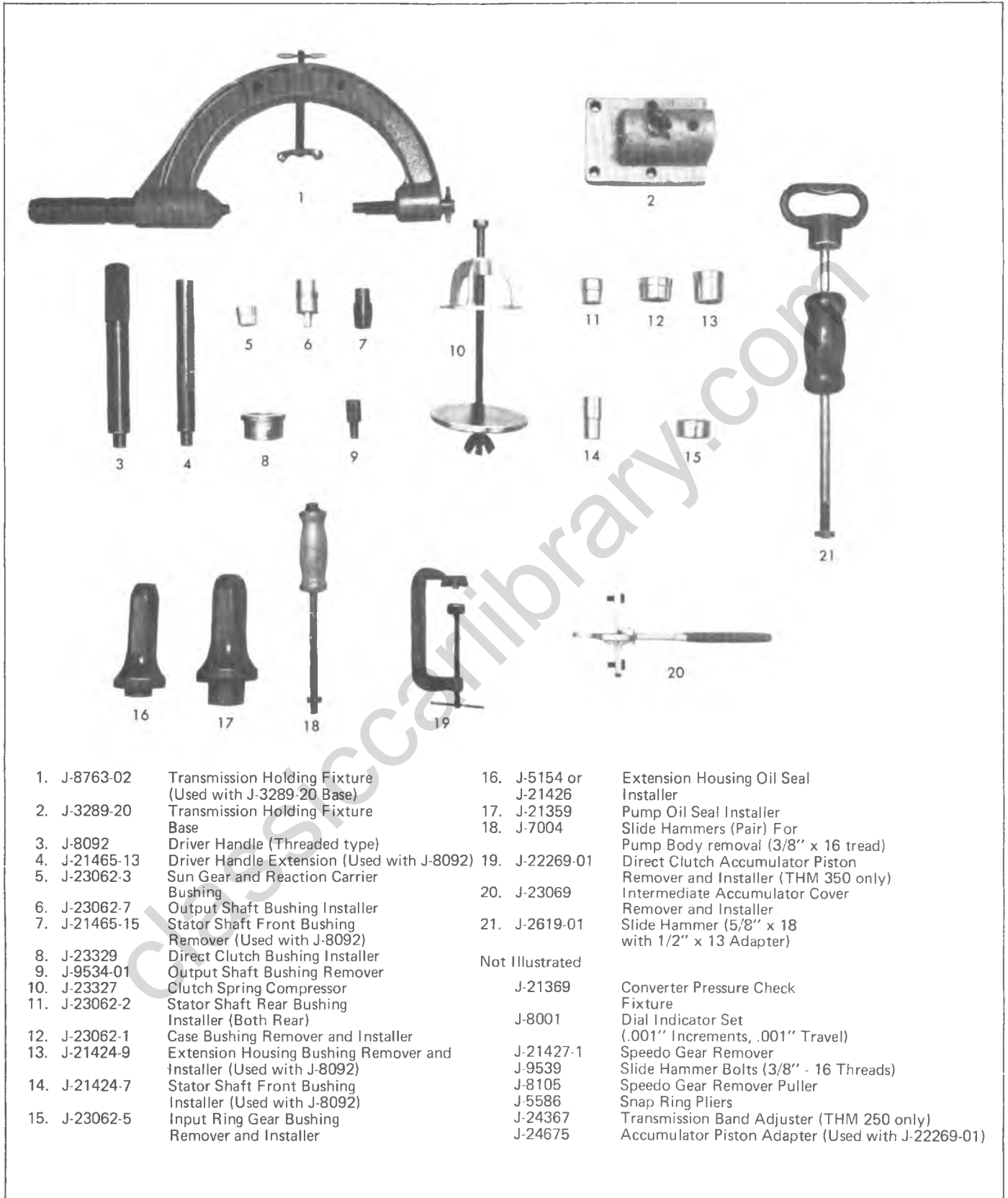
INSTALL CONVERTER ASSEMBLY

With the transmission in cradle or portable jack, install the converter assembly into the pump assembly making certain that the converter hub drive slots are fully engaged with the pump drive gear tangs and the converter installed fully towards the rear of the transmission.

NOTE: The converter used in the CM and CY models has six (6) mounting lugs.

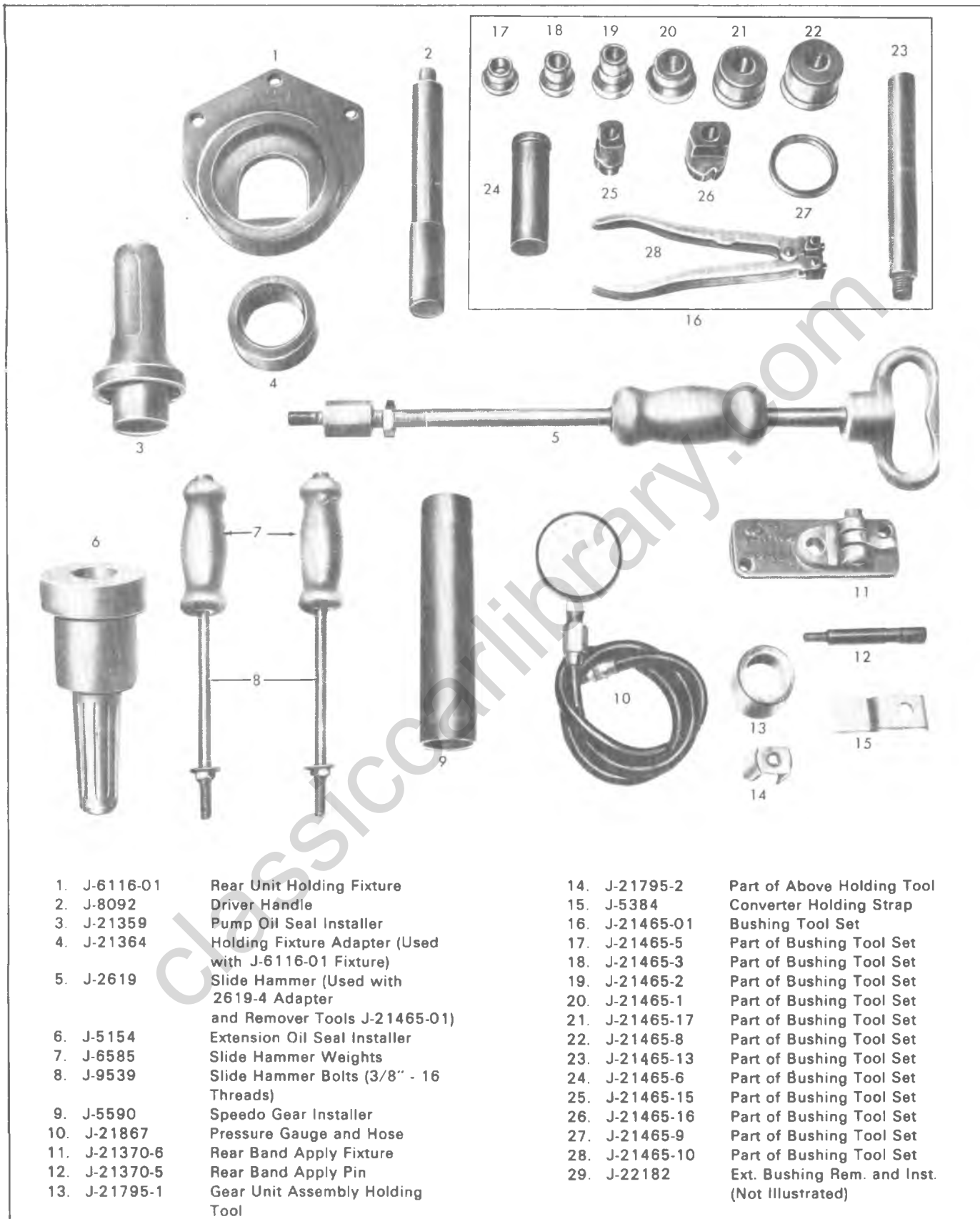
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SPECIAL TOOLS



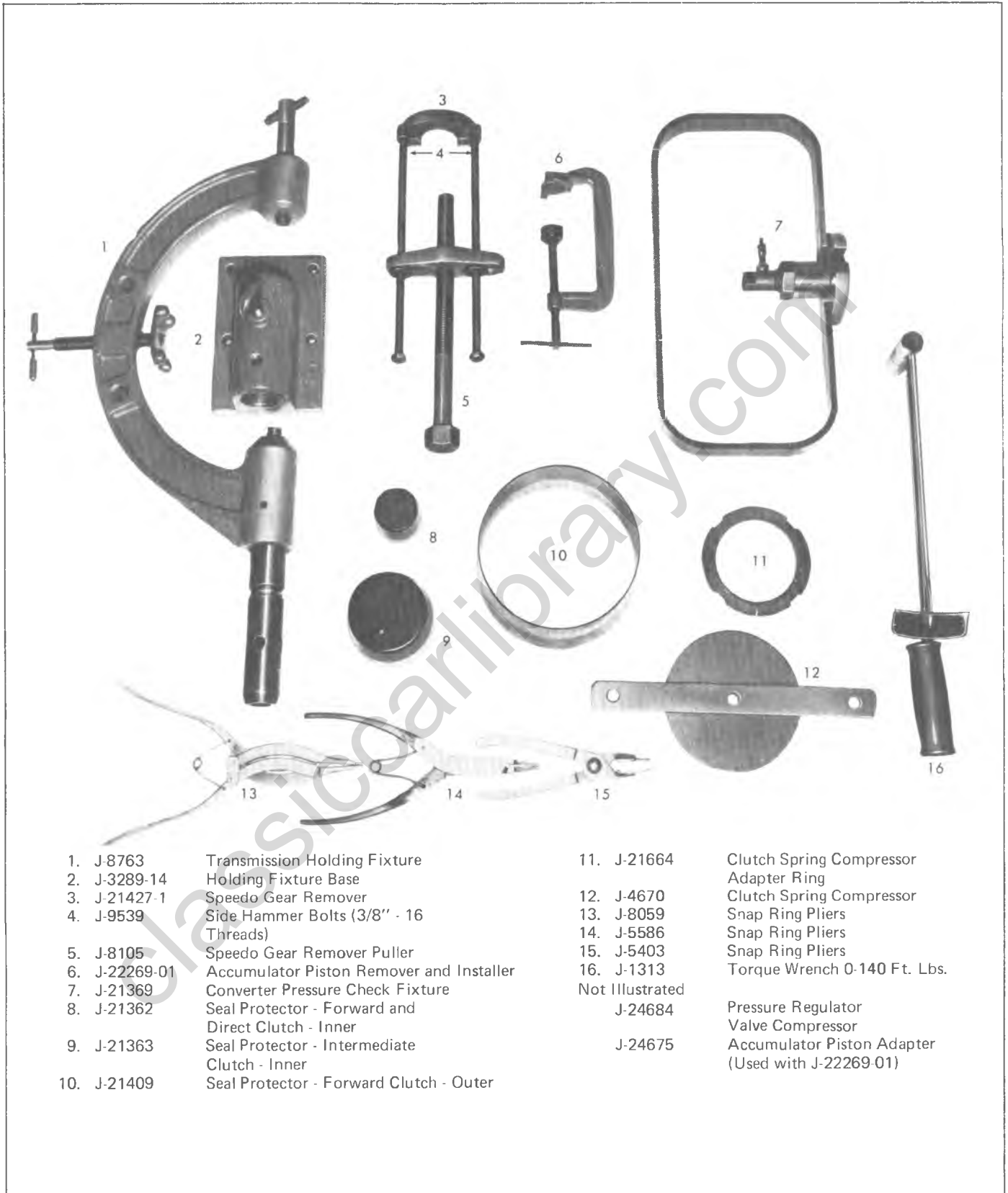
- | | | | |
|---------------|--|-----------------------|---|
| 1. J-8763-02 | Transmission Holding Fixture (Used with J-3289-20 Base) | 16. J-5154 or J-21426 | Extension Housing Oil Seal Installer |
| 2. J-3289-20 | Transmission Holding Fixture Base | 17. J-21359 | Pump Oil Seal Installer |
| 3. J-8092 | Driver Handle (Threaded type) | 18. J-7004 | Slide Hammers (Pair) For Pump Body removal (3/8" x 16 thread) |
| 4. J-21465-13 | Driver Handle Extension (Used with J-8092) | 19. J-22269-01 | Direct Clutch Accumulator Piston Remover and Installer (THM 350 only) |
| 5. J-23062-3 | Sun Gear and Reaction Carrier Bushing | 20. J-23069 | Intermediate Accumulator Cover Remover and Installer |
| 6. J-23062-7 | Output Shaft Bushing Installer | 21. J-2619-01 | Slide Hammer (5/8" x 18 with 1/2" x 13 Adapter) |
| 7. J-21465-15 | Stator Shaft Front Bushing Remover (Used with J-8092) | Not Illustrated | |
| 8. J-23329 | Direct Clutch Bushing Installer | J-21369 | Converter Pressure Check Fixture |
| 9. J-9534-01 | Output Shaft Bushing Remover | J-8001 | Dial Indicator Set (.001" Increments, .001" Travel) |
| 10. J-23327 | Clutch Spring Compressor | J-21427-1 | Speedo Gear Remover |
| 11. J-23062-2 | Stator Shaft Rear Bushing Installer (Both Rear) | J-9539 | Slide Hammer Bolts (3/8" - 16 Threads) |
| 12. J-23062-1 | Case Bushing Remover and Installer | J-8105 | Speedo Gear Remover Puller |
| 13. J-21424-9 | Extension Housing Bushing Remover and Installer (Used with J-8092) | J-5586 | Snap Ring Pliers |
| 14. J-21424-7 | Stator Shaft Front Bushing Installer (Used with J-8092) | J-24367 | Transmission Band Adjuster (THM 250 only) |
| 15. J-23062-5 | Input Ring Gear Bushing Remover and Installer | J-24675 | Accumulator Piston Adapter (Used with J-22269-01) |

Fig. 1ST—Turbo Hydra-Matic 250/350 Special Tools



- | | | | |
|---------------|--|----------------|---|
| 1. J-6116-01 | Rear Unit Holding Fixture | 14. J-21795-2 | Part of Above Holding Tool |
| 2. J-8092 | Driver Handle | 15. J-5384 | Converter Holding Strap |
| 3. J-21359 | Pump Oil Seal Installer | 16. J-21465-01 | Bushing Tool Set |
| 4. J-21364 | Holding Fixture Adapter (Used with J-6116-01 Fixture) | 17. J-21465-5 | Part of Bushing Tool Set |
| 5. J-2619 | Slide Hammer (Used with 2619-4 Adapter and Remover Tools J-21465-01) | 18. J-21465-3 | Part of Bushing Tool Set |
| 6. J-5154 | Extension Oil Seal Installer | 19. J-21465-2 | Part of Bushing Tool Set |
| 7. J-6585 | Slide Hammer Weights | 20. J-21465-1 | Part of Bushing Tool Set |
| 8. J-9539 | Slide Hammer Bolts (3/8" - 16 Threads) | 21. J-21465-17 | Part of Bushing Tool Set |
| 9. J-5590 | Speedo Gear Installer | 22. J-21465-8 | Part of Bushing Tool Set |
| 10. J-21867 | Pressure Gauge and Hose | 23. J-21465-13 | Part of Bushing Tool Set |
| 11. J-21370-6 | Rear Band Apply Fixture | 24. J-21465-6 | Part of Bushing Tool Set |
| 12. J-21370-5 | Rear Band Apply Pin | 25. J-21465-15 | Part of Bushing Tool Set |
| 13. J-21795-1 | Gear Unit Assembly Holding Tool | 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. 2ST—Turbo Hydra-Matic 375/400/475 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 | |
| 8. J-21362 | Seal Protector - Forward and Direct Clutch - Inner | J-24684 | Pressure Regulator 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. 3ST--Turbo Hydra-Matic 375/400/475 Special Tools

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SECTION 7M

CLUTCHES AND MANUAL TRANSMISSIONS

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SINGLE PLATE DIAPHRAGM CLUTCH

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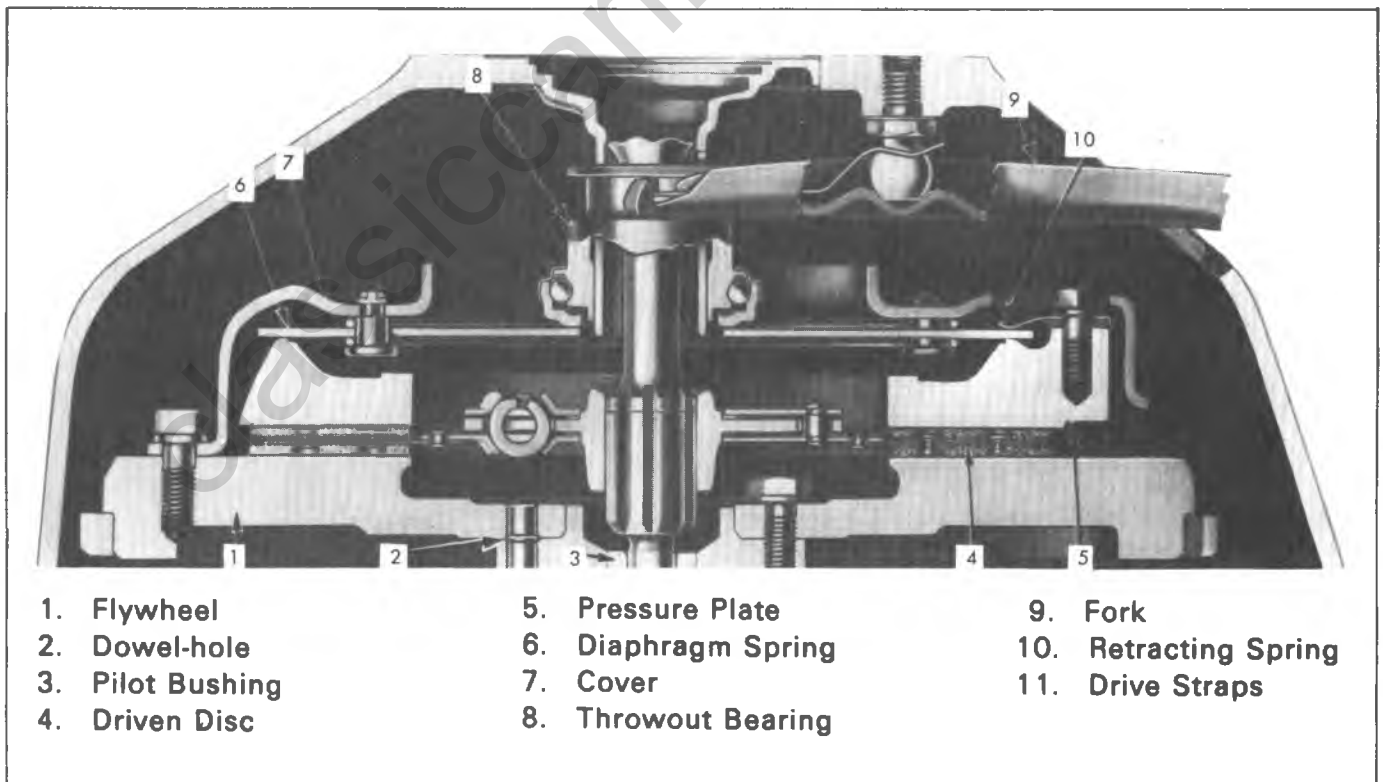
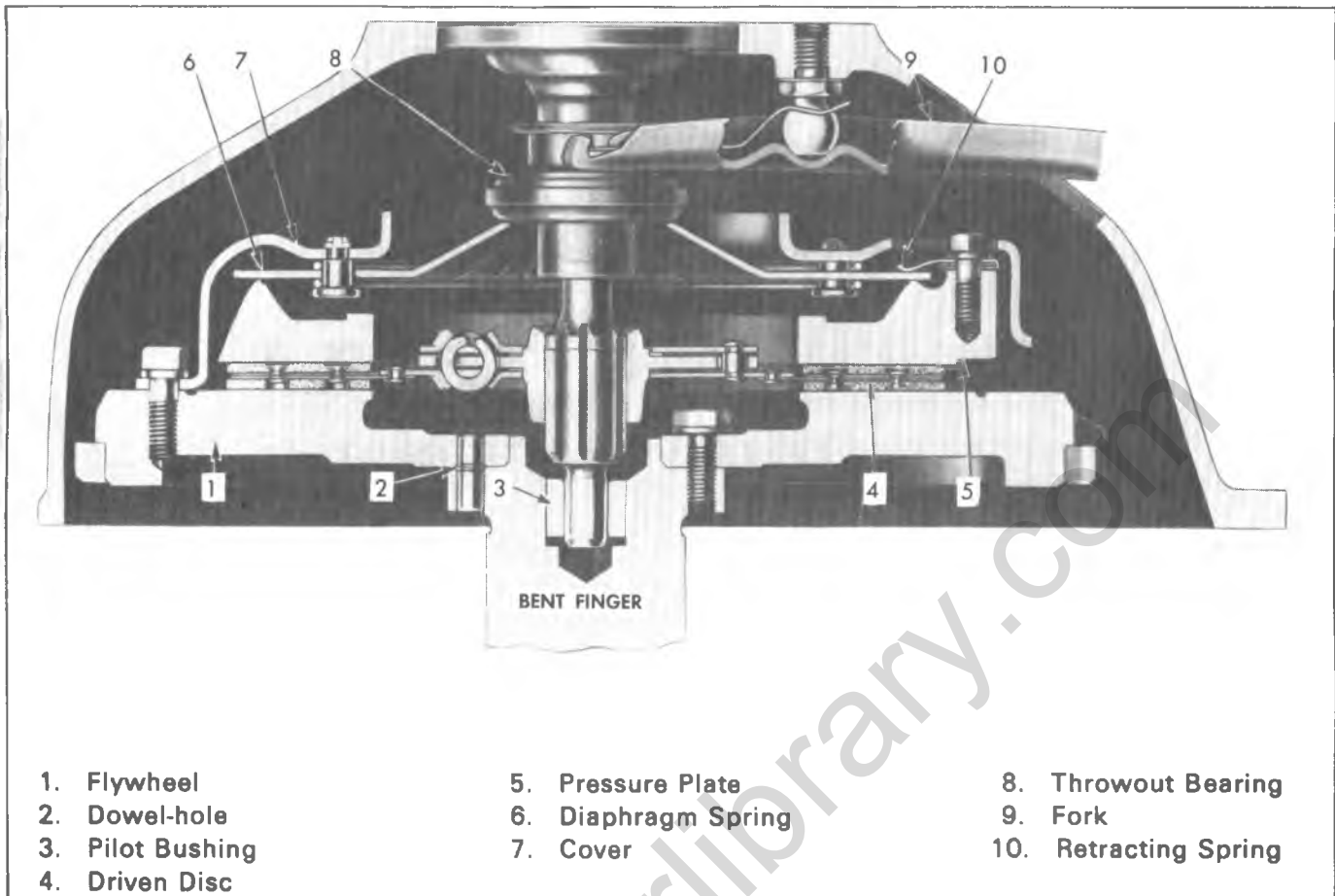


Fig. 1--Flat Finger Clutch Cross-Section (Typical)



- | | | |
|------------------|---------------------|-----------------------|
| 1. Flywheel | 5. Pressure Plate | 8. Throwout Bearing |
| 2. Dowel-hole | 6. Diaphragm Spring | 9. Fork |
| 3. Pilot Bushing | 7. Cover | 10. Retracting Spring |
| 4. Driven Disc | | |

Fig. 2- Bent Finger Clutch Cross-Section (Typical)

NOTE: When disassembling, mark edge of pressure plate and cover. These marks must be aligned in assembly to maintain balance.

DISASSEMBLY (FIG. 3)

1. Remove three drive-strap to pressure plate bolts and retracting springs and remove pressure plate from clutch cover.
2. The clutch diaphragm spring and two pivot rings are riveted to the clutch cover. Spring, rings and cover should be inspected for excessive wear or damage and if there is a defect, it is necessary to replace the complete cover assembly.

INSPECTION

1. Check drive straps for looseness at the clutch cover and evidence of looseness at pressure plate bolt holes.
2. Wash all parts, except driven disk and throwout bearing, in cleaning solvent.

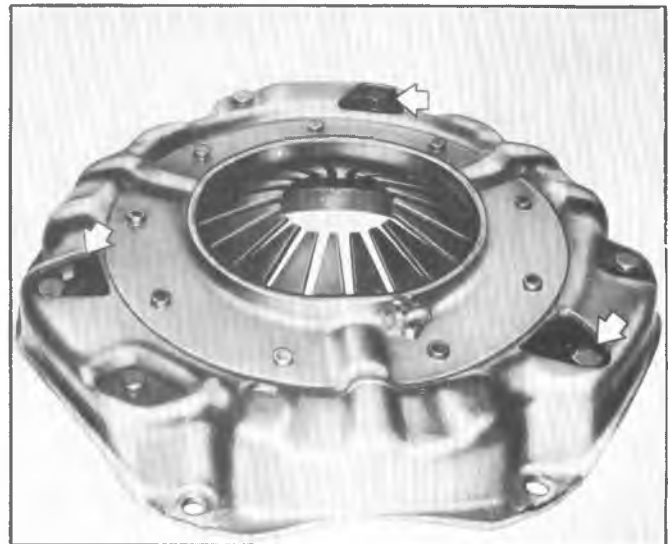


Fig. 3-Retracting Spring Location (Typical)

NOTE: The throwout bearing is permanently packed with lubricant and should not be soaked in cleaning solvent as this will dissolve the lubricant.

3. Inspect pressure plate and flywheel for scores on the contact surfaces. Use a straight-edge and check for flatness of contact surfaces.
4. Check throwout bearing for roughness and free fit on the sleeve of the transmission clutch gear bearing retainer. Replace retainer if rough.
5. Inspect clutch disc for worn, loose or oil soaked facings, broken springs, loose rivets, etc. Replace if necessary.
6. Examine splines in hub and make sure they slide freely on splines of transmission clutch shaft. If splines are worn, the clutch disc or clutch gear should be replaced as necessary.
7. Inspect clutch fork ball socket and fingers for wear and ball retaining spring for damage. Spring should hold fork tightly to ball stud.

NOTE: Ball spring on fork may be bent in toward fork if necessary.

8. Inspect ball stud for wear. Replace if scored.
9. Check run out of transmission pilot hole in clutch housing by removing a flywheel bolt and installing a dial indicator. The run out should be within .000-.015".
10. Lubricate ball stud before reassembly.

ASSEMBLY

1. Install the pressure plate in the cover assembly, lining up the punch marks on the edge of the pressure plate with the punch marks on the edge of the cover.
2. Install pressure plate retracting springs and drivestrap to pressure plate bolts and lock washers and tighten to 11 ft. lbs. torque. The clutch is now ready to be installed.

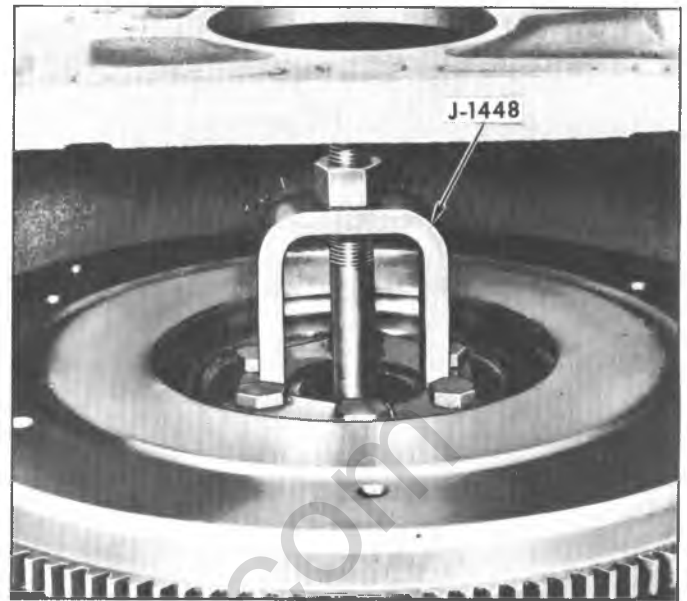


Fig. 4-Clutch Pilot Bearing Removal (Typical)

PILOT BEARING REPLACEMENT

The clutch pilot bearing is an oil impregnated type bearing pressed into the crankshaft. This bearing requires attention when the clutch is removed from the vehicle, at which time it should be cleaned and inspected for excessive wear or damage and should be replaced if necessary.

To remove, install Tool J-1448 and remove bearing from crankshaft (fig. 4). In replacing this bearing, use Tool J-1522. Place bearing on pilot of tool with radius in bore of bearing next to shoulder on tool and drive into crankshaft. Lubricate with several drops of machine oil.

SINGLE PLATE COIL SPRING CLUTCH

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DISASSEMBLY

1. Place the cover assembly on the bed of an arbor or drill press with a block under the pressure plate so arranged that the cover is left free to move down.
2. Place a block or bar across the top of the cover with the spindle. Hold compressed while the adjusting nuts are removed (Fig. 2E), then slowly release pressure to prevent springs flying out.
3. Lift off cover and all parts will be available for inspection. Note carefully the location of all parts

including arrangement of springs, see (fig. 3E).

4. To remove levers grasp lever and eyebolt between thumb and fingers as shown in Figure 4E, so that inner end of lever and upper end of eyebolt are close together, keeping eyebolt pin seated in its socket in lever.
5. Lift strut over ridge on end of lever, (fig. 5E).
6. Lift lever and eyebolt off pressure plate.

NOTE: It is important to replace all parts which show wear.

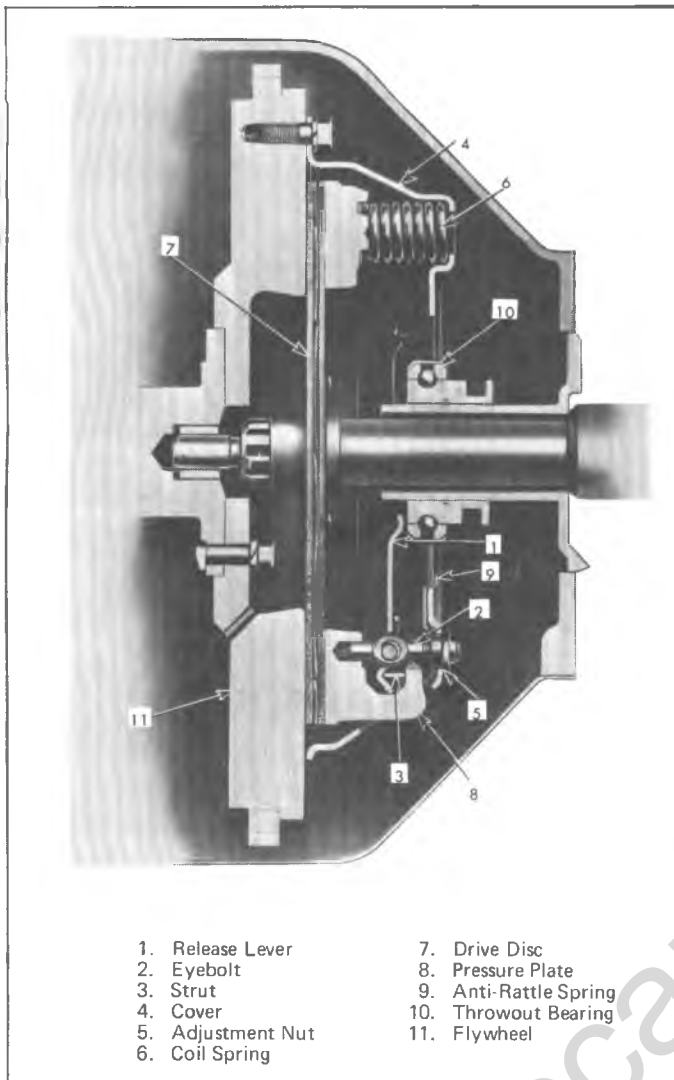


Fig. 1E-Coil Spring Clutch Cross-Section (Single Plate)

INSPECTION

In addition to applicable items listed under Diaphragm Clutch Inspection, check the following items.

1. Check driving lugs for wear.
2. Check clutch cover for distortion or cracks.
3. Check release levers for wear or cracks.

ASSEMBLY

1. Lay the pressure plate on the block in the press and coat the lugs with a thin film of approved lubricant such as lubriplate (Fig. 6E).
2. Assemble lever, eyebolt and pin, holding eyebolt and lever as close together as possible and with the other hand grasp strut as shown in figure 7E.
3. Insert Strut in the slots in the pressure plate lug, drop slightly and tilt the lower edge until it touches vertical milled surface of lug.



Fig. 2E--Compressing Clutch

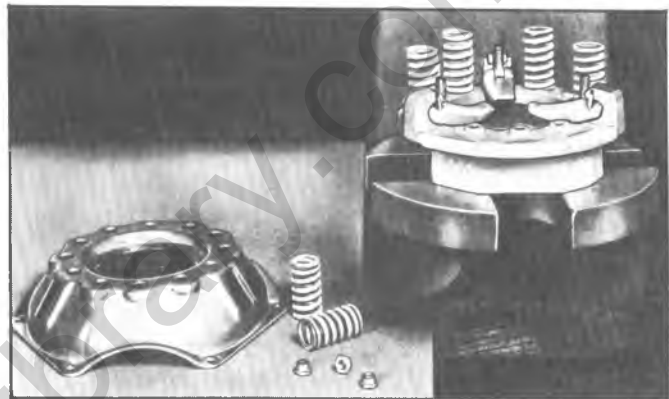


Fig. 3E--Disassembly of Clutch

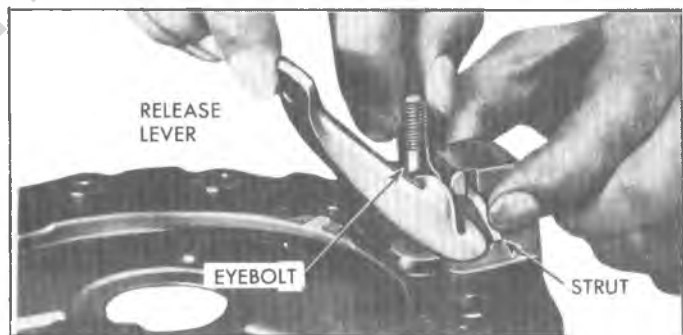


Fig. 4E--Removing Levers (Step 1)

4. Insert lower end of eyebolt in hole in pressure plate. The short end of the lever will then be under the hook of the pressure plate and near the strut, (fig. 5E).
5. Slide the strut upward in the slots of the lug, lifting it over the ridge on the short end of the lever and drop it into the groove in the lever, (fig. 4E).
6. Assemble the pressure springs, on the small bosses of the pressure plate in accordance with Figure 8E in order to retain original balance.

NOTE: If there are spaces for more springs than specified for the particular assembly, or if two different colors of springs are used, Figure 8E shows the proper sequence. It is

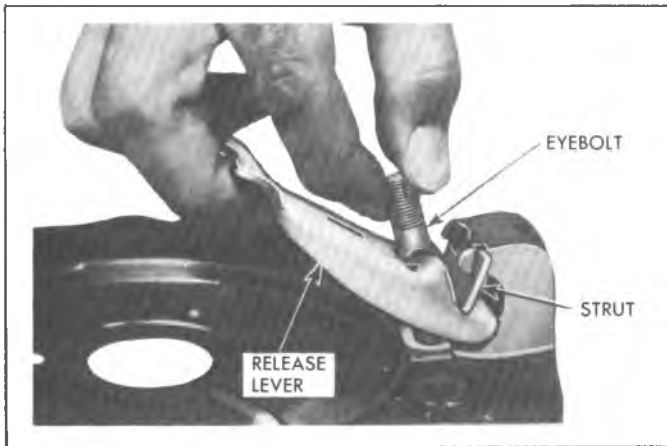


Fig. 5E-Removing Levers (Step 2)

very important that each group be arranged in like sequence.

7. Assemble anti-rattle springs in cover (Fig. 9E). The spring to the left is in operating position.
8. Lower the cover on top of the assembled parts, (fig. 10E) being sure that the anti-rattle springs are in correct position and also that the punch marks made before dismantling are matched to insure retaining the original balance.
9. Place a bar across the cover and slowly compress, guiding the holes in the cover over the pressure plate lugs and all springs into their spring seats in the cover.



Fig. 6E-Greasing Lug

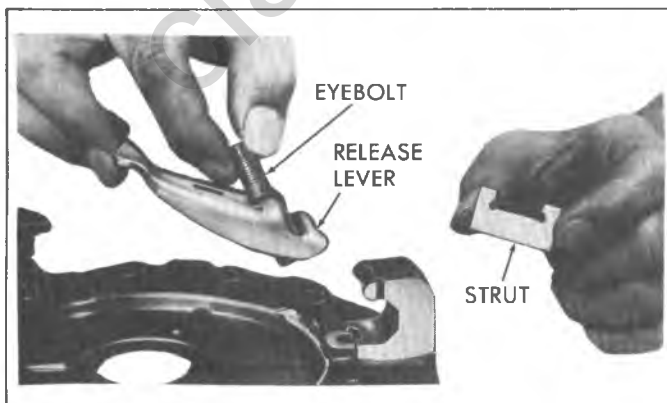


Fig. 7E-Installing Lever

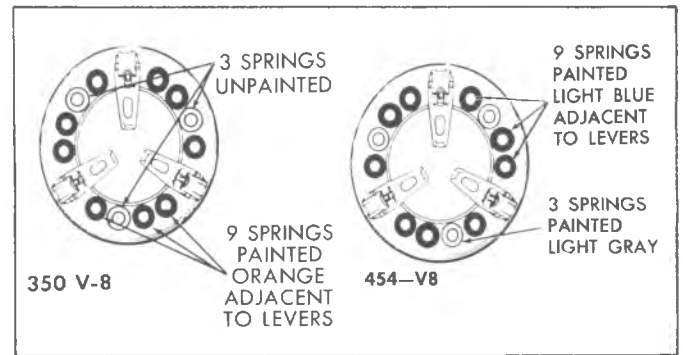


Fig. 8E-Spring Arrangement Diagram

10. Assemble adjusting nuts on the eyebolts and screw them down until their tops are flush with the tops of the eyebolts. Slowly release pressure of spindle and remove cover assembly from press.

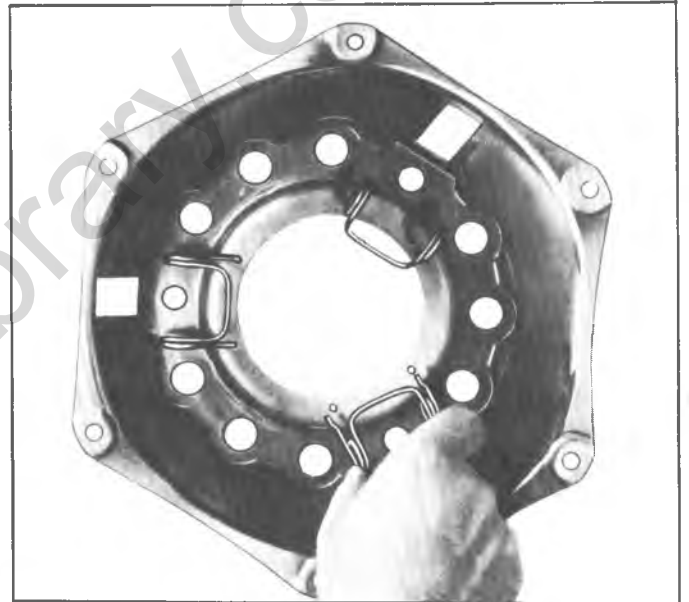


Fig. 9E-Installing Anti-Rattle Spring

ADJUSTING LEVERS

While no wear adjustment is needed because of the coil spring design, it is imperative that the clutch release levers are each set to exactly the same height at the time of manufacture or rebuild to insure uniform clutch application. To obtain exactly the same adjustment at each release lever, use gauge plate J-1048 and release lever height gauge J-6456 as follows:

1. Place gauge plate J-1048 (fig. 11E) on the flywheel in position normally occupied by driven plate.

NOTE: It is recommended that a spare flywheel be obtained so that this operation may be performed at the bench.

2. Bolt cover on flywheel with gauge plate center.

7M-6 CLUTCHES AND MANUAL TRANSMISSIONS

NOTE: On assemblies with three levers, the three flat machined lands of the gauge plate must be located directly under the levers.

3. Depress each lever several times with a hammer handle to settle all parts into working position.
4. Position height gauge J-6456 on the hub of the gauge plate and the bearing surface of one lever (fig. 13E). Turn adjusting nut until lever is flush with proper step of height gauge. Adjust remaining levers in same manner. The height gauge (insert) has three steps for use with the five basic coil spring clutches currently available. One step is used for the 10" clutch, one step for the 13" clutch, while the third step is used for 10-1/2", 11", and 12" clutches. Each side is identified accordingly, with the step of the gauge contacting the bearing surface

of the lever identified by "Lever". Use the 10-1/2, 11 step for 12" clutches.

5. Stake adjusting nut (fig. 14E) to eyebolt with a dull punch to lock adjustment.
6. Loosen the cover to flywheel bolts a turn or two at a time and in rotation until spring pressure is relieved to allow clutch and gauge plate to be removed.

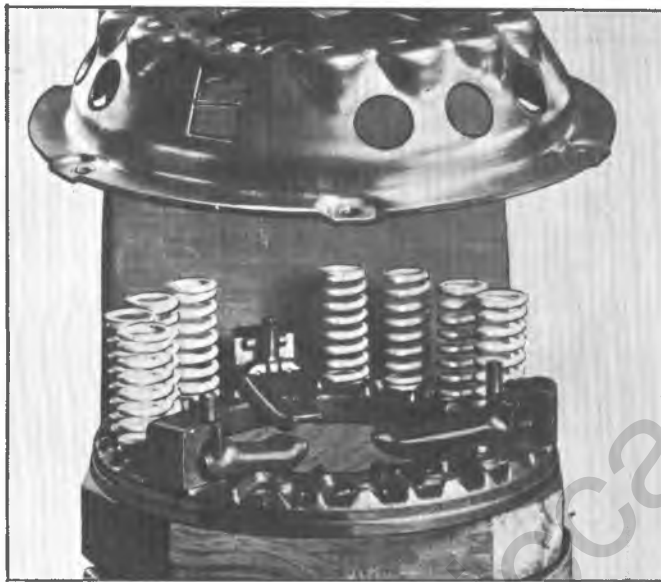


Fig. 10E--Assembling Cover and Pressure Plate



Fig. 12E--Depressing Lever



Fig. 11E--Gauge Plate Position

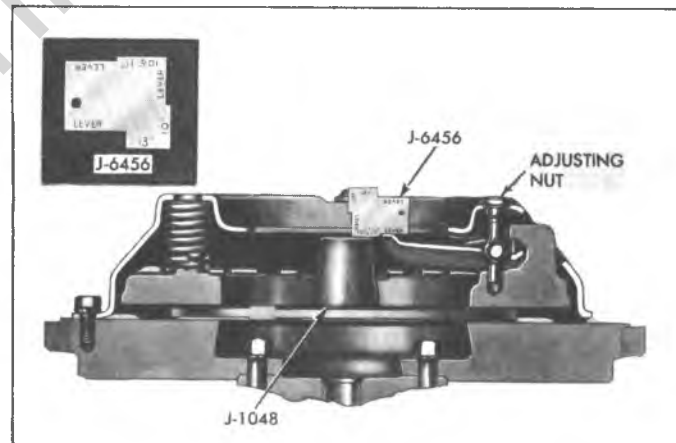


Fig. 13E--Coil Spring Clutch Adjustment



Fig. 14E--Staking Nut

3-SPEED SAGINAW TRANSMISSION

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DISASSEMBLY OF TRANSMISSION

1. Remove side cover attaching screws and remove side cover assembly and shift forks.
2. Remove drive gear bearing retainer and gasket.
3. Remove drive gear bearing to gear stem snap ring, then remove drive gear bearing by pulling outward on gear until a screw driver or other suitable tool can be inserted between bearing large snap ring and case to complete removal. The drive gear bearing is a slip fit on the gear and into the case bore. (This provides clearance for removal of drive gear and mainshaft assembly.)
4. Remove speedometer driven gear from extension.
5. Remove extension to case attaching bolts.
6. Remove the reverse idler shaft "E" ring.
7. Remove drive gear, mainshaft and extension assembly together through the rear case opening. Remove clutch drive gear, needle bearings (14) and synchronizer ring from mainshaft assembly.
8. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (fig. 2A) and remove the extension.
9. Using J-22246 at the front of the countershaft, drive the shaft and its woodruff key out the rear of the case. Tool J-22246 will now hold the roller bearings in position within the countergear bore. Remove the gear, bearings and thrust washers from case.
10. Remove loading tool, bearings and spacers from countergear.
11. Use a long drift or punch through the front bearing case bore and drive the reverse idler shaft and woodruff key through the rear of the case (fig. 3A).

NOTE: The truck 3-speed Saginaw manual transmission uses a different reverse idler gear shaft than passenger car models. The passenger car model idler shaft has the retaining ring groove at the center of the shaft whereas the truck model shaft has the groove relocated off-center and further away from the gear. A spacer is released in conjunction with the truck model shaft to fit

between the retaining ring and idler gear to keep the gear from moving axially. The truck model shaft and spacer unit will be used to service all models.

DISASSEMBLY OF MAINSHAFT

1. Using snap ring pliers, remove the 2nd and 3rd speed sliding clutch hub snap ring from mainshaft and remove clutch assembly, second speed blocker ring and second speed gear from front of mainshaft.
2. Depress speedometer retaining clip and slide gear from mainshaft.
3. Remove rear bearing snap ring from mainshaft groove.
4. Support reverse gear with press plates and press on rear of mainshaft to remove reverse gear, thrust washer, spring washer, rear bearing, and snap ring from rear of mainshaft.
5. Remove the 1st and Reverse sliding clutch hub snap ring from the mainshaft and remove the clutch assembly, 1st speed blocker ring and first speed gear from rear of the mainshaft.

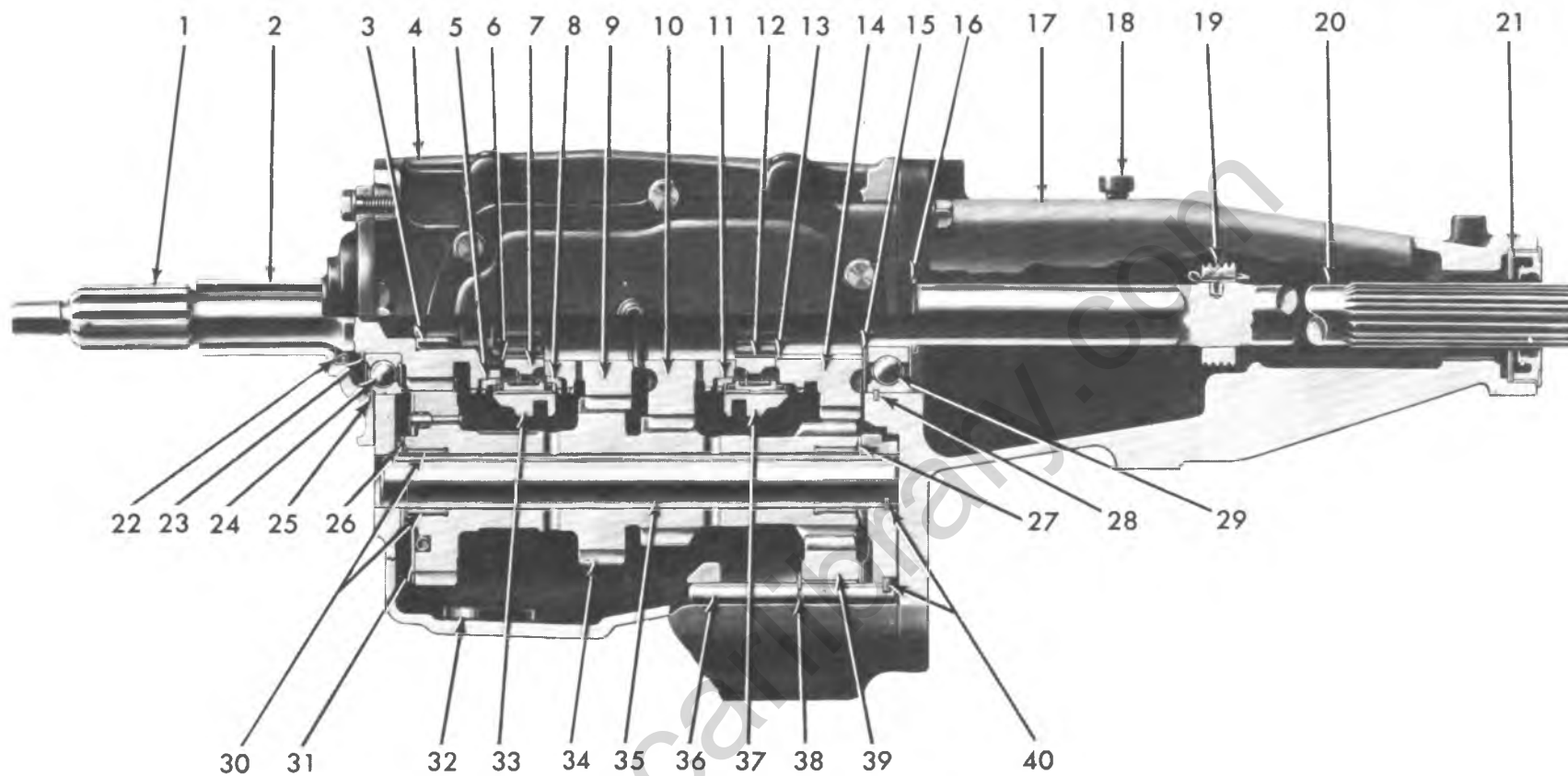
NOTE: Under certain tolerance conditions, it may be necessary to press the synchronizer hub and gear from the shaft.

This completes the disassembly of the mainshaft.

CLEANING AND INSPECTION

Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.
2. Check the front and rear faces for burrs, and if present, dress them off with a fine mill file.
3. Check bearing bores in case and, if damaged, replace case.



- | | | | | |
|---------------------------|--|-------------------------------------|------------------------------------|------------------------------|
| 1. Drive Gear Bearing | 10. 1st Speed Gear | 16. Snap Ring-Bearing to Mainshaft | 24. Drive Gear Bearing | 31. Anti-Lash Plate Assembly |
| 2. Bearing Retainer | 11. 1st Speed Blocker Ring | 17. Extension | 25. Snap Ring-Bearing to Case | 32. Magnet |
| 3. Pilot Bearings | 12. 1st Speed Synch. Hub | 18. Vent | 26. Thrust Washer-Front | 33. 2-3 Synch. Sleeve |
| 4. Case | 13. 1st Speed Synch. Snap Ring | 19. Speedometer Drive Gear and Clip | 27. Thrust Washer-Rear | 34. Countergear |
| 5. 3rd Speed Blocker Ring | 14. Reverse Gear | 20. Mainshaft | 28. Snap Ring-Bearing to Extension | 35. Counter Shaft |
| 6. 2-3 Synch. Snap Ring | 15. Reverse Gear Thrust and Spring Washers | 21. Rear Oil Seal | 29. Rear Bearing | 36. Reverse Idler Shaft |
| 7. 2-3 Synch. Hub | | 22. Retainer Oil Seal | 30. Countergear Roller Bearings | 37. 1st Speed Synch. Sleeve |
| 8. 2nd Speed Blocker Ring | | 23. Snap Ring-Bearing to Gear | | 38. "E" Ring |
| 9. 2nd Speed Gear | | | | 39. Reverse Idler Gear |
| | | | | 40. Woodruff Key |

Fig. 1A-Saginaw 3-Speed Transmission Cross-Section (Passenger Car)

Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.
2. Blow out bearings with compressed air.

CAUTION: Do not allow the bearings to spin, turn them slowly by hand. Spinning bearings will damage the race and balls.

3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

Bearing Rollers

All clutch gear and counter gear bearing rollers should be inspected closely and replaced if they show wear. Inspect counter shaft and reverse idler shaft at the same time, replace if necessary. Replace all worn washers.

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.
2. Inspect reverse gear bushing and if worn or damaged replace the entire gear.

NOTE: Reverse gear bushing is not serviced separately.

3. Check both clutch sleeves to see that they slide freely on their hubs.

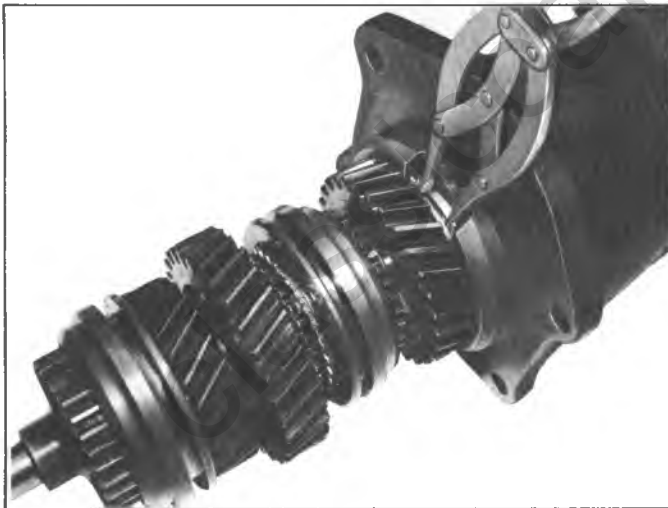


Fig. 2A--Extension to Rear Bearing Snap Ring

Reverse Idler Gear Bushing

The bushing used in the idler gear is pressed into the gear and finished bored in place. This insures the

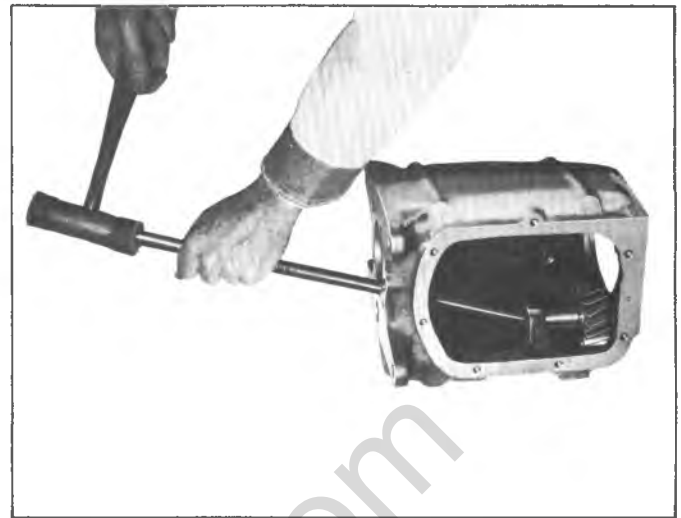


Fig. 3A--Removing Reverse Idler Shaft

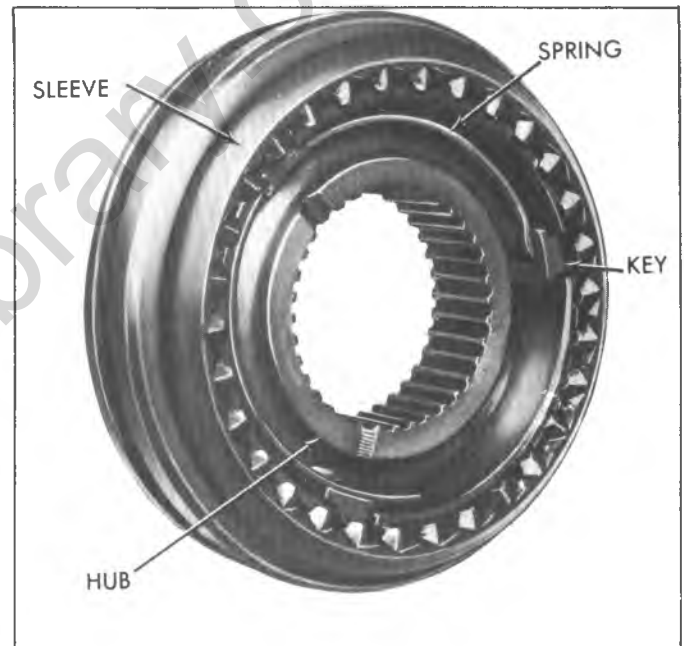


Fig. 4A--Synchronizer Assembly

positive alignment of the bushing and shaft as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushing is not serviced separately.

Countergear Anti-Lash Plate

Inspect the plate teeth for wear or other damage. The plate and two damper springs are retained to the countergear by three rivets. Disassembly is not recommended (fig. 6A).

REPAIRS

Clutch Keys and Springs

Replacement

NOTE: The clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

1. Mark hub and sleeve so they can be matched upon reassembly.
2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.
3. Place the three keys and two springs in position (one on each side of hub), so all three keys are engaged by both springs (fig. 4A). The tanged end of each synchronizer spring should be installed into

different key cavities on either side. Slide the sleeve onto the hub aligning the marks made before disassembly.

NOTE: A groove around the outside of the synchronizer hub identifies the end that must be opposite the fork slot in the sleeve when assembled. This groove indicates the end of the hub with a .07" greater recess depth.

Extension Oil Seal or Bushing

If bushing in rear of extension requires replacement, remove seal and use Tool J-5778 to drive bushing into extension housing. Using the same tool, drive new bushing in from the rear. Coat I.D. of bushing and seal with transmission lubricant, then install new oil seal using Tool J-5154 or J-21426.

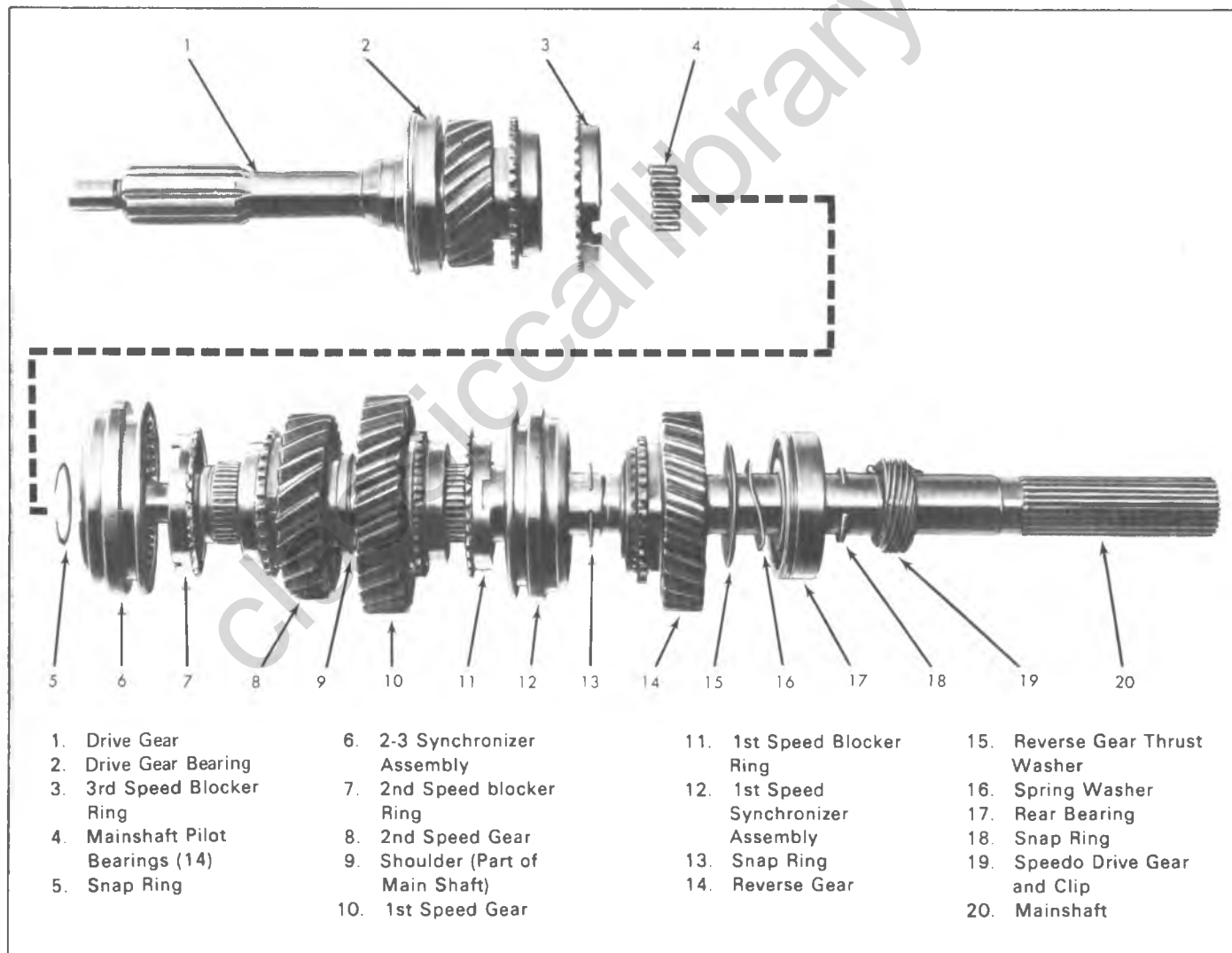


Fig. 5A--Clutch Gear and Mainshaft Assembly

Clutch Bearing Retainer Oil Seal

If the lip seal in the retainer needs replacement; pry the old seal out and replace with a new seal using Installer Tool J-23096, or similar tool, until seal seats in its bore.

ASSEMBLY OF MAINSHAFT (Fig. 5A)

Turn the front of the mainshaft upward. Install the following components of the mainshaft:

1. Install the second speed gear with clutching teeth upward; the rear face of the gear will butt against the flange on the mainshaft.
2. Install a blocking ring with clutching teeth downward over the synchronizing surface of the second speed gear. All three blocker rings used in this transmission are identical.
3. Install the second and third synchronizer assembly with the fork slot downward; press it onto splines on the mainshaft until it bottoms out. Both synchronizer assemblies used in this transmission are identical. (If sleeve becomes removed from 2-3 hub; notches on hub O.D. face forward end of mainshaft).

CAUTION: *Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.*

4. Install snap ring retaining synchronizer hub to mainshaft. Both synchronizer snap rings are identical.
5. Turn the rear of the mainshaft upward and install the first speed gear with clutching teeth upward; the front face of the gear will butt against the flange on the mainshaft.
6. Install a blocker ring with clutching teeth downward over synchronizing surface of the first speed gear.
7. Install the first and reverse synchronizer assembly with fork slot downward; push it onto splines on the mainshaft.

CAUTION: *Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.*

8. Install synchronizer hub to mainshaft snap ring.
9. Install reverse gear with clutching teeth downward.
10. Install reverse gear thrust washer (steel).
11. Install reverse gear spring washer.

12. Install rear ball bearing with snap ring slot downward; press onto mainshaft.
13. Install rear bearing to mainshaft snap ring.
14. Install speedometer drive gear and retaining clip.

ASSEMBLY OF TRANSMISSION

1. Using Tool J-22246 load a row of roller bearings (27) and a bearing thrust washer at each end of the countergear. Use heavy grease to hold them in place (fig. 6A).
2. Place countergear assembly through case rear opening along with a tanged thrust washer (tang away from gear) at each end and install countergear shaft and woodruff key from rear of case.

CAUTION: *Be sure countershaft picks up both thrust washers and that the tangs are aligned with their notches in the case.*
3. Install reverse idler gear and shaft with its woodruff key from the rear of case. Do not install idler shaft "E" ring yet.
4. Using snap ring pliers, expand the snap ring in the extension and assemble extension over rear of mainshaft and onto rear bearing. Seat snap ring in rear bearing groove (fig. 2A).

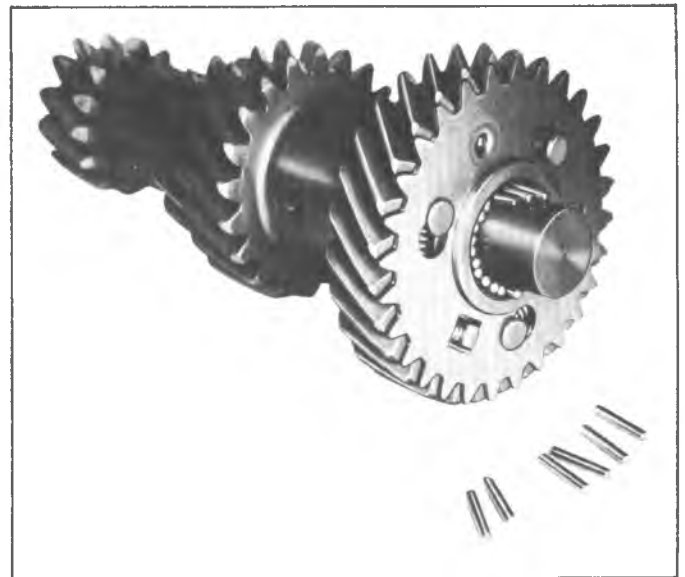


Fig. 6A--Loading Countergear Bearings w/Tool J-22246

7M-12 CLUTCHES AND MANUAL TRANSMISSIONS

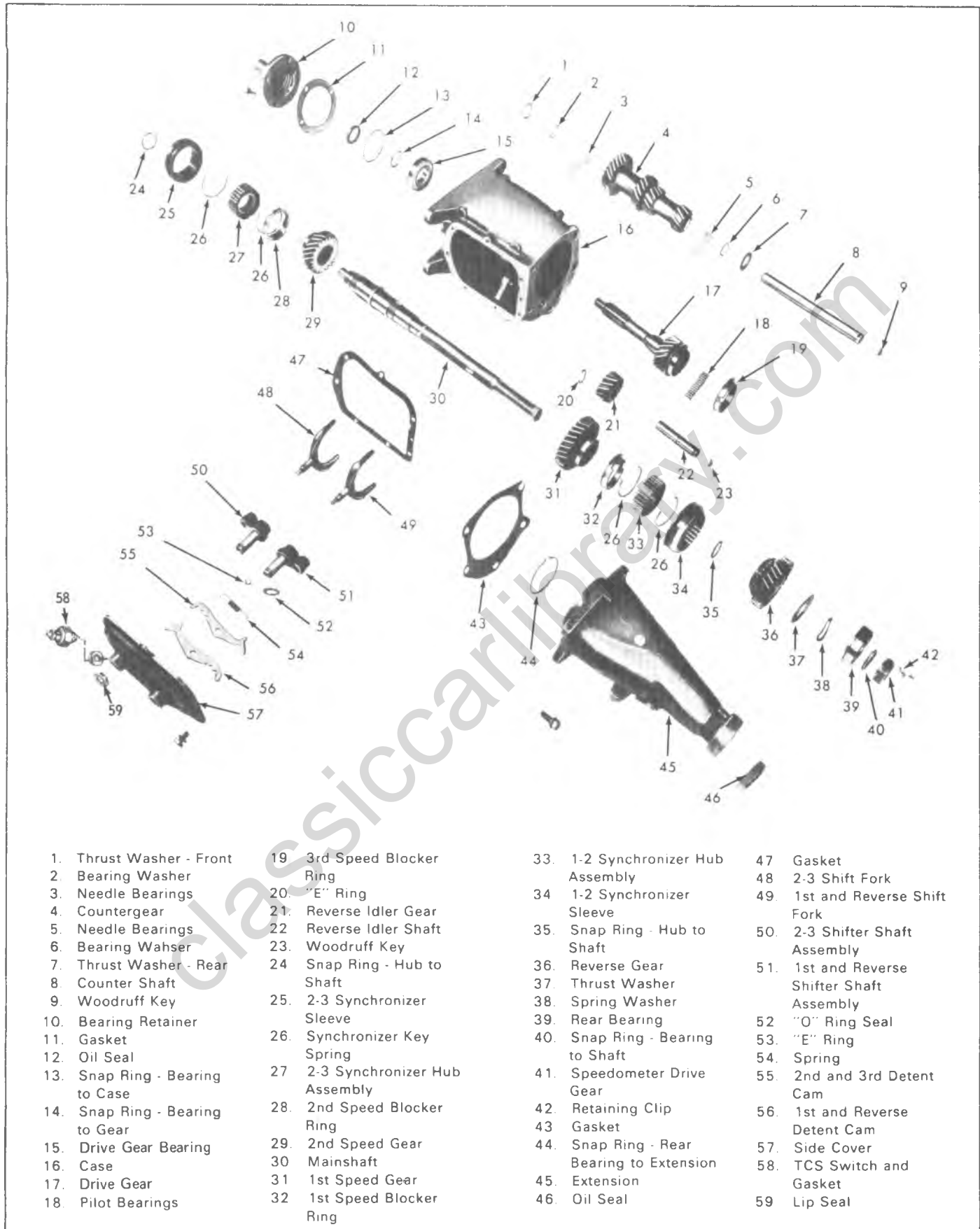


Fig. 7A-3-Speed Transmission Explode

5. Load the mainshaft pilot bearings (14) into the drive gear cavity and assemble the 3rd speed blocker ring onto the drive gear clutching surface with its teeth toward the gear.
6. Pilot the drive gear, pilot bearings and 3rd speed blocker ring assembly over the front of the mainshaft assembly. Do not assemble bearing to gear yet.

CAUTION: *Be sure the notches in the blocker ring align with the keys in the 2-3 synchronizer assembly.*

7. Place extension to case gasket at rear of case holding in place with grease and, from the rear of case, assemble the drive gear, mainshaft and extension to case as an assembly.

CAUTION: *Be sure the drive gear engages the countergear anti-lash plate.*

8. Install extension to case retaining bolts.
9. Install front bearing outer snap ring to bearing and position bearing over stem of drive gear and into front case bore.
10. Install snap ring to drive gear stem, and drive gear bearing retainer and gasket to case.

NOTE: The retainer oil return hole should be at the bottom.

11. Install reverse idler gear retainer "E" ring to shaft.
12. Shift synchronizer sleeves to neutral positions and install cover, gasket and fork assembly to case. Be sure forks align with their synchronizer sleeve grooves.
13. Tighten all bolts to specified torque.
14. Rotate drive gear shaft and shift transmission to free rotation in all gears.
15. Install speedometer driven gear in rear extension.

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THREE-SPEED MUNCIE TRANSMISSION

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DISASSEMBLY OF TRANSMISSION (Fig. 1G)

1. Remove side cover attaching bolts, side cover assembly, gasket and shift forks.
2. Remove drive gear bearing retainer bolts, retainer and gasket.
3. Remove drive gear bearing to gear stem snap ring, then remove drive gear bearing by pulling outward on drive gear until a screw driver or other suitable tool can be inserted between bearing, large snap ring and case to complete removal. The drive gear bearing is a slip fit on the gear and into the case bore. (This provides clearance for removal of drive gear and mainshaft assembly.)
4. Remove extension to case attaching bolts.
5. Rotate extension to left until groove in extension housing flange lines up with the reverse idler shaft. Using a drift or other suitable tool, drive reverse idler shaft out of gear and case (fig. 2G).
6. Remove drive gear, mainshaft and extension assembly together through case rear opening. Remove reverse idler gear from case.
7. Remove drive gear from mainshaft. Remove pilot bearings.
8. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (fig. 3G). Tap gently on end mainshaft and remove extension from mainshaft.
9. Using a brass drift, drive countergear shaft and woodruff key from case.

DISASSEMBLY OF MAINSHAFT (Fig. 4G)

1. Depress speedometer gear retaining clip and slide gear from mainshaft.
2. Remove rear bearing snap ring from mainshaft groove.
3. Support reverse gear with press plates and press on rear of mainshaft to remove reverse gear, thrust washer and rear bearing from shaft.

CAUTION: When pressing rear bearing be careful to center gear, washers, and bearing on shaft.

4. Remove 1st and reverse sliding clutch hub snap ring from the mainshaft.
5. Support 1st gear with press plates and push on rear of mainshaft to remove the clutch assembly, blocker ring and 1st speed gear.

CAUTION: Exercise care to prevent distortion of snap rings during expansion.

6. Using snap ring pliers, remove the 2nd and 3rd speed sliding clutch hub snap ring from mainshaft.
7. Support 2nd speed gear with press plates and press on front of mainshaft to remove clutch assembly, second speed blocker ring and second speed gear from shaft.

This completes the disassembly of mainshaft.

CLEANING AND INSPECTION

Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.
2. Check the front and rear faces for burrs, and if present, dress them off with a fine mill file.
3. Check bearing bores in case and, if damaged, replace case.

Front and Rear Bearings

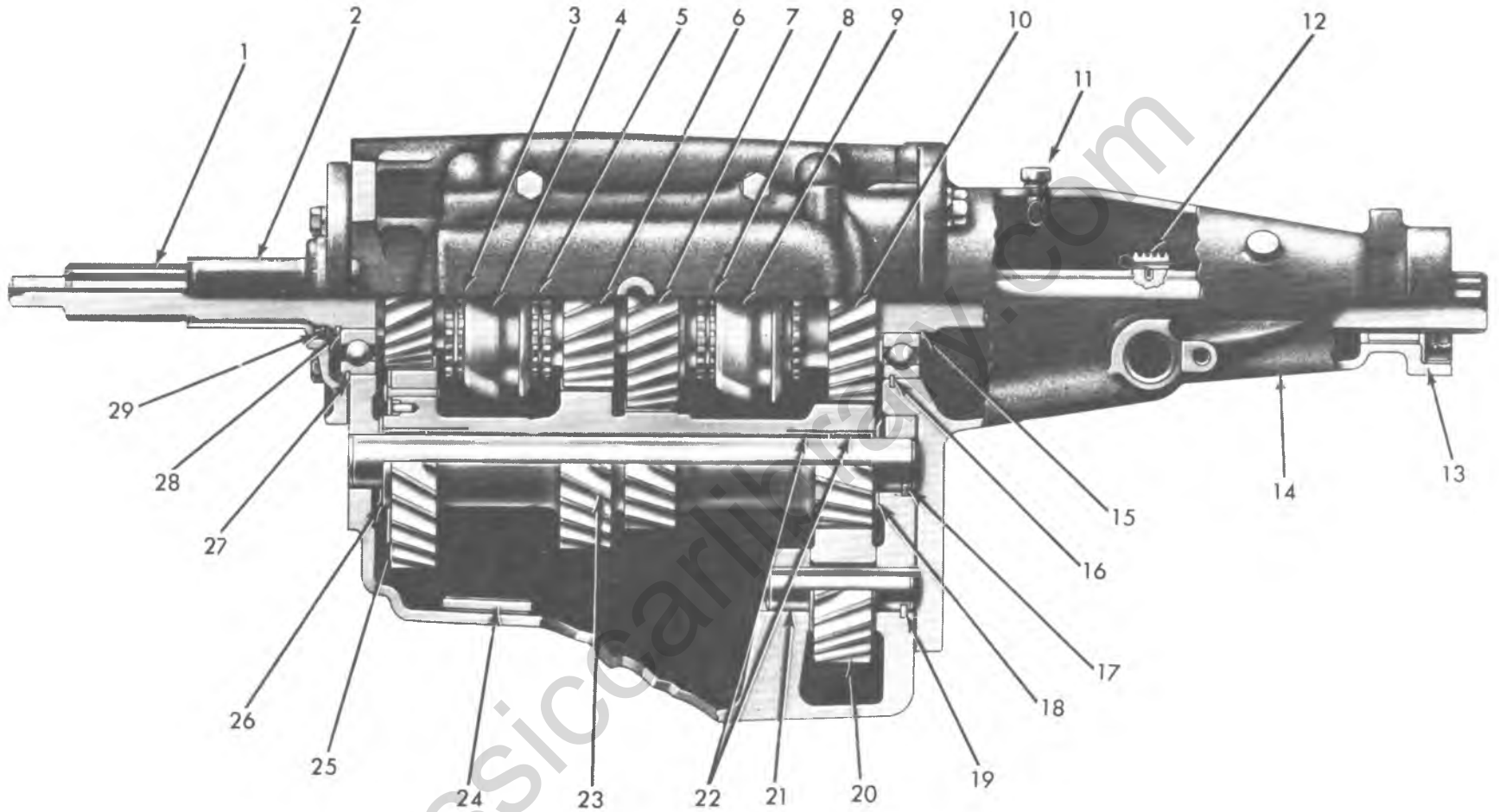
1. Wash the front and rear ball bearings, thoroughly in a cleaning solvent.
2. Blow out bearings with compressed air.

CAUTION: Do not allow the bearings to spin, turn them slowly by hand. Spinning bearings will damage the race and balls.

3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

Bearing Rollers

All drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect



- | | | | |
|--------------------------------|--------------------------------|---|--|
| 1. Drive Gear | 8. 1st Speed Synchronizer Ring | 15. Rear Bearing-to-Shaft Snap Ring | 21. Reverse Idler Shaft |
| 2. Drive Gear Bearing Retainer | 9. 1st Reverse Clutch Assy. | 16. Rear Bearing-to-Extension Snap Ring | 22. Countergear Bearings |
| 3. 3rd Speed Synchronizer Ring | 10. Reverse Gear | 17. Countergear Woodruff Key | 23. Countergear |
| 4. 2nd-3rd Speed Clutch Assy. | 11. Vent | 18. Thrust Washer | 24. Case Magnet |
| 5. 2nd Speed Synchronizer Ring | 12. Speedometer Gear and Clip | 19. Reverse Idler Shaft Woodruff Key | 25. Anti-Lash Plate Assy. (Pass. Only) |
| 6. 2nd Speed Gear | 13. Rear Extension Seal | 20. Reverse Idler Gear | 26. Thrust Washer |
| 7. 1st Speed Gear | 14. Rear Extension | | 27. Drive Gear Bearing |
| | | | 28. Snap Ring |
| | | | 29. Drive Gear Retainer Lip Seal |

Fig. 1G--Muncie 3-Speed Transmission Cross Section

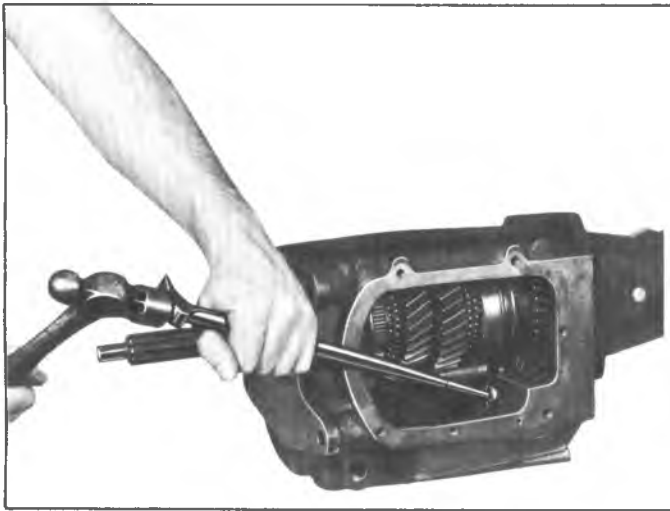


Fig. 2G--Removing Reverse Idler Shaft

counter shaft and reverse idler shaft at the same time, replace if necessary. Replace all worn washers.

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.
2. Inspect reverse gear bushing and if worn or damaged replace the entire gear.

NOTE: Reverse gear bushing is not serviced separately.

3. Check both clutch sleeves to see that they slide freely on their hubs.

Reverse Idler Gear Bushing

The bushing used in the idler gear is pressed into the gear and finish bored in place. This insures the positive alignment of the bushing and shaft as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushing is not serviced separately.

Countergear Anti-Lash Plate

Inspect the plate teeth for wear or other damage. The plate and damper spring is retained to the countergear by three rivets. Disassembly is not recommended.

REPAIRS

Clutch Keys and Springs Replacement

NOTE: The clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

1. Mark hub and sleeve so they can be matched upon reassembly.



Fig. 3G--Removing Rear Extension From Mainshaft

2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.
3. Place the three keys and two springs in position (one on each side of hub), so all three keys are engaged by both springs (fig. 5G). Slide the sleeve onto the hub aligning the marks made before disassembly.

Extension Oil Seal or Bushing

If bushing in rear of extension requires replacement, remove seal and use Tool J-5778 to drive bushing into extension housing. Using the same tool, drive new bushing in from the rear. Coat I.D. of bushing and seal with transmission lubricant, then install new oil seal using Tool J-5154.

Clutch Bearing Retainer Oil Seal

If the lip seal in the retainer needs replacement; pry the old seal out and replace with a new seal using Installer Tool J-23096 or similar tool, until seal seats in its bore.

ASSEMBLY OF MAINSHAFT (Fig. 4G)

Turn the front of the mainshaft upward. Install the following components on the mainshaft:

1. Install the second speed gear with clutching teeth upward; the rear face of the gear will butt against the flange on the mainshaft.
2. Install a blocking ring with clutching teeth downward over the synchronizing surface of the second speed gear. All three blocker rings used in this transmission are identical.
3. Install the second and third synchronizer assembly with the fork slot downward; press it onto splines on the mainshaft until it bottoms out. Both synchronizer assemblies are identical but assembled

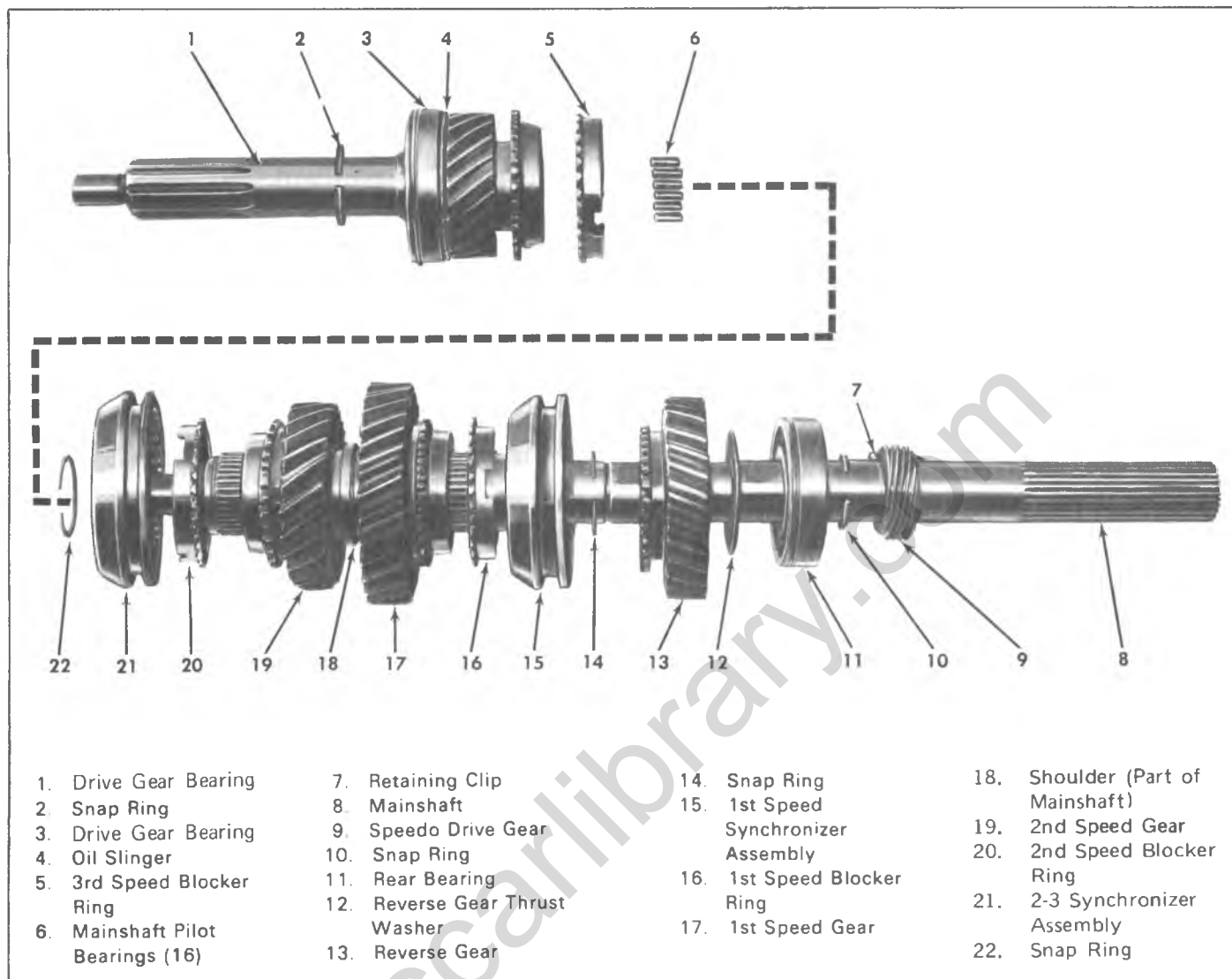


Fig. 4G--Drive Gear and Mainshaft Assembly

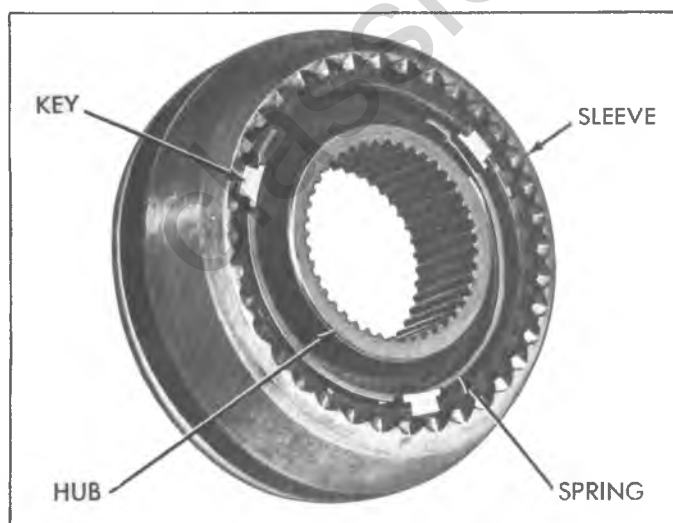


Fig. 5G--Synchronizer Assembly

differently. The 2nd-3rd speed hub and sleeve is assembled with the fork slot in the sleeve toward the thrust face of the hub. The 1st-reverse hub and sleeve is assembled with the fork slot in the sleeve opposite the thrust face (fig. 4G).

CAUTION: Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.

4. Install synchronizer hub to mainshaft snap ring. Both synchronizer snap rings are identical.

Turn the rear of the mainshaft upward. Install the following components on the mainshaft:

5. Install the first speed gear with clutching teeth upward; the front face of the gear will butt against the flange on the mainshaft.
6. Install a blocker ring with clutching teeth downward over synchronizing surface of the first speed gear.
7. Install the first and reverse synchronizer assembly

7M-18 CLUTCHES AND MANUAL TRANSMISSIONS

with fork slot up; press it onto splines on the mainshaft.

CAUTION: *Be sure the notches of the blocker ring align with the keys of the synchronizer assembly and that both synchronizer sleeves face the front of the mainshaft.*

8. Install synchronizer hub to mainshaft snap ring.
9. Install reverse gear with clutching teeth downward.
10. Install reverse gear steel thrust washer (align flats).
11. Install rear ball bearing with snap ring slot downward; press onto mainshaft.
12. Install rear bearing to mainshaft snap ring.
13. Install speedometer drive gear and retaining clip.

This completes the assembly of the mainshaft.

ASSEMBLY OF TRANSMISSION (Fig. 6G)

1. Load a double row of roller bearings (29) and the bearing thrust washers in the countergear (Fig. 6G). Use heavy grease to hold them in place.
2. Place countergear assembly through case rear opening along with a tanged thrust washer (tang away from gear) at each end and install countergear shaft and woodruff key from rear of case. End of shaft must be flush with case.
NOTE: Be sure countershaft picks up both thrust washers and that the tangs are aligned with their notches in the case.
3. Position reverse idler gear in case. Do not install shaft until mainshaft is in place.
4. Using snap ring pliers, expand the snap ring in the extension and assemble extension over rear of mainshaft and onto rear bearing. Seat snap ring in rear bearing groove (fig. 3G).
5. Load the mainshaft pilot bearings (16) into the drive gear cavity and assemble the 3rd speed

blocker ring onto the drive gear clutching surface with its teeth toward the gear.

6. Pilot the drive gear, pilot bearings and 3rd speed blocker ring assembly over the front of the mainshaft assembly. Do not assemble bearing to gear yet.

NOTE: Be sure the notches in the blocker ring align with the keys in the 2-3 synchronizer assembly.

7. Place extension to case gasket on extension holding it in place with grease and, from the rear of case, assemble the clutch gear, mainshaft and extension to case as an assembly.

NOTE: Be sure the clutch gear engages the teeth of the countergear anti-lash plate and that the oil slinger is in place on the clutch gear.

8. Rotate extension and install reverse idler shaft and woodruff key.
9. Install extension to case retaining bolts.
NOTE: Apply sealer to all through bolts.
10. Install front bearing outer snap ring to bearing and install bearing on stem of clutch gear and into front case bore.
11. Install snap ring to clutch gear stem, and clutch gear bearing retainer and gasket to case.

NOTE: The retainer oil return hole should be at the bottom.

12. Shift synchronizer sleeves to neutral positions and install cover, gasket and fork assembly to case. Be sure forks align with their synchronizer sleeve grooves.
13. Tighten all bolts to specified torque.
NOTE: Apply sealer to all through bolts.
14. Rotate clutch gear and shift transmission through gears to check free rotation of gears.

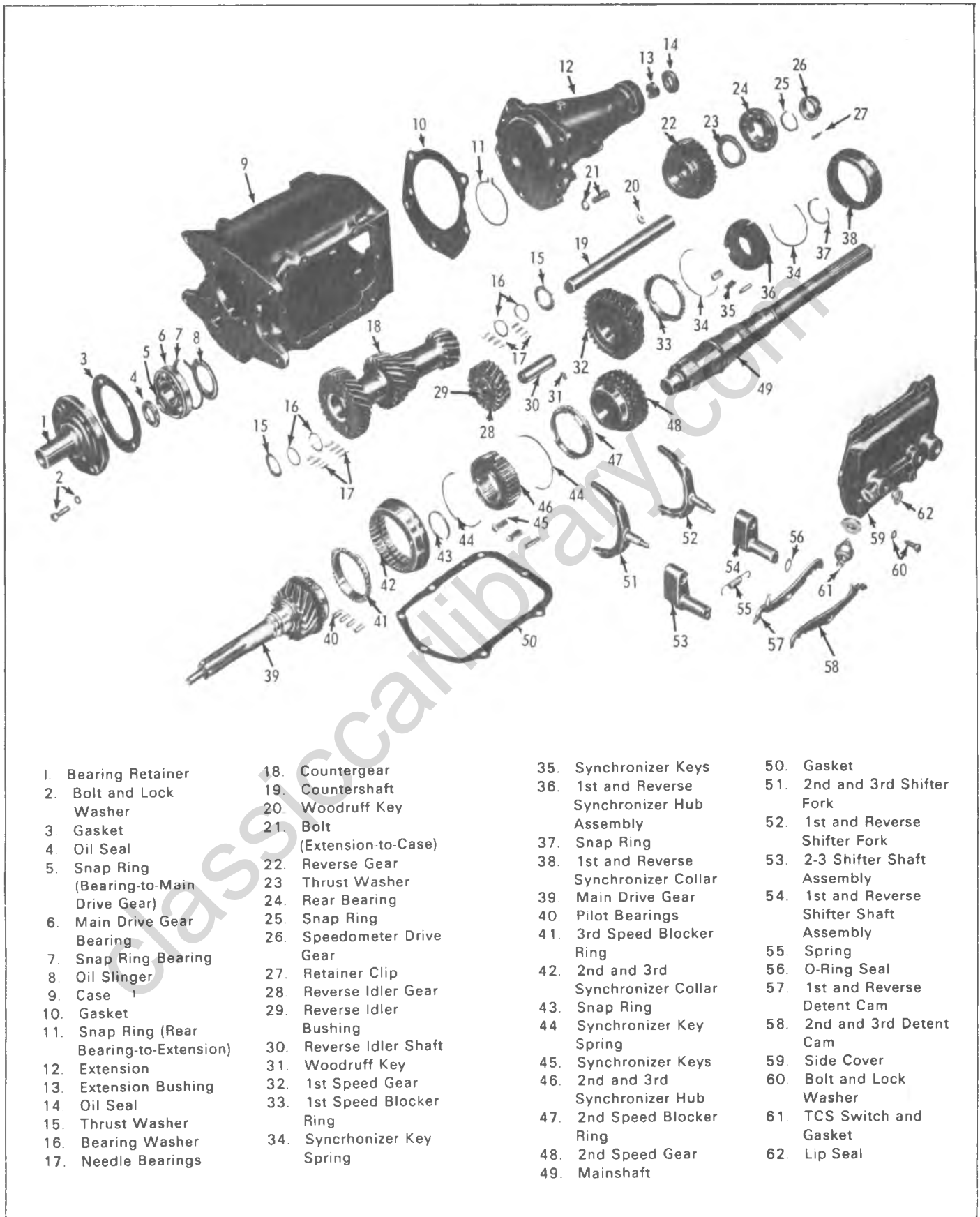


Fig. 6G--Transmission Exploded View

FOUR SPEED SAGINAW TRANSMISSION

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Disassembly of transmission.....	7M-20	Reverse Idler Gear Bushing	7M-23
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DISASSEMBLY OF TRANSMISSION (Fig. 1X)

1. Remove side cover attaching bolts and side cover assembly.
2. Remove drive gear bearing retainer.
3. Remove drive gear bearing to gear stem snap ring, then remove drive gear bearing by pulling outward on gear until a screwdriver or other suitable tool can be inserted between bearing, large snap ring and case to complete removal (Fig. 2X). The drive gear bearing is a slip fit on the gear and into the case bore. This provides clearance between case bore and shaft for removal of drive gear and mainshaft assembly.
4. Remove extension to case attaching bolts.
5. Remove drive gear, mainshaft and extension assembly together through the rear case opening (fig. 3X). Remove drive gear and bearings from mainshaft.
6. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (fig. 4X) and remove the extension.
7. Using J-22246 at the front of the countershaft, drive the shaft and its woodruff key out the rear of the case. Tool J-22246 will now hold the roller bearings in position within the countergear bore. Remove the gear and thrust washers from case (fig. 5X).
8. Remove reverse idler gear stop ring. Use a long drift or punch through the front bearing case bore and drive the reverse idler shaft and woodruff key through the rear of the case (fig. 6X).

DISASSEMBLY OF MAINSHAFT

1. Using snap ring pliers, remove the 3rd and 4th speed sliding clutch hub snap ring from mainshaft and remove clutch assembly, third gear blocker ring and third speed gear from front of mainshaft (figs. 7X).
2. Depress speedometer retaining clip and slide gear from mainshaft.
3. Remove rear bearing snap ring from mainshaft groove (fig. 8X).

4. Support first gear with press plates and press on rear of mainshaft to remove first gear, thrust washer, spring washer, and rear bearing from rear of mainshaft (fig. 9X).
5. Remove the 1st and second sliding clutch hub snap ring from the mainshaft (Fig. 10X) and remove the clutch assembly, 2nd speed blocker ring and second speed gear from the rear of the mainshaft. This completes the disassembly of the mainshaft.

CLEANING AND INSPECTION

Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.
2. Check the front and rear faces for burrs, and if present, dress them off with a fine mill file.

Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.
2. Blow out bearings with compressed air.

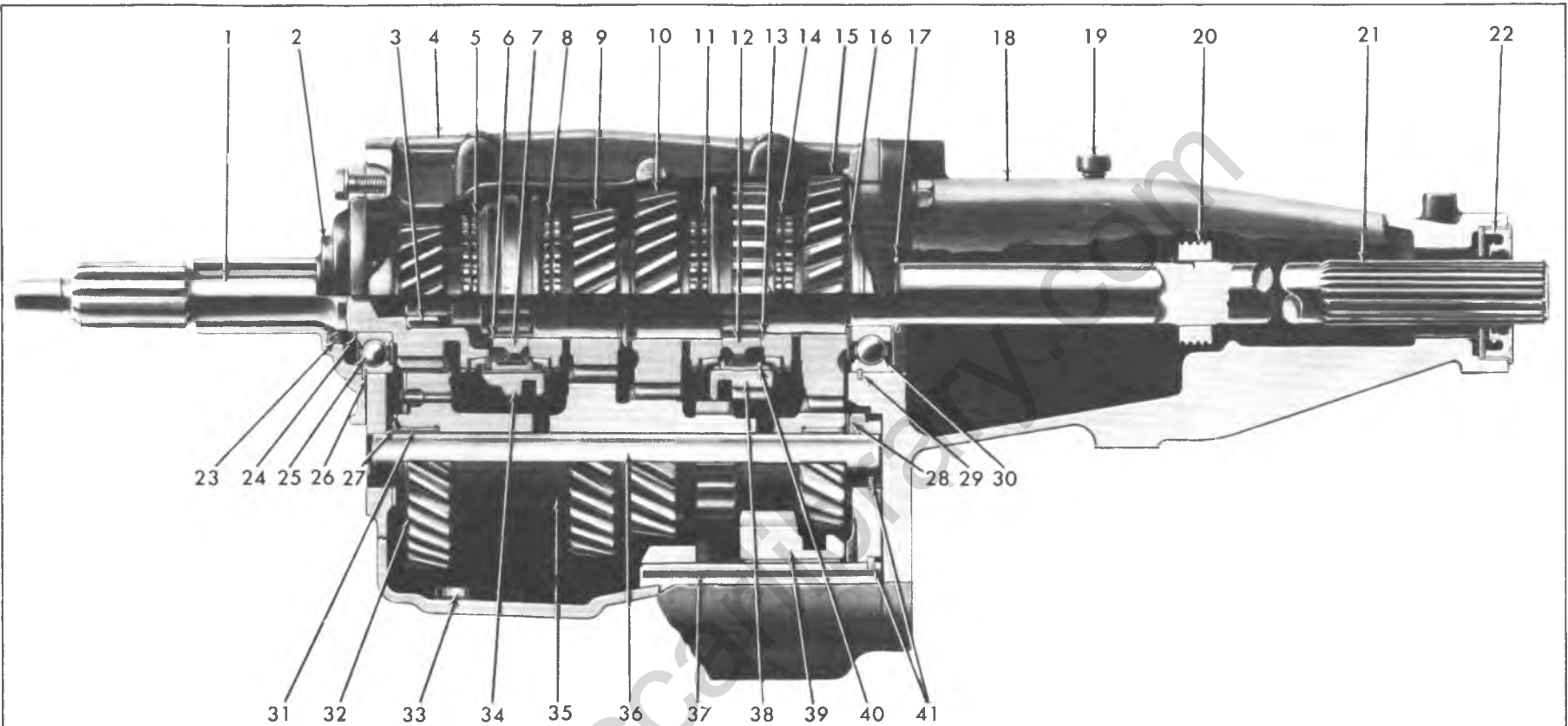
CAUTION: Do not allow the bearings to spin, turn them slowly by hand. Spinning bearings will damage the race and balls.
3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

Bearing Rollers

All clutch gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect counter shaft and reverse idler shaft at the same time, replace if necessary. Replace all worn washers.

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.
2. Check both clutch sleeves to see that they slide freely on their hubs.



- | | | | | |
|---------------------------|--|-------------------------------------|------------------------------------|--|
| 1. Drive Gear | 11. 2nd Speed Blocker Ring | 18. Extension | 27. Thrust Washer-Front | 35. Countergear Assembly |
| 2. Bearing Retainer | 12. 1-2 Speed Synch. Hub | 19. Vent | 28. Thrust Washer-Rear | 36. Counter Shaft |
| 3. Pilot Bearings | 13. 1-2 Speed Synch. Snap Ring | 20. Speedometer Drive Gear and Clip | 29. Snap Ring-Bearing to Extension | 37. Reverse Idler Shaft |
| 4. Case | 14. 1st Speed Blocker Ring | 21. Mainshaft | 30. Rear Bearing | 38. 1-2 Speed Synch. Sleeve and Reverse Gear |
| 5. 4th Speed Blocker Ring | 15. First Gear | 22. Rear Oil Seal | 31. Countergear Roller Bearings | 39. Reverse Idler Gear (Sliding) |
| 6. 4-3 Synch. Snap Ring | 16. Reverse Gear Thrust and Spring Washers | 23. Retainer Oil Seal | 32. Anti-Lash Plate Assembly | 40. Clutch Key |
| 7. 4-3 Synch. Hub | 17. Snap Ring-Bearing to Mainshaft | 24. Snap Ring-Bearing to Gear | 33. Magnet | 41. Woodruff Key |
| 8. 3rd Speed Blocker Ring | | 25. Drive Gear Bearing | 34. 4-3 Synch. Sleeve | |
| 9. 3rd Speed Gear | | 26. Snap Ring-Bearing to Case | | |
| 10. 2nd Speed Gear | | | | |

Fig. 1X--Transmission-Cross Section

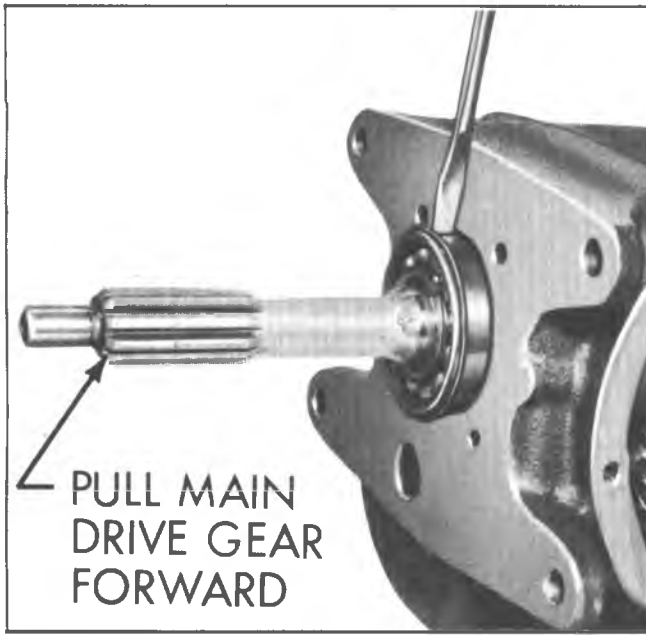


Fig. 2X--Removing Drive Gear Bearing



Fig. 5X--Removing Countershaft

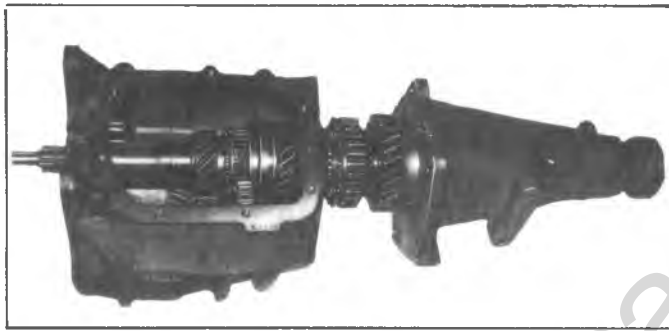


Fig. 3X--Removing Clutch Gear and Mainshaft



Fig. 6X--Removing Reverse Idler Gear Shaft



Fig. 4X--Extension to Rear Bearing Snap Ring

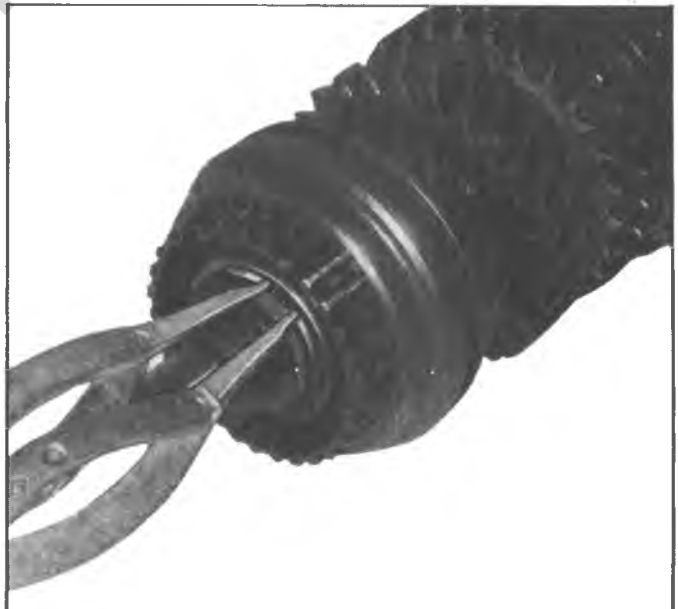


Fig. 7X--Third and Fourth Synchronizer Snap Ring

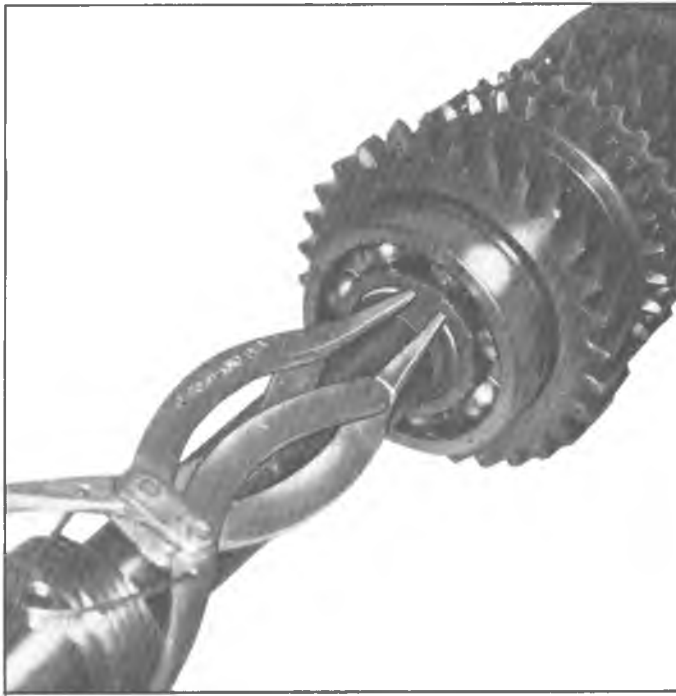


Fig. 8X--Rear Bearing to Mainshaft Snap Ring

Reverse Idler Gear Bushings

The bushing used in the idler gear is pressed into the gear and finish bored in place. This insures the positive alignment of the bushing and shaft as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushing is not serviced separately.

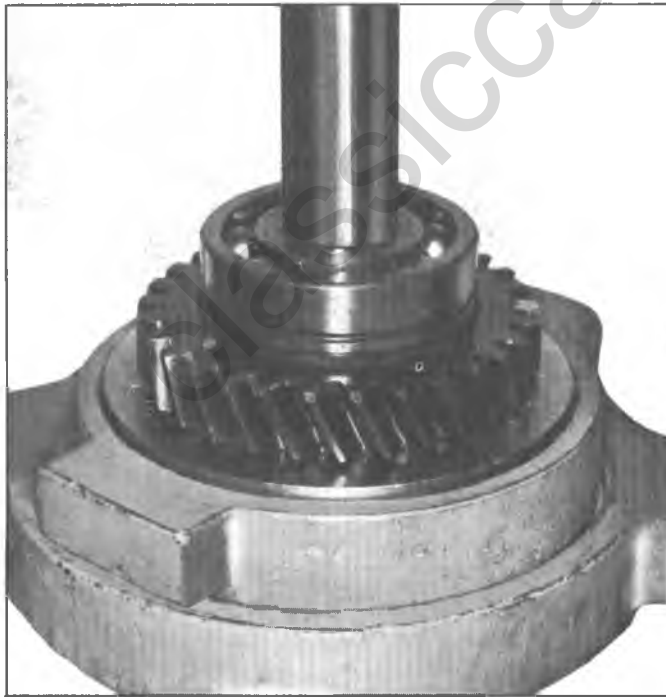


Fig. 9X--Removing Rear Bearing and First Speed Gear

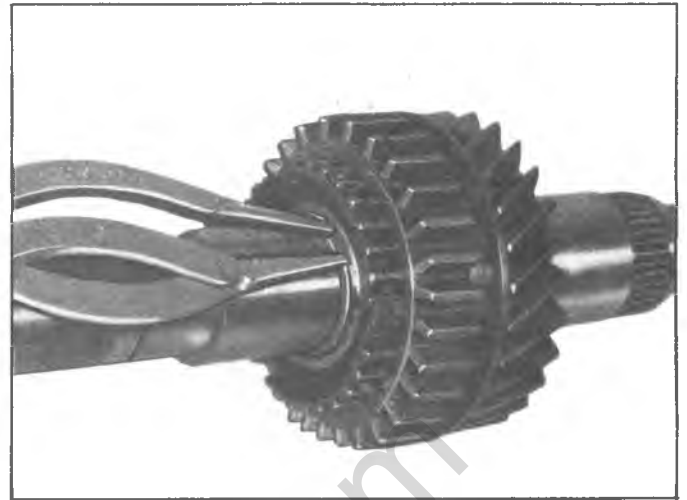


Fig. 10X-First and Second Synchronizer Snap Ring

Countergear Anti-Lash Plate

Inspect the plate teeth for wear or other damage. The plate and two damper springs are retained to the countergear by three rivets. Disassembly is not recommended (fig. 19X).

REPAIRS

Clutch Keys and Springs

NOTE: The clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

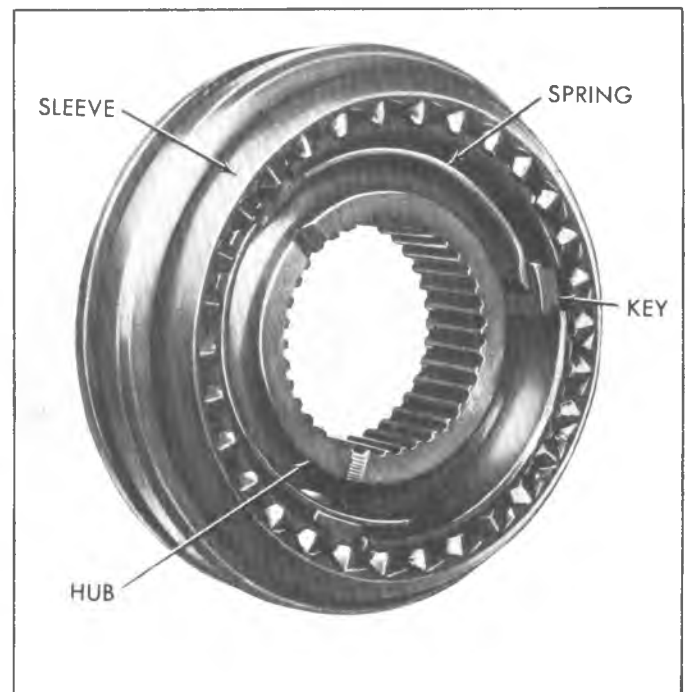


Fig. 11X--Three-Four Synchronizer Assembly

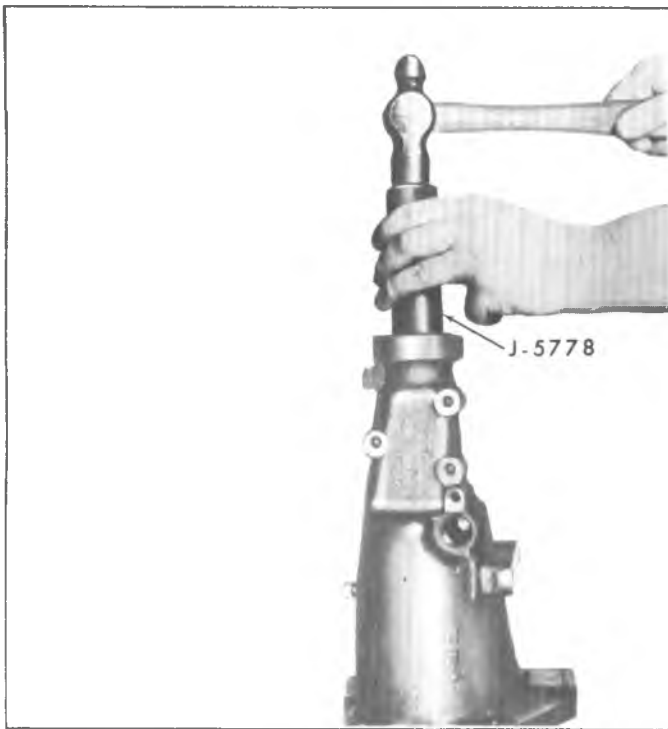


Fig. 12X-Extension Bushing Replacement

1. Mark hub and sleeve so they can be matched upon reassembly.
2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.
3. Place the three keys and two springs in position (one on each side of hub), so all three keys are engaged by both springs (fig. 11X). The tanged end of each synchronizer spring should be installed into different key cavaties on either side. Slide the sleeve

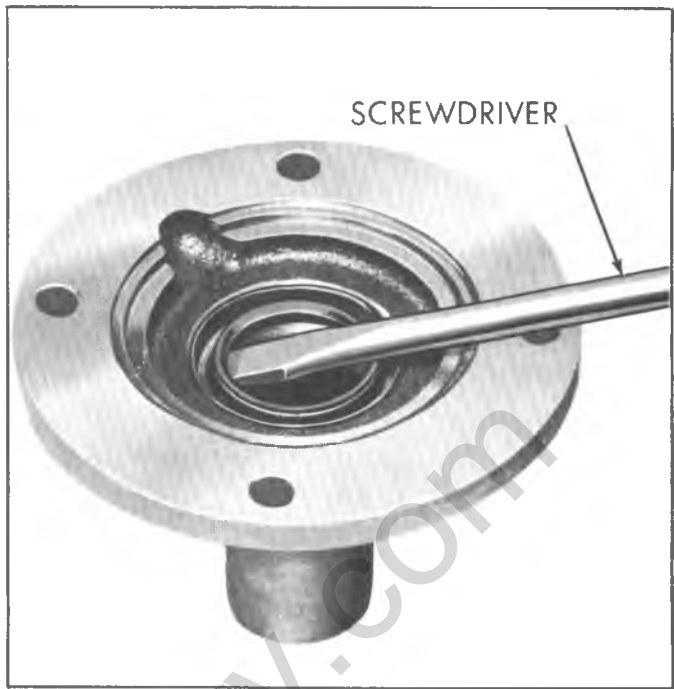


Fig. 14X-Removing Bearing Retainer Oil Seal

onto the hub aligning the marks made before disassembly.

NOTE: A groove around the outside of the synchronizer hub identifies the end that must be opposite the fork slot in the sleeve when assembled. This groove indicates the end of the hub with a greater recess depth.

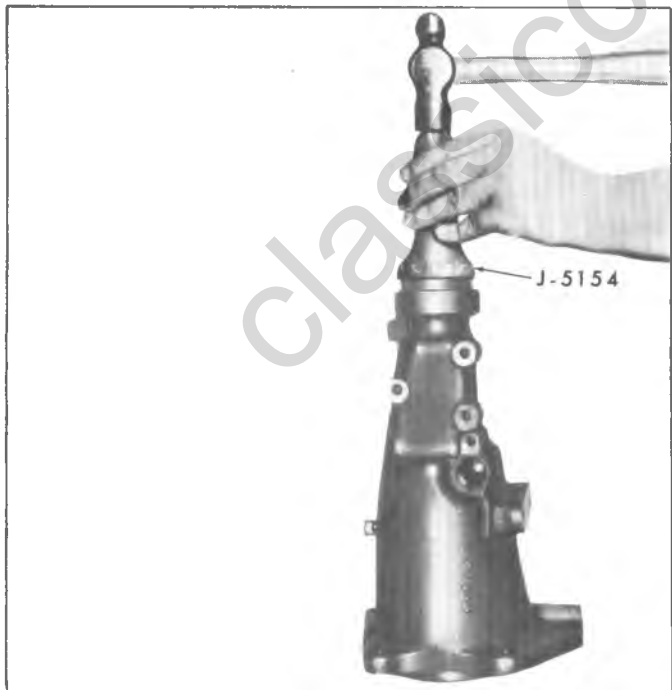


Fig. 13X-Installing Extension Oil Seal

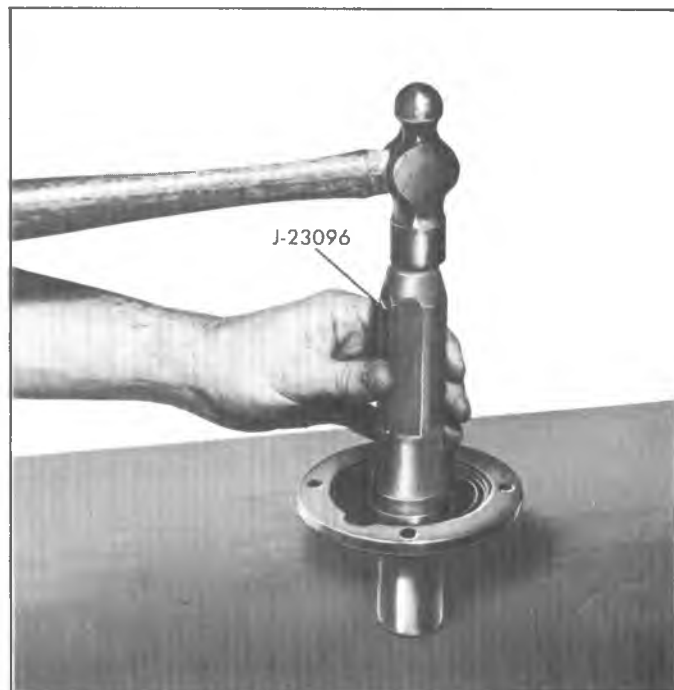


Fig. 15X-Installing Bearing Retainer Oil Seal

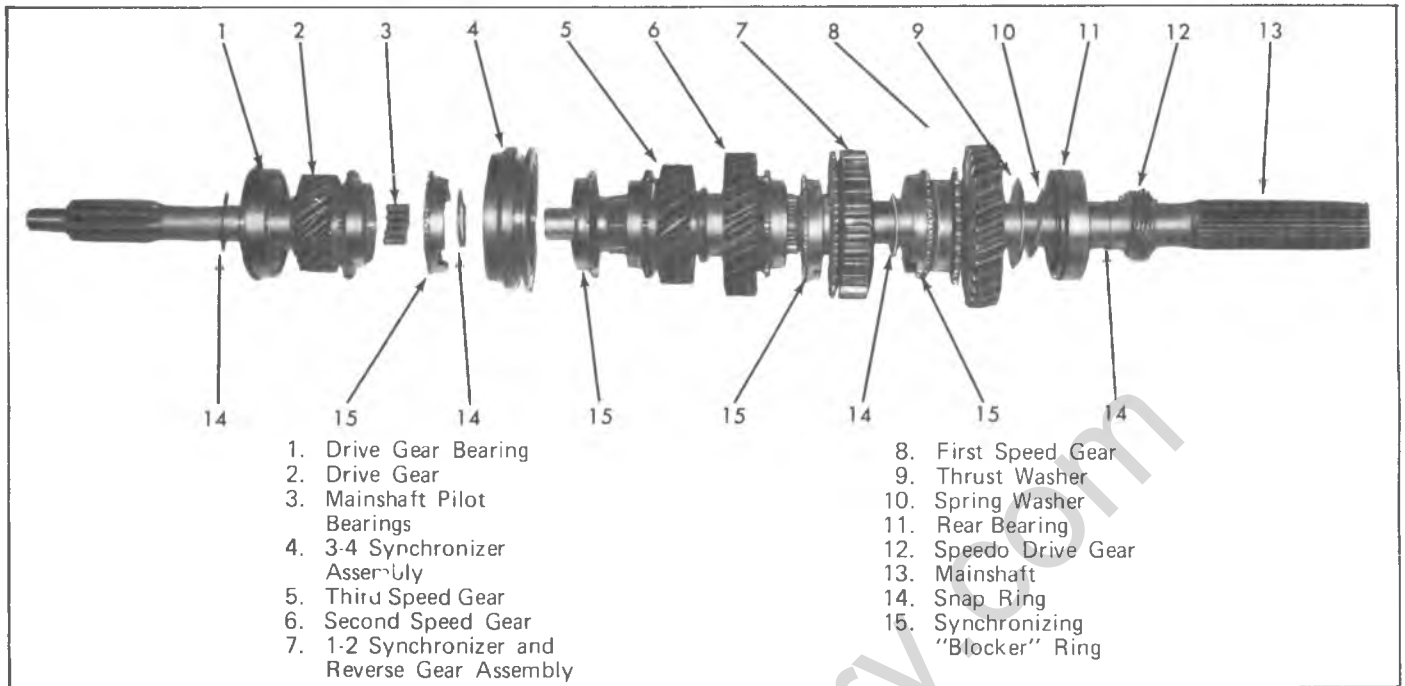


Fig. 16X-Clutch Gear and Mainshaft Details

Extension Oil Seal or Bushing

If bushing in rear of extension requires replacement, remove seal and use Tool J-5778 to drive bushing into extension housing (fig. 12X). Using the same tool, drive new bushing in from the rear. Coat I.D. of bushing and seal with transmission lubricant, then install new oil seal using Tool J-5154 (fig. 13X).

Clutch Gear Bearing Retainer Oil Seal

If the lip seal in the retainer needs replacement; pry the oil seal out (Fig. 14X) and replace with a new seal using Tool J-23096 until seal seats in its bore (Fig. 15X).

NOTE: Lip of seal must face rear of bearing retainer.

ASSEMBLY OF MAINSHAFT (Fig. 16X)

Turn the front of the mainshaft upward. Install the following components on the mainshaft:

1. Install the third speed gear with clutching teeth upward; the rear face of the gear will butt against the flange on the mainshaft.
2. Install a blocking ring with clutching teeth downward over the synchronizing surface of the third speed gear. All four blocker rings used in this transmission are identical.
3. Install the 3rd and 4th synchronizer assembly with the fork slot downward; push assembly onto splines on the mainshaft until it bottoms out against flange.

CAUTION: Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.

4. Install synchronizer hub to mainshaft snap ring (fig. 7X). Both synchronizer snap rings are identical.

Turn the rear of the mainshaft upward. Install the following components on the mainshaft:



Fig. 17X-Installing Rear Bearing

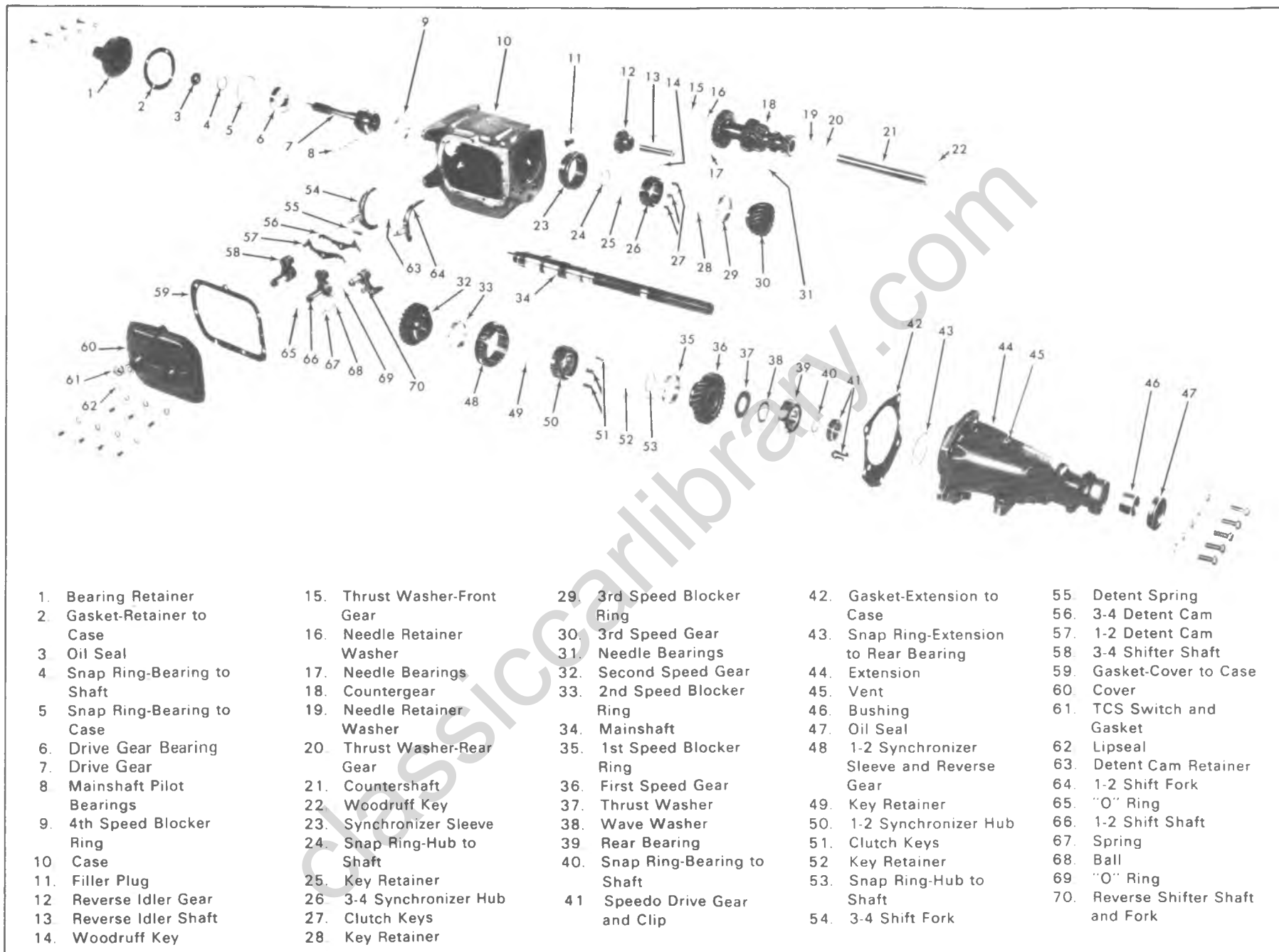


Fig. 18X—Transmission Exploded View

5. Install the second speed gear with clutching teeth upward; the front face of the gear will butt against the flange on the mainshaft.
6. Install a blocker ring with clutching teeth downward over synchronizing surface of the second speed gear.
7. Install the first and second synchronizer assembly with fork slot downward.

CAUTION: *Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.*

8. Install synchronizer hub to mainshaft snap ring (fig. 10X).
 9. Install a blocker ring with notches downward so they align with the keys of the 1-2 synchronizer assembly.
 10. Install first gear with clutching teeth downward.
 11. Install first gear thrust washer (steel).
 12. Install first gear spring washer.
 13. Install rear ball bearing with snap ring slot downward; press onto mainshaft (fig. 17X).
 14. Install rear bearing to mainshaft snap ring (fig. 8X).
 15. Install speedometer drive gear and clip.
- This completes the assembly of the mainshaft.

ASSEMBLY OF TRANSMISSION (Fig. 18X)

1. Using Tool J-22246 load a row of roller bearings (27) and a bearing thrust washer at each end of the countergear. Use heavy grease to hold them in place (fig. 19X).
2. Place countergear assembly through case rear opening along with a tanged thrust washer (tang away from gear) at each end and install countergear shaft and woodruff key from rear of case.

CAUTION: *Be sure countershaft picks up both thrust washers and that the tangs are aligned with their notches in the case.*

3. Install reverse idler gear and shaft with its woodruff key from the rear of case.
4. Using snap ring pliers, expand the snap ring in the extension and assembly extension over rear of mainshaft and onto rear bearing. Seat snap ring in rear bearing groove (fig. 4X).
5. Load the mainshaft pilot bearings (14) into the drive gear cavity and assemble the 4th speed blocker ring onto the drive gear clutching surface with its clutching teeth toward the gear (fig. 20X).
6. Pilot the drive gear, pilot bearings and 4th speed blocker ring assembly over the front of the mainshaft assembly. Do not assemble bearing to gear yet.

CAUTION: *Be sure the notches in the blocker ring align with the keys in the 3-4 synchronizer assembly.*

7. Place extension to case gasket at rear of case holding in place with grease and, from the rear of the case, assemble the clutch gear, mainshaft and extension to case as an assembly.
8. Install extension to case retaining bolts. Using seal cement on bottom bolt only.
9. Install front bearing outer snap ring to bearing and position bearing over stem of drive gear and into front case bore.
10. Install snap ring to drive gear stem, and drive bearing retainer and gasket to case.
NOTE: The retainer oil return hole should be at the bottom.
11. Shift synchronizer sleeves to neutral positions and install cover, gasket and fork assembly to case. Be sure forks align with their synchronizer sleeve grooves.
12. Tighten all bolts to specified torque.



Fig. 19X--Loading Countergear Bearings



Fig. 20X--Loading Mainshaft Pilot Bearings

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FOUR-SPEED MUNCIE TRANSMISSION

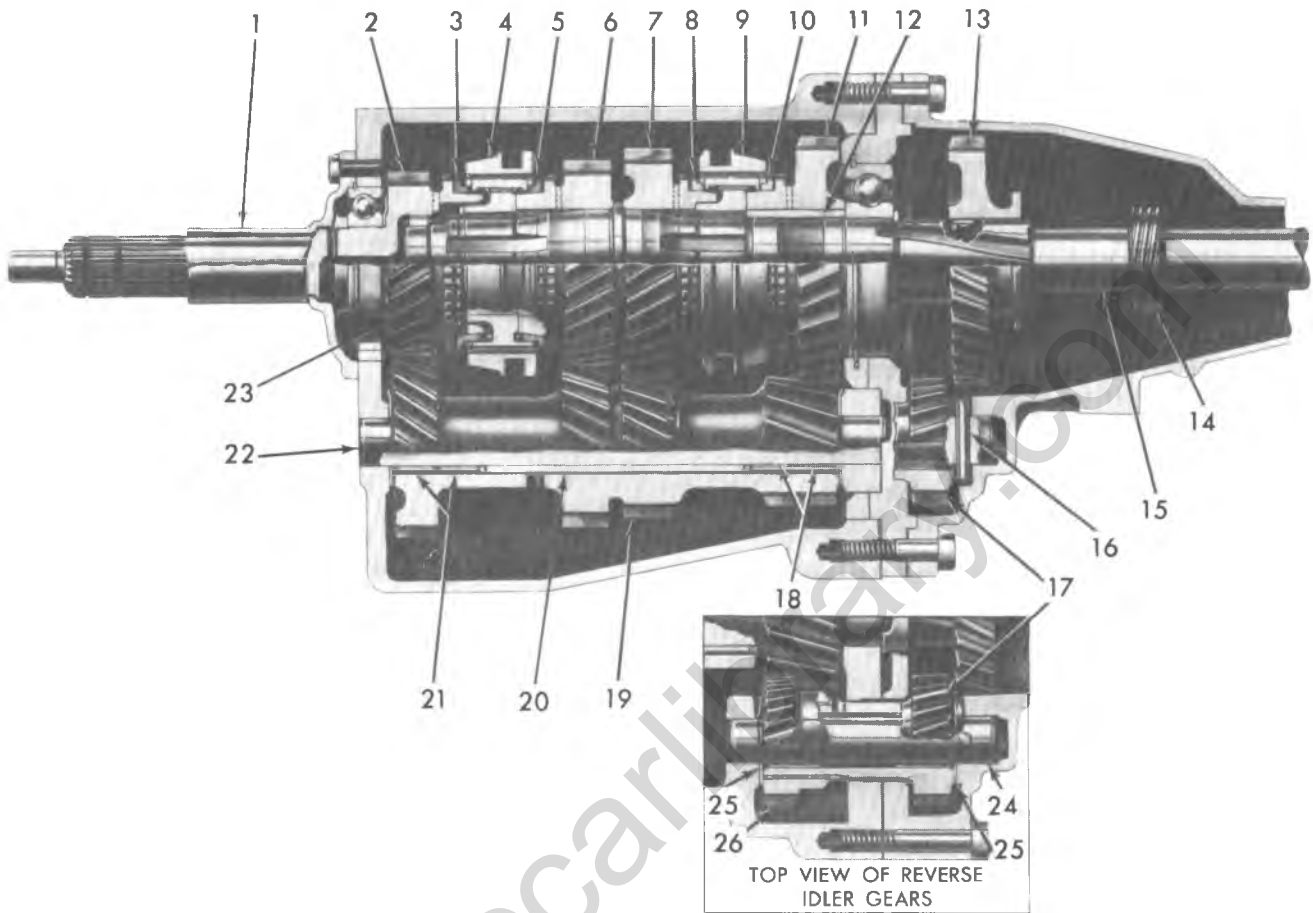
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DISASSEMBLY OF TRANSMISSION (figs. 1B and 2B)

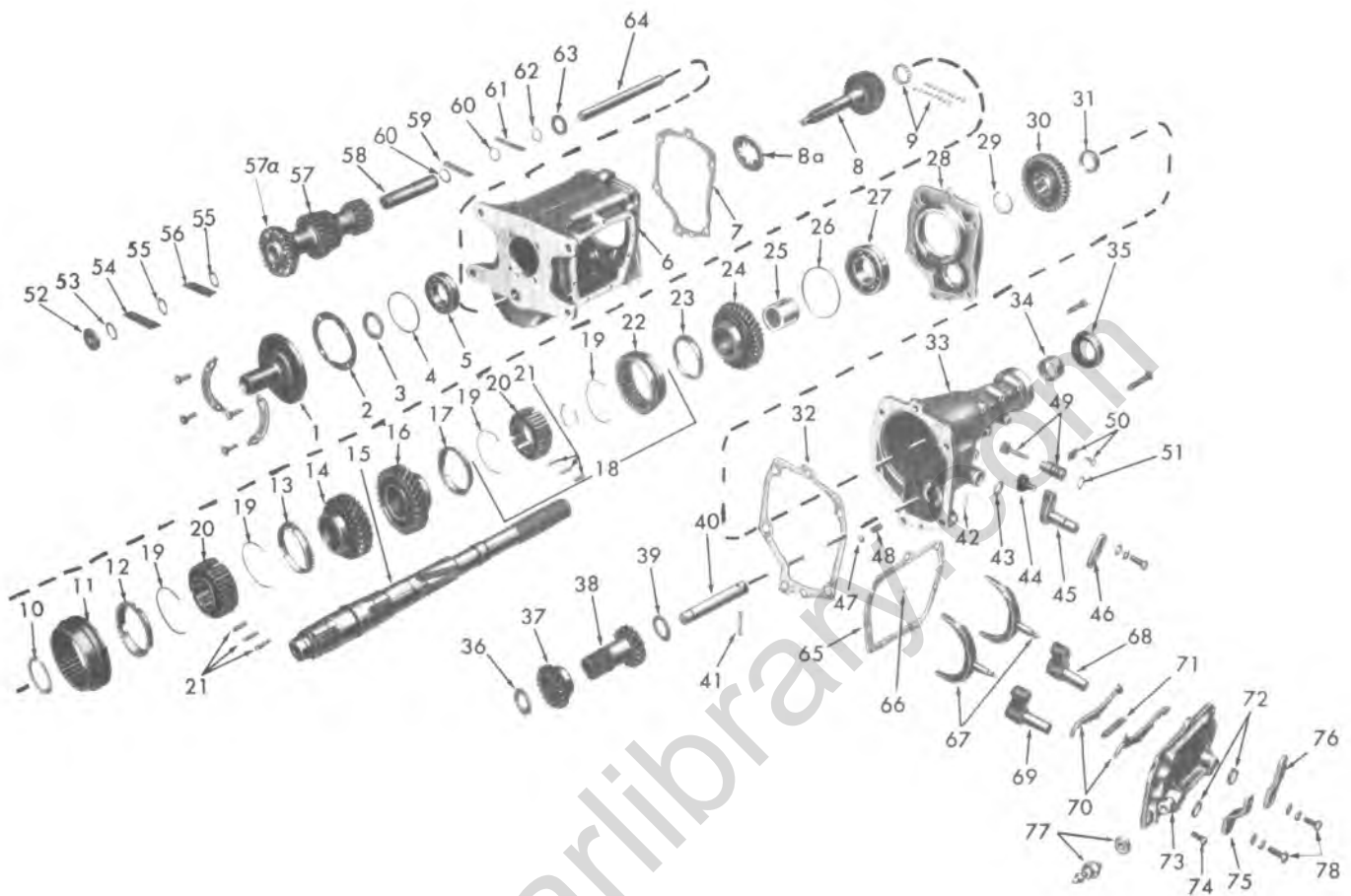
1. Remove transmission side cover.
2. Remove four bolts and (2) bolt lock strips from front bearing retainer and remove retainer and gasket.
3. Remove the main drive gear retaining nut (fig. 3B) using Tool J- 0933, after locking up transmission by shifting into two gears.
4. With transmission gears in neutral, drive lock pin from reverse shifter lever boss, (fig. 4B) and pull shifter shaft out about 1/8". This disengages the reverse shift fork from reverse gear.
5. Remove six bolts attaching the case extension to the case. Tap extension with soft hammer in a rearward direction to start. When the reverse idler shaft is out as far as it will go, move extension to left so reverse fork clears reverse gear and remove extension and gasket.
6. The rear reverse idler gear, flat thrust washer, shaft and roll spring pin may now be removed.
7. Remove speedometer gear and reverse gear using Tool J-5814 (fig. 5B).

NOTE: Slide 3-4 synchronizer clutch sleeve to 4th speed gear position (forward) before trying to remove mainshaft assembly from case (fig. 6B).
8. Carefully remove the rear bearing retainer and entire mainshaft assembly from the case by tapping bearing retainer with a soft hammer.
9. Unload bearing rollers (17) from main drive gear and remove fourth speed synchronizer blocker ring.
10. Lift the front half of reverse idler gear and its tanged thrust washer from case.



- | | | |
|---|---|--|
| 1. Bearing Retainer | 9. First and Second Speed Clutch Assembly | 17. Reverse Idler Gear (Rear) |
| 2. Main Drive Gear | 10. First Speed Synchronizing Ring | 18. Countergear Bearing Roller |
| 3. Fourth Speed Synchronizing Ring | 11. First Speed Gear | 19. Countergear |
| 4. Third and Fourth Speed Clutch Assembly | 12. First Speed Gear Sleeve | 20. Countershaft Bearing Roller Spacer |
| 5. Third Speed Synchronizing Ring | 13. Reverse Gear | 21. Countershaft Bearing Roller |
| 6. Third Speed Gear | 14. Speedometer Drive Gear | 22. Countergear Shaft |
| 7. Second Speed Gear | 15. Mainshaft | 23. Oil Slinger |
| 8. Second Speed Synchronizing Ring | 16. Reverse Idler Shaft Roll Pin | 24. Reverse Idler Shaft |
| | | 25. Thrust Washer |
| | | 26. Reverse Idler Gear (Front) |

Fig. 1B--Transmission Cross Section (Std. Ratio Shown)



- | | | | |
|--|--|---|--|
| 1. Bearing Retainer | 21. Clutch Keys | 39. Flat Thrust Washer | 61. Bearing Rollers (28) |
| 2. Gasket | 22. First and Second Speed Clutch Sliding Sleeve | 40. Reverse Idler Shaft | 62. Spacer |
| 3. Bearing Retaining Nut | 23. First Speed Gear Synchronizing Ring | 41. Reverse Idler Shaft Roll Pin | 63. Tanged Washer |
| 4. Bearing Snap Ring | 24. First Speed Gear Bearing | 42. Reverse Shifter Shaft Lock Pin | 64. Countershaft |
| 5. Main Drive Gear | 25. First Speed Gear Sleeve | 43. Reverse Shifter Shaft Lip Seal | 65. Gasket |
| 6. Transmission Case | 26. Rear Bearing Snap Ring | 44. Reverse Shift Fork | 66. Detent Cams Retainer Ring |
| 7. Rear Bearing Retainer Gasket | 27. Rear Bearing | 45. Reverse Shifter Shaft and Detent Plate | 67. Forward Speed Shift Forks |
| 8. Main Drive Gear | 28. Rear Bearing Retainer | 46. Reverse Shifter Lever | 68. First and Second Speed Gear Shifter Shaft and Detent Plate |
| 8a. Oil Slinger | 29. Selective Fit Snap Ring | 47. Reverse Shifter Shaft Detent Ball | 69. Third and Fourth Speed Gear Shifter Shaft and Detent Plate |
| 9. Bearing Rollers (17) and Cage | 30. Reverse Gear | 48. Reverse Shifter Shaft Ball Detent Spring | 70. Detent Cams |
| 10. Snap Ring | 31. Speedometer Drive Gear | 49. Speedometer Driven Gear and Fitting Retainer and Bolt | 71. Detent Cam Spring |
| 11. Third and Fourth Speed Clutch Sliding Sleeve | 32. Rear Bearing Retainer to Case Extension-Gasket | 50. Retainer and Bolt | 72. Lip Seals |
| 12. Fourth Speed Gear Synchronizing Ring | 33. Case Extension-Gasket | 51. "O" Ring Seal | 73. Transmission Side Cover |
| 13. Third Speed Synchronizing Ring | 34. Extension Bushing | 52. Tanged Washer | 74. Headed Cam Pin |
| 14. Third Speed Gear | 35. Rear Oil Seal | 53. Spacer | 75. Third and Fourth Speed Shifter Lever |
| 15. Mainshaft | 36. Reverse Idler Front Thrust Washer (Tanged) | 54. Bearing Rollers (28) | 76. First and Second Speed Shifter Lever |
| 16. Second Speed Gear | 37. Reverse Idler Gear (Front) | 55. Spacer | 77. First and Second Speed Shifter Lever TCS Switch and Gasket |
| 17. Second Speed Gear Synchronizing Ring | 38. Reverse Idler Gear (Rear) | 56. Bearing Rollers (28) | 78. Lever Attaching Bolts |
| 18. First and Second Speed Clutch Assembly | | 57. Countergear | |
| 19. Clutch Key Spring | | 57a. Damper Plate | |
| 20. Clutch Hub | | 58. Countergear Roller | |
| | | 59. Bearing Rollers (28) | |
| | | 60. Spacer | |

Fig. 2B--Four-Speed Transmission Exploded View

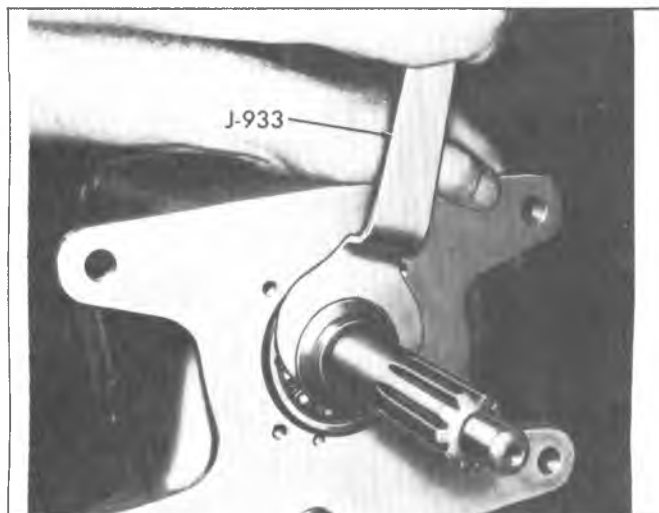


Fig. 3B--Removing Main Drive Gear Retaining Nut

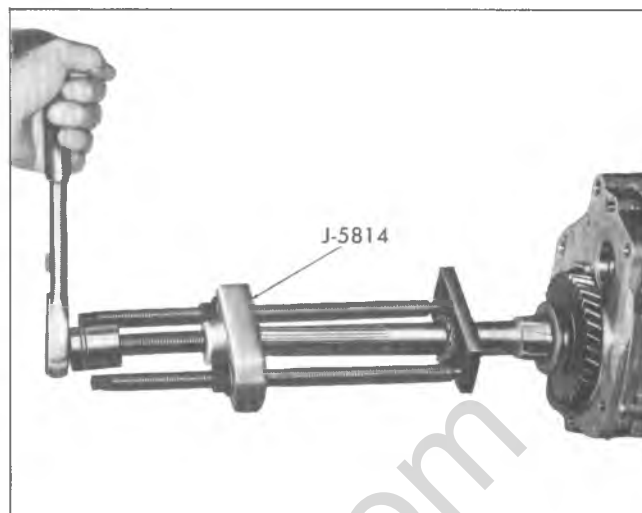


Fig. 5B--Removing Speedometer Gear



Fig. 4B--Removing Reverse Shifter Shaft Lock Pin

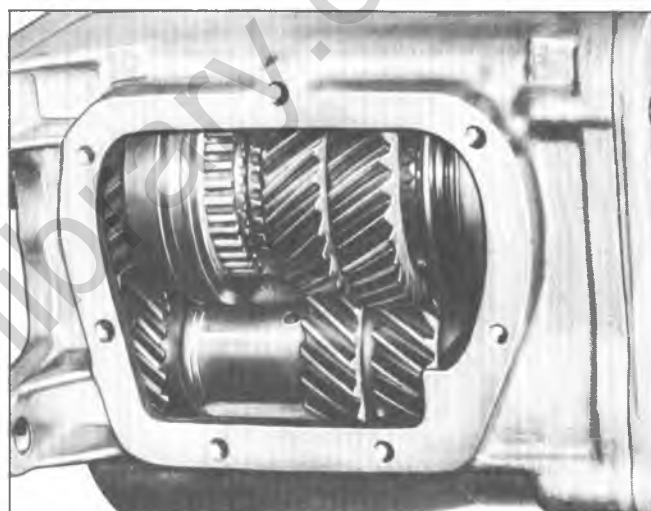


Fig. 6B--Third and Fourth Speed Synchronizer Clutch Sleeve in Fourth Gear Position

11. Press main drive gear down from front bearing (fig. 7B).
12. From inside case, tap out front bearing and snap ring.
13. From the front of the case, press out the countershaft (fig. 8B) using Tool J-22379; then remove the countergear and both tanged washers.
14. Remove the 112 rollers, six .070" spacers and roller spacer from countergear.
15. Remove mainshaft front snap ring as shown in Figure 9B and slide third and fourth speed clutch assembly, third speed gear and synchronizing ring from front of mainshaft.
16. Spread rear bearing retainer snap ring and press mainshaft out of the retainer (fig. 10B).
17. Remove the mainshaft rear snap ring. Support second speed gear and press on rear of mainshaft to remove rear bearing, 1st speed gear and sleeve,

1st speed synchronizing ring, 1-2 speed synchronizer clutch assembly, 2nd speed synchronizer ring and second speed gear.

CLEANING AND INSPECTION

Transmission Case

Wash the transmission case inside and out, with a cleaning solvent and inspect for cracks.

Inspect the front face which fits against clutch housing for burrs and if any are present, dress them off with a fine cut mill file.

CAUTION: Be sure cleaning solvent does not loosen case magnet.

Front and Rear Bearings

1. Wash the front and rear bearings thoroughly in a cleaning solvent.

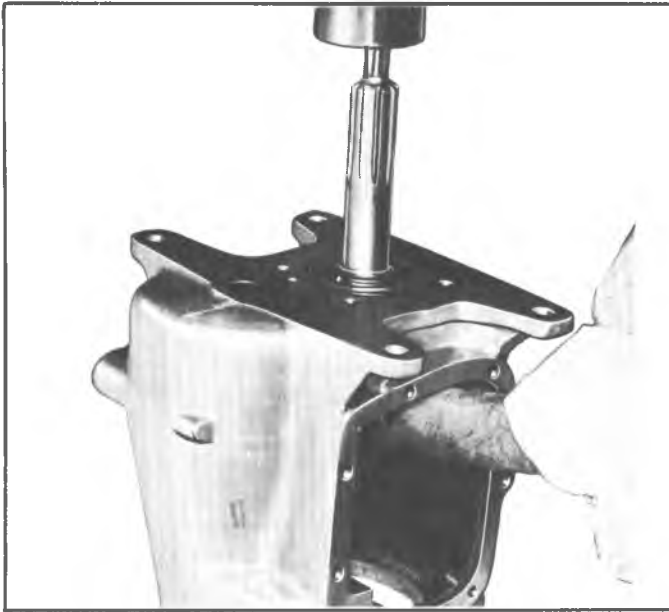


Fig. 7B--Removing Main Drive Gear

2. Blow out bearings with compressed air.

CAUTION: Do not allow the bearings to spin, but turn them slowly by hand. Spinning bearings will damage the race and balls.

3. Make sure bearings are clean, then lubricate them with light engine oil and check them for roughness. Roughness may be determined by slowly turning the outer race by hand.

CAUTION: Bearings must be lubricated with light oil before checking for roughness.

Bearing Rollers and Spacers

All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft at the same time and replace if necessary. Replace all worn spacers.

Gears

Inspect all gears and replace all that are defective or damaged. Inspect for loose damper plate on countergear (if so equipped).

Reverse Idler

1. The bushings used in the idler gear are pressed into the gear then peened into holes in the bores, and are bored in place. This insures the positive alignment of the bushings and their shafts, as well as proper meshing of gears. Because of the high degree of accuracy to which these parts are machined, the bushings are not serviced separately.
2. Check bushings for excessive wear by using a narrow feeler gauge between the shaft and the bushing or use a micrometer. The proper clearance is from .003" to .005".

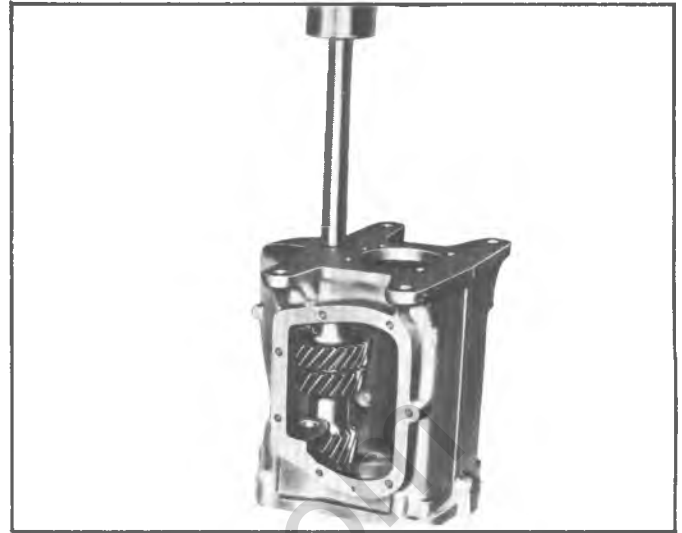


Fig. 8B--Removing Countershaft

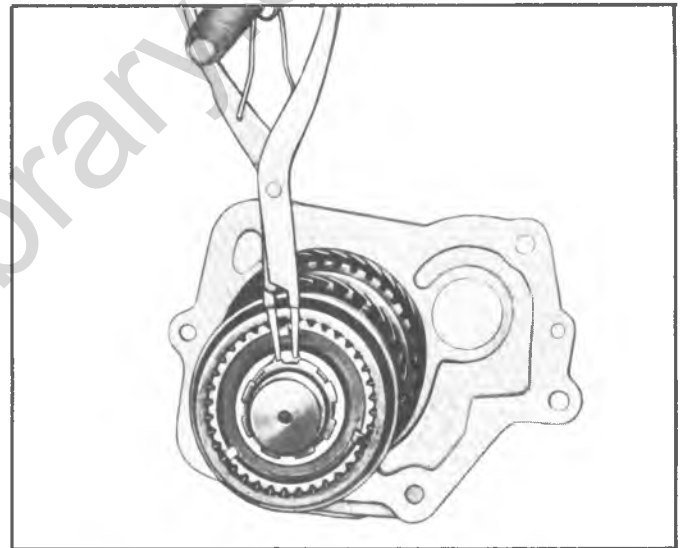


Fig. 9B--Removing Mainshaft Front Snap Ring

REPAIRS

Reverse Shifter Shaft and Seal Replacement

1. With case extension removed from transmission the reverse shifter shaft lock pin will already be removed. (See Step 4 under Disassembly).
2. Remove shift fork.
3. Carefully drive shifter shaft into case extension, allowing ball detent to drop into case.
4. Place ball detent spring into detent spring hole and from inside extension install shifter shaft fully into its opening until the detent plate is butted against inside of extension housing.
5. Place detent ball on spring (fig. 11B) and, holding ball down with your thumb or a suitable tool push the shifter shaft back in away from case until it is directly over the ball and turn until the ball drops into detent on the shaft detent plate.

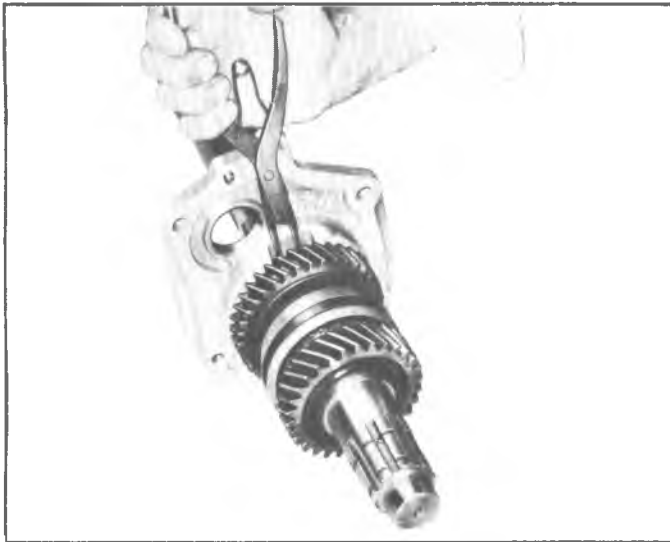


Fig. 10B-Removing Rear Bearing Retainer

6. Install shift fork.

NOTE: Do not drive the shifter shaft lock pin into place until the extension has been installed on the transmission case.

Extension Oil Seal Or Bushing

If bushing in rear of extension requires replacement, remove oil seal and use Tool J-21424-9 to drive bushing into case extension. Using the same tool, drive new bushing in from the rear. Coat I.D. of bushing with transmission lubricant, then install new oil seal using Tool J-21359. Prelubricate seal between lips with cup grease.

Clutch Keys and Springs Replacement

NOTE: The clutch hubs and sliding sleeves are a select fit assembly and should be kept together as originally assembled, but the three keys and two springs may be replaced if worn or broken.

1. Push the hub from the sliding sleeve. The keys will fall free and the springs may be easily removed.
2. Place the two springs in position (one on each side of the hub), so all three keys are engaged by both springs. Place the keys in position and, holding them in place, slide the hub into the sleeve.

NOTE: The sleeve with the large square edge opposite the fork groove identifies the 3-4 synchronizer sleeve.

ASSEMBLY OF MAINSHAFT

1. From the rear of the mainshaft, assemble the second speed gear (with hub of gear toward rear of shaft).
2. Install 1-2 synchronizer clutch assembly to mainshaft (sliding clutch sleeve taper toward the rear, hub to the front); together with a synchronizing

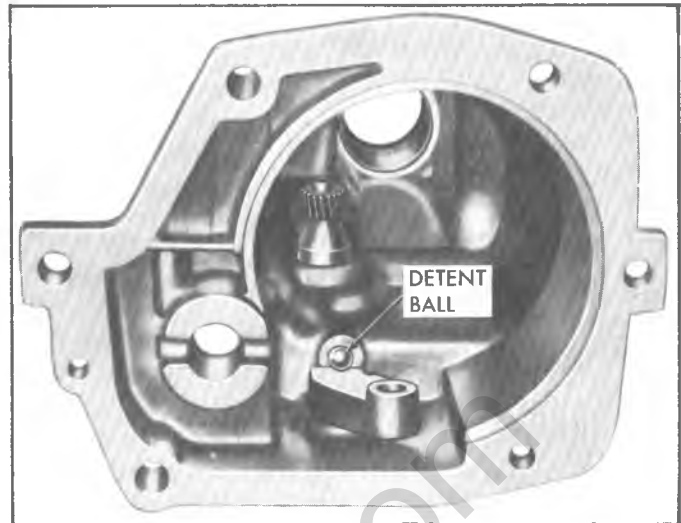


Fig. 11B-Installing Reverse Shifter Shaft and Detent Ball

ring on either side of clutch assembly so their keyways line up with the clutch keys (fig. 12B).

3. Press the 1st gear sleeve onto the mainshaft using a 1 3/4" I.D. pipe cut to a convenient length or other suitable tool.
4. Install the first speed gear (with hub toward front) and using 1 5/8" I.D. pipe cut to a suitable length, press on the rear bearing (fig. 13B).
5. Choose the correct selective fit snap ring (.087", .090", .093", or .096") and install it in the groove in mainshaft behind the rear bearing. With proper ring, maximum distance between snap ring and rear face of bearing will be from zero to .005".

NOTE: Always use new snap rings when reassembling transmission and do not expand the snap ring further than is necessary for assembly.

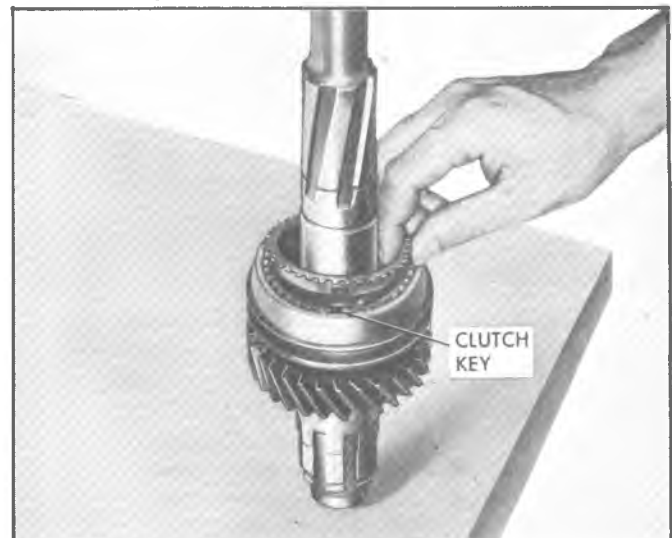


Fig. 12B-Installing Synchronizing Ring

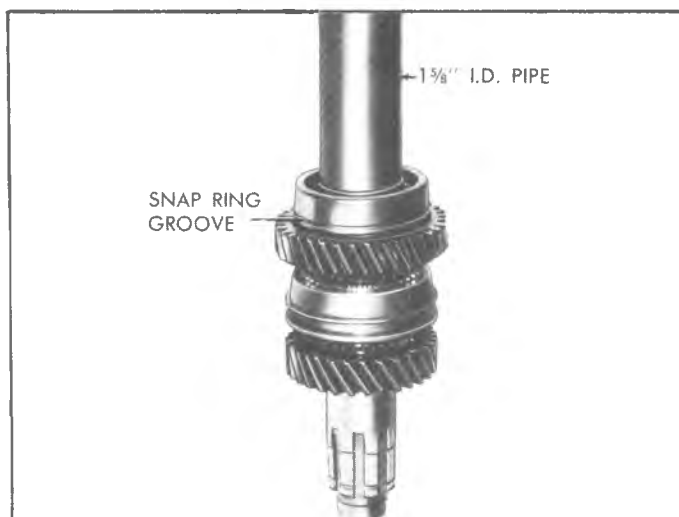


Fig. 13B--Installing Rear Bearing

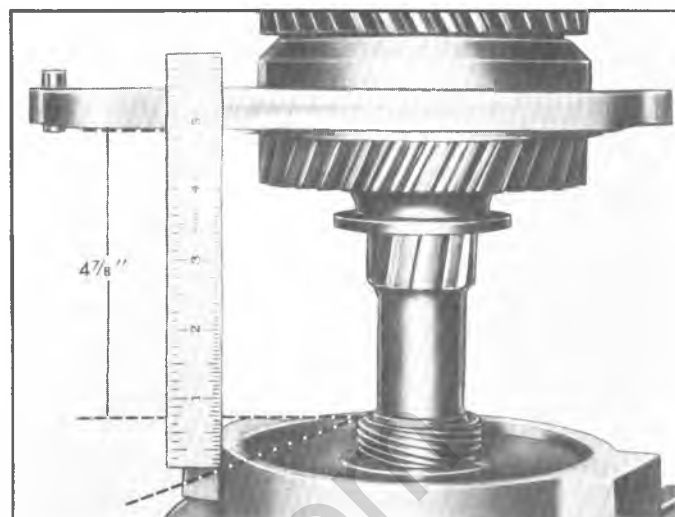


Fig. 14B--Installing Speedometer Gear

6. Install the third speed gear (hub to front of transmission) and the third speed gear-synchronizing ring (notches to front of transmission).
7. Install the third and fourth speed gear clutch assembly (hub and sliding sleeve) with both sleeve taper and hub toward the front, making sure the keys in the hub correspond to the notches in the third speed gear synchronizing ring.
8. Install snap ring in the groove in mainshaft in front of the third and fourth speed clutch assembly, with ends of snap ring seated behind spline teeth.
9. Install the rear bearing retainer (fig. 10B). Spread the snap ring in the plate to allow the snap ring to drop around the rear bearing and press on the end of the mainshaft until the snap ring engages the groove in the rear bearing.
10. Install the reverse gear (shift collar to rear) and 2 anti-rattle springs (RPO M20 only).
11. Install retaining clip and speedometer gear. On models using the metal gear, press speed. Drive gear onto mainshaft using a suitable press plate such as J-1453. Position the gear to obtain a measurement of 4 7/8" from the forward side of the gear to the flat surface of the rear bearing retainer (Fig. 14B).

ASSEMBLY OF COUNTERGEAR

1. Install roller spacer (tube type) in countergear.
2. Using heavy grease to retain the rollers, install a spacer, 28 rollers, a spacer, 28 more rollers, then another spacer. Install in the other end of the countergear, a spacer, 28 rollers, a spacer, 28 more rollers, and another spacer (fig. 15B).
3. Insert Tool J-22379 into countergear.

ASSEMBLY OF CASE COMPONENTS

1. Rest the transmission case on its side with the side

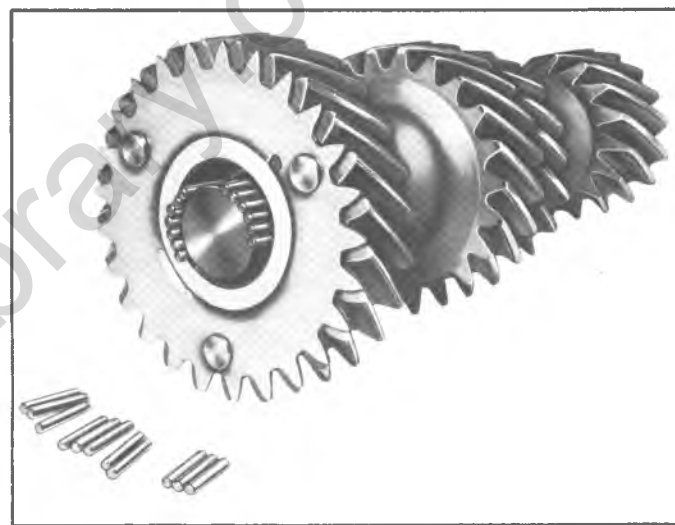


Fig. 15B--Loading Countergear Bearings

cover opening toward the assembler. Put countergear tanged thrust washers in place, retaining them with heavy grease, making sure the tangs are resting in the notches of the case.

2. Set countergear in place in bottom of transmission case, making sure that tanged thrust washers are not knocked out of place.
3. Position the transmission case resting on its front face.
4. Lubricate and insert countershaft in rear of case. Turn countershaft so flat on end of shaft is horizontal and facing bottom of case.
5. Align countergear with shaft in rear and hole in front of case, and press countershaft into case (pushing assembly tool out front of case) until flat on shaft is flush with rear of case. Be sure thrust washers remain in place (fig. 16B).

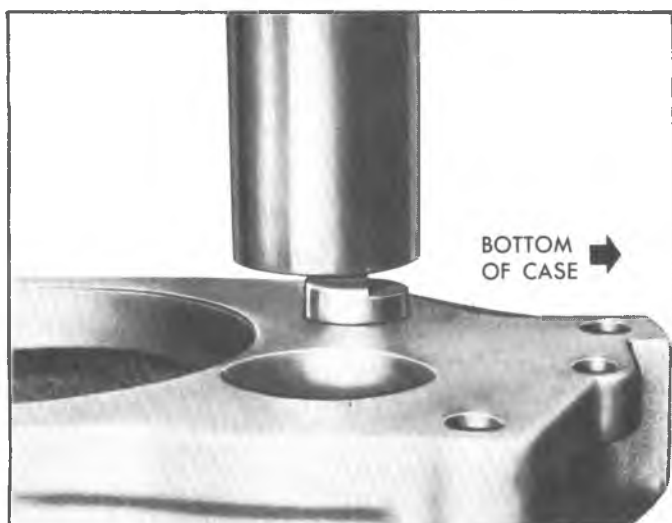


Fig. 16B - Installing Countershaft

6. Attach a dial indicator (fig. 17B) and check end plate of the countergear. If end play is greater than .025" new thrust washers must be installed.
7. Install cage and the seventeen roller bearings into main drive gear, using heavy grease to hold the bearings in place. Install oil slinger on main drive gear with concave side toward gear.
8. Install main drive gear and pilot bearings through the side cover opening and into position in transmission front bore.
9. Place gasket in position on front face of rear bearing retainer.
10. Install the fourth speed synchronizing ring on main drive gear with the notches toward the rear of the transmission.
11. Position the reverse idler gear thrust washer (tanged) on the machined face of the ear cast in the case for the reverse idler shaft and hold with heavy

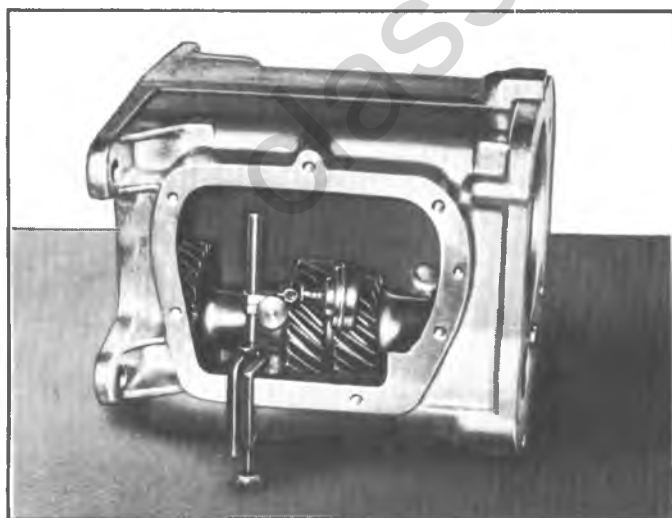


Fig. 17B - Checking Countergear End Play

grease. Position the front reverse idler gear next to the thrust washer, with the hub facing toward rear of the case.

CAUTION: Before attempting to install mainshaft assembly to case, slide the 3-4 synchronizing clutch sleeve forward into fourth speed detent position (fig. 6B).

12. Lower the mainshaft assembly into the case making certain the notches on the fourth speed synchronizing ring correspond to the keys in the clutch assembly (fig. 18B).
- CAUTION:** Be sure main drive gear engages both the countergear and anti-lash plate on standard ration models.
13. With the guide pin in rear bearing retainer aligned with hole in rear of case, tap rear bearing retainer into position with a soft hammer.
14. From the rear of the case, insert the rear reverse idler gear, engaging the splines with the portion of the front gear inside the case.
15. Using heavy grease, place gasket in position on rear face of rear bearing retainer.
16. Install the remaining flat thrust washer on reverse idler shaft. If new idler shaft is being used, drive out the roll pin and press it into new shaft.
17. Install reverse idler shaft, roll pin, and thrust washer into gears and front boss of case. Make sure to pick-up front tanged thrust washer.

NOTE: Roll pin should be in a vertical position.

18. Pull reverse shifter shaft to left side of extension and rotate shaft to bring reverse shift fork forward in extension (reverse detent position). Start the extension onto the transmission case (fig. 19B), while slowly pushing in on the shifter shaft to engage the shift fork with the reverse gear shift

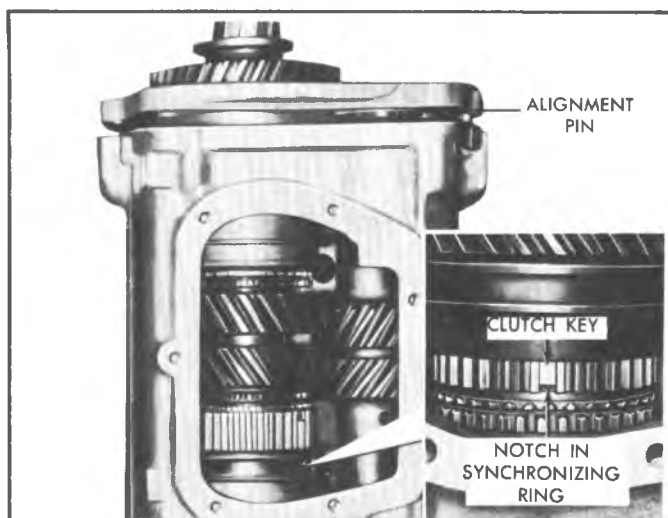


Fig. 18B - Installing Mainshaft Assembly

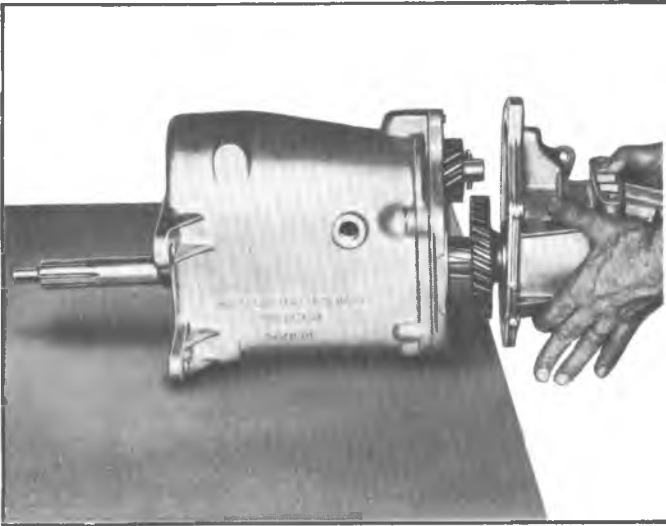


Fig. 19B--Installing Case Extension

collar. Then pilot the reverse idler shaft into the extension housing permitting the extension to slide onto the transmission case.

19. Install 6 extension and retainer-to-case attaching bolts. Torque upper 3 bolts and lower 3 bolts to specification.
20. Push or pull reverse shifter shaft to line up groove

in the shaft with the holes in the boss and drive in the lock pin. Install shifter lever.

21. Press bearing onto main drive gear (snap ring groove to front) and into case until several main drive gear retaining nut threads are exposed.
22. Lock transmission up by shifting into two gears. Install main drive gear retaining nut on the gear shaft and draw it up tight using Tool J-0933. Be sure bearing fully seats against shoulder on gear. Torque retaining nut to 40 ft. lbs. and lock in place by staking securely into main drive gear shaft hole with a center punch. Care must be used to avoid damaging the threads on the shaft.
23. Install the main drive gear bearing retainer, gasket, four attaching bolts and (2) strip bolt lock retainers, using a suitable sealer on bolts. Torque to specification.
24. Shift mainshaft 3-4 sliding clutch sleeve into neutral position and 1-2 sliding clutch sleeve into second gear (forward) detent position. Shift side cover 3-4 shifter lever into neutral detent and 1-2 shifter lever into second gear detent position.
25. Install side cover gasket and carefully position side cover into plate. There is a dowel pin in the cover to assure proper alignment with the case. Install attaching bolts and tighten evenly to avoid side cover distortion. Torque to specification.

FOUR-SPEED MUNCIE TRANSMISSION (CH 465)

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DISASSEMBLY OF TRANSMISSION

Refer to Figures 1Q and 2Q

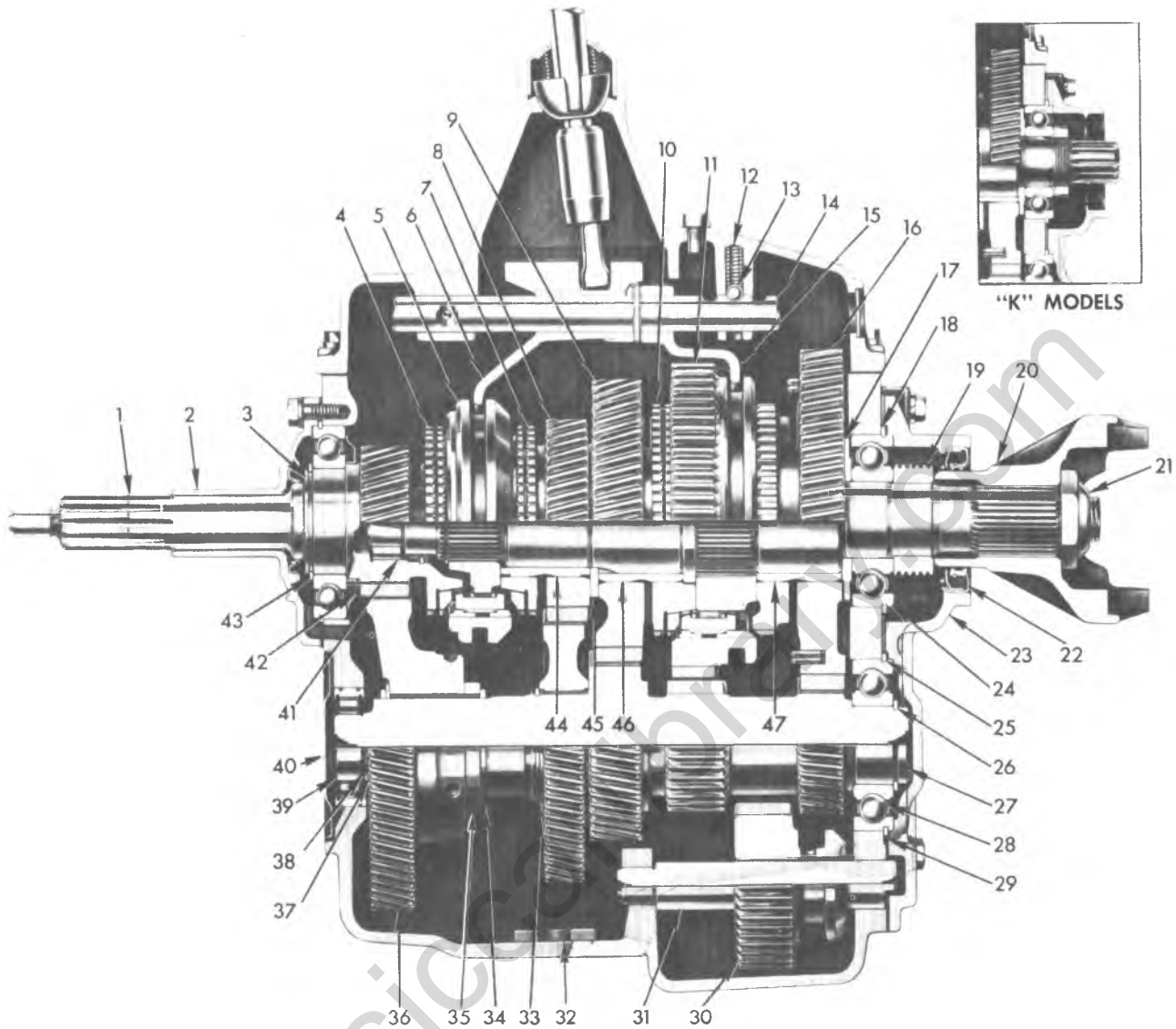
1. Mount transmission in suitable holding fixture and remove cap screws attaching transmission cover assembly to transmission case. If required, insert two 5/16 x 18 screws in cover flange threaded holes and turn evenly to raise cover dowel pins from case.

NOTE: Move reverse shifter fork so that reverse idler gear is partially engaged before attempting to remove cover. Forks must be positioned so rear edge of the slot in the

reverse fork is in line with the front edge of the slot in the forward forks as viewed through tower opening.

2. Place transmission in two gears at once to lock gears. Remove the universal joint flange nut, universal joint front flange and brake drum assembly.

NOTE: On models equipped with 4-wheel drive transfer case, use Tool J- 23070 to remove mainshaft rear lock nut (fig. 26Q).



- | | | | |
|--|------------------------------------|-------------------------------|--------------------------------|
| 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. 1Q-Transmission Assembly-Cross Section

7M-40 CLUTCHES AND MANUAL TRANSMISSIONS

3. Remove parking brake and brake flange plate assembly on models equipped with propeller shaft parking brake. Refer to Section 5, Truck Service Manual.
4. Remove rear bearing retainer and gasket.
5. Slide speedometer drive gear off mainshaft.
6. Remove clutch gear bearing retainers and gasket.
7. Remove countergear front bearing cap and gasket.
8. Pry countergear front bearing out by inserting screw drivers into groove at cast slots in case.
9. Remove countergear rear bearing retaining rings (snap ring) from shaft and bearing. Using Tool J-22832 and J-8433-1, remove countergear rear bearings (fig. 3Q). This will allow countergear assembly to rest on bottom of case.

CAUTION: Make sure Tool J-22832 engages full circumference of groove in bearing to prevent tool damage.

10. Remove drive gear bearing outer race to case retaining ring.
11. Remove drive gear and bearing by tapping gently on bottom side of drive gear shaft and prying directly opposite against the case and bearing snap ring groove at the same time. Remove 4th gear synchronizer ring.

CAUTION: Index cut out section of drive gear in down position with countergear to obtain clearance for removing clutch gear.

12. Remove rear mainshaft bearing retainer ring (snap ring) and using Tool J-22832 and J-8433-1, remove

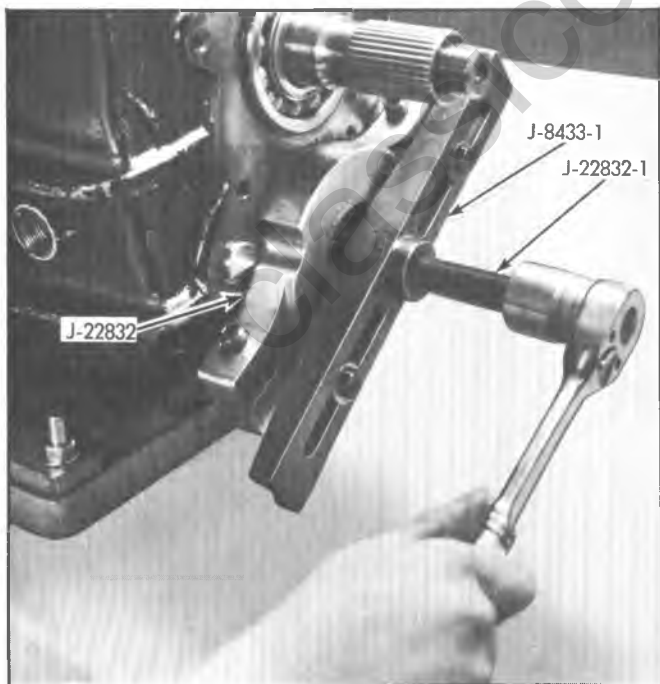


Fig. 3Q--Removing Countergear Rear Bearing

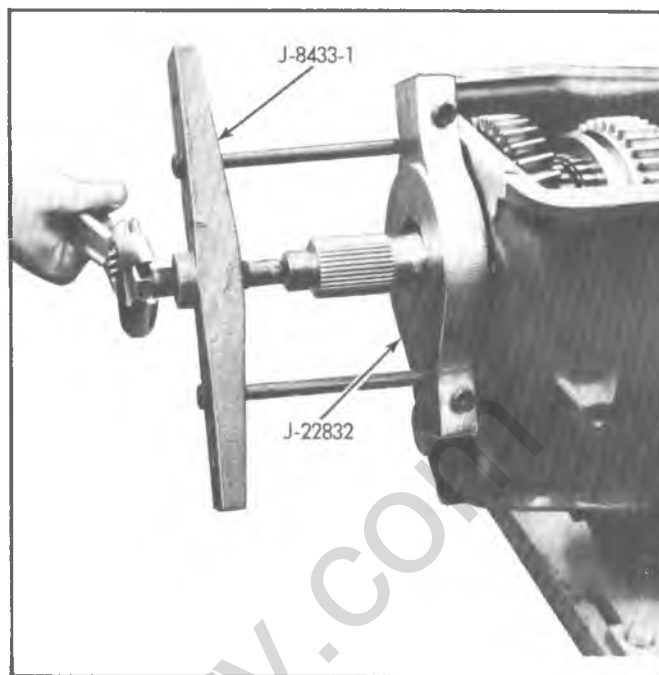


Fig. 4Q--Removing Mainshaft Rear Bearing bearing from case (fig. 4Q). Slide 1st speed gear thrust washer off mainshaft.

13. Raise rear of mainshaft assembly and push rearward in case bore, then swing front end up and lift from case. Remove synchronizer cone from shaft.
14. Slide reverse idler gear rearward and move countergear rearward until front end is free of case, then lift to remove from case.
15. To remove reverse idler gear, drive reverse idler gear shaft out of case from front to rear using a drift. Remove reverse idler gear from case.

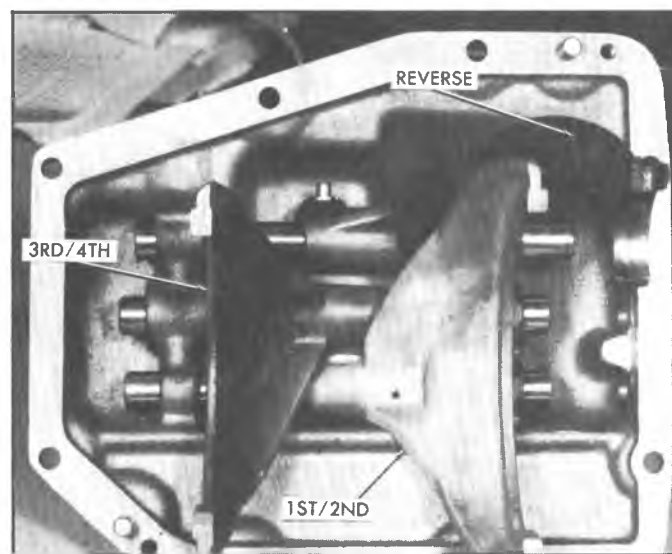


Fig. 5Q--Cover Assembly

SUBASSEMBLY OPERATIONS

TRANSMISSION COVER

Disassembly (Fig. 5Q)

- Using a small punch drive out pins retaining 1st-2nd and 3rd-4th shifter forks to shifter shafts and also drive out expansion plugs.

NOTE: The pin retaining the third and fourth shifter fork to the shaft must be removed, and the shifter fork removed from the cover before the reverse shifter head pin can be removed.

- With shifter shafts in neutral position, drive shafts out of cover and shifter forks.

CAUTION: Exercise care so shaft detent balls, springs and innerlock pin located in the cover are not lost as the shifter shafts are removed.

- Drive out pin holding reverse shifter head and drive out the shaft.

CAUTION: Exercise extreme care during shaft removal since detent balls are under spring tension in the rear rail boss holes.

Assembly (Fig. 6Q)

- In reassembling the transmission cover, care must be used in installing the shifter shafts. They should be installed in the order shown in Fig. 7Q, namely, reverse 3rd-4th, and 1st-2nd.

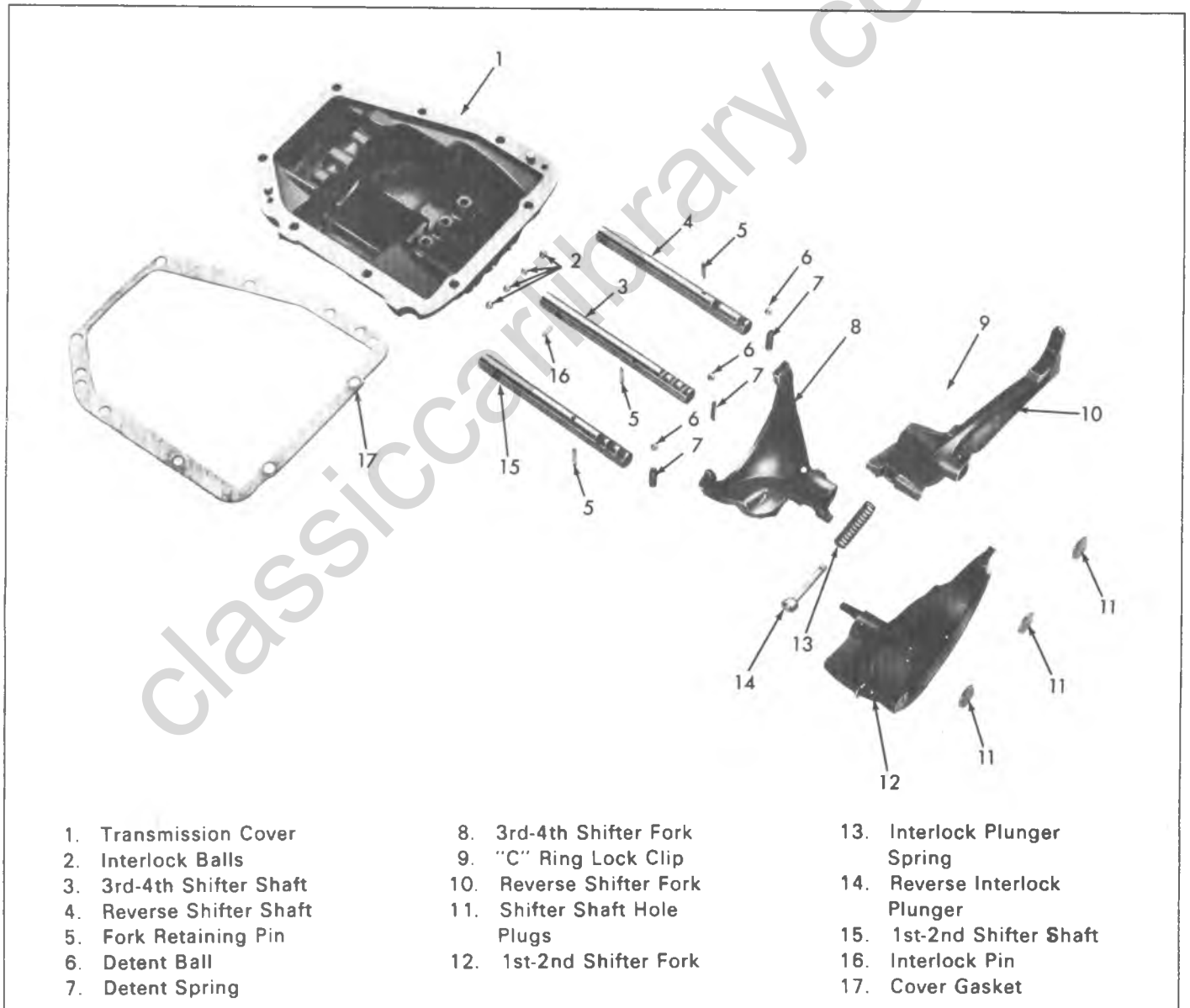


Fig. 6Q—Cover Assembly Exploded View

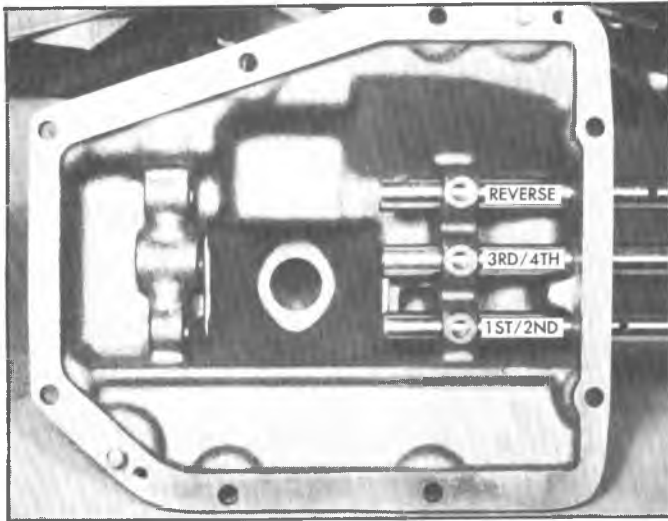


Fig. 7Q-Shifter Shaft Installation

2. Place fork detent ball springs and balls in position in holes in cover.
3. Start shifter shafts into cover; depress yoke detent balls with small punch and push shafts on over balls. Starting with reverse shifter shaft, hold fork in position and push shaft through yoke. Install split pin in fork and shaft, then position fork in neutral position.
4. Push 3rd and 4th shaft through to the neutral position and line up retaining hole in the fork with the hole in the shaft. Install retaining pin.

NOTE: Detent balls should line up with detents in shaft.

5. After 1st and 2nd fork is installed, place two innerlock balls between the low speed shifter shaft and the high speed shifter shaft in the crossbore of the front support boss. Install the innerlock pin in the high speed (center position) shifter shaft hole and grease to hold in place. Continue pushing this shaft through cover bore and fork until retainer hole in fork lines up with hole in shaft. Install retainer pin and move to neutral position.
6. Place two innerlock balls in crossbore in front support boss between reverse, and 3rd and 4th shifter shaft. Then push remaining shaft through fork and cover bore, keeping both balls in position between shafts until retaining holes line up in fork and shaft. Install retaining pin.
7. Install new shifter shaft hole expansion plugs and expand in place.

DRIVE GEAR (FIG. 8Q)

Disassembly

1. Remove mainshaft pilot bearing rollers (17) from drive gear if not already removed, and remove roller retainer. Do not remove snap ring on inside of drive gear.
2. Remove snap ring securing bearing on stem of clutch gear.
3. To remove bearing, position Tool J-22872 to the bearing (fig. 9Q) and using an arbor press and Tool J-0358 press gear and shaft out of bearing (fig. 10Q).

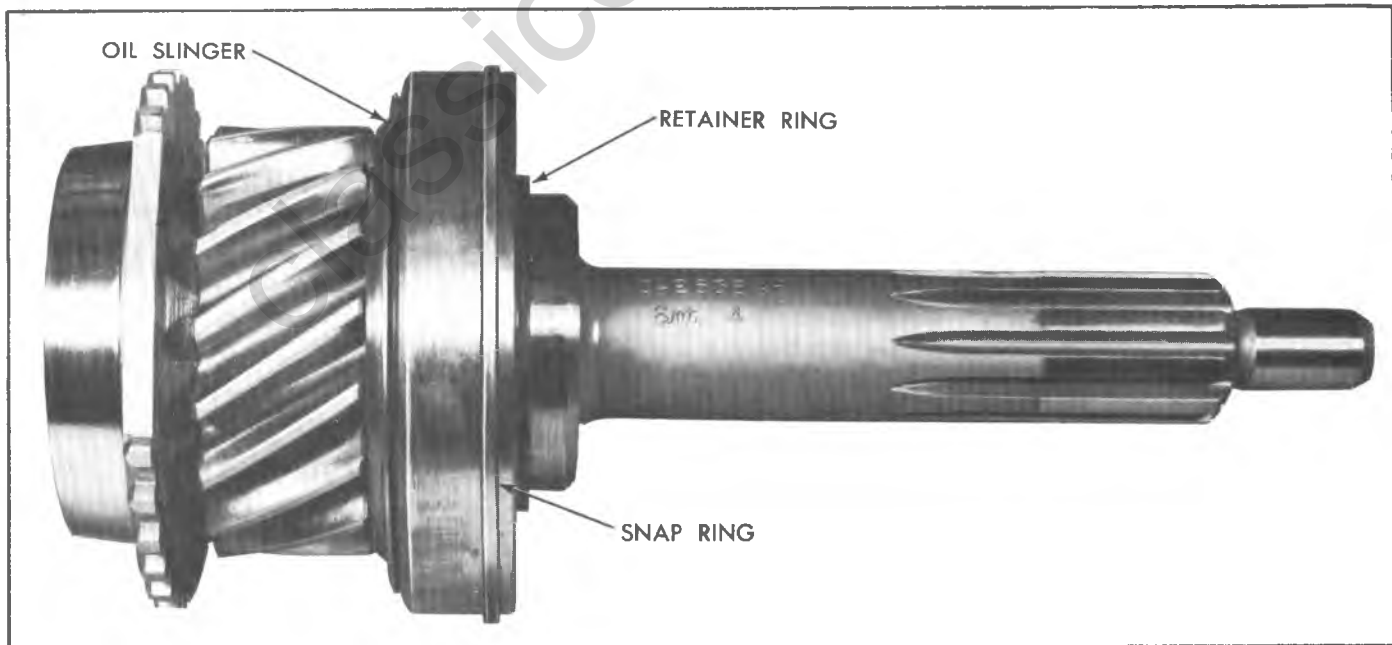


Fig. 8Q-Drive Gear Assembly

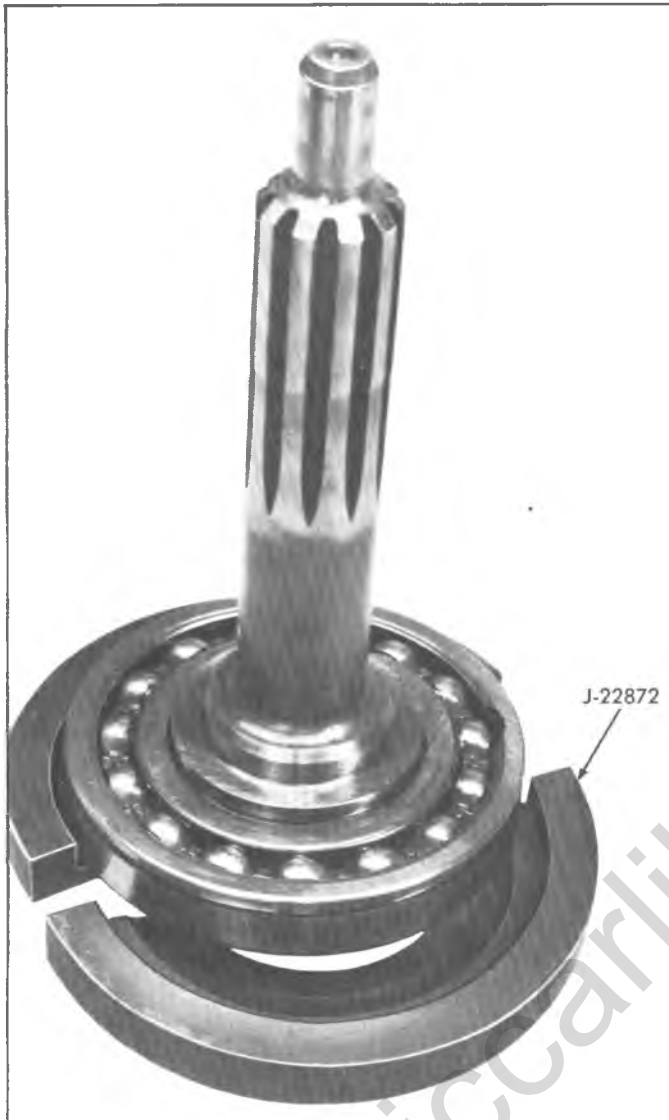


Fig. 9Q--Positioning Tool J-22872 to Drive Gear

Inspection

1. Wash all parts in cleaning solvent.
2. Inspect roller bearings for pits or galling.
3. Inspect bearing diameter in shaft recess for galling.
4. Inspect gear teeth for excessive wear.
5. Inspect clutch shaft pilot for excessive wear.
6. Re-oil bearing, then rotate drive gear bearing slowly by hand and check for roughness.

Assembly

1. Press bearing and new oil slinger onto drive gear shaft using Tool J-22872 (fig. 11Q). Slinger should be located flush with bearing shoulder on drive gear. See Figure 8Q for direction of slinger installation.

CAUTION: Exercise care to prevent distortion of the oil slinger.

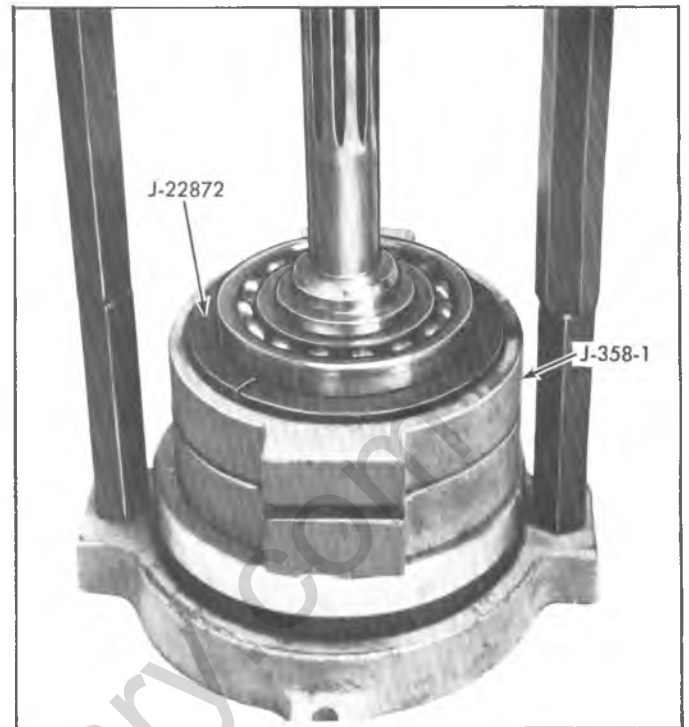


Fig. 10Q--Removing Drive Gear Bearing

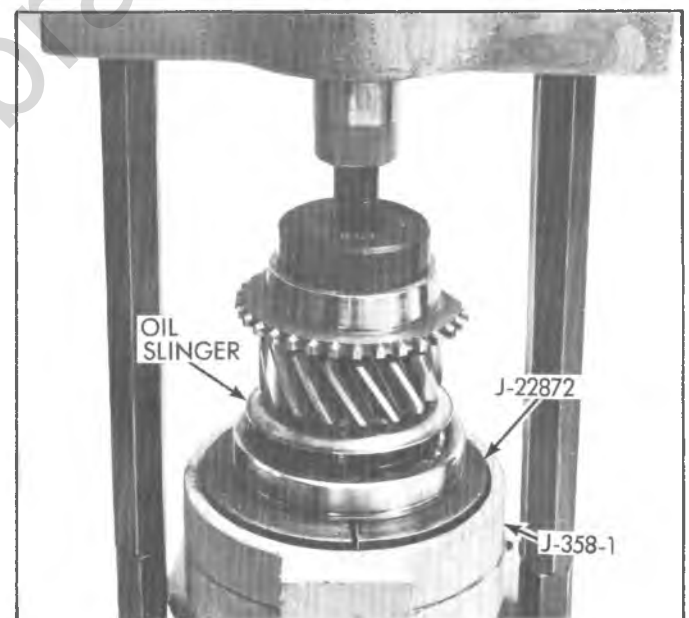


Fig. 11Q--Replacing Drive Gear Bearing

2. Install snap ring to secure bearing on drive gear shaft.
3. Install bearing retainer ring in groove on O.D. of bearing.

CAUTION: The bearing must turn freely, after it is installed on the shaft.

4. Install snap ring on I.D. of mainshaft pilot bearing bore in clutch gear (if previously removed).



Fig. 12Q-Roller Bearing Retainer

5. Apply a small amount of grease to bearing surface in shaft recess, install transmission mainshaft pilot roller bearings (17) and install roller bearing retainer (fig. 12Q).

NOTE: This roller bearing retainer holds bearing in position and in final transmission assembly is pushed forward into recess by mainshaft pilot.

DRIVE GEAR BEARING RETAINER OIL SEAL

Replacement

1. Remove retainer and oil seal assembly and gasket.
2. Pry oil seal out of retainer.
3. Install new seal on Tool J-22833 with lip of seal toward flange of tool.
4. Support front surface of retainer in press, start seal and tool in retainer bore and drive seal into retainer until flange of tool bottoms on retainer (fig. 13Q).
5. Install new gasket on retainer and install retainer on transmission case (when assembling transmission).

MAINSHAFT ASSEMBLY

Disassembly (Fig. 14Q)

1. Remove first speed gear.

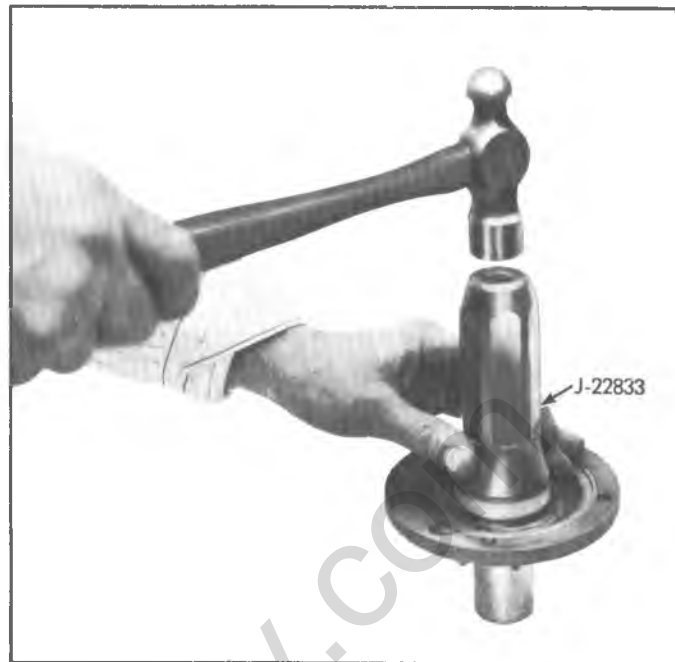


Fig. 13Q-Installing Bearing Retainer Oil Seal

2. Remove snap ring in front of 3rd-4th synchronizer assembly.
3. Remove reverse driven gear.
4. Press behind second speed gear to remove 3rd-4th synchronizer assembly, 3rd speed gear and 2nd speed gear along with 3rd speed gear bushing and thrust washer (fig. 15Q).
5. Remove 2nd speed synchronizer ring.
6. Remove 2nd speed synchronizer keys.
7. Supporting 2nd speed synchronizer hub at front face, press mainshaft through removing 1st speed gear bushing and 2nd speed synchronizer hub.
8. Split 2nd speed gear bushing with chisel and remove bushing from shaft.

CAUTION: Exercise care not to damage mainshaft.

Inspection

1. Wash all parts in cleaning solvent.
2. Inspect mainshaft for scoring or excessive wear at thrust surfaces or splines.
3. Inspect clutch hub and clutch sleeve for excessive wear and make sure sleeve slides freely on clutch hub. Also check fit of clutch hub on mainshaft splines.

NOTE: Third and fourth speed clutch sleeve should slide freely on third and fourth speed clutch hub but clutch hub should be snug fit on shaft splines.

4. Inspect 3rd speed gear thrust surfaces for excessive scoring and inspect third speed gear mainshaft bushing for excessive wear.

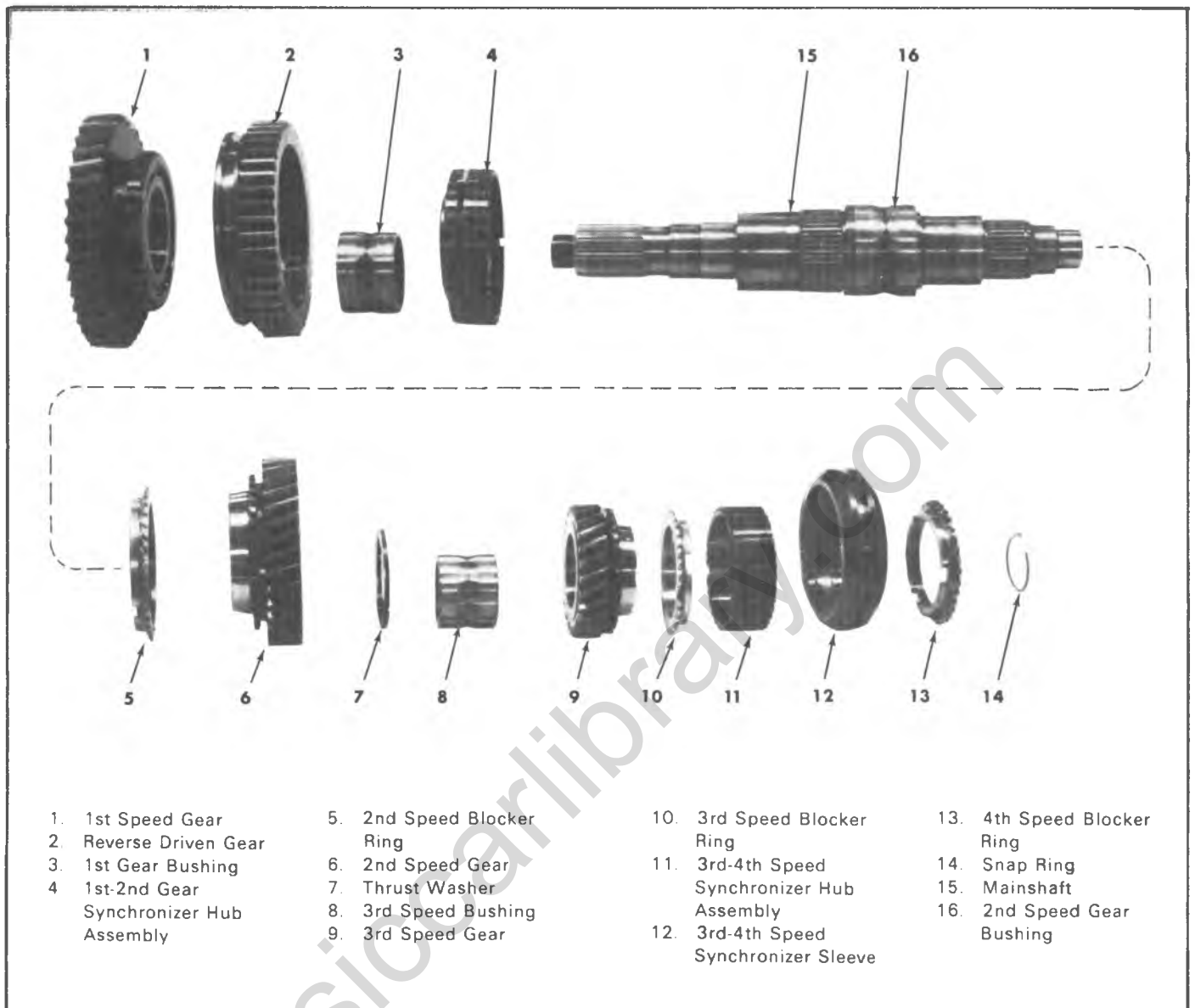


Fig. 14Q--Mainshaft Assembly Exploded View

NOTE: Third speed gear must be a running fit on mainshaft bushing and mainshaft bushing should be press fit on shaft.

5. Check second speed thrust washer for excessive scoring.
6. Inspect 2nd speed gear for excessive wear at thrust surface. Check synchronizer springs for looseness or breakage.
7. Inspect second gear synchronizing ring for excessive wear.
8. Inspect bronze synchronizer cone on 2nd speed gear for excessive wear or damage. Also inspect clutch gear synchronizer cone and third speed gear synchronizer cone for excessive wear or damage.

NOTE: First and reverse sliding gear must be sliding fit on synchronizer hub and must not have excessive radial or circumferential play. If sliding gear is not free on hub, inspect for burrs which may have rolled up on front end of half-tooth internal splines and remove by honing as necessary.

9. Inspect all gear teeth for excessive wear.

Assembly

1. Using Tool J-22873 press 2nd speed bushing onto mainshaft until it bottoms against shoulder (fig. 16Q).

NOTE: Lubricate bushing with E.P. oil before pressing.

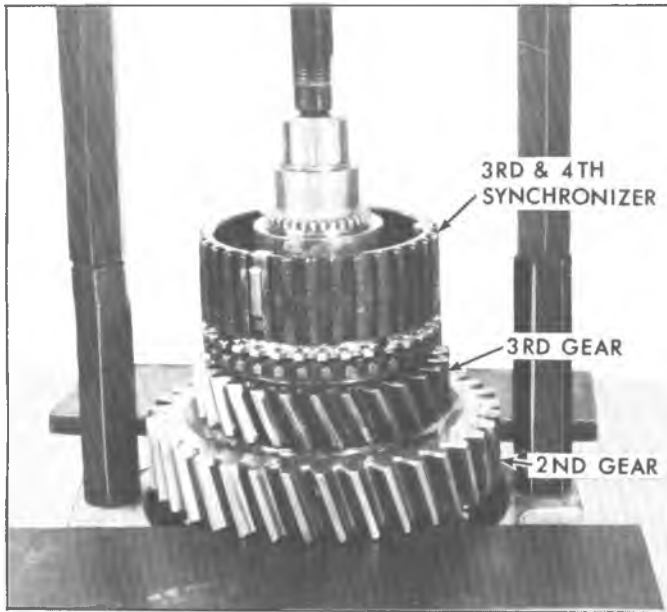


Fig. 15Q--Disassembly of Mainshaft

CAUTION: 1st, 2nd and 3rd speed gear bushings are sintered iron, exercise care when installing.

2. Press 1st and 2nd speed synchronizer hub onto mainshaft until it bottoms against shoulder with annulus toward rear of shaft.
3. Install 1st and 2nd synchronizer keys and springs (if previously removed).
4. Using Tool J-22873 press 1st speed gear bushing onto mainshaft until it bottoms against hub (fig. 17Q).

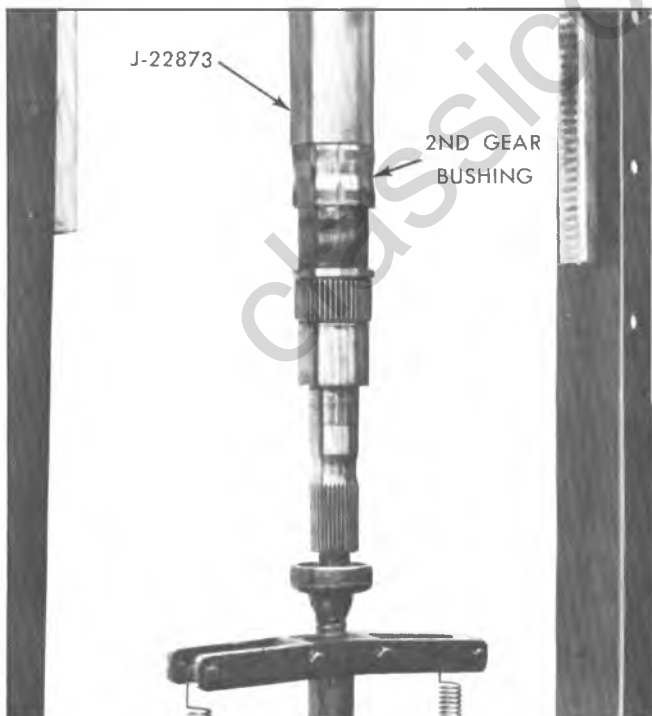


Fig. 16Q--Installing 2nd Speed Gear Bushing

- NOTE: Lubricate all bushing with E.P. oil before installation of gears.
5. Install synchronizer blocker ring and 2nd speed gear onto mainshaft and against synchronizer hub. Index synchronizer key slots with keys in synchronizer hub.
 6. Install 3rd speed gear thrust washer onto mainshaft with tang on thrust washer in slot on shaft and against 2nd speed gear bushing. Then press 3rd speed gear bushing onto mainshaft using Tool J-22875 until it bottoms against thrust washer (fig. 18Q).
 7. Install 3rd speed gear synchronizer blocker ring and 3rd speed gear onto mainshaft, against 3rd speed gear thrust washer.
 8. Index synchronizer ring key slots with synchronizer assembly keys and drive 3rd and 4th synchronizer assembly onto mainshaft using Tool J-22875 and against 3rd speed gear bushing thrust face toward 3rd speed gear (fig. 19Q). Retain synchronizer assembly with snap ring.
 9. Install reverse driven gear with fork groove toward rear.

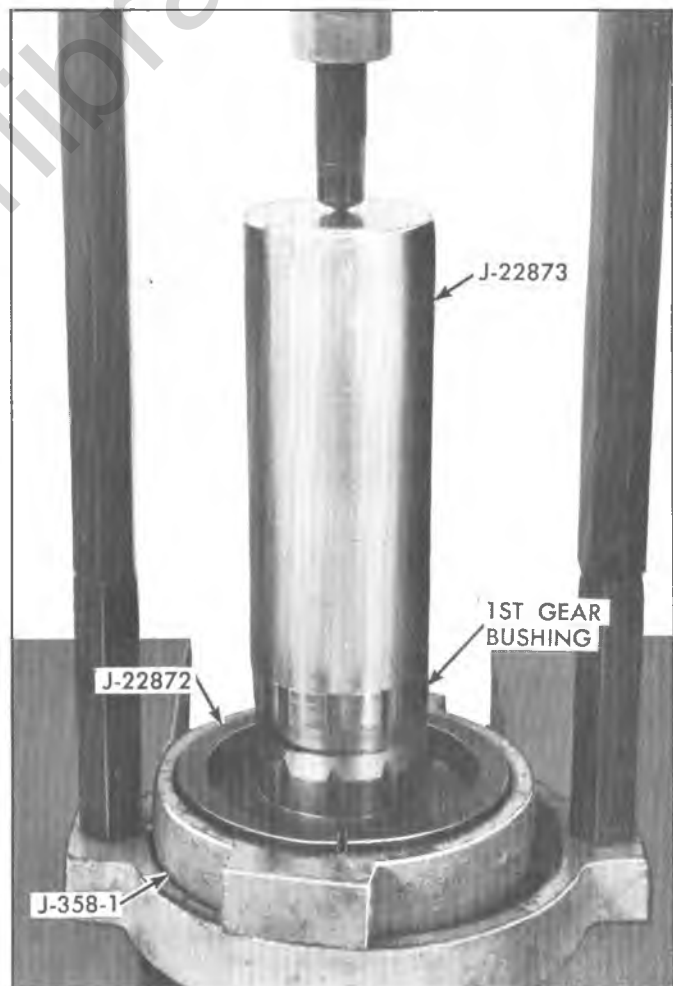


Fig. 17Q--Installing 3rd Speed Gear Bushing

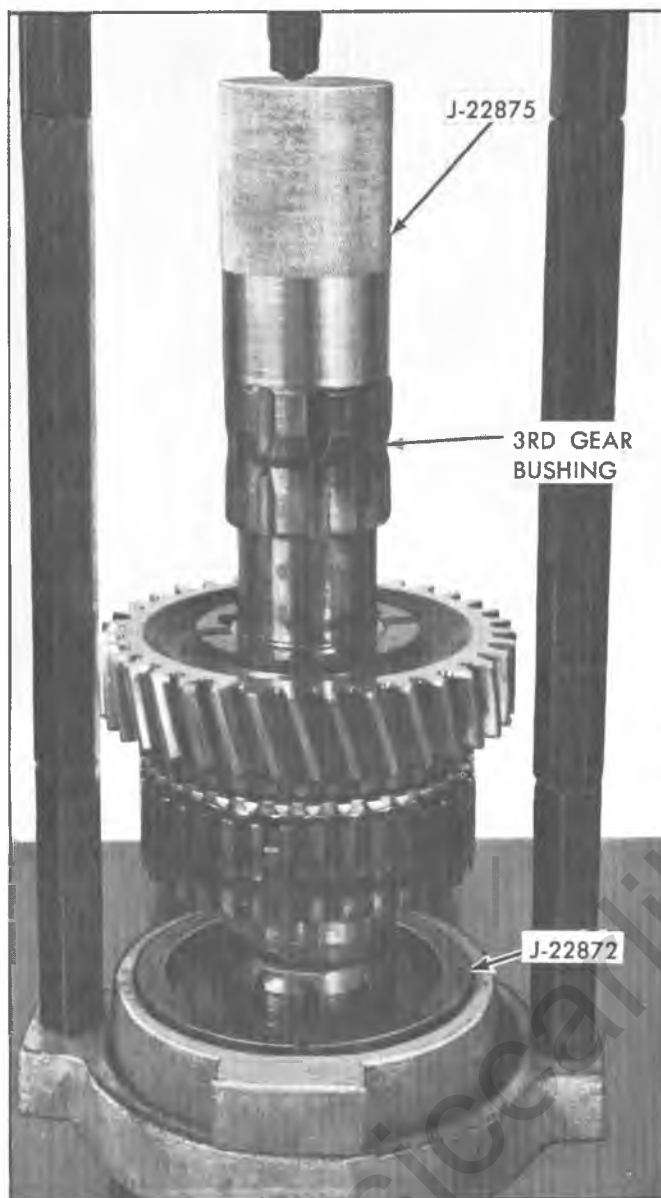


Fig. 18Q--Installing 3rd Speed Gear Bushing

10. Install 1st speed gear onto mainshaft and against 1st and 2nd synchronizer hub. Install 1st speed gear thrust washer.

COUNTERSHAFT ASSEMBLY

Disassembly

1. Remove front countergear retaining ring and thrust washer. Discard snap ring.
2. Install Tool J-22832 or suitable press plates on countershaft, open side to spacer, (fig. 20Q); support assembly in an arbor press and press countershaft out of clutch countergear assembly.

NOTE: Countergear is a slip fit and pressing may not be required.

3. Remove clutch countergear rear retaining ring. Discard snap ring.

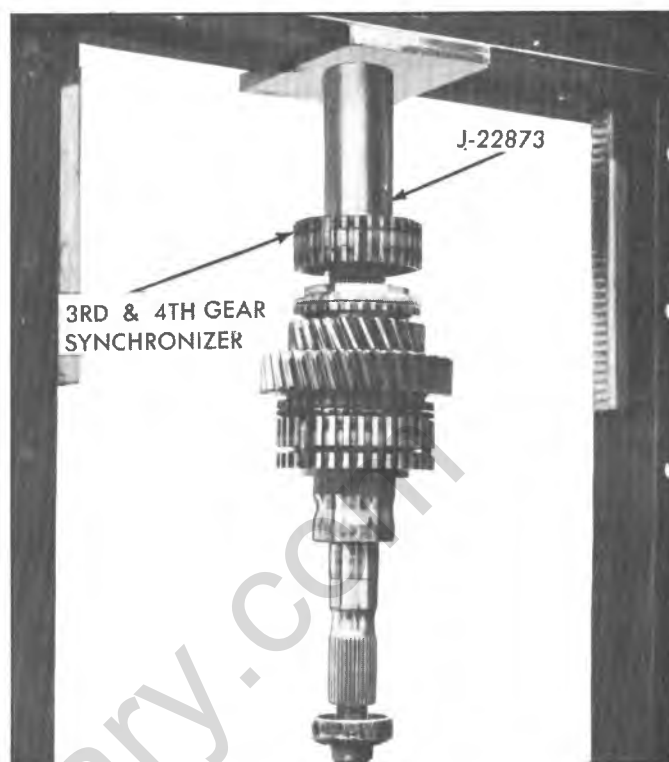


Fig. 19Q--Installing 3rd and 4th Gear Synchronizer

4. Remove 3rd speed countergear retaining ring. Discard snap ring.
5. Position assembly on an arbor press and press shaft from 3rd speed countergear.

Assembly

1. Position 3rd speed countergear and shaft in arbor press and press the gear onto the shaft.

NOTE: Install gear with marked surface toward front of shaft.

2. Install new 3rd speed countergear retaining ring using snap ring pliers.
3. Install new clutch countergear rear retaining ring using Tool J- 22830, J-22873 and snap ring pliers as follows: Install Tool J-22830 on end of shaft and position snap ring on Tool (fig. 21Q). Using Tool J-22873, push down on snap ring until it engages groove on shaft. Using snap ring pliers, carefully expand ring until it just slides onto splines, then push ring down shaft until it engages groove on shaft.

CAUTION: Do not over stress snap ring.

4. Position clutch countergear and spacer on shaft and press countergear onto shaft against snap ring using Tool J-22873, (fig. 22Q).

NOTE: Countergear is a slip fit and pressing may not be required.

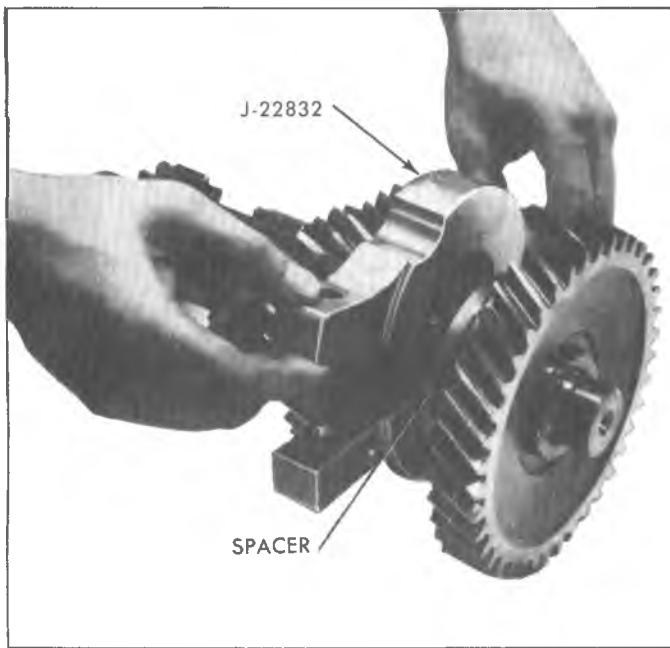


Fig. 20Q--Positioning Tool J-22832 On Countershaft

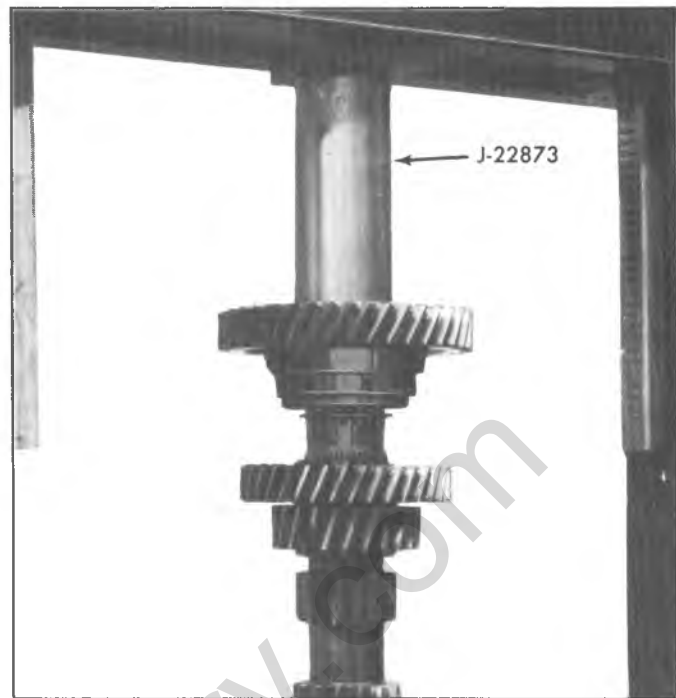


Fig. 22Q--Installing Clutch Countergear

5. Install clutch countergear thrust washer and front retaining ring using Tool J-22830 and J-22873 (fig. 21Q).

CAUTION: Do not over stress snap ring. Ring should be tight in groove without side play.

ASSEMBLY OF TRANSMISSION

1. Lower the countergear into the case until it rests on bottoms of case.

2. Place reverse idler gear in transmission case with gear teeth toward the front. Install idler gear shaft from rear to front, being careful to have slot in end of shaft in facing down. Shaft slot face must be at least flush with case.
3. Install mainshaft assembly into case with rear of shaft protruding out rear bearing hole in case. Position Tool J-22874-5 in clutch gear case opening and engaging front mainshaft (fig. 23Q). Rotate case onto front end.

NOTE: Install 1st speed gear thrust washer on shaft, if not previously installed.

4. Install snap ring on bearing O.D. and position rear mainshaft bearing on shaft. Using Tool J-22874-1 drive bearing onto shaft and into case (fig. 23Q). Rotate case and remove Tool J-22874-5.
5. Install synchronizer cone on pilot end of mainshaft and slide rearward to clutch hub.

CAUTION: Make sure three cut out sections of 4th speed synchronizer cone align with three clutch keys in clutch assembly.

6. Install snap ring on drive gear bearing O.D. Index cut out portion of drive gear teeth to obtain

clearance over countershaft drive gear teeth, and install clutch gear assembly onto case. Raise mainshaft to get clutch gear started and tap bearing outer race with plastic tip hammer.

7. Install drive gear bearing retainer using a new gasket. Install bolts and tighten to 15-18 ft. lbs.

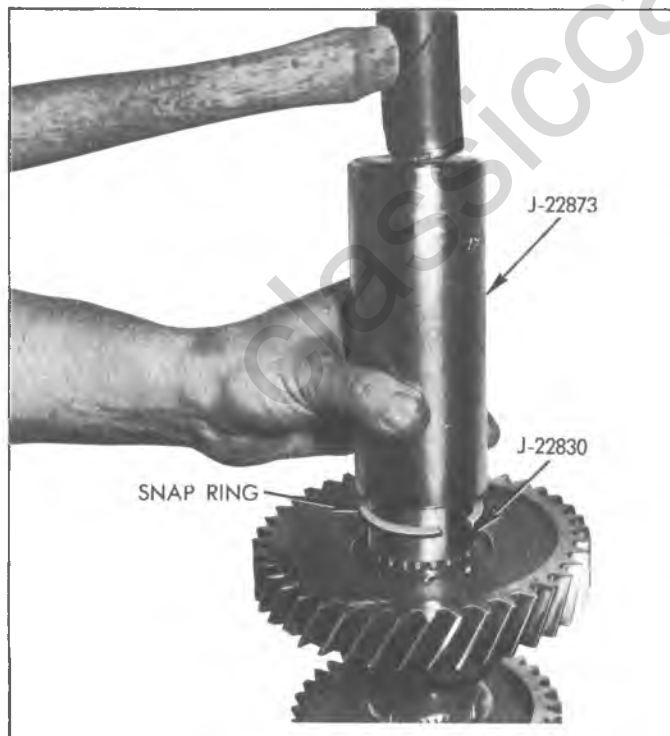


Fig. 21Q--Installing Counter Gear Snap Ring

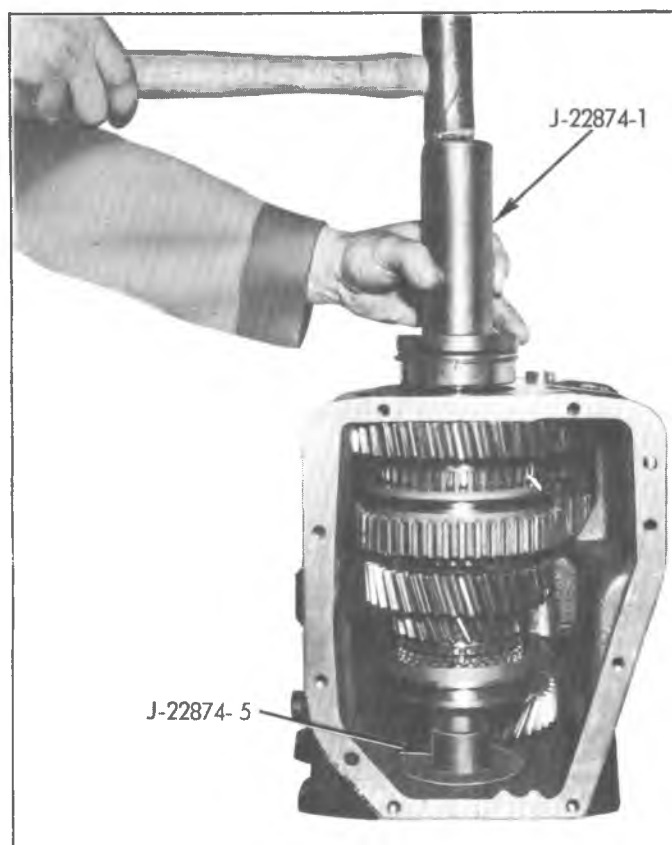


Fig. 23Q-Installing Mainshaft Rear Bearing

8. Install Tool J-22874-2 in countergear front bearing opening in case to support countergear and rotate case onto front end (fig. 24Q).
9. Install snap ring on countergear rear bearing O.D., position bearing on countergear and using Tool

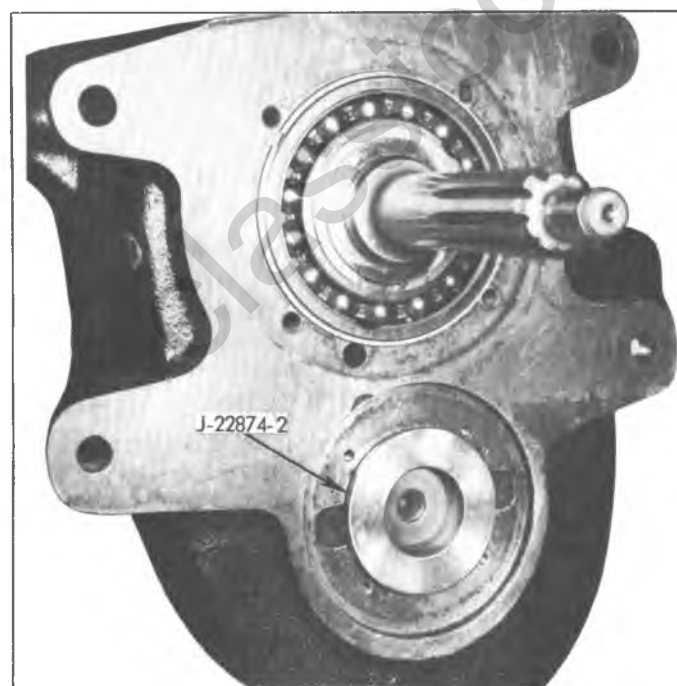


Fig. 24Q-Countergear Front Support Tool

J-22874-2, drive bearing into place (fig. 25Q). Rotate case, install snap ring on countershaft at rear bearing and then remove Tool J-22874-2.

10. Tap countergear front bearing assembly into case.
11. Install countergear front bearing cap and new gasket. Torque cap screws to 20-30 in. lbs.
12. Slide speedometer drive gear over mainshaft to bearing.
13. Install rear bearing retainer with new gasket. Be sure snap ring ends are in lube slot and cut out in bearing retainer. Install bolts and tighten to 15-18 ft. lbs. Install brake backing plate assembly on models equipped with propeller shaft brake.
14. Install parking brake drum and/or universal joint flange.

NOTE: On models equipped with 4-wheel drive, install rear lock nut and washer using Tool J-23070 (fig. 26Q). Torque lock nut to 120 ft. lbs. and bend washer tangs to fit slots in nut.

NOTE: Apply light coat of oil to seal surface.

15. Lock transmission in two gears at once. Install universal joint flange locknut and tighten to 90-120 ft. lbs.

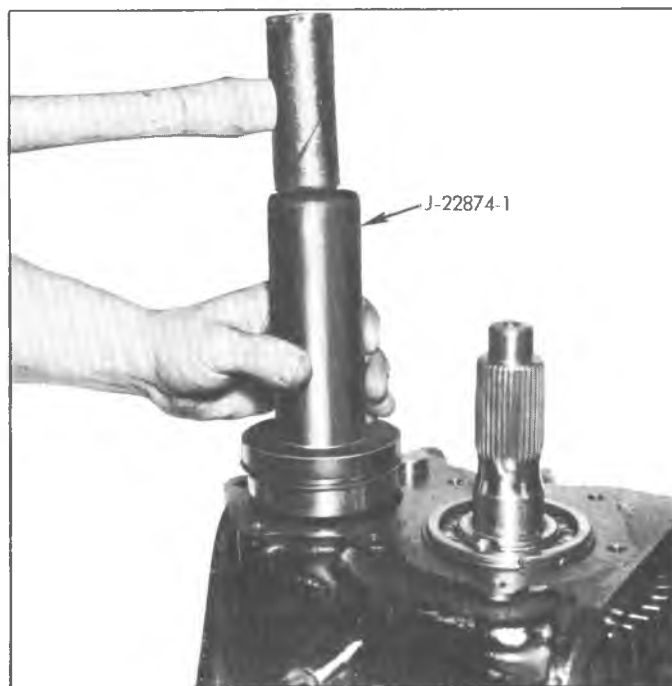


Fig. 25Q-Installing Countergear Rear Bearing

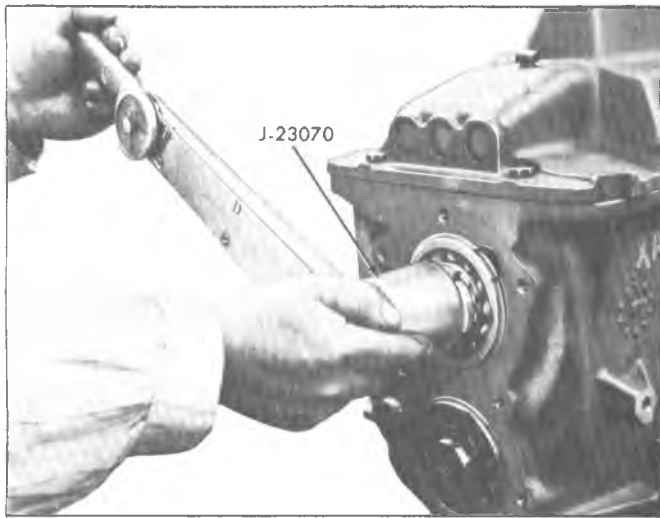


Fig. 26Q -Installing Mainshaft Rear Bearing Lock Nut
(4-Wheel
Drive Only)

16. Move all transmission gears to neutral except the reverse idler gear which should be engaged approximately $\frac{3}{8}$ of an inch (leading edge of reverse idler gear taper lines up with the front edge of the 1st speed gear). Install cover assembly with new gasket to transmission case. Shifting forks must slide into their proper positions on clutch sleeves and reverse idler gear. Forks must be positioned as in removal.
17. Install cover attaching bolts and torque to 20-25 ft. lbs.
18. Using Tool J-8109, replace gearshift lever and check operation of transmission.

DANA MODEL 20 TRANSFER CASE

Index

Disassembly	7M-50	Disassembly of Rear Output Shaft.....	7M-52
Cleaning and Inspection	7M-52	Assembly of Rear Output Shaft.....	7M-53
		Assembly.....	7M-54

DISASSEMBLY

1. Remove cover from bottom of transfer case.
2. Remove poppet hole cap screws from the outside of the front bearing retainer.
3. Remove the intermediate gear shaft lockplate at the rear side of the transfer case.
4. Using dummy shaft J-23419, drive intermediate shaft out of rear of case as shown in Figure 2D.
5. Remove intermediate gear and thrust washers from case.
6. Remove bolts attaching rear output shaft subassembly to transfer case and remove complete unit from case as shown in Figure 3D.

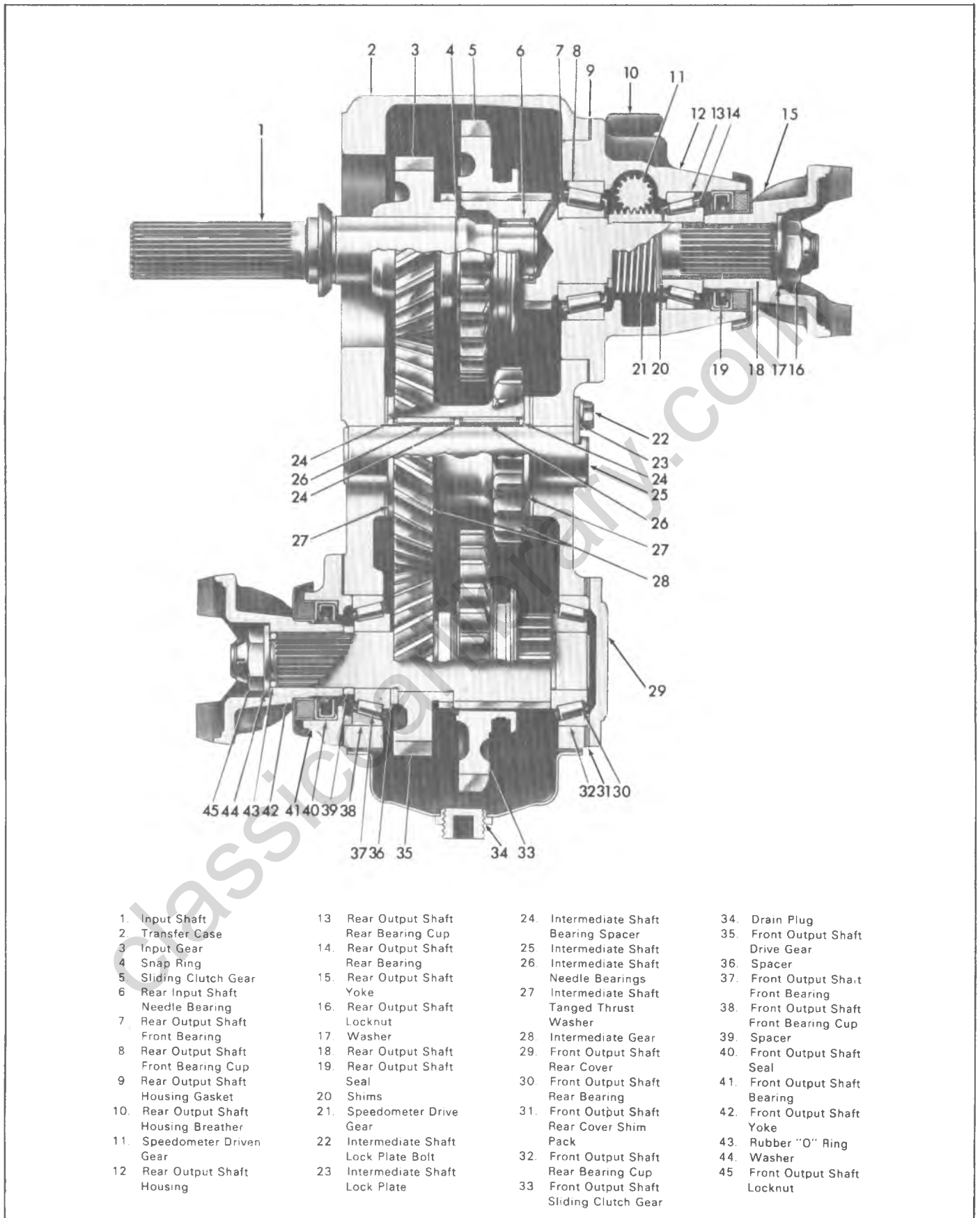
NOTE: Disassembly of rear output shaft subassembly is covered later in this section.

7. Remove locknut and washer from front output shaft yoke, if not removed during unit removal from vehicle, and tap yoke from output shaft.
8. Loosen dog set screw from rear wheel drive shift fork. Rotate shift rail to preload poppet ball and pull rail out of the housing. Remove shift fork and clutch gear from case. Remove poppet ball and spring from retainer.

9. Remove front output shaft rear cover and shims. Tie shims together before laying aside.
10. Tap on front end of front output shaft, removing shaft from the rear of the case as shown in Figure 4D. Remove front washer, front bearing, gear washer, and output gear from case as they clear shaft. This procedure will also remove the rear bearing cup.

NOTE: Remove front bearing cup as required, using a suitable puller or driver.

11. Loosen dog set screw from the front wheel drive shift fork. Swing fork and gear toward cover opening and lift out gear. Rotate shift rail to preload poppet ball and pull rail out of the retainer. Remove fork as it clears the shift rail and remove poppet ball and spring from retainer.
12. Support inner race of rear bearing and press bearing from shaft as shown in Figure 5D.
13. Remove front output shaft bearing retainer and gasket.
14. Remove shift rail lip seals with a suitable puller or pry tool.
15. Remove the front bearing retainer seal using a suitable puller or pry tool.



- | | | | |
|------------------------|------------------------|------------------------|------------------------|
| 1. Input Shaft | 13. Rear Output Shaft | 24. Intermediate Shaft | 34. Drain Plug |
| 2. Transfer Case | Rear Bearing Cup | Bearing Spacer | 35. Front Output Shaft |
| 3. Input Gear | 14. Rear Output Shaft | 25. Intermediate Shaft | Drive Gear |
| 4. Snap Ring | Rear Bearing | 26. Intermediate Shaft | 36. Spacer |
| 5. Sliding Clutch Gear | 15. Rear Output Shaft | Needle Bearings | 37. Front Output Shaft |
| 6. Rear Input Shaft | Yoke | 27. Intermediate Shaft | Front Bearing |
| Needle Bearing | 16. Rear Output Shaft | Tanged Thrust | 38. Front Output Shaft |
| 7. Rear Output Shaft | Locknut | Washer | Front Bearing Cup |
| Front Bearing | 17. Washer | 28. Intermediate Gear | 39. Spacer |
| 8. Rear Output Shaft | 18. Rear Output Shaft | 29. Front Output Shaft | 40. Front Output Shaft |
| Front Bearing Cup | Locknut | Rear Cover | Seal |
| 9. Rear Output Shaft | 19. Rear Output Shaft | 30. Front Output Shaft | 41. Front Output Shaft |
| Housing Gasket | Seal | Rear Bearing | Bearing |
| 10. Rear Output Shaft | 20. Shims | 31. Front Output Shaft | 42. Front Output Shaft |
| Housing Breather | 21. Speedometer Drive | Rear Cover Shim | Yoke |
| 11. Speedometer Driven | Gear | Pack | 43. Rubber "O" Ring |
| Gear | 22. Intermediate Shaft | 32. Front Output Shaft | 44. Washer |
| 12. Rear Output Shaft | Lock Plate Bolt | Rear Bearing Cup | 45. Front Output Shaft |
| Housing | 23. Intermediate Shaft | Front Output Shaft | Locknut |
| | Lock Plate | 33. Front Output Shaft | |
| | | Sliding Clutch Gear | |

Fig. 1D--Dana Transfer Case Cross Section

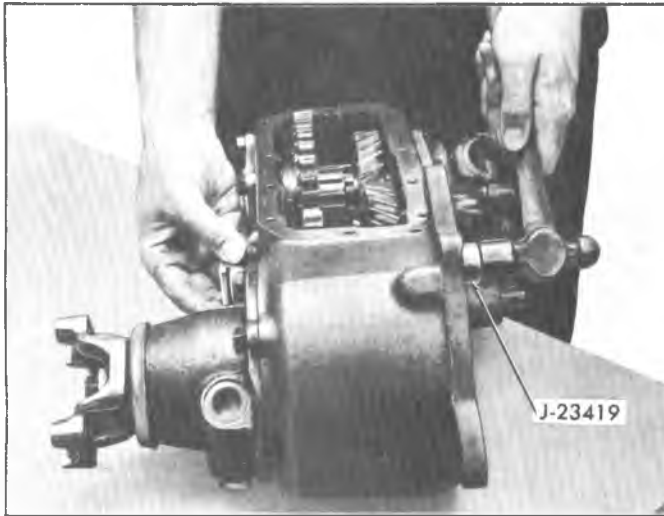


Fig. 2D--Removing Intermediate Gear Shaft

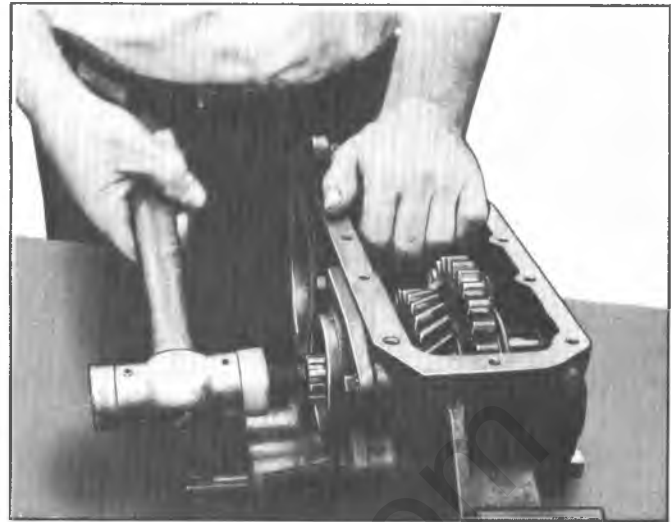


Fig. 4D--Removing Front Output Shaft

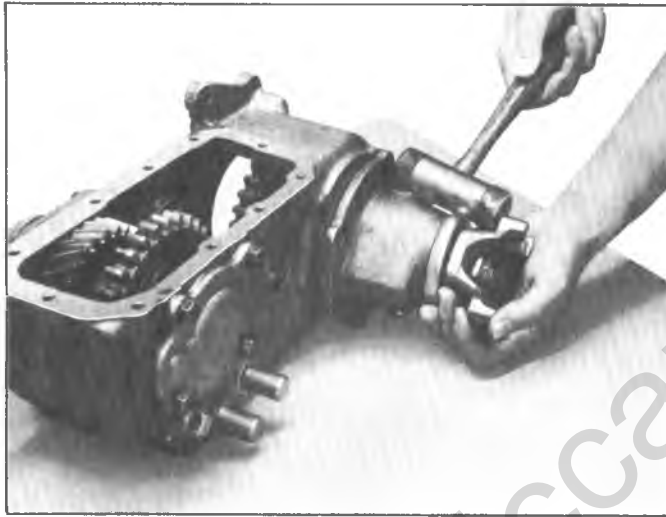


Fig. 3D--Removing Rear Output Shaft Sub-Assembly

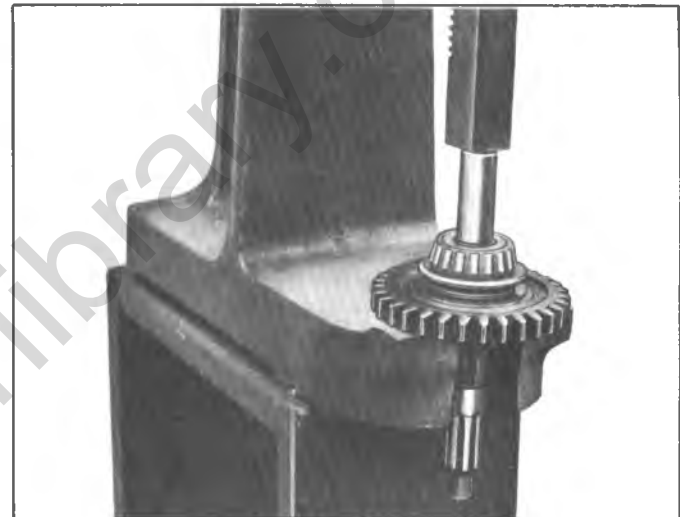


Fig. 5D--Removing Front Output Shaft Rear Bearing

CLEANING AND INSPECTION

Bearings--Place all bearings and rollers in cleaning solution and allow to remain long enough to loosen all accumulated lubricant. Bearings should be sloshed up and down and turned slowly below surface of solution to remove as much lubricant as possible. Remove bearings and blow out with compressed air, being careful to direct air across bearing so that bearings do not spin.

Shafts and Gears--Clean all shafts in cleaning solution to remove all accumulations. Dry with compressed air.

Case, Cover and Bearing Cups--Transfer case, cover, and bearing cups must be thoroughly cleaned in solution to remove all accumulations of lubricant and dirt. Remove all trace of gaskets from surfaces where used.

Inspection--Carefully inspect all bearings and rollers for evidence of chipping, cracks, or worn spots that would render bearing unfit for further service. Bearings are non-adjustable and if worn or damaged, must be replaced with new parts.

Inspect shaft splines and gears. If any indication of failure, such as chipped teeth or excessive wear is indicated, those parts should be replaced with new parts.

DISASSEMBLY OF REAR OUTPUT SHAFT SUB-ASSEMBLY

1. Remove speedometer driven gear from rear retainer.
2. Support yoke assembly in a soft jaw vise and remove yoke locknut and washer.
3. Remove assembly from vise and using a soft hammer, tap yoke from shaft.
4. Support rear face of retainer and press output shaft from the retainer.
5. Pry seal from housing bore.
6. Remove the tapered bearing and, using a drift, drive the bearing cup from the housing rear bore.

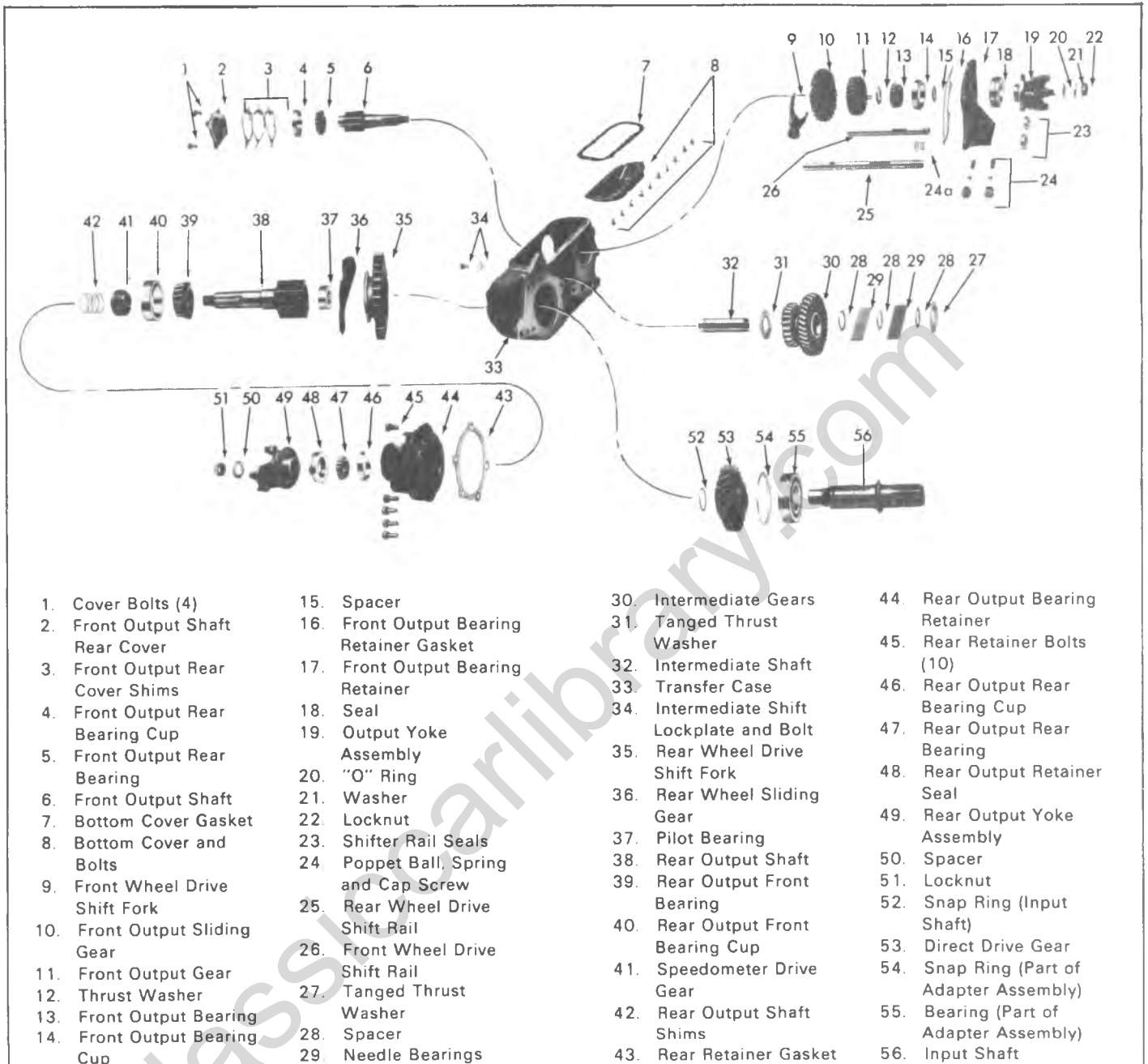


Fig. 6D-Dana Transfer Case Exploded View

- Using a brass drift, remove the bearing cup from the housing front bore.
- Remove shims and speedometer gear from the shaft. Tie shims together before laying aside.
- Using press plates J-8331, remove front bearing from the shaft as shown in Figure 7D.
- Collapse and remove pilot bearing from output shaft pilot bore.

ASSEMBLY OF REAR OUTPUT SHAFT SUB-ASSEMBLY

- Press new pilot bearing in bore of rear output shaft with bearing identification facing out using Tool J-23420 as shown in Figure 8D.

CAUTION: Bearing identification must face out. Opposite end of bearing is soft and must not be used to install bearing in bore or damage to the bearing may result.

- Using Tool J-5590, press front bearing on shaft as shown in Figure 9D.
- Install the front bearing cup in the front housing

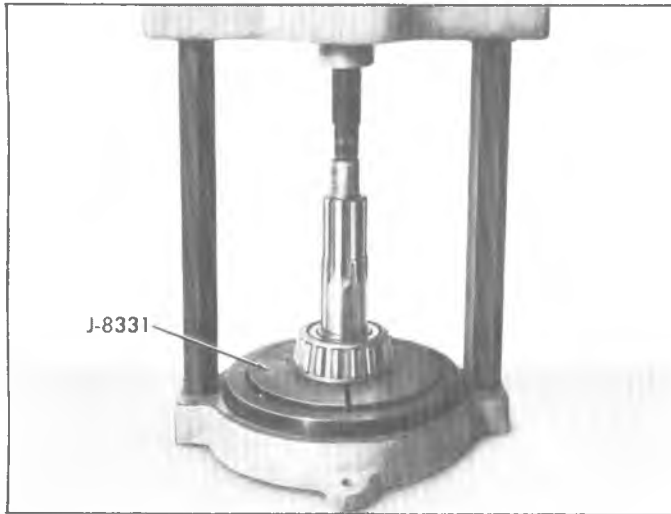


Fig. 7D-Removing Rear Output Shaft Front Bearing

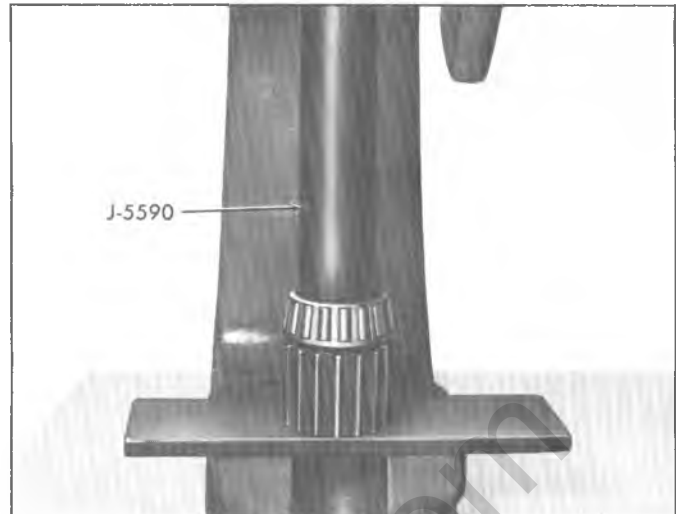


Fig. 9D-Installing Rear Output Shaft Front Bearing

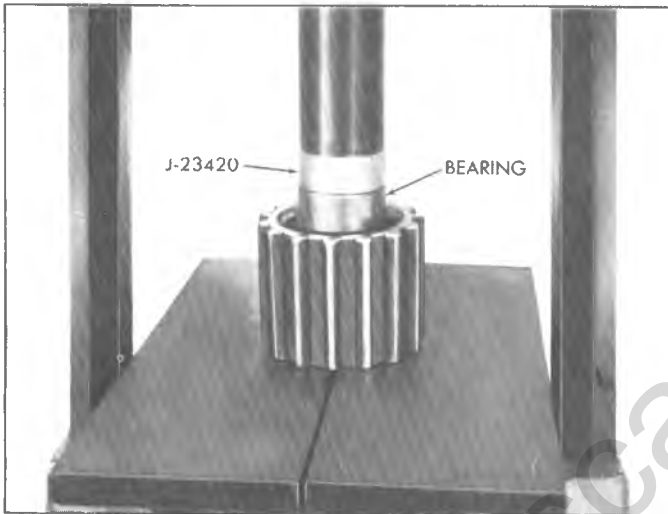


Fig. 8D-Installing Rear Output Shaft Pilot Bearing

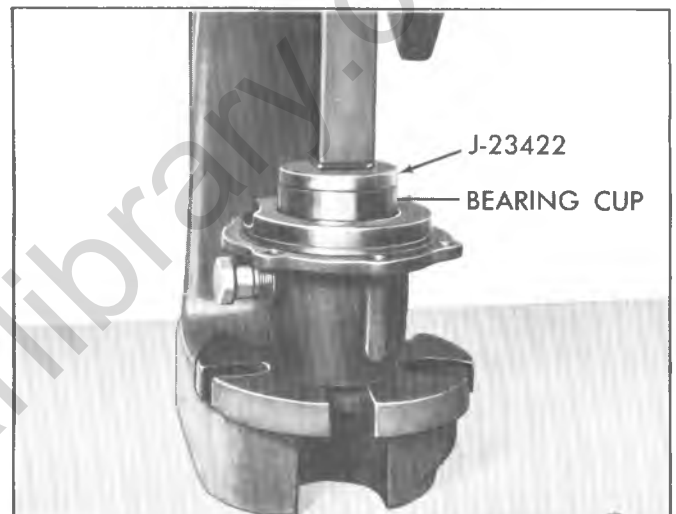


Fig. 10D-Installing Rear Output Shaft Front Bearing Cup

bore using Tool J-23423 as shown in Figure 10D until cup seats in housing.

4. Install the rear bearing and cup in the rear housing bore using Tool J-23423 as shown in Figure 11D until cup seats in housing.
5. Install the seal in the housing rear bore using Tool J-22833 as shown in Figure 12D until seal bottoms in housing.
6. Insert output shaft into front bore of housing and position yoke on rear of shaft. Support front of shaft and press assembly together seating the front bearing on the shaft.
7. Support yoke assembly in soft jaw vise and install washer and locknut.

CAUTION: Locknut must be torqued to 200-250 ft. lbs. before installing prop shaft during unit installation in vehicle.

8. Install speedometer driven gear and lockplate in housing.

ASSEMBLY

1. Position front bearing cup and tap into bore until flush with inner face.
2. Position retainer and gasket to case. Install attaching bolts.

NOTE: If shift rail seals were removed, position new seals in retainer rail bores and press seals into place using a block of wood or other suitable tool.
3. Install the poppet ball and spring (red) for the front wheel drive shift rail in the retainer.
4. Depress the poppet ball and push shift rail through retainer into the case. Install shift fork on the rail and tighten set screw.

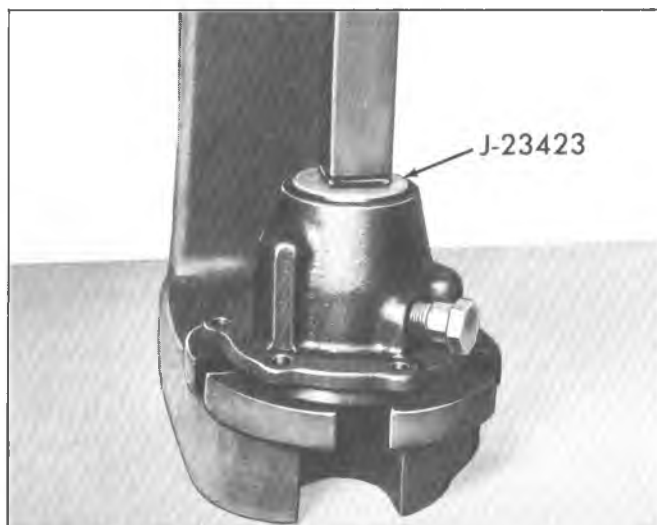


Fig. 11D--Installing Rear Output Shaft Rear Bearing Cup

NOTE: Shift fork set screw boss should face front of case.

5. Install poppet ball and spring (yellow) for rear wheel drive shift rail in the retainer.

NOTE: Position front wheel drive shift rail in neutral so that interlocks do not interfere with second rail installation.

6. Depress poppet ball and install shift rail through retainer into case. Install shift on rail and tighten set screw.
7. Support front output shaft and press rear bearing onto shaft using Tool J-6219 as shown in Figure 13D.
8. Place front wheel drive clutch gear and drive gear in shift fork with collar toward case rear.
9. Install front output shaft through rear of case into clutch gear, drive gear and spacer. Position rear bearing cup to case and tap to within 1/8 inch of seat.

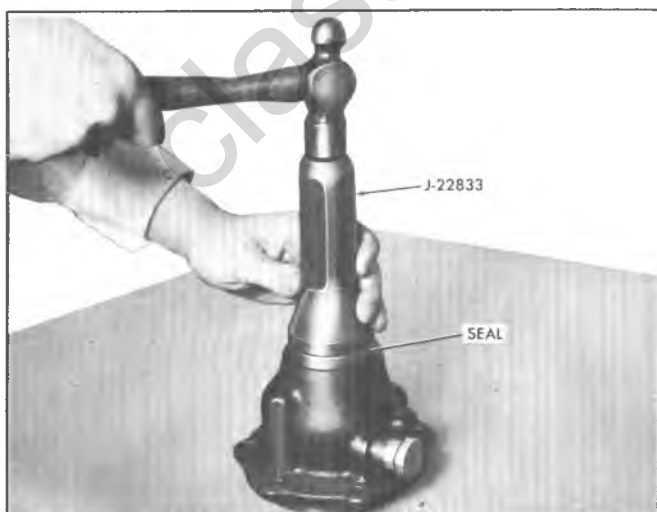


Fig. 12D--Installing Rear Output Shaft Rear Seal

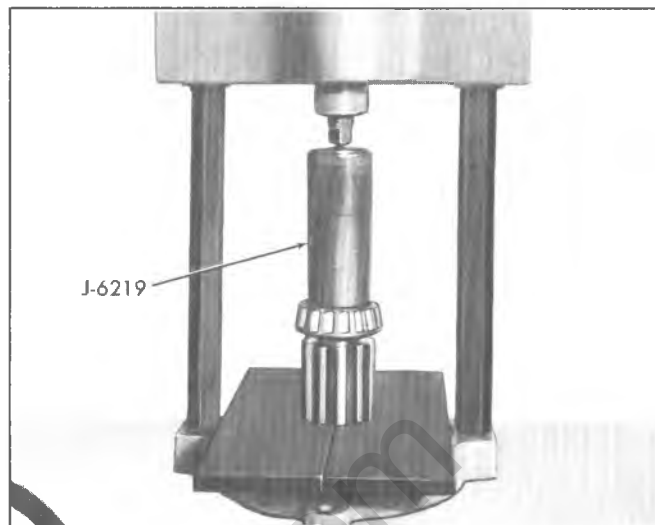


Fig. 13D--Installing Front Output Shaft Rear Bearing

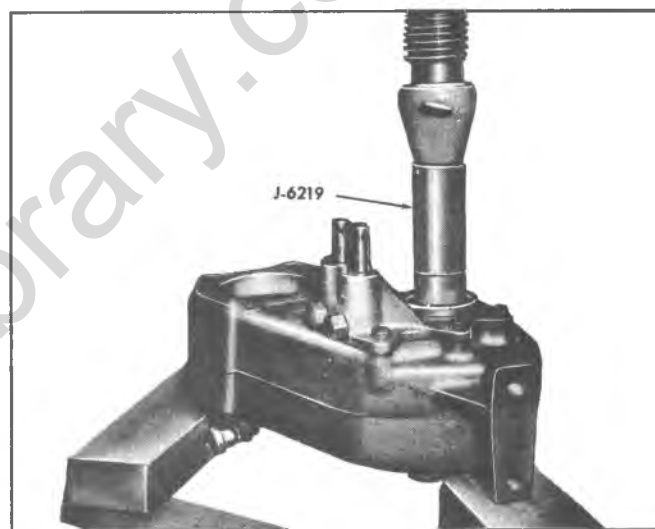


Fig. 14D--Installing Front Output Shaft Front Bearing

10. Position front bearing on shaft. Supporting rear of shaft, press bearing into position using Tool J-6219 as shown in Figure 14D. Tap front of shaft rearward to reposition rear bearing cup.
11. Install front output shaft rear bearing cover and shim pack.
12. Install rear wheel drive clutch gear in case and shift fork. Gear shift collar should face rear of case.
13. Install front output shaft retainer seal using Tool J-22833 as shown in Figure 15D.
14. If shift rail cups are damaged or have been removed, position new cup in case bore and install by tapping on end of cup.
15. Install front output shaft yoke, washer and locknut.

CAUTION: Distorted cups may permit leakage and interfere with shift rail operation.

CAUTION: Locknut must be torqued to specifications before installing prop shaft during unit installation.



Fig. 15D--Installing Front Output Shaft Seal

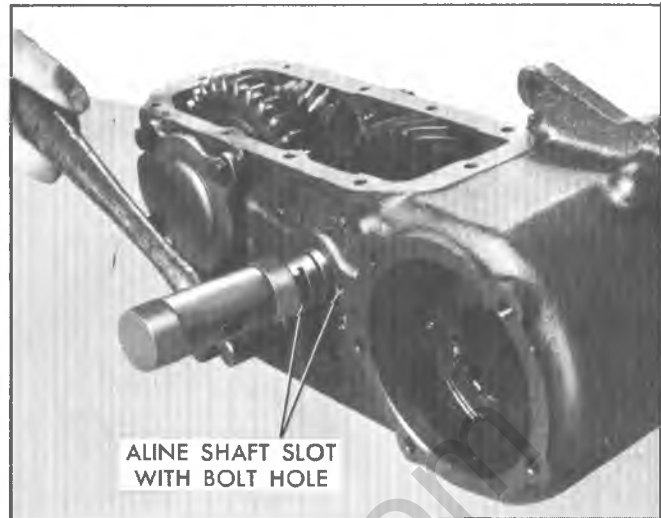


Fig. 16D--Installing Intermediate Shaft

16. Using dummy shaft J-23419, install needle bearings and spacers in intermediate gear. Position thrust washers in case with tang in groove on case and supporting intermediate gear in case, installing intermediate shaft through rear of case as shown in Figure 16D.

CAUTION: *Intermediate shaft is a press fit into the case front bore. Align lock plate slot in shaft with bolt hole before installing shaft in front bore. Use care not to damage shaft "O" ring.*

17. Install intermediate shaft lock plate and bolt. Torque bolt to specifications.
18. Install rear output shaft bearing assembly. Torque retaining bolts to specifications.

CAUTION: *Use care to prevent damage to pilot bearings when engaging input shaft pilot.*

19. Install rear output shaft yoke, washer and locknut if not previously done under reassembly of the sub-assembly.

CAUTION: *Rear yoke locknut must be torqued to specifications before checking end play and before installing the rear prop shaft.*

20. Shift transfer gears. Check gear engagement and shift rail movement. The four-wheel drive rail will have the greater poppet ball spring tension.
21. Position bottom cover and gasket to case. Install cover bolts and torque to specifications.
22. After the complete rebuild of the parts, and bearing retainer caps into unit, check the rear and front output shafts end play for .001 to .005 inch. Add or remove shims at the proper location on rear output bearing cap taper bearing, and the front output rear bearing cover. To obtain proper specified end play, checking of the end play of shafts is important. It controls the seating of all the taper bearings in the transfer case during the operation in the vehicle. Improper end play can shorten the life of the taper bearings in the unit.

NOTE: When installing transfer case in vehicle, yoke locknuts may be torqued after placing transmission in 1st gear and transfer case in front-wheel drive.

NEW PROCESS MODEL 205 TRANSFER CASE

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DISASSEMBLY OF TRANSFER CASE (FIG. 1C)

Rear Output Shaft and Yoke Assembly (Fig. 2C)

1. Loosen rear output shaft yoke nut.
2. Remove rear output shaft housing bolts and remove housing and retainer assembly from case.
3. Remove retaining nut and yoke from shaft, then remove shaft assembly from housing.
4. Remove snap ring using Tool J-23432 and discard.
5. Remove thrust washer and washer pin.
6. Remove tanged bronze washer. Remove gear needle bearings (32 per row), spacer and second row of needle bearings.
7. Remove tanged bronze thrust washer from shaft.
8. Remove pilot rollers (15), retainer ring and washer.
9. Remove oil seal retainer, ball bearing, speedometer gear and spacer. Discard all gaskets. Press out bearing as required.
10. Remove oil seal from the retainer.

Front Output Shaft Assembly (fig. 3C)

1. Remove lock nut, washer and yoke.
2. Remove front bearing retainer attaching bolts and retainer.
3. Remove front output shaft rear bearing retainer attaching bolts.
4. Tap on output shaft with a soft hammer (Fig. 4C) and remove shaft, gear assembly, and rear bearing retainer from case.

NOTE: Remove the sliding clutch from output high gear, washer, and bearing which will have remained in the case.

5. Using large snap ring picks, such as J-23432-1, remove the gear retaining ring from the shaft (Fig. 5C) and discard.
6. Remove thrust washer and pin from shaft.
7. Remove gear, needle bearings (32 per row) and spacer.
8. If necessary to replace front output shaft rear bearing, support cover and press bearing from cover. Position new bearing to outside face of cover

and using a piece of pipe or wood to cover outside diameter of bearing, press bearing into cover until flush with opening.

Shift Rail and Fork Assemblies

1. Remove the two poppet nuts on top of case, two poppet springs, and using a magnet, remove the poppet balls.
2. Drive cup plugs into case using a 1/4 inch punch.
3. Position both shift rails in neutral and using a long, narrow punch, drive shift fork pins through shift rails into the case (fig. 6C).
4. Remove clevis pins and shift rail link.
5. Remove shift rails (Fig. 7C), upper (range) rail first, then lower (4-wheel) rail.
6. Remove shift forks and sliding clutch from case.
7. Remove the front output high gear, washer, and bearing from the case. Remove the shift rail cup plugs and pins from the case.

Input Shaft Assembly

8. Remove snap ring in front of bearing. Using a soft hammer, tap shaft out rear of case. Tap bearing out front of case.
9. Tip case on P.T.O. and remove two interlock pins from inside of case.

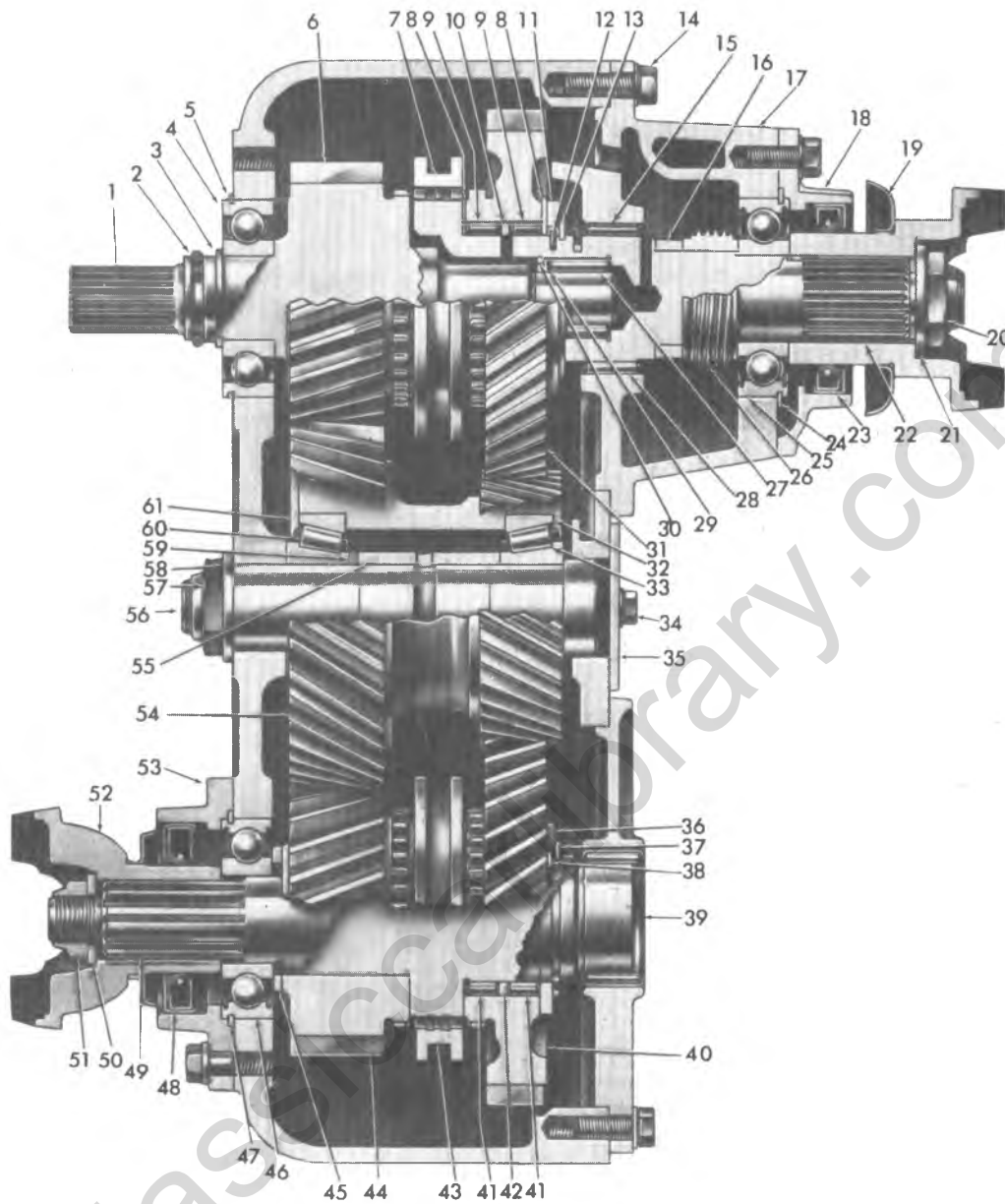
Idler Gear

1. Remove idler gear shaft nut.
2. Remove idler shaft rear cover.
3. Remove idler gear shaft using a soft hammer and tool J-23429 (Fig. 8C).
4. Roll idler gear to front output shaft hole and remove from case.
5. Remove bearing cups (2) as required from idler gear.

CLEANING AND INSPECTION

Bearings-Place all bearings and rollers in cleaning solution and allow to remain long enough to loosen all accumulated lubricant. Bearings should be sloshed up and down and turned slowly below surface of solution to remove as much lubricant as possible. Remove bearings and blow out with compressed air, being careful to direct air across bearing so that bearings do not spin.

Shafts and Gears-Clean all shafts in cleaning solution to remove all accumulations. Dry with compressed air.



- | | | | |
|--------------------------------|-------------------------------------|--|-------------------------|
| 1. Input Shaft | 18. Rear Bearing Retainer | 32. Idler Gear Shaft Bearing Cup | 43. Sliding Clutch |
| 2. "O" Ring | 19. Rear Yoke Assembly | 33. Idler Shaft Bearing Cone | 44. Front Wheel Hi-Gear |
| 3. Snap Ring | 20. Locknut | 34. Idler Shaft Cover Bolts and Lockwasher | 45. Spacer |
| 4. Bearing | 21. Washer | 35. Idler Shaft Gear Cover and Gasket | 46. Bearing |
| 5. Snap Ring | 22. Rear Output Shaft | 36. Thrust Washer | 47. Snap Ring |
| 6. Input Shaft Gear | 23. Bearing Retainer Seal | 37. Snap Ring | 48. Seal |
| 7. Sliding Clutch | 24. Snap Ring | 38. Thrust Washer Pin | 49. Front Output Shaft |
| 8. Tanged Bronze Thrust Washer | 25. Bearing | 39. Rear Bearing Retainer and Output Shaft Cover | 50. Washer |
| 9. Roller Bearings | 26. Speedometer Gear | 40. Front Wheel Drive Low Gear | 51. Locknut |
| 10. Spacer | 27. Pilot Bearings | 41. Roller Bearings | 52. Output Yoke |
| 11. Thrust Washer | 28. Rear Output Shaft Front Bearing | 42. Spacer | 53. Bearing Retainer |
| 12. Thrust Washer Pin | 29. Washer | | 54. Idler Gear |
| 13. Snap Ring | 30. Bearing Retainer | | 55. Idler Gear Spacer |
| 14. Bolt and Lockwasher | 31. Rear Wheel Drive Low Gear | | 56. Idler Shaft |
| 15. Needle Bearings | | | 57. Locknut |
| 16. Spacer | | | 58. Washer |
| 17. Rear Output Shaft Housing | | | 59. Bearing Cone |
| | | | 60. Bearing Cup |

Fig. 1C--New Process Transfer Case Cross Section

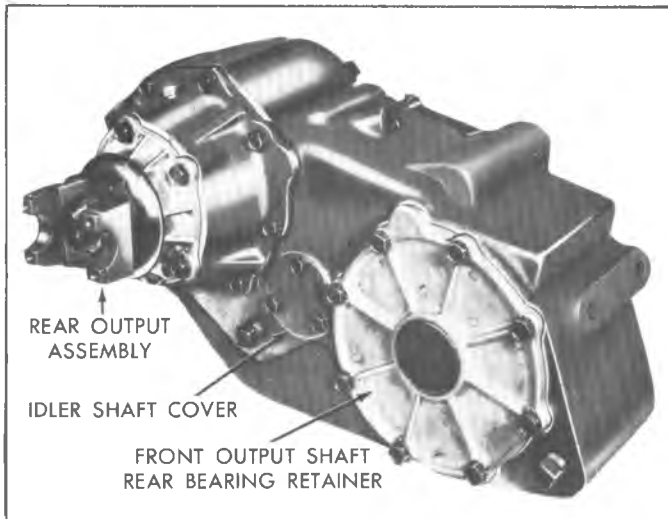


Fig. 2C-Rear View of Transfer Case

Case, Cover and Bearing Cups-Transfer case, cover, and bearing cups must be thoroughly cleaned in solution to remove all accumulation of lubricant and dirt. Remove all trace of gaskets from surfaces where used.

Inspection-Carefully inspect all bearings and rollers for evidence of chipping, cracks, or worn spots that would render bearing unfit for further service. Bearings are non-adjustable and if worn or damaged, must be replaced with new parts.

Inspect shaft splines and gears. If any indication of failure, such as chipped teeth or excessive wear, is indicated, those parts should be replaced with new parts.

ASSEMBLY OF TRANSFER CASE (FIG. 9C)

Idler Gear

1. Press the two bearing cups in the idler gear (if previously removed) using Tool J-9276-2 and Handle J-8092 (Fig. 10C).
2. Assemble the two bearing cones, spacer, shims and idler gear on dummy shaft J-23429 with bore up. Check end play (Fig. 11C). Limits are .000 to .002 inch.
3. Install idler gear assembly with dummy shaft into case through front output bore, large end first (Fig. 12C).

Install idler shaft from large bore side and drive through using a soft hammer (Fig. 13C).

5. Install washer and new locknut. Check for end play and free rotation. Torque nut to 150 ft. lbs.
6. Install idler shaft cover and gasket. Torque bolts to 20 ft. lbs.

NOTE: Flat on cover must be located adjacent to front output shaft rear cover (Fig. 14C).

Shift Rail and Fork Assemblies

1. Press the two rail seals into the case. Seals should be installed with metal lip outward.

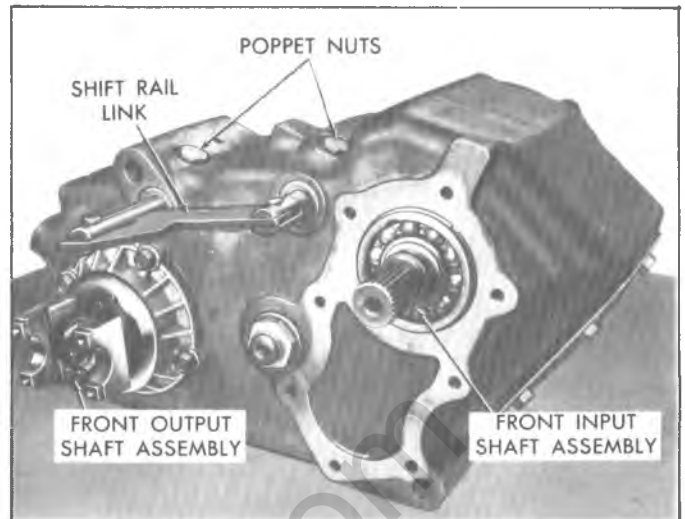


Fig. 3C-Front View of Transfer Case

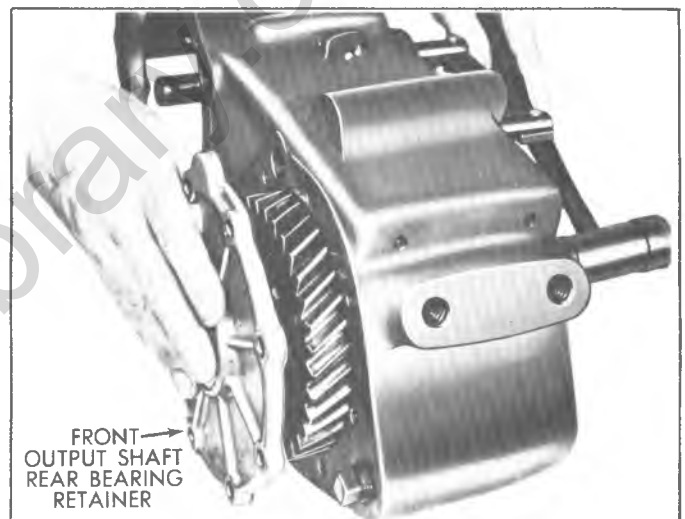


Fig. 4C-Removing Front Output Shaft Rear Bearing Retainer

2. Install interlock pins through large bore or P.T.O. opening.
3. Start front output drive shift rail into case from back, slotted end first, with poppet notches up.
4. Install shift fork (long end inward) into rail, push rail through to neutral position.
5. Install input shaft bearing and shaft into case.
6. Start range rail into case from front, poppet notches up.
7. Install sliding clutch onto fork, place over input shaft in case. Position to receive range rail and push rail through to neutral position.
8. Install new lock pins through holes at top of case and drive them into the forks (Fig. 15C).

NOTE: Tip case on P.T.O. opening when installing range rail lock pin.

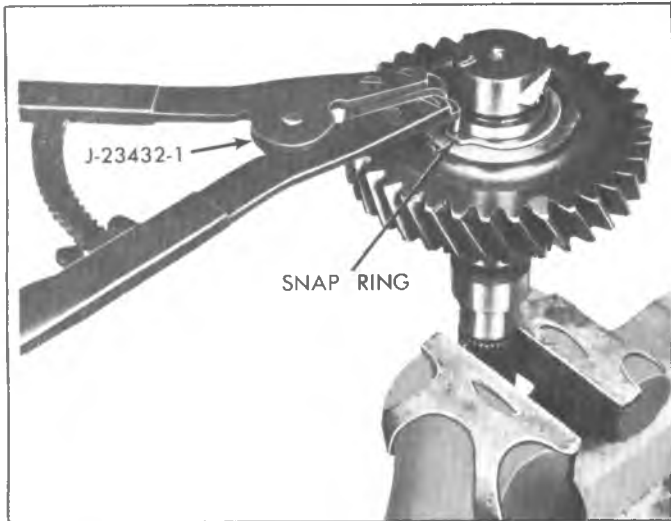


Fig. 5C-Removing Gear Retaining Ring

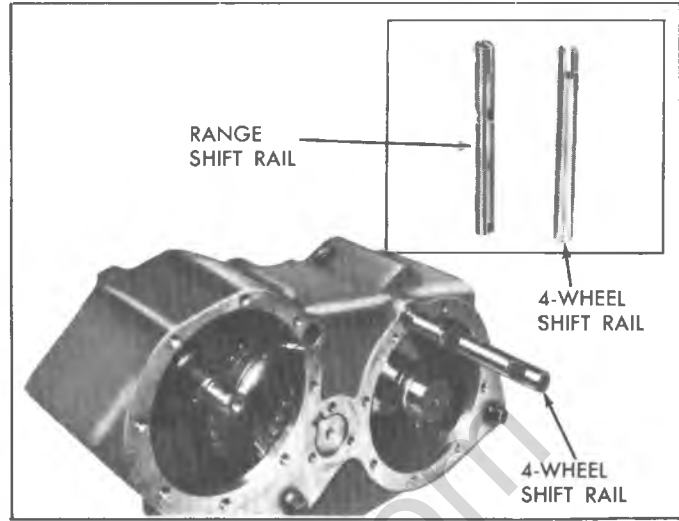


Fig. 7C-Shift Rail Removal

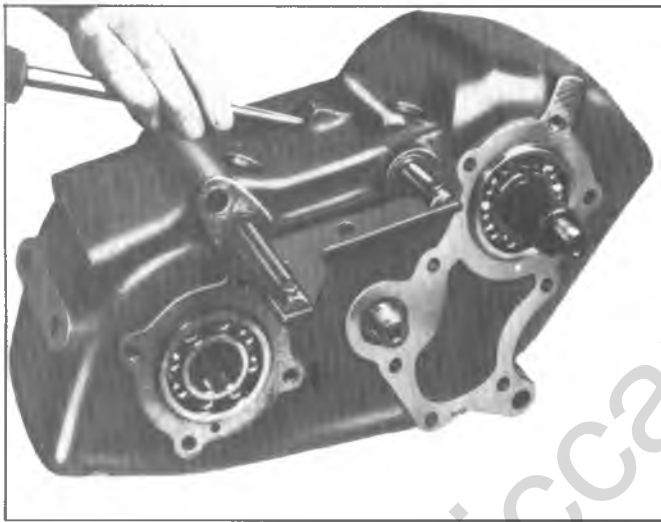


Fig. 6C-Removing Shift Fork Pins



Fig. 8C-Removing Idler Gear Shaft

Front Output Shaft and Gear Assembly

1. Install two rows of needle bearings (32 each) separated by a spacer in the front low output gear and retain with a sufficient amount of grease.
2. Place front output shaft in soft jawed vise, spline end down. Install front low gear over shaft with clutch gear facing down and install thrust washer pin, thrust washer and new snap ring using Tool J-23432.

NOTE: Position the snap ring so that the opening is opposite the pin.

3. Position front wheel hi-gear and washer in case. Install sliding clutch in the shift fork, then put fork and rail in the front wheel drive (4-Hi) position with the clutch teeth in mesh with the teeth of the front wheel hi-gear.
4. Line up washer, high gear, and sliding clutch with

bearing bore. Insert front output shaft and low gear assembly through the high gear assembly.

5. Install new seal in bearing retainer using Tool J-22836 (Fig. 16C) and install the front output bearing and retainer in the case.
6. Clean and grease rollers in front output rear bearing retainer. Install onto case using one gasket. Dip bolts into sealant. Install bolts and torque to 30 ft. lbs.
7. Install front output yoke, washer and lock nut. Torque nut to 150 ft. lbs.

Rear Output Shaft Assembly

1. Install two rows of needle bearings (32 each) separated by a spacer into the output low gear.
- NOTE: Use sufficient grease to retain needles.
2. Install thrust washer onto rear output shaft, tang

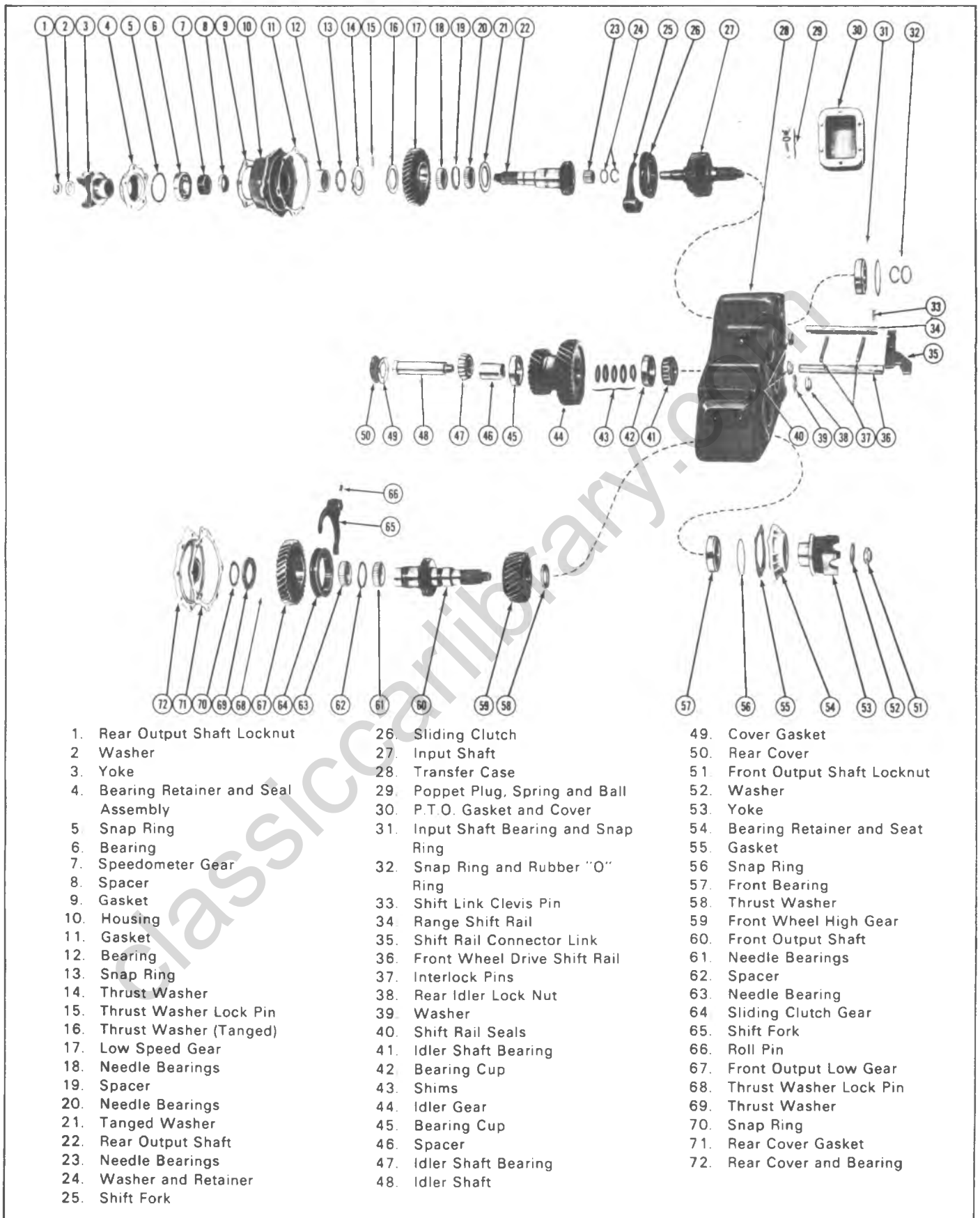


Fig. 9C--New Process Transfer Case Exploded View

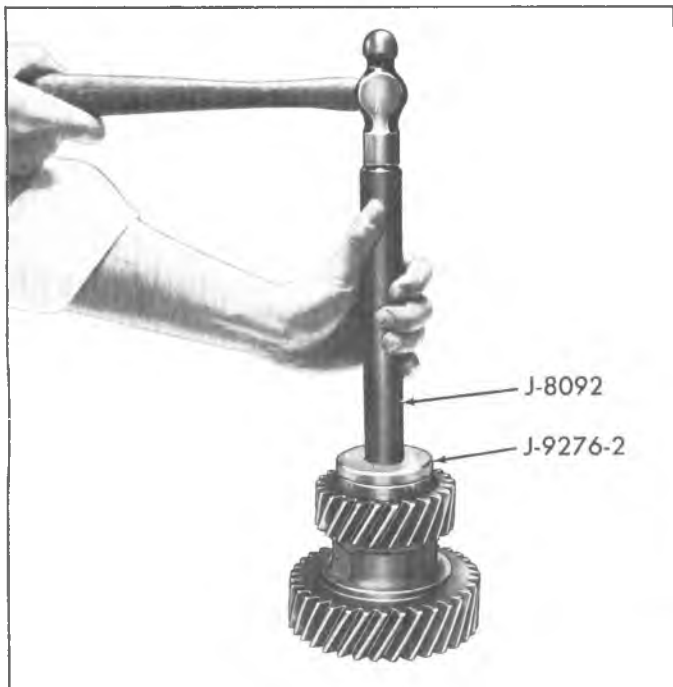


Fig. 10C-Installing New Bearing Cups

down in clutch gear groove. Install output low gear onto shaft with clutch teeth facing down.

3. Install thrust washer over gear with tab pointing up and away from gear. Install washer pin and also large thrust washer over shaft and pin. Rotate washer until tab fits into slot approximately 90 degrees away from pin. Finally, install snap ring using Tool J-23423 and J- 23423-1 and check end play which should be withing .002-.027 inch.
4. Grease pilot bore or rear output shaft and install needle bearings (15). Install thrust washer and new snap ring in bore.
5. Clean, grease, and install new bearing in retainer housing using Tool J-23431 (Fig. 17C).
6. Install housing onto output shaft assembly, install spacer and speedometer gear, then install bearing (Fig. 18C.)
7. Install rear bearing retainer seal using Tool J-21359 or J- 22834-2 (Fig. 19c).
8. Install bearing retainer assembly onto housing with one or two gaskets, depending on clearance. Torque bolts to 30 ft. lbs.
9. Install yoke, washer, and lock nut output shaft.
10. Position range rail in 'high' and install output shaft and retainer assembly on transfer case. Torque housing bolts to 30 ft. lbs.

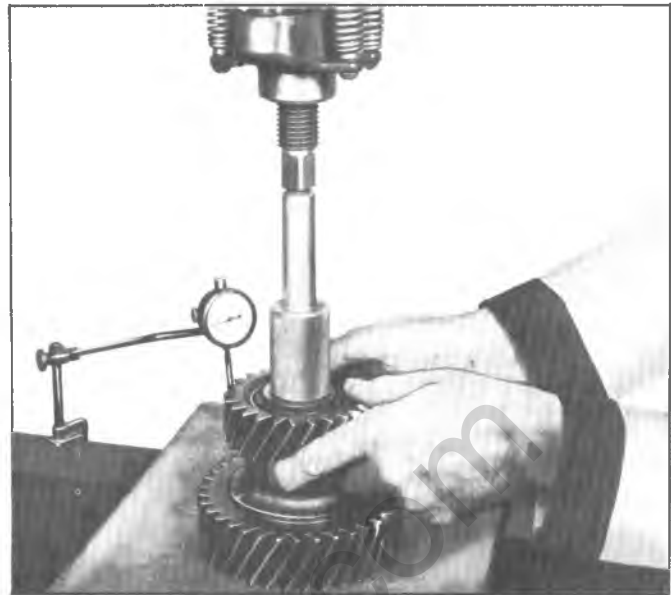


Fig. 11C-Checking Idler Gear End Play

Miscellaneous

1. Install P.T.O. cover and gasket. Torque bolts to 15 ft. lbs.
2. Install and seal cup plugs at rail pin holes, if not previously done.
3. Install drain and filler plugs and torque to 30 ft. lbs.
4. Install shift rail cross link, clevis pins and lock pins.

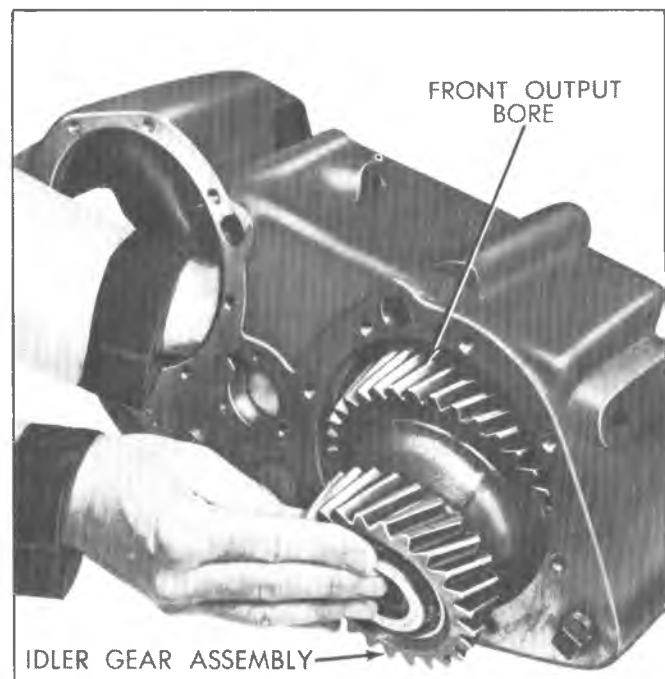


Fig. 12C-Installing Idler Gear

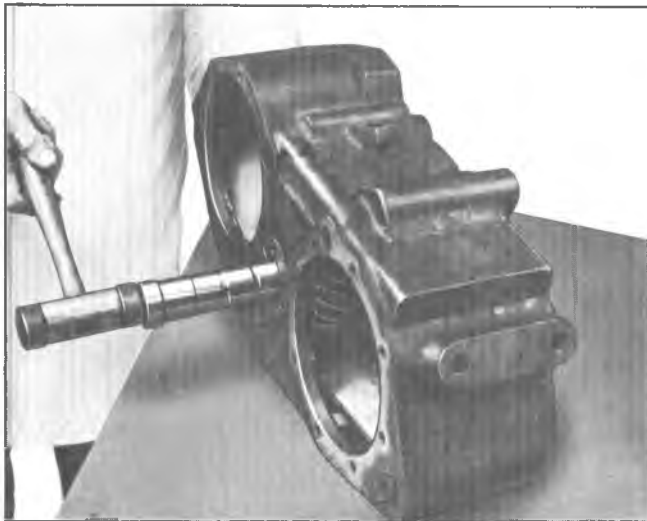


Fig. 13C--Installing Idler Shaft

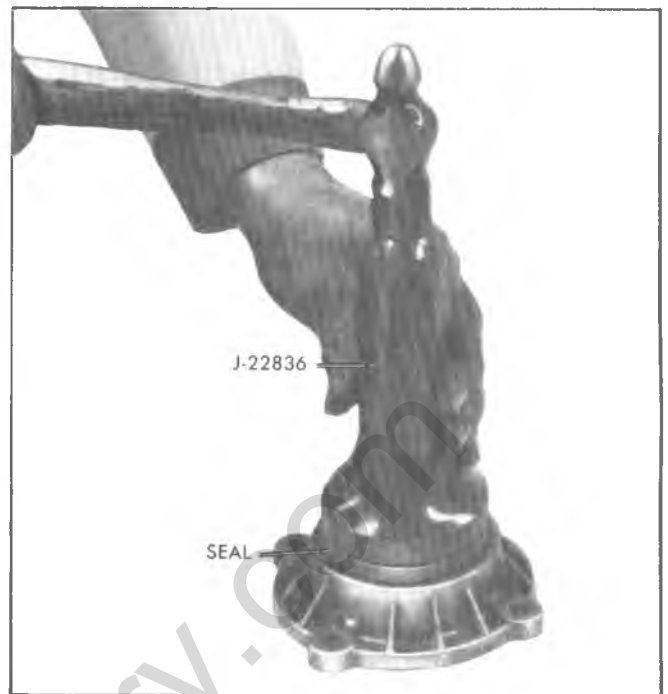


Fig. 16C--Installing Front Output Bearing Retainer Seal

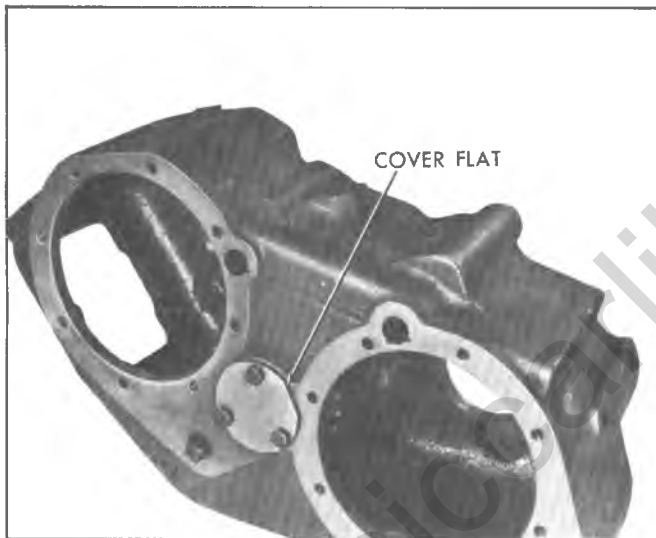


Fig. 14C--Installing Idler Shaft Rear Cover

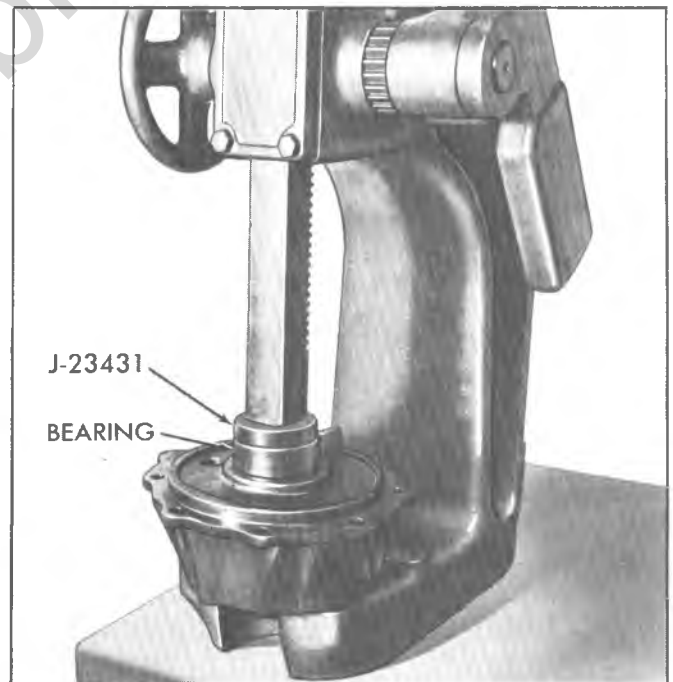


Fig. 17C--Installing Rear Output Shaft Housing Bearing

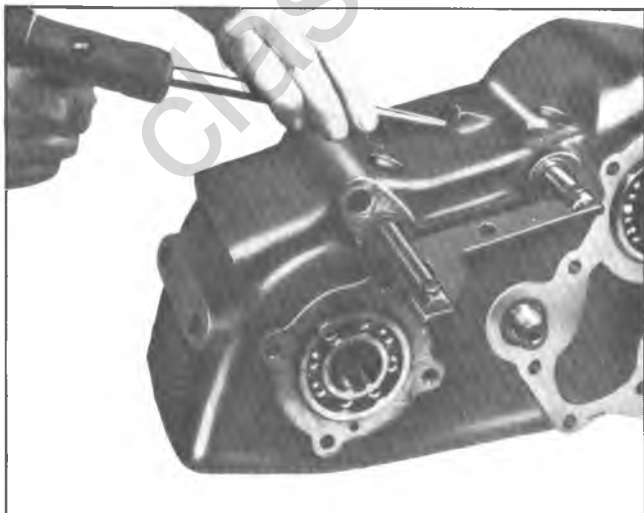


Fig. 15C--Installing Shift Rail Lock Pins



Fig. 18C-Installing Rear Output Shaft Spacer and Speedometer Gear

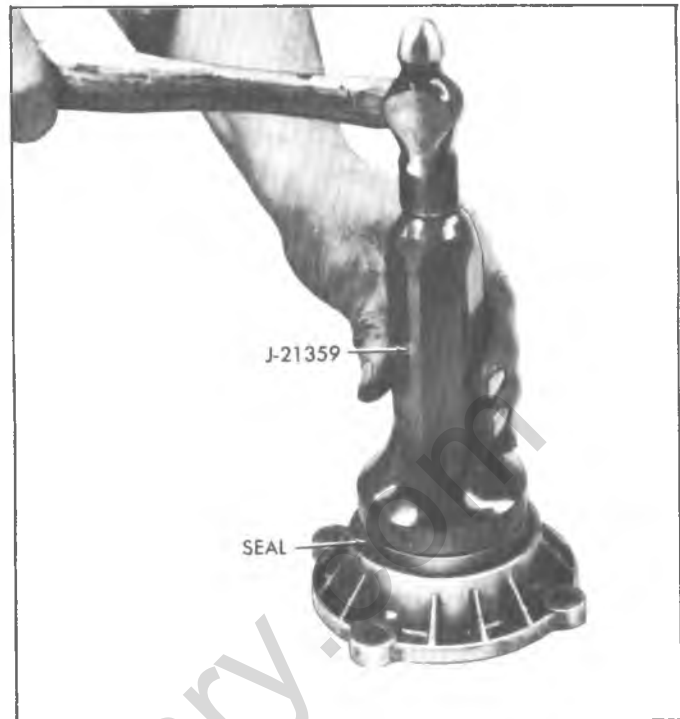


Fig. 19C-Installing Rear Bearing Retainer Seal

NEW PROCESS TRANSFER CASE MODEL 203

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DISASSEMBLY OF TRANSFER CASE

Refer to figures 1F and 11F for cross sectional and exploded views of the transfer case.

1. Position transfer case on work bench or suitable work table (Fig. 2F and 3F).

NOTE: If lubricant was not drained from unit prior to removal from vehicle, remove front output rear cover and P.T.O. cover lower bolts and drain lubricant into waste container.

2. Using Tool J-8614-1, loosen rear output shaft flange retaining nut (Fig. 4F).
3. Using Tool J-8614-1, remove front output shaft flange retaining nut, washer and flange.

NOTE: Tap dust shield rearward on shaft (away from bolts) to obtain clearance to remove bolts from flange and allow installation of Tool J-8614-1.

4. Remove bolts retaining front output shaft front bearing retainer (Fig. 5F). Remove bearing retainer and gasket from transfer case. Discard gasket.
5. Using a hoist or other suitable lifting tool, position assembly on blocks (Fig. 6F).
6. Remove bolts retaining rear output shaft assembly to transfer case and disengage assembly from transfer case. Remove and discard gaskets.
7. Slide carrier unit from shaft.

NOTE: A 1-1/2" to 2" water hose band type clamp may be installed on the input shaft at this time to prevent loosening bearings when removing input shaft assembly from the range box.

8. Raise shift rail and drive out pin retaining shift fork to rail (Fig. 7F).
9. Remove shift rail poppet ball plug, gasket spring and ball from case (Fig. 8F). A small magnet may be used to remove ball from case.
10. Push shift rail down, lift up on lockout clutch and remove shift fork from clutch assembly.
11. Remove bolts retaining front output shaft rear bearing retainer to transfer case. Tap on front of shaft or carefully pry retainer away from case. Remove retainer from shaft and discard gasket. Recover any roller bearings which may fall from rear cover.

NOTE: If necessary to replace rear bearing, support cover and press bearing from cover. Position new bearing to outside face of cover and press bearing into cover until flush with opening.

12. From lower side of case, remove (pry) output shaft front bearing.
13. Disengage front output shaft from chain and remove shaft from transfer case (Fig. 9F).
14. Remove bolts attaching intermediate chain housing to range box. Lift or using a chain hoist, remove intermediate housing from range box (Fig. 10F).
15. Remove chain from intermediate housing.
16. Remove lockout clutch, drive gear and input shaft assembly from range box.

NOTE: A 1 1/2" to 2" hose clamp may be installed on end of the input shaft to prevent loosening the roller bearings (123) which may fall out of clutch assembly if it is pulled off the input shaft.

17. Pull up on shift rail and disconnect rail from link.
18. Remove (lift) input shaft assembly from range box.

NOTE: At this point the transfer case is completely disassembled into its subassemblies. Each of these subassemblies should then be disassembled for cleaning and inspection.

CLEANING AND INSPECTION

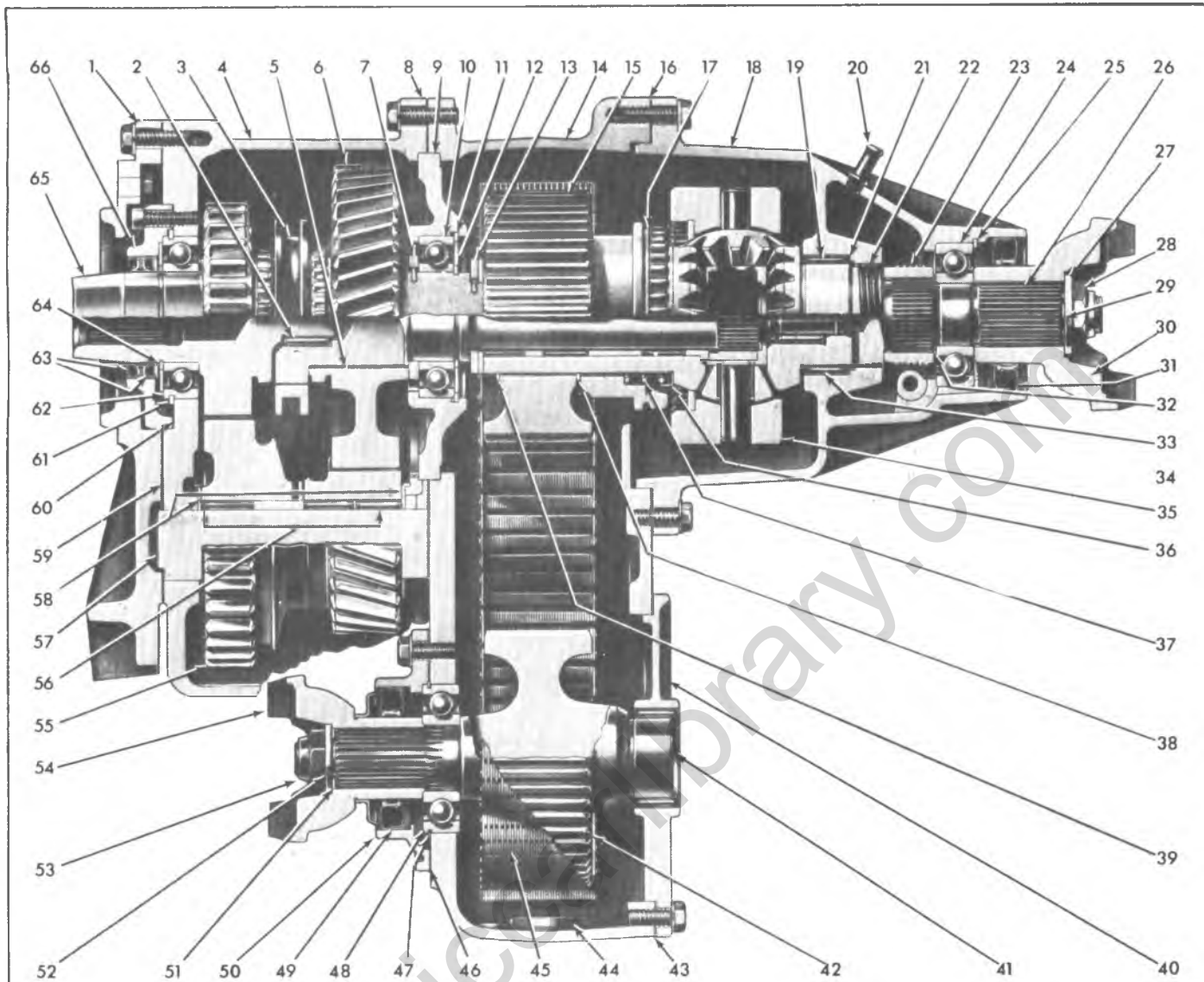
BEARINGS—Place all bearings and rollers in cleaning solution and allow to remain long enough to loosen all accumulated lubricant. Bearings should be sloshed up and down and turned slowly below surface of solution to remove as much lubricant as possible. Remove bearings and blow dry with compressed air, being careful to direct air across bearing so that bearings do not spin.

SHAFTS AND GEARS—Clean all shafts and gears in cleaning solution to remove all accumulations. Dry with compressed air.

CASE, COVER AND HOUSINGS—Transfer case, cover, and housings must be thoroughly cleaned in solution to remove all accumulation of lubricant and dirt. Remove all trace of gaskets from surfaces where used.

INSPECTION—Carefully inspect all bearings and rollers for evidence of chipping, cracks, or worn spots that would render bearing unfit for further service. Bearings are non-adjustable and if worn or damaged, must be

7M-66 CLUTCHES AND MANUAL TRANSMISSIONS



- | | | |
|--|-----------------------------------|-----------------------------------|
| 1. Adapter | 23. Speedometer Drive Gear | 45. Drive Chain |
| 2. Input Drive Gear Pilot Brgs. | 24. Rear Output Rear Brg. | 46. Gasket |
| 3. Range Selector Sliding Clutch | 25. Brg. Retainer Ring | 47. Brg. Outer Ring |
| 4. Range Selector Housing | 26. Rear Output Shaft | 48. Front Output Front Brg. |
| 5. Low Speed Gear Bushing | 27. Washer | 49. Front Output Shaft Seal |
| 6. Low Speed Gear | 28. Locknut | 50. Front Output Brg. Retainer |
| 7. Thrust Washer & Locating Pin | 29. Rubber Spline Seal | 51. Rubber Spline Seal |
| 8. Gasket | 30. Rear Output Yoke | 52. Washer |
| 9. Input Brg. Retainer | 31. Rear Output Seal | 53. Locknut |
| 10. Input Brg. | 32. Shims | 54. Front Output Yoke |
| 11. Brg. Outer Ring | 33. Input Shaft "O" Ring | 55. Countergear |
| 12. Brg. Retaining Ring | 34. Input Shaft Pilot Bearings | 56. Countergear Spacers and Brgs. |
| 13. Thrust Washer, Locating Pin, Lubricating Washer & Spacer | 35. Differential Carrier Assembly | 57. Countergear Shaft |
| 14. Intermediate (Chain Housing) | 36. Spring Washer Cup | 58. Countergear Thrust Washer |
| 15. Drive Shaft Sprocket | 37. Lockout Clutch Spring | 59. Gasket |
| 16. Gasket | 38. Snap Ring | 60. Brg. Retainer Gasket |
| 17. Sliding Lock Clutch | 39. Snap Ring | 61. Brg. Outer Ring |
| 18. Rear Output Housing | 40. Front Output Rear Brg. Cover | 62. Input Gear Brg. |
| 19. Rear Output Front Brg. | 41. Front Output Rear Brg. | 63. Input Gear Seals (2) |
| 20. Vent | 42. Front Output Drive Sprocket | 64. Brg. Snap Ring |
| 21. Oil Seal | 43. Gasket | 65. Input Gear |
| 22. Oil Pump | 44. Magnet | 66. Input Gear Brg. Retainer |

Fig. 1F—Transfer Case Cross Sectional View

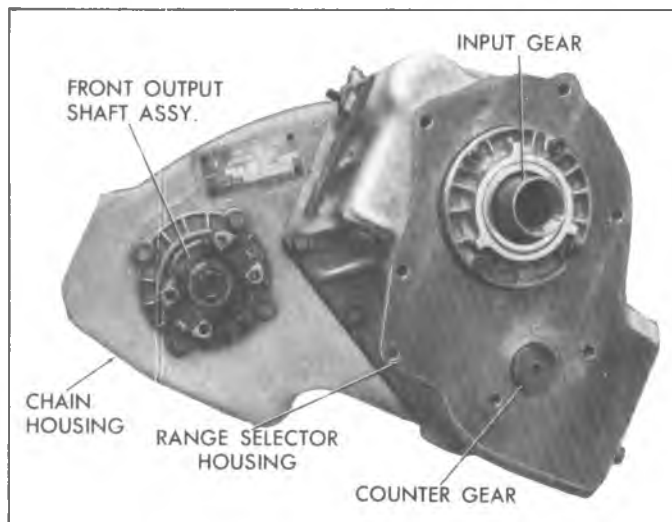


Fig. 2F—Front View of Transfer Case

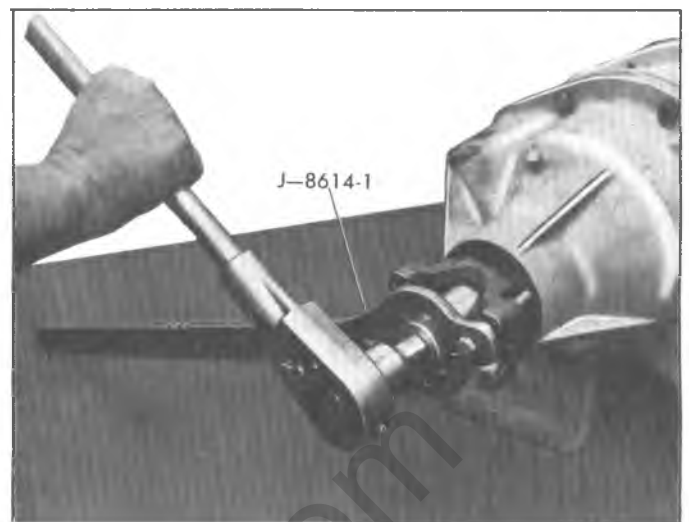


Fig. 4F—Removing Rear Output Shaft Flange Nut

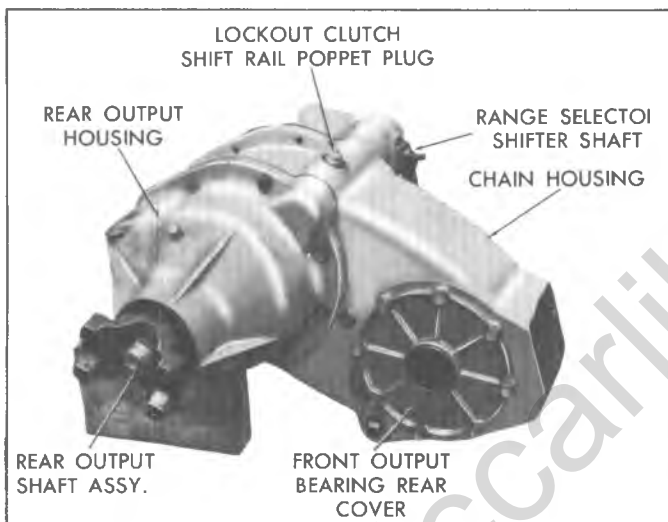


Fig. 3F—Rear View of Transfer Case

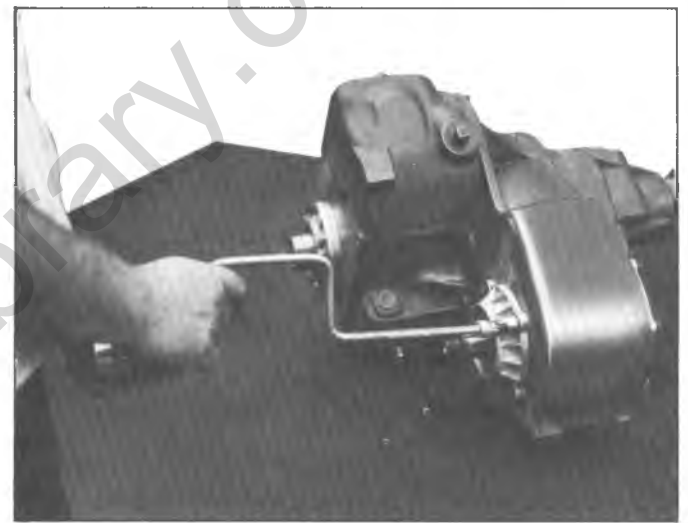


Fig. 5F—Removing Front Output Shaft Front Bearing Retainer

replaced with new parts. Inspect shaft splines drive chain and gears. If any indication of failure, such as chipped teeth or excessive wear, is indicated, those parts should be replaced with new parts.

SUBASSEMBLY REPAIRS

NOTE: Refer to figure 11F for exploded view of subassemblies.

Differential Carrier Assembly (Fig. 11F)

Disassembly

1. Remove bolts from carrier assembly and separate carrier sections.
2. Lift the pinion gear and spider assembly from carrier.

NOTE: Observe that undercut side of pinion gear spider faces toward front side gear.

3. Remove the pinion thrust washers, pinion roller

washers pinion gears and roller bearings from the spider unit.

4. Clean and inspect all components. Replace all worn or broken parts.

Assembly

1. Using a petroleum jelly, load roller bearings in pinion gears (132 required, 33 each pinion).
2. Install pinion roller washer, pinion gear, roller washer and thrust washer on each leg of spider.
3. Place the spider assembly in the carrier (front half) with undercut surface of spider thrust surface facing downward or toward gear teeth.
4. Align marks on carrier sections and position carrier halves together. Install retaining bolts and tighten to specifications.

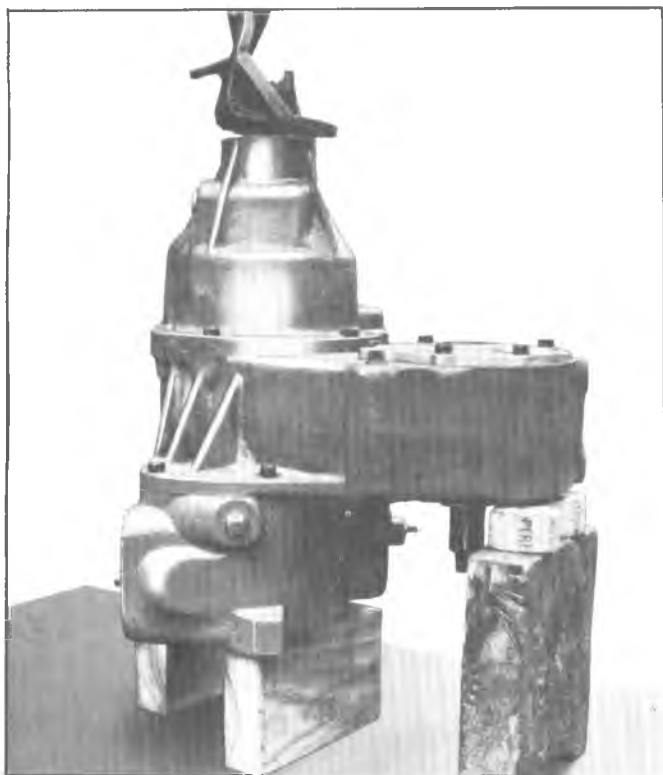


Fig. 6F—Positioning Transfer Case for Disassembly

Input Shaft Assembly (Fig. 11F)

Disassembly

1. Slide thrust washer and spacer from shaft.
2. Using snap ring pliers, remove snap ring retaining input bearing retainer assembly to shaft (fig. 12F) and remove bearing retainer assembly from shaft.
3. Support low speed gear (large gear) and tap shaft from gear and thrust washer.

NOTE: Observe thrust washer pin(s) located in shaft (fig. 11F).

4. Using a screw driver, pry behind open end of large snap ring retaining input bearing in bearing retainer (fig. 13F) and remove ring from retainer. Tap bearing from retainer.
5. Remove pilot roller bearings (15) from end of input shaft.



Fig. 7F—Removing Shift Fork Retaining Pin

Lockout Clutch Assembly (Fig. 11F)

Disassembly

1. Remove front side gear from input shaft assembly and remove thrust washer, roller bearings (123) and spacers from front side gear bore. Note position of spacers to facilitate reassembly.
2. Using snap ring pliers, remove the snap ring retaining drive sprocket to clutch assembly. Slide the drive sprocket from the front side gear.
3. Using snap ring pliers, remove lower snap ring.
4. Remove sliding gear, spring and spring cup washer from front side gear.
5. Clean and inspect all components. Replace all worn or defective parts.

Assembly

1. Install spring cup washer, spring and sliding clutch gear on front side gear.
2. Install snap ring retaining sliding clutch to front side gear.
3. Using a petroleum jelly, load roller bearings (123) and spacers in the front side gear.
4. Install thrust washer in gear end of front side gear.
5. Slide drive sprocket on to clutch splines and install retaining ring.

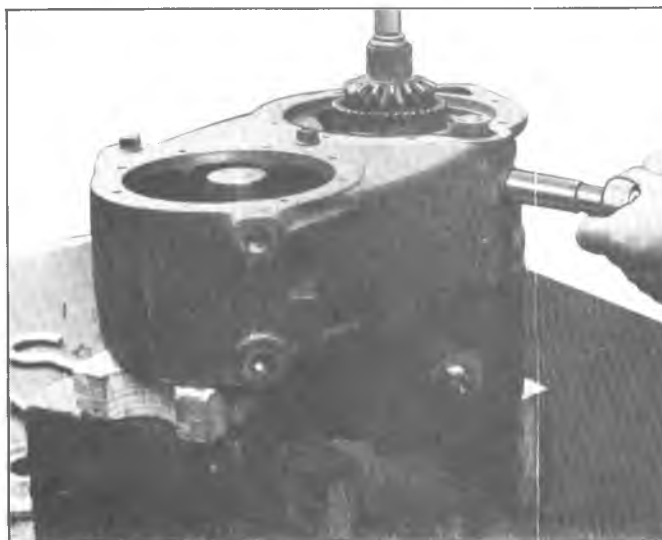


Fig. 8F—Removing or Installing Poppet Ball Plug

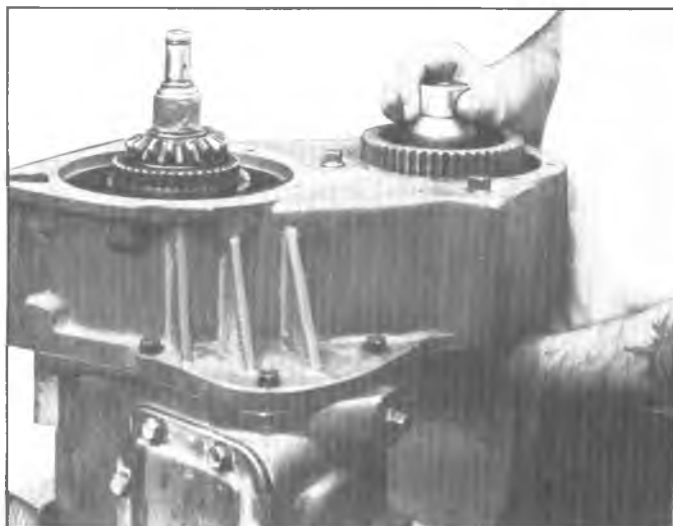


Fig. 9F—Removing Front Output Shaft

6. Remove "O" ring from end of shaft and discard.
7. Clean and inspect all components. Replace as required.

Assembly

1. Position bearing to retainer and tap or press into place. Ball loading slots should be toward concave side of retainer.
2. Install large snap ring securing bearing in retainer.
NOTE: Snap ring is a select fit. Use size A, B, C or D as required to provide tightest fit.
3. Install low speed gear on shaft with clutch end toward gear end of shaft.
4. Position thrust washers on shaft, aligning slot in washer with pin in shaft. Slide or tap washer into place.
5. Position input bearing retainer on shaft and install snap ring, holding bearing in place on shaft.
NOTE: Snap ring is a select fit. Use size A, B, C or D as required to provide tightest fit.
6. Slide spacer and thrust washer onto shaft. Align spacer with locator pin.
7. Using a heavy grease, install roller bearings (15) in end of shaft.
8. Install new rubber "O" ring on end of shaft.

Range Selector Housing (Range Box)

Disassembly (Fig. 11F)

Removing Shifter Assembly

1. Remove poppet plate spring, plug and gasket. Discard gasket.
2. Disengage sliding clutch gear from input gear and remove clutch fork and sliding gear from case.
3. Remove shift lever assembly retaining nut and

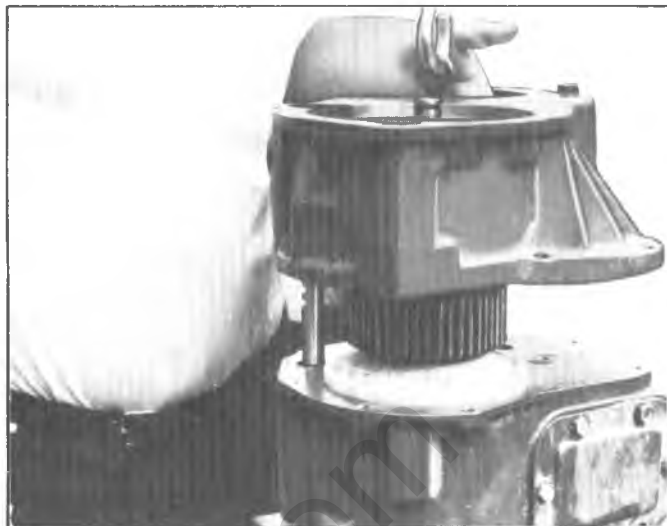


Fig. 10F—Removing Intermediate (Chain) Housing

- upper shift lever from shifter shaft.
4. Remove shift lever snap ring and lower lever.
5. Push shifter shaft assembly downward and remove lockout clutch connector link.

NOTE: Long end of connector link engages poppet plate.

6. Remove shifter shaft assembly from case and separate the inner and outer shifter shafts. Remove and discard "O" rings.
7. Inspect poppet plate for damage. If necessary to remove, drive pivot shaft from case. Remove poppet plate and spring from bottom of case.

Removing Input Gear Assembly

8. Remove input gear bearing retainer and seal assembly. Discard gasket.
9. Remove large snap ring from bearing outer diameter.
10. Tap input gear and bearing from case.
11. Remove snap ring retaining input shaft bearing to shaft and remove bearing from input gear.

NOTE: This is a select fit snap ring. Snap rings, size A, B, C, and D are released for service. Select tightest fit.

Removing Cluster Gear Assembly (Fig. 14F)

12. From intermediate case side, remove counter shaft from cluster gear and case using Tool J-24745. Remove cluster gear assembly from case.

NOTE: Recover roller bearings (72 required) from gear case and shaft.

13. Remove cluster gear thrust washers from case.
14. Clean and inspect all components. Replace worn and defective parts.

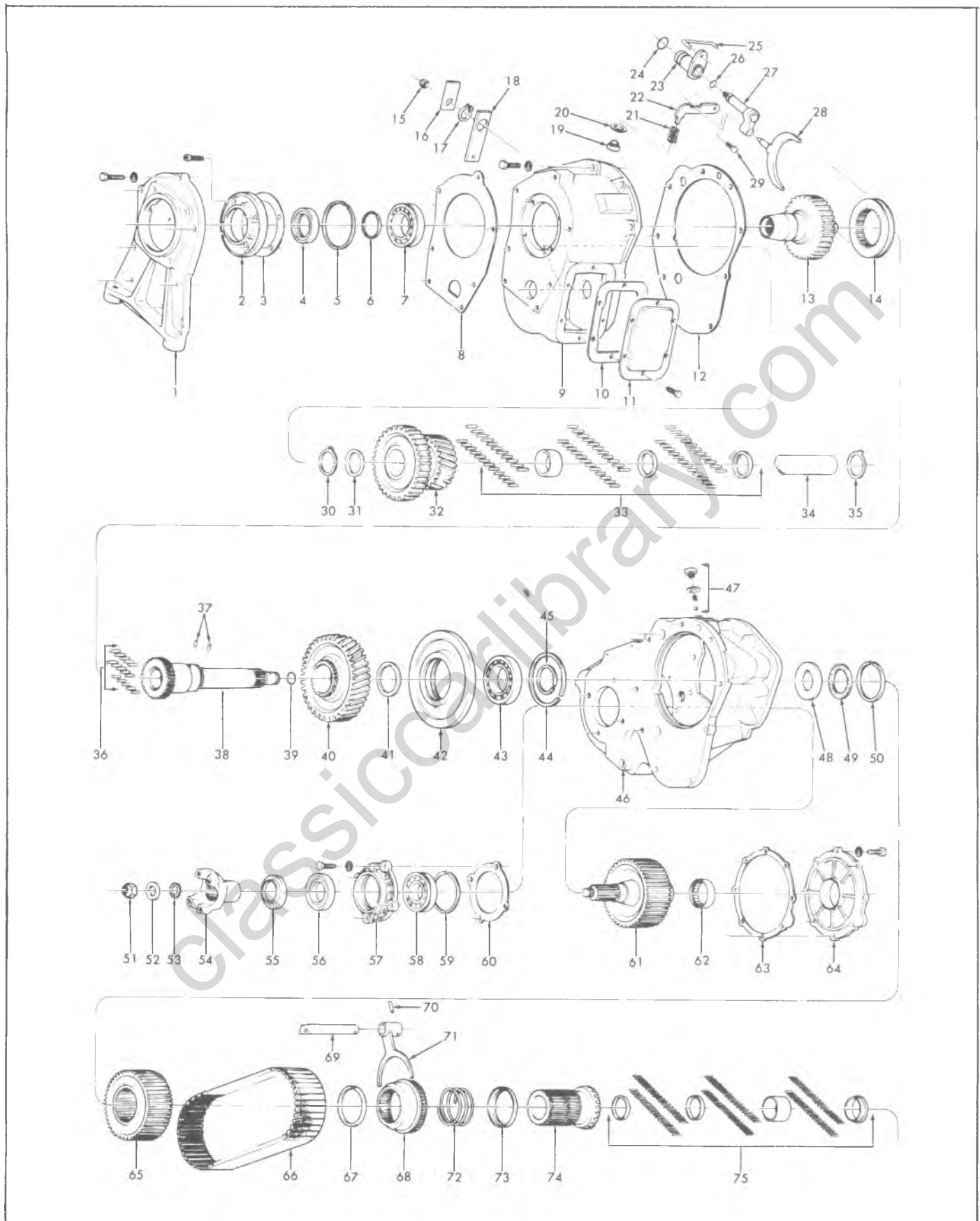


Fig. 11F—Transfer Case Exploded View

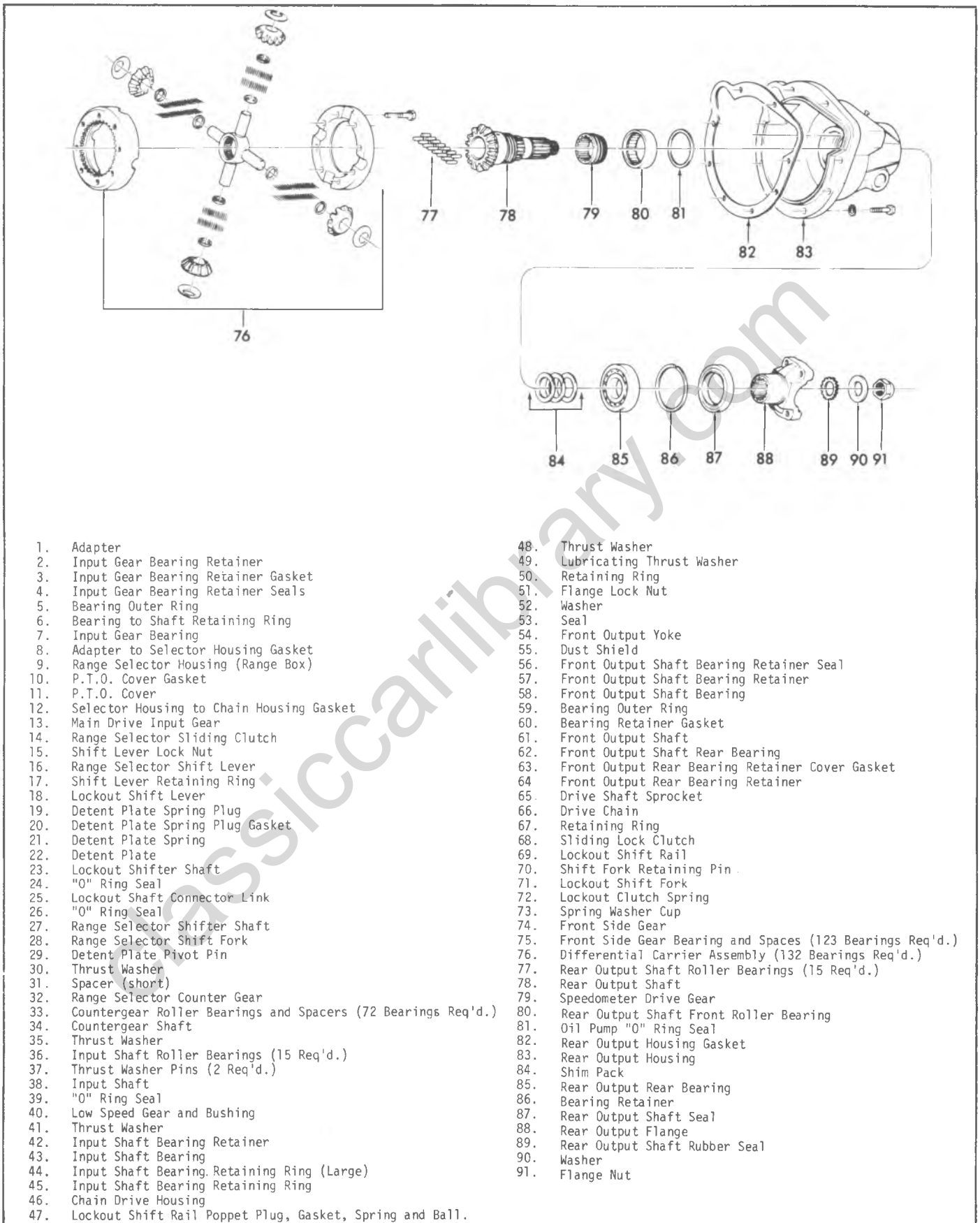


Fig. 11F—Transfer Case Exploded View Continued

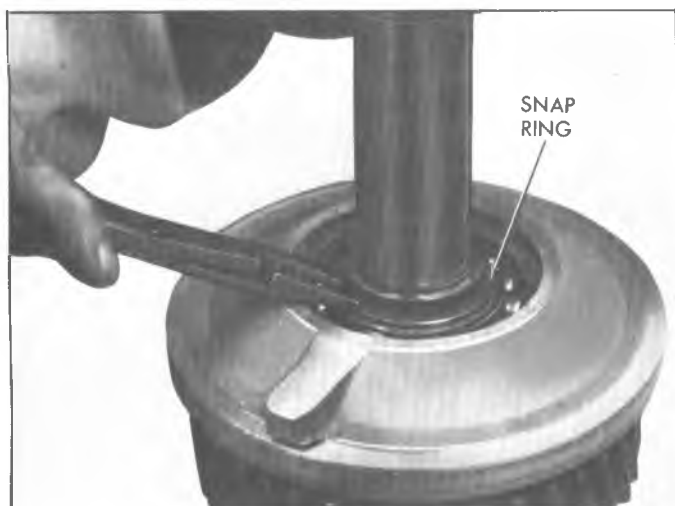


Fig. 12F—Removing Input Shaft-to-Bearing Snap Ring

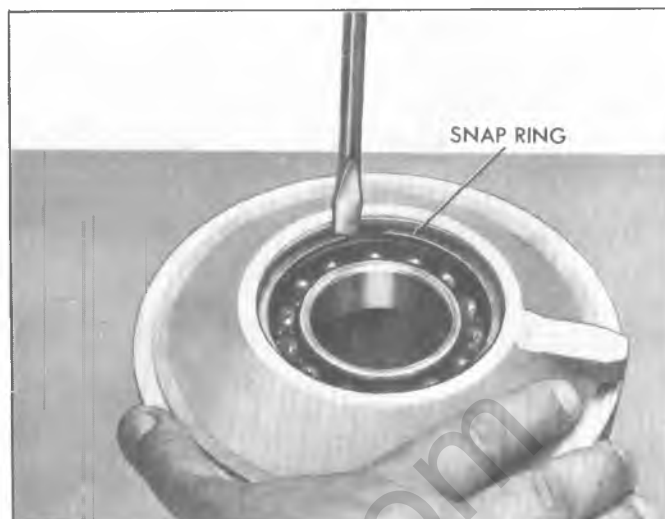


Fig. 13F—Removing Input Shaft Bearing-to-Retainer Snap Ring

Assembly (Fig. 11F)

Installing Countergear Assembly

1. Using Tool J-24745 and a heavy grease, install roller bearings (72 required) and spacers in clustergear bore.
2. Using a heavy grease, position countershaft thrust washers in case. Engage tab on washers with a slot in case thrust surface.
3. Position cluster gear assembly in case and install countershaft through front face of range box into gear assembly. Countershaft face with flat should face forward and must be aligned with case gasket.

Installing Input Gear Assembly

4. Install bearing (without large snap ring) on input gear shaft positioning snap ring groove outward and install new retaining ring on shaft. Position input gear and bearing in housing.

NOTE: The retaining ring is a select fit. Use service ring size A, B, C or D as required to provide tightest fit.

5. Install snap ring in outside diameter of bearing.
6. Align oil slot in retainer with drain hold in case and install input gear bearing retainer, gasket and retaining bolts. Tighten bolts to specifications.

Installing Shifter Shaft Assembly

7. If removed, install poppet plate and pivot pin assembly in housing. Use sealant on pin.
8. Install new "O" rings on the inner and outer shifter shafts. Lubricate "O" rings and assemble inner shaft in the outer shaft.
9. Push the shifter shafts into the housing, engaging the long end of the lockout clutch connector link to the outer shifter shaft before the shaft assembly bottoms out.
10. Install lower shift lever and retaining ring.

11. Install upper shift lever and shifter shaft retaining nut.
12. Install shift fork and sliding clutch gear. Push fork up into shifter shaft assembly to engage poppet plate, sliding clutch gear forward onto the input shaft gear.
13. Install poppet plate spring, gasket and plug in top of housing. Check spring engagement with poppet plate.

Input Gear Bearing Replacement

1. Remove bearing retainer attaching bolts, retainer and gasket from housing. Discard gasket.
2. Using snap ring pliers, remove snap ring retaining bearing on shaft. Discard snap ring.
3. Using a screwdriver or other suitable tool, pry the bearing from case and remove it from the shaft.

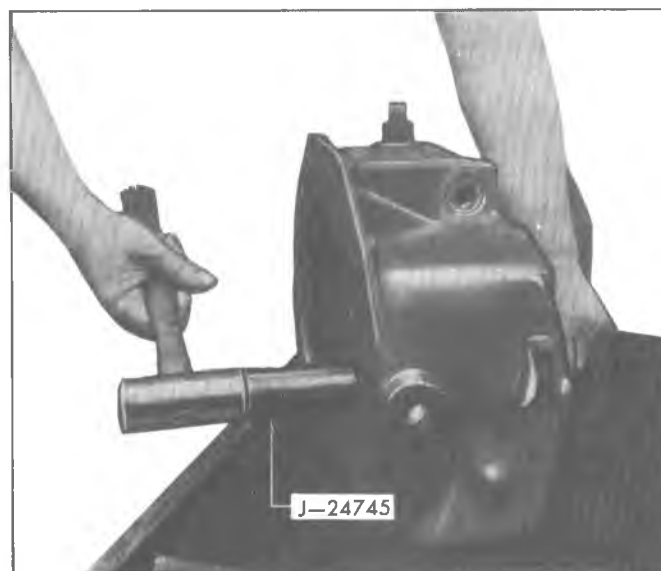


Fig. 14F—Removing Cluster Gear Shaft

NOTE: Inspect input gear for defects such as burrs, scoring, heat discoloration, etc. Inspect seal in bearing retainer. Replace as required.

4. Install new bearing with snap ring on input gear shaft. Position bearing to case and tap in to place with a soft hammer.

NOTE: Select service ring, size A, B, C or D, that will provide tightest fit.

5. Install new snap ring to retain bearing on the shaft.
6. Position new gasket and the bearing retainer to housing. Install retaining bolts, tightening to specifications.

Input Gear Bearing Retainer Seal Replacement

1. Remove bearing retainer attaching bolts, retainer and gasket from housing. Discard gasket.
2. Pry seal out of retainer and discard.
3. Position new seal to retainer and install using tool J-21359 (Fig. 15F).
4. Position bearing retainer and gasket to housing. Install attaching bolts and tighten to specifications.

Rear Output Shaft Housing Assembly (Fig. 11F)

Disassembly

1. Remove speedometer driven gear from housing.
2. Remove flange nut and washer, if not removed during disassembly of transfer case. Remove flange from shaft.
3. Tap on flange end of pinion with a soft hammer and remove pinion from carrier. If speedometer drive gear is not on pinion shaft, reach into carrier and remove it from housing.
4. Pry old seal out of bore, using a screw driver or other suitable tool.
5. Using a screwdriver, pry behind open ends of snap ring and remove snap ring retaining rear bearing in housing (fig. 16F).
6. Pull or tap bearing from housing.
7. To remove the front bearing, insert a long drift through rear opening and drive bearing from housing (Fig. 17F). Remove and discard rubber seal.

Assembly

1. Position rubber seal in bearing bore. Use grease to hold in place. Position roller bearing in bore and press into place until bearing bottoms out in housing.
2. Position rear bearing to case and tap into place.
3. Install snap ring retaining bearing to case.

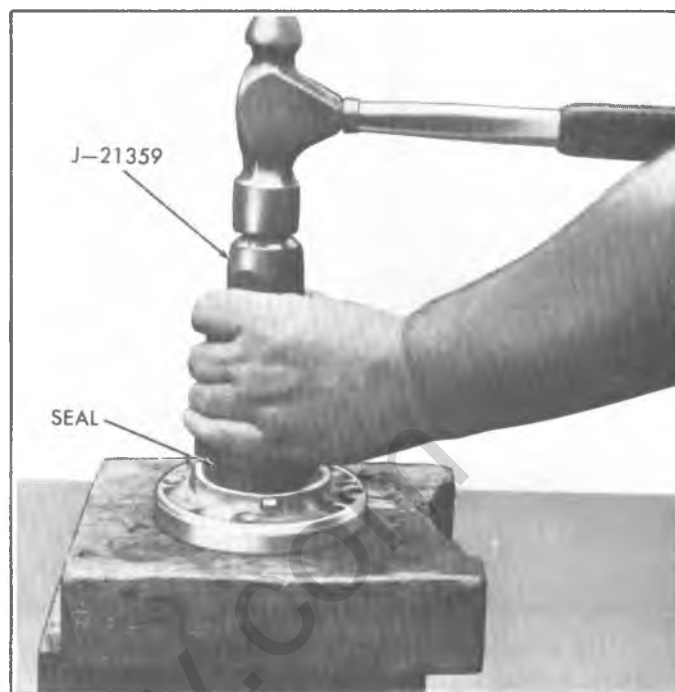


Fig. 15F—Installing Input Shaft Bearing Retainer Seal

NOTE: Retaining Ring is a select fit. Use service ring size A, B, C or D as required to provide tightest fit.

4. Position rear seal to bore and drive into place using tool J-22388 (fig. 18F) or other suitable tool until approximately 1/8" to 3/16" below housing face.
5. Install speedometer drive gear and shims (approximately .050 inch thickness) on output shaft. Install shaft into carrier through front opening.
6. Install flange, washer and retaining nut. Leave nut loose (approximately .060 inch) until shim requirements are determined.
7. Install speedometer driven gear in case.

Front Output Shaft Bearing Retainer Seal Replacement (Fig. 19F)

1. Pry or drive out existing seal from retainer bore.
2. Clean and inspect retainer.
3. Apply sealer to outer diameter of new seal.
4. Position seal to retainer bore and using Tool J-22836 or equivalent, install seal in retainer.

Front Output Shaft Rear Bearing Replacement

1. Remove rear cover from transfer case. Remove gasket and discard.
2. Support rear cover and press bearing from cover.
3. Position new bearing to outside face of cover and using a piece of wood to cover bearing, press

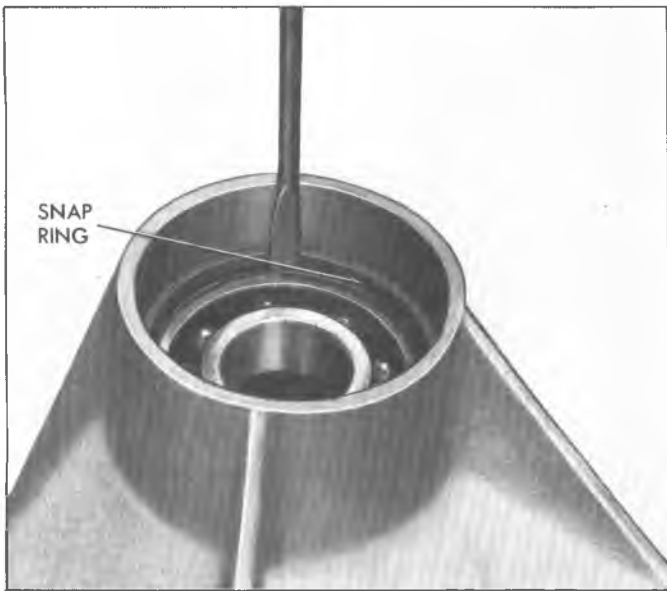


Fig. 16F—Removing Rear Output Bearing Retaining Ring

bearing into cover until flush with opening.

4. Position gasket and cover to transfer case and tap into place.
5. Install cover retaining bolts and torque to specifications.

ASSEMBLY OF TRANSFER CASE (FIGS. 1F AND 11F)

1. Place range box on blocks, with input gear side toward bench (fig. 20F).
2. Position range box-to-transfer case housing gasket on input housing.
3. Install lockout clutch and drive sprocket assembly on the input shaft assembly.

NOTE: A 2" band clamp may be installed on end of shaft to prevent losing bearings from clutch assembly.

4. Install input shaft, lockout clutch and drive sprocket assembly in the range box, aligning tab on bearing retainer with notch in gasket.
5. Connect lockout clutch shift rail to the connector link and position rail in housing bore (fig. 21F). Rotate shifter shaft lowering shift rail into the housing, to prevent the link and rail from being disconnected.
6. Install drive chain in chain housing, positioning the chain around the outer wall of the housing.
7. Install the chain housing on the range box (fig. 22), engaging the shift rail channel of the housing to the shift rail. Position chain on the input drive sprocket.
8. Install the front output sprocket in the case, engaging the drive chain to the sprocket. Rotate

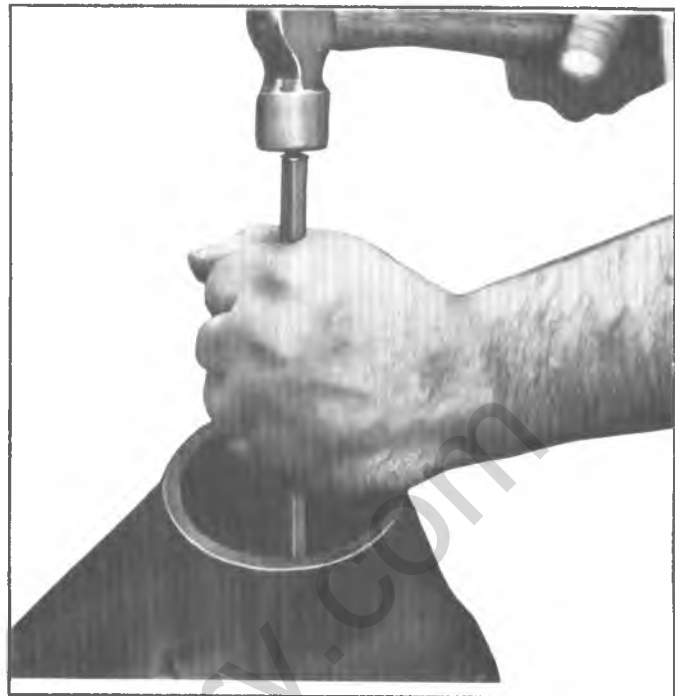


Fig. 17F—Removing Rear Output Shaft Front Bearing



Fig. 18F—Installing Rear Output Housing Seal

clutch drive gear to assist in positioning chain on the drive sprocket.

9. Install the shift fork on the clutch assembly and the shift rail, then push the clutch assembly fully into

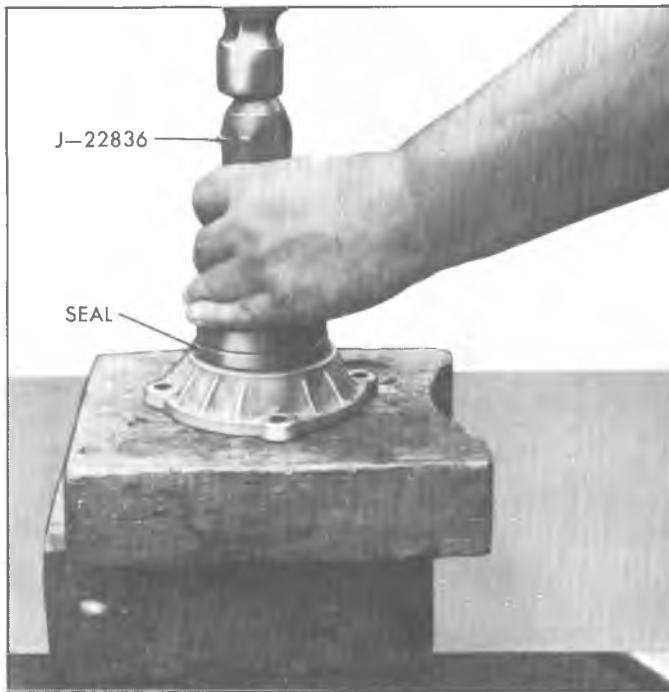


Fig. 19F—Installing Front Output Bearing Retainer Seal

- the drive sprocket. Install roll pin retaining shift fork to shift rail.
10. Install front output shaft bearing.
 11. Install front output shaft bearing retainer, gasket, and retaining bolts.
 12. Install the front output shaft flange, gasket, seal, washer and retaining nut. Tap dust shield back in place after installing bolts in flange.
 13. Install front output shaft rear bearing retainer,



Fig. 20F—Positioning Range Box for Assembly

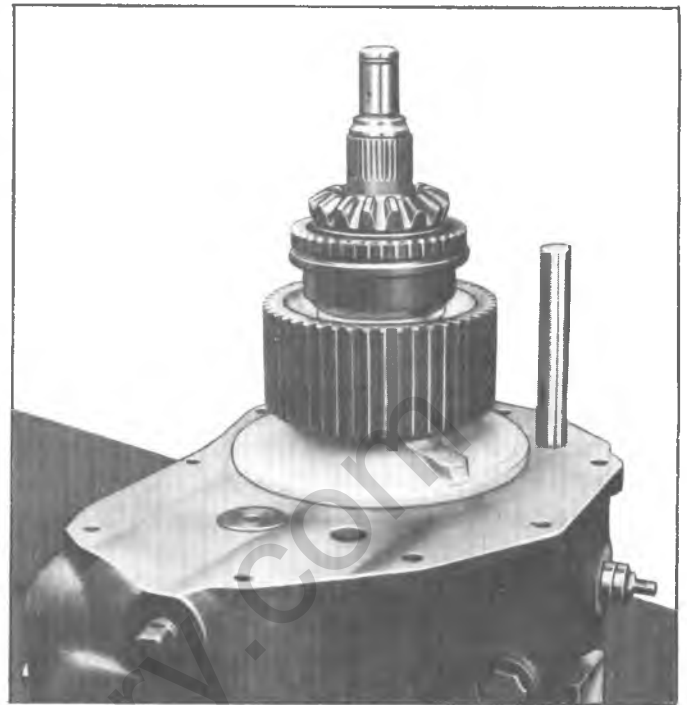


Fig. 21F—Drive Gear and Lockout Clutch Assembly Installed

gasket and retaining bolts. NOTE: If rear bearing was removed, position new bearing to outside face of cover and press into cover until bearing is flush with opening.

14. Install differential carrier assembly on the input shaft. Carrier bolt heads should face rear of shaft.

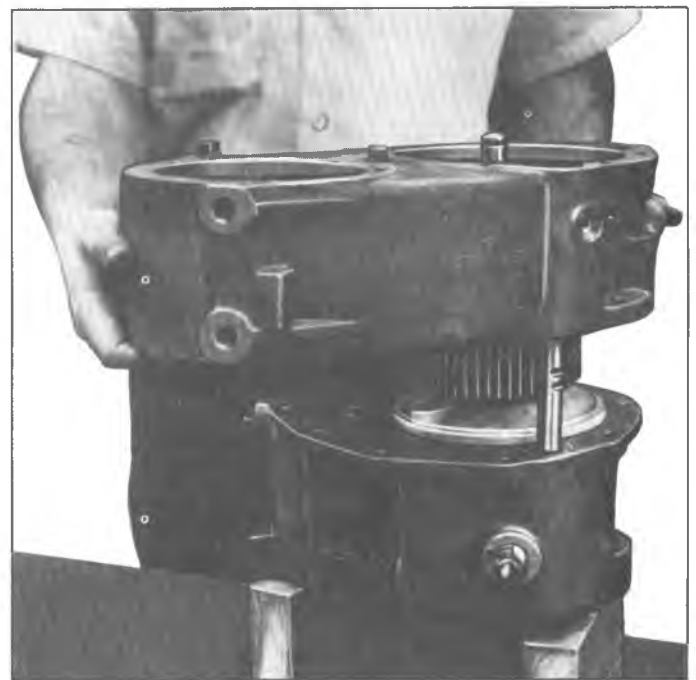


Fig. 22F—Installing Intermediate Housing to Range Box

15. Install rear output housing assembly, gasket and retaining bolts. (Load bearings in pinion shaft.)
16. Check rear output shaft end play. Install a dial indicator on the rear housing (fig. 23F) so that it contacts the end of the output shaft. Holding the rear flange, rotate the front output shaft and determine the highest point of gear hop out on the rear shaft. Zero indicator and with rear shaft set at this high point, pull up on end of shaft to determine end play (gap between bearing shoulders of shaft and the housing).
17. Remove dial indicator and install shim pack onto shaft, in front of rear bearing, to control end play to within 0 to .005". Hold rear flange and rotate front output shaft to check for binding of the rear output shaft.
18. Install lockout clutch shift rail poppet ball, spring and screw plug in case.
19. Install poppet plate spring, gasket and plug, if not installed during reassembly of range box.
20. Install shift levers on the range box shifter shaft, if not left on linkage in vehicle.
21. Torque all bolts, locknuts and plugs (except filler plug) to specifications.
22. Fill transfer case to proper level with specified

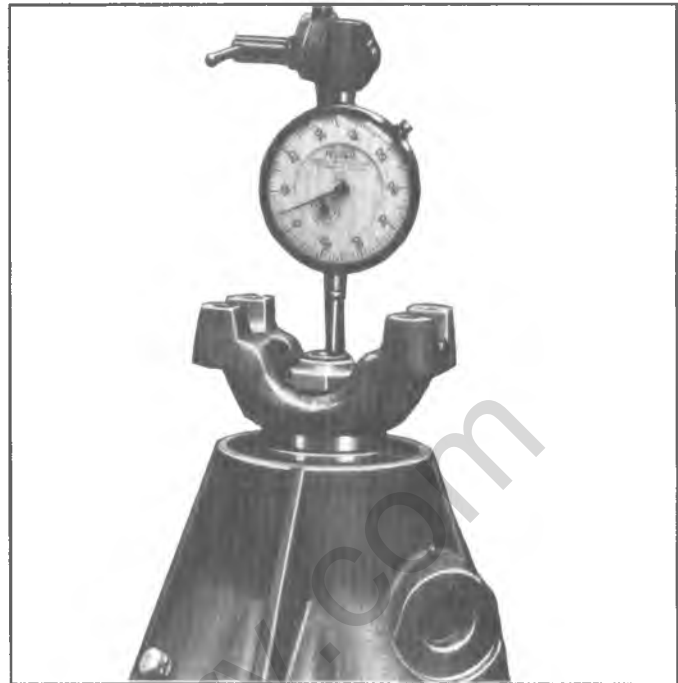


Fig. 23F—Checking Rear Output Shaft End Play lubricant.

23. Install and tighten filler plug to specifications.

ADAPTER ASSEMBLIES

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Automatic Transmissions.....	7M-78

MANUAL TRANSMISSIONS

All Except Adapters Used With the Muncie 3-Speed Transmission or With the Model 203 Transfer Case

Disassembly of Adapter (Figs. 1H and 2H)

1. Using a brass drift or other suitable tool, tap sleeve from adapter.
2. Using a brass drift, punch out oil seal from adapter bore.

Inspection

Inspect the sleeve for any indication of failure. If the

sleeve has chipped teeth or excessive wear, it should be replaced. Check internal snap ring in sleeve. Replace if bent or broken.

Assembly of Adapter

1. Position sleeve to adapter bore and tap into place using a suitable piece of pipe.

NOTE: Assemble drive sleeve with oil groove facing transmission side. Lubricate sleeve spline with transmission oil before assembly.

2. Coat O.D. of seal with sealing compound and install seal using Tool J-23504 and Handle J-8092 in a similar manner as shown in Fig. 2H.

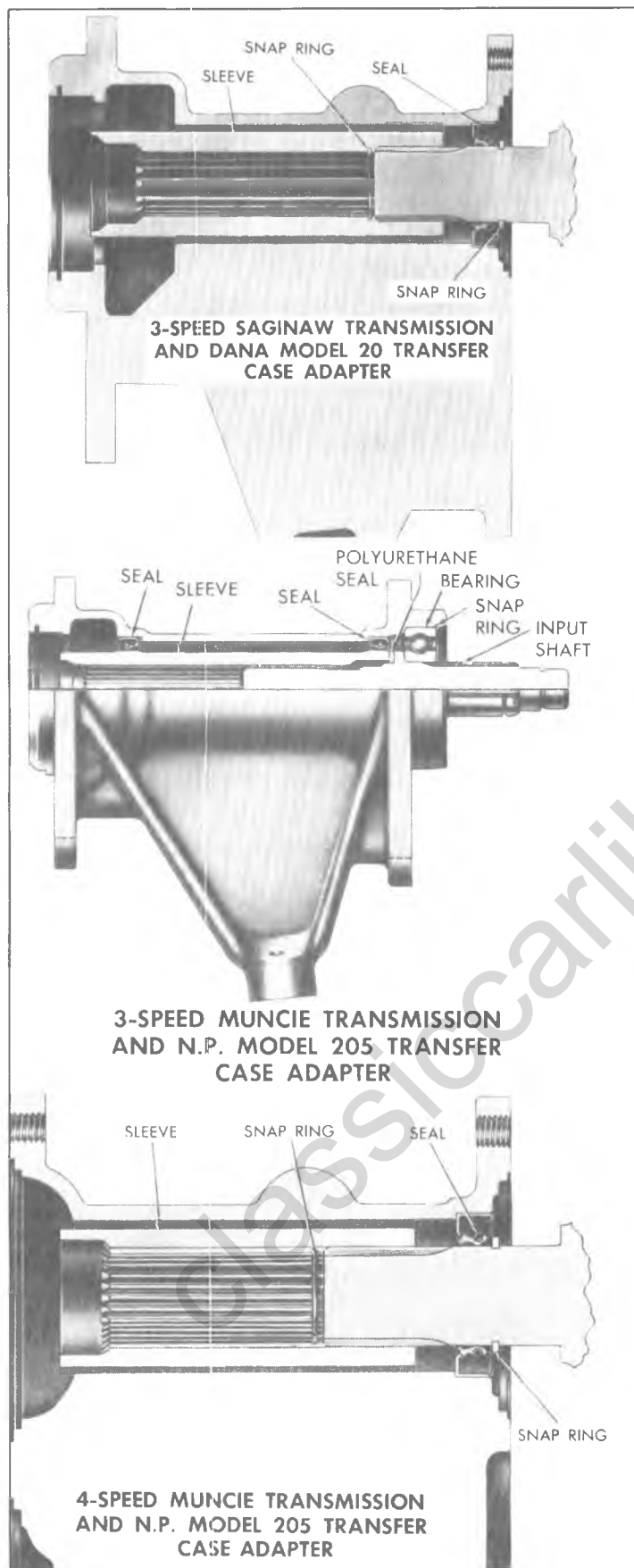


Fig. 1H--Manual Transmission Adapter Assemblies
Except With Model 203 Transfer Case

Muncie 3-Speed Transmission Models

Disassembly of Adapter (Fig. 1H)

1. Remove snap ring retainer drive gear to input shaft and slide gear from shaft.
2. Remove snap ring retaining bearing in adapter bore. Pull input shaft and bearing from adapter.
3. Using a suitable tool or piece of pipe with a diameter comparable to splined sleeve, tap sleeve from adapter.
4. Using a brass drift, punch out the oil seals from the adapter bore.
5. If required, support bearing and press input shaft from bearing.

Assembly of Adapter

1. If removed during disassembly, press new bearing onto input shaft.
2. Using Tool J-7137 and Handle J-8092, install new seals in the adapter bore as shown in Figure 2H.
3. Insert splined sleeve through seals into adapter bore.
4. Insert input shaft and bearing into adapter and install bearing retaining ring.
5. Slide drive gear onto input shaft and install retaining ring.

NOTE: Assemble drive sleeve with oil groove to transmission side. Lubricate sleeve spline and O.D. with transmission oil before assembly.

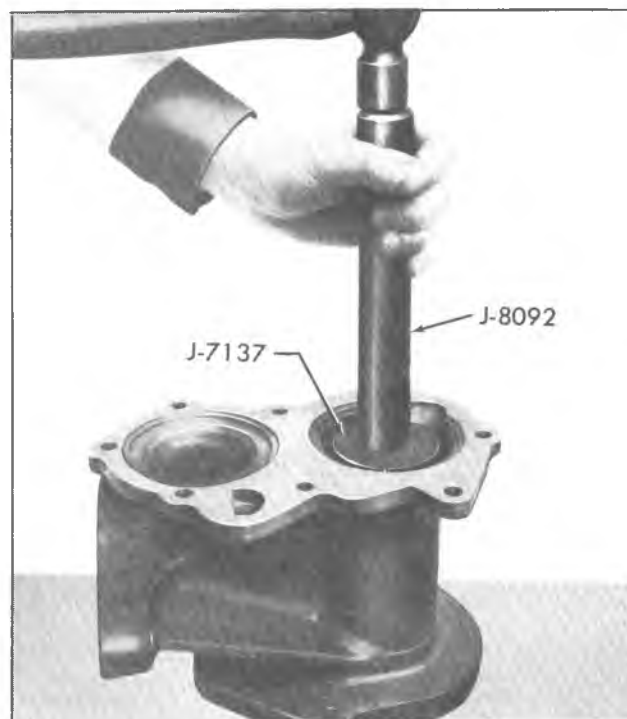


Fig. 2H--Installing Adapter Seal

Model 203 Transfer Case Assemblies

Adapters used the full time 4-wheel drive transfer case assemblies do not require service since there are no internal components such as seals, sleeves or bearings (Fig. 3H).

AUTOMATIC TRANSMISSIONS

All Except Full Time 4-Wheel Drive Units

Disassembly of Adapter (Fig. 4H)

1. Using a brass drift or other suitable tool, tap sleeve through seals and out of adapter.
2. Using a suitable punch or drift, drive seals from adapter.

Inspection

Inspect the sleeve for any indication of failure. If the sleeve has chipped teeth or excessive wear, it should be replaced. Check internal snap ring in sleeve. Replace if bent or broken.

Assembly of Adapter

1. Install new seals in adapter using Tool J-7137 and J-8092 as shown in Figure 2H.
2. Insert sleeve through seals into adapter bore and tap into place.

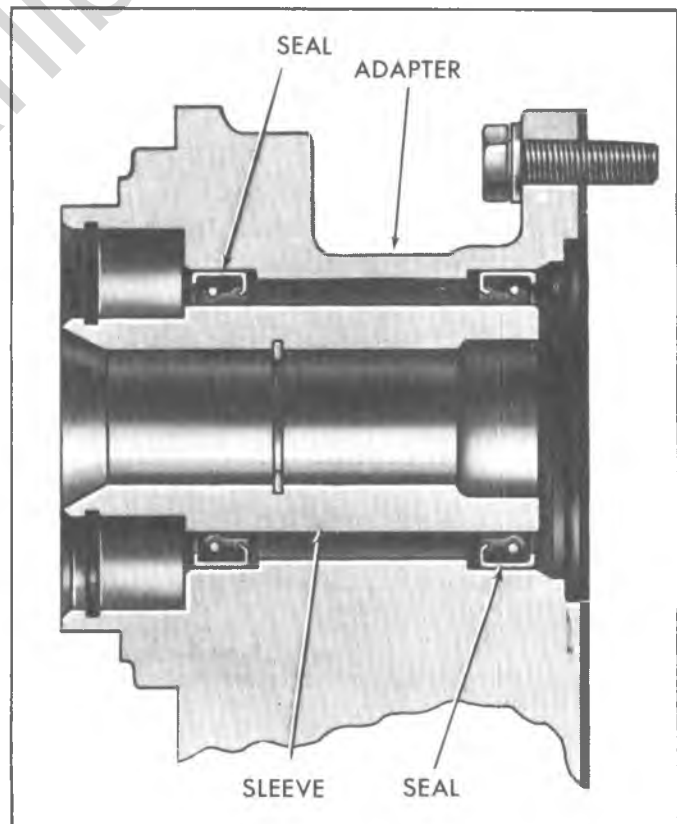
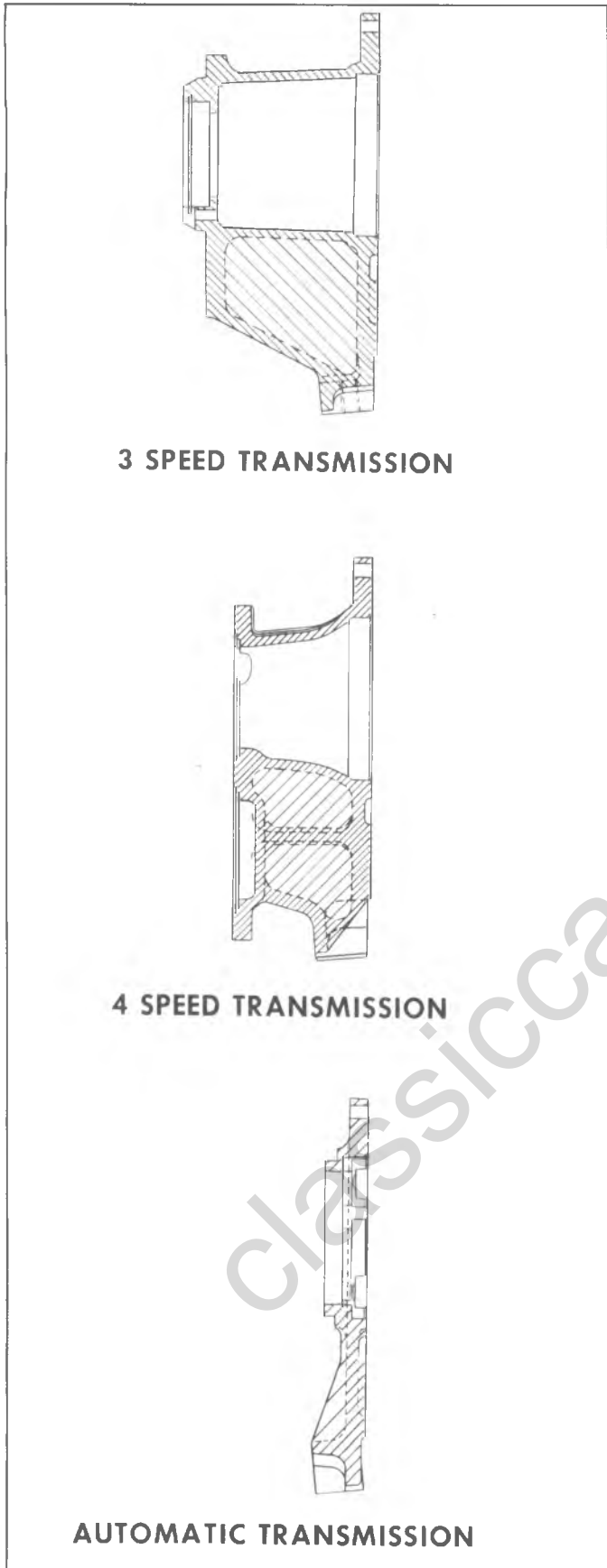
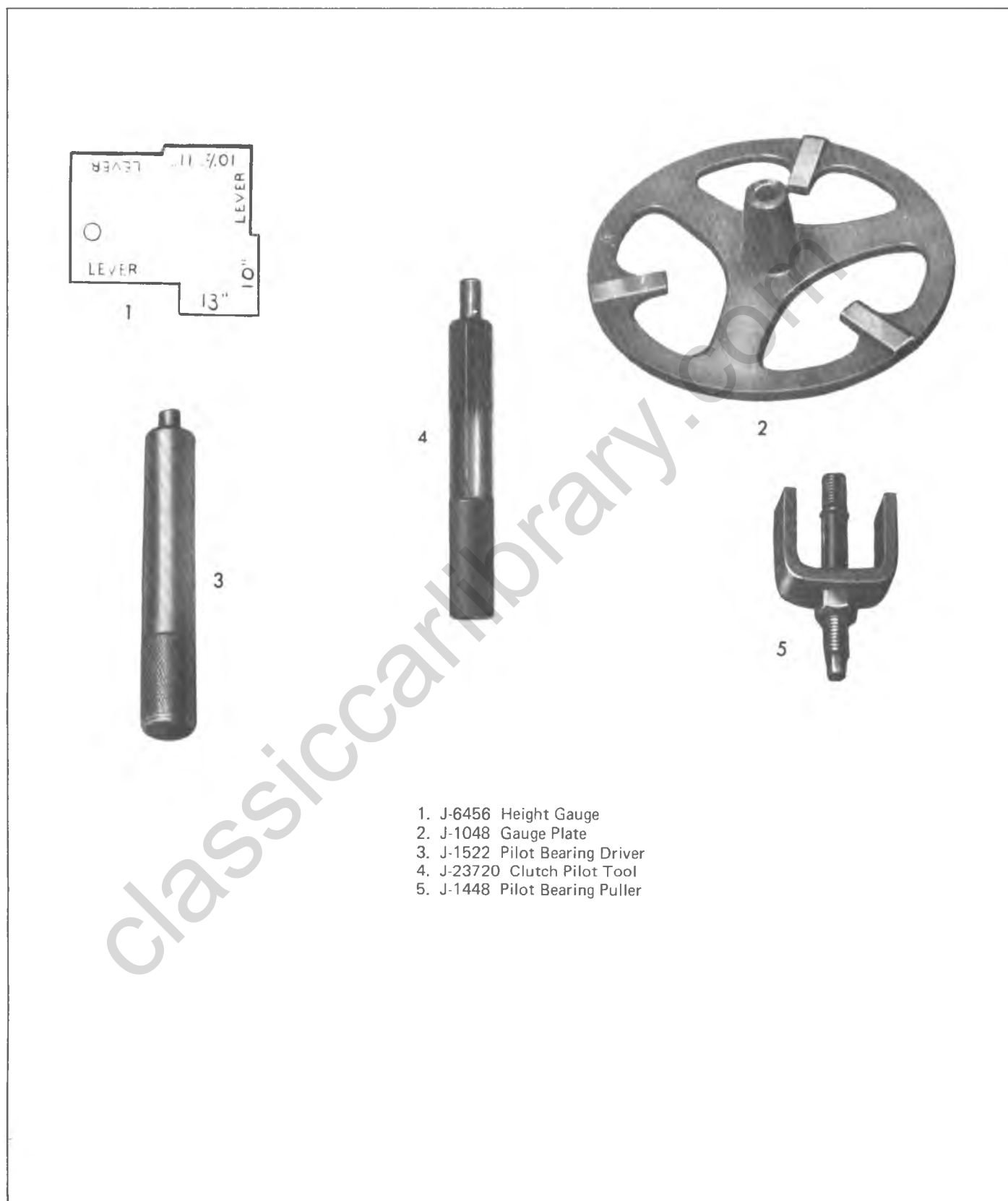


Fig. 3H-Adapter Assemblies Used With the Model 203 Transfer Case

Fig. 4H-Automatic Transmission Adapter Used With Model 205 Transfer Case

SPECIAL TOOLS



1. J-6456 Height Gauge
2. J-1048 Gauge Plate
3. J-1522 Pilot Bearing Driver
4. J-23720 Clutch Pilot Tool
5. J-1448 Pilot Bearing Puller

Fig. 1ST-Clutch Special Tools

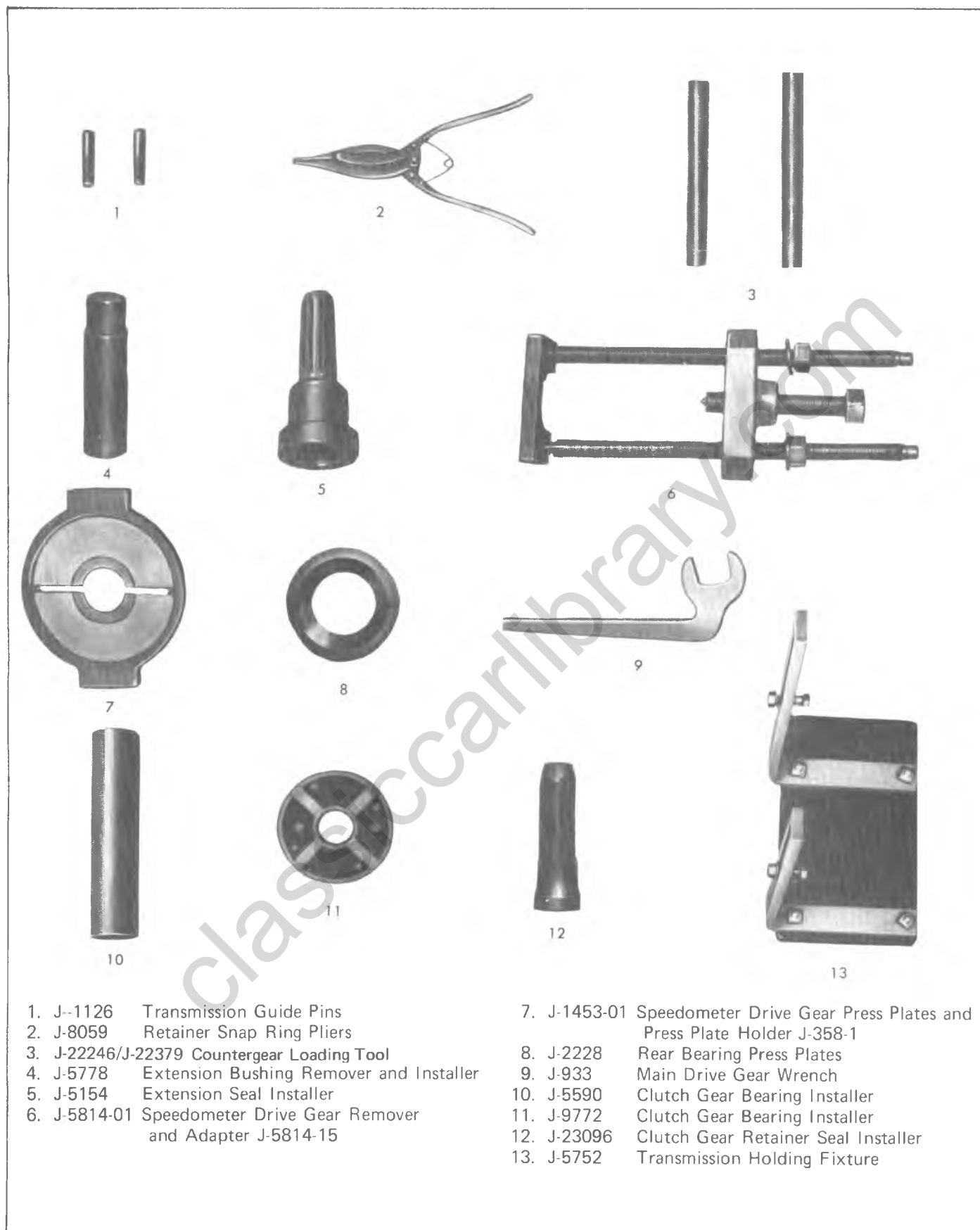
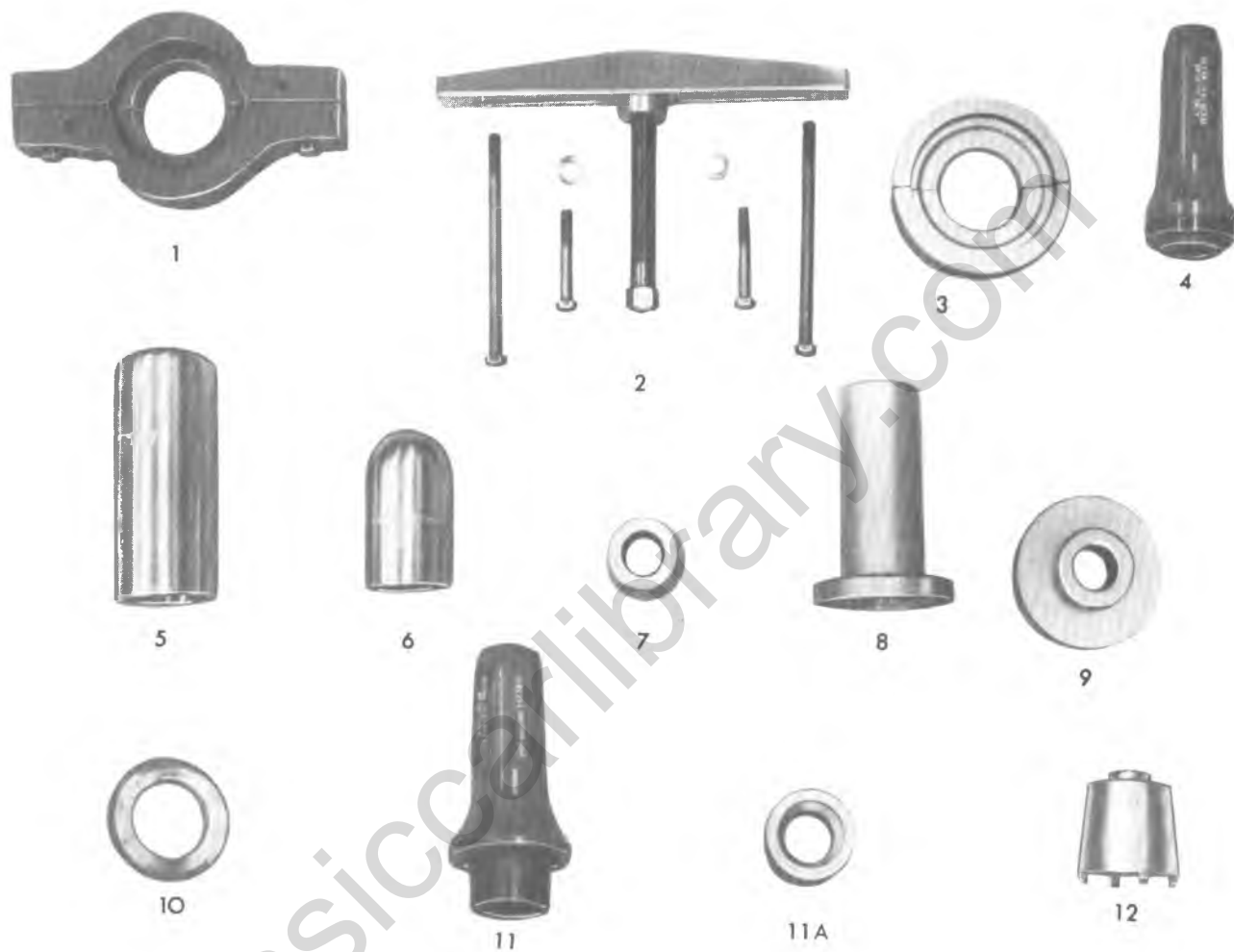
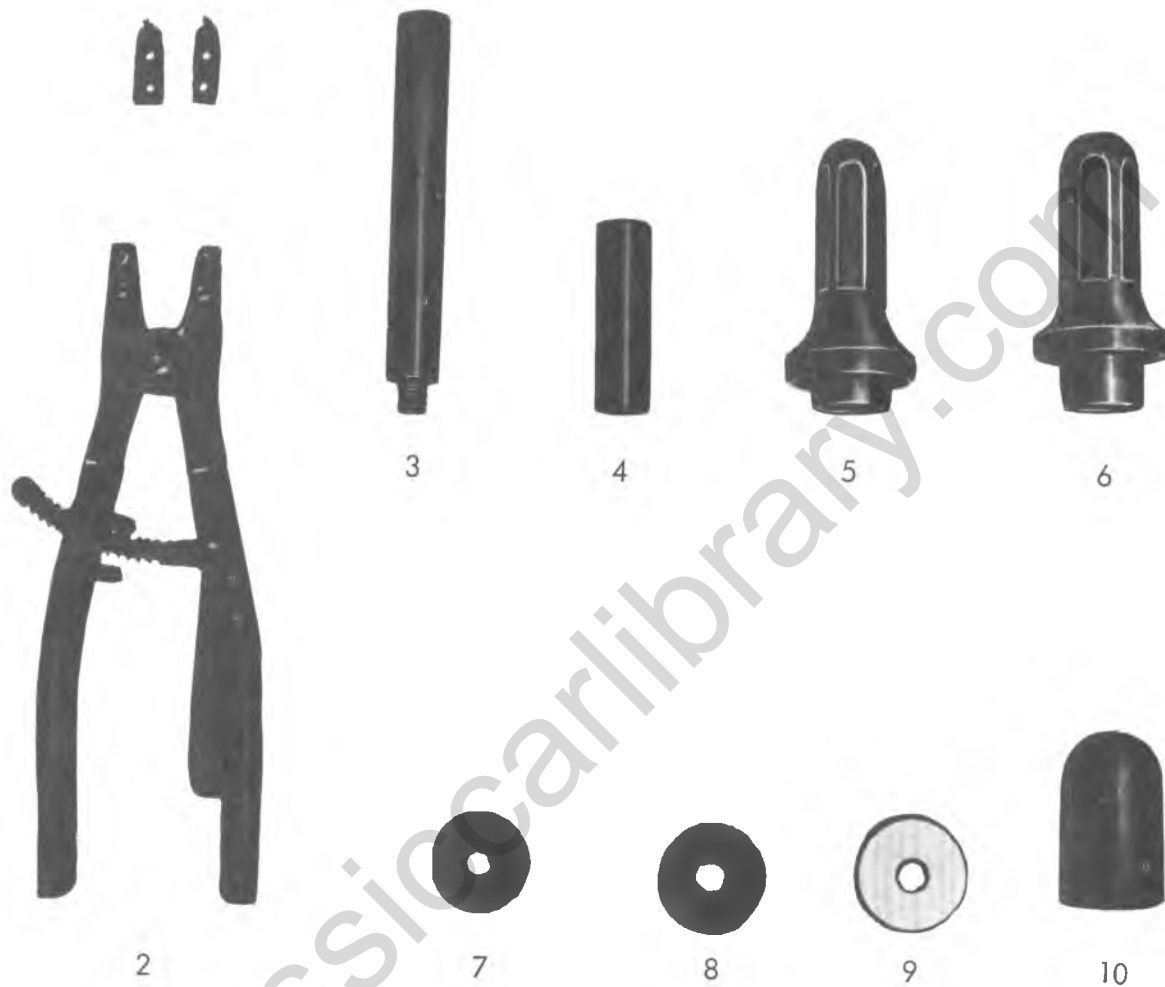


Fig. 2ST--Manual Transmission Special Tools Except CH 465



- | | | | |
|-------------|---|----------------|---|
| 1. J-22832 | Countergear Rear Bearing Remover | 8. J-22874-1 | Bearing Installer |
| 2. J 8433 1 | Bearing Puller | 9. J-22874-5 | Mainshaft Support Tool |
| 3. J-22872 | Clutch Gear Bearing Remover and Installer | 10. J-22874 2 | Countershaft Support Tool |
| 4. J-22833 | Front Bearing Retainer Seal Installer | 11. J-22834-2 | Rear Bearing Retainer Seal Installer |
| 5. J-22873 | 2nd Speed Bushing Installer | 11a. J 22834 1 | Adapter |
| 6. J-22875 | 3rd Speed Bushing Installer | 12. J-23070 | Mainshaft Rear Bearing Lock Nut Installer |
| 7. J-22830 | Snap Ring Installer | | |

Fig. 3ST--Muncie Transmission Model CH 465 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. |

Fig. 4ST--New Process Transfer Case Model 205 Special Tools

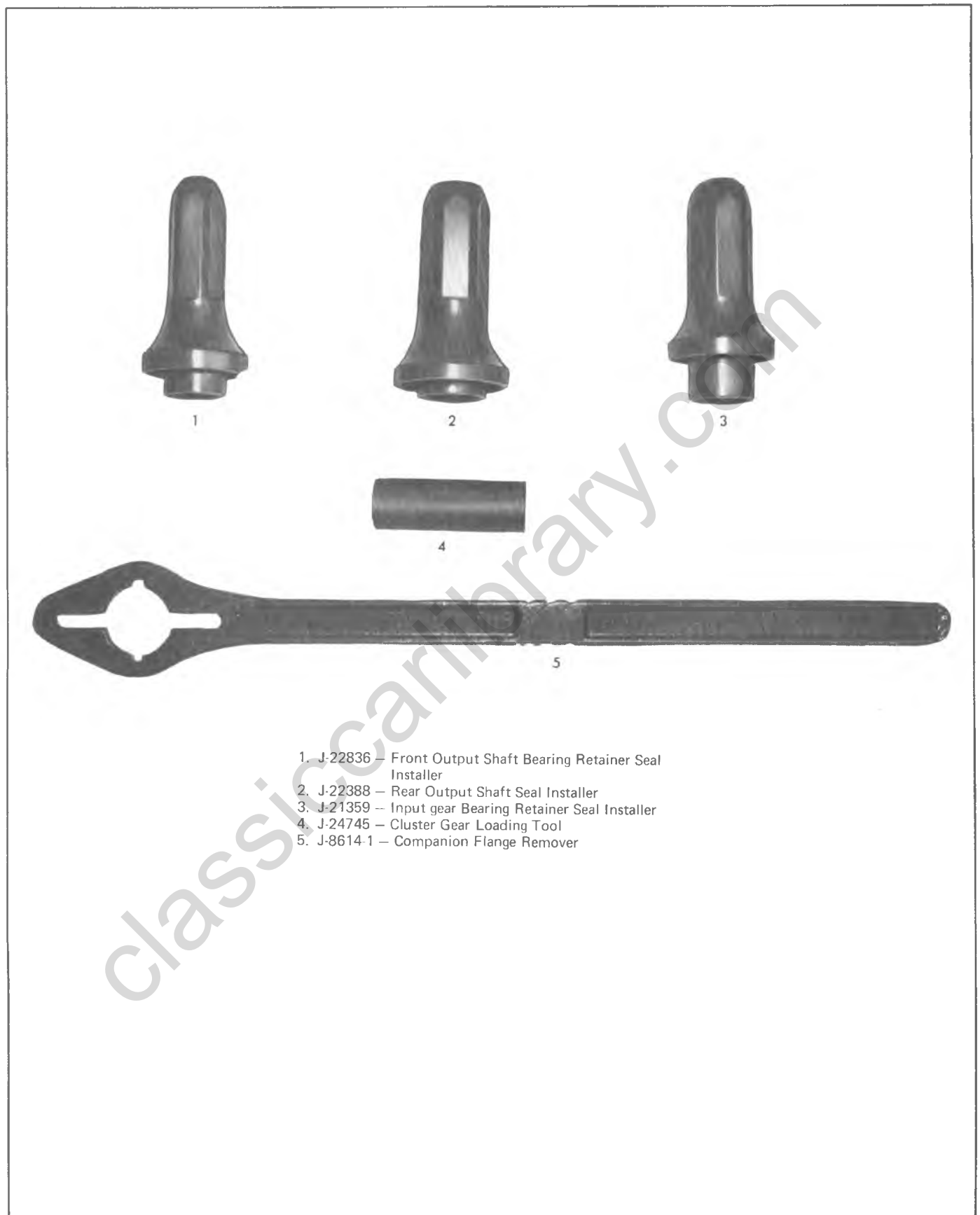
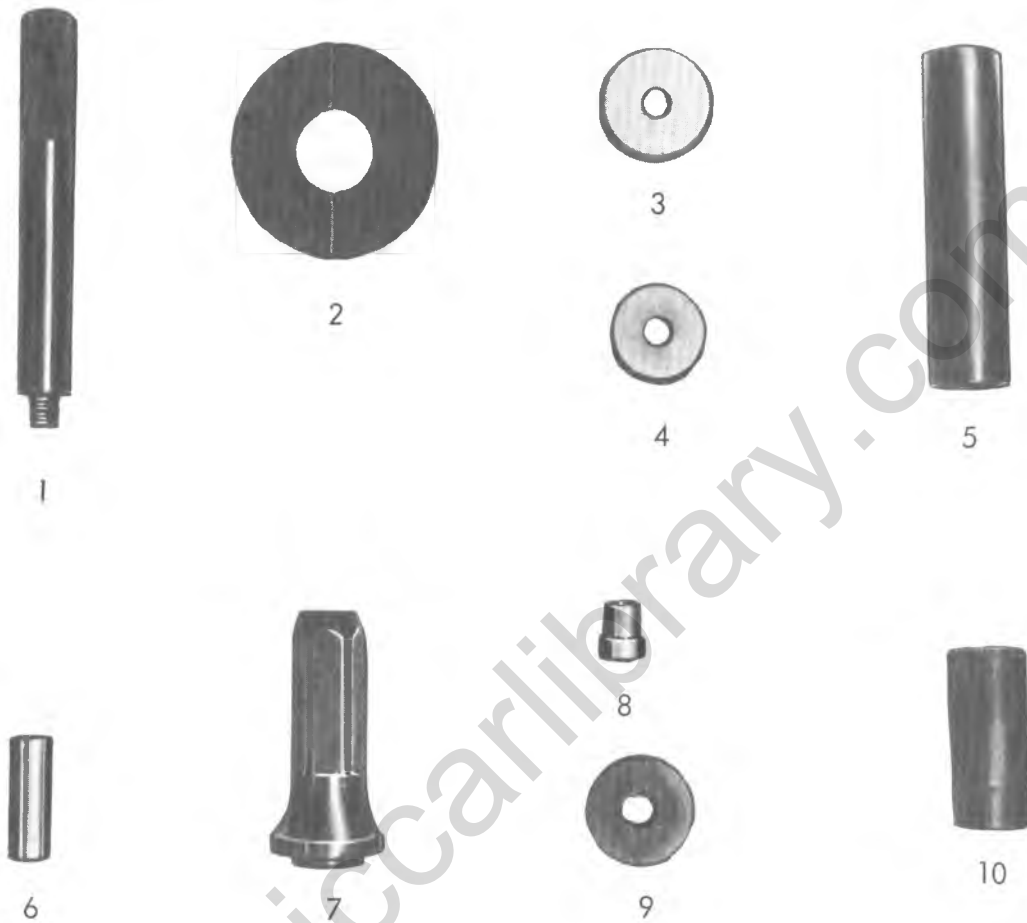


Fig. 5ST--New Process Transfer Case Model 203 Special Tools



- | | |
|------------|--|
| 1. J-8092 | Handle. |
| 2. J-8331 | Rear Output Shaft Front Bearing Remover. |
| 3. J-23422 | Rear Output Shaft Front Bearing Cup Installer. |
| 4. J-23423 | Rear Output Shaft Rear Bearing Cup Installer. |
| 5. J-5590 | Bearing Installer. |
| 6. J-23419 | Intermediate Shaft Remove and Installer. |
| 7. J-22833 | Output Shaft Housing Seal Installer. |
| 8. J-23420 | Pilot Bearing Installer. |
| 9. J-7137 | Adapter Seal Installer. |
| 10. J-6219 | Front Output Shaft Bearing Installer. |

Fig. 6ST--Dana-Transfer Case Model 20 Special Tools

SECTION 9 STEERING

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MANUAL STEERING GEARS

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OVERHAUL OPERATIONS

Disassembly (Figs. 1 through 4)

As with any ball bearing unit the steering gear parts must be kept free of dirt. Clean paper or rags should be

spread on the workbench before starting disassembly of the steering gear.

1. Place the steering gear in a vise, clamping onto one

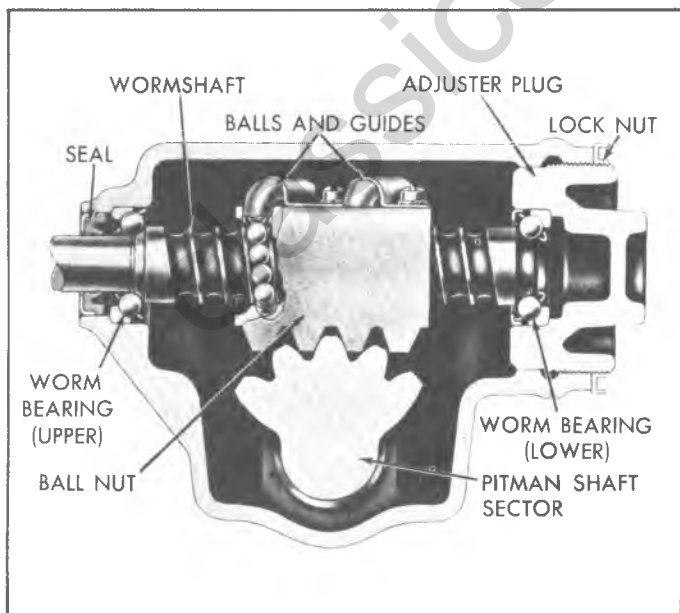


Fig. 1--Steering Gear (Except Corvette)

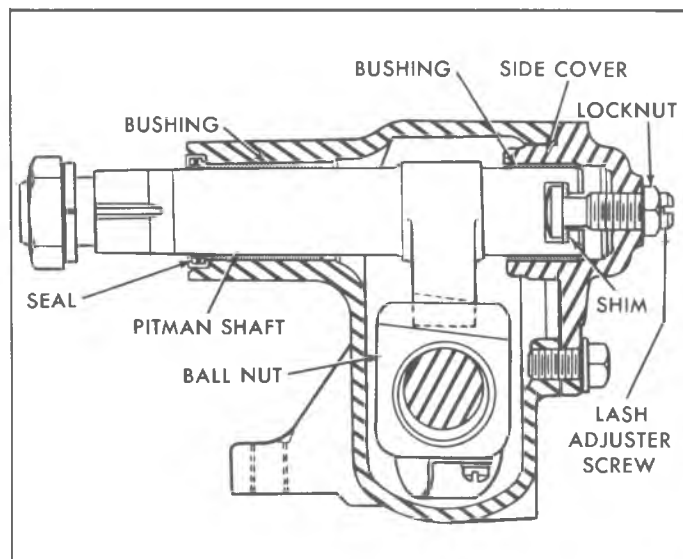


Fig. 2--Steering Gear (Except Corvette and G10-30 Series Trucks)

9-2 STEERING

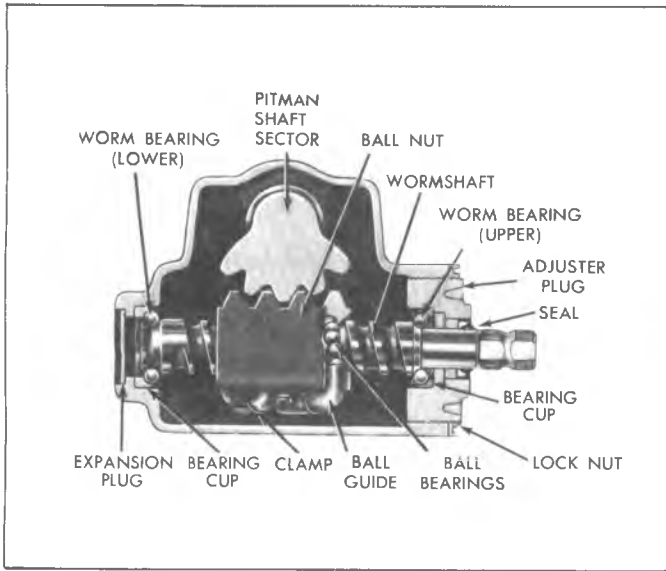


Fig. 3-Steering Gear-Corvette

of the mounting tabs. The wormshaft should be in a horizontal position.

2. Rotate the wormshaft 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). Loosen locknut.
3. Place a pan under the assembly to catch the lubricant and remove the three self locking bolts attaching the side cover to the housing.
4. Tap lightly on the end of the pitman shaft with a plastic hammer and lift the side cover and pitman shaft assembly from the gear housing (fig. 5).

NOTE: If the pitman shaft sector does not clear the opening in the housing easily, turn

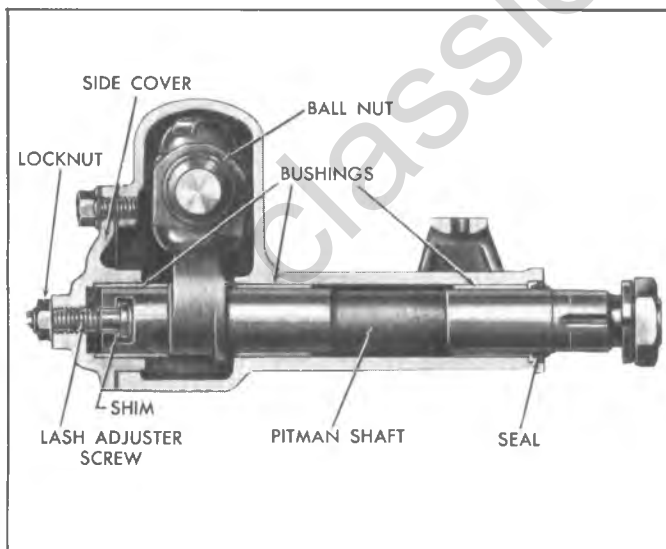


Fig. 4-Steering Gear (Corvette and G10-30 Series Trucks)

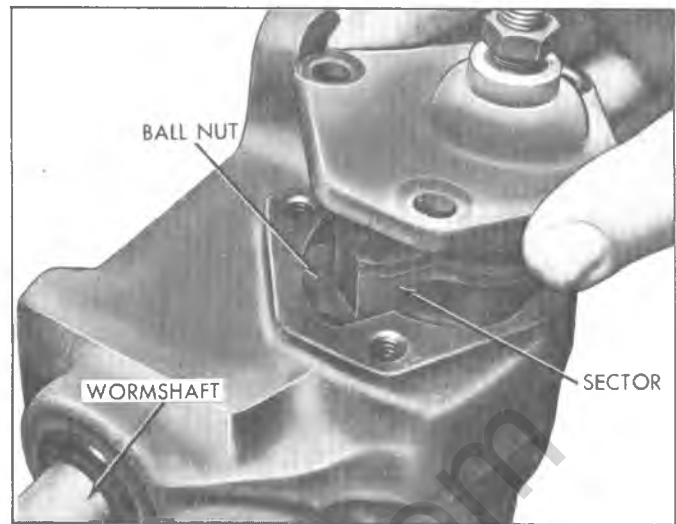


Fig. 5-Removing Pitman Shaft Assembly-Typical

the wormshaft by hand until the sector will pass through the opening in the housing.

5. Remove the adjuster plug and locknut assembly (incorporates the lower wormshaft bearing and race on all except Corvette - upper wormshaft bearing race on Corvette).
6. Draw the wormshaft and ball nut assembly from the housing (fig. 6).

CAUTION: Use care that the ball nut does not run down to either end of the worm. Damage will be done to the ends of the ball guides if the nut is allowed to rotate until stopped at the end of the worm.

7. **All Except Corvette-**Remove the upper bearing from the wormshaft.

Corvette-Remove lower bearing from inside the gear housing.

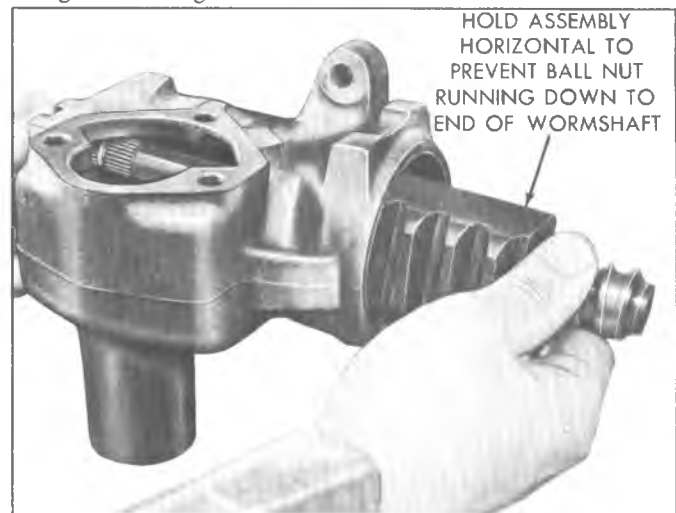


Fig. 6-Removing the Wormshaft and Ball Nut-Typical

8. **All except Corvette**--Using a suitable size screw driver, pry the lower bearing retainer from the adjuster plug housing and remove the bearing (fig. 7).
9. Remove the locknut from the lash adjuster screw in the side cover. Remove the lash adjuster screw from the side cover by turning the screw clockwise. Slide the adjuster screw and shim out of the slot in the end of the pitman shaft.
10. Pry out and discard both the pitman shaft and wormshaft seals.

Inspection

With the steering gear completely disassembled, wash all parts in cleaning solvent. Dry them thoroughly with air. With a magnifying glass inspect the bearings and bearing races for signs of indentation. Also check for any signs of chipping or breakdown of the surface. Any parts that show signs of damage should be replaced.

Inspect all seals. Any seal that is worn or has been removed should be replaced.

Inspect the fit of the pitman shaft in its bushing in the side cover. If this bushing is worn, a new side cover and bushing assembly should be installed.

Check steering gear wormshaft assembly for being bent or damaged in any way. Never attempt to salvage steering parts by welding or straightening.

Repairs

Pitman Shaft and/or Wormshaft Seal Replacement

The double lipped pitman shaft and wormshaft seals should be replaced each time a defective seal is indicated or the steering gear is disassembled.

1. If the seals were not removed at disassembly, pry out the old seals using a suitable size screw driver.

CAUTION: Before installing new seals, check



Fig. 7--Removing Lower Bearing Retainer--Except Corvette

the condition of the pitman shaft bushing(s) and the upper wormshaft bearing race.

2. A suitable size socket, pressing on the outer diameter of the seal, may be used to install new seals.

CAUTION: Care should be taken to insure that the new seals are not assembled in a cocked position.

Pitman Shaft Bushing Replacement

1. Support the steering gear housing in an arbor press and press the pitman shaft bushing (2 bushings on Corvette and G10-30 Series Trucks) from the housing using Tool J-1614, inserted from the lower end of the housing (fig. 8).
2. Press the new bushing(s) into position using Tool J-1614. Position the Corvette and G10-30 Series Truck bushings as shown in Figure 4.

NOTE: Service bushings are diamond bored to size and require no further reaming.

Side Cover Bushing Replacement

The entire side cover assembly, including bushing, is serviced as a unit and should be replaced when it is desired to replace the bushing.

Wormshaft Bearing Race Replacement

ADJUSTER PLUG RACES

1. **All Except Corvette**-- Remove the wormshaft bearing race using Tool J-5822 and a Slide Hammer as shown in Figure 9.

Corvette-- Using a hammer and punch, drive the bearing race out of the adjuster plug.

2. Press the new bearing race into position using Tool J-5755.

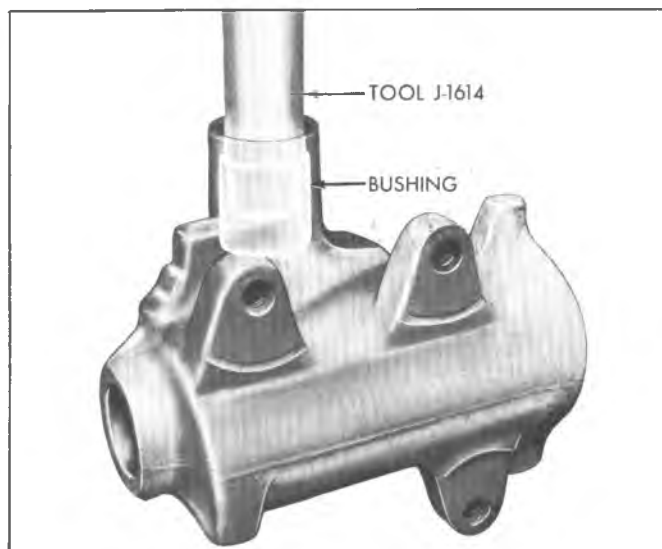


Fig. 8--Removing Pitman Shaft Bushing--Typical

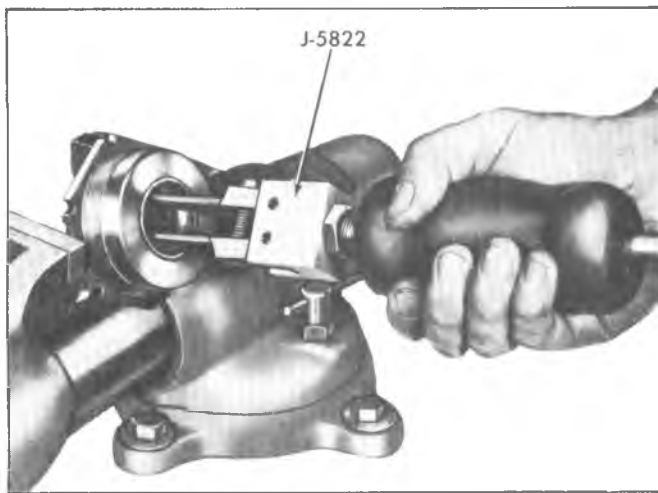


Fig. 9--Removing Adjuster Plug Bearing Race

HOUSING RACES

1. **Corvette only--** Using a drift or punch (inserted into the housing from the adjuster plug end) drive the sheet metal expansion plug out of the lower end of the housing.
2. All Series - Using a drift or punch, drive the bearing race out of the housing.
3. Press the new bearing race into position using Tool J-5755 (fig. 10).
4. **Corvette only--** Install a new expansion plug into the lower end of the housing. Press on the center of the plug to deform it inward and secure it in the housing. Make sure the plug is tight or lubricant leakage could result.

Ball Nut Servicing

As a rule, disassembly of the ball bearing nut will not be necessary if it is perfectly free with no indication of binding or tightness when rotated on the worm. However, if there is any indication of binding or

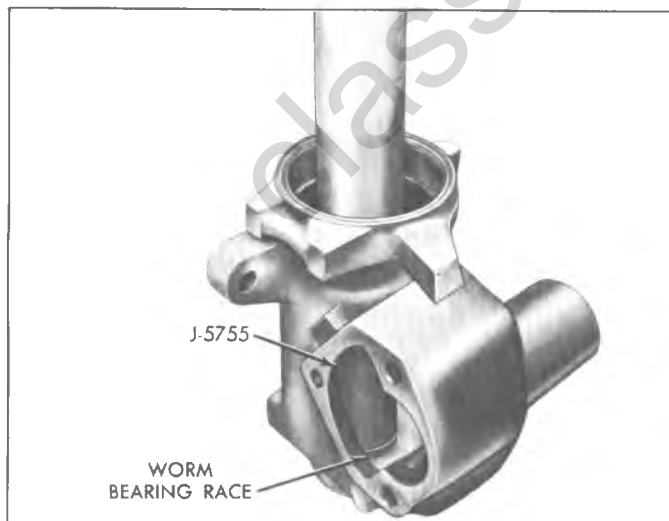


Fig. 10--Installing Wormshaft Bearing Race-Typical

tightness, the unit should be disassembled, cleaned and inspected as follows:

1. Remove screws and clamp retaining the ball guides in nut. Draw guides out of nut.
2. Turn the nut upside down and rotate the wormshaft back and forth until all the balls have dropped out of the nut into a clean pan. With the balls removed, the nut can be pulled endwise off the worm.
3. Wash all parts in cleaning solvent and dry them thoroughly with air. Using a magnifying glass inspect the worm and nut grooves and the surface of all balls for signs of indentation. Check ball guides for damage at ends where they deflect or pick up the balls from the helical path. Any parts that show signs of damage should be replaced.
4. **All Except Corvette (fig. 11):**
 - a. Place the wormshaft flat on the bench and slip the nut over the worm with the ball guide holes up and the shallow end of the ball nut teeth to the left from the steering wheel position. Align the grooves in the worm and nut by sighting through the ball guide holes.
 - b. Place two ball guide halves together and insert them into the upper circuit in the ball nut. Place the remaining two guides together and insert them in the lower circuit.
 - c. Count 24 balls into a suitable container. This is the proper number of balls for one circuit.
 - d. Load the balls into one of the guide holes while turning the wormshaft gradually away from that hole. When all of the balls have been installed, the circuit is complete.
 - e. Fill the remaining ball circuit in the same manner as described for the first circuit in Steps c and d above.
5. **Corvette only (figs. 12 and 13):**

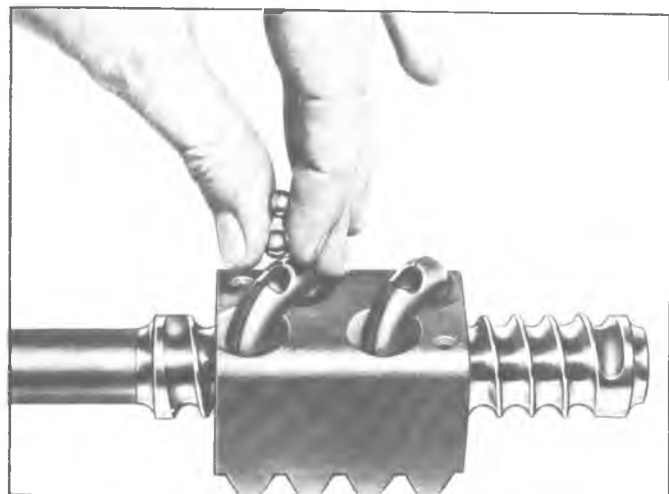


Fig. 11--Filling Ball Circuits--Except Corvette

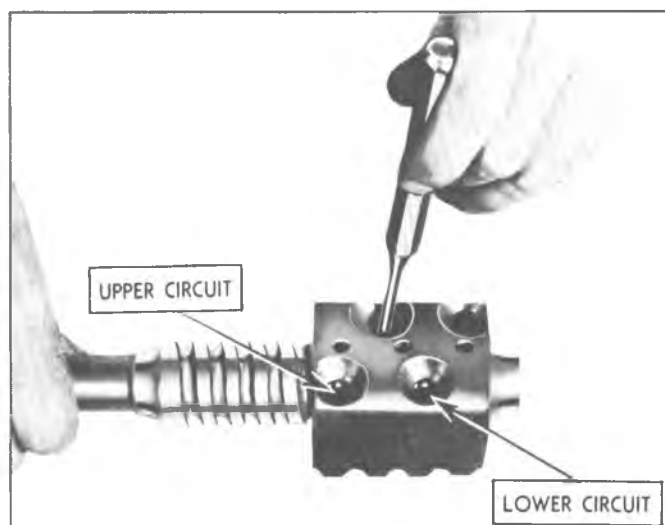


Fig. 12--Filling Ball Circuits--Corvette

- a. Place the wormshaft flat on the bench and slip the nut over the worm with the ball guide holes up and the shallow end of the rack teeth to the left from the steering wheel position. Align the grooves in the worm and nut by sighting through the ball guide holes.
- b. Count 27 balls into a suitable container. This is the proper number of balls for half the circuit. Place these balls into one of the guide holes while turning the worm gradually away from that hole.
- c. Lay one-half of the ball guide, groove up, on the bench and place the remaining balls from the count container in it.
- d. Close this half of guide with the other half. Hold the two halves together and plug each open end with petroleum jelly so that balls will not drop out while installing the guide.
- e. Push the guide into the guide holes of the nut. This completes one circuit of balls. If the guide does not push all the way down easily, tap it lightly into place with the wooden handle of a screw driver.
- f. Fill the second ball circuit in the same manner. Continue until the ball circuit is full from the bottom of one guide hole to the bottom of the other or until stopped by reaching the end of the worm.

NOTE: In cases where the balls are stopped by the end of the worm, hold down those balls already dropped into the nut with the blunt end of a clean rod or punch (fig. 12) and turn the worm in the reverse direction a few turns. The filling of the circuit can then be continued. It may be necessary to work the worm back and forth, holding the balls down first in one hole and then the other, to close



Fig. 13--Filling Ball Guides--Corvette

- up the spaces between the balls and fill the circuit completely and solidly.
6. Assemble the ball guide clamp to the ball nut and tighten the screws to specified torque.

Check the assembly by rotating the nut on the worm to see that it moves freely. Do not rotate the nut to the end of the worm threads as this may damage the ball guides. If there is any "stickiness" in the motion of the nut, some slight damage to the ends of the ball guides or to other gear components may have been overlooked.

Assembly (Fig. 14 and 15)

After a major service overhaul, steering gear lubricant meeting GM Standard GM 4673M (or equivalent) should be applied to the pitman shaft and bearings, wormshaft and bearings and the ball nut teeth.

1. Place the steering gear housing in a vise with the wormshaft bore horizontal and the side cover opening up.
2. With the pitman shaft and wormshaft seals, pitman shaft bushings and wormshaft bearing races installed, and the ball nut installed on the wormshaft, proceed to Step 3 or 4.
3. **All Except Corvette--**
 - a. Slip the upper ball bearing over the wormshaft and insert the wormshaft and nut assembly into the housing, feeding the end of the shaft through the upper ball bearing race and seal.
 - b. Place a ball bearing in the adjuster race and press the stamped retainer into place with a suitable socket.
 - c. Install the adjuster and locknut into the lower end of the housing (being careful to guide the end of the wormshaft into the bearing) until

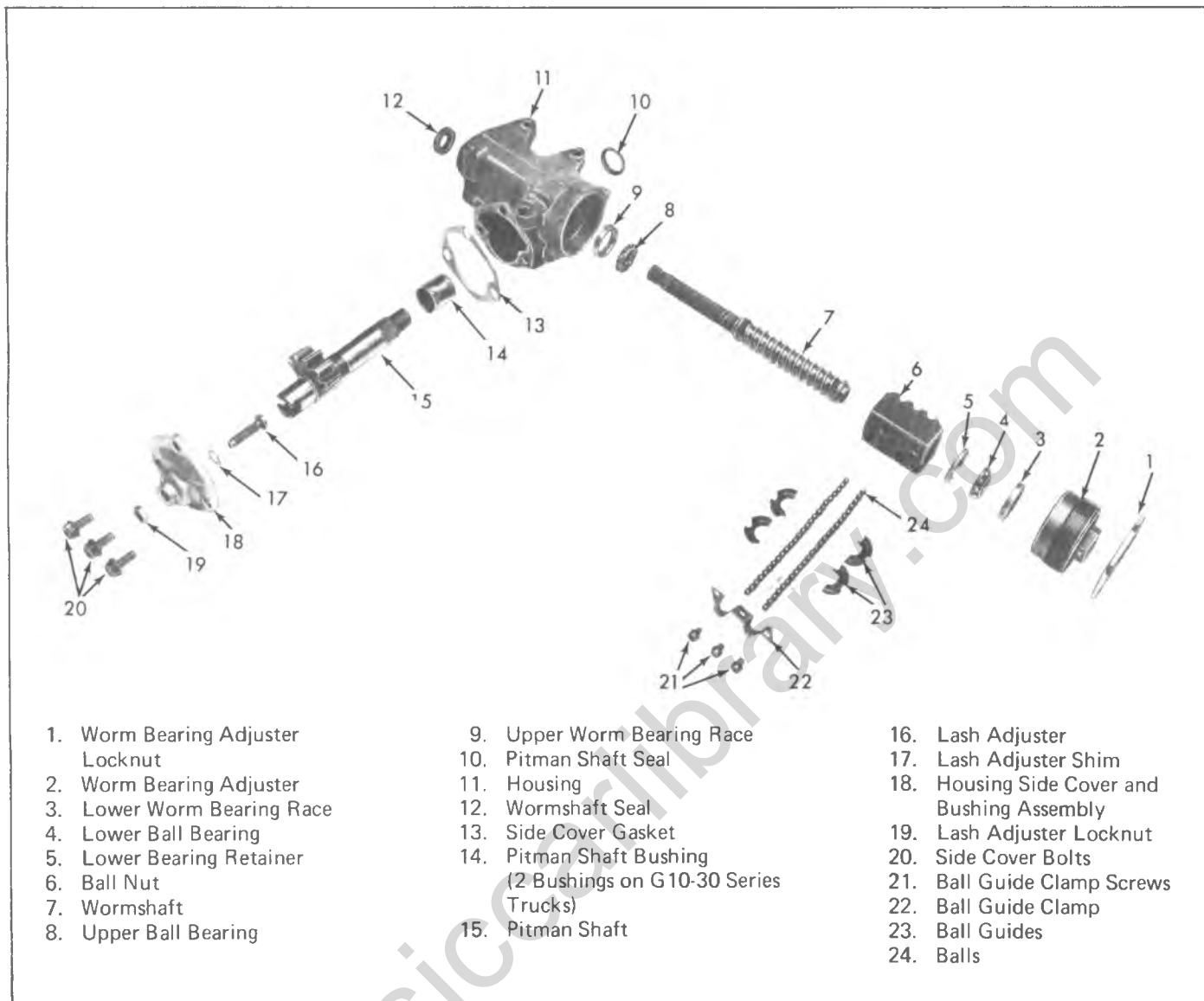


Fig. 14--Steering Gear--Except Corvette

nearly all end play has been removed from the wormshaft.

4. Corvette--

- a. Place a wormshaft bearing in the housing race. Slide the other bearing and the adjuster plug assembly over the upper end of the wormshaft.
 - b. Insert the wormshaft, nut and adjuster assembly into the housing, guiding the lower end of the wormshaft into the housing bearing.
 - c. Thread the adjuster into the housing until nearly all end play is removed from the wormshaft.
5. Position the lash adjuster (with shim) in the slotted end of the pitman shaft. Check the end clearance, which should not be greater than .002" (fig. 16). If clearance is greater than .002", a steering gear lash

adjuster shim unit is available. It contains four shims--.063", .065", .067" and .069" thick.

6. Lubricate the steering gear with 11 oz. of lubricant meeting GM Specification GM 4673 (or equivalent). Rotate the wormshaft until the ball nut is at the end of its travel and then pack as much new lubricant into the housing as possible without losing it out the pitman shaft opening. Rotate the wormshaft until the ball nut is at the other end of its travel and pack as much lubricant into the opposite end as possible.
7. Rotate the wormshaft until the ball nut is about in the center of travel. This is to make sure that the pitman shaft sector and ball nut will engage properly, with the center tooth of the sector entering the center tooth space in the ball nut.
8. Insert the pitman shaft assembly (with lash adjuster

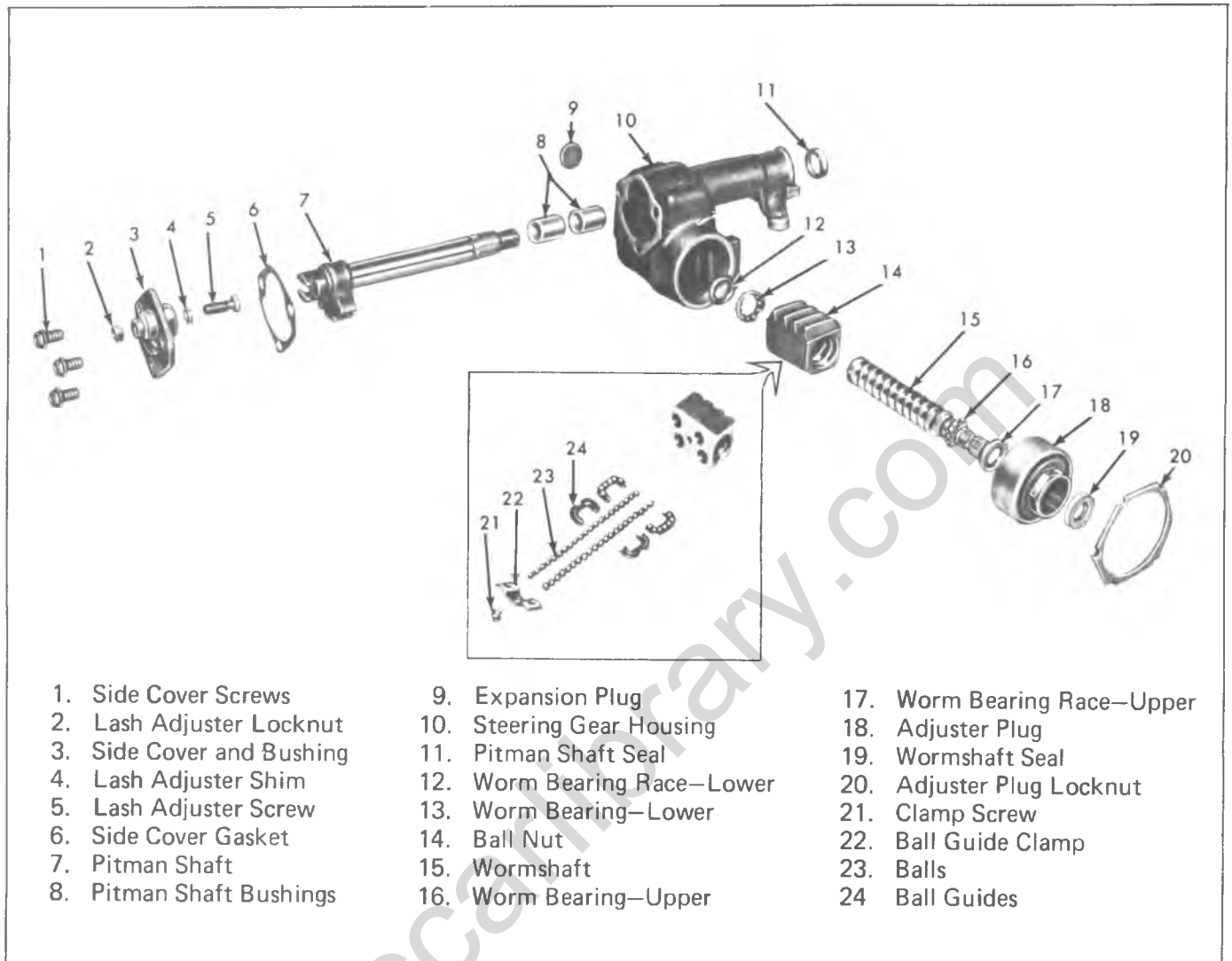


Fig. 15—Steering Gear—Corvette

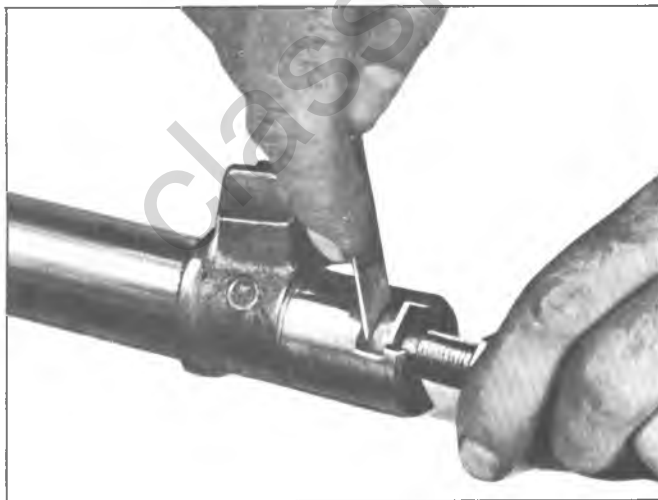


Fig. 16—Checking Lash Adjuster End Clearance

screw and shim but without side cover) into the housing so that the center tooth of the pitman shaft sector enters the center tooth space of the ball nut.

9. Pack the remaining portion of lubricant into the housing.
10. Place the side cover gasket on the housing.
11. Install the side cover onto the pitman shaft by reaching through the side cover with a screwdriver and turning the lash adjuster screw counterclockwise until the screw bottoms; back the screw off one-half turn. Loosely install a new locknut onto the adjuster screw.
12. Install and tighten the side cover bolts to specifications.

CAUTION: If new side cover bolts are used at installation, be sure to use specified bolts which are self locking.

9-8 STEERING

Adjustment on Bench

1. Tighten the adjuster plug until all end play has been removed and then loosen one-quarter turn.
2. Using an 11/16" 12-point socket and an in. lb. torque wrench, carefully turn the wormshaft all the way to the right turn stop and then turn back about one-half turn.
3. Tighten the adjuster plug until the proper thrust bearing preload is obtained; (See the Specifications at the rear of this Manual). Tighten the adjuster plug locknut to specifications.
4. Turn the wormshaft from one stop all the way to the other, counting the number of turns. Then turn the shaft back exactly half the number of turns to the center position.
5. Turn the lash adjuster screw clockwise to remove all lash between the ball nut and sector teeth. Tighten the locknut.
6. Again using the 11/16" 12-point socket and an in. lb. torque wrench, observe the highest reading while the gear is turned through center position. See the Specifications Section for proper over-center adjustment.
7. If necessary, readjust lash adjuster screw to obtain proper torque. Tighten the locknut to 23 ft. lb. torque and again check torque reading through center of travel.

POWER STEERING PUMP

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OVERHAUL OPERATIONS

CAUTION: *If when overhauling a power steering gear or pump, broken components or foreign material are encountered, the remaining components of the entire hydraulic system should be disassembled, inspected, thoroughly cleaned and flushed before servicing is completed.*

Disassembly (Fig. 17)

Clean the outside of the pump in a Nontoxic Solvent before disassembly.

1. Remove the pulley retaining nut and remove the pulley using Tool J-21239-1.
2. Place the pump in a vise and remove the union and "O" ring seal assembly.

CAUTION: *In clamping pump in vise, be careful not to exert excessive force on the pump front hub as this may distort the shaft bushing.*

3. Remove the pump reservoir retaining studs.
4. Remove the reservoir from the pump housing by tapping lightly on the outer edge of the reservoir with a soft hammer. Remove the "O" ring seal from the pump housing and discard seal.
5. Remove magnet from housing assembly.
6. Remove the mounting stud square ring seals and

the flow control valve square ring seal and discard.

7. On Corvette, remove filter and filter cage; discard filter element.
8. Remove the end plate retaining ring. Compress the end plate retaining ring by inserting a small punch in the 1/8" diameter hole in the pump housing. When the ring is in compressed position, remove with a screw driver as shown in Figure 18.
9. Remove the end plate. The end plate is spring loaded and will generally sit above the housing level. If sticking should occur, a slight rocking action or light tapping with a soft hammer will free the plate. Remove the end plate spring.
10. With the pump still in a vise, remove the shaft woodruff key and tap end of shaft gently with a soft hammer until the shaft, pressure plate, pump ring, rotor assembly and thrust plate can be removed as a unit (fig. 19).
11. Separate the parts removed in Step 9 above. If inspection shows the shaft to be defective, separate it from the rotor by removing the retainer snap ring. Discard the snap ring.
12. Remove the end plate and pressure plate "O" rings from the pump housing and discard "O" rings.
13. Remove the dowel pins.
14. Remove the flow control valve and spring assembly.
15. Pry the shaft seal out of the pump housing being

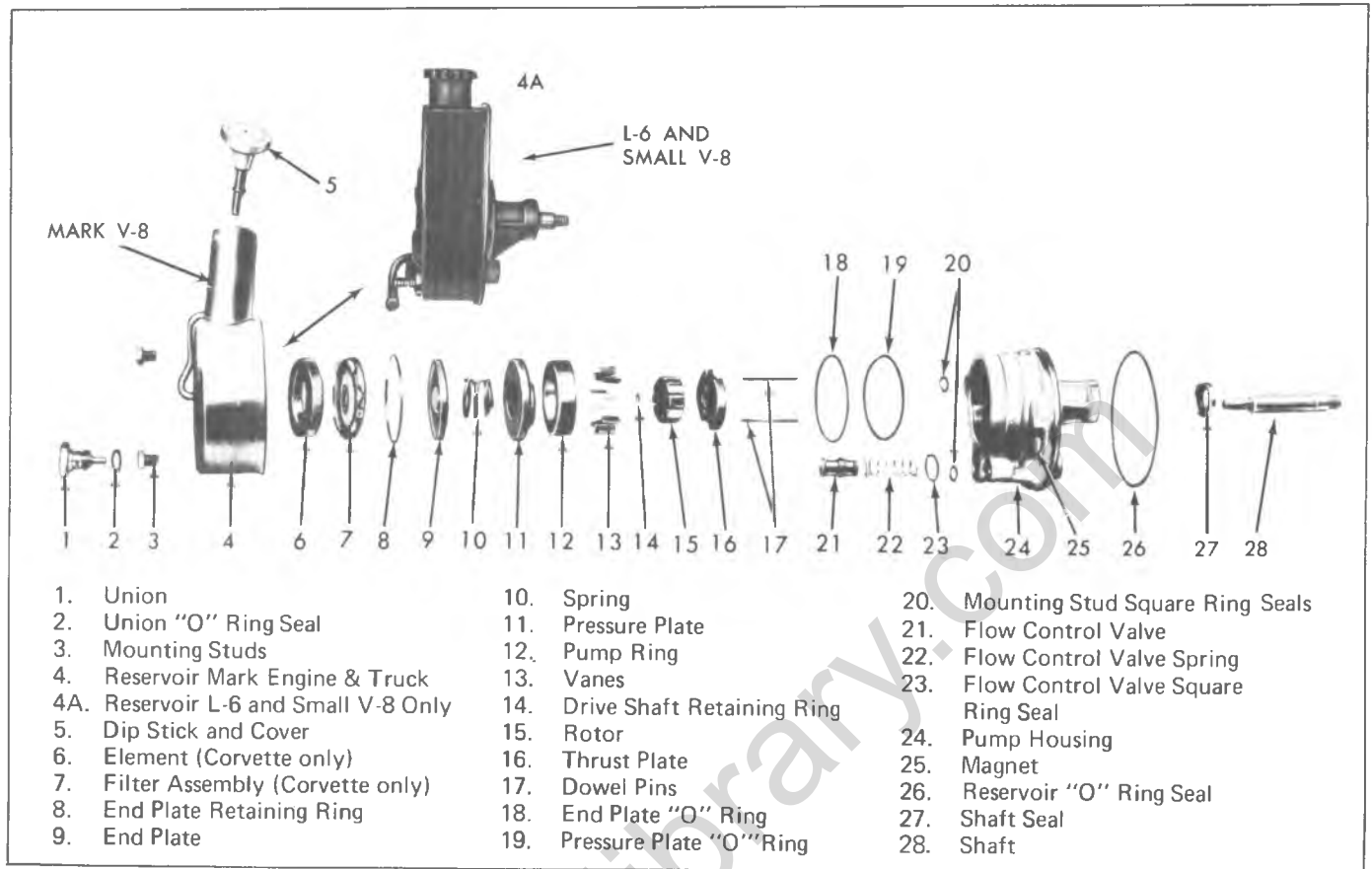


Fig. 17--Power Steering Pump--Exploded View



Fig. 18--Removing End Plate Ring

careful not to damage the housing bore, discard the shaft seal.

Inspection

Clean all metal parts in a nontoxic solvent and inspect as follows:

1. Flow control valve must slide freely in housing



Fig. 19--Impeller Unit Removal

bore. If sticking is observed, check for dirt and burrs.

2. Check cap screw in the end of the flow control valve for looseness; if loose, tighten, being careful not to damage machined surfaces.
3. Be sure that pressure plate and pump plate surfaces

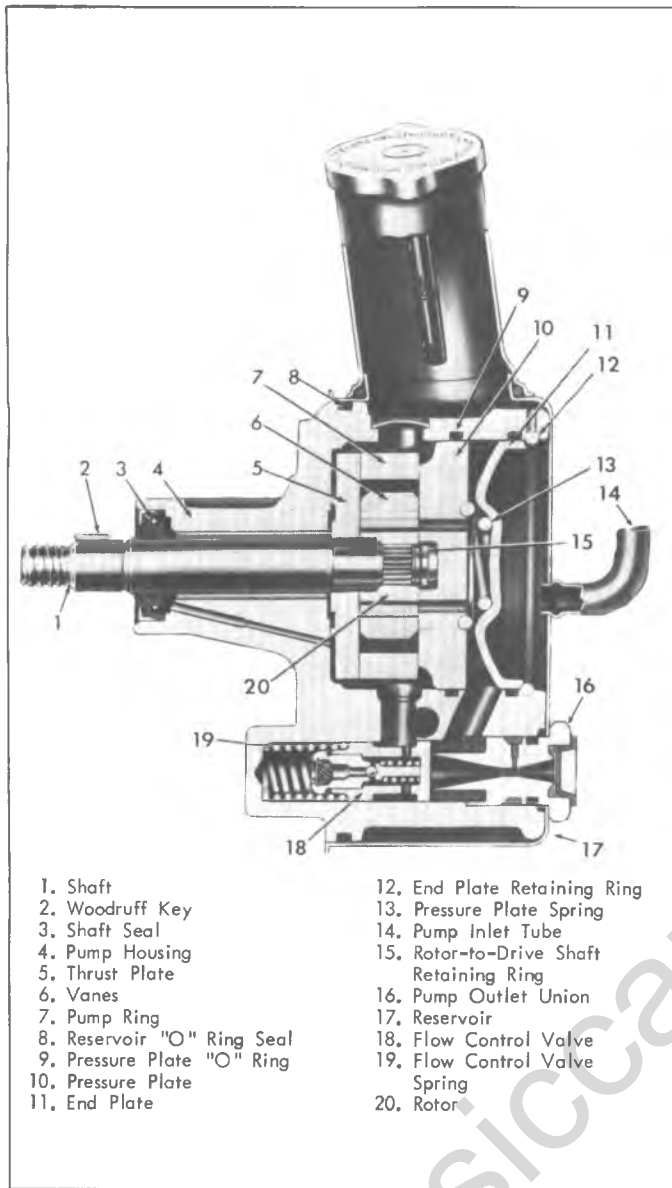


Fig. 20--Power Steering Pump--Typical

are flat and parallel with pump ring. Check all of these parts for cracks and scoring.

NOTE: A high polish is always present on rotor pressure plate and thrust plate as a result of normal wear. Do not confuse this with scoring.

4. Make certain vanes were installed with rounded edge toward pump ring and see that they move freely in rotor slots.
5. If the flow control plunger is determined to be faulty, install a new part. This part is serviced as a unit only and is factory calibrated.
6. Check drive shaft for worn splines, breaks, bushing material pickup, etc.
7. Always replace all rubber seals and "O" rings when pump is dismantled.

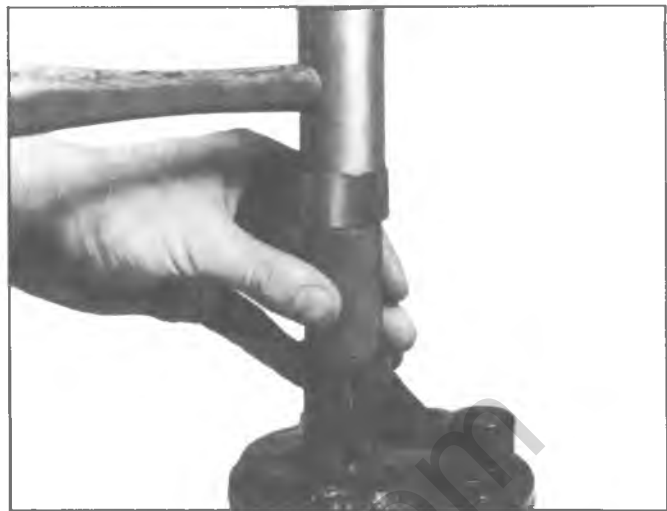


Fig. 21--Installing Seal--Using Tool J-22670



Fig. 22--Installing Thrust Plate

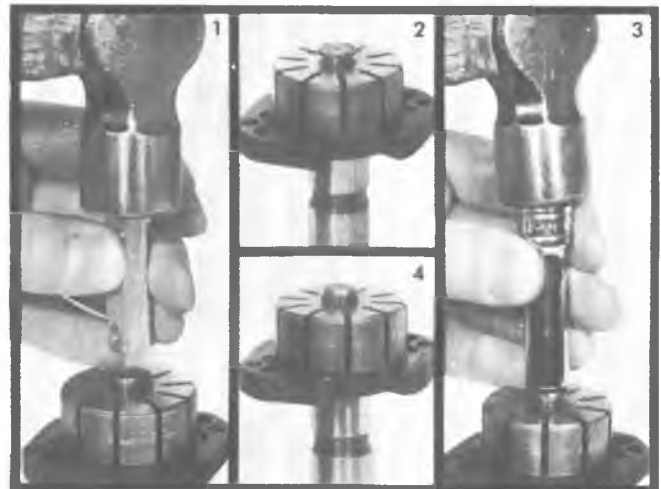


Fig. 23--Installing Shaft Snap Ring

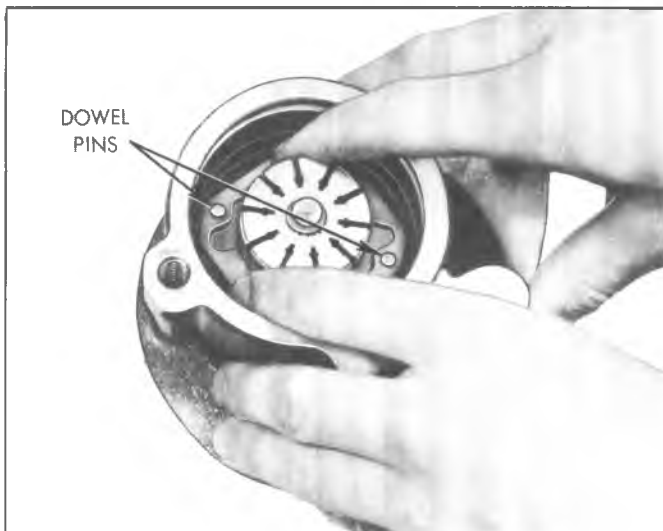


Fig. 24--Installing Shaft, Thrust Plate, and Rotor Assembly

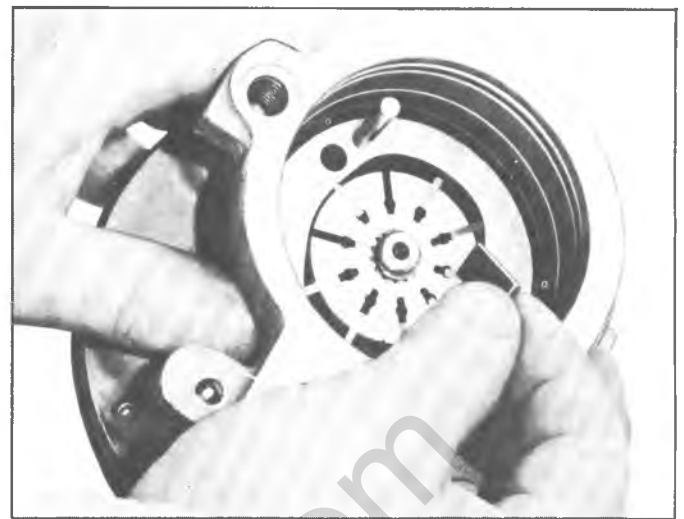


Fig. 26--Installing Vanes

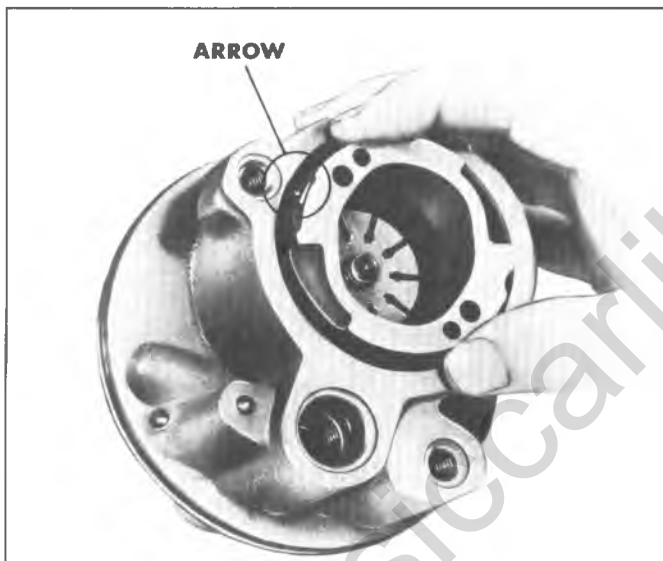


Fig. 25--Installing Pump Ring

8. Check reservoir, studs, casting, etc. for burrs and other faults which would impair proper operation.

Assembly (Fig. 20)

Be sure all parts are clean during reassembly.

NOTE: In the following text, Power Steering Fluid is noted for use in lubricating components upon reassembly. If Power Steering Fluid is not available, Transmission Fluid bearing the mark Dexron®, or Dexron® II (or equivalent) may be used.

1. Install a new shaft seal in the pump housing, using Tool J-22670 as shown in Figure 21.
2. Install both dowel pins in the pump housing and install a new pressure plate "O" ring lubricated with Power Steering Fluid.

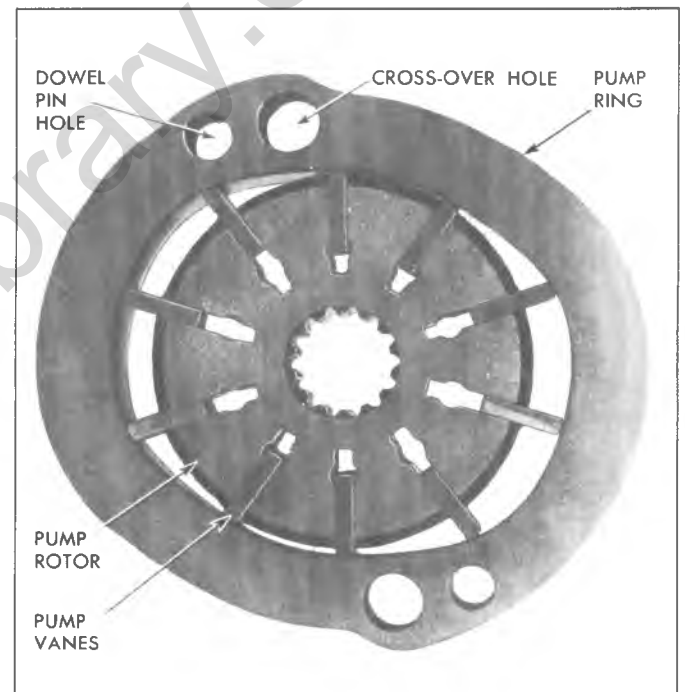


Fig. 27--Correct Vane Assembly

CAUTION: Do not use a "C" ring to replace the full diameter ring. Be sure the retaining ring is firmly seated in the shaft groove before proceeding.

3. Install the thrust plate on the shaft with the ported face towards the splined end of the shaft (fig. 22).
4. Install the rotor, which must be free on the shaft splines, with the countersunk side towards the thrust plate.
5. Install a new shaft retaining ring by placing the ring on the end of the shaft and using first a drift and then a 3/8" socket to tap the NEW ring into place (fig. 23).

9-12 STEERING

6. Place pump housing in a vise and install shaft, thrust plate and rotor assembly into housing, aligning the holes in the thrust plate with the dowel pins as shown in Figure 24.
7. Install the pump ring onto the dowel pins with the direction of rotation arrow to the rear of the housing (fig. 25). Rotation is clockwise as viewed from the pulley end of the shaft.
8. Install the vanes into the rotor slots with the radius edge towards the pump ring and the square edge towards the rotor as shown in Figures 26 and 27.
9. Lubricate the outside diameter and chamfer of the pressure plate with Power Steering Fluid, to ensure against damaging the pressure plate "O" ring, and install the pressure plate onto the dowel pins with the ported face towards the pump ring. Seat the pressure plate by placing a large socket on top of the plate and pressing down by hand (pressure plate will travel approximately 1/16" to seat).
10. Install the pressure plate spring in the center groove of the pressure plate (fig. 28).
11. Lubricate a new end plate "O" ring with Power Steering Fluid and install in housing groove.
12. Lubricate the outside diameter and chamfer of the end plate with Power Steering Fluid, to ensure against damaging the "O" ring, and install into the housing using an arbor press as shown in Figure 29.

NOTE: Place the end of the ring so that it is near the valve bore in the housing.
13. Install the flow control spring and flow control plunger. Be sure the hex head screw goes into the bore first (fig. 30).
14. On Corvette, install cage and a new filter.
15. Place magnet into proper position on housing assembly (Fig. 17).
16. Install new mounting stud and union square ring seals.
17. Install a new reservoir "O" ring seal, lubricated with Power Steering Fluid, onto housing.
18. Lubricate reservoir sealing edge with Power Steering Fluid and place reservoir onto housing in the normal position. Press down on reservoir until it seats onto housing; check position of stud and union seals.
19. Place a new "O" ring seal, lubricated with Power Steering Fluid, onto union and install union assembly and studs.
20. Support the drive shaft on the opposite side of the keyway and tap the woodruff key into place.
21. Slide the pulley onto the shaft. Do not hammer on the pulley.
22. Install the pulley nut and torque to 60 ft. lbs.
CAUTION: Always use a new pulley nut.



Fig. 29--Installing End Plate Retaining Ring



Fig. 28--Installing Pressure Plate Spring



Fig. 30--Installing Flow Control Valve

INTEGRAL POWER STEERING GEAR

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OVERHAUL OPERATIONS

NOTE: In the following text, Power Steering Fluid is noted for use in lubricating components upon reassembly. If Power Steering Fluid is not available, Transmission Fluid bearing the mark DEXRON may be used as a substitute.

CAUTION: *If when overhauling a power steering gear or pump, broken components or foreign material are encountered, the remaining components of the entire hydraulic system should be disassembled, inspected, thoroughly cleaned and flushed before servicing is completed.*

Disassembly (Fig. 31)

In many cases, complete disassembly of the gear will not be necessary since most of the components can be removed without complete disassembly.

NOTE: Disassembly of the major components within the gear must be performed on a clean workbench. The work area, tools and parts must be kept clean at all times.

1. Rotate end cover retainer ring so that one end of the ring is over the hole in the side of the housing. Force the end of the ring from its groove and remove ring (fig. 32).
2. Turn the stub shaft counter-clockwise until the rack-piston just forces end cover out of housing. Remove cover and discard "O" ring.

CAUTION: *DO NOT turn the stub shaft any further than absolutely necessary to remove the end plug, or balls from rack-piston and worm circuit may escape and lay loose inside the rack-piston chamber.*

3. Remove the rack-piston end plug as shown in Figure 33.

NOTE: To aid in loosening end plug, strike end plug with a brass drift.

4. Remove the pitman shaft and side cover as follows:
 - a. Loosen the over-center adjusting screw locknut

and remove the 4 side cover attaching bolts and lock washers.

- b. Rotate the side cover until the rack-piston and pitman shaft teeth are visible, then turn the stub shaft until the pitman shaft teeth are centered in the housing opening. Tap the pitman shaft with a soft hammer and remove the pitman shaft and side cover from the housing. Remove the side cover "O" ring and discard.
5. Remove the rack-piston as follows:
 - a. Insert Ball Retainer Tool J-7539 into the rack-piston bore with pilot of tool seated in the end of the worm (fig. 35). Turn the stub shaft counter-clockwise while holding tool tightly against worm. The rack-piston will be forced onto the tool.
 - b. Remove the rack-piston with Ball Retainer Tool J-7539 from gear housing.
 6. Remove the adjuster plug as follows:
 - a. Loosen the adjuster plug locknut and remove.
 - b. Remove adjuster plug assembly with Spanner Wrench J-7624 (fig. 36). Remove and discard the plug "O" ring.
 7. Grasp the stub shaft and pull the valve and shaft assembly from the housing bore. Separate worm and shaft and remove the stub shaft cap "O" ring and discard.
 8. If the worm or the lower thrust bearing and race remained in the gear housing, remove them at this time.

OVERHAULING INDIVIDUAL UNITS

Adjuster Plug Assembly

Disassembly

1. If the oil seal ONLY is to be replaced, and not the bearing, install the adjuster plug loosely in the gear housing. Remove the retaining ring with Internal Pliers J-4245. With a screw driver, pry the dust seal and oil seal from the bore of the adjuster plug

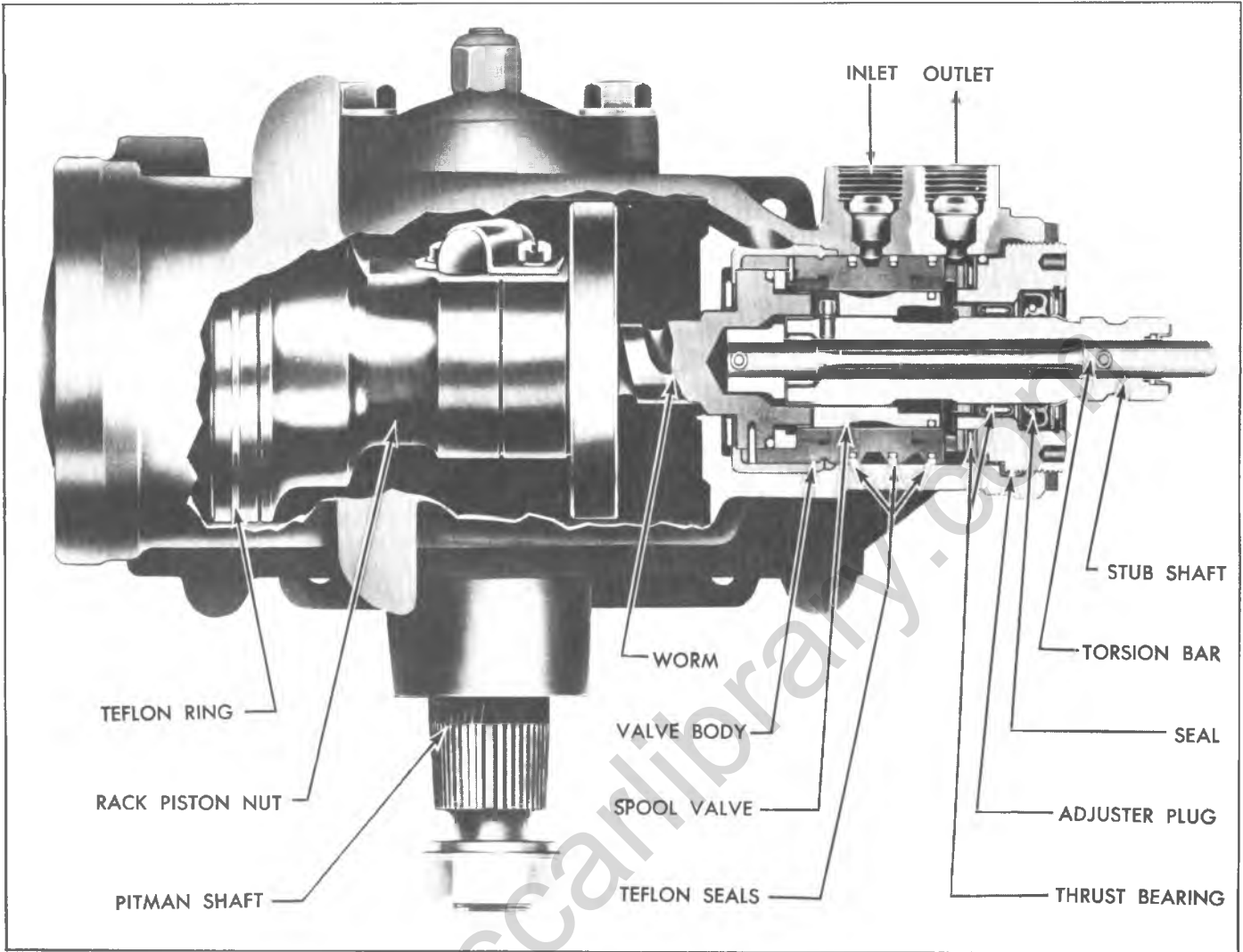


Fig. 31--Power Steering Gear--Typical

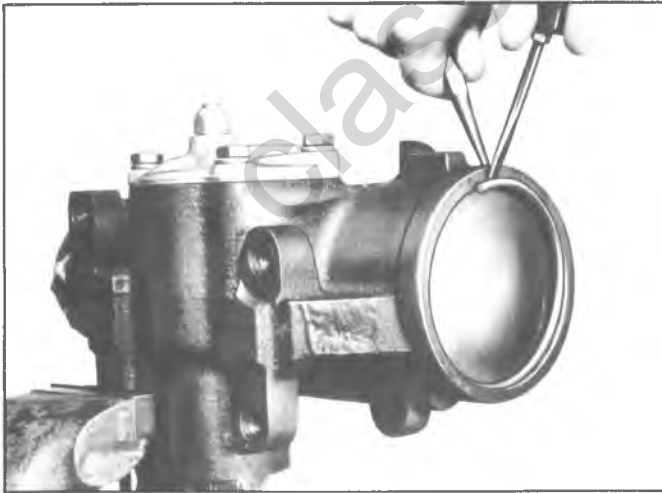


Fig. 32--Removing End Cover Retaining Ring

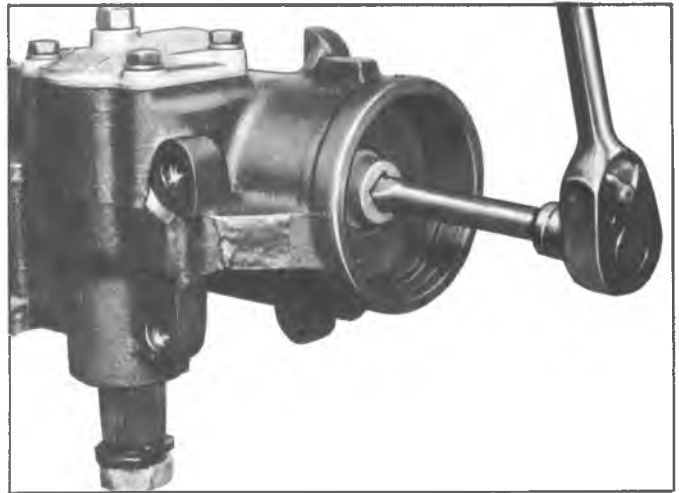


Fig. 33--Removing End Plug

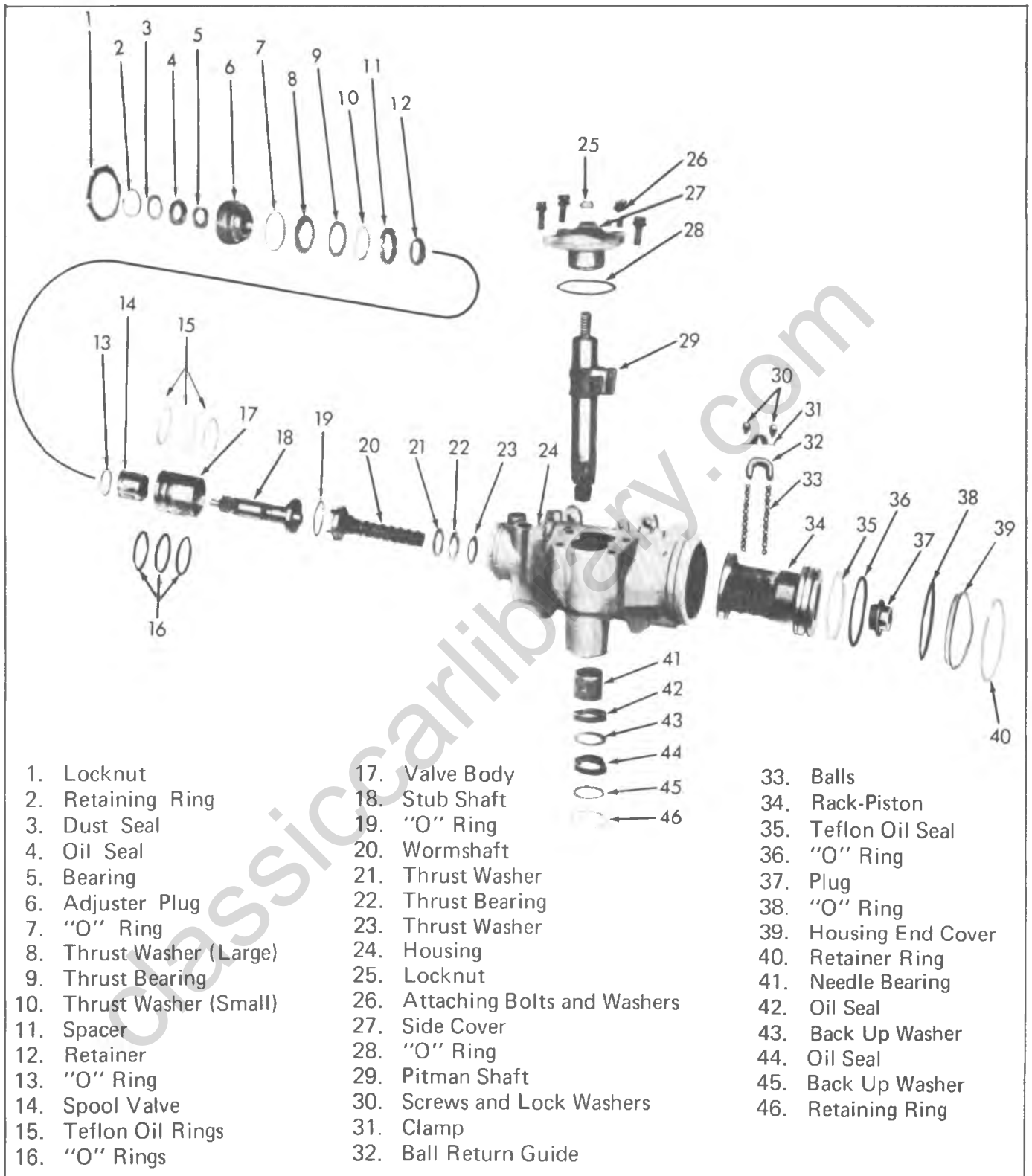


Fig. 34--Power Steering Gear--Exploded View

being careful not to score the needle bearing bore (fig. 37). Discard the oil seal.

2. If the thrust bearing ONLY is to be removed, pry

the thrust bearing retainer at the two raised areas with a small screw driver (fig. 38). Remove the spacer, thrust bearing washer, thrust bearing and washer. Discard the retainer.



Fig. 35--Removing Rack-Piston

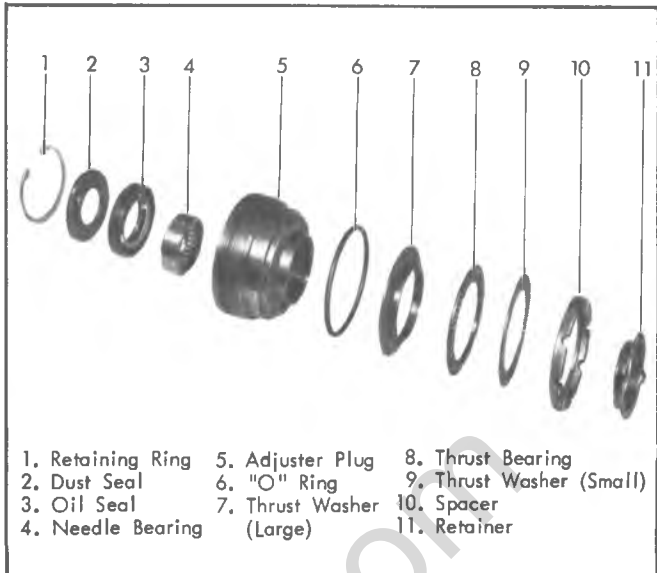


Fig. 37--Adjuster Plug--Exploded View

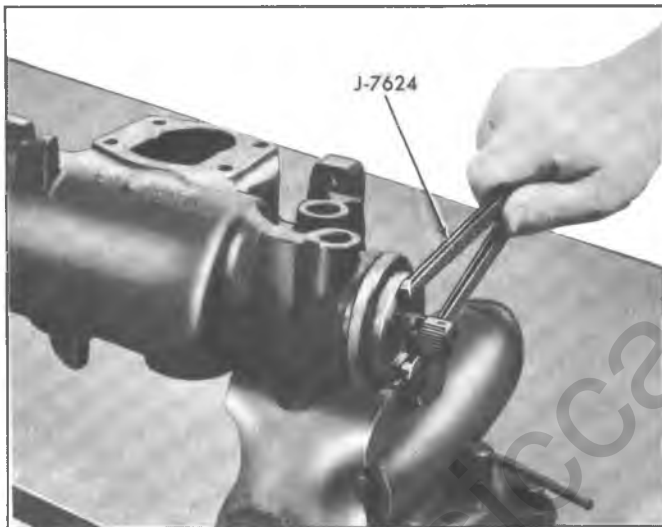


Fig. 36--Removing Adjuster Plug

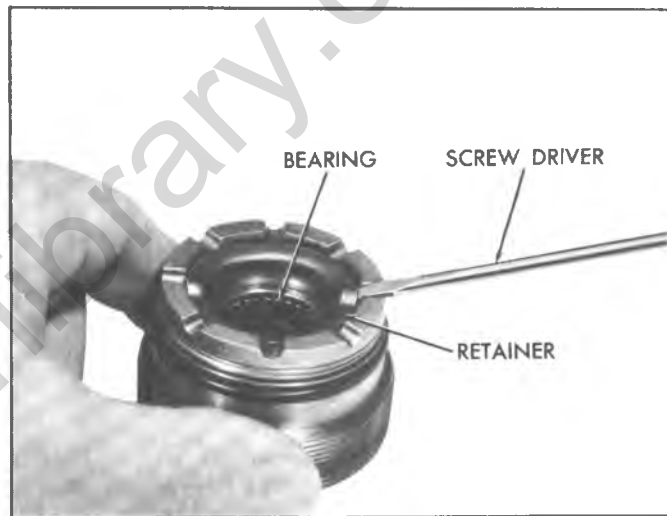


Fig. 38--Removing Retainer

3. If the needle bearing is to be replaced, remove the retaining ring using Internal Pliers J-4245. Remove thrust bearing as outlined in Step 2 above. Drive needle bearing, dust seal and oil seal from adjuster plug using Bearing Remover J-8524-2 and Driver J-7079-2 as shown in Figure 39. Discard the oil seal.
4. Wash all parts in clean solvent and dry parts with compressed air.
5. Inspect thrust bearing spacer for wear or cracks. Replace if damaged.
6. Inspect thrust bearing rollers and washers for wear, pitting or scoring. If any of these conditions exist, replace the bearing and washers.

Assembly

CAUTION: Place a block of wood under the adjuster plug to protect the thrust bearing surface.

1. If the needle bearing was removed, place new needle bearing over Tool J-8524-1 and J-7079-2, with the bearing manufacturer's identification toward the tool, and drive the bearing into the adjuster plug until the tool bottoms in the housing (fig. 40).
2. Place dust seal and a new oil seal on Tool J-8524-1 (lip of seal away from tool). Lubricate seal with Power Steering Fluid and drive or press seals into adjuster plug until seated (fig. 41).
3. Install retaining ring with Internal Pliers J-4245.
4. Lubricate the thrust bearing assembly with Power Steering Fluid. Place the large thrust bearing washer on the adjuster plug hub, then install the upper thrust bearing, small bearing washer and spacer (grooves of spacer away from bearing washer).
5. Install a new bearing retainer on the adjuster plug

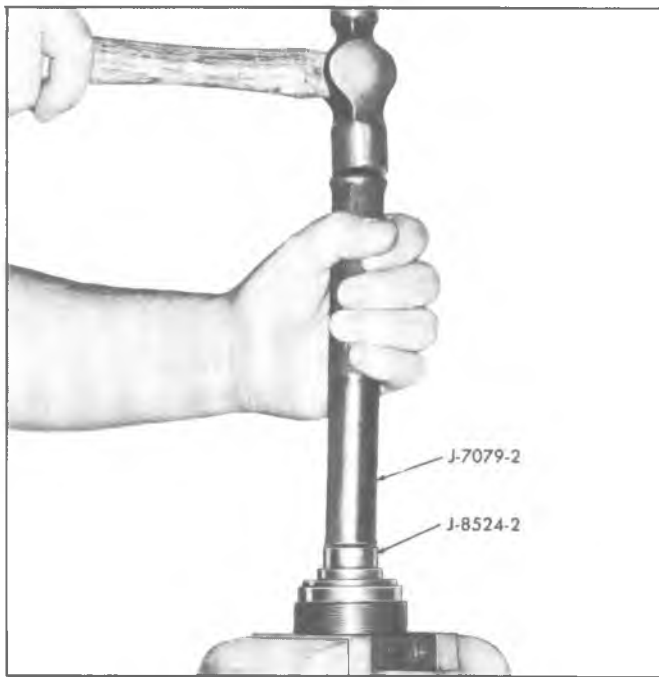


Fig. 39--Removing Bearing and Seal

by carefully tapping on the flat surface of the retainer (fig. 42).

NOTE: The projections must not extend beyond the spacer when the retainer is seated. The spacer must be free to rotate.

Valve and Stub Shaft Assembly

Disassembly

1. Remove and discard the "O" ring in the shaft cap end of the valve assembly.
2. To remove the lower shaft assembly from the valve body, proceed as follows:
 - a. While holding the assembly (stub shaft down),

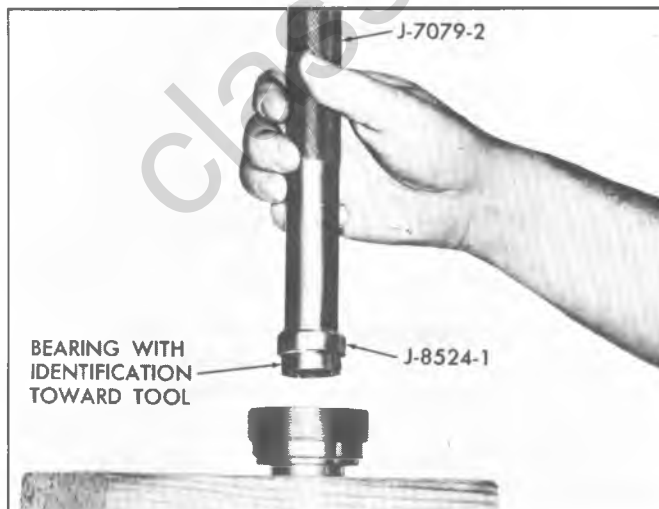


Fig. 40--Installing Bearing

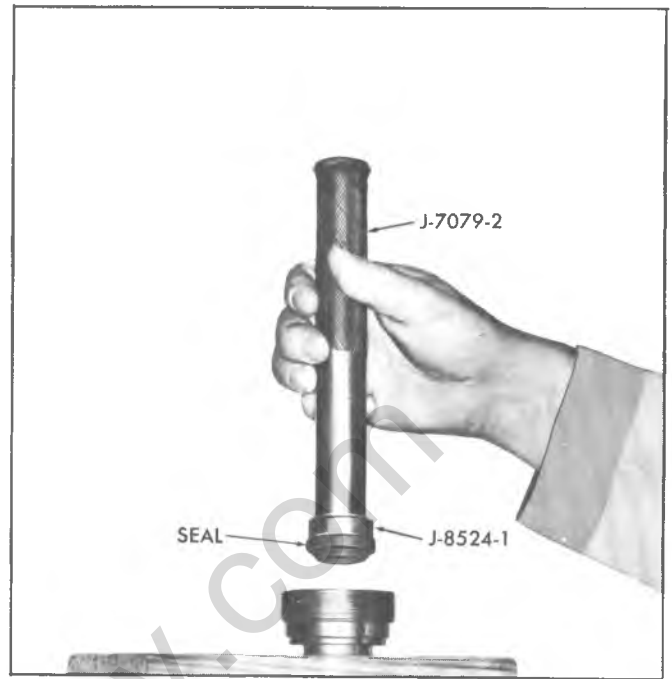


Fig. 41--Installing Adjuster Plug Seal

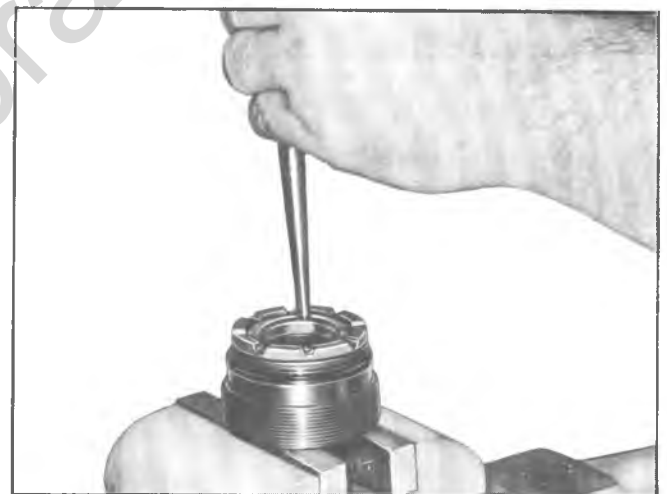


Fig. 42--Installing Retainer

lightly tap the stub shaft against the bench until the shaft cap is free from the valve body (fig. 43).

- b. Pull the shaft assembly out of the spool valve until the shaft cap clears the valve body approximately 1/4".

CAUTION: Do not pull the shaft assembly out too far or the spool valve may become cocked in the valve body.

- c. Carefully disengage the shaft pin from the valve spool and remove the shaft assembly (fig. 43).

3. Push the spool valve out of the flush end of the valve body until the dampener "O" ring is exposed,

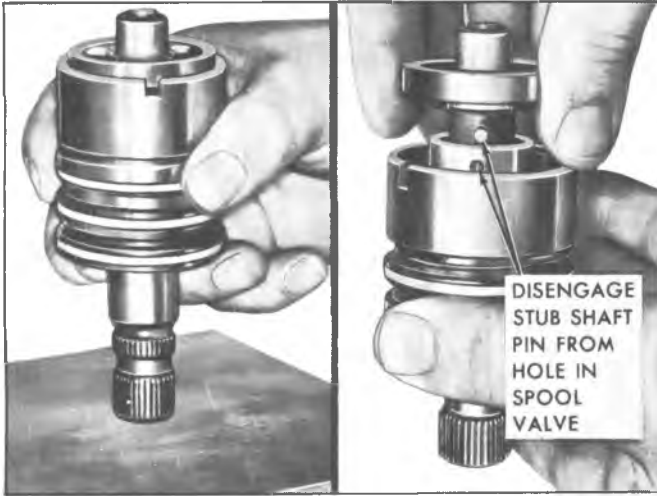


Fig. 43-Removing Stub Shaft Assembly

then carefully pull the spool from the valve body, while rotating the valve (fig. 44). If the spool valve becomes cocked, carefully realign the spool valve, then remove.

4. Remove the dampener "O" ring from the spool valve and discard.
5. If the teflon oil rings are to be replaced, cut the 3 teflon oil rings and "O" rings from the valve body and discard.

Cleaning and Inspection

1. Wash all parts in clean solvent and blow out all oil holes with compressed air.
2. If the drive pin in the stub shaft or valve body is cracked, excessively worn or broken, replace the complete valve and shaft assembly.
3. If there is evidence of leakage between the torsion bar and the stub shaft, or scores, nicks, or burrs on the ground surface of the stub shaft that cannot be



Fig. 44-Removing Spool Valve

cleaned up with crocus cloth, the entire valve and shaft assembly must be replaced.

4. Check the outside diameter of the spool valve and the inside diameter of the valve body for nicks, burrs, or bad wear spots. If the irregularities cannot be cleaned up by the use of crocus cloth, the complete valve and shaft assembly will have to be replaced.
5. If the small notch in the skirt of the valve body is excessively worn, the complete valve and shaft assembly will have to be replaced.
6. Lubricate the spool valve with Power Steering Fluid and check the fit of the spool valve in the valve body (with the spool valve dampener "O" ring removed). If the valve does not rotate freely without binding, the complete valve and shaft assembly will have to be replaced.

Assembly (Fig. 45)

1. If valve body "O" rings and teflon rings were removed, install new "O" rings in the oil ring grooves and lubricate with Power Steering Fluid.
2. Lubricate the 3 new teflon oil rings with Power Steering Fluid and install in grooves over "O" rings.

NOTE: The teflon rings may appear to be distorted, but the heat of the oil during operation of the gear will straighten them out.

3. Lubricate the spool valve dampener "O" ring with Power Steering Fluid and install over the spool valve.
4. Lubricate the spool valve and valve body with Power Steering Fluid and slide the spool valve into the valve body. Rotate the spool valve while pushing it into the valve body. Push the spool valve on through the valve body until the shaft pin hole is visible from the opposite end (spool valve flush with shaft cap end of valve body).
5. Lubricate the shaft assembly with Power Steering Fluid and carefully install it into the spool valve until the shaft pin can be placed into the hole in the spool valve.
6. Align the notch in the shaft cap with the pin in the valve body and press the spool valve and shaft assembly into the valve body (fig. 46).

CAUTION: Make sure that the shaft cap notch is mated with the valve body pin before installing valve body into the gear assembly.

7. Lubricate a new "O" ring with Power Steering Fluid and install it in the shaft cap end of the valve body assembly.

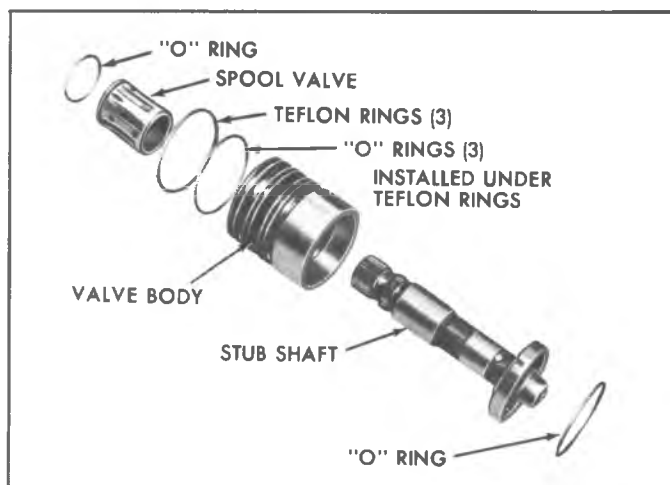


Fig. 45--Valve Body and Shaft Assembly - Explode

Pitman Shaft and Side Cover

Disassembly

Remove the locknut and unscrew the side cover from the adjusting screw. Do not attempt to disassemble pitman shaft. Discard locknut.

Cleaning and Inspection

1. Wash all parts in clean solvent and dry parts with compressed air.
2. Check pitman shaft bearing surface in the side cover for scoring. If badly worn or scored, replace the side cover.
3. Check the sealing and bearing surfaces of the pitman shaft for roughness, nicks, etc. If minor irregularities in surface cannot be cleaned by use of crocus cloth, replace the pitman shaft.
4. Replace pitman shaft assembly if teeth are damaged or if the bearing surfaces are pitted or scored.
5. Check pitman shaft lash adjusting screw. It must be free to turn with no perceptible end play. If adjusting screw is loose replace the pitman shaft assembly.

Assembly

Thread the side cover onto the pitman shaft adjusting screw until it bottoms and then turn in one-half turn. Install a new adjusting screw locknut, but do not tighten.

Rack-Piston

Disassembly

1. Remove tool J-7539 from the rack-piston.
2. Remove the ball return guide clamp, ball guide and balls.
3. If necessary to replace the teflon oil seal and "O" ring, remove at this time.

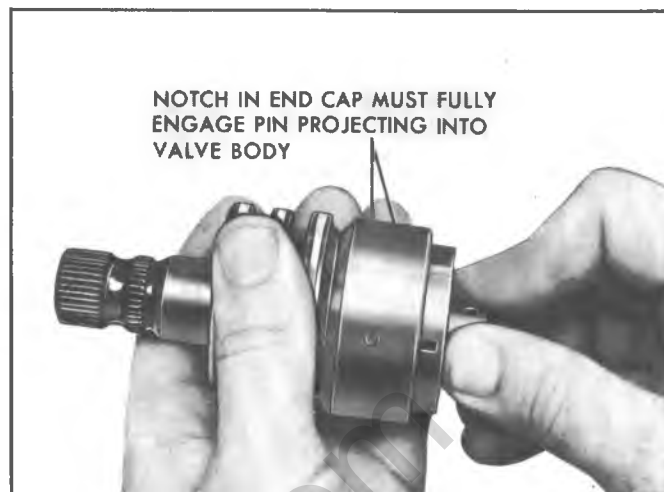


Fig. 46--Installing Stub Shaft Assembly

Cleaning and Inspection

1. Wash all parts in clean solvent and dry with compressed air.
2. Inspect the worm and rack-piston grooves and all the balls for scoring. If either the worm or rack-piston needs replacing, both must be replaced as a matched assembly.
3. Inspect ball return guide halves, making sure that the ends where the balls enter and leave the guides are not damaged.
4. Inspect lower thrust bearing and washers for scores or excessive wear. Check bearing washers to make sure they are not flat but conical in shape to provide proper bearing preload adjustment when reinstalled in the steering gear. If any of these conditions are found, replace the thrust bearing and washers.
5. Inspect rack-piston teeth for scoring or excessive wear. Inspect the external ground surfaces for wear, scoring or burrs.

Assembly

1. If the teflon oil seal and "O" ring were removed, lubricate a new "O" ring and seal with Power Steering Fluid and install in groove on rack-piston. The teflon ring may be slightly loose after assembly, but will tighten up when subjected to the hot oil in the system (fig. 47).
2. Slide the worm all the way into the rack-piston. It is not necessary to have the thrust bearing assembly on the worm at this time.
3. Turn the worm until the worm groove is aligned with the lower ball return guide hole (fig. 48).
4. Lubricate the balls with Power Steering Fluid, then feed 17 balls into the rack-piston, while slowly rotating the worm counter-clockwise.

IMPORTANT: The black balls are .0005" smaller than the silver balls. The black and silver balls must be installed alternately into the rack-piston and return guide.



Fig. 47--Installing Ring on Rack-Piston

5. Alternately install 7 balls into the return guide and retain with chassis lubricant at each end of guide. Install the return guide assembly onto the rack-piston. Install the return guide clamp and tighten the 2 clamp screws to 10 ft. lbs.
6. Insert Bearing Retainer Tool J-7539 into the rack-piston, then while holding tool tightly against end of worm, thread worm out of the rack-piston.

Hose Connector Inverted Flares

If the brass inverted flare connectors show need of replacement, proceed as follows:

1. Tap threads into the center hole of the connector with a 5/16-18 tap.

CAUTION: Do not tap the threads too deep in the pressure hose connector seat as the tap will bottom the poppet valve against the housing and damage it. It is necessary to tap only two or three threads deep.

2. Thread a 5/16-18 bolt, with a nut and flat washer attached, into the tapped hole so that the washer rides against the face of the port boss and the nut rides against the washer.
3. Hold the bolt from rotating while turning the nut off the bolt. This will force the washer against the bolt boss and will back out the bolt, drawing the connector from the housing. Discard the connector.
4. Clean the housing thoroughly to remove any tapping chips.
5. Drive the new connector against the housing seat using Tool J-6217, being careful not to damage either the connector or housing seat (fig. 49).

Pitman Shaft Needle Bearing and Seals

Removal

1. If pitman shaft seals ONLY are to be replaced, remove the seal retaining ring with Internal Pliers J-4245 and remove outer steel washer. Pry out the

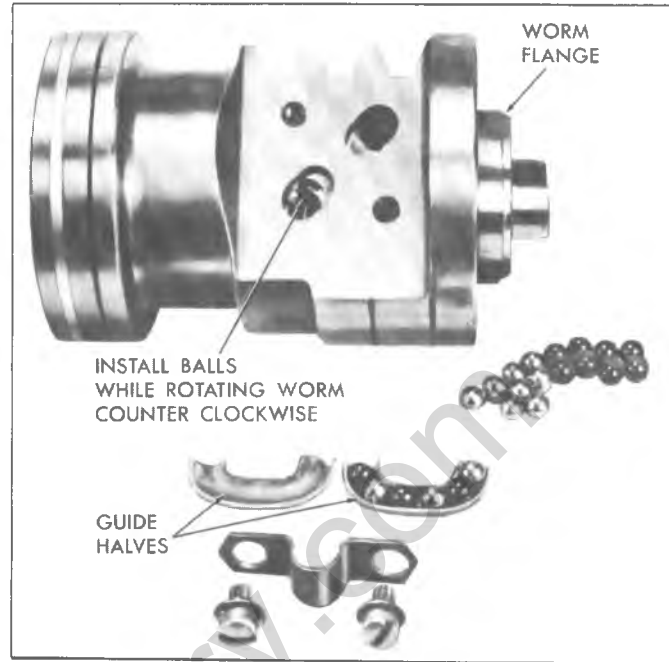


Fig. 48--Installing Balls in Rack-Piston

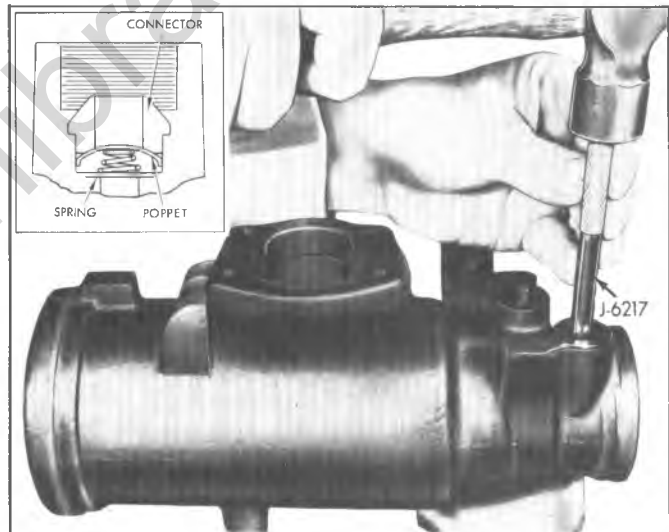


Fig 49--Installing New Connector in Housing

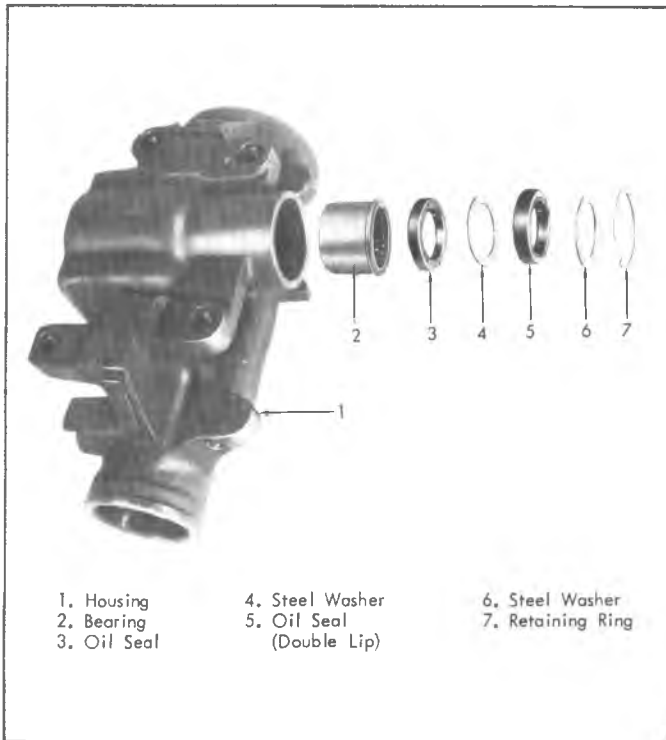
outer seal. Remove the inner steel washer, then pry out the inner seal (fig. 50). Discard seals.

CAUTION: When prying out seals, be extremely careful not to score the housing bore.

2. If pitman shaft needle bearing replacement is necessary, remove with Tool J-6278. Since this bearing is shouldered, it must be pressed out the pitman shaft end of the housing.

Installation

1. If the pitman shaft needle bearing was removed, place bearing Installer Tool J-22407 onto Handle J-8092. Place needle bearing (shouldered end first) on to Tool J-22407. Press bearing into gear housing



1. Housing
2. Bearing
3. Oil Seal
4. Steel Washer
5. Oil Seal (Double Lip)
6. Steel Washer
7. Retaining Ring

Fig. 50--Pitman Shaft Bearing and Seals

until Tool bottoms on housing. The bearing is now correctly positioned (fig. 51).

CAUTION: Do not drive the bearing further into the housing after removing Tool J-22407, since damage to the bearing would result.

2. Lubricate the lips of the oil seals with Power Steering Fluid.
3. Install the pitman shaft oil seals as follows:
 - a. Place Adapter J-6278-2 over Tool J-6278, then install the outer seal (double lip), inner steel

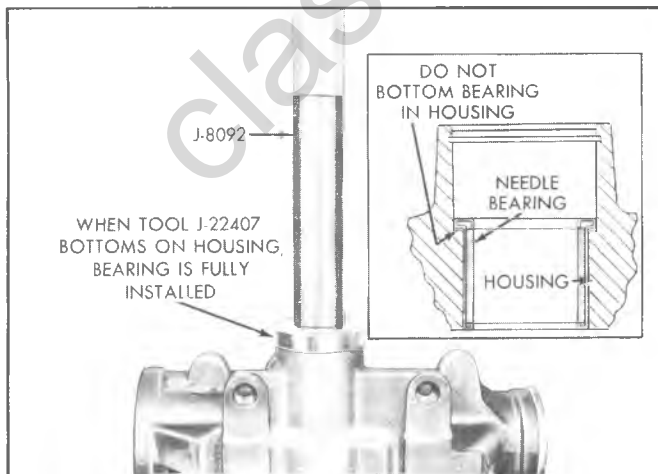


Fig. 51--Installing Pitman Shaft Bearing

- b. Drive the seals into the housing until the top of Adapter J-6278-2 is flush with the housing (fig. 52).
- c. Remove the tool and adapter, then install the outer steel washer and seal retaining ring. The retaining ring will not seat in the groove at this time.
- d. Reinsert Tool J-6278 with Adapter J-6278-2 and continue driving the seals until the retaining ring seats in its groove (Refer to Inset, Figure 52), then remove the tool and adapter.

Removal and Installation of Pitman Shaft Seals with Steering Gear in Vehicle (fig. 53)

If upon inspection of the gear, it is found that oil leakage exists at the pitman shaft seals, the seals may

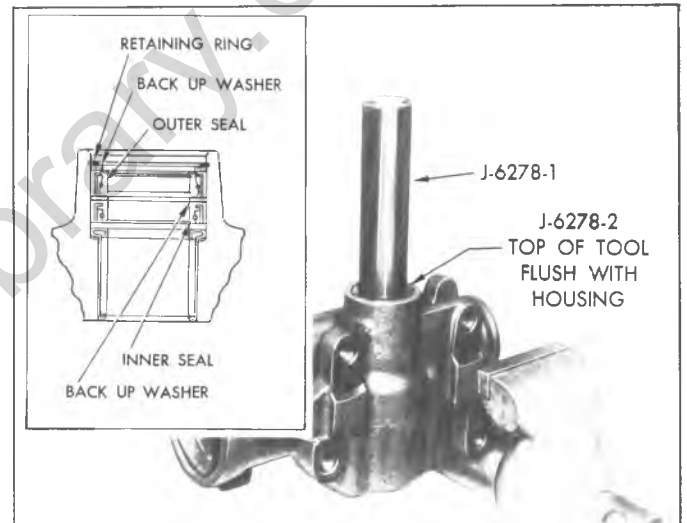


Fig. 52--Installing Pitman Shaft Seals (On Bench)

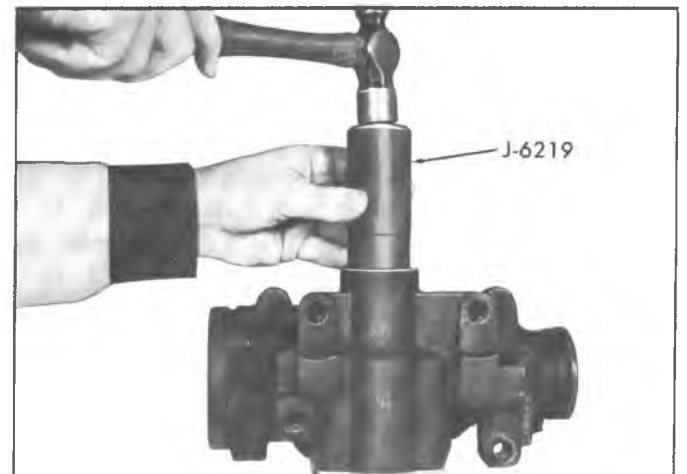


Fig. 53--Installing Pitman Shaft Seals

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often be replaced without removing the gear assembly from the vehicle as follows:

1. Remove pitman nut and disconnect pitman arm from pitman shaft using Puller J-6632.

CAUTION: Do not hammer on the end of Puller Tool J-6632.

2. Thoroughly clean end of pitman shaft and gear housing, then tape splines on end of pitman shaft to insure that seals will not be cut by splines during assembly.

NOTE: Only one layer of tape should be used; an excessive amount of tape will not allow the seals to pass over it, due to the close tolerance between the seals and the pitman shaft.

3. Remove pitman shaft seal retaining ring with Snap Ring Pliers J-4245.
4. Start engine and turn steering wheel fully to the left so that oil pressure in the housing can force out pitman shaft seals. Turn off engine.

NOTE: Use suitable container to catch oil forced out of gear. This method of removing the pitman shaft seals is recommended, as it eliminates the possibility of scoring the housing while attempting to pry seals out. If pressure of oil does not remove seals, turn off engine, remove the steering gear and remove the seals as outlined previously in this section.

5. Clean the end of housing thoroughly so that dirt will not enter housing with the installation of the new seals.
6. Lubricate the seals thoroughly with Power Steering Fluid to install seals with Installer J-6219. Install the inner single lip seal first, then a back-up washer. Drive seal in far enough to provide clearance for the outer seal, back-up washer and retaining ring. Make sure that the inner seal does not bottom on the counterbore. Install the outer double lip seal and the second back-up washer in only far enough to provide clearance for the retaining ring. Install retaining ring.
7. Fill pump reservoir to proper level. Start engine and allow engine to idle for at least three minutes without turning steering wheel. Turn wheel to left and check for leaks.
8. Remove tape and reconnect pitman arm.

CAUTION: The pitman arm to steering gear nut 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.

GEAR ASSEMBLY

1. Lubricate the worm, lower thrust bearing and the two thrust washers with Power Steering Fluid, then install one thrust washer, the bearing, and the other thrust washer over the end of the worm (fig. 54).
2. Lubricate the valve body teflon rings and a new stub shaft cap "O" ring with Power Steering Fluid. Install the stub shaft cap "O" ring in the valve body so it is seated against the stub shaft cap. Align the NARROW NOTCH in the valve body with the pin in the worm, then install the valve and stub shaft assembly in the gear housing (fig. 55). Apply pressure to the VALVE BODY when installing. If pressure is applied to the stub shaft during installation, the stub shaft may be forced out of the valve body (fig. 56).

NOTE: The valve body is properly seated when the oil return hole in the housing is entirely uncovered (fig. 57).

3. Lubricate a new adjuster plug "O" ring with Power Steering Fluid and install in groove on adjuster plug. Place Seal Protector J-6222 over the stub shaft, then install the adjuster plug assembly in the housing until it seats against the valve body (fig. 58). Remove Seal Protector.
4. Adjust the thrust bearing preload (Fig. 59) as follows:
 - a. Using spanner wrench J-7624, tighten the adjuster plug until the plug and thrust bearing are firmly bottomed (clockwise).

CAUTION: AVOID EXCESSIVE TORQUE AS THIS COULD DAMAGE THE BEARING.

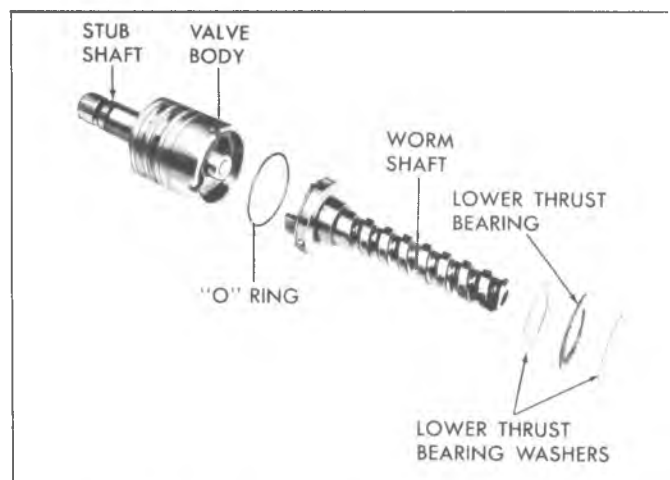


Fig. 54--Worm and Valve Body--Exploded View

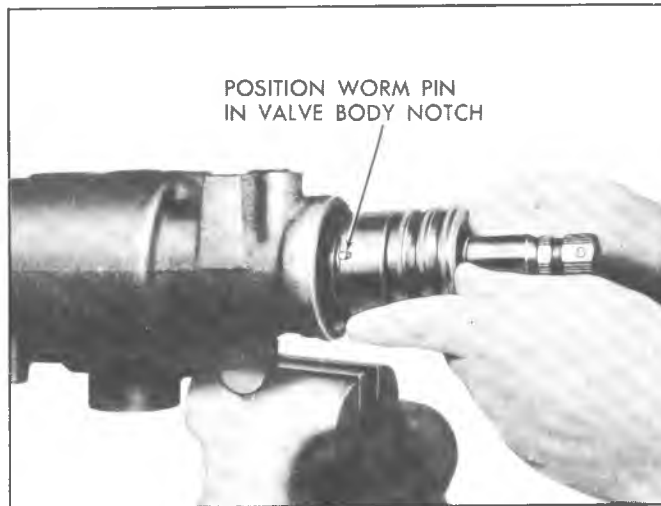


Fig. 55-Valve to Worm Alignment



Fig. 57-Valve Body Position in Housing

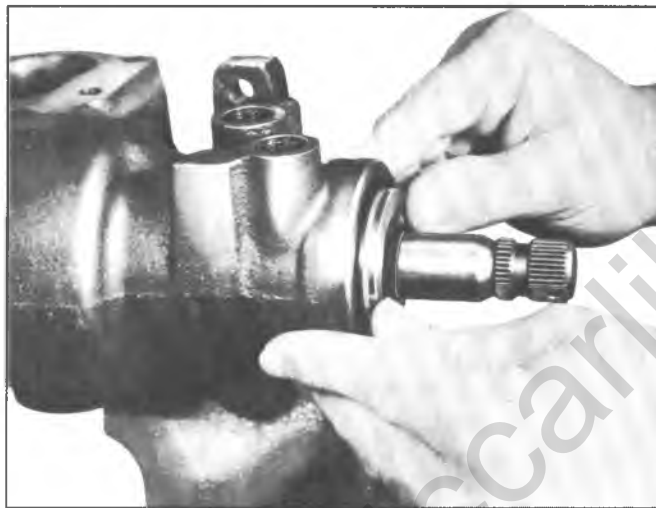


Fig. 56-Installing Valve Body

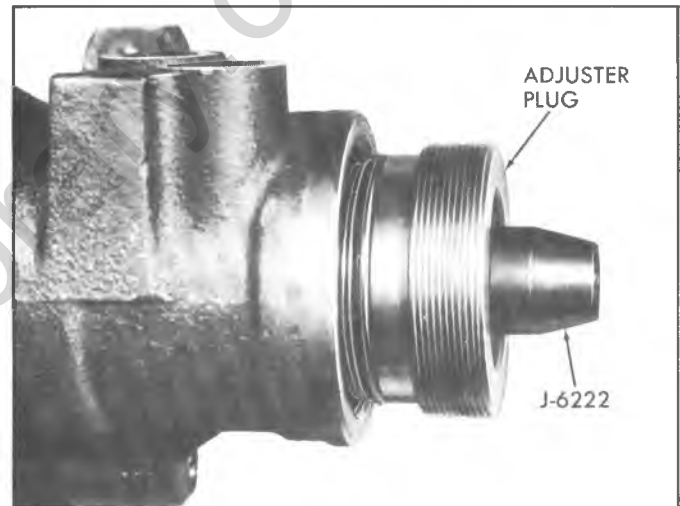


Fig. 58-Installing Adjuster Plug

- b. Back-Off the adjuster plug 5° to 10° (approximately 3/16" at the outside diameter of the adjuster plug).
- c. Tighten the adjuster plug locknut to recommended torque, while holding the adjuster plug locknut securely with tool J-7624.

This will automatically provide the correct thrust bearing preload.

5. Install the rack-piston as follows:

- a. Lubricate the rack-piston teflon seal with Power Steering Fluid.
- b. Position Seal Compressor J-8947 (Passenger Cars) J-7576 (Trucks) against the shoulder in the housing.
- c. With Ball Retainer J-7539 in place in the rack-piston, push the rack-piston (with teeth toward pitman shaft opening), into the housing until Tool J-7539 contacts the center of worm (fig. 60).

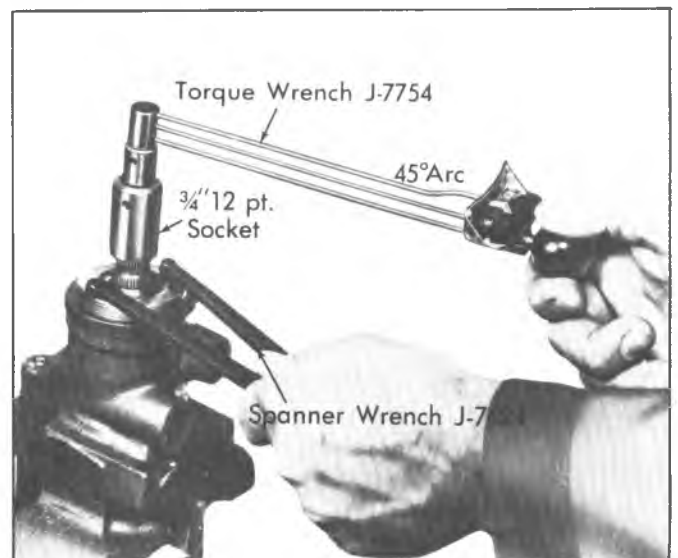


Fig. 59-Adjusting Thrust Bearing Preload

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- d. Turn the stub shaft clockwise with a 3/4" twelve point deep socket or box end wrench to thread the rack-piston onto the worm while holding Tool J-7539 against the end of the worm.
 - e. When the rack-piston is completely threaded on the worm, remove Ball Retainer J-7539 and Seal Compressor J-8947 (Cars) or J-7576 (Trucks).
6. Install the pitman shaft and side cover as follows:
- a. Install a new "O" ring in the pitman shaft side cover and retain with chassis lubricant.
 - b. Turn the stub shaft until the rack-piston teeth are centered in the pitman shaft opening, then install the pitman shaft and side cover so that the center tooth of the pitman shaft engages the center groove of the rack-piston.
 - c. Install the side cover bolts and lock washers and tighten to 30 ft. lbs.
7. Install the rack-piston plug in the rack-piston and torque to 75 ft. lbs.
8. Install a new housing end cover "O" ring and lubricate it with Power Steering Fluid. Install the end cover and retaining ring.
9. Adjust the over-center preload (Fig. 61) as follows:
- a. Make sure the over-center adjusting screw is backed all the way out and then turned back in one-half turn.
 - b. Install an inch-lb. torque wrench with a 3/4", 12-point socket on the stub shaft splines.
 - c. Rotate the stub shaft from one stop to the other. Count the number of turns and locate the center of travel, then check the combined seal drag and thrust bearing preload by rotating the torque wrench through the center of travel. Note the highest reading.
 - d. Tighten the pitman shaft over-center adjusting

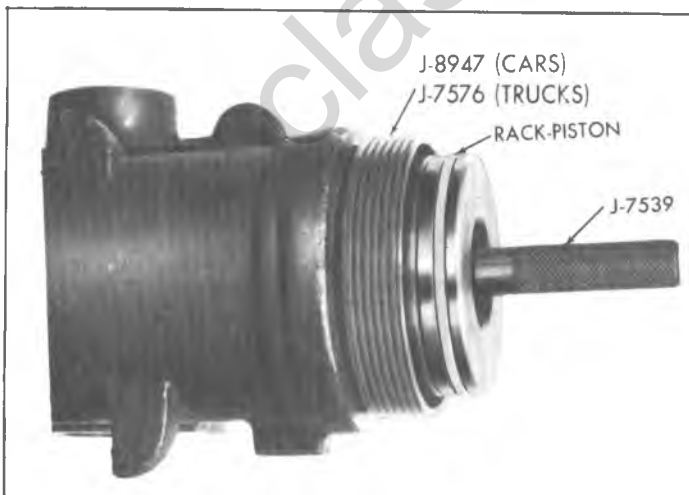


Fig. 60—Installing Rack Piston

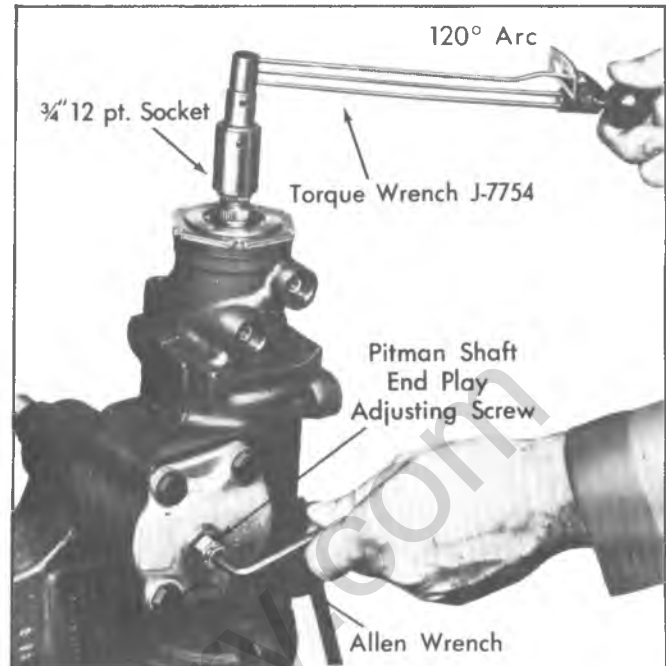


Fig. 61—Adjusting Over Center Preload

- e. While holding the adjusting screw, tighten the lock-nut to 35 ft. lbs. using Adapter J-5860 (fig. 62) and recheck the adjustment.

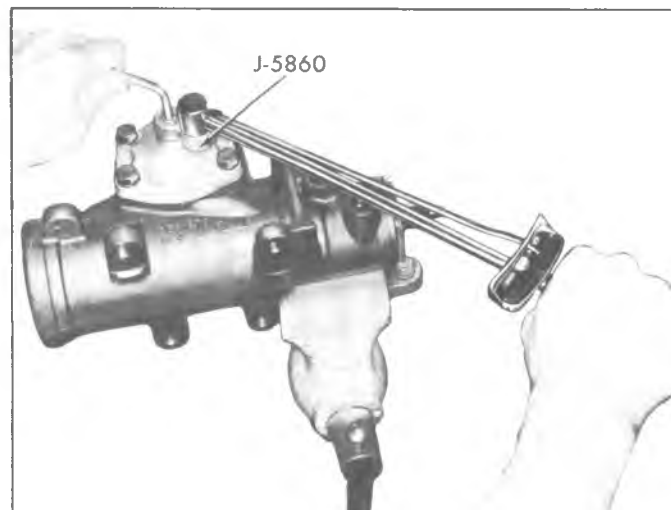


Fig. 62—Torquing Over-Center Locknut

CONTROL VALVE--CORVETTE

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Overhaul Operations	9-25	Repairs.....	9-27
Disassembly	9-25	Assembly	9-27
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OVERHAUL OPERATIONS

Disassembly

1. Place the valve in a vise as shown and remove dust cover (fig. 63).
2. Remove adjusting nut (fig. 64).
3. Remove valve to adapter bolts and remove valve housing and spool from adapter.
4. Remove spool from the housing (fig. 65).
5. Remove spring, reaction spool, washer reaction spring, spring retainer, and seal (fig. 66). "O" ring may now be removed from the reaction spool.
6. Remove the annulus spacer valve shaft washer and plug to sleeve key (See Figure 67).
7. Remove clamp by removing nut, bolt and spacer or, if crimped type clamp is used, straighten clamp end and pull clamp and seal off end of stud (fig. 68).
8. Carefully, so as not to nick the top surface, turn adjuster plug out of sleeve (fig. 69).

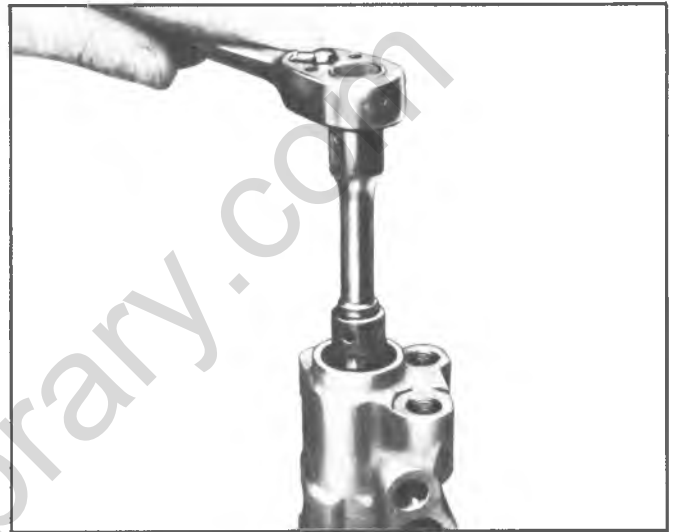


Fig. 64--Removing Adjusting Nut

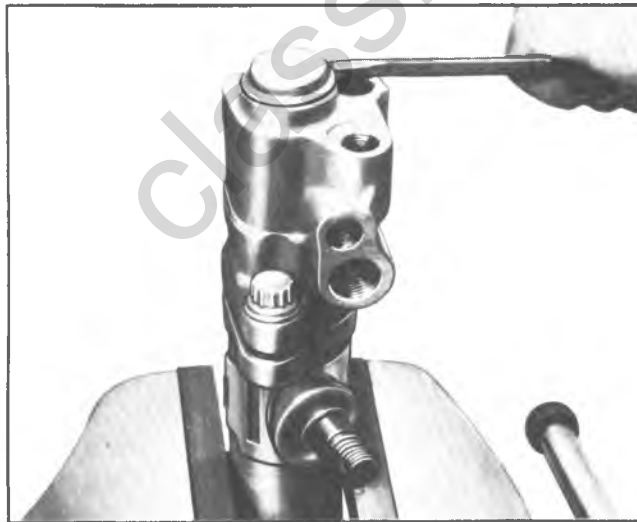


Fig. 63--Dust Cap Removal



Fig. 65--Removing Spool from Housing

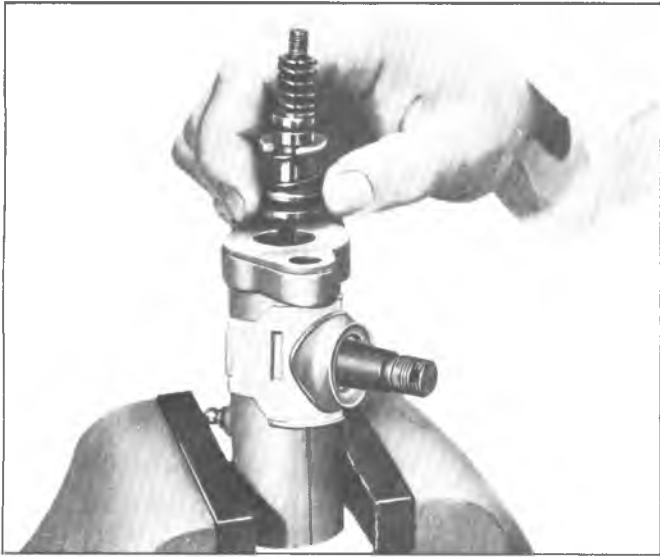


Fig. 66--Removing Valve Parts from Shaft

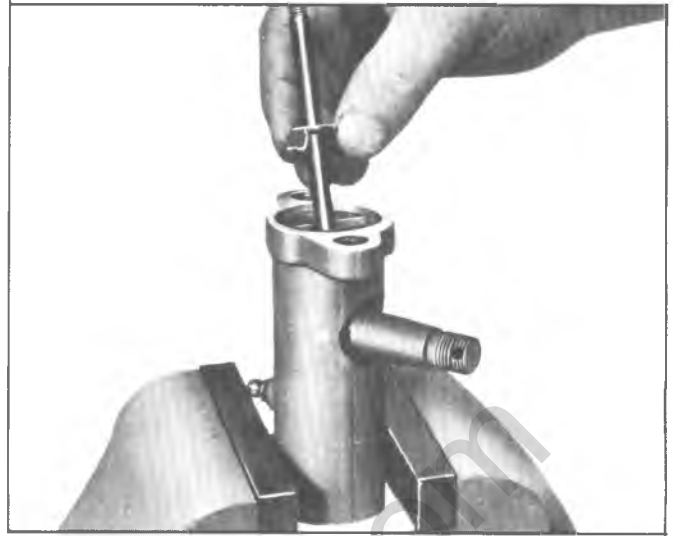


Fig. 67--Removing Plug-to-Sleeve Key

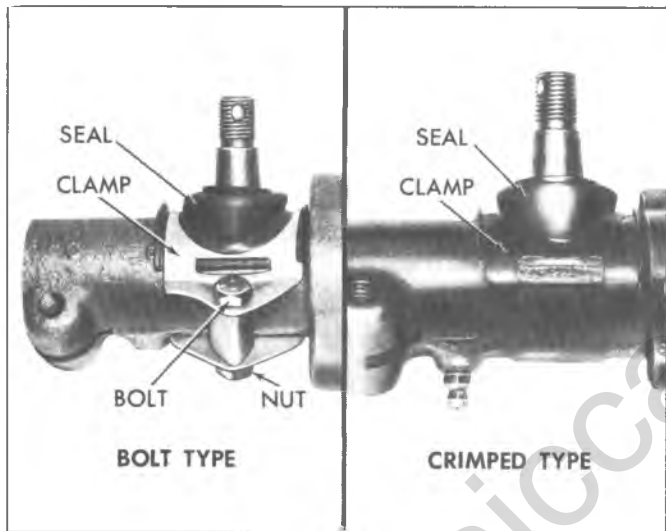


Fig. 68--Seal with Clamp Attachment

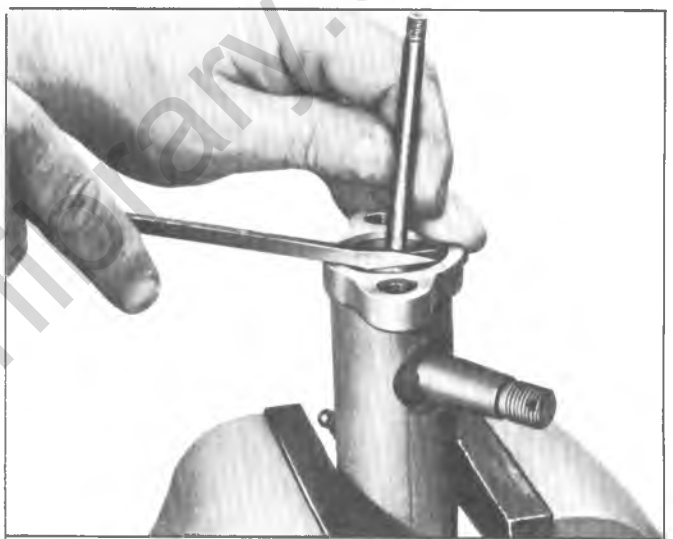


Fig. 69--Turning Adjuster Plug out of Sleeve

9. Remove the adapter from the vise and invert, permitting the spring and one of the two ball seats to fall free.
10. Remove the ball stud and the other ball seat and the sleeve will fall free.

Inspection

1. Wash all metal parts in nontoxic solvent and blow dry with compressed air.
2. Inspect all parts for scratches, burrs, distortion, evidence of wear and replace all worn or damaged parts, including mating parts when necessary.
3. Replace all seals, gaskets, covers with approved service parts.

Repairs

NOTE: The Corvette valve incorporates a 40 lb. centering spring. The Corvette valve incorporating this spring is identified by an "C" stamped on the dust cover.

In case a connector seat becomes damaged, proceed as follows:

To remove connector seat, tap threads in center hole using a 5/16-18 tap. Thread a bolt with nut and flat washer attached into tapped hole so that the washer rides against the face of the port boss and the nut rides against the washer. Hold the bolt from rotating while turning the nut off the bolt. This will force the washer against the port boss face and will back out the bolt thus drawing the connector seat from the top cover housing (fig. 70). Discard the connector seat. Clean the housing out thoroughly to remove any tapping chips.

Drive new connector seat against housing seat, using Tool J-6217, being careful not to damage either the connector seat or the housing seat (fig. 71).

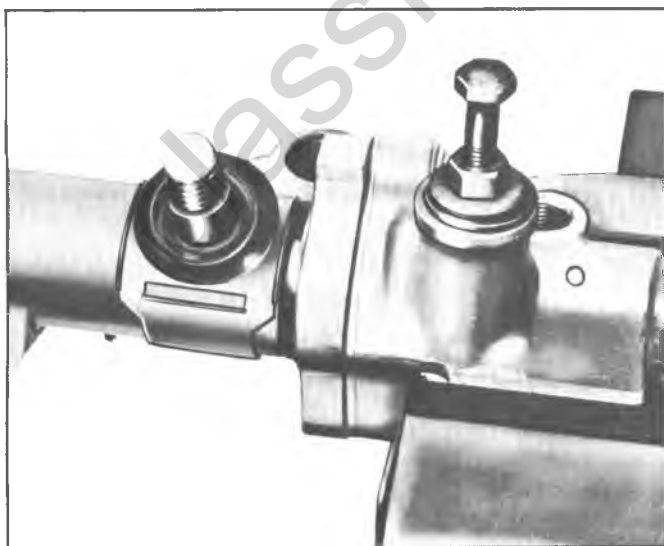


Fig. 70--Removing Connector Seat

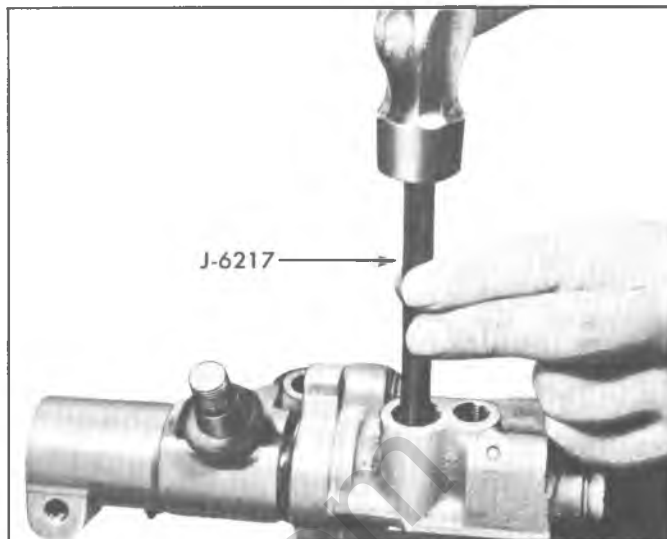


Fig. 71--Installing Connector Seat

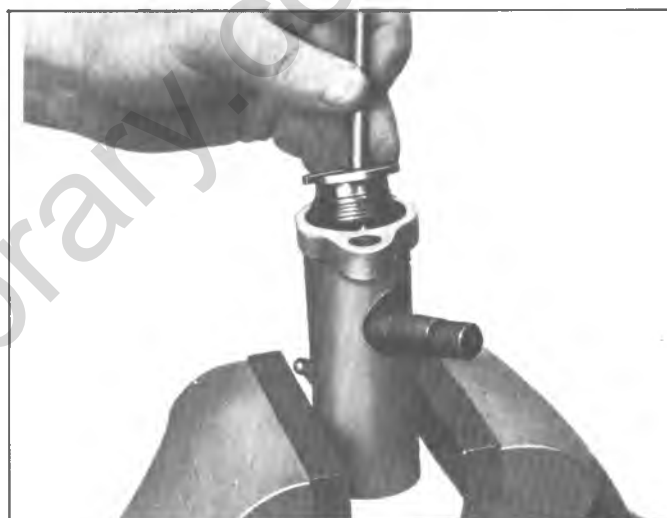


Fig. 72--Replacing Adjuster Plug and Shaft

Assembly (Fig. 73)

1. Replace the sleeve and ball seat in the adapter, then the ball stud, and finally the other ball seat and the spring, small coil down.
2. Clamp the adapter in vise, put the shaft through the seat in the adjuster plug and screw adjuster plug in sleeve (fig. 72).
3. Turn the plug in until it is tight, then back it off until the slot lines up with notches in the sleeve.
4. Install new seal and clamp over stud so lips on seal mate with clamp. (A nut and bolt attachment type clamp replaces the crimped type for service fig. 68).
5. Center the ball stud, seal and clamp at opening in adapter housing, then install spacer, bolt and nut.
6. Insert the key, making sure that the small tangs on the ends of the key fit into the notches in the sleeve (fig. 74).
7. Install the valve shaft washer, annulus spacer, and the reaction seal (lip up), spring retainer, reaction

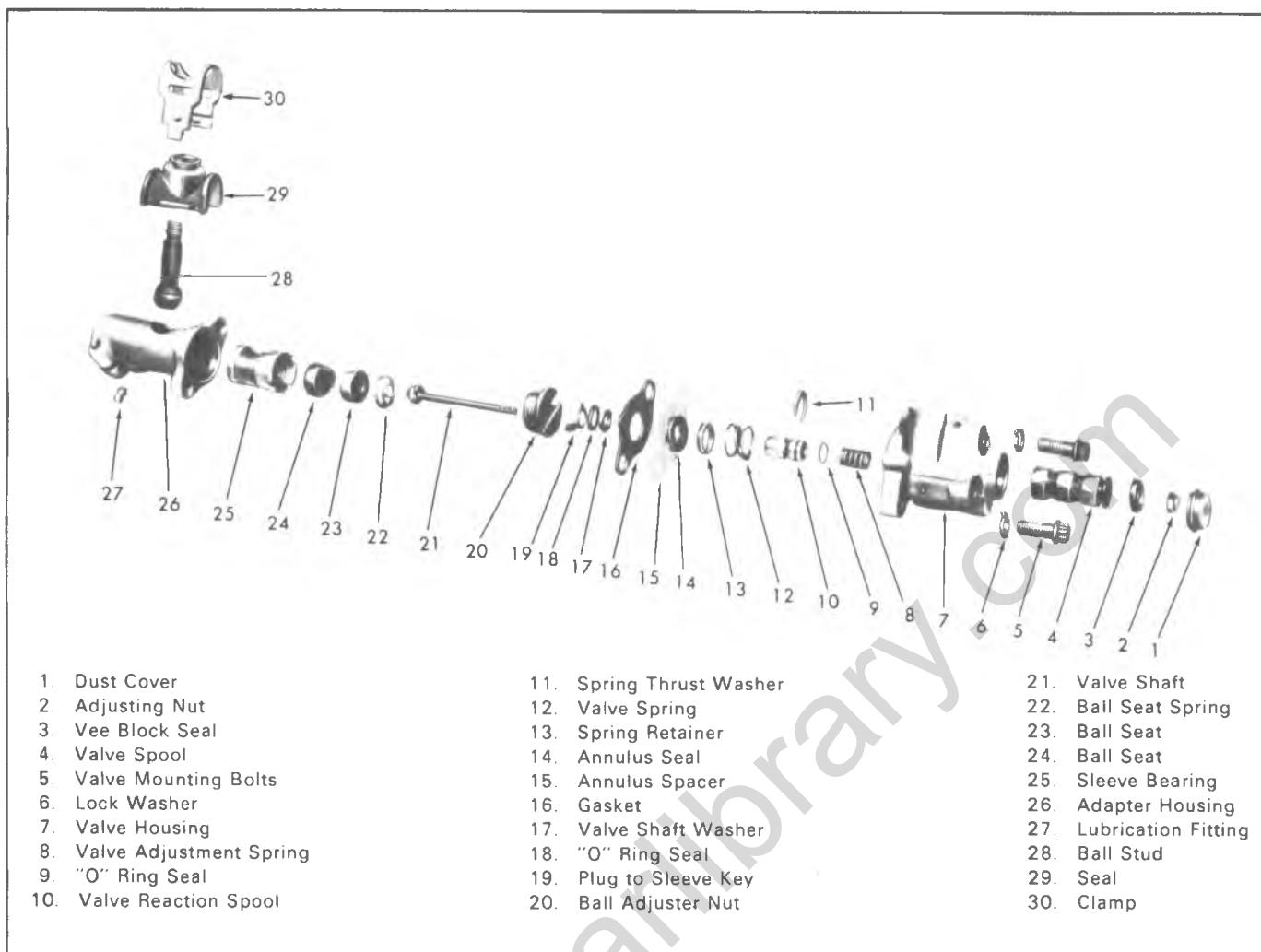


Fig. 73--Power Steering Control Valve and Adapter--Exploded

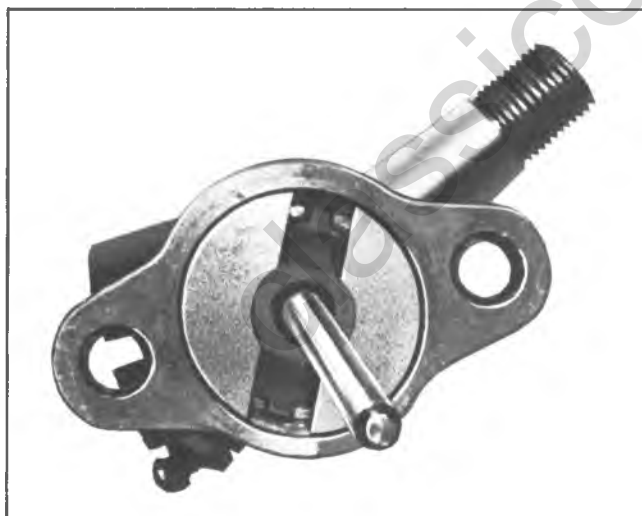


Fig. 74--Proper Key Installation

spring and spool washer and adjustment spring. (Install "O" ring seal on reaction spool before

installing spool on shaft.) Install the washer with the chamfer "up".

8. Install the seal on the valve spool (lip down), then install spool in housing being careful not to jam spool in housing.
9. Install housing and spool onto adapter. The side ports should be on the same side as the ball stud. Bolt the housing to the adapter.
10. Depress the valve spool and turn the locknut onto the shaft about four turns with a clean wrench or socket.

NOTE: Always use a new nut.

Valve Balancing (Fig. 75)

The control valve must be adjusted, after being disassembled, as outlined in the following procedure. The same procedure may be followed to correct a complaint of harder steering effort required in one direction than the other. See Figure 75.

1. Install valve in vehicle. Connect all hoses and fill

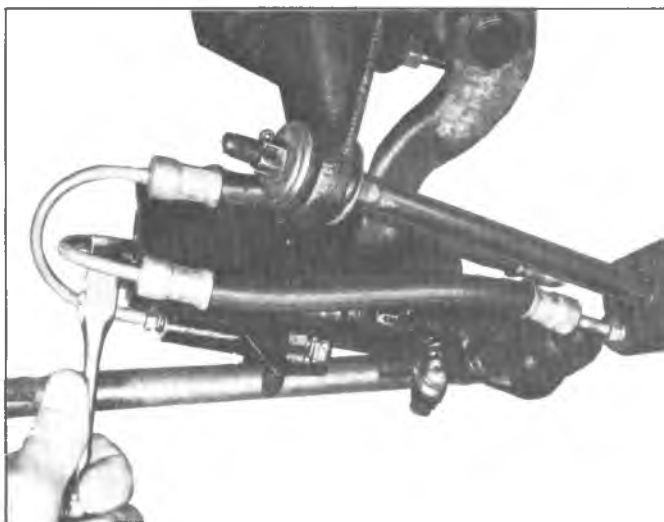


Fig. 75--Balancing Valve

the pump reservoir with oil. Do not connect the piston rod to the frame bracket. If the vehicle is already in operation, it will be necessary to detach the piston rod from the frame bracket.

2. With the car on a hoist, start the engine. One of the following two conditions will exist.

- a. If the piston rod remains retracted, turn the adjusting nut clockwise until the rod begins to move out. Then turn the nut counter-clockwise until the rod just begins to move in. Now turn the nut clockwise to exactly one-half the rotation needed to change the direction of the piston rod movement.
- b. If the rod extends upon starting the pump, move the nut counter-clockwise until the rod begins to move in. Now position the nut exactly one-half the rotation needed to change the direction of the piston rod movement.

CAUTION: Do not turn the nut back and forth more than is absolutely necessary to balance the valve.

3. With the valve balanced it should be possible to move the rod in and out manually.
4. Turn off the engine and connect the cylinder rod to the frame bracket.
5. Restart the engine. If the front wheels (still on the hoist) do not turn in either direction from center, the valve has been properly balanced. Correct the valve adjustment if necessary.
6. When the valve is properly adjusted, grease end of valve and install dust cap.

POWER CYLINDER-- CORVETTE

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OVERHAUL OPERATIONS

Disassembly (Fig. 76)

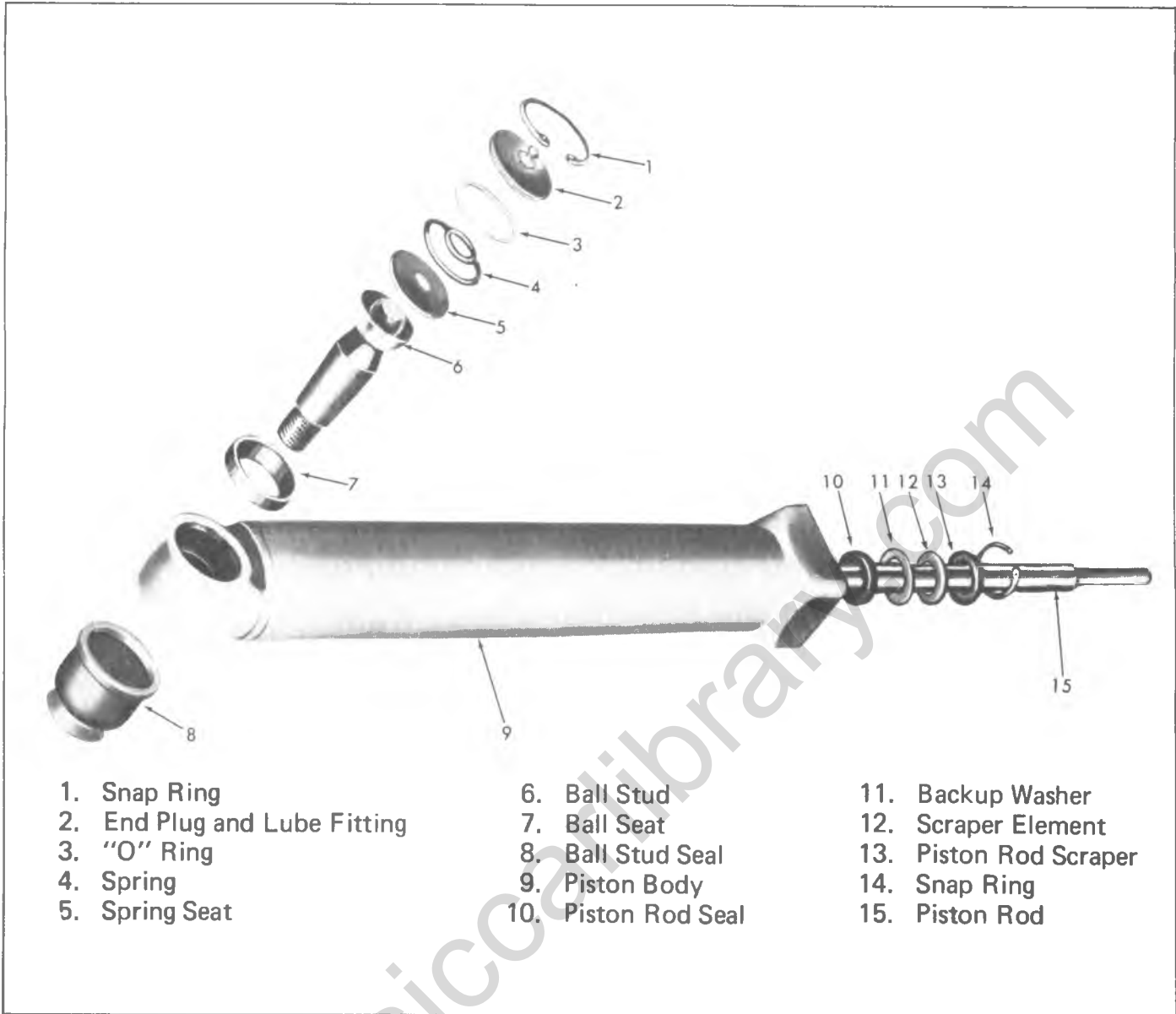
1. To remove the piston rod seal, remove the snap ring; then pull out on rod, being careful not to spray oil.
2. Remove the piston rod scraper and scraper element, back up washer and piston rod seal from the rod.
3. At the ball stud end of the cylinder, remove the ball stud seal.
4. Remove the snap ring retaining the end plug and lube fitting.
5. Push on the end of the ball stud and remove the end plug, spring, spring seat and ball stud.
6. Remove the "O" ring seal from the top lip of the power cylinder ball stud opening.

7. If the ball seat is to be replaced, it must be pressed out using Tool J-8937.

Assembly

1. Reassemble the piston rod seal components by reversing the disassembly procedure. Apply power steering fluid, or transmission fluid bearing the mark DEXRON, on the inner surfaces of the seal and scraper before assembly.
2. Reverse the disassembly procedure when reassembling the ball stud.
3. In each case be sure that the snap ring is securely seated in the ring groove.

NOTE: Be sure to use new seals and "O" rings when re-assembling cylinder.



- 1. Snap Ring
- 2. End Plug and Lube Fitting
- 3. "O" Ring
- 4. Spring
- 5. Spring Seat

- 6. Ball Stud
- 7. Ball Seat
- 8. Ball Stud Seal
- 9. Piston Body
- 10. Piston Rod Seal

- 11. Backup Washer
- 12. Scraper Element
- 13. Piston Rod Scraper
- 14. Snap Ring
- 15. Piston Rod

Fig. 76--Power Steering Power Cylinder Exploded

SPECIAL TOOLS

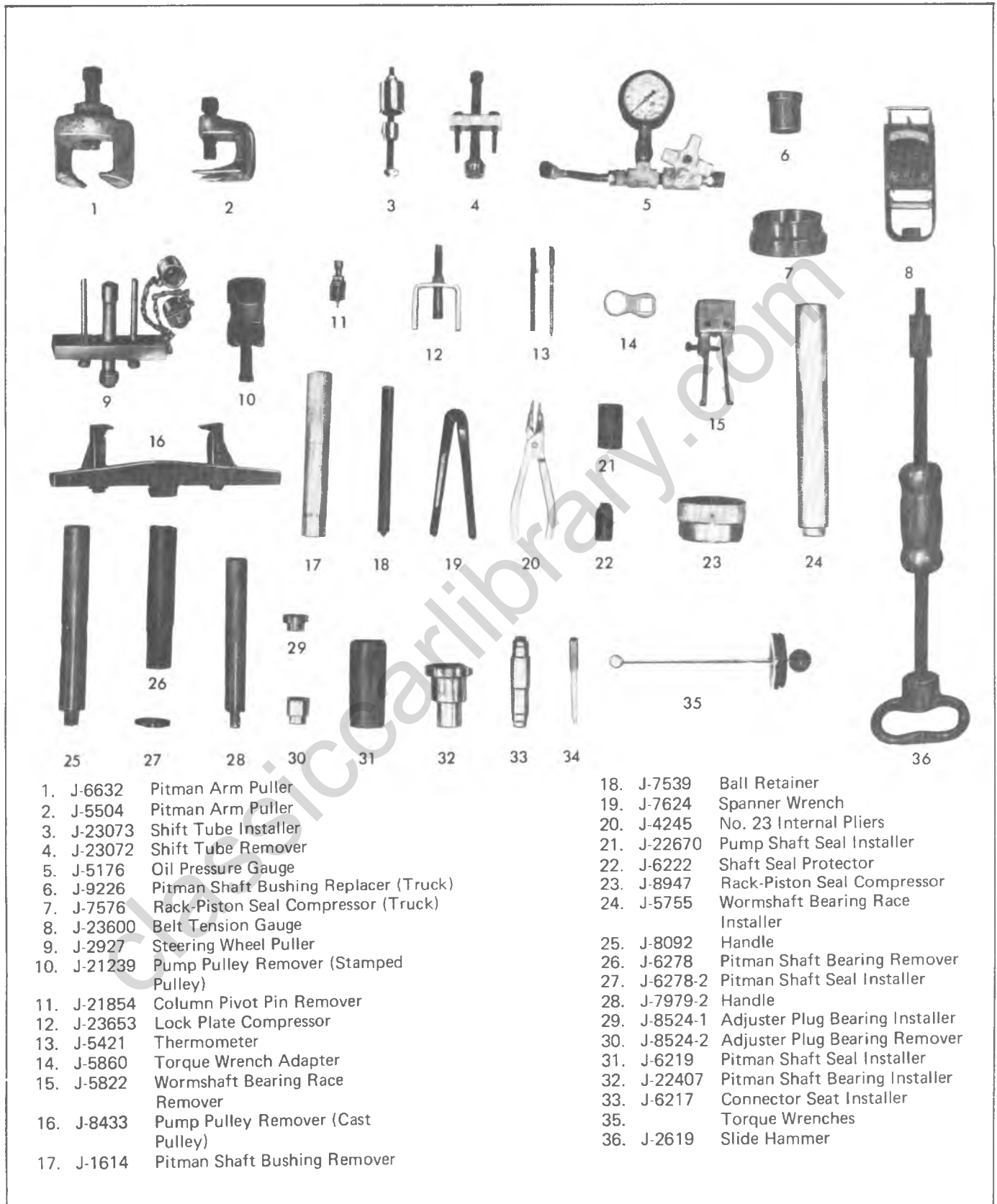


Fig. 77--Manual and Power Steering Special Tools

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SPECIFICATIONS

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PASSENGER CAR SPECIFICATIONS

HEATER AND AIR CONDITIONING

SECTION 1A

HEATER

	<u>Volts</u>	<u>Amps</u> <u>(Cold)</u>	<u>RPM</u> <u>(Cold)</u>
Blower Motor	13.5	6.25 Max.	2550 Min. 2950 Max.
Fuses			
Fuse Block	25 Amp.		

AIR CONDITIONING

Compressor	
Make	Frigidaire
Type	6 Cylinder Axial
Displacement	
Four-Season (Except Corvette) and Comfortron	12.6 Cu. In.
Corvette Four-Season	10.8 Cu. In.
Rotation Clockwise	
Compressor Clutch Coil	
Ohms (at 80°F)	3.70
Amps (at 80°F)	3.22 @ 12 volts

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

System Capacities

Refrigerant 12	
Four-Season (Except Corvette) and Comfortron Systems	3 lbs., 12 oz.
Corvette Four-Season	3 lbs.
525 Viscosity Compressor Oil	
All Systems	11 Fluid oz.

	<u>Volts</u>	<u>Amps</u> <u>(Cold)</u>	<u>RPM</u> <u>(Cold)</u>
Blower Motor			
Four-Season and Comfortron	12	12.8 Max.	3400 Min.
Fuses			
		Fuse Block	In Line
Four-Season		25 amp	30 amp
Comfortron		25 amp	30 amp

BODY

SECTION 1B

SPECIFICATIONS

CORVETTE BODY

	Torque		Torque
Body Mounting Bolts	45 ft. lbs.	Lap Belt Inboard Attachment	40 ft. lbs.
Door Lock-Striker Bolt	45 ft. lbs.	Shoulder Harness Attachment Bolt	35 ft. lbs.
Side Door Wedge Pin Housing	70 in. lbs.	Inboard Lap Belt Mounting Restraining Cable Attaching Nut	30 ft. lbs.
Side Door Wedge Pin Housing Bracket	70 in. lbs.	Seat to Adjuster Screw	150 in. lbs.
Retractor Mounting Bolt-Shoulder Belt	35 ft. lbs.	Seat Adjuster to Floor Screw	150 in. lbs.
Retractor Mounting Bolt-Seat Belt	40 ft. lbs.		

NOVA SKYROOF

Refer to text for detailed data. Also, note during assembly: Caution should be taken not to overcompress the outer cover assembly and rear moulding with the rear moulding retaining screw.

FRONT SUSPENSION

SECTION 3

BOLT TORQUES [§]

VEHICLE	CHEVROLET	CHEVELLE AND MONTE CARLO	NOVA	CAMARO	CORVETTE
Ball Joint Stud Nuts					
Upper Stud	*60' #	*60' #	*50' #	*60' #	*50' #
Lower Stud	*93' #	*83' #	*80' #	*83' #	80' #
Joint to Upper Arm (Service Replacement)			25' #		
Steering Arm Nuts	—	—	70' #	—	70' #
Control Arm Pivot to Frame					
Upper	73' #	97' #	50' #	97' #	50' #
Lower (nut only)	95' #	95' #	80' #	108' #	See Below
Upper Control Arm Shaft Nuts/Bolts	68' #	68' #	40' #	68' #	60' #
Shock Absorber	B02 B07	150' #	90' #		
Upper End	All Others	90' #			
Lower End			20' #		150' #
Stabilizer Bar					
Link Nuts	150' #	150' #	18' #	150' #	18' #
Bracket Bolts			24' #		126' #
Lower Control Arm Shaft to Crossmember					
Front	—	—	—	—	70' #
Rear	—	—	—	—	95' #
Anchor Pin Drum Brakes	—	—	130' #	—	—
Mounting Bolts Disc Brake Caliper			35' #		120' #
Wheel Stud Nuts	75' #		70' #		70' # @
Wheel Bearing Adjustment **			**		
Preload			ZERO		
End Movement			.001" to .005		

*Plus additional torque to align cotter pin hole.
1/6 turn maximum

NEVER back off to align cotter pin.

**See Procedure in FRONT SUSPENSION Section.

§NOTE: Bolt Torques are presented as follows:

Foot Pounds Torque = '#'

Inch Pounds Torque = ''#'

@80' # with special wheels.

TRIM HEIGHTS

The following procedure should be followed before making any trim height measurement.

1. "Z" & "J" DIMENSIONS

a. Lift vehicle up approximately 1-1/2" at the front bumper and gently remove hands allowing vehicle to settle on its own. Repeat this lifting operation twice for a total of three times. Measure the "Z" & "J" heights in the settled position after the third lift.

b. Push vehicle down approximately 1-1/2" at the front bumper and gently remove hands allowing vehicle to

settle on its own. Repeat this pushing down operation twice for a total of 3 times. Measure the "Z" & "J" heights in the settled position after the third push down.

c. The true "Z" & "J" height is the average of (a) and (b) for each side.

2. "D" & "K" DIMENSIONS

NOTE: Follow the same pattern as stated above for the "Z" & "J" dimensions when measuring the "D" & "K" dimensions except: Lift and push on the rear bumper.

DIMENSIONS "Z", "J", "K" & "D" VERTICAL TO GROUND AND APPLY TO ALL VEHICLES

	TIRES	Z	J	K	D
		CURB	CURB	CURB	CURB
CHEVROLET MODELS WITH STANDARD V-8	G-78	3.35	9.91	9.83	6.29
Wagon (125" W.B.)	L-78	2.80	10.07	10.09	5.53
All Sedan With LS4	H-78	3.10	9.91	9.83	6.05
CHEVELLE MODELS Sedans	E-78	2.43	10.36	10.41	5.50
All inc. w/F-40	G-78	2.06			5.08
Coupe	E-78	2.52	10.36	10.40	5.58
	G-78	2.06			5.06
SS Coupe	G-70	2.12			5.09
Pick-Up	G-78	2.13	10.52	10.76	4.61
Wagon	H-78	2.34	10.97	11.02	4.64
MONTE CARLO	GR-70	1.67	10.03	10.19	4.98
CAMARO MODELS Base	E-78	2.08	8.20	7.85	6.04
Z-28	F-60	2.69	9.14	8.92	6.97
NOVA MODELS	E-78	2.23	9.51	9.49	5.00
	E-70	2.27			5.05
	FR-78	2.55			5.29
CORVETTE MODELS Base	GR-70	2.85	8.42	8.27	2.24
FE7		2.54	8.18	8.13	2.15

NOTE: Good judgement should be exercised before replacing a spring when the trim height is only slightly out of specification. The normal allowable tolerance is + 3/4".

SPECIFICATIONS 4

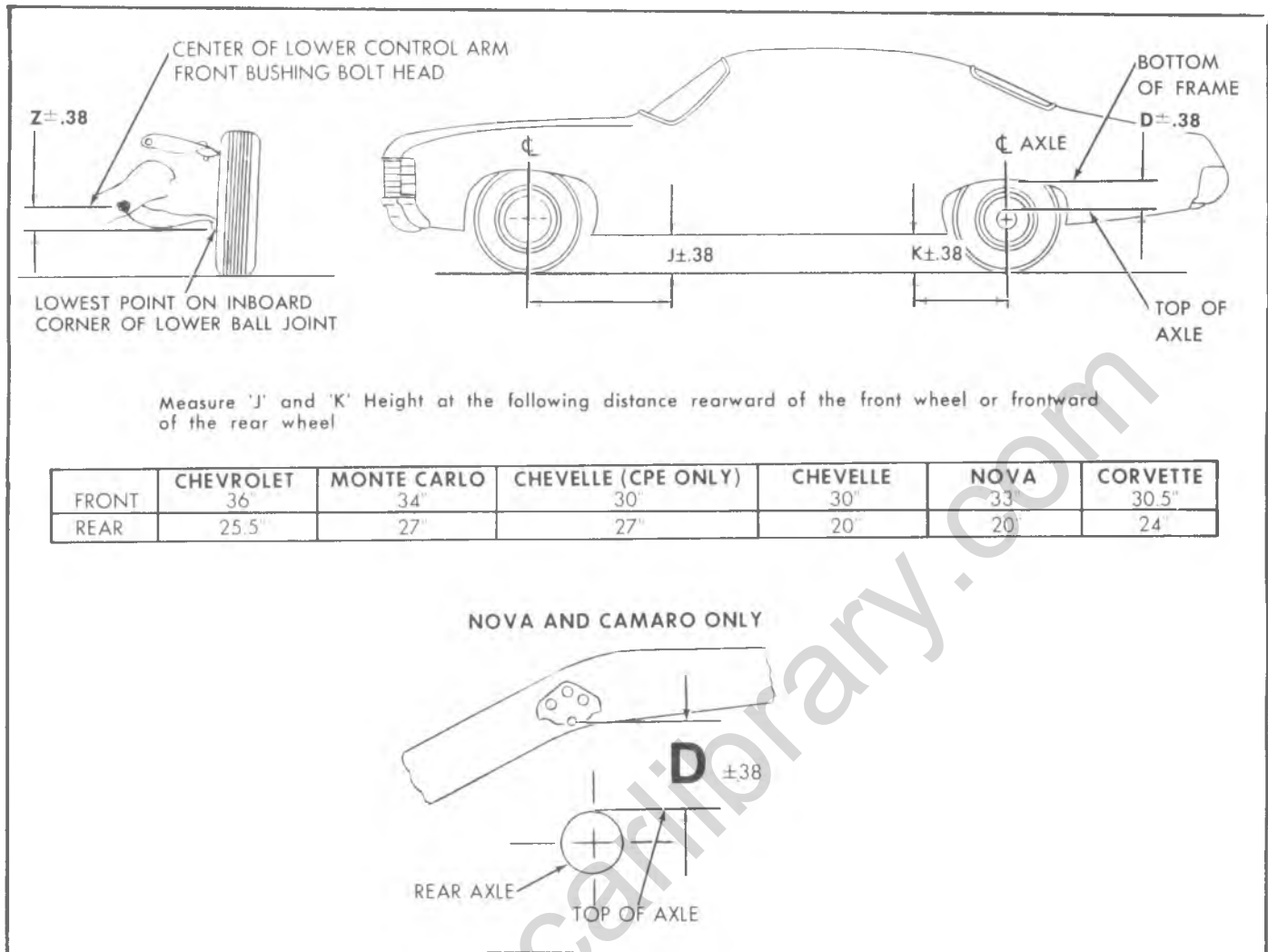


Fig. 1 Trim Height - Except Corvette

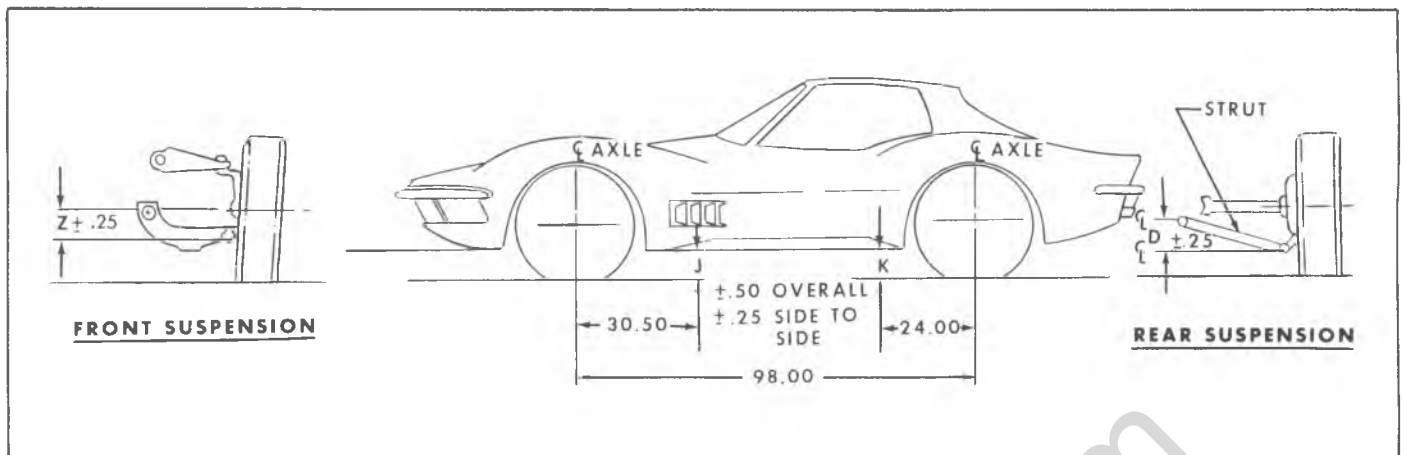


Fig. 2 Corvette Trim Height

VEHICLE ALIGNMENT TOLERANCES ††

	FIELD USAGE	
	Column 1 *Service Checking	Column 3 @ Service Reset
Camber	± 3/4°	± 1/2°
Caster	± 1°	± 1/2°
\$ Toe-in	± 1/8"	± 1/16"
Camber (Side to Side)	1°	1/2°
Caster (Side to Side)	1°	1/2°

VEHICLE INSPECTION TOLERANCES

	Column 2
Caster	± 2°
Camber	± 1 1/2°
Toe-in	± 3/8"

* Caster and Camber must not vary more than 1° from side to side.

@ Caster and Camber must not vary more than 1/2° from side to side.

\$ Toe setting must always be made after caster and camber.

††See explanatory copy in front suspension section.

†See Note under Specifications Chart concerning camber for Chevrolet, Monte Carlo and Chevelle.

SPECIFICATIONS 6

WHEEL ALIGNMENT SPECIFICATIONS (All Vehicles at Curb Weight) +			
	++1 Service Checking	++2 Vehicle Inspection	++3 Service Reset
VEHICLE	Specification for diagnosis for warranty repair or customer paid service	Specification for Periodic motor vehicle inspection	Specification for resetting alignment
CHEVROLET Caster Camber Toe-in (Total) S.A.I. = 10 1/2° ± 1/2°	∅∅ 0° to + 2° ▲L + 1 3/4° to + 1/4° ▲R + 1 1/4° to - 1/4° 3/16" Toe-in to 1/16" Toe-out	- 1° to + 3° L + 2 1/2° to - 1/2° R + 2° to - 1° 7/16" Toe-in to 5/16" Toe-out	∅ + 1° ± 1/2° \$\$ L + 1° ± 1/2° \$\$ R + 1/2° ± 1/2° \$ 1/16" ± 1/16"
MONTE CARLO Caster Camber Toe-in (Total) S.A.I. = 10 1/2° ± 1/2°	∅∅ + 6° to + 4° ▲L + 1 3/4° to + 1/4° ▲R + 1 1/4° to - 1/4° 3/16" Toe-in to 1/16" Toe-out	+ 7° to + 3° L + 2 1/2° to - 1/2° R + 2° to - 1° 7/16" Toe-in to 5/16" Toe-out	∅ + 5° ± 1/2° \$\$ L + 1° ± 1/2° \$\$ R + 1/2° ± 1/2° \$ 1/16" ± 1/16"
CHEVELLE—EL CAMINO MANUAL STEERING Caster Camber Toe-In (Total) S.A.I. = 10 1/2° ± 1/2°	∅∅ - 2° to 0° ▲L + 1 3/4° to + 1/4° ▲R + 1 1/4° to - 1/4° 3/16" Toe-in to 1/16" Toe-out	- 3° to + 1° L + 2 1/2° to - 1/2° R + 2° to - 1° 7/16" Toe-in to 5/16" Toe-out	∅ - 1° ± 1/2° \$\$ L + 1° ± 1/2° \$\$ R + 1/2° ± 1/2° \$ 1/16" ± 1/16"
CHEVELLE—EL CAMINO POWER STEERING Caster Camber Toe-In (Total) S.A.I. = 10 1/2° ± 1/2°	∅∅ - 1° to + 1° ▲L + 1 3/4° to + 1/4° ▲R + 1 1/4° to - 1/4° 3/16" Toe-in to 1/16" Toe-out	- 2° to + 2° L + 2 1/2° to - 1/2° R + 2° to - 1° 7/16" Toe-in to 5/16" Toe-out	∅ 0° ± 1/2° \$\$ L + 1° ± 1/2° \$\$ R + 1/2° ± 1/2° \$ 1/16" ± 1/16"
NOVA Caster Camber Toe-in (Total) S.A.I. = 8 3/4° ± 1/2°	* - 1/2° to + 1 1/2° * - 1/2° to + 1° 1/16" to 5/16" Toe-in	- 1 1/2° to + 2 1/2° - 1 1/4° to + 1 3/4° 9/16" Toe-in to 3/16" Toe-out	@ + 1/2° ± 1/2° @ + 1/4° ± 1/2° \$ 3/16" ± 1/16"
CAMARO (Standard) Caster Camber Toe-In (Total) S.A.I. 9 1/2° ± 1/2°	* - 1° to + 1° * + 1/4° to + 1 3/4° 1/16" to 5/16" Toe-in	- 2° to + 2° - 1/2° to + 2 1/2° 9/16" Toe-in to 3/16" Toe-out	@ 0° ± 1/2° @ + 1° ± 1/2° \$ 3/16" ± 1/16"
CAMARO Z-28 Caster Camber Toe-In (Total) S.A.I. = 9 3/4° ± 1/2°	* - 2° to 0° * 0° to + 1 1/2° 1/16" to 5/16" Toe-in	- 3° to + 1° - 3/4° to + 2 1/4° 9/16" Toe-in to 3/16" Toe-out	@ - 1° ± 1/2° @ + 3/4° ± 1/2° \$ 3/16" ± 1/16"
CORVETTE Caster—M. Strg. Caster—P. Strg. Camber—Front Toe-In-Frt. Total Camber—Rear Toe-In—Rear (per Whl.) S.A.I. = 6 7/8° ± 1/2° @ 0° Camber	* 0° to + 2° * + 1 1/4° to + 3 1/4° * 0° to + 1 1/2° 1/8" to 3/8" Toe-in	- 1° to + 3° + 1/4° to + 4 1/4° - 3/4° to + 2 1/4° 5/8" Toe-in to 1/8" Toe-out	@ + 1° ± 1/2° @ + 2 1/4° ± 1/2° @ + 3/4° ± 1/2° \$ 1/4" Toe-in ± 1/16" - 7/8" ± 1/4" +++ 1/16" ± 1/32"

- + Curb Weight means weight of vehicle including production options and full capacity of engine oil, fuel and coolant.
- ++ See explanatory copy in front suspension section of service manual.
- * CASTER and/or CAMBER must not vary more than 1° from side to side.
- \$ Toe-setting must always be made after caster and camber.
- +++ Check toe-in setting after any camber change.
- @ CASTER and/or CAMBER must not vary more than 1/2° from side to side.
- \$\$ Left and Right side should be different at least 1/4° and no more than 3/4° with the left side having the greater + reading.
- L Equals left side camber.
- R Equals right side camber.
- * LEFT SIDE CAMBER to be from 1 1/2" more positive (+) to 1/2" more negative (-) than right side camber.
- ∅ Caster must not vary more than 1/2° from side to side.
- ∅∅ Caster must not vary more than 1° from side to side.

REAR SUSPENSION

SECTION 4

DIFFERENTIAL				
	All Except Corvette	Corvette		
Ring Gear to Pinion Backlash005" — .008"	.005" — .008"		
Axle Shaft End Play, Band O Type Axles001" — .022"	—		
Pinion Bearing Preload—Inch/Pounds of Rotating Torque NEW	15 — 30	20 — 25		
USED	5 — 10	5 — 10		
<u>BOLTS TORQUES—FOOT/POUNDS</u>	All Except Corvette	Corvette	<u>LUBRICANT CAPACITIES</u> Complete Drain and Refill	
Carrier Cover	25	50		
Ring Gear — 8 1/2" and 8 7/8" Passenger	90	—	8 1/2" R.G.	4.25 pints
— 8 7/8" Truck	60	—	8 7/8" Passenger	5.4 pints
— Corvette	—	50	8 7/8" Truck	3.5 pints
Bearing Caps	60	55		
Pinion Lock Screw	25	20		
Filler Plug	25	20		

TORQUE (FT. LBS.)

	Chevrolet Except 116" W.B. Station Wagon	Chevelle Monte Carlo and 116" W.B. Station Wagon	Nova	Camaro	Corvette
Upper Control Arm					
Front Bushing Nut	115	80			
Rear Bushing Nut	80	80			
Lower Control Arm					
Front Bushing	115	80			50
Rear Bushing	115	80			
Shock Absorber					
Upper	12	12	18	18	50
Lower	65	65	45*	8	35
Leaf Spring					
Front Eye Bolt Nut	80		75	75	
Rear Shackle Bolt Nut	115		50	50	
Leaf Spring Front Mounting Bracket			30	30	
Leaf Spring Retainer (Anchor Plate)	40		40	40	70
Universal Joint Companion Flange	Wagons 15 All Other 75	15	15	15	15
Wheel Stud Nuts	70	70	70	70	75
Axle Drive Shaft to Spindle To Yoke					75 15
Stabilizer-to - Control Arm		55			
Stabilizer					
-To Frame Bracket			60	40	
-To Spring Retainer Plate			18	40	

*60 Ft. Lb. with Special Performance Suspension

TORQUE (FT. LBS.)

CORVETTE	
Stabilizer Shaft	Drive Spindle Support
Bracket to Frame120 in. lb.	to Torque Arm 30
Bracket to Torque Arm120 in. lb.	Strut Rod
Link Bushing Bolts 25	to Spindle Support 75*
Rebound Bumper to Frame 20	Bracket to Carrier 35
Crossmember to Carrier 60	Camber Cam 65
Carrier Front Support	Torque Arm Pivot 50
to Crossmember 65	Spring Link Bolt
Front Bolt 50*	to Torque Arm
Rear Bolt 50*	Rear Wheel Alignment #
Drive Spindle Nut 100*	Install Nut to expose hole then insert cotter pin.

*Plus additional torque necessary to line up cotter pin hole.
#See Wheel Alignment Chart in Front Suspension Specification Section.

RIDING HEIGHTS

See "Riding Heights" in Front Suspension Specification Section.

BRAKES

SECTION 5

TORQUE SPECIFICATIONS

	Chevrolet and 125" W.B. Wagons	Chevelle, 116" W.B. Wagons and Monte Carlo	Camaro	Nova	Corvette
Master Cylinder to Dash	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.
Master Cylinder to Booster	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.
Vacuum Booster to Dash	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.
Push Rod to Clevis	—	—	—	14 ft. lbs.	14 ft. lbs.
Brake Line Nuts (to Master Cyl. and Valves)	150 in. lbs.	150 in. lbs.	150 in. lbs.	150 in. lbs.	150 in. lbs.
Brake Line Nuts (to Front Brake Hose)	150 in. lbs.	150 in. lbs.	150 in. lbs.	150 in. lbs.	150 in. lbs.
Brake Line Nut (to Wheel Cylinder)	150 in. lbs.	150 in. lbs.	150 in. lbs.	150 in. lbs.	—
Brake Line Nut (to Rear Brake Hose)	150 in. lbs.	150 in. lbs.	150 in. lbs.	150 in. lbs.	115 in. lbs.
Brake Hose (to Wheel Cylinder)	—	22 ft. lbs.	—	22 ft. lbs.	—
Brake Line Clip to Frame	100 in. lbs.	100 in. lbs.	100 in. lbs.	100 in. lbs.	100 in. lbs.
Front Brake Hose Support Bracket	100 in. lbs.	100 in. lbs.	100 in. lbs.	100 in. lbs.	—
Rear Hose Frame or Axle Bracket	100 in. lbs.	—	100 in. lbs.	22 ft. lbs.	—
Brake Line Connector to Axle	150 in. lbs.	20 ft. lbs.	100 in. lbs.	120 in. lbs.	—
Brake Bleeder Valves	65 in. lbs.*	65 in. lbs.*	65 in. lbs.*	65 in. lbs.*	65 in. lbs.*
Brake Shoe Anchor Pin	120 ft. lbs.	120 ft. lbs.	120 ft. lbs.	120 ft. lbs.	—
Wheel Cylinder to Flange Plate	50 in. lbs.	50 in. lbs.	50 in. lbs.	50 in. lbs.	—
Caliper Mounting Bolt	35 ft. lbs.	35 ft. lbs.	35 ft. lbs.	35 ft. lbs.	70 ft. lbs.
Caliper Housing Bolt	—	—	—	—	130 ft. lbs.
Flex Hose to Caliper Bolt	22 ft. lbs.	22 ft. lbs.	22 ft. lbs.	22 ft. lbs.	22 ft. lbs.
Support Plate to Steering Knuckle (Upper Bolt)	140 in. lbs.	140 ft. lbs.	140 in. lbs.	140 ft. lbs.	—
Support Plate/Steering Arm to Knuckle nuts	—	70 ft. lbs.	—	70 ft. lbs.	—
Shield to Steering Knuckle Nuts (Hold Bolt)	—	70 ft. lbs.	—	70 ft. lbs.	—
Shield to Steering Knuckle Bolt (Hold Nut)	—	95 ft. lbs.	—	95 ft. lbs.	—
Pedal Mounting Pivot Bolt (Nut)	25 ft. lbs.	25 ft. lbs.	28 ft. lbs.	—	—
Brade Pedal Bracket to Dash	20 ft. lbs.	20 ft. lbs.	—	—	150 in. lbs.
Combination Valve Mounting	150 in. lbs.	150 in. lbs.	150 in. lbs.	150 in. lbs.	—
Distribution Switch Mounting	—	—	—	150 in. lbs.	100 in. lbs.
Parking Brake Equalizer	—	—	—	—	70 in. lbs.
Parking Brake Assembly (to Dash or Floor)	150 in. lbs.	150 in. lbs.	100 in. lbs.	100 in. lbs.	100 in. lbs.
Parking Brake Assembly (to I.P. or Kick Pad)	150 in. lbs.	150 in. lbs.	150 in. lbs.	85 in. lbs.	—
Parking Brake Cable Pulley Bolt	—	—	—	—	45 ft. lbs.
Stoplamp Switch Bracket Screw	42 in. lbs.	42 in. lbs.	—	65 in. lbs.	—
Front Cable to Floor Pan	—	—	30 ft. lbs.	—	—
Front Cable Trans. Support Bracket	72 in. lbs.	—	—	—	—
Rear Cable Bracket	—	—	100 in. lbs.	40 ft. lbs.	100 in. lbs.

* Torque to seal or 100 in. lbs. max. Replace valve if it will not seal at 100 in. lbs.

ENGINE

SECTION 6

GENERAL DATA:										
Type	In Line			V-8						
Displacement (cu. in.)	250			350			400		454	
Horsepower @ rpm	100 @ 3600	145 @ 3600	160 @ 3800	185* @ 4000	245% @ 5200	150 @ 3200	180 @ 3800	235 @ 4000+		
Torque @ rpm	175 @ 1800	250 @ 2200	245 @ 2400	270* @ 2600	280% @ 4000	295 @ 2000	290 @ 2400	360 @ 2800+		
RPO	L-22	L-65	LM-1	L-48	L82 & Z 28	LF6	LT4	LS4		
CARBURETOR	1BBL.	2BBL.	4BBL.	4BBL.	4BBL.	2BBL.	4BBL.	4BBL.		
EXHAUST	SINGLE			SINGLE		DUAL		SINGLE		
Bore	3 7/8			4			4 1/8		4 1/4	
Stroke	3.53		3.25	3.48			3.75		4	
Compression Ratio	8.25:1			8.5:1		9.0:1		8.5:1		
Firing Order	1-5-3-6-2-4			1-8-4-3-6-5-7-2						
CYLINDER BORE:										
Diameter	3.8745-3.8775			3.9995-4.0025			4.1246-4.1274		4.2495-4.2525	
Out of Round	Production	.0005 Max.						.001 Max.		
	Service							.002 Max.		
Taper	Production	Thrust Side							.0005 Max.	
	Production	Relief Side	.0005 Max.						.001 Max.	
	Service								.005 Max.	
PISTON:										
Clearance	Production	.0005	.0005	.0007-.0013		.0036	.0014	.0018		
	Service	.0015	.0011			.0042	.0020	.0028		
		.0025 Max.			.0027 Max.		.0061 Max.	.0034 Max.	.0035 Max.	
PISTON RING:										
COMPRESSION	Clearance Groove	Production	Top	.0012-.0027		.0012-.0032	.0012-.0032		.0017-.0032	
		Service	2nd	.0012-.0032		.0032	.0012-.0027		.0012-.0032	
		Service	Hi Limit Production + .001							
	Gap	Production	Top	.010-.020		.010-.020		.010	.010-.020	
		Production	2nd	.010-.020		.013-.025		.010	.010-.020	
		Service		Hi Limit Production + .01						
OIL	Groove Clearance	Production	.005 Max.		.002-.007	.005 Max.		.0005-.0065		
		Service	Hi Limit Production + .001							
	Gap	Production	.015-.055							
	Service	Hi Limit Production + .01								
PISTON PIN:										
Diameter				.9270-.9273					.9895-.9898	
Clearance	Production	.00015-.00025			.00045		.00015	.00025-.00035		
	Service				.00055		.00025			
Fit in Rod	.0008-.0016 Interference									
CRANKSHAFT:										
Main Journal	Diameter		All	#1 2.4484-2.4493			#1-2-3-4 2.6484		#1 2.7485	
			2.2983	2-3-4 2.4481-2.4490			2.6493		2.7494	
			2.2993	#5 2.4479-2.4488			#5 2.6479		#2-3-4 2.7481	
						2.6488		2.7490		
									#5 2.7478	
									2.7488	
Taper	Production	.0002 Max.								
	Service	.001 Max.								
Out of Round	Production	.0002 Max.								
	Service	.001 Max.								

* Corvette: HP-195@ 4400; Torque - 275@ 2800
 % Corvette (RPO L82): HP-250@ 5200; Torque - 285@ 4000
 * Corvette: HP-270@ 4400; Torque - 380@ 2800

SPECIFICATIONS 10

Type	In Line	V-8					
Displacement (cu. in.)	250	307	350		400	454	
Horsepower	100	145	160	185	245 & 250	235 & 270	
CRANKSHAFT:							
Main Bearing Clearance	Production	All .0003 - .0029	#1 .0008-.0020	Auto. #1 .0019 - .0031	Man. #1-2-3-4 .0013 .0025	#1 .0008 - .0020	#1-2-3-4 .0013-.0025
			#2-3-4 .0011-.0023	#2-3-4 .0013 .0025	#5 .0023	#2-3-4 .0011 - .0023	#5 .0024
			#5 .0017-.0033	#5 .0023 - .0033	#5 .0023 - .0033	#5 .0017 - .0033	#5 .0040
			Service	#1 - .002 Max.; All Others - .0035 Max.			
Crankshaft End Play	.002-.006					.006-.010	
Crankpin	Diameter	1.9928 - 2.000	2.099-2.100			2.199-2.200	
	Taper	Production	.0003 Max.				
		Service	.001 Max.				
	Out of Round	Production	.0002 Max.				
Service		.001 Max.					
Rod Bearing Clearance	Production	.0007 - .0027	.0013-.0035			.0009-.0025	
	Service	.0035 Max.					
Rod Side Clearance	.007-.016		.008-.014		.015-.021		
CAMSHAFT:							
Lobe	Intake	.2217	.2600	.3000	.2235	.2590	
Lift + .002"(X)	Exhaust	.2217	.2733	.3070	.2411	.2590	
Journal Diameter	1.8682-1.8692			1.9482-1.9492			
Camshaft Runout	.0015 Max.						
Camshaft End Play	.001-.005 (In-Line Engine)						
VALVE SYSTEM:							
Lifter	Hydraulic						
Rocker Arm Ratio	1.75:1	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 (Int. & Exh.)	.002 Max.						
Seat Width	Intake	1/32-1/16					
	Exhaust	1/16-3/32					
Stem Clearance	Production	Int. Exh.	.0015-.0032	.0012-.0029	.0010-.0027	.0012-.0027	
	Service	Hi Limit Production ± .001 Intake - .002 Exhaust					
Valve Spring (Outer)	Free Length		1.90	Exhaust 1.91	In. 2.03	2.03	2.10
	Pressure lbs. @ in.	Closed	55-64 @	76-84 @	76-84 @	76-84 @ 1.70	74-86 @
			1.66 @	1.61 @	1.70 @		1.88 @
	Installed Height ± 1/32"	Open	180-192 @	183-195 @	1.94-2.06 @	194-206 @ 1.25	288-312 @
1.27 @			1.20 @	1.25 @		1.38 @	
Damper	Free Length	-				1.94	1.86
	Approx. # of Coils	-				4	4

ENGINE TUNE UP

ENGINE	Type	L-6	V8						
	Displacement	250	350			400		454	
	Horsepower	100	145	160	185 195	245 & 250	150	180	235 & 270
Compression ① (PSI)		130	150	160		150	160		
SPLURK	Make & Number	Standard	AC-R46T		AC-R44T				
		Cold	AC-R45T		AC-R43T				
	Gap	.035"							
DISTRIBUTOR	Point Dwell	31°-34°		29°-31°					
	Point Gap	.016" (Used) - .019" (New)							
	Arm Spring Tension	19-23 Ounces							
	Condenser	.18-.23 Microfarad							
TIMING ②	Synchro.	8°B	0°B	4°B	8°B*	8°B	—	10°B	
	Auto.	6°B	8°B	8°B	8°B	8°B	8°B	10°B	
Drive Belts	Fan & P/S	50 lb. minimum - Adjust to 75 ± 5 lbs. (Used) or 125 ± 5 lbs. (New) using Strand Tension Gauge							
	A/C Compressor	65 lb. minimum - Adjust to 95 ± 5 lbs. (Used) or 140 ± 5 lbs. (New) using Strand Tension Gauge							
	A.I.R. Pump ④	50 lb. minimum - Adjust to 75 ± 5 lbs. (Used) or 125 ± 5 lbs. (New) using Strand Tension Gauge							
Air Cleaner		See Note ⑤							
Valve Lash	Inlet	Hydraulic - One Turn Down From Zero Lash							
	Exhaust								
Idle rpm ⑥	Synchro.	850	900	900	900	900	—	800	
	Auto.	600	600	600	600	700	600	600	
Fuel Pump ⑦	Pressure	3 1/2 to 4 1/2		7 to 8 1/2					
	Volume	One Pint in 30-45 Seconds @ Cranking Speed							
Crankcase Vent Valve		Check at 12,000 Miles/Replace at 24,000 Miles							

* 4°B — State of California Vehicle

① PSI at Cranking Speed, throttle wide open - Maximum variation, 20 PSI between cylinders.

② Rotate cam lubricator 180° at 12,000 mile intervals—Replace at 24,000 mile intervals.

③ At idle speed with vacuum advance line disconnected and plugged. B = B.T.D.C.

④ Do not pry against A.I.R. pump housing. (Corvette—Adjust to 75 ± 5 lbs.)

⑤ **CAUTION:** In addition to its function of filtering air drawn into the engine through the carburetor, the air cleaner also acts as a flame arrestor in the event the engine backfires. Because backfiring may cause fire in the engine compartment, the air cleaner should be installed at all times unless its removal is necessary for repair or maintenance services.

Paper Element Type—First 12,000 miles, inspect element for dust leaks, holes, or other damage and replace if necessary. If satisfactory, rotate element at 24,000 miles. Element must not be washed, oiled, tapped, or cleaned with an air hose. If so equipped, replace P.C.V. breather filter every 24,000 miles (do not attempt to clean). If so equipped, clean wire mesh frame arrester every 12,000 miles.

⑥ See "TUNE-UP" section.

⑦ Replace filter element located in carburetor inlet every 12 months or 12,000 miles, whichever occurs first.

SPECIFICATIONS 12

IDLE MIXTURE ADJUSTMENT SPECIFICATIONS

GM 102 250 CU. IN. – FEDERAL	TRANSMISSION	
	Automatic	Manual
Exhaust Emission Control System	CCS-EGR	AIR-EGR
Timing (°BTC @ RPM)	8° @ 600	8° @ 850
Solenoid Adj. (RPM)	600 (DR)	850 (N)
Lean Drop Idle Mixture (RPM)	650/600 (DR)	950/850 (N)

GM 102 250 CU. IN. – CALIFORNIA	TRANSMISSION	
	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	8° @ 600	8° @ 850
Solenoid Adj. (RPM)	600 (DR)	850 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	950/850 (N)

GM 104-2 350 CU. IN. AND 400 CU. IN. 2BBL – FEDERAL	TRANSMISSION	
	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	8° @ 600	0° @ 900
Solenoid Screw (RPM)	600 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	1000/900 (N)

GM 104-4 350 CU. IN. AND 400 CU. IN. 4BBL – FEDERAL	TRANSMISSION	
	Automatic	Manual
Exhaust Emission Control System	CCS-EGR	AIR-EGR
Timing (°BTC @ RPM)	8° @ 600	8° @ 900
Solenoid Screw (RPM)	600 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	650/600 (DR)	950/900 (N)

GM 104-4 350 CU. IN. 4BBL Z28, L82 – NATIONWIDE	TRANSMISSION	
	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	8° @ 700	8° @ 900
Solenoid Screw (RPM)	700 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	730/700 (DR)	950/900 (N)

GM 104-4 350 CU. IN. AND 400 CU. IN. 4BBL – CALIFORNIA	TRANSMISSION	
	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	8° @ 600	4° @ 900
Solenoid Screw (RPM)	600 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	950/900 (N)

GM 105 454 CU. IN. – NATIONWIDE	TRANSMISSION	
	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	10° @ 600	10° @ 800
Solenoid Screw (RPM)	600 (DR)	800 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	850/800 (N)

IDLE CO ADJUSTMENT SPECIFICATIONS

NOTE: Curb, Idle, Timing and Solenoid Adjustment Specifications are the same for both lean drop and idle CO settings.

	Max. Acceptable CO Level (%)	If over Max. Acceptable Level Reset to (% or Less)
GM 102 (250 cu. in.)	.3	.3 or below
GM 104-2 (350 cu. in. & 400 cu. in. 2bbl)	.5	.5 or below
GM 104-4 (350 cu. in. & 400 cu. in. 4bbl)	.5	.5 or below
GM 105 (454 cu. in.)	.5	.5 or below

ENGINE TORQUES

Size	Usage	In Line	Small V-8	Mark IV-V-8
		250	350 & 400	454
1/4-20	Camshaft Thrust Plate	80 lb. in.		
	Crankcase Front Cover		80 lb. in.	
	Flywheel Housing Cover		80 lb. in.	
	Oil Filter Bypass Valve			80 lb. in.
	Oil Pan (To Crankcase)	80 lb. in.		
	Oil Pan (To Front Cover)	50 lb. in.		55 lb. in.
	Oil Pump Cover	70 lb. in.		80 lb. in.
	Rocker Arm Cover	45 lb. in.		50 lb. in.
11/32-24	Connecting Rod Cap	35 lb. ft.		
5/16-18	Camshaft Sprocket			20 lb. ft.
	Oil Pan (To Crankcase)	75 lb. in.	265 lb. in.	135 lb. in.
	Oil Pump	115 lb. in.		
	Push Rod Cover	50 lb. in.		
	Water Pump	15 lb. ft.		
	Clutch Pressure Plate	20 lb. ft.		
3/8-16	Clutch Pressure Plate		35 lb. ft.	
	Distributor Clamp		20 lb. ft.	
	Flywheel Housing		30 lb. ft.	
	Manifold (Exhaust)			20 lb. ft. ①
	Manifold (Exhaust to Inlet)	30 lb. ft.		
	Manifold (Inlet)			30 lb. ft.
	Manifold-to-head	35 lb. ft.		
	Thermostat Housing	30 lb. ft.		
	Water Outlet		30 lb. ft.	
	Water Pump		30 lb. ft.	
3/8-24	Connecting Rod Cap		45 lb. ft.	50 lb. ft.
7/16-14	Cylinder Head		65 lb. ft.	80 lb. ft.
	Main Bearing Cap	65 lb. ft.	70 lb. ft. ②	
	Oil Pump		65 lb. ft.	
	Rocker Arm Stud			50 lb. ft.
7/16-20	Flywheel	60 lb. ft.		65 lb. ft.
	Torsional Damper	60 lb. ft.		
1/2-13	Cylinder Head	95 lb. ft.		
	Main Bearing Cap			110 lb. ft.
1/2-14	Temperature Sending Unit		20 lb. ft.	
1/2-20	Torsional Damper			85 lb. ft.
	Oil Filter	Hand Tight	25 lb. ft.	
	Oil Pan Drain Plug		20 lb. ft.	
14mm	5/8	Spark Plug	15 lb. ft.	

① Inside bolts on 350 engine 30 lb. ft.

② Outer bolts on engines with 4 bolt caps 65 lb. ft.

CARBURETOR

SECTION 6M

IDENTIFICATION

PASSENGER CARS – EXCEPT VEGA

Also refer to Rochester Carburetor Identification Illustrations in Overhaul.

Vehicles						Engines		Passenger Car Carburetors – Except Vega				
Chevelle	Monte Carlo	Chevrolet	Camaro	Nova	Corvette	Displacement and Type	RPO Option	Barrel (bbl) and Type	Federal		California	
									Manual	Automatic	Manual	Automatic
A	G	B	F	X	V							
X			X	X		250 L-6	L-22	1	7044017	7044014	7044017	7044314
X	X	X				350 V-8	L-65	2	7044113	7044114	N.A.	N.A.
			X			350 V-8	L-65	2	7044111	7044112	N.A.	N.A.
				%		350 V-8	L-65	2	7044115	7044116	N.A.	N.A.
X	X		X			350 V-8	LM-1	4QJ	7044203	7044202	7044503	7044502
		X				350 V-8	LM-1	4QJ	N.A.	N/A	N.A.	7044502
X	X		X			350 V-8	L-48	4QJ	7044203	7044202	7044503	7044502
				%	%	350 V-8	L-48	4QJ	7044207	7044206	7044507	7044506
				%		350 V-8	LM-1	4QJ	7044207	7044206	7044507	7044506
			X			350 V-8	Z-28	4QJ	7044209	7044208	7044209	7044208
					%	350 V-8	L-82	4QJ	7044211	7044210	7044211	7044210
X	X	X				400 V-8	LF-6	2	N.A.	7044118	N.A.	N.A.
X	X	X				400 V-8	LT-4	4QJ	N.A.	7044226	N.A.	7044526
X	X	X				454 M-4	LS-4	4QJ	7044201	7044223	7044201	7044500
					%	454 M-4	LS-4	4QJ	7044221	7044225	7044221	7044505

- NOTES: (X) Throttle Lever Ball Stud in Upper Hole.
 (%) Throttle Lever Ball Stud in Lower Hold.
 (#) With H.I.C. for Air Conditioning Installations
 (\$) Manual Transmission for "A" Body Only

CARBURETOR ADJUSTMENTS

PASSENGER CARS – EXCEPT VEGA

Rochester Carburetors

Model	NUMBER (A) Automatic Trans. (M) Manual Trans.	Float Level	Float Drop	Metering Rod	Pump Rod	Choke Rod (Fast Idle Cam)	Air Valve Wind-Up	Vacuum Break	Unloader
MV	7044014(A)	.295		.079		.230		.275	.500
MV	7044017(M)	.295		.072		.275		.350	.500
MV	7044314(A)	.295		.073		.245		.300	.500
2GV	7044111(M)	19/32	1 9/32		1 9/32	.200		.140	.250
2GV	7044112(A)	19/32	1 9/32		1 3/16	.245		.130	.325
2GV	7044113(M)	19/32	1 9/32		1 9/32	.200		.140	.250
2GV	7044114(A)	19/32	1 9/32		1 3/16	.245		.130	.325
2GV	7044115(M)	19/32	1 9/32		1 9/32	.200		.140	.250
2GV	7044116(A)	19/32	1 9/32		1 3/16	.245		.130	.325
2GV	7044118(A)	19/32	1 9/32		1 3/16	.245		.130	.325
2GV	7044123(M)	19/32	1 9/32		1 9/32	.200		.140	.250
2GV	7044124(A)	19/32	1 9/32		1 3/16	.245		.130	.325
2GV	N/A (M)								
4MV	7044202(A)	1/4			13/32*	.430	7/8	.230	.450
4MV	7044203(M)	1/4			13/32*	.430	7/8	.230	.450
4MV	7044206(A)	1/4			13/32*	.430	7/8	.230	.450
4MV	7044207(M)	1/4			13/32*	.430	7/8	.230	.450
4MV	7044223(A)(225)	3/8			13/32*	.430	7/16	.220	.450
4MV	7044201(M)(221)	3/8			13/32*	.430	7/16	.250	.450
4MV	7044500(A)(505)(A)	3/8				.430	7/16	.250	.450
4MV	7044208(A)	1/4			13/32*	.430	1 Turn	.230	.450
4MV	7044209(M)	1/4			13/32*	.430	1 Turn	.230	.450
4MV	7044210(A)	1/4			13/32*	.430	1 Turn	.230	.450
4MV	7044211(M)	1/4			13/32*	.430	1 Turn	.230	.450
4MV	7044502(A)	1/4			13/32*	.430	7/8	.230	.450
4MV	7044503(M)	1/4			13/32*	.430	7/8	.230	.450
4MV	7044506(A)	1/4			13/32*	.430	7/8	.230	.450
4MV	7044507(M)	1/4			13/32*	.430	7/8	.230	.450

* Pump Rod Location: Inner

FAST IDLE (RUNNING) RPM ADJUSTMENT

Carburetors – Rochester

Vehicle	MV		4QJ		2GV	
	Auto.	Man.	Auto.	Man.	Auto. and Man.	
All (Except Vega)	1800* a, b.		# 1600† a.	(M4)# 1300* a.	ADVISORY SETTINGS 1600† (1 1/2 SAE) a.	These approximate settings are with low idle at 500 RPM, as specified – with viscous clutch fans disengaged.

† with vacuum advance & without EGR signal.

* without vacuum advance.

a. on high step

on M4, 1600 RPM for Auto & 1500 RPM Manual – EGR

Disconnected and EGR vacuum plugged.

b. Without EGR

IDLE MIXTURE ADJUSTMENT

- LEAN DROP METHOD -

(REFER TO SERVICE MANUAL IDLE MIXTURE PROCEDURE (LEAN DROP METHOD))

PASSENGER CARS - EXCEPT VEGA

NOTE: Refer to "Idle Mixture Adjustments"/or "Idle Stop Solenoid Adjustments" as applicable, in Section 6M (Service Manual), under carburetors before using the following charts.

NOTE: All idle speeds listed are to be set with air conditioning OFF.

UNLESS OTHERWISE NOTIFIED - ALWAYS USE CURRENT SPECIFICATIONS THAT AGREE WITH THE "VEHICLE EMISSION CONTROL INFORMATION" STICKER (ON THE VEHICLE).

ENGINES

GM 102 250 CU. IN. - FEDERAL

TRANSMISSION

	Automatic	Manual
Exhaust Emission Control System	CCS-EGR	AIR-EGR
Timing (°BTC @ RPM)	8° @ 600	8° @ 850
#Solenoid Adj. (RPM) energized (curb idle)	600 (DR)	850 (N)
Lean Drop Idle Mixture (RPM)	650/600 (DR)	950/850 (N)
#de-energized (low idle)(RPM)	450 (PR)	450 (N)

GM 102 250 CU. IN. - CALIFORNIA

TRANSMISSION

	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	8° @ 600	8° @ 850
#Solenoid Adj. (RPM) energized (curb idle)	600 (DR)	850 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	950/850 (N)
#de-energized (low idle)(RPM)	450 (DR)	450 (N)

GM 104-2 350 CU. IN. AND 400 CU. IN. 2BBL - FEDERAL

TRANSMISSION

	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	8° @ 600	0° @ 900
#Solenoid Screw (RPM) energized (curb idle)	600 (DR)	900 (N)
#de-energized (low idle)(RPM)	500 (DR)	500 (N)
Lean drop Idle Mixture (RPM)	650/600 (DR)	1000/900 (H)

GM 104-4 350 CU. IN. AND 400 CU. IN. 4BBL - FEDERAL

TRANSMISSION

	Automatic	Manual
Exhaust Emission Control System	CCS-EGR	AIR-EGR
Timing (°BTC @ RPM)	8° @ 600	8° @ 900
#Solenoid Screw (RPM) energized (curb idle)	600 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	650/600 (DR)	950/900 (N)
#de-energized (low idle)(RPM)	500 (DR)	500 (N)

GM 104-4 350 CU. IN. 4BBL Z28, L82 - NATIONWIDE

TRANSMISSION

	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	8° @ 700	8° @ 900
#Solenoid Screw (RPM) energized (curb idle)	700 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	730/700 (DR)	950/900 (N)
#de-energized (low idle)(RPM)	500 (DR)	500 (N)

GM 104-4 350 CU. IN. AND 400 CU. IN. 4BBL – CALIFORNIA

TRANSMISSION

	Automatic	Manual
AIR-EGR Exhaust Emission Control		
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	8° @ 600	4° @ 900
#Solenoid Screw (RPM) energized (curb idle)	600 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	950/900 (N)
#de-energized (low idle)(RPM)	500 (DR)	500 (N)

GM 105-454 CU. IN. – FEDERAL

TRANSMISSION

	Automatic	Manual
AIR-EGR Exhaust Emission Control		
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	10° @ 600	10° @ 800
#Solenoid Screw (RPM) energized (curb idle)	600 (DR)	800 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	850/800 (N)
#de-energized (low idle)(RPM)	500 (DR)	500 (N)

GM 105 454 CU. IN. – CALIFORNIA

TRANSMISSION

	Automatic	Manual
AIR-EGR Exhaust Emission Control		
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	10° @ 600	10° @ 800
#Solenoid Screw (RPM) energized (curb idle)	600 (DR)	800 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	850/800 (N)
#de-energized (low idle)(RPM)	500 (DR)	500 (N)

IDLE "CO" ADJUSTMENT SPECIFICATIONS

ALSO REFER TO ALTERNATE METHOD UNDER, "IDLE MIXTURE ADJUSTMENT" PROCEDURES IN THE SERVICE MANUAL IF RELIABLE CO METER IS AVAILABLE.

NOTE: Curb Idle, Timing and Solenoid Adjustment Specifications are the same for both lean drop and idle CO settings.

	Max Acceptable CO Level (%)	If Over Max. Acceptable Level Reset to (% or Less)
GM 102 (250 cu. in.)	.3	.3 or below
GM 104-2 (350 cu. in. & 400 cu. in. 2bbl)	.5	.5 or below
GM 104-4 (350 cu. in. & 400 cu. in. 4bbl)	.5	.5 or below
GM 105 (454 cu. in.)	.5	.5 or below

ENGINE ELECTRICAL**SECTION 6Y****BATTERIES**

Model No. & Catalog No.	Application	No. of Plates Per Cell	Cranking Power @ 0°F (Watts)	25 Amp Reserve Capacity (Minutes)
1980199 (Y87)	All with 250 L-6	9	2300	60
1980200 (R89)	All with 350, 400 V-8's and RPO Z28.	11	2900	100
1980204 (R89W)	All with 454 V-8 or RPO T-60 Corvette	15	3750	145
1980216 (R-89ST)	Corvette with 350 V-8	13	3250	110
1980205 (R-89WT)	Corvette with 454 V-8	15	3750	145

GENERATORS

Model No.	Application	Delco Remy Spec. No.	Field Current Amps (80°F) @ 12 Volts	Cold Output*			Rated Hot Output** Amps
				Spec. Volts	Amps @ 2000 RPM	Amps @ 5000 RPM	
1100544	Corvette w/AC	4522	4 - 4.5	***	***	55	61
1102353	Corvette with LS-4 w/N40	4521	4 - 4.5	***	***	37	42
1100934	All V-8's exc. Corvette, B02 & B07	4519	4 - 4.5	***	***	32	37
1102347	L6 w/K76	4522	4 - 4.5	***	***	55	61
1100497	All L-6 exc. B02 & B07	4519	4 - 4.5	***	***	36@ 7000 RPM	37
1100573	All V-8 w/B02 & B07	4521	4 - 4.5	***	***	37	42
1100597	Camaro, Chevrolet, Chevelle W/K76, C60, & LT4	4522	4 - 4.5	***	***	55	61
1100560	Nova w/C49, C60 & N40, L22 w/K77	4520	4 - 4.5	***	***	50	55
1100575	Nova w/C60, C49 & N40	4520	4 - 4.5	***	***	50	55
1100950	Corvette, w/LS4 L48 or L82	4521	4 - 4.5	***	***	37	42

*Generator temperature approximately 80°F.

**Ambient Temperature 80°F.

***Voltmeter not needed for cold output check. Load battery with carbon pile to obtain maximum output.

STARTING MOTOR

Model No.	Application	Spec. No.	Ring Gear Dia.-In.	Free Speed		
				Volts	Amperes	RPM
1108365**	250 CID L-6 Engine w/Man. or Auto. Trans.	3573 (Low)	12-3/4	9	50-80*	5500-10500
1108418	350 & 454 CID V-8 Engine w/Man. Trans. Except Corvette w/454 V-8.	3563 (Ultra High)	14	9	65-95*	7500-10500
1108430	350, 400 & 454 CID V-8 Engines w/Auto. Trans. Except Corvette w/454 V-8.	3563 (Ultra High)	14	9	65-95*	7500-10500
1108400	Corvette 454 V-8, w/Man. Trans.	3563 (Ultra High)	14	9	65-95*	7500-10500
1108429	Corvette 454 V-8, w/Auto. Trans.	3563 (Ultra High)	14	9	65-95*	7500-10500

**Incorporates molded armature design

*Includes Solenoid

IGNITION COIL

Application	Primary Resistance @ 75° F.	Secondary Resistance @ 75° F.	Ignition Resistor	
	OHMS	OHMS	Type	OHMS
L-6	1.41 - 1.65	3,000 - 20,000	Fixed (In Wiring Harness)	1.8
V-8	1.77 - 2.05	3,000 - 20,000	Fixed (In Wiring Harness)	1.35

DISTRIBUTORS

Ignition Distributor (Product Part No.)	Application		Centrifugal Advance* (Crank Degrees @ Engine RPM)	Vacuum Advance (In Crank Degrees)	Point Dwell Setting	Trans.	Original Equipment Spark Plug
	Engine	Model					
1110499	250 L-6	A, F & X (FED. & CALIF.)	C-4797 0 @ 1100 RPM 14° @ 2300 RPM 24° @ 4100 RPM	C-3933 0 @ 6-8" Hg. 24° @ 14.5-15.5"	31° - 34°	All	AC-R46T
1112844	350 V-8 2bbl., RPOL-65	A, F & X (FED.)	C-4815 0 @ 1000 RPM 20° @ 2400 RPM	C-6055 0 @ 2-4" Hg 14° @ 7.5-8.5" Hg	29° - 31°	All	AC-R44T
1112093	350 V-8 4bbl.,RPO L-48	F & X (FED.)	C-4818 0 @ 1100 RPM 11° @ 2400 RPM 18° @ 4200 RPM	C-6001 0 @ 5-7" Hg 15° @ 13-14" Hg	29° - 31°	All	AC-R44T
1112847	350 V-8 4bbl.,RPO LM1	A, B, F & X (CALIF.)		C-6055 0 @ 2-4" Hg 14° @ 7.5-8.5" Hg		Auto	
1112852	350 V-8 4bbl., RPO Z-28	F (FED. & CALIF.)	C-4844 0 @ 1200 RPM 2° @ 1460 RPM 12° @ 2200 RPM 20° @ 5000 RPM	C-6055 0 @ 2-4" Hg 14° @ 7.5-8.5" Hg	29° - 31°	All	AC-R44T
1112849	350 V-8 4bbl., RPOL-48 & RPO LMI	A, F & X (CALIF.)	C-4817 0 @ 1000 RPM 10° @ 1800 RPM 15° @ 2400 RPM 22° @ 4200 RPM	C-6055 0 @ 2-4" Hg 14° @ 7.5-8.5" Hg	29° - 31°	Manual	AC-R44T
1112850	350 V-8 4bbl., RPOL-48	Corvette (CALIF.)	C-4817 0 @ 1000 RPM 10° @ 1800 RPM 15° @ 2400 RPM 22° @ 4200 RPM	C-6055 0 @ 2-4" Hg 14° @ 7.5-8.5" Hg	29° 31°	Manual	AC-R44T

* Nominal $\pm 2^\circ$

DISTRIBUTORS (CONT'D.)

Ignition Distributor (Product Part No.)	Application		Centrifugal Advance* (Crank Degrees@ Engine RPM)	Vacuum Advance (In Crank Degrees)	Point Dwell Setting	Trans.	Original Equipment Spark Plug
	Engine	Vehicle					
1112851	350 Cu. In. V-8 4bbl., RPO L-48	Corvette (CALIF.)	C-4818 0 @ 1100 RPM 11 @ 2400 RPM 18 @ 4200 RPM	C-6055 0 @ 2.4" Hg 14 @ 7.5-8.5" Hg	29° - 31°	Automatic	AC-R44T
1112247		Corvette (FED.)		C-6001 0 @ 5.7" Hg 15 @ 13-14" Hg		All	
1112853	350 Cu. In. V-8 4bbl., RPO L-82	Corvette (CALIF. & FED.)	C-4844 0 @ 1000 RPM 12 @ 2200 RPM 20 @ 5000 RPM	C-6055 0 @ 2.4" Hg 14 @ 7.5-8.5" Hg	29° - 31°	Automatic	AC-R44T
1112846	400 Cu. In. V-8, 2bbl., RPO LF-6	A & B (FED.)	C-4815 0 @ 1000 RPM 20 @ 4200 RPM	C-6056 0 @ 3.5" Hg 15 @ 9.5-10.5" Hg	29° - 31°	Automatic	AC-R44T
1112250	400 Cu. In. V-8, 4bbl. RPO LT-4	B Sta, Wgn. (FED.)	C-4818 0 @ 1100 RPM 11 @ 2400 RPM 18 @ 4200 RPM	C-6013 0 @ 9-11" Hg 10 @ 14.5-15.5" Hg	29° - 31°	Automatic	AC-R44T
1112854	400 Cu. In. V-8 4bbl., RPO LT-4	A & B (CALIF.)	C-4815 0 @ 1000 RPM 20 @ 4200 RPM	C-6056 0 @ 3.5" Hg 15 @ 9.5-10.5" Hg	29° - 31°	Automatic	AC-R44T
1112113	454 Cu. In. V-8 4bbl., RPO LS-4	A(FED.)	C-4818 0 @ 1100 RPM 11 @ 2400 RPM 18 @ 4200 RPM	C-3032 0 @ 5.7" Hg 20 @ 14.2-15.7" Hg	29° - 31°	Manual	AC-R44T
		A & B (Calif.)				Automatic	
1112114	454 Cu. In. V-8 4bbl., RPO LS-4	Corvette (FED. & CALIF.)	C-4818 0 @ 1100 RPM 11 @ 2400 RPM 18 @ 4200 RPM	C-3032 0 @ 5.7" Hg 20 @ 14.2-15.7" Hg	29° - 31°	All	AC-R44T
1112504	454 Cu. In. V-8, 4bbl., RPO LS-4	A & B (FED.)	C-4818 0 @ 1100 RPM 11 @ 2400 RPM 18 @ 4200 RPM	C-3036 0 @ 7.9" Hg 16 @ 15-16" Hg	29° - 31°	Automatic	AC-R44T

* Nominal $\pm 2^\circ$

CLUTCH AND MANUAL TRANSMISSION

SECTION 7M

THREE SPEED SAGINAW

Clutch Gear Retainer to Case Bolts	15 ft. lbs.
Side Cover to Case Bolts	15 ft. lbs.
Extension to Case Bolts	45 ft. lbs.
Shift Lever to Shifter Shaft Bolts	25 ft. lbs.
Lubrication Filler Plug	18 ft. lbs.
Transmission Case to Clutch Housing Bolts	75 ft. lbs.
Crossmember to Frame Nuts	25 ft. lbs.
Crossmember to Mount Bolts	40 ft. lbs.
Mount to Transmission Bolts	32 ft. lbs.

THREE SPEED MUNCIE

Clutch Gear Retainer to Case Bolts	15 ft. lbs.
Side Cover to Case Bolts	15 ft. lbs.
Extension to Case Bolts	45 ft. lbs.
Shift Lever to Shifter Shaft Bolts	25 ft. lbs.
Lubrication Filler Plug	18 ft. lbs.
Transmission Case to Clutch Housing Bolts	75 ft. lbs.
Crossmember to Frame Nuts	25 ft. lbs.
Crossmember to Mount Bolts	40 ft. lbs.
Transmission Drain Plug	30 ft. lbs.
Mount to Transmission Bolts	32 ft. lbs.

FOUR SPEED SAGINAW

Clutch Gear Retainer to Case Bolts	15 ft. lbs.
Side Cover to Case Bolts	15 ft. lbs.
Extension to Case Bolts	45 ft. lbs.
Shift Lever to Shifter Shaft Bolts	25 ft. lbs.
Lubrication Filler Plug	18 ft. lbs.
Transmission Case to Clutch Housing Bolts	75 ft. lbs.
Crossmember to Frame Nuts	25 ft. lbs.
Crossmember to Mount and Mount to Extension Bolts	40 ft. lbs.
Mount-To-Transmission Bolts	32 ft. lbs.

FOUR SPEED MUNCIE

Clutch Gear Bearing Retainer to Case Bolts	25 ft. lbs.
Cover to Case Bolts	20 ft. lbs.
Extension and Retainer to Case Bolts—(Upper)	20 ft. lbs.
—(Lower)	30 ft. lbs.
Lubrication Filler Plug	30 ft. lbs.
Shift Lever to Shifter Shaft Nut	20 ft. lbs.
Mount-To-Transmission Bolts	32 ft. lbs.

AUTOMATIC TRANSMISSION**SECTION 7A****TURBO HYDRA-MATIC—250/350****TORQUE SPECIFICATIONS**

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	120 in. lbs.
Oil Cooler Pipe to Connectors	10 ft. lbs.
Gearshift Bracket to Frame	15 ft. lbs.
Gearshift Shaft to Swivel	20 ft. lbs.
Manual Shaft to Bracket	20 ft. lbs.
Detent Cable to Transmission	75 in. lbs.
Intermediate Band Adjust Nut	15 ft. lbs.

TURBO HYDRA-MATIC—375/400**TORQUE SPECIFICATIONS**

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	32 ft. lbs.
Rear Mount to Transmission Bolts	40 ft. lbs.
Rear Mount to Crossmember Bolt	40 ft. lbs.
Crossmember Mounting Bolts	25 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	12-16 ft. lbs.
Oil Cooler Pipe to Connector	10 ft. lbs.
Gearshift Bracket to Frame	15 ft. lbs.
Gearshift Shaft to Swivel	20 ft. lbs.
Manual Shaft to Bracket	20 ft. lbs.
Downshift Switch to Bracket	30 in. lbs.

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STEERING

SECTION 9

STANDARD STEERING

Item	Vehicle	Chevrolet		Chevelle 116" W.B. Wagon Monte Carlo and Camaro	Nova	Corvette	
		All others	w/C-60 or LS4	ALL	ALL	ALL	
Steering Gear	Model	—		—	—	Road	Fast
	Ratio	Type	—		—	—	—
		Gear	24:1	28:1	24:1	28:1	16:1
Overall	28.3:1	33:1	28.7:1	33.06:1	20.2:1	17.6:1	
Linkage	Type	Parallel Relay Rod					
	Location	Front		Front	Rear	Rear	
	Tie Rods	2					

POWER STEERING—PUMP

Vehicle	Constant Ratio Steering	Variable Ratio Steering
Chevrolet		1350-1450
Chevelle		1350-1450
Camaro		1350-1450
Monte Carlo		1350-1450
Nova		1350-1450
Corvette	870-1000	

POWER STEERING GEAR

	ALL
Steering Gear Ball Drag	3 in. lbs. Max.
Thrust Bearing Preload	1/2 to 2 in. lbs.*
Adjuster Plug Locknut	80 ft. lbs.
Over-Center Preload	3 - 6** in. lbs.
Over-Center Adjusting Screw Locknut	35 ft. lbs.
Total Steering Gear Preload	14 in. lbs. Max.

* In excess of valve assembly drag.

** In excess of ball drag and thrust bearing preload.

POWER STEERING—GEAR

	Constant Ratio		Variable Ratio			
	Gear	Overall*	Regular		Fast	
			Gear	Overall	Gear	Overall
Chevrolet	—	—	15:1 to 13:1	17.2:1 to 15.1:1	—	—
Chevelle & Monte Carlo	—	—	16:1 to 12.4:1	18.6:1 to 15.1:1	—	—
Nova	—	—	16:1 to 13:1	18.9:1 to 14.7:1	16:1 to 13:1	14.25:1 to 11:1
Corvette	16:1	17.6:1	—	—	—	—
Camaro	—	—	16:1 to 13:1	15:1 to 11.3:1	—	—

*On Center

MANUAL STEERING GEAR

	ALL
Thrust Bearing Preload	4 to 6 in. lbs.
Adjuster Plug Lock Nut	85 ft. lb.
Over Center Preload	5 to 9 in. lbs.*
Over Center Adjusting Screw Locknut	30 ft. lb.
Total Steering Gear Preload	16 in. lbs. Max.

* In excess of Thrust bearing preload.

TORQUE CHART

Components	Chevrolet	Chevelle & Monte Carlo	Nova	Camaro	Corvette
Steering Gear Mounting Bolts	70 lbs. ft.				30 lbs. ft.
Pitman Shaft Nut	185 lbs. ft.		140 lbs. ft.	185 lbs. ft.	
Pitman Arm to Relay Rod Stud Nut	45 lbs. ft.*				
Idler Arm to Relay Rod Stud Nut	35 lbs. ft.**				
Idler Arm to Frame Nuts	48 lbs. ft.	48 lbs. ft.	30 lbs. ft.	48 lbs. ft.	30 lbs. ft.
Tie Rod End Stud Nut	35 lbs. ft.** outer 60 lbs. ft.† Inner	35 lbs. ft.** inner and outer			
Tie Rod Clamp Nuts	22 lbs. ft.		132 lbs. in.	22 lbs. ft.	132 lbs. in.
Steering Coupling to Shaft Flange Nuts	20 lbs. ft.		18 lbs. ft.	20 lbs. ft.	
Steering Coupling Clamp Bolts	30 lbs. ft.				
Steering Coupling Shield Bolts	—	—	—	100 lbs. in.	—
Steering Wheel Nut	30 lbs. ft.		30 lbs. ft.	30 lbs. ft.	
Steering Wheel to Hub Screws (Corvette and Cushioned Rim Wheels) Shroud Torque	18 lbs. in.		—		25 lbs. in.
Floor Pan Cover Screws	35 lbs. in.	38 lbs. in.	35 lbs. in.	35 lbs. in.	35 lbs. in.
Floor Pan Cover Clamp Screws	35 lbs. in.	45 lbs. in.	35 lbs. in.	—	—
Floor Pan Bracket Nuts	—				150 lbs. in.
Dash Panel Bracket to Column Screws	15 lbs. ft.				—
Dash Panel Bracket to Dash Nuts	20 lbs. ft.				15 lbs. ft.
Ignition Switch Screw	35 lbs. in.				

* Plus additional torque required to align castellation with cotter pin hole in stud (not to exceed 55 lbs. ft. maximum).

** Plus additional torque required to align castellation with cotter pin hole in stud (not to exceed 50 lbs. ft. maximum).

† Plus additional torque required to align castellation with cotter pin hole in stud (not to exceed 85 lbs. ft. maximum).

†† Plus additional torque required to align castellation with cotter pin hole.

TORQUE CHART (CONT'D)

Components	Chevrolet	Chevelle & Monte Carlo	Nova	Camaro	Corvette
Turn Signal Switch Screws	25 lbs. in.				
Column Lock Plate Cover Screws	20 lbs. in.				
Turn Signal Housing Screws	45 lbs. in.				
Lock Bolt Spring Screw (Tilt and Tilt-Telescope)	35 lbs. in.				
Bearing Housing Support Screws Tilt & Tilt-Telescope)	60 lbs. in.				
Trans. Control Lock Tube Hsg. Ext. Screws (Tilt-Telescope)	—	—	—	—	40 lbs. in.
Power Steering Pump Pulley Nut	55 lbs. ft.				
Power Steering Pump Mounting Bolts	24 lbs. ft.				
Power Steering Pump Mounting Stud Nut	25 lbs. ft.				
Power Steering Pump & Gear Hose Fittings	25 lbs. ft.				95 lbs. in.
Power Cylinder to Relay Rod Nut	—	—	—	—	45 lbs. ft.††
Power Cylinder to Frame Bracket	—	—	—	—	23 lbs. ft.††
Power Cylinder Frame Bracket to Frame Nuts	—	—	—	—	17 lbs. ft.
Control Valve to Pitman Arm	—	—	—	—	45 lbs. ft.††

* Plus additional torque required to align castellation with cotter pin hole in stud (not to exceed 55 lbs. ft. maximum).

** Plus additional torque required to align castellation with cotter pin hole in stud (not to exceed 50 lbs. ft. maximum).

† Plus additional torque required to align castellation with cotter pin hole in stud (not to exceed 85 lbs. ft. maximum).

†† Plus additional torque required to align castellation with cotter pin hole.

TIRE USAGE CHARTS - SECTION 10

CHEVROLET			
ENGINE & BODY STYLE		STANDARD	OPTIONAL
350 V-8 400 V-8		G78-15	H78-15, HR78-15 Whitewall
454 V-8		H78-15	HR78-15 Whitewall
STATION WAGON		L78-15B or L78-15C	LR-78-15C Whitewall
CHEVELLE			
ENGINE & BODY STYLE		STANDARD	OPTIONAL
L-6	Coupes and Sedans	E78-14	E78-14, G78-14 Whitewall
V-8	All—Except Malibu Classic w/454 and A/C, Laguna "S3"	G78-14	G78-14, H78-14 Whitewalls, G70-14 White Letters, GR78-15 Whitewalls *GR70-15 White Letters (Space Saver spare)
	Malibu Classic w/454 and A/C Station Wagon	H78-14	H78-14 Whitewalls HR78-15 Whitewalls *HR70-15 Whitewalls
	Laguna "S3"— Except 454 and A/C 454 with A/C	GR70-15	GR70-15 White Letters
		HR70-15	HR70-15 Whitewalls
	El Camino	G-78-14	G70-14 White Letters G78-14, GR78-15 Whitewalls
El Camino Classic SS	G70-14 White Letters	H78-14 Whitewalls, *GR70 White Letters or Stripe HR70-15 White Stripe	

MONTE CARLO		
ENGINE & BODY STYLE	STANDARD	OPTIONAL
All models	GR70-15	GR70-15 White Stripe
Space saver spare also available.		
NOVA		
ENGINES & BODY STYLE	STANDARD	OPTIONAL
All models	E78-14 (bias)	E78-14 Whitewall N65**E78-14 Bias Belted Whitewall E70-14 White Letters FR78-14 White Letters
CAMARO		
ENGINE & BODY	STANDARD	OPTIONAL
All (Except Type LT and Z28)	E78 x 14	E78 X 14, F78 X 14 Space Saver Spare F70 X 14 White Stripe or White Letters F78 X 14 Whitewall or White Letters
Type LT	FR78 x 14	F78 X 14 Space Saver Spare F70 X 14 White Stripe or White Letters FR78 X 14 Whitewall or White Letters
Z28	F60 x 15 White Letters	F78 X 14 Space Saver Spare

All Standard tires are blackwall with whitewall optional. All tires are bias-belted, load range B unless otherwise specified.

* Available with RPO F41 Suspension

** Space Saver Tire — Standard on Hatchback Models.

1. Cold tire pressure ratings are applicable when a vehicle has been in-operative for 3 hours or more, or driven less than 1 mile.
2. The inflation pressure may increase as much as 6 pounds per square inch (psi) when hot (after vehicle has been driven 10 miles or at speeds of more than 60 miles per hour). Do not "bleed" or reduce pressures when tires are hot from driving.
3. For continuous high speed operation (over 75 mph), increase tire inflation pressure 4 psi above the recommended pressure up to a

maximum of 32 psi cold pressure for load range B tires, or 40 psi for D load range tires. Sustained speeds above 75 mph are not recommended when the 4 psi adjustment would require pressures greater than the above maximum pressures.

4. Always use a tire pressure gauge when checking pressures as the appearance of a tire can be deceiving. For example, radial ply tires, in comparison with bias ply tires at the same pressure, may have the appearance of being under-inflated.

Because of possible adverse effects on vehicle handling, do not mix radial ply tires with other type tires on the same vehicle.

CORVETTE TIRE USAGE

TIRE USAGE AND RECOMMENDED TIRE INFLATION PRESSURES POUNDS PER SQUARE INCH (PSI) COOL

Models	Full Rated Load	Tire Ply	Tire Usage	Standard Inflation Pressure For All Loads Including Full Rated And Continuous High Speed Operation (Over 75 MPH)	
				Front	Rear
All Models	1 to 2 Passengers + 150 Lbs. Luggage (450 Lbs. Load)	4 ply rating - 2 ply *	GR70-15	20	20

*Optional tires are not available.

1. Tire inflation pressures may increase as much as six (6) pounds per square inch, (PSI) when hot.
2. Cold tire inflation pressure: after vehicle has been inoperative for three (3) hours or more, or driven less than one (1) mile.
Hot tire inflation pressure: after vehicle has been driven ten (10) miles or more at 60-70 MPH.
3. Vehicles with luggage racks do not have a load limit greater than specified above.

WHEELNUT TORQUES

CHEVROLET	65-85 Ft. Lbs.
CORVETTE with optional Aluminum wheels	70-90 Ft. Lbs.
ALL OTHERS	60-80 Ft. Lbs.

CHASSIS SHEET METAL

SECTION 11

TORQUE SPECIFICATIONS

	Chevrolet	Chevelle	Monte Carlo	Nova	Camaro	Corvette
Hood Lock Striker	25 ft. lbs.	25 ft. lbs.				
Hood Catch to Hood		18 ft. lbs.	18 ft. lbs.			
Lock Support to Rad. Support	18 ft. lbs.	25 ft. lbs.	20 ft. lbs.	18 ft. lbs.	18 ft. lbs.	
Hood Lock Bolt Plate				17 ft. lbs.	18 ft. lbs.	120 in. lbs.
Hood Hinge	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.	20 ft. lbs.
Hood Bumper				85 in. lbs.	85 in. lbs.	
Hood Impact Bolt	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.		25 ft. lbs.	
Fender to Frame (upper)	35 ft. lbs.	35 ft. lbs.	35 ft. lbs.	35 ft. lbs.	35 ft. lbs.	
Fender to Frame (lower)	25 ft. lbs.	28 ft. lbs.	28 ft. lbs.	28 ft. lbs.	28 ft. lbs.	
Header Panel	18 ft. lbs.	18 ft. lbs.	18 ft. lbs.		18 ft. lbs.	
Filler Panel	17 in. lbs.	90 in. lbs.	90 in. lbs.	18 ft. lbs.		
Fender Shield	17 in. lbs.	90 in. lbs.	50 in. lbs.	17 in. lbs.		
Fender to Rad. Support	18 ft. lbs.	150 in. lbs.	18 ft. lbs.	18 ft. lbs.		
Rad. Support to Frame	52 ft. lbs.	52 ft. lbs.	52 ft. lbs.		70 ft. lbs.	
Fender Skirt	18 ft. lbs.	18 ft. lbs.	150 in. lbs.	18 ft. lbs.	13 ft. lbs.	

BODY AND CHASSIS ELECTRICAL

SECTION 12

PASSENGER (EXCEPT VEGA) ELECTRICAL

Lamp Usage

LAMP DESCRIPTION	BULB NUMBER	LAMP DESCRIPTION	BULB NUMBER
Headlamps (Except Chevrolet & Corvette)	6014	Oil Pressure Indicator	
Chevrolet, Corvette		Chevelle, Monte Carlo	168
Outer	4000	Chevrolet, Camaro, Nova	194
Inner	5001	Generator Indicator	
Front Park & Directional Signal		Chevelle, Monte Carlo	168
Nova, Chevelle (Except Laguna)	1157	Chevrolet, Camaro, Nova	194
Chevelle (Laguna), Monte Carlo,		Engine Temperature Indicator	
Chevrolet, Camaro, Corvette	1157NA	Chevelle, Monte Carlo	168
Front Side Marker		Chevrolet, Camaro, Nova	194
Corvette	168	Luggage Compartment	1003
Chevelle, Chevrolet (Caprice),		Underhood	93
Camaro, Nova	194	Radio Dial (AM/FM)	
Chevrolet (Bel Air & Impala),		(Except Corvette & Nova	1816
Monte Carlo	194A	Nova (FM), Corvette	1893
Rear Side Marker (Except Corvette)	194	Nova (AM)	293
Corvette	168	Radio Dial (Stereo)	564
Tail, Stop, & Rear Directional Signal	1157	Stereo Indicator	Drake 66
License Plate (Except Nova)	168	End Gate Ajar/Indicator (Chevelle Station Wagon)	168
Nova	67	Seat Belts Indicator	
Front Seat Courtesy	631	Chevelle, Monte Carlo	168
Dome (Except Corvette)	211	Chevrolet, Camaro, Nova	194
Corvette	212	Corvette	1895
Instrument Panel Compartment		Transmission Control Indicator	
Chevelle, Monte Carlo, Chevrolet	1891	Chevelle	168
Camaro (w/o AC), Nova	1895	Corvette	1895
Camaro (w/AC)	194	WS Wiper/Washer Control	
Heater or AC Control		Chevelle, Monte Carlo	168
Chevelle, Monte Carlo, Camaro	1445	Nova	194
Chevrolet, Nova	1895	Corvette	1445
Corvette	1816	Door Ajar Indicator	
Backing Lamps	1156	Chevrolet	194
Instrument Panel Cluster		Corvette	1895
Chevelle, Monte Carlo, Chevrolet, Nova	168	Reading Lamp (Chevrolet)	
Camaro	194	Bel Air & Impala	211
Corvette	1895	Caprice	1004
Park Brake Alarm		WS Washer Fluid Level Indicator	168
Chevelle, Monte Carlo	168	Rear Seat Courtesy (Camaro)	212
Chevrolet, Camaro, Nova	194	Console Instrument Cluster (Nova)	1816
Corvette	1895	Rear Compartment (Corvette)	1895
Directional Signal Indicator		Clock (Corvette)	1895
Chevelle, Monte Carlo	168	Cigarette Lighter (Corvette)	1445
Chevrolet, Camaro, Nova	194	Mirror/Map (Corvette)	563
Corvette	1895	Headlamp Doors Up (Corvette)	1895
High Beam Indicator			
Chevelle, Monte Carlo	168		
Chevrolet, Camaro, Nova	194		
Corvette	1895		

FUSED CIRCUITS CHEVELLE & MONTE CARLO

			Instrument Lamps	Directional Signals Back-up	Gauges	Tail	Heater & A/C	Circuit Breaker	Wiper	Stop Hazard	Courtesy Clock-Lighter	Radio TCS	
ITEMS	QTY	AMP	8	339	39	49	50	60	93	140	140	141	
Air Cond 19.0 Heater 8.0	1	19.0					19.0						
Cigarette Lighter	1	8.50									8.50		
Clock	1	5.10									5.10		
Cruise Control	1	2.50			2.50								
Defogger Rear	1	2.00			2.00								
Starter Interlock Relay		0.27			0.27								
Gauge—Fuel	1	0.35			0.35								
Over-Ride Relay		0.36			0.36								
Gauge—Temperature	1	0.24			0.24								
Key Warning Buzzer											0.21		
Seat Belt Warning Buzzer	1	0.22			0.22								
Wiper W/S 28.6 Stall 6.1 on Low	1	6.10							6.10				
Radio U63 (1.5) U69 (2.5)													
Radio—Stereo U79 (2.5)													
Radio-Stereo Tape UM1-UM2 (3.5)	1	3.50										3.50	
TCS—Delay Relay-20 Sec.	1	0.10										0.10	
TCS—Idle Stop Solenoid	1	0.40										0.40	
TCS—Vacuum Advance Solenoid	1	0.40										0.40	
Transmission Down Shift	1	0.50										0.50	
Tailgate Unlock	1	20.0			20.0								
Power Window Motor													
Lock—Rear Lid													
Lock—Electric Door													
Electronic Module *(Negligible)													
Lamps	CP												
Backing	32	2	2.10	4.20									
Brake Alarm	3	1	0.35		0.35								
Cluster	3	4	0.35	1.40									
Courtesy	6	2	0.63								1.26		
Rear Courtesy Header	6	1	0.74								0.74		
Dome	12	1	0.74								0.74		
Generator Warning	3	1	0.35				0.35						
Glove Box	2	1	0.24								0.24		
Heater Dial	0.70	1	0.135	0.135									
License	3	1	0.35			0.35							
Luggage	15	1	0.94								0.94		
Oil Pressure Warning	3	1	0.35		0.35								
Parking	3	2	0.59			1.18							
Radio Dial Indicator	2	1	0.44	0.44									
Seat Belt Warning	3	1	0.35		0.35								
End Gate Ajar	3	1	0.35		0.35								
Side Marker (Front)	3	2	0.35			0.70							
Stop	32	4	2.10							8.40			
Tail	3	4	0.59			2.36							
Temperature Warning Header	3	1	0.35		0.35								
W/S Header Map	12	1	0.95		0.95								
Side Marker (Rear)	2	2	0.27			0.54							
Directional Signals													
Rear	32	2	2.10	4.20									
Front	32	1	2.10	2.10									
Front Fender Marker	3	1	0.35	0.35									
Indicator (I.P.)	3	1	0.35	0.35									
Traffic Hazard													
Rear	32	4	2.10							8.40			
Front	32	2	2.10							4.20			
Front Fender Marker	3	2	0.35							0.70			
Indicator (I.P.)	3	2	0.35							0.70			
TOTAL LOAD MAXIMUM				2.68	11.20	8.64	5.29	19.35		6.10	14.00	17.73	4.90
FUSE RELEASED				4	20	10	20	25	30	25	20	20	10

FUSED CIRCUITS CHEVROLET

ITEMS			QTY	AMP	Instrument Lamps	Directional Signals Back-up	Gauges	Tail	Heater & A/C	Circuit Breaker	Wiper	Stop Hazard	Courtesy Clock-Lighter	Radio TCS	
					8	339	39	40	50	60	93	140	140	141	
Air Conditioning 19.0 Heater 8.0			1	19.0					19.0						
Cigarette Lighter			1	8.5									8.5		
Clock			1	5.1									5.1		
Cruise Control			1	2.5											
Defogger Rear			1	2.0			2.5								
Power Tailgate Window Relay			1	0.50		0.50									
Gauge—Fuel			1	0.35			0.35								
Over-ride Relay			1	0.36			0.36								
Starter Interlock Relay			1	0.27			0.27								
Key Warning Buzzer			1	0.21									0.21		
Power Window Motor															
Power Tailgate Motor															
Power Tailgate Window Motor															
Transmission Down Shift			1	0.50										0.50	
Wiper—W/S 28.6 Stall 6.1 on Low			1	6.10							6.10				
Ignition Relay															
Lock—Electric Door															
Radio U63 (1.5) U69 (2.5)															
Radio—Stereo U79 (2.5)															
Radio—Stereo—Tape UM1-UM2 (3.5)			1	3.50										3.50	
Seat Belt Warning Buzzer			1	0.22			0.22								
Power Seat Motor															
Electronic Module *(Negligible)							*								
Lamps	CP														
Backlog	32	2	2	2.10		4.20									
Brake Alarm	2	1	1	0.27			0.27								
Cluster	3	4	4	0.35	1.40										
Courtesy	6	2	2	0.63									1.26		
Temperature Warning	2	1	1	0.27			0.27								
Dome & Reading	15	2	2	0.94									1.88		
Generator Warning	2	1	1	0.27			0.27								
Glove Box	2	1	1	0.24									0.24		
Heater Dial	2	1	1	0.27	0.27										
License	3	1	1	0.35				0.35							
Luggage	15	1	1	0.94									0.94		
Oil Pressure Warning	2	1	1	0.27			0.27								
Parking	3	2	2	0.59				1.18							
Radio Dial Indicator	2	1	1	0.44	0.44										
Seat Belt Warning	2	1	1	0.27			0.27								
Door Open Indicator	2	1	1	0.27				0.27							
Side Marker (Front)	3	2	2	0.35				0.70							
Stop	32	4	4	2.10								8.40			
Tail	3	4	4	0.59				2.36							
Side Marker (Rear)	2	2	2	0.27				0.54							
Directional Signals															
Rear	32	2	2	2.10		4.20									
Front	32	1	1	2.10		2.10									
Front Fender Marker	3	1	1	0.35				0.35							
Indicator (I.P.)	2	1	1	0.27		0.27									
Traffic Hazard															
Rear	32	4	4	2.10								8.40			
Front	32	2	2	2.10								4.20			
Front Fender Marker	3	2	2	0.35								0.70			
Indicator (I.P.)	2	2	2	0.27								0.54			
TOTAL LOAD MAXIMUM						2.11	11.62	6.78	5.56	19.27		6.10	13.84	18.13	4.00
FUSE RELEASED						3	20	10	20	25	30	25	20	20	10

FUSED CIRCUITS CAMARO

ITEMS			QTY	AMP	Instrument Lamps	Directional Signals Back-up	Gauges	Tail	Heater & A/C	Circuit Breaker	Wiper	Stop Hazard	Courtesy Clock-Lighter	Radio TCS	
					8	39	39	40	50	60	93	140	140	141	
Air Conditioning			1	19.0					19.0						
Cigarette Lighter			1	8.5									8.5		
Clock			1	5.1									5.1		
Cruise Control			1	2.5		2.5									
Defogger Rear			1	2.0		2.0									
Electric Window Control 1-Relay 5A			4			.50									
Gauge—Fuel			1	.35			.35								
Gauge—Temperature			1	.27			.27								
Heater (See A/C)			1	8.0											
Key Warning Buzzer and Seat Belt			1	.60									.60		
Lock—Rear Lid															
Lock—Electric Door															
Radio															
Radio—Stereo															
Radio—Stereo Tape				6.0										6.0	
Seat Belt Warning Buzzer															
TCS—Delay Relay—20 Second			1	.25										.25	
TCS—Relay—1 Minute															
TCS Idle Stop Solenoid			1	.50										.50	
Transmission Down Shift				.5										.50	
Wiper—W/S 28.6 Stall 6.1 on Low			1	6.1							6.1				
Vacuum Advance Solenoid			1	.50										.50	
Lamps			CP												
Backing			32	2	2.10	4.20									
Brake Alarm			2	1	.27		.27								
Cluster			2	6	.27	1.62									
Courtesy			6	2	.63								1.26		
Directional Signals			2	2	4.74	9.48									
Dome			12	1	.95								.95		
Generator Warning			2	1	.27		.27								
Glove Box			2	1	.27								.27		
Heater Dial			7	1	.27	.27									
License			3	2	.59								1.18		
Luggage			15	1	.94								.94		
Oil Pressure Warning			2	1	.27		.27								
Parking			2	2	.59			1.18							
Radio Dial Indicator			2	1	.50	.50									
Seat Belt Warning			2	1	.27								.27		
Side Marker			3	4	.27			1.08							
Stop			32	2	2.10							4.20			
Tail			3	2	.59			1.18							
Traffic Hazard			4	4	2.10							8.40			
TOTAL LOAD MAXIMUM							2.39	18.68	1.43	3.44	19.0	6.10	12.60	19.07	7.75
FUSE RELEASED							4	20	10	20	25	25	20	20	10

FUSED CIRCUITS NOVA

ITEMS	QTY	AMP	Instrument	Directional	Gauges	Tail	Heater &	Circuit	Wiper	Stop	Courtesy	Radio	
			Lamps	Signals		A/C	Breaker		Hazard	Clock-Lighter	TCS		
			8	39	39	40	50	60	93	140	140	141	
Air Conditioning	1	19.0					19.0						
Cigarette Lighter	1	8.5									8.5		
Clock	1	5.1									5.1		
Defogger Rear	1	2.0		2.0									
Gauge—Fuel	1	.35			.35								
Gauge—Temp.	1	.27		.27									
Heater—See A/C	1	8.0											
Key Warning Buzzer and Seat Belt	1	.60									.60		
Radio U63 (1.5) U69 (2.5)													
Radio—Stereo U79 (2.5)													
Radio—Stereo Tape UM1-UM2 (3.5)												3.50	
TCS—Delay Relay—20 Sec.	1	.25										.25	
TCS—Idle Stop Solenoid	1	.50										.50	
Wiper—W/S 28.6 Stall 6.1 on Low	1	6.1							6.1				
Vacuum Advance Solenoid	1	.50										.50	
Lamps	CP												
Backings	32	2	2.10	4.20									
Brake Alarm	2	1	.27		.27								
Cluster	3	5	.35	1.75									
Courtesy	6	2	.63								1.26		
Directional Signals	2	2	4.74	9.48									
Dome	12	1	.95								.95		
Generator Warning	2	1	.27		.27								
Glove Box	2	1	.27								.27		
Heater Dial	2	1	.27	.27									
License	4	1	.59								.59		
Luggage	15	1	.94								.94		
Oil Pressure Warning	2	1	.27		.27								
Parking	3	2	.59			1.18							
Radio Dial Indicator	2	1	.50	.50									
Seat Belt Warning	2	1	.27								.27		
Side Marker	3	4	.35			1.40							
Stop	32	2	2.10							4.20			
Tail	3	2	.59			1.18							
Traffic Hazard		4	2.10							8.20			
Taxi Rear Door Warn COPO	2	1	.27								.27		
TOTAL LOAD MAXIMUM				2.52	15.95	1.16	4.76	19.0		6.10	12.40	18.75	4.75
FUSE RELEASED				4	20	10	20	25		25	20	20	10

FUSED CIRCUITS CORVETTE

ITEMS				Instrument Lamps	Directional Signals Back-up	Gauges	Tail	Heater & A/C	Circuit Breaker	Wiper	Stop Hazard	Courtesy Clock-Lighter	Radio TCS			
				8	339	39	40	50	60	93	40	140	141			
Air Conditioning (Compressor Clutch)		1	2.0					2.0								
Cigarette Lighter		1	8.6									8.6				
Clock		1	4.9									4.9				
Defogger Rear		1	1.6										1.60			
Electric Window Control 1—Relay 5A		2	10.0			.5			20.0							
Gauge—Fuel		1	.35			.35										
Gauge—Oil Electric		1	.10			.10										
Gauge—Temperature		1	.30			.30										
Heater A/C Blower		1	18.0					18.0								
Key Warning Buzzer		1	.60								.60					
Radio (U69)		1	3.0										3.00			
Radio—Stereo (U58) (See U69)		1	2.5													
Seat Belt Warning Buzzer		1	.60			.60										
TCS—Delay Relay—20 Sec.		1	.25										.25			
TCS Idle Stop Solenoid		1	.40										.40			
TCS Vacuum Advance Solenoid		1	.40										.40			
Transmission Down Shift (M-40)		1	.50										.50			
Wiper—W/S 28.6 Stall 6.1 on Low		1	6.1							6.1						
Hood Air Door		1	.6										.60			
Anti-Theft Horn		1	5.0									5.00				
Anti-Theft Relay		1	.50									.50				
Starter Interlock System																
Lamps		CP														
Backing		32	2	2.10		4.20										
Brake Alarm		2	1	.27		.27										
Cluster Illumination		2	12	.27	3.24		3.24									
Courtesy		6	2	.63									1.26			
Directional Signals		4	4	4.82		4.82										
Dome (Rear Compartment)		6	1	.74								.74				
Directional Signal		2	2	.27								.27				
Glove Box (Rear)		2	1	.27								.27				
Heater Dial		3	1	.33	.33											
License		3	2	.35			.70									
Head Lamp Door Opening		2	1	.27	.27											
Parking		3	2	.59			1.18									
Radio Dial Indicator		2.0+.1	2	.40	.40											
Seat Belt Warning		2	1	.27		.27										
Seat Separation Shift Indicator		2	1	.27	.27											
Side Marker		3	4	.35			1.40									
Stop		32	2	2.10							4.20					
Tail		3	2	.59			1.18									
Traffic Hazard		8	8	9.54							9.54					
Cigarette Lighter		.7	1	.14												
Door Ajar Warning		2	1	.27		.27										
TOTAL LOAD MAXIMUM							4.51	8.02	3.29	7.70	20.0	20.0	6.10	14.34	21.54	6.75
FUSE RELEASED							5	25	10	20	25	30	25	14.34	20	20

RADIATOR AND GRILLE

SECTION 13

TORQUE SPECIFICATIONS

	Chevrolet	Chevelle	Monte Carlo	Nova	Camaro	Corvette
Grille	12 in. lbs.	55 in. lbs.	50 in. lbs. (upper) 42 in. lbs. (Lower)	150 in. lbs.	12 in. lbs.	25 in. lbs.
Grille Support Brk.		18 in. lbs.	18 in. lbs.	18 in. lbs.		52 in. lbs.
Fan Shroud	50 in. lbs.	50 in. lbs.	50 in. lbs.	50 in. lbs.	50 in. lbs.	80 in. lbs.
Coolant Recovery Tank Bracket	50 in. lbs.	50 in. lbs.	50 in. lbs.	50 in. lbs.	50 in. lbs.	50 in. lbs.
Radiator Mounting to Support	18 ft. lbs.	18 ft. lbs.	18 ft. lbs.	18 ft. lbs.	18 ft. lbs.	
Drain Plug						112 in. lbs.

BUMPERS

SECTION 14

BOLT TORQUES IN POUNDS

Component	Chevrolet	Chevelle	Monte Carlo	Laguna
Front Bumper Beauty Bolts	22 Ft.	22 Ft.	22 Ft.	—
Front Bumper to Reinforcement Brackets	30 Ft.	30 Ft.	30 Ft.	—
Rear Bumper Beauty Bolts	22 Ft.	22 Ft.	22 Ft.	22 Ft.
Rear Bumper to Reinforcement or Support	30 Ft.	27 Ft.	27 Ft.	27 Ft.
Rear Bumper Exc. Wag. Outer Bracket to Frame	90 Ft.	—	—	—
Rear Bumper Bracket to Reinforcement	19 Ft.	EL CAMINO 95 Ft.	—	—
Protective Strip to Face Bar — Front		22 Ft.	22 Ft.	To Urethane 13 In.
Protective Strip to Face Bar — Rear	50 In.	22 Ft.	22 Ft.	22 Ft.
Bumper Guards	30 Ft. Front Bolt 22 Ft. Front Nut 30 Ft. Rear	30 Ft. Front 30 Ft. Rear	30 Ft. Front 30 Ft. Rear	30 Ft. Front Bolt 22 Ft. Front Nut 30 Ft. Rear
Bumper Guard Strip	18 In. Front 50 In. Rear	50 Ft. Front 50 In. Rear		50 In. Front 50 In. Rear
Reinforcement to Bumper or Brackets	30 Ft.	30 Ft.	30 Ft.	30 Ft.
Front or Rear License Plate Brkt.	30 Ft.	—	—	—
Energy Absorber to Frame	70 Ft.	53 Ft.	53 Ft.	53 Ft.
Energy Absorber Front Brackets	85 In. (Wagon)			
Energy Absorber Rear Mount	53 Ft.	—	—	—
Energy Absorber Pivot Brackets	53 Ft.			
Energy Absorber "L" Bracket	—	To Frame 53 Ft. To E/A 53 Ft.		
Front & Rear Filler Panel	Front 96 In. Rear 13 In. Outer Rear 96 In. Inner Rear 35 In. (Wagon)	Rear 50 In.	Rear 50 In.	Rear 50 In. Rear 35 In. (EL CAMINO)
Center Reinforcement Brkt.	30 Ft.	—	30 Ft.	30 Ft.
License Plate Bracket to Center Reinforcement Brkt.	30 Ft.	—	—	—
Urethane to Reinforcement Studs	—	—	—	30 Ft. & Support 53 Ft.
Urethane To Sheet Metal	—	—	—	Top 43 In. Sides 85 In. Bottom Side 43 In.

Ft. = Foot Pounds In. = Inch Pounds.

BUMPERS (Continued)

CAMARO	ALL
Front Face Bar to Brackets	22 in.
Front Face Bar Spring — Bolts	53 ft.
Front Bumper Bracket & Brace	25 ft.
Bumper Guards	23 Ft. Front
Protective Strip to Bumper	50 in.
Lower Valance Panel	19 ft.
Front Filler Panel	18 in.
Rear Face Bar	22 ft.
Rear Spring — Bolts	53 ft.
Rear Spring Brackets to Spring	53 ft.
Rear Filler Panel	18 in.

CORVETTE	ALL
Front Urethane Cover	25 in.
Impact Bar to Slider Bracket	53 ft.
Impact Bar to End Brackets	52 ft.
Slider Bracket to Frame Ext.	150 in.
End Brace to Frame & Ext.	70 ft.
Front Tie Rod Nuts	150 ft.
Impact Bar Lower Reinforcement	52 ft.
Impact Bolt Nut	125 ft.
Rear Urethane Cover	25 in.
Rear Cover to Brace Bolts	53 ft.
Rear Slider Bracket to Frame	70 ft.
Reinforcement bar to Slider Brkts.	70 ft.
Reinforcement Bar Bumper	50 in.
Rear Brace to crossmember	52 ft.
Reinforcement Brkt. to Reinf. Bar	150 in.

	ALL
Front Face Bar	30 ft.
Energy Absorber to Frame	53 ft.
E/A Brkt. to Frame (Front)	53 ft.
E/A Pivot Brackets	53 ft.
Front & Rear Face Bar to Reinf.	30 ft.
Reinforcement Brkts.	97 in.
Bumper Guards	Bolt 30 ft. Nut 22 ft.
Rear Face Bar	22 ft.
Protective Strips	50 in.

ft. = Foot Pounds in. = Inch Pounds

ACCESSORIES

SECTION 15

CRUISE MASTER

Solenoid Resistance	5 ohms ± 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	60 MPH

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LIGHT DUTY TRUCK SPECIFICATIONS

HEATING AND AIR CONDITIONING

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.

AIR CONDITIONING

Compressor	
Make	Frigidaire
Type	6 Cylinder Axial
Displacement	12.6 Cu. In.
Rotation	Clockwise

	<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	
C-K Four-Season System	3 lbs. 12 oz.
C-K-G Overhead Systems	5 lbs. 4 oz.
G Model C60 System	3 lbs.
Motor Home Chassis Unit	3 lbs. 4 oz.

525 Viscosity Refrigeration Oil

All except Overhead systems	10 oz.
Overhead Systems	13 oz.

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 Four-Season Systems	30 Amp.
C-K Overhead System	20 Amp.
Motor Home Chassis Unit	None

Circuit Breaker

G Model Systems35 Amp.
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BODY

SECTION 1B

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.

FRONT SUSPENSION

SECTION 3

* WHEEL ALIGNMENT SPECIFICATIONS

CASTER **											
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"
GA10 - 30 PA 30	+2 1/4°	+2°	+1 1/2°	+1 1/4°	+1°	+3/4°	+1/2°	+1/4°	0°	-1/4°	-1/2°
CA PA 10			+2°	+1 1/2°	+1 1/4°	+1°	+3/4°	+1/2°	+ 1/4°	0°	-1/2°
CA PA 20 - 30	+1 1/2	+1 1/4°	+1°	+3/4°	+1/2°	+1/4°	0°	-1/4°	-1/2°	-3/4°	-1°
K10 - 20	+4° - no provision for resetting										
PA 10-20	-	-	-	+1 1/2°	+1 1/4°	+1°	+3/4°	+1/2°	+1/4°	0°	-1/4°
CAMBER											
CA GA PA 10 - 20 - 30											+1/4°
KA 10 - 20..... No provision for resetting											+1 1/2°
TOE-IN (TOTAL)											
CA GA PA 10 - 20 - 30 K 10 - 20											3/16"††
K 10-20											0°

- * See Column 1, 2 or 3 under Vehicle Alignment Tolerances for applicable tolerances.
- ** See Page 3-15 for the proper method of determining Caster Angle.
- + See Page 3-15 Figure 20 for method of determining Dimension "A".
- †† K-10 with full time four wheel drive toe-in = 0".

VEHICLE ALIGNMENT TOLERANCES ††

	Field Usage	
	Column 1 *Service Checking	Column 3 @Service Reset
Camber	± 3/4°	± 1/2°
Caster	± 1°	± 1/2°
\$ Toe-in	± 1/8"	± 1/16"
Camber (Side to Side) .	1°	1/2°
Caster (Side to Side) . .	1°	1/2°

VEHICLE INSPECTION TOLERANCES ††

	Column 2
Caster	± 2°
Camber	± 1 1/2°
Toe	± 3/8"

- * Caster and Camber must not vary more than 1° from side to side.
- @ Caster and Camber must not vary more than 1/2° from side to side.
- \$ Toe setting must always be made after caster and camber.
- †† See explanatory copy in front suspension section 3 Page 14.

FRONT SUSPENSION BOLT TORQUE (Ft. Lbs.) \$

	CP-10	CP-20-30	K-All	G-10-20	G-30
Lower Control Arm Shaft U-Bolt	45	85	—	45	85
Upper Control Arm Shaft Nuts	70	105	—	70	105
Control Arm Rubber Bushings	140	—	—	140	
Upper Control Arm Bushing Steel \$\$		New 190 Used 115	—	w/Spacer 160 No Spacer 95	w/Spacer 190 No Spacer 115
Lower Control Arm Bushing Steel \$\$		New 280 Used 130	—	w/Spacer 280 No Spacer 130	w/Spacer 280 No Spacer 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	100	100	—	100	100
Crossmember Brake Support Struts		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, G30, P10-30 Steel Bushings.

FOUR WHEEL DRIVE

Axle	5500# (Dana)		Bolt Torques (Ft. Lbs.)
Gear Backlash Preferred	.004" - .009"	Carrier Cover	35
Min. and Max.	.004" - .009"	Ring Gear	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	255
		Brake - Backing Plate	35
		Axle Shaft To Hub Bolts	60

REAR SUSPENSION

SECTION 4

TORQUE SPECIFICATIONS (FT. LBS.)

WHEEL BEARING ADJUSTMENT SPECIFICATIONS

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"	75-100 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.

Ring Gear Size	Lubricant Capacity
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

UNIVERSAL JOINT ATTACHMENT TORQUE SPECIFICATIONS	
Strap Attachments	15 Ft. Lbs.
"U" Bolt Attachment	20 Ft. Lbs.

DIFFERENTIAL SPECIFICATIONS

	8-7/8"	Dana 10-1/2" 9-3/4"	Chevrolet 10-1/2"	12-1/4"
Gear Backlash Preferred	.005"-.008"	.004"-.009"	.005"-.008"	.005"-.008"
Min. and Max.	.003"-.010"	.004"-.009"	.003"-.012"	.003"-.012"
Pinion Bearing Preload (In. Lbs.)				
New	20-25	20-40	25-35	
Used	5-10	10-20	5-15	

Bolt Torques (Ft. Lbs.)

	8-7/8"	Dana 10-1/2" 9-3/4"	Chevrolet 10-1/2"	12-1/4"
Carrier Cover	23	35	18	—
Ring Gear	50	110	110	105
Differential Bearing Caps	55	85	100	205

	8-7/8"	Dana 10-1/2" 9-3/4"	Chevrolet 10-1/2"	12-1/4"
Filler Plugs	18	10	18	10
Differential Pinion Lock	25	—	—	—
Drive Pinion Nut	—	255	220	220
Differential Carrier to Axle Housing	—	—	45	85
Differential Bearing Adjusting Lock	—	—	15	15
Pinion Bearing Cage To Carrier	—	—	70	165
Thrust Pad Lock Nut	—	—	—	135
Brake - Backing Plate	40	105	105	155
Axle Shaft To Hub Bolts	—	90	90	15

*Initial Torque Only, Additional Torque as necessary.

TORQUE SPECIFICATIONS (FT. LBS.) (CONT'D.)

	C-K	G	P
Spring-to-Axle "U" Bolt Nuts	140	120(GP,20) 140(G30)	140
Leaf Spring			
—Front Bushing Bolt	90	135	90
—Rear Shackle Bolt	90	135	90
Shock Absorber			
—Upper Attachment	140	75	140
—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
Bearing Support-to-Hanger	20-30	20-30	20-30
Hanger-to-Frame	40-50	—	—
Rear Stabilizer-to-Anchor Plate	20-30	—	20-30

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BRAKES

SECTION 5 TORQUE SPECIFICATIONS

	C	K	G	P
Master Cylinder to Dash or Booster			25 ft. lbs.	
Booster to Dash or Frame			25 ft. lbs.	
Brake Line to Master Cylinder			150 in. lbs.	
Brake Line to Combination Valve			150 in. lbs.	
Brake Line to Flex Hose			150 in. lbs.	
Combination Valve Mounting Nuts			150 in. lbs.	
Combination Valve Bracket to Frame	—	—	—	25 ft. lbs.
Flex Hose to Caliper			22 ft. lbs.	
Rear Line to Wheel Cylinder			150 in. lbs.	
Rear Line to Connector or Unions			115 in. lbs.	
Rear Flex Hose to Connector	115 in. lbs.	115 in. lbs.	150 in. lbs.	150 in. lbs.
Front Brake Hose to Frame Nut	150 in. lbs.	58 in. lbs.	58 in. lbs.	58 in. lbs.
Front Brake Hose Bracket Bolt	58 in. lbs.	—	150 in. lbs.	150 in. lbs.
Brake Hose Bracket to Axle Housing	150 in. lbs.	150 in. lbs.	—	150 in. lbs.
Brake Hose to Bracket at Axle Housing	150 in. lbs.	150 in. lbs.	90 in. lbs.	150 in. lbs.
Brake Line Clips	150 in. lbs.	150 in. lbs.	100 in. lbs.	150 in. lbs.
Push Rod to Pedal	—	—	—	25 ft. lbs.
Push Rod Adjusting Nut			25 ft. lbs.	
Brake Pedal Bolt Nut	25 ft. lbs.	25 ft. lbs.	20 ft. lbs.	45 ft. lbs.
Brake Pedal Sleeve to Bracket	—	—	—	100 in. lbs.
Stoplamp Switch Bracket to Pedal	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.	—
Pedal Bracket to Dash	25 ft. lbs.	25 ft. lbs.	120 in. lbs.	25 ft. lbs.
Hydro-Boost Pedal Rod — P30(32) Models	—	—	—	25 ft. lbs.
Hydro-Boost Pedal Rod — P30(32) Models	—	—	—	15 in. lbs.
Parking Brake Assembly to Dash	100 in. lbs.	100 in. lbs.	100 in. lbs.	—
Parking Brake Assembly to I.P., Kick Panel or Floorpan	150 in. lbs.	150 in. lbs.	100 in. lbs.	18 ft. lbs.
Parking Brake Cable to Assembly Clip	—	—	18 ft. lbs.	—
Cable Clips to Frame	—	—	150 in. lbs.	150 in. lbs.
Equalizer Nuts	—	—	—	18 ft. lbs.
Prop Shaft Parking Brake Adjusting Nut	—	—	—	25 ft. lbs.
Prop Shaft Parking Brake Cable Bracket to trans.	—	—	—	25 ft. lbs.
Prop Shaft Parking Brake Cable Clip	—	—	—	20 ft. lbs.
Rear Brake Anchor Pin			140 ft. lbs.	
Caliper Mounting Bolt			35 ft. lbs.	
Support Plate to Knuckle			140 in. lbs.	
Wheel Cylinder to Flange Plate Bolt			50 in. lbs.	
Hydro-Boost Accumulator			20 ft. lbs.	
Accumulator Inlet Line			140 in. lbs.	
Accumulator Outlet Line			165 in. lbs.	
Hydro-Boost Inlet, Outlet and Return Lines			25 ft. lbs.	
Hydro-Boost Pivot Lever Bolt			40 ft. lbs.	
Hydro-Boost Brace	—	—	150 in. lbs.	150 in. lbs.
Hydro-Boost Push Rod Retainer Bracket	—	—	150 in. lbs.	25 ft. lbs.
Brake Bleeder Valves	Torque to seal or 100 in. lbs. max. Replace valve if it will not seal at 100 in. lbs.			

ENGINE

SECTION 6

GENERAL DATA:								
Type		In Line		V8				
Displacement (cu. in.)		250	292	350		454		
Horsepower @ rpm		100 @ 3600	120 @ 3600	145 @ 3600	160 @ 3800	230 @ 4000	245 @ 4000	
Torque @ rpm		175 @ 1800	215 @ 2000	250 @ 2200	255 @ 2400	350 @ 2800	365 @ 2800	
RPO		LD4	L25	LF5	LS9	LF8		
Carburetor		1BBL.	1BBL.	2BBL.	4BBL.	4BBL.		
Bore		3 7/8		4		4 1/4		
Stroke		3.53	4.12	3.48		4		
Compression Ratio		8.25:1	8.0:1	8.5:1		8.25:1		
Firing Order		1-5-3-6-2-4		1-8-4-3-6-5-7-2				
CYLINDER BORE:								
Diameter		3.8745 - 3.8775		3.9995 - 4.0025		4.2495 - 4.2525		
Out of Round	Production	.0005 Max.		.001 Max				
	Service			.002 Max.				
Taper	Production	Thrust Side	.0005 Max.					
		Relief Side	.0005 Max.		.001 Max.			
	Service			.005 Max.				
PISTON:								
Clearance	Production	.0005-.0015	.0026-.0036	.0007-.0013		.0018-.0028		
	Service	.0025 Max.	.0045 Max.	.0027 Max.		.0035 Max.		
PISTON RING:								
C O M P R E S S I O N	Clearance Groove	Production	Top	.0012 - .0027	.0020-.0040	.0012 - .0032	.0017 - .0032	
			2nd	.0012-.0032				
		Service	Hi Limit Production + .001					
	Gap	Production	Top	.010 - .020				
			2nd	.010 - .020	.013 - .025	.010 - .020		
		Service	Hi Limit Production + .01					
O I L	Groove Clearance	Production	.005 Max.	.005-.0055	.002 - .007		.0005 - .0065	
		Service	Hi Limit Production + .001					
	Gap	Production	.015 - .055		.010 - .030			
		Service	Hi Limit Production + .01					
PISTON PIN:								
Diameter		.9270 - .9273		.9895 - .9898				
Clearance	Production	.00015 - .00025		.00025 - .00035				
	Service	.001 Max.						
Fit in Rod		.0008 - .0016 Interference						

SPECIFICATIONS 48

CRANKSHAFT:							
Main Journal	Diameter	All 2.2983 - 2.2993		#1-2-3-4 2.4484 - 2.4493	#1 2.7485 - 2.7494		
				#2-3-4 2.7481 - 2.7490	#2-3-4 2.7481 - 2.7490		
				#5 2.4479 - 2.4488	#5 2.7478 - 2.7488		
	Taper	Production	.0002 (Max.)				
		Service	.001 (Max.)				
	Out of Round	Production	.0002 (Max.)				
Service		.001 (Max.)					
Main Bearing Clearance	Production	All .0003	All .0008	#1 .0008 - .0020	#1-2-3-4 .0013 - .0025		
		—	—	#2-3-4 .0011 - .0023	#2-3-4 .0013 - .0025		
		.0029	.0034	#5 .0017 - .0033	#5 .0024 - .0040		
	Service	#1 - .002 (Max.) All Others .0035 (Max.)					
Crankshaft End Play		.002 - .006			.006 - .010		
Crank-pin	Diameter	1.999 - 1.2000	2.099 - 2.100	2.199 - 2.200	2.1985 - 2.1995		
		Production	.0003 (Max.)				
	Taper	Service	.001 (Max.)				
		Production	.0002 (Max.)				
Out of Round	Service	.001 (Max.)					
	Production	.0007 - .0027		.0013 - .0035	.0009 - .0025		
Rod Bearing Clearance	Service	.0006 - .0017		.0035 (Max.)	.0009 - .0025		
	Service	.0006 - .0017		.008 - .014	.013 - .023		
ROD SIDE CLEARANCE							
CAMSHAFT:							
Lobe Lift ± .002"	Intake	.2217	.2315	.2600	.2343		
	Exhaust	.2217	.2315	.2733	.2343		
Journal Diameter		1.8682 - 1.8692			1.9482 - 1.9492		
Camshaft Runout		.0015 Max.					
Camshaft End Play		.001 - .005 (In-Line Engine)					
VALVE SYSTEM:							
Lifter		Hydraulic					
Rocker Arm Ratio		1.75:1	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 (Int. & Exh.)		.002 (Max.)					
Seat Width	Intake	1/32 - 1/16					
	Exhaust	1/16 - 3/32					
Stem Clearance	Production	Int.	.0010 - .0027		.0010 - .0027		
		Exh.	.0015 - .0032	.0010 - .0027	.0012 - .0029		
	Service	Hi Limit Production + .001 Intake + .002 Exhaust					
Valve Spring (Outer)	Free Length		190	Exhaust 1.91	Inlet 2.03	2.12	
	Pressure lbs. @ in.	Closed	55-64 @ 1.66	85-93 @ 1.69	76-84 @ 1.61	76-84 @ 1.70	74-86 @ 1.88
		Open	180-192 @ 1.27	174-184 @ 1.30	183-195 @ 1.20	194-206 @ 1.25	288-312 @ 1.38
Installed Height ± 1/32"		1-21/32	1-5/8	1-5/8	1-23/32	1-7/8	
Damper	Free Length		—		1.94	1.86	
	Approx. # of Coils		—		4	4	

TUNE-UP CHART

ENGINE	Type		In Line		V8		
	Displacement		250	292	350		454
	Horsepower		100	120	145	160	230 & 245
COMPRESSION ①			130 psi		150 psi		
SPARK PLUG	Make & Number	Standard	AC-R46T	AC-R44T	AC-R44T		
		Cold	AC-R45T	AC-R43T			
Gap			.035"				
DISTRIBUTOR ②	Point Dwell		31°-34°		29°-31°		
	Point Gap		.016" (Used) .019" (New)				
	Arm Spring Tension		19-23 ounces				
	Condenser		.18-.23 microfarad				
	Timing ③	Syn.	L.D.	See Idle Mixture Specifications			
H.D.							
Auto.		L.D.					
		H.D.					
DRIVE BELT ④	Fan P/S and Air Pump		50 lb. Min. 75 ± 5 lbs. (Used) 125 ± 5 lbs. (New) Using Strand Tension Gauge				
	A/C Compressor		65 lbs. Min. 95 ± 5 lbs. (Used) 140 ± 5 lbs. (New) Using Strand Tension Gauge				
AIR CLEANER			See Note ⑤				
VALVE LASH			Hydraulic — 1 turn down from zero lash				
IDLE RPM ⑥	Syn.	L.D.	850	—	900	900	800
		H.D.	600	600	—	600	700
	Auto.	L.D.	600	—	600	600	600
		H.D.	600	600	—	600	700
FUEL PUMP ⑦	Pressure in lbs.		3-1/2 to 4-1/2		7 to 8-1/2		
	Volume		1 pint in 30-45 seconds @ cranking speed				
CRANKCASE VENTILATION			Check at 12,000 Miles/Replace at 24,000 Miles				

- ① PSI at Cranking Speed, throttle wide open — Maximum variation, 20 PSI between cylinders.
 - ② Rotate cam lubricator 180° at 12,000 mile intervals — Replace at 24,000 mile intervals.
 - ③ At idle speed with vacuum advance line disconnected and plugged. On Step Van vehicles, use number two cylinder and timing tab on bottom of cover. B — B.T.D.C.
 - ④ Do not pry against A.I.R. pump housing.
 - ⑤ CAUTION: In addition to its function of filtering air drawn into the engine through the carburetor, the air cleaner also acts as a flame arrestor in the event the engine backfires. Because backfiring may cause fire in the engine compartment, the air cleaner should be installed at all times unless its removal is necessary for repair or maintenance services.
 Paper Element Type — First 12,000 miles, inspect element for dust leaks, holes, or other damage and replace if necessary. If satisfactory, rotate element 180° from original installation position. Replace element at 24,000 miles. Element must not be washed, oiled, tapped, or cleaned with an air hose. If so equipped, replace P.C.V. breather filter every 24,000 miles (do not attempt to clean). If so equipped, clean wire mesh frame arrestor every 12,000 miles.
 Oil Bath Type — The oil level in the oil bath air cleaner reservoir should be checked every 12,000 miles and sufficient S.A.E. 50 oil added when temperature is above freezing or S.A.E. 20 oil added when temperature is below freezing. Adding oil and servicing the cleaner will vary greatly, depending upon operating conditions.
 Oil Wetted Paper Element With Polyurethane Wrap — This dual element air cleaner has extremely long life and will not require replacement for 50,000 to 100,000 miles under normal operating conditions. Cleaning and oiling of the polyurethane wrap should be done at 24,000 miles under normal highway or city-type operation. Service under off-the-road or extremely dusty operations should be performed at 12,000 miles or less depending upon severity of operating conditions.
 - ⑥ See "TUNE-UP" section.
 - ⑦ Replace filter element located in carburetor inlet every 12 months or 12,000 miles, whichever occurs first.
- * 2°B on C20 Suburban Models. L.D. All 10 Series; C-K20 Suburban; All G20 Series and G30 Sportvans.
 H.D. All C-K20 Series except C-K20 Suburban; All C-P30 Series and all G30 Series except Sportvans.

SPECIFICATIONS 50

**IDLE MIXTURE ADJUSTMENT SPECIFICATIONS
LIGHT DUTY EMISSION VEHICLES**

GM 102 250 CU. IN. – FEDERAL

TRANSMISSION

	Automatic	Manual
Exhaust Emission Control System	CCS-EGR	AIR-EGR
Timing (°BTC @ RPM)	8° @ 600	8° @ 850
Solenoid Adj. (RPM)	600 (DR)	850 (N)
Lean Drop Idle Mixture (RPM)	650/600 (DR)	950/850 (N)

GM 102 250 CU. IN. – CALIFORNIA

TRANSMISSION

	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)		8° @ 850
Solenoid Adj. (RPM)	N/A	850 (N)
Lean Drop Idle Mixture (RPM)		950/850 (N)

GM 104-2 350 CU. IN. 2 BBL – FEDERAL

TRANSMISSION

	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	8° @ 600	0° @ 900
Solenoid Screw (RPM)	600 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	650/600 (DR)	1000/900 (N)

**GM 104-4 350 CU. IN. 4BBL FED. (EXC. C-K 10 & 20
SUBURBAN AND G20 & 30 SPORTVANS)**

TRANSMISSION

	Auto. Exc. Versavan (COPO)	Auto Versavan (COPO)	Manual
Exhaust Emission Control System	CCS-EGR	AIR-EGR	AIR-EGR
Timing (°BTC @ RPM)	8° @ 600	8° @ 600	8° @ 900
Solenoid Screw (RPM)	600 (DR)	600 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	650/600 (DR)	630/600 (DR)	950/900 (N)

**GM 104-4 350 CU. IN. 4BBL FED. C-K 10 & 20
SUBURBANS AND G20 & 30 SPORTVANS**

TRANSMISSION

	Auto	Manual Exc. Suburban	Manual Suburban
AIR-EGR Exhaust Emission Control			
Timing (°BTC @ RPM)	12° @ 600	8° @ 900	6° @ 900
Solenoid Screw (RPM)	600 (DR)	900 (N)	900 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	950/900 (N)	950/900 (N)

GM 104-4 350 CU. IN. 4BBL CAL.

TRANSMISSION

	Auto Exc. Suburban	Auto Suburban	Manual
AIR-EGR Exhaust Emission Control			
Timing (°BTC @ RPM)	8° @ 600	6° @ 600	4° @ 900
Solenoid Screw (RPM)	600 (DR)	600 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	630/600 (DR)	950/900 (N)

GM 105 454 CU. IN. – NATIONWIDE

TRANSMISSION

	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	10° @ 600	10° @ 800
Solenoid Screw (RPM)	600 (DR)	800 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	850/800 (N)

IDLE MIXTURE ADJUSTMENT SPECIFICATIONS

HEAVY DUTY EMISSION VEHICLES

Family	Engine (CID)	Idle Speed (RPM)	Timing (°BTC)	Lean Drop Settings (RPM)
GM111	250	600	6	700/600
GM112	292	600	8	700/600
GM113	350/4bbl	600	4	750/600
GM115	454	700	8	800/700

IDLE CO ADJUSTMENT SPECIFICATIONS

NOTE: Idle Speed and Timing Adjustment Specifications are the same for both lean drop and idle CO settings.

LIGHT DUTY EMISSION VEHICLES

	Max. Acceptable CO Level (%)	If Over Max. Acceptable Level Reset to (% or Less)
GM 102 (250 cu. in.)	.3	.3 or below
GM 104-2 (350 cu. in.)	.5	.5 or below
GM 104-4 (350 cu. in.)	.5	.5 or below
GM 105 (454 cu. in.)	.5	.5 or below

HEAVY DUTY EMISSION VEHICLES

Engine Family	Max. Acceptable CO Level (%) @ Level	If Over Max. Acceptable Level Reset to (% or Less)
GM 111 (250 cu. in.)	2.0	2.0
GM 112 (292 cu. in.)	0.3	0.3
GM 113 (350 cu. in. 4bbl)	0.5	0.5
GM 115 (454 cu. in.)	0.5	0.5

ENGINE TORQUES

Size	Usage	In Line		Small V-8	Mark IV V-8
		250	292	350	454
1/4-20	Camshaft Thrust Plate	80 lb. in.			
	Crankcase Front Cover			80 lb. in.	
	Flywheel Housing Cover			80 lb. in.	
	Oil Filler Bypass Valve				80 lb. in.
	Oil Pan (To Crankcase)		80 lb. in.		
	Oil Pan (To Front Cover)	50 lb. in.			55 lb. in.
	Oil Pump Cover	70 lb. in.			80 lb. in.
	Rocker Arm Cover		45 lb. in.		50 lb. in.
11/32-24	Connecting Rod Cap	35 lb. ft.			
5/16-18	Camshaft Sprocket				20 lb. ft.
	Clutch Pressure Plate	20 lb. ft.			
	Oil Pan (To Crankcase)	75 lb. in.		65 lb. in.	135 lb. in.
	Oil Pump	115 lb. in.			
	Push Rod Cover	50 lb. in.			
	Water Pump	15 lb. in.			
3/8-16	Clutch Pressure Plate			35 lb. ft.	
	Distributor Clamp			20 lb. ft.	
	Flywheel Housing			30 lb. ft.	
	Manifold (Exhaust)				20 lb. ft. ①
	Manifold (Exhaust to Inlet)	30 lb. ft.			
	Manifold (Inlet)				30 lb. ft.
	Manifold-to-head	35 lb. ft.			
	Thermostat Housing	30 lb. ft.			
	Water Outlet			30 lb. ft.	
	Water Pump				30 lb. ft.
3/8-24	Connecting Rod Cap		40 lb. ft.	45 lb. ft.	50 lb. ft.
7/16-14	Cylinder Head			65 lb. ft.	80 lb. ft.
	Main Bearing Cap	65 lb. ft.		70 lb. ft.	
	Oil Pump				65 lb. ft.
	Rocker Arm Stud				50 lb. ft.
7/16-20	Flywheel	60 lb. ft.		60 lb. ft.	65 lb. ft.
	Torsional Damper		60 lb. ft.		
1/2-13	Cylinder Head	95 lb. ft.			
	Main Bearing Cap				110 lb. ft.
1/2-14	Temperature Sending Unit			20 lb. ft.	
1/2-20	Torsional Damper				85 lb. ft.
	Oil Filter	Hand Tight			25 lb. ft.
	Oil Pan Drain Plug			20 lb. ft.	
	Flywheel		110 lb. ft.		
14mm	5/8	Spark Plug		15 lb. ft.	

① Inside bolts on 350 engine 30 lb. ft.

CARBURETOR
SECTION 6M
IDENTIFICATION
TRUCKS

VEHICLES				ENGINE				TRUCK CARBURETORS			
TYPE				Displacement and Type	RPO	BBL.	Throttle Lever Ball Stud Location	FEDERAL		CALIFORNIA	
C	K	P	G					Manual	Auto.	Manual	Auto.
10-20*	10-20*	10	10-20-30*	250 L-6	LD-4	1	None	7044021	7044022	7044321	N/A
20-30\$	20\$	20-30	30\$	250 L-6	LD-4	1	None	7044025	7044025	F	F
20-30\$	20\$	20-30		292 L-6	L-25	1	None	7044026	7044026	F	F
10	10			350 V-8	LF-5	2	Upper	7044113	7044114	N/A	N/A
			10	350 V-8	LF-5	2	None	7044123	7044124	N/A	N/A
10#	10#			350 V-8	LS-9	4QJ	Upper	7044203	7044202	7044503	7044502
10*-20*	10*-20*			350 V-8	LS-9	4QJ	Upper	7044503	7044502	7044503	7044502
			10#-20#	350 V-8	LS-9	4QJ	Lower	7044219	7044218	7044519	7044518
			10*20*30*	350 V-8	LS-9	4QJ	Lower	7044219	7044224	7044519	7044518
20\$-30\$	20\$			350 V-8	LS-9	4QJ	Upper	7044213	7044213	7044513	7044513
		20-30		350 V-8	LS-9	4QJ	Lower	7044216	7044216	7044516	7044516
			30\$	350 V-8	LS-9	4QJ	Lower	7044214	7044214	7044514	7044514
		30M		350 V-8	LS-9	4QJ	Upper	7044215	7044215	7044515	7044515
10				454 M-4	LF-8	4QJ	Upper	N/A	7044223	7044512	7044500
20\$-30\$		30M		454 M-4	LF-8	4QJ	Upper	7044212	7044212	N/A	7044512
		30		454 M-4	LF-8	4QJ	Lower	N/A	7044217	N/A	7044517
20*				454 M-4	LF-8	4QJ	Upper	N/A	7044220	N/A	7044520

- NOTES: (*) "C" - "K" Suburbans & "G" Sport Vans (A.I.R. Light Duty)
(F) Same as Federal
(\$) "C" - "K" 03 Series and "G" 05 Series (Heavy Duty)
(V) Virginia School Bus
(M) Motor Home
(#) "C" - "K" Except Suburban and "G" Except Sport Vans (C.C.S. Light Duty)

ADJUSTMENTS
TRUCKS
Rochester Carburetors

Model	NUMBER (A) Automatic Trans. (M) Manual Trans.	Float Level	Float Drop	Metering Rod	Pump Rod	Choke Rod (Fast Idle Cam 2nd Step)	Air Valve Wind-Up	Choke Vacuum Break	Choke Unloader
MV	7044021(M)	.295		.080		.275		.350	.500
MV	7044022(A)	.295		.080		.245		.300	.500
MV	7044321(M)	.295		.080		.300		.375	.500
MV	7044025(AM)	1/4		.070		.245		.300	.521*
MV	7044026(AM)	1/4		.070		.275		.350	.521*
2GV	7044113(M)	19/32	1 9/32		1 9/32	.200		.140	.250
2GV	7044114(A)	19/32	1 9/32		1 3/16	.245		.130	.325
2GV	7044123(M)	19/32	1 9/32		1 9/32	.200		.140	.250
2GV	7044124(A)	19/32	1 9/32		1 3/16	.245		.130	.325
4QJ	7044202 & 502	1/4			13/32(*)	.430	7/8	.230	.450
4QJ	7044203 & 503	1/4			13/32(*)	.430	7/8	.230	.450
4QJ	7044218 & 518	1/4			13/32(*)	.430	7/8	.215	.450
4QJ	7044219 & 519	1/4			13/32(*)	.430	7/8	.215	.450
4QJ	7044213 & 513	11/32			13/32(*)	.430	7/8	.215	.450
4QJ	7044223 (227)	.675			13/32(*)	.430	7/16	.220	.450
4QJ	7044212 (217)	.675			13/32(*)	.430	7/16	.230	.450
4QJ	7044512 (517)	.675			13/32(*)	.430	7/16	.230	.450
4 QJ	7044500 (520)	.675			13/32(*)	.430	7/16	.250	.450
4QJ	7044224	11/32			13/32(*)	.430	7/8	.215	.450
4QJ	7044214 & 514	11/32			13/32(*)	.430	7/8	.215	.450
4QJ	7044215 & 515	11/32			13/32(*)	.430	7/8	.215	.450
4QJ	7044216 & 516	11/32			13/32(*)	.430	7/8	.215	.450

* Measured at top of choke blade

FAST IDLE (RUNNING) RPM ADJUSTMENT

Carburetors — Rochester

Vehicles	MV		4QJ		2GV	
	Auto.	Man.	Auto.	Man.	Auto. and Manual	
All Trucks	1800 a, b		(M4)#tc	#tc	Advisory Setting † 1600 (1-1/2 S.A.E)	These settings are approximate with low idle at 500 RPM, as specified — with viscous clutch fans disengaged.
	2400 a † %		1600† a.	(**) a.		

†With vacuum advance without EGR signal

a. On high step

On M4, 1600 RPM for both Auto. and Manual except 7044212, 217, 512, 517, which is 1700 RPM

(**) L/D Truck — Manual, Q-Jet — 1300 RPM w/o Vac. Advance
H/D Truck — Manual, Q-Jet — 1600 RPM with Vac. Advance

b. w/o Vac. Advance, w/o EGR

% 7044025 & 7044026 only

c. w/o EGR, vacuum plugged on EGR equipped units

IDLE MIXTURE ADJUSTMENT
– LEAN DROP METHOD –
(REFER TO SERVICE MANUAL IDLE MIXTURE PROCEDURE – LEAN DROP METHOD.)
LIGHT DUTY (10-30) TRUCKS

NOTE: Refer to "Idle Mixture Adjustments" or "Idle Stop Solenoid Adjustments", as applicable, in Section 6M (Service Manual), under carburetors before using the following charts.

NOTE: All Idle Speeds listed are to be set with Air Conditioning OFF.

UNLESS OTHERWISE NOTIFIED: Always use current specifications that agree with the "Vehicle Emission Control Information" sticker on the vehicle.

LIGHT DUTY EMISSION VEHICLES

GM 102 250 CU. IN. – FEDERAL

	TRANSMISSION	
	Automatic	Manual
Exhaust Emission Control System	CCS-EGR	AIR-EGR
Timing (°BTC @ RPM)	8° @ 600	8° @ 850
(* Solenoid Adj. (RPM) energized (curb idle)	600 (DR)	850 (N)
Lean Drop Idle Mixture (RPM)	650/600 (DR)	950/850 (N)
(* de-energized (low idle)(RPM)	450 (DR)	450 (N)

GM 102 250 CU. IN. – CALIFORNIA

	TRANSMISSION	
	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)		8° @ 850
(* Solenoid Adj. (RPM) energized (curb idle)	N/A	850 (N)
Lean Drop Idle Mixture (RPM)		950/850 (N)
(* de-energized (low idle)(RPM)		450 (N)

GM 104-2 350 CU. IN. 2BBL – FEDERAL

	TRANSMISSION	
	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	8° @ 600	0° @ 900
(* Solenoid Screw (RPM)	600 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	650/600 (DR)	1000/900 (N)
(* de-energized (low idle)(RPM)	500 (DR)	500 (N)

GM 104-4 350 CU. IN. 4BBL FEDERAL (EXC. C-K 10 & 20 SUBURBAN AND G20 & 30 SPORTVANS)

	Auto. Exc.	Auto	
	Versavan (COPO)	Versavan (COPO)	Manual
Exhaust Emission Control System	CCS-EGR	AIR-EGR	AIR-EGR
Timing (°BTC @ RPM)	8° @ 600	8° @ 600	8° @ 900
(* Solenoid Screw (RPM)	600 (DR)	600 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	650/600 (DR)	630/600 (DR)	950/900 (N)
(* de-energized (low idle)(RPM)	500 (DR)	500 (DR)	500 (N)

GM 104-4 350 CU. IN. 4BBL FEDERAL C-K 10 & 20 SUBURBANS AND G20 & 30 SPORTVANS

	Auto	Manual	Manual
		Exc. Suburban	Suburban
AIR-EGR Exhaust Emission Control			
Timing (°BTC @ RPM)	12° @ 600	8° @ 900	6° @ 900
(* Solenoid Screw (RPM) energized (curb idle)	600 (DR)	900 (N)	900 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	950/900 (DR)	950/900 (N)
(* de-energized (low idle)(RPM)	500 (DR)	500 (DR)	500 (N)

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GM 104-4 350 CU. IN. 4BBL CALIFORNIA

	Auto Exc. Suburban	Auto Suburban	Manual
AIR-EGR Exhaust Emission Control			
Timing (°BTC @ RPM)	8° @ 600	6° @ 600	4° @ 900
(*) Solenoid Screw (RPM) energized (curb idle)	600 (DR)	600 (DR)	900 (N)
Lean Drop Idle Mixture (RPM)	630/600 (DR)	630/600 (DR)	950/900 (N)
(*) de-energized (low idle)(RPM)	500 (DR)	500 (DR)	500 (N)

GM 105 454 CU. IN. – FEDERAL

	TRANSMISSION	
	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	10° @ 600	
(*) Solenoid Screw (RPM) energized (curb idle)	600 (DR)	N/A
Lean Drop Idle Mixture (RPM)	630/600 (DR)	
(*) de-energized (low idle)(RPM)	500 (DR)	

GM 105 454 CU. IN. – CALIFORNIA

	TRANSMISSION	
	Automatic	Manual
AIR-EGR Exhaust Emission Control		
Timing (°BTC @ RPM)	10° @ 600	
(*) Solenoid Screw (RPM) energized (curb idle)	600 (DR)	N/A
Lean Drop Idle Mixture (RPM)	630/600 (DR)	
(*) de-energized (low idle)(RPM)	500 (DR)	

HEAVY DUTY EMISSION VEHICLES

Family	Engine (CID)	Curb Idle Speed (RPM)	Timing (°BTC)	Lean Drop Idle Mixture Settings (RPM)	Low Idle
GM111	250	600	6	700/600	450
GM112	292	600	8	700/600	450
GM113	350/4bbl	600	4	750/600	—
GM115	454	700	8	800/700	500

IDLE "CO" ADJUSTMENT SPECIFICATIONS

ALSO REFER TO ALTERNATE METHOD TO LEAN DROP UNDER, "IDLE MIXTURE ADJUSTMENT" PROCEDURES IN THE SERVICE MANUAL IF RELIABLE CO METER IS AVAILABLE.

NOTE: Idle Speed and Timing Adjustment Specifications are the same for both lean drop and idle CO settings.

LIGHT DUTY EMISSION VEHICLES

	Max. Acceptable CO Level (%)	If Over Max. Acceptable Level Reset to (% or Less)
GM 102 (250 cu. in.)	.3	.3 or below
GM 104-2 (350 cu. in.)	.5	.5 or below
GM 104-4 (350 cu. in.)	.5	.5 or below
GM 105 (454 cu. in.)	.5	.5 or below

HEAVY DUTY EMISSION VEHICLES

Engine Family	Max. Acceptable CO Level (%) @ Level	If Over Max. Acceptable Level Reset to (% or Less)
GM 111 (250 cu. in.)	2.0	2.0
GM 112 (292 cu. in.)	0.3	0.3
GM 113 (350 cu. in. 4bbl.)	0.5	0.5
GM 115 (454 cu. in.)	0.5	0.5

ENGINE ELECTRICAL**SECTION 6Y****BATTERY**

Model No.	Application	No. of Plates Per Cell	Cranking Power @ 0° F. (Watts)	25 Amp Reserve Capacity (Minutes)
1980199 (Y87)	250 L-6	9	2300	60
1980200 (R89)	292, 350 V-8	11	2900	100
1980204 (R89W)	454 V-8 & RPO Option	15	3750	145

GENERATORS

Model No.	Application	Delco Remy Spec. No.	Field Current Amps. (80° F.)	Cold Output*			Rated Hot Output** Amps.
				Spec. Volts	Amps. @ 2000 RPM	Amps. @ 5000 RPM	
1100497	250 CID L-6 Engine (Base)	4519	4.4 - 4.9	xxx	xxx	3600 - @ 7000 RPM	37
1102347	250 or 292 CID L-6 Engine W/K-76	4522	4.0 - 4.5	xxx	xxx	55	61
1102346	250 CID L-6 Engine W/K-79	4521	4.0 - 4.5	xxx	xxx	37	42
1102382	292 CID L-6 Engine (Base)	4521	4.0 - 4.5	xxx	xxx	37	42
1102383	292 CID L-6 Engine W/K-76	4522	4.0 - 4.5	xxx	xxx	55	61
1100934	350 & 454 CID V-8 Engines (Base)	4519	4.4 - 4.5	xxx	xxx	36 - @ 7000 RPM	37
1100597	350 & 454 CID V-8 Engines W/K-76	4522	4.0 - 4.5	xxx	xxx	55	61
1100573	350 & 454 CID V-8 Engines W/K-79	4521	4.0 - 4.5	xxx	xxx	37	42
1100575	RPOK77	4520	4.0 - 4.5	xxx	xxx	50	55

*Generator temperature approximately 80° F. **Ambient temperature 80° F. xxx-Voltmeter not needed for cold output check. Load battery with carbon pile to obtain maximum output.

STARTING MOTOR

Model No.	Spec No.	Free Speed		
		Volts	Amperes	RPM
1108365	3573	9	50-80*	5500-10,500
1108367				
1108427	2438	9	55-80*	3500-6000
1108360				
1108430	3563	9	65-95*	7500-10,500
1108480	3573	9	50-80*	5500-10,500
1108502	3563	9	65-95*	7500-10,500

*Includes Solenoid

IGNITION COIL

APPLICATION	PRIMARY RESISTANCE @ 75° F.	SECONDARY RESISTANCE	IGNITION RESISTOR	
	- OHMS -	- OHMS -	TYPE	OHMS
L-6 Engines	1.41 - 1.65	3,000 - 20,000	In Wiring Harness	1.8
V-8 Engines	1.77 - 2.01	3,000 - 20,000	In Wiring Harness	1.35

DISTRIBUTOR

Application		Ignition Distributor (Product Part No.)	Centrifugal Advance † (Crank Degrees @ Engine RPM)	Vacuum Advance (In Crank Degrees)	Point Dwell Setting	Trans.	Original Equipment Spark Plug
250 C.I.D. L-6 Engine	10 Series Exc. G Models	1110499	C-4797 0° @ 1100 14° @ 2300 24° @ 4100	C-3933 0° @ 6-8" Hg. 24° @ 14.5-15.5" Hg.	31° - 34°	All	AC-R46T
	10 Series G Models	1110500					
250 C.I.D. L-6 Engine	20-30 Series Exc. G Models	1110520	C-4797 0° @ 1100 14° @ 2300 24° @ 4100	C-6005 0° @ 12.7-13.2" Hg. 10° @ 12.7-13.5" Hg.	31° - 34°	All	AC-R46T
	20-30 Series G Models	1110525					
292 C.I.D. L-6 Engine	20-30 Series	1110518	C-4797 0° @ 1100 2° @ 1270 14° @ 2300 24° @ 4100	C-6005 0° @ 9-11" Hg. 10° @ 12.7-13.5" Hg.	31° - 34°	All	AC-R44T
350 C.I.D. V-8 Engine RPO LS-9	C, K 10 Sub.	1112093	C-4818 0° @ 1100 RPM 11° @ 2400 RPM 18° @ 4200 RPM	C-6001 0° @ 5-7" Hg. 15° @ 13-14" Hg. C-6055 0° @ 2-4" Hg. 14° @ 7.5-8.5" Hg.	29° - 31°	All	AC-R44T
	G 10-30 (Fed. & Calif.)	1112847				All	
	C, K 10-20 exc. Sub. (Calif.)					Auto.	
350 C.I.D. V-8 Engine RPO LF-5	C, K, G (Fed.)	1112543	C-4817 0° @ 1000 RPM 10° @ 1800 RPM 15° @ 2400 RPM 22° @ 4200 RPM	C-6001 0° @ 5-7" Hg. 15° @ 13-14" Hg.	29° - 31°	All	AC-R44T
350 C. I. D. V-8 Engine RPO LS-9	C, K Sub-urban, G 10-30 Spt. Van (Fed.)	1112848	C-4888 0° @ 900 14° @ 4200	C-6055 0° @ 2-4" Hg. 14° @ 7.5-8.5" Hg.	29° - 31°	Auto.	AC-R44T
350 C.I.D. V-8 Engine RPO LS-9	C 10, K 10-20 Suburban (Fed.)	1112844	C-4815 0° @ 1000 RPM 20° @ 4200 RPM	C-6055 0° @ 2-4" Hg. 14° @ 7.5-8.5" Hg.	29° - 31°	Manual	AC-R44T
	C-10 Suburban (Calif.)						

† Nominal Advance $\pm 2^\circ$

DISTRIBUTOR (CONT'D.)

Application		Ignition Distributor Product Part No.)	Centrifugal Advance (Crank Degrees @ Engine RPM)	Vacuum Advance (In Crank Degrees)	Point Dwell Setting	Trans.	Original Equipment Spark Plug
350 C.I.D. V-8 Engine RPO LS-9	C, K-10 exc. Sub., G10-30 (Calif.)	1112849	C-4817 0° @ 1000 10° @ 1800 15° @ 2400 22° @ 4200	C-6055 0° @ 2.4" Hg. 14° @ 7.5-8.5" Hg.	29° - 31°	Manual	AC-R44T
350 C.I.D. V-8 Engine RPO LS-9	G, P-30 Motor Home	1112097	C-4890 0° @ 1200 17° @ 2800 22° @ 4200	C6006 0° 7-9" Hg. 10° @ 12.2-13.5" Hg.	29° - 31°	All	AC-R44T
454 C.I.D. V-8 Engine	C, K-10 Series	1112113	C-4818 0° @ 1100 11° @ 2400 18° @ 4200	C-3032 0° @ 5.7" Hg. 20° @ 14.2-15.7 Hg.	29° - 31°	All	AC-R44T
454 C.I.D. V-8 Engine	C, K Series Suburban	1112504	C-4818 0° @ 1100 11° @ 2400 18° @ 4200	C-3036 0° @ 7-9" Hg. 16° @ 15-16" Hg.	29° - 31°	Auto	AC-R44T
454 C.I.D.	C, K 20-30 Series	1112105	C-6109 0° @ 1100 RPM 14° @ 2800 20° @ 4200 RPM	C-3932 0° @ 5-7 Hg. 24° @ 13.5-14.3" Hg.	29° - 31°	All	AC-R44T

† Nominal Advance $\pm 2^\circ$

CLUTCH AND MANUAL TRANSMISSION

SECTION 7M

THREE SPEED SAGINAW

Clutch Gear Retainer to Case Bolts	15 ft. lbs.
Side Cover to Case Bolts	15 ft. lbs.
Extension to Case Bolts	45 ft. lbs.
Shift Lever to Shifter Shaft Bolts	25 ft. lbs.
Lubrication Filler Plug	18 ft. lbs.
Transmission Case to Clutch Housing Bolts . .	75 ft. lbs.
Crossmember to Frame Nuts	25 ft. lbs.
Crossmember to Mount Bolts	40 ft. lbs.
2-3 Cross Over Shaft Bracket Retaining Nut .	18 ft. lbs.
1-Rev. Swivel Attaching Bolt	20 ft. lbs.
Mount to Transmission Bolt	50 ft. lbs.

THREE SPEED MUNCIE

Clutch Gear Retainer to Case Bolts	15 ft. lbs.
Side Cover to Case Bolts	15 ft. lbs.
Extension to Case Bolts	45 ft. lbs.
Shaft Lever to Shifter Shaft Bolts	25 ft. lbs.
Lubrication Filler Plugs	18 ft. lbs.
Transmission Case to Clutch Housing Bolts . .	75 ft. lbs.
Crossmember to Frame Nuts	25 ft. lbs.
Crossmember to Mount Bolts	40 ft. lbs.
Transmission Drain Plug	30 ft. lbs.
2-3 Cross Over Shaft Bracket Retaining Nut .	18 ft. lbs.
1-Rev. Swivel Attaching Bolt	20 ft. lbs.
Mount to Transmission Bolt	50 ft. lbs.

FOUR SPEED MUNCIE

Rear Bearing Retainer	18 ft. lbs.
Cover Bolts	25 ft. lbs.
Filler Plug	35 ft. lbs.
Drain Plug	35 ft. lbs.
Clutch Gear Bearing Retainer Bolts	18 ft. lbs.
Universal Joint Front Flange Nut	95 ft. lbs.
Power Take Off Cover Bolts	18 ft. lbs.
Parking Brake	22 ft. lbs.
Countergear Front Cover Screws	25 in. lbs.
Rr. Mainshaft Lock Nut (4 Whl. Drive Mds.) .	95 ft. lbs.
Transmission To Clutch Housing Bolts	75 ft. lbs.
Crossmember to Mount	40 ft. lbs.
Mount to Transmission	50 ft. lbs.

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.

DANA TRANSFER CASE MODEL 20

Shift Rail Set Screws	15 ft. lbs.
Front Output Shaft Rear Cover Bolts	30 ft. lbs.
Front Output Shaft Front Bearing Retainer .	30 ft. lbs.
Front Output Shaft Yoke Lock Nut	150 ft. lbs.
Intermediate Shaft Lock Plate Bolt	15 ft. lbs.
Rear Output Shaft Housing Bolts	30 ft. lbs.
Rear Output Shaft Yoke Lock Nuts	150 ft. lbs.
Case Bottom Cover Bolts	15 ft. lbs.
Transfer Case to Adapter Bolts	45 ft. lbs.
Transfer Case to Frame Bolts	45 ft. lbs.
Adapter Mount Bolts	25 ft. lbs.
Adapter to Transmission Bolts	45 ft. lbs.
Transfer Case Bracket to Frame Nuts (Upper)	30 ft. lbs.
Transfer Case Bracket to Frame Nuts (Lower)	65 ft. lbs.
Transfer Case Control Mounting Bolt	100 ft. lbs.

NEW PROCESS TRANSFER CASE MODEL 203

Adapter to Transfer Case Attaching Bolts . . .	38 ft. lbs.	Adapter Mount Bolts	25 ft. lbs.
Adapter to Transmission Attaching Bolts . . .	40 ft. lbs.	Intermediate Case to Range Box Bolts	30 ft. lbs.
Transfer Case Bracket to Frame nuts (upper)	50 ft. lbs.	Front Output Bearing Retainer Bolts	30 ft. lbs.
Transfer Case Bracket to Frame nuts (lower)	65 ft. lbs.	Output Shaft Yoke Nuts	150 ft. lbs.
Transfer Case Shift Lever Attaching Nuts. . .	25 ft. lbs.	Front Output Rear Bearing Retainer Bolts. . .	30 ft. lbs.
Transfer Case Shift Lever Rod Swivel		Differential Assembly Screws.	45 ft. lbs.
Lock Nuts	50 ft. lbs.	Rear Output Shaft Housing	30 ft. lbs.
Transfer Case Shift Lever Locking Arm Nut .	150 in. lbs.	Poppet Ball Retainer Nut	15 ft. lbs.
Skid Plate Attaching Bolt Retaining Nuts . . .	45 ft. lbs.	Power Take Off Cover Bolts	15 ft. lbs.
Crossmember Support Attaching Bolt		Front Input Bearing Retainer Bolts	20 ft. lbs.
Retaining Nut	45 ft. lbs.	Filler Plug	25 ft. lbs.

AUTOMATIC TRANSMISSIONS

SECTION 7A

TURBO HYDRA-MATIC 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.

TURBO HYDRA-MATIC 400/475

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.

STEERING

SECTION 9

TORQUE VALUES

Components	C10-30	K10-20	G10-30	P10-30
Tie Rod Ball Joint Nut Outer and Inner	C 10 35 lbs. ft.** C 20-30 45 lbs. ft.***	45 lbs. ft.	G 10 35 lbs. ft.** G 20-30 45 lbs. ft.***	
Tie Rod Clamp Bolt	22 lbs. ft.	35 lbs. ft.	22 lbs. ft.	
Idler Arm Mounting Bolts	30 lbs. ft.	—	30 lbs. ft.	
Idler Arm to Relay Rod Nut	60 lbs. ft.	—	70 lbs. ft.	60 lbs. ft.
Pitman Arm to Relay Rod Nut	60 lbs. ft.	—	70 lbs. ft.	60 lbs. ft.
Steering Connecting Rod Nuts	—	50 lbs. ft. Plus next slot for cotter pin.	—	
Steering Connecting Rod Clamps	—	40 lbs. ft.	—	
Pitman Arm to Pitman Shaft Nut	180 lbs. ft. power 140 lbs. ft. manual	90 lbs. ft.	180 lbs. ft. power 140 lbs. ft. manual	
Steering Gear Mounting Bolts	65 lbs. ft.		110 lbs. ft.	65 lbs. ft.
Steering Wheel Nut	30 lbs. ft.		40 lbs. ft.	30 lbs. ft.
Lower Mast Jacket Bearing Adjustment	—		.50 ± .04	1.26 ± .02
Power Steering Belt Tension	125 lbs. New — 75 lbs. Used			
Pump Pulley Nut	60 lbs. ft.			
Pump Pressure	1200-1300 psi.		G10-20 900-1000 p.s.i. G30 1200-1300 p.s.i.	1200-1300 p.s.i. Motor Home 1350-1450 p.s.i.
Pump Bracket and Support	25 lbs. ft.			
Power Steering Hose Clamp Screws	15 lbs. in.			
Power Steering Gear Hose Fittings	30 lbs. ft.			
Flexible Coupling Bolt & Studs	18 lbs. in.			20 lbs. ft.
Lower Mast Jacket Bearing Clamp or Coupling Bolt	—		30 lbs. ft.	
Lower Coupling to Wormshaft Clamp Bolt	30 lbs. ft.			75 lbs. ft.§
Column to Dash Panel Clamp Screws	—		125 lbs. in.	
Toe Panel Cover Screws	30 lbs. in.			24 lbs. in.
Firewall Bracket Clamp Bolt	90 lbs. in.		150 lbs. in.	98 lbs. in.
Lower Bearing Adjusting Ring Bolt	—		70 lbs. in.	

* Upper and Lower Universal Joint Clamp

** Plus Torque Required to Aline Cotter Pin, Max. 50 lbs. ft.

*** Plus Torque Required to Aline Cotter Pin, Max. 60 lbs. ft.

§ Upper and Lower Universal Joint Clamp

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	35 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	3 - 6** 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.

STEERING GEAR RATIOS	MANUAL		POWER	
	Gear	Overall	Gear	Overall
G10-20	24:1	29.4:1 to 36.7:1	17.5:1	21.4:1 to 26.7:1
G30	24:1	29.4:1 to 36.4:1	17.5:1	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	—	—	17.5:1	20.0:1 to 27.4:1
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	20:1 to 16.4:1	16.7:1 to 21.5:1

STEERING COLUMN	C and K
Floor Pan Cover Screws	35 lbs. in.
Floor Pan Cover Clamp Screws	35 lbs. in.
Dash Panel Bracket to Column Screws	15 lbs. ft.
Dash Panel Bracket to Dash Nuts	20 lbs. ft.
Ignition Switch Screw	35 lbs. in.
Turn Signal Switch Screws	25 lbs. in.
Column Lock Plate Cover Screws	20 lbs. in.
Turn Signal Housing Screws	45 lbs. in.
Lock Bolt Spring Screw (Tilt Column)	35 lbs. in.
Bearing Housing Support Screws Tilt Column	60 lbs. in.

WHEELS AND TIRES**SECTION 10****WHEELS**

Wheel Nut Torques - 10-30 Series

SERIES	DESCRIPTION	TORQUES
10	7/16" Bolts	70-90 ft. lbs.
10	1/2" Bolts	75-100 ft. lbs.
20, 30 Single Wheels	9/16" Bolts	90-120 ft. lbs.
20, 30 Dual Wheels	9/16" Bolts	110-140 ft. lbs.
30	Heavy Duty Wheels 5/8" Bolts	130-180 ft. lbs.

TIRES

See "Minimum Tire Inflation" and "Tire Load and Inflation Pressure" Charts in Section 10 of this Manual.

SHEET METAL**SECTION 11****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	18 ft. 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	150 in. lbs.		

BODY AND CHASSIS ELECTRICAL

SECTION 12

LAMP BULB DATA G TRUCK

Used in	Quantity	Trade #	Power
Dome lamps	2	211	12 CP
Oil pressure indicator lamp	1	194	2 CP
Generator indicator lamp	1	194	2 CP
Instrument cluster lamps	3	194	2 CP
Headlamp beam indicator lamp	1	194	2 CP
Tail, stop and rear directional signal lamps	2	1157	3-32 CP
License lamp	1	67	4 CP
Directional signal (front park lamps)	2	1157	3-32 CP
Head Lamps ¹		6014	
Temperature Indicator Lamp	1	194	2 CP
Directional signal indicator lamp	2	194	2 CP
Marker lamps	4	168	3 CP
Brake warning indicator lamp	1	194	2 CP
Back-up lamp	2	1156	32 CP
Radio dial lamp	1	293	2 CP
Heater or A/C Control	1	1445	.7 CP
Transmission Control w/Tilt Wheel	1	1445	.7 CP

¹Double filament sealed beam 60W high beam, 50W low beam.

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 driver's side are:

Heater, Rear A/C	20 amp
Idle Stop Solenoid, T. C. S Time Delay Relay	
Transmission Downshift	3 amp
Cigarette Lighter	15 amp
Fuel Gauge, Brake Warning Lamp, Dome Lamp, Temperature Warning Lamp, Generator Warning Lamp, Oil Pressure Warning Lamp	3 amp
Directional Signal Indicator Lamp, Traffic Hazard	15 amp
Backing Lamp, Radio Dial Lamp, Radio	10 amp
Instrument Cluster Lamp, Heater Dial Lamp, Transmission Control Lamp with Tilt Wheel	3 amp
Dome Lamp, License Lamp, Parking Lamp, Side Marker Lamp, Stop Lamp, Tail Lamp	20 amp
Windshield Wiper	25 amp

In-Line fuses are located in the Ammeter and the rear A/C 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; engine wiring and battery charging circuit, generator and forward lamp harness. Should an electrical overload occur, this wire will fail and prevent damage to the major harness.

CIRCUIT BREAKERS

Device or circuit protected	Amperes	Location
Headlamp and parking lamp circuit	15 AMP	Light switch
Windshield wiper motor	8-10 AMP	Wiper motor

LAMP BULB DATA C-K-P TRUCK

Used in	Quantity	Trade #	Power
Dome lamp ⁵	1	212	6 CP
Oil pressure indicator lamp ¹	1	194	2 CP
Generator indicator lamp ¹	1	194	2 CP
Instrument cluster lamps ²	6	194 or 1895	2 CP
Headlamp beam indicator lamp	1	194	2 CP
Lamp assembly-tail & stop lamp	2	1157	3-32 CP
License lamp ⁴	1	67	4 CP
Directional signal (front park lamps)	2	1157	3-32 CP
Head Lamps ³		6014	
Temperature Indicator Lamp	1	194	2 CP
Directional signal indicator lamp	2	194	2 CP
Cab clearance and identification lamps: Suburban models	5	1155	4 CP
Forward Control models	5	67	4 CP
Other models	5	194	2 CP
Roof marker lamps ⁶	5	194	2 CP
Brake Warning Indicator	1	194	2 CP
Transmission Control	1	1445	.7 CP
Backing lamp	2	1156	32 CP
Heater or A/C	1	1445	.7 CP
Corner marker lamps	7	67	4 CP
Cargo lamp	1	1142	21 CP
Radio Dial lamp	1	293	2 CP
Cruise Control lamp	1	53	1 CP
Courtesy lamp	1	1003	15 CP

On CA, KA 10-35 instrument clusters only.
 3 lamps used on instrument cluster PA20-35 only.
 Double filament sealed beam 60W high beam, 50W low beam.
 2 lamps used with step bumper and P models.
 2 required on Utility vehicles.
 4 required on P models.

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:

Heater, Generator Warning Lamp	20 amp
Idle Stop Solenoid, Auxiliary Battery, Radio, T.C.S. Time Delay Relay, T.C.S. Solenoid, Transmission Downshift	10 amp
Cigarette Lighter, Clock, Dome Lamp, Cargo Lamp	20 amp
Cruise Control, Rear Window, Backing Lamp	10 amp
Fuel Gauge, Brake Warning Lamp, Temperature Warning Lamp, Parking Brake Warning Lamp, Oil Pressure Warning Lamp	3 amp
Courtesy Lamp, Roof Marker Lamp, License Lamp, Parking Lamp, Side Marker Lamp, Stop Lamp, Tail Lamp, Clearance Lamp	20 amp*
Directional Signal Indicator Lamp, Traffic Hazard	15 amp
Instrument Cluster Lamp, Heater Dial Lamp, Radio Dial Lamp, Cruise Control Lamp	3 amp
Windshield Wiper	25 amp

In-Line fuses are located in the Ammeter, Auxiliary Heater and Rear A/C Circuits.

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; engine wiring and battery charging circuit, generator and forward lamp harness. Should an electrical overload occur, this wire will fail and prevent damage to the major harness.

*30 amp. with UY1 Camper option.

Section 12 (Continued)

WINDSHIELD WIPERS

TWO-SPEED WIPER	
Crank Arm Speed (RPM's) (No Load)	
Lo	34 Min.
Hi	65 Min.
Current Draw, AMPS	
No Load (Lo Speed - No Linkage)	3.6
Stall (Lo Speed)	12
WASHER	
Number of "squirts" at full pressure	10
Pressure (PSI)	11-15
Coil Resistance (ohms)	6 ± 1

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RADIATOR AND GRILLE

SECTION 13

TORQUE SPECIFICATIONS

	CK	G	P
Grille to Tie Bar		50 in. lbs.	
Grille	18 ft. lbs.	18 ft. lbs.	
Mounting Panel	150 in. lbs.		150 in. lbs.
Fan Shroud	50 in. lbs.	42 in. lbs.	120 in. lbs P (32) 50 in. lbs. P (42)
Coolant Recovery Tank Brkt.	28 in. lbs.	23 in. lbs.	28 in. lbs.

BUMPERS

SECTION 14

TORQUE SPECIFICATIONS C, P AND K

Front Bumper	30 ft. lbs.
Front Bumper Bracket and Brace	40 ft. lbs.
Rear Bumper to Outer Bracket	30 ft. lbs.
Rear Bumper Outer Bracket and Brace	38 ft. lbs.
License Plate Bracket	18 ft. lbs.
Gravel Deflector	85 in. lbs.
Rear Step Bumper to Bracket or Frame	40 ft. lbs.

TORQUE SPECIFICATIONS G

Front Face Bar to Bracket	24 ft. lbs.
Bracket to Cross Sill	24 ft. lbs.
License Plate Bracket to Face Bar	100 in. lbs.
Rear Face Bar to Brackets	24 ft. lbs.
Bracket to Cross Sill	24 ft. lbs.

ACCESSORIES

SECTION 15

CRUISE-MASTER

Solenoid Resistance	5 ohms ± 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	60 MPH

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WEIGHTS AND MEASURES

LINEAR MEASURE

1/12 foot (ft.)	= 1 inch (in.)
12 inches	= 1 foot
3 feet	= 1 yard (1 yd.)

AREA MEASURE

1/144 square foot (sq. ft.)	= 1 square inch (sq. in.)
144 square inches	= 1 square foot
9 square feet	= 1 square yard (sq. yd.)

LIQUID MEASURE

1/16 pint (pt.)	= 1 ounce (oz.)
1 pint	= 16 ounces
2 pints	= 1 quart (qt.) = 32 ounces
4 quarts	= 1 gallon (gal.)
31 1/2 gallons	= 1 barrel (bbl.)

DRY MEASURE

1/2 quart (qt.)	= 1 pint (pt.)
2 pints	= 1 quart (qt.)
8 quarts	= 1 peck (pk.)
4 pecks	= 1 bushel (bu.)
105 quarts	= 1 barrel

CUBIC MEASURE

1,728 cubic inches	= 1 cubic foot
27 cubic feet	= 1 cubic yard

COMMON WEIGHT

16 ounces	= 1 pound
100 pounds	= 1 hundred weight (cwt.)
2000 pounds	= 1 ton

COMMON U.S.A. EQUIVALENTS

LENGTH

1 inch	= 25.4001 millimeters
1 millimeter	= 0.03937 inches
1 foot	= 0.304801 meters
1 meter	= 3.28083 feet
1 yard	= 9.14402 meters
1 meter	= 1.093611 yards
1 mile	= 1.609347 kilometers
1 kilometer	= 0.621370 miles

LIQUID CAPACITY

1 quart	= 0.94633 liters
1 liter	= 1.05671 quarts
1 gallon	= 3.78533 liters
1 liter	= 0.26418 gallons

DRY CAPACITY

1 quart	= 1.1012 liters
1 liter	= 0.9081 quarts
1 peck	= 8.810 liters
1 liter	= 0.11351 pecks

DECIMAL EQUIVALENTS

$\frac{1}{64}$015625 $\frac{1}{32}$03125 $\frac{3}{64}$046875 $\frac{1}{16}$0625 $\frac{5}{64}$078125 $\frac{3}{32}$09375 $\frac{7}{64}$109375 $\frac{1}{8}$125 $\frac{9}{64}$140625 $\frac{5}{32}$15625 $1\frac{1}{64}$171875 $\frac{3}{16}$1875 $1\frac{3}{64}$203125 $\frac{7}{32}$21875 $1\frac{5}{64}$234375 $\frac{1}{4}$25 $1\frac{7}{64}$265625 $\frac{9}{32}$28125 $1\frac{9}{64}$296875 $\frac{5}{16}$3125 $2\frac{1}{64}$328125 $1\frac{1}{32}$34375 $2\frac{3}{64}$359375 $\frac{3}{8}$375 $2\frac{5}{64}$390625 $2\frac{3}{32}$40625 $2\frac{7}{64}$421875 $\frac{7}{16}$4375 $2\frac{9}{64}$453125 $1\frac{5}{32}$46875 $3\frac{1}{64}$484375 $\frac{1}{2}$5	$3\frac{3}{64}$515625 $1\frac{7}{32}$53125 $3\frac{5}{64}$546875 $\frac{9}{16}$5625 $3\frac{7}{64}$578125 $1\frac{9}{32}$59375 $3\frac{9}{64}$609375 $\frac{5}{8}$625 $4\frac{1}{64}$640625 $2\frac{1}{32}$65625 $4\frac{3}{64}$671875 $1\frac{1}{16}$6875 $4\frac{5}{64}$703125 $2\frac{3}{32}$71875 $4\frac{7}{64}$734375 $\frac{3}{4}$75 $4\frac{9}{64}$765625 $2\frac{5}{32}$78125 $5\frac{1}{64}$796875 $1\frac{3}{16}$8125 $5\frac{3}{64}$828125 $2\frac{7}{32}$84375 $5\frac{5}{64}$859375 $\frac{7}{8}$875 $5\frac{7}{64}$890625 $2\frac{9}{32}$90625 $5\frac{9}{64}$921875 $1\frac{5}{16}$9375 $6\frac{1}{64}$953125 $3\frac{1}{32}$96875 $6\frac{3}{64}$984375 1 1
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GAGES

GAGE NO.	U. S. STANDARD GAGE* Approx. Thickness—Inches	AMERICAN WIRE or B & S GAGE Thickness—Inches
0000000	0.490	
000000	.460	0.5800
00000	.429	.5165
0000	.398	.4600
000	.368	.4096
00	.337	.3648
0	.306	.3248
1	.2757	.2893
2	.2604	.2576
3	.2451	.2294
4	.2298	.2043
5	.2145	.1819
6	.1991	.1620
7	.1838	.1443
8	.1685	.1285
9	.1532	.1144
10	.1379	.1019
11	.1225	.0907
12	.1072	.0808
13	.0919	.0720
14	.0766	.0641
15	.0689	.0571
16	.0613	.0508
17	.0551	.0453
18	.0490	.0403
19	.0429	.0359
20	.0368	.0320
21	.0337	.0285
22	.0306	.0253
23	.0276	.0226
24	.0245	.0201
25	.0214	.0179
26	.0184	.0159
27	.0169	.0142
28	.0153	.0126
29	.0138	.0113
30	.0123	.0100
31	.0107	.00893
32	.0100	.00795
33	.0092	.00708
34	.0084	.00630
35	.0077	.00561
36	.0069	.00500
37	.0065	.00445
38	.0061	.00397
39	.0057	.00353
40	.0054	.00314
41	.0052	
42	.0050	
43	.0048	
44	.0046	

DRILL SIZES

Letter Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches
Z	0.413	1	0.2280	28	0.1405	55	0.0520
Y	0.404	2	0.2210	29	0.1360	56	0.0465
X	0.397	3	0.2130	30	0.1285	57	0.0430
W	0.386	4	0.2090	31	0.1200	58	0.0420
V	0.377	5	0.2055	32	0.1160	59	0.0410
U	0.368	6	0.2040	33	0.1130	60	0.0400
T	0.358	7	0.2010	34	0.1110	61	0.0390
S	0.348	8	0.1990	35	0.1100	62	0.0380
R	0.339	9	0.1960	36	0.1065	63	0.0370
Q	0.332	10	0.1935	37	0.1040	64	0.0360
P	0.323	11	0.1910	38	0.1015	65	0.0350
O	0.316	12	0.1890	39	0.0995	66	0.0330
N	0.302	13	0.1850	40	0.0980	67	0.0320
M	0.295	14	0.1820	41	0.0960	68	0.0310
L	0.290	15	0.1800	42	0.0935	69	0.0292
K	0.281	16	0.1770	43	0.0890	70	0.0280
J	0.277	17	0.1730	44	0.0860	71	0.0260
I	0.272	18	0.1695	45	0.0820	72	0.0250
H	0.266	19	0.1660	46	0.0810	73	0.0240
G	0.261	20	0.1610	47	0.0785	74	0.0225
F	0.257	21	0.1590	48	0.0760	75	0.0210
E	0.250	22	0.1570	49	0.0730	76	0.0200
D	0.246	23	0.1540	50	0.0700	77	0.0180
C	0.242	24	0.1520	51	0.0670	78	0.0160
B	0.238	25	0.1495	52	0.0635	79	0.0145
A	0.234	26	0.1470	53	0.0595	80	0.0135
		27	0.1440	54	0.0550		

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