

**1972**



**PASSENGER CARS and  
10-30 SERIES TRUCKS**

# **OVERHAUL MANUAL**



**ST 333-72**

# 1972

## CHASSIS OVERHAUL MANUAL

covering

### CHEVROLET, CHEVELLE, MONTE CARLO, NOVA, CAMARO, CORVETTE and SERIES 10-30 CHEVROLET TRUCKS

#### FOREWORD

This manual includes procedures involved in disassembly and assembly of major components of 1972 Chevrolet, Chevelle, Monte Carlo, Nova, Camaro, Corvette and Series 10-30 Trucks. Information on maintenance and adjustments, minor service operations, and removal and installation for these components is contained in either the 1972 Passenger Car or Truck Chassis Service Manual.

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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# SECTION 1

## 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 37, 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 37, 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



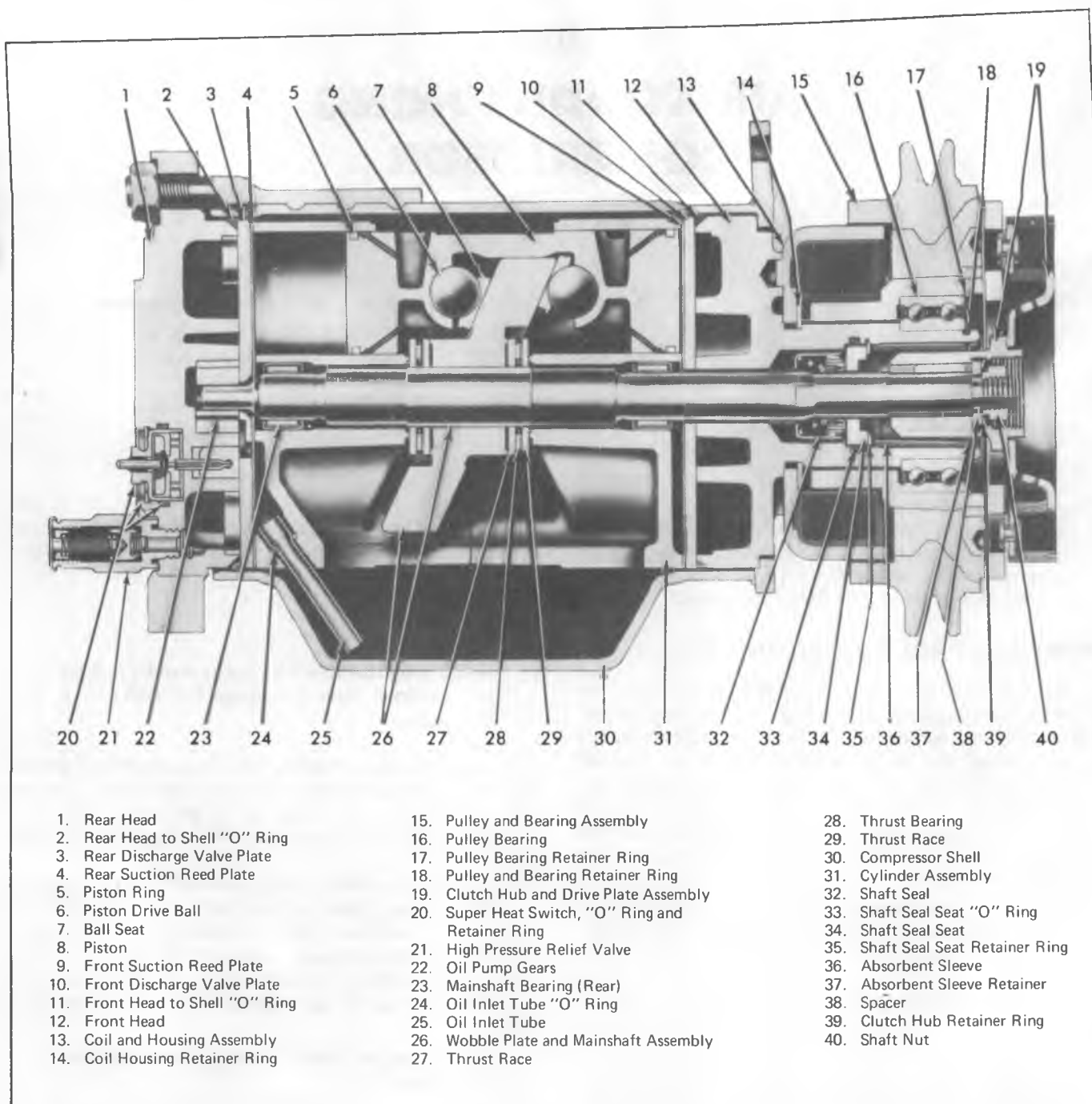


Fig. 1-Six Cylinder Compressor-Cross Sectional View

do so may result in serious internal compressor damage and seal leakage due to shift of crankshaft.

- 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

- Remove the hub and drive plate assembly.
- Using Snap Ring Pliers J-6435, remove the pulley and bearing retainer ring (fig. 6).

- Remove shaft key.
- 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 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.



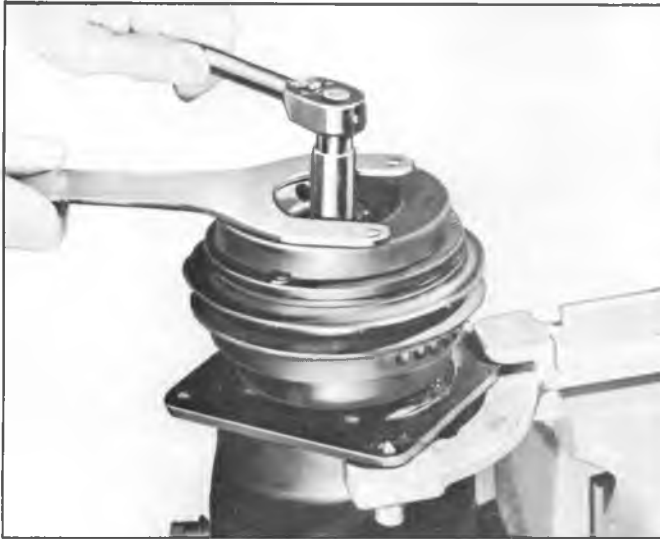


Fig. 2—Removing Shaft Locknut

### 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.



Fig. 3—Removing Hub and Drive Plate Assembly



Fig. 4—Drive Plate Key Installed in Keyway

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 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.



Fig. 5—Installing Hub and Drive Plate Assembly



Fig. 6—Removing Pulley and Bearing Assembly Retainer Ring

### 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.

### 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 be-



Fig. 7—Removing Pulley



Fig. 8—Removing Coil Housing Retainer Ring

ing disassembled and serviced. A clean workbench, preferably covered with a sheet of clean paper, orderliness in the



Fig. 9—Installing Coil Housing

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.
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 Chassis 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

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).

**NOTE:** 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.

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



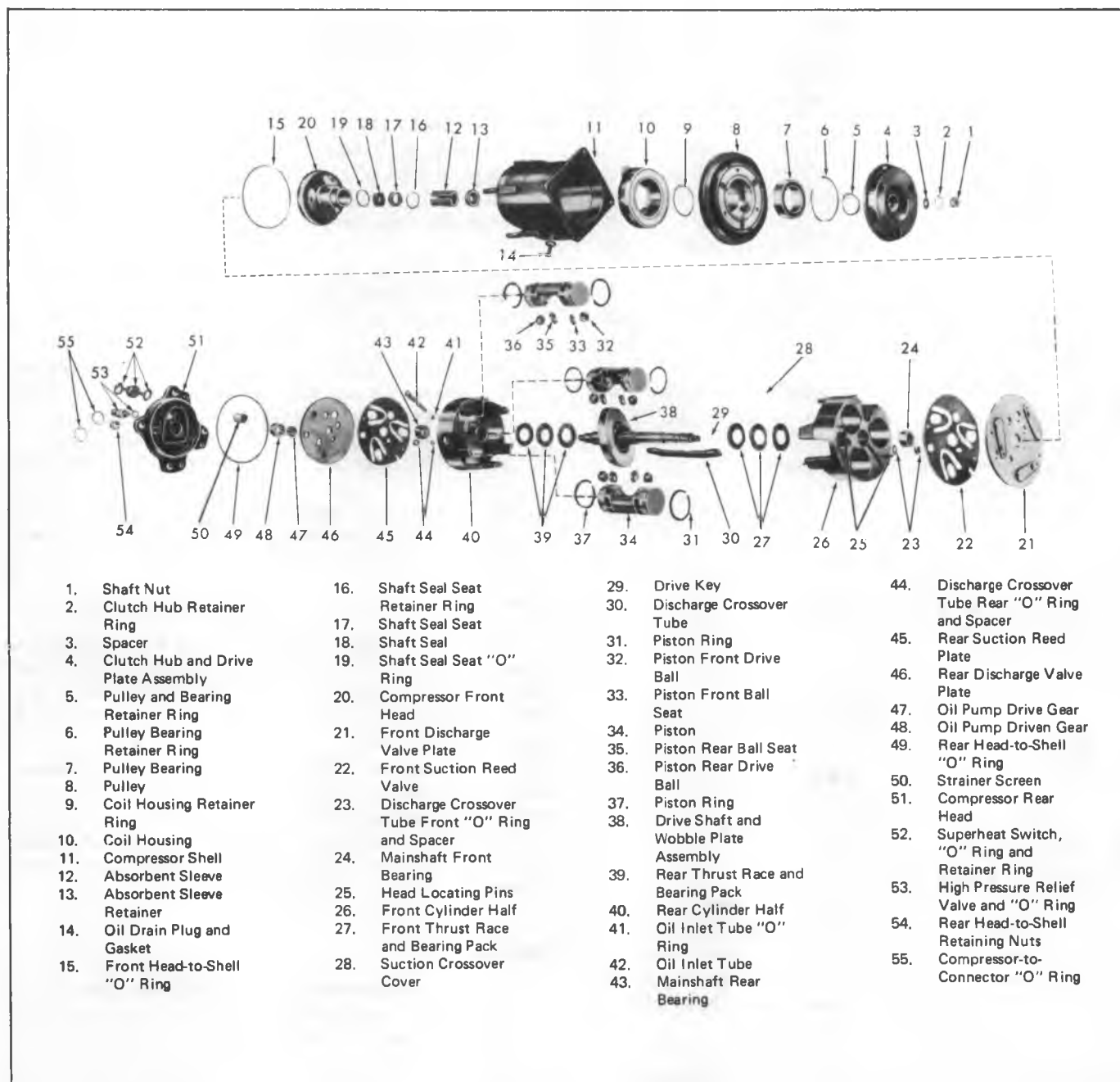


Fig. 10—Six Cylinder Compressor—Exploded View

- 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.
- 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.
- Leak test the compressor as described under "Leak Testing the Compressor" in this section. Correct any leaks found.
- 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.

- 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).
- Reinstall the clutch hub and drive plate assembly.

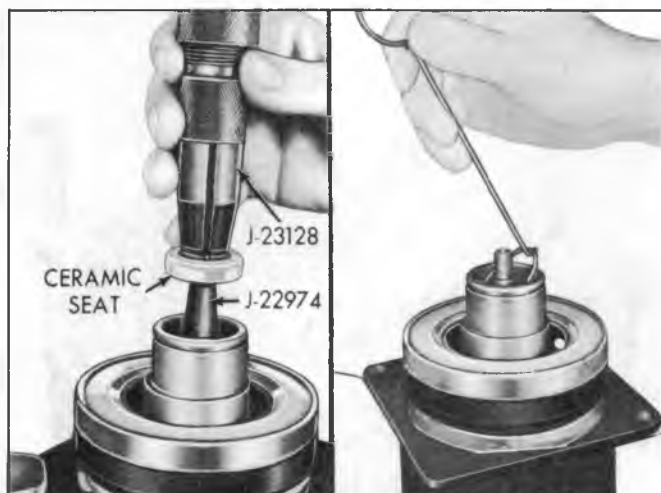


Fig. 11—Removing Seal Seat and "O" Ring

## 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.

### Pressure Relief Valve

When a faulty pressure relief valve, located in the rear

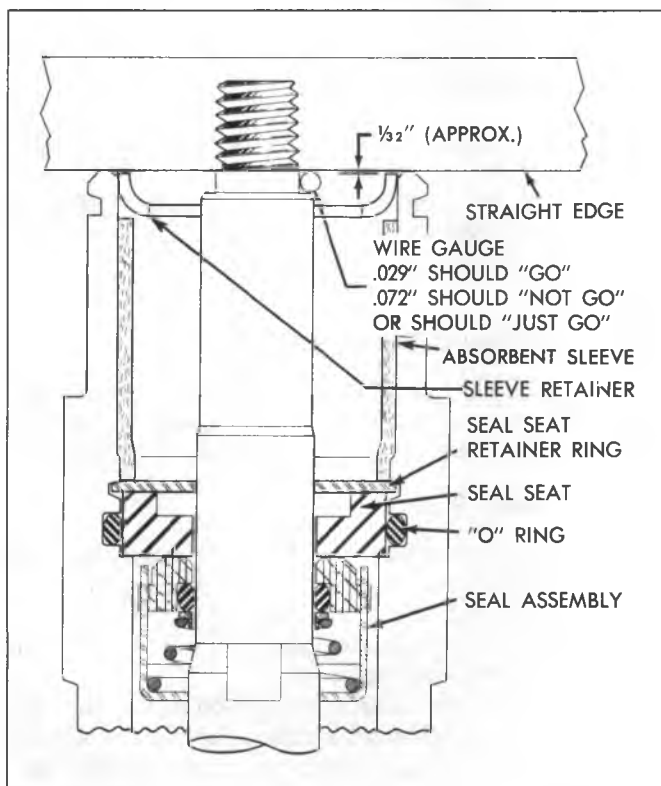


Fig. 12—Checking for Wobble Plate Position on Shaft



Fig. 13—Replacing Seal and "O" Ring

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.

### Superheat Switch

The superheat switch is used on passenger car models only. 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 on 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.

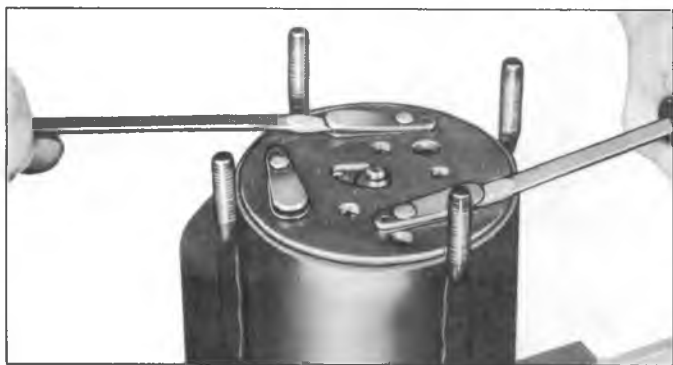


Fig. 14—Removing Rear Discharge Valve Plate

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.

## 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



Fig. 15—Proper Oil Pump Gear Positioning

the rear head, then assemble the rear head to the compressor shell being careful not to damage the sealing surface on 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.





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

**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 on 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 mechanism assembly rather than to replace individual parts. If further dis-

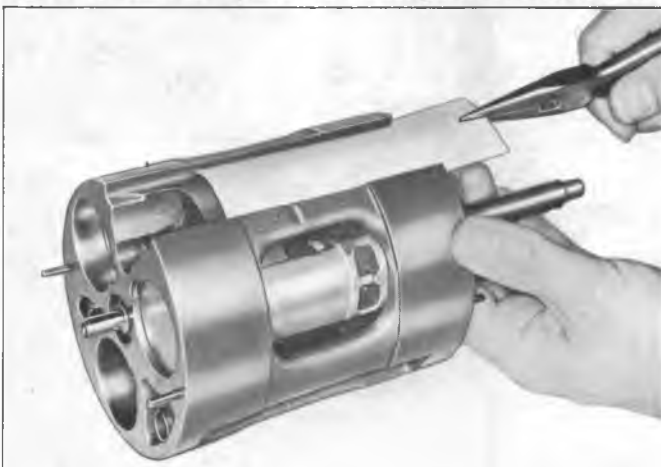


Fig. 17—Removing Suction Crossover Cover



Fig. 18—Unseating Discharge Crossover Tube

sembly 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 apart, position wob-**

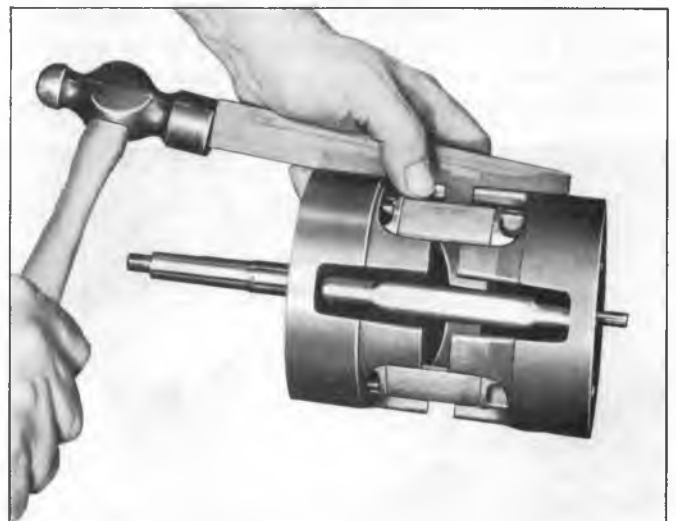


Fig. 19—Separating Cylinder Halves

ble plate toward front of compressor in area of crossover tube.

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

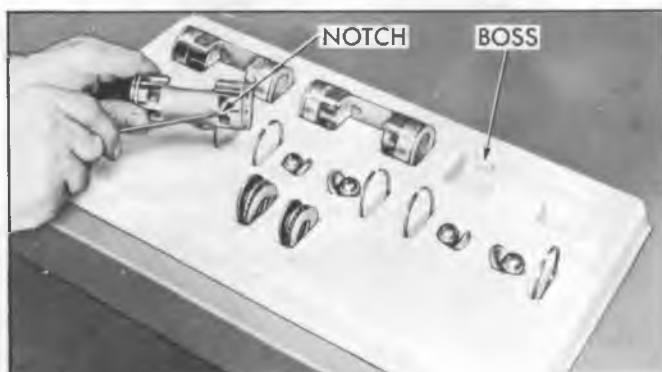


Fig. 20-Notch Identifying Front End of Piston

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 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 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.

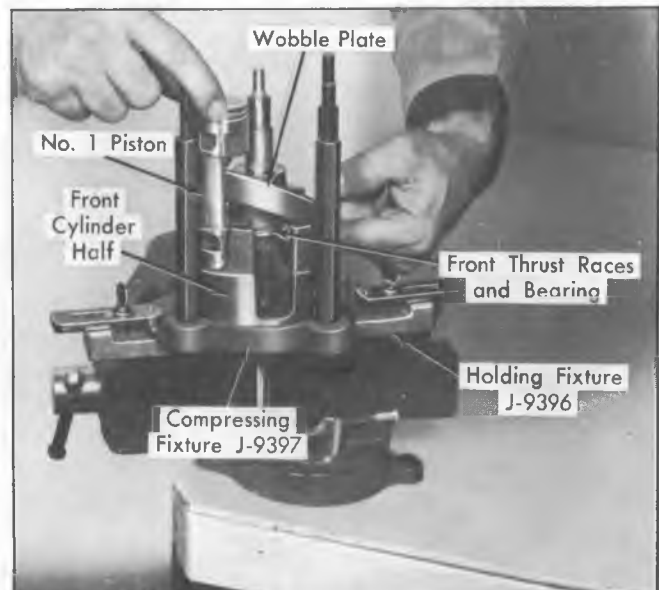


Fig. 21-Installing Piston, Front Ball and Seat and Rear Ball

**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 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,

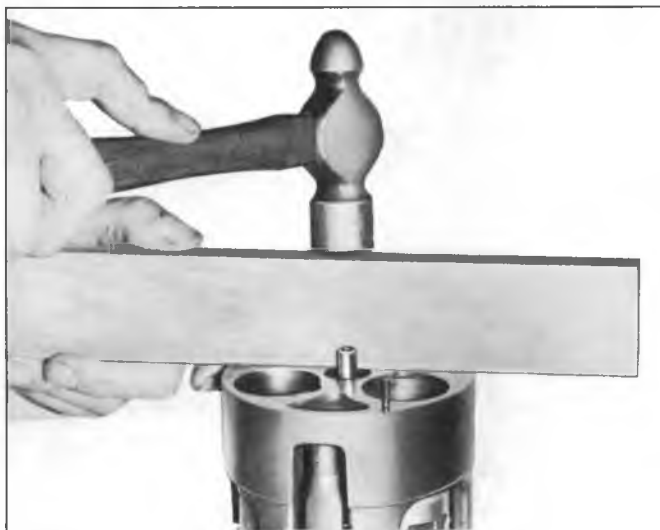


Fig. 22-Assembling Cylinder Halves

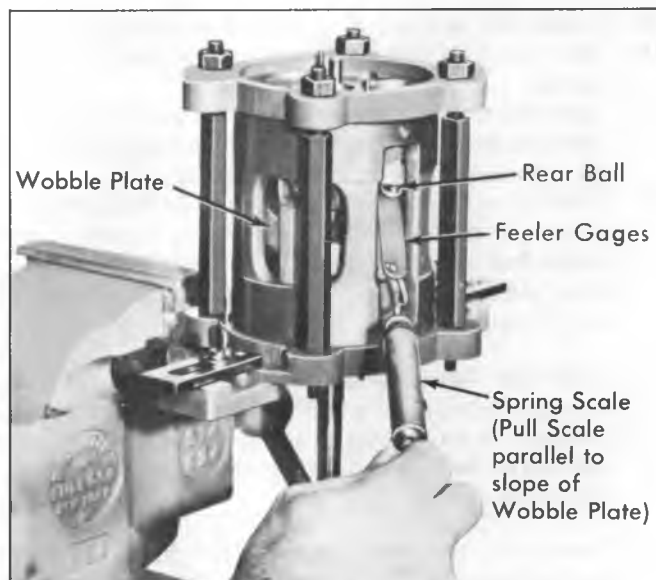


Fig. 23-Checking Clearance Between Rear Ball and Wobble Plate

use a No. 19-1/2 seat). Place this seat in the parts tray in the 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.

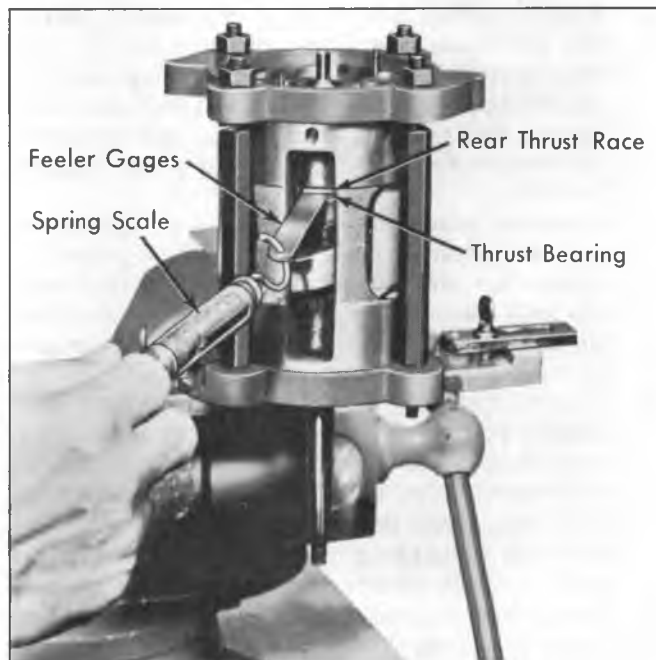


Fig. 24-Checking Clearance Between Rear Thrust Bearing and Outer Thrust Race



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 and 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.

**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.

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.

**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.

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.

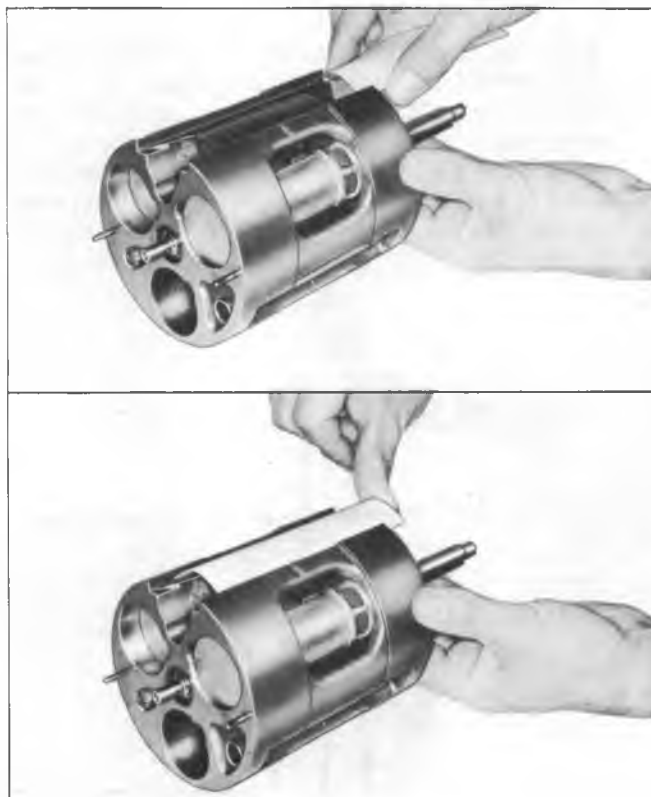


Fig. 25—Installing Suction Crossover Cover

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

6. Check the sealing surface on 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



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



Fig. 27—Installing Shell Over Internal Mechanism

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-9527 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 Chassis 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



Fig. 28--Air Conditioning Special Tools

- b. Install differential without ring gear and check runout of differential case flange. If runout is more than .002", the defect is probably due to bearings or differential case. If flange runout is less than .002" the ring gear was probably at fault. Correct the defect before proceeding further.
6. If runout is satisfactory (less than .002"), remove indicator and determine shim thickness necessary for differential side bearing preload as follows:
  - a. Insert a pry bar between carrier and bearing on end housing half of case to move carrier as far as it will go.
  - b. Measure clearance between carrier and bearing at end housing half of case by inserting long feeler gauges all the way across outer face of bearing. Write down total feeler gauge thickness (For example: .054"). Remove feeler gauge.
  - c. Insert pry bar between carrier and bearing on ring gear flange half of case to move carrier until no backlash can be detected between ring gear and pinion.
  - d. Measure clearance between carrier and bearing at ring gear flange half of case by inserting long feeler gauge all the way across outer face of bearing. Write down feeler gauge thickness. (For example: .036").
  - e. Remove differential assembly from carrier and remove differential side bearings.
  - f. Install shim packs as follows:

**NOTE:** If old shims are to be reinstalled make sure nicks in shims caused by bearing puller are placed to line up with notches in the case.

1. At ring gear flange end of case, install shim pack equal to amount gauged in Step d, above (example: .036"). Install bearing tight against shim.
2. Subtract the amount of shims installed (example: .036") from the amount gauged in Step b, above (example: .054"). To the result (example: .054" .036" .018") add .015" to .020" shims to provide bearing preload.
3. Install the shim pack determined in Step (2) above (example: .018" .015" .033") at end housing half of case and install bearing tight against shim.

### Installing Differential

1. Using dial indicator and Tool J-5231-01 again, as when removing and installing differential, spread carrier not more than .020".
2. Install differential bearing cups and set differential in carrier. Rotate differential and tap ring gear with a soft hammer to assure bearing seating.
3. Install differential bearing caps in their correct locations as indicated by marks made at time of removal. Tighten bolt slinger tight.
4. Release pressure on spreader tool and remove; tighten bearing cap bolts to 80 ft. lbs. torque.
5. Install dial indicator and check ring gear to pinion backlash at four equally spaced points around ring gear. Backlash must be between .003" and .006" and must not vary more than .002" between positions checked. If backlash is not within these limits, change the differential bearing shim pack at both bearings to correct. Total of both shim packs must remain the same.
6. Check ring and pinion tooth contact pattern, using red lead and oil as outlined in Section 4.
7. Install new gasket on carrier and install cover. Install metal ratio tag under one of the cover bolts. Tighten bolts evenly and alternately.
8. Install axle shafts as outlined previously. (Refer to Truck Chassis Service Manual, Section 3).

## PINION AND BEARINGS

### Removal and Disassembly

1. Remove pinion flange, oil seal, gasket, and oil slinger. Use Tool J-8614 to hold flange.
2. Remove differential as outlined in preceding pages.
3. Tap drive pinion and inner bearing cone out of carrier, using a soft hammer. Tag and save shim pack on splined end of pinion (outer bearing shim) for reference during assembly. If ring gear and pinion are to be replaced, write down the markings plus, minus or (0) on face of pinion for reference during assembly.
4. Remove pinion outer bearing cone from carrier.
5. If pinion bearings are to be replaced:
  - a. Remove inner bearing cup, using suitable drift, and driver or slide hammer to take cup out of carrier. Tag and save shim pack for inner bearing cup for reference during assembly.
  - b. Remove outer bearing cup from carrier, using a suitable drift or punch.
  - c. Press pinion inner bearing cone off pinion using J-8553 and remove oil slinger from pinion.

### Assembly and Installation

1. Install oil slinger and new bearing cone on drive pinion, using J-5590 to seat outer bearing against shoulder.
2. Install outer bearing cup in carrier, using Tool J-6368 with driver handle J-8092 to seat cup in counterbore.
3. If a new ring gear and pinion are to be installed, note the "plus" or "minus" markings on the rear face of the original pinion. These markings represent the variation from the nominal pinion depth dimension to obtain the proper tooth contact for individual gear sets.

The approximate depth setting of the new pinion may be made by increasing or decreasing the shim pack next to the pinion inner bearing cup to correspond with the difference in markings on old and new pinions.

To maintain proper pinion bearing preload, shims must be added to or subtracted from the pinion outer bearing shim pack to correspond with changes made to the inner bearing shim pack.

If the difference in the markings on the old and new pinions is in the "plus" direction, shims must be removed from both pinion bearing shim packs. If the difference is in the "minus" direction, shims must be added.

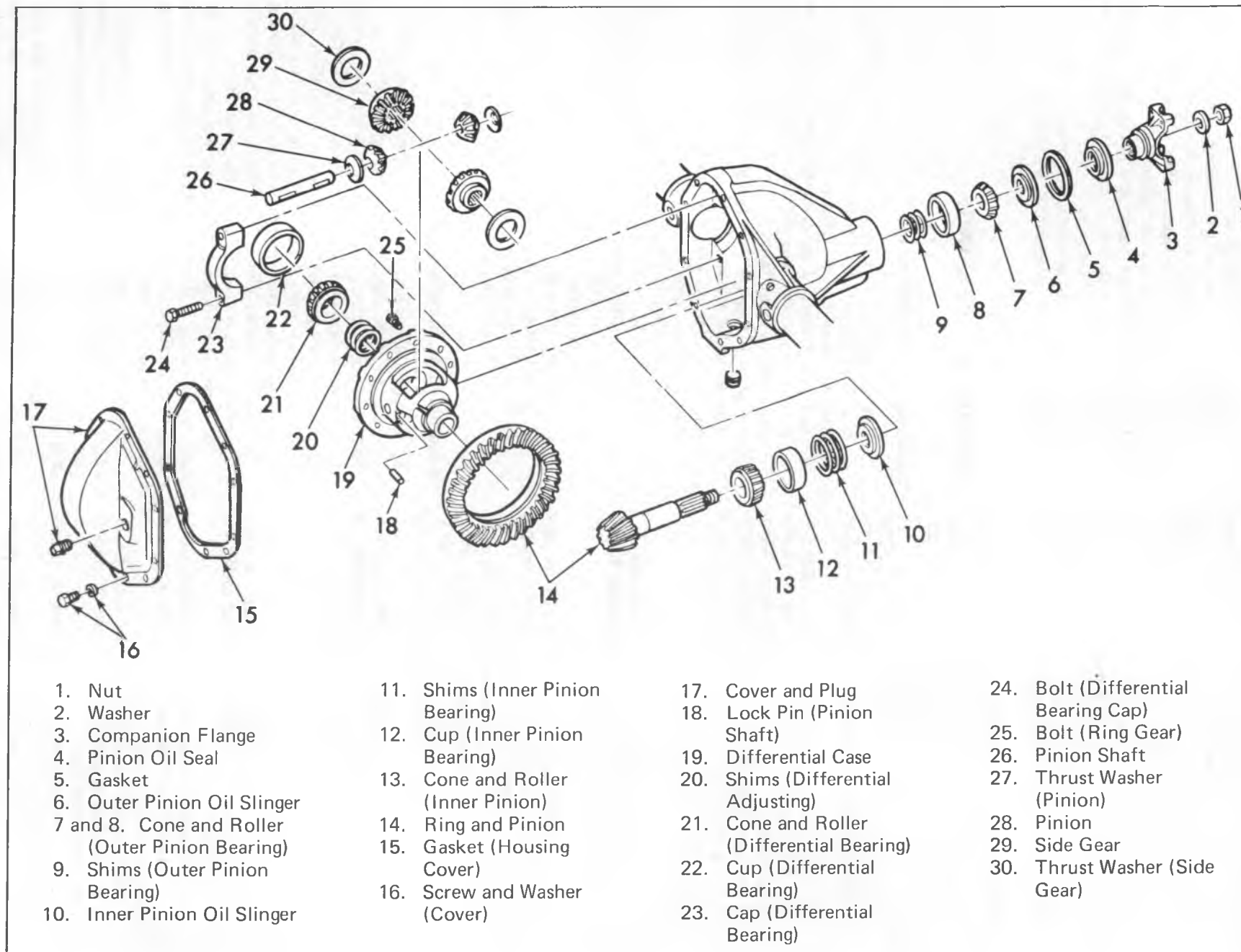


Fig. 2—Front Axle Differential—Explode

## Examples of shim selection-

Markings on Pinions		Difference Between Markings	Amount To Change Each Shim Pack
New Pinion	Old Pinion		
+8	+5	+3	Decrease .003"
+5	+8	-3	Increase .003"
-5	-3	-2	Increase .002"
-3	-5	+2	Decrease .002"
+5	-3	+8	Decrease .008"
-4	+2	-6	Increase .006"

- When the approximate shim packs have been selected, install inner bearing shim pack in carrier and install cup, using Tool J 9276-2 to seat cup tight against shims.
- Insert pinion and inner bearing cone in carrier and install outer bearing shim pack on end of pinion. Install outer bearing cone, using Tool J-5590 to seat bearing tight against shim pack. Do not install oil seal at this time.
- Install pinion flange, washer and nut, using Tool J-8614 to hold flange while tightening nut to 210 ft. lbs. torque.
- Determine proper pinion depth using Pinion Depth Gauge, Tool J- 5341, with Tool J-7892 (SE-1065-1, (2)-5, (2)-6, (2)-9SS, (1)-10, (1)-58 with 1" micrometers). When using the micrometer gauge, the actual pinion depth setting can be determined by adding the micrometer gauge reading to the thickness of the step plate and comparing the result with the nominal dimension of 2.625" plus or minus the marking on the face of the pinion. If the difference in the two figures is less

than minus .001" to plus .003", the pinion depth is satisfactory. If not, change pinion bearing shim packs to make the two figures correspond within the specified limits.

- Using a torque wrench calibrated in inch pound and a suitable socket, check pinion bearing preload. The rotating torque of the pinion shaft should be 10 to 20 inch pounds. Add or remove shims behind the outer bearing cone to bring preload within limits.
- When pinion depth and bearing preload are within limits, install differential in carrier, adjust differential bearing preload and ring gear backlash and complete the axle assembly as outlined under "Differential-Installation."
- Remove flange and install slinger, new oil seal, flange and propeller shaft.

**NOTE:** If not completely assembled, refer back to Step 3, page 3-1 to install differential into carrier housing.

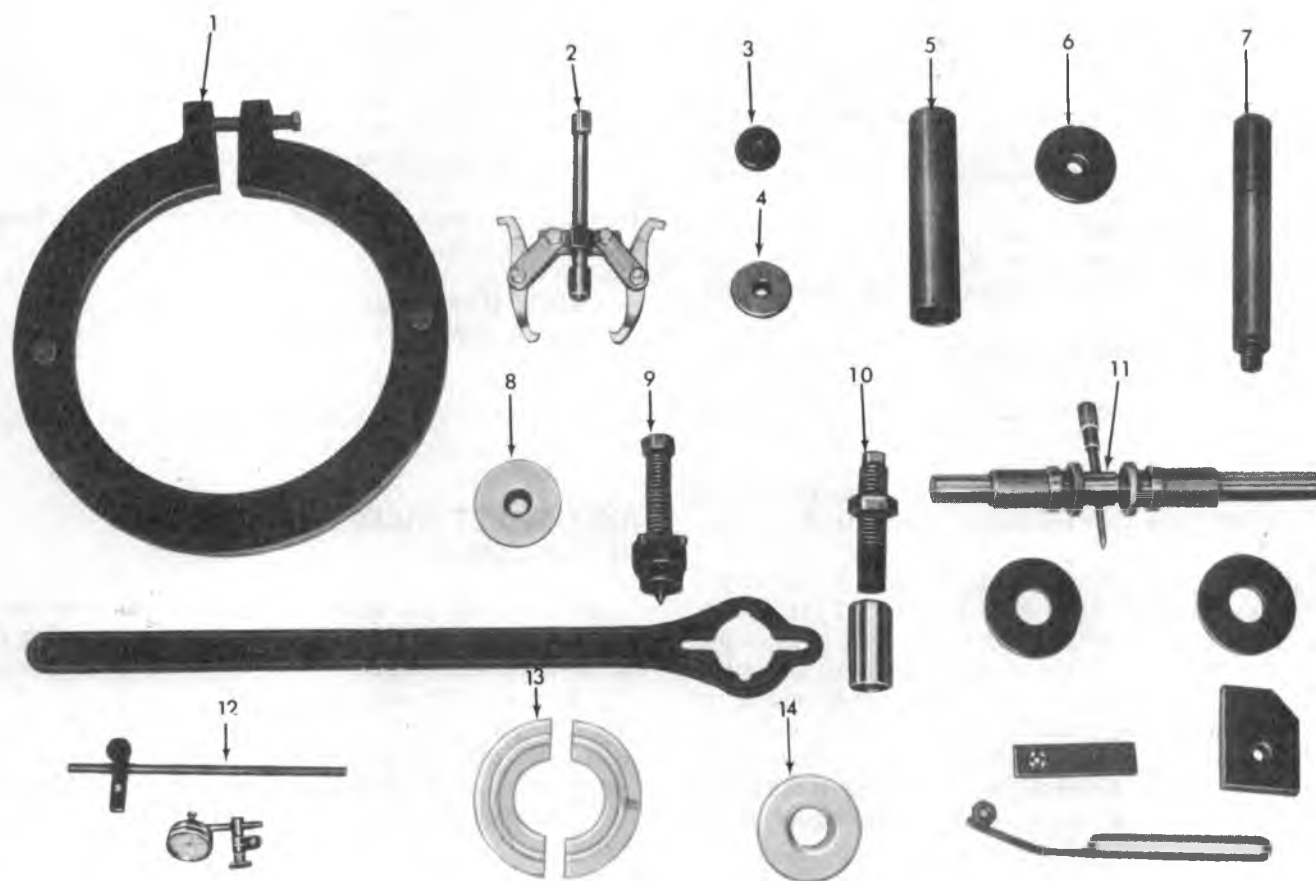
- Fill unit with recommended lubricant, lower vehicle on hoist, and road test vehicle.

## AXLE SHAFT GUIDE AND OIL SEAL REPLACEMENT

The axle shaft guides and oil seals, located just outboard of the differential bearings, can be replaced only after removal of the differential.

- Remove differential as outlined previously.
- Drive the guides and seals inboard out of carrier.
- Install new guides in tube.
- Lubricate new oil seals and install in tube, with lip of seal inboard, with J-8107-4.

## SPECIAL TOOLS



1. J-5231-01 Spreader - Axle Carrier
2. J-22888 Puller - Side Bearing
3. J-8107-4 Adapter - Side Bearing
4. J-22175 Installer - Side Bearing
5. J-5590 Installer - Pinion inner and outer bearing cone
6. J-6368 Installer - Pinion outer bearing cup (use with J-8092)
7. J-8092 Driver Handle (use with J-6368)
8. J-9276-2 Installer - Pinion inner bearing cup (set against shims)

9. J-8614 Holder and Remover - Companion Flange
10. J-23476 Installer - Companion Flange
11. J-5341 Gauge - Pinion Dept Consists of Parts:  
(1) SE 1065-1, (2)-5,(2)-6, (2)-9SS, (1)-10, (1)-58 with 1" micrometer
12. J-8001 Dial Indicator Set
13. J-22872 Remover - Pinion bearing inner cup
14. J-23494 Installer - Pinion oil seal

Fig. 3-- Special Tools



## SECTION 4

# REAR AXLE DIFFERENTIAL CARRIER

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## 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 capacity.

The following chart lists pertinent information needed on Passenger Car and Series 10-30 Truck axles.

PASSENGER CAR			
VEHICLE	AXLE SOURCE	MFG. CODE	RING GEAR SIZE
Chevrolet and 125" W. B. Station Wagons	Chev.-Det.	G	8-1/2
	Buick	B	8-1/2
	Oldsmobile	O	8-1/2
	McKinnon	K	8-1/2
	McKinnon	M	8-7/8
	Pontiac	P	8-7/8
Nova	Chev.-Det.	G	8-1/2
Camaro	Chev.-Det.	G	8-1/2
Chevelle, Monte Carlo 116" W.B. Station Wagon	Chev. Buffalo	C	8-1/8
	McKinnon	K	8-7/8

TRUCK			
MODEL	AXLE SOURCE	TYPE/CAPACITY	RING GEAR SIZE
C-P 10	Chevrolet	Salisbury 3500#	8-7/8
K 10	Chevrolet	Salisbury 3300#	8-7/8
G 10	Chevrolet	Salisbury 2400#	8-1/8
G 10	Chevrolet	Salisbury 3100#	8-7/8
C-P 20	Chevrolet	Banjo 5200#	10-1/8
C 20	Dana	Salisbury 5500#	9-3/4
K 20	Chevrolet	Banjo 5200#	10-1/8
K 20	Dana	Salisbury 5500#	9-3/4
G 20	Chevrolet	Salisbury 3500#	8-7/8
C-P 30	Chevrolet	Banjo 7200#	10-1/8
G 30	Chevrolet	Banjo 5200#	10-1/8
C-P 30	Chevrolet	Banjo 11000#	12-1/4

Fig. 0-1-Axle Usage Chart

### ALTERNATE PINION DEPTH SETTING PROCEDURE

A new pinion setting gauge is available this year. Tool J-21777-01 (Fig. 0-2), is applicable to all Salisbury rear axles on Passenger Car as well as Truck. An additional plate, J-21777-36, is required to service Corvette and Series 10 heavy duty axles. The following procedure is recommended with this new tool.

1. Be sure housing assembly and all gauge parts are clean.
2. Lubricate front and rear pinion bearings which will be used in final assembly and position them in their respective races in carrier.
3. With cloverleaf gauge plate mounted on preload stud, select proper rear bearing pilot and insert stud through front and rear pilot discs and bearings. Install the hex nut until snug and rotate the bearings to make sure they are seated properly.

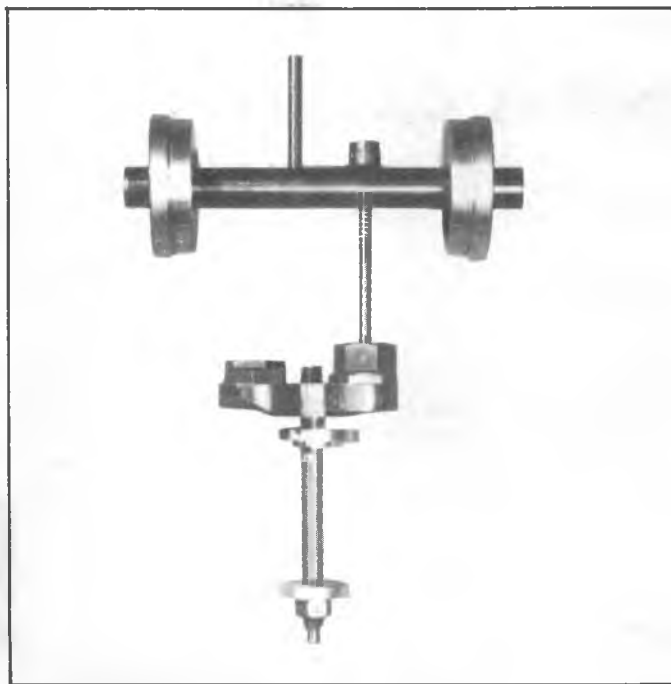


Fig. 0-2-Pinion Setting Tool

4. Hold the stud stationary with a wrench on the flats and tighten hex nut until 20 in. lbs. of torque are required to rotate bearings. See Figure 0-3.
5. Mount the side bearing discs on the ends of the arbor, using the small step for light duty axles and the larger step for heavy duty axles. Position dial indicator, J-8001, on the mounting post with the contact button resting on the top surface of the plunger. Preload the dial indicator 1/2 revolution and tighten in this position.
6. Place the arbor and plunger assembly into the carrier, being sure the side bearing discs are seated properly. Install bearing caps to hold discs firmly. See Figure 0-5.

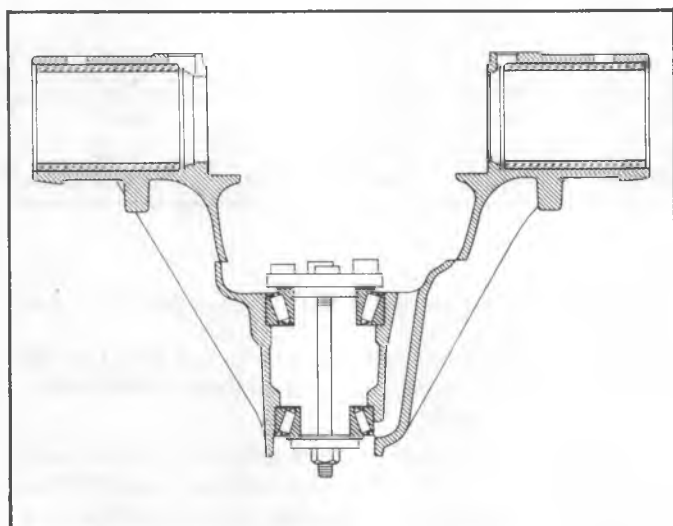


Fig. 0-3-Gauge Plate Installed

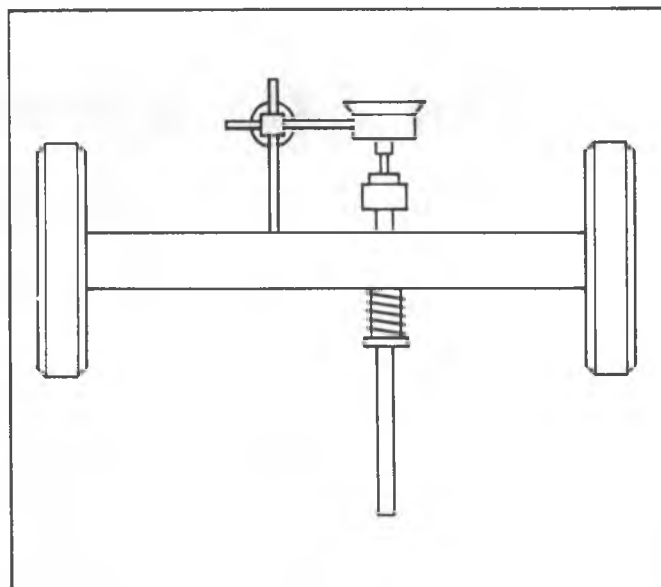


Fig. 0-4-Indicator and Discs Installed

7. Select the button on the cloverleaf gauge plate that corresponds to the ring gear size and position that button squarely and directly below the plunger rod.
8. 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. Repeat the rocking action of the plunger to verify the setting.
9. Once the zero reading is obtained, swing the plunger until it is removed from the gauging button.

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

Although most service pinions are "nominal" occasionally a pinion may be found which varies from this zero

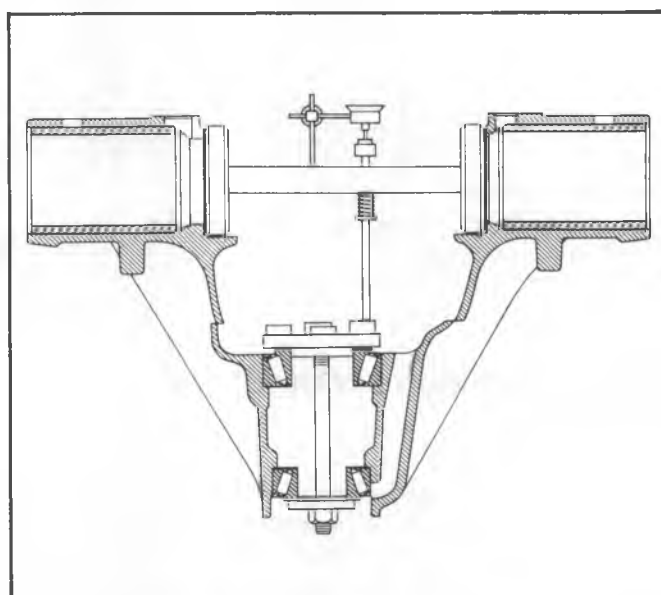


Fig. 0-5-Tool Installed in Carrier

SERVICE CODE #	USE DIAL INDICATOR READING, THEN
40	SUBTRACT .005"
41	SUBTRACT .004"
42	SUBTRACT .003"
43	SUBTRACT .002"
44	SUBTRACT .001"
45	USE READING DIRECT
46	ADD .001"
47	ADD .002"
48	ADD .003"
49	ADD .004"
50	ADD .005"

Fig. 0-6—Service Codes

dimension. Check both ends of the pinion for a Service Code number, which will indicate the amount of variation from "nominal".

If no Service Code number is found, the pinion is a ".45" or nominal.

Use the accompanying chart to select the proper shim.

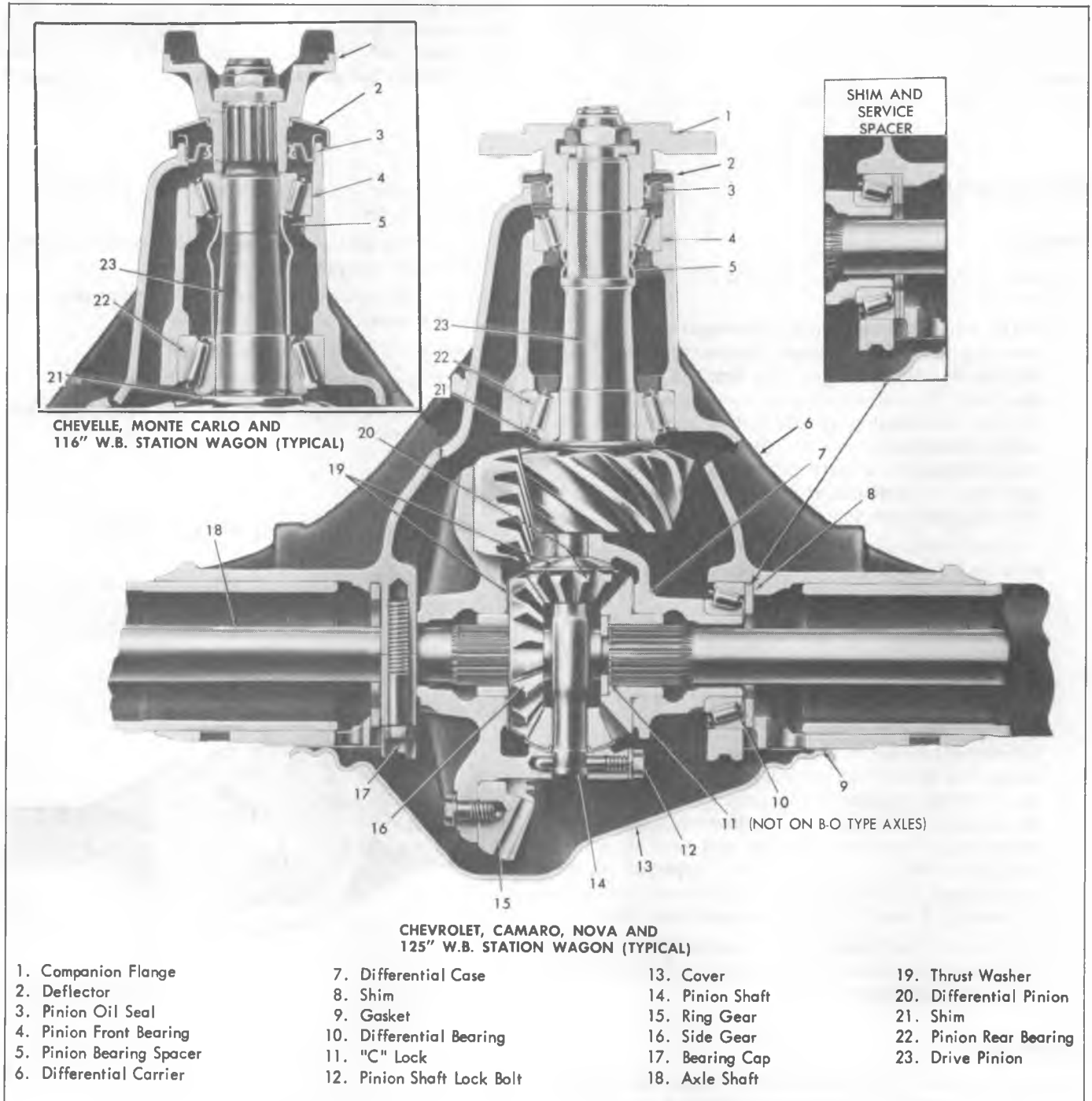


Fig. 0-7—Typical Salisbury Axle Cross-Section

# CHEVROLET, CAMARO, NOVA AND 125" W.B. STATION WAGON

## INDEX

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## DIFFERENTIAL CASE

### Removal

1. Remove rear axle shafts as outlined in Chassis Service Manual.

**NOTE:** Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described under "Ring Gear and Pinion Backlash". This will indicate gear or bearing wear or an error in backlash or preload 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.

2. Remove screw that retains differential pinion shaft. Remove differential pinions, side gears and thrust washers from case.
3. Mark side bearing caps for installation in same position during reassembly. Remove bolts holding differential side bearing caps to housing.

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

4. Differential case assembly can now be removed by prying against ring gear bolt using suitable prybar. 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 1A to prevent case from falling.
5. 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.

### 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 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 on side gears, thrust washers, and pinion thrust faces.
5. Check fit of differential side gears in case.
6. Check fit of side gear and axle shaft splines.
7. Inspect differential pinion shaft for scoring or evidence of excessive wear.

## DIFFERENTIAL BEARING REPLACEMENT

1. If differential side bearings are to be replaced, install Tool J-22888 and Adapter Plug J-8107-4 for P Type Axles and Adapter Plug J-8107-2 for all others. See Figure 2A.

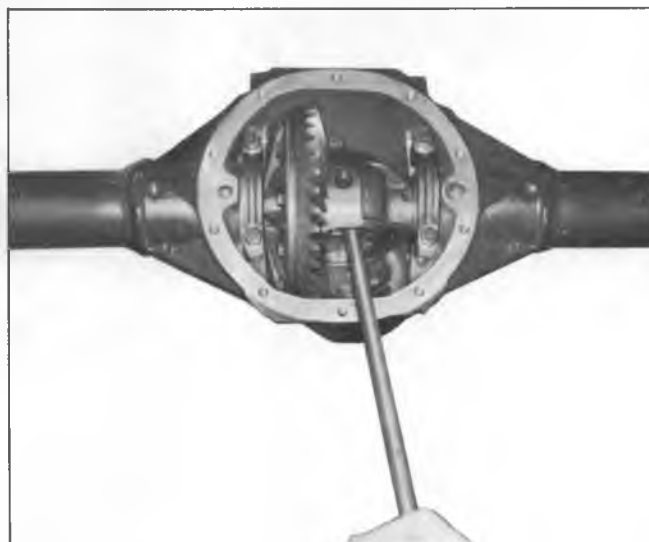


Fig. 1A Differential Case Removal

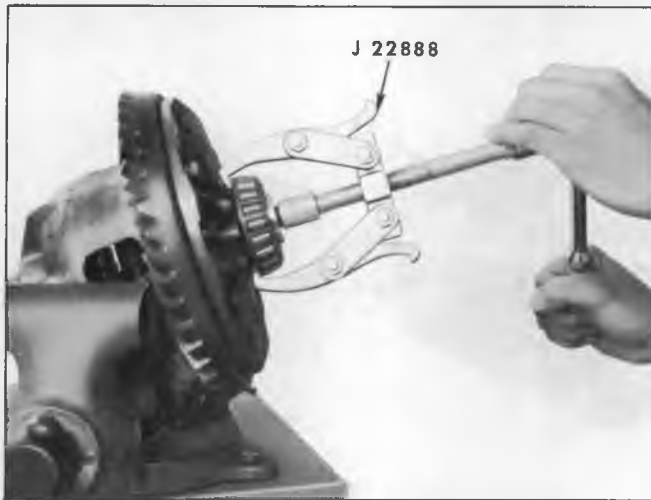


Fig. 2A-Differential Side Bearing Removal

2. Tighten puller screw to remove bearing.
3. Install new bearings using Installer J-22175 for P-Type axles and J-22761 for all others. See Figures 3A and 4A.
4. Before bearing installation on opposite hub, support differential case on Adapter Plugs J-8107-4 (P-Type) or 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 and lock washers and, using a soft faced 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. Install guide pins, made from 3/8" - 24x 1 1/2" long cap screws with heads cut off and ends slotted, to ring gear. See Figure 5A.



Fig. 3A-Differential Bearing Installation (P-Type Axle)



Fig. 4A-Differential Bearing Installation (Except P-Type Axles)

3. Position ring gear over pilot diameter of the case. Install every other ring gear bolt and lock washer, then draw them up evenly and snugly so that gear face is flush with face of case.
4. Remove guide pins and install remaining bolts - torque all bolts to specifications.
5. Install thrust washers and side gears in case. If same parts are used, replace in original sides. Position pinions and



Fig. 5A-Ring Gear Guide Pins Installed



## REAR AXLE DIFFERENTIAL CARRIER 4-6

thrust washers through loading hole in case 180 degrees apart so that they engage side gears. Rotate gears until pinion shaft holes are aligned. Install pinion shaft and lock screws. It is not necessary to torque lock screws until axle shafts are installed.

Differential may be installed in carrier now, or after service is performed on the drive pinion.

### DRIVE PINION

#### Removal

1. Check Pinion bearing preload as described under "Checks and Adjustments." If there is no preload reading, check for looseness of pinion assembly by shaking. Looseness indicates need for bearing replacement. If assembly is run long with very loose bearings, ring and pinion will also require replacement.
2. Install Holder J-8614-10 on flange by using two 5/16-18 x 2" bolts with flat washers. Remove pinion nut and washer. See Figure 6A.
3. Pull pinion flange from pinion using Puller J-8614-2 in Holder J-8614-1. To install puller, back out puller screw, insert puller through holder, and rotate 1/8 turn. See Figure 7A.
4. If deflector requires replacement, remove by tapping from flange.
5. Pry pinion oil seal from carrier and remove front pinion bearing.
6. Remove pinion assembly. If necessary, tap pinion out with soft hammer, while being careful to guide pinion with hand to avoid damage to bearing outer races.

#### Bearing Removal

1. If front bearing is to be replaced, drive outer race from carrier using a brass drift in slots provided for this purpose.
2. If rear pinion bearing is to be replaced, drive outer race from carrier using a brass drift in slots provided for this purpose.

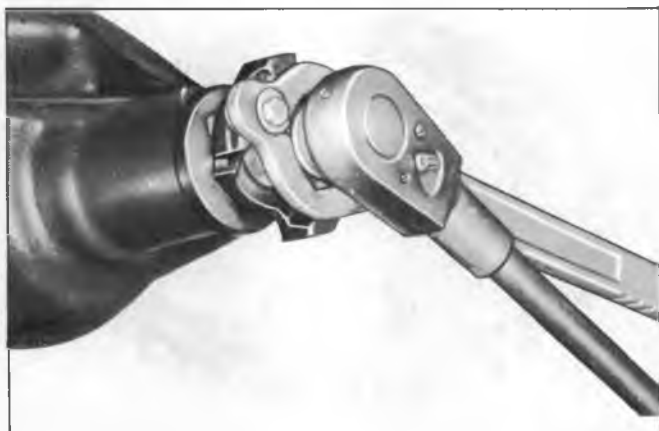


Fig. 6A—Drive Pinion Nut Removal



Fig. 7A—Drive Pinion Flange Removal

3. If rear pinion bearing is to be replaced, remove rear pinion bearing from pinion shaft using Press Plate J-22912. See Figure 8A.

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. Record thickness of shim removed from between bearing and pinion 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



Fig. 8A—Removing Drive Pinion Rear Bearing.

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 machining the parts. However, most production pinions and all pinions used for service replacement are zero or nominal pinions. If during repair, 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 is able to install a shim between the front face of the pinion and its bearing so that pinion depth can be adjusted to an exact required specification for best tooth contact in each axle assembly.

Pinion depth is set with Pinion Setting Gage J-6266.

### Set up pinion setting gage as follows (Fig. 9A):

1. Be certain that all parts of pinion setting gage are clean.
2. Lubricate front and rear pinion bearings which will be used in final reassembly and position them in their respective races in the carrier.
  - a. Position Gauge Plate J-6266-54 into carrier and insert bolt through gauge plate and both pinion bearings.
  - b. Position J-6266-25 onto front bearing. Install nut and rotate bearings several revolutions to make sure they are seated.
  - c. Tighten hex nut until 20 in. lb. of torque is required to rotate bearings. See Figure 10A.

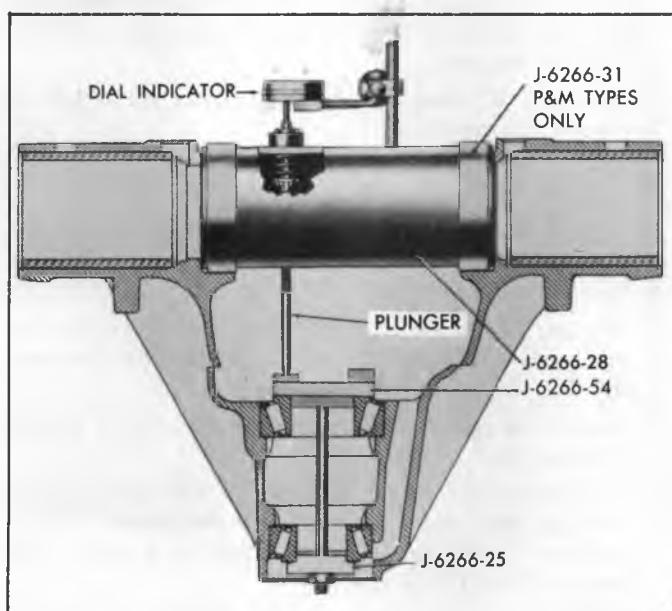


Fig. 9A-Installed View of Pinion Depth Gauge

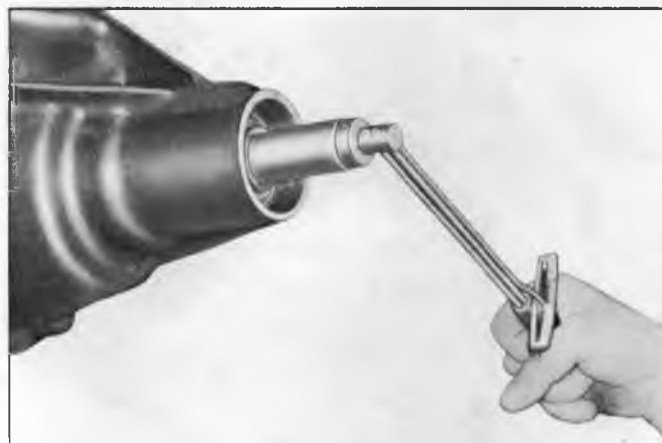


Fig. 10A-Measuring Drive Pinion Bearing Rotating Torque

- d. Position dial indicator (Tool J-8001-3) on gauge post of Tool J-6266-28 so that indicator button rests on top of tool plunger. Preload dial indicator 1/2 revolution, and tighten in this position.

### For All Except P-Type Axles:

- e. Install Tool J-6266-28. Rest plunger of Tool J-6266-28 on low gauging surface marked Y. See Figure 11A.

### For P-Type Axles:

- f. Install adapter rings J-6266-31 onto Tool J-6266-28. Install onto carrier. Rest Plunger of Tool J-6266-28 on high gauging surface marked Z. See Figure 11A.

### For All Axles:

- g. Slowly swing end of tool plunger across gauge plate until highest indicator reading is obtained. See Figure 12A. At this highest reading, zero dial indicator. Recheck to assure zero reading.
- h. Swing rod off gauge plate and read dial indicator. This reading is the proper shim.



Fig. 11A-Gauge Plate Marking

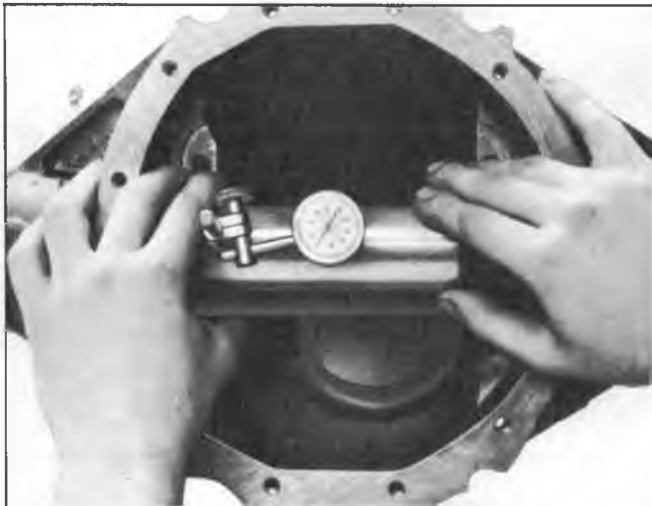


Fig. 12A—Measuring Drive Pinion Shim Requirement

**NOTE:** Read indicator direct. Do not read indicator travel.

3. For P-Type axles, shims are available from .020" to .039" in increments of .001".

For all other axles, shims are available from .020" to .038" in increments of .002". (If odd number shim is required, use next highest number shim).

If necessary to install shim greater than mentioned above use two shims whose thickness equals required number. Each shim has the thickness etched on the flat surface for easy identification.

4. Remove Tool J-6266 and pinion bearing cone and roller assemblies from carrier.
5. Position shim selected in above procedure on pinion shaft and against pinion head.
6. Select the correct shim to be used during pinion reassembly on the following basis.

- a. For B-Type axles - If the production pinion is being reused and the pinion is marked plus, subtract the amount specified on the pinion from the shim thickness determined in Step 2h.

If the production pinion is marked minus, add the amount specified on the pinion to the shim thickness determined in Step 2h.

SERVICE CODE #	USE DIAL INDICATOR READING, THEN
40	SUBTRACT .005"
41	SUBTRACT .004"
42	SUBTRACT .003"
43	SUBTRACT .002"
44	SUBTRACT .001"
45	USE READING DIRECT
46	ADD .001"
47	ADD .002"
48	ADD .003"
49	ADD .004"
50	ADD .005"

Fig. 13A—Service Codes

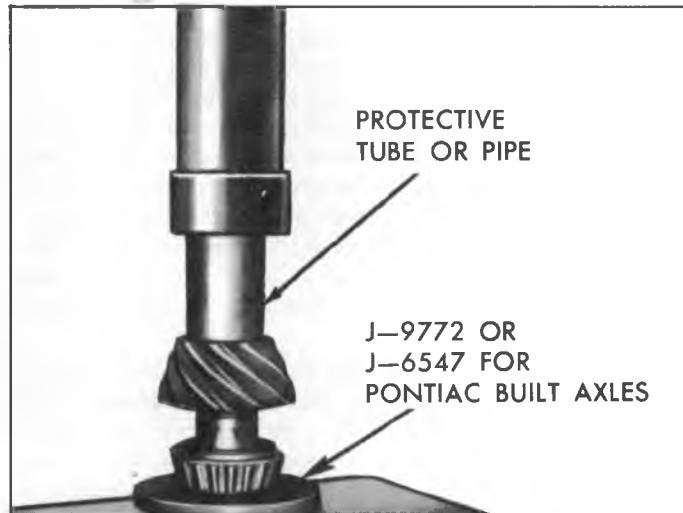


Fig. 14A—Drive Pinion Rear Bearing Installation

If a service pinion is being used (no marking) use shim thickness as determined in Step 2h.

- b. For all other axles - use the chart in figure 13A to aid in selecting proper size shims.

7. Position correct shim on pinion shaft and install rear pinion bearing. Use Installer Tool J-6547 for P-Type axles and J-9772 for all others. See Figure 14A.

## DRIVE PINION AND BEARING INSTALLATION

1. If rear pinion bearing is to be replaced, install new outer race using Driver Handle J-8092 and Installer J-9745 on P-Type and J-8608 on all other axles. See Figure 15A.
2. If front pinion bearing is to be replaced, install new outer race using Installer J-7137 with Driver Handle J-8092. See Figure 15A.
3. Place front bearing into bore.
4. Coat O.D. of pinion seal with sealing compound. Install seal by using Installer J-22388. See Figure 16A. Note that seal does not install flush but it protrudes about .150" out from the housing.
5. Coat lips of pinion oil seal and seal surface of pinion flange with gear lube.
6. Install a new pinion bearing spacer onto the drive pinion.
7. Remove nut and sleeve from Companion Flange Installer J-9458. Screw J-9458 onto drive pinion and insert assembly into housing.
8. Position Companion Flange, in same position as removed, onto drive pinion. Install sleeve and nut onto J-9458.
9. Install Companion Flange Holding Tool J-8614-10. See Figure 17A.
10. Tighten nut on Tool J-9458 which draws drive 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 will no longer pivot freely as

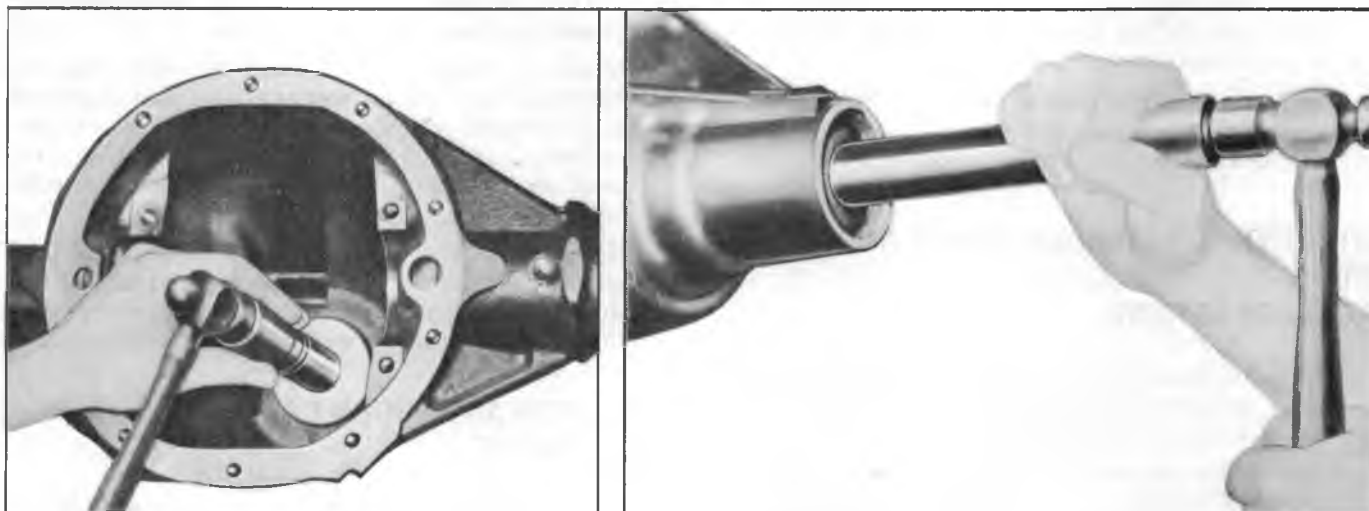


Fig. 15A-Drive Pinion Front and Rear Bearing Cup Installation

11. Pack cavity between end of pinion splines and pinion flange with a non-hardening sealer (such as Permatex Type A or equivalent) and install washer and nut on pinion snugly.

## CHECKS AND ADJUSTMENTS- PINION BEARING PRELOAD

1. Check preload by using an inch pound torque wrench such as J-5853 as shown in Figure 18A.

**NOTE:** After preload has been checked, final tightening should be done very cautiously. For example, if when checking, preload 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 preload should be checked after each slight amount of tightening. Exceeding preload specifications will compress the collapsible spacer too far and require its replacement.

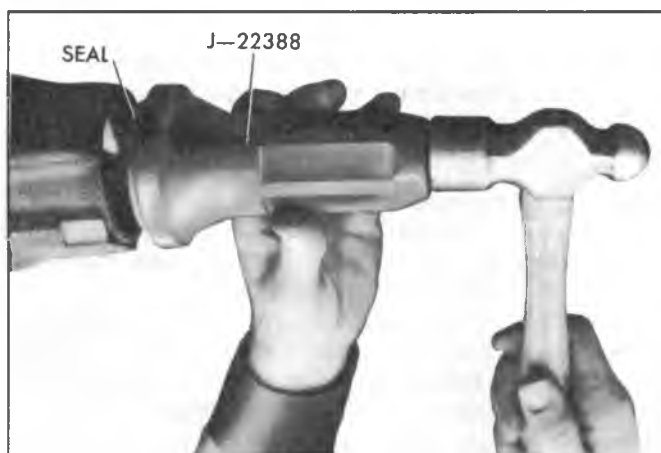


Fig. 16A-Installing Drive Pinion Oil Seal

pinion is rotated, preload specifications are being neared. Further tightening should be done only after nut and washer installation and preload has been checked.

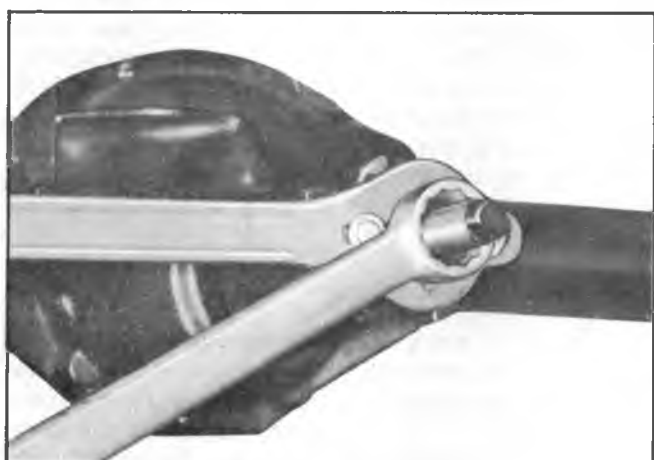


Fig. 17A-Drive Pinion Flange Installation



Fig. 18A-Measuring Drive Pinion Bearing Preload

## REAR AXLE DIFFERENTIAL CARRIER 4-10

2. 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.
3. 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.

## DIFFERENTIAL BEARING PRELOAD AND INITIAL BACKLASH SETTING

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 19A.
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. 20A.
  - a. Using a micrometer as in Figure 21A, 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.

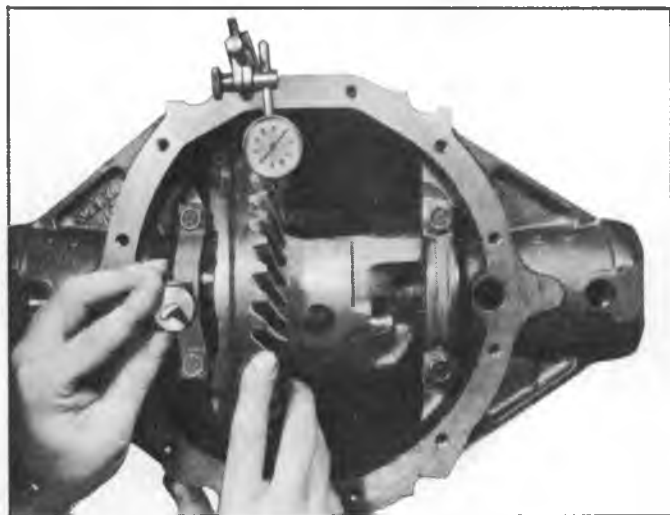


Fig. 19A—Installing Gauging Tool

9. Use the sample procedure in Figure 20A 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 22A.

## RING GEAR AND PINION BACKLASH ADJUSTMENT

Mount a dial indicator on the carrier and check the backlash between the ring gear and pinion, as shown in Figure 23A. The backlash should be within the range of 0.005"-0.008". Check gear lash at four different equally spaced positions around the gear. Variation in readings should not exceed 0.001".

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

If variation in backlash readings exceeds 0.001", measure ring gear and case runout as shown in Figure 24A. Gear runout should not exceed 0.002"; should runout exceed this limit check ring gear and case for deformation and/or foreign matter between case and gear.

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 line-to-line contact.

Backlash changes approximately .002" for each .003" change in shim dimensions. If lash is too high, add thicker shim to left side and decrease right side by same amount; if lash is too low, add thicker shim to right side and decrease left side by same amount.

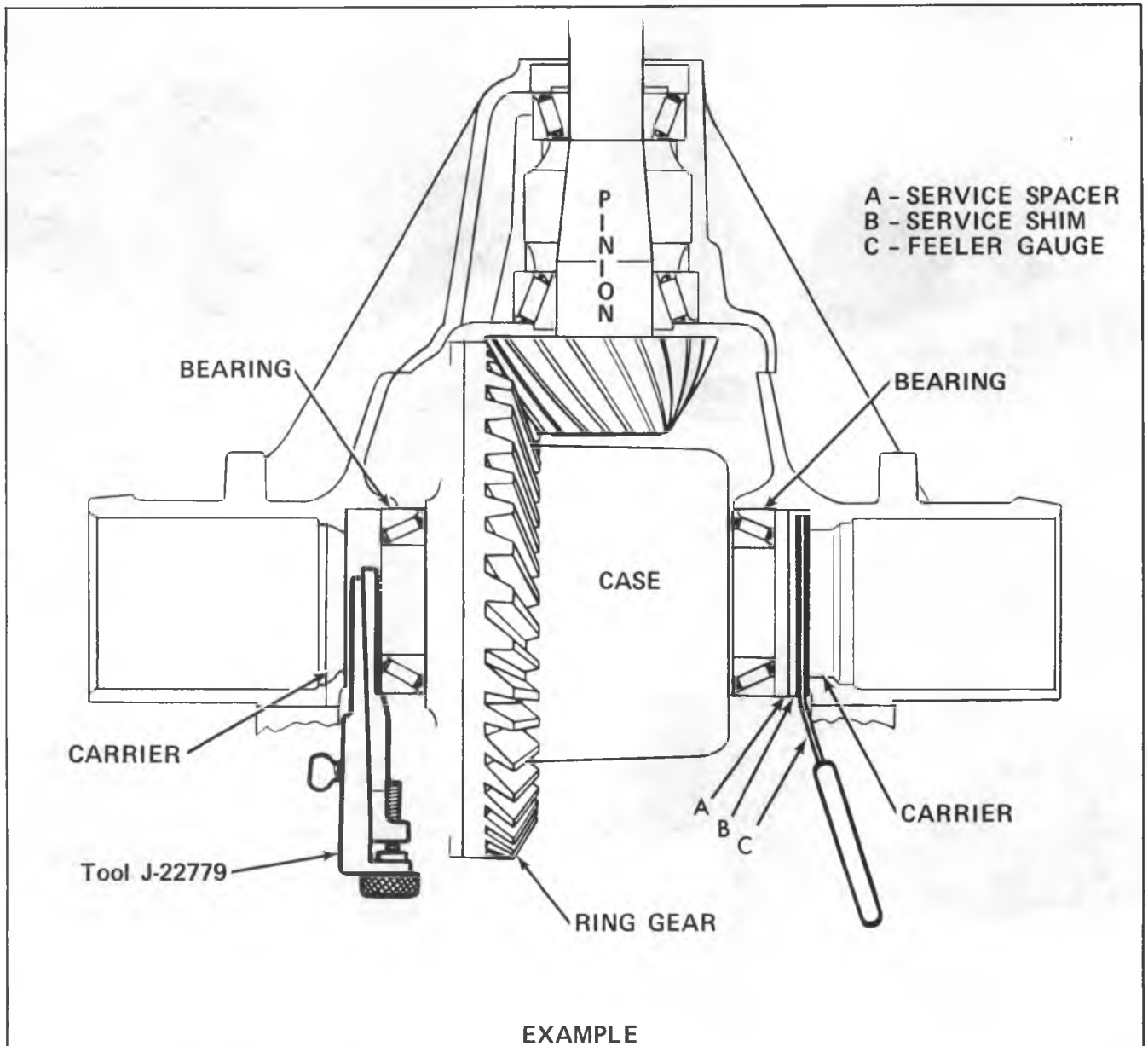
## GEAR TOOTH CONTACT PATTERN CHECK

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.





RING GEAR SIDE		OPPOSITE SIDE	
.250"	Thickness of Tool J-22779 required to force ring gear into contact with pinion	Combined total of: Service Spacer (A) Service Shim (B) Feeler Gauge (C)	.265"
$-.010"$ <u>.240"</u>	TO MAINTAIN PROPER BACKLASH (.005" - .008"), ring gear is moved away from pinion by subtracting .010" shims from ring gear side and adding .010" shims to other side		$+.010"$ <u>.275"</u>
$+.004"$	TO OBTAIN PROPER PRELOAD on side bearings, add .004" shims to each side.		$+.004"$
.244"	Shim dimension required for ring gear side	Shim dimension required for opposite side	.279"

Fig. 20A-Determining Side Bearing Shim Requirements



Fig. 21A—Measuring Gauge Thickness



Fig. 22A—Installing Differential Shim

### Test

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

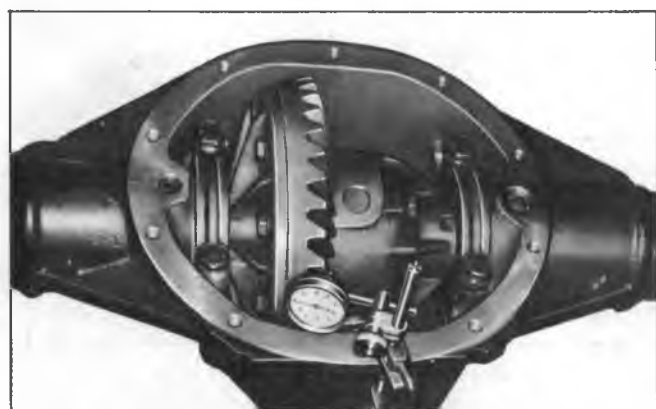


Fig. 23A—Checking Ring Gear Backlash

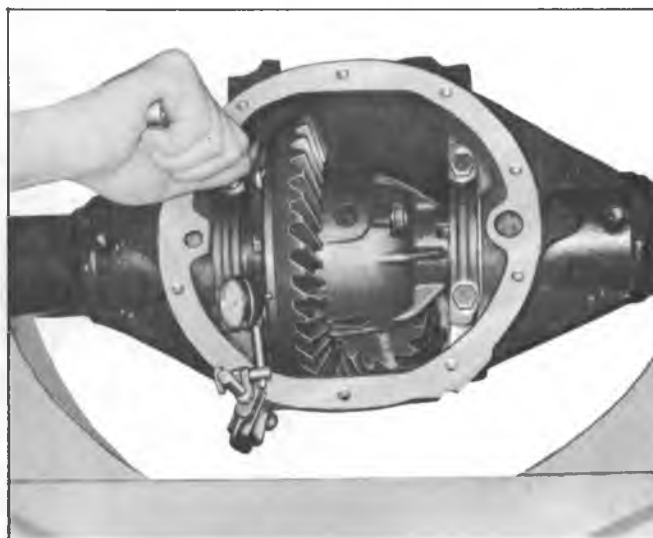


Fig. 24A—Checking Ring Gear Run-Out

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 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 26A.

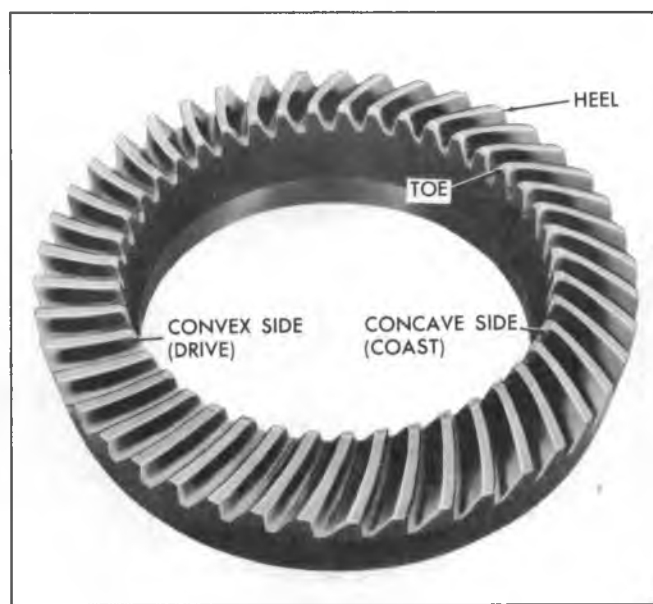


Fig. 25A—Gear Tooth Nomenclature

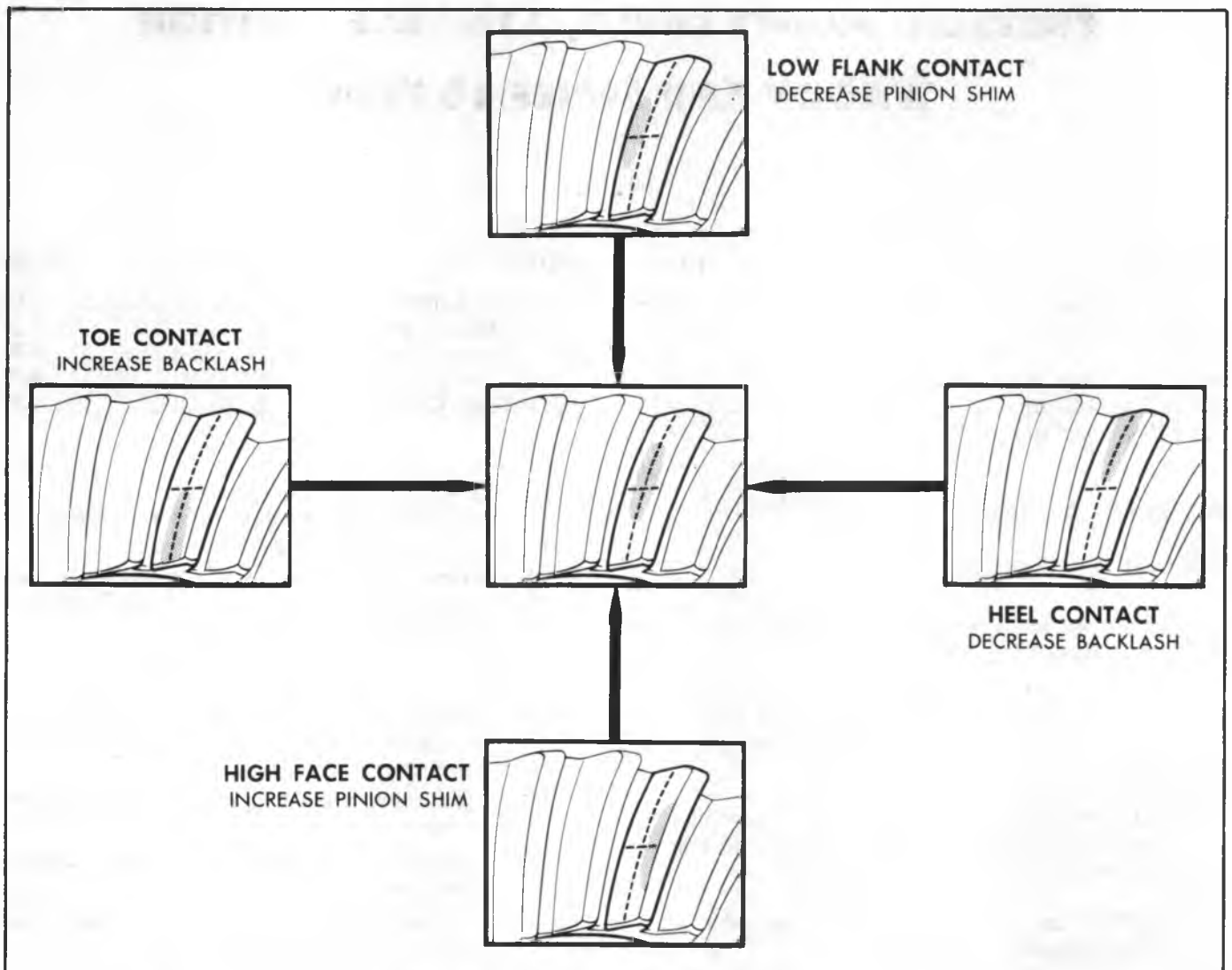


Fig. 26A-Gear Teeth Contact Pattern Check

### 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. (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.

# CHEVELLE, MONTE CARLO, 116" W.B. STATION WAGON AND SERIES 10 TRUCK

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## DIFFERENTIAL CASE

### Removal

1. Remove axle shafts as outlined in the applicable chassis Service Manual.
2. 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.
3. Mark one bearing cap and housing for reassembly in same position. Remove bearing cap bolts and bearing caps, tap surface of bearing caps to loosen.

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

4. Using a pry bar as shown in Figure 1B, 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 bear-

ing caps may be loosely installed, as shown in Figure 1B, to prevent case from falling.

5. Place left and right bearing cups with bearing caps so that they may be reinstalled in original positions. Place shims with appropriate cups.

### 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 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 on side gears, thrust washers, and pinion thrust faces.
5. Check fit of differential side gears in case.
6. Check fit of side gear and axle shaft splines.
7. Inspect differential pinion shaft for scoring or evidence of excessive wear.

## 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.
2. Tighten puller screw to remove bearing. See Figure 2B.
3. Place new bearing on hub with thick side of inner race toward case and drive into place, using Tool J-9537 for light-duty axle and Tool J-8359 for heavy-duty axle.
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 3B. Install remaining bearing as instructed in Step 3.

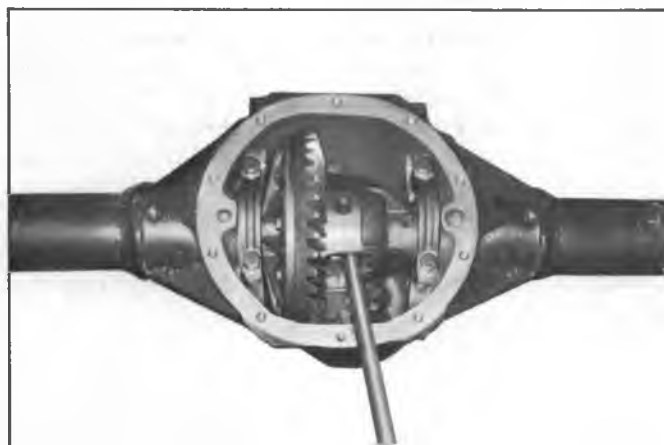


Fig. 1B-Differential Case Removal

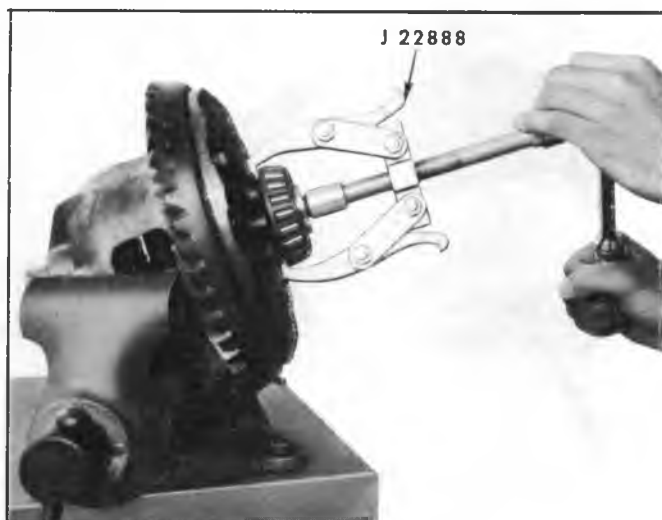


Fig. 2B-Differential Bearing Removal

## RING GEAR OR DIFFERENTIAL CASE

### Replacement

1. Remove the ring gear screws and lock washers and, using a soft faced hammer, tap ring gear off the case.

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



Fig. 3B-Differential Bearing Installation

2. Install guide pins, made from 3/8"-24 x 1-1/2" long cap screws with heads cut off and ends slotted, to ring gear as shown in Figure 4B.
3. Position ring gear over pilot diameter of the case. Install every other ring gear bolt and lock washer, then draw them up evenly and snugly so that gear face is flush with face of case.
4. Remove guide pins and install remaining bolts - torque all bolts to specifications.
5. Install thrust washers and side gears in case. If same parts are used, replace in original sides. Position pinions and thrust washers through loading hole in case 180 degrees apart so that they engage side gears. Rotate gears until pinion shaft holes are aligned. Install pinion shaft and lock screw. It is not necessary to torque lock screw until axle shafts are installed.

Differential may be installed in carrier now, or after service is performed on the drive pinion.

## DRIVE PINION

### Removal

1. Remove differential as previously outlined.
2. Remove propeller shaft.
3. Install Tool J-8614-1 on pinion flange and remove pinion flange nut and washer. See Figure 5B. (Position J-8614-1 on flange so that the four notches are toward flange.) Discard nut and use a new one upon reassembly.
4. Thread end of Tool J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-1 installed as in Step 3, insert J-8614-2 into J-8614-1 and turn it 45 degrees to locked position. Remove flange by turning J-8614-3 while holding J-8614-1 as shown in Figure 6B.
5. Pry old seal out of bore, using a screw driver or a hammer and chisel.

If deflector requires replacement, remove by tapping from flange. Clean up stake points. Install new deflector, and stake deflector at three new equally spaced positions.

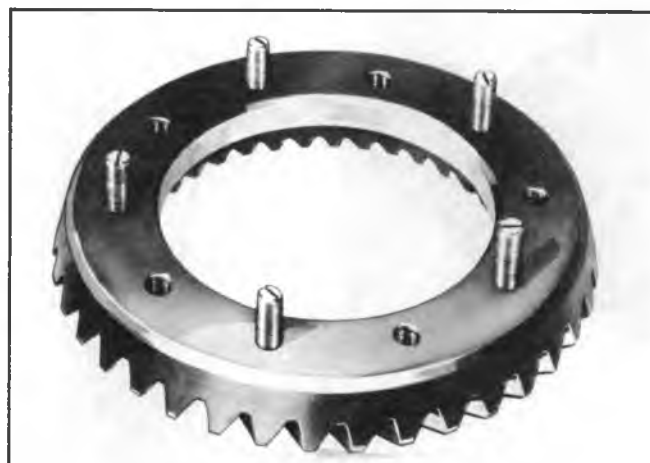


Fig. 4B-Ring Gear Guide Pins Installed



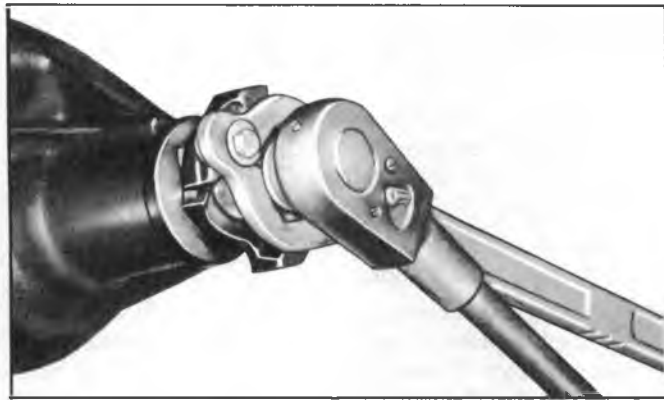


Fig. 5B-Drive Pinion Nut Removal

**NOTE:** Staking operation must be performed in such a manner that the seal operating surface is not damaged.

6. Remove drive pinion by tapping on front end with a soft faced hammer. Then remove pinion front bearing cone from carrier bore. Discard pinion bearing spacer and use a new one upon reassembly.

**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.

#### 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.



Fig. 6B-Drive Pinion Flange Removal

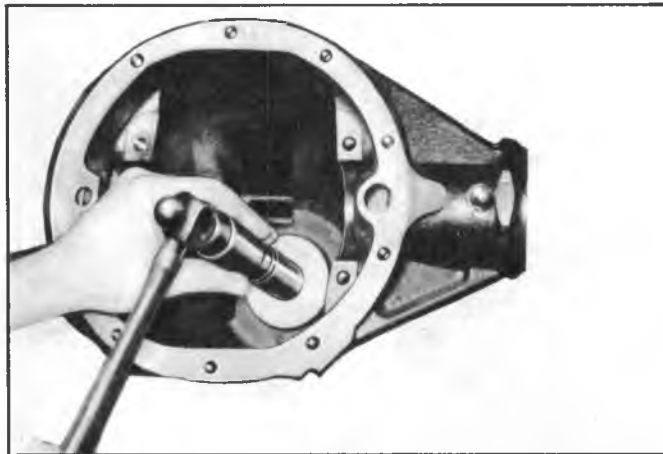


Fig. 7B-Drive Pinion Rear Bearing Cup Installation

3. Inspect ring gear and pinion teeth for possible scoring, cracking or chipping.

#### Pinion and/or Bearing Replacement

1. If necessary to replace pinion bearings, tap old cups out of carrier using a brass drift. 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.
2. Position new bearing cup in carrier, thick edge of cup toward shoulder in carrier. Then, using Cup Installer J-7137 for heavy-duty axle and J-7817 for light-duty axle, install front cup. Using J-0270-14 for light-duty axle and J-8608 for heavy-duty axle, install rear cup. Press cups into carrier until seated against shoulder as shown in Figures 7B and 8B. Check installation to make certain that cup is not cocked and that it is fully seated against shoulder.
3. Remove pinion rear bearing cone and roller assembly, using Press Plate Tool J-22912. See Figure 9B. Record thickness of shim removed from between bearing cone and pinion head.
4. If the original ring gear and pinion and the pinion rear bearing assembly are to be reinstalled, the original shim

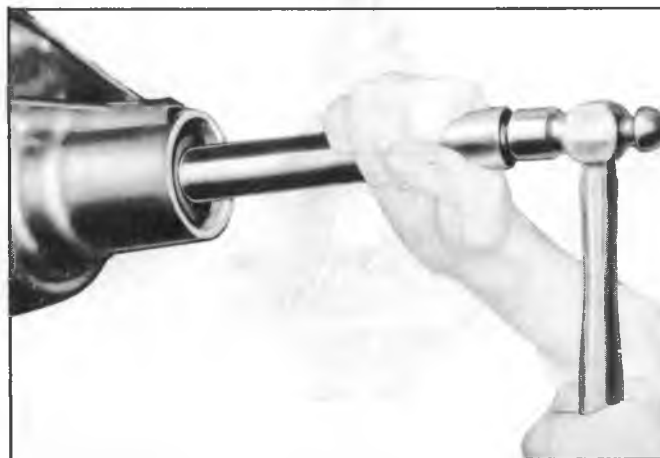


Fig. 8B-Drive Pinion Front Bearing Cup Installation

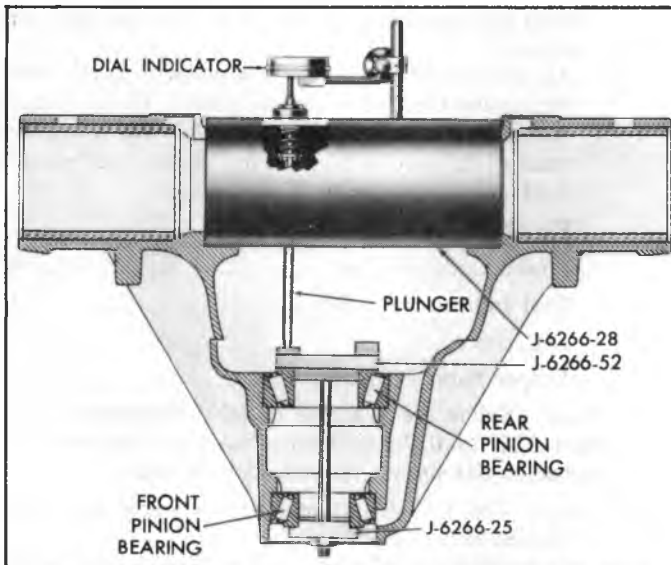


Fig. 9B-Drive Pinion Cone and Roller Assembly Removal

or one of the same thickness may be used. If the ring gear and pinion or the pinion rear bearing assembly are replaced, the correct shim thickness may be determined as follows.

### SETTING PINION DEPTH

1. Lubricate pinion bearing cone and roller assemblies and position them in proper cups.
2. For Passenger Cars: Light-Duty Axles-J-6266-52-position gauge plate with lower surface (x stamped near low side) toward top of carrier as shown in Figure 10B.

Heavy-Duty Axles--J-6266-53--position gauge plate with higher surface (x stamped near high side) toward top of carrier as shown in Figure 11B.

- a. Insert clamp screw through gauge plate and both of the pinion bearings.

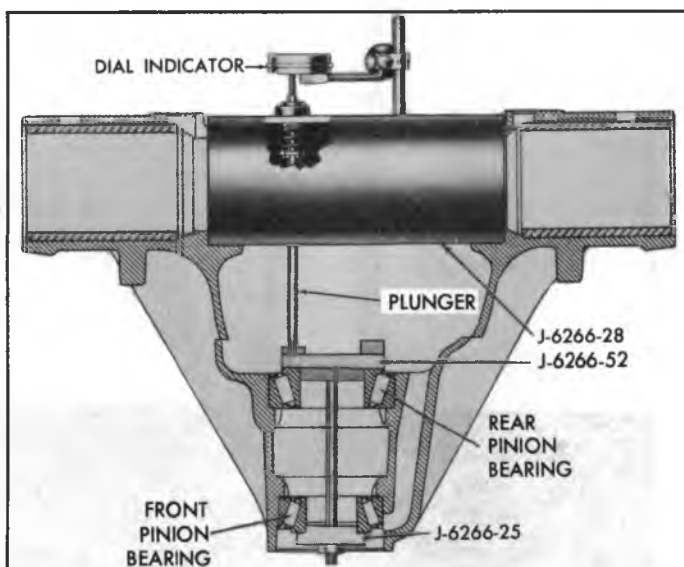


Fig. 10B-Installed View of Pinion Depth Gauge (Light-Duty Passenger Axle)

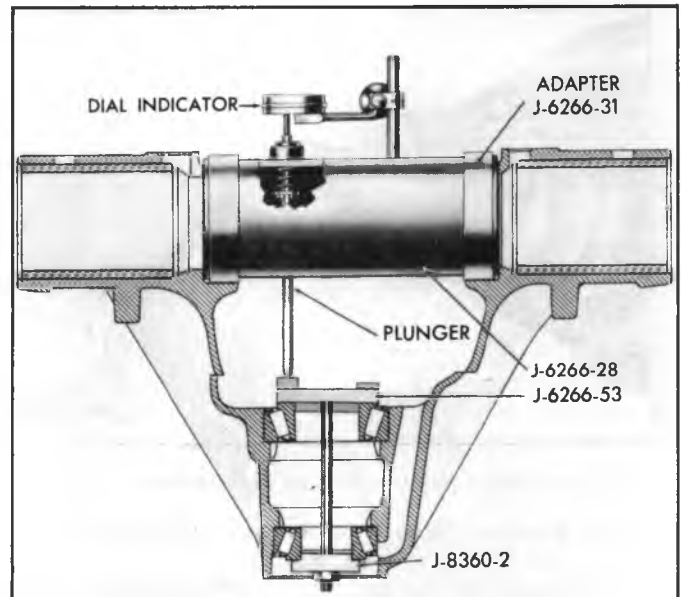


Fig. 11B-Installed View of Pinion Depth Gauge (Heavy-Duty Passenger Axle)

- b. Position J-6266-25 (light-duty axle) or J-8360-2 (heavy-duty axle) on threaded end of clamp screw and index it in front bearing. Install hex nut and rotate bearings several times to make sure that they are seated.
3. For Truck: Position J-6266-52 Pinion Depth Setting Gauge Plate in pinion rear bearing. See Figure 12B. Gauge plate has two gauging surfaces.
    - a. Light-duty axle-position gauge plate with lower surface (x stamped near low side) toward top of carrier.
    - b. Heavy-duty axle-position gauge plate with higher surface toward top of carrier.
    - c. Insert clamp screw through gauge plate and both of the pinion bearings.

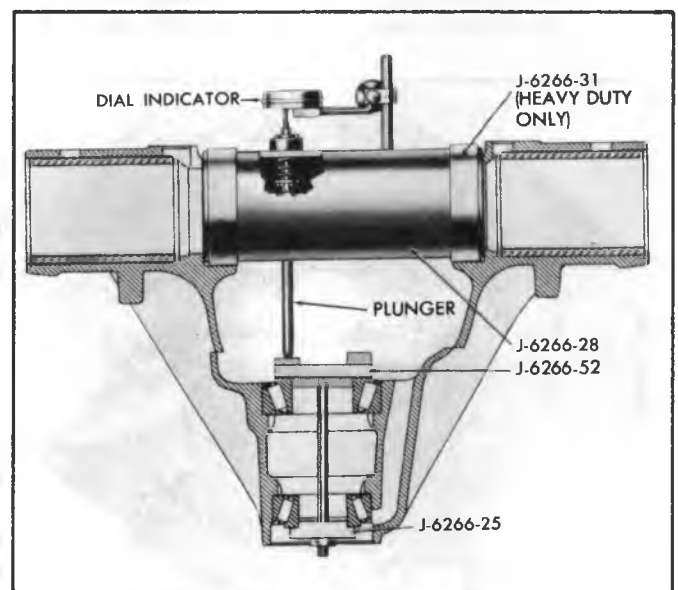


Fig. 12B-Installed View of Pinion Depth Gauge (Truck Axle)

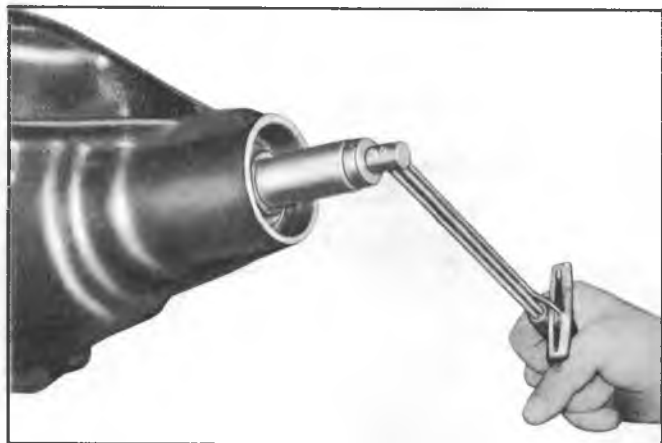


Fig. 13B—Measuring Drive Pinion Bearing Rotating Torque

- d. Position J-6266-25 on threaded end of clamp screw and index it in front bearing.
- e. Install hex nut and rotate bearings several times to make sure that they are seated.
4. Continue with the following steps for both passenger and truck.
  - a. Tighten hex nut until 20 in lbs. of torque is required to rotate bearings. See Figure 13B.
  - b. After torque has been established check position of gauge plate in carrier.
  - c. Position dial indicator (Tool J-8001-2) on gauge post of tool plunger. Preload dial indicator 1/2 revolution, and tighten in this position.
  - d. Position Tool J-6266-28 in carrier as shown in Figure 14B. Swing tool body so that plunger does not touch gauge plate, and set indicator dial at zero.

**NOTE:** Barrel Adapters Tool J-6266-31 must be used when gauging heavy-duty axle. Make sure adapters are seated in differential bearing bores of carrier before measuring depth.

- e. Slowly swing inner end of tool plunger across gauge plate until highest indicator reading is obtained. Re-



Fig. 14B—Measuring Drive Pinion Shim Requirement

cord this measurement and recheck to see that it is correct.

- f. All service pinion gears are stamped with a code number on the threaded end of the pinion. The numerical difference between the code number and the gauge reading obtained in Step 4e. determines the required thickness of the pinion locating shim.

#### EXAMPLE:

Pinion Code Number .....	45
Dial Indicator Reading .....	16
Difference.....	29
Proper Shim Thickness .....	.029"

**NOTE:** Shims are available in .001" increments from .021" to .037". Each shim has the thickness etched on flat surface for easy identification.

5. Remove Tool J-6266 and pinion bearing cone and roller assemblies from carrier.
6. Position shim selected in above procedure on pinion shaft and against pinion head.
7. Install new cone and roller assembly, using Tool J-5590 for light-duty axle. See Figure 15B. Use Tool J-9772 for heavy-duty axle. See Figure 16B. Press cone against shim and rear face of pinion.

## DRIVE PINION AND BEARING

### Installation

1. Position pinion and rear bearing cone and roller assembly in carrier, install a new pinion bearing spacer on pinion

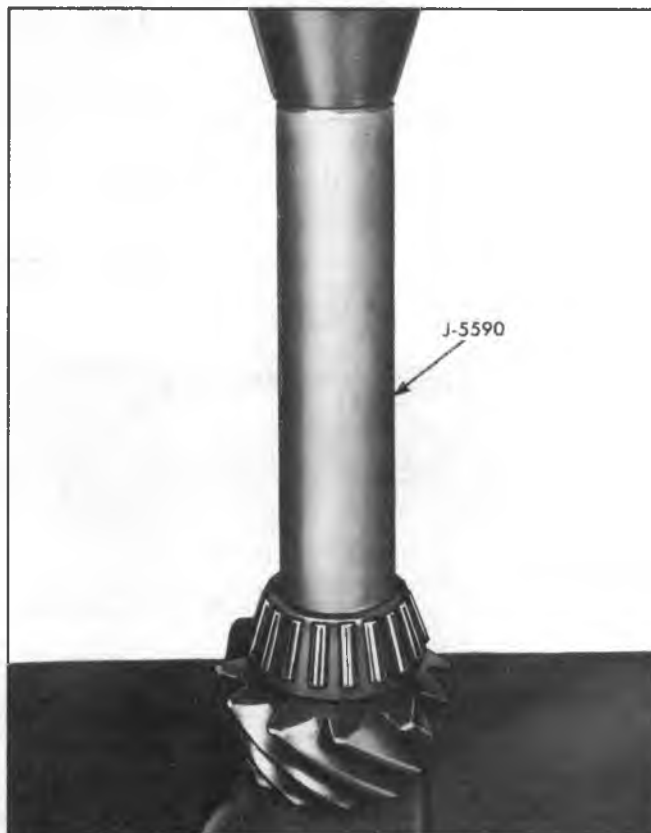


Fig. 15B—Drive Pinion Cone and Roller Assembly Installation (Light Duty)

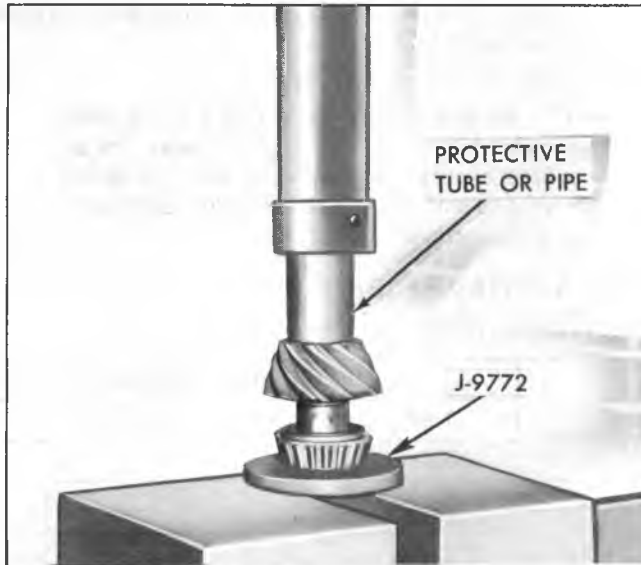


Fig. 16B-Drive Pinion Cone and Roller Assembly Installation (Heavy Duty)

shaft and install pinion front bearing cone and roller assembly.

2. Pack the cavity between the seal lips of the pinion flange oil seal, with a lithium-base extreme pressure lubricant, position seal in bore and place gauge plate J-22804-2 (light-duty axle) or J-22804-1 (heavy-duty axle) over seal and against seal flange. Gauge plate insures proper seating of seal in carrier bore.
3. Use Tools J-21468 and J-9458 for light duty axle as shown in Figure 17B. Use Tool J-21057 for heavy-duty axle. See Figure 18B. Press seal into carrier bore until gauge plate is flush with the carrier shoulder and seal flange. Turn gauge plate 180 degrees from installer position; seal must be square in carrier bore to seal properly against pinion flange.

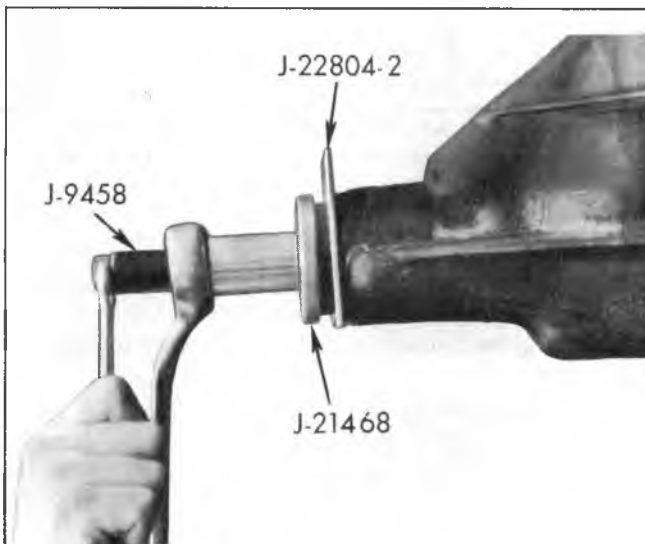


Fig. 17B-Drive Pinion Flange Oil Seal Installation (Light Duty)

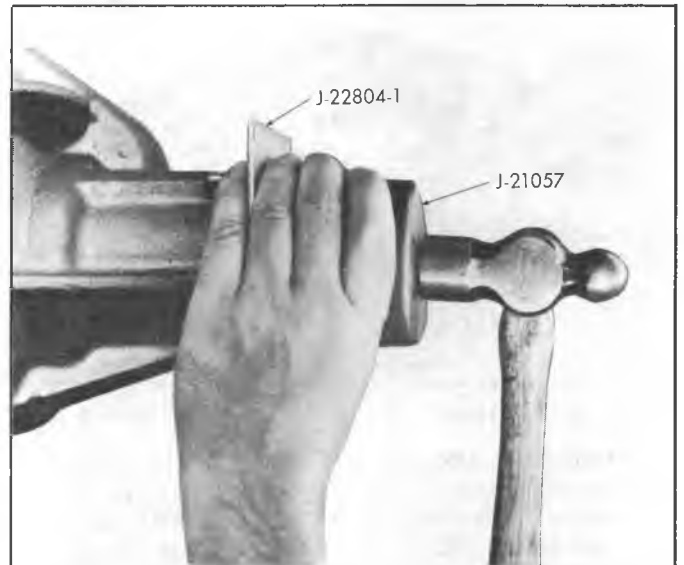


Fig. 18B-Drive Pinion Flange Oil Seal Installation (Heavy Duty)

4. Position and align pinion flange on pinion shaft, using Tools J-9458 and J-8614-1. Tool J-9458-1 is threaded onto pinion shaft and nut tightened against J-9458-2 to pull flange on shaft as in Figure 19B. Remove J-9458 after flange is seated.
5. 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.

## CHECKS AND ADJUSTMENTS- PINION BEARING PRELOAD

1. Install new self-locking 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 20-25 in. lbs. for new bearings and seal, or 5-10 in. lbs. when used parts are reinstalled. See Figure 20B.

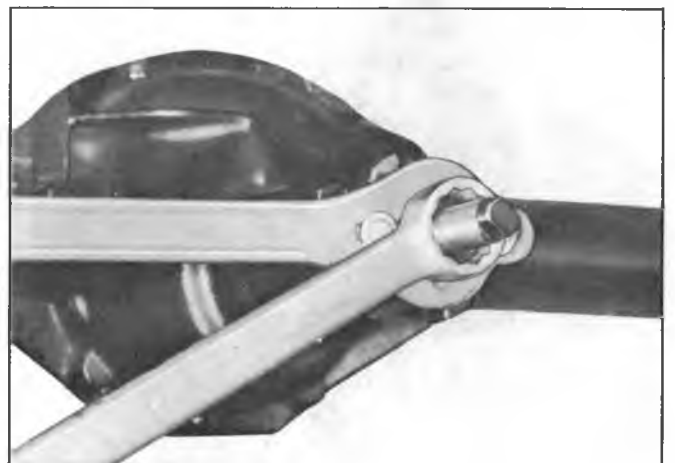


Fig. 19B-Drive Pinion Flange Installation



Fig. 20B—Measuring Drive Pinion Bearing Preload

**CAUTION:** After preload has been checked, final tightening should be done very cautiously. For example, if when checking, preload 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 preload should be checked after each slight amount of tightening. Exceeding preload specifications will compress the collapsible spacer too far and require its replacement.

## DIFFERENTIAL BEARING PRELOAD AND INITIAL BACKLASH SETTING

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 21B.

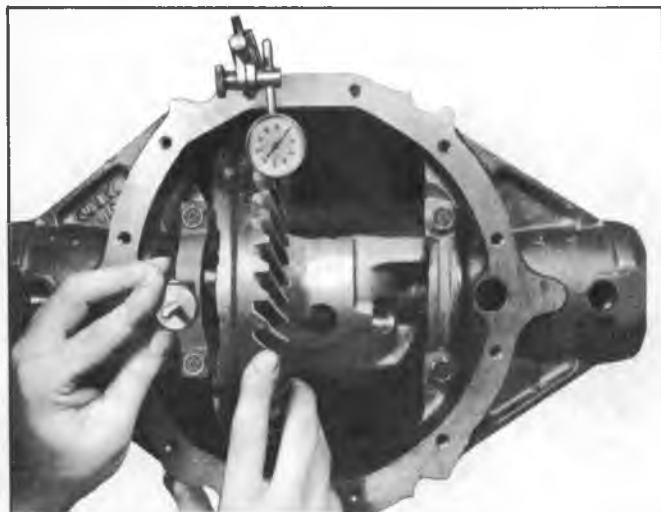


Fig. 21B—Installing Gauging Tool

5. While oscillating tool, turn adjusting nut clockwise until a noticeable drag is produced.
6. Tighten lock bolt on side of tool.

**NOTE:** Service spacers are available in one thickness only: .170"  $\pm$  .001" for light and heavy-duty axles. Steel service shims are used with the service spacer. See shim chart below for shim availability and identification.

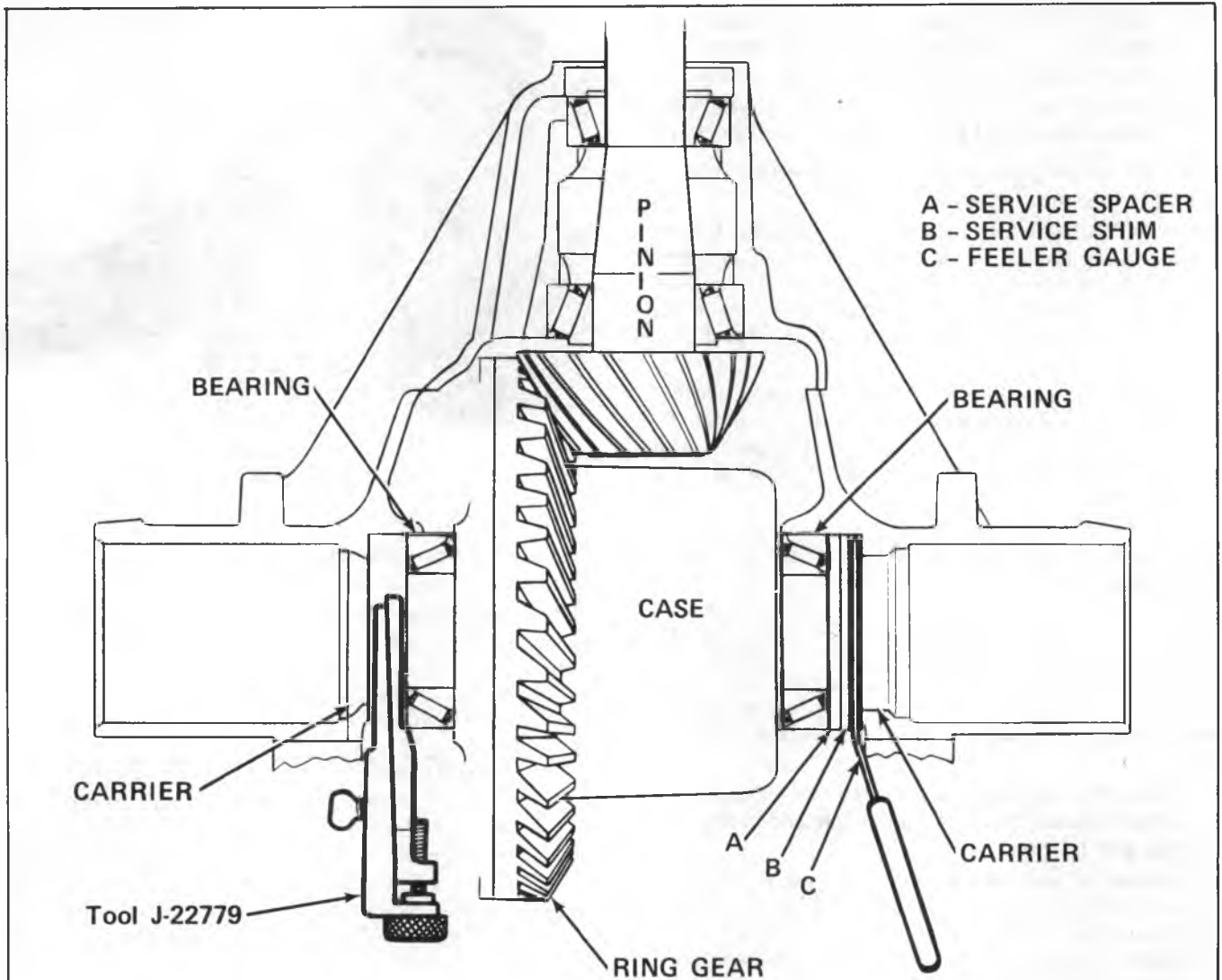
## DIFFERENTIAL BEARING SHIM IDENTIFICATION

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

\* Additional shims are available for the light-duty axle; these shims, with a thickness of .052" through .062", are identified by a number stamped on the shim. This number indicates the shim thickness.

**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.

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. 22B.



## EXAMPLE

RING GEAR SIDE	OPPOSITE SIDE
$.250''$ Thickness of Tool J-22779 required to force ring gear into contact with pinion	Combined total of: Service Spacer (A) $.265''$ Service Shim (B) Feeler Gauge (C)
$-.010''$ $.240''$ TO MAINTAIN PROPER BACKLASH (.005'' - .008''), ring gear is moved away from pinion by subtracting .010'' shims from ring gear side and adding .010'' shims to other side	$+.010''$ $.275''$
$+.004''$ TO OBTAIN PROPER PRELOAD on side bearings, add .004'' shims to each side.	$+.004''$
$.244''$ Shim dimension required for ring gear side	Shim dimension required for opposite side $.279''$

Fig. 22B-Determining Side Bearing Shim Requirements



## REAR AXLE DIFFERENTIAL CARRIER 4-22

- a. Using a micrometer as in Figure 23B 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 22B 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 as shown in Figure 24B.

### RING GEAR AND PINION BACKLASH ADJUSTMENT

Mount a dial indicator on the carrier and check the backlash between the ring gear and pinion, as shown in Figure 25B. The backlash should be within the range of 0.005"-0.008". Check gear lash at four different equally spaced positions around the gear. Variation in readings should not exceed 0.001".

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

If variation in backlash readings exceeds 0.001"; measure ring gear and case runout as shown in Figure 26B. Gear runout should not exceed 0.002"; should runout exceed this limit check ring gear and case for deformation and/or foreign matter between case and gear.

If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of other shim



Fig. 23B—Measuring Gauge Plate Thickness

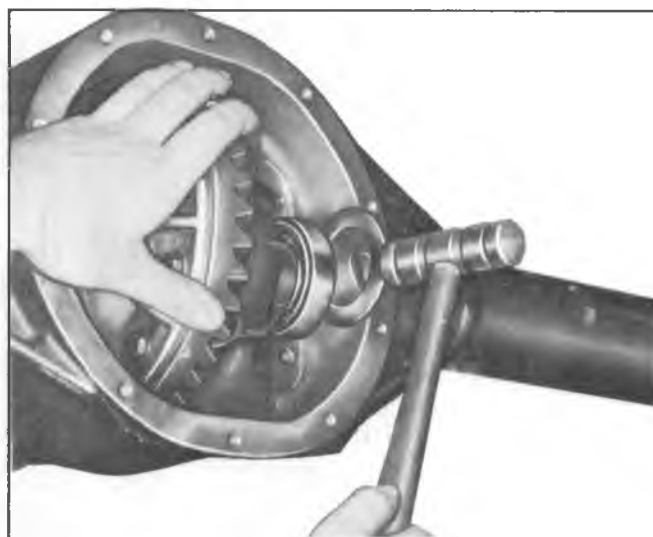


Fig. 24B—Installing Differential Shim

the same amount. Total shim thickness must be maintained at all times to maintain proper line-to-line contact.

Backlash changes approximately .002" for each .003" change in shim dimensions. If lash is too high, add thicker shim to left side and decrease right side by same amount; if lash is too low, add thicker shim to right side and decrease left side by same amount.

### 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 27B.

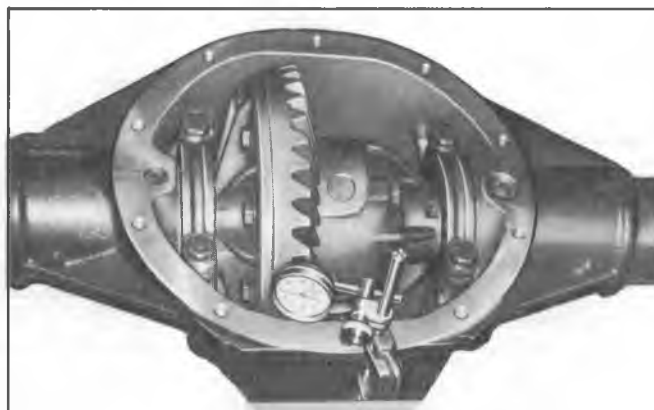


Fig. 25B—Checking Ring Gear Backlash

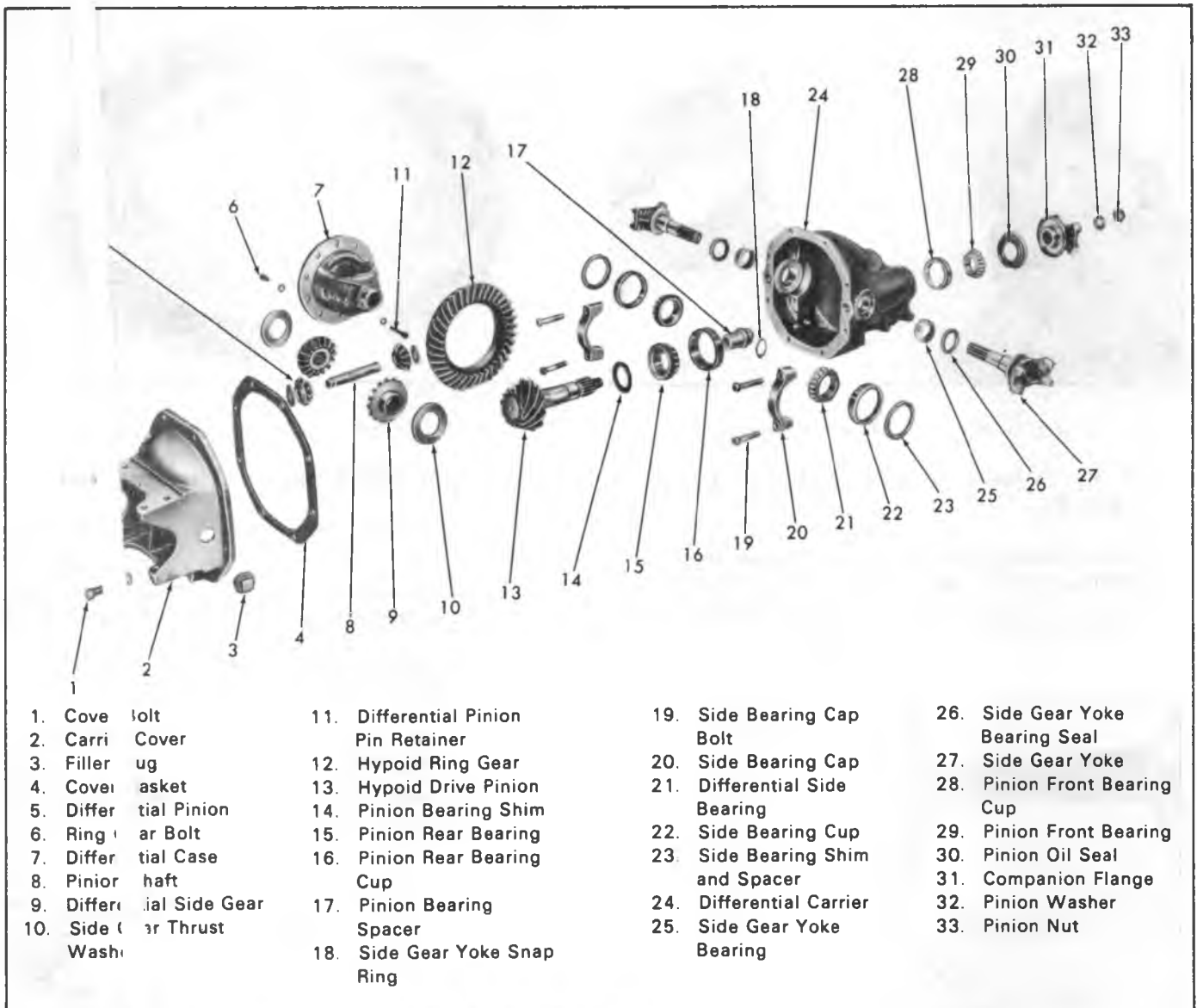


Fig. 1C--Carrier Assembly--Exploded View

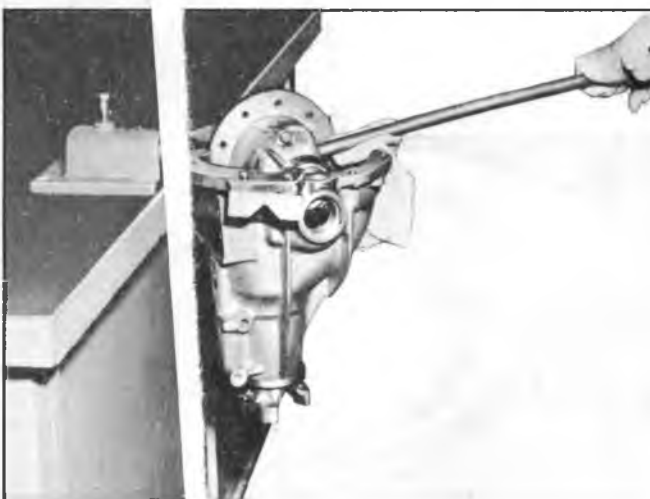


Fig. 2C--Removing Differential

### Disassembly

Follow procedures outlined in "Positraction Differential Case" 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.

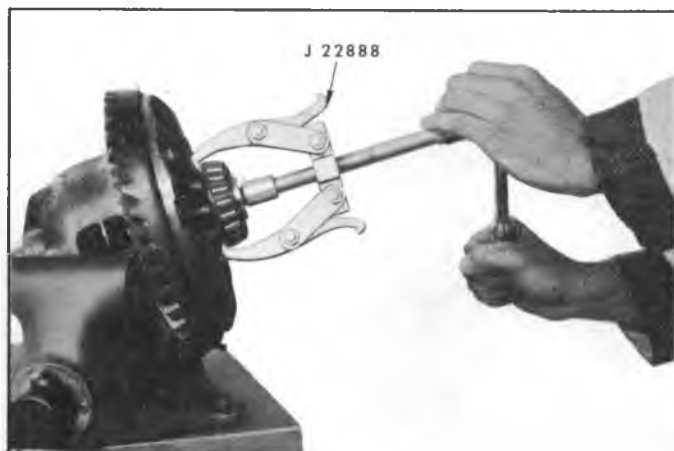


Fig. 3C--Removing Differential Bearing

2. Install new bearing on hub using Installer J-8359. 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 of bearing cage. See Figure 4C. Install remaining bearing.



Fig. 4C--Differential Bearing Installation

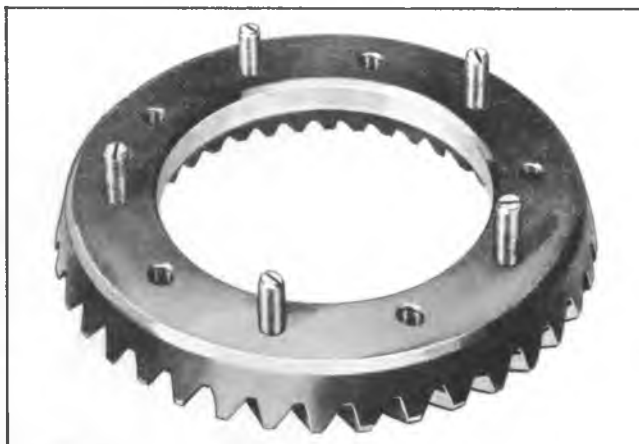


Fig. 5C--Ring Gear Guide Pins Installed

### 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.
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.

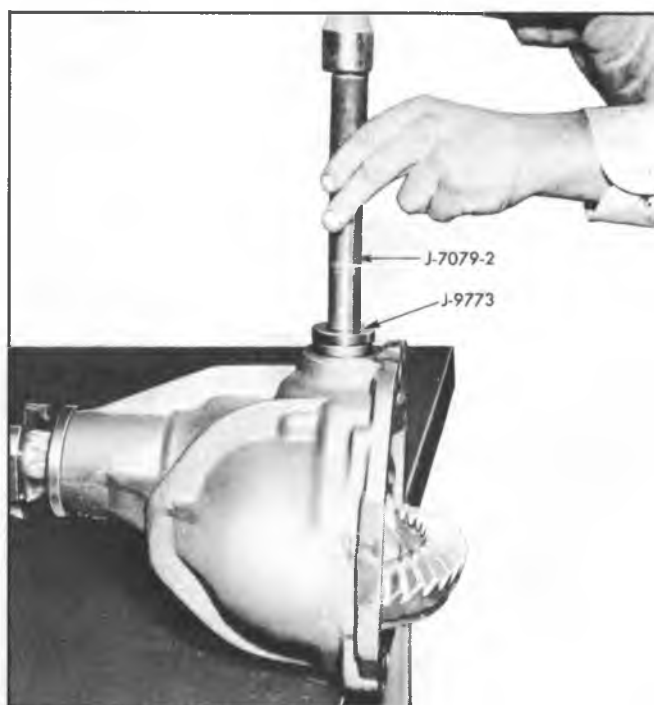


Fig. 6C--Installing Side Gear Yoke Bearings

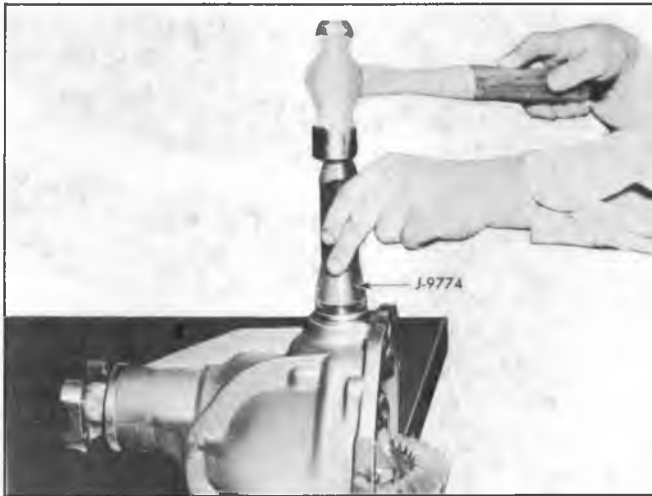


Fig. 7C--Installing Side Gear Yoke Seal

### Differential Case Assembly

Follow procedures outlined in "Positraction Differential Case" Section.

### 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.

### DRIVE PINION

#### Removal

1. Remove differential case as previously outlined.
2. Turn holding fixture over and remove companion flange nut using J-8614-1 Holder. See Figure 8C.
3. Pull companion flange using J-8614-1 Holder with Puller J-8614-2 as shown in Figure 9C.
4. With companion flange removed, pinion gear and rear bearing assembly can be removed from carrier.

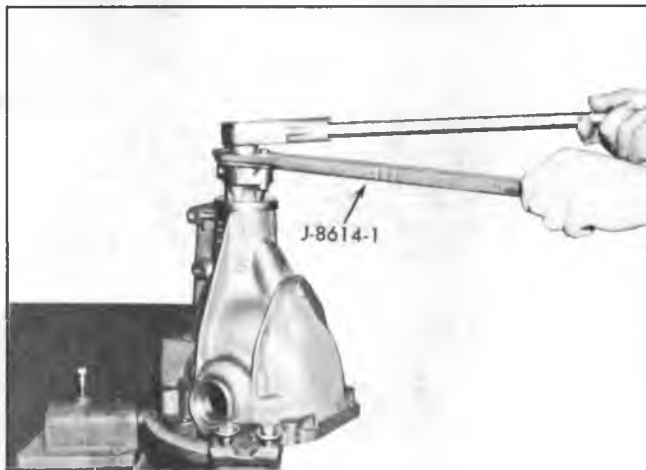


Fig. 8C--Removing Companion Flange Nut

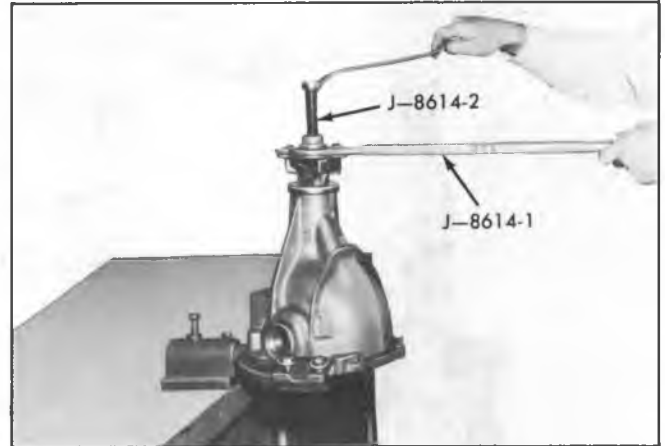


Fig. 9C--Removing Companion Flange

5. Pry companion flange seal out of carrier using screw driver and discard seal. Remove pinion front bearing inner race and roller assembly.
6. 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.

### 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.



Fig. 10C--Removing Pinion Bearing Cup

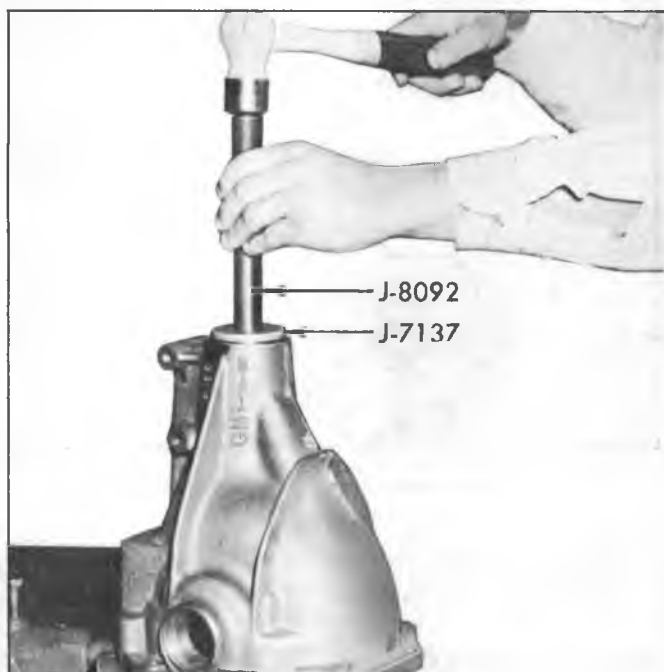


Fig. 11C--Installing Pinion Bearing Cups

### Pinion and/or Bearing Replacement

1. If necessary to replace pinion bearings tap old cups out of carrier using a brass drift. See Figure 10C. 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 Figure 11C. Seat cups securely and squarely against shoulders in carrier.

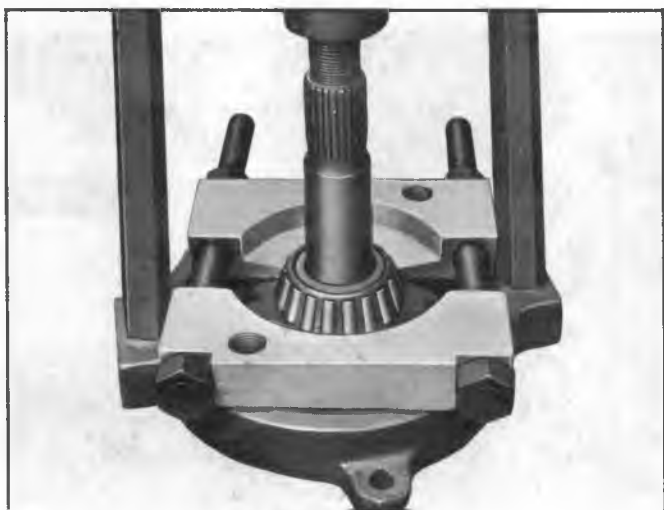


Fig. 12C--Removing Pinion Rear Bearing

3. Remove pinion rear bearing inner race and roller assembly using Press Plates J-9771 in Holder J-0358-1 as shown in Figure 12C. Remove and discard shim between bearing and gear head.

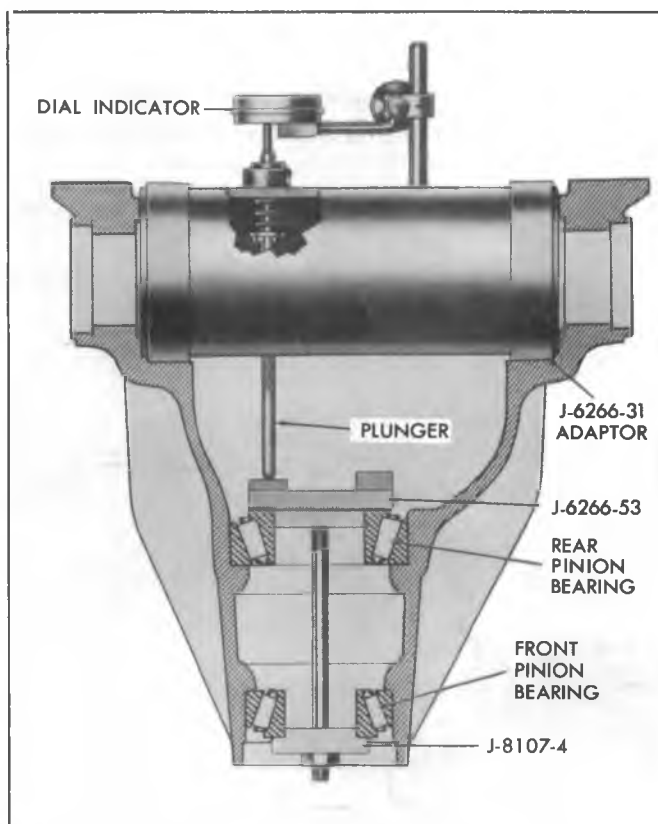


Fig. 13C--Gauge and Clamp Plates Installed

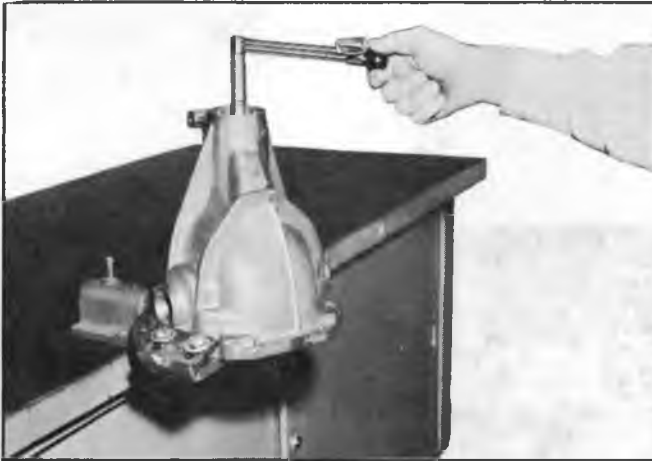


Fig. 14C--Measuring Drive Pinion Bearing Rotating Torque

### Determining Pinion Shim

If hypoid gear set, pinion rear bearings or carrier assembly are to be replaced, thickness of pinion bearing shim will have to be determined as follows:

1. Lightly lubricate pinion bearings, place in carrier and rotate several times to seat properly.
2. Position Gauge Plate J-6266-53 on rear bearing making sure it is properly seated and piloted. Loose pilot allows plate to be easily centered in bearing.
3. Insert clamp screw through gauge plate, both bearings and Clamp Plate J-8107-4 on front bearing. See Figure 13C. Tighten clamp bolt enough to seat properly and check gauge plate alignment.
4. Tighten clamp screw until it takes a torque of 20 in. lb. to rotate bearings as shown in Figure 14C.
5. Carefully slide Adapter Rings J-6266-31 over Gauge Barrel J-6266-28 and place barrel assembly in differential bearing bores. See Figure 15C. Plunger on barrel must rest on lowest step of Gauge Plate J-6266-53.
6. Mount Dial Indicator J-8001 on gauge post and place pointer on top of plunger as in Figure 16C. Swing gauge

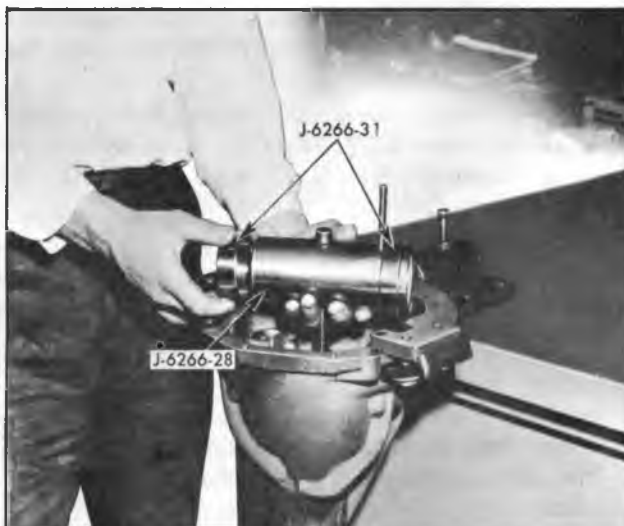


Fig. 15C--Installing Gauge Barrel

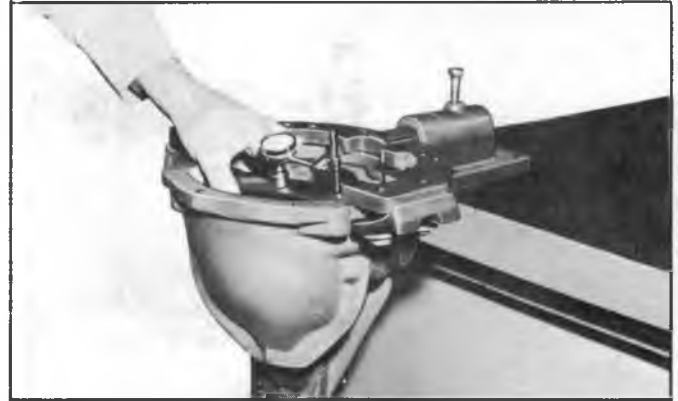


Fig. 16C--Gauging Pinion Depth

barrel aside so plunger does not touch gauge plate and set indicator at zero.

7. Swing gauge plunger back across plate and record highest indicator reading.
8. All service pinion gears are stamped with a code number on the threaded end of the pinion. The numerical difference between the code number and the gauge reading obtained in Step 7 determines the required thickness of the pinion locating shim.

EXAMPLE:	# 1	# 2	# 3
Pinion Code Number	40	45	50
Dial Indicator Reading	19	16	14
Difference	21	29	36
Proper Shim Thickness	.021"	.029"	.036"

**NOTE:** Shims are available in .001 inch increments from .021 inch to .037 inch. Each shim has the thickness etched on flat surface for easy identification.

9. Remove gauge, gauge plates and clamp screw. Remove pinion rear bearing inner race and roller assembly from carrier.
10. Position pinion shim selected in Step 8 on pinion head and press pinion bearing on pinion using J-9772 Press Plate. See Figure 17C.

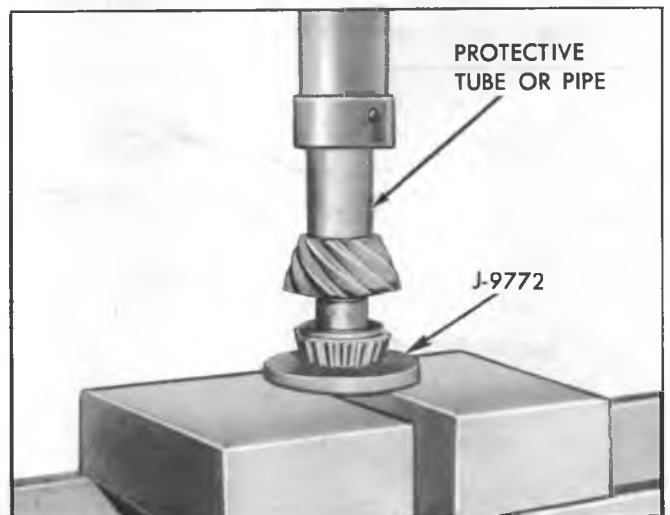


Fig. 17C--Installing Pinion Rear Bearing



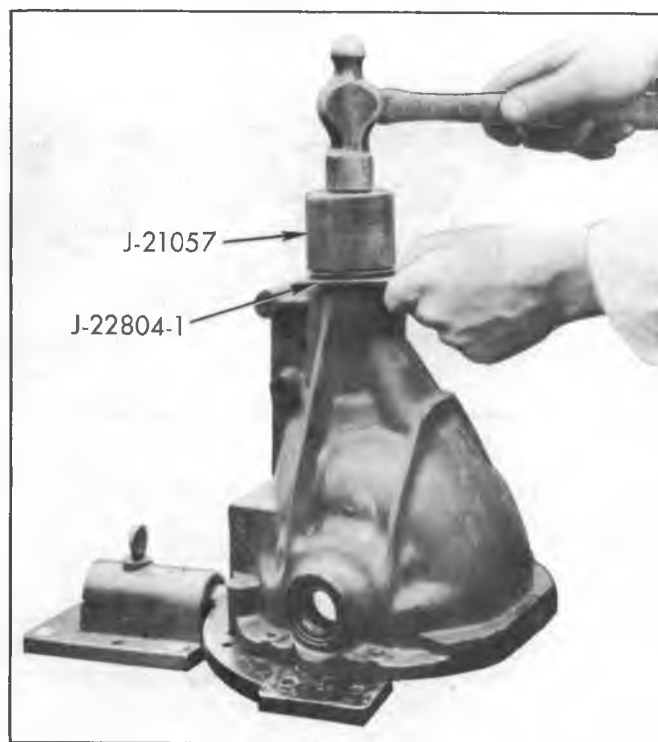


Fig. 18C--Installing Pinion Seal

## Installation

### Drive Pinion and Bearing

1. Lubricate pinion bearings and place pinion gear 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, position seal in bore and place gauge plate J-22804-1 over seal and against seal flange. Gauge plate insures proper seating of seal in carrier bore.

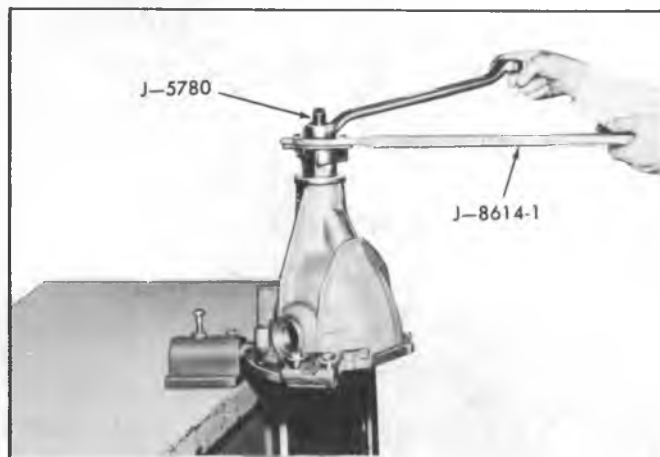


Fig 19C--Installing Companion Flange

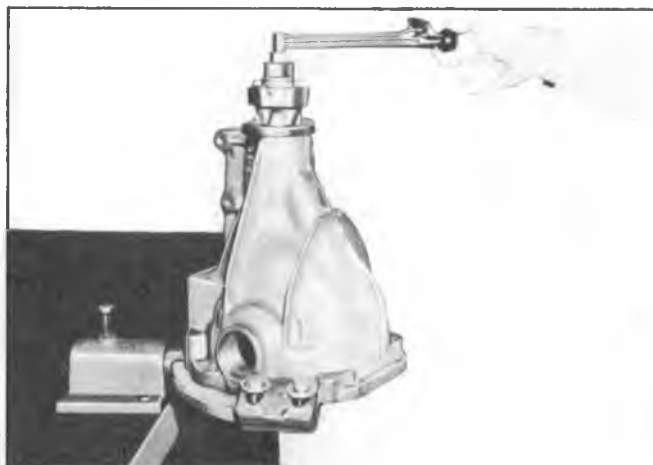


Fig. 20C--Measuring Drive Pinion Bearing Preload

5. Using tool J-21057 as shown in Figure 18C, press seal into carrier bore until gauge plate is flush with the carrier shoulder and seal flange. Turn gauge plate 180 degrees from installed position; seal must be square in carrier bore to seal properly against pinion flange.
6. Install companion flange using Holder J-8614-1 and Installer J- 5780. See Figure 19C.
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 20C.

## CHECKS AND ADJUSTMENTS

### Differential Bearing Preload and Ring Gear 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 21C. Install right bearing cap, tightening the bolts to a snug fit.
3. Service spacers are available in one thickness only .160" 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.

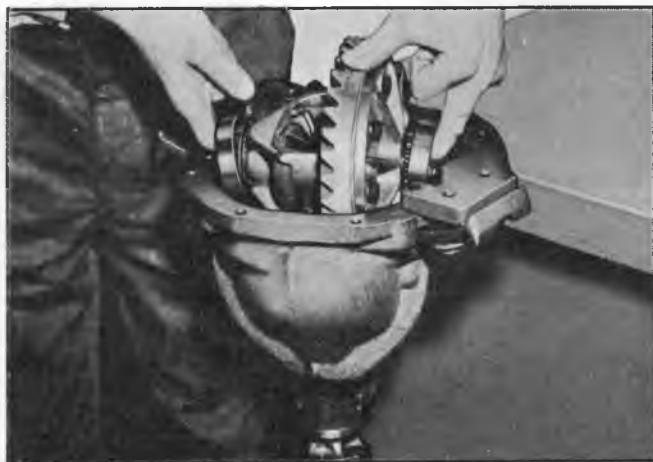


Fig. 21C--Installing Differential Assembly

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 22C. Turn adjusting nut clockwise while oscillating tool until a noticeable drag is produced.
6. Tighten lock bolt on side of the tool then remove tool.

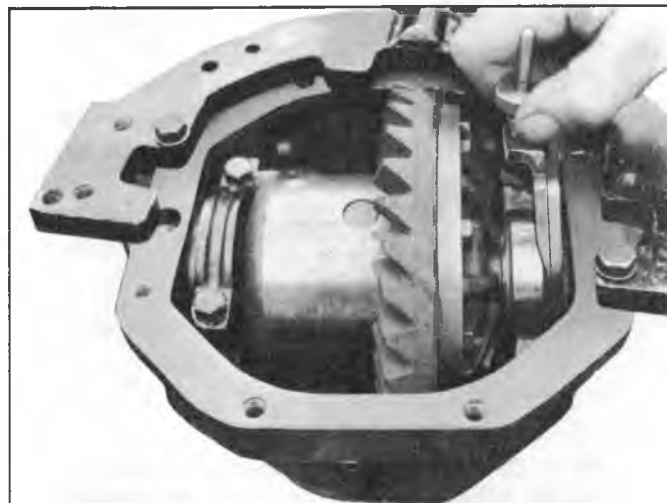


Fig. 22C--Measuring Differential Shim Requirement

7. Using a micrometer, measure the thickness of the gauging plates in a minimum of three places as shown in Figure 23C. Average these readings and record result.
8. Turn ring gear 90 degrees and repeat Steps 5, 6 and 7.
9. The 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 ..... .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

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. 23C--Measuring Gauge Plate Thickness

with tool). Remove tool and measure the thickness of the gauging plate in a minimum of three places. Average these readings and record results.

13. Turn ring gear 90 degrees and repeat Steps 11 and 12.
14. The thickness of the service shim is determined as in Step 9, however, an additional .008" must be added to obtain proper side bearing preload.

**EXAMPLE:**

Gauge thickness (higher reading).....	.226"
Service spacer used .....	minus .170"
Difference .....	.056"
Preload .....	plus .008"
Service shim size .....	.064"

**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 24C.
16. Install 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 25C. Backlash should be within the range of .003" to .010" with a reading of .005" to .008" preferred. Check reading at four equally spaced positions around the ring gear. Variation in reading should not exceed .002".

**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 .002" measure ring gear and case runout as shown in Figure 26C. Gear runout should not exceed .002"; 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

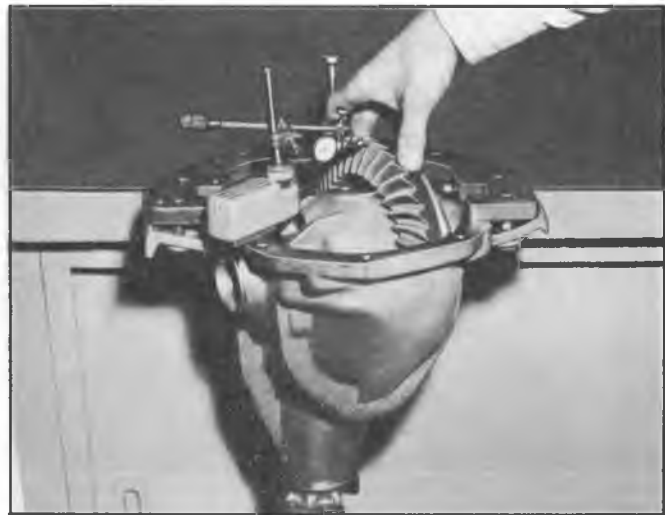


Fig. 25C--Checking Backlash

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".

### 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

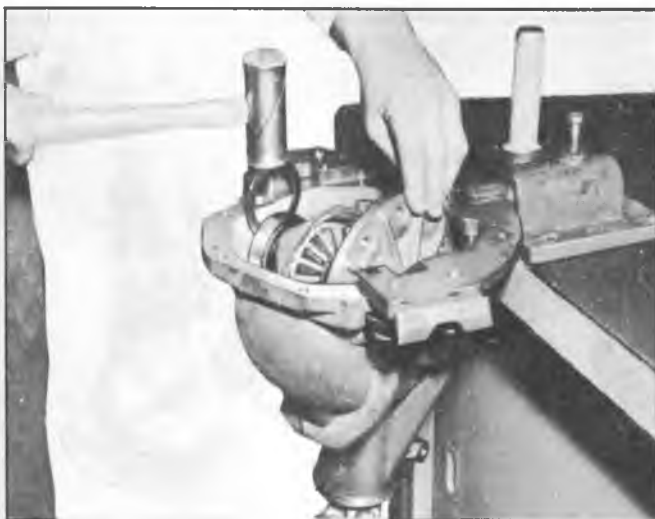


Fig. 24C--Installing Differential Shim



Fig. 26C--Checking Ring Gear Runout

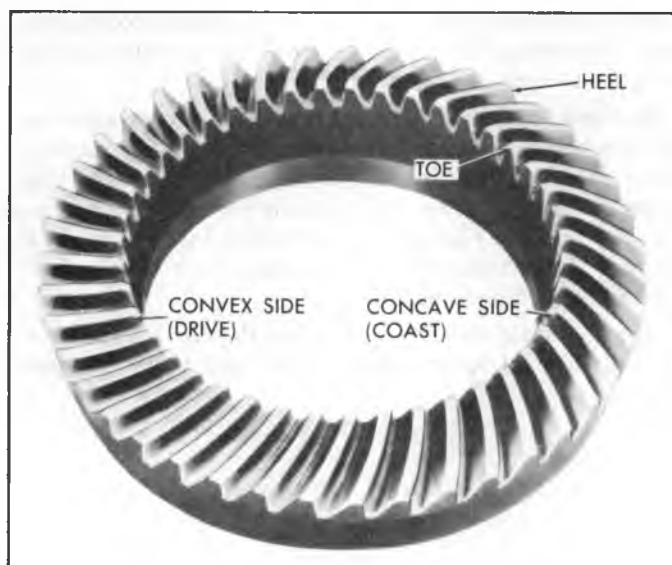


Fig. 27C—Gear Tooth Nomenclature

farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 27C.

### 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 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 28C.

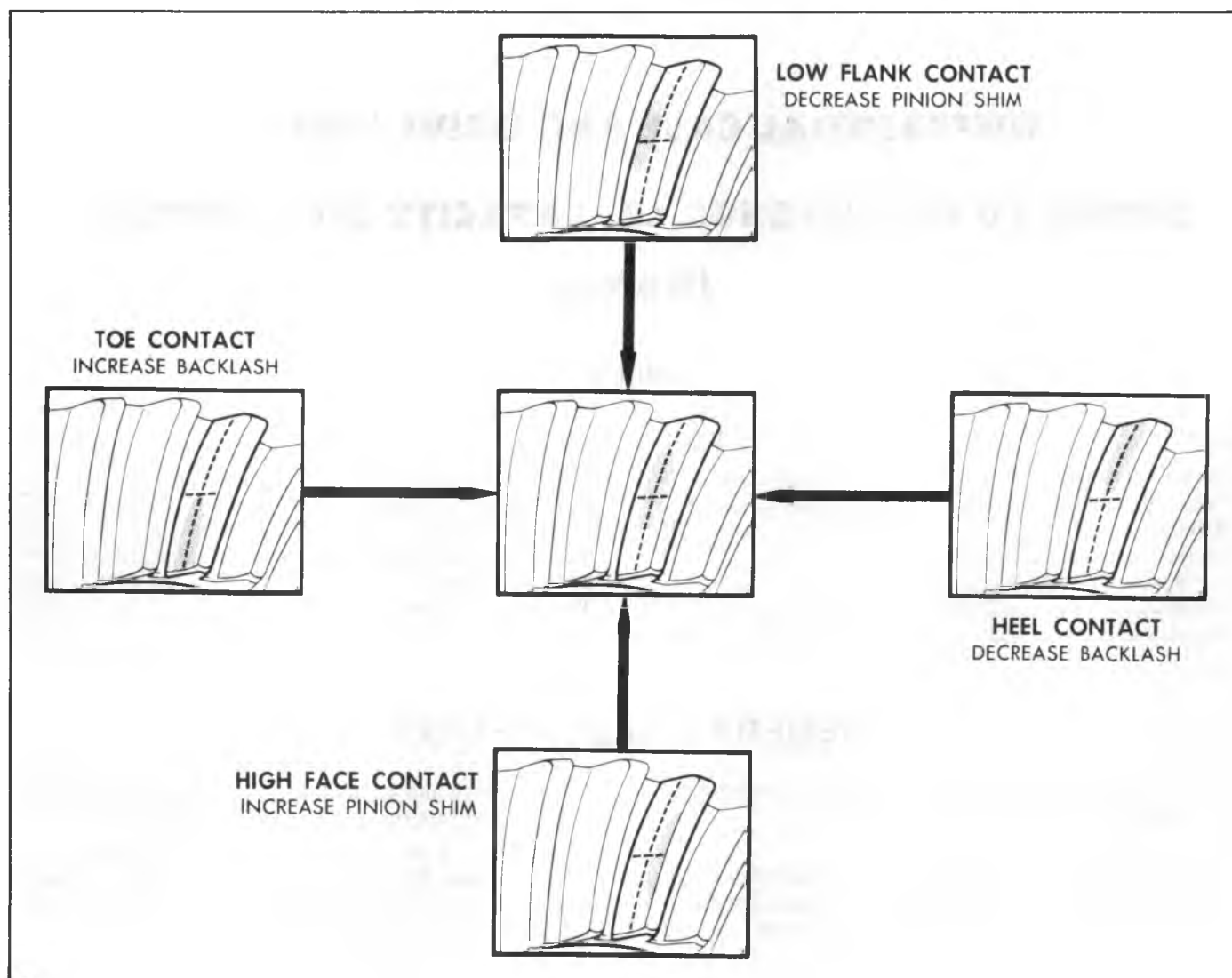


Fig. 28C—Gear Tooth Contact Pattern

### 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.

## DIFFERENTIAL CASE AND DRIVE PINION

### SERIES 20 TRUCK-5500 LB. CAPACITY DIFFERENTIAL (DANA)

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### GENERAL DESCRIPTION

The 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 (fig. 1D). 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.

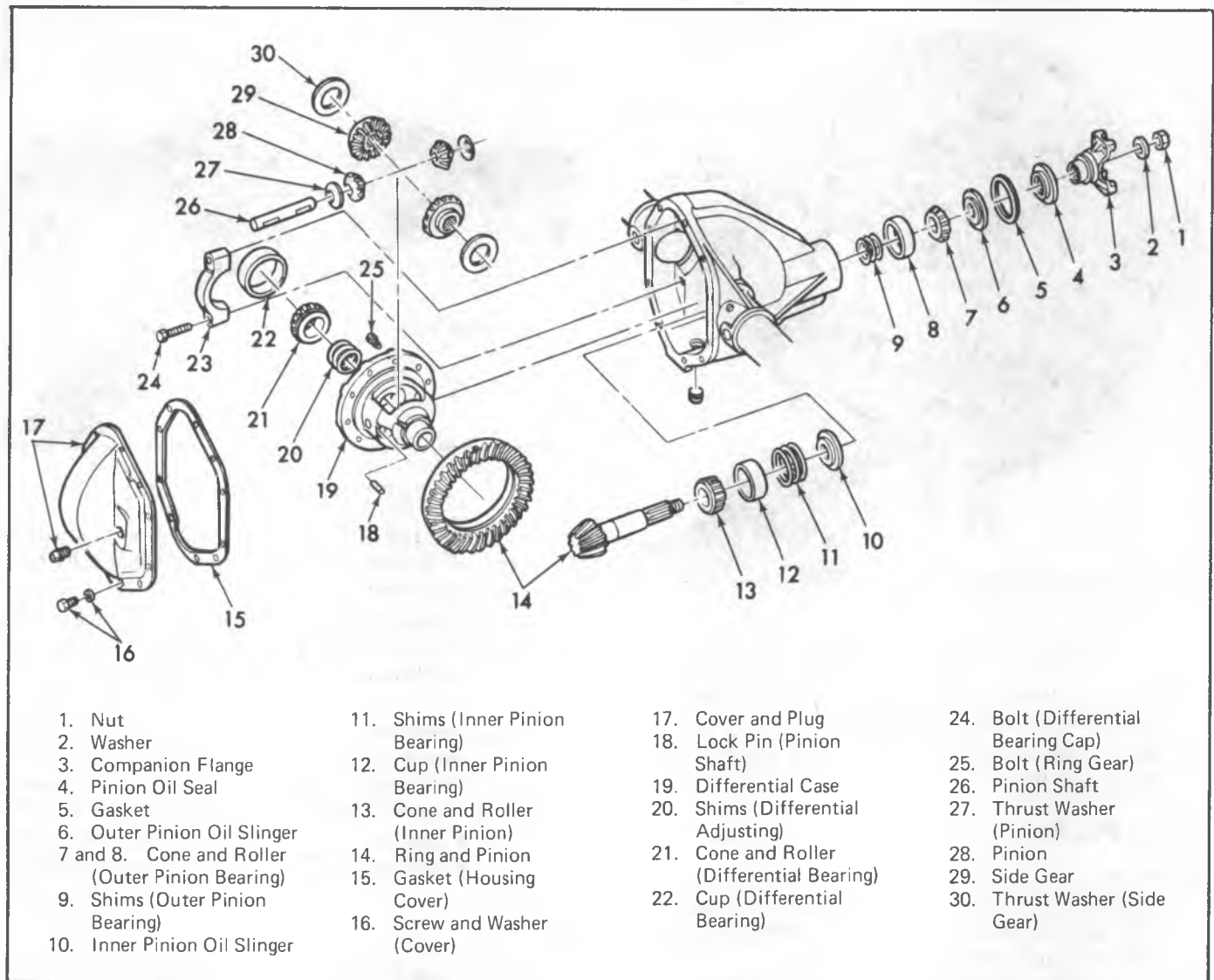


Fig. 1D--Dana Rear Axle Assembly

## 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-5231-01 and dial indicator as shown in Figure 2D, 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, Figure 3D. Tag cone and rollers for assembly.

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



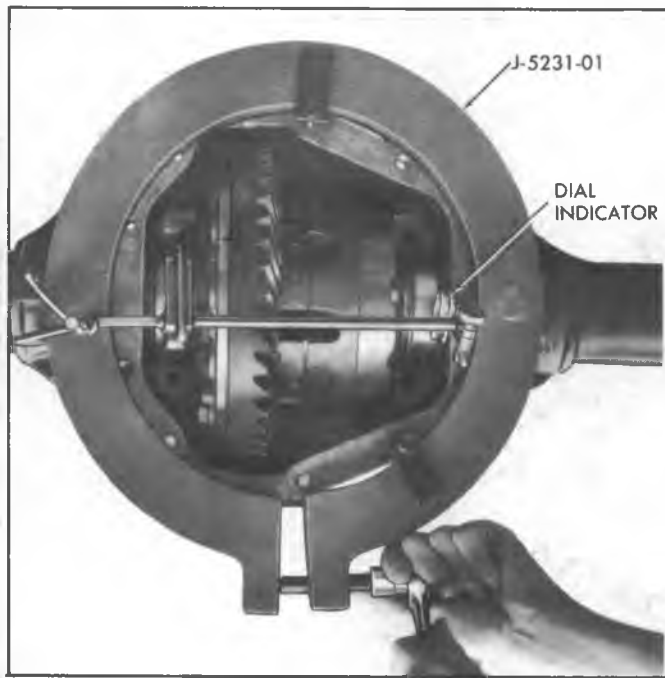


Fig. 2D--Spreader J-5231-01 Mounted on Carrier

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-8614-1, attached to pinion shaft flange, remove self-locking nut and washer from pinion shaft.

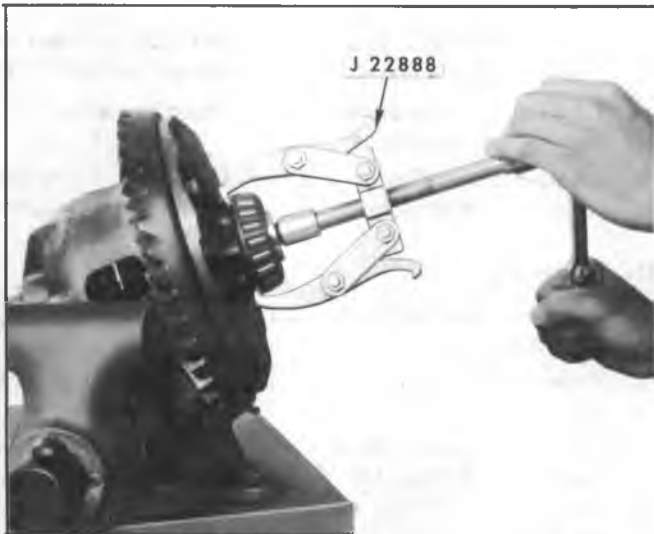


Fig. 3D--Removing Differential Side Bearings

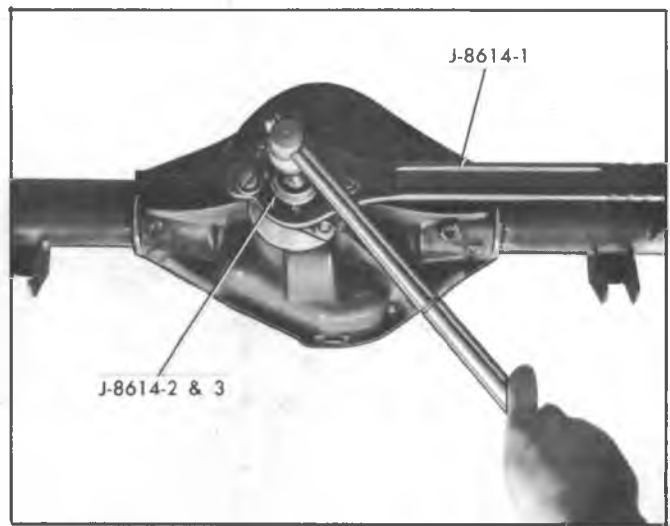


Fig. 4D--Removing Pinion Flange

3. Install Tool J-8614-2, and 3 into holding bar as shown in Figure 4D 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 5D, 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, chip-

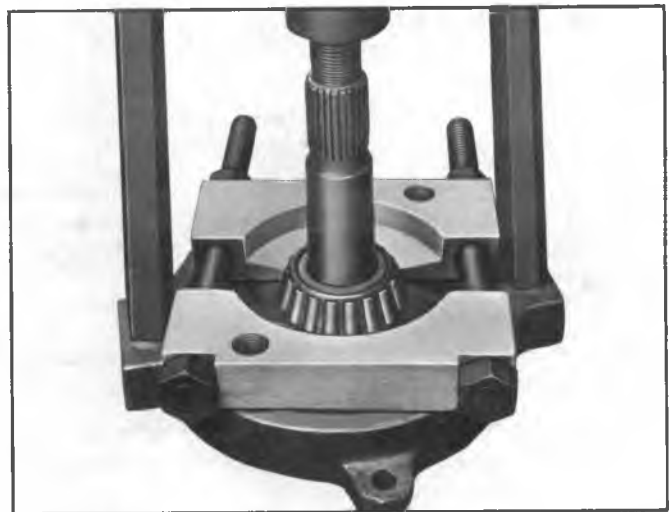


Fig. 5D--Removing Inner Pinion Bearing Cone and Roller

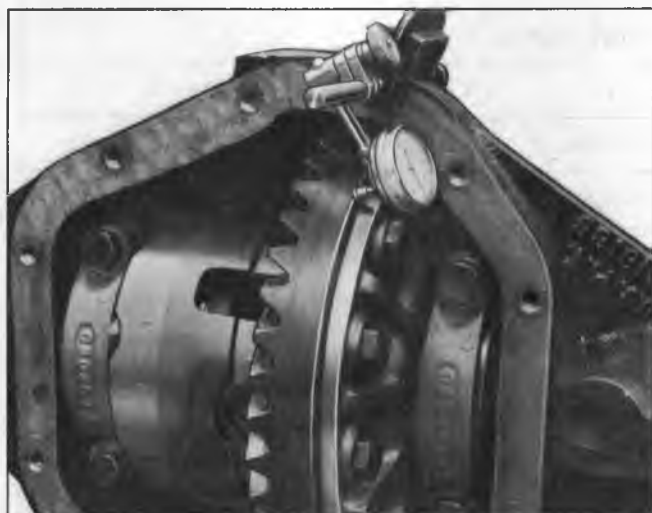


Fig. 6D--Checking Runout

ping 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.

## 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-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 (Fig. 6D). 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 "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. (Fig. 7D).

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.

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

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 above 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 as shown in Fig. 8D.
5. Press inner pinion bearing cone and roller onto pinion shaft using Installer J-9772 on arbor press as shown in Figure 9D.

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. 10D).
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



Fig. 7D-Marking From Nominal on Pinion

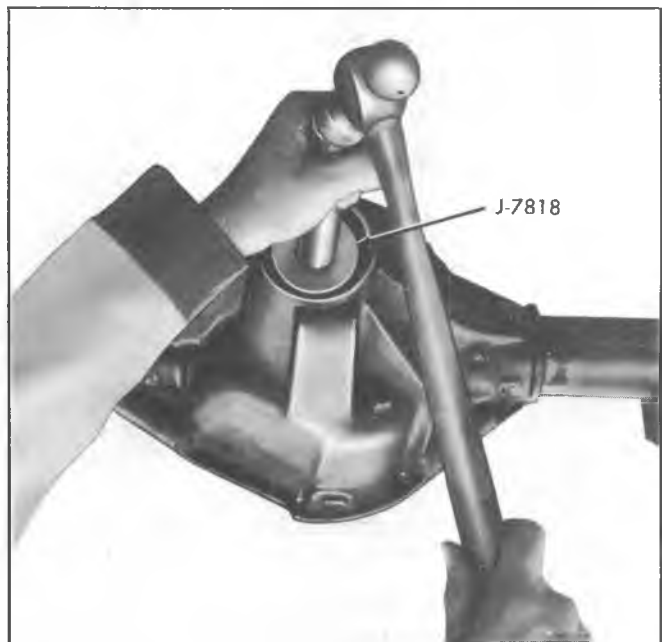


Fig. 8D-Installing Outer Pinion Bearing Cup

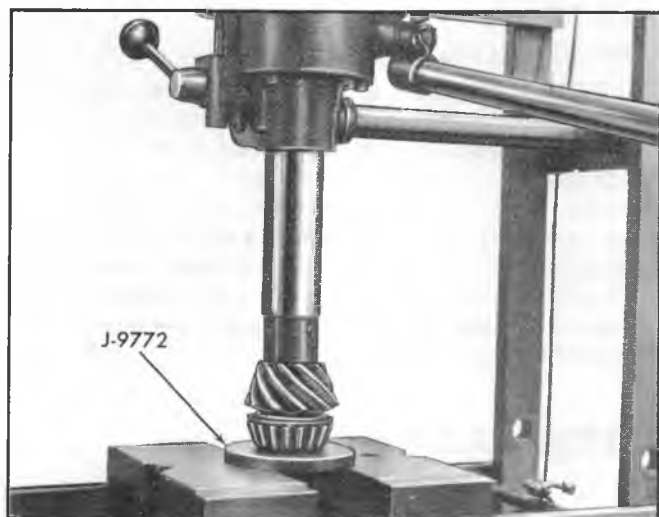


Fig. 9D—Installing Inner Pinion Cone and Roller

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

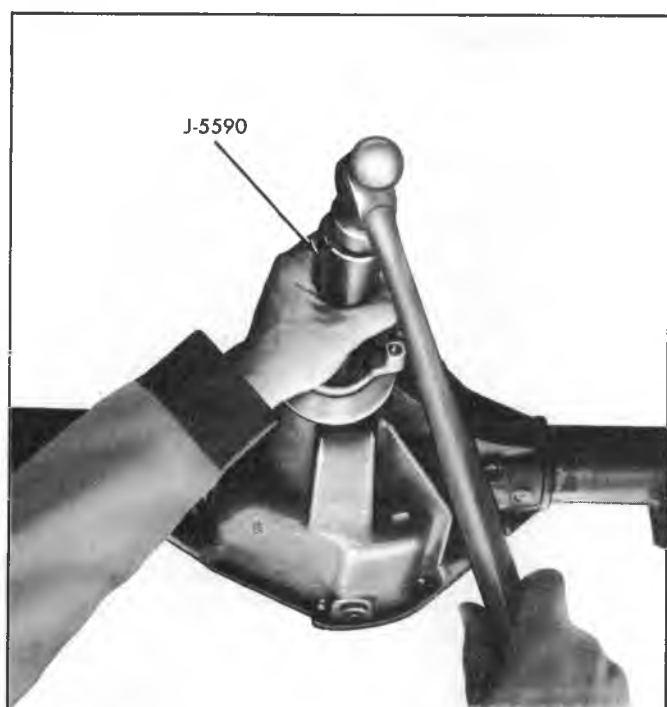


Fig. 10D—Installing Pinion Flange

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. 6D).
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 2D.
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. 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.

**CAUTION:** This propeller 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.

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:** This wheel to axle 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.

## POSITRACTION DIFFERENTIAL CASES

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## GENERAL DESCRIPTION

There are four optional Positraction differential units, namely Chevrolet, Eaton, Borg Warner and Dana Power-Lok. The Dana Power-Lok, shown in Figure 17E, is used only on Truck models and has its own repair procedure.

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 Figures 1E and 16E.

Overhaul procedures for Positraction equipped axles are the same as on a conventional axle except for the operations listed herein.

### EATON POSITRACTION-FIGURE 2E

#### 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 3E. 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 4E.

**On Corvette vehicles**, 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 5E.

3. After installing the retaining bolts in Step 2, 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 6E. Center the bar stock over the axle shaft hole in the spring retainer, then compress "C" clamp sufficiently to permit withdrawal of spring pack.

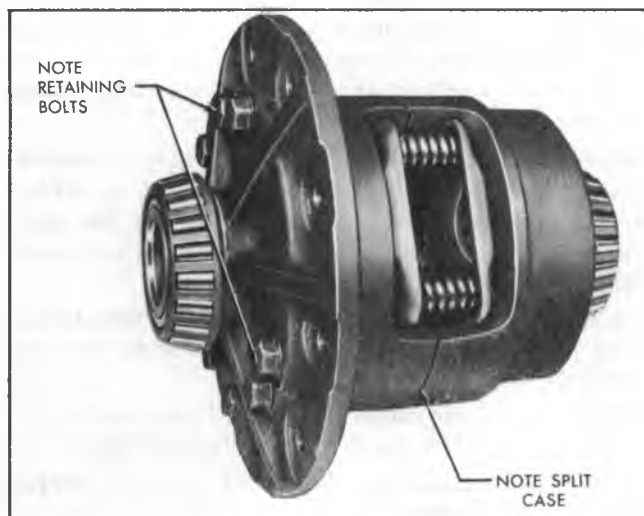


Fig. 1E-Borg Warner Positraction Identification

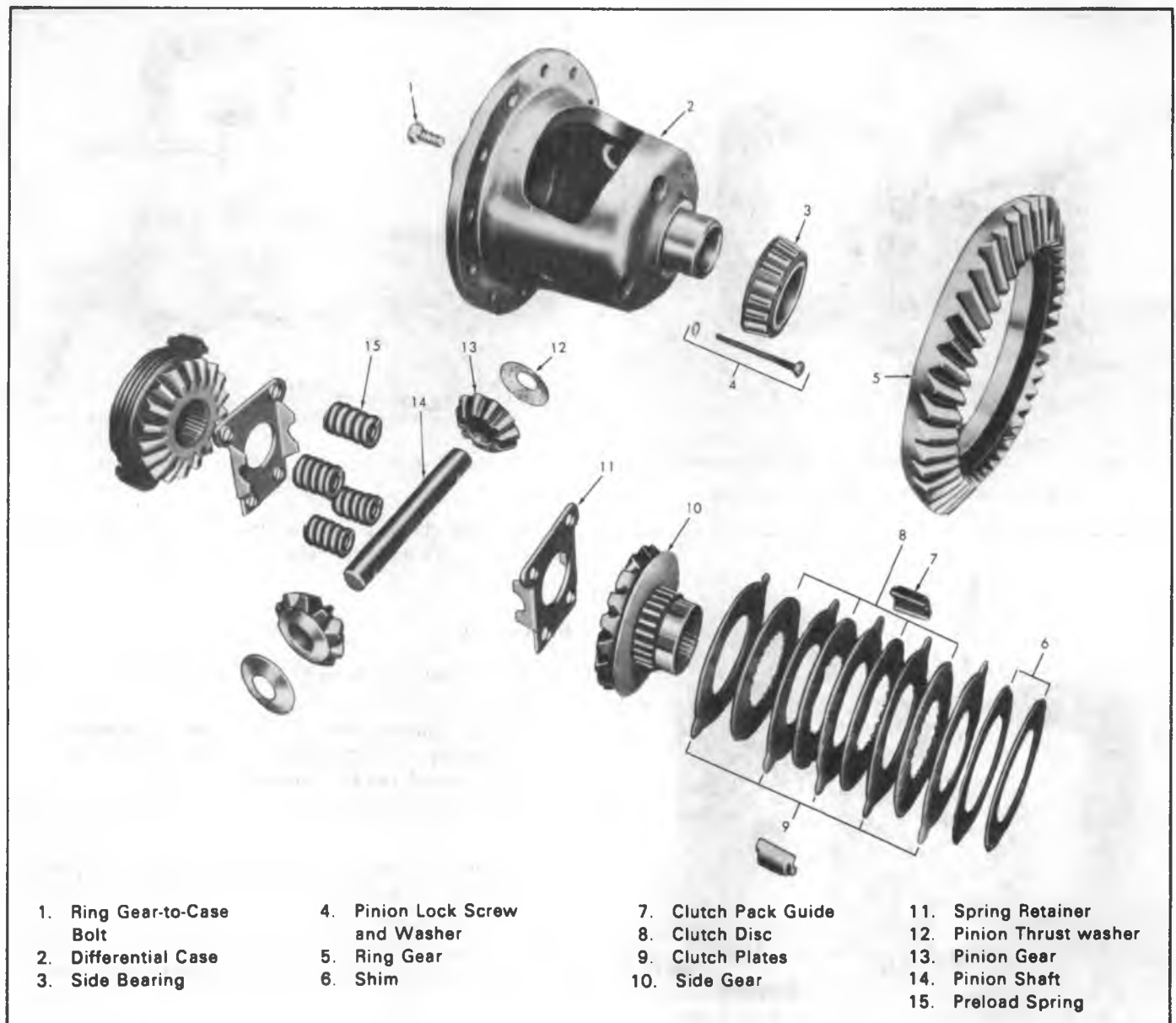


Fig. 2E--Eaton Positraction Exploded View

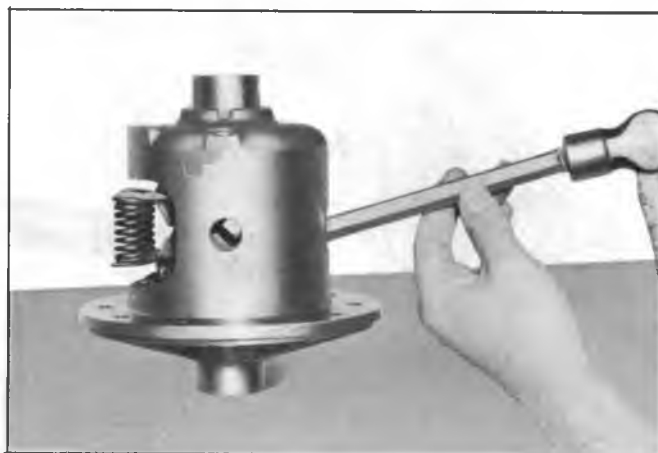


Fig. 3E--Removing Preload Spring Pack (Typical)

4. 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 7E.

5. **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 8E 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.

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



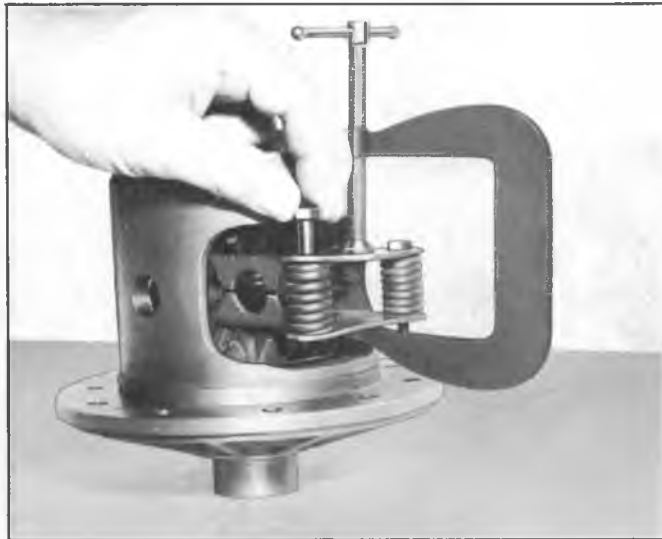


Fig. 4E--Installing Bolts to Retain Springs

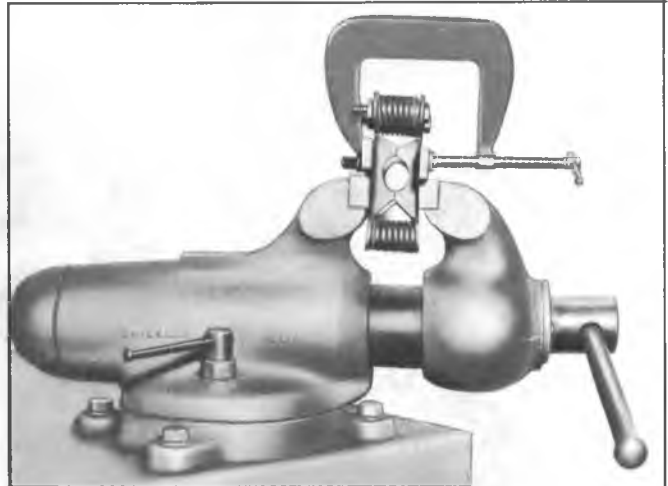


Fig. 7E--Removing Preload Springs from Pack

7. 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.

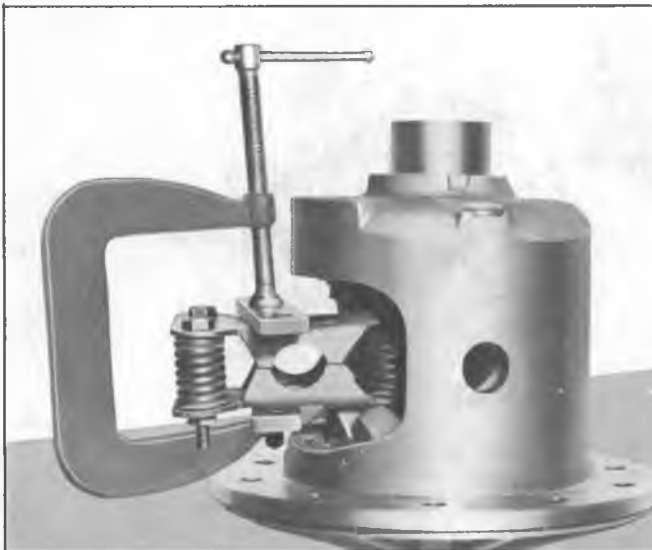


Fig. 5E--Removing Preload Spring Pack (Corvette)



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

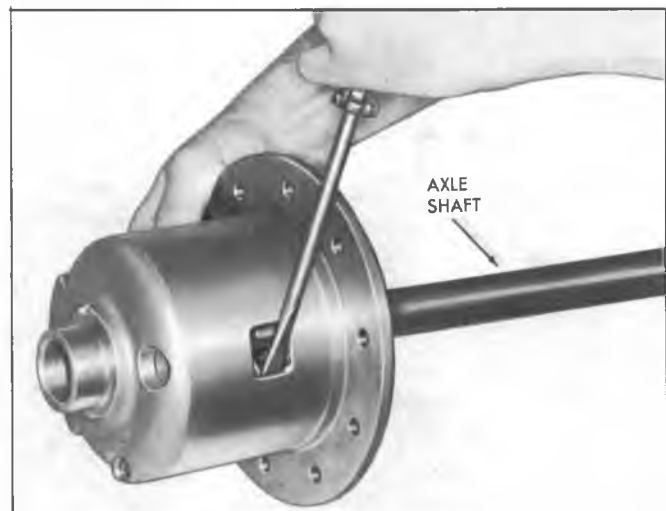


Fig. 8E--Removing Differential Pinion Gears



Fig. 9E--Removing Side Gear

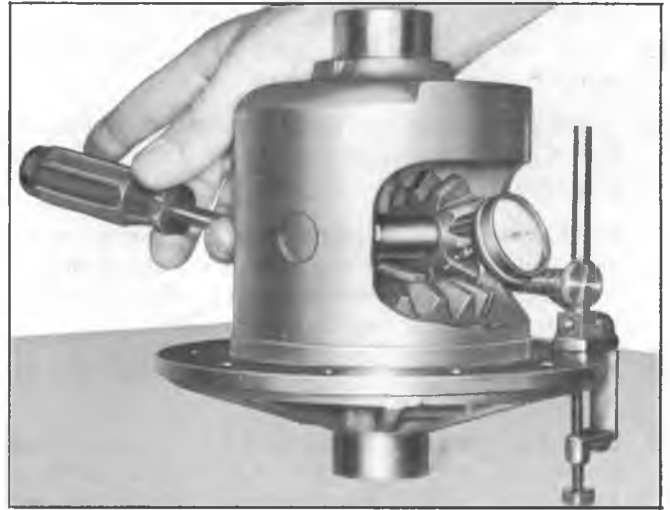


Fig. 11E--Measuring Pinion Gear Tooth Clearance

### 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 10E.
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.
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 11E.
9. Compress clutch pack, using a screw driver as shown in Figure 11E. 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.



Fig. 10E--Assembling Clutch Pack

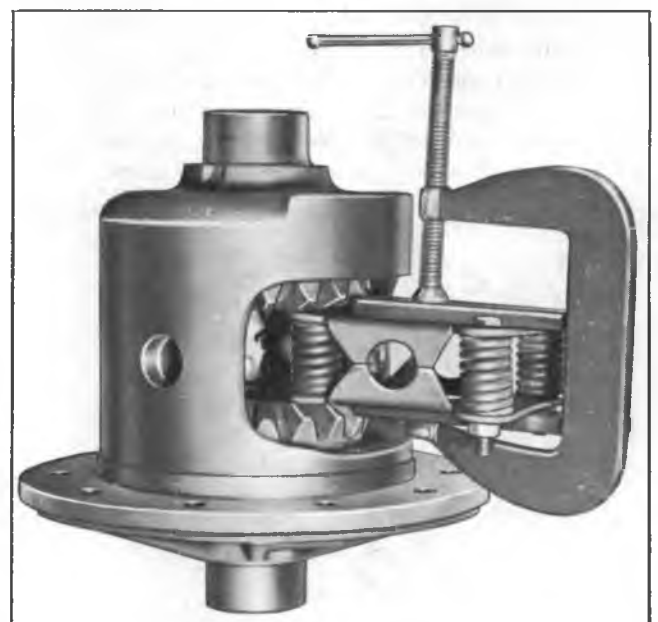


Fig. 12E--Spring Pack Compressed for Installation

## REAR AXLE DIFFERENTIAL CARRIER 4-44

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.
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 12E.
16. Position spring pack between side gears and remove bar stock and "C" clamp.
17. **On Corvette vehicles**, install Tool J-22311 to compress clutch pack, secure pack with 1/4" bolts as shown in Figure 13E. 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 14E.
19. Install the pinion shaft and lock screw to retain side gears until axle shaft installation.
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 gear 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 15E.
  - 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. 13E—Installing Spring Pack Compression Tool (Corvette)

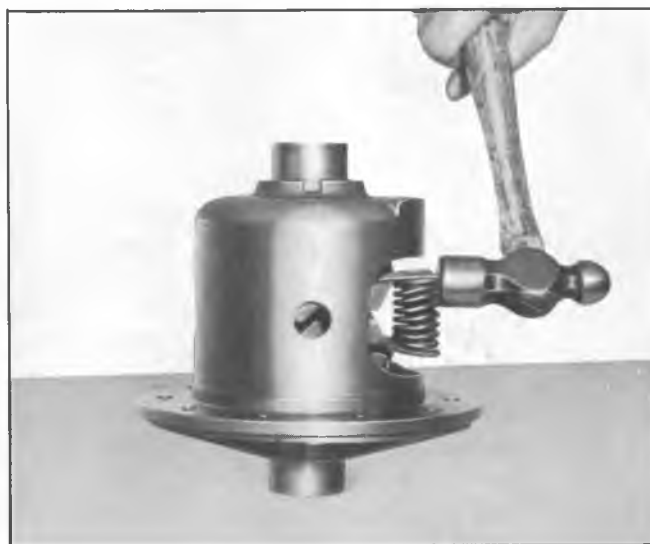


Fig. 14E—Installing Spring Pack

## CHEVROLET POSITRACTION—FIGURE 16E

A Chevrolet produced Positraction differential unit is used optionally in 8 1/2 inch ring gear axles. Like the Eaton unit, it will be serviceable. 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.

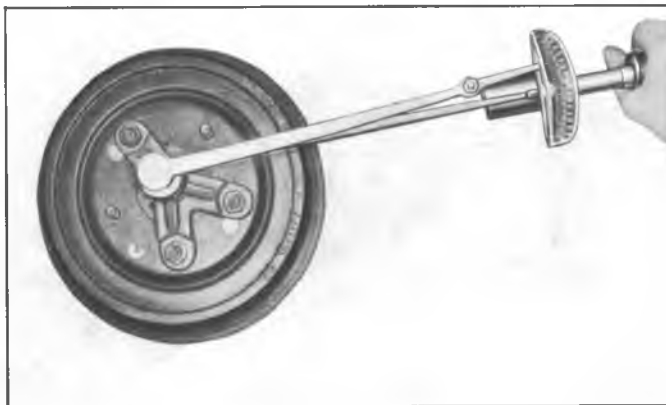


Fig. 15E—Measuring Positraction Rotating Torque

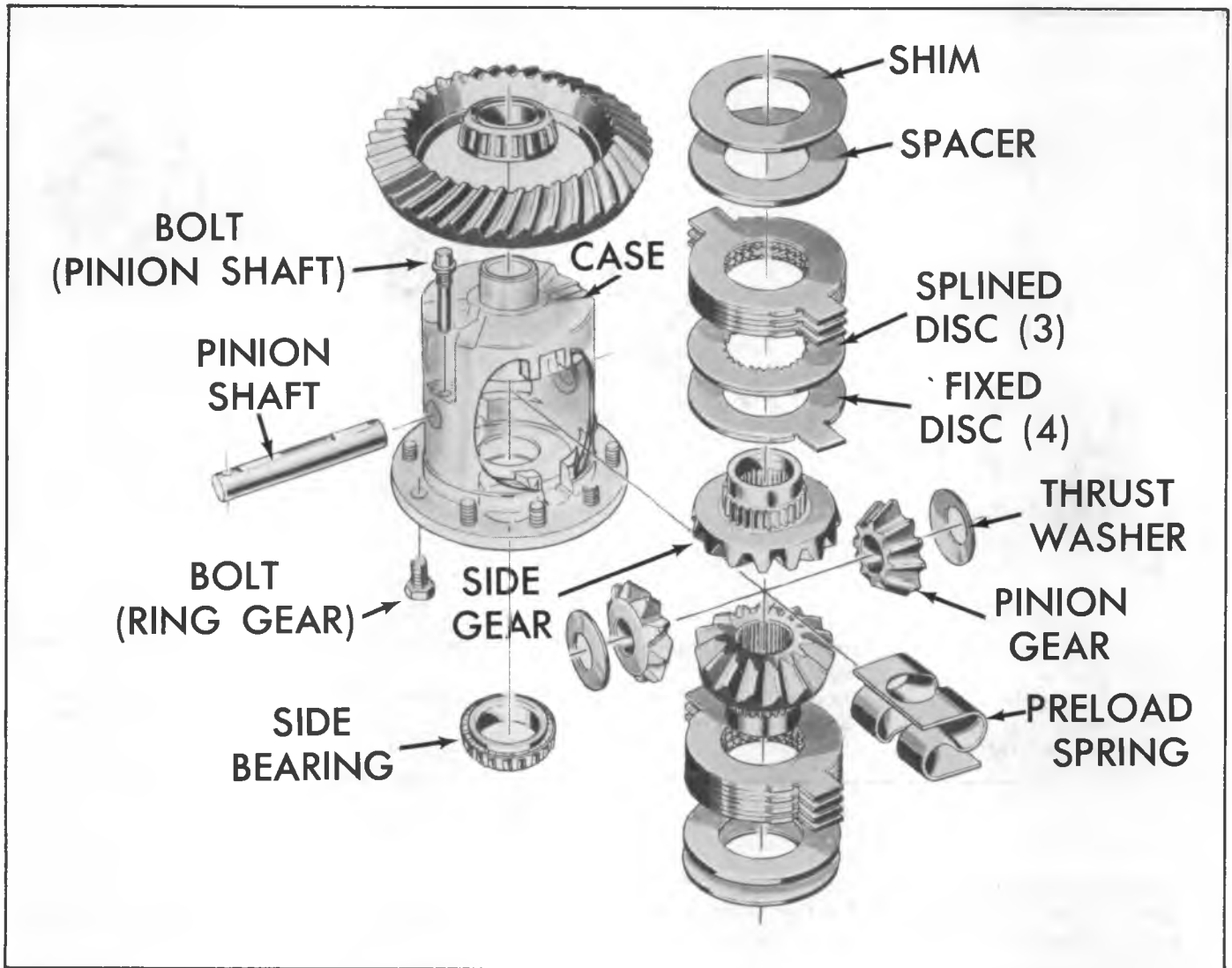


Fig. 16E-Chevrolet Positraction-Exploded

### 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 springs to 1-5/16 inches should be 300 lbs  $\pm$  30 lbs.

### Reassembly

- Lubricate the clutch discs and plates with positraction lubricant.
- Alternately position clutch plates and discs on a side gear, beginning and ending with a clutch plate.
- Position the side gear, clutch pack and original shim into the case.
- Install both pinion gears and thrust washers into the case, and install pinion shaft.
- Place the case onto an axle shaft supported in a vise.
- Insert a screwdriver between the pinion shaft and the face of the side gear. Force the screwdriver in until the clutch pack is compressed.
- 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.

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

- Remove the pinion shaft, pinion gears, side gear, clutch pack and shim from the case.
- 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.
- Follow the procedure in steps 5, 6 and 7 to determine the proper shim dimension.

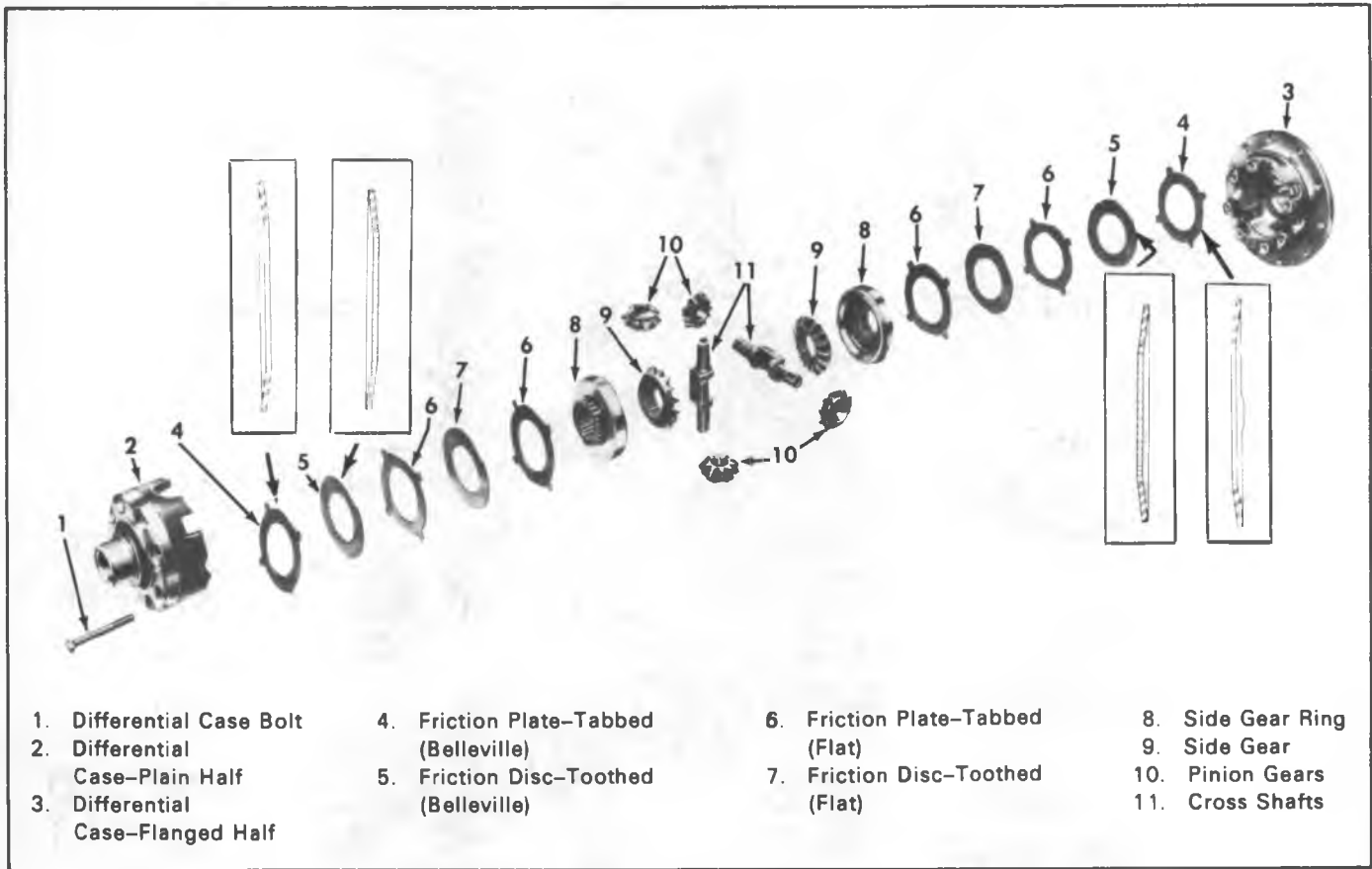


Fig. 17E--Power-Lok Differential

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.

## POWER-LOK DIFFERENTIAL

The Power-Lok differential shown in Figure 17E 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 17E.**
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.
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 17E.
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.

# SERIES 20-30 TRUCK 5200, 7200 AND 11,000 LB. CAPACITY AXLE DIFFERENTIALS

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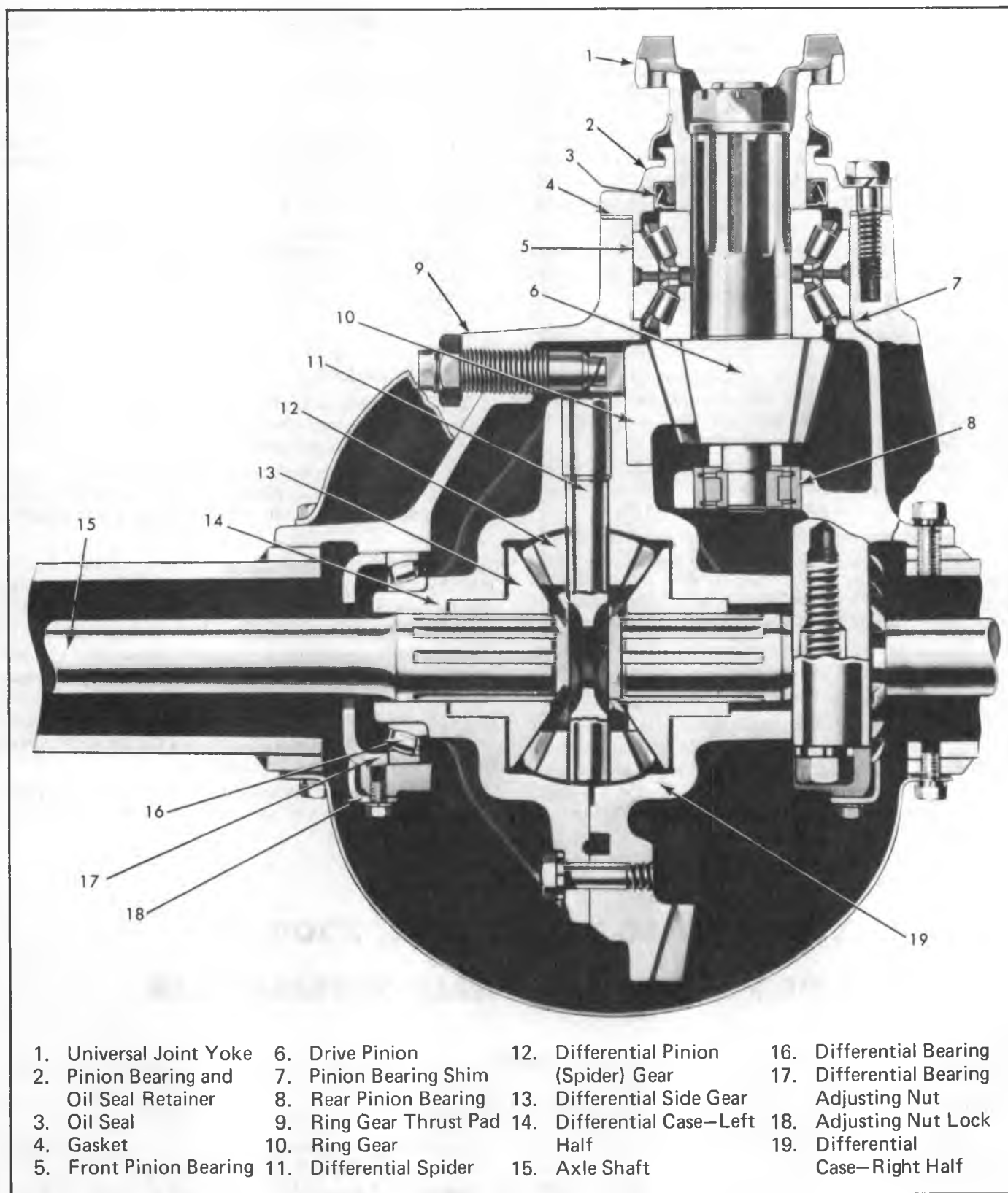
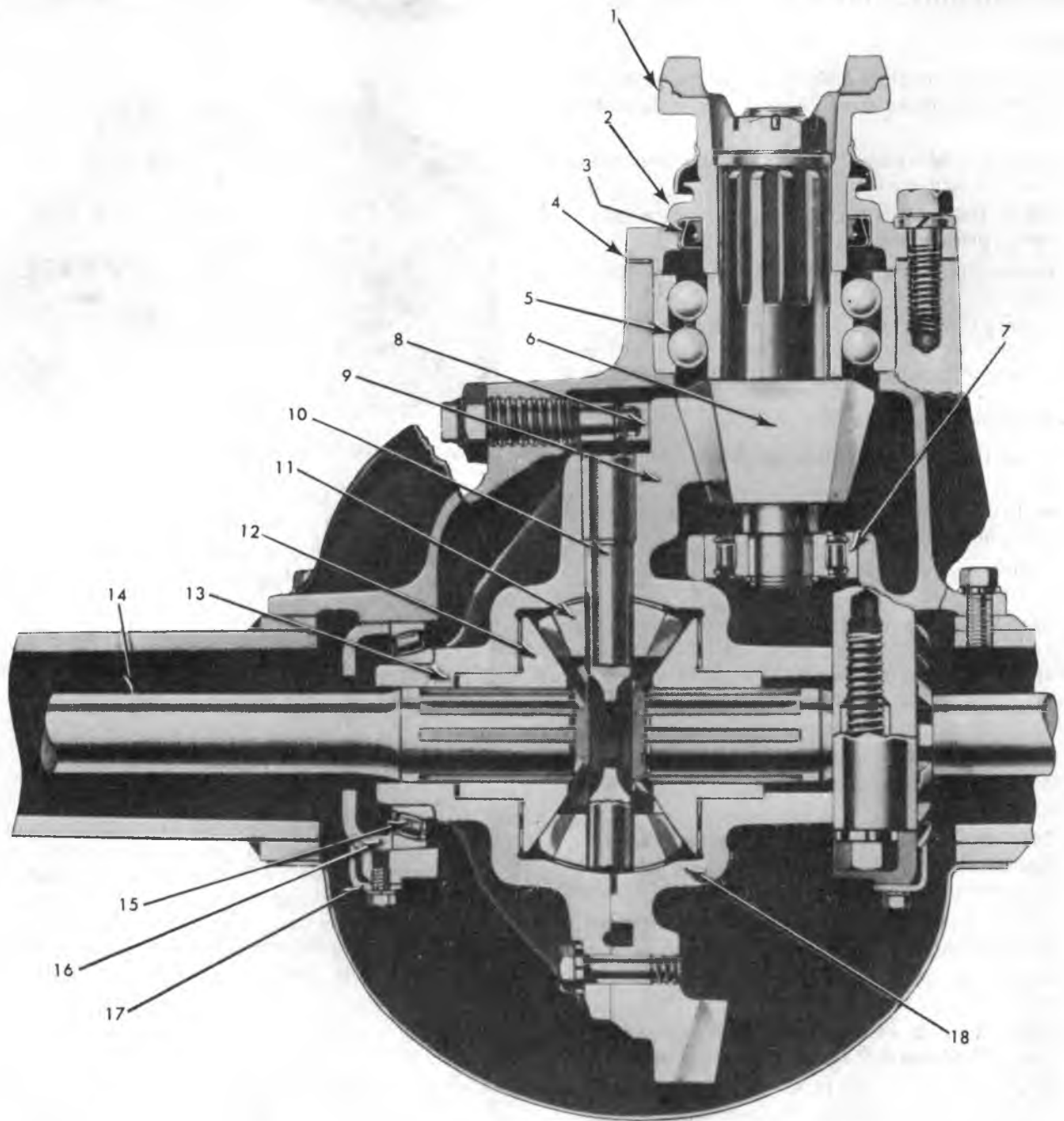


Fig. 1F-5200 and 7200 lb. Capacity Axle—Cross Section



1. Universal Joint Yoke
2. Pinion Bearing Oil Seal and Retainer
3. Oil Seal
4. Oil Seal Gasket
5. Front Pinion Bearing
6. Drive Pinion
7. Rear Pinion Bearing

8. Ring Gear Thrust Pad
9. Ring Gear
10. Differential Spider
11. Differential Pinion (Spider) Gear
12. Differential Side Gear
13. Differential Case-Left Half

14. Axle Shaft
15. Differential Bearing
16. Differential Bearing Adjusting Nut
17. Adjusting Nut Lock
18. Differential Case-Right Half

Fig. 2F--11,000 lb. Capacity Axle--Cross Section

## CASE AND DRIVE PINION (FIG. 1F-2F)

### 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. On 11,000 lb. axle, 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.**

8. On all axles except the 11,000 lb., remove shims from carrier making note of number and total thickness of shims removed.
9. On all axles except the 11,000 lb., the pinion rear bearing outer race and roller assembly is pressed into the carrier. Remove assembly by driving it from its seat using a soft drift or punch as shown in Figure 3F.

### 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.

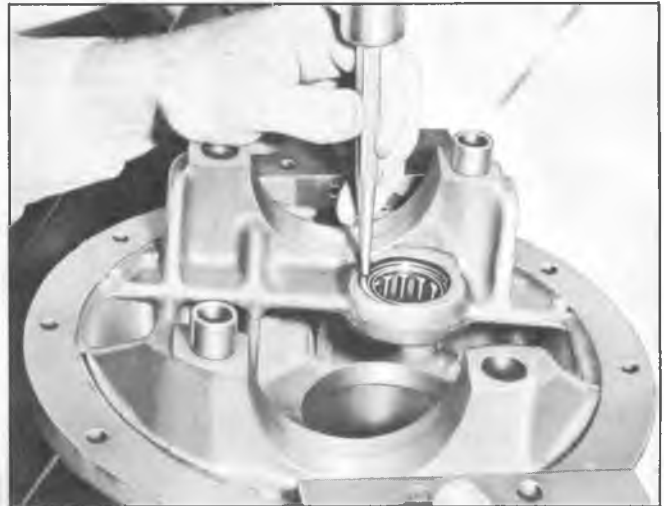


Fig. 3F--Pinion Rear Bearing Removal (Except 11,000 Lb.)

4. Drive oil seal from retainer. Discard seal as new parts should be used at assembly.
5. On the 11,000 lb. axle, remove pinion rear bearing snap ring and press bearing from pinion, using Tool J-1453 (fig. 4F).
6. On the 5200, and 7200 lb. axles position drive pinion in an arbor press as shown in figure 5F, and press pinion from bearing, using appropriate tool as follows.
  - a. J-2224--5200 lb. axle (except P20).
  - b. J-2225--7200 lb. axle (seven tooth pinion and P20).
  - c. J-1439--7200 lb. axle (six tooth pinion).
7. On the 11,000 lb. axles, position drive pinion in an arbor press so that the bearing is supported by two pieces of flat steel stock as shown in Figure 6F. 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.

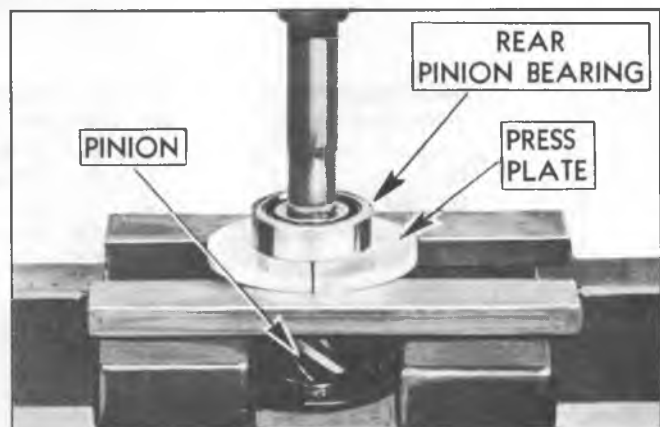


Fig. 4F--Pinion Rear Bearing Removal (11,000 Lb. Axle)

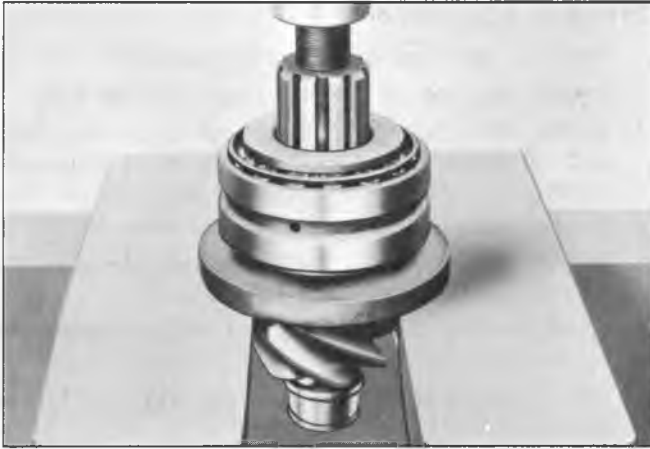


Fig. 5F-- Drive Pinion Front Bearing Removal--5200, 7200 lb. Axle (Typical)

### 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.

### 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 7F.
3. On the 5200, 7200 lb. axles, lubricate the pinion rear bearing and carefully press it into carrier.

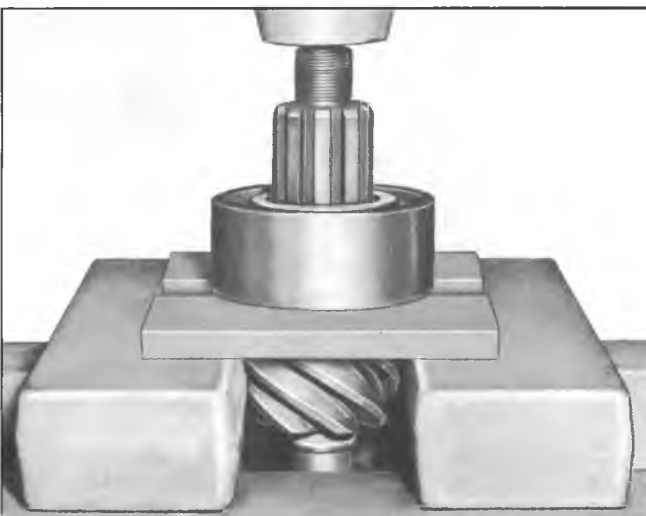


Fig. 6F--Drive Pinion Front Bearing Removal (11,000 Lb. Axle)



Fig. 7F--Pinion Oil Seal Installation (Typical)

4. Install the 11,000 lb. axle 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 8F.
5. Install pinion front bearing as follows:
  - a. 11,000 lb. axles--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.

- b. 5,200, 7,200 lb. axles--Place one cone and roller assembly on pinion shaft so that large end of bearing is toward pinion then position outer race, spacer and cone and roller assembly on pinion shaft. Position pinion and bearing assembly in press as shown in Figure 9F and seat bearing against pinion head.

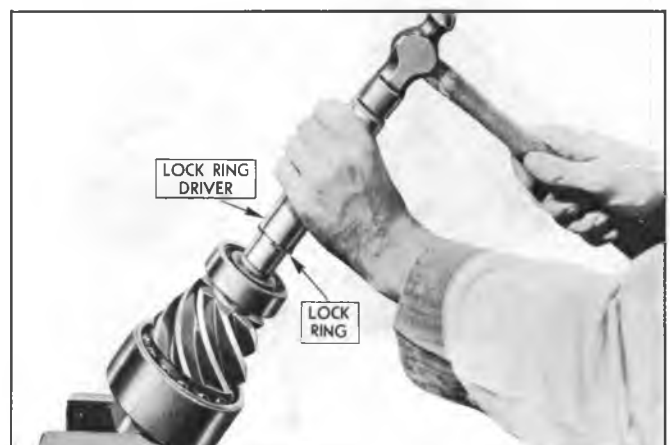


Fig. 8F--Pinion Rear Bearing Lock Ring Installation (11,000 Lb. Axle)



Fig. 9F--Pinion Front Bearing Installation

**NOTE:** The opposed tapered bearing assembly is serviced as a unit and consists of one double outer race, two inner race and roller assemblies and one spacer. These parts should always be installed as a group as the spacer is preselected to give proper pinion bearing adjustment.

6. Slide oil seal retainer on pinion shaft, then tap drive flange onto pinion splines.
7. 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 10F.

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.

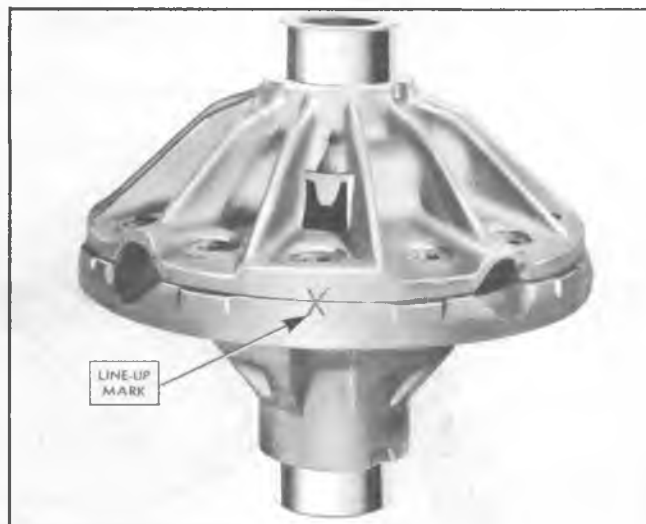


Fig. 10F--Differential Case Line-Up Marks

### 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.
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 11F.
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 appropriate tool as shown in Figure 12F.
  - a. J-2226--5200 and 7200 lb. axles.
  - b. J-1488--11,000 lb. axle.



Fig. 11F--Differential Bearing Removal



Fig. 12F--Differential Bearing Installation

**NOTE:** The side bearing tool is counterbored 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

To facilitate adjusting of pinion depth in the ring gear, there are five shims available for service use. They are .012", .015", .018", .021" and .024".

**NOTE:** Pinion depth adjustment shims are not required for the 11,000 lb. axle.

If the original ring gear and pinion are to be used it is advisable to replace the same thickness of shims in the carrier counter bore that were removed.

If a new ring gear and pinion are used, one .021" shim should be used as a standard starting set up.

1. Place shim in bore in carrier or between carrier and pinion oil seal retainer.

2. 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.

3. Install pinion bearing retainer bolts and lock washers and torque bolts to specifications.
4. Lubricate differential bearing rollers with engine oil and place outer races over them.
5. 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.

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

### Ring Gear and Pinion 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 13F.
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.

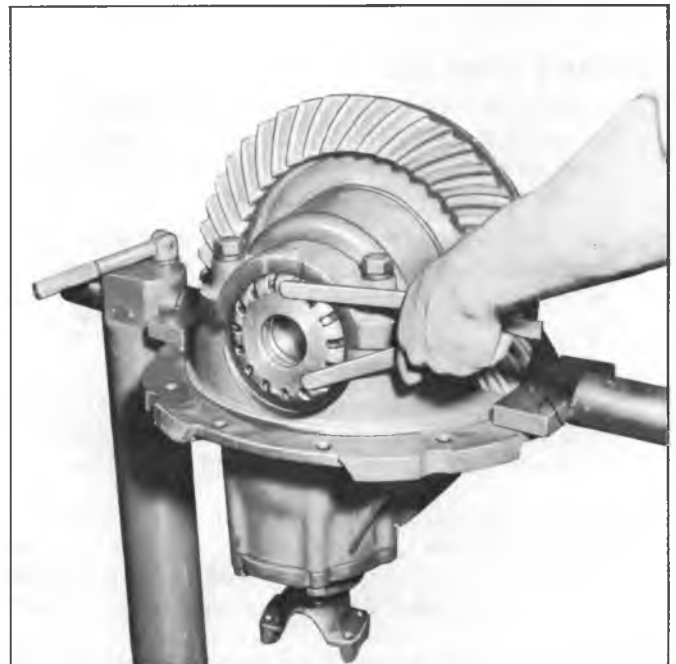


Fig. 13F--Ring Gear and Pinion Adjustment



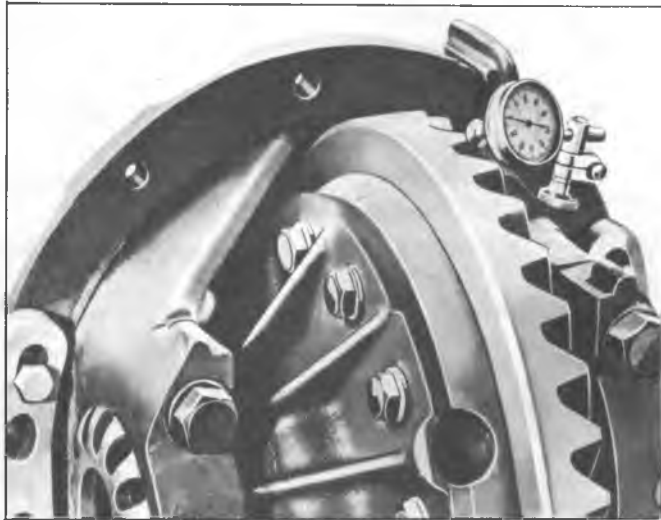


Fig. 14F--Checking Ring Gear and Pinion Backlash

**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 14F. Backlash should be from .003" to .012" (.005" to .008" preferred).

**NOTE:** If backlash is more than .012 in. 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.

### Checking Pinion Depth

1. Coat the ring gear teeth lightly and evenly with a mixture of powdered red lead and oil of a suitable consistency to produce a contact pattern. Then turn the pinion shaft several revolutions in both directions.
2. Examine the pattern on the ring gear teeth. If the pinion depth is correct, the tooth pattern will be centered on the pitch line and toward the toe of the ring gear. See Figure 26A.
3. If the pattern is below the pitch line on the ring gear teeth, the pinion is too deep and it will be necessary to remove the pinion assembly and increase the shim thickness between the pinion bearing and the carrier.
4. If the pattern is above the pitch line on the ring gear teeth, the pinion is too shallow and it will be necessary to remove the pinion assembly and decrease the shim thickness between the pinion bearing and the carrier.
5. Changing the pinion depth will make some change in the backlash; therefore, it will be necessary to readjust the 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 lock-nut to specifications. See Figure 15F.

**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 lock-washers and bolts and tighten securely.
3. Replace axle housing inspection cover, if removed, using new gasket.

**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.

4. Assemble rear universal joint.
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 O in the Truck Service Manual for proper lubricant.



Fig. 15F--Ring Gear Thrust Pad Adjustment

# NO-SPIN DIFFERENTIAL UNIT

The optionally available NO-SPIN differential unit shown in Figure 1G is installed in a conventional 5200 or 7200 lb. rear axle housing and the only difference in service proce-

dures are the Disassembly, Assembly and Adjustment procedures outlined below.

## Disassembly

1. Chisel or punch alignment marks on differential case. See Figure 10F.

**CAUTION:** The no-spin differential is assembled under spring tension. It is originally supplied with a retaining bolt, nut and washers used to compress the unit until the differential case bolts are installed and tightened. If this retainer bolt is not available, use a 1/2-13x6 bolt with nut and washers to compress the unit until the differential case halves are opened. If a retainer bolt is not used, hold differential case halves firmly to prevent sudden spring release.

2. Remove differential case and cover bolts and remove no-spin as shown in Figure 2G.
3. Remove side gears, springs and retainers and driven clutches.
4. Remove split holdout rings with snap ring pliers J-5586. See Figure 3G.

**NOTE:** Spider, center cam and snap ring assembly need not be disassembled as they are not serviced separately.

## Inspection

Wash all parts and inspect as follows:

1. Check side gear and driven clutch splines for excessive wear or fracture.
2. Check spider, center cam, holdout ring and driven clutch teeth for excessive chipping or burring. Minor chips or burrs may be stoned smooth.

**NOTE:** Replace holdout rings or cams in pairs only.

3. Check spring retainer seat and splines for fractures.
4. Measure spring height. Free height should be 2 1/8"-2 1/4" as shown in Figure 4G.

## Reassembly

1. Lubricate all clutch teeth and cams before assembly.
2. Assemble split holdout rings to center cam and spider assembly. Refer to Figure 5G to align spider key with slot in holdout ring.
3. Assemble driven clutches, spring retainers, springs and side gears to spider and center cam assembly.

**NOTE:** Carefully position spring seats inside retainer cups.

4. Compress no-spin assembly as shown in Figure 6G with retainer bolt if available. If bolt is not used, install no-spin in differential case, rotate to engage splines, and hold with firm hand pressure until case and cover bolts are tightened. Torque bolts evenly to specifications.
5. Install no-spin unit in carrier and adjust bearings and backlash as outlined previously for the conventional differential unit.
6. Check operation of unit as follows.
  - a. Raise rear of vehicle until both rear wheels are off the floor.
  - b. Shift transmission into gear.
  - c. Rotate both rear wheels as far forward as possible.

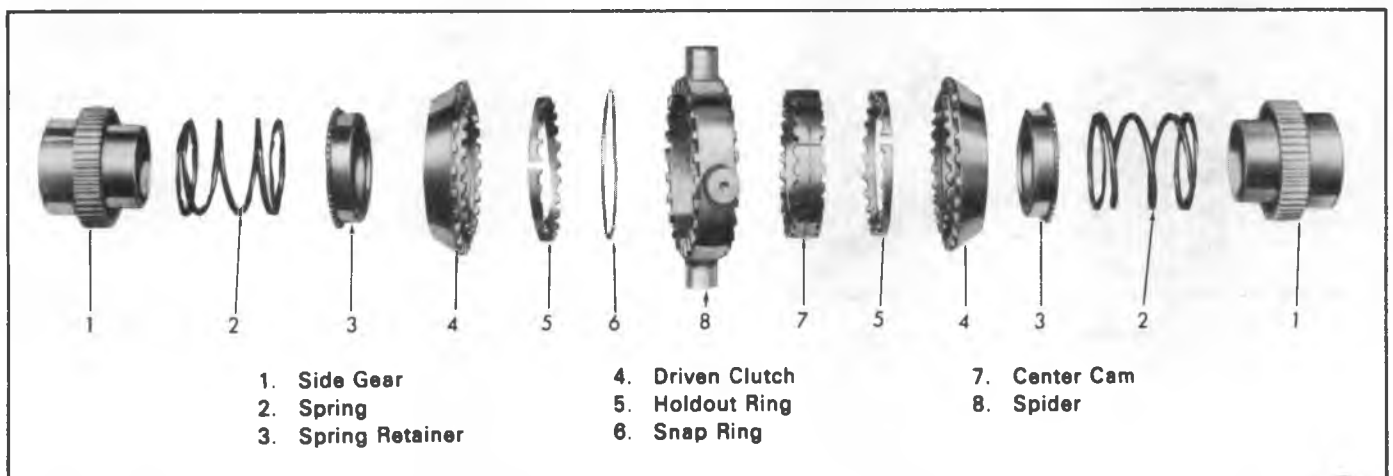


Fig. 1G--No-Spin Differential Unit--Exploded View

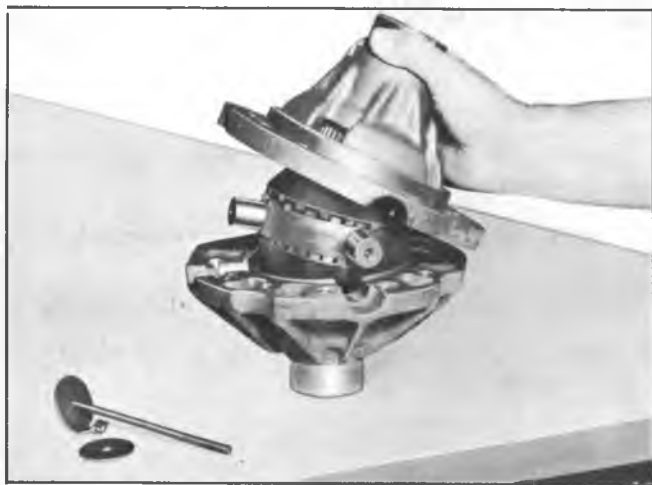


Fig. 2G--Disassembling Case and Cover



Fig. 3G--Removing Holdout Rings

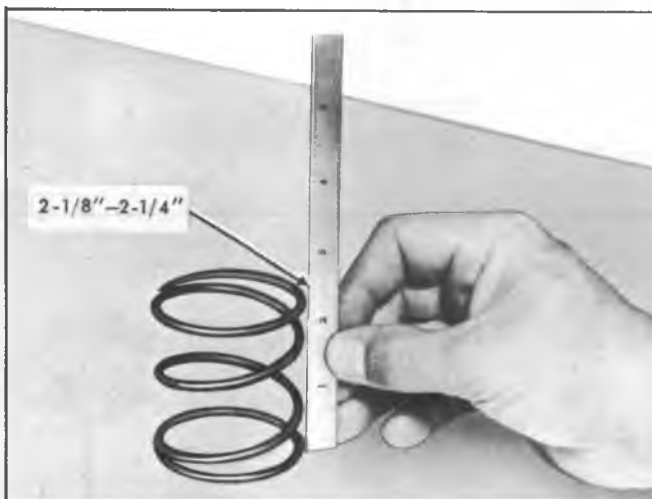


Fig. 4G--Measuring Spring Free Height

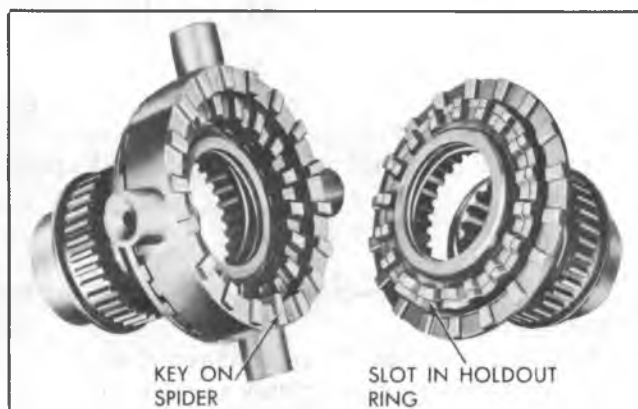


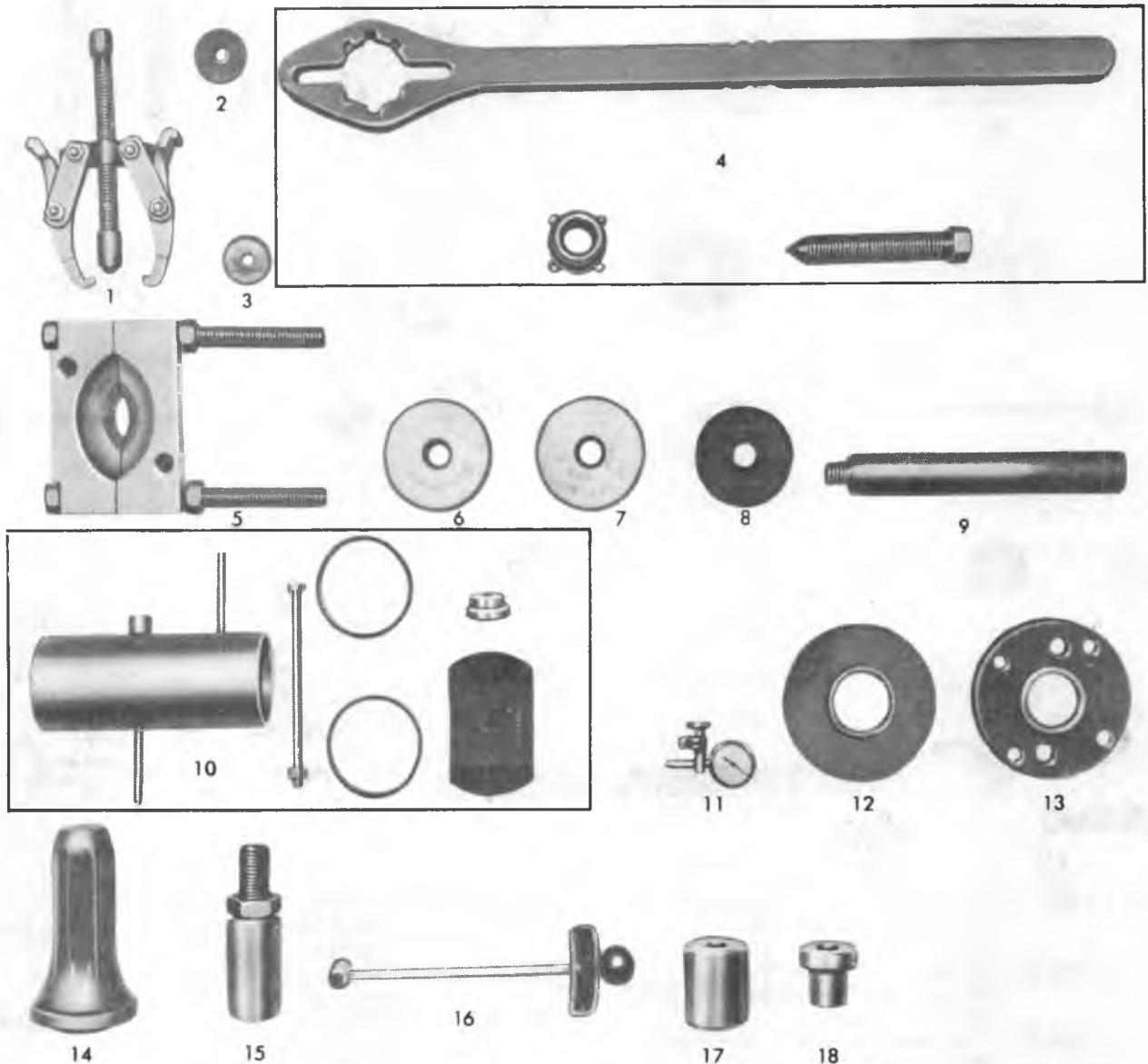
Fig. 5G--Aligning Spider Key and Holdout Ring



Fig. 6G--Assembling No-Spin Unit

- d. With assistant holding left wheel forward, rotate the right wheel to the rear, checking for free rotation.
- e. Rotate both wheels as far to the rear as possible.
- f. While holding the left wheel rearward, rotate the right wheel forward, again checking for free rotation.
- g. Repeat Steps c-f, holding the right wheel and rotating the left wheel for left side forward and rearward operation check.
- h. If wheels cannot be rotated freely as described above, remove and inspect the No-Spin.

# SPECIAL TOOLS



- |             |  |             |   |
|-------------|--|-------------|---|
| 1. J-22888  | Differential Side Bearing Remover Use with J-8107-4 Adapter Plug on P&M Type Axles and J-8107-2 for all others | 10. J-6266  | Pinion Depth Setting Gauge Consists of J-6266-31 Ring Adapters (For P Type Axles) J-6266-54 Gauge Plate J-6266-25 Front Pinion Bearing Bore Plug Used with J-8001 Indicator |
| 2. J-8107-4 | Adapter Plugs—P and M Type Axles   | 11. J-8001  | Dial Indicator  |
| 3. J-8107-2 | Adapter Plug K,G,B,O Type Axles  | 12. J-6547  | Drive Pinion Rear Pinion Bearing (P Type Axle)  |
| 4. J-8614   | Companion Flange Remover Consists of: J-8614-10 Holder J-8614-1 Nut J-8614-2 Screw                             | 13. J-9772  | Drive Pinion Bearing Installer K,G,B,O Type Axles   |
| 5. J-22912  | Press Plate  | 14. J-22388 | Drive Pinion Oil Seal Installer   |
| 6. J-7137   | Drive Pinion Front Bearing Cup Installer Use with J-8092 Driver Handle   | 15. J-9458  | Companion Flange Installer  |
| 7. J-9745   | Drive Pinion Rear Bearing Cup Installer K,G,B,O Type Axles Use with J-8092 Driver Handle                       | 16. J-5853  | In.-Lbs. Torque Wrench  |
| 8. J-860    | Drive Pinion Rear Bearing Cup Installer P Type Axle Use with J-8092 Driver Handle                              | 17. J-22175 | Differential Side Bearing Installer P Type Axle   |
| 9. J-8092   | Drive Handle   | 18. J-22761 | Differential Side Bearing Installer K,G,B,O Type Axles  |

Fig. 1T—Special Tools—Chevrolet, Nova, Camaro and I25" W.B. Station Wagon

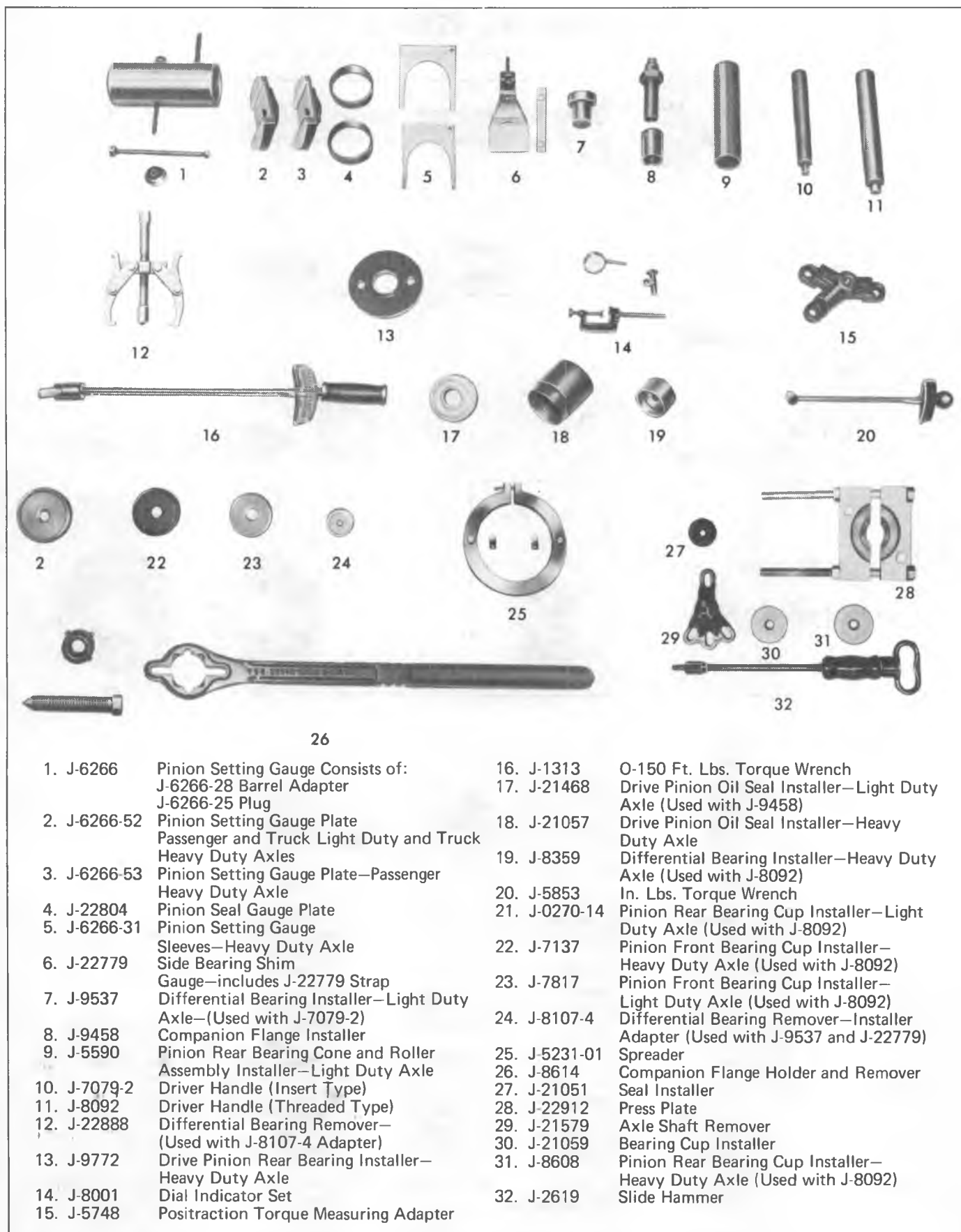
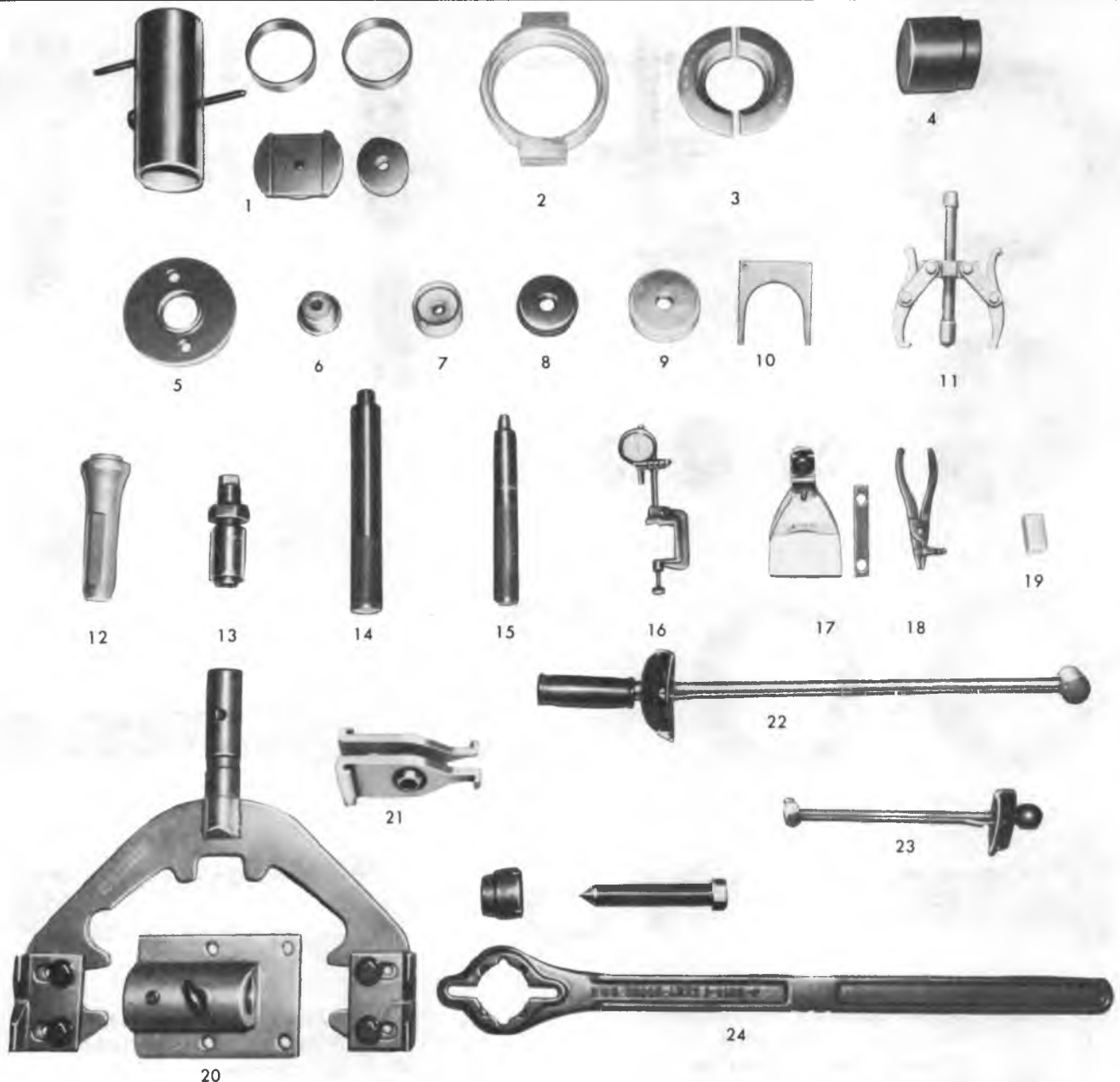


Fig. 2T—Special Tools—Chevelle, Monte Carlo, 116" W.B. Station Wagon and 10 Series Truck



- |               |  |              |   |
|---------------|--|--------------|---|
| 1. J-6266     | Pinion Setting Gauge—Consists of J-6266-28 Barrel Gauge, J-6266-31 Gauge Sleeves and J-6266-53 Gauge Plate | 11. J-22888  | Differential Bearing Remover (Used with J-8107-4) |
| 2. J-0358-1   | Press Plate Holder   | 12. J-9774   | Differential Yoke Bearing Seal Installer          |
| 3. J-9771     | Drive Pinion Bearing Cone and Roller Assembly Remover (Used with J-0358-1)                                 | 13. J-5780   | Companion Flange Installer                        |
| 4. J-21058    | Drive Pinion Oil Seal Installer  | 14. J-8092   | Driver Handle (Threaded Type)                     |
| 5. J-9772     | Drive Pinion Rear Bearing Cone and Roller Assembly Installer   | 15. J-7079-2 | Driver Handle (Insert Type)                       |
| 6. J-9773     | Differential Yoke Bearing Install (Used with J-7079-2)   | 16. J-8001   | Dial Indicator Set                                |
| 7. J-8359     | Differential Bearing Installer (Used with J-8092)  | 17. J-22779  | Side Bearing Shim Gauge—Includes J-22779 Strap    |
| 8. J-7137     | Drive Pinion Front Bearing Cup Installer (Used with J-8092)  | 18. J-4880   | Snap Ring Pliers                                  |
| 9. J-8608     | Drive Pinion Rear Bearing Cup Installer (Used with J-8092)   | 19. J-5810   | Torque Wrench Adapter (3/4" male to 3/8" female)  |
| 10. J-22804-1 | Pinion Seal Gauge Plate  | 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



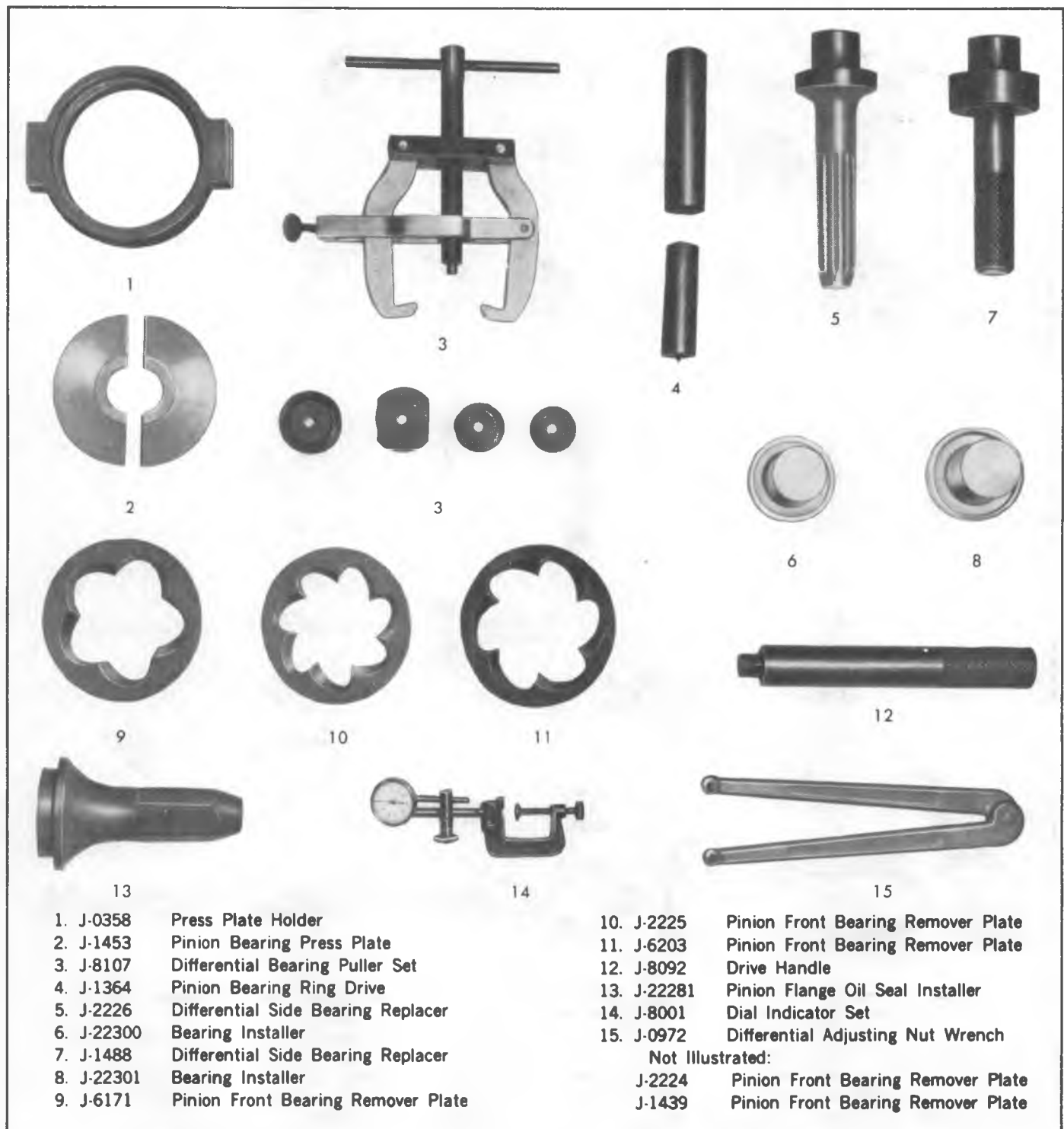


Fig. 4T—Special Tools—5200, 7200 and 11,000 Lb. Axles

## SECTION 5

# BRAKE COMPONENTS

### CONTENTS OF THIS SECTION

Power Brake Cylinder Single Diaphragm (Delco Moraine) .....	5-1	Power Brake Cylinder Single Diaphragm (Bendix) ..	5-16
Power Brake Cylinder Dual Diaphragm (Delco Moraine) .....	5-7	Power Brake Cylinder Dual Diaphragm (Bendix) ..	5-21
		Vacuum Booster, Single Diaphragm (Bendix).....	5-27
		Special Tools .....	5-31

## DELCO-MORaine POWER BRAKE CYLINDER SINGLE DIAPHRAGM

### INDEX

Disassembly .....	5-1	Inspection .....	5-4
Cleaning .....	5-4	Assembly .....	5-4

## OVERHAUL OPERATIONS

### Removal from Vehicle

1. Disconnect push rod at brake pedal arm.
2. Remove vacuum hose from check valve.
3. Disconnect hydraulic lines at master cylinder.
4. Remove four nuts and lock washers securing power unit to dash panel, and remove power unit from engine compartment.

### 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 shells and, if used, across mounting bracket flanges to provide a guide mark for reassembly.
2. Remove master cylinder attaching nuts and lockwashers and set master cylinder aside.
3. Attach base of Tool J-22805 to front shell 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. 2B).

### *Straight Mounting Bracket (Fig. 4B).*

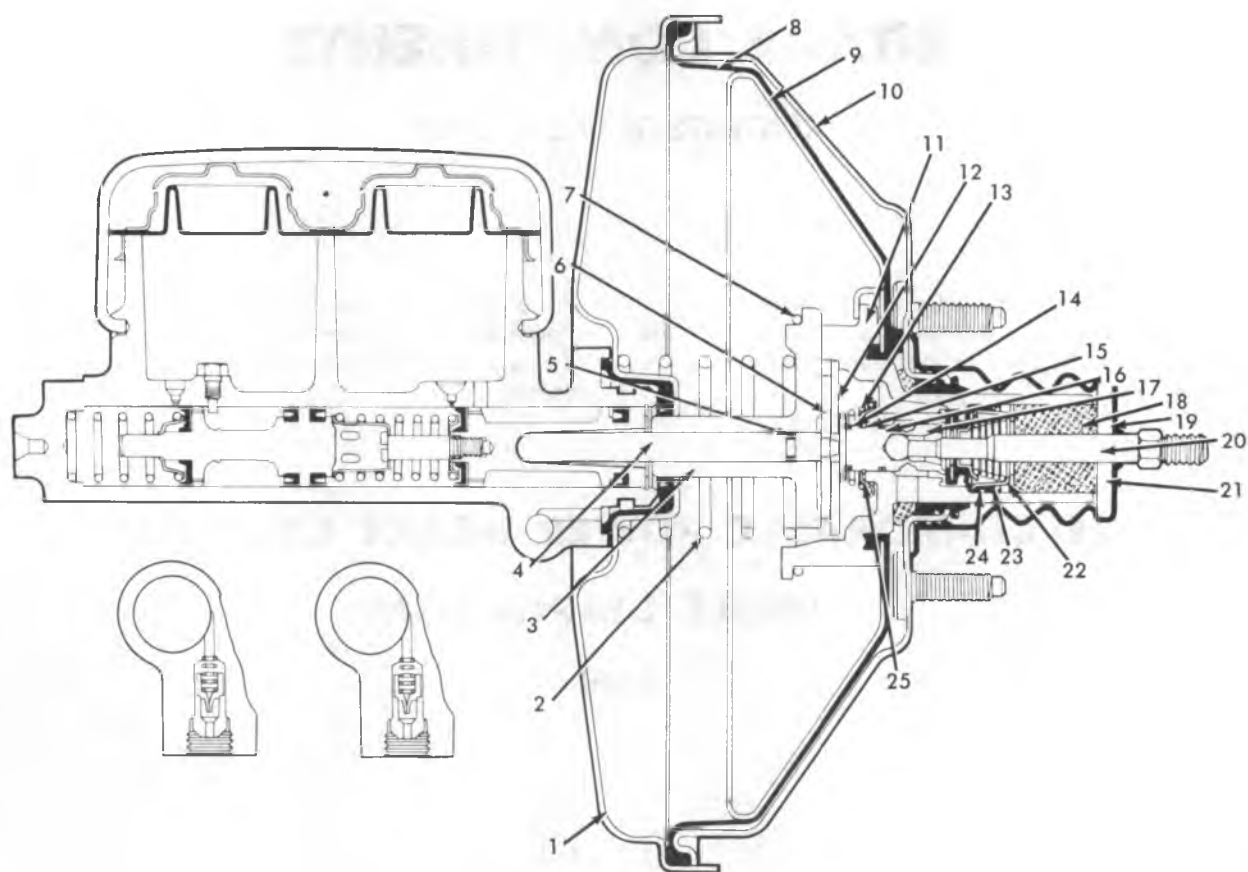
- a. Place Spanner Wrench J-9504 over studs on rear shell and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs.

### *Tilt Mounting Bracket (Fig. 5B)*

- b. Place Tool J-22893 inside tilted mounting bracket. Place Spanner Wrench J-9504 on top of J-22893 and tighten nuts and washers to bolts securing spanner wrench.

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

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



- |                               |                      |                                     |
|-------------------------------|----------------------|-------------------------------------|
| 1. Front Shell                | 11. Power Piston     | 19. Boot                            |
| 2. Power Piston Return Spring | 12. Reaction Levers  | 20. Push Rod                        |
| 3. Reaction Retainer          | 13. Air Valve Spring | 21. Silencer                        |
| 4. Master Cylinder Piston Rod | (Two for Nova only)  | 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      |                                     |
| 10. Rear Shell                |                      |                                     |

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

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

5. Lift the power piston assembly and rear housing from the unit.
6. Remove power piston and boot from the rear housing.
7. Remove the silencer from inside the boot (fig. 2A).

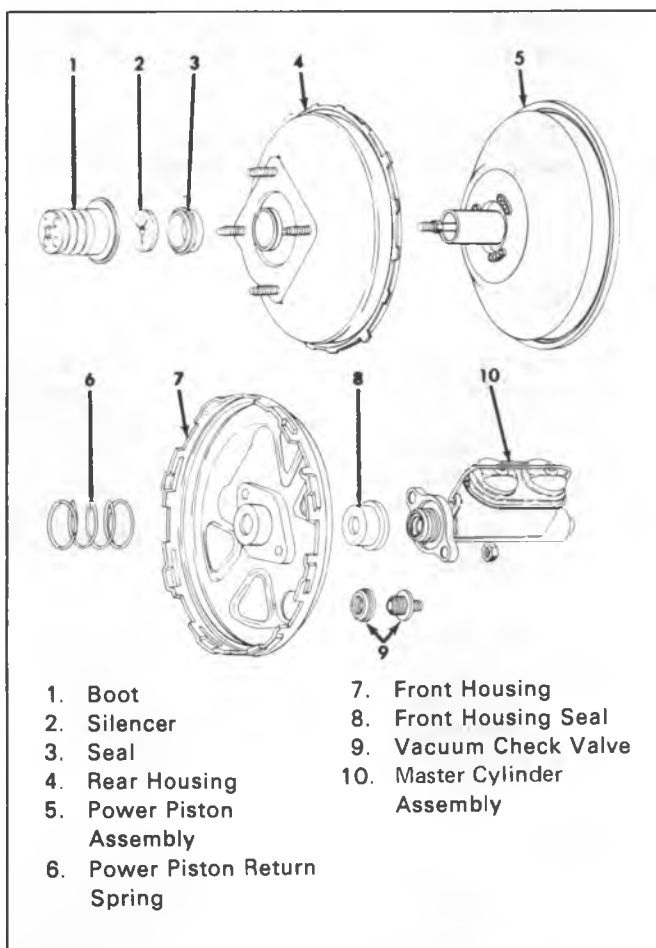


Fig. 2A-Delco-Moraine Power Unit

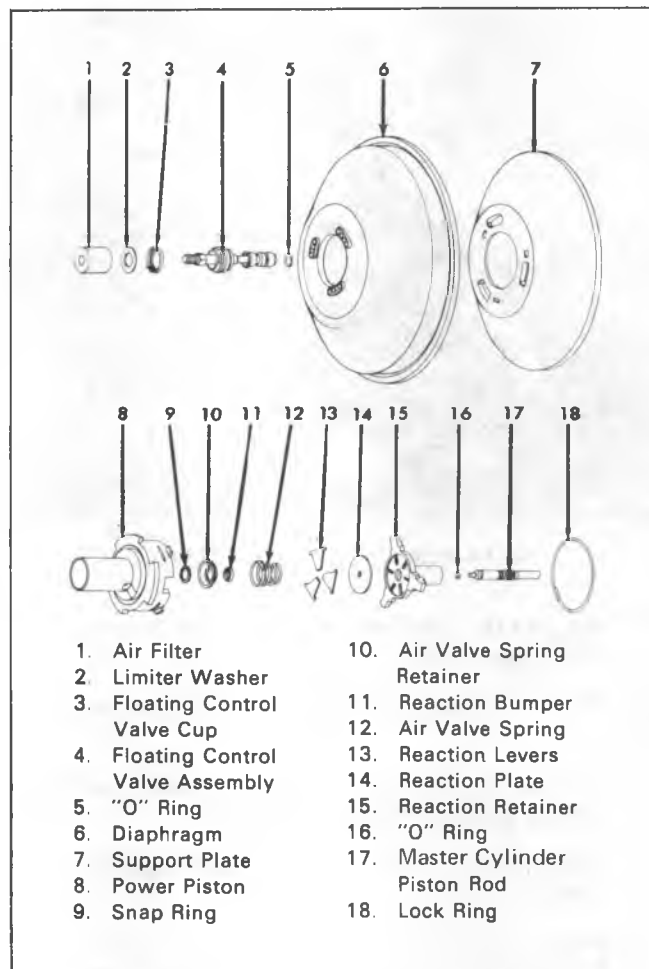


Fig. 3A-Power Piston and Components

8. Remove the power piston return spring from the front housing.
9. Remove Tool J-22805 from front shell and set aside.
10. Remove the front housing seal from the center of the front housing.
11. Remove the check valve and grommet from the front housing.
12. Remove the power piston bearing from the rear housing.

**CAUTION:** Extreme care must be taken in handling the diaphragm of the power piston assembly (fig. 3A). The diaphragm should be guarded against grease, oil, foreign matter and must be protected from nicks, scratches and gouges.

13. 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 from under the remaining two small lugs.
14. Remove the reaction retainer, piston rod, reaction plate, three reaction levers, air valve spring, small reaction bumper, and air valve spring retainer.
15. 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.

16. Pull the diaphragm edges away from the support plate and grip the steel support plate by hand, press down and rotate counter-clockwise to separate the plate from the power piston (fig. 4A).



Fig. 4A-Separating Power Piston from Support Plate

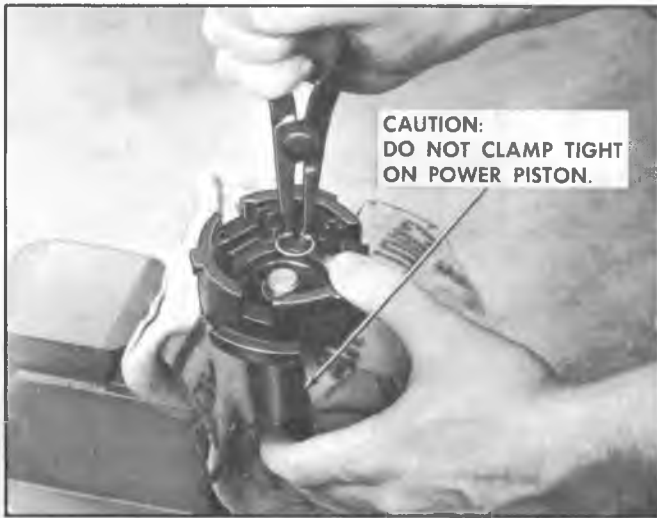


Fig. 5A—Removing Air Valve Snap Ring

17. Remove the diaphragm from the support plate and lay both parts aside.
18. Remove the silencer from the neck of the power piston tube.
19. Position the power piston in a vise padded with shop-towels, with the tube down (fig. 5A).
20. Using Pliers J-4880 remove the snap ring from the air valve.
21. 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. 6A).

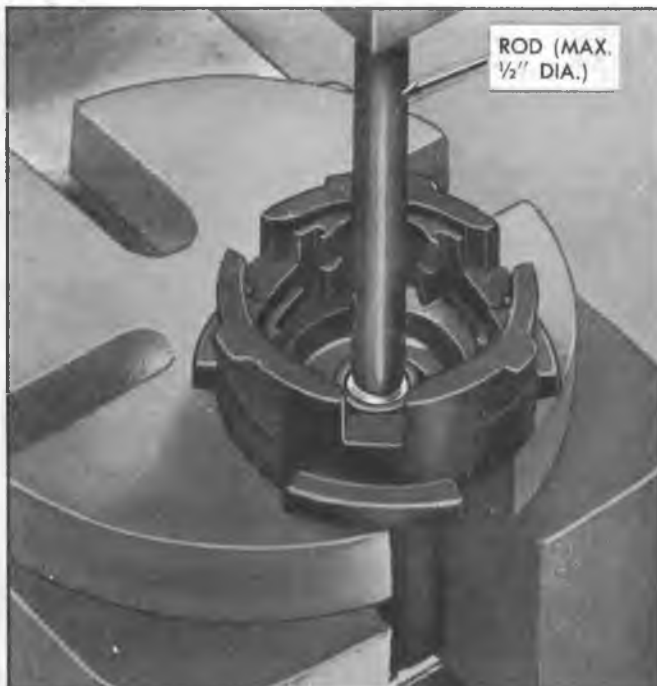


Fig. 6A—Removing Air Valve Assembly from Power Piston

22. Push the master cylinder piston rod from the reaction retainer and remove the "O" ring from the rod.

**NOTE:** A new floating control valve should always be used whenever it is removed from the power piston.

### 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.

**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.

### Assembly (Figs. 1A, 2A, and 3A)

Be sure that all parts are clean. If there is any doubt of cleanliness, rewash and air dry. Lubricate rubber parts with an approved rubber lubricant. Lubricate all plastic and metal friction points with an approved lubricant.

1. Replace the vacuum check valve, using a new grommet, if old one is cracked or damaged.
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. Assemble the master cylinder onto the front housing with the scribe mark on the top of the housing lining up with the center of the master cylinder cover. Install self locking nuts and tighten finger tight only.
4. Install a new "O"ring in the groove on the master cylinder piston rod. Apply a thin film of lubricant to "O" ring.
5. Insert master cylinder piston rod through the reaction retainer with round end of rod at tube end of retainer.
6. 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.



Fig. 7A—Installing Air Valve and Retainer

7. Install a new "O" ring on the air valve in the second groove from the push rod end.
8. Coat the new floating control valve rubber and the air valve "O" ring with a thin film of lubricant.
9. Press the air valve assembly (air valve first) to its seat in the power piston tube.
10. Install a new floating control valve retainer over the push rod, (flat side toward the floating control valve.).
11. Start the floating control valve and retainer into the power piston tube.
12. 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 to power piston tube (fig. 7A).
13. Install the push rod limiter washer over the push rod and then the air filter element.
14. Install the power piston diaphragm on the support plate (opposite side of locking tang).

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

15. Install the support plate assembly over the tube of the power piston (fig. 8A).

**NOTE:** The flange of the diaphragm will fit into the groove on the power piston.

16. Press down and rotate the support plate assembly clockwise, until the lugs on the power piston come against the stops on the support plate.
17. Place this assembly tube down in a padded vise, (Do Not Clamp).
18. Install snap ring in groove of air valve with Pliers J-4880 (fig. 5A).



Fig. 8A—Installing Power Piston to Support Plate

19. Install the air valve spring retainer to seat on the snap ring.
20. Install the reaction bumper into the groove in the end of the air valve.
21. Position the air valve return spring, (large end down) on the spring retainer.
22. Install the 3 reaction levers into the slots of the power piston with the small end resting on the air valve return spring.
23. Install master cylinder piston rod through the reaction retainer with round end out tube side.
24. Center reaction plate on the reaction levers (numbered side up), and place reaction retainer down on power piston. (Make sure small end of push rod engages in center hole of reaction plate), (fig. 9A).
25. Push reaction retainer down and line up the lugs with the notches in the power piston.
26. 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. 10A).
27. Install a new power piston bearing in the center of the rear housing (large flange of bearing on stud side of housing). Lubricate the inside of the bearing.

**NOTE:** Make sure flange on rear housing is engaged in groove of power piston bearing.

28. Install air silencer over the holes on the power piston tube and lubricate tube.
29. Install power piston tube through rear housing, (from side opposite of studs).
30. Attach base of Tool J-22805 to front shell with nuts and washers and draw down tight to eliminate bending or damaging of studs. Place power piston return spring over the insert in the front housing.





Fig. 9A—Installing Reaction Retainer on Power Piston



Fig. 10A—Installing Retainer Lock Ring

31. Lubricate the I.D. of the support plate seal and the reaction retainer tube. Talcum powder the beaded edge of the diaphragm.
32. Place the rear housing assembly over the front housing assembly and align with scribe marks of the two housings so they will match when in locked position.
33. 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 or place Spanner Wrench J-9504 over studs on rear shell and attach with nuts and washers--draw nuts down tight to eliminate bending or damaging of studs. Press down on spanner wrench and twist rear

housing clockwise in relation to front shell until housings are fully locked.

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

34. Install felt silencer over push rod to seat against end of power piston tube, secure with snap ring retainer, and place plastic boot with large holes in center of brackets. Install locknut and clevis on push rod.
35. Remove unit from vise.
36. Place power unit in a vise so that master cylinder push rod is up.
37. Place Tool J-7723-01 over the push 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. 11A).

**NOTE:** If push rod height adjustment gauge is not available, the required dimensions for fabrication are given in Figure 9B.

38. 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.
39. Position master cylinder to power cylinder. Install lock washers and nuts and torque to 25 foot pounds.

**CAUTION:** All brake attachments are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with parts of the same part numbers or with equivalent parts if replacement becomes necessary. Do not use replacement parts of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

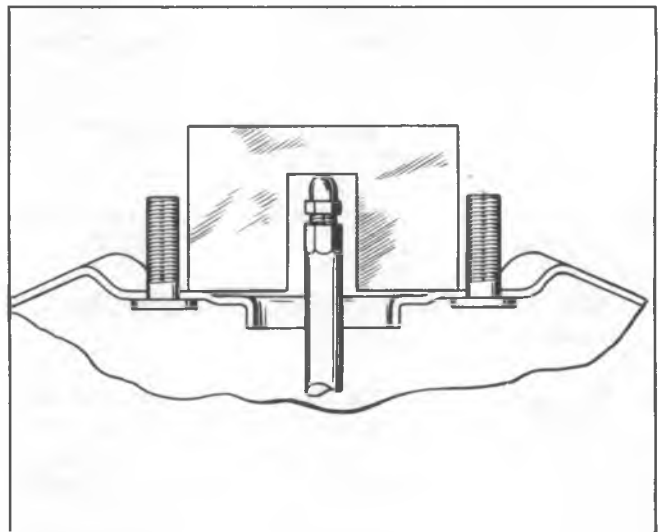


Fig. 11A—Adjustment of Push Rod

# DELCO MORaine POWER BRAKE CYLINDER

## DUAL DIAPHRAGM

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### Removal from Vehicle

1. Disconnect the brake lines from the two master cylinder hydraulic outlets. Cover brake line fittings to prevent dust and dirt from entering brake lines.
2. Disconnect the vacuum hose from the vacuum check valve on the front housing of the power head. Plug vacuum hose to prevent dust and dirt from entering hose.
3. Disconnect the power brake push rod from the brake pedal.
4. Remove the four nuts (inside vehicle) from the mounting studs that hold the power brake to the dash.
5. Carry the power brake to a clean work area and clean the exterior of the power brake prior to disassembly.

### Installation

1. Mount power brake assembly to dash.

**CAUTION:** All brake attachments are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with parts of the same part numbers or with equivalent parts if replacement becomes necessary. Do not use replacement parts of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

2. Connect power brake push rod to brake pedal.
3. Connect vacuum hose to vacuum check valve.
4. Connect brake lines to master cylinder outlets.
5. Bleed brakes as necessary and fill fluid reservoirs to within 1/4" of top of the reservoirs.

### Testing--on Vehicle

1. When the engine is shut off, and the transmission is in neutral, apply brakes several times to deplete all vacuum reserve in the system. Depress brake pedal, hold light foot pressure on the pedal, and start the engine. If the vacuum system is operating, the pedal will tend to fall away under foot pressure, and less pressure will be required to hold pedal in applied position. If no action is felt, the vacuum system is not functioning.
2. Stop engine. Again deplete all vacuum reserve in the system. Depress the brake pedal and hold foot pressure on the pedal. If the pedal gradually falls away under foot pressure, the hydraulic system is leaking.
3. If the brake pedal travels to within one inch of the toe-board, the brake shoes require adjustment or relining.
4. Start engine. With transmission in Park or Neutral, open throttle to medium speed. Close throttle and turn-off engine. This evacuates the housing chambers. Wait no less than 90 seconds, then try brake action. If not vacuum assisted for two or more applications, vacuum check valve is faulty or there is a leak in the vacuum system.

## OVERHAUL OPERATIONS

### Disassembly (Fig. 1H and 2H)

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

1. Remove the two locknuts which hold the master cylinder to the front housing, and remove the master cylinder from the mounting studs. Remove the front housing seal from the front housing.
2. Mount Tool J-22805 to power booster and install two nuts.
3. Position Housing Unlock Tool J-9504 over the rear housing mounting studs. Secure with nuts. Install Tool J-9504 with power booster in a bench vise. Applying downward pressure, rotate rear housing counter-clockwise to unlock the housings. It is normal for this operation to require heavy pressure to unlock the housings.

**WARNING:** Rotate slowly as housing is under spring tension.

### Front Housing Group

1. Remove the power piston return spring. The retainer plate and power piston may come out with the power piston return spring. Remove the vacuum check valve and grommet from the front housing (if the check valve is defective or the grommet cracked, cut or damaged).

### Rear Housing Group

1. Remove Tool J-9504. Remove the boot from the rear housing. Remove the felt silencer from inside the boot.

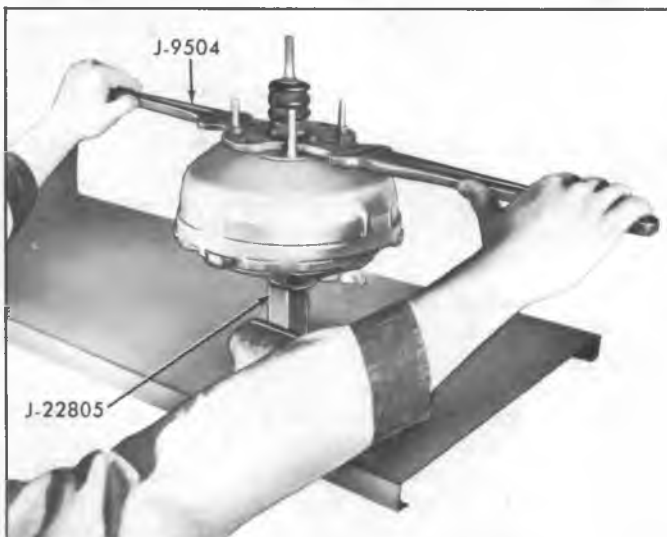


Fig. 1H—Unlocking Front and Rear Housings

2. Remove the power piston group from the rear housing and remove the primary power piston bearing from the center opening of the rear housing.

### Power Piston Group

1. Lift the bead on the O.D. of the secondary diaphragm and remove the diaphragm support ring (fig. 3H).
2. If not already disengaged, remove the retainer plate from the secondary piston. Remove the piston rod retainer and piston rod from the secondary piston.
3. 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. 4H).
4. Fold back primary diaphragm from the O.D. of the primary support plate. Grip the edge of the support plate and rotate counter-clockwise to unscrew the 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 counter-clockwise. Tabs ("stops") on the primary support 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. 5H).

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 clockwise to unlock the secondary support plate from the secondary power piston (fig. 6H).
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. 7H).
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. 8H).

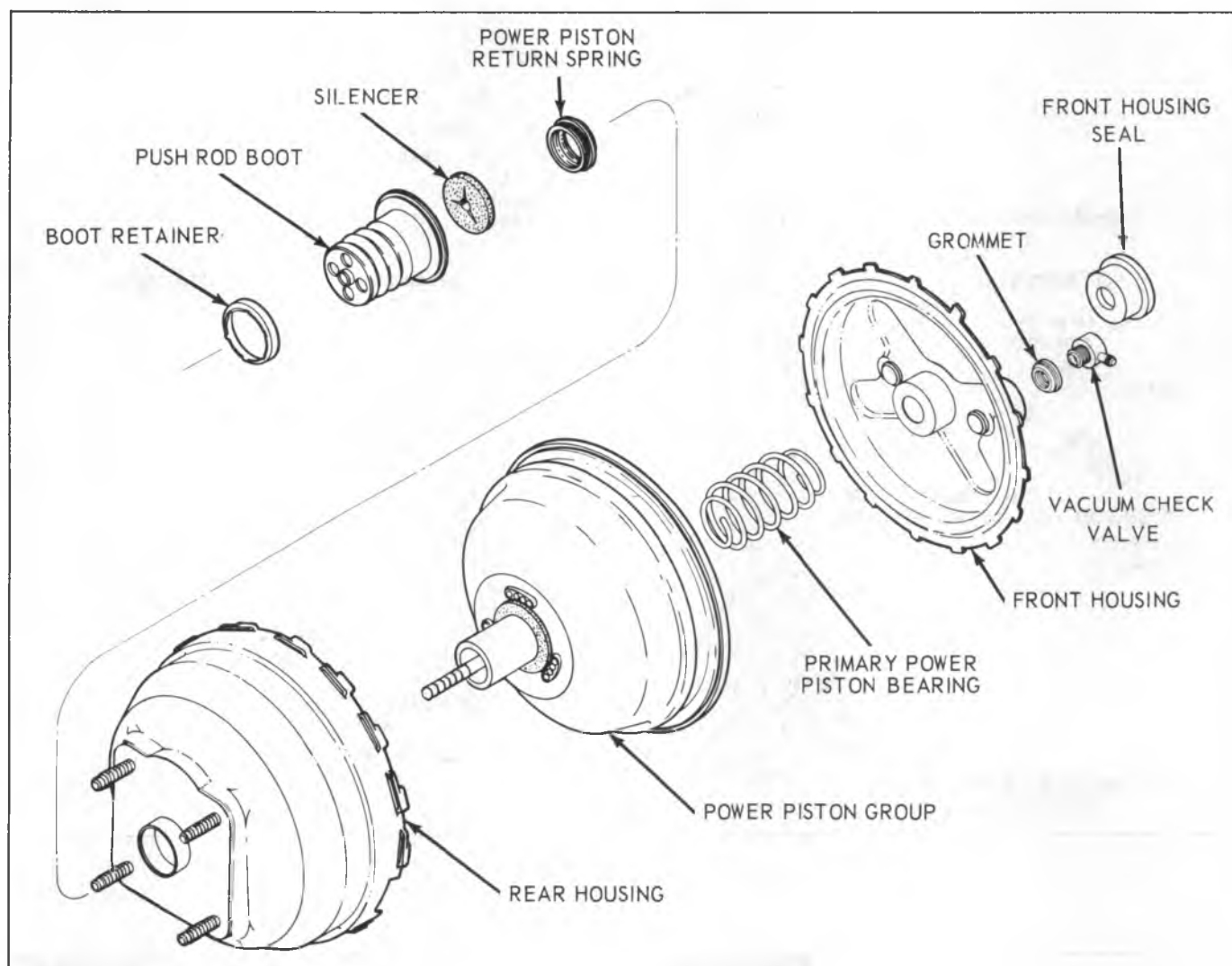


Fig. 2H--Exploded View of Major Assemblies

11. Fold back primary diaphragm from the support plate. Grip the edge of the support plate and rotate in a counter-clockwise direction to unlock the primary support plate from the primary power piston (fig. 9H).
12. Remove the primary diaphragm from the primary support plate.
13. Remove the air filter and push rod limiter washer 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. 10H).
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.

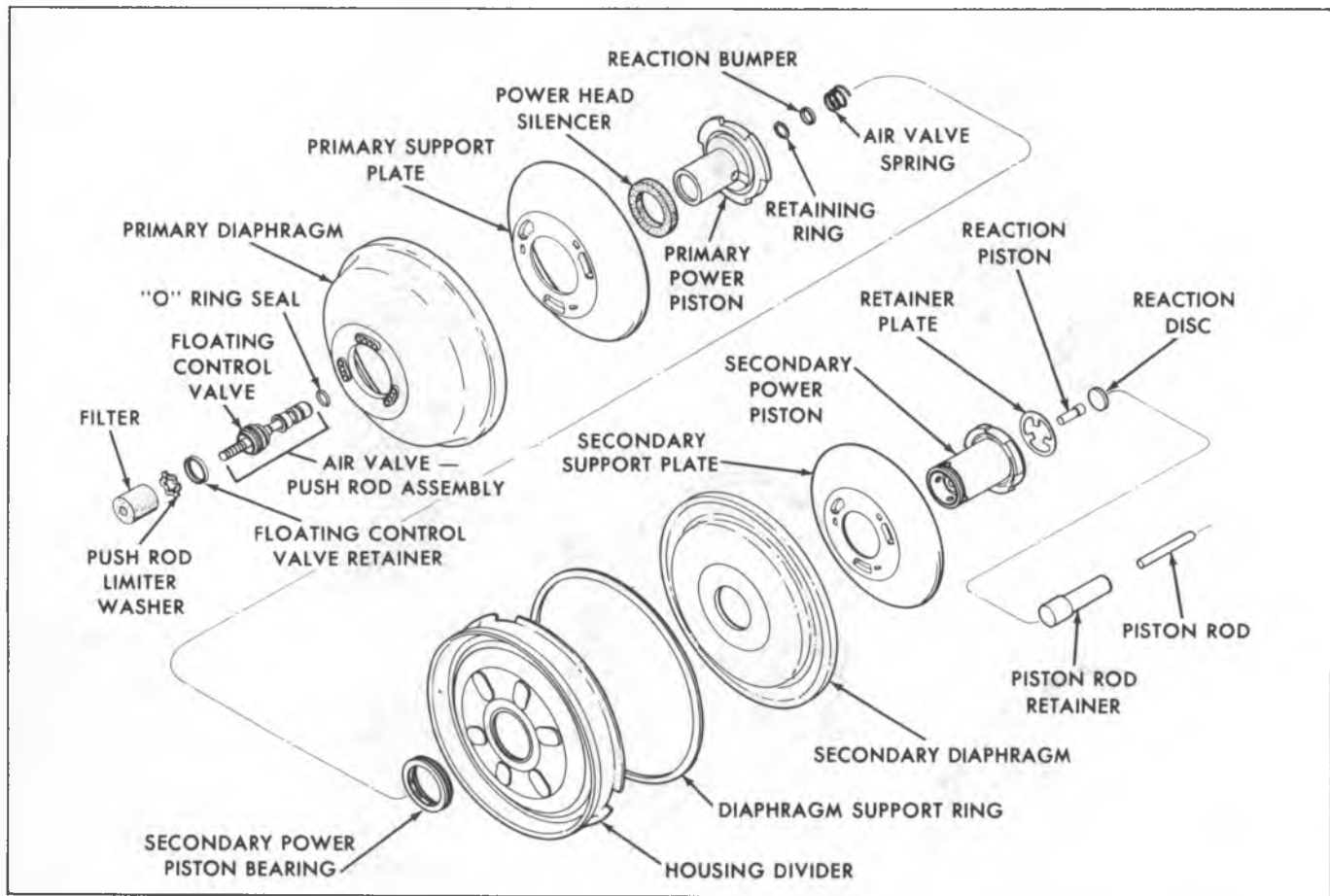


Fig. 3H—Power Piston Group



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



Fig. 5H—Locking or Unlocking Primary and Secondary Power Pistons



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



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



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



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



## Assembly

### Front Housing Group

**CAUTION:** All brake attachments are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with parts of the same part numbers or with equivalent parts if replacement becomes necessary. Do not use replacement parts of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

If the grommet was removed for replacement, insert the new grommet in the front housing and press the vacuum check valve through the grommet.

### Power Piston Group

1. Lubricate the I.D. and O.D. of the "O" ring seal with silicone lubricant and place on the air valve.
2. Wipe a thin film of silicone lubricant on the large and small O.D. of the floating control valve.
3. 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.
4. 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. 11H). With Installer J-23175, manually press the retainer and floating control valve assembly to seat in the primary power piston tube (fig. 12H).



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

5. After the floating control valve is seated, place the push rod limiter washer over the push rod and position on the floating control valve.
6. The filter element can now be stretched over the push rod and pressed into the primary power piston tube.

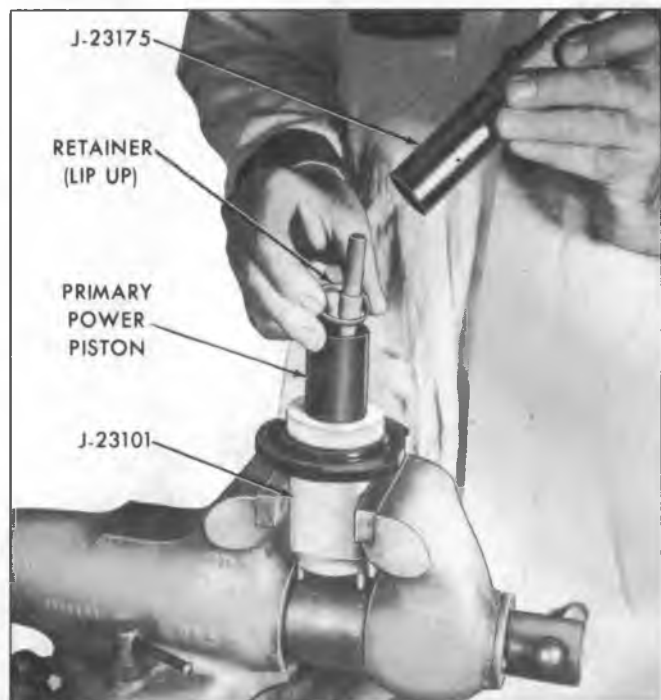


Fig. 11H--Installing Floating Control Valve Retainer with Installer J-23175



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

7. Using No. 2 Snap Ring Pliers (J-4880), place the retaining ring into the groove in the air valve (fig. 10H).

8. 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 critical. In order to maintain correct power brake output, the power piston assembly must be gaged for selective fit of reaction piston whenever the primary power piston, and/or the secondary power piston are replaced during servicing. This gaging operation is not required if neither power piston is replaced during servicing.

If replacing either power piston, the following procedure should be followed (fig. 13H).

- Hand-tighten the secondary power piston to the primary power piston without the air valve spring (the air valve push rod assembly should already be assembled to the primary power piston as described above.)
- Insert the reaction piston into its cavity in the secondary power piston. This is accomplished by placing the reaction piston, small diameter first, through the large cavity and into the smaller cavity.
- With the secondary power piston up, push on the reaction piston to insure that it is seated on the air valve.
- Place Gage J-23337 in the secondary power piston so that the outer edges of the gage rest on the bottom

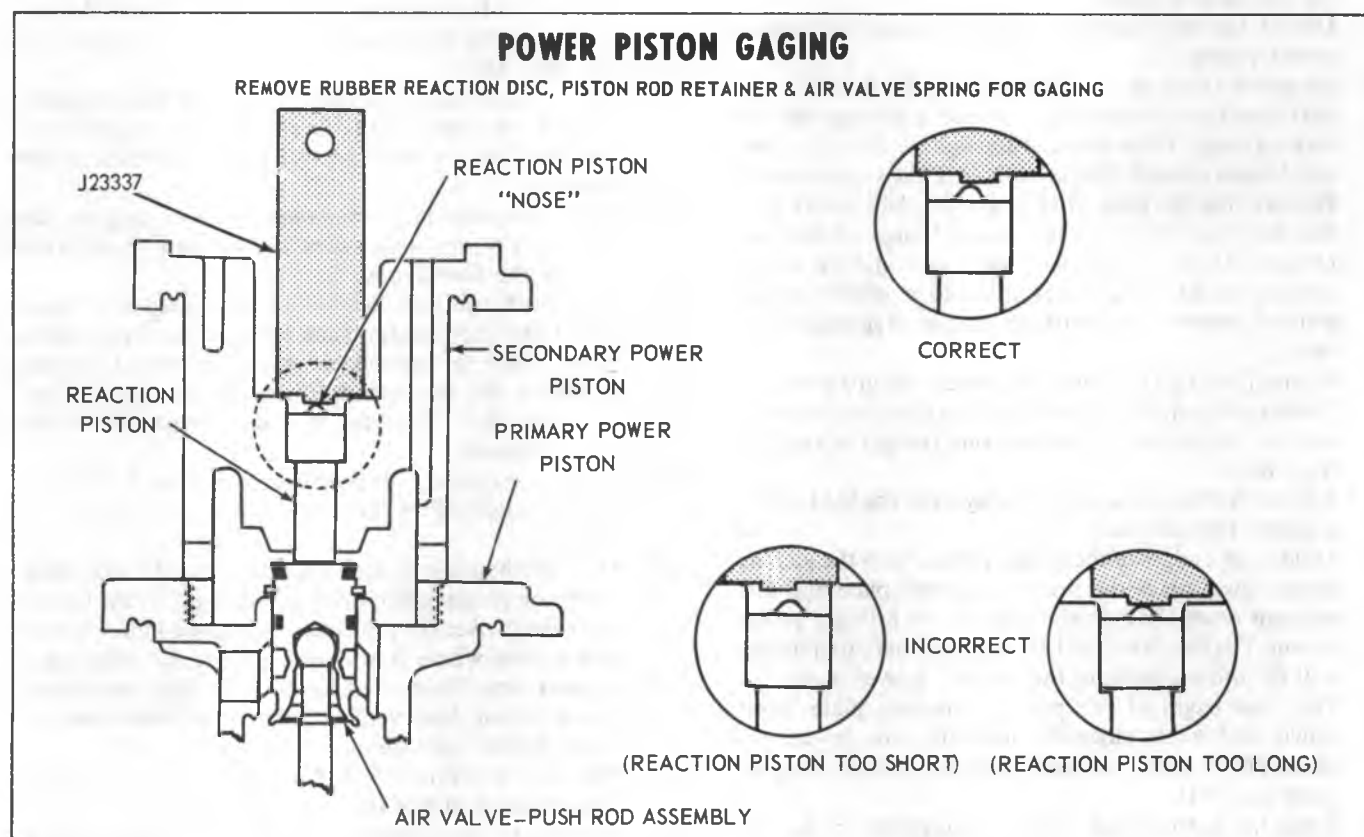


Fig. 13H--Power Piston Gaging

of the large cavity, with the two levels of the center section of the gage within the smaller reaction piston cavity.

- e. Move the gage to the left or right of the "nose" of the reaction piston. The reaction piston is the correct length if the "nose" of the piston "hits" the lower level of the gage and clears the higher level of the gage, while permitting the outer edges of the gage to remain seated on the larger cavity of the secondary power piston.
- f. If the reaction piston is too long, the higher level of the gage will not clear the "nose" without moving the outer edges of the gage off the seat in the large cavity of the secondary power piston. If the reaction piston is too short, both levels of the gage will clear the "nose" of the reaction piston. If either condition exists, a separate kit of three selective reaction pistons (differing in length and color) must be obtained to permit use of piston to meet correct size requirements of step (e) above.

**NOTE:** Care must be taken to insure that the gage is not "cocked."

9. After determination of the correct reaction piston, apply a light film of silicone lubricant to the O.D. of the rubber reaction disc.
10. 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.
11. Unlock the secondary power piston from the primary power piston.
12. 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 silicone lubricant.
13. 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 (tangs) of the tool (fig. 8H).
14. Fold the primary diaphragm away from the O.D. of the primary support plate.
15. 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.
16. 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. 9H).
17. 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.
18. Apply silicone lubricant to the O.D. of the primary power piston tube.
19. Remove the primary piston assembly from Tool J-23101 and lay it aside.
20. 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 silicone lubricant 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).
21. 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 (tangs) of the tool. Apply a light coat of silicone lubricant to the tube of the secondary power piston (fig. 4H).
22. Fold the secondary diaphragm away from the O.D. of the secondary plate.
23. 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.
24. Grip the edges of the secondary support plate, press down, and rotate counter-clockwise 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. 6H).
25. Apply a light coat of talcum powder or silicone lubricant to the bead on the O.D. of the secondary diaphragm. This will facilitate reassembly of front and rear housings.
26. Place the secondary diaphragm support ring on the secondary power piston assembly so that it rests on the edge of the diaphragm.
27. 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.
28. Lubricate the I.D. of the secondary bearing with silicone lubricant.
29. Position secondary Bearing Protector Tool J-23188 on the threaded end of the secondary power piston (fig. 14H).
30. Hold the housing divider with the formed flange (that holds the primary diaphragm) 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.
31. Pick up the primary power piston assembly and position the small end of the air valve return spring on the air valve so that it contacts the air valve retaining ring.
32. Fold the primary diaphragm away from the O.D. of the primary support plate.



Fig. 14H--Positioning Housing Divider Over Secondary Bearing Protector Tool J-23188

33. 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.
34. 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. 5H).
35. Continue to tighten the primary power piston until it is securely attached (approximately 5-15 pounds) to the secondary power piston.
36. 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.
37. Wipe a thin film of silicone lubricant 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. Place the primary power piston bearing in rear housing center hole so that the formed flange of the housing center hole fits into the groove of the primary power piston bearing. The thin lip of the bearing will protrude to the outside of the housing.
2. Coat the I.D. of the primary power piston bearing with silicone lubricant.

### Final Assembly

1. Mount Tool 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. Continue to press down on the rear housing and fit the slots in the appropriate tangs on the front housing.
8. Using Tool J-9504, press down and rotate the rear housing clockwise into the locked position. Remove Tool J-9504.
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.
10. Remove the power head assembly from Holding Fixture J-22805 and remove Fixture J-22805 from the vise.

### Gaging

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 seat to assure that no vacuum is in the power head while gaging.

4. Place Gage J-22647 over the piston rod in a position which will allow the gage to be slipped to the left or right without contacting the studs (fig. 15H).
5. The center section of the gage has two levels. The piston rod should always contact the longer section (lower level) of the gage. The piston rod should never contact the shorter section (higher level) of the gage. Move gage from side to side to check piston rod height.

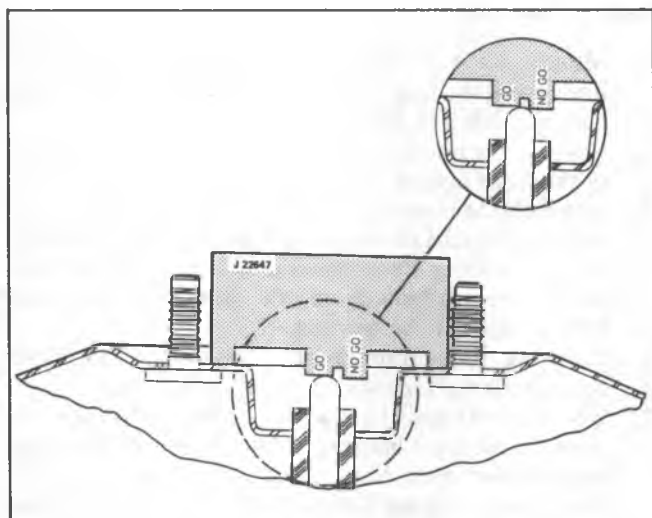


Fig. 15H--Gaging Piston Rod

6. Any variation beyond these two limits must be compensated for by obtaining the service adjustable piston rod and adjusting the self-locking screw to meet the gaging specifications.

7. Wipe a thin film of silicone lubricant 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.

**CAUTION:** This cylinder to dash 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.

## BENDIX POWER BRAKE CYLINDER SINGLE DIAPHRAGM TYPE

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## OVERHAUL OPERATIONS

Passenger car and light duty trucks use the power brake cylinders covered in this section. A noticeable difference is in the valve rod. Passenger cars use a screw-on clevis with an eye where light duty trucks use a straight rod with an eye to attach to the brake pedal.

### Removal from Vehicle

1. Disconnect push rod at brake pedal arm.
2. Remove vacuum hose from check valve.
3. Disconnect hydraulic lines at master cylinder.
4. Remove four nuts and lock washers securing power unit to dash panel, and remove power unit from engine compartment.

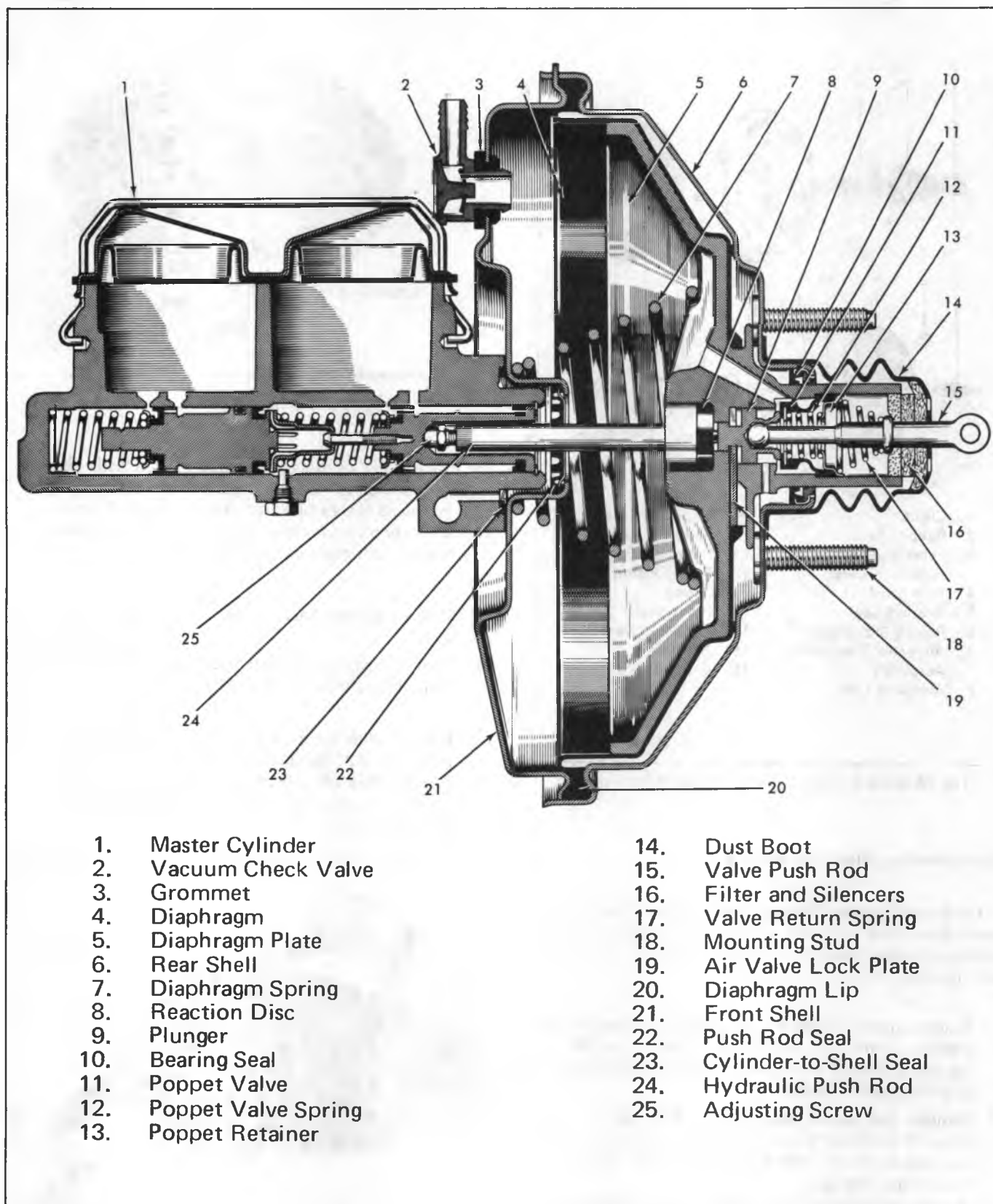


Fig. 1B-Bendix Single Diaphragm Unit (Typical)



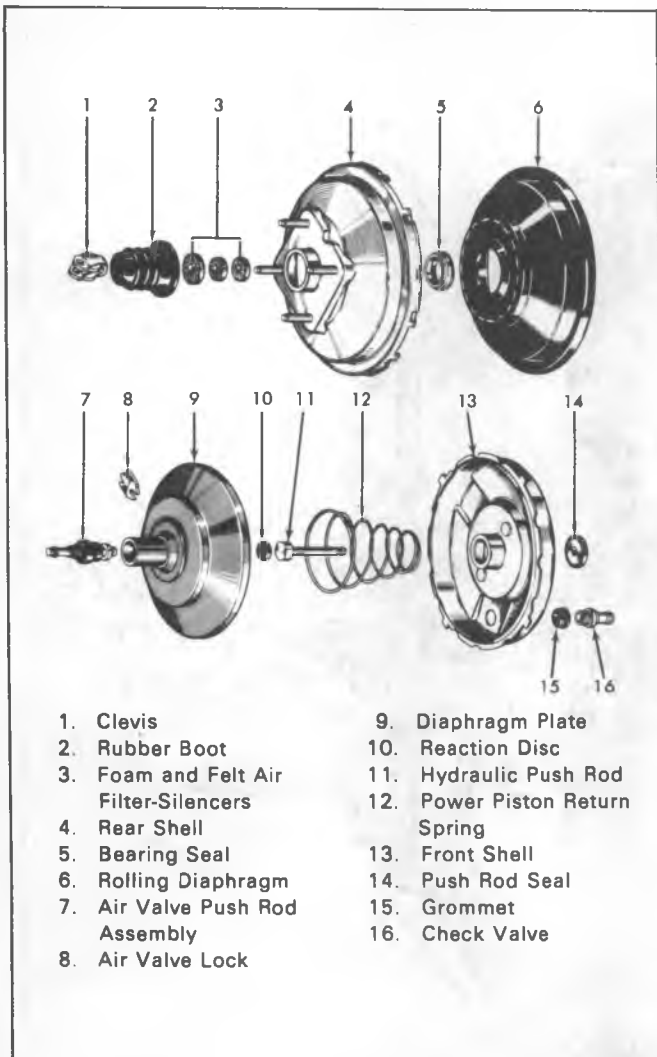


Fig. 2B-Bendix Power Cylinder Components (Typical)

### Disassembly (Figs. 1B and 2B)

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. Remove master cylinder filter, piston seal assembly and master cylinder push rod from front shell (fig. 2B); pulling the push rod from the front shell will also remove the filter and seal assembly.
2. Position and secure Tool J-22805 (fig. 3B) to master cylinder mounting studs, and place tool and power unit in a vise. Be sure to align tool so that check valve in front shell is not damaged.
3. Disconnect linkage at air valve push rod, and remove mounting bracket from rear shell.
4. Remove rubber boot and retainer plate from rear shell.
5. Remove filter retainer from end of diaphragm plate extension and remove air filter element from location within the diaphragm plate extension.

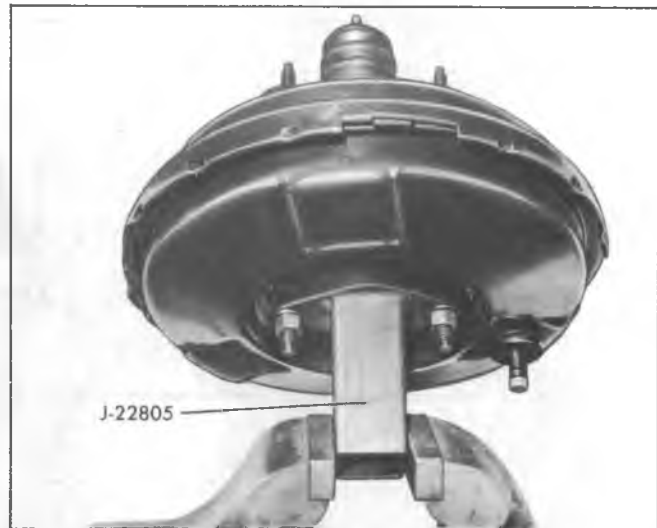


Fig. 3B-Holding Fixture using Tool J-22805

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

6. Scribe alignment mark across surface at front and rear shells.
7. Position Spanner Wrench J-9504 over studs of the rear shell and tighten nuts (fig. 4B).

**NOTE:** With tilt mounting bracket installations, place Tool J-22893 inside mounting bracket. Place Spanner Wrench J-9504 on top of J-22893 and tighten nuts and washers to bolts securing spanner wrench (fig. 5B).

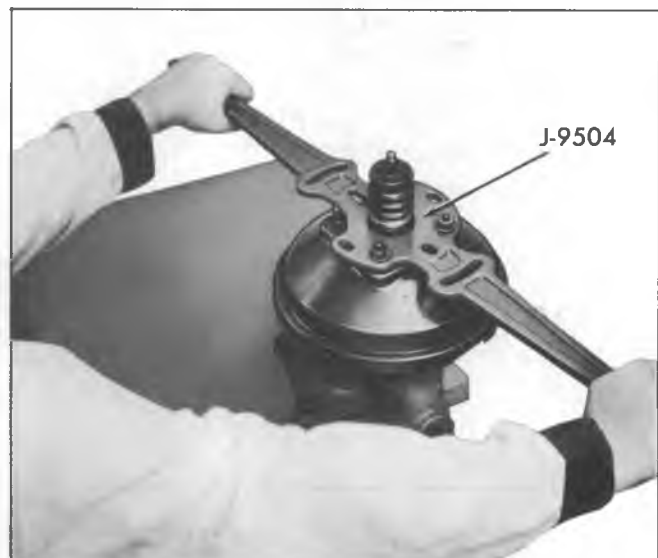


Fig. 4B-Separating Shells with Tools J-9504 and J-22805-(Passenger Car Shown as Typical)

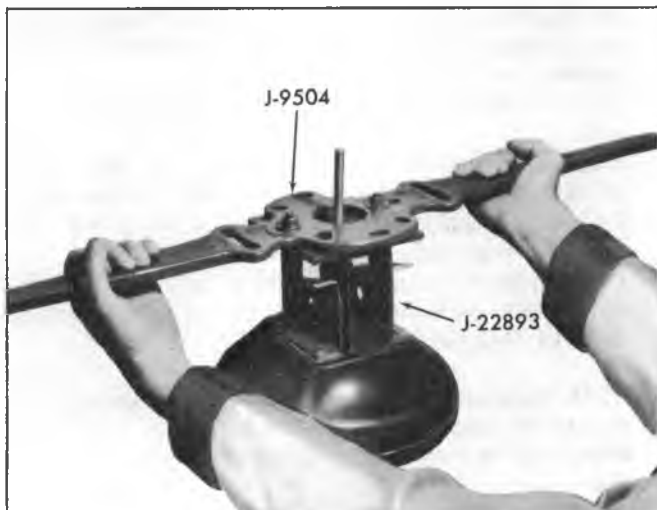


Fig. 5B—Separating Tilt Bracket Type Shells with Tools J-9504 and J-22893

8. Rotate Tool J-9504 until cutouts of rear shell are aligned with lances in front shell.

**NOTE:** It may be necessary to straighten the cut, lanced areas flush with the shell. If the tangs break during this operation, it will be necessary to replace that half of the shell.

9. If shells do not begin to separate, tap rear shell with a soft faced hammer.

**WARNING:** Hold rear shell firmly. Pressure exerted by internal diaphragm spring may cause rear shell to fly off when shells are in the released position.

10. Remove power piston from front shell, separate power piston from rear shell, and remove Tool J-9504 from unit.

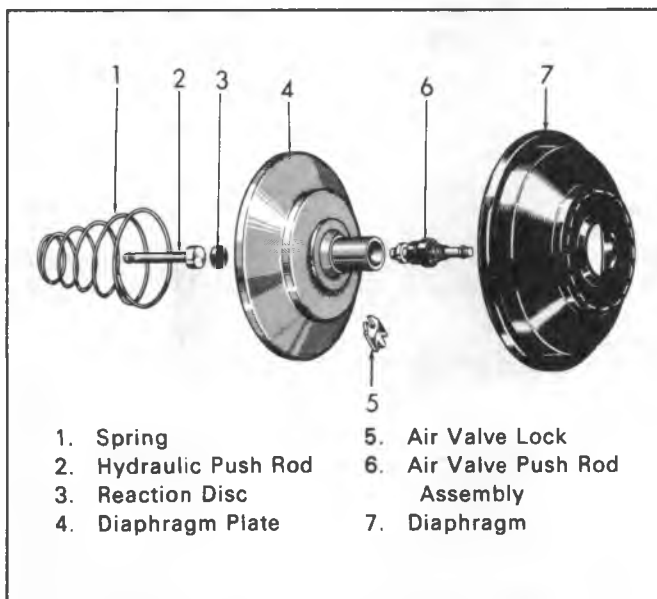


Fig. 6B—Bendix Power Cylinder Components (Typical)

11. Disassemble power piston (fig. 6B).
  - a. Remove rolling diaphragm from the groove in the diaphragm plate hub.
  - 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 piston hub. Remove the air valve push rod assembly from the piston. Remove the reaction disc from its location in the diaphragm plate bore (insert the master cylinder push 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 12 only if seal is defective and new seal is available. Do not reuse seal once it has been removed from the unit.

12. Support outer surface of rear shell on blocks of wood or other suitable material (stud side up) and drive out seal with a punch or a thin blade screw driver. Discard seal.
13. Remove check valve from grommet; then remove grommet from front shell.
14. Remove front shell and holding fixture from vise; then remove holding fixture from front shell.

### Cleaning

Use denatured alcohol to clean all metal parts. Use alcohol or an approved commercial cleaning solvent for cleaning rubber and plastic parts. Immerse parts in cleaning solvent and use a hair brush to remove foreign matter. Blow out all passages crevices and valve holes. Air dry by placing 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.

**CAUTION:** The 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

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 trouble traceable to leakage. If there is any question whatever as to serviceability of any part, replace it.

### Assembly

During assembly, make sure all parts are free of foreign material before applying lubricant. If there is any doubt of cleanliness, rewash and air dry. When applying lubricant as specified in assembly procedure, use an approved lubricant of known quality and composition that will not be harmful to rubber and plastic materials.



Fig. 7B—Installing Piston Bearing Seal

1. Install check valve grommet in front shell with beveled edge of grommet inside of shell. Dip check valve in clean alcohol and install in grommet--check valve stem is to be outside shell.
2. Position and secure Tool J-22805 (fig. 4B) to master cylinder mounting studs, and place tool and front shell in a vise. Be sure to align tool so that check valve is not damaged.

**NOTE:** If either or both of the shells are replaced, make sure alignment marks are transferred to new shell.

3. Place rear shell on block, stud side down, and position bearing seal in center hole. Use Tool J-22677 (fig. 7B) to seat seal in recess of rear shell. Tool bottoms against shell when seal is in place.
4. Assemble power piston assembly (see fig. 6B).
  - a. Apply lubricant to outside diameter of diaphragm plate and extension, to bearing surfaces of valve and plunger, and to outer edge of valve poppet. Insert valve and rod assembly in extension of diaphragm plate.
  - 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 lubricant to surface of reaction disc and position disc in center bore of diaphragm plate. Use master cylinder push rod to seat disc in bore. Make sure disc is fully seated before removing push rod.

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

5. Apply lubricant to I.D. of bearing seal and diaphragm bead contact surface of rear shell. Install power piston assembly in rear shell.
6. Position Spanner Wrench J-9504 over studs of rear shell.
7. Place power piston return spring in front shell and position rear shell assembly on front shell. Position rear shell so that when shells are locked scribe marks on front and rear shells will be in alignment.
8. Depress rear shell assembly. Rotate Tool J-9504 until scribe marks on front and rear shells are in alignment. Remove Tool J-9504 from unit.

**NOTE:** Bend lances in on shell if they were straightened on removal. If the tangs break during this operation it will be necessary to replace that half of the shell.

9. Install air cleaner element and retainer to piston extension.
10. Install boot retainer and boot over piston extension and secure boot to air cleaner retainer.
11. Align and install mounting bracket to rear shell. Connect linkage to air valve push rod.
12. Remove unit from fixture.
13. Apply lubricant sparingly to the hydraulic push rod, keeping lubricant away from adjusting screw end of rod. Guide push rod into center bore of power piston until it is fully seated against reaction disc.
14. Install seal and master cylinder filter and press filter and seal into front shell until seal is bottomed in recess of shell.
15. Place Tool J-7723-01 over the push rod so that it fits between studs on front shell (fig. 8B). Gauge should be parallel to studs and resting on surface of front shell. Cutout portion of gauge should just match height of push rod. Any variation may be compensated for by turning adjusting screw.

**NOTE:** If push rod height adjustment gauge is not available, the required dimensions for fabrication are given in Figure 9B.

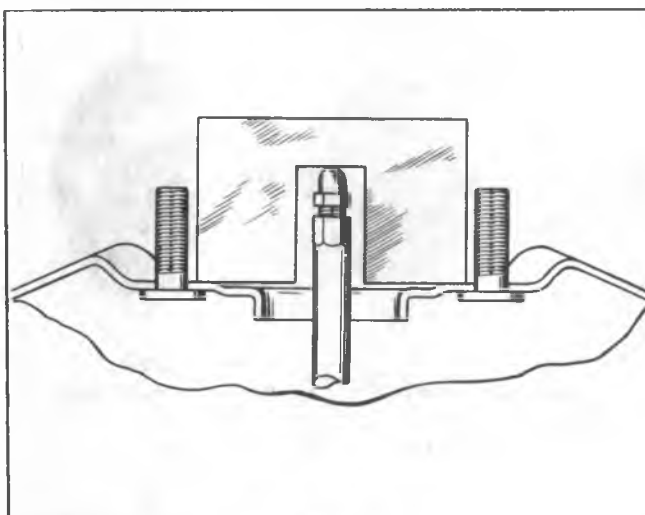


Fig. 8B—Adjustment

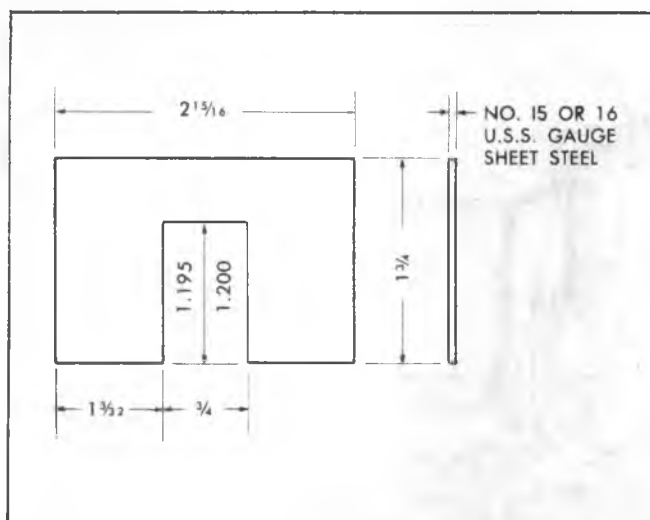


Fig. 9B—Push Rod Gauge

Do not use replacement parts of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

1. Mount the power brake assembly in place and install four attaching nuts and lock washers. Be certain to place push rod through cutout in dash panel.
2. Attach vacuum line to check valve.
3. Secure hydraulic line to master cylinder.
4. Adjust push rod clevis to brake pedal assembly. Adjust pedal height by means of clevis on brake pedal push rod at pedal. Pedal height is obtained by measuring from floor covering at toe pan to top of pedal pad.

**NOTE:** Check operation of stoplight after adjusting pedal height.

16. After push rod adjustment is correct, assemble master cylinder to front shell and securely tighten retaining nuts.

## Installation

**CAUTION:** All brake attachments are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with parts of the same part numbers or with equivalent parts if replacement becomes necessary.

5. Bleed brakes as outlined in the "Service" manual.

**NOTE:** After completing the bleeding operation, make sure reservoir fluid level is at correct height. The reservoir should be filled to 1/4 inch of filler cap opening.

6. Check operation of the brakes.

# BENDIX POWER BRAKE CYLINDER DUAL DIAPHRAGM TYPE

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Corvette and light duty trucks use the power brake cylinders covered in this section. A noticeable difference is in the valve rod. Corvette uses a screw-on clevis with an eye where

light duty trucks use a straight rod with an eye to attach to the brake pedal.

## OVERHAUL OPERATIONS

### Removal from Vehicle

1. Disconnect push rod at brake pedal arm.

**NOTE:** It may be necessary to remove the clevis from the push rod on Corvette models. Note approximate location of clevis on the rod.

2. Remove vacuum hose from check valve.
3. Disconnect hydraulic line at master cylinder.
4. Remove master cylinder attaching nuts, lock-washers, rubber seal and metal retainer and set aside.
5. Remove four nuts and lock washers securing power unit to dash panel, and remove power unit from engine compartment.

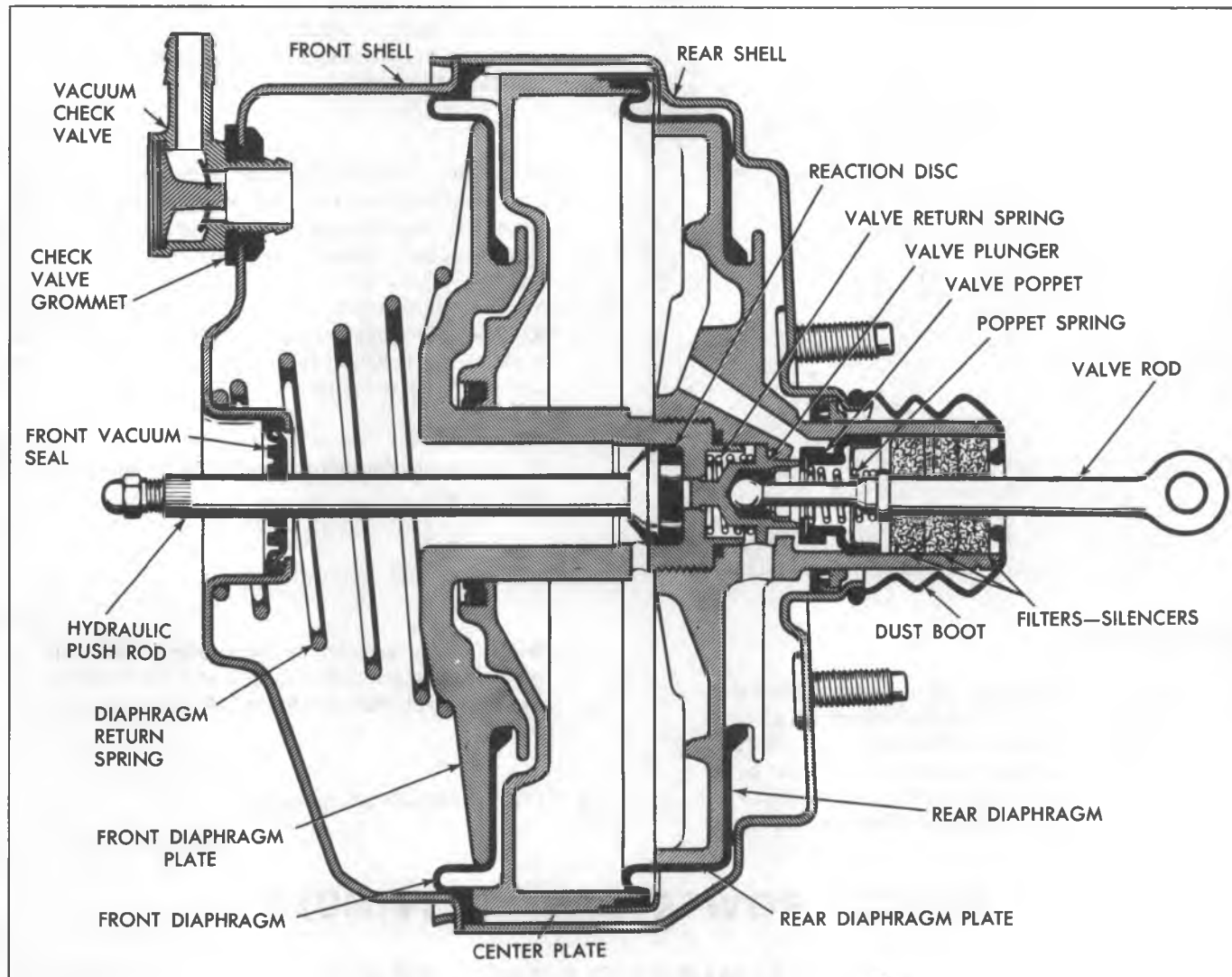


Fig. 1C—Bendix Double Diaphragm Cross Section

**Disassembly (Figs. 1C and 2C)**

1. Scribe across the flanges of both power section shells in line with master cylinder cover to provide a guide mark for re-assembly. Do not remove vacuum check valve (Step 2) unless a new valve is to be installed.
2. Remove vacuum check valve from front shell by pulling straight out on valve. Then remove rubber grommet from front shell.
3. Unseat dust boot from flange of rear shell and remove boot.
4. Use an ice pick to remove two valve silencers and air filter from diaphragm plate hub. Position power section with valve operating rod up and squirt alcohol down rod to wet rubber grommet in valve plunger at ball end of rod.
5. Place assembly in bench vise with rear shell up using Holding Fixture J-22805 and tighten vise jaws securely.
6. Using a thin-bladed screw driver, carefully pry silencer retainer off hub of rear diaphragm plate, being careful not to chip plastic.
7. Place a block of wood 3 inches long on rear shell (fig. 3C). Insert a heavy round shanked screw driver into eye of valve rod or wrench as shown and pry out valve rod, air silencer and air filter. Do not pry with strokes or rear plate may be damaged. A considerable force will be required.

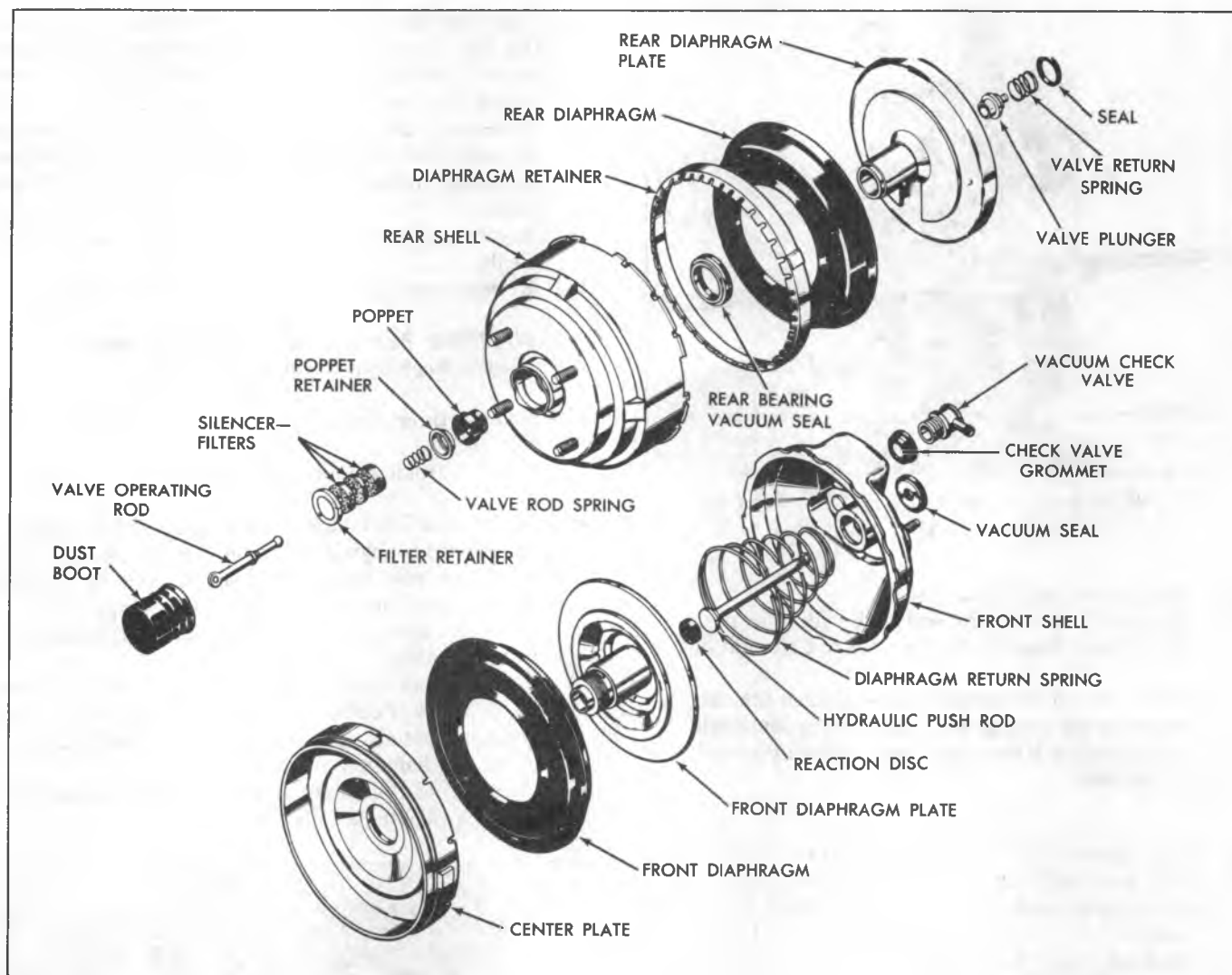


Fig. 2C—Bendix Double Diaphragm Components



Fig. 3C—Removing Valve Rod, Air Silencer and Filter

**NOTE:** On Corvette models, place a box end wrench over the valve operating rod and hold in place with suitable flat washers and a nut (fig. 3C).

**CAUTION:** When separating valve rod from plunger, be careful to avoid damage to plastic diaphragm plate hub.

8. Slide air filter and air silencer from ball end of valve rod.
9. Remove valve rod spring, poppet retainer and valve poppet from hub of rear diaphragm plate (fig. 5C).



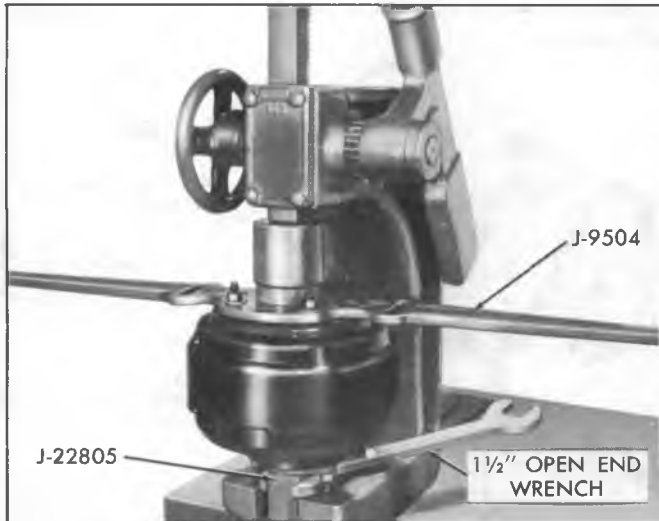


Fig. 4C--Holding and separating Fixture using Tools J-22805 and J-9504 in Arbor Press

10. Remove assembly from vise.
11. Remove front vacuum seal and hydraulic push rod from power head by pulling push rod straight out.

**NOTE:** It will be necessary to straighten the cut, lanced, areas (around the outside of the can) flush with the shell. If the tangs break, replace that half of the shell.

12. Place power unit with Holding Fixture J-22805 in an arbor press with rear shell up and secure to plate of press by a suitable means of holding Tool J-22805 (fig. 4C). 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.

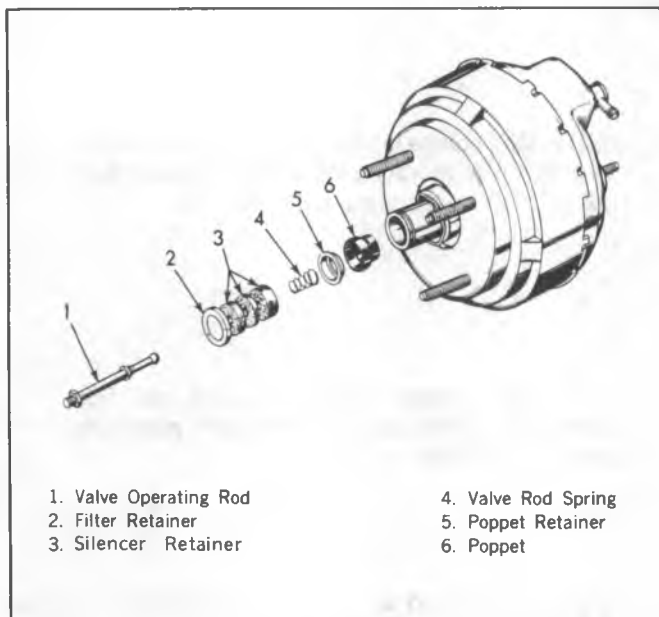


Fig. 5C--Removing Valve Operating Rod, Retainer, Filters and Poppet

13. Place Spanner Wrench J-9504 over studs on rear shell (fig. 4C). Use three washers and nuts to attach wrench to shell. 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 shell down far enough to relieve tension of diaphragm rubber lip and spring.
14. Rotate spanner bar counter-clockwise and unlock shells.
15. Release press and remove diaphragm return spring.

**WARNING:** Be careful when separating shells not to allow diaphragm return spring to fly out.

16. Remove three nuts and washers from bar and remove rear shell.
17. Remove Holding Fixture J-22805 from front shell.
18. With rim of front diaphragm disengaged from scallops in rear shell, align any lug on center plate with any groove on rear shell. This may be done by sighting between shell and center plate. Using finger pressure and screw driver, as little as possible, separate assembly from rear shell.
19. Examine rear bearing vacuum seal in rear shell and remove only if defective. If necessary, place on work bench with studs up and drive out seal with punch or chisel and hammer.
20. Clamp Front Holding Fixture J-22839 in a vise and position front diaphragm plate on it (fig. 6C).



Fig. 6C--Installing Seal Protector Using Tools J-22733 and J-22839

21. Wet rear diaphragm in area of retainer with silicone lubricant. Remove diaphragm retainer using finger pressure. If necessary, a thin-bladed screw driver may be used to pry it free. Be careful not to chip plastic.
22. Remove rear diaphragm from rear diaphragm plate (fig. 7C).

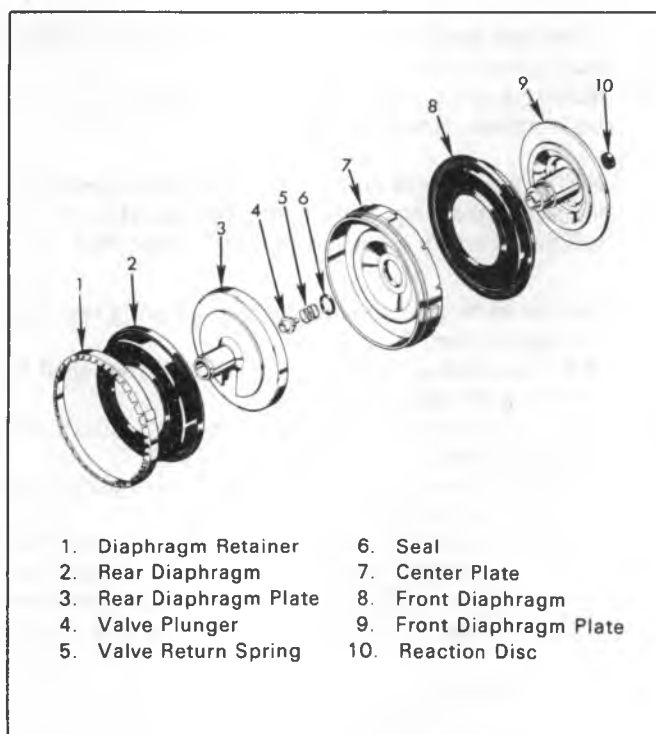


Fig. 7C—Removing Diaphragms, Plates, Retainer and Plunger

23. Twist rear plate counter-clockwise using hand leverage only at outer edge of plate or atmospheric pressure channel and unscrew rear plate from hub of front diaphragm plate.

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

24. Remove front diaphragm and front diaphragm plate.
25. Remove front diaphragm plate from Front Plate Holding Fixture J-22839.
26. Use a screw driver through center bore of front diaphragm plate to push out reaction disc.

### Cleaning

After disassembly, all metal parts should be cleaned in metal parts cleaner. Plastic parts and rubber parts should be cleaned **ONLY** in alcohol. Care should be taken to prevent chipping or cracking plastic parts. Replace all rubber parts, except power diaphragms. After parts have been cleaned, wash them thoroughly with alcohol and use clean, dry compressed air to blow dirt and fluid out of recesses and internal passages. Use all parts furnished in the repair kit.

### Inspection

Inspect all parts for damage or excessive wear. The power diaphragms must be free of kinks, cracks and tears. Replace any damaged, worn or chipped parts.

### Assembly

**CAUTION:** Be sure all parts are clean before assembling unit. Do not let grease or mineral oil come in contact with any rubber parts. Lubricate rubber parts of power piston group with special lubricant included in service kit.

1. Wet valve poppet in alcohol and insert poppet in hub of rear diaphragm plate, small end first.
  2. Wet poppet retainer in alcohol and insert into hub with flange side up. Press against poppet retainer to make certain shoulder of retainer is positioned inside poppet.
  3. Assemble air silencer and air filter over ball end and shoulder of valve rod.
  4. Install valve rod spring over ball end of valve rod, with small diameter of spring against shoulder of valve rod.
  5. Guide valve rod spring, air silencer, air filter and valve rod into hub of rear diaphragm plate.
  6. Apply a light coat of silicone lubricant to front and rear bearing surfaces of valve plunger.
  7. Wet rubber grommet in valve plunger with alcohol. Pour out any excess alcohol from valve plunger.
  8. Secure valve rod in vise. Place valve plunger and a hard-wood block no wider than threaded bore of rear plate over it. While holding rear plate down with hand, tap wood with plastic headed hammer to secure valve rod to valve plunger.
  9. Remove rear plate from vise.
  10. Install silencer retainer on hub of rear diaphragm plate being careful not to chip plastic.
  11. Secure Front Plate Holding Fixture J-22839 in a vise and position front plate on it (fig. 6C).
  12. Install front diaphragm on front diaphragm plate.
  13. Apply a light coat of silicone lubricant to outside surface of front diaphragm plate hub and apply liberal coat to seal in center plate bore.
  14. Install Seal Protector J-22733 on front plate hub and install center plate and seal assembly, seal side first on hub (fig. 6C). Remove Seal Protector J-22733.
  15. Place square-cut vacuum seal firmly against shoulder of front diaphragm plate hub.
  16. Install valve return spring in recess of hub on front diaphragm plate.
  17. Screw rear diaphragm plate over front diaphragm plate and hand tighten. Valve return spring may cock when tightening. Be sure assembly is tight but do not over-tighten.
  18. Install rear diaphragm on rear diaphragm plate over lip of center plate.
  19. Wet diaphragm retainer with silicone and press retainer onto center plate until it **fully seats** against shoulder of center plate.
- NOTE:** Retainer must seat on center plate to properly assemble front and rear shell.
20. If rear bearing vacuum seal was removed, use Bearing Seal Installer J-22677, to press new seal into rear shell until flat rubber is about 5/16" below flat inside surface of shell (fig. 8C).

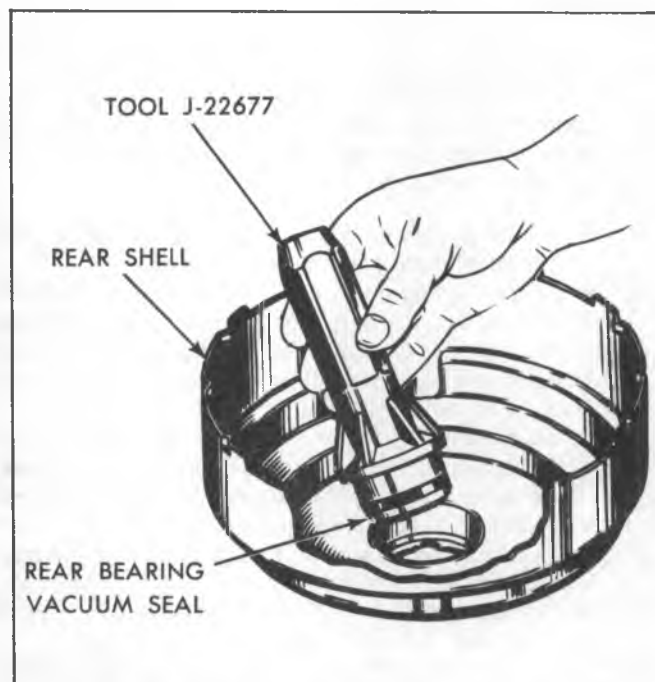


Fig. 8C-Installing Rear Bushing Vacuum Seal

21. Apply talcum powder to inside of rear shell. Apply light coat of silicone lubricant to outside surface of rear diaphragm plate hub and liberal coat to bearing vacuum seal in rear shell.
22. Guide rear shell over assembly so as not to damage rear bearing vacuum seal.
23. Align any lug on center plate and seal assembly with any groove in rear shell. Press down on rear shell evenly to slide lances on rear shell past center plate.
24. Assemble air silencer inside dust guard and install a valve rod with dust guard over scallops on rear shell hub.
25. Remove assembly from Front Plate Holding Fixture J-22839.
26. Secure front shell to Holding Fixture J-22805.
27. Secure Holding Fixture J-22805 on arbor press plate by a suitable means (fig. 4C).
28. Place Spanner Wrench J-9504 over studs on rear shell. Use three washers and nuts to attach wrench to shell. Place a suitable piece of pipe (approximately two inches I.D. and approximately three inches in length) over plastic diaphragm plate hub. Place a piece of flat stock steel over end of pipe.
29. Line up scribe marks on front shell so that front shell is slightly counter-clockwise of scribe mark on rear shell.
30. Install diaphragm return spring so that small end of spring is against front shell.
31. Lubricate outer rim of front diaphragm with silicone lubricant and work rim so it is under each of the retaining lances of rear shell.
32. Apply liberal coat of silicone lubricant to cut-out trim surface of front shell that will engage front diaphragm.

33. Press rear shell down far enough to compress rubber diaphragm and spring.
34. Rotate spanner bar clockwise until tang on front shell butts against rear shell stop.

**NOTE:** Bend lanced areas "in" on the shell to secure in place. If the tangs break during this operation, it will be necessary to replace that half of the shell.

35. Remove three nuts and lock washers securing rear shell to spanner wrench.
36. Remove Holding Fixture J-22805 from front shell by removing two nuts and washers.
37. Dip check valve grommet in alcohol and install into front shell, beveled side first.
38. Dip end of vacuum check valve in alcohol and install valve through grommet.
39. Apply liberal coat of silicone lubricant to entire surface of reaction disc and to piston end of hydraulic push rod; apply a light coat of silicone lubricant to push rod stem. Keep lubricant away from adjusting screw end of push rod.
40. Insert reaction disc and push rod in opening of front shell and into bore of front diaphragm plate hub. Twist push rod to make certain reaction disc is seated in bore and there are no air pockets between disc and end of push rod.
41. Install front vacuum seal, metal support plate side first, over adjustment screw end of push rod, pressing seal until it bottoms in recess of front shell.
42. Assemble master cylinder to front shell and securely tighten retaining nuts.
43. Install backing plate on rear shell and thread clip nut on stud marked during disassembly.

**NOTE:** The push 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.

### Hydraulic Push Rod Adjustment

If adjustment is necessary, grasp push rod with pliers at serrated end and turn adjusting screw either in or out as required.

1. Place top of Push Rod Height Gauge J-7723-01(Truck) or J- 21183 (Corvette) over push rod with legs of gauge resting on front of rear shell Figure 9C. Top of screw should touch gauge.

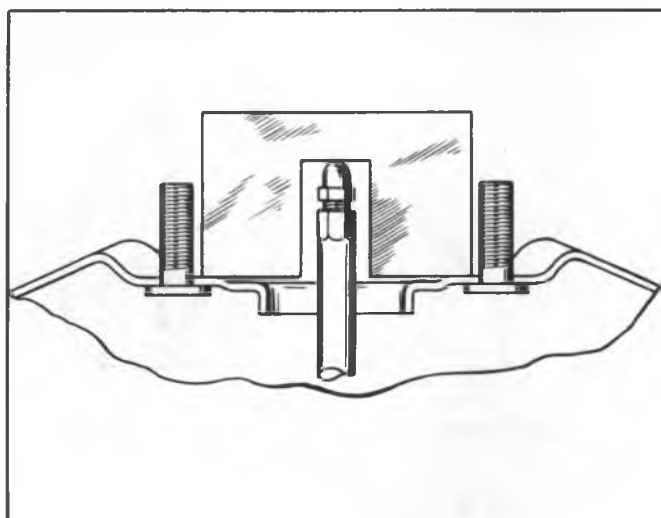


Fig. 9C-Adjustment of Push Rod

### Installation

**CAUTION:** All brake attachments are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with parts of the same part numbers or with equivalent parts if replacement becomes necessary. Do not use replacement parts of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

1. Mount the power brake assembly in place and install four attaching nuts and lock washers. Be certain to place push rod through cutout in dash panel.

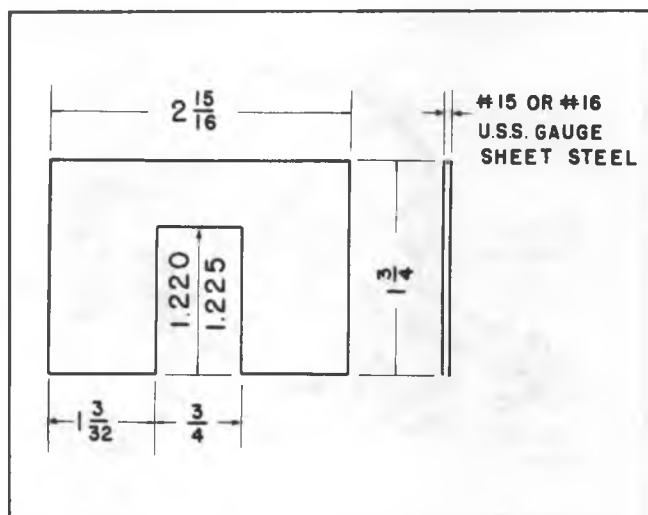


Fig. 10C-Push Rod Gauge

2. Attach vacuum line to check valve.
3. Secure hydraulic line to master cylinder.
4. Adjust push rod clevis to brake pedal assembly. Adjust pedal height by means of clevis on brake pedal push rod at pedal. Pedal height is obtained by measuring from floor covering at toe pan to top of pedal pad.

**NOTE:** Check operation of stoplight after adjusting pedal height.

5. Bleed Brakes as outlined in the service manual.

**NOTE:** If push rod height adjustment gauge is not available, the required dimensions for fabrication are given in Figure 9B for Truck and Figure 10C for Corvette.

## BENDIX SINGLE DIAPHRAGM TYPE HYDROVAC

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## DESCRIPTION AND OPERATION

The Single Diaphragm Hydrovac is a self contained vacuum hydraulic power brake unit for use on a vehicle with a vacuum source such as the intake manifold of the conven-

tional four-cycle gasoline engine (fig. 1D). The Hydrovac consists of three basic elements:

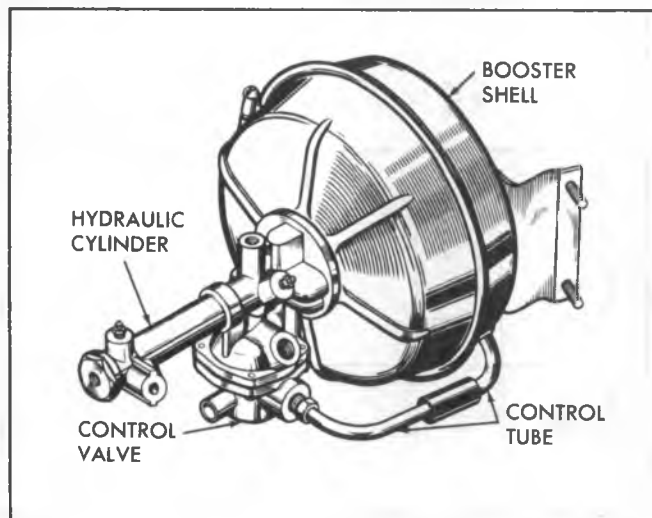


Fig. 1D-Bendix Single Diaphragm Hydrovac

1. A **vacuum power chamber** which consists of a power diaphragm and a push rod that connects the power diaphragm to the hydraulic piston.
2. A **hydraulic (slave) cylinder** which contains a hydraulic piston with a drilled passage to permit the filling of the hydraulic cylinder and return of the fluid to the master cylinder upon release of the brakes.
3. A **vacuum control valve** built integral with the hydraulic cylinder which controls the power output of the vacuum power chamber in accordance with the hydraulic pressure developed within the vehicle master cylinder.

The Hydrovac is attached to the vehicle frame by means of a mounting bracket attached to the power chamber shell and a mounting pad boss on the side of the hydraulic cylinder. The vacuum inlet port of the vacuum control valve is connected to the intake manifold or other vacuum source through a vacuum check valve. The atmospheric port in the control valve is connected to an air cleaner installed in a location protected from road dirt and splash. The hydraulic line from the brake master cylinder is attached to the fluid inlet port on top of the Hydrovac hydraulic cylinder. The outlet port of the Hydrovac is located in the end cap of the hydraulic cylinder and is connected to the vehicle brake wheel cylinders.

### Disassembly (Fig. 2D)

1. Scribe across front and rear shells. Clamp hydraulic cylinder (1) in bench vise.
2. Slide vacuum hose (4) on control tube toward hydraulic cylinder end. Remove control tube and nut (3) with hose from control valve body.
3. Remove nut (7), clamp bolt (9) and clamp ring (8), then remove rear shell (6).

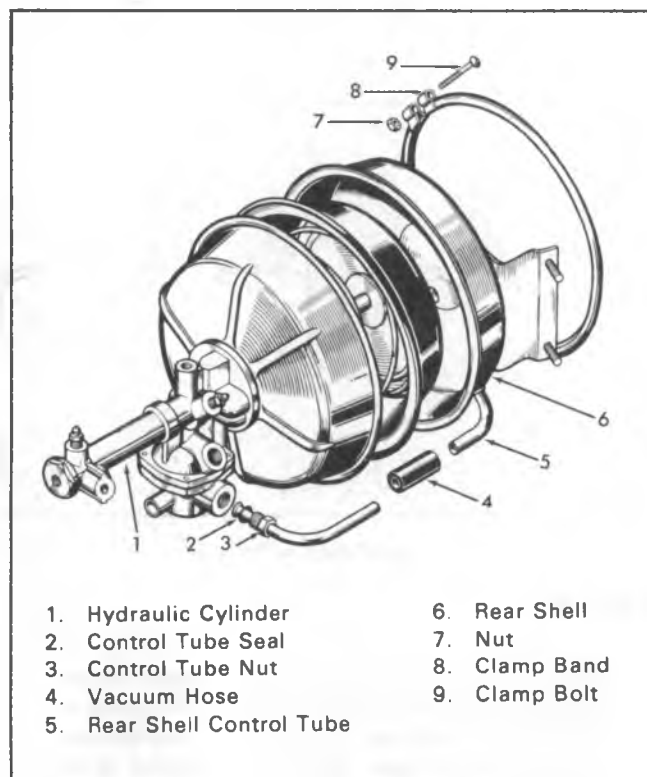


Fig. 2D-Removal of Control Tube, Clamp Band, Rear Shell and Diaphragm

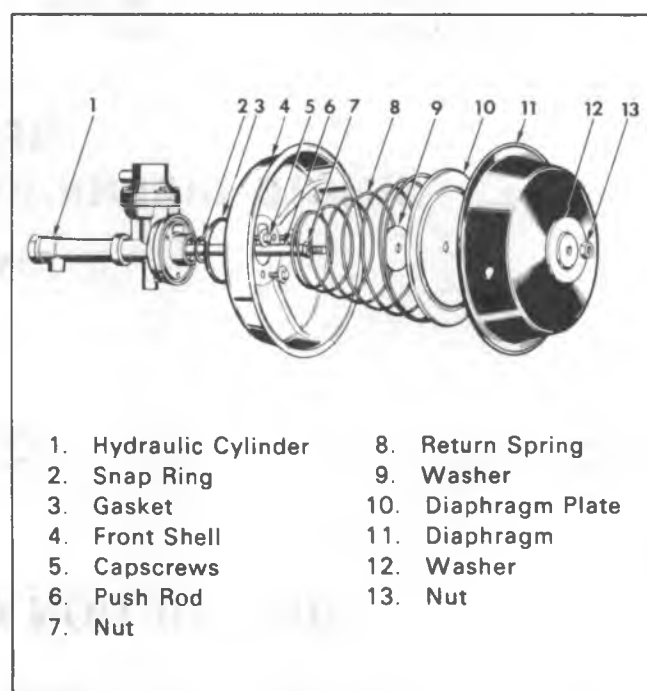


Fig. 3D-Removal of Diaphragm, Spring, Front Shell and Gasket

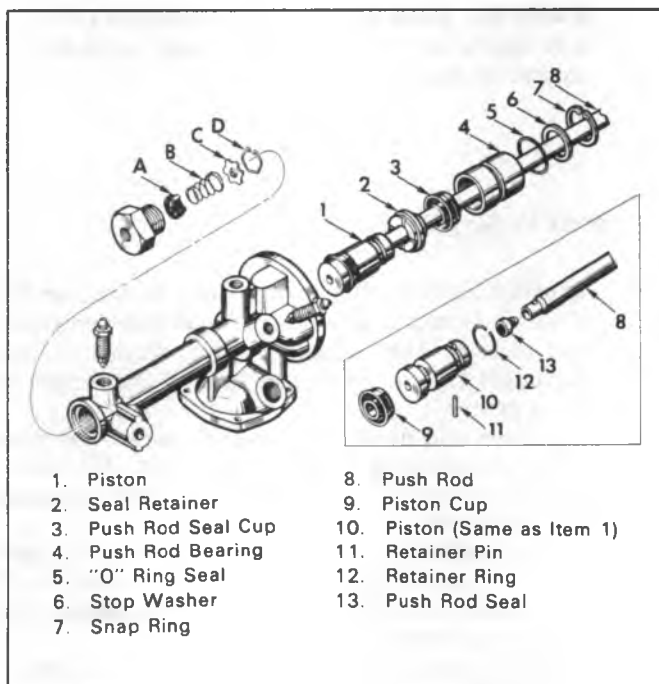


Fig. 4D— Disassembly of Push Rod and Piston

### Diaphragm, Spring and Front Shell (Fig. 3D)

1. With hydraulic cylinder held securely in vise in a horizontal position, press in on diaphragm (11) and plate (10) to compress diaphragm return spring.
2. Turn rim of diaphragm back and, still maintaining pressure with your stomach, use both hands and snap ring pliers to remove snap ring (2) from groove inside bore of cylinder (1).

**NOTE:** After snap ring is free lay pliers aside and use both hands to pull complete assembly of diaphragm, spring, push rod and piston parts straight out of cylinder. If necessary to replace diaphragm or other parts (6 through 13), use open end wrench on nut (7) and remove nut (13), washer (12), diaphragm (11), plate (10), washer (9), return spring (8), nut (7). Remove three capscrews (5) and lift front shell (4) off flange of cylinder. Remove rubber gasket (3) from groove in flange of hydraulic cylinder.

### Push Rod and Piston (Fig. 4D)

1. Working on clean bench, remove piston parts (2 through 12) from push rod (8) off piston end of push rod.
2. Slide retainer ring (12) out of groove in piston (10) and separate piston from push rod (8) by removing retainer pin (11).
3. With ice pick or thin-bladed screw driver, remove cup (9) from piston. Slide seal retainer (2), push rod seal cup

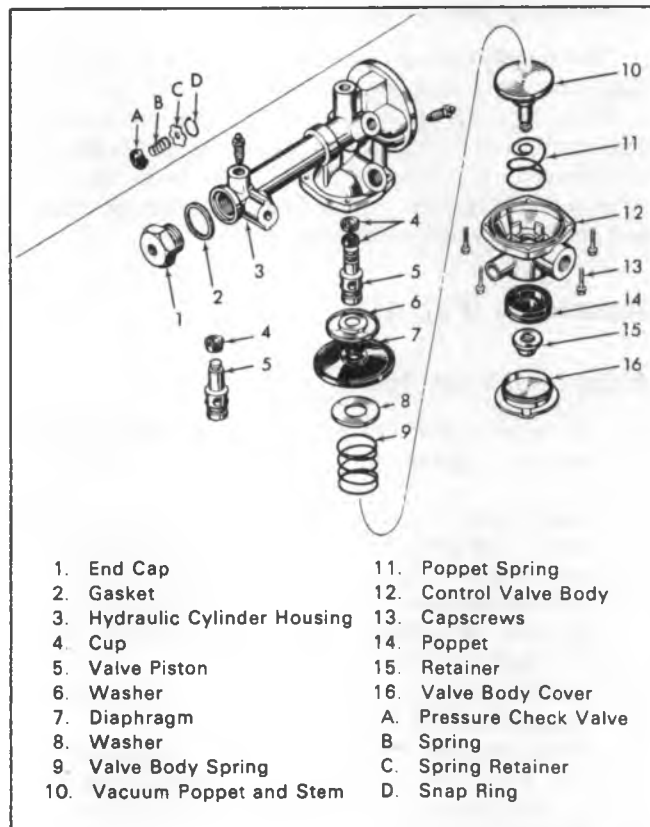


Fig. 5D—Removal and Disassembly of Control Valve

- (3), push rod bearing (4), stop washer (6) and snap ring (7) off piston end of push rod.
4. Remove "O" ring seal (5) from bearing groove.
5. If necessary to replace push rod seal (13) located in end of push rod, grip seal with pliers and pull it from end of push rod. Discard seal.

### Control Valve (Fig. 5D)

1. Scribe across flanges of control valve body (12) and hydraulic cylinder housing (3).
2. Remove four capscrews (13) and lift off valve body and spring (9).
3. Remove washer (8), diaphragm (7), washer (6), and cup (4) from valve piston (5).
4. Using screw driver, carefully pry off plastic valve body cover (16).
5. Pry off plastic retainer (1st stage poppet) (15), lift off atmospheric (2nd stage) poppet (14) and then remove vacuum poppet and stem (10) and poppet spring (11) from valve body (12).
6. Using 1-3/8" wrench, remove end cap (1) and gasket (2).
7. To disassemble residual pressure check valve (if used) contained in end cap, use pliers or screw driver to lift snap ring (D) from groove inside end cap. Remove spring retainer (C) spring (B) and residual pressure check valve (A).



## Cleaning and Inspection

Thoroughly clean all metal parts in Bendix Metalclene or equivalent. After cleaning, rewash all hydraulic system parts in clean isopropyl alcohol or equivalent before reassembly. Inspect all parts for excessive wear or damage. Replace worn or damaged parts. Inspect control valve body atmospheric valve seat. If damaged, replace housing. Always use the correct repair kit when overhauling unit.

## Assembly (Fig. 4D)

### Piston and Push Rod

1. To install a new push rod seal (13) in push rod (8), place new seal (rubber side down) on a clean block of wood.
2. Hold push rod vertically (threaded end up) with drilled end of rod resting on shaft end of seal and then strike threaded end of push rod with soft hammer to seat seal with its shoulder firmly against end of push rod.
3. Dip cup (9) in brake fluid and assemble cup on piston (10) with lip of cup as shown.
4. Install piston parts (2 through 12) on push rod from seal end of push rod in order shown.
5. Slide snap ring (7), stop washer (6), bearing (4) with "O" ring (5) installed in bearing groove, push rod seal cup (3), seal retainer (2), retainer ring (12) and piston assembly (1) on push rod.
6. Assemble retainer pin (11) through holes in piston and rod. Secure pin in place with retainer ring (12), making certain ring is seated in groove on piston.

### Front Shell Assembly to Piston (Fig. 3-D)

1. Place new gasket (3) in groove on flange of hydraulic cylinder (1).
2. Assemble front shell (4) to cylinder, aligning cutout in shell with porting in cylinder flange.
3. Assemble capscrow and tighten to 130-230 in. lbs.
4. If diaphragm, plate and return spring were disassembled, install nut (7) (if nut is undercut, install undercut, side first) and tighten to 160-200 in. lbs., then washer (9), diaphragm plate (10), concave side first, on threaded end of push rod.
5. Install diaphragm (11), washer (12) and nut (13) on push rod, as shown, and securely tighten nuts (7 and 13) to 160-200 in. lbs.
6. Coat hydraulic cylinder bore with clean brake fluid. Dip hydraulic piston and bearing parts in clean brake fluid. Slide diaphragm return spring (8) onto push rod large diameter of spring first, over hydraulic piston end.
7. Seat spring against concave surface of diaphragm plate (10) and align entire assembly with hydraulic cylinder bore.
8. Carefully insert hydraulic piston assembly, retainer, seal and bearing in cylinder bore. Press against diaphragm and plate to compress return spring and seat stop washer against bearing inside bore and then, using snap ring pliers, install snap ring (2) securely in groove in cylinder bore.

**WARNING:** Make sure snap ring is seated all the way around its groove before releasing pressure against return spring.

### Control Valve (Fig. 5D)

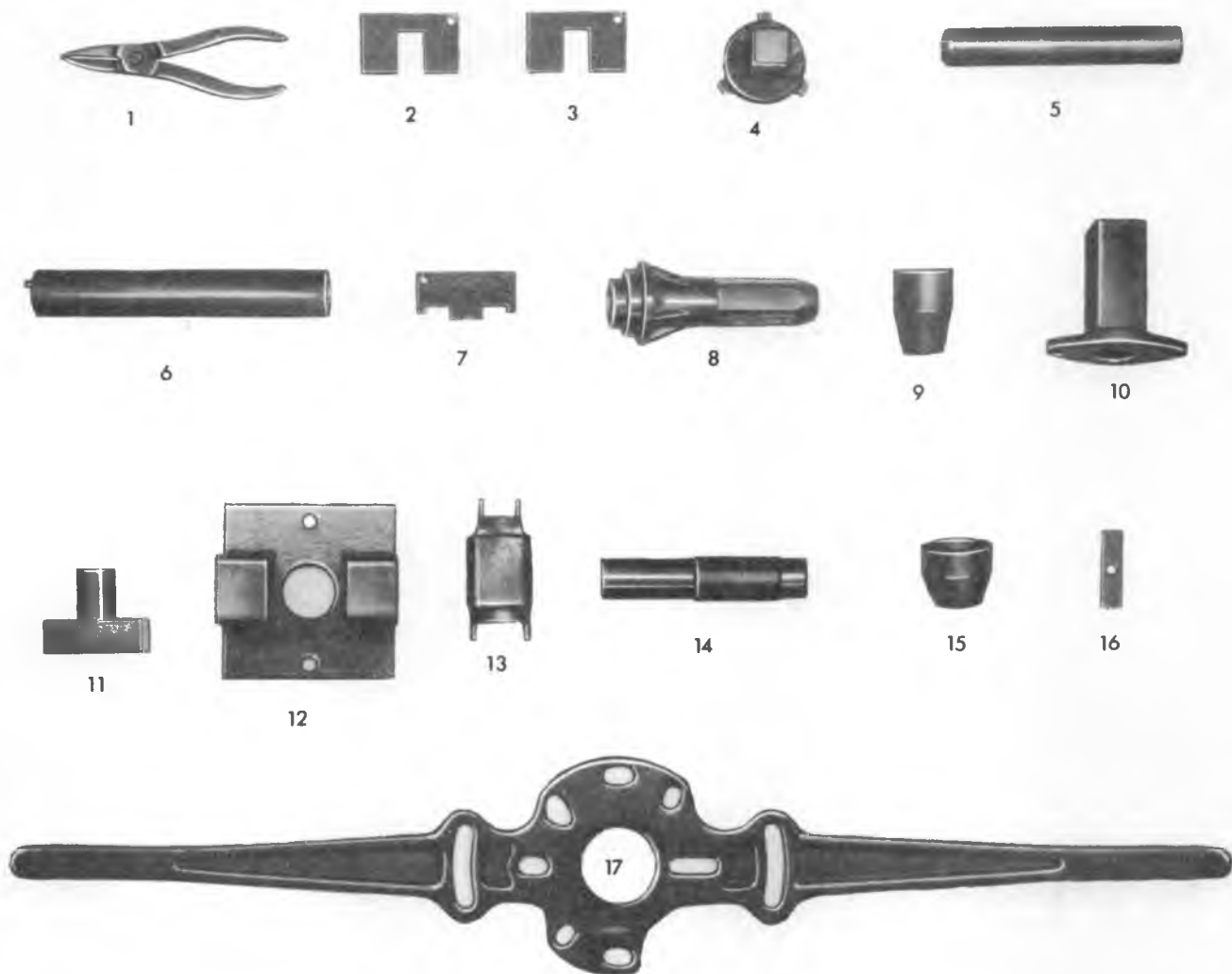
1. Assemble cup (4) facing up on control valve piston (5), as shown. If two cups are used, install them on piston back to back. Then assemble piston, washer (6) and diaphragm (7) and seat inner bead of diaphragm in piston groove.
2. Lay piston and diaphragm assembly aside. Assemble poppet return spring (11), vacuum poppet (10) and atmospheric poppet (14) in valve body (12) from opposite sides, as shown.
3. Snap poppet retainer (15) over end of vacuum poppet stem. Set valve body with vacuum poppet down on 1" wooden cube and tap retainer with soft hammer until it snaps onto stem of vacuum poppet.
4. Assemble cover (16) securely in groove of valve body. Assemble spring retainer washer (8) and spring (9) on end of control valve piston, from end shown. Insert control valve piston, diaphragm and spring assembly in valve body with spring around bosses.
5. Press outer bead of diaphragm into valve body groove and, while holding spring compressed, dip piston and cup(s) in clean brake fluid.
6. Align valve body to scribe marks and assemble control valve piston carefully in its bore below hydraulic cylinder bore. Secure valve body with four capscrews (13).
7. Tighten screws to 40-60 in. lbs. Install check valve (A), spring (B), retainer (C) and snap ring (D) in end fitting (1). Install fitting and gasket (2) on end of hydraulic cylinder and tighten fitting to 50-85 ft. lbs. If removed, install bleed screw(s), tighten to 10-15 ft. lbs.

### Rear Shell, Control Tube, Hose

#### (Fig. 2D)

1. Coat bead of diaphragm or flanges of front and rear shells with talcum powder or equivalent and place rear shell (6) on diaphragm.
2. Align scribe marks on both shells. Make certain bead of diaphragm is seated in outer flanges of both shells and hold rear shell in position while assembling clamp band (8) over flanges of shells and bead of diaphragm. Position opening in band 45 degrees off vertical center line of Hydrovac on side away from mounting bracket.
3. Squeeze ends of band together and assemble bolt (9) and nut (7). Tap band lightly with soft hammer while tightening bolt to seat band securely on shells. After tapping, re-tighten to 40-60 in. lbs.
4. Place new seal (2) on control tube (3), as shown, and assemble hose (4) to tube (5) of rear shell and to control tube. Attach tube and nut (3) to control valve body port. Securely tighten to 7-10 ft. lbs.

## Special Tools



- |              |                                    |             |                                |
|--------------|------------------------------------|-------------|--------------------------------|
| 1. J-4880    | Snap Ring Pliers                   | 10. J-22805 | Power Cylinder Holding Fixture |
| 2. J-7723-01 | Height Gage                        | 11. J-22839 | Front Plate Holding Fixture    |
| 3. J-21183   | Height Gage                        | 12. J-22893 | Booster Separating Adapter     |
| 4. J-21524   | Power Piston Remover and Installer | 13. J-23101 | Power Piston Holding Tool      |
| 5. J-21601   | Power Brake Retainer and Installer | 14. J-23175 | Control Valve Installer        |
| 6. J-22657   | Bushing Retainer Socket            | 15. J-23188 | Secondary Bearing Protector    |
| 7. J-22647   | Height Gage                        | 16. J-23337 | Power Piston Gage              |
| 8. J-22677   | Power Cylinder Seal Installer      | 17. J-9504  | Power Cylinder Spanner Wrench  |
| 9. J-22733   | Seal Installer and Protector       |             |                                |

Fig. 6D-Special Tools

## 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 307-, 350-, and 400-cu. in. V8 engines are identified as "Small V8's". The 402- and 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).

## 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.

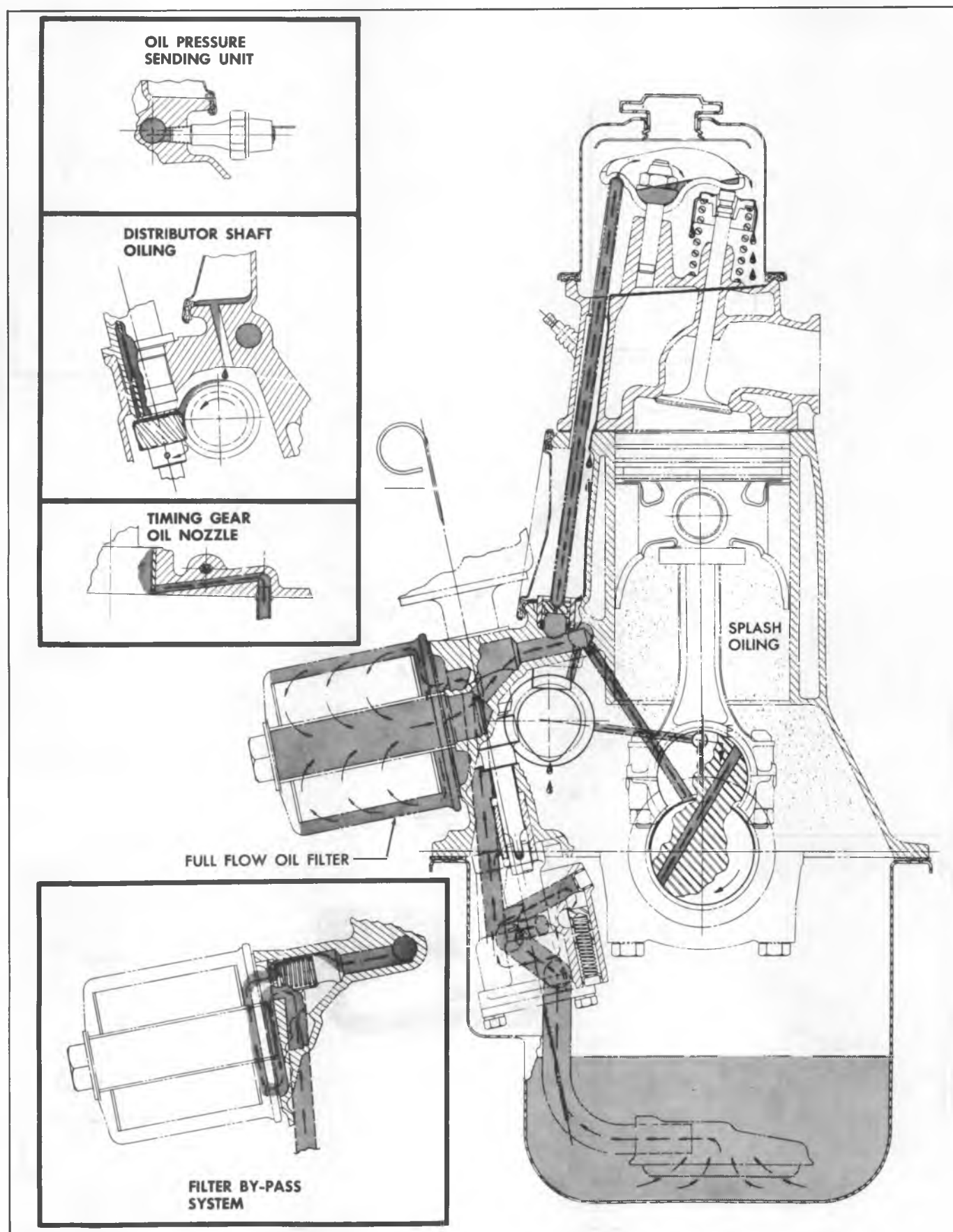


Fig. 1-In-Line Engine Lubrication

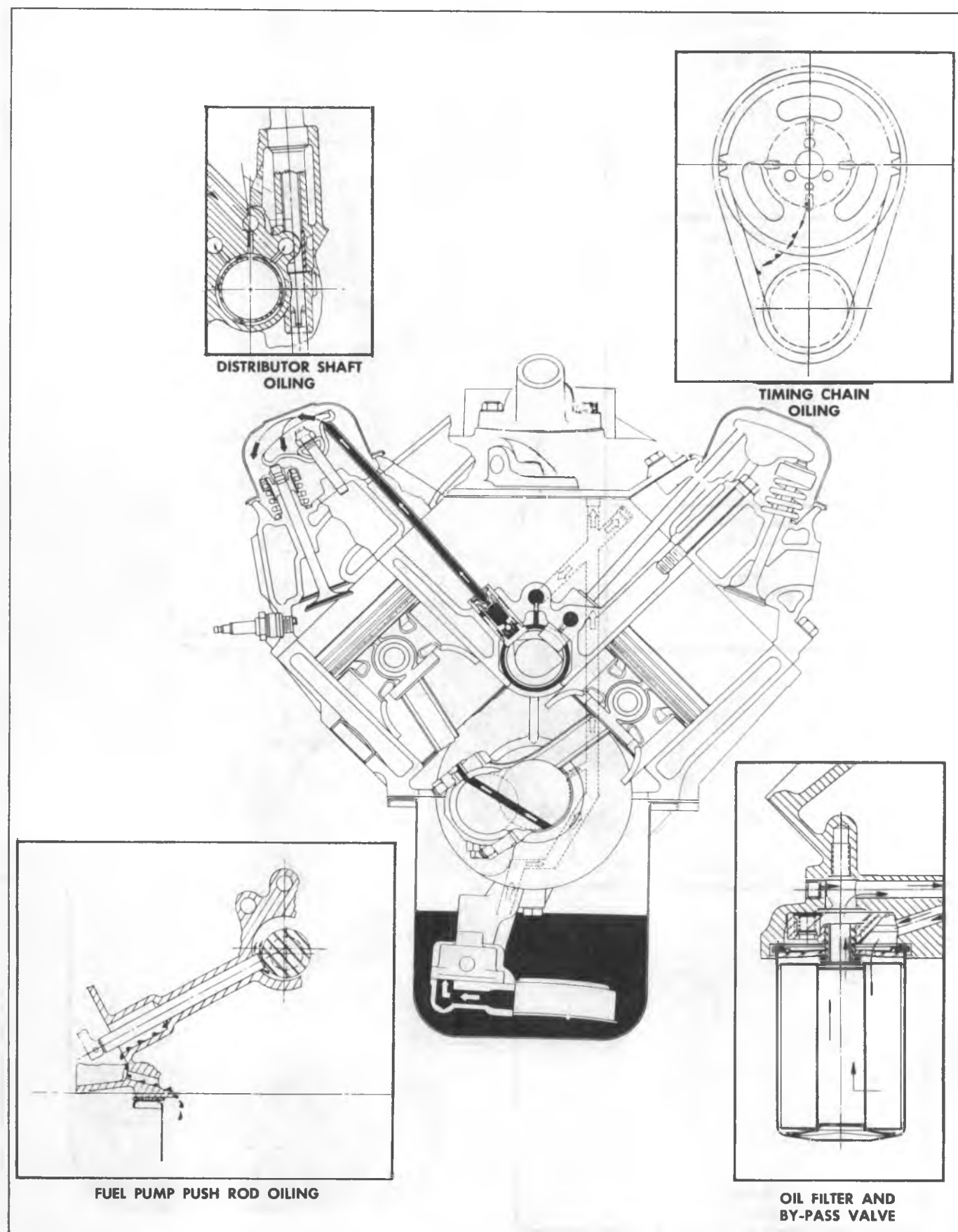


Fig. 2--"Small V8" Engine Lubrication



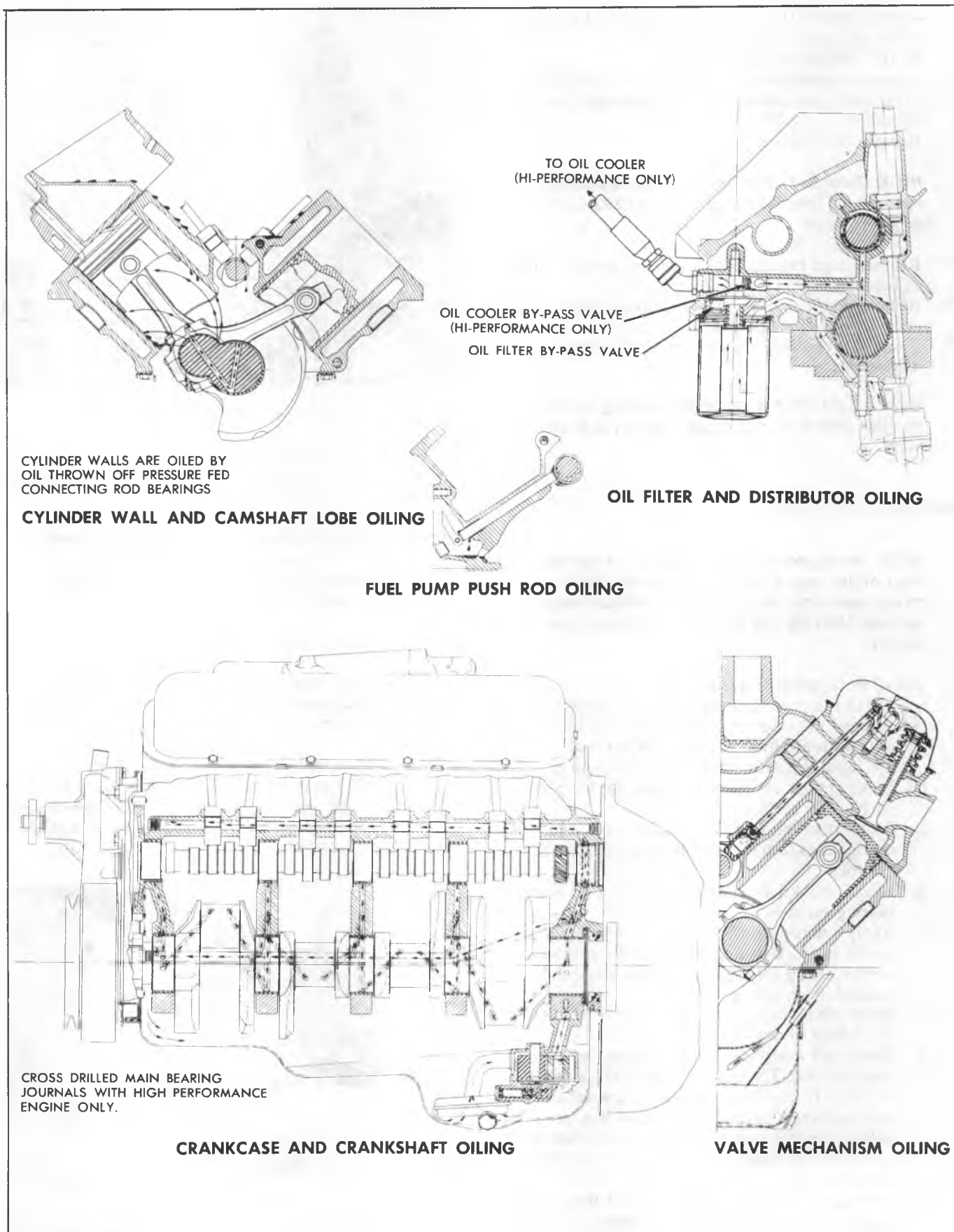


Fig. 3--"Mark IV" Engine Lubrication

---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 lip.
  - 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.

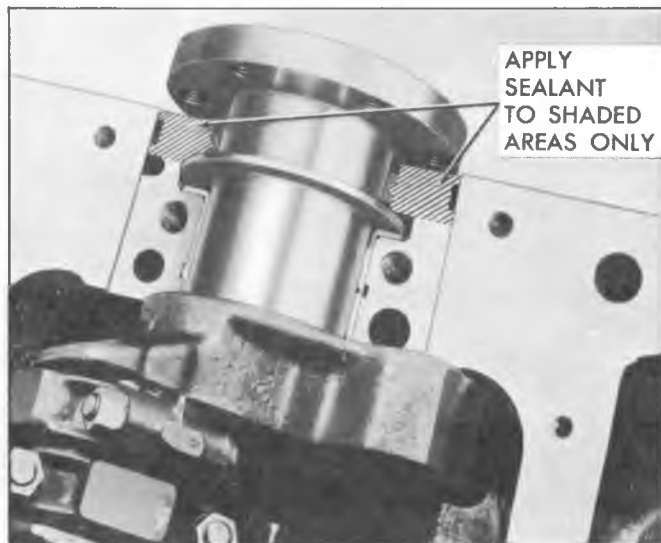


Fig. 4—Sealing Bearing Cap and Block

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 and install camshaft, being careful not to damage bearings (fig. 5). Remove the two 5/16- 18 bolts.

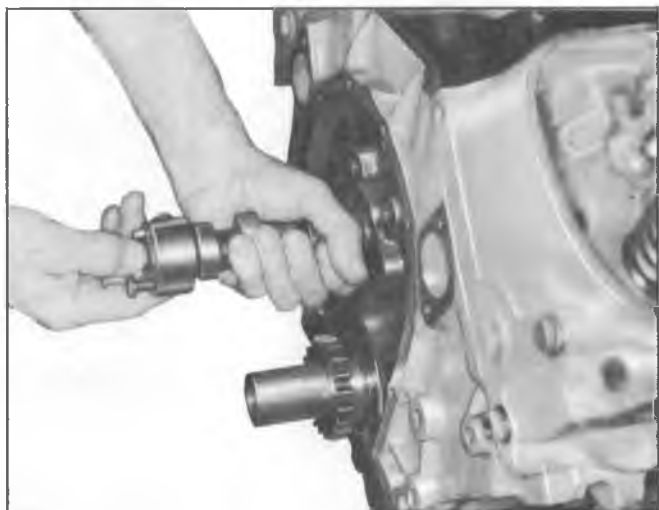


Fig. 5—Installing Camshaft

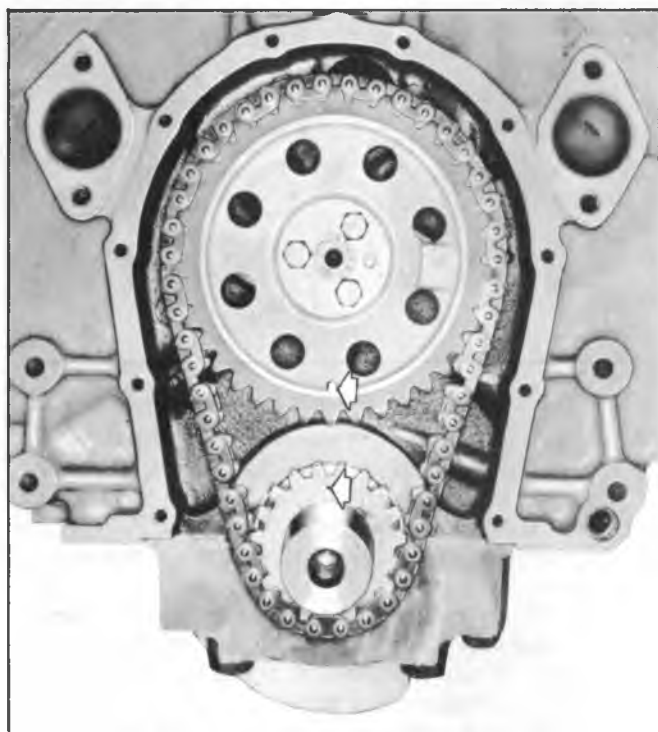


Fig. 6—Timing Sprocket Alignment Marks

- 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 welsh plug.

- 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".

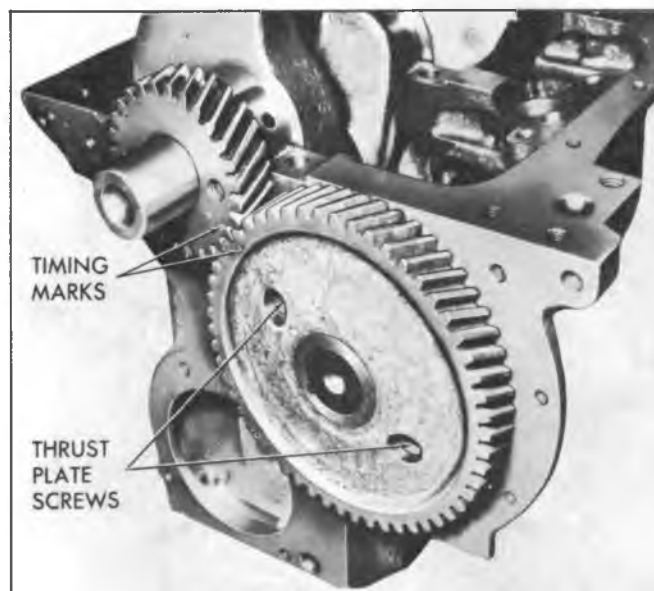


Fig. 7—Timing Gear Alignment Marks

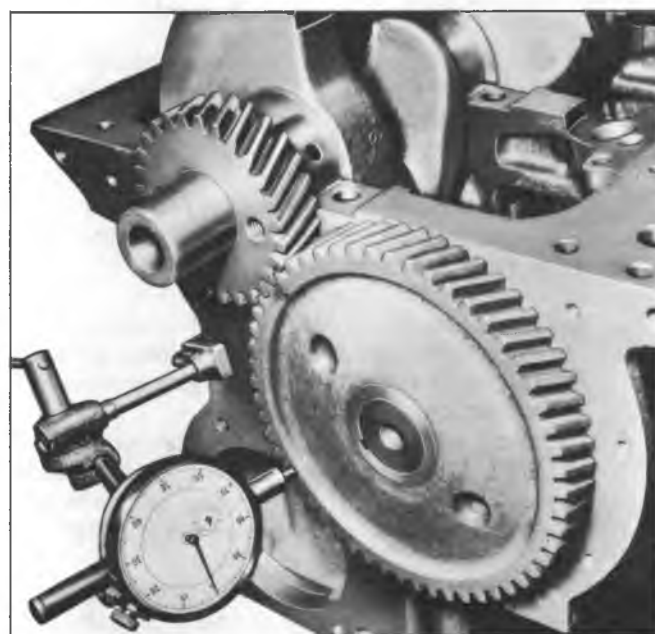


Fig. 8—Checking Timing Gear Runout

- 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 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

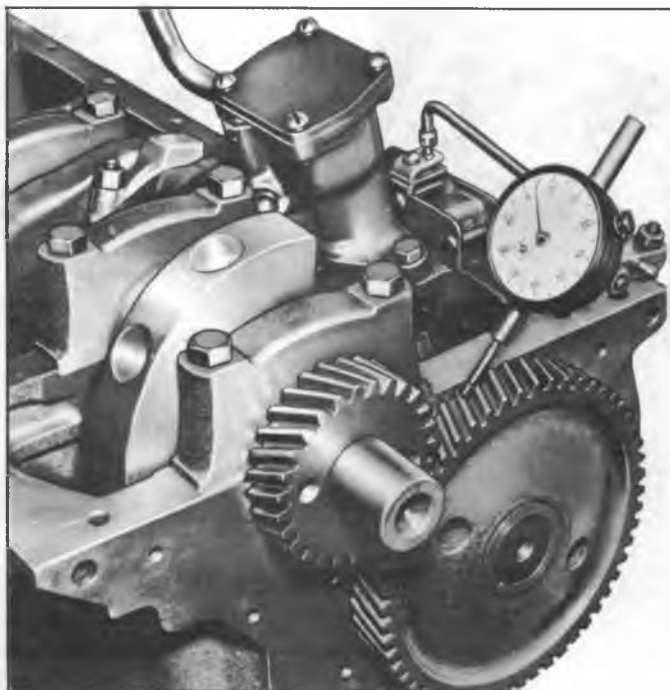


Fig. 9—Checking Timing Gear Backlash

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 positioned on piston and piston is properly positioned in cylinder block. Refer to Figures 58, 60 and 61.

- 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.



Fig. 10—Centering Tool in Cover (In-Line)

- 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. Do not use sealer.
  - b. Install rear oil pan 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)

- 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).

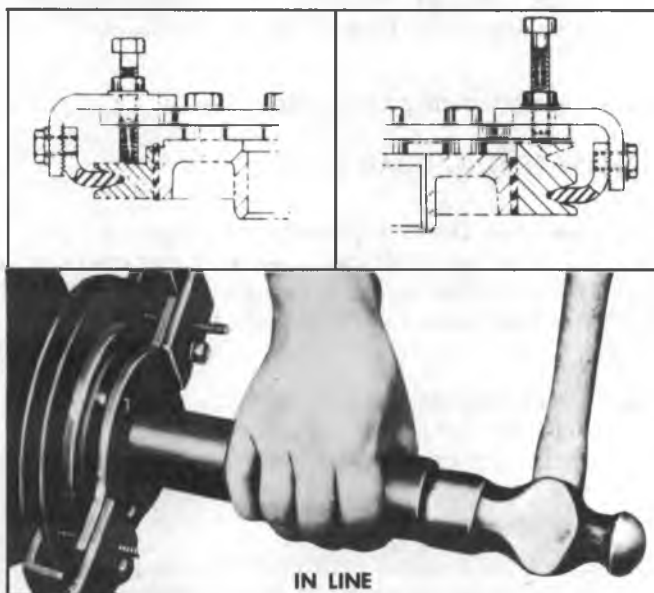


Fig. 11—Installing Torsional Damper (Drive on Type)

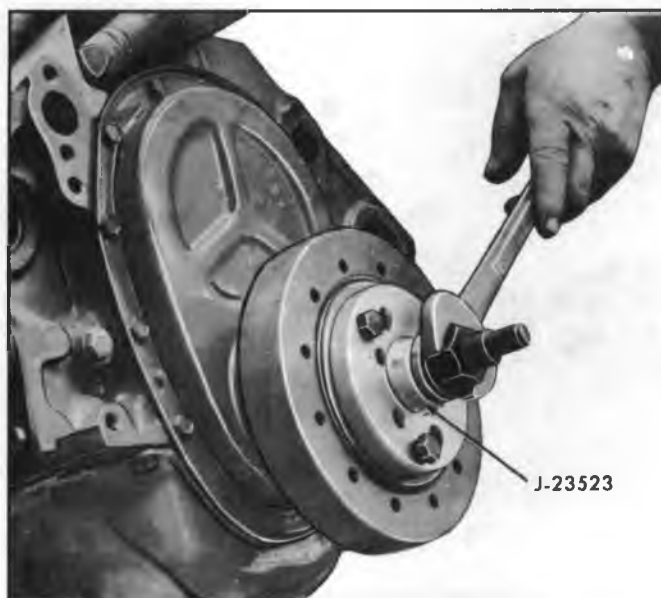


Fig. 12—Installing Torsional Damper (Pull on Type)

- 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.

#### PULL ON TYPE (With Retaining Bolt)

- 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).

**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 77 until the specified torque is reached. (See Engine Torques.)

**NOTE:** All engines using composition STEEL ASBESTOS gaskets must have the cylinder head retorqued after engine warm-up.

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 appropriate cylinder head bolt location or 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 spring caps, spring shields (if so equipped) springs and spring damper, then remove oil seals and valve spring shims.



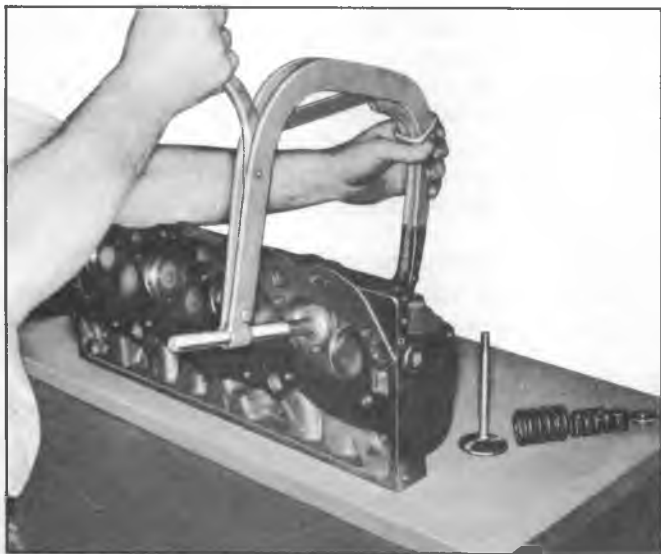


Fig. 13-Compressing Valve Spring

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).
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

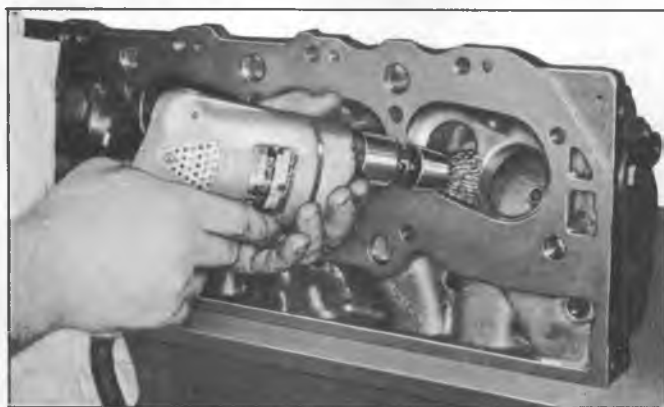


Fig. 14-Cleaning Combustion Chambers

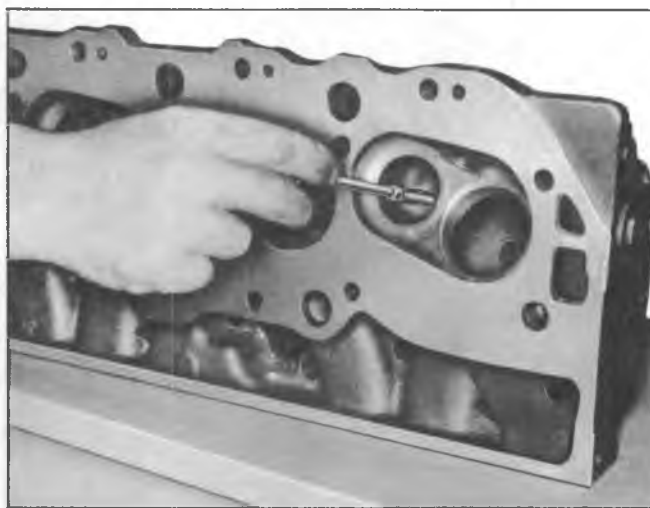


Fig. 15-Cleaning Valve Guides

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 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.



Fig. 16-Measuring Valve Stem Clearance





Fig. 17--Checking Valve Spring Tension

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 V8 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.

### ROCKER ARM STUDS (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).

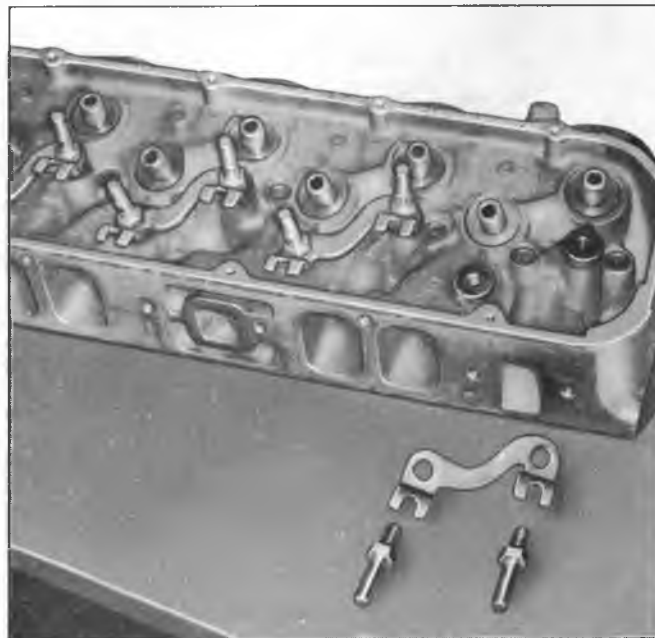


Fig. 18--Rocker Arm Stud and Push Rod Guide

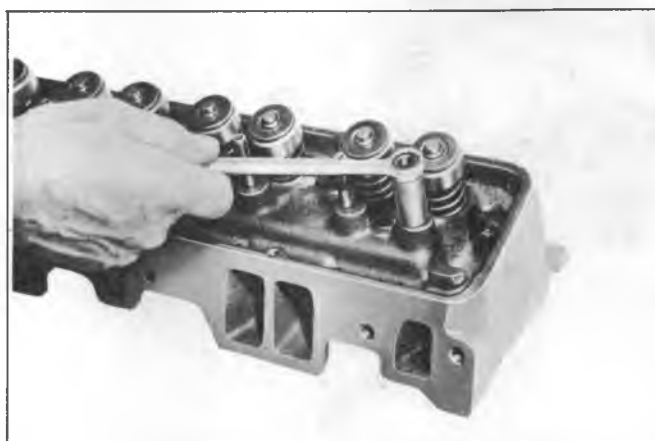
2. Ream hole for oversize stud using Tool J-5715 for .003" oversize or Tool J-6036 for .013" oversize (fig. 20).

**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).

## 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).

Fig. 19--Removing Rocker Arm Stud  
(In-Line and "Small V8")

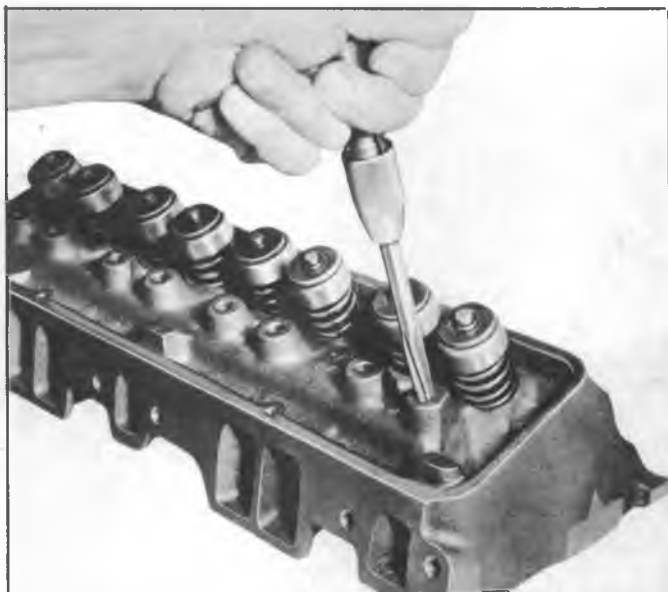


Fig. 20--Reaming Rocker Arm Stud Bore  
(In-Line and "Small V8")

### VALVE SEATS

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for re-seating 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 insure proper centering of pilot in the guide.



Fig. 22--Reaming Valve 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).



Fig. 21--Installing Rocker Arm Stud (In-Line and "Small V8")

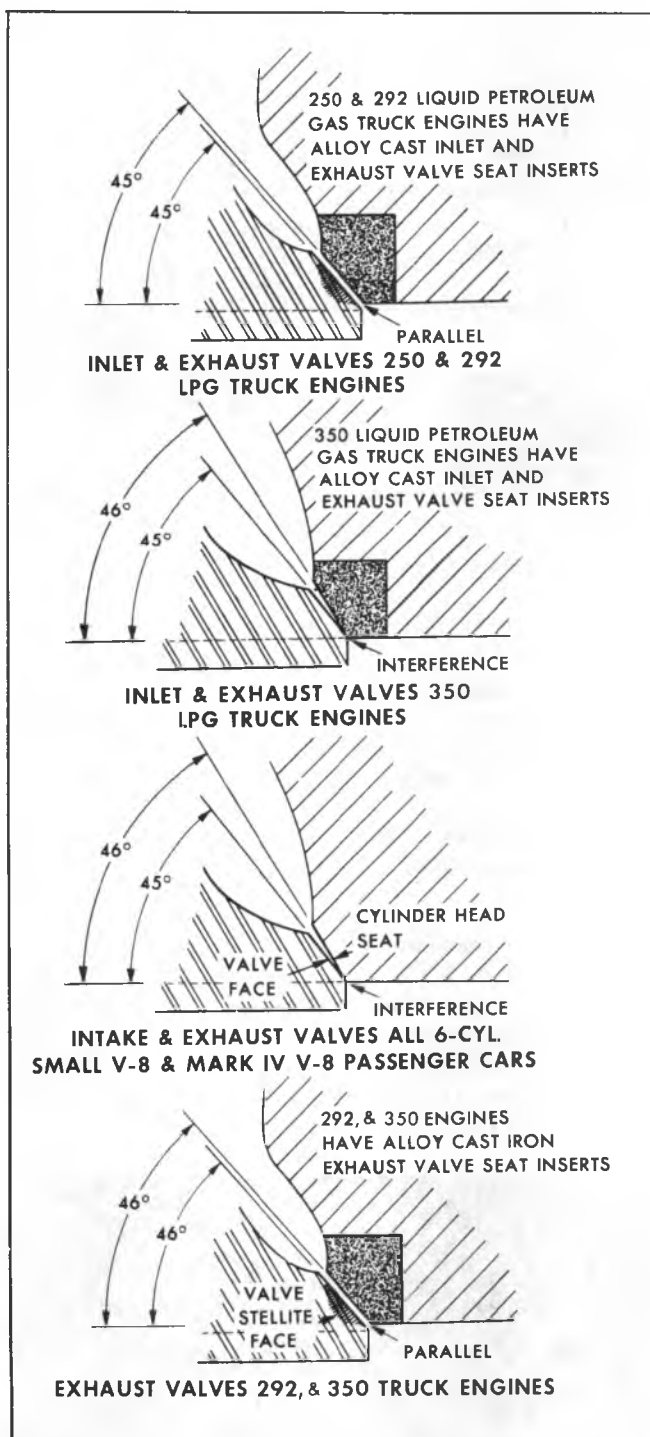


Fig. 23--Relation of Valve and Seat Angles

**NOTE:** Valve seats should be concentric to within .002" total indicator reading.

## VALVES

Valves that are pitted can be refaced to the proper angle, ensuring correct relation between the head and stem on a valve refacing mechanism. Valve stems which show excessive



Fig. 24--Measuring Valve Seat Concentricity

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 stem is hardened to resist wear. Do not grind end of stem excessively.

7. After cleaning valve face and cylinder head valve seat of grinding particles, make pencil marks about 1/4" apart across the valve face, place the valve in cylinder head and give the valve 1/2 turn in each direction while exerting firm pressure on head of valve.
8. Remove valve and check face carefully. If all pencil marks have not been removed at the point of contact with the valve seat, it will be necessary to repeat the refacing operation and again recheck for proper seating.
9. Grind and check the remaining valves in the same manner.

### Assembly

1. Insert a valve in the proper port.
2. Assemble the valve spring and related parts as follows:

#### IN-LINE AND "SMALL V8"

- 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).

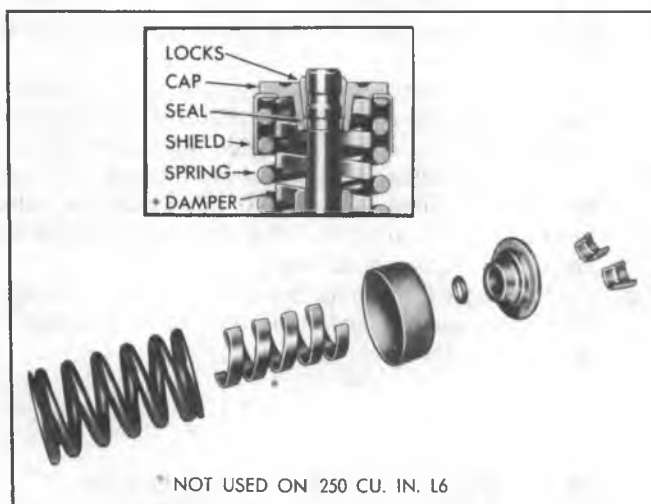


Fig. 25--Valve Spring Installation (In-Line and "Small V8")

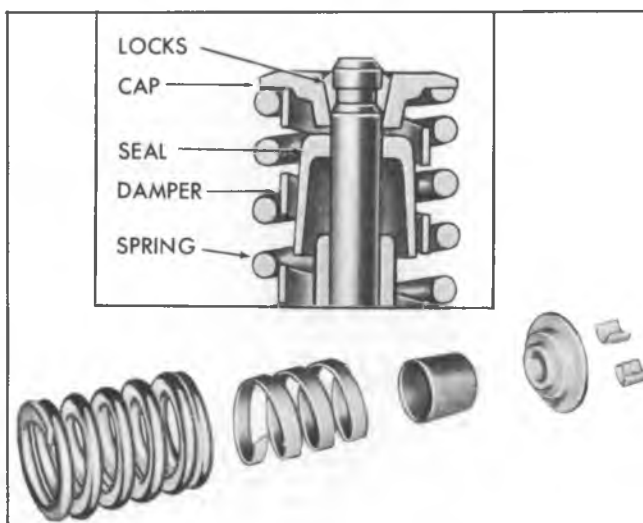


Fig. 26--Exhaust Valve Spring Installation ("Mark IV V8")

- 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).

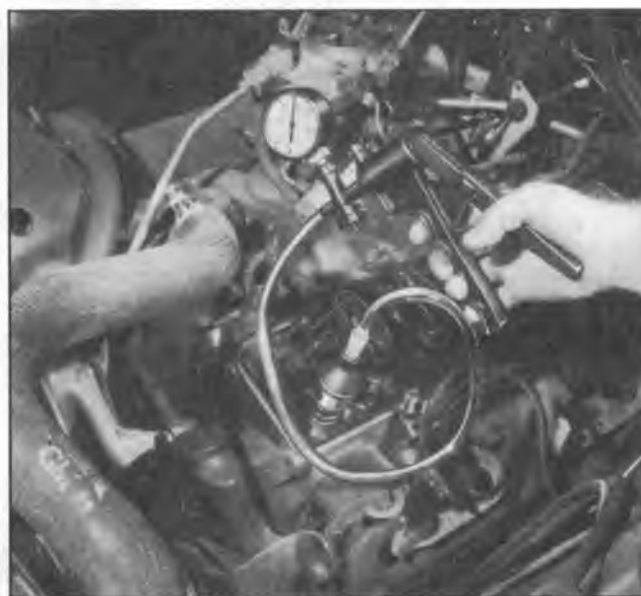


Fig. 27--Checking Valve Stem Oil Seals

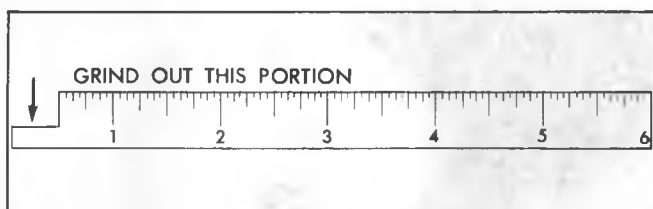


Fig. 28--Cutaway Scale

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 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.

### VALVE LIFTERS (HYDRAULIC)

Two types of hydraulic lifters are used. Both types of lifters operate on the same principle and are serviced basically in the same manner. The complete lifter assemblies are interchangeable but parts from one lifter are not interchangeable with another. Both lifters are easily identified by the outside configuration of the lifter body. For purposes of identification we refer to them as lifter "A" and lifter "B" (fig. 30).

### 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 (lifter

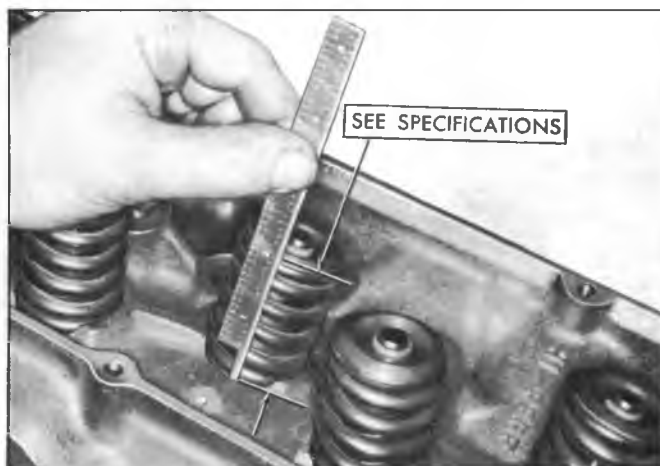


Fig. 29--Measuring Valve Spring Installed Height

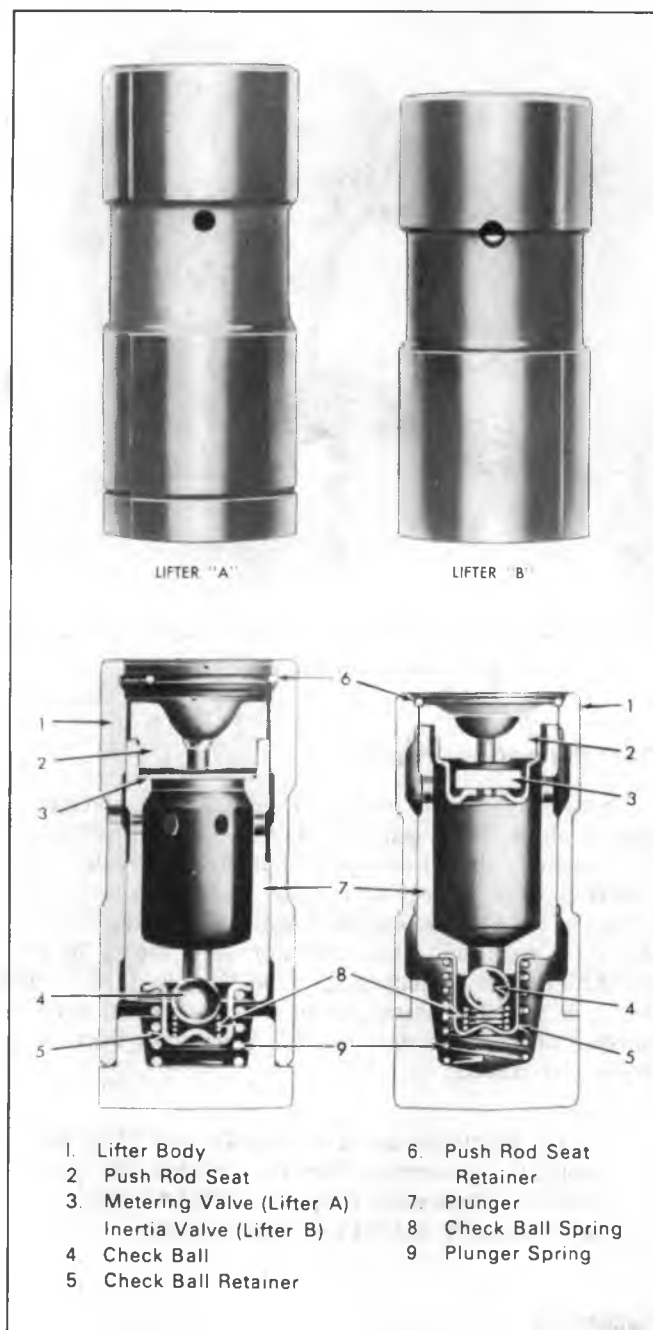


Fig. 30--Hydraulic Valve Lifters

- "A") or the push rod seat and inertia valve assembly (lifter "B") (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).



Fig. 31—Removing Ball Check Valve

### Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn the entire lifter assembly should be replaced. If the lifter body wall is scuffed or worn, inspect the cylinder block lifter bore, if the bottom of the lifter is scuffed or worn inspect the camshaft lobe, if the push rod seat is scuffed or worn inspect the push rod. An additive containing EP lube, such as EOS, should always be added to crankcase oil for run-in when any new camshaft or lifters are installed. All damaged or worn lifters should be replaced.

**NOTE:** Inertia valve and retainer (lifter "B") (fig. 30) should not be removed from the push rod seat. To check the valve, shake the push rod seat and inertia valve assembly and the valve should move.

### 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).



Fig. 32—Installing Ball Check Valve

**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).



Fig. 33—Assembling Hydraulic Lifter



**NOTE:** On lifter "B" (fig. 30) the drift pin must not extend inside the plunger.

6. Remove the 1/8" drift pin, refill assembly with SAE 10 oil.
7. Install the metering valve and push rod seat (lifter "A") or the push rod seat and inertia valve assembly (lifter "B") (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.

**NOTE:** Before installing lifter, 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.

## VALVE LIFTERS (MECHANICAL)

### Cleaning and Inspection

The mechanical valve lifter (fig. 34) should never be disassembled. Wash lifter assembly in cleaning solvent and dry with compressed air. Blow out oil holes in lifter body and push rod seat with compressed air. Inspect push rod seat retainer. Inspect lifter for scuffed or worn lifter body or push rod seat. 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. 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.

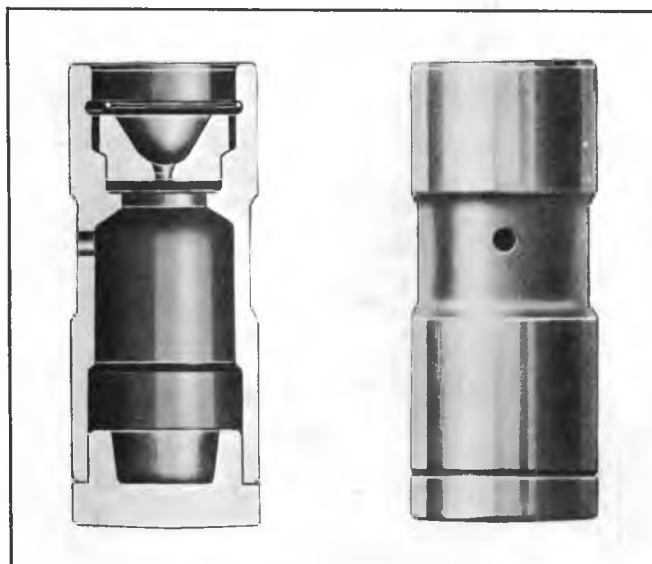


Fig. 34—Mechanical Valve Lifter

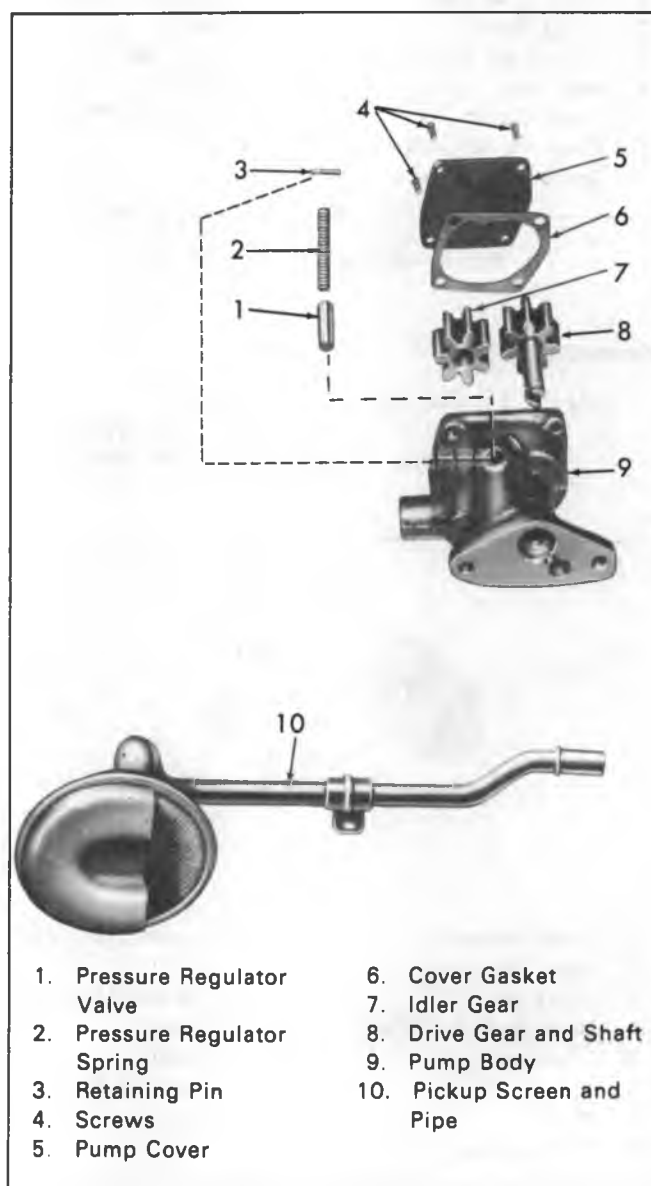


Fig. 35—Oil Pump (L6 Engine)

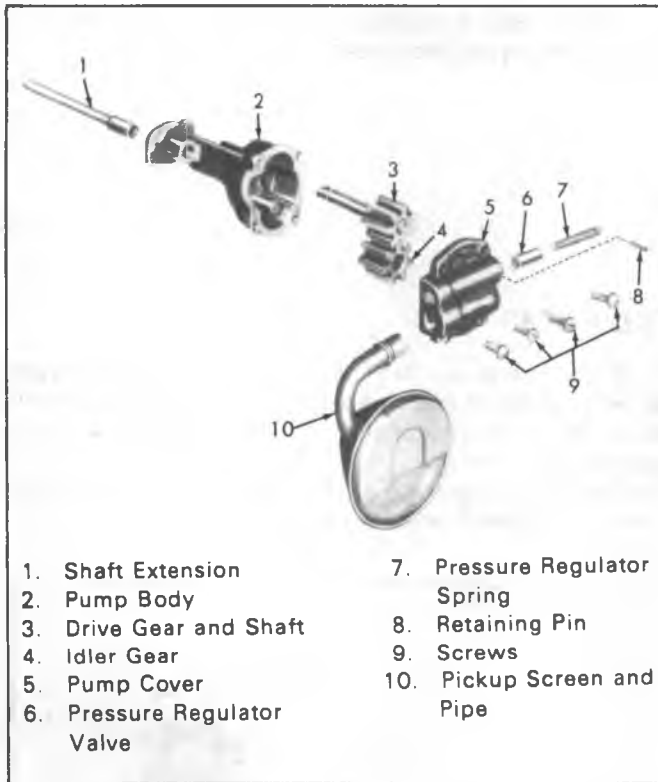


Fig. 36--Oil Pump ("Small V8")

### Disassembly

REFER TO FIGURES 35, 36, AND 37

1. Remove the pump cover attaching screws, the pump cover and on In-Line engines the pump cover gasket.

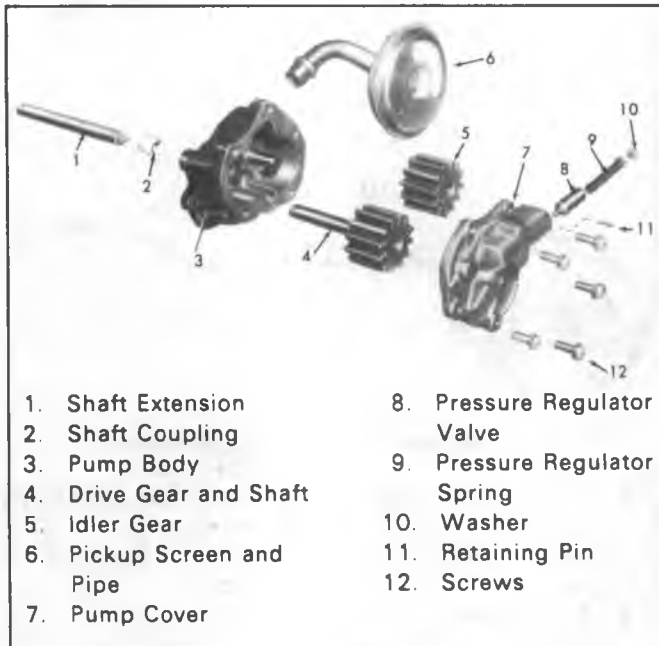


Fig. 37--Oil Pump ("Mark IV V8")

**NOTE:** Mark gear teeth so they may be reassembled with the same teeth indexing.

2. Remove the idler gear and the drive gear and shaft from the pump body.
3. Remove the pressure regulator valve retaining pin, pressure regulator valve and related parts.
4. If the pickup screen and pipe assembly need replacing, mount the pump in a soft-jawed vise and extract pipe from pump.

**CAUTION:** Do not disturb the pickup screen on the pipe. This is serviced as an assembly.

### Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect the pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.
4. Check the drive gear shaft for looseness in the pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.
6. Inspect the pickup screen and pipe assembly for damage to screen, pipe or relief grommet.
7. Check the pressure regulator valve for fit.

**NOTE:** The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.

### Assembly

REFER TO FIGURES 35, 36 and 37

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 In-Line and "Small V8" (fig. 38) or J-22144 for "Mark IV V8" (fig. 39) tap the pipe in place with a plastic hammer.



Fig. 38--Installing Screen ("Small V8")



Fig. 39--Installing Screen ("Mark IV V8")

**CAUTION:** Be careful of twisting, shearing or 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. 40).



Fig. 40--Gauging Plastic on Journal

**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. 41).

**NOTE:** Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (.001" max.), be sure to fit to the maximum diameter of the journal: If the bearing is fitted to the minimum diameter and the journal is out-of-round .001", interference between the bearing and journal will result in rapid bearing failure. If the flattened 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.

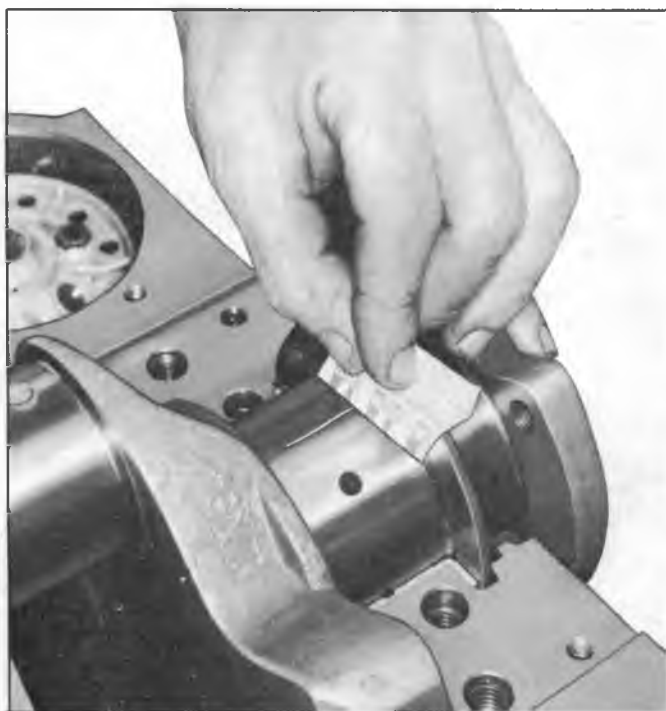


Fig. 41—Measuring Gauging Plastic

**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. 42).
10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

### Replacement

**NOTE:** Main bearings may be replaced with or without removing the crankshaft.

#### WITH CRANKSHAFT REMOVAL

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

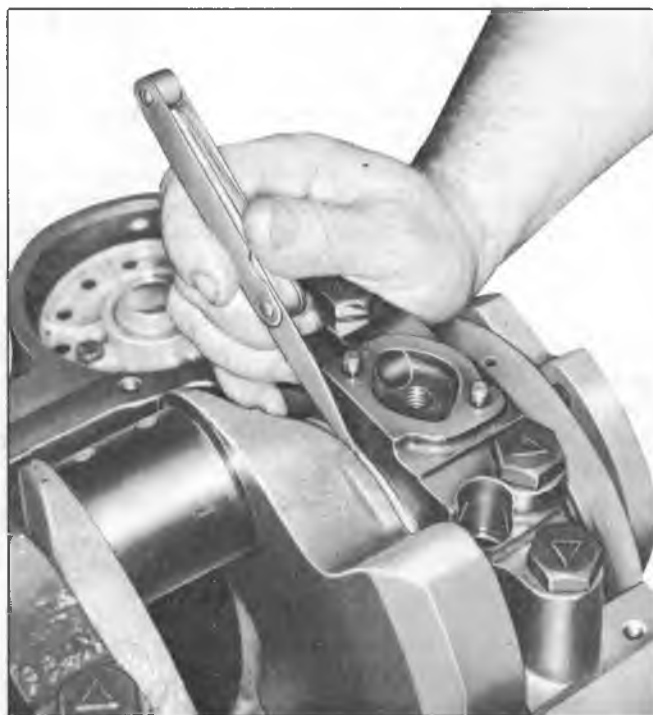


Fig. 42—Measuring Crankshaft End Play

**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 43).
  - c. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block.
  - d. Use pliers as in removing to rotate bearing into place. The last 1/4 movement may be done by holding just the slinger with the pliers or tap in place with a drift punch.
3. All other crankshaft journals (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.

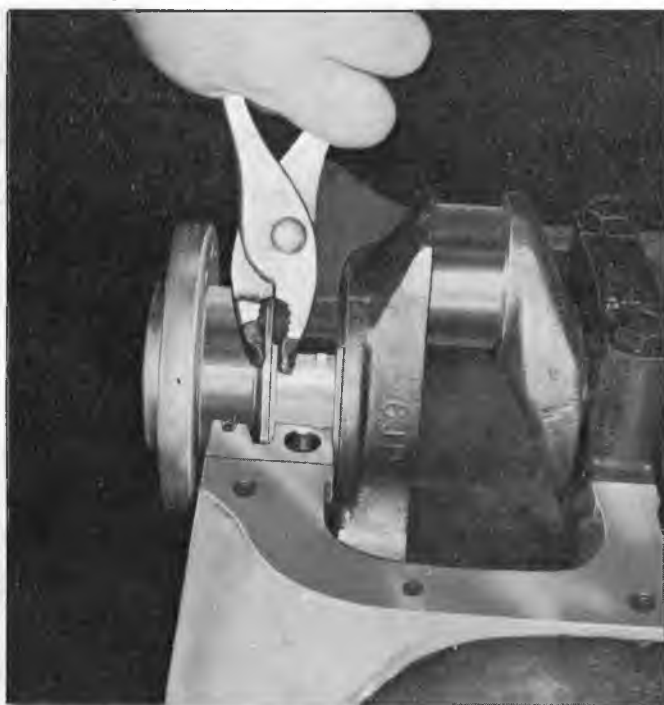


Fig. 43—Replacing Upper Main Bearing (In-Line)

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 (parallel to the crankshaft) (fig. 44).
- 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.

- d. Remove the bearing cap and using the scale on the gauging plastic envelope, measure the gauging plastic width at the widest point (fig. 45).
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. 46) or between connecting rod caps on V8 engines (fig. 47).





Fig. 44--Gauging Plastic on Crankpin

## 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.

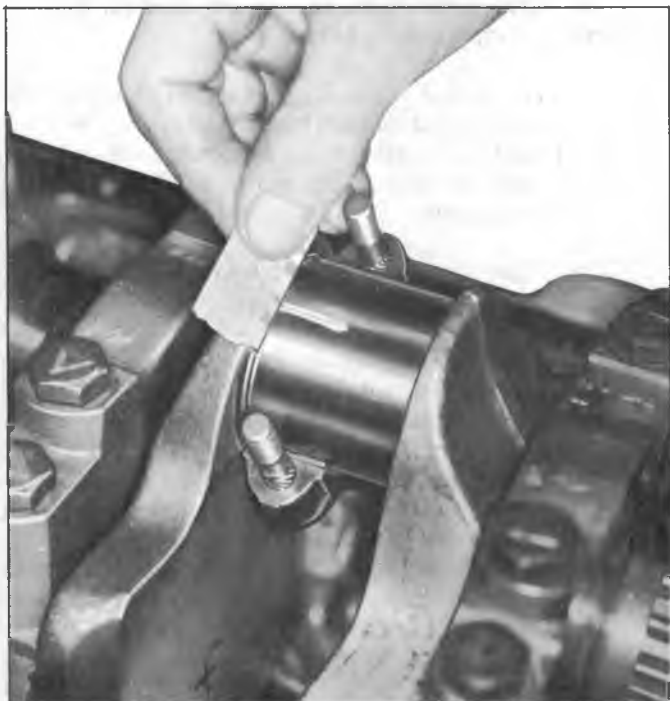


Fig. 45--Measuring Gauging Plastic



Fig. 46--Measuring Connecting Rod Side Clearance (In-Line)

**NOTE:** Before ridge and/or deposits are removed, turn crankshaft until piston is at the bottom of stroke and place a cloth on top of piston to collect the cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke and remove cloth and cuttings.

2. Inspect connecting rods and connecting rod caps for cylinder identification. If necessary mark them.
3. Remove connecting rod cap and install Tool J-5239 (3/8") or J 6305 (11/32") on studs. Push connecting rod and piston assembly out of top of cylinder block (fig. 48).



Fig. 47--Measuring Connecting Rod Side Clearance (V8)





Fig. 48--Removing Connecting Rod and Piston Assemblies

**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

### PISTON SUPPORT TOOL

If bosses on pistons (fig. 49) do not allow piston support Tool J-9510-1 to seat squarely on the piston for press 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 50.

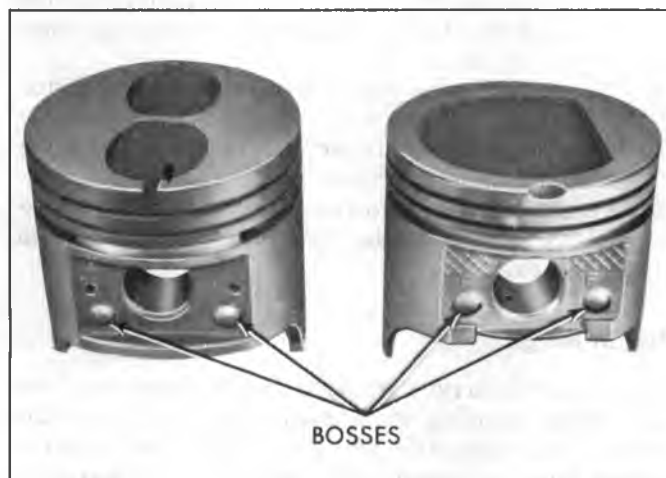


Fig. 49--Piston Bosses

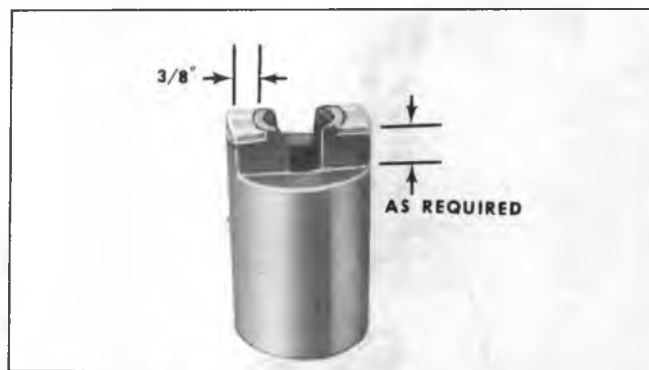


Fig. 50--Piston Support Tool Rework

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 (4-3/32"), and J-22250 (4-1/4") are available for this purpose.
3. Using Tool J-9510 for In-Line and "Small V8" (fig. 51) or Tool J-6994 for "Mark IV V8" (fig. 52), 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.



Fig. 51--Removing Piston Pin (In-Line and "Small V8")



Fig. 52--Removing Piston Pin ("Mark IV V8")

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.

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.

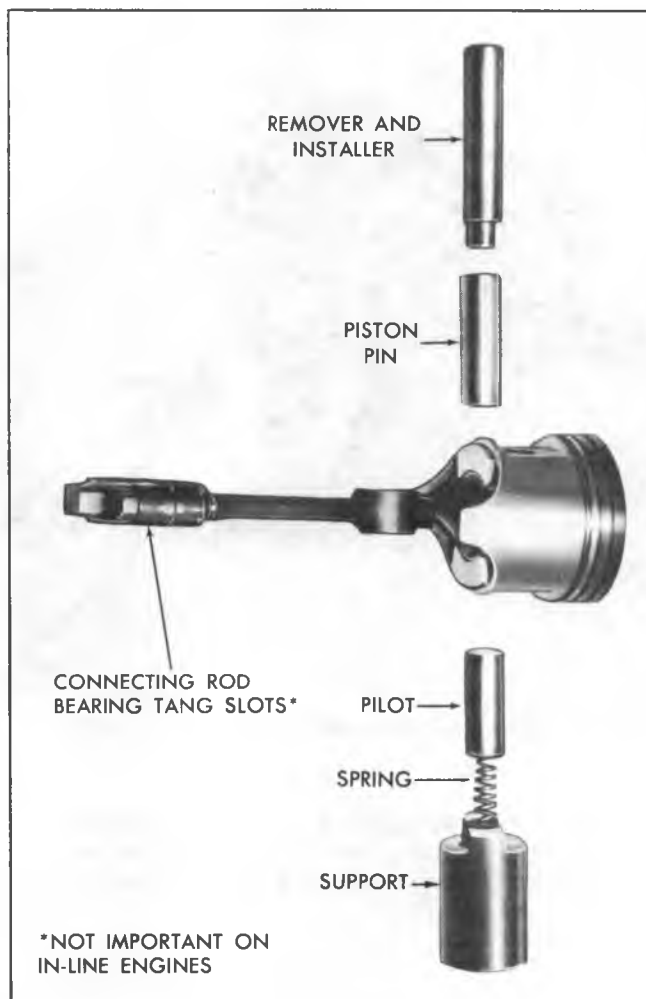


Fig. 53--Piston Pin and Tool Layout (In-Line and "Small V8")

### 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. 53) or Tool J-6994 for "Mark IV V8" (fig. 54) 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. 53 or 54).
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 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.

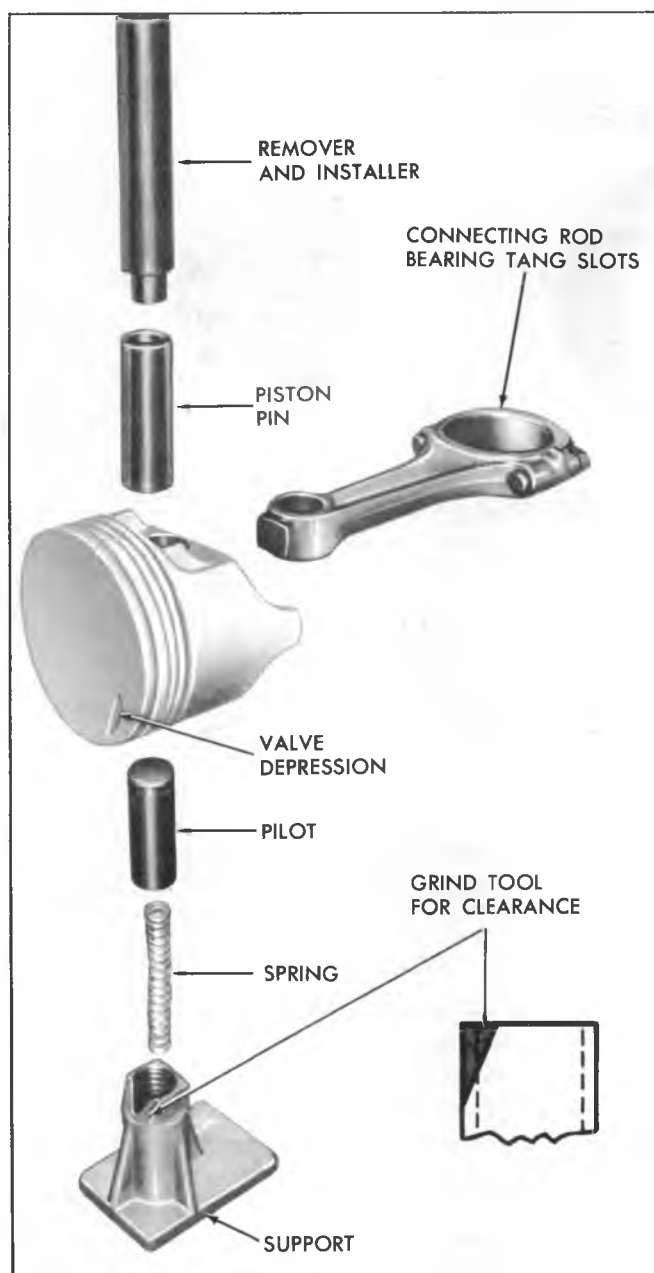


Fig. 54--Piston Pin and Tool Layout ("Mark IV V8")

The oil control rings are of three piece type, consisting of two segments (rails) and a spacer.

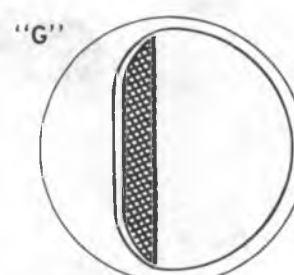
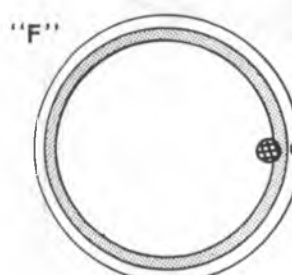
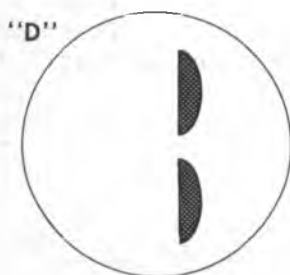
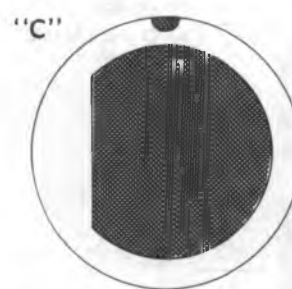
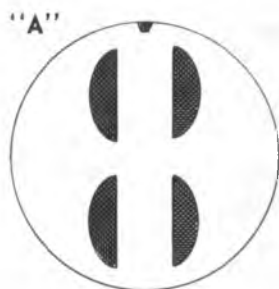
1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about 1/4 inch (above ring travel). Be sure ring is square with cylinder wall.
3. Measure the space or gap between the ends of the ring with a feeler gauge (fig. 56).
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. 57) 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. 58).

**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. 59). (See Specifications.)

## PISTON—VIEWED FROM TOP



ENGINE	PISTON	CYLINDER	SIDE OF PISTON ALIGNED WITH CONNECTING ROD BEARING TANGS
250 CU. IN.	"C"	ALL	ALIGNMENT NOT NECESSARY
292 CU. IN.			NOTCH ON PISTON TOWARD
307 CU. IN.			FRONT OF ENGINE
	"A"	1-3-5-7	LEFT
		2-4-6-8	RIGHT
350 CU. IN. (165 HP)	"F"	1-3-5-7	LEFT
350 CU. IN. (175 HP)		2-4-6-8	RIGHT
350 CU. IN. (200 HP)	"G"	1-3-5-7	LEFT
350 CU. IN. (255 HP)		2-4-6-8	RIGHT
350 TRUCK (LPG)	"D"	1-3-5-7	LEFT
		2-4-6-8	RIGHT
400 CU. IN.	"F"	1-3-5-7	LEFT
		2-4-6-8	RIGHT
402 CU. IN.	"B"	1-3-5-7	LEFT
		2-4-6-8	RIGHT
454 CU. IN.	"E"	1-3-5-7	LEFT
		2-4-6-8	RIGHT

Fig. 55—Connecting Rod and Piston Relationship



Fig. 56—Measuring Ring Gap

### 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.



Fig. 57—Checking Ring In Groove

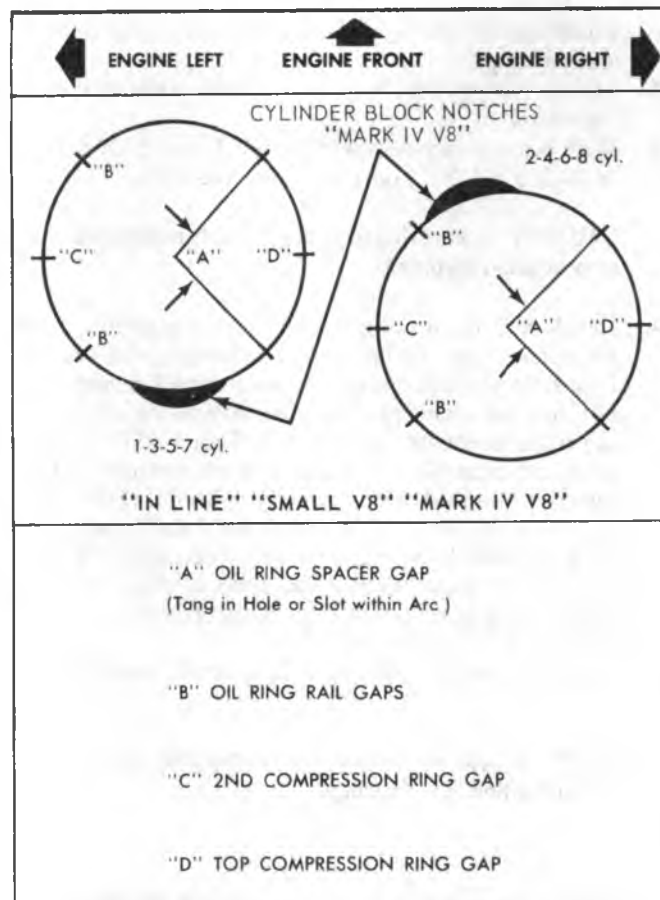


Fig. 58—Ring Gap Location



Fig. 59—Measuring Ring Groove Clearance

1. Lubricate connecting rod bearings and install in rods and rod caps.
2. Lightly coat pistons, rings and cylinder walls with light engine oil.
3. With bearing caps removed, install Tool J-5239 (3/8") or J-6305 (11/32") on connecting rod bolts.

**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. 60). In-Line engine pistons must have piston notch facing front of engine (fig. 61). Use Tool J-8037 to compress the rings (fig. 62). Guide the connecting rod into place on the crankshaft journal with Tool J-5239 (3/8") or J-6305 (11/32"). Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.
5. Remove Tool J-5239 or J-6305.
6. Install the bearing caps and torque nuts to 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



Fig. 60-Connecting Rods-Installed Position V8

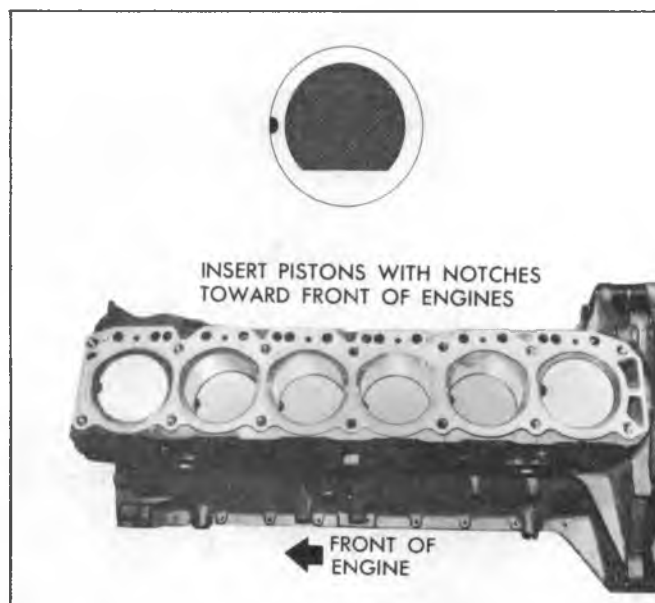


Fig. 61-Pistons-Installed Position (In-Line)

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.



Fig. 62-Installing Connecting Rod and Piston Assemblies



## 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).
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. 63)

- 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. 65).

### Oil Nozzle Replacement (In Line)

1. Remove nozzle with pliers (fig. 66).
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. 67).

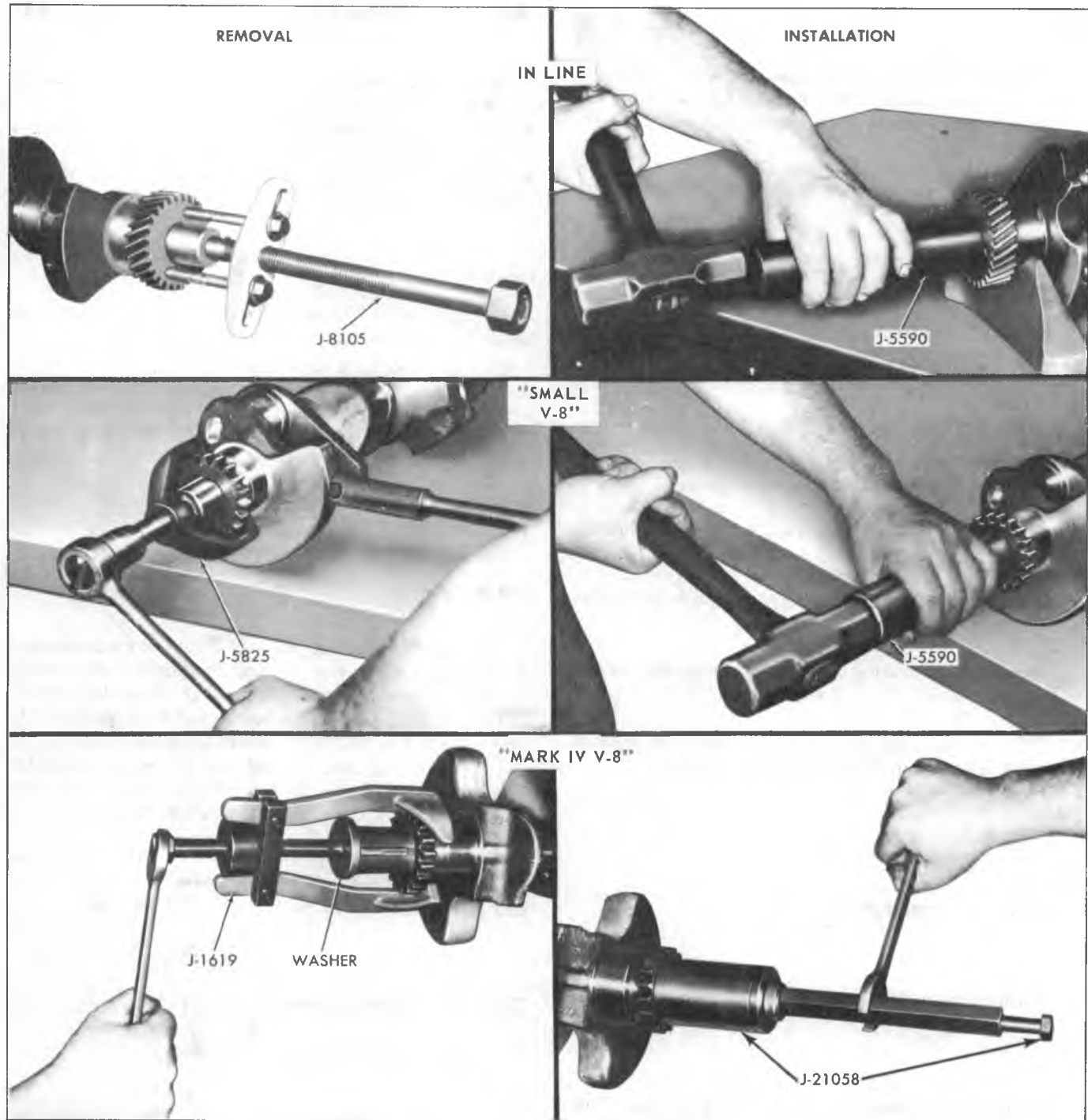


Fig. 63—Sprocket or Gear Replacement

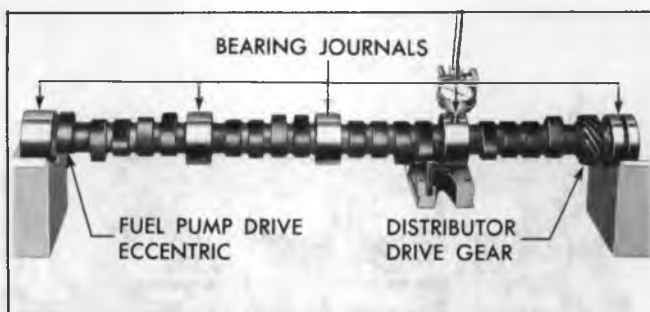


Fig. 64—Checking Camshaft Alignment

**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. 65).

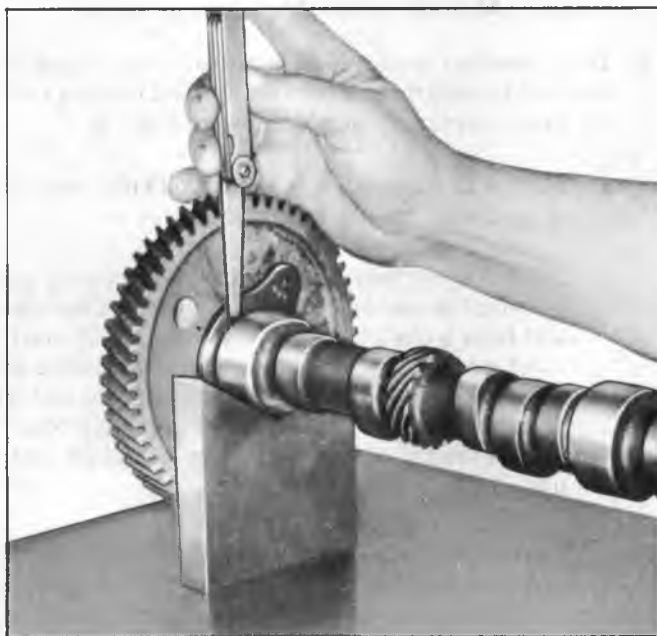


Fig. 65—Measuring Camshaft End Play



Fig. 66—Oil Nozzle Replacement (In-Line)

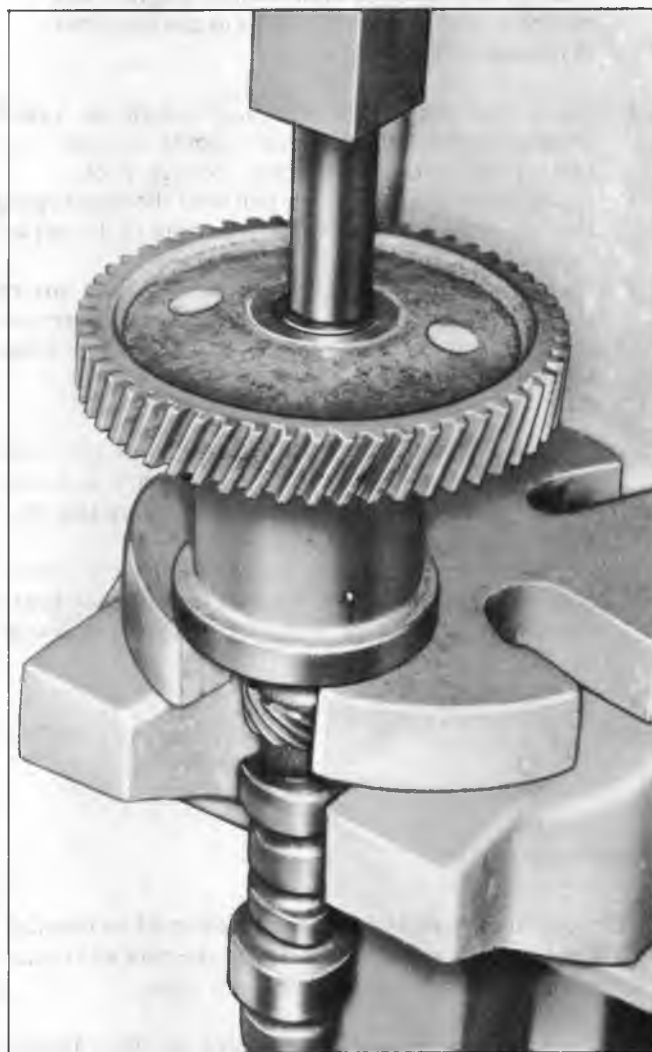


Fig. 67—Removing Camshaft Gear

## 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 nut. When bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw (fig. 68).
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. 69).

### 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. 69).

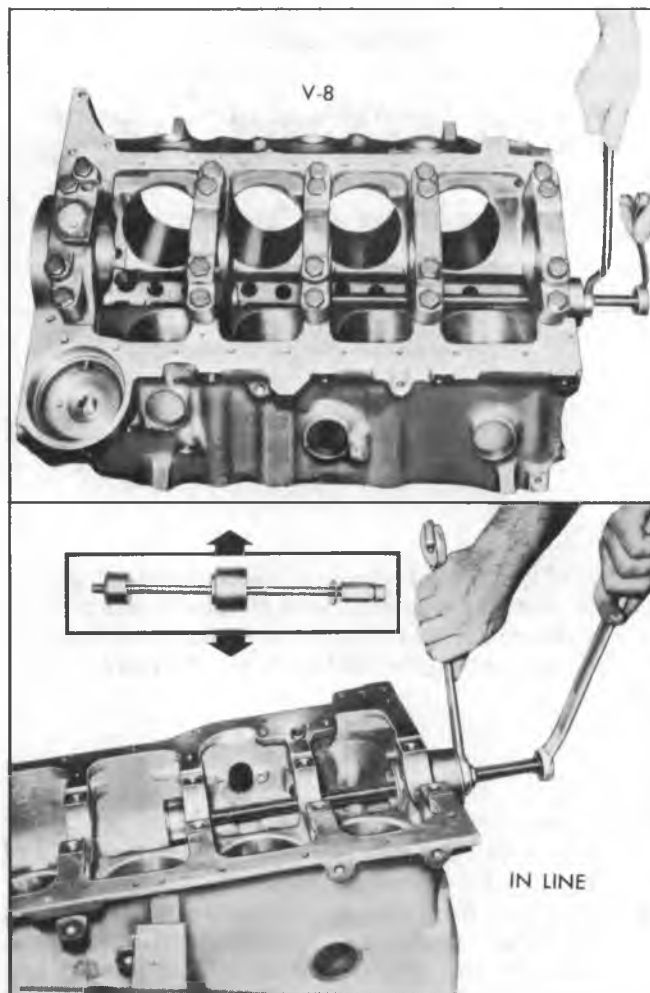


Fig. 68--Replacing Camshaft Center Bearing

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.

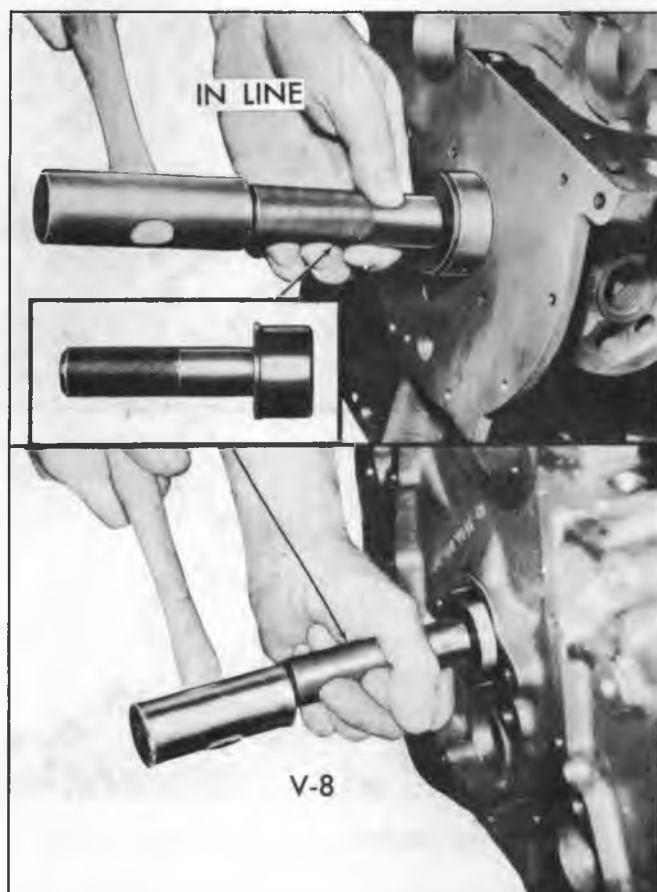


Fig. 69—Replacing Camshaft Front Bearing

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. 68).
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 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 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. 70).

### 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. 71).

##### 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 assembly. Clean valve chamber in cylinder block thoroughly. Torque retaining screws to specifications (fig. 72).



Fig. 70—Measuring Cylinder Bore



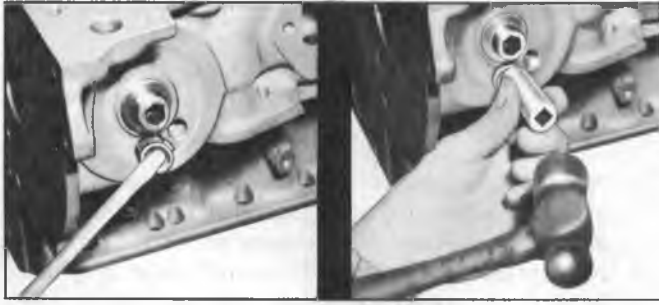


Fig. 71—Oil Filter By-Pass Valve (In-Line)

### Distributor Lower Bearing and Thrust Washer 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.

Some engines have a thrust washer at the upper end of the bushing bore. The thrust washer, where used, may be replaced at the same time the bushing is replaced.

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. 73).
2. Using a drift up through bushing bore, drive thrust washer (if installed) out of bore and remove from block.
3. Clean bushing bore in block and check for burrs or damage.
4. If thrust washer was removed, start new washer in position in bore and drive into place using J-9535.

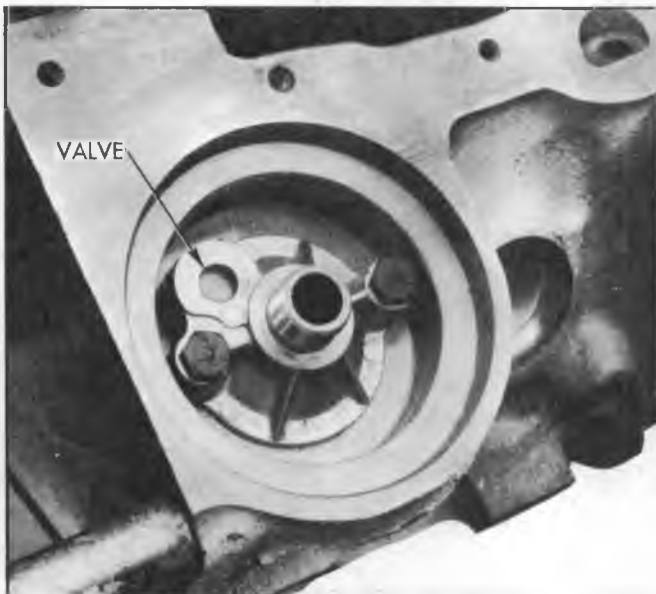


Fig. 72—Oil Filter By-Pass Valve (V8)

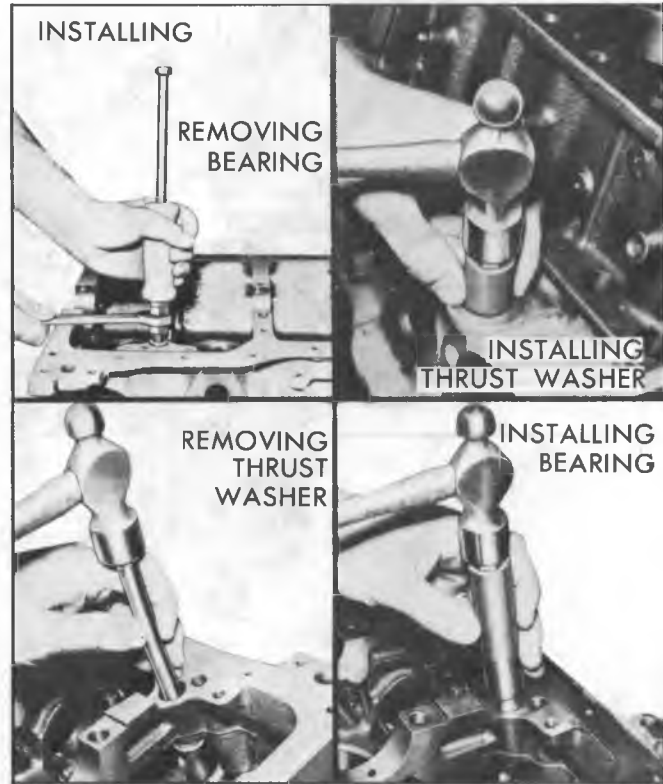


Fig. 73—Replacing Distributor Bearing and Thrust Washer

5. Using Tool J-9535 with driver-bolt in driver handle install driver into new bushing from large inside diameter.
6. Position bushing and driver to block and drive the bushing in position, which is determined by tool bottoming against the block.
7. 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 .005" taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.

When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, the cylinder bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

### CYLINDER BORING

1. Before using any type boring bar, the top of the cylinder block should be filed off to remove any dirt or burrs. This is very important. Otherwise, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.
2. The piston to be fitted should be measured with a micrometer, measuring at the center of the piston skirt and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston and honed to give the specified clearance.

**NOTE:** Hone cylinders as outlined under "Cylinder Honing and Piston Fitting".

3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

### CYLINDER HONING

1. When cylinders are to be honed follow the hone manufacturer's recommendations for the use of the hone and cleaning and lubrication during honing.
2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.

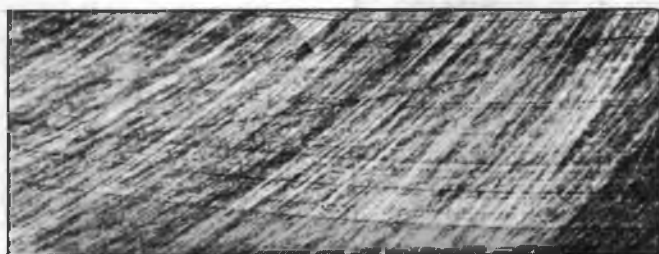


Fig. 74-Cylinder Finish Marks

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° included angle. The finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal (fig. 74).
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 Selection Chart (fig. 75) and determine if piston to bore clearance is in the acceptable range.

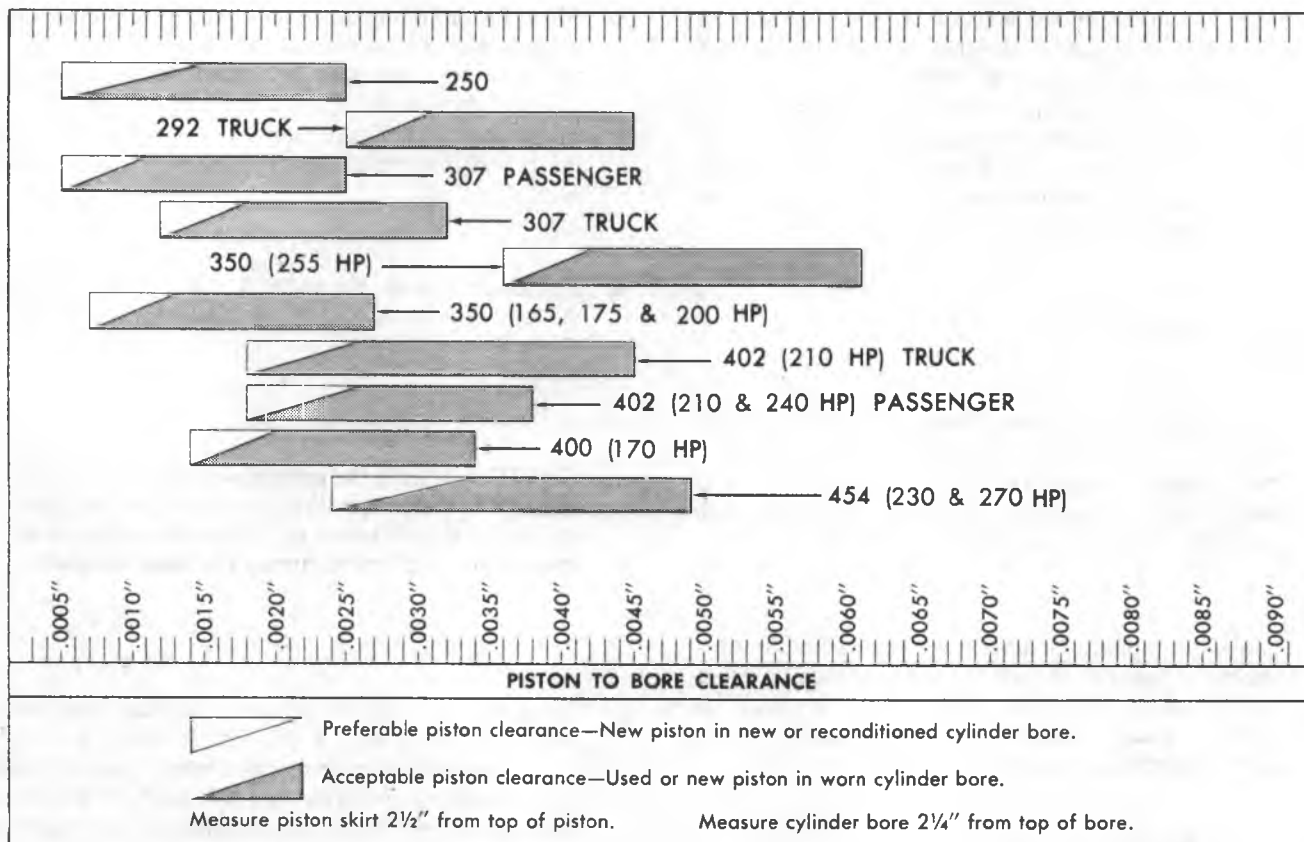


Fig. 75--Piston Selection Chart

2. If used piston is not acceptable, check Piston Size Chart (fig. 76) 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 & 307	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. 255 H.P.)	3.9998	4.0008	4.0283
	4.0008	4.0018	4.0303
350 (255 HP)	3.9953	3.9963	4.0252
	3.9963	3.9973	4.0272
400	4.1241	4.1251	4.1526
	4.1251	4.1261	4.1546
402	4.1237	4.1247	4.1550
	4.1247	4.1257	4.1570
454	4.2481	4.2491	4.2775
	4.2491	4.2501	4.2795

Fig. 76--Piston Size Chart

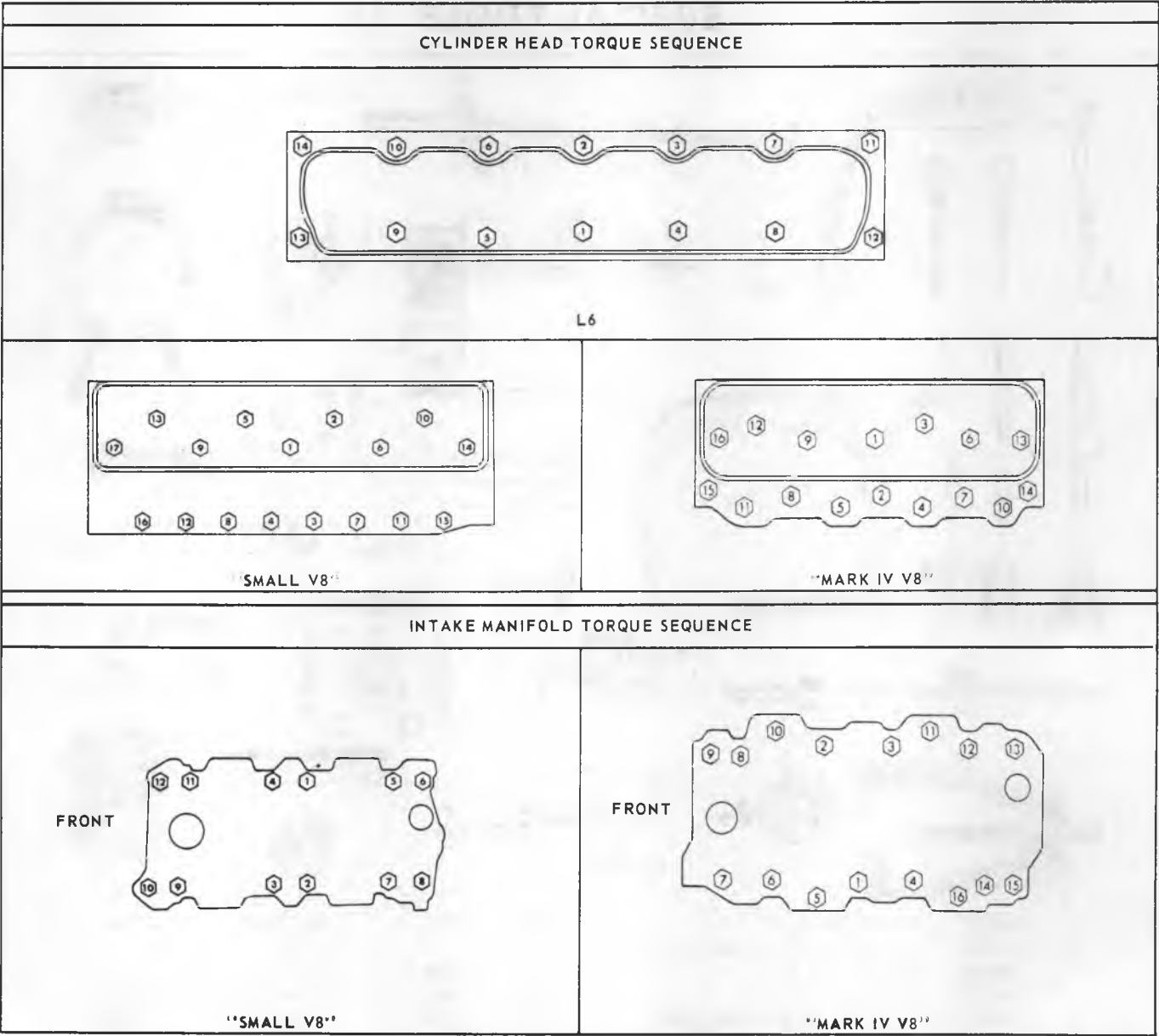


Fig. 77-Torque Specifications

## SPECIAL TOOLS

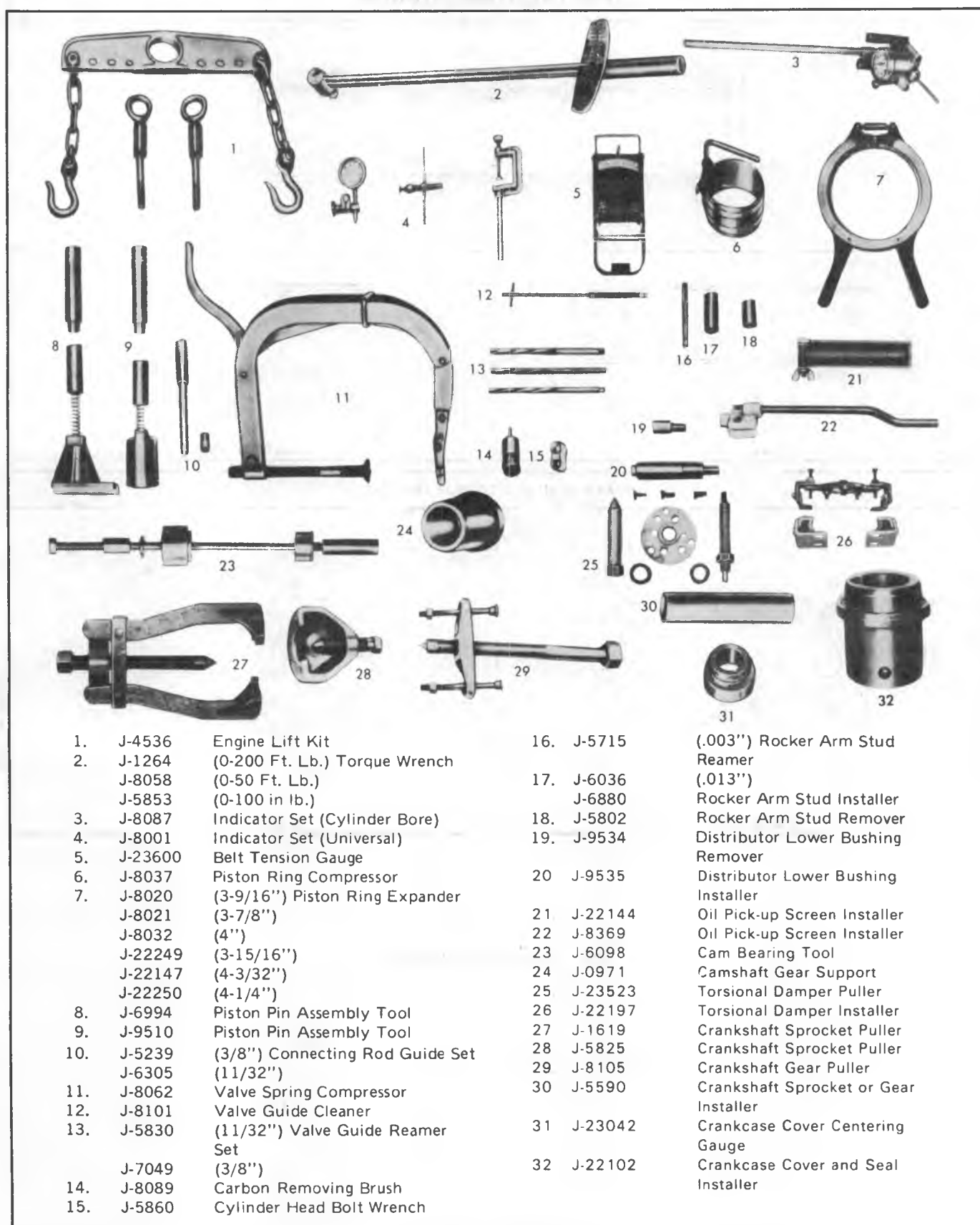


Fig. 78--Engine Special Tools

## SECTION 6M

# CARBURETORS

### CONTENTS OF THIS SECTION

**NOTE:** Also refer to the Emission Control Systems" Booklet for required maintenance and warranty information.

SUBJECT	PAGE	SUBJECT	PAGE
Introduction .....	6M-1	Rochester 4MV (Quadrajel) .....	6M-20
Rochester M and MV (Monojet) .....	6M-1	Holley 4150 .....	6M-26
Rochester 2GV (SAE 1 1/4) .....	6M-8	Special Tools .....	6M-35
Rochester 2GV (SAE 1 1/2) .....	6M-14		

## INTRODUCTION

### (SEE ROCHESTER CARBURETORS IDENTIFICATION, FIG. M1; HOLLEY CARBURETORS IDENTIFICATION, FIG. S2)

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, as-

sembly 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.

**CAUTION:** If the C.E.C. solenoid on the carburetor ( L-6 L/D engines only) is used to set engine idle or is adjusted out of limits specified in the Service Manual, decrease in engine braking may result.

## ROCHESTER M AND MV (MONOJET)

### INDEX

SUBJECT	PAGE	SUBJECT	PAGE
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Air Horn .....	6M-3	Float Bowl .....	6M-6
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Throttle Body .....	6M-5	Adjust Metering Rod .....	6M-7
Cleaning and Inspection .....	6M-5	Air Horn Assembly and Installation .....	6M-7

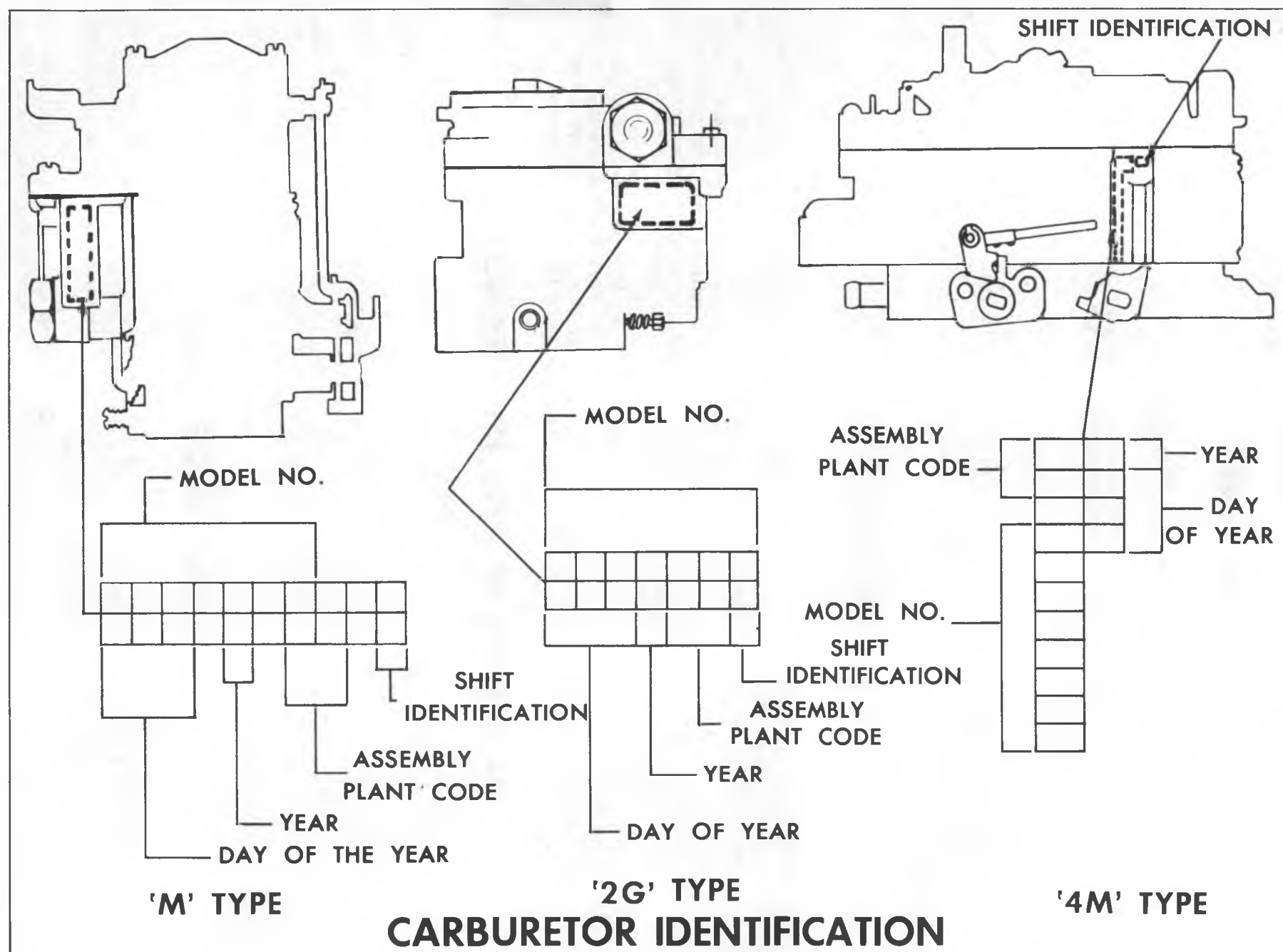
## GENERAL DESCRIPTION

The model MV (Fig. M2) carburetor used on the Chevrolet, 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 main well air bleed and a variable orifice jet. A power enrichment system is used to provide good performance during moderate to heavy acceleration and at higher engine speeds.

The idle system with passenger car automatic transmission incorporates a hot idle compensator to maintain smooth en-





gine idle during periods of extreme hot engine operation.

The model MV carburetor has an automatic choke system. The vacuum diaphragm unit is no longer an integral part of the air horn, and 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 has been attached to the 1972 carburetor float bowl and replaced the curb idle speed screw. The idle stop solenoid is used in conjunction with the combination emission control valve (C.E.C. valve) L/D vehicles only. The idle stop solenoid, energized when the ignition is turned on, controls the engine curb idle speed. The C.E.C. valve, when energized through the transmission, acts as a throttle stop by maintaining a higher idle speed during high gear operation of the engine, which helps in controlling overrun emissions during deceleration. The C.E.C. valve also provides full spark vacuum advance during high gear operation and is de-energized in the lower gears and at idle for retarded spark timing during this period.

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 that the part number can be transferred to the new float bowl.

The idle mixture screw will have a limiter cap installed and no adjustment will be 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 the cleaning and overhaul.

An overhaul idle mixture adjustment procedure will be provided, should the idle mixture needle need replacement or the mixture channels cleaned during the overhaul process. A new idle mixture needle limiter cap will be provided in the overhaul kit.



Fig. M2--Rochester Monojet Carburetor

## DISASSEMBLY OF CARBURETOR

### C.E.C. Valve Assembly and Idle Stop Solenoid

#### Removal

1. Remove vacuum hose from the C.E.C. valve and vacuum tube from throttle body.
2. Bend back retaining tabs on lock washer; then remove large C.E.C. valve nut and remove valve from bracket.

**NOTE:** Do not remove C.E.C. valve bracket from the float bowl assembly unless replacement of the bracket is necessary.

3. Remove the electrically operated idle stop solenoid wire connector, and unscrew the solenoid from the float bowl casting by turning the solenoid body counterclockwise.

**CAUTION:** Do not immerse the C.E.C. valve assembly or Idle Stop Solenoid in any type of carburetor cleaner.

#### Installation

Reverse Procedure:

**NOTE:** Be sure to bend tabs of lockwasher over C.E.C. valve nut after securing to bracket.

### 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 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.
3. Remove float needle, float needle seat and gasket. Use caution in removing needle seat to prevent damage.

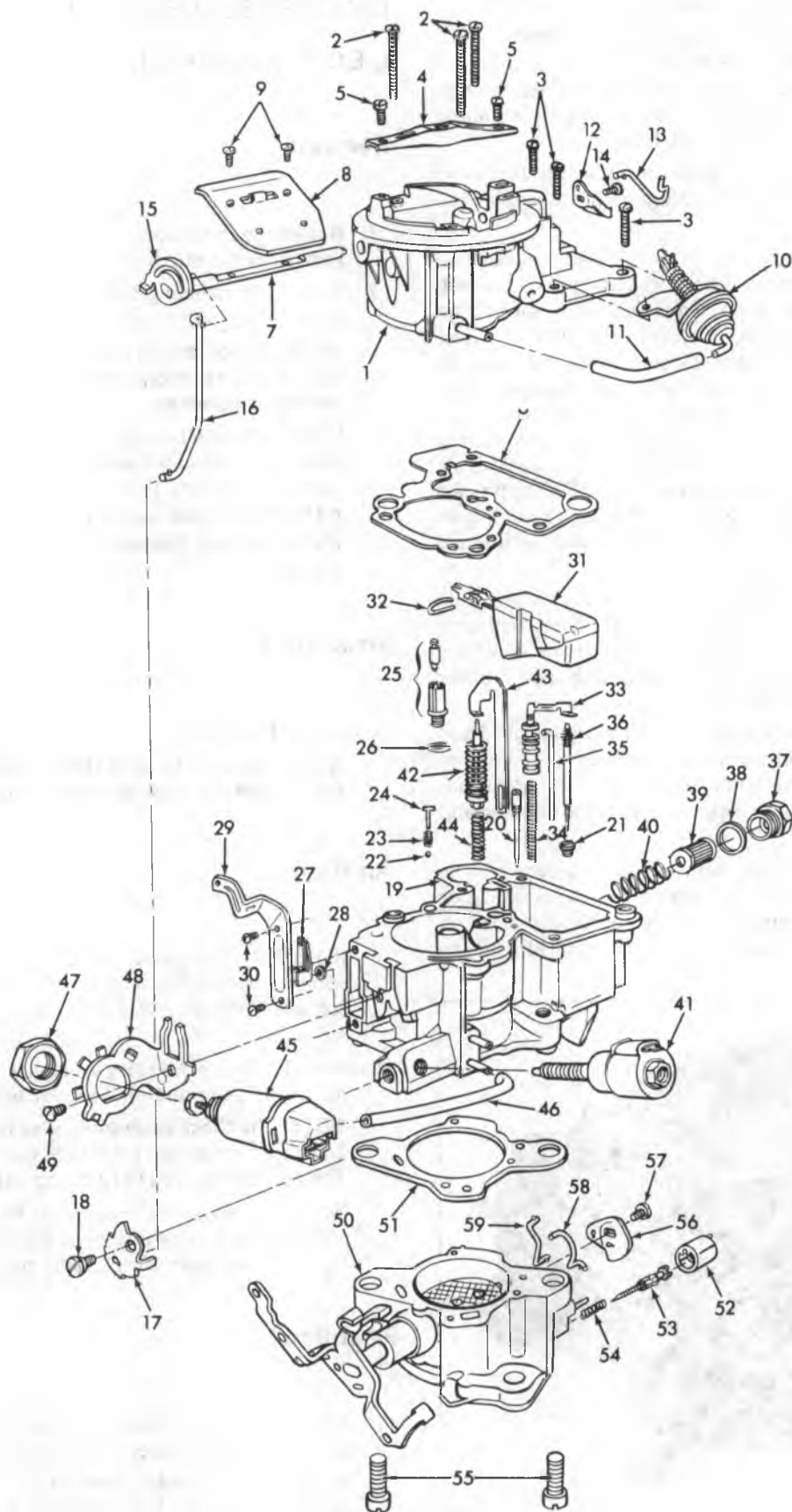


Fig. M3--Monojet--(See Fig. M3a for legend)

## Legend for Fig. M3.

1. Air Horn Assembly	16. Choke Rod	30. Compensator	46. C.E.C. Vacuum Tube
2. Screw—Air Horn—Long	17. Cam—Fast Idle	31. Screw—Cover	47. C.E.C. Valve Nut
3. Screw—Air Horn—Short	18. Screw—Cam	32. Float Assembly	48. C.E.C. Valve Bracket
4. Bracket—Air Cleaner Stud	19. Attaching	33. Hinge Pin—Float	49. C.E.C. Valve Bracket Screw
5. Screw—Bracket Attaching	20. Float Bowl Assembly	34. Power Piston Assembly	50. Throttle Body Assembly
6. Gasket—Air Horn	21. Idle Tube Assembly	35. Jet—Main Metering	51. Spring—Power Piston
7. Choke Shaft and Lever Assembly	22. Ball—Pump Discharge	36. Metering Rod and Spring Assembly	52. Gasket—Throttle Body
8. Choke Valve	23. Spring—Pump Discharge	37. Filter Nut—Fuel Inlet	53. Idle Needle Limiter Cap
9. Screw—Choke Valve	24. Guide—Pump Discharge	38. Gasket—Filter Nut	54. Idle Needle
10. Choke Vacuum Break, Unit	25. Needle and Seat Assembly	39. Filter—Fuel Inlet	55. Spring—Idle Needle
11. Vacuum Break Hose	26. Gasket—Needle Seat	40. Spring—Fuel Filter	56. Screw—Throttle Body
12. Vacuum Break Lever	27. Idle Compensator Assembly	41. Idle Stop Solenoid	57. Lever—Pump and Power Rods—New
13. Vacuum Break Link	28. Gasket—Idle Compensator	42. Pump Assembly	58. Screw—Lever Attaching
14. Vacuum Break Lever Screw	29. Cover—Idle	43. Lever—Pump Actuating	59. Link—Power Piston Rod
15. Choke Lever		44. Spring—Pump Return	
		45. C.E.C. Valve	

Fig. M3a—Legend for Monojet (Fig. M3)

- Remove fuel inlet nut, gasket, paper filter element and pressure relief spring.
- Using long nosed pliers, remove "T" pump discharge spring retainer. Pump discharge spring and ball may be removed by inverting bowl.
- The idle tube can be removed at same time by inverting bowl.
- To remove accelerating pump plunger and metering rod--power piston drive assemblies, perform following operation:
  - Remove actuating lever on throttle shaft by removing attaching screw at end of shaft.
  - Remove upper end of drive link from power piston rod.
  - Rotate drive link from keyhole in actuating lever.
  - Remove actuating lever from pump link by rotating off tang on rod.
  - Remove upper end of pump link by rotating from keyhole in pump slide.
- The power piston--metering rod assembly and drive rod can now be lifted from float bowl.
- Remove power piston spring from power piston cavity.
- Remove pump plunger assembly from float bowl.
- Remove pump return spring from pump well.
- Remove main metering jet from bottom of fuel bowl.
- Remove two screws from idle compensator cover. Then remove cover, hot idle compensator and gasket from recess in bowl beneath compensator.
- 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

- 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.

- 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 plastic limiter cap as a new one is provided in the overhaul kit.

**IMPORTANT:** Before removing idle mixture needle, be certain to count number of turns to bottom the 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 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.

- Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner.

## CARBURETORS 6M-6

**CAUTION:** Any rubber parts, plastic parts, diaphragms, pump plunger, electric parts and solenoids should not be immersed in carburetor cleaner. However, the air horn which was the pressure relief valve will withstand normal cleaning in carburetor cleaner. Make sure the cleaning solution is thoroughly removed from pressure relief valve area.

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.
9. Replace filter element.
10. Check all springs for distortion or loss in tension, replace as necessary.

## CARBURETOR ASSEMBLY

### Throttle Body

#### New Part Replacement

If a new throttle body is being replaced, install and bottom the new idle mixture needle and back off four turns. Do not install plastic limiter cap at this time until proper screw settings have been made.

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 "Additional External Settings and Adjustments".

1. If removed, install idle mixture needle and spring until lightly seated. Back out four turns as a preliminary idle adjustment.

**NOTE:** The plastic limiter cap should not be installed on the idle mixture needle until the idle mixture has been adjusted, as specified, on the engine.

**NOTE:** A new red plastic idle mixture needle limiter cap is provided in the carburetor repair kit and also in the idle mixture needle and limiter cap kit. This cap must be installed after the idle mixture needle has been set on engine (see Specifications), 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). Install a new limiter cap.

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 gasket into recess in idle compensator cavity in float bowl.
3. Install idle compensator assembly with two (2) attaching screws. Tighten securely.
4. Install idle compensator cover, with (2) 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.

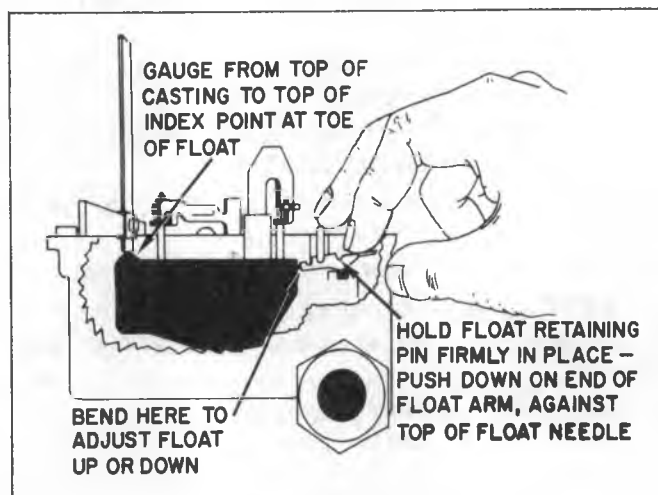


Fig. M4--Float Level Adjustment

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. 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. M4)

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).



Fig. M5--Metering Rod Adjustment

3. Bend float pontoon up or down at float arm junction to adjust.

#### Metering Rod Adjustment (Fig. M5)

1. To check adjustment back out Idle Stop Solenoid to ensure closed throttle valve. Rotate fast idle cam so that fast idle cam follower is not contacting steps on cam.
2. With throttle valve completely closed, apply pressure to hanger directly above power piston and hold piston down against its stop.
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.
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.

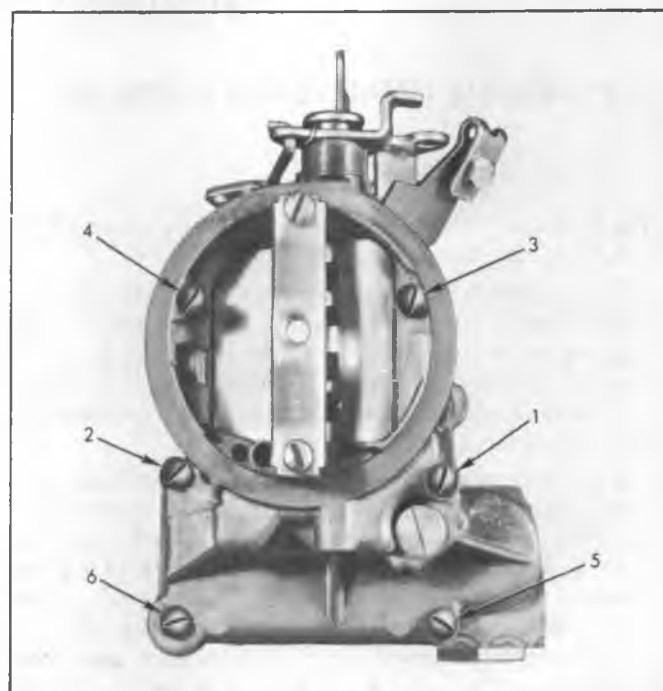


Fig. M6--Tightening Sequence--Air Horn

## CARBURETORS 6M-8

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 and install lever to the end of the choke shaft using retaining screw. Tighten all screws securely.

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.
7. Install C.E.C. valve into bracket on float bowl. Install large retaining nut and tighten securely. Then bend lock retaining ears over on flats of nut, so that the nut is locked securely in place.
8. Install vacuum hose to the lower tube on float bowl and to outer tube on the C.E.C. valve.

**NOTE:** First check carburetor adjustments, then refer to "Additional External Settings and Adjustments" in Section 6M for remaining adjustments; Adjustments must be performed in proper sequence.

**IMPORTANT:** After carburetor overhaul, throttle body part replacement, mixture needle part replacement, or limiter cap and needle removal, the procedures in Section 6M, 1972 Chassis Service Manual, under "Additional External Settings and Adjustments", must be followed.

## ROCHESTER 2GV (SAE 1 1/4)

### INDEX

SUBJECT	PAGE	SUBJECT	PAGE
General Description .....	6M-8	Disassembly .....	6M-9
Rochester 2GV (SAE 1 1/4") Repair Procedures ....	6M-8	Assembly .....	6M-11

## GENERAL DESCRIPTION

### 1 1/4" 2-BARREL (SMALL) EXCEPT VEGA FIG. G1

The Rochester Model 2GV 1-1/4" carburetor used for 1972 has the following design changes:

1. The combined emission control valve (C.E.C. valve) is not used and an idle stop solenoid has been added. Curb idle speed setting is made by adjusting the plunger screw in the idle stop solenoid. This setting should be made using information in the shop manual and on the decal in the engine compartment.
2. The choke system uses the delayed vacuum break diaphragm unit. When the engine is started, vacuum is applied to the choke vacuum diaphragm which opens the choke valve, against the choke coil tension to a point where the engine will run without loading or stalling lean. To delay the choke valve opening too fast, an internal check valve is used in the choke vacuum diaphragm unit. After the engine starts, vacuum is applied through the check valve to the vacuum break diaphragm causing the vacuum break diaphragm to move slowly inward.

This gives sufficient time to overcome engine friction and allow the engine manifold to be wetted to prevent a lean stall.

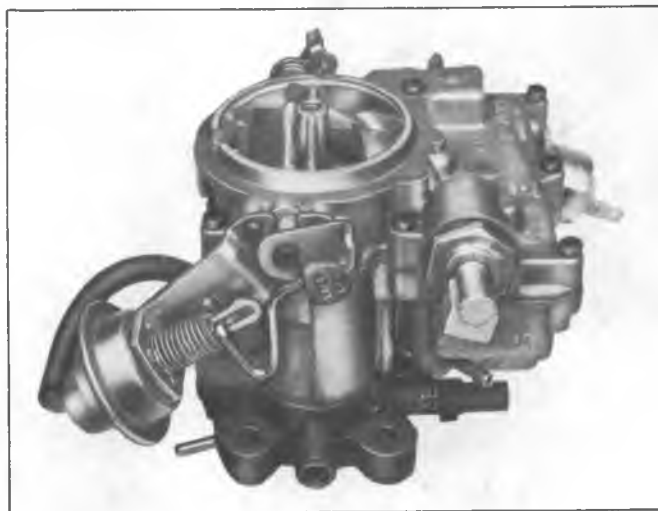


Fig. G1--Rochester 2GV (SAE 1 1/4) Carburetor - Except Vega



A choke closing assist spring has been added to the vacuum break diaphragm plunger stem. The spring assists in closing the choke valve, along with tension from the remote choke thermostatic coil, for improved cold starting. The choke closing assist spring only exerts pressure on the vacuum break link to assist in closing the choke valve during engine starting.

When the engine starts and the choke vacuum break diaphragm seats, the closing spring retainer hits a stop on the plunger stem and no longer exerts pressure on the vacuum break link.

## DISASSEMBLY

### Model 2GV (1 1/4") - 2 Barrel (Small) Except Vega

#### Removal of the Idle Stop Solenoid Assembly From the Carburetor Units

Bend back retaining tabs on lock washer; then remove large idle stop solenoid valve nut and then remove the solenoid from bracket on carburetor.

**NOTE:** Do not remove solenoid valve bracket from the float bowl assembly unless replacement of the bracket is necessary. The bracket is locked securely in place on the float bowl and must be tight.

**CAUTION:** Do not immerse the Idle Stop Solenoid in any type of carburetor cleaner.

#### Disassemble Air Horn (Fig. G3)

1. Remove choke coil lever retaining screw from the end of choke shaft and disengage choke lever from vacuum break diaphragm link. Then remove the vacuum break link from the diaphragm plunger. The compression spring need not be removed from the diaphragm plunger stem.

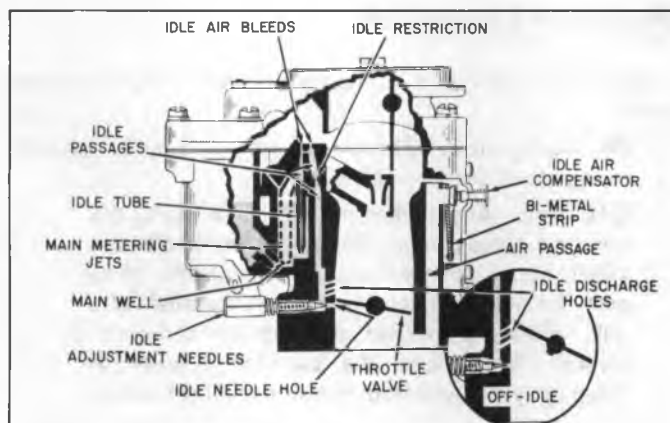


Fig.G2--Hot Idle Compensator

2. Disconnect vacuum break diaphragm hose from tube on throttle body, then remove vacuum break diaphragm from air horn by removing two retaining screws.
3. Place carburetor on a clean bench, being careful not to damage throttle valves. Then remove the fuel inlet filter nut, filter, spring and two gaskets.
4. Remove pump rod retaining clip from the throttle lever end of rod, and remove rod from throttle lever. Rotate upper pump lever counterclockwise, then remove the pump rod from the pump lever by aligning squirt on rod with notch in lever.
5. Using a wide bladed screwdriver, remove the fast idle cam attaching screw rotate cam and remove from rod.
6. Hold choke valve wide open, then rotate the upper end of choke rod towards pump lever and remove the rod from upper choke lever.
7. Remove (8) air horn to float bowl attaching screws, tap air horn lightly to loosen from bowl and lift air horn from bowl.
8. Invert air horn and remove float hinge pin, float, and float needle.
9. Using a wide bladed screwdriver, remove the float needle seat and gasket.
10. Remove air horn to float bowl gasket.
11. Remove power piston by depressing shaft and allowing spring to snap sharply -thus forcing piston from casting.
12. Remove retaining screw from the inner pump lever and remove outer pump lever and plastic washer from air horn. Place plunger in gasoline or kerosene to prevent rubber from drying out.
13. If the choke shaft or valve need replacement, remove two choke valve screws, then remove choke valve and slide shaft and lever from air horn.

**NOTE:** The two choke valve screws are staked in place, remove the staking before removing screws.

#### Disassemble Bowl and Throttle Body (Figure G4)

1. Remove pump plunger return spring from pump well.
2. Remove main metering jets and power valve and gaskets.
3. Remove three screws on top of cluster; then remove the cluster and gasket from the float bowl.  
**NOTE:** The center cluster screw has a fiber washer and the two outer screws have lock washers. Also, the center screw is not threaded the full length of the body. The smaller diameter is required for pump jet discharge.
4. Using a pair of long nose pliers, remove the pump discharge spring retainer. Then remove the spring and check ball from the pump discharge cavity.
5. Invert carburetor and remove three large throttle body to

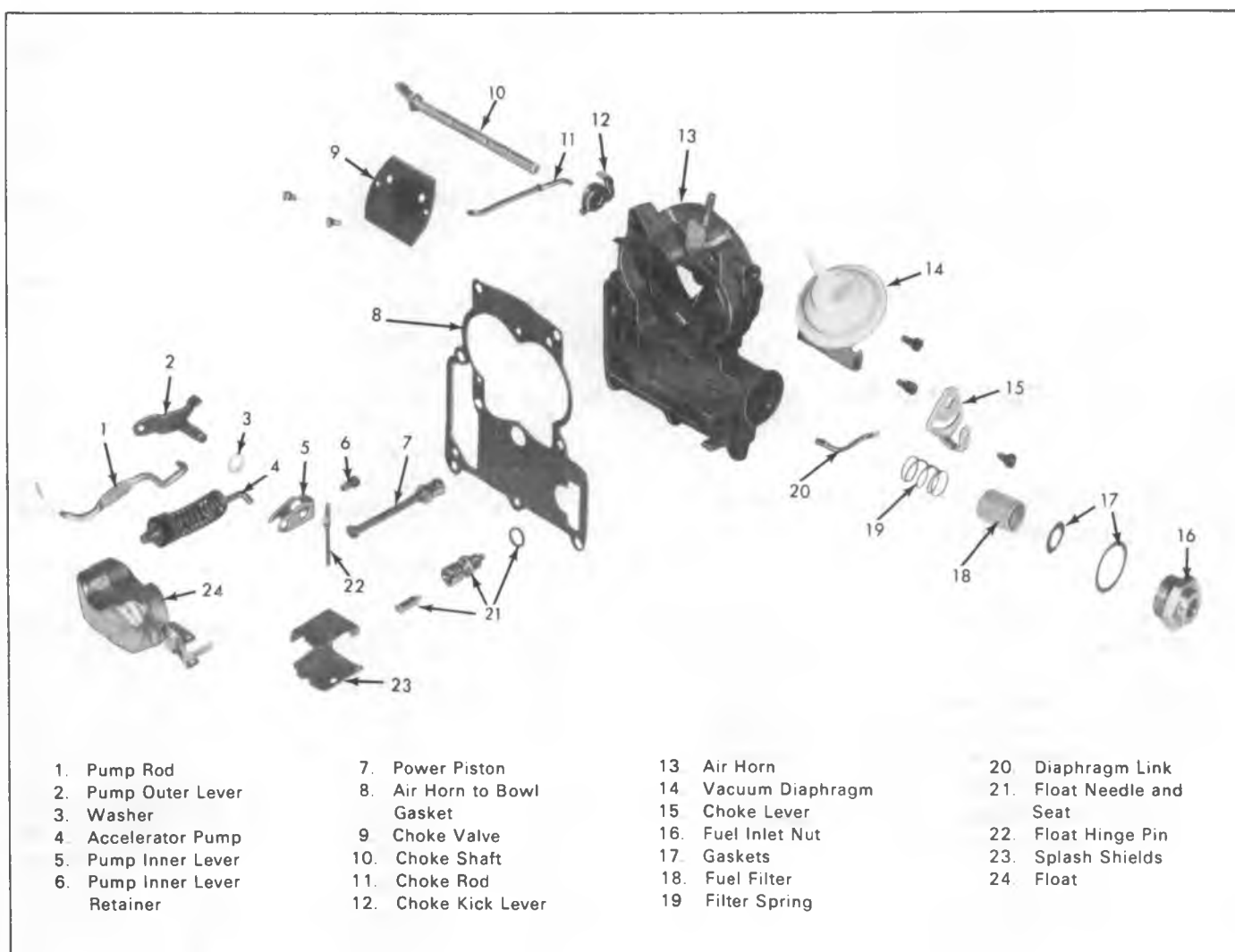


Fig. G3--Air Horn--Exploded View

bowl attaching screws. Throttle body and gasket may now be removed.

**NOTE:** Do not tamper with the idle mixture needles with limiter caps unless performing an overhaul or due to needle damage. This has been set to test requirements by the manufacturer.

6. Further disassembly of the throttle body is not recommended. If parts are damaged, replace the throttle body assembly. The idle mixture needles have plastic limiter caps installed. They should not be removed unless it is necessary to replace the mixture needles or clean the idle mixture channels. If removal is necessary, new limiter caps are provided in the repair kits. They should not be installed until after the idle mixture has been adjusted on the engine per instructions provided in the service manual.

**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 bot-

tom the new needle and then back off the same number of turns it took to bottom the old needle.

7. Remove idle mixture needle and spring, if required.

## 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, diaphragms, pump plunger, electric parts and solenoids should not be immersed in carburetor cleaner. However, the air horn which has the pressure relief valve will withstand normal clarning in carburetor cleaner. Make sure the cleaning solution is thoroughly removed from pressure relief valve area.

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.

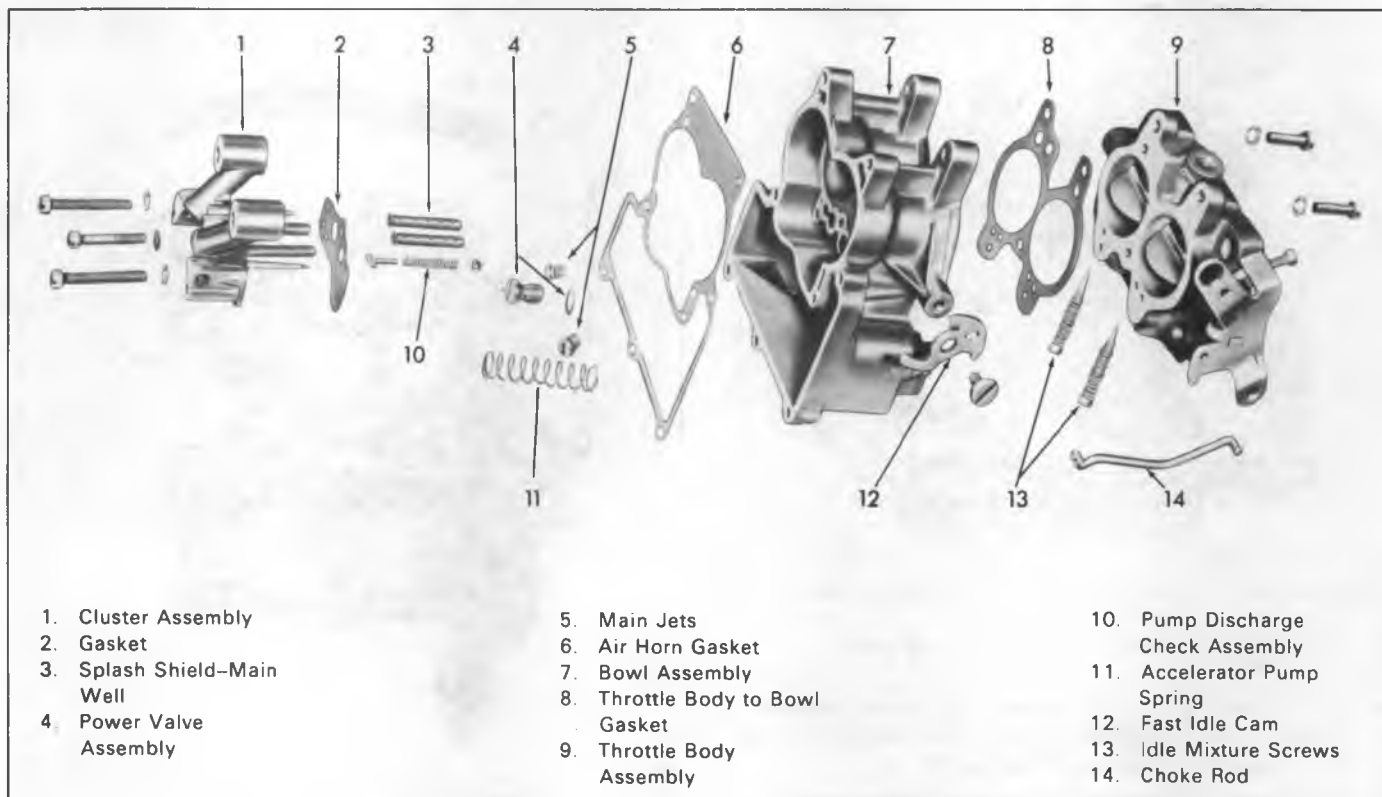


Fig G4--Bowl and Throttle Body--Exploded View

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.
9. Replace filter element.
10. Check all springs for distortion or loss in tension, replace as necessary.

## ASSEMBLY AND ADJUSTMENTS

### Assemble Bowl and Throttle Body

1. If it was necessary to remove the idle mixture adjusting needles and springs, install them into the throttle body until finger tight. Back out screw four turns as a preliminary idle mixture adjustment.

Do not install the idle mixture limiter caps until the idle mixture has been reset with the carburetor installed on the engine per instructions included in the service manual.

**CAUTION:** Do not force the idle mixture needle against the seat or damage will result.

### New Part Replacement

If a new throttle body is being replaced, install and bottom the new idle mixture needle and back off four turns. Do not install plastic limiter cap at this time until proper screw settings have been made.

After completing assembly of the carburetor, and when installed in the vehicle, adjust the idle speed and idle mixture settings as outlined under "Additional External Settings and Adjustments".

2. Invert bowl, place new throttle body gasket in position aligning holes in gasket with holes in the float bowl, and attached throttle body to bowl with the attaching screws. Tighten screws evenly and securely.

**NOTE:** A new red plastic idle mixture needle limiter cap is provided in the carburetor repair kit and also in the idle mixture needle and limiter cap kit. This cap must be installed after the idle mixture needle has been set on engine (see Specifications)

3. Drop pump discharge check ball into discharge hole. Ball is 3/16" diameter steel. Install pump discharge spring and retainer. (Top of pump discharge spring retainer should be flush with top of float bowl casting).

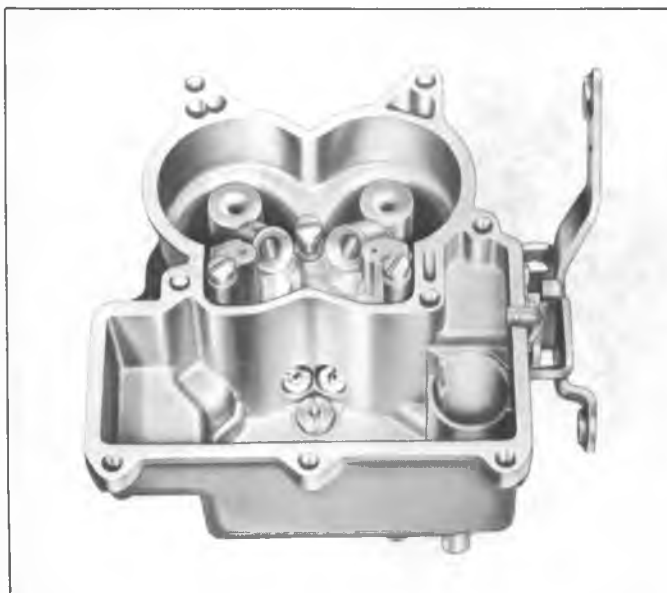


Fig. G5--Bowl Assembly--Parts Location

4. Install main well inserts, gasket and cluster assembly, tighten screws evenly and securely. Make certain that the center screw is fitted with fiber gasket.
5. Install main metering jets, power valve gasket and power valve. Install pump return spring, apply pressure with finger to center it in pump well and to make sure that is properly seated.

### Assemble Air Horn (Figure G6)

1. Install choke kick lever on choke shaft with tang on kick lever towards lever on shaft.
2. Install choke shaft into air horn--insert shaft left to right.
3. Center choke valve on choke shaft with letters "RP" facing upward. Install choke valve screws. Before tightening the choke valve screws, make sure that there is .020" clearance between the choke kick lever on the air horn casting. Then tighten the choke valve screw securely and stake in place to eliminate any possibility of their coming loose.
4. Install accelerator pump plunger and rod to the inner pump lever -- end of pump plunger rod points inward towards air horn bore.
5. Install outer accelerator pump lever with plastic washer partially through air horn and align flats on lever with inner lever. Then install and secure levers with retaining screw.
6. Install power piston into vacuum cavity. Make sure that piston travels freely in cavity. Lightly stake retainer in place.
7. Install the float needle seat and gasket into air horn casting. Tighten securely with a wide blade screw driver. Place the float needle into needle seat.



Figure G6--Air Horn Assembly--Parts Location

8. Install air horn to float bowl gasket. Align position cut-out in float toward power piston and align float hanger with holes in the links on air horn casting; then install retaining pin.
9. Install fuel filter spring, fuel filter, filter gasket, fuel inlet nut gasket and fuel inlet nut. Torque inlet nut sufficiently to seat gasket. Install vacuum break diaphragm assembly on to air horn with the part number on bracket facing outward. Install two attaching screws and tighten securely. Insert off-set and vacuum break diaphragm rod into plunger on vacuum break diaphragm. Then install other end of rod to hole in choke coil lever. Install choke coil lever on to end of choke shaft aligning flats on lever with flats on shaft. Install retaining screw into the end of choke shaft and tighten securely. Part number on choke coil lever face outward when installed correctly.

### Installation of the Idle Stop Solenoid on Float Bowl.

1. Install Idle Stop Solenoid into bracket on float bowl. Install lock washer, large retaining nut and tighten securely. Then, bend retaining ears on lock washer over flats of 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 procedure section.

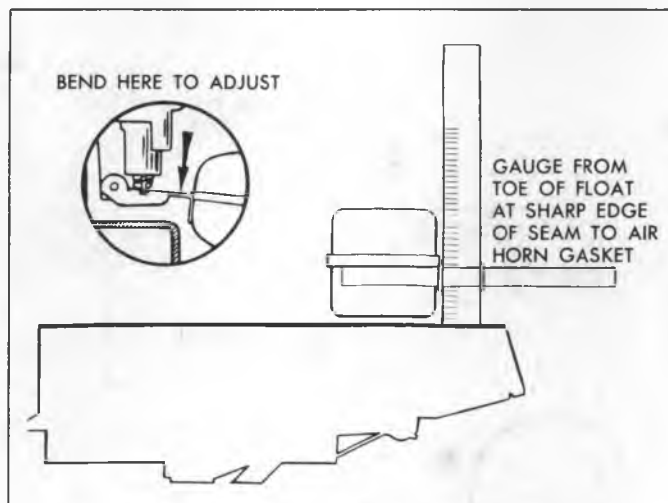


Fig. G7--Float Level Adjustment (Brass)

## Float Adjustment

### Brass-Type

1. With air horn inverted and air horn gasket installed measure the distance from the air horn gasket to the lower edge of the float seam at the outer end of the float pontoon. To adjust, bend the float arm at rear, as shown in inset (Fig. G7).
2. With the air horn assembly held upright and float suspended freely, measure dimension from air horn gasket to bottom of float pontoon at toe. To adjust, bend the float drop tang adjacent to the float needle seat to obtain specified dimension (fig. G8).

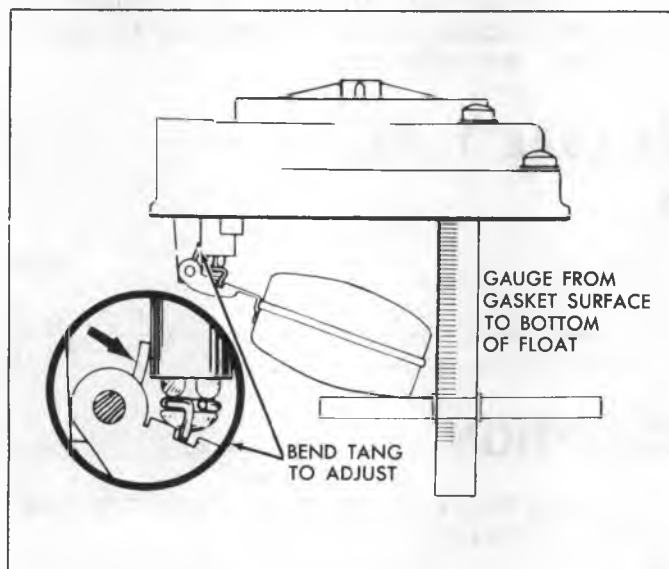


Fig. G8--Float Drop Adjustment (Brass)

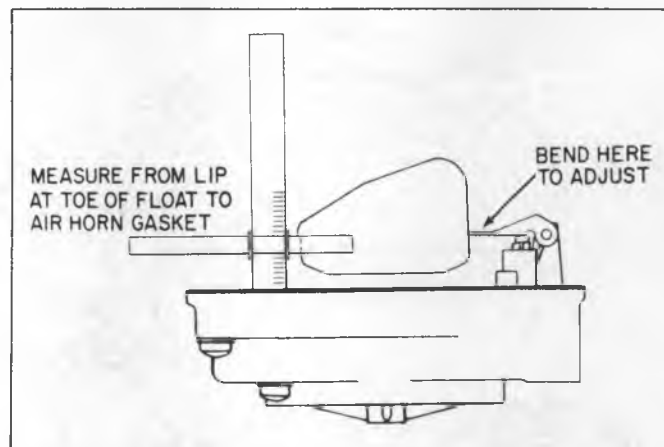


Fig. G9--Float Level Adjustment (Nitrophyl)

### Nitrophyl-Type

1. 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 tang (fig. G9).
2. With air horn right side up so that float can hang free, measure distance from lip at toe of float to air horn gasket. Adjust float to specifications by bending tang (Fig. G10).

### Assemble Air Horn to float Bowl

1. Place air horn on bowl, making certain that accelerator pump plunger is positioned properly and that it will move freely. Raise air horn, index power piston with spring and lower it straight down to ensure proper installation.
2. Install and tighten air horn screws evenly and securely in sequence shown in Figure G11. The number one screw is the long screw.

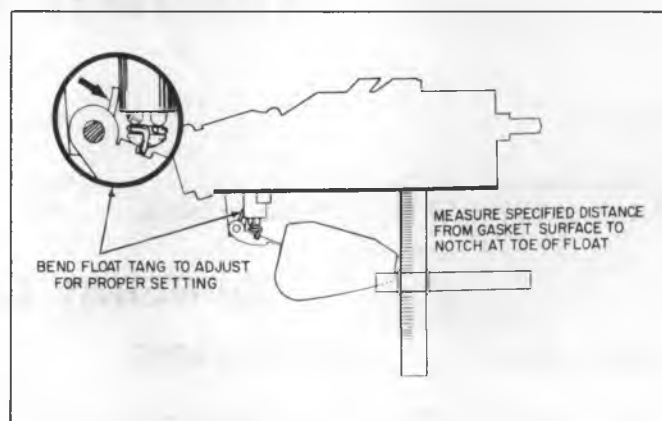


Fig. G10--Float Drop Adjustment (Nitrophyl)

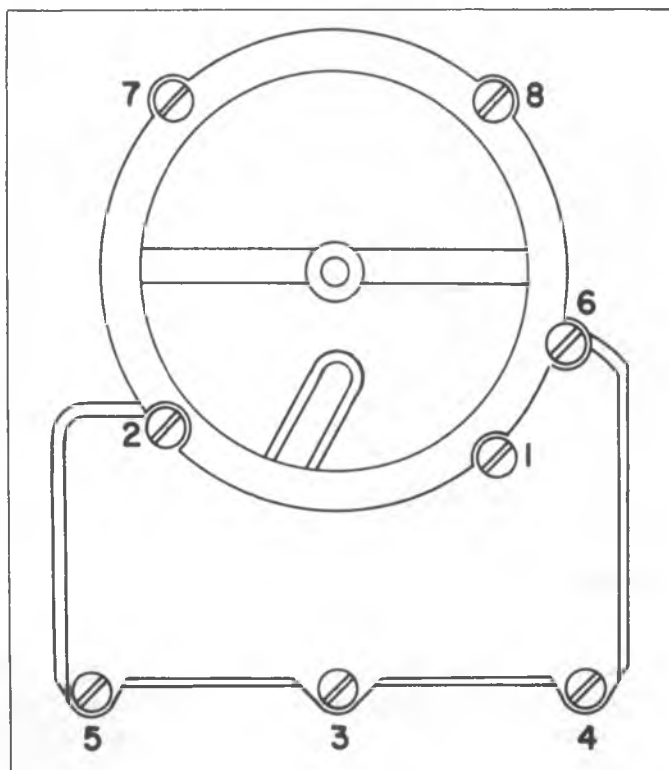


Fig. G11—Air Horn Tightening Sequence

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 fast idle screw "RP" on fast idle cam should 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 hose to fitting on throttle body and vacuum diaphragm unit.

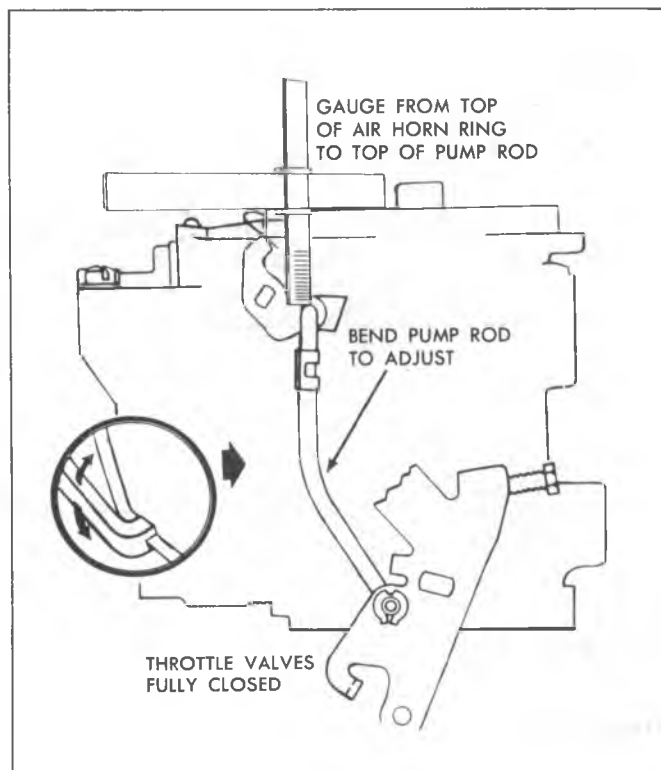


Fig. G12—Accelerator Pump Rod Adjustment

### Adjust Accelerator Pump Rod (Fig. G12)

Back out idle stop screw and solenoid plunger screw so that the throttle valves are completely closed in bores. Place the gauge on top of air horn ring. Bend the pump rod at lower angle to obtain specified dimension to top of 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, 1972 Chassis Service Manual, under "Additional External Settings and Adjustments", must be followed.

## ROCHESTER 2GV (SAE 1 1/2")

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Rochester 2GV (SAE 1 1/2") Repair Procedures ....	6M-14	Assembly .....	6M-18

## GENERAL DESCRIPTION

### MODEL 2GV (1-1/2") 2 BARREL (LARGE)

The SAE 1-1/2" Model 2GV carburetors are used on Chevrolet 350" and 400" V8 engines for passenger cars and Chevrolet Truck 350" V8 engines.

The Model 2G, 2GV carburetors for Chevrolet are similar to prior models except for the following:

1. Recalibration for the new lineup of engine.
2. A slotted choke valve shaft lever allows the choke to fully



close at higher temperatures for improved cold starts. (Fig. V-1).

3. An additional fuel feed circuit has been added on all passenger cars and truck 1-1/2" models to supplement fuel flow of the main metering system. The fuel enrichment system provides additional enrichment to the part throttle system at higher engine speeds during higher air flows.

To accomplish this, two additional fuel feed holes are located in the air horn just above the choke valve. The fuel feeds connect directly to the fuel in the float bowl. Through channels which lead directly into a tube that extends into the fuel, just above the main metering jets. At approximately 8 pounds of air flow per minute and above, the fuel begins to feed from these discharge holes to supplement fuel flow from the main metering system.

The combined emission control valve (C.E.C. valve) is not used on 2GV models. An idle stop solenoid is mounted on the carburetor. Curb idle speed setting is made by adjusting the plunger screw in the idle stop solenoid.

This setting should be made using the shop manual and information located on the decal in the engine compartment. The vacuum tube, formerly located on the throttle body between the idle needles, is removed with the elimination of the C.E.C. valve feature.

The throttle body casting has been re-designed to reduce heat transfer from the intake manifold to the carburetor float bowl. A new carburetor flange mounting gasket is used with non-metallic bushings added to the stud holes at the front of the fuel inlet side and at the rear on the throttle lever side. The diagonally opposite corresponding holes in the gasket will be blank, thus, carburetor hold down nuts are used only in the bushing hole locations for less throttle body distortion and heat transfer to the fuel in the float bowl.

## DISASSEMBLY

### Removal of the Idle Stop Solenoid Assembly.

Bend back retaining tabs on lock washers; then remove large Idle Stop Solenoid valve nut and remove the solenoid from bracket on carburetor.

**NOTE:** Do not remove solenoid valve bracket from the float bowl assembly unless replacement of the bracket is necessary. The bracket is locked securely in place on the float bowl and must be tight.

**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 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 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.

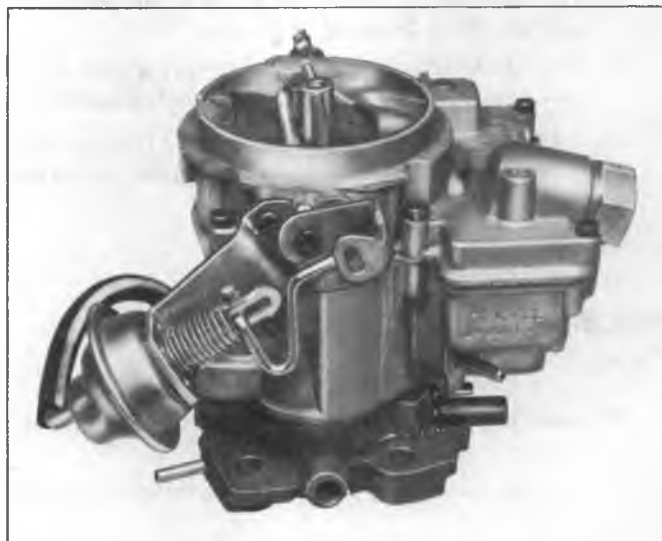
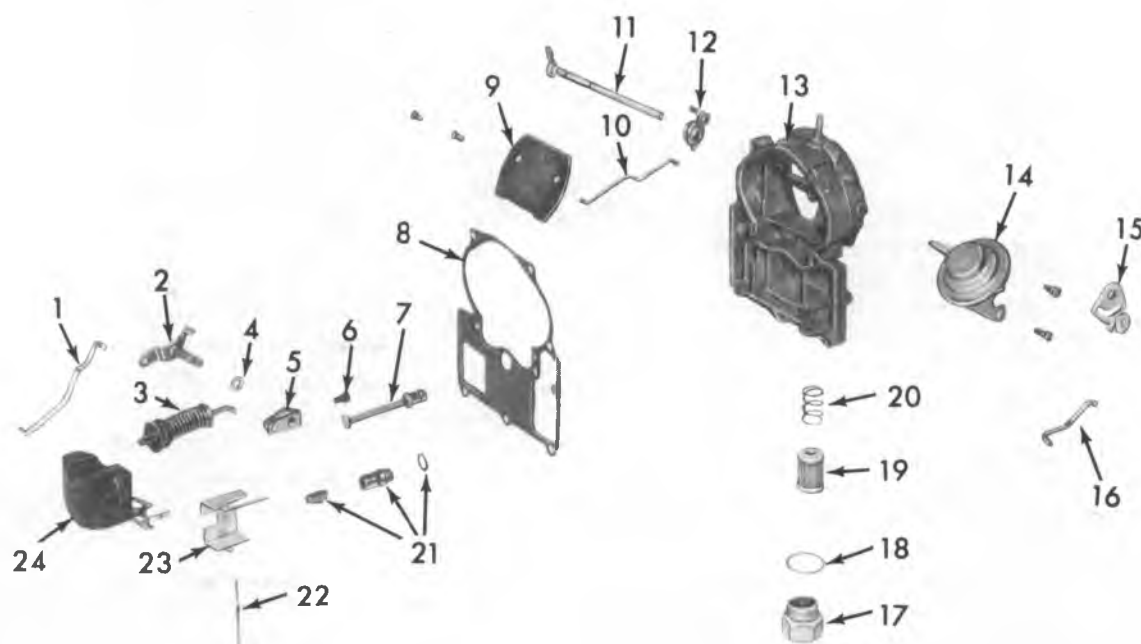


Fig. V1--Rochester 2GV-2BBL. (1 1/2") Carburetor



- |                              |                            |                      |                           |
|------------------------------|----------------------------|----------------------|---------------------------|
| 1. Pump Rod                  | 7. Power Piston            | 13. Air Horn         | 20. Filter Spring         |
| 2. Pump Outer Lever          | 8. Air Horn-to-Bowl Gasket | 14. Vacuum Diaphragm | 21. Float Needle and Seat |
| 3. Accelerator Pump          | 9. Choke Valve             | 15. Choke Lever      | 22. Float Hinge Pin       |
| 4. Washer                    | 10. Choke Rod              | 16. Diaphragm Link   | 23. Splash Shield         |
| 5. Pump Inner Lever          | 11. Choke Shaft            | 17. Fuel Inlet Nut   | 24. Float                 |
| 6. Pump Inner Lever Retainer | 12. Choke Kick Lever       | 18. Gasket           |                           |
|                              |                            | 19. Fuel Filter      |                           |

Fig. V2--Air Horn Disassembled

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.
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.

**NOTE:** The cluster center screw has two fiber washers and a baffle located just above the main well air bleeds. 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. The high speed bleed baffle must be installed between the two fiber gaskets underneath the head of center cluster screw.

4. 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.
5. Remove two screws retaining hot idle compensator and remove compensator assembly and gasket from venturi area. (Air conditioned models only).
6. 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.

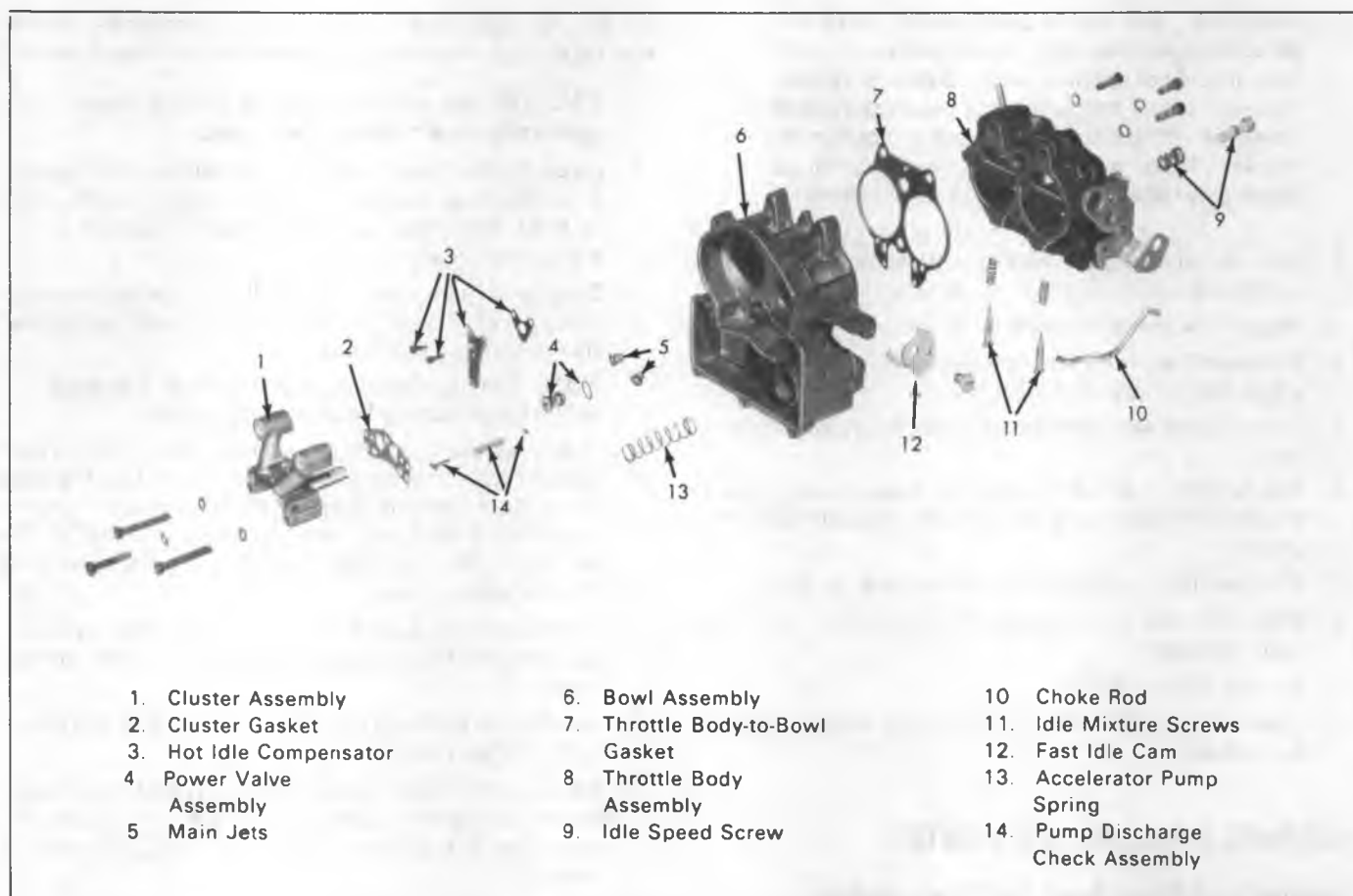


Fig. V3--Bowl and Throttle Body Disassembled

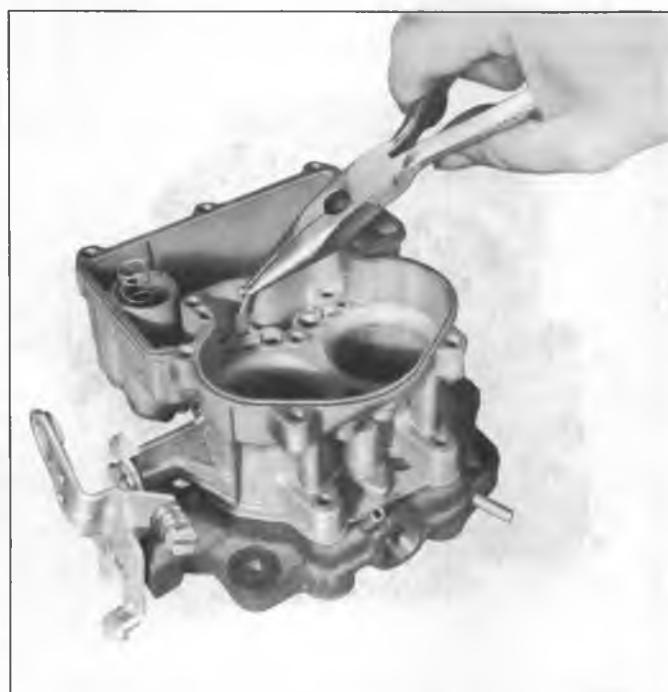


Fig. V4--Removing Pump Discharge Spring Retainer

7. 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 as new ones are provided in the repair kit.

**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.

8. Remove idle mixture needle and spring, if required.

### 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. However, the air horn which has the pressure relief valve will withstand normal cleaning in carburetor cleaner. Make sure the cleaning solution is thoroughly removed from pressure relief valve area.

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.
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. Do not install plastic limiter cap at this time until proper screw settings have been made.

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 "Additional External Settings and Adjustments".

**NOTE:** Do not install the new plastic limiter caps provided until the idle mixture has been adjusted with the carburetor installed on the engine, per instructions in the Service Manual.

A new red plastic idle mixture needle limiter cap is provided in the carburetor repair kit and also in the idle mixture needle and limiter cap kit. This cap must be installed after the idle mixture needle has been set on engine (see Specifications), 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). Install new limiter cap after checking carburetor installed in engine.

**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. 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 gasket and venturi cluster assembly, tighten screws evenly and securely. Make certain that the high speed bleed baffle is installed under the center cluster screw with a fiber gasket on each side of the baffle. The notches on the high speed bleed baffle point downward towards venturi area.
5. On air conditioned models, install the hot idle compensator assembly and gasket. Tighten screws evenly and securely.
6. Install main metering jets, power valve gasket and power valve. Tighten securely.
7. Install pump return spring into pump well, apply pressure with finger to center it in pump well. Figure V5 shows the float bowl and throttle body at this stage of assembly.

### 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.

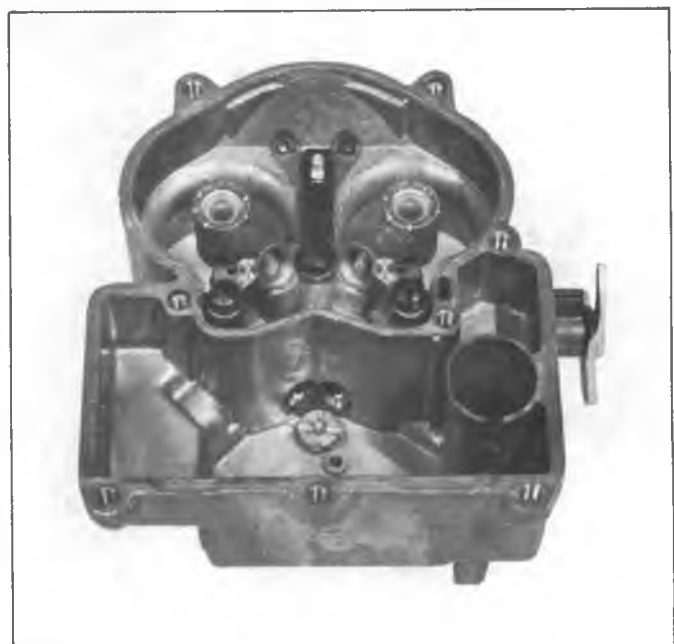


Fig. V5--Bowl Assembly--Parts Location



Fig. V6--Air Horn Assembly--Parts Location

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 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--notch in shield toward accelerator pump.
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 part number on diaphragm bracket facing away from casting or outward. Position vacuum break diaphragm rod into

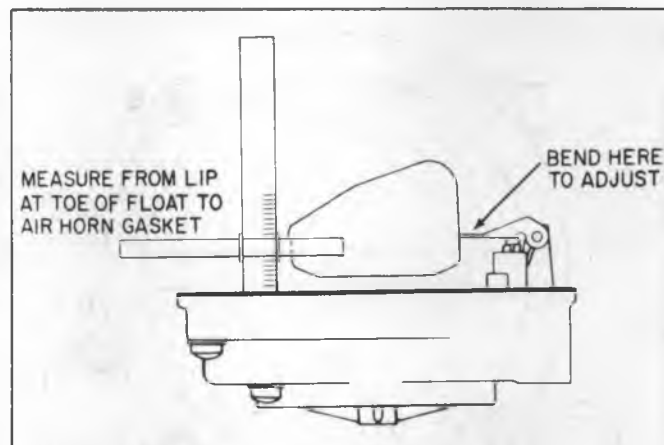


Fig. V7--Float Level Adjustment

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 tang (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 to specifications by bending tang (Fig. V8).

### 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

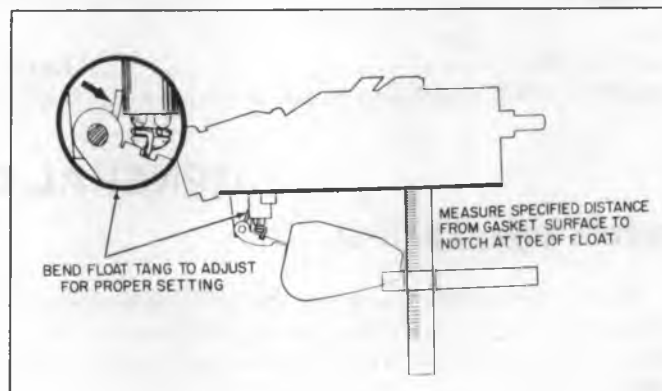


Fig. V8--Float Drop Adjustment

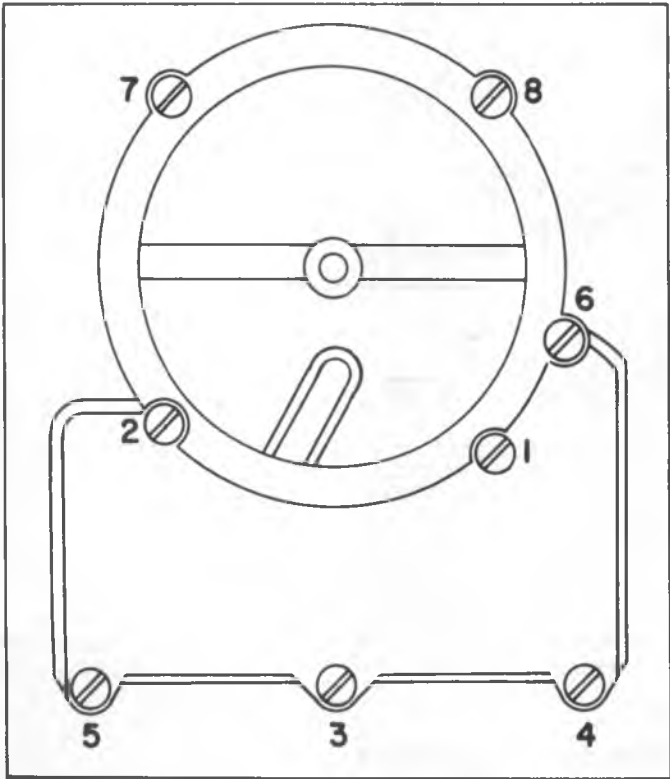


Fig. V9--Air Horn Tightening Sequence

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.

**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 oppo-

site 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, 1972 Chassis Service Manual, under "Additional External Settings and Adjustments", must be followed.

ROCHESTER 4 MV (QUADRAJET)

INDEX

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GENERAL DESCRIPTION

MODEL 4MV - 4 BARREL

The Rochester 4MV Carburetor (fig. Q1), used in conjunction with a temperature sensing choke coil (mounted on the intake manifold), is used with 350 cu. in. and larger displacement engines.

This is a four barrel, two stage carburetor with versatility and principles of operation that make it adaptable for small

to larger engines without design changes.

The fuel bowl is centrally located to avoid problems of fuel slosh, causing engine turn cut-out, and delayed fuel flow to the carburetor bores.

The primary side has small bores and a triple venturi for fine fuel control in the idle and economy ranges. The secondary side has larger bores and an air valve for high air capacity.



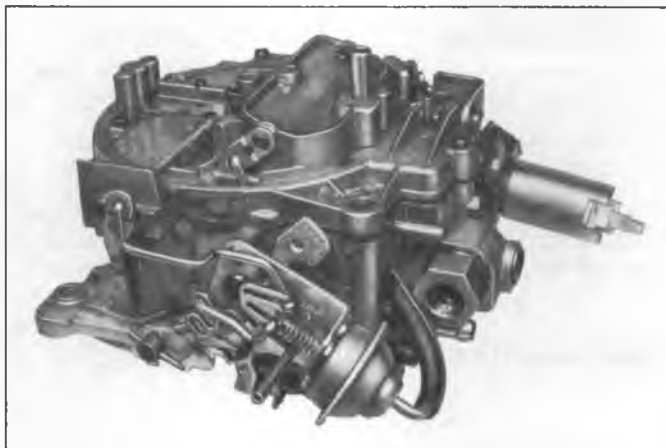


Fig. Q1--Rochester 4MV (Quadrajet) Carburetor

The model 4MV for Chevrolet has the following major changes:

1. Recalibration for engines.
2. The milled slot in the secondary metering rod is removed. Hot engine tests have proved the slot is no longer required.
3. A bottom seal fuel inlet nut is used to prevent possible deterioration of the fuel inlet nut threads. To accomplish this, the fuel inlet nut gasket has been moved from the outside surface to the bottom of the fuel inlet nut threads. The gasket seal, being located at the bottom of the threaded section, prevents any fuel from reaching the threads which might cause thread deterioration.
4. The combined emission control valve (C.E.C. valve) will not be used on the 4MV models. An idle stop solenoid is mounted on a bracket on the carburetor. Curb idle speed setting is made by adjusting the plunger screw in the idle stop solenoid with the solenoid energized electrically. This setting should be made using the shop manual and information located on the decal in the engine compartment.
5. The choke system is changed in that a new metal vacuum break diaphragm assembly incorporating a choke closing assist spring is used for improved choke conditions. The vacuum break diaphragm plunger is revised in that the fast idle cam pull off feature is eliminated, and the slot for free travel of the air valve dashpot link is moved from the air valve shaft lever to the vacuum break plunger. The choke closing assist spring is now incorporated in the vacuum break diaphragm plunger stem and replaced the torsion spring formerly located on the vacuum break lever bracket.

The choke closing spring assists in closing the choke valve along with tension from the remote choke thermostatic coil for improved cold starting. The choke closing assist spring exerts pressure on the vacuum break link to assist in closing the choke valve during cold engine starting. When the engine starts and the choke vacuum break diaphragm seats, the closing spring retainer hits a stop on the plunger stem and no longer exerts pressure on the vacuum break link.

## 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.

### Removal of the Idle Stop Solenoid Assembly

1. Bend back lockwasher retaining ears from retaining nut; then loosen idle stop solenoid retaining nut from solenoid.
2. Remove the idle stop solenoid from the bracket on the float bowl.

**NOTE:** Do not remove the idle stop solenoid bracket from the float bowl unless replacement is necessary, as the bracket must be held securely in place.

**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 vacuum break hose at diaphragm and remove diaphragm unit from retaining bracket.
6. Disconnect choke assist spring.
7. Remove small screw at top of secondary metering rod hanger, then remove metering rod hanger and secondary rods as an assembly.
8. 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.

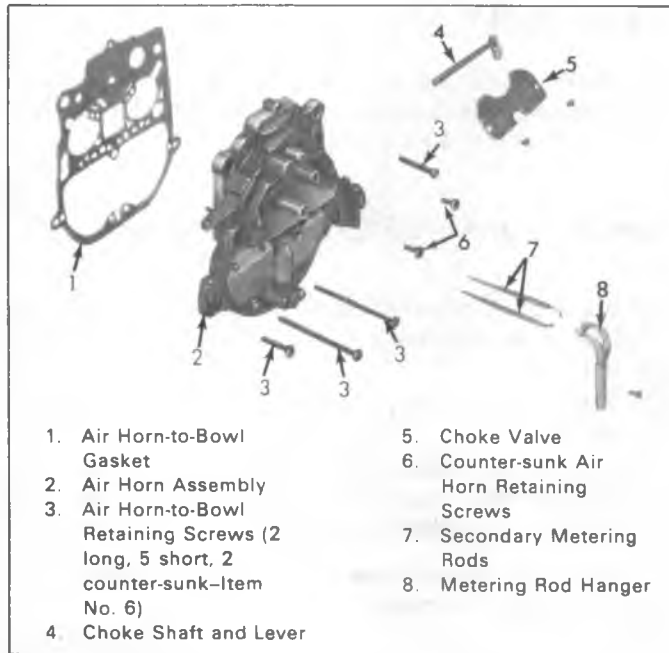


Fig. Q2-Air Horn Exploded View

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.
5. Remove power piston by pressing the piston down and releasing it. Remove power spring from well.

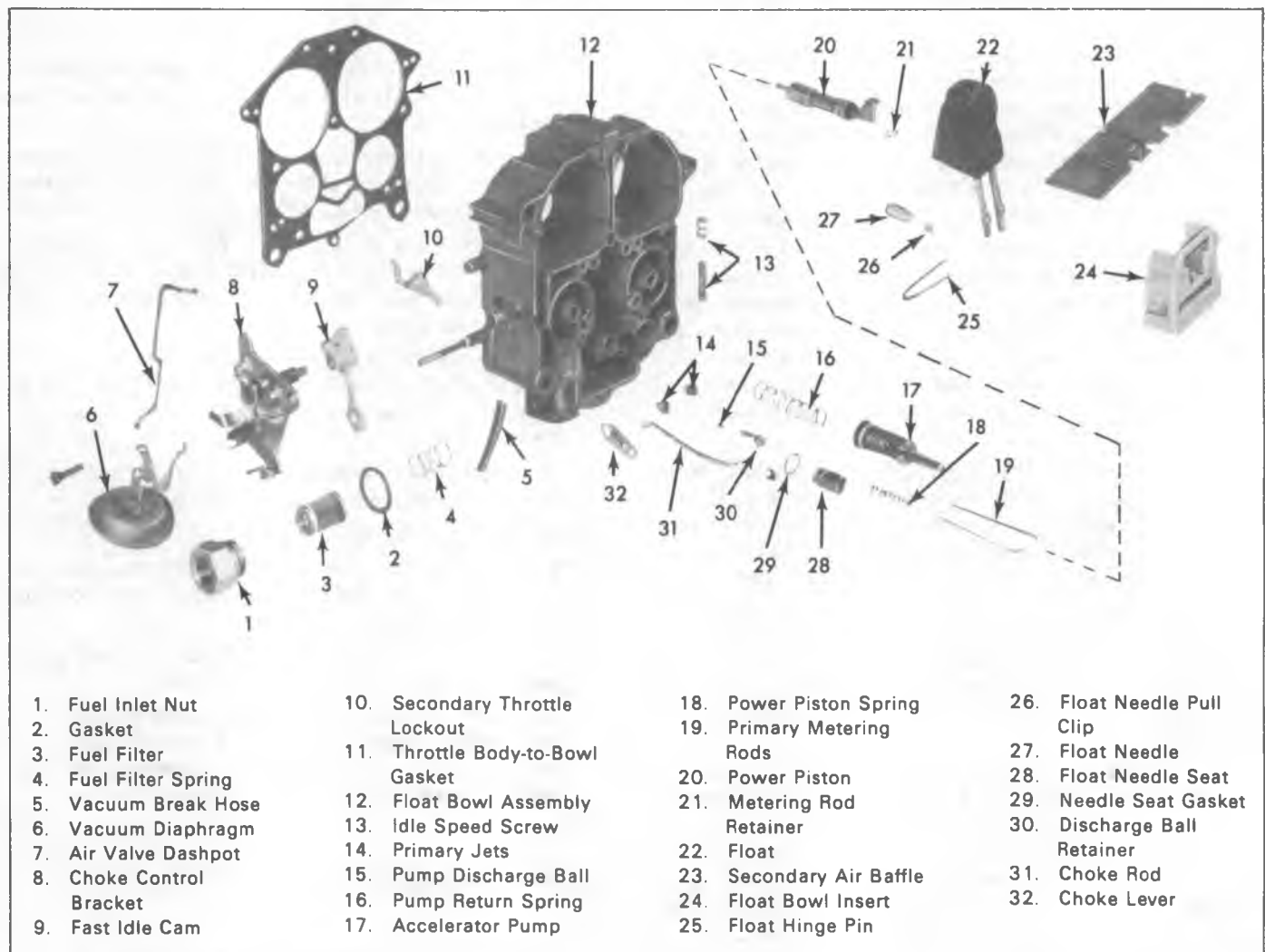


Fig. Q3-Float Bowl Exploded View

**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 and remove assembly from float bowl then remove secondary lock out line from 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 gaskets.

### Throttle Body Disassembly (Figure Q4)

**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.

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 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.

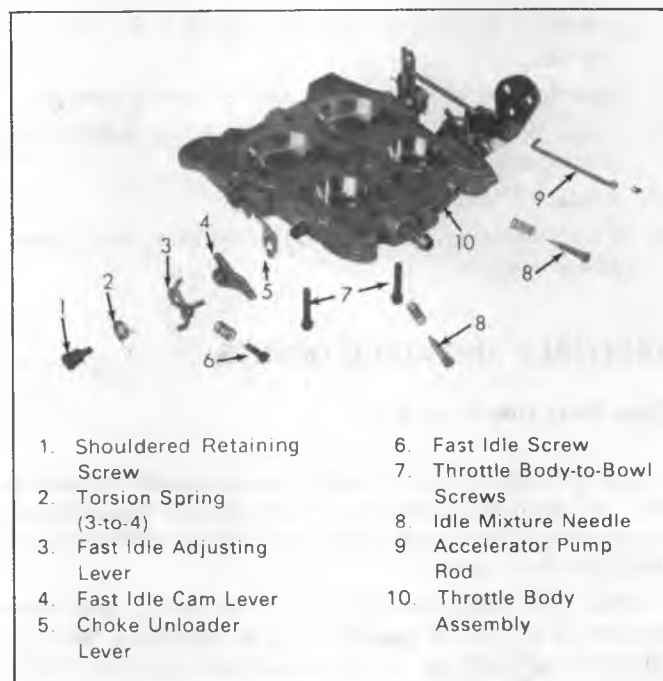


Fig. Q4--Throttle Body Exploded View

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. However the air horn which has the pressure relief valve will withstand normal cleaning in carburetor cleaner. Make sure the cleaning solution is thoroughly removed from pressure relief valve area.

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.
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. Do not install plastic limiter cap at this time until proper screw settings have been made.

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 "Additional External Settings and 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:** Do not install the new plastic limiter caps until the idle mixture has been set with the carburetor installed on the engine. Instructions for adjustment are included in the service manual.

**NOTE:** A new red plastic idle mixture needle limiter cap is provided in the carburetor repair kit and also in the idle mixture needle and limiter cap kit. This cap must be installed after the idle mixture needle has been set on engine (see Specifications) 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). Install new limiter cap after check out of carburetor on engine.

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.
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).

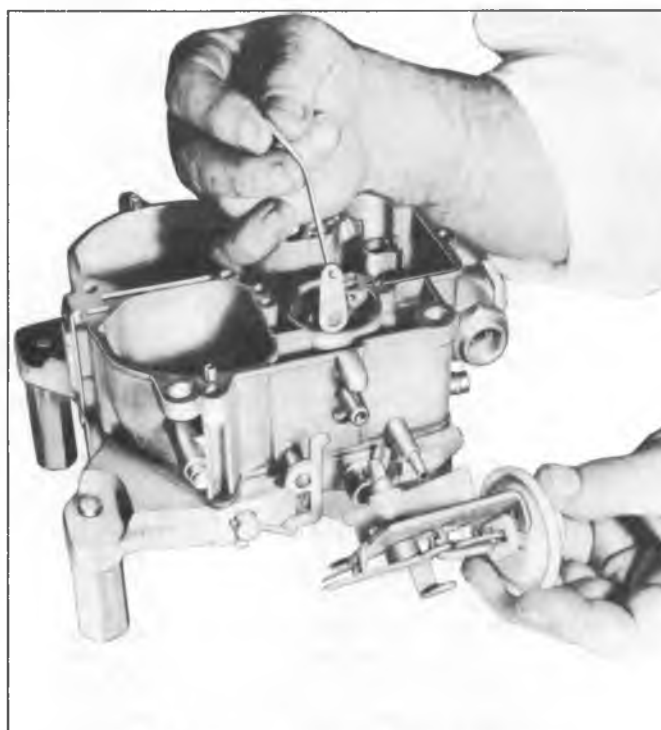


Fig. Q5--Installing Choke Bracket Assembly

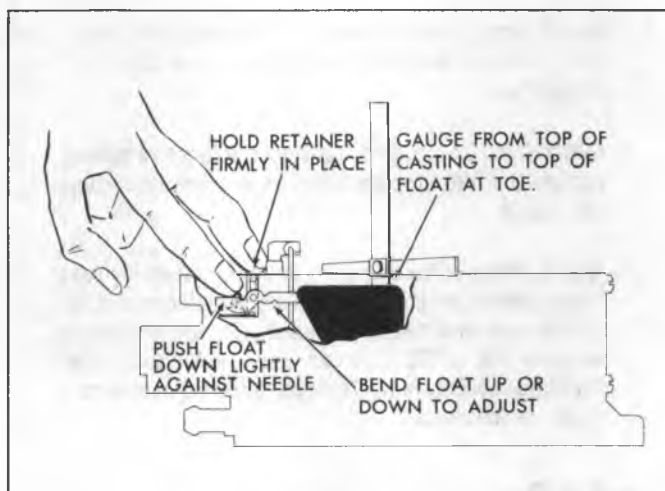


Fig. Q6--Float Level Adjustment

**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 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).

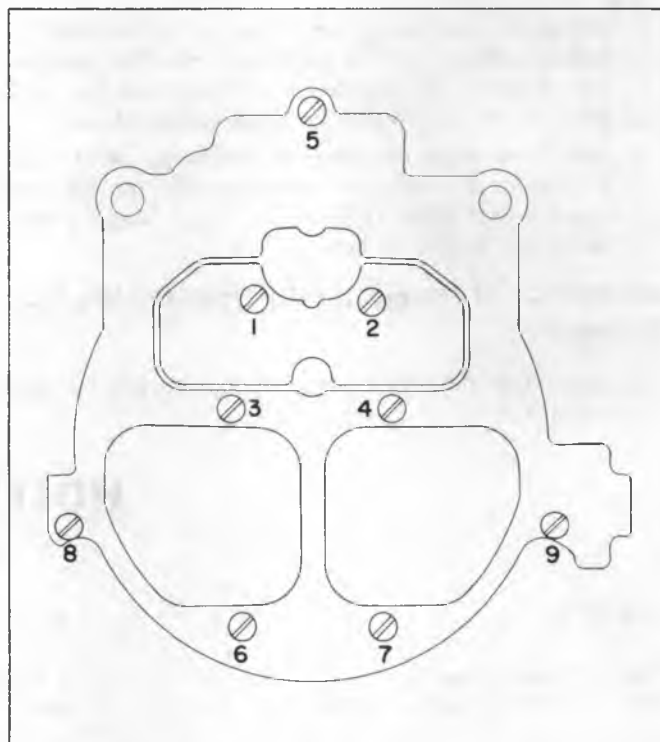


Fig. Q7--Air Horn Tightening Sequence

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.

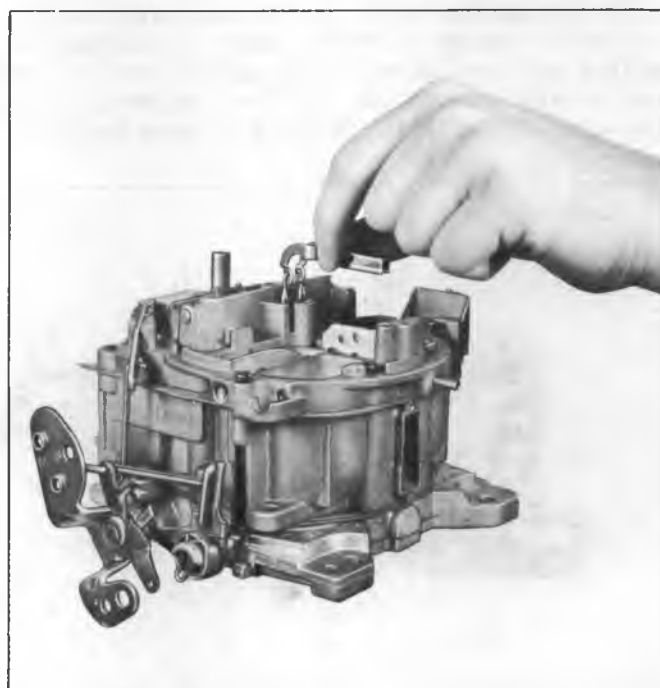


Fig. Q8--Installing Secondary Metering Rods

## CARBURETORS 6M-26

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 and connect choke assist spring and finally the choke vacuum hose.
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.

### Installation of the Electrically Operated Idle Stop Solenoid

1. Install the idle stop solenoid into locating lug in bracket on float bowl.

2. Install large retaining nut and tighten securely. Then, bend locking tabs from lockwasher over flats on the retaining nut.

**CAUTION:** Do not over tighten the large retaining nut on the idle stop solenoid as bracket distortion can result.

**NOTE:** After carburetor overhaul, throttle body part replacement, mixture needle part replacement, or limiter cap and needle removal, the procedures in Section 6M, 1972 Chassis Service Manual, under "Additional External Settings and Adjustments", must be followed.

## HOLLEY 4150

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Holley 4150 Repair Procedures .....	6M-27	Assembly and Adjustment .....	6M-32

## GENERAL DESCRIPTION

### Model 4150 Four Barrel (Fig. S1)

The Holley 4150 center inlet carburetor (fig. S1) is used on 350 and 454 cu. in. engines. See Carburetor identification, fig. S3. This carburetor is used in conjunction with a temperature sensing choke coil mounted on the intake manifold over the exhaust crossover passage.

This four barrel carburetor consists of seven sub-assemblies; the throttle body, the main body, primary and secondary fuel bowls, primary and secondary metering bodies and the secondary throttle operating assembly. The secondary metering body on the Model 4150 Carburetor is similar to the primary

metering body. The secondary throttle operating assembly is vacuum operated (Fig. S4).

The follow major changes to the Holley carburetor reflect further addition to emission control, driveability and serviceability.

- New Calibrations.
- Idle screw mixture limiter caps and needles added.
- Idle Stop Solenoid and bracket added.
- C.E.C. valve deleted.
- Modulated choke diaphragm spring added.

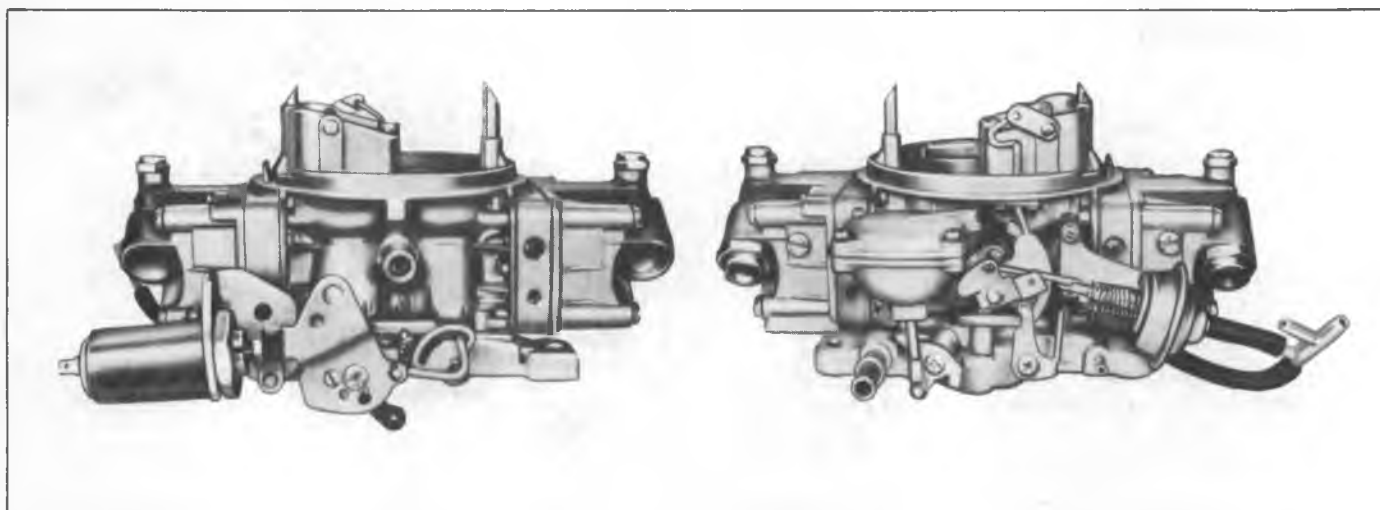


Fig. S1--Holley Model 4150 - Center Inlet Carburetor





Fig. S-2 Holley Carburetor Idle Mixture Needle Limiter Caps

Carburetor mixture screw limiter caps (Fig. S-2), black for production and red for service, are released for all Holley carburetors. Mixture needles are new to suit the new limiter caps. The combined emission control valve (C.E.C. valve) will not be used on the Holley models. An idle stop solenoid is mounted on a bracket on the carburetor. Curb idle speed setting is made by adjusting the plunger screw in the idle stop solenoid with the solenoid energized electrically. This setting should be made using the shop manual and information located on the decal in the engine compartment.

New metal vacuum break diaphragm assembly incorporates a choke closing assist spring for improved choke operation.

The choke closing spring assists in closing the choke valve along with tension from the remote choke thermostatic coil for improved cold starting. The choke closing assist spring exerts pressure on the vacuum break link to assist in closing the choke valve during cold engine starting. When the engine starts and the choke vacuum break diaphragm seats, the closing spring retainer hits a stop on the plunger stem and no longer exerts pressure on the vacuum break link.

## DISASSEMBLY

### REMOVAL OF IDLE STOP SOLENOID

1. Bend back lockwasher retaining ears from retaining nut. Then loosen idle stop solenoid retaining nut from the solenoid.
2. Then remove the idle stop solenoid from the bracket on the throttle body.

**CAUTION:** Do not remove the idle stop solenoid bracket from the throttle body unless replacement is necessary, as the bracket must be held securely in place. The idle stop solenoid should, not be immersed in any type of carburetor cleaner and should always be removed before complete carburetor overhaul.

### Disassemble Into Subassemblies (Fig. S5)

**NOTE:** Before disassembly, loosen the fuel inlet fitting, fuel bowl sight plugs and needle and seat assembly lock screws.

1. Remove primary fuel bowl screw (4) and remove fuel bowl, metering body, baffle and gaskets.
2. Remove secondary fuel bowl screws (4) then remove bowl and metering body and gasket.
3. Disconnect secondary throttle operating rod at throttle lever.
4. Remove secondary throttle operating diaphragm assembly and gasket from main body.
5. Remove secondary diaphragm rod retaining clip.
6. Remove throttle body to main body screws, then remove throttle body and gasket.

### Disassemble-Fuel Bowls (Fig. S6)

1. Loosen inlet needle and seat lock screw, then turn adjusting nut counter-clockwise to remove the needle and seat assembly.
2. Remove float hinge pin retainer and slide float from bowl; note position and remove spring and hinge pin from float assembly. Remove bowl filler from primary bowl after float is removed.
3. Remove sight plug and gasket.
4. Remove inlet fitting, fuel filter, spring and gaskets.
5. **PRIMARY BOWL ONLY--**
  - Remove pump diaphragm screws and lift pump housing, diaphragm and spring from fuel bowl.
  - Check pump inlet ball for free movement and damage. Damage to ball, passage or retainer requires new bowl assembly.

### Disassemble Metering Bodies (Fig. S7)

1. On primary metering body remove the metering body filler block.
2. Remove main metering jets with a jet wrench or a wide blade screw driver (a small screw driver will damage the jets). Remove the power valves using a 1" 12pt. socket. Remove Idle mixture screws and seals (primary side only).

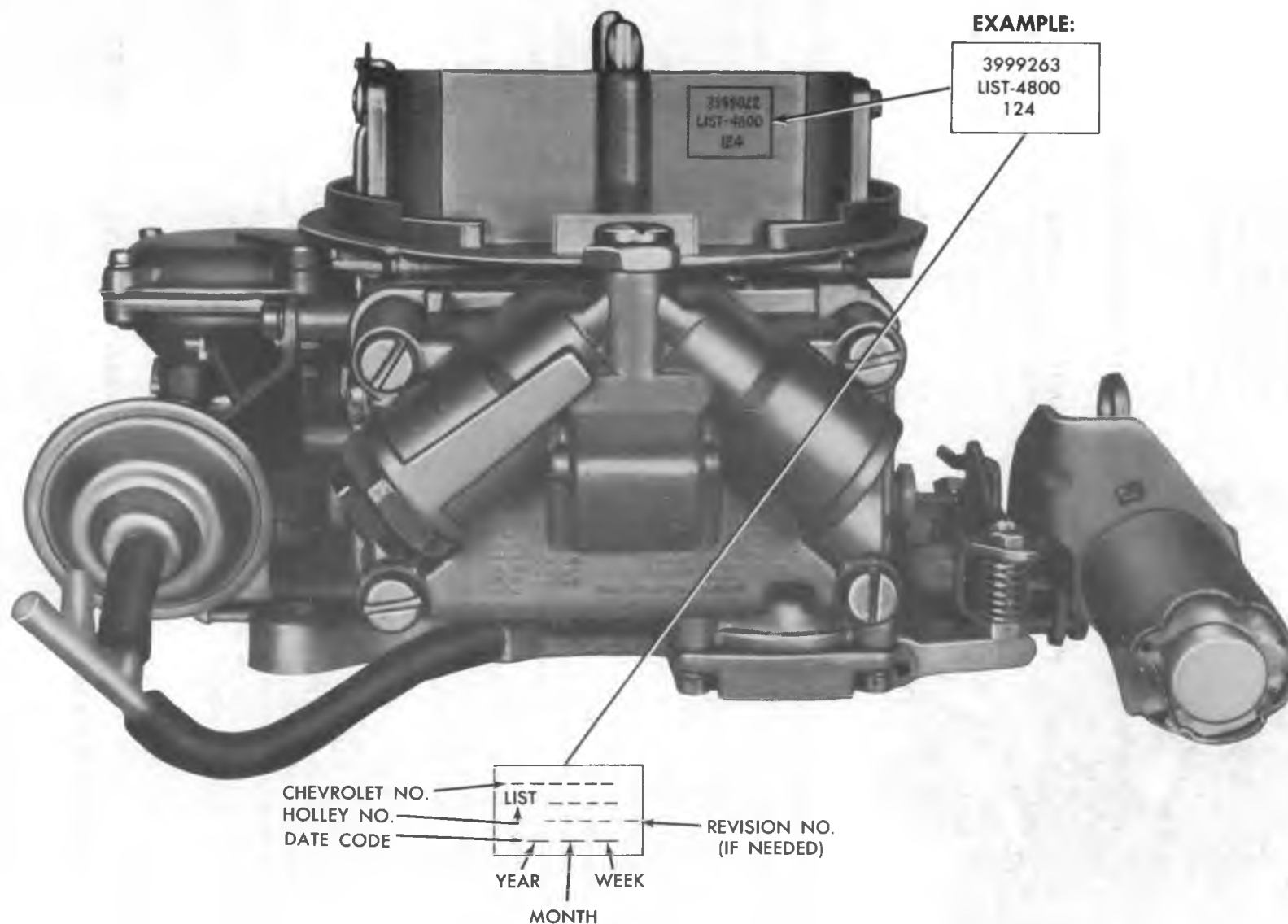
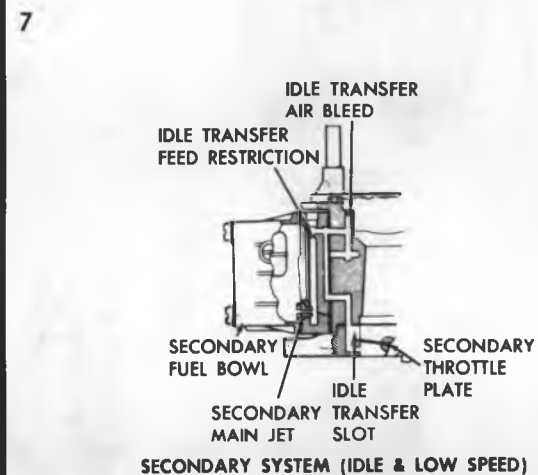
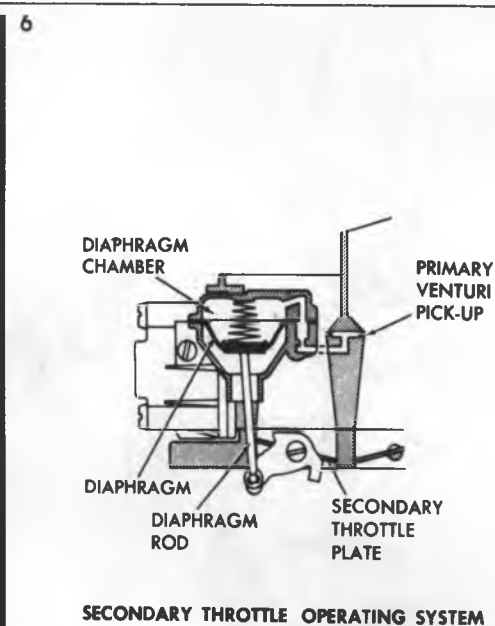
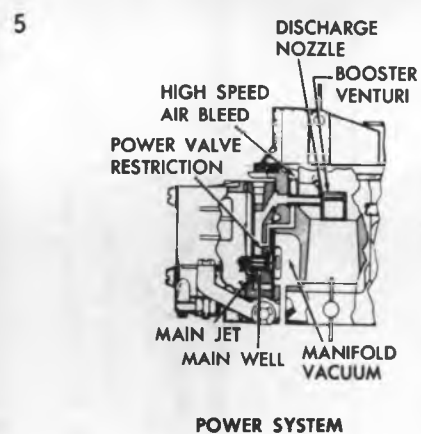
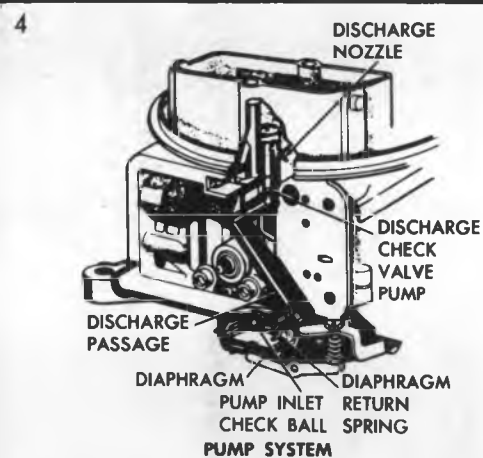
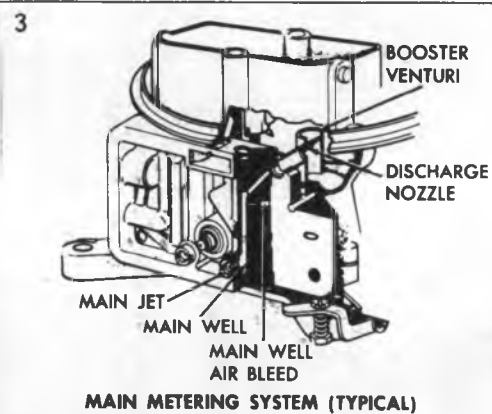
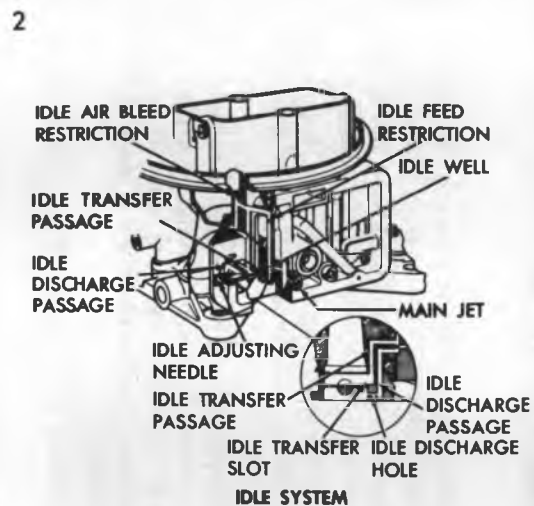
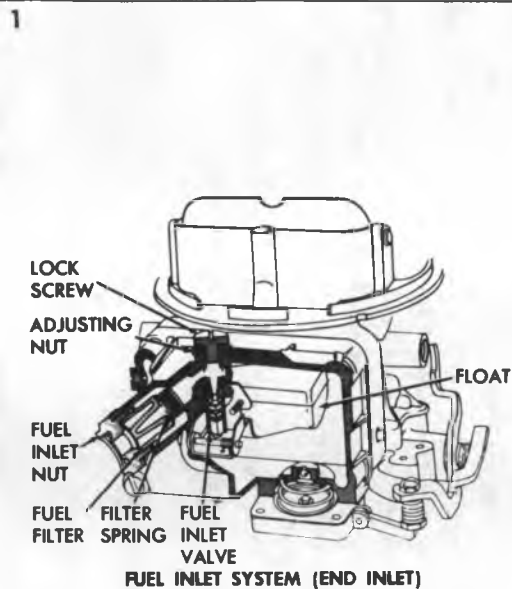


Fig. S3--Carburetor Identification

Fig. S4-Fuel Systems



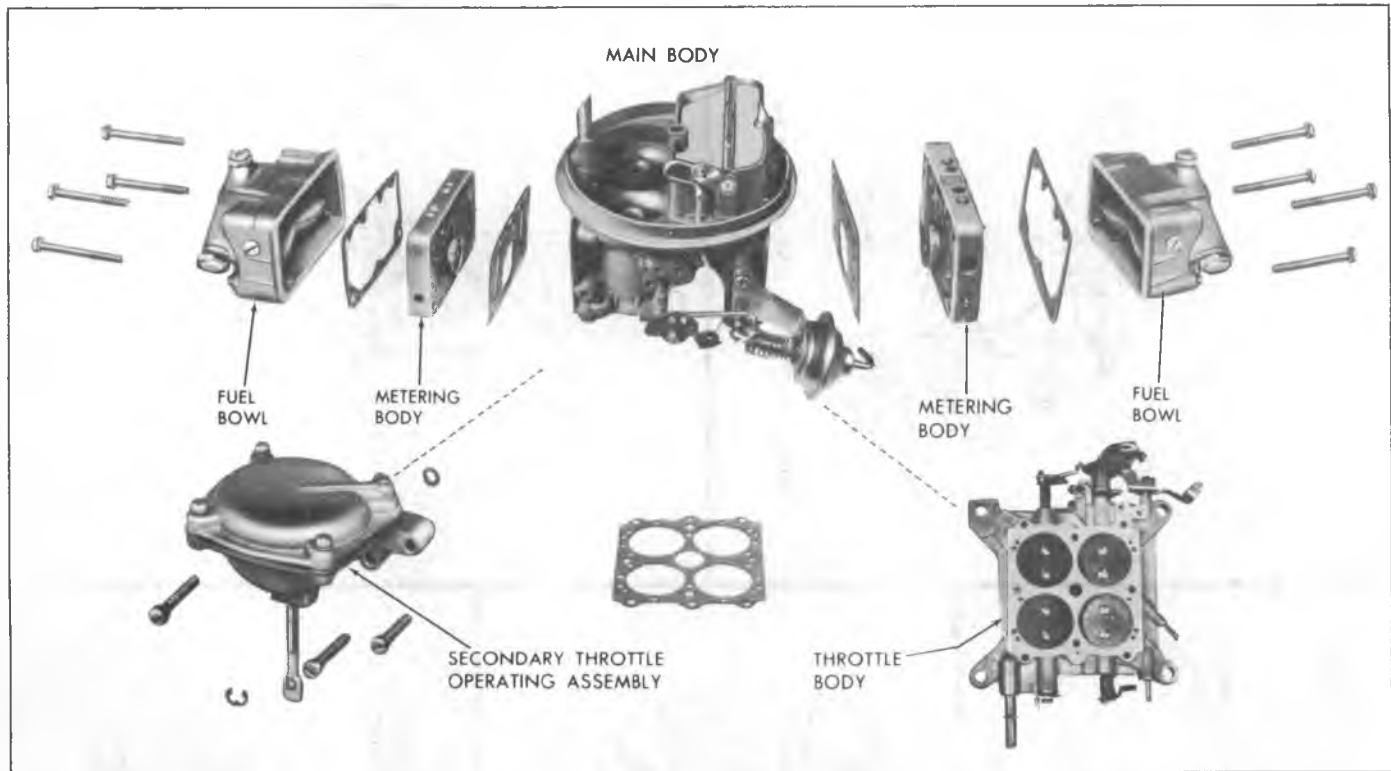


Fig. S5--Subassemblies

### Disassemble Secondary Operating Diaphragm Assembly (Fig. S8)

1. Remove Diaphragm cover.
2. Remove spring and diaphragm.

### Disassemble Main Body (Fig. S9)

1. Remove choke vacuum break retaining screws; remove choke vacuum break disconnecting link at choke lever.
2. Remove choke lever retaining clip and fast idle cam retaining clip; remove choke lever and fast idle cam.
3. Remove pump discharge nozzle screw, nozzle and gaskets; up-end the body assembly to remove pump discharge check valve.

**NOTE:** The choke rod seal will withstand normal cleaning in carburetor cleaner, therefore, further disassembly of the main body is not required for cleaning purposes. If parts replacement is required, proceed as follows:

- File off the staked ends of shaft screws then remove screws.
- Remove choke rod (upward through plastic seal) and remove seal from main body.
- Remove valve from shaft slot and slide shaft from main body.

### Disassemble Throttle Body (Fig. S10)

**NOTE:** Ordinarily the throttle body need not be disassembled for cleaning and inspection purposes.

If necessary, disassemble for part replacement as follows:

1. Remove pump operating lever assembly. Disassemble spring, bolt and nut if needed.
2. Remove idle speed screw and spring.
3. Remove diaphragm lever from secondary throttle shaft and fast idle cam lever from primary throttle shaft.
4. Remove cotter key and disconnect throttle connecting link (secondary lockout) from shaft levers.
5. File off the staked ends of the throttle plate attaching screws, then remove the screws and throttle plates.
6. Remove burrs from throttle shaft and slide the shafts out of flange.
7. Remove accelerator pump cam from throttle lever.
8. Remove vacuum break hose from fitting.

### Cleaning and Inspection

The carburetor should be cleaned in a cold immersion type cleaner.

**NOTE:** The most frequent causes of carburetor malfunction are gum, carbon, and water. Carefully clean and inspect all parts and castings as the carburetor is being serviced as follows:

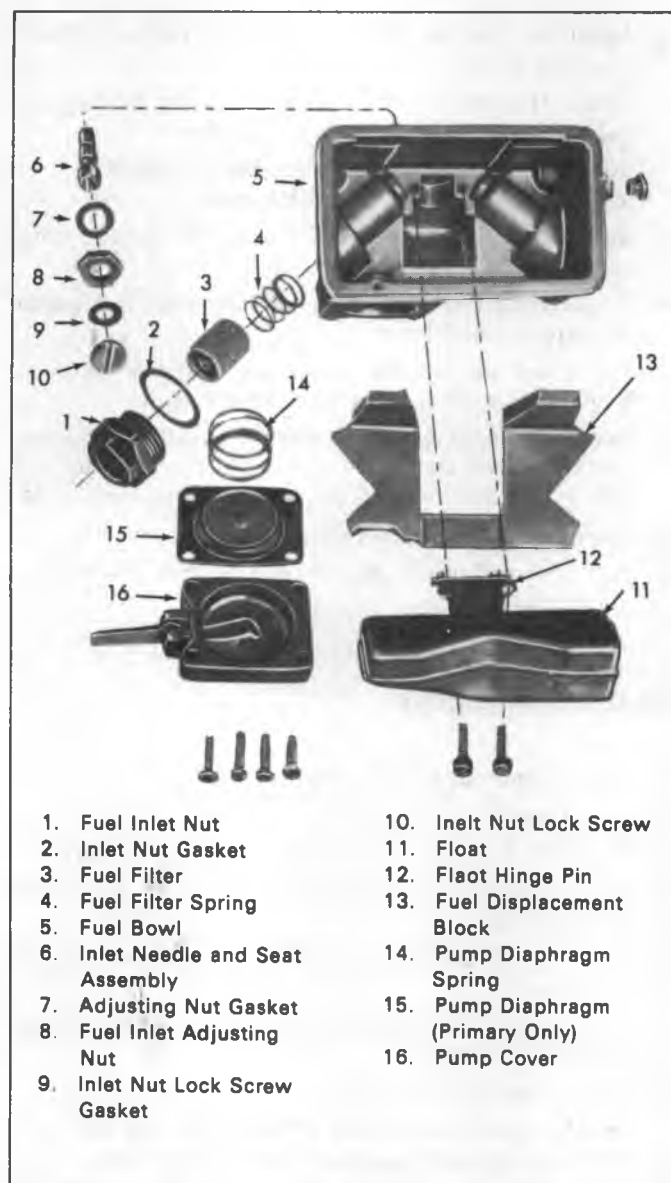


Fig. S6--Fuel Bowl Assembly

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner.

**CAUTION:** Any rubber parts, plastic parts, diaphragms, pump plungers, electric parts, including solenoids, should not be immersed in carburetor cleaner. However the air horn which has the pressure relief valve will withstand normal cleaning in carburetor cleaner. Make sure the cleaning solution is thoroughly removed from pressure relief valve area.

**NOTE:** Secondary throttle shaft bushings and accelerator pump cam are plastic.

2. Check secondary throttle operating diaphragm for free operation and leakage by moving diaphragm rod to the up position then covering vacuum passage opening in housing with thumb. The diaphragm should hold upward. Remove thumb from vacuum passage and dia-

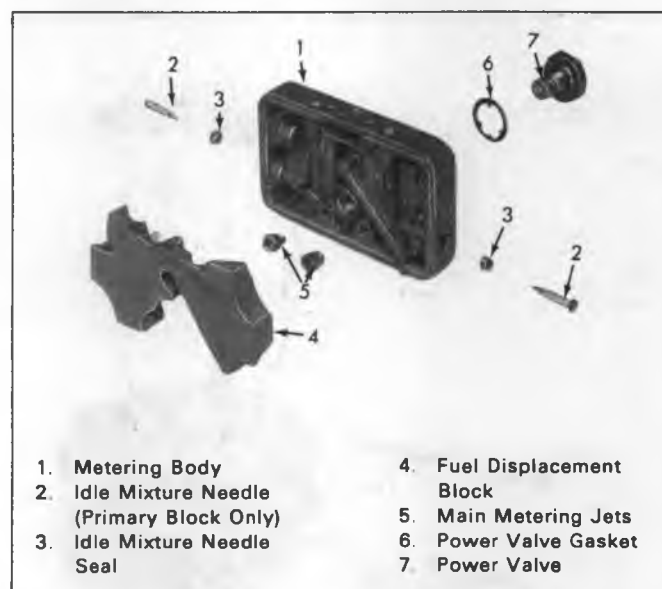


Fig. S7--Metering Body Assembly

phragm rod should move down readily.

3. Blow out all passages in castings with compressed air. Do not pass - drills through jets or passages.
4. Inspect idle mixture needle for damage.
5. Examine float needle and seat assembly for wear. Install a new factory matched set if worn.
6. Inspect upper and lower casting sealing surfaces for damage.
7. Inspect holes in levers for excessive wear or out of round condition. If levers or rods are worn they should be replaced.
8. Examine fast idle cam for excessive wear or damage.

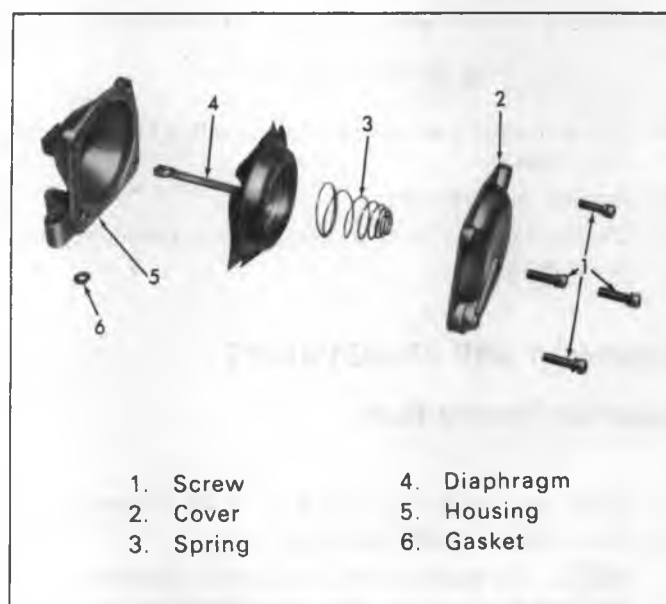


Fig. S8--Secondary Throttle Operating Assembly

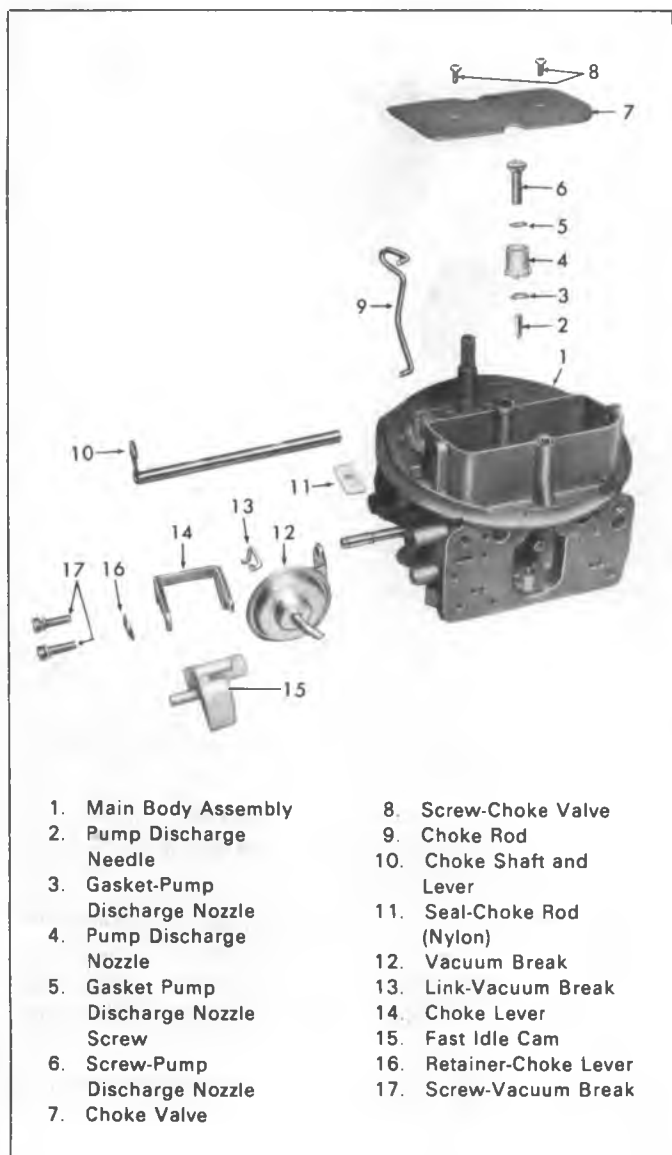


Fig. S9--Main Body Assembly

9. Check throttle and choke levers and valves for binds and other damage.
10. Replace filter element.
11. Check all springs for distortion or loss in tension replace as necessary.

## ASSEMBLY AND ADJUSTMENTS

### Assemble Throttle Body

1. Install secondary throttle stop screw (if removed).
2. Install throttle shafts in throttle body.

**NOTE:** The throttle shafts have plastic bushings. Roll new bushing between thumb and first finger to help shape the bushing on the shaft for easier installation.

3. Install the throttle valves on the shaft (do not tighten retaining screws).
4. Center the throttle valves on the shafts by holding the valves closed while tightening the screws.  
**NOTE:** The throttle valves are installed with identification numbers down (to manifold side).
5. Support the throttle shafts and stake the throttle valve screws.
6. Install the throttle connecting link (secondary lockout) to the throttle shaft levers.
7. Install fast idle cam lever on primary throttle shaft and diaphragm lever on secondary throttle shaft.
8. Install idle speed screw and spring. Turn idle speed screw clockwise until contact with throttle lever is made and turn 1 1/2" additional turns for preliminary adjustment.
9. Install accelerator pump cam on throttle lever.
10. Assemble and install pump operating lever assembly.
11. Install vacuum break hose on fitting.

### Assemble Main Body

1. Install pump discharge valve.
2. Install pump discharge nozzle. Use new gaskets.
3. Install choke rod seal and choke rod in main body.
4. Install choke shaft in main body and connect upper end of choke rod.
5. Install choke valve on choke shaft (do not tighten retaining screws).
6. Center choke valve on shaft by holding valve closed while tightening screws.
7. Stake screw ends with pliers.

**NOTE:** The choke valve is offset and should fall freely to wide open position from its own weight.

8. Install choke lever and fast idle cam; then retainer.
9. Connect vacuum break link to choke lever, then install vacuum break with two retaining screws.

### Assemble Secondary Throttle Operating Assembly

1. Install diaphragm assembly and spring in housing.
2. Install diaphragm cover and tighten securely.

**NOTE:** Diaphragm may be checked for leaks by pushing in on rod then holding finger over vacuum hole. Rod should remain in.

### Assemble Metering Bodies

1. Using a new gasket, install power valve and tighten secure. (Use a 1" 12 pt. socket.) Install main metering jets with a wide blade screw driver.



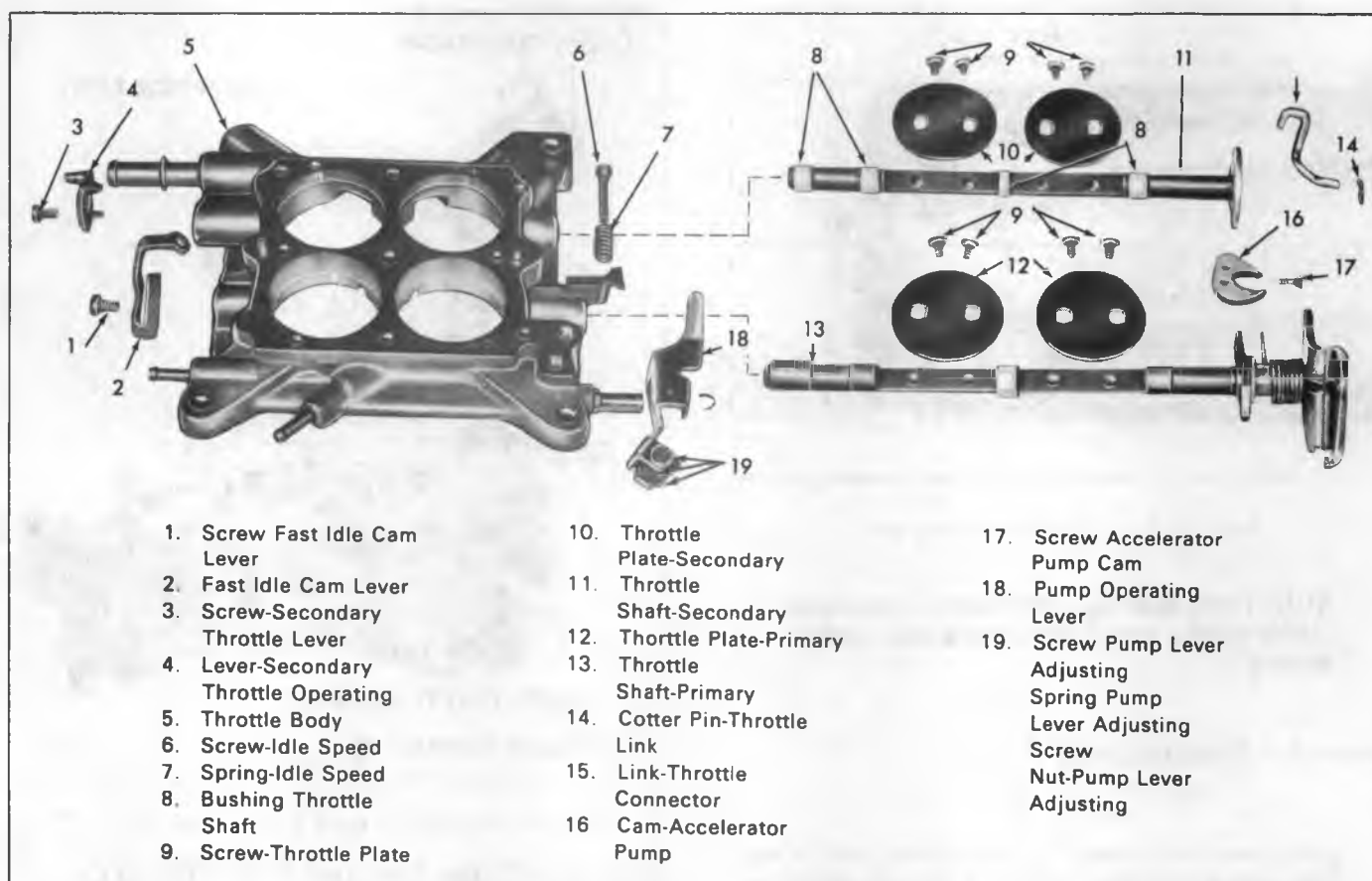


Fig. S10--Throttle Body Assembly

**PRIMARY ONLY--**

Using new seals, install idle mixture screws and make preliminary adjustment of idle mixture screws by turning lightly to seat and back out one turn.

**CAUTION:** Do not turn screw tightly against seal.

- On primary metering body install filler block.

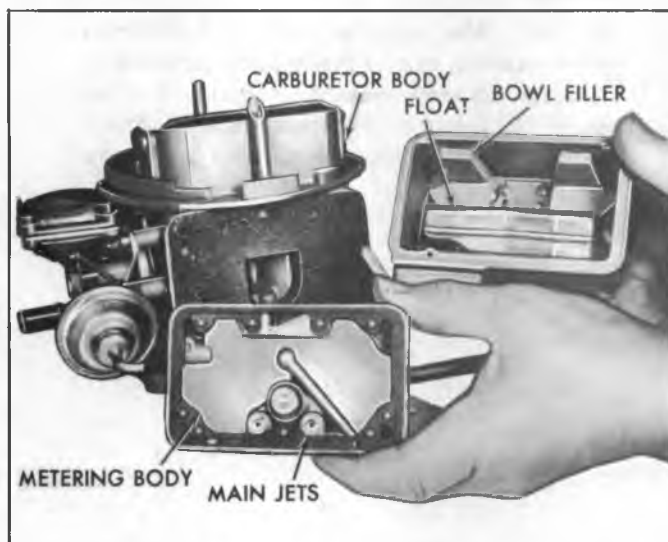


Fig. S11--Fuel Bowl Assembly

**Assemble Fuel Bowls****1. PRIMARY AND SECONDARY BOWL**

- On primary bowl install bowl filler before float installation (Fig. S11).
- Assemble spring to float, slide float into bowl and install float retainer screws.
- Install inlet needle and seats leaving locknuts loose. Use new gaskets.
- Install inlet fitting, fuel filter, spring and gasket (new).
- Install sight plugs in new gaskets.

**2. PRIMARY BOWL ONLY**

- Install pump spring and diaphragm in fuel bowl.

**Adjust Floats (Fig. S12)**

- Make a preliminary float adjustment by inverting primary fuel bowl and turning adjustable needle-seat until top of float is specified distance from top of fuel bowl.
- Repeat Step one for secondary float.

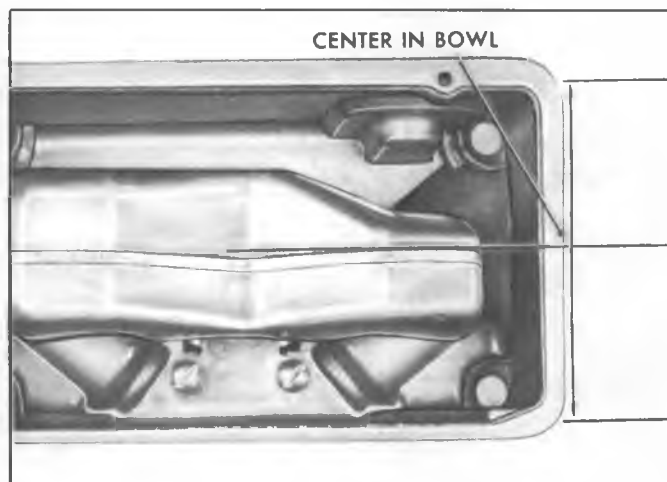


Fig. S12--Preliminary Float Adjustment

**NOTE:** Final adjustment of the float is made on the vehicle. Refer to Section 6M of the Chassis Service Manual.

### Assemble Subassemblies

1. Invert the main body, align new throttle body to main body gasket, then position throttle flange assembly and install the screws and tighten securely. (Fig. S13).
2. Using a new gasket, install secondary throttle operating assembly on main body and tighten securely.
3. Lay flange and main body on primary side then install new fuel bowl gasket and secondary metering body assembly onto main body aligning dowel pins and holes.
4. Install secondary fuel bowl and retaining screws with new gaskets under heads.
5. Lay assembly on secondary bowl then install primary metering body and gasket on main body.
6. Install splash shield, new gasket and primary fuel bowl.
7. Align pump lever under operating lever duration spring, then install fuel bowl retaining screws with new gaskets under heads and tighten securely.

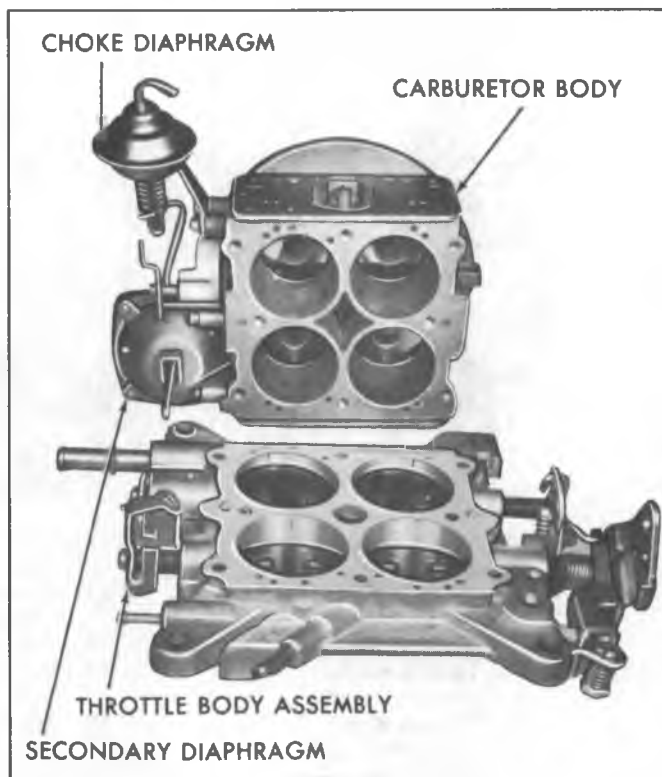


Fig. S13--Assembly of Main Body to Throttle Body

### INSTALLATION ON THE ELECTRICALLY OPERATED IDLE STOP SOLENOID.

1. Install the idle stop solenoid into locating lug in bracket on throttle body.
2. Install large retaining nut and tighten securely. Then, bend locking tabs from lockwasher over flats on the retaining nut.

**CAUTION:** Do not overtighten the large retaining nut on the idle stop solenoid as bracket distortion can result.

**IMPORTANT:** After carburetor overhaul, throttle body part replacement, mixture needle part replacement, or limiter cap and needle removal, the procedures in Section 6M 1972 Chassis Service Manual, under "Additional External Settings and Adjustments", must be followed.

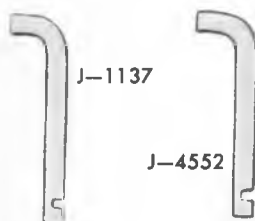
## SPECIAL TOOLS



J-22973

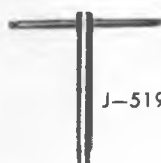


J-10176



J-1137

J-4552

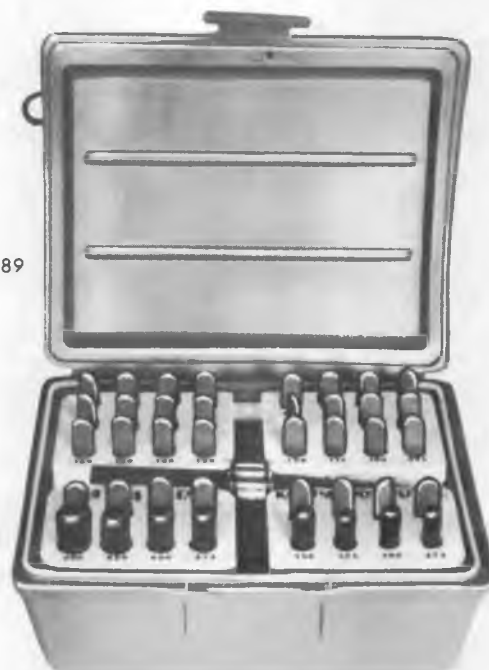


J-5197

## BENDING TOOLS

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

J-9789



J-8328



5. J-9789 Universal Carburetor Kit
6. J-10176 Fast Idle Wrench
7. J-22973 Ther-Mac Thermometer

Fig. S14--Engine Fuel Special Tools

## SECTION 6Y

# ENGINE ELECTRICAL

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## STARTING MOTOR

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Field Coil Test for Open Circuit .....	6Y-4	Pinion Clearance .....	6Y-6
Field Coil Test for Ground.....	6Y-4		

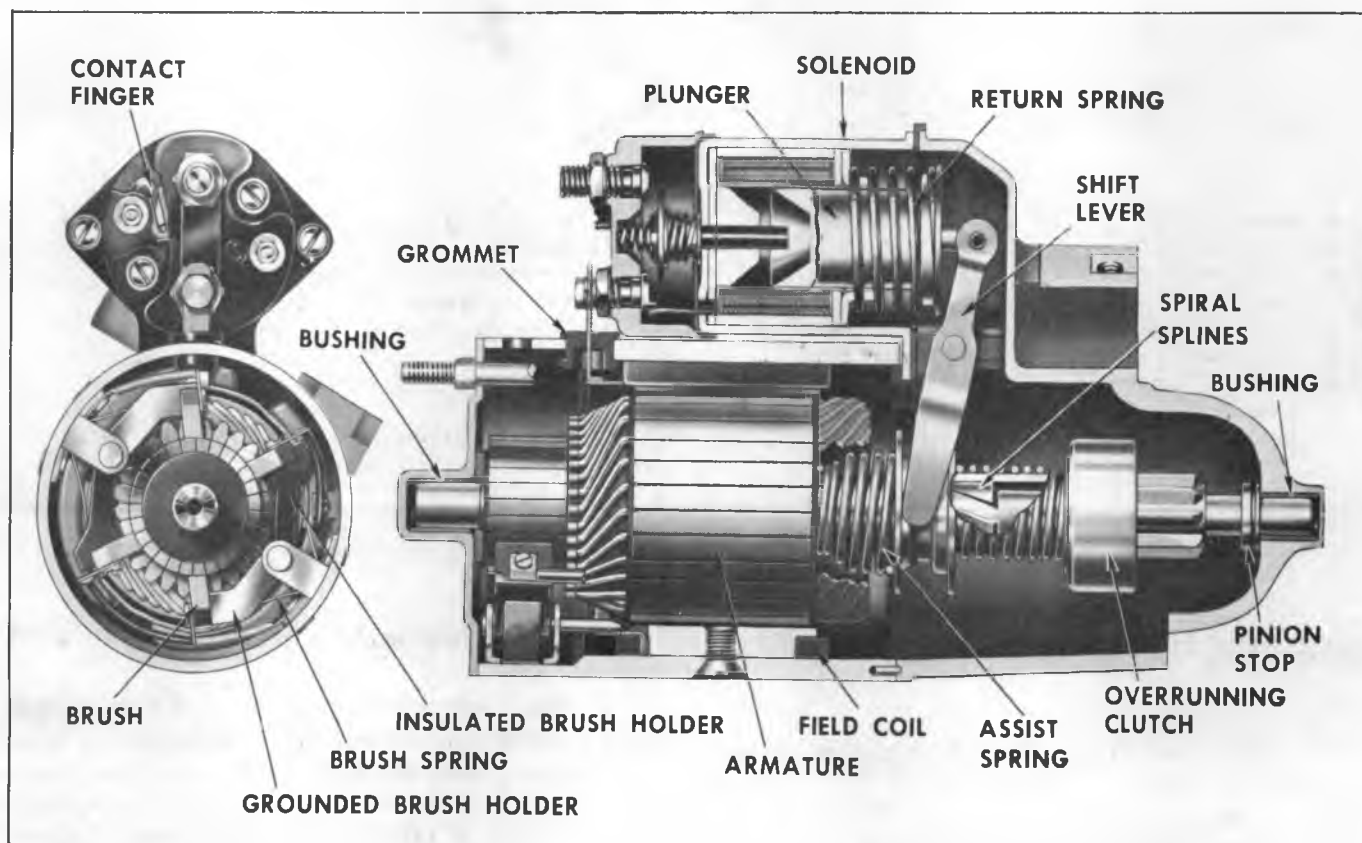


Fig. 1S-Starting Motor Cross Section

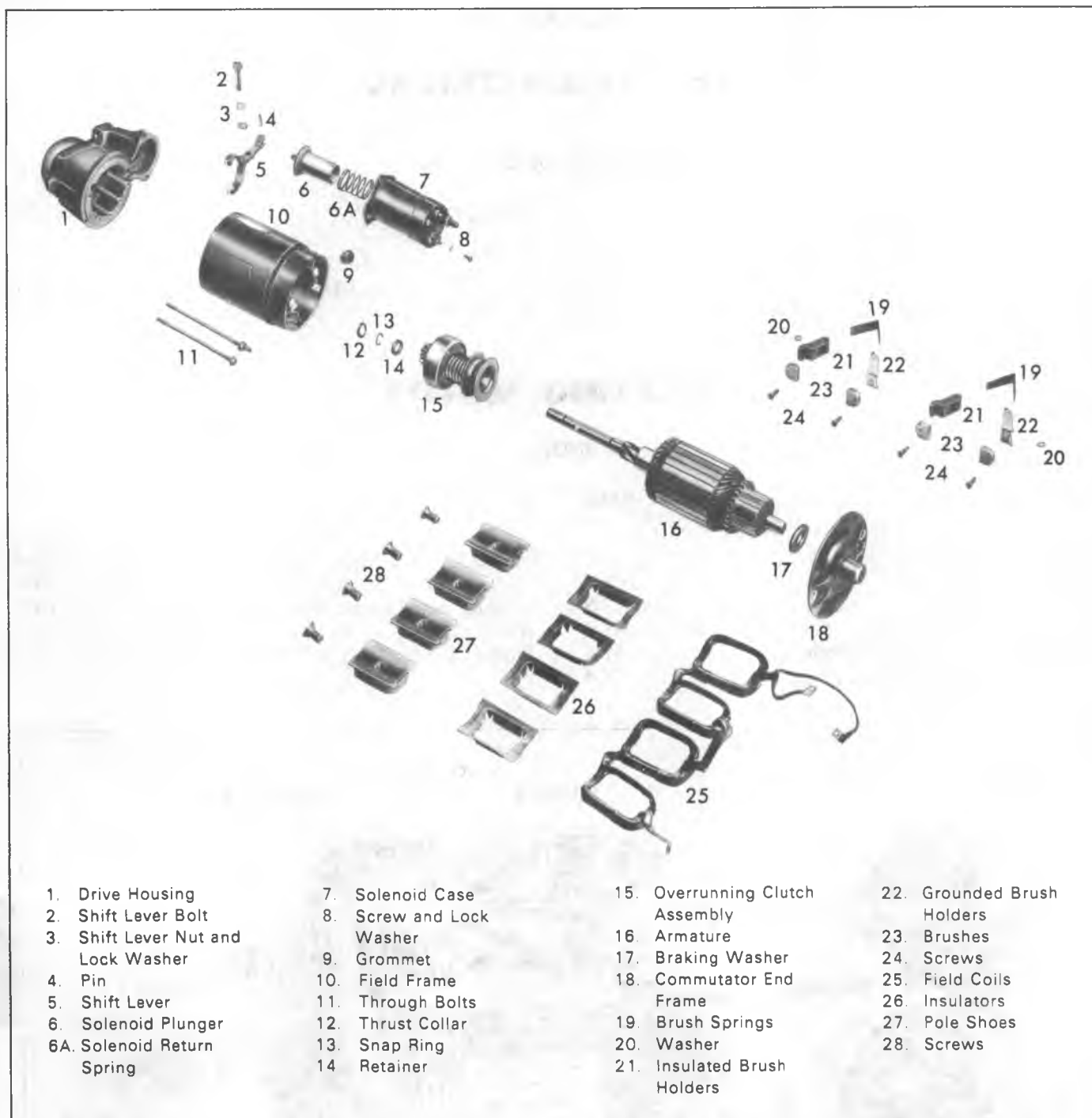


Fig. 2S--Starting Motor Parts Layout

**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:
  - 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.



Fig. 3S--Driving Retainer Off Snap Ring

- c. Remove snap ring from groove in shaft using pliers or other suitable tool. If the snap ring is too badly distorted during removal, it may be necessary to use a new one when reassembling clutch.
- d. Slide retainer and clutch from armature shaft.
5. Disassemble brush rigging from field frame.
  - a. Release "V" spring from slot in brush holder support.
  - b. Remove support pin.
  - c. Lift brush holders, brushes and spring upward as a unit.
  - d. Disconnect leads from each brush.
  - e. Repeat operation for other set of brushes.

## CLEANING AND INSPECTION

With the starting motor completely disassembled except for removal of field coils, the component parts should be cleaned and inspected as described below. Field coils need be removed only where defects in the coils are indicated by the tests described in this section, in which case the pole shoe screws should be removed and the pole shoes and field coils disassembled. Any defective parts should be replaced or repaired (see Repairs).

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.

**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.

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.
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.





Fig. 4S--Armature Short Circuit Test



Fig. 6S--Field Coil Open Circuit Test

### 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.

### 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.

### 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:

### Turning The Commutator

1. Turn down commutator in a lathe until it is thoroughly cleaned.

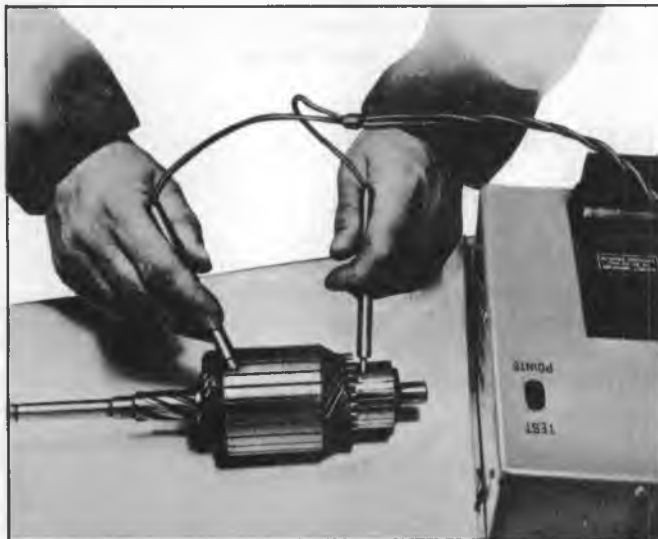


Fig. 5S--Armature Ground Test



Fig. 7S--Field Coil Ground Test

**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 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 which are attached with screws and nuts.

### 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

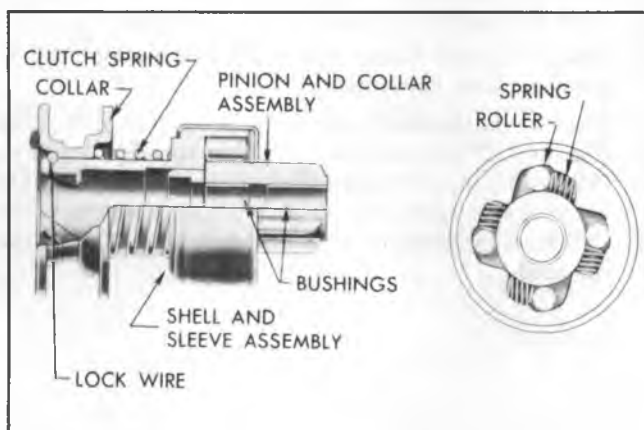


Fig. 8S--Roll Type Clutch Cross-Section

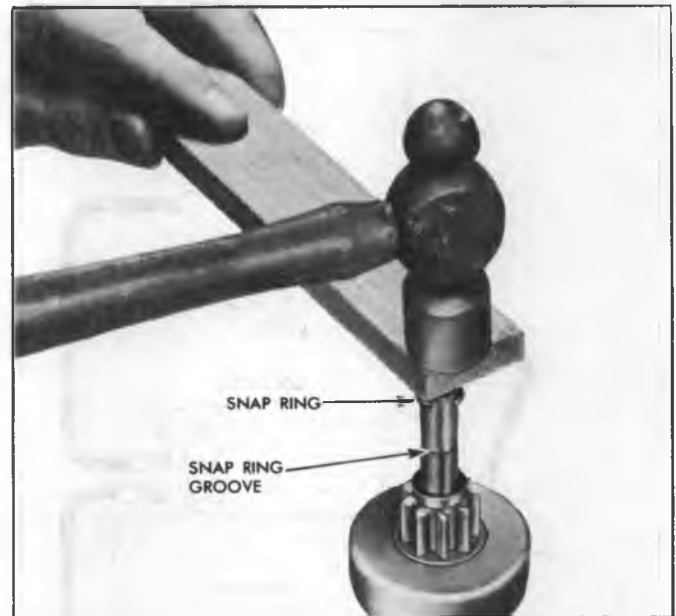


Fig. 9S--Forcing Snap Ring Over Shaft

the support pin. Push holders and spring to bottom of support and rotate spring to engage the "V" in slot in support.

- c. Attach ground wire to grounded brush and field lead wire to insulated brush.
- d. Repeat for other set of brushes.
2. Assemble overrunning clutch assembly to armature shaft.
  - a. Lubricate drive end of armature shaft with silicone lubricant.
  - b. Slide clutch assembly onto armature shaft with pinion outward.

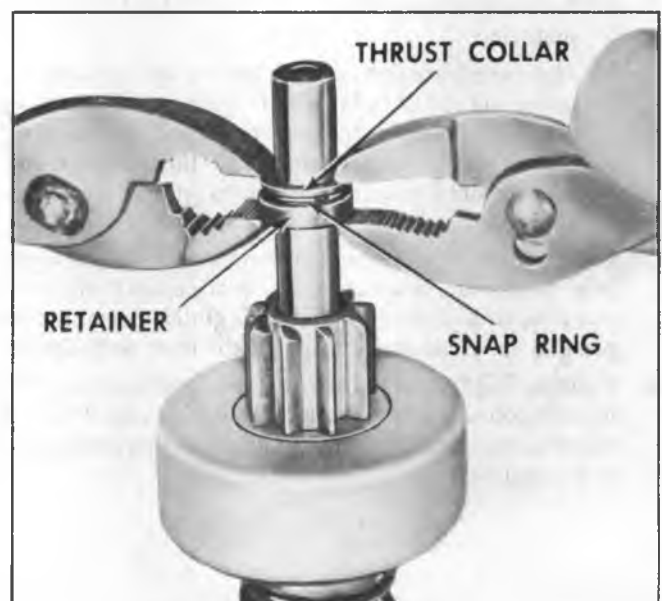


Fig. 10S--Forcing Snap Ring Into Retainer

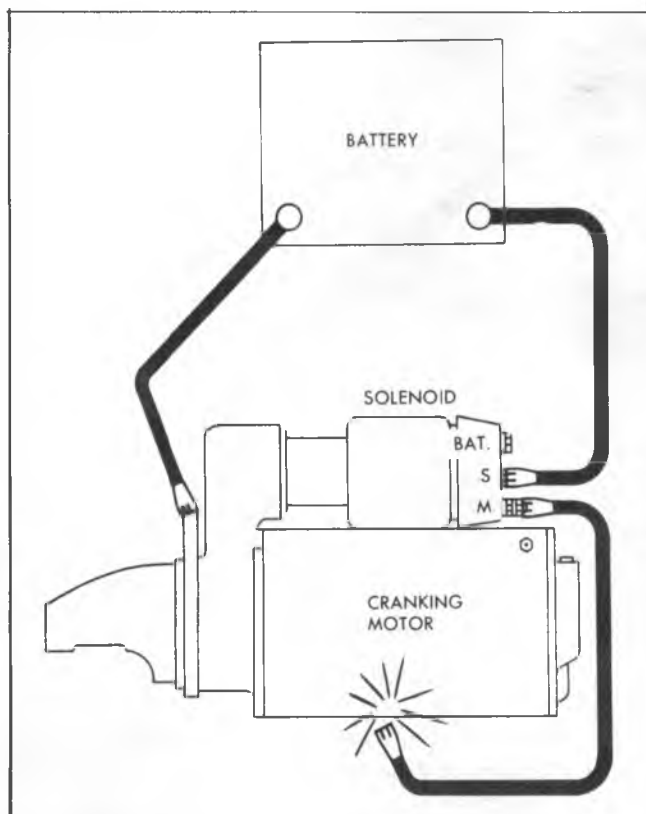


Fig. 11S--Circuit for Checking Pinion Clearance

- 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.

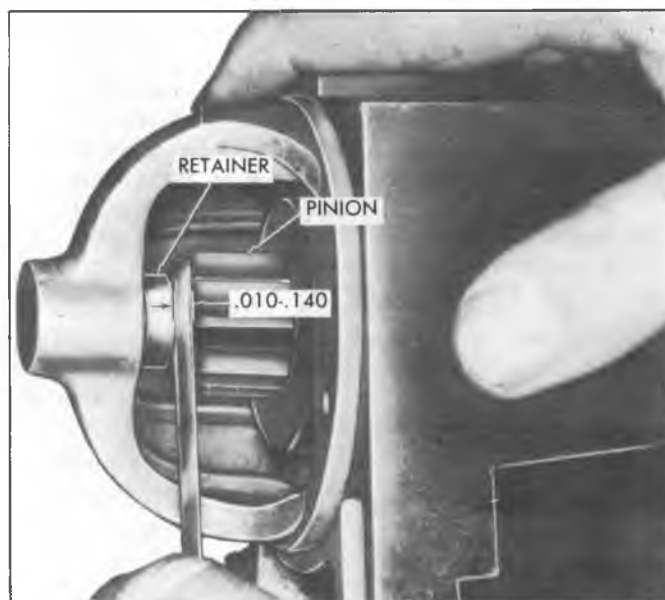


Fig. 12S--Checking Pinion Clearance

5. Lubricate the bushing in the commutator end frame with a silicone lubricant. Place leather brake washer on armature shaft and slide commutator end frame onto shaft.
6. Reconnect the field coil connectors to the "motor" solenoid terminal.
7. After overhaul is completed, perform "Pinion Clearance Check".

## 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.

# STARTING SOLENOID

## INDEX

SUBJECT	PAGE	SUBJECT	PAGE
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Replacement of Contacts .....	6Y-7		

### 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.
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.

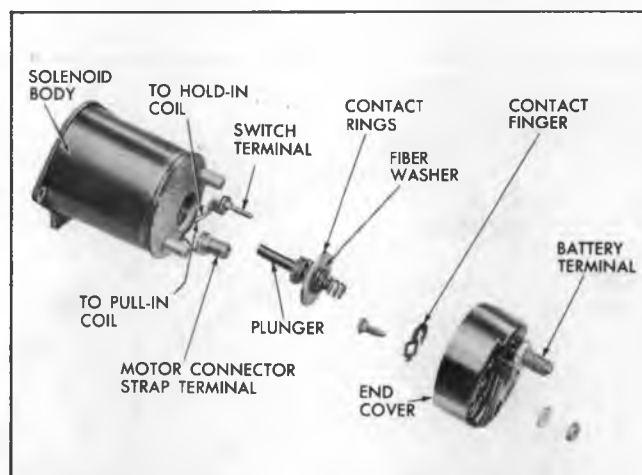


Fig. 13S--Exploded View of Solenoid

# 10-SI SERIES TYPE 100 DELCOTRON

## INDEX

SUBJECT	PAGE	SUBJECT	PAGE
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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 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.

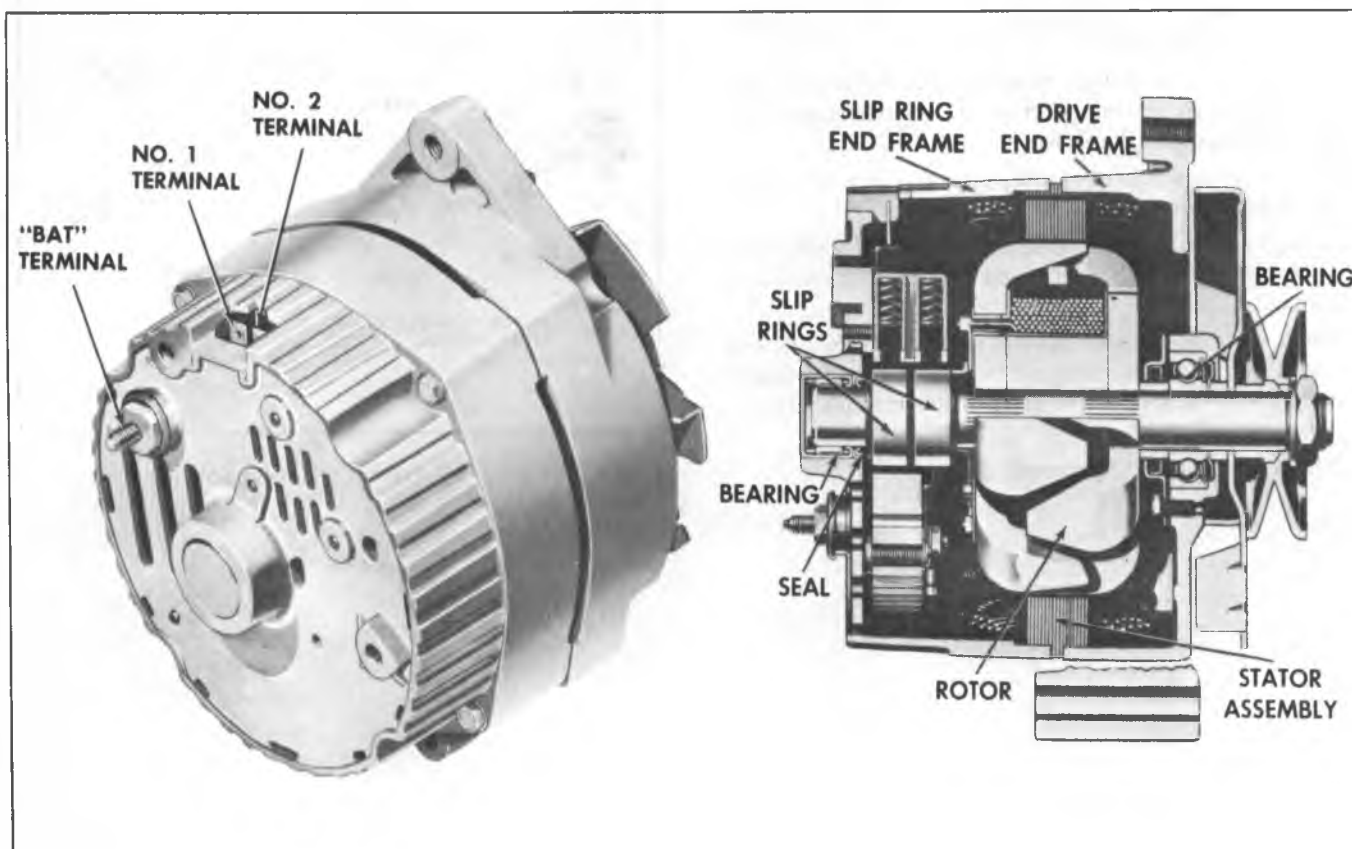


Fig. 1C--10-SI Series Delcotron

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.

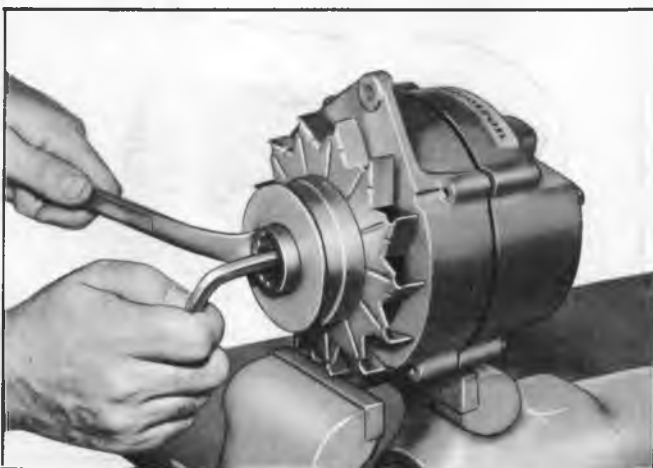


Fig. 2C-Removing Pulley

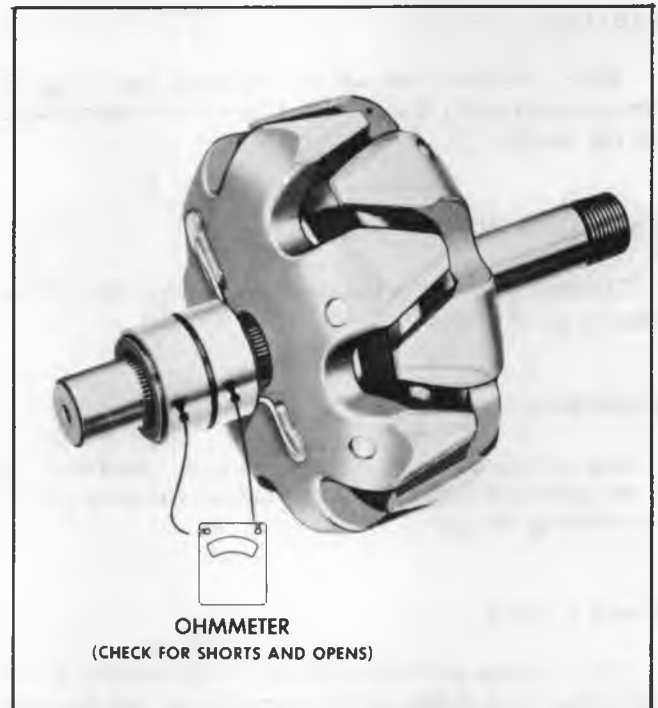


Fig. 3C--Checking Rotor

11. Remove rotor and spacers from the drive end frame assembly.
12. Remove drive end frame bearing retainer plate screws, plate, gasket, bearing, and slinger from end frame (if necessary).

## CLEANING AND INSPECTION

With generator completely disassembled the components should be cleaned and inspected. Be sure testing equipment is in good working order before attempting to check the generator.

1. Wash all metal parts except stator and rotor assemblies.
2. Clean bearings and inspect for sealing, pitting or roughness.
3. Inspect rotor slip rings, they may be cleaned with 400 grain polishing cloth. Rotate rotor for this operation to prevent creating flat spots on slip rings.
4. Slip rings which are out of round may be trued in a lathe to .001" 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 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

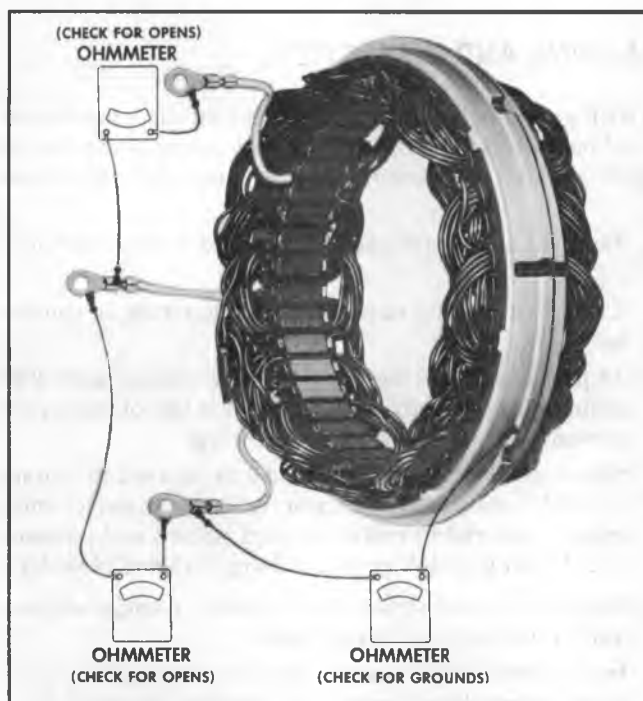


Fig. 4C—Checking Stator

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 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.

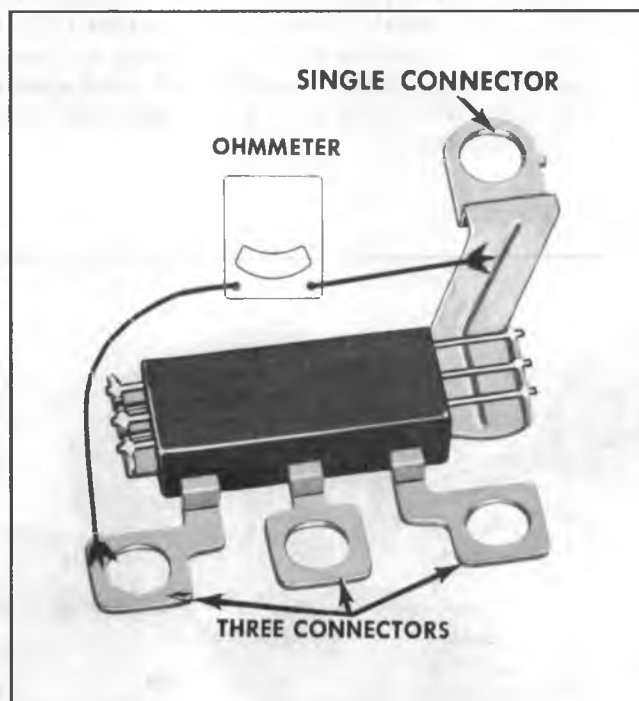


Fig. 5C—Diode Trio Checks

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 to check the diode trio, such as 110 volt test lamp.

### 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 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.

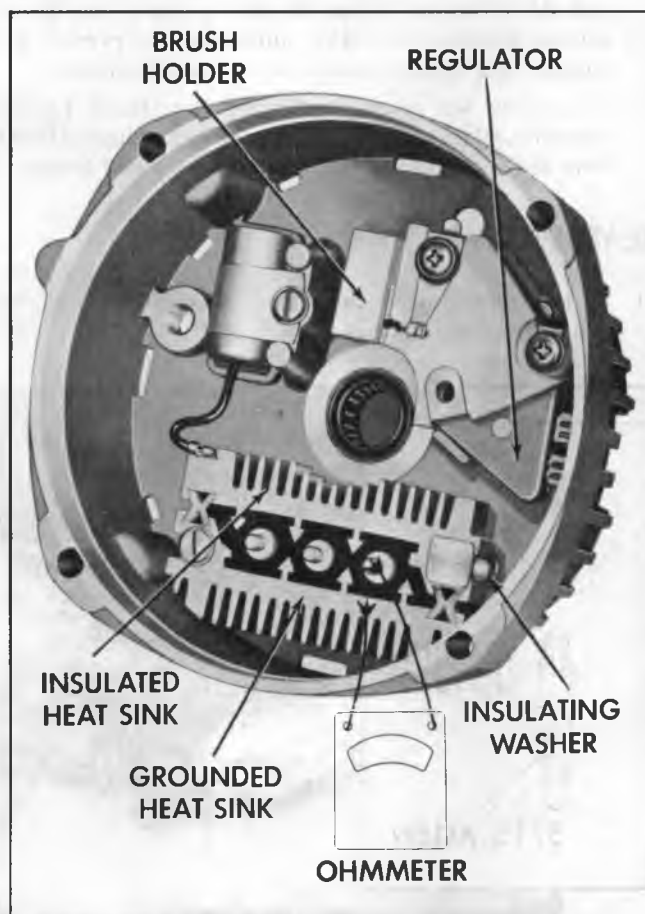


Fig. 6C--Rectifier Bridge Checks

**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.

## 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.

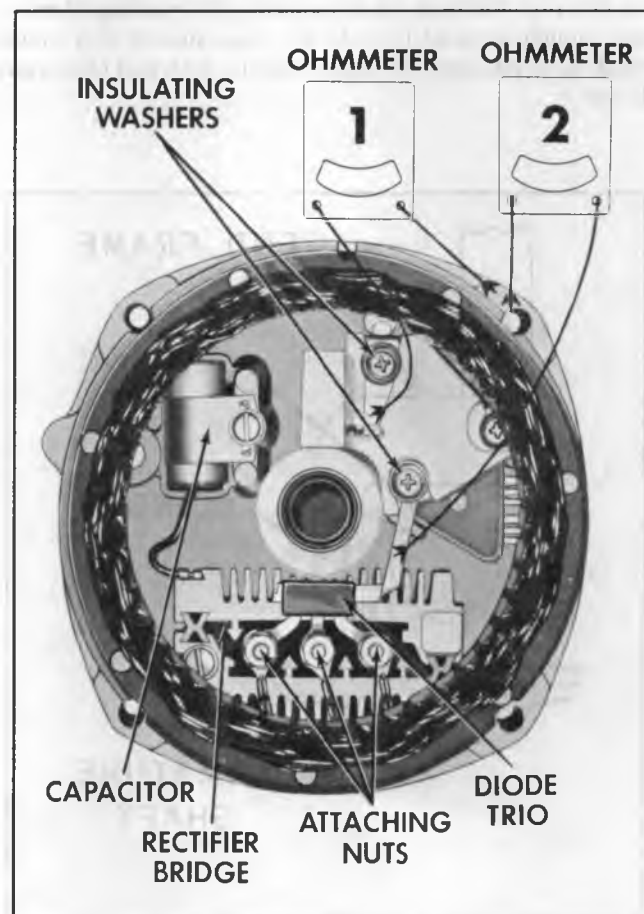


Fig. 7C--Brush Lead Clip Checks

**NOTE:** The two screws retaining the brush clips have insulating washers over the tops of the brush clips and special insulating sleeves over the screw body above the threads. If they are damaged or missing a ground will result causing uncontrolled or no output.

3. Replace defective unit and reassemble using reverse of removal procedures.

**NOTE:** The screw nearest regulator terminals does not have an insulating washer, but may or may not have an insulating sleeve.

## Slip Ring Servicing

If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the rotor, and hold the polishing cloth against the slip rings until they are clean.

**CAUTION:** The rotor must be rotated in order that the slip rings will be cleaned evenly. Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

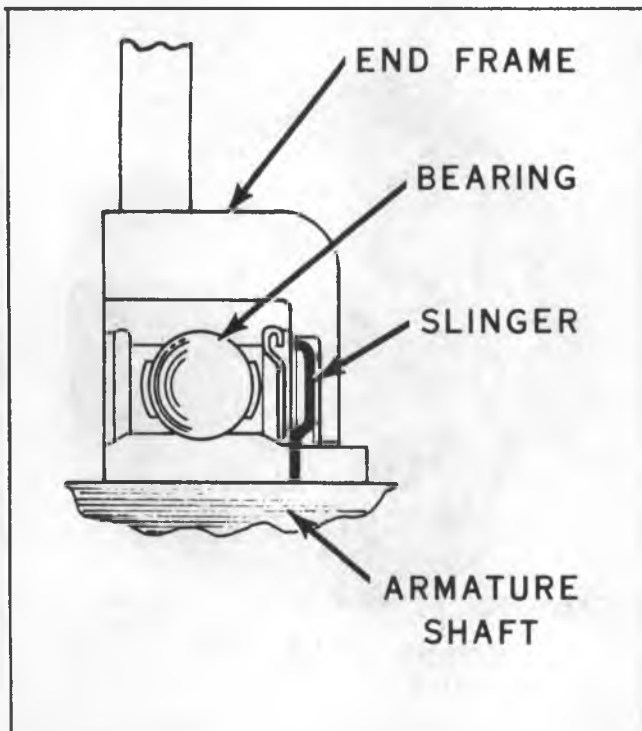


Fig. 8C--Drive End Bearing Cross Section

## Drive End Frame--Bearing Replacement/Lubrication

1. The drive end frame bearing can be removed by detaching the retainer plate bolts and separating retainer plate and seal assembly from end frame, and then pressing bearing out using suitable tube or pipe on outer race.
2. Refill bearing one-quarter full with Delco-Remy No. 1948791 grease or equivalent. Do not overfill.
3. Press bearing into end frame using tube or pipe as in Step 1 with bearing and slinger assembled as shown in Figure 8C.
4. Install retainer plate. Use new retainer plate if felt seal is hardened or excessively worn.

**NOTE:** Stake retainer plate bolts to plate.

## Slip Ring End Frame--Bearing Replacement

1. Replace the bearing if the grease supply is exhausted. Make no attempt to re-lubricate and reuse the bearing.
2. Press out from outside of housing, using suitable tool over outer race of bearing.
3. To install, place a flat plate over the bearing and press in from outside of housing until bearing is flush with the outside of the end frame. Support inside of end frame around bearing bore with a suitable tool to prevent distortion. Use extreme care to avoid misalignment.
4. Install new seal whenever bearing is replaced. Lightly coat the seal lip with oil and press seal into the end frame with the seal lip toward the inside of the end frame.

## REASSEMBLY

1. Install rotor in drive end frame and attach spacer, fan, pulley, washer, and nut.

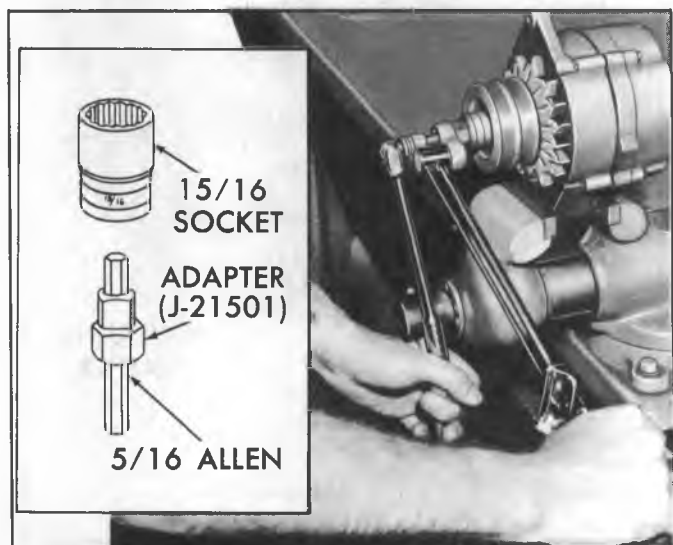


Fig. 9C--Installing Pulley Nut

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 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.

## 10-DN SERIES 100B TYPE DELCOTRON

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### DISASSEMBLY (fig. 10C)

1. Hold generator in a vise, clamping the mounting flange lengthwise.
2. Remove the four thru-bolts and separate the slip ring end frame and stator assembly from the drive end and rotor assembly by prying apart with a screwdriver at the stator slot.

**NOTE:** A scribe mark will help locate the parts in the same position during assembly.

3. Place a piece of tape over the slip ring end frame bearing to prevent entry of dirt and other foreign material, and also a piece of tape over the shaft at the slip ring end.

**CAUTION:** Brushes may drop into 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 nut attaching terminal to rectifier bridge (fig. 13C).
6. Remove three retaining screws and remove brush holder and terminal assemblies.

**NOTE:** Observe that only one of the three brush holder retaining screws is insulated (Fig. 13C).

7. Remove the rectifier bridge attaching screw; "bat" terminal nut and the capacitor lead screw. Remove rectifier bridge from end frame.
8. Remove retaining screw and capacitor from end of frame (Fig. 13C).
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

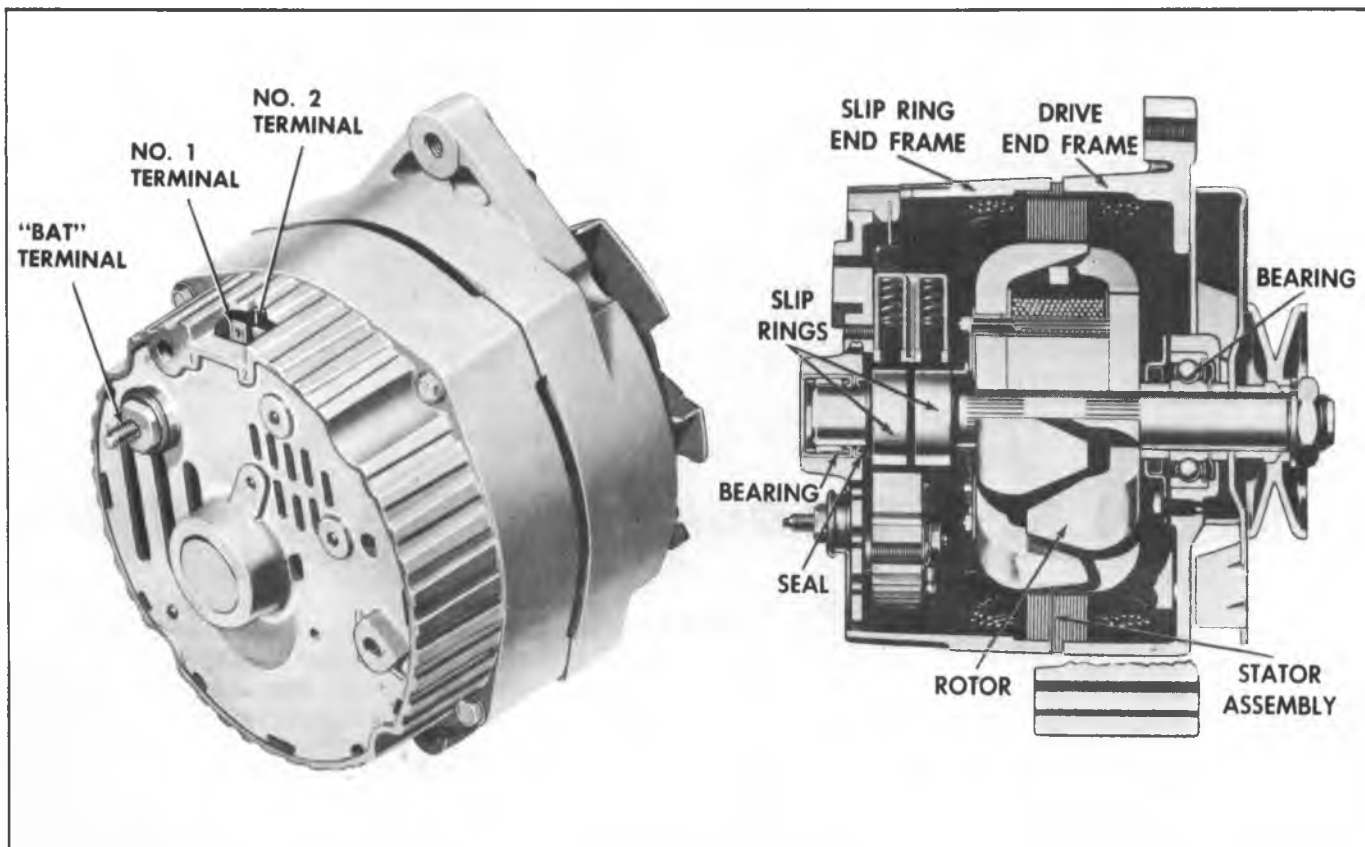


Fig 10C-10-DN Series Delcotron

- 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, bearing, and slinger from end frame (if necessary).

## CLEANING AND INSPECTION

With generator completely disassembled in 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 .001" 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 reading.

### Rotor Field Winding Checks (fig. 11C)

The rotor may be checked electrically with a 110-volt test lamp or an ohmmeter.

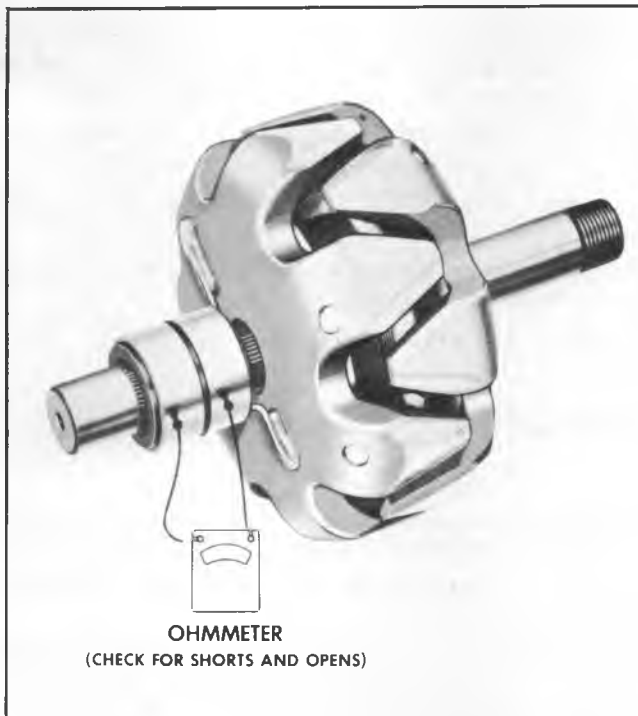


Fig. 11C-Checking Rotor

### Open Circuit

Connect one test lamp or ohmmeter lead to each slip ring. If the lamp fails to light or if the ohmmeter reading is high, the windings are open.

### 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. 12C)

#### 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.

### Rectifier Bridge Check (fig. 13C)

**CAUTION:** Do not use high voltage to check the rectifier bridge, such as a 110-volt test lamp.

Connect an ohmmeter to the grounded heat sink and one of the three terminals. Then reverse the lead connections to the grounded heat sink and same terminal. If both readings are the same, replace the bridge. A good rectifier bridge will give one high and one low reading. Repeat this same test between the grounded heat sink and the other two terminals, and between the insulated heat sink and each of the three terminals. When this is done all six diodes are checked with two readings taken for each diode.

**NOTE:** The diodes are not replaced individually. The entire rectifier bridge is replaced if one or more diodes are defective..

## REPAIRS

### Brush Holder Replacement (fig. 13C)

1. If not previously removed, remove the three stator lead attaching nuts and the stator, from the end frame.

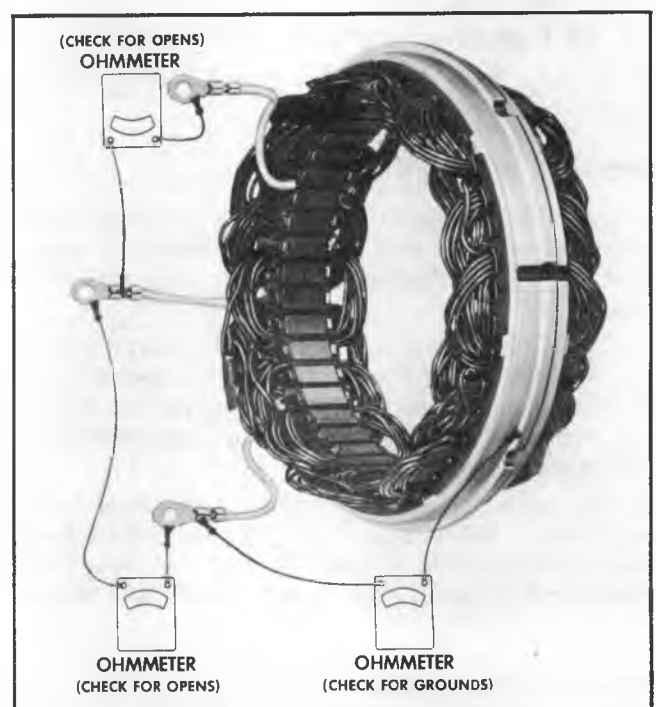


Fig. 12C-Checking stator



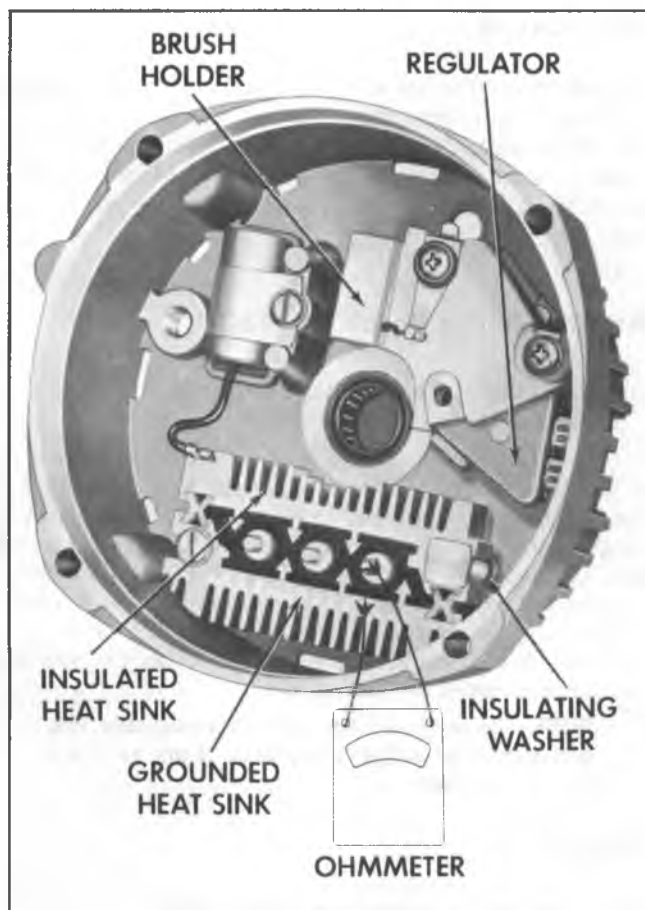


Fig. 13C-Rectifier Bridge Checks

2. Remove the attaching screws and the brush holder from the end frame.

**NOTE:** Observe that only one screw is insulated.

3. Replace defective unit and reassemble using reverse of removal procedures.

### 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 detach-

ing 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.
4. Install retainer plate. Use new retainer plate if felt seal is hardened or excessively worn.

**NOTE:** Stake retainer plate bolts to plate.

### Slip Ring End Frame Bearing Replacement

1. Replace the bearing if the grease supply is exhausted. Make no attempt to re-lubricate and reuse the bearing.
2. Press out from outside of housing, using suitable tool over outer race of bearing.
3. To install, place a flat plate over the bearing and press in from outside of housing until bearing is flush with the outside of the end frame. Support inside of end frame around bearing bore with a suitable tool to prevent distortion. Use extreme care to avoid misalignment.
4. Install new seal whenever bearing is replaced. Lightly coat the seal lip with oil and press seal into the end frame with the seal lip toward the inside of the end frame.

### REASSEMBLY

1. Install rotor in drive end frame and attach spacer, fan, pulley, washer, and nut.
2. Using adapter J-21501, insert an allen wrench into hex shaped hole at end of shaft and torque the shaft nut to 40-50 ft. lbs. (fig. 9C).
3. Install capacitor and retaining screw in slip ring end frame.
4. Position rectifier bridge to end frame. Install attaching screw and the "BAT" terminal screw. Connect capacitor lead to bridge.
5. Position terminal and brush holder assemblies in end frame and install retaining screws.
6. Install nut attaching terminal clip to rectifier bridge.
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



J-21501  
PULLY  
ADAPTER

Fig. 14C - Special Tool

## SECTION 7

# CLUTCHES AND TRANSMISSIONS

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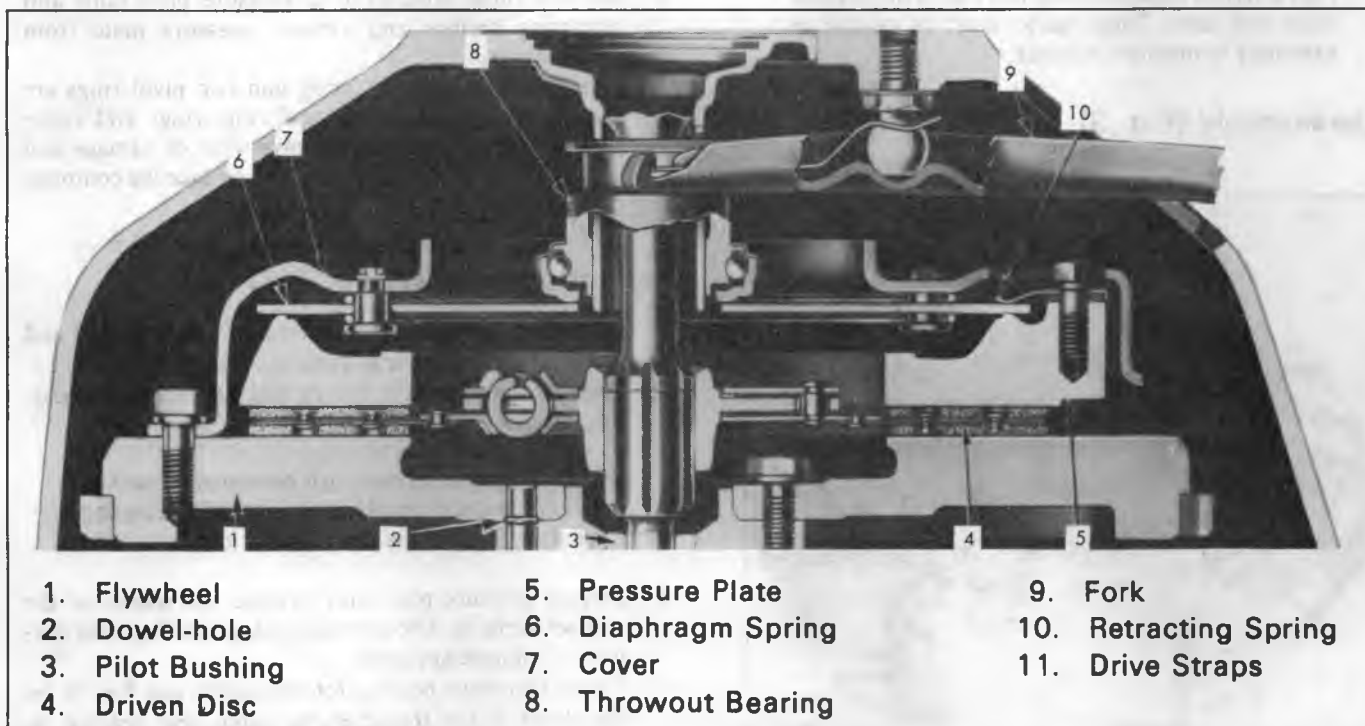


Fig. 1—Flat Finger Clutch Cross-Section (Typical)

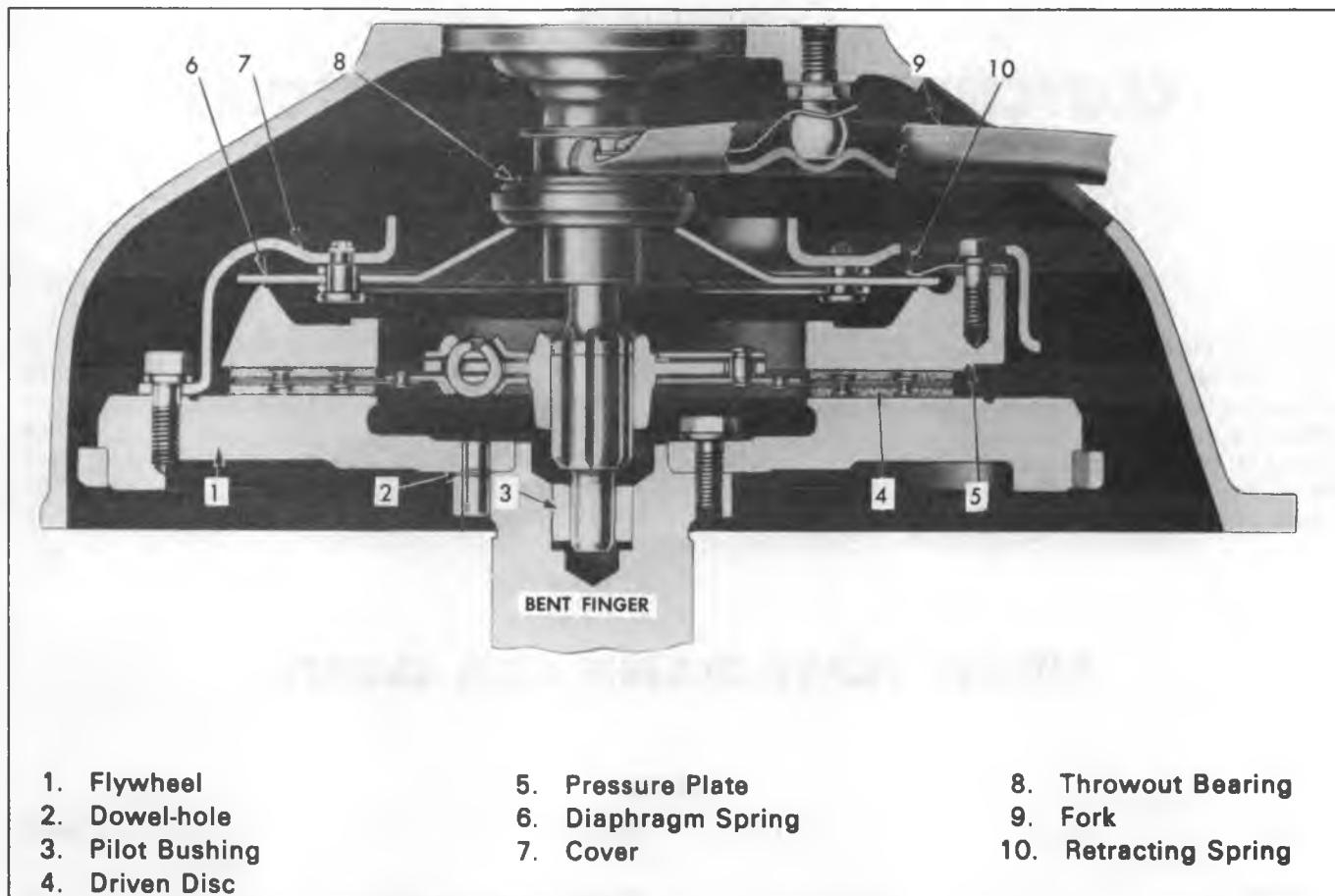


Fig. 2--Bent Finger Clutch Cross-Section (Typical)

**NOTE:** When disassembling, mark edge of pressure plate and cover. These marks must be aligned in assembly to maintain balance.

### Disassembly (Fig. 3)



Fig. 3--Retracting Spring Location (Typical)

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 and Repair

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.

**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.

### Pilot Bearing Replacement

The clutch pilot bearing is an oil impregnated type bearing pressed into the crankshaft. This bearing requires attention

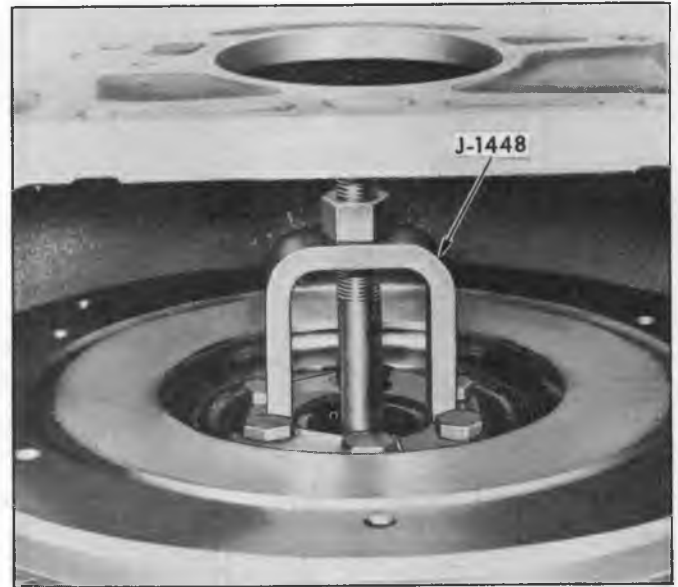


Fig. 4—Clutch Pilot Bearing Removal (Typical)

tion 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.

## DUAL PLATE DIAPHRAGM SPRING CLUTCH

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### Disassembly (Fig. 5)

**CAUTION:** Assembly should be handled with pressure plate face up to prevent movement of the plate and distortion of the retracting spring.

1. With assembly resting on flywheel side of cover, remove drive strap-to-front pressure plate bolts and washers. Care should be taken to support the front pressure plate to prevent bending of the drive straps.

**NOTE:** Before disassembling, note location of "O" marks on edge of intermediate pressure plates and cover stamping. These parts must be aligned in reassembly to maintain the balance of the assembly. Scribe alignment marks, if "O" marks cannot be located.

2. Remove front pressure plate and rear driven disc from the cover assembly.
3. The rear pressure plate, clutch diaphragm spring, and pivot rings are riveted to the clutch cover. These items and the front pressure plate should be inspected for wear or damage and if there is any defect, it is necessary to replace the complete cover and pressure plates assembly.

### Inspection and Repair

Refer to inspection and repair procedures covered under single plate clutch assemblies.

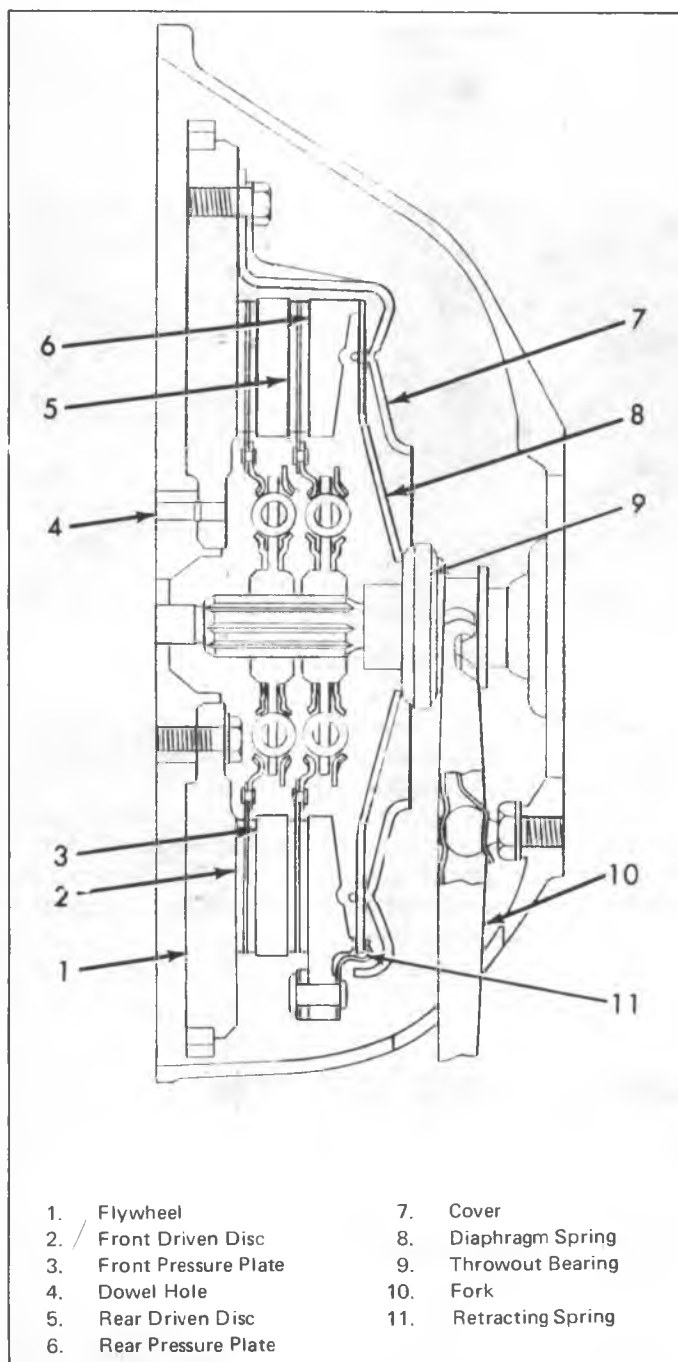


Fig. 5—Dual Plate Clutch Assembly

## Assembly

1. Install clutch disc and front pressure plate in the cover assembly, aligning the reference "0" mark on the edge of the pressure plate with the "0" mark on the edge of the cover.
2. Install lock washers and bolts retaining front pressure plate to the cover. Torque bolts to 18 ft. lbs.

## SINGLE PLATE COIL SPRING CLUTCH

### INDEX

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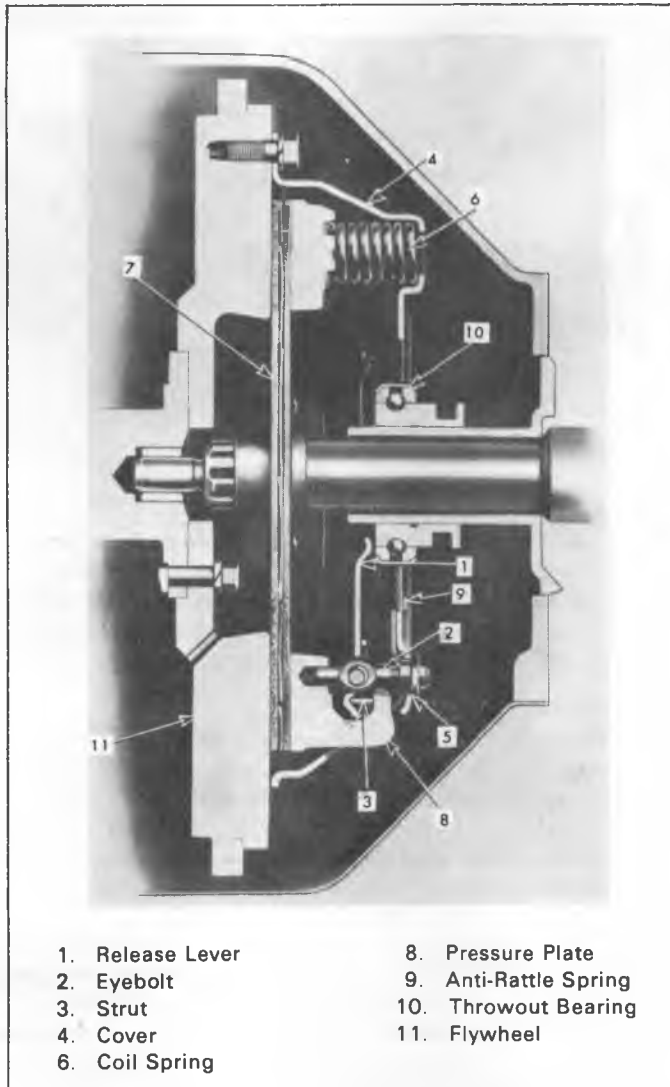


Fig. 1E-Coil Spring Clutch Cross-Section (Single Plate)



Fig. 2E-Compressing Clutch



Fig. 3E-Disassembly of Clutch

## 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 as shown in Figure 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.



Fig. 4E-Removing Levers (Step 1)



Fig. 5E-Removing Levers (Step 2)

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.

### 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 as shown in Figure 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.
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.



Fig. 6E-Greasing Lug

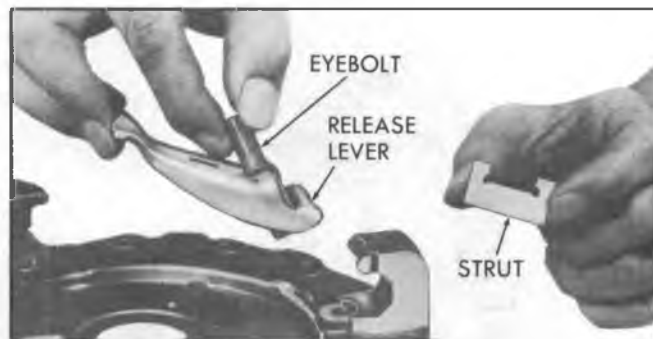


Fig. 7E-Installing Lever

**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 very important that each group be arranged in like sequence.

7. Assemble anti-rattle springs in cover as shown in Figure 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.
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.

### 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:

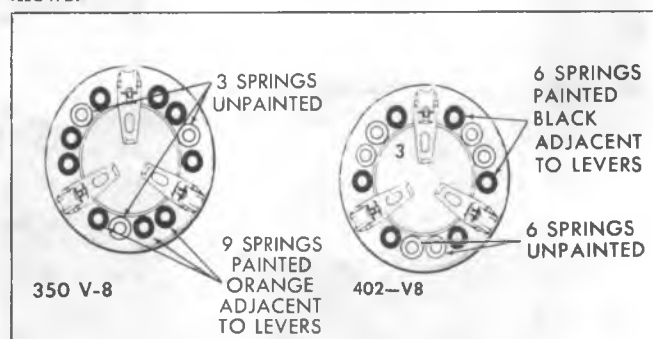


Fig. 8E-Spring Arrangement Diagram

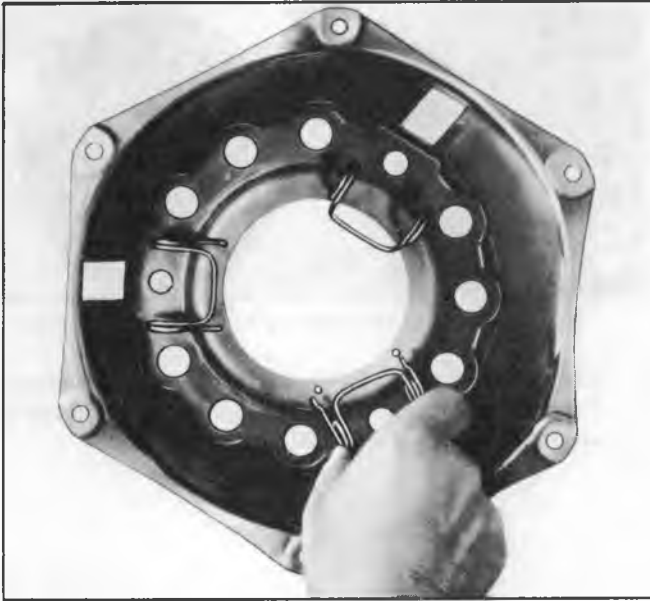


Fig. 9E—Installing Anti-Rattle Spring

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.

**NOTE:** On assemblies with three levers, the three flat machined lands of the gauge plate must be located directly under the levers.



Fig. 10E—Assembling Cover and Pressure Plate



Fig. 11E—Gauge Plate Position

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.



Fig. 12E—Depressing Lever

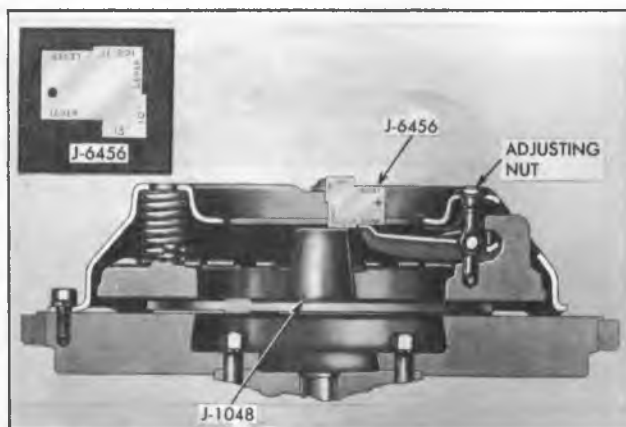


Fig. 13E-Coil Spring Clutch Adjustment



Fig. 14E-Staking Nut

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.

## 3-SPEED SAGINAW TRANSMISSION

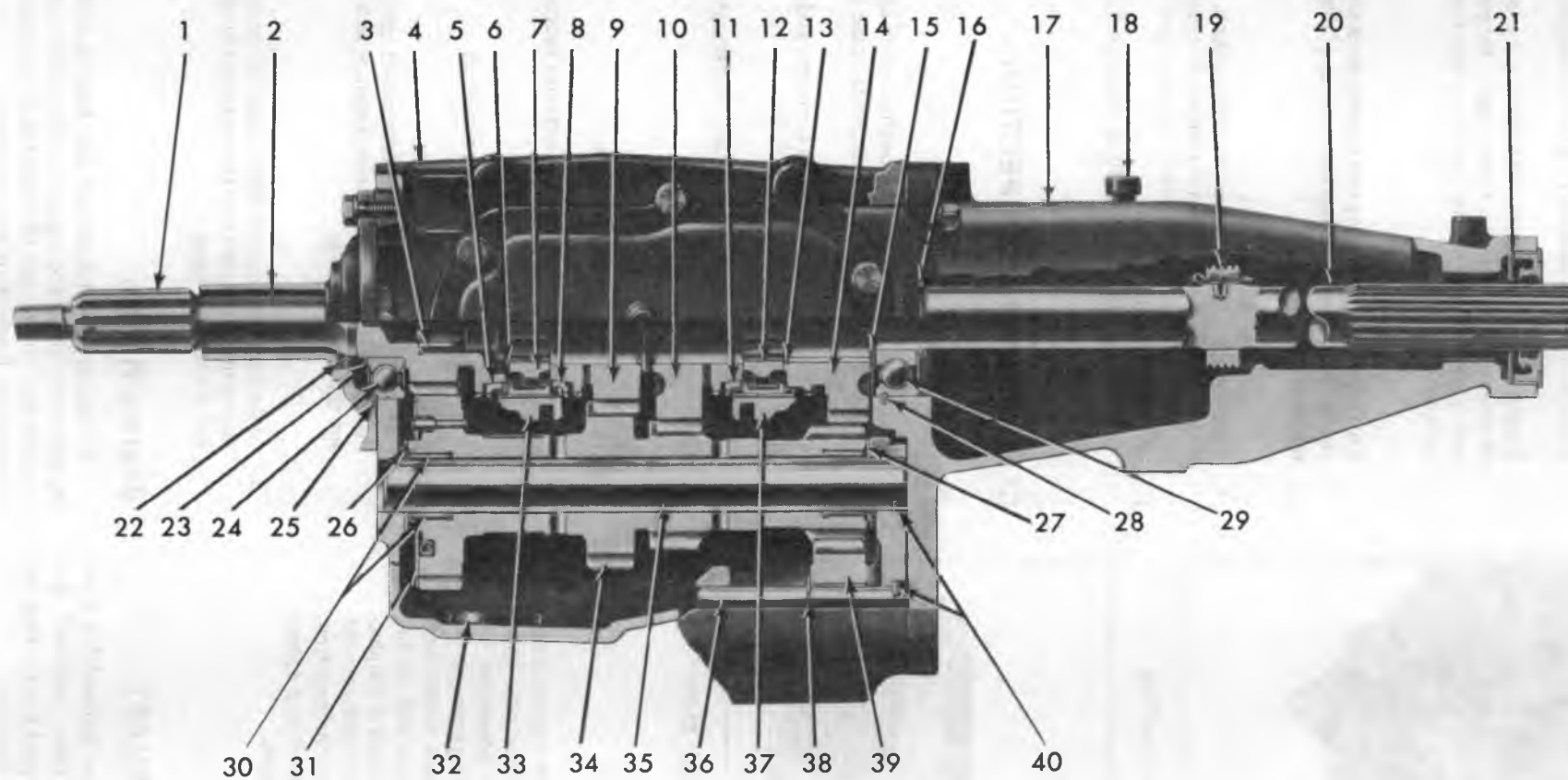
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### DISASSEMBLY OF TRANSMISSION

1. Remove side cover attaching screws and remove side cover assembly and shift forks.
2. Remove clutch gear bearing retainer.
3. Remove clutch gear bearing to gear stem snap ring, then remove clutch gear bearing by pulling outward on clutch gear until a screw driver or other suitable tool can be inserted between bearing large snap ring and case to complete removal. The clutch gear bearing is a slip fit on the gear and into the case bore. (This provides clearance for removal of clutch gear and mainshaft assembly.)
4. Remove extension to case attaching bolts.
5. Remove the reverse idler shaft "E" ring.

6. Remove clutch gear, mainshaft and extension assembly together through the rear case opening. Remove clutch drive gear, needle bearings and synchronizer ring from mainshaft assembly.
7. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (fig. 2A) and remove the extension.
8. 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 bearings.
9. 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).



- |                           |  |                                     |                                    |                              |
|---------------------------|--|-------------------------------------|------------------------------------|------------------------------|
| 1. Clutch Gear            | 10. 1st Speed Gear                         | 16. Snap Ring-Bearing to Mainshaft  | 24. Clutch 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 (Pass. Car)



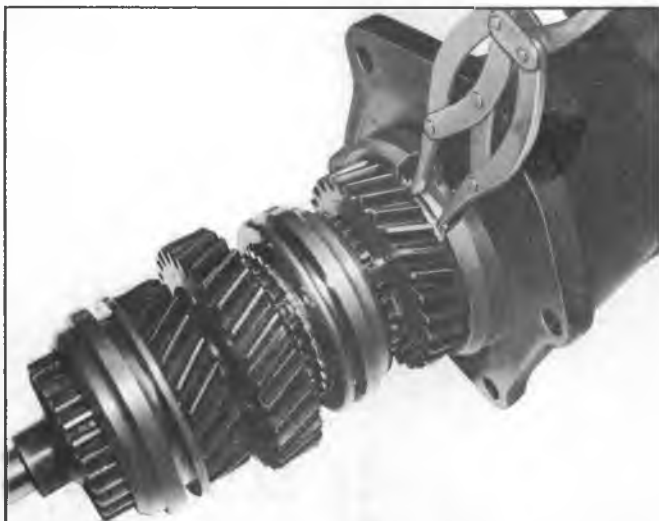


Fig. 2A—Extension to Rear Bearing Snap Ring



Fig. 3A—Removing Reverse Idler Shaft

**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.

**CAUTION:** When pressing rear bearing be careful to center gear, washers, bearings and snap ring on 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.

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.

### 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.

## Reverse Idler Gear Bushing

The bushing used in the idler gear is pressed into the gear and finished 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 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.

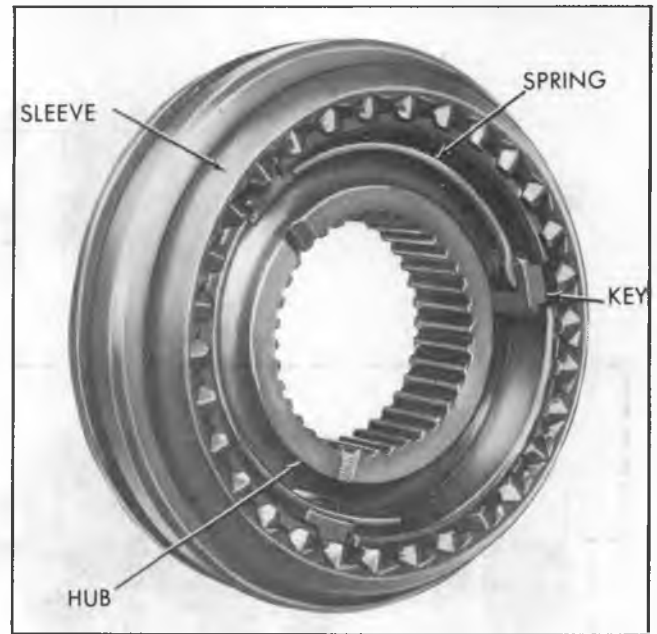


Fig. 4A-Synchronizer Assembly

### 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. 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).

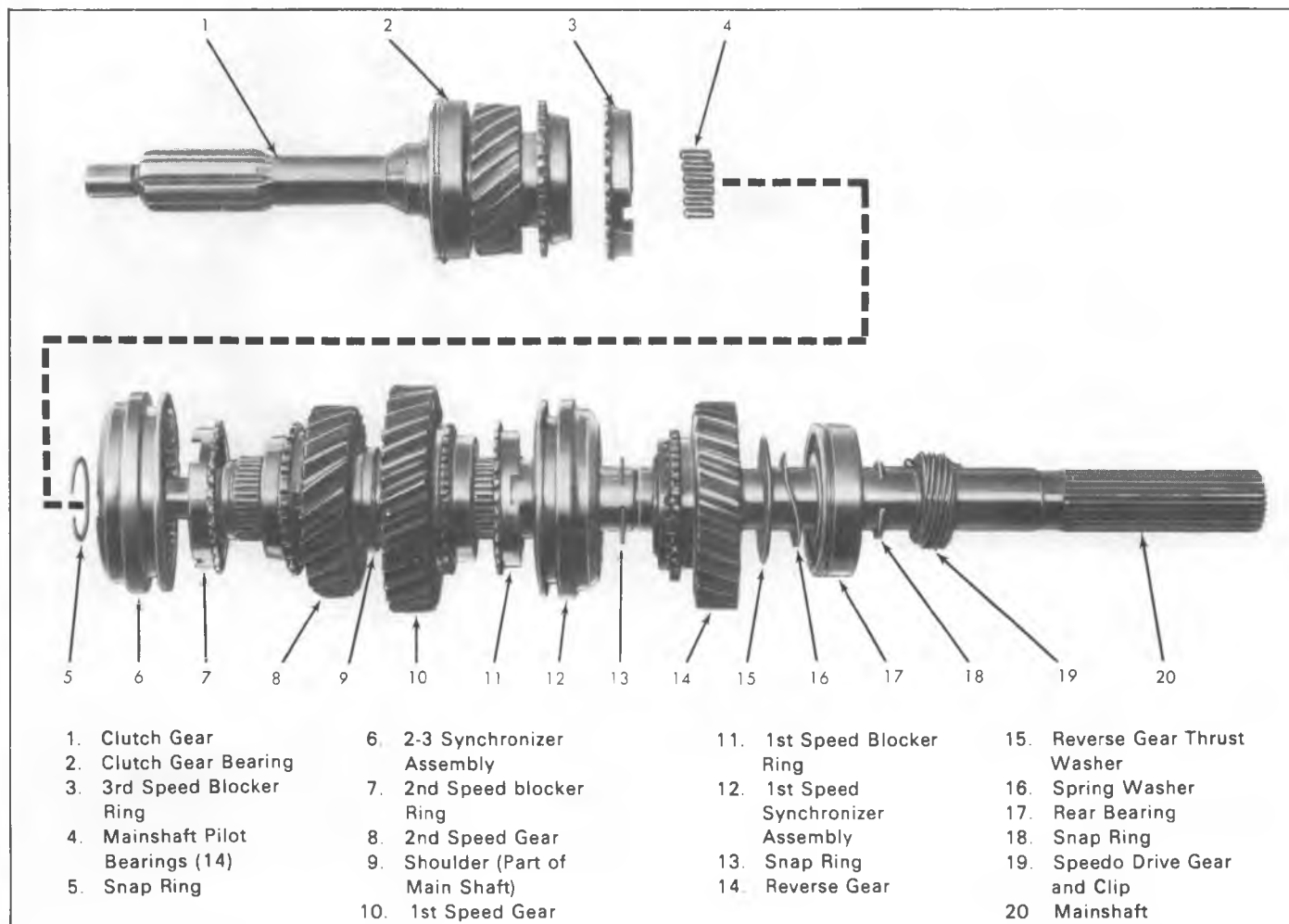


Fig. 5A-Clutch Gear and Mainshaft Assembly

**CAUTION:** Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.

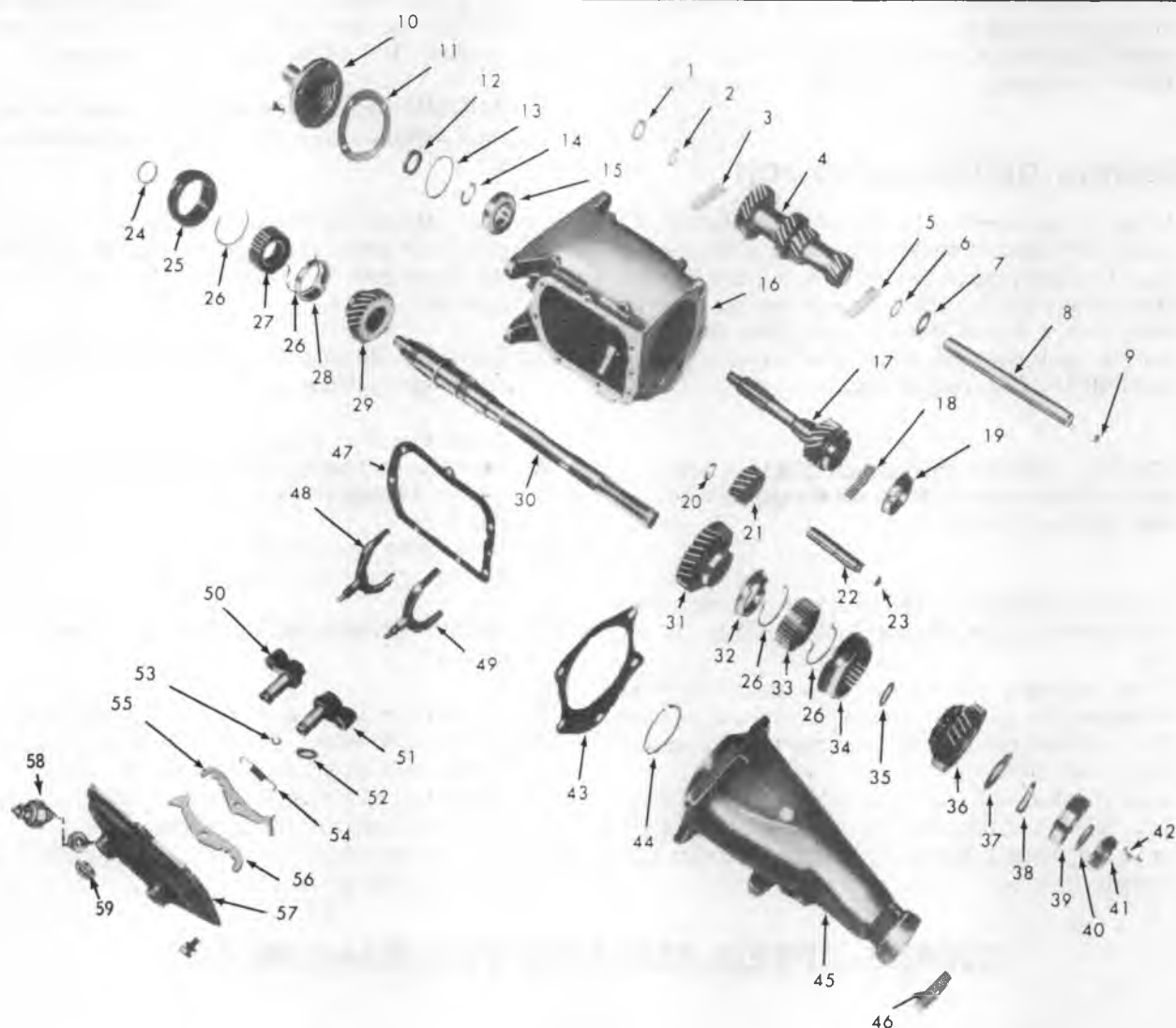
4. Install synchronizer hub to mainshaft snap ring. Both synchronizer snap rings are identical.
- Turn the rear of the mainshaft upward. Install the following components on the mainshaft:
5. Install the first speed gear with clutching teeth upward; the front face of the gear will butt against the flange 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 with fork slot downward; press 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.



Fig. 6A-Loading Counter gear Bearings w/Tool J-22246



- |                                 |                                   |   |  |
|---------------------------------|-----------------------------------|---|--|
| 1. Thrust Washer - Front        | 19. 3rd Speed Blocker Ring        | 33. 1-2 Synchronizer Hub Assembly         | 47. Gasket                                 |
| 2. Bearing Washer               | 20. "E" Ring                      | 34. 1-2 Synchronizer Sleeve               | 48. 2-3 Shift Fork                         |
| 3. Needle Bearings              | 21. Reverse Idler Gear            | 35. Snap Ring - Hub to Shaft              | 49. 1st and Reverse Shift Fork             |
| 4. Countergear                  | 22. Reverse Idler Shaft           | 36. Reverse Gear                          | 50. 2-3 Shifter Shaft Assembly             |
| 5. Needle Bearings              | 23. Woodruff Key                  | 37. Thrust Washer                         | 51. 1st and Reverse Shifter Shaft Assembly |
| 6. Bearing Washer               | 24. Snap Ring - Hub to Shaft      | 38. Spring Washer                         | 52. "O" Ring Seal                          |
| 7. Thrust Washer - Rear         | 25. 2-3 Synchronizer Sleeve       | 39. Rear Bearing                          | 53. "E" Ring                               |
| 8. Counter Shaft                | 26. Synchronizer Key Spring       | 40. Snap Ring - Bearing to Shaft          | 54. Spring                                 |
| 9. Woodruff Key                 | 27. 2-3 Synchronizer Hub Assembly | 41. Speedometer Drive Gear                | 55. 2nd and 3rd Detent Cam                 |
| 10. Bearing Retainer            | 28. 2nd Speed Blocker Ring        | 42. Retaining Clip                        | 56. 1st and Reverse Detent Cam             |
| 11. Gasket                      | 29. 2nd Speed Gear                | 43. Gasket                                | 57. Side Cover                             |
| 12. Oil Seal                    | 30. Mainshaft                     | 44. Snap Ring - Rear Bearing to Extension | 58. TCS Switch and Gasket                  |
| 13. Snap Ring - Bearing to Case | 31. 1st Speed Gear                | 45. Extension                             | 59. Lip Seal                               |
| 14. Snap Ring - Bearing to Gear | 32. 1st Speed Blocker Ring        | 46. Oil Seal                              |  |

Fig. 7A-3-Speed Transmission Explode

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 counter-gear. 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).
5. Load the mainshaft pilot bearings (14) into the clutch gear cavity and assemble the 3rd speed blocker ring onto the clutch gear clutching surface with its teeth toward the gear.

6. Pilot the clutch 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 clutch gear, mainshaft and extension to case as an assembly.

**CAUTION:** Be sure the clutch 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 clutch gear and into front case bore.
10. 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.

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 clutch gear shaft and shift transmission to free rotation in all gears.

## 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 clutch gear bearing retainer bolts, retainer and gasket.

3. Remove clutch gear bearing to gear stem snap ring, then remove clutch gear bearing by pulling outward on clutch gear until a screw driver or other suitable tool can be inserted between bearing, large snap ring and case to complete removal. The clutch gear bearing is a slip fit on the gear and into the case bore. (This provides clearance for removal of clutch gear and mainshaft assembly.)

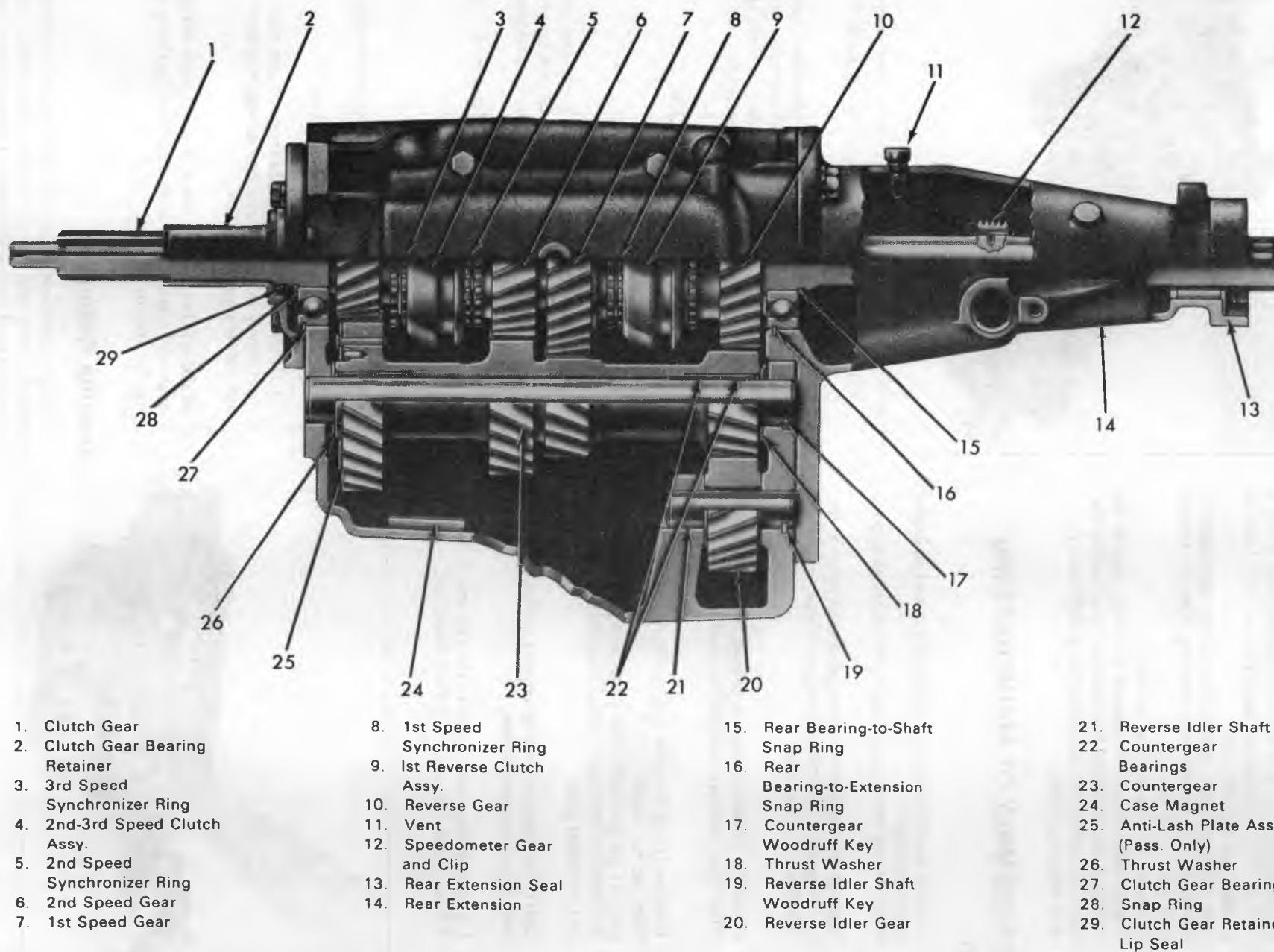


Fig. 1G--Transmission Cross Section

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 clutch gear, mainshaft and extension assembly together through case rear opening. Remove reverse idler gear from case.
7. Remove clutch gear from mainshaft.
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.

## 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.



Fig. 2G—Removing Reverse Idler Shaft



Fig. 3G—Removing Rear Extension 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 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.



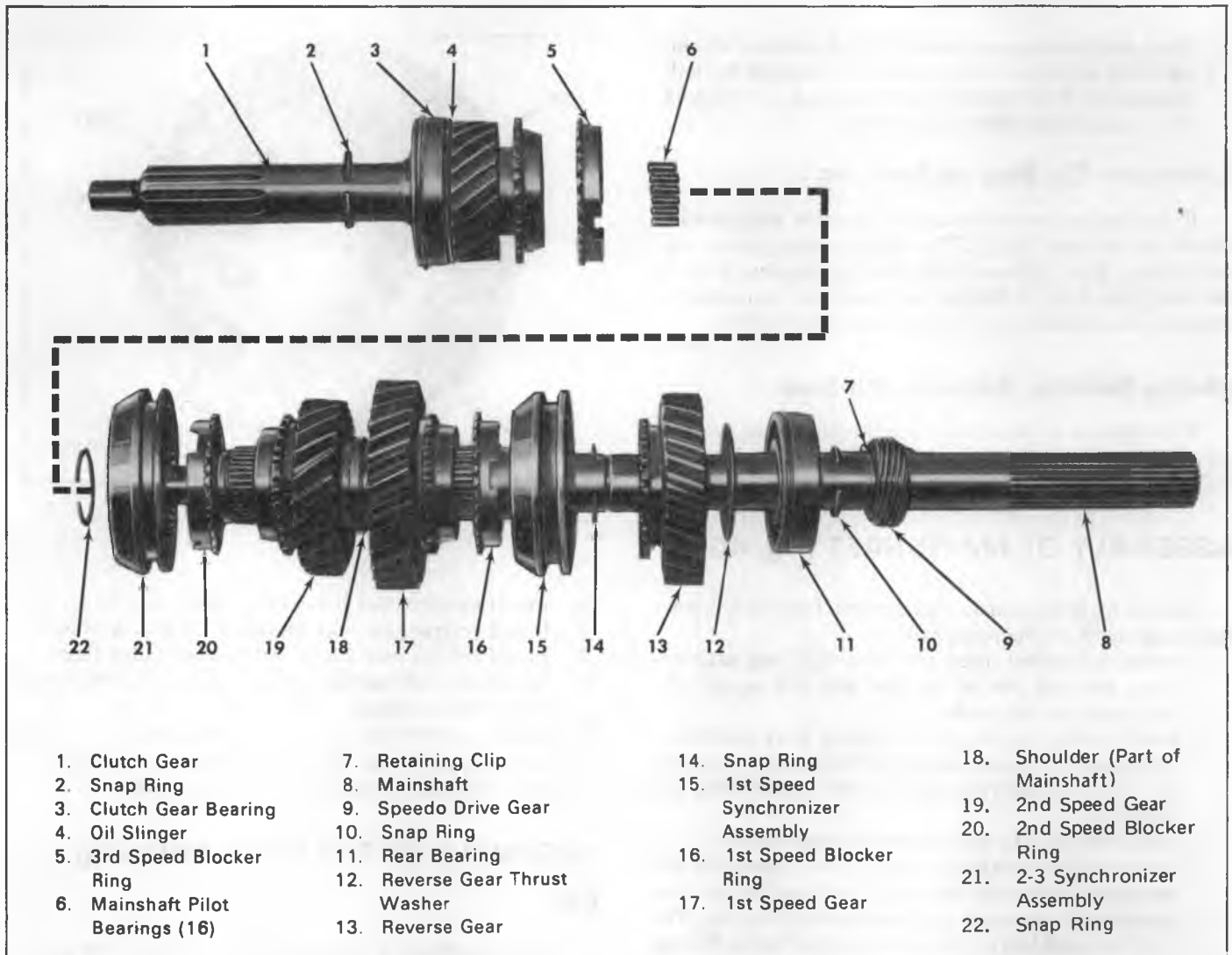


Fig. 4G—Clutch Gear and Mainshaft Assembly

## 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.
2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.

- 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:

- Install the second speed gear with clutching teeth upward; the rear face of the gear will butt against the flange on the mainshaft.
- 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.
- 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 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.

- 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:
- Install the first speed gear with clutching teeth upward; the front face of the gear will butt against the flange on the mainshaft.
  - Install a blocker ring with clutching teeth downward over synchronizing surface of the first speed gear.
  - Install the first and reverse synchronizer assembly 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.

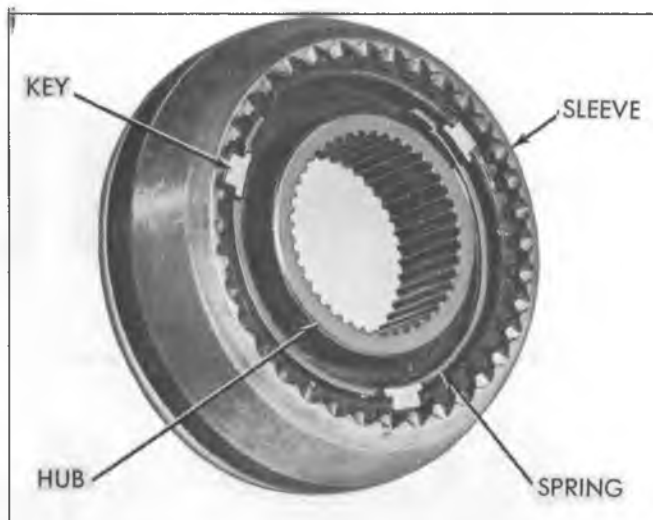


Fig. 5G--Synchronizer Assembly

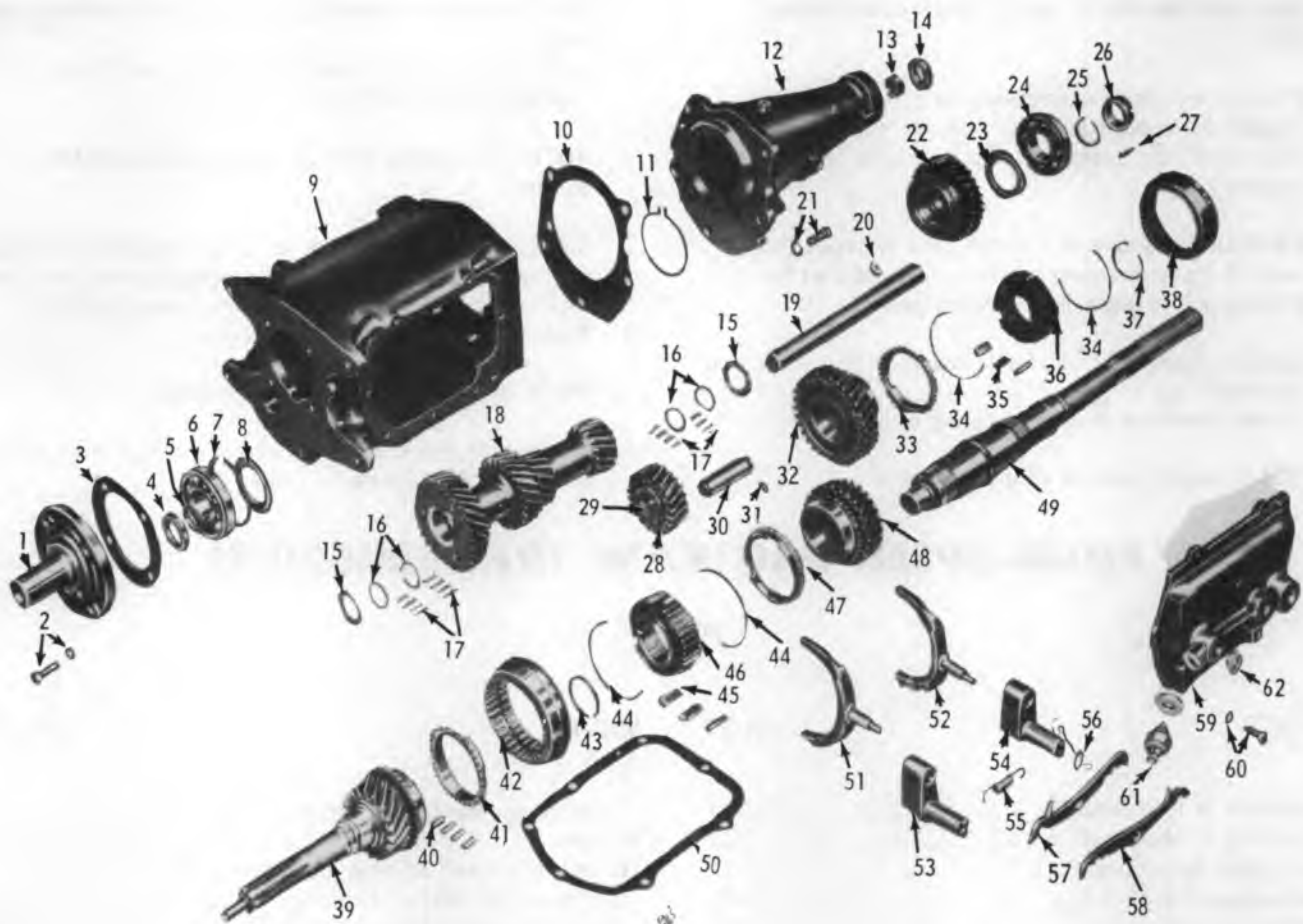
- Install synchronizer hub to mainshaft snap ring.
  - Install reverse gear with clutching teeth downward.
  - Install reverse gear steel thrust washer (align flats).
  - Install rear ball bearing with snap ring slot downward; press onto mainshaft.
  - Install rear bearing to mainshaft snap ring.
  - Install speedometer drive gear and retaining clip.
- This completes the assembly of the mainshaft.

## ASSEMBLY OF TRANSMISSION (Fig. 6G)

- 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.
- 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.

**CAUTION:** Be sure countershaft picks up both thrust washers and that the tangs are aligned with their notches in the case.

- Position reverse idler gear in case.
- 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).
- Load the mainshaft pilot bearings (16) into the clutch gear cavity and assemble the 3rd speed blocker ring onto the clutch gear clutching surface with its teeth toward the gear.
- Pilot the clutch gear, pilot bearings and 3rd speed blocker ring assembly over the front of the mainshaft assembly. Do not assemble bearing to gear yet.



- |   |                              |   |  |
|---|------------------------------|---|--|
| 1. Bearing Retainer                       | 18. Countergear              | 35. Synchronizer Keys                         | 50. Gasket                                 |
| 2. Bolt and Lock Washer                   | 19. Countershaft             | 36. 1st and Reverse Synchronizer Hub Assembly | 51. 2nd and 3rd Shifter Fork               |
| 3. Gasket                                 | 20. Woodruff Key             | 37. Snap Ring                                 | 52. 1st and Reverse Shifter Fork           |
| 4. Oil Seal                               | 21. Bolt (Extension-to-Case) | 38. 1st and Reverse Synchronizer Collar       | 53. 2-3 Shifter Shaft Assembly             |
| 5. Snap Ring (Bearing-to-Main Drive Gear) | 22. Reverse Gear             | 39. Main Drive Gear                           | 54. 1st and Reverse Shifter Shaft Assembly |
| 6. Main Drive Gear Bearing                | 23. Thrust Washer            | 40. Pilot Bearings                            | 55. Spring                                 |
| 7. Snap Ring Bearing                      | 24. Rear Bearing             | 41. 3rd Speed Blocker Ring                    | 56. O-Ring Seal                            |
| 8. Oil Slinger                            | 25. Snap Ring                | 42. 2nd and 3rd Synchronizer Collar           | 57. 1st and Reverse Detent Cam             |
| 9. Case                                   | 26. Speedometer Drive Gear   | 43. Snap Ring                                 | 58. 2nd and 3rd Detent Cam                 |
| 10. Gasket                                | 27. Retainer Clip            | 44. Synchronizer Key Spring                   | 59. Side Cover                             |
| 11. Snap Ring (Rear Bearing-to-Extension) | 28. Reverse Idler Gear       | 45. Synchronizer Keys                         | 60. Bolt and Lock Washer                   |
| 12. Extension                             | 29. Reverse Idler Bushing    | 46. 2nd and 3rd Synchronizer Hub              | 61. TCS Switch and Gasket                  |
| 13. Extension Bushing                     | 30. Reverse Idler Shaft      | 47. 2nd Speed Blocker Ring                    | 62. Lip Seal                               |
| 14. Oil Seal                              | 31. Woodruff Key             | 48. 2nd Speed Gear                            |  |
| 15. Thrust Washer                         | 32. 1st Speed Gear           | 49. Mainshaft                                 |  |
| 16. Bearing Washer                        | 33. 1st Speed Blocker Ring   |   |  |
| 17. Needle Bearings                       | 34. Synchronizer Key Spring  |   |  |

Fig. 6G-Transmission Exploded View

**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 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.

**CAUTION:** 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.

## FOUR-SPEED SAGINAW TRANSMISSION

### INDEX

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### DISASSEMBLY OF TRANSMISSION

(Figs. 1X and 2X)

1. Remove side cover attaching screws and remove side cover assembly and shift forks.
2. Remove clutch gear bearing retainer.
3. Remove clutch gear bearing to gear stem snap ring, then remove clutch gear bearing by pulling outward on clutch gear until a screwdriver or other suitable tool can be inserted between bearing, large snap ring and case to complete removal. The clutch gear bearing is a slip fit on the gear and into the case bore. This provides clearance for removal of clutch gear and mainshaft assembly (Fig. 3X).
4. Remove extension to case attaching bolts.
5. Remove clutch gear, mainshaft and extension assembly together through the rear case opening (fig. 4X).

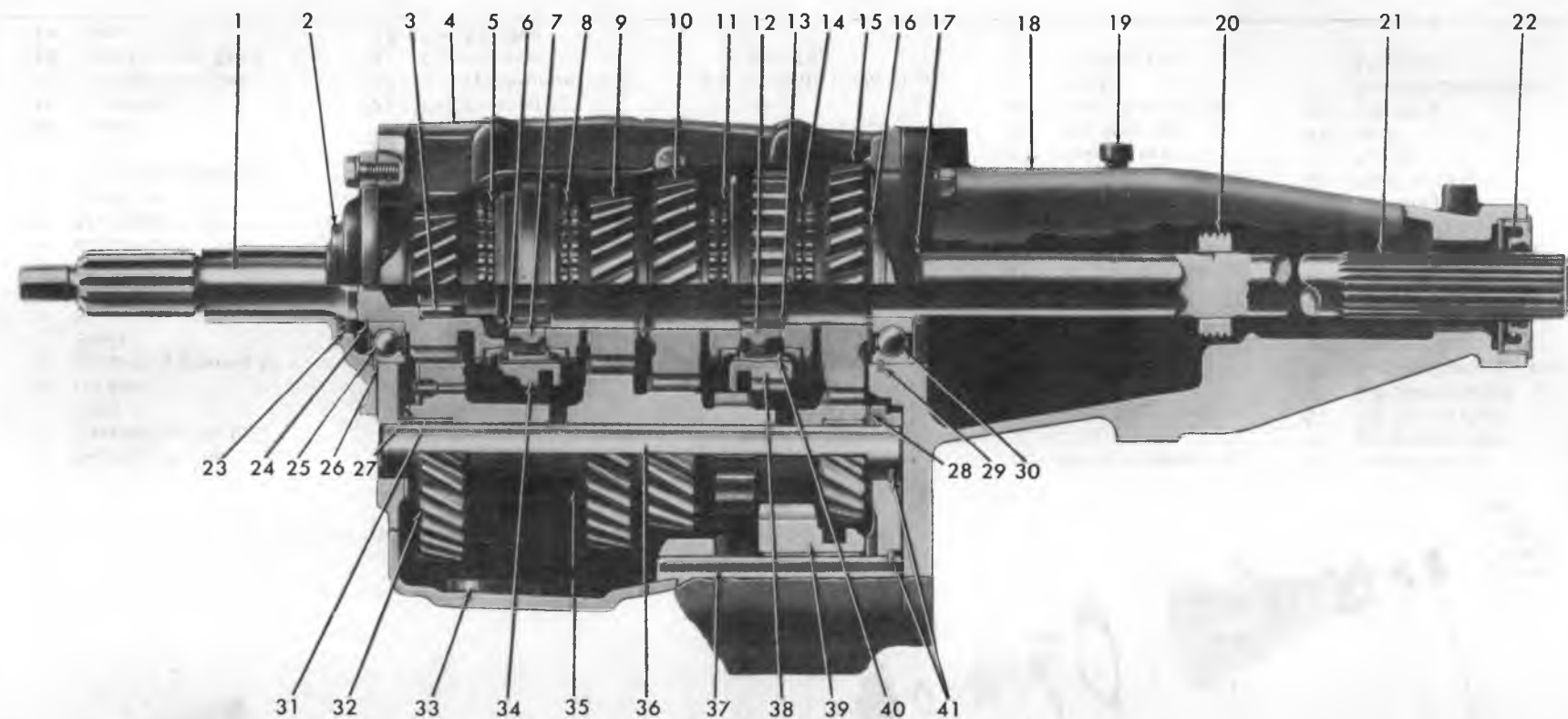
6. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (fig. 5X) and remove the extension.

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 bearings (fig. 6X).

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. 7X).

### 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. 8X and 9X).



- |                           |  |                                     |                                    |  |
|---------------------------|--|-------------------------------------|------------------------------------|--|
| 1. Clutch 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. Clutch 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

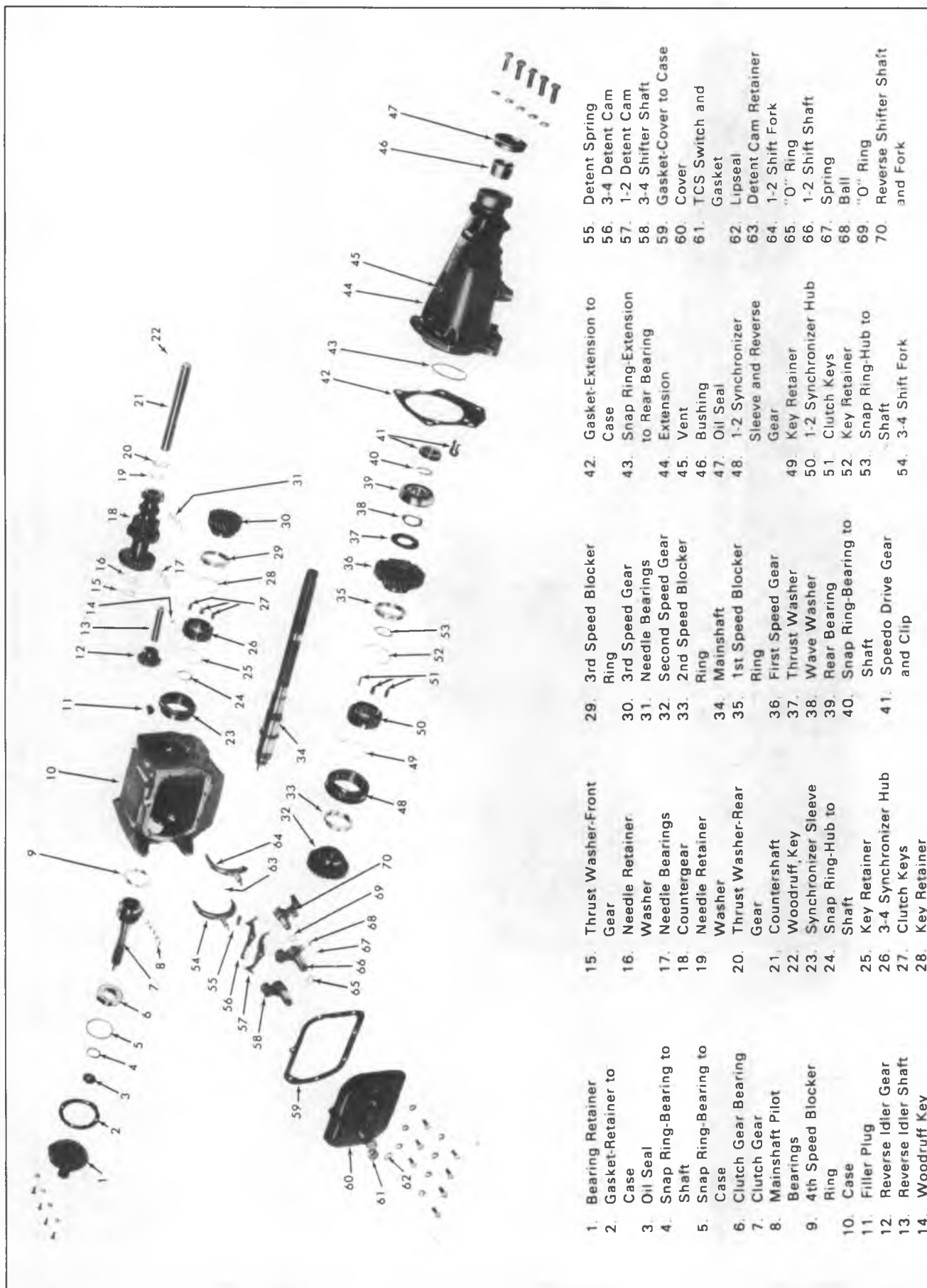


Fig. 2X-Transmission-Exploded View



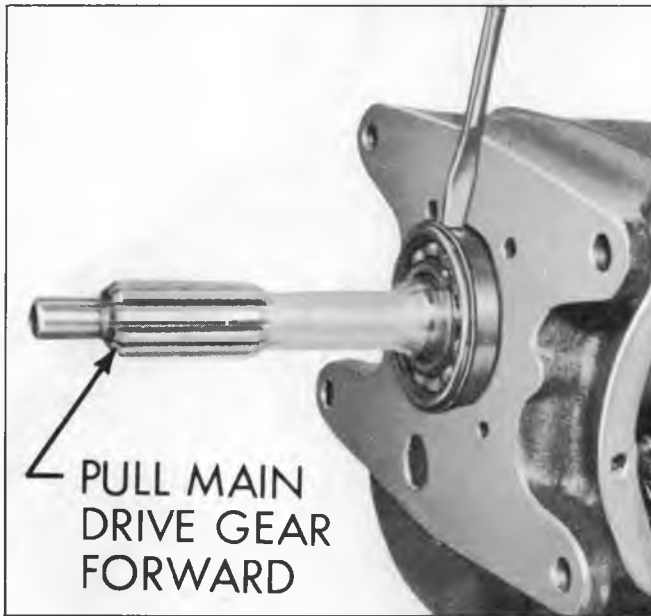


Fig. 3X--Removing Clutch Gear Bearing

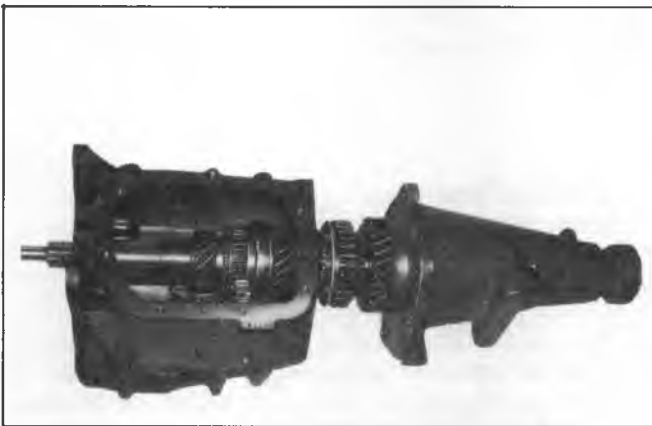


Fig. 4X--Removing Clutch Gear and Mainshaft Assembly



Fig. 5X--Extension to Rear Bearing Snap Ring



Fig. 6X--Removing Countershaft



Fig. 7X--Removing Reverse Idler Gear Shaft



Fig. 8X--Third and Fourth Synchronizer Snap Ring



Fig. 9X—Removing 3-4 Synchronizer and Third Speed Gear



Fig. 11X—Removing Rear Bearing and First Speed Gear

2. Depress speedometer retaining clip and slide gear from mainshaft.
3. Remove rear bearing snap ring from mainshaft groove (fig. 10X).
4. Support first gear with press plates and press on rear of mainshaft to remove first gear, thrust washer, spring washer, rear bearing and snap ring from rear of mainshaft (fig. 11X).

**CAUTION:** When pressing rear bearing be careful to center gear, washers, bearings and snap ring on mainshaft.

5. Remove the 1st and second sliding clutch hub snap ring from the mainshaft and remove the clutch assembly, 2nd speed blocker ring and second speed gear from the rear of the mainshaft (figs. 12X and 13X). This completes the disassembly of the mainshaft.



Fig. 10X—Rear Bearing to Mainshaft Snap Ring

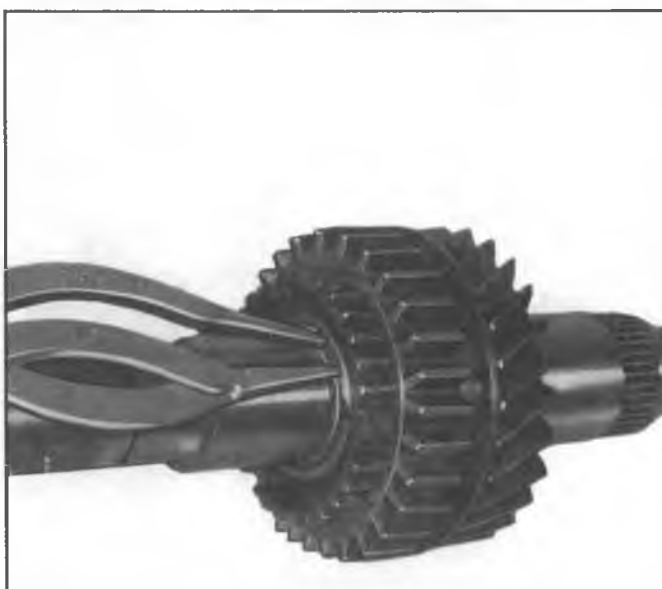


Fig. 12X—First and Second Synchronizer Snap Ring



Fig. 13X—Removing 1-2 Synchronizer and Second Speed Gear

## 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.

## 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.

## 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. 23X).

## 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.

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. 14X). 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.

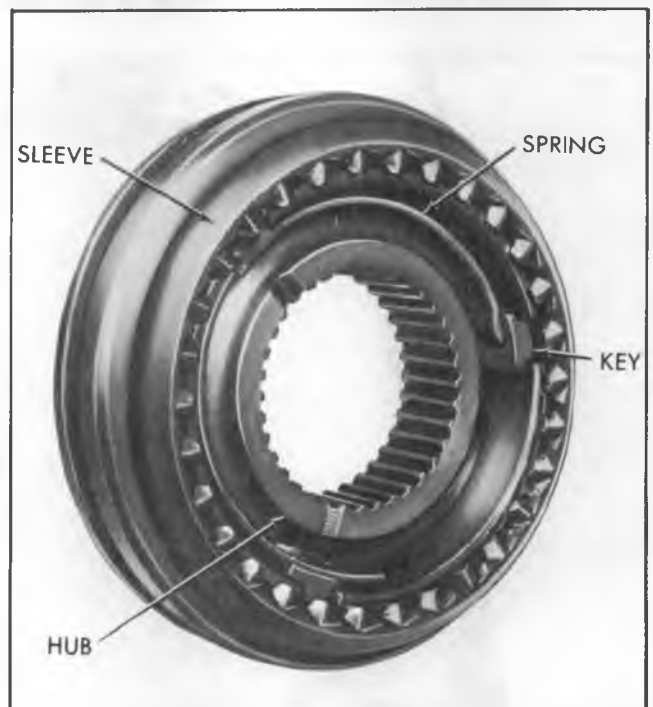


Fig. 14X—Three-Four Synchronizer Assembly

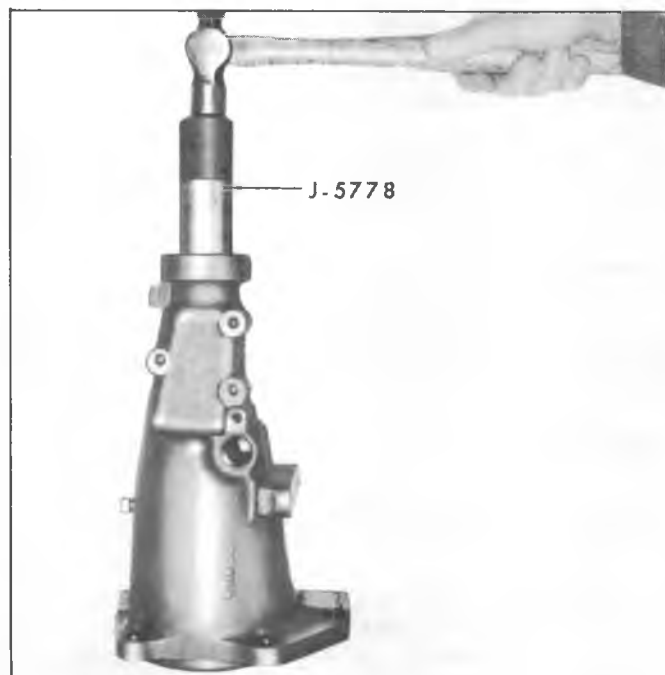


Fig. 15X--Extension Bushing Replacement

**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 (fig. 15X). 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. 16X).

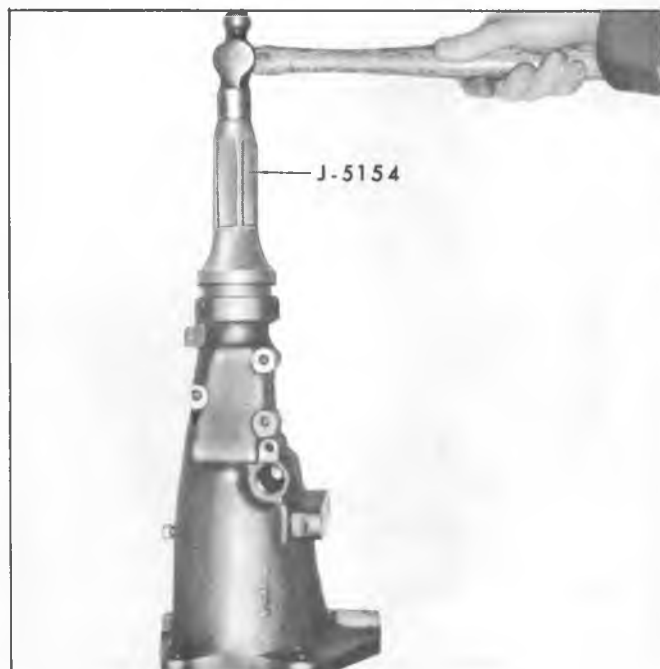


Fig. 16X--Installing Extension Oil Seal



Fig. 17X--Removing Bearing Retainer Oil Seal

If the lip seal in the retainer needs replacement; pry the oil seal out and replace with a new seal using Tool J-23096 until seal seats in its bore (figs. 17X and 18X).

### Clutch Gear Bearing Retainer Oil Seal

If the lip seal in the retainer needs replacement; pry the oil seal out and replace with a new seal using Tool J-23096 until seal seats in its bore (figs. 17X and 18X).

**NOTE:** Lip of seal must face rear of bearing retainer.

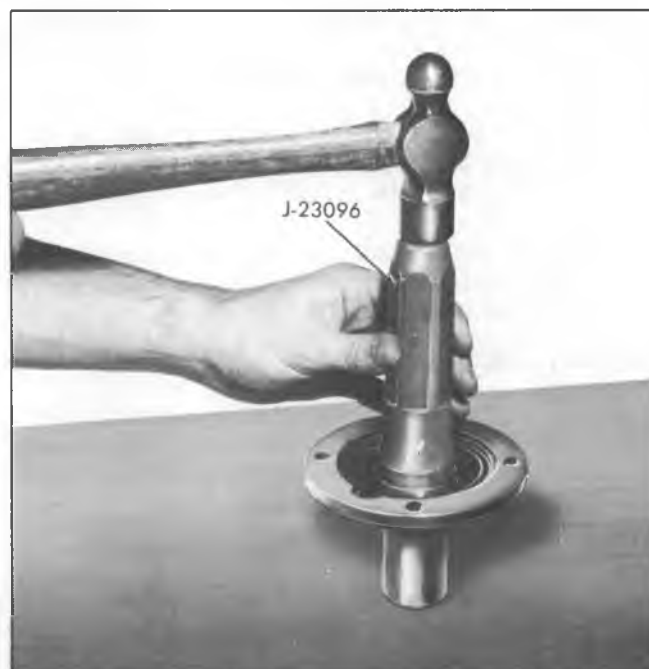


Fig. 18X--Installing Bearing Retainer Oil Seal

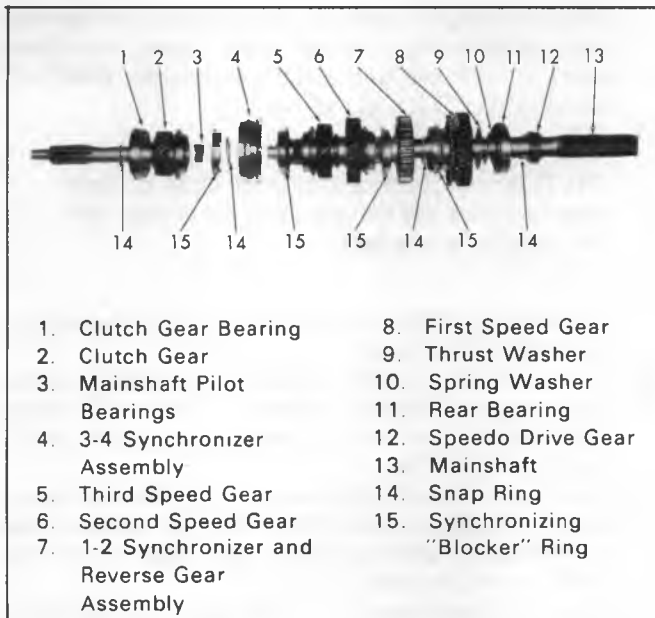


Fig. 19X—Clutch Gear and Mainshaft Details

## ASSEMBLY OF MAINSHAFT (Fig. 19X)

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; press it onto splines on the mainshaft until it bottoms out (fig. 20X).

**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. 8X). Both synchronizer snap rings are identical.

Turn the rear of the mainshaft upward. Install the following components on the mainshaft:

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; press it onto splines on the mainshaft (fig. 21X).

**CAUTION:** Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.



Fig. 20X—Installing 3-4 Synchronizer and Third Gear

8. Install synchronizer hub to mainshaft snap ring (fig. 12X).
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. 22X).
14. Install rear bearing to mainshaft snap ring (fig. 10X).



Fig. 21X—Installing 1-2 Synchronizer and Second Speed Gear



Fig. 22X—Installing Rear Bearing

15. Install speedometer drive gear and clip.  
This completes the assembly of the mainshaft.

## 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. 23X).



Fig. 23X—Loading Countergear Bearings

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. 5X).
5. Load the mainshaft pilot bearings (14) into the clutch gear cavity and assemble the 4th speed blocker ring onto the clutch gear clutching surface with its clutching teeth toward the gear (fig. 24X).
6. Pilot the clutch 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.



Fig. 24X—Loading Mainshaft Pilot Bearings



9. Install front bearing outer snap ring to bearing and position bearing over stem of clutch gear and into front case bore.
10. Install snap ring to clutch gear stem, and clutch gear bearing retainer and gasket to case.
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.

**NOTE:** The retainer oil return hole should be at the bottom.

## FOUR-SPEED MUNCIE TRANSMISSION (PASS. CAR)

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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.
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-22246; then remove the counter-gear 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.

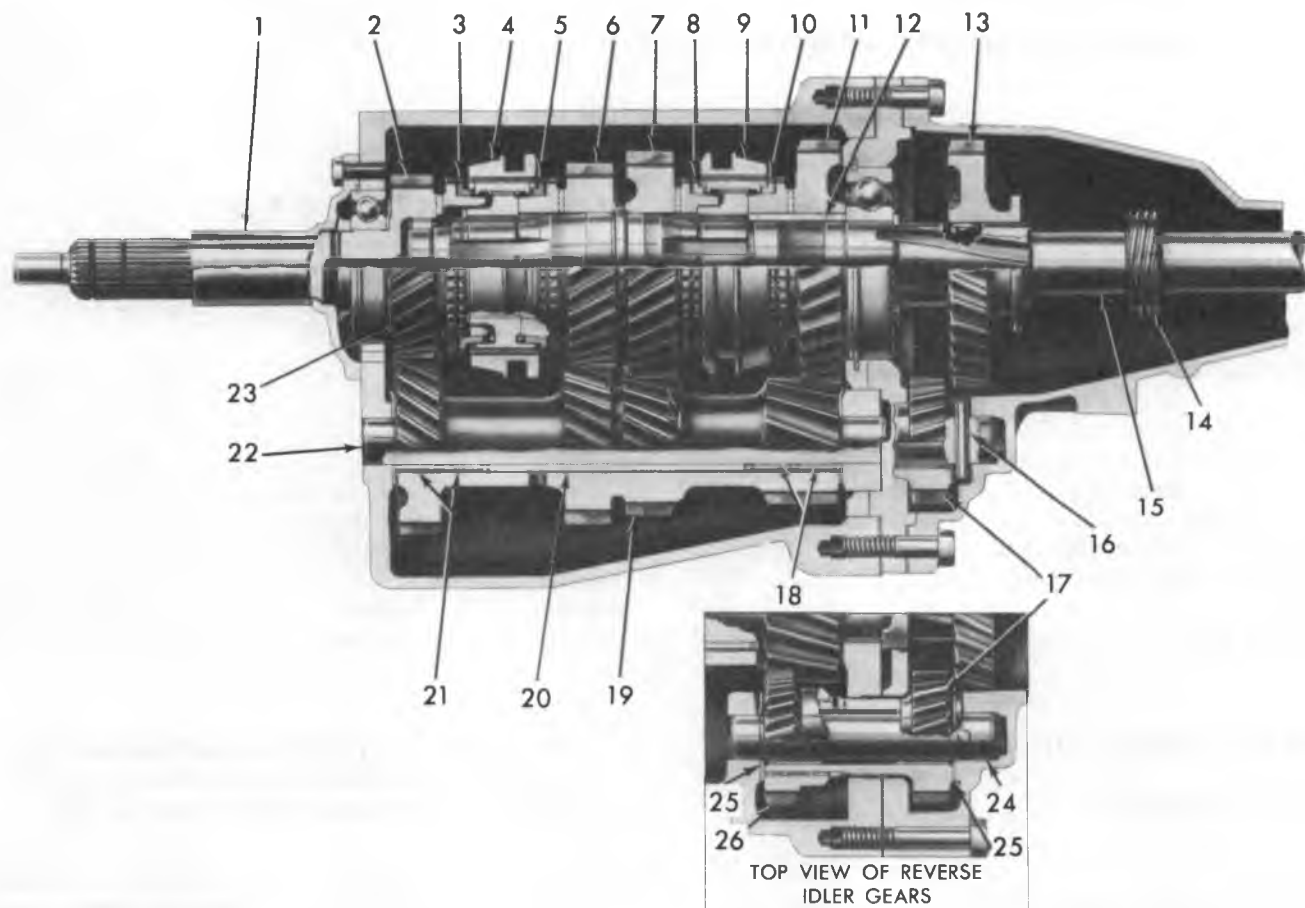
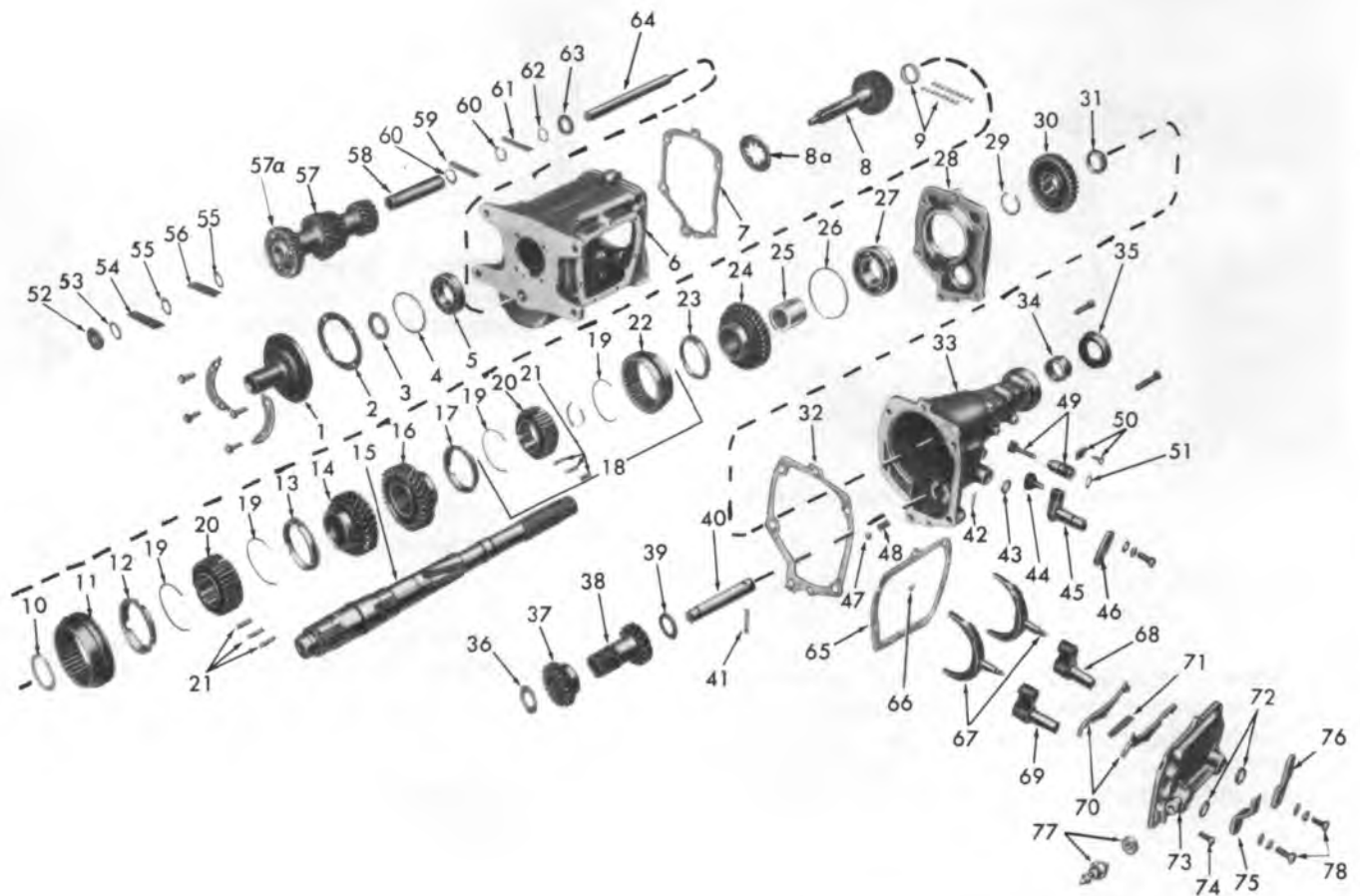


Fig. 1B--Transmission Cross Section (Std. Ratio Shown)



- |  |  |   |  |
|--|--|---|--|
| 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                               | 42. Reverse Shifter Shaft Lock Pin                        | 64. Countershaft   |
| 5. Main Drive Gear Bearing                       | 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                                 | 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. TCS Switch and Gasket                                      |
| 17. Second Speed Gear Synchronizing Ring         | 38. Reverse Idler Gear (Rear)                      | 56. Countergear   | 78. Lever Attaching Bolts                                      |
| 18. First and Second Speed Clutch Assembly       |  | 57a. Damper Plate   |  |
| 19. Clutch Key Spring                            |  | 58. Countergear Roller                                    |  |
| 20. Clutch Hub                                   |  | 59. Spacer  |  |
|  |  | 60. Spacer  |  |

Fig. 2B-Four-Speed Transmission Exploded View

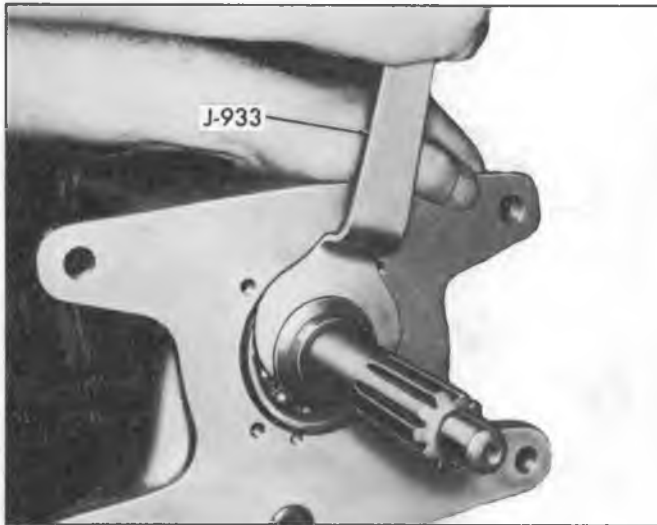


Fig. 3B—Removing Main Drive Gear Retaining Nut

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.

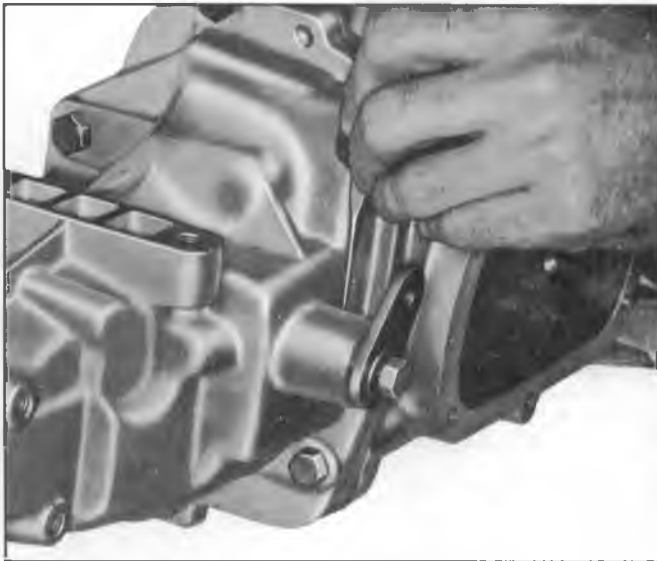


Fig. 4B—Removing Reverse Shifter Shaft Lock Pin

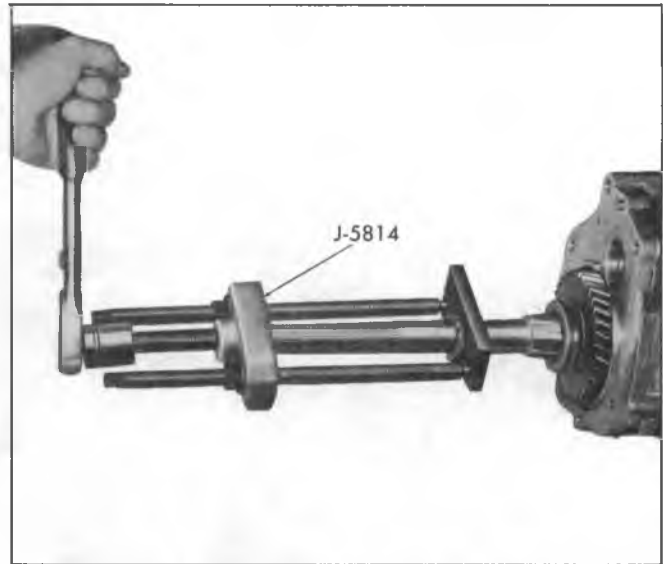


Fig. 5B—Removing Speedometer Gear

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.
2. Blow out bearings with compressed air.

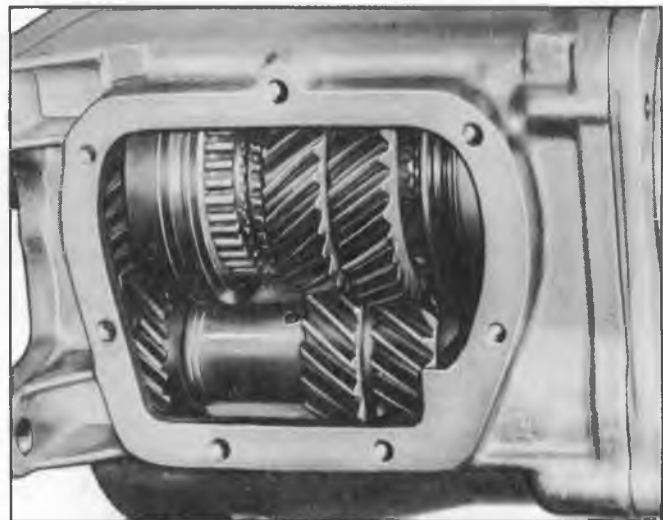


Fig. 6B—Third and Fourth Speed Synchronizer Clutch Sleeve in Fourth Gear Position



Fig. 7B—Removing Main Drive Gear

**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.



Fig. 8B—Removing Countershaft With J-22246

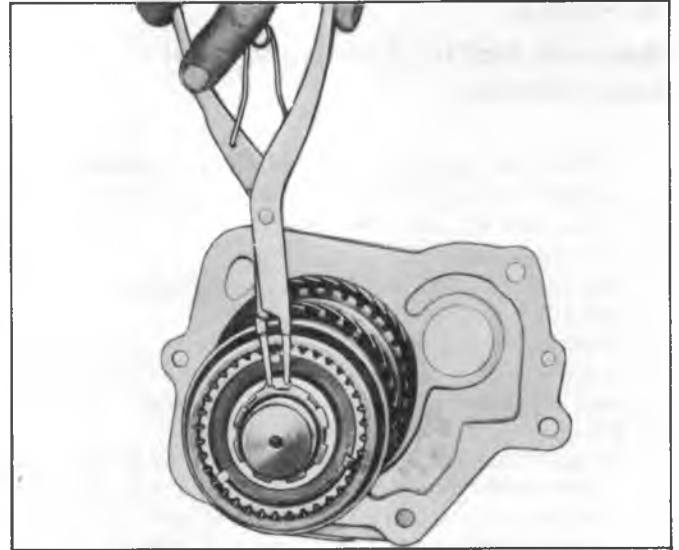


Fig. 9B—Removing Mainshaft Front Snap Ring

### 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. 10B—Removing Rear Bearing Retainer

## 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.
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 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.

6. Install the third speed gear (hub to front of transmission) and the third speed gear synchronizing ring (notches to front of transmission).

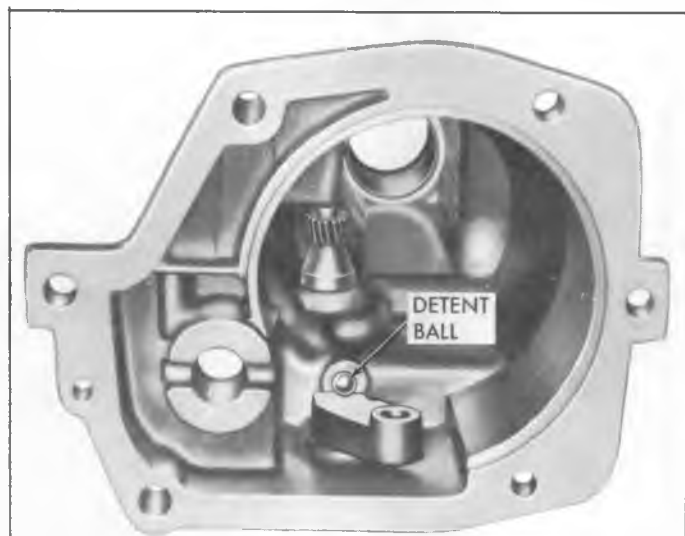


Fig. 11B—Installing Reverse Shifter Shaft and Detent Ball

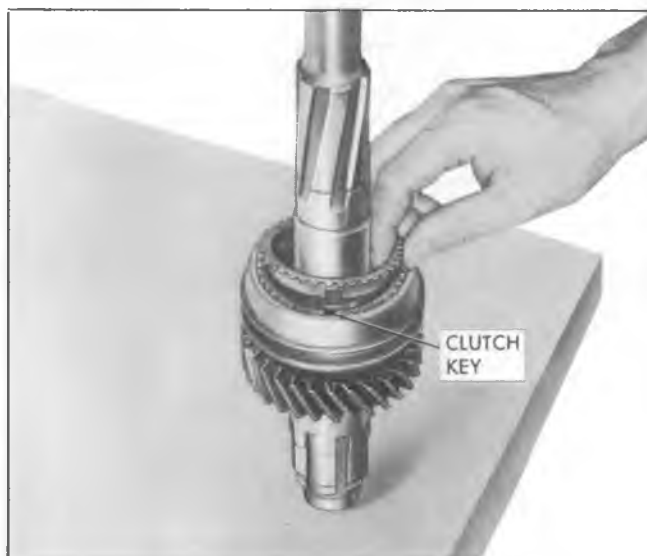


Fig. 12B—Installing Synchronizing Ring



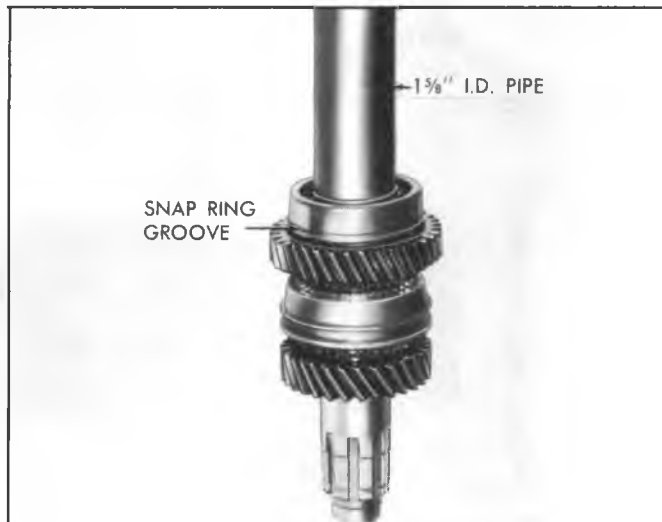


Fig. 13B—Installing Rear Bearing

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).

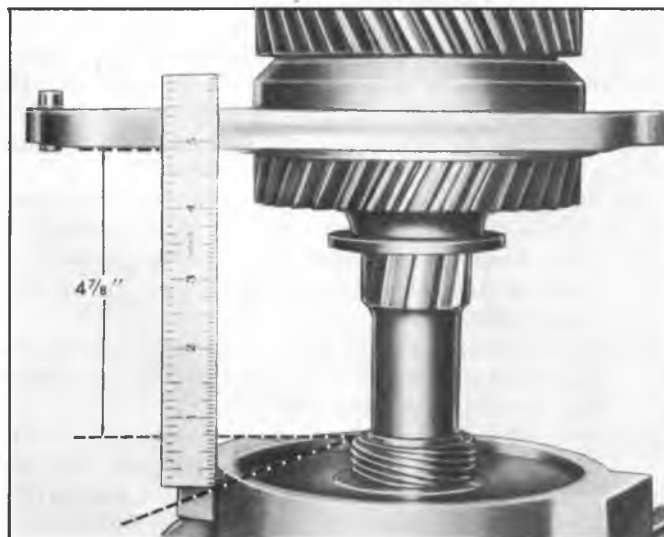


Fig. 14B—Installing Speedometer Gear



Fig. 15B—Loading Countergear Bearings Using J-22246

## 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-22246 into countergear.

## ASSEMBLY OF CASE COMPONENTS

1. Rest the transmission case on its side with the side 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).
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.

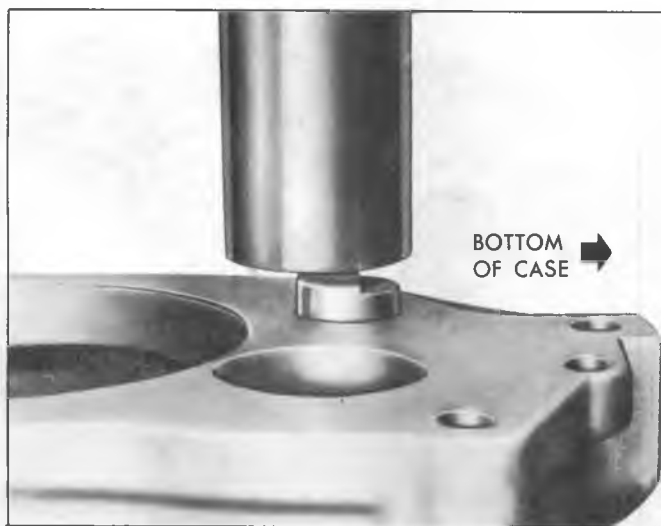


Fig. 16B—Installing Countershaft

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 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).

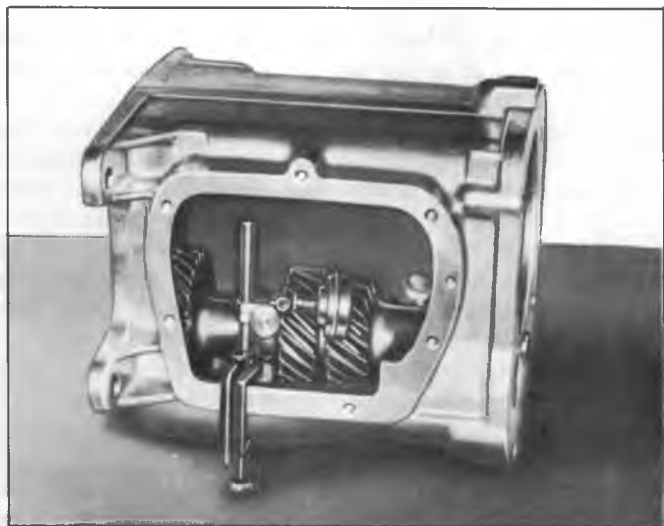


Fig. 17B—Checking Countergear End Play

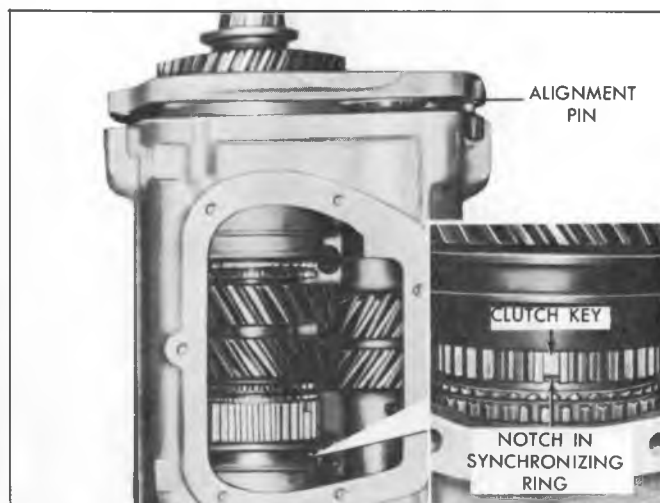


Fig. 18B—Installing Mainshaft Assembly

**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 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

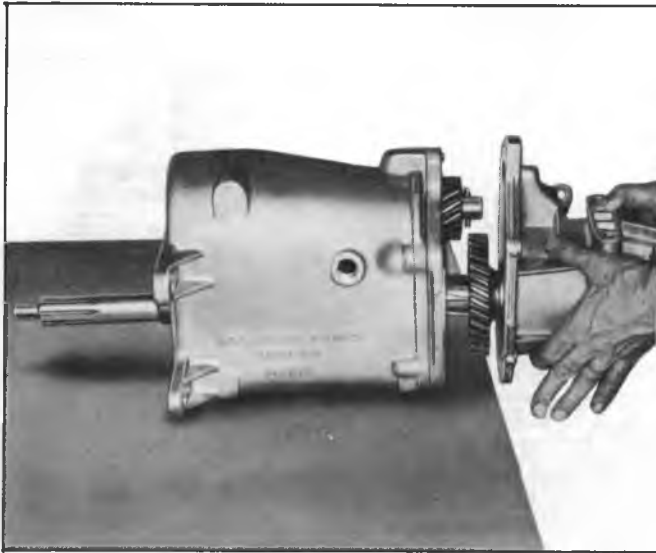


Fig. 19B—Installing Case Extension

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.

## 4-SPEED MUNCIE TRANSMISSION (MODEL 465)

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### DISASSEMBLY OF TRANSMISSION

#### Refer to Figures 1Q and 2Q

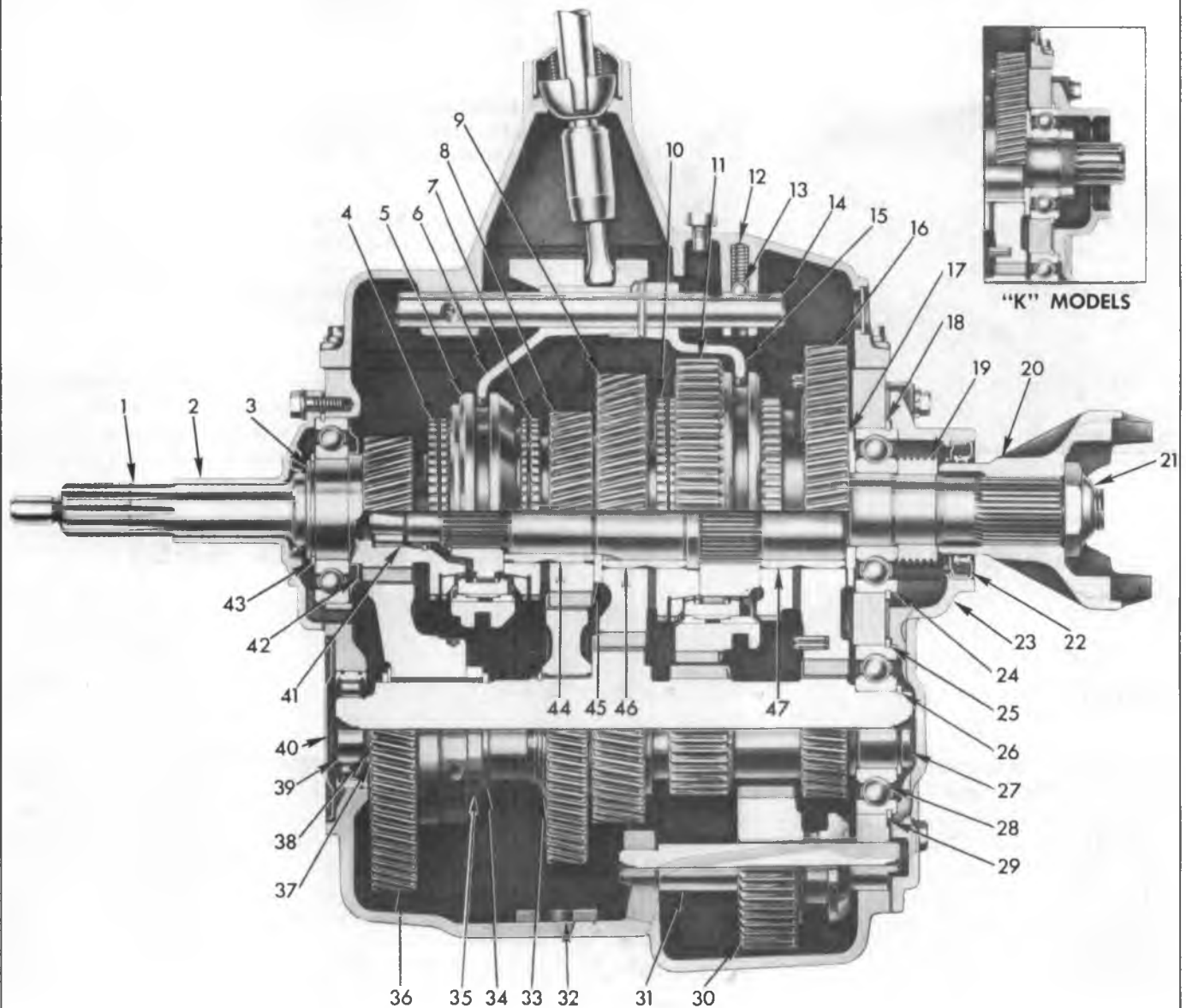
1. Mount transmission in suitable holding fixture and remove cap screws attaching transmission cover assembly to transmission case. If required, insert two 5/16 x 18 screws in cover flange threaded holes and turn evenly to raise cover dowel pins from case.

**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.

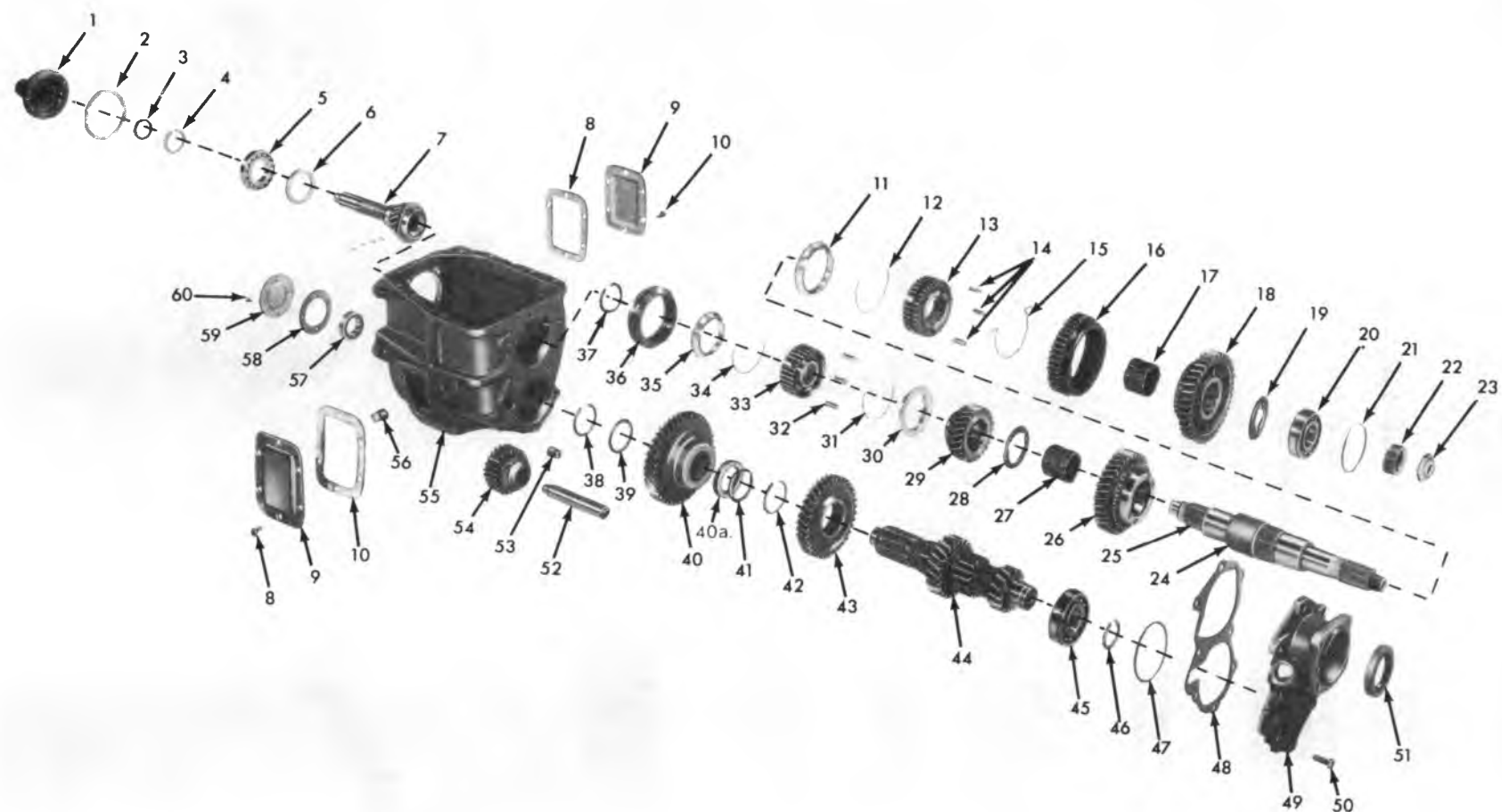
**NOTE:** On models equipped with 4-wheel drive transfer case, use Tool J-23070 to remove mainshaft rear lock nut (fig. 26Q).

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.



- |  |                                    |                               |                                |
|--|------------------------------------|-------------------------------|--------------------------------|
| 1. Main Drive Clutch 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



- |  |                                    |                                       |                              |                               |
|--|------------------------------------|---------------------------------------|------------------------------|-------------------------------|
| 1. Clutch Gear Bearing Retainer          | 13. 1st-2nd Speed Synchronizer Hub | 26. 2nd Speed Gear                    | 37. Snap Ring                | 48. Rear Retainer Gasket      |
| 2. Retainer Gasket                       | 14. Synchronizer Keys              | 27. 3rd Gear Bushing                  | 38. Snap Ring                | 49. Rear Retainer             |
| 3. Lip Seal                              | 15. Synchronizer Spring            | 28. Thrust Washer                     | 39. Thrust Washer            | 50. Retainer Bolts            |
| 4. Snap Ring                             | 16. Reverse Driven Gear            | 29. 3rd Speed Gear                    | 40. Clutch Countergear       | 51. Retainer Lip Seal         |
| 5. Clutch Gear Bearing                   | 17. 1st Gear Bushing               | 30. 3rd Speed Blocker Ring            | 40a. Spacer                  | 52. Reverse Idler Shaft       |
| 6. Oil Slinger                           | 18. 1st Gear                       | 31. Synchronizer Spring               | 41. Snap Ring                | 53. Drain Plug                |
| 7. Clutch Gear and Pilot Bearings        | 19. Thrust Washer                  | 32. Synchronizer Keys                 | 42. Snap Ring                | 54. Reverse Idler Gear        |
| 8. Power Take-Off Cover Gasket           | 20. Rear Main Bearing              | 33. 3rd-4th Synchronizer Hub          | 43. 3rd Speed Countergear    | 55. Case                      |
| 9. Power Take-Off Cover Retaining Screws | 21. Bearing Snap Ring              | 34. Synchronizer Spring               | 44. Countergear Shaft        | 56. Fill Plug                 |
| 10. Retaining Screws                     | 22. Speedometer Gear               | 35. 3rd-4th Speed Blocker Ring        | 45. Countergear Rear Bearing | 57. Countergear Front Bearing |
| 11. 1st-2nd Speed Blocker Ring           | 23. Rear Mainshaft Lock Nut        | 36. 3rd-4th Speed Synchronizer Sleeve | 46. Snap Ring                | 58. Gasket                    |
| 12. Synchronizer Spring                  | 24. 2nd Speed Bushing (On Shaft)   |                                       | 47. Bearing Outer Snap Ring  | 59. Front Cover               |
|  | 25. Mainshaft                      |                                       |                              | 60. Cover Screws              |

Fig. 2Q--Transmission Assembly--Explode

**CAUTION:** Make sure Tool J-22832 engages full circumference of groove in bearing to prevent tool damage.

10. Remove clutch gear bearing outer race to case retaining ring.
11. Remove clutch gear and bearing by tapping gently on bottom side of clutch 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 clutch 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 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.



Fig. 3Q—Removing Countergear Rear Bearing

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.

## SUBASSEMBLY OPERATIONS

### Transmission Cover

#### Disassembly (Fig. 5Q)

1. Using a small punch drive out pins retaining 1st-2nd and 3rd-4th shifter forks to shifter shafts and also drive out expansion plugs.

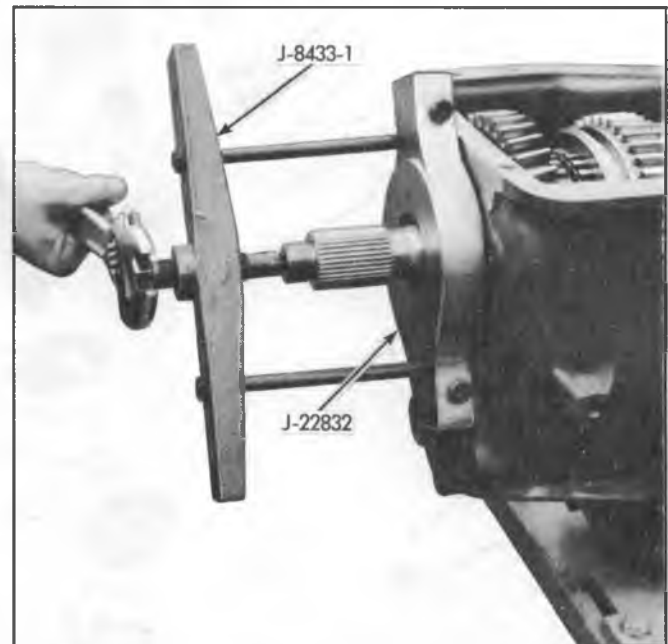


Fig. 4Q—Removing Mainshaft Rear Bearing

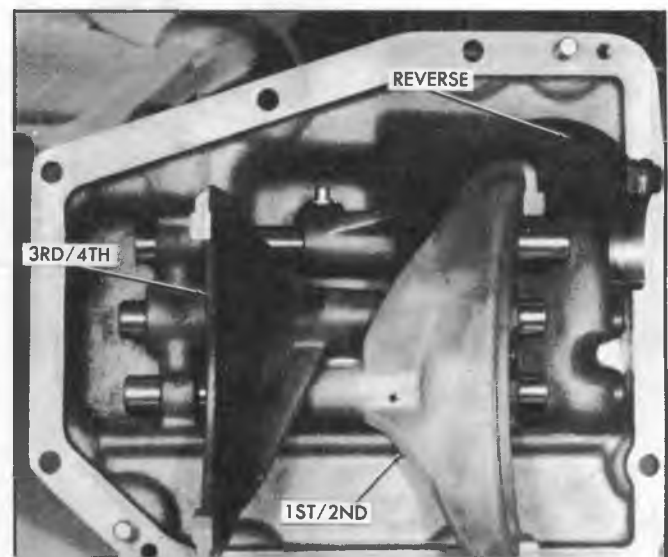


Fig. 5Q—Cover Assembly



**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.

2. 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.

3. 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)

1. 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.
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.



1. Transmission Cover
2. Interlock Balls
3. 3rd-4th Shifter Shaft
4. Reverse Shifter Shaft
5. Fork Retaining Pin
6. Detent Ball
7. Detent Spring

8. 3rd-4th Shifter Fork
9. "C" Ring Lock Clip
10. Reverse Shifter Fork
11. Shifter Shaft Hole Plugs
12. 1st-2nd Shifter Fork

13. Interlock Plunger Spring
14. Reverse Interlock Plunger
15. 1st-2nd Shifter Shaft
16. Interlock Pin
17. Cover Gasket

Fig. 6Q—Cover Assembly—Explode

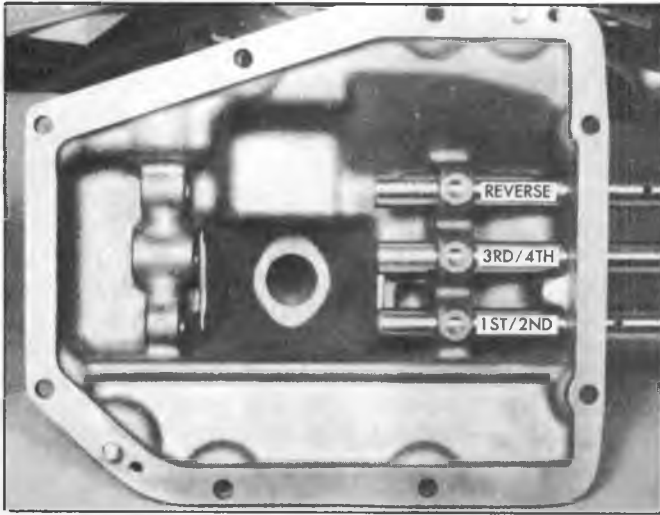


Fig. 7Q-Shifter Shaft Installation

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.

## Clutch Gear and Shaft (Fig. 8Q)

### Disassembly

1. Remove mainshaft pilot bearing rollers (17) from clutch gear if not already removed, and remove roller retainer. Do not remove snap ring on inside of clutch 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).

### 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 clutch gear bearing slowly by hand and check for roughness.

### Assembly

1. Press bearing and new oil slinger onto clutch gear shaft using Tool J-22872 (fig. 11Q). Slinger should be located flush with bearing shoulder on clutch gear. See Figure 8Q for direction of slinger installation.

**CAUTION:** Exercise care to prevent distortion of the oil slinger.

2. Install snap ring to secure bearing on clutch gear shaft.
3. Install bearing retainer ring in groove on O.D. of bearing.

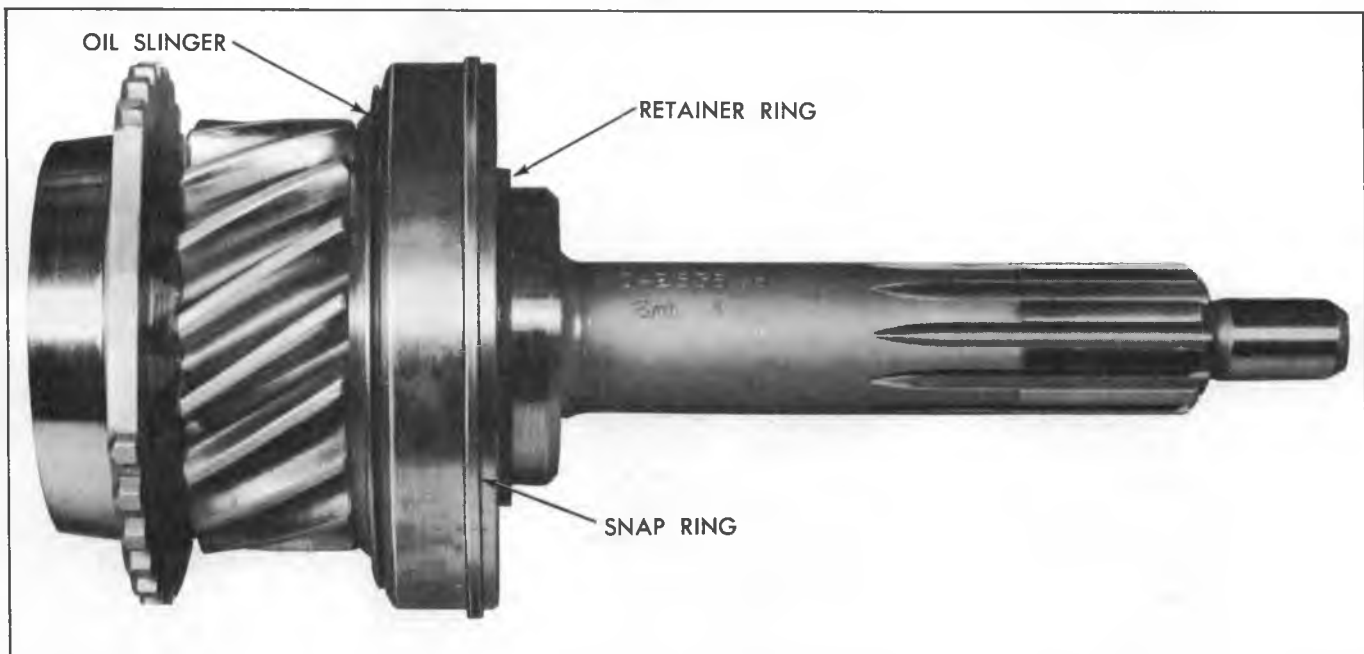


Fig. 8Q-Clutch Gear Assembly

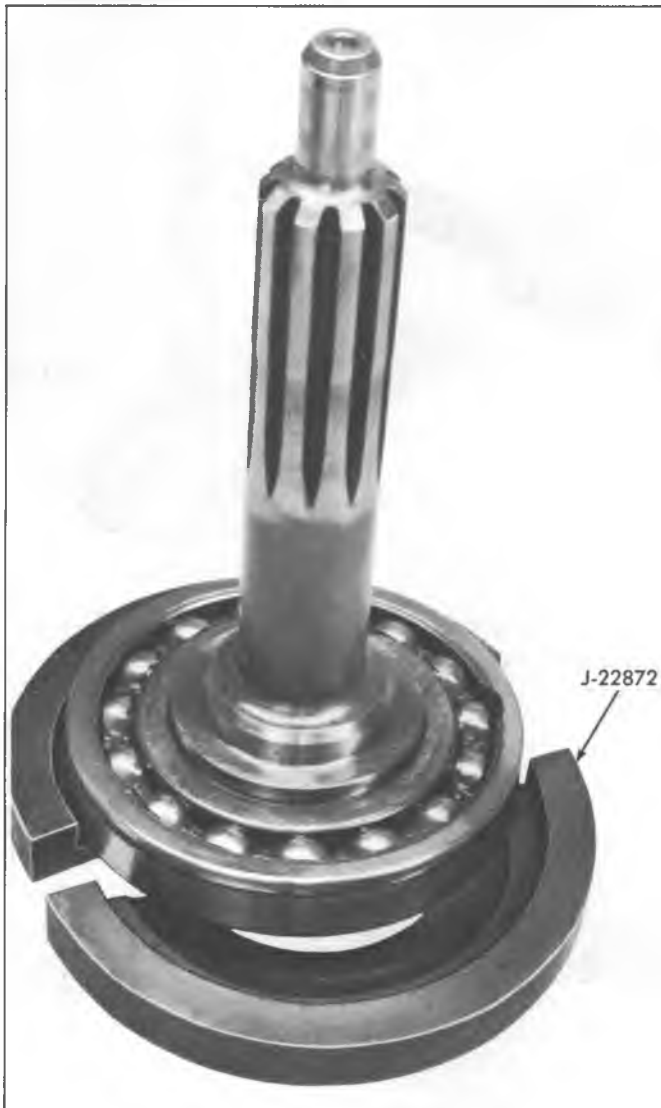


Fig. 9Q--Positioning Tool J-22872 to Clutch Gear

**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).
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.

## Clutch Gear Bearing Retainer Oil Seal

### Replacement

1. Remove retainer and oil seal assembly and gasket.
2. Pry oil seal out of retainer.



Fig. 10Q--Removing Clutch Gear Bearing

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)

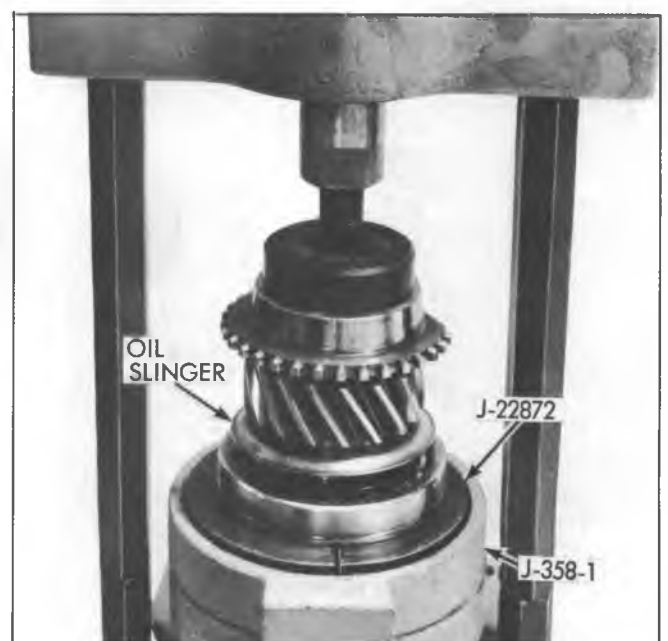


Fig. 11Q--Replacing Clutch Gear Bearing



Fig. 12Q--Roller Bearing Retainer



Fig. 13Q--Installing Bearing Retainer Oil Seal

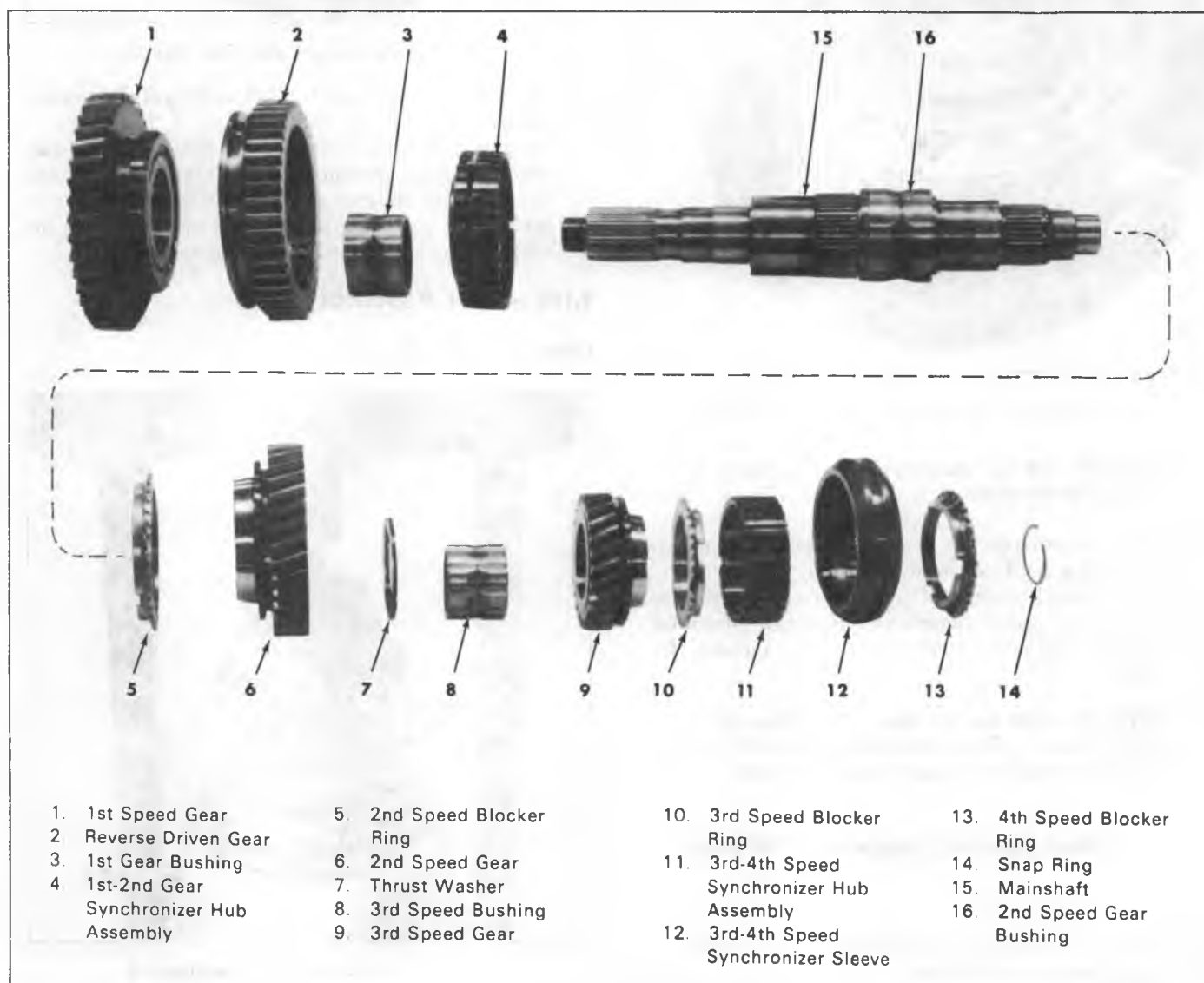


Fig. 14Q--Mainshaft Assembly--Exploded View

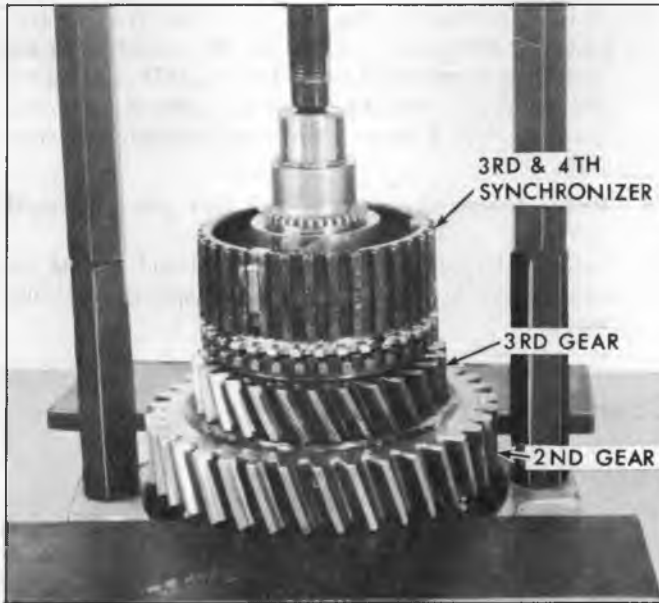


Fig. 15Q--Disassembly of Mainshaft

1. Remove first speed gear.
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.

**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.

**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.

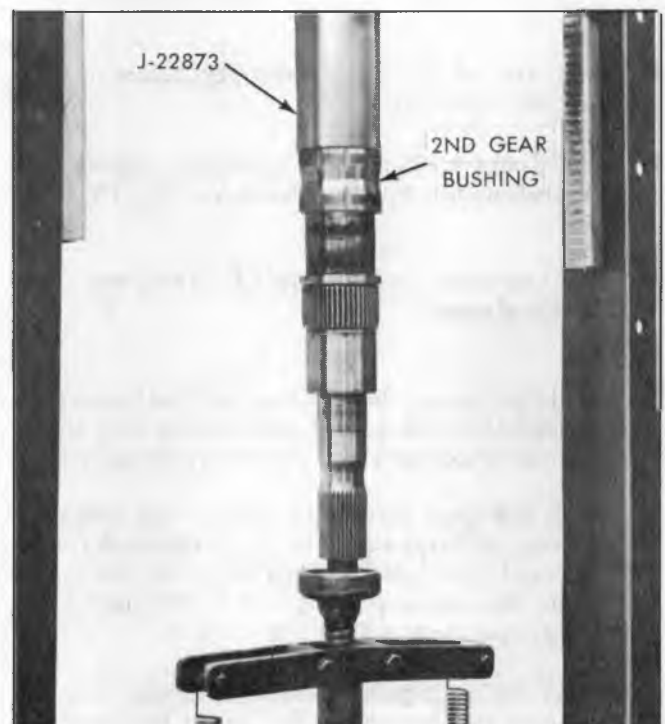


Fig. 16Q--Installing 2nd Speed Gear Bushing

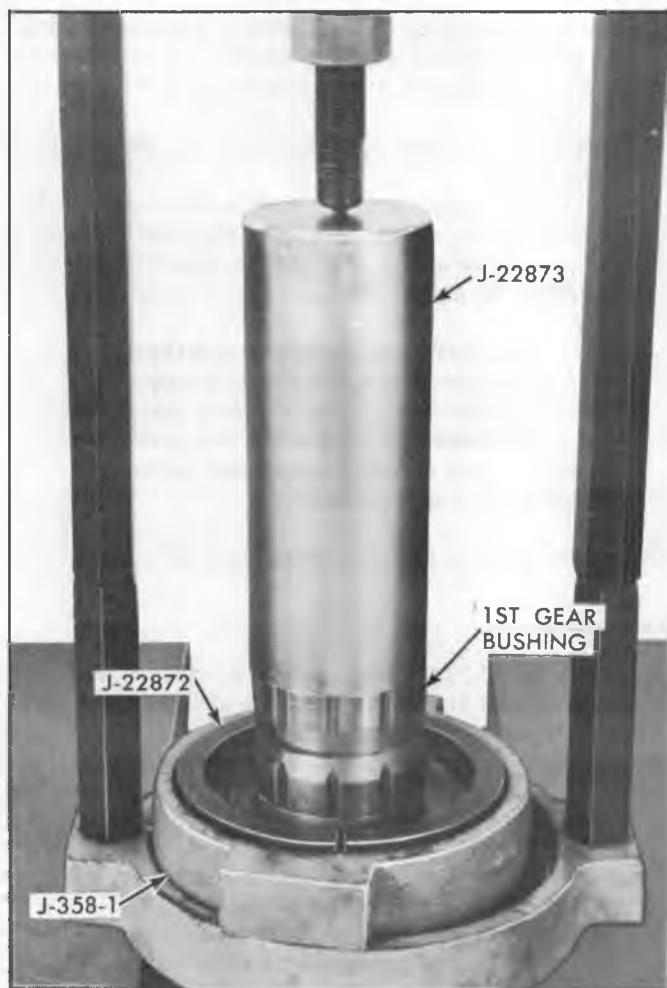


Fig. 17Q—Installing 3rd Speed Gear Bushing

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).

**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.
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.

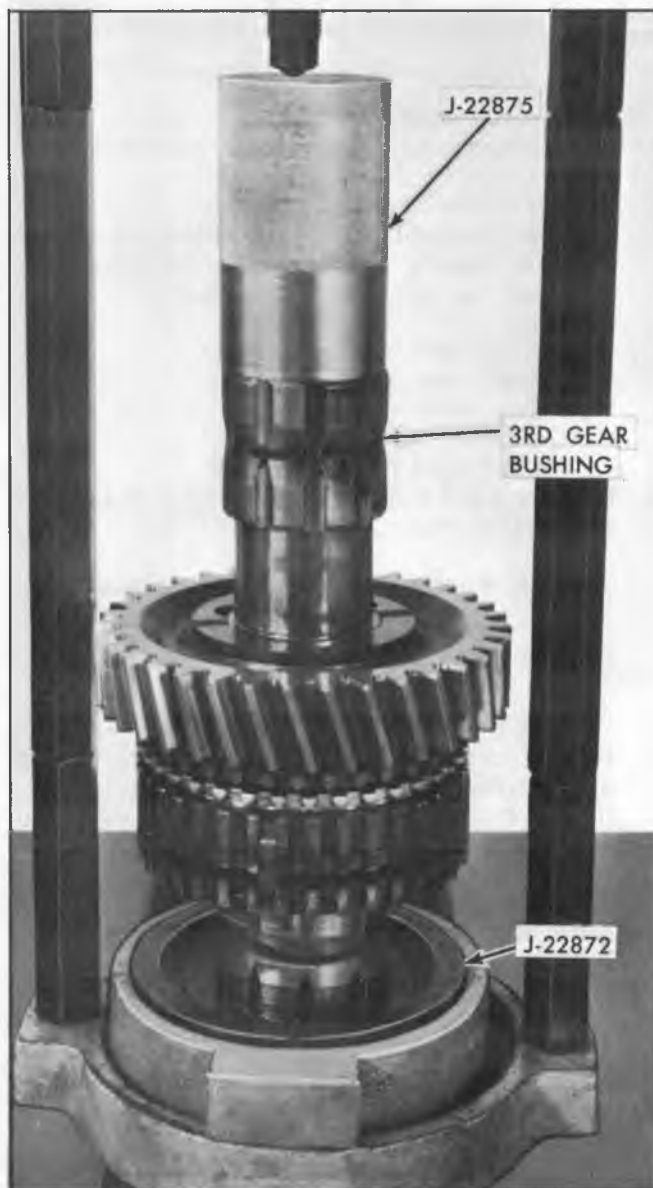


Fig. 18Q—Installing 3rd Speed Gear Bushing



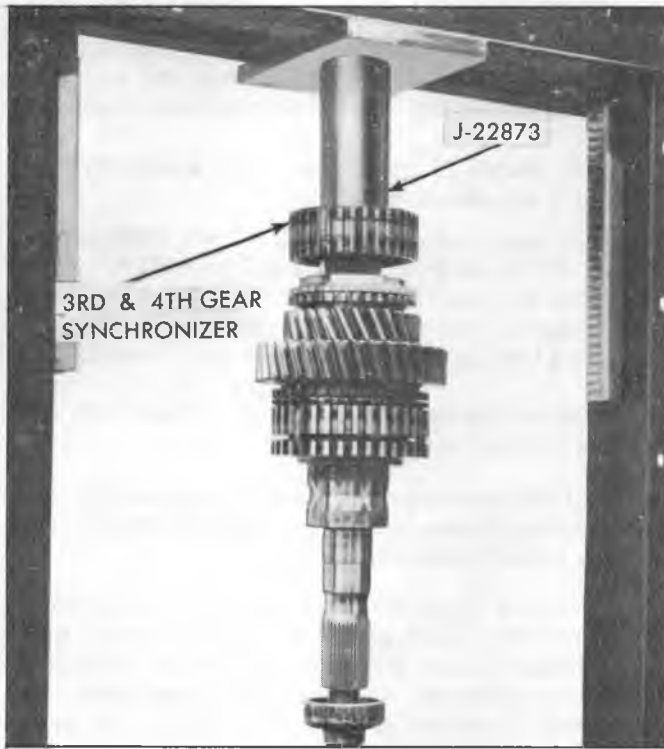


Fig. 19Q--Installing 3rd and 4th Gear Synchronizer

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.

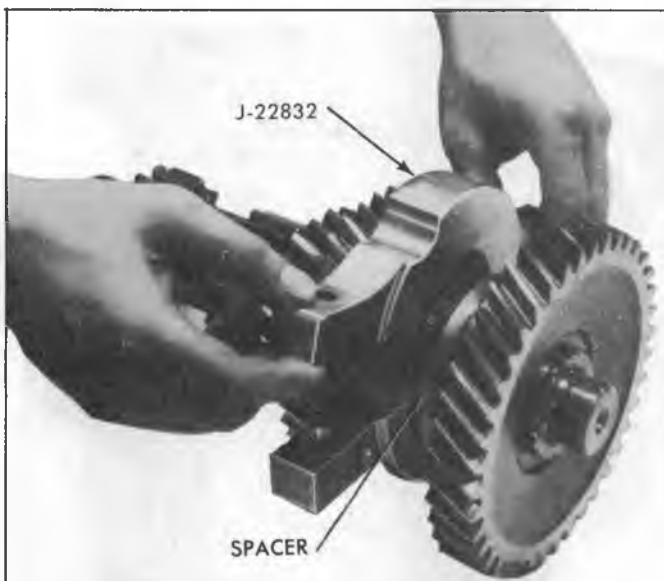


Fig. 20Q--Positioning Tool J-22832 On Countershaft

3. Remove clutch countergear rear retaining ring. Discard snap ring.
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.

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.

#### TRANSMISSION ASSEMBLY

1. Lower the countergear into the case until it rests on bottoms of case.

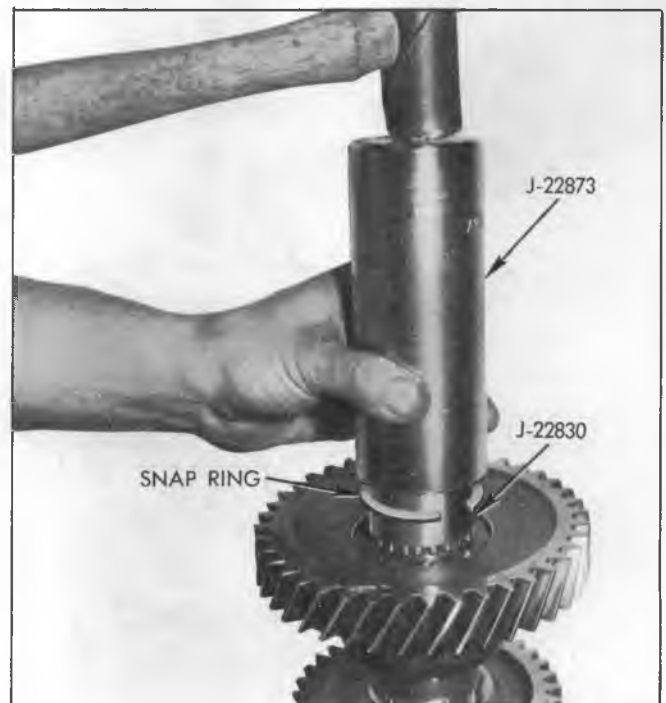


Fig. 21Q--Installing Counter Gear Snap Ring

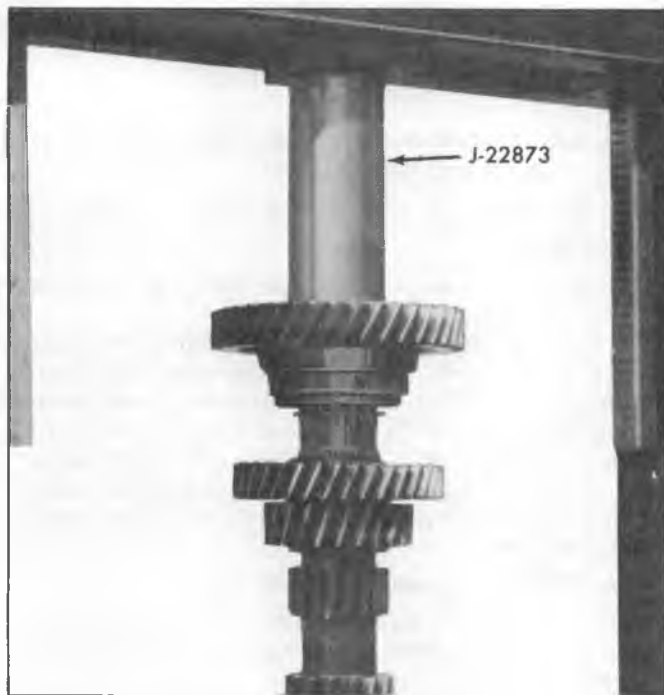


Fig. 22Q—Installing Clutch Countergear

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.



Fig. 23Q—Installing Mainshaft Rear Bearing

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). Align tangs on snap ring with lube slot of case and slot in tool before driving bearing. 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 clutch gear bearing O.D. Index cut out portion of clutch 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 clutch gear bearing retainer using a new gasket. Install bolts and tighten to 15-18 ft. lbs.
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 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.

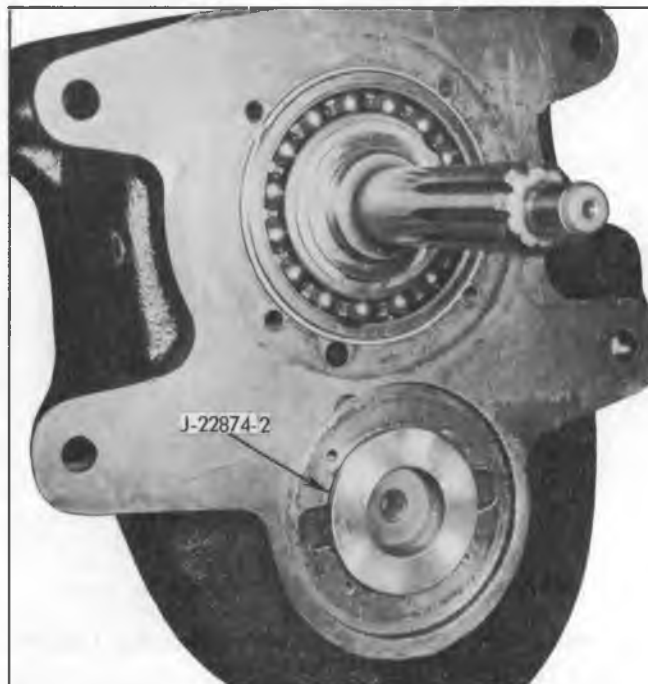


Fig. 24Q—Countergear Front Support Tool



Fig. 25Q--Installing Countergear Rear Bearing

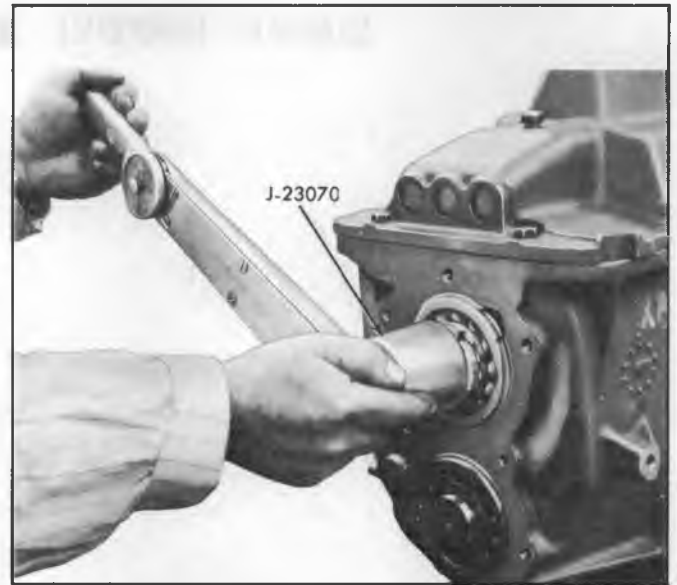


Fig. 26Q--Installing Mainshaft Rear Bearing Lock Nut (4-Wheel Drive Only)

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.

**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.

14. Install parking brake drum and/or universal joint flange.

**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.
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

SUBJECT	PAGE
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Cleaning and Inspection .....	7-50
Disassembly of Rear Output Shaft .....	7-52
Assembly of Rear Output Shaft .....	7-53
Assembly .....	7-55

## 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 sub-assembly is covered later in this section.**

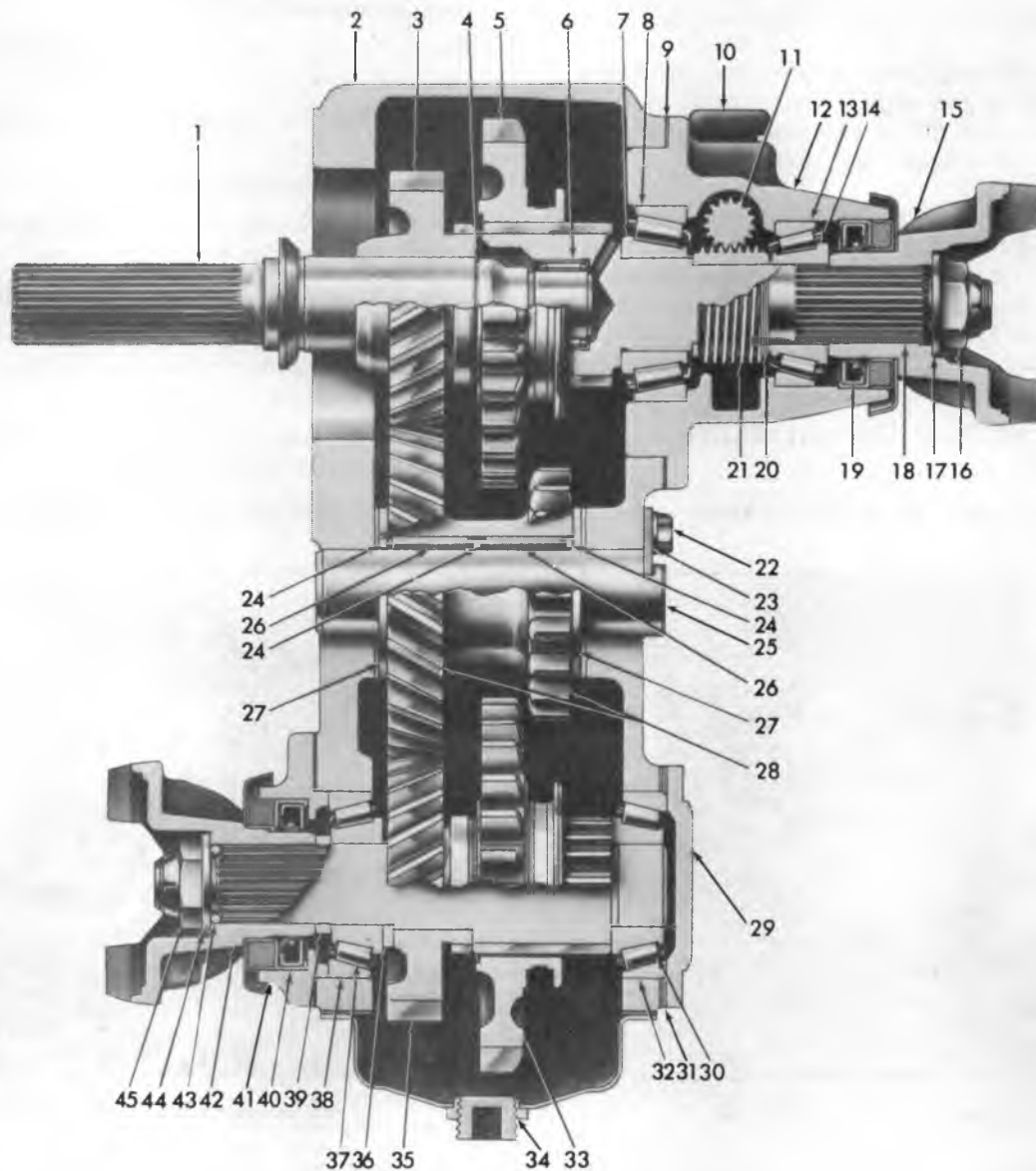
7. Remove locknut and washer from front output shaft yoke, if not removed during unit removal from vehicle, and slide yoke from output shaft.
8. Loosen dog set screw from rear wheel drive shift fork. Rotate shift rail to preload poppet ball and pull rail out of the housing. Remove shift fork and clutch 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.

## 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.



- |                        |                        |                        |                        |
|------------------------|------------------------|------------------------|------------------------|
| 1. Input Shaft         | 13. Rear Output Shaft  | 24. Intermediate Shaft | 34. Drain Plug         |
| 2. Transfer Case       | 14. Rear Output Shaft  | 25. Intermediate Shaft | 35. Front Output Shaft |
| 3. Input Gear          | 15. Rear Output Shaft  | 26. Intermediate Shaft | 36. Spacer             |
| 4. Snap Ring           | 16. Rear Output Shaft  | 27. Intermediate Shaft | 37. Front Output Shaft |
| 5. Sliding Clutch Gear | 17. Washer             | 28. Intermediate Gear  | 38. Front Output Shaft |
| 6. Rear Input Shaft    | 18. Rear Output Shaft  | 29. Front Output Shaft | 39. Spacer             |
| 7. Rear Output Shaft   | 19. Rear Output Shaft  | 30. Front Output Shaft | 40. Front Output Shaft |
| 8. Rear Output Shaft   | 20. Shims              | 31. Front Output Shaft | 41. Front Output Shaft |
| 9. Rear Output Shaft   | 21. Speedometer Drive  | 32. Front Output Shaft | 42. Front Output Shaft |
| 10. Rear Output Shaft  | 22. Intermediate Shaft | 33. Front Output Shaft | 43. Rubber "O" Ring    |
| 11. Speedometer Driven | 23. Intermediate Shaft |                        | 44. Washer             |
| 12. Rear Output Shaft  | 24. Intermediate Shaft |                        | 45. Front Output Shaft |
|                        | 25. Intermediate Shaft |                        |                        |
|                        | 26. Intermediate Shaft |                        |                        |
|                        | 27. Intermediate Shaft |                        |                        |
|                        | 28. Intermediate Gear  |                        |                        |
|                        | 29. Front Output Shaft |                        |                        |
|                        | 30. Front Output Shaft |                        |                        |
|                        | 31. Front Output Shaft |                        |                        |
|                        | 32. Front Output Shaft |                        |                        |
|                        | 33. Front Output Shaft |                        |                        |
|                        | 34. Drain Plug         |                        |                        |
|                        | 35. Front Output Shaft |                        |                        |
|                        | 36. Spacer             |                        |                        |
|                        | 37. Front Output Shaft |                        |                        |
|                        | 38. Front Output Shaft |                        |                        |
|                        | 39. Spacer             |                        |                        |
|                        | 40. Front Output Shaft |                        |                        |
|                        | 41. Front Output Shaft |                        |                        |
|                        | 42. Front Output Shaft |                        |                        |
|                        | 43. Rubber "O" Ring    |                        |                        |
|                        | 44. Washer             |                        |                        |
|                        | 45. Front Output Shaft |                        |                        |

Fig. 1D--Dana Transfer Case Cross-Section

**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 lockplate and gear from rear retainer.

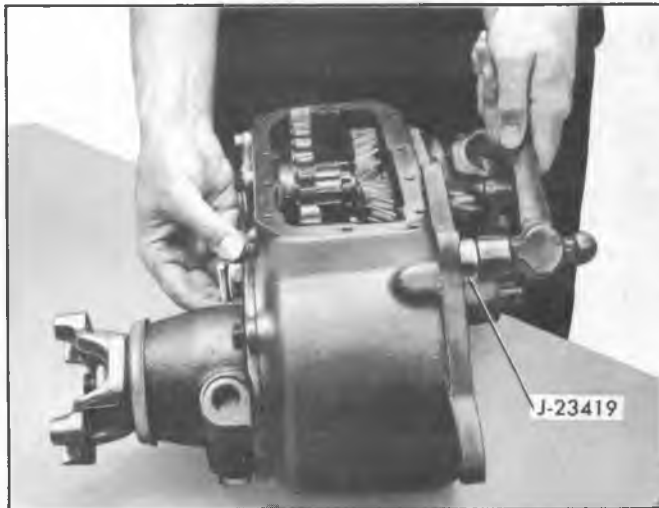


Fig. 2D--Removing Intermediate Gear Shaft

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.
7. Using a brass drift, remove the bearing cup from the housing front bore.
8. Remove shims and speedometer gear from the shaft. Tie shims together before laying aside.
9. Using press plates J-8331, remove front bearing from the shaft as shown in Figure 7D.
10. Collapse and remove pilot bearing from output shaft pilot bore.

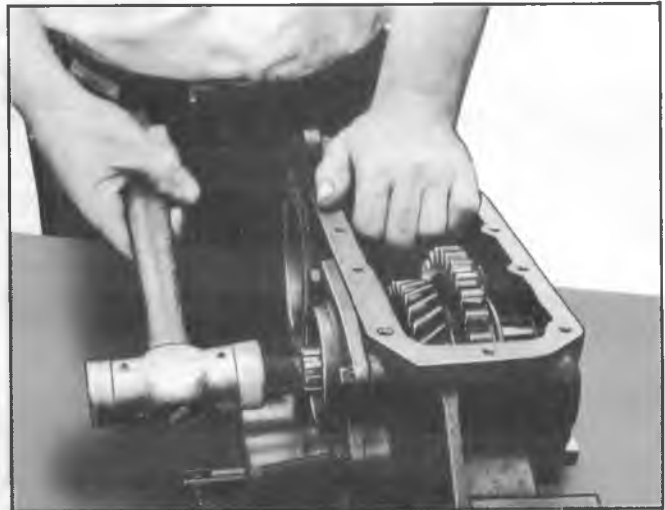


Fig. 4D--Removing Front Output Shaft

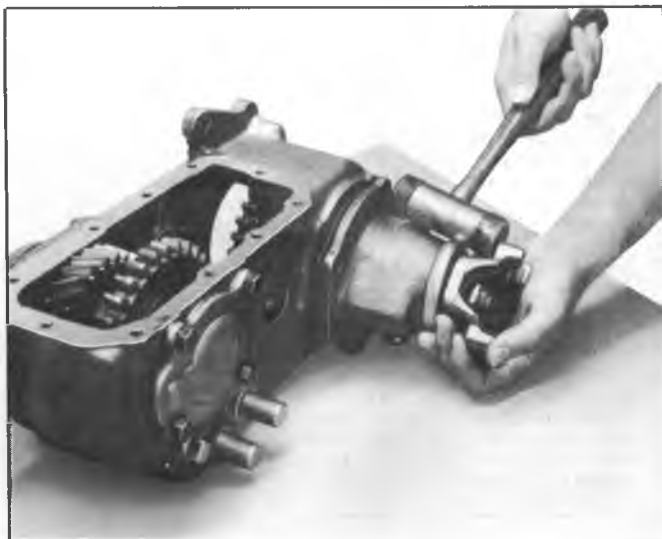


Fig. 3D--Removing Rear Output Shaft Sub-Assembly



Fig. 5D--Removing Front Output Shaft Rear Bearing



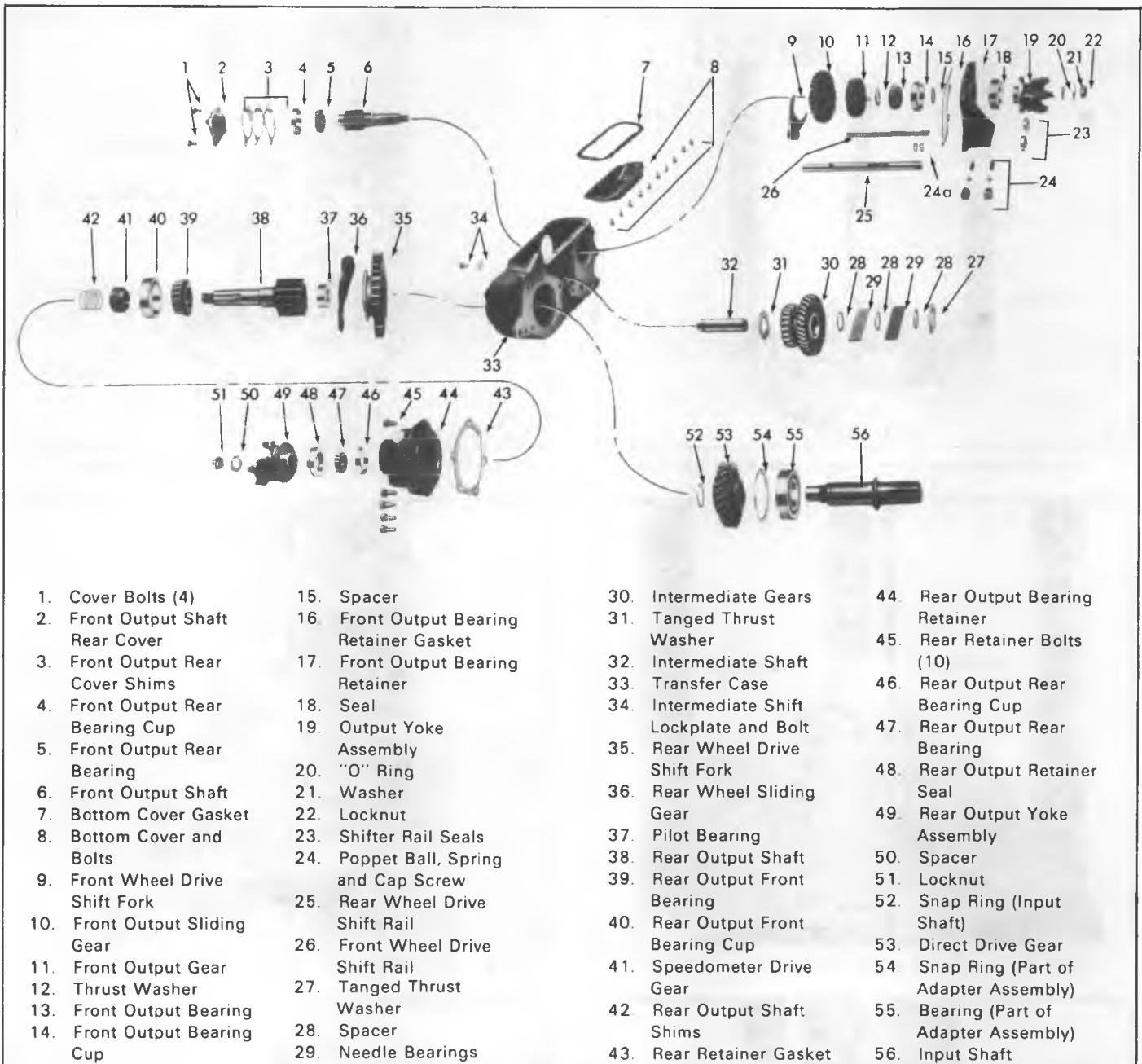


Fig. 6D--Dana Transfer Case Exploded View

## Assembly of Rear Output Shaft Sub-Assembly

1. 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.

2. Using Tool J-5590, press front bearing on shaft as shown in Figure 9D.
3. Install the front bearing cup in the front housing 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.

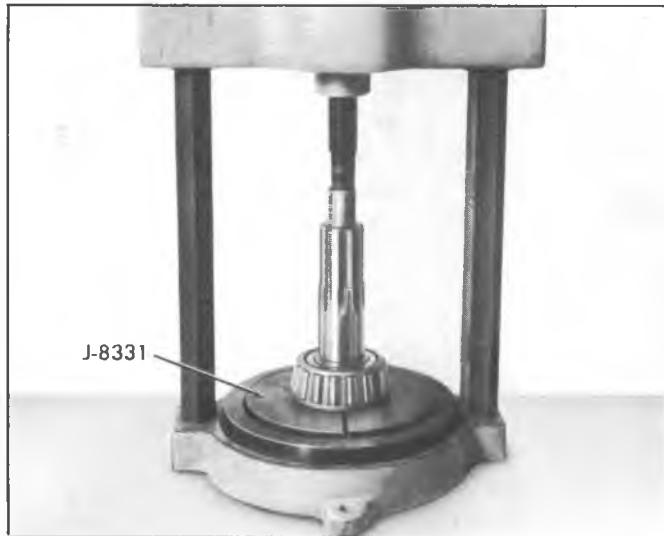


Fig. 7D--Removing Rear Output Shaft Front Bearing

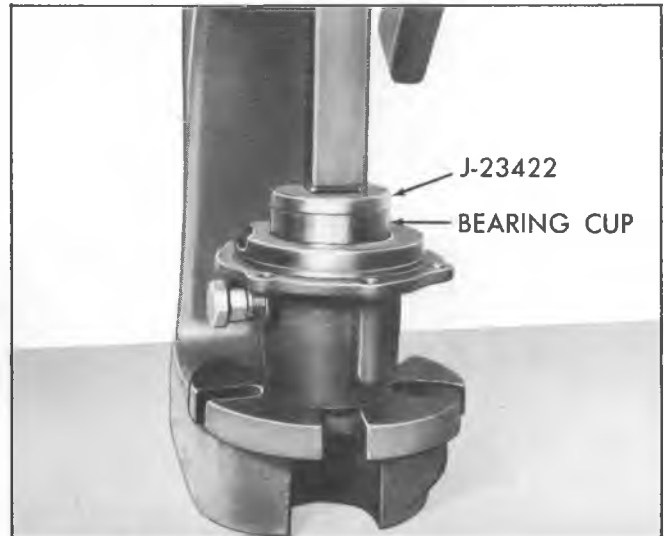


Fig. 10D--Installing Rear Output Shaft Front Bearing Cup

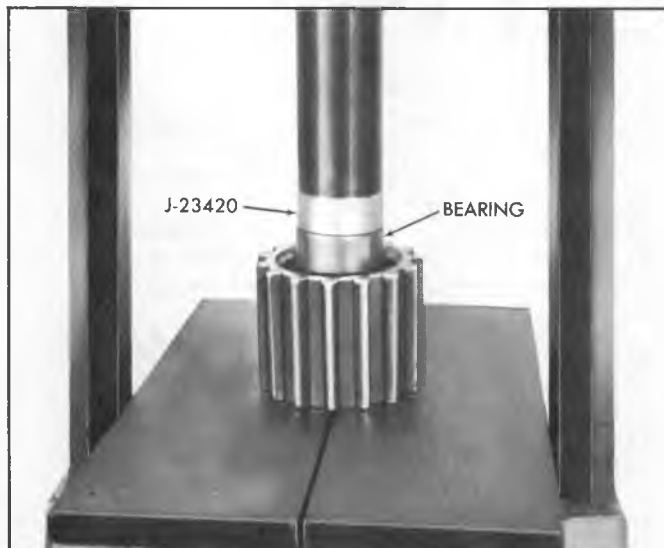


Fig. 8D--Installing Rear Output Shaft Pilot Bearing

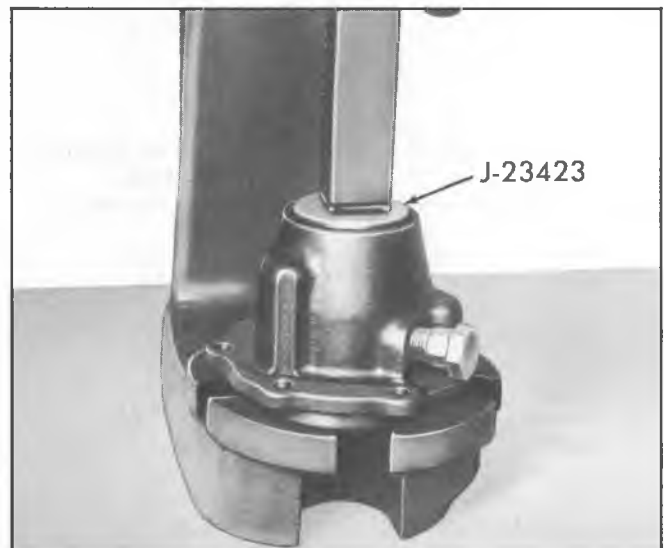


Fig. 11D--Installing Rear Output Shaft Rear Bearing Cup

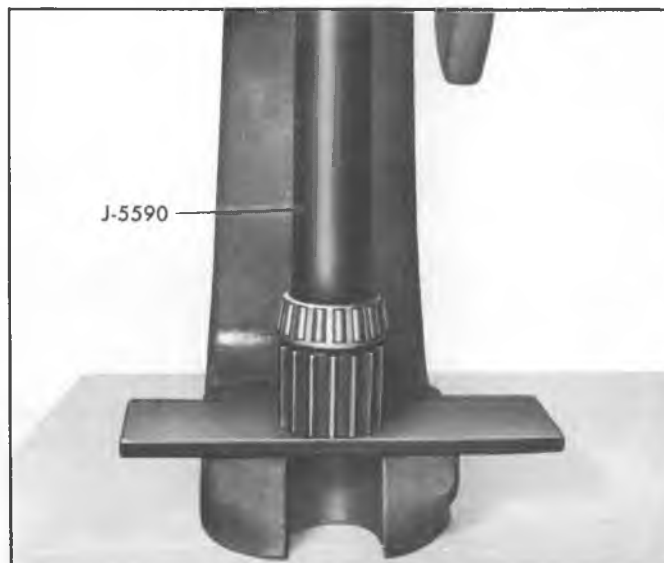


Fig. 9D--Installing Rear Output Shaft Front Bearing

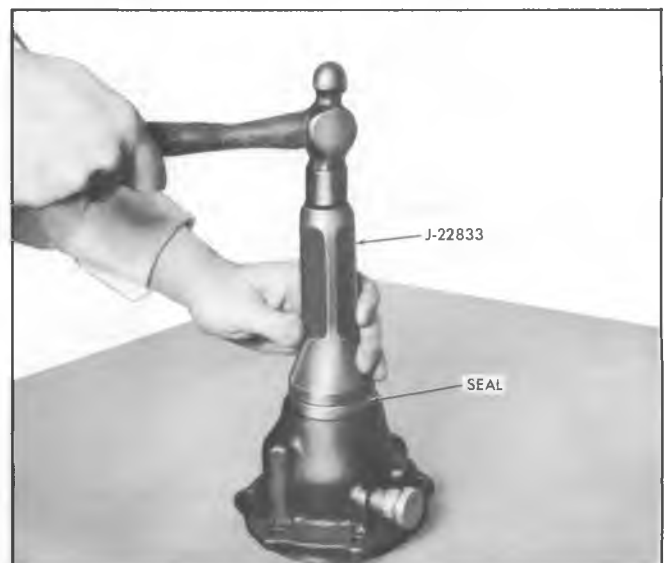


Fig. 12D--Installing Rear Output Shaft Rear Seal

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 wheel drive shift fork in case and push shift rail through case front. Align set screw hole in fork with shaft hole and install set screw. Torque set screw to 15 ft. lbs.

**NOTE:** Shift fork set screw boss should face front of case.

2. Position rear wheel drive clutch gear and shift fork in the case. Push shift rail through case front into fork and case rear. Install set screw and torque to 15 ft. lbs.

**NOTE:** Gear shift collar should face to case rear.

3. Place front wheel drive clutch in shift fork with collar toward case rear.
4. Support front output shaft and press rear bearing onto shaft using Tool J-6219 as shown in Figure 13D.
5. 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.
6. 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.

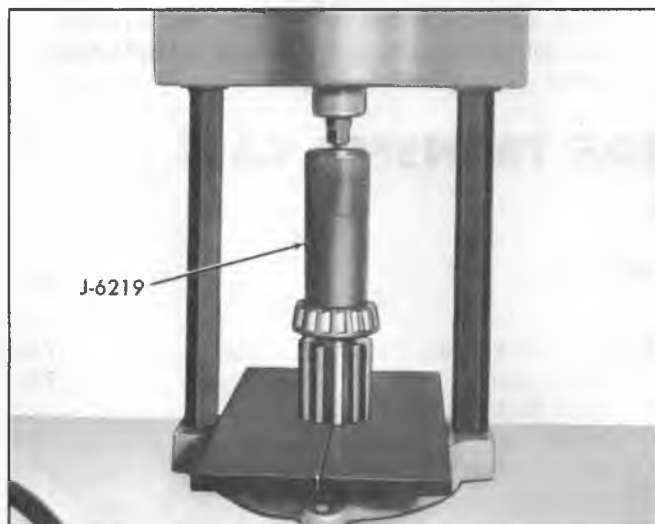


Fig. 13D—Installing Front Output Shaft Rear Bearing

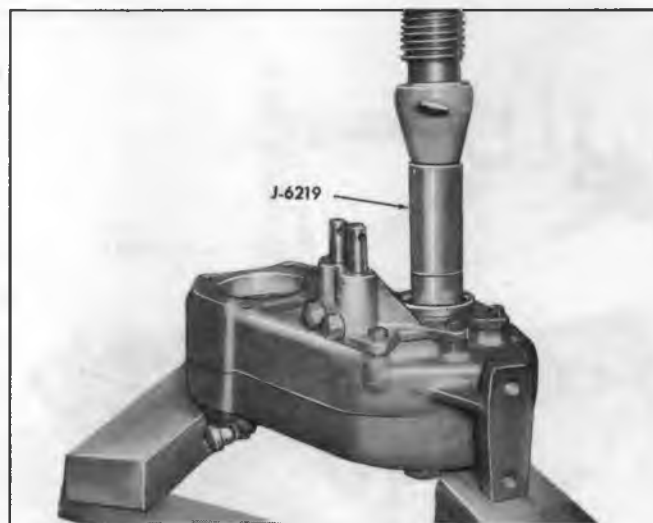


Fig. 14D—Installing Front Output Shaft Front Bearing

7. Slide spacer onto shaft. Position front bearing cup and tap into bore until flush with inner face.
8. Install shim pack and rear cover. Torque bolts to 30 ft. lbs.
9. Position retainer gasket to case and start rails into front bearing retainer.

**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.

10. Install the poppet ball springs in the housing access holes.

**CAUTION:** The longer spring (yellow) must be used on the rear wheel drive rail and the shorter (red) on the front wheel shift rail.

11. Depress the poppet ball on the poppet spring for the rear wheel drive and tap housing until end of rail passes over the ball. Repeat with other rail.
12. Lubricate rail seals and carefully slide shift rails through seals, then tap housing against case.

**CAUTION:** Seals may be damaged unless rails are free of burrs or rough edges.

13. Install front output shaft retainer bolts. Torque to 30 ft lbs.
14. Install front output shaft retainer seal using Tool J-22833 as shown in Figure 15D.
15. If shift rail cups are damaged or have been removed, position new cup in case bore and install by tapping on end of cup.

**CAUTION:** Distorted cups may permit leakage and interfere with shift rail operation.

16. Install front output shaft yoke, washer and locknut.



Fig. 15D—Installing Front Output Shaft Seal

**CAUTION:** Locknut must be torqued to 250 ft. lbs. before installing prop shaft during unit installation.

17. 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.

18. Install intermediate shaft lock plate and bolt. Torque bolt to 15 ft. lbs.
19. Install rear output shaft bearing assembly. Torque retaining bolts to 30 ft. lbs.

**CAUTION:** Use care to prevent damage to pilot bearings when engaging input shaft pilot.

20. Install rear output shaft yoke, washer and locknut if not previously done under reassembly of the sub-assembly.

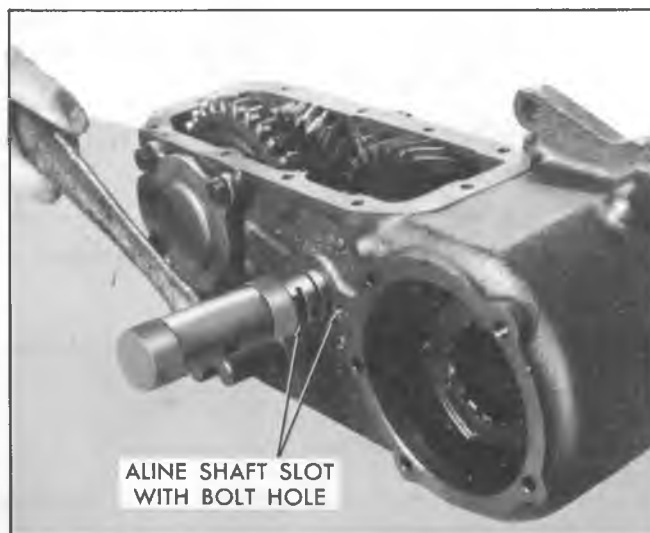


Fig. 16D—Installing Intermediate Shaft

**CAUTION:** Rear yoke locknut must be torqued to 200-250 ft. lbs. before checking end play and before installing the rear prop shaft.

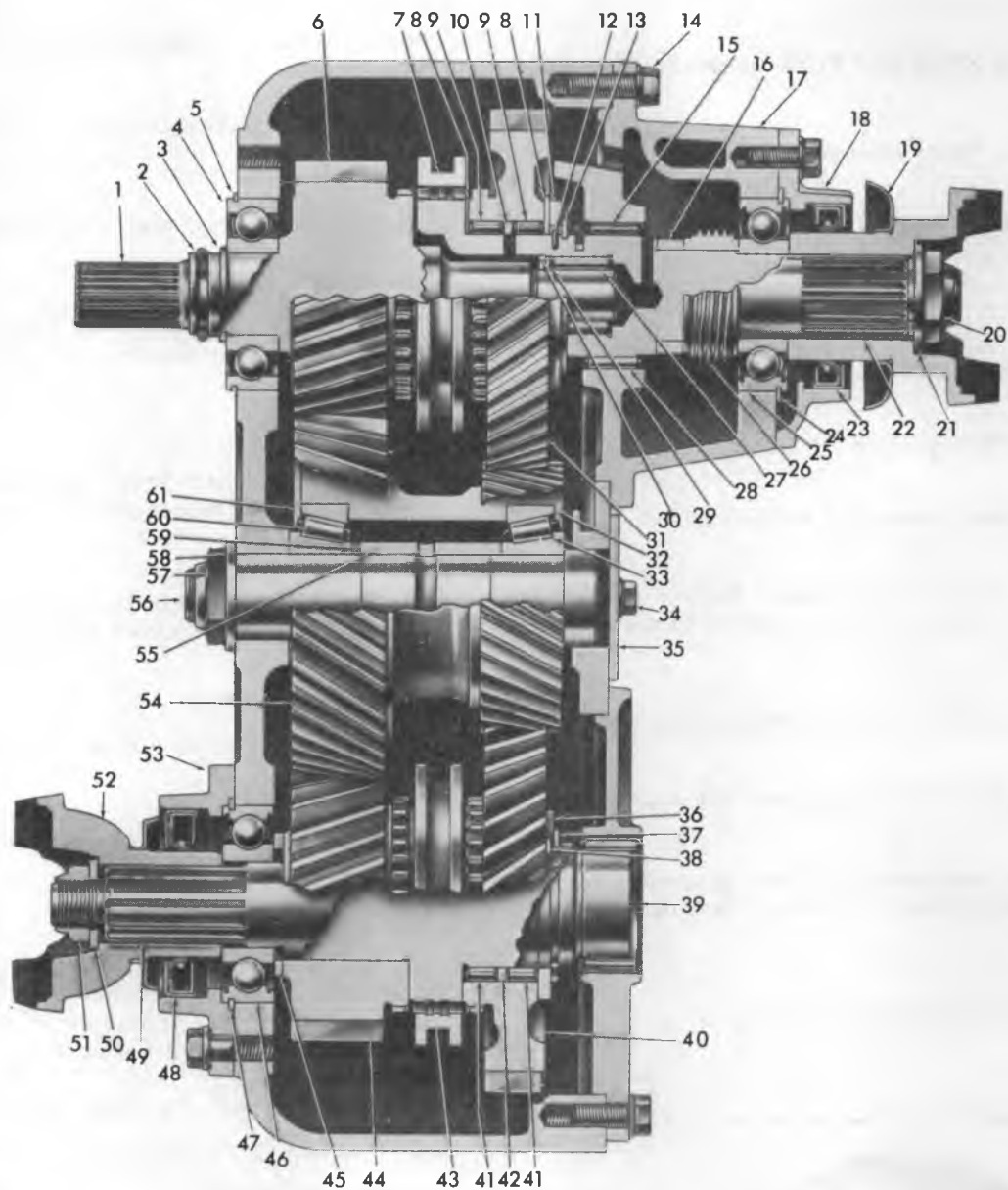
21. Shift transfer gears. Check gear engagement and shift rail movement. The four-wheel drive rail will have the greater poppet ball spring tension.
22. Position bottom cover and gasket to case. Install cover bolts and torque to 15 ft. lbs.
23. After the complete rebuild of the parts, and bearing retainer 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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| 17. Rear Output Shaft Housing  |                                     |  | 59. Bearing Cone        |
|                                |                                     |  | 60. Bearing Cup         |

Fig. 1C—New Process Transfer Case Cross Section

**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.

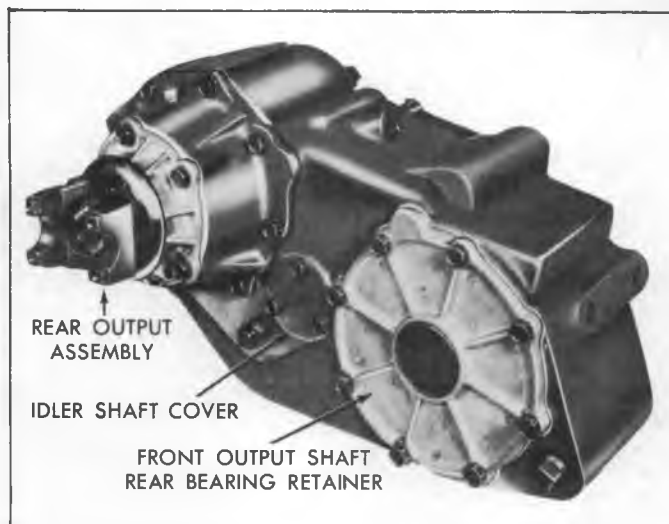


Fig. 2C--Rear View of Transfer Case

**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.

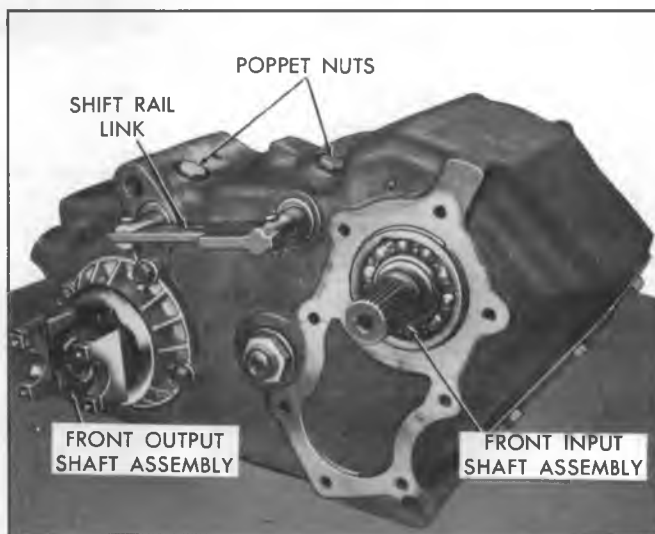


Fig. 3C--Front View of Transfer Case



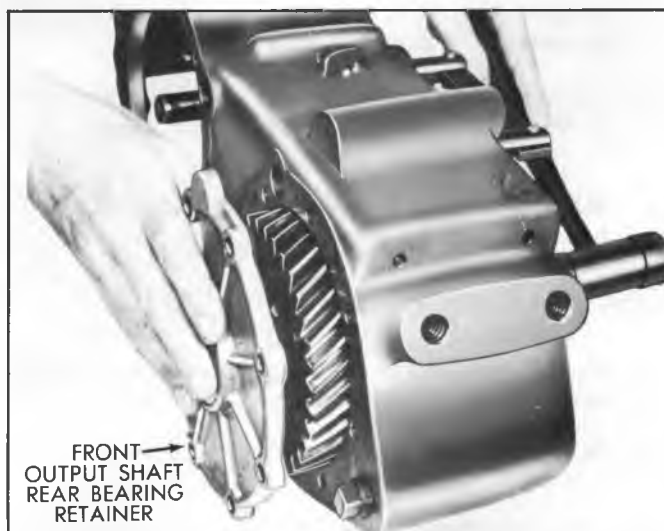


Fig. 4C—Removing Front Output Shaft Rear Bearing Retainer

## 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. Remove cup plugs on top of case using a 1/4 inch punch.
3. Position both shift rails in neutral and remove shift fork pins (Fig. 6C) using a long handle screw extractor.
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 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.

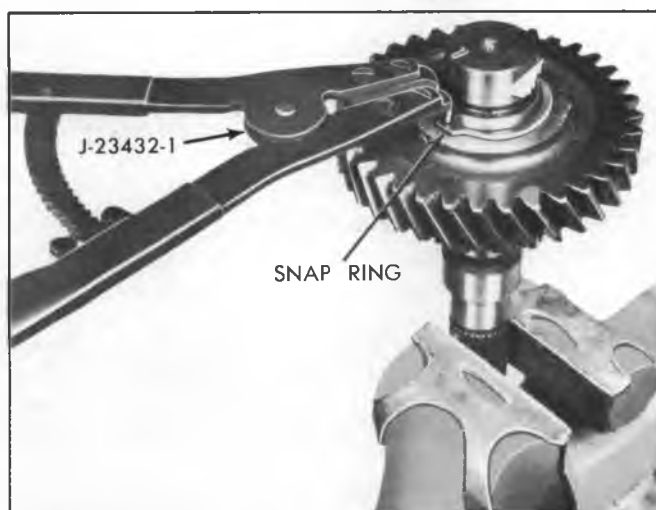


Fig. 5C—Removing Gear Retaining Ring



Fig. 6C—Removing Shift Fork Pins

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 ac-

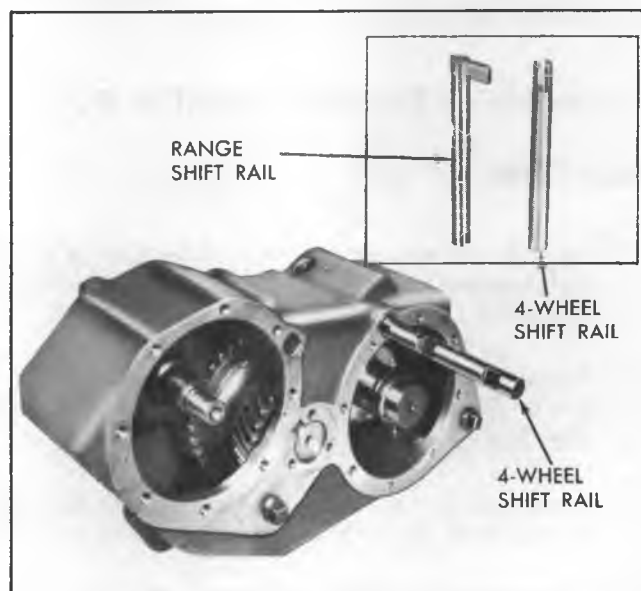


Fig. 7C—Shift Rail Removal



Fig. 8C--Removing Idler Gear Shaft

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 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.
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.

## 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.

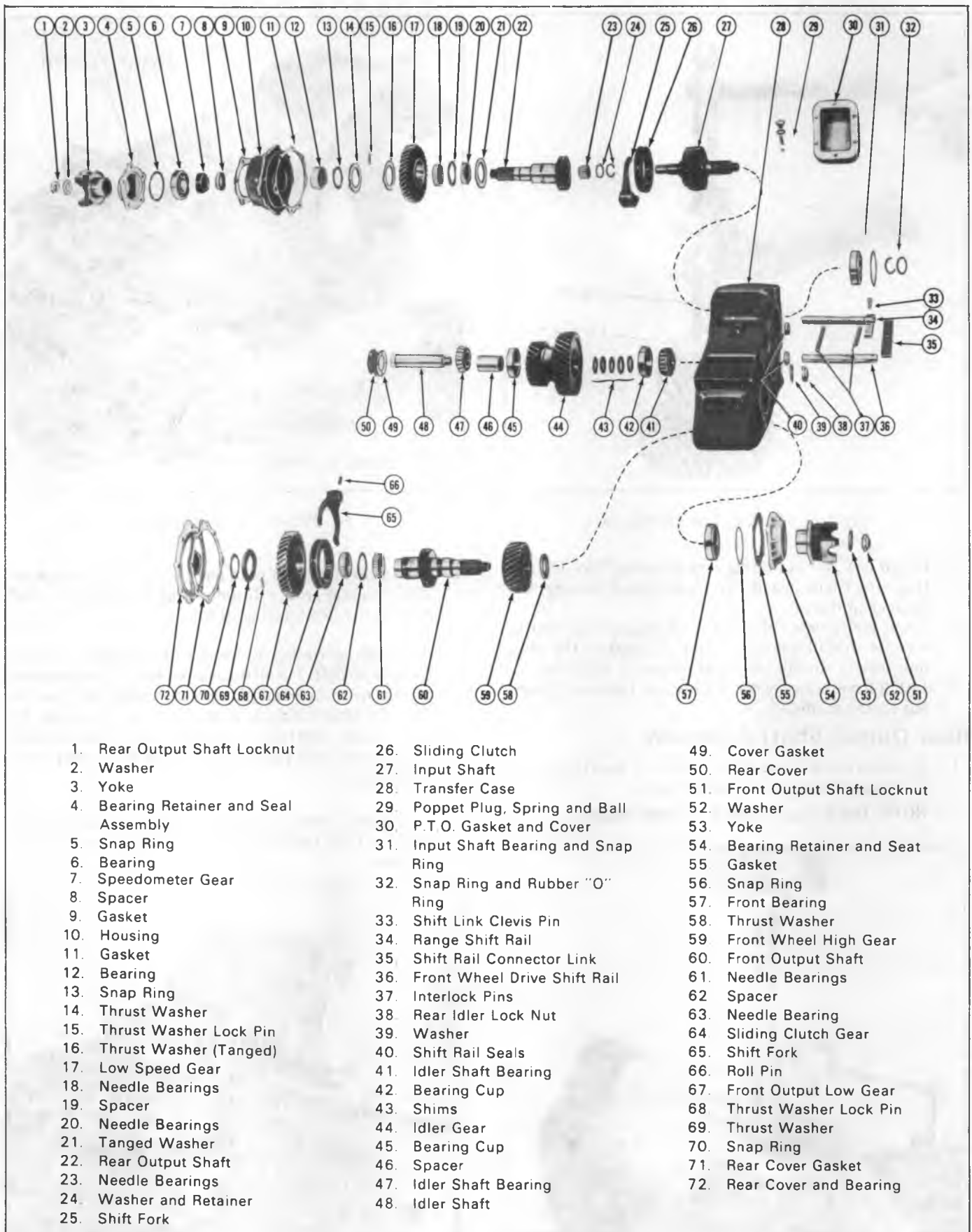


Fig. 9C--New Process Transfer Case Exploded View

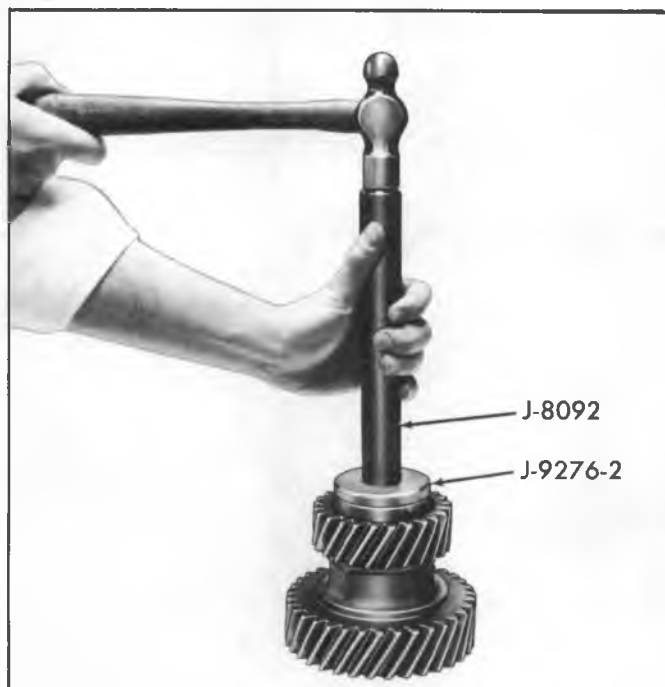


Fig. 10C--Installing New Bearing Cups

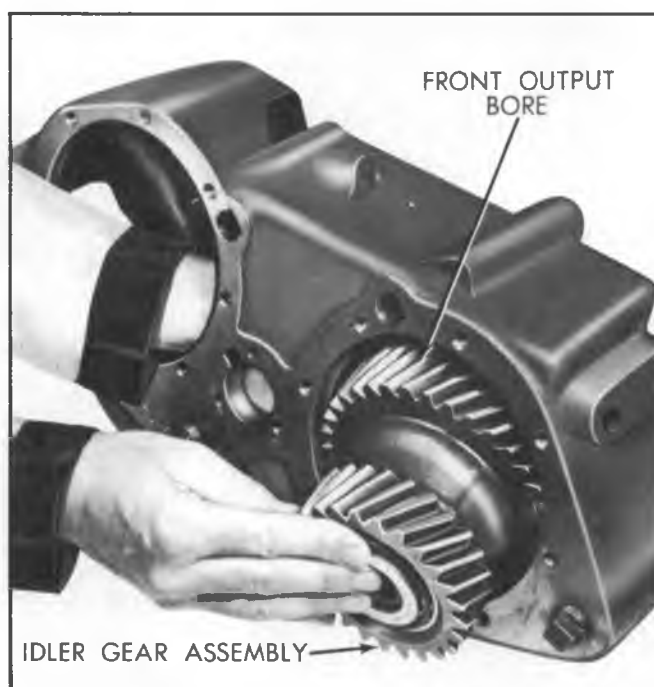


Fig. 12C--Installing Idler Gear

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 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 within .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.

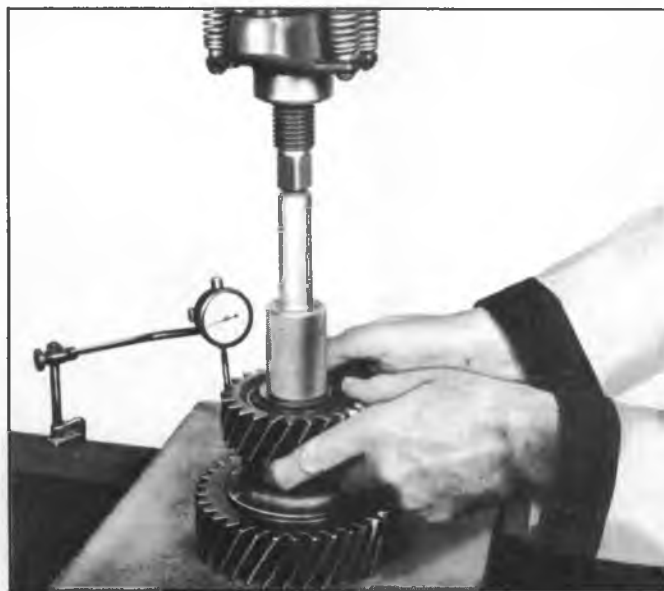


Fig. 11C--Checking Idler Gear End Play

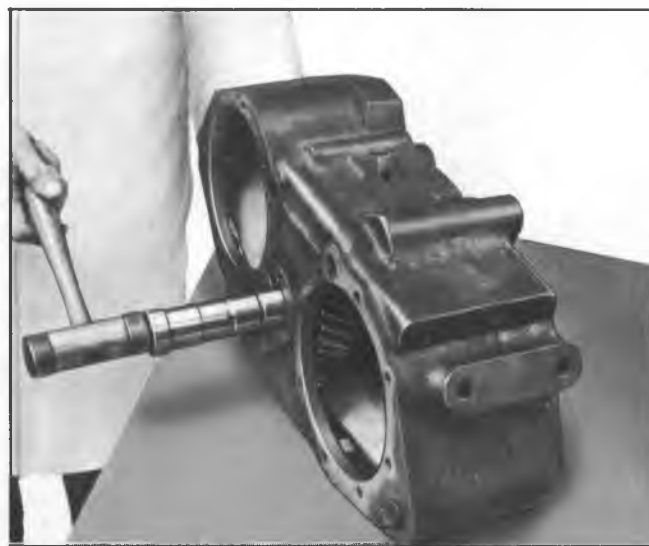


Fig. 13C--Installing Idler Shaft

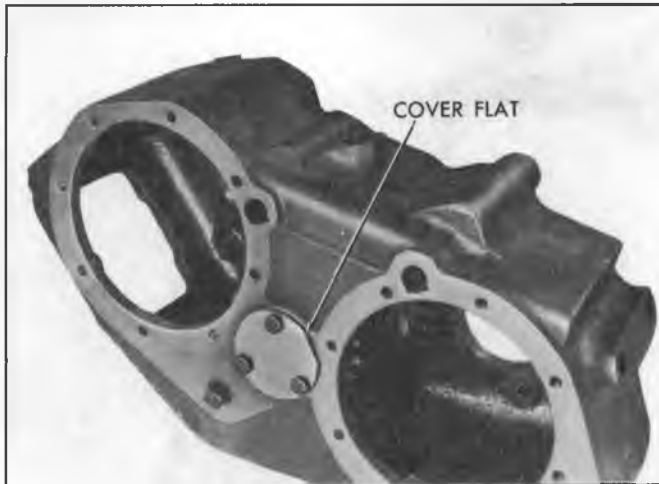


Fig. 14C--Installing Idler Shaft Rear Cover

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.

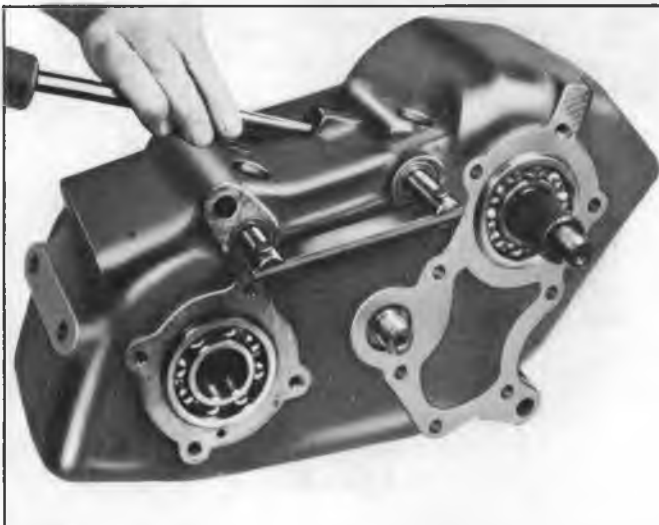


Fig. 15C--Installing Shift Rail Lock Pins



Fig. 16C--Installing Front Output Bearing Retainer Seal

### 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.



Fig. 17C--Installing Rear Output Shaft Housing Bearing



Fig. 18C—Installing Rear Output Shaft Spacer and Speedometer Gear



Fig. 19C—Installing Rear Bearing Retainer Seal

3. Install drain and filler plugs and torque to 30 ft. lbs.
4. Install shift rail cross link, clevis pins and lock pins.

## ADAPTER ASSEMBLIES

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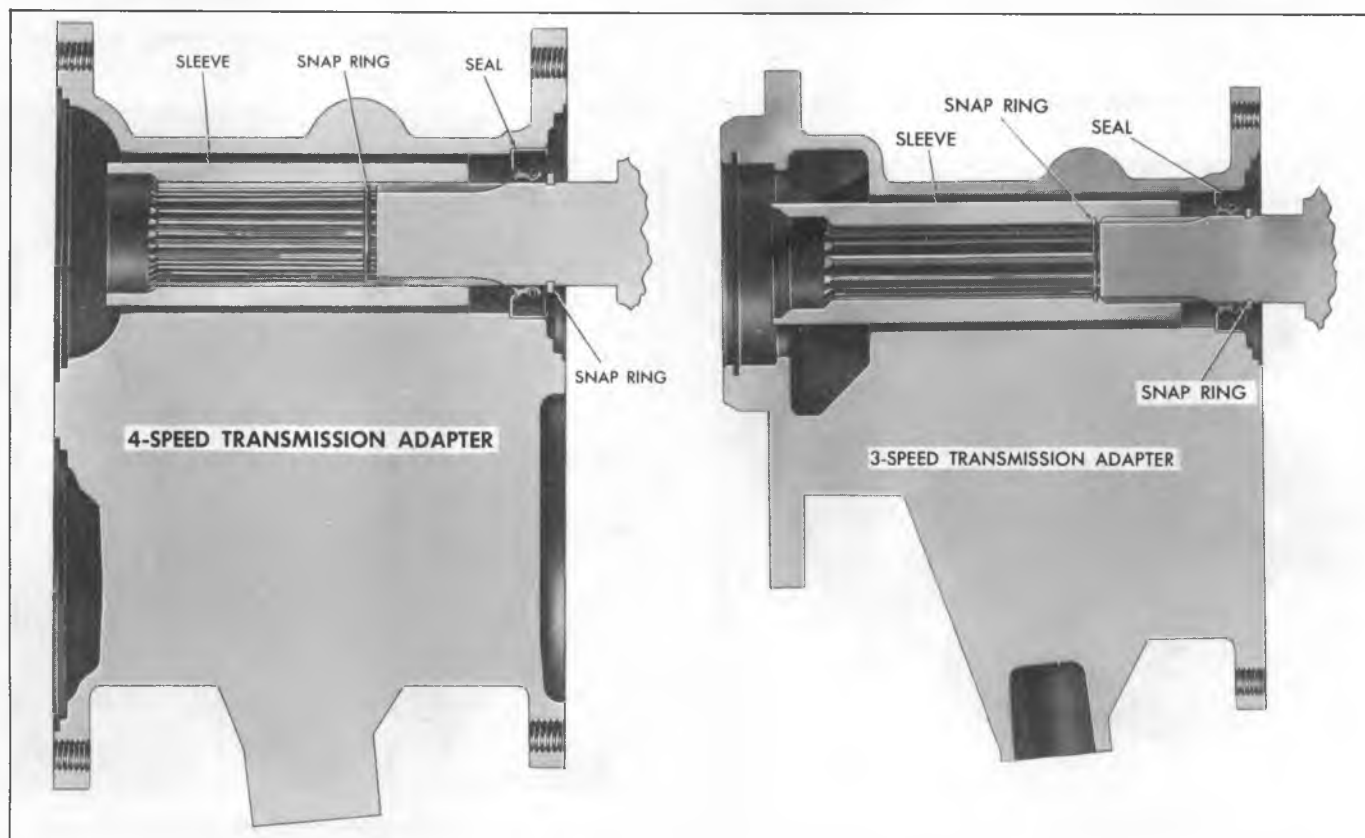


Fig. 1H—Manual Transmission Adapter Assemblies except Blazer



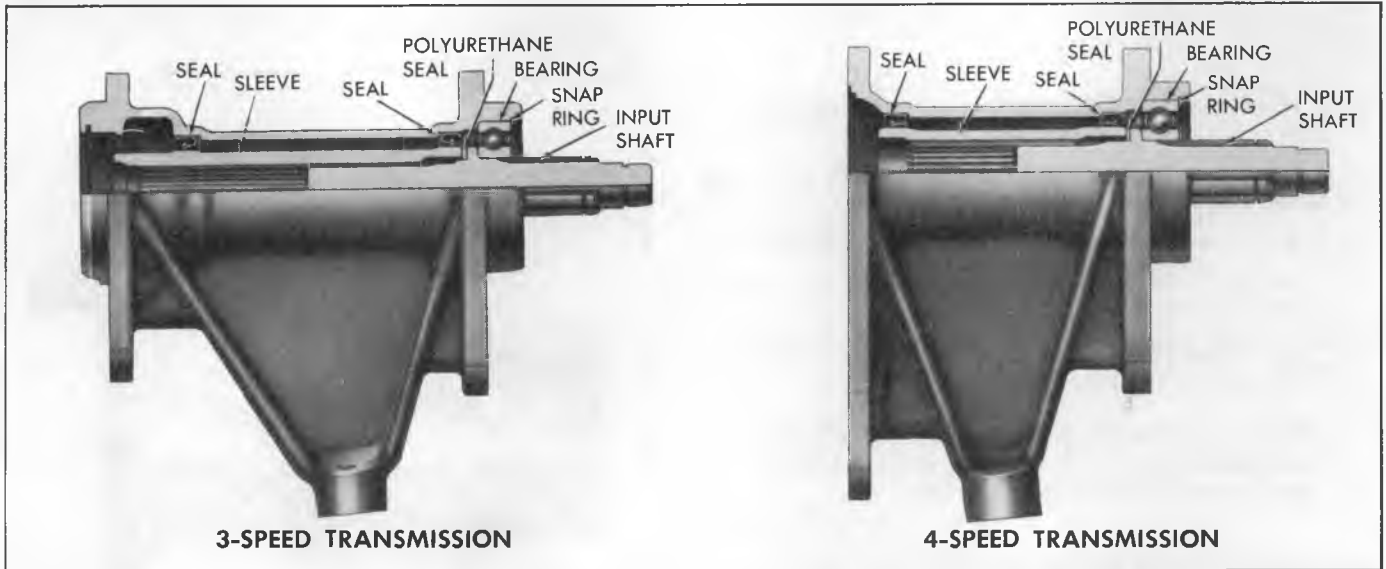


Fig. 2H--Manual Transmission Adapter Assemblies--Blazer Models

## MANUAL TRANSMISSIONS

### Except Blazer Models

#### 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. 3H.

### Blazer Models

#### Disassembly of Adapter (Fig. 2H)

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.

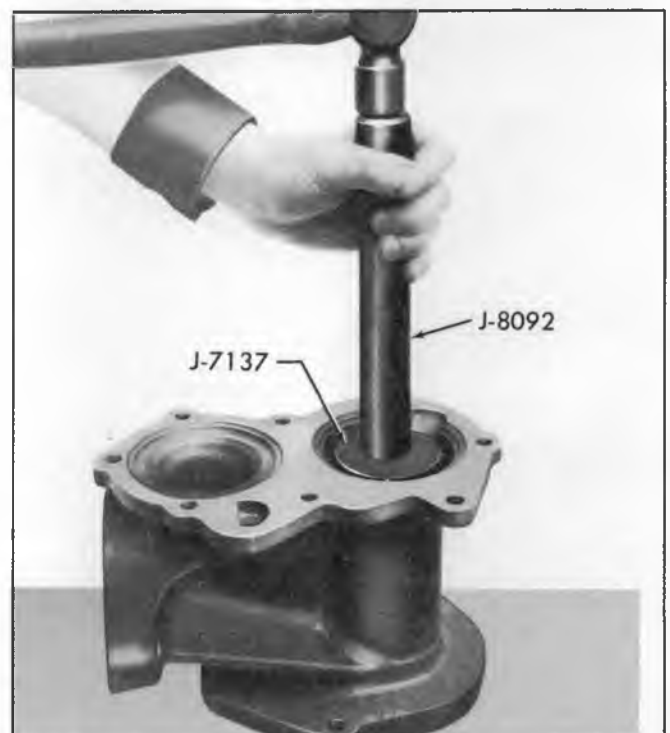


Fig. 3H--Installing Adapter Seal

### 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 3H.
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.

## AUTOMATIC TRANSMISSIONS

### All Models

#### 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.

#### Assembly of Adapter

2. Insert sleeve through seals into adapter bore and tap into place.

1. Install new seals in adapter using Tool J-7137 and J-8092 as shown in Figure 3H.

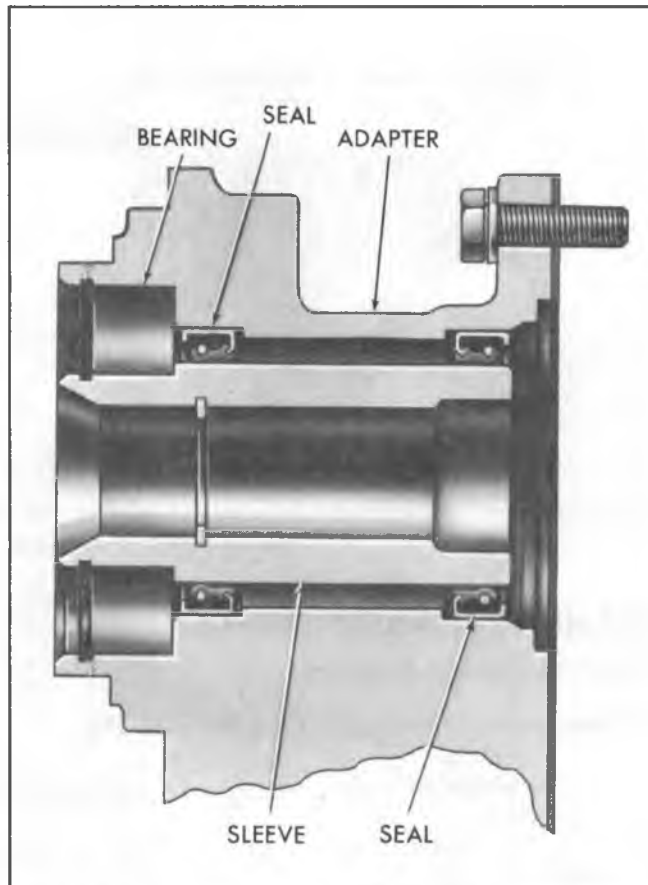


Fig. 4H--Automatic Transmission Adapter Cross Section

# POWERGLIDE

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## DISASSEMBLY OF TRANSMISSION

1. Place transmission in Holding Fixture J-3289-01 and Adapters J-9506 (fig. 2PG).

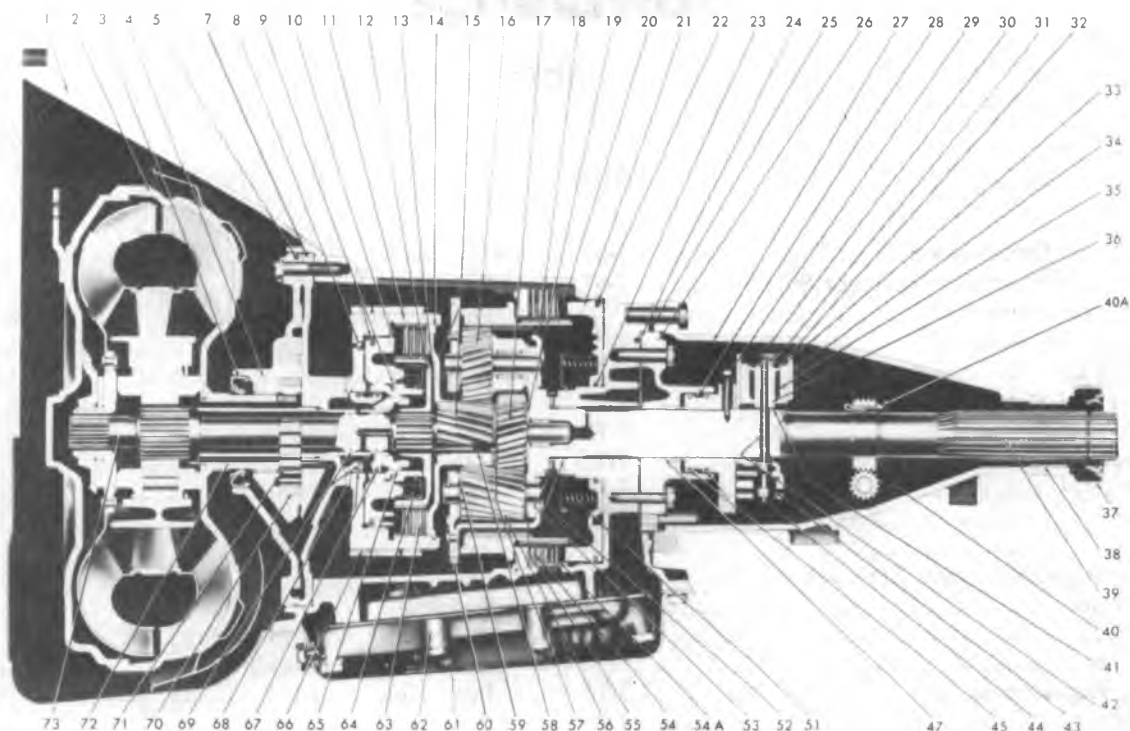
**NOTE:** Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the case should be thoroughly cleaned to prevent the possibility of dirt entering the transmission internal mechanism. During disassembly, all parts should be 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 plate facings.

2. Remove converter holding tool previously installed and remove converter assembly.

## Extension, Governor and Governor Support

3. If replacement is necessary, remove speedometer driven gear. Loosen capscrew and retainer clip holding speedometer driven gear in extension and remove gear.
4. Remove transmission extension by removing five bolts retaining extension to case. Note seal ring on governor support.
5. Remove the speedometer drive gear from output shaft as shown on Figure 3PG.
6. Remove the "C" clip from the governor shaft on the weight side of the governor, then remove the shaft and governor valve from the opposite side of the governor assembly (fig. 4PG) and the urethane washer.



- |   |   |
|---|---|
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| 2. Welded Converter                         | 39. Output Shaft  |
| 3. Oil Pump Seal Assembly                   | 40. Speedometer Drive and Driven Gear                         |
| 4. Oil Pump Body                            | 40A. Speedometer Driven Gear Retaining Clip                   |
| 5. Oil Pump Body Square Ring Seal           | 41. Governor Shaft Urethane Washer                            |
| 7. Oil Pump Cover                           | 42. Governor Shaft  |
| 8. Clutch Relief Valve Ball                 | 43. Governor Valve  |
| 9. Clutch Piston Inner and Outer Seal       | 44. Governor Valve Retaining Clip                             |
| 10. Clutch Piston                           | 45. Governor Hub Seal Rings                                   |
| 11. Clutch Drum                             | 47. Governor Support Bushing                                  |
| 12. Clutch Hub                              | 51. Reverse Piston Return Springs, Retainer and Retainer Ring |
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| 14. Clutch Flange Retainer Ring             | 53. Output Shaft Thrust Bearing                               |
| 15. Low Sun Gear and Clutch Flange Assembly | 54. Reverse Clutch Pack                                       |
| 16. Planet Short Pinion                     | 54A. Reverse Clutch Cushion Spring (Waved)                    |
| 17. Planet Input Sun Gear                   | 55. Pinion Thrust Washer                                      |
| 18. Planet Carrier                          | 56. Planet Long Pinion  |
| 19. Planet Input Sun Gear Thrust Washer     | 57. Low Sun Gear Needle Thrust Bearing                        |
| 20. Ring Gear                               | 58. Low Sun Gear Bushing (Splined)                            |
| 21. Reverse Piston                          | 59. Pinion Thrust Washer                                      |
| 22. Reverse Piston Outer Seal               | 60. Parking Lock Gear   |
| 23. Reverse Piston Inner Seal               | 61. Transmission Oil Pan                                      |
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| 26. Governor Support                        | 64. Clutch Piston Return Spring, Retainer and Retainer Ring   |
| 27. Extension                               | 65. Clutch Drum Bushing                                       |
| 28. Governor Hub                            | 66. Low Brake Band  |
| 29. Governor Hub Drive Screw                | 67. High Clutch Seal Rings                                    |
| 30. Governor Body                           | 68. Clutch Drum Thrust Washer (Selective)                     |
| 31. Governor Shaft Retainer Clip            | 69. Turbine Shaft Seal Rings                                  |
| 32. Governor Outer Weight Retainer Ring     | 70. Oil Pump Driven Gear                                      |
| 33. Governor Inner Weight Retainer Ring     | 71. Oil Pump Drive Gear                                       |
| 34. Governor Outer Weight                   | 72. Stator Shaft  |
| 35. Governor Spring                         | 73. Input Shaft   |
| 36. Governor Inner Weight                   |   |
| 37. Extension Rear Oil Seal                 |   |

Fig. 1PG-Aluminum Powerglide-Typical Sectioned View

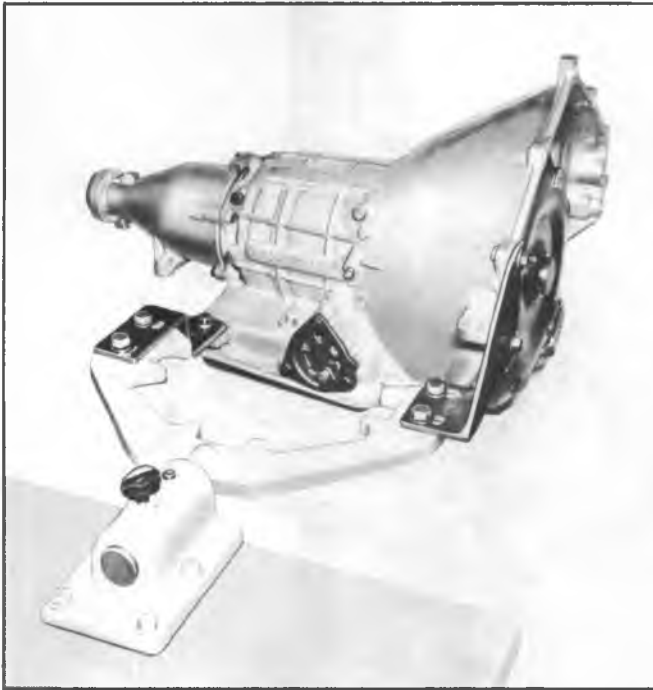


Fig. 2PG--Transmission Mounted in Fixture

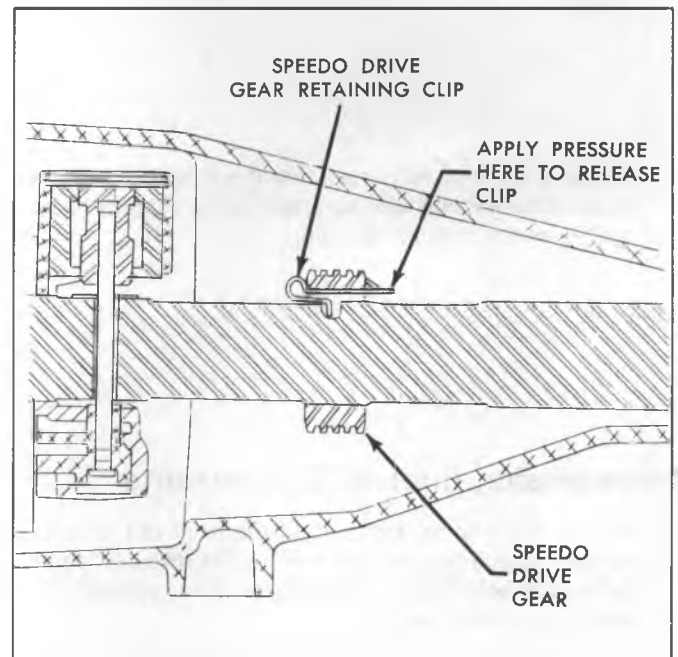


Fig. 3PG--Removing Speedometer Drive Gear



Fig. 4PG--Removing Governor Valve and Shaft

7. Loosen the governor drive screw and remove the governor assembly over the end of the output shaft (fig. 5PG).
8. Remove the four bolts retaining the governor support to the transmission case and remove the support body, gasket and extension seal ring.

### Transmission Internal Components

9. Rotate the holding fixture until the front of the transmission is pointing up and remove the seven oil pump bolts. The bolt holes are offset to facilitate proper location upon installation.
10. Remove the oil pump and stator shaft assembly and the selective fit thrust washer using J-9539 (or two 3/8"-16 x 10" stove bolts) and the slide weights from Tool J-6585 (fig. 6PG). Note the two threaded holes to mount the pullers. Remove the ring seal and gasket.

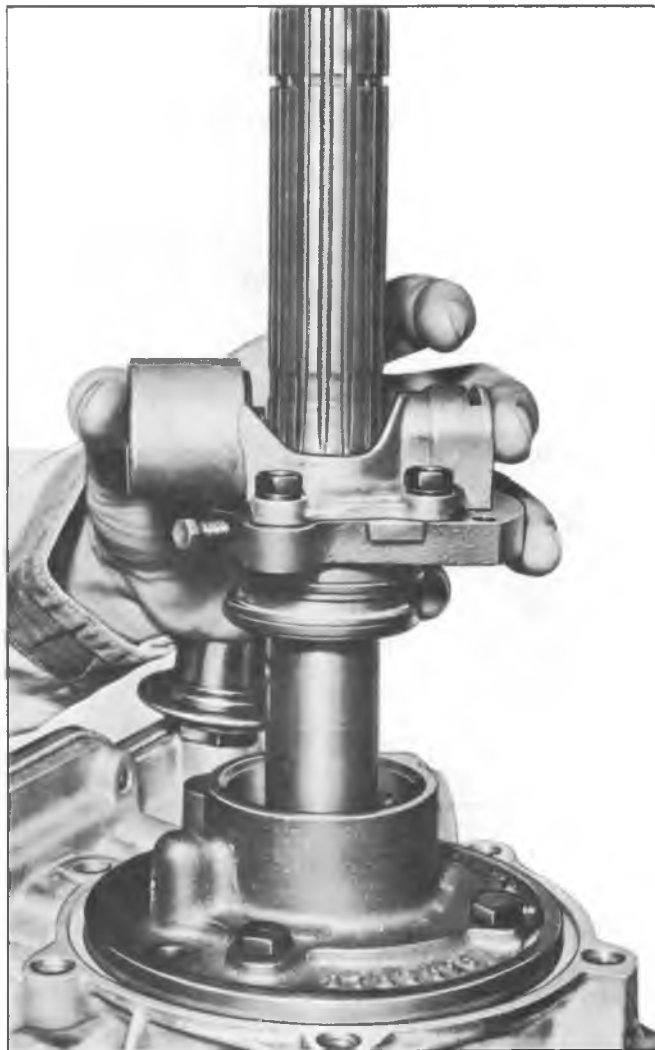


Fig. 5PG--Removing Governor Assembly

**NOTE:** The pump bolts have special sealing washers which must be in place upon installation.

11. Release the tension on the low band adjustment, then, with transmission horizontal, grasp the transmission input shaft and carefully work it and the clutch assembly out of the case (fig. 7PG). Use care so as not to lose the low sun gear (splined) bushing from the input shaft. The low sun gear thrust washer will probably remain in the planet carrier.

**CAUTION:** Use care so as not to damage the machined face on the front of the clutch drum.

12. The low brake band and struts may now be removed.

13. Remove the planet carrier and the output shaft thrust caged bearing from the front of the transmission.
14. Remove the reverse ring gear if it did not come out with the planet carrier.
15. Using a large screw driver remove the reverse clutch pack retainer ring and then lift out the reverse clutch plates and the (waved) cushion spring.

**NOTE:** If difficulty is experienced in getting the snap ring past the shoulder on the reverse pack pressure plate, a feeler gauge may be used as a guide.

16. Install Tool J-9542 through the rear bore of the case with the flat plate on the rear face of the case and turn down the wing nut to compress the rear piston spring retainer and springs, then remove the snap ring (fig. 8PG). Tool J-8039 may be used to remove the snap ring if desired.
17. Remove Tool J-9542, the reverse piston spring retainer and the 17 piston return springs.





Fig. 6PG-Removing Oil Pump

18. Remove the rear piston by applying air to the reverse port in the rear of the transmission case as shown in Figure 9PG. Remove the inner and outer seals.
19. Remove the three servo cover bolts, servo cover, piston and spring.

### Oil Pan and Valve Body

**NOTE:** The oil pan and valve body may be serviced without the necessity of removing the extension and internal components covered in the preceding steps.

20. Rotate the holding fixture until the transmission is upside down and the oil pan is at the top. Remove the oil pan attaching bolts, oil pan and gasket. Remove screen: replace at assembly using new transmission case screen.

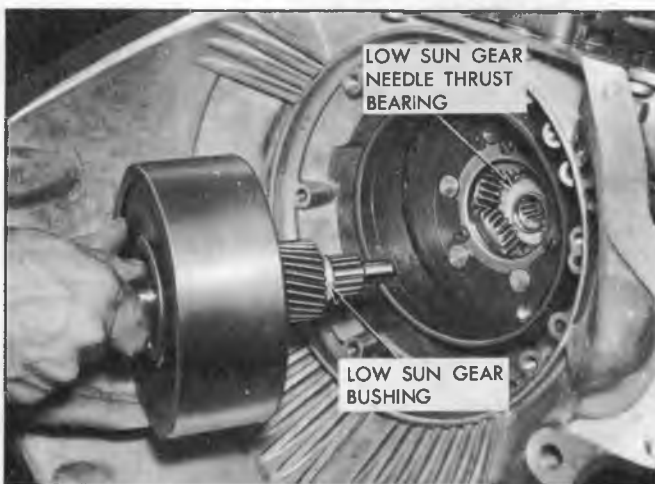


Fig. 7PG-Removing Clutch Drum and Input Shaft

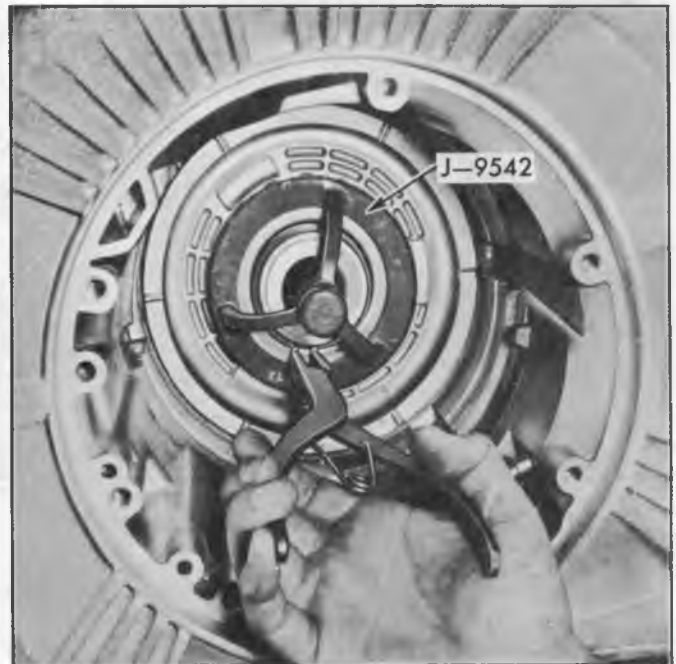


Fig. 8PG-Removing Rear Piston Spring Retainer Snap Ring

21. Remove the vacuum modulator and gasket, and the vacuum modulator plunger, dampening spring (except L-4 base) and valve (fig. 10PG).
22. Remove the two bolts attaching the detent guide plate to the valve body and the transmission case. Remove the guide plate and the range selector detent roller spring.
23. Remove the remaining valve body-to-transmission case attaching bolts (indicated by arrows in Figure 11PG) and carefully lift out the valve body and gasket, disen-

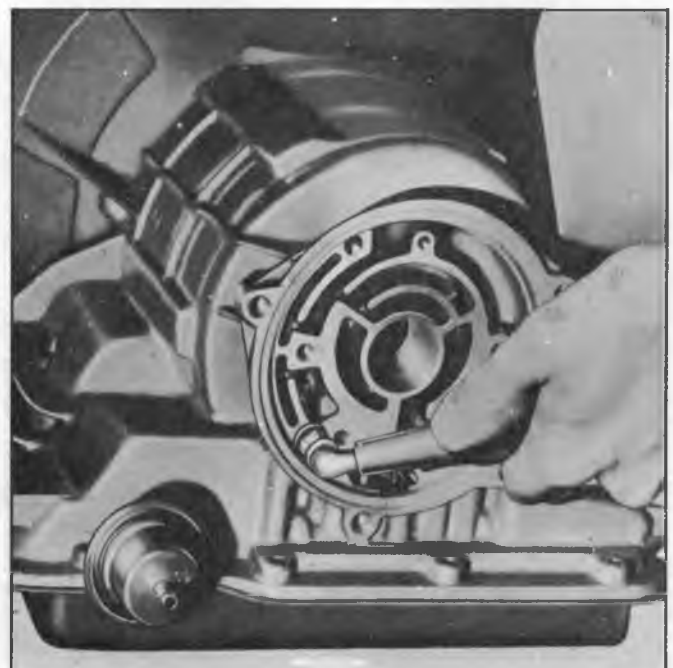


Fig. 9PG-Applying Air to Remove Rear Piston

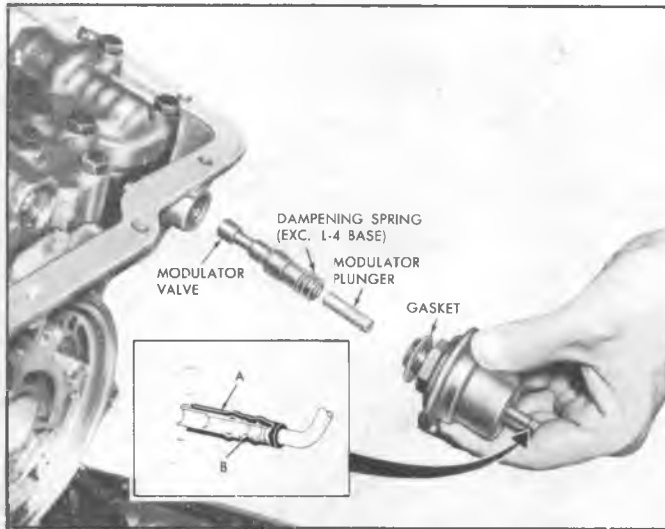


Fig. 10PG--Vacuum Modulator, Dampening Spring, Plunger and Valve

gaging the servo apply tube from the transmission case as the valve body is removed.

24. If necessary, the TV, shift and parking actuator assembly levers, and the parking pawl and bracket (fig. 12PG) may be removed.

This completes the entire transmission disassembly procedure. Component parts disassembly and repair procedures will be found in succeeding pages of this manual.

## OVERHAULING UNIT ASSEMBLIES

### Convertor and Stator

The converter is a welded assembly and no internal repairs are possible. Check the seams for stress or breaks and replace converter if necessary.

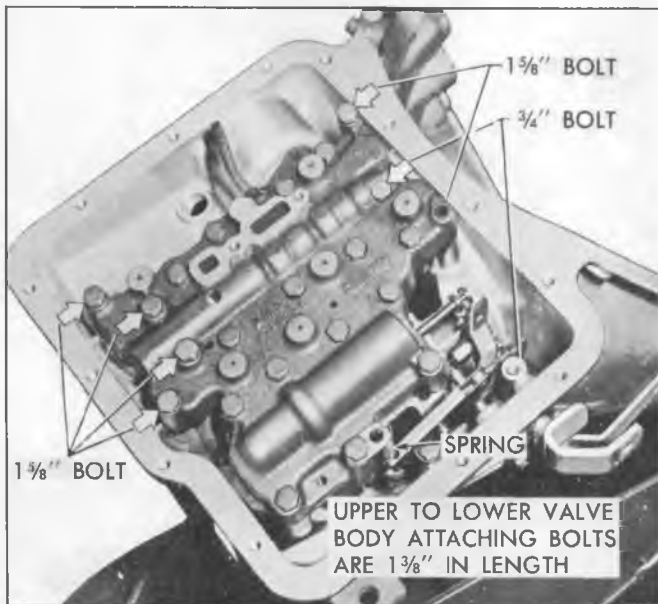


Fig. 11PG--Valve Body Removal

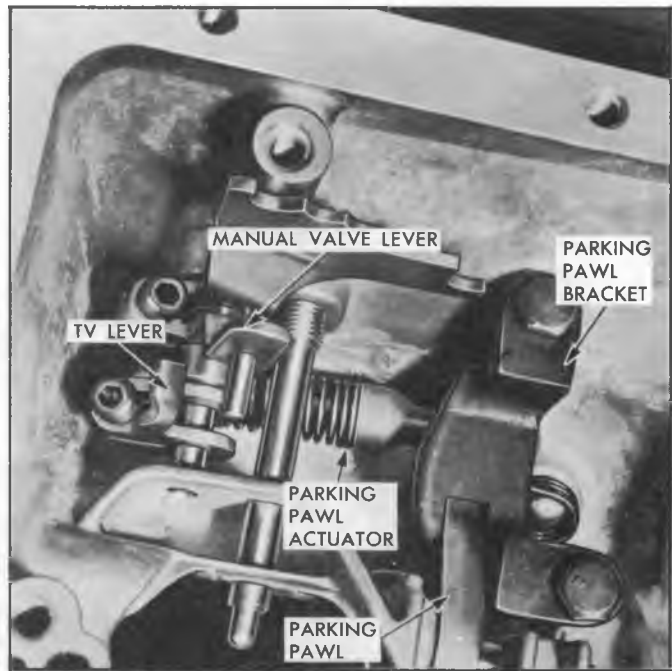


Fig. 12PG--Inner Control Levers, Parking Pawl and Bracket

## Oil Pump

### Seal Replacement

If the pump seal requires replacement, remove the pump from the transmission, pry out and replace the seal. (Drive new seal into place, fully seated in counterbore using J-6839). Then, if no further work is required on the pump, reinstall it in the case.

**NOTE:** Outer diameter of the seal should be coated with non-hardening sealer prior to installation.

### Disassembly

1. Remove bolts attaching pump cover to body and remove the cover.
2. Remove pump gears from body.

**CAUTION:** Do not drop or nick gears. These gears are not heat treated.

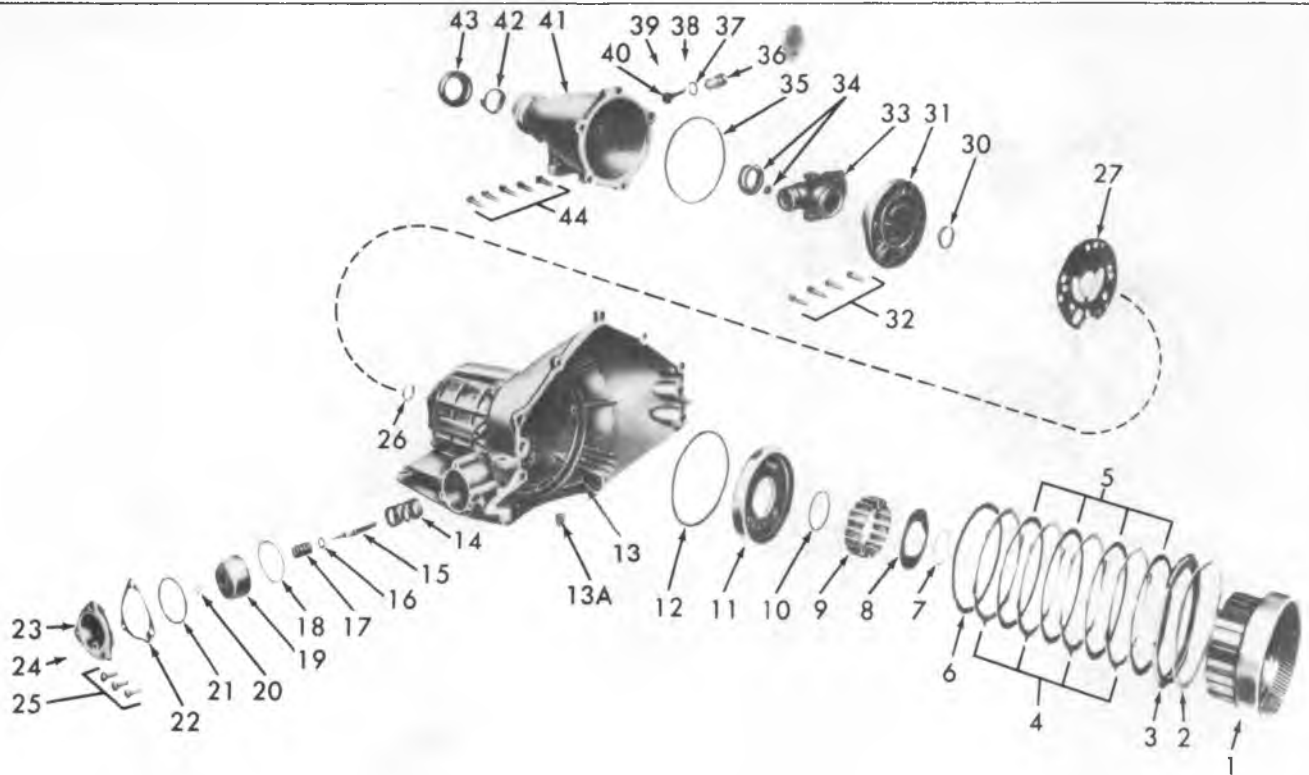
3. Remove the rubber seal ring from the pump body.

**NOTE:** See Figure 14PG for a layout of pump parts.

### 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.



- |   |                                      |  |
|---|--------------------------------------|--|
| 1. Reverse Ring Gear                            | 13. Transmission Case                | 31. Governor Support                         |
| 2. Reverse Clutch Pack Snap Ring                | 13A. Transmission Case Screen        | 32. Governor Support to Case Attaching Bolts |
| 3. Reverse Clutch Pressure Plate                | 14. Servo Piston Return Spring       | 33. Governor Assembly                        |
| 4. Reverse Clutch Reaction Plates               | 15. Servo Piston Rod                 | 34. Speedometer Drive Gear and Clip          |
| 5. Reverse Clutch Drive Plates                  | 16. Servo Piston Apply Spring Seat   | 35. Seal                                     |
| 6. Reverse Clutch Cushion Spring                | 17. Servo Piston Apply Spring        | 36. Speedometer Shaft Fitting                |
| 7. Reverse Clutch Piston Return Spring          | 18. Servo Piston Seal Ring           | 37. Speedometer Shaft Fitting Oil Seal       |
| 8. Reverse Clutch Piston Return Spring Retainer | 19. Servo Piston                     | 38. Lock Plate Attaching Screw               |
| 9. Reverse Clutch Piston Return Springs         | 20. Servo Piston Rod Spring Retainer | 39. Lock Plate                               |
| 10. Reverse Clutch Piston Inner Seal            | 21. Servo Cover Seal                 | 40. Speedometer Driven Gear                  |
| 11. Reverse Clutch Piston Outer Seal            | 22. Servo Cover Gasket               | 41. Transmission Extension                   |
|   | 23. Servo Cover                      | 42. Extension Bushing                        |
|   | 24. Servo Cover Plug                 | 43. Extension Oil Seal                       |
|   | 25. Servo Cover Bolts                | 44. Extension to Case Attaching Screws       |
|   | 26. Transmission Case Bushing        |  |
|   | 27. Gasket                           |  |
|   | 30. Governor Support Bushing         |  |

Fig. 13PG—Transmission Case—Exploded View (Typical)

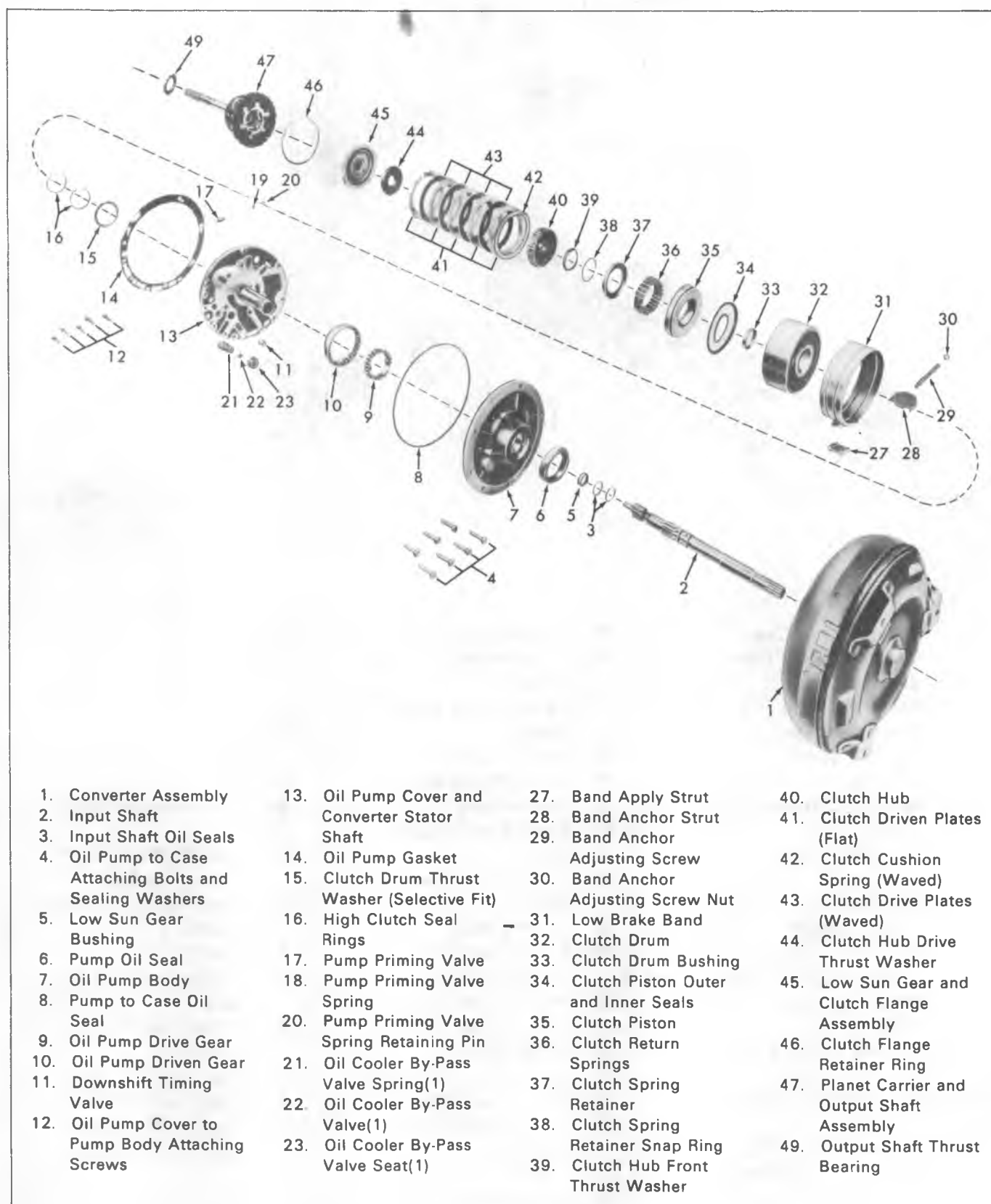
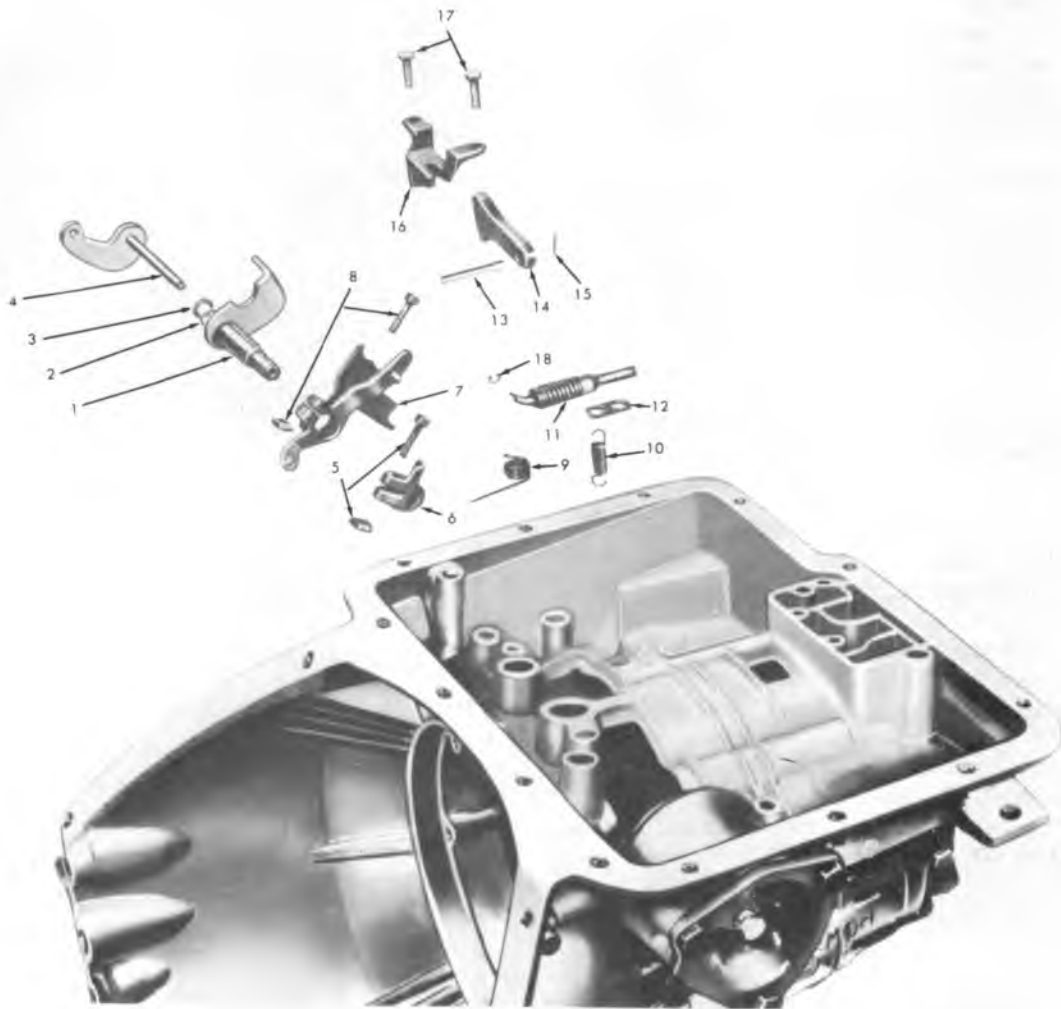


Fig. 14PG--Internal Mechanism--Exploded View (Typical)



- |  |   |   |
|--|---|---|
| 1. Park Lock and Range Selector Outer Lever and Shaft                          | 7. Park Lock and Range Selector Inner Lever                         | 13. Park Lock Pawl Shaft  |
| 2. Throttle Valve Control Shaft Oil Seal                                       | 8. Park Lock and Range Selector Inner Lever Attaching Screw and Nut | 14. Park Lock Pawl  |
| 3. Throttle Valve Control Shaft Washer   | 9. Park Lock Pawl Disengaging Spring                                | 15. Park Lock Pawl Shaft Retaining Ring   |
| 4. Throttle Valve Control Lever and Shaft                                      | 10. Range Selector Detent Roller Spring                             | 16. Park Lock Pawl Reaction Bracket   |
| 5. Throttle Valve Control Inner Lever to Control Shaft Attaching Screw and Nut | 11. Park Lock Actuator Assembly                                     | 17. Park Lock Pawl Reaction Bracket Attaching Bolts                               |
| 6. Throttle Valve Control Inner Lever  | 12. Range Selector Detent Roller Spring Retainer                    | 18. Park Lock Actuator to Park Lock and Range Selector Inner Lever Retaining Clip |

Fig. 15PG--Manual Levers--Typical Exploded View

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. Check for free operation of the priming valve and replace if necessary.
5. Inspect body bushing for galling or scoring. Check clearance between body bushing and converter pump hub (fig. 16PG). Maximum clearance is .005". If the bushing is damaged, the oil pump body should be replaced.
6. Inspect converter housing hub O.D. for nicks or burrs which might damage pump seal or bushing. Repair or replace as necessary.
7. If oil seal is damaged or is leaking (and the pump body is otherwise suitable for reuse), pry out and install a new seal, fully seated in counterbore, using Seal Driver J-6839.

**NOTE:** Outer diameter of seal should be coated with a non-hardening sealer prior to installation.

8. On water cooled models so equipped, check condition of oil cooler by-pass valve and replace if valve leaks excessively. For removal, an "Easy Out" or its equivalent may be used.

For installation tap seat in place with soft hammer or brass drift so it is flush to .010" below the surface.

9. With parts clean and dry, install pump gears and check:
  - a. Clearance between O.D. of driven gear and body should be .0035"-.0065" (fig. 17PG).
  - b. Clearance between I.D. of driven gear and crescent should be .003"-.009" (fig. 18PG).



Fig. 16PG—Checking Pump Body Bushing to Converter Pump Hub Clearance



Fig. 17PG—Checking Driven Gear to Pump Body Clearance

- c. Gear end clearance (fig. 19PG) should be .0005"-.0015".

### Assembly

With the transmission facing up, proceed as follows:

1. Remove the input shaft, clutch drum, low band and struts as outlined under "Transmission Disassembly."
2. Install the downshift timing valve, conical end out, into place in the pump cover to a height of 17/32" measured from the shoulder of the valve assembly to face of pump cover.



Fig. 18PG—Driven Gear to Crescent Clearance





Fig. 19PG—Checking Gear End Clearance

3. Oil drive and driven gears generously and install in the pump body.

**CAUTION:** Assemble drive gear with recessed side of the drive lugs downward-facing the converter.

4. Carefully set the pump cover in place over the body and loosely install 2 attaching bolts.
5. Place the pump assembly, less the rubber seal ring, upside down into the pump bore of the case (use guide pins if desired). Install remaining attaching bolts and torque to specification.
6. Remove pump assembly from case bore. Replace the clutch drum and input shaft, low band and struts as outlined under "Transmission Assembly."

**NOTE:** If necessary, remove two bolts and use J-6585 pullers and J 6585-3 adapters to remove pump assembly. Replace and retorque bolts.

7. Replace rubber seal ring in its groove in the pump body and install the pump assembly properly in place in the case bore, using a new gasket, being sure that the selective fit thrust washer is in place.
8. Install the attaching bolts, using new bolt sealing washers if necessary.

## Governor Support Bushing Replacement

If the governor support bushing must be replaced, it may be removed using Tool J-9557 (and Handle J-7079) and reinstalled using Tool J-6582, pressing or driving the bushing in from the front of the support.

## CLUTCH DRUM

### Disassembly

**CAUTION:** When working with the clutch drum, use extreme care that the machined face on the front of the drum (fig. 20PG) not be scratched, scored, nicked or otherwise damaged during any of the following service operations. This machined

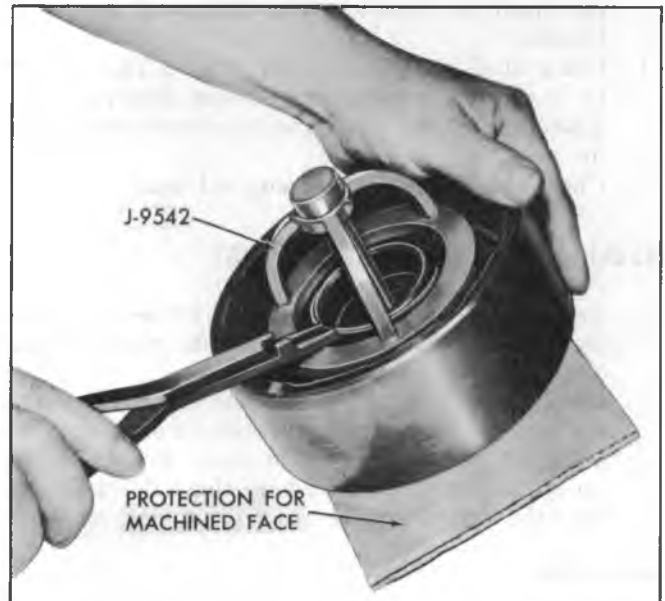


Fig. 20PG—Removing Clutch Spring Retainer Snap Ring

face must be protected whenever it must be brought to bear on a press or tool of any sort.

1. Remove retainer ring and low sun gear and clutch flange assembly from the clutch drum.
2. Remove the hub rear thrust washer.
3. Lift out the clutch hub, then remove the clutch pack and the hub front washer.
4. Remove the spring retainer using J-9542 as shown in Figure 20PG, or if using an arbor press, use J-5133 and J-7782 adapter ring. Compress the springs far enough to allow removal of the retainer snap ring; then, releasing pressure on the springs, remove the retainer and the springs.

**NOTE:** When using J-9542, place a piece of cloth or cardboard between the tool and the front side of the clutch drum as protection for the machined face.

5. Lift up on the piston with a twisting motion to remove from the drum, then remove the inner and outer seals.

### Inspection

1. Wash all parts in cleaning solvent (air dry).

**CAUTION:** Do not use rags to dry parts.

2. Check drum bushing for scoring or excessive wear.
3. Check the steel ball in the clutch drum that acts as a relief valve. Be sure that it is free to move in the hole and that the orifice leading to the front of the drum is open. If the clutch relief valve check ball in the clutch drum is loose enough to come out or not loose enough to rattle, replace the clutch drum as an assembly. Re-

placement or restaking of the ball should not be attempted.

4. Check fit of clutch flange in drum slots. There should be no appreciable radial play between these two parts. Also check low sun gear for nicks or burrs and bushing for wear.
5. Check clutch plates for burning and wear.

### Bushing Replacement (Fig. 21PG)

1. Remove the old bushing with Tool J-9546 using care not to damage the bushing bore or the machined face on the front of the clutch drum.
2. Use the same tool to install the new bushing. Press (do not hammer) the bushing into the clutch drum from the machined face side of clutch drum. Press only far enough so that the tool meets the clutch drum. Do not force the tool against the clutch drum machined face.

### Assembly

1. Install new piston inner seal in hub of clutch drum with seal lip downward (toward front of transmission).
2. Install a new piston seal in clutch piston. Seal lips must be pointed toward the clutch drum (front of transmission). Lubricate seals generously and install piston in clutch drum with a twisting motion.
3. Place the springs in position on the piston, then place the retainer in place on the springs.
4. Using Tools J-5133 and J-7782 and a press, or J-9542 as a hand operation, depress the retainer plate and springs far enough to allow installation of the spring retainer snap ring in its groove on the clutch drum hub.
5. Install the hub front washer with its lip toward the the clutch drum, then install the clutch hub.
6. Install (wave) cushion spring wherever used, see chart.



Fig. 21PG—Removing and Installing Clutch Drum Bushing

7. Install the steel reaction plates and faced drive plates alternately, beginning with a steel reaction plate (fig. 22PG). See clutch chart.
8. Install the rear hub thrust washer with its flange toward the low sun gear, then install the low sun gear and flange assembly and secure with retainer ring. When installed, the openings in the retainer ring should be adjacent to one of the lands of the clutch drum.
9. Check the assembly by turning the clutch hub to be sure it is free to rotate.

### LOW BAND

The brake band used in the aluminum Powerglide transmission has bonded linings which, due to the transmission characteristics and band usage, should require very little attention. However, whenever a transmission is disassembled the band should be cleaned of metal particles and inspected.

1. Check lining for evidence of scoring or burning.
2. Check band and lining for cracks.
3. Check all band linkage for excessive wear.

### PLANET ASSEMBLY AND INPUT SHAFT

#### Inspection

1. Wash planet carrier and input shaft in cleaning solvent, blow out all oil passages and air dry.

**CAUTION:** Do not use rags to dry parts.

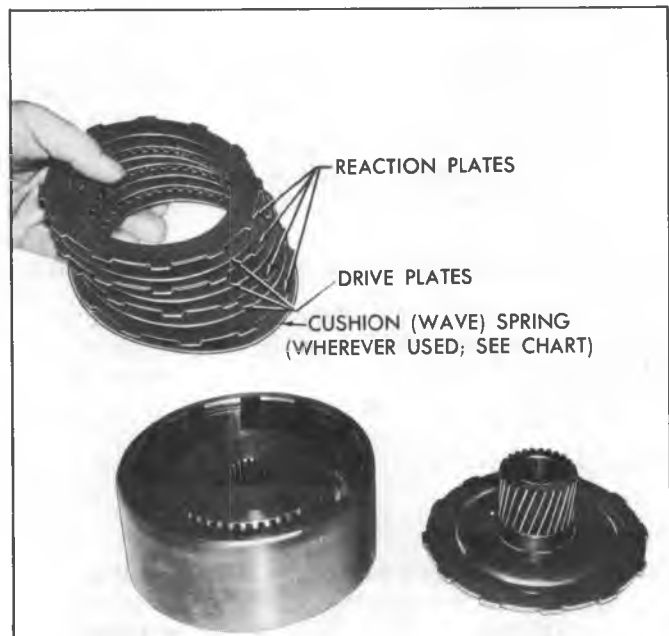


Fig. 22PG—Installing Clutch Drum Plates (typical)

CLUTCH ASSEMBLIES—POWERGLIDE			
	Drive Plate	Driven Plate	Cushion Spring
230 L-6 Pass. Cars	3	4	1
307 V-8; 250 L-6 Exc. Taxi & Hvy. Duty Chassis	4	5	1
Taxi & Hvy. Duty Chassis	5	6	None



Fig. 23PG—Checking Planet Gear End Clearance

### *Small Planet Carrier Assembly--Overhaul (Fig. 24 PG)*

If during inspection, the planet pinions, pinion needle bearing, pinion thrust washers, input sun gear, and/or input sun gear thrust washer should show evidence of excessive wear or damage, they should be replaced by using the following procedure:

2. Inspect planet pinions for nicks or other tooth damage.
3. Check end clearance of planet gears. This clearance should be .006" - .030" (fig. 23PG)
4. Check input sun gear for tooth damage, also check input sun gear rear thrust washer for damage.
5. Inspect output shaft bearing surface for nicks or scoring and inspect input pilot bushing.
6. Inspect input shaft splines for nicks or damage and check fit in clutch hub and input sun gear. Also check fit of splines in turbine hub.
7. Check oil seal rings for damage; rings must be free in input shaft ring grooves. Remove rings and insert in stator support bore and check to see that hooked ring ends have clearance. Replace rings on shaft.

### Repairs

**NOTE:** The large planet carrier assembly has the pinion shafts flared at each end for retention into the carrier. No overhaul of the large planet carrier assembly should be attempted.

1. Place the planet carrier assembly in a fixture or vise so that the front (parking lock gear, end) of the assembly faces up.
  2. Using prick punches or other similar means, mark each pinion shaft and also the planet carrier assembly (fig. 25PG), so that reassembling, each pinion shaft will be reinstalled in the same location from which it was removed.
- NOTE:** The pinion shafts are not selectively fit but it is good practice to reinstall them in their original locations.
3. Remove the pinion shaft lock plate screws and rotate the lock plate counter-clockwise sufficiently to remove it.
  4. Starting with a short planet pinion, and using a soft steel drift drive on the lower end of the pinion shaft until the pinion shaft is raised above the press fit area of the output shaft flange. Feed J-4599 into the short planet pinion from the lower end, pushing the planet pinion shaft ahead of it until the tool is centered in the pinion and the pinion shaft is removed from the assembly.

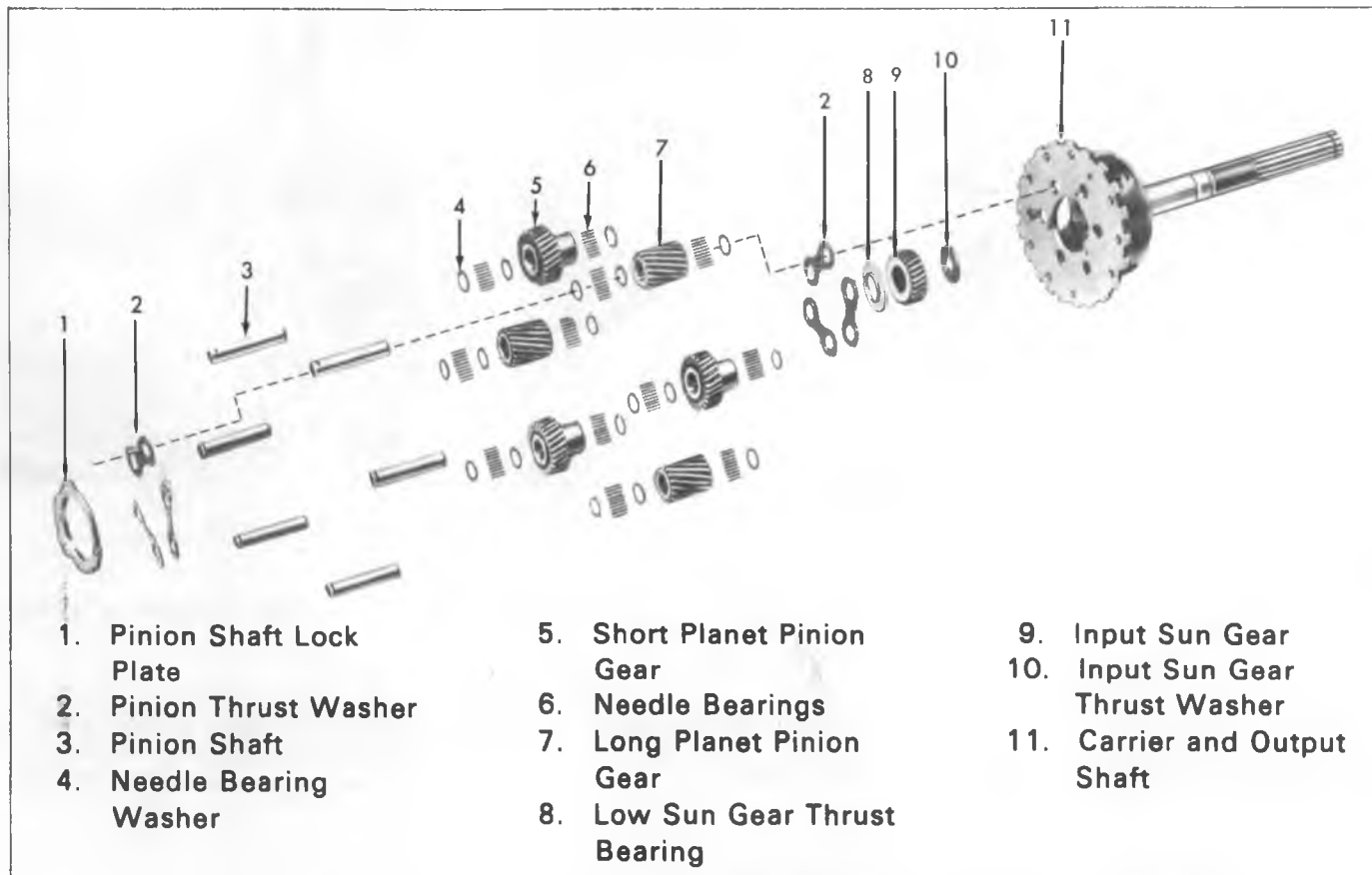


Fig. 24PG-Small Planet Carrier Assembly-Exploded View

**NOTE:** Planet pinion remover and replacer Tool J-4599, comes in two pieces, both alike. Only one is used when removing the planet pinion; two, however, must be used when reassembling.

5. Remove the short planet pinion from the assembly.
6. Remove J-4599, needle bearings and needle bearing spacers (3) from short planet pinion.

**CAUTION:** Use care so as not to lose any of the planet pinion needle bearings. Twenty needle bearings are used in each end and are separated by a bearing spacer in the center.

7. By following the procedure as outlined in Steps 4, 5 and 6, remove the adjacent long planet pinion that was paired by thrust washers to the short planet pinion now removed.

**NOTE:** Twenty needle bearings are used in each end of the long pinion separated by a bearing spacer in the center.

8. Remove the upper and lower thrust washer.
9. Remove and disassemble the remaining planet pinions, in pairs, by first removing a short planet pinion and then the adjacent long planet pinion.
10. Remove low sun gear needle thrust bearing, input sun gear and input sun gear thrust washer.

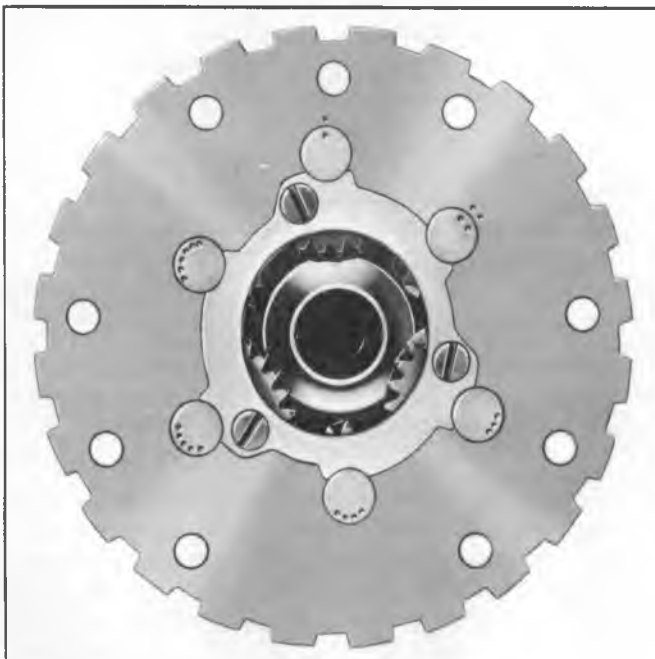


Fig. 25PG-Suggested Pinion Shaft Markings

11. Wash all parts in cleaning solvent and air dry.
12. Recheck the planet pinion gears and input sun gear for nicks or other tooth damage; also check the planet pinion thrust washer and input sun gear thrust washer. Check low sun gear needle thrust bearing for spalled needles. Replace worn or damaged parts.
13. Inspect the planet pinion needle bearings closely and if there is indication of excessive wear, all the needle bearings must be replaced. Also inspect pinion shafts closely and, if worn, replace the worn shafts.
14. Inspect the input shaft bushing installed in the base of the output shaft. If damaged, it may be removed by threading Tool J 9534 into the bushing and pulling the bushing out using Slide Hammer J-6585. New bearing can be installed by pressing in flush or below thrust surface with the pilot end of input shaft as press tool.
15. Using J-4599, assemble needle bearing spacer and needle bearings (20 in each path) in one of the long planet pinions (fig. 24PG). Use petroleum jelly to aid in assembling and holding the needle bearings in position.
16. Position the long planet pinion with J-4599, centered in the pinion assembly and with thrust washers at each end, in the planet carrier. Oil grooves on thrust washers must be toward gears.

**NOTE:** The long planet pinions are located opposite the closed portions of the carrier, while the short planet pinions are located in the openings.

17. Feed the second J-4599 in from the top picking up the upper thrust washer and the planet pinion and pushing the already installed Tool J-4599 out the lower end. As the first tool is pushed down, check that it picks up the lower thrust washer.
18. Select the proper pinion shaft, as marked in Step 2, lubricate the shaft and install it from the top, pushing the assembling tools ahead of it.
19. Turn the pinion shaft so that the slot or groove at the upper end faces the center of the assembly.
20. With a brass or soft steel drift, drive the pinion shaft in until the lower end is flush with the lower face of the planet carrier.
21. Following the same general procedure as outlined in Steps 15 through 20, assemble and install a short planet pinion in the planet carrier adjacent to the long planet pinion now installed.

**NOTE:** The thrust washers already installed with the long planet pinion also suffice for this short planet pinion as the two pinions are paired together on one set of thrust washers.

22. Install the input sun gear thrust washer, the input sun gear and low sun gear needle thrust bearing.
23. Assemble and install the remaining planet pinions, in pairs, by first installing the long planet pinion and then the adjacent short planet pinion.

24. Check end clearance of planet gears. This clearance should be .005" - .030" (fig. 23PG).
25. Place the pinion shaft lock plate in position, then with the extended portions of the lock plate aligned with slots in the planet pinion shafts, rotate the lock plate clockwise until the three attaching screw holes are accessible.
26. Install the pinion shaft lock plate attaching screws and tighten to specification.

## GOVERNOR

The governor assembly is a factory balanced unit. If body replacement is necessary, the two sections must be replaced as a unit. Remove the governor as outlined under "Transmission- Disassembly".

### Disassembly

**NOTE:** The governor valve and shaft were already disassembled from the assembly during the removal procedures.

1. Remove the outer weight assembly by sliding toward center of body.
2. Remove the smaller inner weight retaining snap ring and remove the inner weight and spring.
3. If it is considered necessary, remove the four body assembly bolts and separate the body, hub and gasket. Remove the two seal rings.

### Inspection

Clean all parts thoroughly in a solvent and air dry. Check condition of all component parts of the assembly. Replace any bent, damaged or scored parts. Body and hub must be replaced as a unit.

### Assembly

1. Reassemble governor weights and reinstall in body bore. Replace seal rings on hub.
2. Slide hub into place on output shaft and lock into place with the drive screw. Install gasket and governor body over output shaft, install governor shaft, line up properly with output shaft and install body attaching bolts. Torque to specification.

**NOTE:** Place transmission selector lever in PARK to keep shaft from turning while tightening these bolts.

3. Check the governor weight for free fit in body after the four attaching bolts are torqued. If the weight sticks or binds, loosen the bolts and retorqued.

## VALVE BODY

### Removal

Remove valve body as described under "Transmission- Disassembly." If performing the operation on the vehicle,



Fig. 26PG-Governor-Exploded View

the vacuum modulator and valve, oil pan and gasket, guide detent plate and range selector detent roller spring must be removed in order to remove the valve body from the transmission.

### Disassembly

1. Remove the manual valve, suction screen and gasket.
2. Remove valve body bolts and carefully remove lower valve body and transfer plate from upper valve body. Discard gaskets.
3. From the upper valve body, remove TV and detent valves and the downshift timing valve as follows:
  - a. TV and Detent Valve--Remove the retaining pin by wedging a thin screw driver between its head and

the valve body, then remove the detent valve assembly and throttle valve spring. Tilt the valve body to allow the throttle valve to fall out. If necessary, remove the "C" clip and disassemble the detent valve assembly.

**CAUTION:** Do not disturb the setting of the adjustment hex nut on the detent valve assembly. This is a factory adjustment and should not normally be changed. However, some adjustment is possible if required. See "Throttle Valve Adjustment."

- b. Downshift Timing Valve--Drive out the roll pin, remove the valve spring and the downshift timing valve.



4. From the lower valve body, remove the low drive shift valve and the pressure regulator valve as follows:
  - a. Low-Drive Shift Valve--Remove the snap ring and tilt the valve body to remove the low-drive regulator valve sleeve and valve assembly, valve springs and the shifter valve--Powerglide and Torque Drive.
  - b. Pressure Regulator Valve--Remove the snap ring, then tilt valve body to remove the hydraulic modulator valve sleeve and valve, pressure regulator valve spring retainer, spring and pressure regulator valve assembly.

### Inspection

A thorough cleaning all parts in clean solvent is mandatory. Check all valves and their bores for burrs or other deformities which could result in valve hang-up.

### Assembly

1. Replace valve components in the proper bores, reversing the disassembly procedures given above and checking Figure 27PG, if necessary.

**NOTE:** Upper and lower valve body gaskets are the same.

2. Carefully install the lower valve body and gasket and install 15 1-3/8" attaching bolts. Torque to specification.

### Installation

Install the valve body onto the transmission as outlined under Transmission--Assembly.

## VACUUM MODULATOR

The vacuum modulator is mounted on the left rear of the transmission and can be serviced from beneath the vehicle.

### Removal

1. Remove the vacuum line at the vacuum modulator.
2. Unscrew the vacuum modulator from the transmission using J-9543, if available, or any thin 1" tappet type wrench.
3. Remove the vacuum modulator plunger, dampening spring (except L-4 base) and valve (fig. 10PG) from the transmission case.

### Inspection and Repairs

Check the vacuum modulator plunger and valve for nicks and burrs. If such cannot be repaired with a slip stone, replace the part.

The vacuum modulator can be checked with a vacuum source for leakage. However, leakage normally results in transmission oil pull-over and results in oil smoky exhaust

and continually low transmission oil. No vacuum modulator repairs are possible; replace as an assembly.

### Installation

1. Install vacuum modulator valve, dampening spring (except L-4 model) and plunger in bore of transmission.
2. Place a new gasket on vacuum modulator. The gasket has centering tabs to hold it centered during installation.
3. Install vacuum modulator, tighten firmly, and install vacuum line as follows (fig. 10PG): Rubber tubing "A" should bottom against modulator can. Pipe assembly "B" should bottom against the modulator extension.

## TRANSMISSION CASE

### Inspection

1. Wash case thoroughly with cleaning solvent, air dry and blow out all oil passages.

**CAUTION:** Do not use rags to dry parts.

2. Inspect case for cracks which may contribute to leakage.
3. Inspect case rear bushing for damage or excessive wear.

**NOTE:** This is a precision bushing and if damaged or worn excessively must be replaced.

4. Check shifter shaft seal. If it shows signs of damage or leaking, pry it out and install a new seal. The new seal must be firmly seated in case counterbore.

### Repairs

#### Rear Bushing--Replacement

Transmission case rear bushing is a precision bushing which requires no reaming or finishing after assembly.

1. Remove bushing by driving or pressing from within case using J-9557 and Handle J-7079.
2. To install new bushing, drive or press bushing into place from rear of case using Tool J-9557 and Handle J-7079 (fig. 28PG).

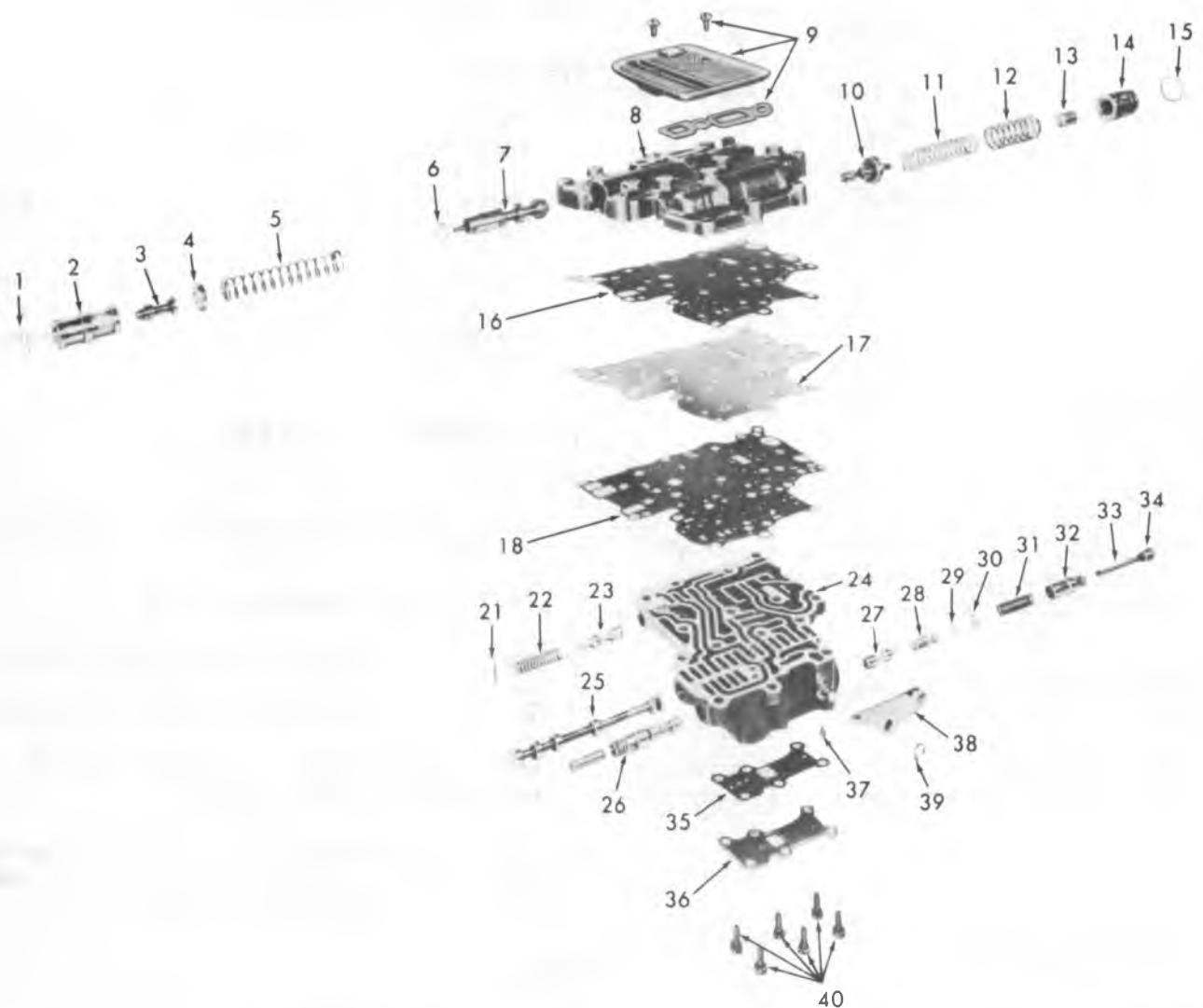
**CAUTION:** Install bushing only until shoulder of J-9557 contacts the rear face of the case. Excessive force, either hammering or pressing may crack or otherwise damage the aluminum case.

## TRANSMISSION EXTENSION

### Inspection

1. Wash extension thoroughly with cleaning solvent and air dry.

**CAUTION:** Do not use rags to dry parts.



- |  |  |   |  |
|--|--|---|--|
| 1. Snap Ring                                   | 11. Low and Drive Valve Inner Spring             | 22. High Speed Down Shift Timing Valve Spring             | 32. Detent Valve   |
| 2. Hydraulic Modulator Valve Sleeve            | 12. Low and Drive Valve Outer Spring             | 23. High Speed Down Shift Timing Valve                    | 33. Throttle Valve Spring Regulator  |
| 3. Hydraulic Modulator Valve                   | 13. Low and Drive Regulator Valve                | 24. Upper Valve Body                                      | 34. Throttle Valve Spring Regulator Nut                                    |
| 4. Pressure Regulator Spring Retainer          | 14. Low and Drive Regulator Valve Sleeve and Cap | 25. Manual Control Valve                                  | 35. Upper Valve Body Plate Gasket  |
| 5. Pressure Regulator Spring                   | 15. Snap Ring                                    | 26. Vacuum Modulator Valve, Plunger and Spring (exc. L-4) | 36. Upper Valve Body Plate   |
| 6. Pressure Regulator Spring Seat              | 16. Transfer Plate to Lower Valve Body Gasket    | 27. Throttle Valve  | 37. Detent Valve and Spring Retaining Stud                                 |
| 7. Pressure Regulator Valve                    | 17. Transfer Plate                               | 28. Throttle Valve Spring                                 | 38. Range Selector Detent Lever  |
| 8. Lower Valve Body                            | 18. Transfer Plate to Upper Valve Body Gasket    | 29. Throttle Valve Spring Seat                            | 39. Snap Ring  |
| 9. Suction Screen, Gasket and Attaching Screws | 21. High Speed Down Shift Timing Valve Stop Pin  | 30. Throttle Valve Spring Regulator Guide Washer          | 40. Upper Valve Body Plate to Upper Valve Body Attaching Bolts and Washers |
| 10. Low and Drive Valve                        |  | 31. Detent Valve Spring                                   |  |

Fig. 27PG-Valve Body-Exploded View



Fig. 28PG—Installing Case Rear Bushing

2. Inspect extension for cracks that may contribute to leakage.
3. Inspect extension rear bushing for damage or excessive wear.
4. Inspect rear oil seal and replace if damaged or worn.

### Repairs

#### Rear Bushing—Replacement

For service, the transmission extension rear bushing is of a precision type which requires no reaming or finishing after installation.

1. Place transmission extension in air arbor press rear end up.
2. Using J-5778, press old bushing from extension.
3. Place new bushing on pilot end of J-5778 and press it into place.
4. Replace extension rear oil seal, using Seal Installer J-5154. Prelubricate between lips of seal with cup grease.

### TRANSMISSION-ASSEMBLY

**NOTE:** Use only transmission oil or petroleum jelly as lubricants to retain bearings or races during assembly. Lubricate all bearings, seal rings and clutch plates prior to assembly.

If removed, assemble manual linkage to case as described in Step 1-7.

1. Install the parking lock pawl and shaft and insert a new "E" ring retainer.
2. Install the parking lock pawl pull-back spring over its boss to the rear of the pawl. The short leg of the spring should locate in the hole in the parking pawl.
3. Install the parking lock pawl reaction bracket with its two bolts.

4. Fit the actuator assembly between the parking lock pawl and the bracket.
5. Insert the outer shift lever into the case, being careful of the shaft seal, and pick up the inner shift lever and parking lock assembly and tighten allen head screw. Lubricate the shaft and seal with oil.
6. Insert outer TV lever and shaft, special washer and "O" ring into case and pick up inner TV lever. Tighten allen head nut.

**NOTE:** To prevent possible binding between throttle and range selector controls; .010 to .020" clearance must exist between inner TV lever and inner shift lever after assembly.

7. Thread the low band adjusting screw into case.

**NOTE:** The above internal components are shown in their proper relationship in Figure 15PG.

### Transmission Internal Components

8. Install the inner and outer seals on the reverse piston and, lubricating the piston and case with transmission oil, install the piston into the case (fig. 29PG). If necessary, carefully slide a feeler gauge around the outer diameter of the piston to start the seal ring into the bore.
9. With the support fixture turned so that the transmission case is facing up, install the 17 reverse piston return springs and their retainer ring.
10. Carefully install Tool J-9542 over the retainer ring and through the rear bore of the case. With the flat plate on the rear face of the case, turn down on the wing nut to compress the return springs and allow the retaining ring snap ring to be installed. Remove Tool J-9542.

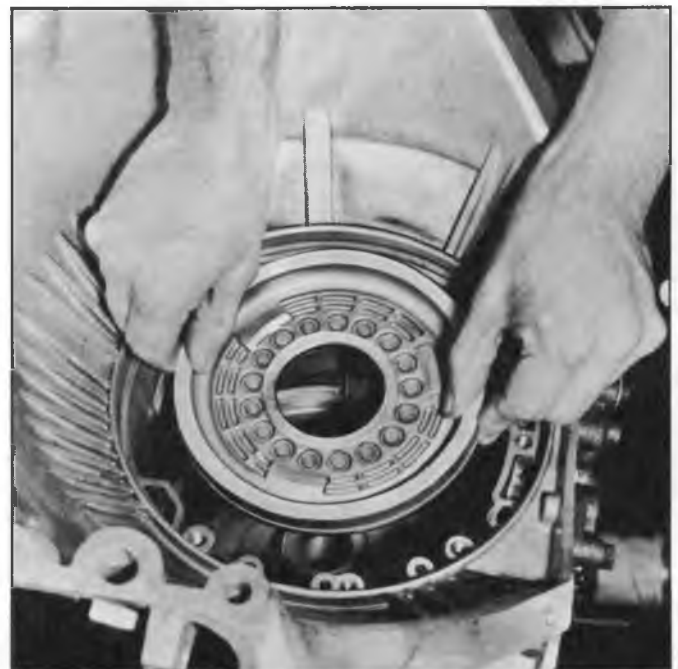


Fig. 29PG—Installing Reverse Piston

**CAUTION:** Use care when performing this operation that the spring retainer is correctly guided over the case internal hub and is not damaged by catching on the edge of the hub or in the snap ring groove.

11. Install the large (waved) cushion spring.
12. Lubricate and install the reverse clutch pack (fig. 30PG) beginning with a reaction (spacer) plate and alternating with the drive plates (faced) until all reaction plates and all drive plates are in place. The notched lug on each reaction plate is installed in the groove at the 7 o'clock position in the case. Then install the thick pressure plate which has a "dimple" in one lug to align with the same slot in the case as the notched lugs on the other reaction plates.

All models have 4 reaction and 4 drive plates.

13. Install the clutch plate retaining ring.
14. With the rear of the transmission case downward, align the internal lands and grooves of the reverse clutch pack faced plates, then engage the reverse ring gear with these plates. This engagement must be made by "feel" while jiggling and turning the ring gear.
15. Place the output shaft thrust bearing over the output shaft and install the planetary carrier and output shaft into the transmission case (fig. 31PG).
16. Move the transmission into a horizontal position. The two input shaft seal rings should be in place on the shaft. Install the clutch drum (machined face first) onto the input shaft and install the low sun gear bushing (splined) against shoulder on shaft.
17. Install clutch drum and input shaft assembly into case aligning thrust needle bearing on input shaft and indexing low sun gear with the short pinions on the planet carrier.
18. Remove the rubber seal ring from the oil pump body and, using guide studs from J-3387 set, install clutch drum selective thrust washer, oil pump gasket and oil pump to case. Install two pump-to- case bolts.

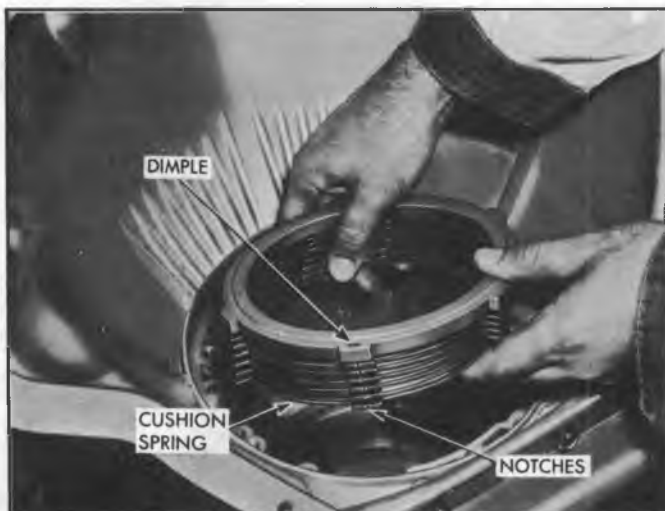


Fig. 30PG—Installing Clutch Plates (Typical)

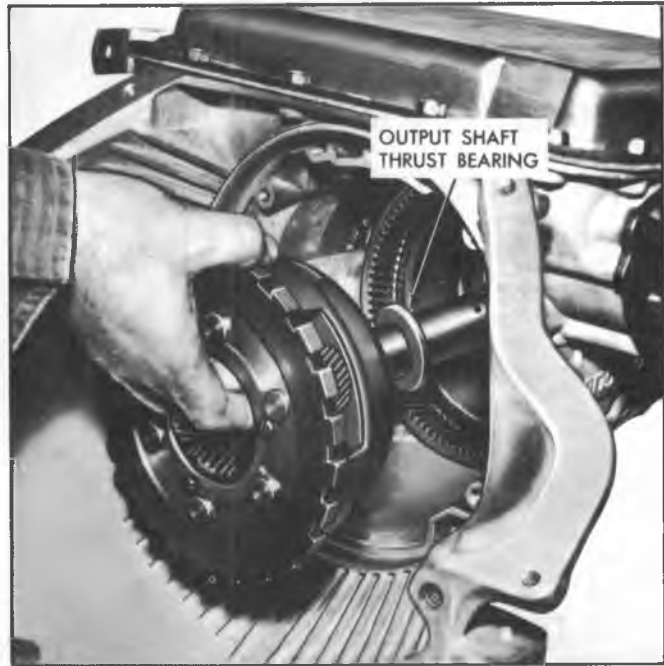


Fig. 31PG—Installing Gearset

19. To check for correct thickness of the selective fit thrust washer, move transmission so that output shaft points down and proceed as follows:
  - a. 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 32PG. Zero the indicator.
  - b. Push up on the transmission output shaft and observe the total indicator movement.
  - c. The indicator should read .028" to .059". 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 front pump, change to a thicker or thinner selective fit thrust

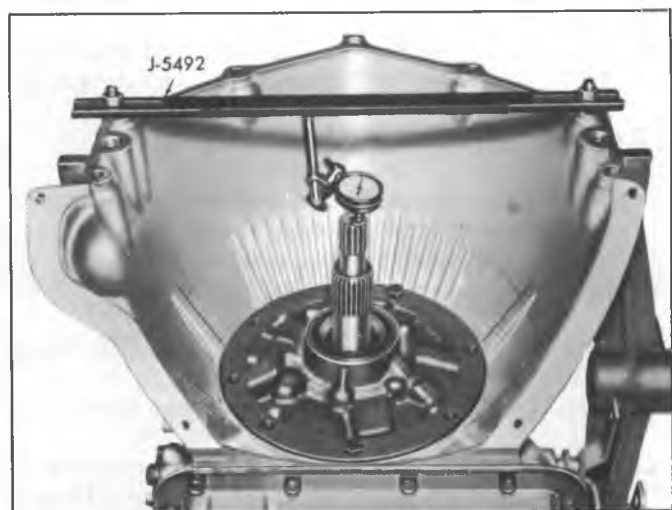


Fig. 32PG—Checking End Play for Proper Thrust Washer Selection

washer, as required to obtain the specified clearance, and repeat the above checking procedure.

**NOTE:** Clutch drum selective thrust washers are available in thicknesses of .061", .078", .092" and .106".

20. Install the servo piston, piston ring, and spring into the servo bore. Then, using a new gasket and "O" ring, install the servo cover. See that gasket is properly aligned with the three bolt holes and the drain back passage in the case.
21. Remove the oil pump and the selective fit washer from the case, and install the low brake band, anchor and apply struts into the case. Tighten the low band adjusting screw enough to prevent struts from falling out of case.
22. Place the seal ring in the groove around the oil pump body and the two seal rings on the pump cover extension. Install clutch drum selective thrust washer, oil pump gasket and oil pump to case. Remove guide pins and install all pump bolts, replacing any damaged bolt sealing washers necessary and torque bolts to specification.

## Extension, Governor and Governor Support

23. Turn transmission so that shaft points upward.
24. Install governor support and gasket, drain back baffle, and support to case attaching bolts. Bolt holes are positioned so that the support may be assembled only in the proper position.
25. Install governor over output shaft (See "Governor-Assembly" for body to hub installation.) Install governor shaft and valve, urethane washer, and retaining "C" clips. Center shaft in output shaft bore and tighten governor hub drive screw.
26. Using Tool J-5814, install speedometer gear into output shaft.
27. Place extension seal ring over governor support and install transmission extension and five retaining bolts.
28. If removed, replace speedometer driven gear.

## Oil Pan and Valve Body

29. With transmission upside down, and manual linkage installed as previously described, and the selector lever detent roller installed, install the valve body (servo apply tube installed) and a new gasket. Carefully guide the

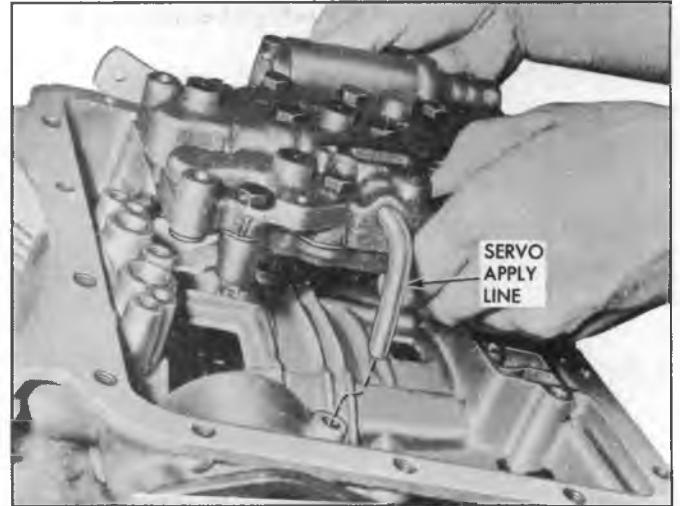


Fig. 33PG—Installing Valve Body

servo apply line into its boss in the case as the valve body is set into place (fig. 33PG). Install six mounting bolts and range selector detent roller spring shown in Figure 11PG.

**NOTE:** Position the manual valve actuating lever fully forward when installing valve body to more easily pick up the manual valve.

30. Install new suction screen and gasket.
31. Install the guide plate (fig. 34PG) making sure that the inner lever properly picks up the manual valve. Install attaching bolts.
32. Install the vacuum modulator valve and the vacuum modulator and gasket.

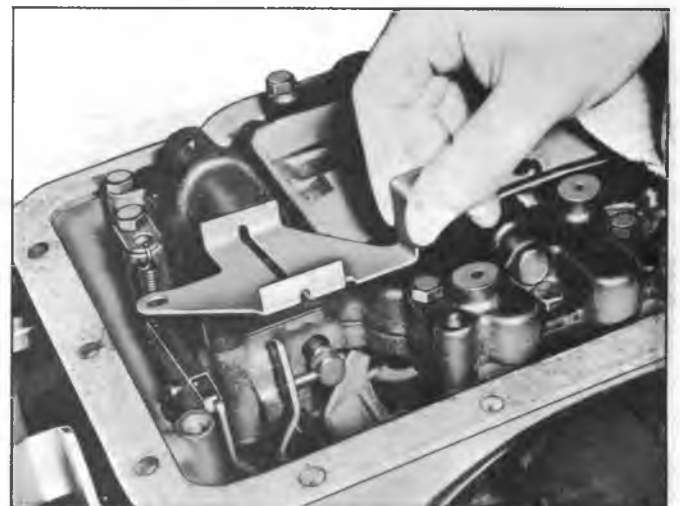


Fig. 34PG—Installing Detent Guide Plate

33. Install the oil pan, using a new gasket, and the oil pan attaching bolts.
34. Install converter and Safety Holding Strap J-9549 or a suitable substitute.

## LOW BAND ADJUSTMENT

Tighten the low servo adjusting screw to 70 inch lbs. using torque wrench, J-5853 and a 7/32" hex head driver (fig. 35PG) or J- 21848. The input and output shaft must be rotated simultaneously to properly center the low band on the clutch drum. Then back off four (4) complete turns for a band which has been in use for 6,000 miles or more, or 3 turns for one in use less than 6,000 miles. Tighten the locknut to specified torque.

**CAUTION:** The amount of back-off is not an approximate figure, it must be exact.

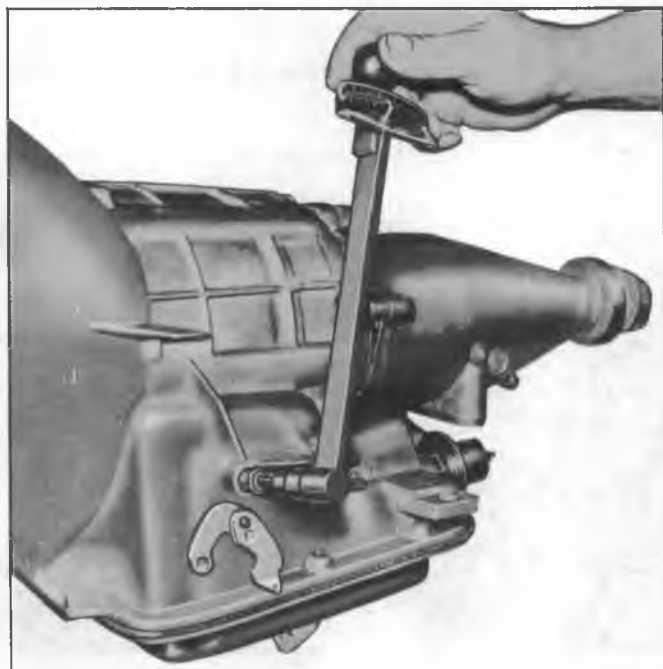


Fig. 35PG--Low Band Adjustment

## THROTTLE VALVE ADJUSTMENT

No provision is made for checking TV pressures. However, if operation of the transmission is such that some adjustment of the TV is indicated, pressures may be raised or lowered by adjusting the position of the jam nut on the throttle valve assembly (fig. 36PG). To raise TV pressure 3 psi, backoff the jam nut one (1) full turn. This increases the dimension from the jam nut to the throttle valve assembly stop. Conversely, tightening the jam nut one (1) full turn lowers TV pressure 3 psi. A difference of 3 psi on TV pressure will cause a change of approximately 2 to 3 MPH in the wide open throttle upshift point. Smaller pressure adjustments can be made by partial turns of the jam nut. The end of TV, adjusting screw has an allen head so the screw may be held stationary while the jam nut is moved.

**NOTE:** Use care when making this adjustment since no pressure tap is provided to check TV pressure.



Fig. 36PG--TV Adjustment Nut



# TURBO HYDRA-MATIC 350 TRANSMISSION

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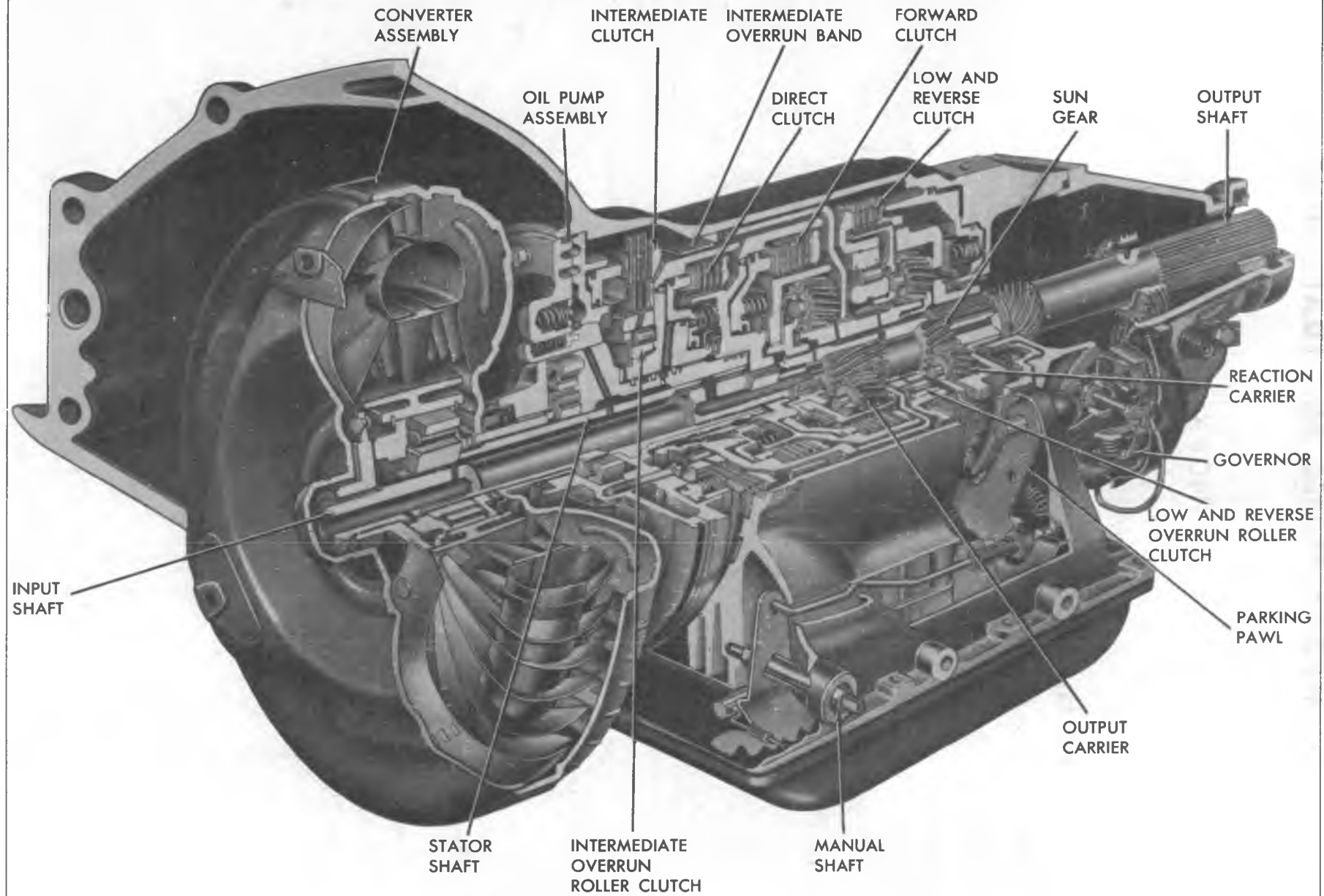


Fig. 1M-Turbo Hydra-Matic 350 Sectioned View

## TRANSMISSION DISASSEMBLY AND REASSEMBLY

### DISASSEMBLY

1. Install Holding Fixture J-8763-01 (Modified as shown on fig. 2M) on transmission and place into Holding Tool base J-3289-14 with converter facing up (fig. 3M).

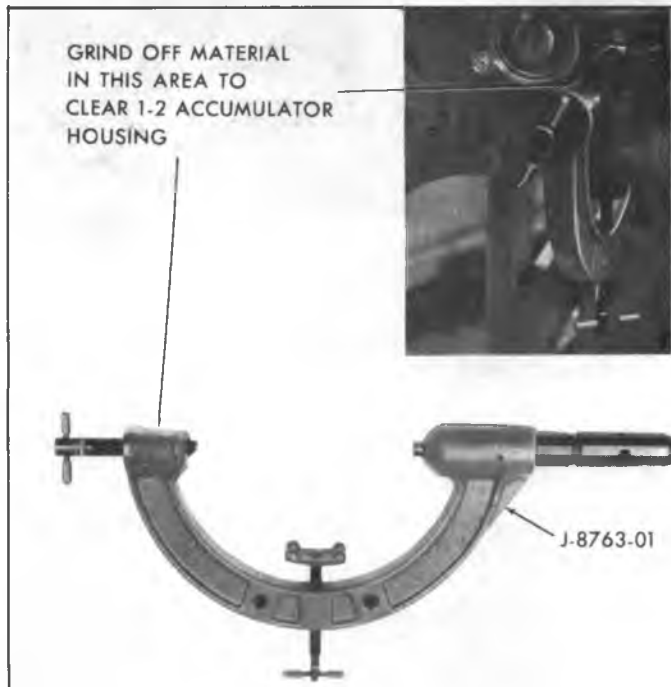


Fig. 2M—Modifying J-8763-01 Holding Fixture

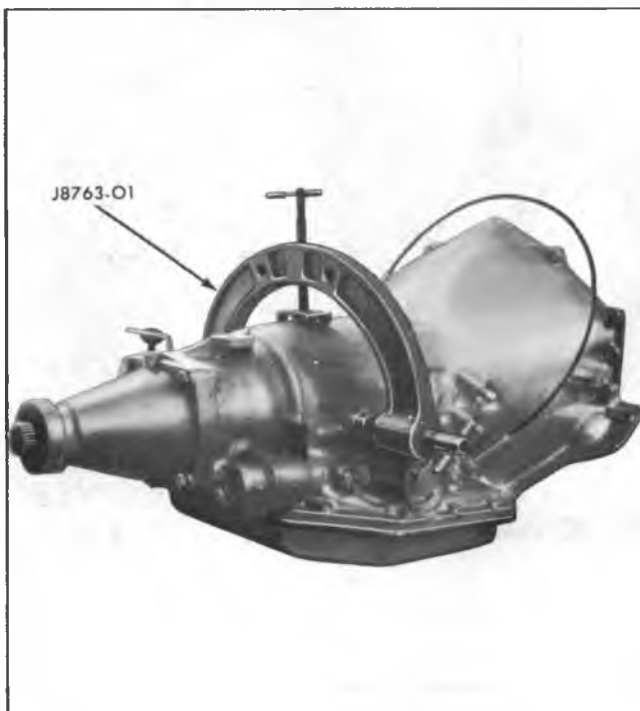


Fig. 3M—Transmission in Holding Fixture

**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. 4M). Discard "O" ring.

### REMOVAL OF EXTENSION, SPEEDOMETER DRIVEN GEAR, GOVERNOR, OIL PAN AND STRAINER

1. Remove four housing to case attaching bolts.

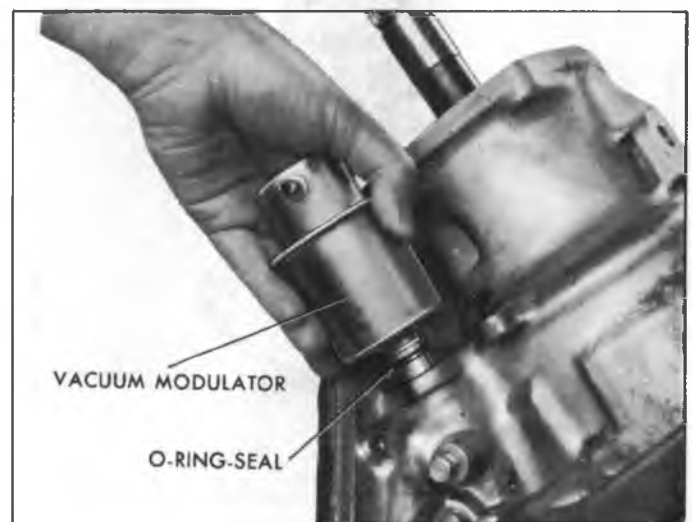


Fig. 4M—Removing Vacuum Modulator Assembly



Fig. 5M--Removing Extension Housing Lip Seal

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. 5M).

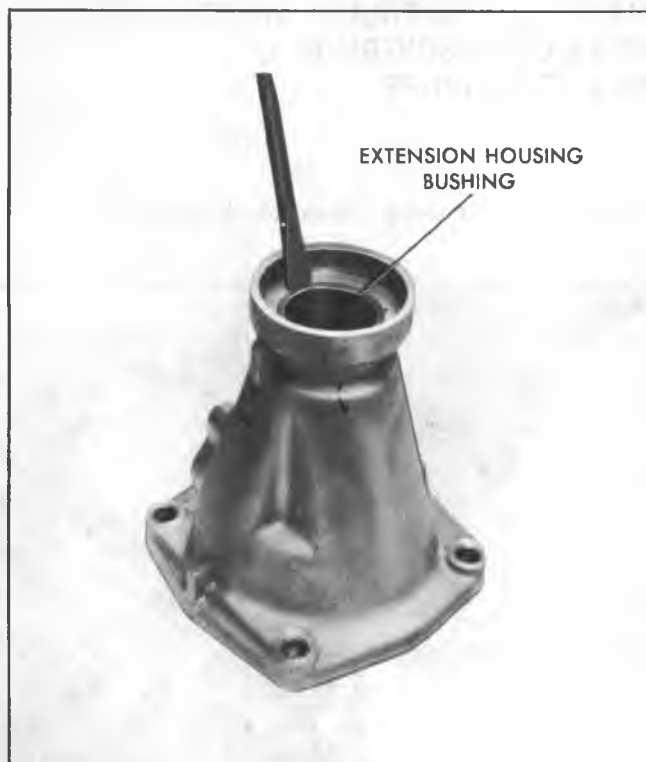


Fig. 6M--Removing Extension Housing Bushing



Fig. 7M--Removing Governor Cover

4. Remove extension housing bushing using screwdriver to collapse bushing (fig. 6M) if necessary to replace.
5. Remove speedometer drive gear and retaining clip from output shaft.
6. Remove governor cover retainer wire with a screwdriver.
7. Using a screwdriver and hammer, gently tap along governor cover lip (fig. 7M), remove governor cover and "O" ring seal (fig. 8M). Discard seal.



Fig. 8M--Governor Cover and "O" Ring Seal

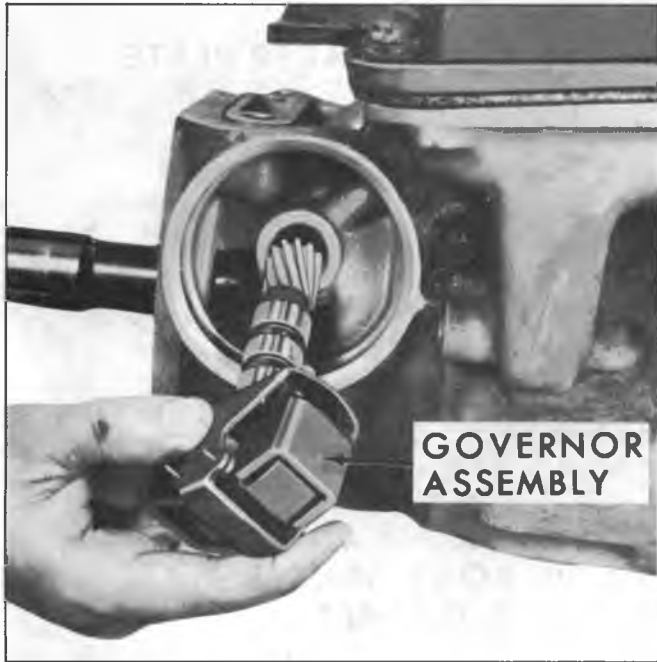


Fig. 9M--Removing Governor from Case

**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. 9M).

**NOTE:** Check governor bore and governor sleeve for scoring.



Fig. 10M--Removing Transmission Oil Pan



Fig. 11M--Removing Oil Pump Suction Screen (Strainer) from Valve Body

9. Remove oil pan attaching screws (fig. 10M), oil pan, and gasket. Discard gasket.
10. Remove oil pump suction screen (strainer) to valve body attaching screws (fig. 11M).
11. Remove oil pump screen (strainer) and gasket from valve body.

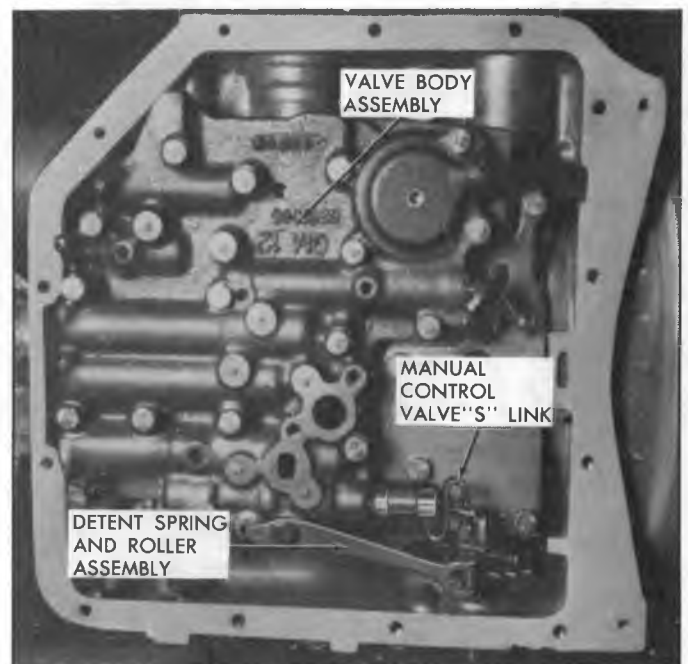


Fig. 12M--Detent Spring and Roller Assembly



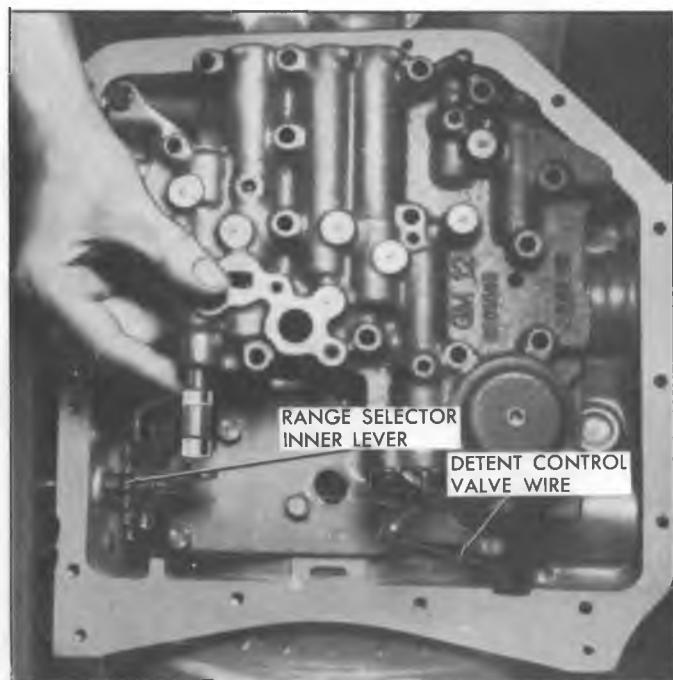


Fig. 13M--Removing Manual Control Valve Link, Valve Body and Detent Actuating Lever

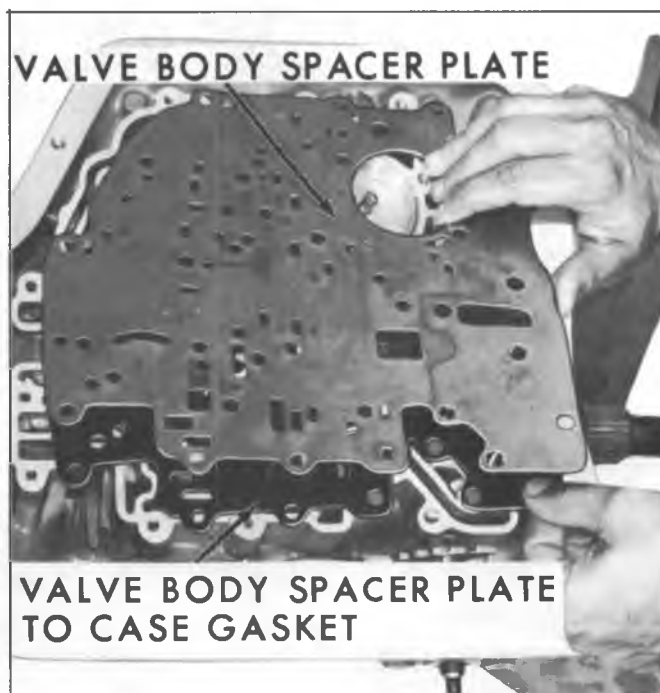


Fig. 15M--Removing Valve Body Transfer (Spacer) Plate and Gasket

## REMOVAL OF VALVE BODY AND LINKAGE

1. Remove detent spring and roller assembly from valve body. Remove valve body to case attaching bolts (fig. 12M).
2. Remove manual control valve link from range selector inner lever. Remove detent control valve link from detent actuating lever (fig. 13M). Refer to page 7-104 for valve body disassembly.

3. Remove transfer support plate bolts. Remove transfer support plate (fig. 14M).
4. Remove valve body transfer (spacer) plate and valve body transfer (spacer) plate to case gasket (fig. 15M).
5. Remove four (4) check balls from correct passages in case face (fig. 16M).

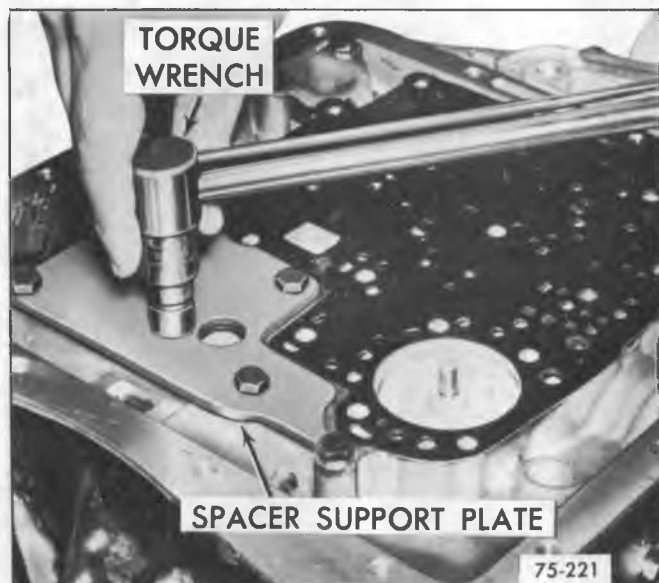


Fig. 14M--Removing Transfer (Spacer) Support Plate

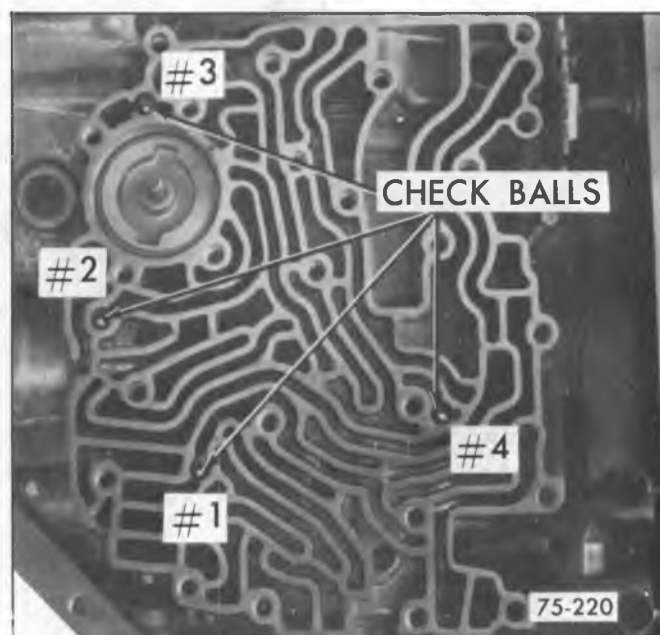


Fig. 16M--Check Ball Four (4) Locations



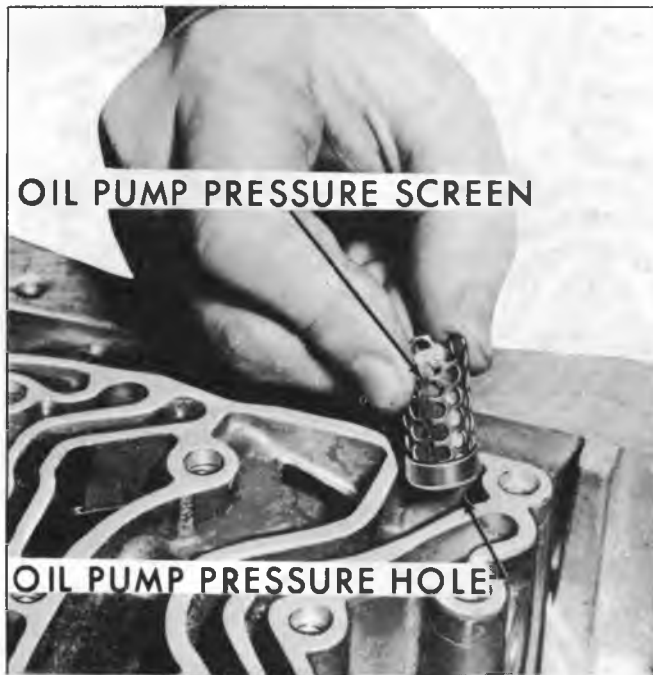


Fig. 17M--Removing Oil Pump Pressure Screen

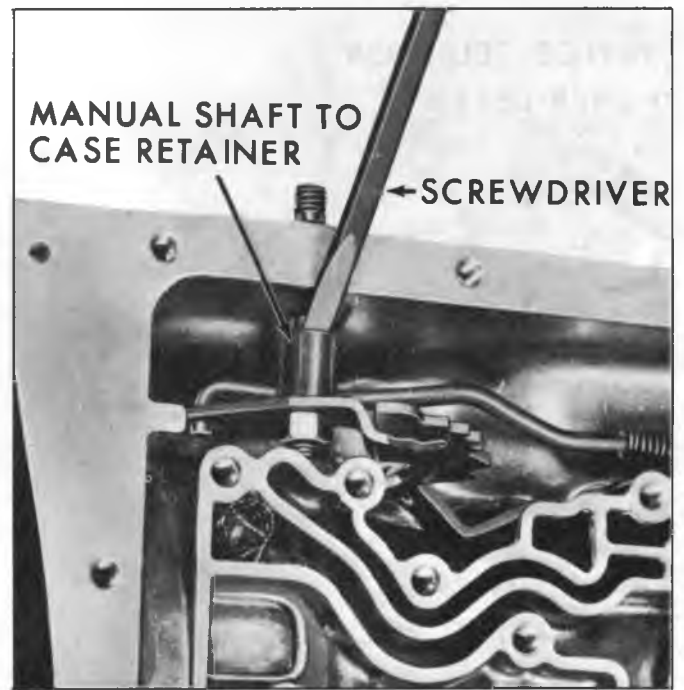


Fig. 19M--Removing Manual Shaft to Case Retainer

6. Remove oil pump pressure screen from oil pump pressure hole in case (fig. 17M).
7. Remove governor feed screen from governor feed hole (drive oil) in case (fig. 18M).

8. Remove manual shaft to case retainer with screwdriver (fig. 19M).
9. Loosen nut holding range selector inner lever to manual shaft (fig. 20M).

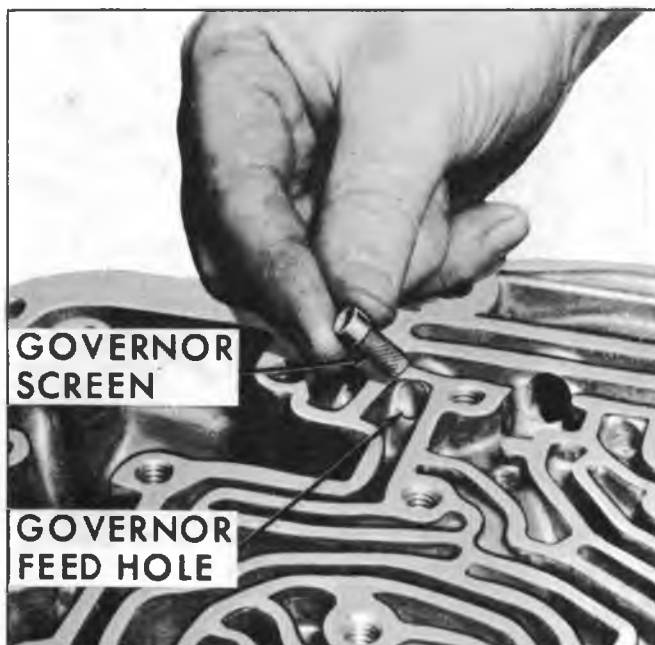


Fig. 18M--Removing Governor Feed Screen

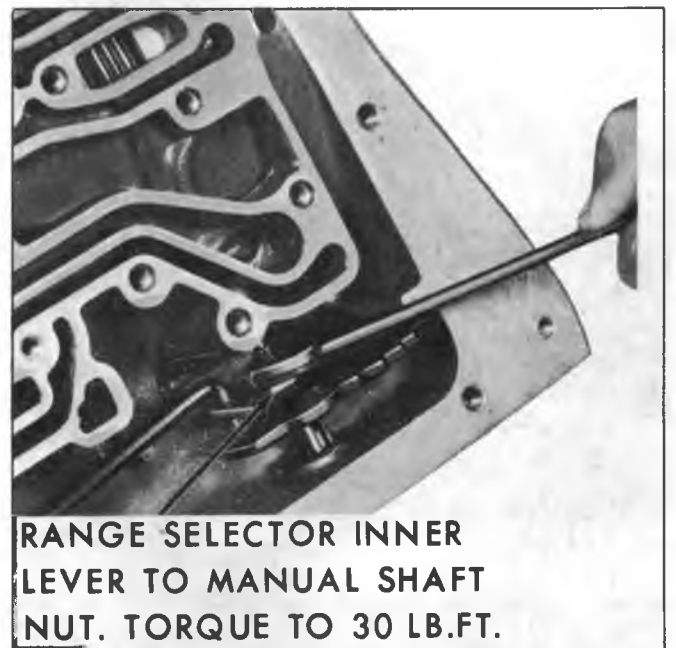


Fig. 20M--Loosening Nut Holding Range Selector Inner Lever to Manual Shaft



Fig. 21M—Removing Manual Shaft and Inner Lever and Parking Pawl Actuator Rod from Case

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. 21M).

11. Remove manual shaft to case lip seal (fig. 22M).

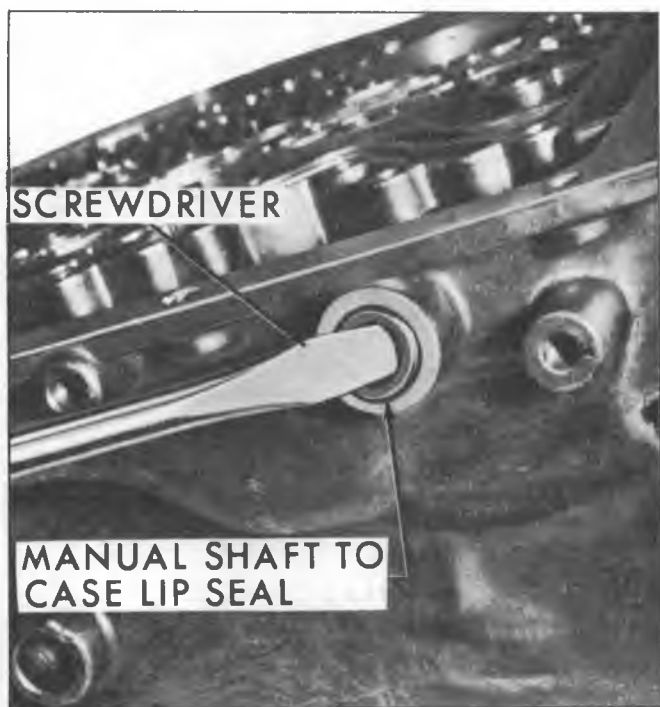


Fig. 22M—Removing Manual Shaft to Case Lip Seal

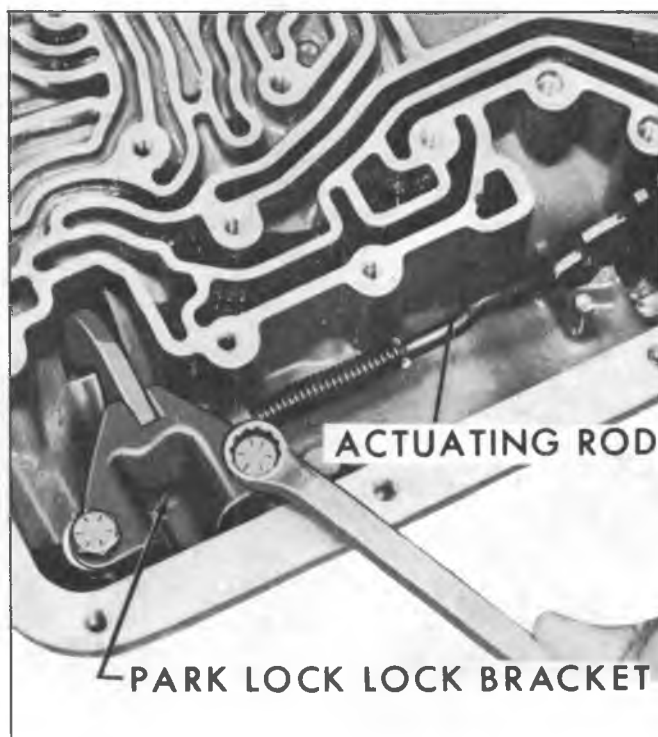


Fig. 23M—Removing Park Lock, Lock Bracket

12. Remove parking lock; lock bracket (fig. 23M). (Special Bolts).

13. Remove parking pawl disengaging spring (fig. 24M).



Fig. 24M—Removing Parking Pawl Disengaging Spring

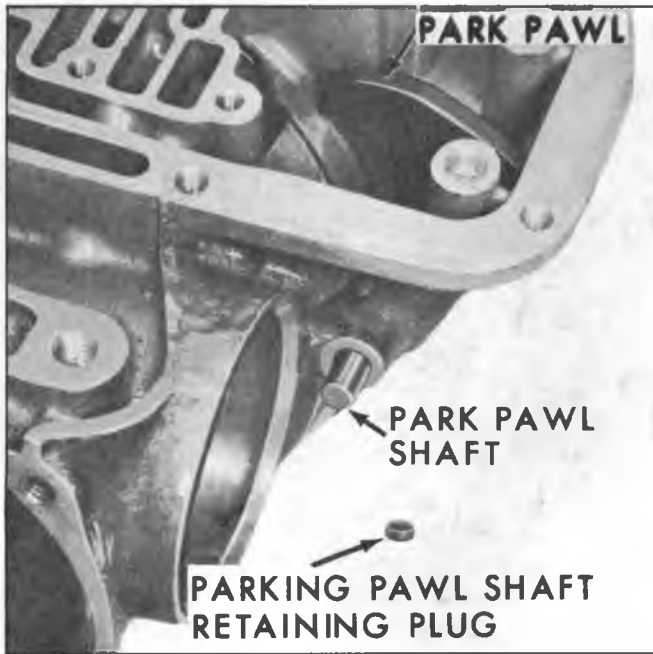


Fig. 25M--Parking Pawl Shaft Retaining Plug, Parking Pawl and Parking Pawl Shaft

14. Remove parking pawl shaft retaining plug, parking pawl shaft, and parking pawl (fig. 25M) if necessary.

**NOTE:** The parking pawl shafts retaining plug may be removed by using a bolt extractor.

15. Remove intermediate servo piston and seal ring. Remove washer, spring seat and apply pin (fig. 26M).

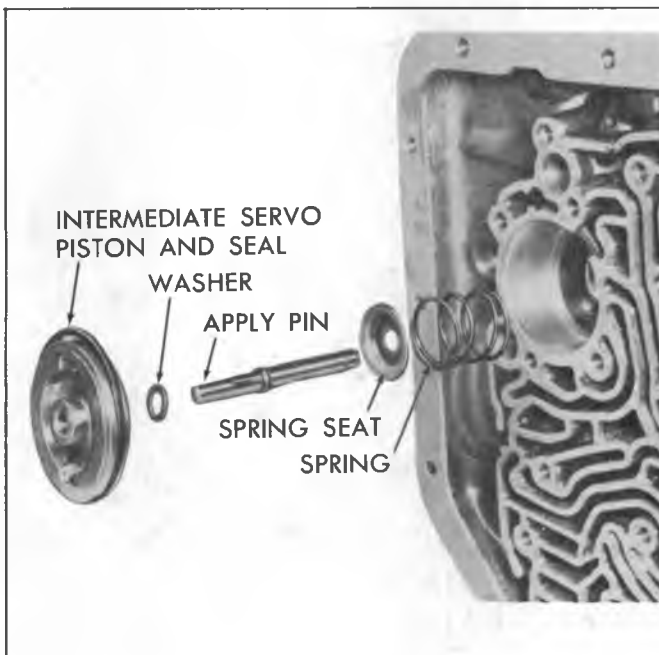


Fig. 26M--Intermediate Servo Piston and Related Parts

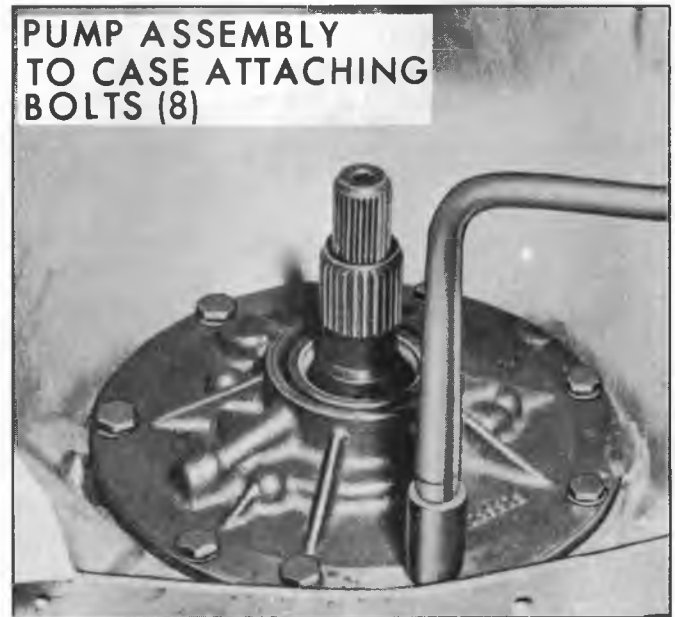


Fig. 27M--Removing Pump Attaching Bolts

## REMOVAL OF OIL PUMP AND INTERNAL CASE COMPONENTS

1. Remove eight (8) pump attaching bolts with washer type seals (fig. 27M).
2. Install two (2) threaded slide hammers J-9539 (weights J 6585) into threaded holes in pump body and remove pump assembly from case (fig. 28M). Discard pump gasket.



Fig. 28M--Removing Pump from Case

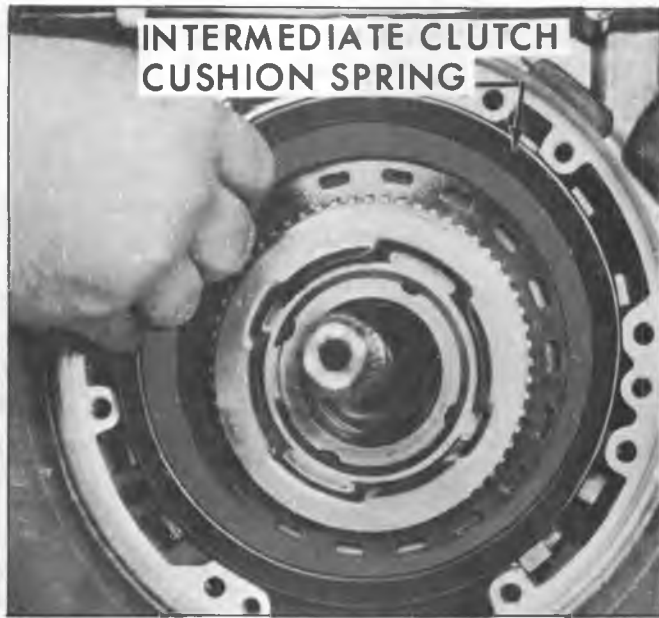


Fig. 29M--Removing Intermediate Clutch Cushion Spring

Refer to pages 7-105 thru 7-109 for disassembly and reassembly of the oil pump.

3. Remove intermediate clutch cushion spring (fig. 29M).
4. Remove intermediate clutch faced plates and steel reaction plates (fig. 30M).

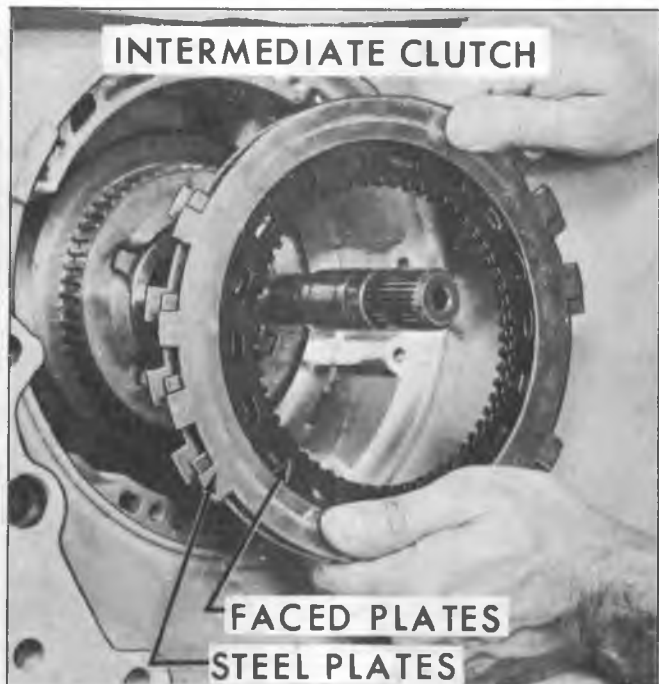


Fig. 30M--Removing Intermediate Clutch Plates

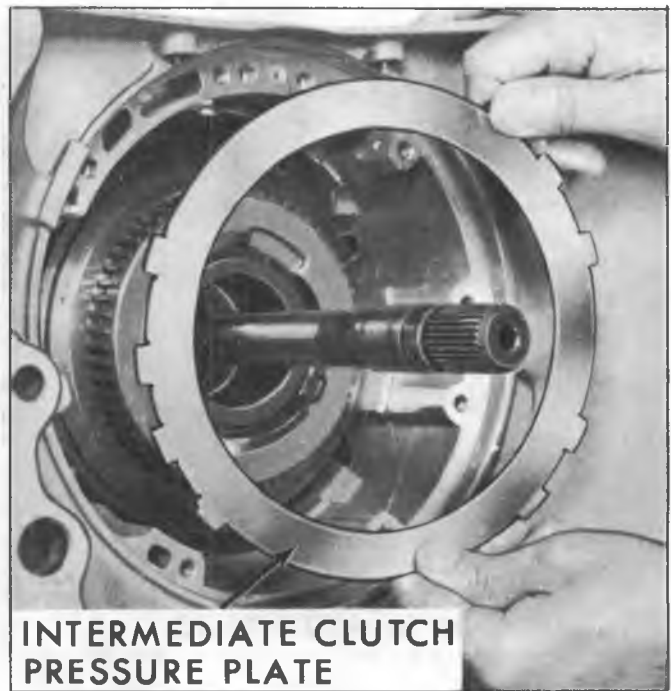


Fig. 31M--Removing Intermediate Clutch Pressure Plate

5. Remove intermediate clutch pressure plate (fig. 31M).
6. Remove intermediate overrun brake band (fig. 32M).



Fig. 32M--Removing Intermediate Overrun Brake Band





Fig. 33M--Removing Direct and Forward Clutch Assemblies

7. Remove direct and forward clutch assemblies from case (fig. 33M).

Refer to pages 7-109 thru 7-116 for disassembly and reassembly of the direct and forward clutches.

8. Remove input ring gear front thrust washer (fig. 34M).

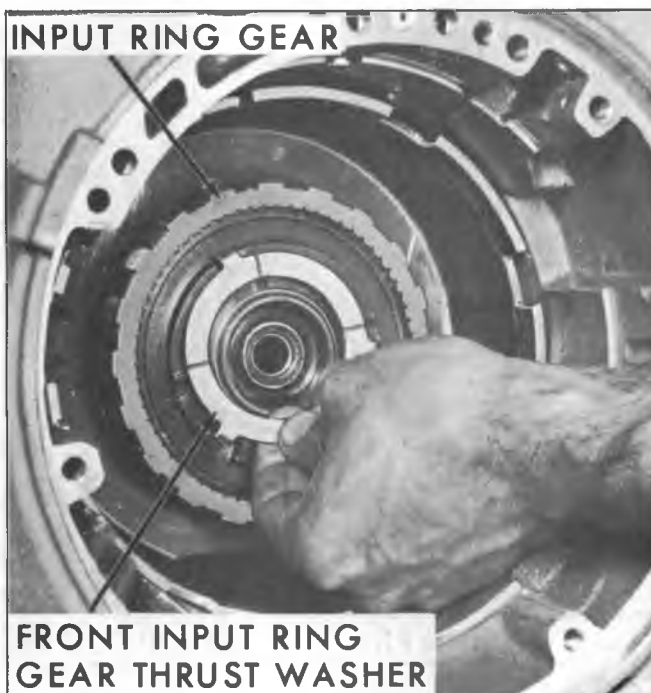


Fig. 34M--Removing Input Ring Gear Front Thrust Washer

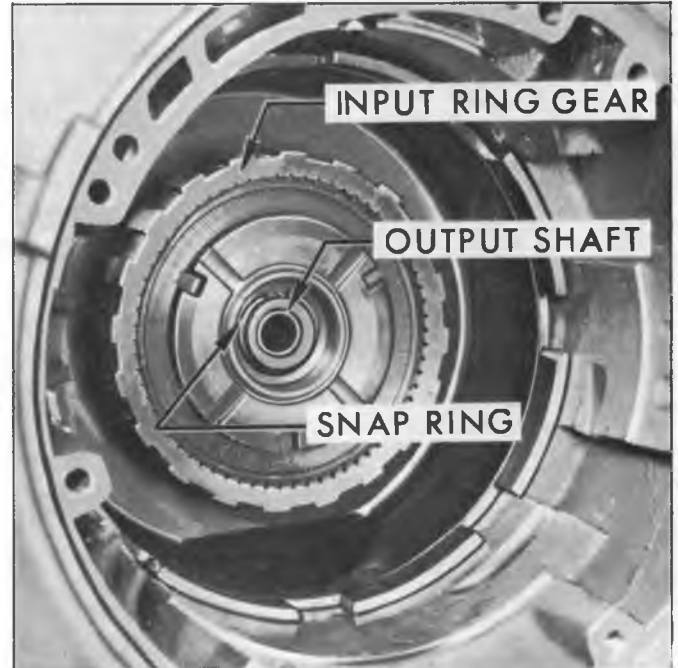


Fig. 35M--Removing Output Carrier to Output Shaft Snap Ring

**NOTE:** Washer has 3 tangs.

9. Remove output carrier to output shaft snap ring (fig. 35M).

**NOTE:** Use new snap ring at assembly.

10. Remove input ring gear (fig. 36M).

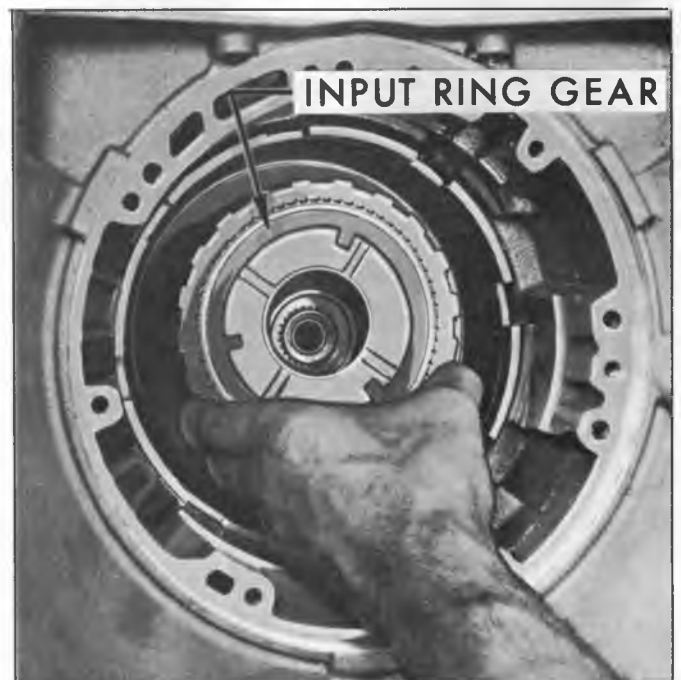


Fig. 36M--Removing Input Ring Gear



Fig. 37M--Removing Input Ring Gear Rear Thrust Washer

11. Remove input ring gear rear (output carrier) thrust washer (fig. 37M).

12. Remove output carrier assembly (fig. 38M).

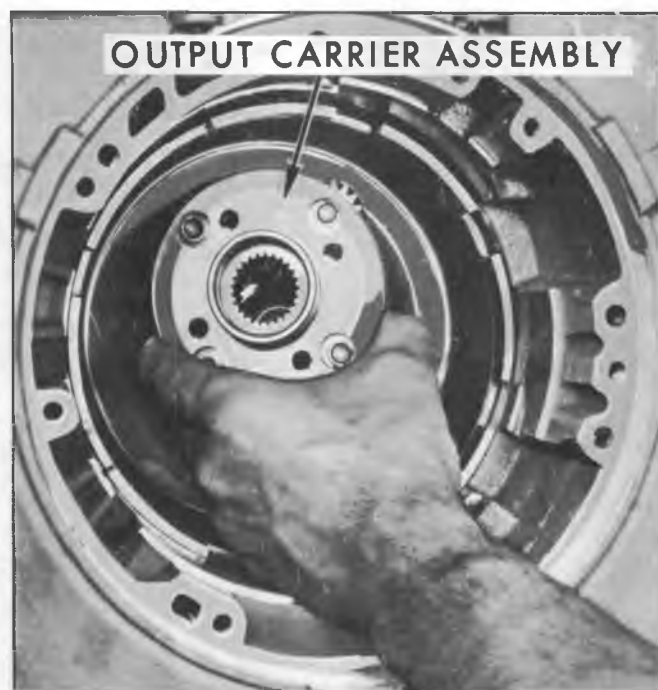


Fig. 38M--Removing Output Carrier Assembly



Fig. 39M--Removing Sun Gear Drive Shell

13. Remove sun gear drive shell assembly (fig. 39M).

14. Remove low and reverse roller clutch support to case retaining ring (fig. 40M).

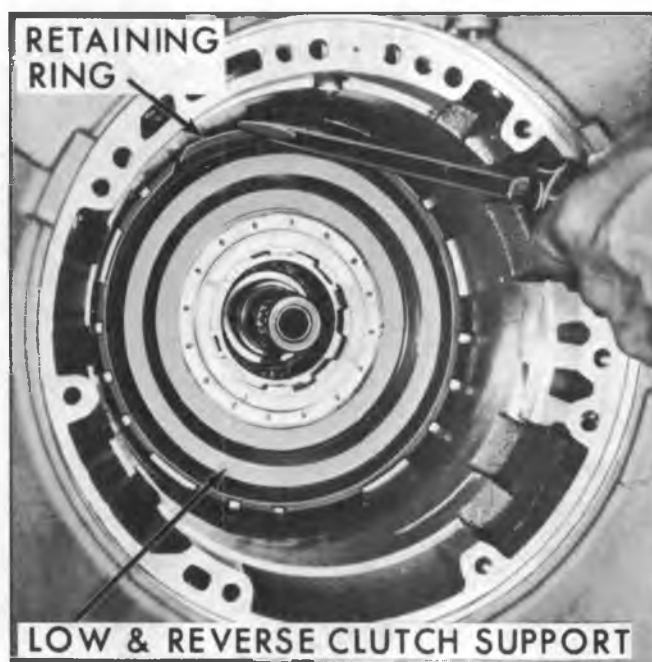


Fig. 40M--Removing Low and Reverse Clutch Support Retaining Ring



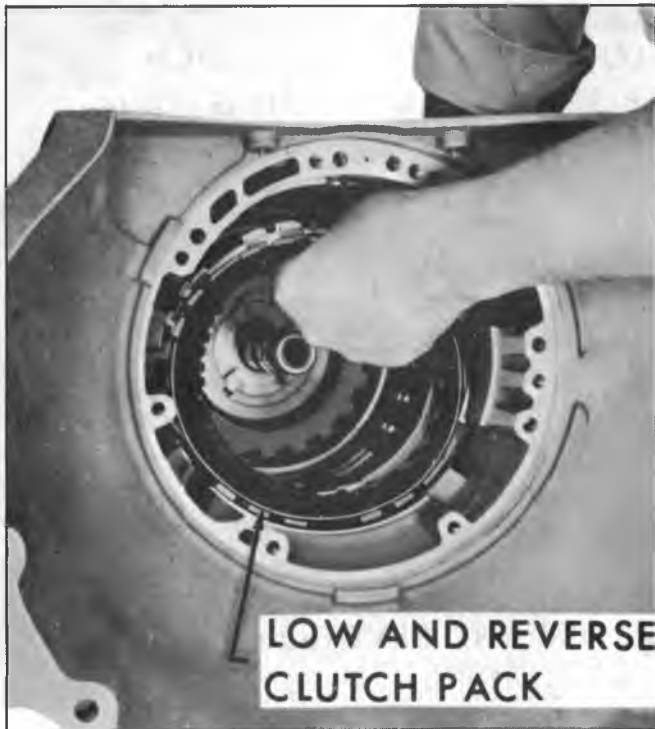


Fig. 41M--Removing Low and Reverse Clutch Pack

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. 41M).
17. Remove reaction carrier assembly from output ring gear and shaft assembly (fig. 42M).

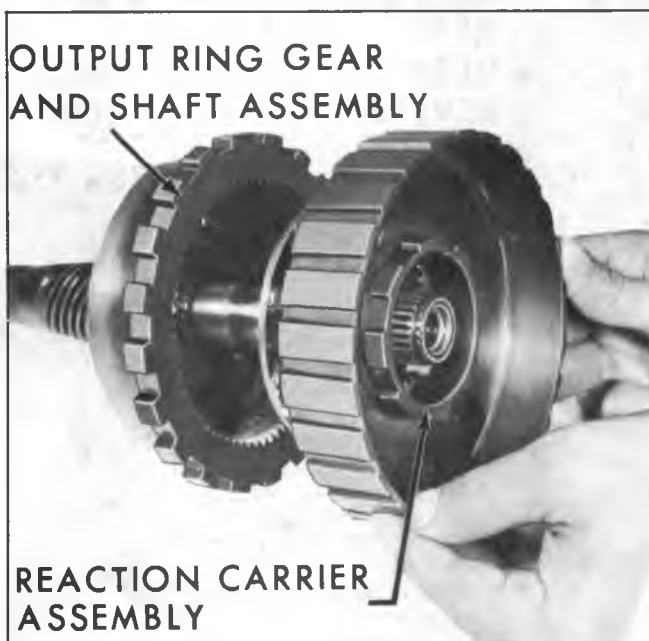


Fig. 42M--Removing Reaction Carrier Assembly

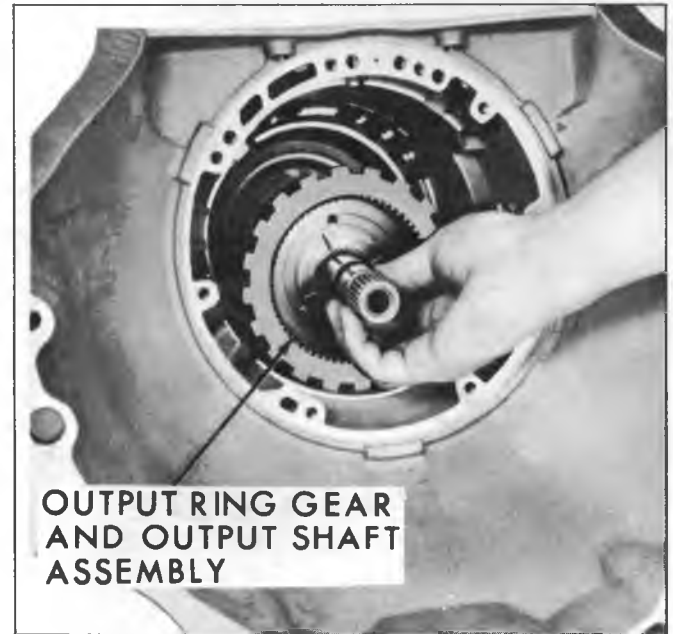


Fig. 43M--Removing Output Ring Gear and Shaft Assembly

18. Remove output ring gear and shaft assembly from case (fig. 43M).
19. Remove reaction carrier to output ring gear tanged (front) thrust washer (fig. 44M).



Fig. 44M--Removing Output Ring Gear Tanged Thrust Washer



Fig. 45M--Removing Output Ring Gear to Case Needle Bearing Assembly

20. Remove output ring gear to case needle bearing assembly (fig. 45M).
21. Compress low and reverse clutch piston spring retainer using tool J-23327 (fig. 46M) and remove piston retaining ring and spring retainer.

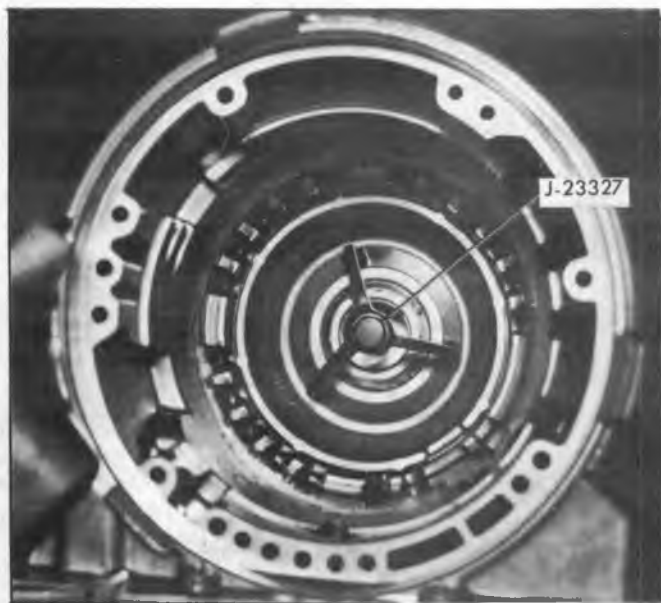


Fig. 46M--Compressing Low and Reverse Clutch Piston Spring Retainer

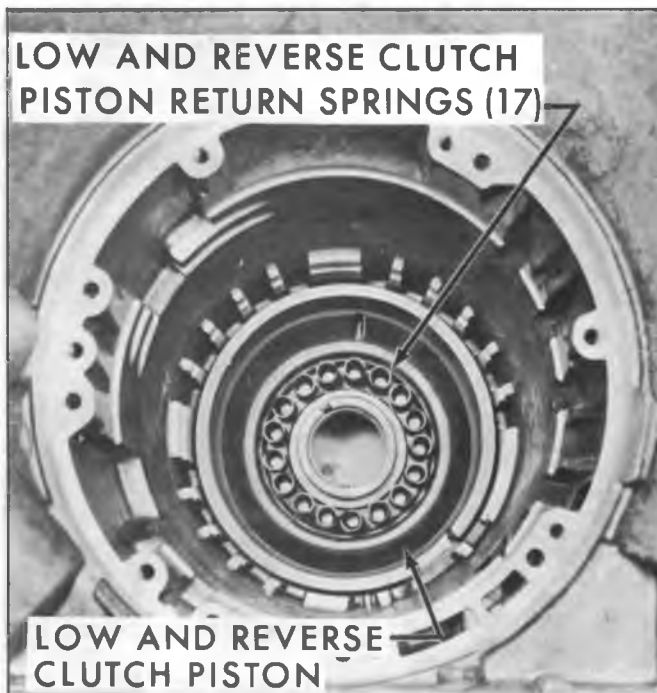


Fig. 47M--Low and Reverse Clutch Piston Springs and Piston

22. Remove seventeen (17) piston springs from piston (fig. 47M).
23. Remove low and reverse clutch piston assembly by applying compressed air in passage shown on Figure 48M.



Fig. 48M--Removing Low and Reverse Clutch Piston

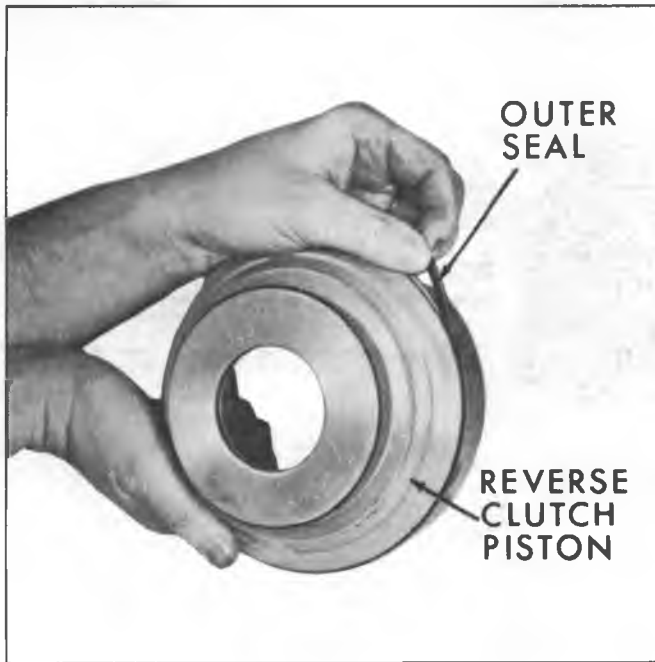


Fig. 49M—Removing Low and Reverse Clutch Piston Outer Seal

24. Remove low and reverse clutch piston outer seal (fig. 49M).
25. Remove low and reverse clutch piston center and inner seal (fig. 50M).



Fig. 50M—Removing Low and Reverse Clutch Piston Center and Inner Seal

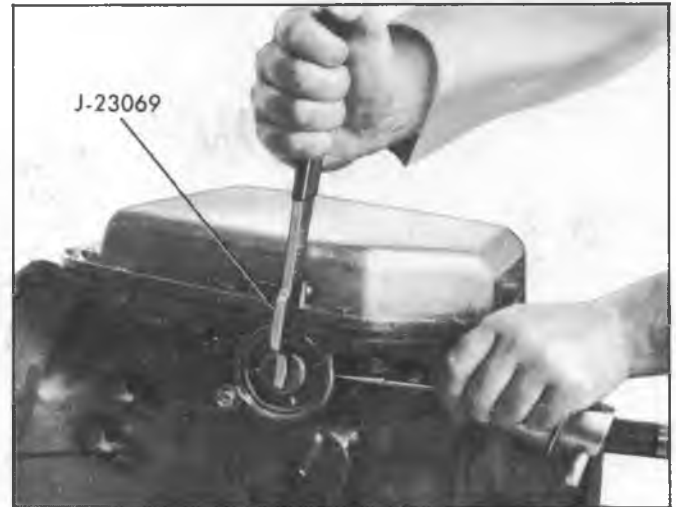


Fig. 51M—Removing Accumulator Piston Cover Retaining Ring

26. Install tool J-23069 to compress intermediate clutch accumulator piston cover and remove retaining ring (fig. 51M).
27. Remove intermediate clutch accumulator piston cover. Remove "O" ring seal from case.
28. Remove intermediate clutch accumulator piston spring. Remove intermediate clutch accumulator piston assembly. See Figure 52M.

Also, remove inner and outer hook type oil seal rings if required.

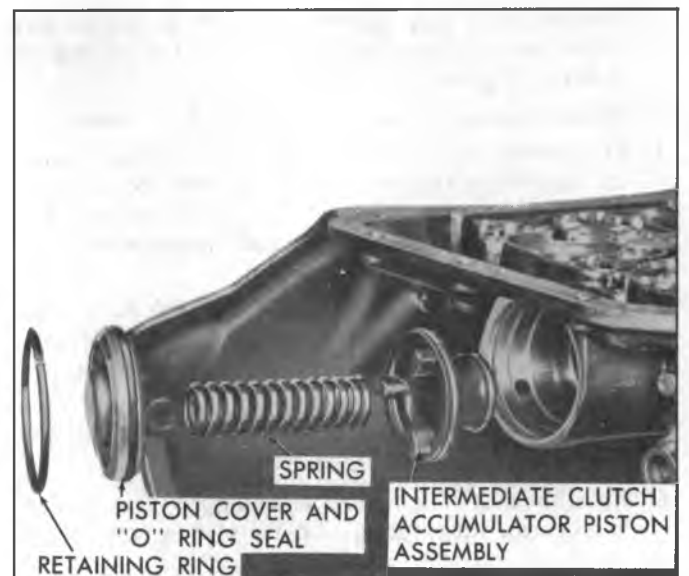


Fig. 52M—Intermediate Clutch Accumulator Components

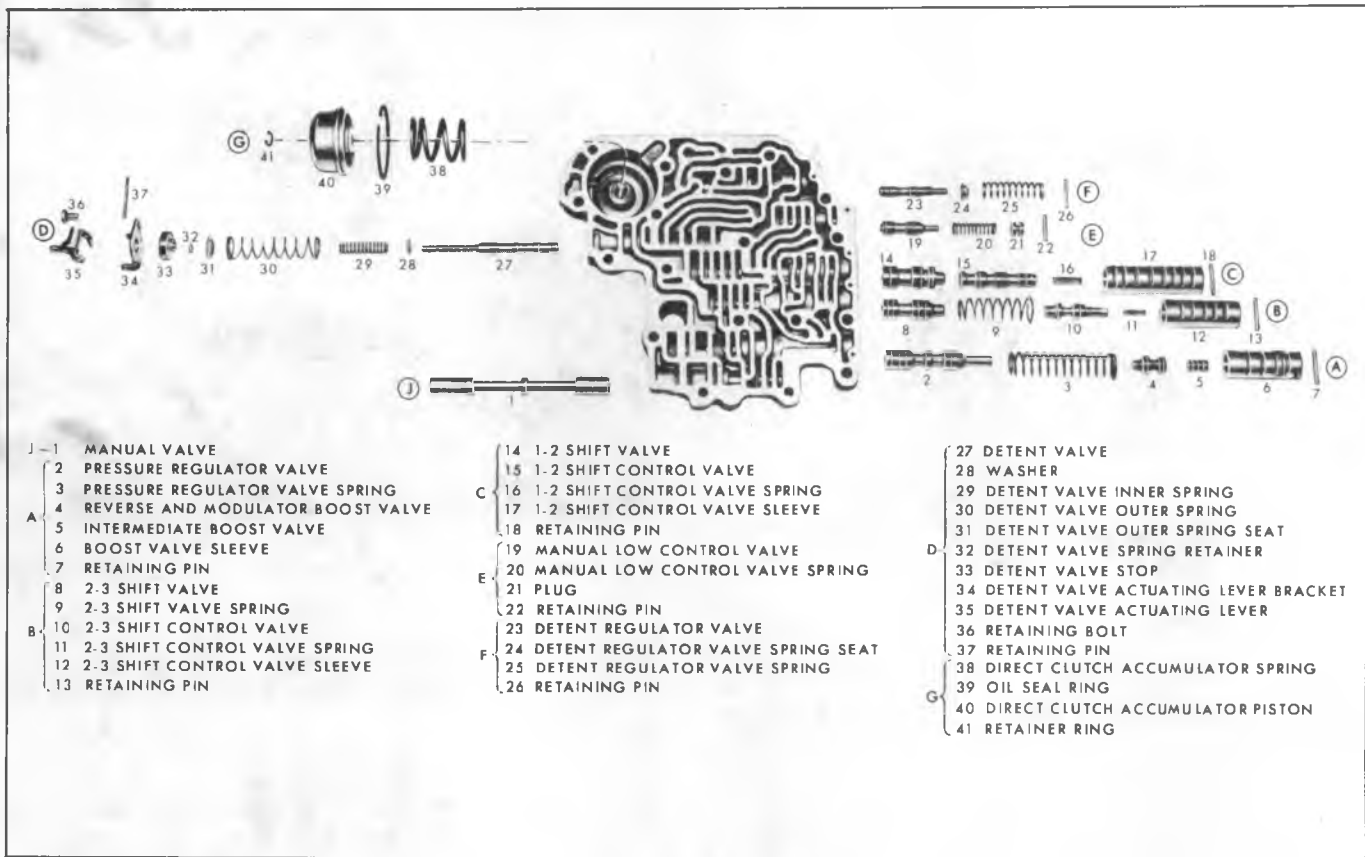


Fig. 53M--Valve Body--Exploded View

## 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 Tool J-21885, on direct clutch accumulator piston and remove retaining "E" ring (fig. 54M).
9. Remove direct clutch accumulator piston, and metal oil seal ring, and spring.

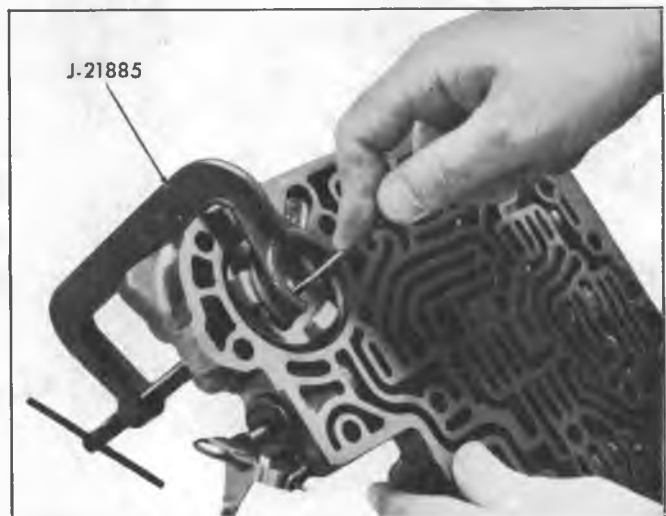


Fig. 54M--Removing Direct Clutch Accumulator Piston Retaining "E" Ring

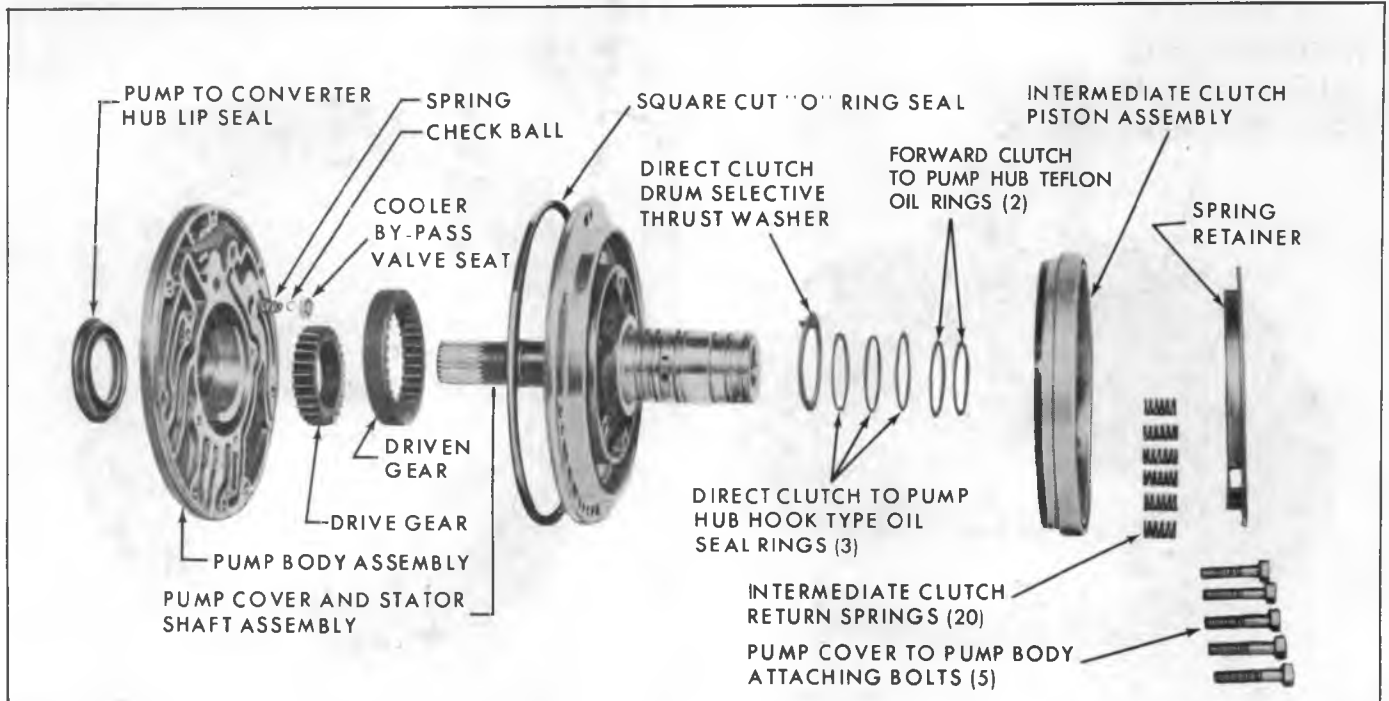


Fig. 55M--Pump Assembly--Exploded View

- 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

- Inspect all valves for scoring, cracks and free movement in their respective bores.
- Inspect valve body for cracks, scored bores, interconnected oil passages and flatness of mounting face.
- Check all springs for distortion or collapsed coils.

### Reassembly

- Install direct clutch accumulator piston spring and piston into valve body.
- Install special tool J-21885, and compress spring and piston and secure with retaining ring.  
**NOTE: Align piston and oil seal ring when entering bore.**
- 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.

- Install the pressure regulator valve, spring, reverse and modulator boost valve, intermediate boost valve, boost valve sleeve and retaining pin.
- In the next bore up, install 2-3 shift control valve, shift control valve spring, 2-3 shift control valve, shift control valve spring, shift control valve sleeve and retaining pin.
- 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.
- In the next bore up, install the manual low control valve, spring, plug and retaining pin.
- In the top right hand bore, install the detent regulator valve, spring seat, spring and retaining pin.

### OIL PUMP DISASSEMBLY, INSPECTION AND REASSEMBLY (FIG. 55M)

#### Disassembly

- Place pump cover and stator shaft assembly through hole in bench.
- Remove pump cover to body attaching bolts 5/16 x 18-1 1/2 (fig. 56M).
- Remove intermediate clutch spring retainer, twenty(20) intermediate clutch return springs and the intermediate clutch piston assembly (fig. 57M).



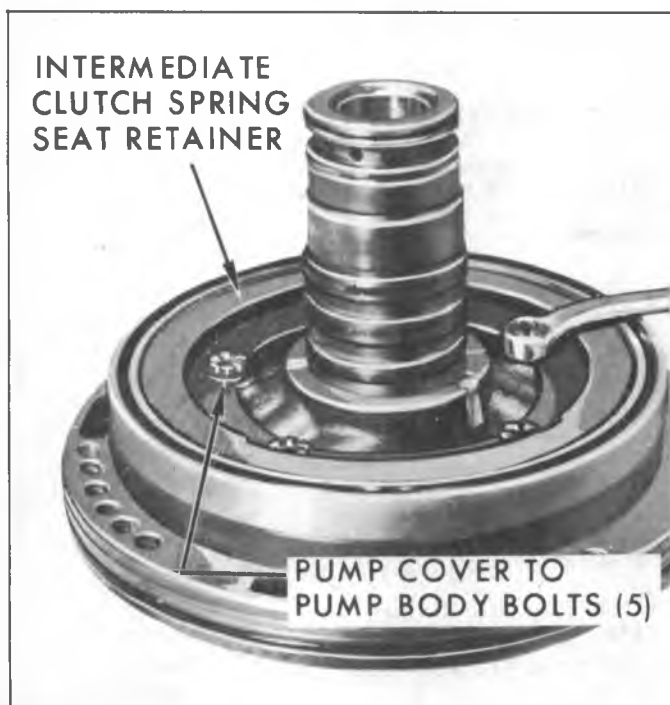


Fig. 56M--Removing Pump Cover to Pump Body Bolts

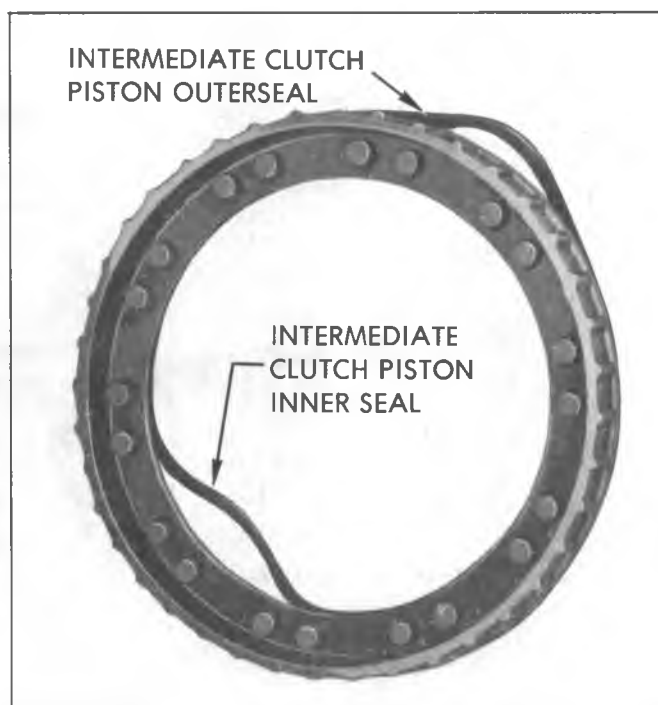


Fig. 58M--Removing Intermediate Clutch Piston Inner and Outer Seal

4. Remove intermediate clutch piston inner and outer seal (fig. 58M).

5. Remove two (2) forward clutch to pump hub hook type oil seal rings and three (3) direct clutch to pump hub hook type oil rings (fig. 59M).

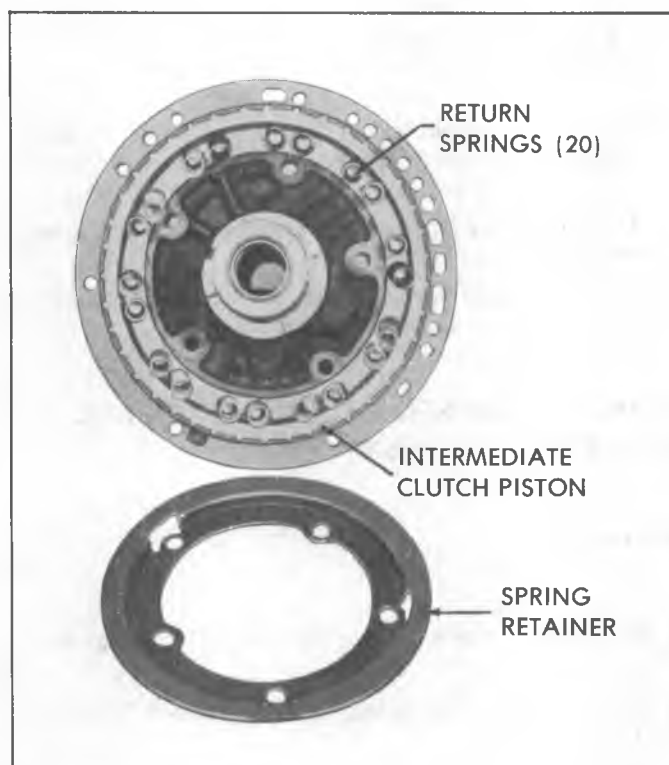


Fig. 57M--Intermediate Clutch Spring Retainer, Return Springs and Piston

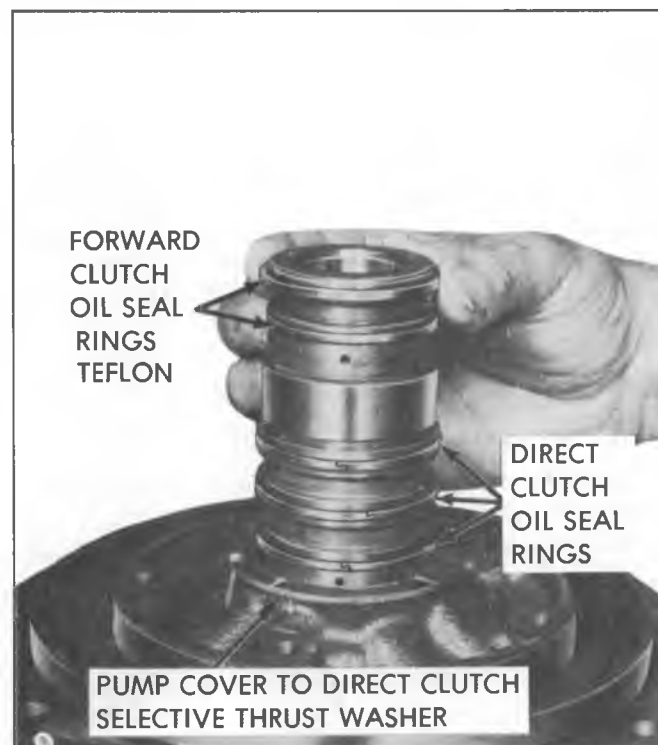


Fig. 59M--Pump Hub Oil Seal Rings



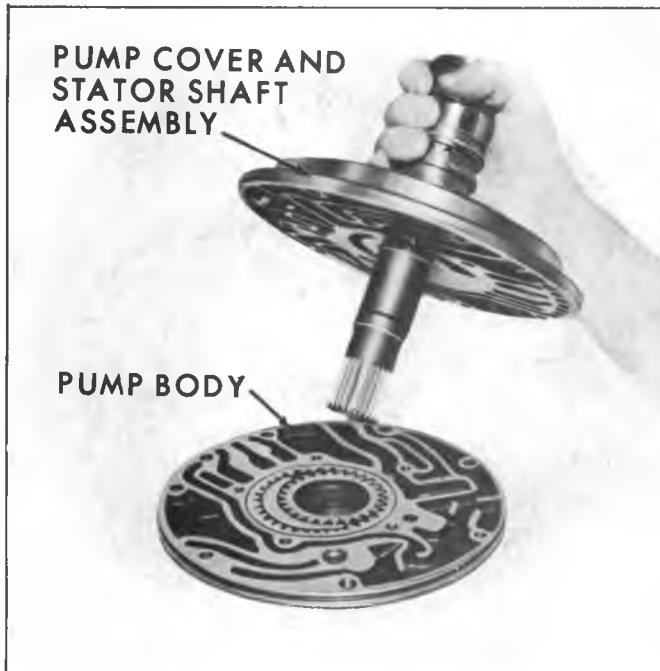


Fig. 60M--Separating Pump Cover from Pump Body

6. Remove pump cover to direct clutch drum housing selective thrust washer.
7. Remove pump cover and stator shaft assembly from pump body (fig. 60M).
8. Remove pump drive gear and driven gear.
9. Remove pump outside diameter to case (square cut) "O" ring seal. Discard seal.
10. Remove pump to converter hub lip seal (fig. 61M).

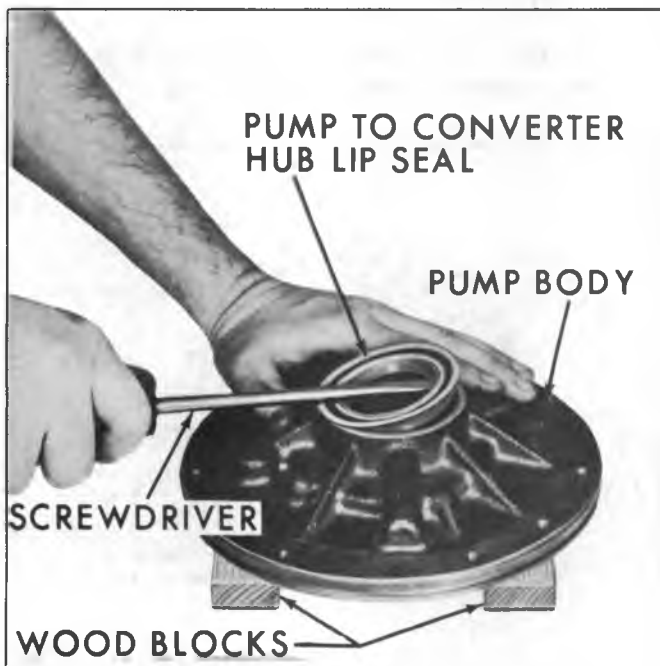


Fig. 61M--Removing Pump to Converter Hub Lip Seal



Fig. 62M--Removing Cooler By-Pass Valve Seat

**NOTE:** Place pump on wood blocks so surface finish is not damaged.

11. Remove cooler by-pass valve seat, check ball and spring by filling cooler by-pass passage with grease, inserting tool J-23124 and forcing by-pass valve seat, check ball, and spring from pump body (fig. 62M).

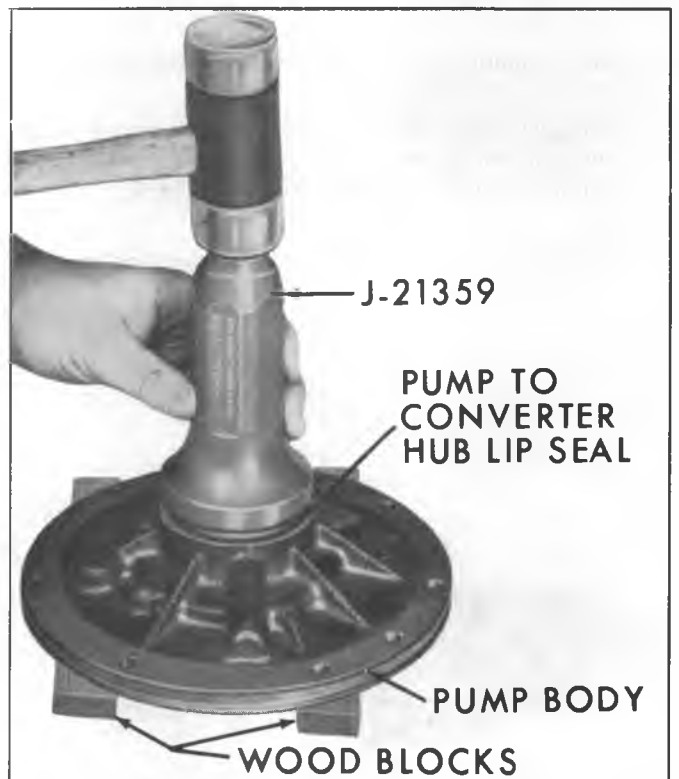


Fig. 63M--Installing Hub Lip Seal

## 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), pry out and install a new seal, fully seated in counterbore, using Seal Driver J-21359 (fig. 63M).

**NOTE:** Outer diameter of seal should be coated with a non-hardening sealer prior to installation.

7. Check condition of oil cooler by-pass valve seat and replace if valve leaks excessively.
8. 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. 64M).



Fig. 64M--Checking Pump Body to Gear Face Clearance



Fig. 65M--Installing Pump Drive and Driven Gears

## Reassembly

1. Install pump drive gear and driven gear (fig. 65M).
2. Install direct clutch drum housing to pump cover selective thrust washer over pump cover delivery sleeve.
3. 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 three (3) pump cover hub lube holes to make sure they are not restricted.

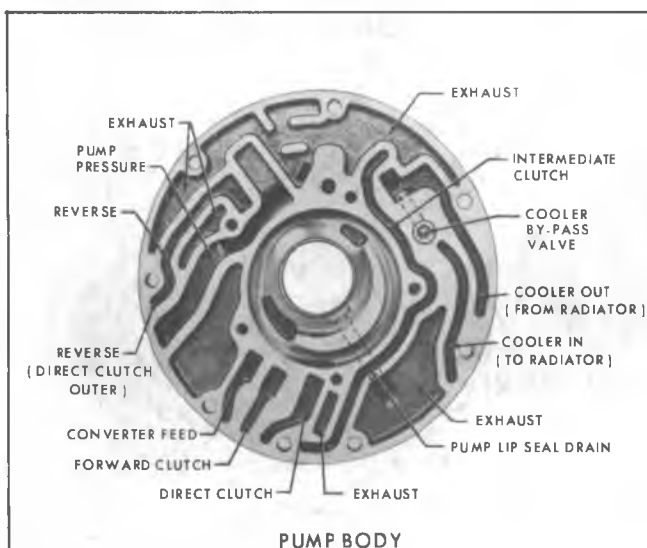


Fig. 66M--Pump Body Oil Passages

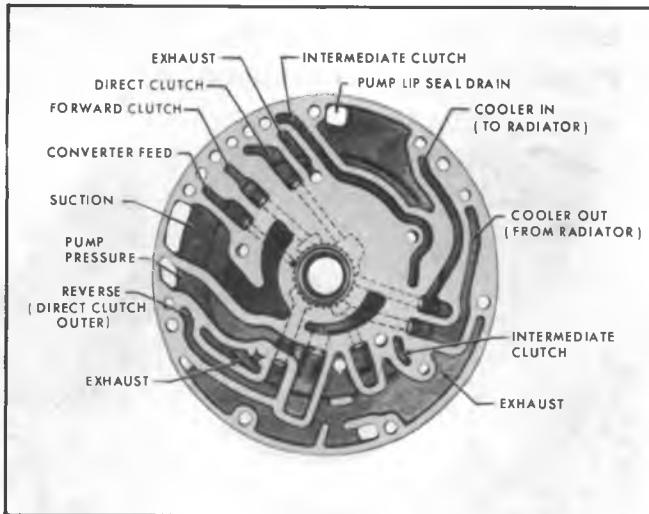


Fig. 67M--Pump Cover Oil Passages

4. Install cooler by-pass valve spring, check ball and seat. Tap seat in place with soft hammer or brass drift so it is flush to .010" below the surface.
5. Install intermediate clutch piston inner seal and outer seal on piston.

6. Install intermediate clutch piston assembly into pump cover being careful not to damage seals.
7. Install twenty (20) clutch return springs.
8. Install spring retainer and install five (5) attaching bolts.
9. Align pump body to cover and start bolts.
10. Install pump outside diameter to case (square cut) "O" ring seal.
11. Install pump to converter hub lip seal using seal installer J- 21359 (fig. 63M).
12. Tighten attaching bolts. Torque to 18 ft. lb.

### DIRECT CLUTCH DISASSEMBLY, INSPECTION, AND OVERHAUL (FIG. 68M)

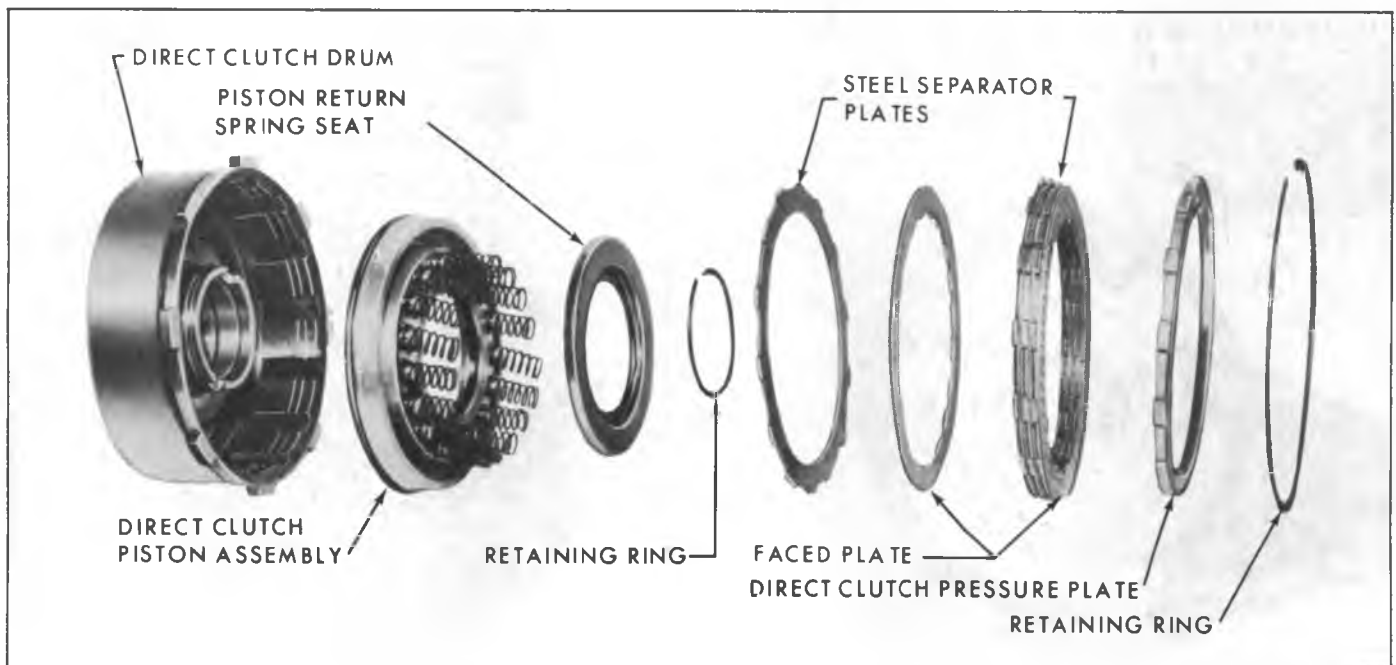


Fig. 68M--Direct Clutch Assembly--Exploded View

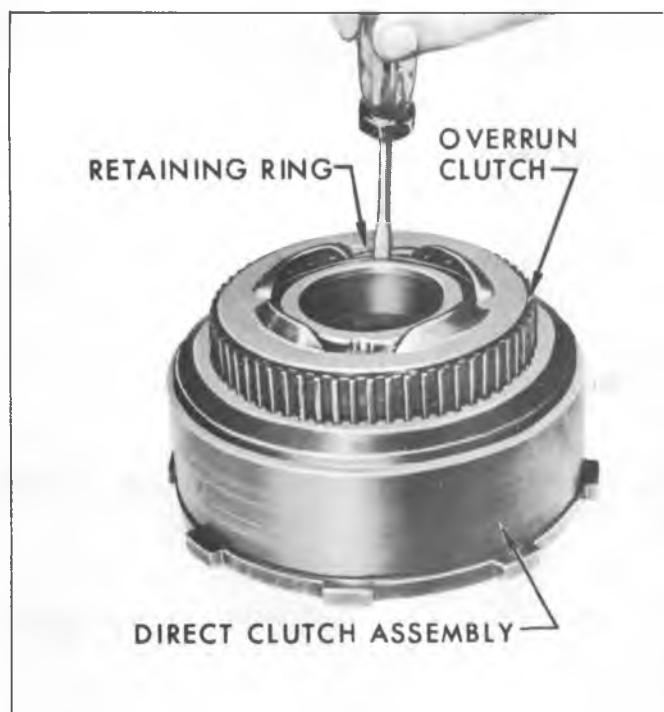


Fig. 69M--Removing Overrun Clutch Retaining Ring and Retainer

### Disassembly

1. Remove intermediate overrun clutch drum front retaining ring and retainer (fig. 69M).
2. Remove intermediate clutch overrun outer race.
3. Remove intermediate overrun roller clutch assembly (fig. 70M).



Fig. 70M--Removing Intermediate Overrun Roller Clutch

### DIRECT CLUTCH DRUM TO FORWARD CLUTCH HOUSING NEEDLE ROLLER BEARING

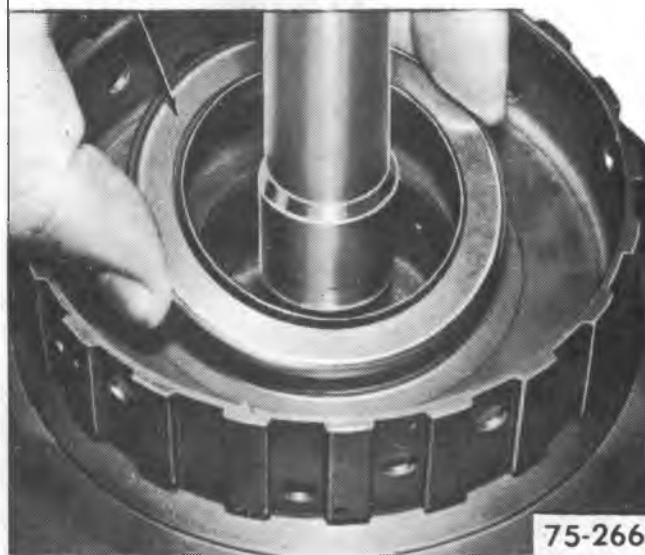


Fig. 71M--Direct Clutch Drum to Forward Clutch Housing Needle Roller Bearing

4. Remove direct clutch drum to forward clutch housing needle roller bearing (fig. 71M).
5. Remove direct clutch pressure plate to clutch drum retaining ring and pressure plate (fig. 72M).



Fig. 72M--Removing Direct Clutch Pressure Plate

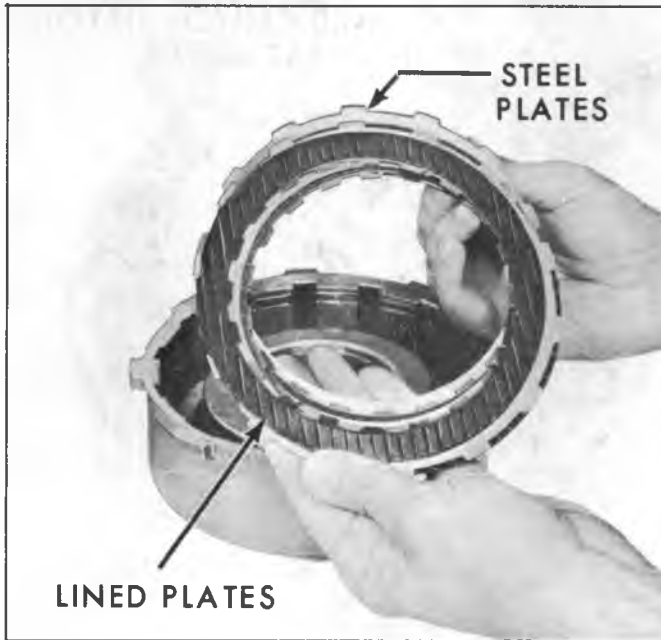


Fig. 73M--Removing Face Plates and Steel Separator Plates

6. Remove face plates and steel separator plates (fig. 73M).
7. Using compressing tool J-23327-1, remove direct clutch piston return spring seat retaining ring, spring seat and seventeen (17) clutch return coil springs (fig. 74M).



Fig. 74M--Compressing Direct Clutch Spring Seat



Fig. 75M--Removing Direct Clutch Outer and Inner Seals

8. Remove direct clutch piston assembly.
9. Remove direct clutch piston outer seal and inner seal (fig. 75M).
10. Remove direct clutch piston center seal on drum (fig. 76M).



Fig. 76M--Removing Direct Clutch Piston Center Seal on Drum

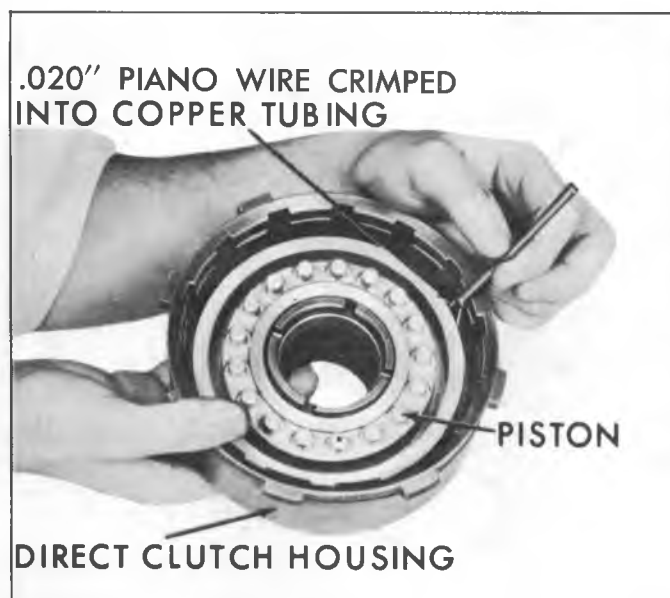


Fig. 77M--Installing Direct Clutch Piston

## 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.

## Reassembly

1. Install the direct clutch piston outer seal and inner seals.
2. Install direct clutch piston center seal on drum with lip facing upward.
3. Install direct clutch piston into housing with aid of a piece of .020" piano wire crimped into copper tubing (fig. 77M).
4. Install seventeen (17) clutch return coil springs.
5. Install piston return spring seat. Compress spring seat with tool J-23327-1 and install retaining ring (fig. 78M).
6. Lubricate with transmission fluid and install face plates and steel separator plates, alternating steel and faced plates.



Fig. 78M--Installing Direct Clutch Springs, Spring Seat and Retaining Ring

7. Install direct clutch pressure plate and retaining ring.
8. Install intermediate overrun roller clutch assembly with two (2) holes toward rear 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 74M.

## 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



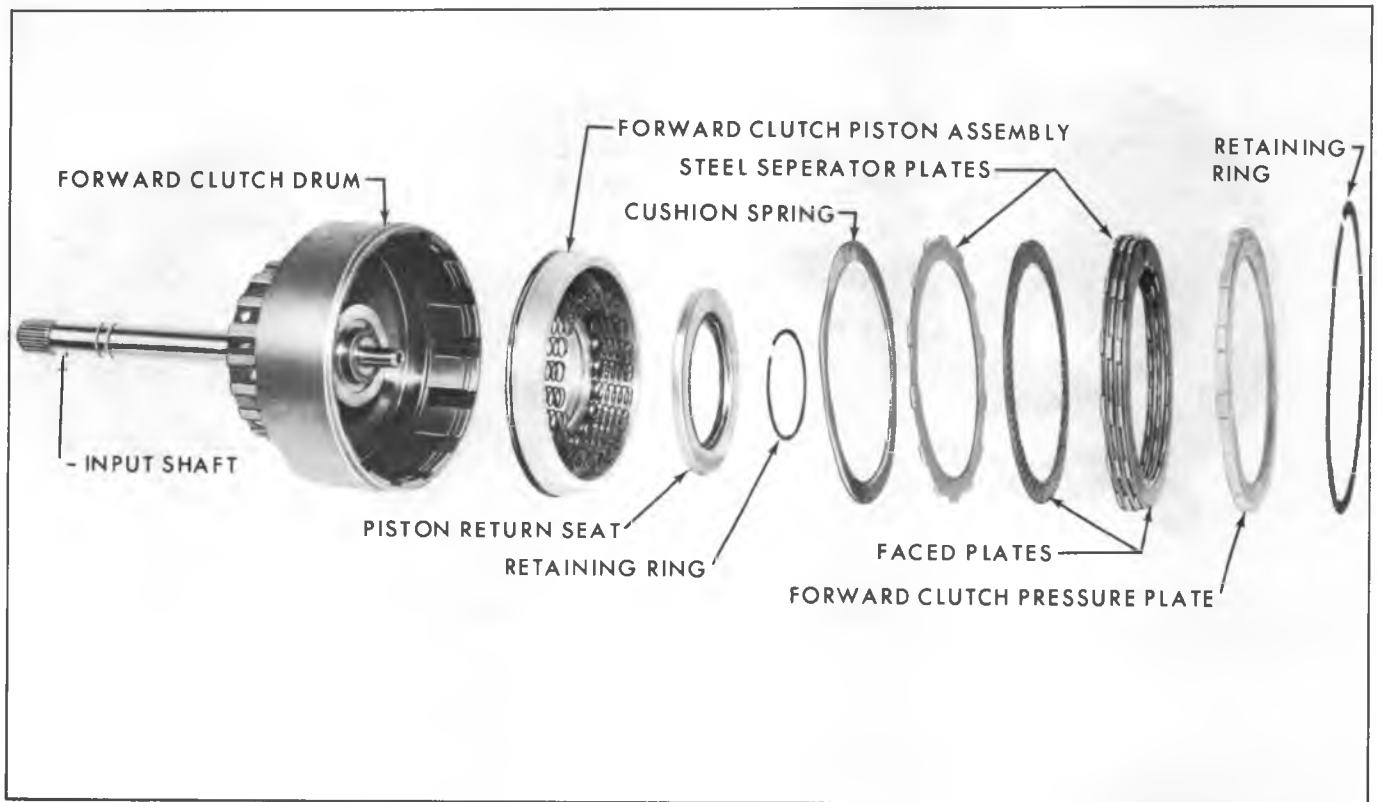


Fig. 79M--Forward Clutch Assembly--Exploded View

### FORWARD CLUTCH DISASSEMBLY, INSPECTION, AND OVERHAUL (FIG. 79M)

#### Disassembly

1. Remove forward clutch retaining ring and pressure plate (fig. 80M).
2. Remove face plates, steel separator plates and cushion spring (fig. 81M).

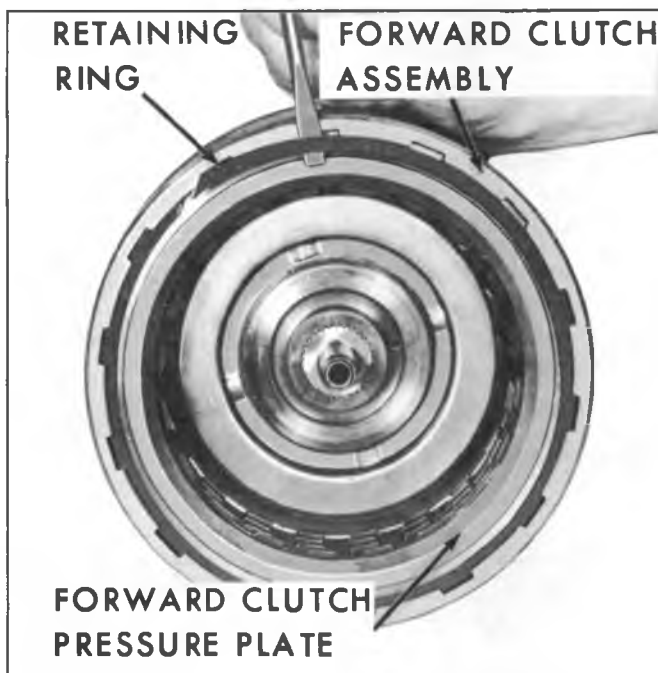


Fig. 80M--Removing Forward Clutch Retaining Ring and Pressure Plate

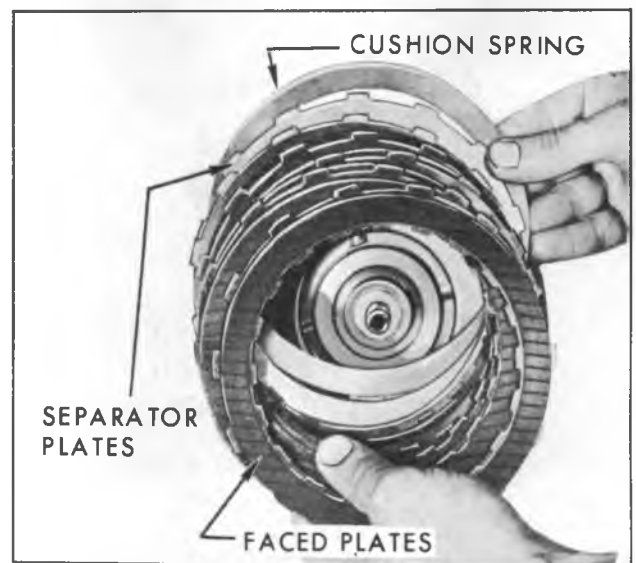


Fig. 81M--Removing Forward Clutch, Clutch Pack



Fig. 82M--Compressing Forward Clutch Piston Return Seat

3. using tool J-23327-1, compress piston return seat and remove retaining ring (fig. 82M).
4. Remove piston return seat and twenty-one (21) clutch return coil springs.
5. Remove forward clutch piston assembly.
6. Remove the forward clutch inner and outer piston seals (fig. 83M).
7. If required, remove input shaft from forward clutch housing with ram press or arbor press.



Fig. 83M--Removing Forward Clutch Piston Inner and Outer Seals

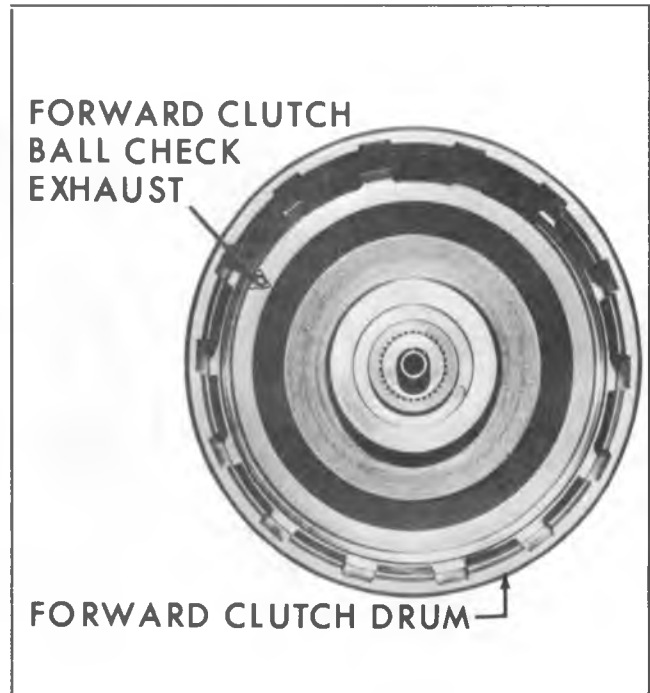


Fig. 84M--Forward Clutch Exhaust Check Ball

## 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. 84M).
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.

## Reassembly

1. If input shaft was removed, install using ram press or arbor press.
2. Install the forward clutch inner piston seal and outer piston seal.
3. 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. 85M).



Fig. 85M--Installing Forward Clutch Piston

4. Install twenty-one (21) clutch return coil springs.
5. Install spring retainer. Compress spring retainer and install retaining ring using tool J-23327-1 as shown on Figure 82M.

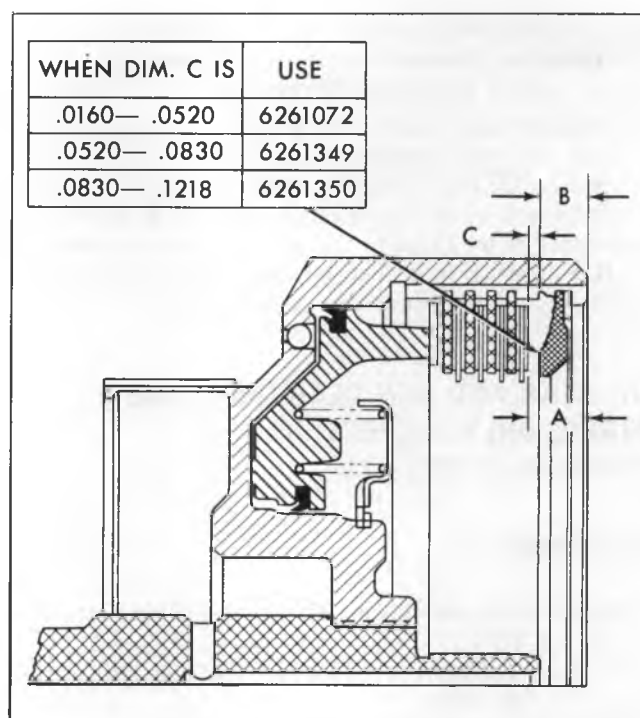


Fig. 86M--Determining Selective Fit for Forward Clutch Pressure Plate

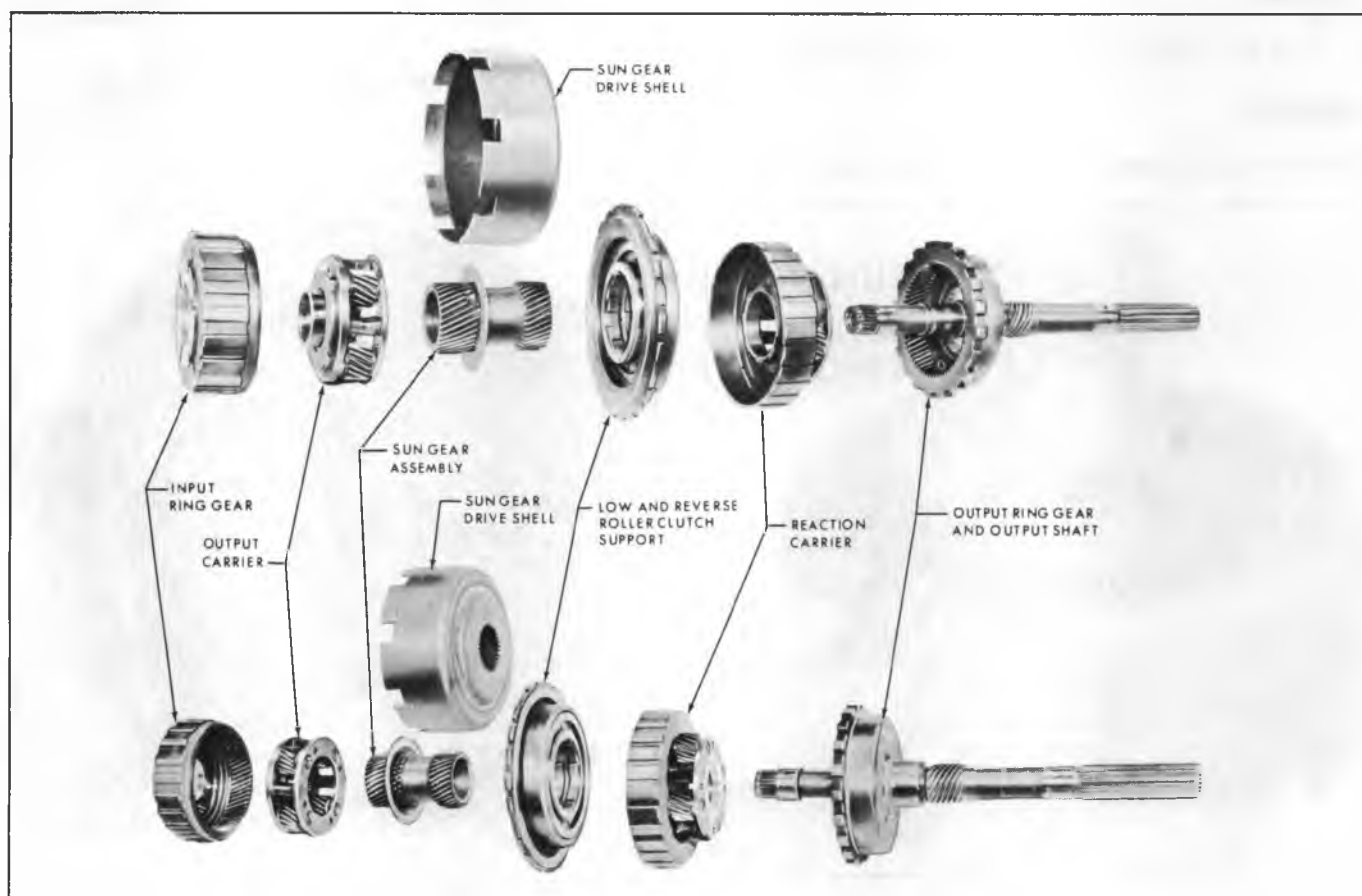


Fig. 87M--Planetary Gear Train--Exploded View

6. Lubricate with transmission fluid and install cushion spring face plates and steel separator plates, starting with the cushion spring and alternating steel and faced.
7. Install forward clutch pressure plate (selective fit) and retaining ring. 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. Use chart on Figure 86 to select correct pressure plate.

## SUN GEAR AND SUN GEAR DRIVE SHELL DISASSEMBLY, INSPECTION, AND REASSEMBLY (FIG. 87M)

### Disassembly

1. Remove sun gear to sun gear drive shell rear retaining ring (fig. 88M).
2. Remove sun gear to drive shell flat rear steel thrust washer (fig. 89M).
3. Remove sun gear assembly from drive shell.
4. Remove sun gear to drive shell front retaining ring (fig. 90M). Discard retaining ring.

### Inspection

1. Check gear and sun gear shell for damage or wear.

### Reassembly

1. Install new sun gear to drive shell front retaining ring.



Fig. 88M—Removing Sun Gear Drive Shell Rear Retaining Ring



Fig. 89M—Removing Sun Gear to Drive Shell Rear Steel Thrust Washer

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. 90M—Removing Sun Gear to Drive Shell Front Steel Thrust Washer

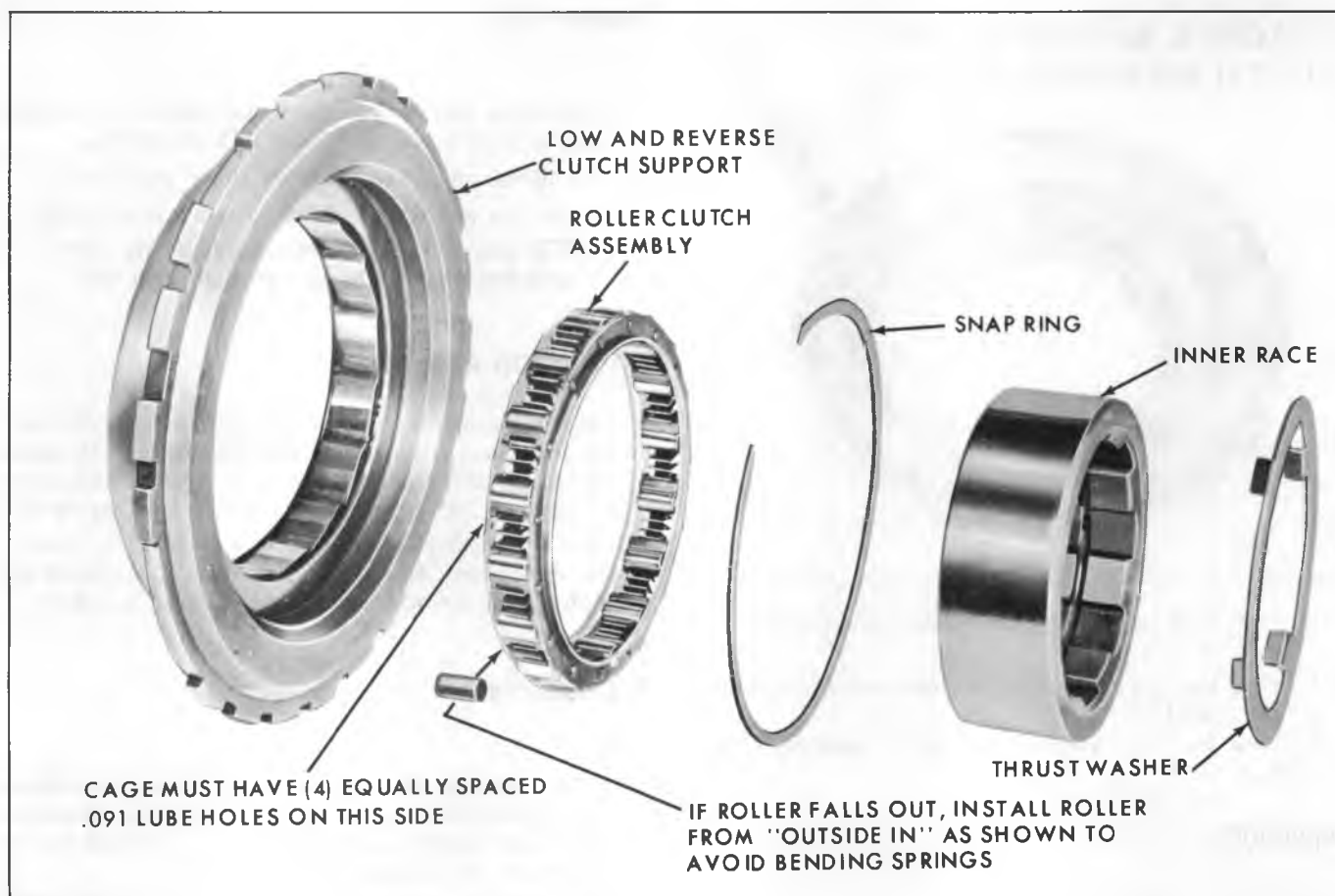


Fig. 91M--Low and Reverse Clutch Assembly--Exploded View



Fig. 92M--Removing Overrun Clutch Inner Race

### LOW AND REVERSE CLUTCH SUPPORT DISASSEMBLY, INSPECTION, AND REASSEMBLY (FIG. 91M)

#### 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. 92M).

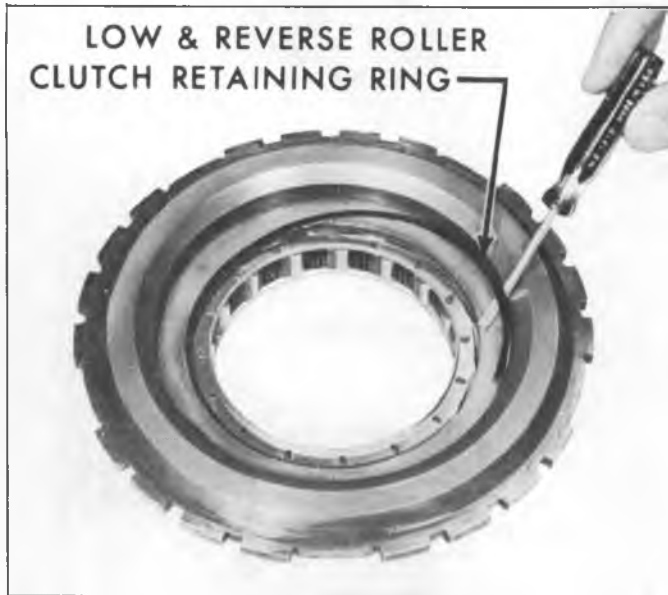


Fig. 93M--Removing Overrun Roller Clutch Retaining Ring

3. Remove low and reverse clutch roller clutch retaining ring (fig. 93M).
4. Remove low and reverse roller clutch assembly (fig. 94M).

### Inspection

1. Inspect roller clutch inner and outer race for scratches and indentations.
2. Inspect rollers for wear and roller springs for distortion.



Fig. 94M--Removing Overrun Roller Clutch Assembly

### Reassembly

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:

### 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. 95M).
2. Remove governor valve from governor sleeve. Be careful not to damage valve.
3. Perform following inspections and replace governor driven gear, if necessary.

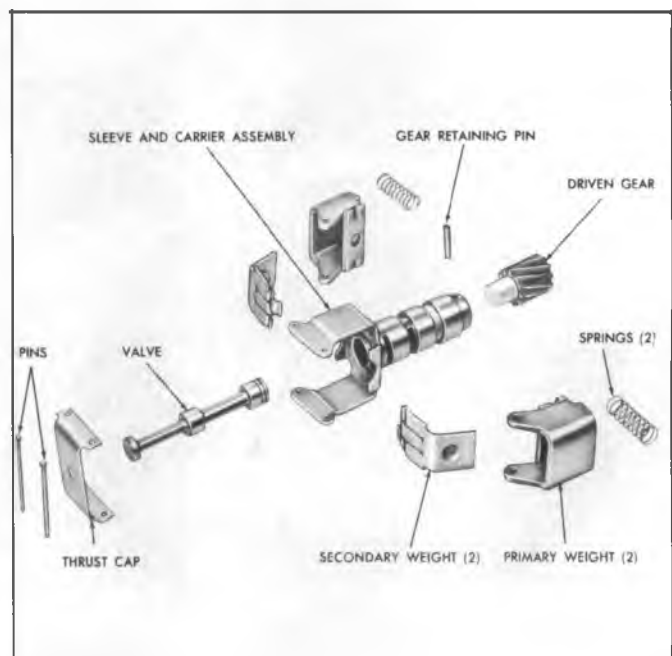


Fig. 95M--Governor Assembly--Exploded View Typical



## 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 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.

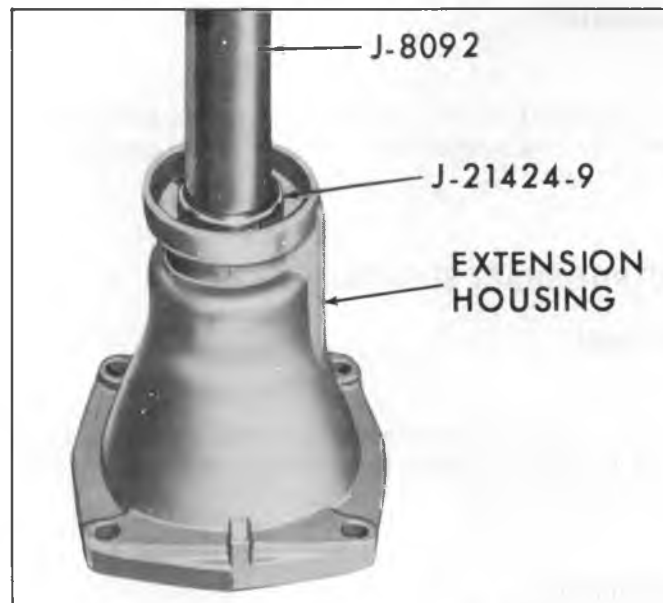


Fig. 96M—Installing Extension Housing Bushing

## Reassembly

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.

## TURBO HYDRA-MATIC 350 BUSHING REPLACEMENT EXTENSION HOUSING BUSHING Removal

Remove bushing with screwdriver as shown in Figure 6M

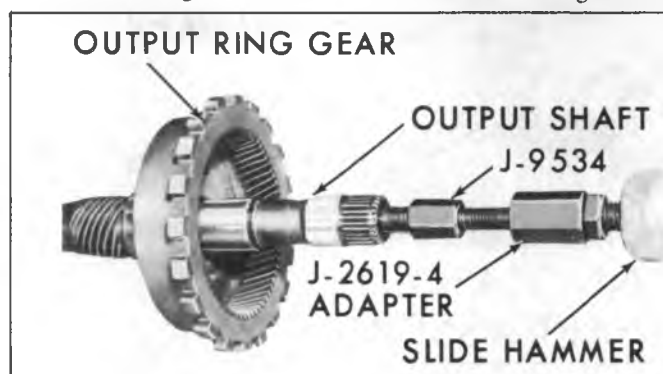


Fig. 97M—Removing Output Shaft Bushing

## Installation

Using tool J-21424-9 and driver handle J-8092 install extension housing bushing flush to .010 below seal counter bore surface (fig. 96M).

## OUTPUT SHAFT BUSHING

### Removal

With output shaft properly supported, remove bushing using J- 9534-01 extractor and slide hammer J-9539, J-6585 (fig. 97M).

### Installation

Using tool J-21424-7 and Drive handle J-8092 install output shaft bushing.

## CASE BUSHING

### Removal

With case properly supported, remove case bushing.

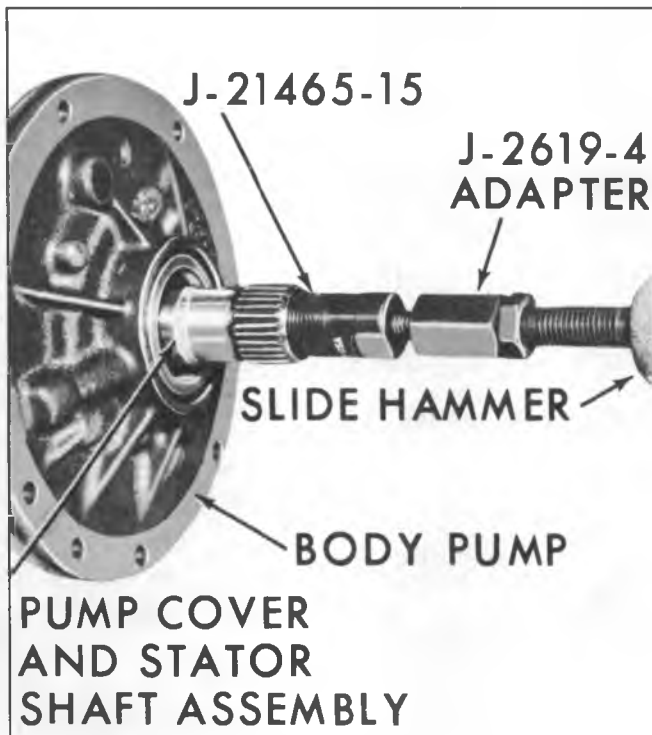


Fig. 98M—Removing Stator Shaft Front Bushing

## Installation

Using tool J-23062-1 and drive handle J-8092 with extension J- 21465-13, install case bushing from interior of case to 3/16" from front surface. Split in the bushing should be located at governor pilot upper bore wall area.

## STATOR SHAFT BUSHING

### Removal (Front)

With stator shaft properly supported, remove front bushing using tool J-21465-15 with slide hammer J-2619 and adapter J-2619-4 (fig. 98M).

### Installation

Using tool J-21424-7 and drive handle J-8092 install front stator shaft bushing (fig. 99M) to .250" from front face.

### Removal (Rear)

With stator shaft properly supported, remove front bushing as previously described. Place tool J-21424-7 extension J-21465-13 and drive handle J-8092, through front of the stator shaft and drive out rear (2) bushings.

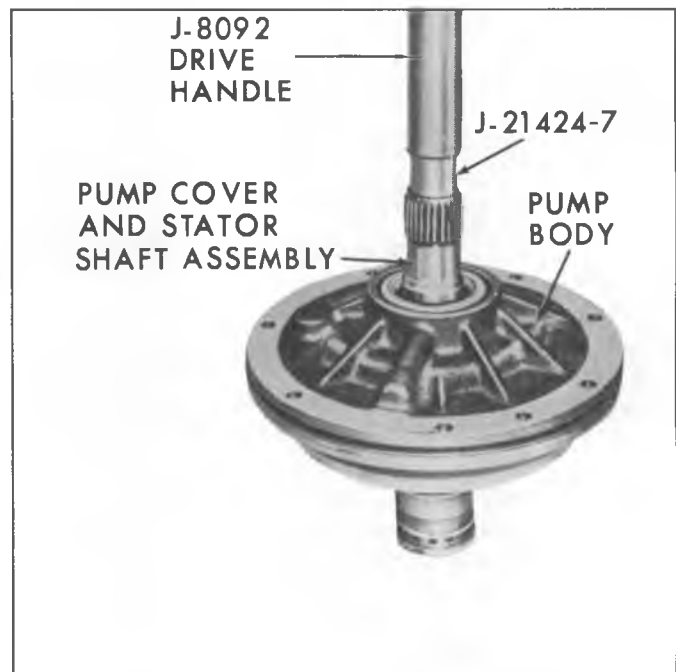


Fig. 99M—Installing Front Stator Shaft Bushing



Fig. 100M--Installing Rear and Center Stator Shaft Bushings

### Installation

Using tool J-23062-2 and extension J-21465-13, install center bushing to approximately  $1 \frac{5}{32}$ " below front face and rear bushing  $\frac{3}{32}$ " below front face (fig. 100M).

### INPUT RING GEAR SUPPORT BUSHING

#### Removal

With input ring gear support properly supported, remove bushing.

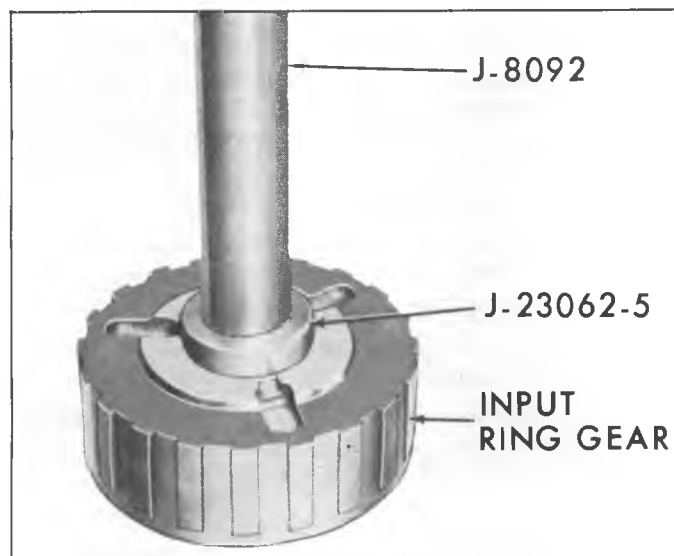


Fig. 101M--Installing Input Ring Gear Support Bushing

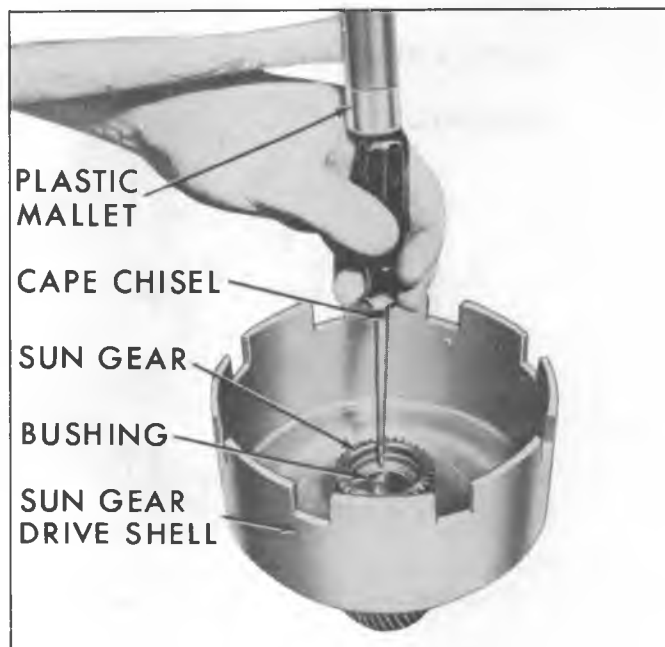


Fig. 102M--Removing Sun Gear Bushings

### Installation

1. Using tool J-23062-5 and drive handle J-8092 install input ring gear bushing to approximately  $\frac{1}{16}$ " below rear face inside gear end (fig. 101M).

### SUN GEAR BUSHING

#### Removal

1. With sun gear properly supported, remove sun gear bushings (fig. 102M).

#### Installation

Using tool J-23062-3 and drive handle J-8092 install sun gear bushings to .010" below surface at either end (fig. 103M).

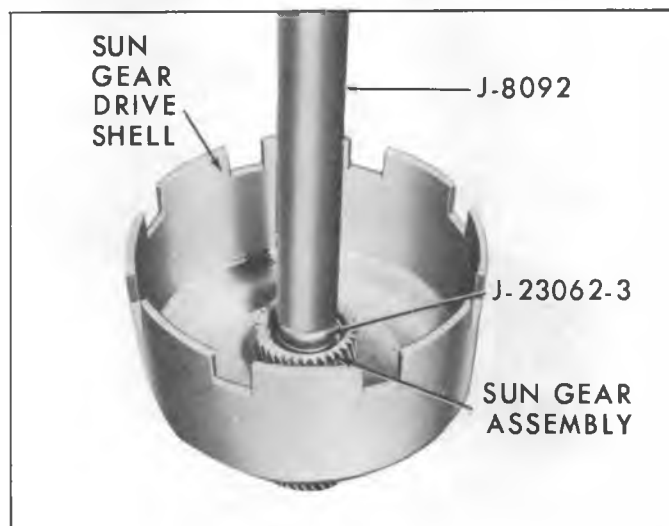


Fig. 103M--Installing Sun Gear Bushings

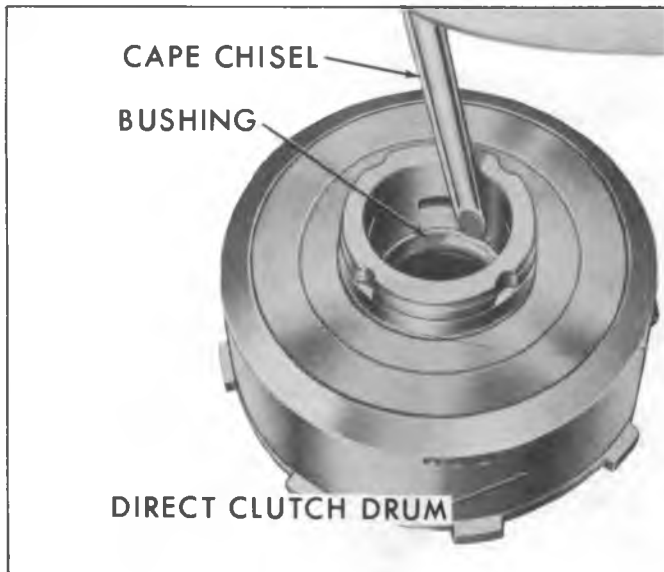


Fig. 104M--Removing Direct Clutch Drum Bushing

## REACTION CARRIER BUSHING

### Removal

With reaction carrier properly supported, remove bushing.

### Installation

Using tool J-23062-3 and drive handle J-8092 install reaction carrier bushing to flush or .010" below inside face.



Fig. 105M--Installing Direct Clutch Drum Bushing

## DIRECT CLUTCH BUSHING

### Removal

With direct clutch drum properly supported, remove bushing (fig. 104M).

### Installation

Using tool J-23329 and drive handle J-8092, install direct clutch @ 1-3 1/2

## TRANSMISSION REASSEMBLY

**NOTE:** Use only transmission oil 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.

**NOTE:** Notch in piston should be 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. Oil and install low reverse clutch steel reaction plates and face plates, starting with a steel plate and alternating with face plates. Install anti-clunk spring.

**NOTE:** Notch in steel separator plates should be placed toward bottom of case.



Fig. 106M--Installing Low and Reverse Clutch Support Assembly

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 106M.

**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 input ring gear to output shaft snap ring.

**CAUTION:** Do not over stress snap ring.

17. Install input gear front thrust washer.
18. Install direct clutch assembly, and special thrust washer to forward clutch assembly.

**NOTE:** 1st design uses thrust washer between forward and direct clutches. 2nd design uses Torington Needle bearing. When replacing 1st design Forward or Direct clutch housing, use 2nd design parts (Direct clutch, forward clutch housings and thrust bearing).

19. Install clutch assemblies into case.



Fig. 107M--Pump Cover to Direct Clutch Selective Thrust Washer

**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.



Fig. 108M--Checking End Play for Proper Thrust Washer Selection

## Pump to Direct Clutch Thrust Washer Selection Procedure

To check for proper thickness of selective fit thrust washer between the oil pump cover and direct clutch assembly, proceed as follows:

- Install selective fit thrust washer, (fig. 107) oil pump gasket and using guide studs from J-3387 set install oil pump. Install two pump to case bolts.
- 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 108M. Zero the indicator.
- Push up on the transmission output shaft and observe the total indicator movement.
- 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".

- Install new pump assembly in case gasket.
- Install new pump assembly to case square cut oil seal ring.
- Install guide pins into case.
- Install pump assembly into case. Install attaching bolts with new washer type seals.



Fig. 109M—Installing Extension Housing Seal

**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

- Place speedometer drive gear retaining clip into hole in output shaft.
- Align slot in speedometer drive gear with retaining clip and install.
- Install extension housing to case square cut "O" ring seal.
- Attach extension housing to case using attaching bolts. Torque to 25 ft. lb.
- If necessary, install a new extension housing seal, using seal installer J-5154 (fig. 109M).

## MANUAL LINKAGE

- If necessary, install a new manual shaft to case lip seal using 3/4" usin 3/4" dia. rod, seat seal in case.
- Install parking pawl, tooth toward the inside of case, into case.
- Install parking pawl shaft into case and through parking pawl.
- Install parking pawl shaft retainer plug. Drive into case using a 3/8" dia. rod, until retainer plug is .130"--.170" below face of case, then stake in three places.
- Install parking pawl disengaging spring, square end hooked on pawl.
- Install park lock bracket, torque bolts to 29 ft. lb. see Figure 110M.

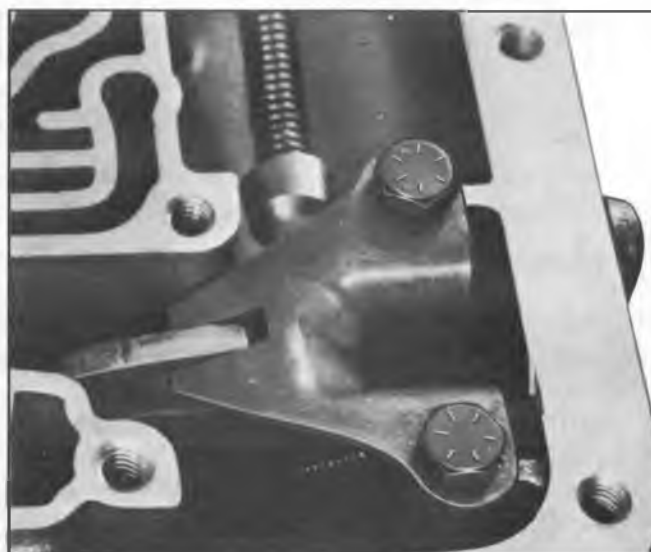


Fig. 110M—Park Lock Bracket Special Bolt Identification



**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.

### INTERMEDIATE SERVO PISTON, VALVE BODY, OIL PAN AND GASKET

1. Install intermediate servo piston, apply pin, spring and spring seat. Check for proper apply pin selection using tool J-23071 as shown on Figure 111M. Use long pin if gauge is flush or below steel rule or short pin if gauge is above steel rule.
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.



Fig. 111M—Gauging for Proper Apply Pin Selection

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. Install strainer assembly gasket and strainer.

**NOTE: Be sure lube holes in strainer match up with those in valve body.**

12. Install oil pan using a new gasket. Tighten bolts to 130 inch pounds in succession until bolts maintain torque specification.

### 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 intermediate clutch accumulator cover and "O" ring seal using tool J-23069.

**NOTE: Using a new "O" ring seal install seal in groove in case before installing cover.**

# TURBO HYDRA-MATIC 400 TRANSMISSION

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## 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).

## 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).



Fig. 1T-Side Cross Section--Typical

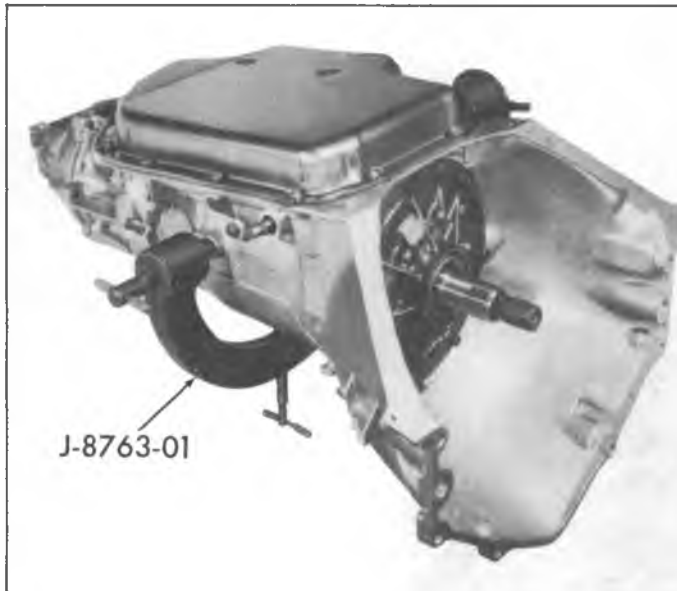


Fig. 2T--Transmission in Holding Fixture



Fig. 3T--Removing Modulator Retainer

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.

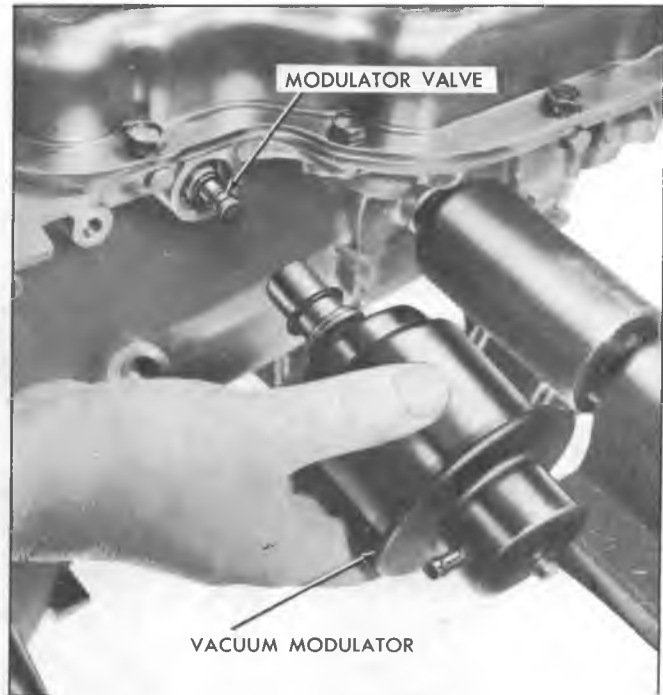


Fig. 4T--Removing Vacuum Modulator and Valve

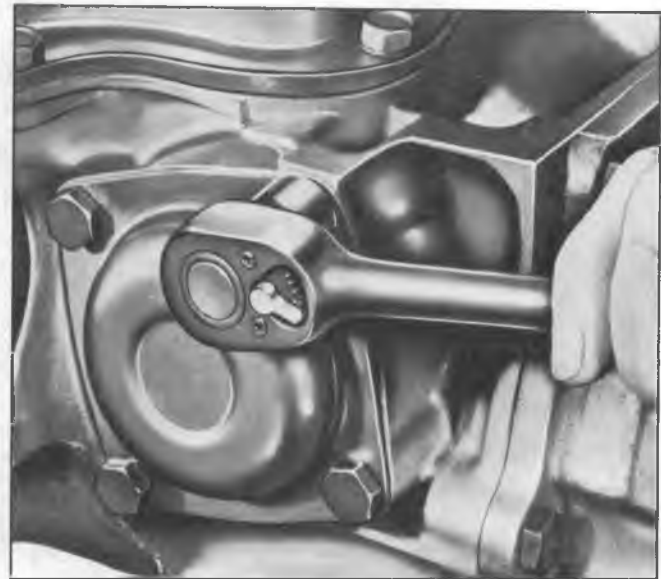


Fig. 5T--Removing Governor Cover Attaching Screws

8. Remove intake pipe to case "O" ring seal from intake pipe or case and discard.

**Removal of Pressure Switch Assembly, Control Valve Assembly, Solenoid Connector, Governor Pipes, Governor Screen Assembly, and Detent Spring Assembly**

**NOTE:** CM Model transmission does not have Pressure Switch (TCS).

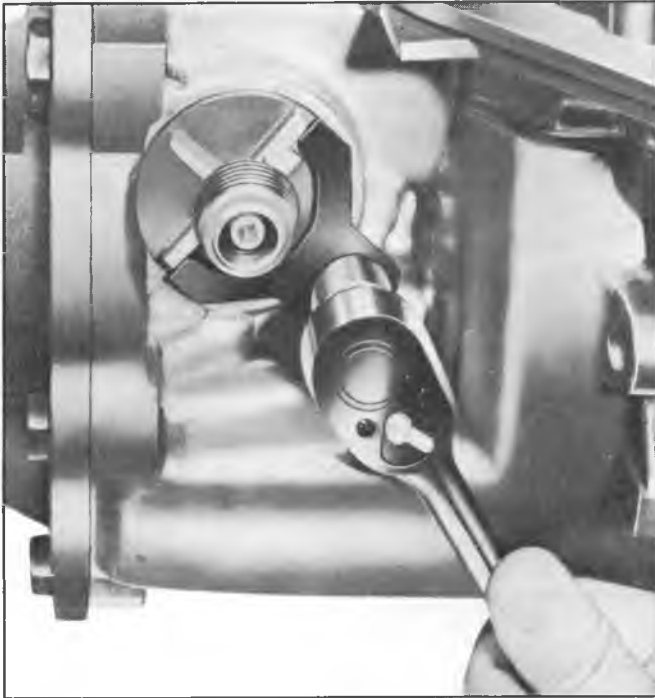


Fig. 6T--Removing Speedometer Driven Gear Retainer

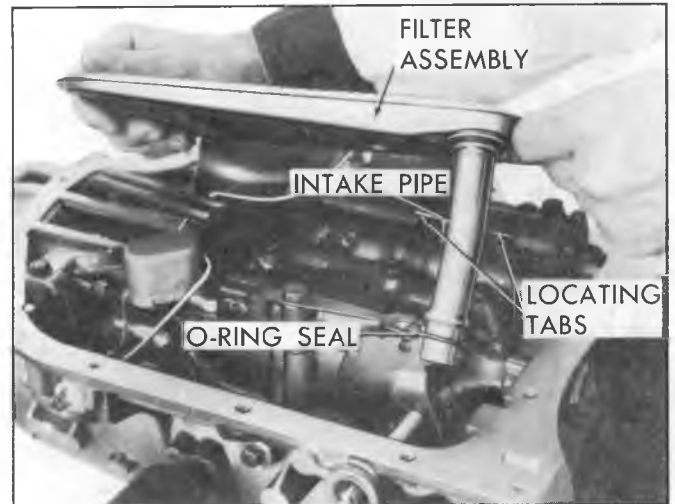


Fig. 8T--Removing Filter Assembly and "O" Ring

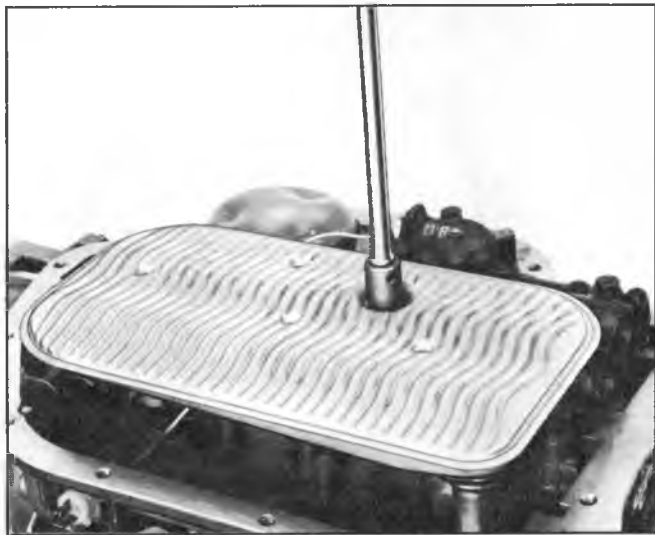


Fig. 7T--Removing Filter Retainer Bolt

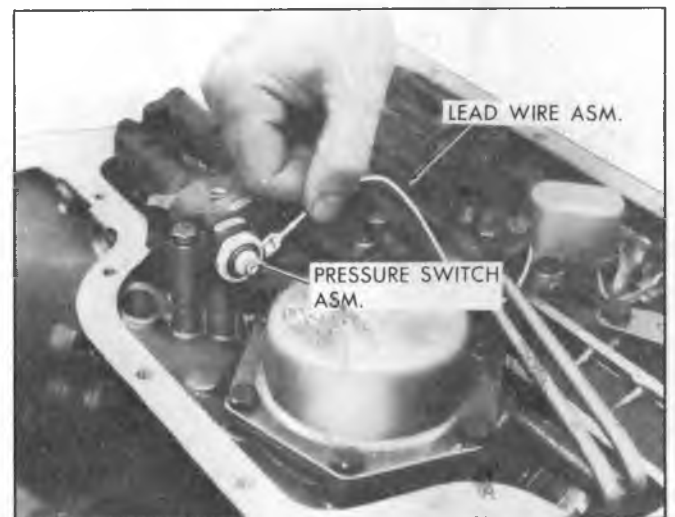


Fig. 8T-A--Disconnecting Pressure Switch Lead Wire Assembly

1. Disconnect the lead wire assembly from the pressure switch assembly (fig. 8T-A).
2. If necessary, remove the pressure switch assembly (fig. 8T- B).
3. 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.

4. Remove control valve assembly and governor pipes (fig. 10T).

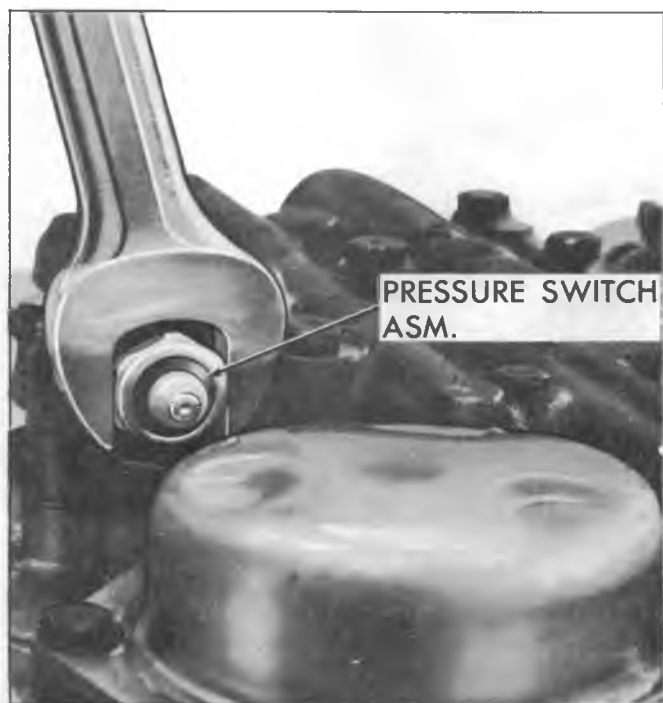


Fig. 8T-B--Removing Pressure Switch

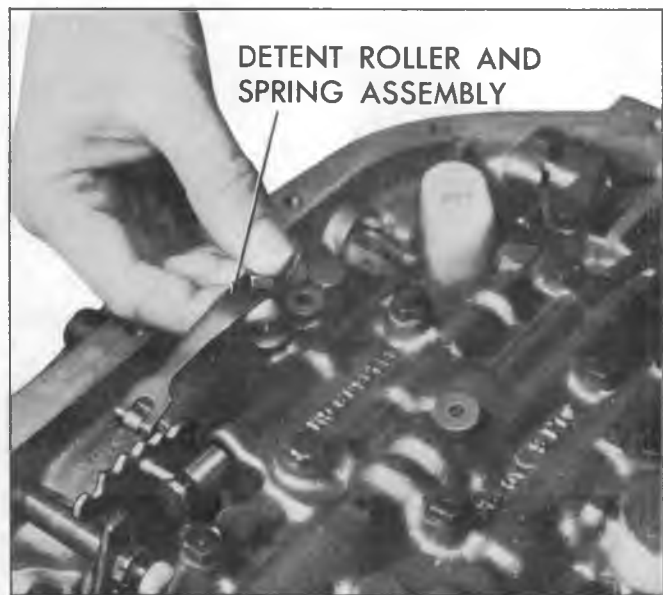


Fig. 9T--Removing Detent Roller and Spring Assembly

**CAUTION:** Do not drop manual valve.

5. 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.
6. Remove governor pipes from control valve assembly.

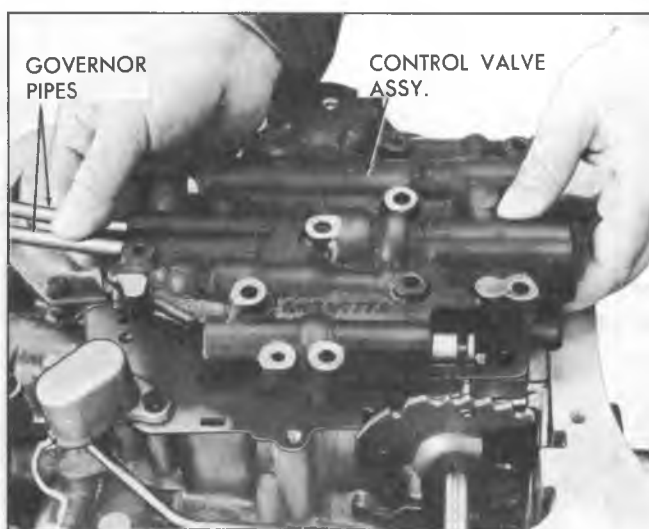


Fig. 10T--Removing Control Valve Assembly and Governor Pipes from Case

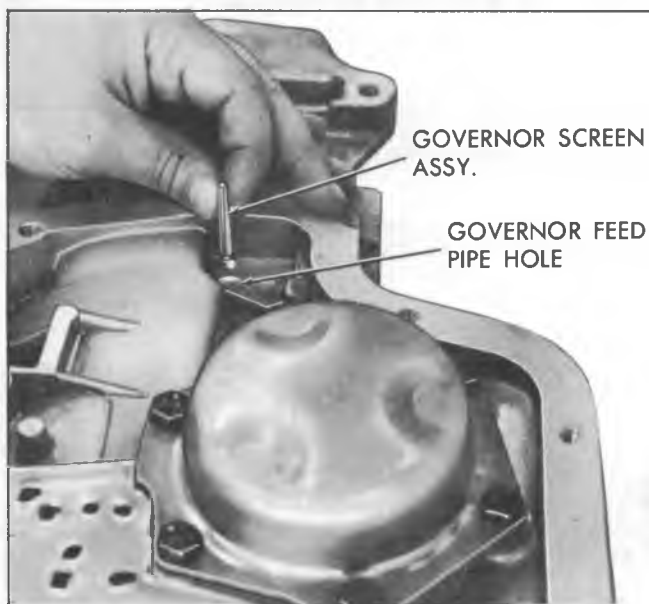


Fig. 10T-A--Removing Governor Screen Assembly

7. Disconnect solenoid lead wires from connector terminal (fig. 10T- B).

### 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).
2. 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).



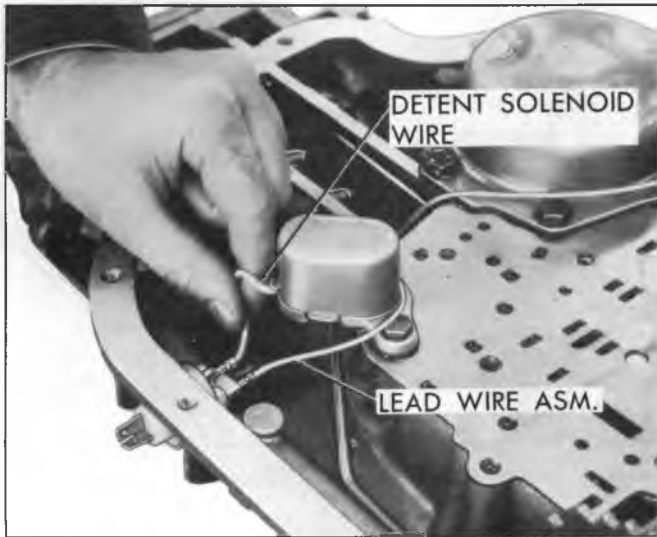


Fig. 10T-B-Disconnecting Lead Wires from Terminal



Fig. 12T-Removing Rear Servo Assembly

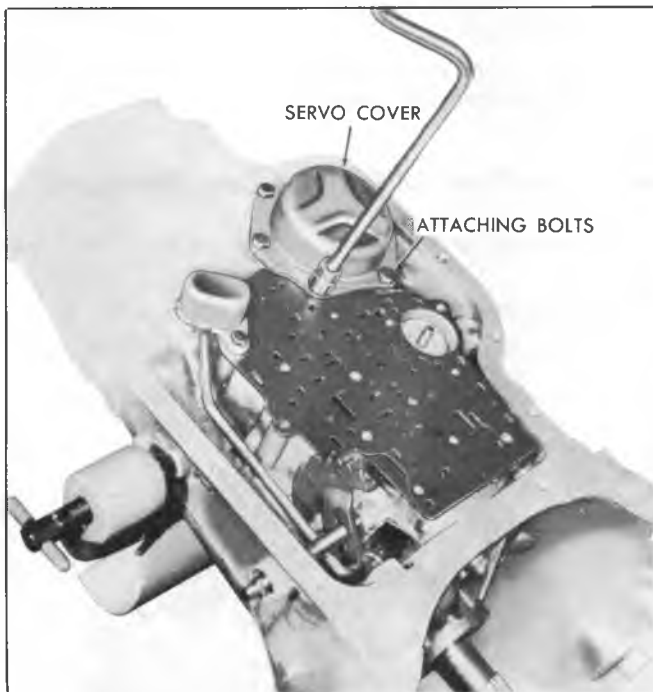


Fig. 11T-Removing Rear Servo Cover Attaching Bolts

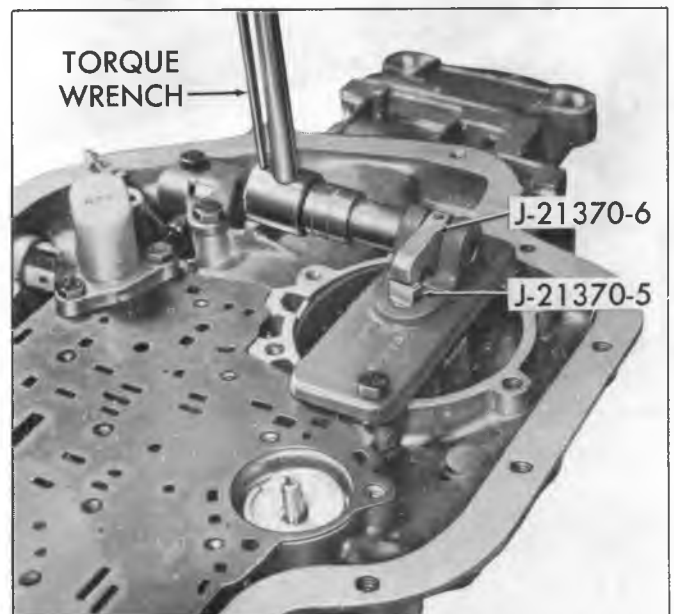


Fig. 13T-Checking Rear Band Apply Pin

### Rear Band Apply Pin Selection

- 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).
- 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 identification in the form of one, two or three rings.

- If both steps of J-21370-5 are below the gauge surface, the long pin, identified by 3 rings, should be used.
- If the gauge surface is between the steps, the medium pin, identified by 2 rings, should be used.
- 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.

- Remove detent solenoid attaching screws, detent solenoid and gasket (fig. 14T).



Fig. 14T--Removing Detent Solenoid and Gasket



Fig. 15T--Removing Electrical Connector and "O" Ring Seal

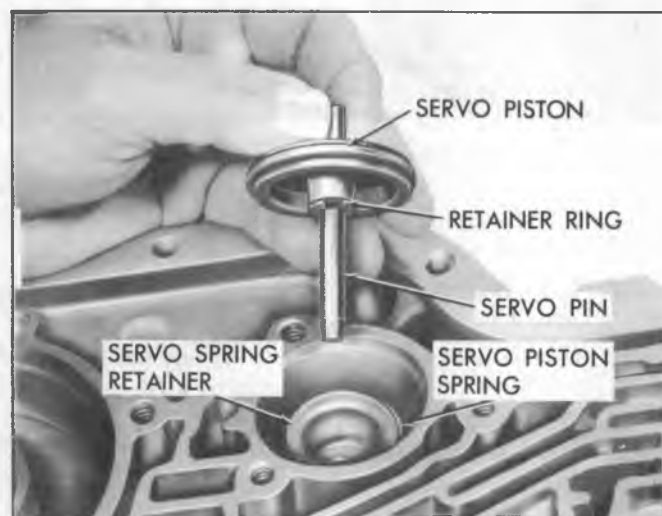


Fig. 16T--Removing Front Servo Piston, Retainer Ring, and Pin



Fig. 17T--Removing Rear Oil Seal from Case Extension

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.
9. Remove front servo piston, retainer ring, washer, pin, spring retainer and spring from transmission case (fig. 16T).

### Removal of Rear Oil Seal and Case Extension

1. If necessary to replace, pry rear oil seal from case extension.
2. Remove case extension to case attaching bolts.
3. Remove case extension to case gasket (fig. 18T).



Fig. 18T--Case Extension and Gasket

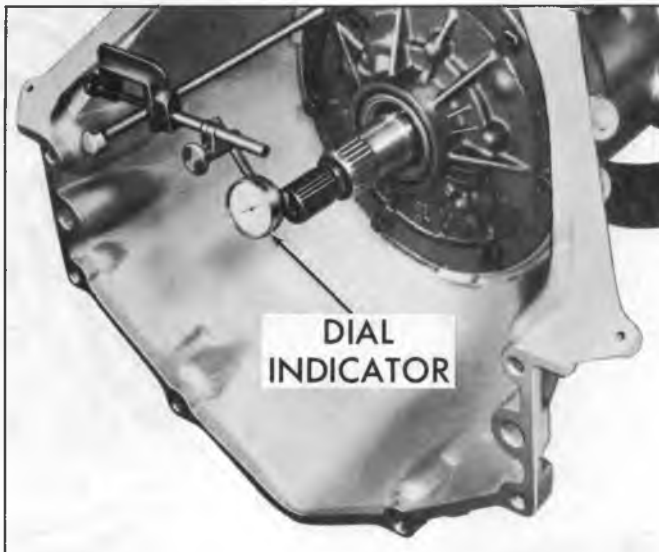


Fig. 19T--Checking Front Unit End Play

4. Make front unit end play check as follows: (fig. 19T).

#### Front Unit End Play Checking Procedure

- Remove one front pump attaching bolt, and bolt washer. (See Figure 19T for location).
- Install a 3/8"-16 threaded slide hammer bolt or J-9539, into bolt hole.
- Mount a dial indicator on rod and index indicator to register with end of turbine shaft.
- Push on turbine shaft rearward.
- Push output shaft forward.
- Set dial indicator to Zero.
- Pull turbine shaft forward.

Read resulting travel or end play. Should be .003"-.024".

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:

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. 20T--Removing Front Seal

#### Removal of Oil Pump and Internal Case Components

- If necessary to replace, pry front seal from pump (fig. 20T).
- Remove pump attaching bolts.
- 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. 21T). (See illustration for location of threaded holes.)

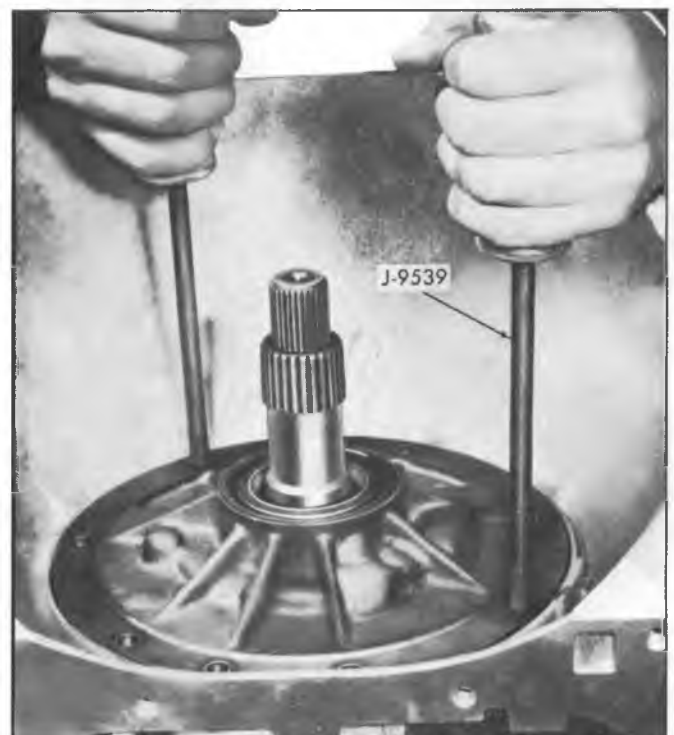


Fig. 21T--Removing Pump Assembly

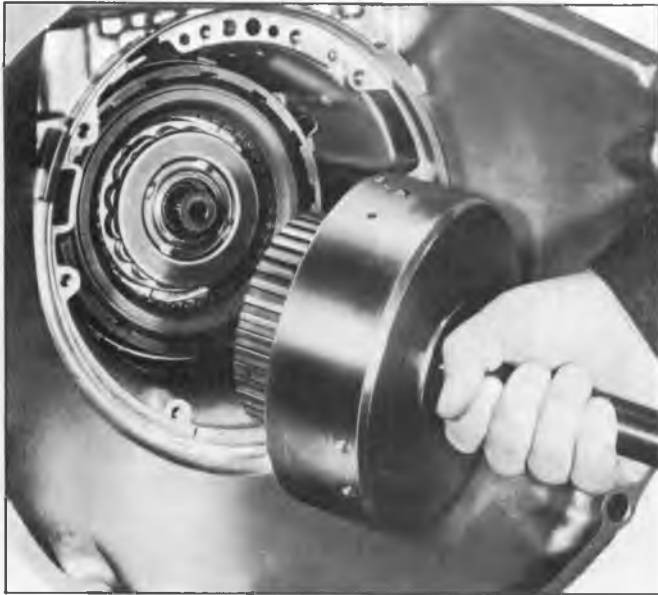


Fig. 22T--Removing Forward Clutch Assembly and Turbine Shaft

4. Remove and discard pump to case seal and gasket.
5. Remove forward clutch assembly and turbine shaft from transmission (fig. 22T).
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. 23T).



Fig. 23T--Removing Direct Clutch Assembly

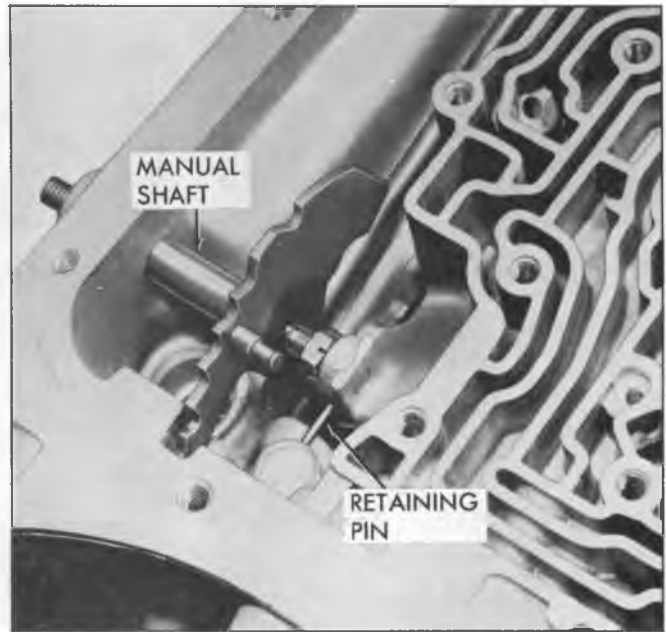


Fig. 24T--Removing Manual Shaft Retaining Pin from Case

### Remove Manual Linkage

**NOTE:** If necessary, remove manual linkage as follows:

- a. Unthread jam nut holding detent lever to manual shaft.
- b. Remove manual shaft retaining pin from case (fig. 24T).

**CAUTION:** Do not lose jam nut as it becomes free from manual shaft.

- c. Remove manual shaft and jam nut from case (fig. 25T).

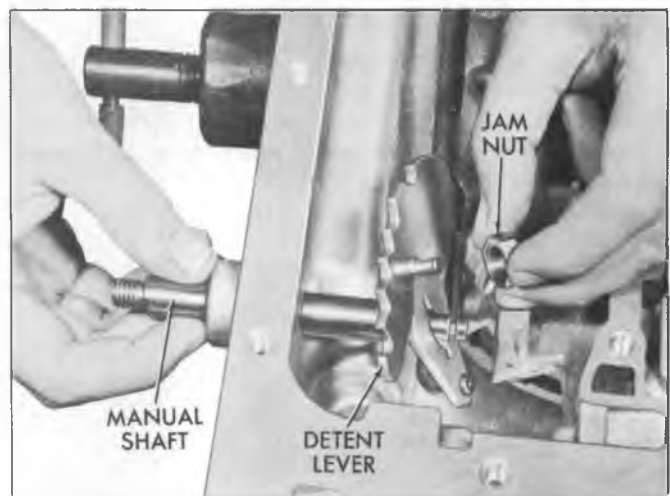


Fig. 25T--Removing Detent Lever and Jam Nut from Manual Shaft

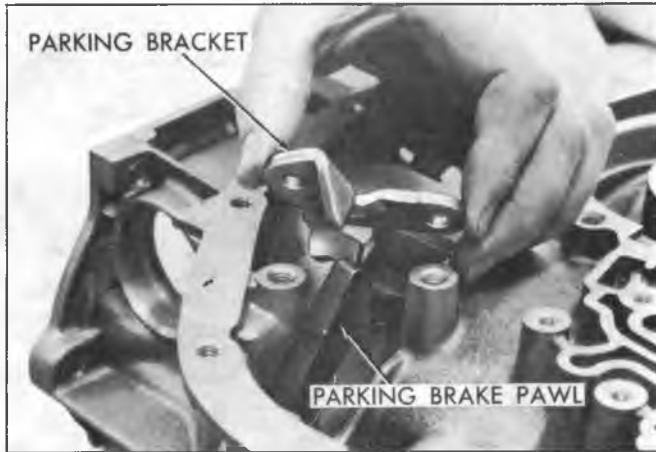


Fig. 26T--Removing Parking Bracket

**NOTE:** Manual shaft should NOT be removed from the case unless replacement is required.

- d. Remove parking actuator rod and detent lever assembly.
- e. Remove attaching screws and parking bracket (fig. 26T).



Fig. 27T--Removing Parking Pawl Return Spring

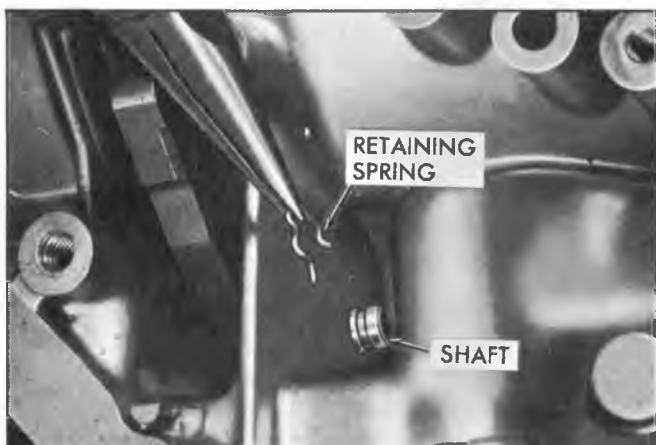


Fig. 28T--Removing Parking Shaft Retaining Spring

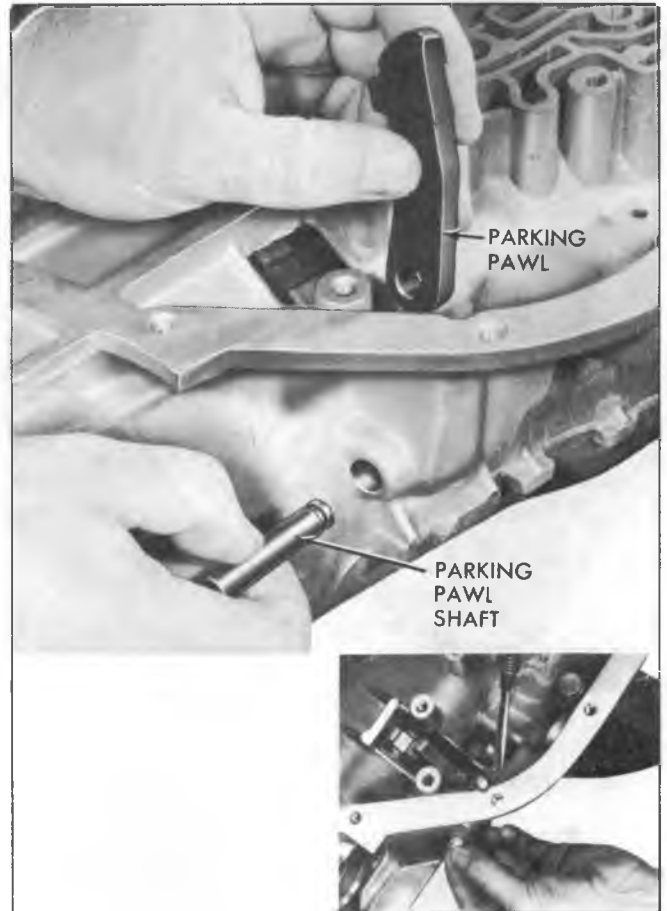


Fig. 29T--Removing Parking Pawl, Shaft and Cup Plug

- f. Remove parking pawl return spring (fig. 27T).

**NOTE:** The following steps are to be completed only if 1 or more of the parts involved require replacement.



Fig. 30T--Removing Front Band



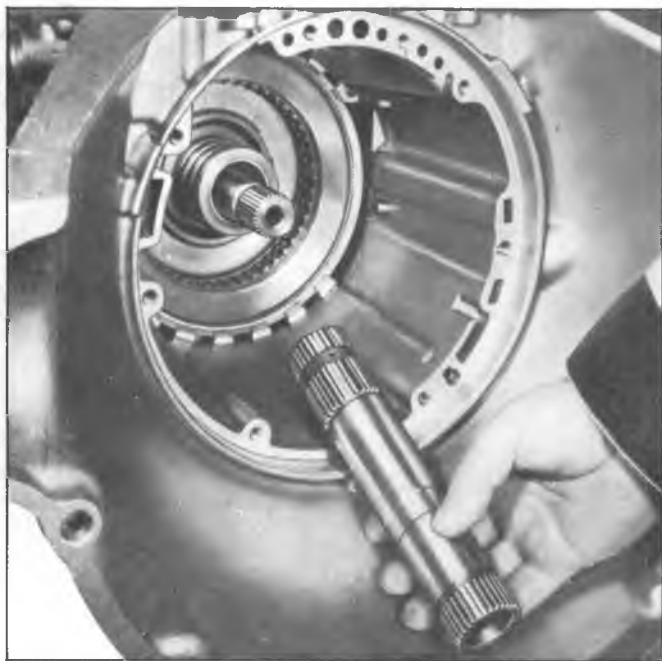


Fig. 31T--Removing Sun Gear Shaft



Fig. 33T--Removing Center Support Bolt

- g. Remove parking pawl shaft retainer (fig. 28T).
- h. Remove parking pawl shaft cup plug by inserting a screwdriver, between the parking pawl shaft and the case rib, and prying outwards (fig. 29T).
- i. Remove parking pawl shaft and parking pawl (fig. 29T).
8. Remove front band assembly (fig. 30T).
9. Remove sun gear shaft (fig. 31T).

#### Check Rear End Play as Follows (Fig. 32T)



Fig. 32T--Checking Rear Unit End Play

- 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.

Thickness	Identification
.074 - .078	Notches and/or Numeral
.082 - .086	None .....1
.090 - .094	1 Tab Side .....2
.098 - .102	2 Tab Side .....3
.106 - .110	1 Tab O.D. ....4
.114 - .118	2 Tabs O.D. ....5
	3 Tabs O.D. ....6

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.
12. Remove intermediate clutch backing plate, three (3) composition, and three (3) steel clutch plates (fig. 34T).
13. Remove center support to case retaining snap ring (fig. 35T).



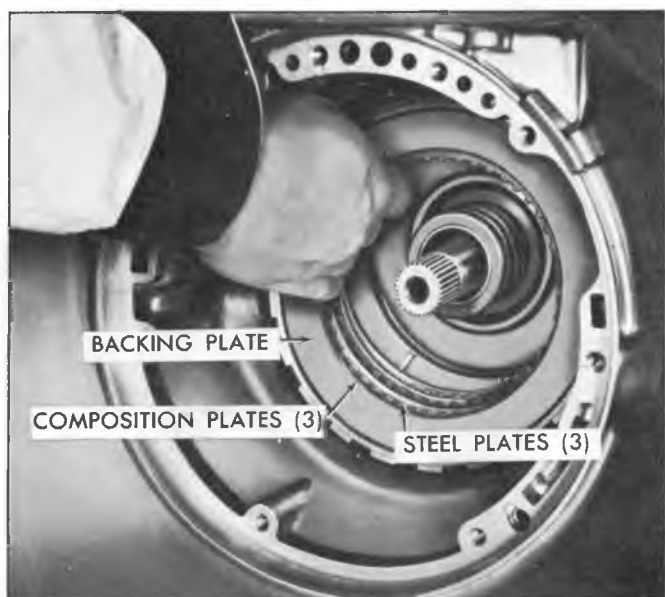


Fig. 34T--Removing Intermediate Backing Plate and Clutch Plates

14. Remove entire gear unit assembly by lifting with gear assembly installing and removing Holding Tool J-21795 with J-9539 slide hammer (fig. 36T).
15. Remove shaft to case thrust washer from rear of output shaft or inside case.

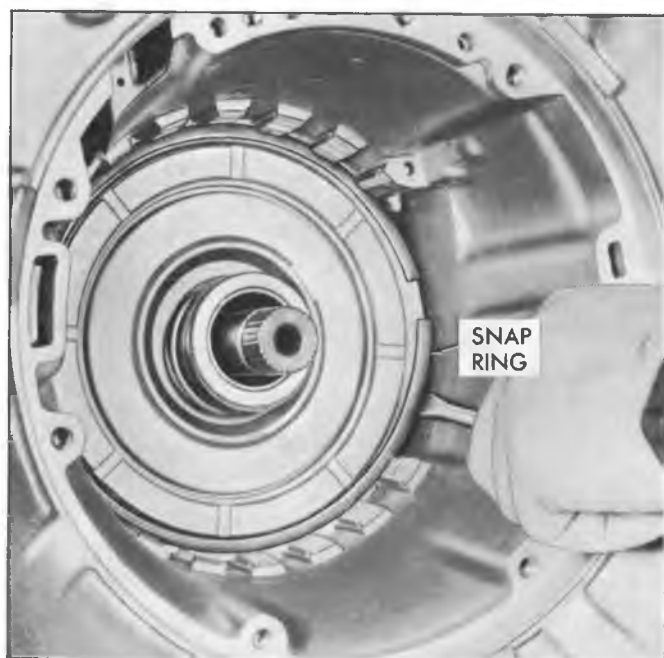


Fig. 35T--Removing Center Support to Case Retaining Snap Ring

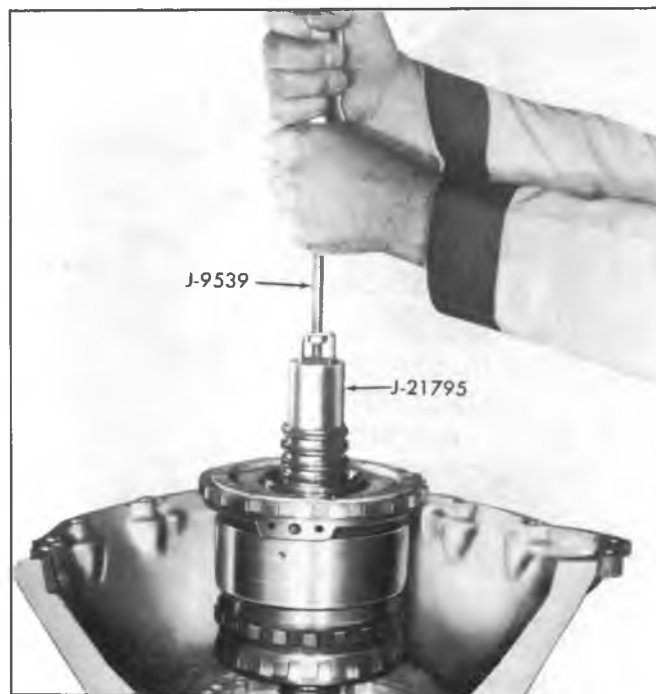


Fig. 36T--Removing Center Support and Gear Unit from Case

16. Place gear unit assembly, with output shaft facing down through hole in work bench or Holding Fixtures J-6116-01 with J-21364 adapter.
17. Remove rear unit selective washer from transmission case (fig. 37T).



Fig. 37T--Removing Selective Washer

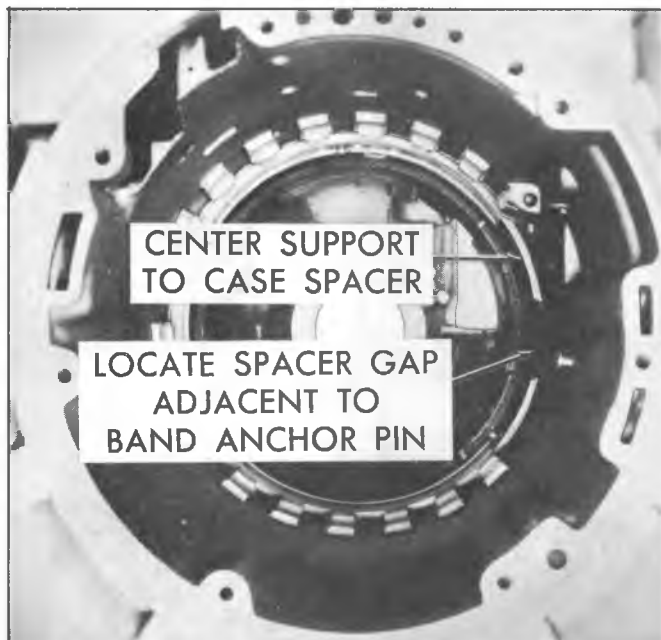


Fig. 37T-A--Removing Center Support to Case Spacer

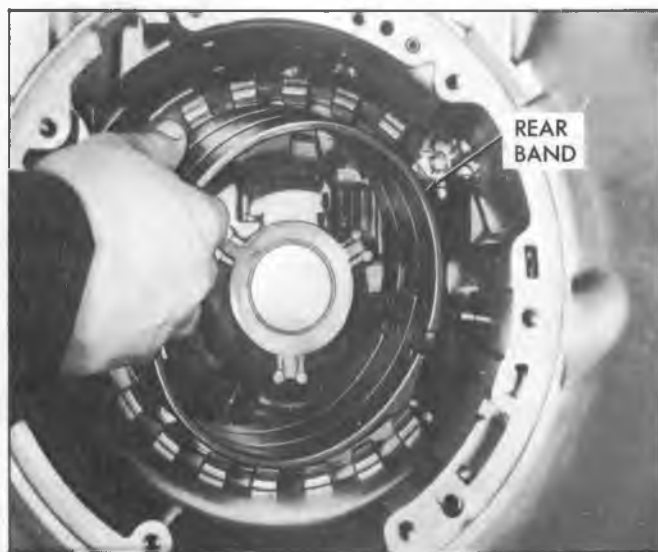


Fig. 38T--Removing Rear Band

18. Remove center support to case spacer (fig. 37T-A).
19. Remove rear band assembly (fig. 38T).

### Disassembly of Gear Unit Assembly

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.



Fig. 39T--Removing Center Support Assembly

**NOTE:** One race may have been removed with center support.



Fig. 40T--Removing Center Support Thrust Washer

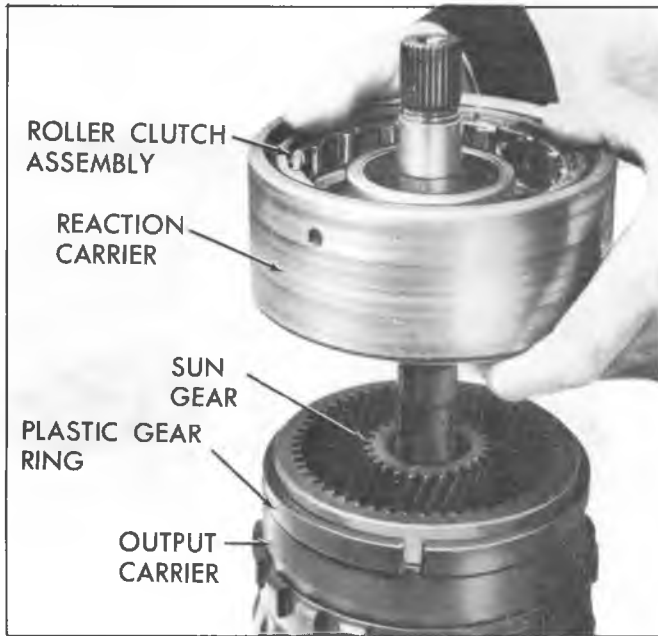


Fig. 41T--Removing Reaction Carrier and Roller Clutch from Output Carrier



Fig. 42T--Removing Sun Gear

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.
6. Remove sun gear (fig. 42T).

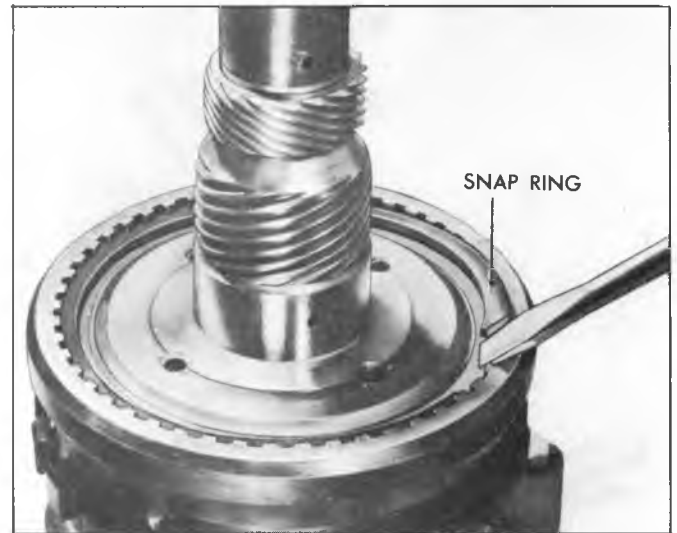


Fig. 43T--Removing Output Shaft to Carrier Snap Ring

7. Remove reaction carrier to output carrier thrust washer.
8. Turn assembly over.
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).



Fig. 44T--Removing Rear Internal Gear and Mainshaft

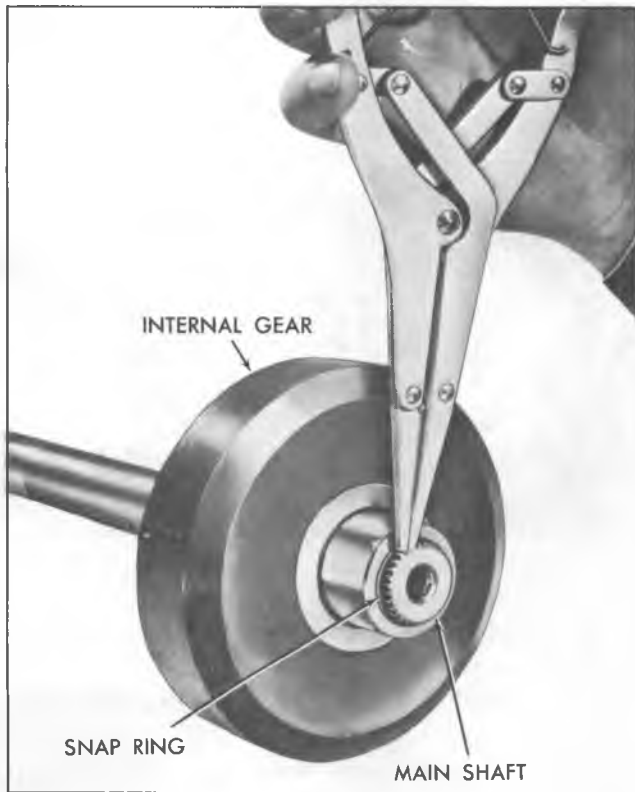


Fig. 45T-Removing Rear Internal Gear to Main Shaft Snap Ring

**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. 46T-Removing Speedometer Drive Gear

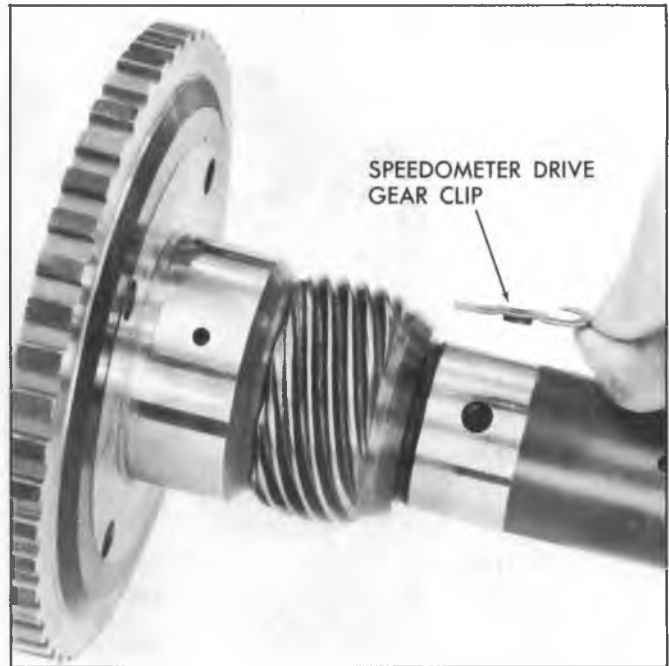


Fig. 47T-Installing Speedometer Drive Gear Clip

### Speedometer Drive Gear

**NOTE:** If removal and installation or replacement of the speedometer drive gear is necessary, proceed as follows:

#### Transmissions ( With Nylon Speedometer Drive Gear)

1. Depress clip and slide speedometer drive gear off output shaft (Fig. 46T).



Fig. 47T-A--Removing Steel Speedometer Drive Gear

- 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.

### Transmissions ( With Steel Speedometer Drive Gear)

- 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).
- 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).

## 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. 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:

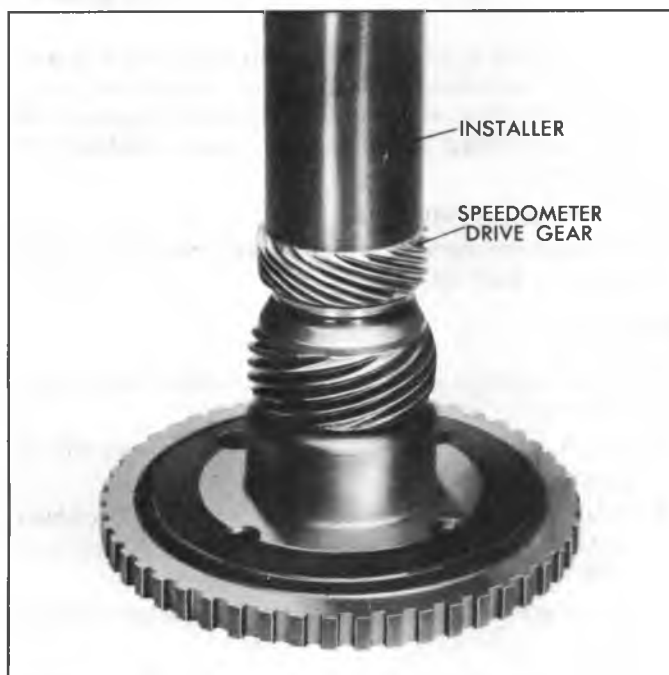


Fig. 47T-B--Installing Steel Speedometer Drive Gear

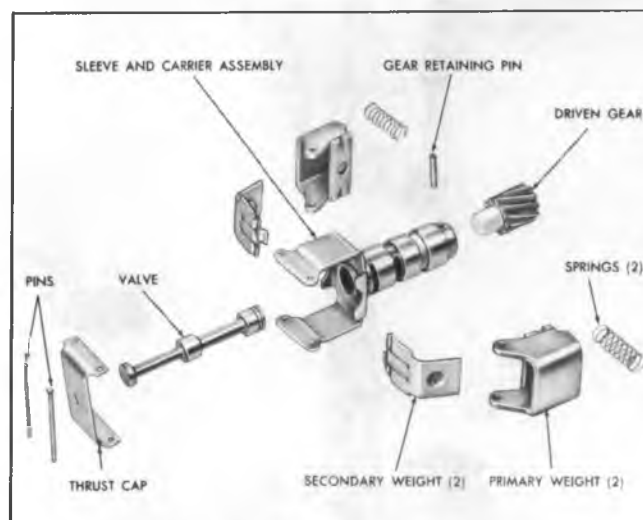


Fig. 48T--Governor--Exploded

### Disassembly

- 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).
- Remove governor valve from governor sleeve. Be careful not to damage valve.
- Perform following inspections and replace governor driven gear, if necessary.

### Inspection

- Wash all parts in cleaning solvent, air dry and blow out all passages.
- Inspect governor sleeve for nicks, burrs, scoring or galling.
- Check governor sleeve for free operation in bore of transmission case.
- Inspect governor valve for nicks, burrs, scoring or galling.
- Check governor valve for free operation in bore of governor sleeve.
- Inspect governor driven gear for nicks, burrs, or damage.
- Check governor driven gear for looseness on governor sleeve.
- Inspect governor weight springs for distortion or damage.
- Check governor weights for free operation in their retainers.
- Check valve operating at entry (.020" minimum) with a feeler gage, holding governor as shown with governor weights extended completely outward (fig. 48T-A).





Fig. 48T-A--Checking Valve Opening With Weights Outward

11. Check valve opening at exhaust (.020" minimum) with a feeler gauge, holding governor as shown 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 gear, two governor weight retaining pins and one governor gear retainer split pin.

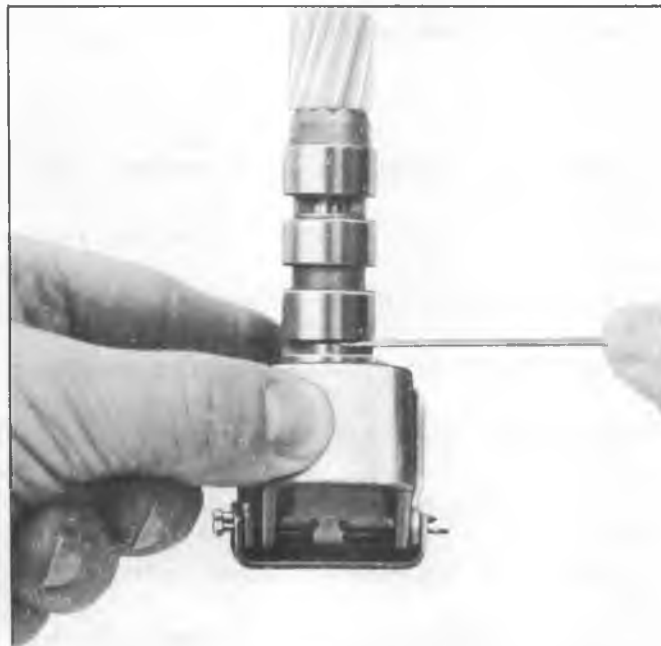


Fig. 48T-B--Checking Valve Opening With Weight Inward



Fig. 49T--Removing Governor Gear Retaining 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 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.



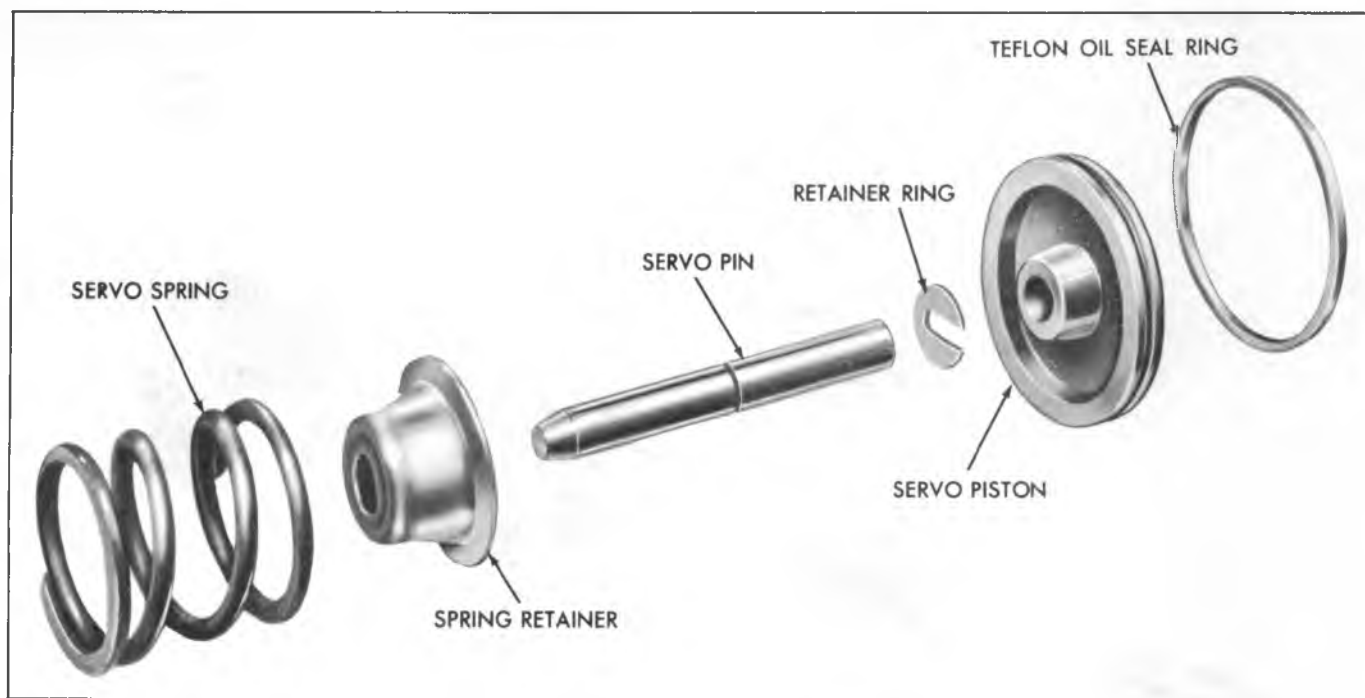


Fig. 50T-- Front Servo Assembly--Exploded View

### 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.

### 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).



Fig. 50T-A--Removing Rear Accumulator Piston from Rear Servo Piston

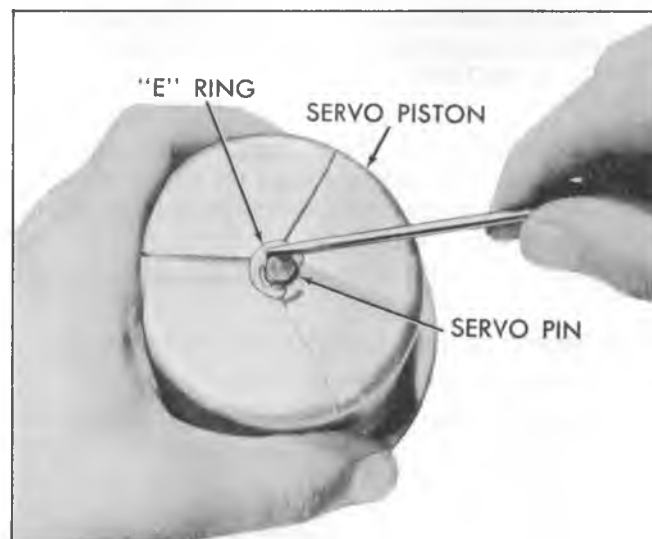


Fig. 51T--Removing Retaining "E" Ring from Rear Servo Pin

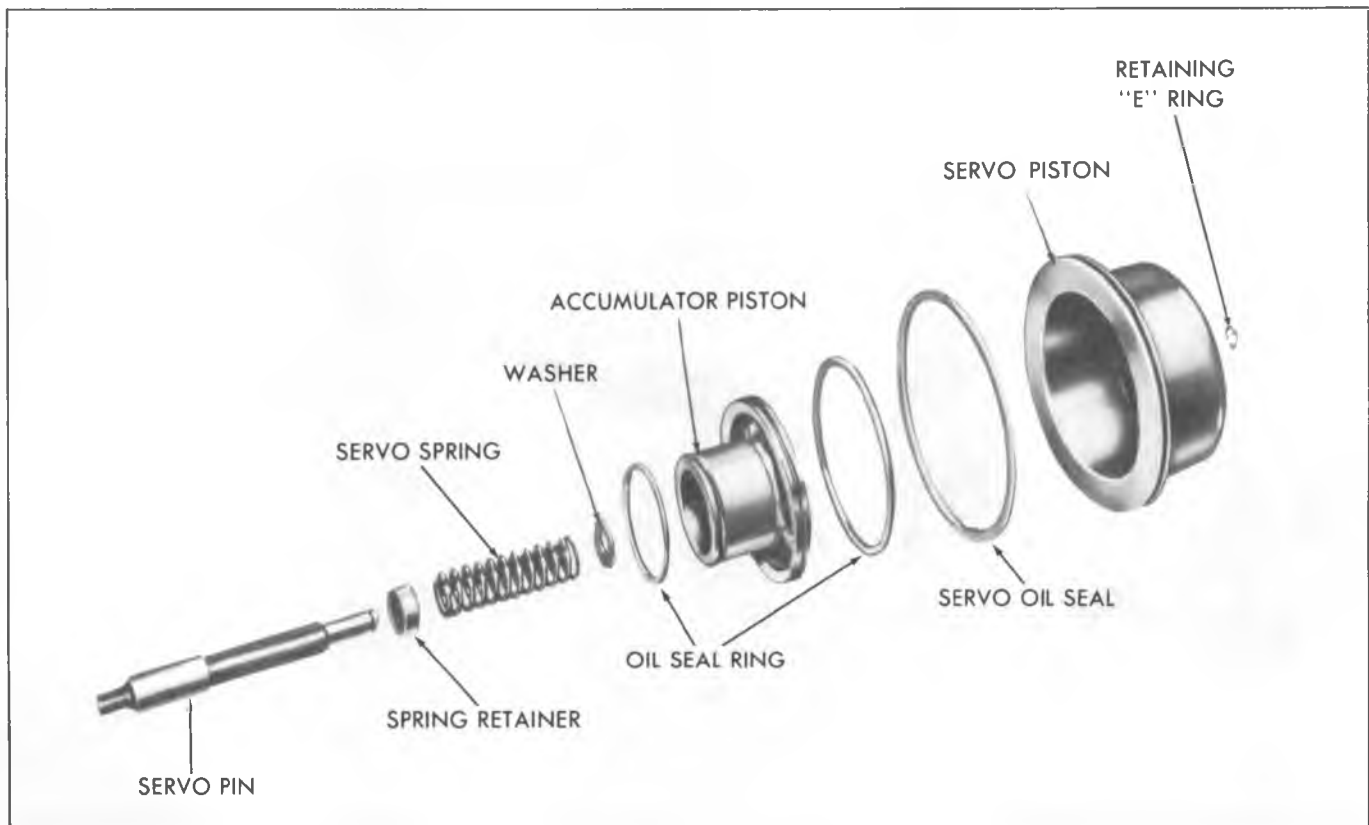


Fig. 52T--Rear Servo and Accumulator Assembly--Exploded View

3. Remove rear servo piston and seal from servo pin (fig. 52T). (Exploded view.)
4. Remove washer, spring, and spring retainer.
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.

### Inspection

**NOTE:** See figure 52T. Do not remove the teflon oil seal rings from the rear accumulator piston, unless the oil seal rings require replacement. If the teflon inner oil seal ring (small diameter) requires replacement, for service, use the aluminum oil seal ring Part Number 8623671.

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.

1. Inspect freedom of accumulator rings in piston 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.

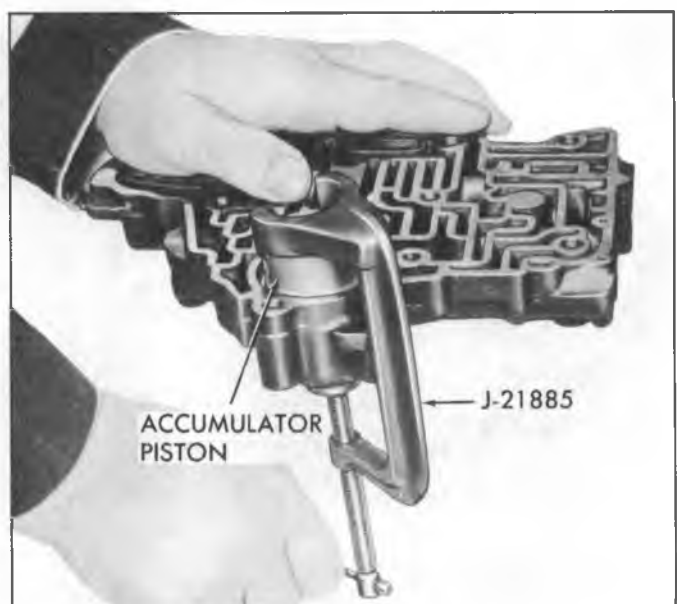


Fig. 53T--Installing Compressor Tool to Front Accumulator Piston

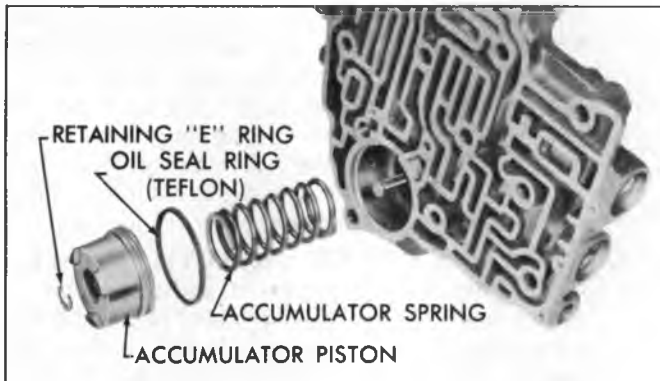


Fig. 54T-Front Accumulator Assembly - Exploded View

## CONTROL VALVE, DISASSEMBLY, INSPECTION AND RE-ASSEMBLY (Fig. 55 T)

### Passenger Cars

#### 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 Tool J-21885, on accumulator piston and remove retaining ring (fig. 53T).
4. Remove front accumulator piston and spring (fig. 54T).

**NOTE:** No front accumulator spring used in CY model.

5. On the right side adjacent to the manual valve, remove the 1-2 valve train as follows:
  - a. (Models CD, CK, CM and CY) Remove retaining pin, 1-2 modulator bushing, 1-2 valve spring, 1-2 modulator valve and 1-2 shift valve.

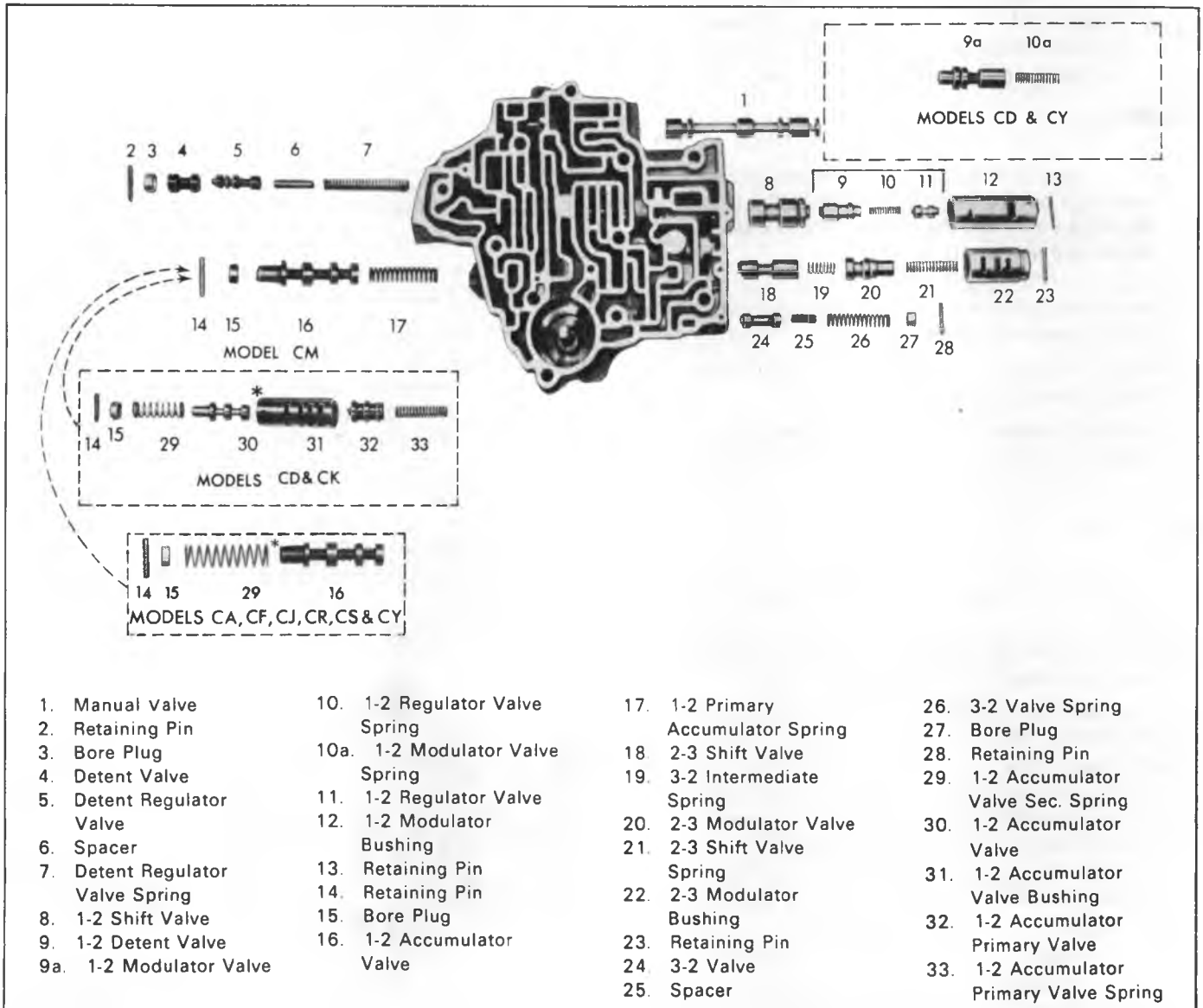


Fig. 55T-Control Valve Assembly-Exploded View

- b. (Models CA, CF, CJ, CR 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 CM) Remove the grooved retaining pin, bore plug, 1-2 accumulator valve and spring.
  - b. (Models CD and CK) Remove the grooved retaining pin, bore plug, 1-2 secondary spring, 1-2 accumulator valve, 1-2 accumulator bushing, 1-2 primary accumulator valve and primary spring.
  - c. (Models CA, CF, CJ, CR, CS 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 distortion.
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 Tool J-21885 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 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.
  - b. (Model CD and CK) Install the 1-2 primary accumulator spring and valve into the valve bore using a retaining pin as a temporary retainer to hold the spring and valve in their operating position. Install the 1-2 secondary accumulator valve, stem end out,

and the 1-2 secondary spring into the 1-2 accumulator valve bushing. Install the bushing into the bore and using the bore plug, compress the spring until the grooved retaining pin can be inserted from the cast surface side of the valve body with the grooves entering the pin hole last. Tap the retaining pin with a hammer until it is flush with the cast surface of the valve body. Remove the temporary retainer pin.

- c. (Models CA, CF, CJ, CR, CS 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 tap in place until flush with cast surface of the valve body.
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. (Models CD and 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, CB, CF, CG, CJ, CK, CP, CR, CS, CW 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 in the bore of the detent valve. Install the parts in the valve body bore.

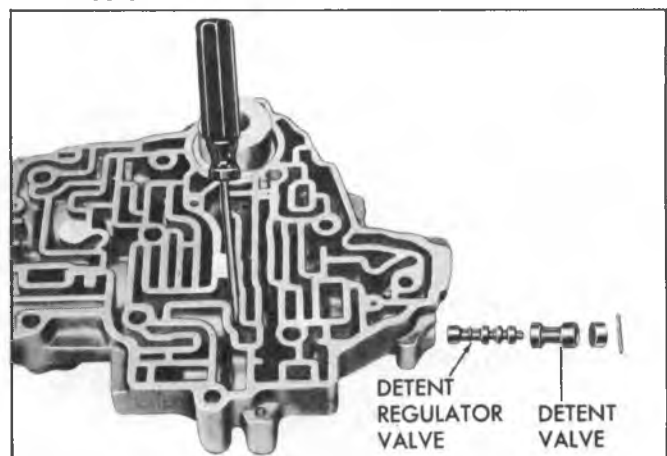


Fig. 56T--Installing Detent Regulator Valve and Detent Valve

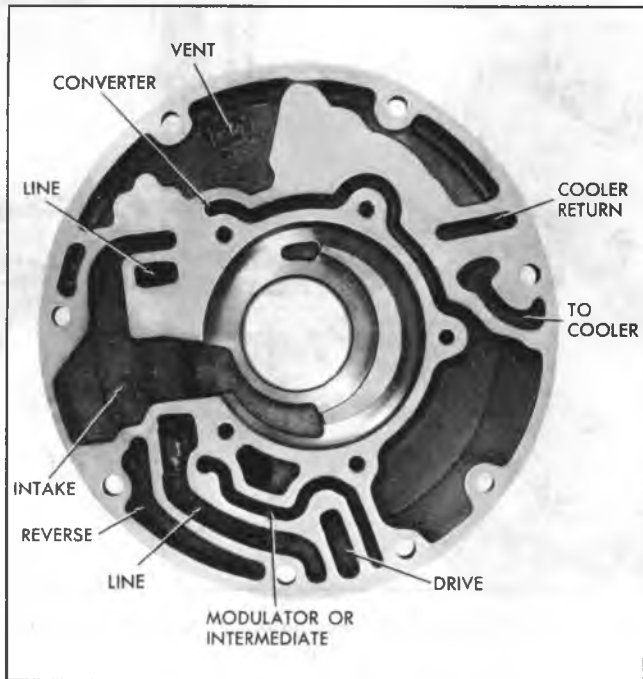


Fig. 57T--Pump Body Oil Passages

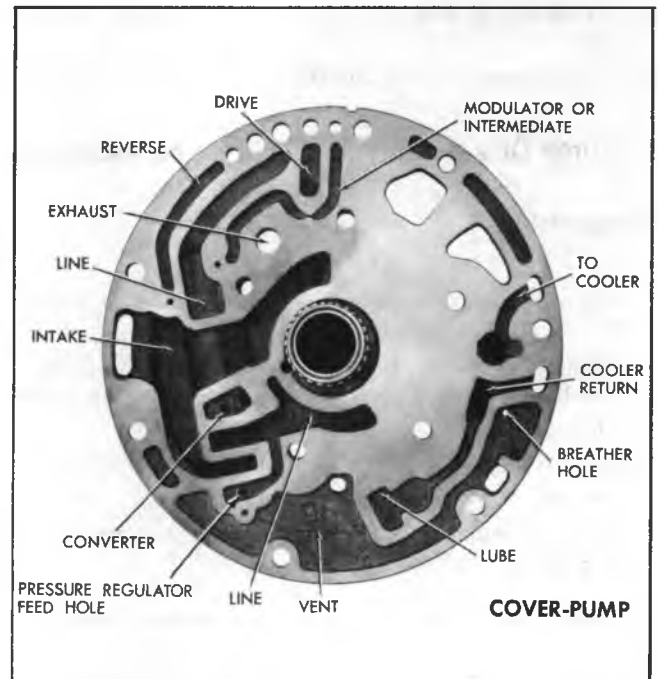


Fig. 58T--Pump Cover Oil Passages

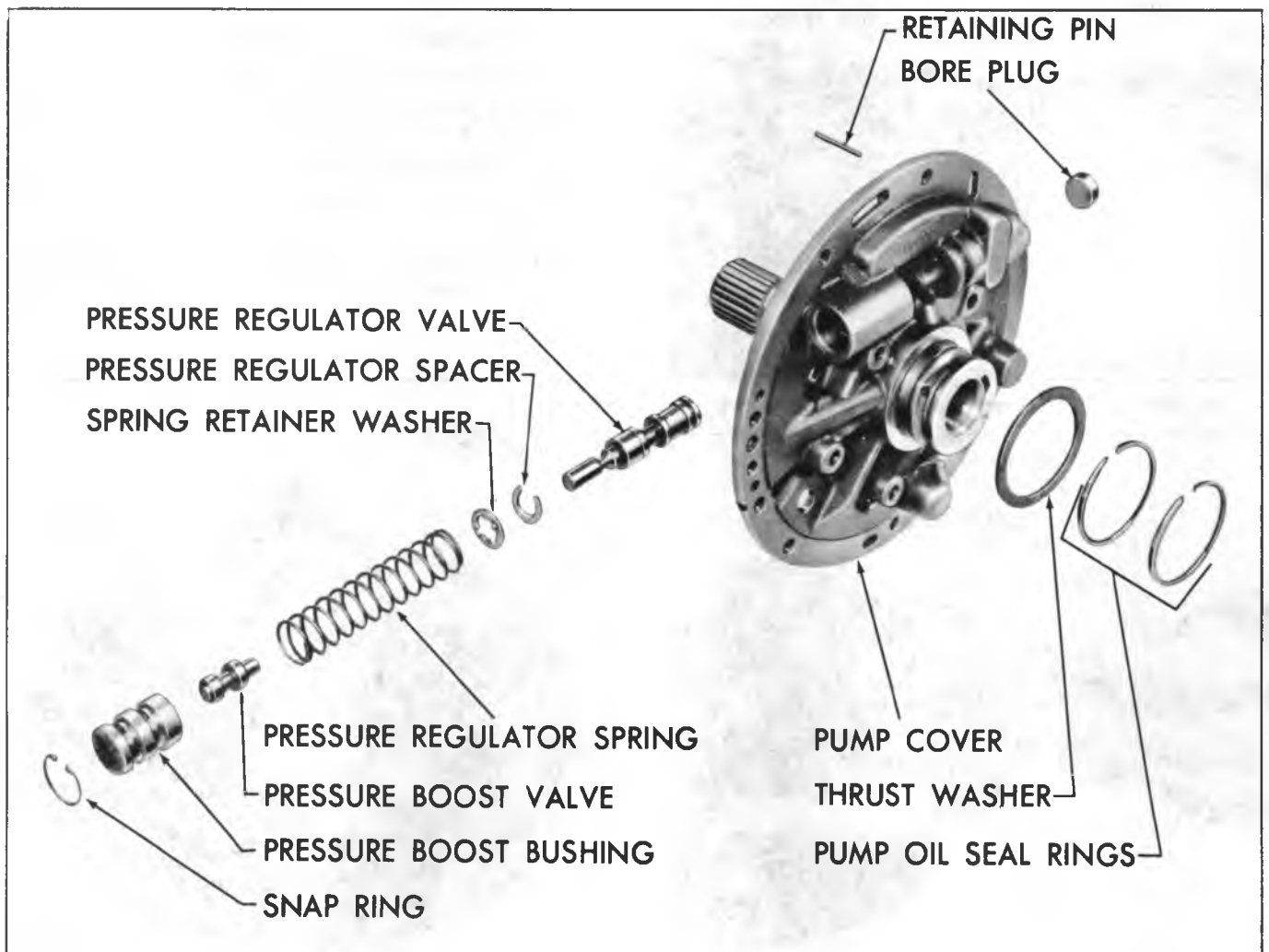


Fig. 59T--Pump Cover--Exploded View

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.
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).

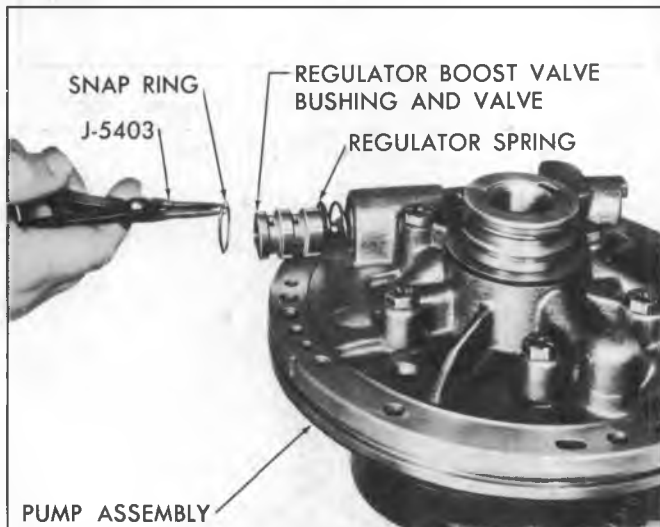


Fig. 60T--Removing Pump Regulator Valve Snap Ring

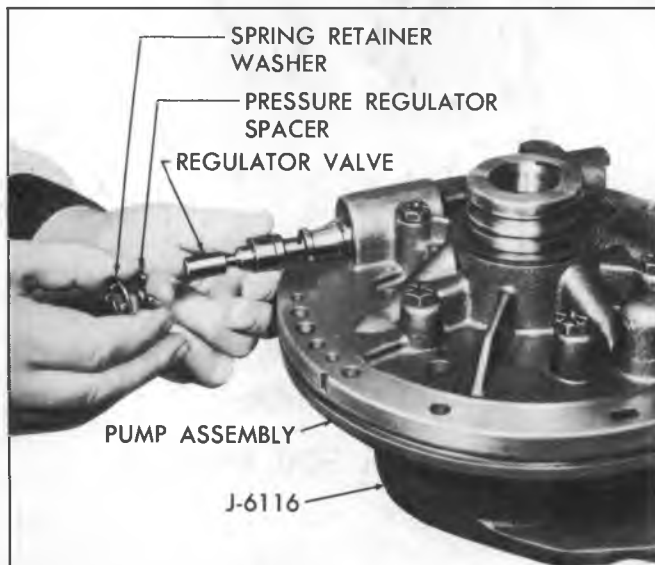


Fig. 61T--Removing Pressure Regulator Valve

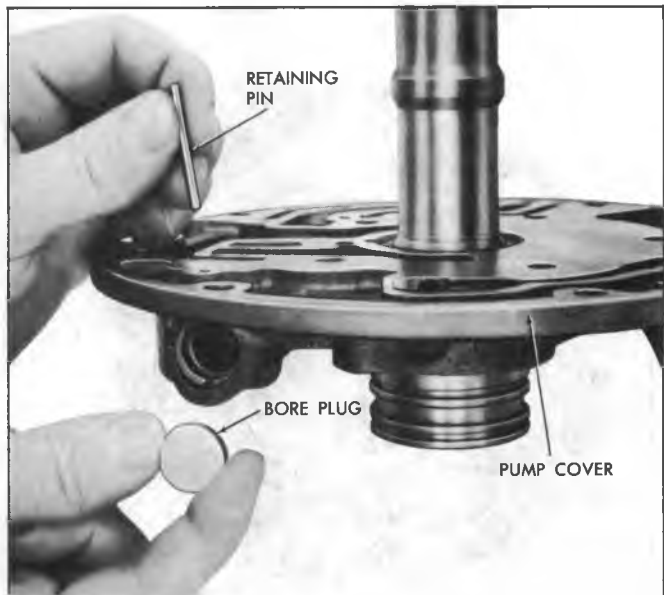


Fig. 62T--Installing Pressure Regulator Retaining Pin and Bore Plug

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.

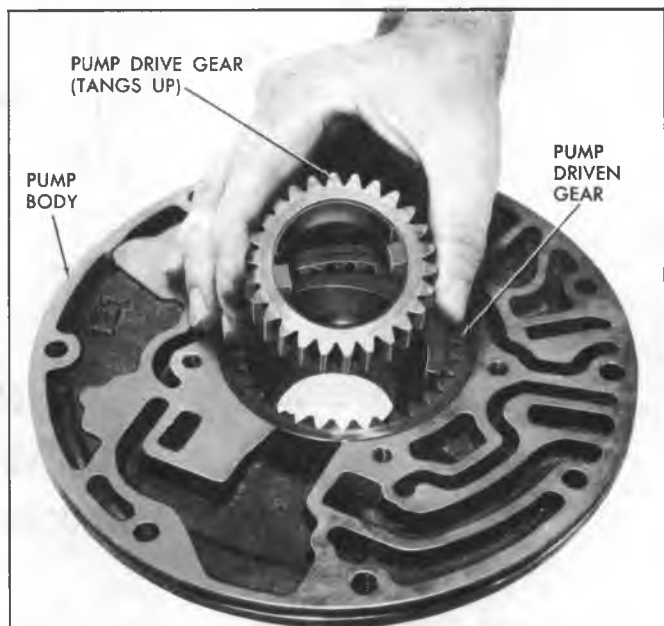


Fig. 63T--Installing Pump Drive Gear



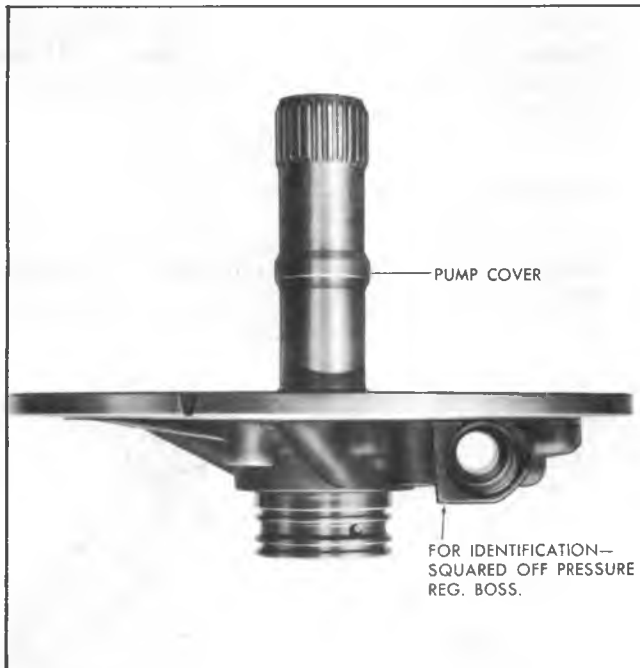


Fig. 64T--Pressure Regulator Valve Identification

### 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 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.
2. Place pump gears in pump body and check pump body face to gear face clearance (should be .0008" - .0035")(fig. 65T).



Fig. 65T--Checking Pump Body Face to Gear Face Clearance

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.
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 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).

## CLUTCHES AND TRANSMISSIONS 7-150

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.
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.

**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



Fig. 66T--Installing Pump Cover to Pump Body

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).



Fig. 67T--Removing Forward Clutch Housing to Direct Clutch Hub Snap Ring

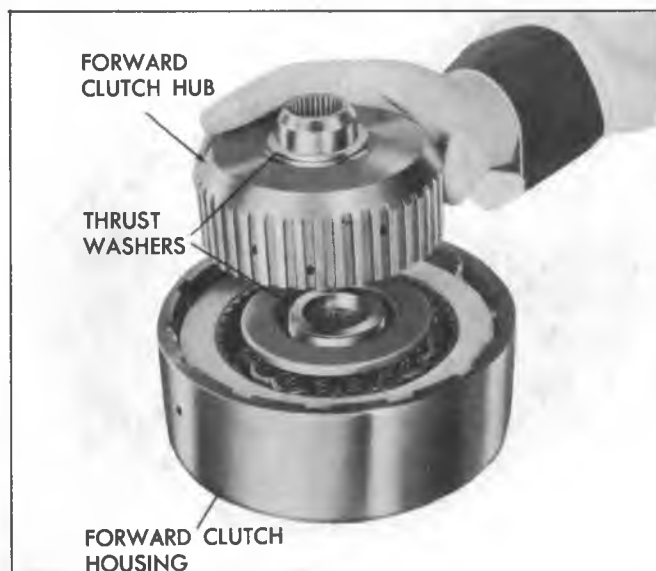


Fig. 68T--Removing Forward Clutch Hub and Thrust Washers

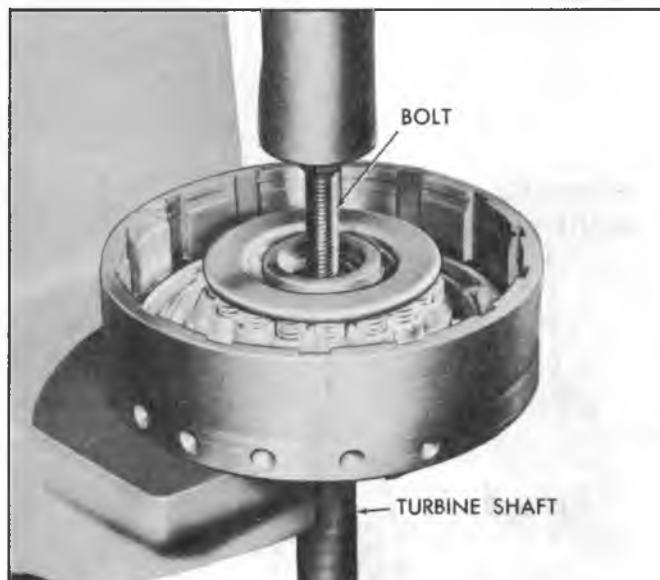


Fig. 69T--Removing Turbine Shaft from Forward Clutch Housing

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).
6. Using J-4670 clutch spring compressor in arbor press with Adapter J-21664, compress spring retainer and remove snap ring (fig. 70T).



Fig. 70T--Removing Forward Clutch Spring Retaining Snap Ring



Fig. 71T--Removing Forward Clutch Piston Outer Seal

7. Remove spring retainer and sixteen (16) clutch release springs.
- 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.



Fig. 72T--Removing Forward Clutch Center Seal

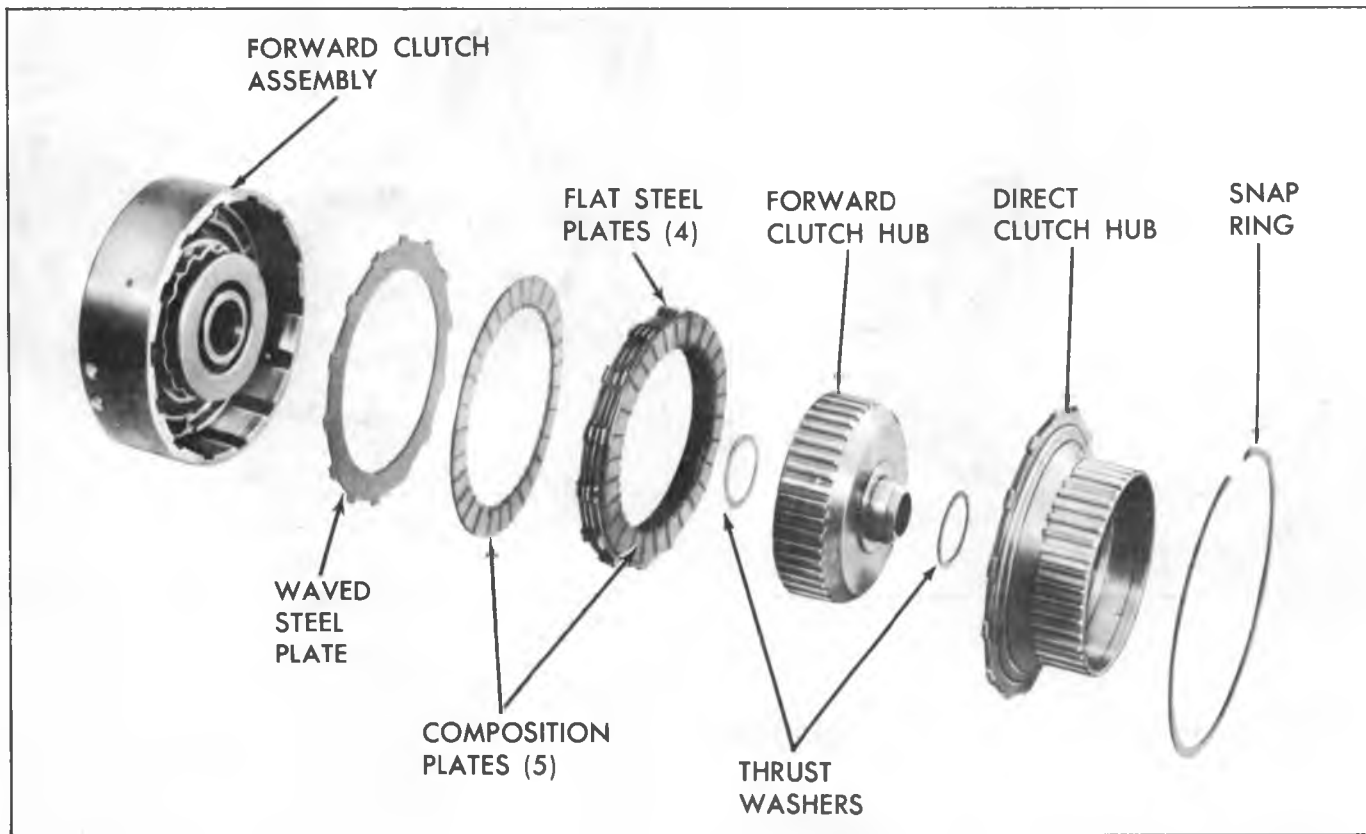


Fig. 73T-Forward Clutch Assembly--Exploded View

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.
  - 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

**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).
4. Install sixteen (16) clutch release springs into pockets in piston.

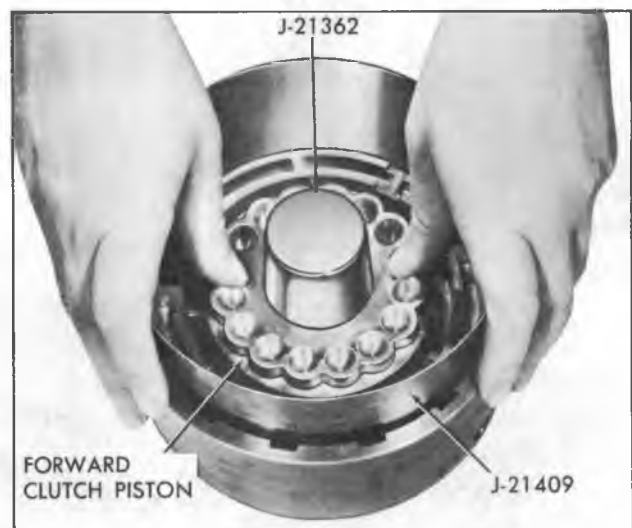


Fig. 74T-Installing Forward Clutch Piston

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).

**CAUTION:** Do not confuse the flat steel clutch plate (plate with "V" notch) with the waved steel clutch plate (plate with "U" notch). (See Fig. 76T).

**NOTE:** Radially grooved composition clutch plates are installed at the factory only. All service composition plates have the smooth surface configuration.

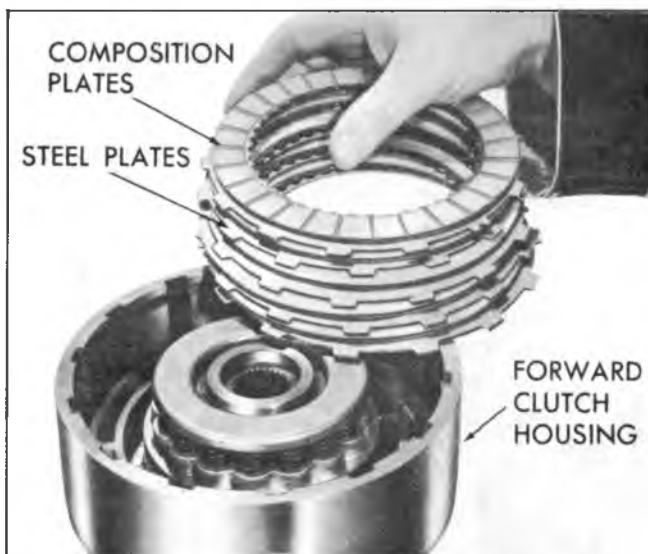


Fig. 75T—Installing Forward Clutch Composition and Steel Plates



Fig. 76T—Forward Clutch Plate Identification



Fig. 77T—Installing Forward Clutch Housing to Direct Clutch Hub Snap Ring

11. Install direct clutch hub and retaining snap ring (fig. 77T).
12. Place forward clutch housing on pump delivery sleeve and air check clutch operation (fig. 78T).



Fig. 78T—Air Checking Forward Clutch Assembly

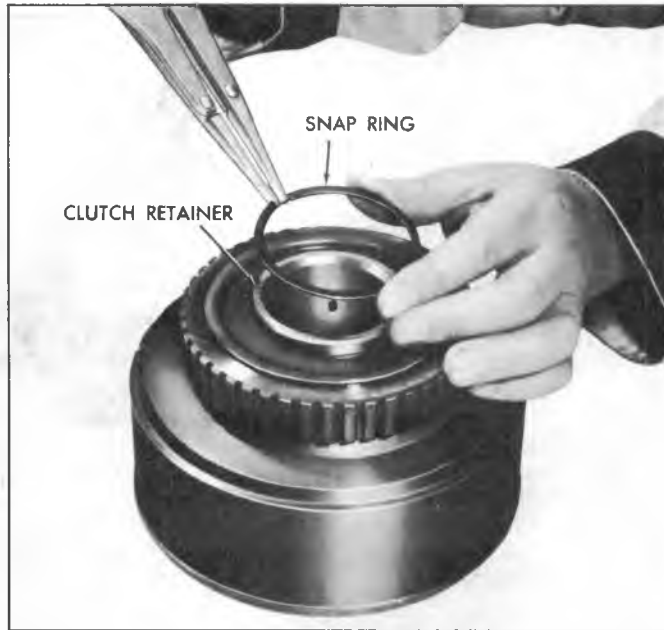


Fig. 79T--Removing Intermediate Clutch Retainer Snap Ring

## DIRECT CLUTCH AND INTERMEDIATE ROLLER DISASSEMBLY, INSPECTION AND ASSEMBLY

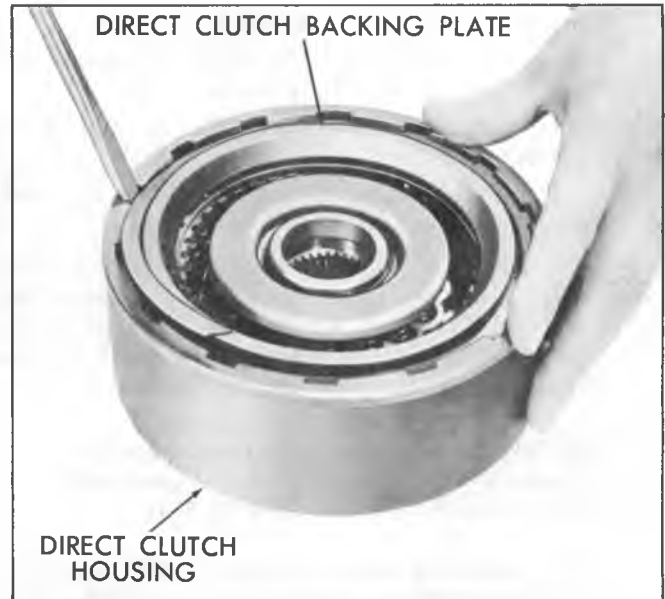


Fig. 80T--Removing Direct Clutch Backing Plate Snap Ring

### Disassembly

1. Remove intermediate roller assembly retainer snap ring and retainer (Fig. 79T).

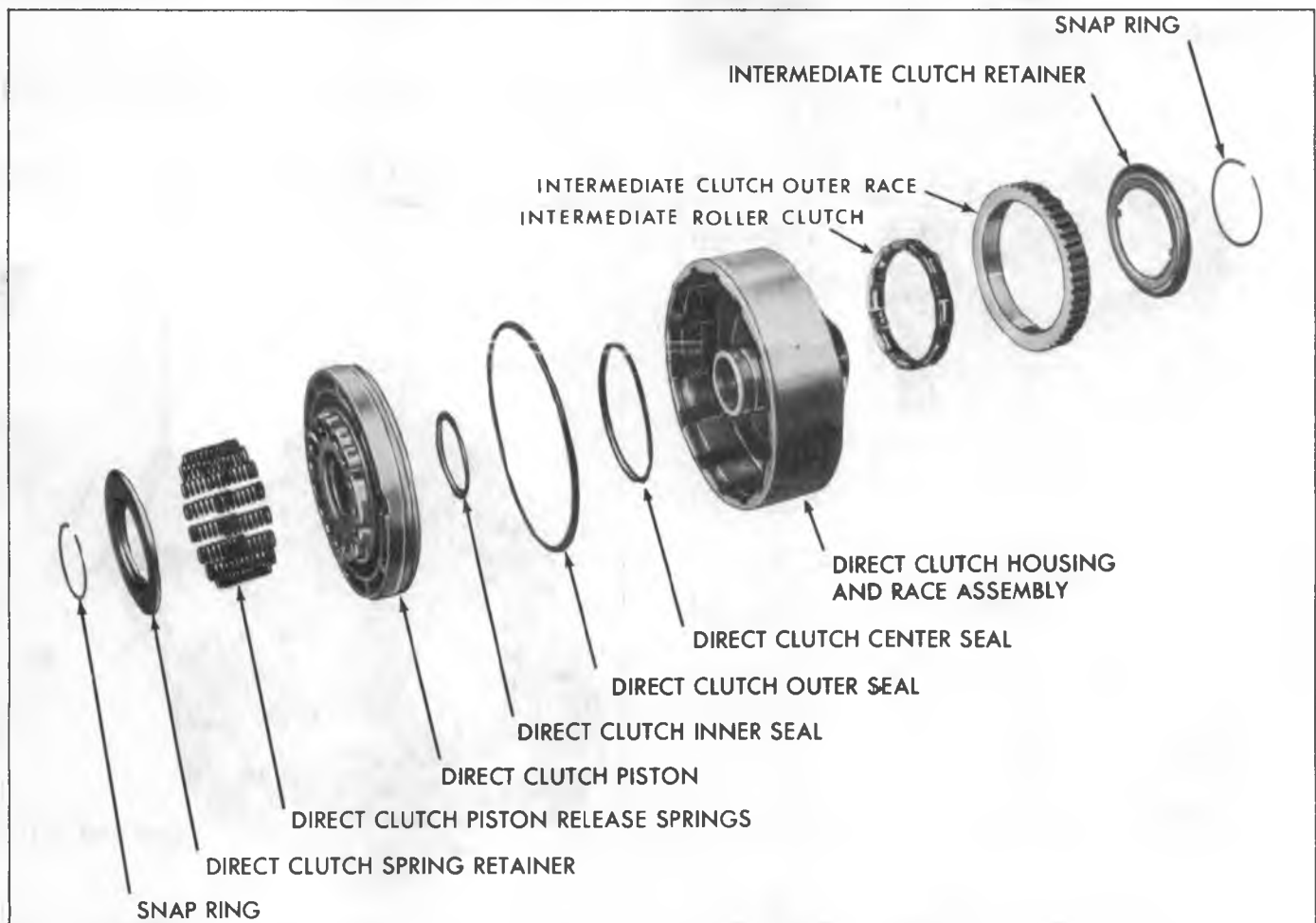


Fig. 81T--Direct Clutch and Intermediate Roller Assembly



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 (five) 5 composition, and (five) 5 steel clutch plates.

**NOTE:** Models CF, CR, CS, and CY, have six (6) composition and six (6) steel clutch plates. No waved steel plate used in model CY.

5. Using clutch compressor Tool J-4670 and J-21664, compress spring retainer in arbor press and remove snap ring (fig. 82T).
6. Remove retainer and fourteen (14) piston release springs.

**NOTE:** Keep springs separate from forward clutch release springs.

7. Remove direct clutch piston (fig. 83T).



Fig. 82T--Removing or Installing Direct Clutch Snap Ring



Fig. 83T--Removing Direct Clutch Piston Assembly

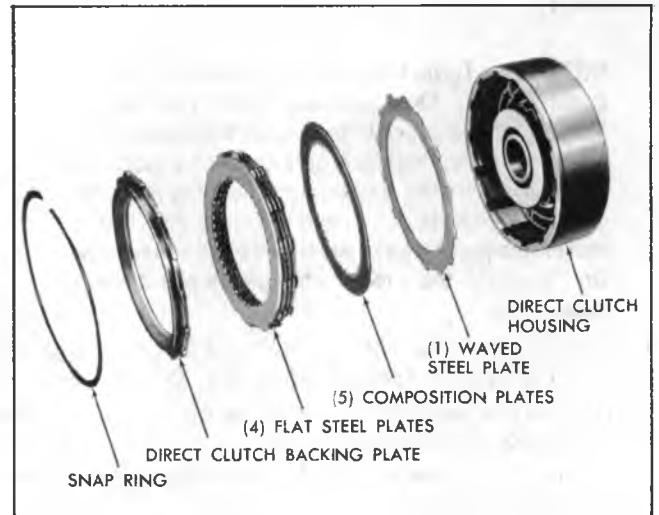


Fig. 84T--Direct Clutch Assembly Exploded

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.
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.



Fig. 85T--Installing Direct Clutch Inner Seal

## Assembly

**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. 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. 85T).
2. Install a new outer clutch piston seal with lip facing away from spring pockets (fig. 86T).
3. Install a new center seal on clutch housing with lip of seal facing up (fig. 87T).

**NOTE:** Apply automatic transmission oil to all seals and clutch plates.

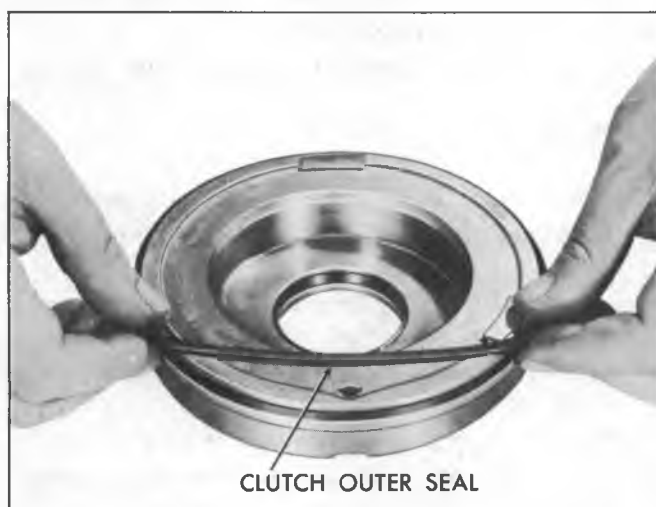


Fig. 86T—Installing Direct Clutch Outer Seal



Fig. 87T—Installing Direct Clutch Center Seal

**CAUTION:** The direct clutch housing for the CF, CR, CS, and CY models use the 6 plate clutch assembly. This housing can be identified by the elimination of the inside diameter chamfer on the clutch plate end and/or a groove in the face at the base of the tower (fig. 87T-A). Should replacement of the direct clutch housing become necessary, extreme care must be taken in obtaining the correct part for the model involved.

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).

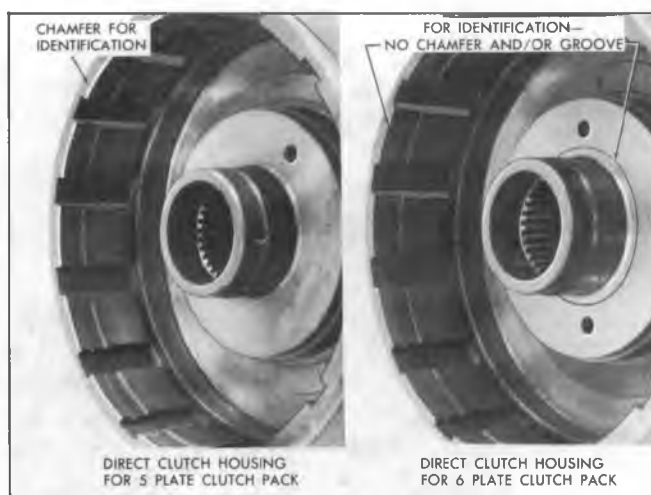


Fig. 87T-A—Direct Clutch Housing Identification

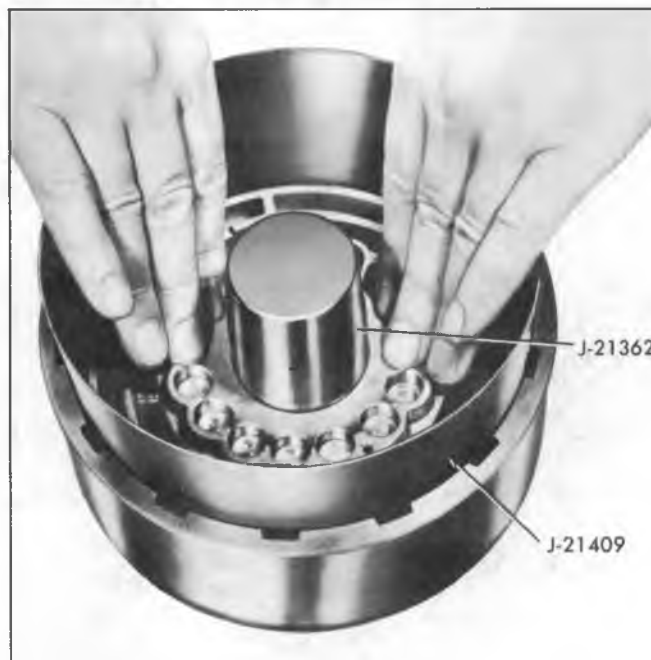


Fig. 88T—Installing Direct Clutch Piston

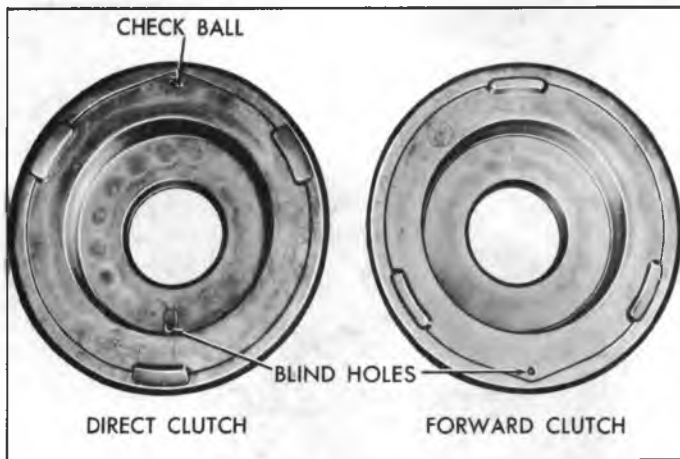


Fig. 89T--Forward and Direct Clutch Piston Identification

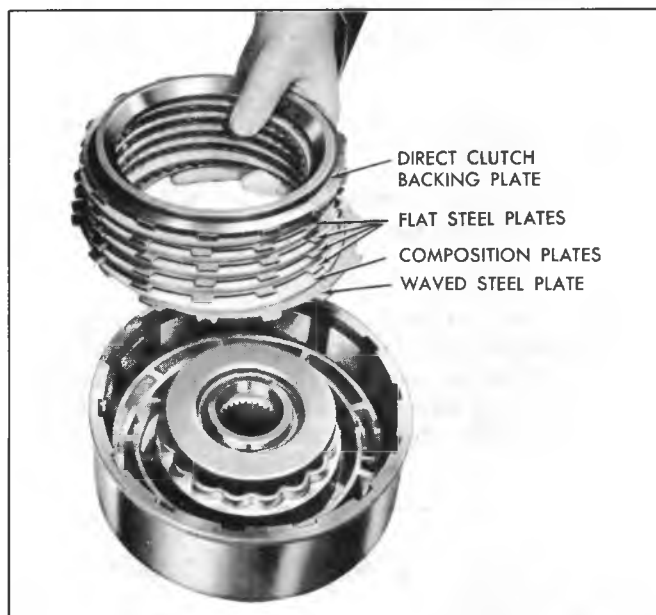


Fig. 90T--Install Direct Clutch Backing Plate, Composition Plates, and Steel Plates

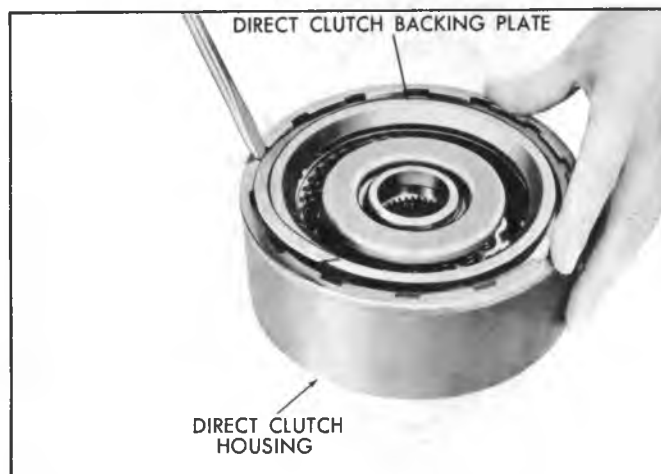


Fig. 91T--Installing Direct Clutch Housing to Backing Plate Snap Ring

8. a. (Models CA, CD, 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 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 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.

See figure 76T for clutch plate identification.

**NOTE:** Do not use radial grooved composition plates here.

9. Install clutch backing plate.
10. Install backing plate retaining snap ring (fig. 91T).

**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.

11. Turn unit over and install the intermediate clutch roller assembly onto the intermediate clutch inner cam (fig. 92T).
12. Install the intermediate clutch outer race with a clock wise turning motion (fig. 92TA).

**NOTE:** Roller clutch is not released for CY model.

**NOTE:** Outer race should not turn counter-clock-wise after installation. (See Figure 93T).

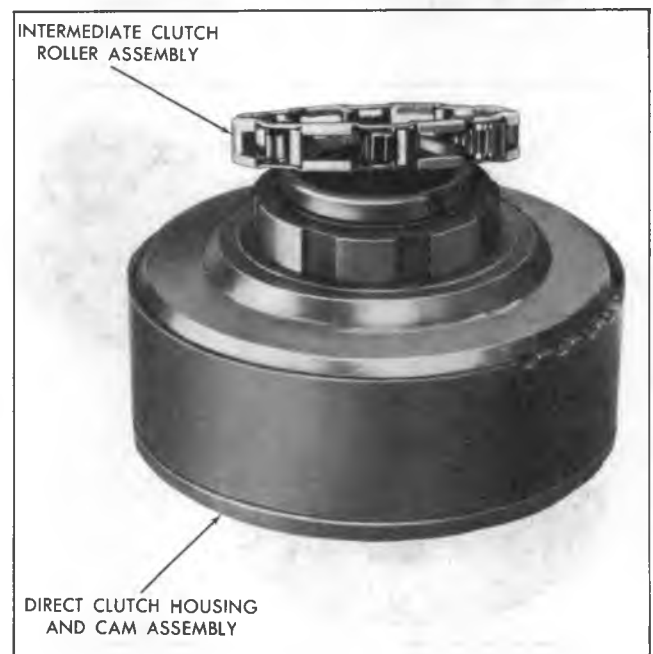


Fig. 92T--Installing Intermediate Clutch Roller Assembly



Fig. 92TA-Installing Intermediate Clutch Outer Race to Direct Clutch



Fig. 95T-Installing Intermediate Clutch Retainer Snap Ring

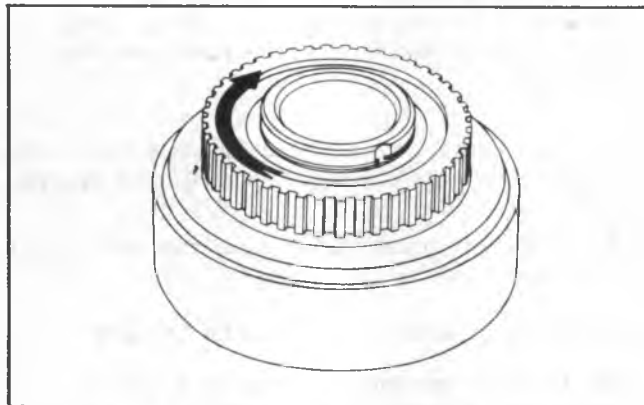


Fig. 93T-Intermediate Roller Clutch Rotation



Fig. 94T-Installing Intermediate Clutch Retainer

13. 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. 97T).

**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.

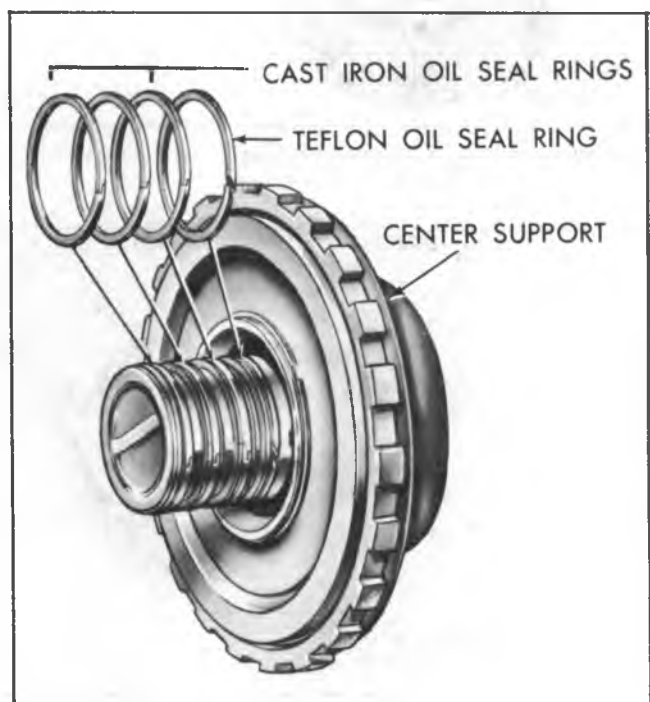


Fig. 96T-Center Support and Oil Seal Rings



Fig. 97T--Air Checking Direct Clutch Assembly

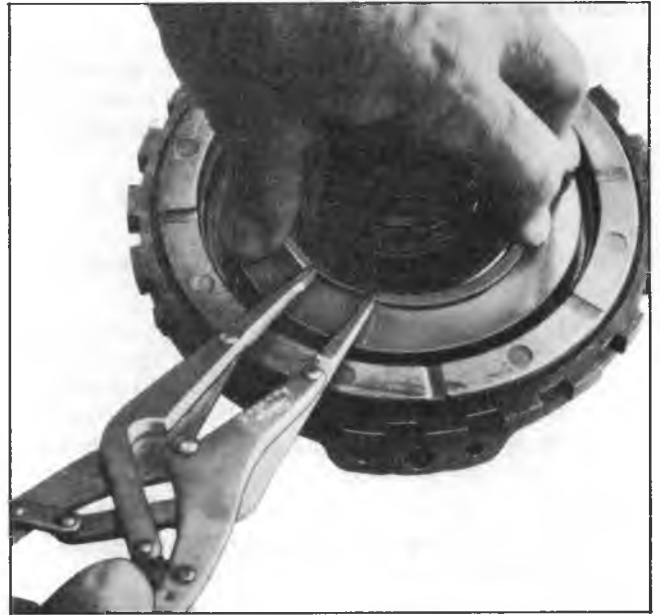


Fig. 98T--Removing Intermediate Clutch Piston Snap Ring

## DISASSEMBLY, INSPECTION AND RE-ASSEMBLY OF CENTER SUPPORT

### Disassembly

1. Remove three (3) hook type cast iron oil seal rings from the center support. Do not remove the teflon oil seal ring unless replacement is required. All service center support oil seal rings are hook type cast iron (fig. 96T).

2. Compress spring retainer and remove snap ring (fig. 98T).
3. Remove spring retainer and three (3) clutch release springs.
4. Remove intermediate clutch piston.
5. Remove inner and outer piston seal.

**CAUTION:** Do not remove three (3) screws retaining roller clutch inner race to center support.

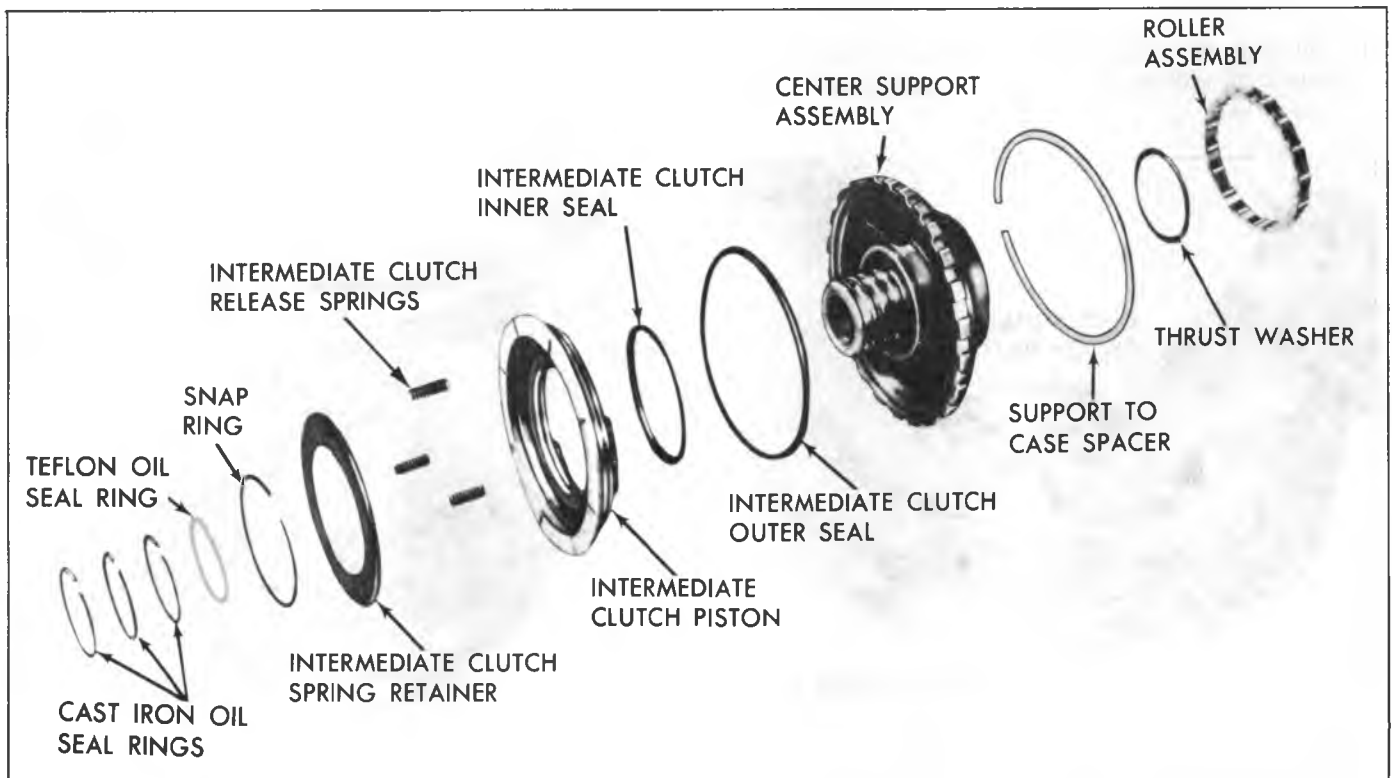


Fig. 99T--Center Support Assembly--Exploded View



### 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 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 or porosity.
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).



Fig. 100T—Installing Intermediate Clutch Inner Seal



Fig. 101T—Installing Intermediate Clutch Outer Seal

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 three (3) release springs into counterbores of piston. Space equally during assembly.
4. Place spring retainer and snap ring over springs.
5. Compress springs and install snap ring (fig. 103T).

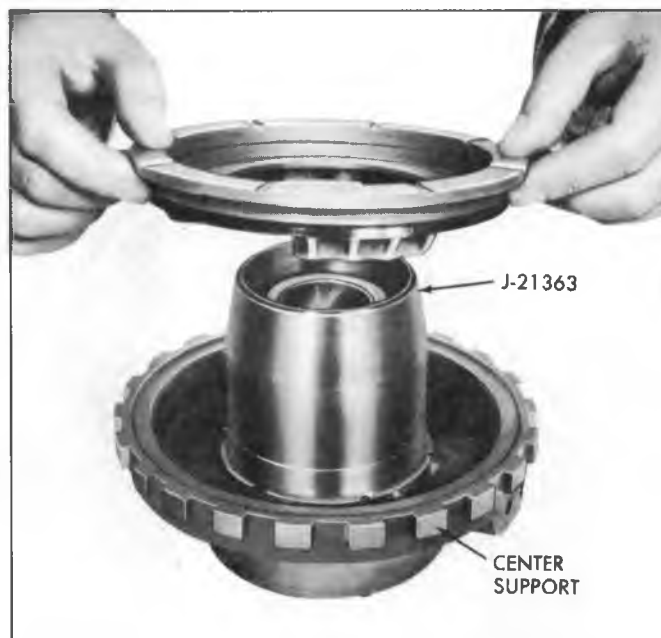


Fig. 102T—Installing Intermediate Clutch Piston



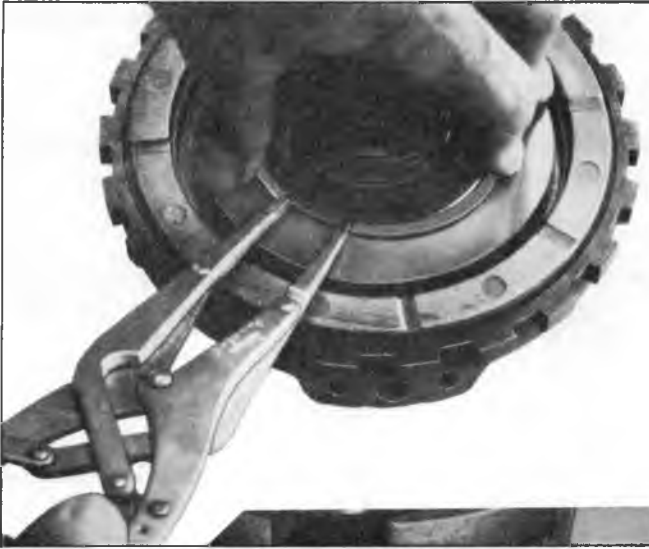


Fig. 103T--Installing Intermediate Clutch Piston Snap Ring



Fig. 104T--Air Checking Intermediate Clutch Piston



Fig. 105T--Checking Pinions End Play

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).

### 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.
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. 41).

### 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



Fig. 106T--Checking Output Carrier Pinion End Play



Fig. 107T-Removing Planet Pinion Pin

reduce the probability of cracking the carrier when pinion pins are pressed out.

**CAUTION:** 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).

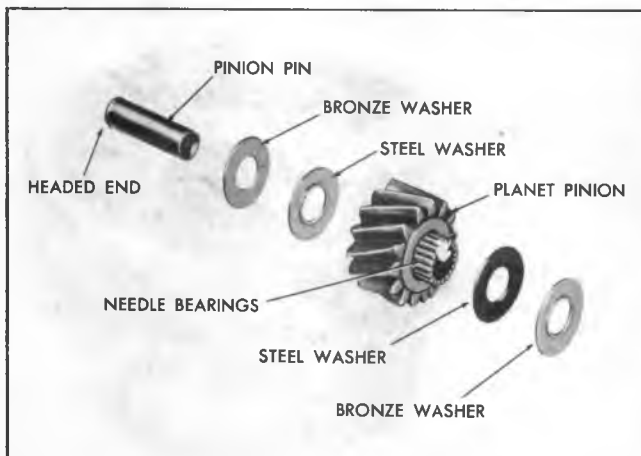


Fig. 108T-Planet Pinion Assembly--Exploded View

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 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.

**NOTE:** Both ends of pinion pins must lie below face of carrier or interference may occur.



Fig. 109T-Installing Planet Pinion Pin

## 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.
  - 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

1. Inspect bushing for excessive wear or damage. If replacement is necessary proceed as follows:
  - a. With rear seal removed and the extension housing properly supported, using tool J-8400-1, remove bushing.

### All Models Except CM

- b. 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.

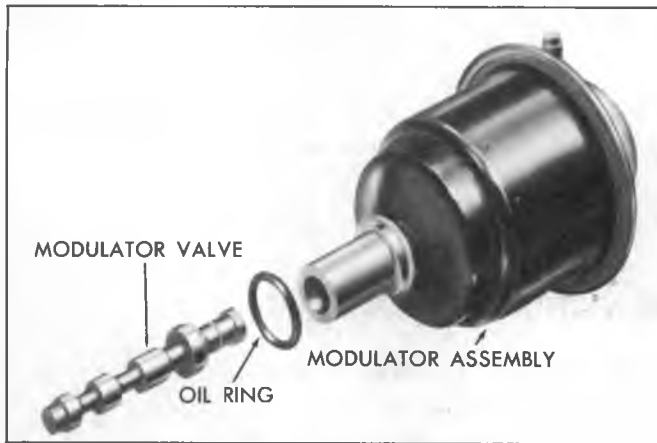


Fig. 110T-Modulator Assembly and Valve

### CM Models

- c. 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 MODULATOR AND VALVE

1. Inspect modulator assembly for any signs of bending or distortion (fig. 110T).
2. Inspect "O" ring seal seat for damage.
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.

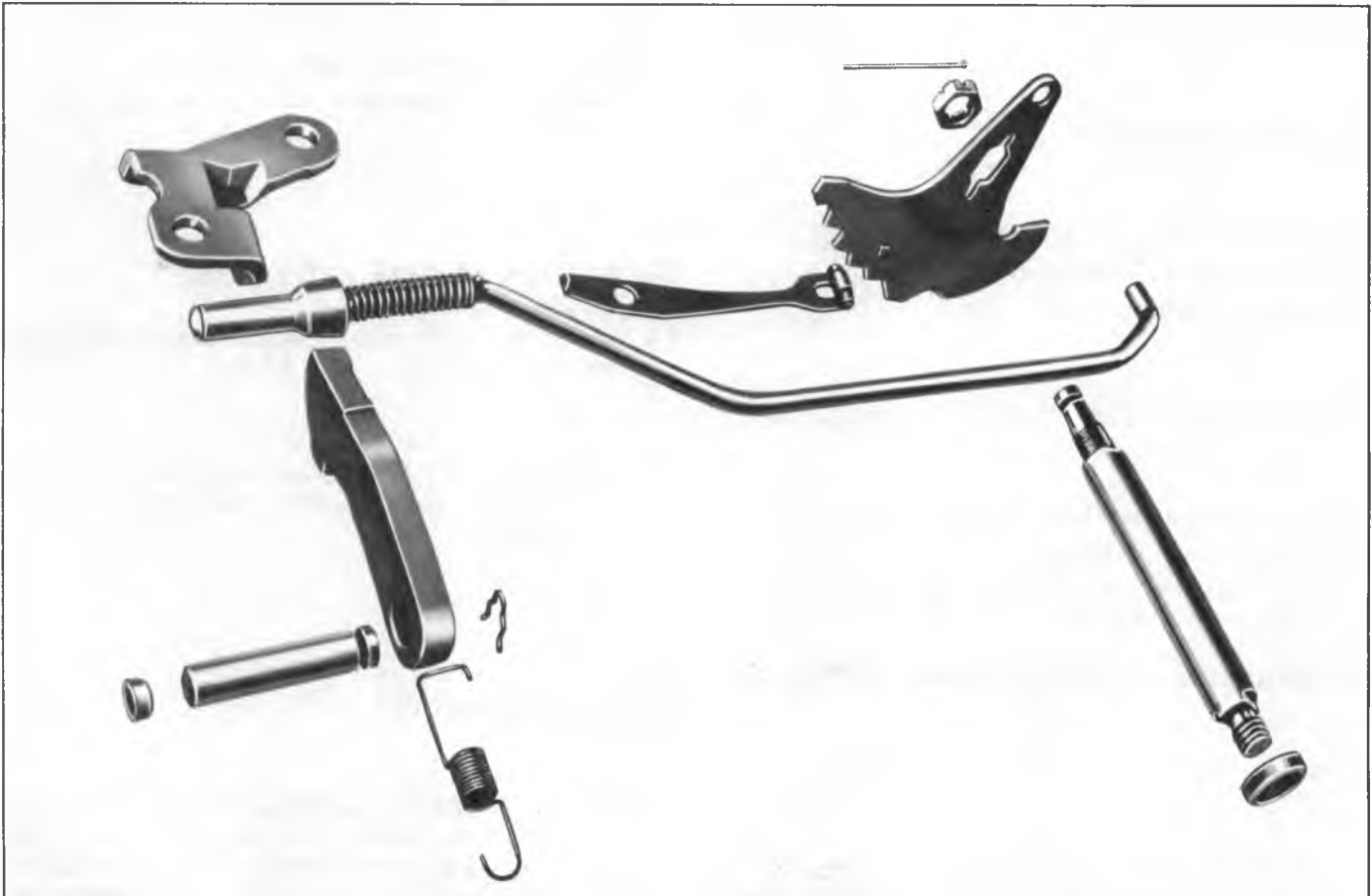


Fig. 111T-Manual and Parking Linkage-Exploded View

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 interconnected 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.
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:

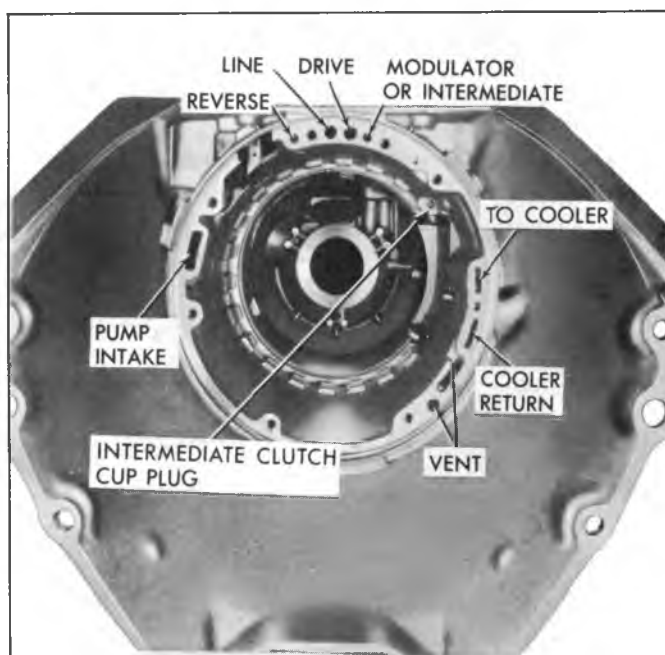


Fig. 112T--Case--Front View Passage Identification

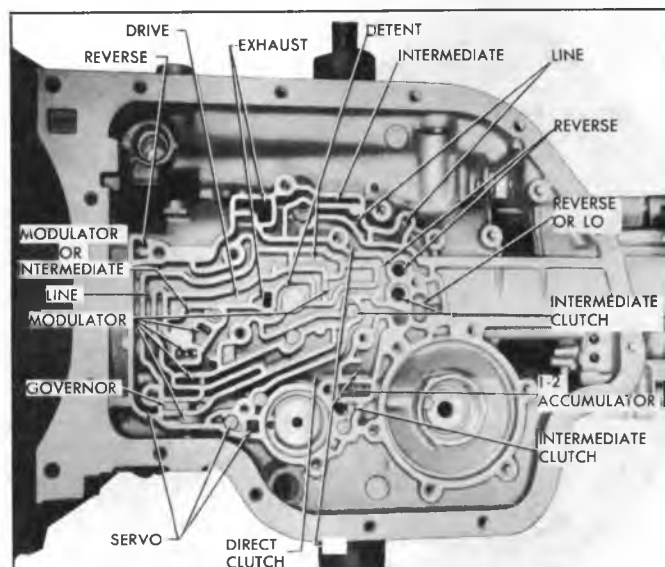


Fig. 113T--Inspect Transmission Case

### 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.

### 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", while its plunger rests on the cap nut of Tool J-21371-8.

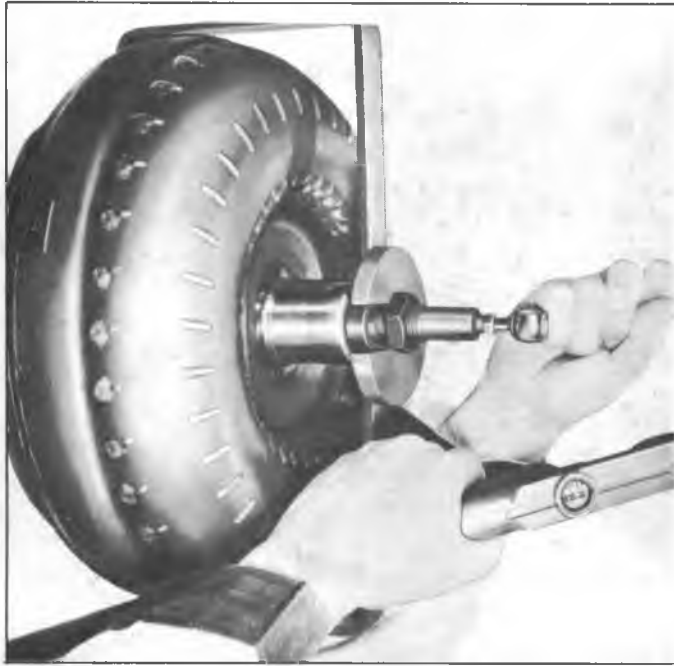


Fig. 114T-A--Loosening Collet on Tool J-21571-8

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.

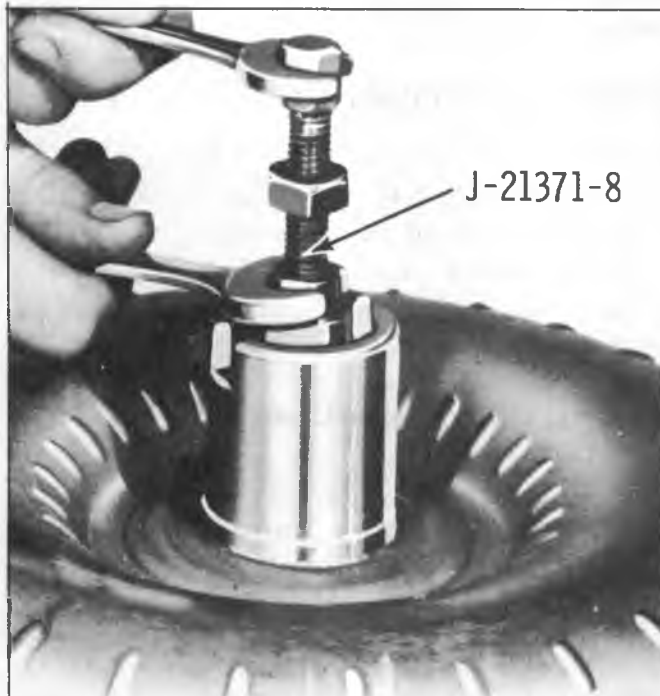


Fig. 114T-B--Checking Converter End Clearance

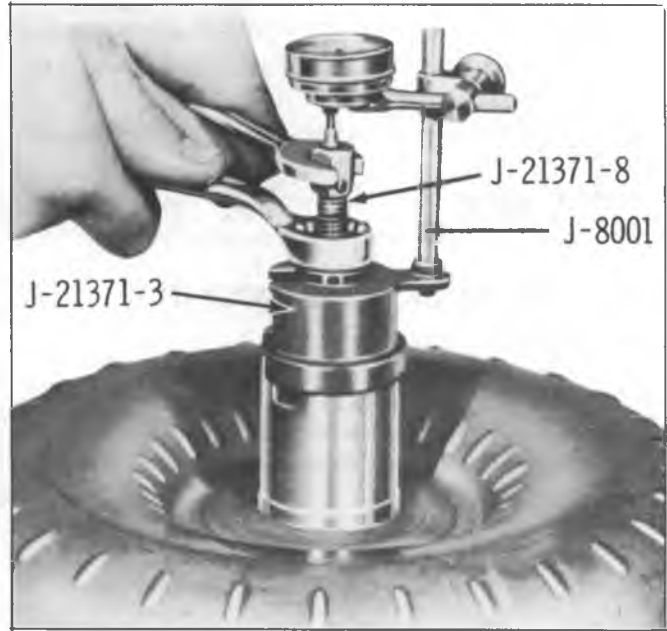


Fig. 114T-C--Checking Converter End Clearance

## 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).
  - 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.
9. Install "O" ring on output shaft of models that use an "O" ring.



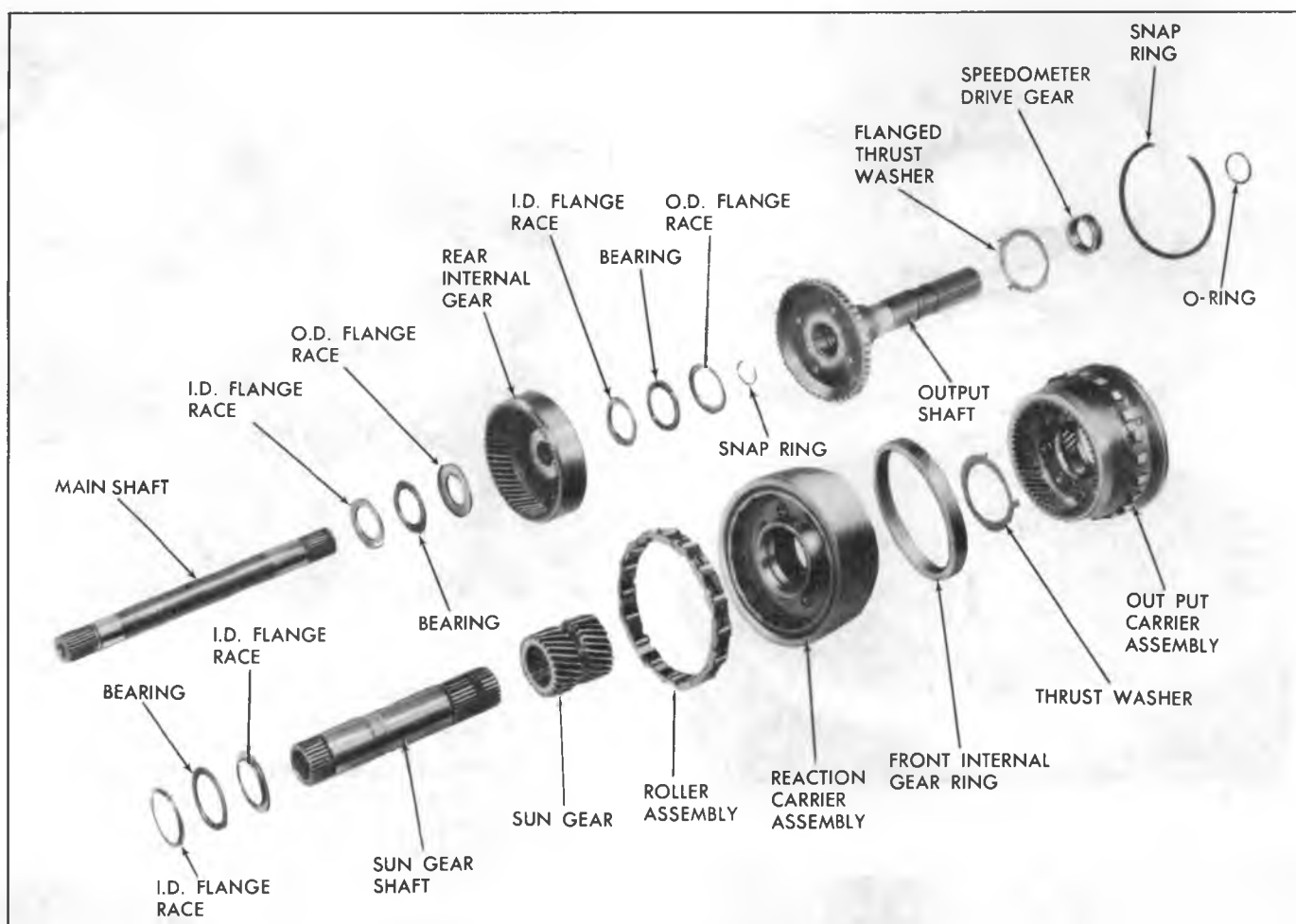


Fig. 115T--Gear Unit Assembly--Exploded View

10. Turn assembly over and support so that output shaft hangs downward.

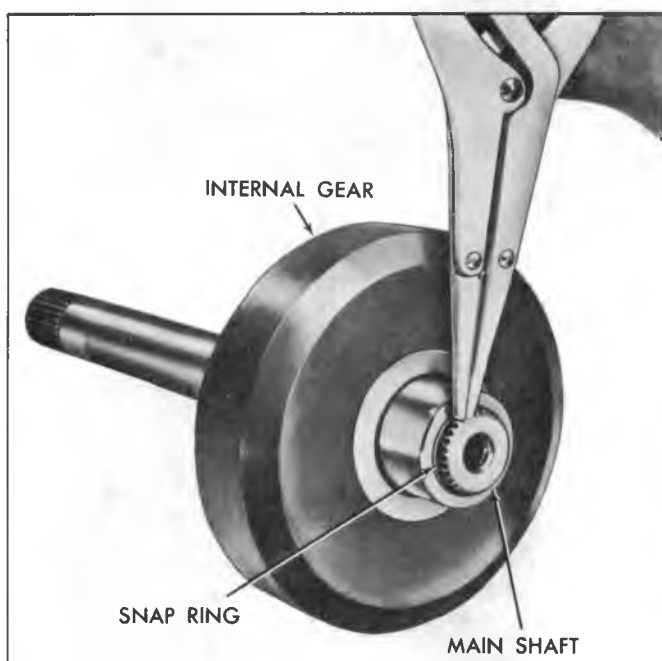


Fig. 116T--Installing Rear Internal Gear Snap Ring

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).

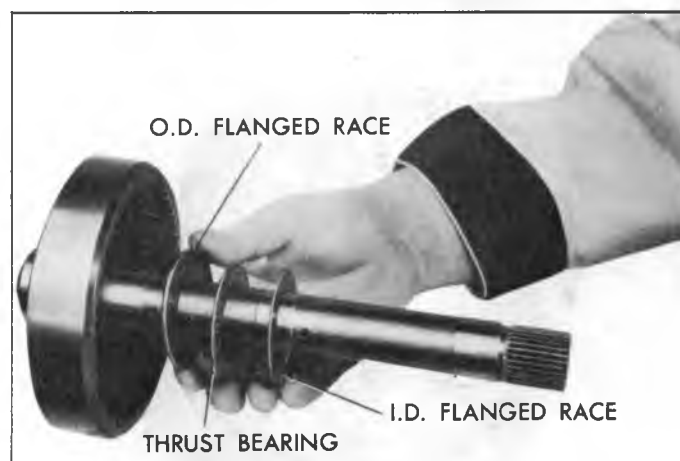


Fig. 117T--Installing Rear Internal Gear to Sun Gear Bearing and Races

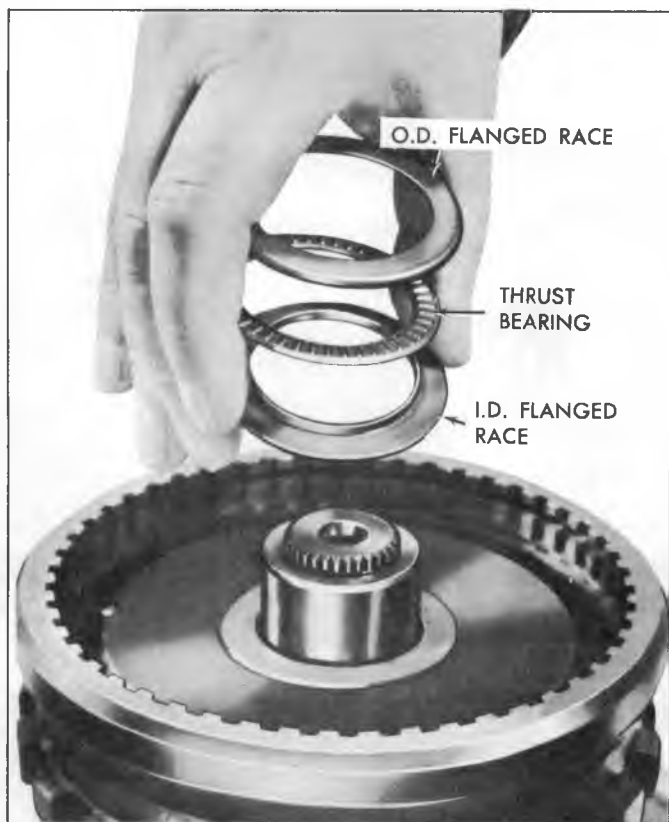


Fig. 118T--Installing Rear Internal Gear to Output Shaft Bearing and Races

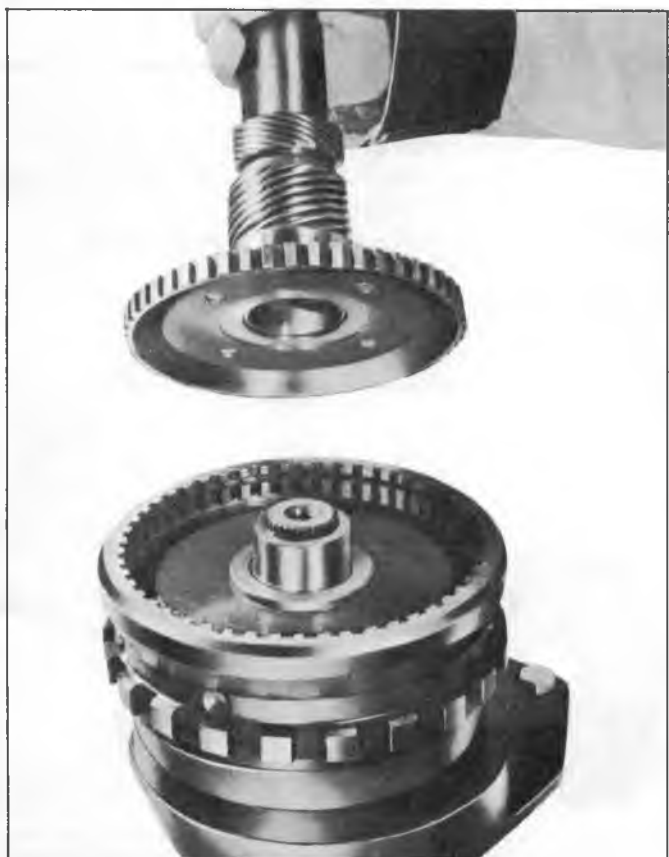


Fig. 119T--Installing Output Shaft

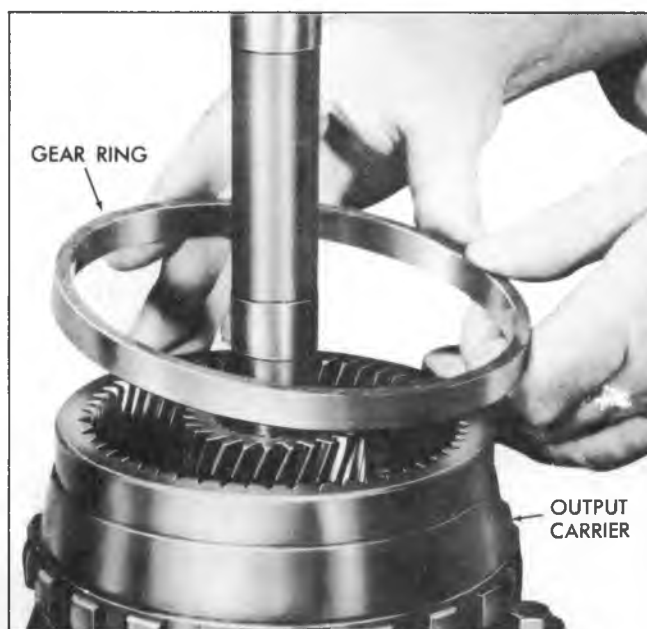


Fig. 120T--Installing Front Internal Gear Ring to Output Carrier

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.



Fig. 121T--Installing Reaction Carrier

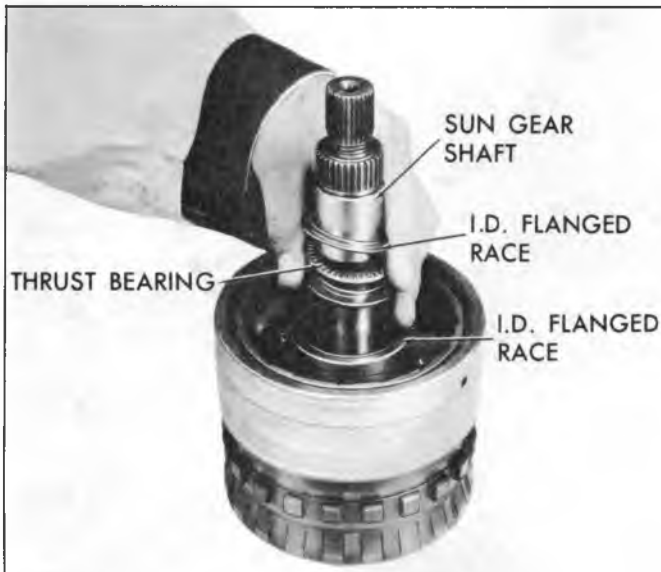


Fig. 122T--Installing Center Support to Sun Gear Thrust Bearing and Races

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).
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).



Fig. 123T--Installing Roller into Roller Clutch Cage

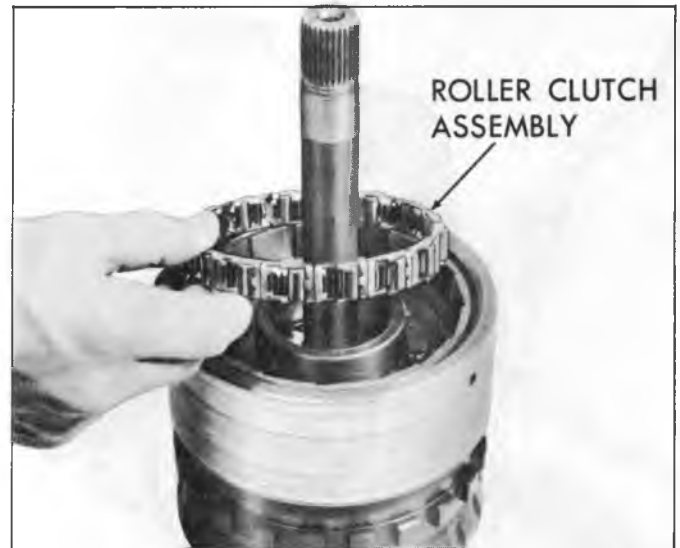


Fig. 124T--Installing Roller Clutch to Reaction Carrier

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).

**NOTE:** With reaction carrier held, center support should only turn counter-clockwise after installation.



Fig. 125T--Installing Center Support to Reaction Carrier

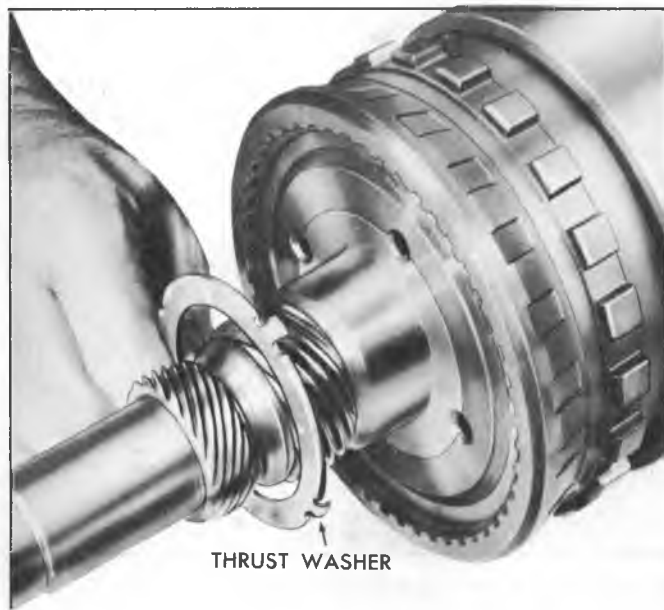


Fig. 126T--Installing Case to Output Shaft Thrust Washer

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.

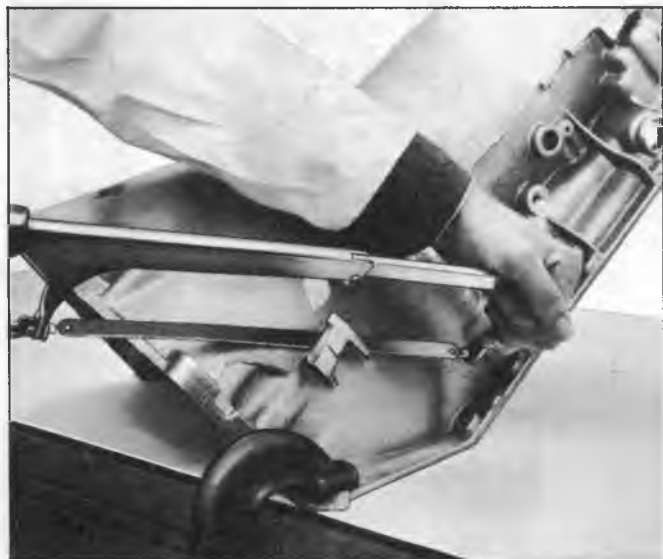


Fig. 126T-A--Modification of Service Case for Corvette Models



Fig. 127T--Installing Parking Pawl Shaft Cup Plug

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).

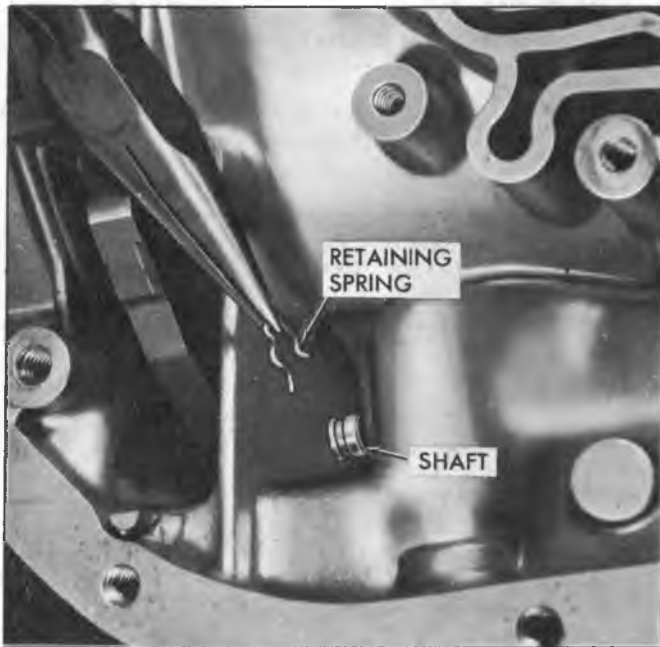


Fig. 128T--Installing Parking Shaft Retaining Spring

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).



Fig. 129T--Installing Rear Band

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).



Fig. 129T-A--Installing Center Support to Case Spacer

**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).

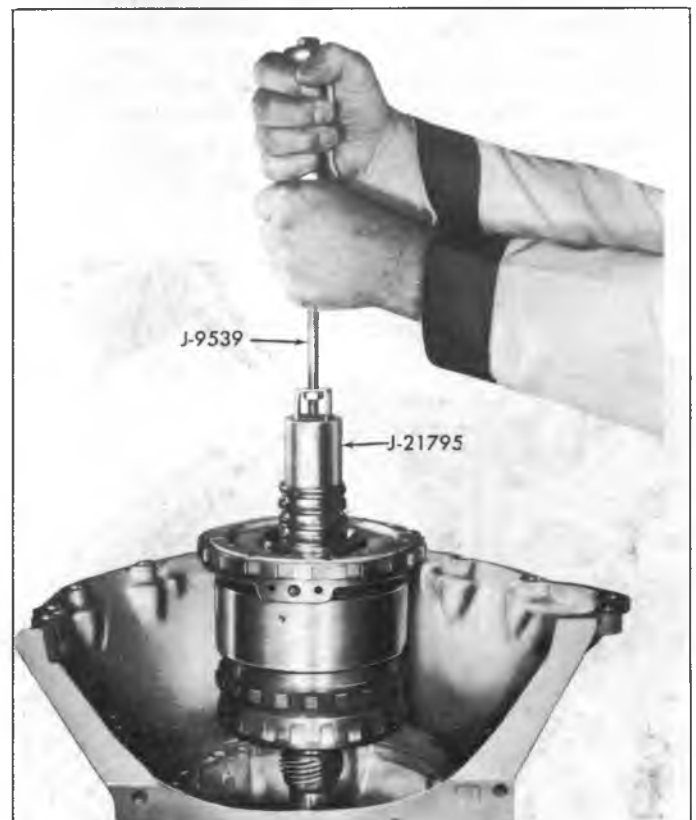


Fig. 130T--Installing Center Support and Gear Unit



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).

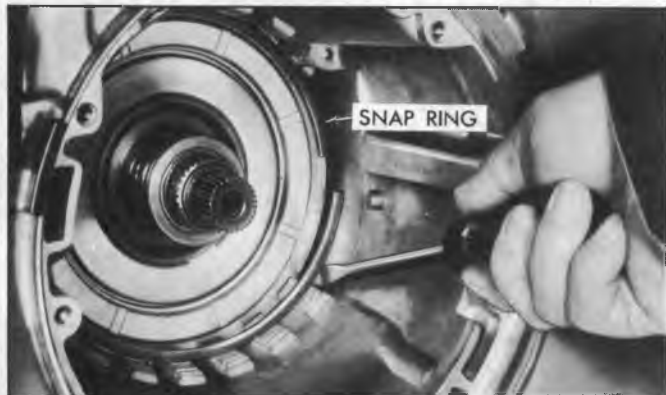


Fig. 131T—Installing Center Support to Case Snap Ring

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 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).

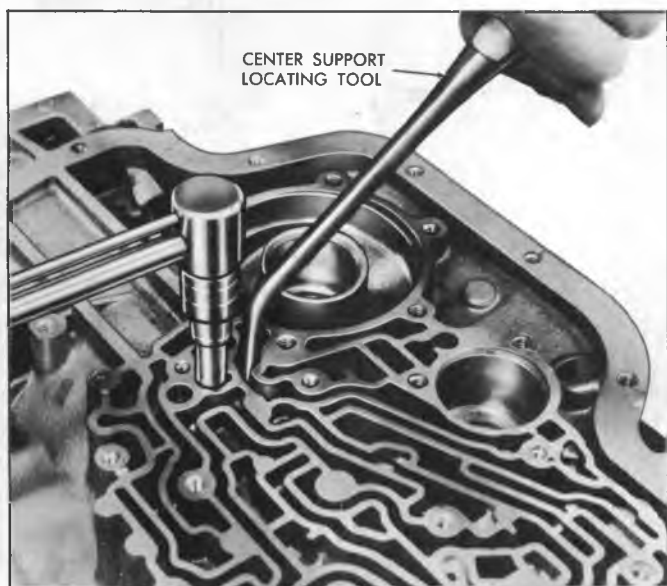


Fig. 131T-A—Installing Center Support Bolt

**CAUTION:** When using the locating tool, care should be taken not to raise burrs on the case valve body mounting face.

12. 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).

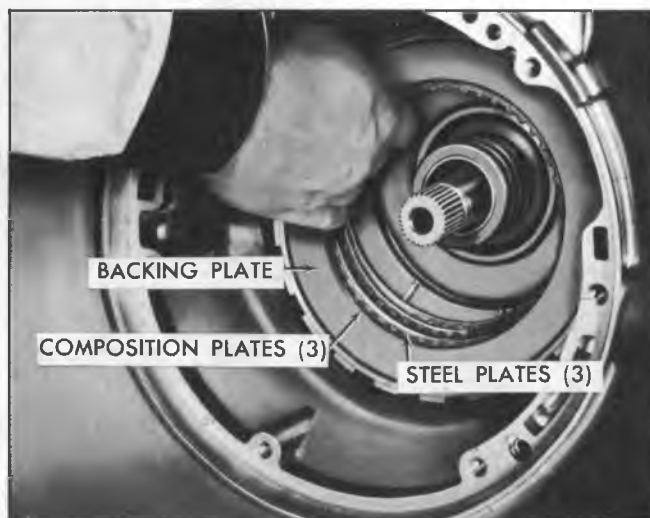


Fig. 132T—Installing Intermediate Backing Plate and Clutch

**NOTE:** No waved steel plate is used in the CY model. Three flat steel plates are used.

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.
  - 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).

Thickness	Identification
.074-.078	Notches and/or Numerals
.082-.086	None .....1
.090-.094	1 Tab Side .....2
.098-.102	2 Tabs Side .....3
.106-.110	1 Tab O.D. ....4
.114-.118	2 Tabs O.D. ....5
	3 Tabs O.D. ....6



### Install Manual Linkage

- a. If necessary, install a new manual shaft seal into transmission case using a 3/4 inch dia. rod to seat the 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.



Fig. 133T--Installing Front Band

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 thrust washer on forward clutch hub. Retain with petrolatum.

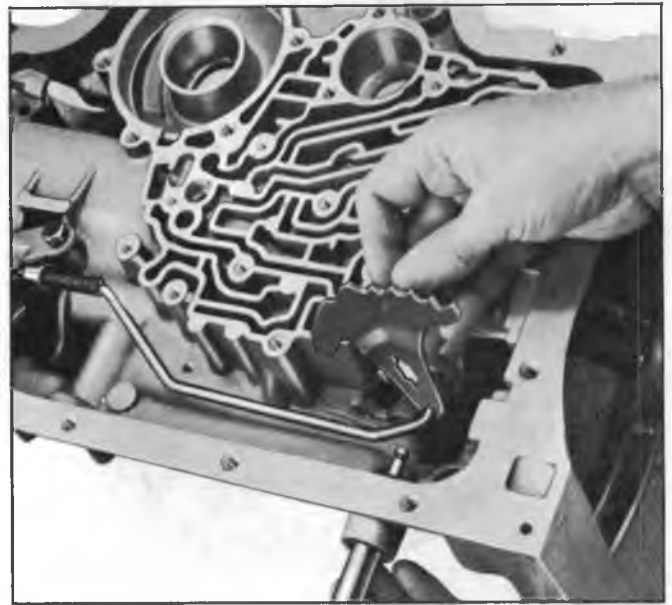


Fig. 134T--Installing Manual Shaft to Case

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.
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).

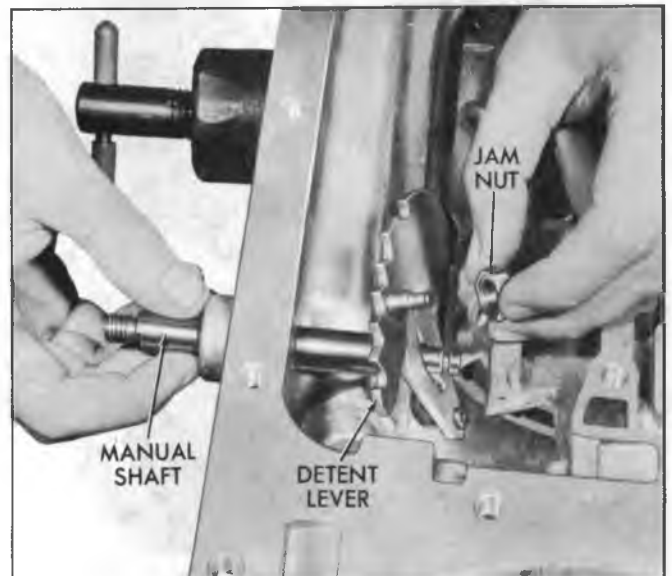


Fig. 135T--Installing Detent Lever and Jam Nut to Manual Shaft

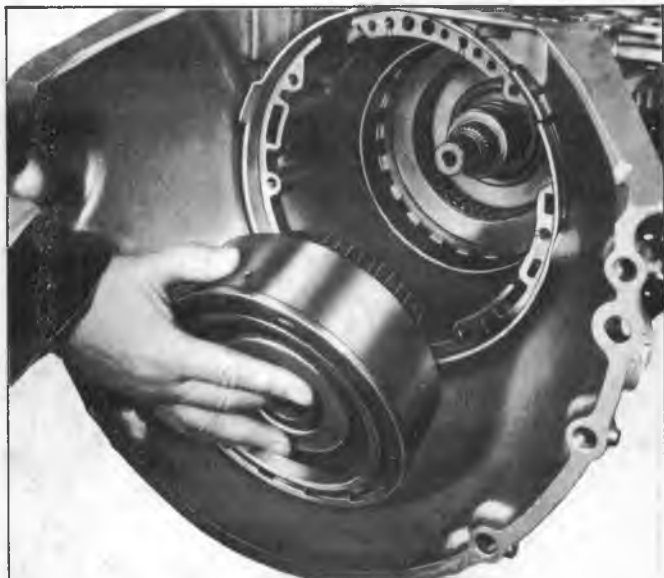


Fig. 136T--Installing Direct Clutch Assembly

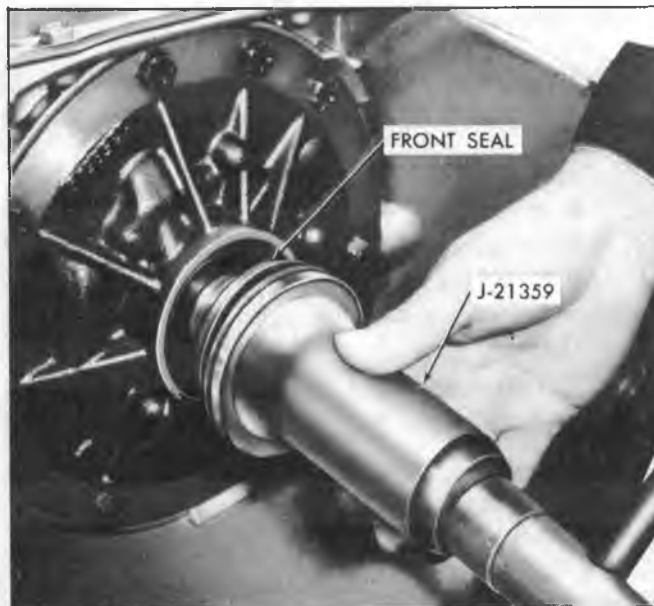


Fig. 138T--Installing Pump Seal

23. Check front unit end play as follows (fig. 139T).

- Install a 3/8"-16 threaded bolt or a Slide Hammer Bolt J 9539 into bolt hole in pump.
- Mount a dial indicator on rod and index indicator to register with end of turbine shaft.
- Push turbine shaft rearward.
- Push output shaft forward.
- Set dial indicator to zero.
- Pull turbine shaft forward.

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.

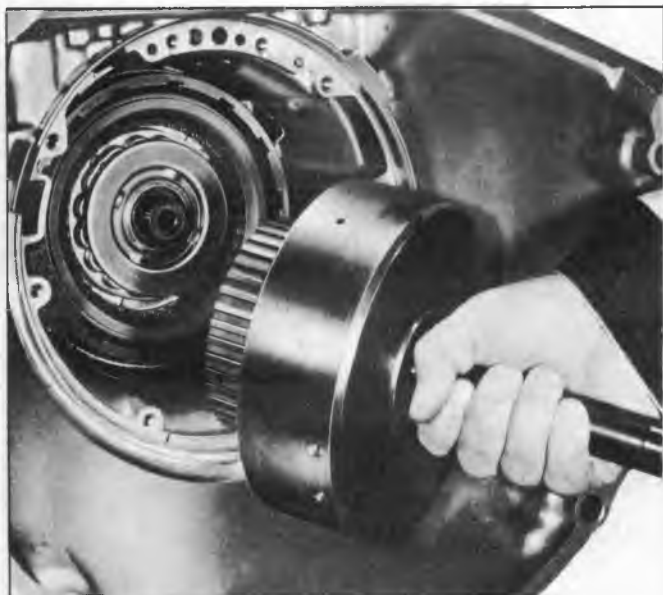


Fig. 137T--Installing Forward Clutch Assembly and Turbine Shaft



Fig. 139T--Checking Front Unit End Play

Thickness	Color
.060-.064	Yellow
.071-.075	Blue
.082-.086	Red
.093-.097	Brown
.104-.108	Green
.115-.119	Black
.126-.130	Purple

## 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 models except "CM"--Use a non-hardening sealer on outside of seal body; and using Tool J-21359, drive seal in place (fig. 140T).
  - b. Model "CM"--Use a non-hardening sealer on outside of seal body; and using Tool J-21464, drive seal in place (fig. 140T).

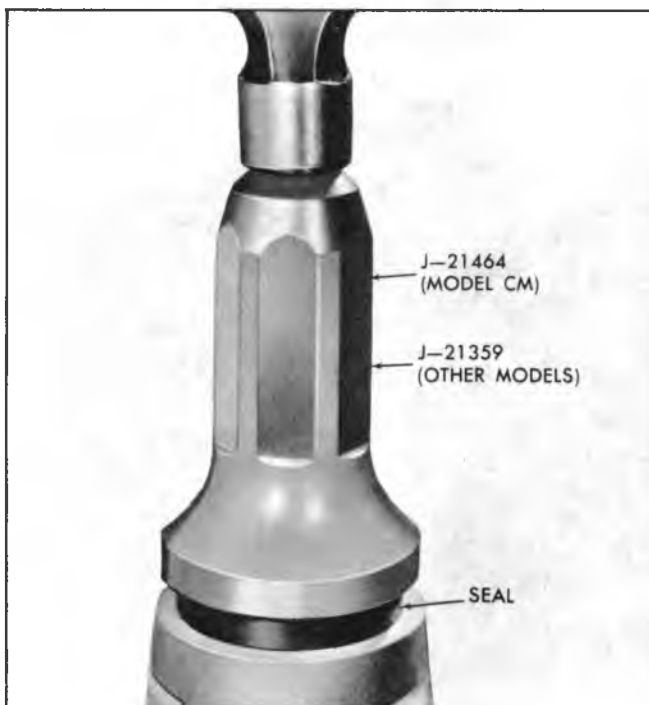


Fig. 140T--Installing Extension Oil Seal (Typical)

## 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.
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.
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.

**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.

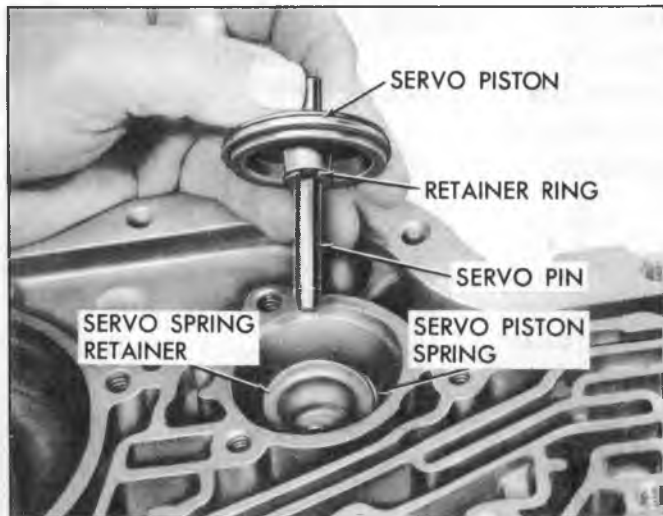


Fig. 141T--Installing Front Servo Piston, Washer, and Pin

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 and lead wire to electrical connector (fig. 10TB).

### Installation of Rear Servo Assembly

**NOTE:** Before installing rear servo assembly, check band apply pin using Tool J-21370-5 and 6 as follows (fig. 146T).

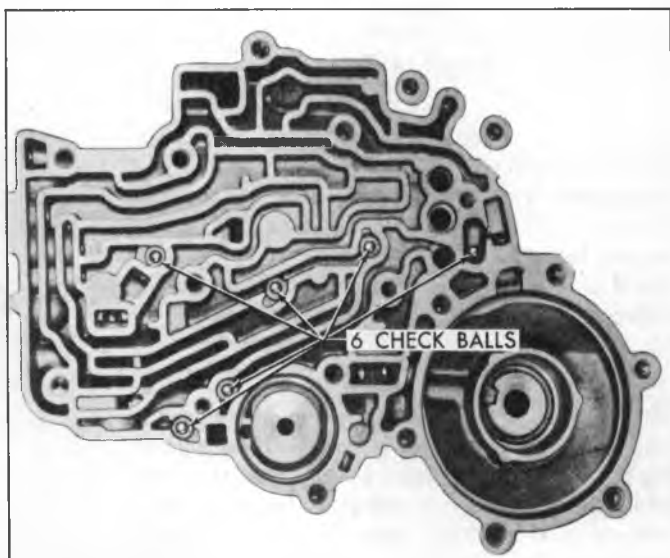


Fig. 142T--Location of Check Balls

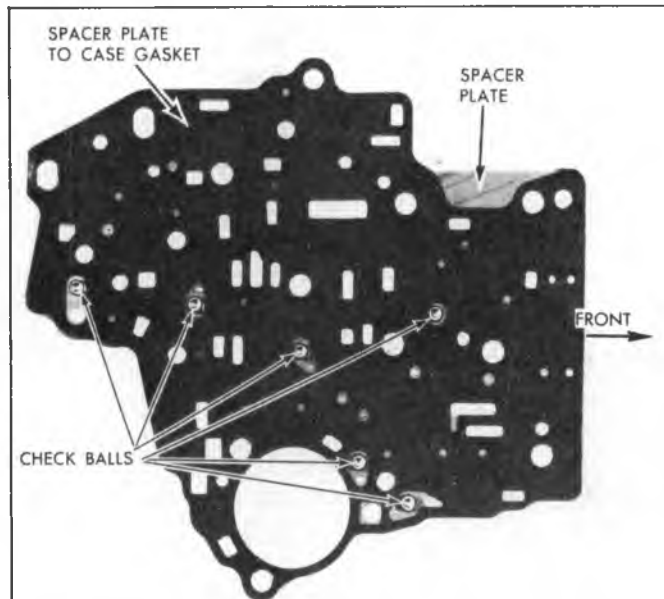


Fig. 142T-A--Location of Check Balls--In Car Installation

- 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.

**NOTE:** 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.

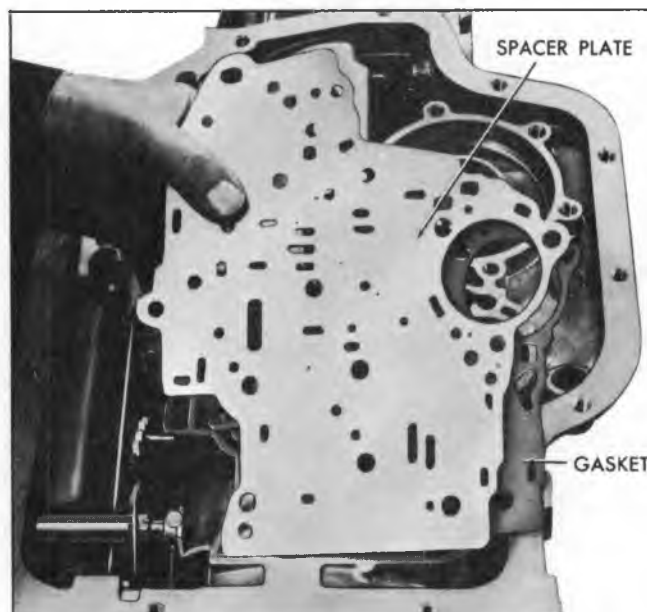


Fig. 143T--Installing Control Valve Assembly Spacer Plate and



Fig. 144T--Installing Detent Solenoid and Gasket

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:

- c. If both steps 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.

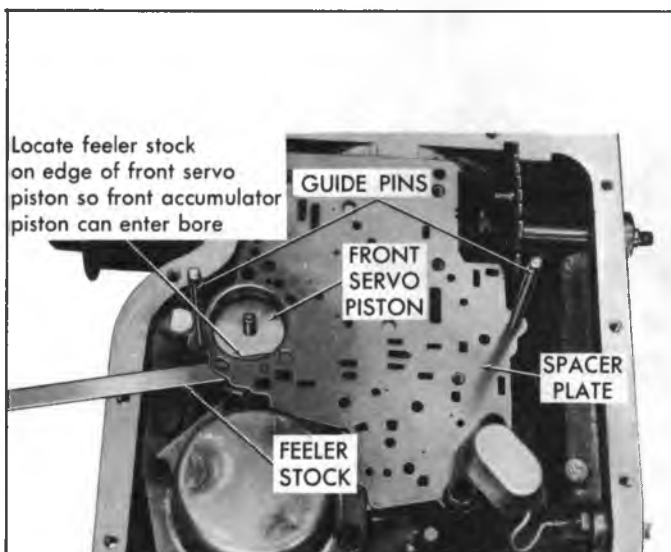


Fig. 144T-A--Front Servo Group--In Car Installation



Fig. 145T--Installing Electrical Connector and "O" Ring Seal

1. Install rear accumulator spring into case (fig. 147T).
2. Lubricate and install rear servo assembly into case (fig. 148T).
3. Install rear servo gasket and cover (fig. 149T).
4. Install attaching screws. Torque bolts to 15-20 ft. lbs.

### INSTALLATION OF CONTROL VALVE ASSEMBLY, GOVERNOR PIPES AND GOVERNOR SCREEN ASSEMBLY

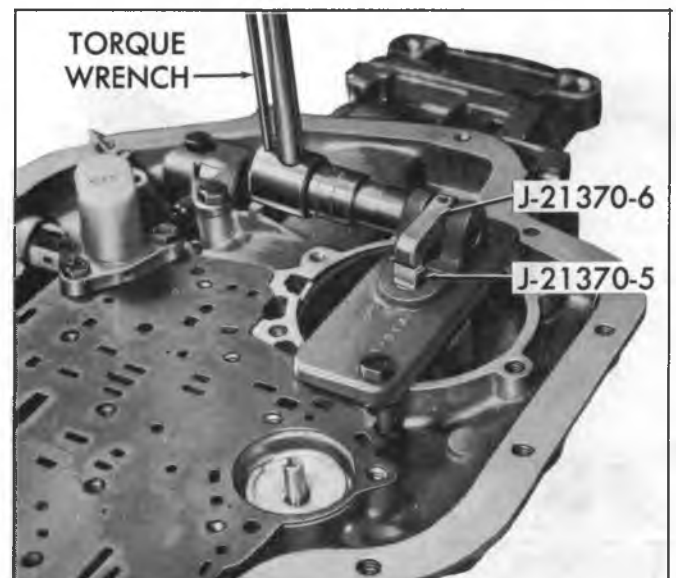


Fig. 146T--Checking Rear Band Pin





Fig. 147T--Installing Rear Accumulator Spring

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.



Fig. 148T--Installing Rear Servo Assembly

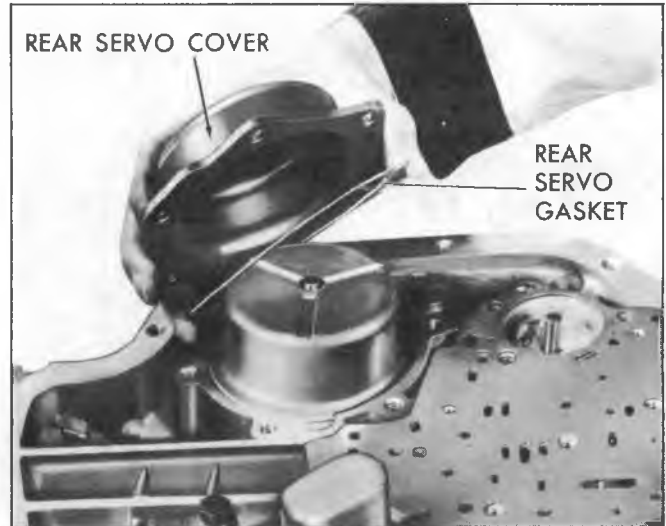


Fig. 149T--Installing Rear Servo Cover and Gasket

**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 and make certain lead wire assembly clip is installed.

**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).
6. If removed, install the pressure switch assembly.

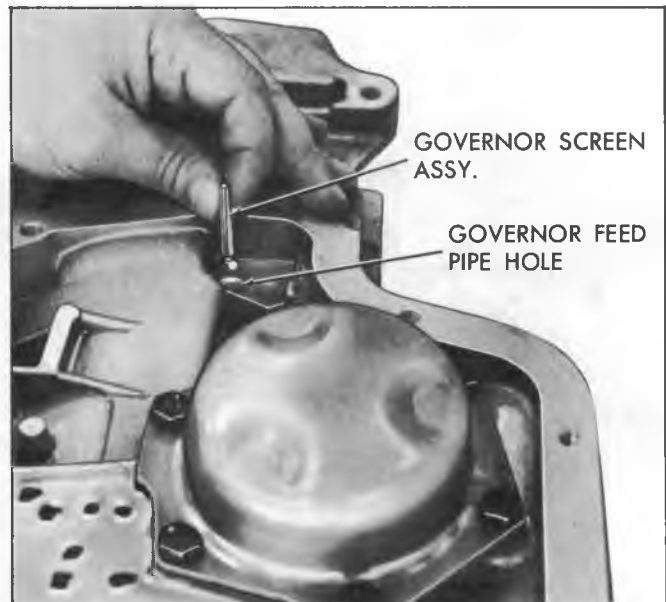


Fig. 150T--Installing Governor Screen Assembly



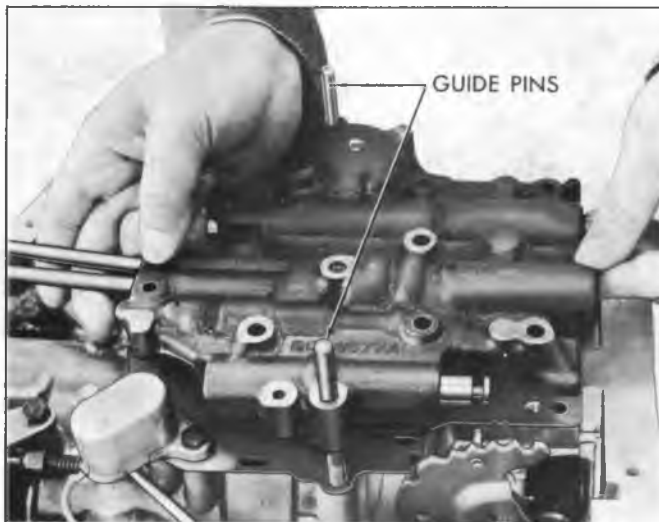


Fig. 151T--Installing Control Valve Assembly and Governor Pipes

**NOTE:** Model CM does not contain a pressure switch assembly.

**NOTE:** The TCS wire is routed from the case electrical connector around the solenoid assembly and under the governor pipe to pressure switch.

7. Connect the lead wire to the pressure switch 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.

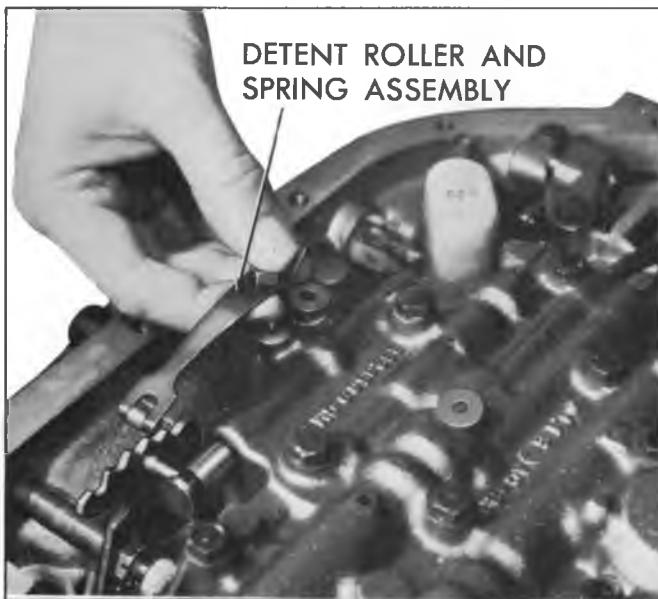


Fig. 152T--Installing Detent Roller and Spring Assembly



Fig. 153T--Installing Vacuum Modulator and Valve

### 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.
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.

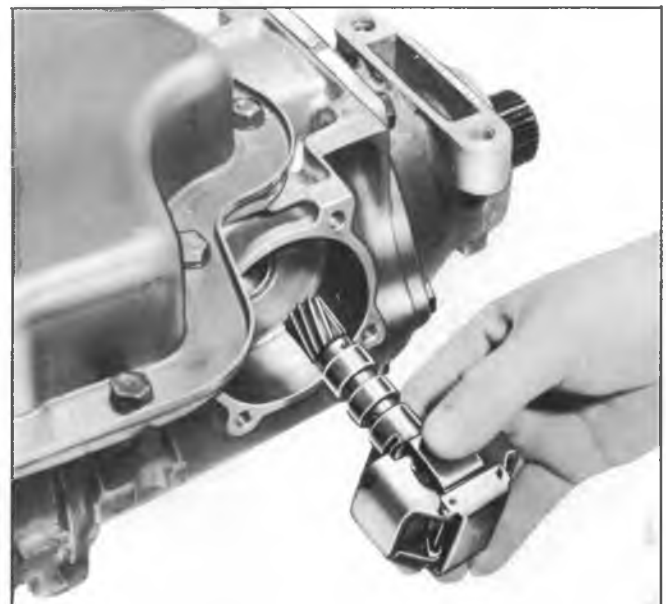


Fig. 154T--Installing Governor Assembly

## 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

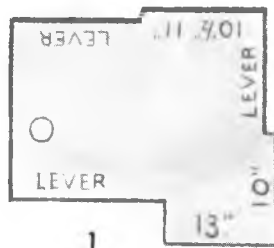
With the transmission in cradle or portable jack, install the converter assembly into the pump assembly making certain that the converter hub drive slots are fully engaged with the pump drive gear tangs and the converter installed fully towards the rear of the transmission.

**NOTE:** The converter used in the CM and CY models has six (6) mounting lugs.



Fig. 155T—Installing Speedometer Driven Gear and Sleeve

## SPECIAL TOOLS



1



3



4



2



5

- 1. J-6456 Height Gauge
- 2. J-1048 Gauge Plate
- 3. J-1522 Pilot Bearing Driver
- 4. J-5824 Clutch Pilot Tool
- 5. J-1448 Pilot Bearing Puller

Fig. 1ST--Clutch Special Tools

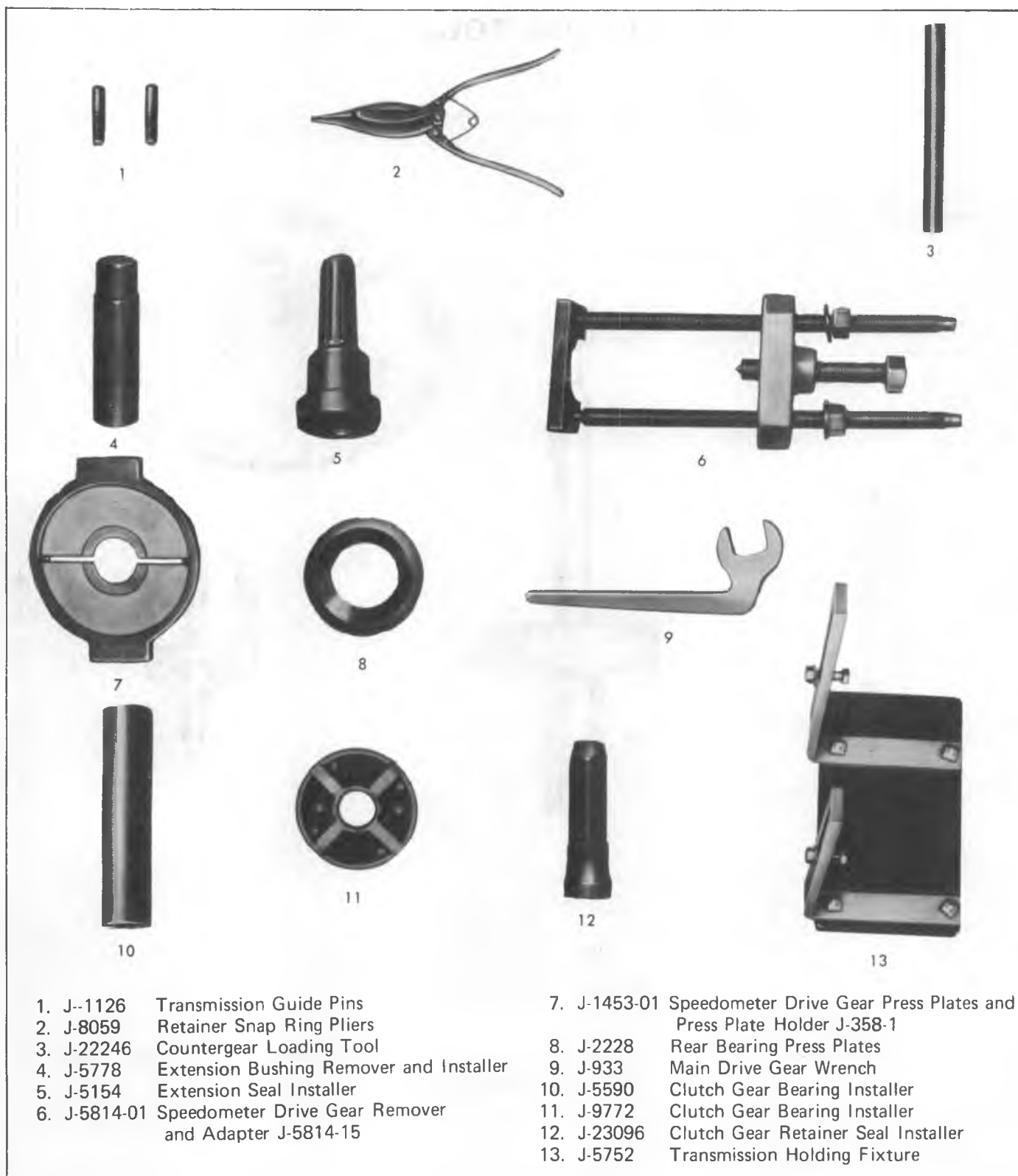
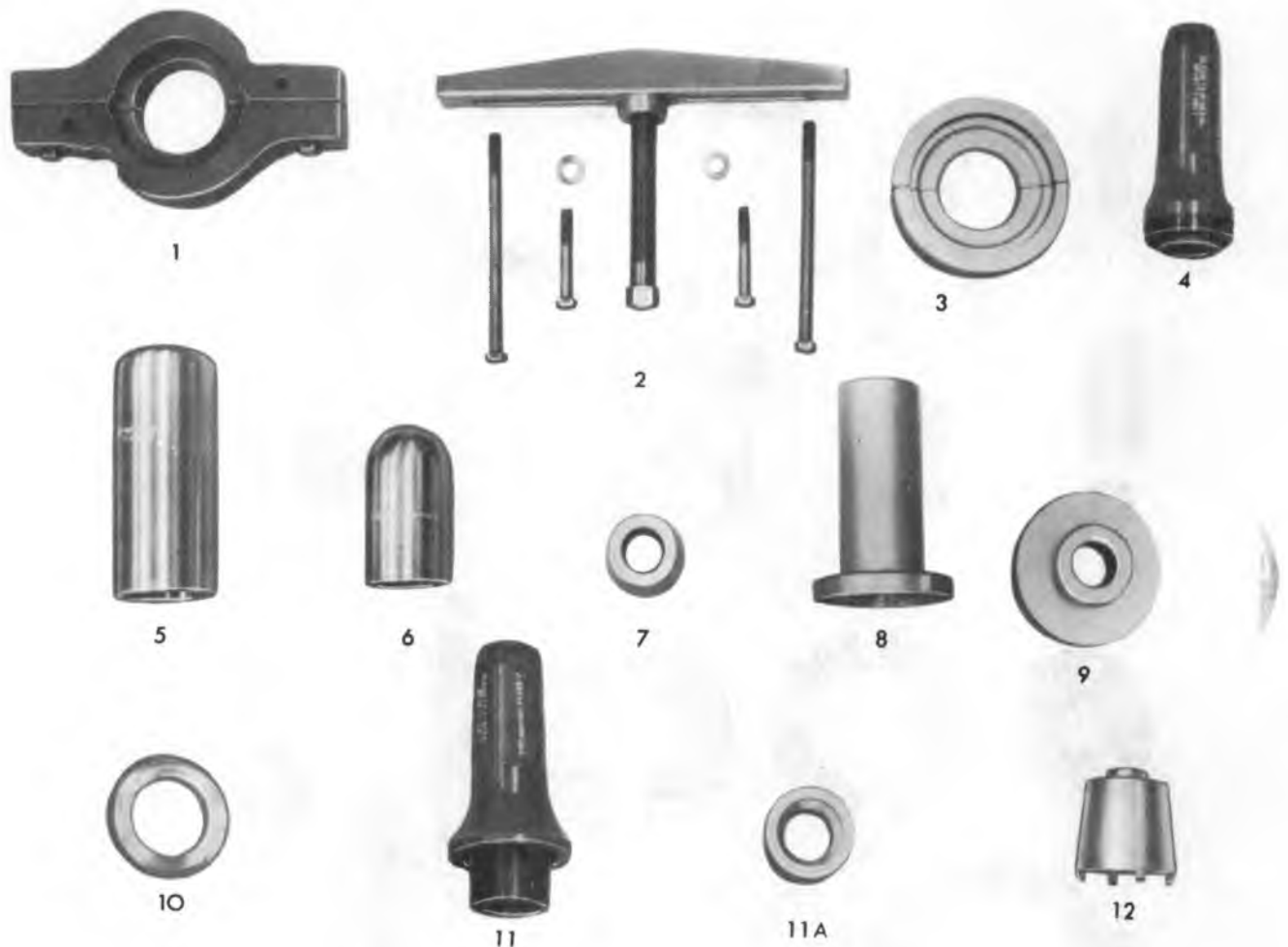
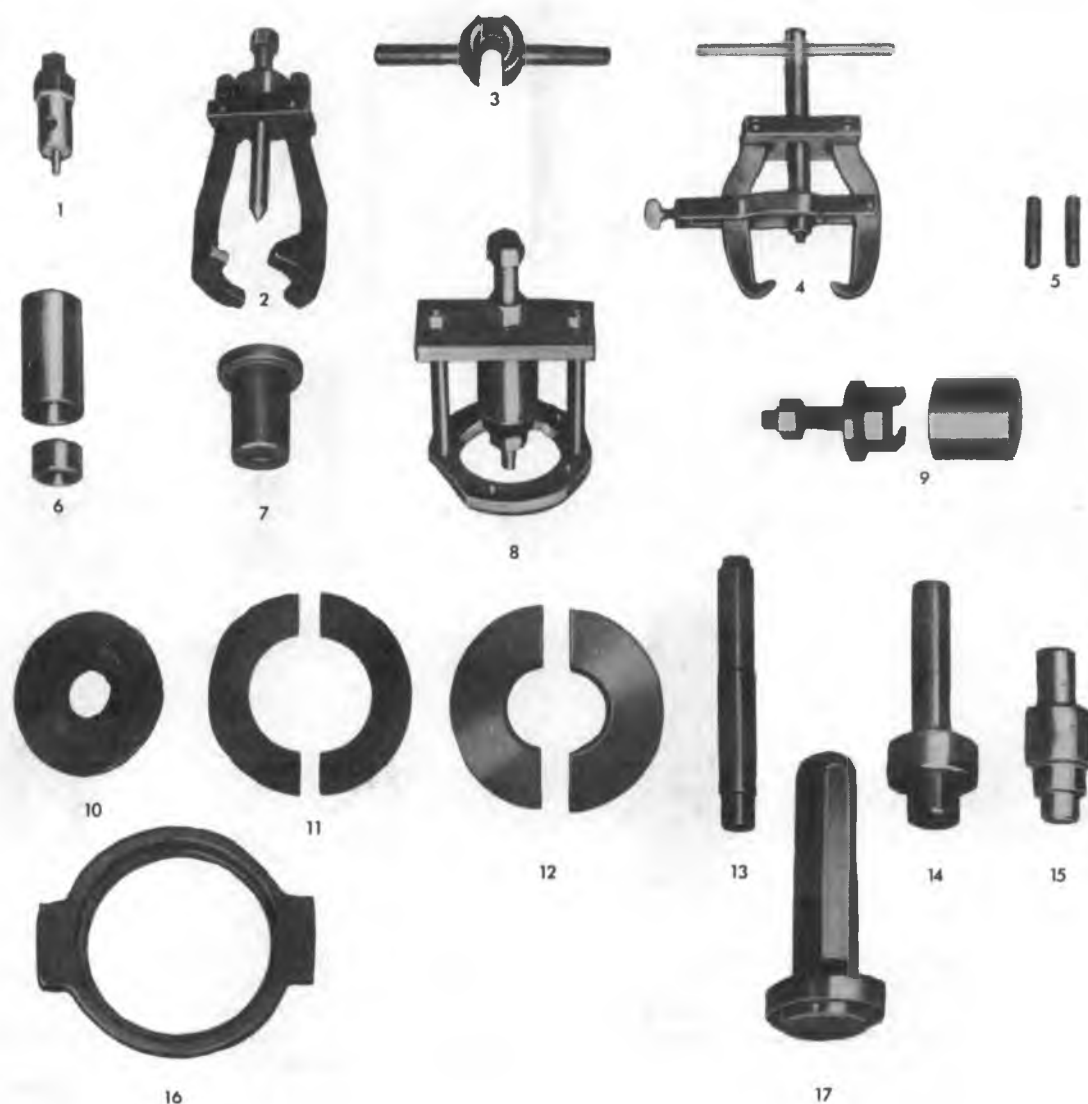


Fig. 2ST-3-Speed and 4-Speed Passenger and 10-30 Series Truck Manual Transmissions



- |             |   |                |   |
|-------------|---|----------------|---|
| 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                       |                |   |

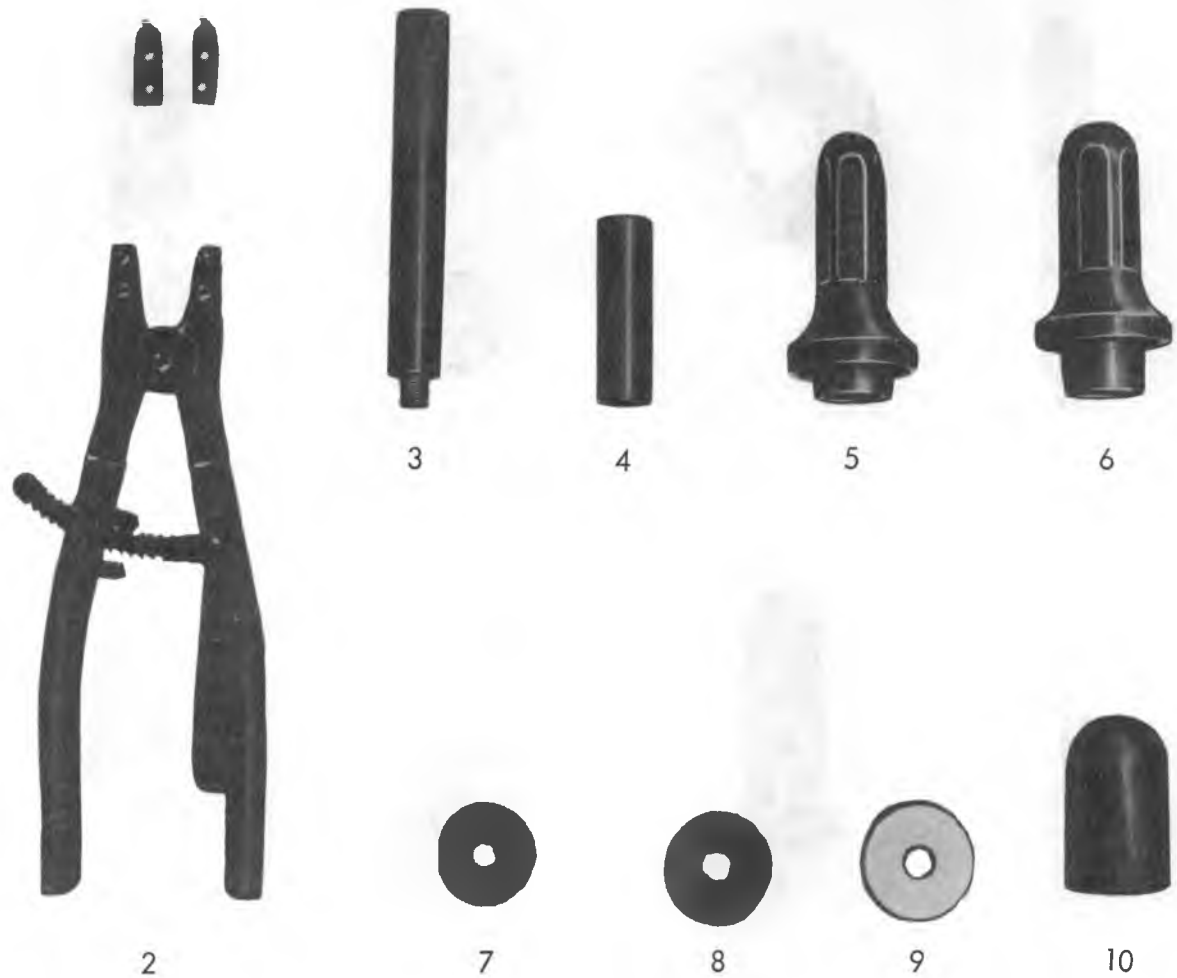
Fig. 3ST--Four Speed Muncie Truck Transmission Model 465



- |   |  |
|---|--|
| 1. J-2680 Reverse Idler Gear Bushing Staking Tool             | 10. J-1453 Clutch Gear Bearing Replacer                    |
| 2. J-1619 Transmission Mainshaft Bearing Puller               | 11. J-2228 Clutch Gear Bearing Remover Plate               |
| 3. J-8109 (K-353)—Gear Shift Lever Remover and Replacer       | 12. J-8106 (K342) Clutch Gear Bearing Replacer             |
| 4. J-8107 (TR-278-R)—Countershaft Rear Bearing Remover        | 13. J-1614 Reverse Idler Gear Bushing Remover and Replacer |
| 5. J-1126 Transmission Guide Pin Set (2)                      | 14. J-1488 Rear Bearing Retainer Oil Seal Driver           |
| 6. J-2671 Third Speed Gear Bushing Installer                  | 15. J-4869 Speedometer Gear Replacer                       |
| 7. J-7785 Oil Seal Installer                                  | 16. J-0358 (J-358-1)—Press Plate Holder                    |
| 8. J-2667 Mainshaft and Bearing Assembly Remover and Replacer | 17. J-6416 Rear Bearing Retainer Seal Installer            |
| 9. J-6382 Reverse Idler Shaft Remover                         |  |

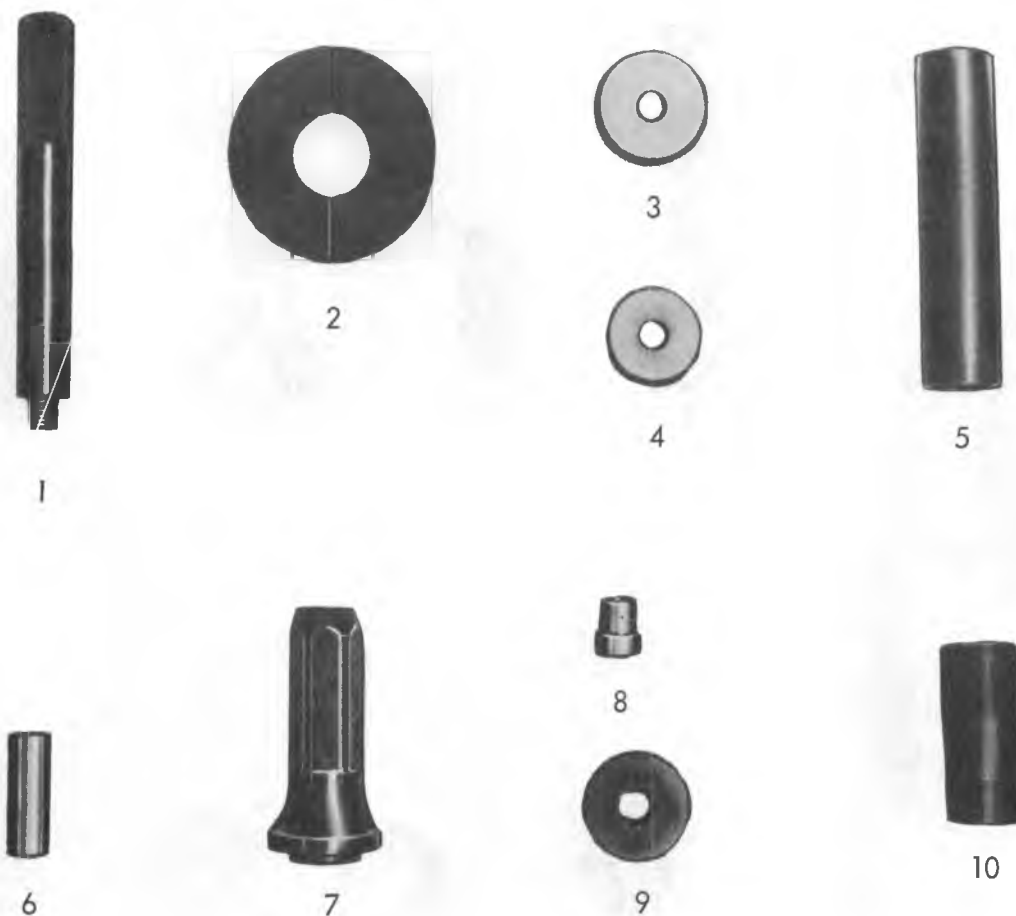
Fig. 4ST--New Process Transmission





- |              |  |
|--------------|--|
| 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. 5ST--New Process Transfer Case 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 Special Tools

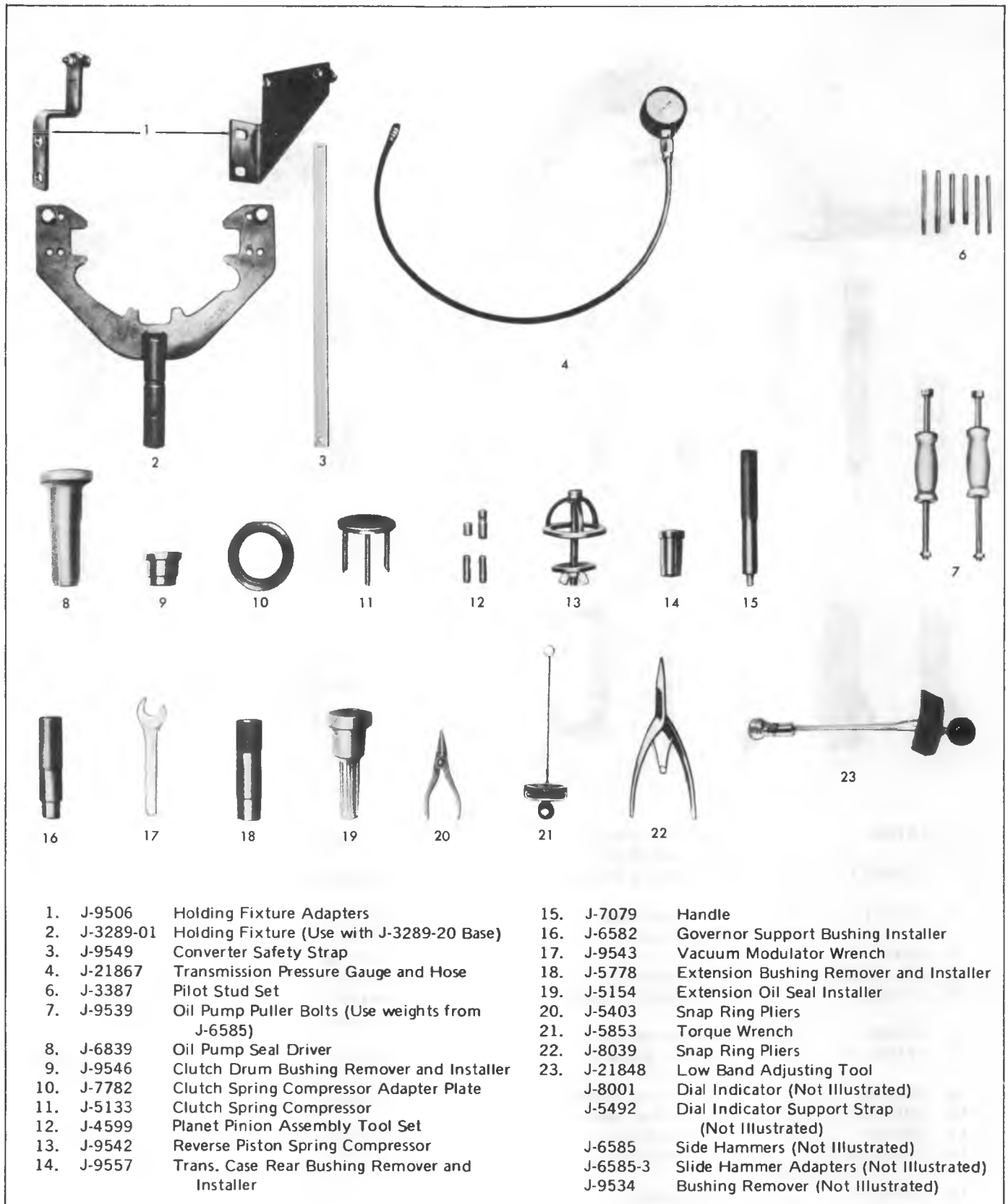
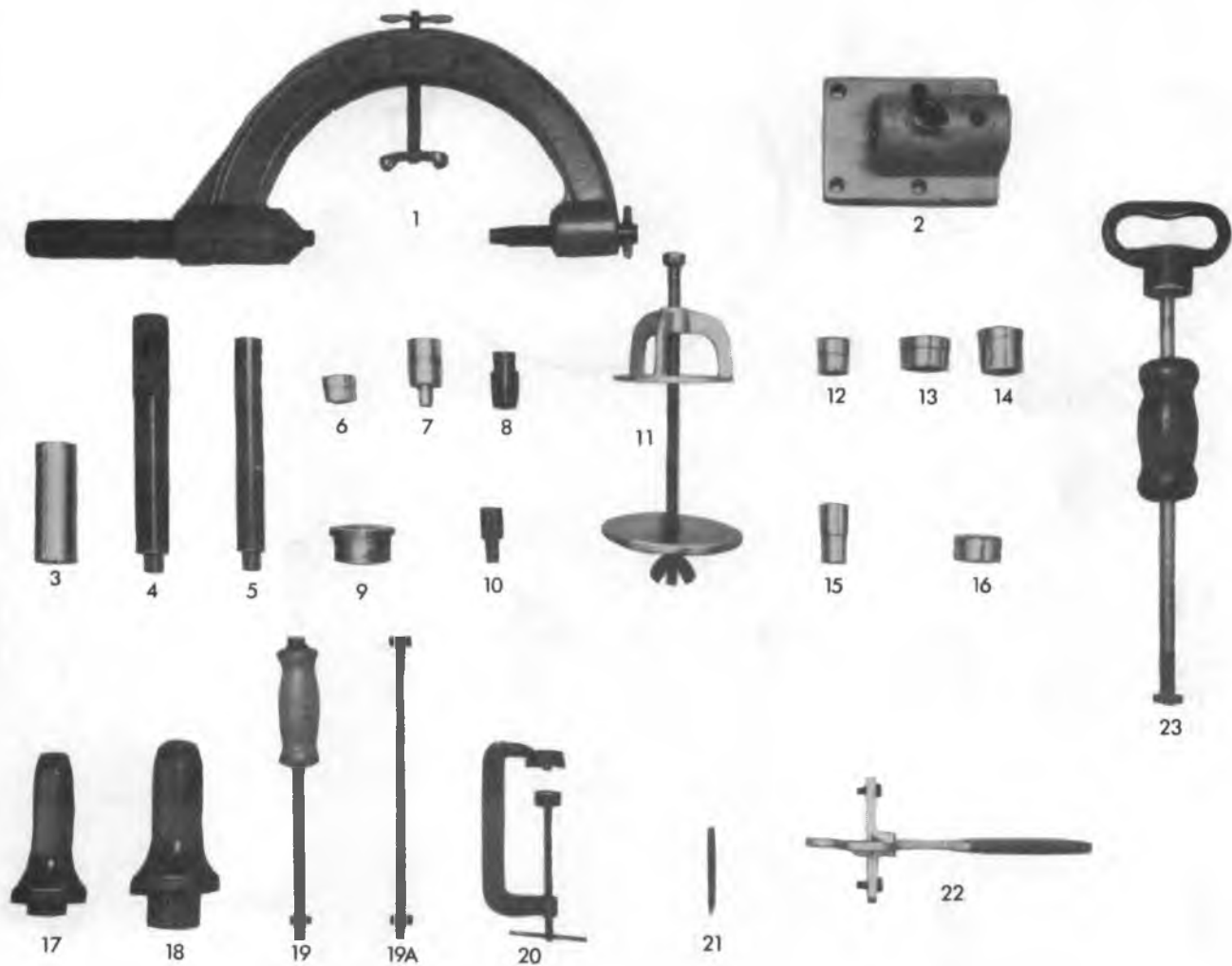
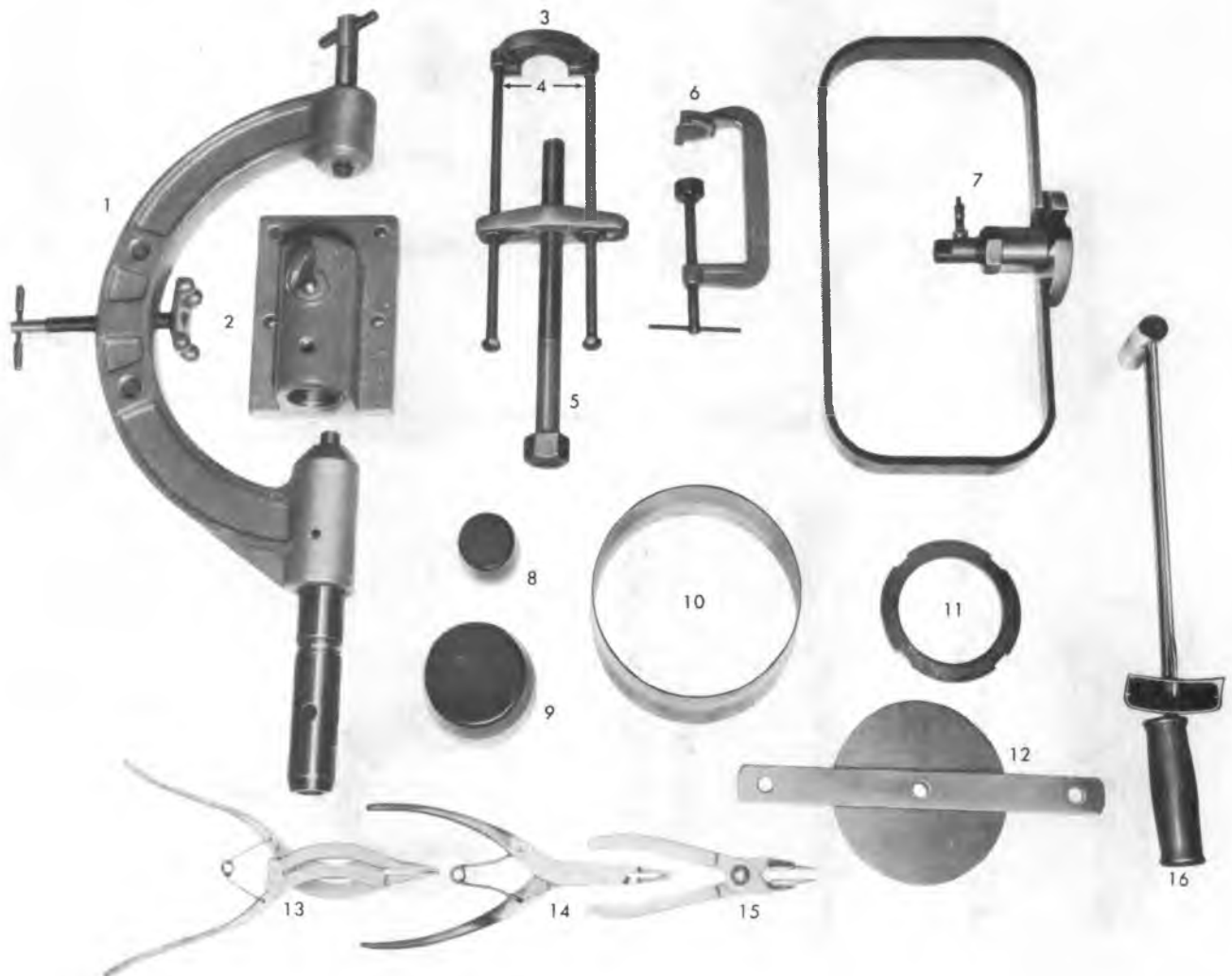


Fig. 7ST-Aluminum Powerglide Special Tools



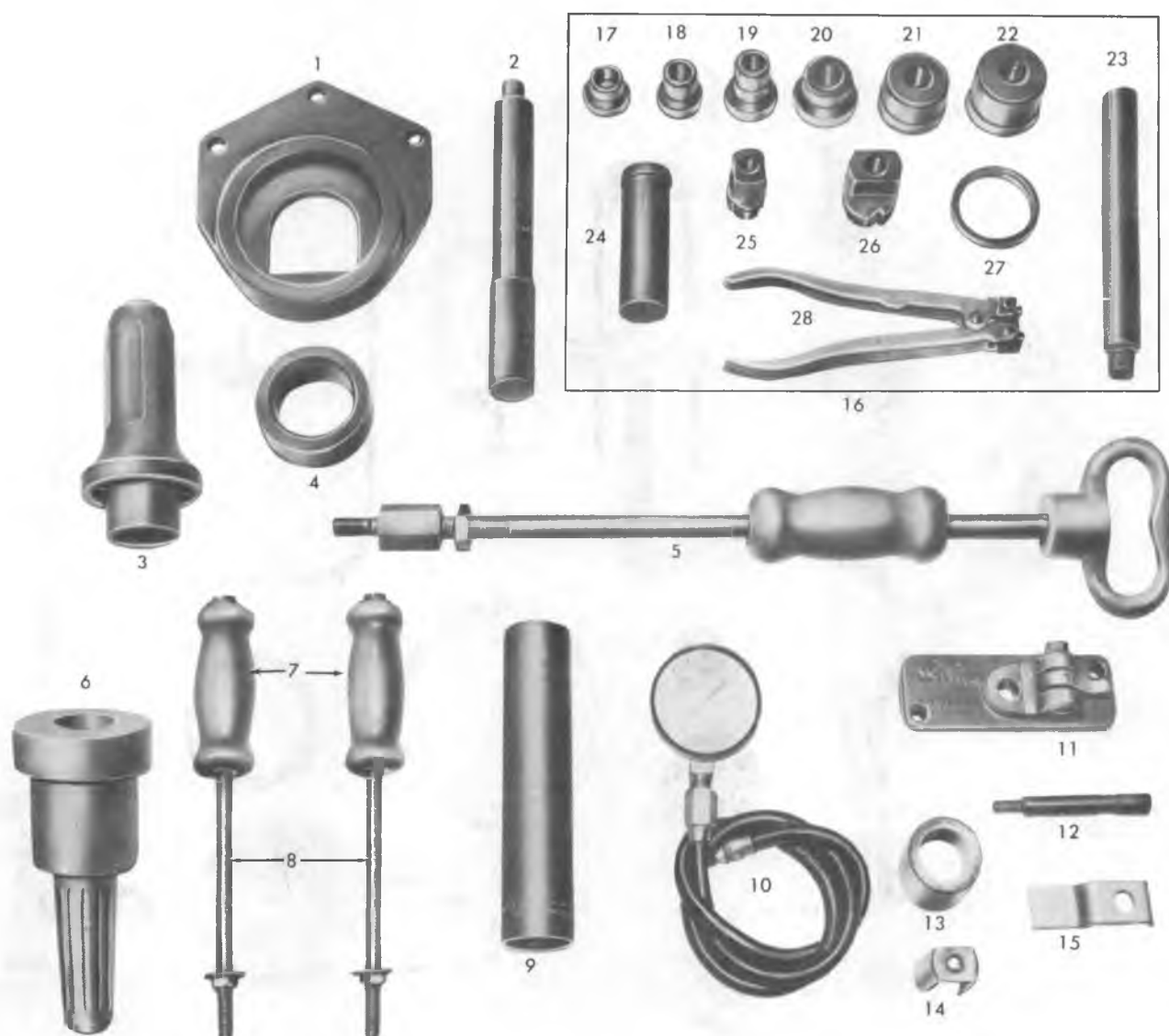
- |               |   |                       |   |
|---------------|---|-----------------------|---|
| 1. J-8763     | Transmission Holding Fixture (Modified for THM 350) | 15. J-21424-7         | Stator Shaft Front Bushing Installer  |
| 2. J-3289-14  | Transmission Holding Fixture Base                   | 16. J-23062-5         | Input Ring Gear Bushing Installer   |
| 3. J-23103    | Propeller Shaft Yoke Seal Remover and Installer     | 17. J-5154 or J-21426 | Extension Housing Seal Installer  |
| 4. J-8092     | Driver Handle                                       | 18. J-21359           | Pump Seal Installer   |
| 5. J-21465-13 | Driver Handle Extension                             | 19. J-6585            | Slide Hammer Weights  |
| 6. J-23062-3  | Sun Gear and Reaction Carrier Bushing               | 19a. J-9539           | Slide Hammer Screw  |
| 7. J-23062-7  | Output Shaft Bushing Installer                      | 20. J-21885           | 2-3 Accumulator Piston Compressing Tool   |
| 8. J-21465-15 | Stator Shaft Front Bushing Remover                  | 21. J-23071           | Intermediate Band Apply Pin Gauge   |
| 9. J-23329    | Direct Clutch Bushing Installer                     | 22. J-23069           | 1-2 Accumulator Cover Remover and Installer   |
| 10. J-9534-01 | Output Shaft Bushing Remover                        | 23. J-2619            | Slide Hammer (Used with J-2619-4 Adapter and J-21465-15 Stator Shaft Front Bushing Remover) |
| 11. J-23327   | Clutch Spring Compressor                            |                       |   |
| 12. J-23062-2 | Stator Shaft Rear Bushing Installer                 |                       |   |
| 13. J-23062-1 | Case Bushing Installer                              |                       |   |
| 14. J-21424-9 | Extension Housing Bushing Installer                 |                       |   |

Fig. 8ST-Turbo Hydra-Matic 350 Special Tools



- |              |  |             |  |
|--------------|--|-------------|--|
| 1. J-8763    | Transmission Holding Fixture                       | 9. J-21363  | Seal Protector - Intermediate Clutch - Inner |
| 2. J-3289-14 | Holding Fixture Base                               | 10. J-21409 | Seal Protector - Forward Clutch - Outer      |
| 3. J-21427-1 | Speedo Gear Remover                                | 11. J-21664 | Clutch Spring Compressor Adapter Ring        |
| 4. J-9539    | Slide Hammer Bolts (3/8" - 16 Threads)             | 12. J-4670  | Clutch Spring Compressor                     |
| 5. J-8105    | Speedo Gear Remover Puller                         | 13. J-8059  | Snap Ring Pliers                             |
| 6. J-21885   | Accumulator Piston Installer                       | 14. J-5586  | Snap Ring Pliers                             |
| 7. J-21369   | Converter Pressure Check Fixture                   | 15. J-5403  | Snap Ring Pliers                             |
| 8. J-21362   | Seal Protector - Forward and Direct Clutch - Inner | 16. J-1313  | Torque Wrench 0-140 Ft. Lbs.                 |

Fig. 9ST--Turbo Hydra-Matic 400 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. 10ST-Turbo Hydra-Matic 400 Special Tools



## SECTION 9

# STEERING

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## MANUAL STEERING GEARS

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Pitman Shaft and/or Wormshaft Seal		Assembly .....	9-5
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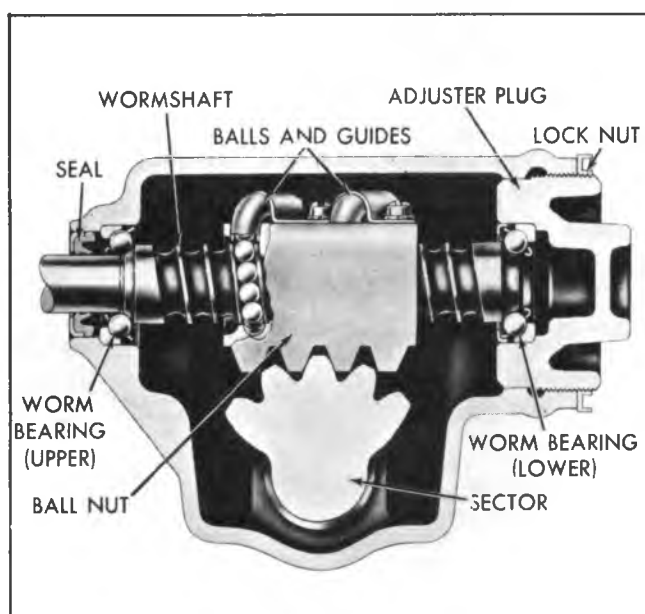


Fig. 1--Steering Gear (Except Corvette)

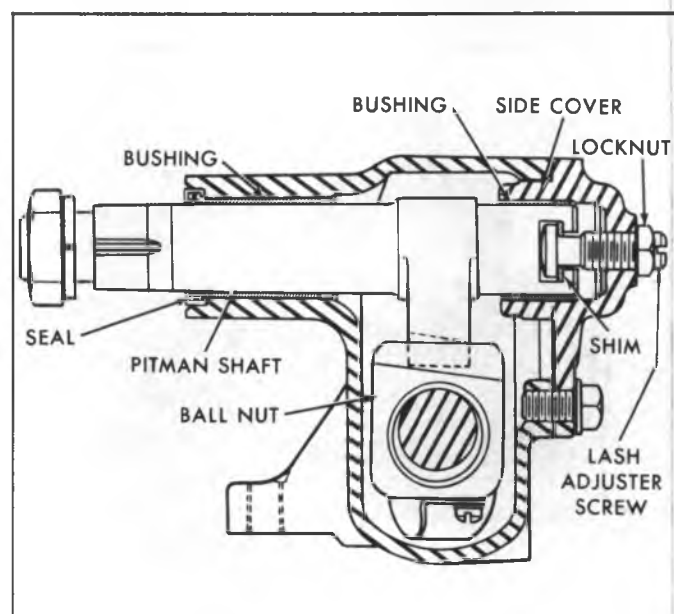


Fig. 2--Steering Gear (Except Corvette and G10-30 Series Trucks)

## 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 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).
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 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).

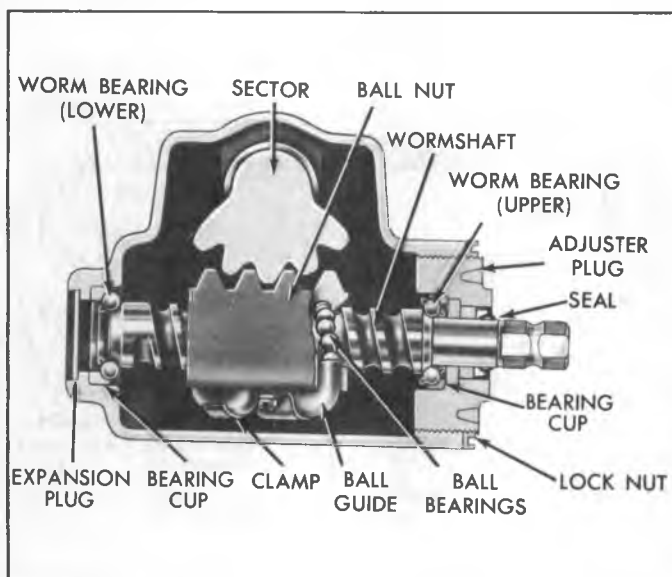


Fig. 3—Steering Gear—Corvette

**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.
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.

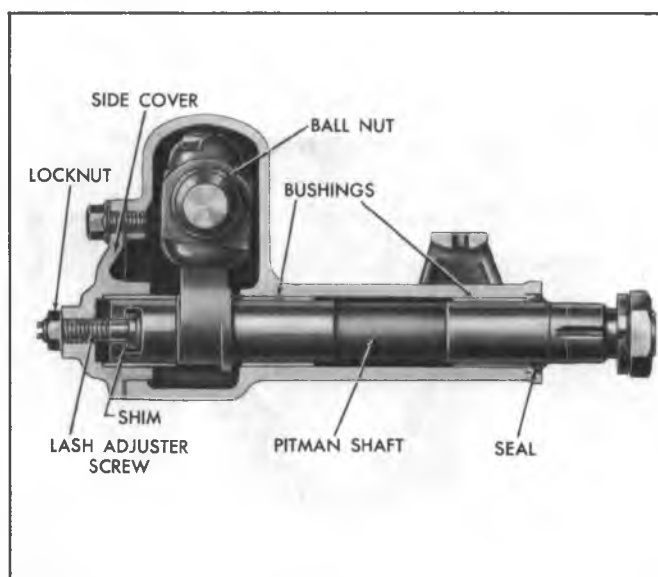


Fig. 4—Steering Gear (Corvette and G10-30 Series Trucks)

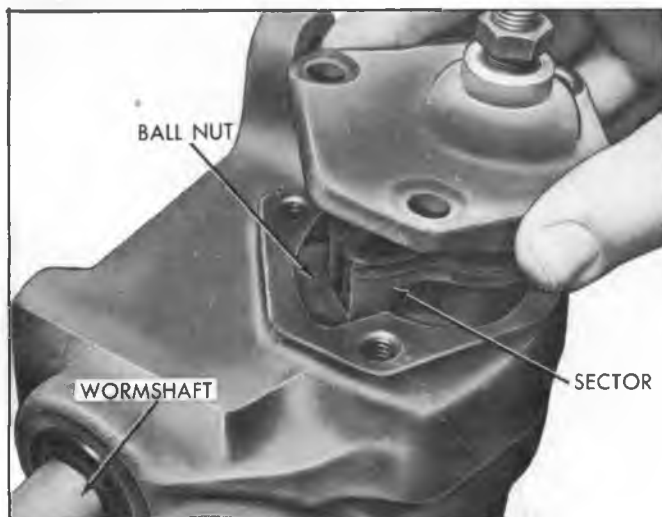


Fig. 5—Removing Pitman Shaft Assembly—Typical

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.



Fig. 6—Removing the Wormshaft and Ball Nut—Typical



Fig. 7—Removing Lower Bearing Retainer—Except Corvette

**CAUTION:** Before installing new seals, check 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).

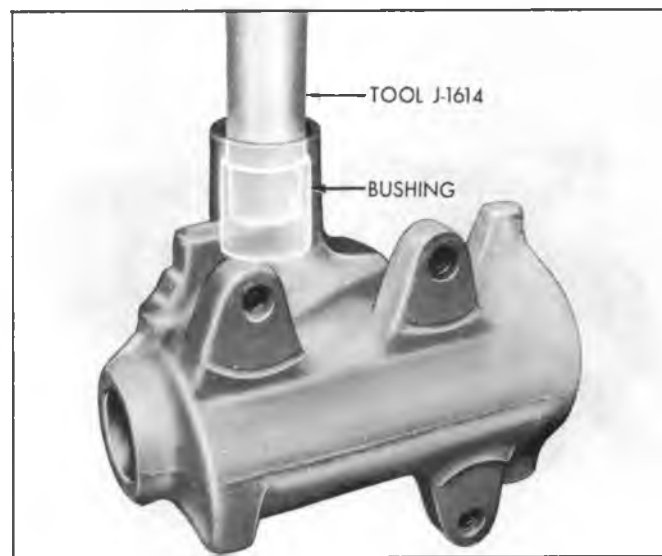


Fig. 8—Removing Pitman Shaft Bushing—Typical

## STEERING 9-4

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 Slide Hammer J-2619 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.

#### 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. 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

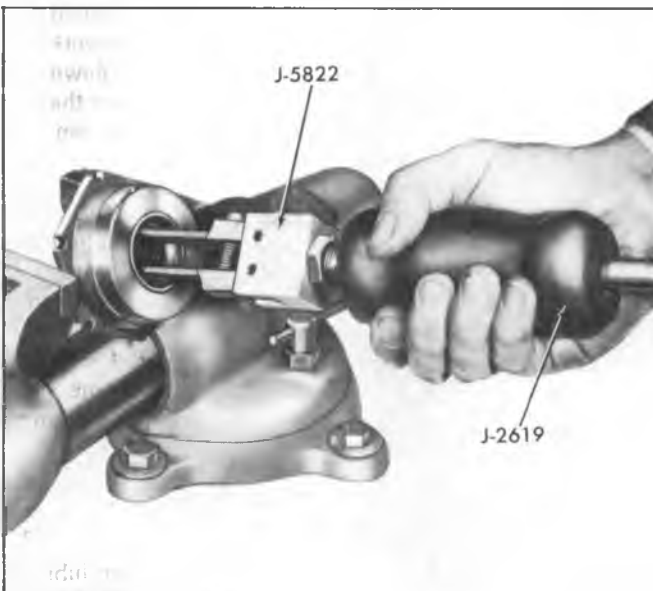


Fig. 9-Removing Adjuster Plug Bearing Race

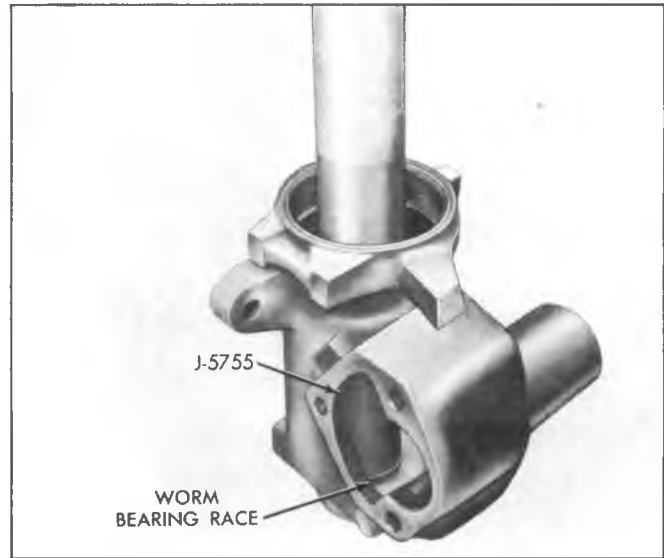


Fig. 10-Installing Wormshaft Bearing Race-Typical

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 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

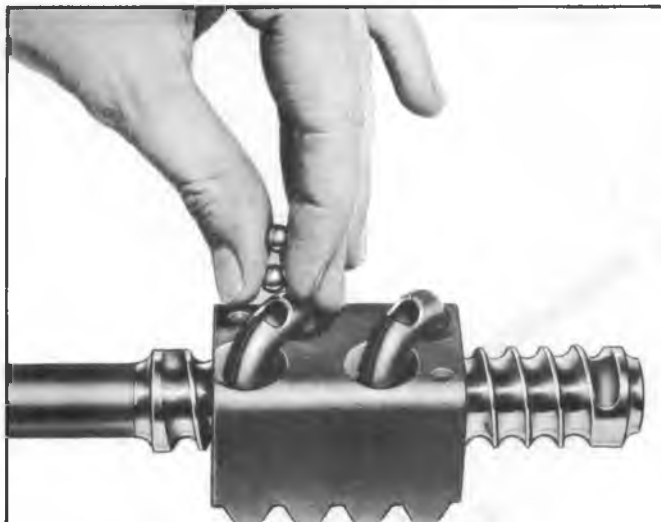


Fig. 11—Filling Ball Circuits—Except Corvette

- 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):**
- 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.

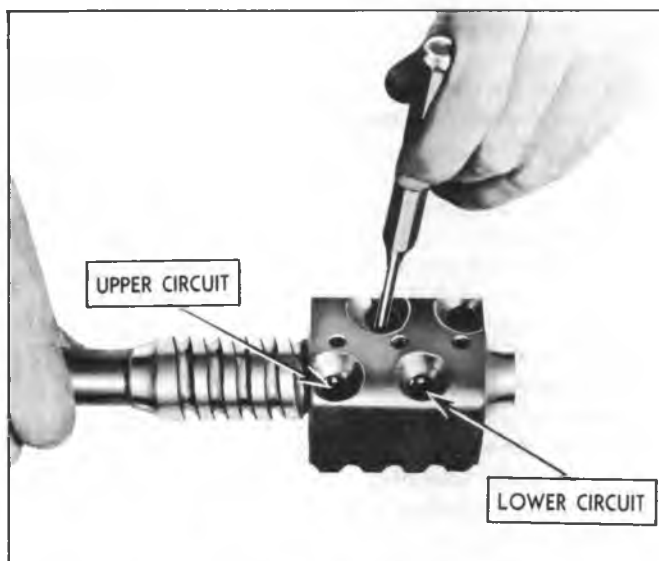


Fig. 12—Filling Ball Circuits—Corvette



Fig. 13—Filling Ball Guides—Corvette

- 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 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.

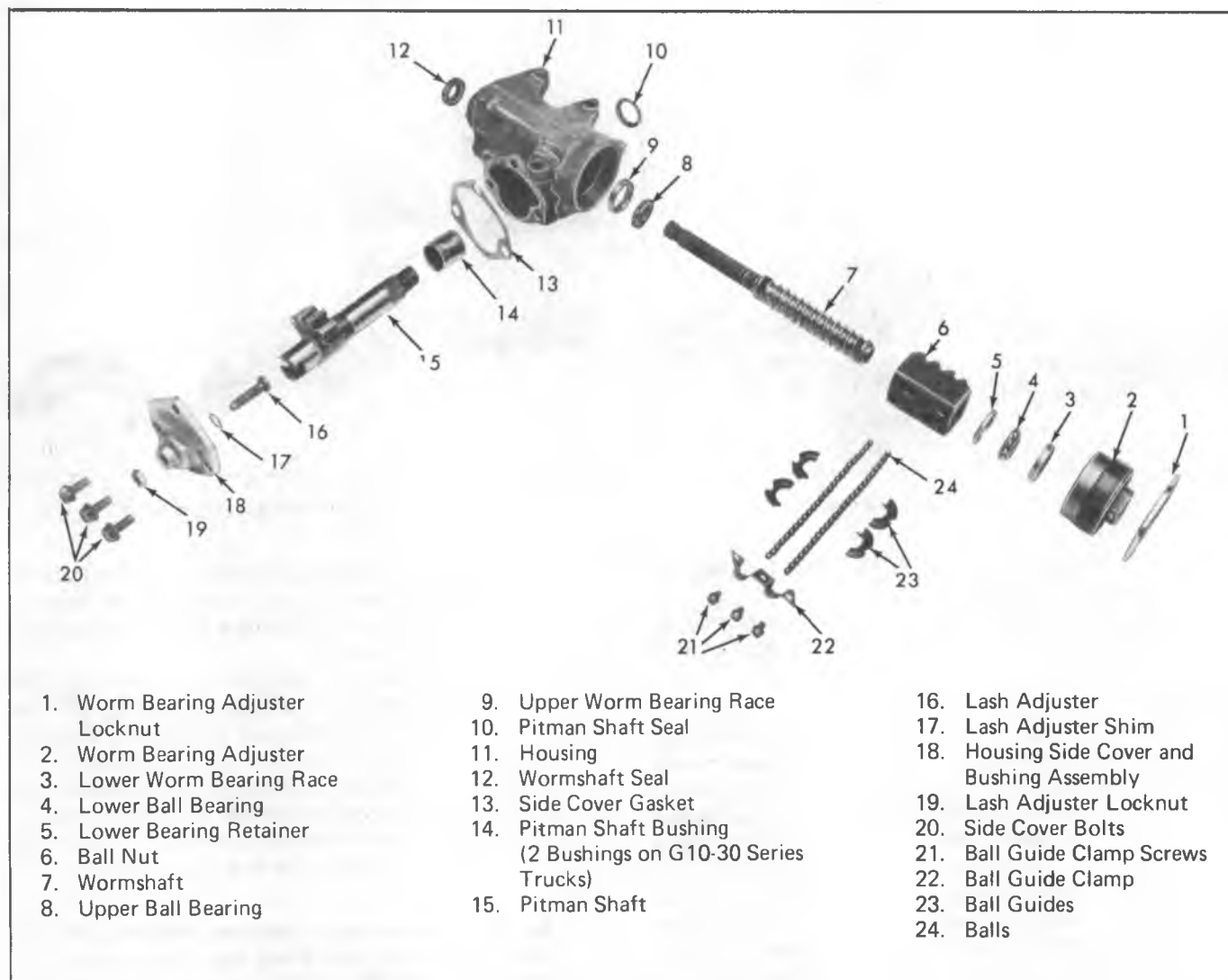


Fig. 14—Steering Gear—Except Corvette

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 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.



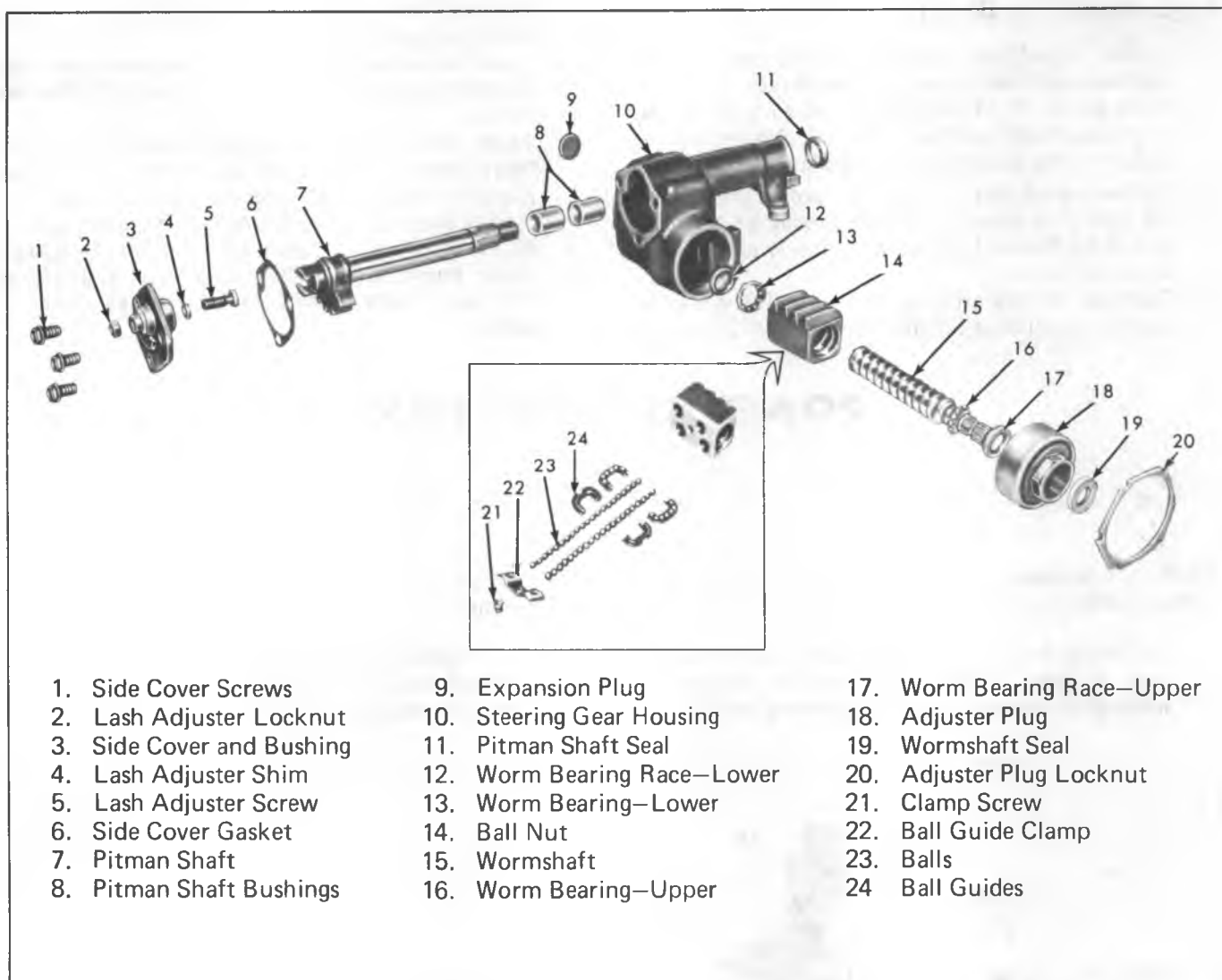


Fig. 15—Steering Gear—Corvette



Fig. 16—Checking Lash Adjuster End Clearance

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 screw and shim but without side cover) into the housing as 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.

## 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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**CAUTION:** If when overhauling a power steering gear or pump, broken components or foreign material are encountered, the remaining compo-

nents of the entire hydraulic system should be disassembled, inspected, thoroughly cleaned and flushed before servicing is completed.

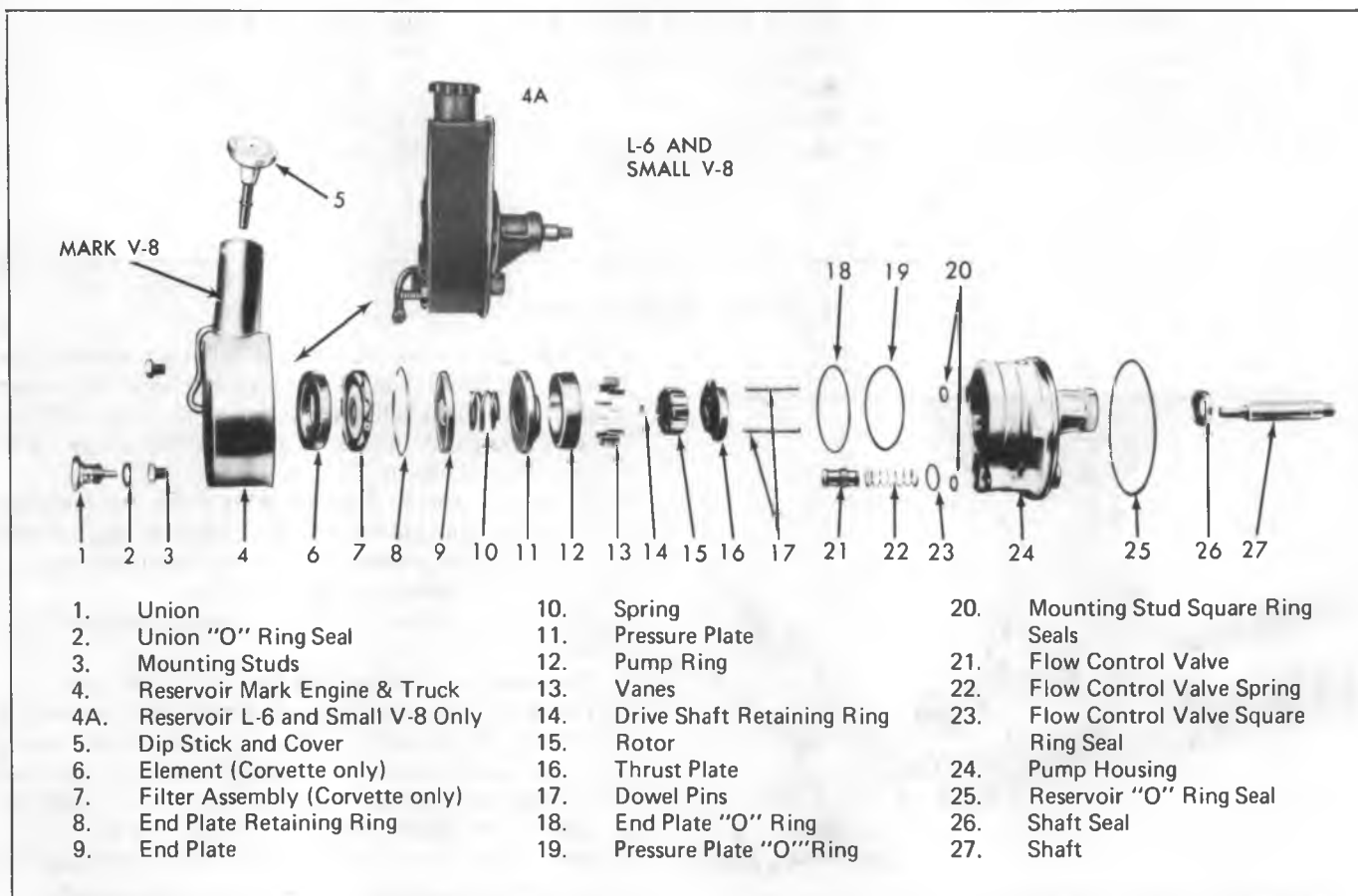


Fig. 17—Power Steering Pump—Exploded View

## OVERHAUL OPERATIONS

### 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 the mounting stud square ring seals and the flow control valve square ring seal and discard.
6. On Corvette, remove filter and filter cage; discard filter element.
7. 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.
8. 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.
9. 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).



Fig. 18—Removing End Plate Ring

10. 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.
11. Remove the end plate and pressure plate "O" rings from the pump housing and discard "O" rings.
12. Remove the dowel pins.
13. Remove the flow control valve and spring assembly.
14. Pry the shaft seal out of the pump housing being 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 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 are flat and parallel with pump ring. Check all of these parts for cracks and 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.

**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.



Fig. 19—Impeller Unit Removal

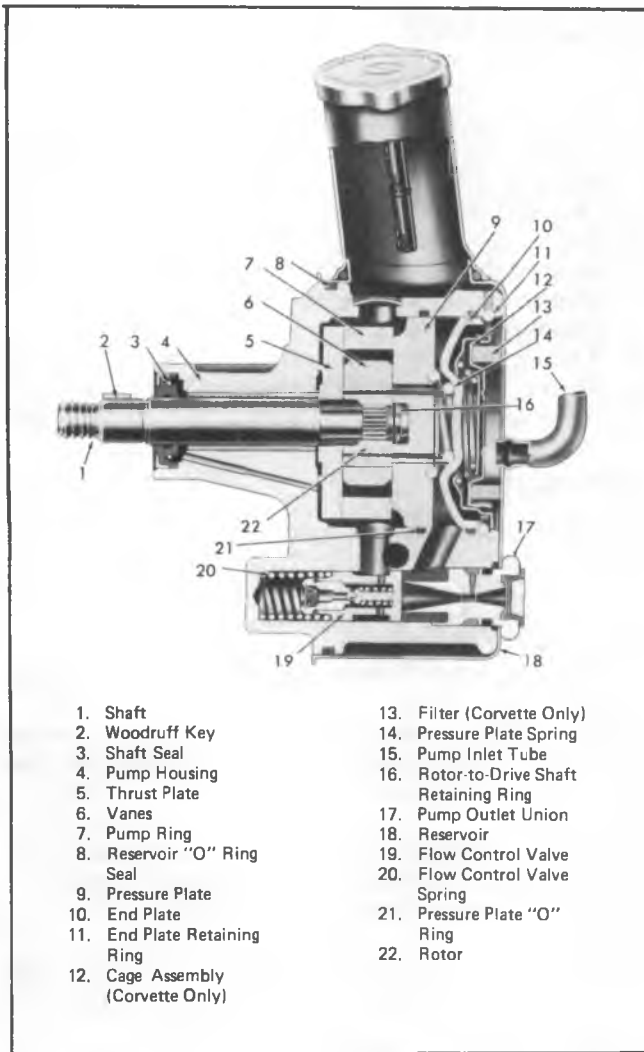


Fig. 20—Power Steering Pump—Typical

7. Always replace all rubber seals and "O" rings when pump is dismantled.
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 may be used as a substitute.

1. Install a new shaft seal in the pump housing, using Tool J- 22670 as shown in Figure 21.



Fig. 21—Installing Seal Using Tool J-22670

2. Install both dowel pins in the pump housing and install a new pressure plate "O" ring lubricated with Power Steering Fluid.
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).

**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.

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.



Fig. 22—Installing Thrust Plate

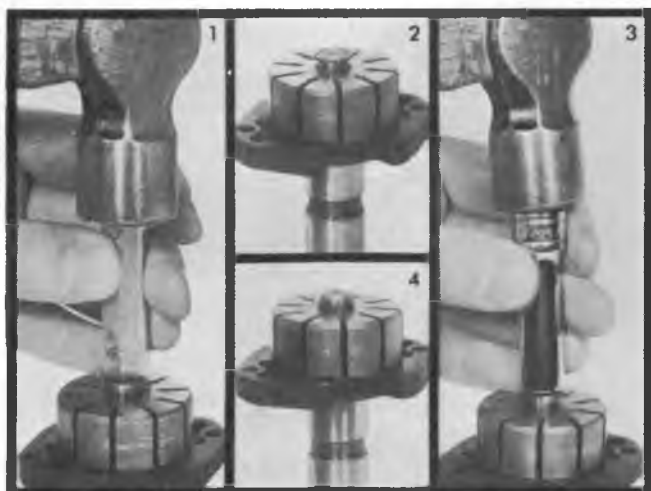


Fig. 23—Installing Shaft Snap Ring



Fig. 26—Installing Vanes

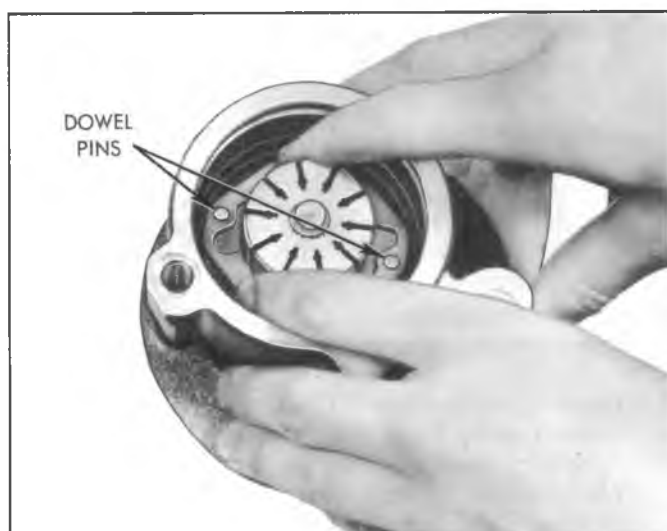


Fig. 24—Installing Shaft, Thrust Plate, and Rotor Assembly

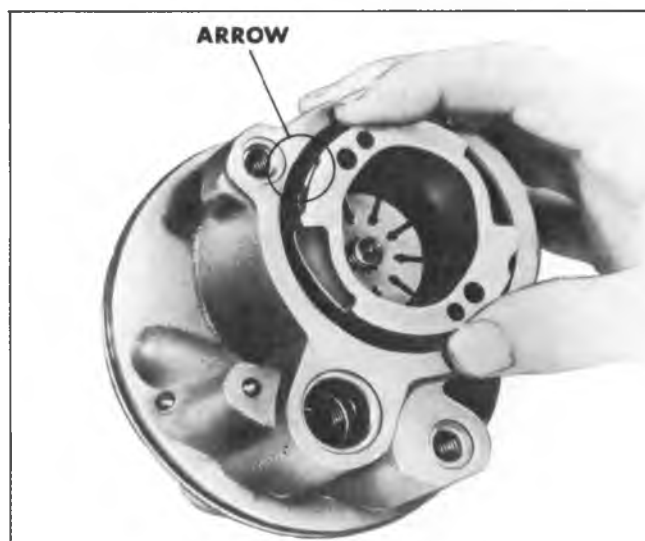


Fig. 25—Installing Pump Ring

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

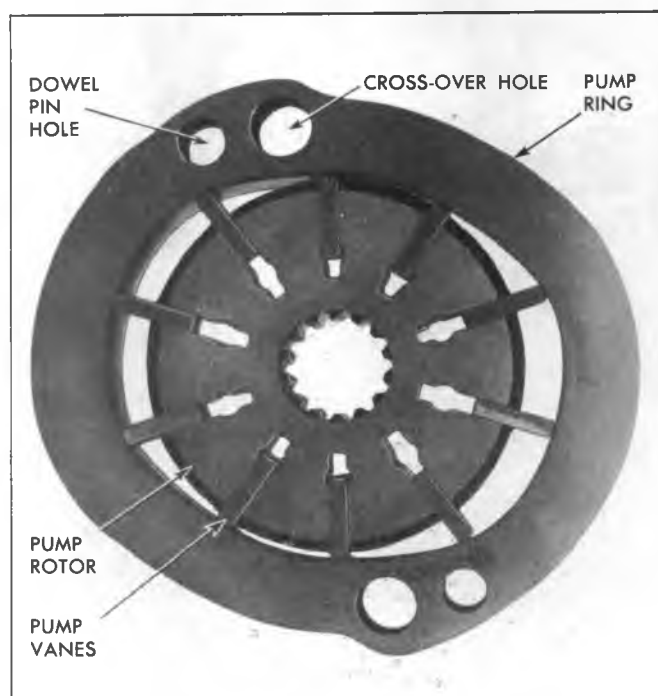


Fig. 27—Correct Vane Assembly



Fig. 28--Installing Pressure Plate Spring

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 da-



Fig. 29--Installing End Plate Retaining Ring



Fig. 30--Installing Flow Control Valve

maging 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. Install new mounting stud and union square ring seals.
16. Install a new reservoir "O" ring seal, lubricated with Power Steering Fluid, onto housing.
17. 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.
18. Place a new "O" ring seal, lubricated with Power Steering Fluid, onto union and install union assembly and studs.
19. Support the drive shaft on the opposite side of the keyway and tap the woodruff key into place.
20. Slide the pulley onto the shaft. Do not hammer on the pulley.
21. Install the pulley nut and torque to 60 ft. lbs.

**CAUTION:** Always use a new pulley nut.



# 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, tap 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.

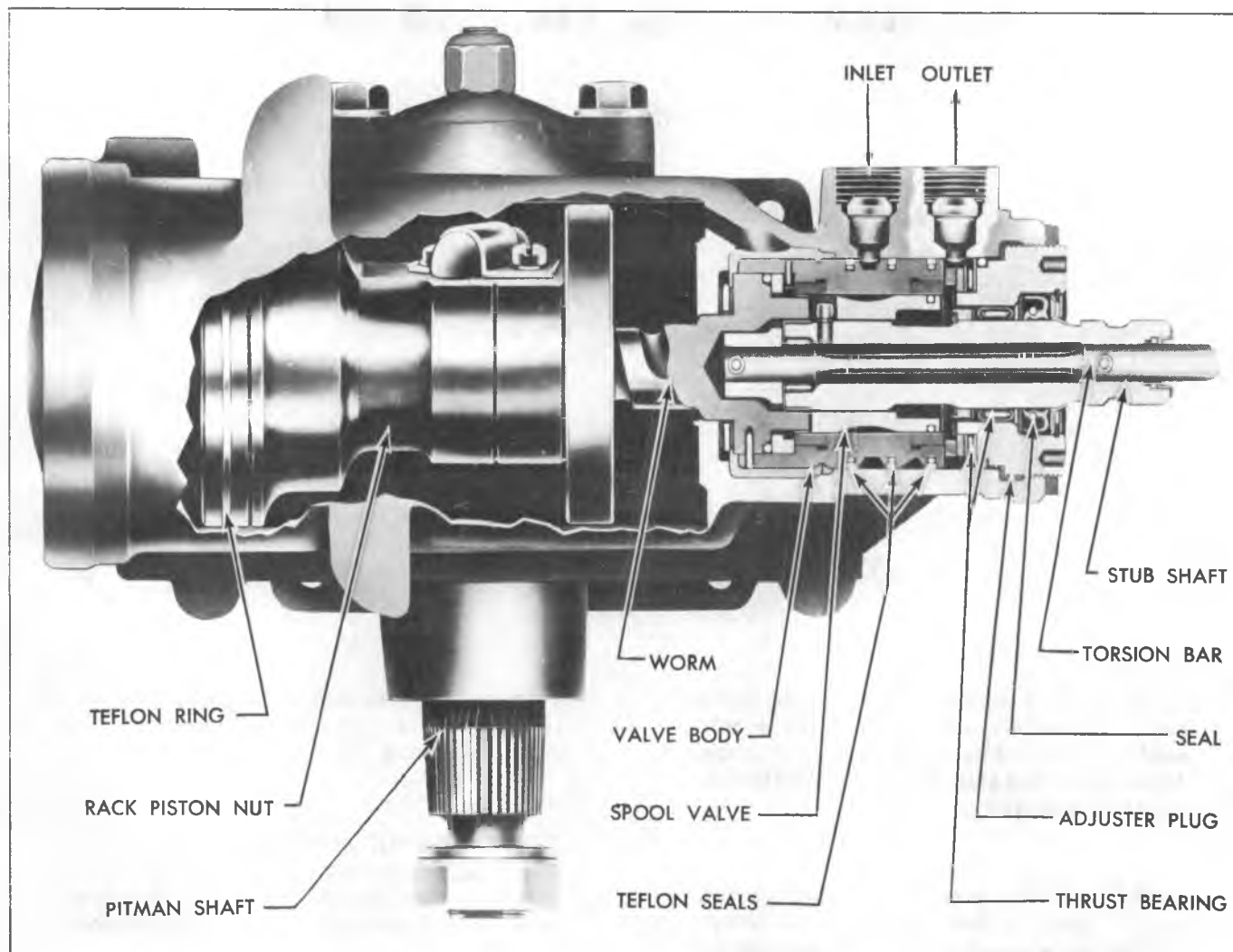


Fig. 31--Power Steering Gear--Typical



Fig. 32--Removing End Cover Retaining Ring

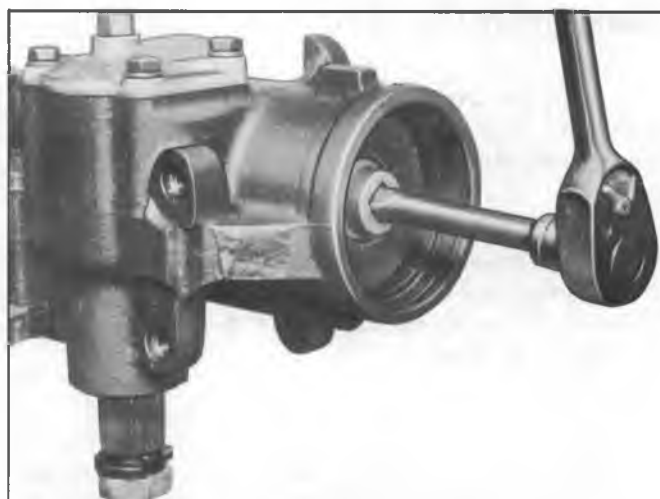


Fig. 33--Removing End Plug

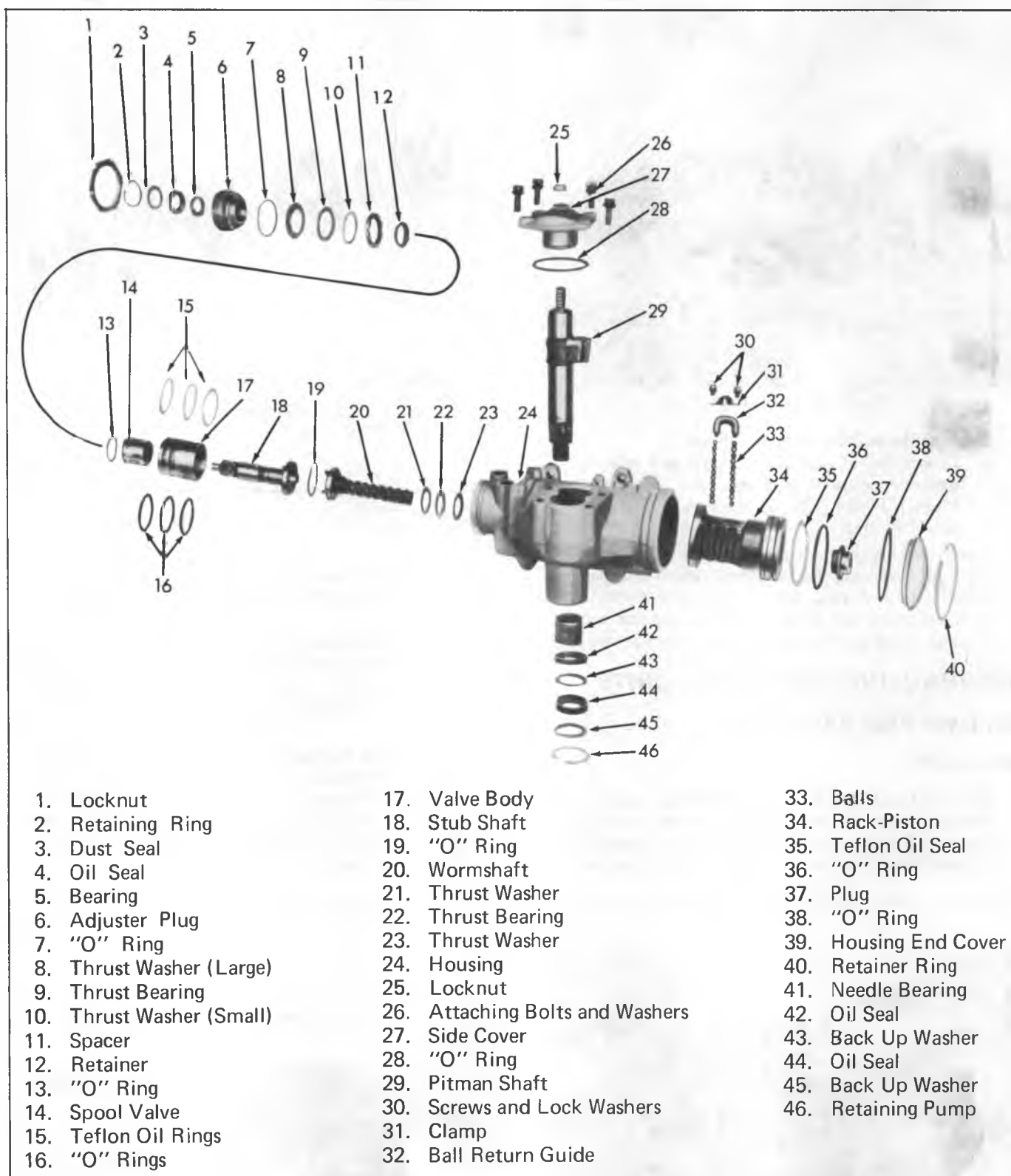


Fig. 34—Power Steering Gear—Exploded View

## 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-clock-

wise 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.



Fig. 35—Removing Rack-Piston

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



Fig. 36—Removing Adjuster Plug

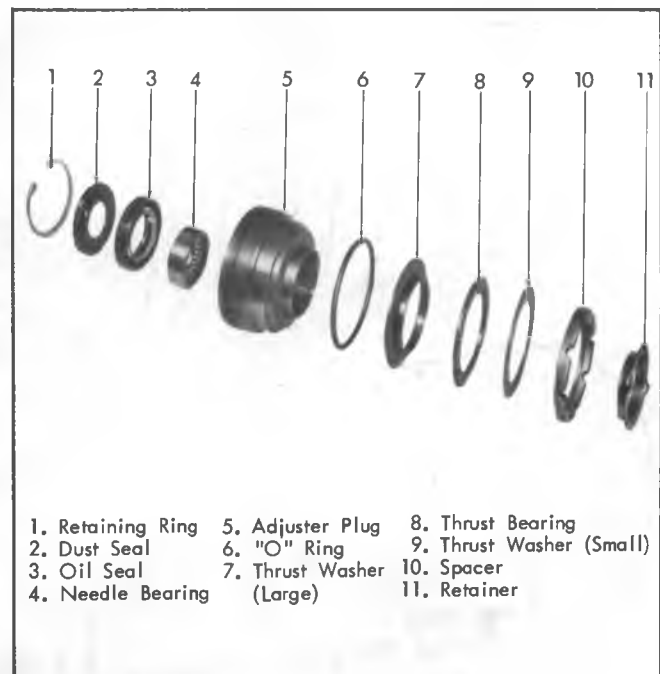


Fig. 37—Adjuster Plug—Exploded View

- seal from the bore of the adjuster plug 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.
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.

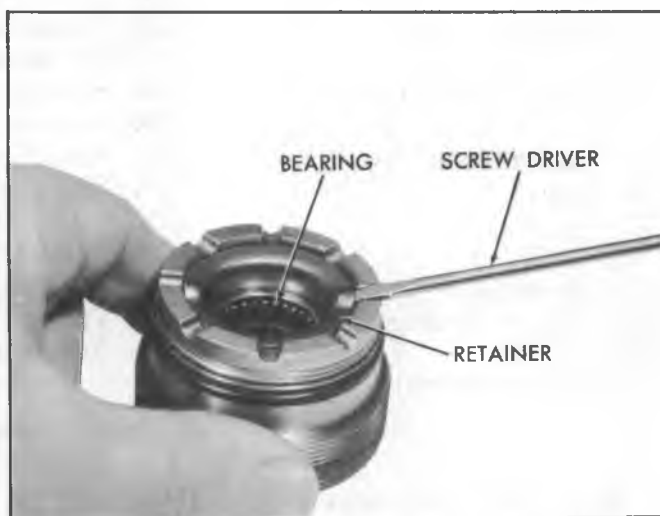


Fig. 38—Removing Retainer

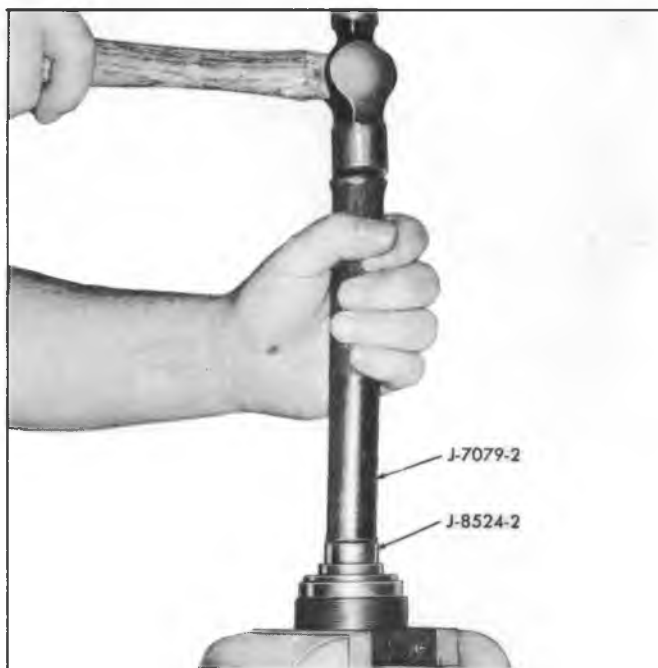


Fig. 39—Removing Bearing and Seal

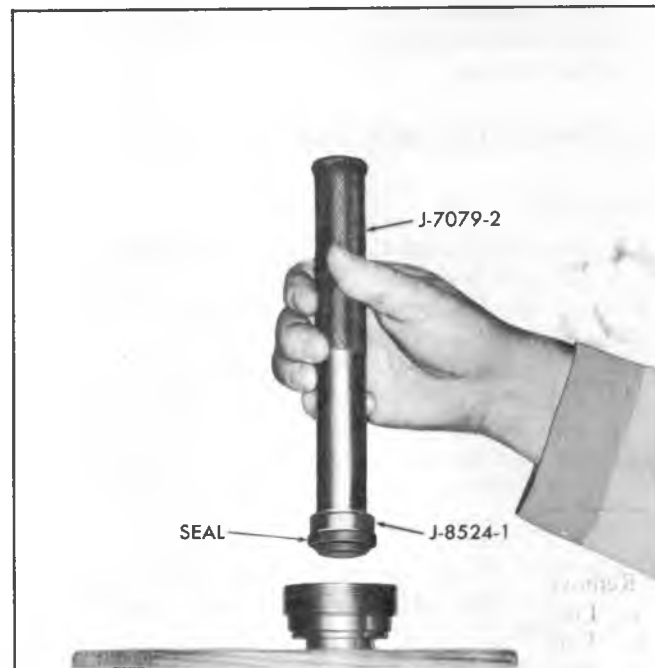


Fig. 41—Installing Adjuster Plug Seal

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 by carefully tapping on the flat surface of the retainer (fig. 42).

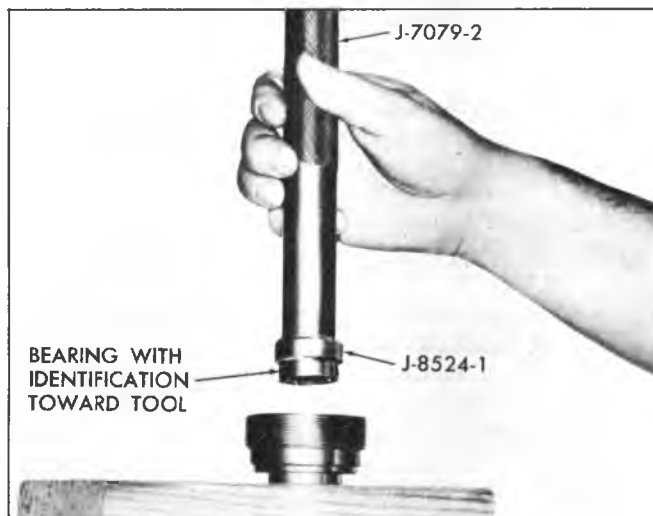


Fig. 40—Installing Bearing



Fig. 42—Installing Retainer

**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), 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, 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.

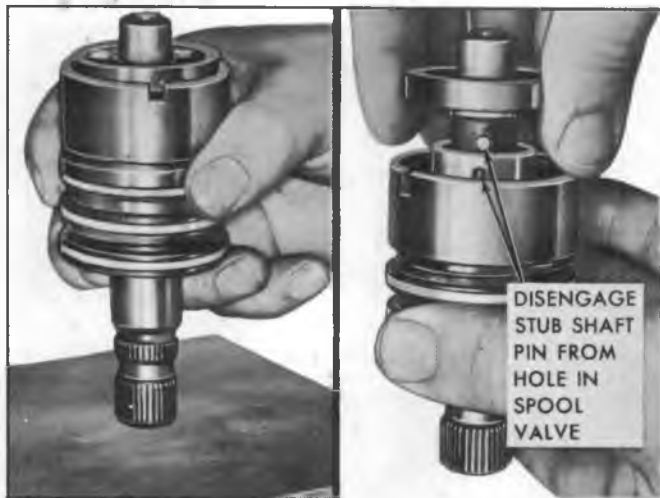


Fig. 43-Removing Stub Shaft Assembly



Fig. 44-Removing Spool Valve

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 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.



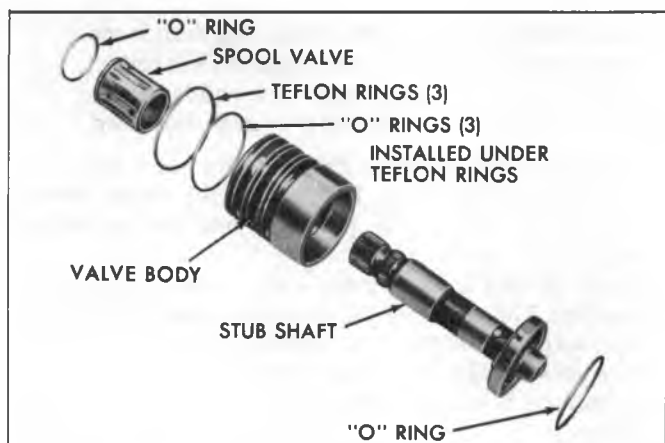


Fig. 45--Valve Body and Shaft Assembly - Explode

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.

## 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.



Fig. 46--Installing Stub Shaft Assembly

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.

### 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. 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.



Fig. 47--Installing Ring on Rack-Piston

## 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.

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.

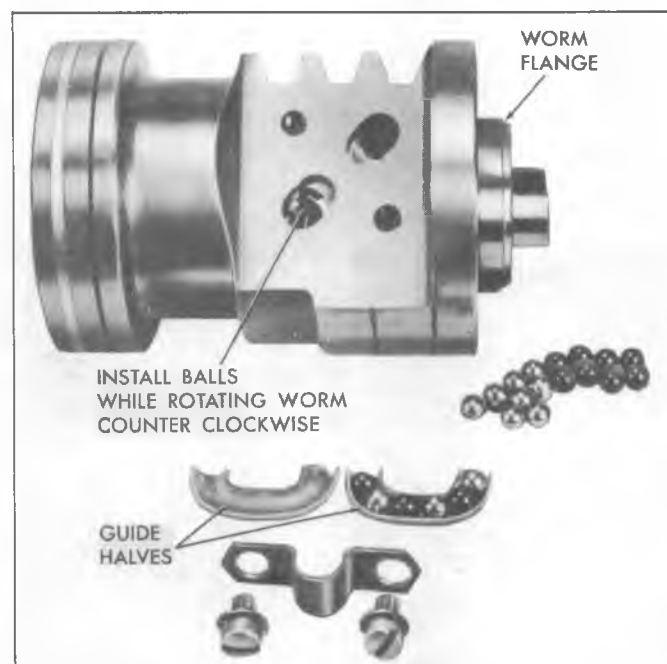


Fig. 48—Installing Balls in Rack-Piston

**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 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 until Tool bottoms on housing. The bearing is now correctly positioned (fig. 51).

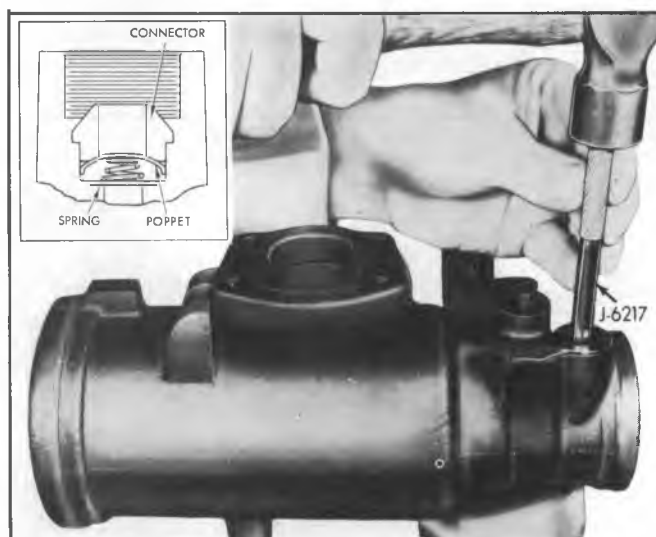


Fig. 49—Installing New Connector in Housing

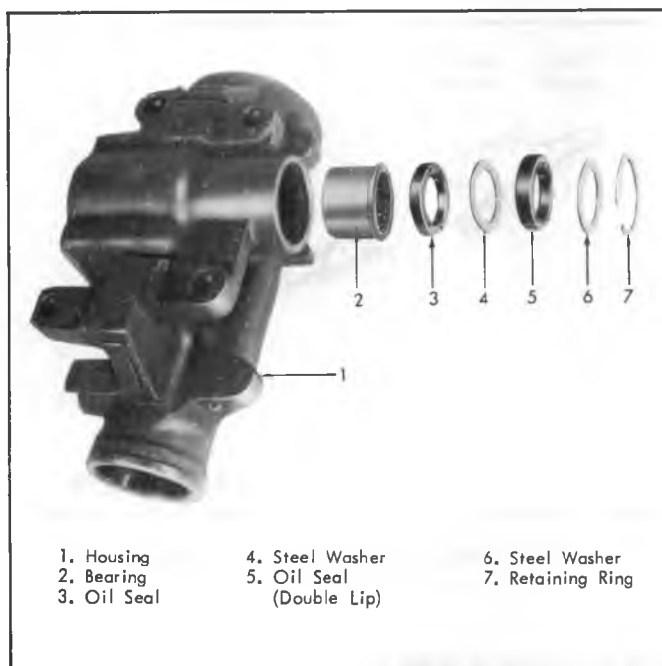


Fig. 50--Pitman Shaft Bearing and Seals

**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 washer, and inner seal with the lips of the seals facing away from the adapter.
  - b. Drive the seals into the housing until the top of Adapter J-6278-2 is flush with the housing (fig. 52).

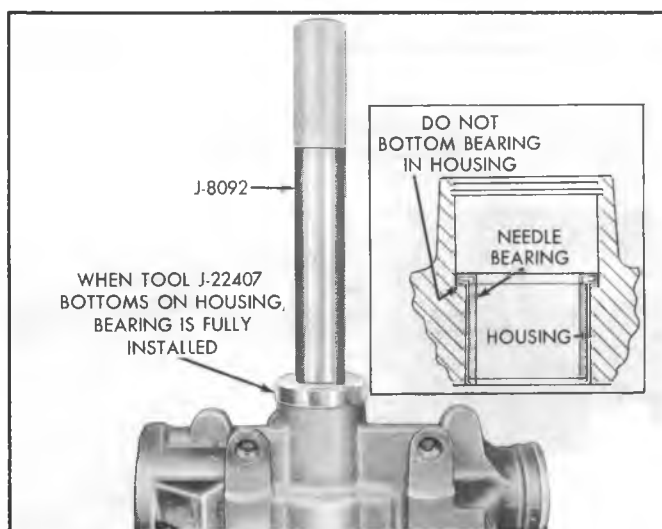


Fig. 51--Installing Pitman Shaft Bearing

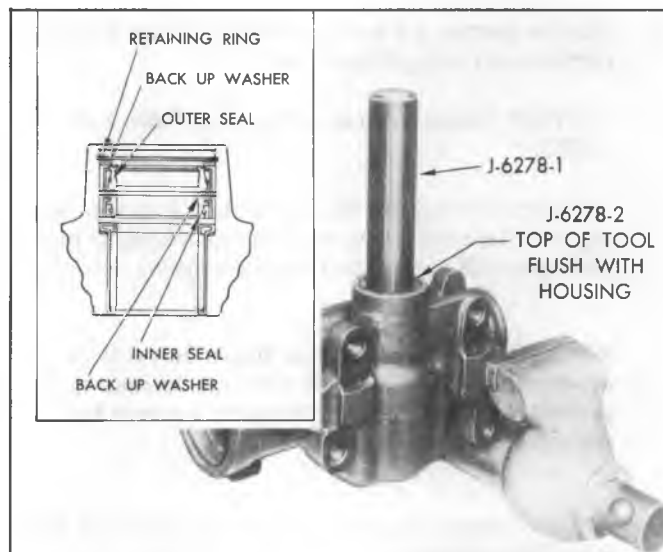


Fig. 52--Installing Pitman Shaft Seals (On Bench)

- 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 often be replaced without removing the gear assembly from the vehicle as follows:

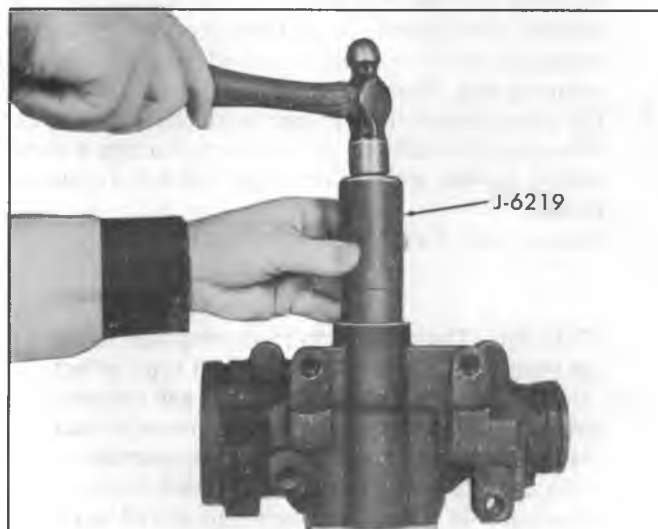


Fig. 53--Installing Pitman Shaft Seals

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.

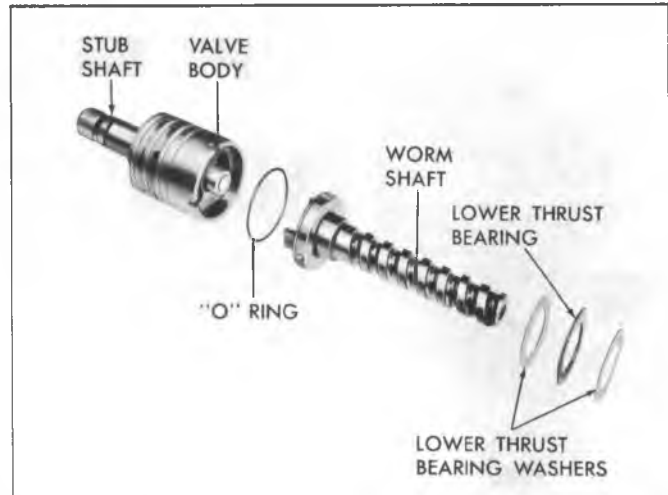


Fig. 54--Worm and Valve Body--Exploded View

## 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).



Fig. 55--Valve to Worm Alignment



Fig. 56—Installing Valve Body

**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. Do not adjust the thrust bearing preload at this time.
4. 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.



Fig. 57—Valve Body Position in Housing

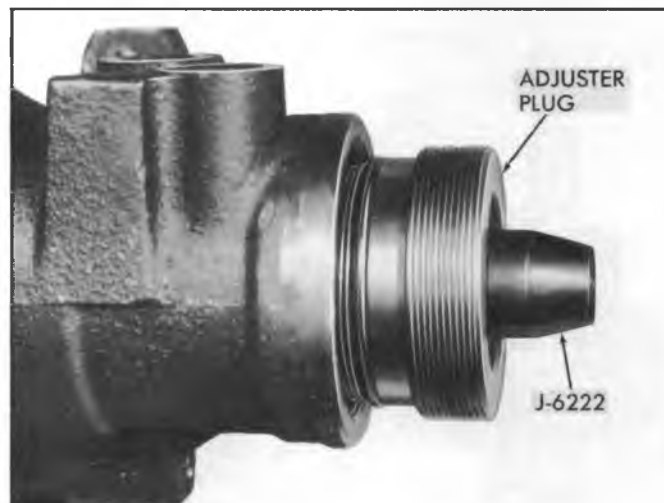


Fig. 58—Installing Adjuster Plug

- 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. 59).
  - d. Turn the stub shaft clockwise with a 3/4" twelve point 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).
5. 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.

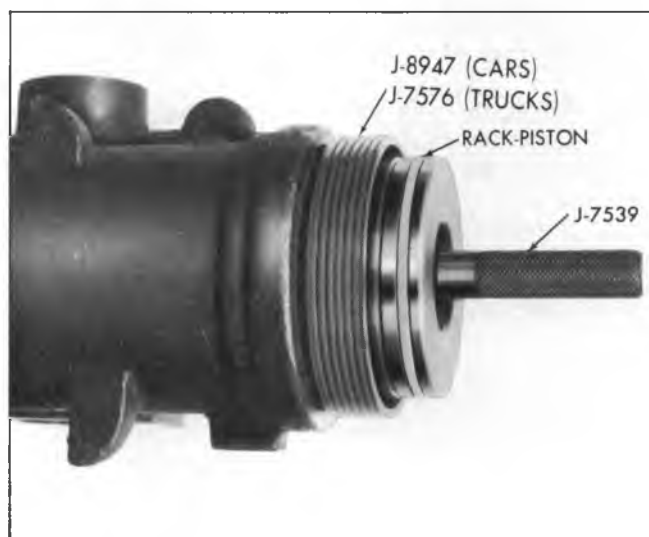


Fig. 59—Installing Rack-Piston

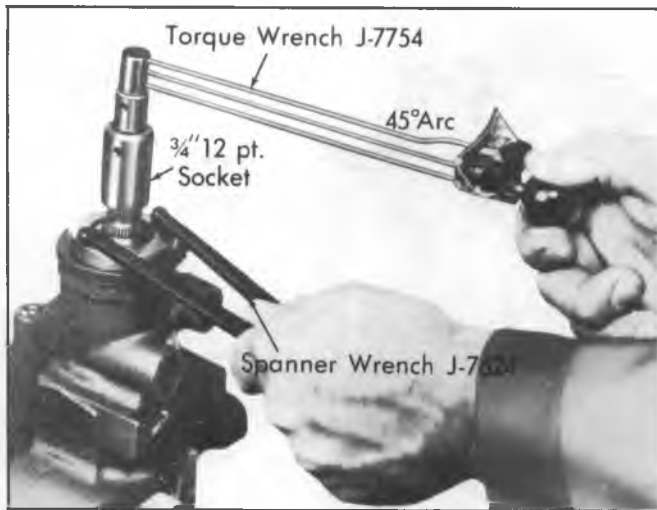


Fig. 60—Adjusting Thrust Bearing Preload

- c. Install the side cover bolts and lock washers and tighten to 30 ft. lbs.
6. Install the rack-piston plug in the rack-piston and torque to 75 ft. lbs.
7. Install a new housing end cover "O" ring and lubricate it with Power Steering Fluid. Install the end cover and retaining ring.
8. Adjust the thrust bearing preload as follows:
  - a. Using Spanner Wrench J-7624, tighten adjuster plug up snug (clockwise). Back adjuster plug off 1/8 turn and measure valve drag.
  - b. Adjust thrust bearing preload to obtain approximately 2 in. lbs. in excess of seal drag. Tighten adjuster plug locknut securely while holding adjuster plug in position with Tool J-7624.
9. Adjust the over-center preload 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 screw until the torque wrench reads 3-6 in. lbs. higher than

the reading noted in Step c. The total reading should not exceed 14 in. lb.

- e. While holding the adjusting screw, tighten the locknut to 25 ft. lbs. using Adapter J-5860 (fig. 60) and recheck the adjustment.

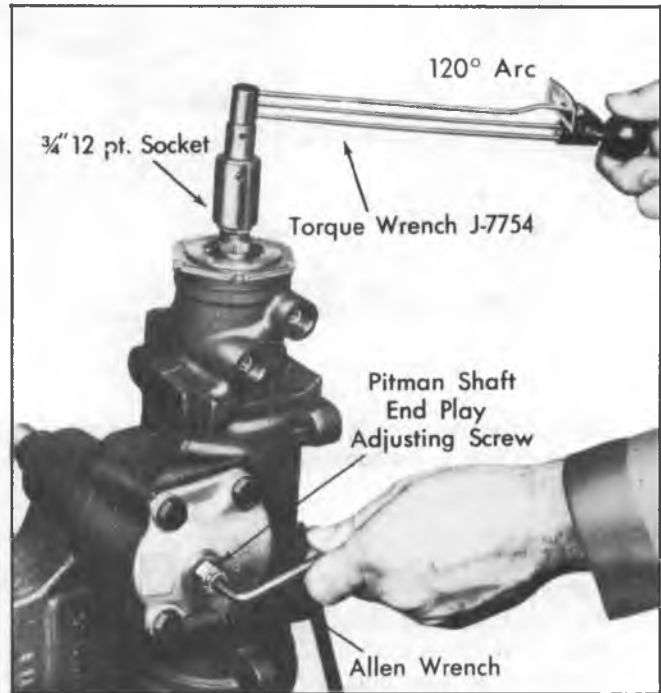


Fig. 61—Adjusting Over Center Preload

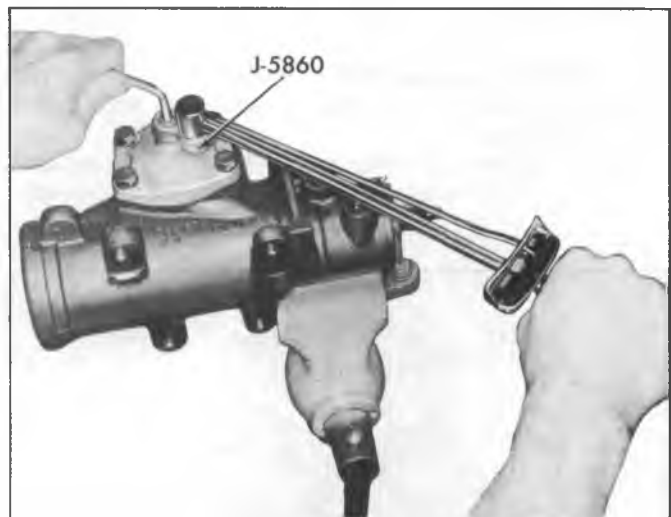


Fig. 62—Torquing Over-Center Locknut



# CONTROL VALVE CORVETTE

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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).
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 55 lb. centering spring. The Corvette valve incorporating this spring is identified by an "X" 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).

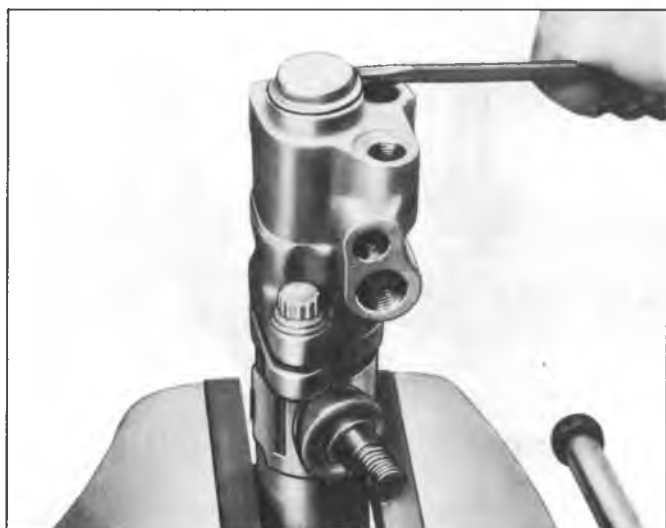


Fig. 63—Dust Cap Removal



Fig. 64—Removing Adjusting Nut



Fig. 65--Removing Spool from Housing



Fig. 67--Removing Plug-to-Sleeve Key

### 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 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.



Fig. 66--Removing Valve Parts from Shaft

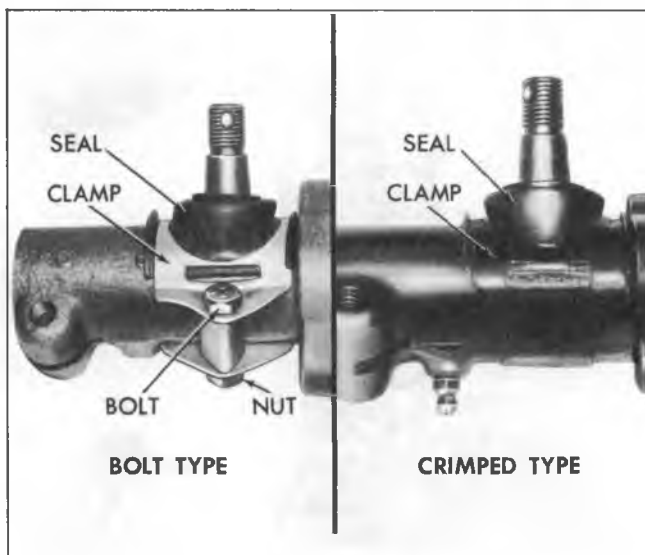


Fig. 68--Seal with Clamp Attachment



Fig. 69--Turning Adjuster Plug out of Sleeve

### 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 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.

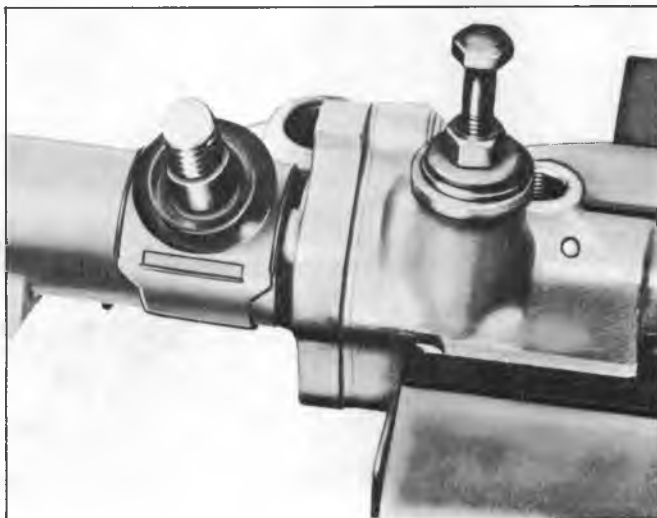


Fig. 70--Removing Connector Seat

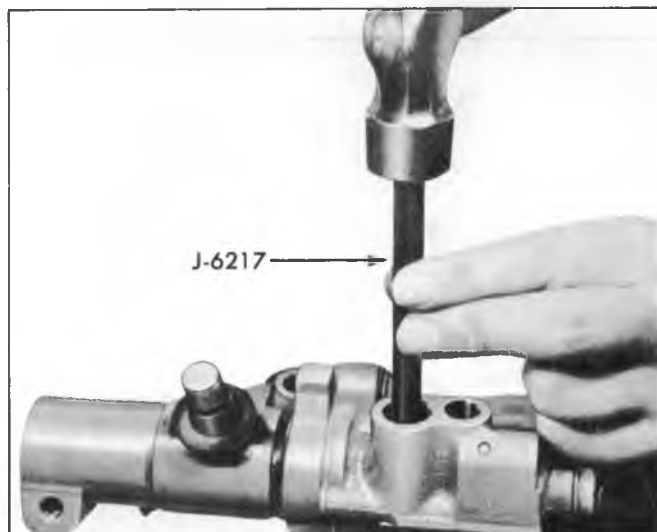


Fig. 71--Installing Connector Seat

- 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.



Fig. 72--Replacing Adjuster Plug and Shaft

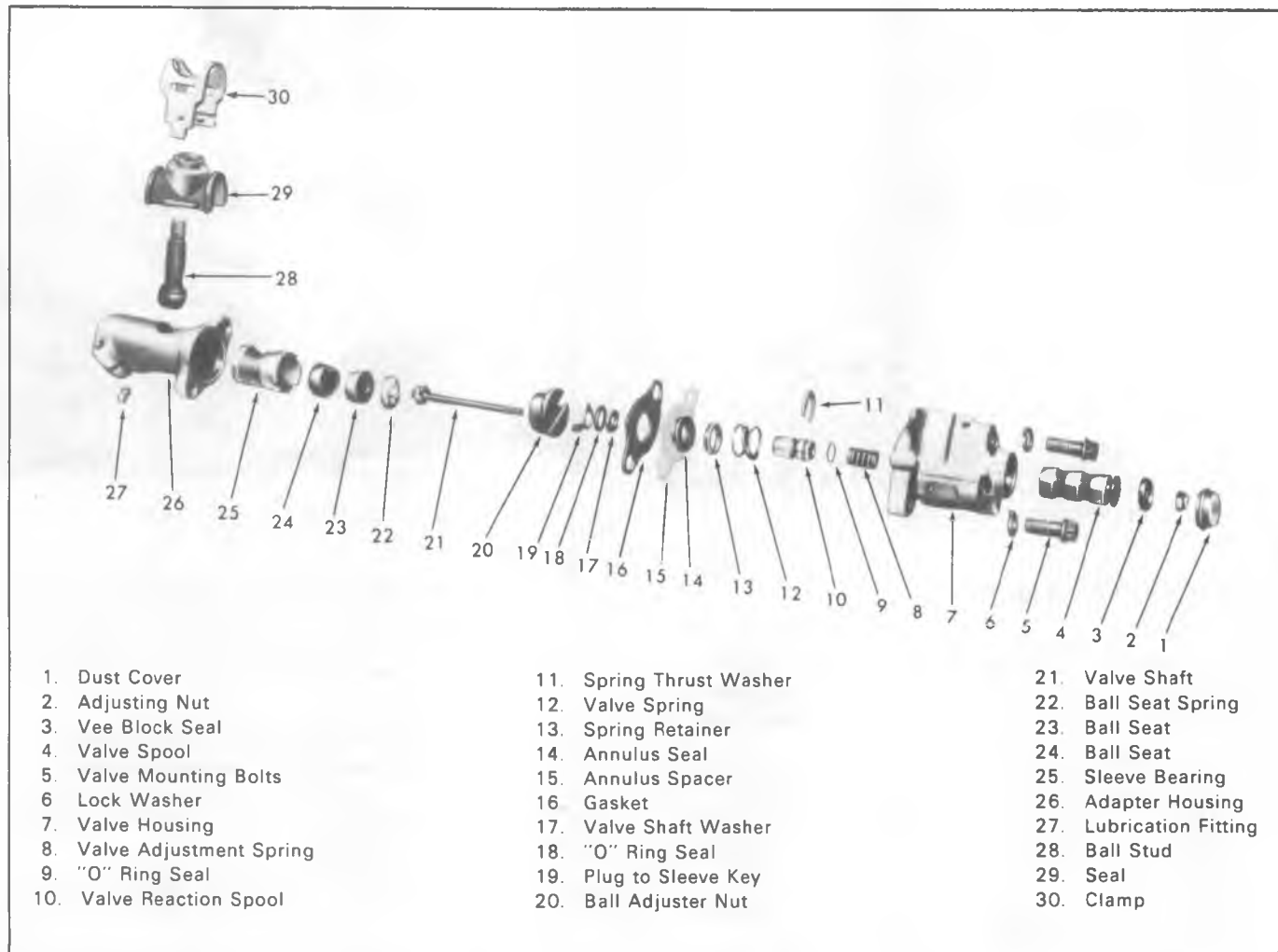


Fig. 73--Power Steering Control Valve and Adapter--Exploded



Fig. 74--Proper Key Installation



Fig. 75--Balancing Valve

## 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.

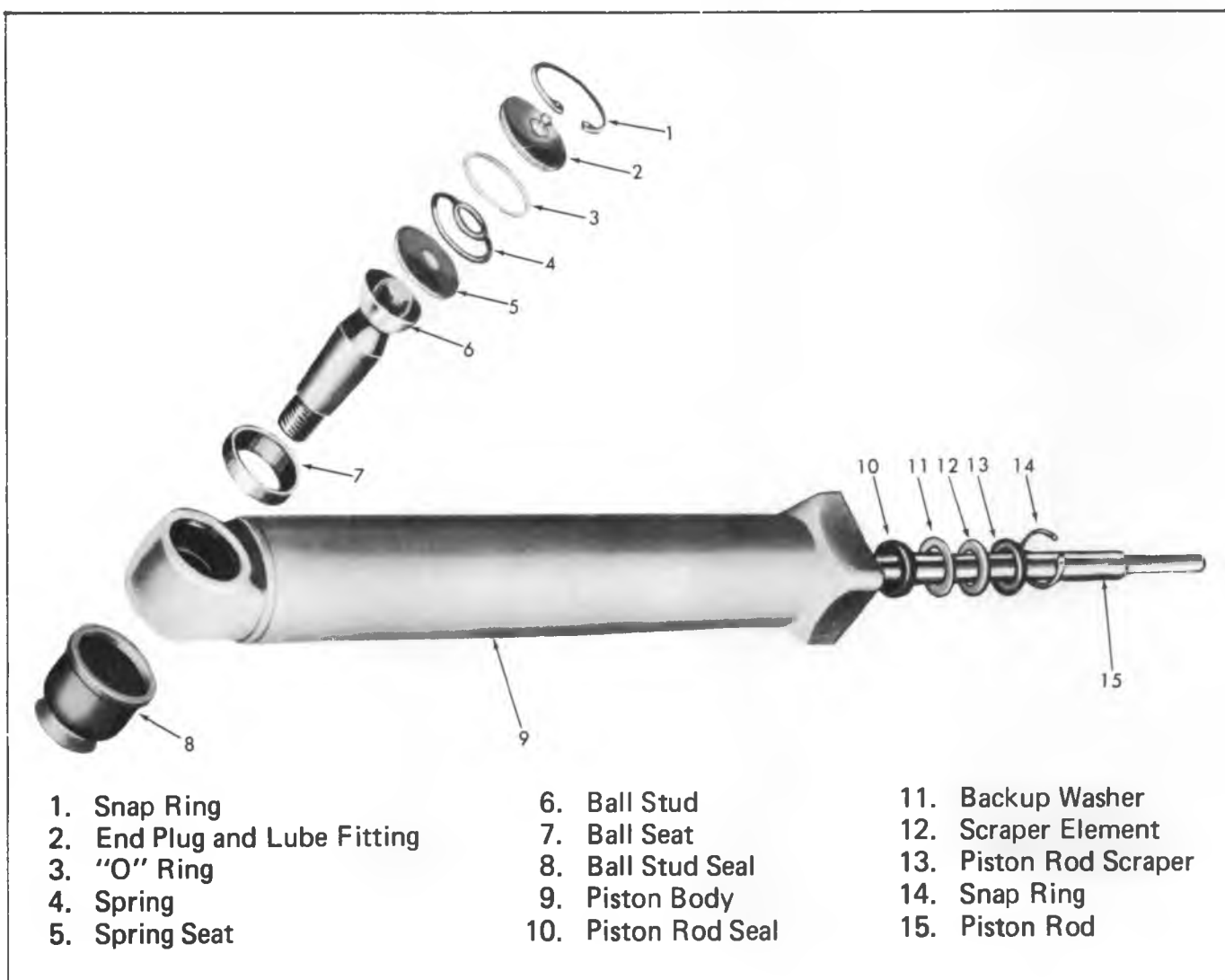


Fig. 76--Power Steering Power Cylinder Explode

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,

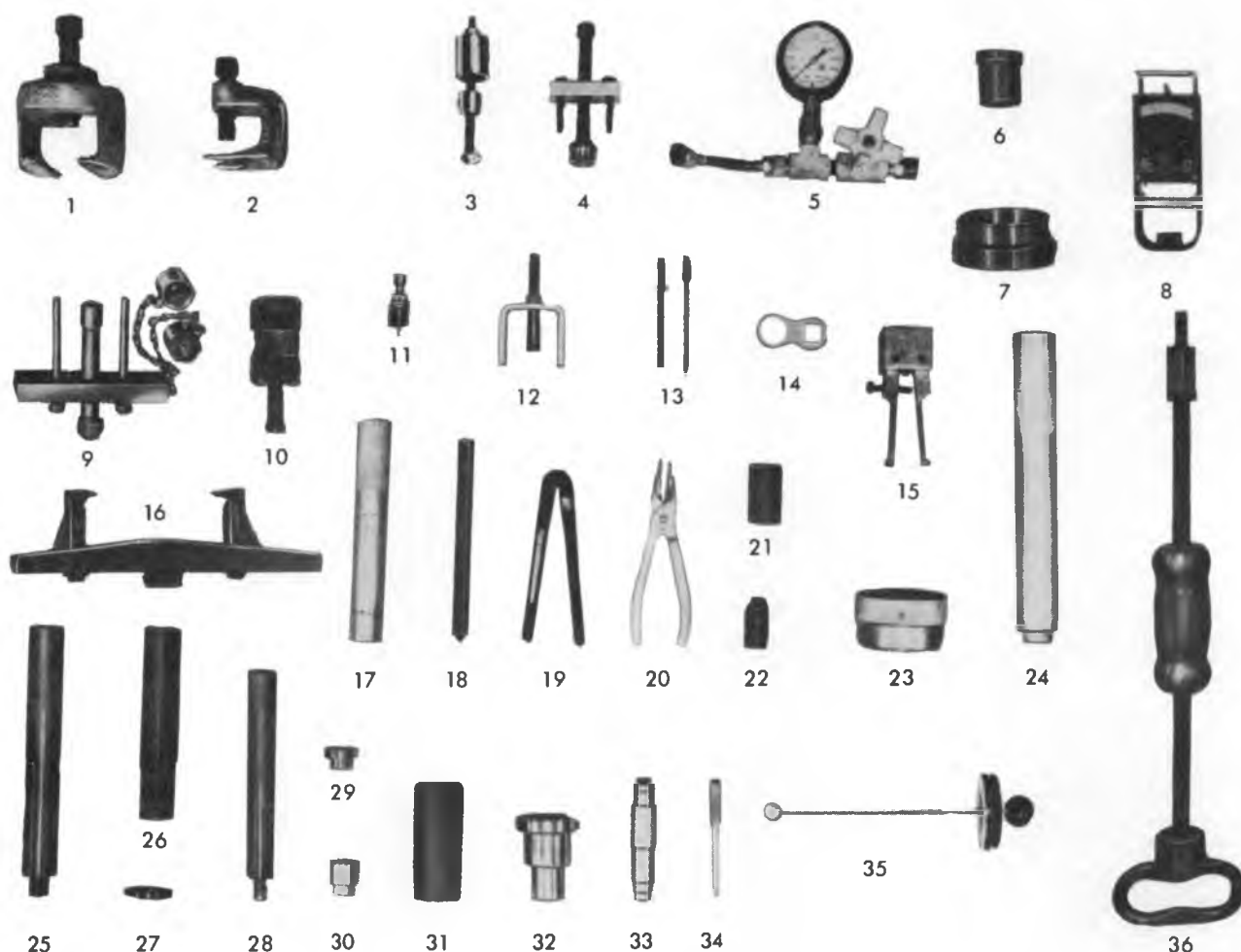
or transmission fluid bearing the mark DEXRON, on the inner surfaces of the seal and scraper before assembly.

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.**



## SPECIAL TOOLS



- |             |                                       |              |                                  |
|-------------|---------------------------------------|--------------|----------------------------------|
| 1. J-6632   | Pitman Arm Puller                     | 18. J-7539   | Ball Retainer                    |
| 2. J-5504   | Pitman Arm Puller                     | 19. J-7624   | Spanner Wrench                   |
| 3. J-23073  | Shift Tube Installer                  | 20. J-4245   | No. 23 Internal Pliers           |
| 4. J-23072  | Shift Tube Remover                    | 21. J-22670  | Pump Shaft Seal Installer        |
| 5. J-5176   | Oil Pressure Gauge                    | 22. J-6222   | Shaft Seal Protector             |
| 6. J-9226   | Pitman Shaft Bushing Replacer (Truck) | 23. J-8947   | Rack-Piston Seal Compressor      |
| 7. J-7576   | Rack-Piston Seal Compressor (Truck)   | 24. J-5755   | Wormshaft Bearing Race Installer |
| 8. J-23600  | Belt Tension Gauge                    | 25. J-8092   | Handle                           |
| 9. J-2927   | Steering Wheel Puller                 | 26. J-6278   | Pitman Shaft Bearing Remover     |
| 10. J-21239 | Pump Pulley Remover (Stamped Pulley)  | 27. J-6278-2 | Pitman Shaft Seal Installer      |
| 11. J-21854 | Column Pivot Pin Remover              | 28. J-7979-2 | Handle                           |
| 12. J-23653 | Lock Plate Compressor                 | 29. J-8524-1 | Adjuster Plug Bearing Installer  |
| 13. J-5421  | Thermometer                           | 30. J-8524-2 | Adjuster Plug Bearing Remover    |
| 14. J-5860  | Torque Wrench Adapter                 | 31. J-6219   | Pitman Shaft Seal Installer      |
| 15. J-5822  | Wormshaft Bearing Race Remover        | 32. J-22407  | Pitman Shaft Bearing Installer   |
| 16. J-8433  | Pump Pulley Remover (Cast Pulley)     | 33. J-6217   | Connector Seat Installer         |
| 17. J-1614  | Pitman Shaft Bushing Remover          | 35.          | Torque Wrenches                  |
|             |                                       | 36. J-2619   | Slide Hammer                     |

Fig. 77-Manual and Power Steering Special Tools--Passenger Car

POL



# PASSENGER CAR SPECIFICATIONS

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## SECTION 1

### HEATER AND AIR CONDITIONING

#### HEATER

	Volts	Amps (Cold)	RPM (Cold)
<b>Blower Motor</b> . . . . .	13.5	6.25 Max.	2550 Min. 2950 Max.
<b>Fuses</b>			
Fuse Block . . . . .			25 Amp.

#### AIR CONDITIONING

<b>Compressor</b>	
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

<b>Compressor Clutch Coil</b>	
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 . . . . .	15 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., 4 oz.
525 Viscosity Compressor Oil	
All Systems. . . . .	11 Fluid oz.

	Volts	Amps (Cold)	RPM (Cold)
<b>Blower Motor</b>			
Four-Season and Comfortron. . . . .	12	16.5 Max.	3700 Min.

	Fuse Block	In Line
<b>Fuses</b>		
Four-Season . . . . .	25 amp	30 amp
Comfortron . . . . .	25 amp	30 amp

## SECTION 1B

### CORVETTE BODY

#### SPECIFICATIONS

	Torque		Torque
Body Mounting Bolts . . . . .	45 ft. lbs.	Lap Belt Inboard Attachment Bolt . . . . .	40 ft. lbs.
Door Lock-Striker Bolt . . . . .	45 ft. lbs.	Inboard Lap Belt Mounting Restraining Cable Attaching Nut . . . . .	30 ft. lbs.
Side Door Wedge Pin Housing . . . . .	70 in. lbs.	Seat to Adjuster Screw . . . . .	150 in. lbs.
Side Door Wedge Pin Housing Bracket . . . . .	70 in. lbs.	Seat Adjuster to Floor Screw . . . . .	150 in. lbs.
Retractor Mounting Bolt-Shoulder Belt . . . . .	35 ft. lbs.		
Retractor Mounting Bolt-Seat Belt . . . . .	40 ft. lbs.		

# FRONT SUSPENSION

## SECTION 3 BOLT TORQUES

	Chevrolet	Chevelle and Monte Carlo	Nova	Camaro	Corvette
Ball Joint Stud Nut					
Upper Stud	*50 ft. lbs.	*50 ft. lbs.	*50 ft. lbs.	*50 ft. lbs.	*50 ft. lbs.
Lower Stud	*90 ft. lbs.	*80 ft. lbs.	*80 ft. lbs.	*80 ft. lbs.	*90 ft. lbs.
Joint to Upper Arm (Service Replacement)	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.
Steering Arm Nuts	—	70 ft. lbs.	70 ft. lbs.	—	70 ft. lbs.
Control Arm Pivot to Frame					
Upper	85 ft. lbs.	55 ft. lbs.	50 ft. lbs.	80 ft. lbs.	55 ft. lbs.
Lower	110 ft. lbs.	85 ft. lbs.	85 ft. lbs.	85 ft. lbs.	See Below
Upper Control Arm Shaft Nuts/Bolts	60 ft. lbs.	40 ft. lbs.	40 ft. lbs.	60 ft. lbs.	60 ft. lbs.
Shock Absorber					
Upper End	100 in. lbs.	100 in. lbs.	100 in. lbs.	100 in. lbs.	100 in. lbs.
Lower End	20 ft. lbs.	20 ft. lbs.	20 ft. lbs.	20 ft. lbs.	150 in. lbs.
Stabilizer Bar					
Link Nuts	13 ft. lbs.	13 ft. lbs.	18 ft. lbs.	13 ft. lbs.	20 ft. lbs.
Bracket Bolts	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.	120 in. lbs.
Lower Control Arm Shaft to Crossmember					
Front	—	—	—	—	70 ft. lbs.
Rear	—	—	—	—	95 ft. lbs.
Anchor Pin Drum Brakes	—	130 ft. lbs.	130 ft. lbs.	—	—
Mounting Bolts Disc Brake Caliper	35 ft. lbs.	35 ft. lbs.	35 ft. lbs.	35 ft. lbs.	120 ft. lbs.
Wheel Stud Nuts	70 ft. lbs.	70 ft. lbs.	70 ft. lbs.	70 ft. lbs.	75 ft. lbs.
Wheel Bearing Adjustment	12 ft. lbs.	12 ft. lbs.	12 ft. lbs.	12 ft. lbs.	12 ft. lbs.
Preload	Zero	Zero	Zero	Zero	Zero
End Movement	.001 to .008	.001 to .008	.001 to .008	.001 to .008	.001 to .008

\*Plus additional torque to align cotter pin hole.

NEVER back off to align cotter pin.

## TRIM HEIGHTS

The following procedure should be followed before making any trim height measurement.

### 1. "Z" Dimension

- 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 three times. Measure the "Z" height in the settled position after the third lift.
- 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 three times. Measure the "Z" height in the settled position after the third push down.
- The true "Z" height is the average of (a) and (b) for each side.

### 2. "D" Dimension

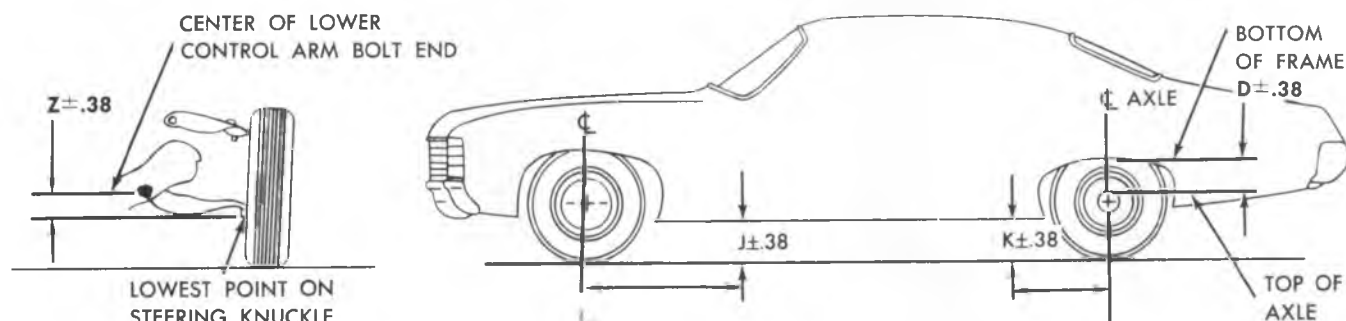
NOTE: Follow the same pattern as stated above for the "Z" dimension when measuring the "D" dimension except: lift and push on the rear bumper.

### 3. "J" & "K" Dimensions

- Jostle the front of the car up and down three times by lifting the vehicle up approximately 1-1/2" at the front bumper and immediately push vehicle down approximately 3" from the raised position raising up 3" and repeating the cycle three times.
- Jostle the rear of the car three times by applying the same procedure to the rear bumper as used on the front in (3a).
- Repeat the jostling of front a second time.
- Measure the "J" and "K" dimensions in the settled position.

DIMENSIONS "Z", "J", "K" & "D" VERTICAL TO GROUND AND APPLY TO REG. PROD. WITH P/S, P/B AND RADIO

		Z	J	K	D
	Tires	Curb	Curb	Curb	Curb
CHEVROLET MODELS Coupes, Sedans and Convertible with V-8 Engines (Exc. 116" W.B. Wag.)	F-78	3.13	9.62	9.56	6.24
	G-78		9.78	9.73	
	H-78		10.06	10.02	
	F-78		9.65	9.58	
Coupes, Sedans with L-6 Engines	F-78	2.90	10.28	10.21	5.74
Wagon 2-Seat (125" W.B.)	L-78				
Wagon 3-Seat (125" W.B.)	L-78				
Wagon 2-Seat (116" W.B.)	G-78	2.66	11.09	11.32	6.13
Wagon 3-Seat (116" W.B.)	G-78				
CHEVELLE MODELS Sedans	E-78	2.20	10.00	10.00	5.16
	F-78		10.20	10.20	
Coupe and Convertible	E-78	2.18	10.00	10.00	5.17
	F-78		10.22	10.24	
SS Coupe and Convertible	F-60	2.23	10.00	10.00	5.17
Pick-Up	E-78, F-78	2.63	10.57	10.69	5.88
SS Pick-Up	F-60		10.69	10.81	
MONTE CARLO	G-78	1.64	10.31	10.30	4.69
	G-70		10.22	10.21	
CHEVELLE MODELS w/F-40 Suspensions Sedan	E-78	2.20	10.00	10.00	5.16
	F-78		10.20	10.20	
Coupe and Convertible	E-78	2.18	10.00	10.00	5.17
	F-78		10.22	10.24	
Pick-Up	F-78	2.63	10.67	10.69	5.88
SS Pick-Up	F-60		10.69	10.81	
CAMARO MODELS Base	All	1.82	8.07	7.63	5.83
	Z-28	2.69	9.16	8.84	6.97
NOVA MODELS All Except "SS"	All	2.18	9.70	9.69	5.54
	"SS"	2.19	9.38	9.39	5.57
CORVETTE, Coupe Standard Suspension	F70-15	2.51	7.95	7.90	2.10
	Convertible Standard Suspension	F70-15	2.59	7.94	1.89
F-41 Suspension Coupe and Convertible	F70-15	1.63	7.28	7.47	1.81



Measure "J" and "K" Height at the following distance rearward of the front wheel or frontward of the rear wheel

	CHEVROLET	MONTE CARLO	CHEVELLE	CAMARO	NOVA	CORVETTE
Front	36"	31"	31"	36"	33"	30"
Rear	24"	24"	24"	16"	20"	24"

### VEHICLE ALIGNMENT TOLERANCES ††

	FIELD USAGE	
	Column 1 *Service Checking	Column 3 @ Service Reset
Camber .....	$\pm 3/4^\circ$	$\pm 1/2^\circ$
Caster .....	$\pm 1^\circ$	$\pm 1/2^\circ$
\$ Toe-in .....	$\pm 1/8''$	$\pm 1/16''$
Camber (Side to Side) .....	$1^\circ$	$1/2^\circ$
Caster (Side to Side) .....	$1^\circ$	$1/2^\circ$

### VEHICLE INSPECTION TOLERANCES

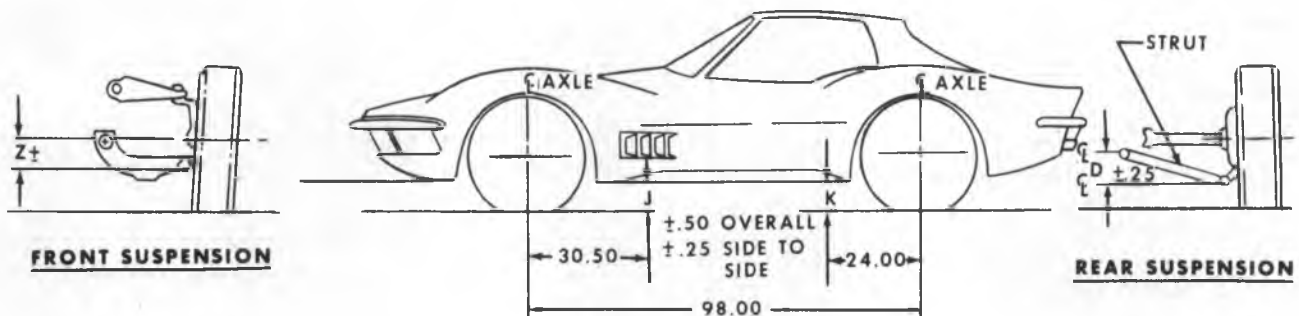
	Column 2
Caster .....	$\pm 2^\circ$
Camber .....	$\pm 1\ 1/2^\circ$
Toe .....	$\pm 3/8''$

\* Caster and Camber must not vary more than  $1^\circ$  from side to side.

@ Caster and Camber must not vary more than  $1/2^\circ$  from side to side.

\$ Toe setting must always be made after caster and camber.

††See explanatory copy in front suspension section.





**WHEEL ALIGNMENT SPECIFICATIONS**  
† (All Vehicles at Curb Weight)

	††1 Service Checking	††2 Vehicle Inspection	††3 Service Reset
	Specification for diagnosis for warranty repair or customer paid service	Specification for periodic motor vehicle inspection	Specification for resetting Alignment
<b>CHEVROLET</b> (Except 116" W.B. Wagon) Caster Camber Toe-in (Total)	* 0° to + 2° * 1/4° to + 1 1/4° 1/16" to 5/16"	- 1° to + 3° - 1° to + 2° 7/16" toe-in to 1/16" toe-out	@ + 1° ± 1/2° @ + 1/2° ± 1/2° \$ 3/16" toe-in ± 1/16"
<b>MONTE CARLO</b> Caster Camber Toe-in (Total)	* - 1° to + 1° * - 0° to + 1 1/2° 1/16" to 5/16"	- 2° to + 2° - 3/4° to + 2 1/4° 1/2" toe-in to 1/8" toe-out	@ 0° ± 1/2° @ + 3/4° ± 1/2° \$ 3/16" toe-in ± 1/16"
<b>CORVETTE</b> Caster - Manual Strg. Caster - Power Strg. Camber - Front Toe-in - Front Total Camber - Rear Toe-in - Rear (Per Wheel)	* 0° to + 2° * + 1 1/4° to + 3 1/4° * 0° to + 1 1/2° 1/8" to 3/8"	- 1° to + 3° + 1/4° to + 4 1/4" <sup>d</sup> - 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"
<b>CHEVELLE, EL CAMINO</b> and 116" W.B. Wagon Caster Camber Toe-in (Total) S.A.I.	- 2° to 0° * 0° to + 1 1/2° 1/16" to 5/16"	- 3° to + 1° - 3/4° to + 2 1/4° 1/2" toe-in to 1/4" toe-out	@ - 1° ± 1/2° @ + 3/4° ± 1/2° \$ 1/8" to 1/4" 8-1/4° ± 1/2°
<b>NOVA</b> Caster Camber Toe-in (Total) S.A.I.	* - 1/2° to + 1 1/2° * - 1/2° to + 1° 1/16" to 5/16"	- 1 1/2° to + 2 1/2° - 1 1/4° to + 1 3/4° 1/2" toe-in to 1/4" toe-out	@ + 1/2° ± 1/2° @ + 1/4° ± 1/2° \$ 1/8" to 1/4" 8-3/4° ± 1/2°
<b>CAMARO (standard)</b> Caster Camber Toe-in (Total) S.A.I.	* - 1° to + 1° * + 1/4° to + 1 3/4° 1/16" to 5/16"	- 2° to + 2° - 1/2° to + 2 1/2° 1/2" toe-in to 1/4" toe-out	@ 0° ± 1/2° @ + 1° ± 1/2° \$ 1/8" to 1/4" 9-1/2° ± 1/2°
<b>Z-28</b> Caster Camber Toe-in (Total) S.A.I.	* - 2° to 0° * 0° to + 1 1/2° 1/16" to 5/16"	- 3° to + 1° - 3/4° to + 2 1/4° 1/2" toe-in to 1/4" toe-out	@ - 1° ± 1/2° @ + 3/4° ± 1/2° \$ 1/8" to 1/4" 9-3/4° ± 1/2°

+ 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.

\$ Toe setting must always be made after caster and camber.

\* CASTER and CAMBER must not vary more than 1° from side to side. ††† Check toe-in setting after any camber change.

@ CASTER and CAMBER must not vary more than 1/2° from side to side.

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## TORQUE (FT. LBS.)

CORVETTE (CONT'D)	
Stabilizer Shaft	
Bracket to Frame . . . . .	120 in. lb.
Bracket to Torque Arm . . . . .	120 in. lb.
Link Bushing Bolts . . . . .	25
Rebound Bumper to Frame . . . . .	20
Crossmember to Carrier . . . . .	60
Carrier Front Support	
to Crossmember . . . . .	65
Front Bolt . . . . .	50*
Rear Bolt . . . . .	50*
Drive Spindle Nut . . . . .	100*
Drive Spindle Support	
to Torque Arm . . . . .	30
Strut Rod	
to Spindle Support . . . . .	75*
Bracket to Carrier . . . . .	35
Camber Cam . . . . .	65
Torque Arm Pivot . . . . .	50
Spring Link Bolt	Install Nut to expose hole
to Torque Arm	then insert cotter pin.
Rear Wheel Alignment #	

\*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.	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.	120 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.	120 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.	—	—	—
Brake Line Connector to Axle . . . . .	150 in. lbs.	120 in. 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 Backing 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) . . . . .	28 ft. lbs.	—	28 ft. lbs.	—	—
Combination Valve Mounting . . . . .	150 in. lbs.	150 in. lbs.	150 in. lbs.	150 in. lbs.	—
Distribution Switch Mounting . . . . .	—	100 in. lbs.	—	150 in. lbs.	100 in. lbs.
Parking Brake Equalizer . . . . .	55 in. lbs.	85 in. lbs.	85 in. lbs.	85 in. lbs.	70 in. lbs.
Parking Brake Assembly (to Dash or Floor) . . . . .	150 in. lbs.	100 in. lbs.	100 in. lbs.	100 in. lbs.	100 in. lbs.
Parking Brake Assembly (to IR or Kick Pad) . . . . .	—	85 in. lbs.	150 in. lbs.	85 in. lbs.	—
Front Cable to Floor Pan . . . . .	—	—	30 ft. lbs.	—	—
Front Cable Trans. Support Bracket . . . . .	72 in. lbs.	—	—	—	—
Rear Cable Bracket . . . . .	—	—	—	40 ft. lbs.	100 in. lbs.

## ENGINE

## SECTION 6

GENERAL DATA:												
Type	In Line		V-8									
Displacement (cu. in.)	250	307	350			400	402	454				
Horsepower @ rpm	110	200	165	175*	255	170	240**	270\$				
	@	@	@	@	@	@	@	@				
Torque @ rpm	3800	4600	4000	4000	5600	3400	4400	4000				
	@	@	@	@	@	@	@	@				
Bore	185	230	280	280	280	325	345	390				
	@	@	@	@	@	@	@	@				
Stroke	3 7/8	3.25	4			4 1/8		4 1/4				
Compression Ratio	3.53	3.25	3.48			3.75	3.76	4				
Firing Order	8.5:1			9.0:1			8.5:1					
CYLINDER BORE:	1-5-3-6-2-4		1-8-4-3-6-5-7-2									
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.									
		Relief Side	.0005 Max.		.001 Max.							
	Service		.005 Max.									
PISTON:												
Clearance	Production		.0005	.0005	.0007-.0013	.0036	.0014	.0018	.0024			
	Service		.0015	.0011		.0042	.0020	.0026	.0034			
			.0025 Max.	.0027 Max.	.0061 Max.	.0034 Max.	.0035 Max.	.0049 Max.				
PISTON RING:												
C O M P R E S S I O N	Clearance	Production	Top	.0012-.0027		.0012-	.0012-.0032		.0012-.0027			
			2nd	.0012-.0032		.0032	.0012-.0027		.0012-.0032			
	Groove	Service	Hi Limit Production + .001									
			Gap	Production	Top	.010-.020		.010-.020	.010		.010-.020	
					2nd	.010-.020		.013-.025	.013		.010-.020	
						Service		Hi Limit Production + .01				
O I L	Groove	Production	.005 Max.		.002-.007	.005 Max.		.0005-.0065				
			Clearance	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		.001 Max.									
Fit in Rod	.0008-.0016 Interference											
CRANKSHAFT:												
Main Journal	Diameter	All 2.2983 - 2.2993	#1 2.4484-2.4493			#1-2-3-4 2.6484 - 2.6493	#1-2 2.7487 - 2.7496	#1 2.7485 - 2.7494				
			2-3-4 2.4481-2.4490				#3-4 2.7481 - 2.7490	#2-3-4 2.7481 - 2.7490				
			#5 2.4479-2.4488			#5 2.6479 - 2.6488	#5 2.7473 - 2.7483	#5 2.7478 - 2.7488				
			Taper	Production	.0002 Max.							
					.001 Max.							
	Out of Round	Production	.0002 Max.									
			.001 Max.									

\* Camaro, Nova &amp; Base Corvette 200 HP @ 4400; Torque 300 @ 2800

\*\* Chevrolet 210 HP @ 4000; Torque 320 @ 2400

\$ Chevrolet Wagons 230 HP @ 4000; Torque 360 @ 2800

Type			In Line			V-8				
Displacement (cu. in.)			250	307	350		400	402	454	
Horsepower			110	130	165	175	255	170	240	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 .0007 - .0019	#1-2-3-4 .0013-.0025		
				#2-3-4 .0011-.0023	#2-3-4 .0013 - .0025	#2-3-4 .0011 - .0023	#2-3-4 .0013 - .0025			
			#5 .0017-.0033	#5 .0023 - .0033	#5 .0023 - .0033	#5 .0017 - .0033	#5 .0019 - .0035	#5 .0024 - .0040		
				#1 - .002 Max.; All Others - .0035 Max.						
	Service									
Crankshaft End Play			.002-.006					.006-.010		
Crankpin	Diameter		1.999 - 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			.009-.014	.008-.014			.013-.023	.015-.021		
CAMSHAFT:										
Lobe	Intake		.2217	.2600	.3057	.2235	.2343	.2714		
Lift ± .002"(X)	Exhaust		.2217	.2733	.3234	.2411	.2343	.2824		
Journal Diameter			1.8682-1.8692				1.9482-1.9492			
Camshaft Runout			.0015 Max.							
VALVE SYSTEM:										
Lifter			Hydraulic		Mechanical		Hydraulic			
Rocker Arm Ratio			1.75:1	1.50:1		1.70:1				
Valve Lash	Intake		One Turn Down From Zero Lash		.024*		One Turn Down From Zero Lash			
	Exhaust				.030*					
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.	.0015-.0032	.0012-.0029			.0010-.0027			
	Exh.	.0012-.0027								
Service		Hi Limit Production ± .001 Intake - .002 Exhaust								
Valve Spring (Outer)	Free Length		1.90	2.03				2.12		
	Pressure lbs. @ in.	Closed	55-64 @ 1.66	76-84 @ 1.70				69-81 @ 1.88		
			180-192 @ 1.27					228-252 @ 1.38		
		Open	194-206 @ 1.25							
	Installed Height ± 1/32"		1 21/32	1 23/32				1 7/8		
Valve Spring (Inner)	Free Length		N.A.					2.06		
	Pressure lbs. @ in.	Closed	N.A.					26-34 @ 1.78		
		Open	N.A.					81-99 @ 1.28		
Installed Height ± 1/32"		N.A.					1 25/32			
Damper	Free Length		-	1.94				N.A.		
	Approx. # of Coils		-	4				N.A.		

\*Engine at operating temperature and running

(X) California Camshafts: #6262810 (L6) Inlet 0.2217 - Exhaust 0.2315  
#6262944 (Small V-8) Inlet 0.2671 - Exhaust 0.2733  
#3864896 (L6) Inlet 0.2217 - Exhaust 0.2217

## ENGINE TUNE UP

ENGINE	Type		L-6	V8						
	Displacement		250	307	350			400	402	454
	Horsepower		110	130 + 135	155 + 165	175	255	170	210 + 240	270
Compression ① (PSI)			130	150	160		150	160		
SPARK PLUG	Make & Number	Standard	AC-R46T	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	Synchro.	4°B	4°B	6°B	4°B*	4°B	2°B	8°B	
Auto.		4°B	8°B	6°B	8°B	8°B	6°B	8°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 Note⑤							
Valve Lash ⑥	Inlet	Hydraulic - One Turn Down From Zero Lash				.024	Hydraulic - One Turn Down From Zero Lash			
	Exhaust					.030				
Idle rpm ⑦	Synchro.	700	900	900	800	900	900	750	750	
	Auto.	600	600	600	600	700	600	600	600	
Fuel Pump ⑧	Pressure	3 1/2 to 4 1/2	5 to 6 1/2	7 to 8 1/2						
	Volume	One Pint in 30-45 Seconds @ Cranking Speed								
Crankcase Vent Valve			Replace at 24,000 Miles							

\* 8°B- Corvette only

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 Mechanical-Set with engine at operating temperature and running.

⑦ See "TUNE-UP" section.

⑧ Replace filter element located in carburetor inlet every 12 months or 12,000 miles, whichever occurs first.



## ENGINE TORQUES

Size		Usage	In Line	Small V-8		Mark IV-V-8	
			250	307	350	402	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.		80 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.	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)	25 lb. ft.					
	Manifold (Inlet)		30 lb. ft.				
	Manifold-to-head	30 lb. ft.					
	Thermostat Housing	30 lb. ft.					
	Water Outlet		20 lb. ft.				
3/8-24	Water Pump		30 lb. ft.				
	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.	75 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		105 lb. ft.				
1/2-14	Temperature Send 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 307-350 engines 30 lb. ft.

② Outer bolts on engines with 4 bolt caps 65 lb. ft.

# CARBURETOR

## SECTION 6M

### IDENTIFICATION

#### ALL PASSENGER CARS

Also refer to Rochester and Holley Carburetor identification illustrations in the Overhaul Shop Manual.

Vehicles						Engines		Passenger Car Carburetor					
Chevelle	Monte Carlo	Chevrolet	Camaro	Nova	Corvette	Displacement and Type	RPO Option	Barrel (bbl) and Type	All (Except California)		California		
									Manual	Automatic	Manual	Automatic	
A	G	B	F	X	V								
x		x	x	x		250 L-6	Base	1MV	7042017	7042014	7042987	7042984	
x			x	x		307 V-8	Base	2GV	7042101	7042100	7042821	7042820	
	x	x				350 V-8	Base	2GV	7042113	7042114	7042833	7042834	
x				x		350 V-8	L-65	2GV	7042113	7042114	7042833	7042834	
			x			350 V-8	L-65	2GV	7042111	7042112	7042831	7042832	
			x			350 V-8	Z-28	4H	3999263	3997788	3999263	3997788	
x	x		x	x		350 V-8	L-48	4QJ	7042203	7042202	7042903	7042902	
					x	350 V-8	Base	4QJ	7042203	7042202	7042903	7042902	
					x	350 V-8	LT1	4H	3999263	N/A	3999263	N/A	
	x	x				400 V-8	LF-6	2GV	N/A	7042118	N/A	7042838	
x		x	x			402 M-4	LS-3	4QJ	7042215	7042220	N/A	N/A	
x	x	x				454 M-4	LS-5	4QJ	7042215	7042220	N/A	N/A	
					x	454 M-4	LS-5	4QJ	7042217	7042216	N/A	N/A	

## ADJUSTMENTS (CONT'D)

## PASSENGER CARS — EXCEPT VEGA

## Rochester Carburetors

Model	NUMBER (A) Automatic Transmission (M) Manual Trans.	Float Level	Float Drop	Metering Rod	Pump Rod	Choke Rod (Fast idle cam)	Air Valve Dashpot	Vacuum Break	Unloader
MV	7042014 (A)	1/4	—	.080	—	.125	—	.190	.500
MV	7042984 (A)	1/4	—	.078	—	.125	—	.190	.500
MV	7042017 (M)	1/4	—	.078	—	.150	—	.225	.500
MV	7042987 (M)	1/4	—	.076	—	.150	—	.225	.500
2GV	7042111 (M)	23/32	1 9/32	—	1 1/2	.100	—	.180	.325
2GV	7042113 (M)	23/32	1 9/32	—	1 1/2	.100	—	.180	.325
2GV	7042831 (M)	23/32	1 9/32	—	1 1/2	.100	—	.180	.325
2GV	7042833 (M)	23/32	1 9/32	—	1 1/2	.100	—	.180	.325
2GV	7042112 (A)	23/32	1 9/32	—	1 1/2	.100	—	.170	.325
2GV	7042114 (A)	23/32	1 9/32	—	1 1/2	.100	—	.170	.325
2GV	7042118 (A)	23/32	1 9/32	—	1 1/2	.100	—	.190	.325
2GV	7042832 (A)	23/32	1 9/32	—	1 1/2	.100	—	.170	.325
2GV	7042834 (A)	23/32	1 9/32	—	1 1/2	.100	—	.170	.325
2GV	7042838 (A)	23/32	1 9/32	—	1 1/2	.100	—	.190	.325
2GV	7042100 (A)	25/32	1 31/32	—	1 5/16	.040	—	.080	.215
2GV	7042820 (A)	25/32	1 31/32	—	1 5/16	.040	—	.080	.215
2GV	7042101 (M)	25/32	1 31/32	—	1 5/16	.075	—	.110	.215
2GV	7042821 (M)	25/32	1 31/32	—	1 5/16	.075	—	.110	.215
4MV	7042220 (A)	1/4	—	—	3/8	.100	.020	.250	.450
4MV	7042216 (A)	1/4	—	—	3/8	.100	.020	.250	.450
4MV	7042215 (M)	1/4	—	—	3/8	.100	.020	.250	.450
4MV	7042217 (M)	1/4	—	—	3/8	.100	.020	.250	.450
4MV	7042202 (A)	1/4	—	—	3/8	.100	.020	.215	.450
4MV	7042203 (M)	1/4	—	—	3/8	.100	.020	.215	.450
4MV	7042902 (A)	1/4	—	—	3/8	.100	.020	.215	.450
4MV	7042903 (M)	1/4	—	—	3/8	.100	.020	.215	.450

## FAST IDLE (RUNNING) RPM ADJUSTMENT

## Carburetors — Rochester

Vehicle	MV		4QJ		2GV	
	Auto.	Man.	Auto.	Man.	Auto. and Man.	
All (Except Vega)	2400 2400† a.		1500* b.	1350* b.	ADVISORY SETTINGS 1850*(1 1/4 SAE) 2200*(1 1/2 SAE) a.	These approximate settings are with low idle at 450 RPM — with viscous clutch fans disengaged

† with vacuum advance.

\* without vacuum advance.

a. on high step

b. on second step.

NOTE: For vacuum advance on 1 bbl. carburetors — Pull lead off of temperature switch and ground it — this will energize the C.E.C. Valve.

P/Cars — Two terminals at temperature switch located in the engine cylinder head—LEFT SIDE

Trucks — Located in the water thermostat housing on top of engine.

## HOLLEY CARBURETORS

## PASSENGER CARS — EXCEPT VEGA (CON'T)

Holley Number Chevrolet Number	R-6238A 3997788	R-6239A 3999263
TRANSMISSION	Automatic	Standard
FLOAT LEVEL (Bowl Inverted) Primary Secondary	Float Centered in Bowl Float Centered in Bowl	
WET FUEL LEVEL (On Engine) Primary Secondary	Fuel Level with Bottom of Sight Plug Hole. Fuel Level with Bottom of Sight Plug Hole.	
ACCELERATOR PUMP (Wide Open Throttle)	.015 min.	.015 min.
FAST IDLE Mechanical (Hi-Step) Running (R.P.M.) (Hi-Step)	.025 .2350*	.025 2350*
CHOKE COIL ROD ADJUSTMENT (Bottom of Throttle Body to Center of Hole in Choke Coil Rod Operating Lever)	1.320 ±.015	1.320 ±.015
CHOKE VACUUM BREAK	.350	.350
CHOKE UNLOADER	.350	.350
SECONDARY STOP	1/2 Turn Open	
MAIN METERING JET Primary Secondary	68 73	68 73
THROTTLE BORE Primary Secondary	1 11/16" 1 11/16"	1 11/16" 1 11/16"

\* With Vacuum Spark Advance.

NOTE: For full vacuum advance —

- Z-28 without gauges: ground dual temperature terminal on left side of engine block.
- Z-28 and LT-1 with gauges: ground cold override temperature switch located in right side of engine — single terminal switch for Camaro and dual terminal switch for Corvette.

## OTHER ADJUSTMENTS

## PASSENGER CARS — EXCEPT VEGA

NOTE: Refer to "Additional External Settings and Adjustments"/or "Idle Stop Solenoid Adjustment" and "CEC Valve Adjustment, 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.

EQUIPMENT		COLUMN No. 1 (See Note Above)	COLUMN No. 2 (See Note Above)	COLUMN No. 3 (See Note Above)
Transmission	Engine	Initial Curb Idle Speed (RPM)	Final Curb Idle Speed (RPM)	C.E.C. Valve Engine Speed (RPM) (4)
		Use Lean Drop Method — Except on Vehicles Equipped with A.I.R. (See Procedures in Section 6M)		
Manual (In Neutral) (2)	L-6 250 C.I.D.	800 (1)	700 (3)	850
	V-8 307 C.I.D.	1000 (1)	900 (3)	
	V-8 350 C.I.D. (L-65)	1050 (1)		
	V-8 350 C.I.D. (L-48)	1000 (1)	900 (3)	
	MK IV 402 C.I.D. (LS-3) MK IV 454 C.I.D.(LS-5)	750 (1)	750 (3)	
Automatic (In Drive) (2)	L-6 250 C.I.D.	630 (1)	600 (3)	
	V-8 307 C.I.D.	650 (1)		
	V-8 350 C.I.D. (L-65) V-8 400 C.I.D. (LF-6)			
	V-8 350 C.I.D. (L-48)			
	MK IV 402 C.I.D. (LS-3) MK IV 454 C.I.D. (LS-5)	600 (1)		
Manual (In Neutral)	V-8 350 C.I.D. (Z-28) V-8 350 C.I.D. (LT-1)	900 (1)	900 (3)	
Automatic (In Drive)	V-8 350 C.I.D. Z-28	700 (1)	700 (3)	—

- (1) Idle Adjustment for vehicles equipped with A.I.R. is: 1/4 turn rich from lean roll (mixture screw).
- (2) With A.I.R. operating, if so equipped.
- (3) Set low idle, using idle speed screw or/solenoid allen head screw adjustment (with solenoid de-energized), at 450 RPM, except Holley carburetor which is set at 500 RPM.
- (4) CAUTION: If the C.E.C. Valve (solenoid) on the carburetor is used to set engine idle or is adjusted out of limits specified in this Service Manual, decrease in engine braking may result.

# ENGINE ELECTRICAL

## SECTION 6Y

### BATTERIES

Model No. & Catalog No.	Application	No. of Plates Per Cell	Cranking Power @ 0°F (Watts)	Capacity @ 20 Hour Rate (Amp. Hr.)
1980141 (y-86)	All with 250 L-6	54	2300	45
1980145 (R-88)	All with 307, 350 and 400 V-8's	66	2900	61
1980149 (R-88W)	Chevrolet, Chevelle, Monte Carlo and with 454 V-8. All with RPOT-60	90	3750	76
1980147 (R-88ST)	Corvette with 350 V-8	72	3250	62
1980150 (R-88WT)	Corvette with 454 V-8	90	3750	76

### 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
1100543	Corvette with RPO LS5, LS6	4521	4 - 4.5	***	***	37	42
1100566	All with 307, 350, 400 and 454 V-8's. All with base L-6. Not used RPO BO2, BO7, Z28 or LS6	3395	2.2 - 2.6	14	25	35	37
1100836	All L-6 with N-40	3395	2.2 - 2.6	14	25	35	37
1100837	All with RPO Z28, and LS6	3395	2.2 - 2.6	14	25	35	37
1100843	Chevelle, Camaro and Nova w/C60	4500	2.2 - 2.6	14	33	58	61
1100917	Chevrolet with C60, Chevrolet and Chevelle w/RPOK85	3398	2.8 - 3.2	14	35	59	63
1100567	RPO BO2 & BO7	3396	2.2 - 2.6	14	28	40	42
1100950	Corvette Base and RPO LT1	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.



## VOLTAGE REGULATOR

Model No.	Application	Field Relay			Voltage Regulator		
		Air Gap	Point Opening	Closing Voltage	Air Gap	Point Opening	Voltage Setting
1119515	Base	.015	.030	1.5 - 3.2	.067	.014	13.8-14.8 @ 85° F.
1119519	With Delcotron #1100917	.030	.030	1.5 - 3.2	.067	.014	13.8-14.8 @ 85° F.

## STARTING MOTOR

Model No.	Application	Spec. No.	Ring Gear Dia.-In.	Free Speed		
				Volts	Amperes	RPM
1108365**	Chevrolet, Chevelle, Camaro, Nova 250 L-6 with 3-Spd., P.G., or M-38	3573 (Low)	12-3/4	9	50-80*	5500-10500
1108367	Monte Carlo, Chevelle, Camaro & Nova 307 V-8 w/3 spd. 4-spd., P.G., or M-38	3573 (Low)	12-3/4	9	50-80*	5500-10500
1108418	All 350 V-8 w/3 spd. or 4 spd. Chevrolet and Monte Carlo 400 V-8 w/3 spd. or 4 spd. Camaro 402 V-8 w/3 spd. or 4 spd. Chevrolet, Chevelle, Camaro and Monte Carlo 454 V-8 w/3 spd. or 4 spd.	3563 (Ultra High)	14	9	65-95*	7500-10500
1108430	All 350 V-8 w/M-38 or M-40 Chevrolet and Monte Carlo 400 V-8 w/M-38 or M-40 Camaro 402 V-8 w/M-38 or M-40 Chevrolet, Chevelle, Camaro and Monte Carlo 454 V-8, w/M-38 or M-40	3563 (Ultra High)	14	9	65-95*	7500-10500
1108400	Corvette 454 V-8, w/4 Spd	3563 (Ultra High)	14	9	65-95*	7500-10500
1108429	Corvette 454 V-8, w/M-40	3563 (Ultra High)	14	9	65-95*	7500-10500

\*\*Incorporates molded armature design

\*Includes Solenoid

## DISTRIBUTORS

Engine Description and Available	Ignition Distributor (Product Part No.)	Centrifugal Advance (Crank Degrees @ Engine RPM)	Vacuum Advance (In Crank Degrees)	Point Dwell Setting	Ignition Timing BTDC at Engine Idle*	Trans.	Original Equipment Spark Plug
250 Cu. In. L-6	1110489	<u>C-4797</u> 0 @ 930 RPM 2° @ 1270 RPM 14° @ 2300 RPM 24° @ 4100 RPM	<u>C-3990</u> 0 @ 8" Hg 23° @ 16" Hg	31° - 34°	4°	All	AC-46T
307 Cu. In. V-8	1112039	<u>C-4815</u> 0 @ 680 RPM 2° @ 1320 RPM 20° @ 4200 RPM	<u>C-3954</u> 0 @ 8" Hg 20° @ 17" Hg	29° - 31°	8°	Automatic	AC-R44T
307 Cu. In. V-8	1112005	<u>C-4753</u> 0 @ 800 RPM 2° @ 1200 RPM 12° @ 2200 RPM 24° @ 4300 RPM	<u>C-3954</u> 0 @ 8" Hg 20° @ 17" Hg	29° - 31°	4°	Manual	AC-R44T
350 Cu. In. V-8 (2-bbl)	1112005	<u>C-4573</u> 0 @ 800 RPM 2° @ 1200 RPM 12° @ 2200 RPM 24° @ 4300 RPM	<u>C-3954</u> 0 @ 8" Hg 20° @ 17" Hg	29° - 31°	6°	All	AC-R44T
350 Cu. In. V-8 (4-bbl)	1112044	<u>C-4817</u> 0 @ 840 RPM 2° @ 1160 RPM 10° @ 1800 RPM 15° @ 2400 RPM 22° @ 4200 RPM	<u>C-3036</u> 0 @ 8" Hg 15° @ 15.5" Hg	29° - 31°	4°	Manual	AC-R44T
350 Cu. In. V-8 (4-bbl)	1112045	<u>C-4818</u> 0 @ 865 RPM 2° @ 1335 RPM 11° @ 2400 RPM 18° @ 4200 RPM	<u>C-3036</u> 0 @ 8" Hg 15° @ 15.5" Hg	29° - 31°	8°	Automatic	AC-R44T
350 Cu. In. V-8 RPO Z28.	1112049	<u>C-4827</u> 0 @ 1070 RPM 2° @ 1330 RPM 16° @ 2250 RPM 24° @ 5000 RPM	<u>C-3036</u> 0 @ 8" Hg 15° @ 15.5" Hg	29° - 31°	8°	Automatic	AC-R44T

\*Refer to Vehicle Emission Control Information Sticker.

## DISTRIBUTORS (CONT'D)

Engine Description and Available	Ignition Distributor (Product Part No.)	Centrifugal Advance (Crank Degrees @ Engine RPM)	Vacuum Advance (In Crank Degrees)	Point Dwell Setting	Ignition Timing BTDC at Engine Idle*	Trans.	Original Equipment Spark Plug
350 Cu. In. V-8 RPO Z28	1112095	<u>C-4831</u> 0 @ 1090 RPM 2° @ 1310 RPM 21° @ 2350 RPM 28° @ 5000 RPM	<u>C-3036</u> 0 @ 8" Hg 15° @ 15.5" Hg	29° - 31°	4°	Manual	AC-R44T
350 Cu. In. V-8, Base Corvette	1112050	<u>C-4818</u> 0 @ 865 RPM 2° @ 1335 RPM 11° @ 2400 RPM 18° @ 4200 RPM	<u>C-3036</u> 0 @ 8" Hg 12° @ 15.5" Hg	29° - 31°	8°	All	AC-R44T
350 Cu. In. V-8, RPO LT-1 Corvette	1112101	<u>C-4831</u> 0 @ 1090 RPM 2° @ 1310 RPM 21° @ 2350 RPM 28° @ 5000 RPM	<u>C-3036</u> 0 @ 8" Hg 15° @ 15.5" Hg	29° - 31°	4°	Manual	AC-R44T
400 Cu. In. V-8, RPO LF-6	1112055	<u>C-4857</u>	<u>C-3993</u> 0 @ 10" Hg 18° @ 17" Hg	29° - 31°	2°	Manual	AC-R44T
400 Cu. In. V-8 RPO LF-6	1112099	<u>C-4829</u> 0 @ 930 RPM 2° @ 1270 RPM 14° @ 2300 RPM 24° @ 4500 RPM	<u>C-3954</u> 0 @ 8" Hg 20° @ 17" Hg	29° - 31°	6°	Automatic	AC-R44T
402 Cu. In. V-8 RPO LS-3	1112057	<u>C-4830</u> 0 @ 930 RPM 2° @ 1260 RPM 16° @ 2400 RPM 30° @ 4400 RPM	<u>C-3954</u> 0 @ 8" Hg 20° @ 17" Hg	29° - 31°	8°	All	AC-R44T
454 Cu. In. V-8, RPO LS-5 (Exc. Corvette)	1112052	<u>C-4823</u> 0 @ 857 RPM 2° @ 1143 RPM 14° @ 2000 RPM 22° @ 3900 RPM	<u>C-3954</u> 0 @ 8" Hg 20° @ 17" Hg	29° - 31°	8°	All	AC-R44T
454 Cu. In. V-8, RPO LS-5 Corvette	1112051	<u>C-4823</u> 0 @ 857 RPM 2° @ 1143 RPM 14° @ 2000 RPM 22° @ 3900 RPM	<u>C-3954</u> 0 @ 8" Hg 20° @ 17" Hg	29° - 31°	8°	All	AC-R44T

\*Refer to Vehicle Emission Control Information Sticker.

**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 (Non- Transistor)	1.77 - 2.05	3,000 - 20,000	Fixed (In Wiring Harness)	1.35
V-8 (Transistor)	.41 - .51	3,000 - 20,000	Fixed (In Wiring Harness)	.43 & .68

**TRANSMISSION AND CLUTCH****SECTION 7****THREE SPEED SAGINAW**

Clutch Gear Retainer to Case Bolts . . . . .	16 ft. lbs.
Side Cover to Case Bolts . . . . .	22 ft. lbs.
Extension to Case Bolts . . . . .	45 ft. lbs.
Shift Lever to Shifter Shaft Bolts . . . . .	20 ft. lbs.
Lubrication Filler Plug . . . . .	15 ft. lbs.
Transmission Case to Clutch Housing Bolts . . . . .	55 ft. lbs.
Crossmember to Frame Nuts . . . . .	25 ft. lbs.
Crossmember to Mount and Mount to Extension Bolts . . . . .	40 ft. lbs.

**THREE SPEED MUNCIE**

Clutch Gear Retainer to Case Bolts . . . . .	16 ft. lbs.
Side Cover to Case Bolts . . . . .	22 ft. lbs.
Extension to Case Bolts . . . . .	45 ft. lbs.
Shift Lever to Shifter Shaft Bolts . . . . .	20 ft. lbs.
Lubrication Filler Plug . . . . .	15 ft. lbs.
Transmission Case to Clutch Housing Bolts . . . . .	55 ft. lbs.
Crossmember to Frame Nuts . . . . .	25 ft. lbs.
Crossmember to Mount and Mount to Extension Bolts . . . . .	40 ft. lbs.
Transmission Drain Plug . . . . .	30 ft. lbs.



## 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.
Oil Pan Drain Plug	20 ft. lbs.
Transmission Case to Engine	35 ft. lbs.
Oil Cooler Pipe Connectors to Transmission Case or Radiator	12-16 ft. lbs.
Oil Cooler Pipe to Connectors	10 ft. lbs.

## TURBO HYDRA-MATIC—400

FT.-LBS.

Pump Cover Bolts	18
Parking Pawl Bracket Bolts	18
Center Support Bolt	23
Pump to Case Attaching Bolts	18
Extension Housing to Case Attaching Bolts	23
Rear Servo Cover Bolts	18
Detent Solenoid Bolts	7
Control Valve Body Bolts	8
Bottom Pan Attaching Screws	12
Modulator Retainer Bolt	18
Governor Cover Bolts	18
Manual Lever to Manual Shaft Nut	8
Manual Shaft to Inside Detent Lever	18
Linkage Swivel Clamp Nut	43
Converter Dust Shield Screws	93
Transmission to Engine Mounting Bolts	28
Converter to Flywheel Bolts	33
Rear Mount to Transmission Bolts	40
Rear Mount to Crossmember Bolt	40
Crossmember Mounting Bolts	25
Oil Cooler Line	10
Line Pressure Take-Off Plug	13
Strainer Retainer Bolt	10
Oil Cooler Pipe Connectors to Transmission Case or Radiator	12-16
Oil Cooler Pipe to Connector	10



# STEERING

## SECTION 9

### STANDARD STEERING

Item	Vehicle		Camaro		Chevelle 161" W.B. Wagon Monte Carlo and Camaro	Nova	Corvette	
Steering Gear	Model		All others	w/C-60 or LS3	ALL	ALL	ALL	
	Ratio	Type	—		—	—	Road	Fast
		Gear	24:1	28:1	24:1	28:1	16:1	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-Camaro		1350-1450 (V-8)
Station Wagon	900-1000	
Monte Carlo		1350-1450
Nova		1350-1450 (V-8)
Corvette	870-1000	

### POWER STEERING—GEAR

	Constant Ratio				Variable Ratio			
	Regular		Fast		Regular		Fast	
	Gear	Overall*	Gear	Overall*	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	—	—
125" W.B. Sta. Wagon			—	—	—	—	—	—
116" W.B. Sta. Wagon			—	—	—	—	—	—
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
Worm Bearing Preload	4 to 6 in. lbs.
Worm Bearing Lock Nut	85 ft. lb.
Sector Lash Adjustment	5 to 9 in. lbs.*
Sector Lash Lock Nut	30 ft. lb.
Total Steering Gear Preload	16 in. lbs. Max.

\* In excess of worm bearing preload.

**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	25 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 — PUMP**

Vehicle	Constant Ratio Steering	Variable Ratio Steering
Chevrolet		1350 - 1450
Chevelle - Camaro		1350 - 1450
Station Wagon	900 - 1000	
Monte Carlo		1350 - 1450
Nova		1350 - 1450
Corvette	870 - 1000	

## TORQUE CHART

Components	Chevrolet & 125" W.B. Station Wagon	Chevelle, 116" W.B. Wagon & Monte Carlo	Nova	Camaro	Corvette
Steering Gear Mounting Bolts	70 lbs. ft.				30 lbs. ft.
Pitman Shaft Nut	180 lbs. ft.				140 lbs. ft.
Pitman Arm to Relay Rod Stud Nut	45 lbs. ft.*				
Idler Arm to Relay Rod Stud Nut	40 lbs. ft.**	35 lbs. ft.**			
Idler Arm to Frame Nuts	45 lbs. ft.	35 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.		150 lbs. in.	22 lbs. ft.	150 lbs. in.
Steering Coupling to Shaft Flange Nuts	20 lbs. ft.				
Steering Coupling Clamp Bolts	30 lbs. ft.				
Steering Wheel Nut	30 lbs. ft.				
Steering Wheel to Hub Screws (Corvette and Cushioned Rim Wheels)	25 lbs. in.		—	25 lbs. in.	
Floor Pan Cover Sews	35 lbs. in.				
Floor Pan Cover Clamp Screws	35 lbs. in.				
Floor Pan Bracket Nuts	—				120 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 & 125" W.B. Station Wagon	Chevelle, 116" W.B. Wagon & Monte Carlo	Nova	Camaro	Corvette
Turn Signal Switch Screws	35 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.		—	35 lbs. in.	
Bearing Housing Support Screws (Tilt & Tilt-Telescope)	60 lbs. in.		—	60 lbs. in.	
Trans. Control Lock Tube Hsg. Ext. Screws (Tilt-Telescope)	—	—	—	—	40 lbs. in.
Power Steering Pump Pulley Nut	58 lbs. ft.				
Power Steering Pump Mounting Bolts	24 lbs. ft.				
Power Steering Pump Mounting Stud Nut	25 lbs. ft.				
Power Steering Pump Return Hose Clamp Screw	26 lbs. in.				15 lbs. in.
Power Steering Pump & Gear Hose Fittings	25 lbs. ft.				
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.††
Control Valve Clamp Bolt	—	—	—	—	25 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.

# WHEELS AND TIRES

## SECTION 10

### CHEVROLET TIRE USAGE CHARTS

CHEVROLET			
Engine and Body Style		Standard	Optional
All L-6 Base V-8 without A/C	Biscayne and Bel Air	F78-15 or G78-15	G78-15, H78-15 Whitewall
Base V-8 with A/C 400 V-8 (2 bbl.) Base V-8 400 V-8 (2 bbl.) Base V-8 (400 V-8 2 bbl.)	Biscayne and Bel Air  Impala  Caprice	G78-15	H78-15 Whitewall
402 V-8 454 V-8	Biscayne, Bel Air Impala Caprice	H78-15	H78-15 Whitewall
CHEVELLE			
L-6	Sedans, Coupes, Convertibles	E78-14	F78-14; Whitewall
	Except SS Models	E78-14	E78-14 or F78-14 Whitewall
V-8	402 cu. in. V-8	F78-14	F78-14 Whitewall
	SS Models	F60-15 White Letters	—
All	El Camino Except SS Models	E78-14 or F78-14	—
	SS Models	F60-14 White Letters	—

CAMARO			
Engine and Body Style		Standard	Optional
All		E78-14	F70-14 White Stripe
SS Models		F70-14 White Letters	
Z-28		F60-15 White Letters	—
MONTE CARLO			
All	All Exc. SS454	G78-15	G70-15 Blackwall and White Stripe
	SS454	G70-15	G70-15 White Stripe
NOVA			
All	All except SS Models	E78-14	E78-14, 2 Ply Whitewall
All	SS Models	E70-14 White Letters	E78-14, 2x2, Belted Whitewall
CHEVROLET STATION WAGONS			
All	Station Wagon (125" W.B.)	L78-15 or L78-15D	L78-15D
All	Station Wagon (116" W.B.)	G78-14 or G78-14D	G78-14D

Standard and Optional Tires are Load Range B unless otherwise specified.

Tire inflation pressure may increase as much as 6 pounds per square inch (psi) when hot. For continuous high speed operation (over 75 mph) increase tire inflation pressure 4 pounds per square inch over the recommended pressures up to a maximum of 32 pounds per square inch cold for load range B tires. Sustained speeds above 75 mph are not recommended when the 4 pounds per square inch adjustment would require pressures great than the maximum stated above.

Cold tire inflation pressure: after vehicle has been inoperative for 3 hours or more, or driven less than 1 mile.

Hot tire inflation pressure: after vehicle has been driven 10 miles at speeds of more than 60 miles per hour.

Station wagon loads should be distributed as far forward as possible. Vehicles with luggage racks do not have a vehicle load limit greater than specified. When towing trailers, the allowable passenger and cargo load must be reduced by an amount equal to the trailer tongue load on the trailer hitch.

## CORVETTE TIRE USAGE

Tire Usage and Recommended Tire Inflation Pressures Pounds per Square Inch

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*	F70-15 Nylon	24	24

\*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.

## CHASSIS SHEET METAL

### SECTION 11

	Chevrolet	Chevelle	Monte Carlo	Nova	Camaro	Corvette
Hood Catch Assembly	20 ft.					
Hood Catch Tension Spring	20 ft.					
Hood Catch Plate	20 ft.	20 ft.	20 ft.	20 ft.	20 ft.	
Hood Lock Bolt		30 ft.	30 ft.	30 ft.	30 ft.	25 ft.
Hood Lock Bolt Plate		20 ft.	20 ft.	20 ft.	20 ft.	120 in.
Hood Hinge	25 ft.	25 ft.	25 ft.	25 ft.	25 ft.	20 ft.
Hood Bumper	85 in.	85 in.	85 in.	85 in.	85 in.	85 in.
Hood Impact Bolt	25 ft.	25 ft.	25 ft.		25 ft.	



**BODY AND CHASSIS ELECTRICAL****SECTION 12****PASSENGER (EXCEPT VEGA) ELECTRICAL****Lamp Usage**

	C.P. or Watts	Bulb Number
Directional Signal		
(except Corvette) . . . . .	2	194
Corvette . . . . .	2	1895
Door Ajar (Corvette) . . . . .	2	1895
Generator . . . . .	2	194
Head Lamps up (Corvette) . . . .	2	1895
Hi Beam		
Except Corvette . . . . .	2	1895
Corvette . . . . .	2	1895
Low Fuel (Nova) . . . . .	2	194
Oil Pressure . . . . .	2	194
Seat Belts (except Corvette) . . .	2	194
Corvette . . . . .	2	1895
Stereo Except Chevrolet . . . . .	3	2182
Chevrolet . . . . .	.07	66
Temperature . . . . .	2	194
Windshield Washer Fluid . . . . .	3	168
Cigar Lighter - Corvette . . . . .	1	1445
Dome and courtesy		
Cartridge type - all . . . . .	12	211
Bayonet		
Except Corvette . . . . .	6	31
Corvette . . . . .	6	90
Glove Box		
Chevrolet, Nova, Corvette and		
Camaro without AC . . . . .	2	1895
Chevelle and Monte Carlo . . . .	2	1893
Camaro with AC . . . . .	2	194
Heater or AC Control Panel		
Chevelle, Monte Carlo, Camaro .	1	1445
Chevrolet and Nova . . . . .	2	1895
Corvette . . . . .	3	1816
Seat Separator - Courtesy . . . . .	6	212
Map Lamp in Mirror . . . . .	4	563
Luggage compartment		
Except Chevrolet . . . . .	15	1003
Chevrolet . . . . .	6	89
Underhood . . . . .	15	93
Radio Dial		
Except Corvette . . . . .	3	1816
Corvette . . . . .	2	1893
Tape Player Lens		
Except Chevrolet . . . . .	1	216
Chevrolet . . . . .	2	564

	C.P. or Watts	Bulb Number
Headlamp Unit		
Chevrolet & Corvette		
Outer - High Beam . . . . .	37 1/2	4001
Outer - Low Beam . . . . .	55	
Inner - High Beam Only . . . .	37 1/2	4001
Nova, Camaro, Chevelle,		
Monte Carlo		
High Beam . . . . .	60	6014
Low Beam . . . . .	50	
Parking lamp and front		
directional signal		
R.S. Camaro, Monte Carlo . . .	3-32	1157NA
Chevrolet, Chevelle, Nova,		
Corvette, and Camaro		
(Except R.S.) . . . . .	3-32	1157
Tail, stop and rear directional		
signal . . . . .	3-32	1157
Backing lamps . . . . .	32	1156
Side Marker - Front or rear		
Except Corvette . . . . .	2	194
Corvette . . . . .	3	168
License Plate Lamp		
Except Corvette . . . . .	2	194
Corvette . . . . .	3	168
License Plate Lamp		
Except Corvette . . . . .	4	67
Corvette . . . . .	4	97
Instrument Illumination Lamps		
Chevelle, Monte Carlo and		
Camaro . . . . .	2	194
Corvette . . . . .	2	1895
Chevrolet, Nova . . . . .	3	168
Floor Console Cluster (Nova) . .	3	1816
Indicator Lamps		
Automatic Transmission		
Chevrolet, Chevelle &		
Monte Carlo		
(without seat separator) . .	2	194
Camaro, Nova, Chevelle		
(with seat separator) . . . . .	1	1445
Corvette . . . . .	2	1895
Brake Warning		
(except Corvette) . . . . .	2	194
Corvette . . . . .	2	1895

## FUSES AND CIRCUIT BREAKER

A circuit breaker in the light control switch protects the headlamp circuit, thus eliminating one fuse. A separate 30 amp circuit breaker mounted on the firewall (except Chevrolet, which is in the fuse panel) protects the power window, seat and top circuits. Where the current load is too heavy, the circuit breaker rapidly opens and closes, protecting the circuit until the cause is found and eliminated. Fuses located in the Fuse Panel under the instrument panel are:

Radio, Transmission Control Spark System, rear defogger, 3 Speed A/T Down shift, Glove Box Lamp . . . . .	10 Amp.
Wiper/Washer . . . . .	25 Amp.
Stop Lamps, Hazard Flasher . . . . .	20 Amp.
Heater and Air Conditioning . . . . .	25 Amp.
Directional Signals, Back-up Lamp	
Cruise Master, Power Window Relay . .	20 Amp.
Instrument Lamps - Chevrolet, Camaro . .	3 Amp.
Instrument Lamps (incl. A/T Quadrant Illumination)	
Nova, Chevelle, Monte Carlo . . . . .	4 Amp.
Instrument Lamps, Corvette . . . . .	5 Amp.
Gauges and Tell-Tale Warning Lamps . . .	10 Amp.
Clock, Cigar Lighter, Courtesy Lamps, Deck Lid Lock, Anti-Theft Alarm, Glove Box and Dome Lamps . . . . .	20 Amp.
Tail, License, Marker, Luggage and Parking Lamps . . . . .	20 Amp.

### IN-LINE FUSES

Air Conditioning High Blower Speed Fuse in wire running from horn relay to A/C Relay Confortron and Four Season . . . . .	SAE 30 Ampere
Hood and Spot Lamp circuit . . . . .	SAE 15 Ampere

### FUSIBLE LINKS - IN ENGINE COMPARTMENT

Molded splice at Solenoid "Bat" terminal . . . . .	14 gauge brown wire
Molded splice Located at the horn relay. . . . .	16 gauge black wire
Molded splice in Voltage Regulator #3 terminal wire .	20 gauge orange wire
Molded splice in Ammeter circuit (Both sides of meter) . . . . .	20 gauge orange wire

### Windshield Wipers

Depressed Park	Two Speed
Operation Test Voltage (Bench or Battery) .	12 VDC
Gear Ratio . . . . .	51:1
Current Draw (Amps.) No Load (no linkage)	
Low Speed . . . . .	6 Max.
Hi Speed . . . . .	4.5 Max.
Stall . . . . .	18 Max.
Shunt Field Resistance (ohms) . . . . .	5-6
Crank Arm Speed (rpm's) No-Load	
Low . . . . .	35-50
Hi . . . . .	70-95

### Washer Pump

Number of "squirts" at full pressure . . . . .	10
Pressure (psi) . . . . .	11-15
Coil Resistance (ohms) . . . . .	9±1

## RADIATOR AND GRILLE

### SECTION 13

	Chevrolet	Chevelle	Monte Carlo	Nova	Camaro	Corvette
Grille	12 In.	18 In.	85 In.	30 In.	18 In.	30 In.
Grille Brackets	18 Ft.	18 In.	20 Ft.	20 Ft.	18 Ft.	20 Ft.
Fan Shroud	50 In.	50 In.	50 In.	50 In.	50 In.	20 Ft. (Upr. Grille) 150 In. (Lwr. Grille)

Torque measurements above are in either "Inch Lbs." or "Foot Lbs."

## BUMPERS

### SECTION 14

	Chevrolet	Chevelle	Monte Carlo	Nova	Camaro	Corvette
Front Bumper	30 Ft.	25 Ft.	25 Ft.	30 Ft.	20 Ft.	30 Ft.
Front Bumper Bracket & Brace	55 Ft.	70 Ft.	70 Ft.	70 Ft.	24 Ft.	30 Ft. (Otr.) 55 Ft. (Otr.)
Rear Bumper to Outer Bracket	30 Ft.	25 Ft. (Upr.) 40 Ft. (Lwr.)	55 Ft.	30 Ft.	17 Ft.	30 Ft.
Rear Bumper to Outer Brace	30 Ft.		30 Ft.		17 Ft.	
Rear Bumper to Center Bracket	24 Ft.		38 Ft.		17 Ft.	
Rear Bumper to Body Frame	55 Ft. (Wag. Only)	55 Ft.	38 Ft.			
Rear Bumper Outer Bracket & Brace	70 Ft. 55 Ft. (Wag.)	55 Ft.	38 Ft.	25 Ft.	24 Ft.	70 Ft.
Rear Bumper Center Bracket	—		38 Ft.	—		

Torque measurements above are in either "Inch Lbs." or "Foot Lbs."

## ACCESSORIES

### SECTION 15

#### CRUISE MASTER

Solenoid Resistance . . . . .	5 ohms $\pm$ 1/4 ohm
Solenoid Wire Resistance . . . . .	40 ohms
Maximum allowable Vacuum Leakage Rate for Servo Unit . . . . .	5 inches of Vacuum Per Minute
	Not greater than 1 inch of Vacuum per 10 seconds
Operational Test Speed . . . . .	60 MPH



# 10-30 TRUCK

## SPECIFICATIONS

### HEATING AND AIR CONDITIONING

#### SECTION 1A

#### HEATER

	<u>Volts</u>	<u>Amps.</u> <u>(Cold)</u>	<u>RPM</u> <u>(Cold)</u>
<b>Blower Motor</b>			
Deluxe Air . . . . .	13.5	6.25 Max.	2550 Min. 2950 Max.

#### Fuses

Deluxe Heater . . . . . 10 Amp.

#### AIR CONDITIONING

#### Compressor

Make . . . . . Frigidaire  
 Type . . . . . 6 Cylinder Axial  
 Displacement . . . . . 12.6 Cu. In.  
 Rotation . . . . . Clockwise

	<u>Volts</u>	<u>Amps.</u> <u>(Cold)</u>	<u>RPM</u> <u>(Cold)</u>
<b>Blower Motor</b>			
Four-Season . . . . .	12	16.5 Max.	3700 Min.
GM Chevrolet and Roof-Mounted . . .	12	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  
 Four-Season and GM Chevrolet . . . . . 3 lbs. 4 oz.  
 Roof-Mounted . . . . . 5 lbs. 8 oz.  
 525 Viscosity Compressor Oil  
 Four-Season and GM Chevrolet . . . . . 10 fluid oz.  
 Roof-Mounted . . . . . 13 fluid oz.

#### Torque Specifications

Compressor Suction and Discharge  
 Connector Bolt . . . . . 25 ft. lbs.  
 Rear Head to Shell Stud Nuts . . . . . 23 ft. lbs.  
 Shaft Mounting Nut . . . . . 15 ft. lbs.  
 Belt Tension . . . . . See Tune Up Chart

#### Fuses

##### Fuse Block—

Four-Season and Roof-Mounted Systems . . . . . 25 Amp.  
 GM Chevrolet Systems . . . . . 10 Amp.

##### In-Line—

Roof-Mounted System . . . . . 25 Amp.

## BODY SECTION 1B

### MIRRORS AND SUNSHADE

Inside Rear View Mirror	
Mirror to Bracket . . . . .	45 in. lb.
Bracket to Header Panel . . . . .	15 in. lb.
Sunshade Support to Header Panel . . . . .	20 in. lb.
Outside Rear View Mirror to Door Panel	
Series 10-20-30 Except (03-04-34 Models) . . . . .	40 in. lb.
Series 20-30 (03 Models) . . . . .	120 in. lb.

### DOORS

Window Regulator to Door Panel . . . . .	40 in. lb.
Door Lock to Door Panel . . . . .	75 in. lb.
Lock Striker to Body Pillar . . . . .	25 ft. lb.
Rear Door Lock Striker . . . . .	95 in. lb.
Outside Door Handle . . . . .	40 in. lb.
Rear Door Arm Check . . . . .	55 in. lb.
Hinge to Door and Body	
All Except Rear Doors . . . . .	25 ft. lb.
Rear Doors . . . . .	30 ft. lb.
Rear Door Bumpers . . . . .	30 in. lb.
Rear Door Latch Control . . . . .	85 in. lb.
Rear Door Latch . . . . .	85 in. lb.

### LIFTGATE

Hinge Bolts . . . . .	25 ft. lb.
Liftgate Support . . . . .	40 in. lb.
Handle . . . . .	40 in. lb.
Striker . . . . .	95 in. lb.

### ENDGATE (EXCEPT SUBURBAN)

Handle . . . . .	95 in. lb.
Tailgate-to-Pickup Box Support . . . . .	17 ft. lb.
Latch . . . . .	150 in. lb.
Trunnion . . . . .	17 ft. lb.

### ENDGATE (SUBURBAN)

Latch . . . . .	85 in. lb.
Latch Remote Control . . . . .	40 in. lb.
Endgate to Body Support . . . . .	45 ft. lb.
Striker (Body Mounted) . . . . .	90 in. lb.
Hinges . . . . .	30 ft. lb.
Bumpers . . . . .	10 in. lb.

### SEATS

Seat Back-to-Seat Cushion . . . . .	25 ft. lb.
Front Seat	
Bench Type	
Adjuster-to-Seat . . . . .	150 in. lb.
Adjuster-to-Floor . . . . .	150 in. lb.
Bucket Type	
Adjuster-to-Seat . . . . .	150 in. lb.
Adjuster-to-Floor . . . . .	18 ft. lb.
Center and Rear Seat (Bench Type)	
Leg-to-Seat . . . . .	17 ft. lb.
Leg-to-Floor . . . . .	50 ft. lb.
Rear Mounting Bracket	
to Seat . . . . .	18 ft. lb.
to Floor . . . . .	30 ft. lb.
Body Mounts All Except Rear #2 . . . . .	20 ft. lb.
Rear #2 . . . . .	50 ft. lb.
Seat Belt . . . . .	40 ft. lb.



## FRONT SUSPENSION

### SECTION 3

#### \*WHEEL ALIGNMENT SPECIFICATIONS

	CASTER										
Dimension "A" in inches	2 1/2"	2 1/4"	3"	3 1/4"	3 1/2"	3 1/4"	4"	4 1/4"	4 1/2"	4 1/4"	5"
CA PA 10			+ 2°	+ 1 3/4°	+ 1 1/2°	+ 1 1/4°	+ 1°	+ 3/4°	+ 1/2°	+ 1/4°	0°
CA PA 20 - 30	+ 2 3/4°	+ 2 1/2°	+ 2°	+ 1 3/4°	+ 1 1/2°	+ 1 1/4°	+ 1°	+ 3/4°	+ 1/2°	+ 1/4°	0°
K - 10 - 20	+ 4°	no provision for resetting									
CAMBER											
CA PA - 10 - 20 - 30 . . . . .											+ 1/4°
K 10 . . . . . No provision for resetting											+ 1 1/2°
TOE-IN (TOTAL)											
CA PA 10 - 20 - 30 KA 10 - 20											3/16"

\*See column 1, 2 or 3 under Vehicle Alignment Tolerances for applicable tolerances.

#### 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.

## FRONT SUSPENSION BOLT TORQUE (Ft. Lbs.)

	CP-10	CP-20-30	K-All
Lower Control Arm Shaft U-Bolt	45	110	-
Upper Control Arm Shaft Nuts	70	120	-
Lower Control Arm Bushing	New 160 Replace 95	New 190 Replace 115	-
Lower Control Arm Bushing	New 280 Replace 130	New 280 Replace 130	-
Upper Ball Joint Nut	*50	**90	**100
Lower Ball Joint Nut	***90	***90	*** 80
Crossmember to Side Rail	65	65	-
Crossmember to Bottom Rail	100	100	-
Stabilizer Bar to Control Arm	25	25	-
Stabilizer Bar to Frame	25	25	-
Shock Absorber Upper End	140	140	65
Shock Absorber Lower End	75	75	65
Brake Splash Shield to Knuckle	140 In. Lbs.	140 In. Lbs.	-
Wheel Bearing Adjustment	#15	#40	Inner#-35 Outer -50
Wheel Bearing Preload	Zero	Zero	Zero
Wheel Bearing End Movement	.001-.008	.001-.010	.001-.010
Caliper Mounting Bolt	35	35	35
Spring-Front Eye Bolt	-	-	90
Spring-Rear Eye Bolt	-	-	50
Spring-To Rear Shackle Bolt	-	-	50
Spring-To Axle U-Bolt	-	-	120
Spring-Front Hanger to Frame	-	-	30
Suspension Bumper	15	15	15
Shackle Stop Bracket Bolts	-	-	40

\* 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.

## REAR SUSPENSION

### SECTION 4

#### TORQUE SPECIFICATIONS (FT. LBS.)

#### WHEEL BEARING ADJUSTMENT SPECIFICATIONS

Rear Axle Capacity	Bearing Adjusting Nut Torque*	Adjusting Nut Back-off*	Outer Locknut Torque	Resulting Bearing Adjustment	Type of Bearing
5,200# and 7,200#	50-60 Ft. Lbs.	1/8 *	175 Ft. Lbs.	Slight Preloaded	Barrel Roller
11,000#	75-100 Ft. Lbs.	1/8 *	250 Ft. Lbs.	Slight Preloaded	Barrel Roller
5,500#	50 Ft. Lbs.	**	65 Ft. Lbs.	.001 to .010 End Play	Tapered Roller

\*\* Back-off nut and retighten to 35 Ft. Lbs. then, back-off nut 1/4 turn.

\* With wheel rotating.

#### UNIVERSAL JOINT ATTACHMENT

#### TORQUE SPECIFICATIONS

Strap Attachments . . . . .	15 Ft. Lbs.
"U" Bolt Attachment . . . . .	20 Ft. Lbs.

#### DIFFERENTIAL SPECIFICATIONS

	3300-3600 Lb. Capacity	5500# (Dana)	5200-7200 Lb. Capacity	11,000 Lb. Capacity
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		
Used	5-10	10-20		

#### Bolt Torques (Ft. Lbs.)

Carrier Cover	23	35	18	—
Ring Gear	50	110	110	105
Differential Bearing Caps	55	85	100	205

	3300-3600 Lb. Capacity	5500# (Dana)	5200-7200 Lb. Capacity	11,000 Lb. Capacity
Filler Plugs	18	10	18	10
Differential Pinion Lock	20	—	—	—
Drive Pinion Nut	—	255	220	220
Differential Carrier to Axle Housing	—	—	45	85
Differential Bearing Adjusting Lock	—	—	15	15
Pinion Bearing Cage To Carrier	—	—	95	165
Trust Pad Lock Nut	—	—	135	135
Brake - Backing Plate	35	35	105	155
Axle Shaft To Hub Bolts	—	60	90	15

## TORQUE SPECIFICATIONS (FT. LBS.) (CONT'D)

	CA-PA10	CA20	K10-20	PA20-30	CA30
Tie Rod Attaching Bolts	*	**	-	-	-
- Stud to Axle	135	135	-	-	-
- Tie Rod to Stud	135	135	-	-	-
- Frame					
Axle to Control Arm U Bolts	145	145	-	-	-
Spring to Axle U Bolts Nuts	-	120	120	150	120
Control Arm Front Attaching Bolts	145	145	-	-	-
Coil Spring Attaching Bolt Lower	55	55	-	-	-
Coil Spring Attaching Bolt Upper	50	50	-	-	-
Spring Front Bushing Bolt	-	90	90	90	90
Spring Rear Shackle Bolts	-	90	90	90	90
Shock Absorber Attaching Bolts	75	75	65	65	-
Propshaft Bearing Support Hanger	20	#	-	35	35
Rear Stabilizer	-	-	-	25	-

\* C-P10 Models - 135 Ft. Lbs.

\*\* Models CE-CS 25903-04-34 - 250 Ft. Lbs.

All others - 135 Ft. Lbs.

# C20 Except 133" W.B. Models - 20 Ft. Lbs.

C20 133" W.B. Models - 35 Ft. Lbs.

# BRAKES

## SECTION 5

### TORQUE SPECIFICATIONS

Master Cylinder to Dash or Booster . . . . .	25 Ft. Lbs.
Vacuum Booster to Frame . . . . .	25 Ft. Lbs.
Brake Line to Master Cylinder . . . . .	150 In. Lbs.
Brake Line to Combination Valve . . . . .	150 In. Lbs.
Brake Line From Combination Valve . . . . .	150 In. Lbs.
Brake Line to Frame . . . . .	150 In. Lbs.
Combination Valve Mounting Nuts . . . . .	17 Ft. Lbs.
Combination Valve Master Cylinder Brace/Dash . . . . .	150 In. Lbs.
Flex Hose to Caliper . . . . .	22 Ft. Lbs.
Flex Hose to Tubing . . . . .	100 In. Lbs.
Rear Pipe to Wheel Cylinder . . . . .	150 In. Lbs.
Rear Pipe to Connector . . . . .	115 In. Lbs.
Flex Hose to Connector . . . . .	115 In. Lbs.
Flex Hose to Pipe . . . . .	115 In. Lbs.
Front Brake Hose to Frame Nut . . . . .	58 In. Lbs.
Brake Line to Front Crossmember Bolt . . . . .	100 In. Lbs.
Brake Line Bracket to Axle Housing Nut . . . . .	18 Ft. Lbs.
Brake Line to Bracket Bolt at Axle Housing . . . . .	90 In. Lbs.
Push Rod to Pedal . . . . .	27 Ft. Lbs.
Push Rod to Clevis Nut . . . . .	25 Ft. Lbs.
Brake Pedal Bolt Nut . . . . .	95 In. Lbs.
Pedal Bracket to Dash . . . . .	25 Ft. Lbs.
Pedal Support to Bracket . . . . .	150 In. Lbs.
Parking Brake Assembly to Dash . . . . .	100 In. Lbs.
Parking Brake Assembly to Instrument Panel . . . . .	100 In. Lbs.
Parking Brake Cable to Assembly Clip . . . . .	18 Ft. Lbs.
Cable Clips to Frame . . . . .	18 Ft. Lbs.
Equalizer Nuts . . . . .	17 Ft. Lbs.
Rear Brake Anchor Pin . . . . .	140 Ft. Lbs.
Caliper Mounting Bolt . . . . .	35 Ft. Lbs.
Support Plate to Knuckle . . . . .	140 In. Lbs.

# ENGINE

## SECTION 6

### TUNE-UP CHART

ENGINE	Type		In Line		V8			
	Displacement		250	292	307		350	402
	Horsepower		110	125	135	215	175	210
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	Syn.	4° B a	4° B	4° B		4° B	8° B
③		Auto.	4° B a	4° B	8° B b		8° B	8° B
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 lb. 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.	700	700	900 c		800	750	
	Auto.	600	700	600		600	600	
FUEL PUMP ⑦	Pressure in lbs.	3-1/2 to 4-1/2		5 to 6-1/2		7 to 8-1/2		
	Volume	1 pint in 30-45 seconds @ cranking speed						
CRANKCASE VENTILATION			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.

a 0°-K20 suburban models for California only.

b 4° B - 20 & 30 series.

c 950 - C&K series for California only.



GENERAL DATA:											
Type	In Line			V8							
Displacement (cu. in.)	250		292	307		350		402			
Horsepower @ rpm	110 @ 3600		125 @ 3600	135 @ 4000		175 @ 4000		210 @ 4000			
Torque @ rpm	185 @ 1600		225 @ 2400	230 @ 2400		290 @ 2400		320 @ 2800			
Bore	3-7/8			3-7/8		4		4-1/8			
Stroke	4.12			3.25		3.48		3.76			
Compression Ratio	8.5:1			8.5:1		8.5:1		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			3.8745 - 3.8775		3.9995 - 4.0025		4.1246 - 4.1274			
Out of Round	.0005 Max.					.001 Max.					
Taper	Production	Thrust Side	.002 Max.								
	Service	Relief Side	.0005 Max.								
	.0005 Max.			.005 Max.		.001 Max.					
PISTON:											
Clearance	Production	.0005 - .0015		.0025 - .0031		.0012 - .0018		.0007 - .0013			
	Service	.0025 Max.		.0045 Max.		.0032 Max.		.0027 Max.			
PISTON RING:											
COMPRESSION	Clearance Groove	Production	Top	.0012 - .0027		.0012 - .0027		.0012 - .0032			
			2nd	.0012 - .0032		.0020 - .0040		.0012 - .0032			
	Gap	Service	Hi Limit Production + .001								
			.010 - .020								
		Production	Top	.010 - .020							
			2nd	.010 - .020							
OIL	Groove Clearance	Production	.005 Max.		.005 - .0055		.005 Max.		.002 - .007		
		Service	Hi Limit Production + .001								
	Gap	Production	.015 - .055								
		Service	Hi Limit Production + .01								
		PISTON PIN:									
		Diameter	.9270 - .9273			.9870 - .9873		.9895 - .9898			
Clearance	Production	.00015 - .00025			.001 (Max.)		.00025 - .00035				
Fit in Rod	.0008" - .0018 Interference										
CRANKSHAFT:											
Main Journal	Diameter	All			#1-2-3-4		#1-2				
		2.2983 - 2.2993			2.4484 - 2.4493		2.7487 - 2.7496				
					#5		#3-4				
	Taper				2.4479 - 2.4488		#5		2.7481 - 2.7490		
		Production				.0002 (Max.)		2.7473 - 2.7483			
		Service				.001 (Max.)					
Main Bearing Clearance	Production	All		#1		#1					
		.0003		.0008		.0008 - .0020		.0007 - .0019			
		.0029		.0034		#2-3-4		#2-3-4			
	Service					.0011 - .0023		.0013 - .0025			
						#5		#5			
						.0017 - .0033		.0019 - .0033			
CRANKSHAFT END PLAY:											
Crank-pin	Diameter	1.999 - 2.000		2.099 - 2.100		2.199 - 2.200		.006 - .010			
		2.099 - 2.100				2.1985 - 2.1995					
						.0003 (Max.)					
	Taper	.0001 (Max.)				.0002 (Max.)					
		.0002 (Max.)				.001 (Max.)					
		.0001 (Max.)				.0013 - .0035		.0009 - .0025			
Rod Bearing Clearance	Production	.0007 - .0027		.0035 (Max.)		.008 - .014		.013 - .023			
Rod Side Clearance	Production	.0009 - .0014		.008 - .014		.013 - .023					
CAMSHAFT:											
Lobe Lift ± .002" (X)	Intake	.2217		.2315		.2600		.2343			
Journal Diameter	Exhaust	.2217		.2315		.2733		.2343			
Camshaft Runout	1.8682 - 1.8692			.0015 Max.		1.9482 - 1.9492					
VALVE SYSTEM:											
Lifter	Hydraulic			1.50:1		1.70:1					
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°			46°		.002 (Max.)					
Seat Angle (Int. & Exh.)	.002 (Max.)			1/32 - 1/16		1/16 - 3/32					
Seat Runout (Int. & Exh.)	1/32 - 1/16			1/16 - 3/32		.0010 - .0027					
Seat Width	Intake	.0015 - .0032			.0010 - .0027		.0012 - .0029				
Stem Clearance	Production	.0015 - .0032			Hi Limit Production + .001 Intake - .002 Exhaust		.0012 - .0029				
	Service										
Valve Spring (Outer)	Free Length	1.90			2.03		2.12				
	Pressure	55-64 @ 1.66		85-93 @ 1.69		76-84 @ 1.70		69-81 @ 1.88			
	lbs. @ in. Open	180-192 @ 1.27		174-184 @ 1.30		194-206 @ 1.25		228-252 @ 1.38			
	Installed Height ± 1/32"	1-21/32		1-5/8		1-23/32		1-7/8			
Valve Spring (Inner)	Free Length	-			-		2.06				
	Pressure	-			-		26-34 @ 1.78				
	lbs. @ in. Open	-			-		81-99 @ 1.28				
	Installed Height ± 1/32"	-			-		1-25/32				
Damper	Free Length	-			1.94		-				
	Amorox. # of Coils	-			4		-				

(X) California Camshafts: #6262810(L6) Inlet 0.2217 - Exhaust 0.2315  
 #6262944 (Small V8) Inlet 0.2671 - Exhaust 0.2733  
 #3864896(L6) Inlet 0.2217 - Exhaust 0.2217

## ENGINE TORQUES

Size		Usage	In Line		Small V-8		Mark IV V-8
			250	292	307	350	402
1/4-20	Camshaft Thrust Plate	80 lb. in.					
	Crankcase Front Cover				80 lb. in.		
	Flywheel Housing Pans				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.					80 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)	25 lb. ft.					
	Manifold (Inlet)			30 lb. ft.			
	Manifold-to-head	30 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 307-350 engines 30 lb. ft.

# CARBURETOR

## SECTION 6M

### IDENTIFICATION

Also refer to Rochester Carburetor Identification  
Illustration in the Overhaul Shop Manual.

VEHICLES						ENGINES		TRUCK CARBURETORS				
Type						Displacement and Type	RPO	BBL.	All (Except Calif.)		California	
C	K	P	G	M	S				Manual	Auto.	Manual	Auto.
10	10	10	10-20			250 L-6	Base	1	7042021	7042022	7042991	7042992
20-30	20	20-30	30			250 L-6	Base	1	7042025	7042025	7042025	7042025
20	20		30			250 L-6	Base	1	7042021	7042022	7042991	7042992
40					40	250 L-6	Base	1	7042011	7042011	7042011	7042011
20-30	20	20-30				292 L-6	L-25	1	7042026	7042026	7042026	7042026
40-50				50	50	292 L-6	L-25	1	7042012	7042012	7042012	7042012
			10			307 V-8	Base	2	7042103	7042102	7042823	7042822
10	10					307 V-8	Base	2	7042105	7042104	7042825	7042824
40						350 V-8	Base	2	7042123	7042123	7042123	7042123
50				50	50	350 V-8	Base	2	7042124	7042124	7042124	7042124
			20-30			350 V-8	Base	4QJ	7042211	7042210	7042911	7042910
10	10		10			350 V-8	LS-9	4QJ	7042211	7042210	7042911	7042910
20-30	20-30	20-30	30			350 V-8	LS-9	4QJ	7042208	7042208	7042208	7042208
20-30	20-30	20-30				307 V-8	Base	2	7042108	7042108	N/A	N/A
60				60		366 M-4	Base	4H	685981	685981	685981	685981
50					50	366 M-4	L-86	4H	685981	685981	685981	685981
10-20						402 M-4	L-47	4QJ	7042219	7042218	N/A	N/A
20-30		30%				402 M-4	L-47	4QJ	7042207	7042206	7042207	7042206
60					60	427 M-4	L-43	4H	685982	N/A	685982	N/A

(%) Auto transmission only.

**HEAVY DUTY:** (Emissions Definition) All C, K, P & G over 6,000 GVW except 06 & 16 C & K (Suburbans) and 06 & 36 G (Sportvans) which are "People Carriers". Refer to GVW plate for gross vehicle weight specified on a permanent plate attached to the cab or vehicle body.

## ADJUSTMENTS

### Rochester Carburetors

M O D E L	Number (A) Automatic Trans. (M) Manual Trans.	Float Level	Float Drop	Metering Rod	Pump Rod	Choke Rod (Fast Idle Cam 2nd Step)	Air Valve Dashpot	Choke Vacuum Break	Choke Unloader
MV	7042011 (A) (M)	1/4		.070		.150			
MV	7042012 (A) (M) H/D	1/4		.070		.150			
MV	7042021 (M)	1/4		.078		.150		.225	.500
MV	7042991 (M)	1/4		.076		.150		.225	.500
MV	7042022 (A)	1/4		.079		.125		.190	.500
MV	7042992 (A)	1/4		.078		.125		.190	.500
MV	7042025 (A) (M) H/D	1/4		.070		.180		.260	.500
MV	7042026 (A) (M) H/D	1/4		.070		.275		.350	.500
2GV	7042102 (A)	21/32	1-9/32		1-5/16	.040		.080	.210
2GV	7042104 (A)	21/32	1-9/32		1-5/16	.040		.080	.210
2GV	7042822 (A)	21/32	1-9/32		1-5/16	.040		.080	.210
2GV	7042824 (A)	21/32	1-9/32		1-5/16	.040		.080	.210
2GV	7042103 (M)	21/32	1-9/32		1-5/16	.075		.110	.210
2GV	7042105 (M)	21/32	1-9/32		1-5/16	.075		.110	.210
2GV	7042823 (M)	21/32	1-9/32		1-5/16	.075		.110	.210
2GV	7042825 (M)	21/32	1-9/32		1-5/16	.075		.110	.210
2GV	7042108 (A) (M) H/D	25/32	1-9/32		1-1/2	.100		.170	.325
2G	7042123 (A) (M) H/D	23/32	1-9/32		1-1/2				
2G	7042124 (A) (M) H/D	23/32	1-9/32		1-1/2				
4MV	7042206 (A) H/D	1/4			13/32	.100	.020	.250	.450
4MV	7042207 (M) H/D	11/32			13/32	.100	.020	.250	.450
4MV	7042208 (A) (M) H/D	3/16			3/8	.100	.020	.215	.450
4MV	7042219 (M)	11/32			3/8	.100	.020	.250	.450
4MV	7042210 (A) H/D	3/16			3/8	.100	.020	.215	.450
4MV	7042218 (A)	1/4			3/8	.100	.020	.250	.450
4MV	7042211 (M) H/D	3/16			3/8	.100	.020	.215	.450
4MV	7042910 (A) H/D	3/16			3/8	.100	.020	.215	.450
4MV	7042911 (M) H/D	3/16			3/8	.100	.020	.215	.450

L/D Light Duty, H/D Heavy Duty — See Identification Chart

### FAST IDLE (RUNNING) RPM ADJUSTMENT

#### Carburetors—Rochester

Vehicles	MV		4QJ		2GV
	Auto.	Man.	Auto.	Man.	Auto. and Manual
All Trucks	2400† a.		* 1500 b.	* 1350 b.	*1850 (1-1/4 S.A.E.) These settings are approximate with low idle at 450 RPM — *2200 (1-1/2 S.A.E.) with viscous clutch fans disengaged.

† With vacuum advance

\* Without vacuum advance

a. On high step

b. On second step

**NOTE:** For vacuum advance for 1 bbl. carburetors — pull lead off of cold over-ride switch and ground it — this will energize the C.E.C. valve.

## OTHER ADJUSTMENTS

**NOTE:** Refer to "Additional External Settings and Adjustments" or "Idle Stop Solenoid adjustment and "C.E.C. Valve Adjustment", 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.

Equipment		(See Note Above) Column No. 1	(See Note Above) Column No. 2	(See Note Above) Column No. 3
Transmission	Engine	Initial Curb Idle Speed (RPM)	Final Curb Idle Speed (RPM)	CEC Valve Engine Speed (RPM)
		Use Lean Drop Method - Except with A.I.R.		(4)
Manual (Neutral)	L-6 250 C.I.D.	800 (1) L/D 775 (3) H/D	700 (3)	1000
	L-6 292 C.I.D. (L-25)	775 (3)	700	—
	V-8 307 C.I.D.	1000 (1) L/D 700 (1) H/D	900 (3) L/D 600 (3) H/D	—
	V-8 350 C.I.D. (LS-9)	1000 (1)	900 (3)	—
	MK IV 402 C.I.D. (L-47)	675 (1) H/D	750 (3) (1) L/D 600 (3) H/D	—
Automatic (In Drive)  Neutral for H/D	L-6 250 C.I.D.	630 (1) L/D 775 (3) H/D	600 (3) 700	650
	L-6 292 C.I.D. (L-25)	775 (3)	700	—
	V-8 307 C.I.D.	650 (1) L/D 700 (1) H/D	600 (3) (1)	—
	V-8 350 C.I.D. (LS-9)	630 (1)		—
	MK IV 402 C.I.D. (L-47)	675 (1) H/D		—

- (1) Idle adjustment for vehicles equipped with A.I.R. is: 1/4 turn rich from lean roll (mixture screw).  
 (2) With A.I.R. operating (if so equipped).  
 (3) Set low idle, using idle speed screw or solenoid allen head screw adjustment (with solenoid de-energized), at 450 RPM.  
 (4) **CAUTION:** If the C.E.C. valve (solenoid) on the carburetor is used to set engine idle or is adjusted out of limits specified in the Service Manual, decrease in engine braking may result.  
 L/D Light Duty, H/D Heavy Duty - See truck identification.

## ENGINE ELECTRICAL

## SECTION 6Y

## BATTERY

Model No.	Application	No. of Plates Per Cell	Cranking Power @ 0° F. (Watts)	Capacity @ 20 Hour Rate (Amp. Hr.)
1980141 (Y86)	250 L-6	54	2300	45
1980145 (R88)	292 L-6, 307 V-8, 350 V-8 & 402 V-8	66	2900	61
1980182 (R88X)	T60 Option	90	3750	76

## GENERATORS

Model No.	Applications	Delco Remy Spec. No.	Field Current Amps. (80° F.)	Cold Output*			Rated Hot Output** Amps.
				Spec. Volts	Amps. @ 2000 RPM	Amps. @ 5000 RPM	
1102452	CA, KZ, GS and PS 10-30 Models	3395	2.2-2.6	14	25	35	37
1102440	GE and PE 10-30 Models	3395	2.2-2.6	14	25	35	37
1102453	CS, KS and GS 10-30 w/N40 (or) K19, PS 10 w/N40	3395	2.2-2.6	14	25	35	37
1102456	CS, KS 10-30 w/N40/K19, PS 10-30 w/N40 & K19 GS10-20 w/N40/K19/L25/E56/RO5/K79	3395	2.2-2.6	14	25	35	37
1102458	CA-KA 10-30/w/N40 K19, GS 10-30 w/K79 PS 20-30 w/L25/K79/N40	3396	2.2-2.6	14	28	40	42
1102459	GE 10-30 w/K79/C62 PE 10-30/ w/K79	3396	2.2-2.6	14	28	40	42
1102455	GS, PS 10-30 w/K76, CA, KA 10-30 w/K76/C60	4500	2.2-2.6	14	33	58	61
1102463	GE 10-30 w/K76/C60 PE 10-30 w/K76	4500	2.2-2.6	14	33	58	61
1100487 (10SI)	PE30 (Motor Home)	4500	2.2-2.6	14	33	33	61

\*Generator temperature approximately 80° F. \*\*Ambient temperature 80° F.

## VOLTAGE REGULATOR

MODEL NO.	APPLICATION	FIELD RELAY			VOLTAGE REGULATOR		
		AIR GAP	POINT OPENING	CLOSING VOLTAGE	AIR GAP	POINT OPENING	VOLTAGE SETTING
1119515	All except 1100487	.015	.030	1.5 - 3.2	.067	.014	13.5 - 14.4 @ 125° F.

## STARTING MOTOR

Model No.	Application	Spec. No.	Free Speed		
			Volts	Amperes	RPM
1108365	GS 10-20	3573	9	50-80*	5500-10,500
1108367	PS, CS, KS w/250 L-6 & A.T., GE w/307 V-8				
1108368	PS, CS, KS w/250 L-6 & M.T., PE, CE, KE 307 V-8 M.T.				
1108338	GE w/350 V-8, PE, CE, KE w/350 V-8 & A.T.	2438	9	55-80*	3500-6000
1108360	PS, CS, KS w/292 L-6 & M.T., PE, CE, KE, 350 V-8 & M.T.				
1108385	CE w/402 V-8 & M.T.	3563	9	65-95*	7500-10,500
1108425	GS 30 w/250 L-6 & M.T., CS 30 w/250 L-6 & A.T., PS, CS, KS w/292 L-6 & A.T.	3533	9	40-105*	3500-6500
1108418	CE w/402 V-8 & A.T.	3563	9	65-95*	7500-10,500

\*Includes Solenoid



## DISTRIBUTORS

Engine Description and Available	Ignition Distributor (Product Part No.)	Centrifugal Advance (Crank Degrees @ Engine RPM)	Vacuum Advance (In Crank Degrees)	Point Dwell Setting	Ignition Timing BTDC at Engine Idle*	Transmission	Original Equipment Spark Plug
250 Cu. In. L-6 Except "G" Series	1110489	C-4797 0 @ 930 RPM 2° @ 1270 RPM	C-3990 0 @ 8" Hg 23° @ 16" Hg	31°-34°	4°	All	AC-R46T
250 Cu. In. L-6 "G" Series	1110493	14° @ 2300 RPM 24° @ 4100 RPM					
250 Cu. In. L-6 20-30 Series w/RPO NB2	1110498		C-3997 0 @ 8" Hg 16° @ 13" Hg				
292 Cu. In. L-6 RPO L25	1110486	C-4809 0 @ 860 RPM 2° @ 1140 RPM 17° @ 2150 RPM 20° @ 4000 RPM	C-3991 0 @ 8" Hg 18° @ 16" Hg	31°-34°	4°	All	AC-R44T
307 Cu. In. V-8 10 Series	1112040	C-4815 0 @ 680 RPM 2° @ 1320 RPM 20° @ 4200 RPM	C-3954 0 @ 8" Hg 20° @ 17" Hg	29°-31°	8°	Automatic	AC-R44T
307 Cu. In. V-8 10 Series	1112041	C-4753 0 @ 800 RPM 2° @ 1200 RPM 12° @ 2200 RPM 24° @ 4300 RPM	C-3954 0 @ 8" Hg 20° @ 17" Hg	29°-31°	4°	Manual	AC-R44T
307 Cu. In. V-8 20-30 Series	1112043	C-4824 0 @ 800 RPM 2° @ 1200 RPM 11° @ 2100 RPM 20° @ 4200 RPM	C-3036 0 @ 8" Hg 15° @ 15.5" Hg	29°-31°	4°	All	AC-R44T
350 Cu. In. V-8 RPO LS9	1112047	C-4818 0 @ 865 RPM 2° @ 1335 RPM 11° @ 2400 RPM 18° @ 4200 RPM	C-3036 0 @ 8" Hg 15° @ 15.5" Hg	29°-31°	8°	Automatic	AC-R44T
350 Cu. In. V-8 RPO LS9	1112046	C-4753 0 @ 800 RPM 2° @ 1200 RPM 12° @ 2200 RPM 24° @ 4300 RPM	C-3036 0 @ 8" Hg 15° @ 15.5" Hg	29°-31°	4°	Manual	AC-R44T
402 Cu. In. V-8 RPO L-47	1112064	C-4830 0 @ 930 RPM 2° @ 1260 RPM 16° @ 2400 RPM 30° @ 4400 RPM	C-3954 0 @ 8" Hg 20° @ 17" Hg	29°-31°	8°	All	AC-R44T

\*Refer to Vehicle Emission Control Information Sticker.

## 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	1.8

# TRANSMISSION AND CLUTCH

## SECTION 7

### 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 . . . . .	20 ft. lbs.
Lubrication Filler Plug . . . . .	15 ft. lbs.
Transmission Case to Clutch Housing Bolts . . . . .	55 ft. lbs.
Crossmember to Frame Nuts . . . . .	25 ft. lbs.
Crossmember to Mount and Mount to Extension Bolts . . . . .	40 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 . . . . .	20 ft. lbs.
Lubrication Filler Plug . . . . .	15 ft. lbs.
Transmission Case to Clutch Housing Bolts . . . . .	55 ft. lbs.
Crossmember to Frame Nuts . . . . .	25 ft. lbs.
Crossmember to Mount and Mount to Extension Bolts . . . . .	40 ft. lbs.
Transmission Drain Plug . . . . .	30 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.
Rear Mainshaft Lock Nut (4 Wheel Drive Models). . . . .	95 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 . . . . .	200 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 . . . . .	35 ft. lbs.
Adapter Mount Bolts . . . . .	75 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.
- (Automatic Transmission) . . . . .	35 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 . . . . .	200 ft. lbs.
Intermediate Shaft Lock Plate Bolt . . . . .	15 ft. lbs.
Rear Output Shaft Housing Bolts . . . . .	30 ft. lbs.
Rear Output Shaft Yoke Lock Nut . . . . .	200 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 . . . . .	75 ft. lbs.
Adapter to Transmission Bolts . . . . .	45 ft. lbs.

# STEERING

## SECTION 9

Components	C-P10	C20 - 30	K10 - 20	P20 - 30
Tie Rod Ball Joint Nut Outer and Inner	35 lbs. ft.**	45 lbs. ft.***	45 lbs. ft.	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.		-	60 lbs. ft.
Pitman Arm to Relay Rod Nut	60 lbs. ft.		-	60 lbs. ft.
Steering Connecting Rod Nuts	-	-	50 lbs. ft. Plus next slot for cotter pin.	-
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.			
Steering Wheel Nut	40 lbs. ft.			
Lower Mast Jacket Bearing Adjustment	P10-1.26 +.02 C10- .50 +.02	.50 + .02		1.26 +.02
Power Steering Belt Tension	125 lbs. New - 75 lbs. Used			
Pump Pulley Nut	58 lbs. ft.			
Pump Pressure	900 - 1000 psi.			
Pump Bracket and Support	25 lbs. ft.			
Power Steering Hose Clamp Screws	15 lbs. in.			
Power Steering Gear Hose Fittings	25 lbs. ft.			
Flexible Coupling Bolt & Studs	18 lbs. in.			
Lower Mast Jacket Bearing Clamp or Coupling Bolt	32 lbs. ft.			
Lower Coupling to Wormshaft Clamp Bolt	C10-30 lbs. ft. P10-75 lbs. ft.	30 lbs. ft.		75 lbs. ft.*
Column to Dash Panel Clamp Screws	125 lbs. in.			120 lbs. in.
Toe Panel Cover Screws	30 lbs. in. C10 24 lbs. in. P10	30 lbs. in.		24 lbs. in.
Firewall Bracket Clamp Bolt	90 lbs. in. C10 98 lbs. in. P10	90 lbs. in.		98 lbs. in.
Lower Bearing Adjusting Ring Bolt	70 lbs. in.			

\* Upper and Lower Universal Joint Clamp

\*\* Plus Torque Required to Align Cotter Pin, Max. 50 lbs. ft.

\*\*\*Plus Torque Required to Align Cotter Pin, Max. 60 lbs. ft.

## SECTION 9 (CONT'D)

## MANUAL STEERING GEAR

Components	C-P10	C20 - 30	K10 - 20	P20 - 30
Worm Bearing Preload	4 to 6 lbs. in.			9 to 12 lbs. in.
Worm Bearing Lock Nut	85 lbs. ft.			
Over Center Adjustment	4 to 10 lbs. in.*			9 to 13 lbs. in.*
Over Center Lock Nut	30 lbs. ft.			
Total Steering Gear Preload	14 lbs. in. Max.			25 lbs. in. Max.

\* In excess of worn bearing preload.

## POWER STEERING GEAR

Components	All
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	25 lbs. ft.
Total Steering Gear Preload	14 lbs. in. Max.

\* In excess of ball drag.

\*\* In excess of ball drag and thrust bearing preload.

## WHEELS AND TIRES

### SECTION 10

#### WHEELS

Wheel Nut Torques - 10-30 Series

SERIES	DESCRIPTION	TORQUE
K10	7/16" Bolts (6)	55-75 ft. lbs.
C, P10	1/2" Bolts (5)	65-90 ft. lbs.
C, P20, 30	9/16" Bolts (8)	90-120 ft. lbs.
C30	Heavy Duty Wheels 5/8" Bolts (10)	200-250 ft. lbs.

#### TIRES

See "Load Capacity Charts" in Section 0 and "Tire Load and Inflation Pressure" tables in Section 10 of this manual.

## SHEET METAL

### SECTION 11

Hood Safety Plate . . . . .	20 ft. lbs.
Hood Lock Bolt . . . . .	30 ft. lbs.
Hood Lock Bolt Plate . . . . .	150 in. lbs.
Hood Hinge . . . . .	25 ft. lbs.
Hood Bumper . . . . .	85 in. lbs.



# BODY AND CHASSIS ELECTRICAL

## SECTION 12

### LAMP USAGE

Application	Trade No.	Rating*
Instrument Cluster		
Conventional Cab	194	2CP
F/F Cowl	1895	2CP
Temperature Indicator		
Conventional Cab	194	2CP
Brake Warning Indicator		
Conventional Cab	194	2CP
F/F Cowl	1895	2CP
Generator Indicator		
Conventional Cab	194	2CP
Directional Indicator		
P-Models	194	2CP
Conventional Cab	168	3CP
F/F Cowl	1445	1CP
Oil Pressure Indicator		
Conventional Cab	194	2CP
High Beam Indicator		
Conventional Cab	194	2CP
F/F Cowl	1445	1CP

Use	Trade No.	Rating*
Oil Pressure Gauge	1895	2CP
Tachometer	194	2CP
Heater Control	1895	2CP
Dome Lamp	211	12CP
License Lamp	67	4CP
Back-Up Lamps	1156	32CP
Parking and		
Directional Signal	1157	4-32CP
Tail, Stop and Rear		
Directional Signal	1157	4-32CP
Headlamp	6014	60W-High Beam 50W-Low Beam
Side Marker Lamps	194	2CP
Roof Clearance and		
Identification Lamps		
All Exc. P & Suburban	194	2CP
Suburbans	1155	4CP
P-Models	67	4CP

\* CP - Candle Power  
W - Watts

### 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

### FUSE AND CIRCUIT BREAKER USAGE

Applicability	Location	Amps	Type
Instrument Cluster Feed	Fuse block in driver's compartment	3	3AG/AGC
Panel Lights		3	3AG/AGC
Wiper Motor		20	SFE/SAE
Air Conditioning		25	3AG/AGC
Heater Motor		15	3AG/AGC
Backup Lamps		10	3AG/AGC
Tail, Stop, Dome License Lamps Marker Lights Spotlamp, Park Lamps		20	SAE/SFE
Radio - TCS		3	3AG/AGC
Hazard Flash	Light Switch	15	3AG/AGC
Headlamps		15	Circuit breaker
Ammeter	In-Line Part of Gen. & fwd. lamp harness (2 reqd.)	4	3AG/AGC

**RADIATOR AND GRILLE**

**SECTION 13**

**TORQUE SPECIFICATIONS**

Grille . . . . .	150 in. lbs. outer
	10 ft. lbs. inner
Grille Bracket . . . . .	20 ft. lbs.
Fan Shroud . . . . .	45 in. lbs.

**BUMPERS**

**SECTION 14**

**TORQUE SPECIFICATIONS**

Front Bumper . . . . .	35 ft. lbs.
Front Bumper Bracket and Brace . . . . .	40 ft. lbs.
Rear Bumper to Outer Bracket . . . . .	35 ft. lbs.
Rear Bumper Outer Bracket and Brace . . . . .	45 ft. lbs.

**ACCESSORIES**

**SECTION 15**

**CRUISE—MASTER**

Solenoid Resistance . . . . .	5 ohms $\pm$ 1/4 ohm
Solenoid Wire Resistance . . . . .	40 ohms
Maximum allowable Vacuum Leakage rate for Servo unit . . . . .	5 inches of Vacuum Per Minute
	Not Greater than 1 inch of Vacuum per 10 seconds
Operational Test Speed . . . . .	60 MPH

# 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.)
3 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	= 1.09361 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	$\frac{33}{64}$ .....	.515625
$\frac{1}{32}$ .....	.03125	$\frac{17}{32}$ .....	.53125
$\frac{3}{64}$ .....	.046875	$\frac{35}{64}$ .....	.546875
$\frac{1}{16}$ .....	.0625	$\frac{9}{16}$ .....	.5625
$\frac{5}{64}$ .....	.078125	$\frac{37}{64}$ .....	.578125
$\frac{3}{32}$ .....	.09375	$\frac{19}{32}$ .....	.59375
$\frac{7}{64}$ .....	.109375	$\frac{39}{64}$ .....	.609375
$\frac{1}{8}$ .....	.125	$\frac{5}{8}$ .....	.625
$\frac{9}{64}$ .....	.140625	$\frac{41}{64}$ .....	.640625
$\frac{5}{32}$ .....	.15625	$\frac{21}{32}$ .....	.65625
$\frac{11}{64}$ .....	.171875	$\frac{43}{64}$ .....	.671875
$\frac{3}{16}$ .....	.1875	$\frac{11}{16}$ .....	.6875
$\frac{13}{64}$ .....	.203125	$\frac{45}{64}$ .....	.703125
$\frac{7}{32}$ .....	.21875	$\frac{23}{32}$ .....	.71875
$\frac{15}{64}$ .....	.234375	$\frac{47}{64}$ .....	.734375
$\frac{1}{4}$ .....	.25	$\frac{3}{4}$ .....	.75
$\frac{17}{64}$ .....	.265625	$\frac{49}{64}$ .....	.765625
$\frac{9}{32}$ .....	.28125	$\frac{25}{32}$ .....	.78125
$\frac{19}{64}$ .....	.296875	$\frac{51}{64}$ .....	.796875
$\frac{5}{16}$ .....	.3125	$\frac{13}{16}$ .....	.8125
$\frac{21}{64}$ .....	.328125	$\frac{53}{64}$ .....	.828125
$\frac{11}{32}$ .....	.34375	$\frac{27}{32}$ .....	.84375
$\frac{23}{64}$ .....	.359375	$\frac{55}{64}$ .....	.859375
$\frac{3}{8}$ .....	.375	$\frac{7}{8}$ .....	.875
$\frac{25}{64}$ .....	.390625	$\frac{57}{64}$ .....	.890625
$\frac{23}{32}$ .....	.40625	$\frac{29}{32}$ .....	.90625
$\frac{27}{64}$ .....	.421875	$\frac{59}{64}$ .....	.921875
$\frac{7}{16}$ .....	.4375	$\frac{15}{16}$ .....	.9375
$\frac{29}{64}$ .....	.453125	$\frac{61}{64}$ .....	.953125
$\frac{15}{32}$ .....	.46875	$\frac{31}{32}$ .....	.96875
$\frac{31}{64}$ .....	.484375	$\frac{63}{64}$ .....	.984375
$\frac{1}{2}$ .....	.5	1 .....	

## 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		





**CHEVROLET**

**SERVICE**