

**PASSENGER  
CARS  
&  
LIGHT DUTY  
TRUCKS**

**UNIT REPAIR  
MANUAL  
(OVERHAUL)**



ST 333-78

**1978 CHEVROLET**

## **FOREWORD**

This manual includes procedures involved in disassembly and assembly of major components of 1978 Chevrolet, Malibu, Monte Carlo, Nova, Camaro, Corvette and Light Duty Trucks. Information on diagnosis, maintenance and adjustments, minor service operations, and removal and installation for these components is contained in either the 1978 Passenger Car or the Light Duty Truck Service Manuals.

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

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

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

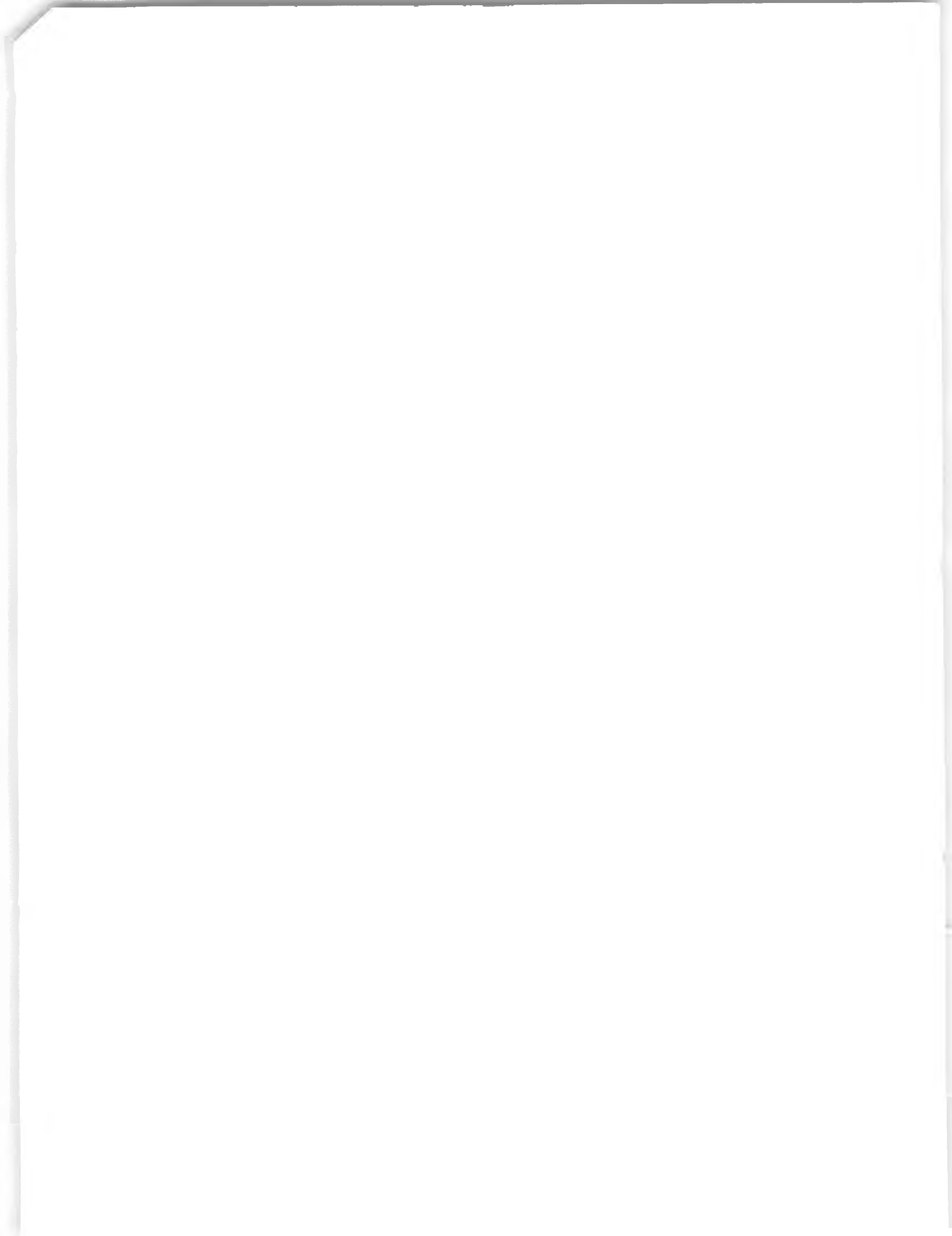
The manual should be kept in a handy place for ready reference. If properly used, it will enable the technician to better service the owners of Chevrolet built vehicles.

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.

## **IMPORTANT SAFETY NOTICE**

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

It is important to note that this manual contains various Warnings, and Cautions which should be carefully read in order to minimize the risk of personal injury to service personnel or the possibility that improper service methods will be followed which may damage the vehicle or render it unsafe. It also is important to understand that these Warnings, and Cautions are not exhaustive. Chevrolet could not possibly know, evaluate and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, Chevrolet has not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Chevrolet must first satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects.





**1978  
UNIT REPAIR (OVERHAUL)  
MANUAL  
covering  
CHEVROLET, MALIBU,  
MONTE CARLO, NOVA,  
CAMARO, CORVETTE  
and  
LIGHT DUTY TRUCKS  
(SERIES 10-35)**

**CAUTION**

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

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# AIR CONDITIONING COMPRESSOR OVERHAUL

## CONTENTS OF THIS SECTION

For Compressor REMOVAL AND INSTALLATION, DIS- CHARGING, ADDING OIL, EVALUATING AND CHARG- ING PROCEDURES FOR C.C.O.T. A/C SYSTEMS, see the appropriate Service Manual.

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For all practical purposes, all vehicles make use of the same air conditioning 4 and 6-cylinder compressors. Actual differences between compressors are found in their mounting brackets, pulleys, connector assemblies and compressor capacities, none of which will affect the following Overhaul Procedures.

When servicing the compressor, it is essential that steps be taken to prevent dirt or foreign material from getting on or into the compressor parts and system during disassembly or reassembly of the compressor. **CLEAN TOOLS AND CLEAN WORK AREA ARE VERY IMPORTANT FOR PROPER SERVICE.** The compressor connection areas and the exterior of the compressor should be cleaned off as much as possible prior to any "on car" repairs or removal of the compressor for workbench service. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with trichlorethylene, naphtha, stoddard solvent, kerosene or equivalent solvent and dried off with **dry** air. When necessary to use a cloth on any part, it should be of a non-lint producing type.

Although certain service operations can be performed without completely removing the compressor from the vehicle, the operations described herein are based on bench over-haul with the compressor removed from the vehicle. They have been prepared in sequence in order of accessibility of the components. Pad fender/skirt and secure compressor near top of fender skirt with wire, rope, etc. when performing on-car service.

**When an A-6 or R-4 compressor is removed from the vehicle FOR SERVICING, the amount of oil remaining in the compressor should be drained and measured. This oil should then be discarded and new 525 viscosity refrigerant oil added to the compressor** (See Fig. 1D-1, and "C.C.O.T. Refrigerant Oil Distribution" in the AIR CONDITIONING section).

**SHOULD AN A-6 COMPRESSOR, IT'S COMPRESSOR SHAFT SEAL OR ANY OTHER COMPONENT EVER BE REMOVED FOR SERVICING BECAUSE IT WAS DETERMINED TO BE THE CAUSE OF EXCESSIVE SIGNS OF OIL LEAKAGE IN THE A/C SYSTEM, THEN THE OIL IN THE A-6 COMPRESSOR MUST BE DRAINED, measured and replaced according to "C.C.O.T. Refrigerant Oil Distribution" in the AIR CONDITIONING section to determine oil loss. THE ACCUMULATOR IN THIS A-6 SYSTEM THEN MUST ALSO be removed - oil drained - measured, etc. according to same section.**

**CAUTION:** *Do not kink or place excessive tension on refrigerant lines or hoses.*

## MINOR REPAIR PROCEDURES FOR THE A-6 COMPRESSOR

**THE FOLLOWING OPERATIONS TO THE A-6 COMPRESSOR CLUTCH PLATE AND HUB, PULLEY AND BEARING, AND COIL AND HOUSING ARE COVERED AS "MINOR" BECAUSE THEY MAY BE PERFORMED WITHOUT FIRST PURGING THE SYSTEM OR REMOVING THE COMPRESSOR from the vehicle.**

The Compressor Shaft Seal assembly, Pressure Relief Valve and Pressure 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-12.**

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

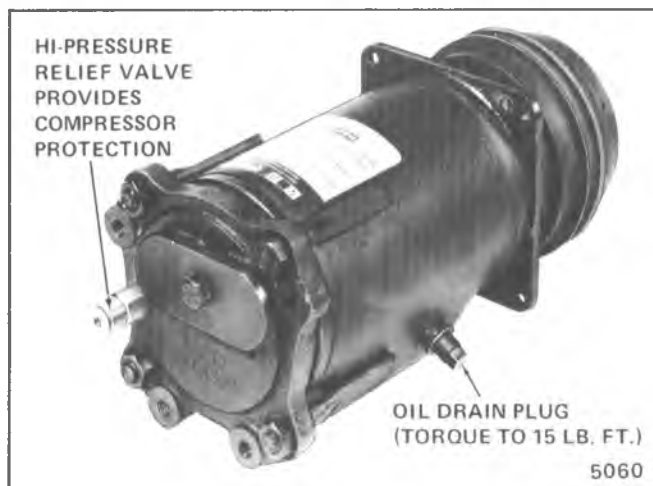


Fig. 1D-1 A-6 Compressor

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to the AIR CONDITIONING section and Fig. 1D-2 and Fig. 1D-3 for information relative to parts nomenclature and location.

Removal and illustration of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench. **The work area, tools, and parts must be kept clean at all times.** Parts Tray J 9402 (Fig. 1D-38) should be used for all A-6 internal compressor parts being removed, as well as for replacement parts.

## A-6 COMPRESSOR CLUTCH PLATE AND HUB ASSEMBLY

### Remove

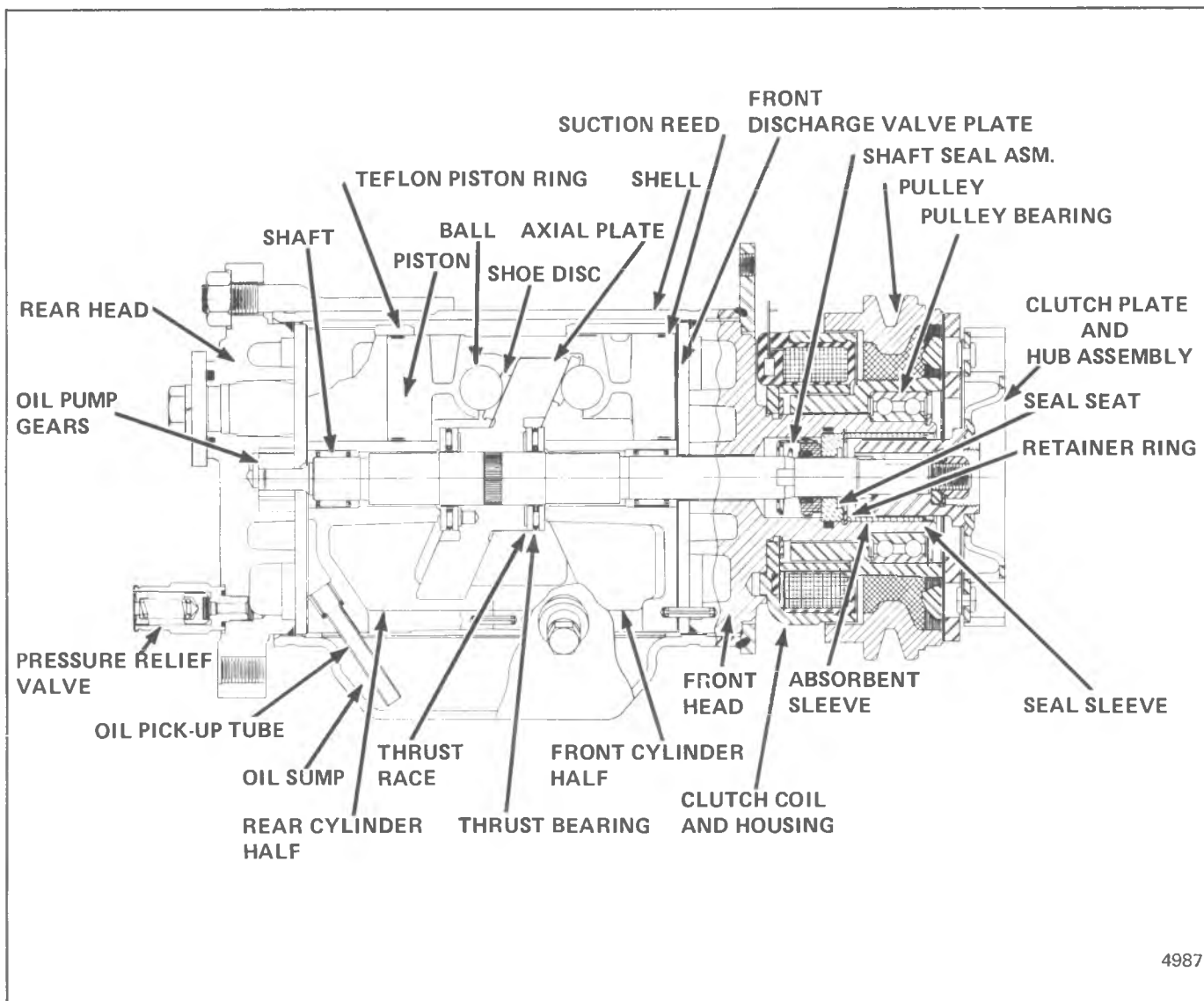
1. Place Holding Fixture J 9396 in a vise and clamp the compressor in the Holding Fixture.
2. Keep clutch hub from turning with Clutch Hub Holder J 25030 or J 9403, and remove locknut from end of shaft using Thin Wall Socket J 9399 (Fig. 1D-4).

**CAUTION:** *To avoid internal damage to the compressor, DO NOT DRIVE OR POUND on the Clutch Plate and Hub assembly OR on the end of the shaft. If proper tools to remove and replace clutch parts are not used, it is possible to disturb the position of the axial plate (keyed to the main shaft), resulting in compressor damage and seal leakage due to shifting of the crankshaft.*

3. Thread Clutch Plate and Hub assembly Remover J 9401 into hub. Hold body of Remover with a wrench and tighten center screw to remove Clutch Plate and Hub assembly (Fig. 1D-5).

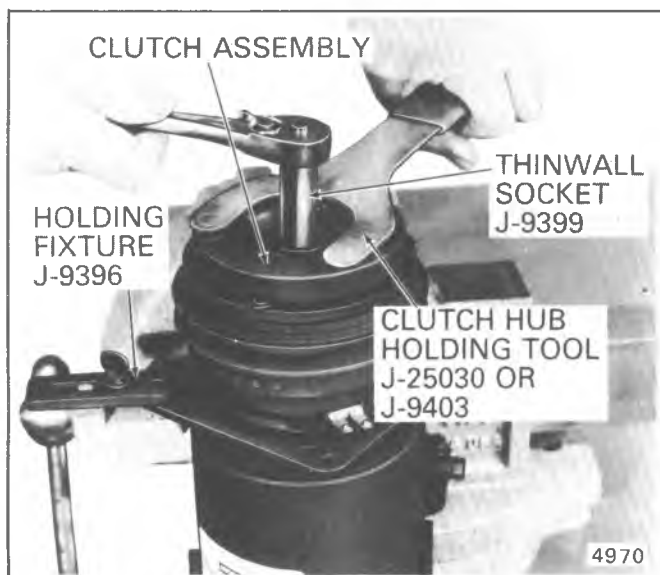






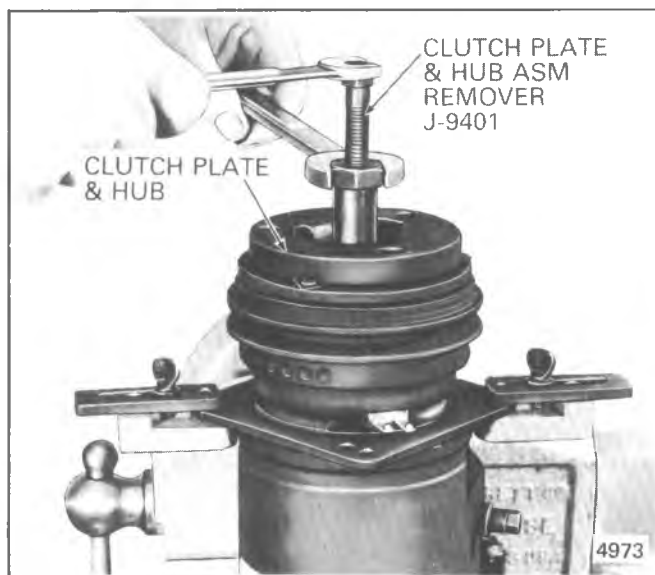
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Fig. 1D-3 A-6 Compressor Cross Section



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Fig. 1D-4 Removing A-6 Shaft Lock Nut



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Fig. 1D-5 Removing A-6 Clutch Plate and Hub Asm.

4. Remove square drive key from shaft or drive plate hub.
5. Remove hub spacer retainer ring using Snap-Ring Pliers J 5403 (#21), and then remove hub spacer (Fig. 1D-6).

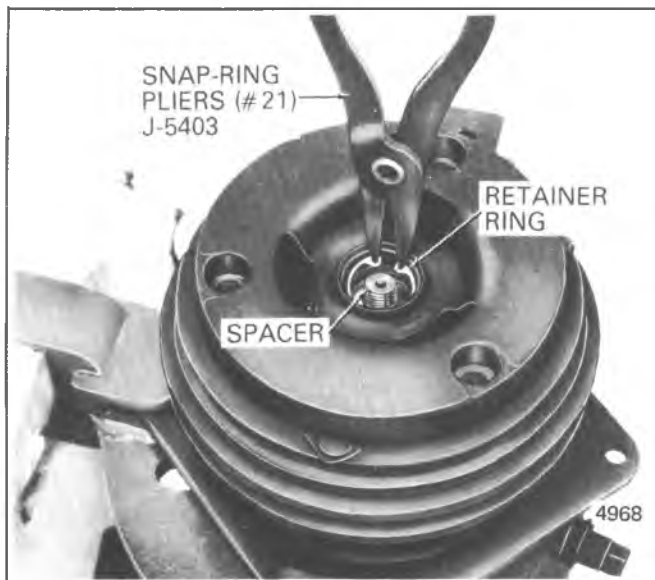


Fig. 1D-6 Removing or Installing Retainer Ring in A-6 Clutch Drive Plate

6. Inspect driven plate for cracks or stresses in the drive surface. Do not replace driven plate for a scoring condition (Fig. 1D-7).

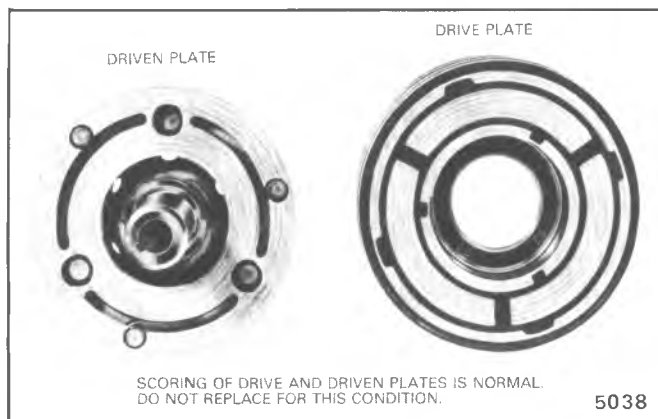


Fig. 1D-7 A-6 Clutch Driven Plate and Drive Plate

If the frictional surface shows signs of damage due to excessive heat, the Clutch Plate and Hub and Pulley and Bearing should be replaced. Check further for the underlying cause of the damage (i.e. low coil-voltage - coil should draw 3.2 amps at 12 volts - or binding of the compressor internal mechanism (cylinder and shaft assembly), clutch air gap too wide (see Fig. 1D-11), broken drive plate to hub asm. springs, etc.

## Replace

1. Insert the square drive key into the hub of driven plate; allow it to project approximately  $\frac{3}{16}$ " out of the keyway.

2. Line up the key in the hub with keyway in the shaft (Fig. 1D-8).

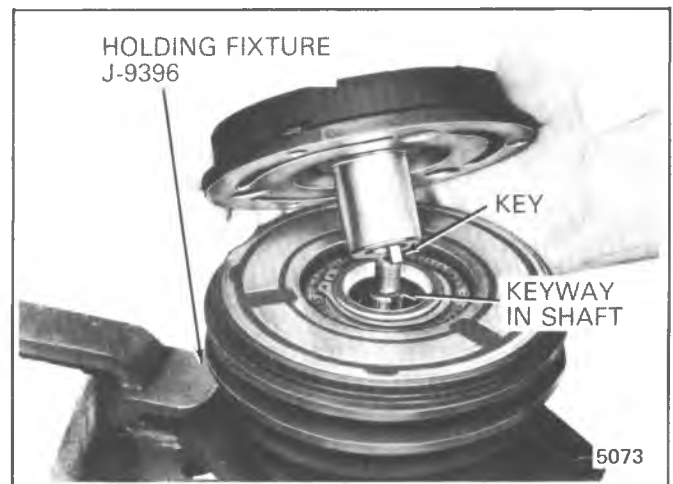


Fig. 1D-8 Aligning A-6 Drive Plate Key

3. Install the Drive Plate Installer J 9480-1 as illustrated. This Installer has a left hand thread on the body (Fig. 1D-9).

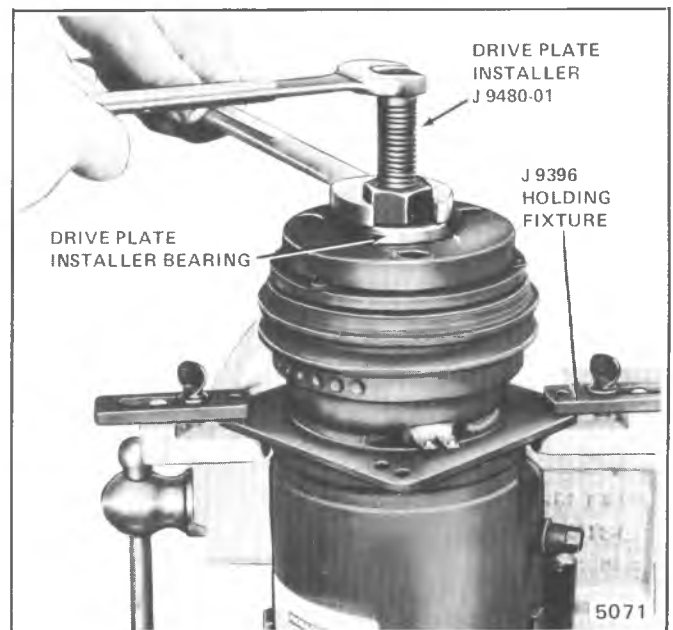


Fig. 1D-9 Installing A-6 Drive Plate

4. Press the driven plate onto the shaft until there is approximately  $\frac{3}{32}$ " space between the frictional faces of the Clutch Drive Plate and Pulley.

**CAUTION:** Make certain key remains in place when pressing hub on shaft.

A ZERO thrust race is approximately  $\frac{3}{32}$ " thick and may be used to roughly gage this operation. Use Clutch Hub Holder J 25030 or J 9403 to hold Clutch Plate and Hub if necessary.

5. Install the hub spacer and, using Snap-Ring Pliers J 5403 (#21), install the retainer ring (see installed Retainer Ring in Fig. 1D-10), with convex side of ring facing spacer.

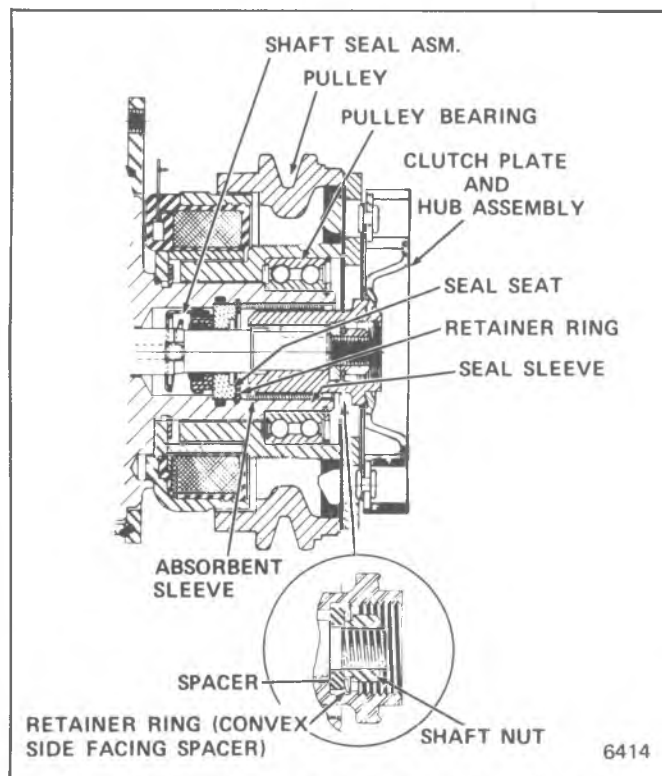


Fig. 1D-10 Installing Hub Retainer Ring On A-6 Compressor

6. Using Thin-Wall Socket J 9399 and Clutch Hub Holder J 25030 or J 9403 to install a new shaft locknut **with shoulder or circular projection on the locknut facing towards retainer ring**. Tighten the nut to 14-26 lb.ft. torque. Air gap between the frictional faces should now be .022" to .057" (Fig. 1D-11). If not, check for mispositioned key or shaft.

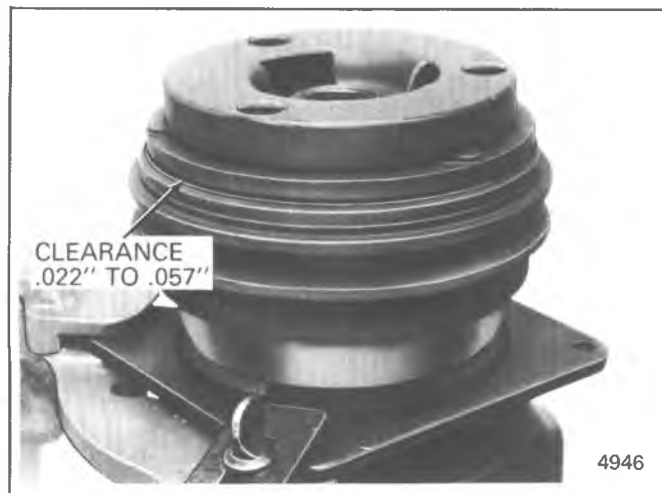


Fig. 1D-11 Checking A-6 Air Gap

7. The pulley should now rotate freely.

8. Operate the refrigeration system in the MAX A/C control selector (mode) lever position and warm engine (off fast idle) speed at 2000 RPM. Rapidly cycle the compressor clutch by turning the A/C control selector (mode) lever from OFF-to-MAX at least 15 times at approximately one second intervals to burnish the mating parts of the clutch.

## A-6 COMPRESSOR PULLEY AND BEARING ASSEMBLY

### Remove

1. Remove Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Removal procedure.

2. Remove pulley retainer ring, using Snap-Ring Pliers J 6435 (#26), Fig. 1D-12.

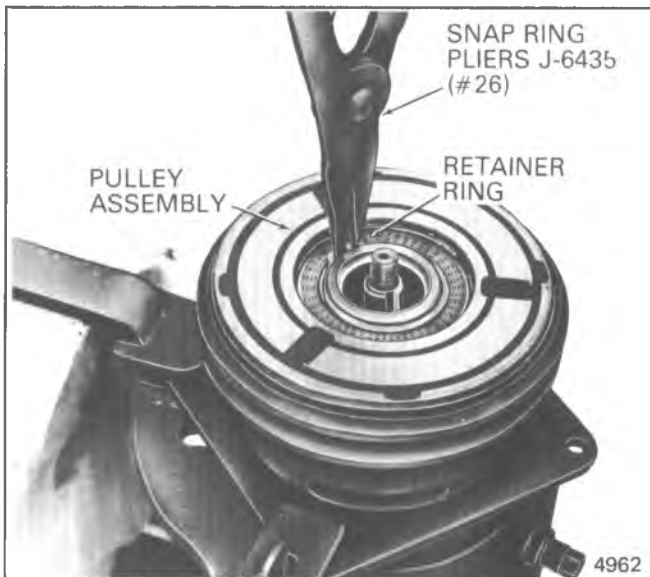


Fig. 1D-12 Removing A-6 Pulley Retainer Ring

3. Pry out absorbent sleeve retainer, and remove absorbent sleeve from compressor neck.

4. Place Puller Pilot J 9395 over end of compressor shaft.

**CAUTION:** It is important that Puller Pilot J 9395 be used to prevent internal damage to compressor when removing pulley. Under no circumstances should Puller be used DIRECTLY against drilled end of shaft.

5. Remove Pulley and Bearing Assembly, using Pulley Puller J 8433 (Fig. 1D-13).

### Inspection

Check the appearance of the Pulley and Bearing assembly (see Fig. 1D-7). The frictional surfaces of the Pulley and Bearing assembly should be cleaned with trichlorethylene, naphtha, stoddard solvent, kerosene or equivalent solvent before reinstallation.

### Replace

1. If original Pulley and Bearing assembly is to be reinstalled, wipe frictional surface of pulley clean. If frictional surface of pulley shows any indication of damage due to overheating, the Pulley and Bearing assembly should be replaced.

2. Check bearing for brinelling, excessive looseness, noise, and lubricant leakage. If any of these conditions exist, bearing should be replaced. See "A-6 Compressor Pulley Bearing" Replacement procedure.

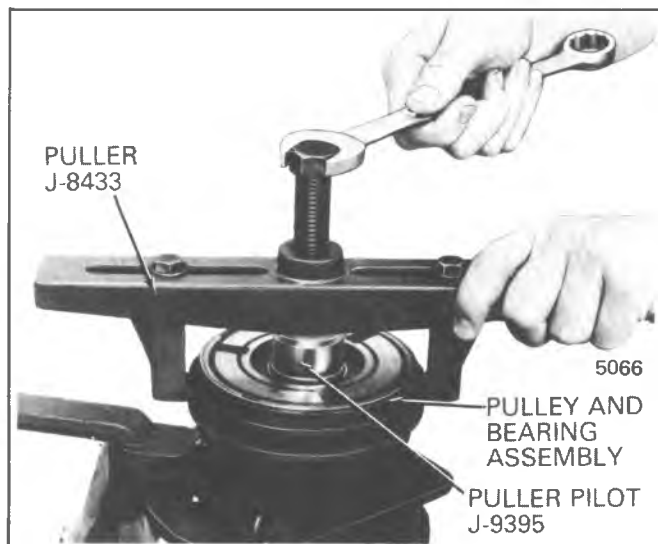


Fig. 1D-13 Removing A-6 Pulley and Bearing Asm.

3. Press or tap Pulley and Bearing assembly on neck of compressor until it seats, using Pulley and Bearing Installer J 9481 with Universal Handle J 8092 (Fig. 1D-14). The Installer will apply force to inner race of bearing and prevent damage to bearing.

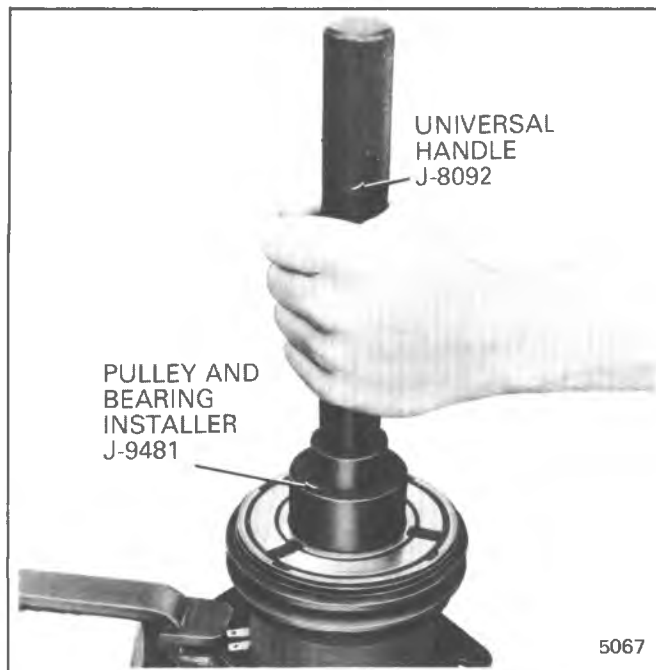


Fig. 1D-14 Installing A-6 Pulley and Bearing Asm.

4. Check pulley for binding or roughness. Pulley should rotate freely.

5. Install retainer ring, using Snap Ring Pliers J 6435 (#26).

6. Install absorbent sleeve retainer in neck of compressor. Using sleeve from Seal Seat Remover-Installer J 23128, install retainer so that outer edge is recessed 1/32" from compressor neck face.

7. Install Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Replacement procedure.

## A-6 COMPRESSOR PULLEY BEARING

### Remove

1. Remove Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Removal procedure.

2. Remove Pulley and Bearing assembly as described in "A-6 Compressor Pulley and Bearing Asm." Removal procedure.

3. Remove pulley bearing retainer ring with a small screwdriver or pointed tool (Fig. 1D-15).

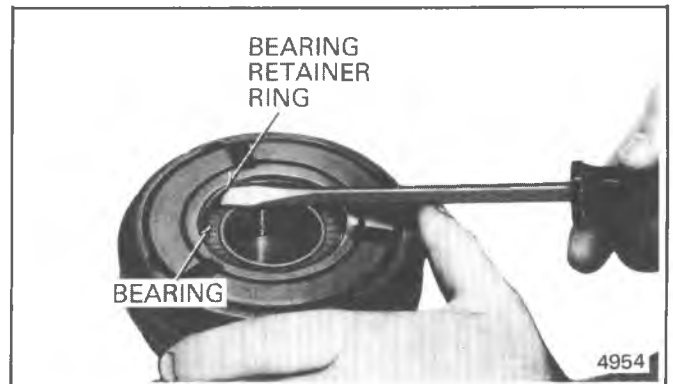


Fig. 1D-15 Removing A-6 Pulley and Bearing Retainer Ring

4. Place Pulley and Bearing assembly on inverted Support Block J 21352 and, using Pulley Bearing Remover J 9398 with Universal Handle J 8092, drive Bearing assembly out of pulley (Fig. 1D-16).



Fig. 1D-16 Removing Bearing From A-6 Pulley Asm.

### Replace

1. Install new bearing in pulley using Pulley and Bearing Installer J 9481 with Universal Handle J 8092 (Fig. 1D-17). The Installer will apply the force to the outer race of the bearing.

**CAUTION: DO NOT CLEAN NEW BEARING ASSEMBLY WITH ANY TYPE OF SOLVENT.** Bearing is supplied with correct lubricant when assembled and requires no other lubricant at any time.

2. Install bearing retainer ring, making certain that it is properly seated in ring groove.

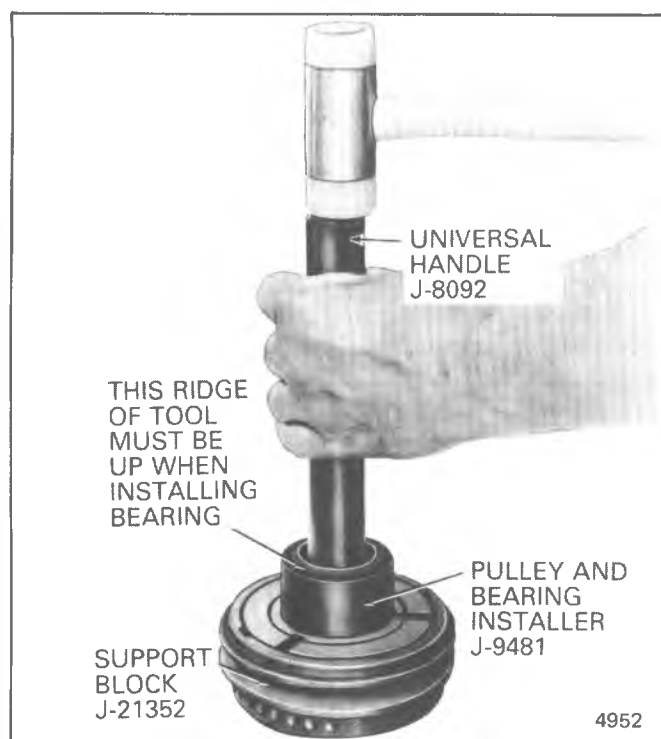


Fig. 1D-17 Installing Bearing on A-6 Pulley

3. Install Pulley and Bearing assembly as described in "A-6 Compressor Pulley and Bearing Asm." Replacement procedure.

4. Install Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Replacement procedure.

## A-6 COMPRESSOR CLUTCH COIL AND HOUSING ASSEMBLY

### Remove

1. Remove Clutch Plate and Hub assembly as described in "Compressor Clutch Plate and Hub Asm." Removal procedure.

2. Remove Pulley and Bearing assembly as described in "A-6 Compressor Pulley and Bearing Asm." Removal procedure. **Note position of terminals on coil housing and scribe location on compressor front head casting.**

3. Remove coil housing retaining ring, using Snap-Ring Pliers J 6435 (#26) (Fig. 1D-18).

4. Lift Coil and Housing assembly off compressor.

### Replace

1. Position coil and housing assembly on compressor front head casting so that electrical terminals line up with marks previously scribed on compressor (Fig. 1D-19).

2. Align locating extrusions on coil housing with holes in front head casting.

3. Install coil housing retaining ring **with flat side of ring facing coil**, using Snap-Ring Pliers J 6435 (#26).

4. Install Pulley and Bearing assembly as described in "A-6 Compressor Pulley and Bearing Asm." Replacement procedure.

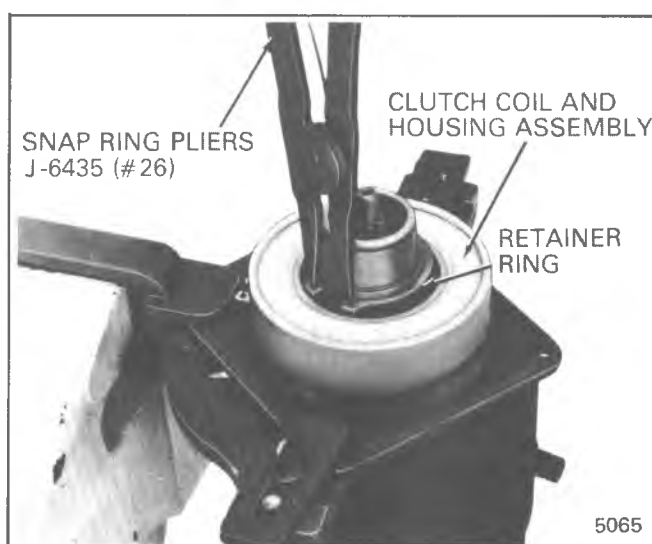


Fig. 1D-18 Removing A-6 Coil Housing Retainer Ring



Fig. 1D-19 Installing A-6 Coil Housing

5. Install Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Replacement procedure.



# MAJOR A-6 COMPRESSOR REPAIR PROCEDURES

Service repair procedures to the Compressor Shaft Seal, Pressure Relief Valve, Pressure Switch or disassembly of the Internal Compressor Cylinder and Shaft Assembly are considered **"MAJOR" SINCE THE REFRIGERATION SYSTEM MUST BE COMPLETELY PURGED OF REFRIGERANT** before proceeding and/or because major internal operating and sealing components of the compressor are being disassembled and serviced.

SHOULD AN A-6 COMPRESSOR, ITS COMPRESSOR SHAFT SEAL, OR ANY OTHER COMPONENT EVER BE REMOVED FOR SERVICING BECAUSE IT WAS DETERMINED TO BE **THE CAUSE OF EXCESSIVE SIGNS OF OIL LEAKAGE** IN THE A-6 A/C SYSTEM, THEN THE OIL IN THE COMPRESSOR MUST BE DRAINED, measured and replaced according to "C.C.O.T. Refrigerant Oil Distribution" in the AIR CONDITIONING section to determine oil loss. THE ACCUMULATOR IN THIS A-6 SYSTEM MUST THEN ALSO be removed - oil drained - measured, etc. according to same section.

WHEN REPLACING THE SHAFT SEAL ASSEMBLY (see Fig. 1D-20), PRESSURE RELIEF VALVE (see Fig. 1D-26) OR PRESSURE SWITCH (see Figures 1D-27 and 28), 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 AIR CONDITIONING section (see "Discharging, Adding Oil, Evacuating and Charging Procedures for C.C.O.T. A/C Systems"). THE SAME HOLDS TRUE FOR ANY DISASSEMBLY OF THE INTERNAL A-6 COMPRESSOR CYLINDER AND SHAFT ASSEMBLY.

If the A-6 Compressor Internal Cylinder and Shaft Assembly is to be serviced or replaced, then the oil in the compressor must be drained, measured and replaced according to "C.C.O.T. Refrigerant Oil Distribution" in the AIR CONDITIONING section to determine addition of proper oil quantity to new assembly.

A clean workbench, preferably covered with a sheet of clean paper, orderliness in the work area and a place for all parts being removed and replaced is of great importance, as is the use of the proper, clean service tools. Any attempt to use make-shift or inadequate equipment may result in damage and/or improper compressor operation.

These procedures are based on the use of the proper service tools and the condition that an adequate stock of service parts is available. All parts required for servicing the internal compressor 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 internal assembly just as they are removed from the service package.

Piston shoe discs and shaft thrust races will be identified by "number" on the parts themselves for reference to determine their size and dimension (see Fig. 1D-38).

## A-6 COMPRESSOR SHAFT SEAL

### SEAL LEAK DETECTION

A SHAFT SEAL SHOULD NOT BE CHANGED BECAUSE OF AN OIL-LINE ON THE HOOD INSULATOR. The Seal is designed to seep some oil for lubrication purposes. Only change a Shaft Seal when a leak is detected by evidence of oil sprayed in LARGE AMOUNTS and then only after actual refrigerant leakage is determined by test with Electronic Leak Detector J 23400.

SHOULD AN A-6 COMPRESSOR SHAFT SEAL EVER HAVE TO BE REPLACED BECAUSE IT WAS DETERMINED TO BE **THE CAUSE OF EXCESSIVE SIGNS OF OIL LEAKAGE** IN THE A/C SYSTEM, THEN THE OIL IN THE A-6 COMPRESSOR MUST BE DRAINED, measured and replaced according to "C.C.O.T. Refrigerant Oil Distribution" in the AIR CONDITIONING section to determine oil loss. THE ACCUMULATOR IN THIS A-6 SYSTEM MUST THEN ALSO be removed - oil drained - measured, etc. according to same section.

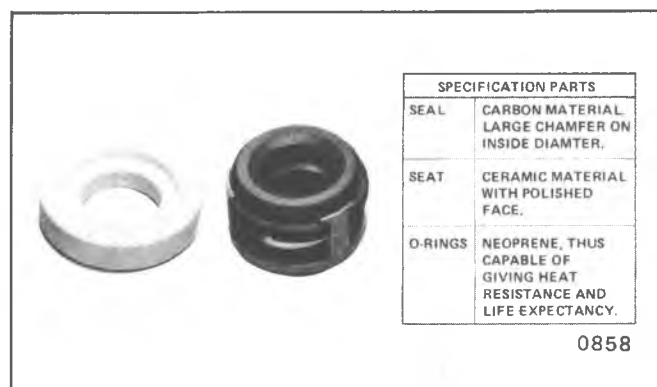


Fig. 1D-20 Specification A-6 and R-4 Compressor Shaft Seal Kit

### Remove

1. "Discharge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

2. Remove the Clutch Plate and Hub assembly and shaft key as described in "A-6 Compressor Clutch Plate and Hub Asm." Removal procedure.

3. Pry out the sleeve retainer and remove the absorbent sleeve. Remove the shaft seal seat retaining ring, using Snap-Ring Pliers J 5403 (#21). See Figure 1D-21.

4. Thoroughly clean inside of compressor neck area surrounding the shaft, the exposed portion of the seal seat and the shaft itself. **This is absolutely necessary to prevent any dirt or foreign material from getting into compressor.**

5. Place Seal Protector J 22974 over the end of the shaft to prevent chipping the ceramic seat. Fully engage the knurled tangs of Seal Seat Remover-Installer J 23128 into the recessed portion of the seal seat by turning the handle



Fig. 1D-21 Removing or Installing A-6 Shaft Seal Seat Retaining Ring

**clockwise**. Remove the Seal Seat from the compressor with a rotary-pulling motion (Fig. 1D-22). Discard the Seat.

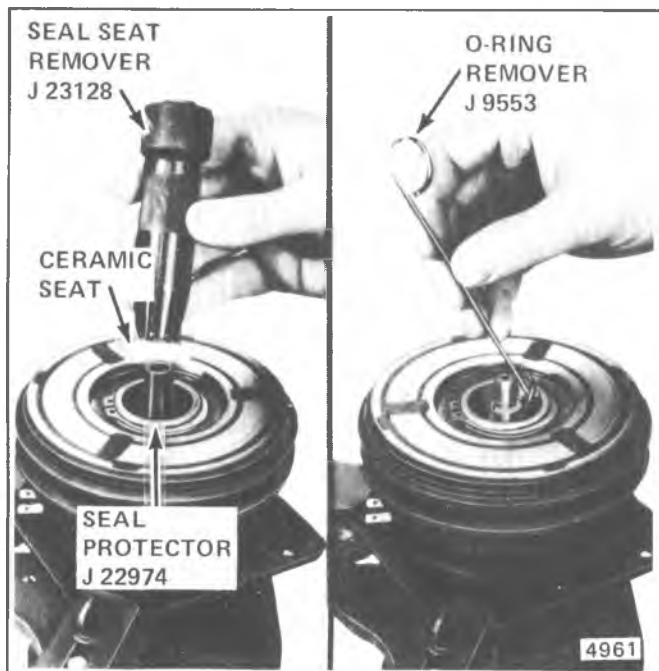


Fig. 1D-22 Removing A-6 Shaft Seal Seat and O-Ring

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

6. With Seal Protector J 22974 still over the end of the shaft, set Seal Remover-Installer J 9392 down over shaft end, **turning clockwise, while pressing down**, to engage Remover tangs with the tabs on the Seal assembly. Then lift the Shaft Seal assembly out (see Fig. 1D-23). Discard the Seal.

7. Remove and discard the seal seat O-ring from the compressor neck, using O-Ring Remover J 9533 (see Fig. 1D-22).

8. Recheck the shaft and inside of the compressor neck for dirt or neck foreign material and be sure these areas are perfectly clean before installing new parts.

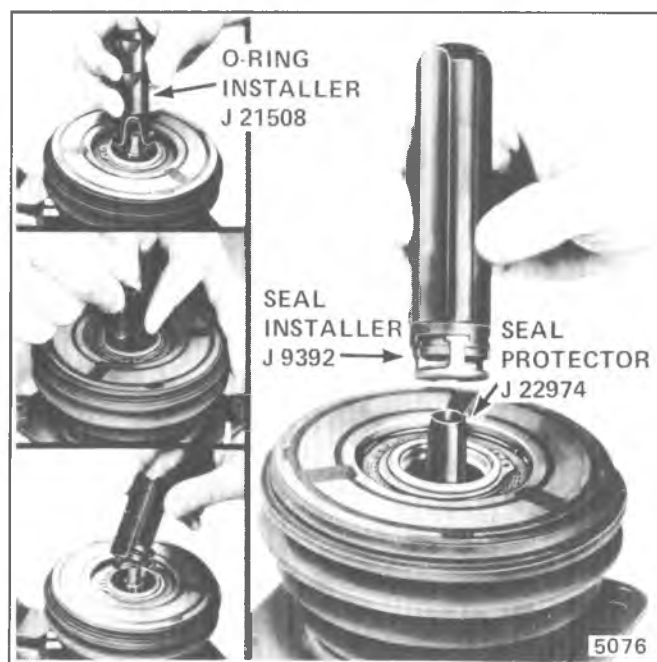


Fig. 1D-23 Replacing A-6 Seal and O-Ring

### Inspection

**SEALS SHOULD NOT BE REUSED. ALWAYS USE A NEW SEAL KIT ON REBUILD** (see Fig. 1D-20). 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 or prevent sealing.

### Replace

1. Coat the new seal seat O-ring in clean 525 viscosity refrigerant oil and assemble onto O-Ring Installer J 21508 (see Fig. 1B-23).

2. Insert the O-Ring Installer J 21508 **completely down** into the compressor neck until the Installer "bottoms". Lower the movable slide of the O-Ring Installer to release the O-ring into the seal seat O-ring **lower** groove. (The compressor neck top groove is for the shaft seal seal retainer ring). Rotate the Installer to seat the O-ring and remove Installer (See Fig. 1D-24).

3. Coat the O-ring and seal face of the new Seal assembly with clean 525 viscosity refrigerant oil. Carefully mount the Seal assembly to Seal Installer J 9392 by engaging the tabs of the Seal with the tangs of the Installer (Fig. 1D-23).

4. Place Seal Protector J 22974 (Fig. 1D-23) over end of compressor shaft and **carefully slide the new Seal assembly down onto the shaft. Gently twist the Installer J 9392 CLOCK-WISE, while pushing the seal assembly down the shaft until the Seal assembly engages the flats on the shaft and is seated in place.** Disengage the Installer by pressing downward and twisting counter-clockwise.

5. Attach the ceramic Seal Seat to the Seal Seat Remover and Installer J 23128 and dip the ceramic Seat in clean 525 viscosity refrigerant oil to coat the seal face and outer surface. Carefully install the Seat over the compressor shaft end and Seal Protector J 22974 and push the Seat into

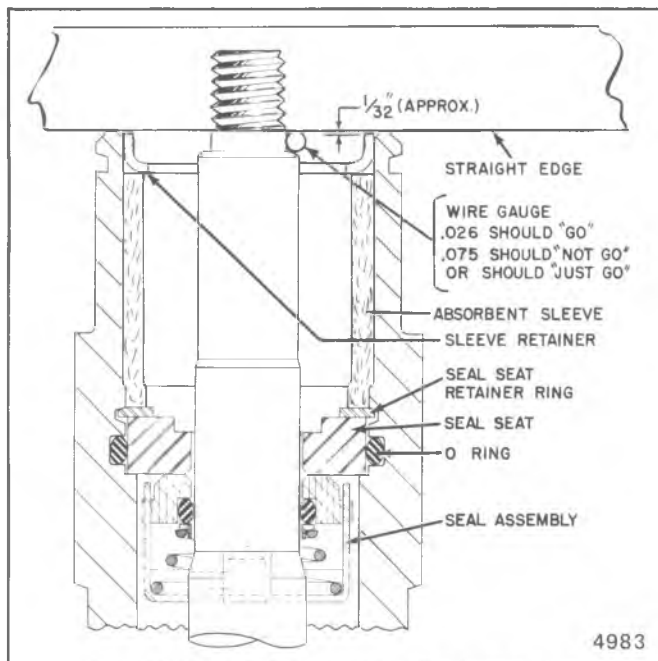


Fig. 1D-24 A-6 Compressor Shaft and Seal

place with a rotary motion. Take care not to dislodge the seat O-ring. However, be sure Seal Seat makes a good seal with O-ring. Remove Installer J 23128 and Seal Protector J 22974 (Fig. 1D-22).

6. Install the new seal seat retainer ring **with its flat side against the Seal Seat**, using Snap-Ring Pliers J 5403 (#21). See Fig. 1D-21. Use the sleeve from Seal Seat Remover-Installer J 23128 (Fig. 1D-22) to press in on the seal seat retainer ring so that it snaps into its groove.

7. Install Compressor Leak Test Fixture J 9625 (Fig. 1D-25) on rear head of compressor and connect gage charging lines or pressurize SUCTION SIDE (low-pressure side) of compressor on vehicle with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position and oil sump down, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the Seal with Electronic Leak Detector J 23400. Correct any leak found. Remove, discard and later replace the shaft nut.

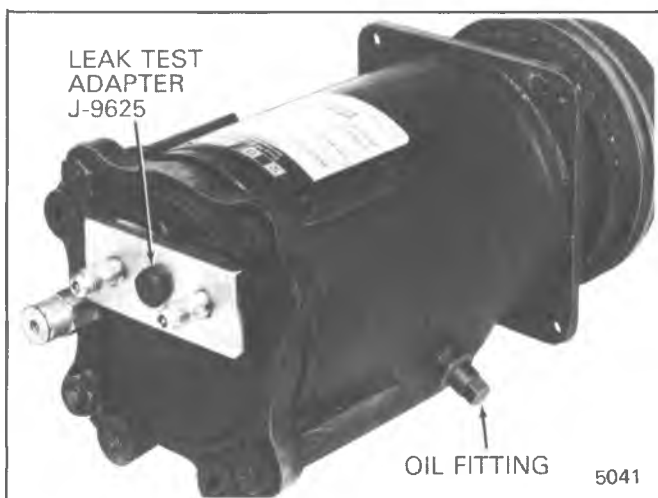


Fig. 1D-25 Leak Testing A-6 Compressor

8. Remove any excess oil, resulting from installing the new seal parts, from the shaft and inside the compressor neck.

9. Install the new absorbent sleeve by rolling the material into a cylinder, overlapping the ends, and then slipping the sleeve into the compressor neck with the overlap towards the top of the compressor. With a small screwdriver or similar instrument, carefully spread the sleeve until the ends of the sleeve butt at the top vertical centerline.

10. Position the new metal sleeve retainer so that its flange face will be against the front end of the sleeve. Pulley Puller Pilot J 9395 (see Fig. 1D-13) may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place (retainer should be recessed approximately 1/32" from the face of the compressor neck). (See Fig. 1D-24).

11. Reinstall the Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Replacement procedure.

**Some compressor shaft seal leaks may be the result of mispositioning of the axial plate on the compressor shaft.** The mispositioning of the axial plate may be caused by improper procedures used during pulley and driven plate removal, pounding, collisions or dropping the compressor. If the axial plate is mispositioned, the carbon face of the shaft seal assembly may not contact the seal seat and the rear thrust races and bearing may be damaged.

To check for proper positioning of the axial plate on the shaft, remove the clutch driven plate and measure the distance between the front head extension and the flat shoulder on the shaft as shown in Fig. 1D-24. To measure this distance, use a wire gage (**the clearance should be between .026" and .075"**). If the shaft has been pushed back in the axial plate (measurement greater than .075"), disassemble the compressor and replace the shaft and axial plate assembly rear thrust races and thrust bearing.

If there also appears to be too much or insufficient air gap between the drive and driven plates, dislocation of the shaft should be suspected. If the carbon seal is not seating against the seal seat, it will not be possible to completely "Evacuate the System" as outlined under DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

12. "Add Oil, Evacuate and Charge System" (see DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section).

## A-6 COMPRESSOR PRESSURE RELIEF VALVE OR PRESSURE SWITCH

When necessary to replace the Pressure Relief Valve (or Pressure Switch if so located), located in the compressor rear head casting (Fig. 1D-26 and Figures 1D-27 and 28), the valve/switch assembly should be removed after PURGING THE SYSTEM OF REFRIGERANT. A new valve/switch and O-ring coated with 525 viscosity refrigerant oil should be installed (see DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section).

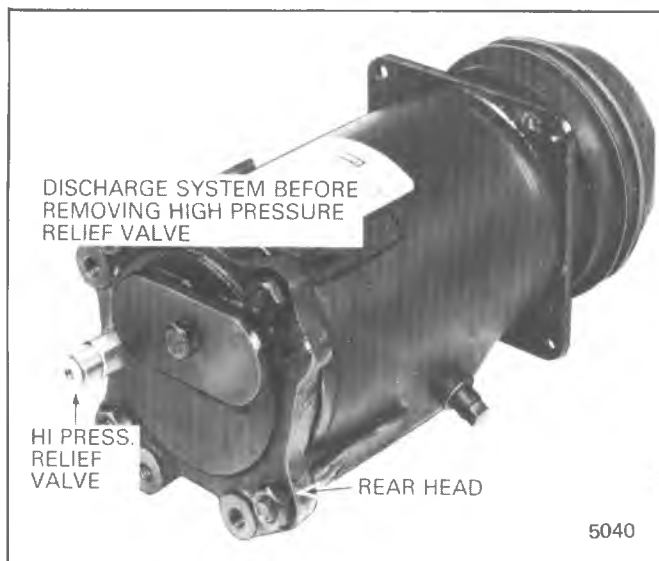


Fig. 1D-26 A-6 High Pressure Relief Valve

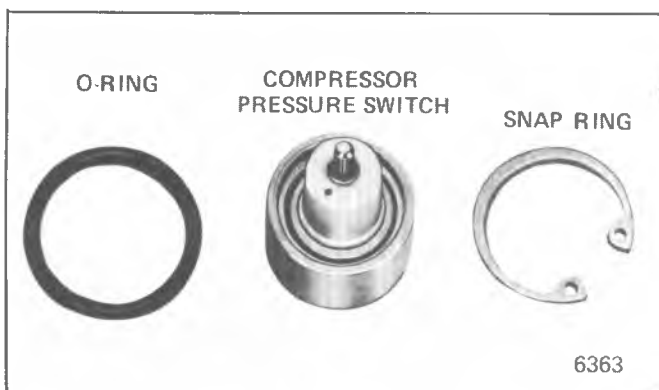


Fig. 1D-27 Compressor Pressure Switch

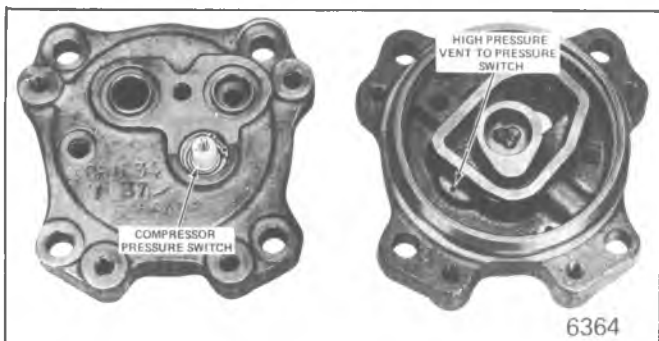


Fig. 1D-28 A-6 Compressor Pressure Switch on A, B, Series

## A-6 COMPRESSOR INTERNAL MECHANISM (CYLINDER AND SHAFT ASM.)

Service operations to the A-6 compressor Rear Head or Internal Mechanism (Cylinder and Shaft) of the compressor should be performed with the system **PURGED OF REFRIGERANT** according to the **DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS** in the **AIR CONDITIONING** section. The compressor must also be removed from the vehicle to insure that the necessary degree of cleanliness may be maintained. Additionally, "Compressor Clutch Plate and Hub, Pulley and Bearing,

Clutch Coil and Housing and Shaft Seal" Removal procedures, as described earlier in the **OVERHAUL** section, all are to have been followed. Clean hands, clean tools and a clean bench, preferably covered with clean paper, are of extreme importance.

An inspection should be made of the Internal Mechanism (Cylinder and Shaft) assembly to determine if any service operations should be performed. A detailed inspection of parts should be made to determine if it is feasible to replace them.

### Removal

1. Before proceeding with disassembly, wipe exterior surface of compressor clean.
2. All oil in compressor should be drained and measured. Assist draining by positioning compressor with oil drain plug down. **Record the amount of oil drained from the compressor (See "C.C.O.T. Refrigerant Oil Distribution" in the AIR CONDITIONING section).**
3. Invert compressor and Holding Fixture J 9396, with front end of compressor shaft now facing downward (Fig. 1D-29).

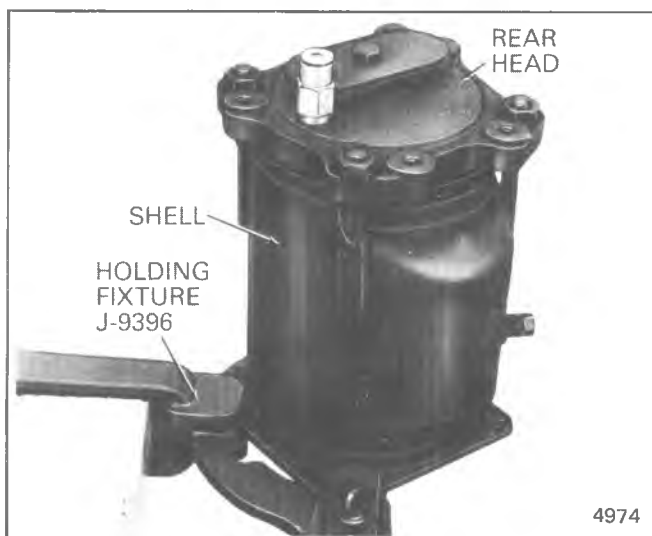


Fig. 1D-29 A-6 Compressor Installed in Holding Fixture

Additional oil may leak from the compressor at this time. All oil must be drained into a container so that **TOTAL** amount can be measured. (SEE STEP 2 ABOVE). A liquid measuring cup may be used for this purpose. Drained oil should then be discarded.

4. Remove four locknuts from threaded studs on compressor shell and remove rear head. Tap uniformly around rear head if head is binding (Fig. 1D-29).

5. Wipe excess oil from all sealing surfaces on rear head casting webs, and examine sealing surfaces (Fig. 1D-30). If any damage is observed, the Rear Head should be replaced.

6. Remove Suction Screen and examine for any damage or contamination. Clean or replace if necessary.

7. Paint an identifying mark on exposed face of inner and outer Oil Pump Gears and then remove gears. Identifying marks are to assure that gears, if re-used, will be installed on identical position.

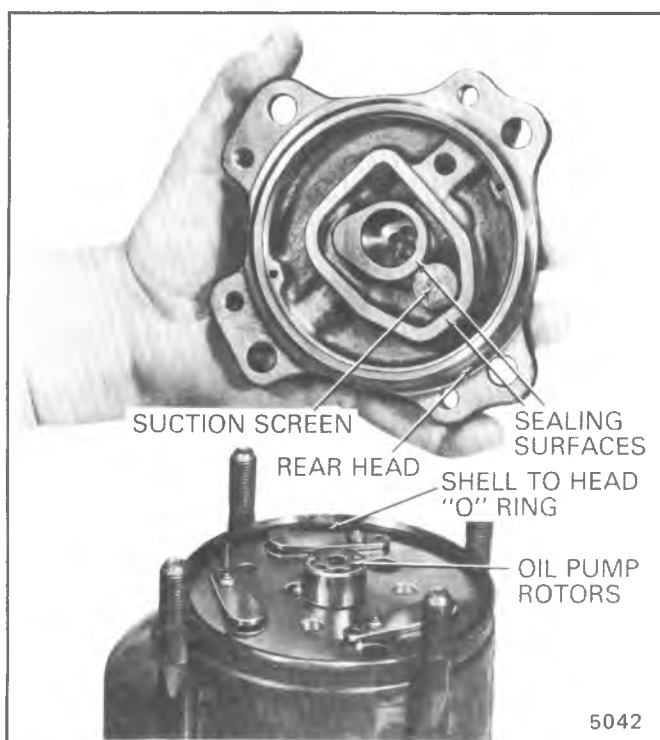


Fig. 1D-30 A-6 Rear Head Removal

8. Remove and discard rear head to shell O-ring.

9. Carefully remove Rear Discharge Valve Plate assembly. Use two small screwdrivers under reed retainers to pry up on assembly (Fig. 1D-31). **Do not position screwdrivers between reeds and reed seats.**

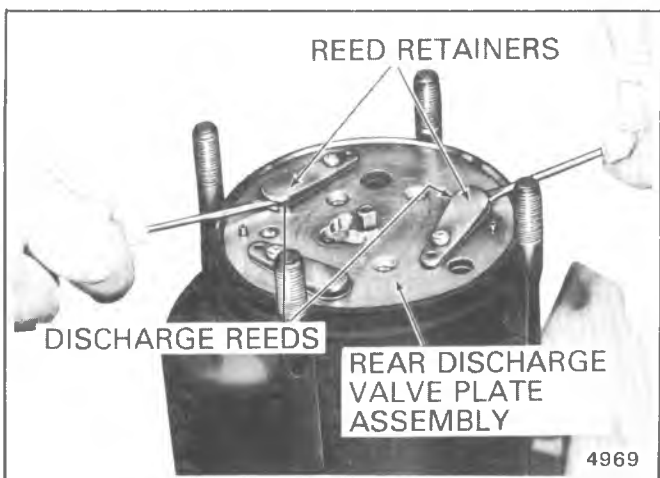


Fig. 1D-31 Removing A-6 Rear Discharge Valve Plate

10. Examine Valve Reeds and Seats. Replace entire assembly if any reeds or seats are damaged.

11. Using two small screwdrivers, carefully remove Rear Suction Reed (Fig. 1D-32). **Do not pry up on horseshoe-shaped reed valves.**

12. Examine reeds for damage, and replace if necessary.

13. Using Oil Pick-Up Tube Remover J 5139 (Fig. 1D-33), remove Oil Pick-Up Tube. Remove O-ring from oil inlet.

14. Loosen compressor from Holding Fixture J 9396, place Internal Cylinder and Shaft Assembly Support Block J 21352 over oil pump end of shaft and, while holding

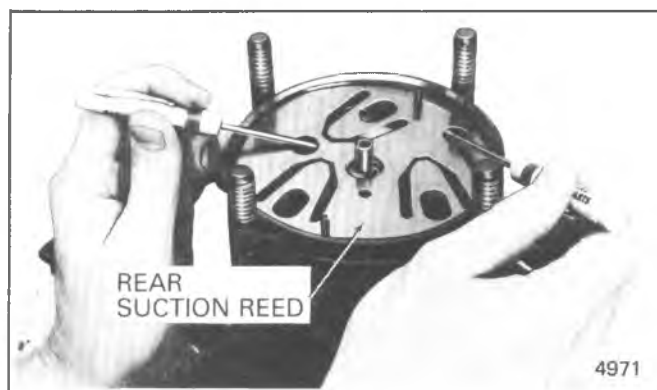


Fig. 1D-32 Removing A-6 Rear Suction Reed



Fig. 1D-33 Removing A-6 Oil Pick-Up Tube

Support Block in position with one hand, lift compressor from Holding Fixture with other hand. Invert compressor (shaft will now be facing upward) and position on bench with Internal Assembly Support Block resting on bench.

15. Lift Front Head and Compressor Shell Assembly up, leaving Internal Cylinder and Shaft Assembly resting on Internal Assembly Support Block.

**CAUTION:** To prevent damage to shaft, **DO NOT TAP ON END OF COMPRESSOR SHAFT** to remove Internal Cylinder and Shaft Assembly. If Internal Assembly will not slide out of compressor shell, tap on Front Head with a plastic hammer.

16. Rest compressor shell on its side and push Front Head assembly through Compressor Shell, **being careful not to damage sealing areas on inner side of front head.** Discard O-ring.

It may be necessary to tap on outside of front head, using a plastic hammer, to overcome friction of O-ring seal between front head and compressor shell.

17. Wipe excess oil from sealing surfaces on front head casting webs and examine sealing surface. If any surface damage is observed, the head should be replaced.

18. Remove Front Discharge Valve Plate assembly and Front Suction Reed Plate. Examine reeds and seats. Replace necessary parts.

19. Remove Suction Cross-Over Cover by prying with screwdriver between cylinder casting and cover (Fig. 1D-34).



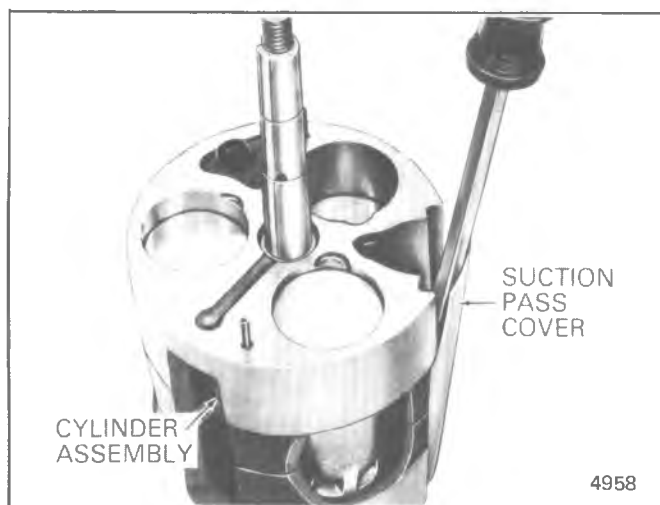


Fig. 1D-34 Removing A-6 Suction Cross-Over Cover

20. Examine Internal Cylinder and Shaft Assembly for any obvious damage. If Internal Assembly has sustained major damage, due to loss of refrigerant or oil, it may be necessary to use the Service Internal Cylinder and Shaft Assembly rather than replace individual parts.

## A-6 COMPRESSOR INTERNAL CYLINDER AND SHAFT ASM

### Disassembly

Use Parts Tray J 9402 (Fig. 1D-38) to retain compressor parts during disassembly.

1. Remove Internal Cylinder and Shaft Assembly from compressor as described in "A-6 Compressor Internal Mechanism (Cylinder and Shaft Asm.)" **Removal** procedure.

2. Identify by pencil mark, or some other suitable means, each piston numbering them as 1, 2 and 3 (Fig. 1D-35).

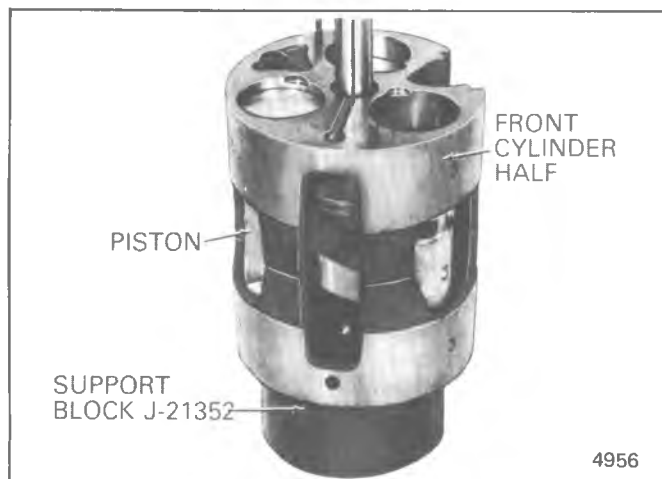


Fig. 1D-35 Numbering A-6 Piston and Cylinder Bores

Number the piston bores in the front cylinder half in like manner, so that pistons can be replaced in their original locations.

3. Separate cylinder halves, using a wood block and mallet (Fig. 1D-36). Make certain that discharge cross-over tube does not contact axial plate when separating cylinder halves (a new Service Discharge Cross-Over Tube will be installed later - see Step 5 of Internal Cylinder and Shaft Assembly procedure).

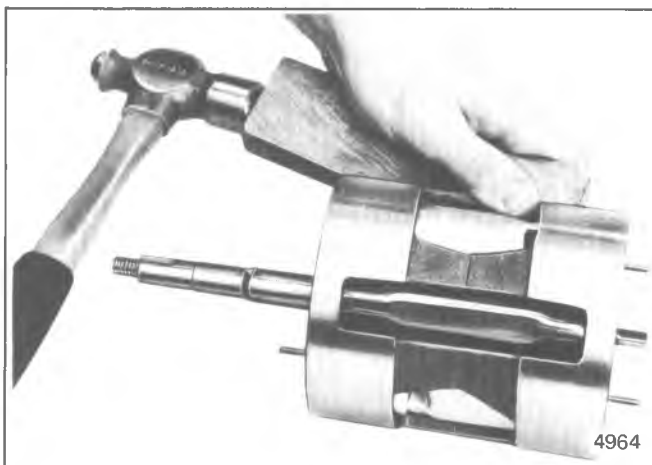


Fig. 1D-36 Separating A-6 Cylinder Halves

**CAUTION: UNDER NO CIRCUMSTANCES SHOULD SHAFT BE STRUCK AT EITHER END in an effort to separate upper and lower cylinder halves because the shaft and the axial plate could be damaged.**

4. Carefully remove the Rear Half of the cylinder from the pistons and set the Front Cylinder Half, with the piston, shaft and axial plate in Compressing Fixture J 9397.

5. Pull up on compressor shaft and remove piston previously identified as No. 1, with balls and shoe discs, from axial plate.

a. **Inspect the Teflon piston rings** for nicks, cuts or metal particles imbedded in exposed ring surface and replace the piston rings as required if either condition exists. See "A-6 Teflon Piston Ring" Replacement procedure.

6. Remove and discard the piston shoe discs.

7. Remove and examine piston balls, and if satisfactory for re-use, place balls in No. 1 compartment of Parts Tray J 9402 (Fig. 1D-38).

8. Place piston in No. 1 compartment of Parts Tray J 9402, **with notch in casting web at front end of piston (Fig. 1D-37) into the dimpled groove** of Parts Tray compartment.

9. Repeat Steps 5 through 9 for Pistons No. 2 and No. 3.

10. Remove rear combination of thrust races and thrust bearing from shaft. Discard races and bearing.

11. Remove shaft assembly from front cylinder half. If the Discharge Cross-Over Tube remained in the front cylinder half, it may be necessary to bend discharge cross-over tube slightly in order to remove shaft.

12. Remove front combination of thrust races and bearing from shaft. Discard races and bearing (Fig. 1D-39).

13. Examine surface of Axial Plate and Shaft. Replace **as an assembly**, if necessary.

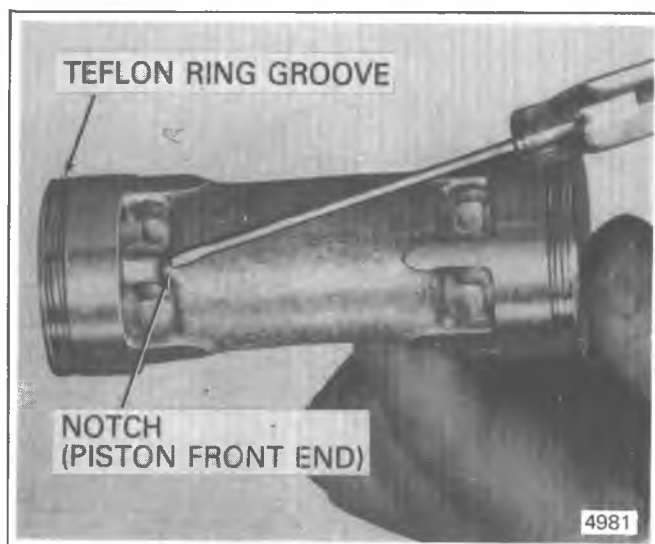


Fig. 1D-37 Notch Identifying Front End of A-6 Piston

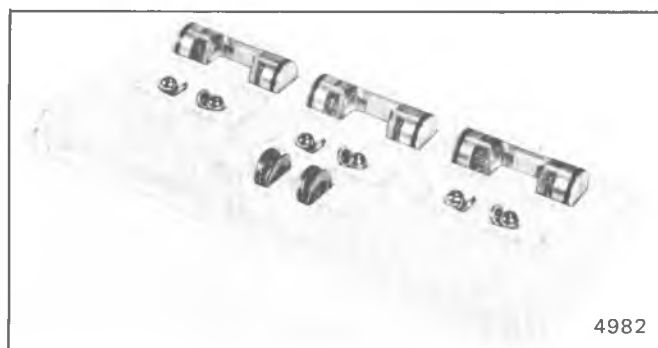


Fig. 1D-38 A-6 Parts Tray

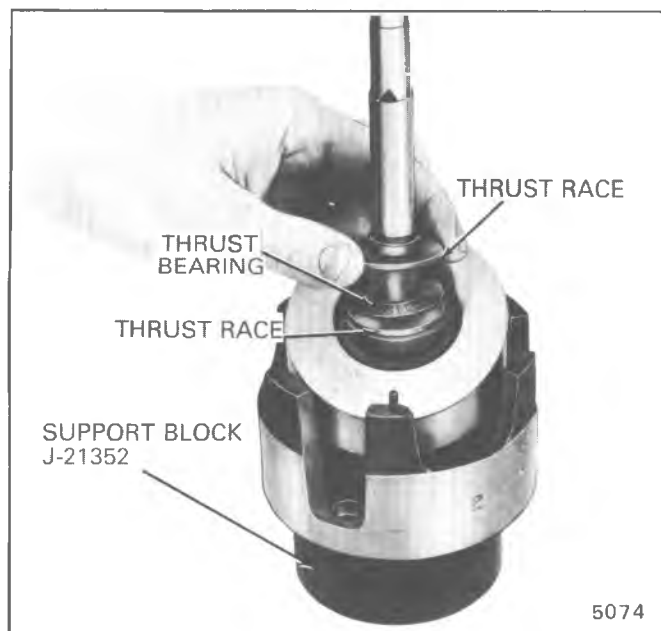


Fig. 1D-39 Removing A-6 Front Thrust Races and Bearings

A certain amount of shoe disc wear on axial plate is normal, as well as some markings indicating load of needle bearings on shaft.

14. Remove Discharge Cross-Over Tube from cylinder half, using self-clamping pliers.

This is necessary only on original factory equipment, as ends of the tube are swaged into cylinder halves. The discharge cross-over tube in Internal Cylinder and Shaft Assemblies that have been **previously** serviced have an O-ring and bushing at EACH END of the tube, and can be easily removed by hand (see Fig. 1D-58).

15. Examine piston bores and needle bearings in front and rear cylinder halves. Replace Front and Rear Cylinder Halves. Replace front and rear cylinders if any cylinder bore is deeply scored or damaged.

16. Needle bearings may be removed if necessary by driving them out with special Thin-Wall Socket J 9399. Insert socket in hub end (inner side) of cylinder head and drive bearing out.

To install needle bearing, place cylinder half on Support Block J 21352, and insert bearing in end of cylinder head with bearing **identification marks UP**. Use Needle Bearing Installer J 9432 and drive bearing into cylinder head (Fig. 1D-40), until Installer "bottoms" on the cylinder face.

Two different width needle bearings are used in Production compressors - a 1/2" size and a 5/8" size. **The bearings ARE interchangeable.** Service replacement bearings are all 1/2".



Fig. 1D-40 Installing A-6 Needle Bearing

17. Wash all parts to be re-used with trichlorethylene, naphtha, stoddard solvent, kerosene, or a similar solvent. Air-dry parts using a source of clean, **dry** air.

A-6 compressor internal components may be identified by referring to Fig. 1D-2 and Fig. 1D-3.

## A-6 COMPRESSOR INTERNAL CYLINDER AND SHAFT ASM

### Gaging Operation

1. Install Compressing Fixture J 9397 on Holding Fixture J 9396 in vise. **PLACE FRONT CYLINDER HALF** in Compressing Fixture, flat side down. **Front**

cylinder half has long slot extending out from shaft hole. "Legs" of front cylinder half will be pointed upward.

2. Secure from Service parts stock **four ZERO** thrust races, **two** thrust bearings and **three ZERO** shoe discs.

3. Now install a **ZERO THRUST RACE**, then one thrust bearing, and a **SECOND ZERO THRUST RACE ONTO FRONT END** of compressor shaft. Lubricate races and bearing with petrolatum.

4. Insert threaded end of axial shaft through needle bearing in front cylinder half, and allow thrust race and bearing assembly (race-bearing-race) to rest on hub of cylinder.

5. Now install a **ZERO THRUST RACE ON REAR END** of compressor axial shaft (Fig. 1D-41), so that it rests on hub of axial plate. Then add one thrust bearing and a **SECOND ZERO THRUST RACE** onto shaft. Lubricate races and bearing with petrolatum.

At this point, **BOTH** front end **and** rear end of axial shaft will have a stack-up of one ZERO race-one bearing-one ZERO race.

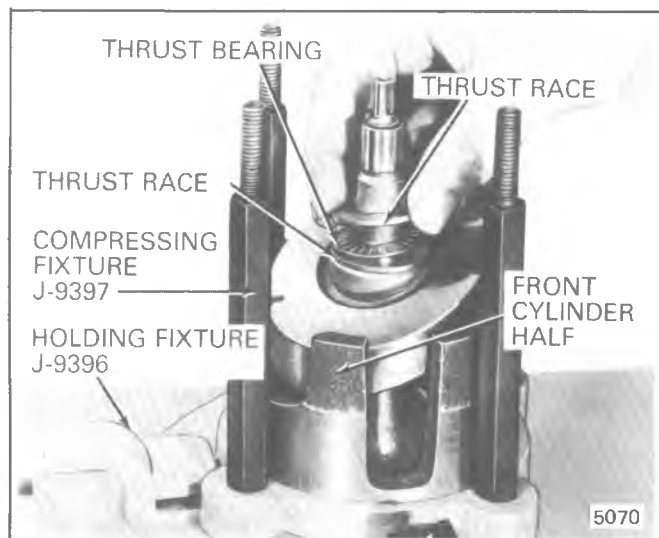


Fig. 1D-41 Installing A-6 Rear Thrust Races and Bearings

6. Lubricate ball pockets of the No. 1 Piston with 525 viscosity refrigerant oil and place a ball in each socket. Use balls previously removed if they were considered acceptable for re-use.

7. Lubricate cavity of a **ZERO SHOE** disc with 525 viscosity refrigerant oil and place shoe disc **OVER BALL IN FRONT END** of piston (Fig. 1D-42). **Front end of piston has an identifying notch in casting web** (Fig. 1D-37).

**CAUTION:** Exercise care in handling the Piston and Ring Assembly, particularly during assembly into and removal from the cylinder bores to prevent damage to the Teflon piston rings.

**SHOE DISCS SHOULD NOT BE INSTALLED ON REAR** of piston during following "Gaging" operation.

8. Rotate shaft and axial plate until high point of axial plate is over the No. 1 Piston cylinder bore.

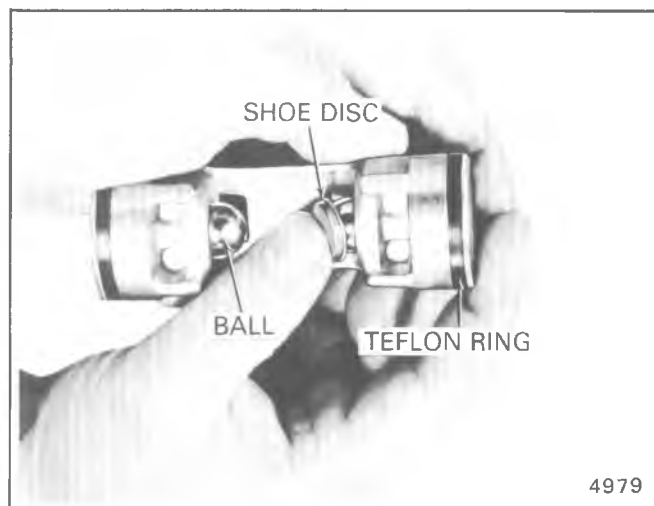


Fig. 1D-42 Installing A-6 Front Shoe Disc

9. Lift the axial shaft assembly up a little out of front cylinder half and hold front thrust race and bearing assembly ("zero" race-bearing-"zero" race) against axial plate hub.

10. Position No. 1 Piston over No. 1 cylinder bore (notched end of piston being on bottom and piston straddling axial plate) and lower the shaft to allow No. 1 Piston to drop into its bore (Fig. 1D-43).

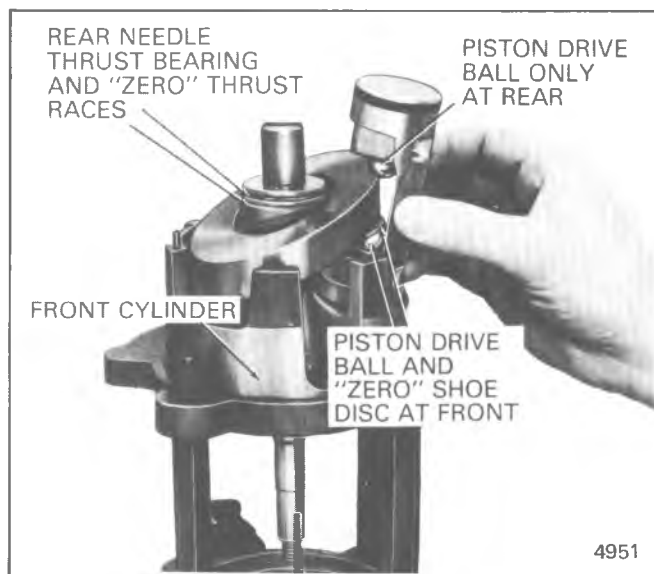


Fig. 1D-43 Installing A-6 Piston During Gaging Operation

11. Repeat Steps 6 through 10 for Pistons No. 2 and No. 3.

12. **NOW INSTALL REAR CYLINDER HALF ONTO PISTONS**, aligning cylinder with discharge cross-over tube hole in front cylinder half.

Tap into place using a plastic mallet or piece of clean wood and hammer (Fig. 1D-44).

13. Position discharge cross-over tube opening between a pair of Compressing Fixture J 9397 bolts to permit access for feeler gage.

14. Install top plate on Compressing Fixture J 9397. Tighten nuts to 15 lb. ft. (20 N·m) torque using a 0-25 lb. ft. (0-60 N·m) torque wrench.



Fig. 1D-44 Assembling A-6 Cylinder Halves

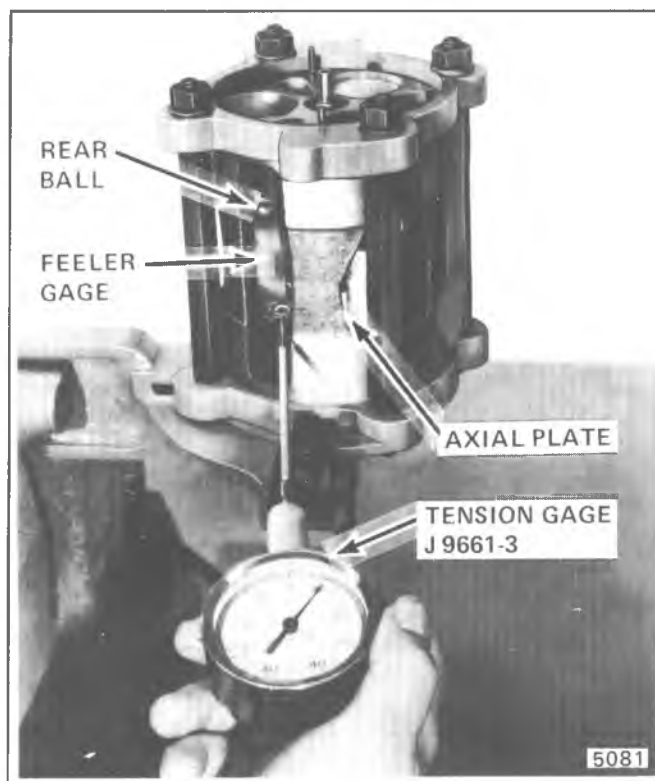


Fig. 1D-45 Gaging A-6 Rear Piston Ball

### Gaging Procedure (Steps 15 thru 18)

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

**The first is made to choose the proper size shoe discs** to provide, at each piston, a .0016" to .0024" total preload between the seats and the axial plate at the tightest place through the 360-degree rotation of the axial plate. The bronze shoe discs are provided in .0005" variations, including a basic ZERO shoe.

**The second, performed at the rear shaft thrust race and bearing stack-up, is designed to obtain .0025" to .0030" preload between the hub surfaces** of the axial 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.

Feeler and Tension Gage Set J 9564-01 or J 9661-01 may be used for gaging proper shoe disc size. Feeler Gage Set J 9564-01 or Dial Indicator Set J 8001 may be used to determine proper thrust race size.

**PROPER SELECTION OF THRUST RACES AND BALL SEATS IS OF EXTREME IMPORTANCE.**

15. Measure clearance between REAR BALL of No. 1 Piston AND AXIAL PLATE, in following manner:

a. Select a suitable combination of well-oiled Feeler Gage leaves to fit snugly between ball and axial plate.

b. Attach Tension Gage J 9661-3 to the feeler gage. A distribution point checking scale or Spring Scale J 544 may be used.

c. Pull on Spring Scale to slide Feeler Gage stock out from between ball and axial plate, and note reading on Spring Scale as Feeler Gage is removed (Fig. 1D-45). **Reading should be between 4 and 8 ounces.**

d. If reading in Step "c" above is under 4 OR over 8 ounces, reduce or increase thickness of Feeler Gage leaves and repeat Steps a. through c. above until a reading of 4 to 8 ounces is obtained. Record the clearance between ball and axial plate that results in the desired 4 to 8 ounce pull on Spring Scale.

16. Now rotate shaft 120° and repeat Step 15 between this same No. 1 Piston Rear Ball and axial plate. Record this measurement.

If shaft is hard to rotate, install shaft nut onto shaft and turn shaft with wrench.

17. Rotate shaft another 120° and again repeat Step 15 between these same parts and record measurements.

18. Select a "NUMBERED" SHOE disc corresponding to **minimum** feeler gage reading recorded in the three checks just made above. (See example in Fig. 1D-47). Place the selected shoe discs in Parts Tray J 9402 compartment corresponding to Piston No. 1 and Rear Ball pocket position.

Shoe discs are provided in .0005" (one-half thousandths) variations. There are a total of 11 sizes available for field servicing. All shoe discs are marked with the shoe size, which corresponds to the last three digits of the piece part number. (See Shoe Disc Size Chart in Fig. 1D-46).

**Once a proper selection of the shoe has been made, the MATCHED COMBINATION OF SHOE DISC TO REAR BALL AND SPHERICAL CAVITY IN PISTON MUST BE KEPT IN PROPER RELATIONSHIP during disassembly after Gaging operation, and during final assembly into the Internal Cylinder and Shaft Assembly.**

19. Repeat in detail the same Gaging Procedure outlined in Steps 15 through 18 for Piston No. 2 and No. 3.

SHOE DISC			THRUST BEARING RACE		
PART NO. ENDING IN	IDENTIFICATION STAMP	MIN. FEELER GAGE READING	PART NO. ENDING IN	IDENTIFICATION STAMP	DIAL INDICATOR READING
000	0	.0000	000	0	.0000
175	17-1/2	.0175	050	5	.0050
180	18	.0180	055	5-1/2	.0055
185	18-1/2	.0185	060	6	.0060
190	19	.0190	065	6-1/2	.0065
195	19-1/2	.0195	070	7	.0070
200	20	.0200	075	7-1/2	.0075
205	20-1/2	.0205	080	8	.0080
210	21	.0210	085	8-1/2	.0085
215	21-1/2	.0215	090	9	.0090
220	22	.0220	095	9-1/2	.0095
			100	10	.0100
			105	10-1/2	.0105
			110	11	.0110
			115	11-1/2	.0115
			120	12	.0120

0913

Fig. 1D-46 Available A-6 Service Shoes and Thrust Races

	POSITION 1	POSITION 2	POSITION 3	SELECT AND USE SHOE NO.
PISTON NO. 1	.019"	.0195"	.019"	19
PISTON NO. 2	.020"	.020"	.020"	20
PISTON NO. 3	.021"	.021"	.022"	21

0914

Fig. 1D-47 Selection of Proper A-6 Shoe Disc

20A. Mount Dial Indicator J 8001 on edge of Compressing Fixture J 9397 with Clamp J 8001-1 and Sleeve J 8001-2 (Fig. 1D-48). Position Dial Indicator on rear end of axial shaft and adjust to "zero".

From bottom, apply full hand-force at end of shaft a few times before reading clearance. This will help squeeze the oil out from/between mating parts. Now push upward again and record measurement. Dial Indicator increments are .001"; therefore, reading must be estimated to nearest .0005".

20B. An alternate method of selecting a proper race is to use Gage Set J 9661-01 selecting a suitable feeler gage leaf until the result is a 4 to 8 ounce pull on the scale between the rear thrust bearing and upper (which also happens to be the outer rear) thrust race (Fig. 1D-49). If the pull is just less than 4 ounces, add .0005" to the thickness of the feeler stock used to measure the clearance. If the pull on the scale reads just over 8 ounces, then subtract .0005" from the thickness of the feeler stock.

21. For either method used, select a thrust race with a "number" corresponding to TWO (2) FULL SIZES LARGER than Dial Indicator or Feeler Gage measurement of the amount of end play shown. (If measurement is .007", select a No.9 or 090 race.)

PLACE THRUST RACE IN RIGHT-HAND SLOT AT BOTTOM CENTER OF PARTS TRAY J 9402.

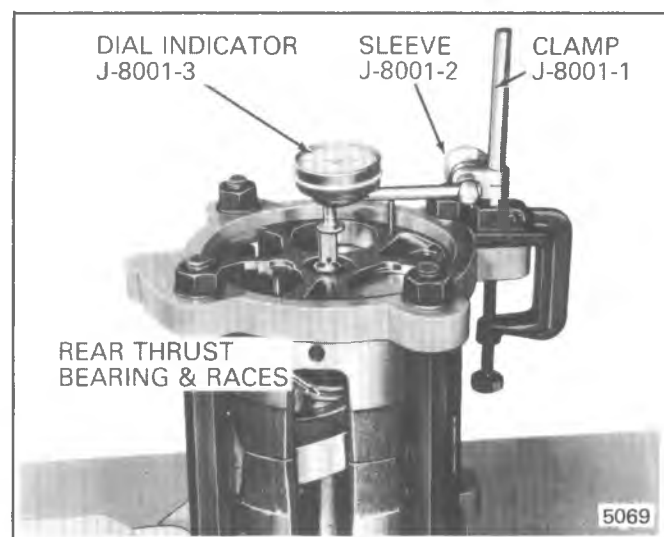


Fig. 1D-48 Gaging A-6 Rear Thrust Race

Fifteen (15) thrust races are provided in increments of .0005" (one-half thousandths) thickness and one ZERO gage thickness, providing a total of 16 sizes available for field service. The thrust race "number" also corresponds to the last three digits of the piece part number. See Thrust Race Size Chart in Fig. 1D-46.

22. Remove nuts from top plate of Compressing Fixture J 9397, and remove top plate.

23. Separate cylinder halves while unit is in Fixture. It may be necessary to use a wooden block and mallet.

24. Remove Rear Cylinder Half and carefully remove one piston at a time from axial plate and front cylinder half. DO NOT LOSE THE RELATIONSHIP of the front ball and shoe disc and rear ball. Transfer each piston, ball and shoe disc to its proper place in Parts Tray J 9402.

25. Now remove REAR OUTER ZERO thrust race (it will be on top) from shaft AND INSTALL THE THRUST RACE JUST SELECTED in Steps 20 and 21 that is



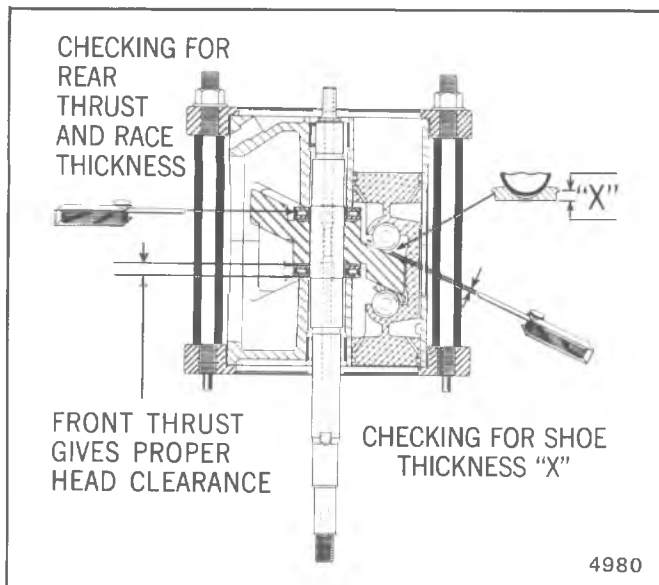


Fig. 1D-49 Checking A-6 Piston and Shaft End Play

presently setting in the right-hand slot at bottom center of Parts Tray J 9402.

The removed ZERO thrust race may be put aside for re-use in additional Gaging or rebuilding operations.

26. Repeat for each piston.

## A-6 COMPRESSOR CYLINDER AND SHAFT ASSEMBLY

### A-6 Teflon Piston Ring Replacement

The Teflon piston ring installing, sizing and gaging tools are shown in Fig. 1D-50.

1. Remove the old piston rings by **CAREFULLY** slicing through the ring with a knife or sharp instrument, holding the blade almost flat with the piston surface. Be careful not to damage the aluminum piston OR piston

**WARNING: EXERCISE PERSONAL CARE IN CUTTING THE PISTON RING FOR REMOVAL.**

2. Clean the piston and piston ring grooves with trichlorethylene, naphtha, stoddard solvent, kerosene or equivalent solvent and blow the piston dry with DRY air.

3. Set the piston on-end on a clean, flat surface and install the Ring Installer Guide J 24608-2 on the end of the piston (Fig. 1D-51).

4. Install a Teflon ring on the Ring Installer Guide J 24605-2 as shown in Fig. 1D-51, **with the dished or dull-side down and glossy-side up.**

5. Push the Ring Installer J 24608-5 down over the Installer Guide J 24608-2 to install the Teflon ring in the piston ring groove (Fig. 1D-52). If the Teflon ring is slightly off position in the ring groove, it can be positioned into place by fingernail or blunt-edged tool that will not damage the piston.

The Ring Installer J 24608-5 will retain the Installer Guide J 24608-2 internally when the Teflon ring is installed on the piston. Remove the Installer Guide from the Ring Installer and **DO NOT STORE THE INSTALLER GUIDE IN THE RING INSTALLER, as the Ring Installer Segment Retainer O-Ring J 24608-3 will be stretched and possibly weakened during storage.** This could result in the O-Ring J 24608-3 not holding the Ring Installer segments tight enough to the Installer Guide J 24608-2 to properly install the Teflon ring on the piston.

6. Lubricate the piston ring area with 525 viscosity refrigerant oil and rotate the Piston and Ring Assembly into the Ring Sizer J 24608-6 **at a slight angle** (Fig. 1D-53). Rotate the piston, while pushing inward, until the piston is inserted against the center stop of the Ring Sizer J 23608-6.

**CAUTION: DO NOT push the Piston and Ring Assembly into the Ring Sizer J 24608-6 without proper positioning and rotating as described above, as the ends of the needle bearings of the Ring Sizer may damage the end of the piston.**



Fig. 1D-50 A-6 Teflon Piston Ring Installing, Sizing and Gaging Tools

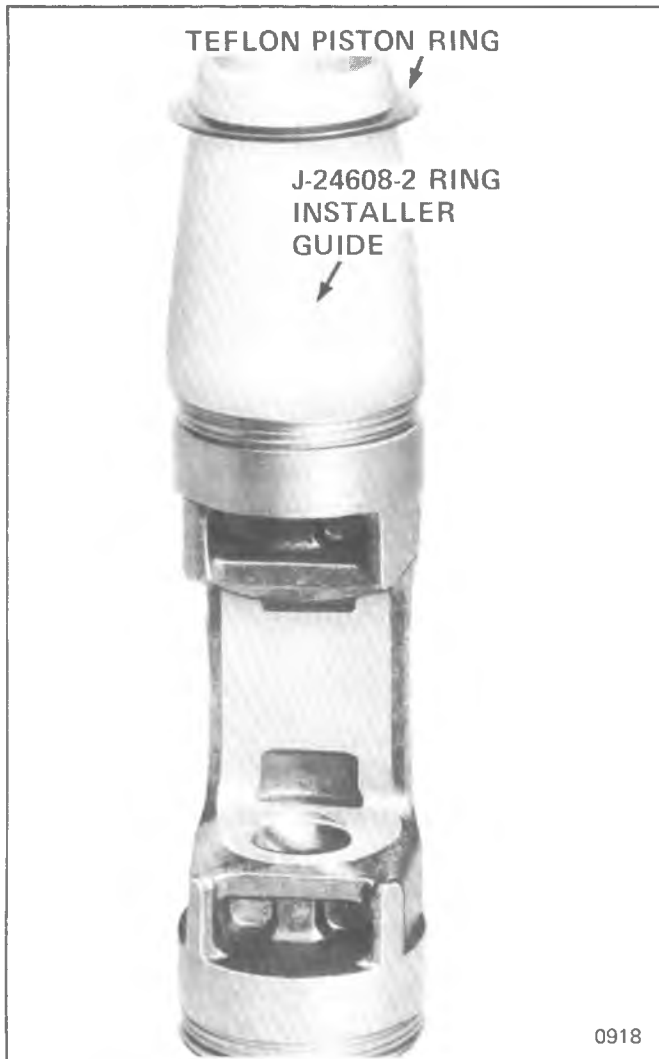


Fig. 1D-51 A-6 Teflon Piston Ring Positioned on Ring Installer Guide



Fig. 1D-52 Installing A-6 Teflon Piston Ring

7. Rotate the Piston and Ring Assembly in the Ring Sizer J 24608-6 several **COMPLETE** turns, until the Assembly rotates relatively free in the Ring Sizer (Fig. 1D-53).

8. Remove the Piston and Ring Assembly, wipe the end of the piston and ring area with a clean cloth and then push the Piston and Ring Assembly into the Ring Gage J 24608-1 (Fig. 1D-54). The piston should go through the Ring Gage with a 6-lb. force or less without lubrication. If not, repeat Steps 6 and 7.

9. Repeat the procedure for the opposite end of the piston (Fig. 1D-55).

**CAUTION:** *DO NOT lay the piston down on a dirty surface where dirt or metal chips might come into contact and become imbedded in the Teflon ring surface.*

10. Lubricate **BOTH ENDS** of the piston with 525 viscosity refrigerant oil before inserting the piston into the cylinder bore.

**CAUTION:** *Reasonable care should be exercised in installing the piston into the cylinder bore to prevent damage to the Teflon ring.*



Fig. 1D-53 Turning A-6 Piston and Ring Asm. Into Ring Sizing Tool

## A-6 COMPRESSOR INTERNAL CYLINDER AND SHAFT ASM.

### Assembly

After properly performing the "Gaging Procedure", choosing the correct shoe discs and thrust races, and installing any needed Teflon piston rings, the cylinder

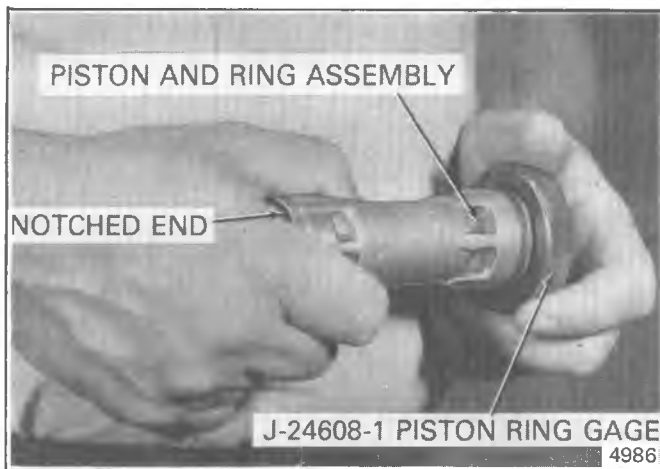


Fig. 1D-54 Gaging A-6 Piston Ring Size

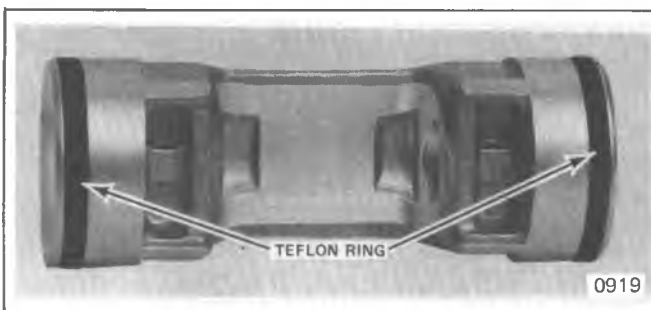


Fig. 1D-55 A-6 Teflon Piston Ring Installed in Piston Groove.

assembly may now be reassembled. Be sure to install all **NEW** seals and O-rings. All are included in the compressor O-Ring Service Kit.

Assembly procedure is as follows:

1. Support the **FRONT** half of the cylinder assembly on Compressing Fixture J 9397. Install the shaft and axial plate, threaded end **down**, with its front bearing race pack (**ZERO** race-bearing-**NUMBERED** race), if this was not already done at the end of the "Gaging Procedure".

2. Apply a light smear of petroleum jelly to the "numbered" shoe discs chosen in the Gaging Procedure and install all balls and shoe discs in their proper place in the piston assembly.

3. Rotate the axial plate so that the high point is above cylinder bore No. 1.

- a. Carefully assemble Piston No. 1, complete with **BALL AND "ZERO" SHOE DISC ON THE FRONT** and **BALL AND "NUMBERED" SHOE DISC ON THE REAR**, over the axial plate.

- b. Hold front thrust bearing pack tightly against axial plate hub while lifting hub.

- c. Insert the Piston Assembly into the Front Cylinder Half (Fig. 1D-56).

4. Repeat this operation for Pistons No. 2 and No. 3 (Fig. 1D-57).

5. Without installing any O-rings or bushings, assemble one end of the new Service Discharge Cross-Over Tube into the hole in the front cylinder half (Fig. 1D-58 and 1D-59).

**Be sure the flattened portion of this tube faces the inside** of the compressor to allow for axial plate clearance (Fig. 1D-59).

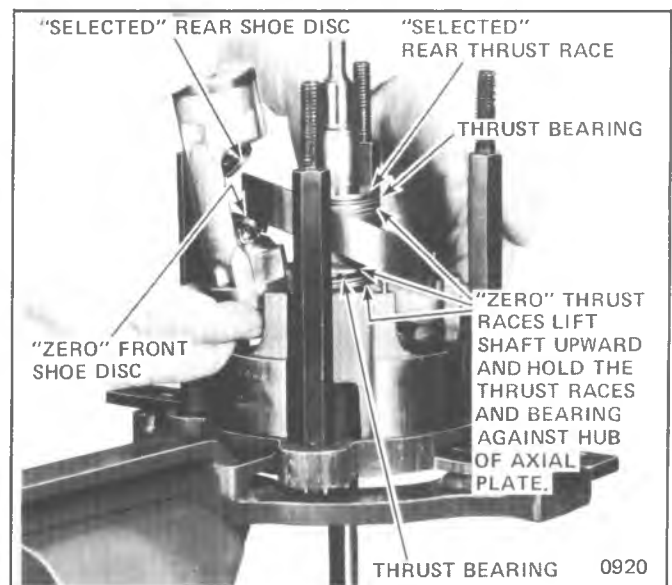


Fig. 1D-56 Installing 1st A-6 Piston Assembly Into Front Cylinder Half

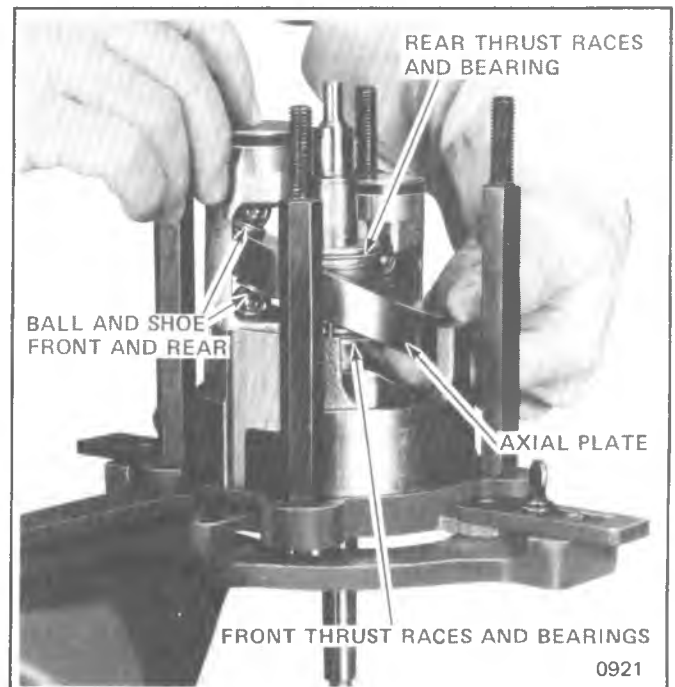


Fig. 1D-57 Installing 2nd A-6 Piston

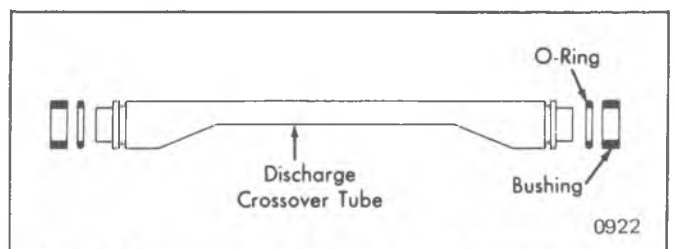


Fig. 1D-58 Service-type A-6 Discharge Cross-Over Tube

6. Now 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 bore (Fig. 1D-60).

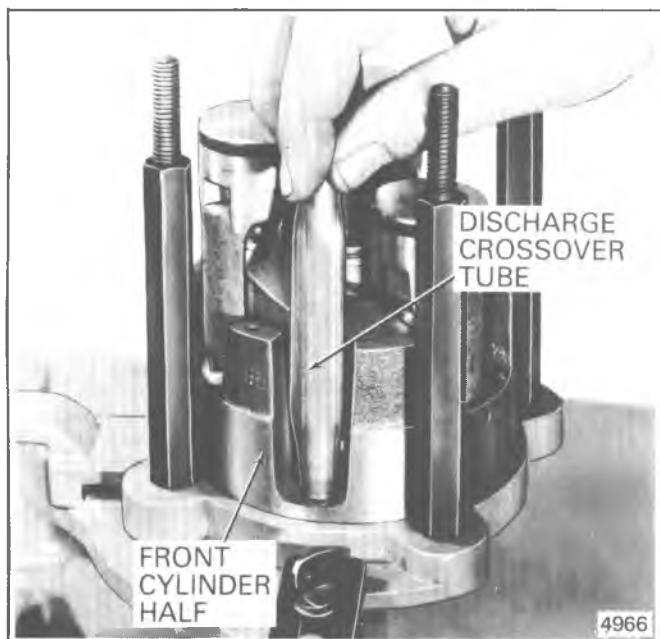


Fig. 1D-59 Installing A-6 Discharge Cross-over Tube

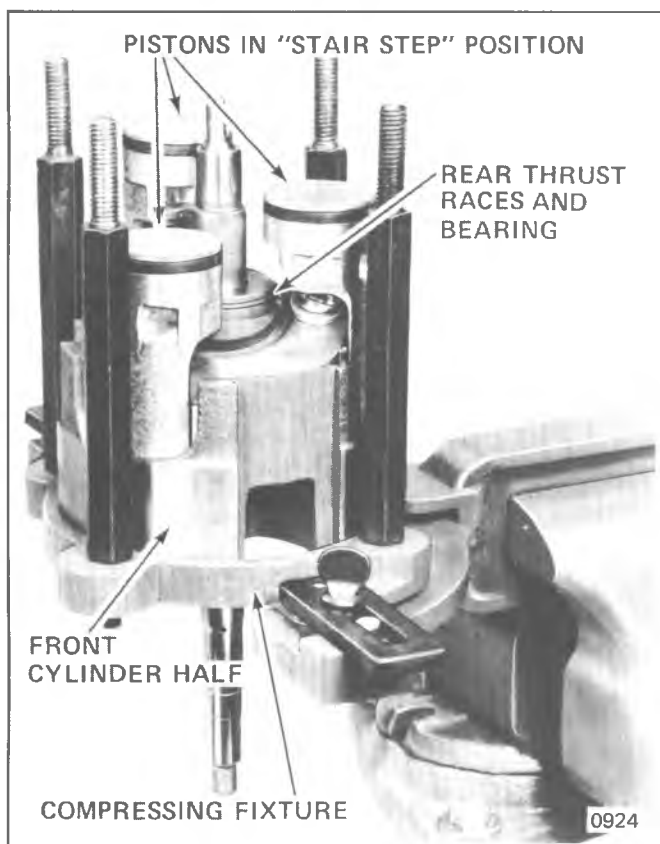


Fig. 1D-60 A-6 Pistons Positioned in Stair-Step Arrangement

7. When all three Piston and Ring assemblies are in their respective cylinders, align the end of the discharge cross-over tube with the hole in the rear half of the cylinder.

8. When all parts are in proper alignment, tap with a clean wooden block and mallet to seat the rear half of the cylinder over the locating dowel pins. If necessary, clamp the cylinder in Compressing Fixture J 9397, to complete drawing the cylinder halves together.

9. Generously lubricate all moving parts with clean 525 viscosity refrigerant oil and check for free rotation of the parts.

10. Replace the Suction Cross-Over Cover (Fig. 1D-61). Compress the cover as shown to start it into the slot, and then press or carefully tap it in until flush on both ends.

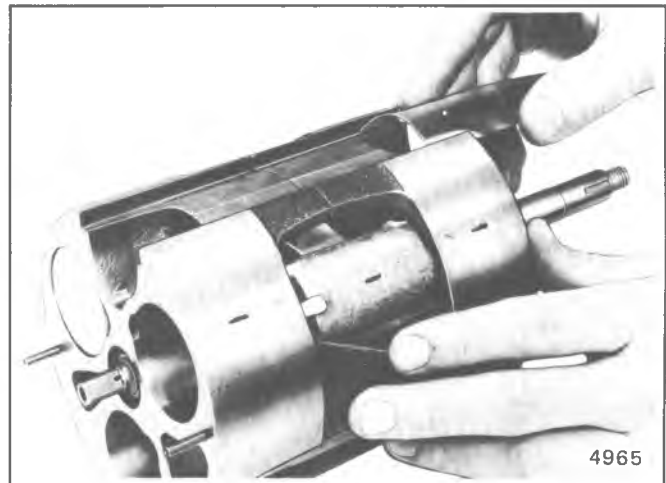


Fig. 1D-61 Installing A-6 Suction Cross-over Cover

## A-6 COMPRESSOR INTERNAL CYLINDER AND SHAFT ASM

### Re-Install

1. Place Internal Cylinder and Shaft Assembly on Internal Assembly Support Block J 21352, with **rear-end** of shaft in Support Block hole.

2. Now install new O-ring and bushing in **front-end** of discharge cross-over tube (Fig. 1D-62). The O-ring and bushing are Service parts only for Internal Cylinder and Shaft Assemblies that have been disassembled in the field (Also see Fig. 1D-58).

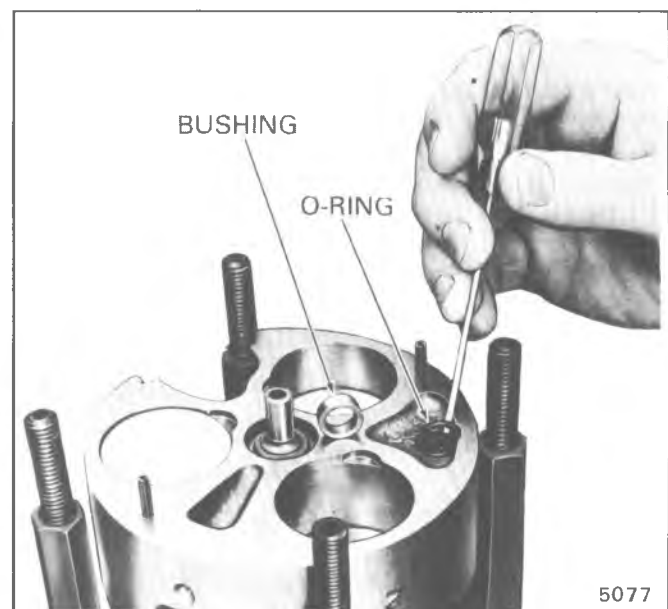


Fig. 1D-62 Installing O-Ring On A-6 Discharge Cross-Over Tube

3. Install new dowel pins in front cylinder half, if previously removed.

4. Install Front Suction Reed Plate on front cylinder half. Align with dowel pins, suction ports, oil return slot, and discharge cross-over tube (Fig. 1D-63).

5. Install Front Discharge Valve Plate assembly (it has a large diameter hole in the center), aligning holes with dowel pins and proper openings in front suction reed plate (Fig. 1D-64 and Fig. 1D-65.)

6. Coat sealing surfaces on webs of compressor front head casting with clean 525 viscosity refrigerant oil.

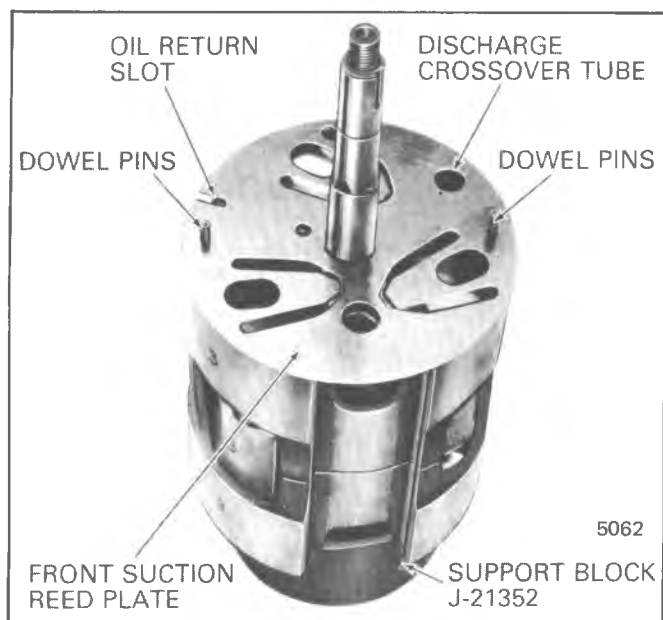


Fig. 1D-63 Installing A-6 Front Suction Reed

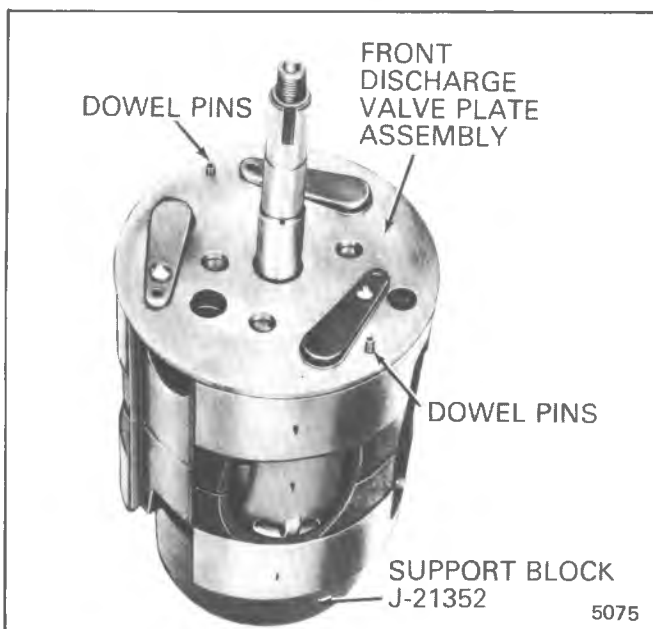


Fig. 1D-64 Installing A-6 Front Discharge Valve Plate

7. Determine **exact** position of Front Head casting in relation to dowel pins on Internal Cylinder and Shaft Assembly. Mark position of dowel pins on sides of Front Head assembly and on sides of Internal Cylinder and Shaft Assembly with a grease pencil. Carefully lower Front Head

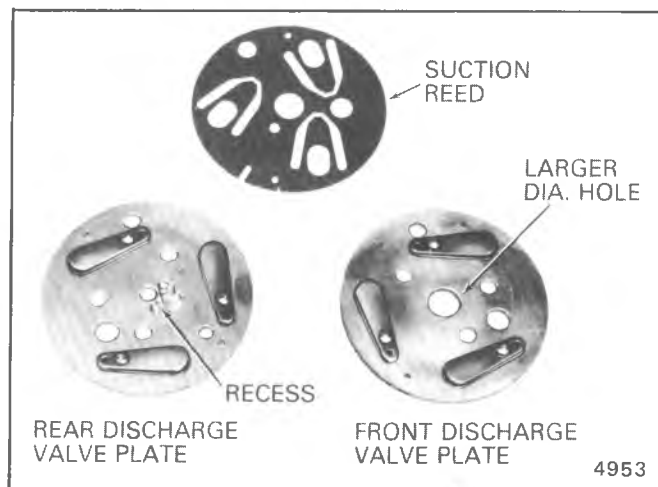


Fig. 1D-65 Front and Rear A-6 Discharge Valve Plates

casting into position (Fig. 1D-66), **making certain that sealing area around center bore of head assembly does not contact shaft** as head assembly is lowered. **Do not rotate head assembly** to line up with dowel pins, as the sealing areas would then contact the reed retainers.

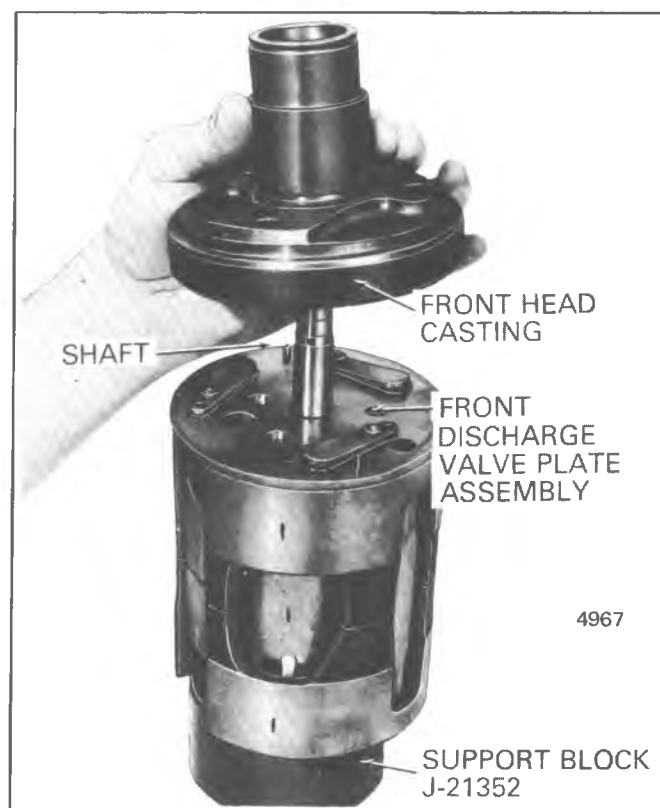


Fig. 1D-66 Installing A-6 Front Head Casting

8. Generously lubricate new O-ring and angled groove at lower edge of front head casting with 525 viscosity refrigerant oil and install new O-ring into groove (Fig. 1D-67).

9. Coat inside machined surfaces of compressor shell with 525 viscosity refrigerant oil and position shell on Internal Cylinder and Shaft Assembly, resting on O-ring seal.

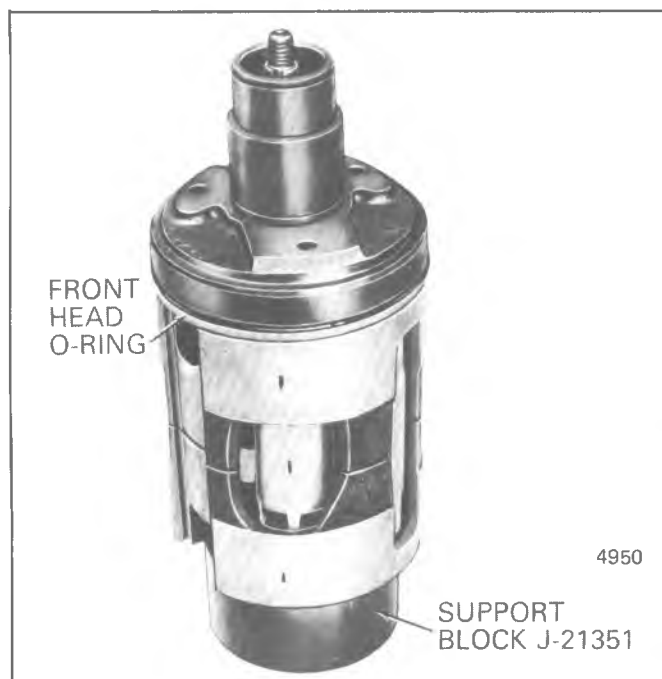


Fig. 1D-67 A-6 Front Head O-Ring Installed

10. Using flat-side of a small screwdriver, gently position O-ring in around circumference of Internal Cylinder and Shaft Assembly until Compressor Shell slides down over Internal Cylinder and Shaft Assembly. As shell slides down, line up oil sump with oil intake tube hole (Fig. 1D-68).

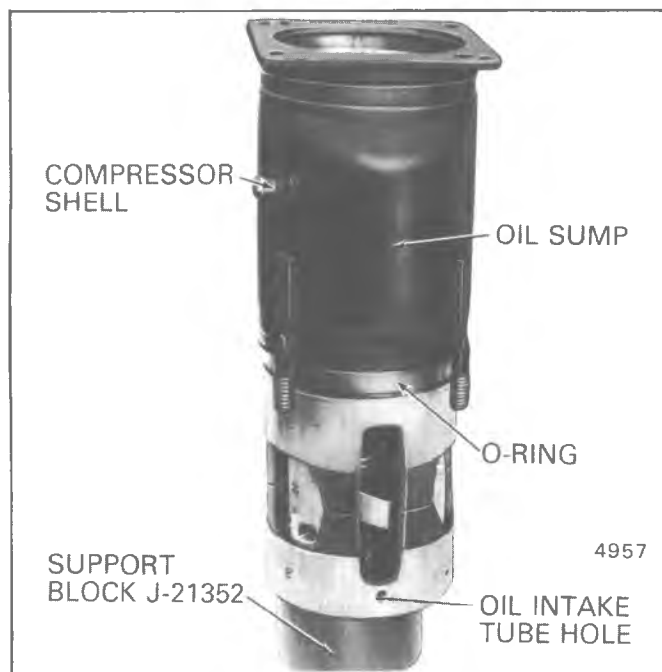


Fig. 1D-68 Installing A-6 Compressor Shell

11. Holding Support Block J 21352 with one hand, invert Internal Cylinder and Shaft Assembly and place back into Holding Fixture J9396 with front end of shaft now facing downward. Remove Support Block.

12. Install new dowel pins in rear cylinder half, if previously removed.

13. Install new O-ring in oil pick-up tube cavity.

14. Lubricate Oil Pick-Up Tube with 525 viscosity refrigerant oil and install into cavity, rotating compressor mechanism to align tube with hole in shell baffle (Fig. 1D-69).

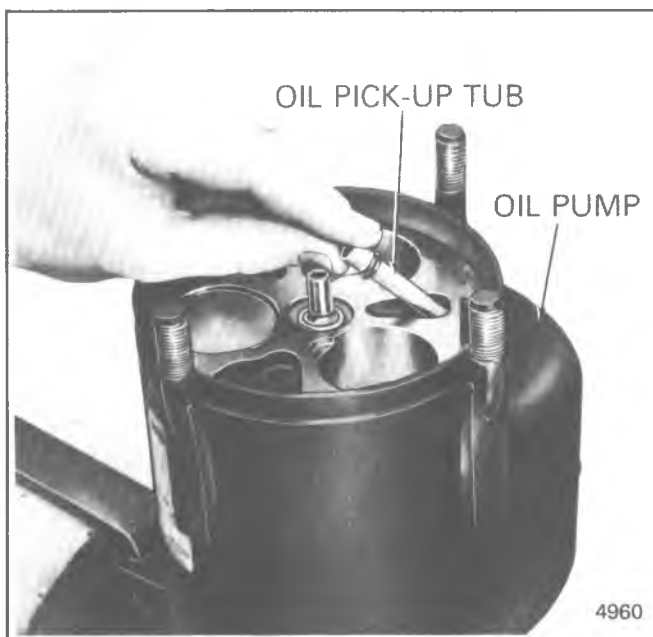


Fig. 1D-69 Installing A-6 Oil Pick-up Tube

15. Now install new O-ring and bushing on **rear-end** of discharge cross-over tube (See Fig. 1D-58).

16. Install Rear Suction Reed over dowel pins, **with slot TOWARDS sump**.

17. Install Rear Discharge Valve Plate assembly over dowel pins, **with reed retainers UP**.

18. Position Inner Oil Pump Gear over shaft with previously applied identification **mark UP**.

19. Position Outer Oil Pump Gear over inner gear with previously applied identification **mark up** and, when standing facing oil sump, position outer gear so that it meshes with inner gear at the 9-o'clock position. The resulting cavity between gear teeth is then at 3-o'clock position (Fig. 1D-70).

20. Generously oil Rear Discharge Valve Plate assembly with 525 viscosity refrigerant oil around outer edge where large diameter O-ring will be placed. Oil the valve reeds, pump gears, and area where sealing surface will contact Rear Discharge Valve Plate.

21. Using the 525 oil, lubricate new head to-shell O-ring and install on rear discharge valve plate, in contact with shell (Fig. 1D-71).

22. Install Suction Screen in rear head casting, using care not to damage screen.

23. Coat sealing surface on webs of compressor rear head casting with 525 viscosity refrigerant oil.

24. Install Rear Head assembly over studs on compressor shell. **The two lower threaded compressor mounting holes should be in alignment with the compressor sump.**

Make certain that suction screen does not drop out of place when lowering rear head into position (Fig. 1D-72).

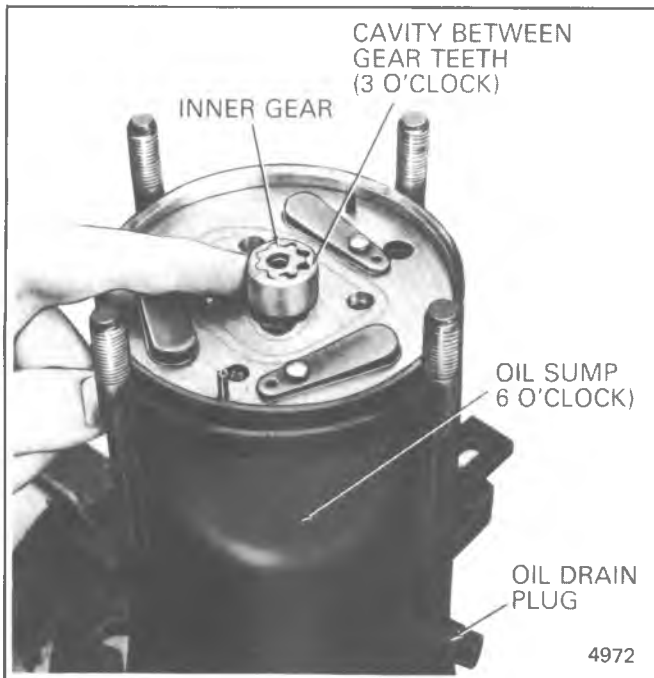


Fig. 1D-70 Positioning A-6 Oil Pump Gears

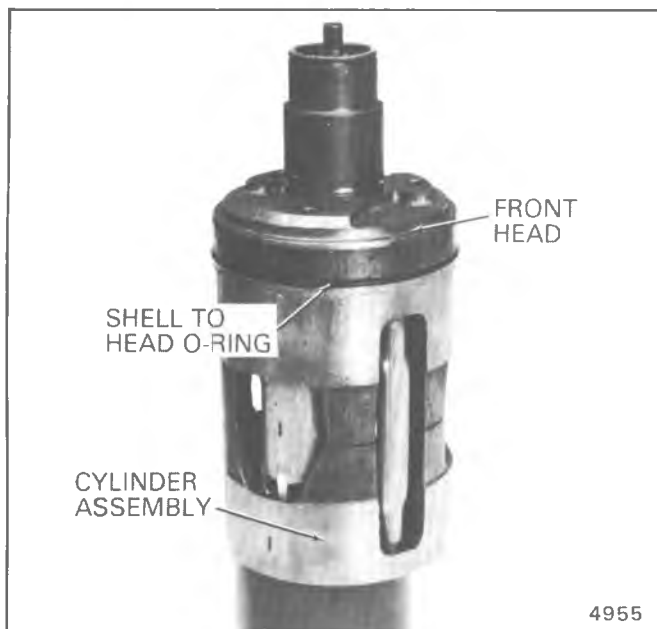


Fig. 1D-71 A-6 Shell-To-Front Head O-Ring Installation

If Rear Head assembly will not slide down over dowels in Internal Cylinder and Shaft Assembly, twist Front Head assembly back-and-forth very slightly by-hand until Rear Head drops over dowel pins.

25. Install nuts on threaded shell studs and tighten evenly to 25 lb. ft. (34 N·m) torque using a 0-50 lb. ft. (0-60 N·m) torque wrench.

26. Invert compressor in Holding Fixture and install compressor Shaft Seal as described in "A-6 Compressor Shaft Seal" Replacement procedure.

27. Install compressor Clutch Coil and Housing assembly as described in "A-6 Compressor Clutch Coil and Housing Asm." Replacement procedure.

28. Install compressor Pulley and Bearing assembly as described in "A-6 Compressor Pulley and Bearing" Replacement procedure.

29. Install compressor Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Replacement procedure.

30. Add required amount of 525 viscosity refrigerant oil (see "C.C.O.T. Refrigerant Oil Distribution" in the AIR CONDITIONING section).

31. Check for external and internal leaks as described in the following "A-6 Compressor Leak Testing" procedure found at the end of this OVER-HAUL section.

32. "Evacuate and Charge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

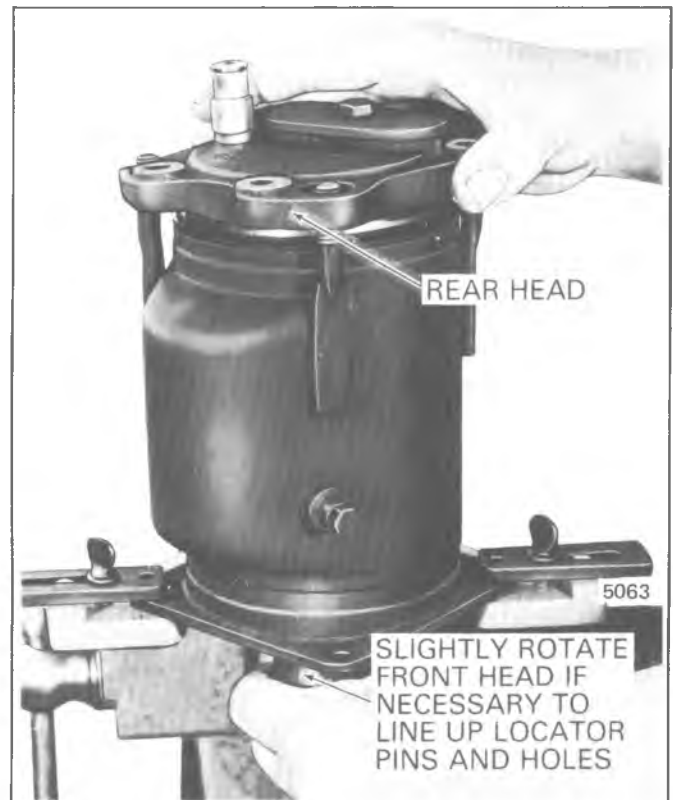


Fig. 1D-72 Installing A-6 Rear Head



## MINOR REPAIR PROCEDURES FOR THE R-4 COMPRESSOR

THE FOLLOWING OPERATIONS TO THE R-4 COMPRESSOR CLUTCH PLATE AND HUB, ROTOR AND BEARING, AND COIL & PULLEY RIM ARE COVERED AS "MINOR" BECAUSE THEY MAY BE PERFORMED WITHOUT FIRST PURGING THE SYSTEM OR REMOVING THE COMPRESSOR FROM THE VEHICLE.

The Compressor Shaft Seal assembly, Pressure Relief Valve and Pressure 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-12.

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

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to the **AIR CONDITIONING** section and Fig. 1D-74 and Fig. 1D-75 for information relative to parts nomenclature and location.

Removal and installation of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench. **The work area, tools and parts must be kept clean at all times.**



Fig. 1D-73 R-4 Compressor

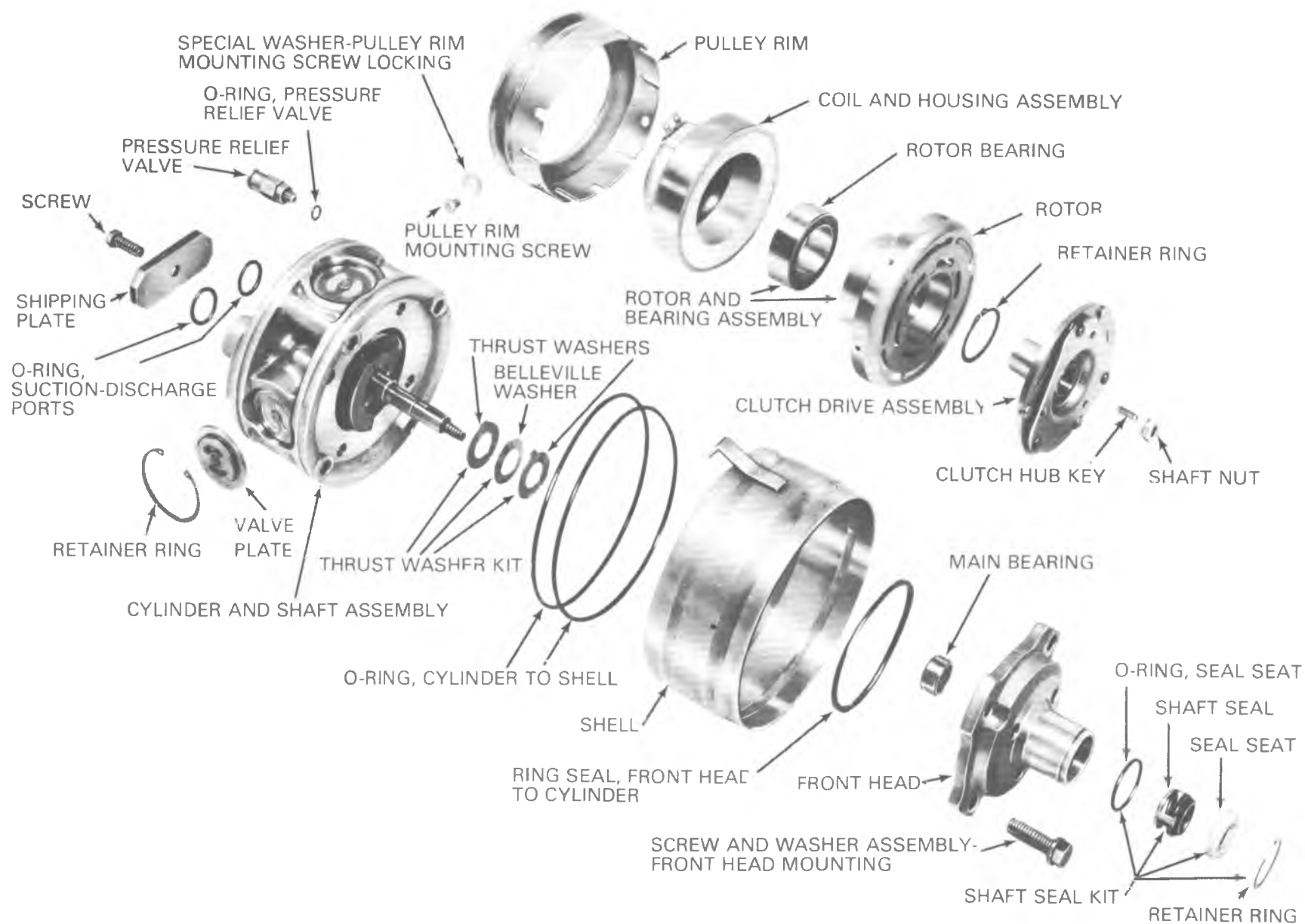
### R-4 COMPRESSOR CLUTCH PLATE AND HUB ASM.

#### Remove

1. If compressor is not removed from the car, loosen compressor mounting brackets, disconnect the compressor drive belt and reposition the compressor for access, if necessary.

If compressor has been removed from the car, attach the compressor to Holding Fixture J 25008-1, and clamp the Holding Fixture in a vise (Fig. 1D-76).

Fig. 1D-74 Exploded View of R-4 Compressor



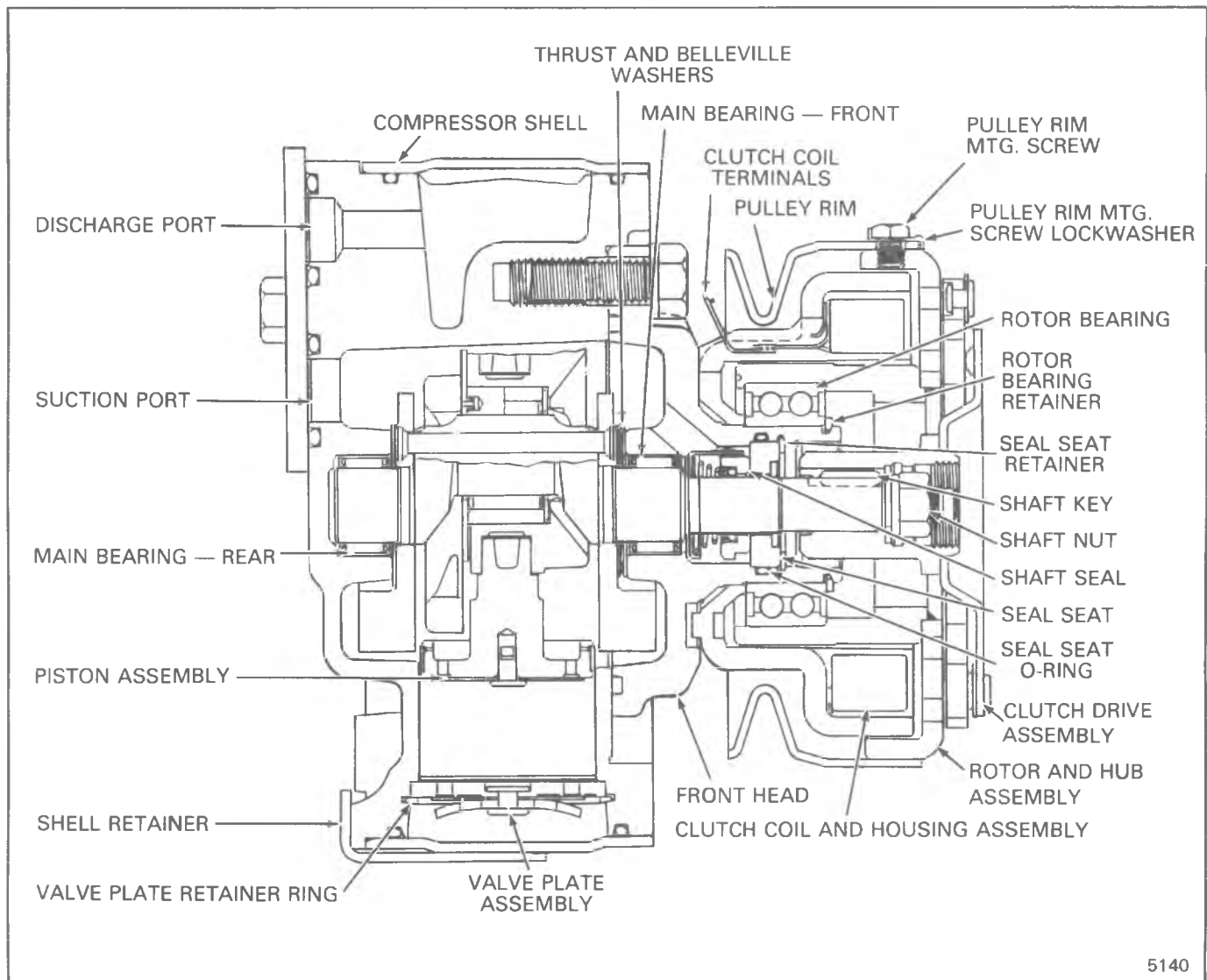


Fig. 1D-75 R-4 Compressor Cross Section

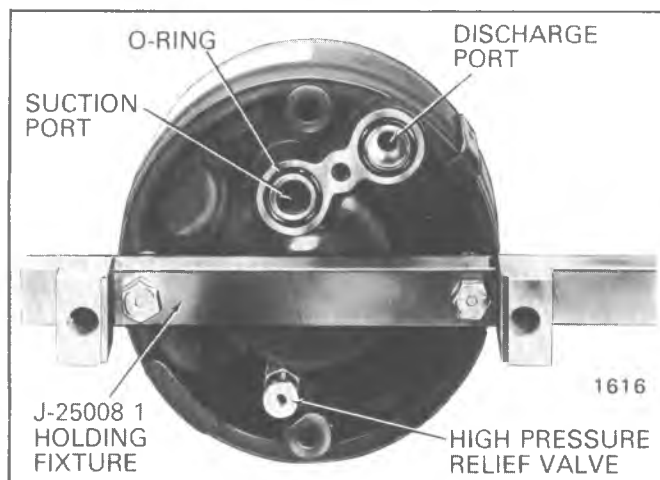


Fig. 1D-76 R-4 In Holding Fixture

2. Keep the clutch hub from turning with the Clutch Hub Holding Tool J 25030, and remove, discard and later replace the shaft nut, using Thin Wall Socket J 9399, Fig. 1D-77.

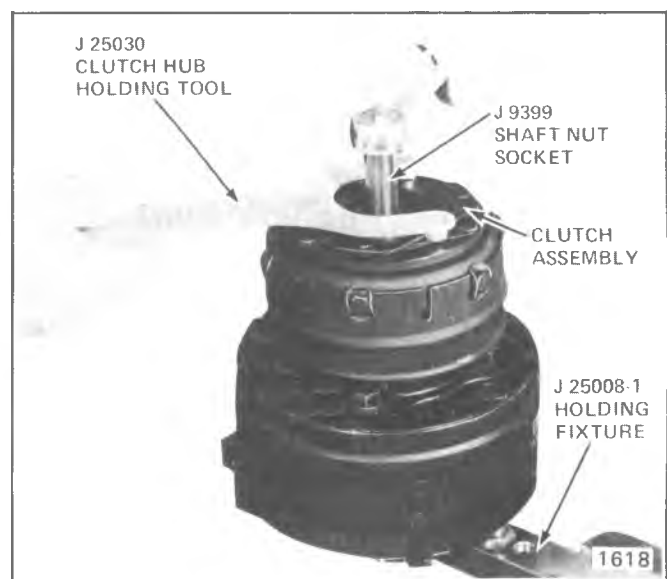


Fig. 1D-77 Removing R-4 Shaft Nut

3. Thread the Clutch Plate and Hub Assembly Remover J 9401, into the hub. Hold the body of the Remover with a wrench and turn the center screw into the Remover body to remove the Clutch Plate and Hub assembly (Fig. 1D-78).

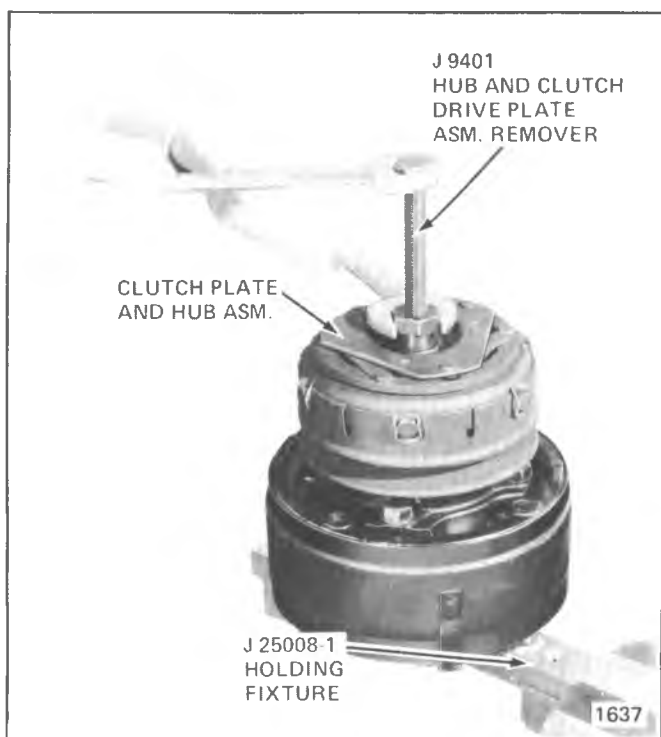


Fig. 1D-78 R-4 Clutch Plate & Hub Asm. Removal

4. Remove the shaft key.

### Replace

1. Install the shaft key into the hub key groove (Fig. 1D-79). Allow the key to project approximately 3/16" out of the keyway.

The shaft key is curved slightly to provide an interference fit in the shaft key groove to permit the key projection without falling out.

2. Be sure the frictional surface of the clutch plate and the clutch rotor are clean before installing the Clutch Plate and Hub assembly.

3. Align the shaft key with the shaft keyway and place the Clutch Plate and Hub assembly onto the compressor shaft.

**CAUTION:** To avoid internal damage to the compressor, do not drive or pound on the clutch hub or shaft.

4. Install the Clutch Plate and Hub Installer J 9480-01 as illustrated in Fig. 1D-80.

5. Hold the hex portion of the Installer Body J 9480-1 with a wrench and tighten the center screw to press the hub onto the shaft until there is a .020-.040 inch air gap between the frictional surfaces of the clutch plate and clutch rotor.

6. Install a new shaft nut with the small diameter boss of the nut against the crankshaft shoulder, using Thin Wall Socket J 9399. Hold the Clutch Plate and Hub assembly with Clutch Hub Holding Tool J 25030, and tighten to 8-12 foot pounds (11-16 N·m) torque, using a 0-25 pounds (0-60

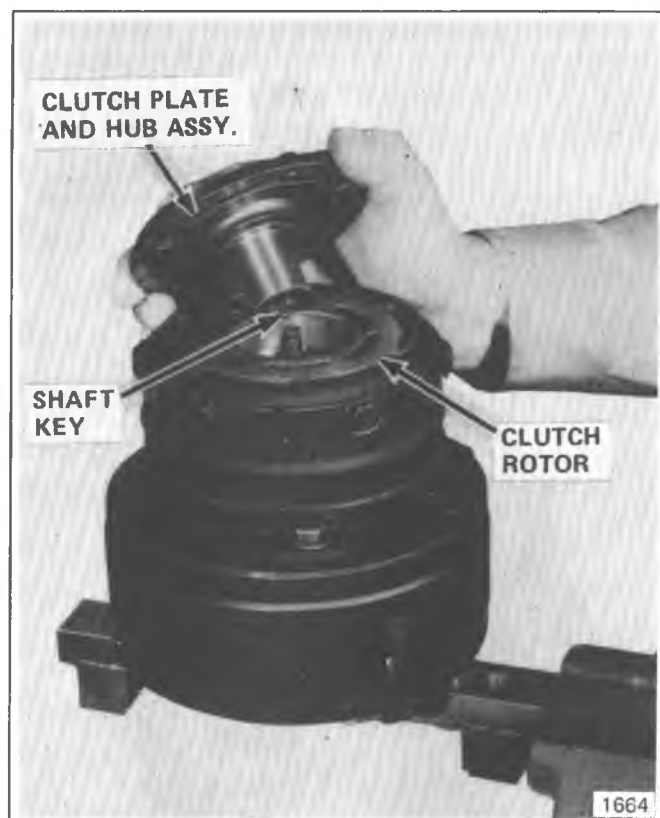


Fig. 1D-79 Installing R-4 Shaft Key

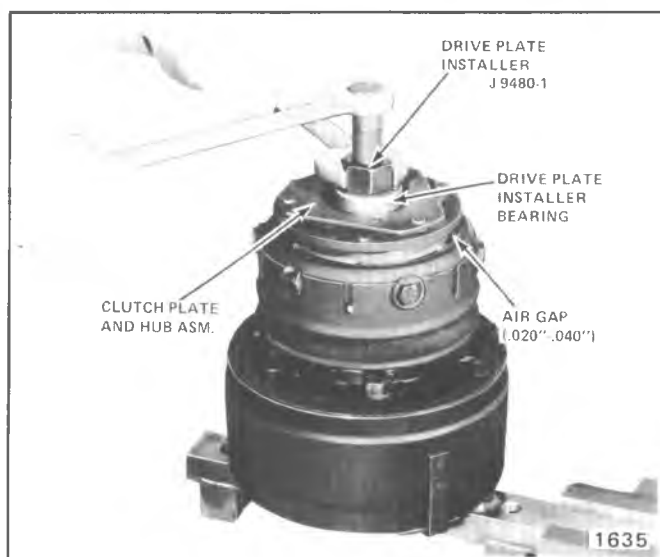


Fig. 1D-80 Installing R-4 Clutch Plate & Hub Asm.

N·m) torque wrench.

7. If operation is performed with compressor on car, connect drive belt, tighten mounting brackets and adjust belt tension.

## R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING

### Remove

1. Remove the Clutch Plate and Hub assembly as described in "R-4 Compressor Clutch Plate & Hub Asm." Removal procedure.

2. Remove Rotor and Bearing assembly retaining ring, using Snap Ring Pliers J 6083 (#24), Fig. 1D-81. Mark the location of the clutch coil terminals.

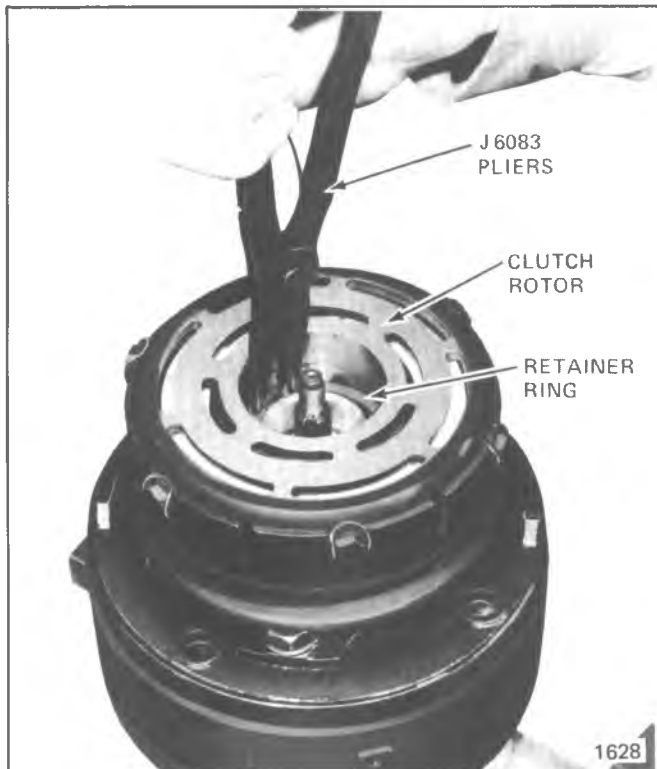


Fig. 1D-81 Removing R-4 Rotor & Bearing Asm. Retainer Ring

If the Clutch Rotor and/or Rotor Bearing only are to be replaced, bend the lockwashers away from the pulley rim mounting screws (see Fig. 1D-79), and remove the six mounting screws and special lock washers before proceeding with Step 3. Discard the lock washers.

3. Install Rotor and Bearing Puller J 25031-2 down into the rotor until the Puller arms engage the recessed edge of the rotor hub. Hold the Puller and arms in place and tighten the Puller screw against the Puller Guide to remove the Clutch Rotor and Bearing assembly (Fig. 1D-82 and 1D-83), being careful not to drop the Puller Guide.

4. If the pulley rim mounting screws and washers were removed in Step 2, only the Clutch Rotor and Bearing assembly will be removed for replacement. The Clutch Coil and Housing assembly is pressed onto the Front Head of the compressor with a press fit and will not be removed unless the pulley rim mounting screws are left securely in place and the pulley rim pulls the Coil and Housing assembly off with the total Clutch Rotor and Pulley Rim Assembly.

5. Place the Rotor and Bearing assembly on blocks as shown in Fig. 1D-84. Drive the bearing out of the rotor hub with Rotor Bearing Remover J 25029.

It is not necessary to remove the staking at the rear of the rotor hub to remove the bearing (see Fig. 1D-85).

## Replace

1. Place the Rotor and Hub assembly face down on a clean, flat and firm surface.



Fig. 1D-82 Installing R-4 Rotor & Bearing Puller Guide



Fig. 1D-83 Removing R-4 Clutch Rotor Asm.

2. Align the new bearing squarely with the hub bore and using Pulley and Bearing Installer J 9481 with Universal Handle J 8092, drive the bearing fully into the hub (Fig. 1D-86). The Installer will apply force to the outer race of the bearing.

3. Using a center punch with a 45° angle point, stake (0.45"-0.055" deep) the bearing in three places 120° apart as shown in Fig. 1D-85, but do not stake too deeply to avoid distorting the outer race of the bearing.

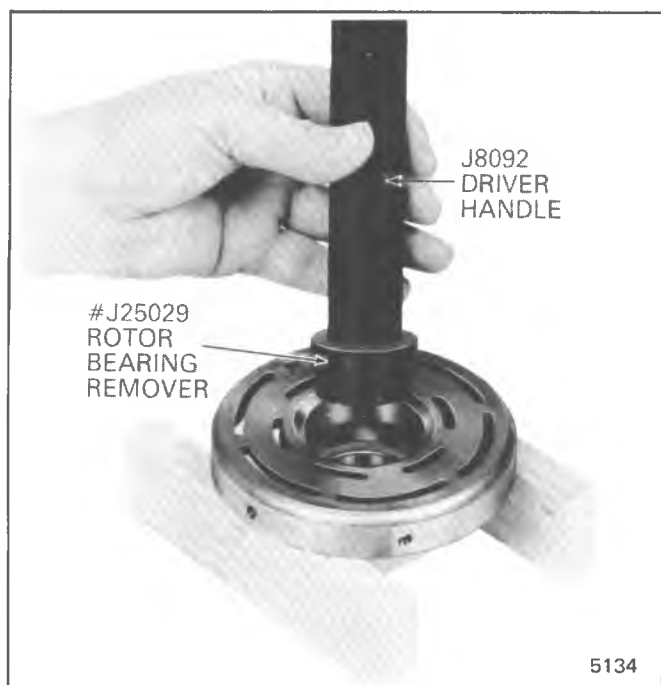


Fig. 1D-84 R-4 Clutch Rotor Bearing Removal

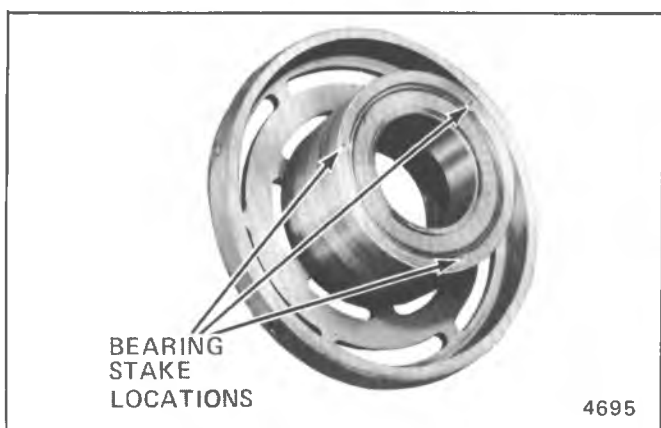


Fig. 1D-85 R-4 Rotor &amp; Bearing Asm.

#### 4. REPLACE ROTOR & BEARING ASM. (ON CAR)

**NOTE:** Rotor and Bearing assembly removal and installation may be completed on the car without "Discharging" the A/C system.

A. Position the Rotor and Bearing assembly on the front head.

B. With Rotor & Bearing Installer J 26271 (without driver handle) in position and Rotor and Bearing assembly aligned with the Front Head as illustrated, drive the assembly part way onto the head (Fig. 1D-87).

C. Plug clutch coil connector onto Clutch Coil.

D. Position the Clutch Coil so the 3 locating tabs will align with the holes in the head and continue to drive the Rotor and Bearing assembly onto the front head.

E. Install the retainer ring (Fig. 1D-81).

F. Reassemble the Clutch Plate and Hub with the shaft key onto the shaft with Installer J 9480-1 until .020" to .040" air gap is obtained.

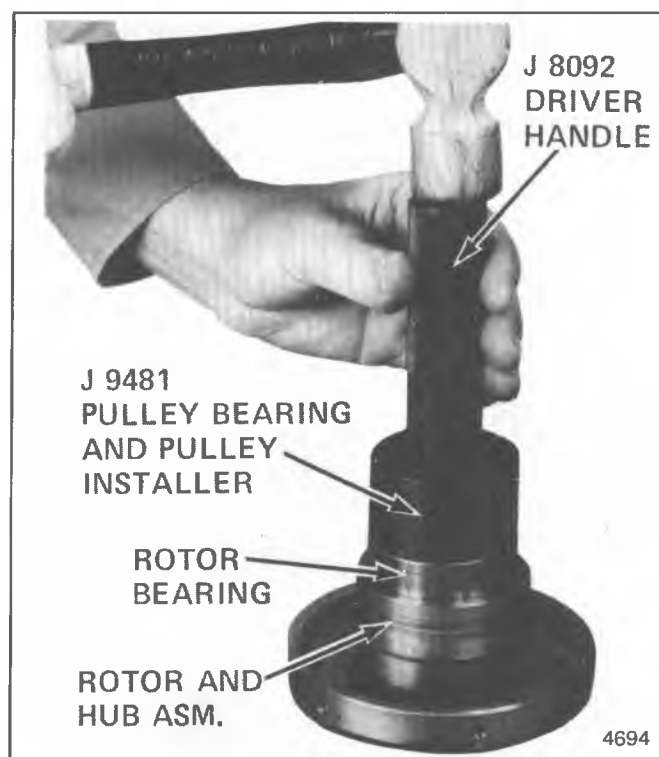


Fig. 1D-86 Installing R-4 Clutch Rotor Bearing



Fig. 1D-87 Installing R-4 Rotor and Bearing Asm. (On Car)

G. Install shaft lock nut. Torque to 12 ft. lbs.

#### 4. REPLACE ROTOR & BEARING ASM. (ON BENCH)

Reassemble the Rotor and Bearing assembly to the front head of the compressor using Rotor & Bearing Installer J 26271. With Installer assembled to the Universal Handle J 8092, as shown in Fig. 1D-88, force will be applied to the inner race of the bearing when installing the assembly onto the front head of the compressor.

5. Install rotor and bearing assembly retainer ring, using Snap Ring Pliers J 6083 (#24) (see Fig. 1D-81).

6. Apply sealer (Loctite RC-75, Loctite 601 or equivalent) to threads of pulley rim mounting screws. Install screws and new special lock washers but do not torque the screws.

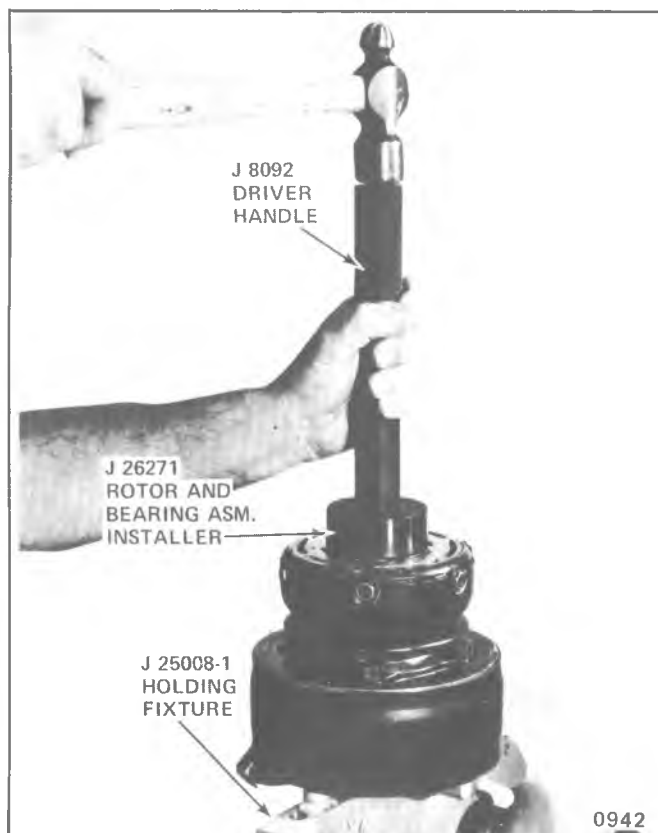


Fig. 1D-88 Installing R-4 Rotor & Bearing Asm. (On Bench)

7. Rotate the pulley rim and rotor to insure that pulley rim is rotating "in-line". If pulley rim is distorted (does not rotate in-line) adjust or replace pulley rim.

8. Tighten pulley rim mounting screws to 100 inch-pounds torque and lock screw heads in place by bending special lock washers (Fig. 1D-88).

9. Reinstall Clutch Plate and Hub assembly as described in "R-4 Compressor Clutch Plate and Hub" Replacement procedures.

## R-4 COMPRESSOR CLUTCH COIL AND/OR PULLEY RIM

**NOTE:** If original pulley rim was equipped with an inertia ring, either bolted or welded on, or if a ring is to be added, refer to INERTIA RING INSTALLATION following.

### Remove

1. Perform Steps 1 through 4 of "R-4 Compressor Clutch Rotor and/or Bearing" Removal procedure **but do not loosen or remove the pulley rim mounting screws until the Clutch Rotor, Coil and Pulley Rim assembly have been removed from the Front Head**. Be careful not to drop the Puller Guide J 25031-1 when removing the assembly.

2. Remove the pulley rim mounting screws and special lock washers. Discard the lock washers.

3. Slide the pulley rim off the Rotor and Hub assembly. The Pulley Rim and the Clutch Coil (Fig. 1D-89) are replaceable at this point.

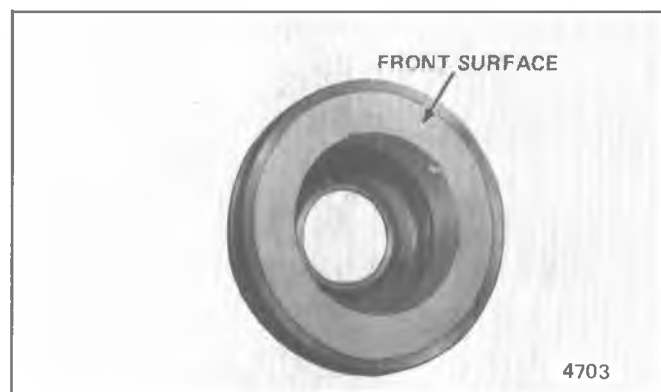


Fig. 1D-89 R-4 Clutch Coil Asm.

### Replace

1. Assemble the Clutch Coil, Pulley Rim and the Clutch Rotor and Bearing assembly as shown in Fig. 1D-90. Use new special lock washers and apply sealer (Loctite RC-75, Loctite 601, or equivalent) to screw threads but do not lock the screws in place.



Fig. 1D-90 Assembling R-4 Clutch Coil, Pulley Rim and Rotor & Bearing

2. Place the assembly on the neck of the Front Head and seat into place using Rotor & Bearing Installer J 26271 (Fig. 1D-88).

Before fully seating the assembly on the Front Head, be sure the clutch coil terminals are in the proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in the Front Head.

3. Install the rotor and bearing assembly retaining ring and reassemble the Clutch Plate and Hub assembly as described in "R-4 Compressor Clutch Plate and Hub Asm." Replacement procedure. Check to see that the clutch plate to clutch rotor air gap is .020 - .040 inches.

Rotate the Pulley Rim and Rotor to be sure the Pulley Rim is rotating "in-line" and adjust or replace as required.

4. Tighten the pulley rim mounting screws to 100 inch-pounds torque and lock the screw heads in place by bending lock washers (Fig. 1D-88).



## R-4 COMPRESSOR INERTIA RING INSTALLATION

R-4 compressors will be built with one of three conditions:

1) No Inertia Ring installed - no installation is required unless directed by a diagnostic procedure. If a ring is to be added, use Procedure I.

2) A bolted - on Inertia Ring is installed - replace using Procedure I. All new screws, washers, and Loctite 601 (or equivalent) must be used.

3) A welded - on Inertia Ring is installed - replace using Procedure II.

### Procedure I

1. Loosen the compressor drive belt and rotate the compressor pulley as required to locate one screw and lock washer mounted through a "mounting hole" of the Pulley Rim, Figure 1D-91, rather than a "mounting notch" screw location. **DO NOT** remove the drive belt unless necessary.

**NOTE:** For identification purposes, washers locked over the edge of the Pulley Rim at the "mounting hole" locations will not usually dimple down in the center like the indentation of the lockover at a "mounting notch" screw location.

2. Remove the three mounting screws and lockwashers at the pulley rim "mounting hole" locations. (The pulley rim "mounting holes" are located 120° apart radially around the rim or every other mounting screw location.) Do not remove the screws in the "mounting notches".

3. Temporarily make a trial fit of the Inertia Ring to the Pulley Rim. If any portion of the sheer edge of the Pulley Rim prevents the installation of the Inertia Ring, the raised edge may be filed off to remove the excess metal and facilitate installation. **DO NOT** use undue force or cock the ring in assembling the Inertia Ring in place over the Pulley Rim that could cause ring distortion or stress.

4. Assemble the Inertia Ring onto the Pulley Rim, being careful to align the inertia ring mounting holes with the mounting holes in the pulley rim. If the Inertia Ring must be rotated on the Pulley Rim for centering the mounting holes and cannot be shifted by hand, use a drift punch or blunt tool and a hammer to carefully tap the Inertia Ring at a clearance notch, Figure 1D-92, to move the ring into position.

5. Install a special lockwasher onto each 1/4-28 X 17/32" mounting screw.

6. Apply Loctite 601 (or equivalent sealer) to the screw threads of each mounting screw and threads of the mounting holes in the Clutch Rotor. Wet the threads thoroughly to ensure complete thread coverage.

7. Install the screws into the mounting holes and tighten finger-tight. Torque each screw to 100 in. lbs. torque.

8. Lock the three screws in place by flattening the special washer against two sides of the hex head screw using vise grip pliers and one portion of the lockwasher bent down over the edge of the inertia ring slot, Fig. 1D-92. **DO NOT** move the screw heads from the torqued position. Locking of the screws must be similar to the production forming of the lockwasher in order to effectively retain the screw.

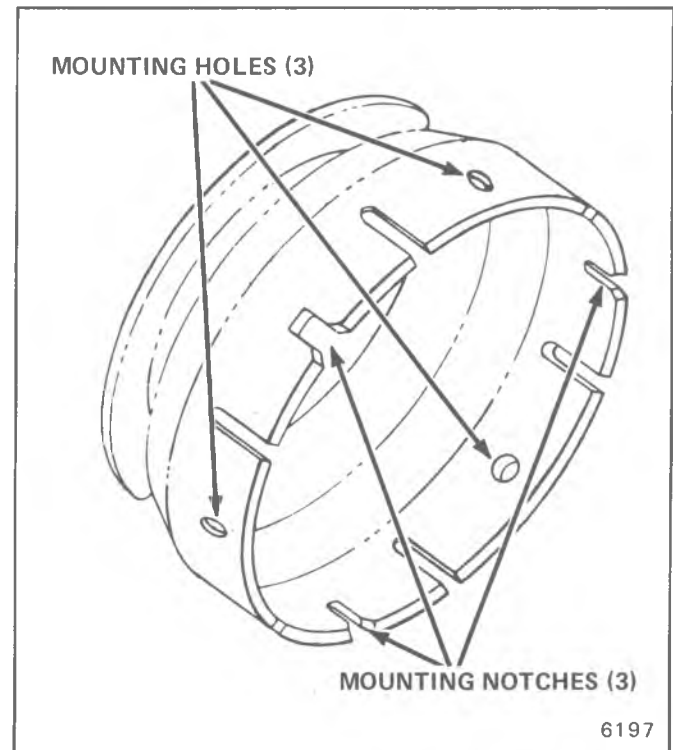


Fig. 1D-91 R-4 Pulley Rim Mounting Location Detail

9. Retighten the compressor drive belt to proper belt tension.

10. Check compressor and system operation.

**NOTE:** If "mounting notch" screws must be replaced for any reason, the screws should be torqued into place (100 in. lbs. torque) using Loctite 601 (or equivalent sealer) on the threads and locked into place similar to the original locking method.

### Procedure II

#### INERTIA RING AND PULLEY RIM WELDED ASSEMBLY - REPLACEMENT (NEW PULLEY RIM AND INERTIA RING KIT REQUIRED)

1. Loosen the compressor mounting bracket and remove the compressor drive belt.

2. Remove the Clutch Hub and Drive Plate assembly as described in "R-4 Compressor Clutch Plate and Hub Asm." Removal procedure.

3. To remove as an assembly, perform Steps 1 through 4 of "R-4 Compressor Clutch Rotor and/or Bearing" Removal procedures **but do not loosen or remove the pulley rim mounting screws**, so as to remove the Clutch Rotor and Bearing, Clutch Coil, Pulley Rim and Inertia Ring as a TOTAL assembly. Be careful not to drop the Puller Guide J 25031 when removing the assembly.

4. Remove all six pulley rim mounting screws and lockwashers from the assembly and discard.

5. Separate the Pulley Rim and Inertia Ring assembly away from the Rotor and Bearing assembly.

6. Inspect the drive surfaces of the Rotor and Drive Plate to be sure they are still in good condition. Replace as required.

7. Assemble a new Pulley Rim over the Clutch Coil and mount the Pulley Rim to the Rotor and Bearing assembly,

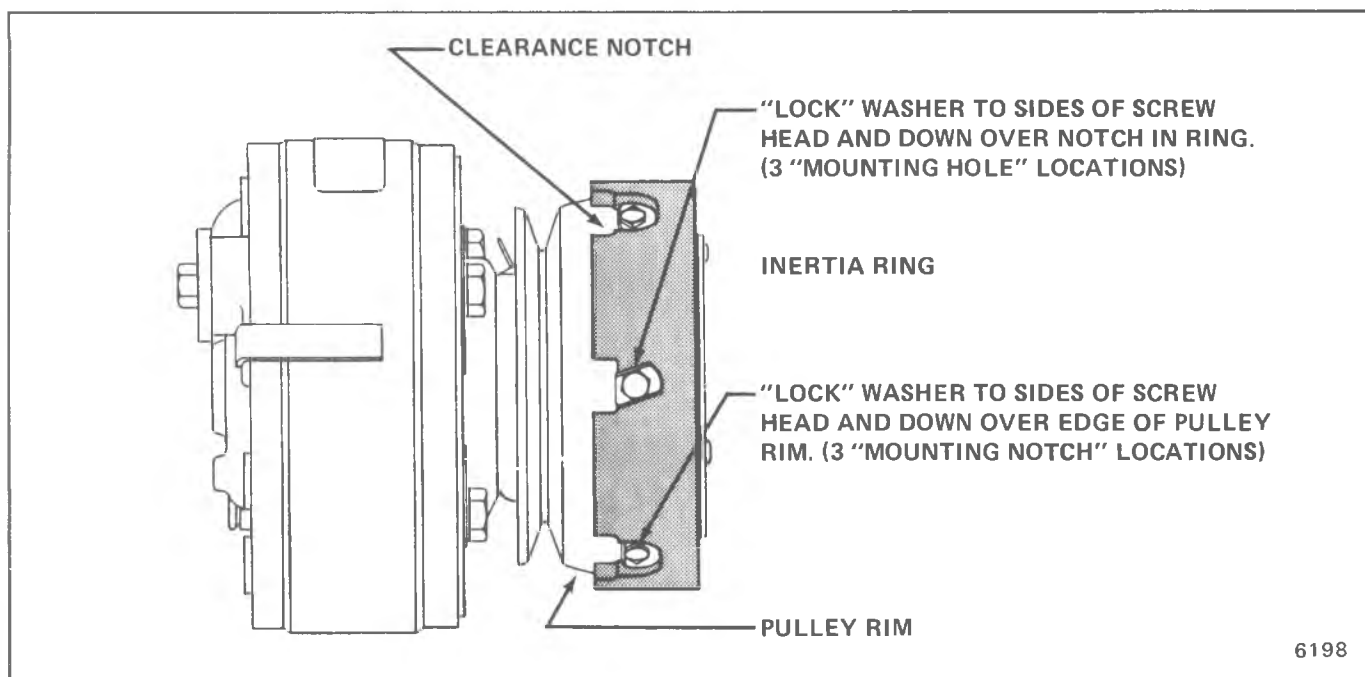


Fig. 1D-92 R-4 Pulley Rim and Inertia Ring Mounting Detail

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using the short notch mounting locations, Figure 1D-91. The mounting notches are located 120° apart radially around the Pulley Rim.

8. Assemble three new lockwashers on the three new 1/4-28 X 5/16" mounting screws and apply Loctite 601 (or equivalent sealer) to the entire thread surface of the mounting screws and the mounting hole threads in the Rotor. Assemble the three screws into the short notch mounting hole locations and tighten finger tight.

9. Align the Pulley Rim so that the bottom of the rim notches touch the mounting screws at all three mounting locations. Also center the drilled holes in the Pulley Rim with the remaining mounting holes in the Rotor. When the rim is positioned properly, tighten the three mounting screws to 100 in. lbs. torque.

10. Temporarily make a trail fit of the Inertia Ring to the Pulley Rim. If any portion of the sheer edge of the Pulley Rim prevents the installation of the Inertia Ring, the raised edge may be filed off to remove the excess metal and facilitate installation. **DO NOT** use undue force or cock the ring in assembling the Inertia Ring in place over the Pulley Rim that could cause ring distortion or stress.

11. Assemble the Inertia Ring onto the Pulley Rim being careful to align the Inertia Ring mounting holes with the mounting holes in the Pulley Rim. If the Inertia Ring cannot be moved by hand and must be rotated for centering the mounting holes, use a drift punch or blunt tool and a hammer to carefully tap at one of the large clearance notches in the inertia ring to rotate the ring into position, Fig. 1D-92.

12. Install the special lock washers onto the 1/2-28 X 17/32" mounting screws and apply Loctite 601 (or equivalent sealer) to the total screw thread and the threads of the mounting holes in the rotor.

13. Install the screw and washers into the rotor mounting holes and tighten finger tight. When all screws are in place, torque each screw to 100 in. lbs. torque.

14. Using Rotor and Bearing assembly Installer J-26271 and Universal Handle J-8092, install the Pulley, Clutch Coil, Rotor and Bearing assembly onto the Front Head of the compressor. Be sure to locate the clutch coil terminals in the proper position.

15. Spin the Rotor and Pulley assembly to ascertain that the pulley runs "in line". If not, the mounting screws will have to be loosened and the parts aligned.

16. When all screws are torqued in place, lock all mounting screws in position by flattening the special washer against two opposite sides of the hex head screw, using vise-grip pliers. Form a portion of the lock washer down over the pulley rim or over the Inertia Ring slot to secure the screws in place. **DO NOT** move the screw heads from the torqued position. See Fig. 1D-92.

17. Install the Clutch Hub and Drive Plate as described in "R-4 Compressor Clutch Plate and Hub Asm." Replacement procedures.

18. Install the compressor drive belt and adjust for proper tension.

19. Operate the air conditioning system to check for proper operation.

# MAJOR R-4 COMPRESSOR REPAIR PROCEDURES

Service repair procedures to the Compressor Shaft Seal, Pressure Relief Valve, Pressure Switch or disassembly of the Internal Compressor Cylinder and Shaft Assembly are considered **"MAJOR"** SINCE THE REFRIGERATION SYSTEM MUST BE COMPLETELY PURGED OF REFRIGERANT before proceeding and/or because major internal operating and sealing components of the compressor are being disassembled and serviced.

WHEN REPLACING THE SHAFT SEAL ASSEMBLY (see Fig. 1D-20), PRESSURE RELIEF VALVE (see Fig. 1D-102) or PRESSURE SWITCH (see Figures 1D-27 and 1D-102), 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 AIR CONDITIONING section (see "Discharging, Adding Oil, Evacuating and Charging Procedures for C.C.O.T. A/C Systems"). THE SAME HOLDS TRUE FOR ANY DISASSEMBLY OF THE INTERNAL R-4 COMPRESSOR CYLINDER AND SHAFT ASM.

IF THE R-4 COMPRESSOR INTERNAL CYLINDER AND SHAFT ASSEMBLY IS TO BE SERVICED OR REPLACED, THEN THE OIL IN THE R-4 COMPRESSOR MUST BE DRAINED, measured and replaced according to "C.C.O.T. Refrigerant Oil Distribution" in the AIR CONDITIONING section to determine addition of proper oil quantity to new assembly.

A clean workbench, preferably covered with a sheet of clean paper, orderliness in the work area and a place for all parts being removed and replaced is of great importance, as is the use of the proper, clean service tools. Any attempt to use make-shift or inadequate equipment may result in damage and/or improper compressor operation.

These procedures are based on the use of the proper service tools and the condition that an adequate stock of service parts is available. All parts required for servicing the internal compressor 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 internal assembly just as they are removed from the service package.

## R-4 COMPRESSOR SHAFT SEAL

### Seal Leak Detention

A SHAFT SEAL SHOULD NOT BE CHANGED BECAUSE OF AN OIL-LINE ON THE HOOD INSULATOR. The Seal is designed to seep some oil for lubrication purposes. Only change a Shaft Seal when a leak is detected by evidence of oil sprayed in large amounts and then only after actual refrigerant leakage is determined by test with Electronic Leak Detector J 23400.

SHOULD AN R-4 COMPRESSOR SHAFT SEAL EVER HAVE TO BE REPLACED BECAUSE IT WAS DETERMINED TO BE THE CAUSE OF EXCESSIVE SIGNS OF OIL LEAKAGE IN THE A/C SYSTEM,

THEN THE ACCUMULATOR IN THIS R-4 SYSTEM MUST ALSO BE REMOVED FROM THE VEHICLE; THE OIL IN THE ACCUMULATOR THEN MUST BE DRAINED, measured and replaced according to "C.C.O.T. Refrigerant Oil Distribution" in the AIR CONDITIONING section to determine oil loss.

## R-4 COMPRESSOR SHAFT SEAL REPLACEMENT

### Remove (On Car)

1. "Discharge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

2. Loosen and reposition compressor in mounting brackets.

3. Remove Clutch Plate and Hub assembly from compressor as described in "R-4 Compressor Clutch Plate & Hub Asm." Removal procedure.

4. Remove the shaft seal seat retainer ring, using Snap Ring Pliers J 5403 (#21). See Fig. 1D-21.

5. Thoroughly clean inside of compressor neck area surrounding the shaft, the exposed portion of the seal seat and the shaft itself. **This is absolutely necessary to prevent any dirt or foreign material from getting into compressor.**

6. Place Seal Protector J 22974 over the end of the shaft to prevent chipping the ceramic seat. Fully engage the knurled tangs of Seal Seat Remover-Installer J 23128 into the recessed portion of the seal seat by turning the handle **clockwise**. Remove the Seal Seat from the compressor with a rotary-pulling motion (Fig. 1B-93). Discard the Seat.

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

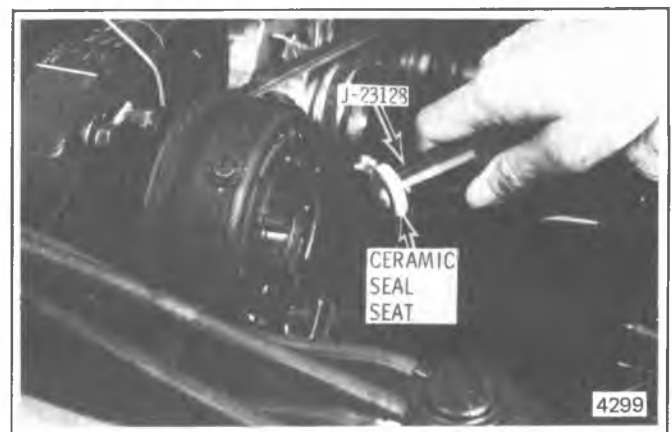


Fig. 1D-93 Removing R-4 Ceramic Seal Seat (On Car)

7. With Seal Protector J 22974 still over the end of the shaft, set Seal Remover-Installer J 9392 down onto shaft end, turning **clockwise, while pressing down** to engage Remover tangs with the tabs on the Seal assembly. Then lift the Shaft Seal assembly out (see Fig. 1B-94).

Discard the Seal.

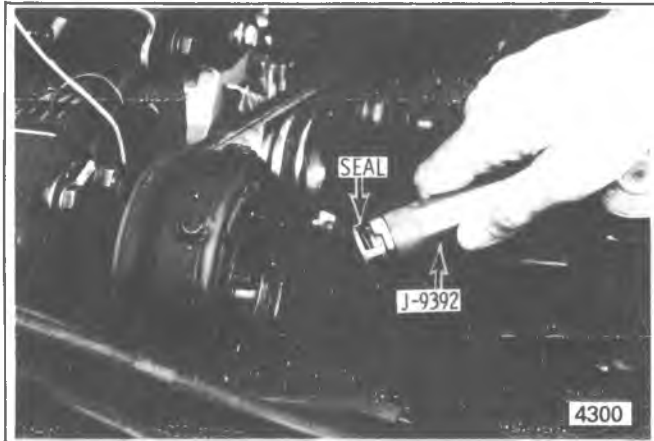


Fig. 1D-94 Removing R-4 Seal (On Car)

8. Remove and discard the seal seat O-ring from the compressor, neck using O-Ring Remover 9553 (Fig. 1D-95).

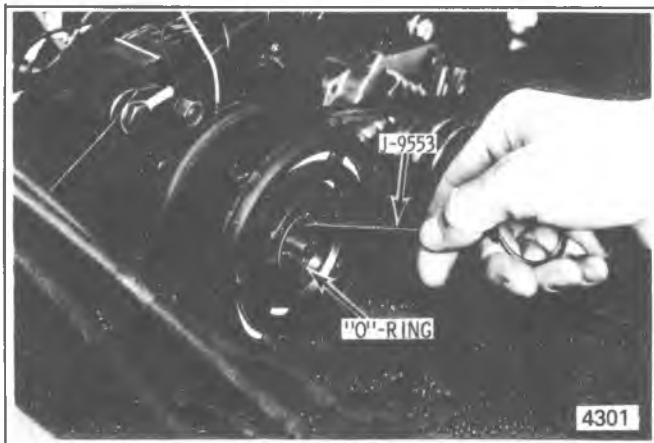


Fig. 1D-95 Removing R-4 O-Ring (On Car)

9. Recheck the shaft and inside of the compressor neck for dirt or neck foreign material and be sure these areas are perfectly clean before installing new parts.

### Inspection

**SEALS SHOULD NOT BE RE-USED. ALWAYS USE A NEW SPECIFICATION SERVICE SEAL KIT ON REBUILD** (see Fig. 1D-20). 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 or prevent sealing.

### Replace (On Car)

1. Coat the new seal seat O-ring in clean 525 viscosity refrigerant oil and assemble onto O-Ring Installer J 21508 (see Fig. 1D-96).

2. Insert the O-Ring Installer J 21508 **completely down** into the compressor neck until the Installer "bottoms". Lower the moveable slide of the O-Ring Installer to release the O-Ring into the seal seat O-ring **lower** groove. (The compressor neck top groove is for the shaft seal retainer ring). Rotate the Installer to seat the O-

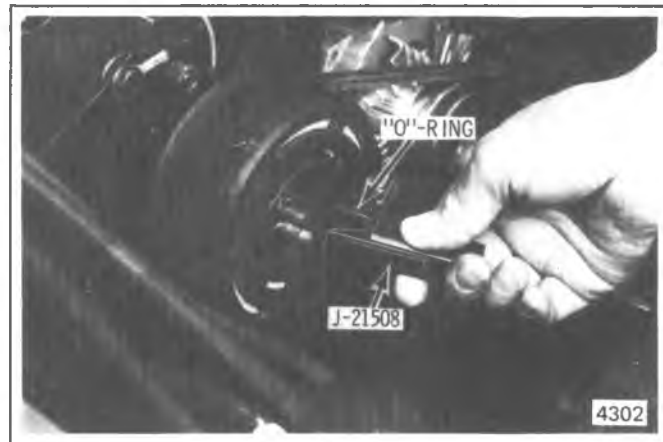


Fig. 1D-96 Installing R-4 O-Ring (On Car)

ring and remove the Installer. (See Fig. 1D-24.)

3. Coat the O-Ring and seal face of the new Seal assembly with clean 525 viscosity refrigerant oil. Carefully mount the Seal assembly to Seal Installer J 9392 by engaging the tabs of the seal with the tangs of the Installer (Fig. 1D-97).

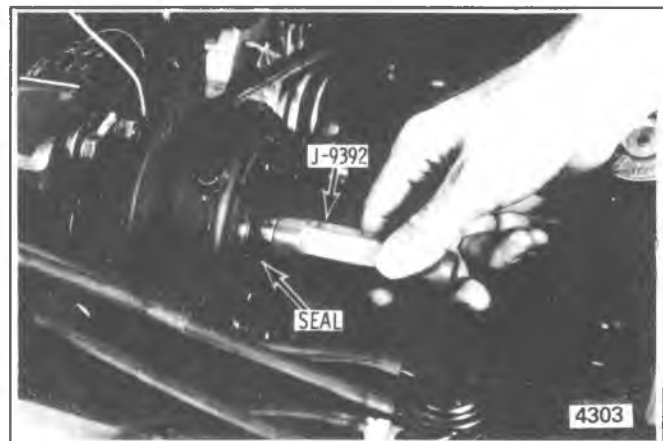


Fig. 1D-97 Installing R-4 Seal (On Car)

4. Place Seal Protector J 22974 over end of compressor shaft and **carefully slide the new Seal assembly onto the shaft. Gently twist the Installer J 9392 CLOCK-WISE**, while pushing the Seal assembly down the shaft until the Seal assembly engages the flats on the shaft and is seated in place. Disengage the Installer by pressing downward and twisting counterclockwise.

5. Attach the ceramic Seal Seat to the Seal Seat Remover and Installer J 23128 and dip the ceramic Seat in clean 525 viscosity oil refrigerant to coat the seal face and outer surface. Carefully install the Seat over the compressor shaft and J 22974 Seal Protector and push the Seat into place with a rotary motion (Fig. 1D-98). Take care not to dislodge the seat O-ring. However, be sure Seal Seat makes a good seal with O-ring. Remove Installer J 23128 and Seal Protector J 22974.

6. Install the new seal seat retainer ring **with its flat side against the Seal Seat**, using Snap-Ring Pliers J 5403 (#21). See Fig. 1D-21. Use the sleeve from Seal Seat Remover-Installer J 23128 to press in on the seal seat retainer ring so that it snaps into its groove.

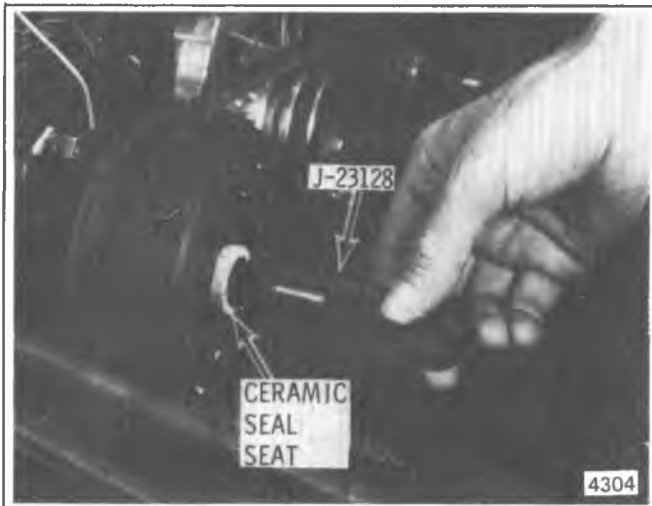


Fig. 1D-98 Installing R-4 Ceramic Seal Seat (On Car)

7. For Leak Test, pressurize SUCTION SIDE (low-pressure side) of compressor on vehicle with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the Seal with Electronic Leak Detector J 23400. Correct any leak found. Remove, discard and later replace the shaft nut.

8. Remove any excess oil, resulting from installing the new seal parts, from the shaft and inside the compressor neck.

9. Install the Clutch Plate and Hub assembly as described in "R-4 Compressor Clutch Plate & Hub Asm." Replacement procedure.

10. Re-install compressor belt and tighten bracketry.

11. "Evacuate and Charge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

## R-4 COMPRESSOR SHAFT SEAL REPLACEMENT (OFF CAR)

1. Follow applicable ON-CAR PROCEDURES.

2. For Leak Test, use Compressor Test Fixture J 9625 as described in Step 7 of "A-6 Compressor Shaft Seal" Replacement procedure.

3. See Figures 1D-99, 1D-100 and 1D-101.

## R-4 COMPRESSOR PRESSURE RELIEF VALVE OR PRESSURE SWITCH

When necessary to replace the Pressure Relief Valve (or Pressure Switch if so located), located in the compressor rear head casting (Figures 1D-27 and 102), the valve/switch assembly should be removed after PURGING THE SYSTEM OF REFRIGERANT. A new valve/switch and O-ring coated with 525 viscosity refrigerant oil should be installed (see DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section).



Fig. 1D-99 Removing & Installing R-4 Seal Seat (Off Car)



Fig. 1D-100 Removing & Installing R-4 Seal (Off Car)

## R-4 COMPRESSOR FRONT HEAD AND/OR O-RING

### Remove

1. "Discharge the Refrigerant System" according to the "DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEM" in the AIR CONDITIONING section.



Fig. 1D-101 Installing R-4 Seal Seat O-Ring(Off Car)



Fig. 1D-102 R-4 Compressor Pressure Relief Valve and Pressure Switch on A, B, Series

2. Perform steps 1 through 4 of "R-4 Compressor Clutch Rotor and/or Bearing" Removal procedure **but do not loosen or remove the pulley rim mounting screws** so as to remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as a TOTAL assembly. Be careful not to drop the Puller Guide J 25031, when removing the assembly.

3. Remove and discard the Shaft Seal parts as described in "R-4 Compressor Shaft Seal" Removal procedure.

4. Remove the four front head mounting screws (Fig. 1D-103) and remove the Front Head assembly (Fig. 1D-104).

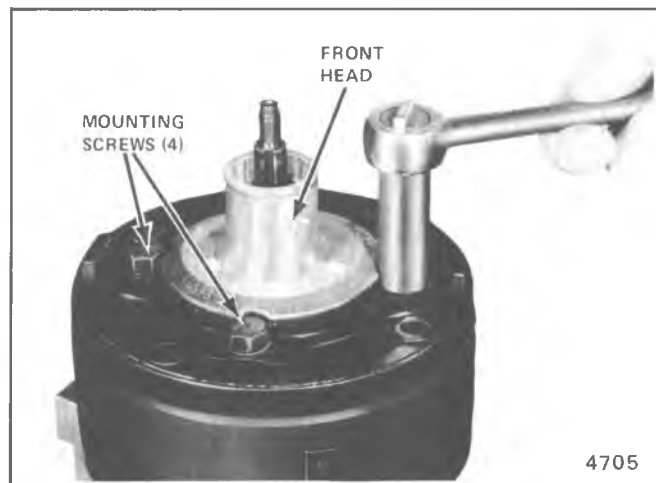


Fig. 1D-103 Removing R-4 Front Head Mounting Screws

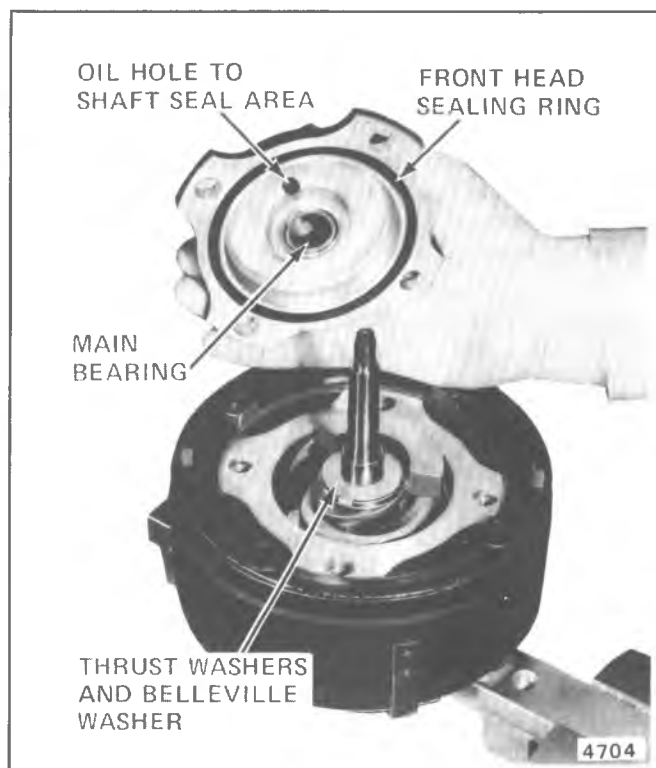


Fig. 1D-104 Removing R-4 Front Head Asm.

5. Remove and discard the front head O-ring.

### Replace

1. Check the Front Head and compressor cylinder area for any dirt, lint, etc. and clean, if necessary. Install a new Service thrust washer kit, if required, as described in "R-4 Compressor Thrust and Belleville Washers" Removal and Replacement procedures.

2. Coat the new front head O-ring in clean 525 viscosity refrigerant oil and install in the seal groove on the front head (Fig. 1D-104).

3. Position the oil hole in the Front Head to be "up" when assembled to the compressor cylinder to correspond with the "up" position of the compressor. Install the Front Head and tighten the front head mounting screws to an 20 lb. ft. (27 N·m) torque.



4. Install new specification Service Shaft Seal kit (Fig. 1D-20) as described in "R-4 Compressor Shaft Seal" Replacement procedure.

5. Install the Clutch Rotor and Bearing assembly, Clutch Coil and Pulley Rim assembly to the Front Head, using Rotor and Bearing Installer J 26271 (Fig. 1D-88).

Before fully seating the assembly onto the Front Head, be sure the clutch coil terminals are in the proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in the Front Head.

6. Install the rotor and bearing assembly retainer ring and reassemble the Clutch Plate and Hub assembly as described in "R-4 Compressor Clutch Plate and Hub" Replacement procedure. Check to see that the clutch plate to clutch rotor gap is .020 - .040 inches.

7. "Evacuate and Charge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING, AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

## R-4 COMPRESSOR THRUST AND BELLEVILLE WASHERS

### Remove and Replace

1. Discharge the Refrigerant System" according to the "DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

2. Remove the Front Head assembly as described in "R-4 Compressor Front Head" Removal procedure. Remove and discard the front head O-ring seal.

3. Remove the two thrust washers and one belleville washer from the compressor shaft. Note the assembled position of the washers.

4. Install a new thrust washer on the compressor shaft with the thrust washer tang pointing "up" (Fig. 1D-105).

5. Install the new belleville washer on the shaft with the high center of the washer "up".

6. Install the remaining thrust washer on the shaft with the tang pointing "down" (Fig. 1D-105).

7. Lubricate the three washers with clean 525 viscosity refrigerant oil and assemble the Front Head and new O-ring onto the compressor as described in "R-4 Compressor Front Head" Replacement procedure.

## R-4 COMPRESSOR MAIN BEARING

### Remove

1. "Discharge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

2. Remove the Front Head assembly as described in "R-4 Compressor Front Head" Removal procedure. Discard front head O-ring.

3. Place the Front Head assembly on two blocks, as shown in Fig. 1D-106, and use Main Bearing Remover J 24896 to drive the Main Bearing out of the Front Head.



Fig. 1D-105 Replacing R-4 Thrust and Belleville Washers

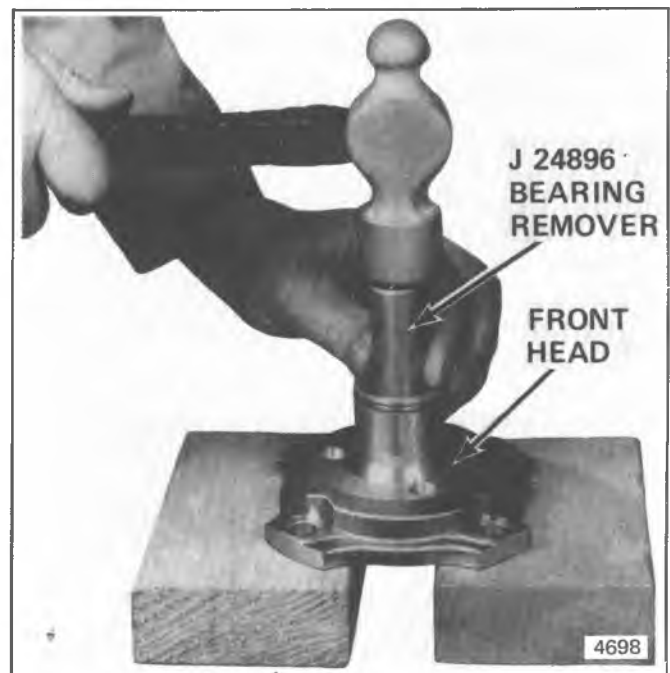


Fig. 1D-106 Removing R-4 Main Bearing

### Replace

1. Place the Front Head "with neck-end down" on a flat, solid surface.

2. Align the new Main Bearing and the Bearing Installer J 24895 squarely with the bearing bore of the Front Head and drive the bearing into the Front Head. The Installer J 24895 must seat against the Front Head to insert the bearing to the proper clearance depth (see Fig. 1D-107).

3. Assemble the Front Head to the cylinder, using a new O-ring as described in "R-4 Compressor Front Head" Replacement procedure.

4. "Evacuate and Charge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES



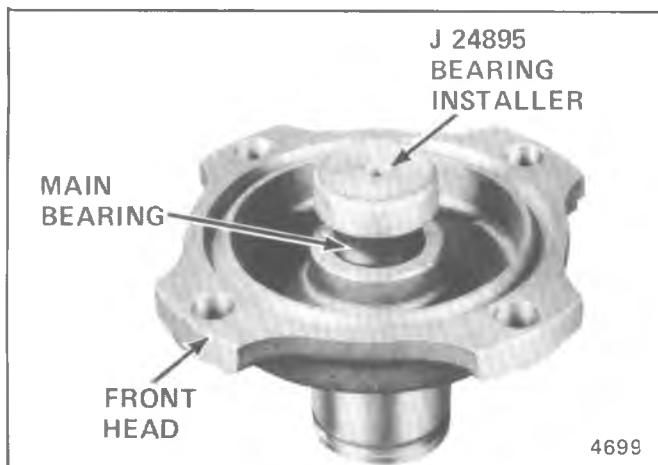


Fig. 1D-107 Installing R-4 Main Bearing

FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

## R-4 COMPRESSOR SHELL AND/OR O-RINGS

### Remove

1. "Discharge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

2. Thoroughly clean exterior of compressor to prevent dirt from getting into compressor during shell removal.

3. Remove the Clutch Plate and Hub assembly as described in "R-4 Compressor Clutch Plate and Hub" Removal procedures.

4. Perform Steps 1 through 4 of "R-4 Compressor Clutch Rotor and/or Bearing" Removal procedure **but do not loosen or remove the pulley rim mounting screws** so as to remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as a TOTAL assembly. Be careful not to drop the Puller Guide J 25031 when removing the assembly.

5. Pry the shell retaining strap away from the cylinder and position the strap high enough to clear the cylinder as the Shell is removed (Fig. 1D-108).

6. Remove Compressor Holding Fixture J 25008-1, and reverse Holding Fixture with step block protrusions engaging the compressor Shell. Install the medium-length bolts through the Holding Fixture and thread them finger-tight on both sides into the compressor cylinder until the step of the fixture protrusions contact the compressor Shell (Fig. 1D-109). With compressor at room temperature, check to be sure the step protrusions do not overlap the cylinder but will pass both sides.

7. Using a wrench, alternately tighten each bolt approximately 1/4 turn to push the Shell free of the O-rings on the cylinder.

If one screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw threading sequence in-step or the Shell will be cocked and made more difficult to remove. Normal removal does not require much force on the wrench if the screws are kept in-step while turning. The Shell can be removed by hand as

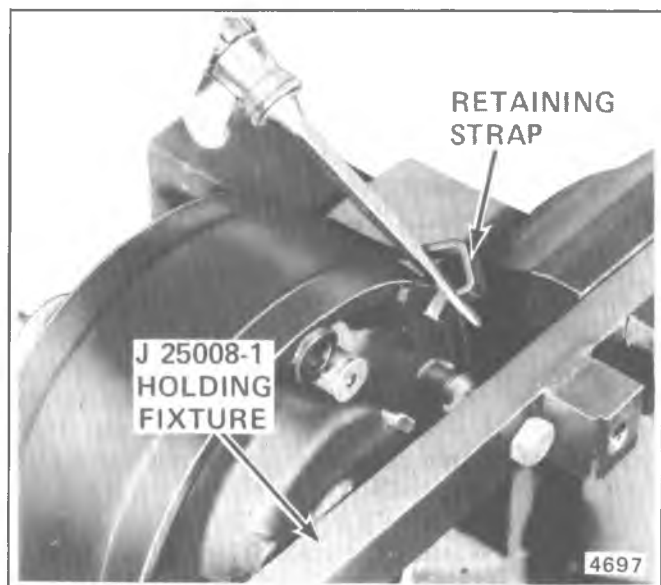


Fig. 1D-108 Releasing R-4 Shell Retaining Strap

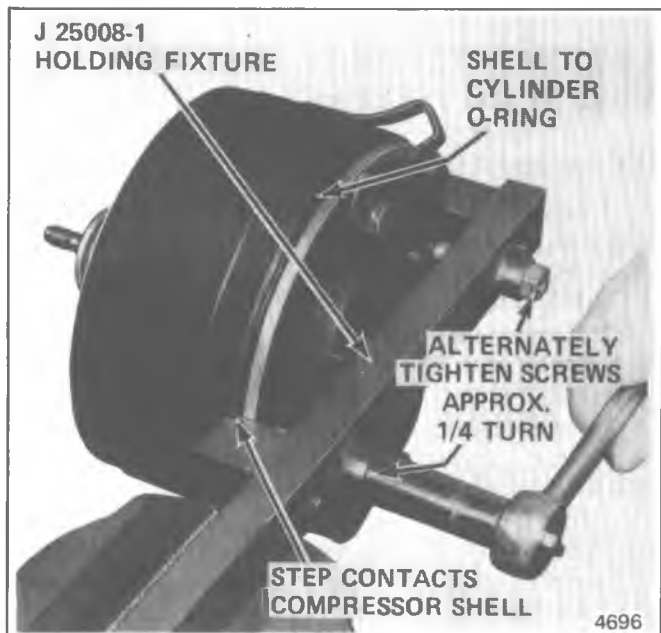


Fig. 1D-109 Removing R-4 Shell

soon as the Shell is free of the shell to cylinder O-rings. Do not turn the screws any further than necessary to release the Shell.

8. Remove the compressor Shell and remove the Holding Fixture J 25008-1 from the compressor. Reverse the Holding Fixture to again hold the compressor by the opposite side, using the short-length screws.

9. Remove and discard both cylinder to Shell O-rings.

### Replace

1. Check the compressor cylinder assembly and interior of the compressor Shell to be sure they are free of lint, dirt, etc.

2. Dip a new cylinder-to-shell O-ring in clean 525 viscosity refrigerant oil and install in the **rear** O-ring groove of the cylinder. Be careful in moving the O-ring across the cylinder surface to prevent damaging the O-ring.

3. Dip the remaining cylinder-to-shell O-ring in the 525 oil and install it in the **front** O-ring groove of the cylinder.

4. Also coat inner surface of compressor Shell with the oil and swab oil onto shell-to-cylinder O-rings. Place the compressor Shell on the cylinder and rotate the retaining strap to its original location.

5. Attach the Shell Installing Fixture J 25008-2 to the Holding Fixture J 25008-1, using the long-bolts and plate washers of the set. Align the step projections of the Installing Fixture J 25008-2, to contact the compressor Shell evenly on both sides.

6. Push the compressor shell as close to the O-ring, Fig. 1D-110, as possible by hand and check for equal alignment of the shell around the cylinder. Tighten the Fixture screws finger tight.

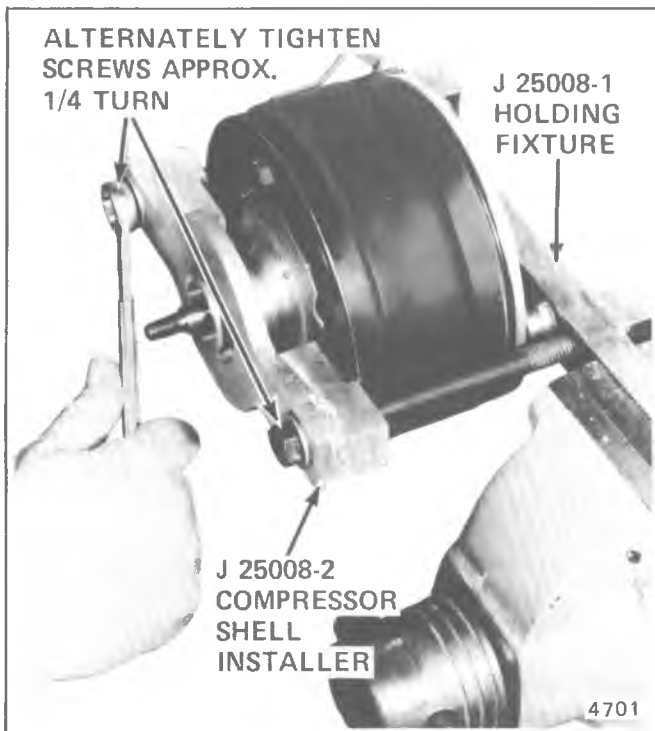


Fig. 1D-110 Installing R-4 Shell

7. Using a wrench, alternately tighten each bolt approximately 1/4 turn to push the compressor Shell over the O-rings and back against the shell stop flange at the rear of the compressor cylinder.

If one screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw threading sequence in-step or the Shell will be cocked and made more difficult to install. Normal installation does not require much force on the wrench if the screws are kept in-step while turning.

8. When the Shell is seated against the stops, bend the shell retaining strap down into place by tapping gently with a hammer. Remove the Shell Installing Fixture J 25008-2.

9. Re-install Clutch Rotor and Bearing Asm., Clutch Coil and Pulley Rim as an assembly with Installer J 26271 (Fig. 1D-88), and the Clutch Plate and Hub Assembly with Installer J 9480-01 (Fig. 1D-80).

10. "Evacuate and Charge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES

FOR C.C.O.T. A/C SYSTEMS IN THE AIR CONDITIONING section.

## R-4 COMPRESSOR DISCHARGE VALVE PLATE AND/OR RETAINER

### Remove and Replace

1. "Discharge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

2. Perform Steps 1 through 9 of "R-4 Compressor Shell and/or O-Rings" Removal procedure.

3. Remove valve plate retainer ring, using Internal Snap Ring Pliers J 4245 (#23), Fig. 1D-111. Remove Compressor Discharge Valve Plate (Fig. 1D-112) for valve plate replacement and/or piston inspection.

Repeat this operation for additional valve plates and retainer rings. If all four valve plates and retainers are to be removed, remove two sets and then rotate compressor and Holding Fixture J 25008-1 in vise for access to the remaining two valve plates and retainers.

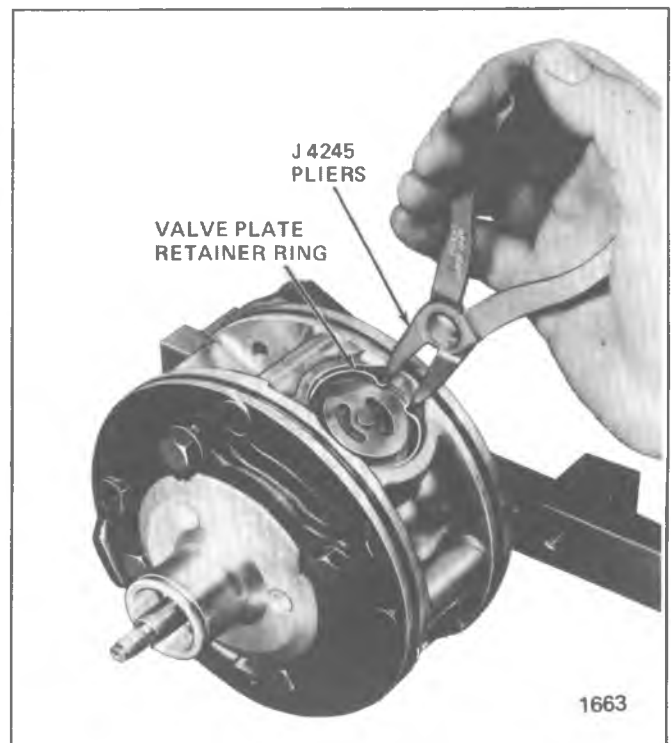


Fig. 1D-111 Replacing R-4 Valve Plate Retainer

4. Install Discharge Valve Plates and/or Retainers as shown in Figs. 1D-111 and 1D-112. Reposition compressor and Holding Fixture in vise as necessary for access.

5. Re-install compressor Shell as described in "R-4 Compressor Shell and/or O-Rings" Replacement procedures.

6. "Evacuate and Charge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

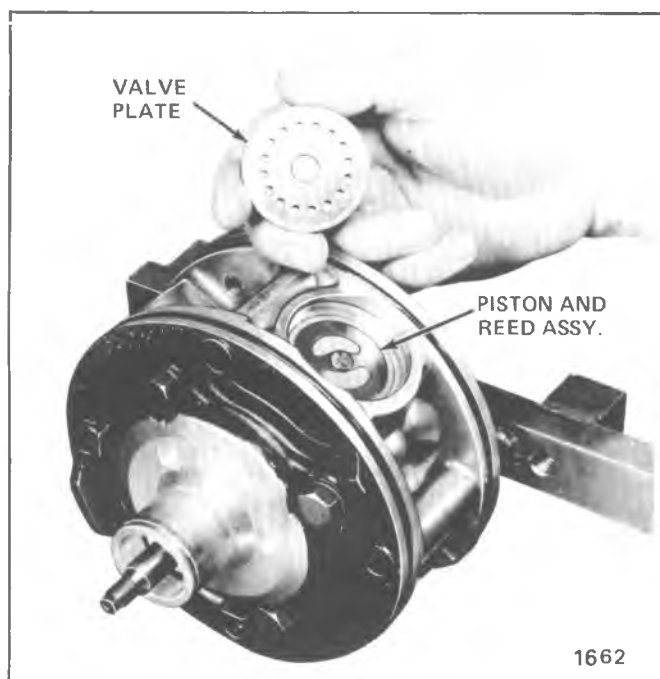


Fig. 1D-112 Replacing R-4 Discharge Valve Plate

## R-4 COMPRESSOR CYLINDER AND SHAFT ASM.

### Remove

1. "Discharge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

2. Remove the Clutch Plate and Hub assembly as described in "R-4 Compressor Clutch Plate and Hub" Removal procedure.

3. Perform Steps 1 through 4 of "R-4 Compressor Clutch Rotor and/or Bearing" Removal procedure **but do not loosen or remove the pulley rim mounting screws**, so as to remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as a TOTAL assembly. Be careful not to drop the Puller Guide J 25031, when removing the assembly.

4. Remove the Shaft Seal as described in "R-4 Compressor Shaft Seal" Removal procedure.

5. Remove the Front Head as described in "R-4 Compressor Front Head" Removal procedure.

6. Remove the Thrust and Belleville Washers as described in "R-4 Compressor Thrust and Bellville Washers" Removal procedures.

7. Remove the compressor Shell as described in "R-4 Compressor Shell" Removal procedure.

8. Remove the Discharge Valve Plate and Retainer as described in "R-4 Compressor Discharge Valve Plate and/or Retainer" Removal procedure.

9. Remove the High Pressure Relief Valve and Pressure Switch (if so equipped) as described in "R-4 Compressor High Pressure Relief Valve or Pressure Switch" Removal procedure.

### Replace

1. Replace above parts in opposite order.

2. "Evacuate and Charge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the AIR CONDITIONING section.

## A-6 AND R-4 COMPRESSOR LEAK TESTING (EXTERNAL AND INTERNAL)

### Bench-Check Procedure

1. Install Test Plate J 9625 on Rear Head of compressor.

2. Attach center hose of Manifold Gage Set on Charging Station to a refrigerant drum standing in an upright position and open valve on drum.

3. Connect Charging Station HIGH and LOW pressure lines to corresponding fittings on Test Plate J 9625, using J 5420 Gage Adapters.

**NOTE:** Suction port (low-side) of compressor has large internal opening. Discharge port (hi-side) has smaller internal opening into compressor.

4. Open LOW pressure control, HIGH pressure control and REFRIGERANT control on Charging Station to allow refrigerant vapor to flow into compressor.

5. Using Electronic Leak Detector J 23400, check for leaks at Pressure Relief Valve, Pressure Switch (if so located) on compressor, compressor Shell to cylinder, compressor front head seal (and also rear head seal and oil charge port on A-6 compressor), and compressor Shaft Seal. After checking, shut off LOW pressure control and HIGH pressure control on Charging Station.

6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.

7. Loosen the Manifold Gage hose connections to the Gage Adapters J 5420 connected to the LOW and HIGH sides and allow the vapor pressure to release from the compressor.

8. Disconnect both Gage Adapters J 5420 from the Test Plate J 9625.

9. Rotate the COMPLETE compressor assembly (**not the crankshaft or drive plate hub**) slowly several turns to distribute oil to all cylinder and piston areas.

10. Install a shaft nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.

11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to ensure piston assembly to cylinder wall lubrication.

12. Connect the Charging Station HIGH pressure line or a HIGH pressure gage and Gage Adapter J 5420 to the Test Plate J 9625 HIGH side connector.

13. Attach an Adapter J 5420 to the suction or LOW pressure port of the Test Plate J 9625 to open the schrader-type valve.

**NOTE:** Oil will drain out of the compressor suction port adapter if the compressor is positioned with the suction port downward.

14. Attach the compressor to the Holding Fixture J 25008-1 (R-4 compressor), and J 9396 (A-6 compressor), and clamp the Holding Fixture in a vise so that the compressor can be manually turned with a wrench.

15. Using a wrench, rotate the compressor crankshaft or drive plate hub 10-complete revolutions at a speed of approximately one-revolution per second.

**NOTE:** Turning the compressor at less than one-revolution per second can result in a lower pump-up pressure and disqualify a good pumping compressor.

16. Observe the reading on HIGH pressure gage at the completion of the tenth revolution of the compressor. THE PRESSURE READING FOR A GOOD PUMPING COMPRESSOR SHOULD BE 50 P.S.I. OR ABOVE FOR THE R-4 AND 60 P.S.I. OR ABOVE FOR THE A-6 COMPRESSOR. **A pressure reading of less than 45 p.s.i. for the R-4 or 50 p.s.i. for the A-6 would indicate one or more suction and/or discharge valves leaking, an internal leak, or an inoperative valve and the compressor should be disassembled and checked for cause of leak.** Repair as needed, reassemble and repeat the pump-up test. Externally leak test with Electronic Leak Detector J 23400.

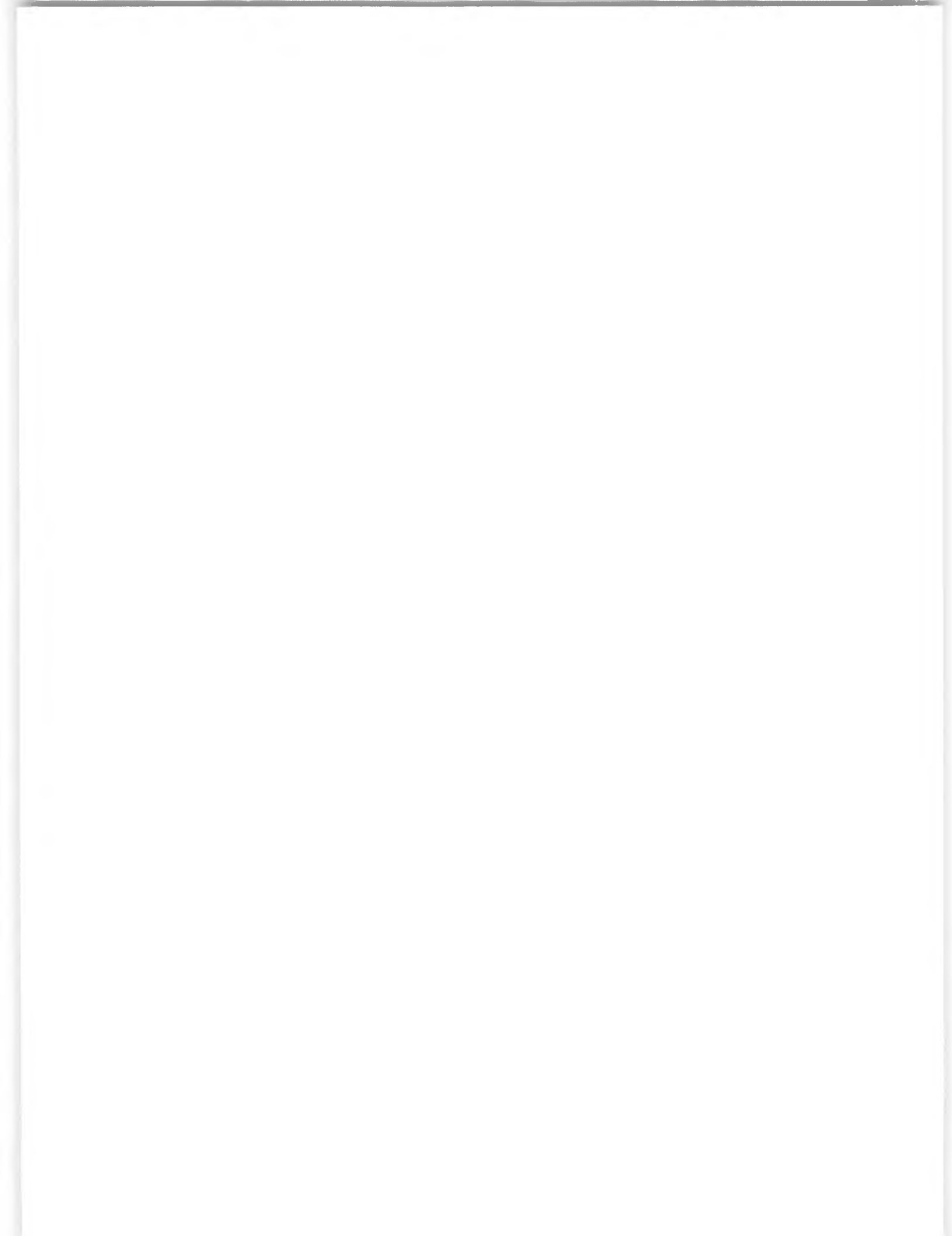
17. When the pressure pump-up test is completed, release the air pressure from the HIGH side and remove the Gage Adapters J 5420 and Test Plate J 9625.

18. On the R-4 compressor, tilt the compressor so that the compressor suction and discharge ports are down. Drain the oil from the compressor.

On the A-6 compressor, remove oil charge screw and drain the oil sump.

19. Allow the compressor to drain for 10 minutes, then charge with the proper amount of oil. The oil may be poured into the suction port.

**NOTE:** If further assembly or processing is required, a shipping plate or Test Plate J 9625 should be installed to keep out air, dirt and moisture until the compressor is installed.



## SECTION 3B

# STEERING

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Power Steering Pump .....	3B-8
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## MANUAL STEERING GEARS

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## OVERHAUL OPERATIONS

### Disassembly (Figs. 3B-1A through 3B-4A)

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). Loosen locknut.

3. Place a pan under the assembly to catch the lubricant and remove the three self locking bolts attaching the side cover to the housing.

4. Tap lightly on the end of the pitman shaft with a plastic hammer and lift the side cover and pitman shaft assembly from the gear housing (fig. 3B-5A).

**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

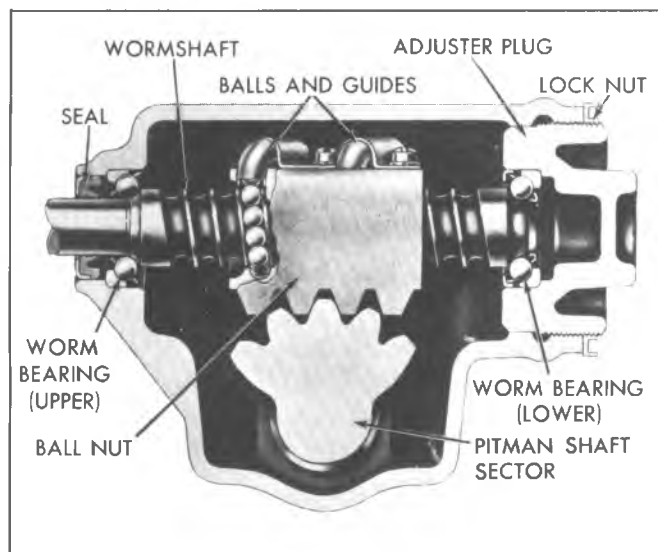


Fig. 3B-1A--Steering Gear (Except Corvette)

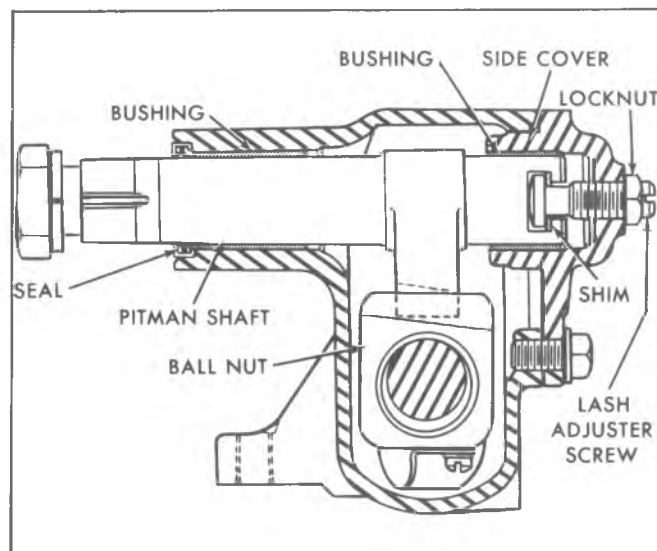


Fig. 3B-2A--Steering Gear (Except Corvette and G10-30 Series Trucks)

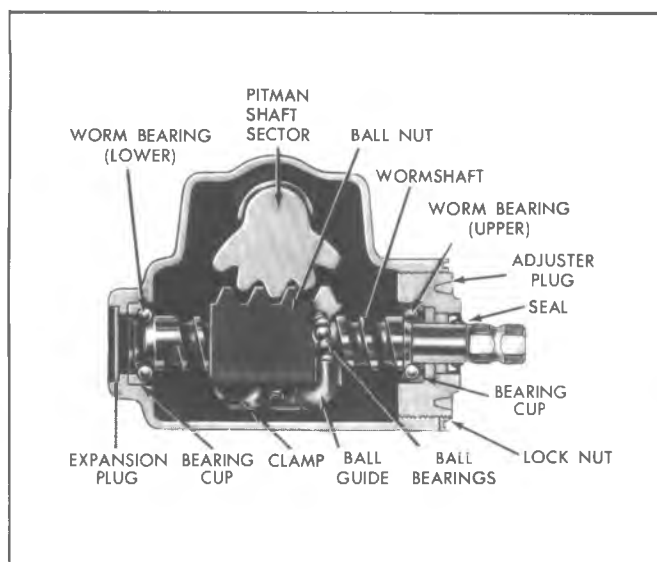


Fig. 3B-3A--Steering Gear--Corvette

except Corvette - upper wormshaft bearing race on Corvette).

6. Draw the wormshaft and ball nut assembly from the housing (fig. 3B-6A).

**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. 3B-7A).

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

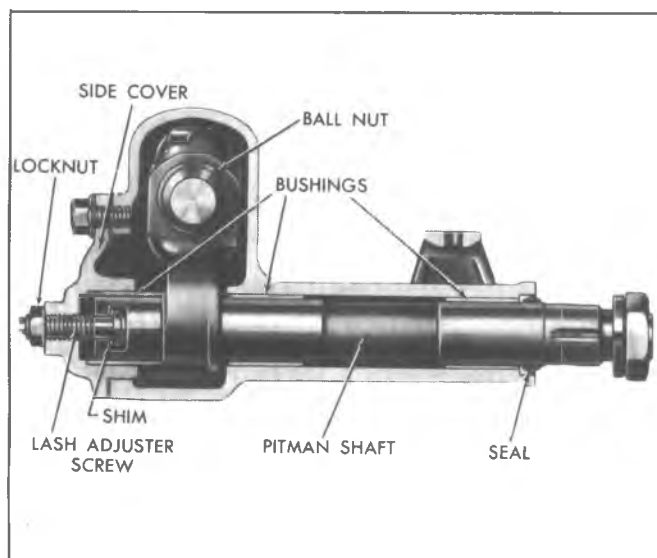


Fig. 3B-4A--Steering Gear (Corvette and G10-30 Series Trucks)

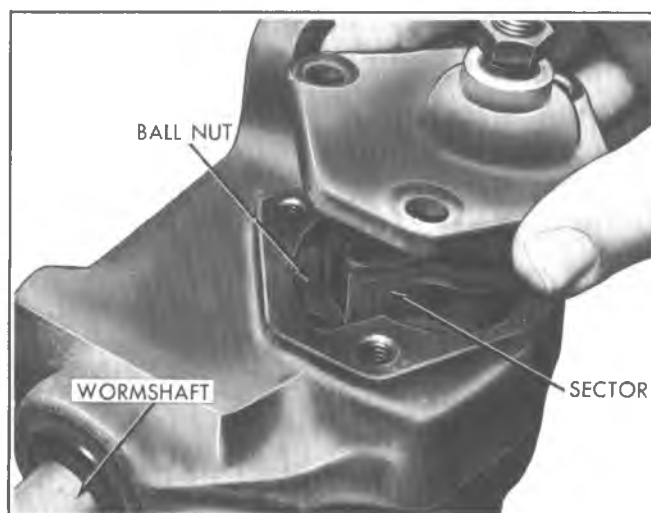


Fig. 3B-5A--Removing Pitman Shaft Assembly--Typical

screw and shim out of the slot in the end of the pitman shaft.

10. Pry out and discard both the pitman shaft and wormshaft seals.

### Inspection

With the steering gear completely disassembled, wash all parts in cleaning solvent. Dry them thoroughly with air. With a magnifying glass inspect the bearings and bearing races for signs of indentation. Also check for any signs of chipping or breakdown of the surface. Any parts that show signs of damage should be replaced.

Inspect all seals. Any seal that is worn or has been removed should be replaced.

Inspect the fit of the pitman shaft in its bushing in the side cover. If this bushing is worn, a new side cover and bushing assembly should be installed.

Check steering gear wormshaft assembly for being bent or damaged in any way. Never attempt to salvage steering parts by welding or straightening.

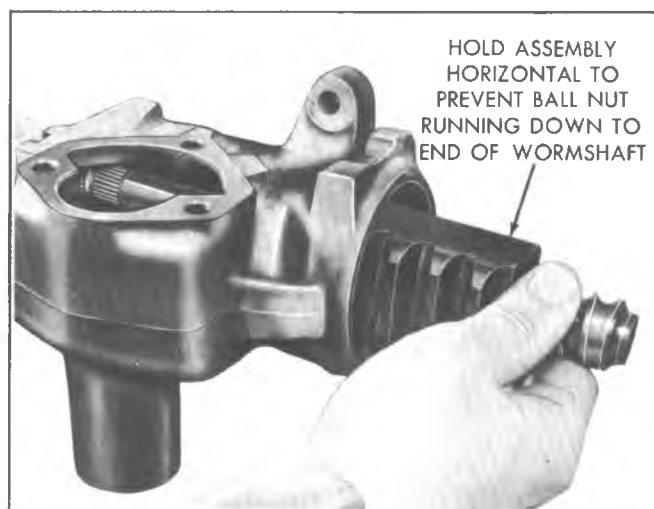


Fig. 3B-6--Removing the Wormshaft and Ball Nut--Typical





Fig. 3B-7A--Removing Lower Bearing Retainer--Except Corvette

## Repairs

### Pitman Shaft and/or Wormshaft Seal Replacement

The double lipped pitman shaft and wormshaft seals should be replaced each time a defective seal is indicated or the steering gear is disassembled.

1. If the seals were not removed at disassembly, pry out the old seals using a suitable size screw driver.

**CAUTION:** Before installing new seals, check 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. 3B-8).

2. Press the new bushing(s) into position using Tool J-1614. Position the Corvette and G10-30 Series Truck bushings as shown in Figure 3B-4A.

**NOTE:** Service bushings are diamond bored to size and require no further reaming.

### Side Cover Bushing Replacement

The entire side cover assembly, including bushing, is serviced as a unit and should be replaced when it is desired to replace the bushing.

### Wormshaft Bearing Race Replacement

#### ADJUSTER PLUG RACES

1. **All Except Corvette--** Remove the wormshaft bearing race using Tool J-5822 and a Slide Hammer as shown in Figure 3B-9A.

**Corvette--** Using a hammer and punch, drive the bearing race out of the adjuster plug.

2. Press the new bearing race into position using Tool J-5755.

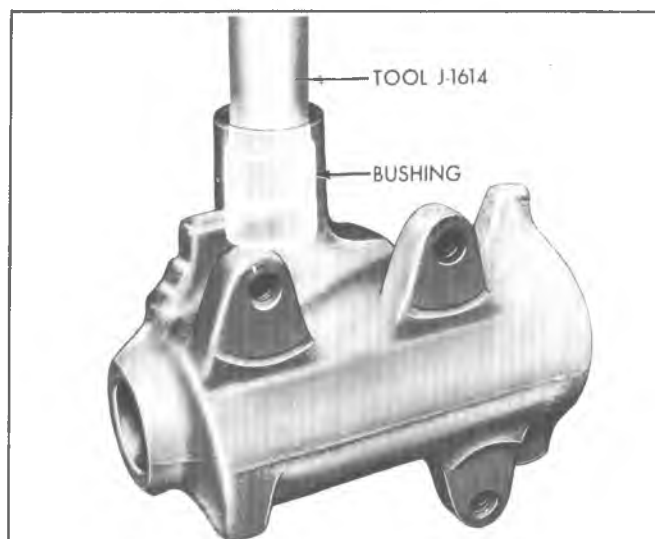


Fig. 3B-8A--Removing Pitman Shaft Bushing--Typical

## HOUSING RACES

1. **Corvette only--** Using a drift or punch (inserted into the housing from the adjuster plug end) drive the sheet metal expansion plug out of the lower end of the housing.

2. All Series - Using a drift or punch, drive the bearing race out of the housing.

3. Press the new bearing race into position using Tool J-5755 (fig. 3B-10A).

4. **Corvette only--** Install a new expansion plug into the lower end of the housing. Press on the center of the plug to deform it inward and secure it in the housing. Make sure the plug is tight or lubricant leakage could result.

## Ball Nut Servicing

As a rule, disassembly of the ball bearing nut will not be necessary if it is perfectly free with no indication of binding or tightness when rotated on the worm. However, if there is any indication of binding or 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.

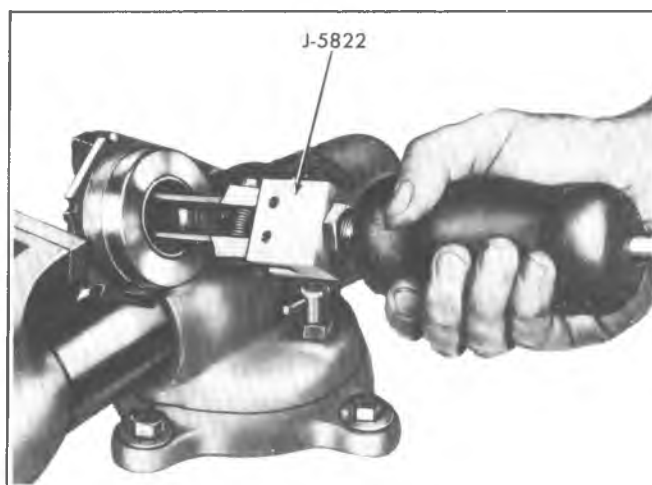


Fig. 3B-9A--Removing Adjuster Plug Bearing Race

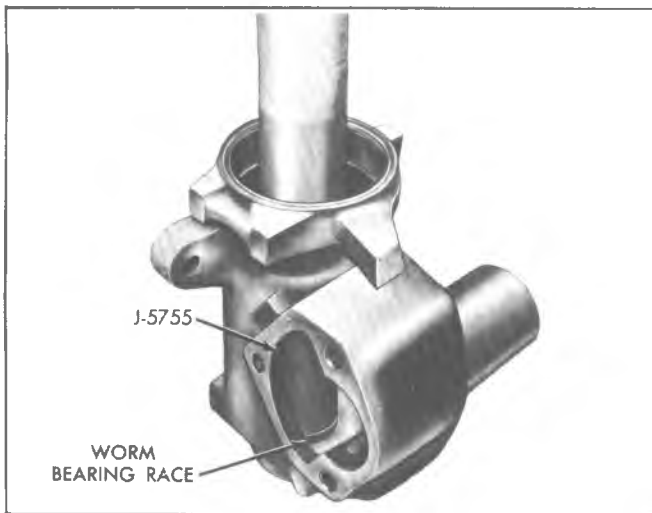


Fig. 3B-10A--Installing Wormshaft Bearing Race-Typical

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. 3B-11A):

a. Place the wormshaft flat on the bench and slip the nut over the worm with the ball guide holes up and the shallow end of the ball nut teeth to the left from the steering wheel position. Align the grooves in the worm and nut by sighting through the ball guide holes.

b. Place two ball guide halves together and insert them into the upper circuit in the ball nut. Place the remaining two guides together and insert them in the lower circuit.

c. Count 24 balls into a suitable container. This is the proper number of balls for one circuit.

d. Load the balls into one of the guide holes while turning the wormshaft gradually away from that hole. When all of the balls have been installed, the circuit is complete.

e. Fill the remaining ball circuit in the same manner

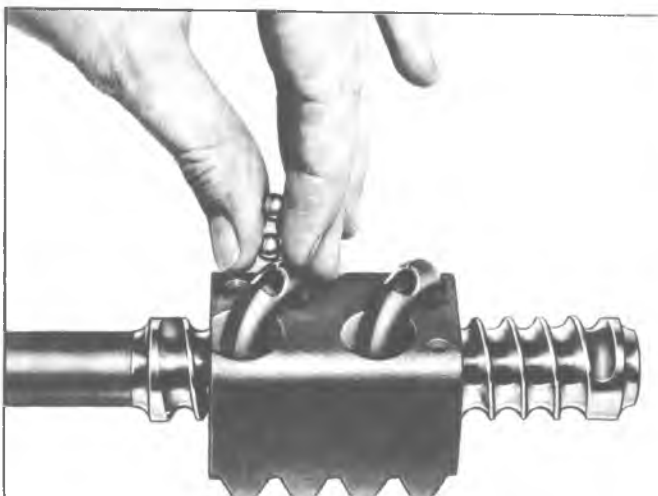


Fig. 3B-11A--Filling Ball Circuits--Except Corvette

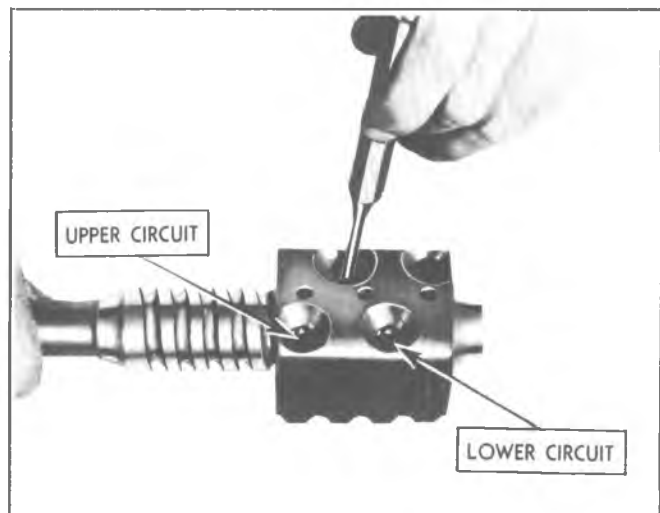


Fig. 3B-12A--Filling Ball Circuits--Corvette

as described for the first circuit in Steps c and d above.

#### 5. Corvette only (figs. 3B-12A and 3B-13A):

a. Place the wormshaft flat on the bench and slip the nut over the worm with the ball guide holes up and the shallow end of the rack teeth to the left from the steering wheel position. Align the grooves in the worm and nut by sighting through the ball guide holes.

b. Count 27 balls into a suitable container. This is the proper number of balls for half the circuit. Place these balls into one of the guide holes while turning the worm gradually away from that hole.

c. Lay one-half of the ball guide, groove up, on the bench and place the remaining balls from the count container in it.

d. Close this half of guide with the other half. Hold the two halves together and plug each open end with petroleum jelly so that balls will not drop out while installing the guide.

e. Push the guide into the guide holes of the nut. This completes one circuit of balls. If the guide does not push all the way down easily, tap it lightly into place with the wooden handle of a screw driver.

f. Fill the second ball circuit in the same manner.



Fig. 3B-13A--Filling Ball Guides--Corvette

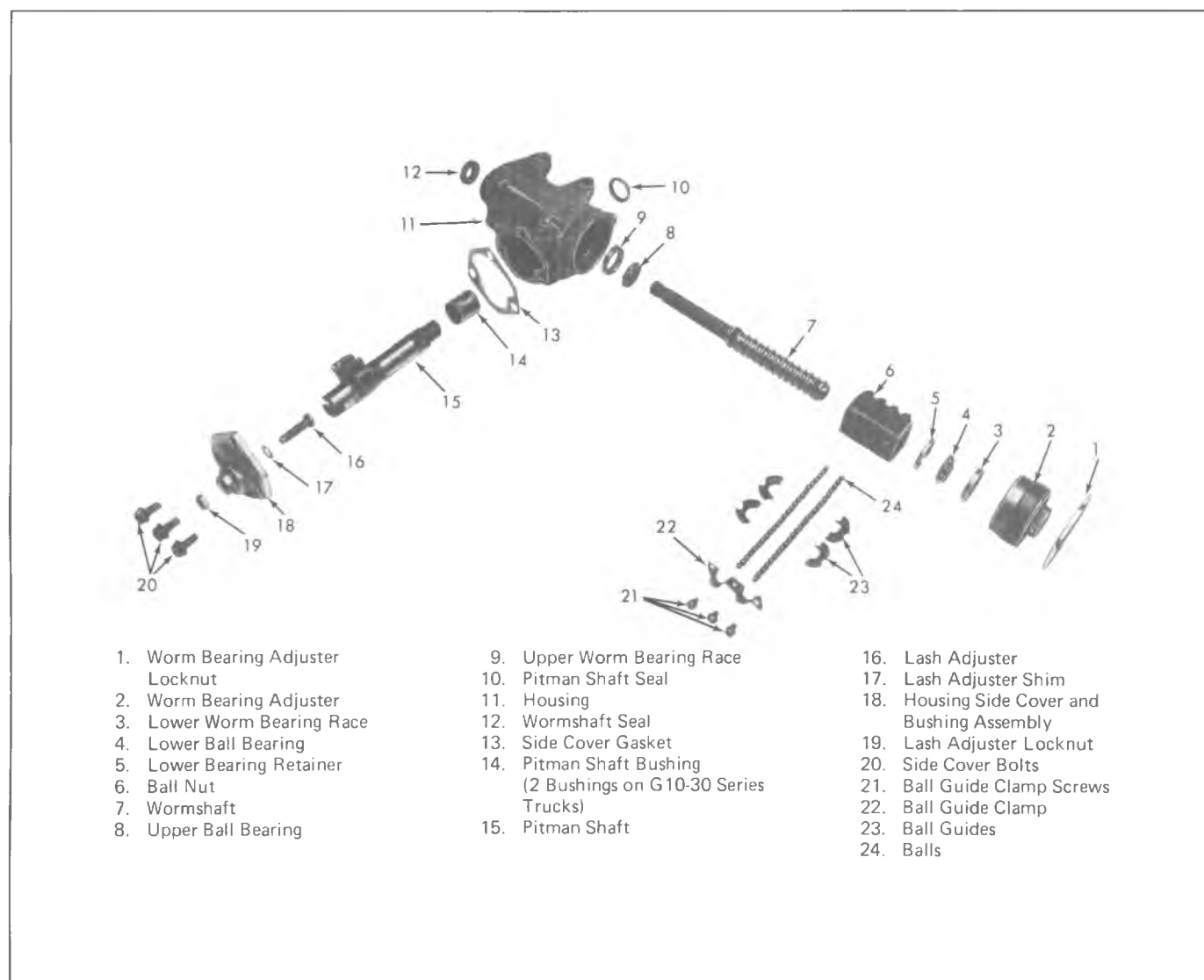


Fig. 3B-14A--Steering Gear--Except Corvette

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. 3B-12A) 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. 3B-14A and 3B-15A)

After a major service overhaul, steering gear lubricant

meeting GM Standard GM 4673M (or equivalent) should be applied to the pitman shaft and bearings, wormshaft and bearings and the ball nut teeth.

1. Place the steering gear housing in a vise with the wormshaft bore horizontal and the side cover opening up.

2. With the pitman shaft and wormshaft seals, pitman shaft bushings and wormshaft bearing races installed, and the ball nut installed on the wormshaft, proceed to Step 3 or 4.

#### 3. All Except Corvette--

a. Slip the upper ball bearing over the wormshaft and insert the wormshaft and nut assembly into the housing, feeding the end of the shaft through the upper ball bearing race and seal.

b. Place a ball bearing in the adjuster race and press the stamped retainer into place with a suitable socket.

c. Install the adjuster and locknut into the lower end of the housing (being careful to guide the end of the wormshaft into the bearing) until nearly all end play has been removed from the wormshaft.

#### 4. Corvette--

a. Place a wormshaft bearing in the housing race. Slide

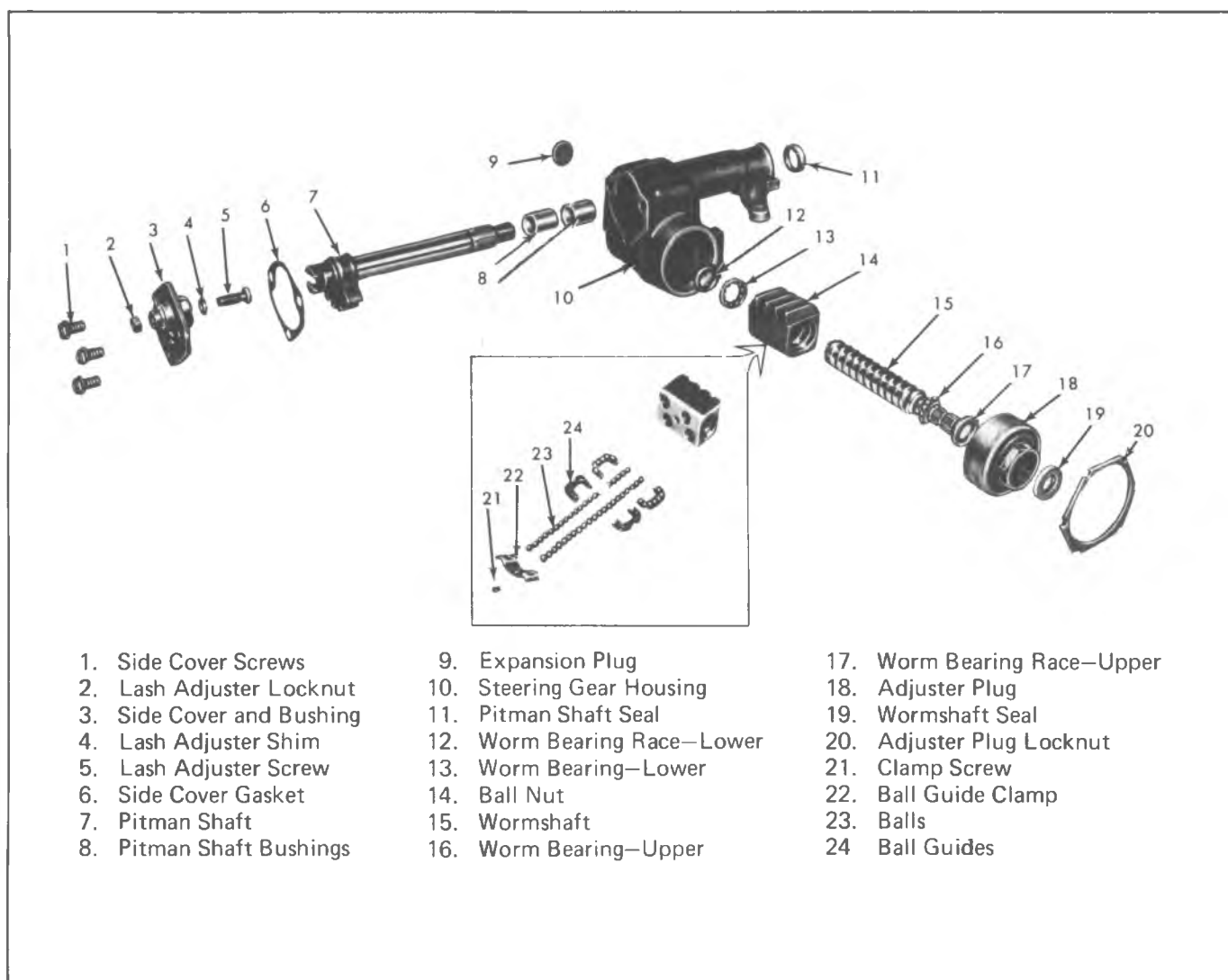


Fig. 3B-15A—Steering Gear—Corvette

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. 3B-16A). If clearance is greater than .002", a steering gear lash adjuster shim unit is available. It contains four shims—.063", .065", .067" and .069" thick.

6. Lubricate the steering gear with 11 oz. of lubricant meeting GM Specification GM 4673 (or equivalent). Rotate the wormshaft until the ball nut is at the end of its travel and then pack as much new lubricant into the housing as possible without losing it out the pitman shaft opening. Rotate the wormshaft until the ball nut is at the other end of its travel and pack as much lubricant into the opposite end as possible.

7. Rotate the wormshaft until the ball nut is about in the center of travel. This is to make sure that the pitman

shaft sector and ball nut will engage properly, with the center tooth of the sector entering the center tooth space in the ball nut.



Fig. 3B-16A—Checking Lash Adjuster End Clearance

8. Insert the pitman shaft assembly (with lash adjuster screw and shim but without side cover) into the housing so that the center tooth of the pitman shaft sector enters the center tooth space of the ball nut.

9. Pack the remaining portion of lubricant into the housing.

10. Place the side cover gasket on the housing.

11. Install the side cover onto the pitman shaft by reaching through the side cover with a screwdriver and turning the lash adjuster screw counterclockwise until the screw bottoms; back the screw off one-half turn. Loosely install a new locknut onto the adjuster screw.

12. Install and tighten the side cover bolts to specifications.

**CAUTION:** *If new side cover bolts are used at installation, be sure to use specified bolts which are self locking.*

### 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. 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

## INDEX

Overhaul Operations .....	3B-8
Disassembly .....	3B-8
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## OVERHAUL OPERATIONS

**CAUTION:** *If when overhauling a power steering gear or pump, broken components or foreign material are encountered, the remaining components of the entire hydraulic system should be disassembled, inspected, thoroughly cleaned and flushed before servicing is completed.*

### Disassembly (Fig. 3B-1B)

Clean the outside of the pump in a nontoxic solvent before disassembly.

1. Remove pump pulley by using tool J-25034 as shown in Figure 3B-2B.

2. Place the pump in a vise and remove the union and "O" ring seal assembly.

**CAUTION:** *In clamping pump in vise, be careful not to exert excessive force on the pump front hub as this may distort the shaft bushing.*

3. Remove the pump reservoir retaining studs.

4. Remove the reservoir from the pump housing by

tapping lightly on the outer edge of the reservoir with a soft hammer. Remove the "O" ring seal from the pump housing and discard seal.

5. Remove magnet from housing assembly.

6. Remove the mounting stud square ring seals and the flow control valve square ring seal and discard.

7. On Corvette, remove filter and filter cage; discard filter element.

8. Remove the end plate retaining ring. Compress the end plate retaining ring by inserting a small punch in the 1/8" diameter hole in the pump housing. When the ring is in compressed position, remove with a screw driver as shown in Figure 3B-3B.

9. Remove the end plate. The end plate is spring loaded and will generally sit above the housing level. If sticking should occur, a slight rocking action or light tapping with a soft hammer will free the plate. Remove the end plate spring.

10. With the pump still in a vise, remove the shaft

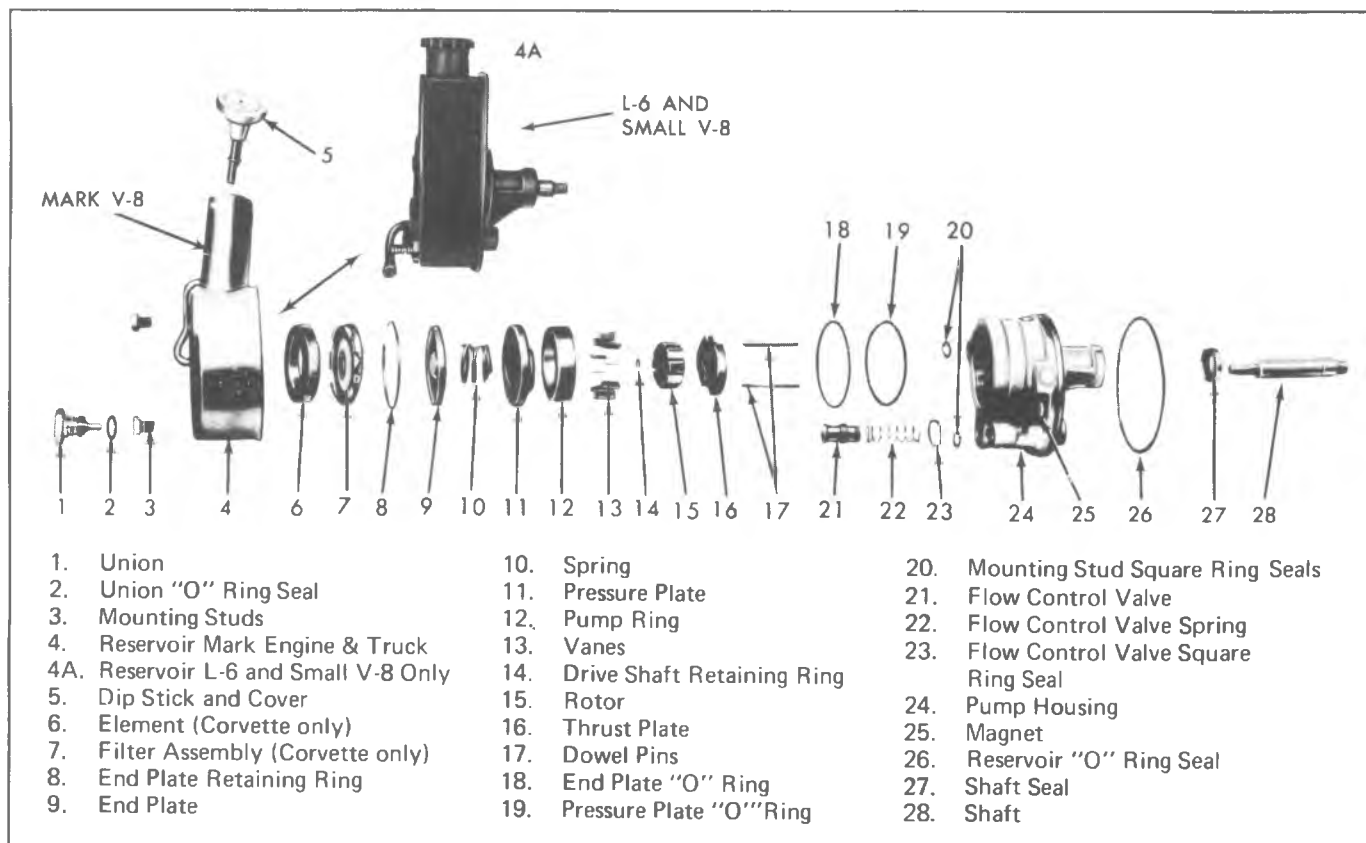


Fig. 3B-1B—Power Steering Pump—Exploded View

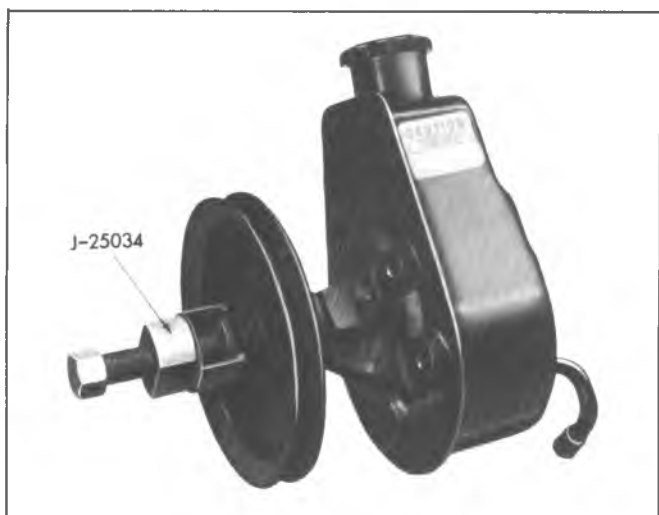


Fig. 3B-2B--Power Steering Pump Pulley--Removal

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. 3B-4B).

11. Separate the parts removed in Step 9 above. If inspection shows the shaft to be defective, separate it from the rotor by removing the retainer snap ring. Discard the snap ring.

12. Remove the end plate and pressure plate "O" rings from the pump housing and discard "O" rings.

13. Remove the dowel pins.

14. Remove the flow control valve and spring assembly.

15. Pry the shaft seal out of the pump housing being 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



Fig. 3B-3B--Removing End Plate Ring

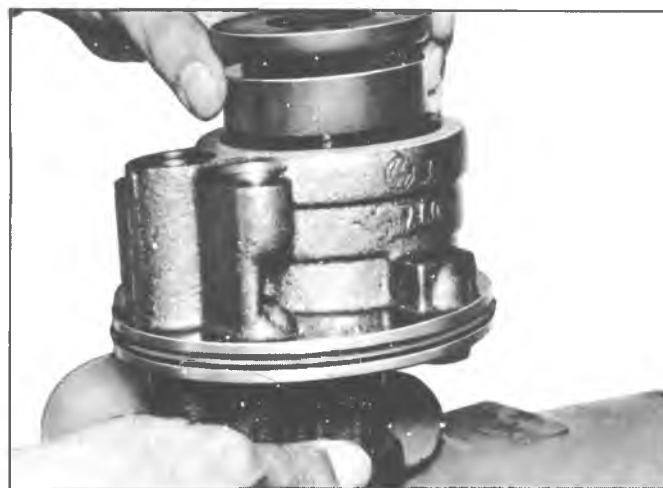


Fig. 3B-4B--Impeller Unit Removal

are flat and parallel with pump ring. Check all of these parts for cracks and scoring.

**NOTE:** A high polish is always present on rotor pressure plate and thrust plate as a result of normal wear. Do not confuse this with scoring.

4. Make certain vanes were installed with rounded edge toward pump ring and see that they move freely in rotor slots.

5. If the flow control plunger is determined to be faulty, install a new part. This part is serviced as a unit only and is factory calibrated.

6. Check drive shaft for worn splines, breaks, bushing material pickup, etc.

7. Always replace all rubber seals and "O" rings when pump is dismantled.

8. Check reservoir, studs, casting, etc. for burrs and other faults which would impair proper operation.

### Assembly (Fig. 3B-5B)

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.

1. Install a new shaft seal in the pump housing, using Tool J-22670 as shown in Figure 3B-6B.

2. Install both dowel pins in the pump housing and install a new pressure plate "O" ring lubricated with power steering fluid.

**CAUTION:** Do not use a "C" ring to replace the full diameter ring. Be sure the retaining ring is firmly seated in the shaft groove before proceeding.

3. Install the thrust plate on the shaft with the ported face towards the splined end of the shaft (fig. 3B-7B).

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. 3B-8B).

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 3B-9B.

7. Install the pump ring onto the dowel pins with the



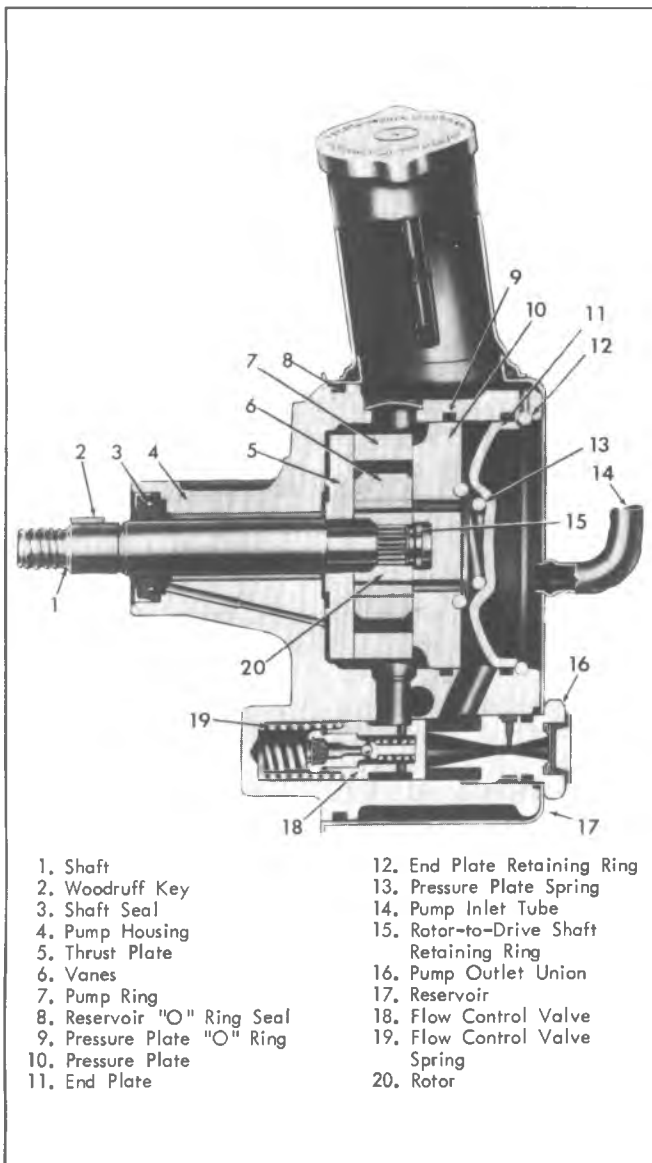


Fig. 3B-5B--Power Steering Pump--Typical



Fig. 3B-7B--Installing Thrust Plate

direction of rotation arrow to the rear of the housing (fig. 3B-10B). 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 3B-11B and 3B-12.

9. Lubricate the outside diameter and chamfer of the pressure plate with power steering fluid, to ensure against damaging the pressure plate "O" ring, and install the pressure plate onto the dowel pins with the ported face towards the pump ring. Seat the pressure plate by placing a large socket on top of the plate and pressing down by hand (pressure plate will travel approximately 1/16" to seat).

10. Install the pressure plate spring in the center groove of the pressure plate (fig. 3B-13B).

11. Lubricate a new end plate "O" ring with power steering fluid and install in housing groove.

12. Lubricate the outside diameter and chamfer of the end plate with power steering fluid, to ensure against damaging the "O" ring, and install into the housing using an arbor press as shown in Figure 3B-14B.

**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



Fig. 3B-6B--Installing Seal Using Tool J-22670

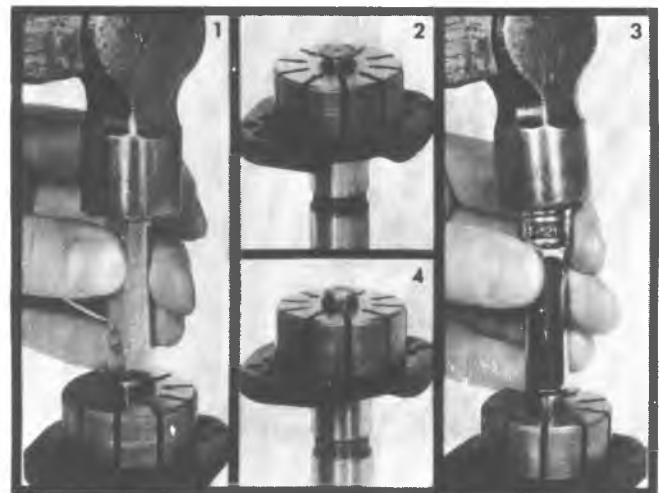


Fig. 3B-8B--Installing Shaft Snap Ring

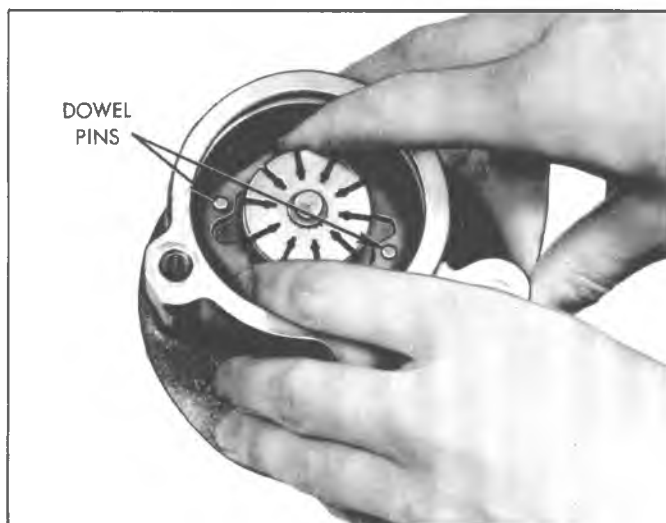


Fig. 3B-9B--Installing Shaft, Thrust Plate, and Rotor Assembly



Fig. 3B-11B--Installing Vanes

plunger. Be sure the hex head screw goes into the bore first (fig. 3B-15B).

14. On Corvette, install cage and a new filter.

15. Place magnet into proper position on housing assembly (Fig. 3B-1B).

16. Install new mounting stud and union square ring seals.

17. Install a new reservoir "O" ring seal, lubricated with power steering fluid, onto housing.

18. Lubricate reservoir sealing edge with power steering fluid and place reservoir onto housing in the normal position. Press down on reservoir until it seats onto housing; check position of stud and union seals.

19. Place a new "O" ring seal, lubricated with power steering fluid, onto union and install union assembly and studs.

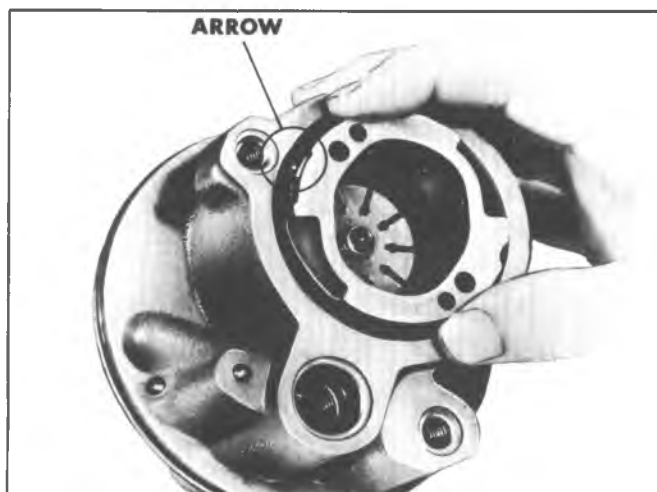


Fig. 3B-10B--Installing Pump Ring

20. Install pump pulley by inserting tool J-25033 through pulley hub and threading the bolt into the power steering pulley shaft as shown in figure 3B-16B.

**NOTE:** Pulley must be flush with end of shaft.

**CAUTION:** *DO NOT hammer on pump shaft. Use special tools to prevent possible damage to internal pump components.*

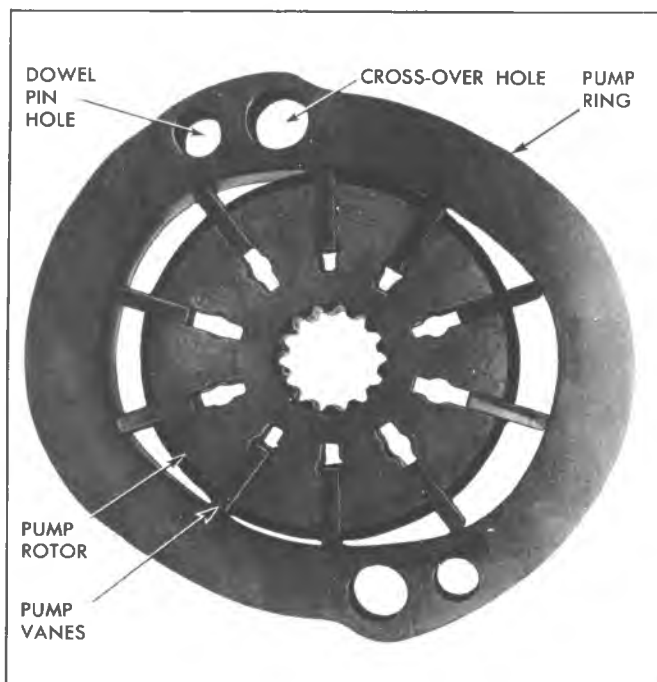


Fig. 3B-12B--Correct Vane Assembly



Fig. 3B-13B--Installing Pressure Plate Spring



Fig. 3B-15B--Installing Flow Control Valve



Fig. 3B-14B--Installing End Plate Retaining Ring

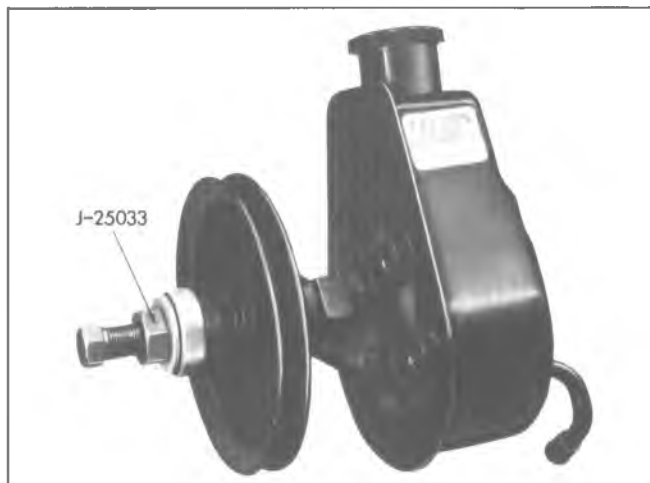


Fig. 3B-16B--Power Steering Pump Pulley - Installation

## INTEGRAL POWER STEERING GEARS

Overhaul, 605 Gear .....	3B-13
Overhaul, 800 and 808 Gear .....	3B-18

## OVERHAUL OPERATIONS

**CAUTION:** If when overhauling a power steering gear or pump, broken components or foreign material are encountered, the remaining components of the entire hydraulic system should

*be disassembled, inspected, thoroughly cleaned and flushed before servicing is completed.*

## POWER STEERING GEAR (605 MODEL)

### GENERAL DESCRIPTION

This Integral Power Steering Gear has a control valve which directs oil to either side of the rack piston. The rack piston converts hydraulic power into mechanical force. This force is transmitted to the mating pitman shaft teeth, through the pitman shaft to the steering linkage.

This is a small design steering gear. To determine this gear from our large steering gear see difference in side cover below.

**NOTE:** Whenever a part which forms a sealing surface for an "O" ring seal is removed, the "O" ring seal should also be removed and replaced with a new seal. Whenever one of the Pitman shaft or stub shaft seals are removed all adjacent seals should be removed and replaced with new seals. Lubricate all new seals with power steering fluid to ease assembly.

Round side cover — held in place with retaining ring



**SMALL GEAR**  
(605 MODEL)

Rectangular side cover held in place with four bolts



**LARGE GEAR**  
(800-808 MODEL)

Key No.	Part Name	Key No.	Part Name
1	HOUSING, STEERING GEAR	20	SHAFT ASSY. STUB
2	RETAINER, STRG. COUPLING SHIELD	21	SEAL, "O" RING (SHAFT TO WORM)
3	BEARING ASSY., NEEDLE (STUB SHAFT)	22	WORM ASSY., PIN & STRG.
4	SEAL, STUB SHAFT	23	RING, RETAINING (SHAFT TO WORM)
5	SEAL, STUB SHAFT DUST	24	RING, RACK PISTON
6	RING, RETAINING (STUB SHAFT SEAL)	25	SEAL, "O" RING (RACK PISTON)
7	BEARING ASSY., NEEDLE (PITMAN SHAFT)	26	RACK-PISTON-NUT
8	SEAL PITMAN SHAFT	27	BEARING ASSY. SUPPORT & LWR. THR.
9	WASHER, SEAL BACK-UP (PITMAN SHAFT)	28	SEAL, "O" RING (ADJUSTOR PLUG)
10	SEAL, PITMAN SHAFT DUST	29	PLUG, ADJUSTOR
11	RING, RETAINING (PITMAN SHAFT SEAL)	30	NUT, ADJUSTOR LOCK
12	WASHER, LOCK (PITMAN SHAFT)	31	SPRING, SIDE COVER
13	NUT, PITMAN ARM	32	SEAL, "O" RING (ADJUSTOR PLUG)
14	BEARING ASSY., RACE & UPPER	33	GEAR ASSY., PITMAN SHAFT
15	RING, VALVE BODY (3)	34	COVER, ASSY., HOUSING SIDE
16	SEAL, "O" RING (VALVE BODY) (3)	35	RING, RETAINING (SIDE COVER)
17	BODY ASSY., VALVE	36	NUT, PRELOAD ADJUSTOR SEALING
18	SEAL, "O" RING (DAMPNER)	37	CONNECTOR, INVERTED FLARE (2)
19	SPOOL, VALVE		

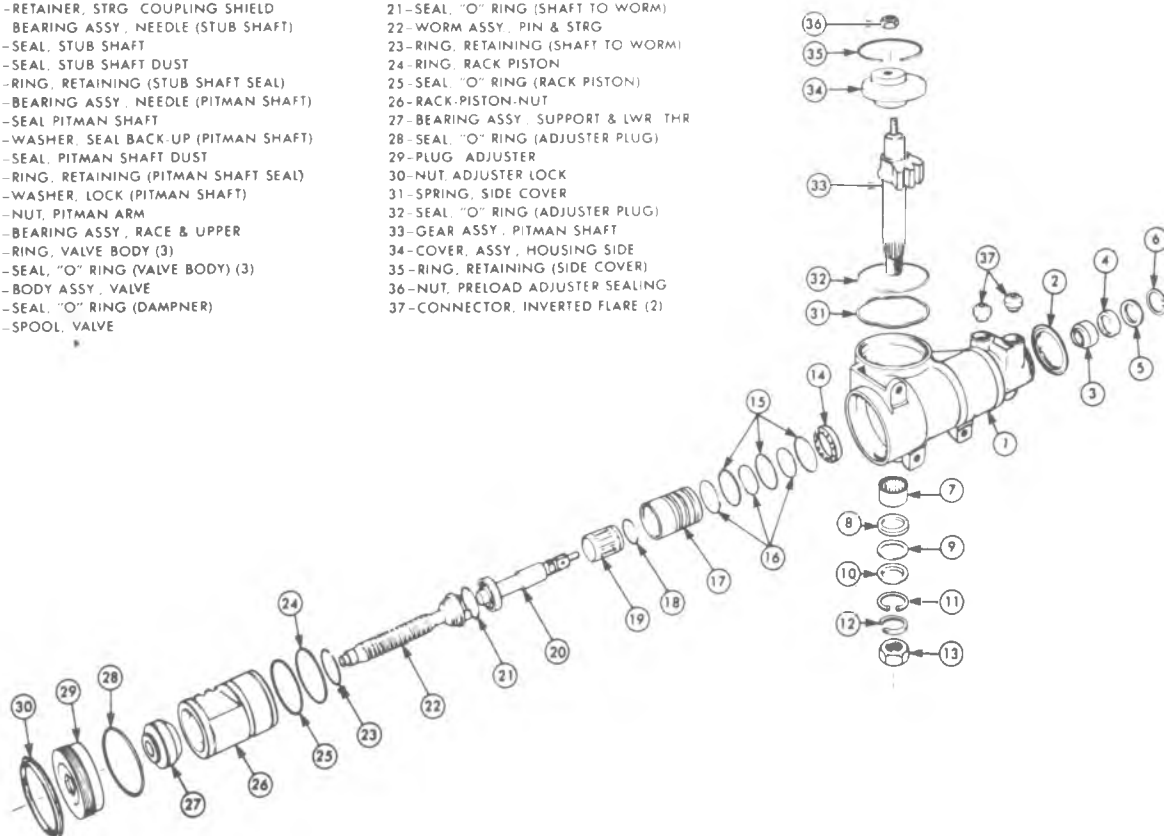


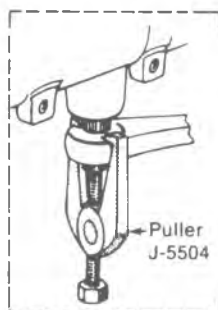
Fig. 3B-1C--Overhaul 605 Gear, Chart A

# 1. REMOVE AND INSTALL PITMAN SHAFT SEALS IN CAR

## REMOVE

1. Clean exposed end of pitman shaft and end of housing after removing arm.
2. Remove retaining ring
3. Start engine and turn wheels fully to the right to force seals and washer out.
4. Turn off engine
5. Inspect housing and shaft

**PITMAN SHAFT** —  
Inspect seal surface for roughness and pitting

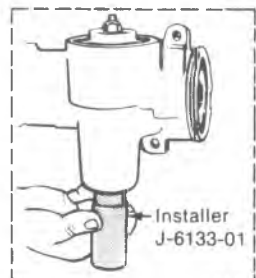
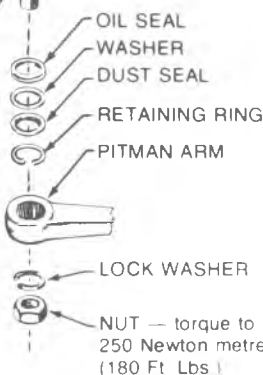


Remove Pitman Arm

## INSTALL

1. Install parts as shown

**HOUSING ASSEMBLY**  
Inspect for burrs



Install Seals

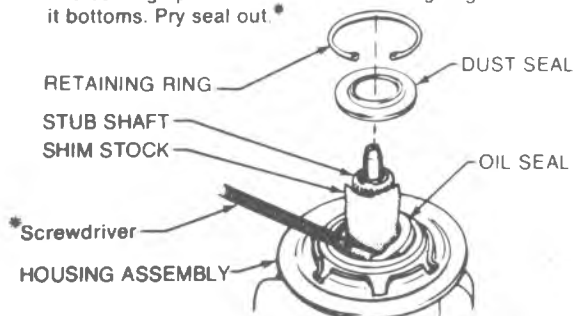
# 2. REMOVE AND INSTALL STUB SHAFT SEALS WITHOUT DISASSEMBLING GEAR

## REMOVE

1. Remove retaining ring and dust seal. Take care not to scratch shaft.
2. Wrap 0.1mm to 0.2mm (.005" to .008") shim stock around shaft and insert between shaft and sealing lip until it bottoms. Pry seal out.\*

## INSTALL

1. Install stub shaft seal. Liberally coat top of seal with anhydrous calcium grease.
2. Install dust seal just deep enough to clear retaining ring groove, then install retaining ring.



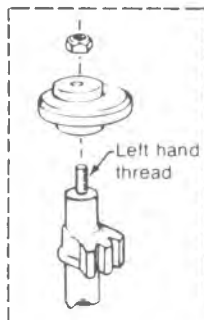
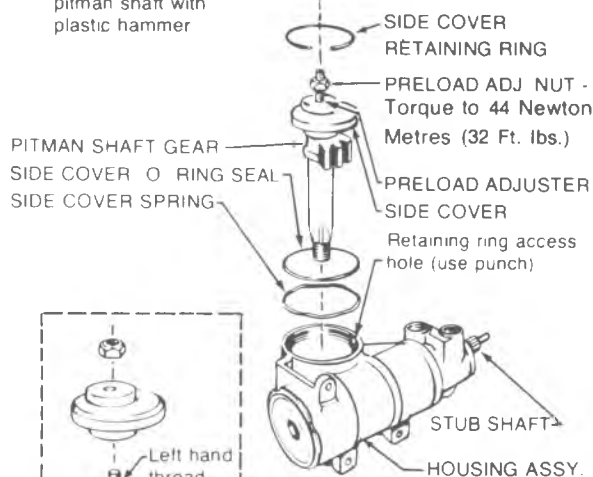
# 3. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

## REMOVE

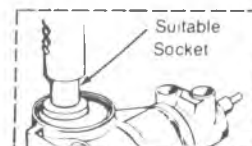
1. If pitman shaft and side cover are to be separated, remove preload adjuster nut. IT IS A LEFT HAND THREAD.
2. Rotate stub shaft to center gear, then remove parts as shown. Tap on thread end of pitman shaft with plastic hammer

## INSTALL

1. Install parts as shown. Use new retaining ring, make sure that open end of retaining ring is approx. 13mm (1/2") from access hole.
2. Side cover must be depressed to install retaining ring. (SEE BELOW)\*



Separate pitman shaft from side cover if required.



\* Depress side cover

# 4. REMOVE AND INSTALL LOWER BEARING AND ADJUSTER

## REMOVE

1. Loosen lock nut. Use punch against edge of one slot.
2. Remove parts as shown.
3. Inspect lower thrust bearing assembly.

## INSTALL

1. Install parts as shown
2. Adjust thrust bearing preload (see adjustment procedure) before tightening lock nut.

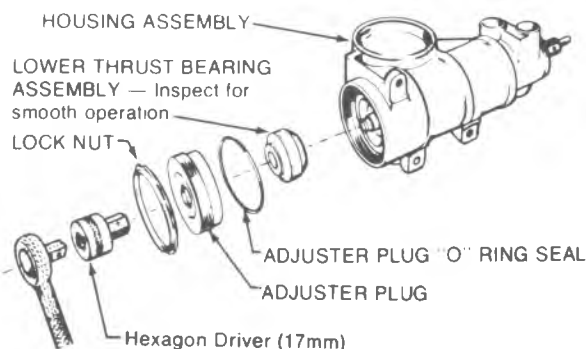


Fig. 3B-2C--Overhaul 605 Gear, Chart B

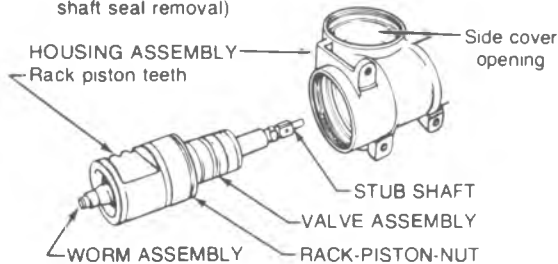
### 5. REMOVE AND INSTALL RACK PISTON AND VALVE ASSEMBLY

#### REMOVE

1. Remove parts as shown. Push on stub shaft. DO NOT remove upper bearing assembly (see stub shaft seal removal)

#### INSTALL

1. Install parts as shown. Make sure rack piston teeth are positioned toward side cover opening.



### 6. REMOVE AND INSTALL VALVE AND WORM ASSEMBLY FROM RACK PISTON

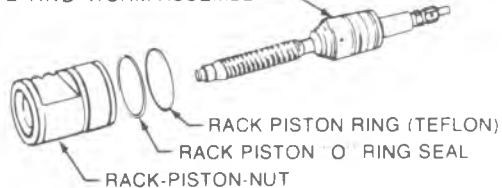
#### REMOVE

1. Unscrew valve and worm from rack.
2. Remove teflon ring and rack piston "O" ring from rack piston

#### INSTALL

1. Install "O" ring and teflon ring as shown
2. Screw worm and valve into rack piston. See procedure below.

VALVE AND WORM ASSEMBLY

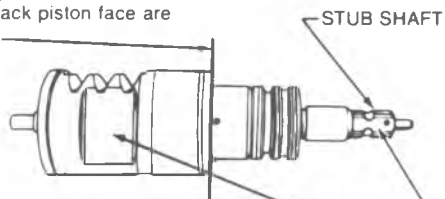


#### A. Assemble worm and valve to rack piston

- a. Hold rack teeth and worm drive pin in relation shown with light pressure to hold worm thread against piston.
- b. Turn worm and valve counterclockwise slowly until one "Click" is felt.
- c. Turn worm and valve clockwise to complete assembly

#### B. Check relation of stub shaft and rack piston

- a. Screw worm and valve into rack piston until valve face and rack piston face are flush



- b. With rack piston in position shown, flats on stub shaft and piston are to be parallel. If not parallel, disassemble and repeat "A" above.

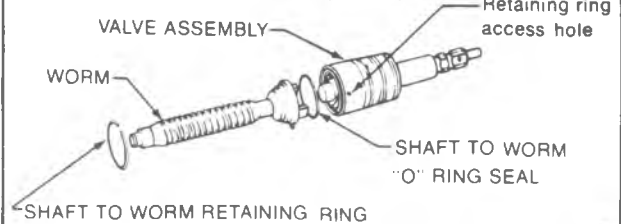
### 7. REMOVE AND INSTALL VALVE ASSEMBLY FROM WORM ASSEMBLY

#### REMOVE

1. Remove parts as shown.

#### INSTALL

1. Install parts as shown. See below.



Assemble worm to valve

RETAINING RING — Install with "curved in end" on same side as access hole

WORM ASSEMBLY — Retaining ring access hole

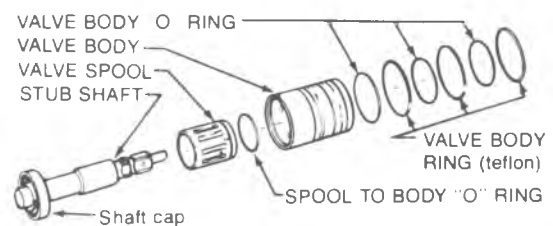
### 8. DISASSEMBLE AND ASSEMBLE VALVE

#### DISASSEMBLE

1. Disassemble parts as shown.

#### ASSEMBLE

2. Assemble parts as shown.

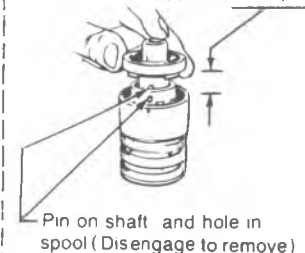


#### A. Loosen shaft cap

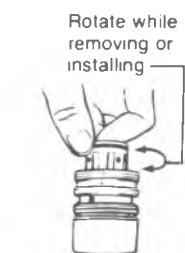


#### B. Remove and install stub shaft.

Pull cap out approx. 6 mm (1/4")



#### C. Remove and install spool



Lubricate spool and body with power steering fluid.

#### D. Engage stub shaft

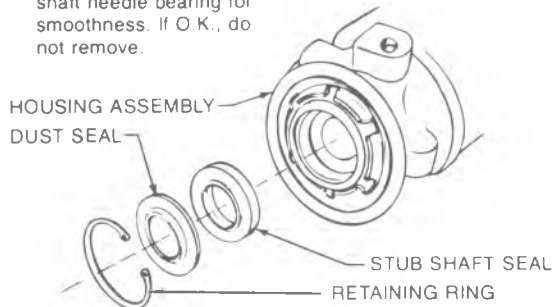


Fig. 3B-3C--Overhaul 605 Gear, Chart C

# 9. REMOVE AND INSTALL STUB SHAFT SEALS AND BEARINGS

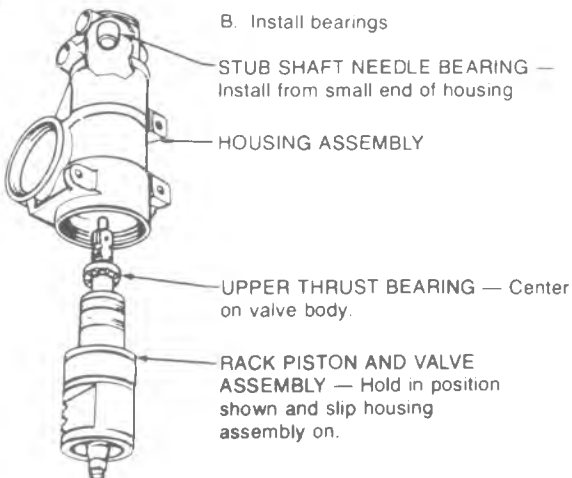
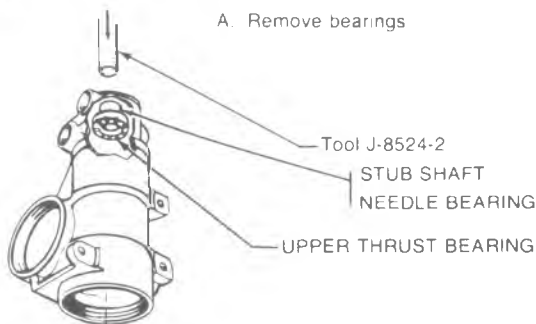
## REMOVE

1. Clean end of housing to prevent dirt from entering gear.
2. Remove parts as shown, being careful not to score housing bore.
3. Remove stub shaft needle bearing and upper thrust bearing if required. Put a finger into the stub shaft cavity and hook it onto the upper thrust bearing race. Turn the race while pulling up. If bearing operation is smooth, it does not need removal. Check the stub shaft needle bearing for smoothness. If O.K., do not remove.



## INSTALL

1. If removed, install new stub shaft needle bearing. Bottom tool on housing counterbore.  
**NOTE: SERVICE thrust bearing DOES NOT SNAP ON needle bearing.** If removed, install as shown below.
2. Install stub shaft seal. Liberally coat top of seal with anhydrous calcium grease.
3. Install dust seal just deep enough to clear retaining ring groove, then install retaining ring.



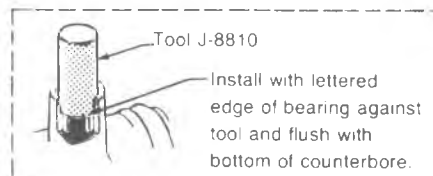
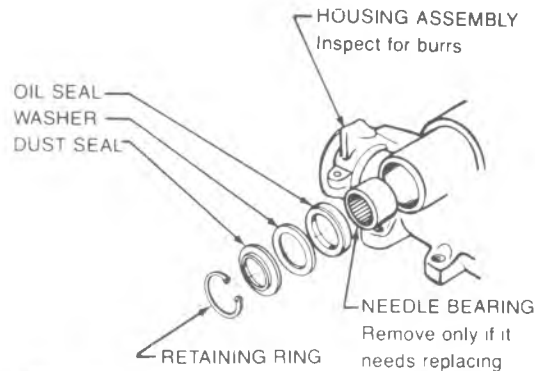
# 10. REMOVE AND INSTALL PITMAN SHAFT SEALS AND BEARING

## REMOVE

1. Remove parts as shown  
**CAUTION: Do not damage housing bore.**

## INSTALL

1. Bottom oil seal in counterbore. Install washer. Coat seal lip and washer face with anhydrous calcium grease.
2. Install remaining parts as shown.



Remove and install bearing (not necessary unless bearing is to be replaced).

# 11. REMOVE AND INSTALL CONNECTORS

## REMOVE

1. Remove Parts As Shown

## INSTALL

1. Install Parts As Shown

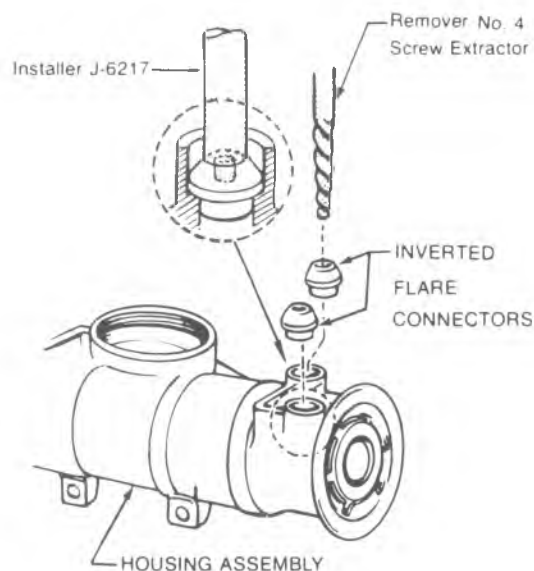
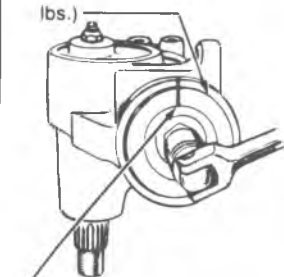


Fig. 3B-4C—Overhaul 605 Gear, Chart D



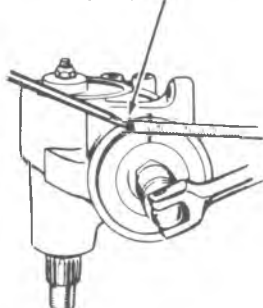
**12. ADJUST WORM BEARING PRELOAD**

A. Tighten adjuster plug until it bottoms (use 17mm hex. driver). Torque to approx. 40 Newton metres (30 Ft. lbs.)

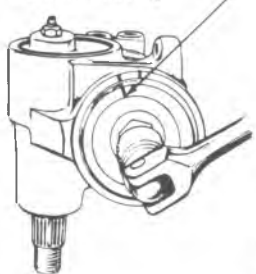


Mark housing and adjuster in line

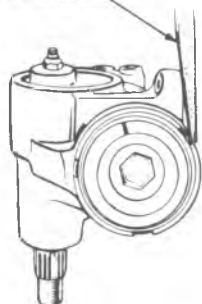
B. Measure 13mm (1/2") counterclockwise and mark housing only



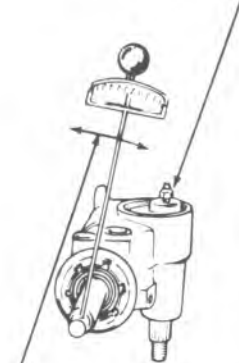
C. Turn adjuster back until mark lines up with second mark on housing



D. Tighten lock nut. Use punch in notch

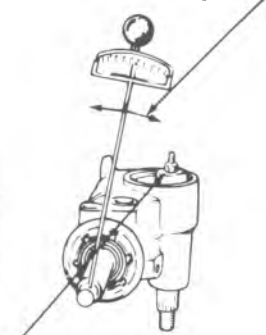
**13. ADJUST "OVER CENTER" PRELOAD**

A. Back off preload adjuster (LEFT HAND THREAD) until it stops, then turn it in one full turn.



With gear at center of travel, check torque to turn stub shaft (reading #1)

B. Turn adjuster in until torque to turn stub shaft is 0.6 to 1.2 Newton metres (6 to 10 in. lbs.) more than reading #1



Torque adjuster lock nut to 44 Newton metres (32 Ft. lbs.) Prevent adjuster screw from turning while torquing lock nut.

**RECOMMENDED TORQUE SPECIFICATIONS****NEWTON METRES****FOOT-POUNDS**

Gear to Frame Bolts .....	95 .....	70
High Pressure Line Fitting (At Gear) .....	54 .....	40
Oil Return Line Fitting (At Gear) .....	54 .....	40
Pitman Shaft		
Adjusting Screw Locknut .....	44 .....	32
Adjuster Plug Locknut .....	110 .....	80
Pitman Shaft Nut .....	250 .....	180
Coupling Flange Bolt .....	42 .....	30

**SPECIAL TOOLS**

J-4245	— Internal Snap Ring Pliers
J-6133-01	— Pitman Shaft Seal Installer
J-6217	— Connector Seat Installer
J-7754	— 0-5 Newton-metre Torque Wrench (0-25 inch-pounds)
J-8058	— 0-125 Newton-metre Torque Wrench (0-50 foot-pounds)
J-8810	— Pitman Shaft Bearing Remover and Installer
J-25323	— Power Steering Analyzer

Fig. 3B-5C--Overhaul 605 Gear, Chart E

## POWER STEERING GEAR (800 AND 808 MODELS)

### GENERAL DESCRIPTION

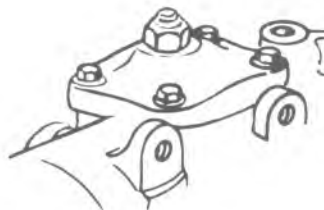
These Integral Power Steering Gears have a control valve which directs oil to either side of the rack piston. The rack piston converts hydraulic power into mechanical force. This force is transmitted to the mating pitman shaft teeth, through the pitman shaft to the steering linkage.

These gears incorporate a recirculating ball system in which steel balls act as a rolling thread between a steering worm-shaft and the rack-piston. Two sizes of these gears are used. One (model 800) uses a 70mm (2¾") diameter cylinder bore and the other (model 808) uses a 79mm (3⅛") diameter bore. Two types of each gear are used, but they are serviced exactly the same. Some vehicles use a constant ratio gear and others use a variable ratio gear.

The variable ratio type gear is generally faster, and requires fewer turns of the steering wheel. Variable ratio is accomplished by a pitman shaft sector incorporating a short tooth on either side of a long outer tooth, rather than a sector with three teeth of equal length as in constant ratio gears. Similar changes are also made in the rack-piston teeth (see below).

This is a large design steering gear. To determine this gear from the small steering gear see difference in side cover below.

Rectangular side cover held in place with four bolts

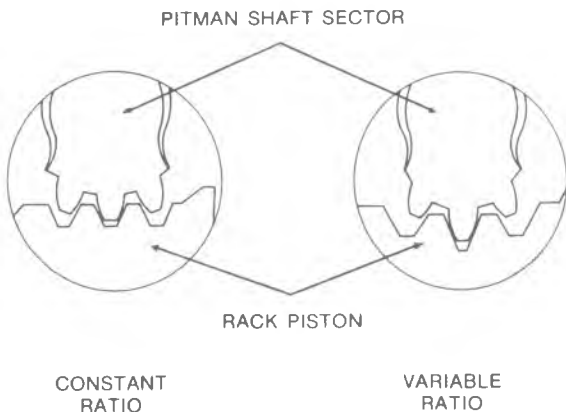


**LARGE GEAR**  
(800-808 MODEL)

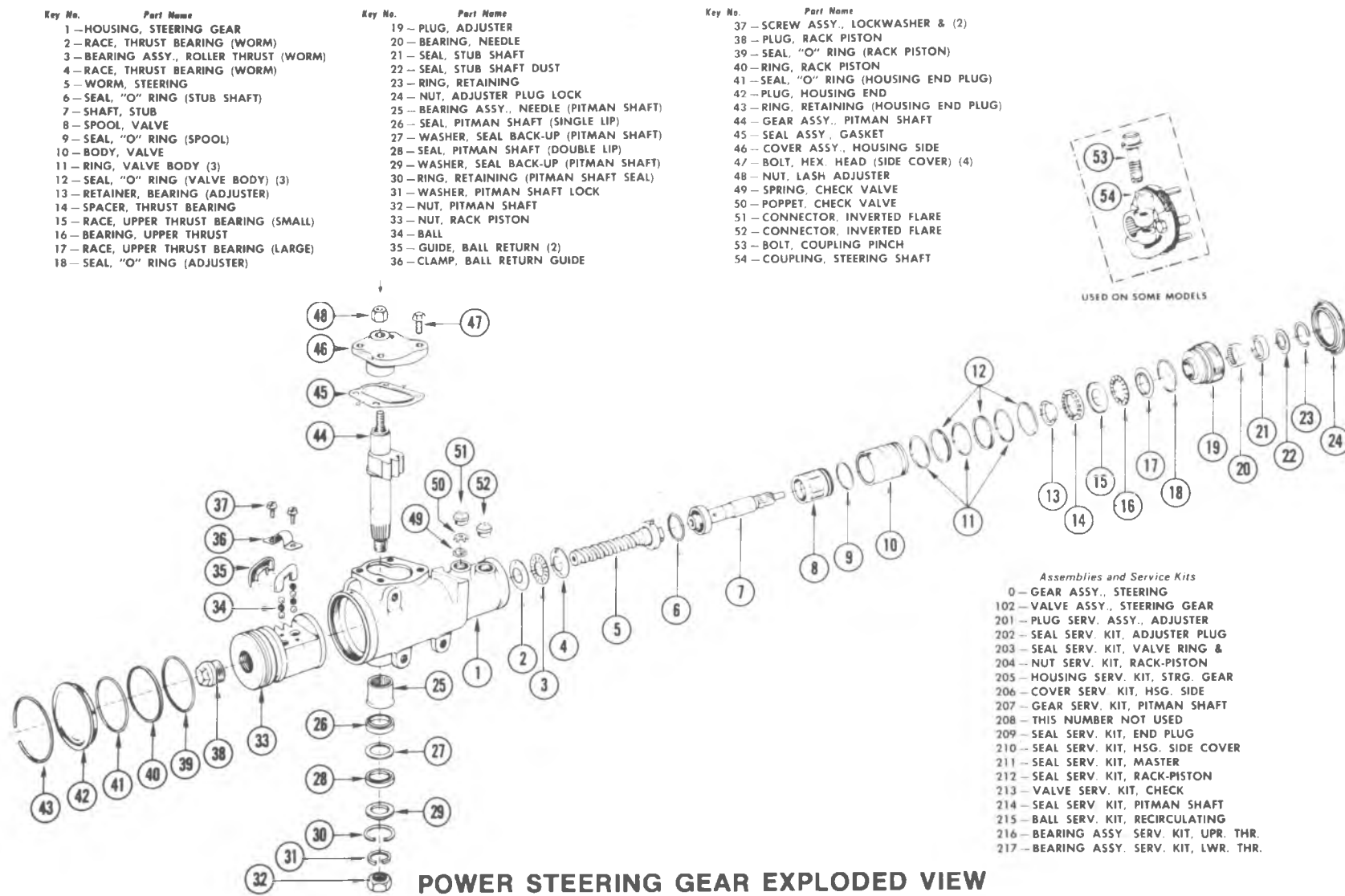
Round side cover held in place with retaining ring



**SMALL GEAR**  
(605 MODEL)



**NOTE:** Whenever a part which forms a sealing surface for an "O" ring is removed, the "O" ring seal should also be removed and replaced with a new seal. Whenever one of the Pitman shaft or stub shaft seals are removed all adjacent seals should be removed and replaced with new seals. Lubricate all new seals with power steering fluid to ease assembly.

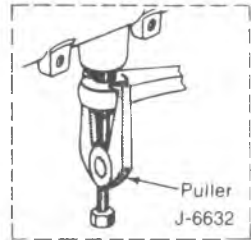


# 1. REMOVE AND INSTALL PITMAN SHAFT SEALS IN CAR

## REMOVE

1. Clean exposed end of pitman shaft and end of housing after removing arm.
2. Remove retaining ring with snap ring pliers J-4245.
3. Start engine and turn wheels fully to the left to force seals and washer out.
4. Turn off engine.
5. Inspect housing and shaft.

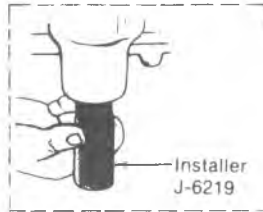
PITMAN SHAFT  
Inspect seal surface for roughness and pitting



Remove Pitman Arm

## INSTALL

1. Install parts as shown.
- HOUSING ASSEMBLY  
Inspect for burrs
- SEAL (SINGLE LIP)
- WASHER
- SEAL (DOUBLE LIP)
- WASHER
- RETAINING RING
- PITMAN ARM
- LOCK WASHER
- NUT-Torque to 250 N·m (180 Ft. Lbs.)

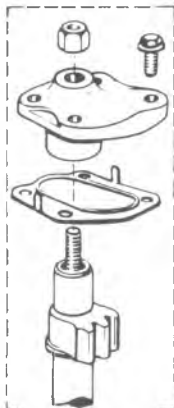


Install Seals

# 2. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

## REMOVE

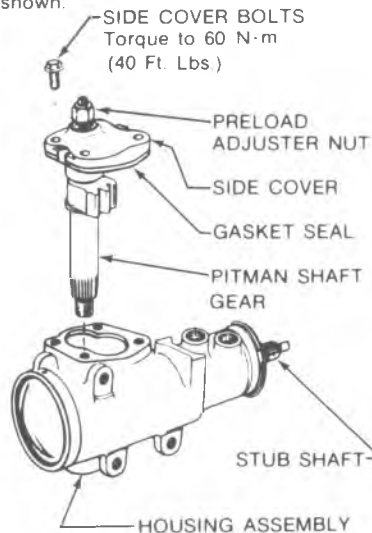
1. If pitman shaft and side cover are to be separated, remove preload adjuster nut.
2. Rotate stub shaft to center gear, then remove parts as shown.



Separate pitman shaft and gasket seal from side cover if required.

## INSTALL

1. If removed, install gasket seal by bending tabs around cover edges
2. Install parts as shown



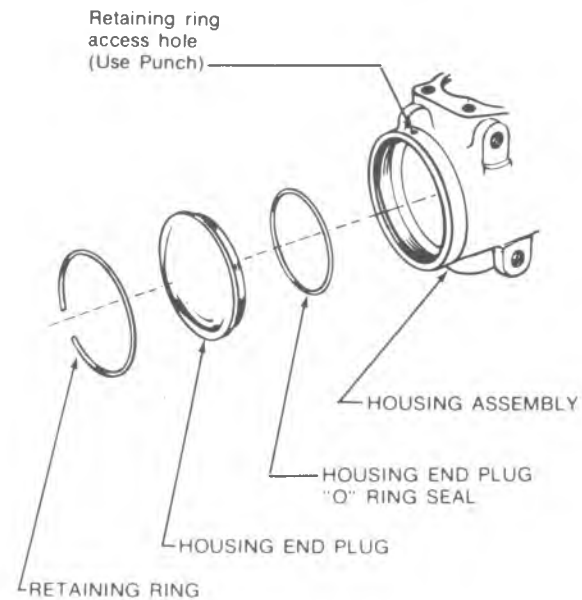
# 3. REMOVE AND INSTALL HOUSING END PLUG

## REMOVE

1. Remove parts as shown.

## INSTALL

1. Install parts as shown. Open end of retaining ring to be approx. 25 mm (1 inch) from access hole.



# 4. REMOVE AND INSTALL RACK PISTON

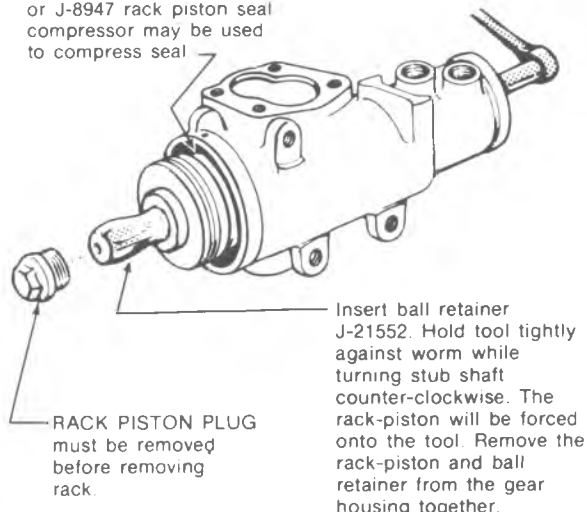
## REMOVE

1. Remove parts as shown

## INSTALL

1. Install parts as shown

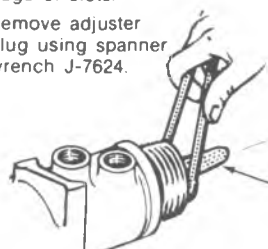
When installing rack, care should be taken not to cut teflon seal, J-7576 or J-8947 rack piston seal compressor may be used to compress seal



### 5. REMOVE AND INSTALL ADJUSTER PLUG ASSEMBLY

#### REMOVE

1. Loosen lock nut. Use punch against edge of slots.
2. Remove adjuster plug using spanner wrench J-7624.



#### INSTALL

1. Install parts as shown.

#### ADJUSTER PLUG



Use J-6222 stub shaft seal protector when installing adjuster plug.

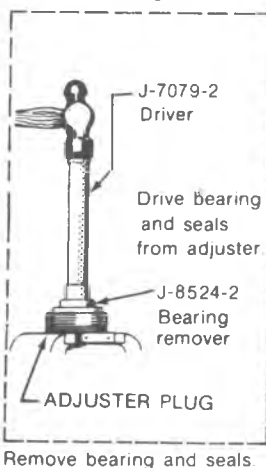
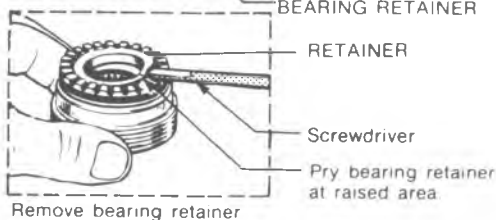
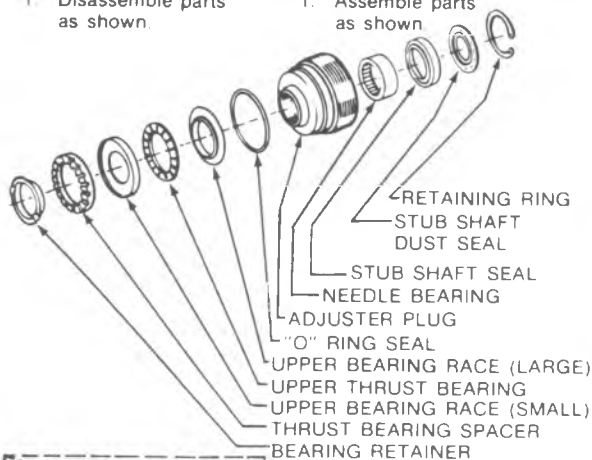
### 6. DISASSEMBLE AND ASSEMBLE ADJUSTER PLUG ASSEMBLY

#### DISASSEMBLE

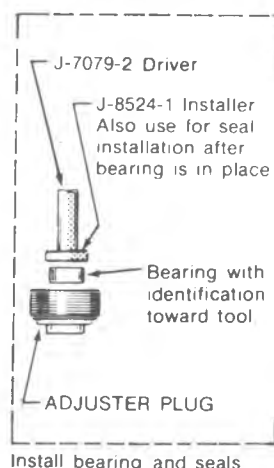
1. Disassemble parts as shown.

#### ASSEMBLE

1. Assemble parts as shown.



Remove bearing and seals.



Install bearing and seals

### 7. REMOVE AND INSTALL BEARING, WORM, AND VALVE ASSEMBLY

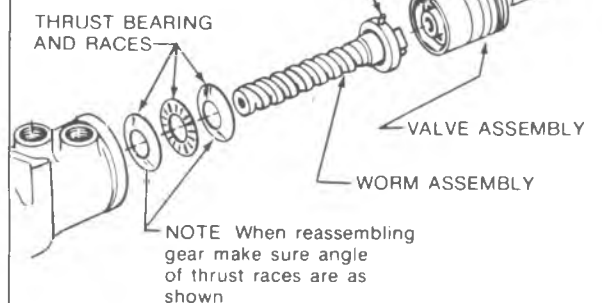
#### REMOVE

1. Grasp stub shaft and remove valve and worm assembly as a unit.

#### INSTALL

1. Install parts as shown.

Separate the valve from the worm. Note how the pin in the worm fits the slot in the valve.



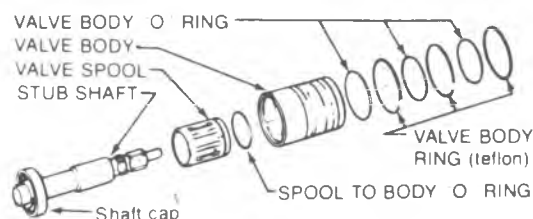
### 8. DISASSEMBLE AND ASSEMBLE VALVE

#### DISASSEMBLE

1. Disassemble parts as shown.

#### ASSEMBLE

2. Assemble parts as shown.



#### A. Loosen shaft cap



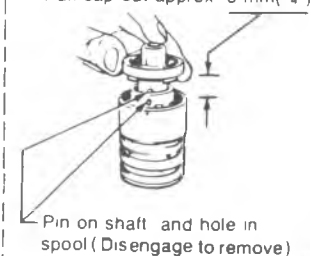
#### C. Remove and install spool



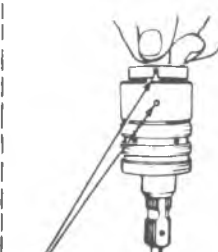
Lubricate spool and body with power steering fluid.

#### B. Remove and install stub shaft

Pull cap out approx 6 mm (1/4")



#### D. Engage stub shaft



Notch must fully engage pin and cap must seat against shoulder.

Fig. 3B-9C--Overhaul 800 and 808 Gears, Chart D

# 9. DISASSEMBLE AND ASSEMBLE RACK PISTON

## DISASSEMBLE

1. Disassemble parts as shown.
2. Clean and inspect all parts for excessive wear.

## ASSEMBLE

1. Assemble parts as shown.

NOTE: The black balls are smaller than the silver balls. The black and silver balls must be installed alternately into the rack-piston and return guide to maintain rack piston to worm gear preload.

TEFLON SEAL AND "O" RING—  
If replaced lubricate new seal and "O" ring with power steering fluid.

Turn worm until worm groove is aligned with the lower ball return guide hole.

WORM—Slide all the way into the rack-piston.

Lubricate balls with power steering fluid.

Before assembling rack in housing, ball retainer J-21552 must be inserted into rack to allow removal of worm.

Install balls, through ball return guide hole, while rotating worm counterclockwise.

GUIDE—Alternately install remainder of balls and retain with grease at each end of guide.

CLAMP

SCREW—Tighten to 5 N·m (4 Ft. Lbs.)

# 10. REMOVE AND INSTALL PITMAN SHAFT SEALS AND BEARING

## REMOVE

1. Clean end of housing thoroughly to prevent dirt from entering and be extremely careful not to score the housing bore.
2. Remove retaining ring with snap ring pliers J-4245.
3. Using screw driver, pry seals and washers from bore.

## INSTALL

1. Install parts as shown.

HOUSING ASSEMBLY

Inspect for burrs.

PITMAN SHAFT SEAL (SINGLE LIP)

PITMAN SHAFT SEAL (DOUBLE LIP)

RETAINING RING

SEAL BACK UP WASHER

NEEDLE BEARING

Remove only if it needs replacing.

J-6278

Removing bearing

J-8092

J-22407

When tool bottoms on housing bearing is fully installed.

Install Pitman shaft bearing

J-6219

Install Pitman shaft seals

Fig. 3B-10C—Overhaul 800 and 808 Gears, Chart E

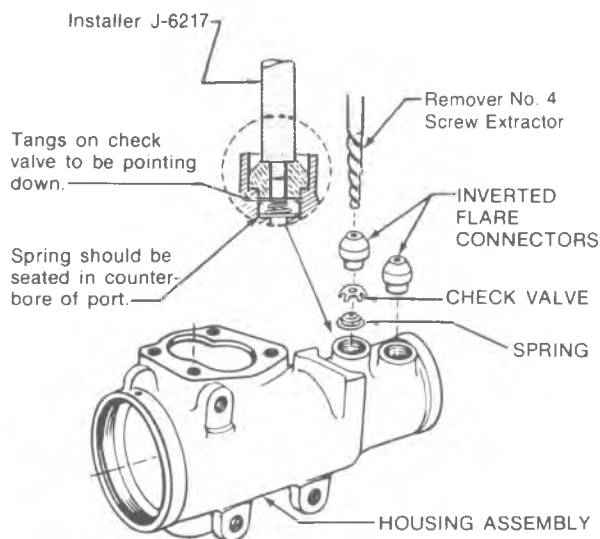
### 11. REMOVE AND INSTALL CONNECTORS & CHECK VALVE

#### REMOVE

1. Remove parts as shown

#### INSTALL

1. Install parts as shown

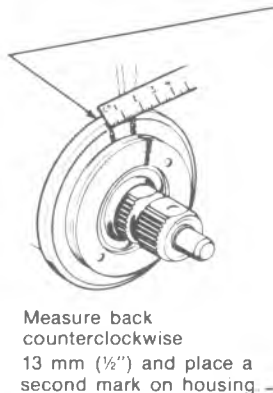


### 12. ADJUST WORM BEARING PRELOAD

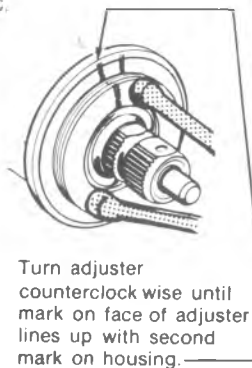
- A. Using spanner wrench J-7624, tighten adjuster plug until thrust bearing is firmly bottomed 27 N-m (20 ft. lbs.)



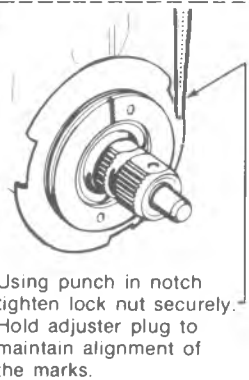
- B.



- C.

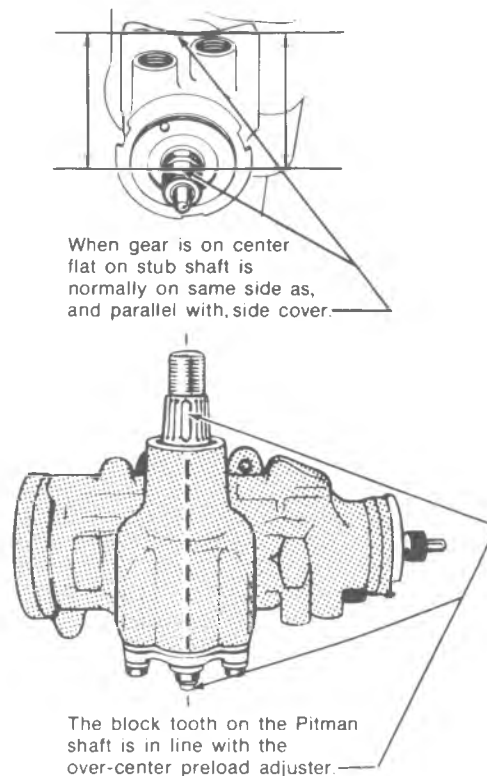


- D.

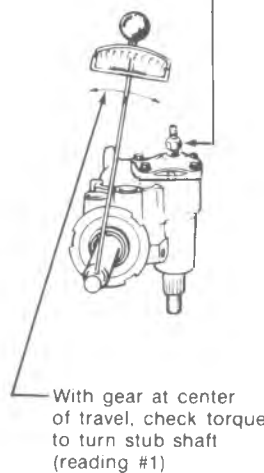


### 13. PITMAN SHAFT "OVER-CENTER" SECTOR ADJUSTMENT

- A.



- B. Back off preload adjuster until it stops, then turn it in one full turn.



- C. Turn adjuster in until torque to turn stub shaft is 0.6 to 1.2 N-m (6 to 10 in. lbs.) more than reading #1, but not to exceed 2 N-m (18 in. lbs.)

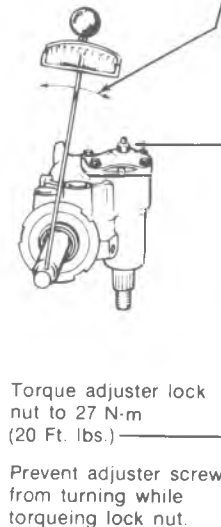


Fig. 3B-11C—Overhaul 800 and 808 Gears, Chart F



## RECOMMENDED TORQUE SPECIFICATIONS

	FOOT-POUNDS	NEWTON METRES
Gear to Frame Bolts .....	70	95
High Pressure Line Fitting (At Gear) .....	40	54
Oil Return Line Fitting (At Gear) .....	40	54
Pitman Shaft		
Adjusting Screw Locknut .....	35	48
Side Cover Bolts .....	45	61
Adjuster Plug Locknut .....	80	108
Coupling Flange Nuts .....	20	27
Return Guide Clamp Screws .....	4	5
Rack-Piston Plug .....	75	102
Pitman Shaft Nut .....	180	244
Coupling Flange Bolt .....	30	41

## SPECIAL TOOLS

J-21552 — Ball Retainer	J-6219 — Pitman Shaft Seal Installer
J-7624 — Spanner Wrench	J-6222 — Stub Shaft Seal Protector
J-7079-2 — Handle	J-8947 — Rack Piston Seal Compressor (70mm [2¾"] Piston Bore)
J-8524-2 — Adjuster Plug Bearing Remover	J-8058 — 0-50 Ft-Lb Torque Wrench
J-8524-1 — Adjuster Plug Bearing Installer	J-7754 — 0-25 In-Lb Torque Wrench
J-6217 — Connector Seat Installer	J-25323 — Power Steering Analyzer
J-8092 — Handle	J-7576 — Rack Piston Seal Compressor (79mm [3¼"] Piston Bore)
J-22407 — Pitman Shaft Bearing Installer	
J-6278 — Pitman Shaft Bearing Remover	

# CONTROL VALVE AND POWER CYLINDER-CORVETTE

## INDEX

Overhaul Control Valve.....	3B-25
Disassembly .....	3B-25
Inspection .....	3B-25
Repairs.....	3B-25
Assembly.....	3B-25
Valve Balancing.....	3B-26
Overhaul Power Cylinder.....	3B-27

## OVERHAUL CONTROL VALVE

### Disassembly

1. Place the valve in a vise as shown and remove dust cover (fig. 3B-1D).
2. Remove adjusting nut (fig. 3B-2D).
3. Remove valve to adapter bolts and remove valve housing and spool from adapter.
4. Remove spool from the housing (fig. 3B-3D).
5. Remove spring, reaction spool, washer reaction spring, spring retainer, and seal (fig. 3B-4D). "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 3B-5D).
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. 3B-6D).
8. Carefully, so as not to nick the top surface, turn adjuster plug out of sleeve (fig. 3B-7D).
9. Remove the adapter from the vise and invert, permitting the spring and one of the two ball seats to fall free.
10. Remove the ball stud and the other ball seat and the sleeve will fall free.

### Inspection

1. Wash all metal parts in nontoxic solvent and blow dry with compressed air.
2. Inspect all parts for scratches, burrs, distortion, evidence of wear and replace all worn or damaged parts,

including mating parts when necessary.

3. Replace all seals, gaskets, covers with approved service parts.

### Repairs

**NOTE:** The Corvette valve incorporates a 40 lb. centering spring. The Corvette valve incorporating this spring is identified by an "C" stamped on the dust cover.

In case a connector seat becomes damaged, proceed as follows:

To remove connector seat, tap threads in center hole using a 5/16-18 tap. Thread a bolt with nut and flat washer attached into tapped hole so that the washer rides against the face of the port boss and the nut rides against the washer. Hold the bolt from rotating while turning the nut off the bolt. This will force the washer against the port boss face and will back out the bolt thus drawing the connector seat from the top cover housing (fig. 3B-8D). 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. 3B-9D).

### Assembly (Fig. 3B-11D)

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. 3B-10D).

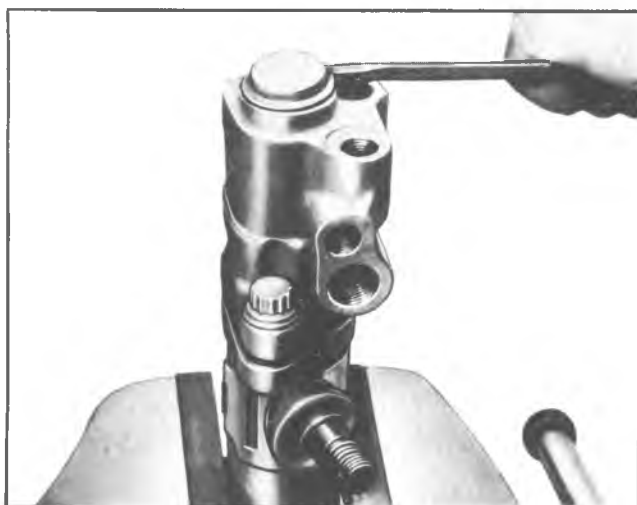


Fig. 3B-1D—Dust Cap Removal



Fig. 3B-2D—Removing Adjusting Nut



Fig. 3B-3D--Removing Spool from Housing

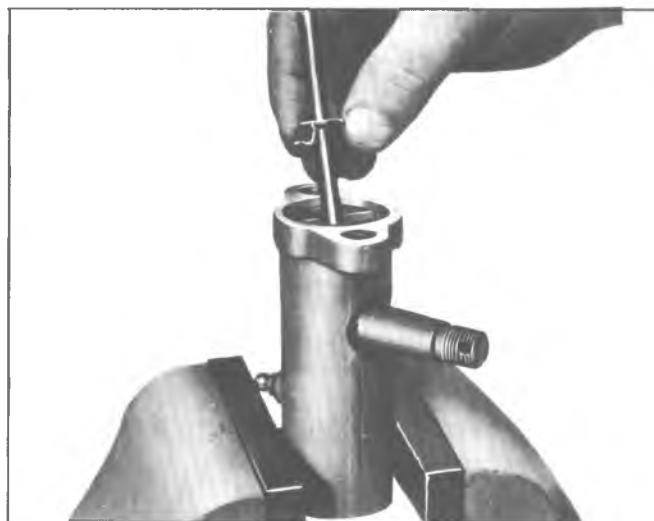


Fig. 3B-5D--Removing Plug-to-Sleeve Key

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. 3B-6D).

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. 3B-12D).

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 wrench or socket.

**NOTE:** Always use a new nut.

### Valve Balancing (Fig. 3B-13D)

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 3B-13D.

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. 3B-4D--Removing Valve Parts from Shaft

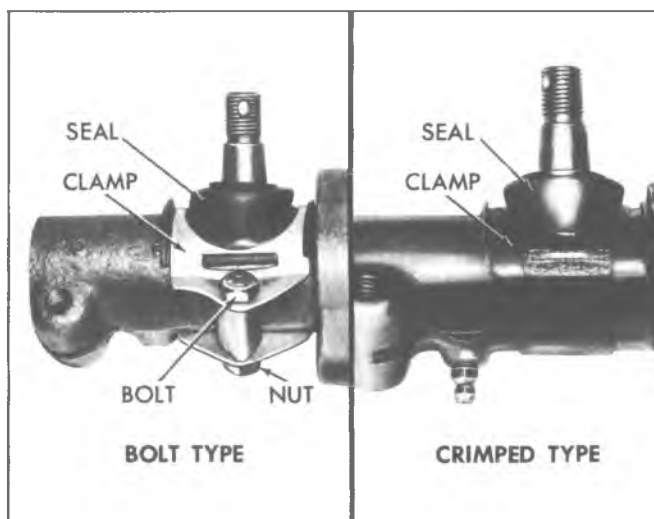


Fig. 3B-6D--Seal with Clamp Attachment

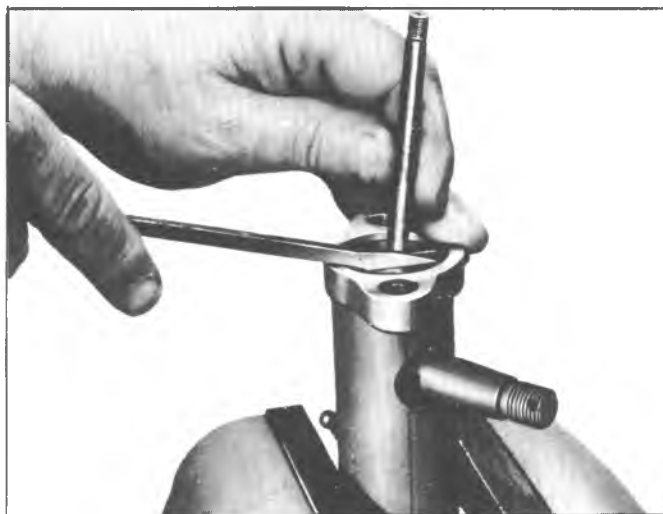


Fig. 3B-7D--Turning Adjuster Plug out of Sleeve

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.

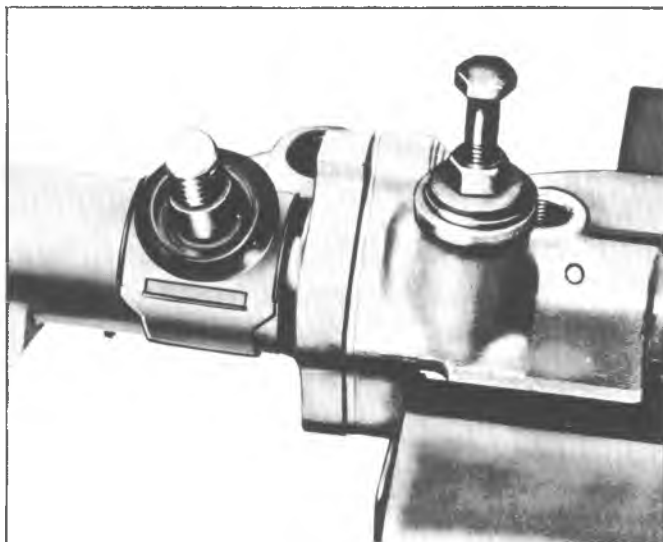


Fig. 3B-8D--Removing Connector Seat

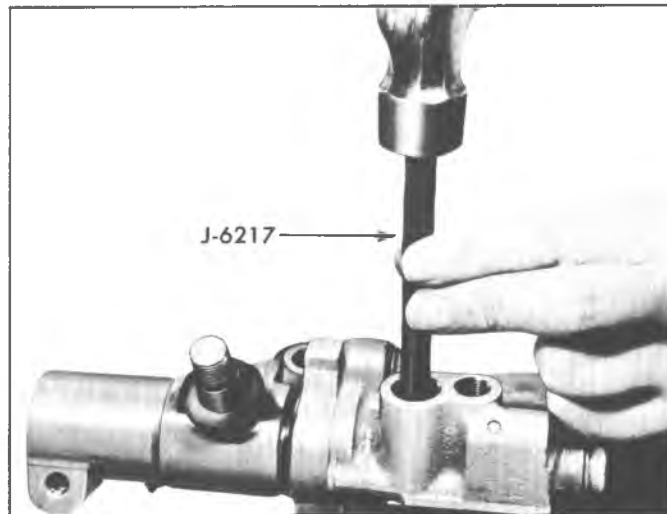


Fig. 3B-9D--Installing Connector Seat

## OVERHAUL POWER CYLINDER

### Disassembly (Fig. 3B-14D)

1. To remove the piston rod seal, remove the snap ring; then pull out on rod, being careful not to spray oil.

2. Remove the piston rod scraper and scraper element, back up washer and piston rod seal from the rod.

3. At the ball stud end of the cylinder, remove the ball stud seal.

4. Remove the snap ring retaining the end plug and lube fitting.

5. Push on the end of the ball stud and remove the end plug, spring, spring seat and ball stud.

6. Remove the "O" ring seal from the top lip of the power cylinder ball stud opening.

7. If the ball seat is to be replaced, it must be pressed out using Tool J-8937.

### Assembly

1. Reassemble the piston rod seal components by reversing the disassembly procedure. Apply power steering fluid on the inner surfaces of the seal and scraper before assembly.



Fig. 3B-10D--Replacing Adjuster Plug and Shaft

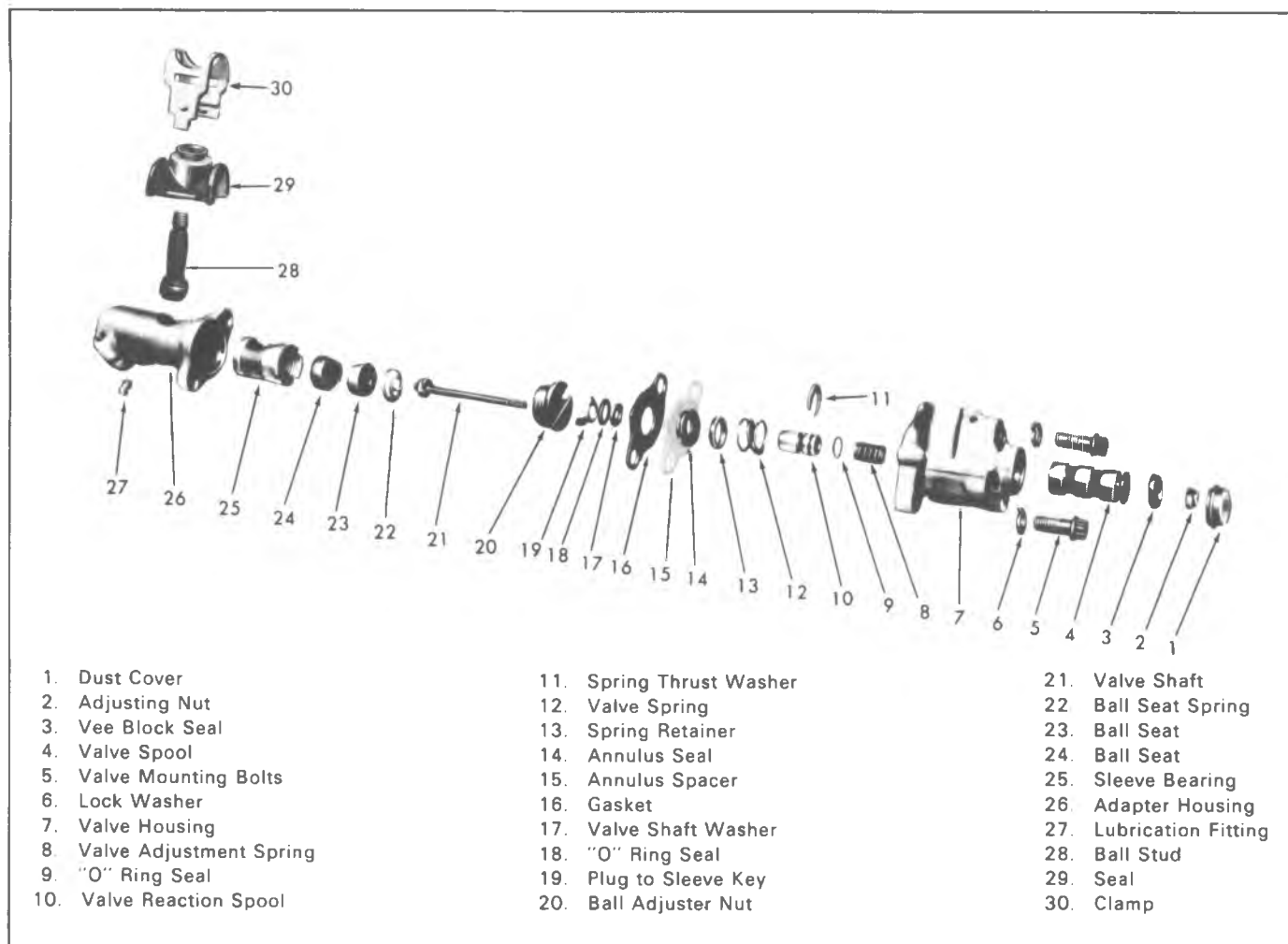


Fig. 3B-11D--Power Steering Control Valve and Adapter--Exploded

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.

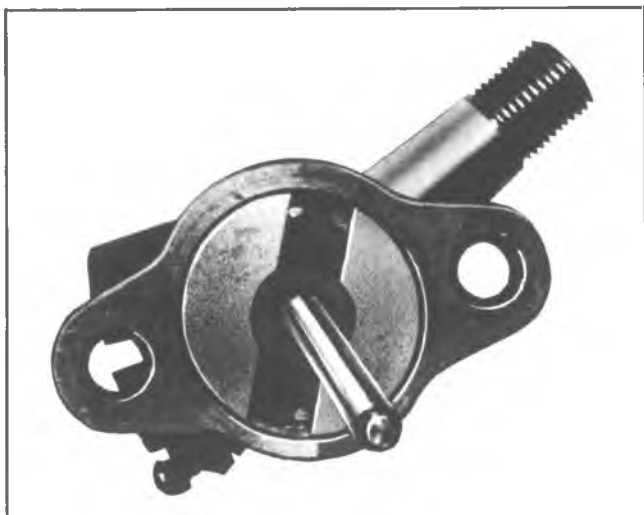


Fig. 3B-12D--Proper Key Installation

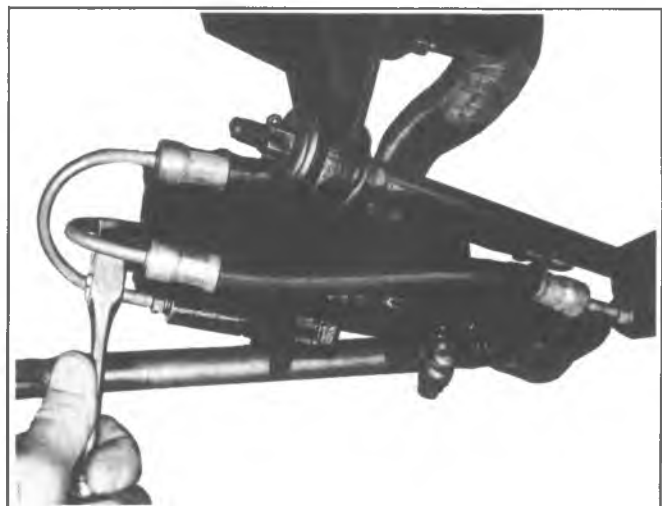


Fig. 3B-13D--Balancing Valve

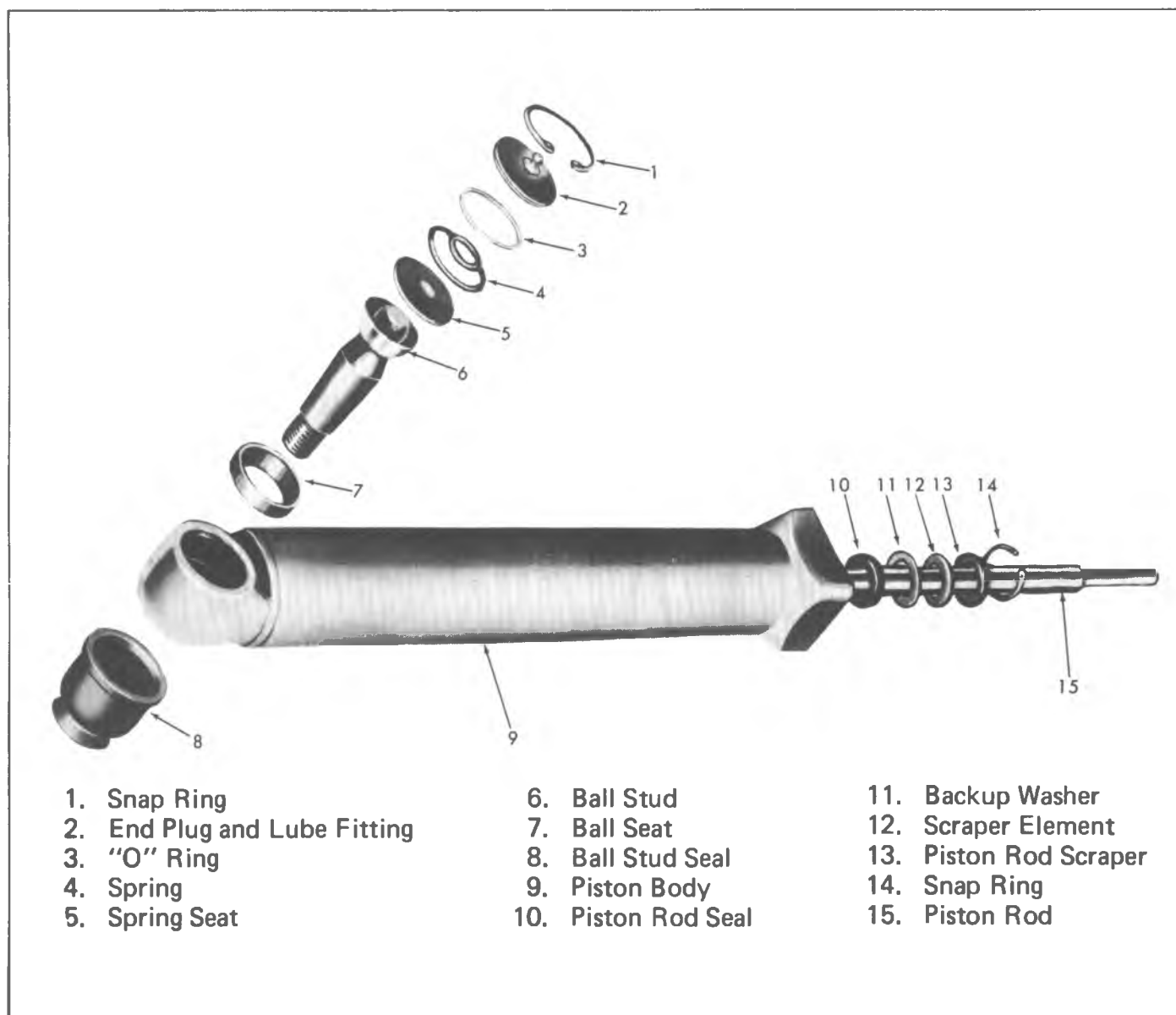


Fig. 3B-14D—Power Steering Power Cylinder Exploded

## SPECIAL TOOLS

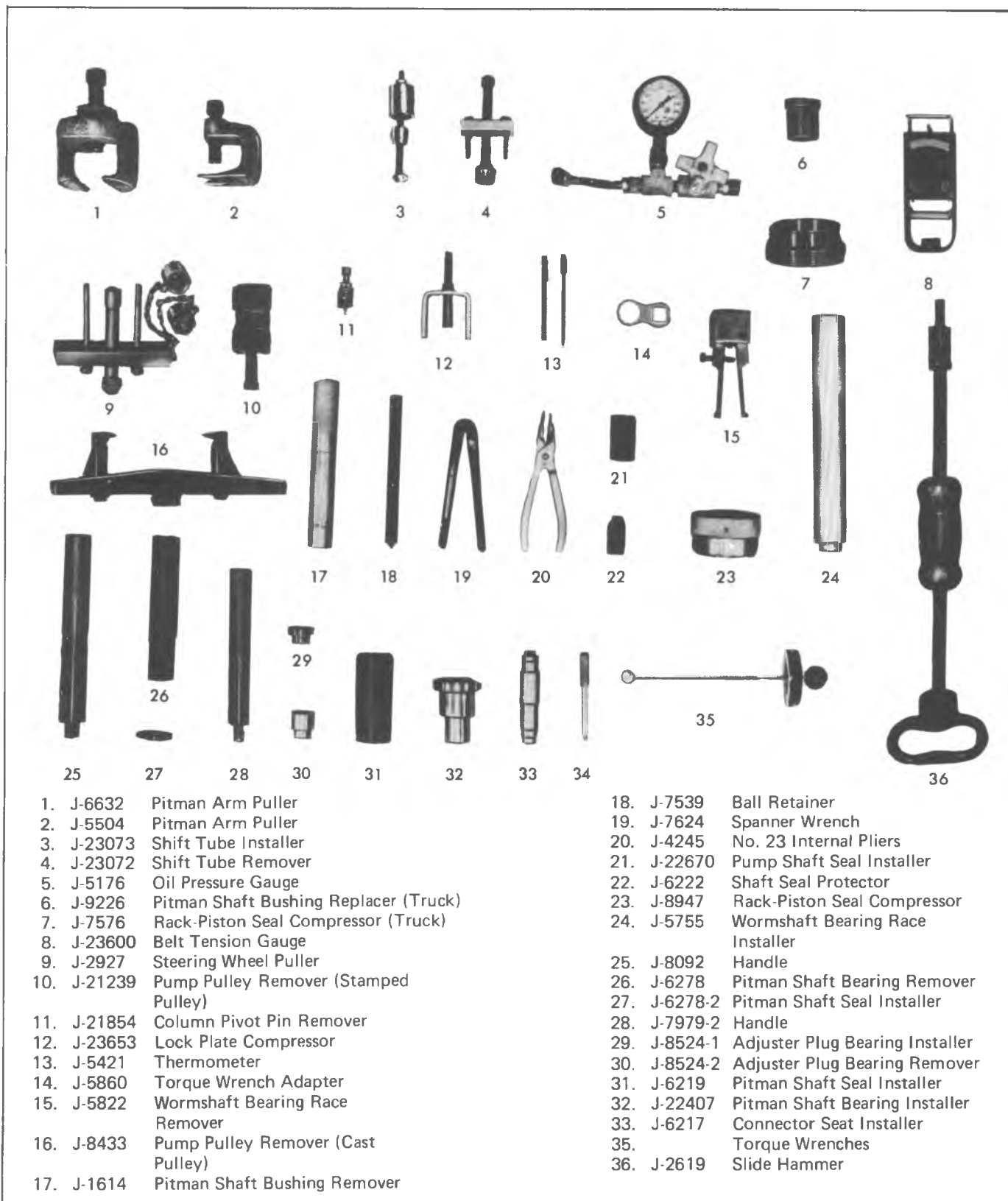


Fig. 3B-ST-Manual and Power Steering Special Tools



# SECTION 4B

## REAR AXLE DIFFERENTIAL CARRIER

### CONTENTS OF THIS SECTION

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7-1/2", 8-1/2 and 8-3/4" Ring Gear.....	4B-3	Truck - Chevrolet 12-1/4" Ring Gear.....	4B-54
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## GENERAL 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: 2HD B 8 218 1, the manufacturer could be determined from the third letter, B. Truck axles are identified in this section by ring gear size.

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

### ALTERNATE PINION DEPTH SETTING PROCEDURE

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

gears, on Corvette, and on truck models with 8-7/8 inch ring gears.

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

#### 8-1/2" Ring Gear - Passenger Car

1. Set up the tools as shown in figure 4B-3A.
2. Preload the dial indicator one half revolution, with the plunger off the gauge plate, and tighten in this position.
3. Rest the plunger on the low gauging surface, marked Y.
4. "Zero" the indicator on the highest spot of the gauging surface.
5. Swing the plunger off the plate and read the dial indicator. This reading is the required shim thickness for a nominal pinion.

6. If a pinion is coded +2, +1, -1, or -2, alter the shim thickness that many thousandths of an inch.

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

#### Corvette and 8-7/8" Ring Gear - Truck

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

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

VEHICLE SERIES	RING GEAR SIZE			
	8-1/2	8-3/4	7-1/2	8-3/8
CHEVROLET	X	X	X	
MALIBU EL CAMINO			X	
MONTE CARLO			X	
CAMARO	X			
NOVA	X			
CORVETTE				X

Fig. 4B-1A--Axle Usage Passenger Car

## 4B-2 REAR AXLE DIFFERENTIAL

MODEL	SOURCE	TYPE/CAPACITY	RING GEAR SIZE
C10	Chevrolet	Salisbury/3750#	8-7/8"
C10	Chevrolet	Salisbury/3750#	8-1/2"
K10	Chevrolet	Salisbury/3750#	8-7/8"
K10	Chevrolet	Salisbury/4000#	8-7/8"
P10	Chevrolet	Salisbury/3500#	8-7/8"
G10	Chevrolet	Salisbury/3500#	8-7/8"
G10	Chevrolet	Salisbury/3100#	8-1/2"

C20 (Except Crew Cab)	Chevrolet	Salisbury/5700#	10 1/2"
C20 (Crew Cab)	Chevrolet	Salisbury/7500#	10-1/2"
K20	Chevrolet	Salisbury/5700#	10-1/2"
P20	Chevrolet	Salisbury/5700#	10-1/2"
G20	Chevrolet	Salisbury/3500#	8-7/8"
G20	Chevrolet	Salisbury/3500#	8-1/2"

C30 K30 (Except Dual Wheel Camper)	Chevrolet	Salisbury/7500#	10-1/2"
C30 K30 (Dual Wheel Camper)	Dana	Salisbury/7500#	10-1/2"
P30	Chevrolet	Salisbury/7900#	10-1/2"
P30 (With H22/H23)	Chevrolet	Banjo/11,000#	12-1/4"
G30	Chevrolet	Salisbury/5700#	10-1/2"
G30 (Dual Wheel)	Dana	Salisbury/6200#	9-3/4"
G30 (Dual Wheel)	Dana	Salisbury/7500#	10 1/2"

Fig. 4B-2A--Axle Usage Truck

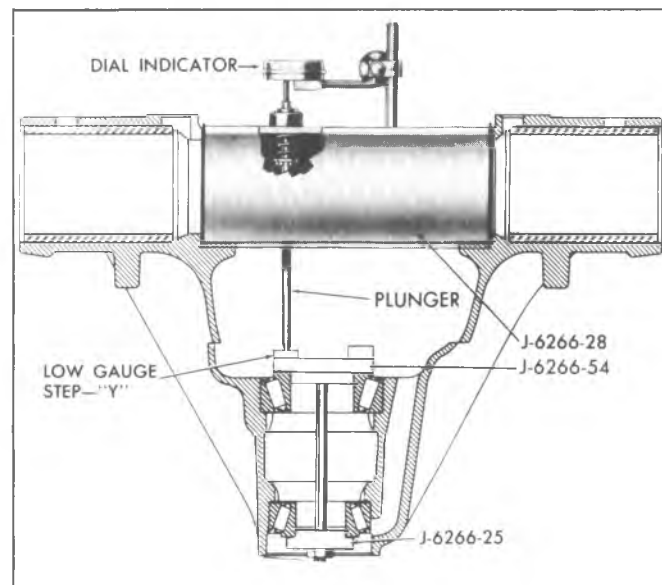


Fig. 4B-3A--Pinion Gauging Tools - 8 1/2" Ring Gear

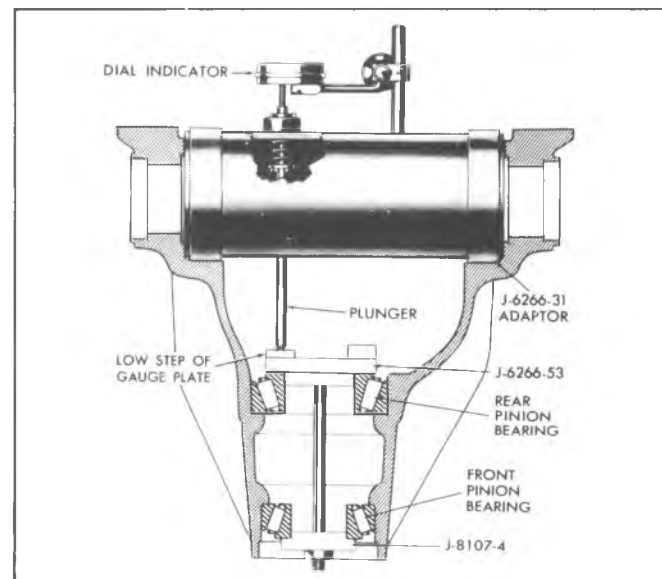


Fig. 4B-4A--Pinion Gauging Tools - Corvette

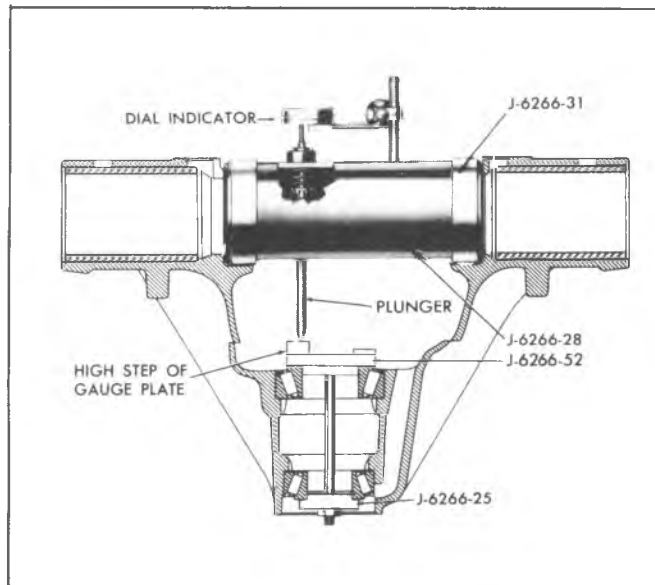


Fig. 4B-5A—Pinion Gauging Tools - 8-7/8" Truck

## 7-1/2", 8-1/2" and 8-3/4" RING GEAR

### INDEX

Differential Case .....	4B-3
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Inspection .....	4B-3
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### DIFFERENTIAL CASE

#### Removal and Disassembly

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

1. Remove screw that retains differential pinion shaft and remove pinion shaft.

2. Remove rear axle shaft.

3. Roll out the differential pinions and thrust washers; then remove side gears and thrust washers. Mark the pinions and side gears so they can be reassembled in their original positions.

4. Mark side bearing caps for installation in same position during reassembly. Loosen bolts holding differential side bearing caps to housing.

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

5. Using a pry bar as shown in figure 4B-2, pry differential case out of carrier. Exercise caution in prying on carrier so that gasket sealing surface is not damaged. If the bearings are preloaded, the case will suddenly fall free when it is pried past a certain point; therefore, make sure case is properly supported to prevent damage. The bearing cups may be loosely installed, as shown in figure 4B-2, to prevent case from falling.

6. Place right and left bearing outer races and shims in sets with marked bearing caps so that they can be reinstalled in their original positions.

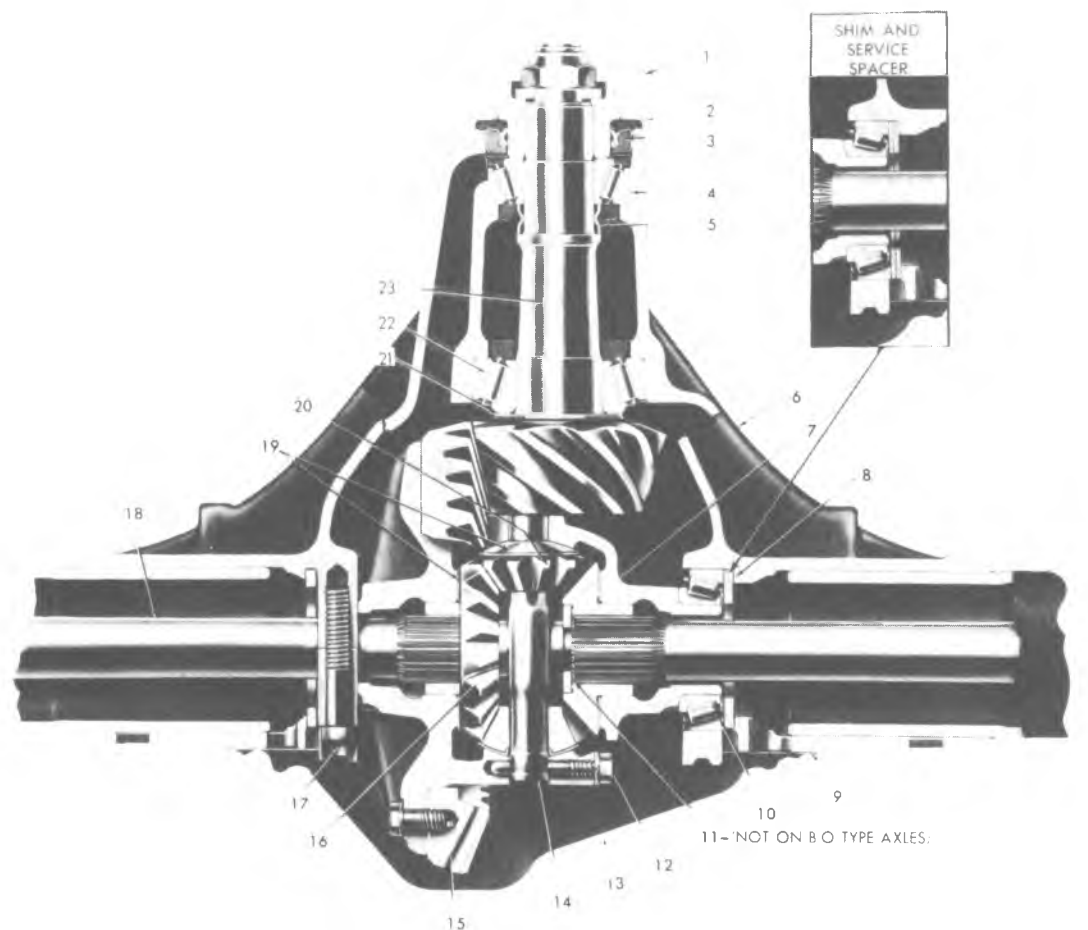
#### Inspection

1. Clean all parts in cleaning solvent; inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear.

2. Inspect axle shaft and side gear for evidence of excessive wear.

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

4. Inspect differential case, pinions, side gears, thrust



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

11 - NOT ON B O TYPE AXLES.

Fig. 4B-1--Cross Section of Typical Differential

washers and pinion shaft for cracks scoring, spalling or excessive wear.

5. Check fit of differential side gears in case.

### Differential Bearing Replacement

1. Install side bearing remover and proper adapter plug tool J-22888 shown in figure 4B-3. Make sure that the puller legs are fitted securely in case notches, against inner race.

2. Tighten puller screw to remove bearing.

3. Place new bearing onto hub, with the thick side of the inner race toward the case. Drive the bearing into place, using J-22761 for 8-1/2" ring gear, J-22175 for the 8-3/4" ring gear, or J-25299 for 7-1/2" ring gear, as shown in figure 4B-4.

4. Before bearing installation on opposite hub, support differential case on proper adapter plug. This allows differential case to rest on adapter plug instead of bearing

cage. Install other bearing as done in Step 3.

### Ring Gear or Differential Case Replacement

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

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

2. Remove any nicks or imbedded dirt from case flange surface which mates with ring gear. Clean all surfaces.

3. Liberally coat the differential case pilot with hypoid lubricant. Pre-align ring gear and differential case bolt holes and press against proper adapter plug to initially start ring gear on case pilot, as shown in figure 4B-5.

4. Start all ring gear bolts during initial assembly to maintain bolt hole alignment. Draw up all bolts evenly, using a criss-cross pattern to avoid cocking the gear on the

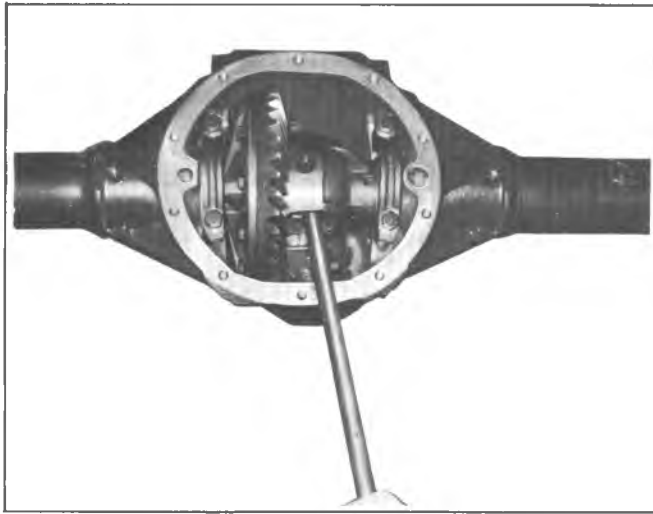


Fig. 4B-2--Differential Case Removal

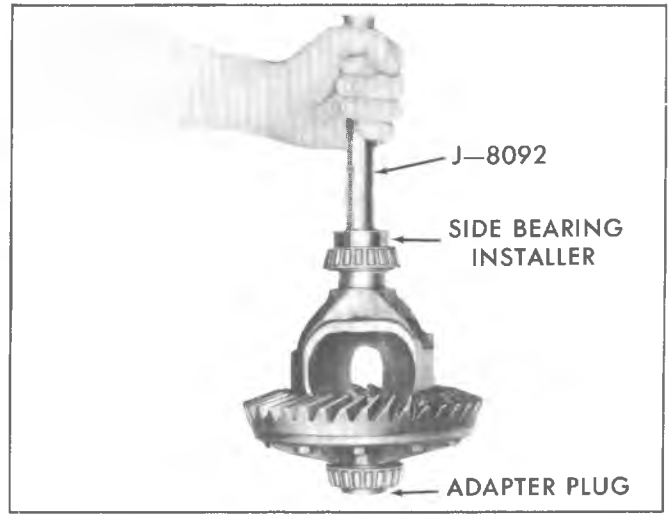


Fig. 4B-4--Differential Bearing Installation

case.

5. Insure that gear is seated firmly against the case, then torque all bolts to 50 lb. ft.

#### Reassembly

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

2. Position pinions and thrust washers through loading hole in case 180° apart so that they engage side gears.

3. Rotate gears until the differential pinion bores and the case shaft holes are aligned.

4. Install pinion shaft and lock screw. It is not necessary to torque lock screw until axle shafts are installed.

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

#### Installation and Adjustment

1. Check condition of bearing, bearing cups, cup seat in carrier and carrier caps to make sure that they are free from nicks, burrs and foreign material.

2. Lubricate bearings with axle lubricant; position cups on proper bearing, then install differential assembly in carrier and support the assembly to prevent it from falling.

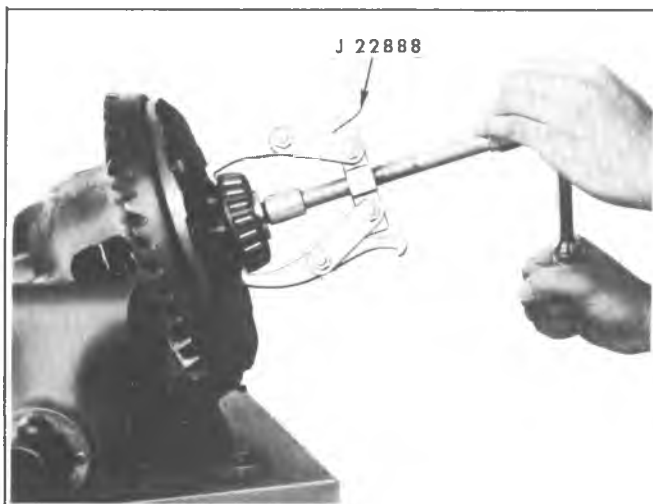


Fig. 4B-3--Differential Side Bearing Removal

3. For 8-1/2" and 8-3/4" ring gear:

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

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 4B-6.

While oscillating tool, turn adjusting nut clockwise until a noticeable drag is produced.

Tighten lock bolt on side of tool.

b. For 7-1/2" ring gear:

Position the ring gear tightly against the drive pinion (zero backlash). Being sure that the bearings are properly seated, install a Service Spacer A (.160 inch), Service Shim B and Feeler Gauge C, as shown in the ring gear side of Figure 4B-7. The thickness of the Feeler Gauge must be sufficient to produce a slight "drag" when moved between the carrier and the Service Shim.

4. Between the right bearing and carrier, install Service Spacer A (.170 for the 8-1/2" and 8-3/4" ring gear, .160

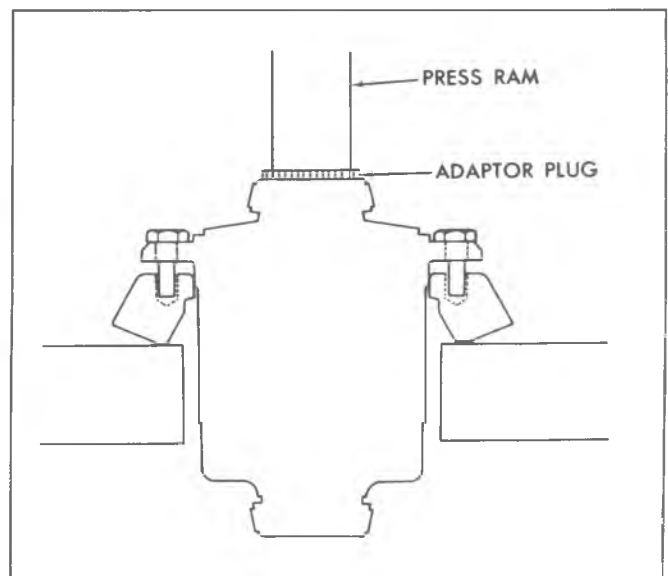


Fig. 4B-5--Ring Gear to Case Installation

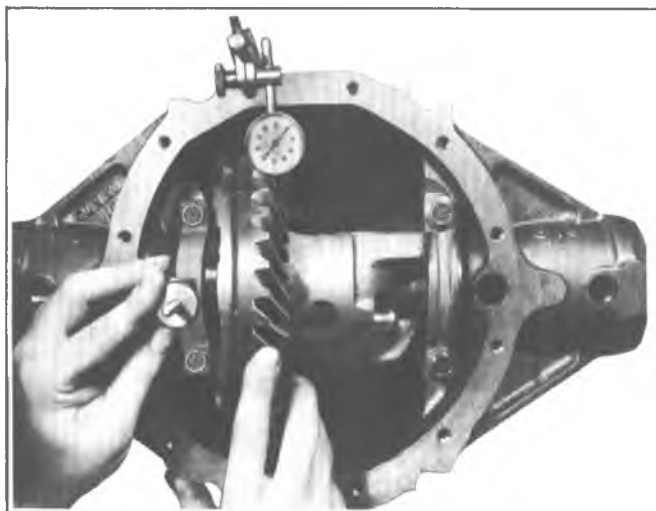


Fig. 4B-6--Installing Gauging Tool

for the 7-1/2" ring gear, 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. Now measure the above dimensions as shown in Figure 4B-8, for 8-1/2" and 8-3/4" ring gear, figure 4B-7 for the 7-1/2" ring gear.

5. For the 8-1/2" and 8-3/4" ring gear: Using a micrometer as in Figure 4B-9, measure the thickness of J-22779 in a minimum of three places and average these readings. Record the result.

Add together the dimensions of the Service Shim, Service Spacer and Feeler Gauge. Record the result.

For the 7-1/2" ring gear: Add together the dimensions of the Service Shim, Service Spacer and Feeler Gauge. Record the result for each side.

6. Use the sample procedure in Figure 4B-8 for the 8-1/2" and 8-3/4" ring gear, Figure 4B-7 for the 7-1/2" ring gear to determine the proper thickness for each shim pack.

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

For proper bearing preload, the shims must not be installed loosely, nor should they require undue force for installation.

7. 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.

8. If difficulty is encountered in installing shim, partially remove case slide case and shim into position. Tap shim into position, using soft faced hammer, while rotating differential case with free hand. See Figure 4B-10.

9. Install bearing caps in original position and torque to 60 ft. lbs. for the 8-1/2" and 8-3/4" ring gear, 55 ft. lbs. for the 7-1/2" ring gear.

**NOTE:** At this point, the differential side bearings are properly preloaded. If any adjustments are required in

later procedures, make sure that preload remains established. If backlash is changed, be sure that total thickness of two shim packs does not change.

10. Mount a dial indicator on the carrier and check the backlash between the ring gear and pinion, as shown in Figure 4B-11. 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 .002".

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

11. If variation in backlash readings exceeds .002", measure ring gear and case runout as shown in Figure 4B-12. Gear runout should not exceed .003", should runout exceed this limit check ring gear and case for deformation and/or foreign matter between case and gear.

12. If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of other shim the same amount. Total shim thickness must be maintained at all times to maintain proper preload.

13. Backlash changes approximately .002" for each .003" change in shim dimensions. If backlash exceeds .008", increase the shim thickness on ring gear side, while decreasing shim thickness on opposite side an equal amount. If backlash is less than .005", decrease the shim thickness on ring gear side, while increasing shim thickness on opposite side an equal amount.

## DRIVE PINION

### Removal

1. Remove differential as previously outlined.

2. Check torque required to rotate drive pinion as described under "Drive Pinion - Installation and Adjustment". If there is no torque reading, check for looseness of pinion assembly by shaking (push-pull) the companion flange. Looseness indicates the need for bearing replacement.

3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 4B-13. Position J-8614-11 on flange so that the four notches are toward the flange.

4. Remove pinion nut and washer.

5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 4B-14.

6. To remove the drive pinion, first thread the original pinion nut half-way on the pinion, for thread protection.

7. Place the differential cover temporarily back onto the housing, using two screws. This will prevent the pinion from falling to the floor during removal.

8. Tap the end of the pinion nut with a large hammer and a soft drift, as shown in figure 4B-15.

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

9. Remove the pinion oil seal and the front pinion bearing. Remove the cover and retrieve the drive pinion

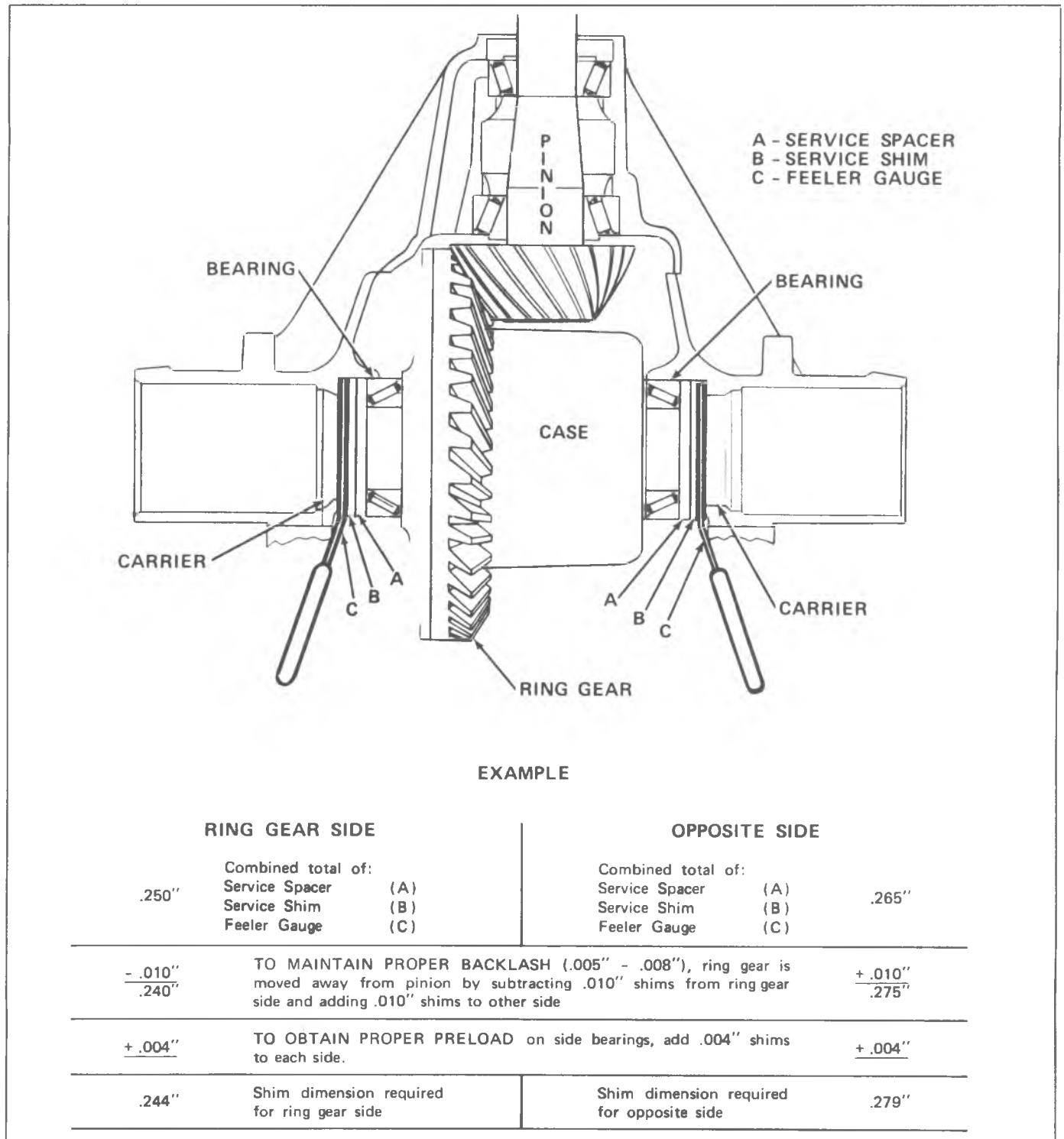


Fig. 4B-7--Determining Side Bearing Shim Requirements 7-1/2"

from the housing. Discard the pinion oil seal, nut and collapsible spacer. Use a new seal, nut and spacer on reassembly.

### Bearing Removal and Cup Replacement

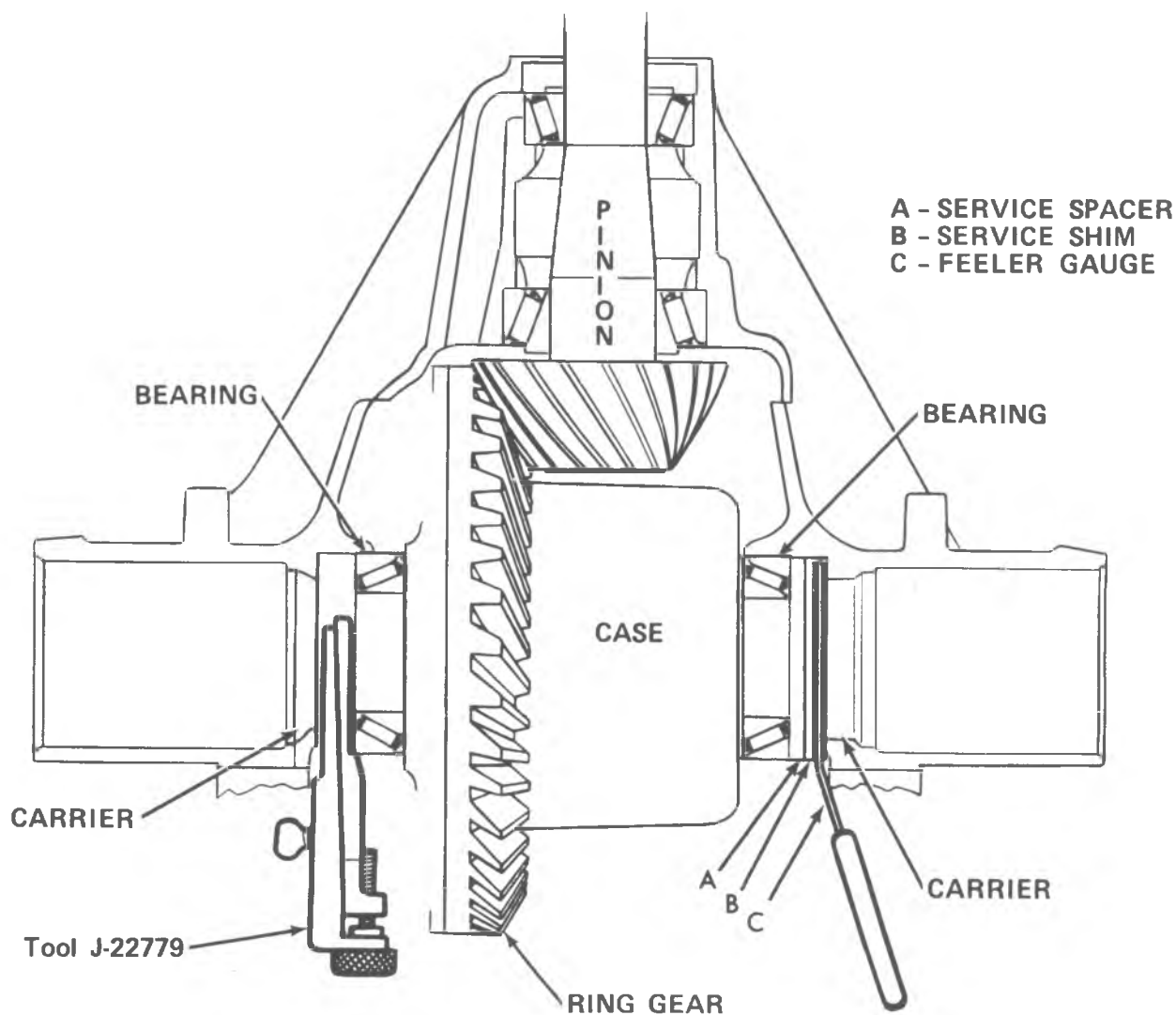
1. If front pinion bearing is to be replaced, drive outer race from carrier using drift in slots provided for this purpose. Tap alternately on opposite sides of bearing cup to avoid cocking.

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

3. Remove rear pinion bearing from pinion shaft using rear pinion bearing remover J-8612 for the 8-1/2" ring gear, J-9746-02 for the 8-3/4" ring gear, and J-21493-01 for the 7-1/2" ring gear. See figure 4B-16.

Tighten nuts on tool until plates are under the bearing inner race. Then, set tool on press. Make sure the plates





### EXAMPLE

#### RING GEAR SIDE

.250"

Thickness of Tool J-22779 required to force ring gear into contact with pinion

$-.010''$   
 $\underline{.240''}$

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

$+.004''$

TO OBTAIN PROPER PRELOAD on side bearings, add .004" shims to each side.

.244"

Shim dimension required for ring gear side

#### OPPOSITE SIDE

Combined total of:

Service Spacer (A)  
 Service Shim (B)  
 Feeler Gauge (C)

.265"

$+.010''$   
 $\underline{.275''}$

$+.004''$

.279"

Shim dimension required for opposite side

Fig. 4B-8--Side Bearing Shim Requirements 8-1/2" and 8-3/4"



Fig. 4B-9--Measuring Gauge Thickness

straddle opening on press. Do not position bolts across opening. To do so may bend the bolts when pressure is applied. Press bearing from pinion. Record thickness of shim removed from between bearing and pinion head.

4. Inspect carrier pinion bearing bores and shoulders for nicks. Remove as necessary. Clean the bores and the installation tools.

5. Lubricate both outer cups with liberal amounts of hypoid lubricant.

6. Install the rear cup, with the large end against the bore shoulder, using Rear Pinion Bearing Cup Installer J-8608 for the 8-1/2" ring gear, J-9745 for the 8-3/4" ring gear and J-6197 for the 7-1/2" ring gear, as shown in figure 4B-17.

7. Install the front cup, with the large end against the bore shoulder, using Installer J-8611-01 for the 8-1/2" and 8-3/4" ring gear and J-7817 for the 7-1/2" ring gear as shown in figure 4B-18.

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



Fig. 4B-10--Installing Differential Shim

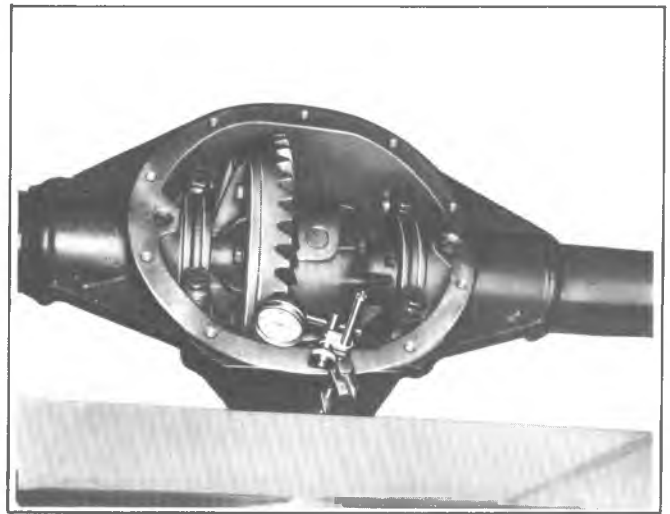


Fig. 4B-11--Checking Ring Gear Backlash

### Setting Pinion Depth and Installing Pinion Bearings

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

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or "nominal" setting due to allowable variation in machining the parts. When a pinion is found having a plus or minus reading recorded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.

In order to compensate for all of the allowable machining variables, a procedure of gauging the carrier and shimming the pinion has been developed. After gauging a carrier, the assembler must install the appropriate shim

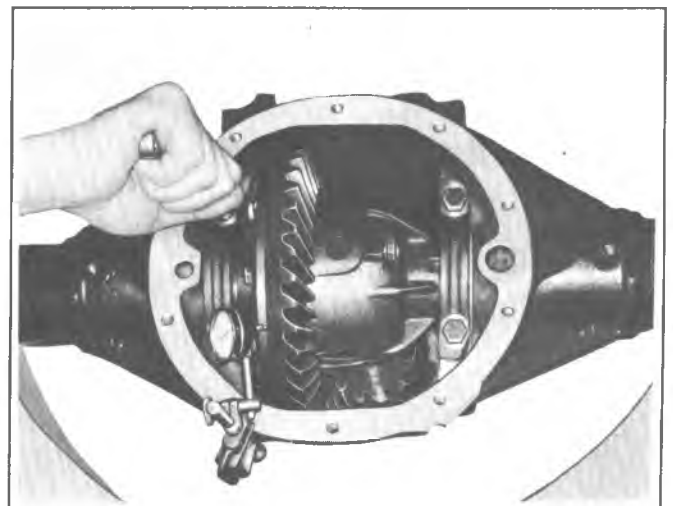


Fig. 4B-12--Checking Ring Gear Runout

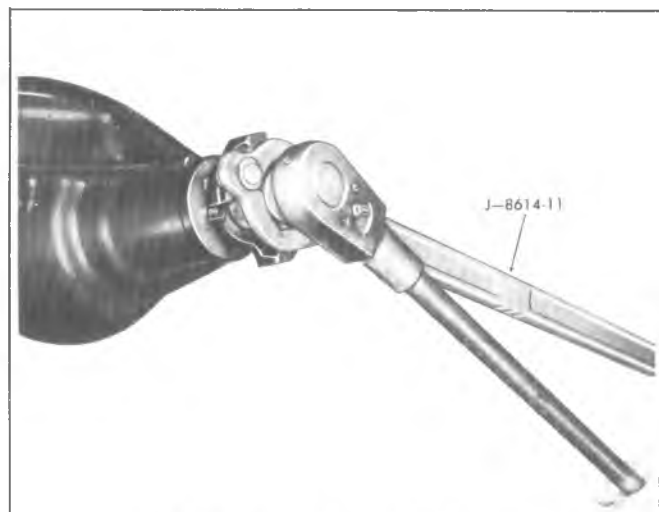


Fig. 4B-13--Drive Pinion Nut Removal

between the drive pinion shoulder and rear bearing so that pinion depth can be adjusted to the required position for best tooth contact in each axle assembly.

Proper pinion depth is determined with Pinion Setting Gauge J-21777-01 for the 8-1/2" and 8-3/4" ring gear, gauge J-23597-01 for the 7-1/2" ring gear.

1. Clean the housing assembly and all gauge parts to insure accurate measurements.

2. Lubricate front and rear pinion bearings which will be used in final assembly and position them in their respective races in the carrier.

3. Position gauge plate J-21777-29 on preload stud J-21777-43 (8-1/2" and 8-3/4" ring gear) J-23597-11 on preload stud J-21777-43 (7-1/2" ring gear), insert stud through rear bearing and pilot J-21777-35 (8-1/2" and 8-3/4" ring gear) J-23597-12 (7-1/2" ring gear) and through front bearing and pilot J-21777-42. Insert the hex nut until snug and rotate the bearings to make sure they are properly seated. See figure 4B-19 for illustration of proper positioning.

4. Hold the preload stud stationary with a wrench on the flats and tighten hex nut until 20 in. lbs. of torque are

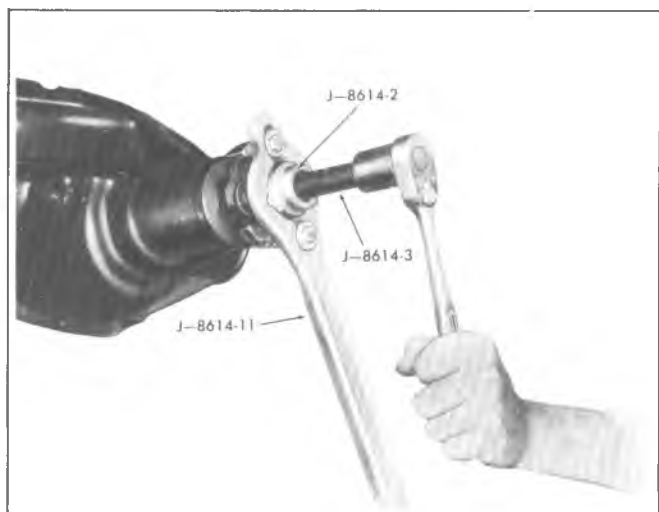


Fig. 4B-14--Drive Pinion Flange Removal

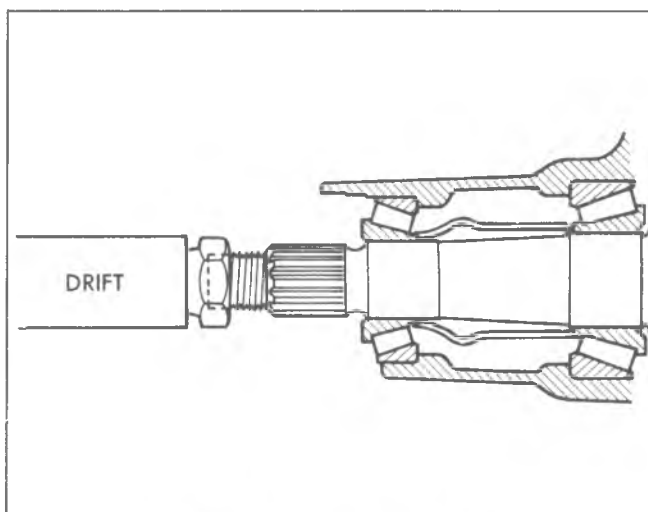


Fig. 4B-15--Removing Drive Pinion

required to rotate the bearings as shown in figure 4B-20.

5. Mount the side bearing discs J-21777-45 on the ends of arbor J-21777-1 (8-1/2" and 8-3/4" ring gear). Side bearing discs J-21777-45 on the ends of arbor J-23597-1 (7-1/2" ring gear), using the step of the disc that corresponds to the base of the carrier.

6. Place the arbor and plunger assembly into the carrier, being sure the side bearing discs are seated properly.

7. Install the bearing caps finger tight to prevent the discs from moving.

8. Position dial indicator J-8001 on the mounting post of the arbor with the contact button resting on the top surface of the plunger.

9. Preload the dial indicator one half revolution and tighten in this position.

10. Place the plunger onto the gauge plate. For 8-1/2" and 8-3/4" ring gear select the button on the gauge plate that corresponds to the ring gear size and rotate the plate until the plunger rests directly upon that button.

11. Rock the plunger rod slowly back and forth across the button until the dial indicator reads the greatest deflection. At this point, set the dial indicator to zero. Tools

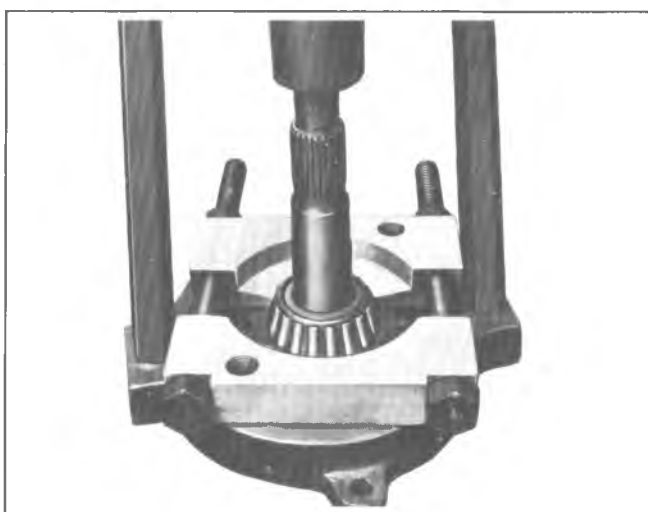


Fig. 4B-16--Removing Drive Pinion Rear Bearing Typical

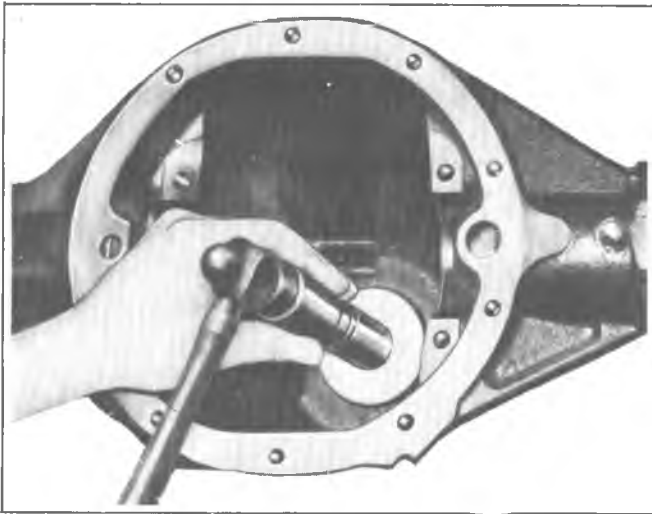


Fig. 4B-17--Installing Pinion Rear Bearing Cup

will now be positioned as shown in figure 4B-21.

**NOTE:** Select the gauging button that corresponds to the ring gear size for the 8-1/2" and 8-3/4" ring gear. The 8-7/8" button should be used for the 8-3/4" ring gear.

It is important to use a dial indicator correctly when determining pinion depth requirements. Be sure to record the number indicated by the indicator needle; do not record the amount of travel of the needle.

After "zeroing" the dial indicator on the highest point of deflection on the gauge plate, the indicator probe is swung off the gauge plate, allowing the needle to move. The number which the needle points toward is the correct shim thickness required for a nominal pinion. See figure 4B-22.

12. Repeat the rocking action of the plunger several times to verify the setting.

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

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

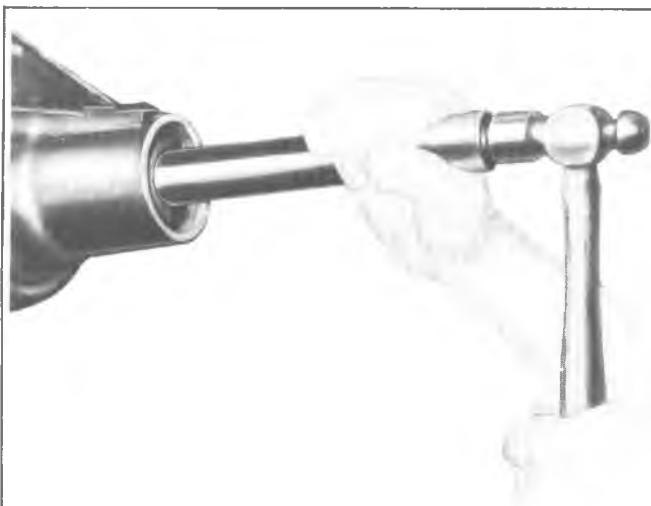


Fig. 4B-18--Installing Pinion Front Bearing Cup

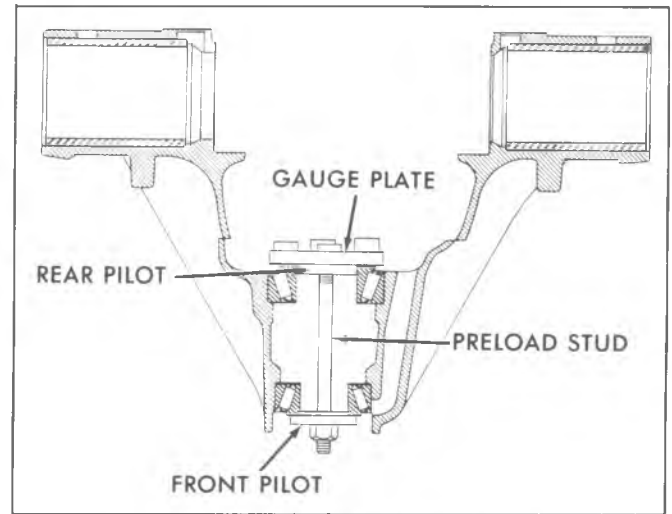


Fig. 4B-19--Gauge Plate Installed

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

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

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

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

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

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

17. Lubricate the rear pinion bearing with liberal amounts of hypoid lubricant and install rear bearing onto

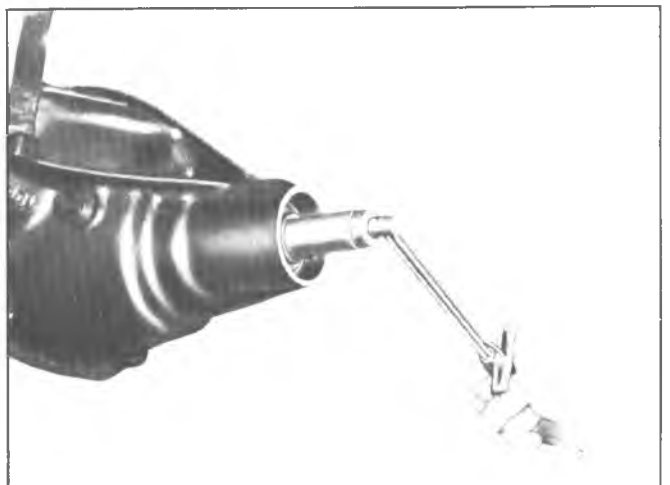


Fig. 4B-20--Measuring Rotating Torque

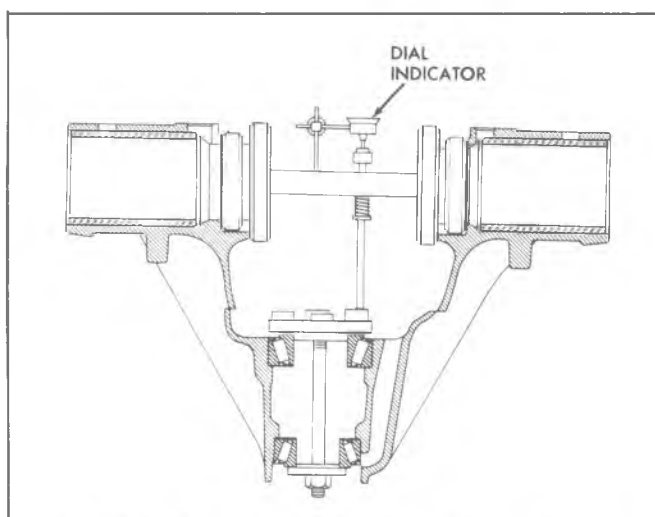


Fig. 4B-21—Depth Gauge Installed in Position Typical

pinion using J-8609-01 (8-1/2" and 8-3/4" ring gear) J-21022-02 (7-1/2" ring gear) as shown in figure 4B-23.

### Installation and Adjustment

1. Lubricate the front bearing with liberal amounts of hypoid lubricant, and place into outer cup.
2. Place a new pinion oil seal into position in carrier bore. Tap lightly with a protective plate and a hammer until seal flange seats against carrier, as shown in figure 4B-24.
3. Coat lips of pinion oil seal and seal surface of pinion flange with gear lube.
4. Install a new pinion bearing spacer onto the drive pinion.
5. Remove nut and sleeve from Companion Flange Installer J-9458. Screw J-9458 onto drive pinion and insert assembly into housing.
6. Position companion flange onto drive pinion. Install sleeve and nut onto J-9458.
7. Install Companion Flange Holding Tool J-8614-11. See Figure 4B-25.
8. 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-8614-11 will no longer pivot freely as pinion is rotated, bearing preload specifications are being neared. Further tightening should be done only after nut and washer installation and preload has been checked with a torque wrench.

9. Lubricate cavity between end of pinion splines and pinion flange with a non-hardening sealer (such as Permatex Type A or equivalent) and install washer. Lubricate new nut threads with a liberal amount of hypoid lubricant, and install on pinion snugly.

10. Check preload by using an inch pound torque wrench such as J-5853 as shown in Figure 4B-26.

**NOTE:** After torque has been checked, final tightening should be done very cautiously. For example, if when checking, torque was found to be 5 inch pounds,

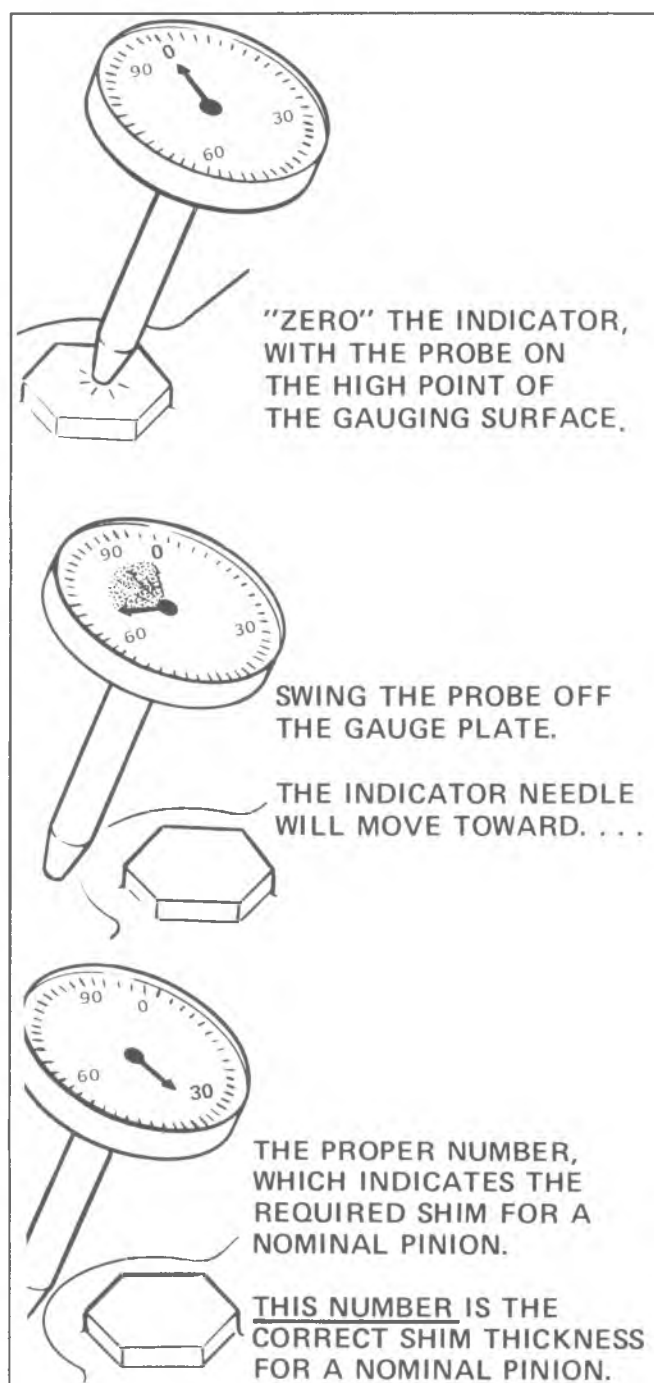


Fig. 4B-22—Use of Dial Indicator

additional tightening of the pinion nut as little as 1/8 turn can add 5 additional inch pounds drag. Therefore, the pinion nut should be further tightened only a little at a time and torque should be checked after each slight amount of tightening. Exceeding torque specifications may compress the collapsible spacer too far and require its replacement.

11. While observing the preceding caution, carefully set preload drag at 20-25 in lb. on new bearings or 10-15 in lb. on reused bearings.

12. Rotate pinion several times to assure that bearings have been seated. Check preload again. If drag has been reduced by rotating pinion, re-set preload to specification.

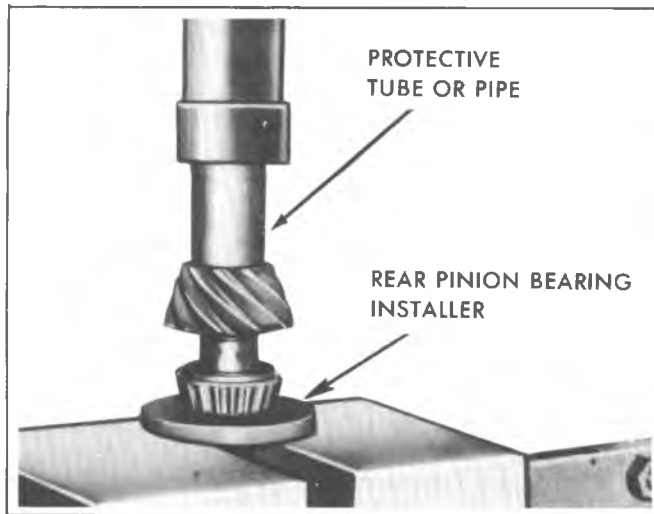


Fig. 4B-23--Drive Pinion Rear Bearing Installation

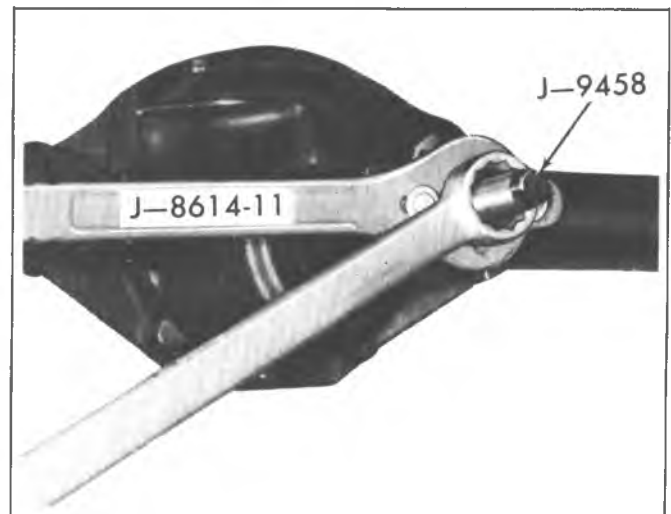


Fig. 4B-25--Drive Pinion Flange Installation

## CHECKS AND ADJUSTMENTS

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

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

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

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

## Gear Tooth Contact Pattern Check

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have

short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

## Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 4B-27.

## 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. (47 lb. ft. for B-type axles).
4. Expand brake shoes until a torque of 20-30 lb. ft. is required to turn the pinion.

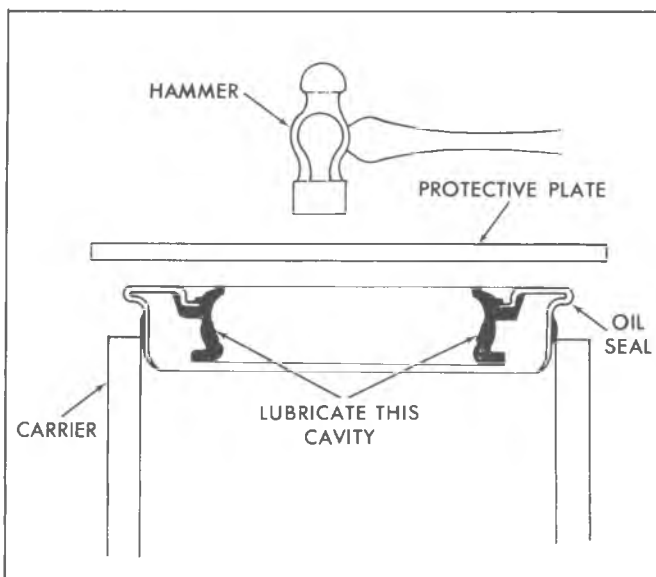


Fig. 4B-24--Installing Pinion Oil Seal

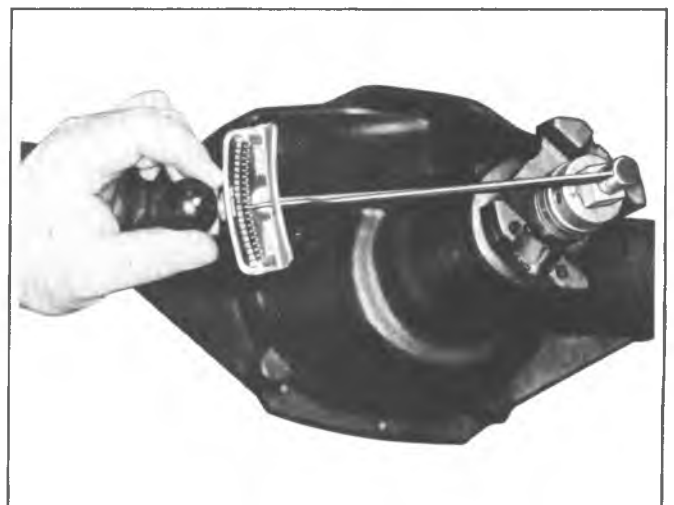


Fig. 4B-26--Measuring Rotating Torque

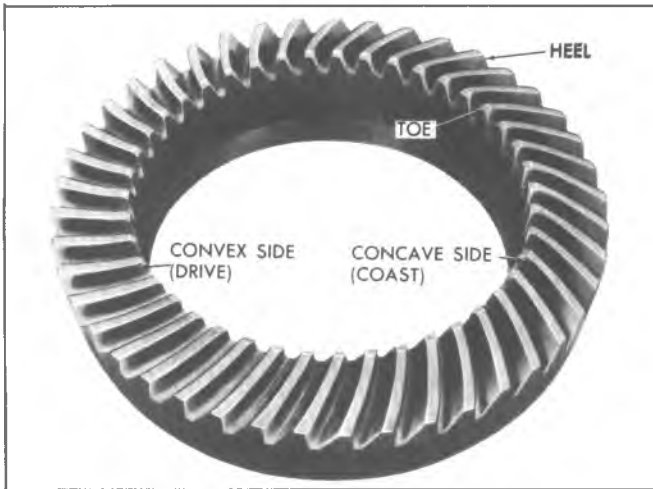


Fig. 4B-27--Gear Tooth Nomenclature

**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 4B-28.

#### Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth

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

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

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

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

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



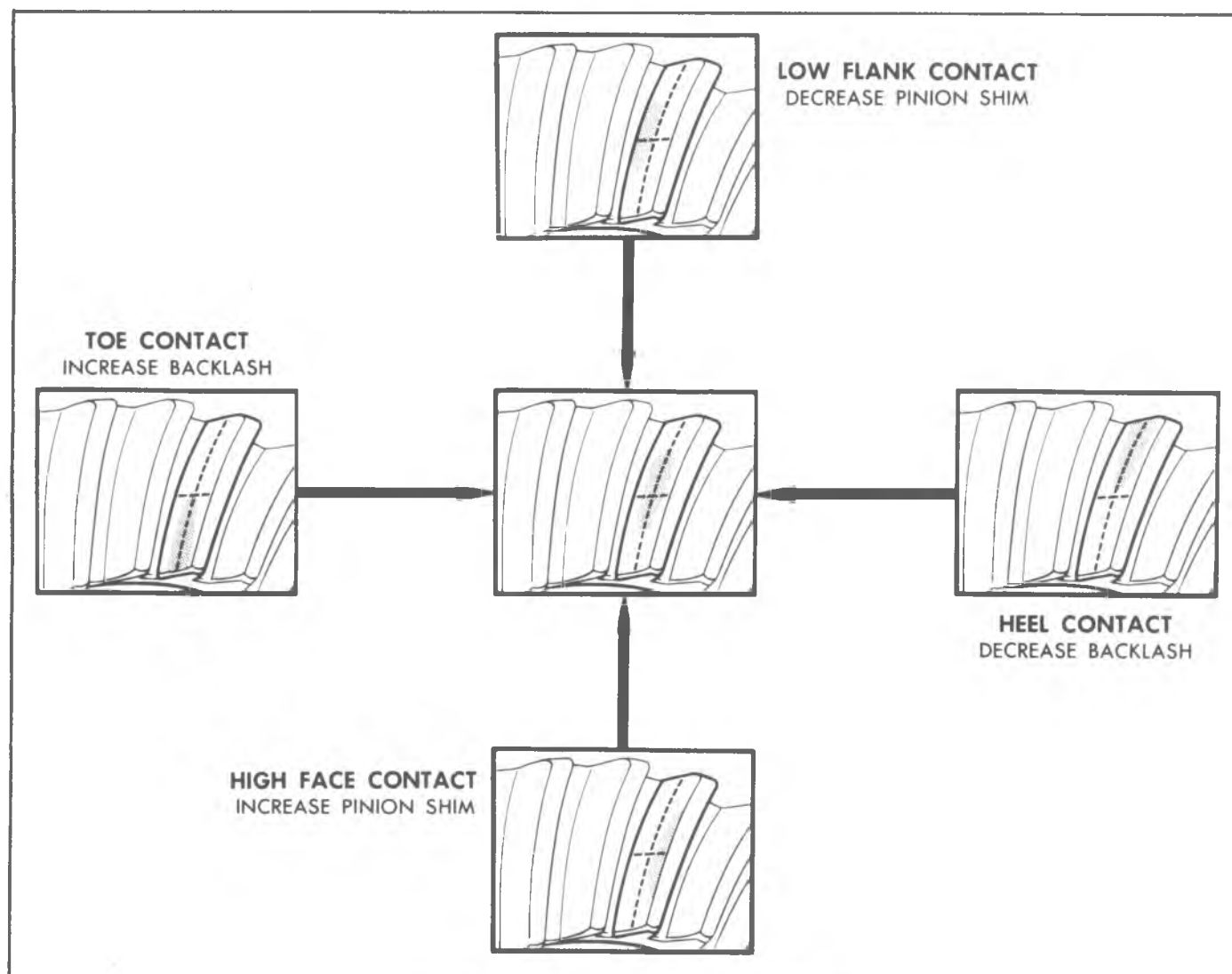


Fig. 4B-28--Gear Teeth Contact Pattern Check

## SERIES 10 TRUCK DIFFERENTIAL 8-7/8" RING GEAR

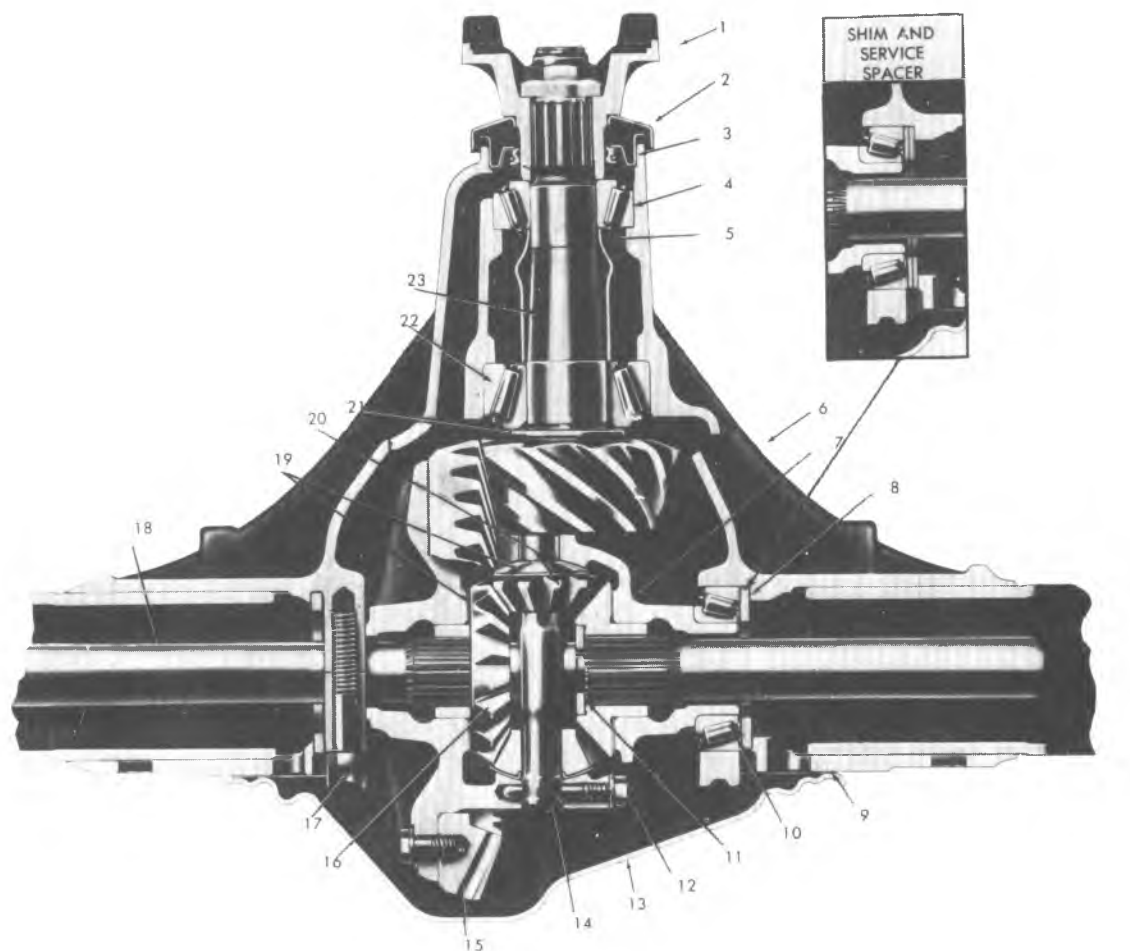
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### DIFFERENTIAL CASE

#### Removal and Disassembly

**NOTE:** Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described under "Checks and Adjustments". This will indicate gear or bearing wear or an error in backlash or pinion depth setting which



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

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

will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, they may be reinstalled at original lash to avoid changing gear tooth contact.

1. Remove screw that retains differential pinion shaft, and remove pinion shaft.

2. Remove rear axle shafts as outlined in the Service Manual.

3. Roll out the differential pinions and thrust washers, then remove side gears and thrust washers. Mark pinions and side gears so that they can be reassembled in original position.

4. Mark the bearing caps and housing for reassembly in same position. Loosen bearing cap bolts. Tap surface of bearing caps to loosen.

**CAUTION:** Do not attempt to pry caps off as this

may damage machined face of caps.

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

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

### Inspection

1. Clean all parts in cleaning solvent; inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear.

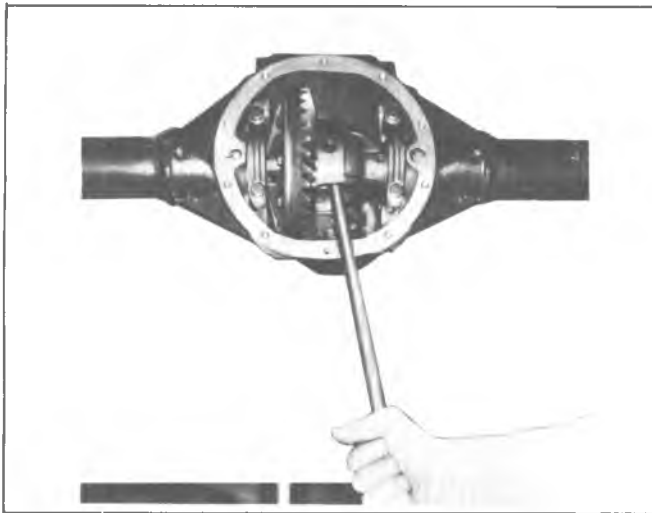


Fig. 2B--Differential Case Removal

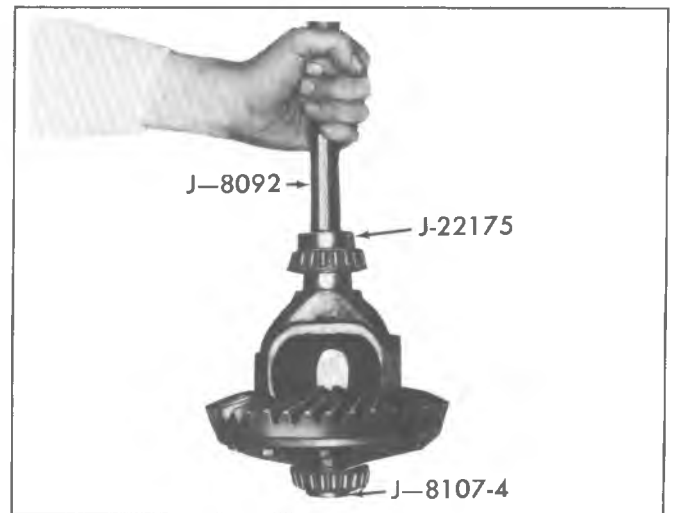


Fig. 4B--Differential Bearing Installation

2. Inspect axle shaft and side gear splines for evidence of excessive wear.

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

4. Inspect differential case, pinions, side gears, thrust washers and pinion shaft for cracks, scoring, spalling or excessive wear.

5. Check fit of differential side gears in case.

### Differential Bearing Replacement

1. Install Tool J-22888 and Adapter Plug J-8107-4, assuring puller legs are fitted securely in notches in case and against bearing cone, as shown in figure 3B.

2. Tighten puller screw to remove bearing.

3. Place new bearing on hub with thick side of inner race toward case and drive into place, using J-22175 and Driver Handle J-8092, as shown in figure 4B.

4. Before bearing installation on opposite hub, support differential case on Adapter Plug J-8107-4. This allows differential case to rest on adapter instead of bearing cage. See figure 4B. Install remaining bearing as instructed in step 3.

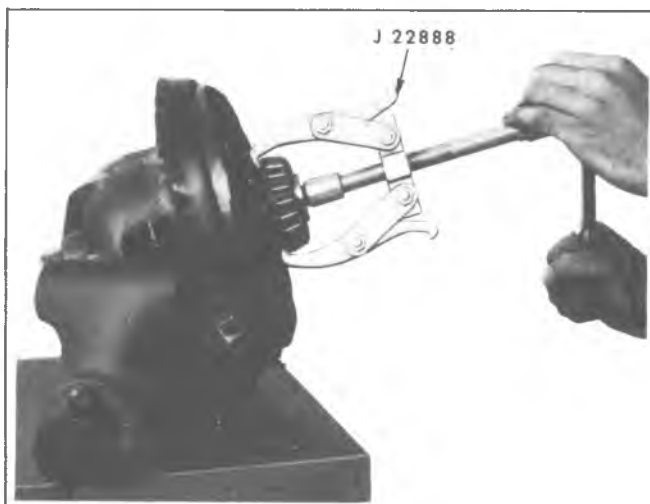


Fig. 3B--Differential Bearing Removal

### Ring Gear or Differential Case Replacement

1. Remove the ring gear bolts and, using a soft drift and a hammer, tap ring gear off the case.

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

2. Remove any nicks or imbedded dirt from case flange surface which mates with ring gear. Clean all surfaces.

3. Liberally coat the differential case pilot with hypoid lubricant. Pre-align ring gear and differential case bolt holes, and press on adaptor plug J-8107-4 to initially start ring gear on case pilot, as shown in figure 5B.

4. Start all ring gear bolts during initial assembly to maintain bolt hole adlignment. Draw up all bolts evenly, using a criss-cross pattern to avoid cocking the gear on the case.

5. Insure that the gear is seated firmly against the case, then torque the bolts to 60 ft. lbs. for truck models.

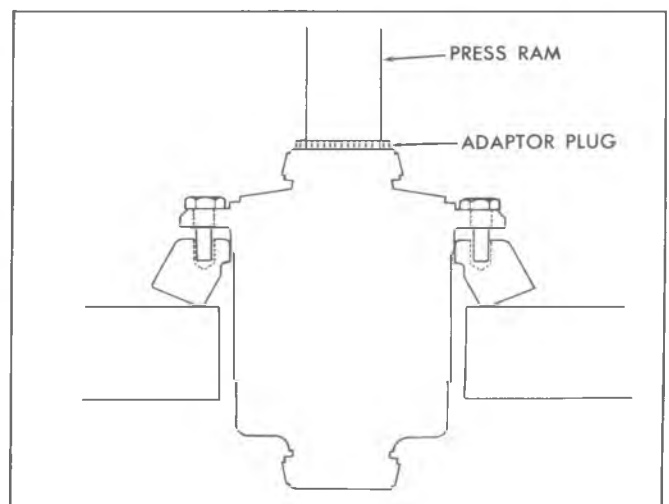


Fig. 5B--Ring Gear-to-Case Installation

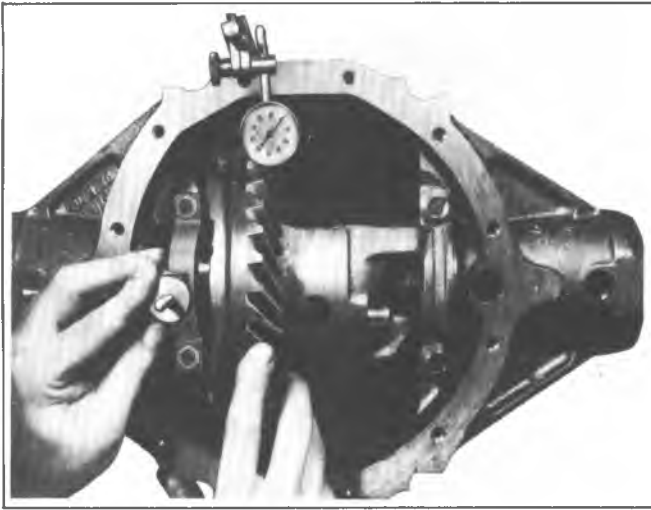


Fig. 6B--Installing Gaging Tool

### Reassembly

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

### Installation and Adjustment

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

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

10. Install left shim first, then wedge right shim between bearing cup and spacer. Position shim so that chamfered side is outward or next to spacer. If shim does not have sufficient chamfer or lead around O.D. to allow easy installation without scraping spacer, file or grind chamfer before installing.

11. If difficulty is encountered in installing shim, partially remove case and slide case and shim into position. Tap shim into position, using a soft faced hammer, while rotating differential case with free hand as shown in figure 9B.

12. Install bearing caps in original position and torque to 60 ft. lbs.

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

13. Mount a dial indicator on the carrier and check the backlash between the ring gear and pinion, as shown in figure 10B. The backlash should be within the range of .005"-.008". Check gear lash at four different equally spaced positions around the gear. Variation in readings should not exceed .001".

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

14. If variation in backlash readings exceeds .002"; measure ring gear and case runout as shown in figure 11B. Gear runout should not exceed .003"; should runout exceed this limit, check ring gear and case for deformation and/or foreign matter between case and gear.

15. If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of other shim **the same amount**. Total shim thickness must be maintained at all times to maintain proper preload.

16. Backlash changes approximately .002" for each .003" change in shim dimensions.

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

### DRIVE PINION

#### Removal

1. Remove differential as previously outlined.
2. Check torque required to rotate drive pinion, as described under "Drive Pinion - Installation and Adjustment". If there is no preload reading, check for looseness of pinion assembly by shaking (push-pull) the companion flange. Looseness indicates the need for bearing replacement.

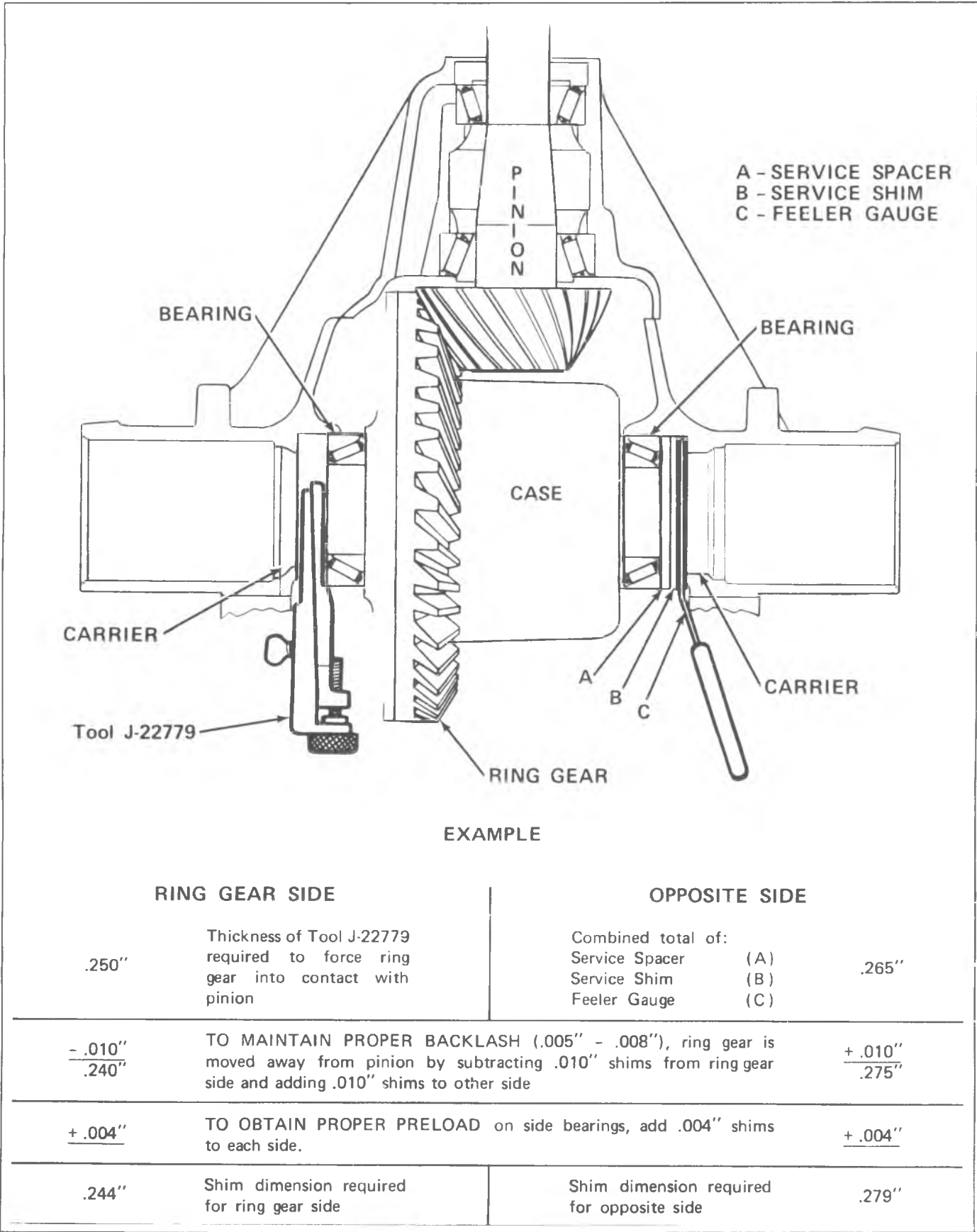


Fig. 7B--Determining Side Bearing Shim Requirements



Fig. 8B--Measuring Gage Plate Thickness

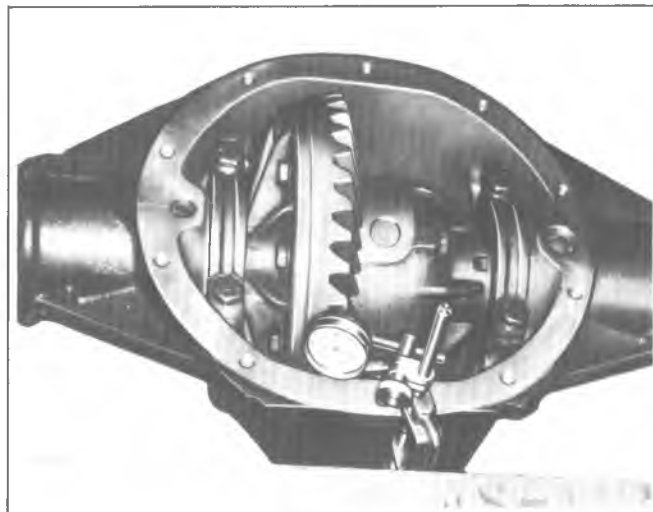


Fig. 10B--Checking Ring Gear Backlash

3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 12B. Position J-8614-11 on flange so that the four notches are toward the flange.

4. Remove pinion nut and washer.

5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 13B.

6. To remove the drive pinion, first thread the original pinion nut half way on the pinion, for thread protection.

7. Place the differential cover temporarily back onto the housing, using two screws. This will prevent the pinion from falling to the floor during removal.

8. Tap the end of the pinion nut with a large hammer and a soft drift, as shown in figure 14B.

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

9. Remove the pinion oil seal and the front pinion bearing. Remove the cover and retrieve the drive pinion

from the housing. Discard the pinion oil seal, nut, and collapsible spacer. Use a new oil seal, nut and spacer on reassembly.

### Bearing Removal and Cup Replacement

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

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

3. Remove rear pinion bearing from pinion shaft using press plate J-22912 as shown in Figure 15B.

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

4. Inspect carrier pinion bearing bores and shoulders



Fig. 9B--Installing Differential Shim

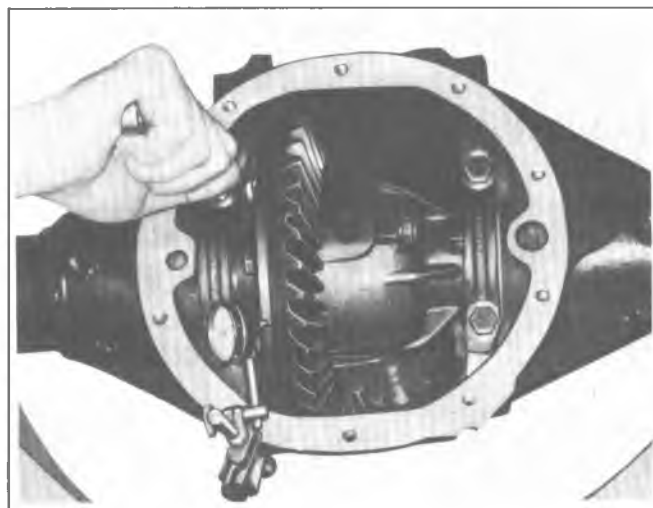


Fig. 11B--Checking Ring Gear Runout

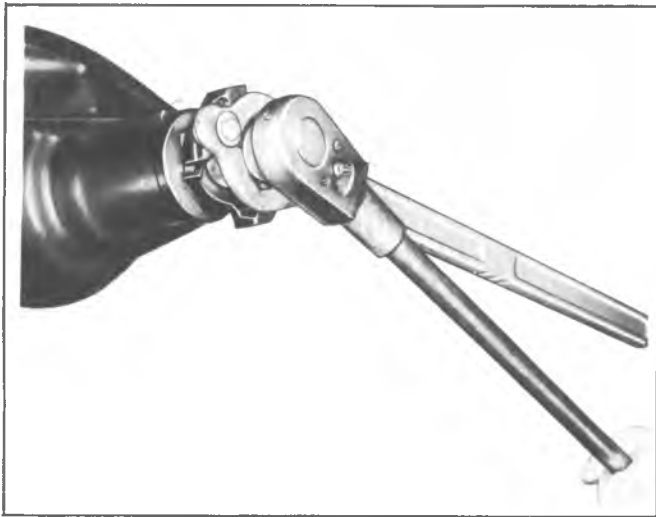


Fig. 12B--Drive Pinion Nut Removal

for nicks. Remove as necessary. Clean the bores and the installation tools.

5. Lubricate both bearing cups with liberal amounts of hypoid lubricant.

6. Install the rear cup, with the large end against the bore shoulder, using Installer J-0270-14 for Truck models as shown in figure 16B.

7. Install the front cup, with the large end against the bore shoulder, using Installer J-7137 as shown in figure 17B.

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

### Setting Pinion Depth and Installing Pinion Bearings

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

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

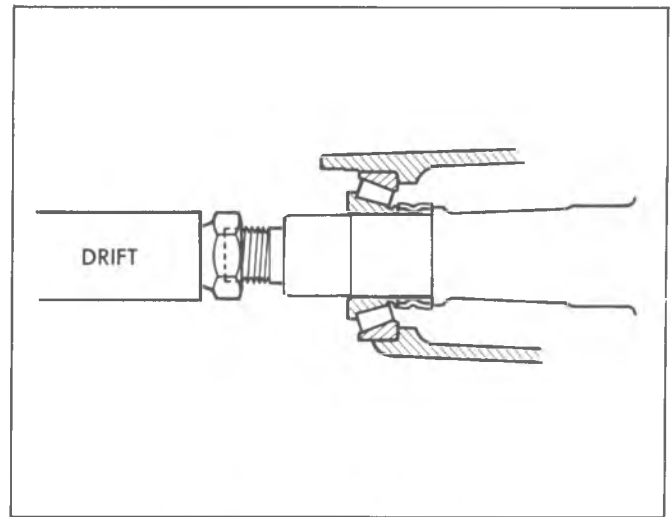


Fig. 14B--Removing Drive Pinion

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

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

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

1. Clean the housing assembly and all gage parts to insure accurate measurements.

2. Lubricate front and rear pinion bearings which will be used in final assembly and position them in their respective races in the carrier.

3. Use cloverleaf gage plate J-21777-36 mounted on



Fig. 13B--Drive Pinion Flange Removal

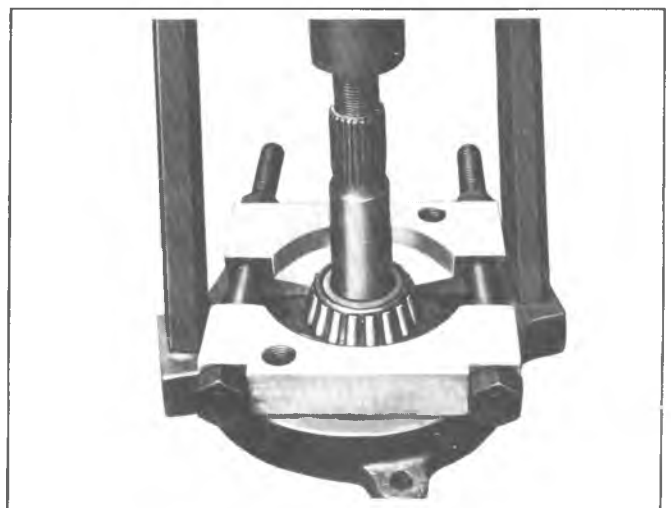


Fig. 15B--Removing Drive Pinion Rear Bearing



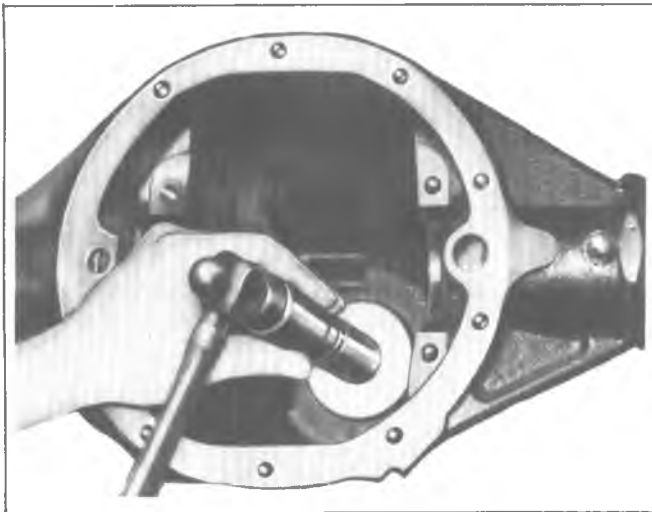


Fig. 16B--Installing Pinion Rear Bearing Cup

preload stud J-21777-43 insert stud through rear bearing and pilot J-21777-35, and through front bearing and pilot J-21777-42. Install the hex nut until snug and rotate the bearings to make sure they are properly seated. See figure 18B for illustration of proper positioning.

4. Hold the preload stud stationary with a wrench on the flats and tighten hex nut. Tighten until 20 in. lbs. of torque are required to rotate the bearings, as shown in figure 19B.

5. Mount the side bearing discs J-21777-45 on the ends of arbor J-21777-1, using the step of the disc that corresponds to the bore of the carrier.

6. Place the arbor and plunger assembly into the carrier, being sure the side bearing discs are seated properly.

7. Install the bearing caps finger tight to hold the discs from movement.

8. Position dial indicator J-8001 on the mounting post of the arbor with the contact button resting on the top surface of the plunger.

9. Preload the dial indicator one-half revolution, and tighten in this position.

10. Select the button on the gage plate that corresponds

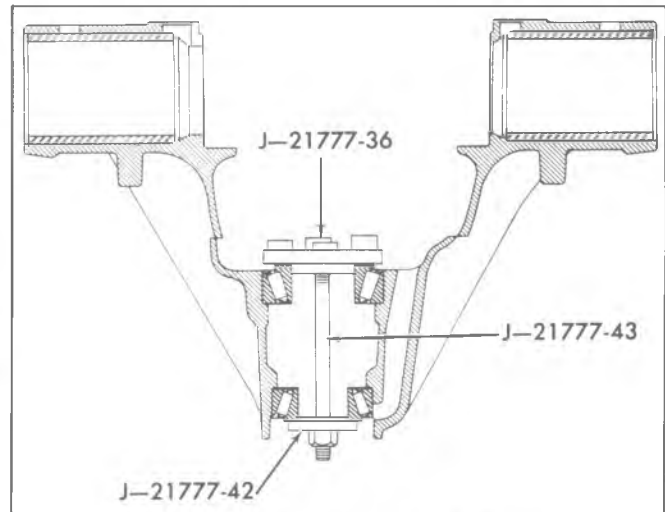


Fig. 18B--Gage Plate Installed - Truck

to the ring gear size and rotate the plate until the plunger rests directly upon that button.

11. Rock the plunger rod slowly back and forth across the button until the dial indicator reads the greatest deflection. At this point, set the dial indicator to zero. Tools will now be positioned as shown in figure 20B.

12. Repeat the rocking action of the plunger several times to verify the setting.

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

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

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

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

b. If the pinion has no plus (+) or minus (-), use the

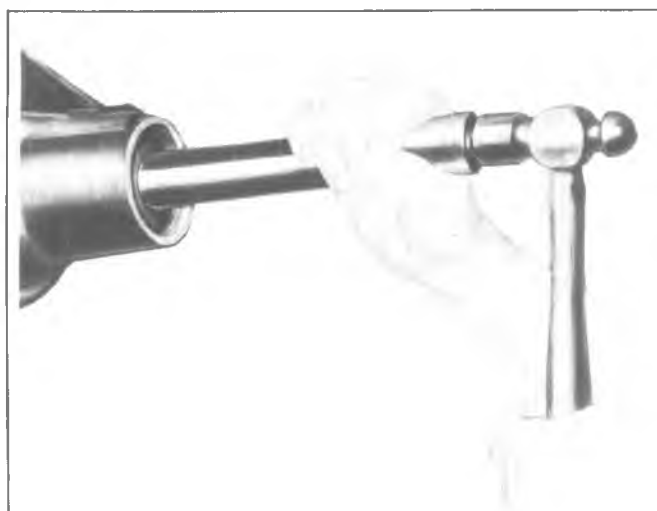


Fig. 17B--Installing Pinion Front Bearing Cup

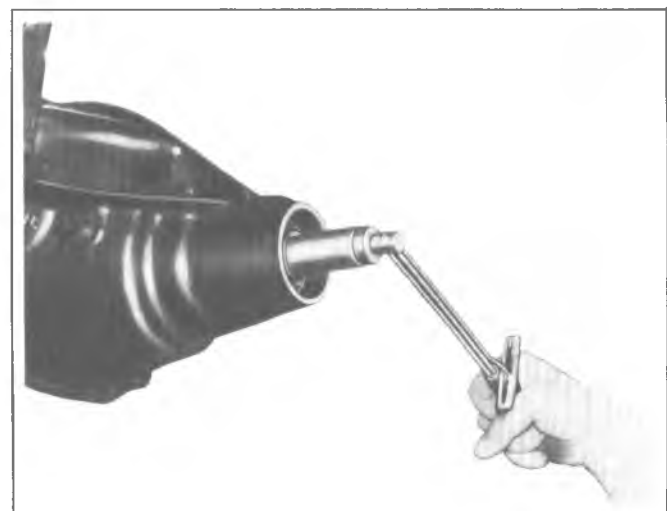


Fig. 19B--Measuring Rotating Torque

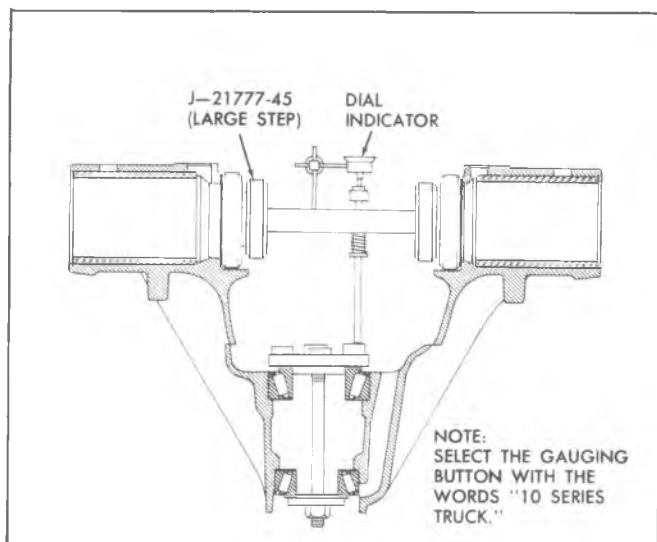


Fig. 20B--Gaging Tools Installed in Carrier - Truck

indicator reading as the correct shim thickness.

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

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

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

17. Lubricate the rear pinion bearing with liberal amounts of hypoid lubricant and install rear bearing. Use J-5590 for truck models, as shown in figure 21B.

### Installation and Adjustment

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

2. Position seal in bore and place gage plate J-22804-2 over seal and against flange. Gage plate insures proper seating of seal in carrier bore. See figure 22B. Use J-23911



Fig. 21B--Installing Rear Bearing - Truck

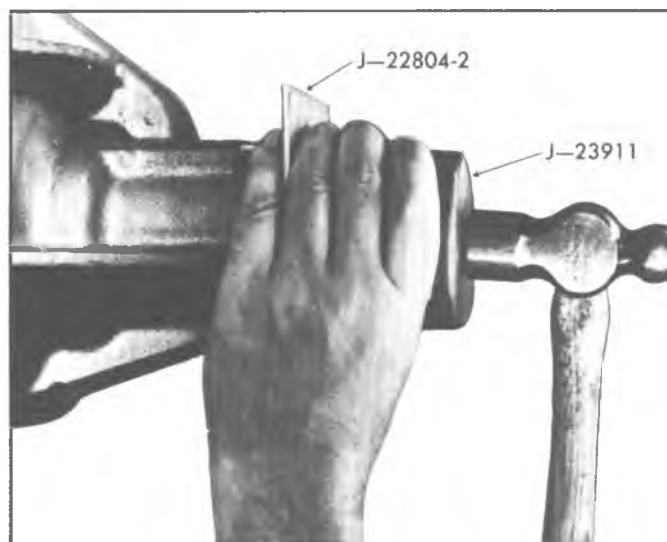


Fig. 22B--Installing Pinion Oil Seal - Truck

to press seal into bore until gage plate is flush with the carrier shoulder and seal flange. Turn gage plate 180°, seal must be square in carrier to seal properly.

3. Coat lips of pinion oil seal and seal surface of pinion flange with hypoid lubricant.

4. Install a new pinion bearing spacer onto drive pinion.

5. Place drive pinion into position, and mount a suitable thick washer or sheet metal plate over the pinion stem. Install the original pinion nut and tighten sufficiently to draw pinion through the front bearing far enough to leave threads exposed when the companion flange is placed into position. Remove the washer and install the companion flange, using J-8614-11.

6. Tighten nut until all end play is removed from drive pinion.

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

7. While observing the preceding caution, carefully set preload drag at 20-25 inch pounds on new bearings, or 10-15 inch pounds on reused bearings. Use an inch-pound torque wrench such as J-5853, as shown in figure 23B, to measure the rotating torque.

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

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

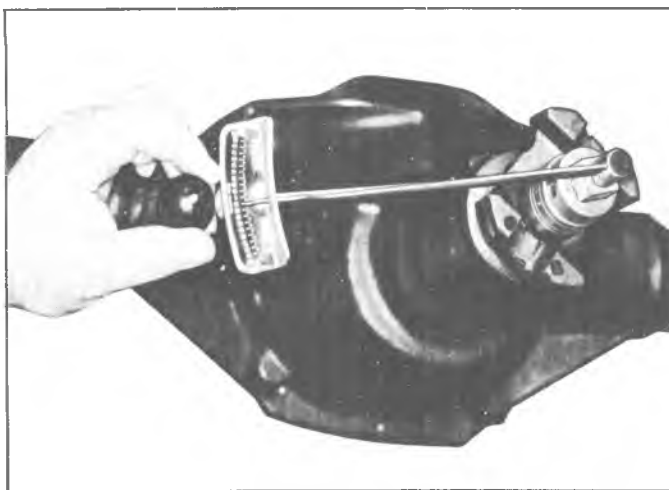


Fig. 23B--Measuring Rotating Torque

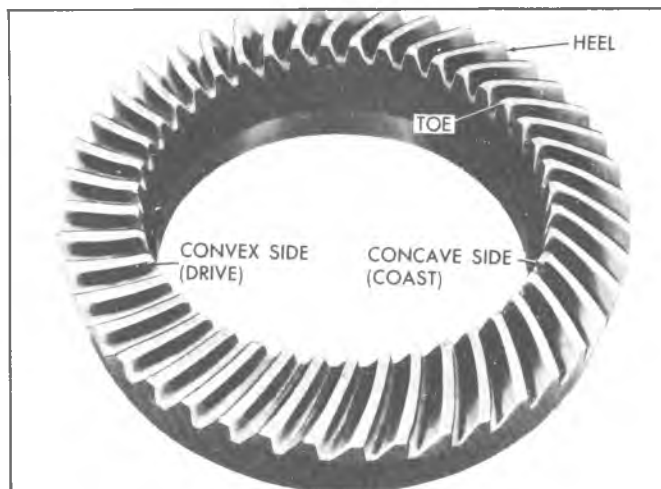


Fig. 24B--Gear Tooth Nomenclature

## CHECKS AND ADJUSTMENTS

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

Pinion Bearing Preload is set to specifications in step 7 of "Drive Pinion-Installation and Adjustment".

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

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

### Gear Tooth Contact Pattern Check

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

### Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See figure 24B.

### Test

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

required to turn the pinion.

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

5. Observe pattern on ring gear teeth and compare with Figure 25B.

### Adjustments Affecting Tooth Contact

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

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

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

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

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

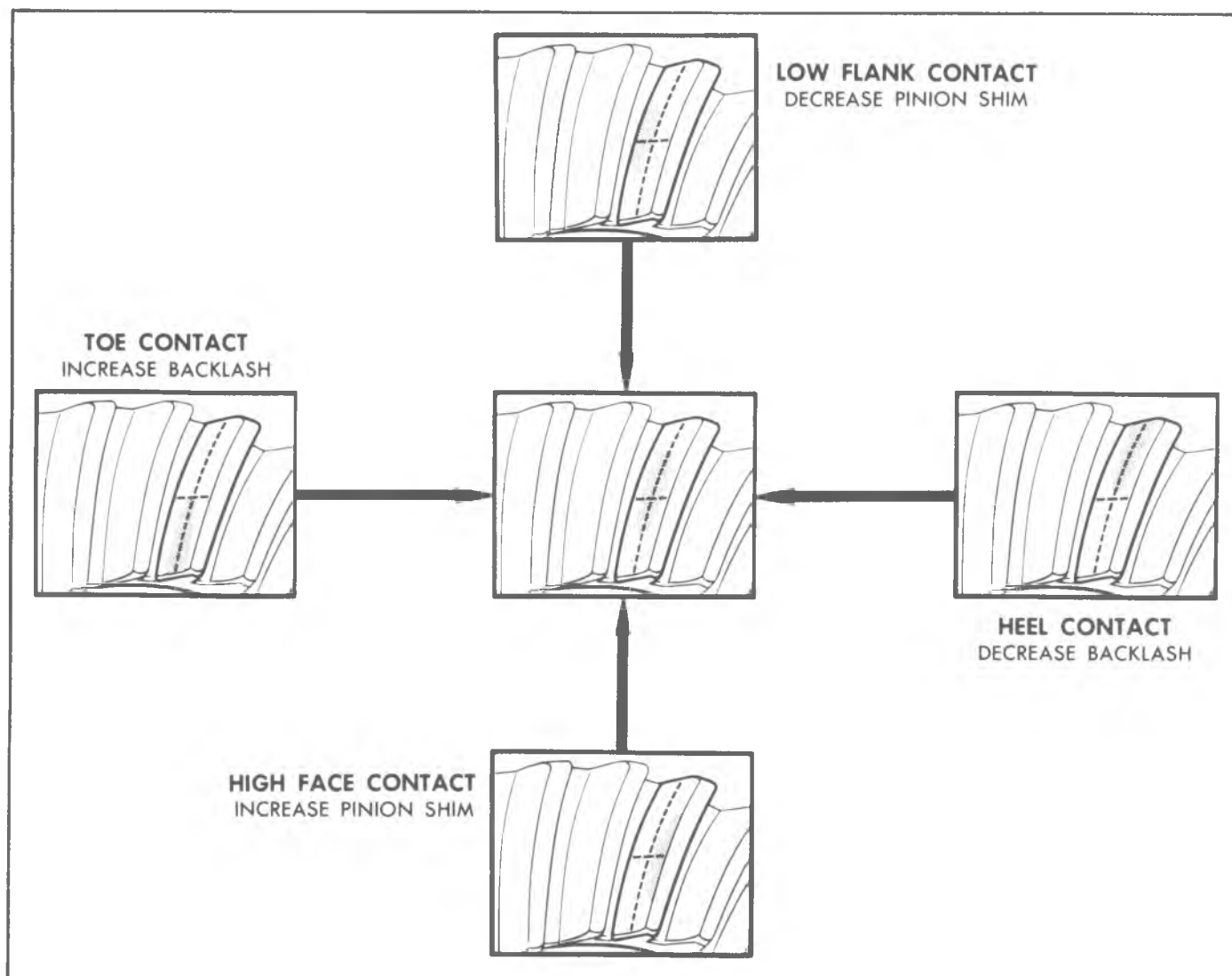


Fig. 25B--Gear Tooth Contact Pattern Check

## CORVETTE DIFFERENTIAL

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### DIFFERENTIAL CASE

#### Removal and Disassembly

1. Clamp carrier in Holding Fixture J-3289.
2. Remove snap rings securing side gear yokes and pull yokes out of carrier. See figure 1C.
3. Mark differential bearing caps for reassembly in same relative location and remove caps.
4. Pull differential assembly out of carrier, taking care not to damage machined mounting surface on carrier. See figure 2C. Remove differential bearing shims and mark for future reference.

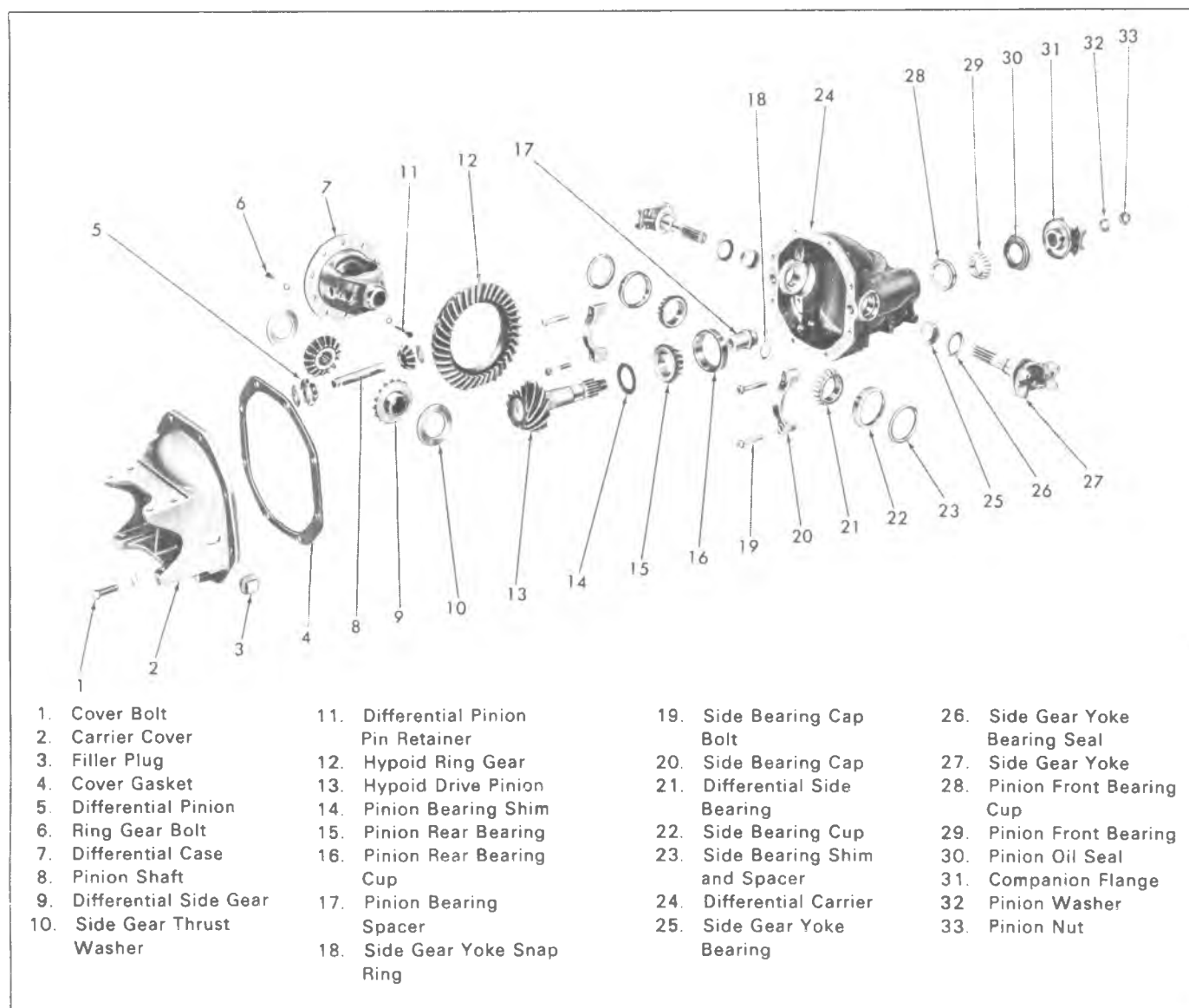


Fig. 1C--Carrier Assembly - Exploded View

5. To disassemble, and reassemble, follow procedures outlined in "Limited Slip Differential Unit" section.

### Inspection

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

2. Inspect gears for scoring, pitting or cracks.

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

4. Inspect side gear driveshaft yokes closely for spline wear or yoke cracking. If equipment is available, use magnetic penetrant method to check for minute fractures in yokes or gears.

### Differential Bearing Replacement

1. Place Puller J-22888 over differential bearing using Adapter Plug J-8107 in side gear bore. Tighten puller screw to remove bearing as in figure 3C.

1. Install new bearing on hub using Installer J-22175. See figure 4C.

3. Before bearing installation on opposite hub, support

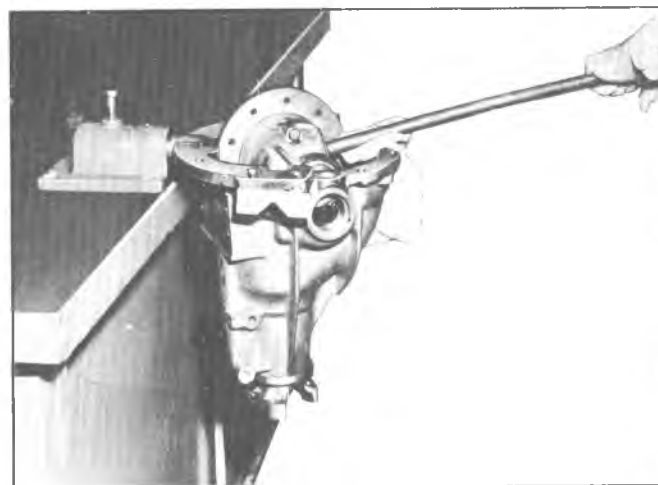


Fig. 2C--Removing Differential Case

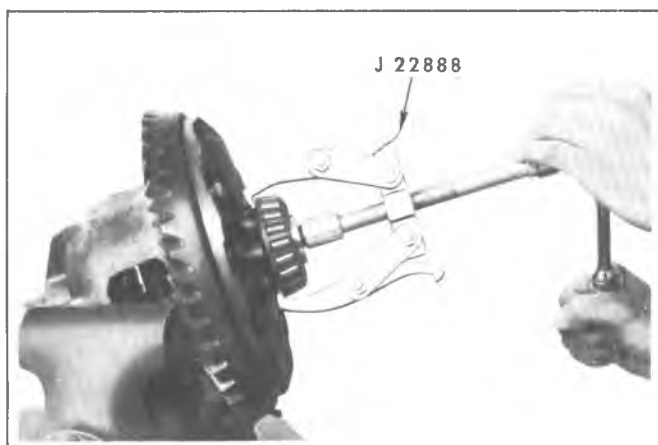


Fig. 3C--Removing Differential Bearing

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.

### 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.

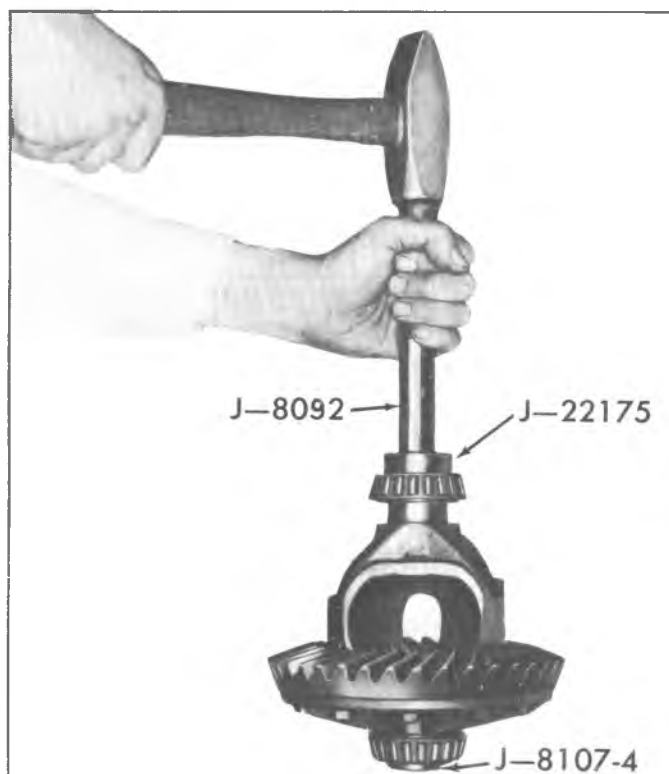


Fig. 4C--Differential Bearing Installation

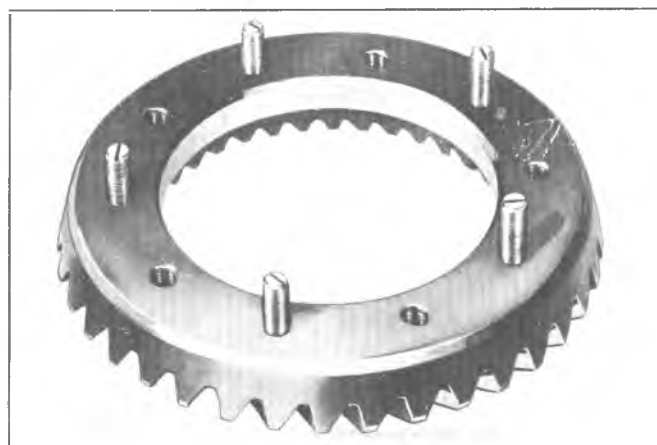


Fig. 5C--Ring Gear Guide Pins Installed

### 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.

### Installation and Adjustment

1. Check condition of bearing cups, cup seat in carrier and carrier caps to make sure they are free from nicks, burrs and foreign material.
2. Lubricate bearings with axle lubricant. Position cups on proper bearings then install differential assembly in carrier as shown in figure 8C. Install right bearing cap, tightening the bolts to a snug fit.
3. Service spacers are available in one thickness only

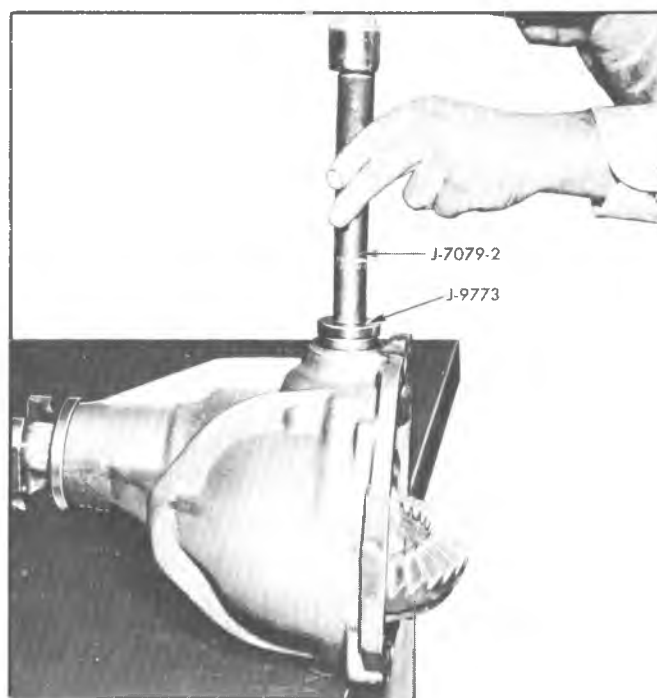


Fig. 6C--Installing Side Gear Yoke Bearings

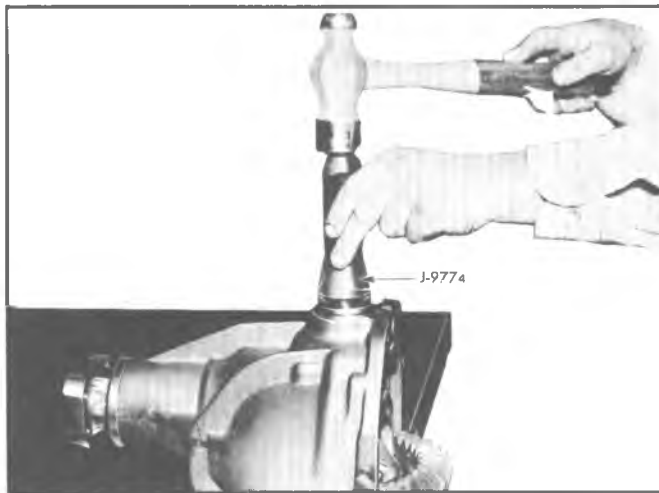


Fig. 7C--Installing Side Gear Yoke Seal

- .170" plus or minus .001". Steel service shims are used with the service spacer. See following Shim Chart for shim availability and identification.

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

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

5. With the ring gear tight against the pinion gear (.000" to .001" backlash), insert gaging Tool J-22779 between the left bearing cup and carrier housing. See figure 10C. Turn adjusting nut clockwise while oscillating the tool until a noticeable drag is produced.

6. Tighten lock bolt on side of the tool, then remove tool.

7. Using a micrometer, measure the thickness of the gaging plates in a minimum of three places as shown in figure 11C. Average these readings and record the result.

8. Turn the ring gear 90 degrees and repeat Steps 5, 6 and 7.



Fig. 8C--Installing Differential Assembly

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

Fig. 9C--Shim Chart

9. The required thickness of the service shim is determined by subtracting the thickness of the service spacer from the **higher** of the two averaged readings obtained in Steps 7 and 8.

Example:

Gage thickness (higher reading) .254"

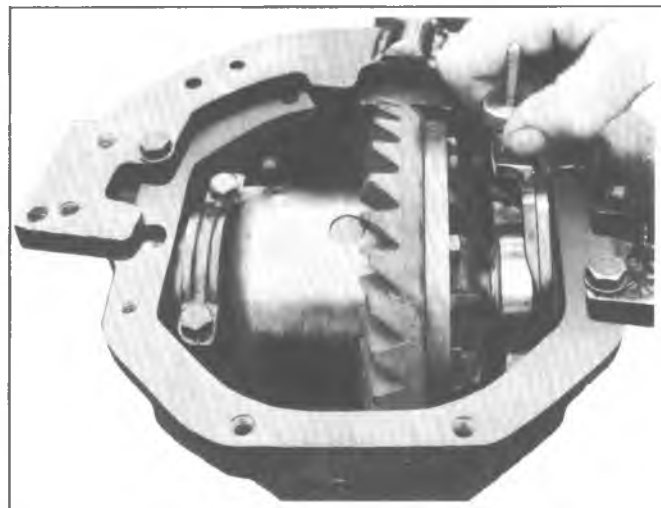


Fig. 10C--Measuring Differential Shim Requirement





Fig. 11C--Measuring Gage Plate Thickness

Service spacer minus .170"

Service shim size (left side) .084"

10. Install the selected shim between the service spacer and bearing. Remove strap J-22779-6 and install left bearing cap. Torque bearing cap bolts to specifications.

11. Remove right-hand bearing cap and install Tool J-22779 between right bearing cup and carrier housing.

12. Turn adjusting nut clockwise while oscillating tool until a noticeable drag is produced (bearing outer race rotates with tool). Remove tool and measure the thickness of the gaging plate in a minimum of three places. Average these readings and record the results.

13. Turn the ring gear 90 degrees and repeat Steps 11 and 12.

14. The required thickness of the service shim is determined as in Step 9; however, an additional .008" must be added to obtain proper side bearing preload.

#### EXAMPLE:

Gage thickness (higher reading) .226"

Service spacer used minus .170"

Difference .056"

For preload add .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 12C.

16. Install the right bearing cap and torque both bearing caps to specifications.

17. Mount a dial indicator on the carrier and check backlash between the ring gear and pinion, as shown in figure 13C. 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 .003".

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

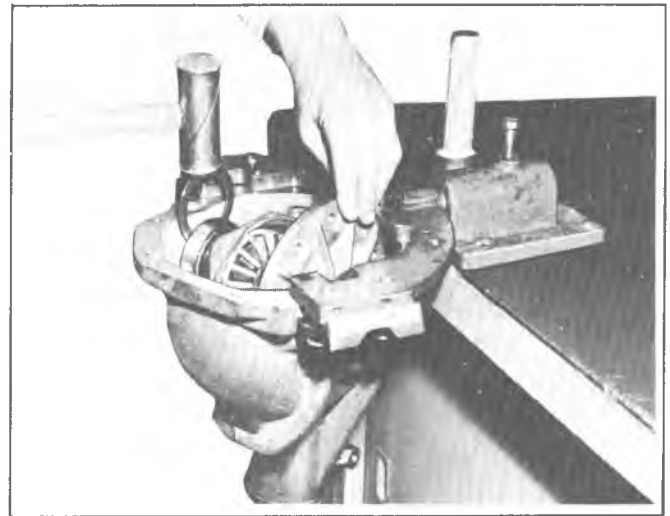


Fig. 12C--Installing Differential Shim

18. If variation in backlash exceeds .003", measure ring gear and case runout as shown in figure 14C. Gear runout should not exceed .003"; should runout exceed this limit, check ring gear and case for deformation and/or foreign matter between case and gear.

19. If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of the other shim the same amount. Total shim thickness must be maintained to maintain proper preload.

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

## DRIVE PINION

### Removal

1. Remove differential case as previously outlined.

2. Check pinion bearing preload as described under "Drive Pinion - Installation and Adjustment". If there is no preload reading, check for looseness of pinion assembly by shaking the companion flange. Looseness indicates the need for bearing replacement.

3. Turn holding fixture over and install Holder J-8614-

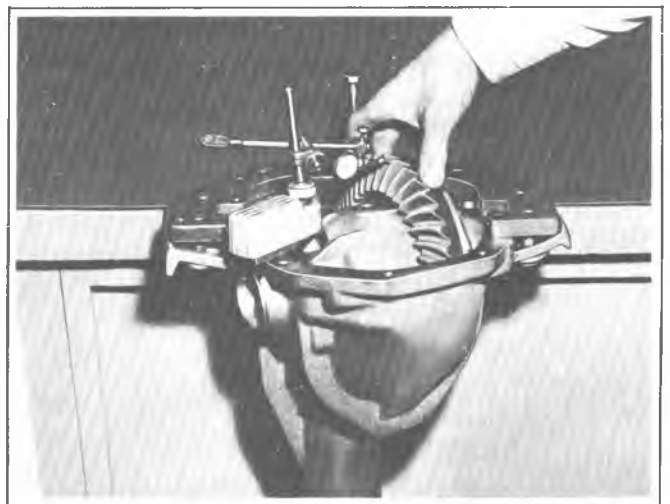


Fig. 13C--Checking Backlash

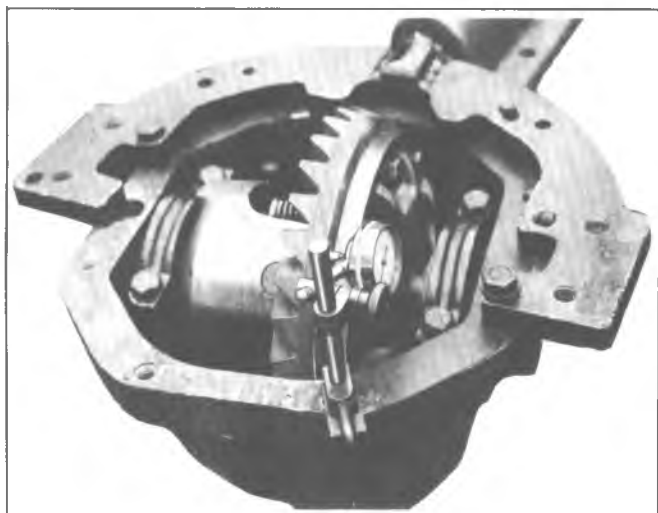


Fig. 14C--Checking Ring Gear Runout

11 on flange by using two bolts with flat washers, as shown in figure 15C. Position J-8614-11 on flange so that the four notches are toward the flange.

4. Remove pinion nut and washer. Discard pinion nut and use a new one upon reassembly.

5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in Step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 16C.

6. With companion flange removed, drive pinion and rear bearing assembly can be removed from carrier.

7. Pry companion flange seal out of carrier using screwdriver and discard seal. Remove pinion front bearing assembly.

8. Pry differential side gear yoke seals out of carrier and discard seals. Using a piece of 1 3/4" O.D. pipe of suitable length, tap yoke bearings out of bore.

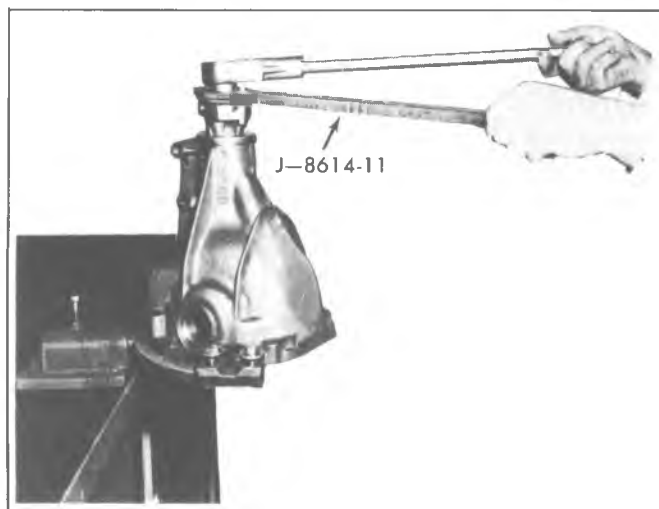


Fig. 15C--Removing Companion Flange Nut

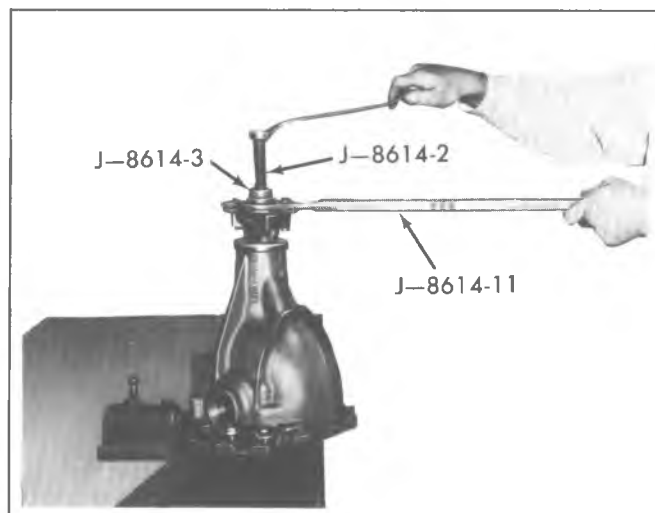


Fig. 16C--Removing Companion Flange

## Inspection

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

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

2. Inspect gears for scoring, pitting or cracks.

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

## Pinion and/or Bearing Replacement

1. If necessary to replace pinion bearings, tap old cups out of carrier using a brass drift. See figure 17C. Tap alternately on opposite sides of cup to prevent cups from cocking in carrier. Inspect cup seats and bore for any nicks or burrs and remove as necessary before installing new bearing cups.

2. Select front and rear pinion bearings and drive cups into carrier using Drive Handle J-8092 and Cup Installers J-8608 for the rear cup and J-7137 for front cup. See figures 18C and 19C. Seat cups securely and squarely against shoulders in carrier.



Fig. 17C--Removing Pinion Bearing Cup

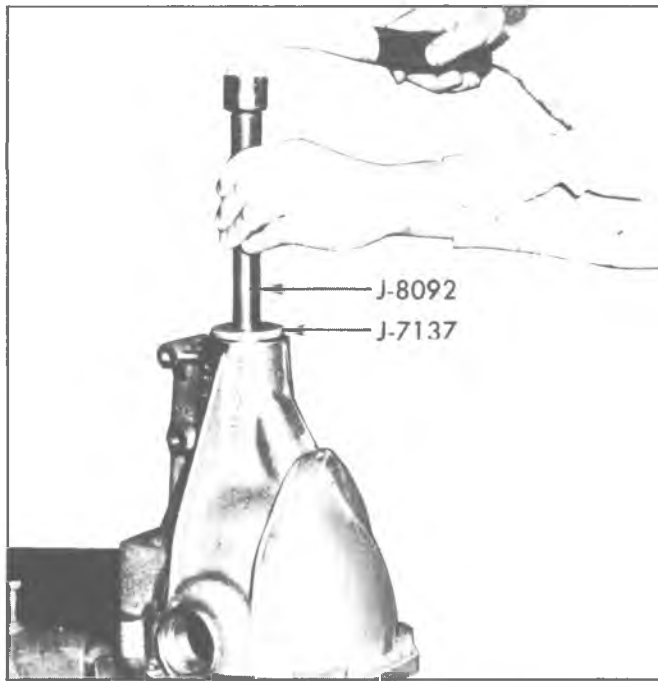


Fig. 18C--Installing Pinion Front Bearing Cup

3. Remove pinion rear bearing using Press Plates J-9771 in Holder J-0358-1 as shown in figure 20C. Remove and discard shim between bearing and gear head.

### Setting Pinion Depth

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

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring

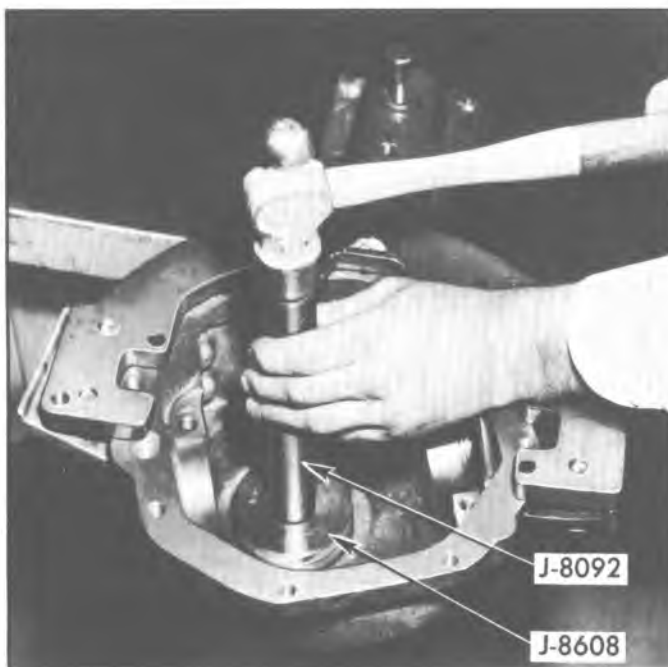


Fig. 19C--Installing Pinion Rear Bearing Cup

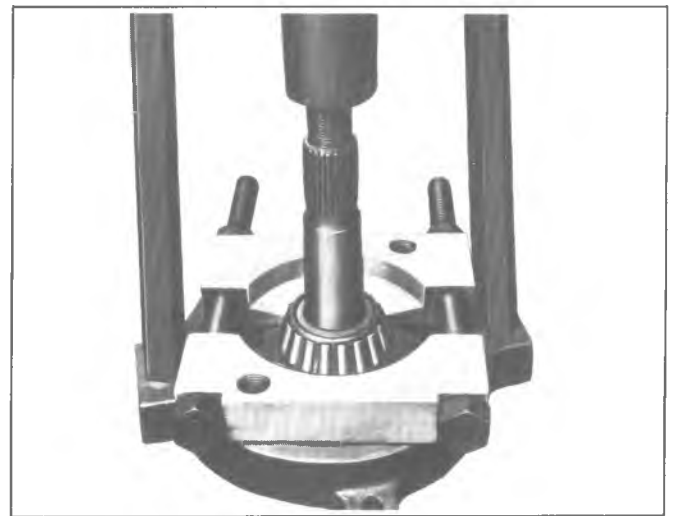


Fig. 20C--Removing Pinion Rear Bearing

gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or "nominal" setting due to allowable variation in machining the parts. When a pinion is found having a plus or minus reading recoded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.

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

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

1. Clean the housing assembly and all gage parts to insure accuracy of measurements.

2. Lubricate the front and rear pinion bearings which will be used in final assembly and position them in their respective races in the carrier.

3. With cloverleaf gage plate J-21777-36 mounted on preload stud J-21777-43, insert stud through rear bearing and pilot J-21777-35, and through front bearing and pilot J-21777-42. Install the hex nut until snug and rotate the bearings to make sure they are properly seated. See figure 21C for illustration of proper positioning.

4. Hold the preload stud stationary with a wrench on the flats and tighten hex nut until 20 in. lbs. of torque are required to rotate the bearings, as shown in figure 22C.

5. Mount the side bearing discs J-21777-45 on the ends of arbor J-21777-1, using the step of the disc that corresponds to the bore of the carrier.

6. Place the arbor and plunger assembly into the carrier, being sure the side bearing discs are seated properly.

7. Install the bearing caps finger tight to hold the discs from movement.

8. Position dial indicator J-8001 on the mounting post of the arbor with the contact button resting on the top

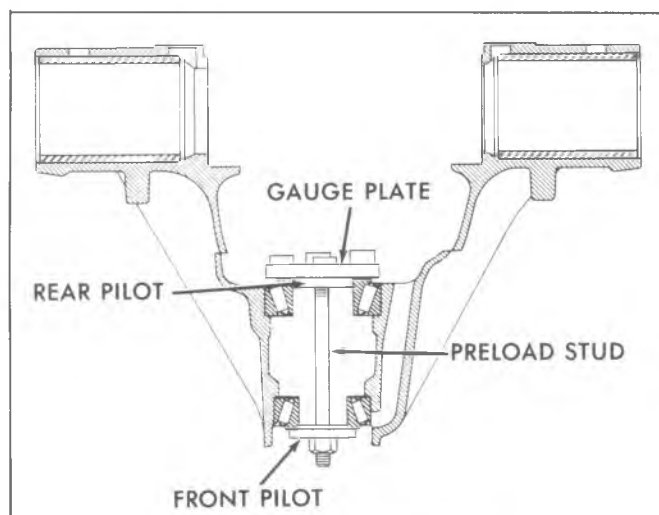


Fig. 21C--Gage Plate Installed

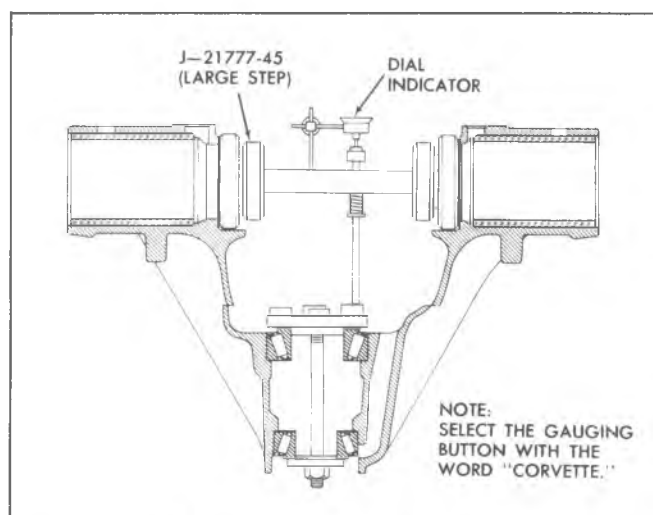


Fig. 23C--Pinion Depth Gaging Tools Installed

surface of the plunger.

9. Preload the dial indicator one half revolution, and tighten in this position.

10. Select the button on the gage plate that corresponds to the ring gear size and rotate the plate until the plunger rests directly upon that button.

11. Rock the plunger rod slowly back and forth across the button until the dial indicator reads the greatest deflection. At this point, set the dial indicator to zero. Tools will now be positioned as shown in figure 23C.

12. Repeat the rocking action of the plunger several times to verify the setting.

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

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

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

a. If the pinion is stamped with a plus (+) number, **add** that many thousandths to the indicator reading. For example, if indicator reading is .019, and pinion is marked

(+2), the correct depth shim for installation will be  $.019 + .002 = .021$  inch.

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

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

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

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

17. Install the rear bearing on drive pinion, using J-8609 as shown in figure 24C.

### Installation and Adjustment

1. Lubricate pinion bearings and outer races and place drive pinion in carrier.

2. Place a new pinion bearing spacer over pinion so it seats on inner race of rear bearing.

3. Slide pinion front bearing cone and roller assembly

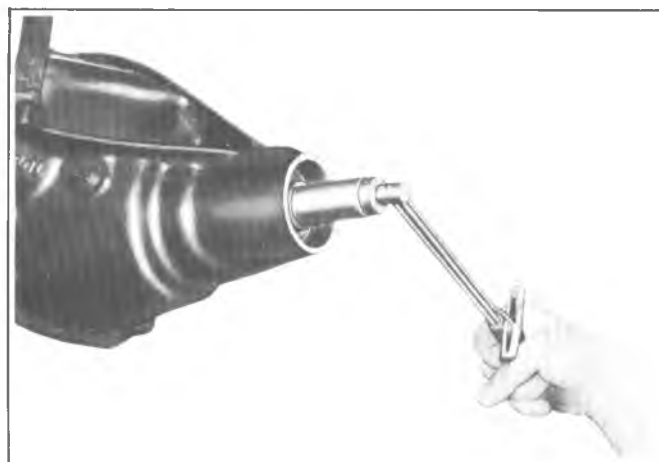


Fig. 22C--Measuring Rotating Torque

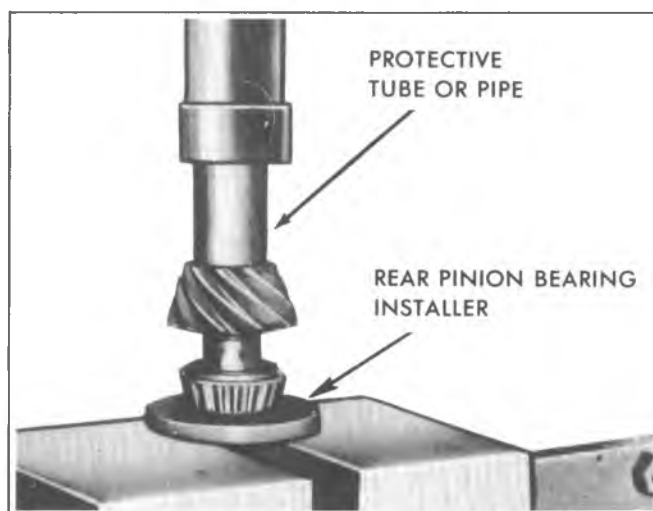


Fig. 24C--Installing Pinion Rear Bearing

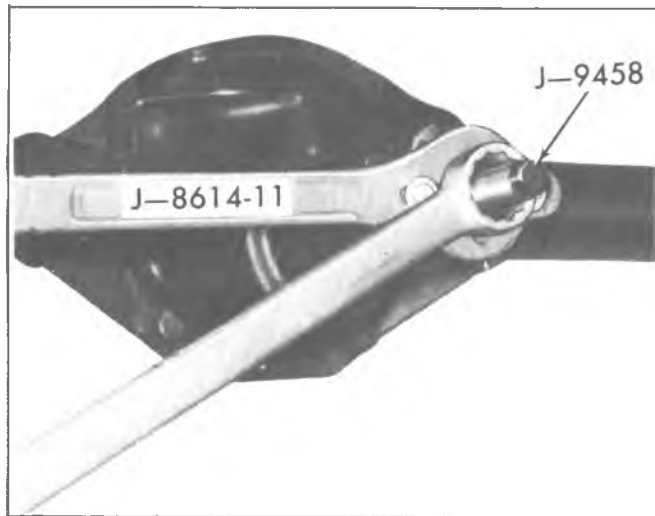


Fig. 25C--Installing Companion Flange

over pinion shaft so it seats against spacer.

4. Pack the cavity between the seal lips of the pinion flange oil seal with a lithium-base extreme pressure lubricant.

5. Place oil seal in carrier bore and tap into position with a hammer and drift, until oil seal flange seats against the carrier.

6. Install Companion Flange Using Holder J-8614-11 and Installer J-5780. See figure 25C.

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 26C.



Fig. 26C--Measuring Rotating Torque

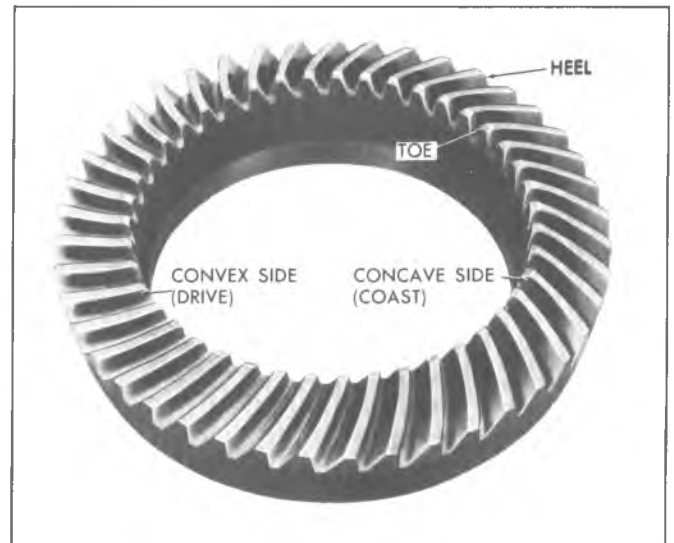


Fig. 27C--Gear Tooth Nomenclature

## CHECKS AND ADJUSTMENTS

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

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

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

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

## Gear Tooth Contact Pattern Check

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

## Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See figure 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 20-30 lb. ft. is required to turn the pinion.

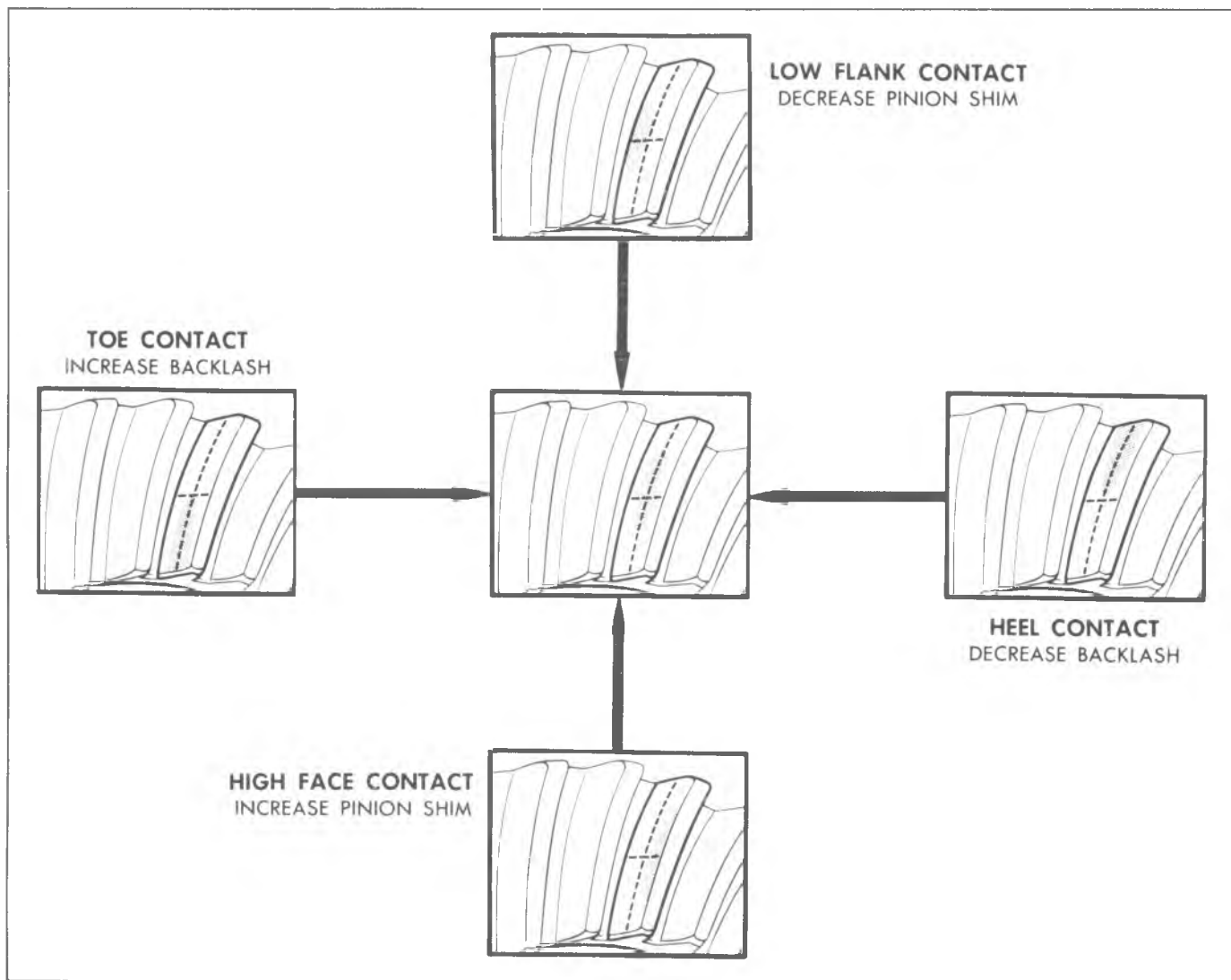


Fig. 28C—Gear Tooth Contact Pattern

**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.

#### 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.

# CHEVROLET SERIES 20-30 TRUCK DIFFERENTIAL

## 10-1/2" RING GEAR

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### DIFFERENTIAL CASE

#### Removal

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

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

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

#### Side Bearing Replacement

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

4. Inspect bearings and hub for nicks, burrs or evidence of abnormal wear.

5. To install bearings, place bearing onto hub, and use driver handle J-8092 and bearing installer J-24430 to drive bearing onto hub until it seats against the shoulder.

6. When installing the second bearing, support case on pilot plug as shown in figure 5E to prevent damage to first bearing installed.

#### Ring Gear Replacement

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

#### Disassembly of Case

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

#### Inspection

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

#### Reassembly of Differential

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

#### Installation and Adjustment

1. Place bearing cups over side bearings and lift the differential assembly into the carrier. Install bearing caps, making sure marked caps are installed in original positions. Secure the cap bolts snugly.
2. Loosen the right side adjusting nut and tighten the left side nut, using J-24429 as shown in figure 3E, until the ring gear contacts the drive pinion. Do not force the gears into contact so as to bind them. At this point, zero lash is obtained.



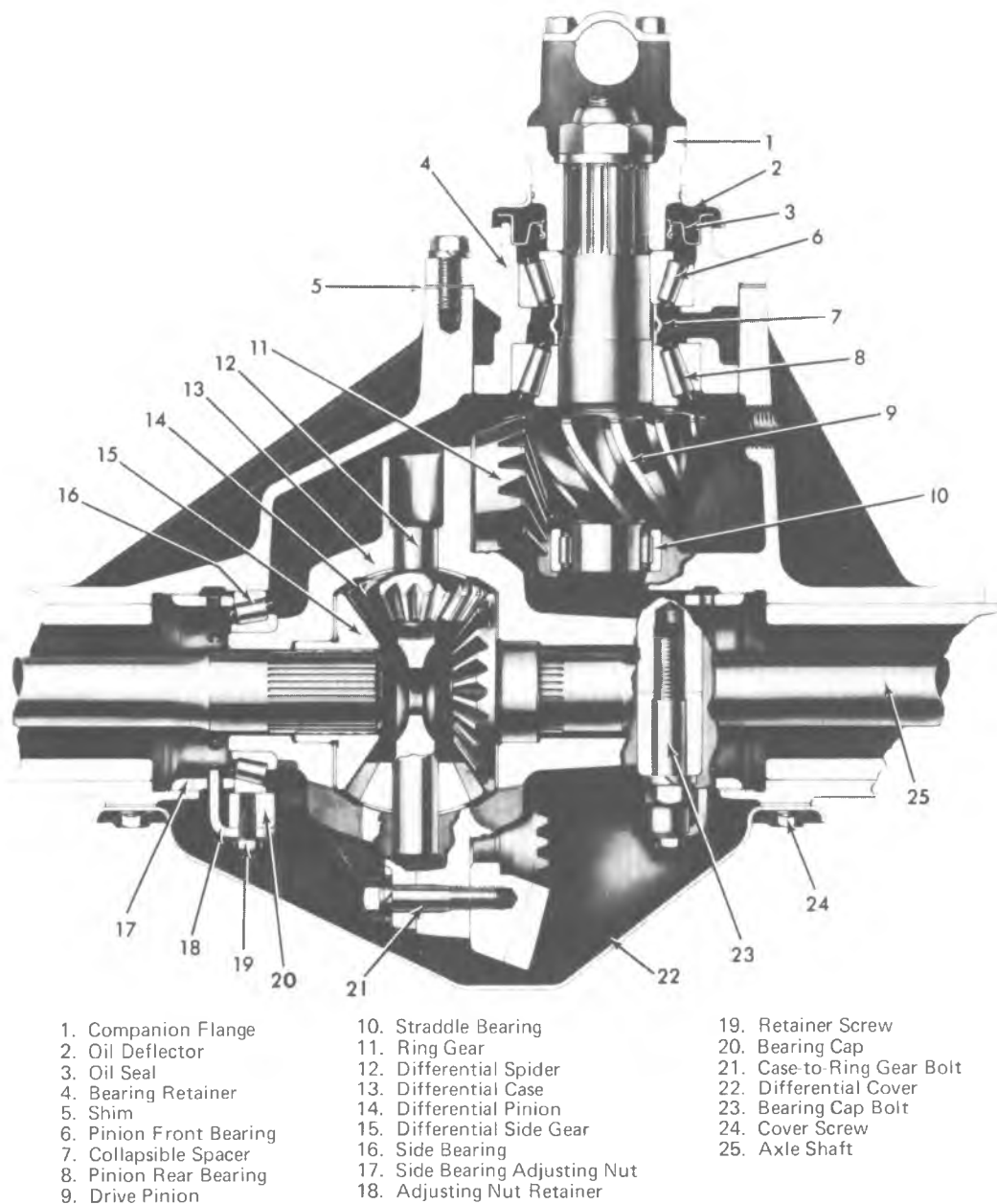


Fig. 1E--Cross Section of Chevrolet Truck Differential with 10 1/2" Ring Gear

3. Back off the left adjusting nut approximately two slots. Install locking fingers into holes and fasten fingers to bearing cap.

4. Tighten right adjusting nut firmly to force the case into solid contact with the left adjusting nut.

5. Loosen right adjusting nut until it is free from its bearing, then retighten until it contacts the bearing.

6. Tighten right adjusting nut approximately two slots if used bearings are being installed, or three slots if new bearings are being installed.

7. Install locking retainer into holes and attach fingers to bearing cap.

8. Torque bearing cap bolts to specifications.

**NOTE:** At this point the differential bearings are

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

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

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



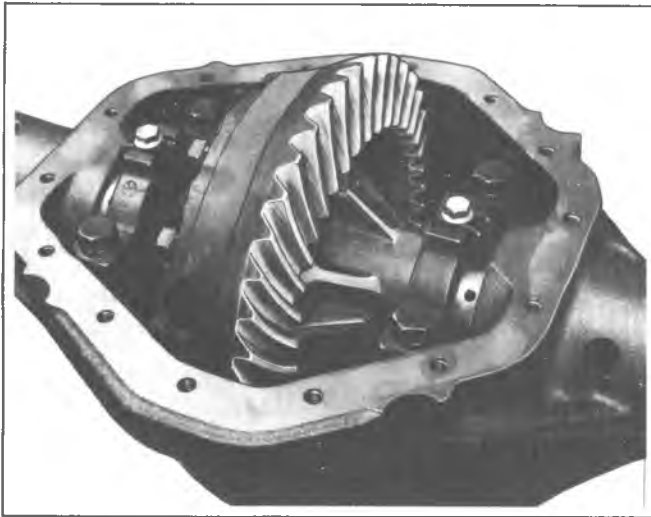


Fig. 2E--Cover Removed from Carrier



Fig. 4E--Differential Bearing Removal

## DRIVE PINION ASSEMBLY

### Removal

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

### Disassembly

1. Clamp the pinion assembly in vise.
2. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 8E. Position J-8614-11 on flange so that the four notches are toward the flange.
3. Use a suitable sized socket to remove the pinion nut

and washer. Discard the pinion nut and use a new one upon reassembly.

4. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as a step 2, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 9E.

5. Support the bearing retainer as shown in figure 10E and press out the drive pinion. Do not allow drive pinion to fall onto the floor.

6. Separate the pinion flange, the oil seal, the front bearing and the bearing retainer. The oil seal may have to be driven from the bearing retainer if it is being replaced.

7. Drive the pinion front and rear bearing cups from the bearing retainer, using a drift.

8. To remove the rear bearing, use J-22912 as shown in figure 11E.

9. Drive the pinion straddle bearing from the carrier

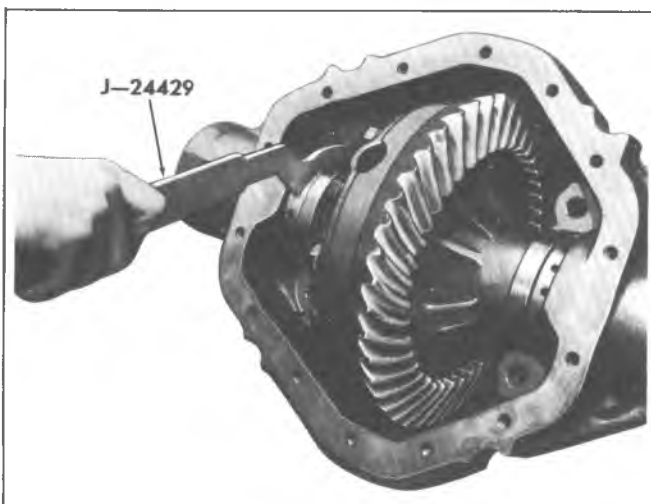


Fig. 3E--Loosening Adjusting Nuts



Fig. 5E--Differential Bearing Installation

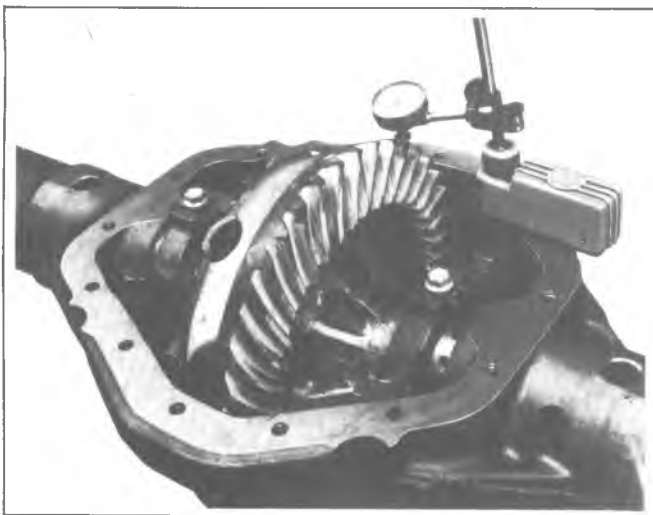


Fig. 6E--Measuring Backlash

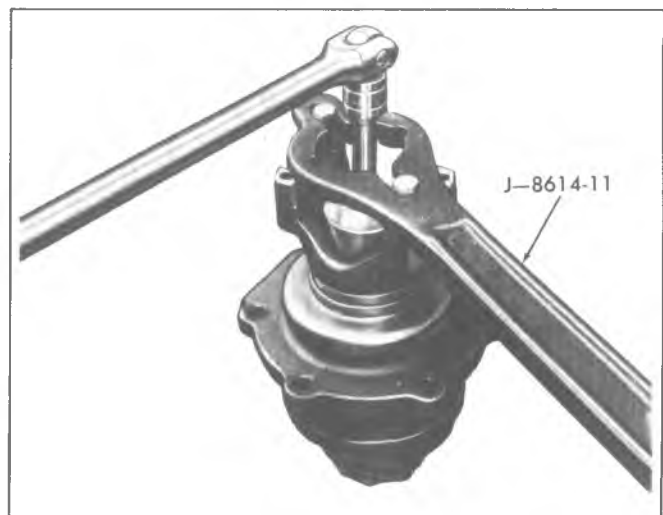


Fig. 8E--Removing Pinion Nut

housing, using a drift as shown in figure 12E.

### Inspection

1. Clean all parts in a suitable solvent and dry with air.
2. Inspect the drive pinion for chipped, cracked or excessively worn teeth and inspect the splines for wear.
3. Inspect the bearings for worn or pitted rollers or races. Inspect the pinion flange splines for wear.
4. Inspect the bearing retainer for cracks, imperfections, corrosion, pits and grooves.
5. Replace parts as required.

### Reassembly

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



Fig. 7E--Removing Retainer Bolts

5. Place bearing retainer, with cups in position, onto the drive pinion. Install a new collapsible spacer into position.

6. Press front bearing onto drive pinion.

7. Lubricate the oil seal lips with a lithium-base extreme pressure lubricant, and install the seal in the retainer bore. Use J-24434 with driver handle J-8092. Press the seal into the bore until it seats against internal shoulder.

8. Install pinion flange and oil deflector onto the splines, then install lock washer and new pinion nut.

9. Clamp the pinion flange into a vise. Install J-8614-11 as in figure 8E. Tighten the nut to achieve proper bearing preload.

- a. Proper preload is attained when rotational torque required to rotate the pinion is 25-35 in. lbs. for new bearings, or 5-15 in. lbs. for used bearings.

- b. Tighten pinion nut to approximately 350 ft. lbs., then take a torque reading as shown in figure 15E, using J-5853.

- c. Continue tightening pinion nut in small increments

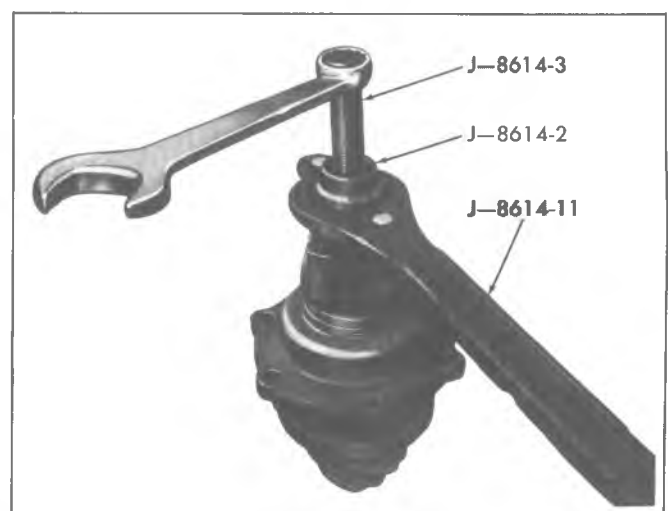


Fig. 9E--Removing Flange

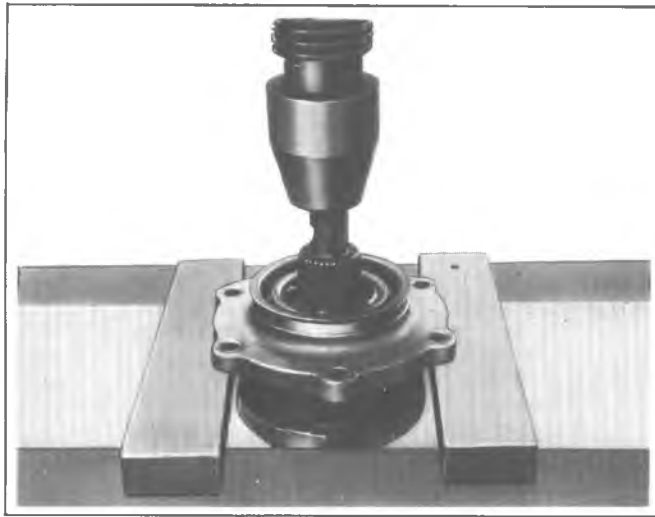


Fig. 10E--Pressing Drive Pinion from Bearing Retainer

until proper preload is attained.

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

#### Installation and Adjustment

1. Examine the head of the drive pinion for a pinion depth code number.
2. Compare the depth code number with the number on the original pinion. Use the following chart to select the proper shim for preliminary setting of pinion depth.
3. Refer to the thickness of the shim recorded earlier in Pinion Removal procedures. Increase or decrease the shim dimension as indicated by the chart in figure 16E.
  - a. For example, if original shim measured .014 inch, original code was -1 and new code is +2, the correct shim would be .014 inch plus .003 = .017 inch.
  - b. If original shim was .012 inch, original code +2, and new code is -2, the correct shim would be .012 minus .004 = .008 inch.
4. Place the pinion shim as determined in step 3 onto

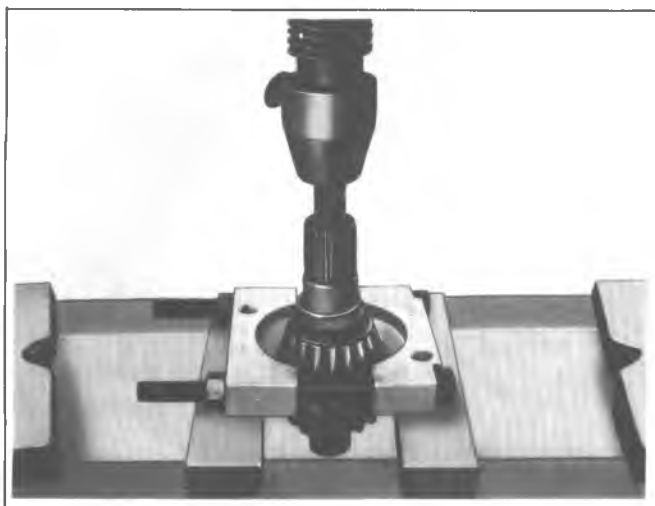


Fig. 11E--Removing Pinion Rear Bearing

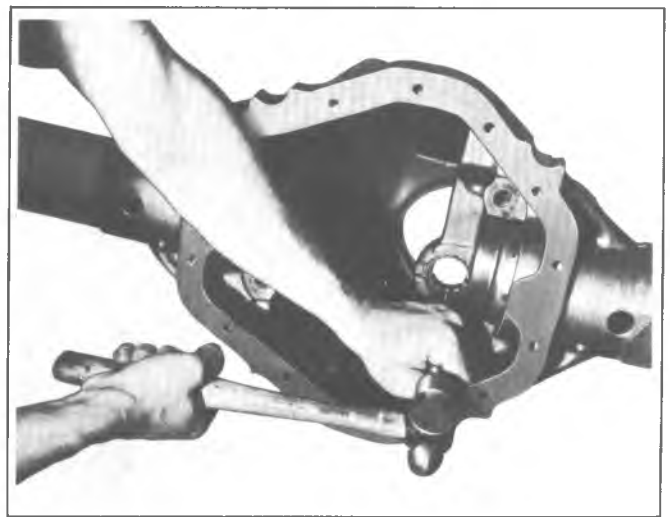


Fig. 12E--Removing Straddle Bearing

the carrier housing, making sure the bolt holes align with those of carrier, and that the mating surfaces are clean and free from foreign material.

5. Place the pinion retainer assembly into position, and align bolt holes to carrier. Install retaining bolts and tighten in a crosswise manner. Torque to specifications.
6. Following drive pinion service, a Contact Pattern Check must be made.

#### CHECK AND ADJUSTMENTS

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

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

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

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

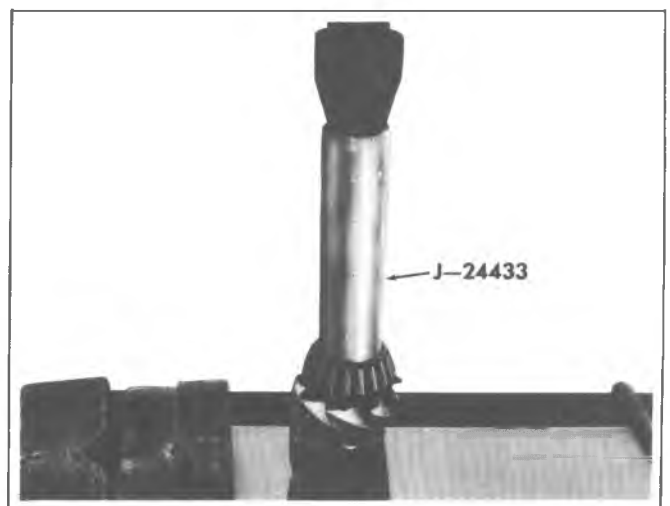


Fig. 13E--Installing Pinion Rear Bearing

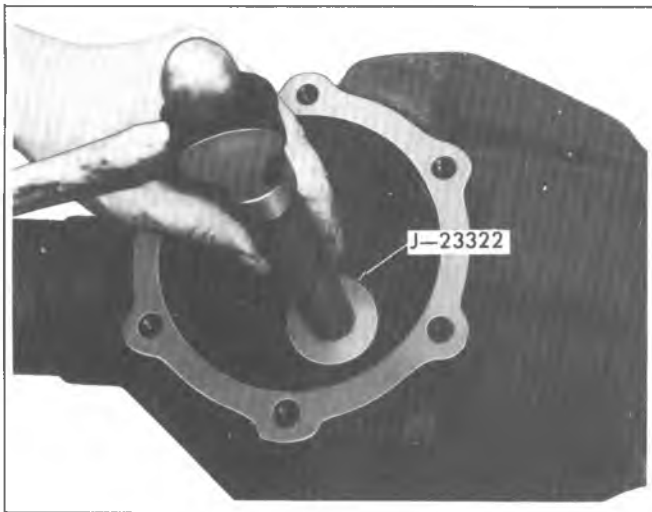


Fig. 14E--Installing Straddle Bearing

### 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-in" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 17E.

### Pattern Check

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound and apply this mixture to ring gear teeth. When properly applied, the area of tooth contact will be clearly visible after load is applied.

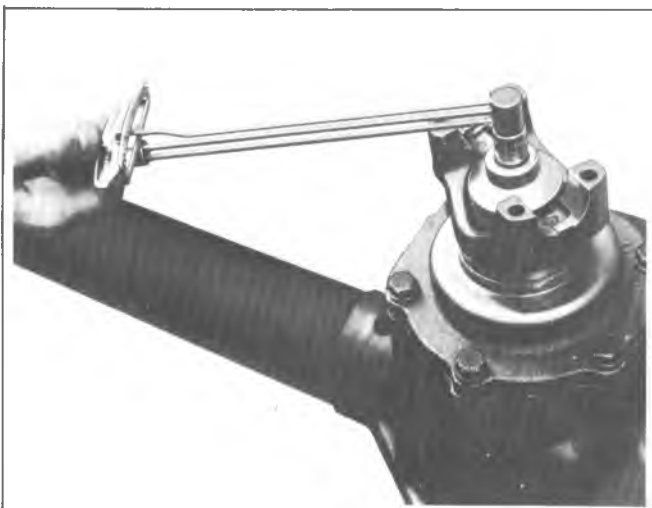


Fig. 15E--Measuring Rotating Torque

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

Fig. 16E--Pinion Depth Codes

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

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

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

### Pinion Depth Adjustment

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

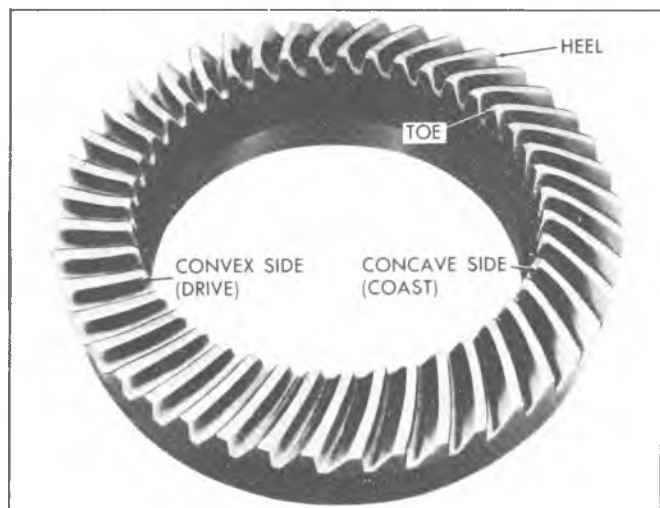


Fig. 17E--Gear Tooth Nomenclature

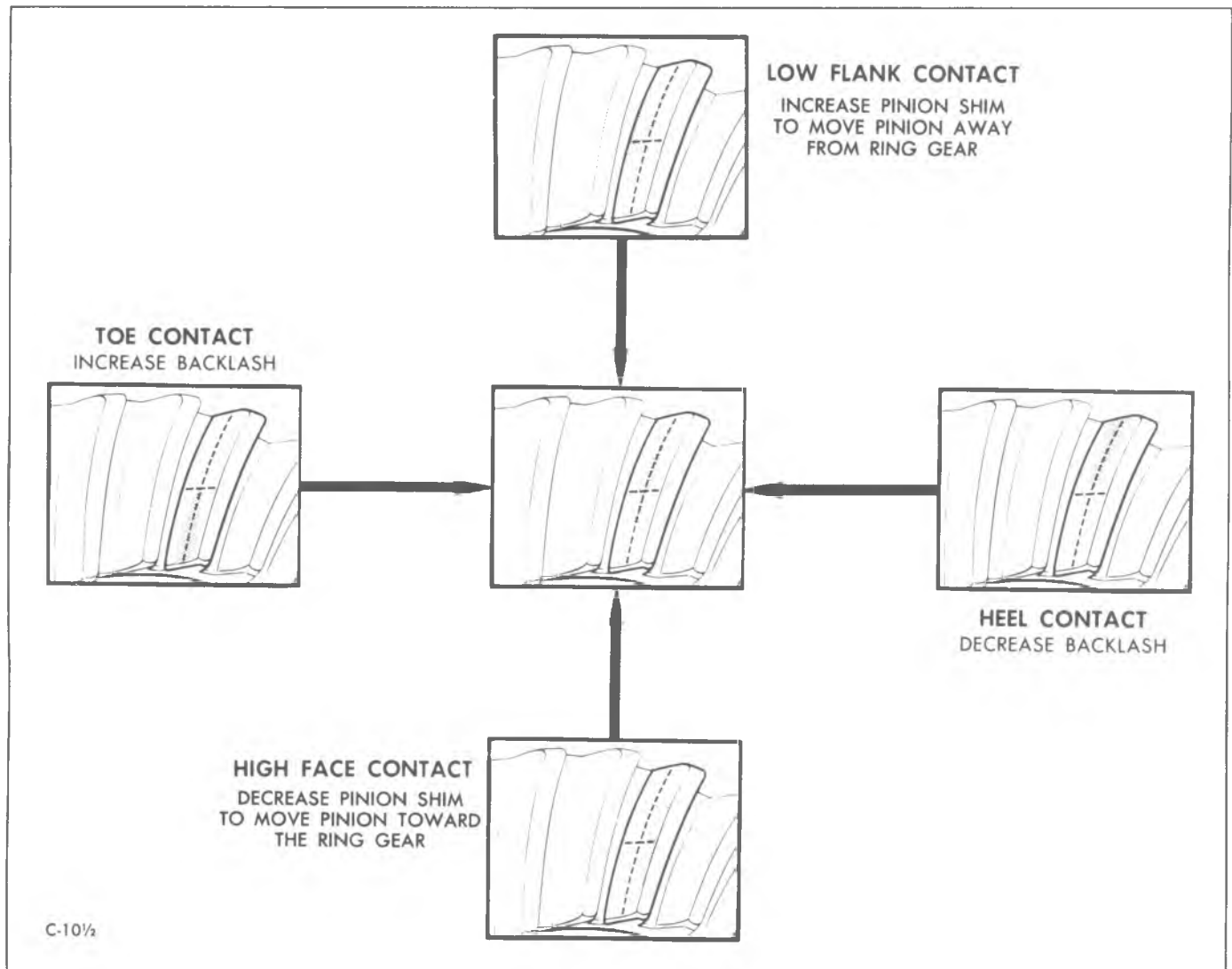


Fig. 18E--Gear Teeth Contact Pattern Check

### Backlash Adjustment

1. Remove locking retainers from side bearing adjusting nuts.
2. Move adjusting nuts **an equal amount** in or out to achieve proper backlash.

- a. To increase backlash, loosen the left adjusting nut and tighten the right adjusting nut **an equal amount**.
- b. To decrease backlash, loosen the right adjusting nut and tighten the left adjusting nut **an equal amount**.

## DANA DIFFERENTIALS 10-1 1/2." RING GEAR

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### GENERAL DESCRIPTION

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

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

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

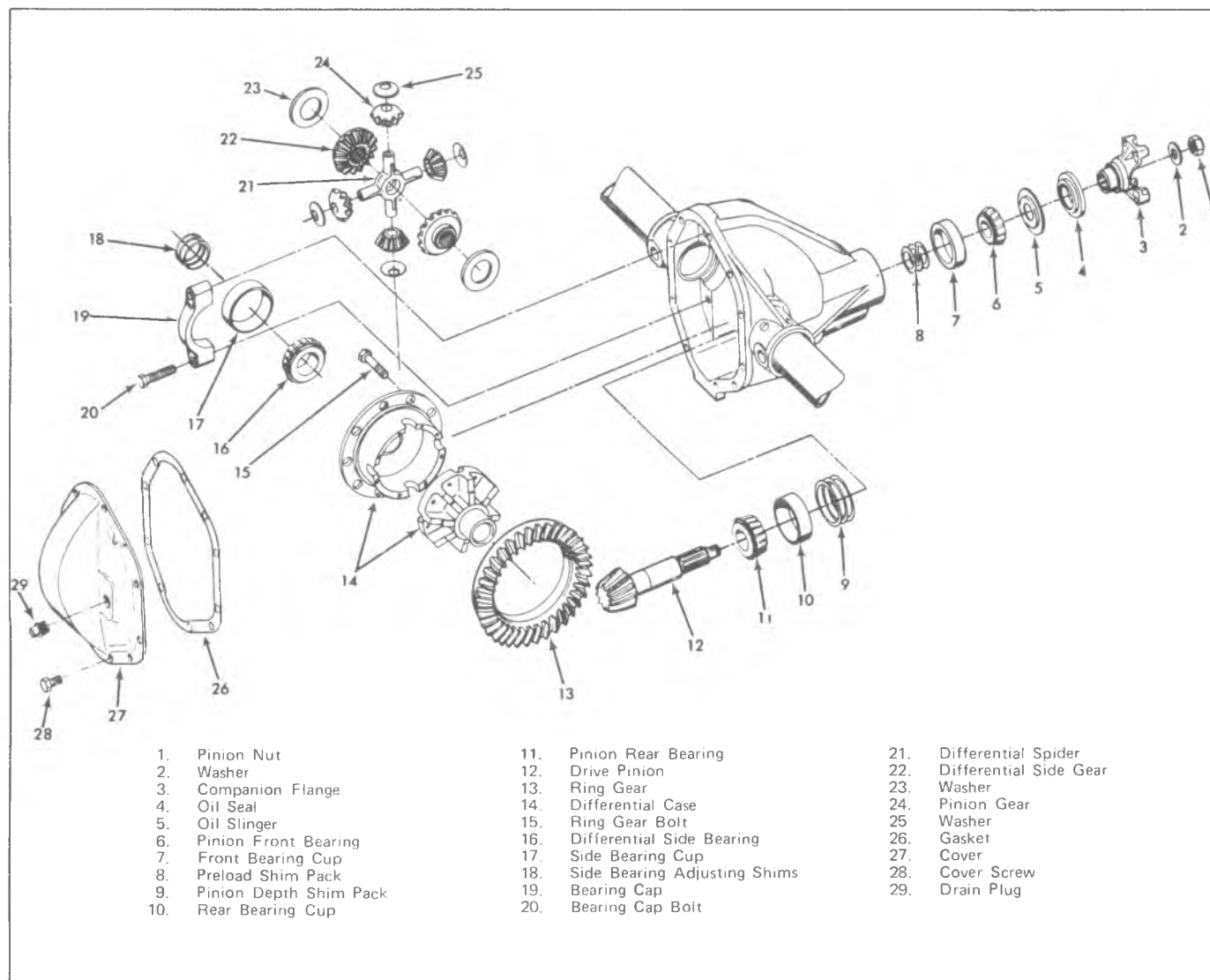


Fig. 1F--Dana Differential with 10-1/2" Ring Gear - Exploded View

## DIFFERENTIAL CASE

### Removal

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

shown in figure 2F, spread carrier a maximum of .015 inch.

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

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

### Disassembly

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

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

2. Remove the ring gear bolts and the ring gear. Tap the ring gear with a soft-faced hammer to free it from the case.

3. Scribe both case halves for reassembly in same

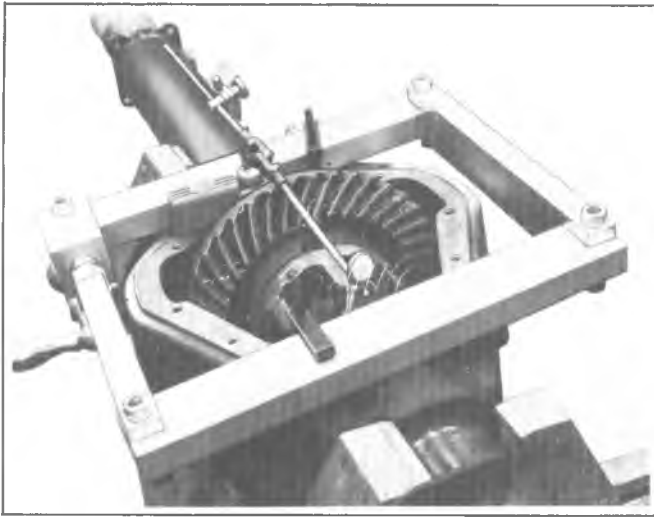


Fig. 2F--Spreading the Carrier

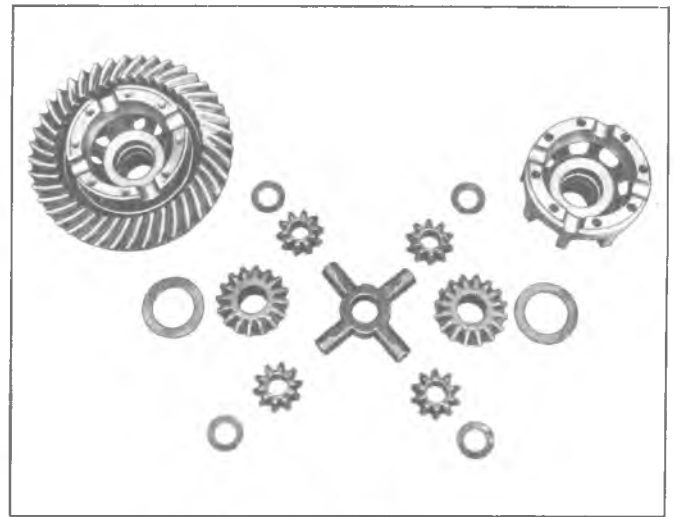


Fig. 4F--Internal Parts Inspection

position.

4. Remove bolts holding case halves together, as shown in figure 3F.

5. Tap lightly on top half of case to free it from the bottom half. Remove top half of case.

6. Lift out all internal parts.

### Inspection

1. Clean all gears and bearings in solvent. Inspect cups, races and rollers for scoring, chipping or evidence of excessive wear.

2. Inspect ring gear teeth and machined surfaces. Examine fit of internal gears.

3. Inspect pinion cross-shaft.

4. Replace parts as required.

### DRIVE PINION

#### Removal and Disassembly

1. Remove differential as previously outlined.

2. Check pinion bearing preload as described under "Drive Pinion - Installation and Adjustment." If there is no preload reading, check for looseness of pinion assembly by

shaking the companion flange. Looseness indicates the need for bearing replacement.

3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 5F. Position J-8614-11 on flange so that the four notches are toward the flange.

4. Remove pinion nut and washer. Discard pinion nut and use a new one upon reassembly.

5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-22 as shown in figure 6F.

6. Remove drive pinion from carrier. It may be necessary to tap on the pinion with a soft faced hammer.

7. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.

8. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.



Fig. 3F--Separating Case Halves

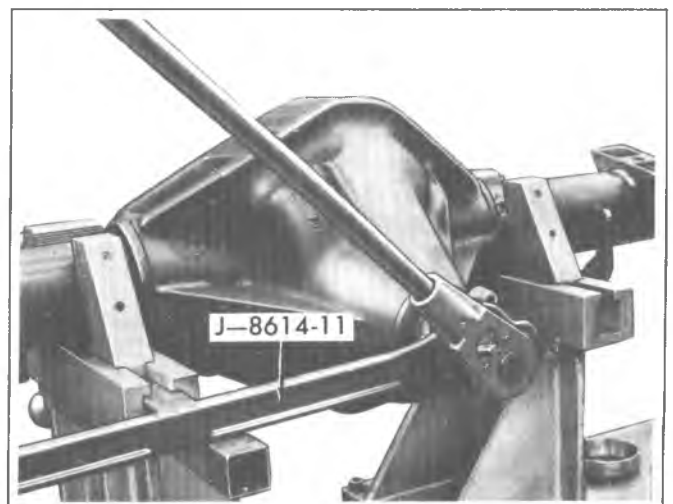


Fig. 5F--Removing Pinion Nut



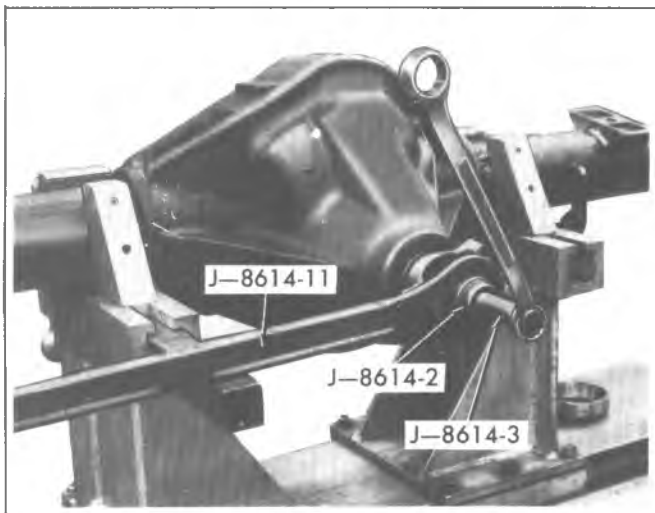


Fig. 6F--Removing Companion Flange

9. Remove rear pinion bearing using J-22912, and an arbor press.

### Inspection

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

2. Inspect pinion splines and flange splines for evidence of excessive wear.

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

4. Inspect differential case for cracks or scores or side gears, thrust washers, and pinion thrust faces.

5. Check fit of differential side gears in case.

6. Check fit of side gears and axle shaft splines.

7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.

### DIFFERENTIAL CASE

#### Reassembly

1. Assemble new washers to side gears. Apply a small amount of hypoid lubricant on the side gear hubs.

2. Assemble pinion gears and new washers onto cross shaft.

3. Place side gears, pinion gears, cross shaft and washers into flanged half of case.

4. Assemble top half of case to bottom half, making sure scribe marks are aligned.

5. Assemble body bolts finger tight. Then tighten bolts alternately to specifications.

6. Install ring gear to differential case.

7. Install ring gear-to-case bolts finger tight, then tighten alternately to specifications.

8. Place side bearing into position and install, using tools J-8092 and bearing installer J-24383 as shown in figure 7F.

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



Fig. 7F--Installing Side Bearing

### SHIM REQUIREMENTS - GAGING PROCEDURES

#### Side Bearing Shims

1. With the pinion removed from the carrier, place the bearing cups over the side bearings, and install the differential case into the carrier.

2. Place the shim which was originally installed on the ring gear side into its original position.

3. Install the bearing caps lightly in their marked positions. Tighten the caps just enough to keep the bearings in place.

4. Mount a dial indicator on the carrier with the tip of the indicator on the back face of the ring gear.

5. Position two screwdrivers between the bearing shim and carrier on the ring gear side of the case. Pull on the screwdrivers and force the differential case as far as possible away from the dial indicator.

6. With force still applied, set the indicator dial to "zero", being sure the probe is still in contact with the ring gear.

7. Reposition the screwdrivers to the opposite side of the differential case as shown in figure 8F.

8. Pull on the screwdrivers and force the differential case back toward the dial indicator. Repeat several times until the same indicator reading is obtained.

9. To the dial indicator reading, add the thickness of the shim. Record the result, as this figure will be used during determination of side bearing shim requirements.

#### Pinion Shims

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

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



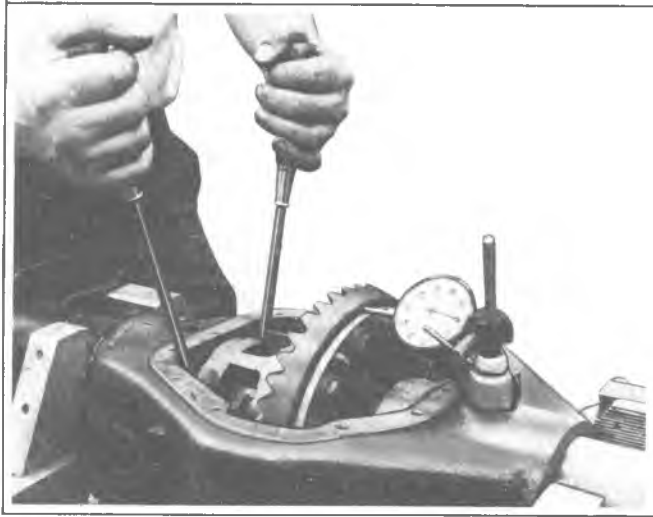


Fig. 8F--Screwdrivers Against Case

pack.

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

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

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

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

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

If a new gear set is being used, notice the plus or minus etching on both the old and new pinion, and adjust the 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 pinion is (-2), add .004" shims to the original shim pack.

## DRIVE PINION

### Assembly and Installation

1. Determine the correct pinion depth shim by using the chart in figure 9F.

2. Install the pinion depth shim in rear cup bore.

3. Install rear bearing cup by using driver handle J-8092 and installer J-24381.

4. To the outer shim pack (for setting preload) add or remove an equal amount as was added or removed from the inner shim pack.

5. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092.

6. Press rear pinion bearing onto pinion shaft, using installer J-24433.

7. Install drive pinion and bearing into the differential carrier.

8. Install preload shims and front pinion bearing. Do not install oil seal at this time.

9. Install flange and holding bar J-8614-11 as shown in "Drive Pinion - Removal".

10. Install washer and nut onto pinion shaft. Torque nut to 250 lbs. ft.

11. Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.

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

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

Fig. 9F--Dana Pinion Code Chart



Fig. 10F--Pinion Code Location

12. If torque requirements (preload) are not to specifications, adjust shim pack as necessary.

a. To increase preload, decrease the thickness of preload shims.

b. To decrease preload, increase the thickness of preload shims.

13. When bearing preload meets specifications, remove nut, washer and flange from pinion shaft.

14. Install new pinion oil seal into housing as shown in figure 11F, using J-24384.

15. Install flange, washer and nut. Using holder bar J-8614-11, torque nut to 250 lbs. ft.

## DIFFERENTIAL CASE

### Installation and Adjustment

1. Place the differential case, with side bearings and cups installed, into position in the carrier.

2. Select the smallest of the original shims as a "gaging" shim and place it between the bearing cup and the carrier on the ring gear side of the case.

3. Install bearing caps and bearing screws finger tight.

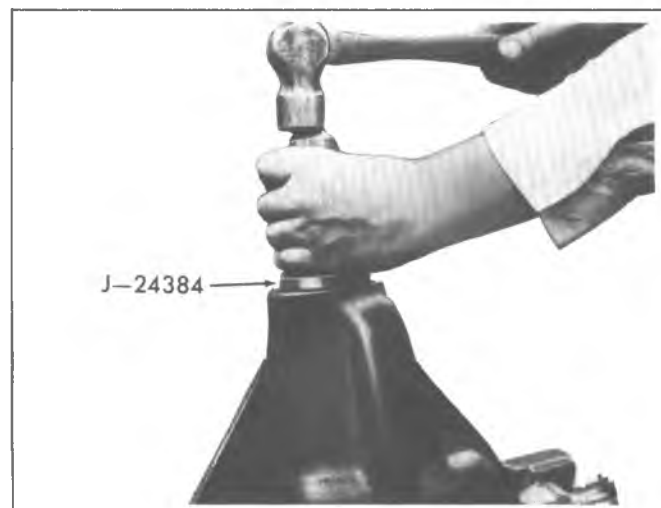


Fig. 11F--Installing Pinion Oil Seal

Make sure bearing caps are in correct marked position.

4. Mount a dial indicator on the ring gear side of the carrier, with the indicator probe in contact with the back face of the ring gear.

5. Position two screwdrivers between the bearing cup and the carrier on the side opposite the ring gear.

6. Pull on the screwdrivers and force the differential case as far as possible toward the indicator. With force still applied, set the dial indicator to zero.

7. Reposition the screwdrivers on the ring gear side of the case. Force the ring gear into mesh with the drive pinion and observe the dial indicator. Repeat this operation several times until the same reading is obtained.

8. Add the indicator reading to the "gaging" shim thickness to determine the correct shim dimension for installation on the ring gear side of the case.

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

9. Remove the "gaging" shim and install the correct size shim into position between the bearing cup and the carrier on the ring gear side of the case.

10. To determine the correct dimension for the remaining shim, first refer to the dimension obtained in step 8 of "Gaging Procedures--Side Bearing Shims". From that figure, subtract the size of the shim installed in step 9 above; then add .006 inch for preload and backlash.

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

11. Spread the differential carrier as shown in figure 2F.

12. Assemble the shim determined in step 10 into place between the bearing cup and the carrier.

13. Remove the spreader and the dial indicator.

14. Install the bearing caps in marked positions and torque cap screws to specifications.

15. Install dial indicator and check ring gear backlash at four equally spaced points around the ring gear. Backlash must be held to .004" to .009" and must not vary more than .002" between positions checked.

16. Whenever backlash is not within limits, differential bearing shim pack should be corrected to bring backlash within limits.

a. Low backlash is corrected by decreasing the shim on the ring gear side and increasing the opposite side shim **an equal amount**.

b. High backlash is corrected by increasing the shim on the ring gear side and decreasing the opposite side shim **an equal amount**.

17. Check gear tooth contact, as described in "Gear Tooth Contact Pattern Check".

18. Using a new gasket, install housing cover and torque bolts to specifications.

19. Reinstall the rear universal joint, and torque "U" bolt nuts to specifications.

20. Install axles into carrier and axle flange over hub studs.

21. Torque hub stud nuts to specifications.

22. Fill differential with lubricant.

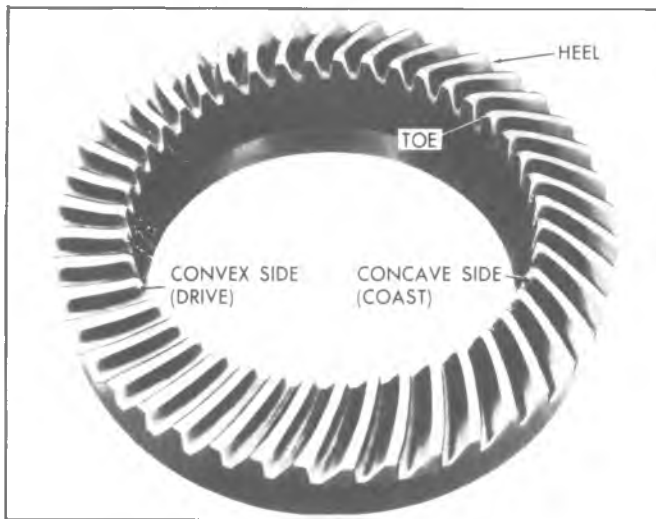


Fig. 12F--Gear Tooth Nomenclature

23. Install wheel and tire assembly.

### CHECKS AND ADJUSTMENTS

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

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

### GEAR TOOTH CONTACT PATTERN CHECK

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

### Gear Tooth Nomenclature

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

### Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
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 specifications.
4. Apply load to gears by expanding brake shoes or by wrapping a heavy rag around the companion flange to resist rotation.

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

5. Observe pattern on ring gear teeth and compare with figure 13F. Make adjustments as necessary.

6. The important thing to achieve in the pattern check and subsequent adjustments is to locate the contact pattern centrally on the face of the ring gear teeth.

### Adjustments Affecting Tooth Contact

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

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

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

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

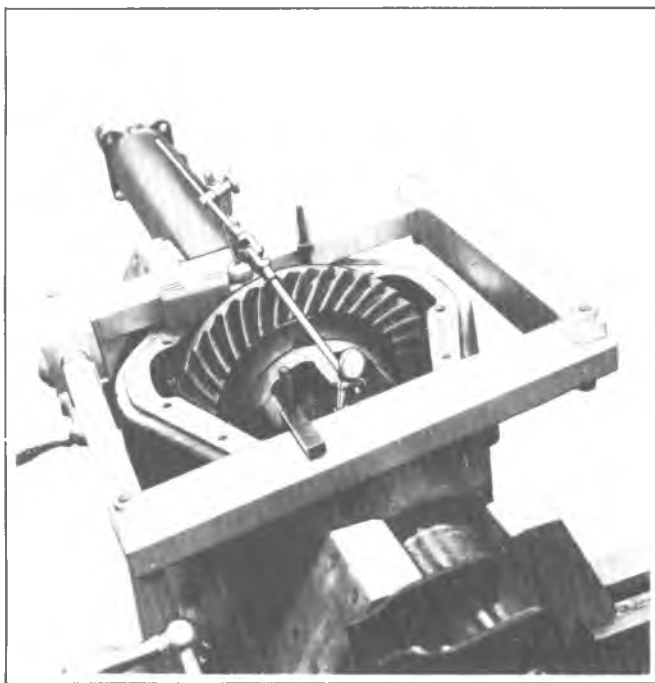


Fig. 15F--Tool J-24385 Mounted on Carrier

cone and rollers for assembly.

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

4. Remove spacer, pinion shaft, pinions, side gears and thrust washers from differential case.

5. Remove screws attaching ring gear to differential case. Remove gear.

## DRIVE PINION

### Removal

1. Separate rear universal joint, tape trunnion bearings to joint, position propeller shaft to one side and tie propeller shaft to frame side rail.

2. Using Holding Bar J-8614-11, attached to pinion shaft flange, remove self-locking nut and washer from pinion shaft.

3. Install Tool J-8614-2, and 3 into holding bar as shown in figure 17F and remove flange from drive pinion. Remove drive pinion from carrier.

4. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.

5. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.

6. Remove inner pinion cone and roller using Tool J-22912, installed as shown in Figure 18F, and press pinion from bearing.

### Inspection

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

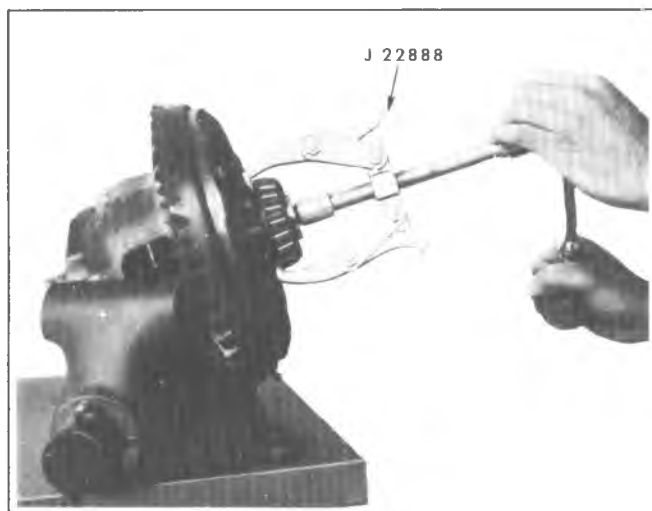


Fig. 16F--Removing Differential Side Bearings

wear is most evident on tapered roller bearings.

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

2. Inspect pinion splines and flange splines for evidence of excessive wear.

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

4. Inspect differential case for cracks or scores. Inspect side gears, thrust washers, and pinion thrust faces.

5. Check fit of differential side gears in case.

6. Check fit of side gears and axle shaft splines.

7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.

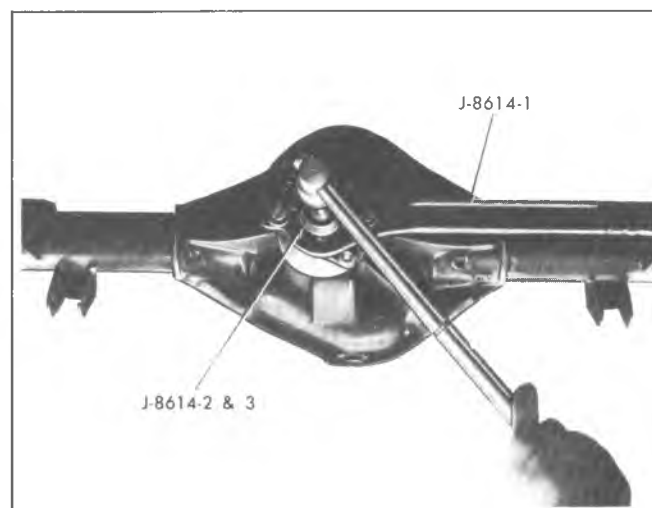


Fig. 17F--Removing Pinion Flange

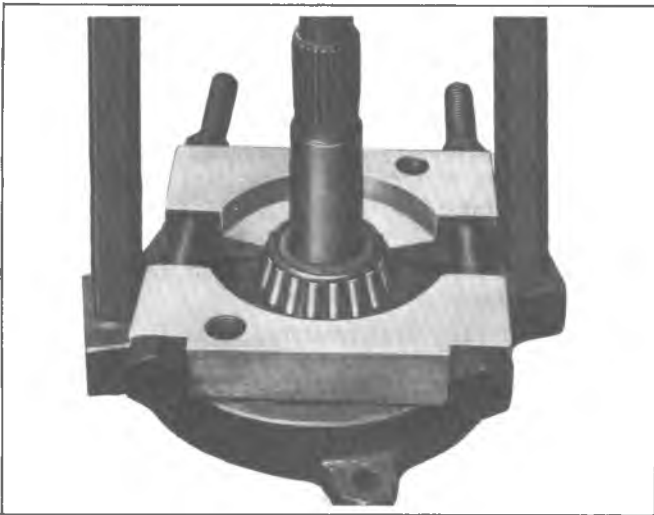


Fig. 18F--Removing Inner Pinion Bearing Cone and Roller

## DIFFERENTIAL CASE

### Reassembly

1. Position differential side gears and new thrust washers in differential case.
2. Position differential pinions and new thrust washers in differential case. Align pinions with holes in differential case.
3. Install pinion shaft in differential case. Align hole in shaft with hole in case, then install lock pin. Peen hole to prevent pin dropping out of case.
4. Position ring gear to case, then install cap screws. Tighten cap screws evenly and alternately to specifications.
5. With an arbor press, press differential side bearings onto case using Tool J-21051. Do not install shims at this time.
6. Place differential case in carrier and install bearing caps. Care should be taken to install caps in original position. Use mark placed on caps and carrier at removal. Tighten caps just enough to keep bearing caps in place.
7. Install dial indicator on carrier with indicator button contacting back of ring gear, as in figure 19F. Rotate

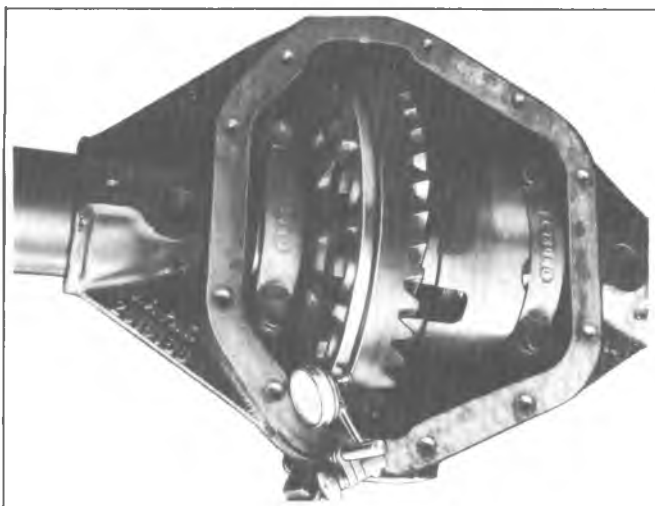


Fig. 19F--Checking Runout

differential case and check for runout. If runout is greater than .002", the assembly should be removed and the ring gear removed from the case. Again install differential case and check runout at differential case flange.

8. Should runout of case flange be greater than .002", the defect is probably due to bearings or differential case, and should be corrected before proceeding further.

9. Position two screwdrivers between bearing cup and carrier on opposite side of ring gear (away from dial indicator side). Pull on screwdrivers and force differential case as far as possible toward the dial indicator. Rock the ring gear to set the bearings. With force still applied, set indicator at "O".

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

11. Remove differential from carrier.

## DRIVE PINION

### Installation and Adjustment of Depth and Preload

Ring gears and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring gear 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. See figure 20F.

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

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

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

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

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

For example: If the old pinion reads (+2) and the new

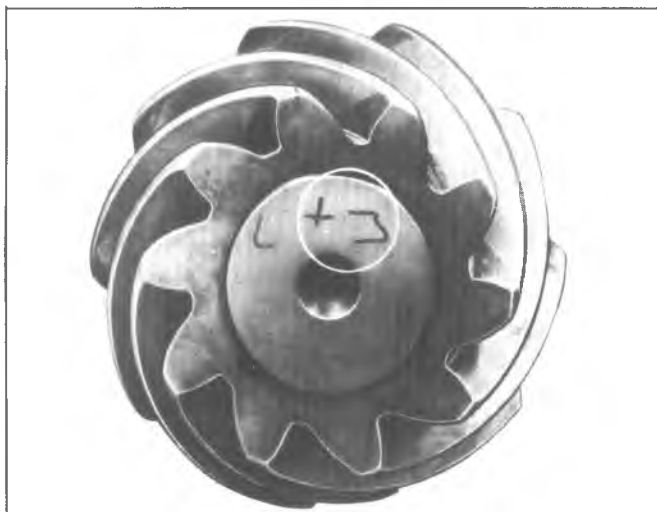


Fig. 20F--Marking From Nominal on Pinion

pinion is (-2), add .004" shims to the original shim pack.

1. Determine proper inner shim pack (for setting pinion depth) by using chart in figure 21F.

2. Install inner shim pack and oil slinger in inner cup bore and drive inner cup into position using Tool J-21059 used with J-8092.

3. To the outer shim pack (for setting preload) add or remove an equal amount as was added or removed from the inner shim pack.

4. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092 as shown in figure 22F.

5. Press inner pinion bearing cone and roller onto pinion shaft using Installer J-9772 on arbor press as shown in figure 23F.

6. Install drive pinion and inner bearing cone and roller assembly in differential carrier.

7. Install shims and outer pinion cone and roller on pinion shaft using Tool J-5590 and companion flange to

press bearing onto pinion, as in figure 24F.

8. Install flange holding bar and install washer and nut on pinion shaft. Torque nut to 255 ft. lbs.

9. Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.

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

10. If torque requirements (preload) are not to specifications, adjust shim pack as necessary. Increase the outer shim pack to reduce rotation torque. Decrease shim pack to increase rotating torque.

11. Remove nut, washer and flange from pinion shaft.

12. Install oil slinger, gasket and using Tool J-22804 install oil seal.

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

## DIFFERENTIAL CASE

### Preload and Adjustment

1. Place differential assembly (with pinion assembled) into housing. Install bearing caps in their proper position and tighten screws just enough to hold the bearing cups in place.

2. Install dial indicator on carrier with indicator button contacting back of ring gear, as in figure 19F.

3. Place two screwdrivers between bearing cup and housing on ring gear side of case, and pry ring gear into mesh with pinion gear as far as it will go. Rock ring gear to allow bearings to seat and gears to mesh. With force still applied, set indicator to "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 side gear. Remove differential bearing from the ring

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

Fig. 21F--Dana Pinion Code Chart

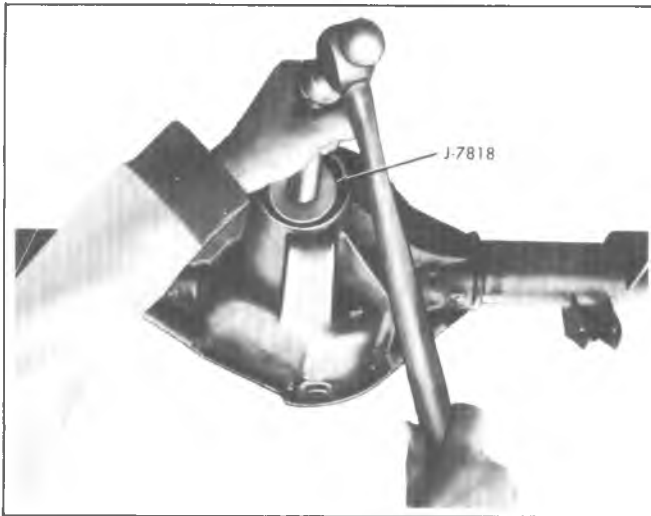


Fig. 22F--Installing Outer Pinion Bearing Cup

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.

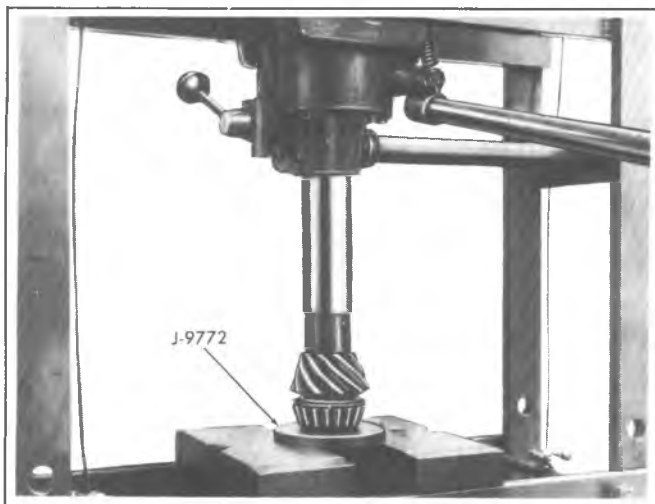


Fig. 23F--Installing Inner Pinion Cone and Roller

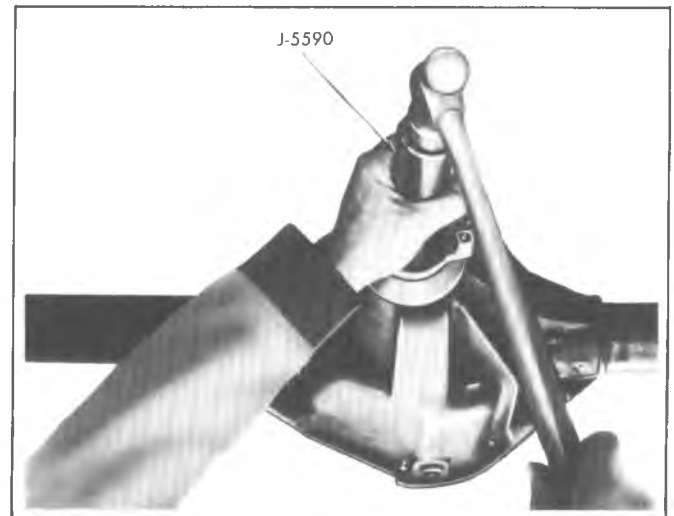


Fig. 24F--Installing Pinion Flange

### Installation

1. Spread differential carrier, using spreader as shown in figure 15F.

2. Install differential bearing outer races in their correct location, then install differential case into carrier.

3. Install differential bearing caps in the correct location as indicated by marks made at disassembly. Install cap screws finger tight. Rotate differential assembly and rap on case with a soft faced hammer to ensure proper seating of case in carrier.

4. Remove spreader and torque cap bolts to specifications.

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, as described earlier in "Dana 10-1/2" Ring Gear" section, under "Gear Tooth Contact Pattern Check". Refer to figure 25F.

8. Using a new gasket, install housing cover and torque bolts to specifications.

9. Reinstall the rear universal joint, and torque "U" bolt nuts to specifications.

10. Install axles into carrier and axle flange over hub studs. Torque hub stud nuts to specifications.

11. Fill differential with lubricant.

12. Install wheel and tire assembly.

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

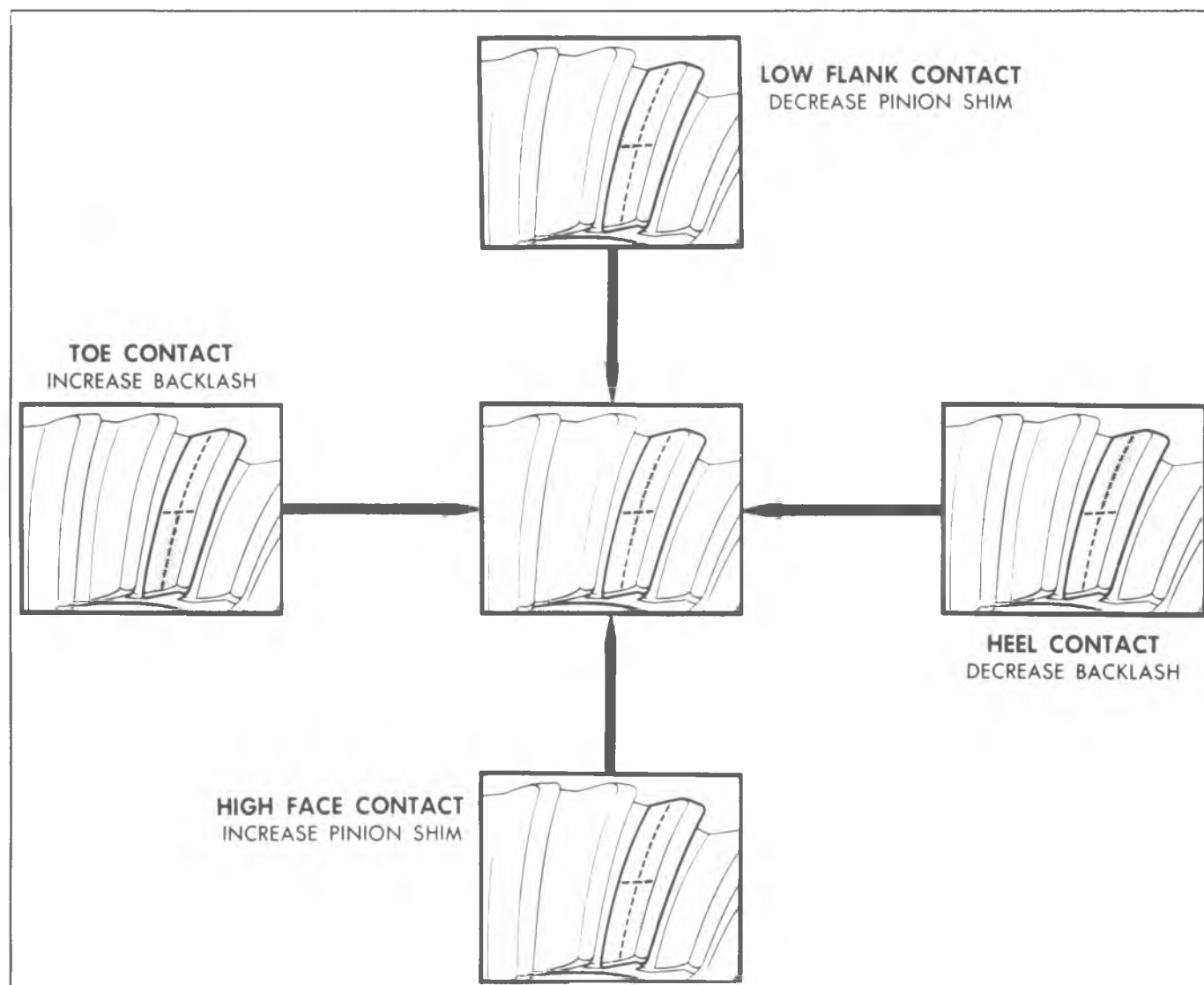


Fig. 25F--Gear Teeth Contact Pattern Check

## CHEVROLET TRUCK DIFFERENTIAL 12-1/4" RING GEAR

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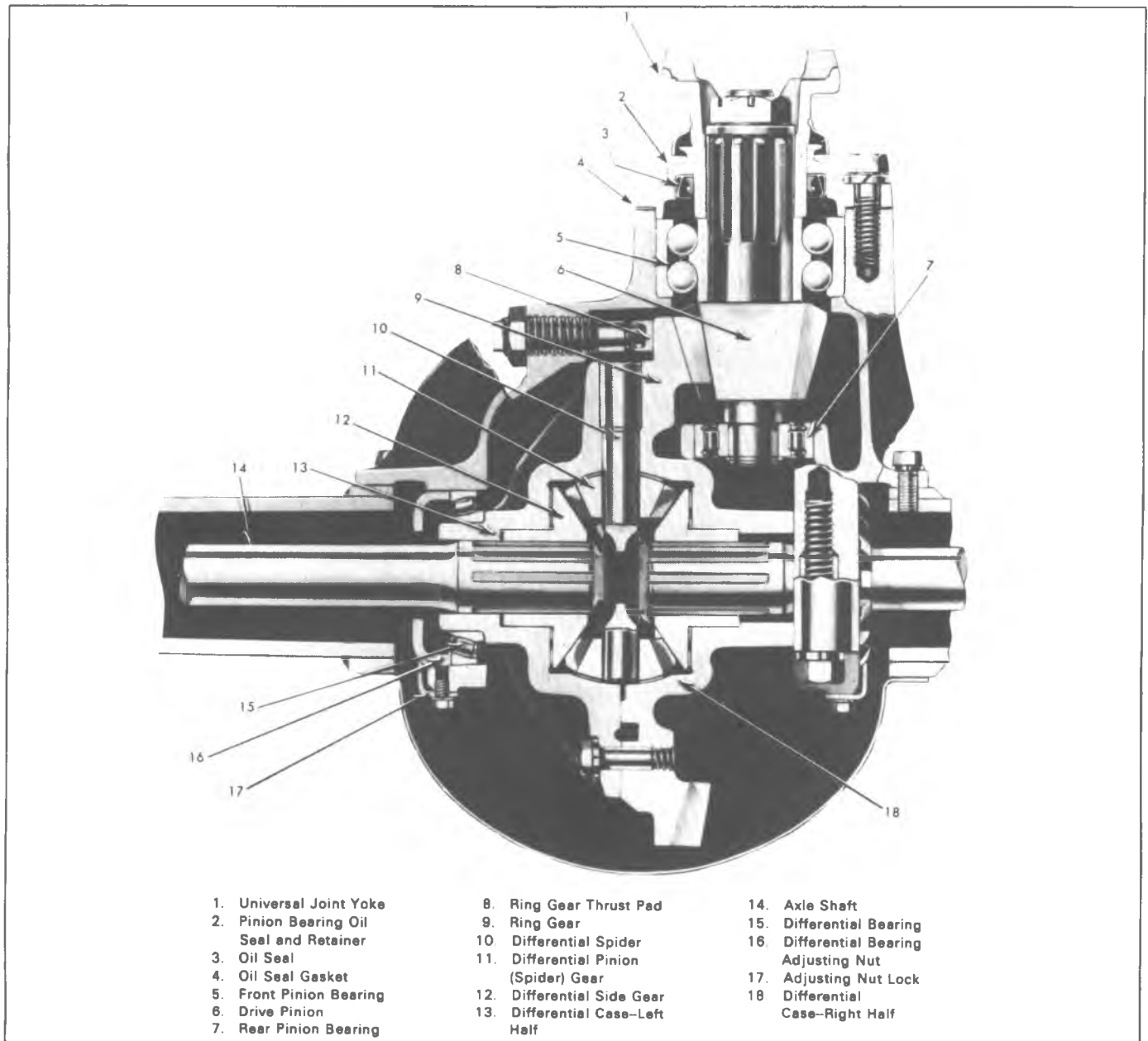


Fig. 1G--Cross Section of Truck Differential with 12 1/4" Ring Gear

## CASE AND DRIVE PINION

### Removal

1. Drain lubricant from differential, remove axle shaft as outlined in Truck Service Manual. See "Axle Shaft Removal".

2. Remove two trunnion bearing "U" bolts from the rear yoke and split the rear universal joint.

**NOTE:** The bearings can be left on the trunnion and held in place with tape.

3. Swing propeller shaft to one side and tie to the frame side rail.

4. Remove bolts and lock washers which retain the carrier assembly to the axle housing. Support the differential housing with a floor jack and roll it from under truck.

### Disassembly

1. Mount carrier assembly in a bench vise or holding fixture.

2. Loosen ring gear thrust pad locknut and remove thrust pad.

3. Remove differential adjusting nut locks and bearing cap bolts and lock washers.

4. Mark bearing caps and carrier for reassembly in same position. Remove bearing caps and adjusting nuts by tapping on bosses of caps with a soft faced hammer until caps are free from dowels.

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

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

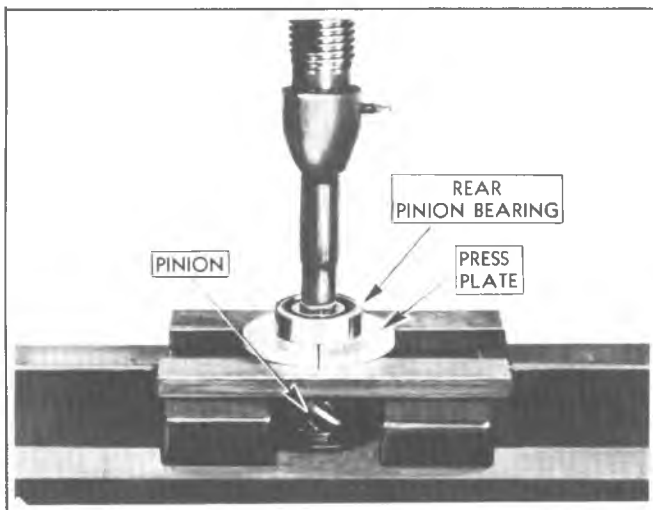


Fig. 2G--Pinion Rear Bearing Removal

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

6. Remove the bolts which attach the pinion bearing retainer to the carrier.

7. Remove the pinion and bearing assembly from the carrier.

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

## Repairs

### Pinion Disassembly

1. Clamp pinion drive flange in bench vise.
2. Remove cotter pin, nut and washer from end of pinion.
3. Remove drive flange and bearing retainer assembly from pinion.
4. Drive oil seal from retainer. Discard seal as new parts should be used at assembly.
5. Remove pinion rear bearing snap ring and press bearing from pinion, using Tool J-1453, as shown in figure 2G.
6. Position drive pinion in an arbor press so that the bearing is supported by two pieces of flat steel stock as shown in figure 3G. Place flat stock parallel to each other and against pinion so as to pick up a large area of bearing outer race. Press pinion from bearing making sure pinion is supported to prevent damage when removed from bearing.

### Pinion Inspection

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

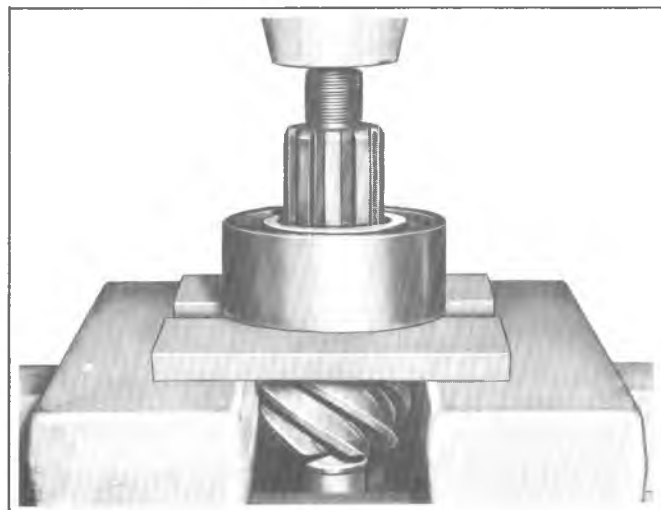


Fig. 3G--Drive Pinion Front Bearing Removal

### Pinion Reassembly

1. Pack the cavity between the pinion oil seal lips with a lithium-base EP lubricant to provide initial lubrication and to aid in inserting pinion flange.

2. Press the oil seal into the retainer. Position seal lips toward the pinion bearing, using Tool J-22281 as shown in figure 4G.

3. Install the pinion rear bearing assembly on pinion shaft making sure that chamfered side of inner race seats against shoulder on pinion shaft. Then install pinion bearing lock ring using Tool J-1364 as shown in figure 5G.

4. To install pinion front bearing, position the one-piece double row ball bearing on pinion shaft, so that extended portion of inner race is toward pinion head. Then, using a suitable length of 2 inch pipe, press bearing onto shaft until it seats against the pinion head.

**CAUTION:** When pressing bearing on pinion, exercise care to prevent damage to ground surface of pilot.

5. Slide oil seal retainer on pinion shaft, then tap drive flange onto pinion splines.



Fig. 4G--Pinion Oil Seal Installation

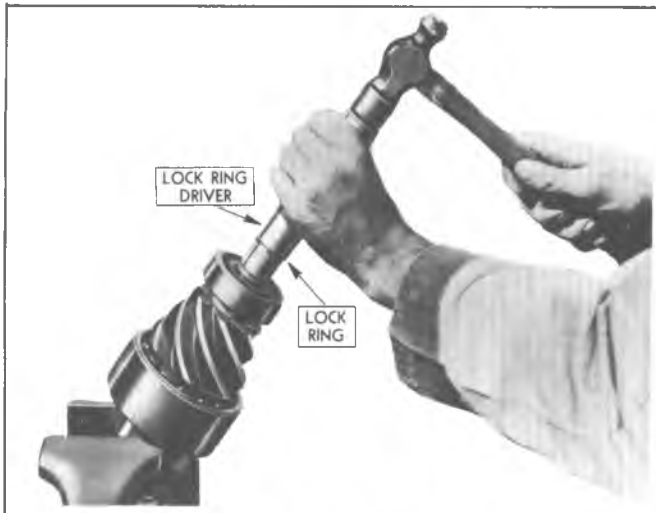


Fig. 5G--Pinion Rear Bearing Lock Ring Installation

6. Clamp drive flange in a bench vise and install flange washer and nut. Torque to specifications and install cotter pin without backing off on nut.

### Differential Disassembly

1. Check differential case to make sure that the two halves are marked so they may be reassembled in same relation. See figure 6G.

2. Remove bolts holding case and cover together.

**NOTE:** Ring gear is mounted on the case.

3. Separate cover from case and remove differential side gears and thrust washers, pinion gears with thrust washers and differential spider.

### Differential Inspection

1. Wash all parts thoroughly in cleaning solvent.
2. Inspect ring gear for chipped, scored or worn teeth.
3. Check radial clearance between differential side gears and differential case, also fit of differential pinions on spider.
4. Inspect spider arms for wear and distortion.
5. Inspect splines and teeth of differential side gears and

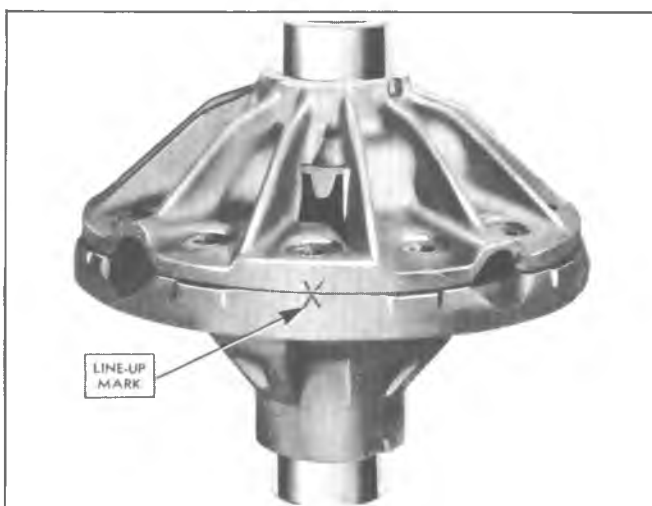


Fig. 6G--Differential Case Line-Up Marks

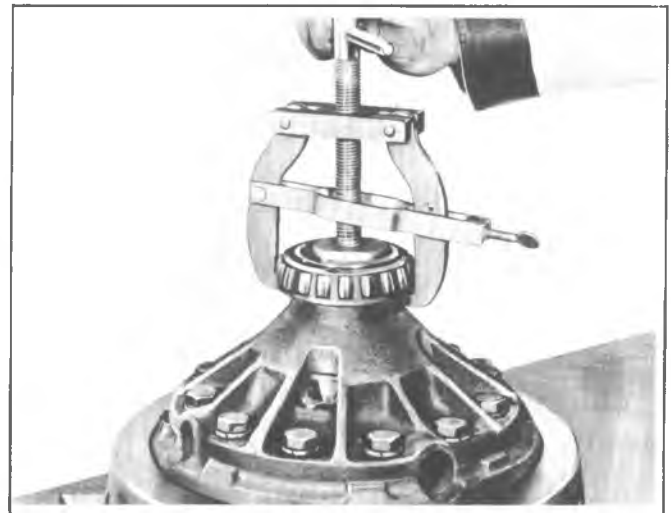


Fig. 7G--Differential Bearing Removal

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 7G.

2. Tighten puller screw to remove bearing.

3. Place new bearing on hub with thick side of inner race toward case and install bearing using J-1488 as shown in figure 8G.

**NOTE:** The side bearing tool is counterbored 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 bolts and lock washers and tighten evenly until ring gear is flush with case flange.

6. Remove two guide pins and install remaining two



Fig. 8G--Differential Bearing Installation

bolts. Torque all bolts alternately and evenly to specifications.

### Reassembly

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

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

2. Install pinion bearing retainer bolts and lock washers and torque bolts to specifications.

3. Lubricate differential bearing rollers with engine oil and place outer races over them.

4. Install differential assembly in carrier and install adjusting nuts.

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

5. Install differential bearing caps making sure the marks on the caps line up with the marks on the carrier.

6. Install bearing cap bolts and lock washers and tighten until lock washers just flatten out.

### Backlash and Preload Adjustment

1. With differential bearing cap bolts loosened just enough to permit turning the bearing adjustment nuts with Tool J-0972, remove all lash between ring gear and pinion. See figure 9G.

2. Back off left hand adjusting nut one to two notches to a locking position.

3. Tighten right hand adjusting nut firmly to force differential in solid contact with left hand adjusting nut.

4. Back off right hand adjusting nut until free of bearing; then retighten snugly against bearing.

5. Tighten right hand nut from one to two additional notches to a locking position.

**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

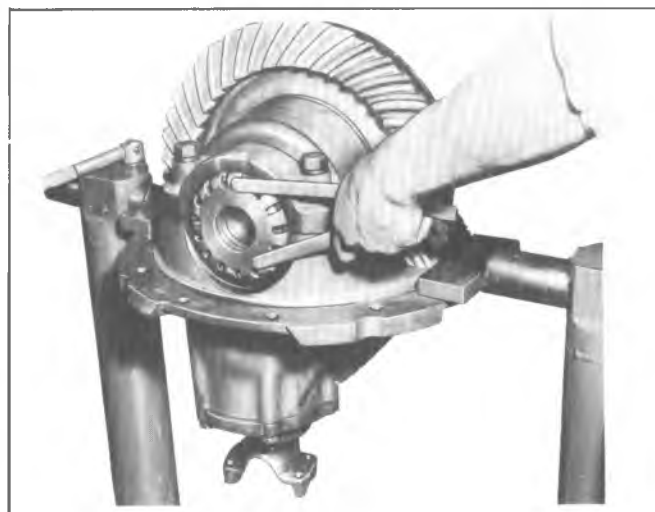


Fig. 9G--Backlash and Preload Adjustment

10G. Backlash should be from .003" to .012" (.005" to .008" preferred).

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

### Ring Gear Thrust Pad Adjustment

1. Inspect bronze tip of thrust pad and if worn install a new one.

2. Install thrust pad and tighten screw until bronze tip engages back face of ring gear while rotating gear.

3. Back off screw one-twelfth (1/12) turn and tighten locknut to specifications. See figure 11G.

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

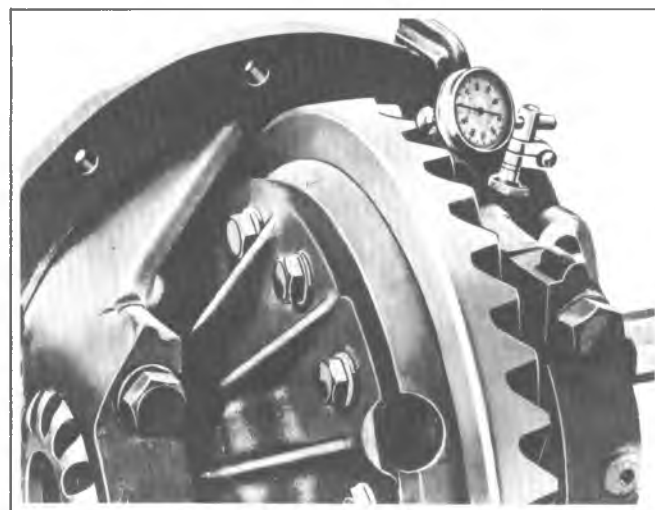


Fig. 10G--Checking Backlash

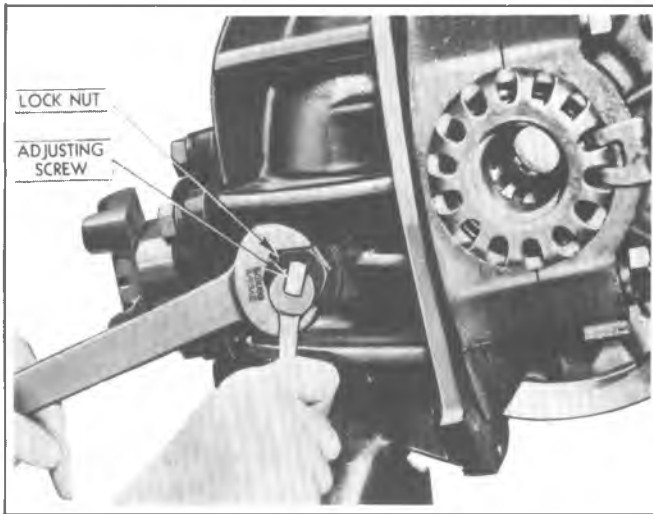


Fig. 11G--Ring Gear Thrust Pad Adjustment

### Installation

1. Clean out axle housing and cover and place new gasket over axle housing.

2. Assemble differential carrier to axle housing, install lockwashers and bolts and tighten securely.

3. Replace axle housing inspection cover, if removed, using new gasket.

4. Assemble rear universal joint.

**CAUTION:** This propeller shaft to pinion flange fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

5. Install axle shafts as outlined in applicable axle installation procedure in Service Manual.

6. Fill axle with lubricant to a level even with bottom of filler hole. See Section 0 in the Truck Service Manual for proper lubricant.

## LIMITED SLIP DIFFERENTIAL UNITS

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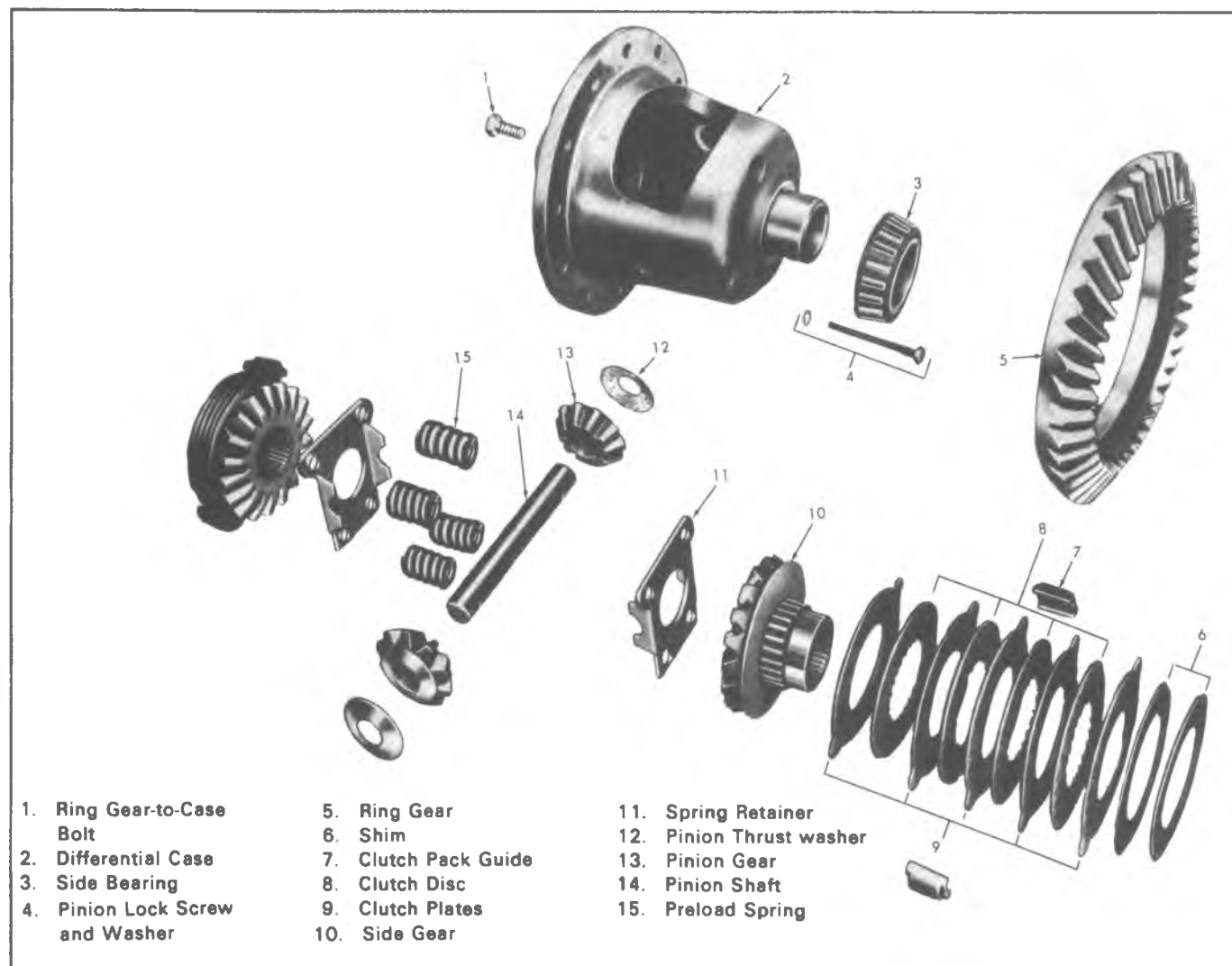


Fig. 1D-Eaton Limited Slip Exploded View

## EATON LIMITED SLIP - FIGURE 1D

### 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 2D. 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 3D.

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

figure 4D.

4. After installing the retaining bolts continue to drive spring retainer from the case until enough of the retainer is exposed to permit installation of bar stock and "C" clamp as shown in figure 5D. Center the bar stock over the axle shaft hole in the spring retainer, then compress "C" clamp sufficiently to permit withdrawal of spring pack.

5. Position spring pack in vise and remove 1/4 inch bolts. Alternately relieve "C" clamp pressure and vise pressure until spring compression is relieved. See figure 6D.

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

**For Passenger models**, pinion gears can be

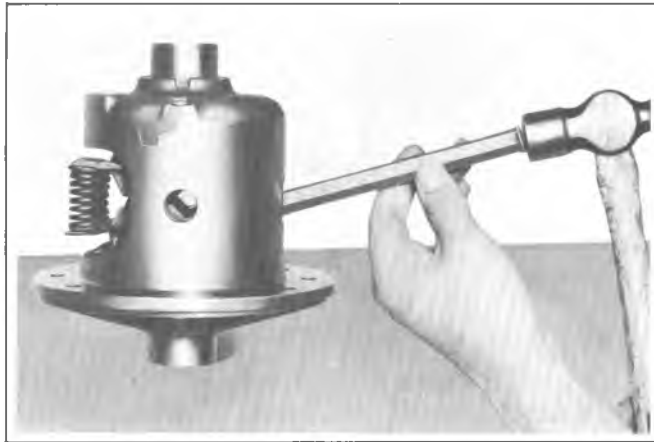


Fig. 2D--Removing Preload Spring Pack (Typical)

removed by rotating them in one direction only. Using figure 7D as a reference, rotate differential case clockwise to remove the first gear, then rotate case counter-clockwise to remove the second gear. To remove second gear, it may be necessary to assist pinion gear upon its seat by prying on gear through observation holes on case. Mark pinions and side gears for reassembly in original position.

7. Remove side gear, clutch pack, shims and guides from case. Tap the assembly from the case, using a brass drift as shown in figure 8D. Repeat removal on opposite gear.

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

### Inspection

1. Check clutch plates and discs for excessive wear and signs of overheating.

**NOTE:** Clutch plates and discs are not serviced separately. If replacement is required, clutch pack must be replaced as an assembly.

2. Inspect preload springs for distortion and other defects.

3. Compress springs and determine if they are capable



Fig. 4D--Removing Preload Spring Pack (Corvette)

of properly preloading the clutch pack, replace springs that are weak or questionable.

4. Examine spring retainer for alignment between the retainer halves and for excessive wear at spring seats.

### Reassembly

1. Lubricate clutch plates and discs with special limited slip 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 9D.

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.

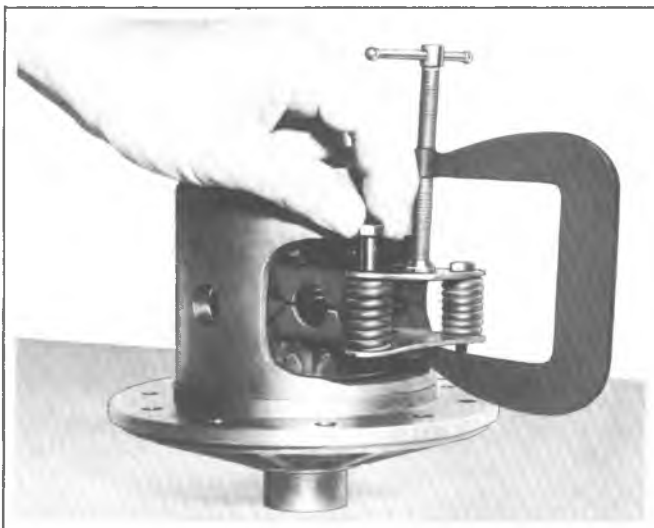


Fig. 3D--Installing Bolts to Retain Springs

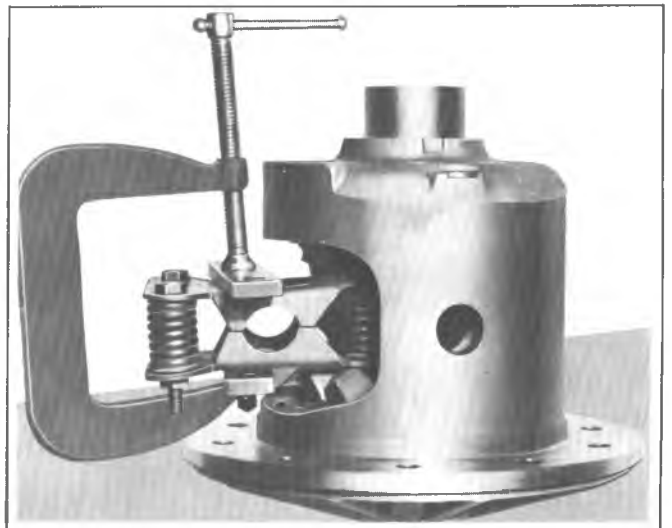


Fig. 5D--C-Clamp and Bar Stock Installed for Spring Removal

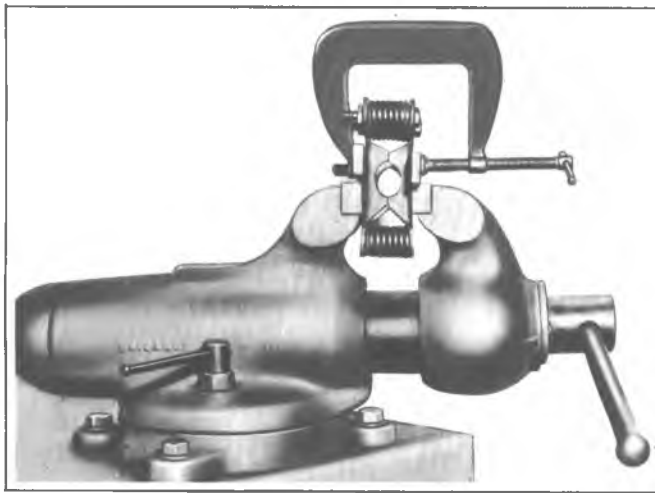


Fig. 6D--Removing Preload Springs from Pack

7. Position pinion gears and thrust washers on side gears. Install pinion shaft through case and gears.

8. Install dial indicator in case so that contact button rests against pinion gear as shown in figure 10D.

9. Compress clutch pack, using a screwdriver as shown in figure 11D. Move the pinion gear to obtain tooth clearance.

10. Tooth clearance should be .001" to .008". If required, change shims to obtain proper tooth clearance.

11. Remove side gear assembly and repeat tooth clearance procedure for other side gear on opposite side of case.

12. Remove pinion shaft, gears and thrust washers.

13. Install remaining side gear, clutch pack assembly and shims in case.

14. Install pinion gears and thrust washers. Installation of pinion gears can be performed by reversing the pinion gear removal procedure.

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 11D.

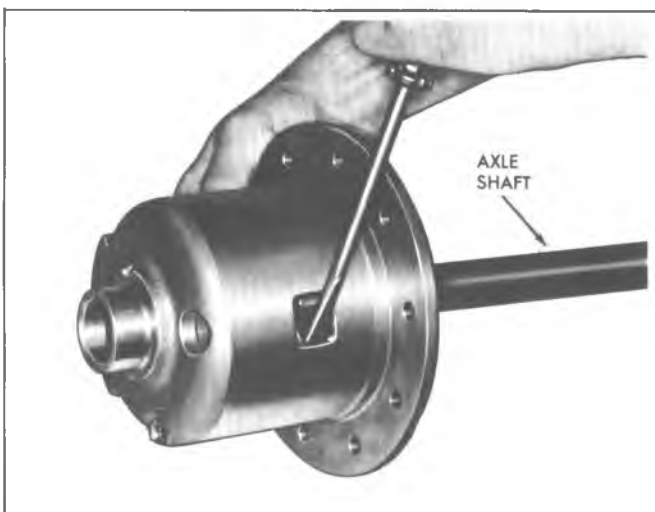


Fig. 7D--Removing Differential Pinion Gears



Fig. 8D--Removing Side Gear

16. Position spring pack between side gears and remove bar stock and "C" clamp.

17. **On Corvette**, install Tool J-22311 to compress clutch pack, secure pack with 1/4" bolts as shown in figure 12D. 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 13D.

19. Install the pinion shaft and lock screw to retain side gears until axle shafts are installed.

20. Check alignment of spring retainer with side gears. Slight movement of the spring pack can be made if necessary.

21. Install side bearings and ring gear to case using procedure outlined for the conventional differential.

22. Place differential in carrier and adjust bearings and backlash as outlined for the conventional differential.

23. Check operation of unit as follows:

a. Raise rear of vehicle until rear wheels are off the ground, and remove one wheel and tire assembly.

b. Attach Adapter J-5748 to axle shaft flange and install a 1/2-13 bolt into adapter, shown in figure 14D.

c. With wheel and tire assembly still on vehicle held



Fig. 9D--Assembling Clutch Pack



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.

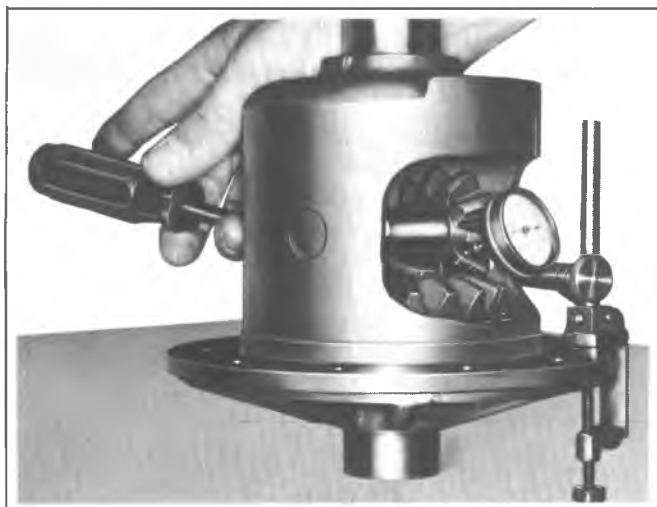


Fig. 10D--Measuring Pinion Gear Tooth Clearance

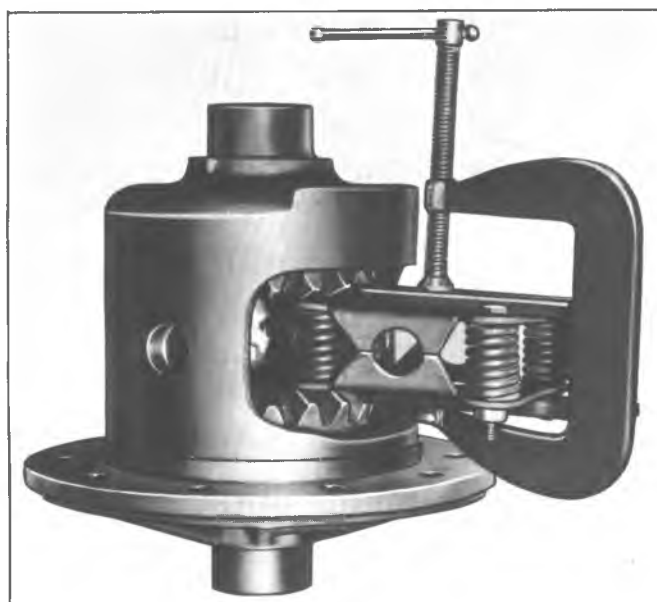


Fig. 11D--Spring Pack Compressed for Installation



Fig. 12D--Installing Spring Pack Compression Tool (Corvette)

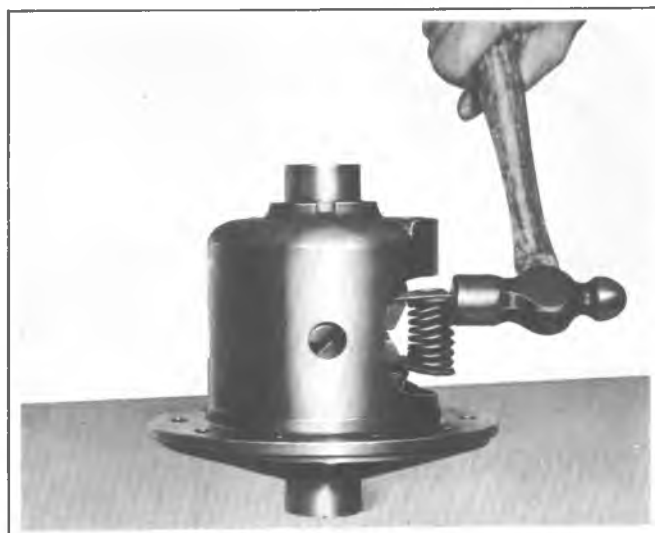


Fig. 13D--Installing Spring Pack

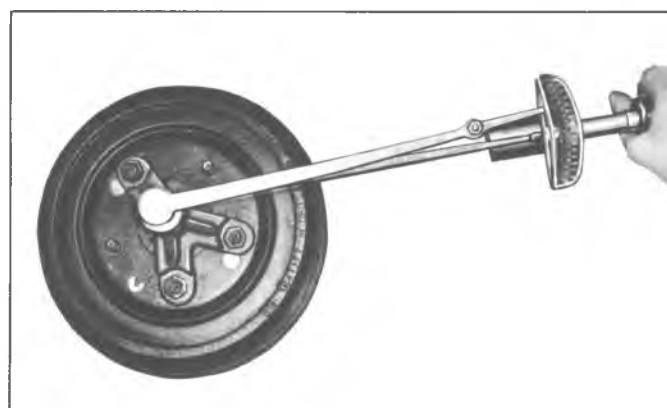


Fig. 14D--Measuring Positraction Rotating Torque

## CHEVROLET LIMITED SLIP - FIGURE 15D

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

**Inspection**

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

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

**Reassembly**

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

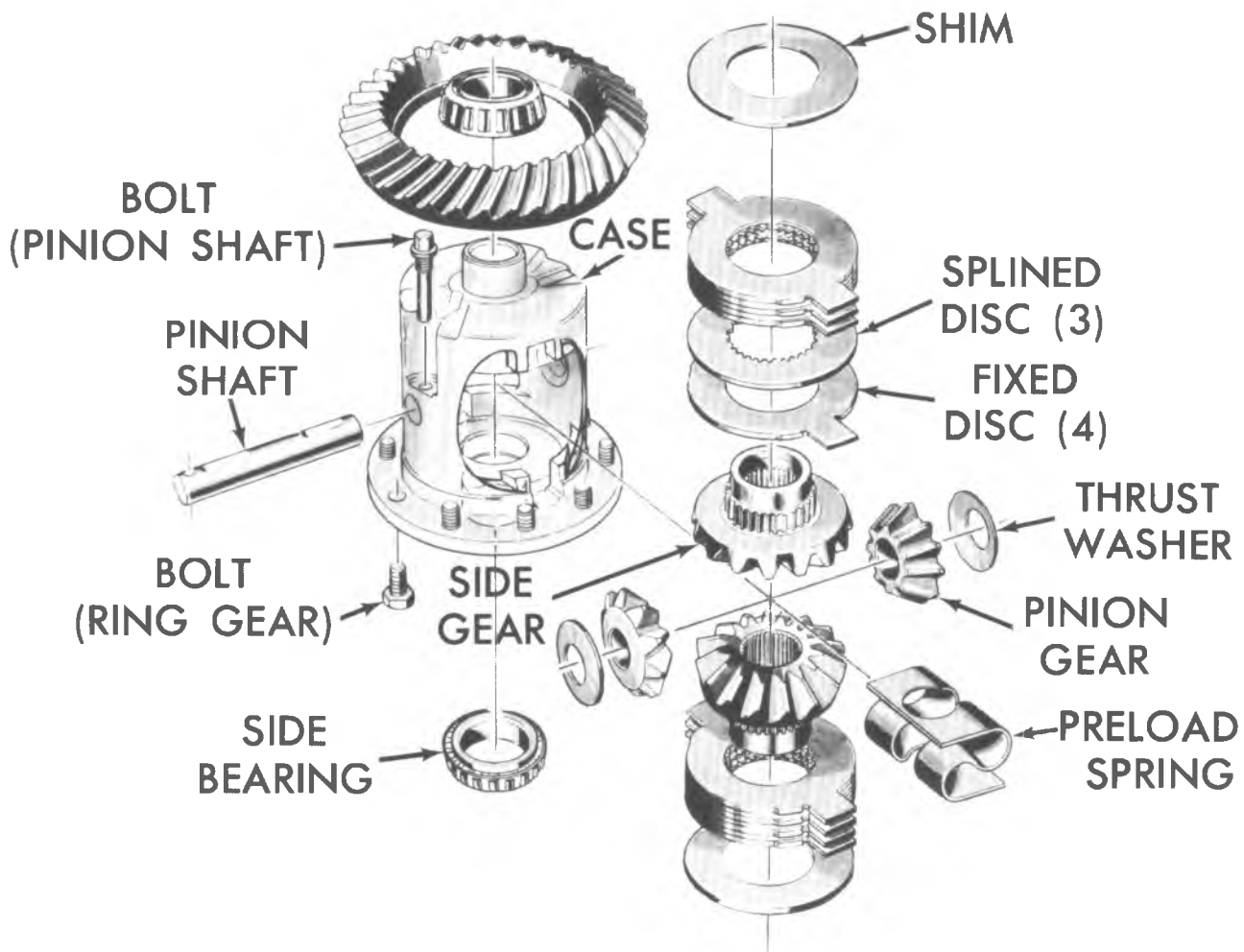


Fig. 15D--Chevrolet Limited Slip - Exploded

.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".

8. Remove the pinion shaft, pinion gears, side gear, clutch pack and shim from the case.

9. Install the opposite gear, clutch pack and original shim into the opposite side of the case. Place both pinion gears, and thrust washers into position, and install the pinion shaft.

10. Follow the procedure in steps 5, 6 and 7 to determine the proper shim dimension.

11. When the proper shims have been determined to achieve .005" to .008" backlash between both pinion gears and both side gears, install shims, clutch packs and side

gears into case.

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

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

13. Tap the preload spring into place with a hammer.

14. Install the pinion shaft and lock screw.

15. Install the side bearings and ring gear using the procedure outlined for conventional units.

16. Place the differential unit in the carrier and adjust ring gear and pinion backlash, and gear tooth pattern.

## BORG WARNER (CONE TYPE)

### DESCRIPTION

The limited slip differential can be identified by a tag attached to the lower right section of axle cover. It is designed to direct the major driving force to the wheel with greater traction, thereby reducing the possibility of the car becoming stuck while driving under adverse conditions.

All rear axle parts of cars equipped with the limited slip differential are interchangeable with those equipped with the conventional differential, except for the case assembly. It is similar in all respects to the conventional case assembly, with the addition of cone clutches splined to each side gear.

### LUBRICATION

The differential should be checked for leaks and level every oil change. Maintain level to within 3/8" of the filler plug opening.

If necessary to add lubricant, use only lubricant No. 1052271 or equivalent.

### SERVICE PROCEDURES

Rear axle service procedures are the same for the limited slip as for the conventional differential, except for servicing the case assembly.

If the case, clutch cone/side gears, or pinion gears are damaged, it is necessary to replace case assembly.

**WARNING:** Never raise one wheel and run the engine with the transmission in gear. The driving force to the wheel on the floor will cause the car to move. Do not use "on the car" type wheel balancers on the rear wheels, unless both wheels are off the floor.

### Differential Case

#### Disassemble

1. Before disassembling differential case, inspect differential side bearings for visible damage of rollers and outer races.

2. Place one outer race onto its matched inner race and roller assembly and turn slowly, applying hand load.

3. If bearing outer race turns smoothly and no visible damage is found, bearing can be reused.

4. Repeat above operation with other race and matched bearing and check for smoothness.

**NOTE:** Both side bearings and their outer races are matched parts. If either bearing is to be replaced, its matching outer race must also be replaced.

5. Inspect fit of inner races on case hubs by prying against shoulders at puller recesses. Bearing inner races must be tight on case hubs.

**NOTE:** If either bearing is loose on case, entire case must be replaced.

6. If bearing inspection indicates that bearings should be replaced, remove side bearings by using tools as shown in the 1978 Service Manual.

7. If removing ring gear, clamp case in vise so jaws are 90° to pinion shaft holes and remove ten ring gear retaining bolts.

8. Partially install two bolts on opposite sides of ring gear.

9. Remove ring gear from case by alternately tapping on bolts.

**NOTE:** Do not pry between case and ring gear.

10. Remove differential case half attaching bolts.

11. Lift cap half of case from flange half. Remove clutch cone/side gears, spring blocks, preload springs,

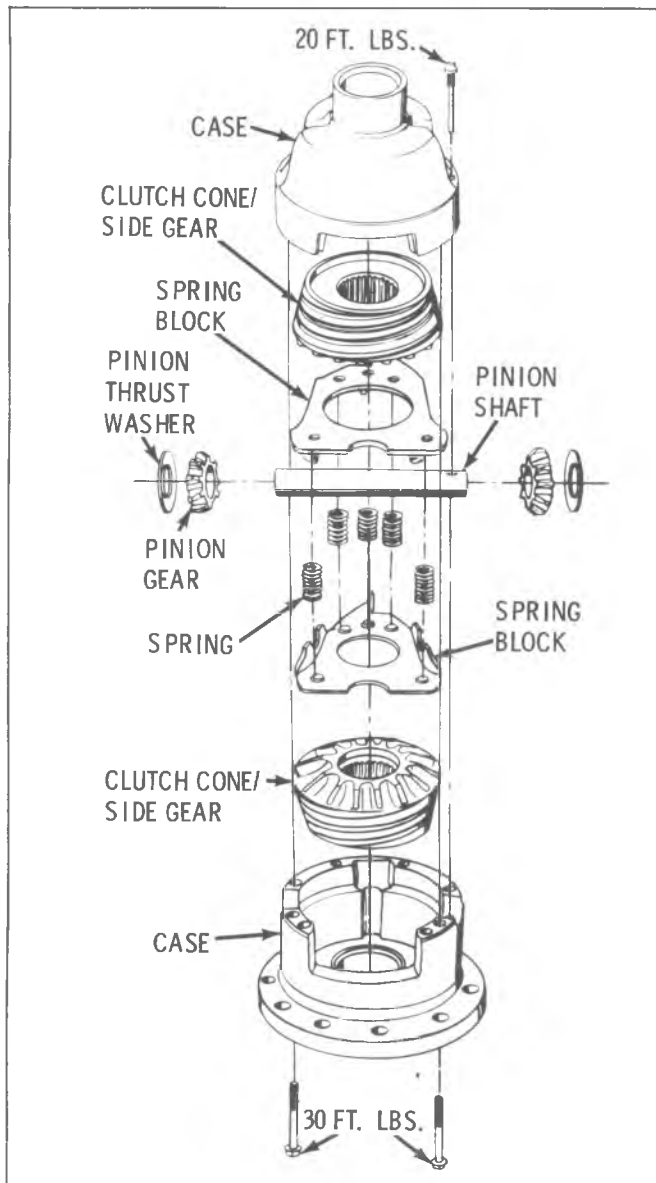


Fig. 4B-16D--Limited Slip (Cone Type)

pinion gears and shaft.

**NOTE:** Be certain that each clutch cone/side gear and pinion gear are marked so they can be installed in their original location.

### Cleaning and Inspection

1. Make certain all parts are absolutely clean and dry.

2. Inspect pinion shaft, pinion and side gears, brake cone surfaces and corresponding cone seats in case. The cone seats in case should be smooth and free of any excessive scoring. Slight grooves or scratches, indicating passage of foreign material, are permissible and normal. The land surface on the heavy spirals of male cones will duplicate case surface condition. If case or clutch cone/side gear are damaged, it is necessary to replace case assembly. All other parts are serviceable.

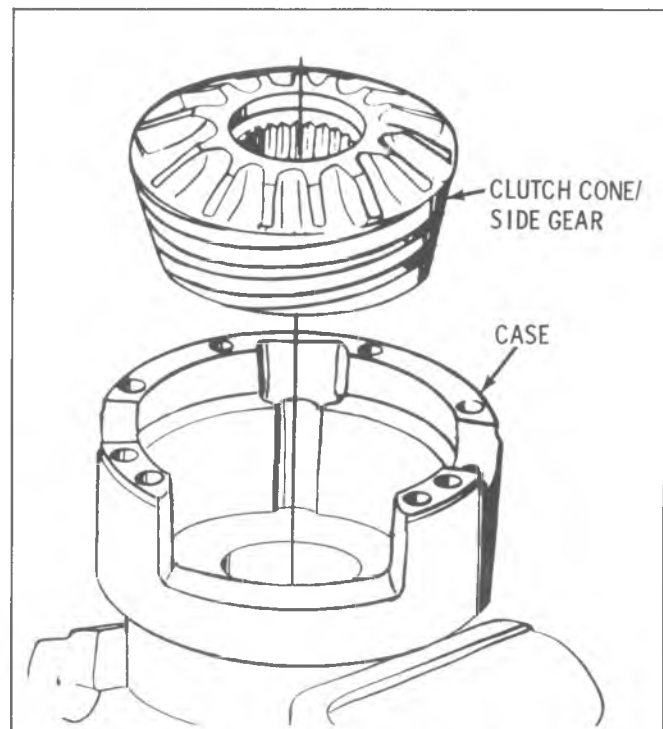


Fig. 4B-17D--Cone-Gear Position

### Assembly

1. Install proper cone/gear assembly, seating it into position in cap half of case. (Fig. 4B-17D).

**NOTE:** Be certain that each cone/gear is installed in proper case half, since tapers and surfaces become matched and their positions should not be changed.

2. Place one spring block in position over gear face, in alignment with pinion gear shaft grooves. Install pinion shaft, pinion gears and thrust washers into cap half or differential case in such a manner that pinion shaft retaining dowel can be inserted through pinion gear shaft into differential case. This prevents pinion shaft from sliding out and causing damage to carrier. (Fig. 4B-18D).

**NOTE:** Be certain that pinion gears are installed in their original locations.

3. Insert five springs into spring block that is already installed into case, then place second spring block over springs. (Fig. 4B-19D).

4. Install second cone/gear assembly face down on spring block so that gear will mesh with pinion gears.

5. Install flange half of differential case over cone, insert case bolts finger tight. (Fig. 4B-20D).

6. Tighten bolts one turn at a time in sequence shown in Fig. 4B-21D. Then torque case bolts to 30 ft. lbs.

7. If side bearings were removed, lubricate outer bearing surfaces and press on bearings as shown in the 1978 Service Manual.

8. After making sure that matching surfaces are clean and free of burrs, position ring gear on case so holes are in line.

9. Lubricate NEW attaching bolts with clean engine oil and install.

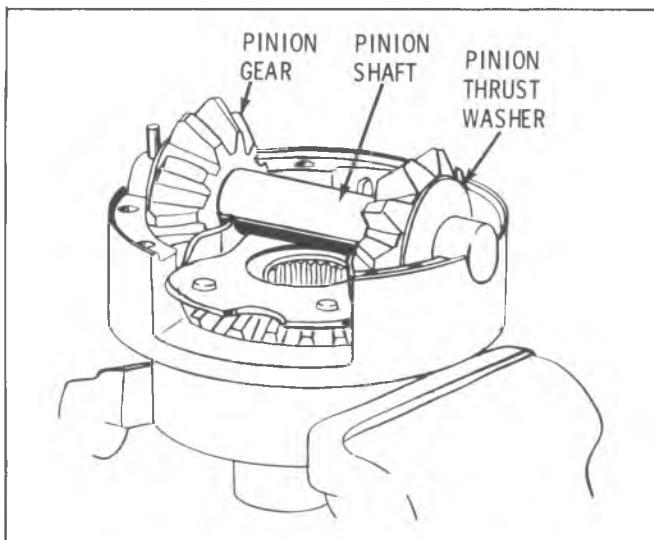


Fig. 4B-18D--Pinion Shaft Position

10. Pull ring gear onto case by alternately tightening bolts around case. When all bolts are snug, tighten bolts evenly and alternately across diameter to 120 ft. lbs. torque.

**NOTE:** Do not use hammer to force ring gear on case.

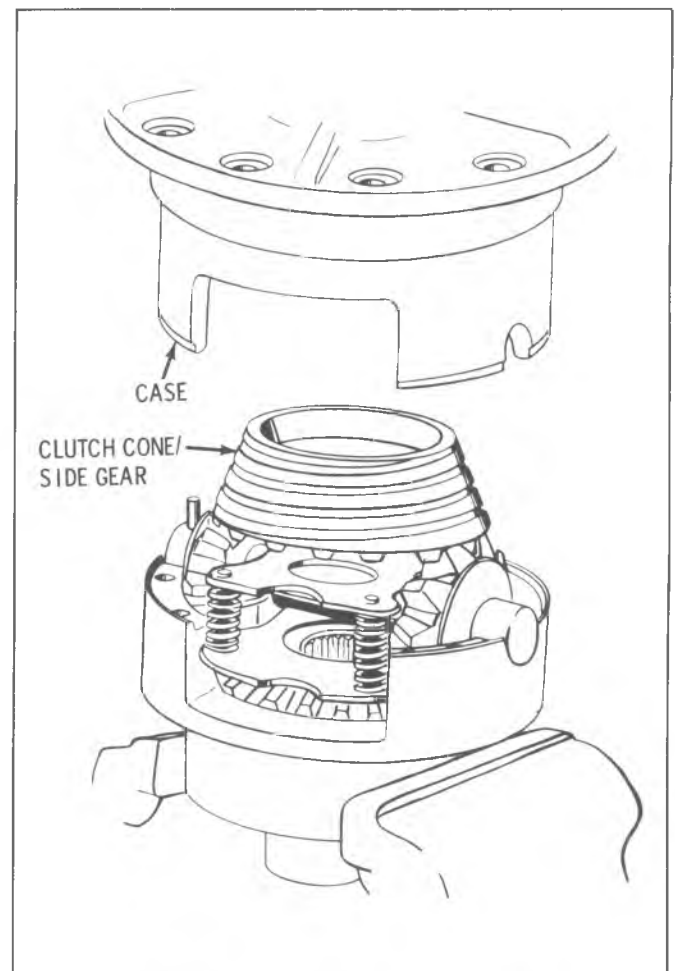


Fig. 4B-20D--Case-Cone Installation

11. Install unit into axle carrier following instructions given for Standard Differential.

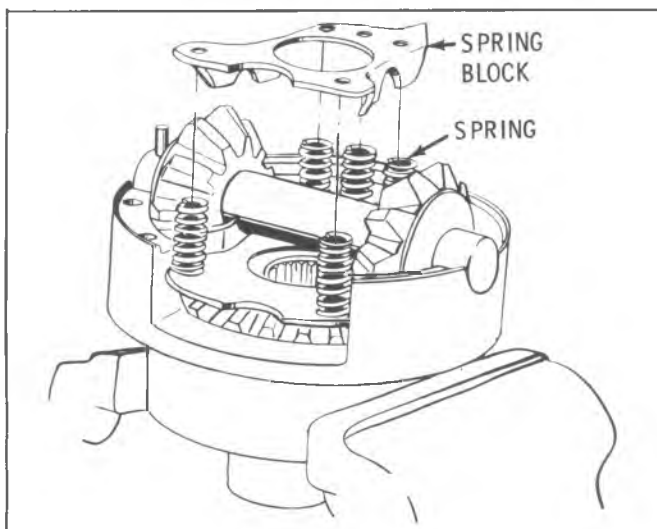


Fig. 4B-19D--Spring and Spring Block

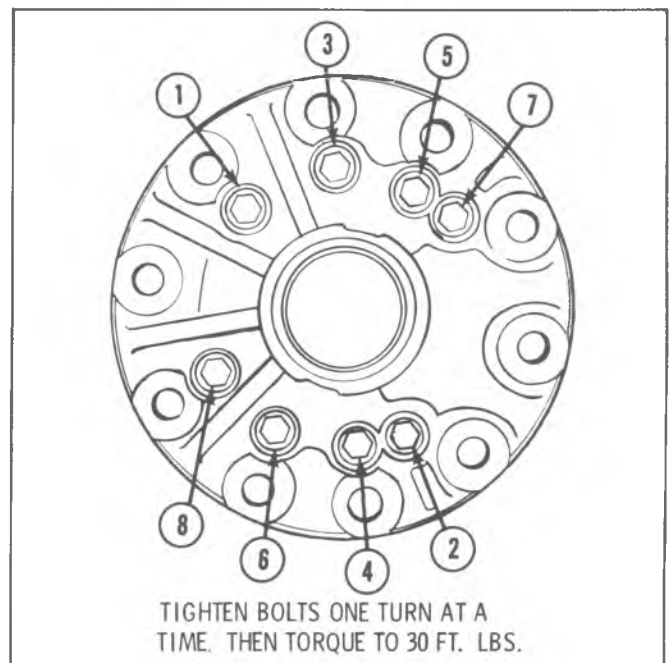


Fig. 4B-21D--Bolt Torque Sequence

## POWER-LOK DIFFERENTIAL

The Power-Lok differential shown in figure 22D 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 22D.

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.
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.

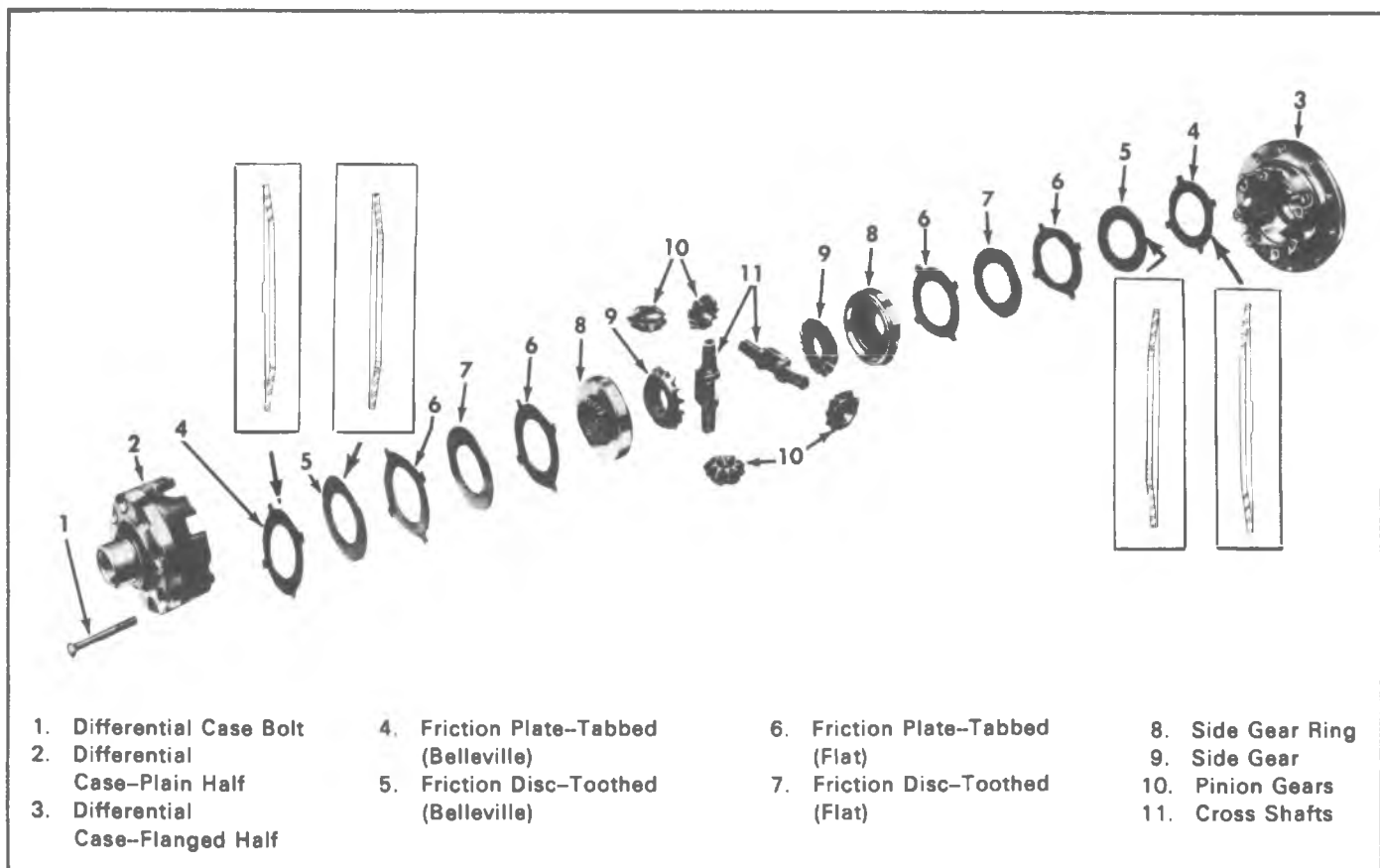


Fig. 22D--Power-Lok Differential

## 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 22D.

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. lbs., the unit should be disassembled and the necessary repairs made.

# EATON POSITIVE LOCKING DIFFERENTIAL

## DESCRIPTION

Chevrolet Trucks equipped with locking differentials use one of the Eaton locking units in Figure 4B-1H, 2H. These differentials provide true differential action and also incorporate a speed sensitive device which automatically and positively locks both rear wheels together if either wheel should spin excessively during slow vehicle operation.

Locking is accomplished through the use of a flyweight governor mechanism, cam system, and multi-disc clutch. The flyweights on the governor mechanism move outward to engage a latching bracket whenever the wheel-to-wheel speed varies by approximately 100 rpm or more. This action retards a cam which, in turn, compresses a multi-disc clutch locking one side gear to the case. At wheel-to-wheel differentials of less than approximately 100 rpm, the unit operates as a standard or open differential.

**NOTE:** At vehicle speeds above approximately 20 mph, the latching bracket overcomes a spring preload and swings away from the flyweights. At this vehicle speed or greater, the differential will not lock as the added traction is not necessary.

## Service Test Procedure

1. Place the Truck on a frame-contact hoist, allowing free rotation of the rear wheels.

2. Raise hoist until wheels clear floor. Holding one wheel stationary, slowly rotate other wheel approximately 1/2 revolution per second, in both the forward and reverse directions. Wheel should rotate freely. If both wheels attempt to turn together, the differential is locking and is defective.

**NOTE:** Rapid wheel rotation will cause a properly operating differential to lock and both wheels will rotate in the same direction.

3. Raise hoist to maximum height with one person in vehicle.

4. Start engine making sure that carburetor is set to provide a low idle speed of 600-800 rpm.

5. Place transmission in drive range and apply brakes. With manual transmission, depress clutch and place transmission in first gear.

6. Lock one rear wheel by pulling one parking brake cable from under the vehicle.

7. With engine at low idle, slowly release brakes. With manual transmission, slowly engage clutch.

8. Locked rear wheel will remain stationary and free

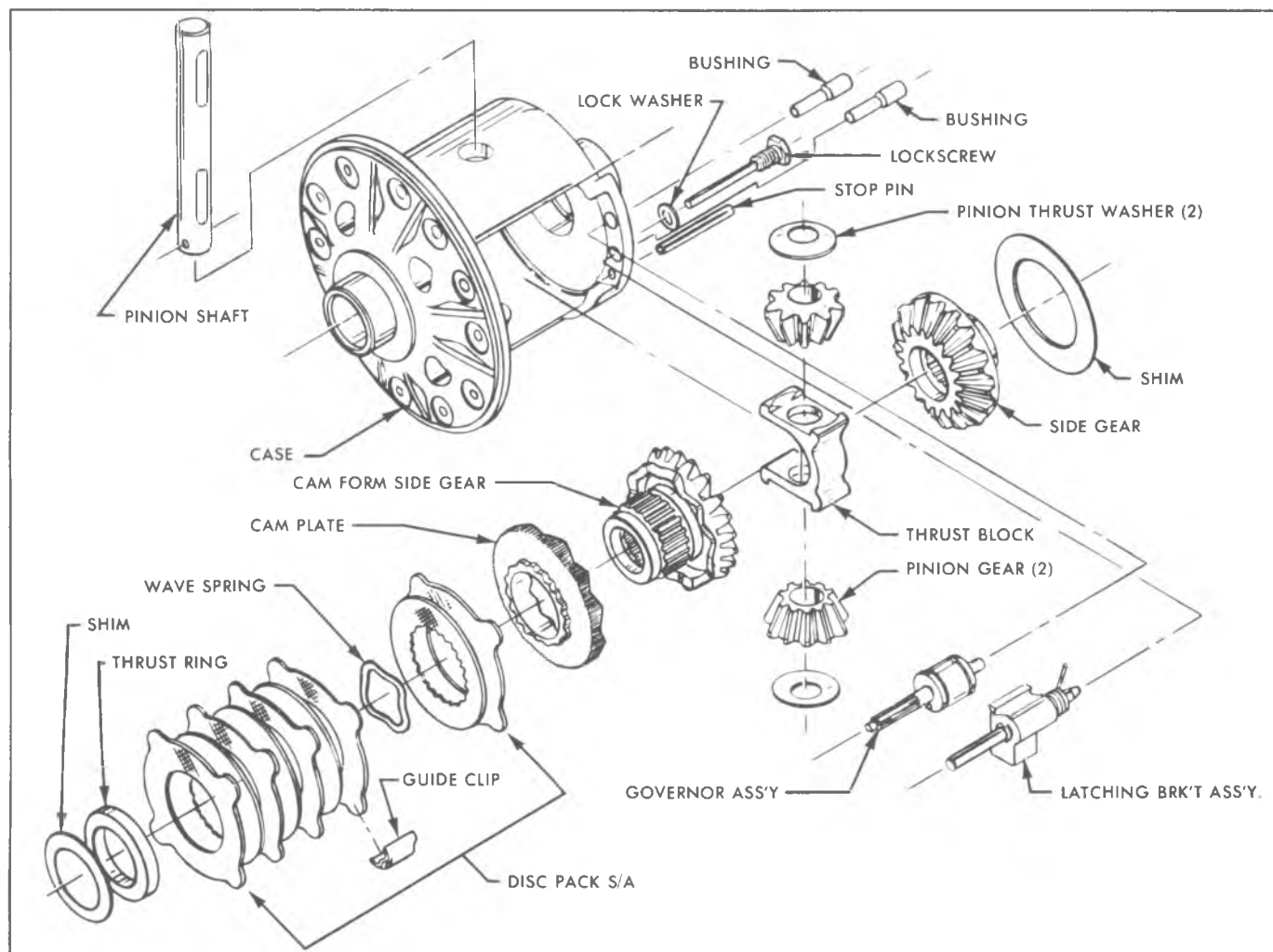


Fig. 4B-1H-1/2 Ton Unit

wheel will begin turning. It is important that brakes or clutch be released slowly enough to start the free wheel turning and allow the free wheel to gradually increase in speed. As speed of the free wheel is increased, the differential will lock causing the rotating wheel to stop or both wheels to turn at the same speed. The engine may stall if equipped with a manual transmission. It may be necessary to accelerate engine until approximately 10 mph is indicated on vehicle speedometer to cause differential lock. If indicated speed can be increased beyond 20 mph without causing differential lock, the unit is not functioning properly.

**NOTE:** Rapid release of brakes or clutch, or rapid acceleration of engine will invalidate test.

9. Lock opposite rear wheel and repeat procedure. The following chart provides guidelines for diagnosis and repair of differential complaints.

#### OVERHAUL PROCEDURES 8-7/8 RING GEAR AXLE 1/2 TON TRUCKS

**CAUTION:** Due to critical internal clearance dimensions, differential side gears and case cannot be serviced separately. If any side gear or case damage is found, the entire differential must be

replaced.

Internal clearances are such that shims, reaction block, and thrust rings should not be replaced unnecessarily even if slight wear indications are present. If shims, reaction block, or thrust ring must be replaced due to damage, correct measurement and replacement procedures must be followed. Failure to do so may disturb critical clearances and could result in differential complaints.

Internal components can be inspected through the windows of the differential housing.

If the governor assembly and latching bracket are the only items to be replaced, proceed only through step No. 2 of the disassembly procedure. To install new governor and latching bracket, begin at step No. 6 of the reassembly procedure.

#### Disassembly

1. Note position of governor and latching bracket assembly, Figure 4B-4H. Remove ring gear and side bearings following procedures established for the standard differential.

2. Using bushing puller tool No. J-26252, remove governor assembly and latching bracket by pulling the retaining bushings as shown in Figure 4B-5H. Pull the



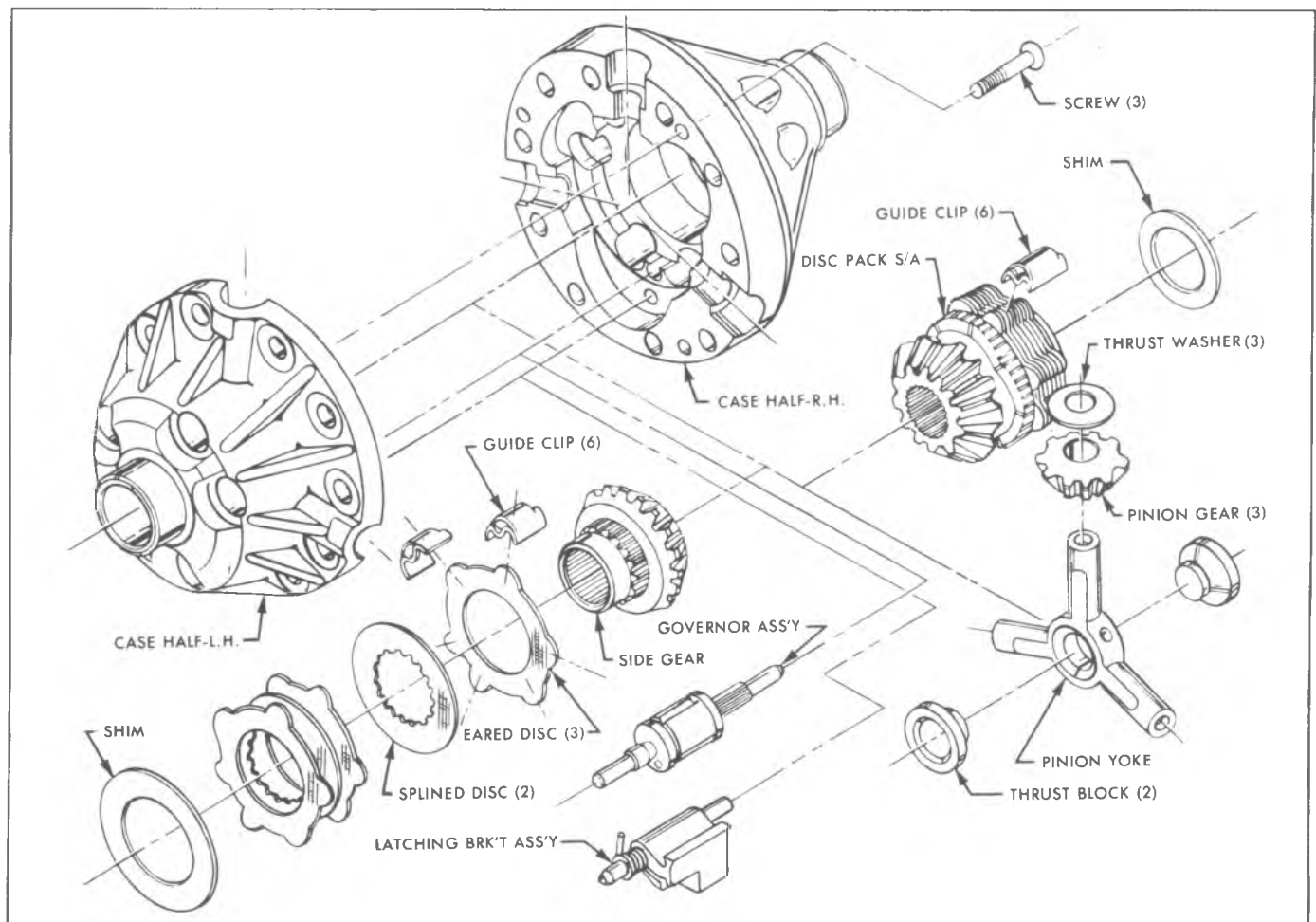


Fig. 4B-2H-3/4 Ton Unit

latching bracket spring out of the way while pulling the governor assembly bushing to prevent damage. Remove the stop pin by driving through the case with a drive pin punch.

3. Remove lock screw and pinion shaft, and roll out differential pinion gears.

4. Remove thrust block and pinion thrust washers.

5. Remove cam gear, disc pack assembly and disc pack guide clips.

6. Remove plain side gear and shims.

### Inspection

1. Clean all parts with solvent. Inspect all bearing for chipping or evidence of excessive wear. Replace parts as needed.

2. Inspect all differential components for excessive wear and breakage. Replace parts as needed. The following are serviceable components for this differential:

- Governor assembly and latching bracket with spring and stop pin.

- Cam plate.
- Clutch disc pack with guides and guide clip.
- Pinion cross-shaft.
- Pinion gears.
- Pinion thrust washers.
- Reaction block (4 sizes).
- Thrust ring.

- Flange end shim (4 sizes).

**CAUTION:** Attempts to service other components may disturb critical clearances and could result in differential complaints.

*If reaction block or flange end shim must be replaced, the original pieces must be carefully measured for thickness and replaced with a piece of the same size.*

### CAM/CLUTCH SERVICE

#### Disassembly

If cam plate or clutch discs must be replaced, the cam gear sub-assembly must be serviced as follows:

1. Measure and record overall length of gear assembly (front face of gear to back side of thrust ring, include shim). This dimension will be needed to reassembly unit if thrust ring is replaced. **DO NOT REPLACE THRUST RING UNLESS NECESSARY.** If ring is excessively worn or scored, check bore in case for scoring. If bore is scored, replace entire differential.

2. With gear hub end up, compress disc pack and install jaws of split ring bearing remover (J-22912) between the thrust ring and the top eared disc. Bevel side of bearing remover should face up toward thrust ring.

3. Place cam gear assembly with bearing remover attached in an arbor press supporting the bearing remover

## DIFFERENTIAL DIAGNOSIS

Complaint	Possible Cause	Correction
Does not lock:	A. Little or no spring preload on the latching bracket.	A. Replace governor assembly and latching bracket.
	B. Flyweights on governor assembly stuck closed.	B. Replace governor assembly and latching bracket.
	C. Broken Drive teeth on governor and/or cam gear assembly.	C. Replace cam plate, governor assembly and latching bracket.
	D. Broken clutch plates in cam gear assembly.	D. Replace clutch plates and wave spring.
Locks in turns:	A. Governor assembly tight in case.	A. Free up governor assembly.
	B. Broken or weak governor flyweight spring.	B. Replace governor assembly and latching bracket.
	C. Flyweight in governor assembly stuck open.	C. Replace governor assembly and latching bracket.
	D. Broken cam plate and/or governor drive teeth.	D. Replace cam plate, governor assembly and latching bracket.
Noisy:		
NOTE: In addition to normal axle noise (see section on standard differential), the locking differential exhibits some clutch noise upon engagement and disengagement.		
	A. Broken clutch plates.	A. Replace clutch plates and wave spring.
	B. Broken reaction block.	B. Replace reaction block.* Check closely for other damage. Replace entire unit if housing, side gear, or pinion gears are damaged.
	C. Broken differential gears.	C. Replace entire unit.

\*Reaction blocks must be replaced with blocks of identical thickness.

Fig. 4B-3H-Diagnosis Chart



Fig. 4B-4H-Governor and Latching Bracket

on both sides.

4. Install a 1-1/2" to 1-3/4" diameter plug similar to (J-8107-4) on gear hub. Press against plug with ram of press to remove thrust ring. Keep all components in the proper order, Figure 4B-6H.

#### Reassembly

Replace cam plate and wave spring or clutch discs as necessary and reassemble as follows: See Fig. 4B-1H.

1. Place gear on bench with hub end up.
2. Assemble cam plate with cam form down to mate with cam form on gear.
3. Assemble onto cam plate: (2) eared discs, (1) splined disc, and (1) wave spring alternately as shown.



Fig. 4B-5H-Bearing Puller J-26252

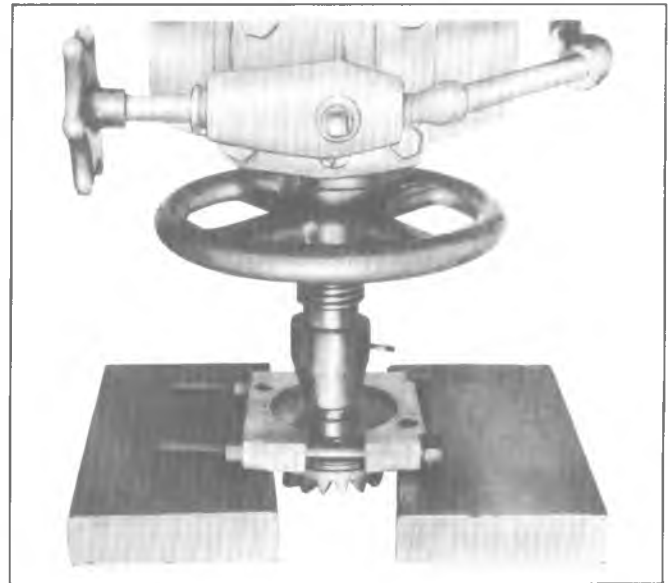


Fig. 4B-6H-Bearing Remover J-22912

4. Assemble on to gear hub (3) splined discs and (3) eared discs alternately as shown. Begin with a splined disc and end with an eared disc.

5. Locate cam gear assembly in arbor press with hub end up. Place thrust ring on gear hub and press to shoulder making sure that ring is square with hub.

**NOTE:** Compress disc pack by pushing down on the discs to keep the splined discs from becoming wedged between the thrust ring and gear shoulder while pressing the sub-assembly together. Completed sub-assembly should be checked for proper disc sequence. Also, make sure the first splined disc (large spline) is properly located on the cam plate.

#### Reassembly

1. Install (4) clutch pack guide clips on the ears of the cam gear clutch pack using grease for retention.

2. Install cam gear assembly and original shim in flange end of case. If a new thrust ring has been pressed on the cam gear, reshimming may be necessary. Measure the overall length of the new cam gear assembly, including the shim and compare to the dimension obtained in Step A of cam gear service section. If the length of the new assembly varies by more than .003" larger or smaller than the original dimension, reshimming will be necessary. Select a shim which will result in a reading closest to the original.

**NOTE:** INCORRECT SHIMMING WILL DISTURB CRITICAL CLEARANCE DIMENSIONS AND MAY RESULT IN DIFFERENTIAL FAILURE.

3. Lock an axle shaft in vise, in a vertical position. Mount the differential case over the end of the axle shaft engaging the spline of the side gear with the shaft. Grease the two pinion gear thrust washers and locate them in their proper position. Install the opposite end side gear and original shim.

**NOTE:** ORIGINAL SHIM MUST BE USED TO

# MAINTAIN PROPER CLEARANCE DIMENSIONS.

4. Insert one pinion gear through the small window opening in the case while at the same time inserting the reaction block and other pinion gear through the large window opening. Rotate the two pinion gears and thrust block 90° so as to position the reaction block with the open side towards the small window opening in the case. Be sure the two pinion gears and thrust washers are in their proper location.

**NOTE:** REACTION BLOCK MUST BE REPLACED WITH A BLOCK OF THE IDENTICAL THICKNESS. INCORRECT BLOCK THICKNESS WILL DISTURB CRITICAL CLEARANCE DIMENSIONS AND MAY RESULT IN DIFFERENTIAL FAILURE.

5. Install shaft and lock screw.

6. Insert governor assembly and latching bracket into case, Figure 4B-4H. Place straight end of latching bracket spring over and to the outside of the engagement shaft to preload the latching bracket against the governor assembly. Press bushing and 1/4" stop pin into case. Press bushing for governor assembly into case to give .004 to .020 shaft end play. Press bushing for latching bracket into case to remove end play. A 3/8 diameter plug or socket will aid in pressing the bushings into the housing. Press stop pin flush with top of case.

**NOTE:** For the latching bracket use bushing with the tapered hole. The bushing for the governor assembly has a straight hole.

7. Install ring gear and side bearings using the procedure outlined for conventional differentials.

8. Place differential unit in carrier and adjust ring gear and pinion backlash and gear tooth pattern as outlined in the conventional differential section.

9. Check operation as outlined in the Service Test Procedure.

**NOTE:** USE STANDARD DIFFERENTIAL LUBRICANT. DO NOT USE LUBRICANT DESIGNED FOR "LIMITED SLIP" DIFFERENTIALS.

## 10-1/2" RING GEAR AXLE 3/4 TON AND 1-TON TRUCKS

**CAUTION:** Due to critical internal clearance dimensions, differential side gears and case cannot be serviced separately. If any side gear or case damage is found, the entire differential must be replaced.

Internal clearances are such that shims, reaction blocks, and thrust ring should not be replaced unnecessarily even if slight wear indications are present. If shims, reaction blocks, or thrust ring must be replaced due to damage, correct measurement and replacement procedures must be followed. Failure to do so may disturb critical clearances and could result in differential complaints.



Fig. 4B-7H--3/4 Ton Unit

## Disassembly

1. Remove ring gear and side bearings following procedures established for the standard differential.

2. Remove (3) screws on front face of ring gear flange.

3. Set unit on right side case half and gently pry apart at yoke hole locations Fig. 4B-7H.

4. Remove left side case half. To prevent side gear from falling out, hold thumb against inside of gear hub while separating case halves.

5. Inspect components for damage. If the governor assembly and latching bracket are the only items to be replaced, remove and proceed to Step 7 of reassembly procedure. Pry under pinion yoke and remove and proceed with detailed inspection if further damage is observed.

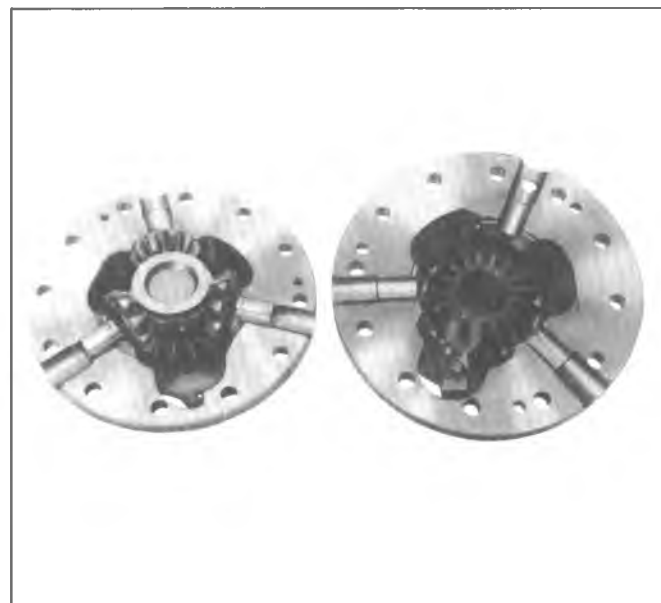


Fig. 4B-8H--3/4 Ton Assembly

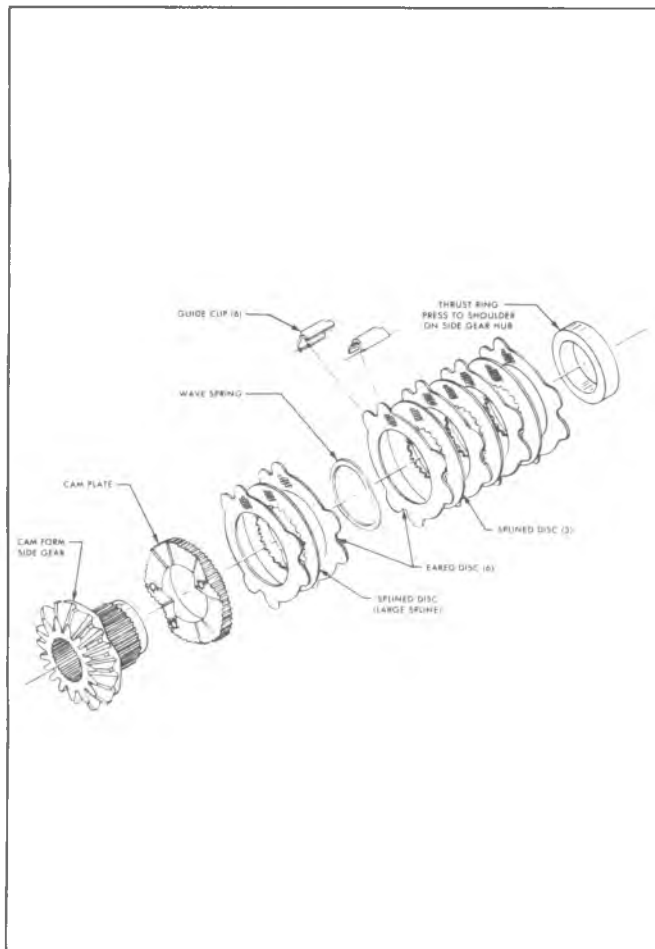


Fig. 4B-9H-Cam Plate and Clutch Discs

### Inspection

1. Clean all parts with solvent. Inspect all bearings for chipping or evidence of excessive wear. Replace parts as needed.

2. Inspect all differential components for excessive wear and breakage. Replace parts as needed. **THE FOLLOWING ARE SERVICEABLE COMPONENTS FOR THIS DIFFERENTIAL.**

- Governor assembly and latching bracket with spring.
- Cam Plate.
- Clutch disc pack with wave spring and guide clips.
- Pinion yoke.
- Pinion gears.
- Pinion thrust washers.
- Reaction blocks (4 sizes).
- Thrust ring.
- Right side shim (4 sizes).
- Left side guide clips.

Attempts to service other components will disturb critical clearances and may result in differential failure. If reaction blocks or right side shim must be replaced, the original pieces must be carefully measured for thickness and replaced with a piece of the same size.

### CAM/CLUTCH SERVICE

#### Disassembly

If cam plate or clutch discs must be replaced, the cam gear sub-assembly must be serviced as follows: Refer to Figure 4B-9H.

1. Measure and record overall length of gear assembly (front face of gear to back side of thrust ring, include shim). This dimension will be needed to reassemble unit if thrust ring is replaced. **DO NOT REPLACE THRUST RING UNLESS NECESSARY**. If ring is excessively worn or scored, check bore in case for scoring. If bore is scored, replace entire differential.

2. With gear hub end up, compress disc pack and install jaws of split ring bearing removed (J-22912) between the thrust ring and the top eared disc. Bevel side of bearing remover should face up toward thrust ring.

3. Place cam gear assembly with bearing remover attached in an arbor press supporting the bearing remover on both sides.

4. Install a 1-1/2" to 1-3/4" diameter plug (J-8107-4) on gear hub. Press against plug with ram of press to remove thrust ring. Keep all components in the proper order.

#### Reassembly

Replace cam plate and/or clutch discs as necessary and reassemble as follows:

1. Place gear on bench with hub end up.
2. Assemble cam plate with cam form down to mate with cam form on gear.
3. Assemble onto cam plate: (2) eared discs, (1) splined disc, and (1) wave spring alternately as shown, Fig. 4B-9H.
4. Assemble onto gear hub: (4) eared discs and (3) splined discs alternately as shown. Begin and end with an eared disc.
5. Locate cam gear assembly in arbor press with hub end up. Place thrust ring on gear hub and press to shoulder making sure that ring is square with hub.

**NOTE:** Compress disc pack by pushing down on the discs to keep the splined discs from becoming wedged between the thrust ring and gear shoulder while pressing the sub-assembly together. Completed sub-assembly should be checked for proper disc sequence. Also, make sure the first splined disc (large spline) is properly located on the cam plate.

#### Reassembly

1. Install (6) clutch pack guide clips on the ears of the cam gear clutch pack using grease for retention.

2. Install cam gear assembly and original shim in right side case half. If a new thrust ring has been pressed on the cam gear, reshimming may be necessary. Measure the overall length of the new cam gear assembly, including the shim and compare to the dimension obtained in Step A of cam gear service section. If the length of the new assembly varies by more than .003" larger or smaller than the original dimension, reshimming will be necessary. Select a shim which will result in a reading closest to the original.

**NOTE:** INCORRECT SHIMMING WILL DISTURB CRITICAL CLEARANCE DIMENSIONS AND MAY RESULT IN

**DIFFERENTIAL FAILURE.**

3. Install right side reaction block on gear face with button side of block facing up. Use original block unless severely scored or worn. If new block is used, determine face-to-face thickness of original block with calipers and replace with a service block of the same thickness.

**NOTE:** INCORRECT BLOCK THICKNESS WILL DISTURB CRITICAL CLEARANCES AND MAY RESULT IN DIFFERENTIAL FAILURE.

4. Preassemble pinions and pinion thrust washers on pinion yoke. Index yoke to proper position and install in housing with center over button end of reaction block. A light tap on the yoke may be needed to seat it in the housing.

5. Install left side reaction block on the yoke with flange side up. Use original block unless severely scored or worn. If new block is used, determine face-to-face thickness of original block with calipers and replace with a service block of the same thickness.

**NOTE:** Right and left side reaction blocks may not be the same thickness. If blocks are broken or cannot be accurately measured for thickness, the entire differential must be replaced. Incorrect block thickness will disturb critical clearances and may result in differential failure.

6. Install governor assembly and latching barcket in their respective locations. Place straight end of latching bracket spring over and to the outside of the governor shaft to preload the latching bracket against the governor assembly.

7. Install the original (3) eared and (2) splined clutch plates on the left side gear alternately, starting and ending with an eared disc.

**NOTE:** ORIGINAL DISCS MUST BE USED. ATTEMPTS TO INSTALL OTHER THAN ORIGINAL DISCS WILL DISTURB CRITICAL CLEARANCES AND MAY RESULT IN DIFFERENTIAL FAILURE.

8. Install (6) clutch pack guide clips on the left side disc pack assembly using grease for retention.

9. Install original shim in left side case half.

**NOTE:** ORIGINAL SHIM MUST BE USED. ATTEMPTS TO INSTALL OTHER THAN ORIGINAL SHIM WILL DISTURB CRITICAL CLEARANCES AND MAY RESULT IN DIFFERENTIAL FAILURE. Slight polishing or scuffing on discs and shims is normal.

10. Remove disc pack from side gear and carefully lower disc pack assembly into left side case half. Make sure car guide clips are in their proper position.

11. Install side gear in left side case half. Rotate gear to engage spline with splines on discs.

12. Being careful not to dislodge side gear assembly (hold thumb on inside of side gear spline), lower the left hand case assembly onto the right hand case. Index left hand case so holes in housing will line up for the governor assembly and latching bracket shafts.

13. Turn entire unit over and install three (3) screws.

14. Lock an axle shaft in a vise in a vertical position. Install differential assembly on axle shaft engaging the spline of the axle with a side gear. Rotate unit slowly. A short shaft held in pinion yoke hole will aid in rotating. The unit should turn smoothly without binding or locking up.

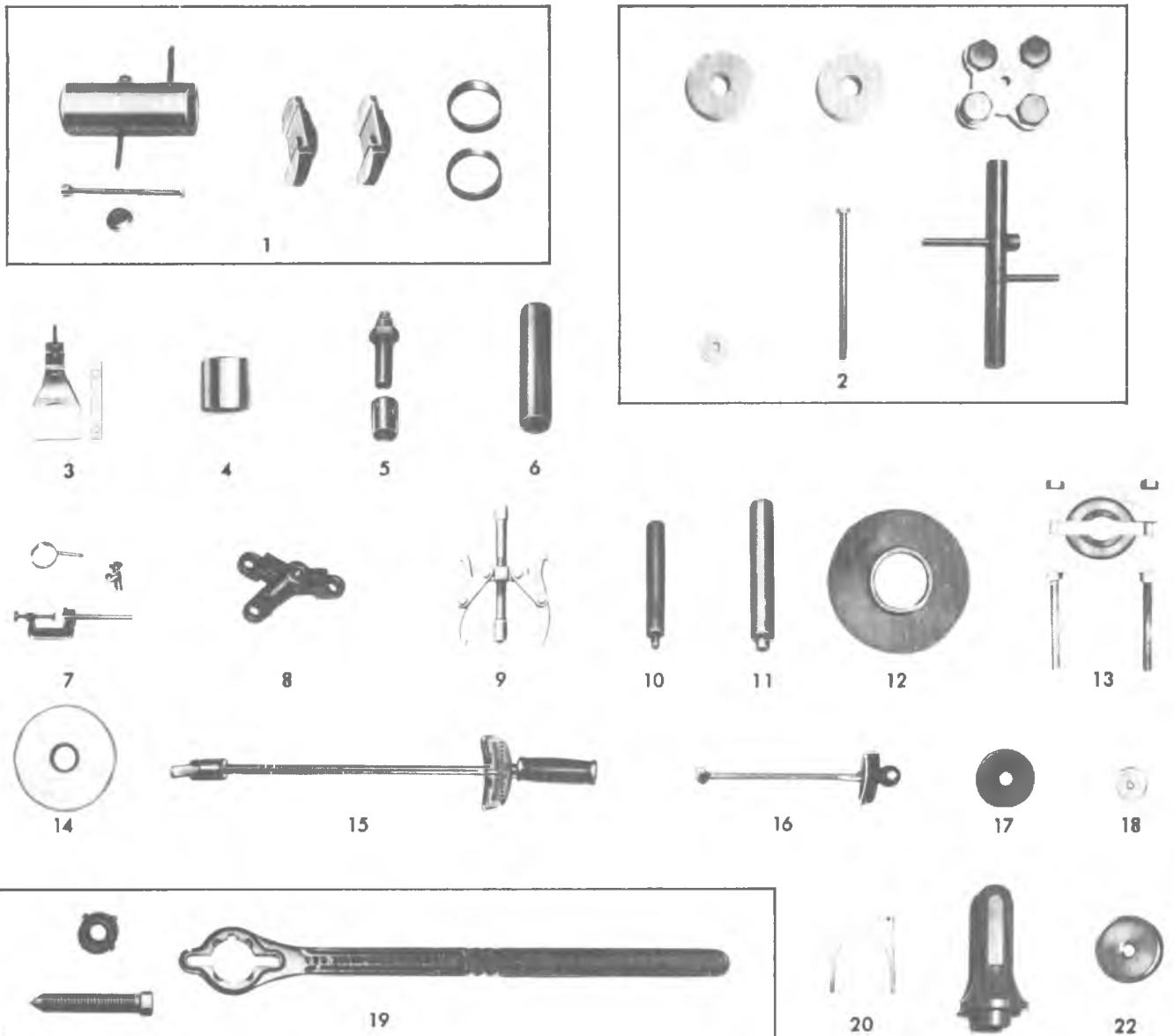
**NOTE:** Differential will lock if turned rapidly--50 rpm or greater.

15. Install ring gear and side bearings using the procedure outlined for conventional differentials.

16. Place differential unit in carrier and adjust ring gear to pinion backlash and gear tooth pattern as outlined in the conventional differential section.

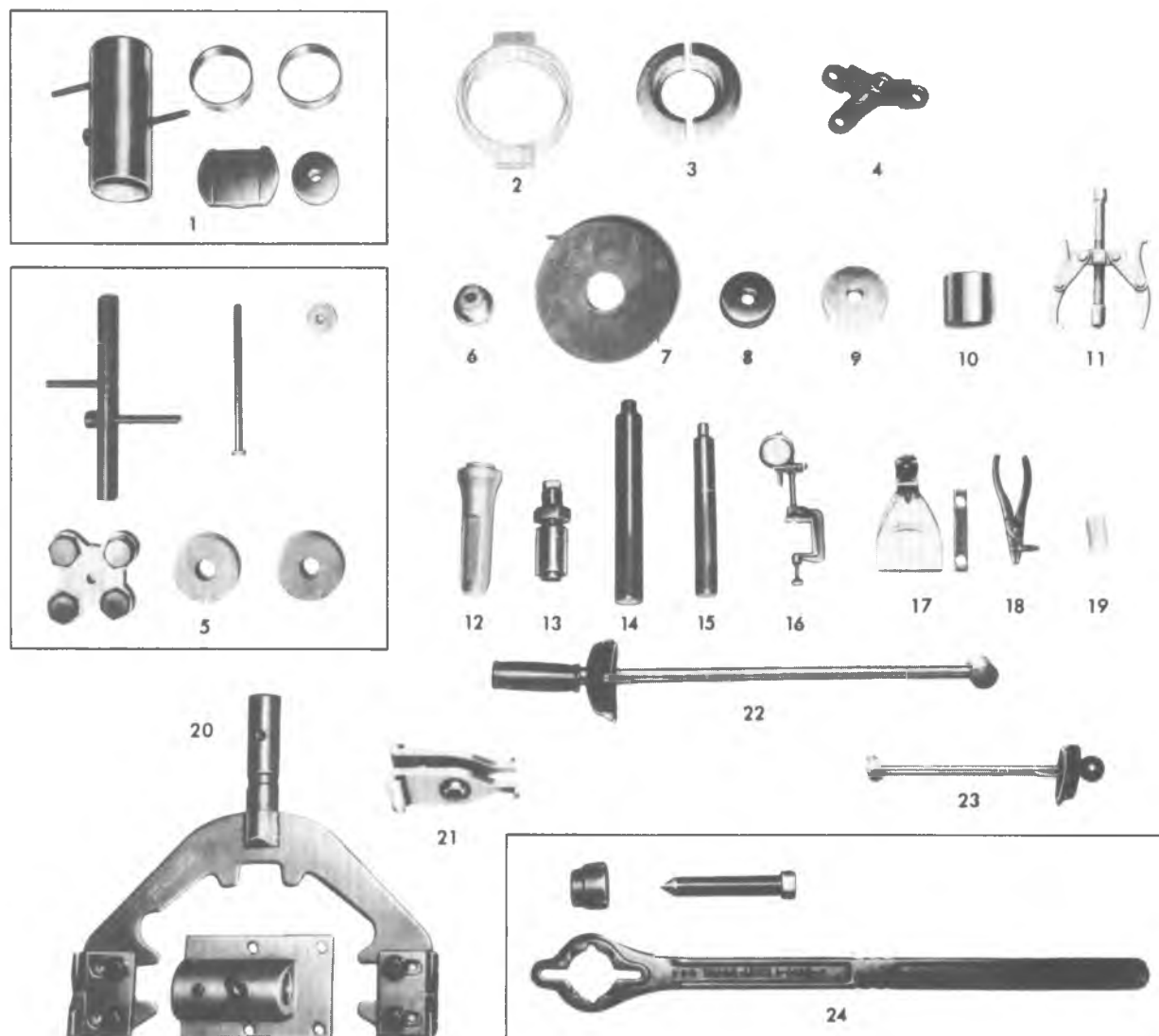
**NOTE:** Use standards differential lubricant. DO NOT use lubricants specifically designed for "limited slip differentials".

# SPECIAL TOOLS



- |              |  |                  |  |
|--------------|--|------------------|--|
| 1. J 6266    | Pinion Setting Gauge                           | 9. J-22888       | Differential Bearing Remover                       |
|              | J-6266-28 Barrel Adapter                       | 10. J-7079-2     | Driver Handle (Insert Type)                        |
|              | J-6266-25 Plug                                 | 11. J-8092       | Driver Handle (Threaded Type)                      |
|              | J-6266-52 Gauge Plate                          | 12. J-8609 01    | Pinion Rear Bearing Installer - Passenger Car      |
|              | J-6266-53 Gauge Plate                          | J-5590           | (7-1/2")   |
|              | J-6266-31 Adapter Rings                        | 13. J-8612       | Rear Pinion Bearing Remover                        |
| 2. J 23597 1 | Pinion Setting Gauge (7-1/2")                  | J-253200         | (7-1/2")   |
|              | J-21777-1 Arbor                                | 14. J 8608       | Pinion Rear Bearing Cup Installer                  |
|              | J-21777-45 Side Discs                          | J 7817           | (7-1/2")   |
|              | J-21777-29 Gauge Plate                         | 15. J-1313       | 0-150 Ft. Lbs. Torque Wrench                       |
|              | J-21777-42 Front Bearing Plug                  | 16. J-5853       | In. Lbs. Torque Wrench                             |
|              | J-21777-43 Stud                                | 17. J 7137       | Pinion Front Bearing Cup Installer                 |
| 3. J 22779   | Side Bearing Shim Gauge                        | J 7817           | (Used with J-8092)                                 |
|              | J-22779 Strap                                  |                  | (7-1/2")   |
| 4. J 22175   | Side Bearing Installer (8-3/4")-(8-7/8")       | 18. J-8107-4     | Differential Bearing Remover - Installer           |
| J 22761      | (8-1/2")                                       |                  | (Used with J 9537 and J 22779)                     |
| J 25299      | (7-1/2")                                       | 19. J 8614       | Companion Flange Holder                            |
| 5. J 9458    | Companion Flange Installer - Passenger Car     | 20. J-22864-1, 2 | Pinion Seal Gauge Plate (7-1/2", 8-1/2", 8-7/8")   |
| 6. J 5590    | Pinion Rear Bearing Cup Installer - Truck Axle | 21. J-23911      | Pinion Oil Seal Installer (7-1/2", 8-1/2", 8-7/8") |
| 7. J 8001    | Dial Indicator Set                             | 22. J-0270-14    | Pinion Rear Bearing Cup Installer                  |
| 8. J 5748    | Positraction Torque Measuring Adapter          |                  | Truck Axle (Used with J-8092)                      |

Fig. 1T--Special Tools - 7-1/2", 8-1/2", 8-3/4", 8-7/8" Ring Gear Differentials



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

Fig. 2T--Special Tools - Corvette Differential





Fig. 3T--Special Tools 10-1/2" and 12-1/4" Ring Gear Differentials



## SECTION 4C

# FRONT AXLE DIFFERENTIAL (4-WHEEL DRIVE)

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Front Axle Differential.....	4C-1	Drive Pinion.....	4C-5
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Differential Case .....	4C-1	Differential Case .....	4C-6
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## GENERAL INFORMATION

K10-20 Models use a Chevrolet or a Dana (44 Series) style front axle, which incorporates an 8-1/2" ring gear. The K-30 axle is a Dana (60 series) which incorporates a 9-3/4" ring gear.

The following procedures pertain to Dana model axles only. Procedures for the Chevrolet 8-1/2" model are the same as covered previously in Section 4B of this manual.

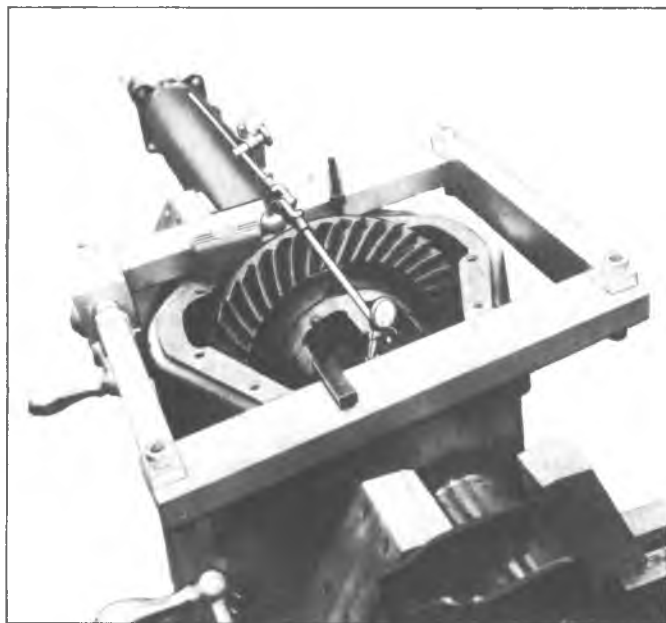


Fig. 4C-1—Spreading Case With J-24385

### FRONT AXLE DIFFERENTIAL

#### Differential Case (Dana-Models)

##### Removal (Fig. 4C-1)

1. If front axle assembly is removed from vehicle, mount assembly in suitable holding fixture and remove axle shafts as outlined in Axle Shaft Removal, Truck Service Manual.

2. Remove cover attaching bolts and lock washers and the metal tag secured by one of the attaching bolts. Remove cover and gasket.

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

3. Remove differential side bearing caps, making sure they are marked for reassembly in the same position.

4. Position Spreader Tool J-24385 so the two dowels on tool fit into recesses in carrier, install two hold down bolts and install a dial indicator at one end of opening in carrier to indicate width of opening.

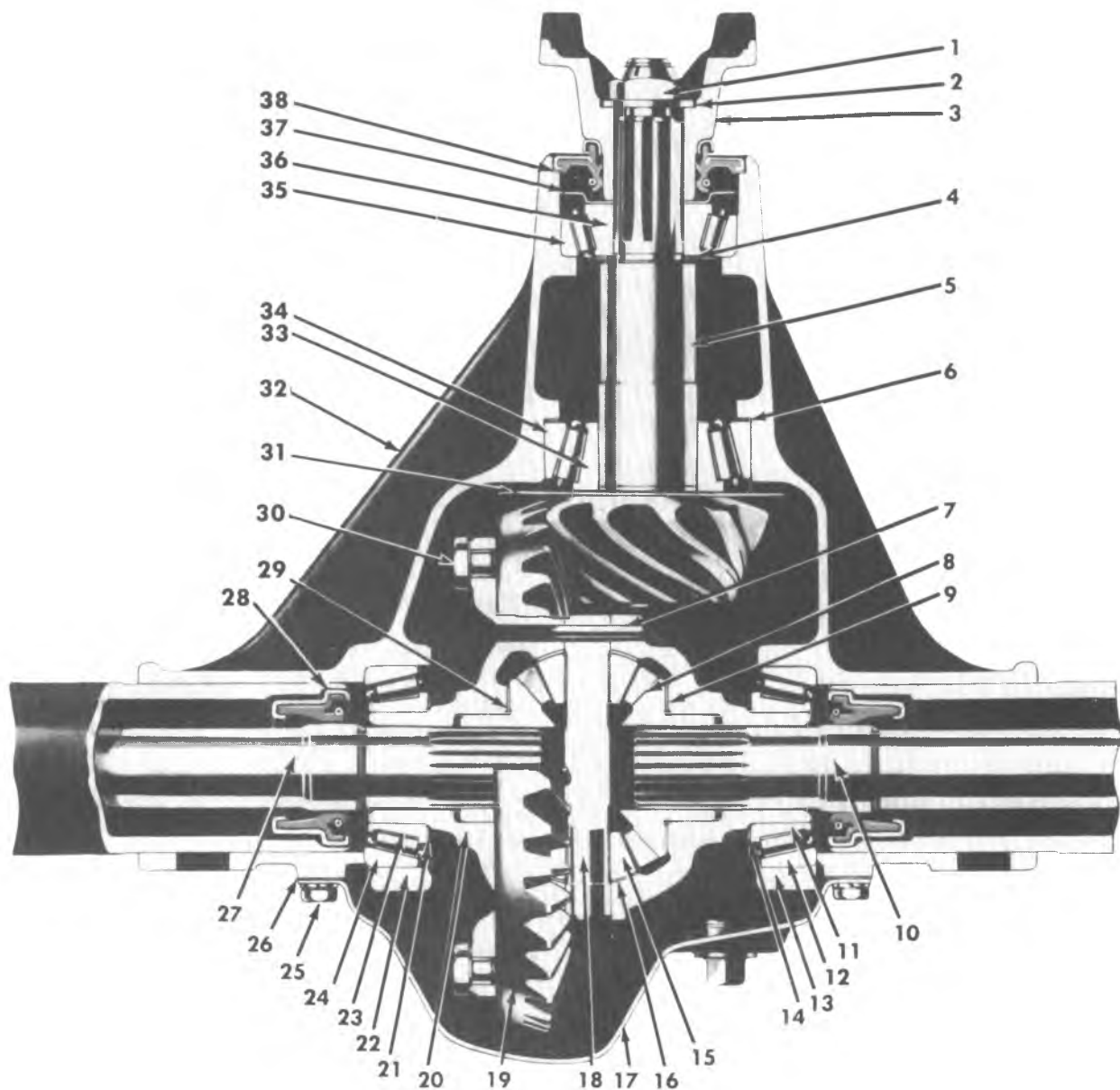
5. Expand spreader tool to spread carrier a maximum of .020".

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

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

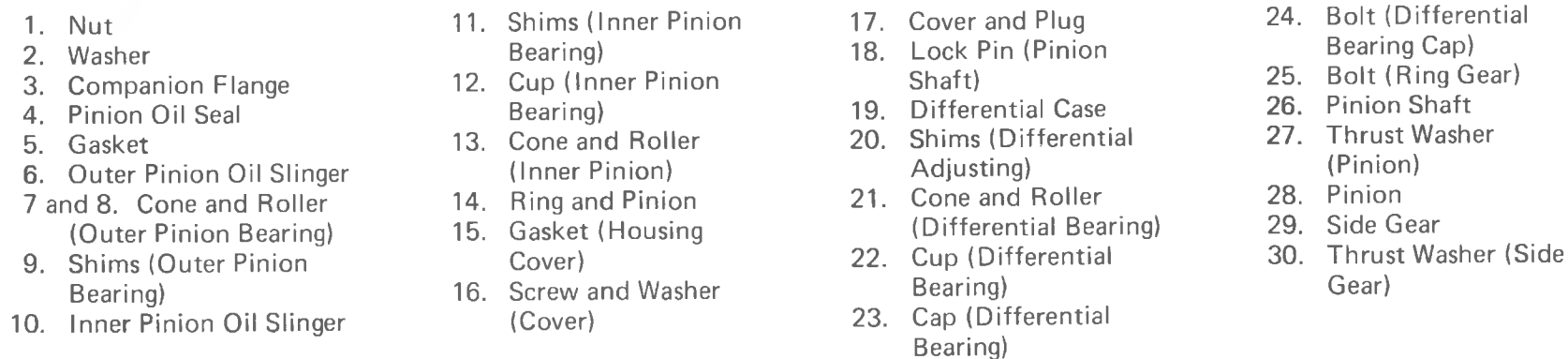
##### Oil Seal Replacement

The axle shaft inner oil seals are located just outboard of the differential bearings, item 28, Fig. 4C-2. They can be replaced only after the differential is removed from the carrier, using tool J-25111.



- |                           |  |  |                          |
|---------------------------|--|--|--------------------------|
| 1. Nut                    | 11. Differential Bearing Cone            | 20. Differential Case                    | 29. Thrust Washer        |
| 2. Washer                 | 12. Differential Bearing Cup             | 21. Differential Bearing Adjusting Shims | 30. Ring Gear Bolt       |
| 3. Pinion Flange          | 13. Bearing Cap                          | 22. Differential Bearing Cap             | 31. Oil Slinger          |
| 4. Outer Bearing Shims    | 14. Differential Bearing Adjusting Shims | 23. Differential Bearing Cone            | 32. Differential Carrier |
| 5. Drive Pinion           | 15. Differential Pinion                  | 24. Differential Bearing Cup             | 33. Inner Bearing Cone   |
| 6. Inner Bearing Shims    | 16. Thrust Washer                        | 25. Cover Bolt                           | 34. Inner Bearing Cup    |
| 7. Lock Pin               | 17. Cover                                | 26. Gasket                               | 35. Outer Bearing Cup    |
| 8. Differential Side Gear | 18. Pinion Cross Shaft                   | 27. Axle Shaft                           | 36. Outer Bearing Cone   |
| 9. Thrust Washer          | 19. Ring Gear                            | 28. Oil Seal                             | 37. Oil Slinger          |
| 10. Axle Shaft            |  |  | 38. Oil Seal             |

Fig. 4C-2--Front Axle Differential Assembly



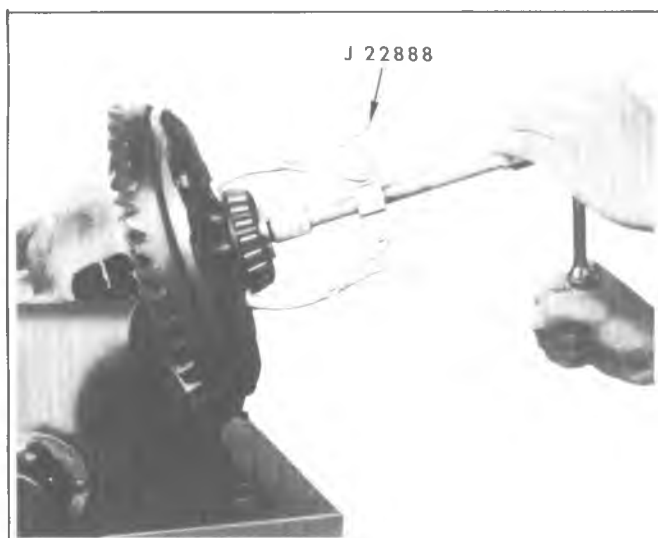


Fig. 4C-4--Removing Side Bearing

### Disassembly

1. Remove bearing cups from differential case and identify for reassembly.
2. Remove bearing cones from case, using puller J-22888 and correct plug (fig. 4C-4) and remove shims from case. Identify all parts so they may be reassembled in their original location.
3. Drive the pinion shaft lock pin out of case.
4. Remove ring gear bolts from case and separate ring gear from case.
5. Remove pinion shaft, pinions, side gears and thrust washers from case.

### DRIVE PINION

#### Removal

1. Using Holding Bar J-8614-1, attached to pinion shaft flange, remove self-locking nut and washer from pinion shaft.
2. Install Tool J-8614-2, and 3 into holding bar as shown in Figure 4C-5 and remove flange from drive pinion. Remove drive pinion from carrier.
3. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.
4. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.
5. Remove inner pinion cone and roller using Tool J-22912, installed as shown in Figure 4C-6, and press pinion from bearing.

#### Inspection

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

**NOTE:** The pinion bearings are of the tapered type, and the natural wear pattern is a frosted condition with occasional slight scratches on races or rollers. This does

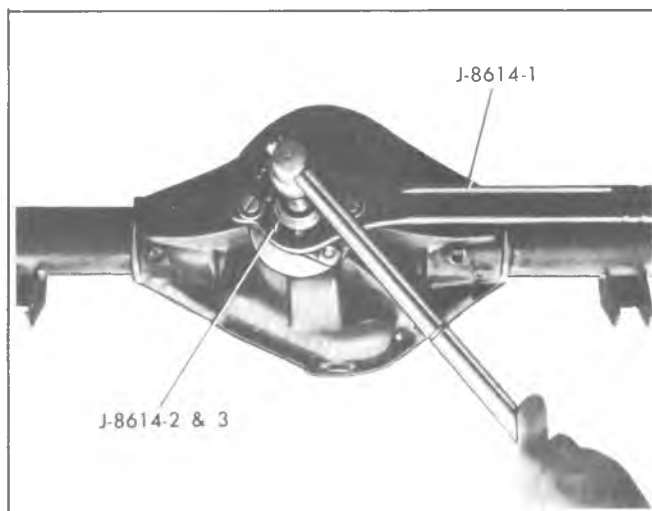


Fig. 4C-5--Removing Pinion Flange

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.

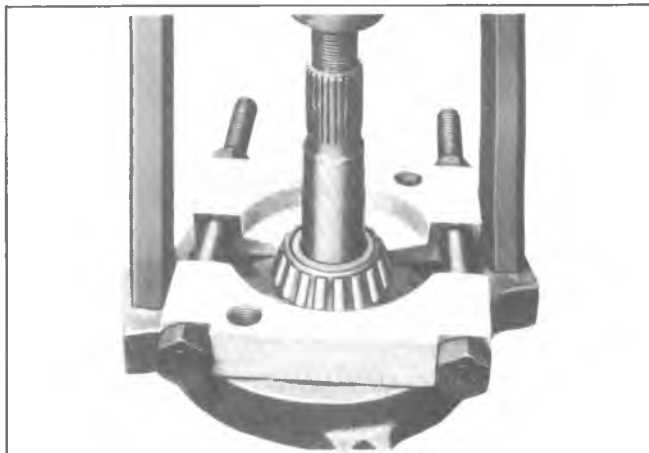


Fig. 4C-6--Removing Inner Pinion Bearing Cone and Roller

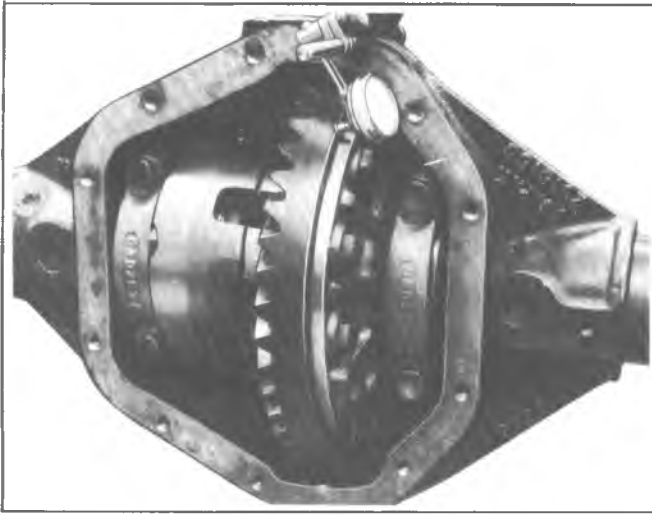


Fig. 4C-7--Checking Runout

5. With an arbor press, press differential side bearings onto case using Tool J-22175. Do not install shims at this time.

6. Place differential case in carrier and install bearing caps. Care should be taken to install caps in original position. Use mark placed on caps and carrier at removal. Tighten caps just enough to keep bearing caps in place.

7. Install dial indicator on carrier with indicator button contacting back of ring gear (Fig. 4C-7). Rotate differential case and check for runout. If runout is greater than .002", the assembly should be removed and the ring gear removed from 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.

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

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

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

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

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

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

1. Determine proper inner shim pack (for setting pinion depth) by using chart (fig. 4C-8).

2. Install inner shim pack and oil slinger in inner cup bore and drive inner cup into position using Tool J-21059 used with J-8092.

3. To the outer shim pack (for setting preload) add or remove an equal amount as was added or removed from the inner shim pack.

4. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092.

5. Press inner pinion bearing cone and roller onto pinion shaft using Installer J-9772 on arbor press as shown in Figure 4C-9.

6. Install drive pinion and inner bearing cone and roller assembly in differential carrier.

7. Install shims and outer pinion cone and roller on pinion shaft using Tool J-5590 and companion flange to press bearing onto pinion (Fig. 4C-10).

8. Install flange holding bar and install washer and nut on pinion shaft. Torque nut to 255 ft. lbs.

9. Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.

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

10. If torque requirements (preload) are not to specifications, adjust shim pack as necessary. Increase the outer shim pack to reduce rotation torque. Decrease shim pack to increase rotating torque.

11. Remove nut, washer and flange from pinion shaft.

12. Install oil slinger, gasket and using Tool J-22804 install oil seal.

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

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

Fig. 4C-8--Drive Pinion Shim Chart

## DIFFERENTIAL CASE

### Preload and Adjustment

1. Place differential assembly (with pinion assembled) into housing. Install bearing caps in their proper position and tighten screws just enough to hold the bearing cups in place.

2. Install dial indicator on carrier with indicator button contacting back of ring gear (Fig. 4C-7).

3. Place two screwdrivers between bearing cup and housing on ring gear side of case, and pry ring gear into mesh with pinion gear as far as it will go. Rock ring gear to allow bearings to seat and gears to mesh. With force still applied, set indicator to "0".

4. Reposition screw drivers on opposite side of ring gear and pry ring gear as far as it will go. Now take and 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 4C-1.

2. Install differential bearing cups in their correct locations then install differential case into carrier.

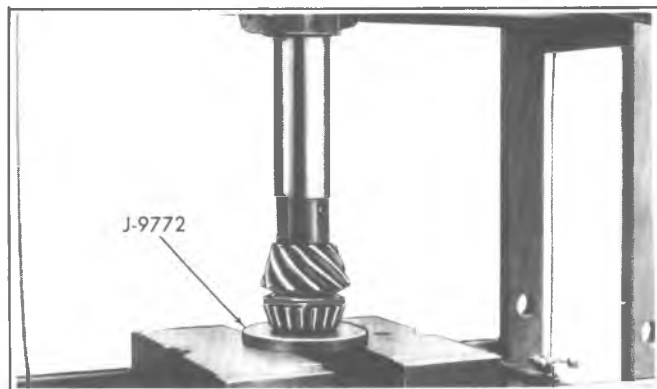


Fig. 4C-9--Installing Inner Pinion Core and Roller

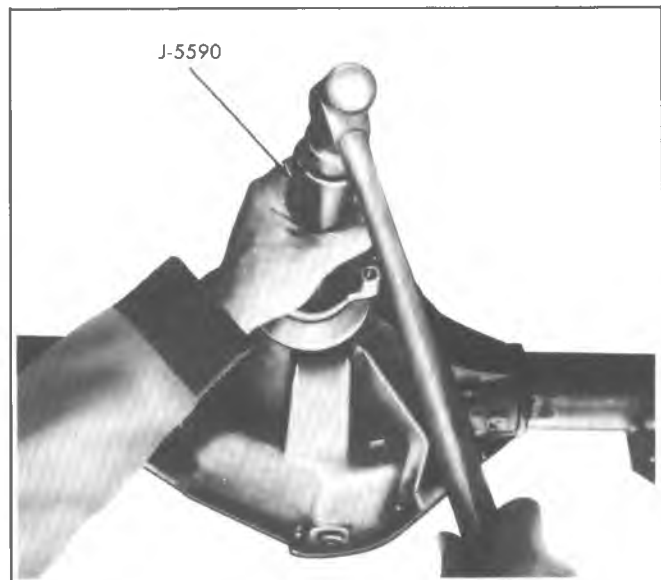


Fig. 4C-10--Installing Pinion Flange



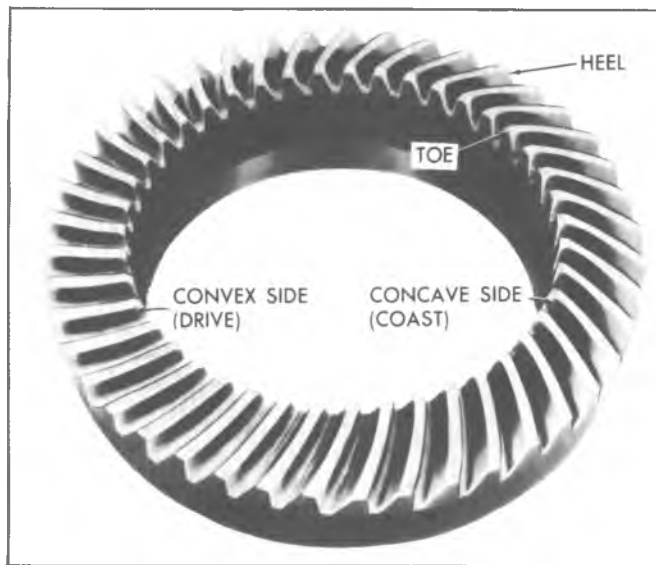


Fig. 4C-11—Gear Tooth Nomenclature

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 as described in "Gear Tooth Contact Pattern Check".

8. After a successful pattern check, install housing cover using a new gasket.

9. Install axle shafts and install axle assembly into vehicle (See Service Manual).

10. Fill with recommended lubricant, lower vehicle to floor and road test vehicle.

### GEAR TOOTH CONTACT PATTERN CHECK

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

### Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 4C-11.

### Test

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

2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.

3. Tighten bearing cap bolts to 55 lb. ft.

4. Apply a load until a torque of 40-50 lb. ft. is required to turn the pinion.

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

5. Observe pattern on ring gear teeth and compare with Figure 4C-12.

### Adjustments Affecting Tooth Contact

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

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

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

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

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

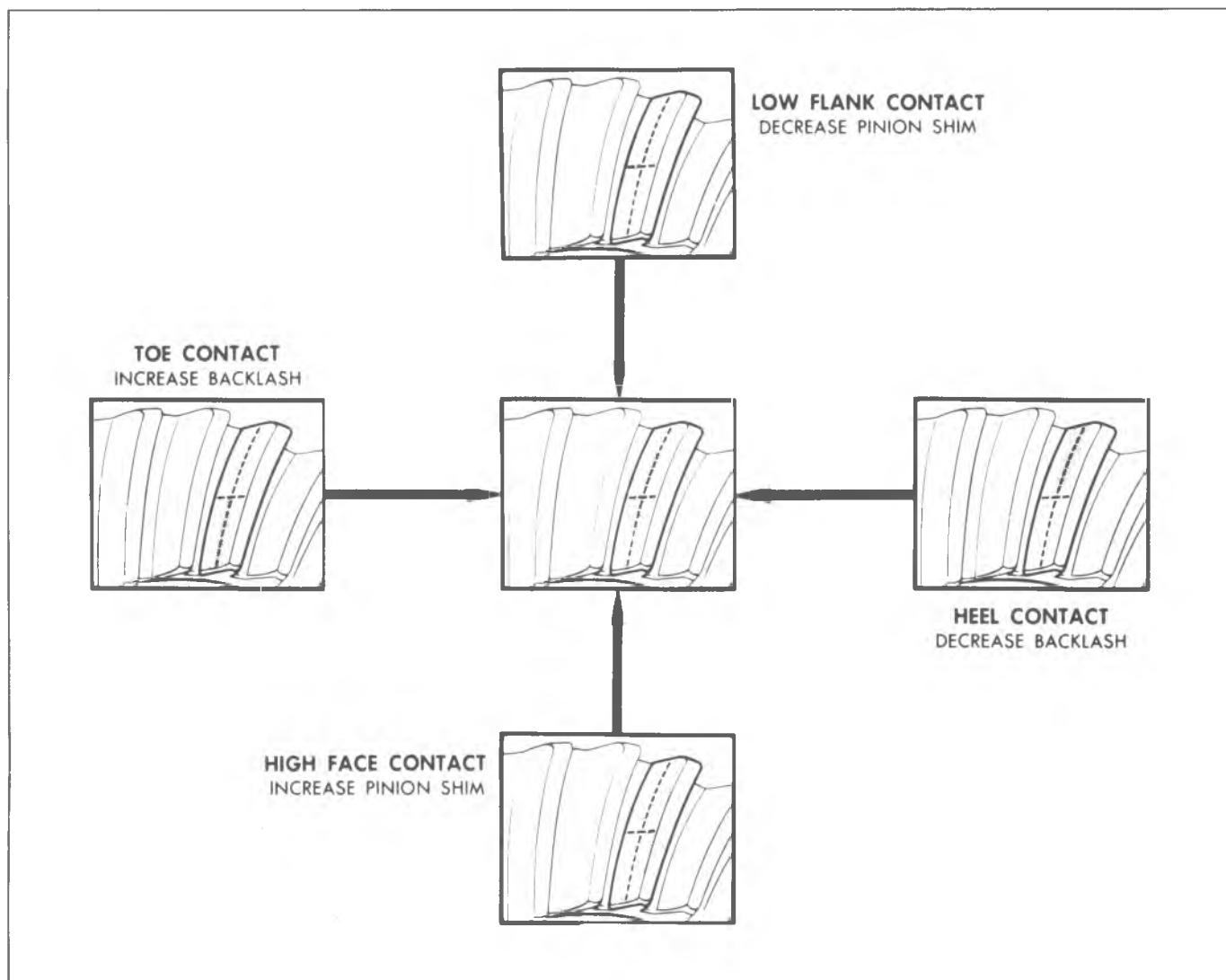


Fig. 4C-12--Gear Tooth Pattern Contact Pattern

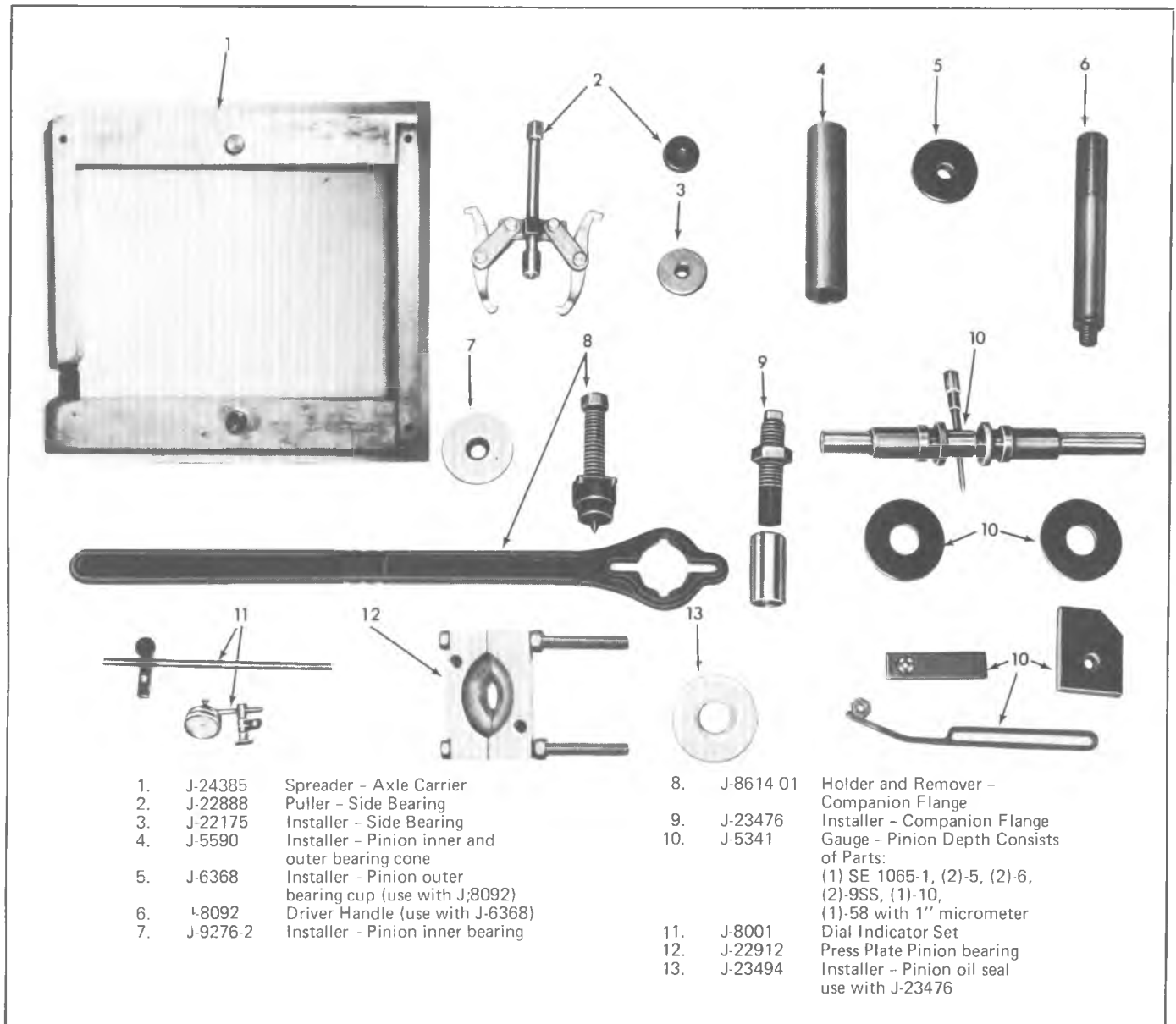
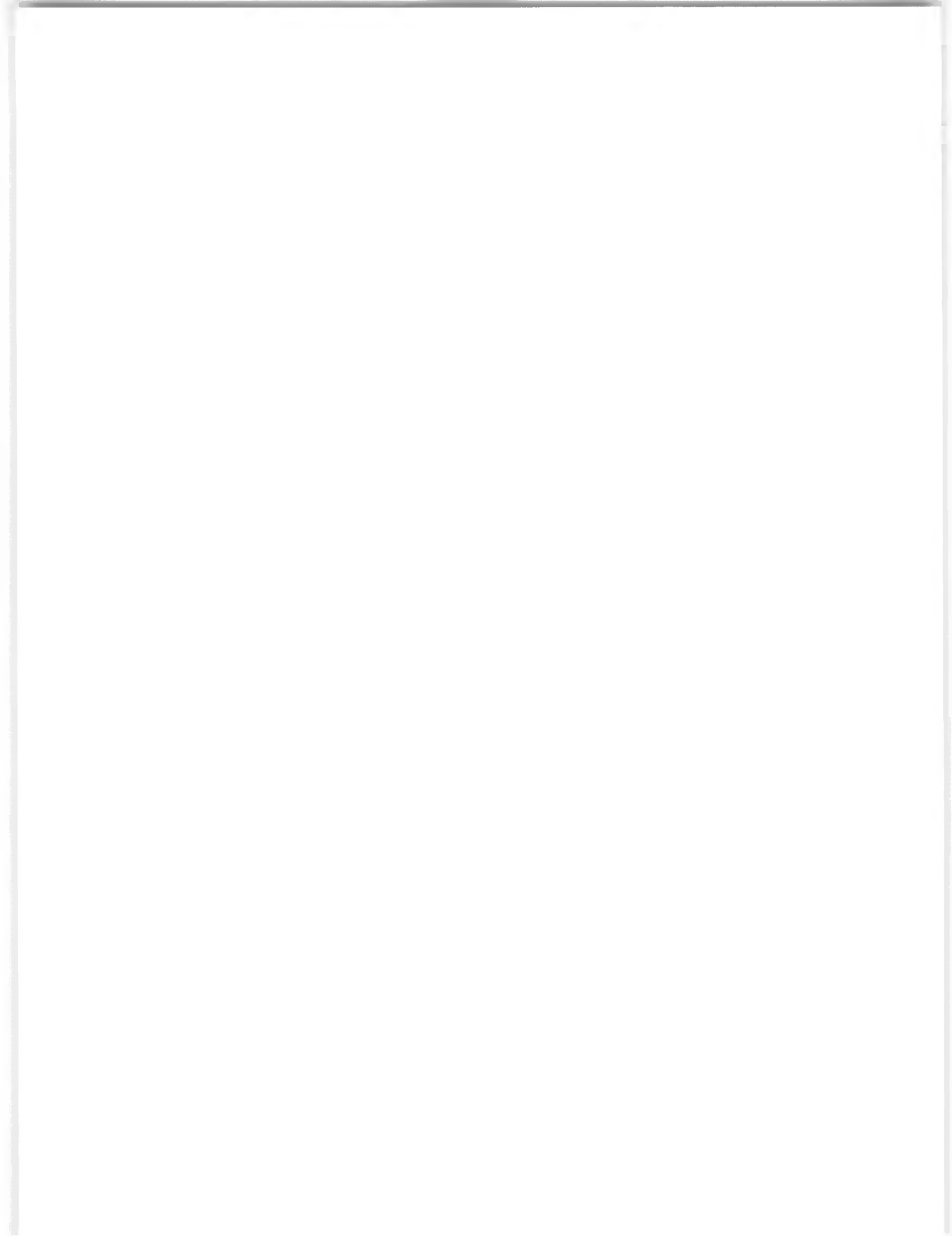


Fig. 4C-13--Special Tools Chart 4C-A



## SECTION 5

## BRAKES

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 1 of this section".

**CAUTION:** *THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.*

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Delco Tandem Power Brake Unit.....	5-1
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## DELCO TANDEM POWER BRAKE UNIT UNIT REPAIR

**Disassembly**

**NOTE:** Scribe a line across front and rear housing to facilitate reassembly.

1. Remove and discard the vacuum check valve and grommet from the front housing.

2. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate damage to studs. Clamp base in a bench vise with the power section up (fig. 5-2A).

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

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

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

4. Remove Tools J-9504 and J-22805 from front and rear housings.

5. Remove the power piston return spring.

6. Remove front housing seal.

**Rear Housing Group**

1. Remove the boot and boot retainer from the rear housing and push rod. Remove the felt silencer from inside the boot.

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

**Power Piston Group (Fig. 5-3A)**

1. Remove reaction retainer and piston rod from the power piston.

2. Remove the power head silencer from the neck of the power piston tube.

3. Turn power piston group upside down so that end of push rod is against a hard surface. Grasp entire power piston group with both hands and use slight force or impact on push rod to remove diaphragm retainer.

4. Remove diaphragms, support plates and divider from the power piston.

5. Separate both the primary and secondary diaphragms from the support plate.

6. Using a screwdriver, remove reaction body retainer.

7. Remove reaction body.

8. Remove reaction disc and reaction piston from the center of reaction body by pushing down on the end of the reaction piston with a small cylindrical object, such as a pencil or dowel.

9. Remove air valve spring.

10. Remove the rubber reaction bumper on the end of the air valve.

11. Using Truarc No. 2 pliers (J-4880 or equivalent) remove the retaining ring from the air valve.

12. Remove the air filter from the tubular section of the power piston.

13. Remove the air valve push rod assembly from the push rod end of the power piston. The following removal methods are recommended.

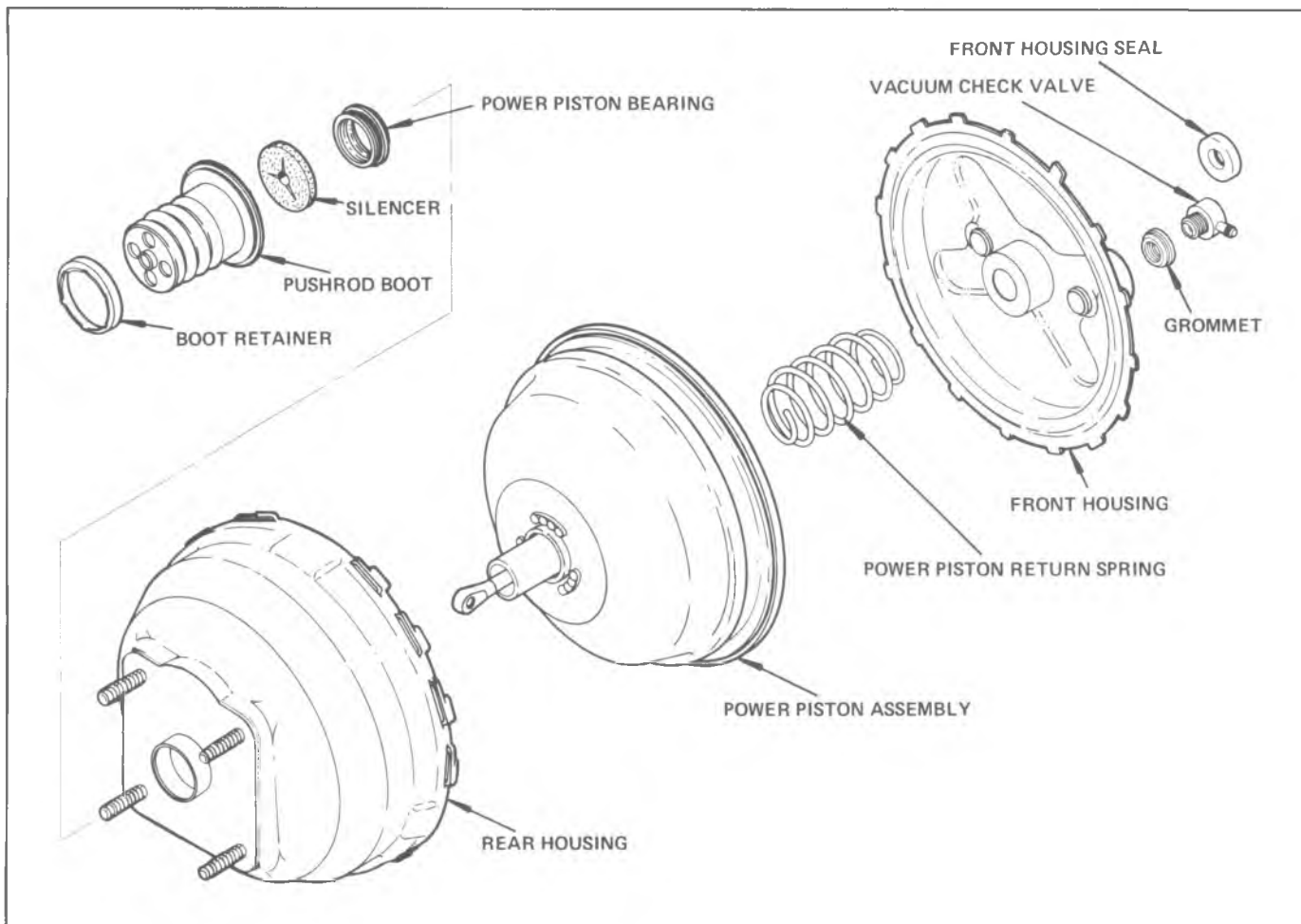


Fig. 5-1A--Delco Tandem Power Brake Unit--Explode

a. Place the power piston in an arbor press and press the air valve push rod assembly out of the bottom of the power piston tube with a rod not exceeding 1/2" in diameter.

b. An alternate method would be the use of a heavy, round shanked screwdriver. Insert screwdriver on both sides of the push rod, and pull the air valve push rod assembly

straight out. A considerable force will be required.

14. Removal of the air valve push rod assembly will disassemble the control valve retainer.

15. Remove the "O" ring from the air valve.

16. Models using air valve push rod rod assemblies with a formed eye on the end of the push rod will be serviced using a complete assembly, since the floating control valve cannot be removed over the eye end of the push rod.

### Cleaning

After disassembly, immerse all metal parts in metal cleaner. Plastic parts, as well as the rubber power diaphragms, should be cleaned in denatured alcohol or clean brake fluid. Care should be taken to avoid chipping or damaging plastic parts in handling. After parts have been thoroughly cleaned, those parts which come in contact with hydraulic brake fluid (that is, all master cylinder parts and the power section push rod) should be thoroughly washed in denatured alcohol or clean brake fluid before assembly. Use air to blow out dirt and cleaning solvent from recesses and internal passages.

### Inspection of Rubber Parts

Wipe fluid from the rubber parts and carefully inspect each rubber part for cuts, nicks or other damage. These parts are the key to the control of fluid or air flow. If there is any question as to the serviceability of rubber parts, **REPLACE** them!

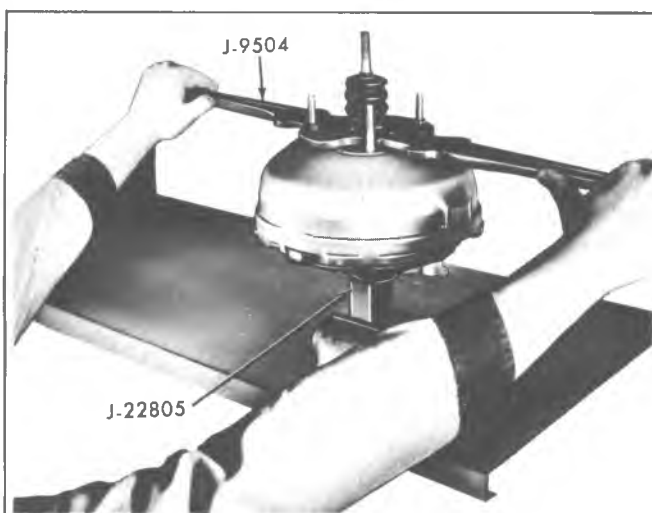


Fig. 5-2A--Unlocking Front and Rear Housings

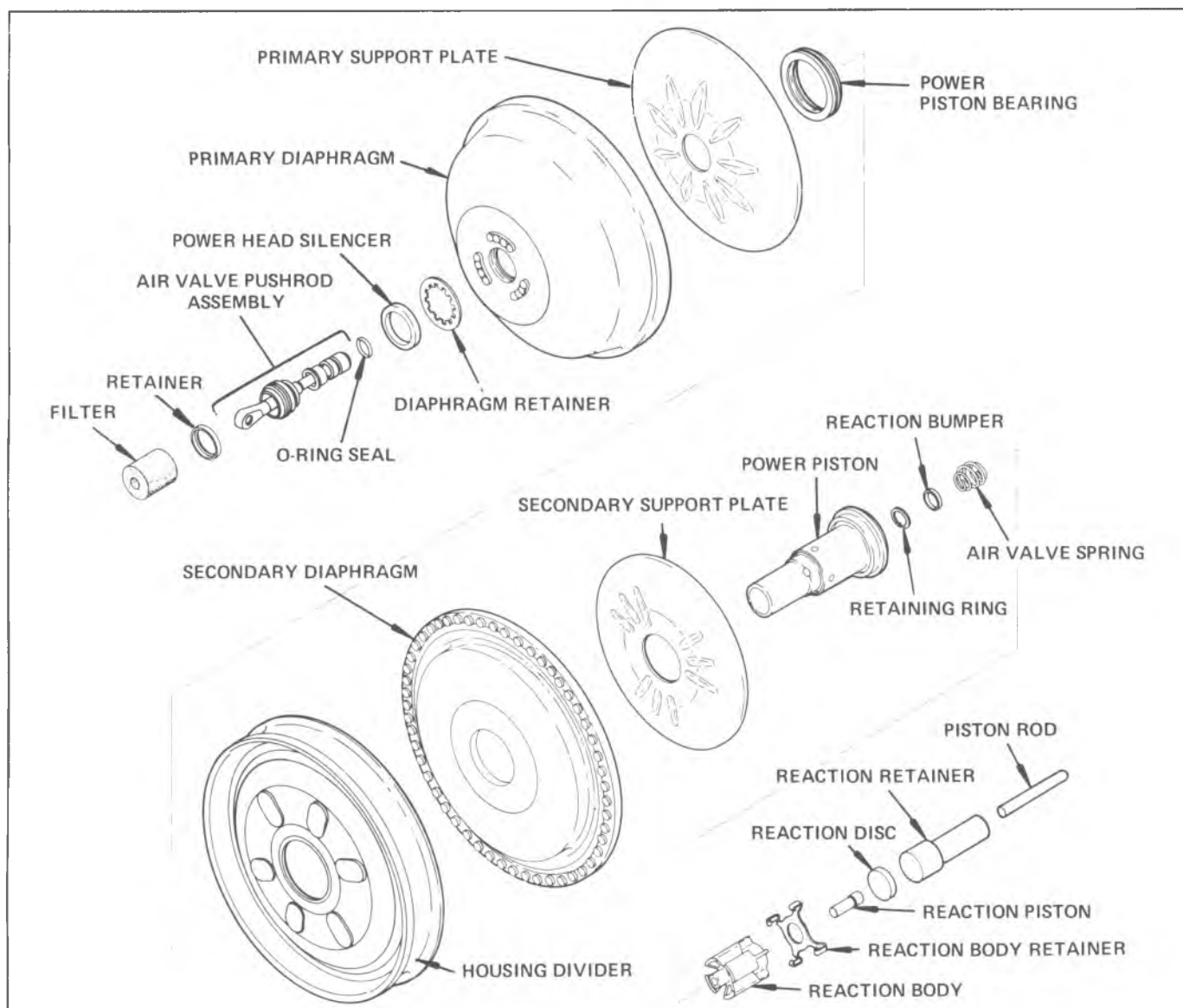


Fig. 5-3A--Power Piston Group--Explode

### Inspecting Metal Parts

BADLY DAMAGED ITEMS, OR THOSE WHICH WOULD TAKE EXTENSIVE WORK OR TIME TO REPAIR, SHOULD BE REPLACED. In case of doubt, install new parts.

### Assembly

1. Be careful during the rebuild procedure that no grease or mineral oil comes in contact with the rubber parts of the power brake unit.

2. Lubricate power unit parts, as outlined below, with power brake silicone lubricant. This lubricant is provided in the service repair kit.

### Front Housing Group Assembly

1. Insert the NEW grommet in the front housing.
2. Install the NEW vacuum check valve into the grommet.
3. Install NEW front housing seal.

### Power Piston Group (Fig. 5-3A)

1. Lubricate 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. If the floating control valve needs replacement, replace the complete air valve push rod assembly.
4. Place the air valve end of the air valve push rod assembly into the tube of the power piston. Manually press the air valve push rod assembly so that the floating control valve bottoms on the tube section of the power piston.
5. Place lip of retainer on the O.D. of Tool J-23175 (fig. 5-4A). Manually press the retainer until seated in the power piston tube (fig. 5-5A).
6. Install filter element over the push rod eye and press into the power piston tube.
7. Using snap ring pliers, place the snap ring into the groove in the air valve.
8. Install the rubber reaction bumper on the end of the air valve.

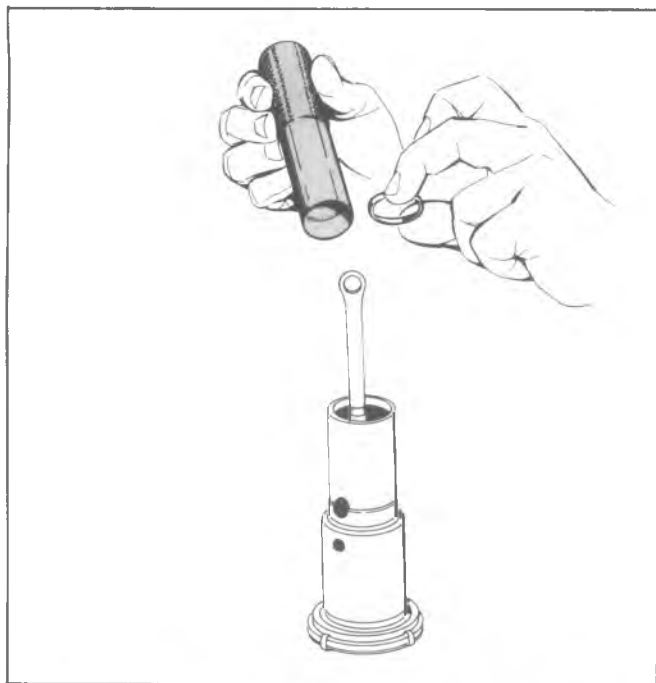


Fig. 5-4A--Installing Air Valve Push Rod Retainer

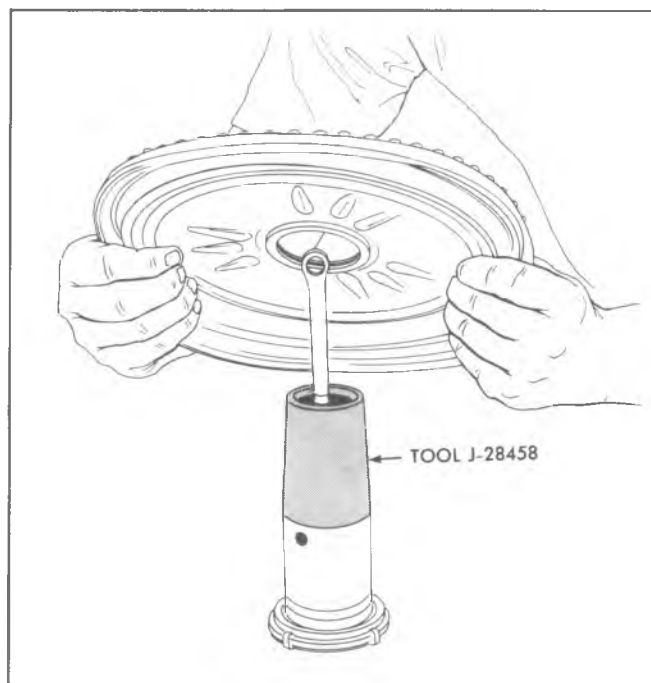


Fig. 5-6A--Installing Secondary Diaphragm and Support Plate Assembly

9. Install air valve spring on end of air valve.
10. Install reaction body with large I.D. hole up.
11. Replace reaction body retainer.
12. Install reaction piston into reaction body large diameter up.
13. Apply a light film of silicone lubricant to the O.D. of the rubber reaction disc.
14. Place the rubber reaction disc in the cavity of the reaction body.
15. Place the power piston on bench with the push rod up. Install assembly cone J-28458 over push rod end of

piston (fig. 5-6A).

16. Assemble secondary diaphragm to secondary support plate. 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.

17. With assembly Tool J-28458 mounted on the power piston, place the secondary diaphragm and support plate assembly over the power piston (see Figure 5-6A) and push

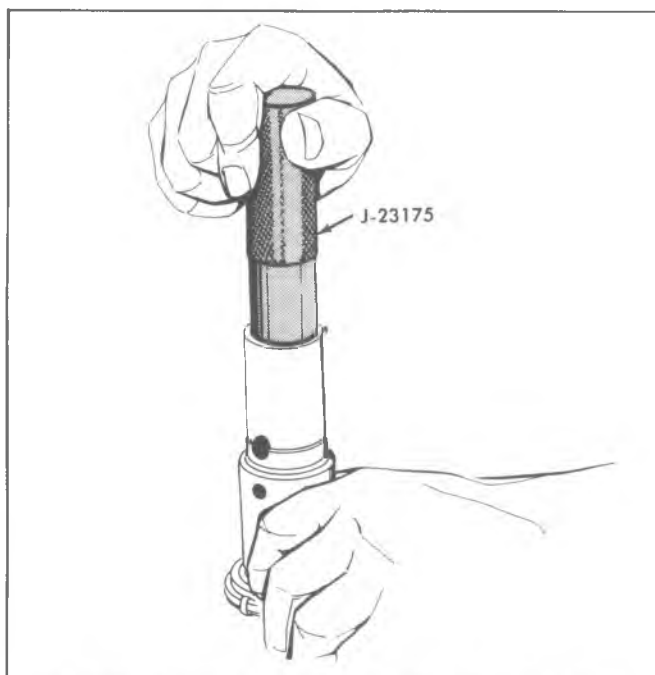


Fig. 5-5A--Seating Air Valve Push Rod Retainer Using J-23175

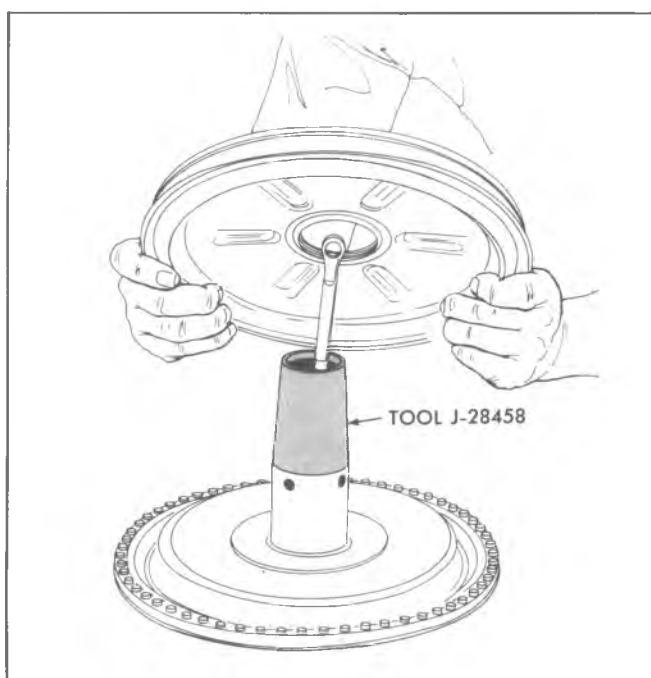


Fig. 5-7A--Installing Divider



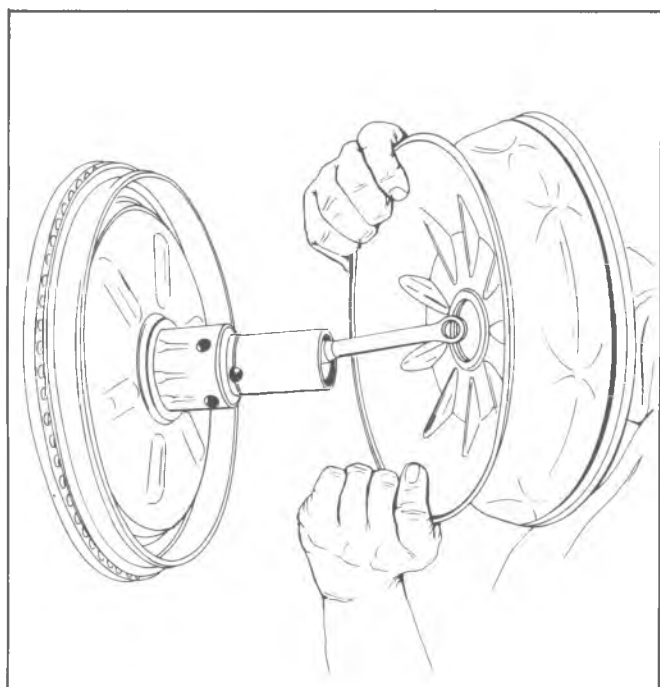


Fig. 5-8A--Installing Primary Support Plate and Diaphragm Assembly

down until it bottoms on power piston.

18. Hold the housing divider so that the formed over flange (that holds the primary diaphragm) of the divider faces down. Place the power piston bearing in the I.D. of the divider so that the extended lip of the bearing faces up.

19. Lubricate the I.D. of the power piston bearing with silicone lubricant.

20. With Tool J-28458 still positioned on the power piston, hold the housing divider so that formed over flange of the divider faces up. Press the divider down over the tool and onto the power piston tube where it will rest against

the secondary diaphragm (fig. 5-7A).

21. Assemble the primary diaphragm to the primary support plate. 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. with silicone lubricant.

22. Remove Tool J-28458 from power piston.

23. Fold the primary diaphragm away from the O.D. of the primary support plate and place the primary support plate and diaphragm assembly over the power piston and push down until it bottoms (fig. 5-8A).

24. 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.

25. Place the diaphragm retainer over power piston and onto diaphragm. Place Tool J-28458 over power piston onto diaphragm retainer. Strike with hammer until retainer is locked on neck of power piston (fig. 5-9A).

26. 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 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 power piston bearing in rear housing center hole so that the formed flange of the housing center hole fits into the groove of the power piston bearing. The thin lip of the bearing will protrude to the outside of the housing.

2. Coat the I.D. of the power piston bearing with silicone lubricant.

### Final Assembly

1. Mount Holding Fixture J-22805 in a vise and position the front housing on the tool so that the housing studs fit in the holes provided in the tool. Install washers and nuts and draw them down tight to eliminate damage to studs.

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 power piston through the rear housing bearing. Press down until the housing divider seats in the rear housing and the 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 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 rear housing, the scribe marks on the top of the housings will be in line.

6. Lower the rear housing assembly onto the front housing. The power piston spring must seat in the depression of the power piston retainer. Check that the bead on the O.D. of the secondary diaphragm is positioned between the edges of the housing.

7. Place Spanner Wrench J-9504 over studs on the rear housing, and attach with nuts and washers-- draw nuts

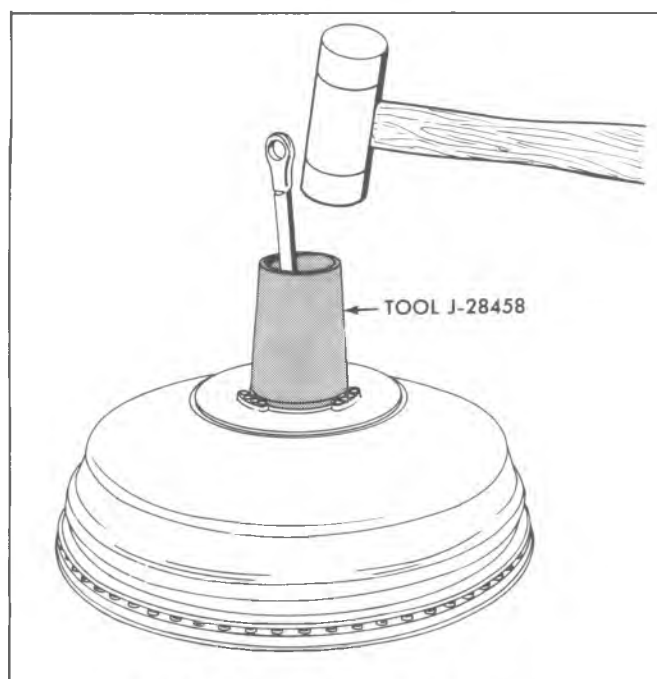


Fig. 5-9A--Installing Diaphragm Retainer

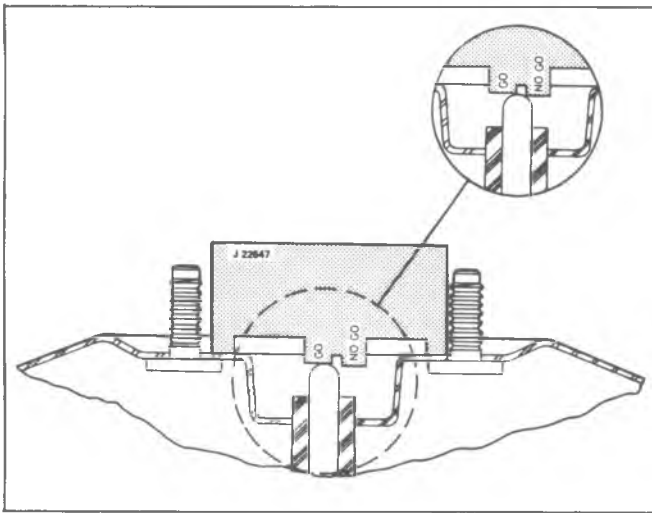


Fig. 5-10A--Gaging Piston Rod

down tight to eliminate bending or damage of studs.

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

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

8. Remove Tool J-9404 from the rear housing.

9. Place the silencer in the closed end of the power head boot. Push the boot retainer over the 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.

4. Remove the front housing seal to assure that no vacuum is in the power head while gaging.

5. 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. 5-10A).

6. 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.

7. 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 gaging specifications.

8. 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.

## BENDIX TANDEM POWER BRAKE UNIT UNIT REPAIR

### Disassembly

1. Scribe a line across the front and rear housings to facilitate reassembly.

2. Carefully remove hydraulic push rod and seal and slide seal from rod.

3. Remove vacuum check valve and grommet.

4. Remove dust boot and silencer from operating valve rod.

5. Remove dust guard retainer, dust guard and silencers from rear plate hub with an awl. Then, reinstall steel retainer on hub.

6. Squirt denatured alcohol down the operating valve rod to lubricate rubber grommet in the valve plunger.

7. Position two small blocks of wood on either side of air valve rod and install end of air valve rod in vise, leaving just enough clearance to position two (2) open end wrenches between the vise and retainer on hub of rear plate.

8. Using the wrench nearest the vise as a pry, force the air valve off the ball end of the rod. **DO NOT** damage the plastic hub or allow vacuum cylinder to fall to the floor (fig. 5-1B and 5-2B).

9. The edge of the rear housing contains twelve (12) lances. Four (4) of these lances (one in each quadrant) are deeper than the other lances. The metal that forms the four (4) deep lances must be partially straightened so that the

lances will clear the cutouts in the front housing. If the metal tabs that form the deep lances break during straightening, the housing must be replaced (fig. 5-3B).

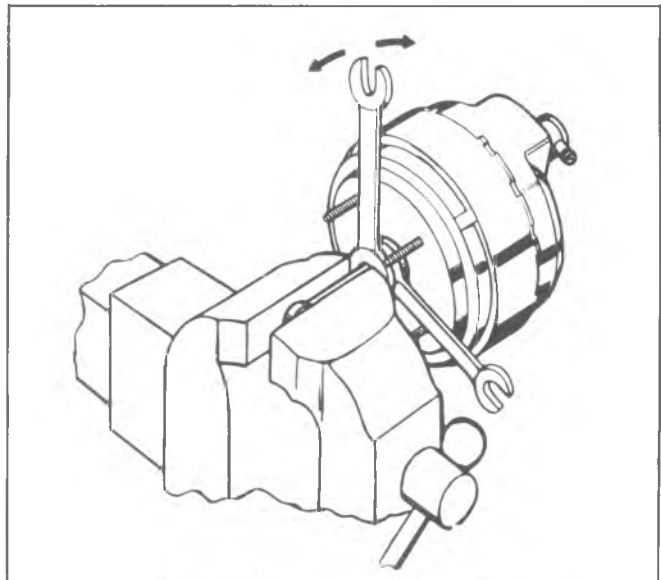


Fig. 5-1B--Removing Air Valve Rod

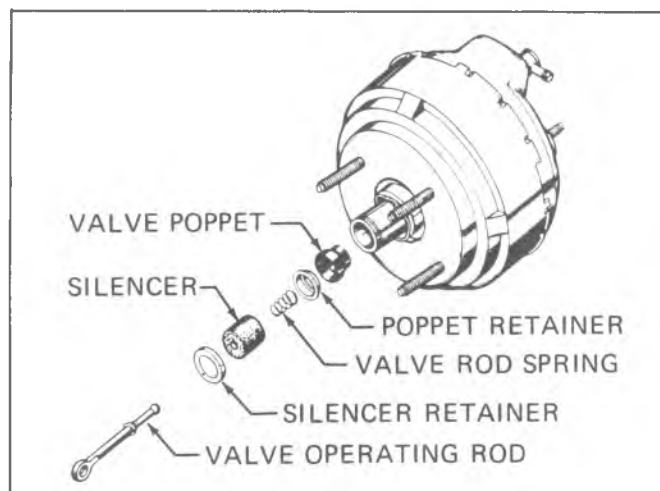


Fig. 5-2B--Air Valve Rod Assembly

10. Remove the hydraulic push rod and vacuum seal from the front housing.

11. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs.

12. Place power unit with Holding Fixture J-22805 in an arbor press with rear housing up and secure to plate of press by a suitable means of holding Tool J-22805 (fig. 5-4B). 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.

13. Place Spanner Wrench J-9504 over studs on rear shell (fig. 5-4B). Use three washers and nuts to attach wrench to housing. Use a suitable piece of pipe of approximately two inches I.D. and approximately three inches in length. Place over plastic diaphragm plate hub. Place a piece of flat stock steel over end of pipe and press

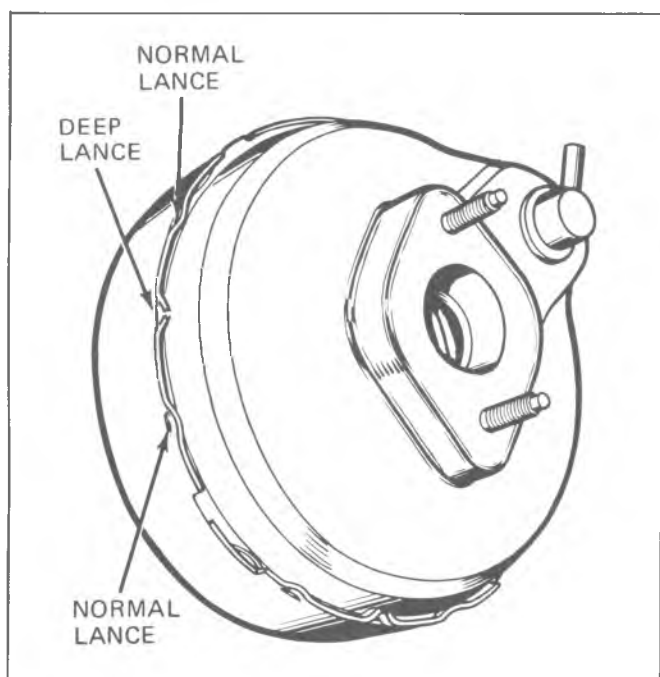


Fig. 5-3B--Lances in Rear Housing

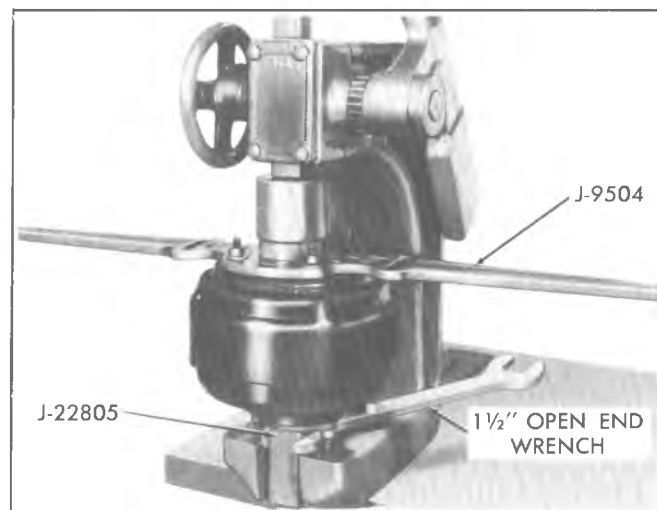


Fig. 5-4B--Holding and Separating Housings Using J-22805 and J-9504 in Arbor Press

rear housing down far enough to relieve tension of diaphragm rubber lip and spring.

14. Rotate spanner bar counterclockwise until the lances in the edge of the rear housing are aligned with the cut-outs in the front housing. Considerable effort may be required to rotate the front housing.

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

15. Slowly release press to permit the two housings to separate.

16. Continue to release press until diaphragm spring tension has been removed.

17. Remove the front housing and return spring.

18. Remove three nuts and washers from Spanner Wrench and separate wrench and rear housing.

19. Remove Holding Fixture J-22805 from front housing.

20. Work edges of front diaphragm from under lances of rear housing and remove complete vacuum assembly from rear housing, using care not to damage rear housing seal. Bosses on center plate must be aligned with cutouts in rear housing to remove the assembly.

21. Wet the rear diaphragm retainer with denatured alcohol and remove the retainer using fingers only.

22. Clamp Tool J-22839 in a vise. Place the diaphragm and plate assembly on the tool with the tool seated in the hex opening in the front plate.

23. Twist the rear diaphragm plate counterclockwise, using hand leverage on the outer edge of the plate. It may be necessary to use a 1" x 1-3/16" x 8" wood strip as a lever in cover slot on outside circumference of rear plate.

24. After the two (2) plates have been loosened, remove the plates from Tool J-22839 and place on a bench with the

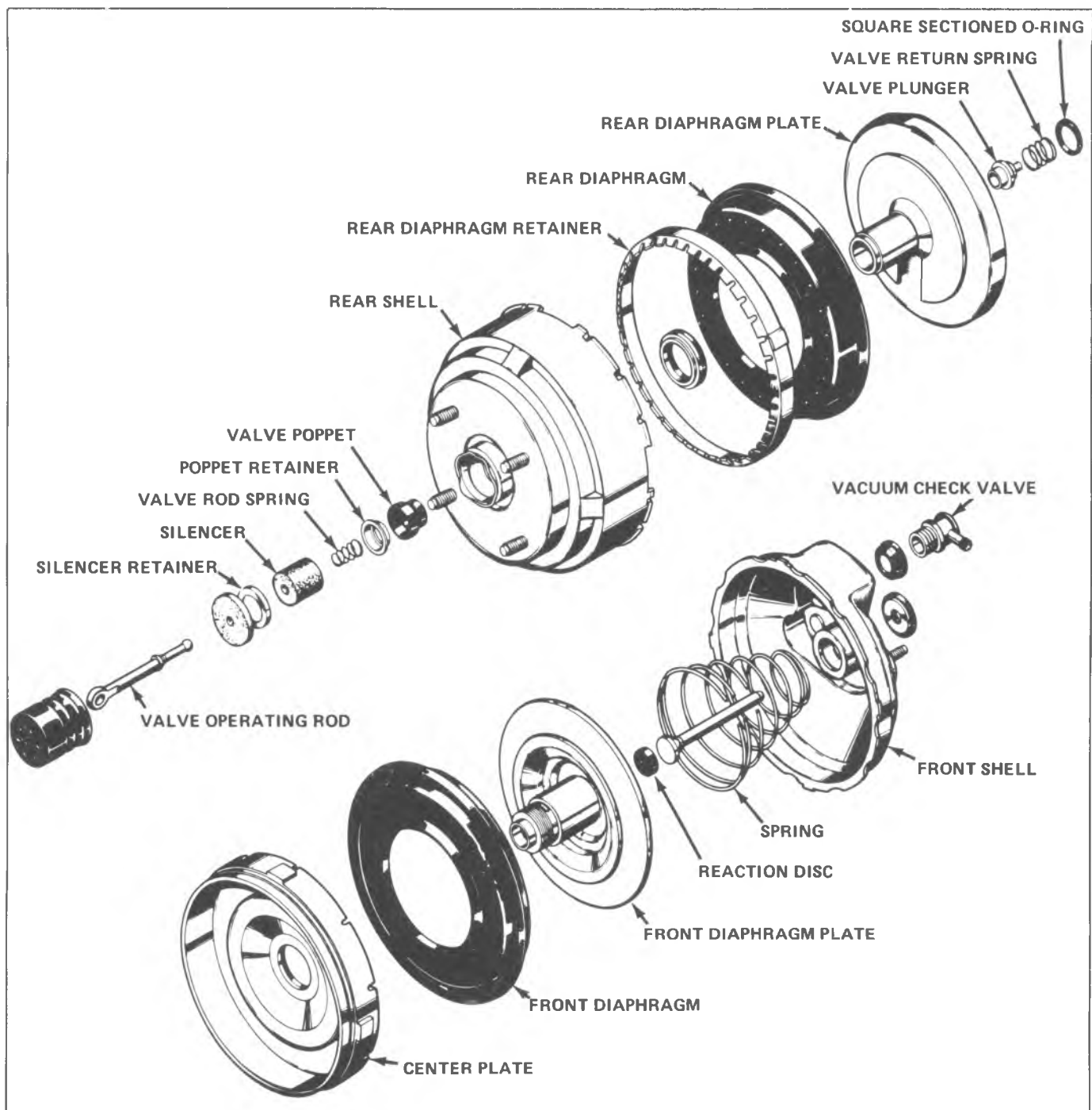


Fig. 5-5B--Diaphragm and Plates

front plate down. Unscrew the rear plate completely and carefully lift it off the front plate hub, grasping the air valve plunger and valve return spring as the parts are separated (fig. 5-5B).

25. Remove the square ring seal from the shoulder of the front diaphragm plate hub.

26. Remove the reaction disc from inside the front diaphragm plate hub. Carefully slide the center plate off the hub of the front plate.

27. Remove the diaphragms from the plates.

28. Use a blunt punch or 1-1/4" socket to drive seal from rear housing (figs. 5-6B and 5-7B).

## Cleaning

All parts to be reused should be washed in denatured alcohol or brake fluid. Dry the parts with compressed air and place them on clean paper or lint free cloth.

Small rust spots inside the shells may be removed with crocus cloth or fine emery cloth. Be sure to clean thoroughly after using any abrasive.

Inspect all parts and replace any that are damaged or show excessive wear.



Fig. 5-6B--Removing Rear Seal

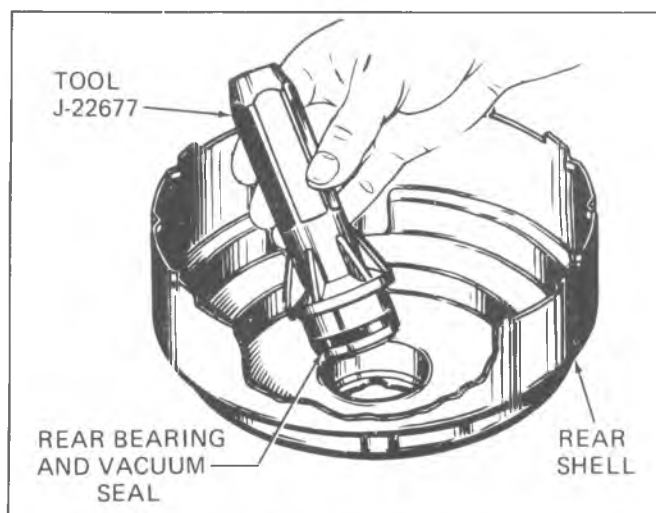


Fig. 5-8B--Installing Rear Bearing and Vacuum Seal

### Assembly

1. Press the new bearing and seal into the cavity in the rear housing using Tool J-22677 (fig. 5-8B). The flat rubber surface of the seal should be  $\frac{5}{16}$ " below the flat, inside surface of the rear housing.

2. Install reaction disc in hub of front plate with small tip toward hole. Use rounded rod to seat disc.

3. Mount Tool J-22839 in vise.

4. Install front diaphragm on front plate. Long fold of diaphragm must be facing down.

5. Install Tool J-22733 over threads on front plate hub (fig. 5-9B).

6. Apply a light film of silicone lubricant to front plate hub and to seal in center plate, then guide center plate, seal first, onto the front plate hub, being careful not to damage center plate seal. Remove Seal Protector J-22733.

7. Apply a light coat of silicone lubricant to bearing surfaces of air valve plunger, being careful not to apply lubricant to rubber grommet inside plunger. Install square ring seal on shoulder of front plate hub and install valve plunger return spring and plunger in base of front plate hub (fig. 5-10B).

8. Set rear plate over hub of front plate, and using hands only, screw plate on hub, making sure that valve and spring are properly aligned. Hand torque plates to 150 in. lbs. Check travel of valve plunger with index finger.

9. Assemble rear diaphragm to rear plate and place lip of diaphragm in groove in rear plate. Install diaphragm retainer over rear diaphragm and lip of center plate. Using fingers, press retainer until it seats on shoulder of center plate (fig. 5-11B).

10. Apply talcum powder to inside wall of rear housing and silicone lubricant to the scalloped cutouts of front housing and to seal in rear housing. Assemble diaphragm and plate assembly into rear housing by carefully guiding rear plate hub through seal in rear housing. Bosses on center plate must be aligned between lances in rear housing for reassembly. Work outer rim of front diaphragm into rear housing with screwdriver blade so that it is under lances in housing.

11. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs.

12. Secure front housing and Holding Fixture J-22805

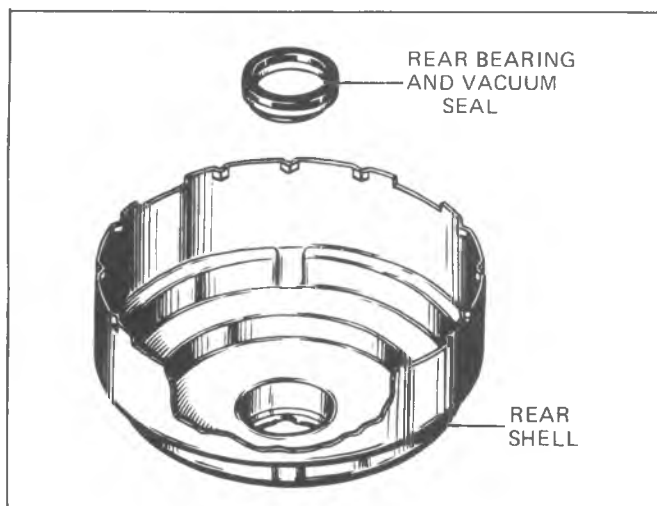


Fig. 5-7B--Rear Bearing and Rear Shell

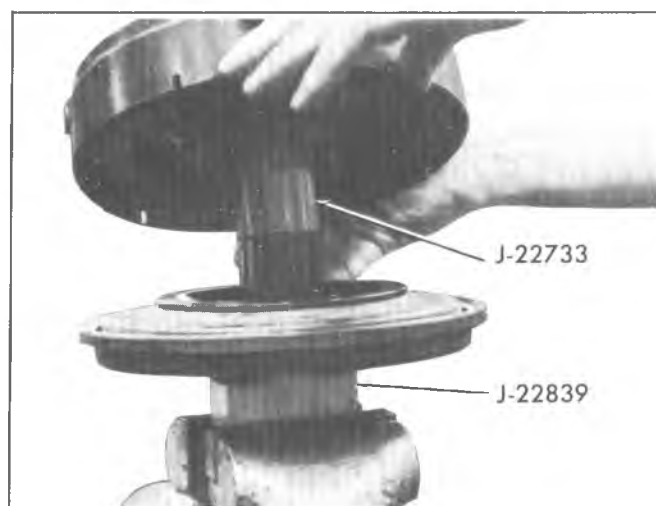


Fig. 5-9B--Seal Protector J-22733 Installed



Fig. 5-10B--Installing Air Valve Plunger

on arbor press plate by a suitable means (fig. 5-4B).

13. Place Spanner Wrench J-9504 over studs on rear housing. Use three washers and nuts to attach wrench to housing. Place a suitable piece of pipe (approximately two inch I.D. and approximately three inches in length) over plastic diaphragm plate hub. Place a piece of flat stock steel over end of pipe.

14. Install diaphragm return spring so that small end of spring is against front housing.

15. Place rear housing over front housing, and align scribe marks.

16. Rotate spanner wrench clockwise until housings are locked together. Bend tabs of the four deep lances back to their original position.

17. Remove three nuts and lock washers securing rear housing to spanner wrench.



Fig. 5-11B--Installing Rear Diaphragm Retainer

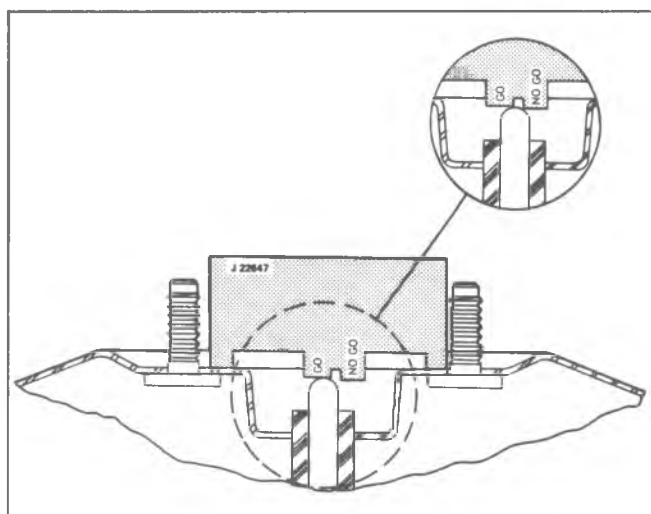


Fig. 5-12B Gaging Piston Rod

18. Remove Holding Fixture J-22805 from front housing by removing two nuts and washers.

19. Wet poppet valve with denatured alcohol and assemble in rear plate hub, small end first. Wet poppet retainer with denatured alcohol and assemble with shoulder inside poppet. Assemble retainer, filters and silencer over ridge on rod and return spring over ball end of operating valve rod. Wet grommet in valve plunger with denatured alcohol and guide air valve rod into valve plunger. Tap end of operating valve rod with plastic hammer to lock ball in grommet. Press filters and silencers into hub and install retainer on hub.

20. Assemble silencer in dust boot, wet dust boot opening with denatured alcohol and assemble over operating valve rod and over flange of rear housing.

21. Install **new** check valve and grommet.

22. Apply silicone lubricant to piston end of hydraulic push rod and insert in cavity in front plate. Twist rod to eliminate air bubbles at reaction disc. Assemble seal over push rod and press into recess in front housing.

### Piston Rod Gauging

1. Place the power head assembly in a padded vise (front housing up); **Do not clamp tight.**

2. Remove the front housing seal to assure that no vacuum is in the power head while gaging.

3. Insert the master cylinder piston rod, flat end first, into the piston rod retainer.

4. Press down on the master cylinder piston rod (with approximately a 40-50 pound load) to be sure it is properly seated.

5. 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. 5-12B).

6. 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.

7. 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.

8. 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.

## DELCO SINGLE DIAPHRAGM POWER BRAKE UNIT UNIT REPAIR

### Disassembly

1. Scribe a mark on bottom center of front and rear housings to facilitate reassembly.

2. Attach base of Tool J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs. Clamp base in bench vise with power section up (fig. 5-2C).

3. Separate front and rear housings as follows:

a. **Straight Mounting Bracket (Fig. 5-3C)** - Place Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs.

b. **Tilt Mounting Bracket (Fig. 5-4C)** - Place tool J-22893 inside tilted mounting bracket. Place Spanner Wrench J-9504 on top of J-22893 and tighten nuts and washers securing spanner wrench.

c. Press down on Spanner Wrench J-9504 and rotate the rear housing counterclockwise to unlocked position. Loosen housing carefully as it is spring loaded.

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

4. Lift rear housing and power piston assembly from unit. Then remove return spring.

5. Remove retaining ring on push rod that holds silencer in place on push rod; remove silencer.

6. Remove seal and vacuum check valve and grommet from front housing.

### Power Piston Assembly Group (Fig. 5-5C)

**CAUTION:** Care must be used in handling the diaphragm of power piston assembly. Guard diaphragm against grease, oil, foreign matter and nicks or cuts.

1. Remove power piston assembly from rear housing.

2. Remove silencer from neck of power piston tube.

3. Remove lock ring from power piston by prying one end out from under large divided locking lug and then proceed to pull ring from under other two locking lugs on power piston (fig. 5-6C).

4. Remove reaction retainer, piston, reaction plate, three (3) reaction levers and air valve spring. Also remove reaction bumper and air valve spring retainer from air valve (fig. 5-7C).

5. Place power piston Wrench J-21524 with square

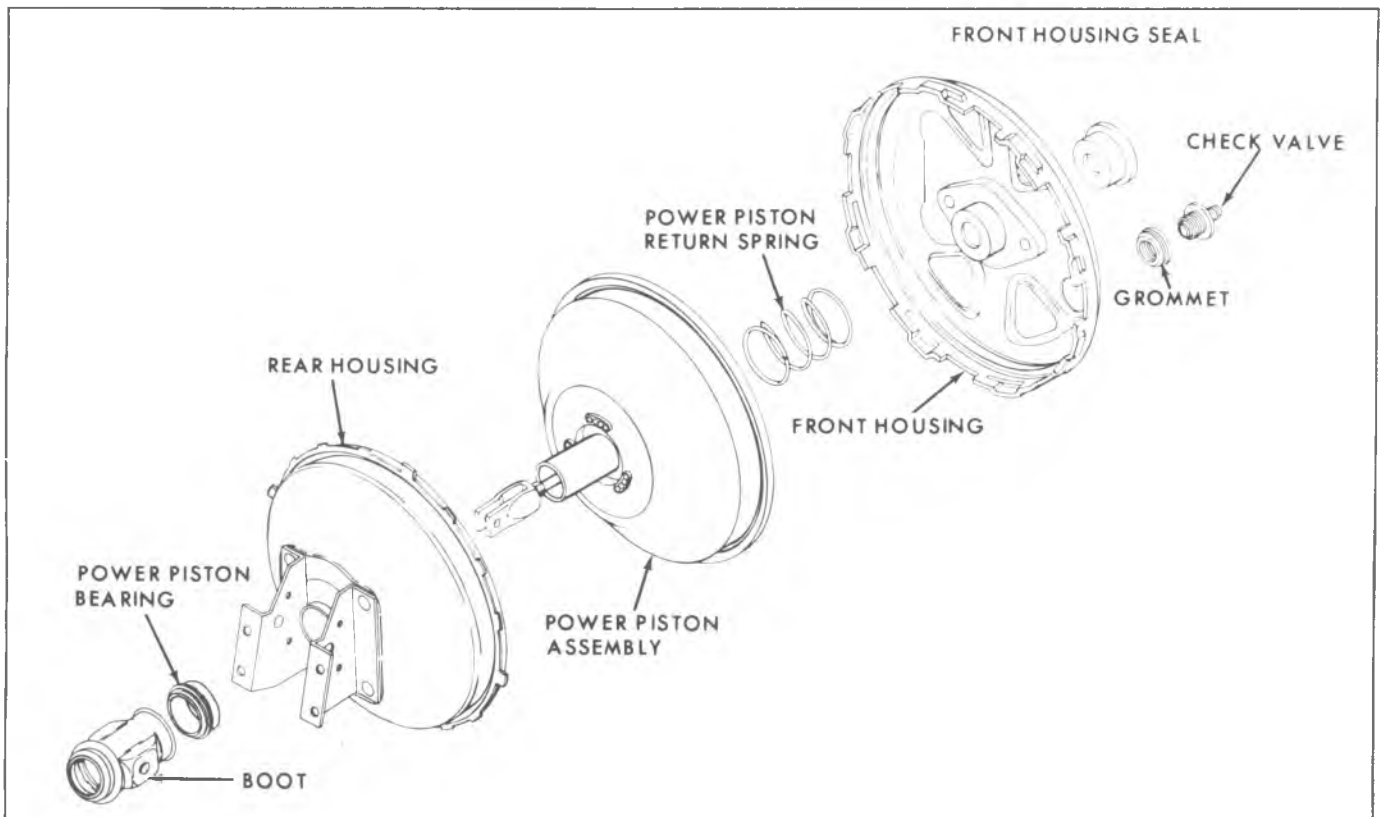


Fig. 5-1C-- Typical Power Brake Unit - Exploded View



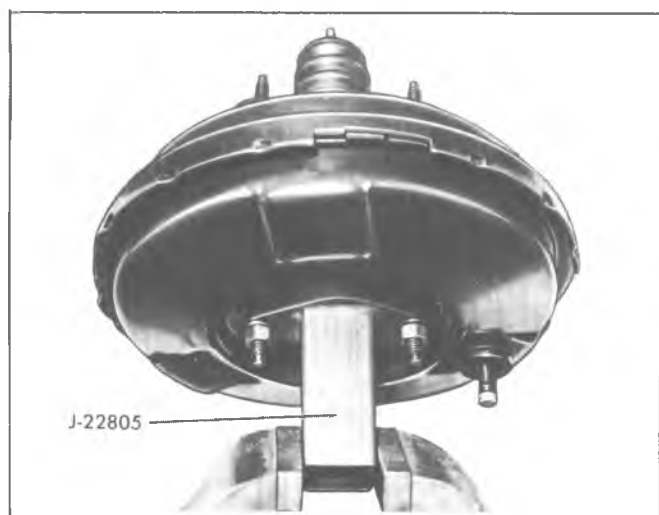


Fig. 5-2C--Holding Power Cylinder Using Tool J-22805

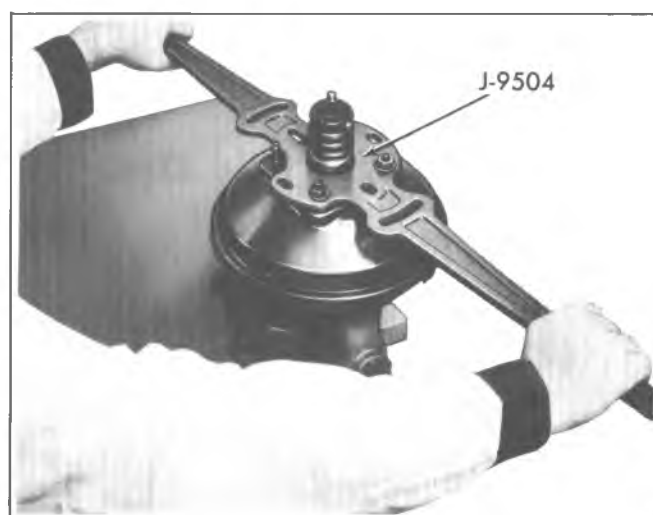


Fig. 5-4C--Separating Tilt Bracket Type Housings

shank in vise. Hold support plate and power piston with tube of power piston up (fig. 5-8C).

6. Pull diaphragm edges away from support plate so hands can grip steel support plate. Position assembly on power piston Wrench J-21524 so three lugs on tool fit into three notches in power piston (fig. 5-9C).

7. Press down on support plate and rotate counterclockwise until support plate separates from power piston (fig. 5-10C).

8. Remove diaphragm from support plate and lay both parts aside.

9. Position power piston, tube down, in a tool, fabricated from a piece of wood 2" x 4" x 8" long with a 1-3/8" hole in center, clamped in a vise. Do not clamp tube in vise.

10. Use Snap Ring Pliers J-4880 to remove snap ring on air valve (fig. 5-11C).

11. Set up Power Ram and Hydraulic Pump with J-9746 Press Plate. Insert power piston, tube down, in press plate and remove air valve assembly using a 3/8" drive extension as a remover (fig. 5-12C).

12. Removal of air valve-push rod assembly

disassembles the following parts from power piston: floating control valve assembly, floating valve retainer, push rod limiter washer and air filter.

13. Remove floating control valve assembly from push rod as it must be replaced by a new floating control valve assembly at rebuild.

14. The master cylinder push rod can now be pushed from center of reaction retainer. Remove "O" ring from groove in master cylinder piston rod.

### Cleaning of Parts

1. Use denatured alcohol to clean thoroughly all metal brake parts. Immerse in cleaning fluid and brush with 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 clean cloth.

2. If slight rust is found inside either front or rear housing assemblies, polish clean with crocus cloth or fine emery paper, washing clean afterwards with specified cleaning fluid.

**CAUTION:** *If there is any suspicion of contamination or any evidence of corrosion, completely flush hydraulic brake system. Failure to clean hydraulic brake system can result in early repetition of trouble. Use of gasoline, kerosene, anti-freeze alcohol or any other cleaner with even a trace of mineral oil will damage rubber parts.*

Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean. Rewash at reassembly if there is any occasion to doubt cleanliness--such as parts dropped or left exposed for eight hours or longer.

### Inspection and Replacement of Parts

1. Inspect all rubber parts. Wipe free of fluid and carefully inspect each rubber part for cuts, nicks or other damage. These parts are the key to control of fluid or air flow and should account for the majority of troubles traceable to leakage. Re-use rubber parts only if a fairly new unit is disassembled for some particular trouble and only then if there is no doubt that the parts are in equal-to-new condition. Badly damaged items or those which would take extensive work or time to repair should be replaced. In case of doubt, install new parts for safety.

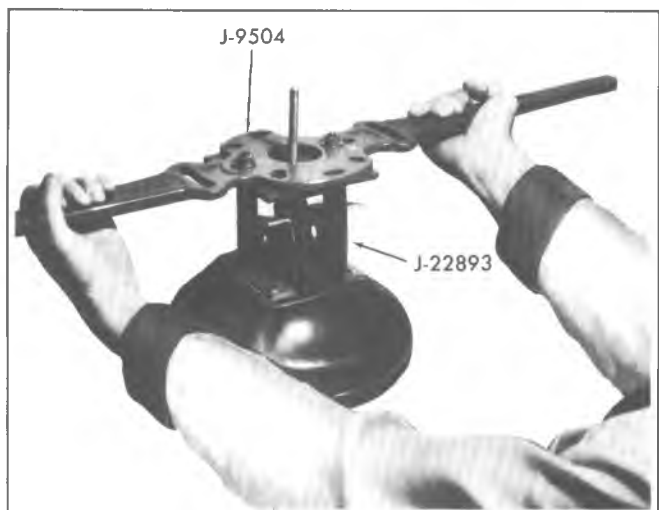


Fig. 5-3C-- Separating Housings With Tool J-9504



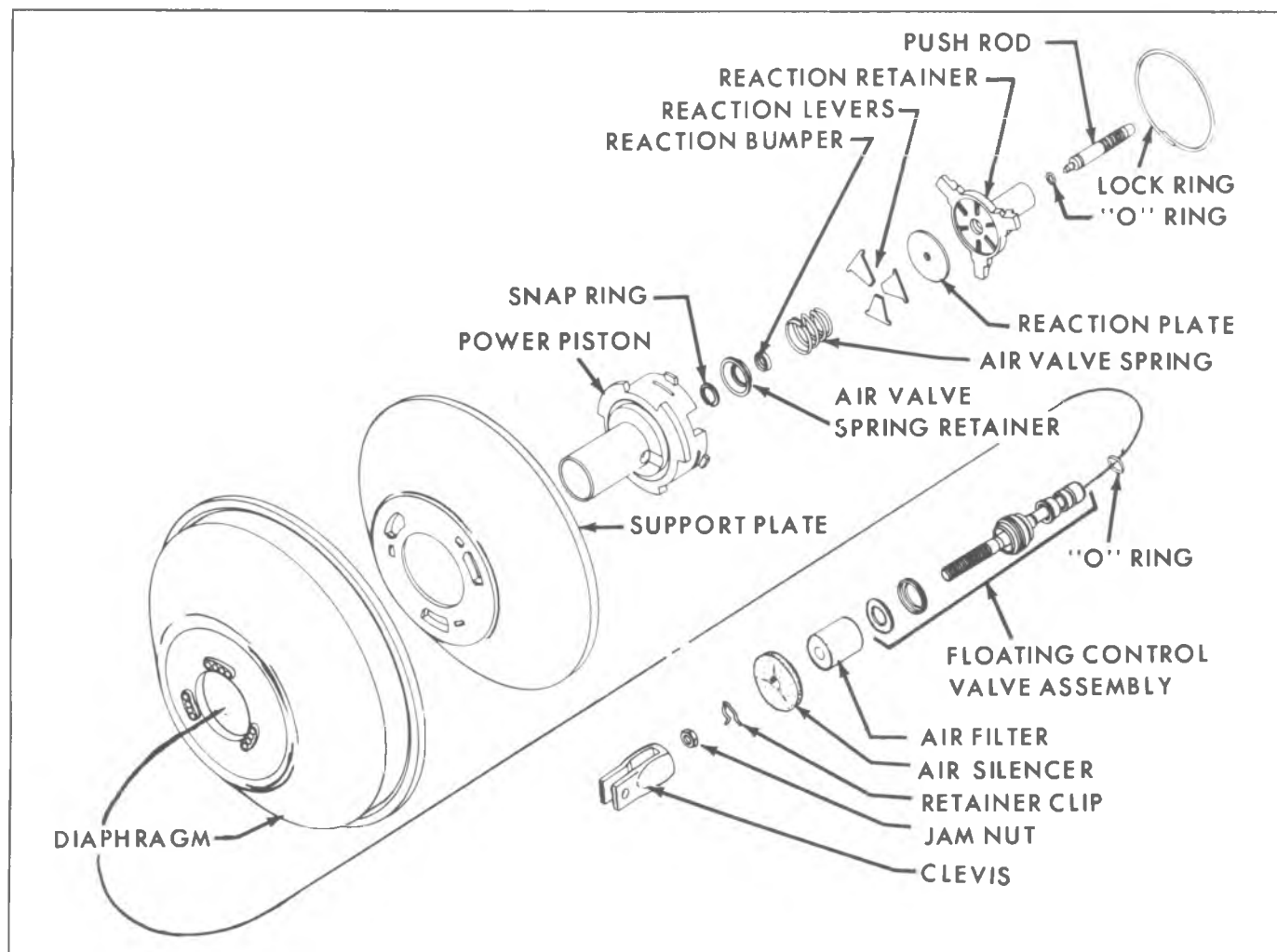


Fig. 5-5C--Power Piston Assembly - Exploded View

2. Inspect in accordance with Inspection Table: (The table is organized by power brake unit groups.)

### Assembly

Be certain that all rubber parts are clean at reassembly. Rewash in specified cleaning fluid if there is any doubt of cleanliness. Be careful during rebuild process that no grease or mineral oil comes in contact with rubber parts of power brake unit. Lubricate rubber parts with Delco approved lubricant or equivalent.

### Front Housing Group

1. Install a new vacuum check valve using a new grommet.
2. Place new front housing seal in housing so flat surface of cup lies against bottom of depression in housing.

### Power Piston Group

1. Place new "O" ring in groove on the master cylinder piston rod. Wipe a thin film of Power Brake Lube or equivalent on "O" ring.
2. Master cylinder piston rod is now inserted through the reaction retainer so round end of piston rod protrudes from end of the tube on reaction retainer.
3. Place J-21524 power piston wrench in a vise. Position power piston on wrench with three lugs fitting into notches in power piston.

4. Position new "O" ring on air valve in second groove from push rod end.

5. On reassembly of power piston, floating control valve assembly must be replaced with a new one since the force required to remove it distorts component parts.

6. Place floating control valve on push rod-air valve assembly so flat face of valve will seat against valve seat on air valve.

7. Wipe a thin film of Power Brake Lube (or equivalent) on large O.D. of floating control valve and on "O" ring on air valve.

8. Press air valve-push rod assembly, air valve first, onto its seat in tube of power piston.

9. Place floating control valve retainer over push rod so flat side seats on floating control valve.

10. Start floating control valve and its retainer into power piston tube. Press the floating control valve to seat in the tube, by placing J-21601-01 Floating Control Valve Retainer Installer on top of retainer and pushing down by hand (fig. 5-13C).

11. After floating control valve is seated, position push rod limiter washer over push rod and down onto floating control valve. Air filter element can now be stretched over end of push rod and pressed into power piston tube.

12. Assemble power piston diaphragm to diaphragm

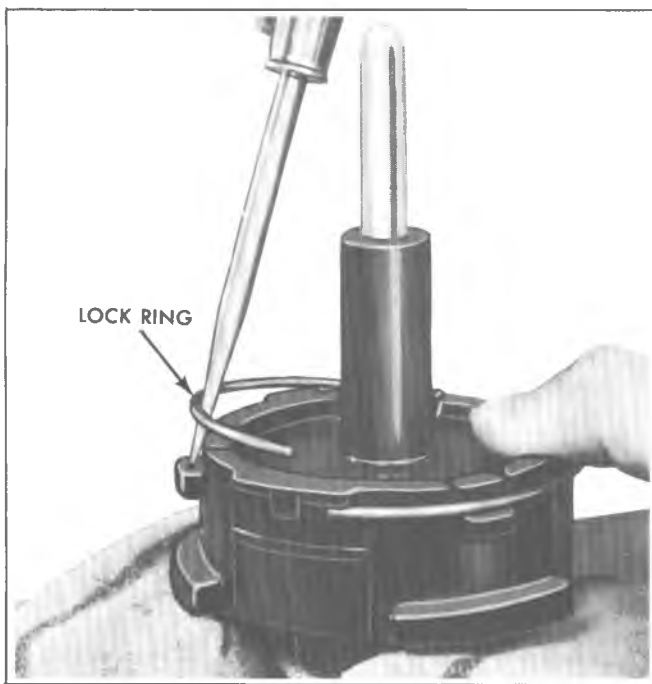


Fig. 5-6C—Removing Lock Ring From Power Piston

support plate from side of support plate opposite locking tangs. The raised flange of diaphragm is pressed through hole in center of support plate. Be sure that edge of center hole fits into groove in flange of diaphragm.

13. Pull diaphragm away from O.D. of support plate so that support plate can be gripped with hands.

14. With power piston still positioned on holding tool in vise, coat bead of diaphragm that contacts power piston with Power Brake Lube (or equivalent).

15. Holding support plate by metal, with locking tangs down, place support plate and diaphragm assembly over

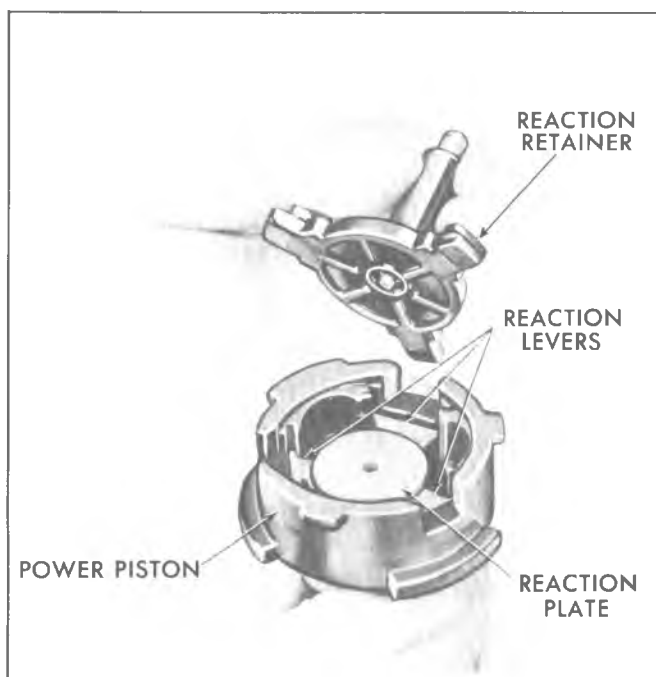


Fig. 5-7C—Removing Reaction Retainer

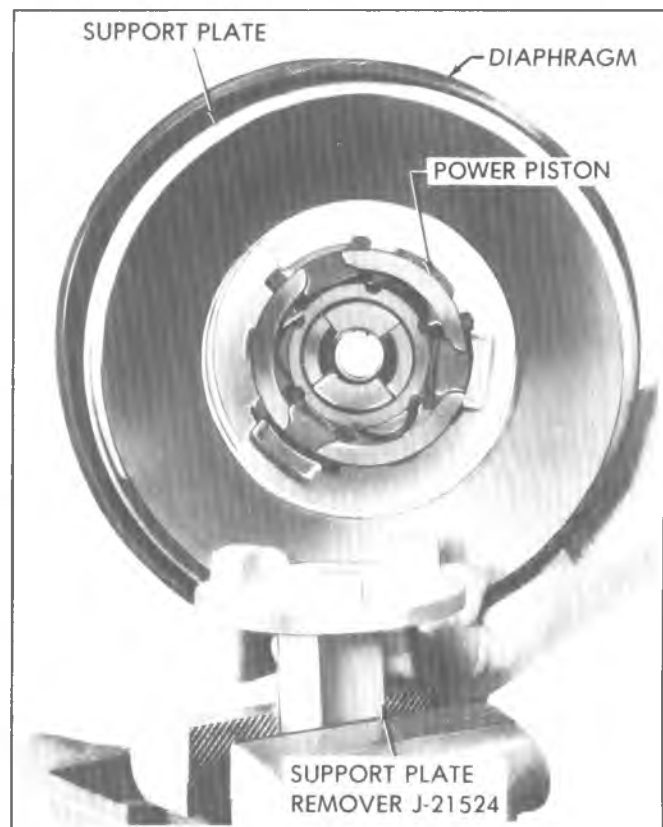


Fig. 5-8C—Positioning Support Plate Retainer in Vise

tube of power piston. The flange of diaphragm will fit into groove on power piston (fig. 5-10C).

16. Press down and rotate support plate clockwise, until lugs on power piston come against stops on support plate (fig. 5-10C).

17. This assembly can now be turned over and placed, tube down, in a tool, fabricated from a piece of wood, 2" x 4" x 8" long with a 1-3/8" hole in the center, clamped in a vise.

18. With Snap Ring Pliers J-4880, assemble snap ring into groove in air valve.

19. Place air valve spring retainer on snap ring.



Fig. 5-9C—Positioning Power Piston on Support Plate Remover

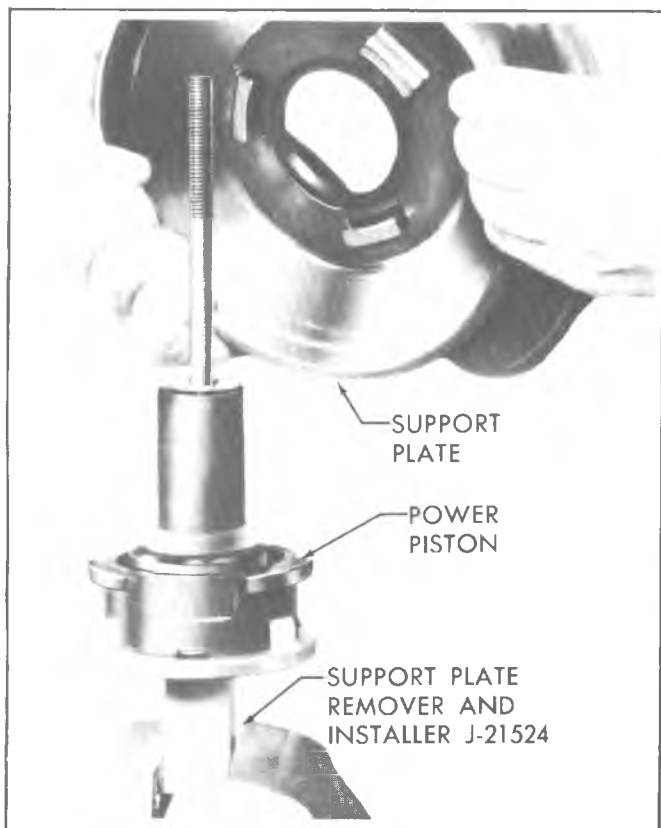


Fig. 5-10C--Removing Support Plate

Assemble reaction bumper into groove in end of air valve.

20. Position air valve return spring, large end down, on spring retainer.

21. The three reaction levers are now placed into position with ears on wide end in slots in power piston. The narrow ends will rest on top of air valve return spring.

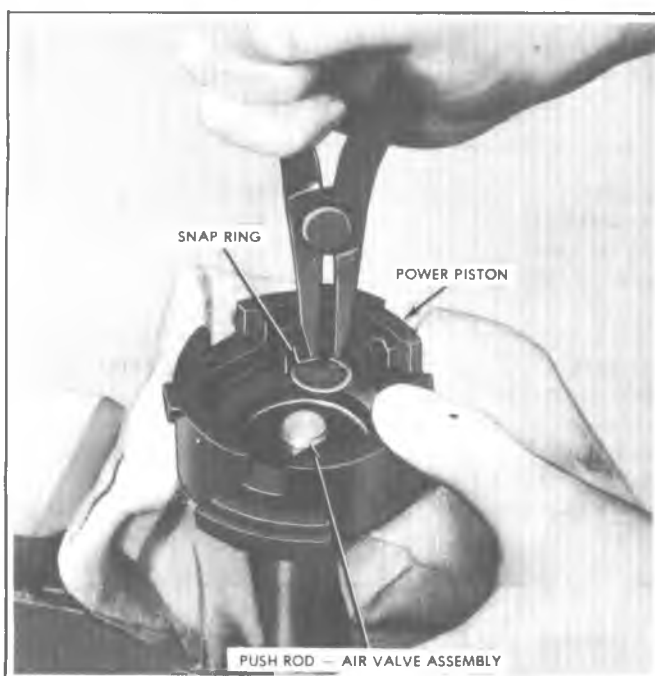


Fig. 5-11C--Removing Power Piston Snap Ring

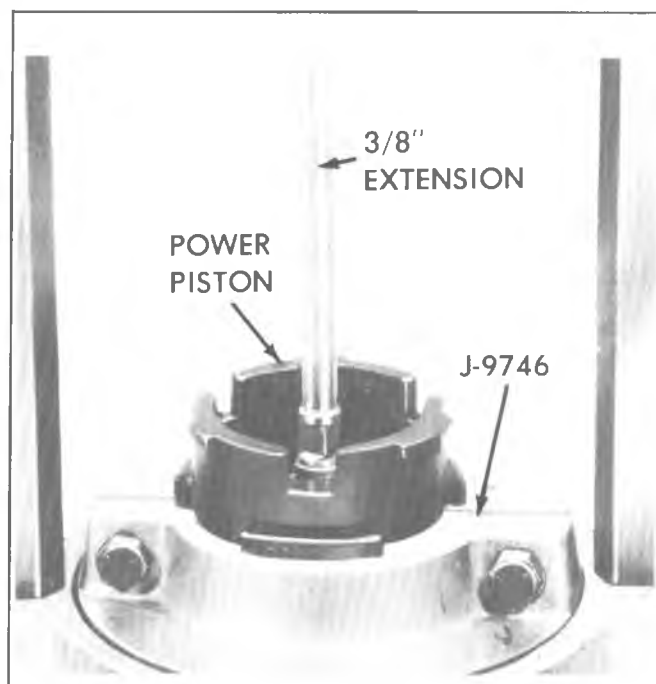


Fig. 5-12C--Removing Air Valve Assembly

22. Position reaction plate (with numbered side up) on top of reaction levers. Press down on plate until large ends of reaction levers pop up so plate rests flat on levers. Be sure reaction plate is centered.

23. Master cylinder piston rod and reaction retainer assembly is now assembled to the power piston.

24. With round end of piston rod up, and with reaction retainer held toward top of piston rod, place small end of piston rod in hole in center of reaction plate. Line up ears on reaction retainer with notches in power piston and push reaction retainer down until ears seat in notches.

25. Maintain pressure on reaction retainer and position large lock ring down over master cylinder push rod.

26. There is a lug on the power piston which has a raised divider in the center. One end of lock ring goes under lug and on one side of divider.

27. As you work your way around power piston (either way), the lock ring goes over ear of reaction retainer, under a lug on power piston, and so forth, until other end of lock ring is seated under lug with raised divider.

Be sure both ends of lock ring are securely under large lug.

### Rear Housing Group

1. Place a new power piston bearing in center of rear housing so flange on center hole of housing fits into groove of power piston bearing. The large flange on power piston bearing will be on stud side of housing.

2. Coat inside of power piston bearing with Delco Power Brake Lube (or equivalent).

### Final Assembly

1. Place air silencer over holes on tube of power piston. Wipe tube of power piston with Delco Power Brake Lube (or equivalent).

2. Assemble power piston to rear housing.

3. Wipe tube of reaction retainer with Delco Power Brake Lube (or equivalent) and lay assembly aside.

## INSPECTION CHART

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

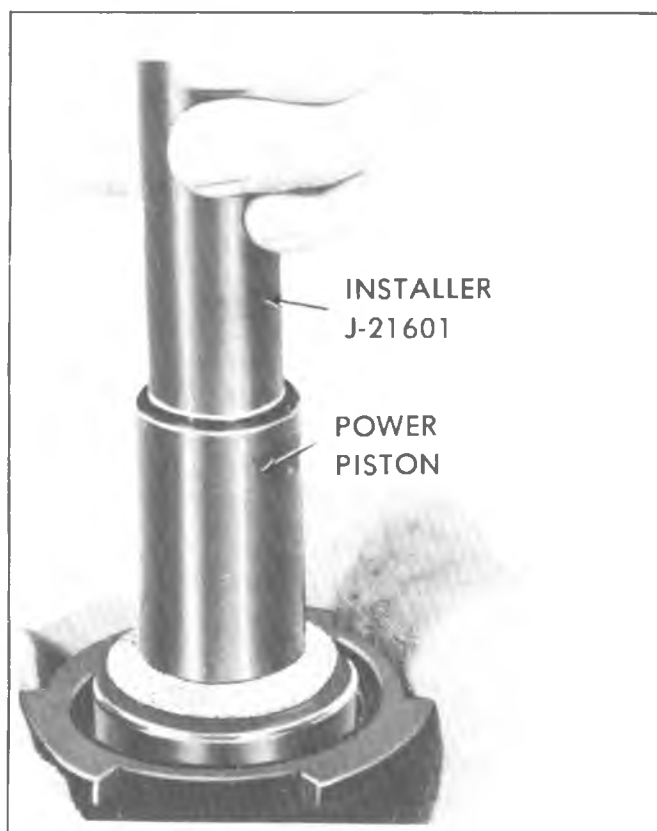


Fig. 5-13C--Installing Floating Control Valve Assembly

4. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damaging of studs. Clamp base in a vise. Place power piston return spring over the insert in the front housing.

5. Lubricate the I.E. of the support plate seal, the reaction retainer tube and the beaded edge of the diaphragm with Power Brake Lube (or equivalent).

6. Place the rear housing assembly over the front housing assembly and align the scribe marks of the two housings so they will match when in locked position.

7. Assemble front and rear housings as follows:

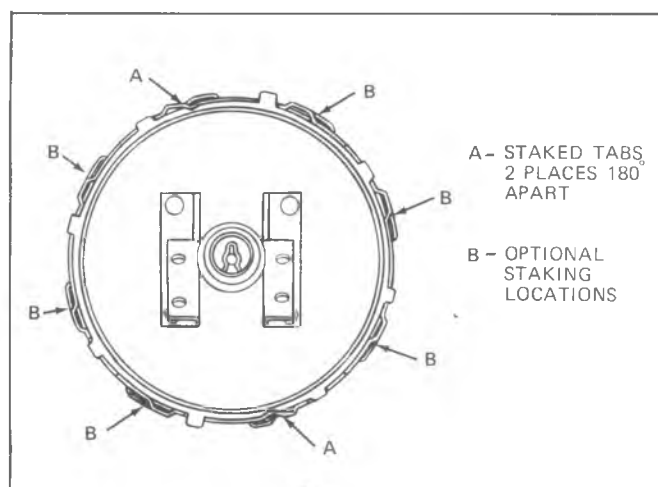


Fig. 5-14C--Housing Locking Tabs

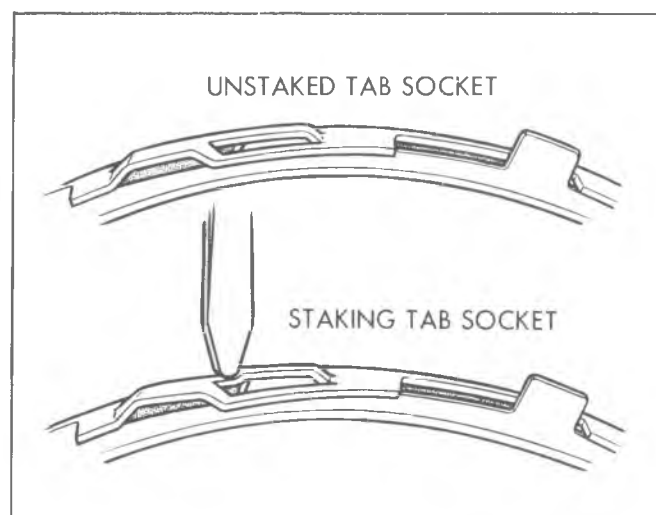


Fig. 5-15C--Staking Housing Tabs

a. **Straight Mounting Bracket** - Place Spanner Wrench J-9504 over studs on rear housing, and attach with nuts and washers--draw nuts down tight to eliminate bending or damaging of studs.

b. **Tilt Mounting Bracket** 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.

c. Press down on spanner wrench and twist rear housing clockwise in relation to front housing until fully locked. Do not break studs loose in rear housing or put pressure on power piston tube when locking housings.

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

9. Push felt silencer over push rod to seat against end of power piston tube. Snap ring retainer is now placed on push rod so it can hold silencer against power piston tube.

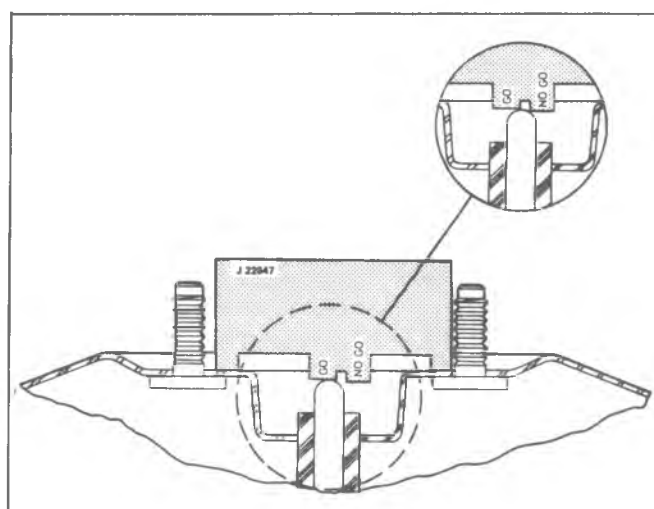


Fig. 5-16C--Gaging Master Cylinder Push Rod

Plastic boot is now pushed to seat against rear housing. Raised tabs on side of boot will locate in holes in center of brackets.

10. Using a 1/8" diameter rod (or similar tool), stake the front and rear housing in two places 180° apart (figs. 5-14C and 5-15C).

**CAUTION:** *The interlock tabs should not be used for staking a second time. Stake two of the remaining tabs. When all tabs have been staked once, the housing must be replaced.*

### Gaging of Power Brake Unit

The following gaging operation is necessary only when a major structural part such as front or rear housing, power piston assembly, master cylinder piston or master cylinder assembly is replaced with a new part. The gage measures how far the master cylinder push-rod projects from front

housing. This dimension must be correct to insure proper clearance in master cylinder between primary cup and compensating port.

Make check as follows:

1. Place gage over piston rod in a position which will allow gage to be slipped to left or right without contacting studs.

The center section of gage has two levels. The piston rod end should always touch the longer section of gage which extends into front housing. The piston rod end should **never** touch the shorter section of gage (fig. 5-16C).

2. Any variation beyond these two limits must be compensated for by obtaining the service adjustable piston rod, and adjusting the screw in end to match height of gage.

## BENDIX SINGLE DIAPHRAGM POWER BRAKE UNIT UNIT REPAIR

### Disassembly (Figs. 5-1D and 5-2D)

1. Scribe a line across front and rear housings to facilitate reassembly.

2. Remove the front housing seal (fig. 5-2D); pulling the piston rod from the front housing will also remove the seal assembly. Remove the piston rod.

3. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs. Clamp base in bench vise with power section up (fig. 5-2A).

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

4. Loosen locknut and remove push rod clevis and locknut, if so equipped.

5. Remove the mounting bracket from the rear housing, if so equipped.

6. Remove the dust boot retainer, dust boot and silencer from the diaphragm plate extension.

7. The edge of the rear housing contains twelve lances. Four of these lances (one in each quadrant) are deeper than the other lances (fig. 5-3D). The metal that forms the four deep lances must be partially straightened so that the lances will clear the cutouts in the front housing. If the metal tabs that form the deep lances crack or break during straightening, the housing must be replaced.

8. Place Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs (fig. 5-2A).

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

10. Remove Tool J-9504 from the rear housing.

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

11. Lift the rear housing assembly from the unit.

### Rear Housing Group

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

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

2. Separate the diaphragm plate assembly from the rear housing and lay the rear housing aside.

3. Disassemble diaphragm plate assembly (fig. 5-2D).

a. Remove rolling diaphragm from the groove in the diaphragm plate hub.

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

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

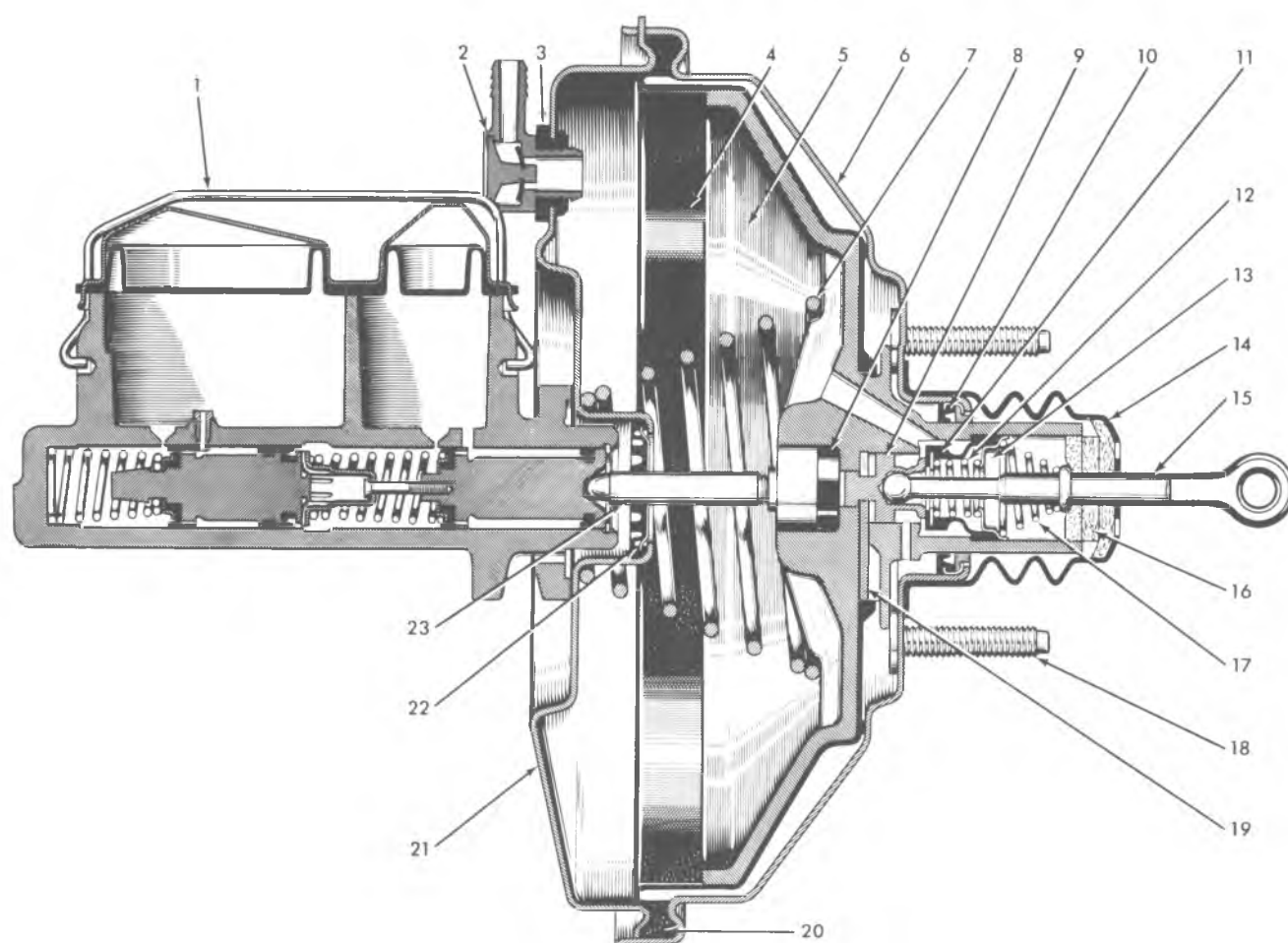
**NOTE:** Perform Step 4 only if seal is defective and a new seal is available. Do not reuse seal once it has been removed from the unit.

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

### Front Housing Group

1. Remove check valve from grommet and then remove grommet from front housing; discard valve and grommet.

2. Remove front housing and holding fixture from vise; then remove holding fixture from front housing.



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

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

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

Fig. 5-1D--Bendix Single Diaphragm Unit (Typical)

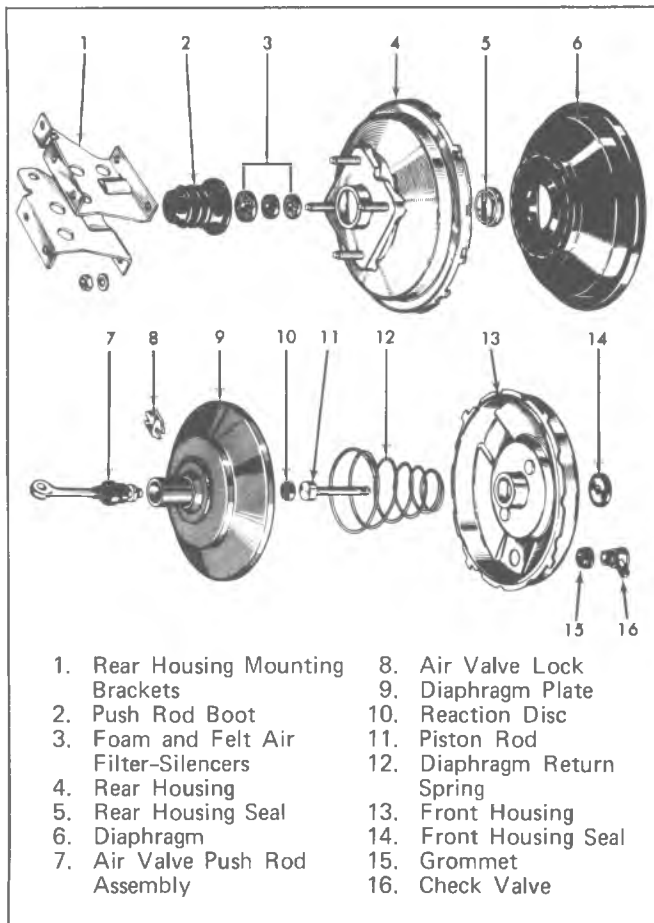


Fig. 5-2D--Bendix Power Booster Components (Typical)

## Cleaning

Use clean brake fluid to thoroughly clean all reusable brake parts. Immerse in the cleaning fluid and brush metal parts with 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 clean cloth. If slight rust is found inside either the front or rear half housing assemblies, polish clean with crocus cloth or fine emery

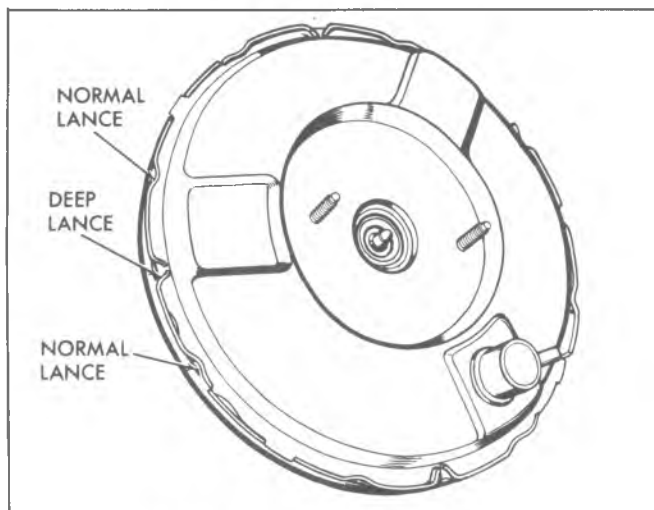


Fig. 5-3D--Lances in Rear Housing

paper, washing clean afterwards. Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean until re-assembly. Re-wash at re-assembly if there is any occasion to doubt cleanliness--such as parts dropped or left exposed for eight hours or longer.

**CAUTION:** If there is any suspicion of contamination or any evidence of corrosion, completely flush the vehicle hydraulic brake system. Failure to clean the hydraulic brake system can result in early repetition of trouble. Use of gasoline, kerosene, anti-freeze, alcohol or any other cleaner, with even a trace of mineral oil, will damage rubber parts.

## Inspecting Rubber Parts

Wipe fluid from the rubber parts and carefully inspect each rubber part for cuts, nicks or other damage. These parts are the key to the control of fluid or air flow, if the unit is in for overhaul, or if there is any question as to the serviceability of rubber parts, REPLACE them.

## Inspecting Metal Parts

**BADLY DAMAGED ITEMS, OR THOSE WHICH WOULD TAKE EXTENSIVE WORK OR TIME TO REPAIR, SHOULD BE REPLACED.** In case of doubt, install new parts. Do not rely on the brake unit being overhauled at an early or proper interval. New parts will provide more satisfactory service, even if the brake unit is allowed to go beyond the desired overhaul period.

## Assembly (Figs. 5-1D and 5-2D)

1. Be careful during the rebuild procedure that no grease or mineral oil comes in contact with the rubber parts of the power brake unit.

2. Lubricate power head parts, as outlined below, with silicone lubricant provided in the service repair kit.

## Front Housing Group

1. Install new check valve grommet in front housing with beveled edge of grommet inside of housing. Dip new check valve in clean denatured alcohol and install in grommet--check valve stem is to be outside of housing.

2. Position and secure Holding Fixture J-22805 to mounting studs, and place tool and front housing in a vise. Be sure to align tool so that check valve is not damaged.

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

## Rear Housing Group

1. Place rear housing on a block of wood, stud side down, and position housing seal in center hole. Use Tool J-22677 (fig. 5-4D) to seat seal in recess of rear housing. Tool bottoms against housing when seal is in place.

2. Assemble diaphragm plate assembly (see fig. 5-2D).

a. Apply silicone lubricant to outside diameter of diaphragm plate and extension, to bearing surfaces of air valve and to outer edge of valve poppet. Insert air valve and push rod assembly in extension of diaphragm plate.

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

b. Depress the push rod slightly and install the air valve lock. Make sure the lock indexes and retains the air valve.



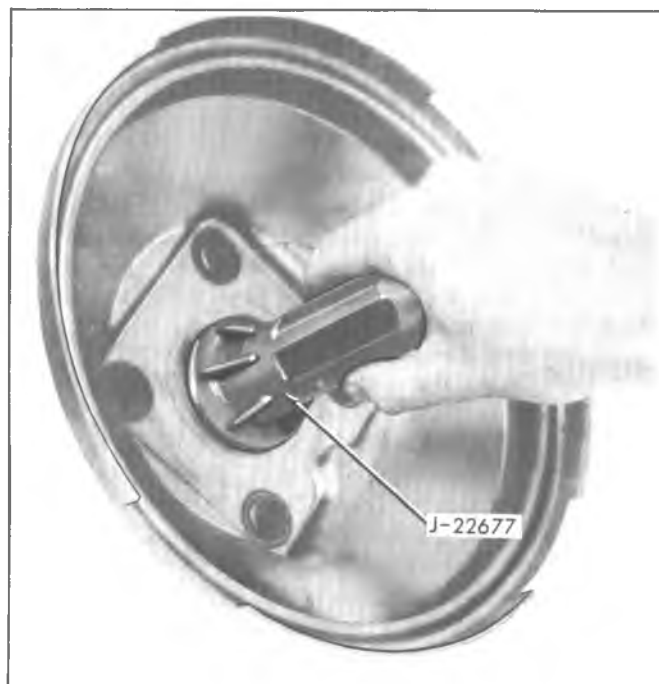


Fig. 5-4D--Installing Rear Housing Seal

c. Install the rolling diaphragm in the groove of diaphragm plate.

d. Apply silicone lubricant to surface of reaction disc and position disc in center bore of diaphragm plate. Use piston rod to seat disc in bore. Make sure disc is fully seated before removing piston rod.

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

3. Apply silicone lubricant to I.D. of rear housing seal and diaphragm bead contact surface of rear housing. Install diaphragm plate assembly in rear housing.

4. Place air filter element over push rod and into diaphragm plate extension. Install filter retainer.

### Final Assembly

1. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs. Clamp base in bench vise with power section up (fig. 5-2A).

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

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

3. Place diaphragm plate return spring in front housing and position rear housing assembly on front housing (small end of spring downward). Position rear housing so that when housings are locked, scribe marks on front and rear housings will be in alignment.

4. Press down on Spanner Wrench J-9504 and rotate the rear housing counterclockwise to assemble the two housings.

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

5. Remove Tool J-9504 from the rear shell.

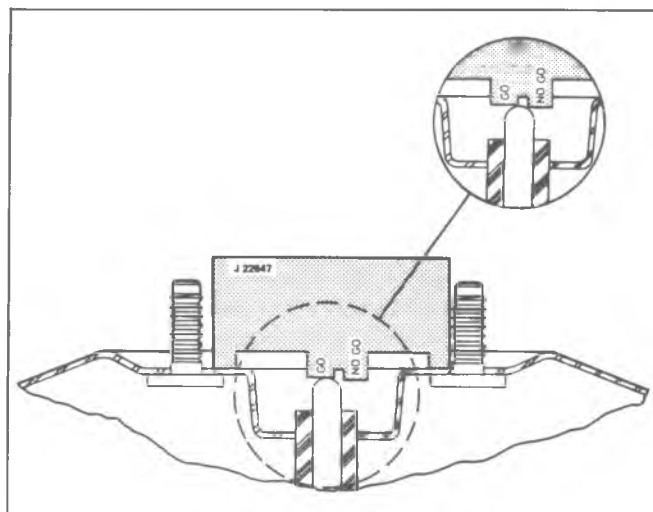


Fig. 5-5D--Gaging Piston Rod

6. Install air silencers over push rod end and then install push rod boot. Install boot retainer.

7. **Clevis Type Push Rod** - Install locknut and push rod clevis.

8. Install mounting bracket to the rear shell, if so equipped.

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

9. Remove power cylinder from vise and remove Holding Fixture J-22805.

10. Apply silicone lubricant sparingly to the piston rod, keeping lubricant away from rounded end of rod. Guide piston rod into center bore of the diaphragm plate until it is fully seated against reaction disc.

11. Install front housing seal. Press seal into front housing until seal is bottomed in recess of housing.

### Gaging

1. Place the power head assembly in a padded vise (front housing up). *Do not clamp tight.*

2. Remove the front housing seal to assure that no vacuum is in the power head while gaging.

3. Insert the master cylinder piston rod, flat end first, into the piston rod retainer.

4. Press down on the master cylinder piston rod (with approximately a 40-50 pound load) to be sure it is properly seated.

5. 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. 5-5D).

6. 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.

7. 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.

8. 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.

## BENDIX HYDRAULIC BRAKE BOOSTER (HYDRO-BOOST) UNIT REPAIR

**WARNING:** The accumulator contains compressed gas. Always use proper tools and follow recommended procedures or personal injury may result. Do not apply heat to accumulator. Do not attempt to repair an inoperative accumulator, always replace with a new accumulator. Dispose of an inoperative accumulator by drilling a 1/16" diameter hole through the end of the accumulator can opposite the "O" ring.

The Bendix Hydraulic Brake Booster utilizes the hydraulic pressure supplied by the power steering pump to provide power assist for brake applications. The dual master cylinder is mounted to the output push rod end of the booster.

The procedures below include removal of the mounting bracket even though it is not necessary to remove the bracket for overhaul of the internal assembly.

### Disassembly (Fig. 5-1E)

1. Secure the booster in a vise (bracket end up) and use

a hammer and chisel to cut the bracket nut that secures the mounting bracket to the power section (cut the nut at the open slot in the threaded portion of the housing). Be careful to avoid damage to the threads on the booster hub. Spread the nut and remove it from the power section. Then remove the mounting bracket.

2. Remove the pedal rod boot (if equipped) by pulling it off over the pedal rod eyelet.

3. Place Tool J-24569 around the pedal rod and resting on the input rod end as shown in Figure 5-2E.

4. Place a punch (or similar tool) through the pedal rod from the lower side of Tool J-24569. Push the punch on through to rest on the higher side of the tool. Lift up on the punch to shear the pedal rod retainer; remove the pedal rod.

5. Remove the remnants of the rubber grommet from the groove near the end of the pedal rod and from the groove inside the input rod end.

6. With a small screwdriver, pry the plastic guide out of the output push rod retainer. Disengage the tabs of the spring retainer from the ledge inside the opening near the master cylinder mounting flange of the booster. Remove the retainer, the piston return spring and output rod from the opening (fig. 5-3E).

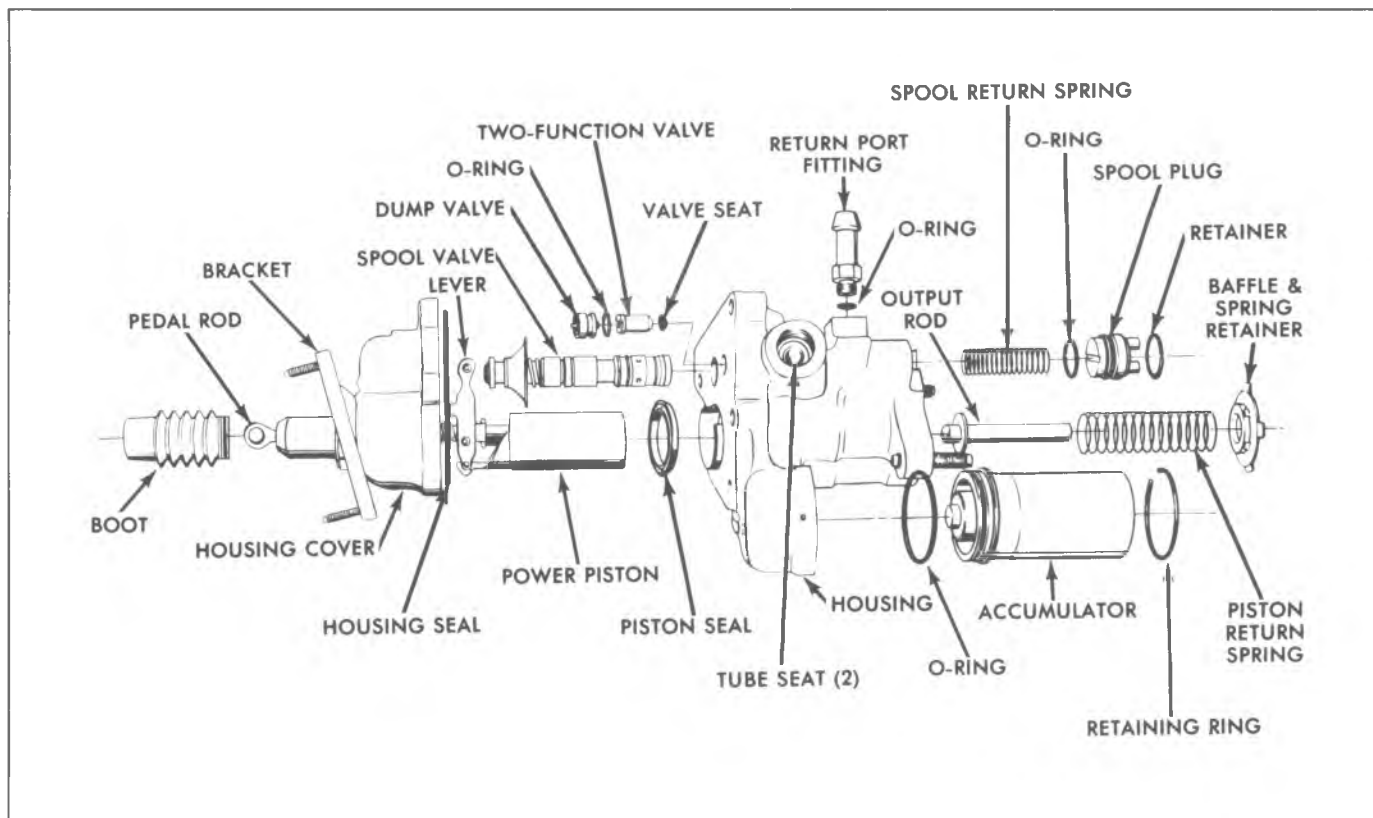


Fig. 5-1E--Bendix Hydro-Boost Explode--Typical

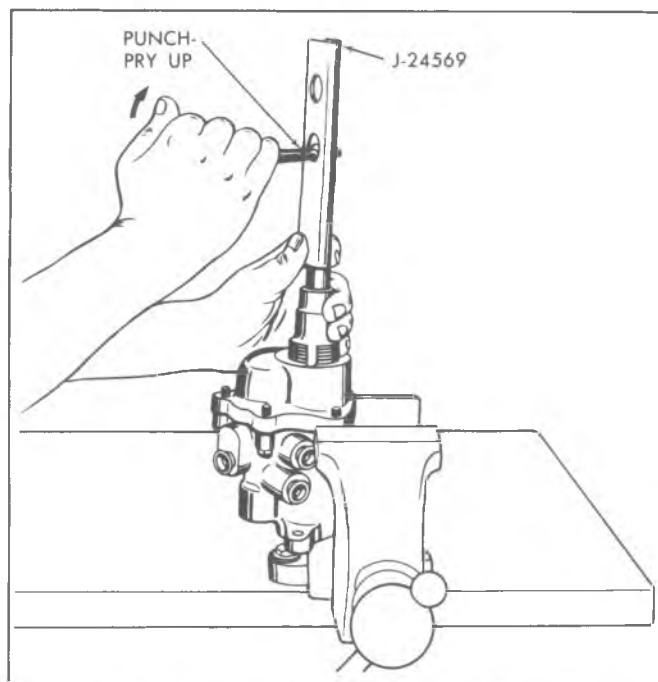


Fig. 5-2E--Removing Booster Pedal Rod (Typical)

7. Place the booster cover in a vise equipped with soft jawed devices. Remove the five screws that secure the booster housing to the cover.

8. Remove the booster assembly from the vise and while holding the unit over a pan, separate the cover from the housing. Remove the "figure eight" seal from the housing cover; discard the seal.

9. Remove the input rod and piston assembly, the spool assembly and spool spring from the booster housing. Compare spool valve condition to Figure 5-4E. If spool valve is defective, the complete unit must be replaced.

10. Inspect power piston. If scratches big enough to be felt with a fingernail are present, the input rod and piston must be replaced.

11. Remove the input rod seals from the input rod end, and the piston seal from the piston bore in the housing; discard the seals.

12. Place the accumulator retaining cap Tool J-26889 over the master cylinder stud and install the nut as shown in Figure 5-6E.

13. Using Tool J-22269-01 or a large "C" clamp (6"

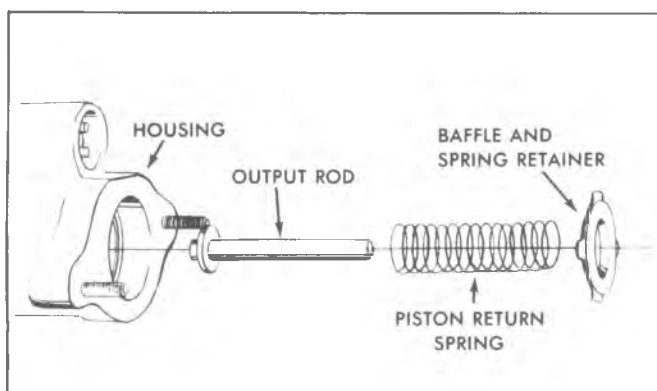


Fig. 5-3E--Output Rod, Spring and Retainer

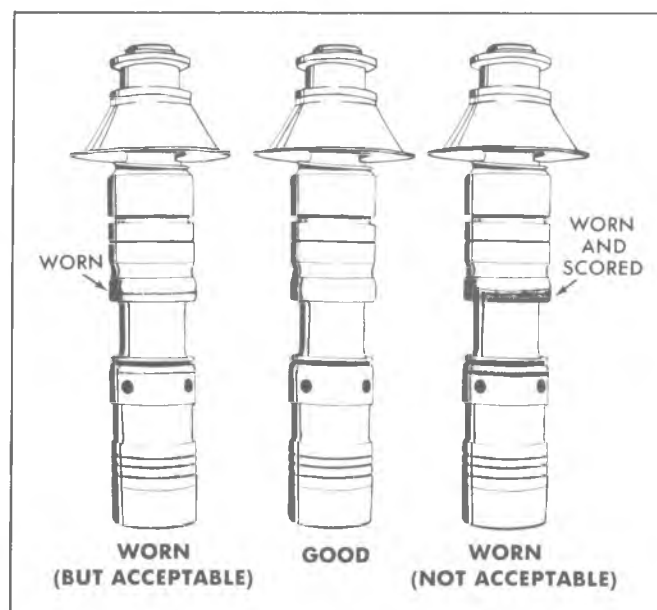


Fig. 5-4E--Spool Valve Inspection

minimum), depress the accumulator. Insert a punch into the hole in the housing and remove retaining ring with a small screwdriver, (fig. 5-6E).

14. Slowly back off the clamp until tension on the accumulator is released; remove accumulator and "O" ring.

15. If accumulator valve was determined to be faulty, remove valve using a small diameter wire tool (fig. 5-5E). Remove the dump valve by catching the tool under the pin guide near the center of the valve, then remove two function valves and seat (fig. 5-8E).

16. Return hose fitting "O" ring can be removed if leaking.

17. Push spool valve plug in and use a small screwdriver to remove retaining ring (Fig. 5-9E).

18. Remove spool valve plug and "O" ring.

19. Remove the tube seats using No. 4 easy-out as shown in Figure 5-10E.

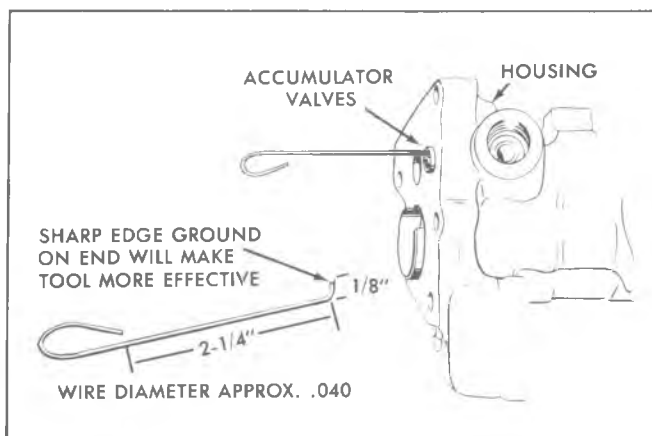


Fig. 5-5E--Removing Accumulator Valves

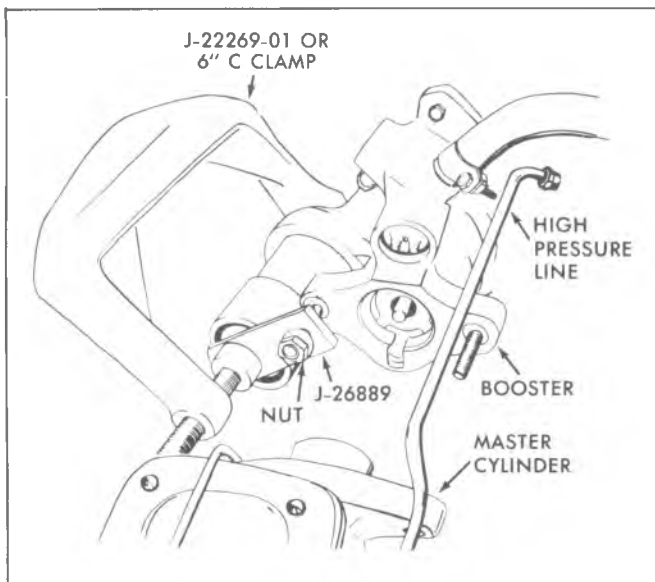


Fig. 5-6E--Compressing Accumulator With J-26889

### Cleaning and Inspection

**CAUTION:** Be sure to keep parts clean until reassembly. Wash at reassembly if there are any parts dropped or left exposed for eight hours or longer. Lubricate all seals and metal friction points with power steering fluid. Whenever the booster is disassembled and all disturbed seals and damaged tube inserts should be replaced. All of these parts are included in a kit. If any of the accumulator valve components are damaged or lost, replace all the valve components.

1. Clean all metal parts in a suitable solvent. Be careful to avoid losing small parts.
2. Inspect the valve spool and the valve spool bore in the housing for corrosion, nicks, scoring or other damage.

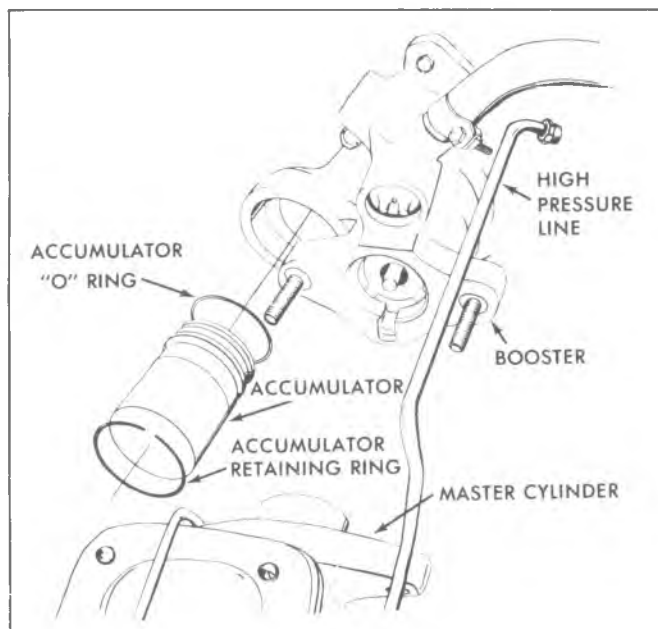


Fig. 5-7E--Accumulator Installation

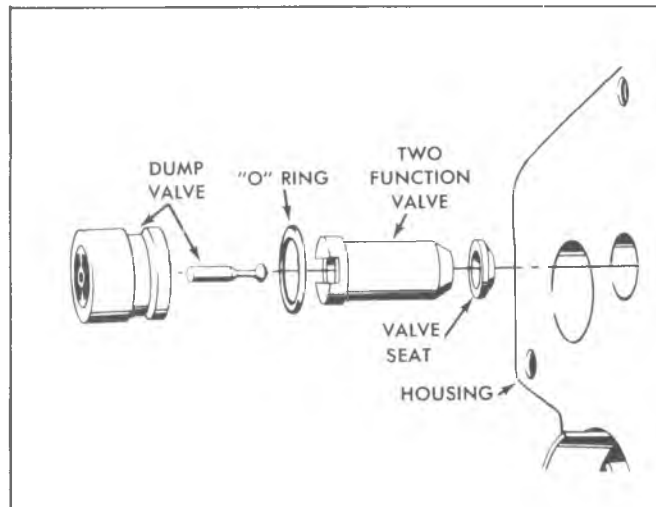


Fig. 5-8E--Accumulator Valves

Discoloration of the spool or bore, particularly in the grooves, is not harmful and is no cause for replacement.

3. If the valve spool or the valve spool bore has nicks or scoring that can be felt with a fingernail, particularly on the lands, the entire booster should be replaced as an assembly.

**NOTE:** The clearance between the spool valve and the spool valve bore of the housing assembly is important. Because of this, the valve spool valve and the housing assembly make up a selective assembly. The spool valve is selected to match the spool valve bore.

4. Inspect the piston for scratches, nicks, etc. If scratches on the outside diameter can be felt with a fingernail, the input rod and piston must be replaced.

### Assembly

1. Install tube seat with Tool J-6217 as shown in Figure 5-11E.
2. Install "O" ring and spool valve plug (fig. 5-9E).
3. Push spool valve plug in and install retaining ring.
4. Coat the piston bore and the piston seal with clean power steering fluid, and assemble the **NEW** seal in the bore. The lip of the seal must be toward the rear (away from

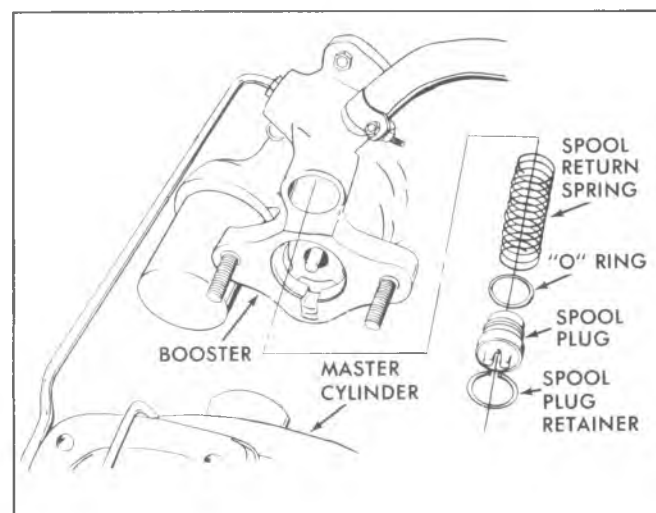


Fig. 5-9E--Spool Valve Plug Removal

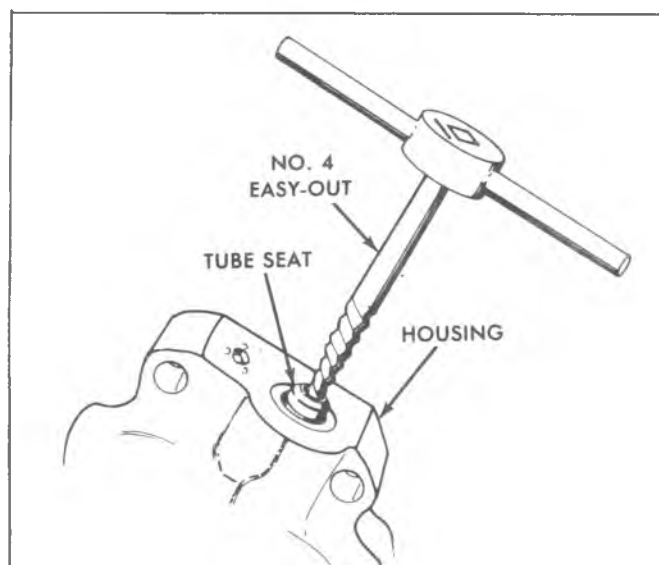


Fig. 5-10E--Removing Tube Seat

the master cylinder mounting flange). Be sure the seal is fully seated in the housing.

5. Lubricate the input rod end, **NEW** input rod seals and Seal Installer with clean power steering fluid. Slide the seals on the tool with the lip of the cups toward the open end of the tool (fig. 5-12E).

6. Slide the tool over the input rod end and down to the second groove; then slide the forward seal off the tool and into the groove. Assemble the other seal in the first groove. Be sure that both seals are fully seated.

**NOTE:** Only one seal is used on JD3 and JD5 applications.

7. The piston counterbore on JF9 applications is of a different diameter than on JB8. Remove the pilot portion of Tool J-24551.

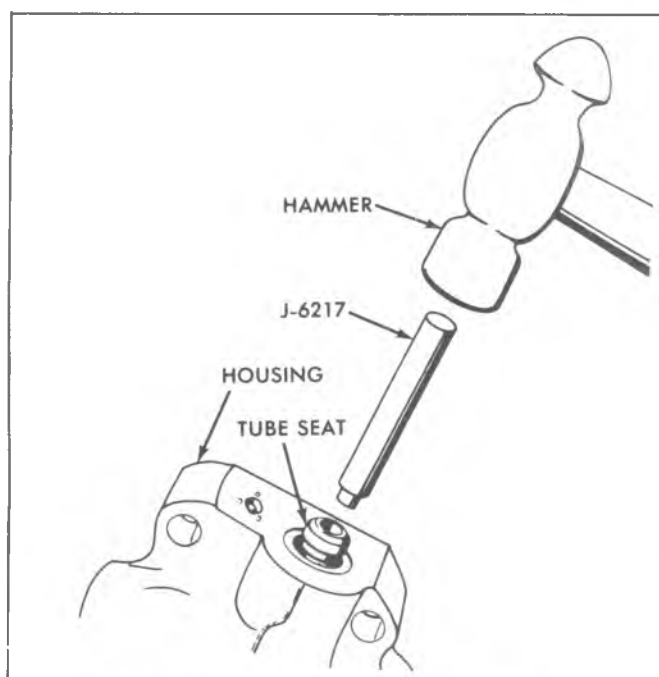


Fig. 5-11E--Installing Tube Seat Using J-6217

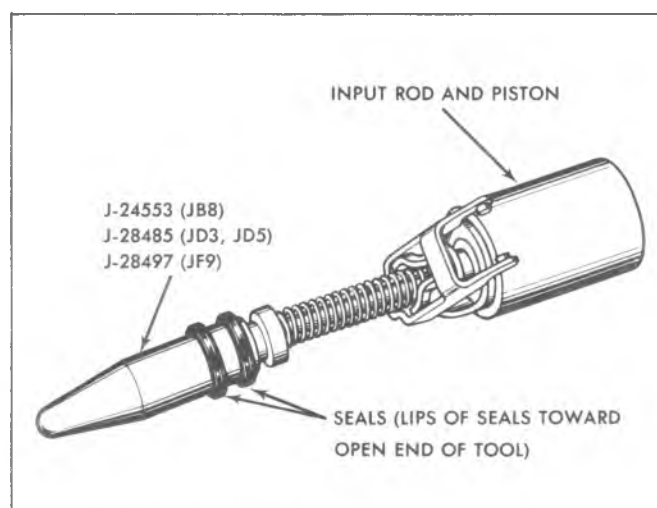


Fig. 5-12E--Installing Input Rod Seals

8. Lubricate the piston and Piston Installing Tool with clean power steering fluid. Hold the large end of the tool against the piston (fig. 5-13E), and slide the tool and piston into the piston bore and through the piston seal. Remove piston installing tool.

9. If removed, install return hose fitting with new "O" ring.

10. If accumulator valve was removed, install new seat into the valve bore. The seat can be forced to the bottom by installing the two function valve (fig. 5-8E).

**NOTE:** Make certain the check valve seat is cup side up when in bore.

11. If removed, insert new dump valve over the two function valve making certain that the dump valve plunger is held in place until installation is complete.

12. Insert spool valve spring and spool valve assembly into bore in housing. Extend power piston lever to accept sleeve on spool valve, then slide lever pins into slot in sleeve.

13. Position a **NEW** "figure eight" seal in the groove in the housing cover. Then join the booster housing and cover and secure with five screws. Tighten the screws to 20 ft. lbs.

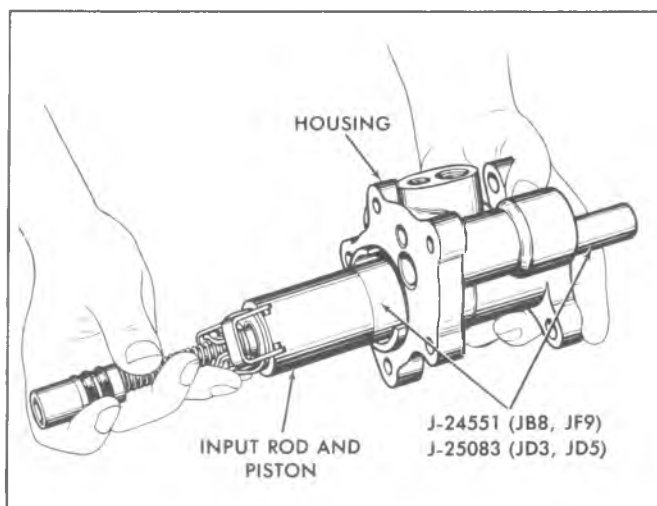


Fig. 5-13E--Installing Input Rod and Piston Assembly into Booster (Typical)

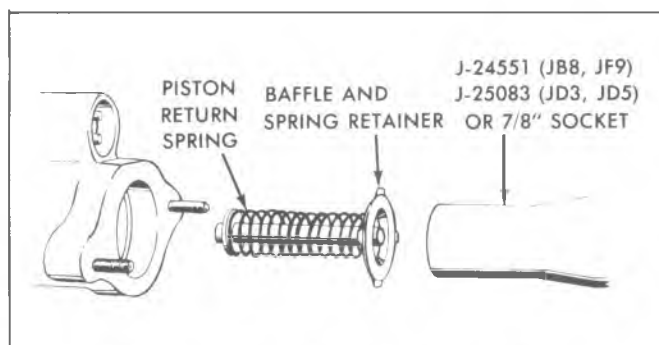


Fig. 5-14E--Installing Baffle and Spring Retainer

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

14. Install output rod, spring and new spring retainer.

15. Secure new baffle and spring retainer using Piston Installing Tool or 7/8" socket as shown in Figure 5-14E.

16. Using clean power steering fluid, lubricate accumulator seal. Install seal and accumulator in housing and then place the retaining ring over the accumulator (fig. 5-7E). Place Tool J-26889 over accumulator.

17. Using Tool J-22269-01 or a large "C" clamp (6" minimum) depress the accumulator making certain that the accumulator is compressed straight (fig. 5-6E).

18. Snap the retaining ring into the housing groove by pushing it down all the way around with a small screwdriver.

19. Remove Tool J-22269-01 or "C" clamp and retaining cap Tool J-26889.

**CAUTION:** Carefully check to make sure the retaining ring was completely installed properly.

20. Position the mounting bracket on the booster. The tab on the inside diameter of the large hole in the bracket should fit into a slot in the threaded portion of the booster hub.

21. Install the **NEW** bracket nut with the staking groove outward on the threaded hub of the booster. Using Tool J-24554 and a torque wrench (fig. 5-15E), tighten the nut to 110 ft. lbs.

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

22. Use a hammer and a small punch inserted into the staking groove of the nut, at the slot in the booster hub (fig. 5-16E), to stake the nut in place. Be sure that the outer thread of the nut is upset.

23. Assemble a boot (if used) on the pedal rod. Then assemble a **NEW** grommet in the groove near the end of the pedal rod.

24. Moisten the grommet with water (to ease assembly), and insert the grommet end of the pedal rod into the input rod end of the booster housing. Push on the end

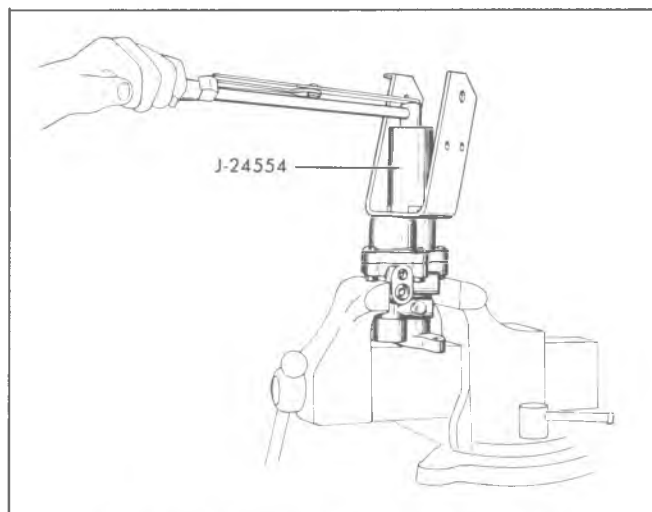


Fig. 5-15E--Installing Mounting Bracket Nut

of the pedal rod to seat the grommet in the groove inside the housing.

**NOTE:** When the grommet is fully seated, the pedal rod will rotate freely with no binding.

25. Slide the boot on the pedal rod and assemble the large end of the boot onto the hub of the power section.

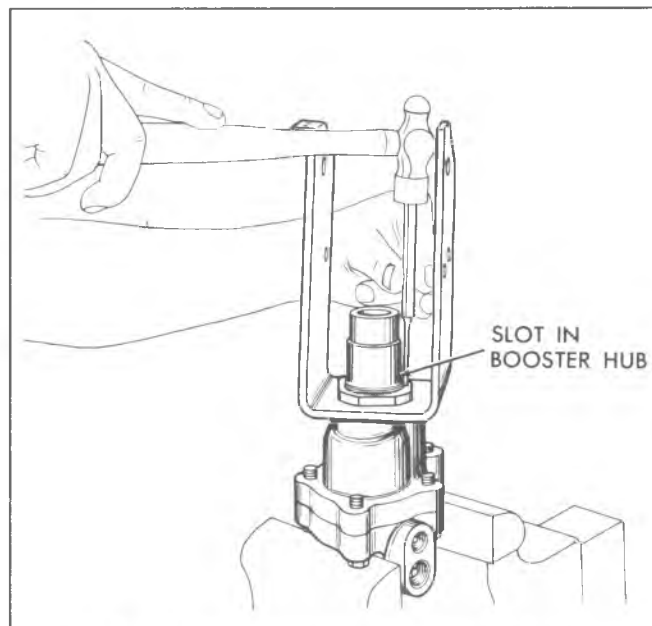
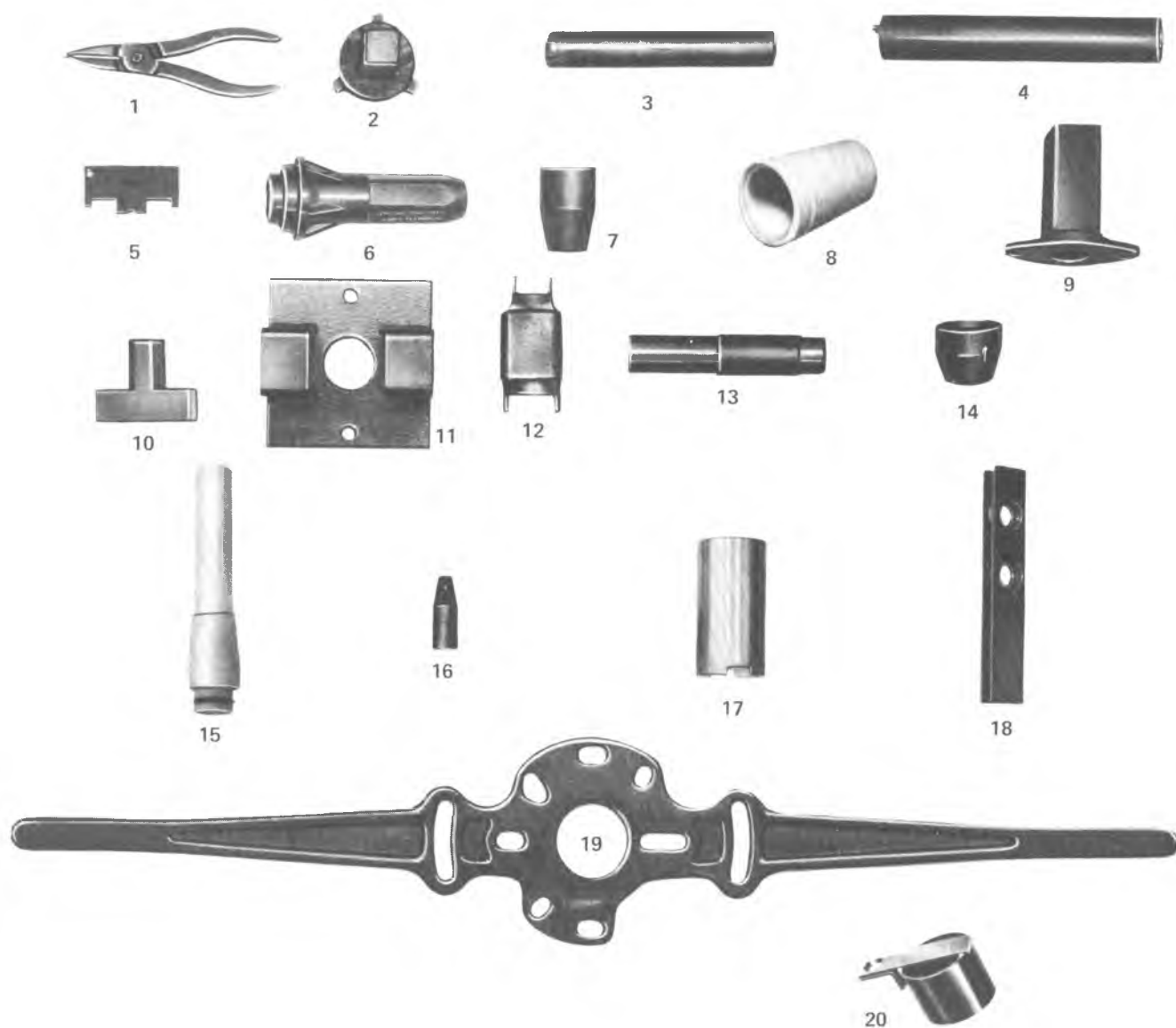


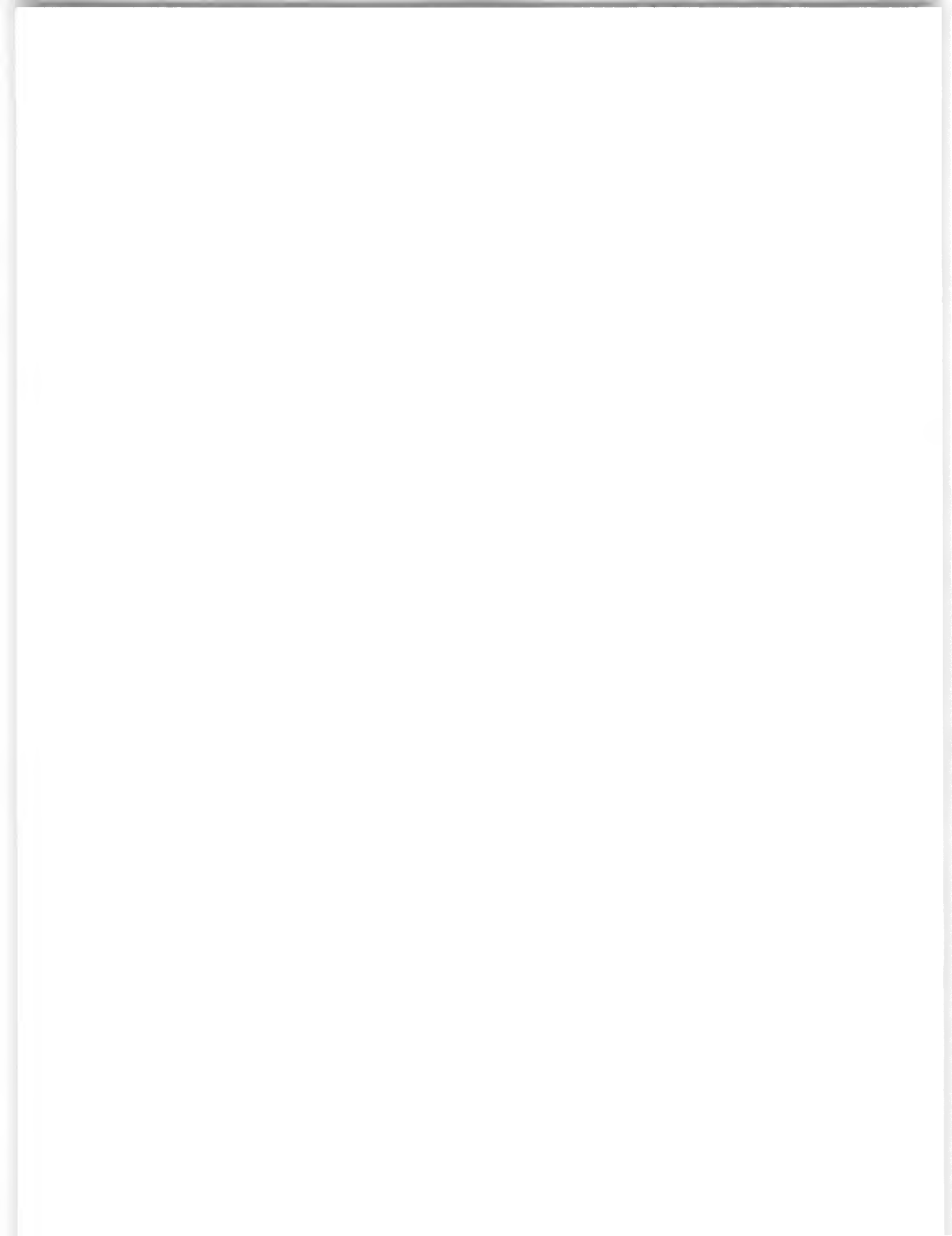
Fig. 5-16E--Staking Mounting Bracket Nut

## SPECIAL TOOLS



- |   |  |
|---|--|
| 1. J-4880 Snap Ring Pliers                    | 13. J-23175 Control Valve Installer      |
| 2. J-21524 Power Piston Remover and Installer | 14. J-23188 Secondary Bearing Protector  |
| 3. J-21601 Power Brake Retainer and Installer | 15. J-24551 Piston Installers            |
| 4. J-22657 Bushing Retainer Socket            | J-25083                                  |
| 5. J-22647 Height Gauge                       | 16. J-24553 Input Rod Seal Installers    |
| 6. J-22677 Power Cylinder Seal Installer      | J-28485                                  |
| 7. J-22733 Seal Installer and Protector       | J-28497                                  |
| 8. J-28458 Power Piston Seal Protector        | 17. J-24554 Socket                       |
| 9. J-22805 Power Cylinder Holding Fixture     | 18. J-24569 Pedal Push Rod Remover       |
| 10. J-22839 Front Plate Holding Fixture       | 19. J-9504 Power Cylinder Spanner Wrench |
| 11. J-22893 Booster Separating Adapter        | 20. J-26889 Accumulator Compressor       |
| 12. J-23101 Power Piston Holding Tool         |  |

Fig. 5-17E--Special Tools





# SECTION 7A

## AUTOMATIC TRANSMISSION UNIT REPAIR (OVERHAUL)

### CONTENTS

THM 200 Transmission .....	(200)7A-1
CBC 350 Transmission.....	(350)7A-1
THM 400 Transmission .....	(400)7A-1

## THM 200 TRANSMISSION

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### DISASSEMBLY

#### Removal of Converter

1. With transmission in cradle of portable jack, remove J-21366 and then converter assembly by pulling straight out.
2. Install Holding Fixture, J-8763-02 on transmission and place into Holding Fixture, J-3289-20, with manual shaft facing bench and oil pan side up (Fig. 7A-1A).

**CAUTION:** Do not over-torque fixture holding screw.

**NOTE:** Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the transmission should be thoroughly cleaned to prevent the possibility of dirt entering the transmission internal mechanism. During inspection and reassembly, all parts should be thoroughly cleaned with cleaning fluid and then air dried. Wiping cloths or rags should not be used to dry parts.

**CAUTION:** Do not use solvents on neoprene seals, composition-faced clutch plates or thrust washers.

#### Teflon Seals

If any teflon seal rings are damaged (distorted, cut,

scored, etc.), or do not rotate freely in their groove, and replacement is necessary, do the following:

1. Remove and discard old angle cut seal rings; full circle rings must be cut off.
2. Inspect seal ring groove for burrs or damage.

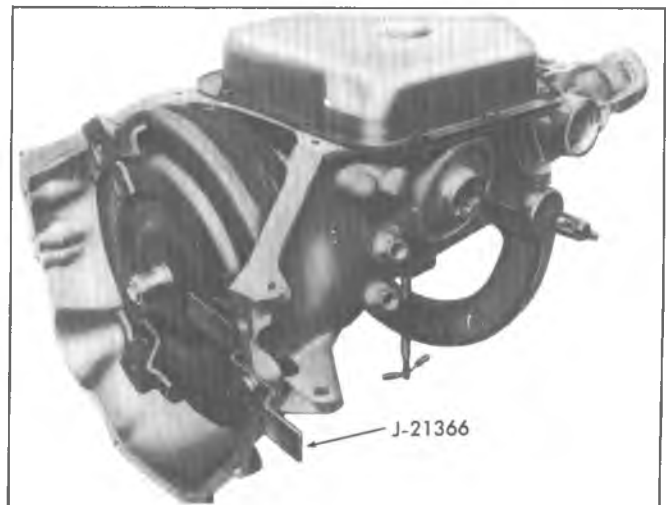


Fig. 7A-1A--Transmission Holding Fixture

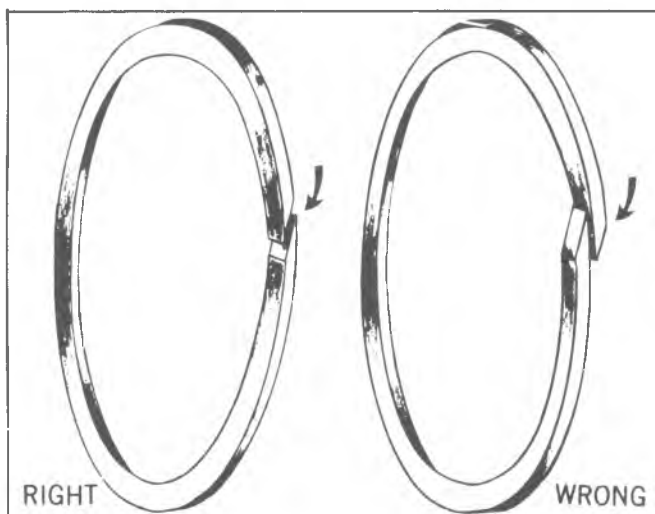


Fig. 7A-2A--Teflon Oil Seal Rings

3. When installing angle cut seal rings, do not overstretch. Make sure cut ends are in same relation as cut (Fig. 7A-2A). Also, make sure rings are seated in the grooves to prevent damage to the rings during reassembly of mating part over rings. Retain with petrolatum.

4. New angle cut or full circle teflon seal rings may appear to be distorted after being installed. Once exposed to normal transmission oil temperatures, the new seal rings will return to their normal shape and fit freely in their bores.

5. The teflon seal rings allow for a free fit in their bores after operation. The free fit of the rings in their bores does not indicate leakage during operation.

### Snap Rings

Do not over expand snap rings when removing or installing.

### Thrust Washer Surfaces

The thrust washers and thrust bearings will polish the surfaces they protect. This is not to be considered a damaged part because of this condition.

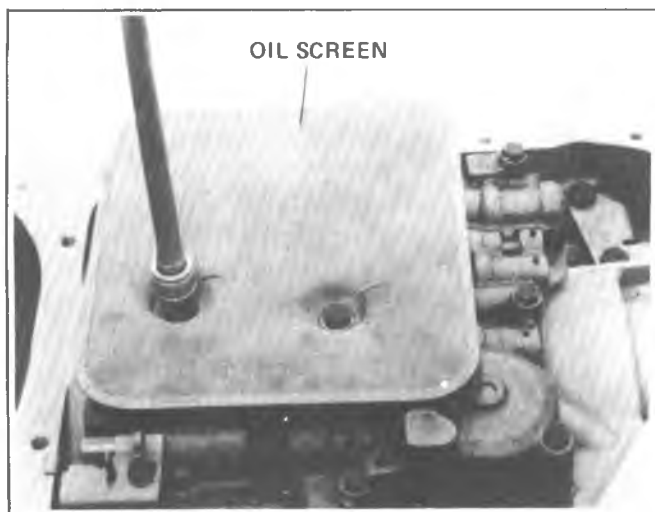


Fig. 7A-3A--Removing Oil Screen

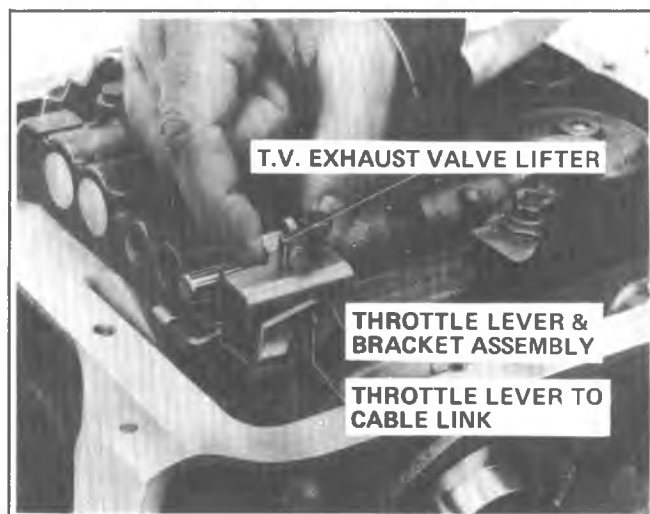


Fig. 7A-4A--Removing Throttle Valve and Bracket Assembly

### EXTERNAL PARTS - REMOVAL

2. Remove oil screen and discard gasket (Fig. 7A-3A).

**CAUTION:** The two oil screen attaching bolts are about 10mm (3/8") longer than the control valve assembly attaching bolts, and they are not interchangeable.

3. Control Valve Assembly:

- a. Remove throttle lever and bracket assembly (Fig. 7A-4A). Do not bend throttle lever link.

**NOTE:** T.V. exhaust valve lifter and spring may separate from throttle lever and bracket assembly.

- b. Remove manual detent roller and spring assembly (Fig. 7A-5A).

- c. Remove remaining control valve assembly attaching bolts.

**CAUTION:** Do not drop manual valve.

- d. Holding manual valve with finger, remove control valve assembly, spacer plate, and gaskets together, to prevent the dropping of 4 check balls, located in the control



Fig. 7A-5A--Removing Manual Detent Roller and Spring Assembly

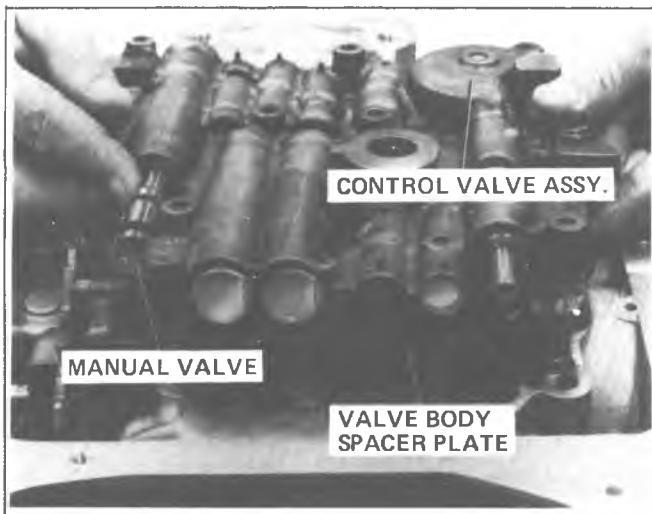


Fig. 7A-6A--Removing Control Valve Assembly from Case

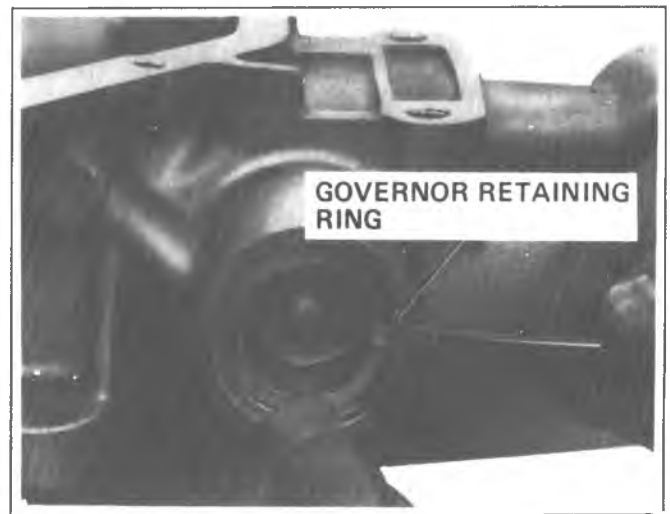


Fig. 7A-9A--Removing Governor Cover Retaining Ring

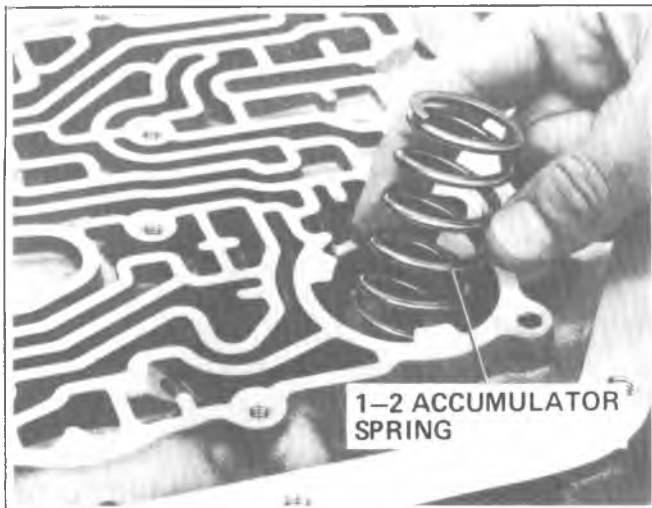


Fig. 7A-7A--Removing 1-2 Accumulator Spring

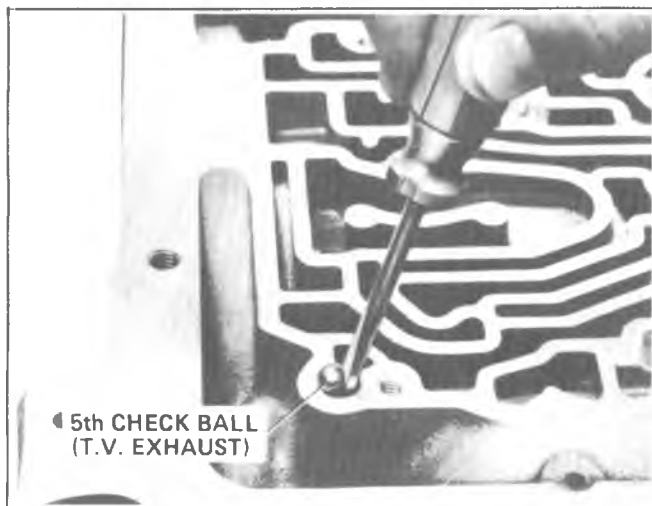


Fig. 7A-8A--Removing 5th Check Ball



Fig. 7A-10A--Removing Governor Cover

valve assembly (Fig. 7A-6A).

e. Lay control valve assembly down with spacer plate side up and discard gaskets.

4. Remove 1-2 accumulator spring (Fig. 7A-7A).

5. Remove 5th check ball located in case (Fig. 7A-8A).

6. Governor Assembly:

**CAUTION:** To prevent damage to the governor driven gear and speedometer driven gear, they must be removed from the transmission before removing the output shaft and rear unit parts.

a. Using small screwdriver, remove governor cover retaining ring (Fig. 7A-9A).

b. Using pliers, remove governor cover and discard 2 seal rings; seal rings may be located in case (Fig. 7A-10A).

**NOTE:** Governor assembly may come out with cover.

**CAUTION:** Do not use any type of pliers to remove governor assembly.

c. Remove governor assembly from case. It may be



Fig. 7A-11A--Removing Intermediate Servo Retaining Ring



Fig. 7A-14A--Direct Clutch Accumulator Port

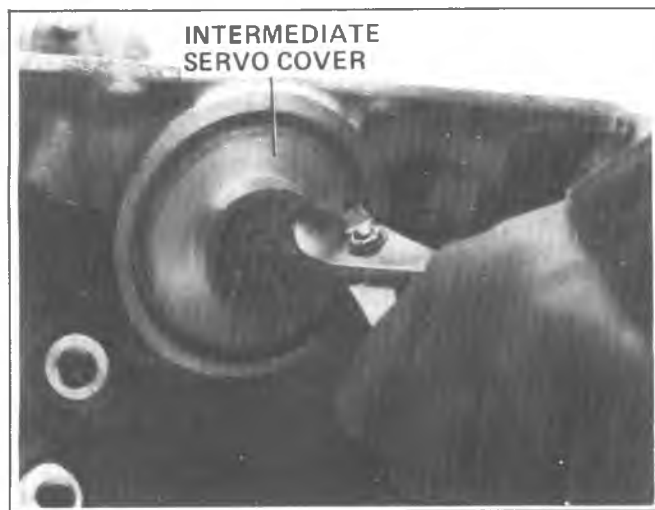


Fig. 7A-12A--Removing Servo Cover and Seal

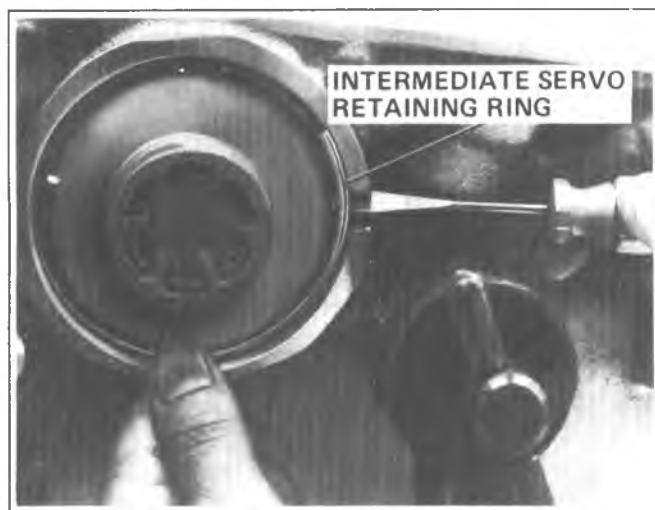


Fig. 7A-13A--Removing Intermediate Servo



Fig. 7A-15A--Apply Air Pressure to Remove Intermediate Servo

necessary to rotate output shaft counterclockwise while removing the governor.

7. Intermediate Servo Assembly:

- a. Using small screwdriver, remove intermediate servo cover retaining ring (Fig. 7A-11A).
- b. Using pliers, remove intermediate servo cover and discard seal rings; cover seal ring may be located in case (Fig. 7A-12A).
- c. Remove intermediate servo piston and band apply pin assembly (Fig. 7A-13A).

**NOTE:** If intermediate servo cover and seal assembly can not be removed easily, place shop towels and hand over cover and case. Apply air pressure into the direct clutch accumulator port (Figs. 7A-14A and 7A-15A).

8. Check for proper intermediate band apply pin as follows:



Fig. 7A-16A--Checking for Proper Intermediate Band Apply Pin

- a. Install J-25014-2 in intermediate servo bore and retain with intermediate servo cover retaining ring, aligning ring with gap at case slot (Fig. 7A-16A).
- b. Install pin J-25014-1 into J-25014-2 (Fig. 7A-16A).

INTERMEDIATE BAND APPLY PIN CHART			
DIAL INDICATOR TRAVEL		APPLY PIN IDENTIFICATION	
0	- 2.16 mm (0 - .086")	2 Rings	
2.16 mm - 2.88 mm (.086" - .114")		Wide Band	

Fig. 7A-17A--Intermediate Band Apply Pin Selector Chart

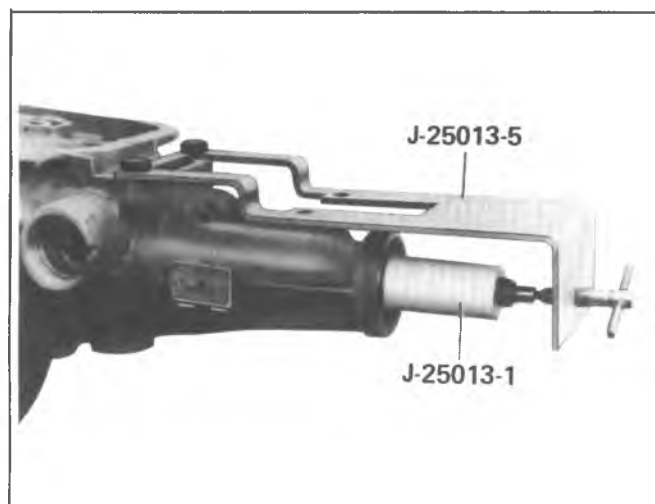


Fig. 7A-18A--Installing Tools on Rear End of Case

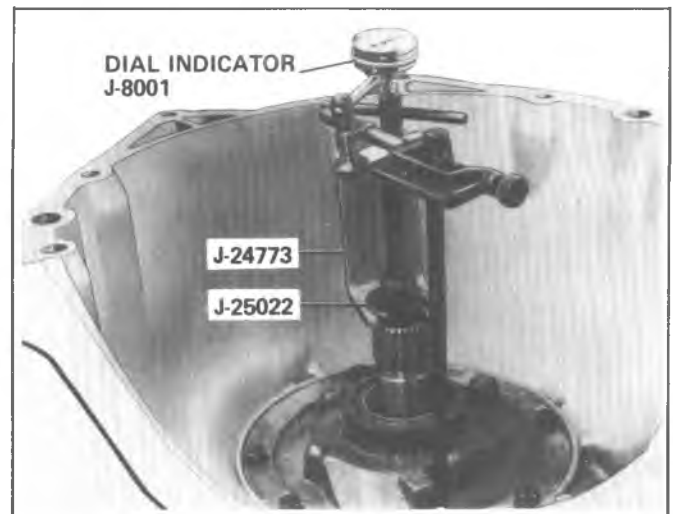


Fig. 7A-19A--Checking Front Unit End Play

**CAUTION:** Make sure the tapered pin end is properly located against the band apply lug. Also, make sure the band anchor pin is properly located in the case and band anchor lug.

- c. Install dial indicator J-8001 and position dial indicator point (Fig. 7A-16A) on top of J-25014-2 zero post and set dial indicator to zero.

**NOTE:** Seat J-25014-2 squarely against the servo retaining snap ring.

- d. Align stepped side of pin J-25014-1 with torquing arm of J-25014-2. Arm must stop against step of pin J-25014-1.

**NOTE:** If band selection pin does not register between the high and low limits, look for possible problem with the intermediate band, direct clutch or case.

- e. Apply 12 N·m (100 in. lbs.) of torque to hex nut on side of gauge. Slide dial indicator over pin J-25014-1 (Fig. 7A-16A). Read dial indicator and see chart in Fig. 7A-17A for proper size.

**NOTE:** Dial indicator travel is reversed, making the indicator readings backwards. On an indicator that ranges from 0-100, a .5mm(.020") travel will read 2mm (.080"), a 1.5mm (.060") travel will read 1mm (.040"). The identification ring is located on the band end of the pin.

- f. Remove tools J-25014-2 and J-25014-1.

## FRONT UNIT PARTS

### Removal

1. Check front unit end play as follows:
  - a. Install J-25013-1 sleeve on output shaft first; then bolt J-25013-5 on end of case (Fig. 7A-18A).
  - b. Turn transmission to vertical position, pump side up.
  - c. Remove pump to case bolt and washer and install 278mm (11") long bolt and locking nut as shown (Fig. 7A-19A).
  - d. Push turbine shaft downward.
  - e. Install J-25022 on J-24773 tool and secure on end of turbine shaft (Fig. 7A-19A).

FRONT UNIT END PLAY CHART

THICKNESS		IDENTIFICATION
		Number and/or Color
1.66-1.77mm	(0.065"-0.070")	1
1.79-1.90mm	(0.070"-0.075")	2
1.92-2.03mm	(0.076"-0.080")	3 - Black
2.05-2.16mm	(0.081"-0.085")	4 - Light Green
2.18-2.29mm	(0.086"-0.090")	5 - Scarlet
2.31-2.42mm	(0.091"-0.095")	6 - Purple
2.44-2.55mm	(0.096"-0.100")	7 - Cocoa Brown
2.57-2.68mm	(0.101"-0.106")	8 - Orange
2.70-2.81mm	(0.106"-0.111")	9 - Yellow
2.83-2.94mm	(0.111"-0.116")	10 - Light Blue
2.96-3.07mm	(0.117"-0.121")	11
3.09-3.20mm	(0.122"-0.126")	12
3.22-3.33mm	(0.127"-0.131")	13 - Pink
3.35-3.46mm	(0.132"-0.136")	14 - Green
3.48-3.59mm	(0.137"-0.141")	15 - Gray

Fig. 7A-20A--Front Unit End Play Washer Chart

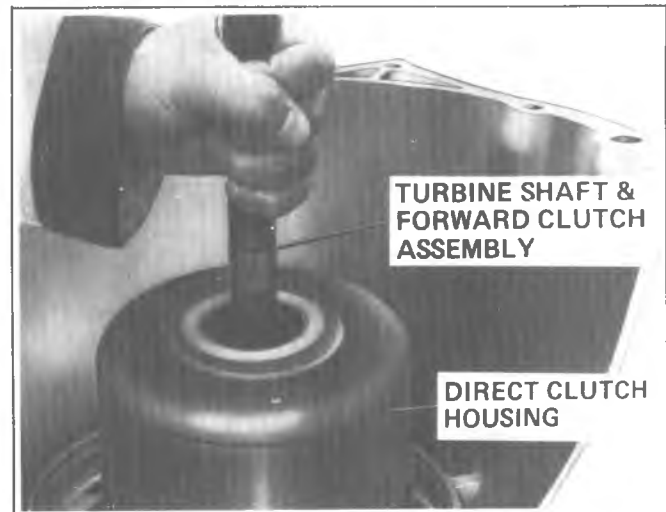


Fig. 7A-23A--Removing Forward and Direct Clutch Assemblies



Fig. 7A-21A--Removing Oil Pump Seal

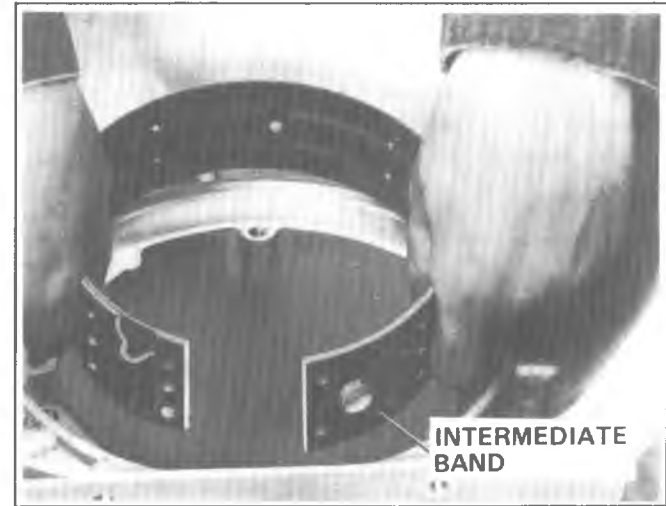


Fig. 7A-24A--Removing Intermediate Band Assembly

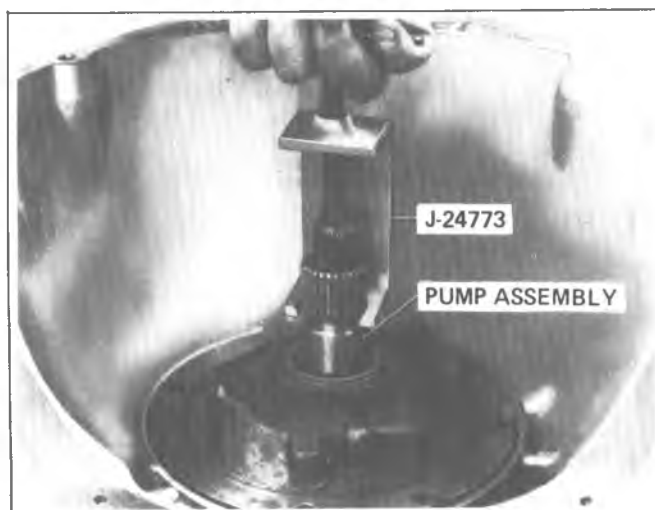


Fig. 7A-22A--Removing Pump Assembly

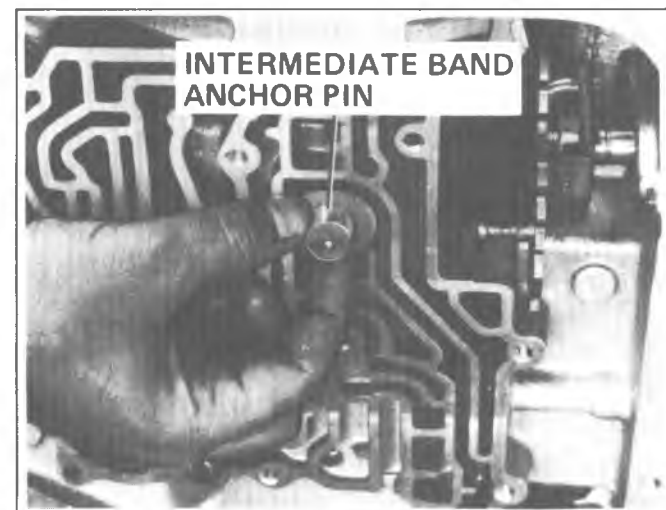


Fig. 7A-25A--Removing Intermediate Band Anchor Pin



f. Mount dial indicator and clamp assembly on bolt, positioning indicator point against cap nut of J-24773.

g. Move output shaft upward by turning the adjusting screw on J-25013-5 until the white or scribed line on sleeve J-25013-1 begins to disappear (Fig. 7A-18A), then set dial indicator to zero.

h. Pull J-24773 on turbine shaft upward and read end play. Front unit end play should be 0.56mm-1.30mm (.022"-.051").

**NOTE:** Selective washer controlling this end play is located between the output shaft and turbine shaft. If more or less washer thickness is required to bring end play within specifications, select proper washer from the chart shown in figure 7A-20A.

i. Remove dial indicator clamp assembly, J-24773 and J-25022 (Fig. 7A-19A).

j. Do not remove J-25013-5 or J-250131-1.

2. Pump:

a. If necessary, remove pump oil seal and discard (Fig. 7A-21A).

b. Remove remaining pump to case bolts and washers; discard washers.

c. Using J-24773 tool, remove pump assembly, pump to case gasket and discard gasket (Fig. 7A-22A).

3. Forward and Direct Clutch:

a. Grasp turbine shaft and remove direct and forward clutch assemblies (Fig. 7A-23A).

b. Lift direct clutch assembly off forward clutch assembly.

**NOTE:** The direct-to-forward clutch thrust washer may stick to the end of the direct clutch housing when it is removed from the forward clutch housing.

4. Remove intermediate band assembly (Fig. 7A-24A).

5. Remove band anchor pin (Fig. 7A-25A).

## FRONT GEAR PARTS

### Removal

1. Remove output shaft to turbine shaft front selective washer (Fig. 7A-26A).

**NOTE:** This washer may be stuck to the end of the turbine shaft.

2. Check Rear Unit end play as follows:

a. Loosen J-25013-5 adjusting screw on output shaft and push output shaft downward (Fig. 7A-18A).

b. Install gauge clamp on case as shown (Fig. 7A-27A).

c. Install dial indicator J-8001 and plunger extension J-7057. Position extension against end of output shaft and set dial indicator to zero (Fig. 7A-27A).

d. Move output shaft upward by turning adjusting screw on J-25013-5 until the white or scribed line on sleeve J-25013 begins to disappear; then read end play. (Rear unit end play should be 0.10-0.63mm.) (.004"-.025".)

**NOTE:** Selective washer controlling this end play is located between the front internal gear thrust washer and output shaft snap ring. If more or less washer

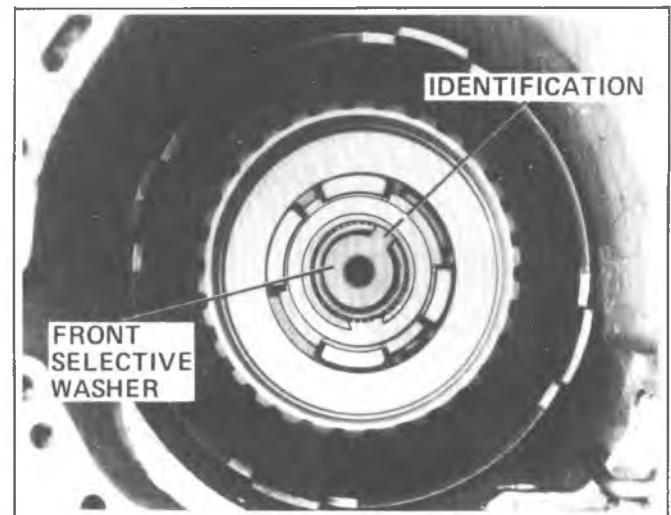


Fig. 7A-26A--Location of Front Selective Washer

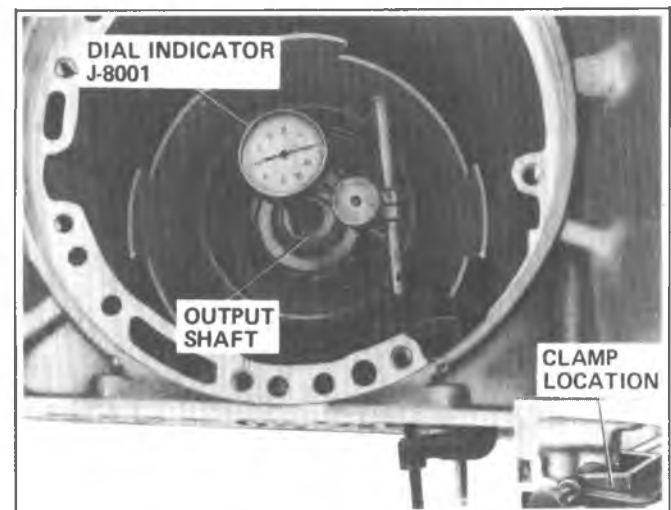


Fig. 7A-27A--Checking Rear Unit End Play

thickness is required to bring end play within specifications, select proper washer from the chart shown in Fig. 7A-28A.

e. Remove dial indicator and clamp assembly (Fig. 7A-27A). Do not remove J-25013 tools.

**NOTE:** It may be necessary to tighten J-25013 adjusting screw on output shaft to remove snap ring.

REAR UNIT END PLAY CHART

THICKNESS			IDENTIFICATION
			Number and/or Color
2.90 - 3.01mm	(0.114"-.0.119")		1 Orange
3.08 - 3.19mm	(0.121"-.0.126")		2 White
3.26 - 3.37mm	(0.128"-.0.133")		3 Yellow
3.44 - 3.55mm	(0.135"-.0.140")		4 Blue
3.62 - 3.73mm	(0.143"-.0.147")		5 Red
3.80 - 3.91mm	(0.150"-.0.154")		6 Brown
3.98 - 4.09mm	(0.157"-.0.161")		7 Green
4.16 - 4.27mm	(0.164"-.0.168")		8 Black
4.34 - 4.45mm	(0.171"-.0.175")		9 Purple

Fig. 7A-28A--Rear Unit End Play Washer Chart

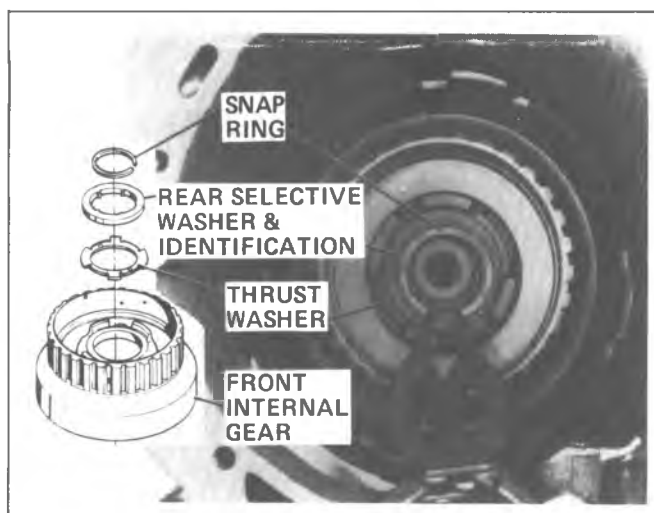


Fig. 7A-29A--Removing Output Shaft to Selective Washer Snap Ring

3. Using snap ring pliers, remove output shaft to selective washer snap ring (Fig. 7A-29A).

4. Front Internal Gear:

a. Remove front internal gear, rear selective washer and thrust washer.

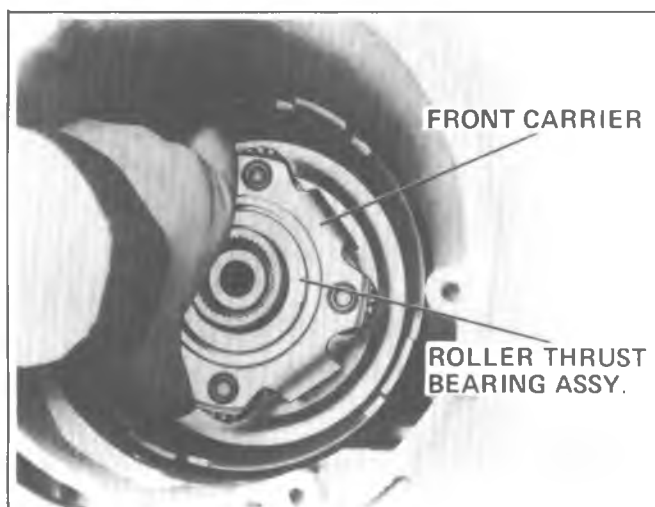


Fig. 7A-30A--Removing Front Carrier and Roller Thrust Bearing

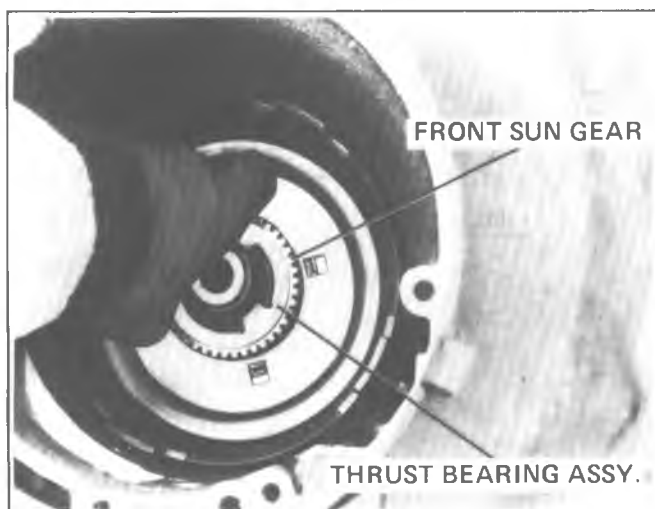


Fig. 7A-31A--Removing Thrust Bearing Assembly and Front Sun Gear

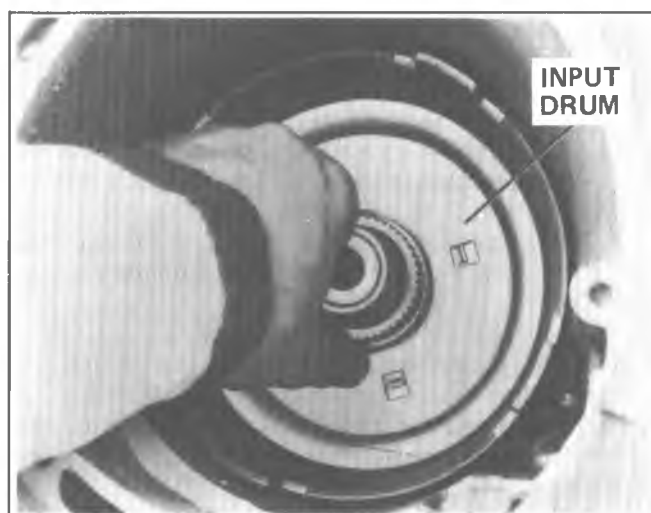


Fig. 7A-32A--Removing Input Drum and Rear Sun Gear

b. Remove rear selective washer and thrust washer from front internal gear.

5. Remove front carrier assembly and the front internal gear to front carrier roller bearing assembly (Fig. 7A-30A).

**NOTE:** The front sun gear to front carrier thrust bearing assembly may come out as the front carrier is removed.

6. Remove front sun gear and front sun gear to front carrier thrust bearing assembly (Fig. 7A-31A).

**NOTE:** This thrust bearing requires only one thrust race.

7. Input drum and rear sun gear assembly:

a. Remove input drum and rear sun gear (Fig. 7A-32A).

b. Remove the 4 tanged input drum to reverse clutch housing thrust washer from rear of input drum or from reverse clutch housing.

8. Low and Reverse clutch housing assembly:

a. Using a No. 14 sheet metal screw, remove housing to case cup plug and seal by turning screw 2 or 3 turns and pulling straight out. Discard cup plug and seal (Fig. 7A-33A).

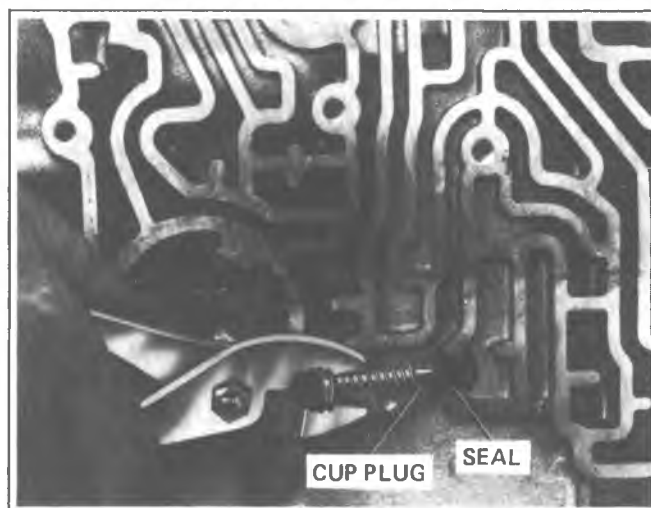


Fig. 7A-33A--Removing Cup Plug and Seal



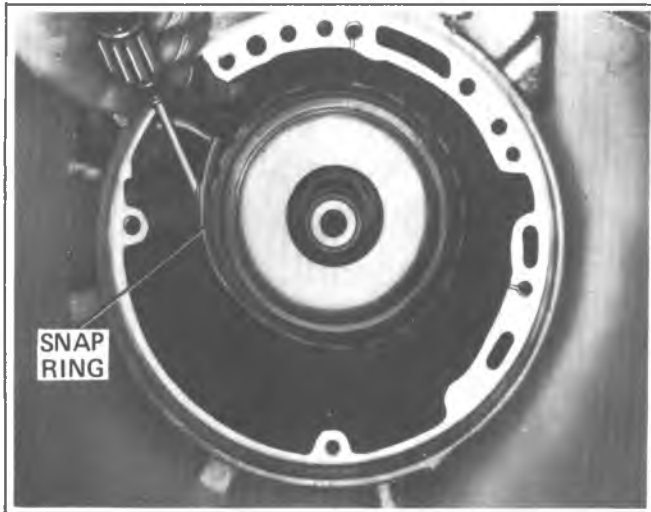


Fig. 7A-34A--Removing Low and Reverse Housing to Case Snap Ring

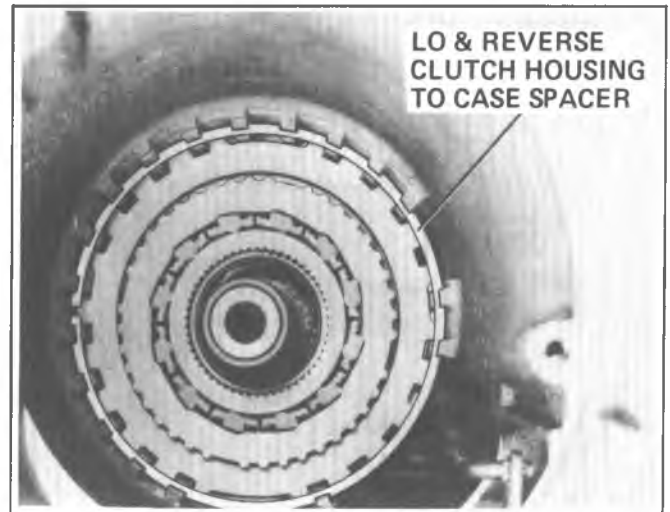


Fig. 7A-36A--Proper Location of Low and Reverse Housing to Case Spacer

**NOTE:** If cup plug will not remove, grind approximately 20mm (3/4") from end of 6.3mm (No. 4) easy out to remove cup plug. Then use No. 14 sheet metal screw to remove seal.

b. Remove low and reverse clutch housing to case beveled snap ring (Fig. 7A-34A).

**NOTE:** The flat side of the ring should have been against the low and reverse clutch housing with beveled side up.

c. Using J-25012, remove low and reverse clutch housing assembly by moving J-25012 back and forth (Fig. 7A-35A).

d. Remove low and reverse clutch housing to case spacer ring (Fig. 7A-36A).

## REAR GEAR PARTS

### Removal

**NOTE:** Make sure governor has been removed at this time.

1. Grasp output shaft and lift out remainder of rear unit parts and lay down in a horizontal position (Fig. 7A-37A).

2. Roller clutch and rear carrier assembly.

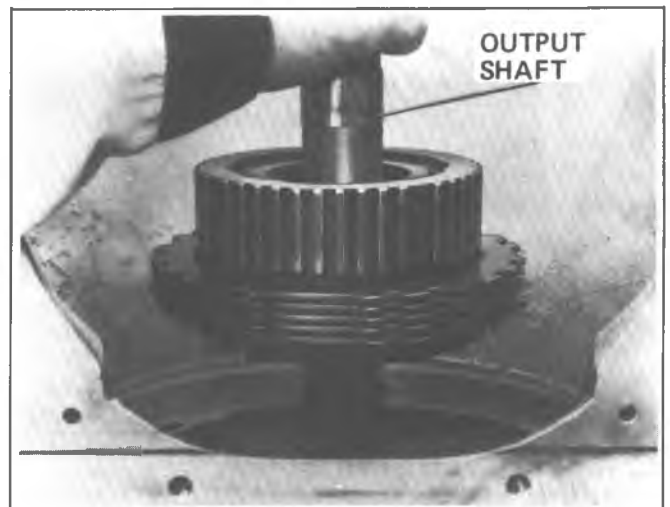


Fig. 7A-37A--Removing Rear Unit Parts

a. Remove roller clutch and rear carrier assembly off output shaft.

b. Remove the 4 tanged rear carrier to rear internal gear thrust washer off the end of the rear carrier, or inside the rear internal gear (Fig. 7A-38A).

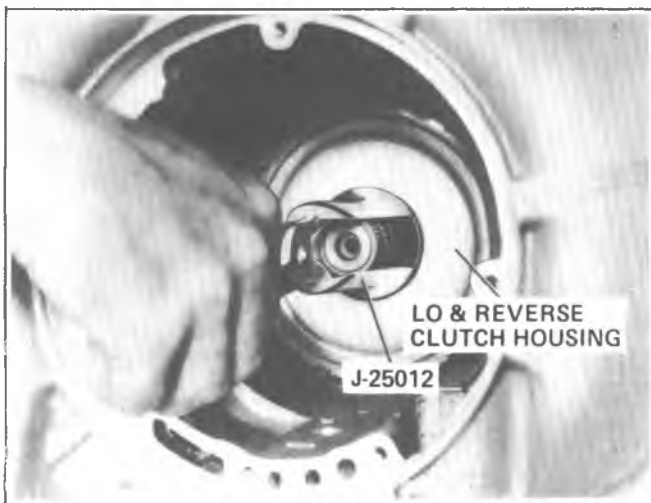


Fig. 7A-35A--Removing Low and Reverse Clutch Housing



Fig. 7A-38A--Removing Thrust Washers

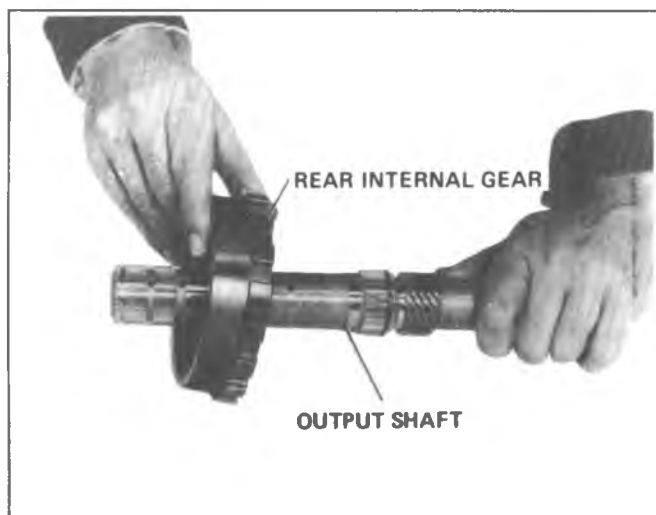


Fig. 7A-39A--Removing Rear Internal Gear



Fig. 7A-40A--Removing Rear Oil Seal

3. Remove low and reverse clutch plates off output shaft.

4. Rear internal gear:

a. Remove rear internal gear to rear sun gear roller thrust bearing assembly off rear internal gear.

b. Remove gear internal gear off output shaft (Fig. 7A-39A).

5. Turn transmission to horizontal position and remove J-25013-5 and J-25013-1 tools from case. Turn transmission

to vertical position with rear end up.

6. If necessary, remove rear oil seal (Fig. 7A-40A).

## MANUAL SHAFT AND PARKING PAWL PARTS

### Removal

1. Turn transmission to horizontal position, oil pan side up.

2. If necessary, remove manual shaft and parking linkage as follows:

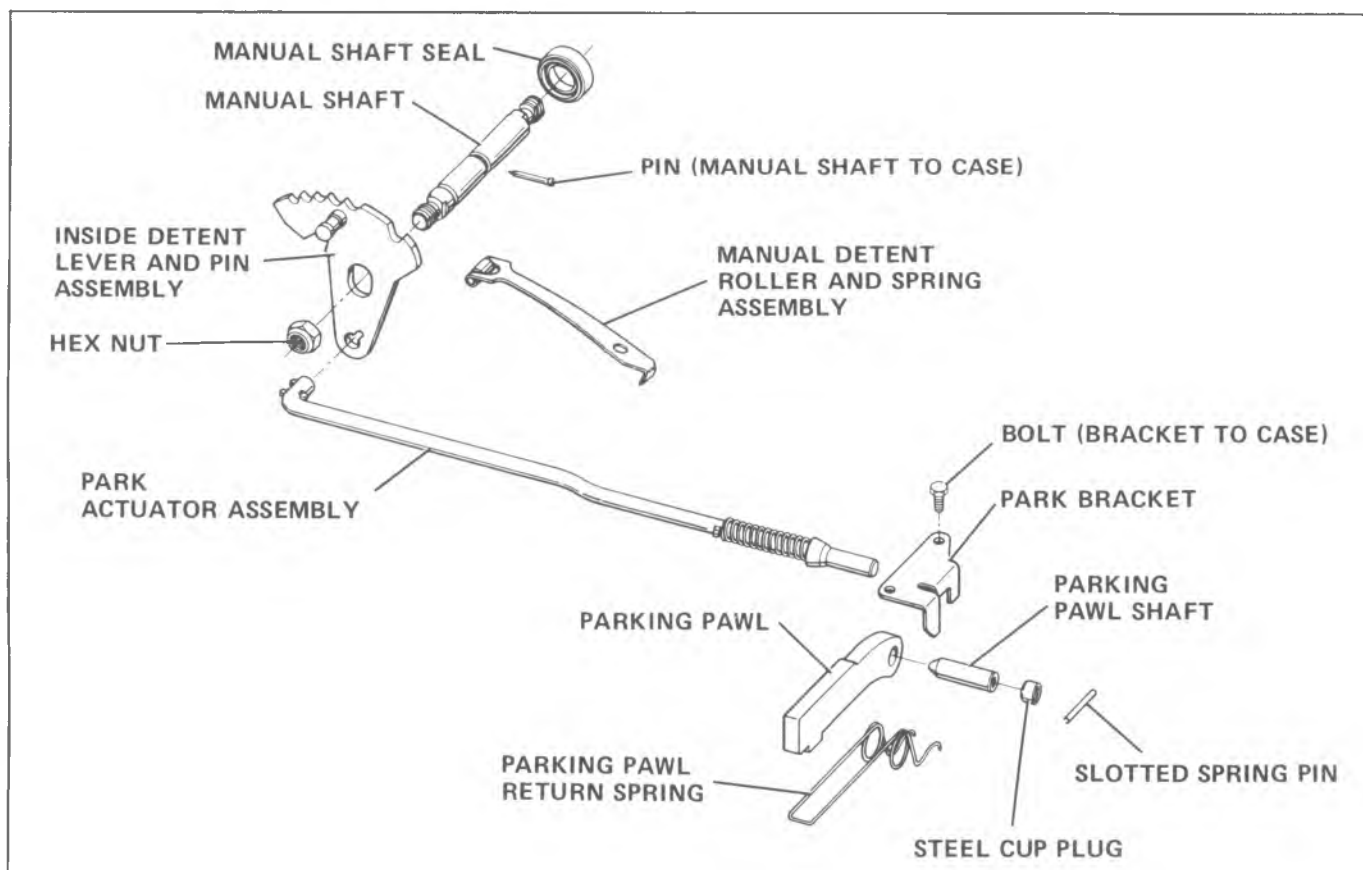


Fig. 7A-41A--Manual Shaft and Parking Shaft Parts

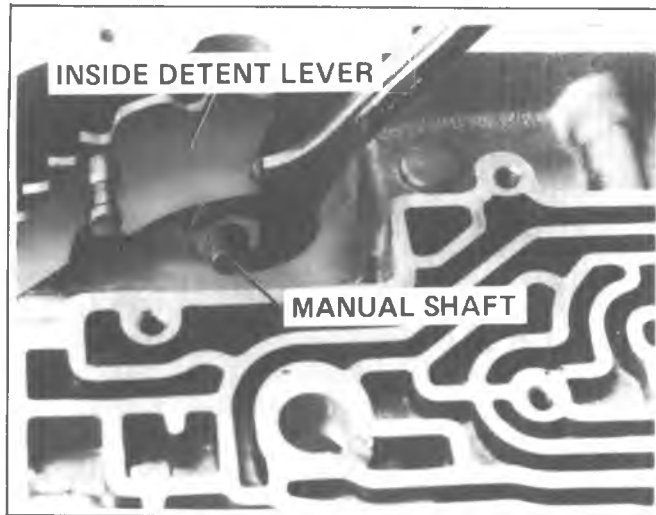


Fig. 7A-42A--Removing Manual Shaft Nut

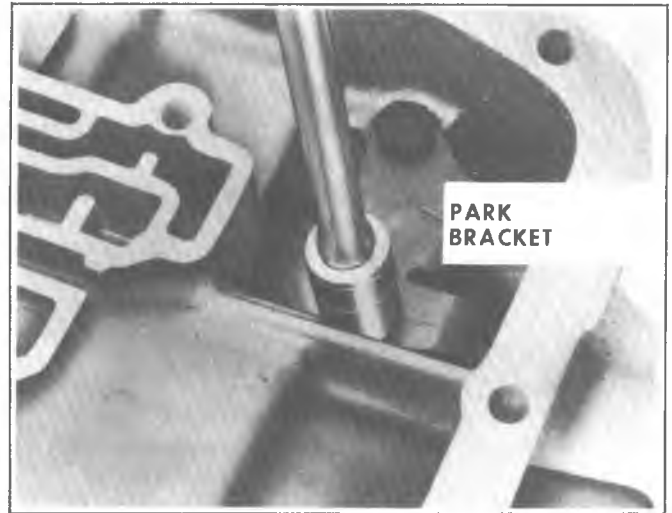


Fig. 7A-45A--Removing Parking Pawl Bracket Bolt

- a. Remove hex nut which holds inside detent lever to manual shaft (Fig. 7A-42A).
- b. Remove parking brake actuator rod and inside detent lever assembly.
- c. Remove manual shaft retaining pin from case and slide manual shaft out (Fig. 7A-43A).
- d. Inspect manual shaft to case seal for damage. If

necessary, pry out manual shaft seal using screwdriver (Fig. 7A-44A).

- e. Remove parking lock bracket (Fig. 7A-45A).

- f. Remove parking pawl shaft retaining pin (Fig. 7A-46A).

- g. Using 6.3mm (No. 4) easy out, remove parking pawl cup plug and discard (Fig. 7A-47A).

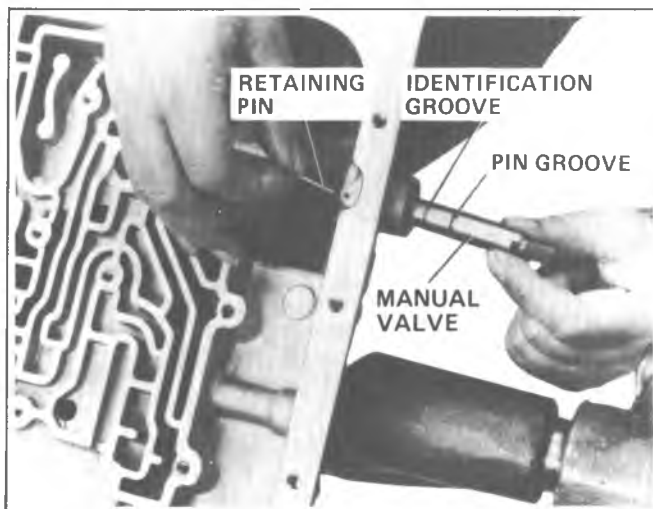


Fig. 7A-43A--Removing Manual Shaft from Case

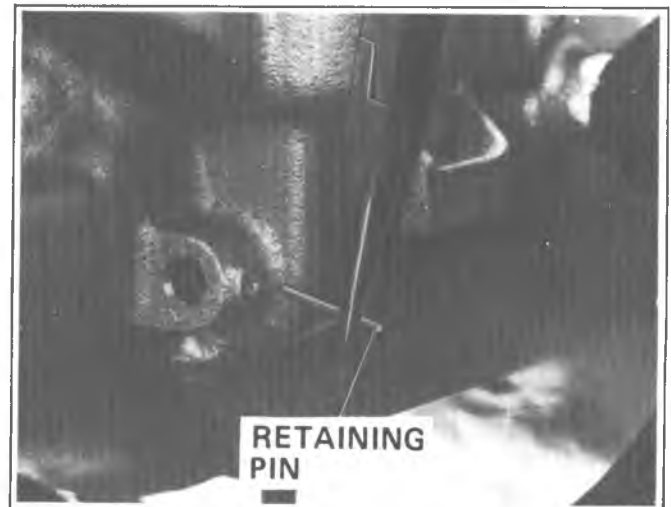


Fig. 7A-46A--Removing Parking Pawl Shaft Pin



Fig. 7A-44A--Removing Manual Shaft Seal From Case



Fig. 7A-47A--Removing Parking Pawl Shaft Cup Plug from Case

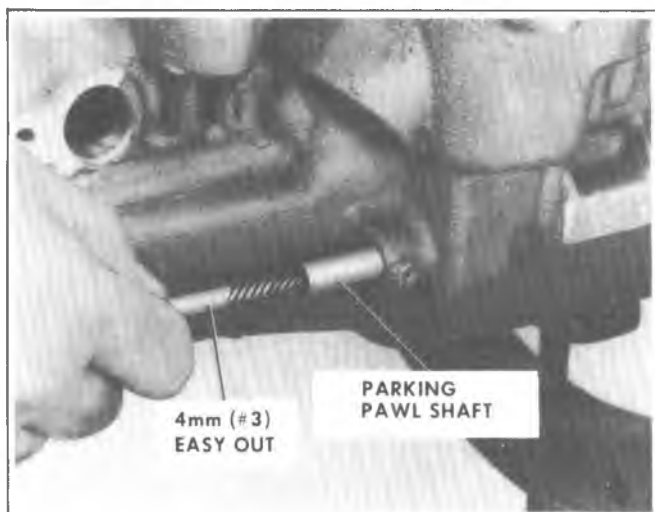


Fig. 7A-48A--Removing Parking Pawl Shaft from Case

**NOTE:** Grind approximately 20mm (3/4") from end of 6.3mm (No. 4) easy out to remove cup plug.

h. Using sheet metal screw or 4mm (No. 3) easy out, remove parking pawl shaft (Fig. 7A-48A).

i. Remove parking pawl and return spring.

## INSPECTION AND REASSEMBLY

### Inspection of Case Assembly

1. Inspect case assembly for damage, cracks, porosity or interconnected oil passages. If case is porous, refer to porosity repair.

2. Inspect orifice plug in the intermediate servo bore. If the plug requires replacement, place the new plug, orifice end first, into plug hole in case. Drive plug flush to slightly below top of plug hole.

3. Inspect the exhaust vents for being opened.

4. Inspect reverse clutch lugs, governor bore, intermediate servo bore, speedometer bore and snap ring grooves for damage.

5. Inspect reverse clutch seal and intermediate band anchor pin bores for damage.

6. Inspect vent assembly in case for damage. Do not remove unless replacement is required.

7. Inspect for damaged or stripped bolt holes. If any threaded holes require heli-coils or equivalent, install these to renew the threads.

8. Turn transmission to vertical position, rear end up.

9. Inspect cooler line connectors for damage. Do not remove unless replacing.

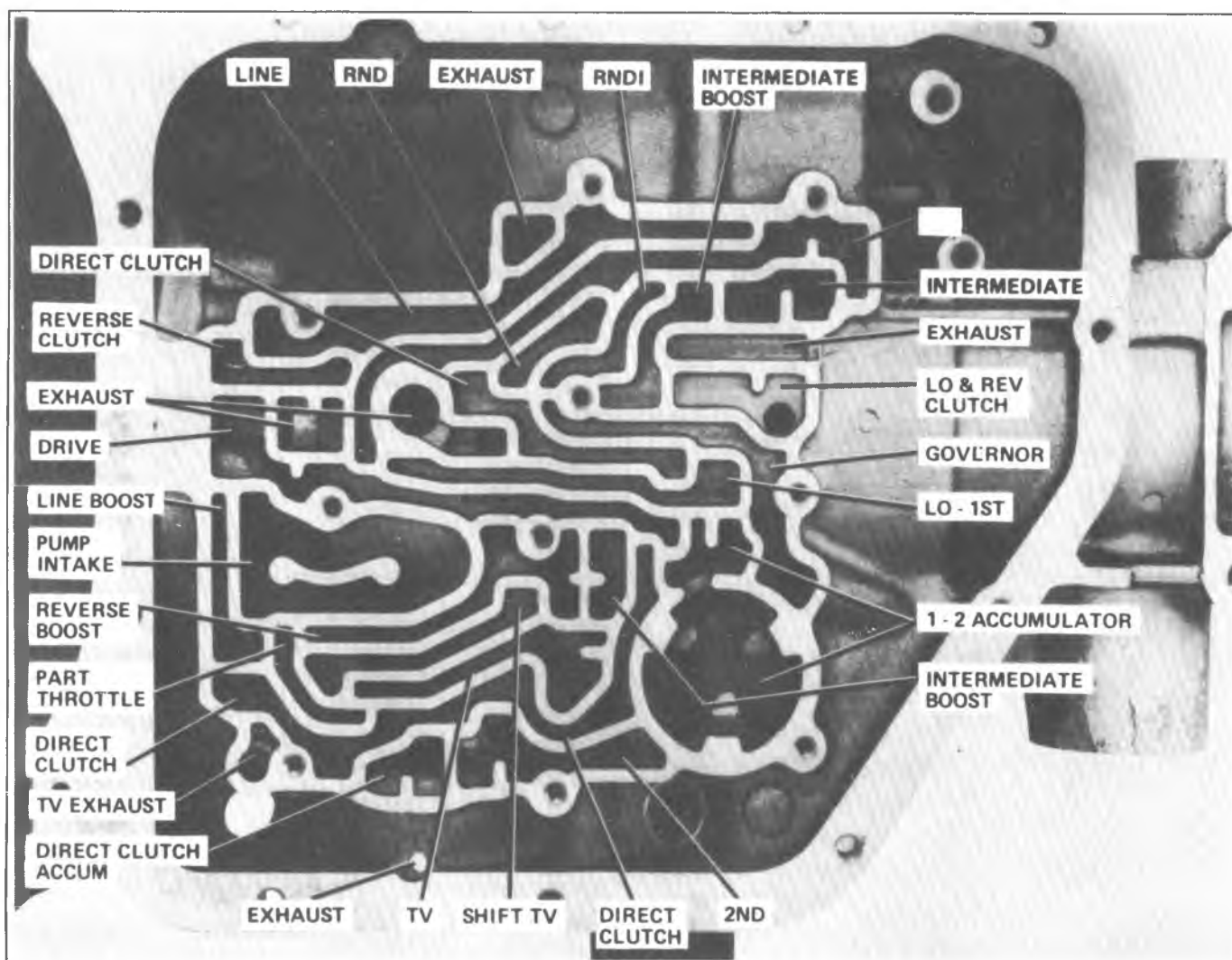


Fig. 7A-49A--Oil Passages - Bottom of Case

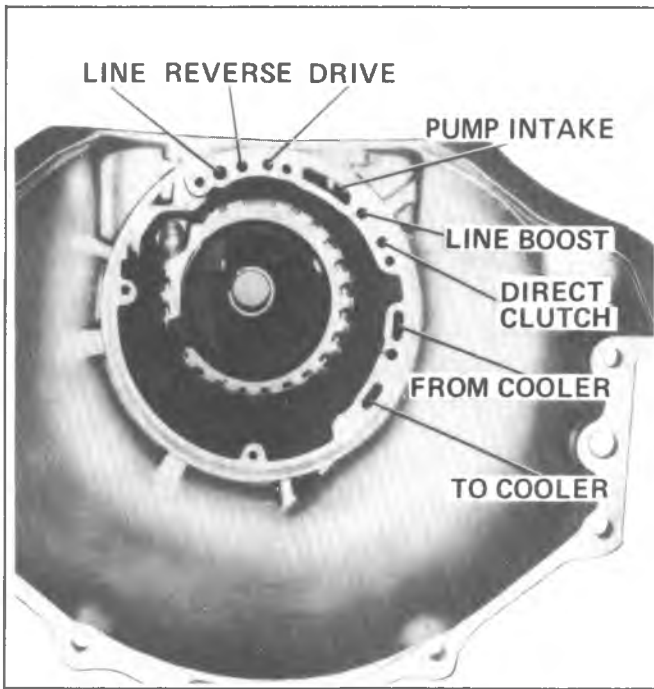


Fig. 7A-50A--Oil Passages, Front of Case



Fig. 7A-51A--Installing Rear Oil Seal

10. Inspect case bushing for damage or scoring.
11. If removed, install a new oil seal, using J-21426 (Fig. 7A-51A).
12. If vent was removed, apply Loctite Primer "T", or equivalent, to the outside diameter of the vent that locates in the case and Loctite 35, or equivalent, to the vent hole in the case. Install vent, using a rubber or plastic hammer.

## MANUAL SHAFT AND PARKING PAWL PARTS (Fig. 7A-52A)

### Inspection

1. Align actuator rod tangs with hole in inside detent lever and separate.
2. Inspect parking actuator rod for damage, or broken retainer lugs.

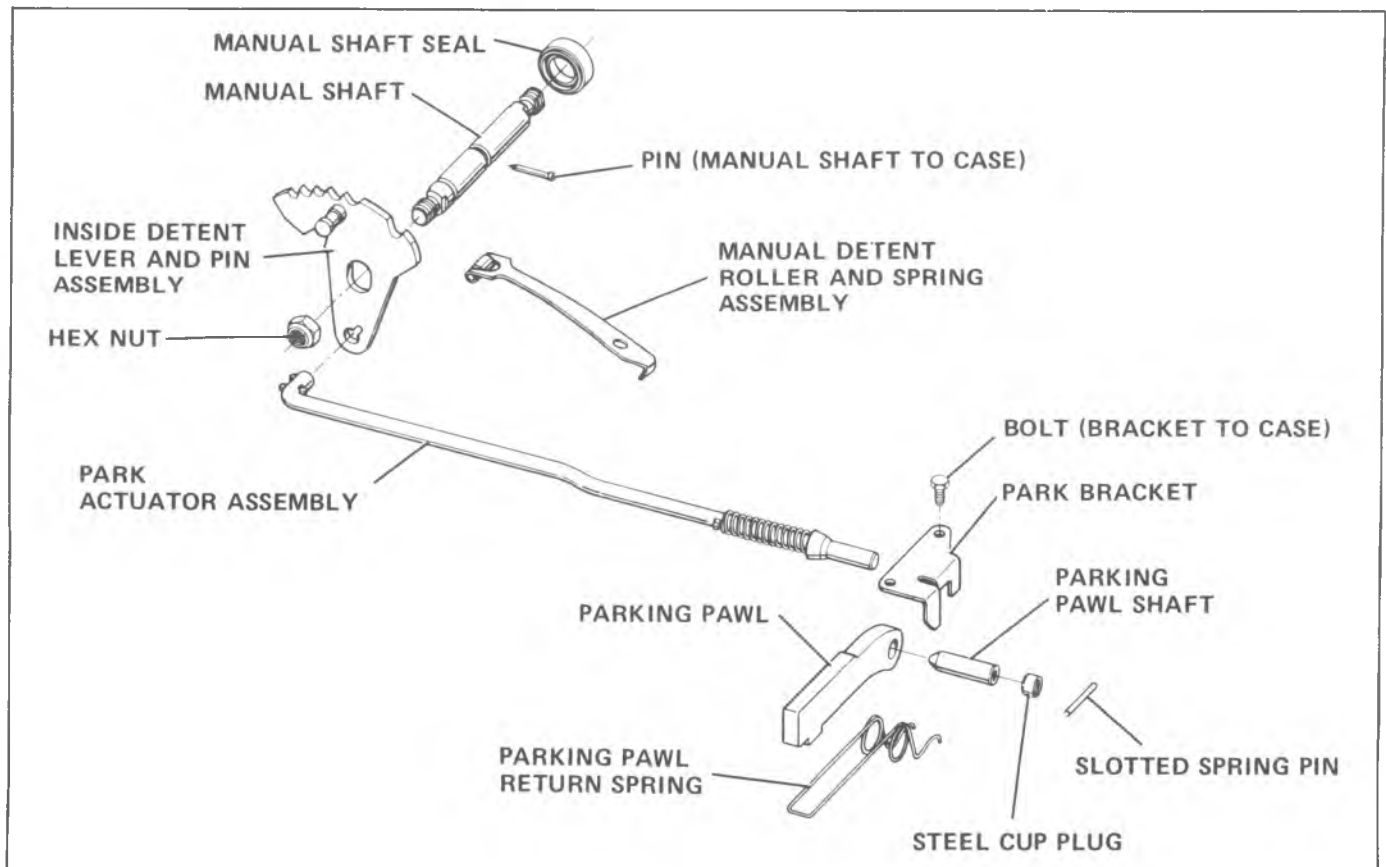


Fig. 7A-52A--Manual Shaft and Parking Shaft Parts

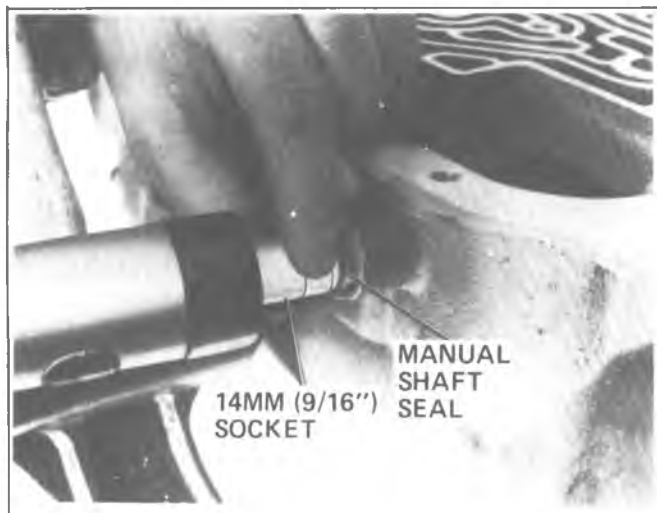


Fig. 7A-53A--Installing Manual Shaft Seal Into Case

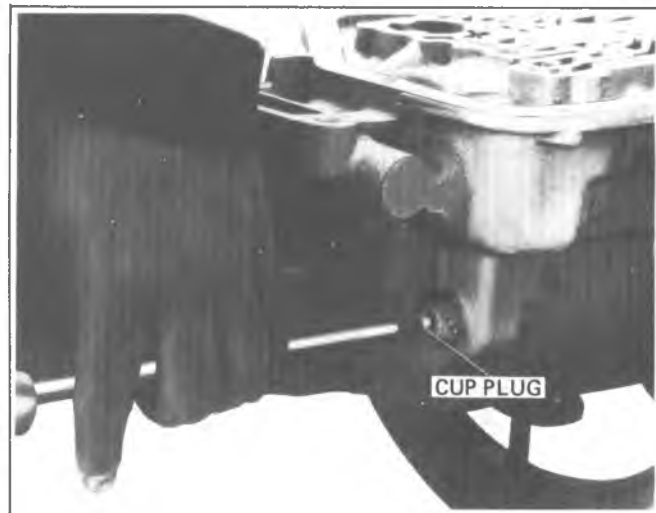


Fig. 7A-55A--Installing Parking Pawl Cup Plug

3. Inspect parking actuator spring for damage.
4. Inspect actuator for free fit on actuator rod.
5. Inspect parking pawl for cracks or damage.
6. Inspect parking pawl return spring for deformed end or coils.
7. Inspect parking pawl shaft for damage.
8. Inspect parking bracket for cracks or wear.
9. Inspect inside detent lever for cracks or loose pin.
10. Inspect manual shaft for damaged threads and the flats for raised edges. File down any raised edges.

#### Reassembly

1. Turn transmission to horizontal position, oil pan side up.
2. If removed, install new manual shaft seal with lip facing inward into transmission case using a 13mm or 9/16" socket to seat seal (Fig. 7A-53A).
3. Install parking pawl and return spring with tooth toward inside of case and parking pawl return spring under pawl tooth with spring ends toward inside of case (Fig. 7A-54A). Make sure spring ends locate against case pad.

4. Align parking pawl and return spring with case shaft bore.

5. Install parking pawl shaft, tapered end first.
6. Using 10mm (3/8") rod, install new parking pawl shaft cup plug, open end out, past retaining pin hole (Fig. 7A-55A).

7. Install parking pawl shaft retaining pin.
8. While holding the parking pawl toward center of transmission, install parking bracket. Torque bolts to 20.0-27.0 N·m (15-20 ft. lbs.).
9. Install parking actuator rod into inside detent lever on pin side, locating lever between actuator rod tangs.

10. Install parking actuator rod and inside detent lever with detent lever pin toward center of transmission and actuator plunger between parking pawl and parking bracket (Fig. 7A-56A).

**CAUTION:** File any burrs or raised edges off the manual shaft that could damage the seal during installation of the shaft.

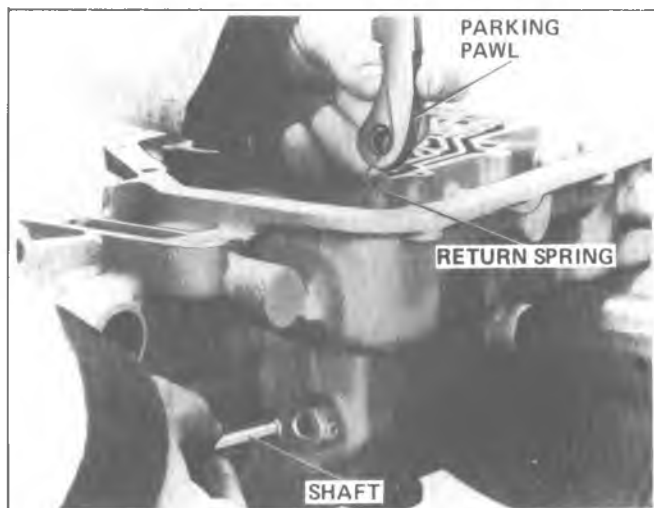


Fig. 7A-54A--Installing Parking Pawl

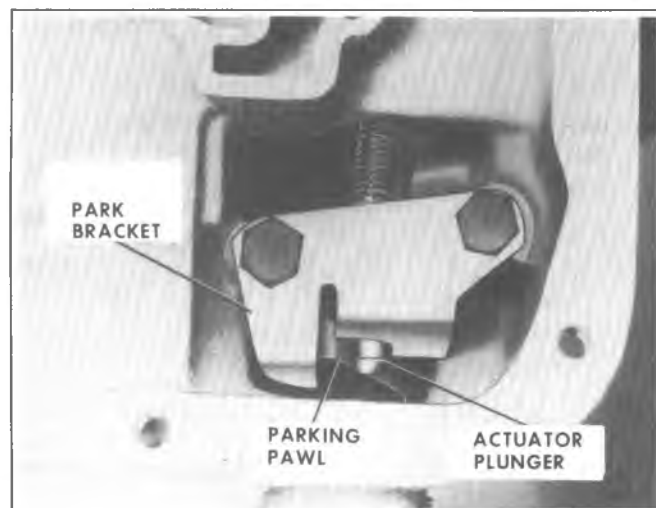


Fig. 7A-56A--Installing Parking Pawl Rod



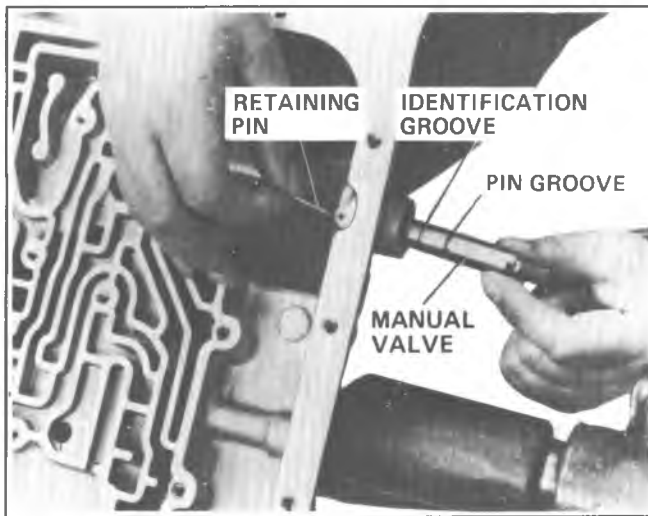


Fig. 7A-57A--Installing Manual Shaft Into Case

11. Install manual shaft, small identification ring groove first, through case. Install manual shaft to case retaining pin, indexing with larger groove on manual shaft (Fig. 7A-57A).

12. Aligning inside detent lever with flats on manual shaft, install inside detent lever on shaft.

13. Install hex nut on manual shaft and torque to 27.0-34.0 N·m (20-25 ft. lbs.).

## REAR GEAR PARTS

### Output Shaft (Fig. 7A-58A)

**NOTE:** The service output shaft has one speedometer drive gear clip hole at the front speedometer gear location which is about 6.3mm (1/4") diameter and opposite this hole is another clip hole which is about 4.0mm (5/32"). The shaft also has the same size holes at the rear speedometer gear location.

1. Inspect journals and snap ring grooves for wear or damage.

2. Inspect lubrication passages for being plugged or damaged.

3. Inspect splines for damage.

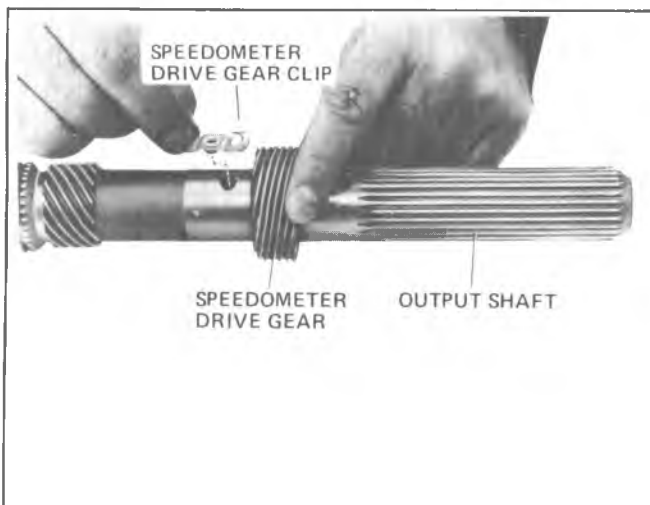


Fig. 7A-58A--Output Shaft

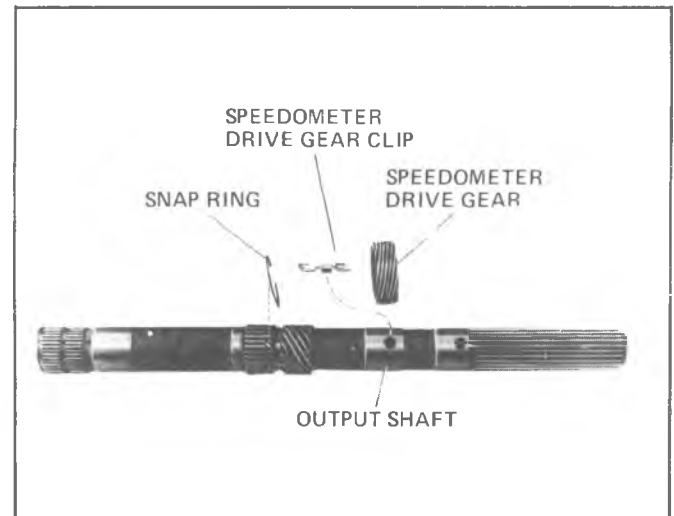


Fig. 7A-59A--Installing Speedometer Drive Gear and Clip

4. Inspect governor drive gear for rough or damaged teeth.

5. Inspect speedometer drive gear for rough or damaged teeth and also the clip for damage.

6. If necessary to replace speedometer drive gear, proceed as follows:

#### For nylon gear,

a. Depress speedometer drive gear clip.

b. Remove gear and clip, tapping gear lightly with plastic hammer.

**NOTE:** Make sure speedometer drive gear is located so speedometer driven gear will mesh with it.

c. Place speedometer drive gear clip with the tanged end in the correct hole in the output shaft (Fig. 7A-59A).

d. Align the slot of the speedometer drive gear with the clip and install the gear.

#### For steel gear, (models PA, CO, CR, CS, CY),

a. Remove steel gear, using J-21427-01 and suitable puller such as J-8433. (Fig. 7A-60A)

b. Position front end of shaft on a block of wood to prevent damaging the front end.



Fig. 7A-60A--Removing Steel Gear

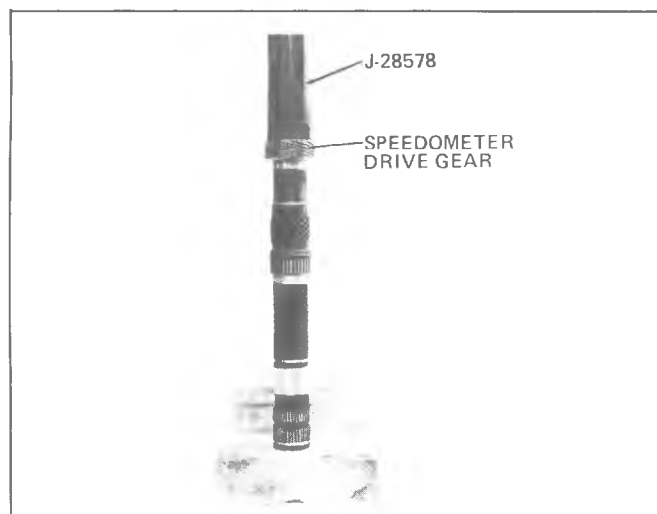


Fig. 7A-61A--Installing Steel Gear

c. Position gear, larger chamfered inside diameter first, over rear end of output shaft.

d. Using J-28578 or J-6133, drive the gear to 156 mm (6-5/32") from end of output shaft to rear face of gear. (Figs. 7A-61A, 7A-62A)

7. If necessary, remove rear internal gear to output shaft snap ring. If damaged, replace with a new snap ring (Fig. 7A-58A).

### Rear Internal Gear

1. Inspect rear internal gear, splines, teeth and bearing surface for wear, cracks or damage.

2. Inspect parking pawl lugs for cracks or damage.

3. Install rear internal gear, hub end first, on output shaft, as shown in Fig. 7A-63A.

4. Thoroughly clean, air dry and inspect closely, the rear internal gear to rear sun gear roller thrust bearing assembly for pitted or rough conditions.

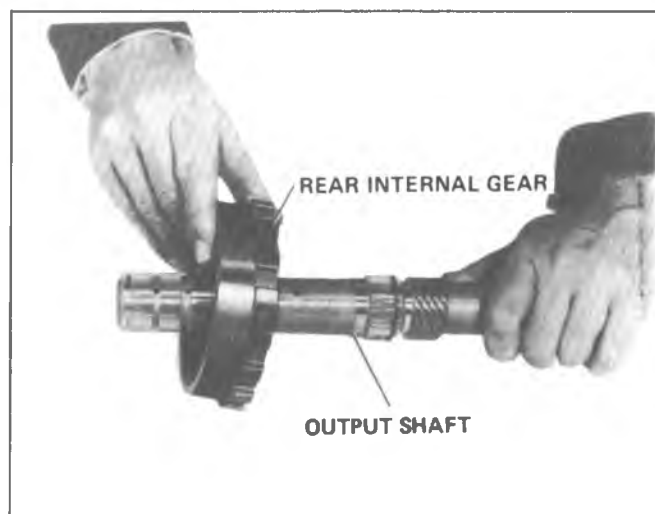


Fig. 7A-63A--Installing Rear Internal Gear on Output Shaft

5. Install rear internal gear to rear sun gear roller thrust bearing assembly by placing the small diameter race over the output shaft (Fig. 7A-64A).

### Roller Clutch and Rear Carrier Assembly

#### Inspection

1. Remove roller clutch race. Inspect race and spline for scoring or wear (Fig. 7A-65A).

2. Remove roller clutch assembly and inspect roller bearings cage and springs for damage or wear (Fig. 7A-65A).

3. Remove and inspect rear carrier to roller clutch thrust washer for signs of scoring or excessive wear.

4. Inspect 4 tanged rear carrier to rear internal gear thrust washer for being scored or distorted tangs (Fig. 7A-65A).

5. Inspect rear carrier for damage.

6. Inspect roller clutch cam ramps for damage.

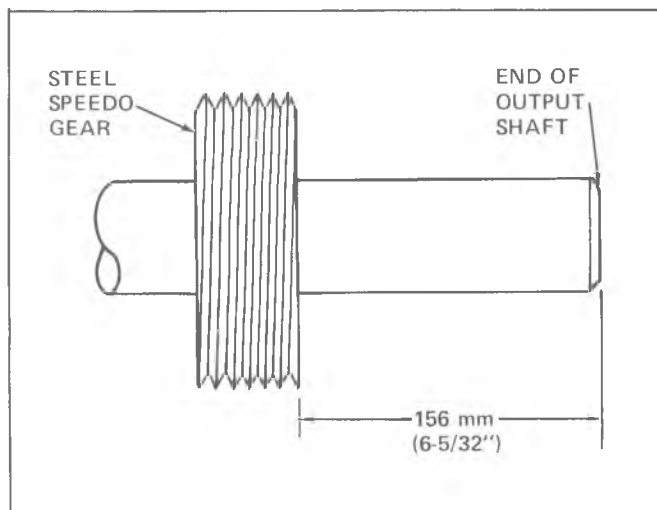


Fig. 7A-62A--Positioning Steel Gear

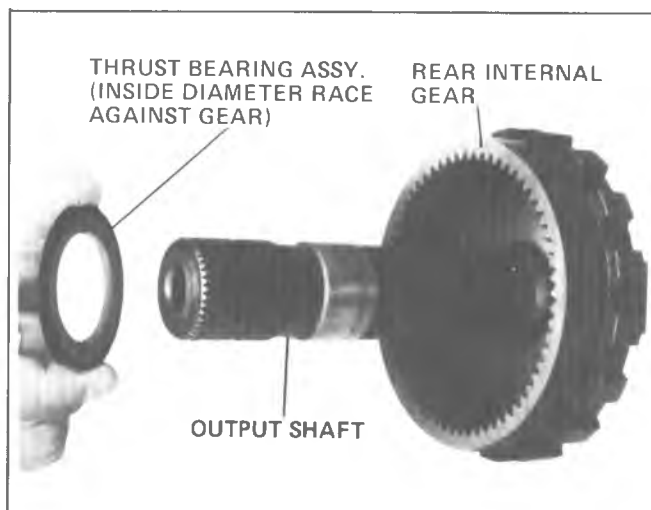


Fig. 7A-64A--Installing Thrust Bearing Assembly



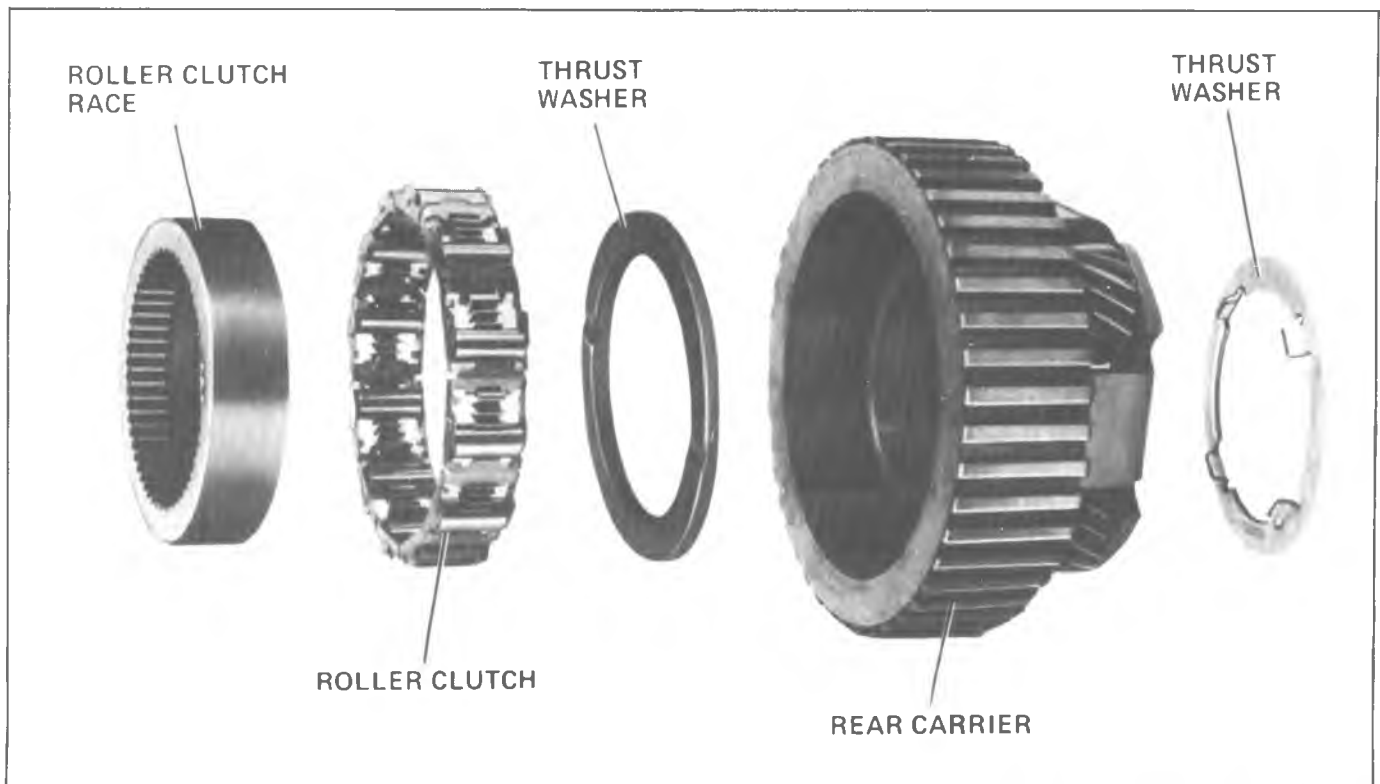


Fig. 7A-65A--Roller Clutch and Rear Carrier-Exploded

7. Inspect bushing for damage or scoring.
8. Inspect planet pinions for damage, rough bearings or tilt.
9. Check pinion end play. Pinion end play should be 0.24-0.69mm (0.009"-0.027") (Fig. 7A-66A).

#### Reassembly

1. Install roller clutch to rear carrier thrust washer (Fig. 7A-67A).
2. Install rollers that may have come out of roller clutch cage, by compressing the energizing spring with forefinger and inserting roller from outer edge (Fig. 7A-68A).



Fig. 7A-67A--Installing Thrust Washer Into Rear Carrier

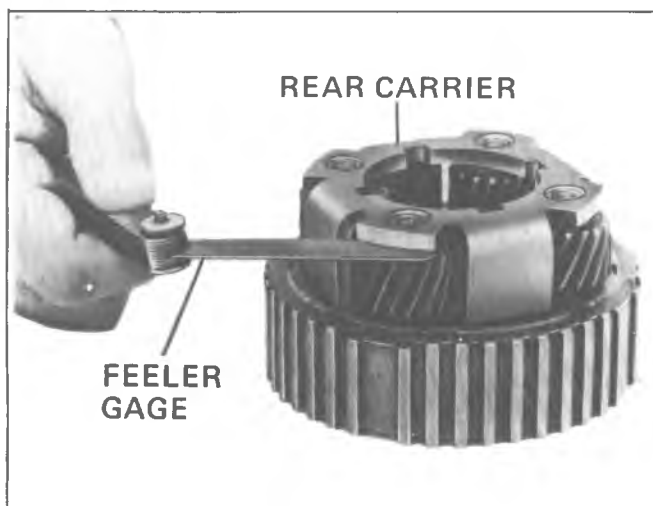


Fig. 7A-66A--Checking Rear Carrier Pinion End Play

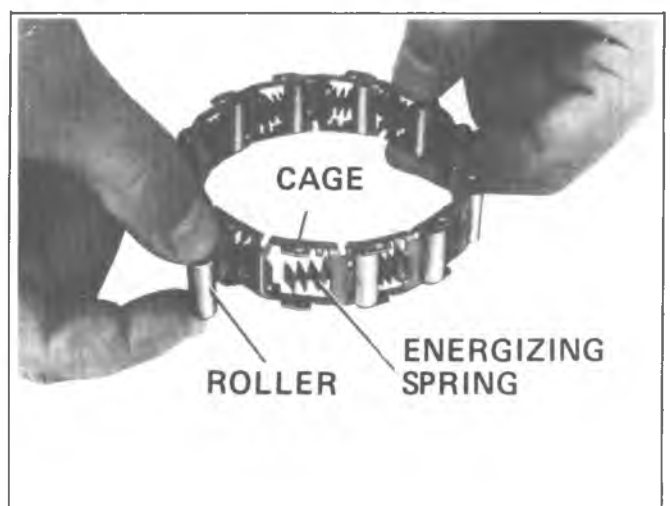


Fig. 7A-68A--Installing Roller Into Cage

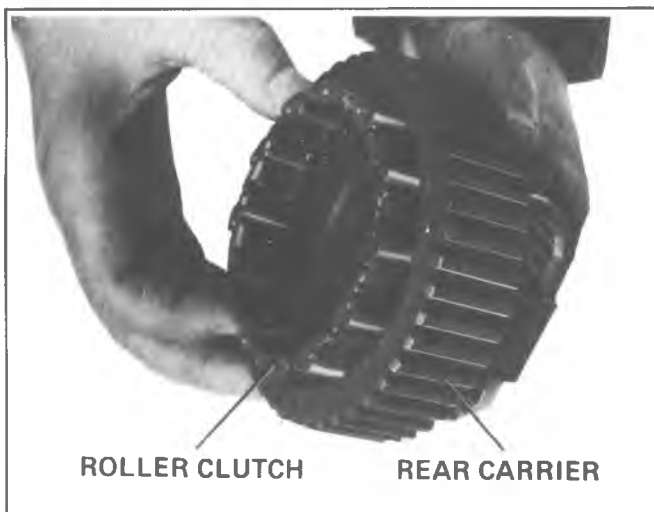


Fig. 7A-69A--Installing Roller Clutch Into Rear Carrier

3. Install roller clutch assembly into roller clutch cam (Fig. 7A-69A).

4. Install roller clutch race, spline side out and rotate clutch race counterclockwise into position (Fig. 7A-70A).

5. Install 4 tanged rear carrier to rear internal gear thrust washer. Align tangs into slots of rear carrier and retain with petrolatum (Fig. 7A-71A).

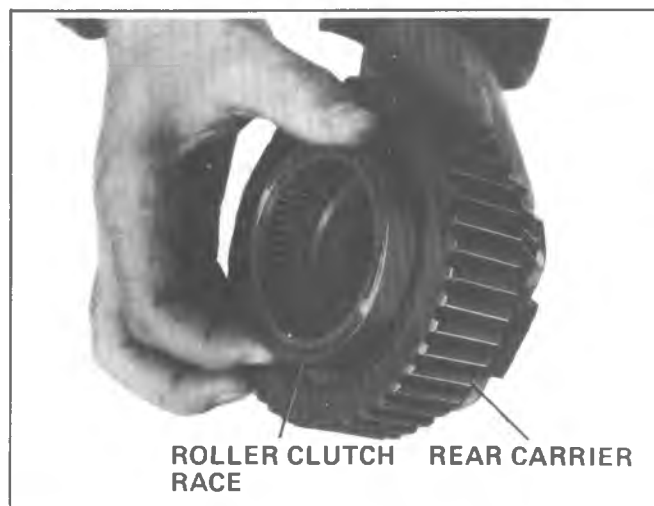


Fig. 7A-70A--Installing Roller Clutch Race

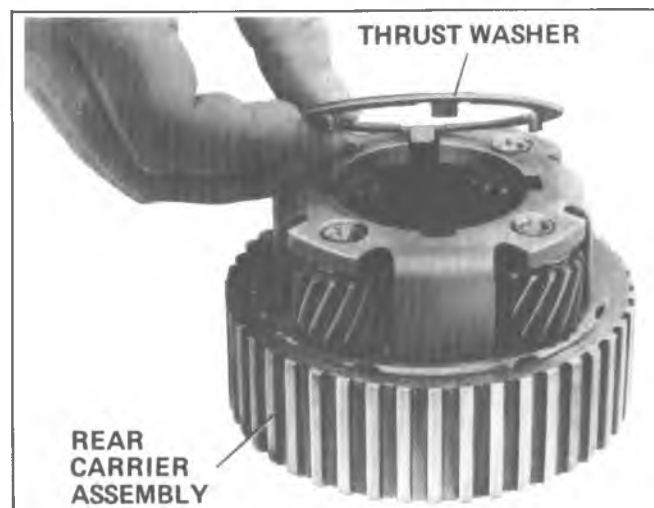


Fig. 7A-71A--Installing Thrust Washer

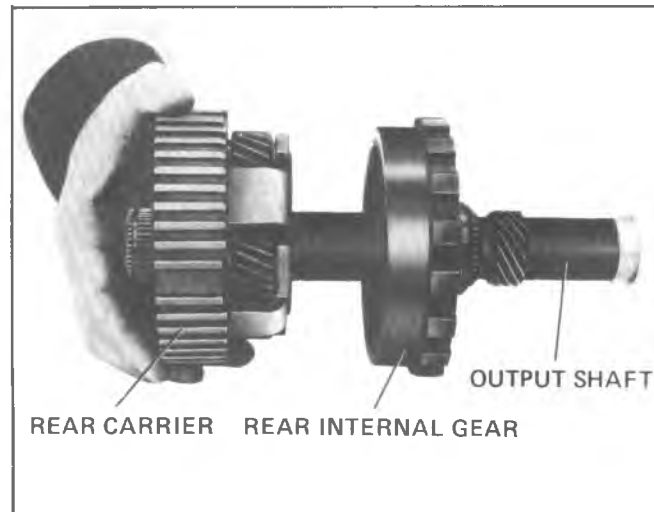


Fig. 7A-72A--Installing Rear Carrier Into Rear Internal Gear

6. Install roller clutch and rear carrier assembly into rear internal gear (Fig. 7A-72A).

7. Install J-25013-1, open end first, into rear end of case. Bolt J-25013-5 on end of case (Fig. 7A-73A).

8. Turn case to vertical position, pump end up.

9. Install rear unit parts into case and into J-25013-1 sleeve (Fig. 7A-74A) indexing rear internal gear parking pawl lugs to pass by parking pawl tooth.

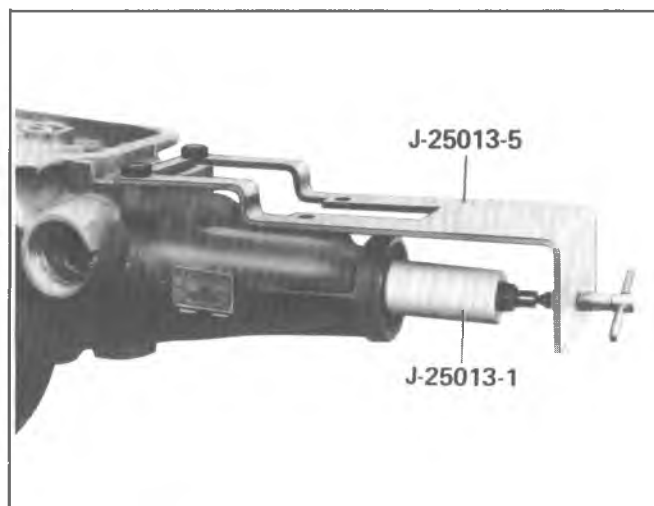


Fig. 7A-73A--Installing Tools on Rear End of Case

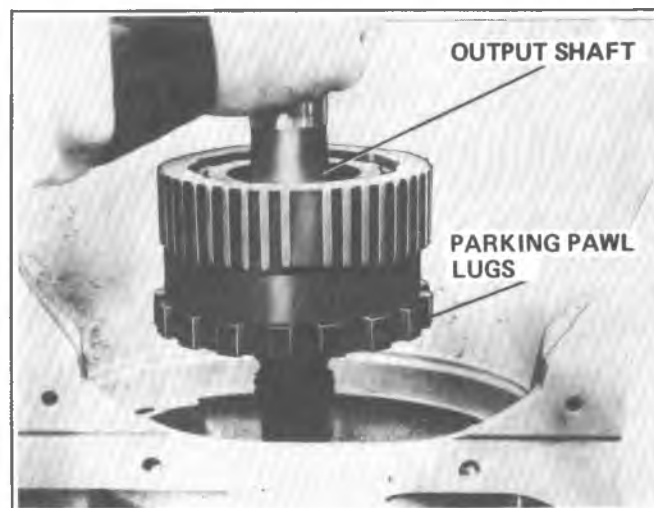


Fig. 7A-74A--Installing Rear Unit Parts

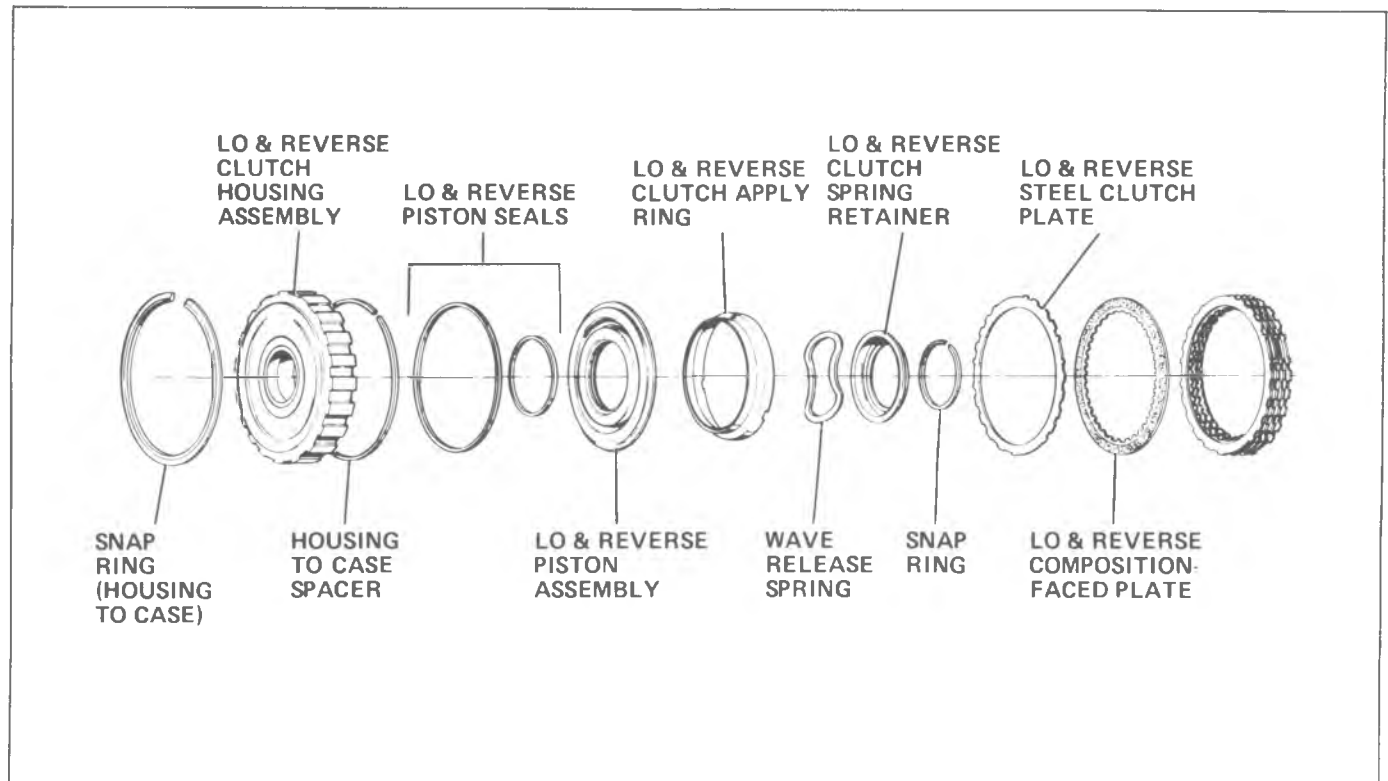


Fig. 7A-75A--Low and Reverse Clutch Housing-Exploded View

10. Using J-25013-5 adjusting screw (Fig. 7A-73A) and looking through parking pawl case slot, adjust the height of the rear internal gear parking pawl lugs to align flush with the parking pawl tooth.

**NOTE:** Make sure speedometer drive gear is visible through speedometer gear bore. If drive gear is not visible, it may be located on wrong journal of shaft.

## LOW AND REVERSE CLUTCH

### Inspection

Inspect low and reverse clutch composition-faced and steel clutch plates for signs of wear or burning.

## Low and Reverse Clutch Housing Assembly

(Fig. 7A-75A)

### Disassembly

1. Compress low and reverse clutch spring retainer, remove snap ring and retainer and inspect for damage or distortion (Fig. 7A-76A).

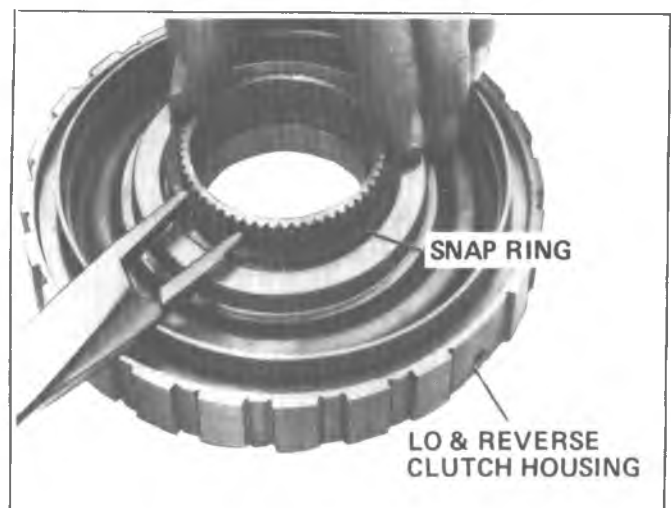


Fig. 7A-76A--Removing or Installing Low and Reverse Clutch Spring Retaining Snap Ring

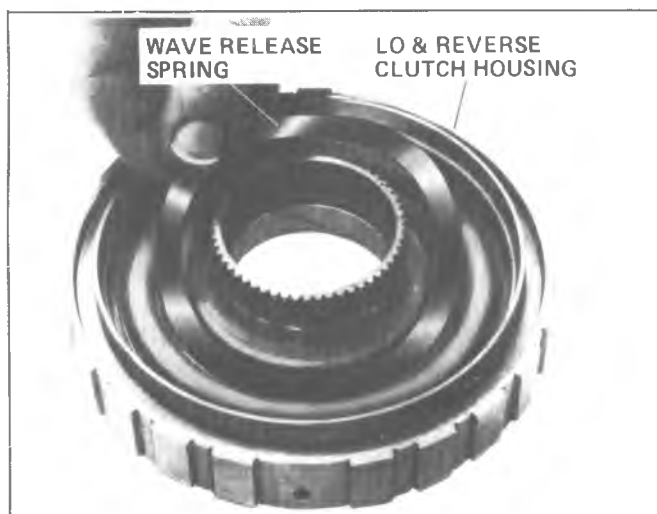


Fig. 7A-77A--Removing or Installing Low and Reverse Clutch Wave Release Springs

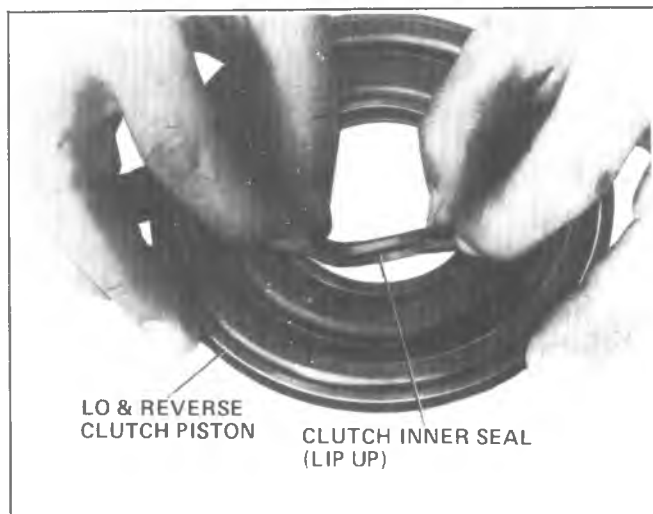


Fig. 7A-79A--Removing or Installing Low and Reverse Clutch Inner Seal

2. Remove waved spring (Fig. 7A-77A).
3. Remove low and reverse clutch piston.
4. Remove outer and inner piston seals (Figs. 7A-78A and 7A-79A).
5. Remove clutch apply ring.

#### Inspection

1. Inspect low and reverse clutch housing for damage, plugged feed hole.
2. Inspect low and reverse clutch housing bushing for damage or scoring.
3. Inspect low and reverse clutch splines and snap ring groove for damage or burrs. Remove any burrs on splines or snap ring groove.
4. Inspect low and reverse clutch piston and clutch apply ring assembly for distortion, cracks or damage.

**NOTE:** The apply ring is identified by a number located on the ring. See Fig. 7A-82A.

5. Inspect low and reverse clutch spring retainer for damage.
6. Inspect waved spring for damage.

7. Inspect low and reverse clutch housing to case spacer ring for damage.

#### Reassembly

1. Install clutch apply ring on low and reverse clutch piston.
2. Install new outer and inner seals on piston with lips facing away from clutch apply ring side.
3. Install seal protector J-25011.

**NOTE:** Apply transmission fluid to all clutch seals before reassembly.

**CAUTION:** Flat screwdriver surface area must be smooth to prevent damaging outer seal.

4. Using flat edged small screwdriver, or piston installing tool shown in Fig. 7A-107A, install low and reverse clutch piston, while rotating and pushing down into place (Fig. 7A-80A).
5. Remove seal protector J-25011.
6. Install waved release spring (Fig. 7A-77A).
7. Install retainer, cupped faced down.

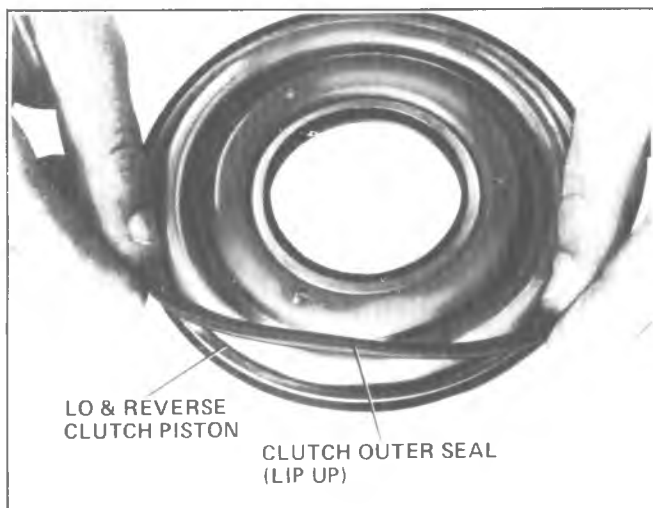


Fig. 7A-78A--Removing or Installing Low and Reverse Clutch Outer Seal

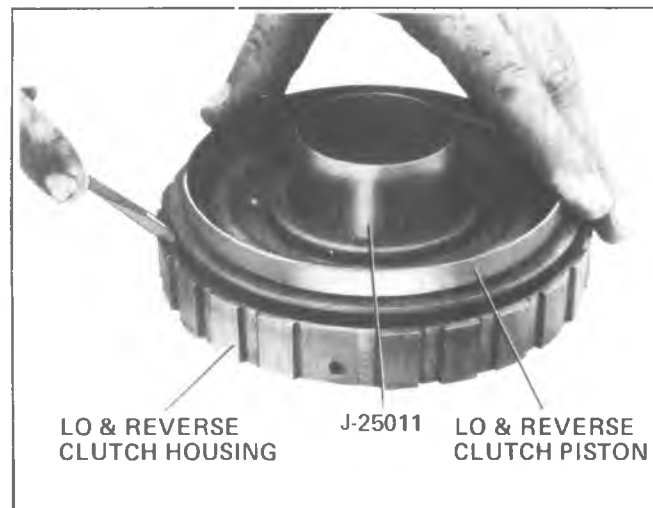


Fig. 7A-80A--Installing Low and Reverse Clutch Piston

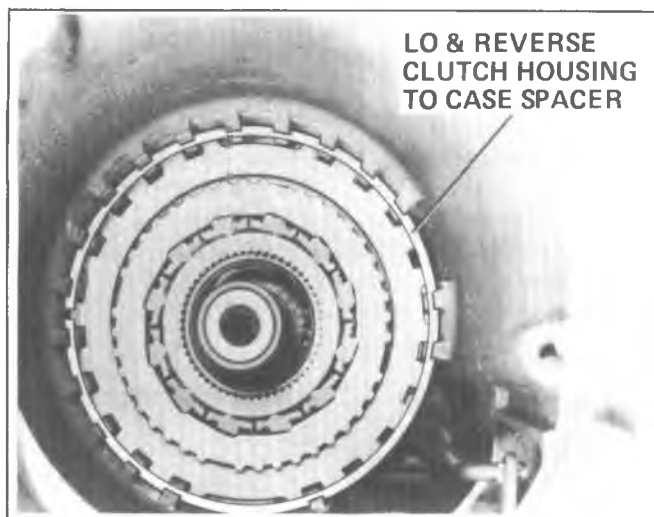


Fig. 7A-81A--Proper Location of Low and Reverse Housing to Case Spacer

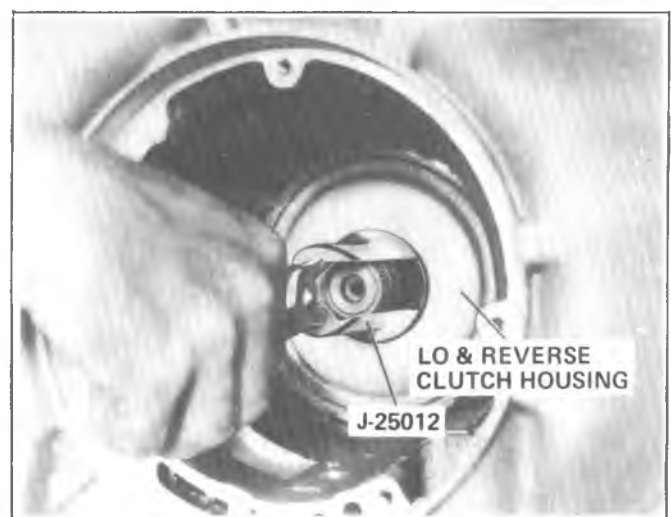


Fig. 7A-83A--Installing Low and Reverse Clutch Housing

8. Compress retainer and install snap ring (Fig. 7A-76A).

### Installation

1. Oil and install the lo and reverse clutch plates into the case, starting with a flat steel and alternating composition-faced and flat steel clutch plates. (See Clutch Plate Usage Chart, Fig. 7A-82A).

2. Install low and reverse clutch housing to case spacer ring in case (Fig. 7A-81A).

3. Install low and reverse clutch housing assembly aligning reverse clutch housing feed hole to reverse clutch case feed passage, using J-25012 (Fig. 7A-83A).

If the low and reverse clutch housing does not seat past the case snap ring groove, proceed as follows:

a. Remove tool J-25012.

b. Using rear sun gear and input drum as a tool, install input drum and rear sun gear in case.

MODELS	DIRECT CLUTCH					FORWARD CLUTCH							LOW & REV. CLUTCH			
	FLAT STEEL PLATE		COMP. FACED PLATE	APPLY RING		WAVED PLATE		FLAT STEEL PLATE		COMP. FACED PLATE	APPLY RING		FLAT STEEL PLATE	COMP. FACED PLATE	APPLY RING	
	NO.	THICKNESS	NO.	I.D.	*WIDTH	NO.	THICKNESS	NO.	THICKNESS	NO.	I.D.	*WIDTH	NO.	NO./TYPE	I.D.	*WIDTH
PA, PY	4	2.324mm (.091")	4	1	16.99mm (.669")	1	1.585mm (.062")	2	1.969mm (.077")	3	0	17.50mm (.689")	5	4-/GROOVED	5	24.34mm (.958")
BR, CX	3	2.324mm (.091")	3	2	21.44mm (.844")	1	1.585mm (.062")	2	1.969mm (.077")	3	0	17.50mm (.689")	5	4-/GROOVED	5	24.34mm (.958")
CS	4	2.324mm (.091")	4	1	16.99mm (.669")	1	1.585mm (.062")	3	1.969mm (.077")	4	8	13.51mm (.532")	6	5-/NON-GROOVED	4	20.14mm (.793")
BZ, OW	5	2.324mm (.091")	5	9	12.50mm (.492")	1	1.585mm (.062")	3	1.969mm (.077")	4	8	13.51mm (.532")	6	5-/NON-GROOVED	4	20.14mm (.793")
PG, PH, CO, CR, CY, BA, OS, OT	5	2.324mm (.091")	5	9	12.50mm (.492")	1	1.585mm (.062")	3	1.969mm (.077")	4	8	13.51mm (.532")	7	6-/NON-GROOVED	3	15.94mm (.628")

NOTE: THE DIRECT AND FORWARD CLUTCH FLAT STEEL CLUTCH PLATES AND THE FORWARD CLUTCH WAVED STEEL PLATE SHOULD BE IDENTIFIED BY THEIR THICKNESS.

THE DIRECT AND FORWARD PRODUCTION INSTALLED COMPOSITION-FACED CLUTCH PLATES MUST NOT BE INTERCHANGED. FOR SERVICE, DIRECT AND FORWARD CLUTCH USE THE SAME COMPOSITION-FACED PLATES.

ALL LOW AND REVERSE CLUTCH COMPOSITION-FACED PLATES ARE SERVICED WITH THE GROOVED COMPOSITION-FACED PLATES.

\* MEASURE THE WIDTH OF THE CLUTCH APPLY RING FOR POSITIVE IDENTIFICATION.

Fig. 7A-82A--Clutch Plate Usage and Apply Ring Identification

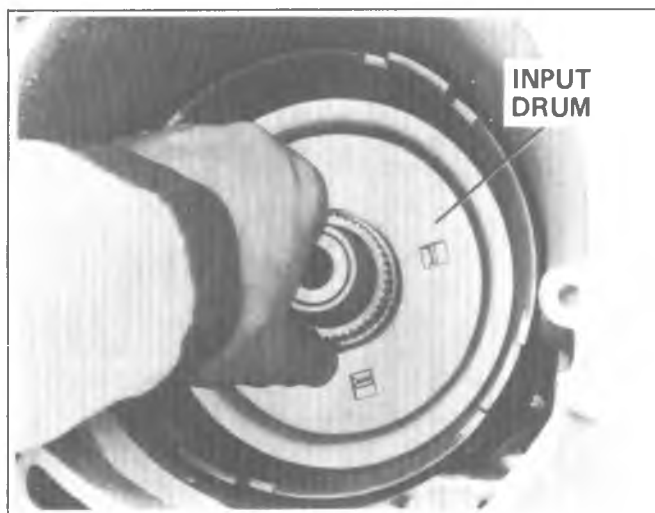


Fig. 7A-84A--Installing Input Drum and Rear Sun Gear

c. Rotate rear sun gear back and forth, tapping lightly with input drum, to align roller clutch race and low and reverse clutch hub splines (Fig. 7A-84A).

d. Remove tool (input drum and rear sun gear).

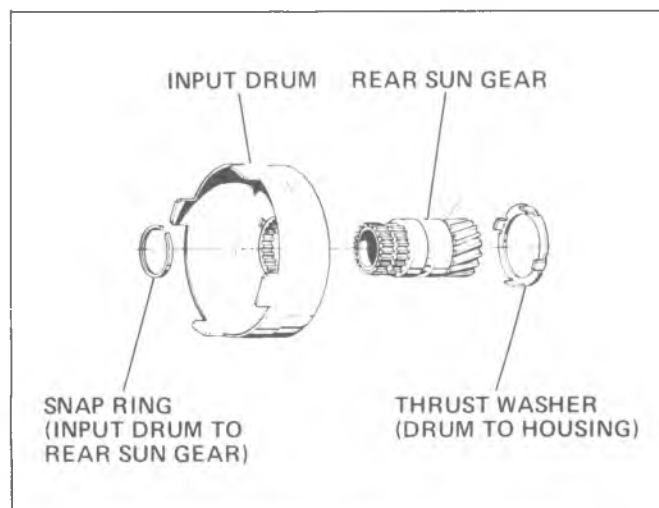


Fig. 7A-85A--Rear Sun Gear and Input Drum

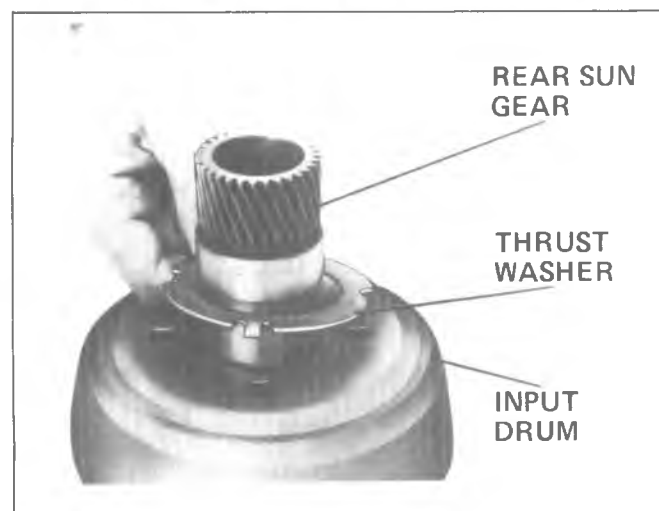


Fig. 7A-86A--Installing Thrust Washer

**NOTE:** It may be necessary to loosen adjusting screw on J-25013-5 on output shaft to install snap ring.

e. Repeat the above steps if low and reverse clutch housing is not fully seated past case snap ring groove.

4. Install low and reverse clutch housing to case snap ring, flat side against housing (beveled side up). Position snap ring gap on opposite side of parking actuator rod.

## FRONT GEAR PARTS

### Rear Sun Gear and Input Drum (Fig. 7A-85A)

#### Inspection

1. Inspect rear sun gear for cracks, splits, damage spline, worn gear or journals and plugged lubrication holes (Fig. 7A-85A).

2. Inspect rear sun gear bushing for damage or scoring.

3. If necessary, remove input drum to rear sun gear snap ring and remove sun gear from input drum.

4. Inspect input drum for damage.

5. Inspect 4 tanged input drum to low and reverse clutch housing thrust washer for scoring or distorted tangs.

6. If damaged, replace rear sun gear to input drum snap ring.

#### Reassembly

1. Install rear sun gear into input drum, spline side first, and retain with snap ring.

2. Install 4 tanged thrust washer on input drum over sun gear end; align tangs into input drum and retain with petrolatum (Fig. 7A-86A).

3. Install rear sun gear and input drum assembly (Fig. 7A-84A).

### Front Sun Gear

1. Inspect front sun gear splines and teeth for damage or wear.

2. Inspect machined face for pitting, scoring or damage.

3. Install front sun gear face with the identification mark (a drill spot or groove) against input drum to rear sun gear snap ring (Fig. 7A-87A and 7A-88A).

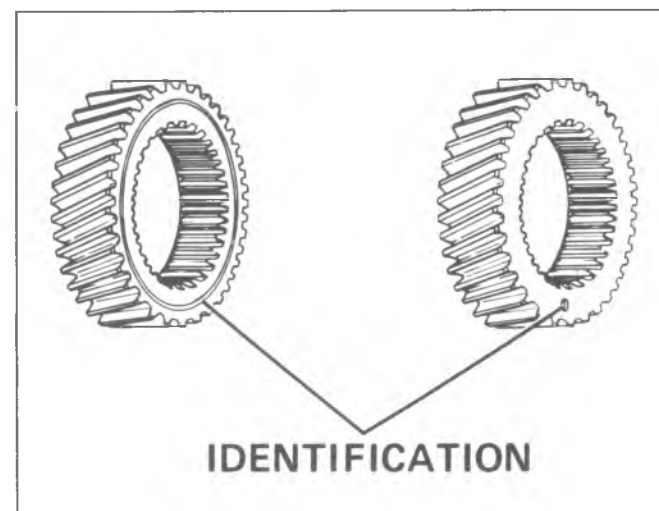


Fig. 7A-87A--Front Sun Gear Identification

4. Thoroughly clean, air dry and inspect front sun gear to front carrier thrust race and thrust bearing for pitted or rough conditions.

5. Install front sun gear to front carrier thrust bearing and race assembly with roller thrust bearing against the front sun gear (Fig. 7A-89A).

**NOTE:** This thrust bearing requires only 1 thrust race.

## Front Carrier Assembly

### Inspection

1. Inspect front carrier for damage (Fig. 7A-90A).
2. Inspect pinions for damage, rough bearings or tilt.
3. Check pinion end play. Pinion end play should be 0.24mm-0.69mm (0.009" to 0.027")(Fig. 7A-90A).
4. Thoroughly clean, air dry and inspect closely, front carrier to front internal gear roller thrust bearing assembly for pitted or rough conditions.

### Reassembly

1. Install front carrier to front internal gear roller thrust bearing assembly by placing the smaller diameter race against carrier. Retain with petrolatum (Fig. 7A-91A).
2. Install front carrier and thrust bearing assembly (Fig. 7A-93A).

## Front Internal Gear and Thrust Washer

1. Inspect forward clutch hub for worn splines and for lubrication holes.
2. Inspect internal gear for cracks or damage.
3. Inspect gear teeth for excessive wear or damage.
4. Inspect bushing for damage or scoring.
5. Inspect thrust washer, front internal gear to selective washer for scoring or damage.
6. Install thrust washer on front internal gear and retain with petrolatum (Fig. 7A-92A).
7. Install front internal gear and thrust washer.

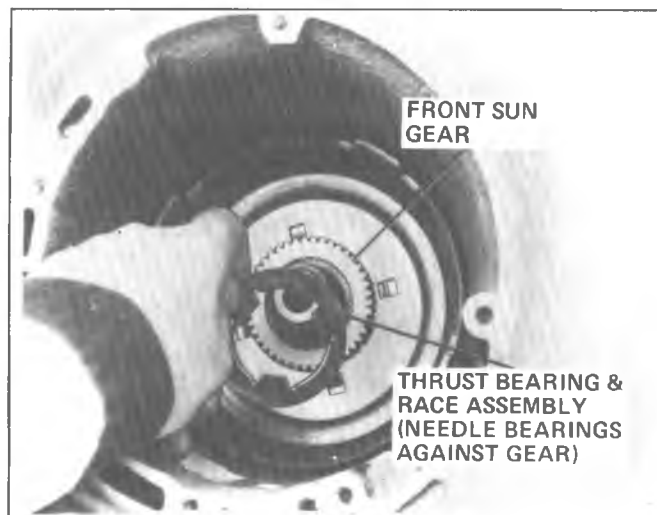


Fig. 7A-89A--Installing Thrust Bearing Assembly Against Front Sun Gear

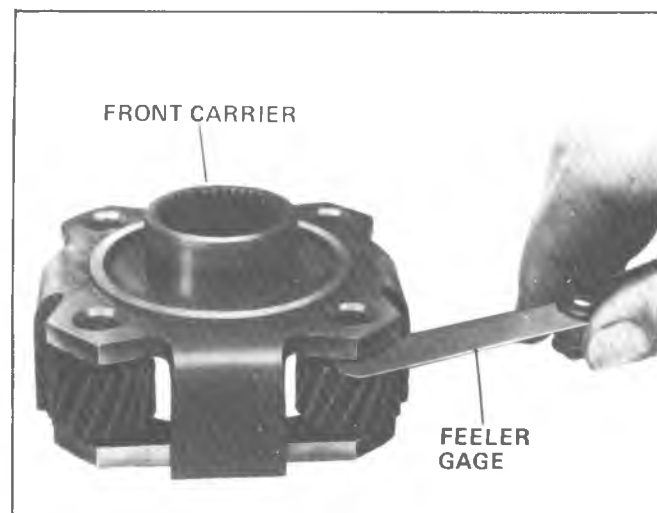


Fig. 7A-90A--Checking Front Carrier Pinion End Play

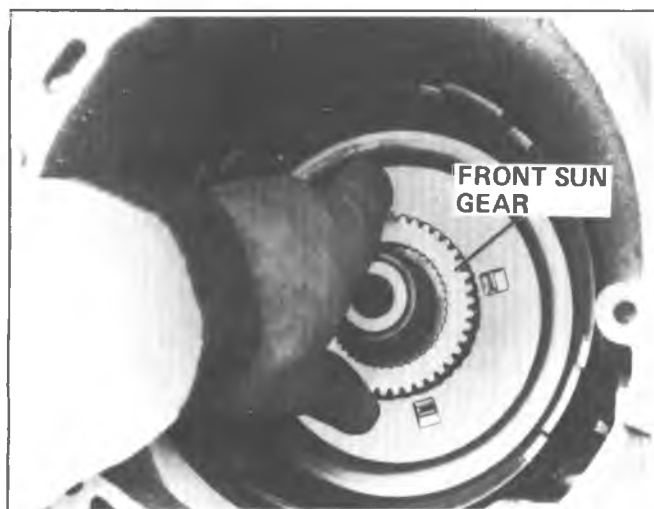


Fig. 7A-88A--Installing Front Sun Gear



Fig. 7A-91A--Installing Thrust Bearing Assembly Onto Front Carrier



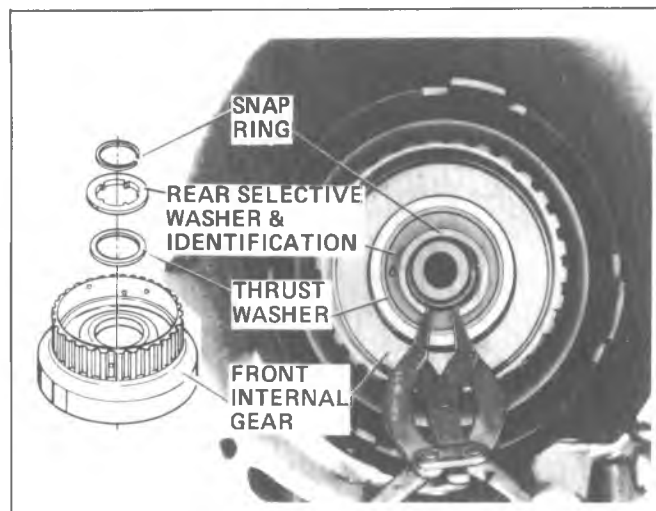


Fig. 7A-92A--Installing Output Shaft to Selective Washer Snap Ring

### Rear Selective Thrust Washer

1. Inspect selective washer for scoring or damage (Fig. 7A-92A).

**CAUTION:** The rear selective thrust washer must be installed with the identification number toward the front of the transmission.

2. Install rear selective washer.

3. Inspect output shaft to selective thrust washer snap ring for damage or distortion.

**NOTE:** It may be necessary to move output shaft upward by turning the adjusting screw on J-25013-5 to install output shaft to selective washer snap ring.

4. Install snap ring on output shaft (Fig. 7A-92A).

**CAUTION:** Make sure snap ring is fully seated in output shaft groove.

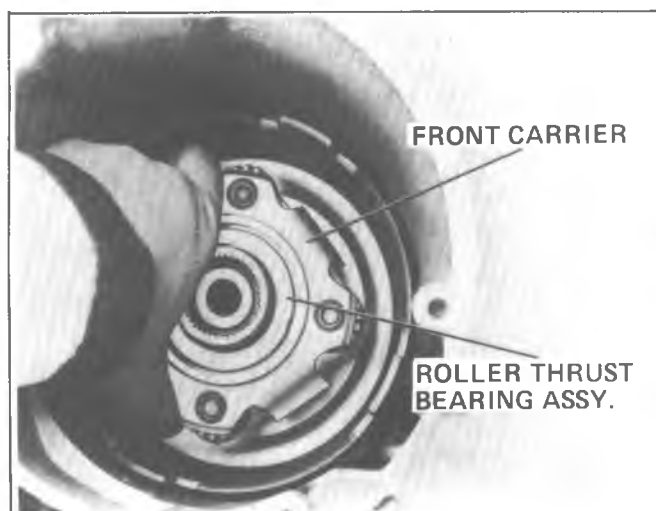


Fig. 7A-93A--Installing Front Carrier and Roller Thrust Bearing

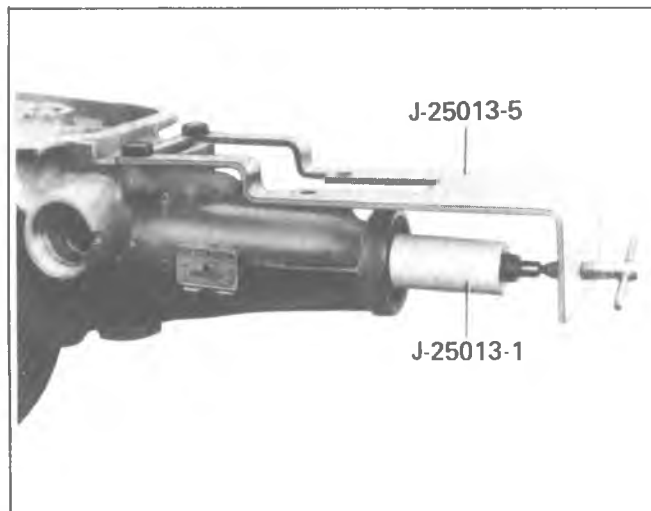


Fig. 7A-94A--Installing Tools on Rear End of Case

### Check Rear Unit End Play

1. Loosen J-25013-5 adjusting screw on output shaft and push output shaft downward (Fig. 7A-94A).

**CAUTION:** Do not install clamp assembly on any machined case surfaces.

2. Install gauge clamp on case as shown in Fig. 7A-95A.

3. Install dial indicator J-8001 and plunger extension J-7057. Position extension against end of output shaft. Set dial indicator to zero (Fig. 7A-95A).

4. Move output shaft upward by turning the adjusting screw on J-25013-5 until the white or scribed line on sleeve J-25013-1 begins to disappear (Fig. 7A-94A) and read end play. Rear unit end play should be 0.10-0.64mm (.004"-.025").

**NOTE:** Selective washer controlling this end play is located between the front internal gear thrust washer and output shaft snap ring. If more or less washer

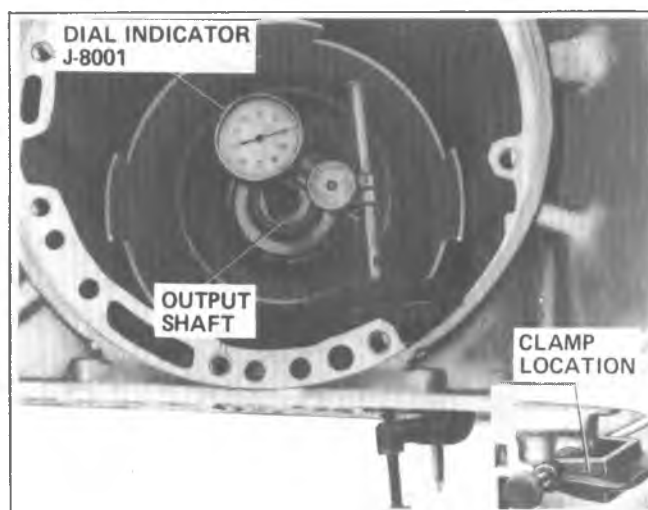


Fig. 7A-95A--Checking Rear Unit End Play



REAR UNIT END PLAY CHART

THICKNESS			IDENTIFICATION
			Number and/or Color
2.90 - 3.01mm	(0.114"-0.119")		1 Orange
3.08 - 3.19mm	(0.121"-0.126")		2 White
3.26 - 3.37mm	(0.128"-0.133")		3 Yellow
3.44 - 3.55mm	(0.135"-0.140")		4 Blue
3.62 - 3.73mm	(0.143"-0.147")		5 Red
3.80 - 3.91mm	(0.150"-0.154")		6 Brown
3.98 - 4.09mm	(0.157"-0.161")		7 Green
4.16 - 4.27mm	(0.164"-0.168")		8 Black
4.34 - 4.45mm	(0.171"-0.175")		9 Purple

Fig. 7A-96A--Rear Unit End Play Washer Thickness Chart

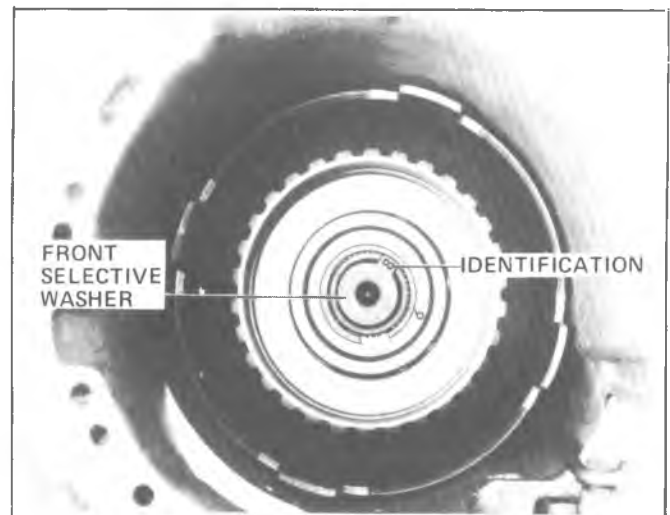


Fig. 7A-97A--Location of Front Selective Washer

thickness is required to bring end play within specifications, select proper washer from the chart shown in Figure 7A-96A.

5. Remove dial indicator and clamp assembly (Fig. 7A-95A).

6. Loosen J-25013-5 adjusting screw on output shaft.

7. Inspect output shaft to turbine shaft front selective thrust washer for damage or scoring.

8. Install output shaft to turbine shaft, front selective thrust washer, locating in output shaft and retain with petrolatum (Fig. 7A-97A).

## FRONT UNIT PARTS

### Direct Clutch Housing Assembly (Fig. 7A-98A)

1. Remove snap ring (Fig. 7A-99A).

2. Remove the clutch backing plate from the direct clutch housing.

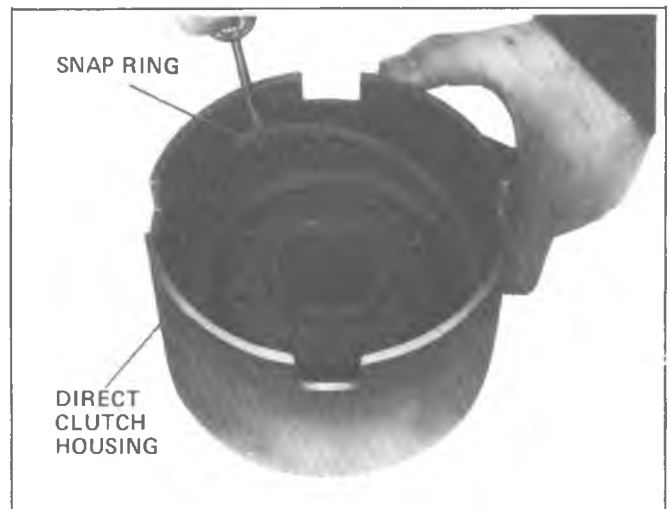


Fig. 7A-99A--Removing or Installing Direct Clutch Snap Ring

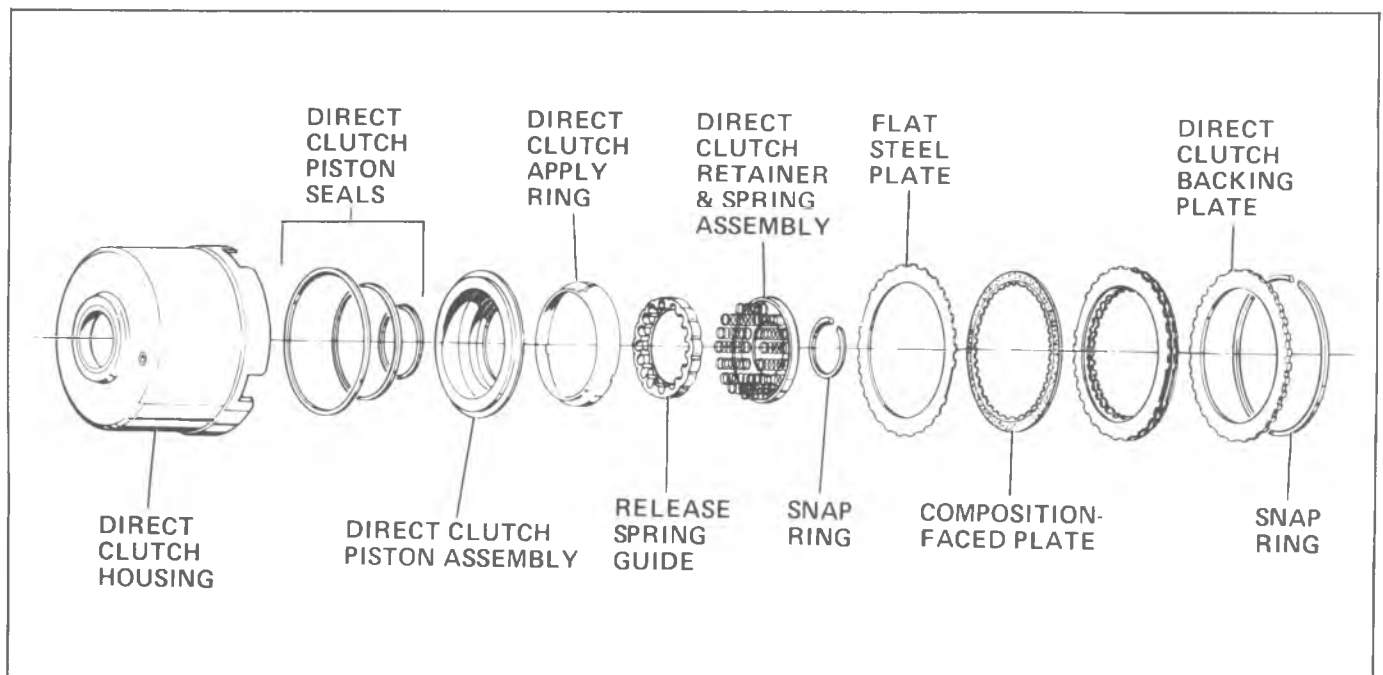


Fig. 7A-98A--Direct Clutch Assembly - Exploded

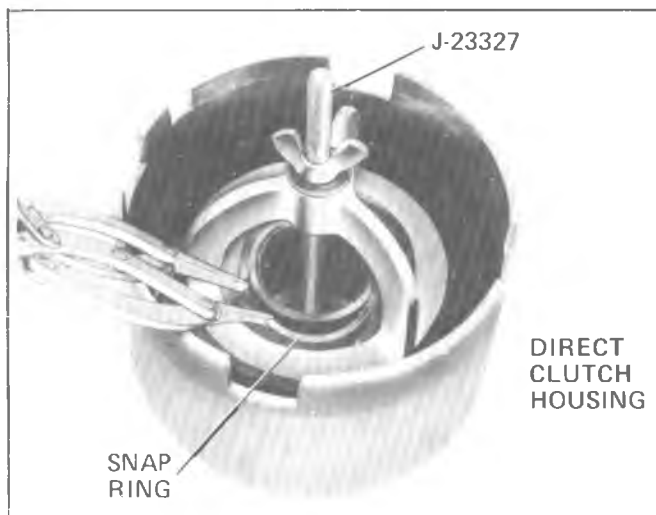


Fig. 7A-100A--Removing or Installing Direct Clutch Inner Snap Ring

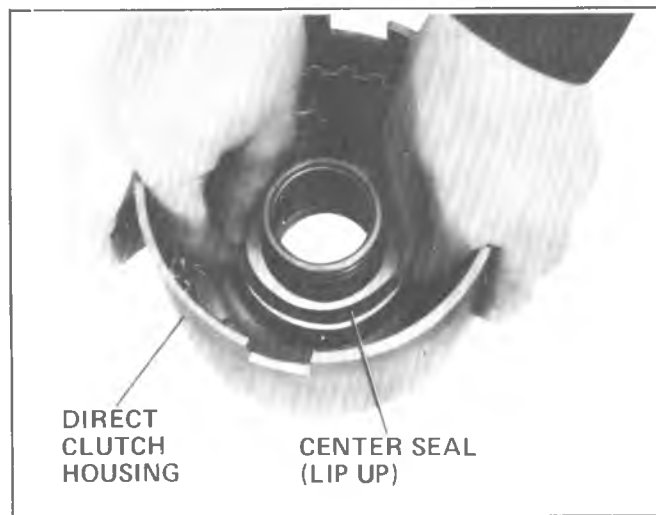


Fig. 7A-103A--Removing or Installing Center Seal of Direct Clutch Housing

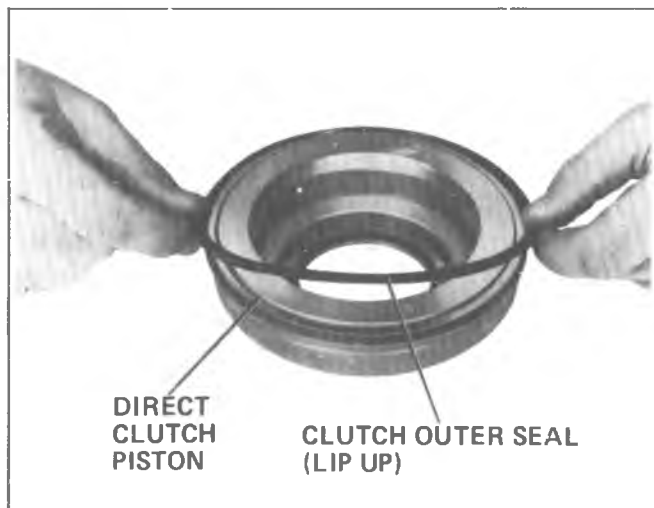


Fig. 7A-101A--Removing Direct Clutch Piston Outer Seal

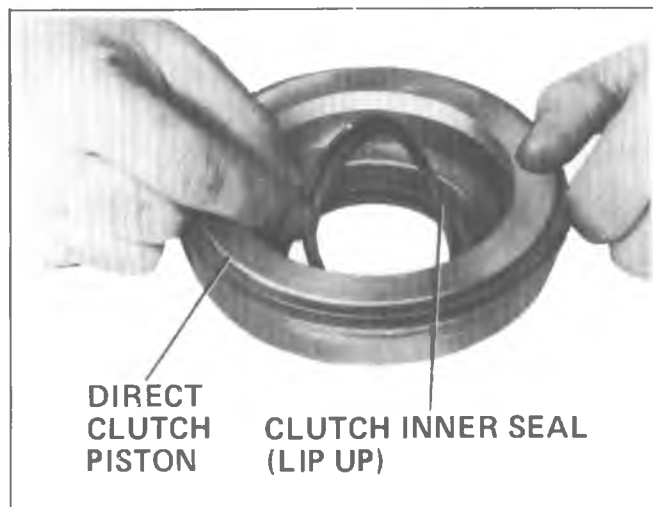


Fig. 7A-102A--Removing Direct Clutch Piston Inner Seal

3. Remove the clutch plates from the direct clutch housing and keep them separated from the forward clutch plates. (See Clutch Plate Usage Chart, Fig. 7A-82A).

4. Inspect composition-faced plates and steel clutch plates for wear or burning.

5. Inspect clutch backing plate for scoring or other damage.

6. Using J-23327, compress retainer and spring assembly (Fig. 7A-100A), remove snap ring and inspect for damage distortion.

7. Remove J-23327.

8. Remove retainer and spring assembly from housing.

9. Inspect release spring retainer for being collapsed.

10. Inspect release springs for being collapsed.

11. Remove release spring guide and inspect for damage.

12. Remove direct clutch piston.

13. Remove outer and inner seals from direct clutch piston and discard (Figs. 7A-101A and 7A-102A).

14. Do not remove the clutch apply ring from the piston unless the piston or apply ring requires replacement.

**NOTE:** The apply ring is identified as shown in Fig. 7A-82A.

15. Inspect direct clutch piston assembly for distortion, cracks, damage and check ball for free operation.

16. Remove center seal from direct clutch housing and discard (Fig. 7A-103A).

17. Inspect direct clutch housing for cracks, wear and open oil passages.

18. Check for free operation of check ball.

19. Inspect direct clutch housing snap ring grooves for damage.

20. Inspect direct clutch bushings for damage or scoring.

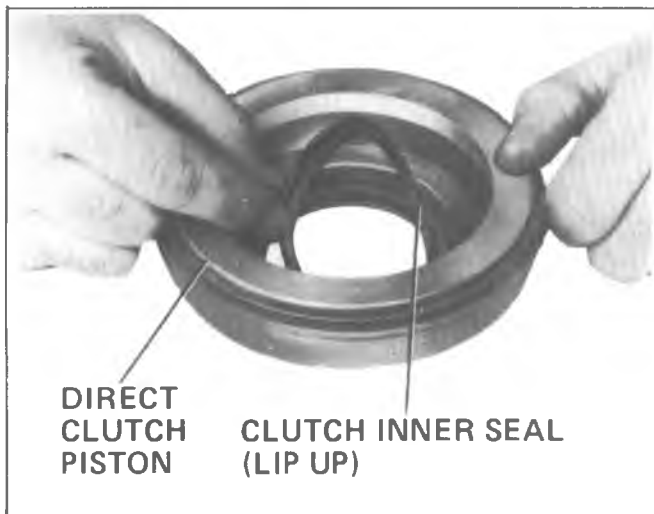


Fig. 7A-104A--Installing Direct Clutch Piston Inner Seal

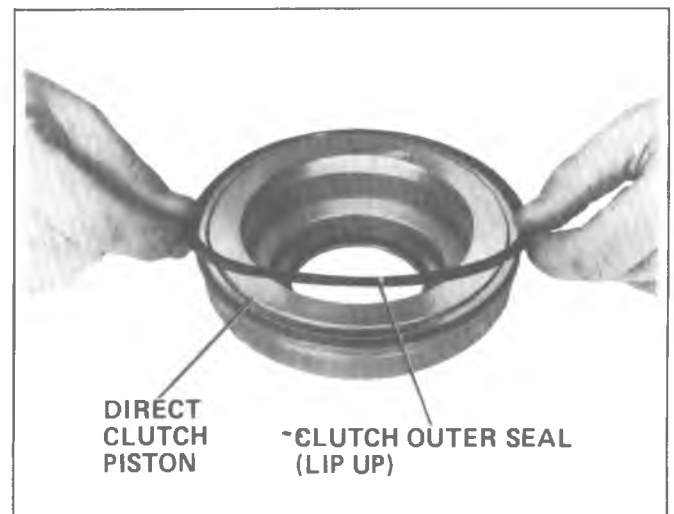


Fig. 7A-105A--Installing Direct Clutch Piston Outer Seal

### Reassembly

1. Install clutch apply ring on piston.
2. Install new inner and outer seals on piston with lips facing away from clutch apply ring side (Figs. 7A-104A and 7A-105A).
3. Install new center seal on direct clutch housing with lip facing up.
4. Install seal protector J-25010 (Fig. 7A-105A).

**CAUTION:** Use extreme care when installing direct clutch piston past larger direct clutch snap ring groove. Groove could cut outer seal on piston.

5. Oil seals and install direct clutch piston (Fig. 7A-106A).

**NOTE:** To make the piston easier to install, insert tool between seal and housing; rotate tool around the housing to compress the lip of the seal, while pushing down slightly on the piston. See Fig. 7A-107A.

6. Remove seal protector J-25010.
7. Install release spring guide with the omitted rib over

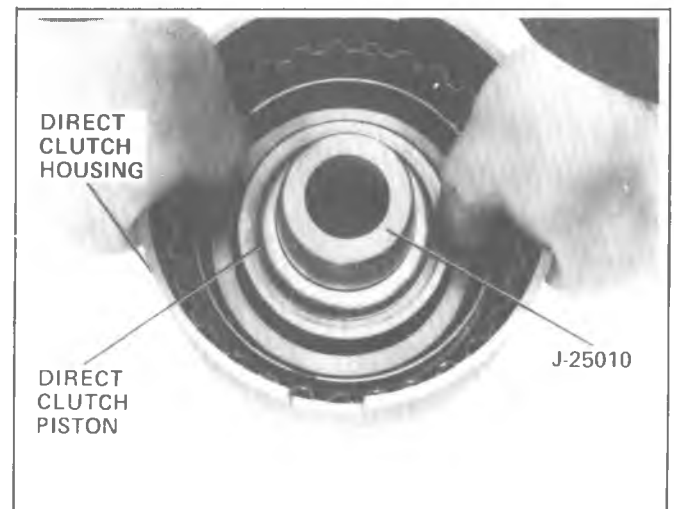


Fig. 7A-106A--Installing Direct Clutch Piston

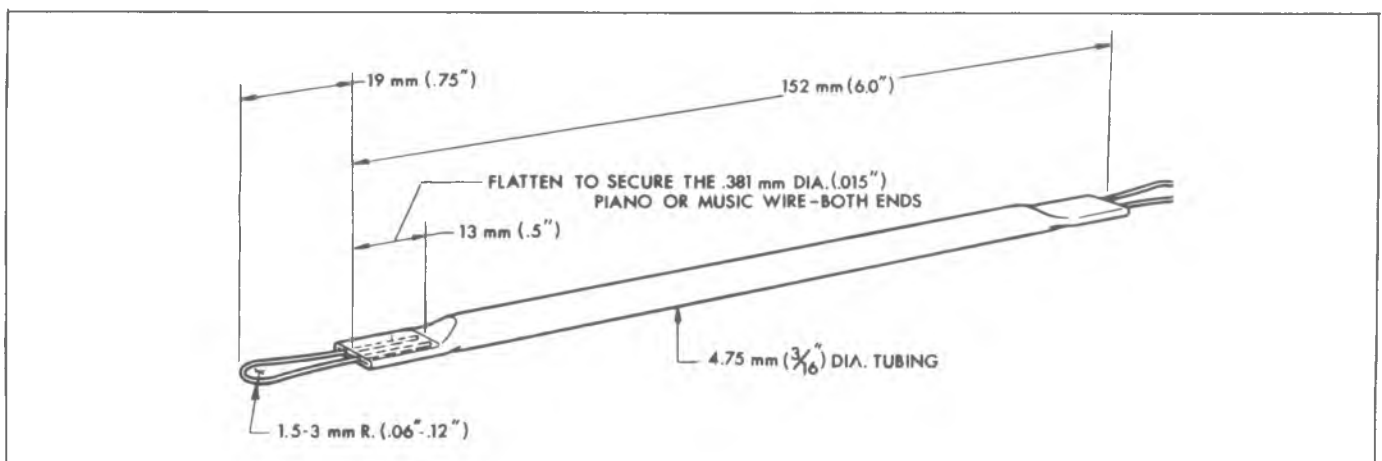


Fig. 7A-107A--Piston Installing Tool

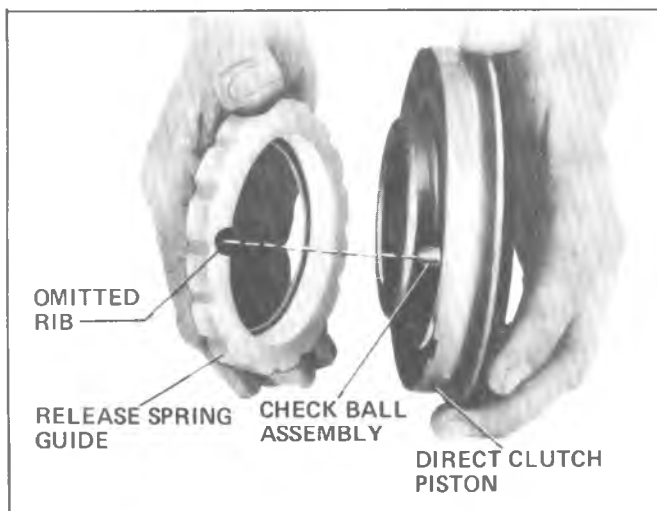


Fig. 7A-108A--Installing Release Spring Guide

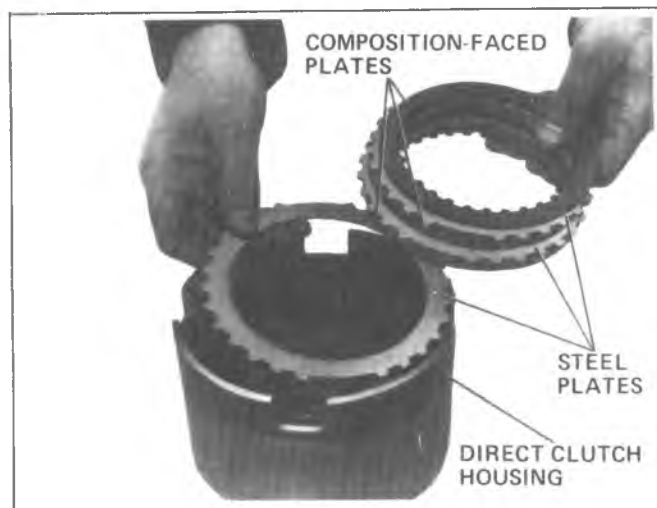


Fig. 7A-109A--Installing Clutch Plates into Direct Clutch Housing

the check ball in the piston, as shown in Fig. 7A-108A.

8. Install retainer and spring assembly.

**NOTE:** Models BR, CX, PA and PY use a direct clutch retainer and spring assembly which contains (16) release springs. All other models use a retainer and spring assembly with (10) release springs.

**CAUTION:** Retainer could locate in snap ring groove and forcing retainer to compress springs, could damage retainer plate when installing.

9. Using J-23327 tool, compress retainer and spring assembly past the snap ring groove. Install the snap ring (Fig. 7A-100A). An arbor press and J-23327-1 can be used to compress the retainer and spring assembly.

10. Remove J-23327-1 and/or J-6129.

11. Oil and install the direct clutch plates into the direct clutch housing, starting with a flat steel and alternating composition-faced and flat steel clutch plates. (See Figs. 7A-109A and Fig. 7A-82A).

12. Install backing plate, chamfered side up.

13. Install snap ring (Fig. 7A-99A).

**NOTE:** Make sure composition clutch plates turn freely.

14. Set direct clutch assembly aside.

### Forward Clutch Housing Assembly (Fig. 7A-110A)

#### Inspection

1. Inspect teflon oil seals on turbine shaft for damage and free fit in grooves. Do not remove unless replacing.

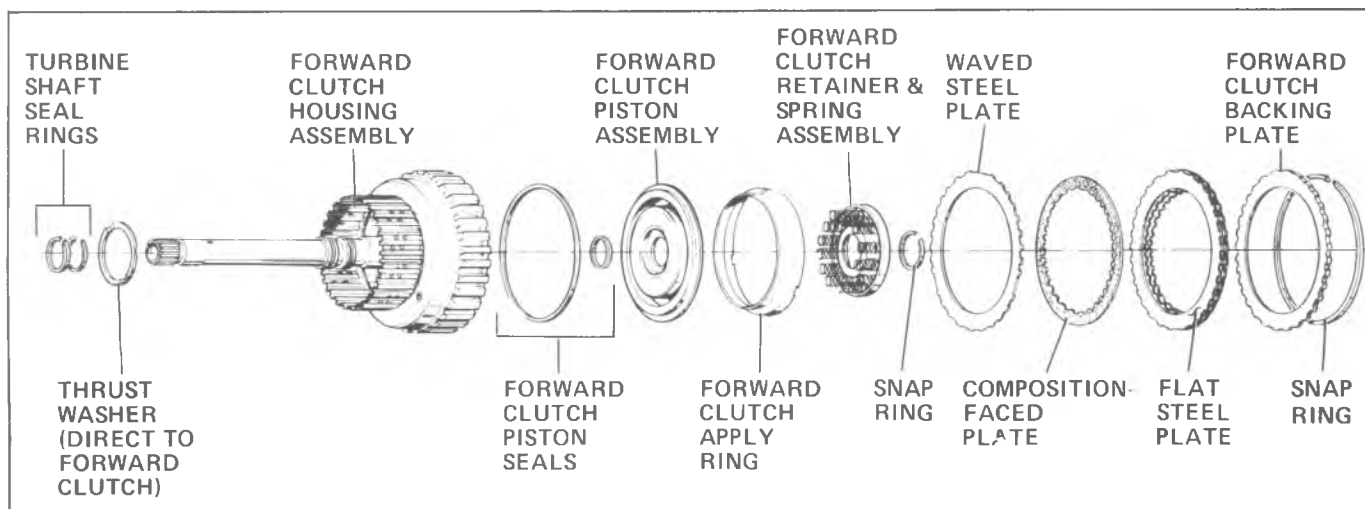


Fig. 7A-110A--Forward Clutch Assembly - Exploded View

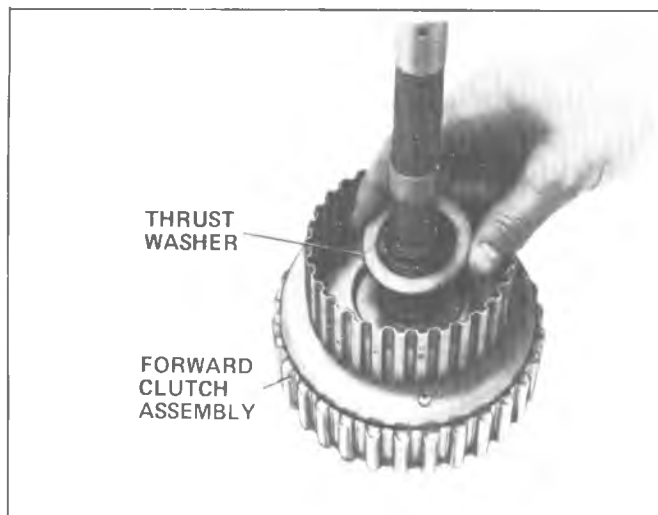


Fig. 7A-111A--Removing or Installing Forward Clutch to Direct Clutch Thrust Washer

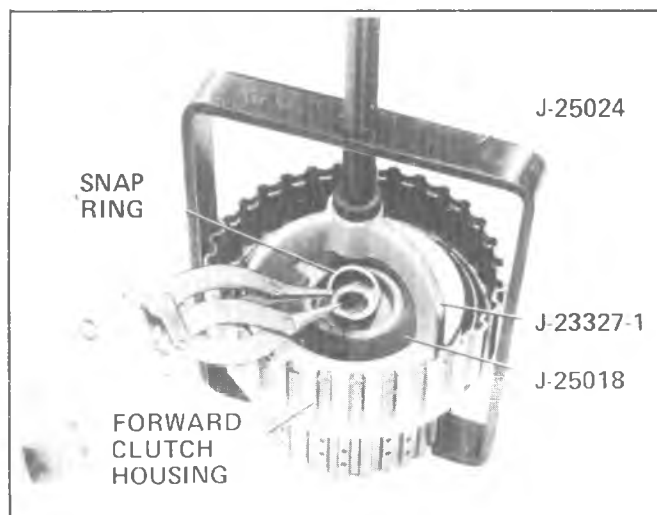


Fig. 7A-113A--Removing or Installing Forward Clutch Release Spring Snap Ring

2. Remove and inspect forward clutch to direct clutch thrust washer for damage (Fig. 7A-111A).
3. Place forward clutch down with turbine shaft through hole in work bench.
4. Remove snap ring and inspect for damage (Fig. 7A-112A).
5. Remove backing plate from the forward clutch housing.
6. Remove the clutch plates from the forward clutch housing and keep them separated from the direct clutch plates. (See Clutch Plate Usage Chart Fig. 7A-82A).
7. Inspect composition-faced and steel clutch plates for signs of wear or burning.
8. Inspect backing plate for scratches or damage.
9. Using tools J-25018, -25024 and J-23327, compress retainer and spring assembly and remove snap ring (Fig. 7A-113A). An arbor press and tools J-25018 and J-23327-1 can be used to compress the retainer and spring assembly.
10. Remove J-23327-1, J-25024 and J-25018.
11. Remove retainer and spring assembly from housing.

12. Inspect release spring retainer for distortion.
13. Inspect release springs for being collapsed.
14. Remove forward clutch piston.
15. Remove forward clutch outer and inner piston seals and discard (Figs. 7A-114A and 7A-115A).



Fig. 7A-114A--Removing or Installing Outer Piston Seal

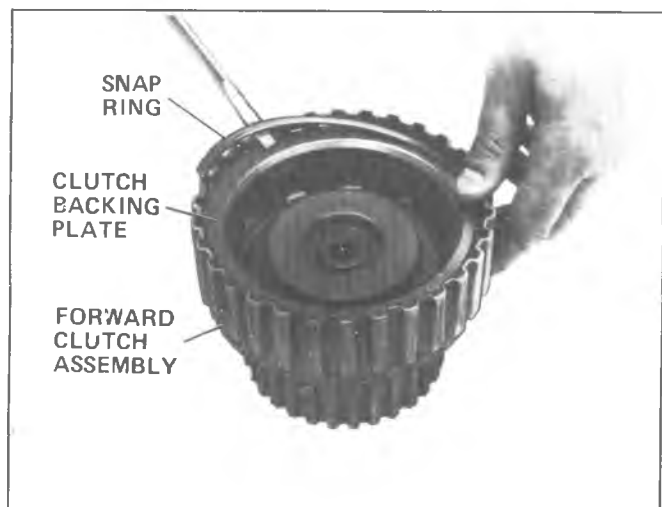


Fig. 7A-112A--Removing or Installing Snap Ring from Forward Clutch Housing



Fig. 7A-115A--Removing or Installing Inner Piston Seal

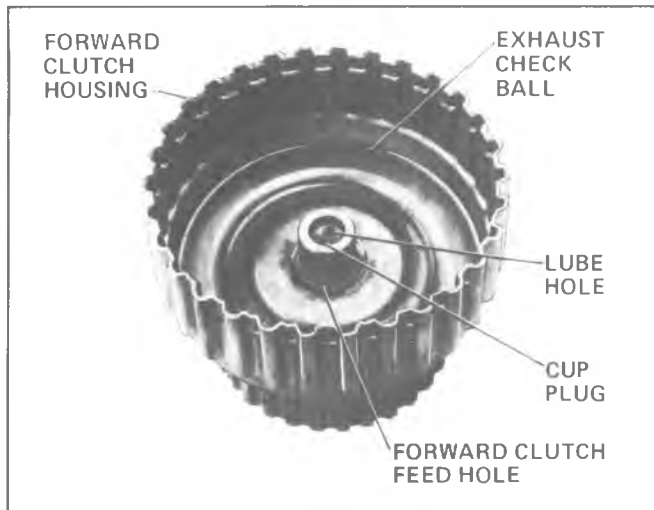


Fig. 7A-116A--Forward Clutch Housing

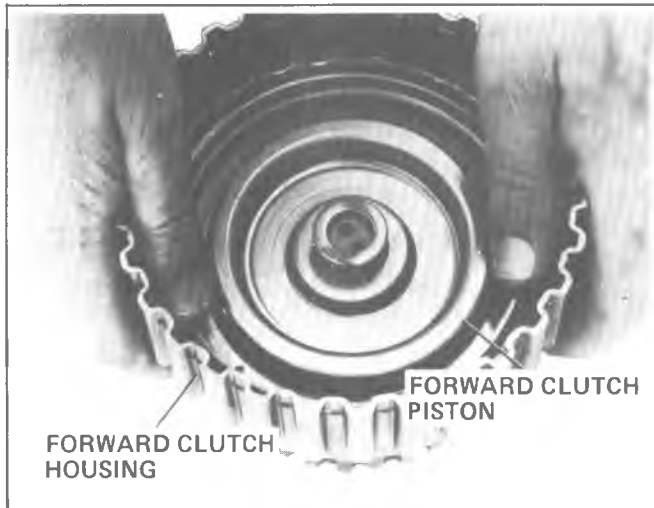


Fig. 7A-117A--Installing Forward Clutch Piston

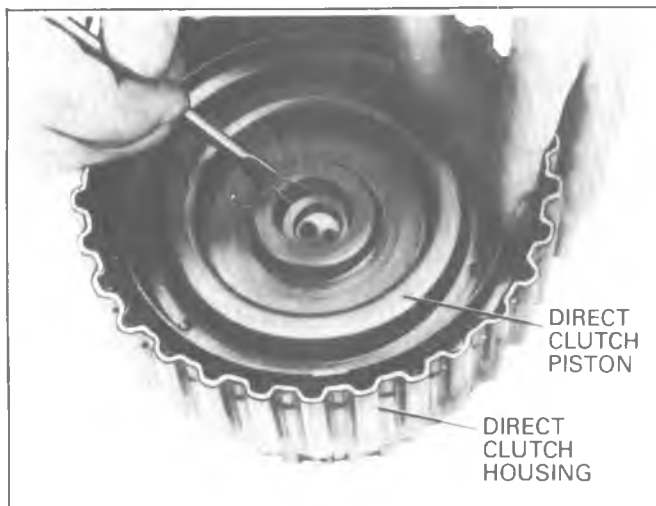


Fig. 7A-118A--Installing Forward Clutch Piston

16. Do not remove the clutch apply ring from the piston unless the piston or apply ring requires replacement.

17. Inspect the forward clutch piston and clutch apply ring assembly for cracks or damage.

**NOTE:** The apply ring is identified as shown in Fig. 7A-82A.

18. Inspect forward clutch housing for cracks, opened oil passages or other damage (Fig. 7A-116A).

19. Check for free operation of check ball.

20. Inspect forward clutch housing snap ring groove for damage or burrs.

21. Inspect turbine shaft for open oil passages on both ends of shaft and journals for damage.

22. Inspect cup plug for damage. If cup plug is damaged or missing, proceed as follows:

- Use 4mm (No. 3) easy out (grind to fit) and remove cup plug.
- Install new cup plug to 1.0mm (.039") below surface.

### Reassembly

- Install clutch apply ring on piston.
- Install new outer and inner seals on piston with lips facing away from clutch apply ring side (Figs. 7A-114A and 7A-115A).

**CAUTION:** Use extreme care when installing forward clutch piston past large forward clutch snap ring groove. Groove could cut outer seal on piston.

3. Lubricate seals and install forward clutch piston (Fig. 7A-117A).

**NOTE:** To make the piston easier to install, insert tool between the inner seal and shaft; rotate tool around the shaft to compress the lip of the seal, while pushing down slightly on the piston. Use the same procedure between the outer seal and the housing. Refer to Figs. 7A-117A and 7A-118A.

4. Install retainer and spring assembly.

**CAUTION:** Retainer could locate in snap ring groove and forcing retainer to compress springs, could damage retainer plate.

5. Using J-23327-1, J-25024 and J-25018 adaptor, compress retainer past the snap ring groove, and install snap ring (Fig. 7A-113A).

**NOTE:** An arbor press and J-23327-1 and J-25018 can be used to compress the retainer and spring assembly.

6. Remove J-23327-1 and J-25018.

7. Oil and install the forward clutch plates into the forward clutch housing, starting with the waved steel plate



Fig. 7A-119A--Installing Clutch Plates Into Forward Clutch Housing

and alternating composition- faced and flat steel clutch plates. (See Fig. 7A-119A, and Clutch Plate Usage Chart Fig. 7A-82A).

8. Install backing plate, chamfered side up.
9. Install snap ring (Fig. 7A-112A).

**NOTE:** Make sure composition clutch plates turn freely.

10. Install forward to direct clutch thrust washer and retain with petrolatum (Fig. 7A-111A).

11. If removed, install new turbine shaft seal rings, making sure cut ends are assembled in the same relationship as cut and rings are seated in their groove. Retain with petrolatum. (See Fig. 7A-120A for correct way to position cut ends.)

### Intermediate Band Assembly

1. Inspect band for burning, flaking or damage.

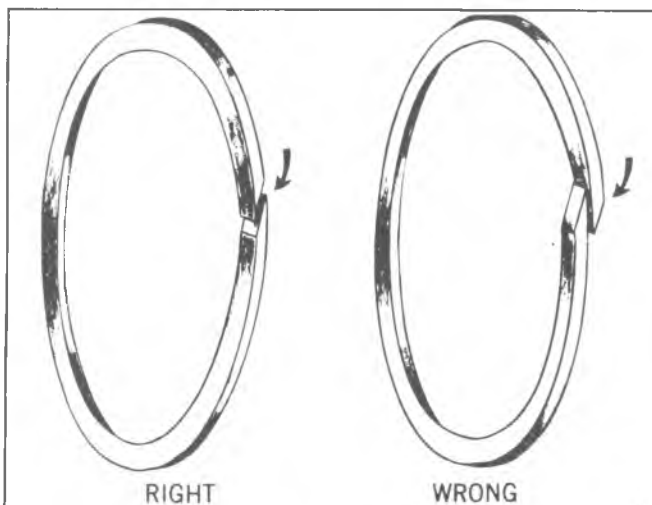


Fig. 7A-120A--Teflon Oil Seal Rings

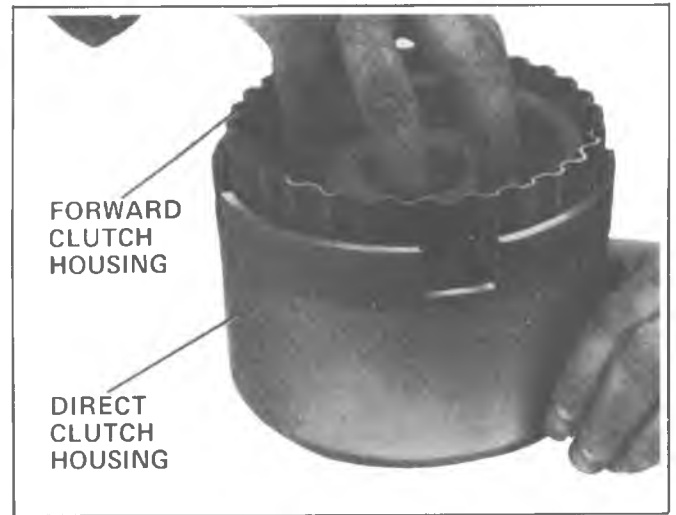


Fig. 7A-121A--Installing Forward Clutch Assembly

2. Install intermediate band, locating band apply lug and anchor pin lug in case slots (Fig. 7A-125A).

### Forward and Direct Clutch

#### Installation

1. Position direct clutch assembly, clutch plate end up, over hole in bench.

**NOTE:** Align direct clutch composition-faced clutch plate teeth one above the other to make the forward clutch assembly easier to install.

2. Install forward clutch assembly into direct clutch. Hold direct clutch housing and rotate forward clutch back and forth until the forward clutch is seated (Fig. 7A-121A).

**NOTE:** When the forward clutch is seated, it will be approximately 15.8mm (5/8") from the tang end of the direct clutch housing to the end of the forward clutch drum, Fig. 7A-122A.

3. Grasp direct and forward clutch assemblies to prevent their separation and position on bench, with the turbine shaft up.

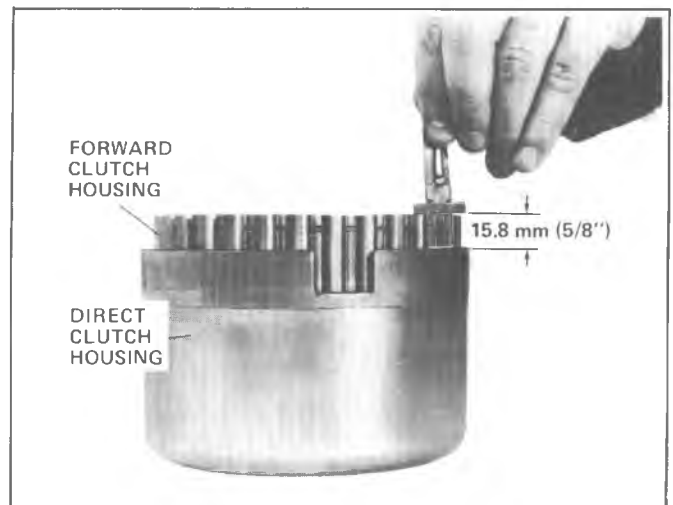


Fig. 7A-122A--Forward Clutch Properly Seated in Direct Clutch





Fig. 7A-123A--Installing Direct and Forward Clutch Assemblies

4. Install J-25021 as shown in Fig. 7A-123A.
5. Install direct and forward clutch assemblies, using J-25021, and rotate into position (Fig. 7A-123A).



Fig. 7A-124A--Direct and Forward Clutch Assemblies Properly Installed

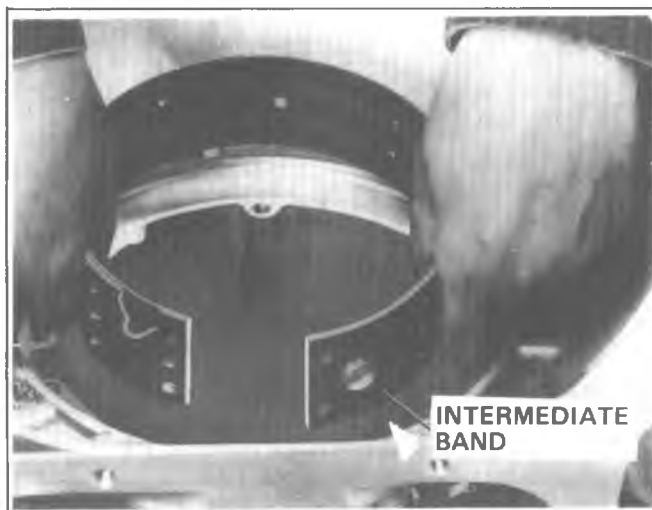


Fig. 7A-125A--Installing Intermediate Band Assembly

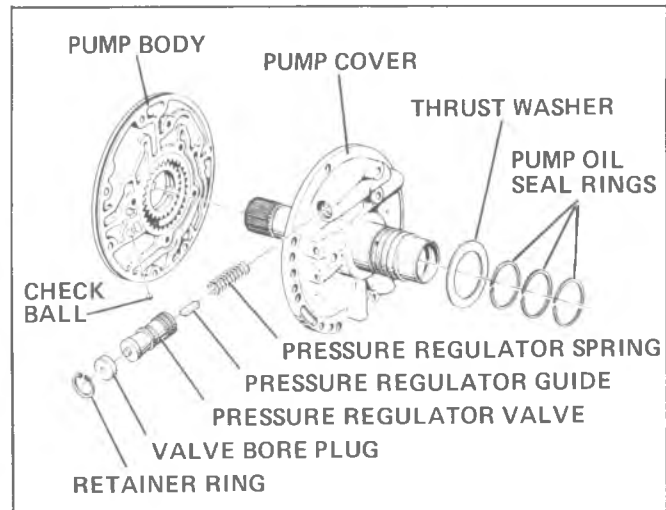


Fig. 7A-126A--Pump Assembly - Exploded View

**NOTE:** The direct clutch housing will be approximately 33.34mm (1-5/16'') from the pump face in case when correctly seated. See Fig. 7A-124A.

6. Remove J-25021.

### Pump Assembly (Fig. 7A-126A)

#### Inspection

1. Remove pump to case seal ring and inspect groove for damage.
2. Place pump over hole in bench with pump cover side up.
3. Remove pump to direct clutch thrust washer and inspect for damage or wear (Fig. 7A-127A).
4. Inspect 3 teflon oil ring seals for damage and free fit in grooves. Do not remove unless replacing.

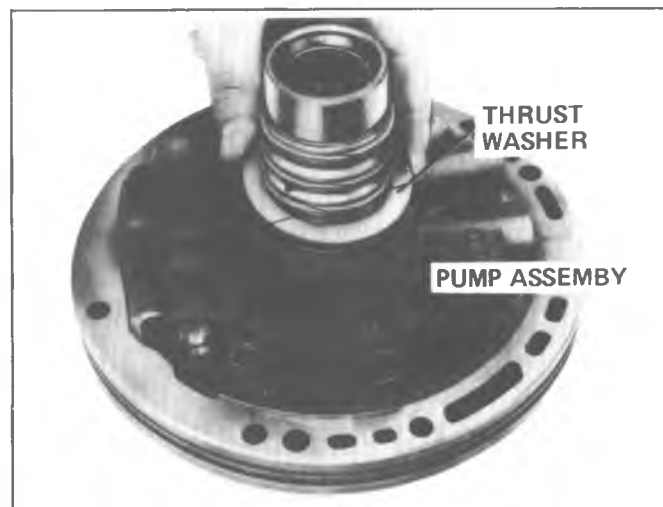


Fig. 7A-127A--Removing or Installing Thrust Washer from Pump



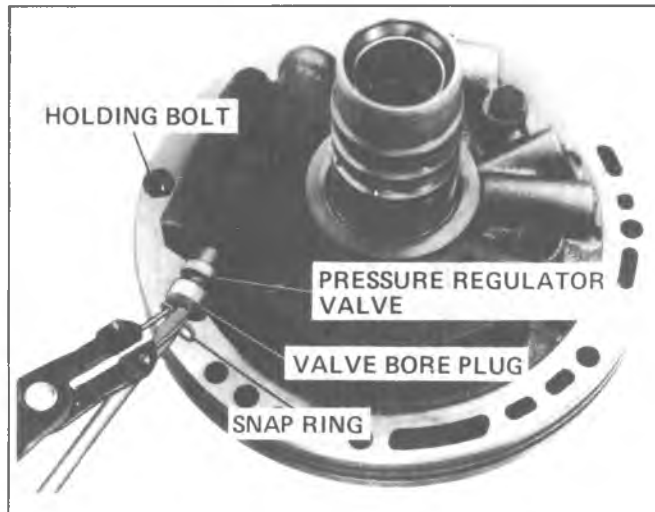


Fig. 7A-128A Removing or Installing Pressure Regulator Valve

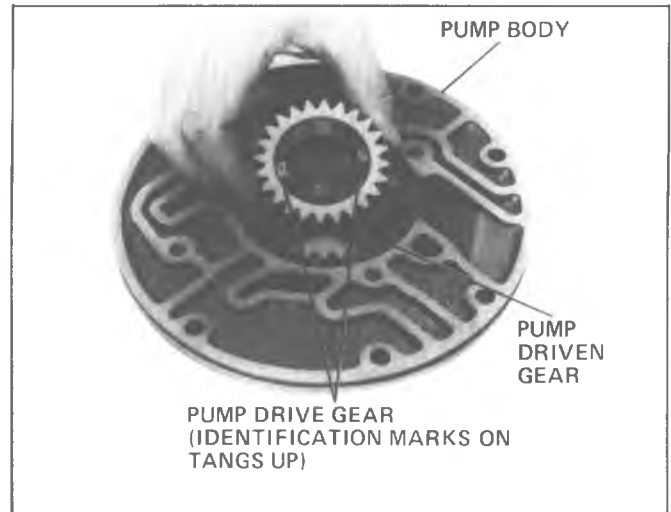


Fig. 7A-129A--Removing Pump Drive Gear

## Pressure Regulator

### Inspection

1. To prevent the pump from turning while removing the pressure regulator valve, place a bolt or screwdriver through a hole in the pump and bench (Fig. 7A-128A).
2. Using small screwdriver, push on bore plug, compressing pressure regulator spring; and using snap ring pliers, remove retaining ring (Fig. 7A-128A).
3. Release valve spring tension slowly and remove valve train.
4. Inspect pressure regulator valve for nicks or damage.
5. Inspect spring and guide for damage or distortion.
6. Inspect pressure regulator valve for free operation in bore.

**CAUTION:** Do not drop the check ball that is in the pump, as the pump body and pump cover are separated.

7. Remove pump cover to pump body attaching bolts and separate pump cover from pump body.

## Pump Body

### Inspection

1. Remove the 7.14mm (.281") check ball from the pump body or pump cover and keep it separated from the five 6.35mm (.250) check balls used in the case and control valve assembly.
  2. Remove drive gear and driven gear from pump body (Fig. 7A-129A).
  3. Inspect drive and driven gears for scoring, galling or damage.
- NOTE:** Driven gear identification marks should have been against the pump body gear pocket. (See Fig. 7A-133A for identification.) The drive gear has 1 identification mark on each drive tang (Fig. 7A-129A). This side should be facing away from the pump body gear pocket.
4. Inspect drive and driven gear pocket and crescent for scoring or damage.
  5. Inspect pump body face for nicks and overall flatness.
  6. Inspect for open oil passages (Fig. 7A-130A).

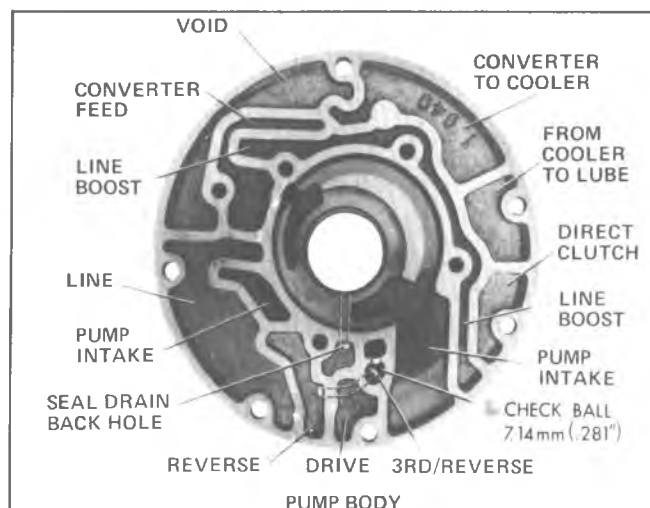


Fig. 7A-130A--Pump Body Assembly

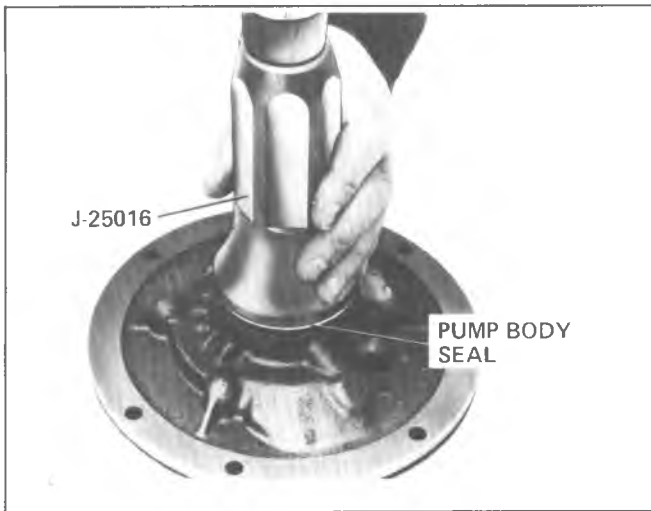


Fig. 7A-131A--Installing Seal Into Pump Body

7. Inspect for damaged bolt hole threads.
8. Inspect for open drainback hole.
9. Inspect bushing for scores or nicks.
10. If removed, coat outside of seal body with non-hardening sealing compound; support pump body, oil seal side up, and using J-25016, install new pump body oil seal (Fig. 7A-131A).

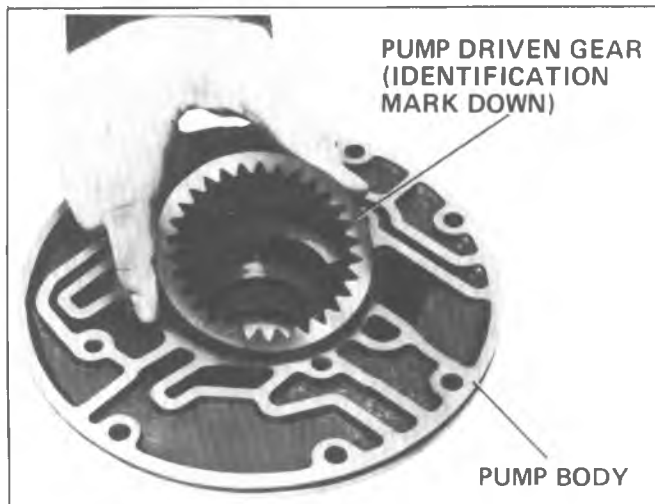


Fig. 7A-132A--Installing Pump Driven Gear

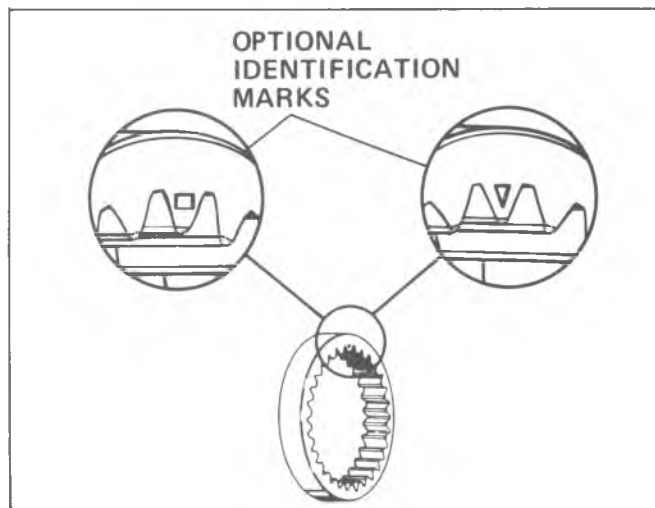


Fig. 7A-133A--Pump Driven Gear Identification



Fig. 7A-134A--Checking Pump Body-to-Gear End Clearance

11. Install driven pump gear with identification mark down against gear pocket of pump body (Figs. 7A-132A and 7A-133A).

12. Install drive gear with identification marks on drive tangs up (Fig. 7A-129A).

13. Pump body face to gear face clearance should be 0.020-0.055mm (.0007"-.0021") (Fig. 7A-134A).

14. Place the check ball into the check ball pocket in the pump body and retain it with petrolatum. (See Fig. 7A-130A for ball location).

## Pump Cover

### Inspection

1. Inspect for open oil passages (Figs. 7A-135A and 7A-136A).

2. Inspect seven (7) cup plugs. If a plug is missing, drive a new cup plug to .79mm (1/32") below top of hole, using a 7.14mm (9/32") diameter rod on the smaller plugs and a 7.92mm (5/16") diameter rod on the larger plugs. Stake top of hole two places, directly opposite each other, to retain plug.

3. Inspect pump cover face for nicks and overall flatness.

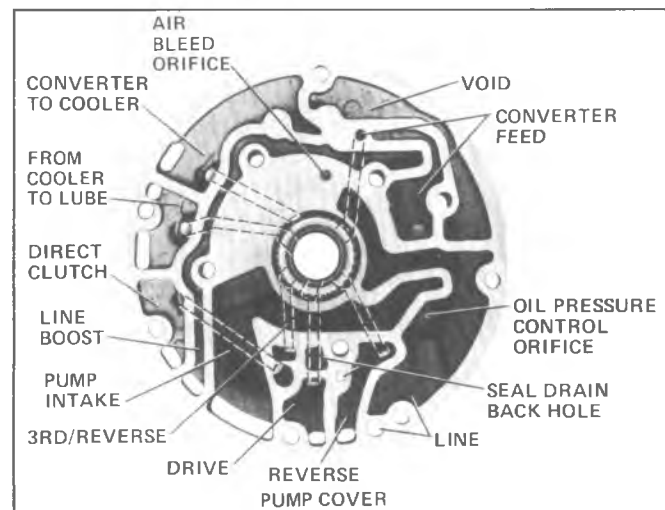


Fig. 7A-135A--Pump Cover Assembly

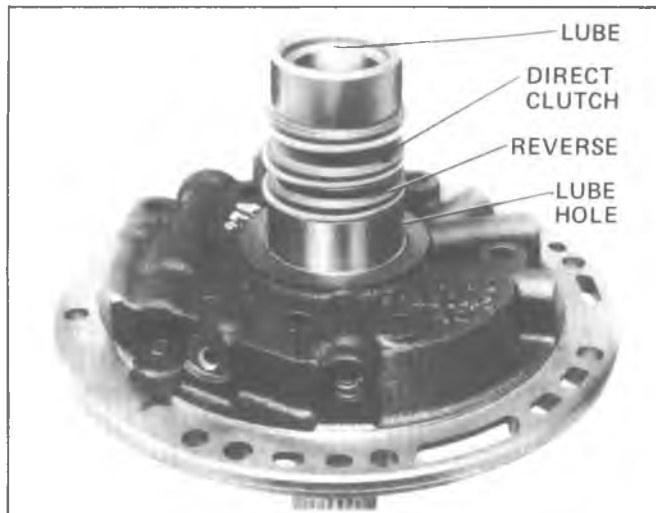


Fig. 7A-136A--Pump Cover Oil Passages



Fig. 7A-138A--Installing Pump Assembly

4. Inspect for chips in pressure regulator bore.
5. Inspect stator shaft for damaged splines or damaged bushings.
6. Inspect orifice plug (see Fig. 7A-135A). If the plug requires replacement, place new plug, orifice end first, into plug hole from the rough casting side. Drive the plug flush to .25mm (.010") below top of hole, rough casting side. Stake the top of hole two places to retain the plug.

#### Reassembly

1. Place pump body over hole in bench.
2. Assemble pump cover to pump body with attaching bolts, finger tight.
3. Align pump cover and pump body using J-25015 (Fig. 7A-137A) and place bolt or screwdriver through pump to case bolt hole and bench.
4. Torque pump cover attaching bolts to 20.0-27.0 N·m (15-20 ft. lbs.).
5. Remove J-25015.
6. Install pressure regulator spring, guide, valve with stem end out, and bore plug, hole side out (Fig. 7A-126A).
7. Compress pressure regulator valve spring by pushing on bore plug with small screwdriver and install retaining ring (Fig. 7A-128A).

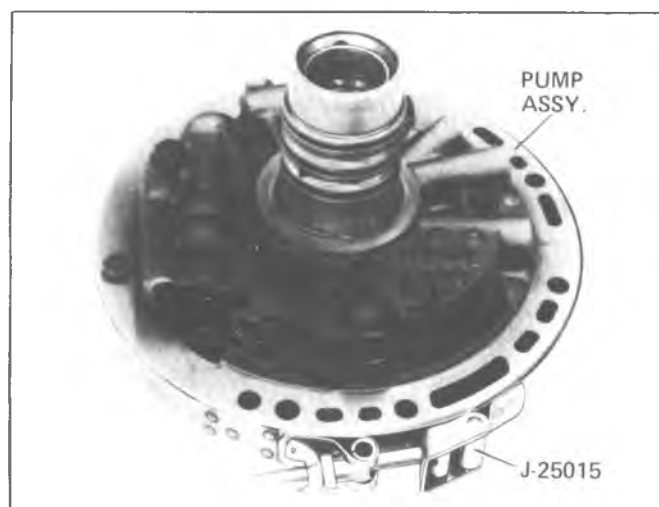


Fig. 7A-137A--Aligning Pump Cover and Pump Body

8. If removed, install 3 new oil seal rings, making sure cut ends are assembled in the same relationship as cut (Fig. 7A-120A). Also, make sure rings are seated in the grooves to prevent damage to the rings during reassembly of mating part over rings Retain with petrolatum.

9. Install pump to case seal ring, chamfered side out, making sure the ring is not twisted.
10. Install pump to direct clutch thrust washer and retain with petrolatum (Fig. 7A-127A).
11. Remove holding bolt or screwdriver.
12. Install new pump to case gasket on pump and retain with petrolatum.
13. Install 2 pump to case alignment pins in case as shown in Fig. 7A-138A.

**NOTE:** Before installing pump, make sure intermediate band anchor pin lug is aligned with band anchor pin hole in case.

14. Install pump assembly and finger start pump to case bolts and new washers, except one bolt hole (Fig. 7A-139A), which will be used to make the front unit end play check.

**NOTE:** If turbine shaft cannot be rotated as pump is being pulled into place, the forward or direct clutch



Fig. 7A-139A--Checking Front Unit End Play

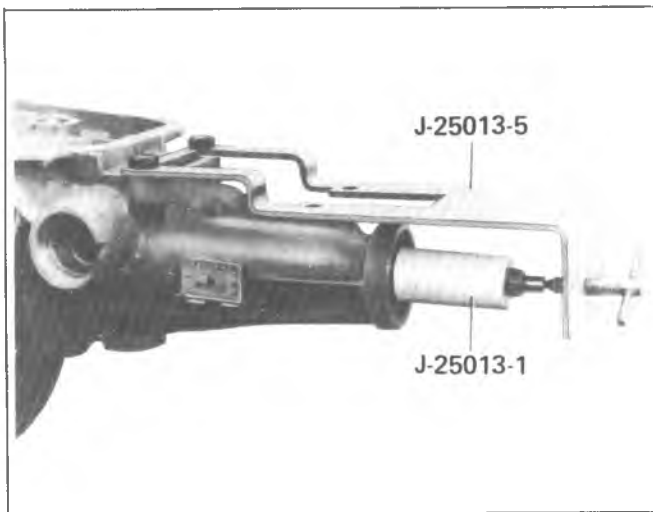


Fig. 7A-140A--Front Unit End Play Washer Thickness Chart

housings have not been installed properly to index with all the clutch plates. This condition must be corrected before pump is pulled fully into place.

15. Replace 2 alignment pins with 2 bolts and new washers.

16. Torque pump to case bolts to 20.0-27.0 N·m (15-20 ft. lbs.).

**NOTE:** Make sure turbine shaft rotates freely.

#### Check Front Unit End Play (Fig. 7A-139A)

1. Install 278mm (11") bolt and locking nut as shown in Fig. 7A-139A.

2. Push turbine shaft downward.

3. Install J-25022 on J-24773 tool and locate on end of turbine shaft (Fig. 7A-139A).

4. Mount dial indicator on bolt and position indicator point against cap nut of J-24773.

5. Move output shaft forward by turning the adjusting screw on J-25013-5 until the white or scribed line on sleeve J-25013-1 begins to disappear, then set dial indicator to zero.

6. Pull turbine shaft upward, and read end play. Front unit end play should be 0.56mm-1.30mm (.022"-.051").

FRONT UNIT END PLAY CHART		
THICKNESS	IDENTIFICATION	
	Number and/or Color	
1.66-1.77mm (0.065"-0.070")	1	
1.79-1.90mm (0.070"-0.075")	2	
1.92-2.03mm (0.076"-0.080")	3 - Black	
2.05-2.16mm (0.081"-0.085")	4 - Light Green	
2.18-2.29mm (0.086"-0.090")	5 - Scarlet	
2.31-2.42mm (0.091"-0.095")	6 - Purple	
2.44-2.55mm (0.096"-0.100")	7 - Cocoa Brown	
2.57-2.68mm (0.101"-0.106")	8 - Orange	
2.70-2.81mm (0.106"-0.111")	9 - Yellow	
2.83-2.94mm (0.111"-0.116")	10 - Light Blue	
2.96-3.07mm (0.117"-0.121")	11	
3.09-3.20mm (0.122"-0.126")	12	
3.22-3.33mm (0.127"-0.131")	13 - Pink	
3.35-3.46mm (0.132"-0.136")	14 - Green	
3.48-3.59mm (0.137"-0.141")	15 - Gray	

Fig. 7A-141A--Installing Tools on Rear End of Case

**NOTE:** Selective washer controlling this end play is located between the output shaft and turbine shaft. If more or less washer thickness is required to bring end play within specifications, select proper washer from Fig. 7A-140A.

7. Remove front unit end play checking tools.

8. Install remaining pump to case bolt and new washer, torquing bolt to 20.0-27.0 N·m (15-20 ft. lbs.).

9. Remove J-25013-5 and J-25013-1 from rear end of transmission (Fig. 7A-141A).

10. Turn transmission to horizontal position, oil pan side up.

## EXTERNAL PARTS

### Governor Assembly

#### Inspection

1. Inspect governor cover for damage, scored or worn bore, or plugged oil passage.

2. Wash in cleaning solvent and blow out oil passage.

3. Inspect governor driven gear for nicks or damage.

4. Inspect governor shaft seal ring for cuts, damage and free fit in groove.

5. Inspect for free operation of governor weights.

6. Inspect for damaged, mispositioned, or tilted springs. (Models BR and CX use one spring; all other models use two.)

7. Inspect for presence of 2 check balls.

8. Inspect shaft for damage.

9. Inspect governor washer for damage.

10. If damaged, cut seal ring off governor shaft.

**CAUTION:** Do not damage seal ring when removing seal.

#### Installation

1. If removed, install new seal ring on shaft and place seal ring end into governor cover to size seal; lubricate with petrolatum.

2. Lubricate with petrolatum and install 2 new seal rings on governor cover.

**CAUTION:** The governor cover seal rings must be well lubricated with petrolatum to prevent damage or cutting of the rings. Also, make sure 2 check balls are in the governor before installation.

3. Install governor assembly, seal ring end first, into cover.

**CAUTION:** Do not use any type of hammer to install governor assembly and cover into case. Damage to case, governor or cover could result.

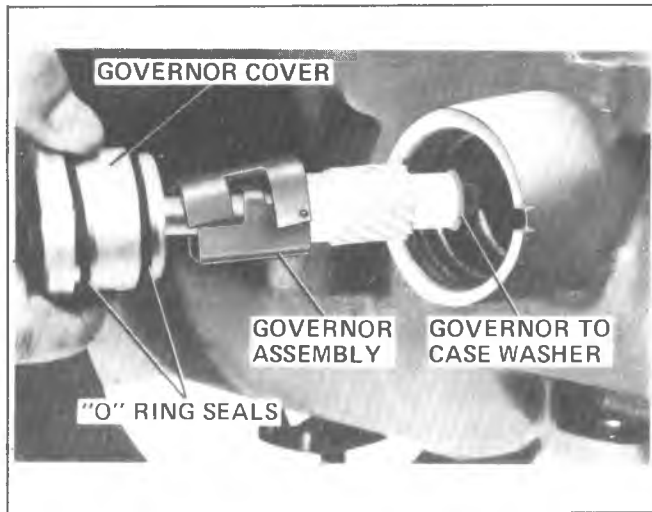


Fig. 7A-142A--Installing Governor and Cover Assembly

4. Install governor and cover assembly, aligning governor shaft with shaft hole in case (Fig. 7A-142A). Rotate governor and cover assembly and output shaft slightly. The governor cover fits tight in the bore the last 1.5mm (1/16").

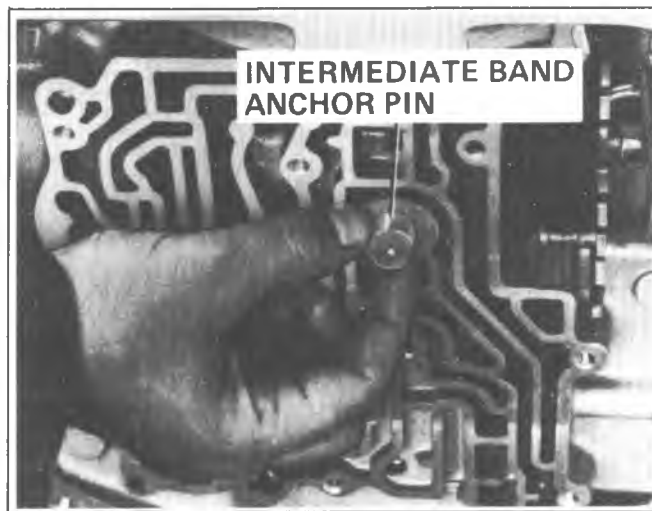


Fig. 7A-143A--Installing Intermediate Band Anchor Pin

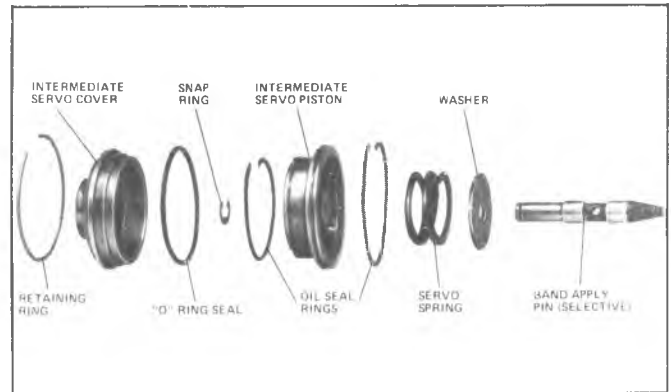


Fig. 7A-144A--Intermediate Servo Exploded

**NOTE:** Governor shaft is not aligned with case hole, if retaining ring cannot be installed.

5. Install governor retaining ring. Align ring gap with an end showing in case slot.

### Intermediate Band Anchor Pin

1. Inspect anchor pin for damage.
2. Install anchor pin, stem end first, making sure stem locates in hole of intermediate band lug (Fig. 7A-143A).

### Intermediate Servo Piston Assembly (Fig. 7A-144A)

#### Inspection

**NOTE:** Production transmissions may be built with either two or zero oil seal rings on the band apply pin. All service band apply pins will have two oil seal rings.

1. Inspect pin for damage and fit in case bore.
2. Inspect inner and outer piston seal rings for damage and free fit in ring grooves. Do not remove unless replacing.
3. Inspect spring.
4. Inspect intermediate servo cover and piston assembly for proper combination and usage. (See Fig. 7A-145A).
5. Check for proper intermediate band apply pin as follows:

MODEL	SERVO COVER	SERVO PISTON
	IDENTIFIED BY CAST NO. ON COVER	IDENTIFIED BY CAST NO. ON COVER
BR, CX, PA, PY, CS	8628696	8630131
BZ, OW, PG, CO, OS	8630085	8630083
PH, CR, CY, BA, OT	8628133	8628111

Fig. 7A-145A--Intermediate Servo Cover and Piston Usage Chart

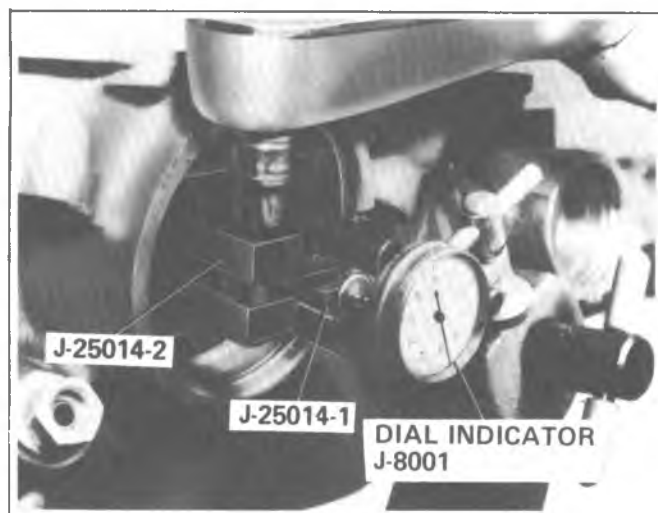


Fig. 7A-146A--Intermediate Band Apply Gages

a. Install J-25014-2 in intermediate servo bore and retain with intermediate servo cover retaining ring, aligning ring with gap at case slot (Fig. 7A-146A).

b. Install pin J-25014-1 into J-25014-2.

**CAUTION:** Make sure the tapered pin end is properly located against the band apply lug. Also, make sure the band anchor pin is properly located in the case and band anchor lug.

INTERMEDIATE BAND APPLY PIN CHART			
DIAL INDICATOR TRAVEL		APPLY PIN IDENTIFICATION	
0	- 2.16 mm (0 - .086")	2 Rings	
2.16 mm - 2.88 mm (.086" - .114")		Wide Band	

Fig. 7A-147A--Intermediate Band Apply Pin Chart

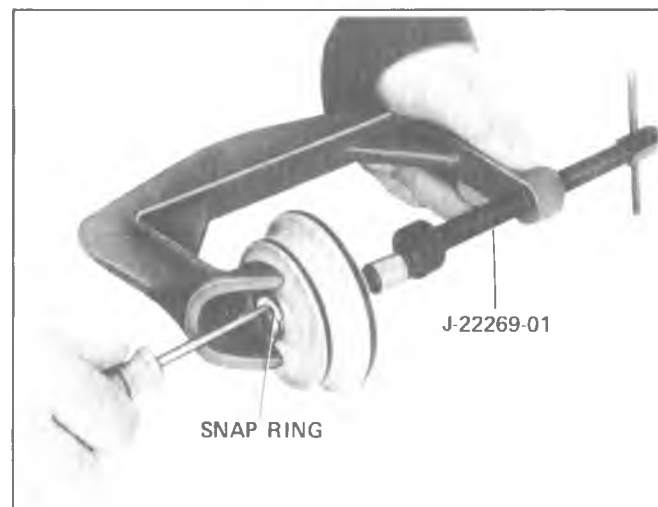


Fig. 7A-148A--Removing Intermediate Servo Piston from Apply Pin

c. Install dial J-8001 and position dial indicator point on top of J-25014-2 zero post, and set dial indicator to zero.

d. Align stepped side of pin J-25014-1 with torquing arm of J-25014-2. Arm must stop against step of pin J-25014-1.

**NOTE:** If band selection pin does not register between the high and low limits, look for possible problem with the intermediate band, direct clutch or case

Make sure J-25014-2 gauge plate is pulled backwards and seated squarely against the retaining ring.

e. Apply 12 N·m (100 in. lbs.) of torque to hex nut on side of gauge. Slide dial indicator over gauge pin J-25014-1 (Fig. 7A-146A). Read dial indicator and see Fig. 7A-147A for proper size.

**NOTE:** Dial indicator travel is reversed, making the indicator readings backwards. On an indicator that ranges from 0-100, a 5mm (.020") travel will read 2mm (.080"), a 1.5mm (.060") travel will read 1mm (.040"). The identification ring is located on the band end of the pin.

f. Remove retaining ring and band apply pin gauges. If new apply pin or replacement of piston is required, proceed as follows:

### Disassembly

1. Using J-22269-01, compress intermediate servo piston spring (Fig. 7A-148A).

2. Using small flat edge screwdriver, remove intermediate pin to piston snap ring.

3. Remove J-22269-01 and separate band apply pin, spring and washer from intermediate servo piston.

### Reassembly

1. Install washer on snap ring end of band apply pin (Fig. 7A-144A).

2. Install spring on washer.

3. Install band apply pin, spring end first through intermediate servo piston.

4. Using J-22269-01, compress intermediate servo piston spring (Fig. 7A-148A).

5. Using small pliers, install intermediate servo pin to piston snap ring. Remove J-22269-01.

6. If removed, install new intermediate servo piston, inner and outer seal rings. Make sure cut ends are assembled in the same relationship as cut (Fig. 7A-120A). Make sure rings are seated in the grooves to prevent damage to the rings. Retain with petrolatum.

7. Lubricate with petrolatum and install new seal ring on intermediate servo cover.

**CAUTION:** The intermediate servo cover seal rings must be well lubricated with petrolatum to prevent damage or cutting of ring.

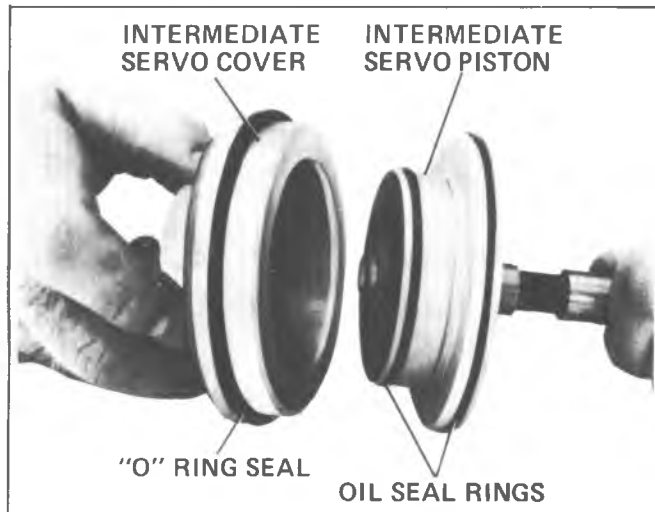


Fig. 7A-149A--Installing Intermediate Servo Piston into Cover

8. Install intermediate servo piston assembly into intermediate servo cover (Fig. 7A-149A).

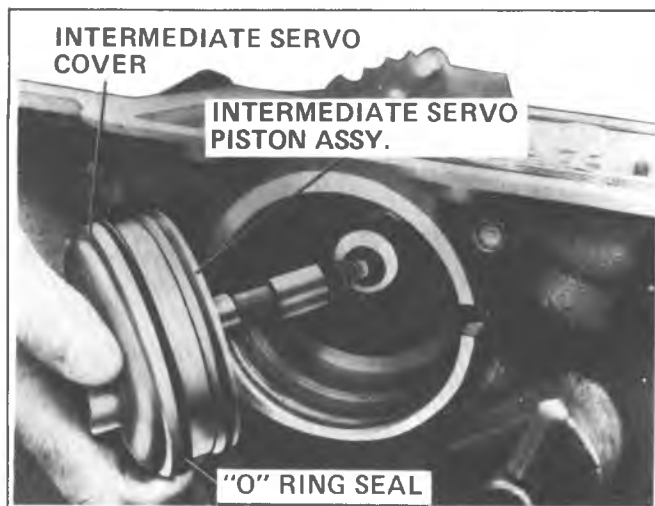
9. Install intermediate servo assembly into case, tapping lightly with non-metal or plastic hammer if necessary (Fig. 7A-150A).

**CAUTION:** *Make sure the tapered end of the band apply pin is properly located against the band apply lug.*

10. Install servo retaining ring. Align ring gap with an end showing in case slot.

### Low and Reverse Clutch Housing to Case Cup Plug and Seal (Fig. 7A-151A)

1. Install new seal, making sure it seats against the housing.



7A-150A--Installing Intermediate Servo Piston and Cover Assembly

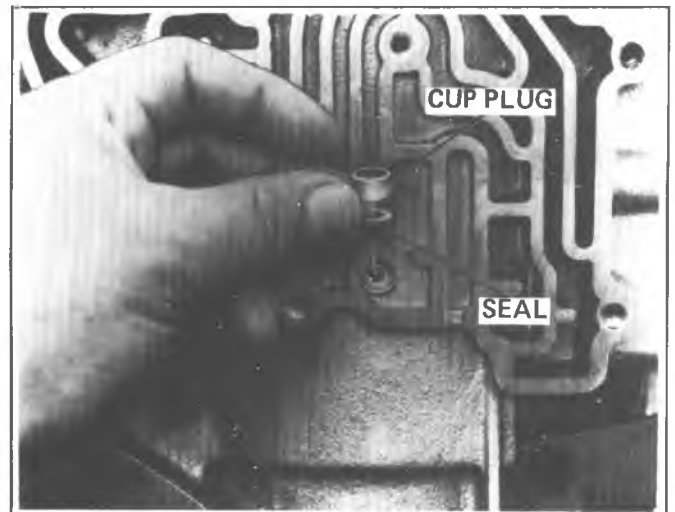


Fig. 7A-151A--Installing Low and Reverse Clutch Housing to Case Cup Plug and Seal

2. Place cup plug, with smaller hole end first, into hole in case. Using a 10mm (3/8") diameter by 150mm (6") metal rod and hammer, drive plug until it seats against the seal.

### Control Valve Assembly

#### Disassembly

**NOTE:** As each valve train is removed, place the individual valve train in the order that it is removed and in a separate location relative to its position in the valve body. None of the valves, bushings or springs are interchangeable; some coiled pins are interchangeable.

Remove all coiled pins by pushing through from the rough cast surface side of the control valve assembly, except the 2 pins which retain the throttle valve and throttle valve plunger.

1. Remove the 4 check balls.

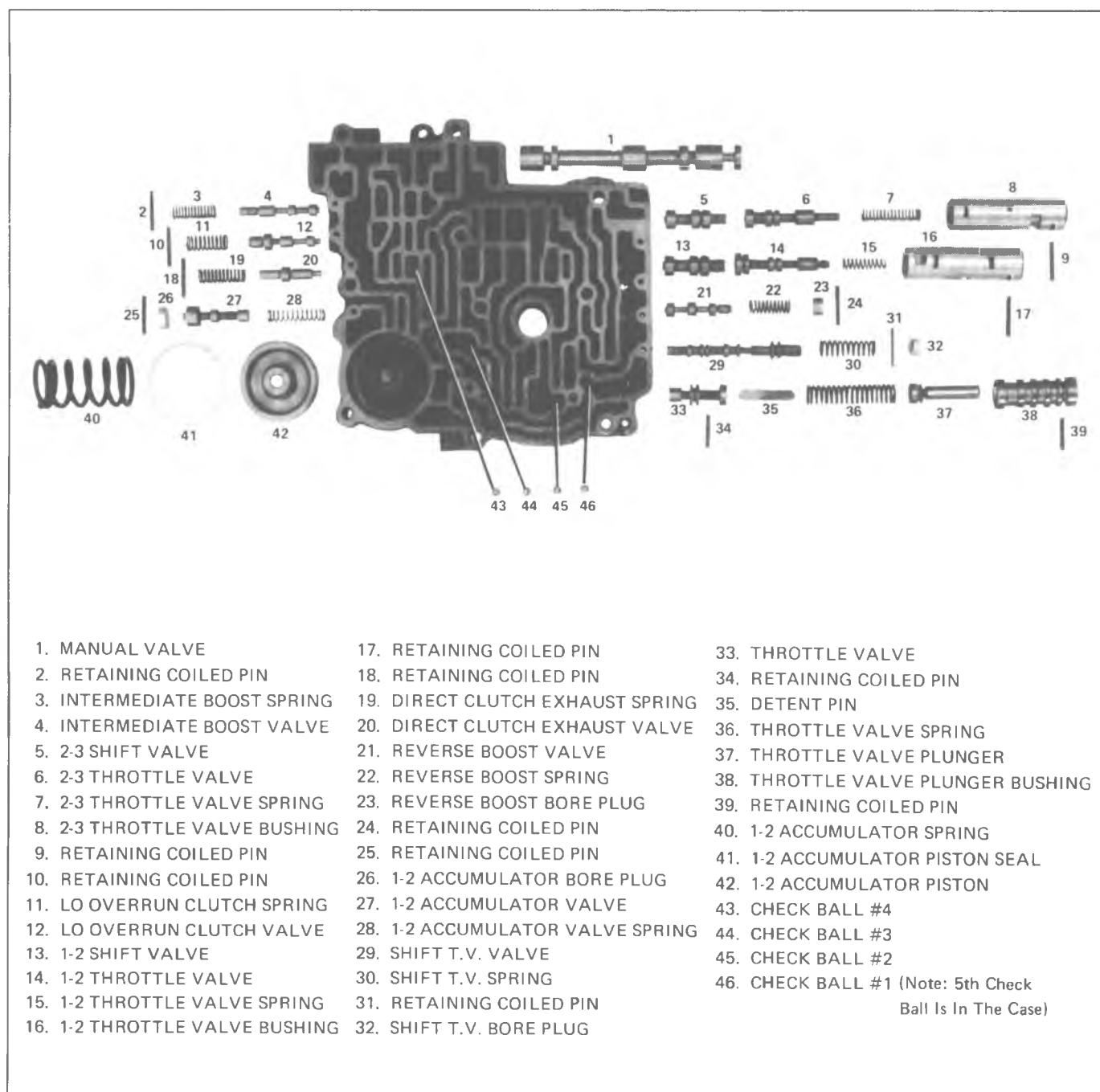


Fig. 7A-152A--Control Valve Assembly - Exploded View

- |                                |                                  |  |
|--------------------------------|----------------------------------|--|
| 1. MANUAL VALVE                | 17. RETAINING COILED PIN         | 33. THROTTLE VALVE   |
| 2. RETAINING COILED PIN        | 18. RETAINING COILED PIN         | 34. RETAINING COILED PIN                                   |
| 3. INTERMEDIATE BOOST SPRING   | 19. DIRECT CLUTCH EXHAUST SPRING | 35. DETENT PIN   |
| 4. INTERMEDIATE BOOST VALVE    | 20. DIRECT CLUTCH EXHAUST VALVE  | 36. THROTTLE VALVE SPRING                                  |
| 5. 2-3 SHIFT VALVE             | 21. REVERSE BOOST VALVE          | 37. THROTTLE VALVE PLUNGER                                 |
| 6. 2-3 THROTTLE VALVE          | 22. REVERSE BOOST SPRING         | 38. THROTTLE VALVE PLUNGER BUSHING                         |
| 7. 2-3 THROTTLE VALVE SPRING   | 23. REVERSE BOOST BORE PLUG      | 39. RETAINING COILED PIN                                   |
| 8. 2-3 THROTTLE VALVE BUSHING  | 24. RETAINING COILED PIN         | 40. 1-2 ACCUMULATOR SPRING                                 |
| 9. RETAINING COILED PIN        | 25. RETAINING COILED PIN         | 41. 1-2 ACCUMULATOR PISTON SEAL                            |
| 10. RETAINING COILED PIN       | 26. 1-2 ACCUMULATOR BORE PLUG    | 42. 1-2 ACCUMULATOR PISTON                                 |
| 11. LO OVERRUN CLUTCH SPRING   | 27. 1-2 ACCUMULATOR VALVE        | 43. CHECK BALL #4  |
| 12. LO OVERRUN CLUTCH VALVE    | 28. 1-2 ACCUMULATOR VALVE SPRING | 44. CHECK BALL #3  |
| 13. 1-2 SHIFT VALVE            | 29. SHIFT T.V. VALVE             | 45. CHECK BALL #2  |
| 14. 1-2 THROTTLE VALVE         | 30. SHIFT T.V. SPRING            | 46. CHECK BALL #1 (Note: 5th Check<br>Ball Is In The Case) |
| 15. 1-2 THROTTLE VALVE SPRING  | 31. RETAINING COILED PIN         |  |
| 16. 1-2 THROTTLE VALVE BUSHING | 32. SHIFT T.V. BORE PLUG         |  |

2. Position control valve assembly as shown in Fig. 7A-152A.

3. Remove 1-2 accumulator piston.

4. Remove manual valve from upper bore.

**CAUTION:** Some of the coiled pins in the control valve assembly have pressure against them. Therefore, hold a shop towel over the bore while removing the pin, to prevent possibly losing a bore plug, spring, etc.

5. Remove coiled pin from upper right bore. Remove 2-3 throttle valve bushing 2-3 throttle valve spring, 2-3 throttle valve and 2-3 shift valve.

**NOTE:** The 2-3 throttle valve spring and 2-3 throttle valve may be inside the 2-3 throttle valve bushing.

6. From next bore down, remove coiled pin. Remove 1-2 throttle valve bushing, 1-2 throttle valve spring, 1-2 throttle valve and 1-2 shift valve.

**NOTE:** The 1-2 throttle valve spring and the 1-2 throttle valve may be inside the 1-2 throttle valve bushing.

7. From next bore down, remove coiled pin and bore plug. Remove reverse boost spring and reverse boost valve.

8. Check the operation of the shift T.V. valve in the next bore down, by moving the valve against the spring. If



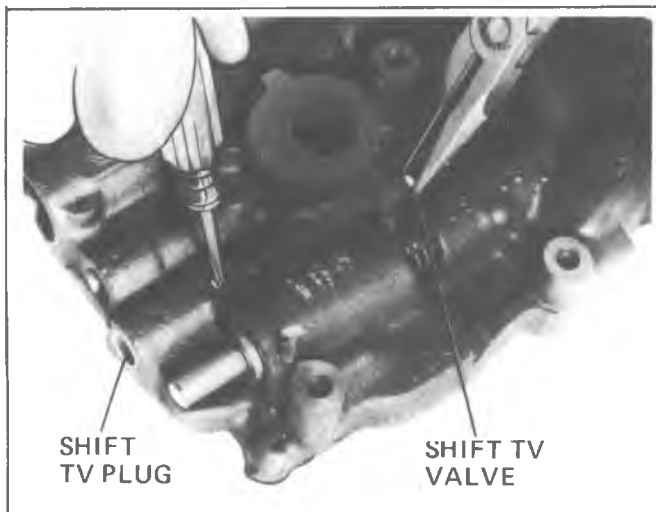


Fig. 7A-153A--Removing Shift T. V. Plug

it is necessary to remove the valve, proceed as follows: (Figs. 7A-153A and 7A-154A).

- a. Remove coiled pin and place valve body on shop towel with rough casting surface up.
- b. Using needle nose pliers, compress the shift T.V. spring by pushing on the shift T.V. valve; hold valve with small screwdriver.
- c. Place 6.3mm (1/4") rod, 9.5mm (3/8") long, against the end of the shift T.V. valve.

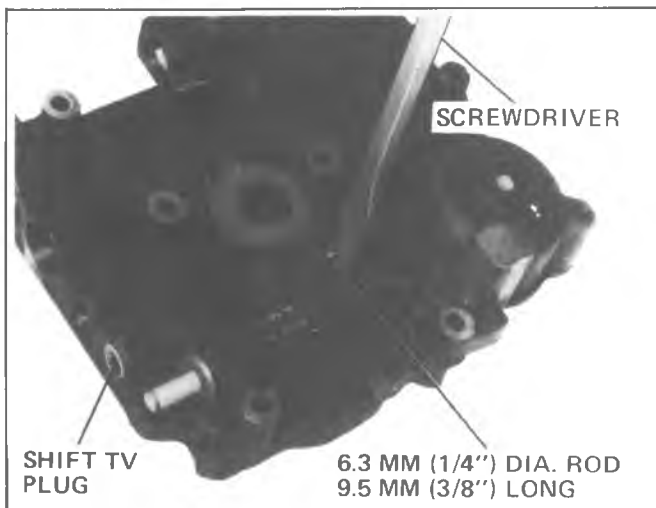


Fig. 7A-154A--Removing Shift T.V. Plug

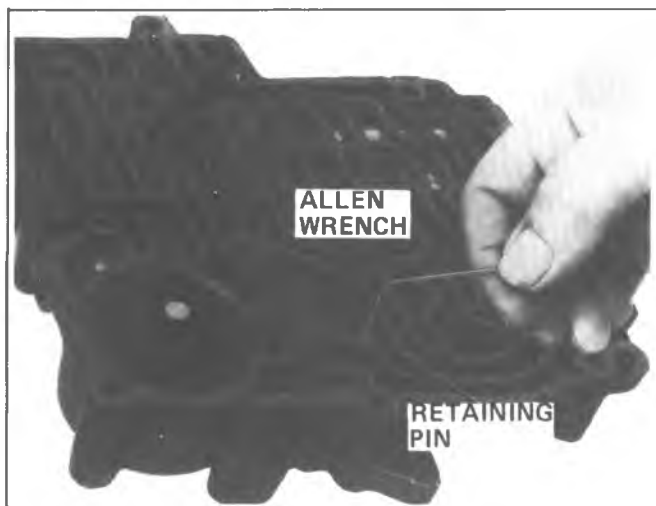


Fig. 7A-155A--Removing Inner Coiled Retaining Pin

d. Prying on end of the rod with a large screwdriver, remove small screwdriver and remove shift T.V. plug, shift T.V. spring and shift T.V. valve.

e. Discard shift T.V. plug and remove 6.3mm (1/4") rod from shift T.V. bore.

9. From next bore down, remove outer coiled pin. Remove the throttle valve plunger, bushing, throttle valve spring and, on models BR and CX, remove the detent pin. Using a 1.5mm (1/16") allen wrench with ground sides to fit inside the pin, remove the inner coiled pin (Fig. 7A-155A). Remove the throttle valve.

10. From upper left bore, remove coiled pin, intermediate boost spring and intermediate boost valve.

11. From next bore down, remove coiled pin, low overrun clutch spring and low overrun clutch valve.

12. From next bore down, remove coiled pin, direct clutch exhaust spring and direct clutch exhaust valve.

13. From next bore down, remove coiled pin, valve bore plug, 1-2 accumulator valve and 1-2 accumulator valve spring.

### Inspection

1. Wash control valve body, valves, springs, and other parts in clean solvent and air dry.
2. Inspect 1-2 accumulator piston for damage.
3. Inspect 1-2 accumulator piston seal for damage and free fitting groove. Do not remove seal unless replacing.
4. Inspect valve for scoring, cracks and free movement in their bores.
5. Inspect bushings for cracks or scored bores.
6. Inspect valve body for cracks damage or scored bores.
7. Inspect springs for distortion or collapsed coils.
8. Inspect bore plugs for damage.

### Reassembly

**NOTE:** Install all flared coiled pins (zinc coated), with the flared end out, and from the machined face of the control valve assembly. Install the two (2) tapered coiled pins (black finish) that retain the throttle valve and throttle valve bushing, with the tapered end first. Coiled pins do not fit flush on rough casting face. Make sure that all coiled pins are flush at the machined face.

1. Position control valve body as shown in Fig. 7A-152A.
2. Install into lower left bore, 1-2 accumulator spring, 1-2 accumulator valve, smaller stem end out. Install bore plug, hole out, and coiled pin.
3. In next bore up, install direct clutch exhaust valve, longer stem end out, direct clutch exhaust spring and coiled pin.
4. In next bore up, install low overrun clutch valve, longer stem end out, low overrun clutch spring and coiled pin.
5. In next bore up, install intermediate boost valve, longer stem end out, intermediate boost spring and coiled pin.
6. In lower right bore, install throttle valve, smaller outside diameter land first, making sure valve is seated at the bottom of the bore. Install inner coiled pin between the lands of this valve (Fig. 7A-155A). Install the detent pin (on

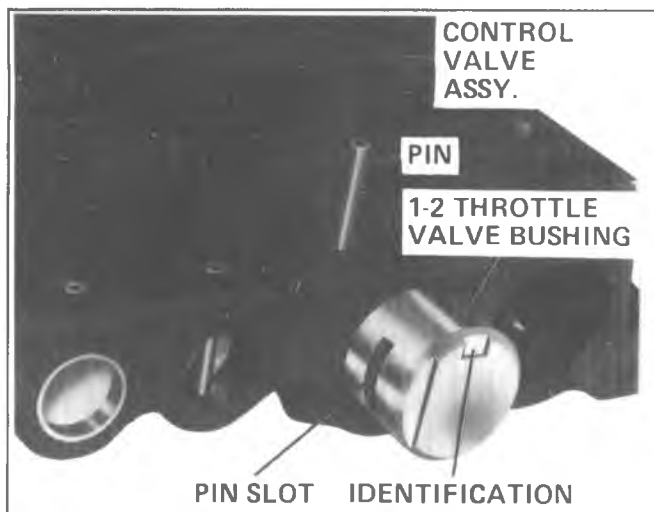


Fig. 7A-156A--Install 1-2 Throttle Valve Bushing

models BR and CX only) into the shift T.V. spring and install these 2 parts into the bore. Install the throttle valve plunger, stem end first, into the throttle valve plunger bushing and install these 2 parts into the bore, valve end first. Install outer coiled pin from rough cast surface side, aligning pin with slot in bushing.

7. In next bore up, if removed, install shift T.V. valve, larger outside diameter stem end out, shift T.V. spring and coiled pin. Then, using plastic hammer, install new shift T.V. plug flush with rough casting surface.

8. In next bore up, install reverse boost valve, stem end out, reverse boost spring. Install bore plug, hole side out and coiled pin.

9. In next bore up, install 1-2 shift valve, longer stem end out, making sure valve is seated at the bottom of the bore. Install 1-2 throttle valve spring into the 1-2 throttle valve bushing and 1-2 throttle valve, stem end first, into the bushing. Install these 3 parts, valve end first, into the bore, aligning bushing so the pin can be installed in the pin slot. (See Fig. 7A-156A for pin slot and identification of 1-2 throttle valve bushing.)

10. In next bore up, install 2-3 shift valve, longer stem end out, making sure valve is seated at the bottom of the bore. Install 2-3 throttle valve spring into the 2-3 throttle

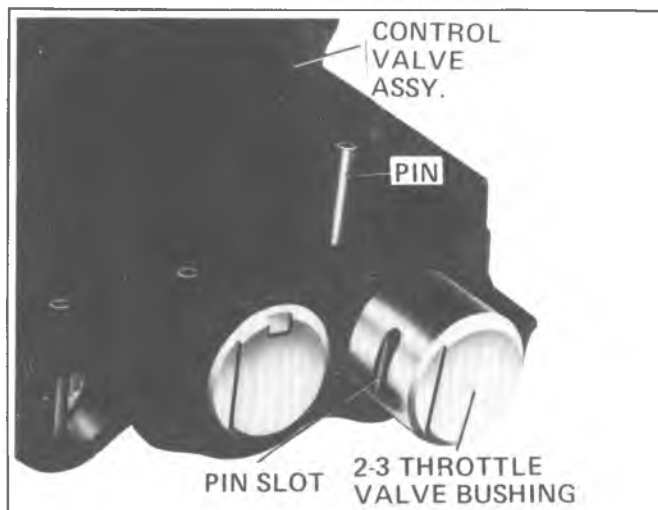


Fig. 7A-157A--Installing 2-3 Throttle Valve Bushing



Fig. 7A-158A--Installing 1-2 Accumulator Spring

valve bushing and 2-3 throttle valve, stem end first, into the bushing. Install these 3 parts, valve end first, into the bore, aligning bushing so pin can be installed in the pin slot (Fig. 7A-157A).

11. Install manual valve with the inside detent lever pin groove to the right.

12. If removed, install new seal ring on 1-2 accumulator piston.

13. Oil and install 1-2 accumulator piston, spring pocket side out, into 1-2 accumulator piston bore of valve body.

## Control Valve Assembly

## Installation

**NOTE:** When installing a NEW control valve assembly, always be sure to use one with the same

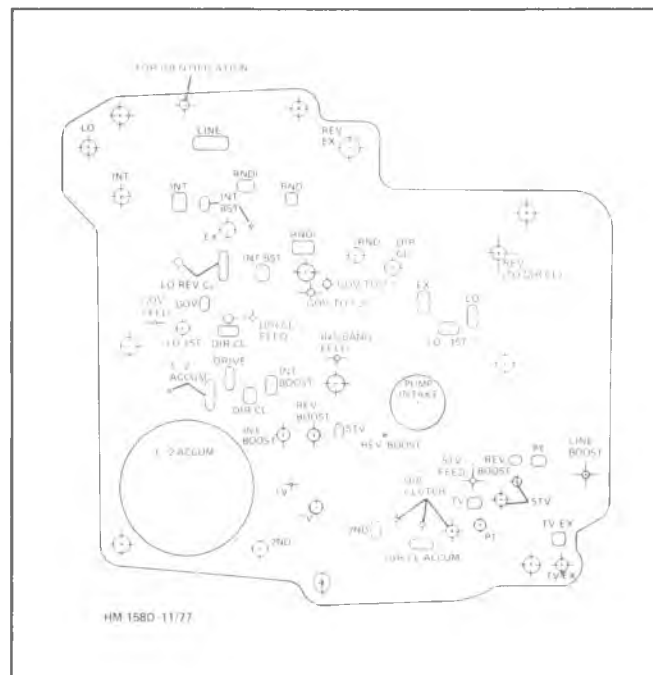


Fig. 7A-159A--Typical Valve Body Spacer Plate

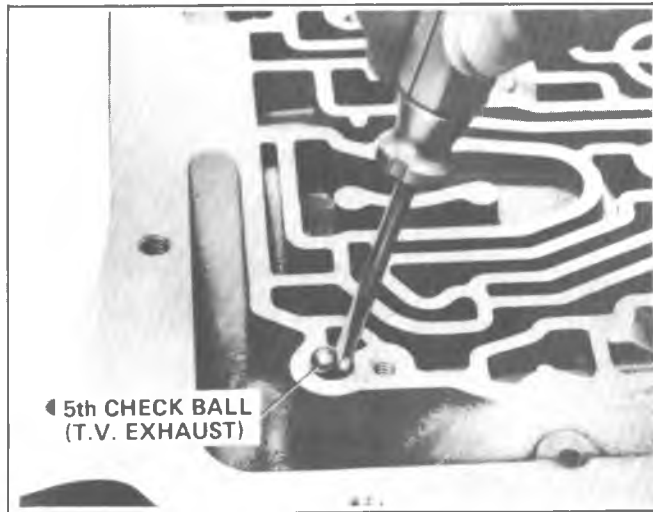


Fig. 7A-160A--Installing 5th Check Ball

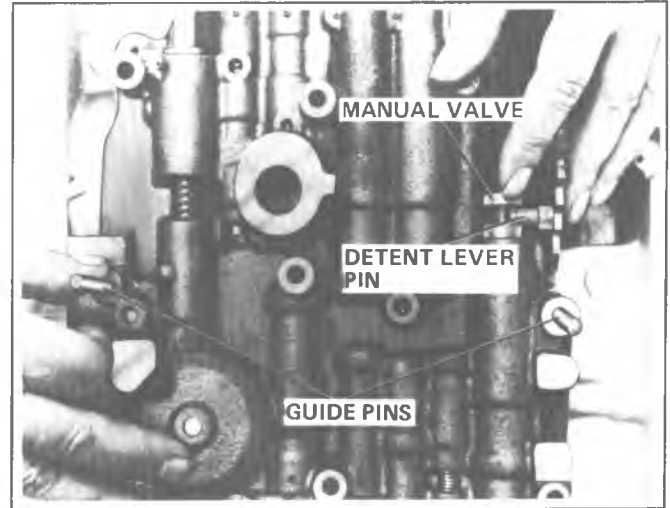


Fig. 7A-161A--Installing Control Valve Assembly Using Guide Pins

casting number as the original.

1. Inspect 1-2 accumulator spring for damage.

2. Install 1-2 accumulator spring into case (Fig. 7A-158A).

3. Inspect control valve assembly and spacer plate for damage (Fig. 7A-159A).

**NOTE:** The size of the 5 check balls used in the case and control valve assembly is 6.35mm (.250"). The size of the check ball used in the pump is 7.14mm (.281"). Do not interchange.

4. Install 5th check ball in case as shown (Fig. 7A-160A).

5. Install 2 guide pins as shown in Fig. 7A-161A.

6. Install 4 check balls into ball seat pockets in control valve assembly and retain with petrolatum. (See Fig. 7A-162A for check ball location.)

7. Place the control valve assembly to spacer plate gasket marked "VB" on the control valve assembly.

8. Place the valve body spacer plate on the gasket marked "VB".

9. Place the spacer plate to case gasket marked "C" on the spacer plate.

10. Insert 2 control valve assembly to case attaching bolts through the control valve assembly, gaskets and spacer plate; and install these parts, aligning the manual valve with the detent lever pin (Fig. 7A-161A).

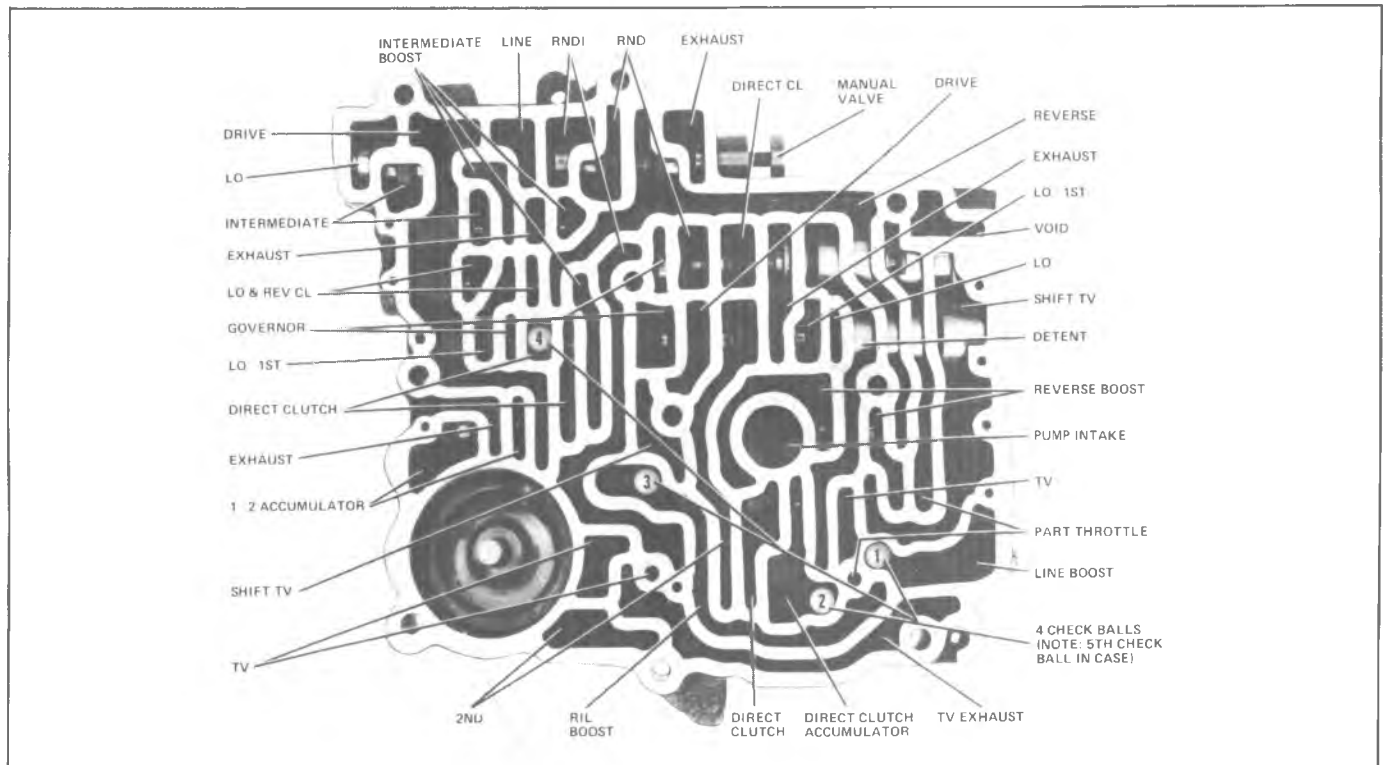


Fig. 7A-162A--Location of Four Check Balls

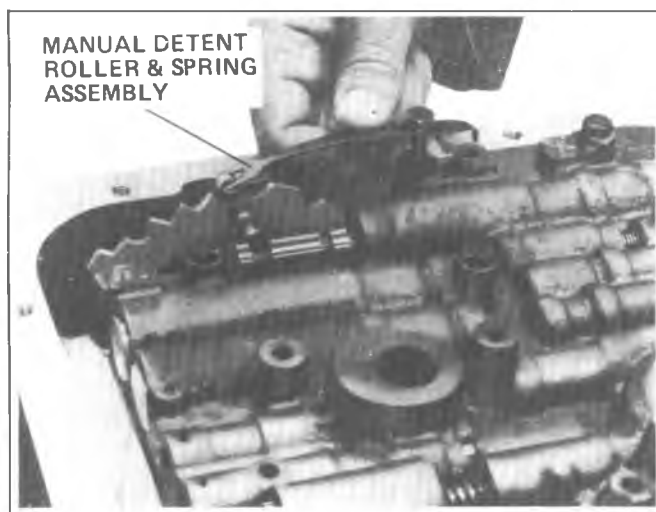


Fig. 7A-163A--Installing Manual Detent Roller and Spring Assembly

**NOTE:** Make sure check balls, 1-2 accumulator piston and manual valve do not fall out.

11. Start control valve assembly to case attaching bolts, except the throttle lever and bracket assembly and the oil screen attaching bolts.

**CAUTION:** The (2) oil screen attaching bolts are about 10mm (3/8") longer than the control valve assembly attaching bolts, and they are not interchangeable.

12. Inspect inside manual detent roller and spring assembly for damage.

13. Remove guide pins and replace with bolts and inside manual detent roller and spring assembly, locating the tang in the control valve assembly, and the roller on the inside detent lever (Fig. 7A-163A).

14. Throttle lever and bracket assembly.

a. Inspect throttle lever and bracket assembly for damage (Fig. 7A-164A).

b. If removed, install spring on top of lifter, then lifter spring first into throttle bracket.

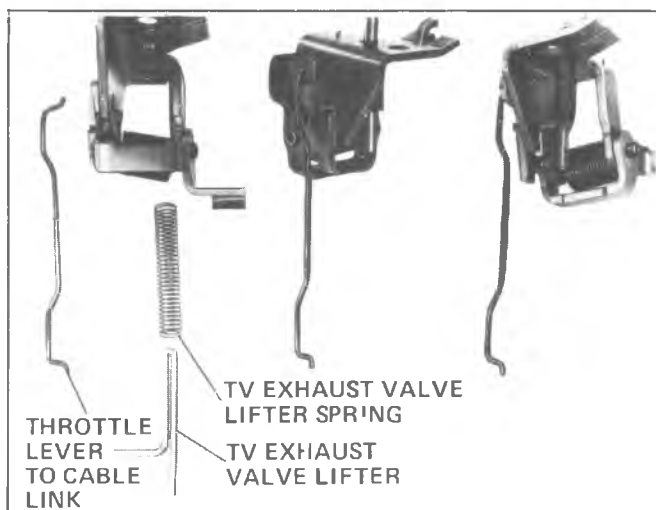


Fig. 7A-164A--Throttle Lever and Bracket Assembly

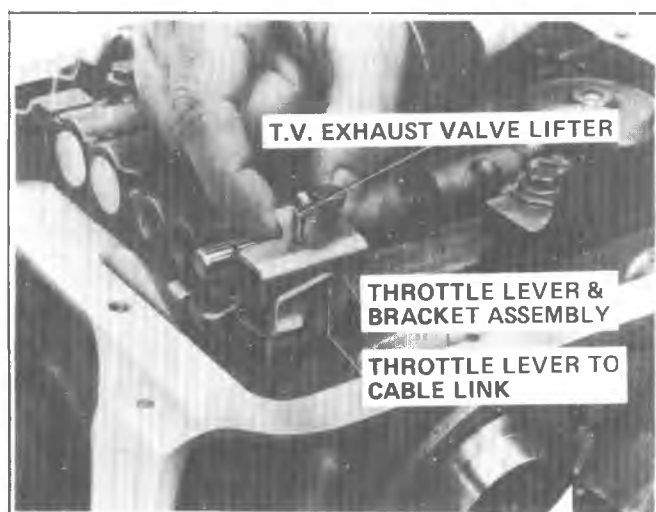


Fig. 7A-165A--Installing Throttle Valve and Bracket Assembly

c. Install link on throttle lever making sure link is hooked as shown (Fig. 7A-165A).

d. Install throttle lever and bracket assembly, locating slot in bracket with coiled pin, aligning lifter through valve body hole and link through T.V. linkage case bore. Retain with bolt.

15. Torque all control valve assembly to case attaching bolts to 13.0-17.0 N·m (9-12 ft. lbs.).

### Oil Screen

1. Thoroughly clean, air dry and inspect oil screen assembly.

2. Install new oil screen gasket on screen and retain with petrolatum.

3. Install oil screen assembly and attaching bolts (Fig. 7A-166A). Torque bolts to 13.0-17.0 N·m (9-12 ft. lbs.).

### Oil Pan

1. Clean and inspect oil pan for damage.

2. Install new oil pan to case gasket on case.

3. Install oil pan and retaining bolts. Torque bolts to 14.0-18.0 N·m (10-13 ft. lbs.).

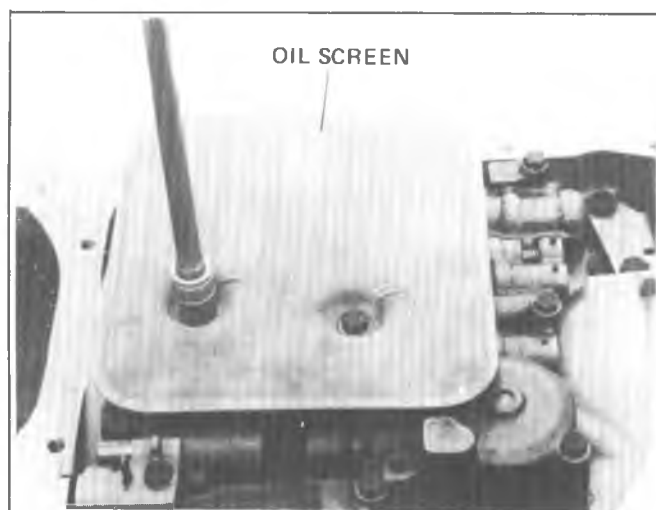


Fig. 7A-166A--Installing Oil Screen

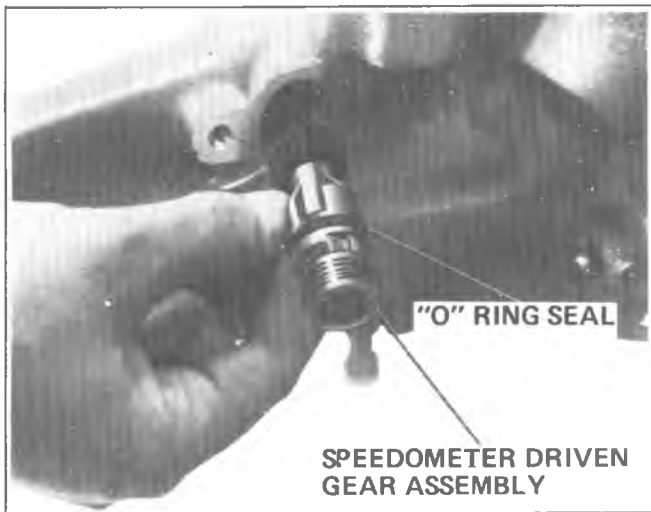


Fig. 7A-167A--Removing and Installing Speedometer Driven Gear - Typical

### Speedometer Driven Gear (Fig. 7A-167A)

#### Inspection

1. Remove speedometer driven gear from housing and inspect for damage.
2. Inspect housing for damage and "O" ring for damage or cuts.
3. If damaged, remove and discard "O" ring.

#### Reassembly

1. If removed, install new "O" ring on housing.
2. Install speedometer driven gear into housing.
3. Install speedometer driven gear assembly into case (Fig. 7A-167A).
4. Install speedometer retainer and attaching bolt, align slot in speedometer driven gear housing with retainer. Torque bolt to 8.0-14.0 N·m (6-10 ft. lbs.).

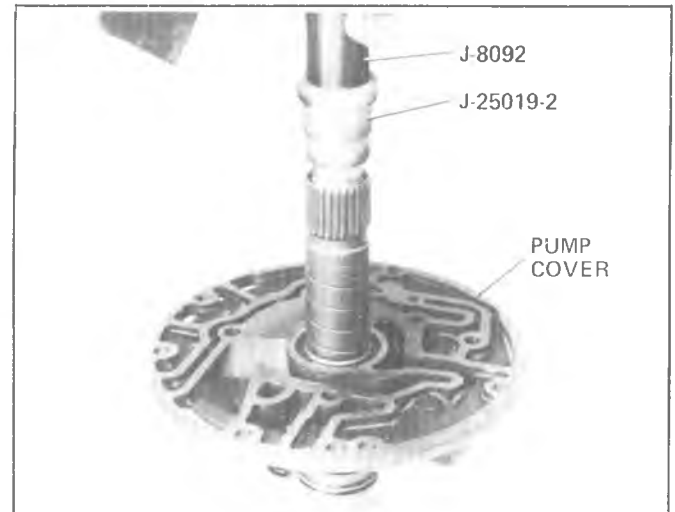


Fig. 7A-169A--Installing Pump Cover Bushing - Front

5. Place transmission in cradle or transmission jack. Remove holding fixture, J-8763-02 from transmission.

## BUSHING REPLACEMENT

### PUMP COVER BUSHINGS

#### Front Bushing

1. Using tool J-24036 with Slide Hammer, J-7004-1, remove bushing (Fig. 7A-168A).
2. Using tool J-25019-2 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-169A).

#### Rear Bushing

1. Using tool J-25019-14 with Slide Hammer J-7004-1, remove bushing (Fig. 7A-170A).

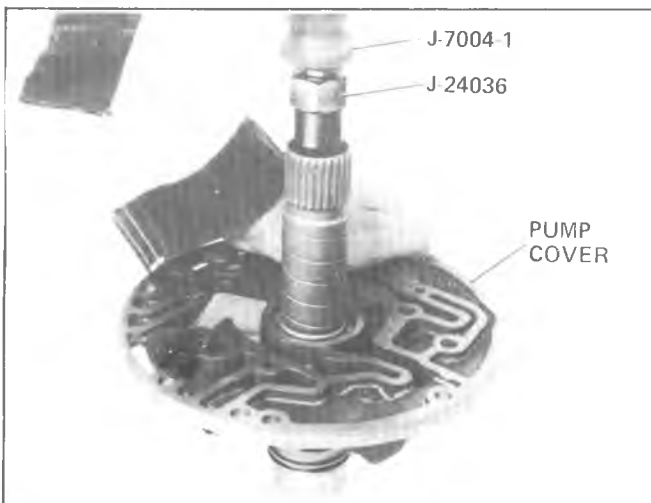


Fig. 7A-168A--Removing Pump Cover Bushing - Front



Fig. 7A-170A--Removing Pump Cover Bushing - Rear



Fig. 7A-171A--Installing Pump Cover Bushing - Rear

2. Using tool J-25019-6 with Driver Handle J-8092, drive or press new bushing until tool bottoms (Fig. 7A-171A).

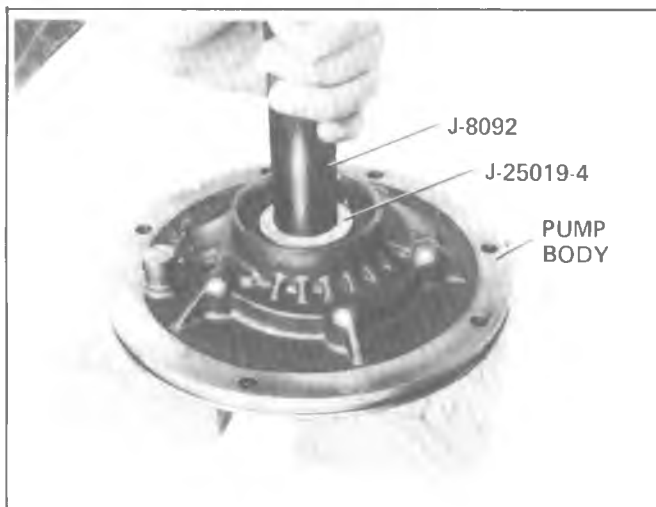


Fig. 7A-172A--Removing Pump Body Bushing

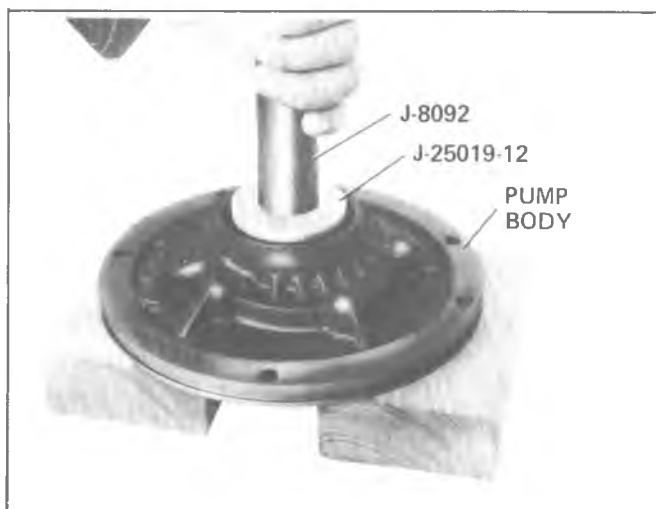


Fig. 7A-173A--Installing Pump Body Bushing

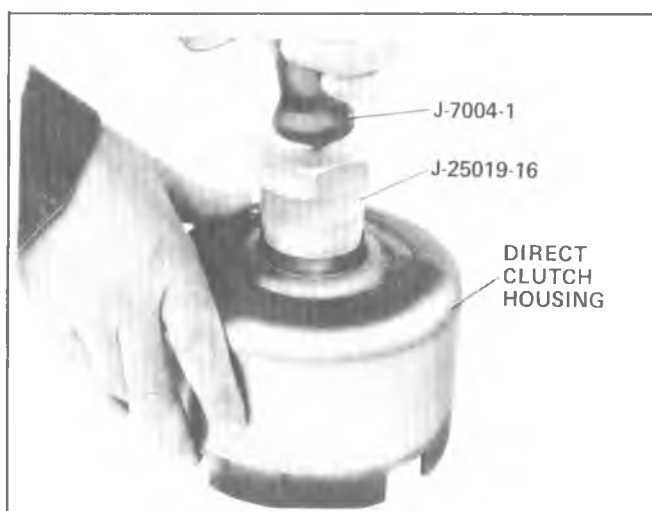


Fig. 7A-174A--Removing Direct Clutch Housing Bushing - Front

### PUMP BODY BUSHING

1. Place pump body with the machined face down, on two blocks of wood, to prevent damaging the machined surface.

2. Using tool J-25019-4 with Drive Handle J-8092, remove bushing (Fig. 7A-172A).

3. Using tool J-25019-12 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-173A).

### DIRECT CLUTCH HOUSING

#### Front Bushing

1. Using tool J-25019-16 with Slide Hammer J-7004-1, remove bushing (Fig. 7A-174A).

2. Place bushing, chamfered inside diameter end first, over tool J-25019-9. Using tool J-25019-9 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-175A).

#### Rear Bushing

1. Place direct clutch housing with the thrust washer face down on a block of wood to prevent damaging the thrust washer surface.



Fig. 7A-175A--Installing Direct Clutch Housing Bushing - Front

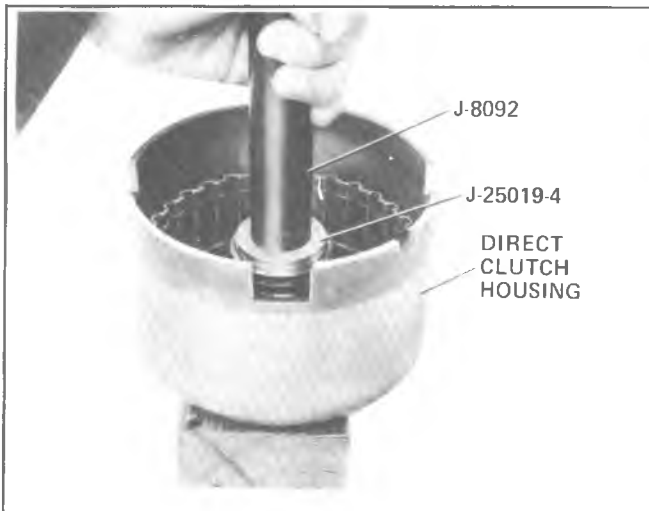


Fig. 7A-176A--Removing Direct Clutch Housing Bushing - Rear

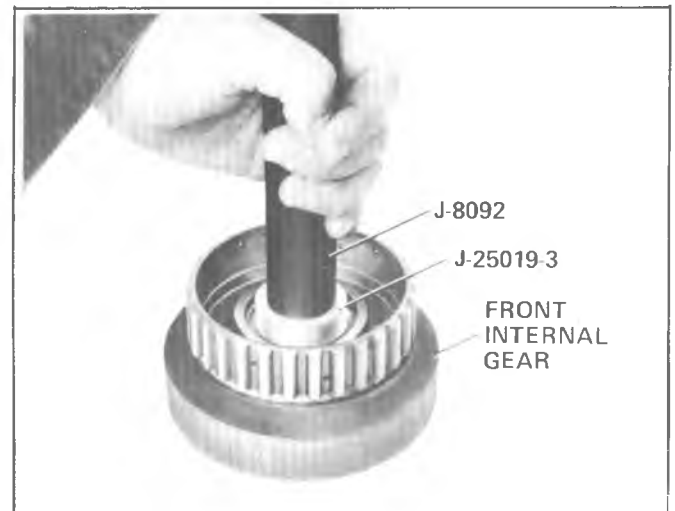


Fig. 7A-178A--Removing Front Internal Gear Bushing

2. Using tool J-25019-4 with Driver Handle J-8092, remove bushing (Fig. 7A-176A).

3. Using tool J-25019-6 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-177A).

### FRONT INTERNAL GEAR BUSHING

1. Using tool J-25019-3 with Driver Handle J-8092, remove bushing (Fig. 7A-178A).

2. Using tool J-25019-9 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-179A).

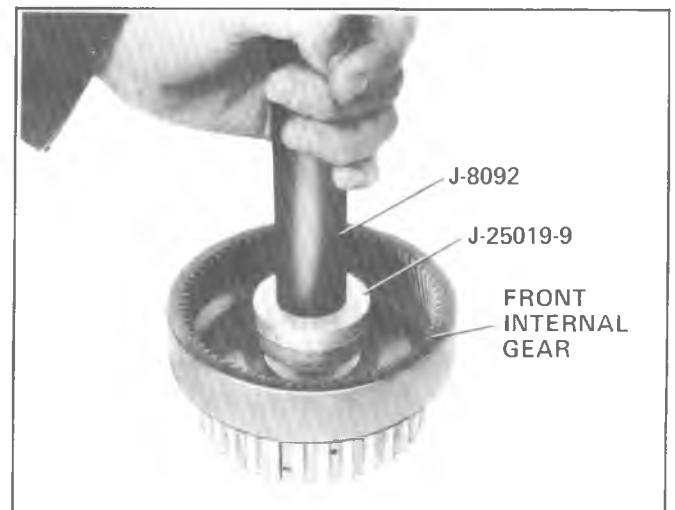


Fig. 7A-179A--Installing Front Internal Gear Bushing

### REAR SUN GEAR

1. Using tool J-25019-14 with Slide Hammer J-7004-1, remove bushing (Fig. 7A-180A).

2. Place rear sun gear with gear side down on block of wood to prevent damaging the gear.

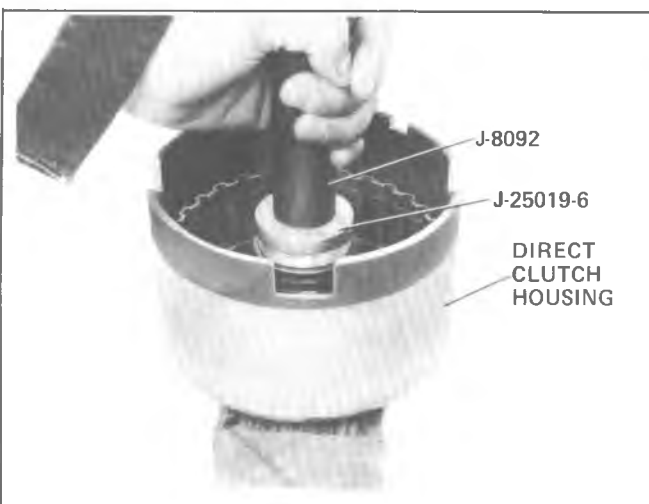


Fig. 7A-177A--Installing Direct Clutch Housing Bushing - Rear

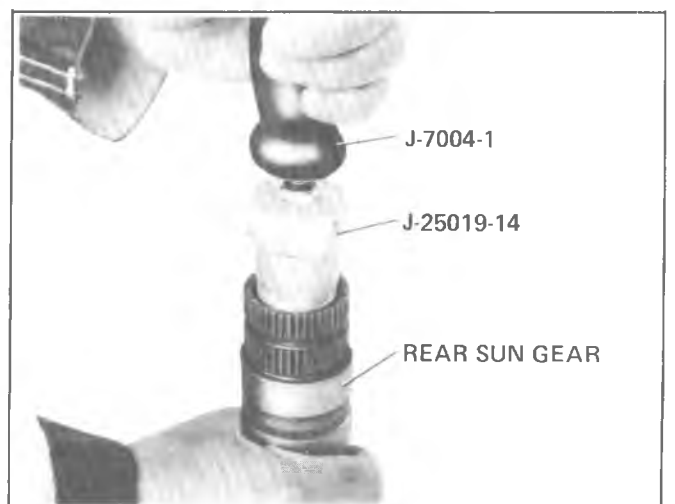


Fig. 7A-180A--Removing Rear Sun Gear Bushing





Fig. 7A-181A--Installing Rear Sun Gear Bushing



Fig. 7A-184A--Removing Rear Carrier Bushing



Fig. 7A-182A--Removing Lo and Reverse Clutch Housing Bushing

3. Using tool J-25019-2 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-181A).

#### LO AND REVERSE CLUTCH HOUSING BUSHING

1. Using tool J-25019-16 with Slide Hammer J-7004-1, remove bushing (Fig. 7A-182A).

2. Place lo and reverse clutch housing with splined hub between two blocks of wood to prevent damaging the splines.

3. Using tool J-25019-8 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-183A).

#### REAR CARRIER BUSHING

1. Using tool J-25019-16 with Slide Hammer J-7004-1, remove bushing (Fig. 7A-184A).

2. Using tool J-25019-7 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-185A).

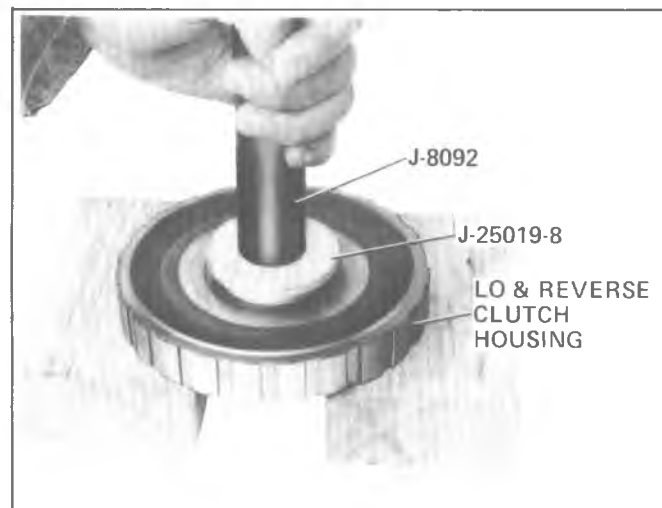


Fig. 7A-183A--Installing Lo and Reverse Clutch Housing Bushing

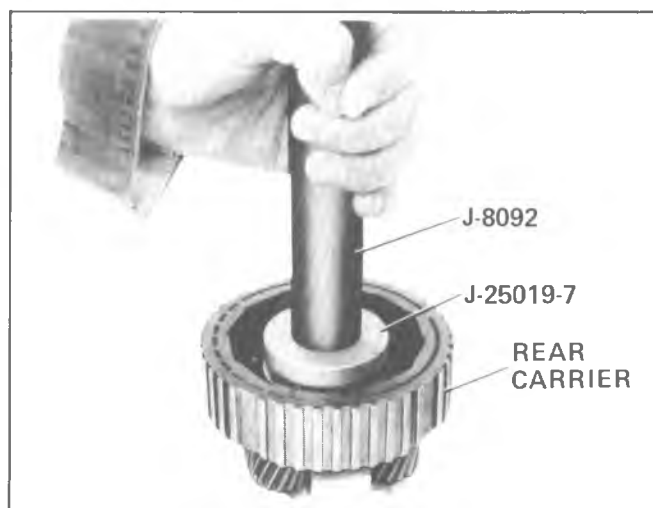


Fig. 7A-185A--Installing Rear Carrier Bushing



## CASE BUSHING

1. Using tool J-21424-9 with Driver Handle J-8092, remove bushing (Fig. 7A-186A).

2. Using tool J-21424-9 with Driver Handle J-8092, drive or press new bushing to a distance of approximately 17.3mm (11/16") between rear end of the bushing and rear end of the case (Fig. 7A-186A).

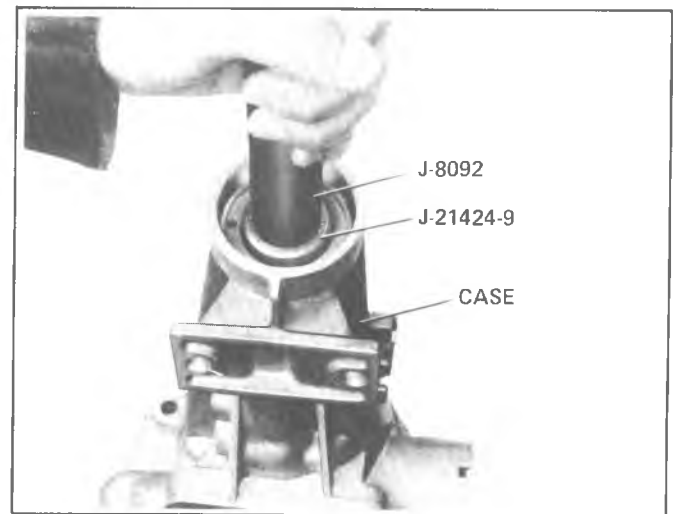
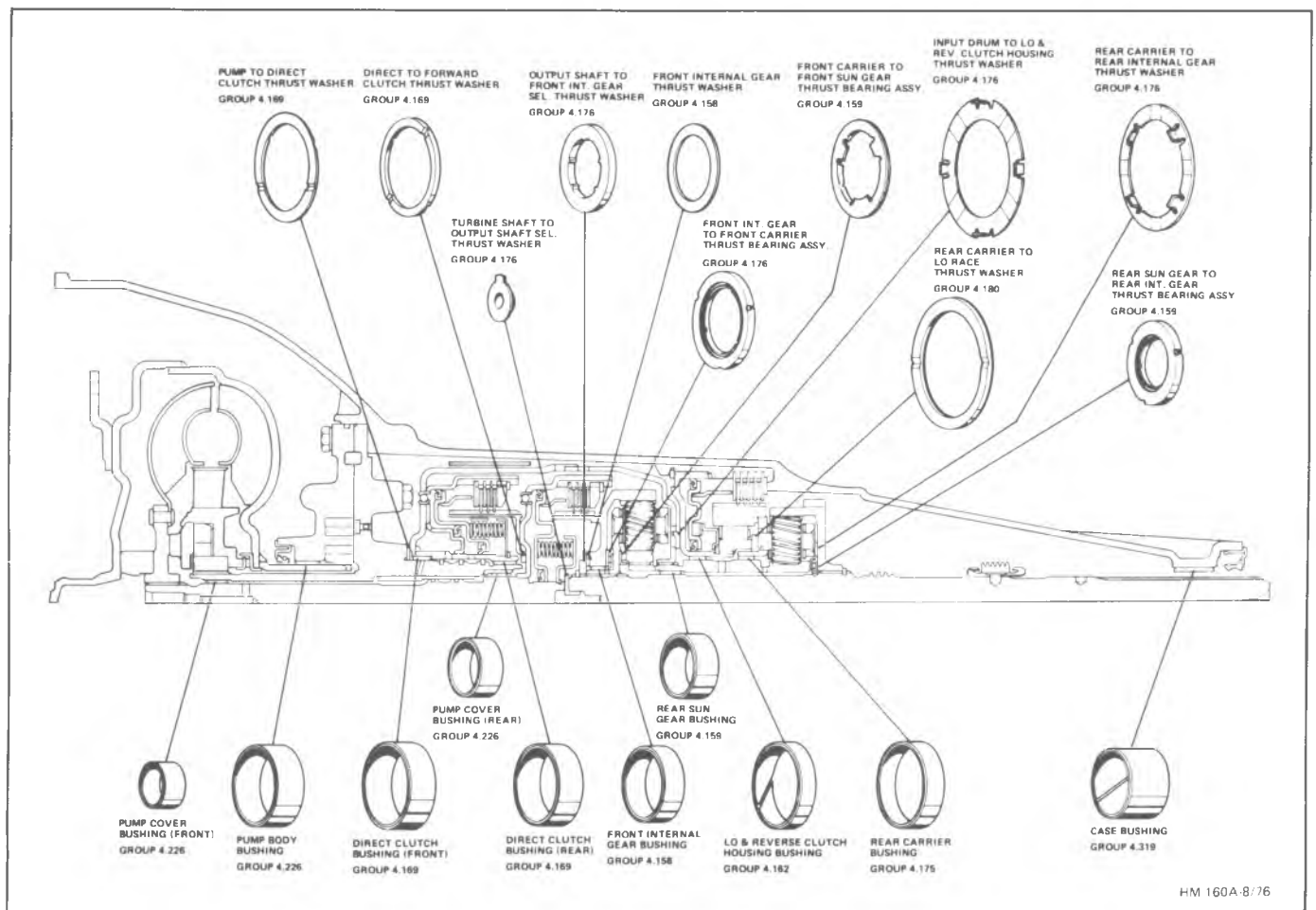


Fig. 7A-186A--Removing or Installing Case Bushing



HM 160A-8/76

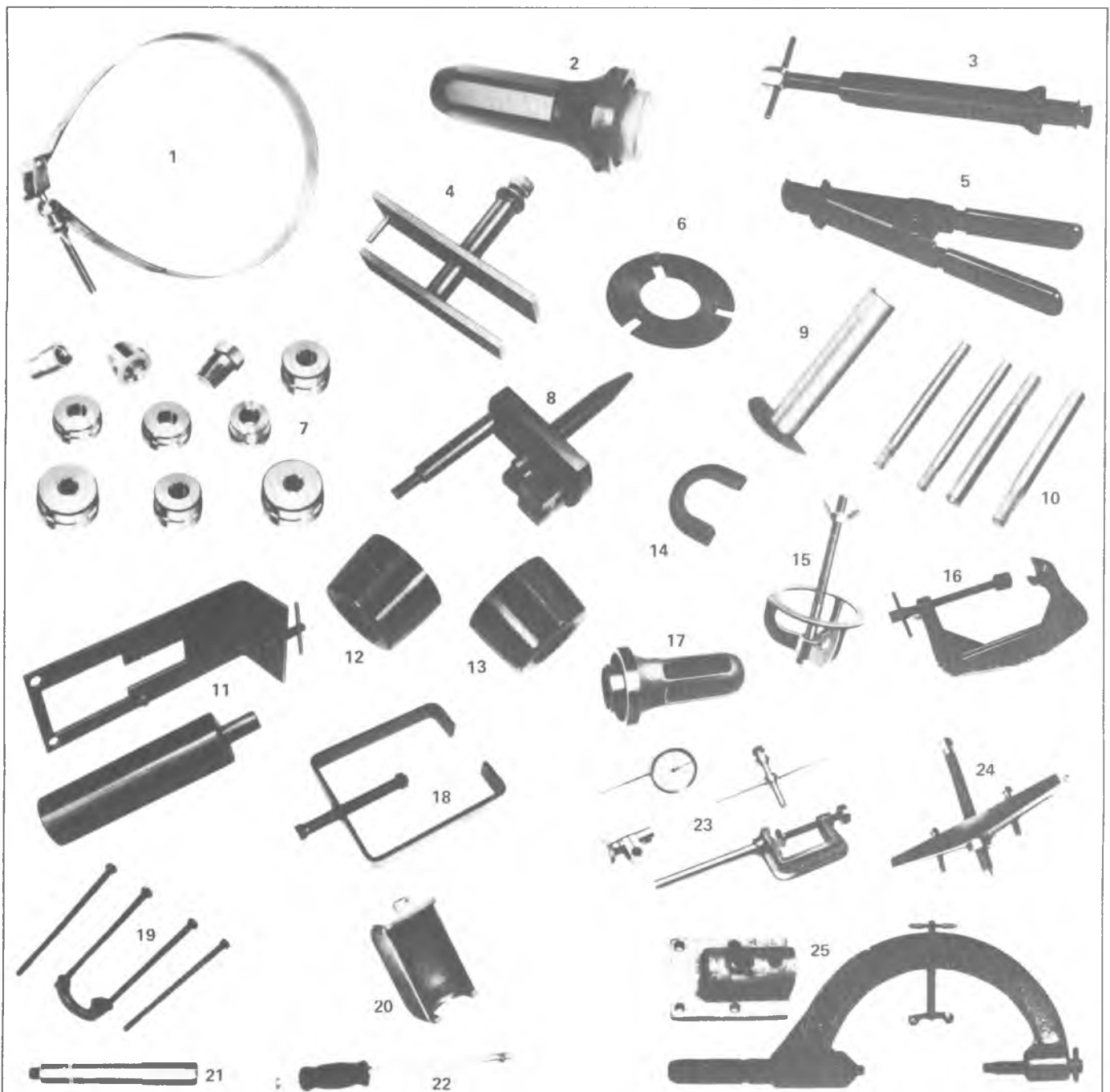
Fig. 7A-187A--Bushing Locations

## SPECIFICATIONS

## TURBO-HYDRAMATIC "200"

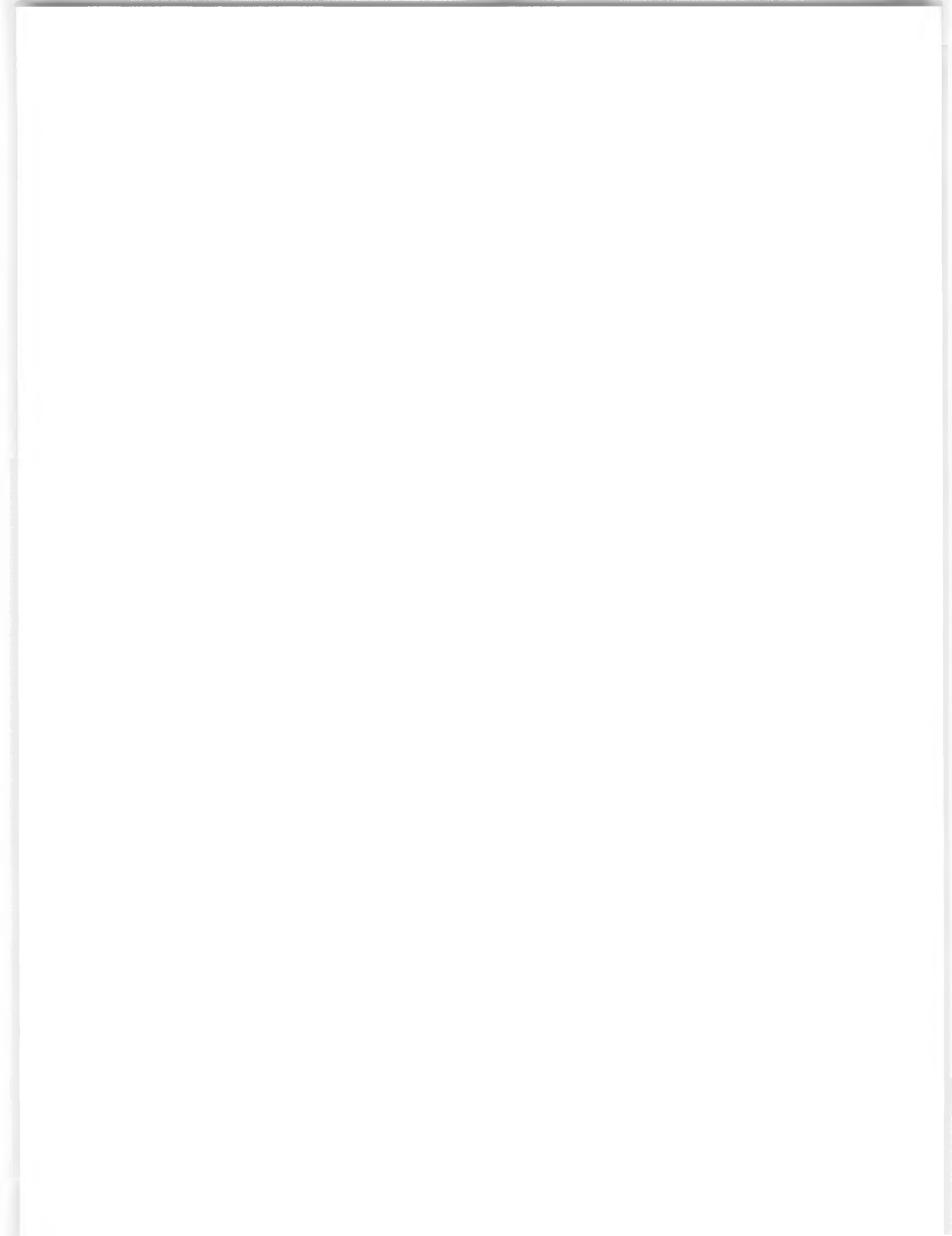
Pump Cover Bolts .....	24 N·m	(18 ft. lbs.)
Pump to Case Attaching Bolts .....	24 N·m	(18 ft. lbs.)
Parking Pawl Bracket Bolts .....	24 N·m	(18 ft. lbs.)
Control Valve Body Bolts .....	15 N·m	(11 ft. lbs.)
Oil Screen Retaining Bolts .....	15 N·m	(11 ft. lbs.)
Bottom Pan Attaching Bolts .....	16 N·m	(12 ft. lbs.)
Converter to Flywheel Bolts .....	48 N·m	(35 ft. lbs.)
Transmission to Engine Mounting Bolts .....	34 N·m	(25 ft. lbs.)
Converter Dust Shield Screws .....	11 N·m	(8 ft. lbs.)
Manual Shaft Nut .....	31 N·m	(23 ft. lbs.)
Speedometer Driven Gear Attaching Bolts .....	11 N·m	(8 ft. lbs.)
Detent Cable Attaching Screw .....	9 N·m	(6 ft. lbs.)
Oil Cooler Line to Transmission Connector .....	37 N·m	(25 ft. lbs.)
Oil Cooler Line to Radiator Connector .....	27 N·m	(20 ft. lbs.)
Linkage Swivel Clamp Nut .....	41 N·m	(30 ft. lbs.)
Shifter Assembly to Sheet Metal Screws .....	10 N·m	(8 ft. lbs.)
Converter Bracket to Adapter Nuts .....	17 N·m	(13 ft. lbs.)
Catalytic Converter to Rear Exhaust Pipe Nuts .....	23 N·m	(17 ft. lbs.)
Exhaust Pipe to Manifold Nuts .....	16 N·m	(12 ft. lbs.)
Rear Transmission Support Bolts .....	54 N·m	(40 ft. lbs.)
Mounting Assembly to Support Nuts .....	29 N·m	(21 ft. lbs.)
Mounting Assembly to Support Center Nut .....	44 N·m	(33 ft. lbs.)
Adapter to Transmission Bolts .....	44 N·m	(33 ft. lbs.)

## SPECIAL TOOLS



- |              |  |               |                                   |
|--------------|--|---------------|-----------------------------------|
| 1. J25015    | Oil Pump Body and Cover Alignment Band                 | 14. J25022    | End-Play Checking Fixture Adapter |
| 2. J25016    | Front Oil Pump Seal Installer                          | 15. J-23327   | Clutch Spring Compressor          |
| 3. J25020-01 | Converter Stator and Turbine End-Play Checking Fixture | 16. J22269-01 | Direct Clutch Spring Compressor   |
| 4. J25023    | Reverse Clutch Selective Shim Group                    | 17. J21426    | Rear Oil Seal Installer           |
| 5. J25012    | Reverse Clutch Housing Installer and Remover           | 18. J25024    | Forward Clutch Spring Compressor  |
| 6. J25018    | Forward Clutch Spring Compressor                       | 19. J21427-01 | Speedo Gear Puller                |
| 7. J25019    | Bushing Service Set                                    | 20. J24773    | Gaging Fixture                    |
| 8. J25014    | Intermediate Band Apply Pin Gauge                      | 21. J8092     | Driver Handle                     |
| 9. J25021    | Turbine Shaft and Direct Clutch Installer              | 22. J7004     | Slide Hammer                      |
| 10. J25025   | Alignment Pin and Stud Set                             | 23. J8001     | Dial Indicator Set                |
| 11. J25013   | Output Shaft and Rear Unit Support Fixture             | 24. J8433     | Puller                            |
| 12. J25010   | Direct Clutch Seal Protector                           | 25. J8763-02  | Holding Fixture and Base          |
| 13. J25011   | Reverse Clutch Seal Protector                          |               |                                   |

Fig. 7A-ST--THM 200, Special Tools



# SECTION 7A

## AUTOMATIC TRANSMISSION UNIT REPAIR (OVERHAUL)

### CBC 350 TRANSMISSION

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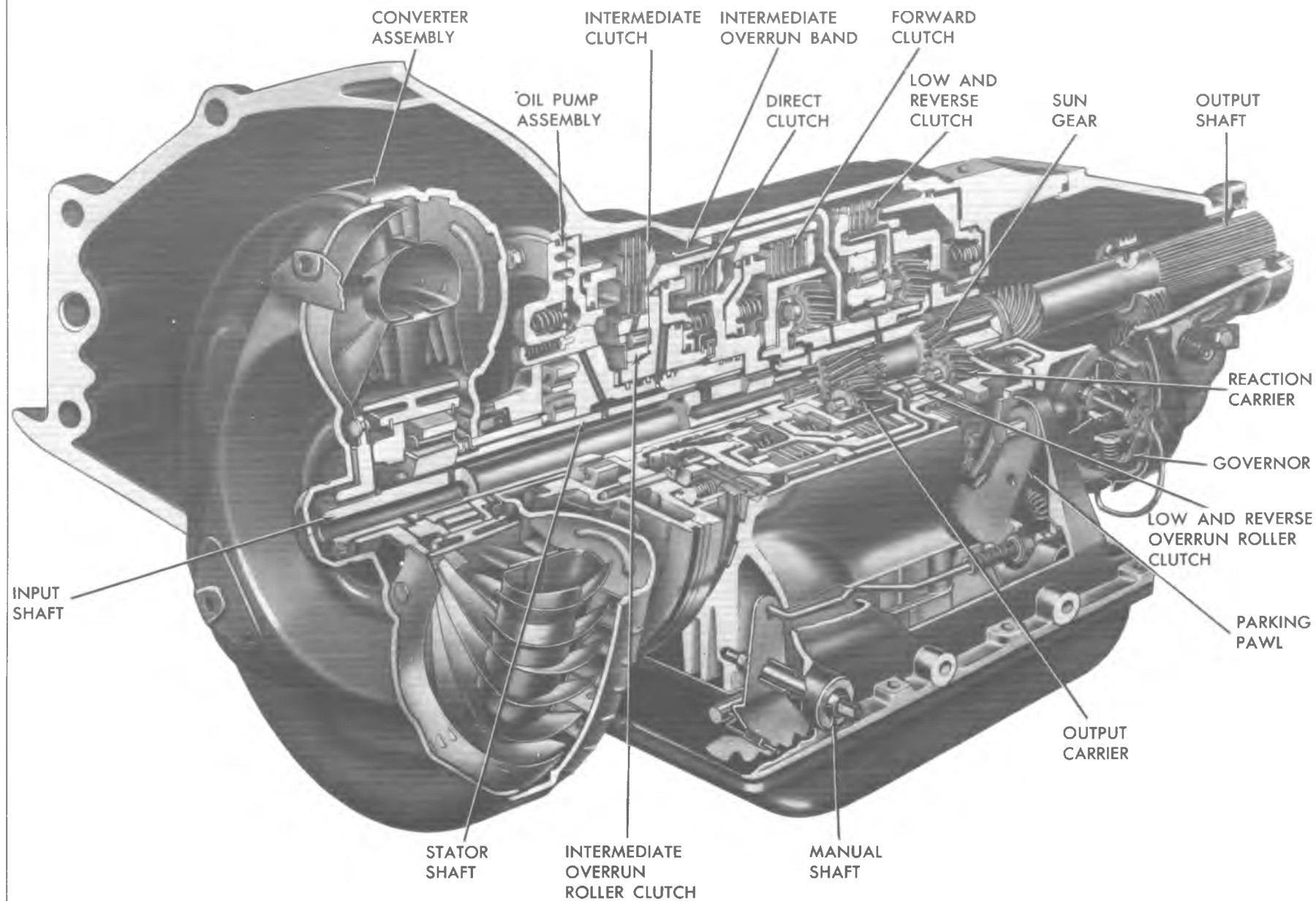


Fig. 7A-1B--CBC 350 Sectioned View

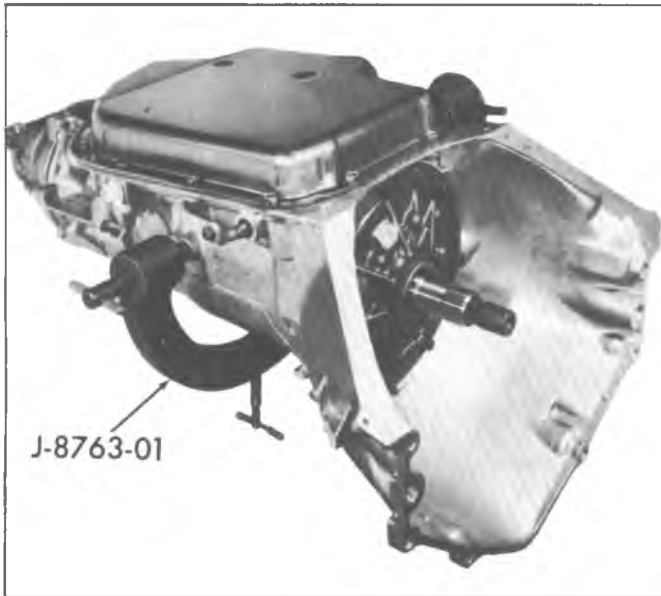


Fig. 7A-2B--Transmission in Holding Fixture

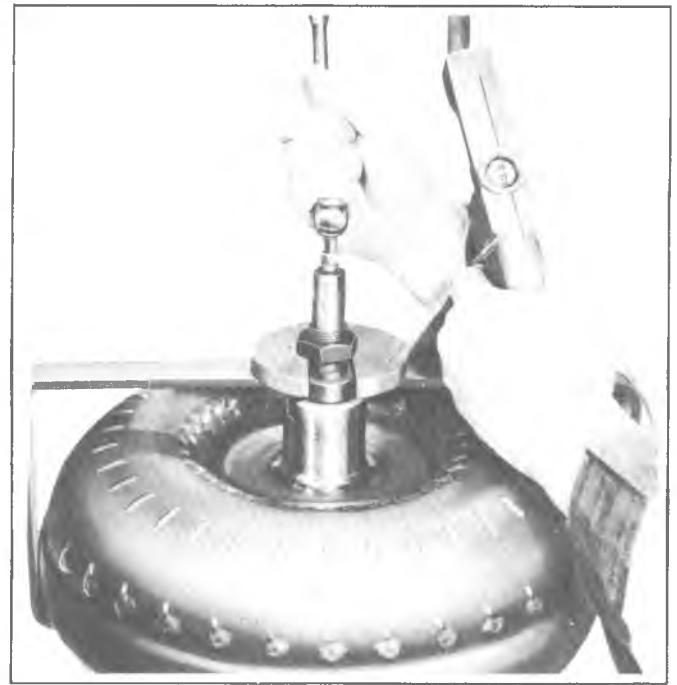


Fig. 7A-4B--Checking Converter for Leaks

## TRANSMISSION DISASSEMBLY AND REASSEMBLY

### DISASSEMBLY

1. Install Holding Fixture J-8763-02 on transmission and place into Holding Tool base J-3289-20 with converter facing up (fig. 7A-2B).

**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. 7A-3B). Discard "O" ring.

### Inspection of Converter

1. Check converter for leaks as follows (fig. 7A-4B):

- Install Tool J-21369 and tighten.
- Apply 80 psi air pressure to tool.
- Submerge in water and check for leaks.

2. Check converter hub surfaces for signs of scoring or wear.

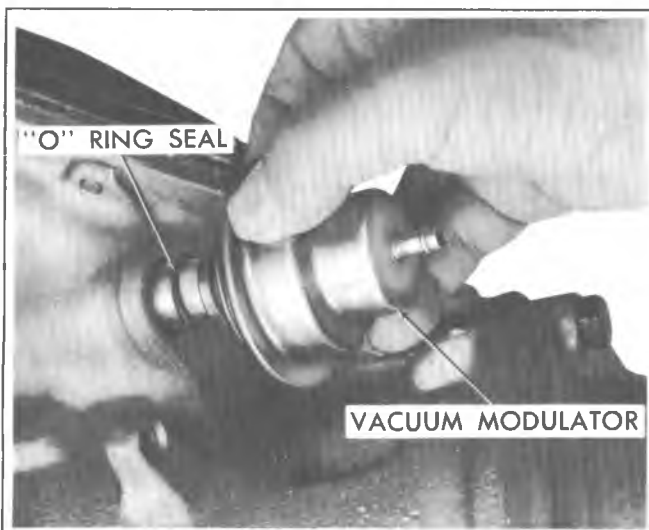


Fig. 7A-3B--Removing Vacuum Modulator Assembly

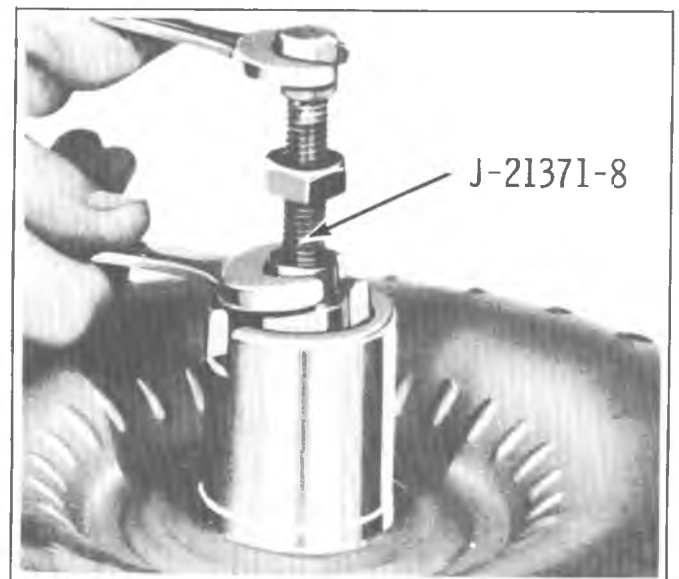


Fig. 7A-5B--Installing J-21571-8

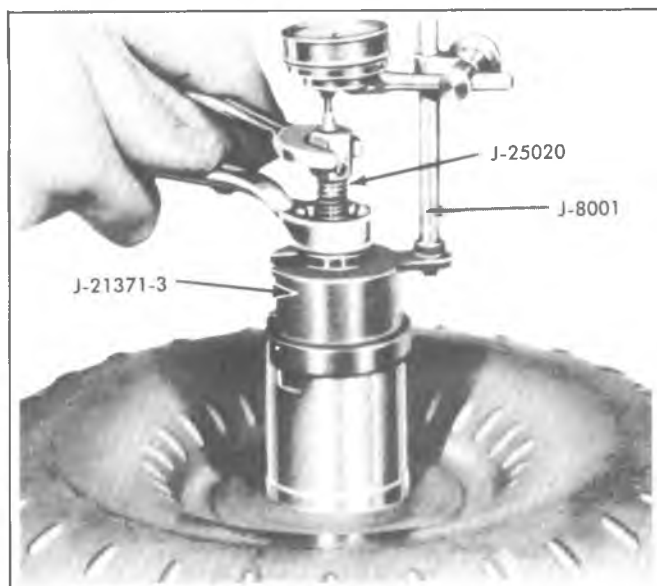


Fig. 7A-6B--Checking Converter End Clearance

### Converter End Clearance Check (Figs. 7A-5B, 7A-6B)

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 ft. lbs. (fig. 7A-5B).
3. Install Tool J-21371-3 and tighten hex nut to 3 ft. lbs. (fig. 7A-6B).
4. Install Dial Indicator J-8001 and set it at "zero", while its plunger rests on the cap nut of Tool J-21371-8.
5. Loosen hex nut while holding cap nut stationary. With the hex nut loosened and holding Tool J-21371-3 firmly against the converter hub, the reading obtained on the dial indicator will be the converter end clearance. End clearance should be less than .050". If the end clearance is .050" or greater, the converter must be replaced.



Fig. 7A-7B--Removing Extension Housing Lip Seal

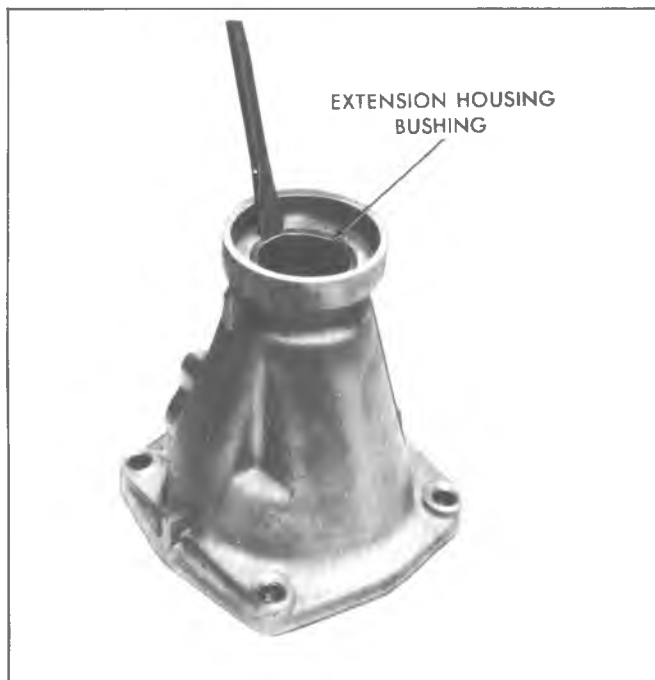


Fig. 7A-8B--Removing Extension Housing Bushing

### REMOVAL OF EXTENSION, SPEEDOMETER DRIVEN GEAR, GOVERNOR, OIL PAN AND SCREEN

1. Remove four housing to case attaching bolts.
2. Remove extension housing from case and remove square cut "O" ring seal from extension housing.
3. Remove extension housing lip seal using screw driver (fig. 7A-7B).
4. If extension housing bushing is to be replaced, collapse bushing (fig. 7A-8B) and refer to Figure 7A-98B for installation.
5. Install speedometer drive gear remover tool J-21427-01 and J-9539 bolts with J-8105 or suitable puller on output shaft and remove speedometer drive gear. Remove retaining clip.
6. Remove governor cover retainer with a screwdriver.
7. Using a screwdriver and hammer, gently tap along governor cover lip (fig. 7A-9B), remove governor cover and "O" ring seal (fig. 7A-10B). Discard seal.

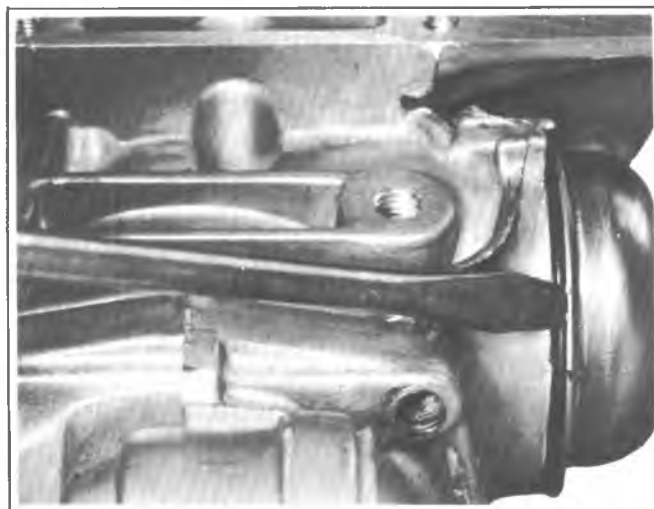


Fig. 7A-9B--Removing Governor Cover





Fig. 7A-10B--Governor Cover and "O" Ring Seal

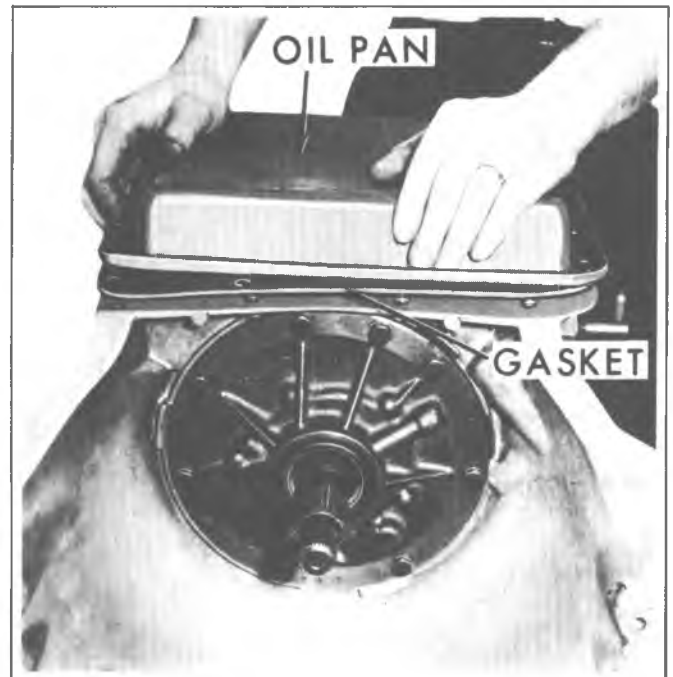


Fig. 7A-12B--Removing Transmission Oil Pan

**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. 7A-11B) and check governor bore and governor sleeve for scoring.

9. Remove oil pan attaching screws (fig. 7A-12B), oil pan, and gasket. Discard gasket.

10. Remove oil pump suction screen (strainer) to valve body attaching screws (fig. 7A-13B).

11. Remove oil pump screen (strainer) and gasket from valve body.

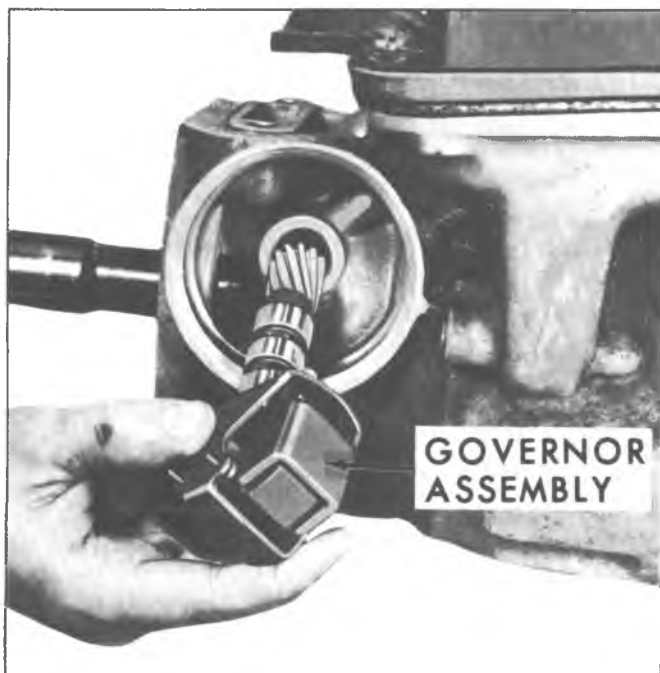


Fig. 7A-11B--Removing Governor from Case



Fig. 7A-13B--Removing Oil Pump Suction Screen (Strainer) from Valve Body

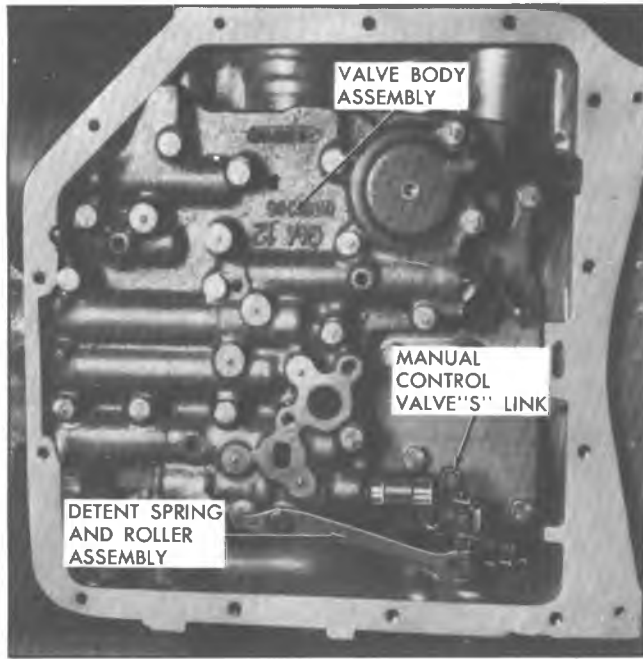


Fig. 7A-14B--Detent Spring and Roller Assembly

#### REMOVAL OF VALVE BODY AND LINKAGE

1. Remove detent spring and roller assembly from valve body. Remove valve body to case attaching bolts (fig. 7A-14B).
2. Remove manual control valve link from range selector inner lever. Remove detent control valve link from

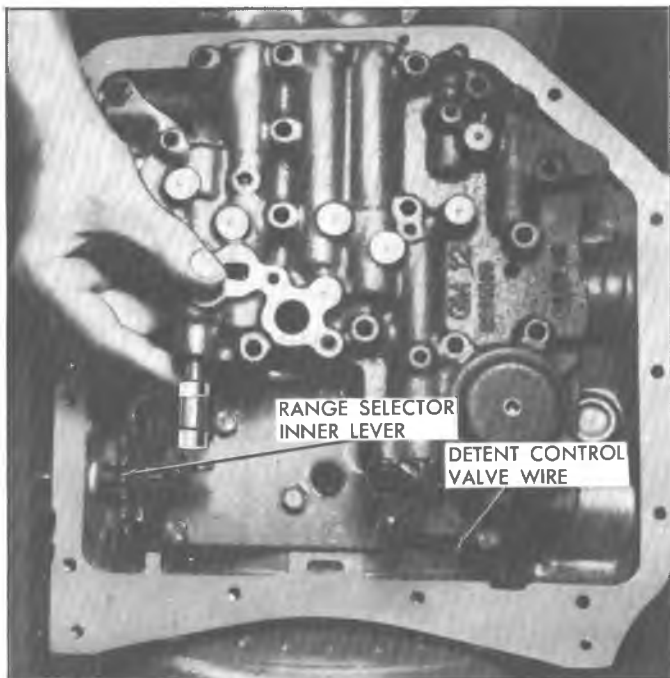


Fig. 7A-15B--Removing Manual Control Valve Link, Valve Body and Detent Actuating Lever

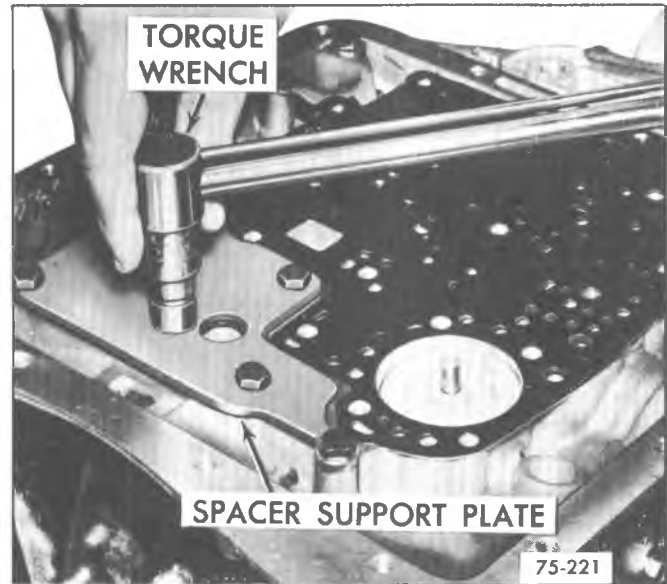


Fig. 7A-16B--Removing Transfer (Spacer) Support Plate

- detent actuating lever (fig. 7A-15B). Refer to valve body disassembly.
3. Remove transfer plate support bolts. Remove transfer support plate (fig. 7A-16B).
4. Remove upper gasket, valve body transfer (spacer) plate and valve body transfer (spacer plate to case gasket (fig. 7A-17B).

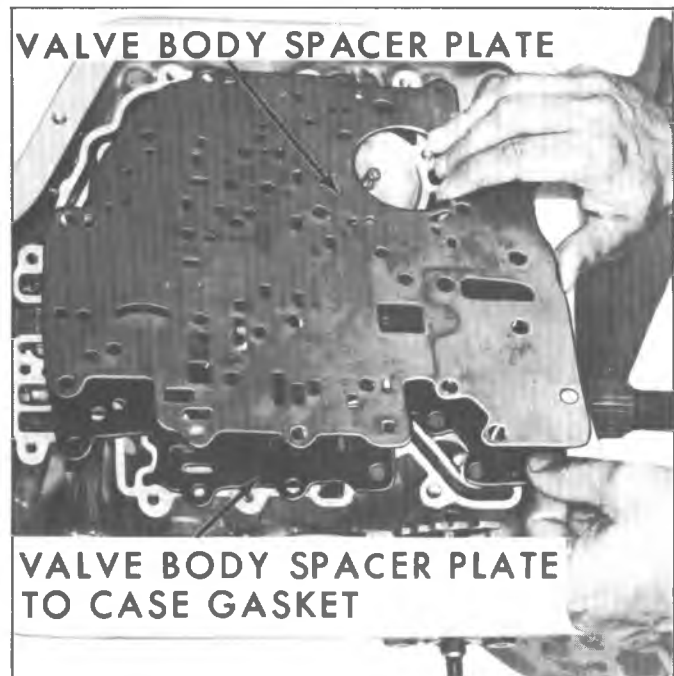


Fig. 7A-17B--Removing Valve Body Transfer (Spacer) Plate and Gasket

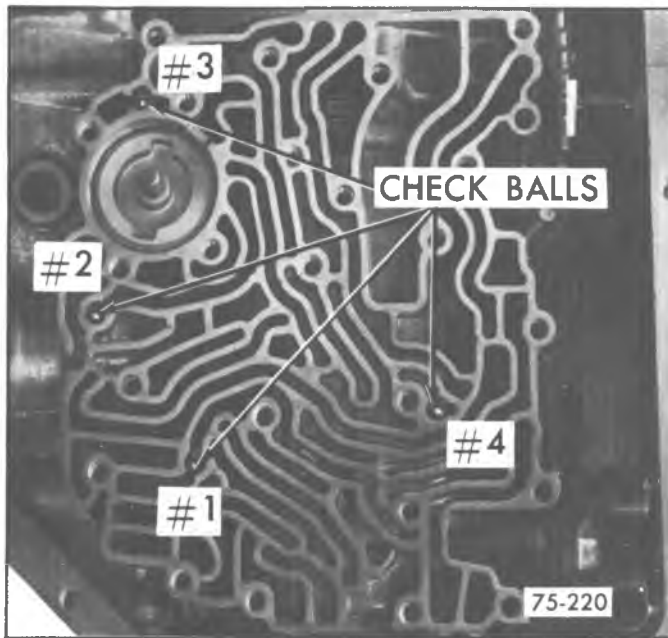


Fig. 7A-18B--Check Ball Four (4) Locations



Fig. 7A-20B--Removing Governor Feed Screen

5. Remove four (4) check balls from correct passages in case face (fig. 7A-18B).

6. Remove oil pump pressure screen from oil pump pressure hole in case (fig. 7A-19B).

7. Remove governor feed screen from governor feed hole (drive oil) in case (fig. 7A-20B).

**NOTE:** on JA and JH models, there are two governor feed screens.

8. Remove manual shaft to case retainer with screwdriver (fig. 7A-21B).

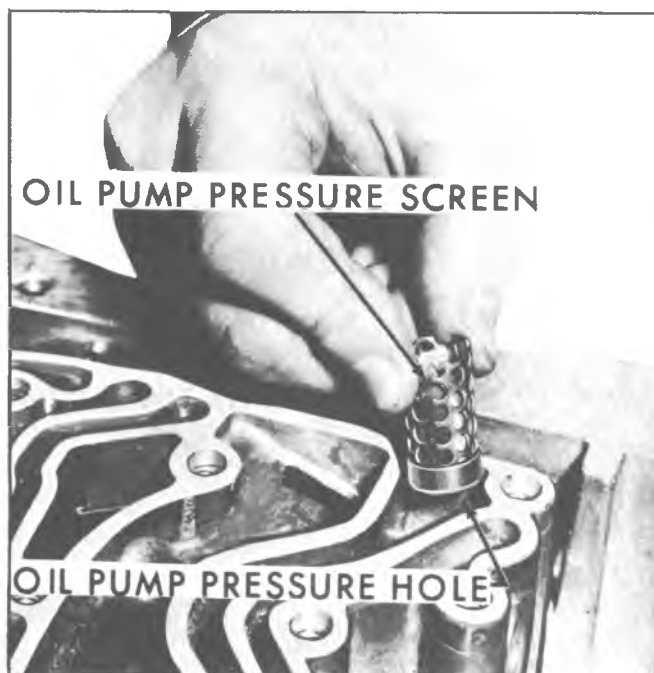


Fig. 7A-19B--Removing Oil Pump Pressure Screen

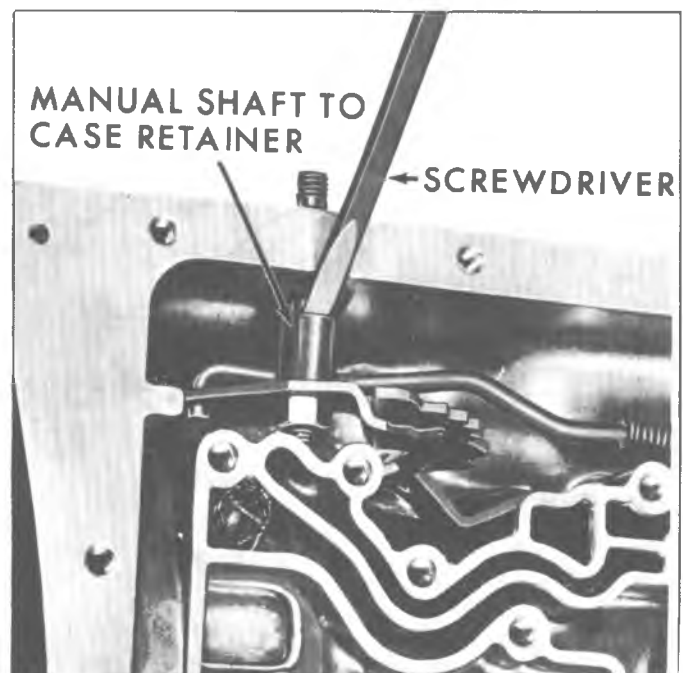


Fig. 7A-21B--Removing Manual Shaft to Case Retainer

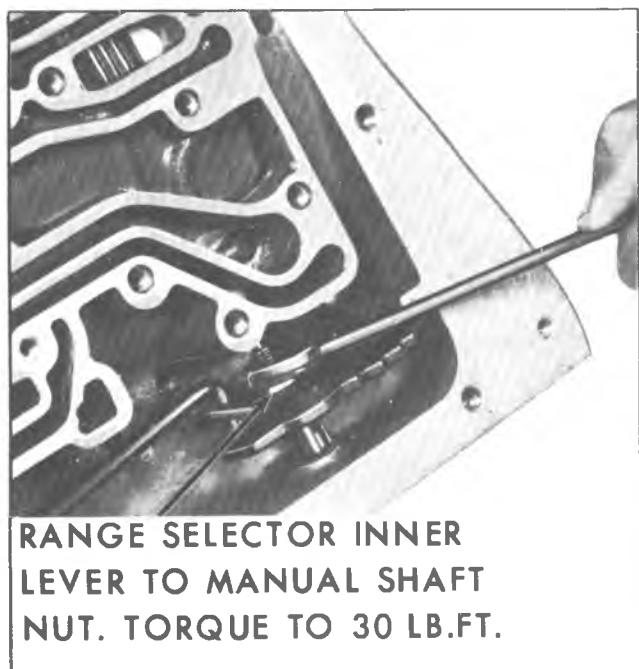


Fig. 7A-22B--Loosening Nut Holding Range Selector Inner Lever to Manual Shaft



Fig. 7A-24B--Removing Manual Shaft to Case Lip Seal

9. Loosen nut holding range selector inner lever to manual shaft (fig. 7A-22B).

10. Remove range selector inner lever from manual shaft. Remove manual shaft from case. Remove inner lever and parking pawl actuator rod from case. Disassembly inner lever from parking pawl actuator rod (fig. 7A-23B).

11. Remove manual shaft to case lip seal (fig. 7A-24B).

12. Remove parking lock; lock bracket (fig. 7A-25B). (Special Bolts).



Fig. 7A-23B--Removing Manual Shaft and Inner Lever and Parking Pawl Actuator Rod from Case

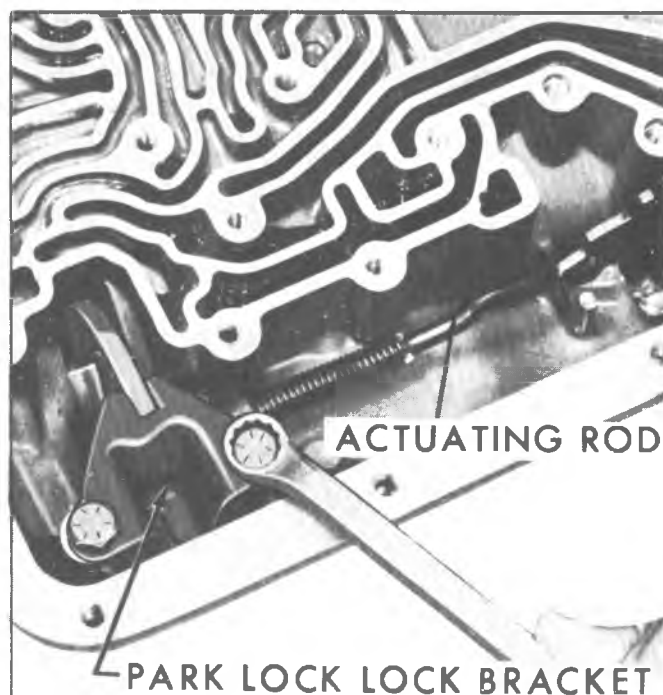


Fig. 7A-25B--Removing Park Lock, Lock Bracket



Fig. 7A-26B--Removing Parking Pawl Disengaging Spring

13. Remove parking pawl disengaging spring (fig. 7A-26B).

14. Remove parking pawl shaft retaining plug, parking pawl shaft, and parking pawl (fig. 7A-27B) if replacement is required.

**NOTE:** The parking pawl shafts retaining plug may be removed by using a bolt extractor.

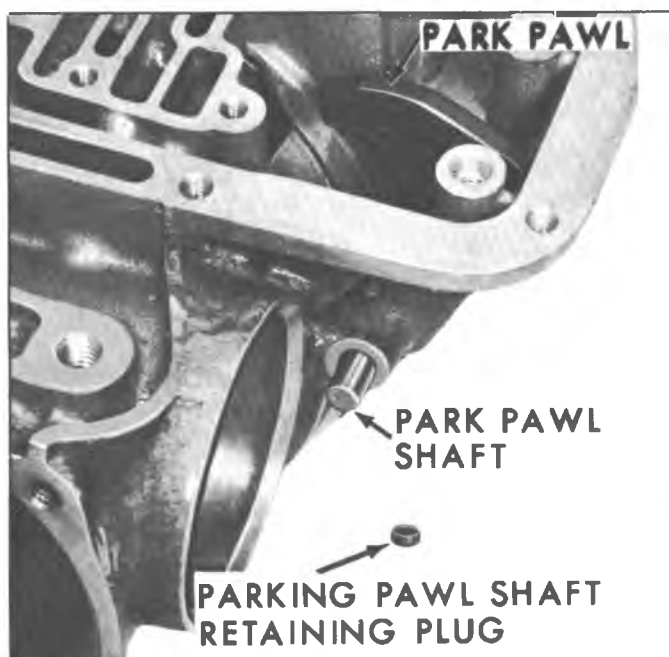


Fig. 7A-27B--Parking Pawl Shaft Retaining Plug, Parking Pawl Shaft and Parking Pawl

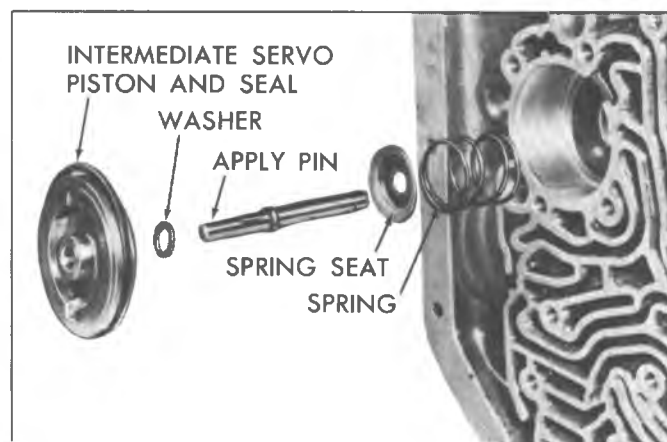


Fig. 7A-28B--Intermediate Servo Piston and Related Parts

15. Remove intermediate servo piston and seal ring. Remove washer, spring seat and apply pin (fig. 7A-28B).

### REMOVAL OF OIL PUMP AND INTERNAL CASE COMPONENTS

1. Remove eight (8) pump attaching bolts with washer type seals (fig. 7A-29B).



Fig. 7A-29B--Removing Pump Attaching Bolts





Fig. 7A-30B--Removing Pump from Case

2. Install two (2) threaded slide hammers J-7004 into threaded holes in pump body and remove pump assembly from case (fig. 7A-30B). Discard pump gasket.

3. Remove intermediate clutch cushion spring (fig. 7A-31B).



Fig. 7A-31B--Removing Intermediate Clutch Cushion Spring

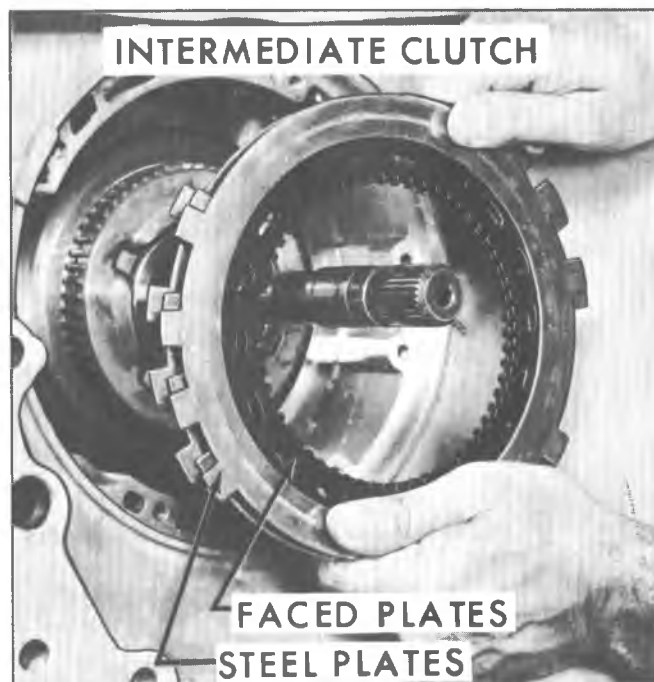


Fig. 7A-32B--Removing Intermediate Clutch Plates

4. Remove intermediate clutch drive plates and steel reaction plates (fig. 7A-32B).

5. Remove intermediate clutch pressure plate (fig. 7A-33B).

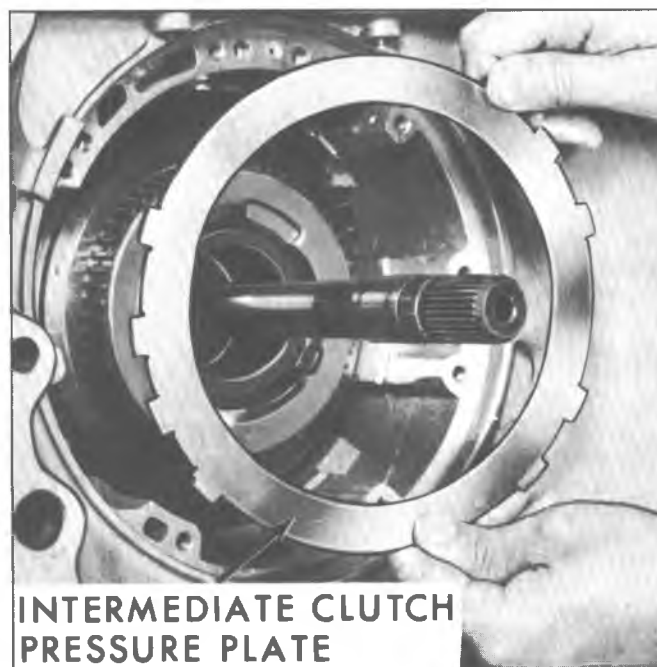


Fig. 7A-33B--Removing Intermediate Clutch Pressure Plate

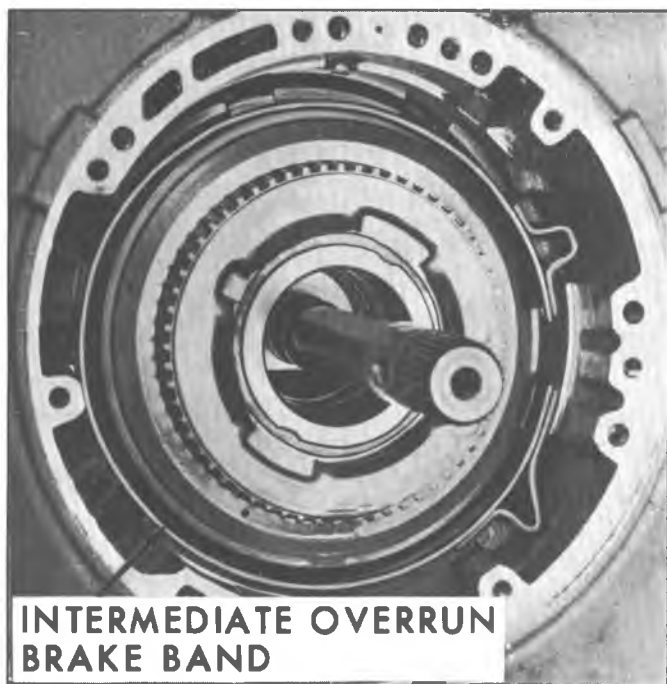


Fig. 7A-34B--Removing Intermediate Overrun Brake Band

6. Remove intermediate overrun brake band (fig. 7A-34B).

7. Pull outward on the input shaft to remove the direct and forward clutch assemblies from case (fig. 7A-35B).

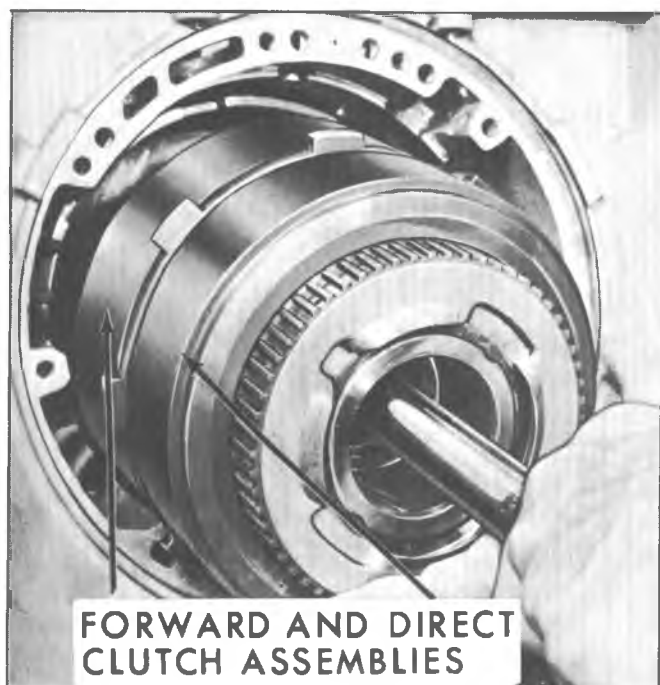


Fig. 7A-35B--Removing Direct and Forward Clutch Assemblies

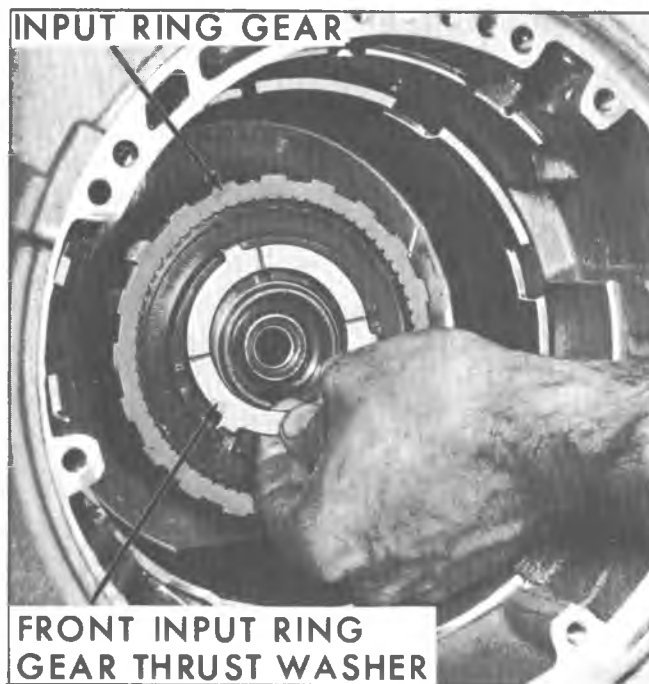


Fig. 7A-36B--Removing Input Ring Gear Front Thrust Washer

8. Remove input ring gear front thrust washer (fig. 7A-36B).

**NOTE:** Washer has 3 tangs.

9. Remove input ring gear to output shaft snap ring (fig. 7A-37B).

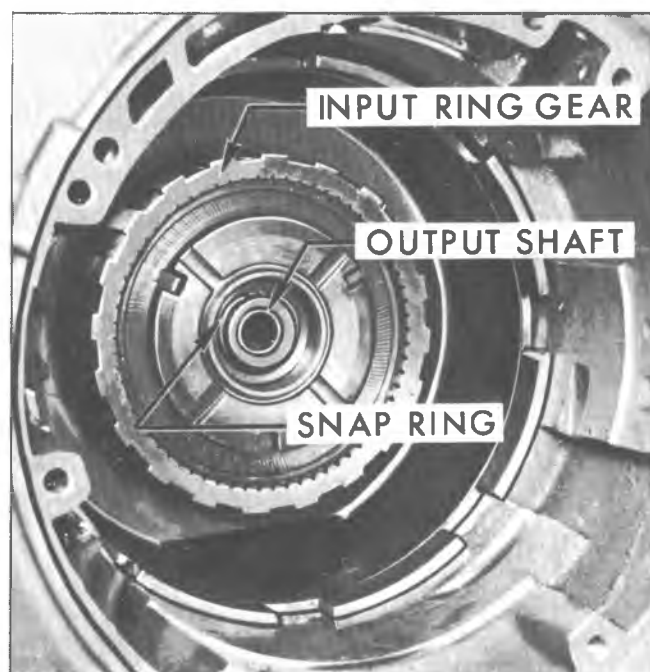


Fig. 7A-37B--Removing Input Ring Gear to Output Shaft Snap Ring

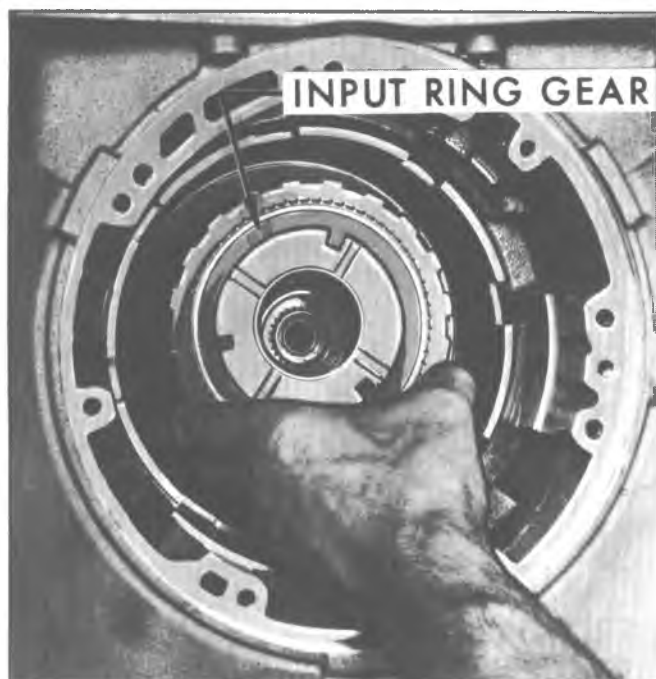


Fig. 7A-38B--Removing Input Ring Gear

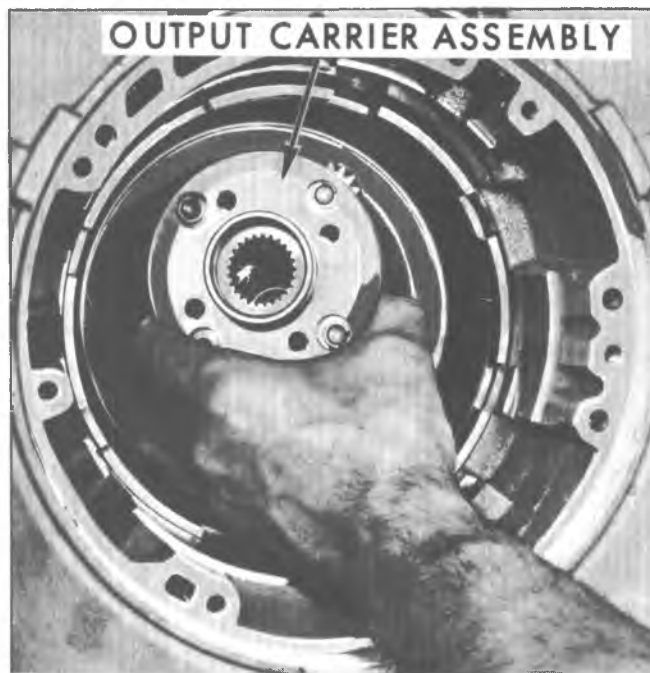


Fig. 7A-40B--Removing Output Carrier Assembly

10. Remove input ring gear (fig. 7A-38B).

11. Remove input ring gear rear (output carrier) thrust washer (fig. 7A-39B).

12. Remove output carrier assembly (fig. 7A-40B).

13. Remove sun gear drive shell assembly (fig. 7A-41B).

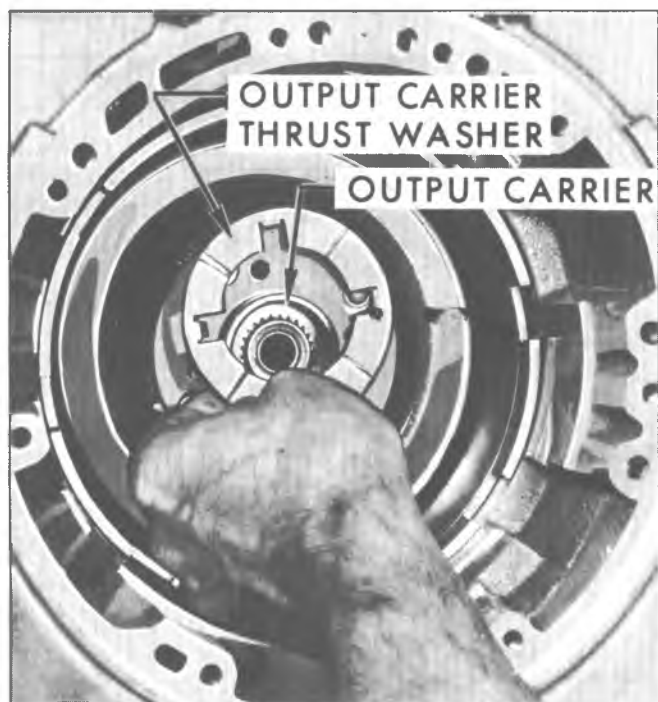


Fig. 7A-39B--Removing Input Ring Gear Rear Thrust Washer



Fig. 7A-41B--Removing Sun Gear Drive Shell



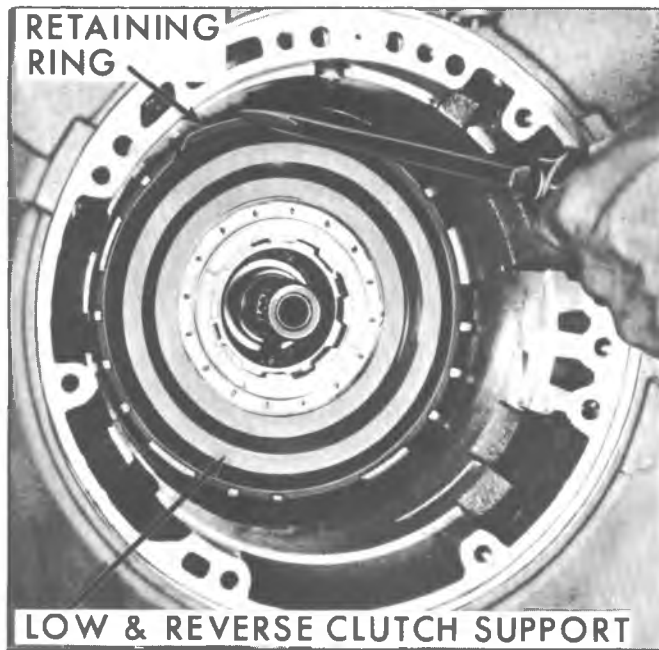


Fig. 7A-42B--Removing Low and Reverse Clutch Support Retaining Ring

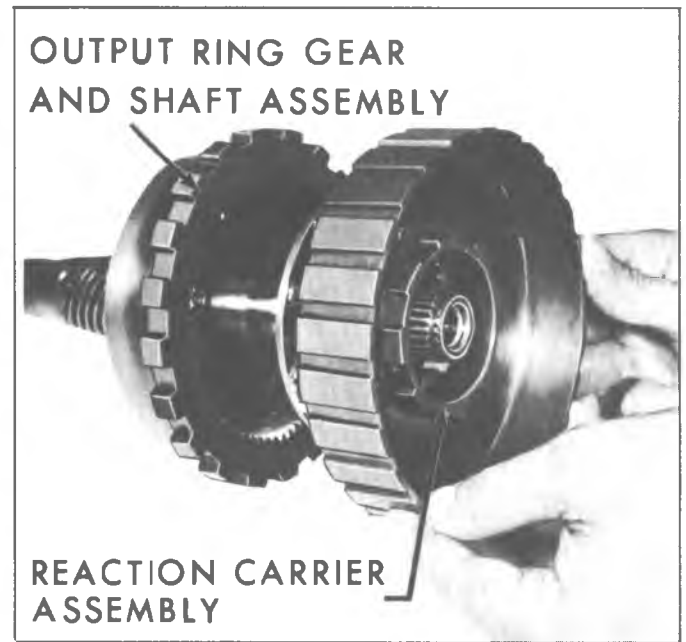


Fig. 7A-44B--Removing Reaction Carrier Assembly

14. Remove low and reverse roller clutch support to case retaining ring (fig. 7A-42B).

15. Remove low and reverse clutch support and race assembly and anti-clunk spring.

16. Remove low and reverse clutch plates and steel reaction plates (fig. 7A-43B).

17. Remove reaction carrier assembly from output ring gear and shaft assembly (fig. 7A-44B).

18. Remove output ring gear and shaft assembly from case (fig. 7A-45B).

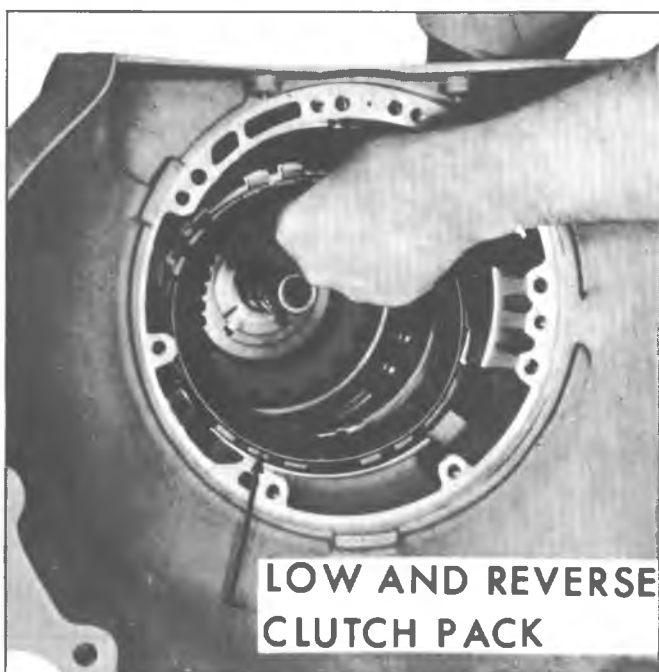


Fig. 7A-43B--Removing Low and Reverse Clutch Pack

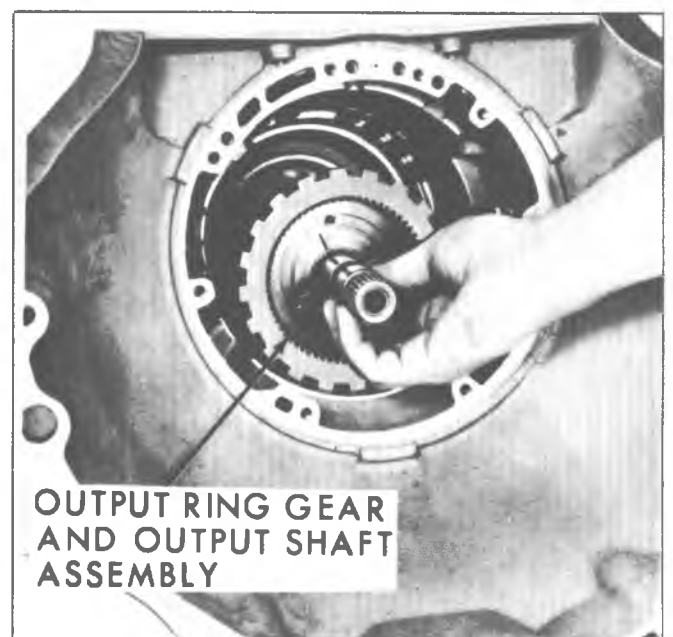


Fig. 7A-45B--Removing Output Ring Gear and Shaft Assembly

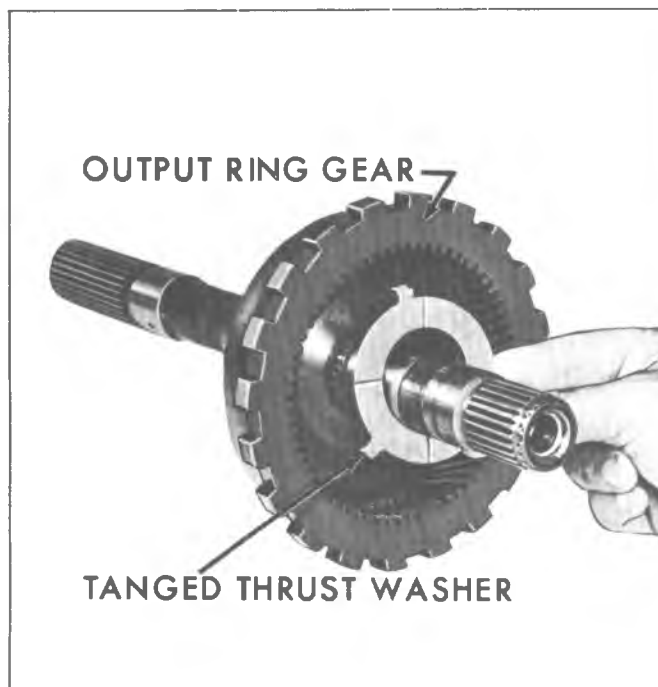


Fig. 7A-46B--Removing Output Ring Gear Torrington Bearing

**NOTE:** On models so equipped, also remove grease pack sleeves from output shaft before taking shaft from case.

19. Remove reaction carrier-to-output ring gear torrington bearing (fig. 7A-46B).

20. Remove output ring gear to case needle bearing assembly (fig. 7A-47B).

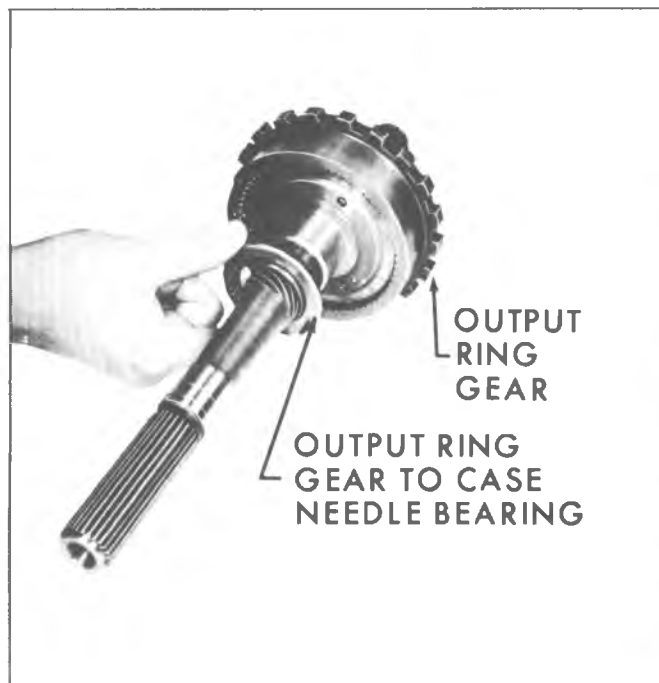


Fig. 7A-47B--Removing Output Ring Gear to Case Needle Bearing Assembly

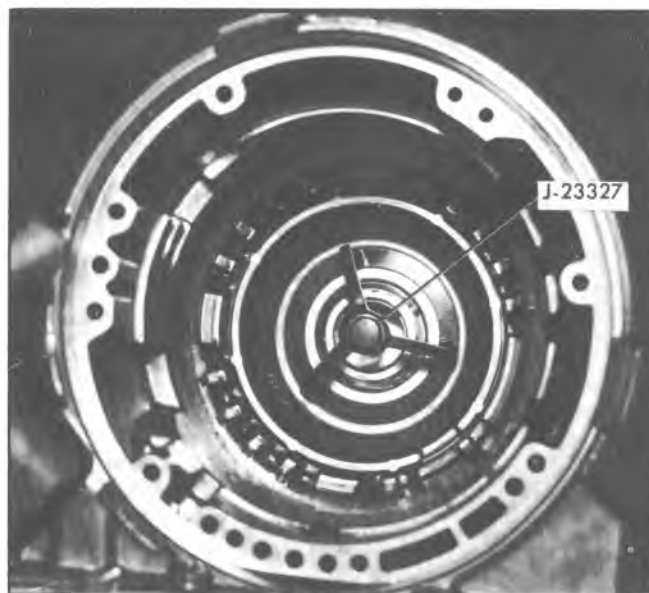


Fig. 7A-48B--Compressing Low and Reverse Clutch Piston Spring Retainer

21. Compress low and reverse clutch piston spring retainer using tool J-23327 (fig. 7A-48B) and remove piston retaining ring and spring retainer.

22. Remove seventeen (17) piston springs from piston (fig. 7A-49B).

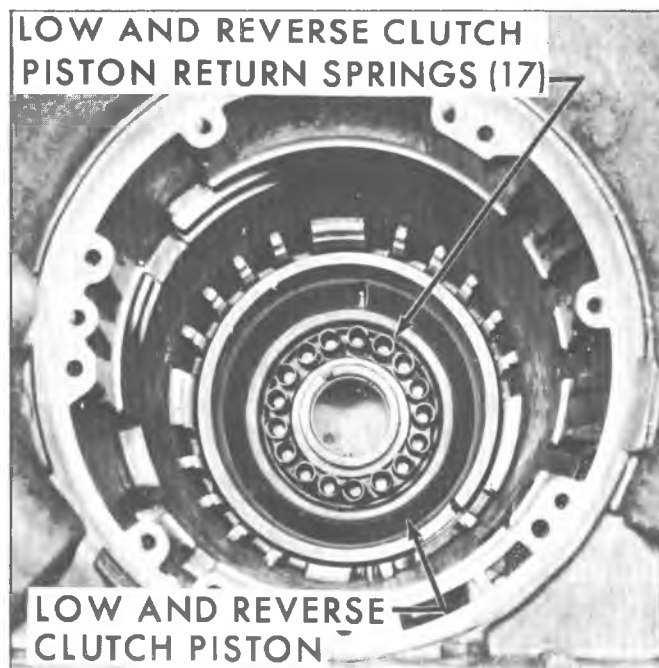


Fig. 7A-49B--Low and Reverse Clutch Piston Springs and Piston



Fig. 7A-50B--Removing Low and Reverse Clutch Piston

23. Remove low and reverse clutch piston assembly by applying compressed air in passage shown on Figure 7A-50B.

24. Remove low and reverse clutch piston outer seal (fig. 7A-51B).

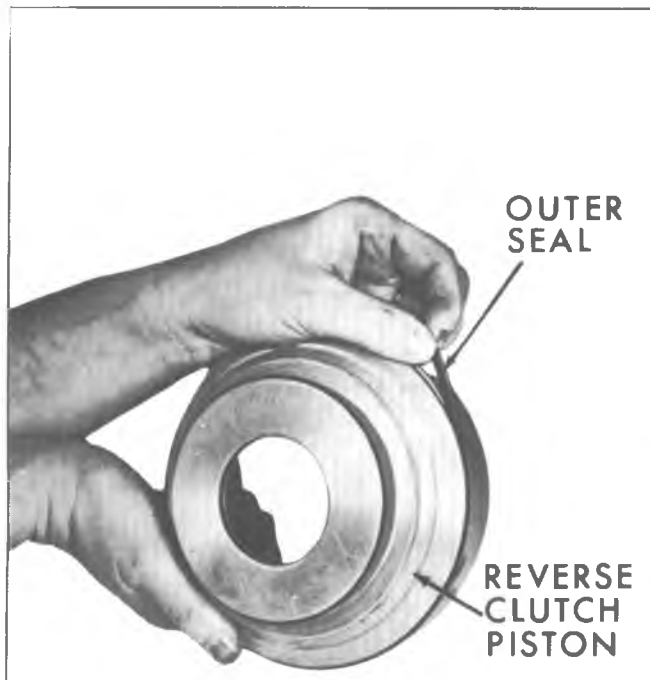


Fig. 7A-51B--Removing Low and Reverse Clutch Piston Outer Seal

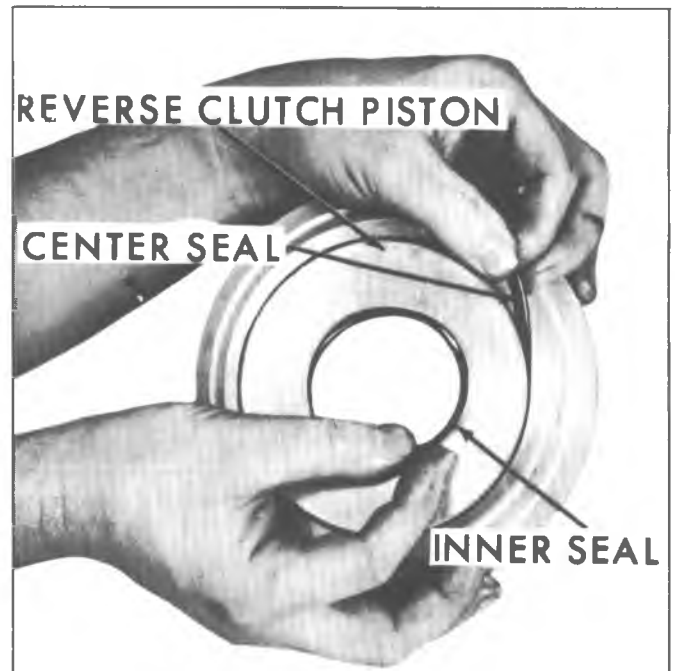


Fig. 7A-52B--Removing Low and Reverse Clutch Piston Center and Inner Seal

25. Remove low and reverse clutch piston center and inner seal (fig. 7A-52B).

26. Install tool J-23069 to compress intermediate clutch accumulator piston cover and remove retaining ring (fig. 7A-53B).

27. Remove intermediate clutch accumulator piston cover and remove "O" ring seal from case.

28. Remove intermediate clutch accumulator piston spring.

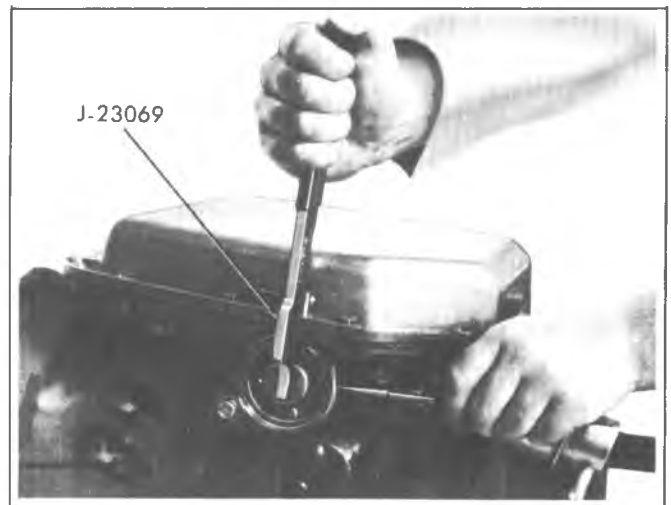


Fig. 7A-53B--Removing Accumulator Piston Cover Retaining Ring

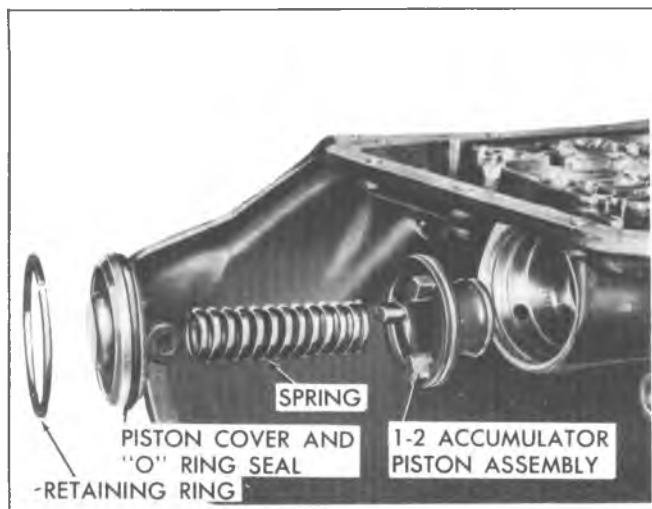


Fig. 7A-54B--Intermediate Clutch Accumulator Components

30. Also, remove inner and outer hook type oil seal rings if required.

29. Remove intermediate clutch accumulator piston assembly (fig. 7A-54B).

## VALVE BODY DISASSEMBLY, INSPECTION, AND REASSEMBLY (FIG. 7A-56B)

### Disassembly

1. Position valve body assembly with cored face up and direct clutch accumulator piston pocket positioned as shown in Figure 7A-56B.

2. Remove manual valve from lower left hand bore.
3. From lower right hand bore remove the pressure regulator valve train retaining pin, boost valve sleeve, intermediate boost valve, reverse and modulator boost valve, pressure regulator valve spring, and the pressure regulator valve.
4. From the next bore, remove the 2-3 shift valve train retaining pin, sleeve, control valve spring, 2-3 shift control valve, shift valve spring, and the 2-3 shift valve.
5. From the next bore, remove the 1-2 shift valve train retaining pin, sleeve, shift control valve spring, 1-2 shift control valve, and the 1-2 shift valve.
6. From the next bore, remove retaining pin, plug, manual low control valve spring, and the manual low control valve.
7. From the next bore, remove the retaining pin, spring, seat, and the detent regulator valve.
8. Install Tools J-22269 and J-24675 on direct clutch accumulator piston and compress piston only enough to remove retaining "E" ring (fig. 7A-55B).

**CAUTION:** *Piston may be damaged if piston is over compressed.*

9. Remove direct clutch accumulator piston, and metal oil seal ring, and spring.
10. From the next bore down from the direct clutch accumulator, remove the detent actuating lever bracket bolt, bracket, actuating lever and retaining pin, stop, spring retainer, seat, outer spring, inner spring, washer and detent valve.

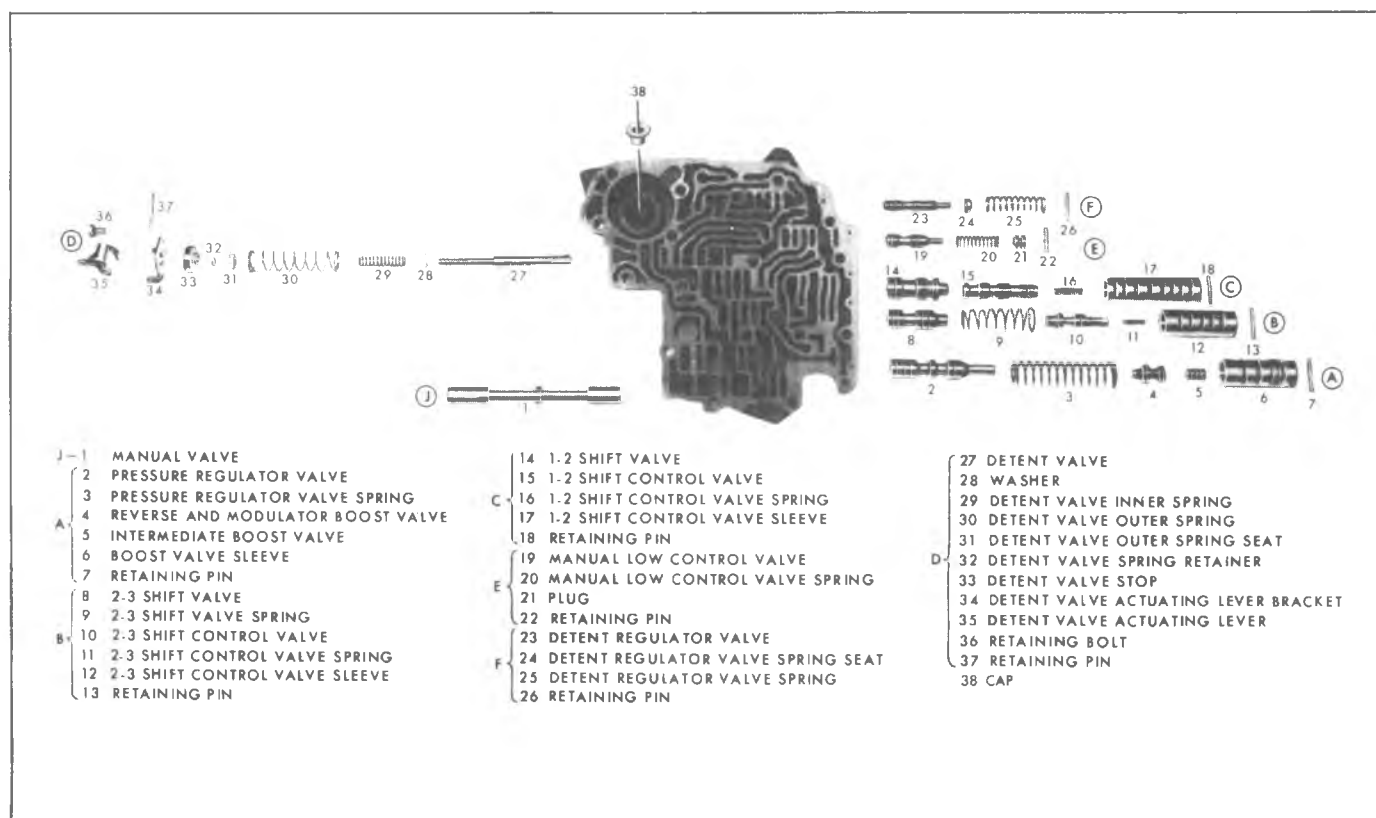


Fig. 7A-56B--Valve Body - Exploded View



Fig. 7A-55B--Removing Direct Clutch Accumulator Piston Retaining "E" Ring

### Inspection

1. Inspect all valves for scoring, cracks and free movement in their respective bores.
2. Inspect valve body for cracks, scored bores, interconnected oil passages and flatness of mounting face.
3. Check all springs for distortion or collapsed coils.

### Reassembly

1. Install direct clutch accumulator piston spring and piston into valve body.

2. Install special tools J-22269 and J-24675 and compress spring and piston only enough to install retaining ring.

**NOTE:** Align piston and oil seal ring when entering bore.

3. Install the detent valve, washer, outer spring, inner spring, spring seat, and spring retainer. Install detent valve stop and detent valve actuating bracket. Torque bolt to 52 in. lbs. Assemble detent actuating lever with retaining pin.

4. Install the pressure regulator valve, spring, reverse and modulator boost valve, intermediate boost valve, boost valve sleeve and retaining pin.

5. In the next bore up, install 2-3 shift valve, shift valve spring, 2-3 shift control valve, shift control valve spring, shift control valve sleeve and retaining pin.

6. In the next bore up, install the 1-2 shift valve, 1-2 shift control valve, control valve spring, control valve sleeve and retaining pin.

7. In the next bore up, install the manual low control valve, spring, plug and retaining pin.

8. In the top right hand bore, install the detent regulator valve, spring seat, spring and retaining pin.

### OIL PUMP (FIG. 7A-57B)

#### Disassembly

1. Place pump cover and stator shaft assembly through hole in bench.

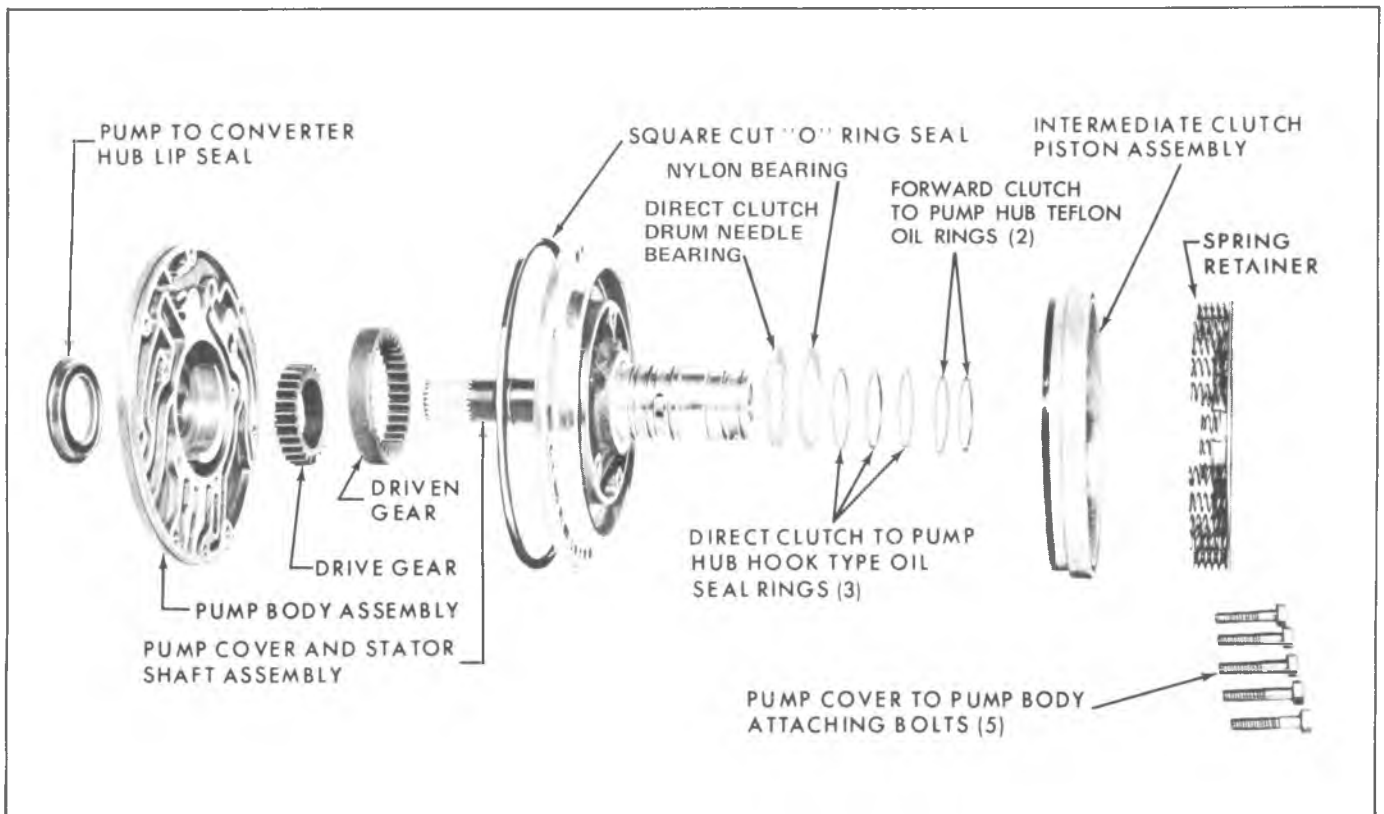


Fig. 7A-57B--Pump Assembly - Exploded View

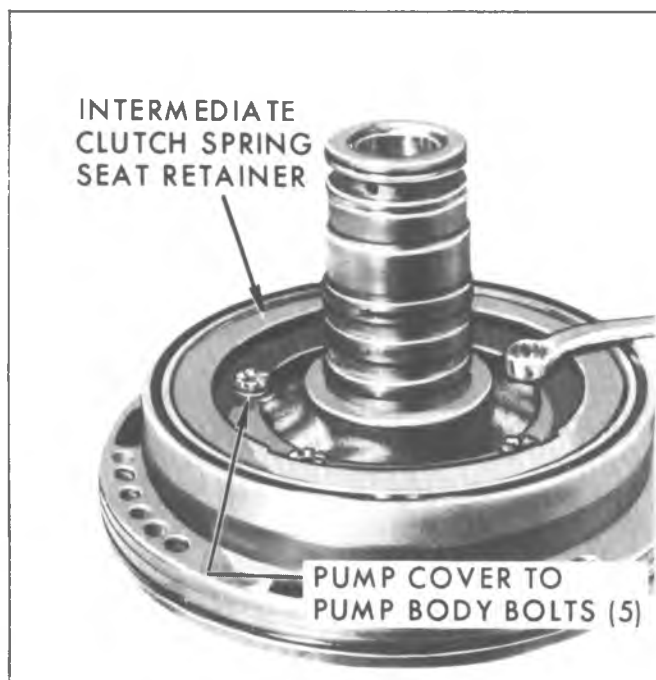


Fig. 7A-58B--Removing Pump Cover to Pump Body Bolts

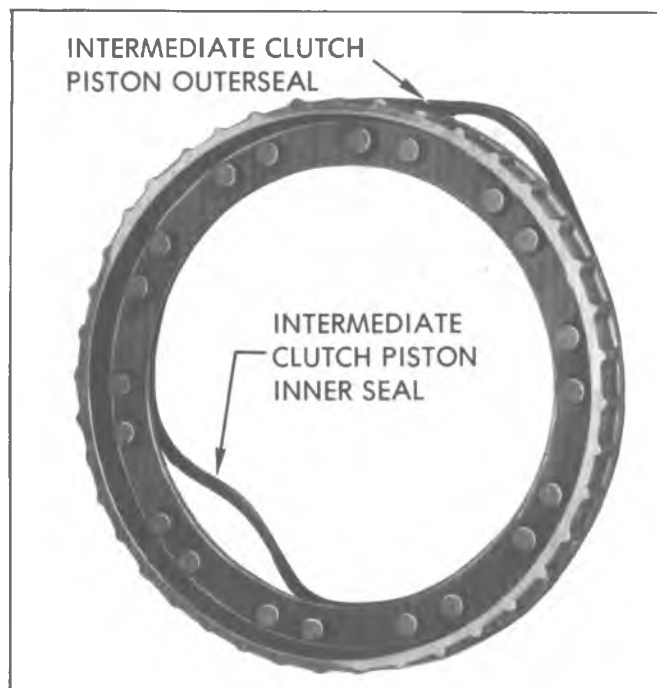


Fig. 7A-60B--Removing Intermediate Clutch Piston Inner and Outer Seal

2. Remove pump cover to body attaching bolts 5/16 x 18-1 1/2 (fig. 7A-58B).

3. Remove intermediate clutch spring retainer, twenty (20) intermediate clutch return springs and the intermediate clutch piston assembly (fig. 7A-59B).

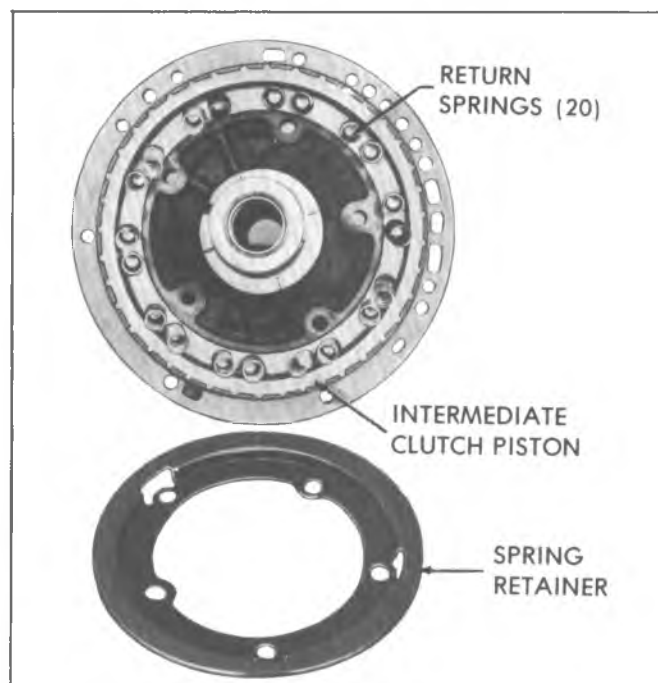


Fig. 7A-59B--Intermediate Clutch Spring Retainer, Return Springs and Piston

4. Remove intermediate clutch piston inner and outer seals (fig. 7A-60B).

5. Remove two (2) forward clutch housing to pump hub hook type oil seal rings and three (3) direct clutch drum to pump hub hook type oil rings (fig. 7A-61B).

**NOTE:** Forward clutch oil seal rings are teflon on JA and JH models.

6. Remove pump cover to direct clutch drum housing torrrington bearing (fig. 7A-61B).

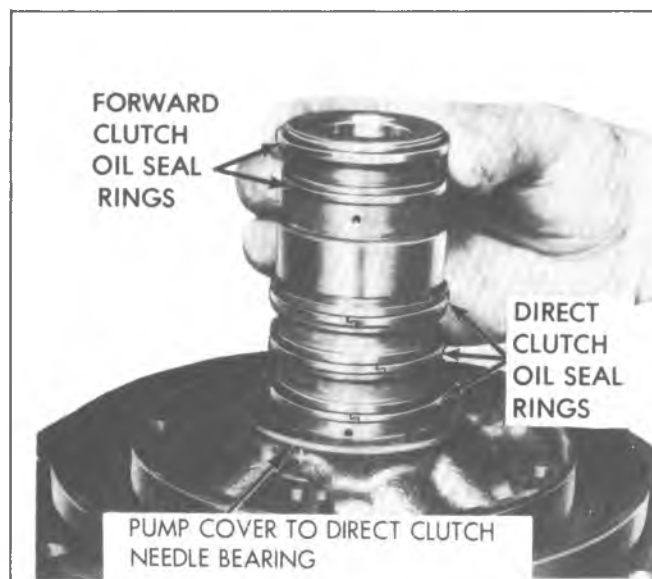


Fig. 7A-61B--Pump Hub Oil Seal Rings



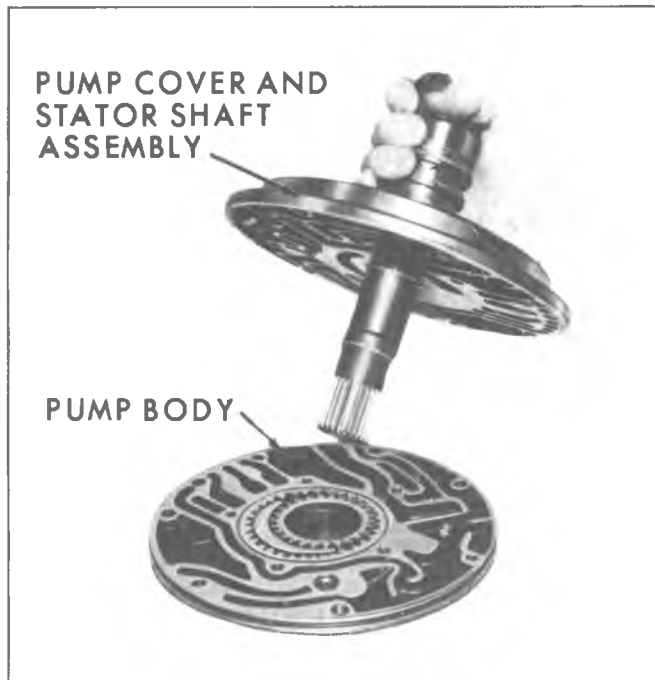


Fig. 7A-62B--Separating Pump Cover From Pump Body

7. Remove pump cover and stator shaft assembly from pump body (fig. 7A-62B).
8. Remove pump drive gear and driven gear.
9. Remove pump outside diameter to case (square cut) "O" ring seal. Discard seal.

### Inspection

1. Wash all parts in cleaning solvent and blow out all oil passages. **DO NOT USE RAGS TO DRY PARTS.**



Fig. 7A-63B--Checking Pump Body to Gear Face Clearance

**CAUTION:** Some solvents may be harmful to rubber seals.

2. Inspect pump gears for nicks or damage.
3. Inspect body and cover faces for nicks or scoring. Inspect cover hub O.D. for nicks or burrs which might damage clutch drum bushing journal.
4. Inspect body bushing for galling or scoring. Check clearance between body bushing and converter pump hub. Maximum clearance is .005". If the bushing is damaged, the oil pump body should be replaced.
5. Inspect converter housing hub O.D. for nicks or burrs which might damage pump seal or bushing. Repair or replace as necessary.
6. If hub lip seal is damaged or is leaking (and the pump body is otherwise suitable for reuse), replace seal.
7. With parts clean and dry, install pump gears in pump body and check pump body face to gear face clearance. Clearance should be .0005"-.0015" (fig. 7A-63B).

### Reassembly

1. Replace hub lip seal if defective (figs. 7A-64B and 7A-65B).

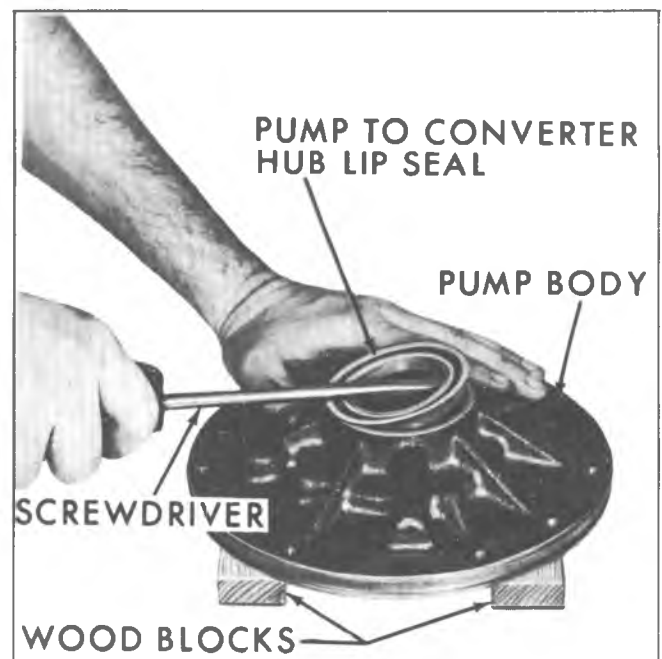


Fig. 7A-64B--Removing Pump to Converter Hub Lip Seal

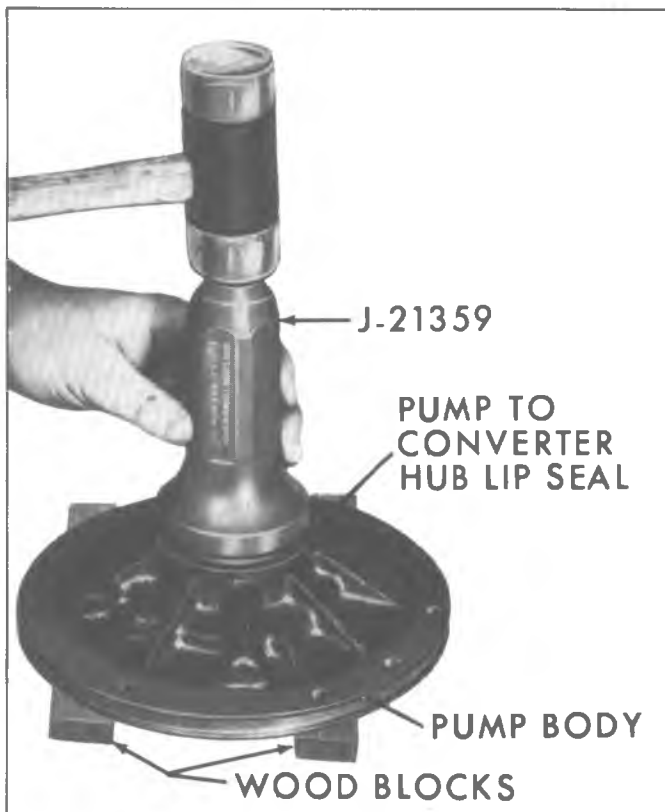


Fig. 7A-65B—Installing Hub Lip Seal

2. Place pump body on wood blocks and pry out defective seal. Coat outer diameter of new seal with a non-hardening sealer and install seal using seal installer J-21359 to seat seal fully in counterbore.

3. Install pump drive gear and driven gear (fig. 7A-66B).

4. Install direct clutch drum housing to pump cover selective thrust washer over pump cover delivery sleeve.



Fig. 7A-66B—Installing Pump Drive and Driven Gears

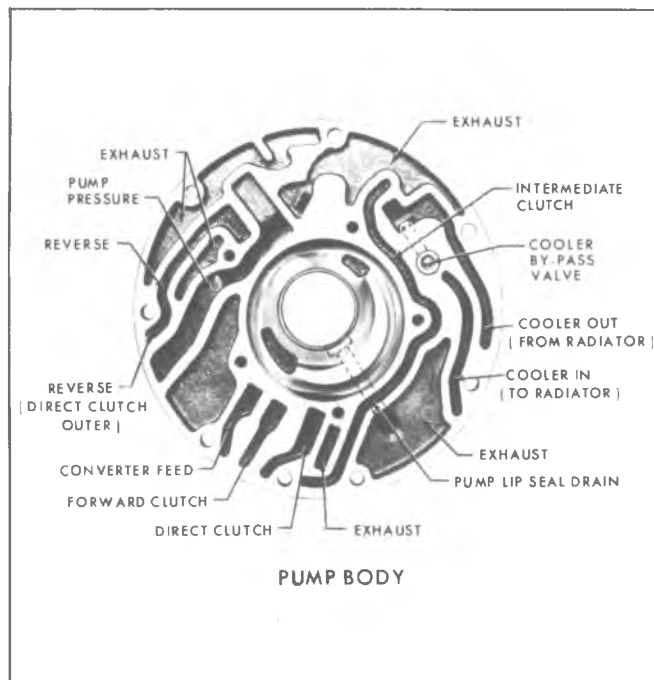


Fig. 7A-67B—Pump Body Oil Passages

5. Install three (3) direct clutch to pump hub hook type oil seal rings. Install two (2) forward clutch to pump hub hook type oil seal rings.

**NOTE:** If the (2) forward clutch-to-hub oil seals are teflon, be sure to compress the seals slightly to "set" them, to insure a tight fit on the hub. Use care when assembling the forward clutch not to damage the seals.

**CAUTION:** Check pump cover and body oil passages to make sure they are not restricted (figs. 7A-67B and 7A-68B).

6. Install intermediate clutch piston inner seal and outer seal on piston.

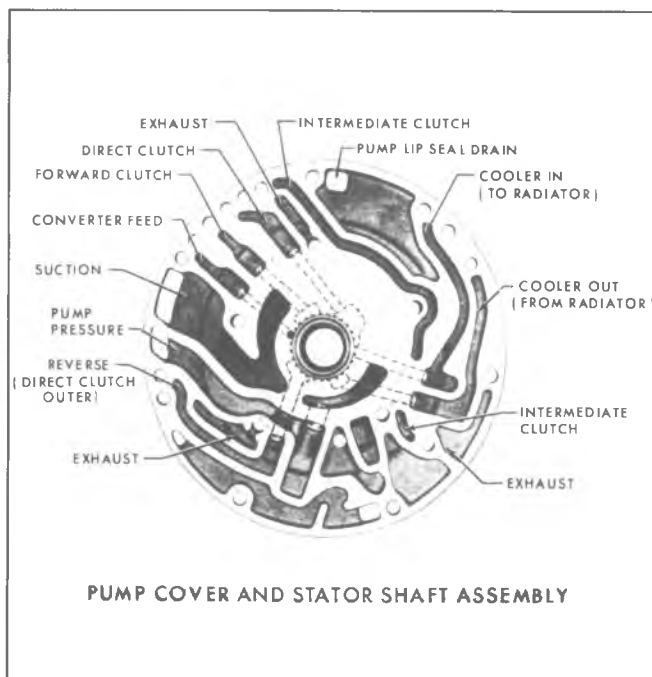


Fig. 7A-68B—Pump Cover Oil Passages



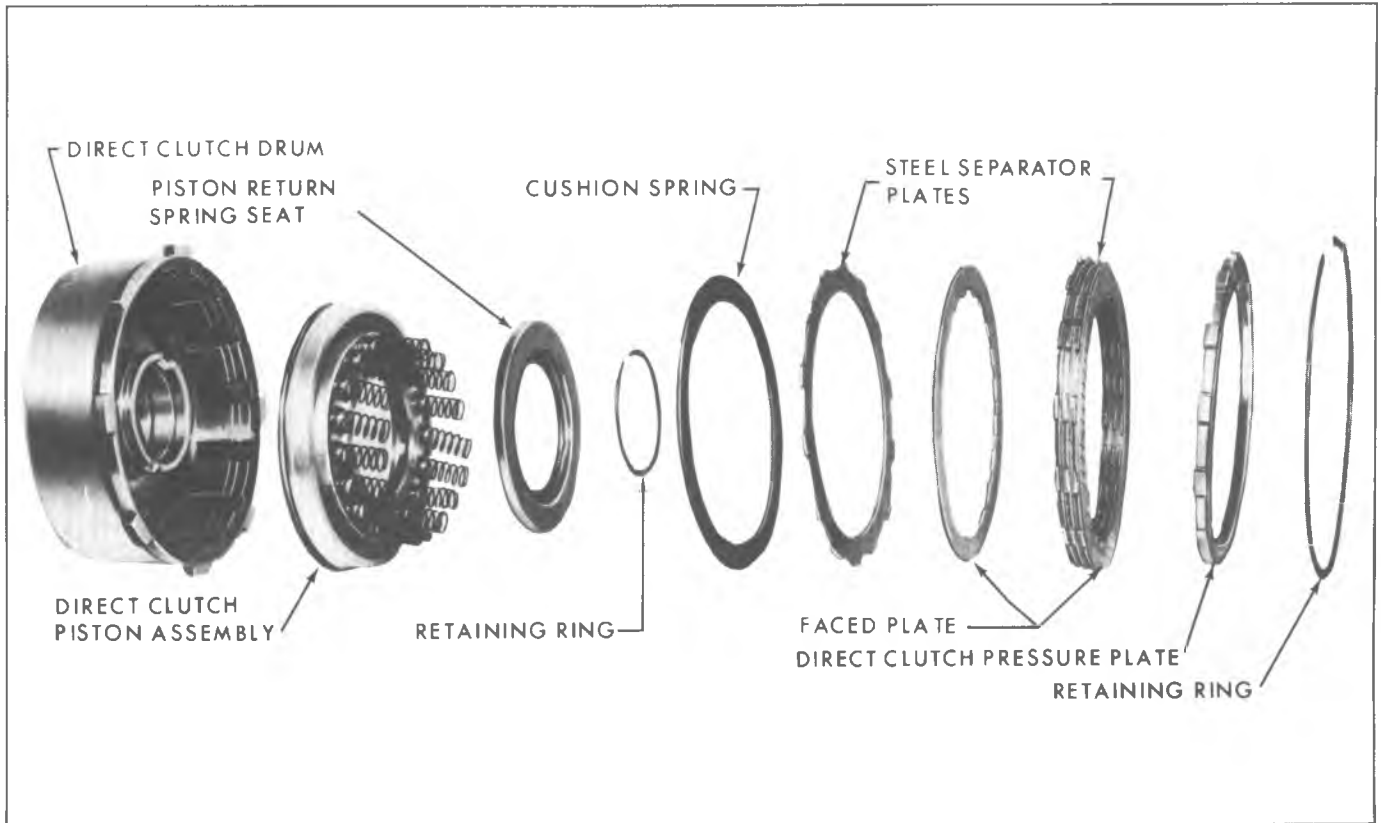


Fig. 7A-69B--Direct Clutch Assembly - Exploded View

7. Install pump outside diameter to case (square cut) "O" ring seal.

8. Install intermediate clutch piston assembly into pump cover being careful not to damage seals.

9. Install spring retainer with attached clutch return springs, align pump body to cover, and install five (5) attaching bolt. Tighten bolts to 18 pound-feet.

10. Align pump body to cover and start bolts.

## DIRECT CLUTCH AND INTERMEDIATE OVERRUN ROLLER CLUTCH (FIG. 7A-69B)

### Disassembly

1. Remove intermediate overrun clutch drum front retaining ring and retainer (fig. 7A-70B).

2. Remove intermediate clutch overrun outer race (fig. 7A-70B).

3. Remove intermediate overrun roller clutch assembly (fig. 7A-71B).

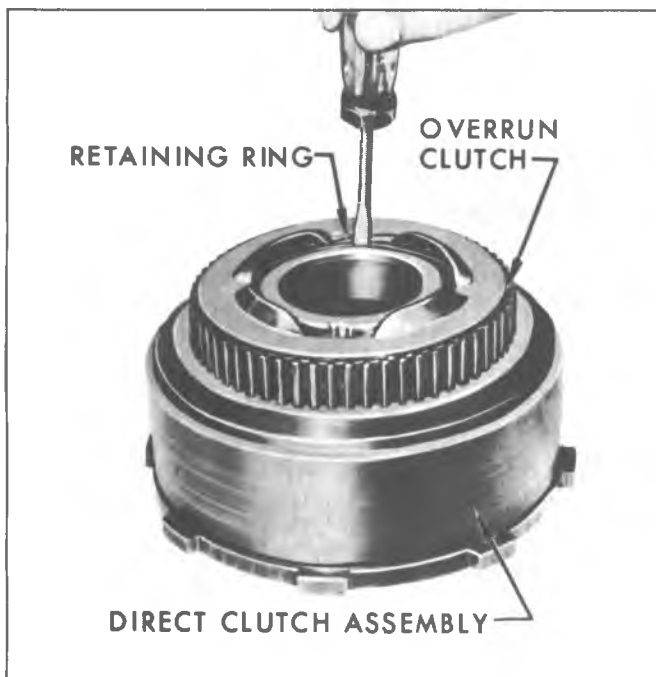


Fig. 7A-70B--Removing Overrun Clutch Retaining Ring and Retainer

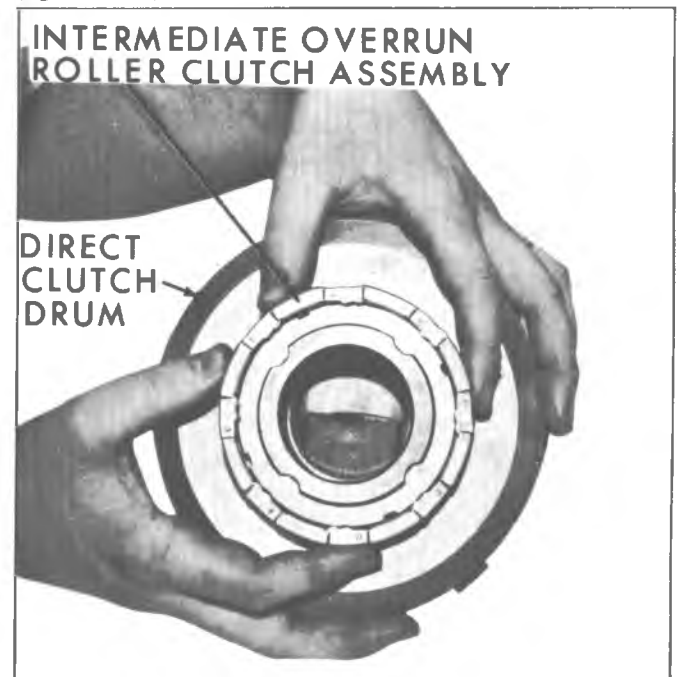


Fig. 7A-71B--Removing Intermediate Overrun Roller Clutch

**DIRECT CLUTCH DRUM TO  
FORWARD CLUTCH HOUSING  
NEEDLE ROLLER BEARING**

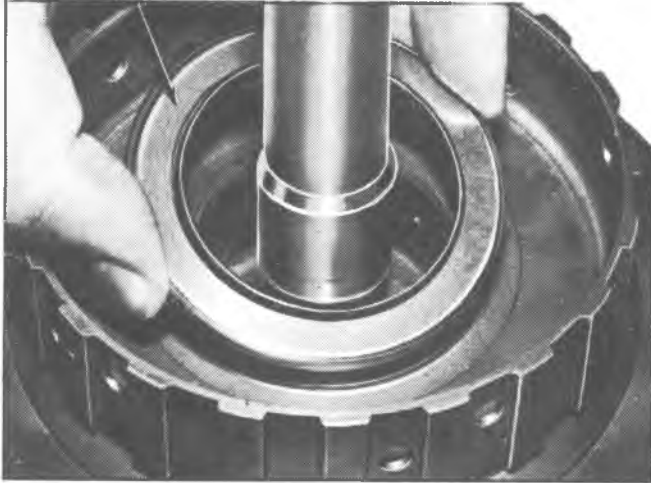


Fig. 7A-72B--Direct Clutch Drum to Forward Clutch Housing Needle Roller Bearing

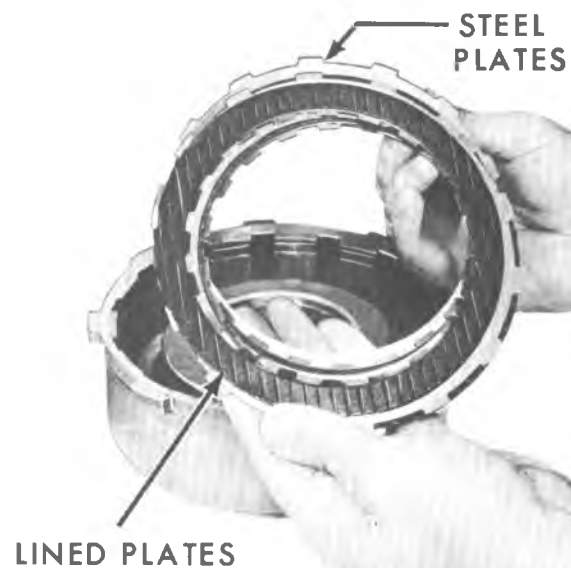


Fig. 7A-74B--Removing Drive and Driven Plates

**NOTE:** Intermediate overrun roller clutch inner race is a press fit. Do not remove unless replacement is necessary.

4. Remove direct clutch drum to forward clutch housing needle roller bearing (fig. 7A-72B).

5. Remove direct clutch pressure plate to clutch drum retaining ring and pressure plate (fig. 7A-73B).

6. Remove drive plates and steel driven plates (fig. 7A-74B).

7. Using compressor tool J-23327, remove direct clutch piston return spring seat retaining ring, spring seat and seventeen (17) clutch return coil springs (fig. 7A-75B).

**NOTE:** On JA and JH models, return coil springs are attached to retaining ring.

8. Remove direct clutch piston.

**RETAINING RING  
PRESSURE PLATE  
DIRECT CLUTCH DRUM**



Fig. 7A-73B--Removing Direct Clutch Pressure Plate

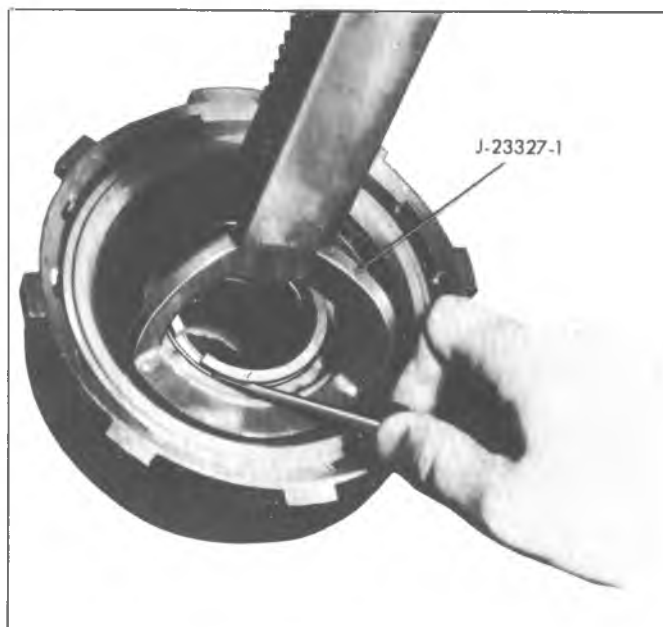


Fig. 7A-75B--Compressing Direct Clutch Spring Seat



Fig. 7A-76B--Removing Direct Clutch Outer and Inner Seals

9. Remove direct clutch piston outer seal and inner seal (fig. 7A-76B).

10. Remove direct clutch piston center seal from drum (fig. 7A-77B).

### 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.



Fig. 7A-77B--Removing Direct Clutch Piston Center Seal

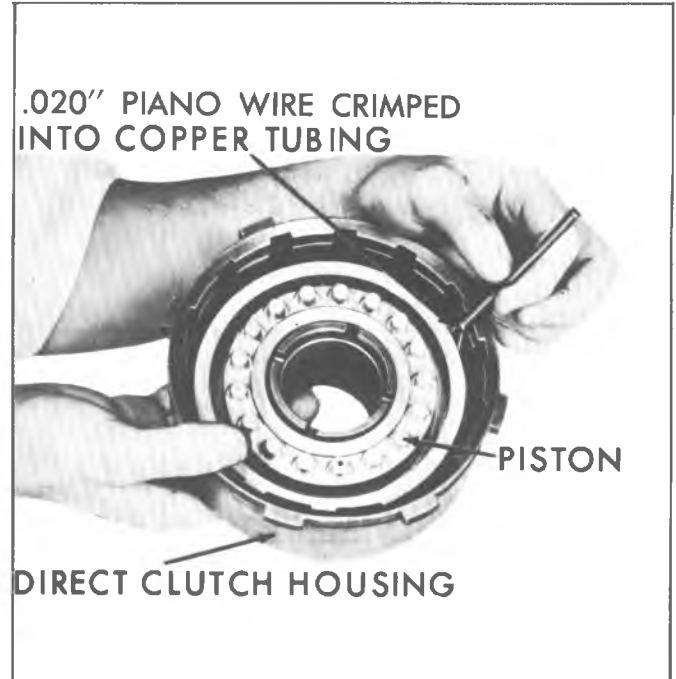


Fig. 7A-78B--Installing Direct Clutch Piston

6. Inspect roller cage for wear and roller springs for distortion.

### Reassembly

1. Install new direct clutch piston outer seal and inner seals.
2. Install new direct clutch piston center seal on drum with lip facing upward.
3. Install direct clutch piston into housing with aid of a feeler gage or a piece of .020" piano wire crimped into copper tubing (fig. 7A-78B).
4. Install seventeen (17) clutch return coil springs.
5. Install piston return spring seat. Compress spring seat with tool J-23327 and install retaining ring (fig. 7A-79B).



Fig. 7A-79B--Installing Direct Clutch Springs, Spring Seat and Retaining Ring

CLUTCH PLATES IN CBC 350								
MODELS	Intermediate Drive Driven		Direct Drive Driven		Forward Drive Driven		Low/Reverse Drive Driven	
AJ 5WB, 5TL, 5TM	3	3	4	4	4	4	5	5
AG 5WC	3	3	4	4	4	4	4	4
AN 5WL, WK, 5WZ, 5TE 5KE, 5KK	2	2	3	3	4	4	4	4

Fig. 7A-80B--Automatic Clutch Chart

6. Lubricate with transmission fluid and install face plates and steel separator plates, alternating steel and faced plates.

7. Install direct clutch pressure plate and retaining ring.

8. Install intermediate overrun roller clutch assembly with four (4) holes toward front of transmission.

**CAUTION:** If roller falls out during assembly operation, reinstall roller from inside to outside

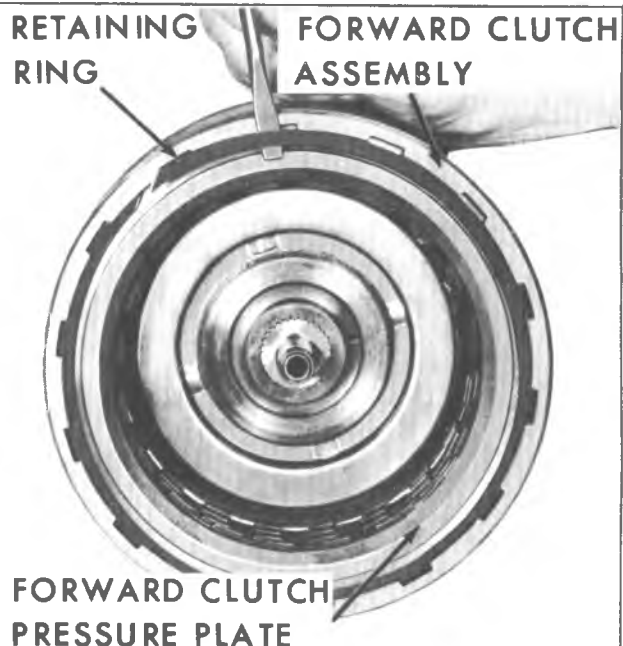


Fig. 7A-82B--Removing Forward Clutch Retaining Ring and Pressure Plate

*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 7A-70B.

### FORWARD CLUTCH (FIG. 7A-81B)

#### Disassembly

1. Remove forward clutch retaining ring and pressure plate (fig. 7A-82B).

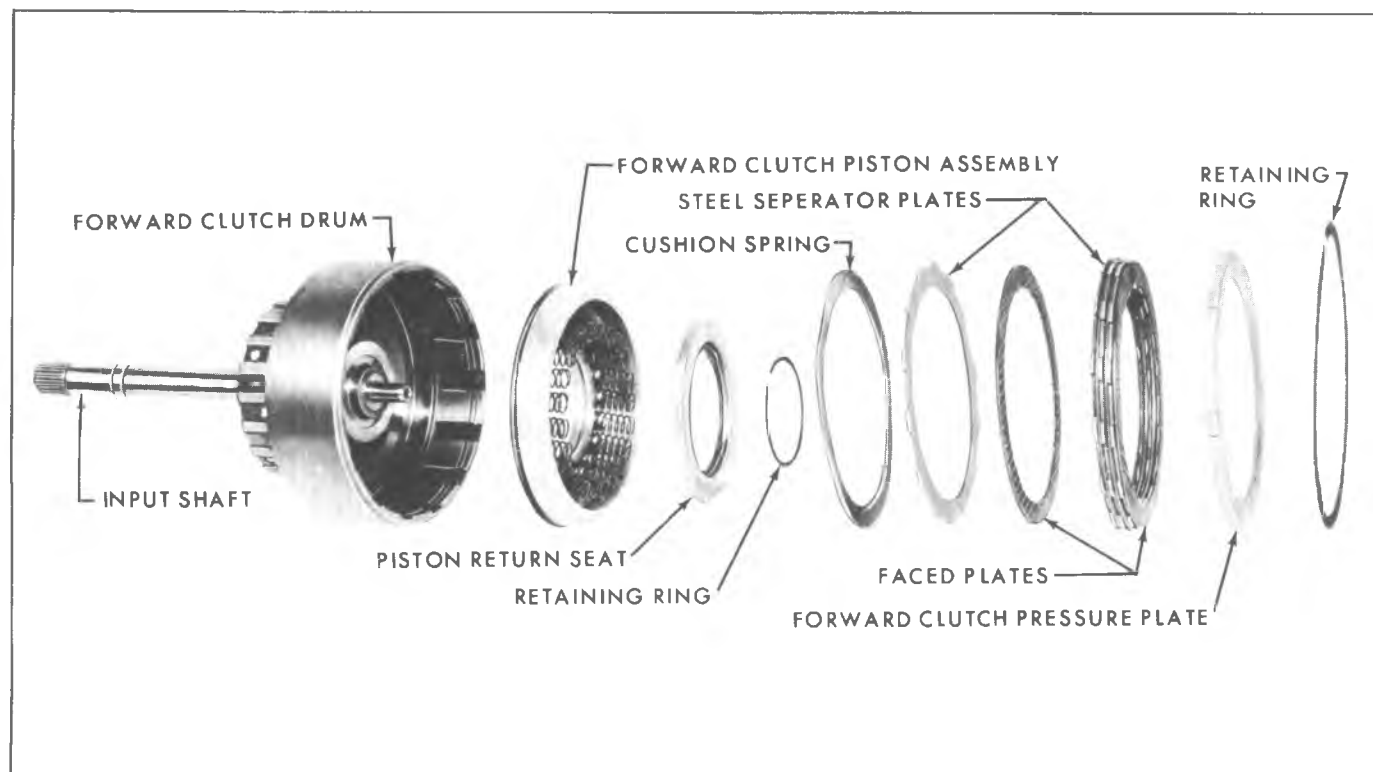


Fig. 7A-81B--Forward Clutch Assembly - Exploded View

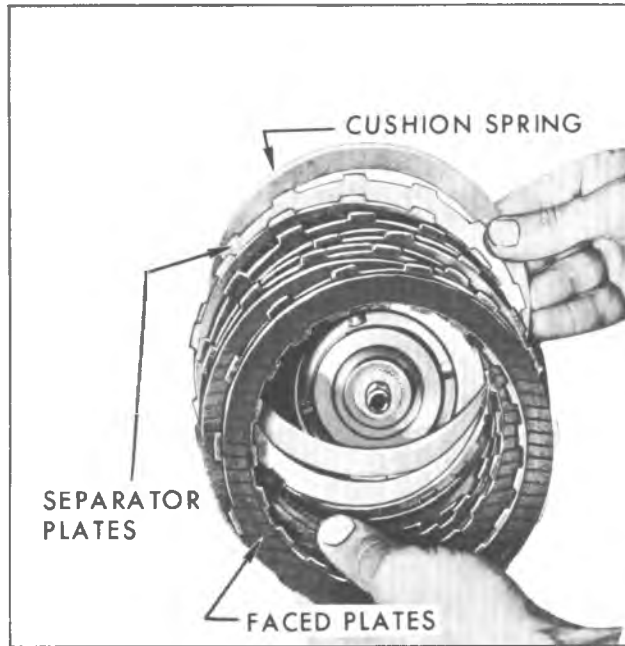


Fig. 7A-83B--Removing Forward Clutch, Clutch Pack

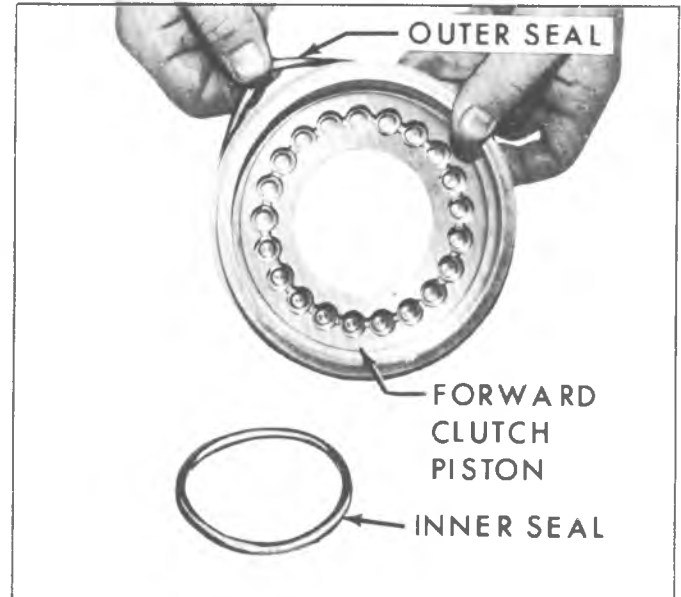


Fig. 7A-85B--Removing Forward Clutch Piston Inner and Outer Seals

2. Remove face plates, steel separator plates and cushion spring (fig. 7A-83B).

3. Using tool J-23327, compress piston return seat and remove retaining ring (fig. 7A-84B).

4. Remove piston return seat and twenty-one (21) clutch return springs.

**NOTE:** On JA and JH models, return springs are attached to return seat.

5. Remove forward clutch piston assembly.

6. Remove the forward clutch inner and outer piston seals (fig. 7A-85B).

### 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.



Fig. 7A-84B--Compressing Forward Clutch Piston Return Seat

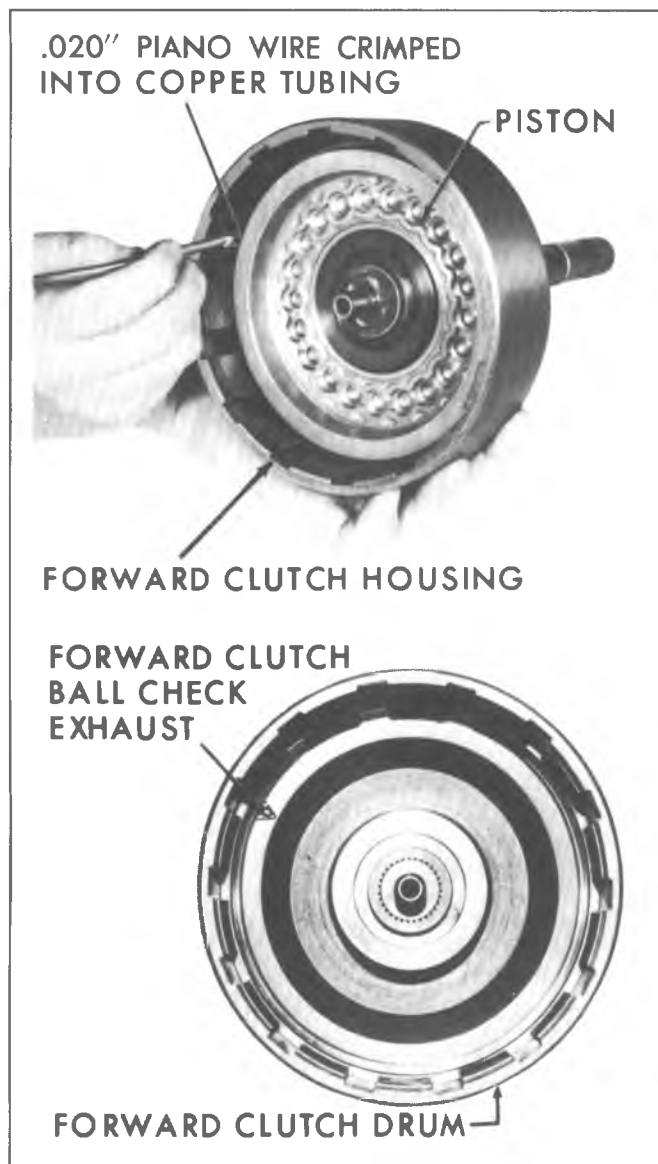


Fig. 7A-86B--Forward Clutch Exhaust Check Ball Installing Piston

4. Inspect clutch housing for wear, scoring, open oil passages and free operation of exhaust check ball (fig. 7A-86B).

**NOTE:** Input shaft and clutch housing are serviced separately.

- 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.
- e. On models with a teflon seal at the end of the input shaft, proceed as follows:

- Inspect the input shaft teflon seal ring for damage. See Figure 7A-87B. If the seal is cut or otherwise damaged, it must be replaced. Some scoring and/or scuffing of the shaft is normal. Remove seal with a sharp pointed knife by inserting under the seal and cutting, making sure not to damage the seal land area. Install new seal using J-22974 and J-9392-01. Position J-22974 with large open end on top of input shaft chamfer. Slide teflon seal partially down tool taper by hand. Position J-9392-01 or 9/16" box end wrench

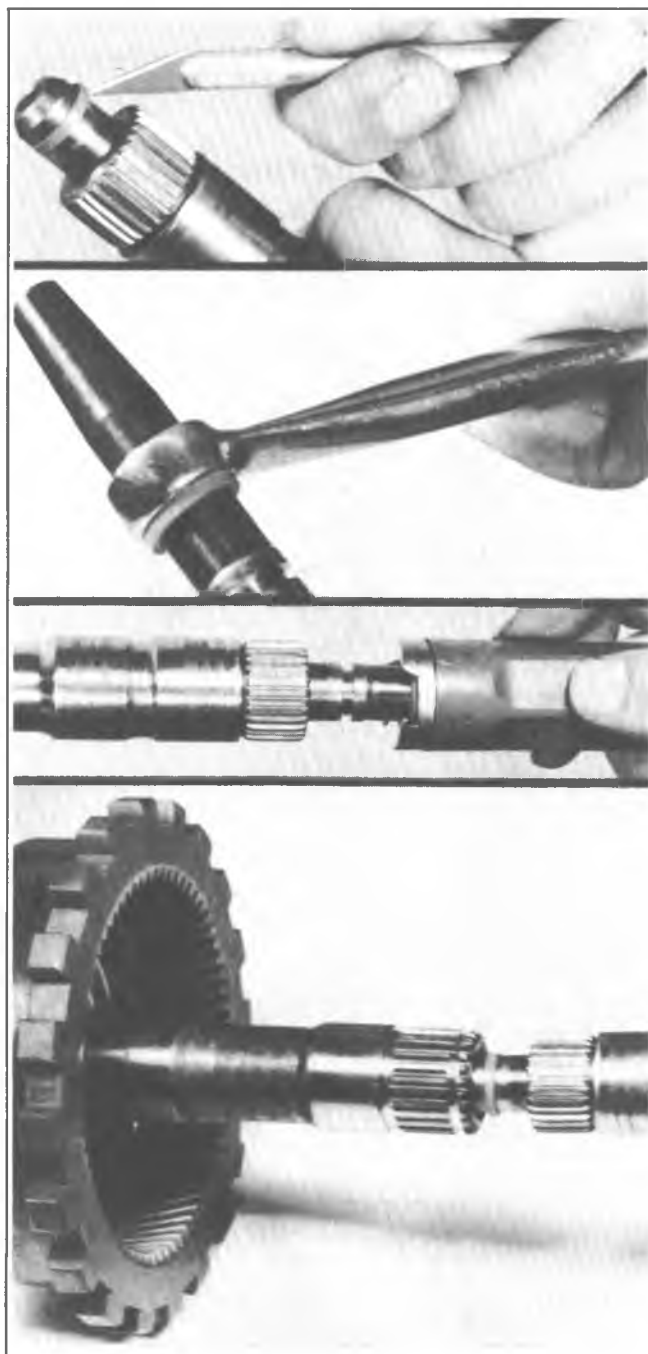


Fig. 7A-87B--Input Shaft, Teflon Seal Replacement

over end of J-22974 and slowly push teflon seal down taper and onto shaft and groove. Do not leave seal on untapered or middle of tool as this will stretch the seal excessively. After the seal is on the shaft, it must be sized. Dip end of input shaft in automatic transmission fluid to lubricate seal and shaft, and slowly insert seal and shaft into output shaft three times before final assembly of transmission. Check that seal has not been cut and is free in the groove.

### Reassembly

1. Install new forward clutch inner piston seal and outer piston seal.

2. Install the forward clutch pistons assembly with the aid of a feeler gage or a piece of .020" piano wire crimped into copper tubing (fig. 7A-86B).

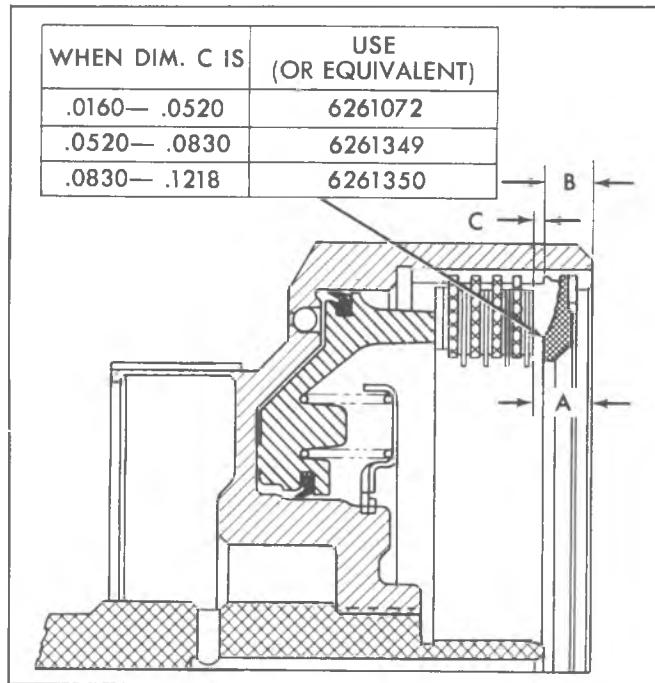


Fig. 7A-88B--Determining Selective Fit for Forward Clutch Pressure Plate

3. Install twenty-one (21) clutch return coil springs.
4. Install spring retainer. Compress spring retainer and install retaining ring using tool J-23327-1 as shown on Figure 7A-84B.
5. Lubricate with transmission fluid and install cushion spring face plates and steel separator plates, starting with the cushion spring and alternating steel and faced.
6. Install forward clutch pressure plate (selective fit) and retaining ring. Using chart on Figure 7A-88B to select correct pressure plate (dimension C), measure distance from the top of clutch pack to the top of clutch drum (dimension A). Measure distance from the lower edge of the notch on the inner surface of the drum to the end of the drum (dimension B). Subtract B from A to get dimension C.

**SUN GEAR AND SUN GEAR DRIVE SHELL  
(FIG. 7A-89B)**

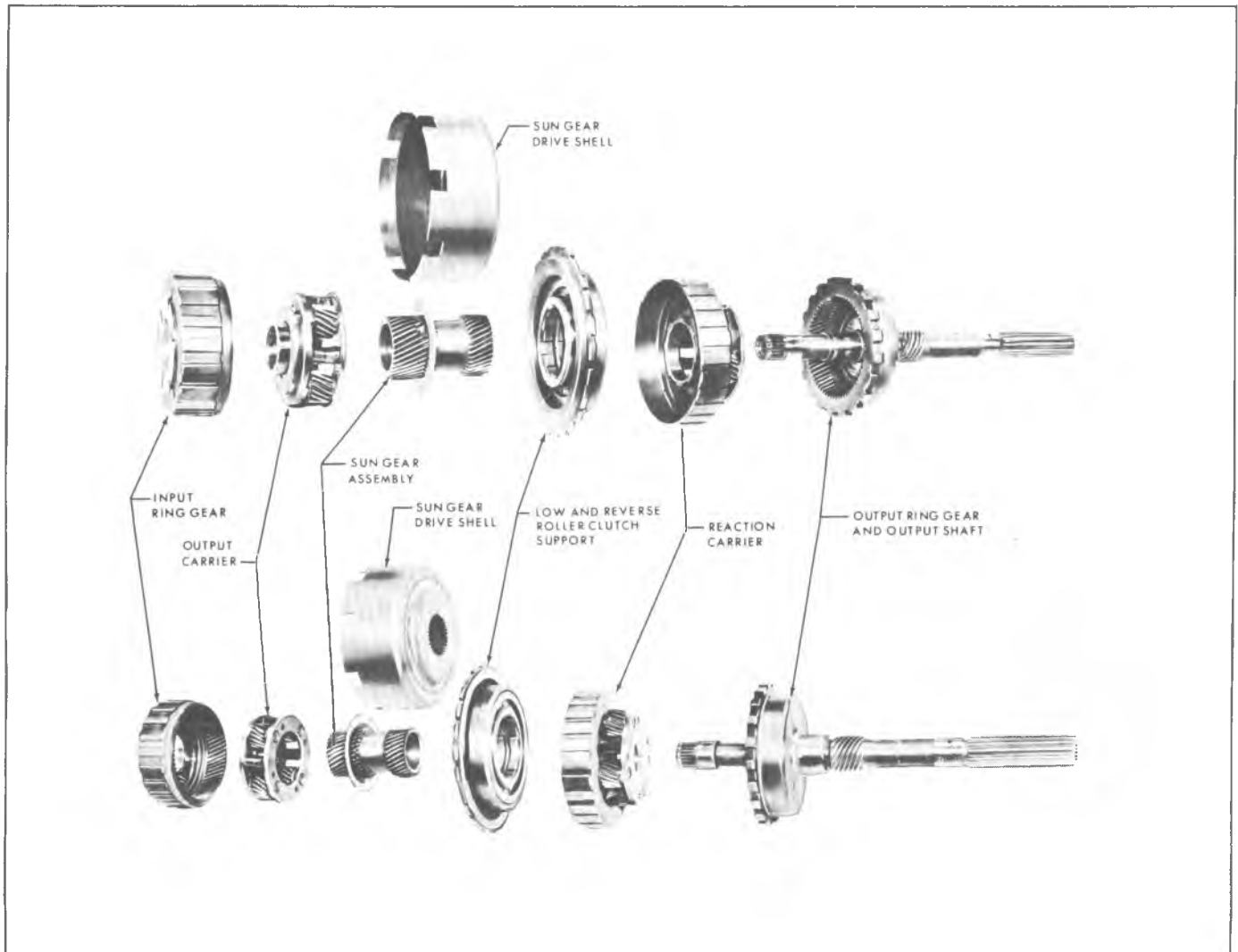


Fig. 7A-89B--Planetary Gear Train - Exploded View





Fig. 7A-90B--Removing Sun Gear Drive Shell Rear Retaining Ring

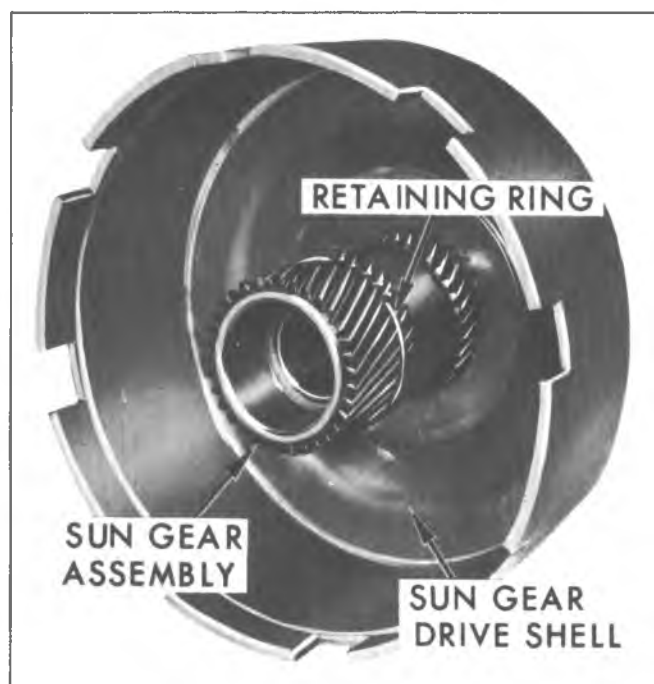


Fig. 7A-92B--Removing Sun Gear to Drive Shell Front Steel Thrust Washer

### Disassembly

1. Remove sun gear to sun gear drive shell rear retaining ring (fig. 7A-90B).
2. Remove sun gear to drive shell flat rear steel thrust washer (fig. 7A-91B).
3. Remove sun gear assembly from drive shell.
4. Remove sun gear to drive shell front retaining ring (fig. 7A-92B). Discard retaining ring.
5. If bushing is to be replaced, refer to Figure 7A-104B.

### Inspection

Check gear and sun gear shell for damage or wear.

### Reassembly

1. Install new sun gear to drive shell front retaining ring.
2. Install sun gear assembly into drive shell.
3. Install sun gear to drive shell flat steel thrust washer.
4. Install new sun gear to sun gear drive shell retaining ring.

**NOTE:** Do not stress front and rear retaining rings at installation.

### LOW AND REVERSE ROLLER CLUTCH SUPPORT (FIG. 7A-93B)

#### Disassembly

1. Remove low and reverse clutch to sun gear shell thrust washer.

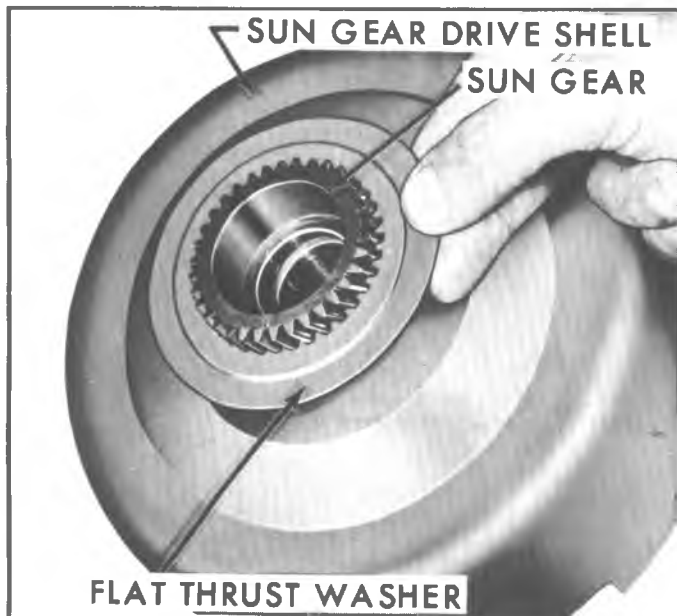


Fig. 7A-91B--Removing Sun Gear to Drive Shell Rear Steel Thrust Washer



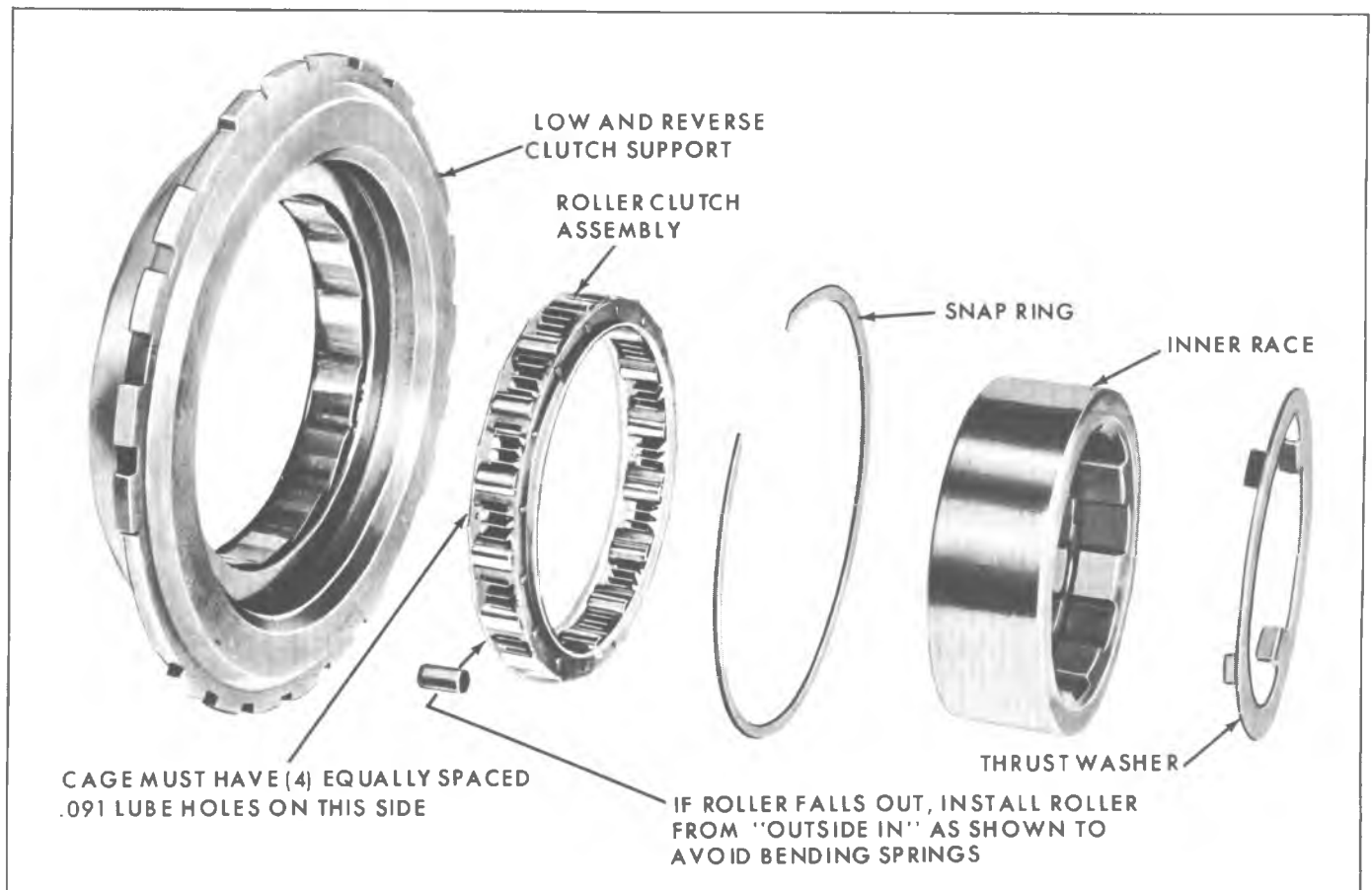


Fig. 7A-93B--Low and Reverse Clutch Assembly - Exploded View

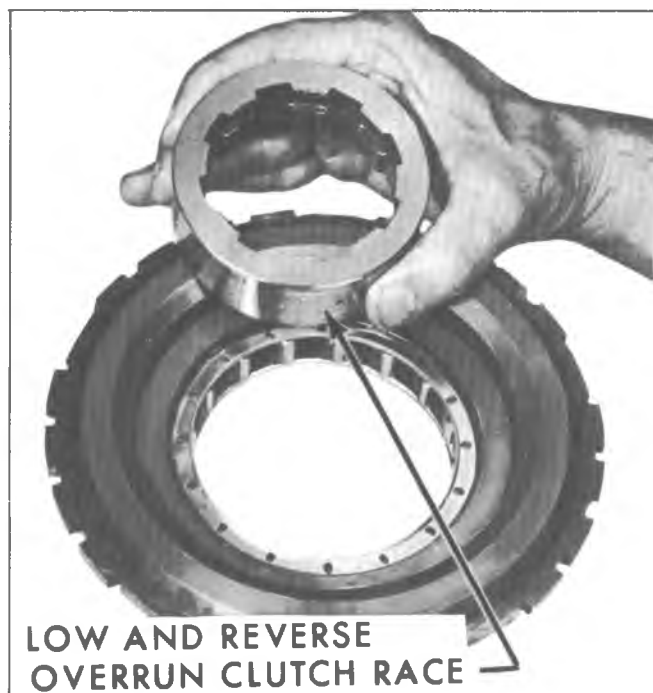


Fig. 7A-94B--Removing Overrun Clutch Inner Race



Fig. 7A-96B--Removing Overrun Roller Clutch Assembly

2. Remove low and reverse overrun clutch inner race from support (fig. 7A-94B).

3. Remove low and reverse clutch roller clutch retaining ring (fig. 7A-95B).

4. Remove low and reverse roller clutch assembly (fig. 7A-96B).

### Inspection

1. Inspect foller clutch inner and outer race for scratches and identations.

2. Inspect rollers for wear and roller springs for distortion.

### Assembly

1. Install low and reverse roller clutch assembly to inner race with oil holes toward rear of transmission.

2. Install low and reverse overrun clutch outer race.

3. Install low and reverse clutch to cam retaining ring.

**NOTE:** Low and reverse overrun clutch inner race should free wheel in the clockwise direction only.

### GOVERNOR ASSEMBLY

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is serviced as a complete assembly. The driven gear can be serviced separately.

It is necessary to disassembly governor assembly in order to replace driven gear. Disassembly may also be necessary due to improper operation. In such cases, proceed as follows:

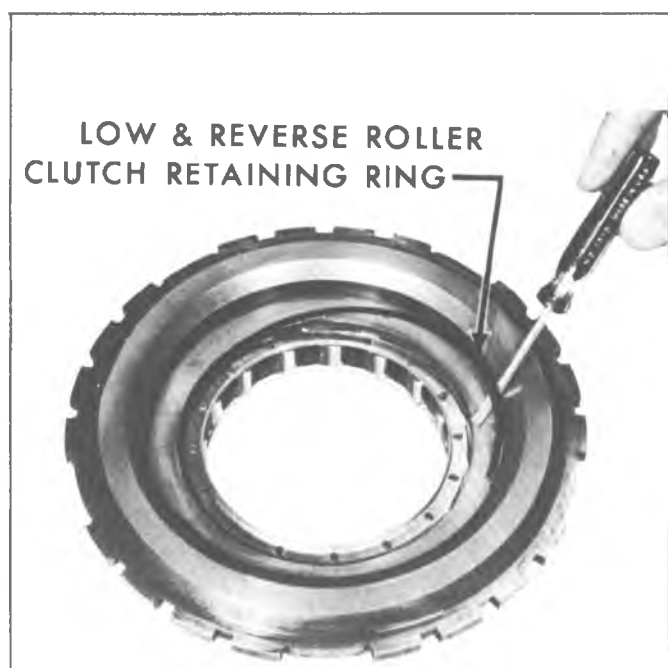


Fig. 7A-95B--Removing Overrun Roller Clutch Retaining Ring

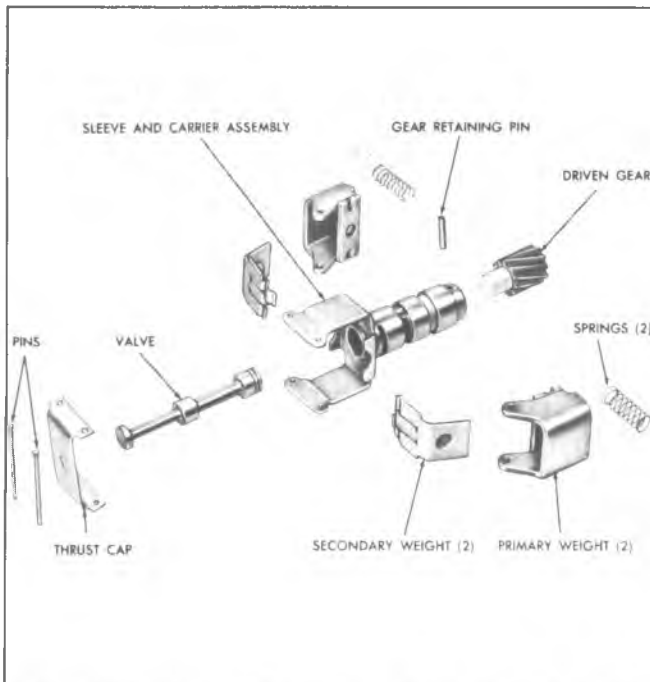


Fig. 7A-97B--Governor Assembly - Exploded View Typical

## 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. 7A-97B).
2. Remove governor valve from governor sleeve. Be careful not to damage valve.
3. Perform following inspections and replace governor driven gear, if necessary.

## Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring or galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs, or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect governor weight springs for distortion or damage.
9. Check governor weights for free operation in their retainers.
10. Check valve opening at entry and exhaust (.020 inch minimum).

## Governor Driven Gear Replacement

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

1. Drive out governor gear retaining split pin using small punch.
2. Support governor on 3/16 inch plates installed in exhaust slots of governor sleeve, place in arbor press, and with a long punch, press gear out of sleeve.
3. Carefully clean governor sleeve of chips that remain from original gear installation.
4. Support governor on 3/16 inch plates installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.
5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90 degrees from existing hole, center punch and then, while supporting governor in press, drill new hole through sleeve and gear using a standard (1/8 inch) drill.
6. Install split retaining pin.
7. Wash governor assembly thoroughly to remove any chips that may have collected.

## Assembly

1. Install governor valve in bore of sleeve, large land end first.
2. Install governor weights and springs, and thrust cap on governor sleeve.
3. Align pin holes in thrust cap, governor weight assemblies and governor sleeve, and install new pins. Crimp both ends of pins to prevent them from falling out.
4. Check governor weight assemblies for free operation on pins.
5. Check governor valve for free movement in governor sleeve.

## BUSHING REPLACEMENT

### Extension Housing Bushing

Remove extension housing bushing from housing using tool J-21424-9 with drive handle J-8092. Install extension

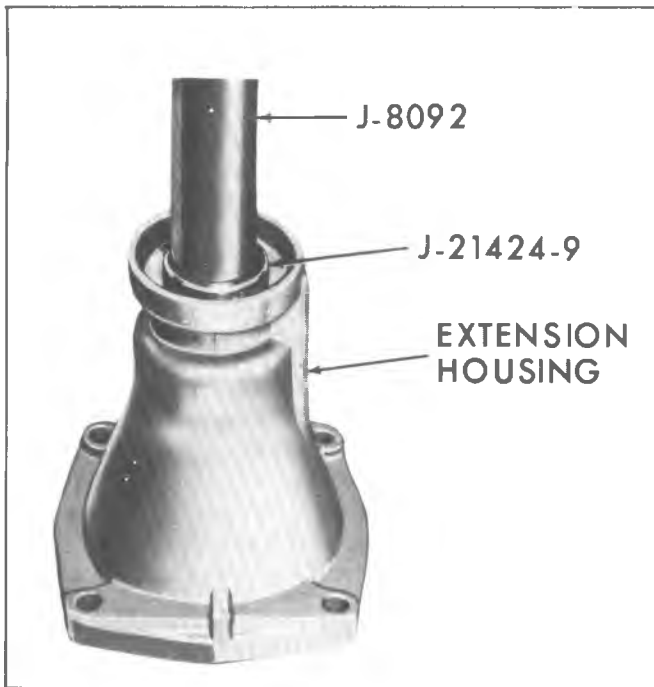


Fig. 7A-98B--Installing Extension Housing Bushing

housing bushing in housing flush to .010 below seal counter bore surface using tool J-21424-9 with drive handle J-8092 (fig. 7A-98B).

### Output Shaft Bushing

With output shaft properly supported, remove bushing using remover J-9534-01 and slide hammer J-7004 (fig. 7A-99B). Using tool J-23062-7, install bushing until tool bottoms on output shaft.

### Case Bushing

With case properly supported, drive out bushing from rear of case using tool J-23062-1 and drive handle J-8092.

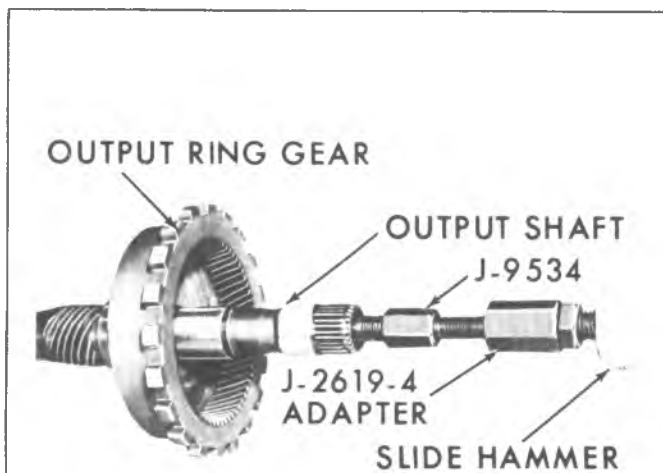


Fig. 7A-99B--Removing Output Shaft Bushing

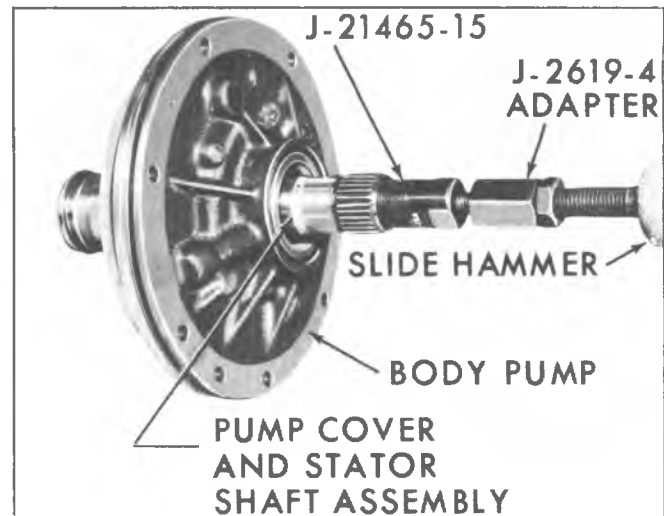


Fig. 7A-100B--Removing Stator Shaft Front Bushing

Using tool J-23062-1 and drive handle J-8092 with extension J-21465-13, install bushing from interior of case to 3/16" from front surface with crimped line in bushing located between the 10 o'clock and the 2 o'clock position.

### Stator Shaft Front Bushing

With stator shaft properly supported, remove front bushing using tool J-21465-16 and slide hammer with adapter J-2619-01 (fig. 7A-100B). Using tool J-21424-7 and drive handle J-8092, install bushing to .250" from face (fig. 7A-101B).

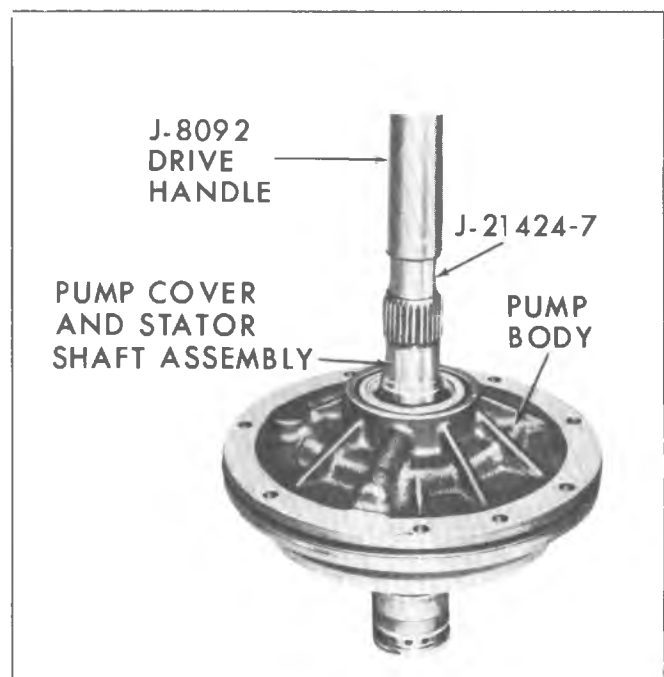


Fig. 7A-101B--Installing Stator Shaft Front Bushing



Fig. 7A-102B--Installing Inner and Outer Stator Shaft Bushing

### Stator Shaft Rear Bushing

With stator shaft properly supported, remove front bushing (fig. 7A-102B). Place tool J-21424-7 and drive handle J-8092 with extension J-21465-13 through front of stator shaft and drive out two (2) rear bushings. Using tool J-23062-2 and extension J-21465-13, install inner bushing to approximately  $1\frac{5}{32}$ " below front face and outer bushing  $\frac{3}{32}$ " below front face (fig. 7A-102B). Install new front bushing (fig. 7A-101B).

### Input Ring Gear Bushing

With input ring gear properly supported, remove bushing using tool J-23062-5 and drive handle J-8092. Using tool J-23062-5 and drive handle J-8092, install bushing to approximately  $\frac{1}{16}$ " below rear face inside gear end (fig. 7A-103B).

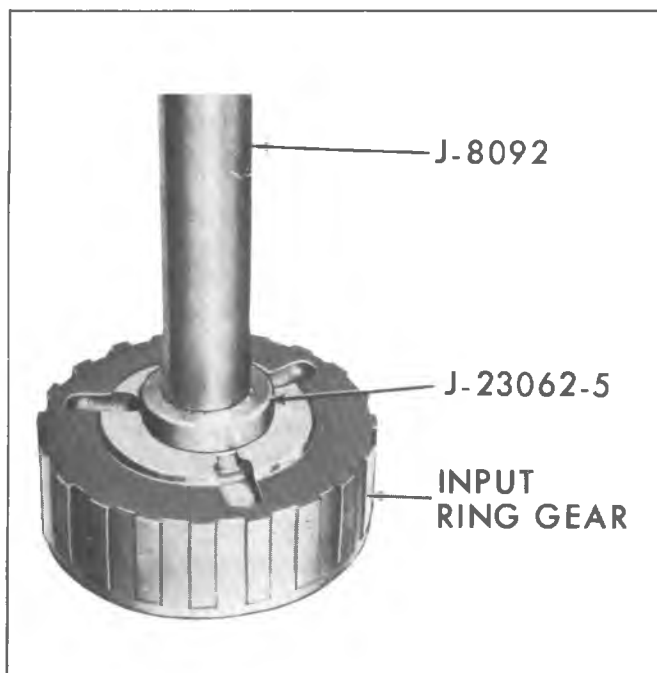


Fig. 7A-103B--Installing Input Ring Gear Support Bushing

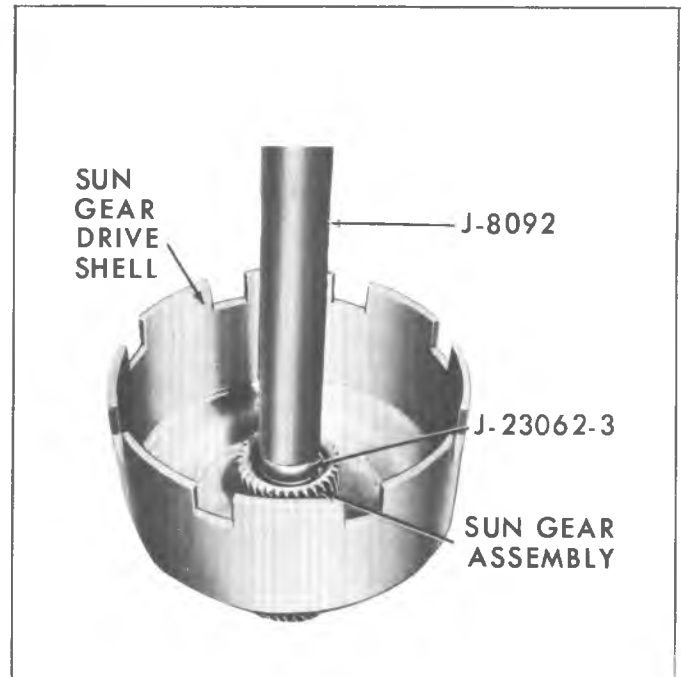


Fig. 7A-104B--Installing Sun Gear Bushings

### Sun Gear Bushing

With sun gear properly supported, remove two (2) sun gear bushing using tool J-23062-3 and drive handle J-8092 with extension J-21465-13. Using tool J-23062-3 and drive handle J-8092, install sun gear bushing to .010" below surface at either end (fig. 7A-104B).

### Reaction Carrier Bushing

With reaction carrier properly supported, remove bushing using tool J-23062-3 and drive handle J-8092. Using tool J-23062-3 and drive handle J-8092, install bushing flush to or .010" below inside face.

### Direct Clutch Bushing

With direct clutch drum properly supported, remove bushing (fig. 7A-105B). Using tool J-23329 and drive handle

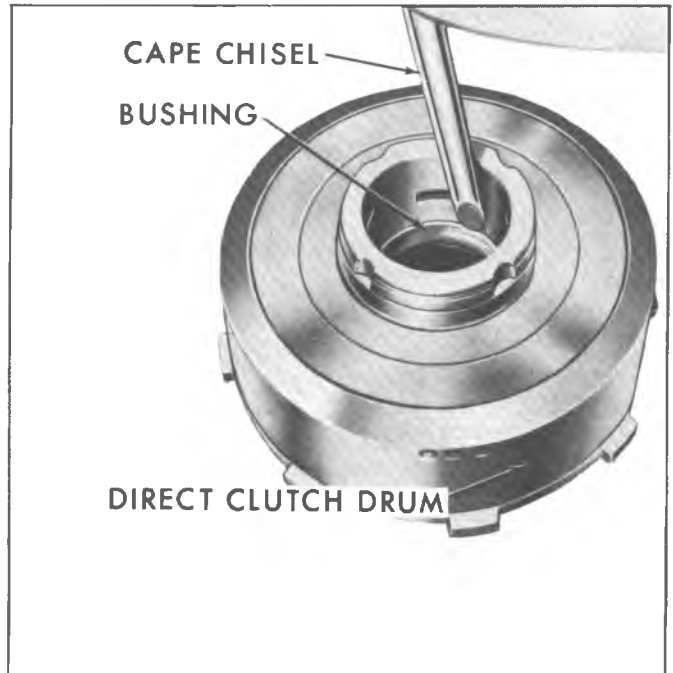


Fig. 7A-105B--Removing Direct Clutch Drum Bushing



Fig. 7A-106B--Installing Direct Clutch Drum Bushing

J-8092, install direct clutch drum bushing (fig. 7A-106B).

### TRANSMISSION ASSEMBLY

When servicing transmission, 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 with notch in piston installed adjacent to parking pawl.
2. Install seventeen (17) piston return (coil) springs.

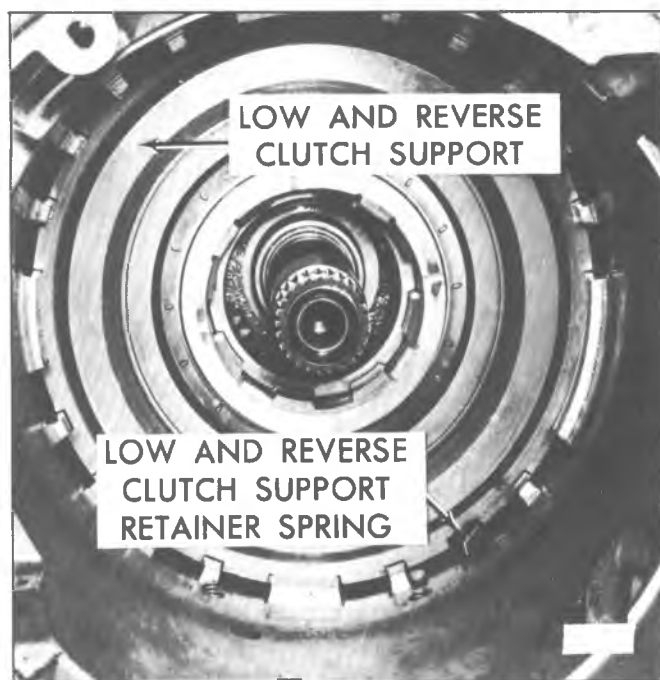


Fig. 7A-107B--Installing Low and Reverse Clutch Support Assembly

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 Torrington bearing 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 low and reverse clutch support retainer (anti-clunk) spring.

**NOTE:** Notch in steel separator plates should be placed toward bottom of case.

9. Install low and reverse clutch support assembly with position of notch with low and reverse clutch support retainer (anti-clunk) spring as shown on Figure 7A-107B.

**SIMP** Make certain the splines on inner race of the roller clutch align with splines on reaction carrier.

10. Install low and reverse roller clutch inner race to sun gear shell thrust washer.

11. Install low and reverse clutch support to case snap ring with anti-clunk spring between gap.

12. Install rear thrust washer and sun gear drive shell assembly.

13. Install output carrier assembly.

14. Install input ring gear rear thrust washer.

15. Install input ring gear.

16. Install new input ring gear to output shaft snap ring.

**CAUTION:** Do not over stress snap ring.

17. Install input gear front thrust washer.

18. Install direct clutch assembly, and special thrust washer to forward clutch assembly.

19. Install clutch assemblies into case.

**CAUTION:** Make certain forward clutch face plates are positioned over input ring gear and the tangs on direct clutch housing are installed into slots on the sun gear drive shell.

20. Install intermediate clutch overrun brake band.

21. Install intermediate clutch pressure plate.

22. Install face and steel intermediate clutch plates, starting with a face plate and alternating steel and face.

**NOTE:** Notch in steel reaction plates is installed toward selector lever inner bracket.

23. Install intermediate clutch cushion spring.

### Pump to Direct Clutch Thrust Washer Selection Procedure

24. To check for proper thickness of selective fit thrust washer between the oil pump cover and direct clutch assembly, proceed as follows:



Fig. 7A-108B--Pump Cover to Direct Clutch Torrington Bearing

a. Install torrington bearing, (fig. 7A-108B) oil pump gasket and using guide studs from J-3387 set install oil pump. Install two pump to case bolts.

b. Move transmission so that output shaft points down. Mount a dial indicator so that plunger of indicator is resting on end of the input shaft. J-5492 may be used to support the dial indicator as shown in Figure 7A-109B. Zero the indicator.

c. Push up on the transmission output shaft and observe the total indicator movement.

d. The indicator should read .010" to .044". If the reading is within limits, the proper selective fit washer is being used. If the reading is not within limits, it will be necessary to remove the pump and change to a thicker or thinner selective fit thrust washer, as required to obtain the specified clearance. Repeat the above checking procedure.

**NOTE:** Selective fit thrust washers are available in thicknesses of .066", .083" and .100".

25. Install new pump assembly in case gasket.

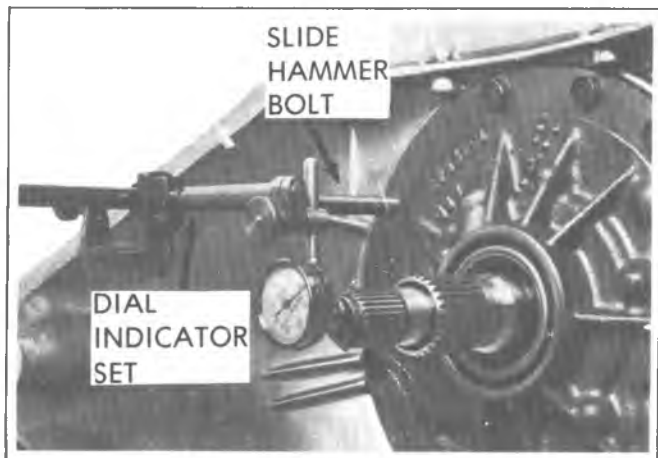


Fig. 7A-109B--Checking End Play for Proper Thrust Washer Selection

26. Install new pump assembly to case square cut oil seal ring.

27. Install guide pins into case.

28. Install pump assembly into case. Install attaching bolts with new washer type seals.

**SIMP** If the input shaft can not be rotated as the pump is being pulled into place, the direct and forward clutch housings have not been properly installed to index the faced plates with their respective parts. This condition must be corrected before the pump is pulled into place.

### Speedometer Drive Gear and Extension

1. Place speedometer drive gear retaining clip into hole in output shaft.

2. Heat a new speedometer drive gear using a heat lamp or suitable heat method.

3. Align slot in speedometer drive gear with retaining clip and install.

4. Install extension housing to case square cut "O" ring seal.

5. Attach extension housing to case using attaching bolts. Torque to 25 ft. lbs.

6. If necessary, install a new extension housing seal, using seal installer J-5154 or J-21426 (fig. 7A-110B).

### Manual Linkage

1. If necessary, install a new manual shaft to case lip seal using 3/4" diameter rod, seat seal in case.

2. Install parking pawl, tooth toward the inside of case, into case.

3. Install parking pawl shaft into case and through parking pawl.

4. Install parking pawl shaft retainer plug. Drive into case using a 3/8" dia. rod, until retainer plug is .130" to .170" below face of case, then stake in three places.

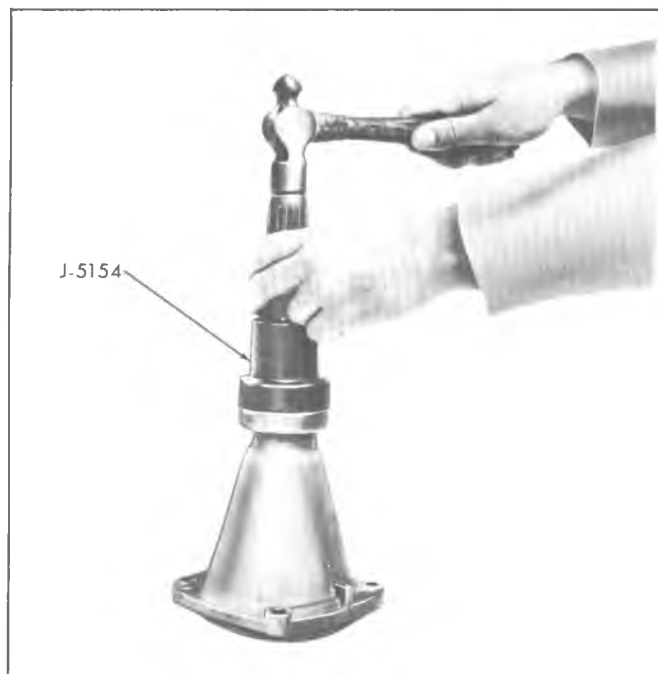


Fig. 7A-110B--Installing Extension Housing Seal

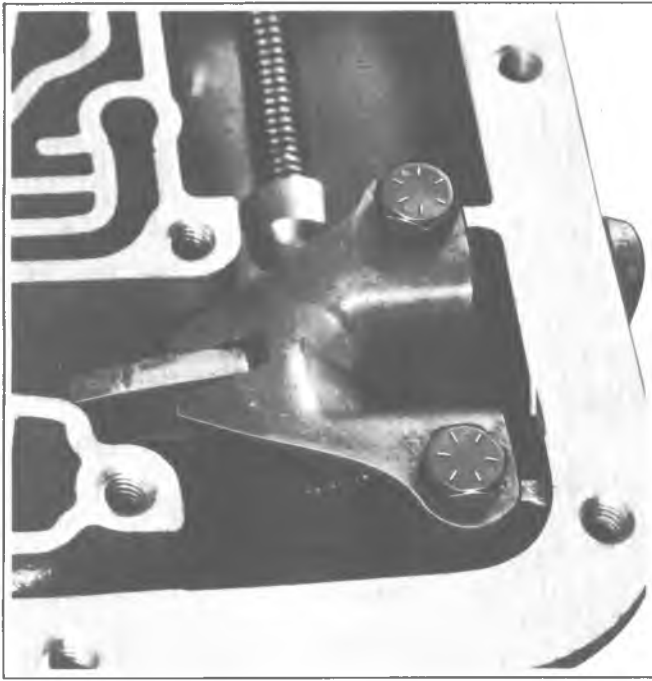


Fig. 7A-111B--Park Lock Bracket Special Bolt Identification

5. Install parking pawl disengaging spring, square end hooked on pawl.

6. Install park lock bracket, torque bolts to 29 ft. lb. (fig. 7A-111B).

**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.

2. Install intermediate servo piston and metal oil seal ring.

9. Connect detent control valve wire to detent valve actuating lever, then attach lever to valve body.

10. Install detent roller and spring assembly to valve body.

11. Align lube holes in strainer with those in valve body and install strainer assembly gasket and strainer.

12. Install oil pan using a new gasket. Tighten bolts to 130 inch pounds in succession until bolts maintain torque specification.

**NOTE:** If a new oil pan is being installed, transfer production code number is on right side of old pan to new pan. On JA and JH models, production code number is on governor cover.

### Governor and Vacuum Modulator

1. Install governor assembly, cover and seal and retainer wire.

2. Install vacuum modulator valve.

3. Install vacuum modulator and retainer clip. Torque bolt to 130 inch pounds.

**NOTE:** Position retainer with tangs pointing toward modulator.

### Intermediate Clutch Accumulator (Refer to Figures 7A-54B and 7A-55B)

1. Install intermediate clutch accumulator piston assembly.

2. Install intermediate clutch accumulator spring.

3. Install new "O" ring seal in groove in case before installing cover.

4. Install intermediate clutch accumulator cover and retaining ring using tool J-23069.

3. Install four (4) check balls into proper transmission case pockets (fig. 7A-18B).

4. Install oil pump pressure screen and governor feed screen.

5. Install valve body transfer plate and gasket assembly.

6. Install valve body to transfer plate gasket.

7. Install valve body. Connect manual control valve link to range selector inner lever. Torque bolts in random sequence to 130 inch pounds.

8. Install spacer support plate, torque bolts to 130 in. lbs.



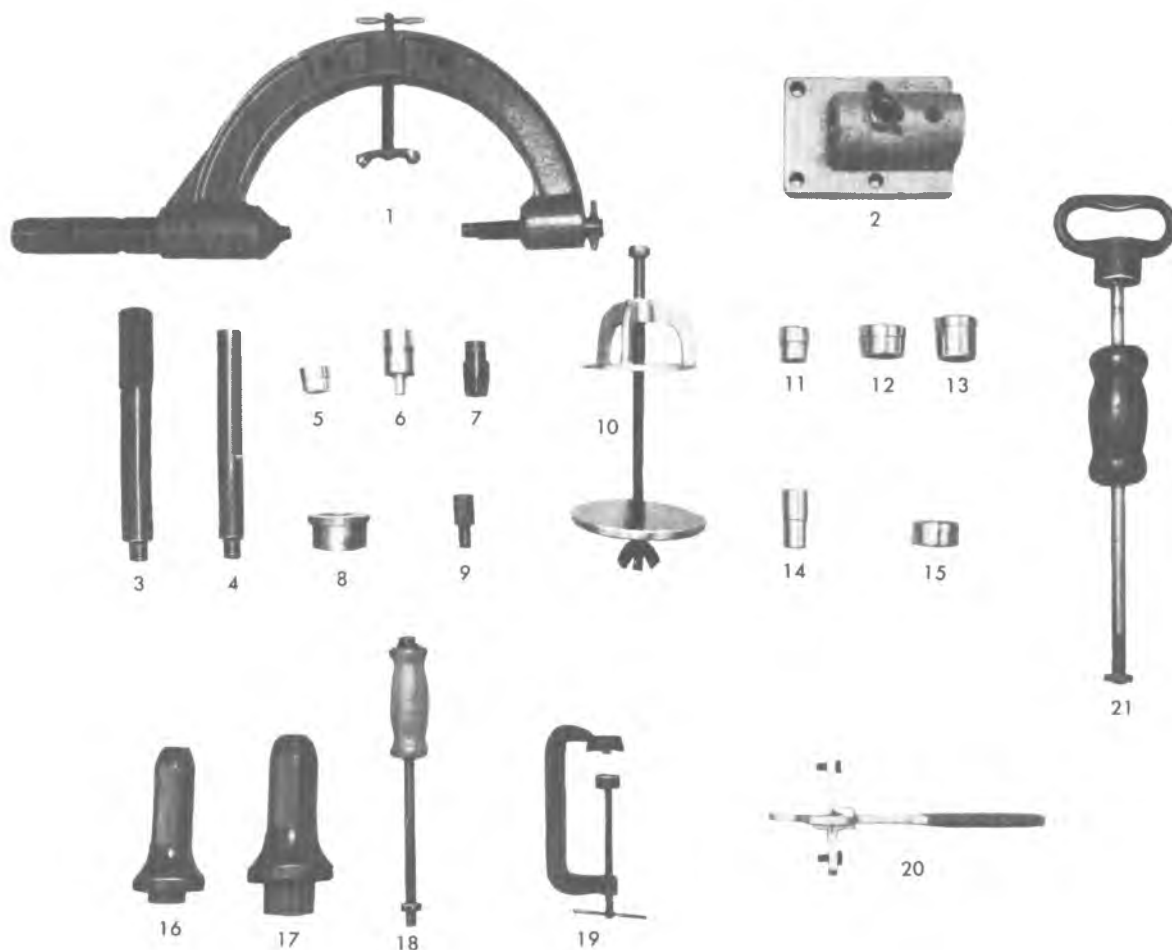
## SPECIFICATIONS

### TURBO HYDRA-MATIC— 350

#### TORQUE SPECIFICATIONS

Pump Cover to Pump Body . . . . .	17 ft. lbs.
Pump Assembly to Case . . . . .	18-1/2 ft. lbs.
Valve Body and Support Plate . . . . .	130 in. lbs.
Parking Lock Bracket . . . . .	29 ft. lbs.
Oil Suction Screen . . . . .	40 in. lbs.
Oil Pan to Case . . . . .	130 in. lbs.
Extension to Case . . . . .	25 ft. lbs.
Modulator Retainer to Case . . . . .	130 in. lbs.
Inner Selector Lever to Shaft . . . . .	25 ft. lbs.
Detent Valve Actuating Bracket . . . . .	52 in. lbs.
Converter to Flywheel Bolts . . . . .	35 ft. lbs.
Under Pan to Transmission Case . . . . .	110 in. lbs.
Transmission Case to Engine . . . . .	35 ft. lbs.
Oil Cooler Pipe Connectors to Transmission	
Case (Straight Pipe Fitting) . . . . .	25 ft. lbs.
(Tapered Pipe Fitting) . . . . .	15 ft. lbs.
Oil Cooler Pipe to Connectors . . . . .	10 ft. lbs.
Gearshift Bracket to Frame . . . . .	15 ft. lbs.
Gearshift Shaft to Swivel . . . . .	20 ft. lbs.
Manual Shaft to Bracket . . . . .	20 ft. lbs.
Detent Cable to Transmission . . . . .	75 in. lbs.
Intermediate Band Adjust Nut . . . . .	15 ft. lbs.

## SPECIAL TOOLS



- |               |   |                          |  |
|---------------|---|--------------------------|--|
| 1. J-8763-02  | Transmission Holding Fixture<br>(Used with J-3289-20 Base)            | 16. J-5154 or<br>J-21426 | Extension Housing Oil Seal<br>Installer                                  |
| 2. J-3289-20  | Transmission Holding Fixture<br>Base                                  | 17. J-21359              | Pump Oil Seal Installer  |
| 3. J-8092     | Driver Handle (Threaded type)   | 18. J-7004               | Slide Hammers (Pair) For<br>Pump Body removal (3/8" x 16 tread)          |
| 4. J-21465-13 | Driver Handle Extension (Used with J-8092)                            | 19. J-22269-01           | Direct Clutch Accumulator Piston<br>Remover and Installer (THM 350 only) |
| 5. J-23062-3  | Sun Gear and Reaction Carrier<br>Bushing                              | 20. J-23069              | Intermediate Accumulator Cover<br>Remover and Installer                  |
| 6. J-23062-7  | Output Shaft Bushing Installer  | 21. J-2619-01            | Slide Hammer (5/8" x 18<br>with 1/2" x 13 Adapter)                       |
| 7. J-21465-15 | Stator Shaft Front Bushing<br>Remover (Used with J-8092)              |                          |  |
| 8. J-23329    | Direct Clutch Bushing Installer                                       | Not Illustrated          |  |
| 9. J-9534-01  | Output Shaft Bushing Remover  | J-21369                  | Converter Pressure Check<br>Fixture                                      |
| 10. J-23327   | Clutch Spring Compressor  | J-8001                   | Dial Indicator Set<br>(.001" Increments, .001" Travel)                   |
| 11. J-23062-2 | Stator Shaft Rear Bushing<br>Installer (Both Rear)                    | J-21427-1                | Speedo Gear Remover  |
| 12. J-23062-1 | Case Bushing Remover and Installer                                    | J-9539                   | Slide Hammer Bolts (3/8" - 16 Threads)                                   |
| 13. J-21424-9 | Extension Housing Bushing Remover and<br>Installer (Used with J-8092) | J-8105                   | Speedo Gear Remover Puller   |
| 14. J-21424-7 | Stator Shaft Front Bushing<br>Installer (Used with J-8092)            | J-5586                   | Snap Ring Pliers   |
| 15. J-23062-5 | Input Ring Gear Bushing<br>Remover and Installer                      | J-24367                  | Transmission Band Adjuster (THM 250 only)                                |
|               |   | J-24675                  | Accumulator Piston Adapter (Used with J-22269-01)                        |

Fig. 7A-ST--CBC 350 Special Tools

## SECTION 7A

## AUTOMATIC TRANSMISSION

## THM 400 TRANSMISSION

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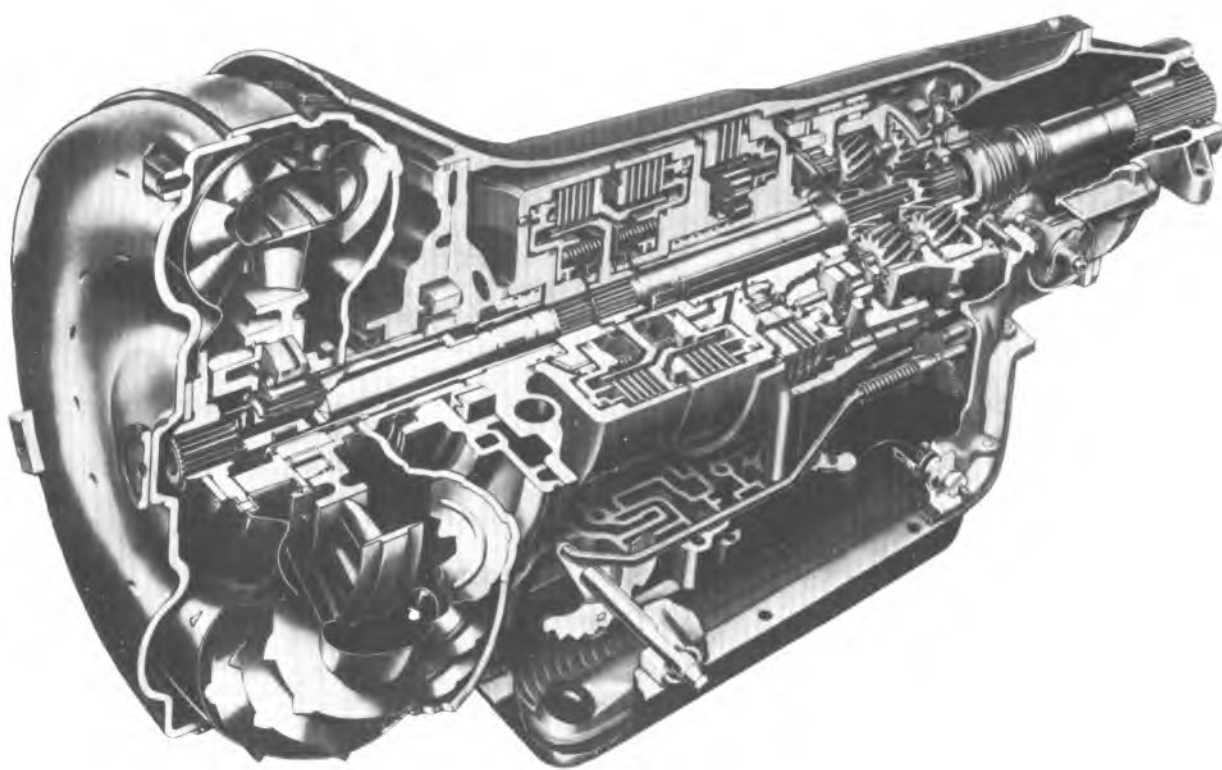


Fig. 7A-1C--THM 400 Side Cross Section--Typical

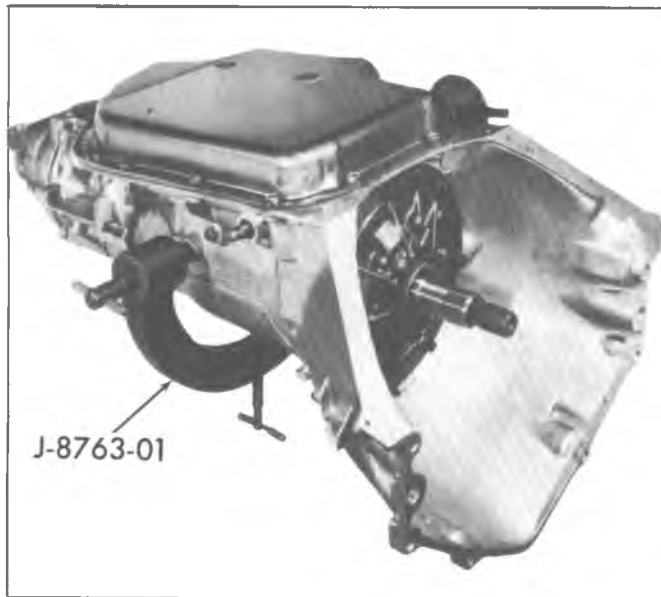


Fig. 7A-2C--Transmission in Holding Fixture

### 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 7A-2C).

**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. 7A-2C).



Fig. 7A-3C--Removing Modulator Retainer

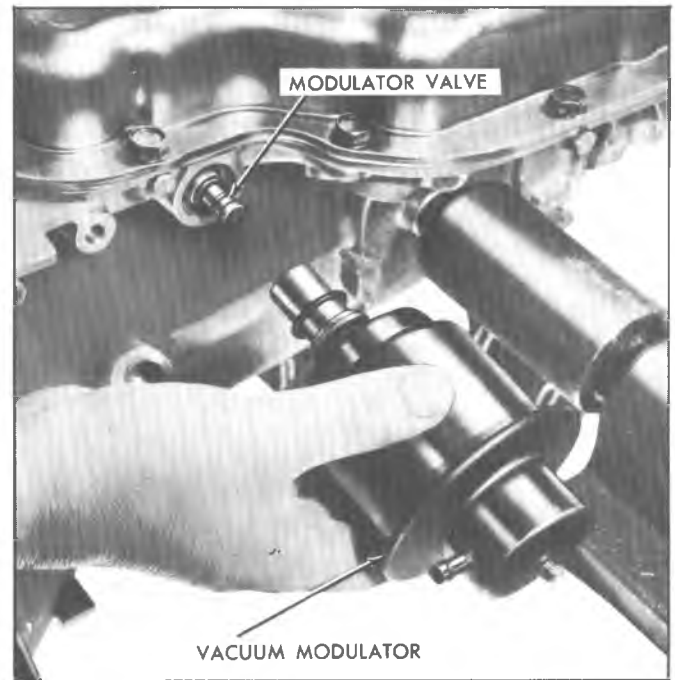


Fig. 7A-4C--Removing Vacuum Modulator and Valve

4. Remove modulator assembly attaching screw and retainer (Fig. 7A-3C).

5. Remove vacuum modulator assembly and "O" ring seal from case (Fig. 7A-4C). Discard "O" ring.

6. Remove modulator valve from transmission case (Fig. 7A-4C).

### Removal of Governor,

### Speedometer Driven Gear,

### Pan, Filter and Intake Pipe

1. Remove attaching screws, governor cover and gasket (Fig. 7A-5C). Discard gasket.

2. Withdraw governor assembly from case.

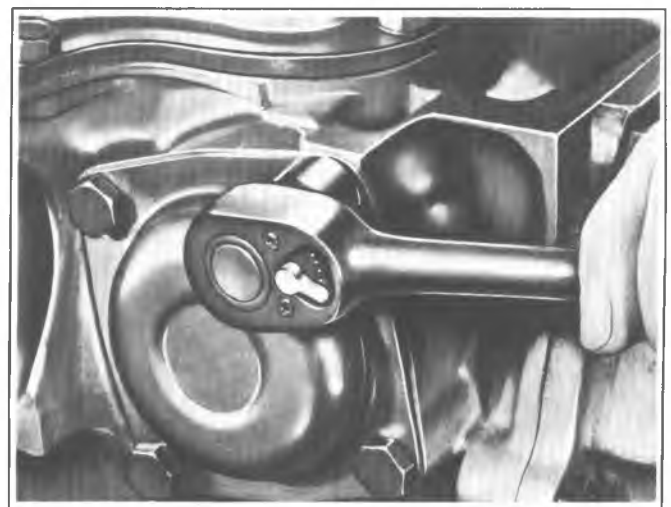


Fig. 7A-5C--Removing Governor Cover Attaching Screws



Fig. 7A-6C--Removing Speedometer Driven Gear Retainer

3. Remove speedometer driven gear attaching screw and retainer (Fig. 7A-6C).
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. 7A-7C).
7. Remove filter and intake pipe assembly from case (Fig. 7A-8C) and discard filter.
8. Remove intake pipe to case "O" ring seal from intake pipe or case and discard.

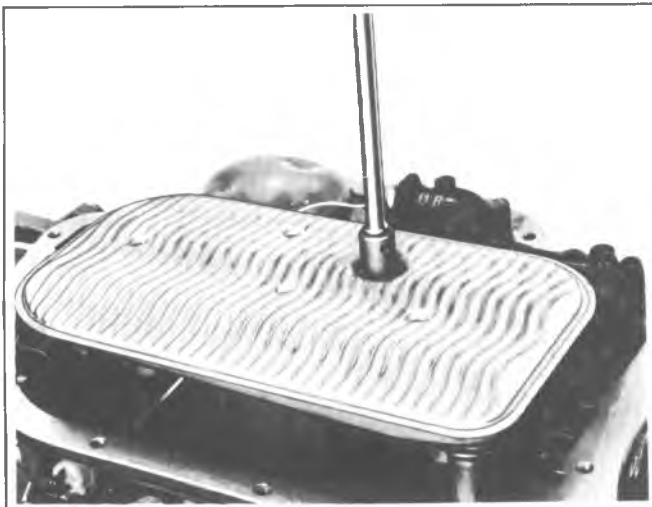


Fig. 7A-7C--Removing Filter Retainer Bolt

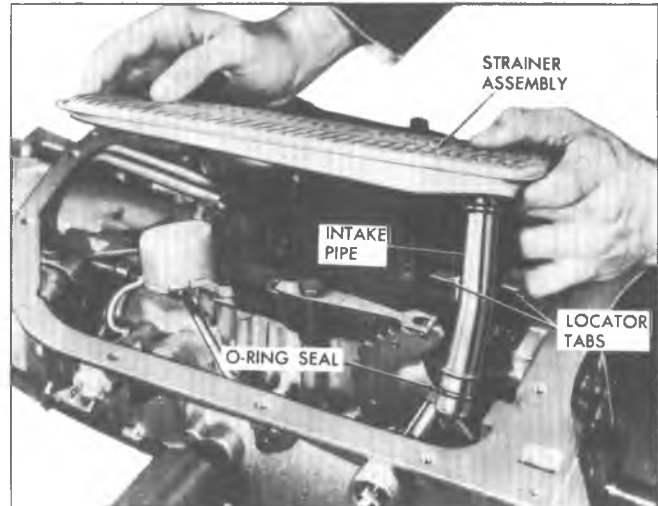


Fig. 7A-8C--Removing Filter Assembly and "O" Ring

### Removal of Control Valve Assembly, Solenoid Connector, Governor Pipes, Governor Screen Assembly, and Detent Spring Assembly

1. Remove control valve body attaching screws and detent roller and spring assembly (Fig. 7A-9C).

**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.

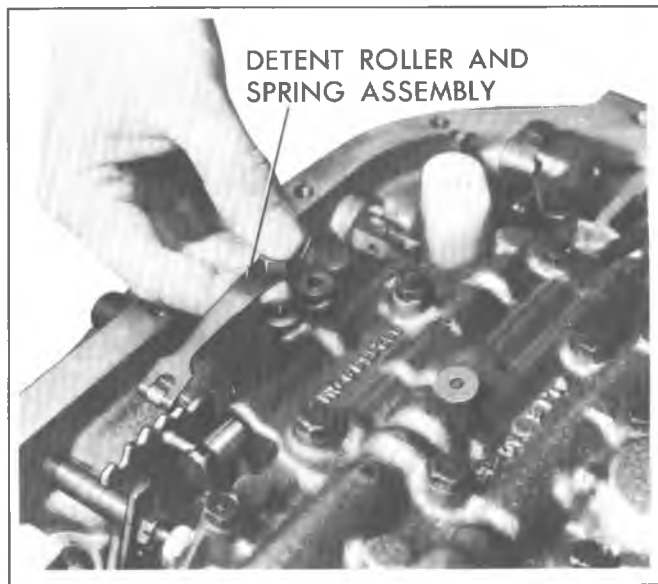


Fig. 7A-9C--Removing Detent Roller and Spring Assembly

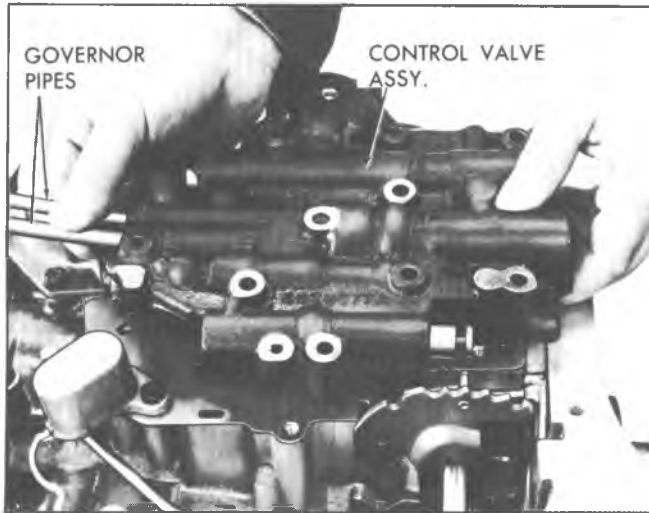


Fig. 7A-10C--Removing Control Valve Assembly and Governor Pipes from Case

2. Remove control valve assembly and governor pipes (Fig. 7A-10C).

**CAUTION:** *Do not drop manual valve.*

3. Remove governor screen assembly from governor feed pipe hole in the case or from end of governor feed pipe (Fig. 7A-11C). Clean governor screen in clean solvent and air dry.

4. Remove governor pipes from control valve assembly.

5. Disconnect solenoid lead wire from connector terminal (Fig. 7A-12C).

### **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. 7A-13C).

2. Remove rear servo assembly from case (Fig. 7A-14C).

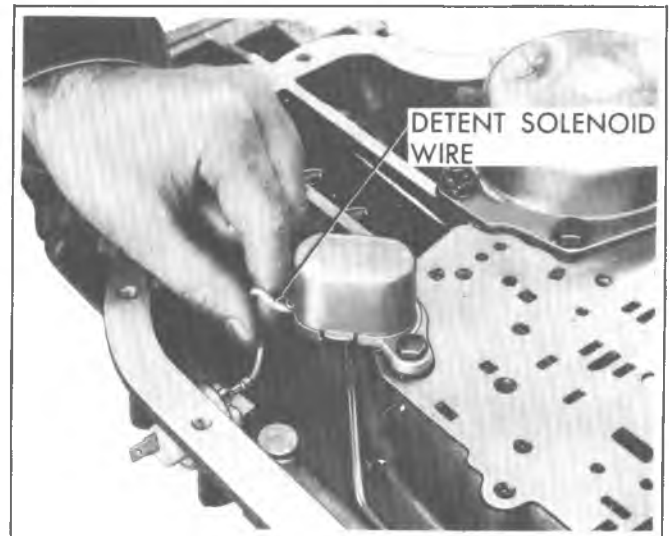


Fig. 7A-12C--Disconnecting Detent Solenoid Wire

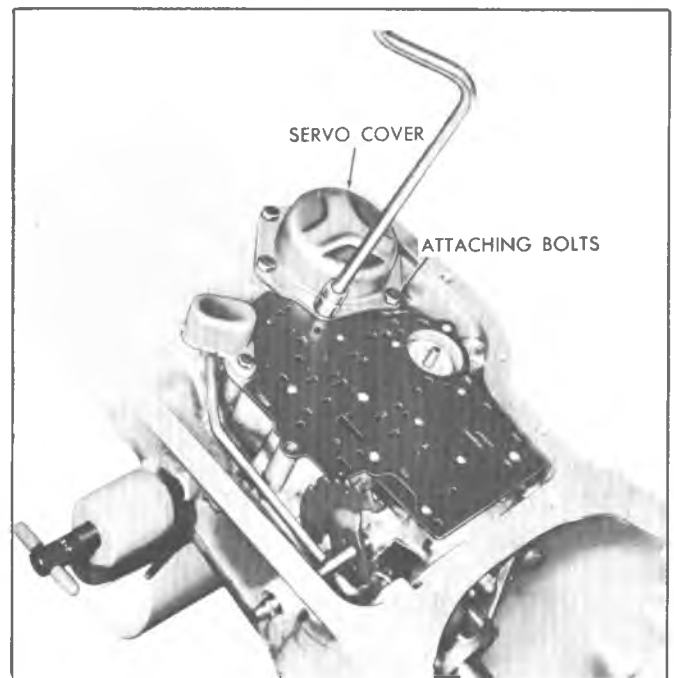


Fig. 7A-13C--Removing Rear Servo Cover Attaching Bolts

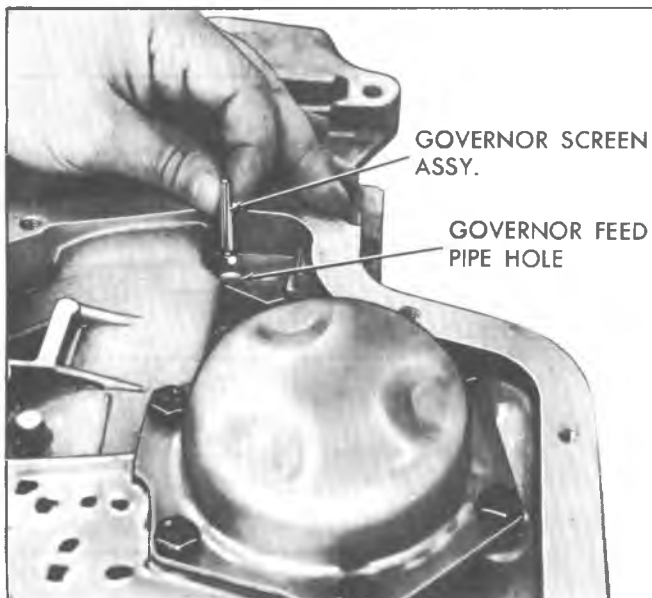


Fig. 7A-11C--Removing Governor Screen Assembly

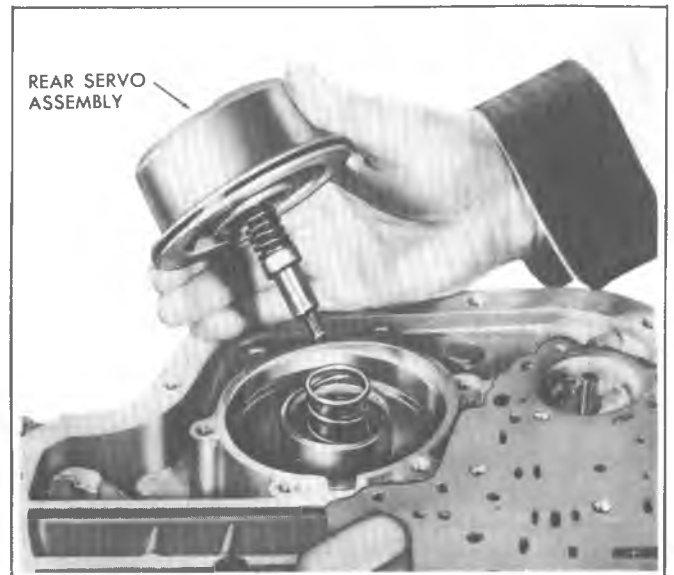


Fig. 7A-14C--Removing Rear Servo Assembly

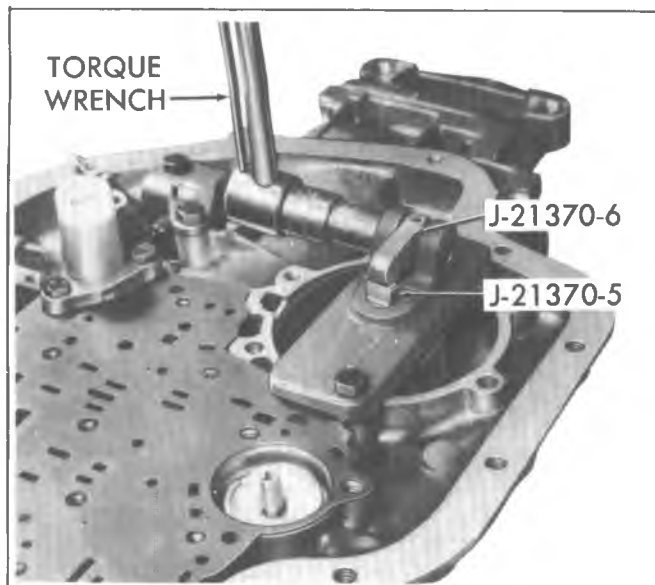


Fig. 7A-15C--Checking Rear Band Apply Pin, Except Models CD and CL

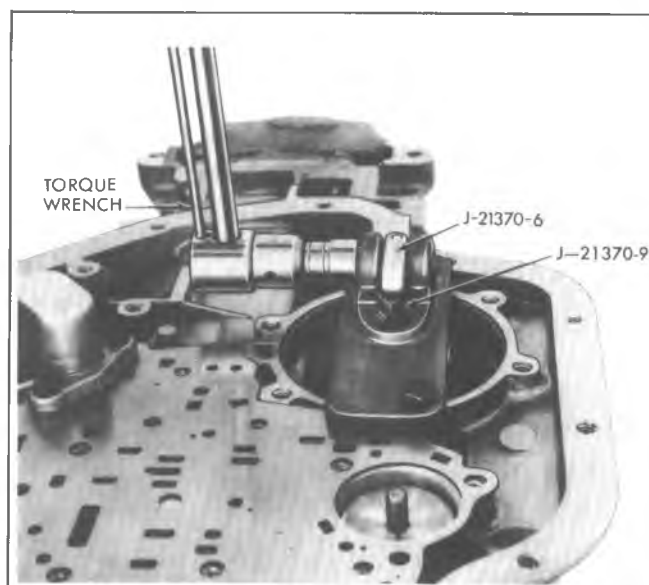


Fig. 7A-16C--Checking Rear Band Apply Pin, Models CD and CL

b. Apply 25 ft. lb. torque and select proper pin to be used during assembly of transmission.

**NOTE:** 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.

c. If both steps of J-21370-5 are below the gage surface, the long pin, identified by 3 rings, should be used.

d. If the gage surface is between the steps, the medium pin, identified by 2 rings, should be used.

e. If both steps are above the gage surface, the short pin, identified by 1 ring, should be used.

#### Rear Band Apply Pin Selection (Models CD and CL)








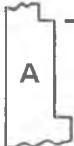


**NOTE:** There are six selective pins identified as shown in Figure 7A-17C. Selecting proper pin is equivalent to adjusting band.

3. Remove rear servo accumulator spring.

4. Make band apply pin selection check to determine possible cause of malfunction (Fig. 7A-15C).

#### Rear Band Apply Pin Selection (All Models Except CD and CL)

a. Attach band apply pin selection Gage J-21370-5 and J-21370-6 to transmission case with attaching screws

GAGING STEPS LOCATED ON THREE SIDES OF TOOL J-21370-9		PART NO.	PIN IDENTIFICATION	
	 C	LONGEST PIN	THIS STEP: USE PIN NO. 8627195	
			THIS STEP: SIDES B TO C USE PIN NO. 8627194	
	 B		THIS STEP: USE PIN NO. 8624141	
			THIS STEP: SIDES A TO B USE PIN NO. 8627193	
	 A		THIS STEP: USE PIN NO. 8624140	
		LOWER STEP SHORTEST PIN	LOWER STEP: USE PIN NO. 8627192	

**Note:** The Identification Rings are .030" and .100" wide.

Fig. 7A-17C--Rear Band Apply Pin Identification





Fig. 7A-18C--Removing Detent Solenoid and Gasket

checking to make certain the gage pin does not bind in servo pin hole (Fig. 7A-15C).

a. Attach band apply pin selection gage (J-21370-9 and J-21370-6), to transmission case (lever pivot pin to rear) with rear servo cover attaching screws.

b. Attach tool attaching screws finger tight and check freeness of selective pin. Torque attaching screws to 15 foot-pounds and recheck pin to make certain it does not bind.

c. Apply 25 foot-pounds torque to the lever on Tool J-21370-6 (Fig. 7A-16C). Selection of the proper rear band apply pin is determined by the relation of the flat on Tool J-21370-9 to the flat machined area around the hole on Tool J-21370-6.

d. Before removing gaging tool make note of the proper band apply pin to be used during assembly of the transmission as determined by the six selective pins identified as shown in Fig. 7A-17C.

**NOTE:** If the transmission is in the vehicle, be careful when the detent solenoid is removed as it prevents the spacer plate and gasket and check balls from dropping down.

5. Remove detent solenoid attaching screws, detent solenoid and gasket (Fig. 7A-18C).

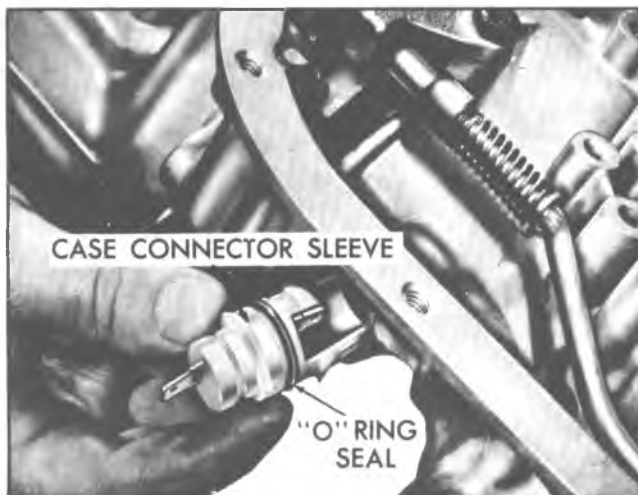


Fig. 7A-19C--Removing Electrical Connector and "O" Ring Seal

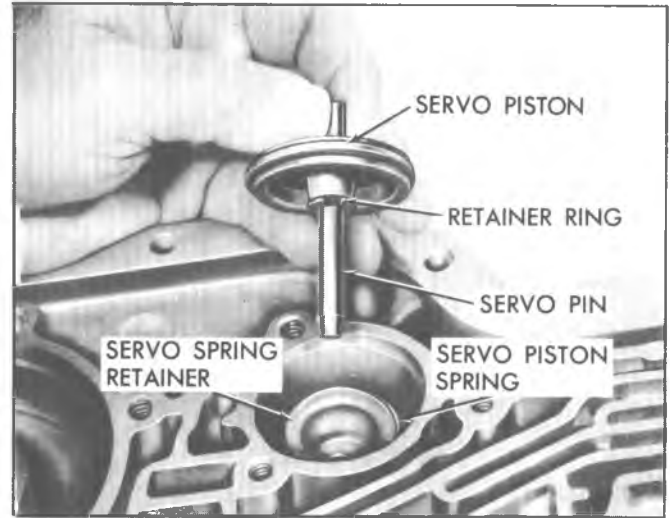


Fig. 7A-20C--Removing Front Servo Piston, Retainer Ring, and Pin

6. Withdraw electrical connector and "O" ring seal (Fig. 7A-19C).

7. Remove control valve assembly spacer plate and gasket.

8. Remove six (6) check balls from cored passages in transmission case.

**NOTE:** Mark location of balls for aid in reassembly.

9. Remove front servo piston, retainer ring, washer, pin, spring retainer and spring from transmission case (Fig. 7A-20C).

## Remove Manual Linkage

**NOTE:** If necessary, remove manual linkage as follows:

1. Unthread jam nut holding detent lever to manual shaft.

**NOTE:** Model CD transmission does not have parking lock mechanism.

2. Remove manual shaft retaining pin from case (Fig. 7A-21C).

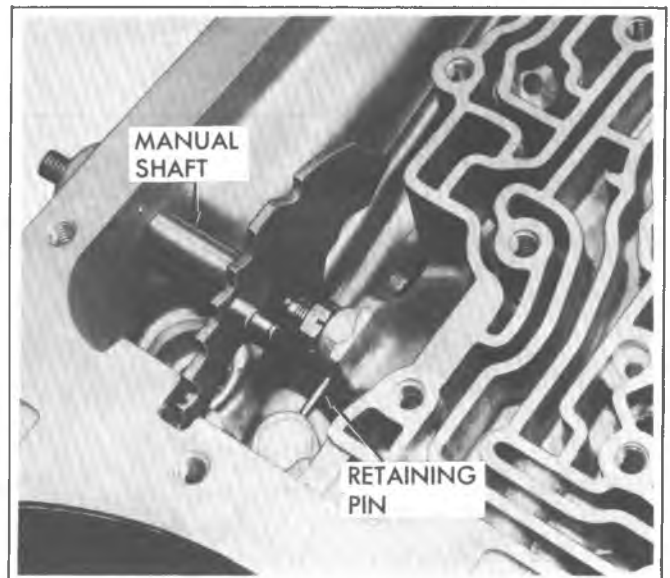


Fig. 7A-21C--Removing Manual Shaft Retaining Pin from Case

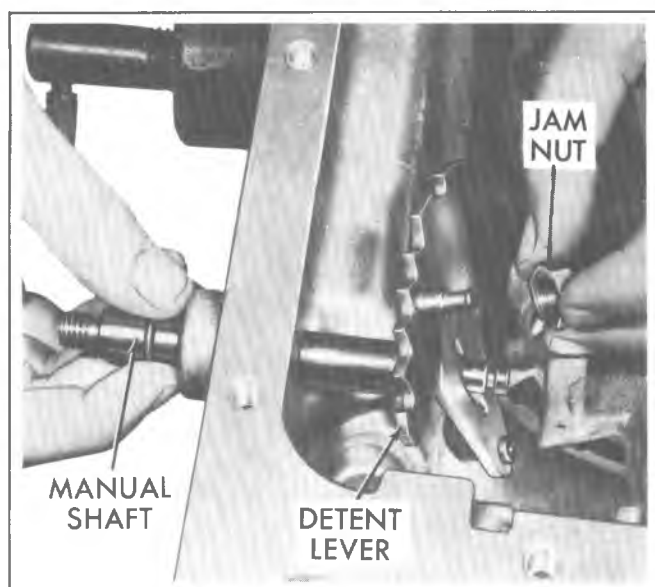


Fig. 7A-22C--Removing Detent Lever and Jam Nut from Manual Shaft

3. Remove manual shaft and jam nut from case (Fig. 7A-22C). Do not lose jam nut as it becomes free from manual shaft.

4. Remove parking actuator rod and detent lever assembly.

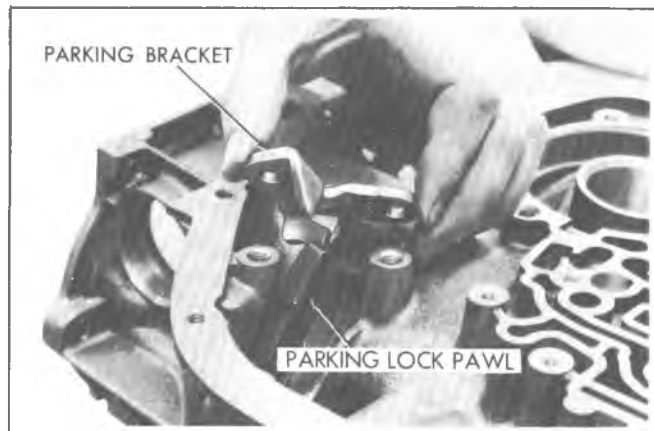


Fig. 7A-23C--Removing Parking Bracket



Fig. 7A-24C--Removing Parking Pawl Return Spring

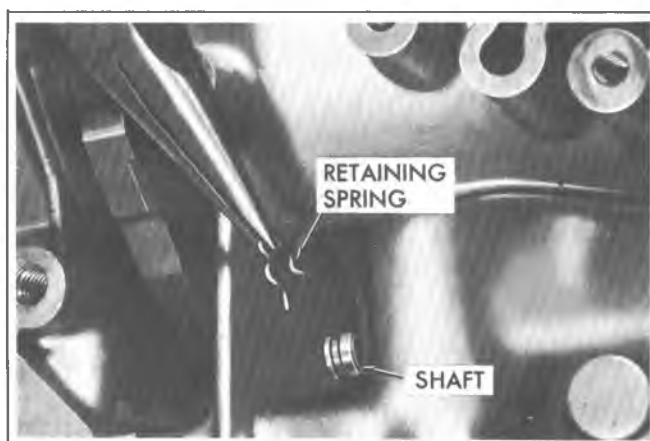


Fig. 7A-25C--Removing Parking Shaft Retaining Spring

5. Remove attaching screws and parking bracket (Fig. 7A-23C).

6. Remove parking pawl return spring (Fig. 7A-24C).

**NOTE:** The following steps are to be completed only if 1 or more of the parts involved require replacement.

7. Remove parking pawl shaft retainer (Fig. 7A-25C).

8. Remove parking pawl shaft cup plug by inserting a screwdriver, between the parking pawl shaft and the case rib, and prying outwards (Fig. 7A-26C).

9. Remove parking pawl shaft and parking pawl (Fig. 7A-26C).

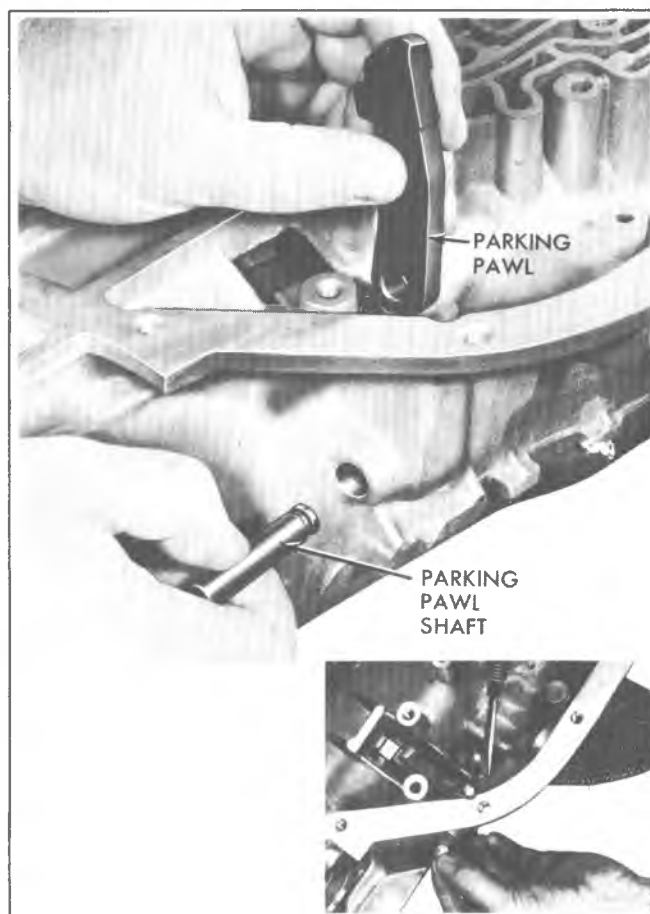


Fig. 7A-26C--Removing Parking Pawl, Shaft and Cup Plug

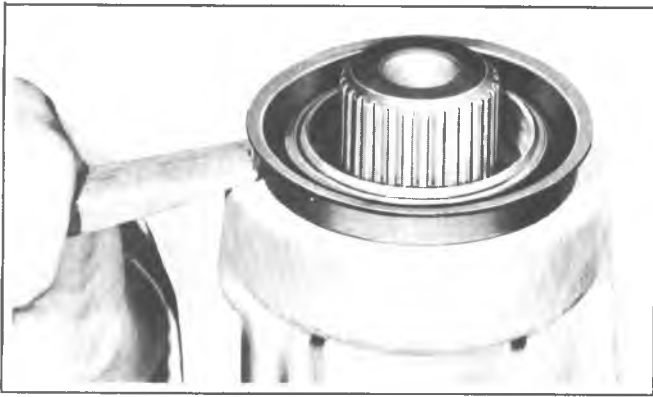


Fig. 7A-27C--Removing Rear Oil Seal from Case Extension

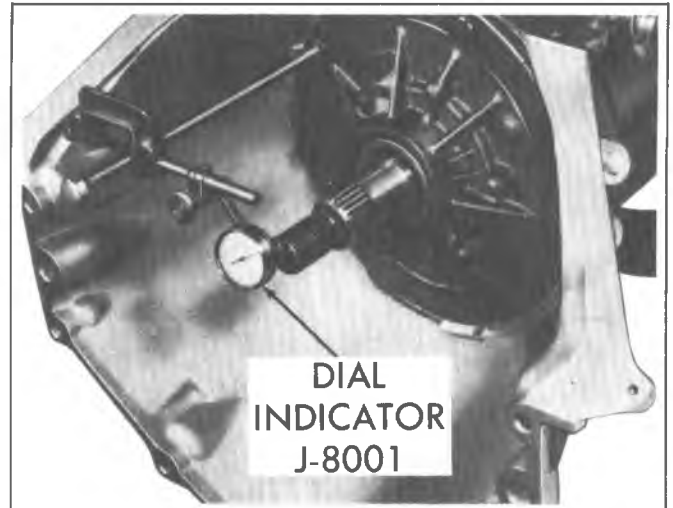


Fig. 7A-29C--Checking Front Unit End Play

### Removal of Rear Oil Seal and Case Extension and Front Unit End Play Check

1. If necessary to replace, pry rear oil seal from case extension (Fig. 7A-27C).
2. Remove case extension to case attaching bolts.
3. Remove case extension to case gasket (Fig. 7A-28C).
4. Make front unit end play check as follows (Fig. 7A-29C):
  - a. Remove one front pump attaching bolt, and bolt washer. (See Fig. 7A-29C for location).
  - b. Install a 3/8"-16 threaded slide hammer bolt or J-9539, into bolt hole.

- c. Mount a dial indicator on rod and index indicator to register with end of turbine shaft.
  - d. Push on turbine shaft rearward.
  - e. Push output shaft forward.
  - f. Set dial indicator to Zero.
  - g. Pull turbine shaft forward.
- Read resulting travel or end play. Should be .003"-.024".

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 chart shown in Fig. 7A-30C.

**NOTE:** An oil soaked washer may tend to discolor, so it will be necessary to measure washer for its actual thickness.

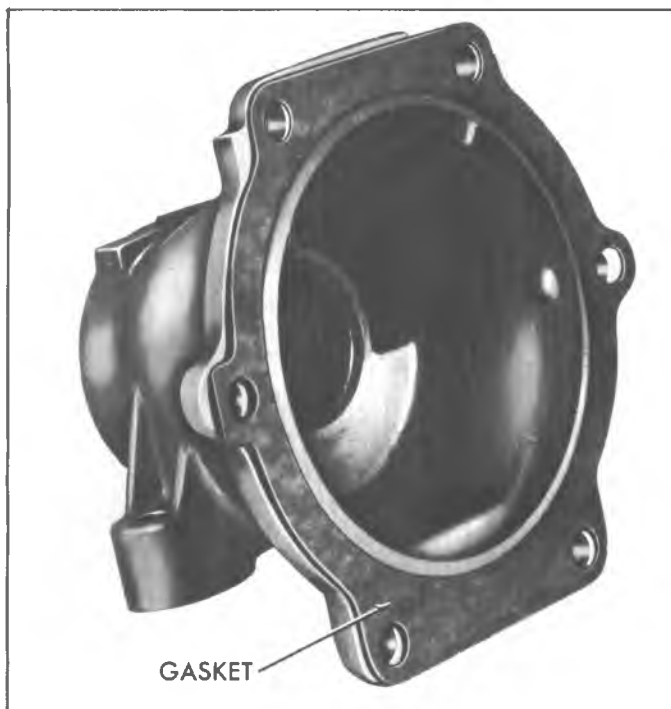


Fig. 7A-28C--Case Extension and Gasket

### FRONT END WASHER THICKNESS

Thickness	Number	Color
.060 - .064	- 0 -	Yellow
.071 - .075	- 1 -	Blue
.082 - .086	- 2 -	Red
.093 - .097	- 3 -	Brown
.104 - .108	- 4 -	Green
.115 - .119	- 5 -	Black
.126 - .130	- 6 -	Purple

Fig. 7A-30C--Front End Washer Selection Chart

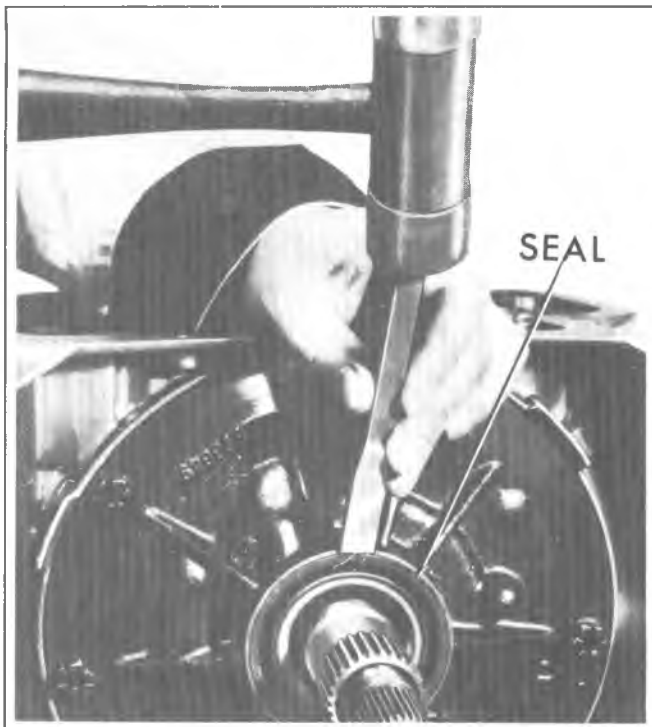


Fig. 7A-31C--Removing Front Seal

## Oil Pump and Internal Case Components

### Removal

1. If necessary to replace, pry front seal from pump (Fig. 7A-31C).
2. Remove pump attaching bolts.



Fig. 7A-32C--Removing Pump Assembly

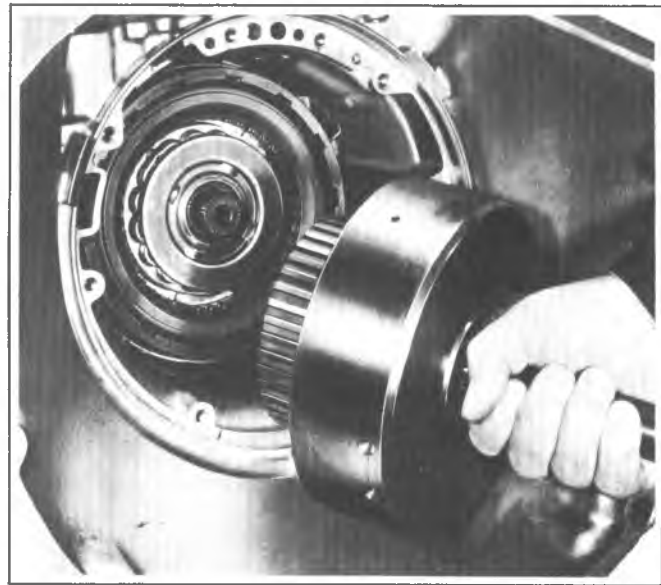


Fig. 7A-33C--Removing Forward Clutch Assembly and Turbine Shaft

3. Install two 3/8"-16 threaded slide hammer bolts, J-9539 with weights J-6585-01, into bolt holes in pump body and remove pump assembly from case (Fig. 7A-32C). (See illustration for location of threaded holes.)
4. Remove and discard pump to case seal and gasket.
5. Remove forward clutch assembly and turbine shaft from transmission (Fig. 7A-33C).
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. 7A-34C).

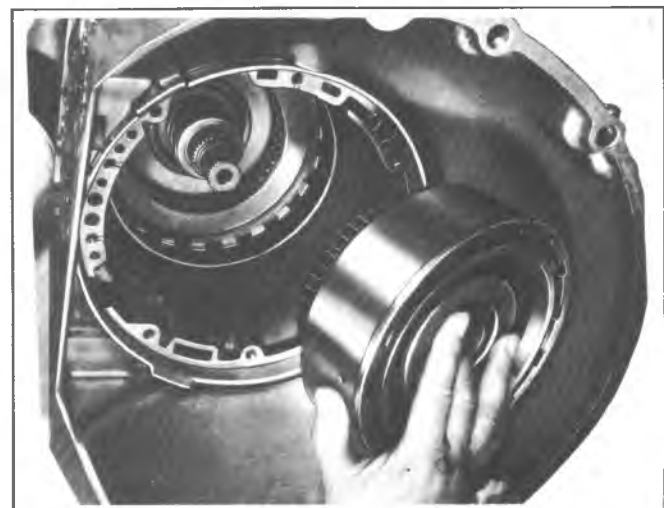


Fig. 7A-34C--Removing Direct Clutch Assembly



Fig. 7A-35C--Removing Front Band

8. Remove front band assembly (Fig. 7A-35C).
9. Remove sun gear shaft (Fig. 7A-36C).

**Check Rear End Play as Follows (Fig. 7A-37C)**

- a. Install J-9539 or a 3/8"-16 threaded bolt into an extension housing attaching bolt hole (Fig. 7A-37C).
- 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.

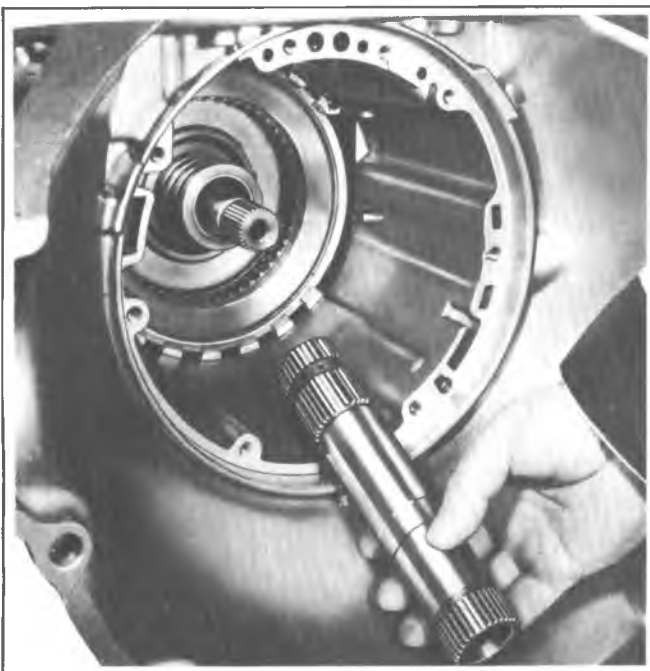


Fig. 7A-36C--Removing Sun Gear Shaft

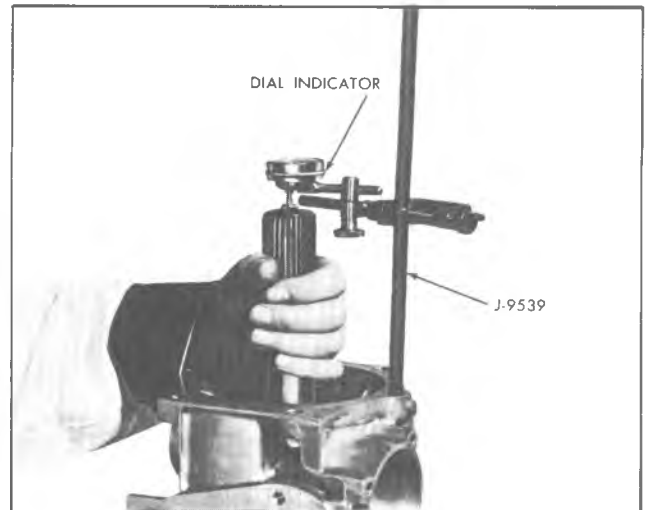


Fig. 7A-37C--Checking Rear Unit End Play

**REAR END WASHER THICKNESS**

Thickness	Identification Notches and/or Numeral
.074 - .078	None . . . . . 1
.082 - .086	1 Tab Side . . . . . 2
.090 - .094	2 Tab Side . . . . . 3
.098 - .102	1 Tab O.D. . . . . 4
.106 - .110	2 Tabs O.D. . . . . 5
.114 - .118	3 Tabs O.D. . . . . 6

Fig. 7A-38C--Rear End Washer Thickness Chart

If a different washer thickness is required to bring end play within specification, it can be selected from the chart shown in Fig. 7A-38C.

10. Remove center support to case bolt (Fig. 7A-39C), using a 3/8" 12-point thin wall deep socket.

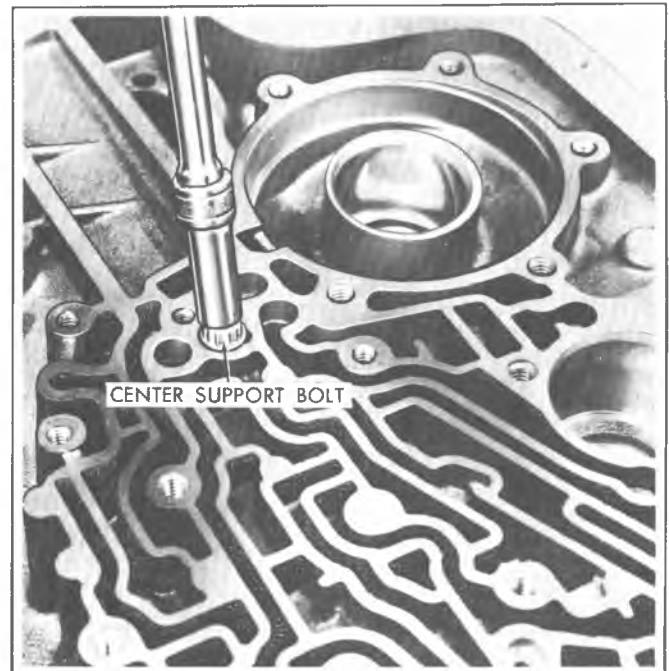


Fig. 7A-39C--Removing Center Support Bolt



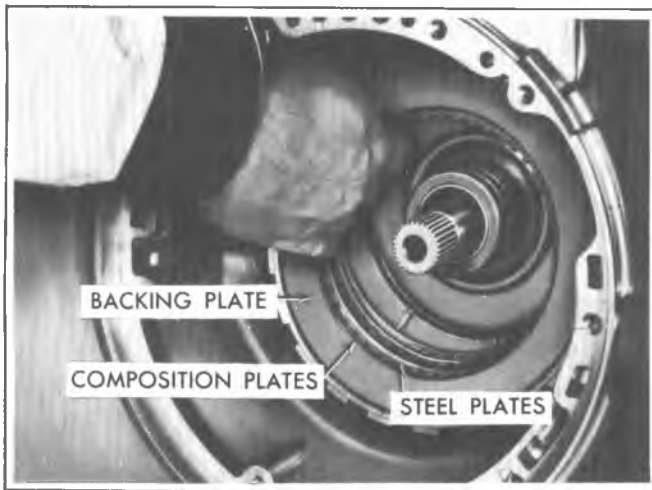


Fig. 7A-40C--Removing Intermediate Backing Plate and Clutch Plates

11. Remove intermediate clutch backing plate to case snap ring.

12. Remove intermediate clutch backing plate, as shown in Fig. 7A-40C.

13. Remove intermediate clutch plates.

a. (All except CB, CL and CD models) Remove three (3) composition, two (2) steel clutch plates and one waved steel plate.

b. (CB, CL and CD models) Remove three (3) composition, and three (3) steel clutch plates.

14. Remove center support to case retaining snap ring (Fig. 7A-41C).

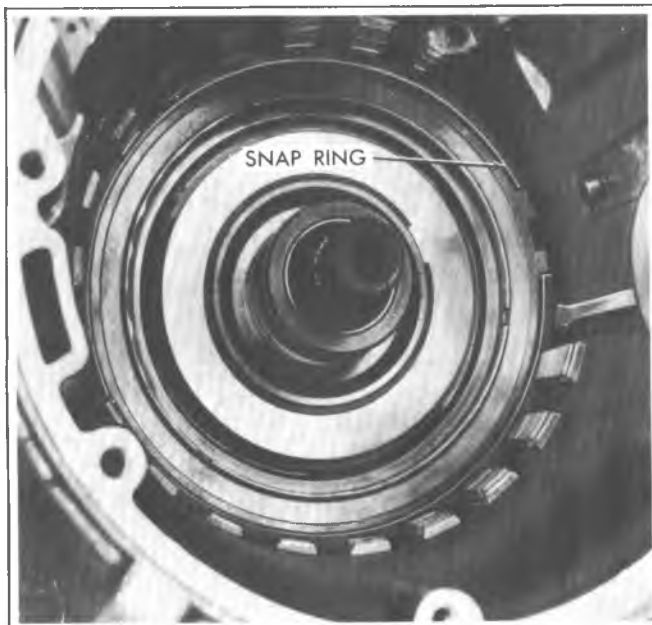


Fig. 7A-41C--Removing Center Support to Case Retaining Snap Ring

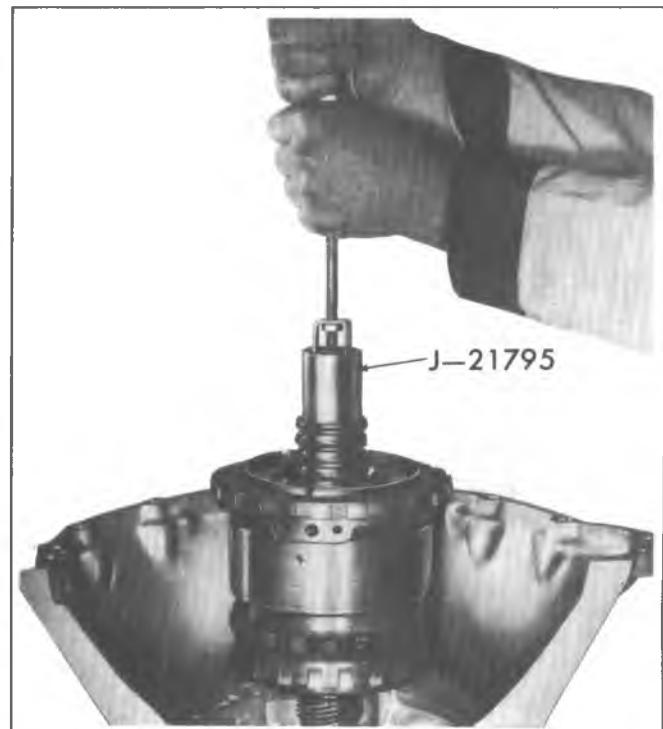


Fig. 7A-42C--Removing Center Support and Gear Unit from Case

15. Remove entire gear unit assembly by lifting with gear assembly installing and removing Holding Tool J-21795 with J-9539 slide hammer (Fig. 7A-42C).

16. Remove shaft to case thrust washer from rear of output shaft or inside case.

17. Place gear unit assembly, with output shaft facing down through hole in work bench.

18. Remove rear unit selective washer from transmission case (Fig. 7A-43C).



Fig. 7A-43C--Removing Selective Washer



Fig. 7A-44C--Removing Center Support to Case Spacer



Fig. 7A-46C--Removing Center Support Assembly

19. Remove center support to case spacer (Fig. 7A-44C).

20. Remove rear band assembly (Fig. 7A-45C).

### Disassembly of Gear Unit Assembly

**NOTE:** CL Model (spur gears) disassembly procedure is identical as illustrated.

1. Remove center support assembly (Fig. 7A-46C).

2. Remove center support to reaction carrier thrust washer (Fig. 7A-47C).

3. Remove center support to sun gear races and thrust bearing.

**NOTE:** One race may have been removed with center support.

4. Remove reaction carrier and roller clutch assembly

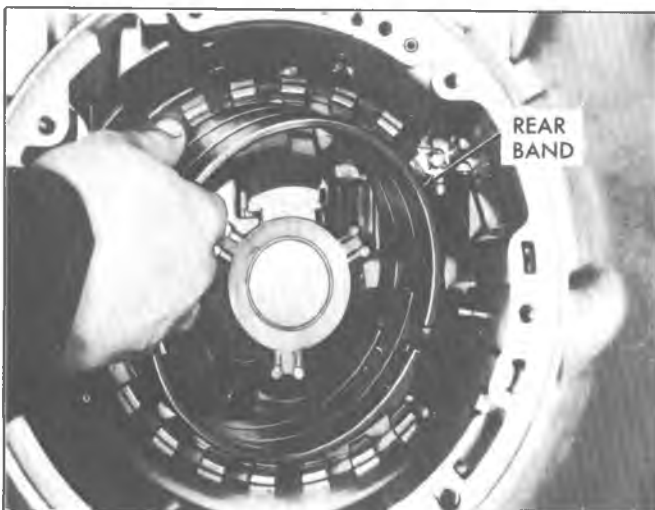


Fig. 7A-45C--Removing Rear Band

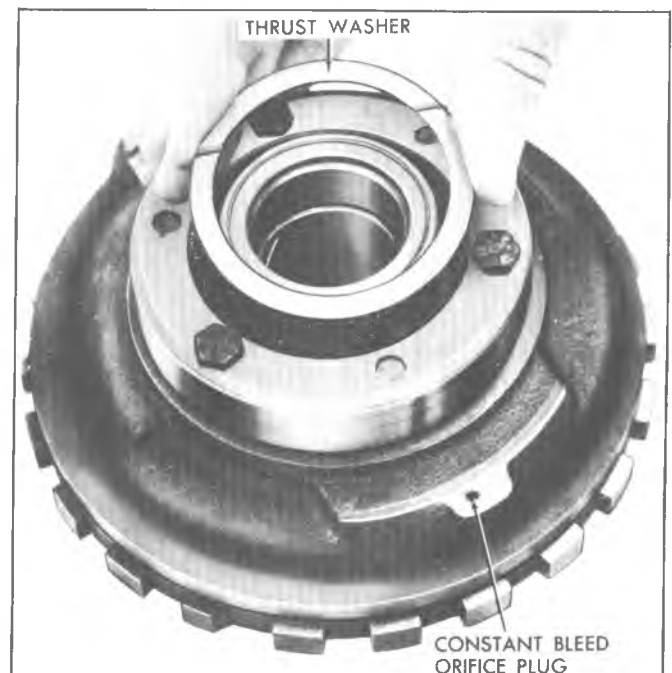


Fig. 7A-47C--Removing Center Support Thrust Washer

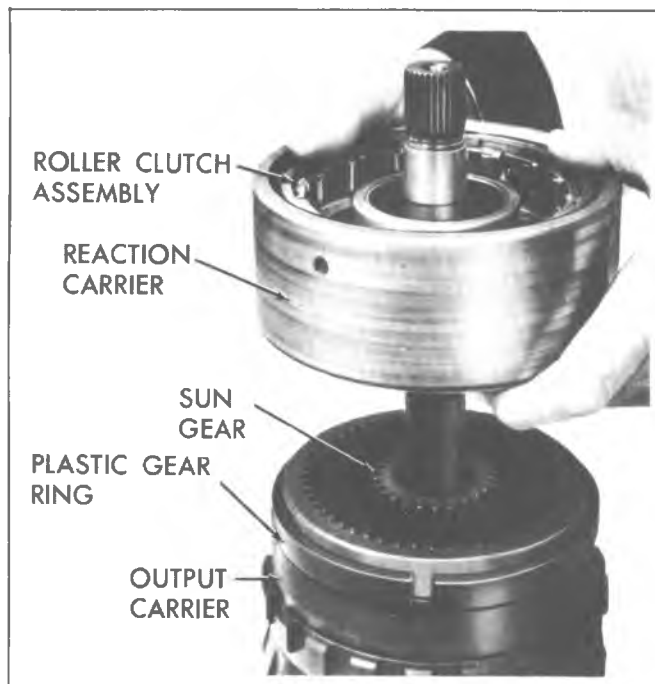


Fig. 7A-48C--Removing Reaction Carrier and Roller Clutch from Output Carrier

(Fig. 7A-48C). Lift roller clutch assembly out of carrier.

5. Remove front internal gear ring from output carrier assembly.

6. Remove sun gear (Fig. 7A-49C).

7. Remove reaction carrier to output carrier thrust washer.

8. Turn assembly over and place main shaft through hole in work bench.



Fig. 7A-49C--Removing Sun Gear

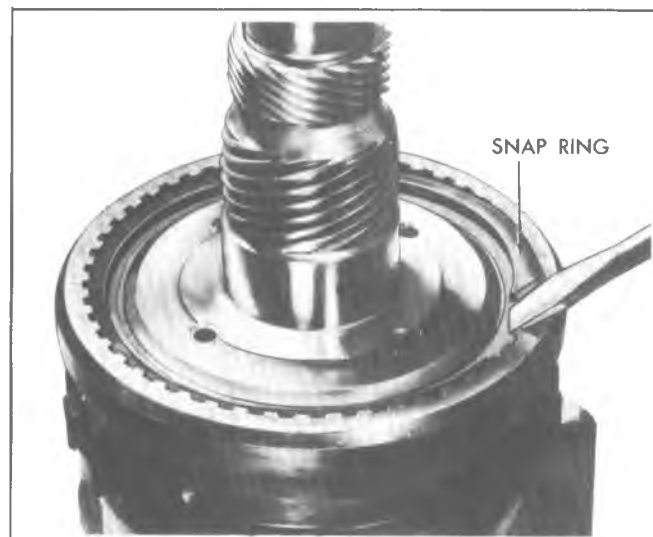


Fig. 7A-50C--Removing Output Shaft to Carrier Snap Ring

9. Remove "O" ring from output shaft of models that use an "O" ring.

10. Remove output shaft to output carrier snap ring (Fig. 7A-50C).

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. 7A-51C).



Fig. 7A-51C--Removing Rear Internal Gear and Mainshaft



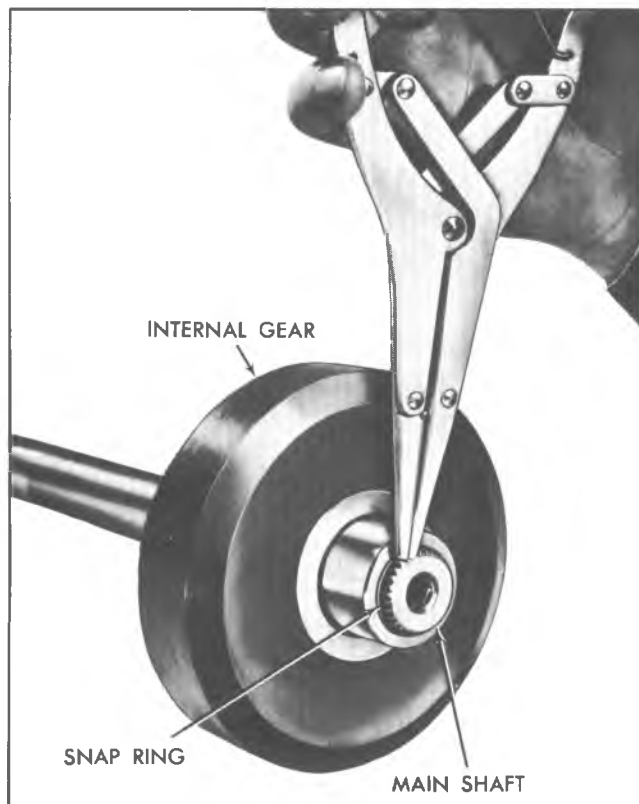


Fig. 7A-52C--Removing Rear Internal Gear to Main Shaft Snap Ring

**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. 7A-52C).

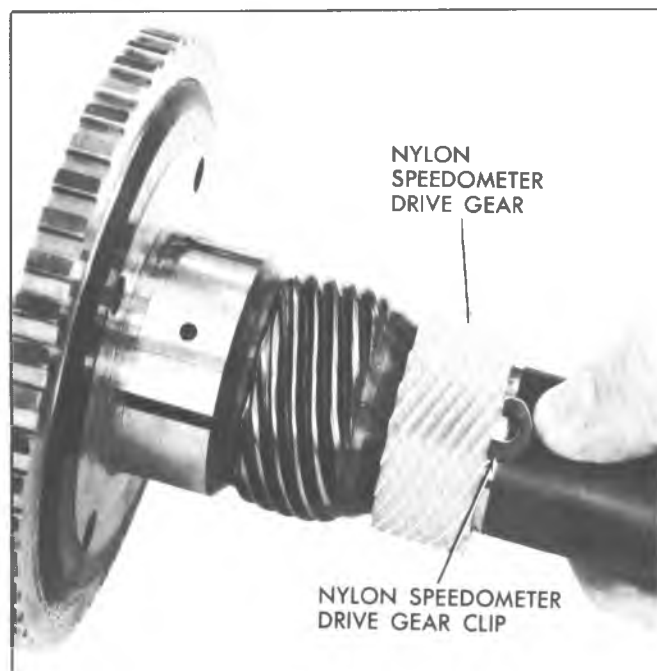


Fig. 7A-53C--Removing Nylon Speedometer Drive Gear

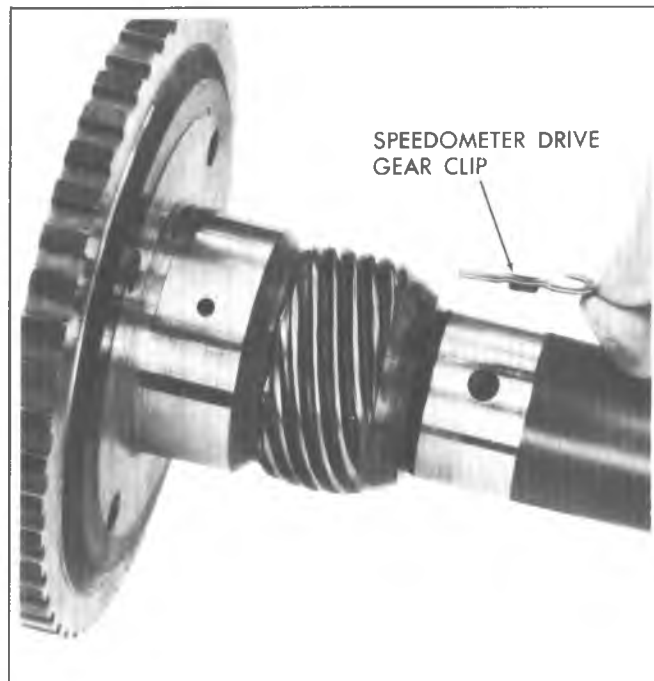


Fig. 7A-54C--Installing Speedometer Drive Gear Clip

## Speedometer Drive Gear Replacement

If removal and installation or replacement of the speedometer drive gear is necessary, proceed as follows:

### Nylon Speedometer Drive Gear

1. Depress clip and slide speedometer drive gear off output shaft (Fig. 7A-53C).

2. To install, place clip (square end toward flange of shaft) into hole in output shaft (Fig. 7A-54C). 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.

**NOTE:** Models CA, CF and CG do not have a speedometer drive gear.

### Steel Speedometer Drive Gear

1. Install speedometer drive gear remover Tool J-21427-01 and J-9539 bolts with J-8105 or suitable puller on



Fig. 7A-55C--Removing Steel Speedometer Drive Gear

output shaft, and remove speedometer drive gear (fig. 7A-55C).

2. Install new steel speedometer drive gear and drive to location 5-21/32" below end of output shaft for all models. (Fig. 7A-56C).

### GOVERNOR ASSEMBLY

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is

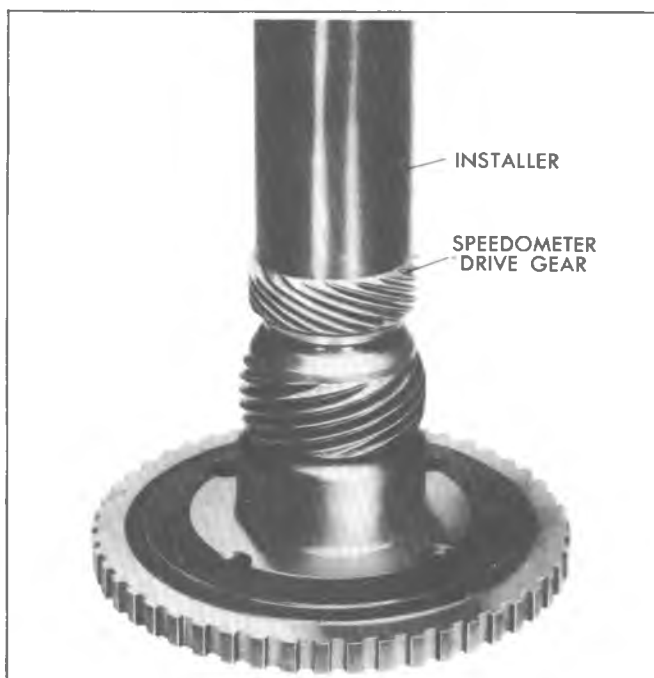


Fig. 7A-56C--Installing Steel Speedometer Drive Gear

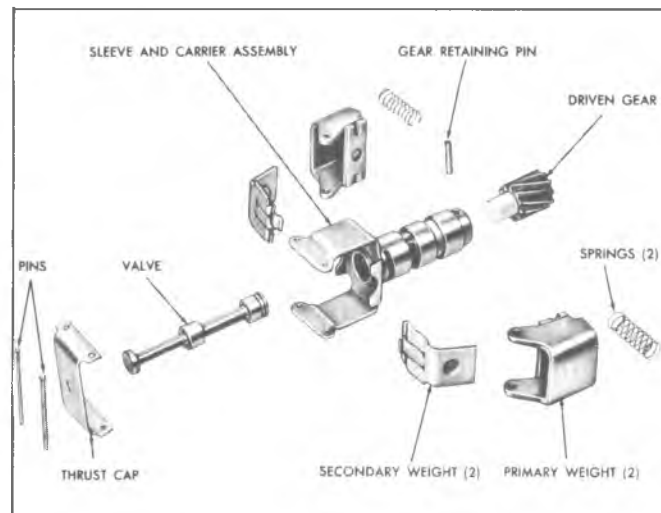


Fig. 7A-57C--Governor--Exploded

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:

### 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. 7A-57C).

2. Remove governor valve from governor sleeve. Be careful not to damage valve.

3. Perform following inspections and replace governor driven gear, if necessary.

### Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.

2. Inspect governor sleeve for nicks, burrs, scoring or galling.

3. Check governor sleeve for free operation in bore of transmission case.

4. Inspect governor valve for nicks, burrs, scoring or galling.

5. Check governor valve for free operation in bore of governor sleeve.

6. Inspect governor driven gear for nicks, burrs, or damage.

7. Check governor driven gear for looseness on governor sleeve.

8. Inspect governor weight springs for distortion or damage.

9. Check governor weights for free operation in their retainers.

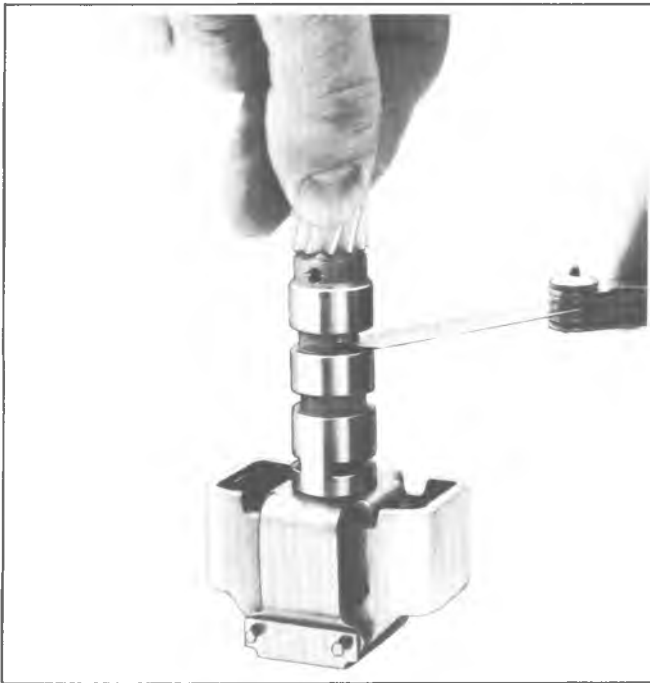


Fig. 7A-58C--Checking Valve Opening With Weights Outward

10. Check valve operating at entry (.020" minimum) with a feeler gage, holding governor as shown with governor weights extended completely outward (Fig. 7A-58C).

11. Check valve opening at exhaust (.020" minimum) with a feeler gage, holding governor as shown with governor weights completely inward (Fig. 7A-59C).

#### **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



Fig. 7A-59C--Checking Valve Opening With Weight Inward



Fig. 7A-60C--Removing Governor Gear Retaining Pin

with care in the following manner:

1. Drive out governor gear retaining split pin using small punch (Fig. 7A-60C).

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.

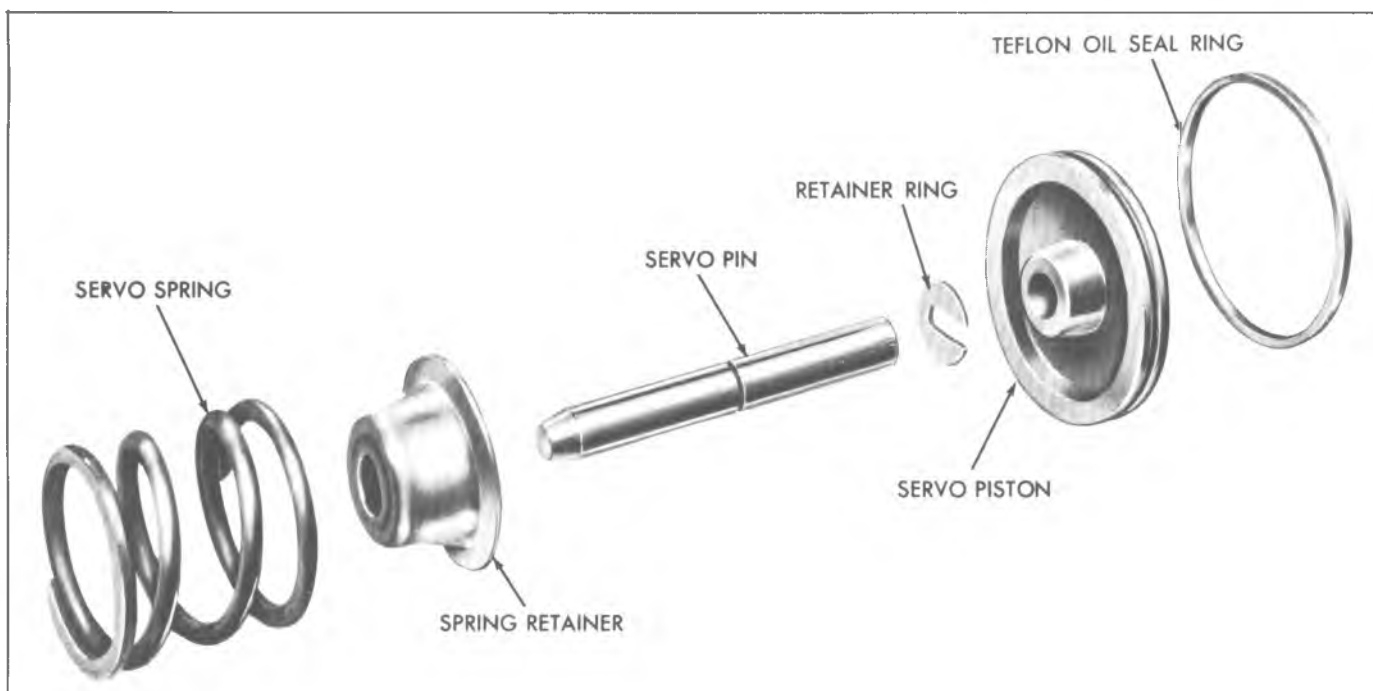


Fig. 7A-61C--Front Servo Assembly--Exploded View

### Front Servo Parts Inspection

**NOTE:** See Fig. 7A-61C. 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.



Fig. 7A-62C--Removing Rear Accumulator Piston from Rear Servo Piston

### Rear Servo Assembly

#### Disassembly

1. Remove rear accumulator piston from rear servo piston (Fig. 7A-62C-A).
2. Remove "E" ring retaining rear servo piston to servo pin (Fig. 7A-63C).

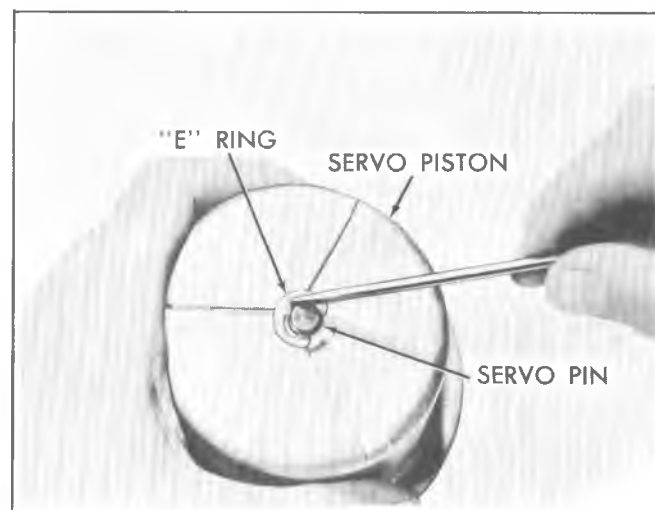


Fig. 7A-63C--Removing Retaining "E" Ring from Rear Servo Pin

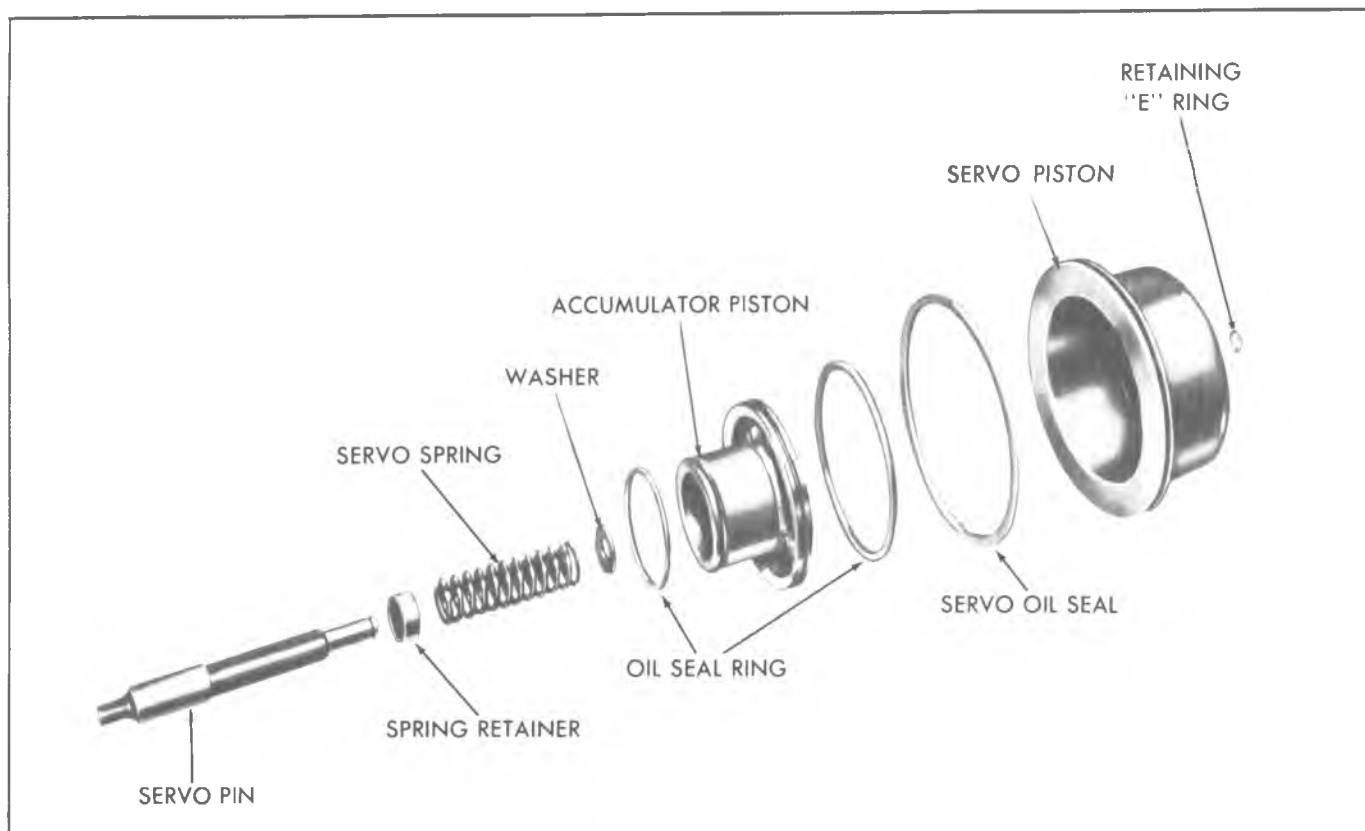


Fig. 7A-64C--Rear Servo and Accumulator Assembly--Exploded View

3. Remove rear servo piston and seal from servo pin (Fig. 7A-64C). (Exploded view.)
4. Remove washer, spring, and spring retainer.

### Inspection

**NOTE:** See Fig. 7A-64C. 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.

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.

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.
2. Install servo pin, retainer, spring and washer, into bore of servo piston and secure with "E" ring.
3. Install oil seal ring on servo piston, if removed.
4. Install outer and inner oil rings on accumulator piston, if removed, and assemble into bore of servo piston.

## CONTROL VALVE, DISASSEMBLY, INSPECTION AND RE-ASSEMBLY (Fig. 7A-67C)

### Disassembly

1. Position control valve assembly with cored face up and accumulator pocket nearest operator.
2. Remove manual valve from upper bore.
3. Install Special Tools J-22269 and J-24675, on accumulator piston and remove retaining ring (Fig. 7A-65C).



Fig. 7A-65C--Installing Compressor Tool to Front Accumulator Piston

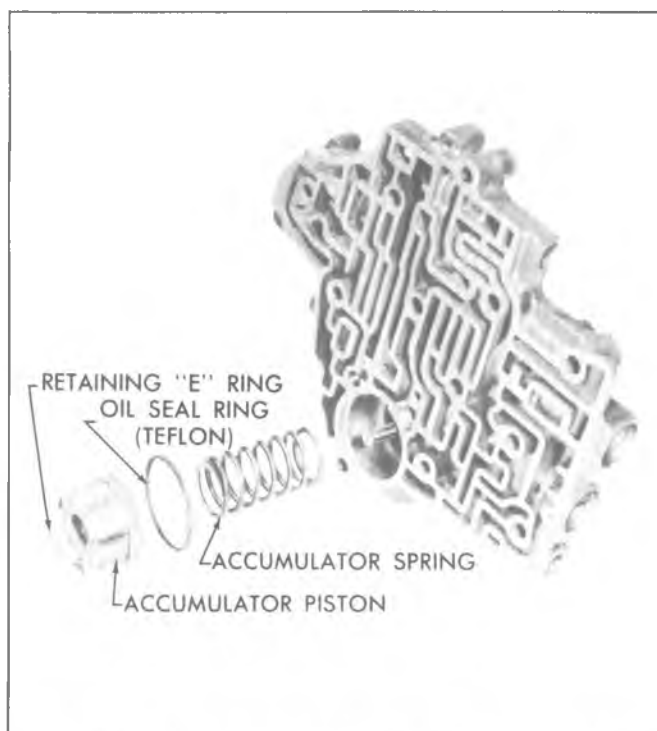


Fig. 7A-66C--Front Accumulator Assembly - Exploded View

4. Remove front accumulator piston and spring (Fig. 7A-66C).

5. On the right side adjacent to the manual valve, remove the 1-2 valve train as follows:

a. (Models CG, CJ and CP) Remove retaining pin, 1-2 modulator bushing, 1-2 valve spring, 1-2 modulator valve, and 1-2 shift valve.

b. (All other models) 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, 2-3 modulator valve bushing, 2-3 modulator valve, 3-2 intermediate spring, and 2-3 shift valve.

**NOTE:** Model CC does not use a 2-3 shift valve spring.

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. (Model CP, CC, and CK) Remove the grooved retaining pin, bore plug, 1-2 accumulator valve and spring.

b. (Models CB, CD, CJ, and CL) Remove the grooved retaining pin, bore plug, 1-2 accumulator valve.

c. (Models CA, CF, CG, CM and CT) Remove the grooved retaining pin, bore plug, 1-2 accumulator secondary spring and 1-2 accumulator valve.

## Inspection

**NOTE:** See Fig. 7A-66C. 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 Tools J-22269 and J-24675 and compress spring and piston and secure with retaining "E" ring.

3. Install the 1-2 accumulator valve train into the lower left hand bore as follows:

a. (Model CC, CK and CP) 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 of valve body.

b. (Models CB, CD, CJ, and CL) Install 1-2 accumulator valve stem end out, into bore. Place bore plug into valve bore and install grooved retaining pin from cast surface side of the valve body, with the groove entering the pin holes last. Tap pin with a hammer until flush with cast surface of valve body.

c. (Models CA, CF, CG, CM and CT) 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. 7A-68C).

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.

**NOTE:** Model CC does not use a 2-3 shift valve spring.

13. In next bore up, install 1-2 valve, stem end out.

14. Install parts as follows:

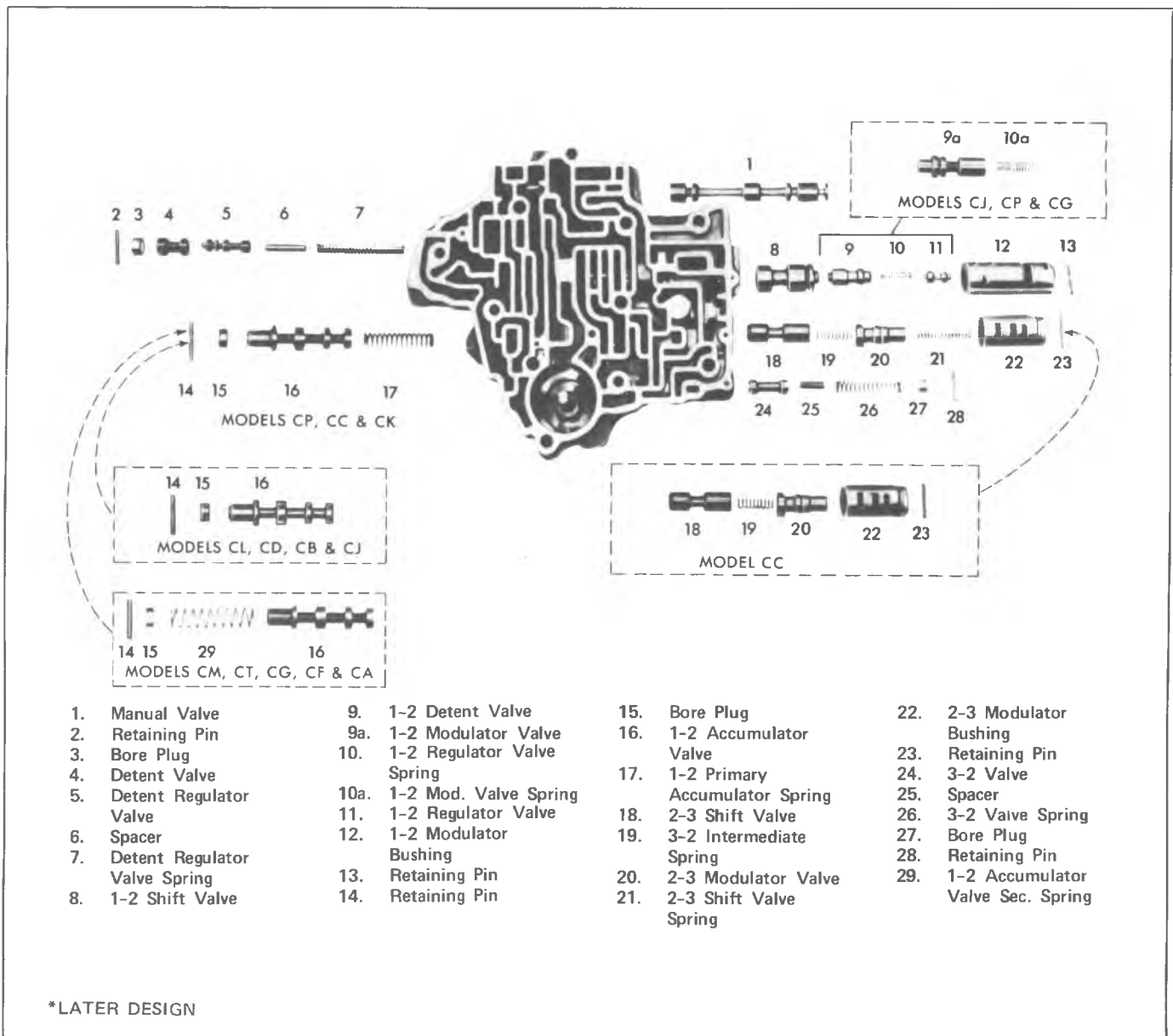


Fig. 7A-67C--Control Valve Assembly--Exploded View

a. (Models CG, CJ and CP) 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. (All other models) 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.

15. Compress bushing against spring and install retaining pin.

16. Install manual valve with detent pin groove to the right.

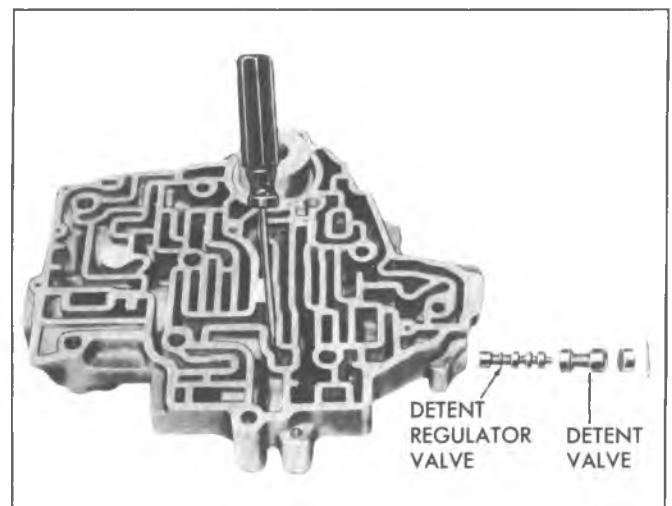


Fig. 7A-68C--Installing Detent Regulator Valve and Detent Valve

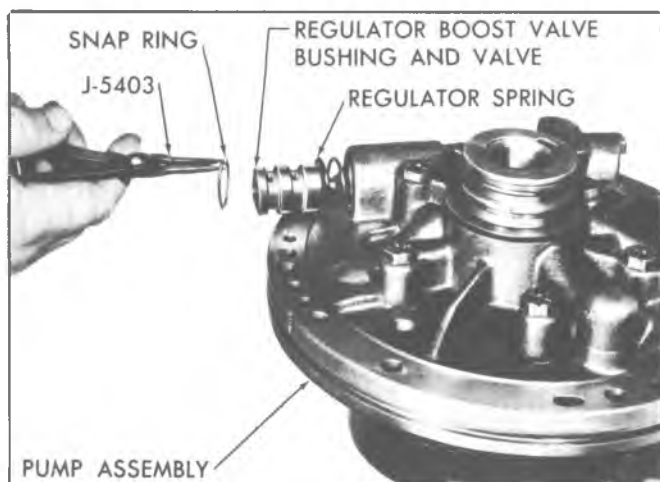


Fig. 7A-69C--Removing Pump Regulator Valve Snap Ring

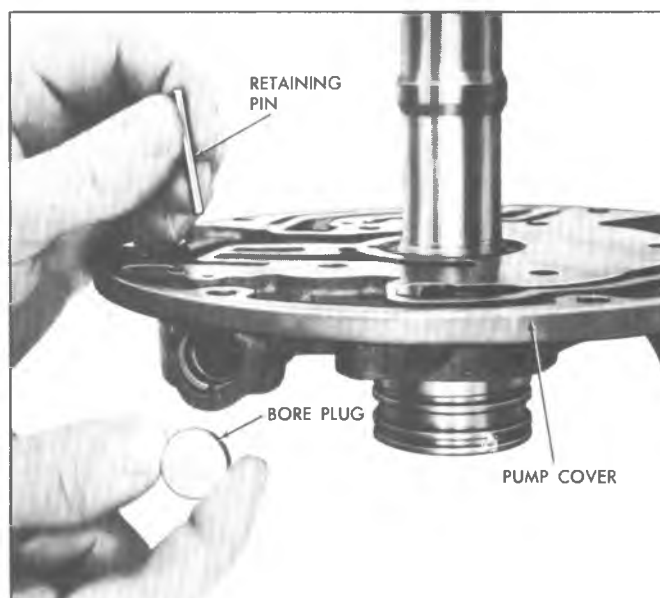


Fig. 7A-71C--Installing Pressure Regulator Retaining Pin and Bore Plug

## 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. 7A-69C).
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. 7A-70C).
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. 7A-71C).
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 Fig. 7A-72C.

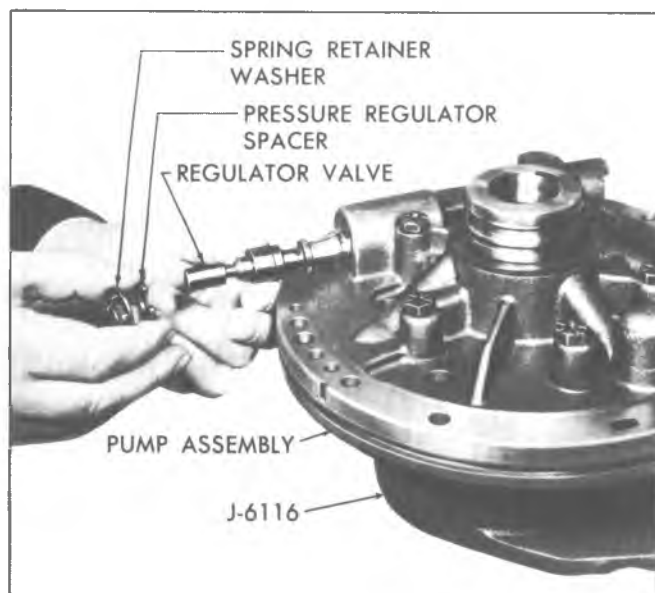


Fig. 7A-70C--Removing Pressure Regulator Valve

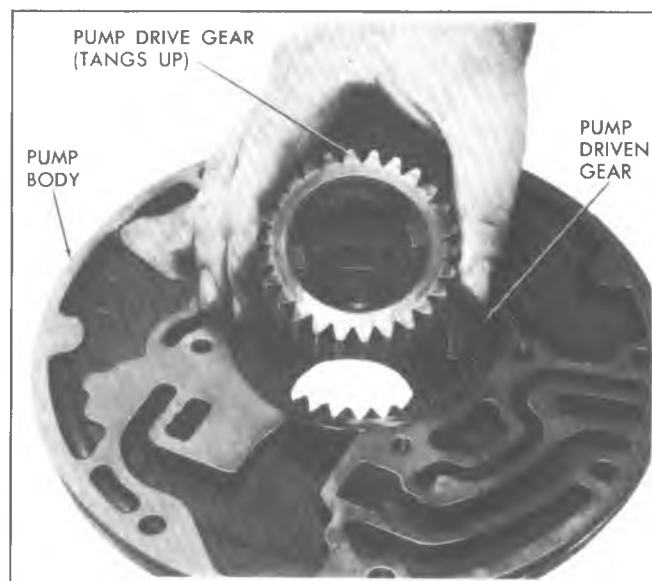


Fig. 7A-72C--Installing Pump Drive Gear



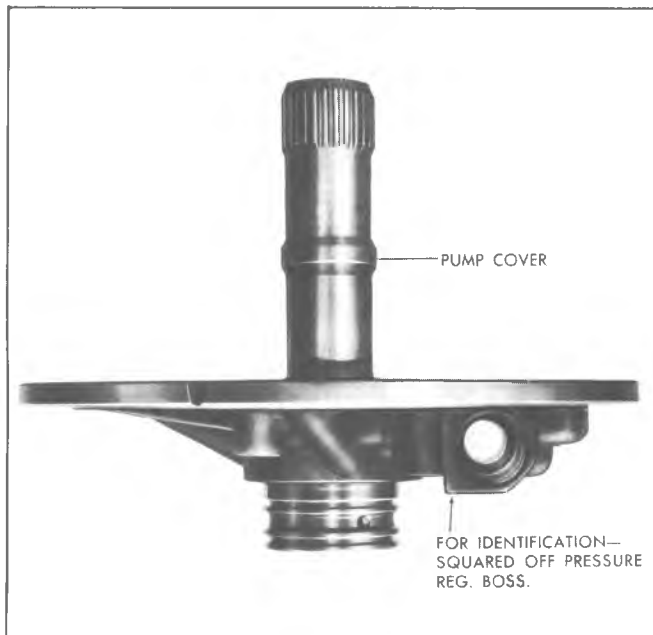


Fig. 7A-73C--Pressure Regulator Valve Identification

### 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 off pressure regulator boss. See Fig. 7A-73C. 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. 7A-74C).
3. Check face of pump body for scores or nicks.
4. Check oil passages (Fig. 7A-75C).
5. Check for damaged cover bolt attaching threads.
6. Check for overall flatness of pump body face.



Fig. 7A-74C--Checking Pump Body Face to Gear Face Clearance

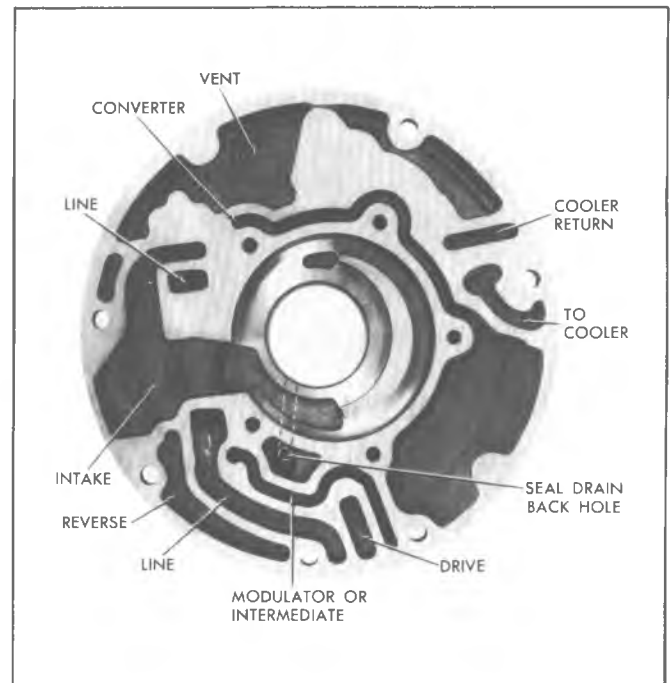


Fig. 7A-75C--Pump Body Oil Passages

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. 7A-76C).

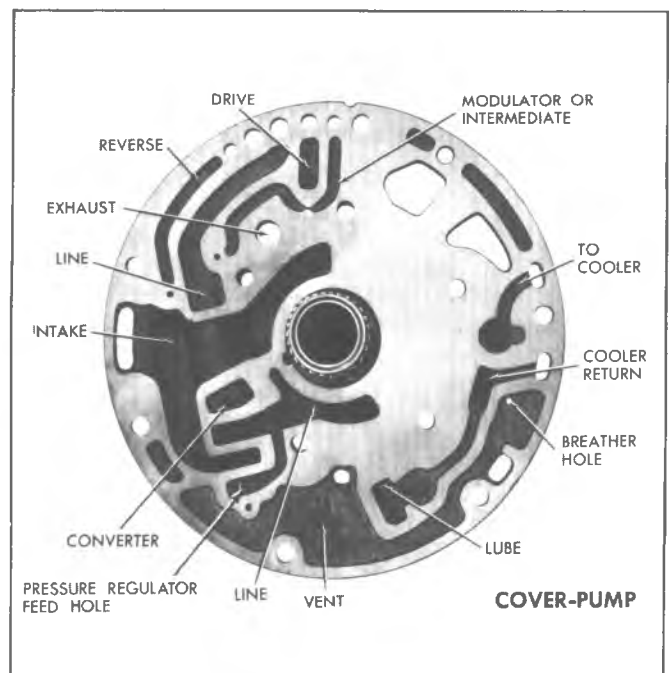


Fig. 7A-76C--Pump Cover Oil Passages

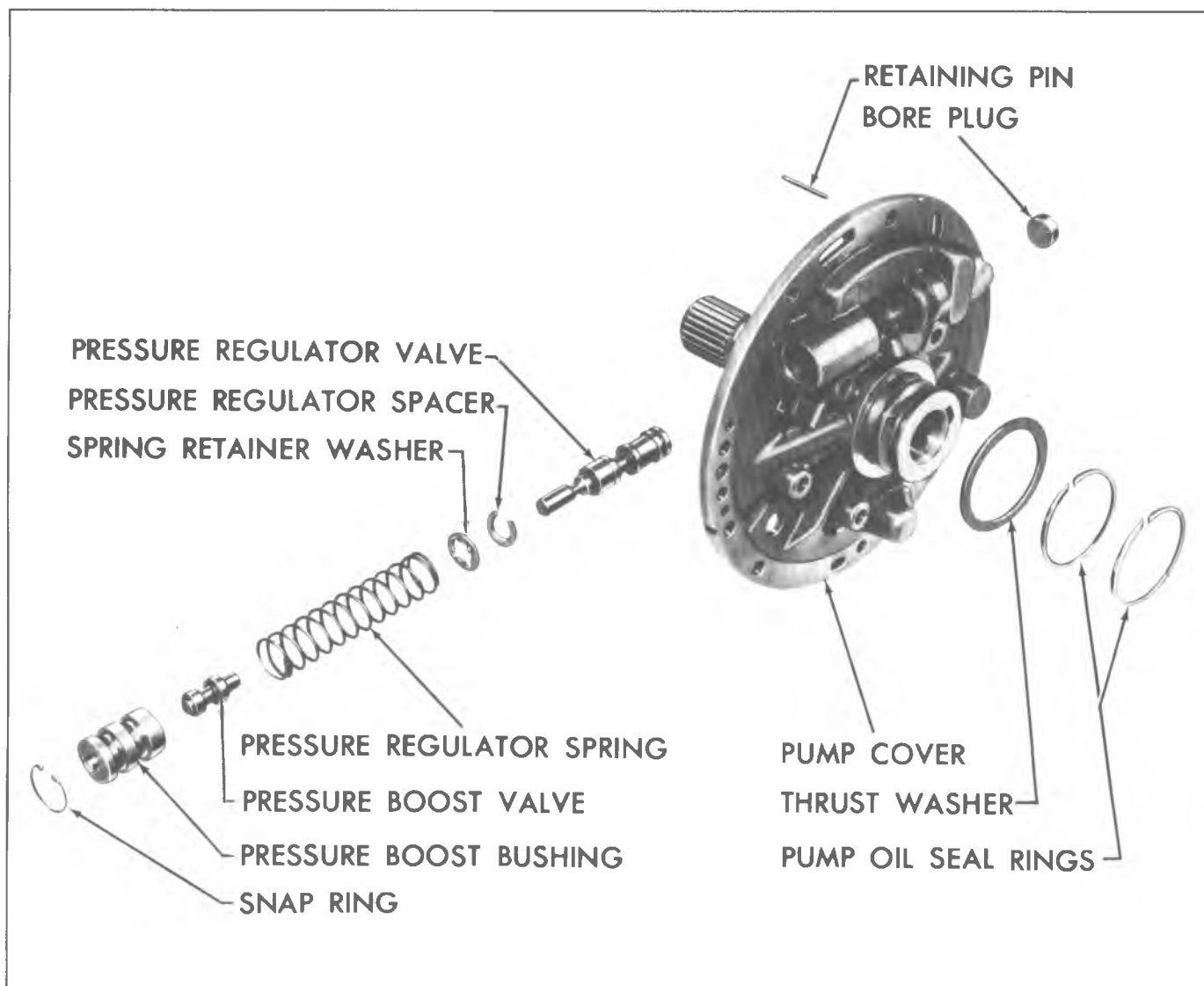


Fig. 7A-77C--Pump Cover--Exploded View

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. 7A-76C).

#### Assembly

1. Install drive and driven pump gears with alignment marks up into pump body (Fig. 7A-72C) 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. 7A-77C).

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

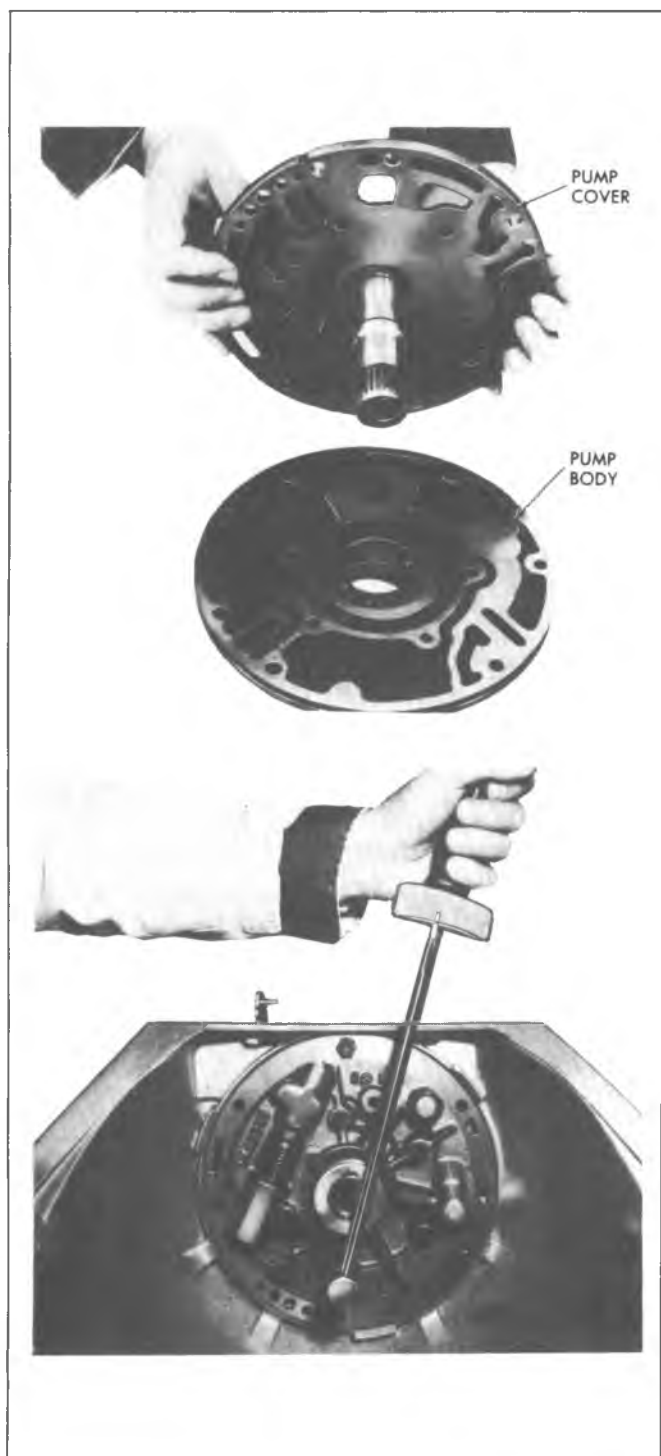


Fig. 7A-78C--Aligning and Installing Pump Cover to Pump Body

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 (Fig. 7A-78C).

**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. 7A-78C).

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**

**NOTE:** See Clutch Chart, Fig. 7A-79C, for details of clutch components by specific model designations.

**1978 CLUTCH APPLICATION CHART  
400, 475 AND 425**

Model	Forward Clutch					Direct Clutch			Intermediate Clutch		
	Flat Steel plates		No. of waved steel plates	No. of dished steel plates	No. of composition plates	No. of flat steel plates	No. of waved steel plates	No. of composition plates	No. of flat steel plates	No. of waved steel plates	No. of composition plates
	No.	Thickness									
BB, OB, OD, AA, AB, AC, AE, AH, AT	3	.0775	1	0	4	4	0	4	2	1	3
CM, CT, CJ, CP, CG, CF, CK	4	.0775	1	0	5	5	0	5	2	1	3
BC	3	.0775	1	0	4	5	0	5	2	1	3
AD, AL	4	.0915	1	0	5	4	1	5	2	1	3
AM	4	.0915	1	0	5	6	0	6	2	1	3
CC	4	.0775	1	0	5	3	1	4	2	1	3
CB	4	.0775	1	0	5	6	0	6	3	0	3*
CL, CD	5	.0915	0	0	5	6	0	6	3	0	3*
AJ, OJ	5	.0915	0	1	5	5	0	5	3	0	3
AK	5	.0915	0	1	5	4	1	5	3	0	3
GM	5	.0915	0	1	5	5	1	6	3	0	3
JM, JR	3	.0775	1	0	4	4	1	5	2	1	3
JC, JS, JK	3	.0775	1	0	4	3	1	4	2	1	3

NOTE: For Service use only the 1978 Direct and Forward Composition-faced clutch plates. Refer to the parts catalog for correct usage.

\* Models CB, CL and CD have intermediate clutch plates which are different than other models. Refer to the parts catalog for correct usage.

Fig. 7A-79C--Clutch Chart, Component Details

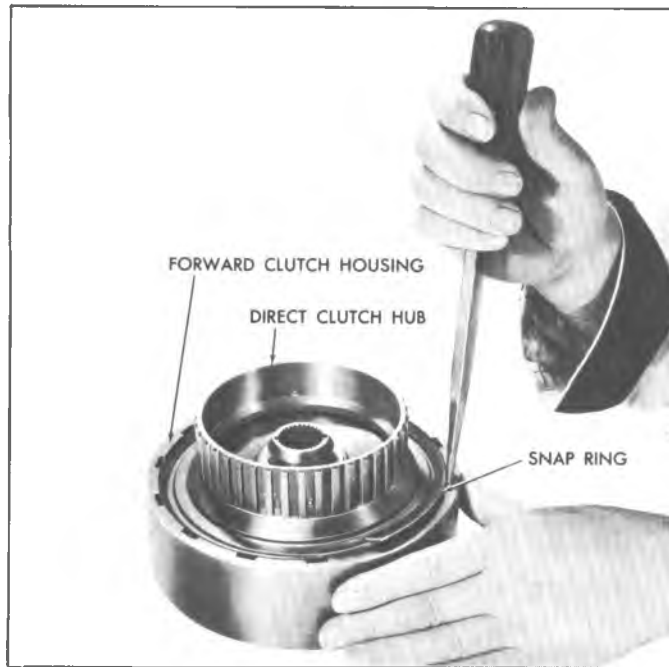


Fig. 7A-80C--Removing Forward Clutch Housing to Direct Clutch Hub Snap Ring

#### Disassembly

1. Place forward clutch assembly with turbine shaft through hole in bench or Holding Fixture J-6116, and remove forward clutch housing to direct clutch hub snap ring (Fig. 7A-80C).
2. Remove direct clutch hub.
3. Remove forward clutch hub and thrust washers (Fig. 7A-81C).
4. Remove composition, steel clutch plates, and waved steel plate.

**NOTE:** Models CL and CS do not use a waved steel plate.

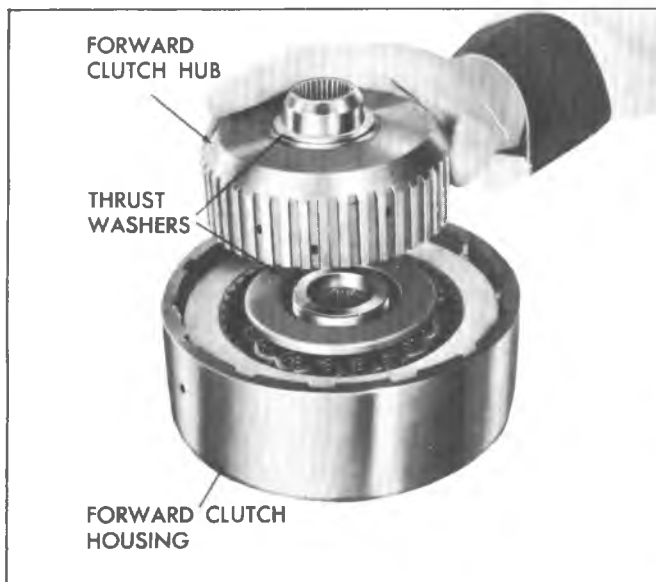


Fig. 7A-81C--Removing Forward Clutch Hub and Thrust Washers

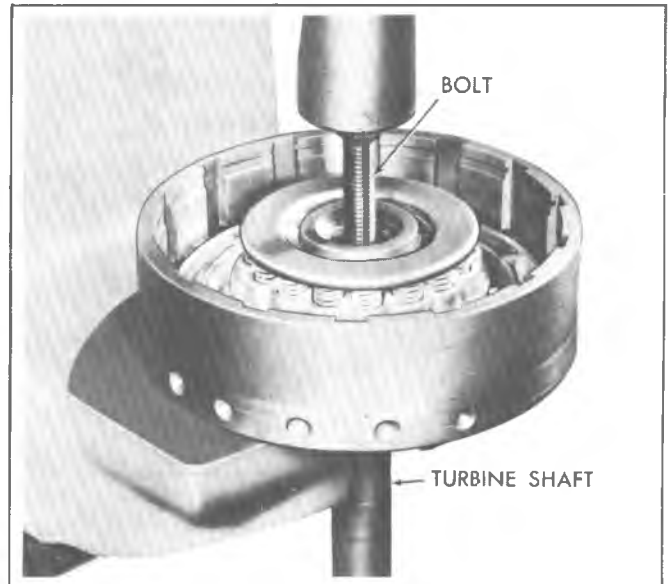


Fig. 7A-82C--Removing Turbine Shaft from Forward Clutch Housing

5. If necessary place forward clutch and turbine shaft in arbor press and remove turbine shaft (Fig. 7A-82C).

6. Using J-4670 clutch spring compressor in arbor press with Adapter J-21664, compress spring retainer and remove snap ring (Fig. 7A-83C).

7. Remove spring retainer and sixteen (16) clutch release springs.

**NOTE:** Keep springs separate from direct clutch release springs.

8. Remove forward clutch piston.

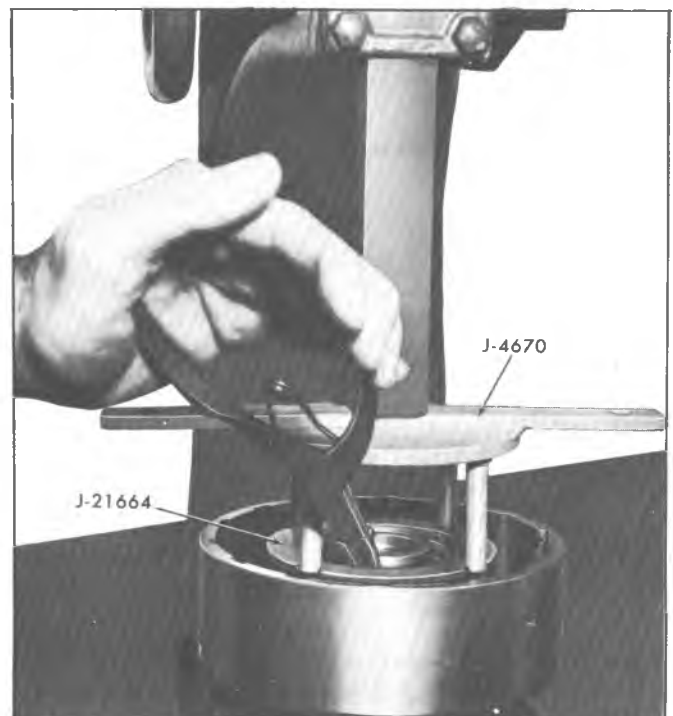


Fig. 7A-83C--Removing Forward Clutch Spring Retaining Snap Ring



Fig. 7A-84C--Removing Forward Clutch Piston Outer Seal

9. Remove inner and outer clutch piston seals (Fig. 7A-84C).

10. Remove center piston seal from forward clutch housing (Fig. 7A-85C).

### 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.

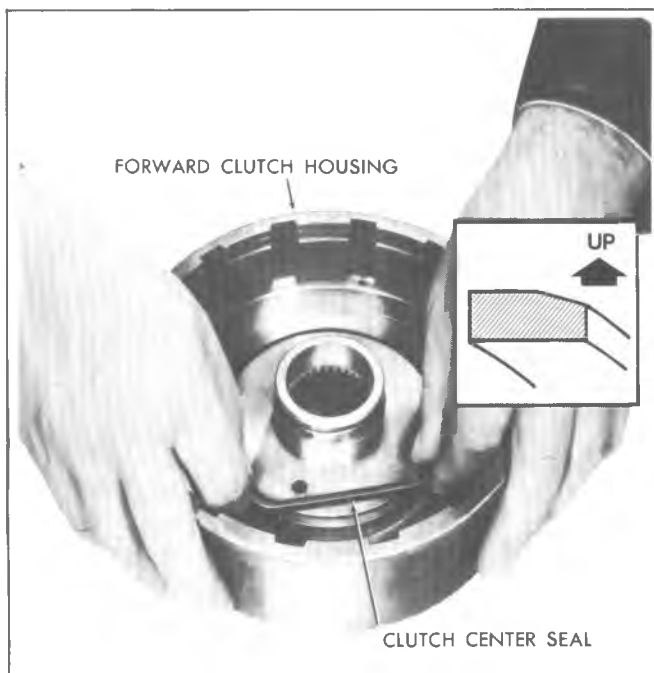


Fig. 7A-85C--Removing Forward Clutch Center Seal

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. 7A-82C).

### Assembly (Fig. 7A-86C)

**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 7A-102C.

1. Place new inner and outer oil seals on clutch piston, lips face away from spring pockets (Fig. 7A-84C).

2. Place a new center seal on clutch housing, as shown in Fig. 7A-85C.

**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. 7A-87C).

4. Install sixteen (16) clutch release springs into pockets in piston.

5. Place spring retainer and snap ring on springs.

6. Compress springs in arbor press, using clutch compressor Tools J-4670 and J-21664, install snap ring.

7. If removed, install turbine shaft in forward clutch housing, using arbor press.

8. Install forward clutch hub washers on forward clutch hub. Retain with petrolatum.

9. Place forward clutch hub into forward clutch housing.

10. Oil and install five (5) composition, and four (4) flat steel and one (1) waved steel clutch plate (with "U" notches), starting with waved steel and then alternating composition and steel clutch plates, as shown in Fig. 7A-88C.

**NOTE:** Models CD and CL do not use a waved steel clutch plate.

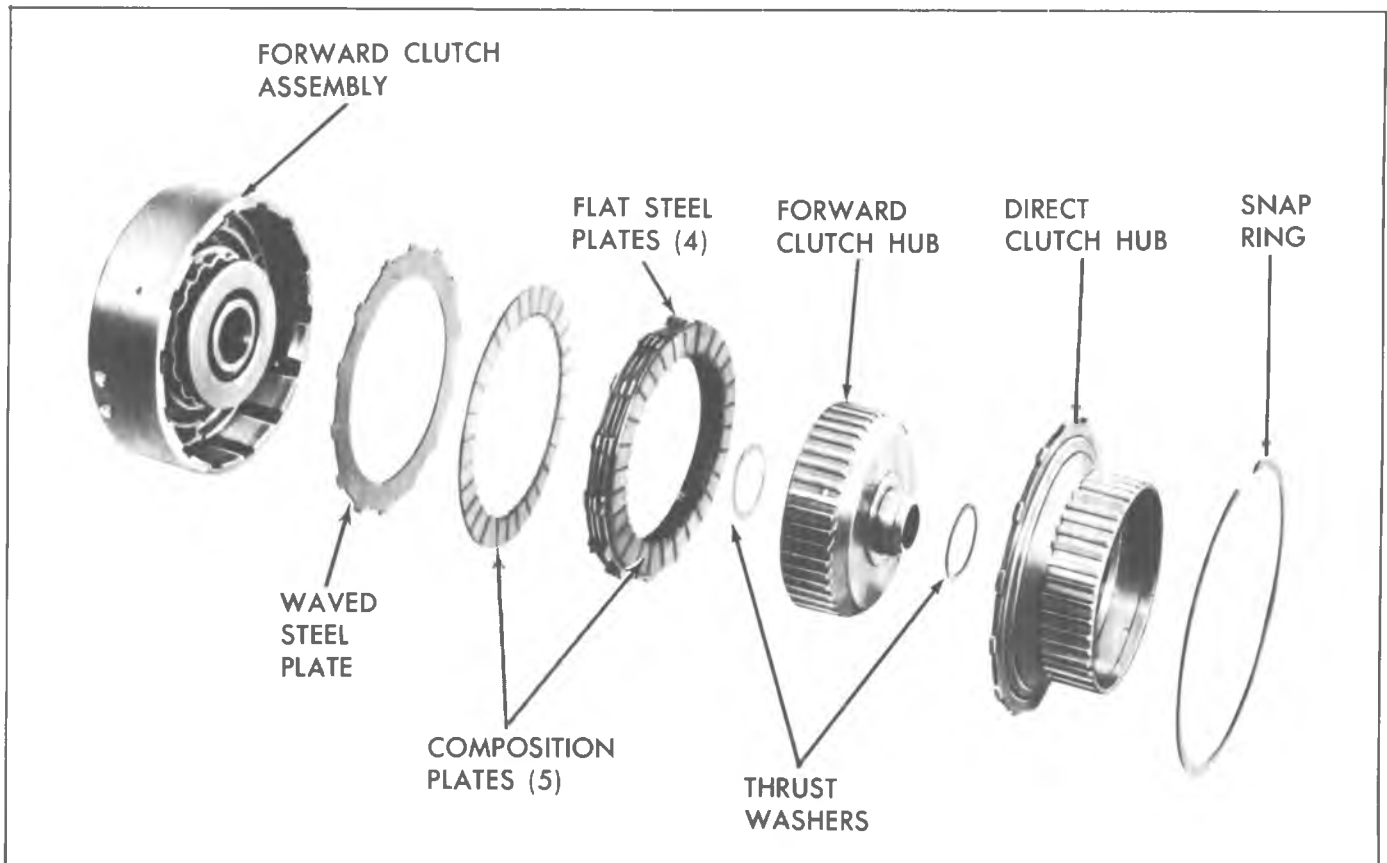


Fig. 7A-86C--Forward Clutch Assembly--Exploded View

**CAUTION:** Do not confuse the flat steel clutch plate (plate with "V" notch) with the waved steel clutch plate (plate with "U" notch).

**NOTE:** Radially grooved composition clutch plates are installed at the factory only. All service composition plates have the smooth surface configuration.

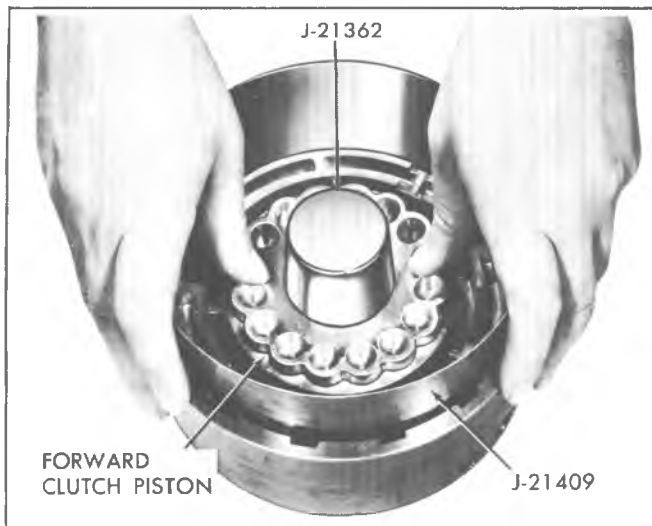


Fig. 7A-87C--Installing Forward Clutch Piston

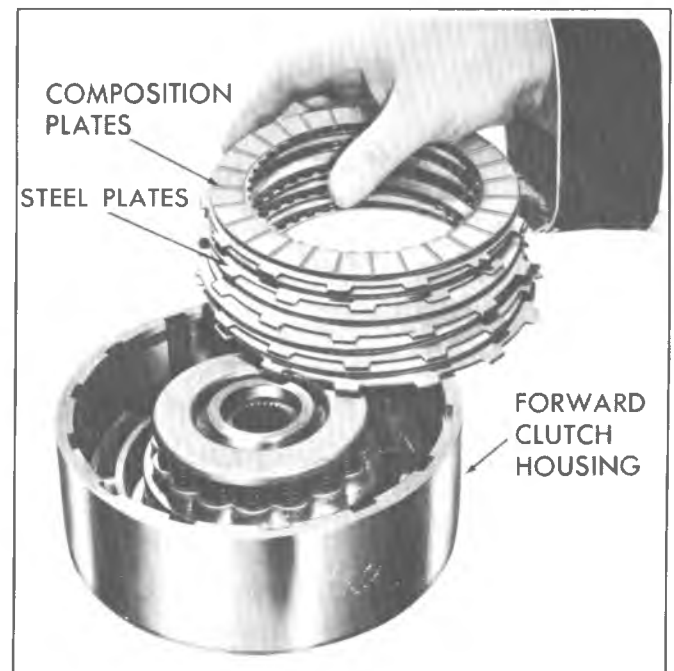


Fig. 7A-88C--Installing Forward Clutch Composition and Steel Plates



Fig. 7A-89C--Installing Forward Clutch Housing to Direct Clutch Hub Snap Ring



Fig. 7A-90C--Air Checking Forward Clutch Assembly

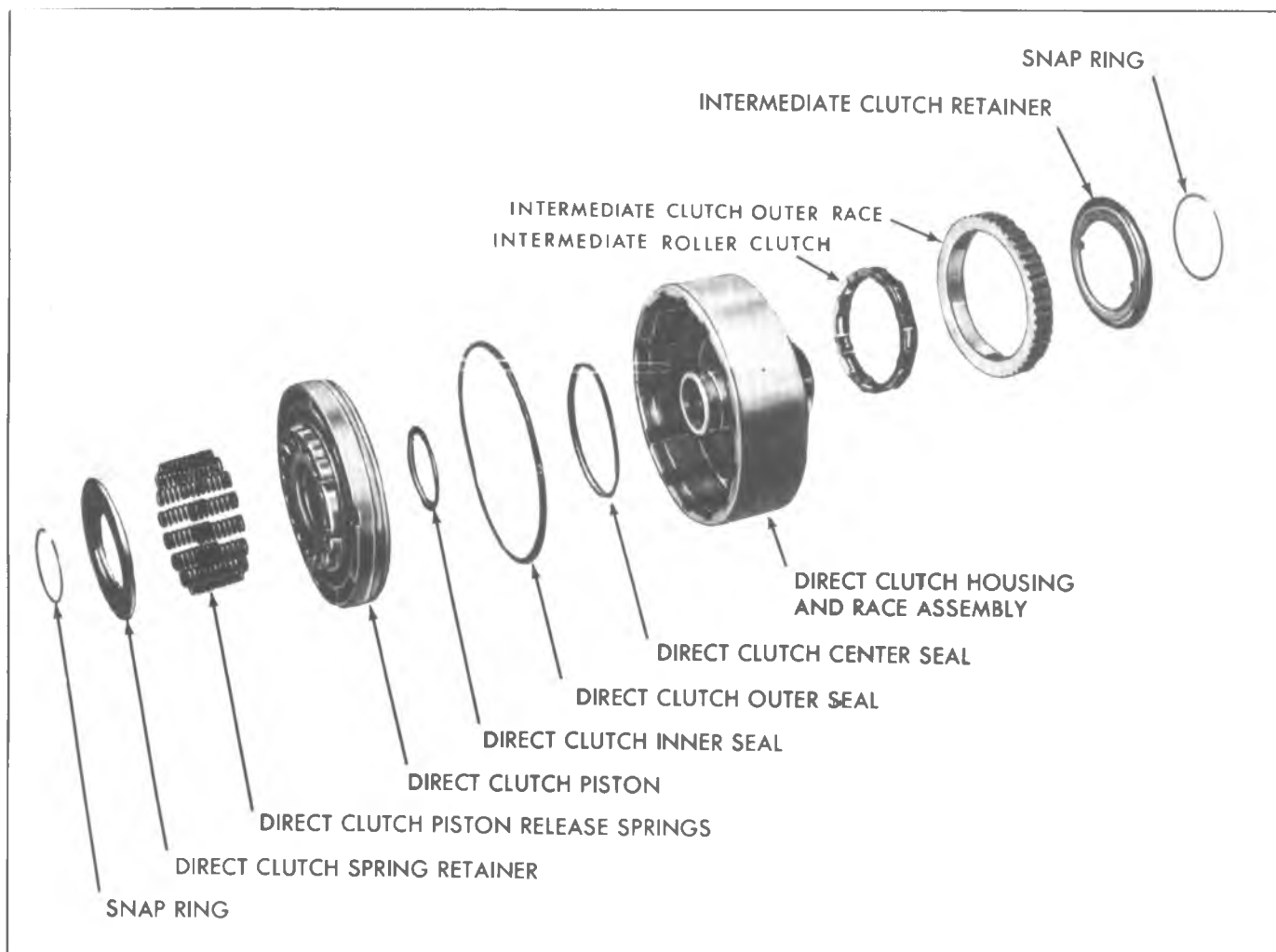


Fig. 7A-91C--Direct Clutch and Intermediate Roller Assembly





Fig. 7A-92C--Removing Intermediate Clutch Retainer Snap Ring

11. Install direct clutch hub and retaining snap ring (Fig. 7A-89C).

12. Place forward clutch housing on pump delivery sleeve and air check clutch operation (7A-90C).

### **DIRECT CLUTCH AND INTERMEDIATE ROLLER DISASSEMBLY, INSPECTION AND ASSEMBLY**

**NOTE:** Refer to Fig. 7A-79C.

#### **Disassembly (Fig. 7A-91C)**

1. Remove intermediate roller assembly retainer snap ring and retainer (Fig. 7A-92C).

2. Remove roller outer race and roller assembly.

3. Turn unit over and remove backing plate to direct clutch housing snap ring (Fig. 7A-93C).

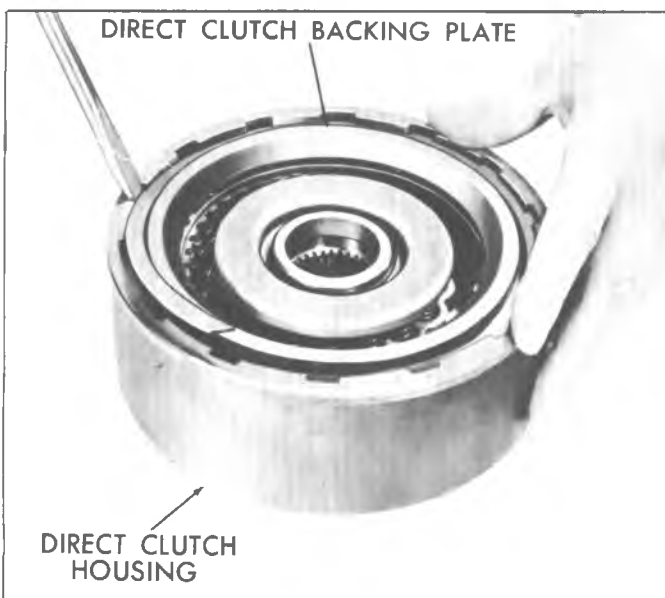


Fig. 7A-93C--Removing Direct Clutch Backing Plate Snap Ring



Fig. 7A-94C--Removing or Installing Direct Clutch Snap Ring

4. Remove direct clutch backing plate, composition plates, and steel clutch plates.

5. Using clutch compressor Tool J-4670 and J-21664, compress spring retainer in arbor press and remove snap ring (Fig. 7A-94C).

6. Remove retainer and fourteen (14) piston release springs.

**NOTE:** Keep springs separate from forward clutch release springs.

7. Remove direct clutch piston (Fig. 7A-95C).

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.

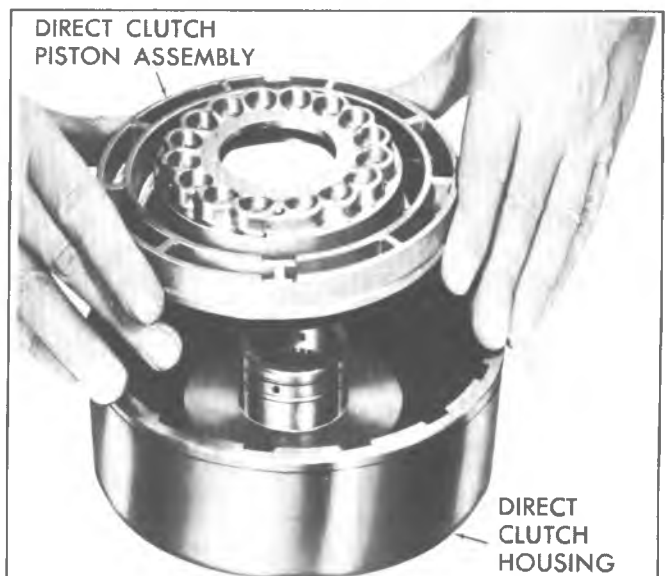


Fig. 7A-95C--Removing Direct Clutch Piston Assembly

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.
7. Inspect fourteen (14) release springs for collapsed coils or signs of distortion.

**NOTE:** The 14 direct clutch release springs are not serviced. If one or more of these springs require replacement, discard all of them and install the 16 service direct clutch release springs.

8. Inspect housing for free operation of check ball.

## 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 7A-102C.

1. Install a new inner clutch piston seal on piston with lip facing away from spring pockets (Fig. 7A-96C).
2. Install a new outer clutch piston seal with lip facing away from spring pockets (Fig. 7A-97C).
3. Install a new center seal on clutch housing with lip of seal facing up (Fig. 7A-98C).

**NOTE:** Apply automatic transmission oil to all seals and clutch plates before installation.

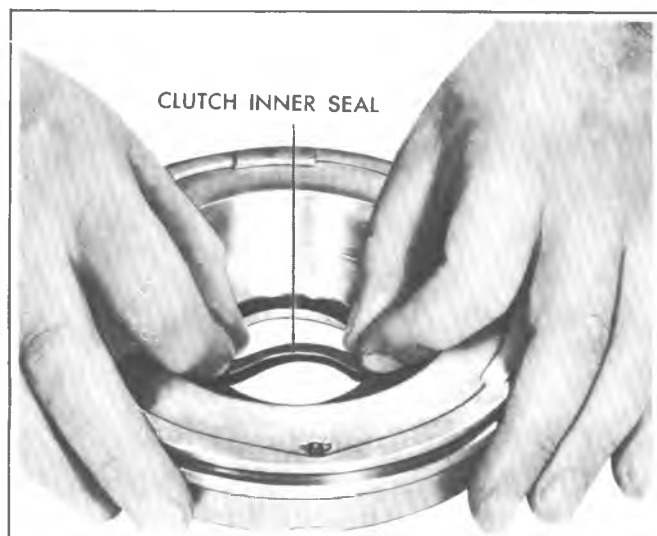


Fig. 7A-96C--Installing Direct Clutch Inner Seal

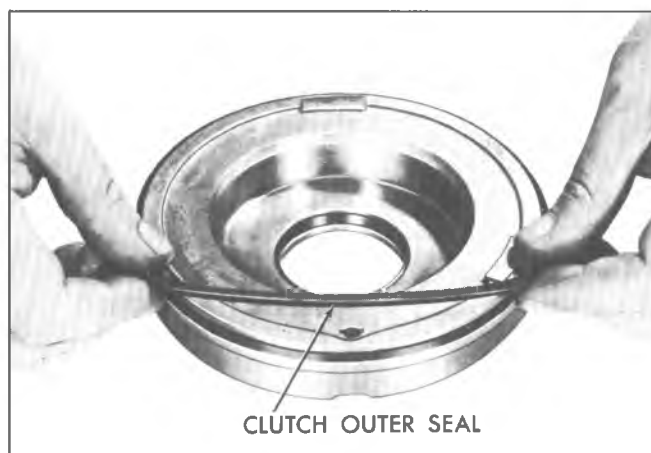


Fig. 7A-97C--Installing Direct Clutch Outer Seal

**CAUTION:** The direct clutch housing for models CB, CD and CL 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

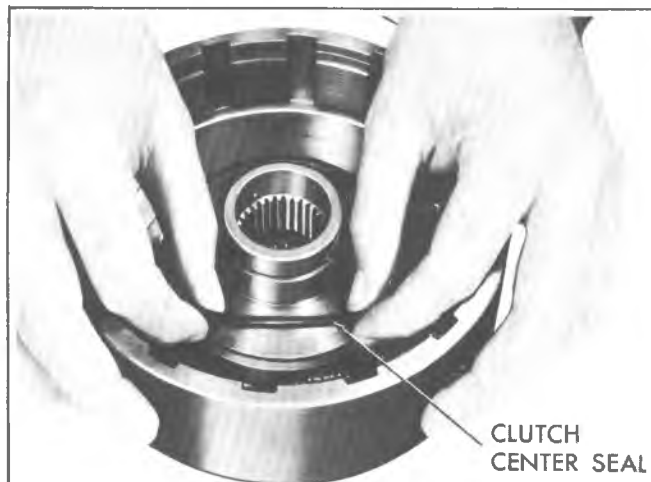


Fig. 7A-98C--Installing Direct Clutch Center Seal

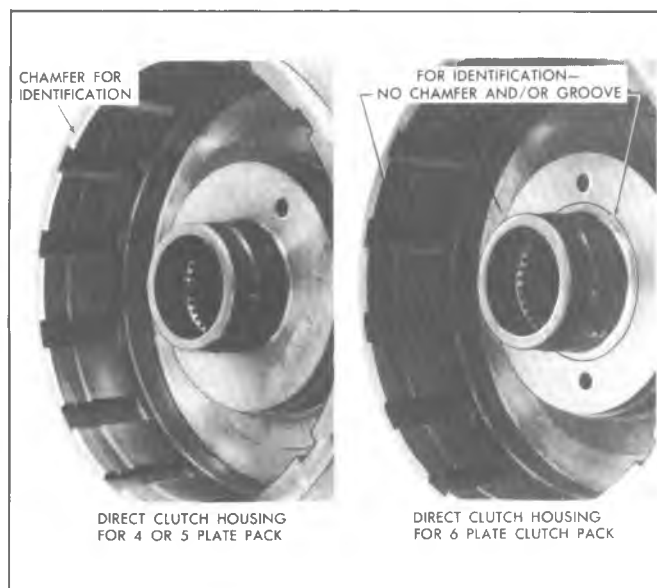


Fig. 7A-99C--Direct Clutch Housing Identification

tower (Fig. 7A-99C). Should replacement of the direct clutch housing become necessary, extreme care must be taken in obtaining the correct part for the model involved.

Production built transmissions use a direct clutch housing with a check ball (See Fig. 7A-100C). If the housing requires replacement and the replacement housing does not contain a check ball, replace the direct clutch piston with the service piston which has a check ball (Models CB, CD and CL service piston has 2 check balls). **EITHER THE DIRECT CLUTCH HOUSING AND/OR THE PISTON MUST CONTAIN A CHECK BALL(S).**

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. 7A-101C).

5. Install fourteen (14) springs into piston leaving two pockets diagonally opposite with no springs.

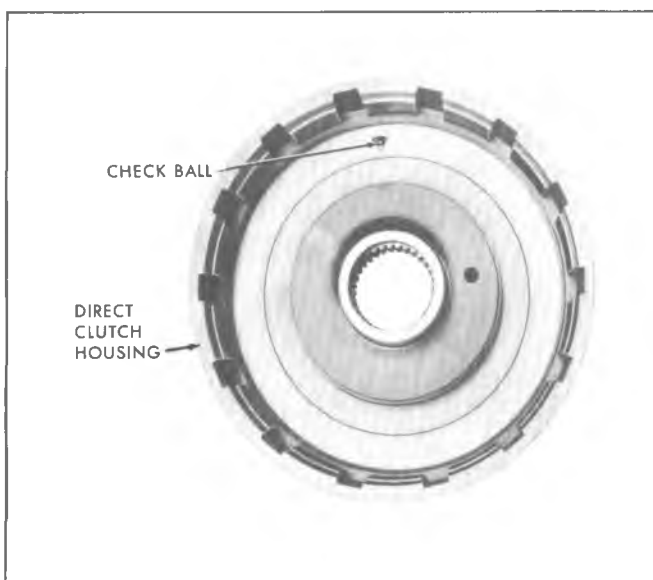


Fig. 7A-100C--Direct Clutch Housing with Check Ball

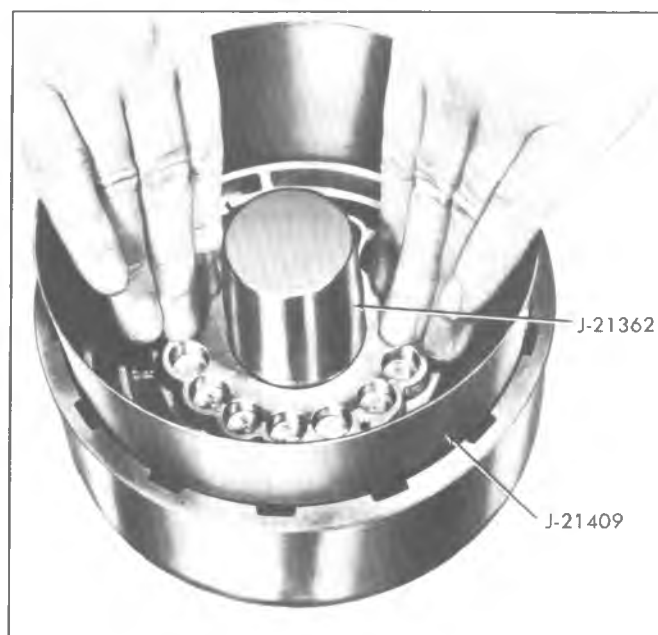


Fig. 7A-101C--Installing Direct Clutch Piston

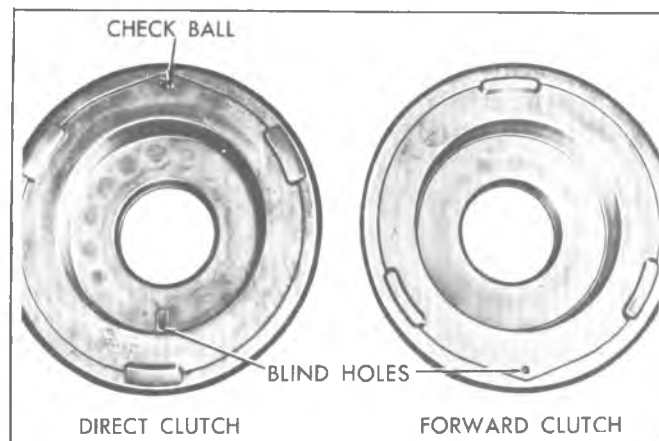


Fig. 7A-102C--Forward and Direct Clutch Piston Identification

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. 7A-94C):

8. Install direct clutch plates. See Fig. 7A-103C.

a. For model CC, start with one (1) waved steel plate,

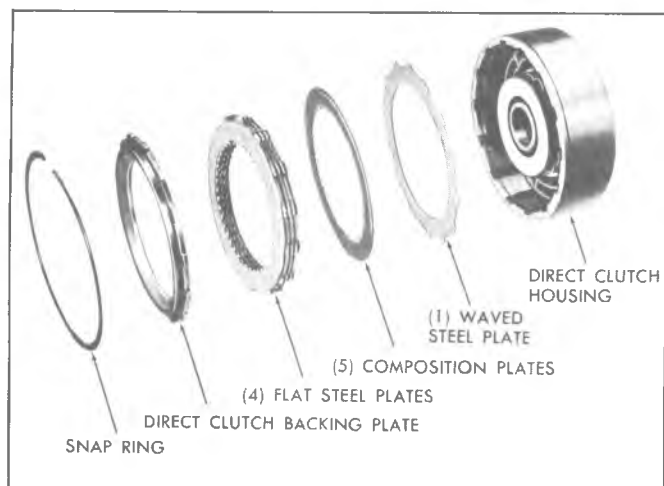


Fig. 7A-103C--Direct Clutch Assembly Exploded

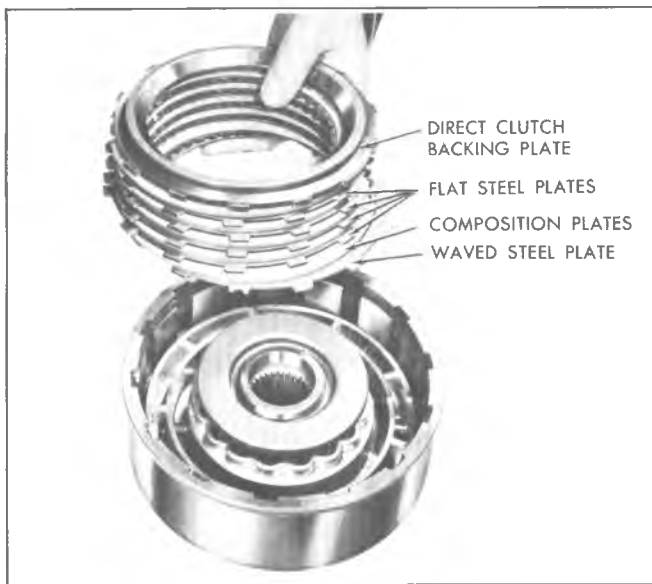


Fig. 7A-104C--Install Direct Clutch Backing Plate, Composition Plates, and Steel Plates

followed alternately by four (4) composition plates and three (3) flat steel plates. (Fig. 7A-104C).

b. (Models CB, CD and CL) 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.

**NOTE:** Do not use radial grooved composition plates here.

9. Install clutch backing plate.

10. Install backing plate retaining snap ring (Fig. 7A-105C).

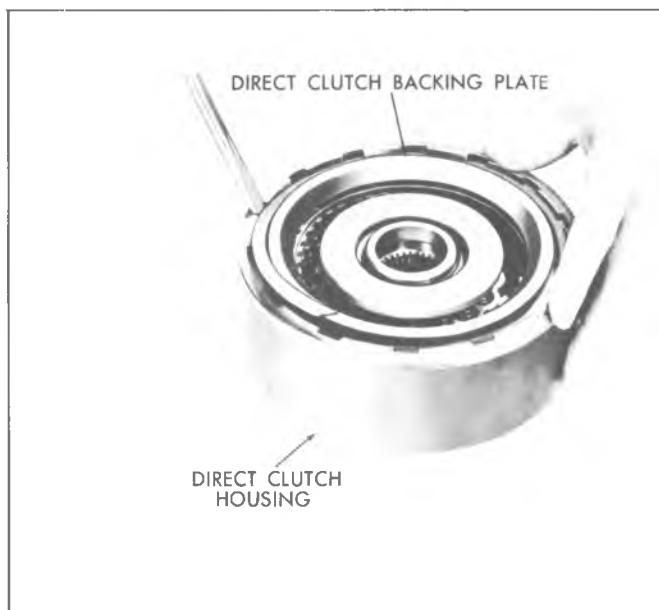


Fig. 7A-105C--Installing Direct Clutch Housing to Backing Plate Snap Ring

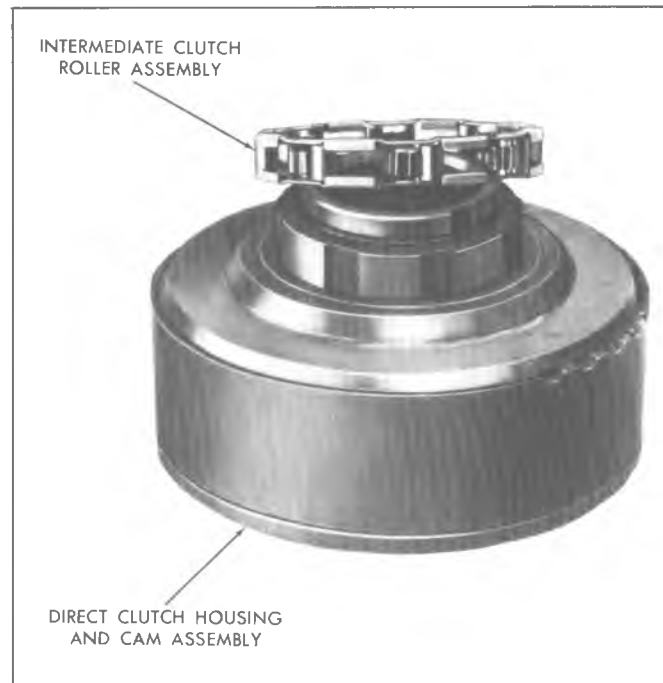


Fig. 7A-106C--Installing Intermediate Clutch Roller Assembly

**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. 7A-106C).

12. Install the intermediate clutch outer race with a clockwise turning motion (fig. 7A-107C).

**NOTE:** Intermediate roller clutch is not released for the CB, CD and CL models. The sprag assembly is released for these models.

Outer race should not turn counter-clockwise after installation. (See Figure 7A-108C).

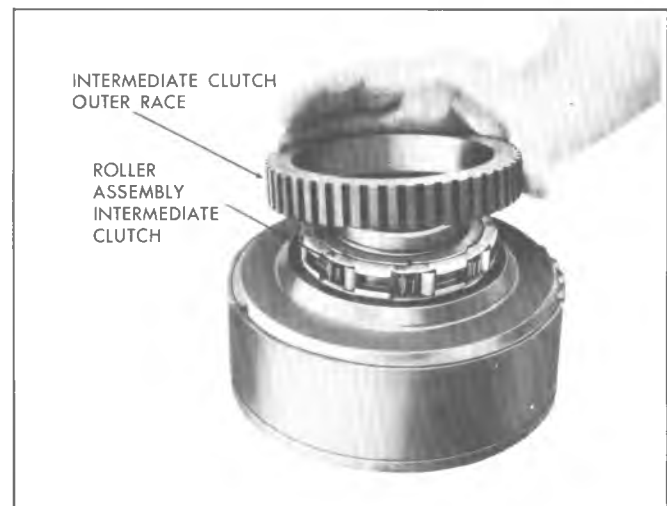


Fig. 7A-107C--Installing Intermediate Clutch Outer Race to Direct Clutch

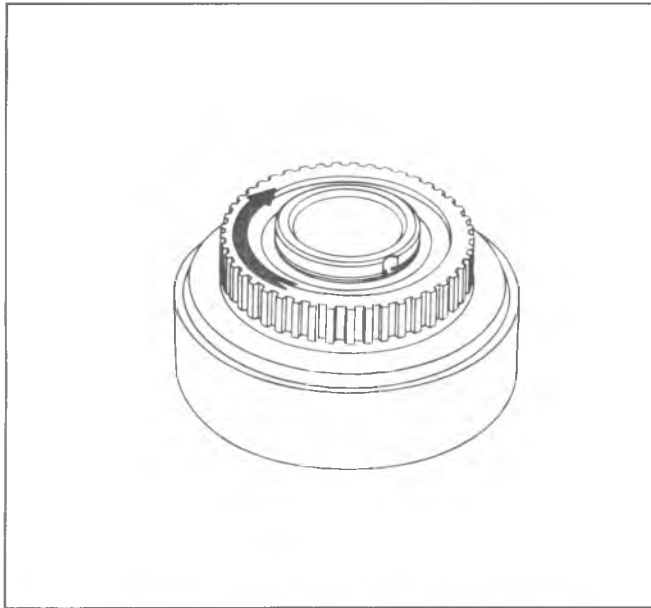


Fig. 7A-108C--Intermediate Roller Clutch Rotation

13. Install intermediate clutch retainer and snap ring (Fig. 7A-109C and 7A-110C).

14. Place direct clutch assembly over center support and air check operation of direct clutch (Fig. 7A-111C).

**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 plates.

## DISASSEMBLY, INSPECTION AND RE-ASSEMBLY OF CENTER SUPPORT

### Disassembly

1. Remove four (4) oil seal rings from the center support (Fig. 7A-112C).



Fig. 7A-109C--Installing Intermediate Clutch Retainer

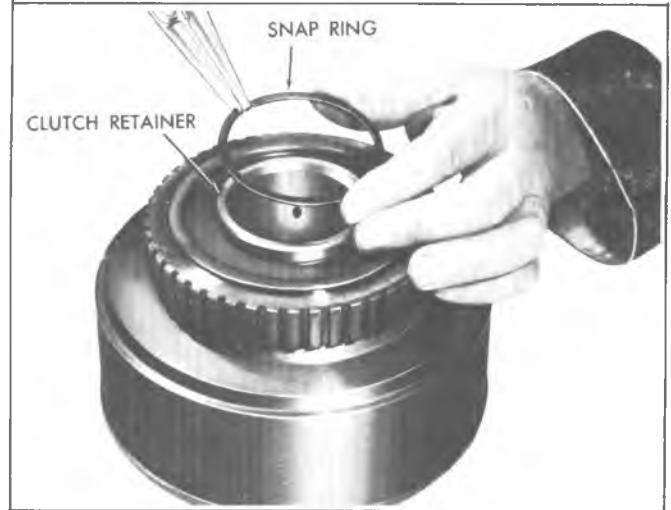


Fig. 7A-110C--Installing Intermediate Clutch Retainer Snap Ring

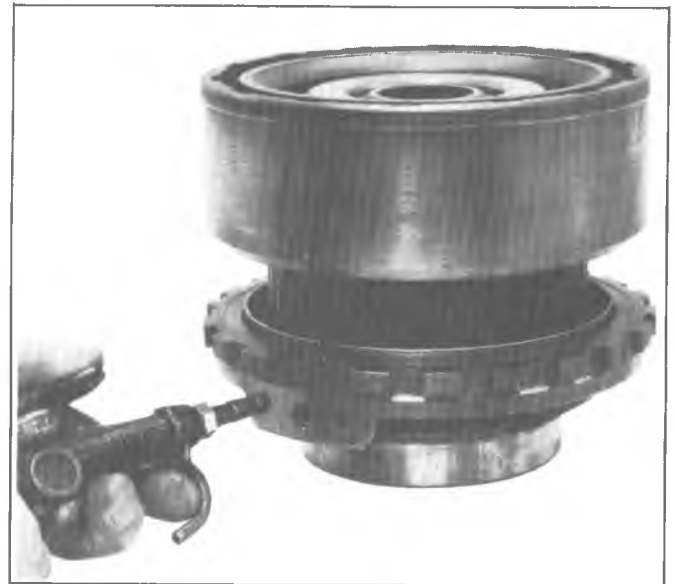


Fig. 7A-111C--Air Checking Direct Clutch Assembly

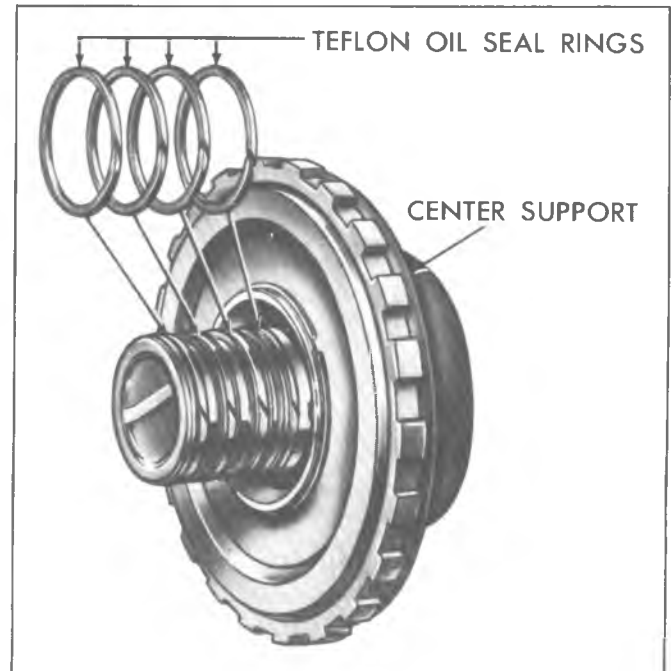


Fig. 7A-112C--Center Support and Oil Seal Rings



Fig. 7A-113C--Removing Intermediate Clutch Piston Snap Ring

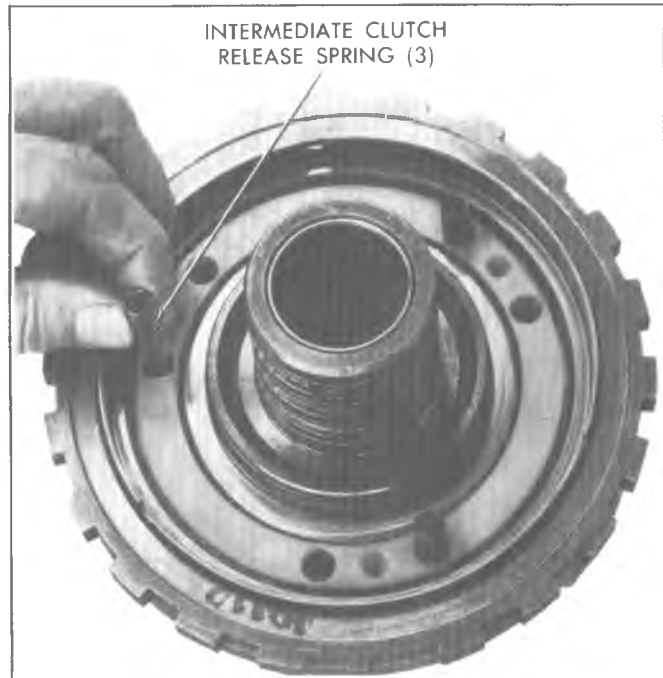


Fig. 7A-115C--Removing Clutch Release Springs

2. Compress spring retainer and remove snap ring (7A-113C).

3. Remove spring retainer (Fig. 7A-114C) and three (3) clutch release springs (Fig. 7A-115C).

4. Remove intermediate clutch spring guide (Fig. 7A-116C).

5. Remove intermediate clutch piston (Fig. 7A-117C).

6. Remove inner and outer piston seal.

**CAUTION:** *Do not remove three (3) screws retaining roller clutch inner race to center support.*

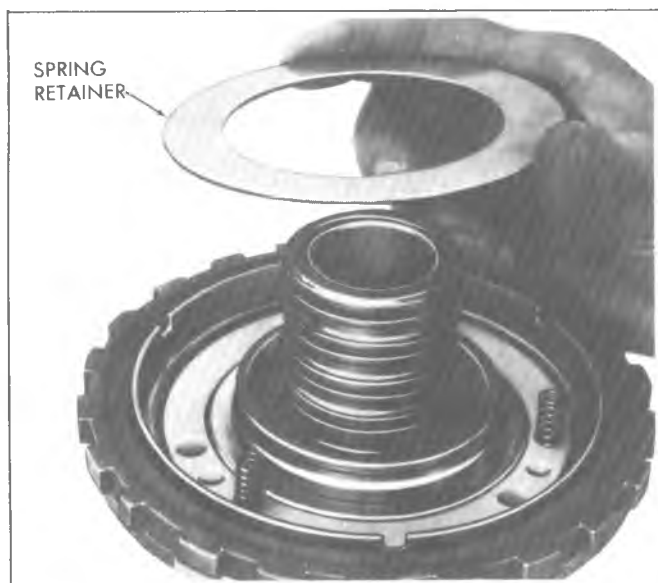


Fig. 7A-114C--Removing Spring Retainer

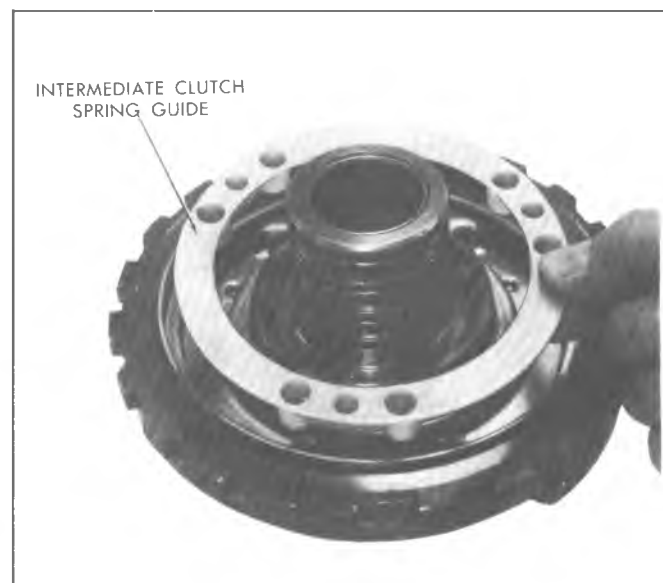


Fig. 7A-116C--Removing Intermediate Clutch Spring Guide



Fig. 7A-117C--Removing Intermediate Clutch Piston

### Inspection (Fig. 7A-118C)

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. 7A-47C).

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.

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.

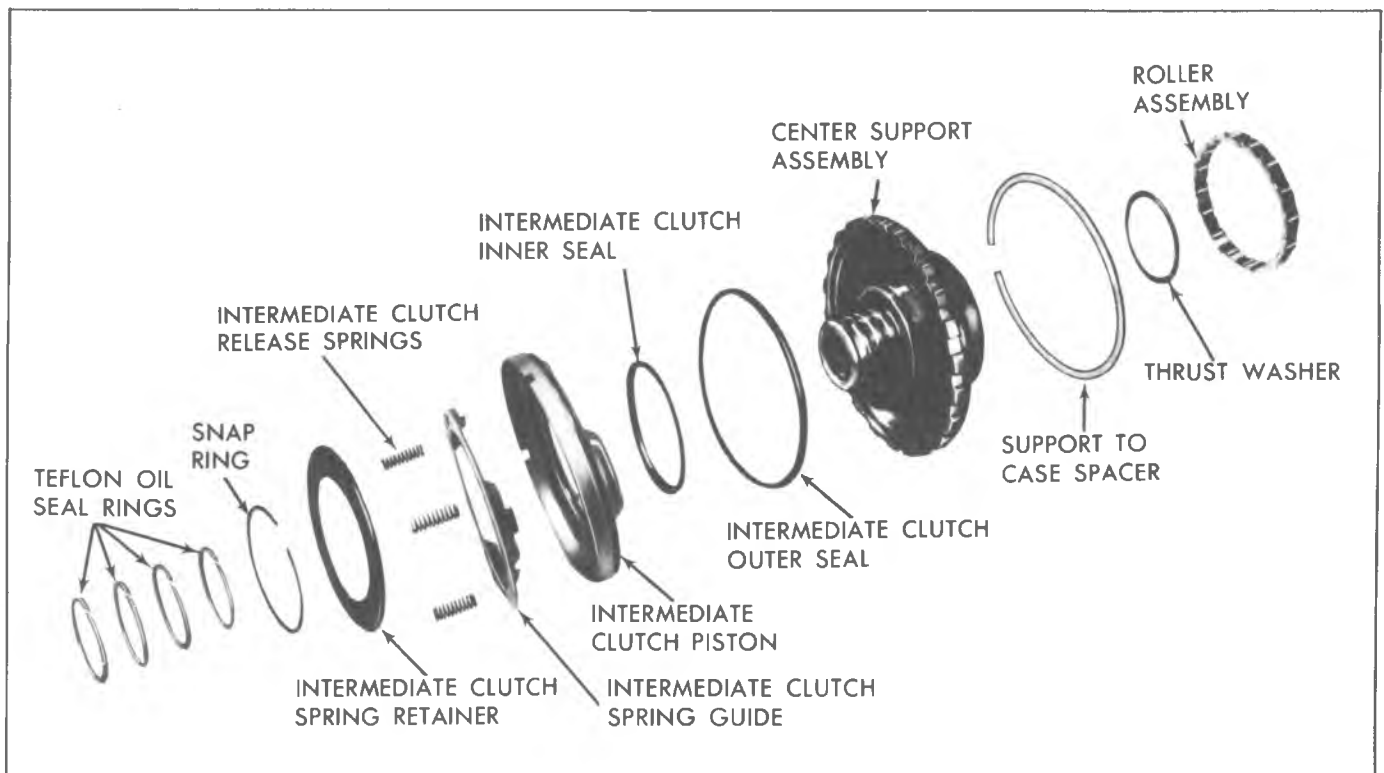


Fig. 7A-118C--Center Support Assembly--Exploded View



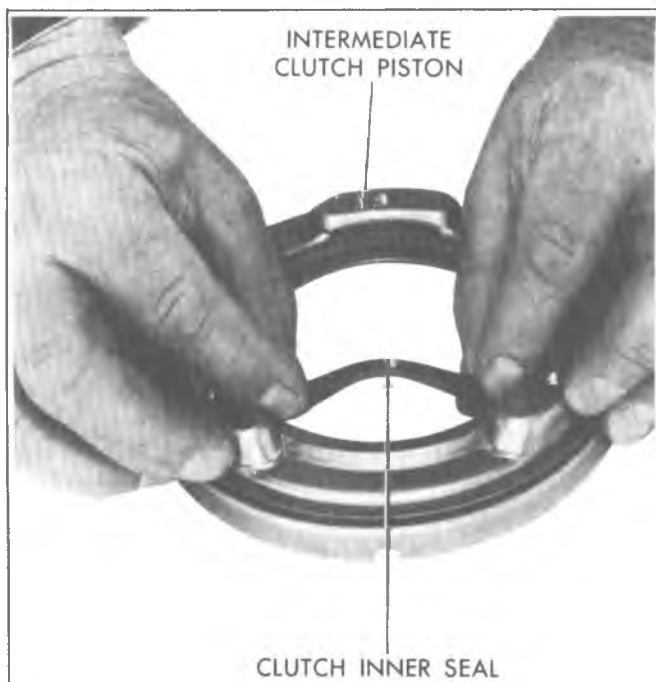


Fig. 7A-119C--Installing Intermediate Clutch Inner Seal

### Assembly

1. Lubricate and install new inner and outer seals on piston with lip of seal facing away from spring pocket (Fig. 7A-119C and 7A-120C).



Fig. 7A-120C--Installing Intermediate Clutch Outer Seal

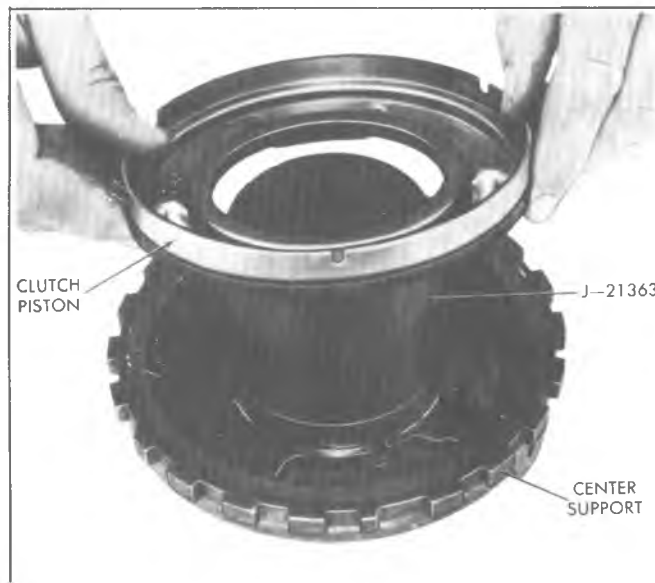


Fig. 7A-121C--Installing Intermediate Clutch Piston

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. 7A-121C).

3. Install intermediate clutch spring guide (Fig. 7A-122C).

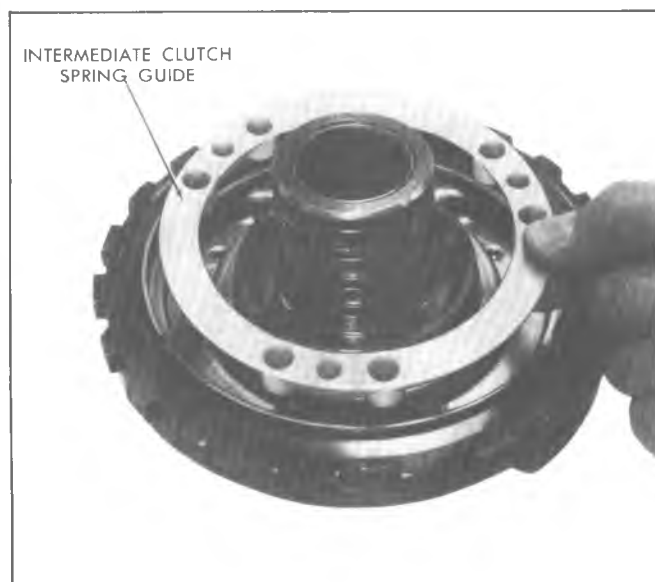


Fig. 7A-122C--Installing Intermediate Clutch Spring Guide



Fig. 7A-123C--Installing Intermediate Clutch Release Springs

4. Install three (3) release springs into holes of spring guide. Space equally during assembly (Fig. 7A-123C).
5. Place spring retainer and snap ring over springs.



Fig. 7A-124C--Installing Intermediate Clutch Piston Snap Ring



Fig. 7A-125C--Teflon Rings

6. Compress springs and install snap ring (Fig. 7A-124C).
7. Install four (4) oil seal rings on the center support.

**NOTE:** When installing teflon oil seal rings, make sure slit ends are assembled in same relation as cut (Fig. 7A-125C). Also, make sure oil seal rings are seated in ring grooves to prevent damage to rings during re-assembly of mating parts over rings. Retain with petrolatum.

8. Air check operation of intermediate clutch piston (Fig. 7A-126C).



Fig. 7A-126C--Air Checking Intermediate Clutch Piston

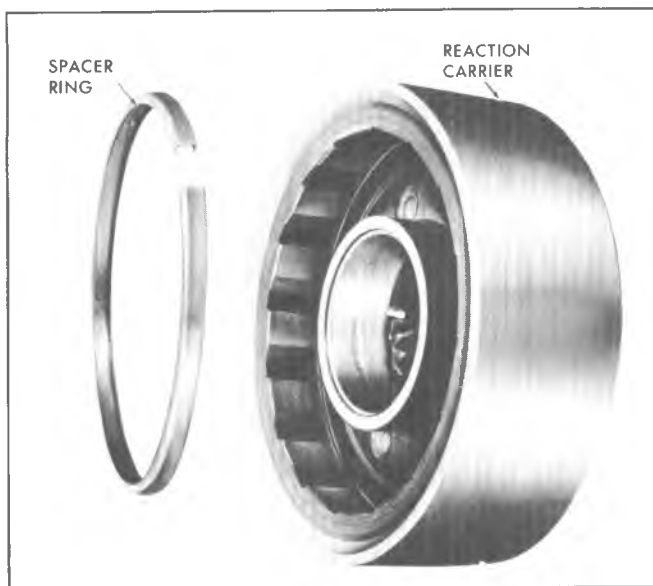


Fig. 7A-127C--Inspecting Spacer Ring

### Inspection of Reaction Carrier, Roller Clutch, and Output Carrier Assembly

1. If the reaction carrier has a spacer ring in an undercut at the bottom of the roller cam ramps, inspect it for damage (Fig. 7A-127C).

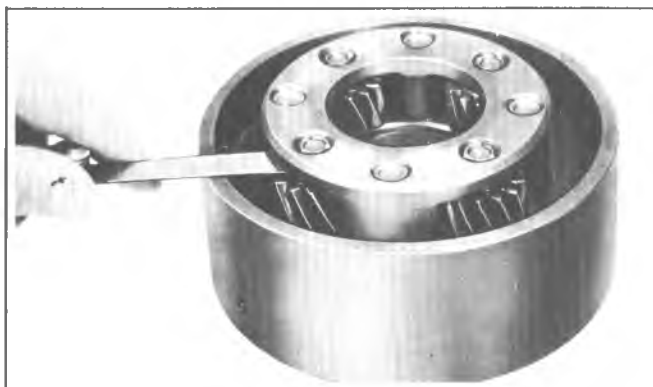


Fig. 7A-128C--Checking Pinions End Play

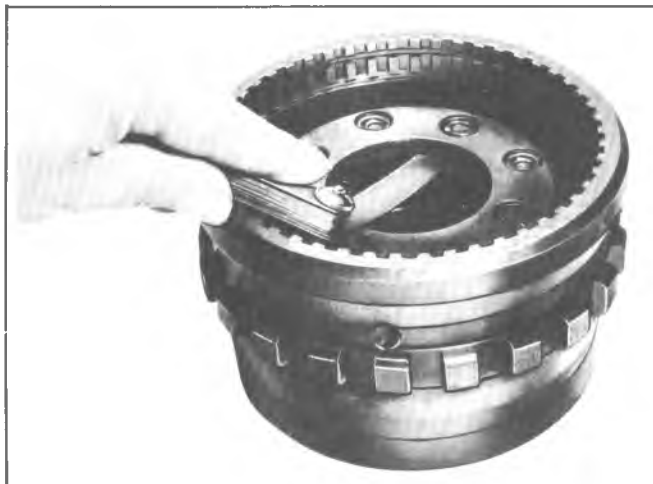


Fig. 7A-129C--Checking Output Carrier Pinion End Play

**NOTE:** The reaction carrier with the undercut and spacer ring is used optionally and interchangeably with

the reaction carrier which does not have an undercut and spacer ring.

2. Inspect band surface on reaction carrier for signs of burning or scoring.

3. Inspect roller clutch outer race for scoring or wear.

4. Inspect thrust washer surfaces for signs of scoring or wear.

5. Inspect bushing for damage. If bushing is damaged, reaction carrier must be replaced.

6. Inspect reaction carrier pinions for damage, rough bearings, or excessive tilt.

7. Check pinion end play. Pinion end play should be .009"-.024" (Fig. 7A-128C).

8. Inspect roller clutch for damaged rollers.

9. Inspect roller clutch cage and springs for damage.

10. Inspect front internal gear (output carrier) for damaged teeth.

11. Inspect output carrier pinions for damage, rough bearings or excessive tilt.

12. Check pinion end play. Pinion end play should be .009"-.024" (Fig. 7A-129C).

13. Inspect parking pawl lugs for cracks or damage.

14. Inspect output locating splines for damage.

15. Inspect front internal gear ring for flaking (Fig. 7A-49C).

### Pinion Replacement Procedure

1. Support carrier assembly on its front face.

2. Using a 1/2 inch diameter drill, remove stake marks from the end of the pinion pin, or pins, to be replaced. This will reduce the probability of cracking the carrier when pinion pins are pressed out. Do not allow drill to remove any stock from the carrier.

3. Using a tapered punch, drive or press pinion pins out of carrier (Fig. 7A-130C).

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

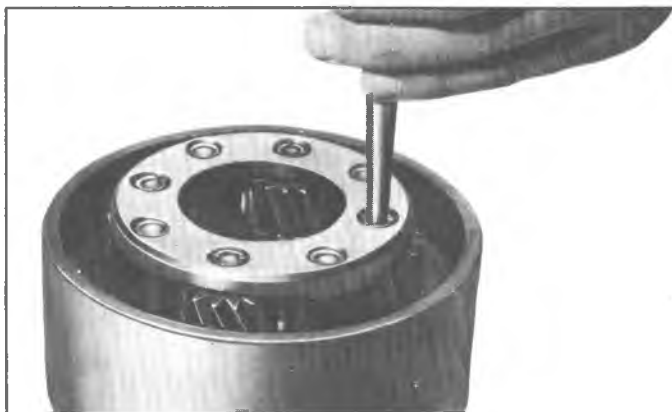


Fig. 7A-130C--Removing Planet Pinion Pin

using petrolatum to hold bearings in place. Use pinion pin as guide (Fig. 7A-131C).

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. 7A-132C).

10. Place a large punch in a bench vise to be used as an anvil while staking opposite end of pinion pin in three places. Both ends of pinion pins must lie below face of carrier or interference may occur.

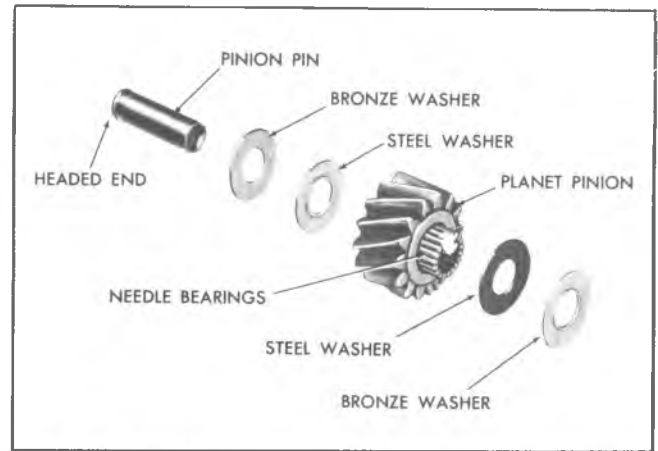


Fig. 7A-131C--Planet Pinion Assembly--Exploded View

## 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 drive lugs for damage.

6. Inspect speedometer drive gear.

### 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, burning, or looseness.

2. Inspect bands for cracks or distortion.

3. Inspect end for damage at anchor lugs or apply lugs.

4. Inspect support to case spacer for burrs or raised edges, if present remove with stone or fine abrasive.

### INSPECTION OF CASE EXTENSION - ALL EXCEPT CL MODEL

1. Inspect bushing for excessive wear or damage. If replacement is necessary, remove rear seal and with



Fig. 7A-132C--Installing Planet Pinion Pin

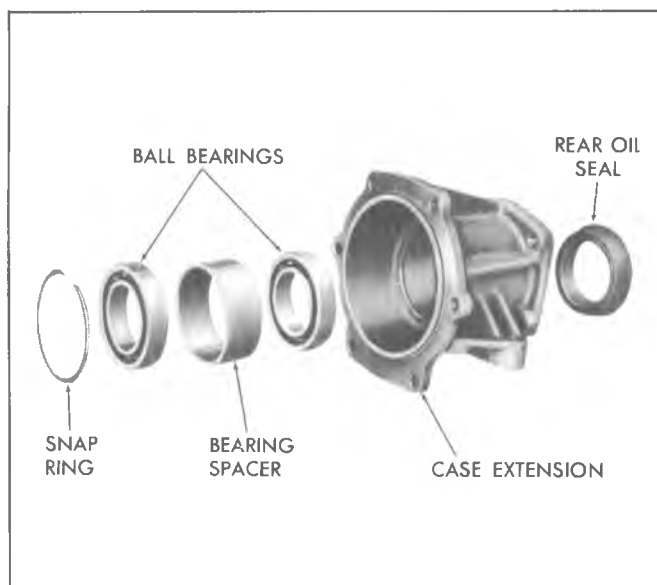


Fig. 7A-133C—Model CL Case Extension

extension housing properly supported, remove bushing as follows:

a. With rear seal removed, position case extension on bench, with seal end up. Assemble remover J-21465-17 on handle J-8092, and drive out bushing with lead or brass hammer.

b. Using tool J-21465-17, 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.

2. Inspect gasket mounting face for damage.
3. Inspect housing for cracks or porosity.
4. Be sure rear seal drain back port is not obstructed.

### INSPECTION OF CASE EXTENSION—

#### CL MODEL (FIG. 7A-133C)

1. Inspect seal (case extension to case) groove for damage.
2. Inspect for cracks, or porosity.
3. Inspect dowel pin in rear face for damage.

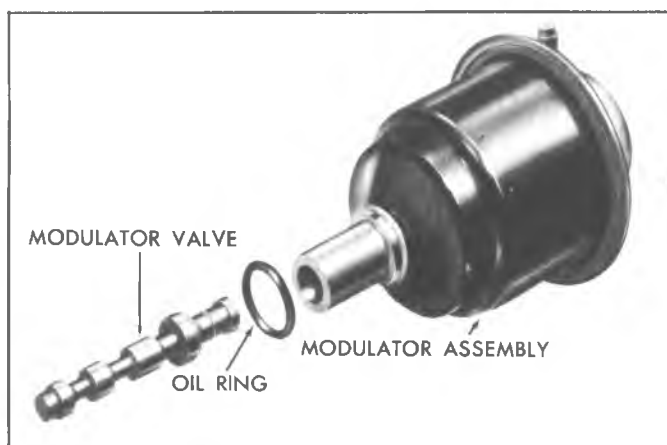


Fig. 7A-134C—Modulator Assembly and Valve

4. Inspect oil seal for damage. If replacement is required, proceed as follows:

- a. Pry oil seal from extension.
- b. Apply non-hardening sealer to outside of new oil seal, and install oil seal into case extension using tool (J-24057) (see Fig. 7A-171C).

5. Inspect ball bearing assemblies. If they are damaged, or if they require cleaning, proceed as follows:

- a. Remove rear seal.
- b. Remove snap ring.
- c. Remove ball bearings and bearing spacer, using a brass rod on the outside race of bearing. An arbor press can be used if tool to press bearing out is located on outer race of bearing.

**CAUTION:** *DO NOT* locate against inner race or balls.

- d. Install ball bearing assembly and spacer, bearing first.
- e. Install ball bearing assembly and snap ring.
- f. Install new rear oil seal.

### INSPECTION OF MODULATOR AND VALVE

1. Inspect modulator assembly for any sign of bending or distortion (Fig. 7A-134C).

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. 7A-135C).

2. Inspect actuator spring for damage.

3. Inspect actuator for free fit on actuator rod.

4. Inspect parking pawl for cracks or wear.

5. Inspect manual shaft for damaged threads, rough oil surface or loose lever.

6. Inspect inside detent lever for cracks or a loose pin.

7. Inspect parking pawl shaft if removed for damaged retainer groove.

8. Inspect parking pawl return spring for deformed coils or end.

9. Inspect parking bracket for cracks or wear.

10. Inspect detent roller and spring assembly.

### INSPECTION OF CASE ASSEMBLY (FIGS. 7A-136C AND 7A-137C)

**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.*

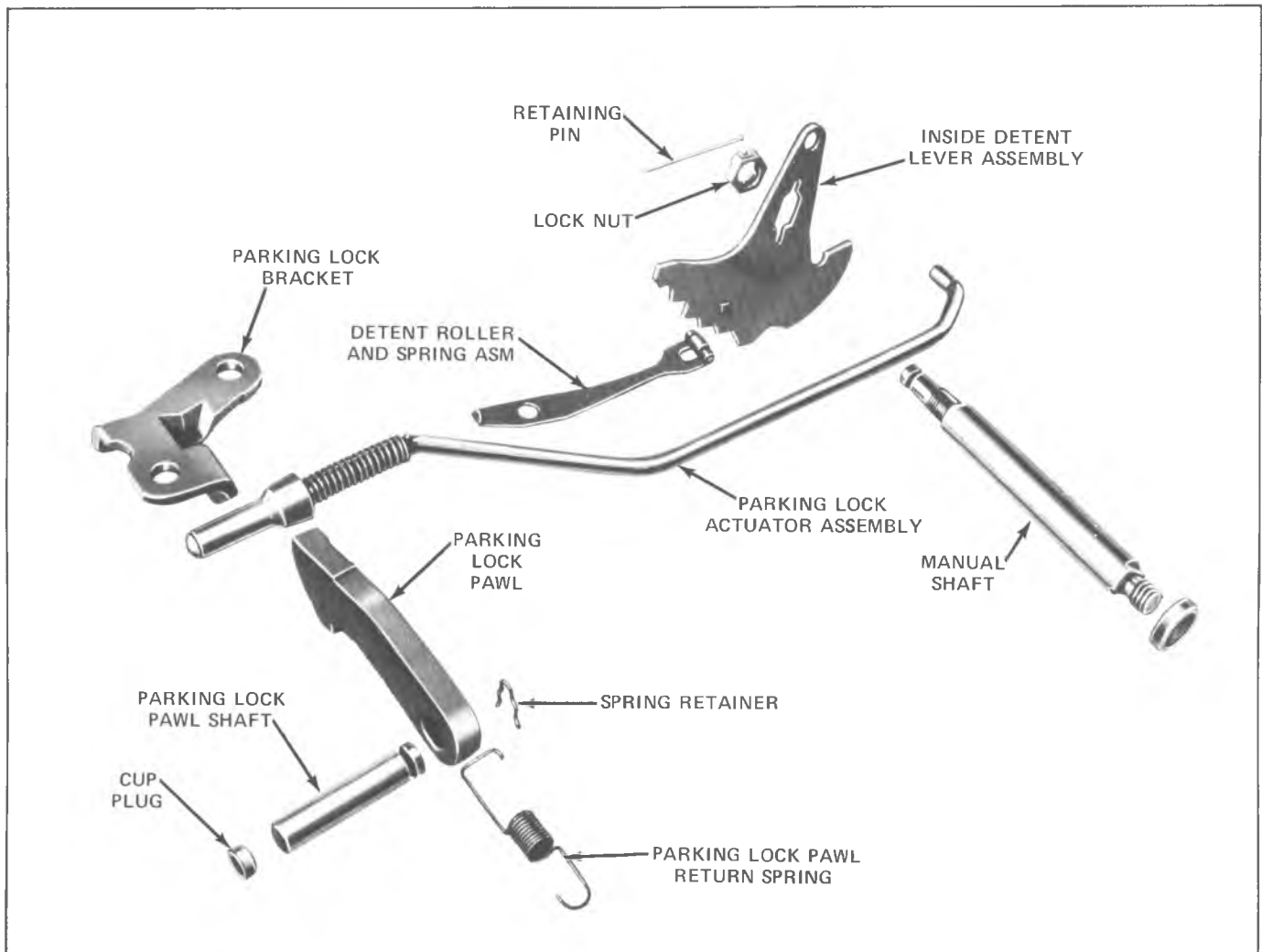


Fig. 7A-135C--Manual and Parking Linkage--Exploded View

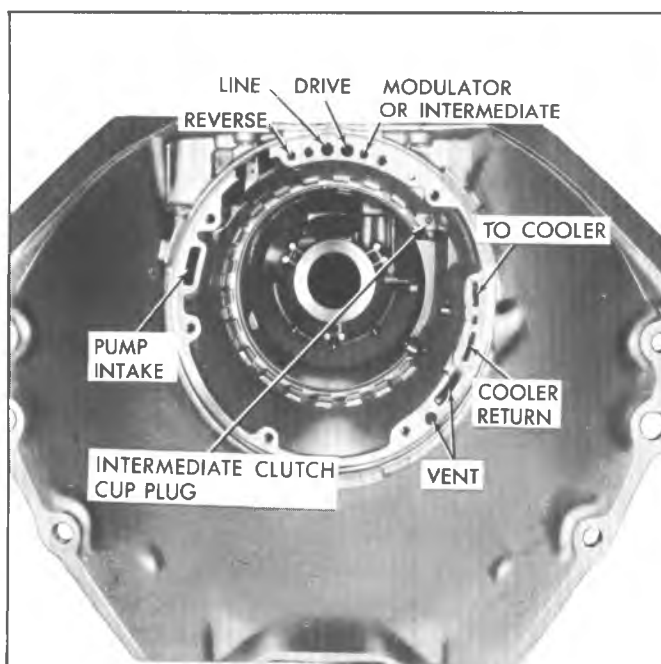


Fig. 7A-136C--Case-Front View Passage Identification

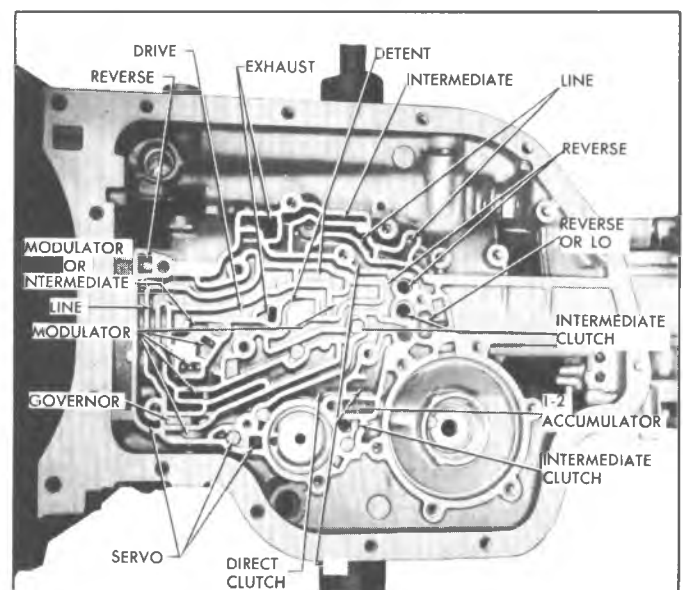


Fig. 7A-137C--Inspect Transmission Case

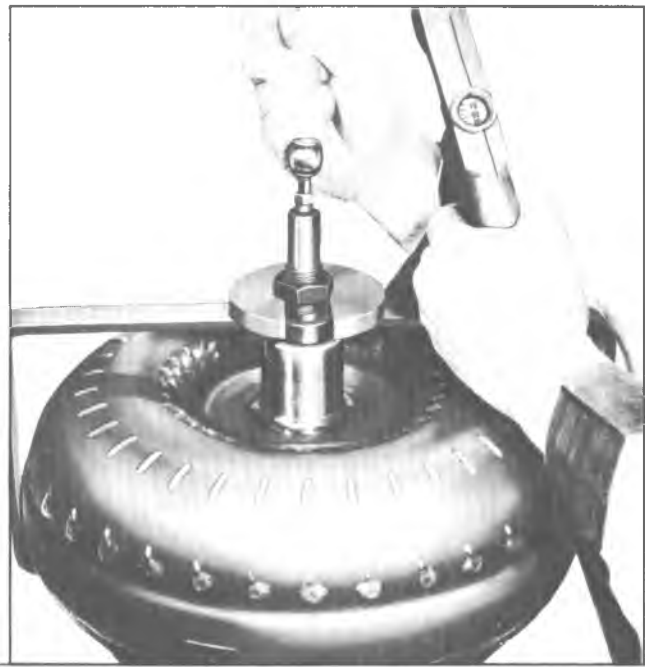


Fig. 7A-138C--Air Checking Converter

1. Inspect case assembly for cracks, porosity or inter-connected passages.
2. Check for good retention of band anchor pins.
3. Inspect all threaded holes for thread damage.
4. On model CL inspect studs for thread damage, and make sure they are tight.

**NOTE:** The two (2) studs at 9 o'clock and 11 o'clock (when viewed from the rear of case and transmission in vehicle) are approximately 1/4" longer than the other four (4) studs. These two longer studs are required to accommodate the parking brake actuating cable bracket.

5. Inspect intermediate clutch driven plate lugs for damage or brinelling.

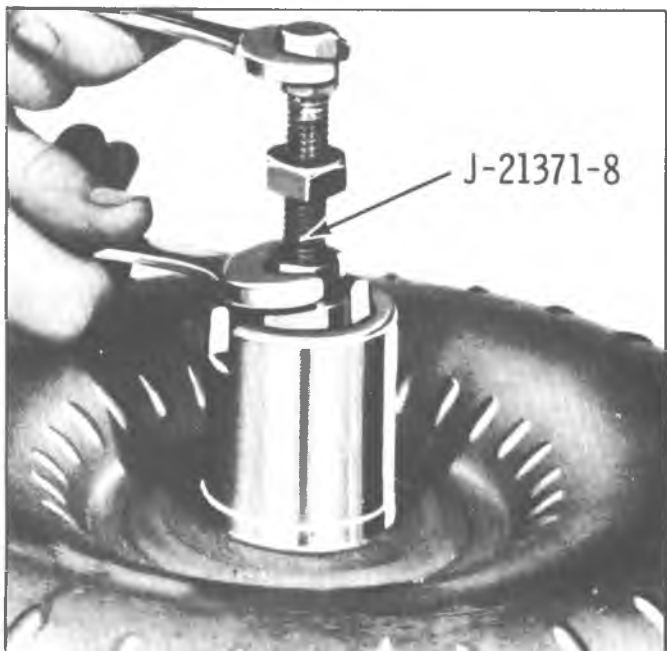


Fig. 7A-139C--Loosening Collet on Tool J-21571-8

**NOTE:** If the case assembly requires replacement, remove the nameplate from the old case and re-install it on the new case, using the truss head nameplate attaching screw that is serviced with the case.

6. Inspect snap ring grooves for damage.
7. Inspect bore for governor assembly for scratches or scoring.
8. Inspect modulator valve bore for scoring or damage.
9. Inspect cup plug inside case for good staking and sealing.
10. Inspect case bushing. If necessary to replace, proceed as follows:

### Case Bushing

#### Remove

With case properly supported, using tool J-21465-8, with Driver Handle J-8092, remove bushing.

#### Replace

Using tool J-21465-8 adaptor ring J-21465-9, Driver Handle J-8092, and extension J-21465-13, with lube passage facing front of transmission case, drive replacement bushing into case until .040 to .055 above selective washer face. Stake bushing with tool J-21465-10. Stake marks to be in bushing lubrication grooves.

### INSPECTION OF CONVERTER

1. Check converter for leaks as follows (Fig. 7A-138C):
  - 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. 7A-139C and 7A-140C)

1. Fully release collet end of Tool J-21371-8.
2. Install collet end of Tool J-21371-8 into converter

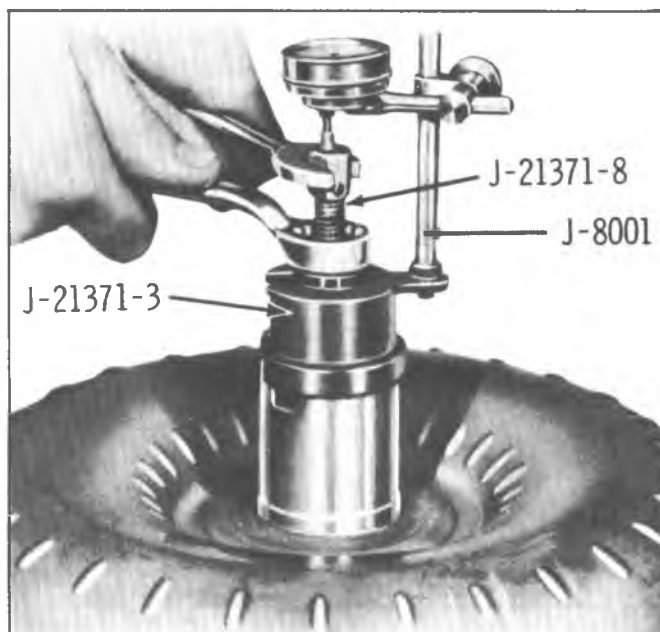


Fig. 7A-140C--Checking Converter End Clearance



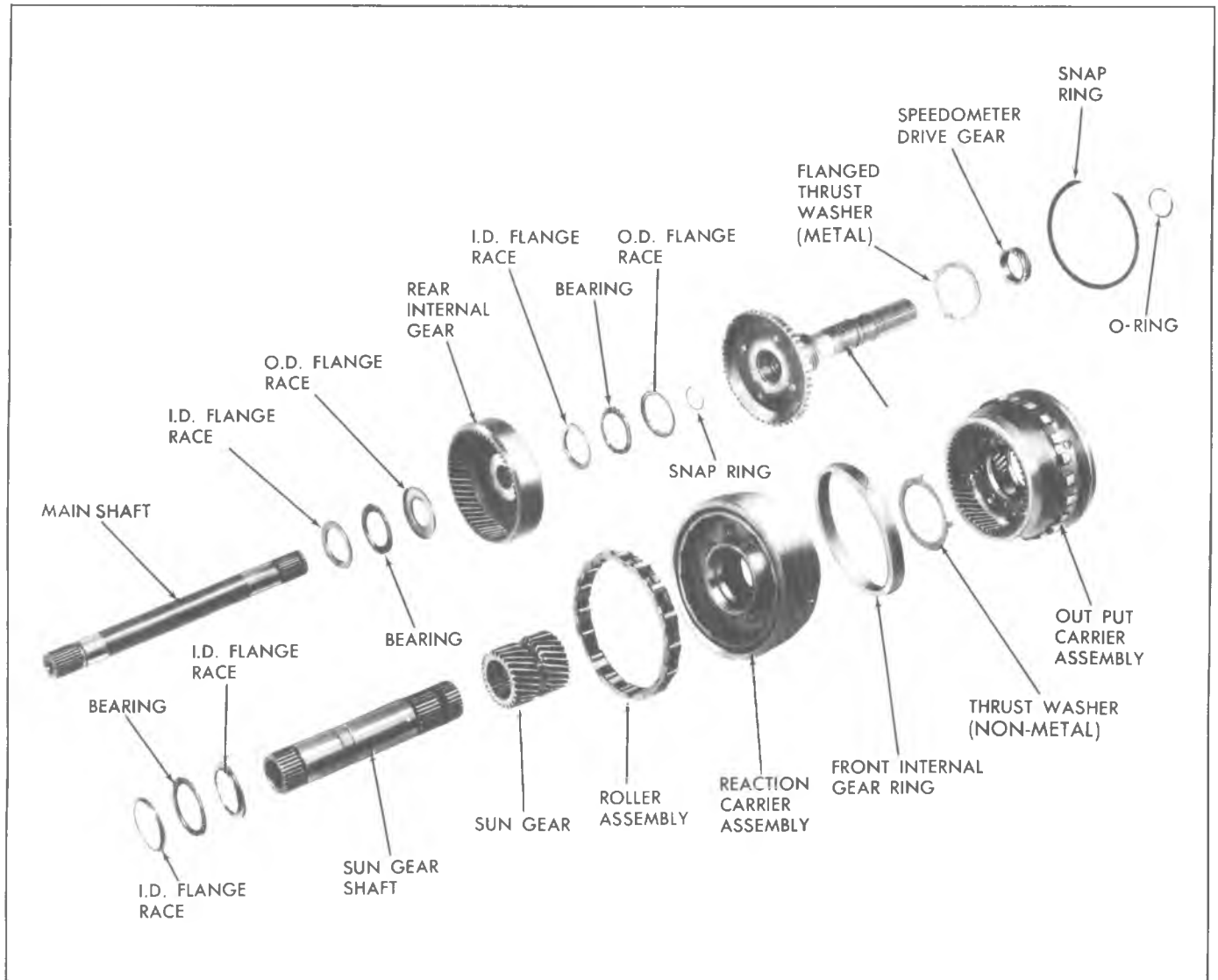


Fig. 7A-141C--Gear Unit Assembly--Exploded View

hub until it bottoms; then tighten cap nut to 5 lb. ft. (Fig. 7A-139C).

3. Install Tool J-21371-3 and tighten hex nut to 3 lb. ft. (Fig. 7A-140C).

4. Install Dial Indicator J-8001 and set it at "zero", while its plunger rests on the cap nut of Tool J-21371-8.

5. Loosen hex nut while holding cap nut stationary. With the hex nut loosened and holding Tool J-21371-3 firmly against the converter hub, the reading obtained on the dial indicator will be the converter end clearance. End clearance should be less than .050". If the end clearance is .050" or greater, the converter must be replaced.

## ASSEMBLY OF REAR UNIT (FIG 7A-141C)

1. Install rear internal gear on end of main shaft.

2. Install rear internal gear retaining snap ring (Fig. 7A-142C).

3. Install sun gear to internal gear thrust races and bearings against inner face of rear internal gear as follows, and retain with petrolatum.

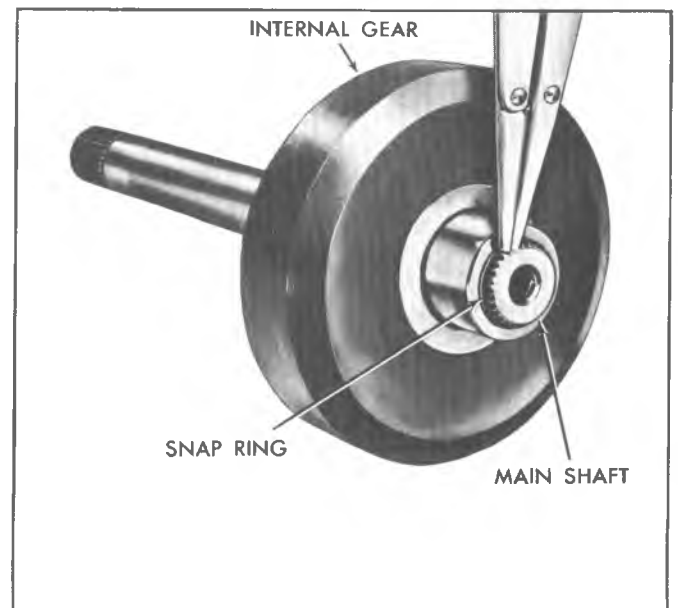


Fig. 7A-142C--Installing Rear Internal Gear Snap Ring

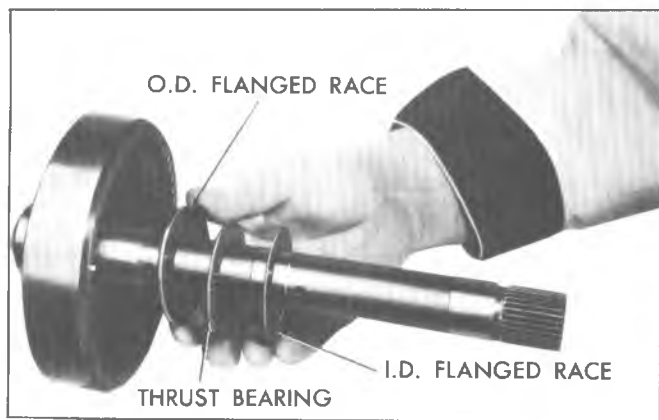


Fig. 7A-143C--Installing Rear Internal Gear to Sun Gear Bearing and Races

- a. Place large race against internal gear with outer flange facing forward or up (Fig. 7A-153C).
- 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. 7A-144C).

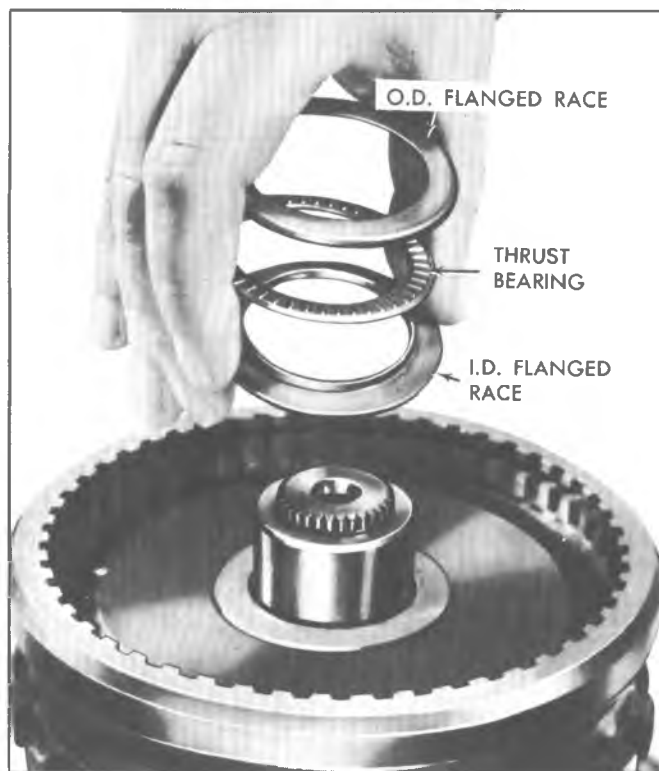


Fig. 7A-144C--Installing Rear Internal Gear to Output Shaft Bearing and Races



Fig. 7A-145C--Installing Output Shaft

- 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. 7A-145C).
8. Install output shaft to output carrier snap ring.
9. Install "O" ring on output shaft of models that use an "O" ring.

**NOTE:** Models CA, CB, CD, CF and CG do not use an output shaft "O" ring.

10. Turn assembly over and support so that output shaft hangs downward.

11. Install reaction carrier to output carrier metal or non-metal thrust washer with tabs facing down in pockets of output carrier and retain with petrolatum.

**NOTE:** The production built transmissions use a non-metal washer here. However, the service replacement washer is made of metal.

12. Install sun gear I.D. splines with chamfer down.

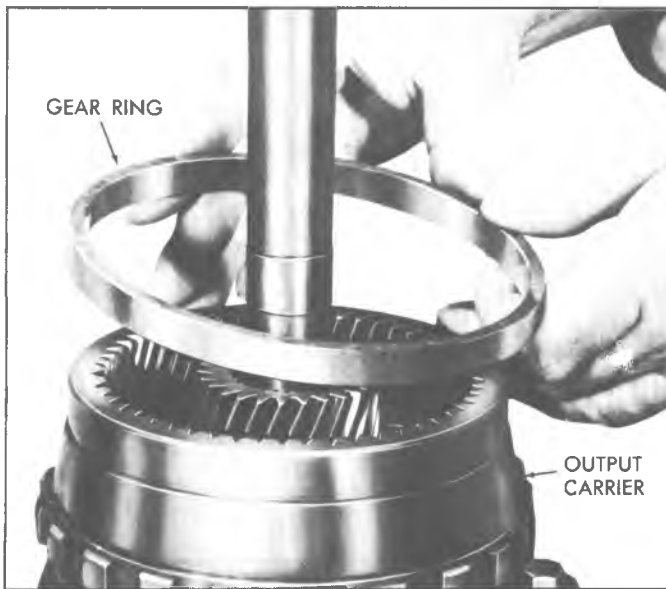


Fig. 7A-146C--Installing Front Internal Gear Ring to Output Carrier

13. Install front internal gear ring over output carrier (Fig. 7A-146C).
14. Install sun gear shaft with long splined end down.
15. Install reaction carrier (Fig. 7A-147C).



Fig. 7A-147C--Installing Reaction Carrier

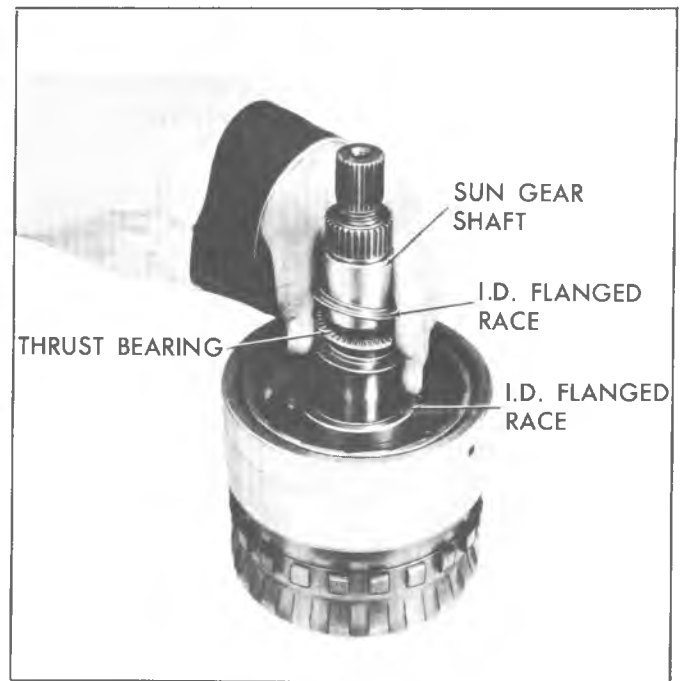


Fig. 7A-148C--Installing Center Support to Sun Gear Thrust Bearing and Races

**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 ring with the SERVICE ring.

16. Install center support to sun gear thrust races and bearings as follows: (Retain with petrolatum).

- a. Install large race, center flange up over sun gear shaft.
- b. Install thrust bearing against race.
- c. Install second race, center flange up (Fig. 7A-148C).

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. 7A-149C).



Fig. 7A-149C--Installing Roller into Roller Clutch Cage

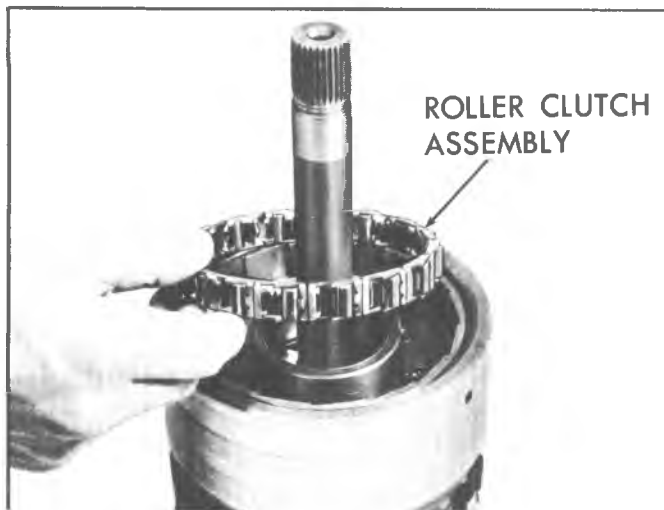


Fig. 7A-150C--Installing Roller Clutch to Reaction Carrier

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. 7A-152C), and retain with petrolatum.

**NOTE:** This must be a metal washer.

#### 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. 7A-154C).

18. Install roller clutch assembly (Fig. 7A-150C) into reaction carrier.

19. Install center support to reaction carrier thrust washer into recess in center support. Retain with petrolatum (Fig. 7A-47C).

20. Install center support into roller clutch in reaction carrier (Fig. 7A-151C).

**NOTE:** With reaction carrier held, center support should only turn counter-clockwise after installation. See Fig. 7A-152C for check of roller clutch.



Fig. 7A-151C--Installing Center Support to Reaction Carrier

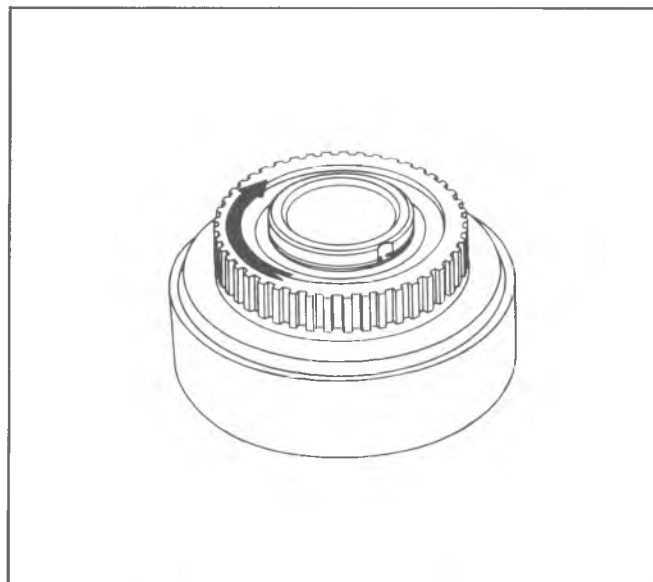


Fig. 7A-152C--Checking Roller Clutch Rotation



Fig. 7A-153C--Installing Case to Output Shaft Thrust Washer



Fig. 7A-154C--Installing Parking Pawl Shaft Cup Plug

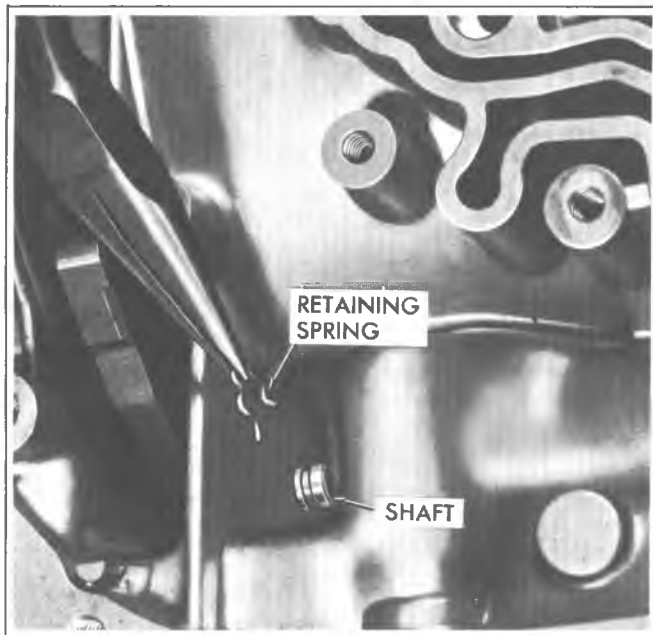


Fig. 7A-155C--Installing Parking Shaft Retaining Spring

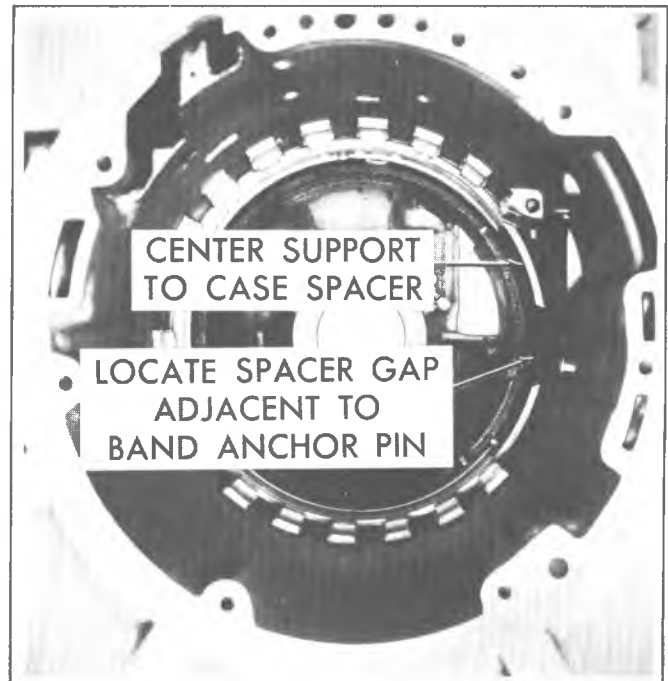


Fig. 7A-157C--Installing Center Support to Case Spacer

2. Install parking pawl shaft retainer clip (Fig. 7A-155C).

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. 7A-154C).

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. 7A-156C).

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. 7A-157C).

**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. 7A-156C--Installing Rear Band

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. 7A-158C).

10. Install center support to case retaining snap ring with bevel side up (flat surface against the center support)

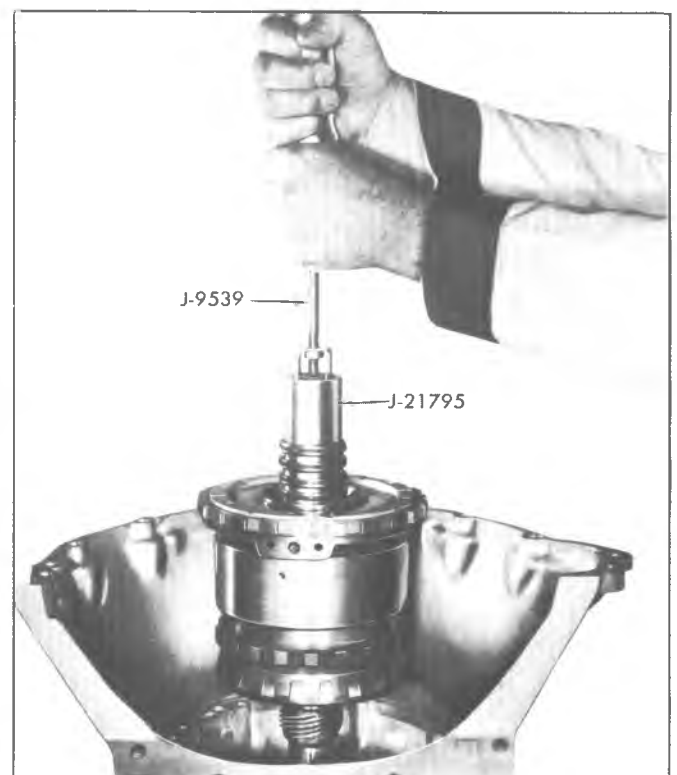


Fig. 7A-158C--Installing Center Support and Gear Unit

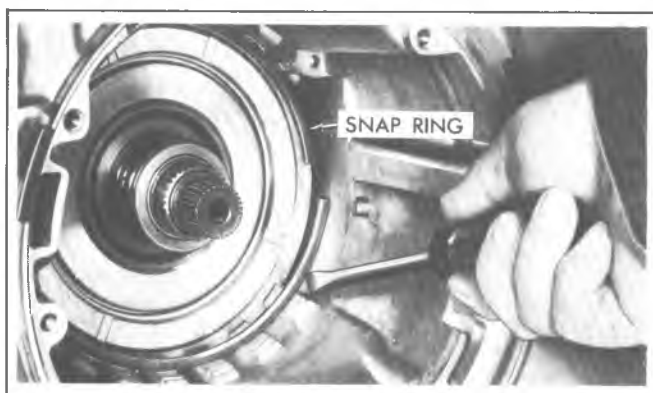


Fig. 7A-159C--Installing Center Support to Case Snap Ring

and locating gap adjacent to band anchor pin. Make certain ring is properly seated in case (Fig. 7A-159C).

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. 7A-160C).

**CAUTION:** When using the locating tool, care should be taken not to raise burrs on the case valve body mounting face.

12. Install intermediate clutch plates.

a. (All models except CB, CD and CL) Lubricate with transmission oil two (2) flat steel and one (1) waved steel plates and three (3) composition-faced intermediate clutch plates and install, starting with waved steel plate and alternating composition-faced and flat steel plates (Fig. 7A-161C).

b. (Models CB, CD and CL) Lubricate with transmission oil three (3) flat steel and three (3)

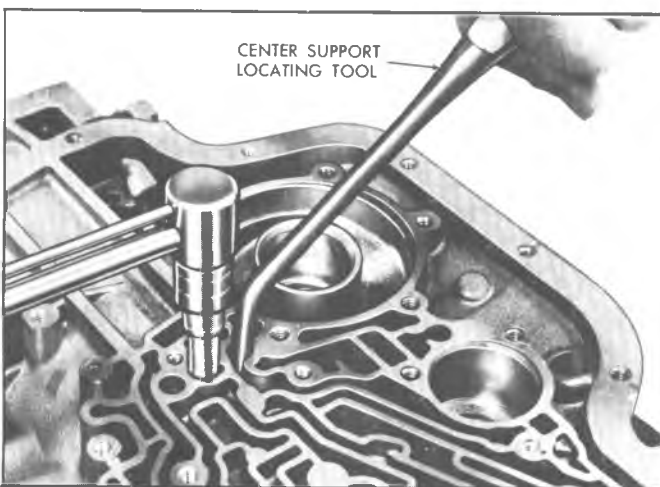


Fig. 7A-160C--Installing Center Support Bolt

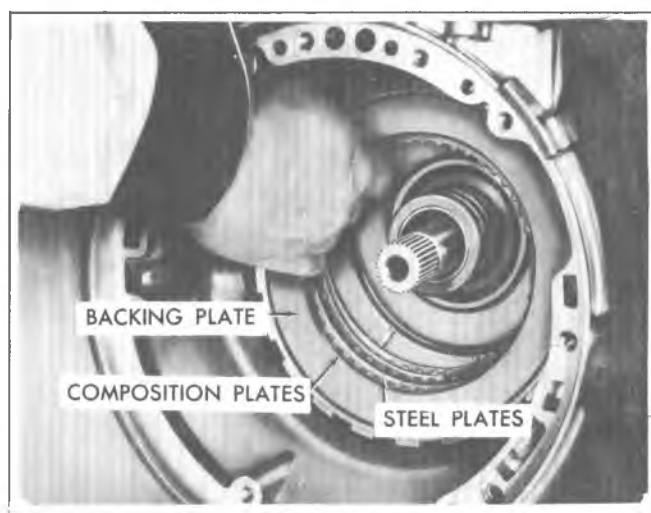


Fig. 7A-161C--Installing Intermediate Backing Plate and Clutch Plates

composition-faced intermediate clutch plates and install, starting with flat steel and alternating composition-faced and flat steel plates (Fig. 7A-161C).

**NOTE:** The models CB, CD and CL intermediate composition-faced plates are different from the other models. Refer to parts catalog for correct usage.

13. Install intermediate clutch backing plate, ridge up (Fig. 7A-161C).

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. 7A-37C).

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 chart shown in Fig. 7A-162C.

#### REAR END WASHER THICKNESS

Thickness	Identification Notches and/or Numeral
.074 - .078	None . . . . . 1
.082 - .086	1 Tab Side . . . . . 2
.090 - .094	2 Tab Side . . . . . 3
.098 - .102	1 Tab O.D. . . . . 4
.106 - .110	2 Tabs O.D. . . . . 5
.114 - .118	3 Tabs O.D. . . . . 6

Fig. 7A-162C--Rear End Washer Selection Chart



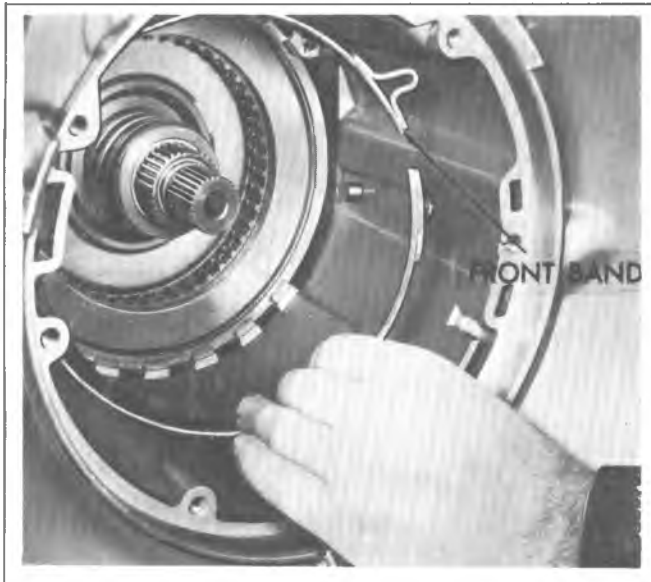


Fig. 7A-163C--Installing Front Band

16. Install front band with anchor hole placed over band anchor pin and apply lug facing servo hole (Fig. 7A-163C).

#### Install Manual Linkage

- a. Install a new manual shaft seal into transmission case using a 3/4 diameter rod to seat seal.
- b. If removed, insert actuator rod into manual detent lever from side opposite pin.
- c. Install actuator rod plunger under parking bracket over parking pawl.
- d. Install manual shaft through case and detent lever (Fig. 7A-164C).
- e. Install detent jam nut on manual shaft, and tighten to 18 ft. lbs. (Fig. 7A-165C).
- f. Install retaining pin indexing with groove in manual

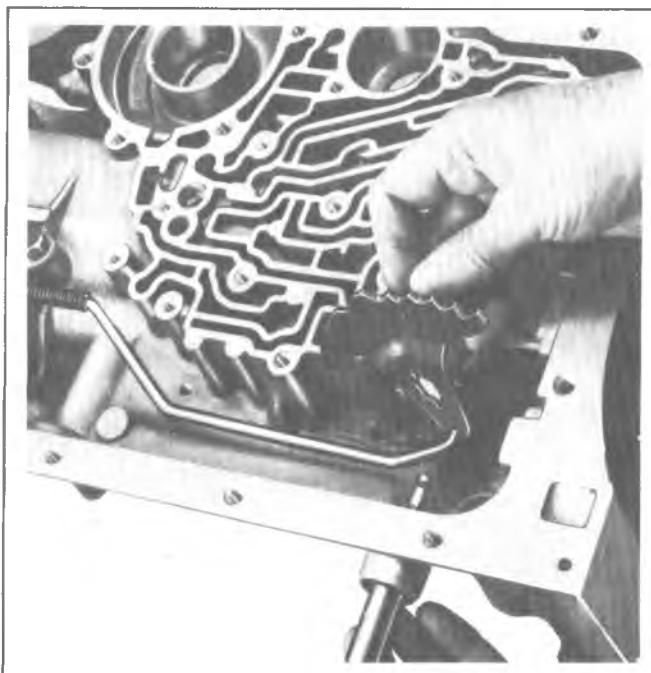


Fig. 7A-164C--Installing Manual Shaft to Case

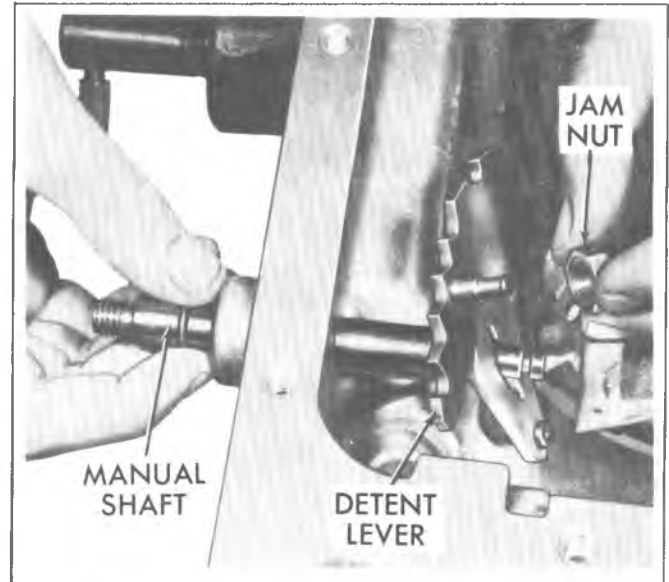


Fig. 7A-165C--Installing Detent Lever and Jam Nut to Manual Shaft

shaft. Rotate transmission to vertical position and remove J-21795.

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. 7A-166C).

**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, if not already installed. Retain with petrolatum.

19. Install forward clutch assembly and turbine shaft; indexing direct clutch hub so end of mainshaft will bottom on end of forward clutch hub. When forward clutch is

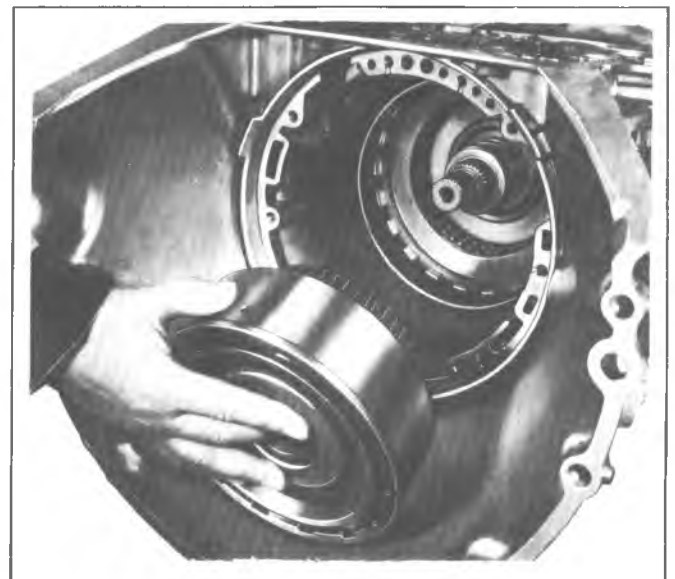


Fig. 7A-166C--Installing Direct Clutch Assembly



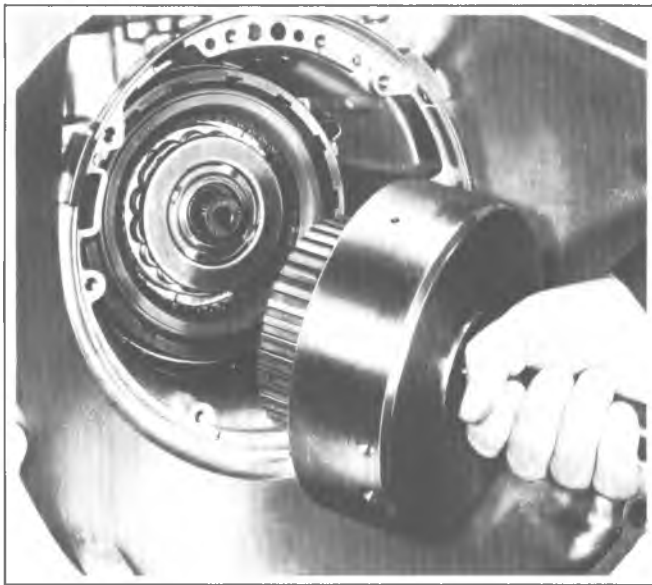


Fig. 7A-167C--Installing Forward Clutch Assembly and Turbine Shaft

seated it will be approximately 1-1/4" from pump face in case (Fig. 7A-167C).

**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 7A-169C 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. 7A-168C).

23. Check front unit end play as follows (Fig. 7A-169C).



Fig. 7A-168C--Installing Pump Seal

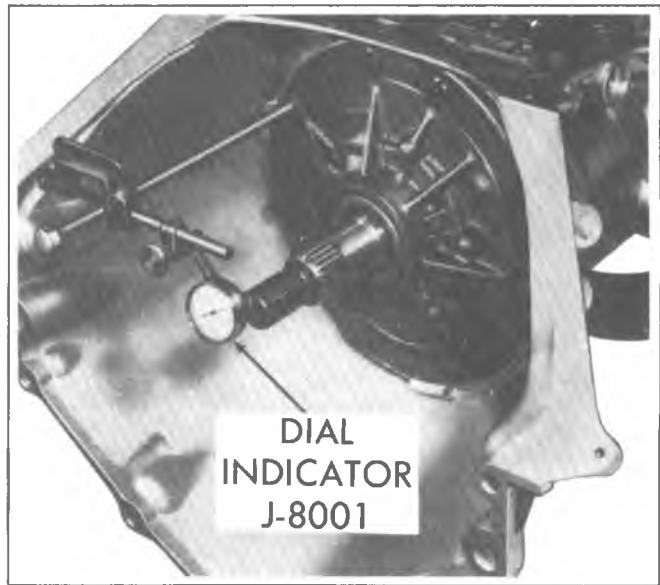


Fig. 7A-169C--Checking Front Unit End Play

a. Install a 3/8"-16 threaded bolt or a Slide Hammer Bolt J-9539 into bolt hole in pump.

b. Mount a dial indicator on rod and index indicator to register with end of turbine shaft.

c. Push turbine shaft rearward.

d. Push output shaft forward.

e. Set dial indicator to zero.

f. Pull turbine shaft forward.

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 in Fig. 7A-170C.

**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.

#### CASE EXTENSION ASSEMBLY

1. Install new case extension housing to case gasket on extension housing. Model CL uses a seal between the extension housing and case extension.

#### FRONT END WASHER THICKNESS

Thickness	Number	Color
.060 - .064	- 0 -	Yellow
.071 - .075	- 1 -	Blue
.082 - .086	- 2 -	Red
.093 - .097	- 3 -	Brown
.104 - .108	- 4 -	Green
.115 - .119	- 5 -	Black
.126 - .130	- 6 -	Purple

Fig. 7A-170C--Front End Washer Selection Chart

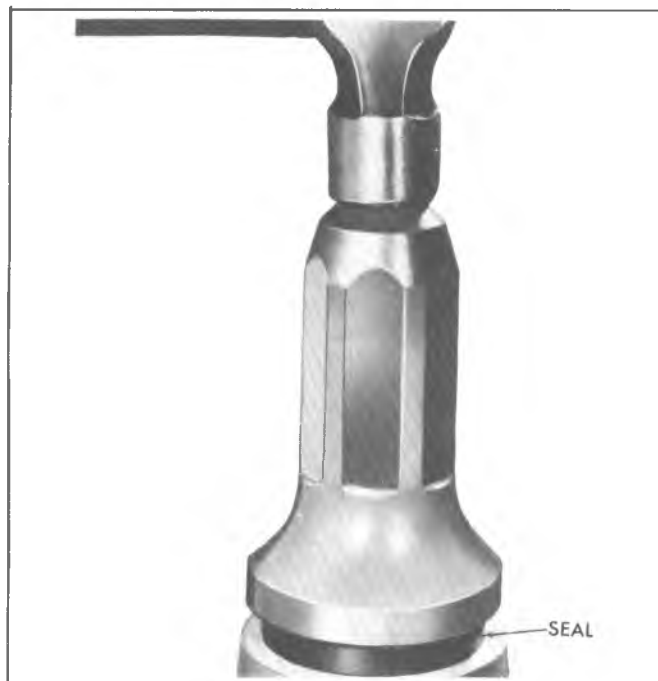


Fig. 7A-171C--Installing Extension Oil Seal (Typical)

2. Attach extension housing to case using attaching bolts and/or studs. Torque bolts to 20-25 ft. lbs.

**NOTE:** Models CA, CG and CR use two (2) studs at 5 o'clock and 7 o'clock positions (when viewed from the rear of case and transmission in vehicle). These studs are for the installation of the catalytic converter. Torque the studs to 20-25 ft. lbs.

3. If necessary, install a new seal as follows:

a. (All except CL Models) use a non-hardening sealer on outside of seal body; and using Tool J-21359, drive seal in place (Fig. 7A-171C).

b. (Model CL) use a non-hardening sealer on outside of seal body; and using Tool J-24057 drive seal in place (Fig. 7A-171C).

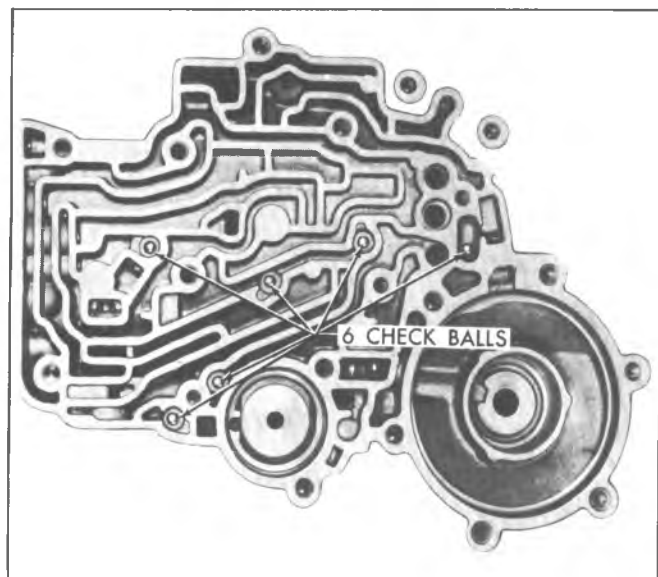


Fig. 7A-172C--Location of Check Balls

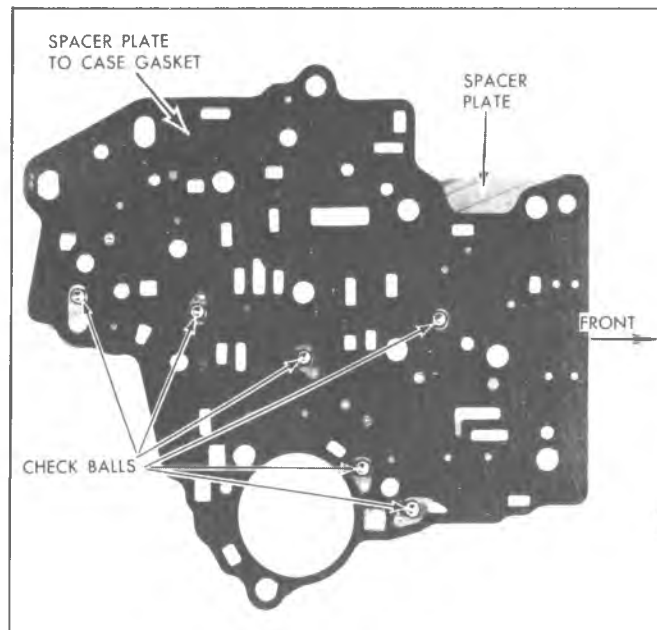


Fig. 7A-173C--Location of Check Balls--In Vehicle Installation

### 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 7A-183C.

2. Install six (6) check balls into ball seat pockets in transmission case. Figure 7A-172C.

**NOTE:** If transmission is in the vehicle, install check balls into ball seat pockets on spacer plate (Fig. 7A-173C).

3. Install control valve spacer plate-to-case gasket (gasket with extension for detent solenoid and a "C" near front servo location) (Fig. 7A-174C).

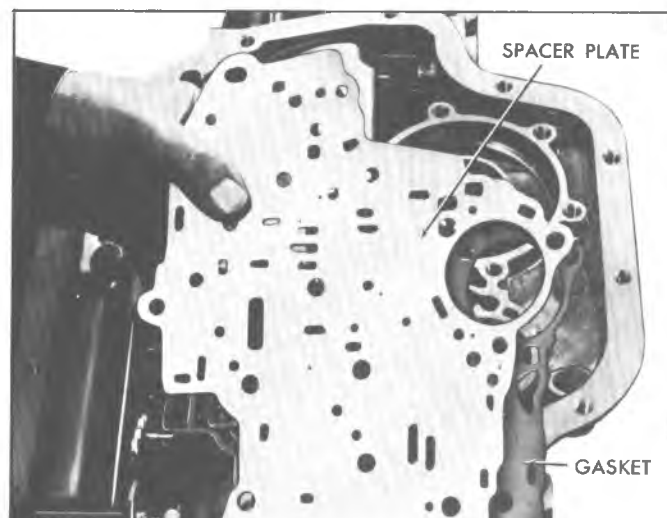


Fig. 7A-174C--Installing Control Valve Assembly Spacer Plate and Gasket

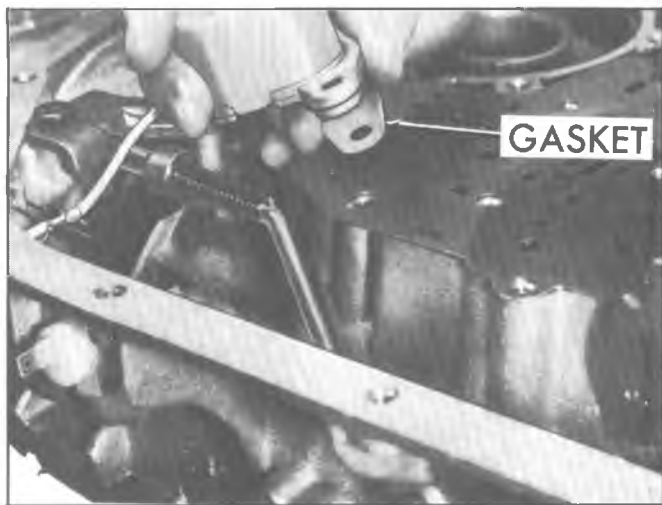


Fig. 7A-175C--Installing Detent Solenoid and Gasket

4. Install control valve spacer plate and control valve to spacer plate gasket (gasket identified with a "VB" near front servo).

5. Install detent solenoid gasket.

6. Install detent solenoid assembly with connector facing outer edge of case (Fig. 7A-175C). 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 7A-176C).

**NOTE:** The teflon ring allows the front servo piston to slide very freely in the case. The free fit of the ring

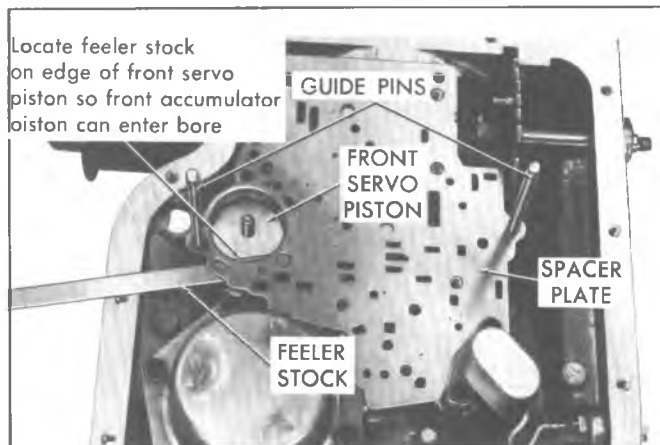


Fig. 7A-177C--Front Servo Group--In Vehicle Installation

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.

If transmission is in the vehicle, assemble front servo group as shown in figure 61T and install this group of parts into front servo bore in case and hold. Slip a length of straight, clean feeler gage or shim stock (about .020") between spacer plate and front servo piston to temporarily retain front servo group. Figure 7A-177C.

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. 7A-178C).

12. Install detent wire to electrical connector (Fig. 7A-12C).

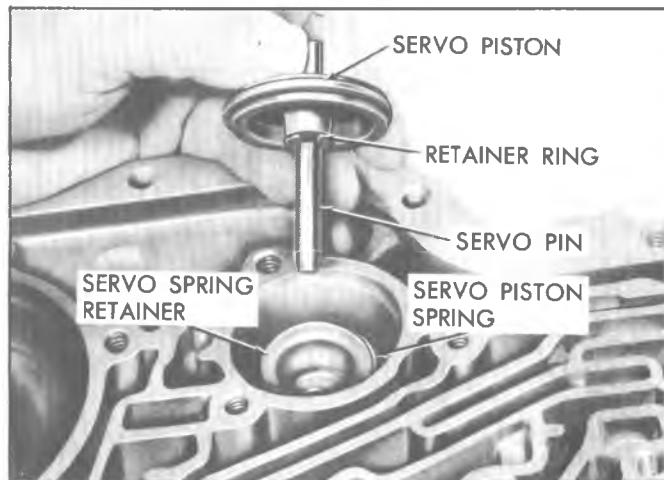


Fig. 7A-176C--Installing Front Servo Piston, Washer, and Pin

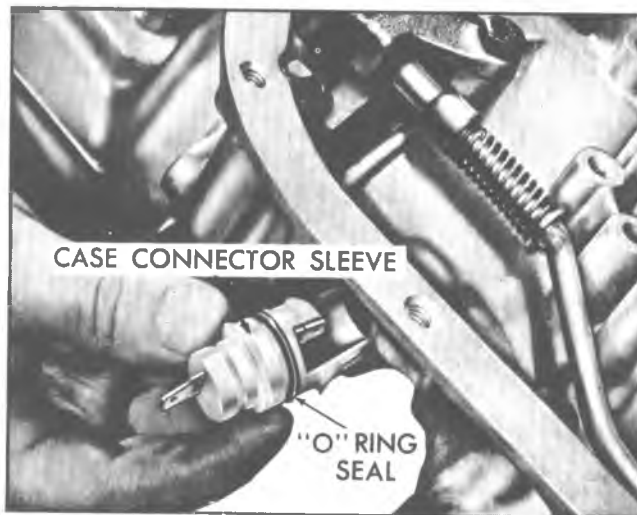


Fig. 7A-178C--Installing Electrical Connector and "O" Ring Seal

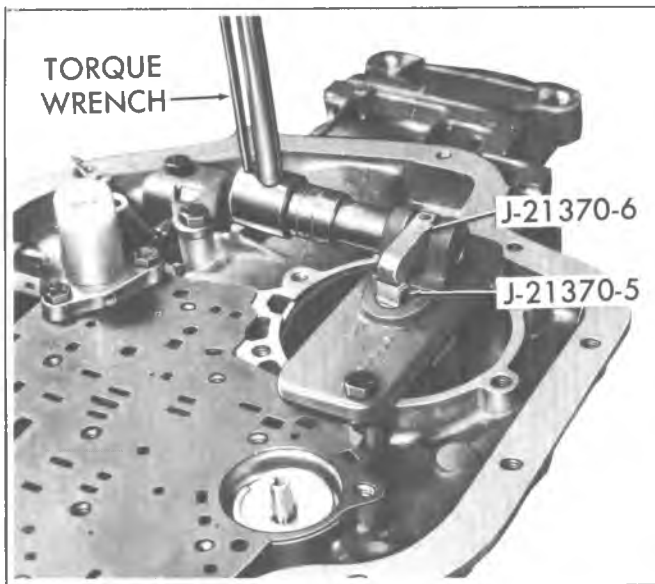


Fig. 7A-179C--Checking Rear Band Pin



Fig. 7A-181C--Installing Rear Servo Assembly

### Installation of Rear Servo Assembly

1. Check rear servo band apply pin. (Fig. 7A-179C).

a. Attach band apply pin selection Gage J-21370-6 and J-21370-5 to transmission case (lever pivot pin to rear) with attaching screws.

Attach tool attaching screws finger tight and check freeness of selective pin. Torque attaching screws to 15 ft. lbs. and recheck pin to make certain it does not bind.

b. Apply 25 ft. lb. torque and select proper servo pin to be used from scale on tool.

Selecting proper length pin is equivalent to adjusting band. The band lug end of each selective apply pin bears identification in the form of one, two, or three rings.

There are three selective pins identified as follows:

1. If both steps are below the gage surface, the long pin, identified by 3 rings, should be used.

2. If the gage surface is between the steps, the medium pin, identified by 2 rings, should be used.

3. If both steps are above the gage surface, the short pin, identified by 1 ring, should be used.

2. Install rear accumulator spring into case (Fig. 7A-180C).

3. Lubricate and install rear servo assembly into case (Fig. 7A-181C).

4. Install rear servo gasket and cover (Fig. 7A-182C).

5. Install attaching screws. Torque bolts to 15-20 ft. lbs.



Fig. 7A-180C--Installing Rear Accumulator Spring

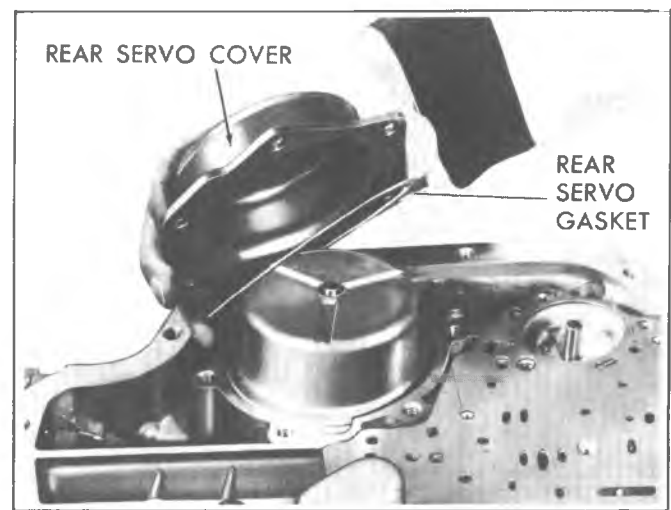


Fig. 7A-182C--Installing Rear Servo Cover and Gasket

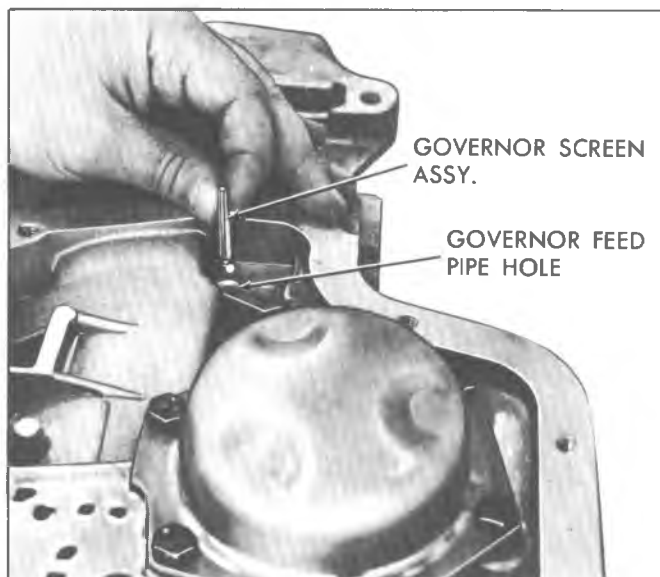


Fig. 7A-183C--Installing Governor Screen Assembly

### INSTALLATION OF CONTROL VALVE ASSEMBLY, GOVERNOR PIPES AND GOVERNOR SCREEN ASSEMBLY

1. Install governor pipes on control valve assembly. Governor pipes are interchangeable.
2. Install governor screen assembly, open end first, into governor feed pipe hole in case (hole nearest the center of the transmission) (Fig. 7A-183C).

**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

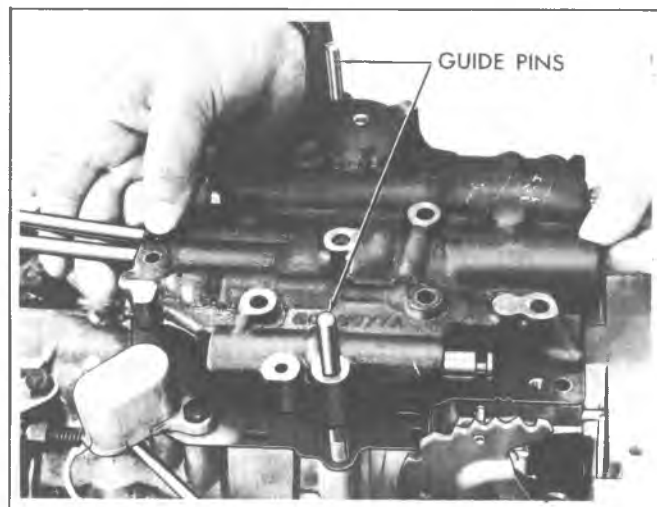


Fig. 7A-184C--Installing Control Valve Assembly and Governor Pipes

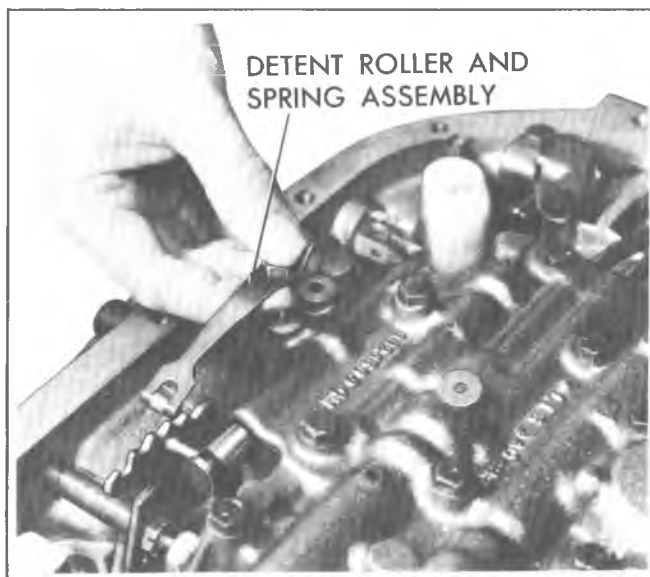


Fig. 7A-185C--Installing Detent Roller and Spring Assembly

the center of the transmission). See Figure 7A-183C).

3. Install control valve assembly and governor pipes on transmission, while carefully aligning the governor feed pipe over the governor screen (Fig. 7A-184C). Make certain gasket and spacer do not become mispositioned.

**NOTE:** Check manual valve to make sure it is indexed properly with pin on detent lever and check governor pipes to make certain they are properly seated in case holes.

4. Start control valve assembly attaching bolts.

**NOTE:** If transmission is in the vehicle, remove feeler stock before tightening any control valve bolts.

5. Remove guide pins and install detent roller and spring assembly and remaining bolts (Fig. 7A-185C).

### 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. 7A-8C).

**NOTE:** It is recommended that the filter be replaced, rather than cleaned, whenever the transmission is disassembled.

3. Install filter retainer bolt (Fig. 7A-7C).
4. Install new bottom pan gasket and bottom pan, with attaching screws. Torque to 12 ft. lbs.



Fig. 7A-186C--Installing Vacuum Modulator and Valve

### INSTALLATION OF MODULATOR VALVE AND VACUUM MODULATOR

1. Install modulator valve into case, stem end out (Fig. 7A-186C).
2. Install "O" ring seal on vacuum modulator.
3. Install vacuum modulator into case.

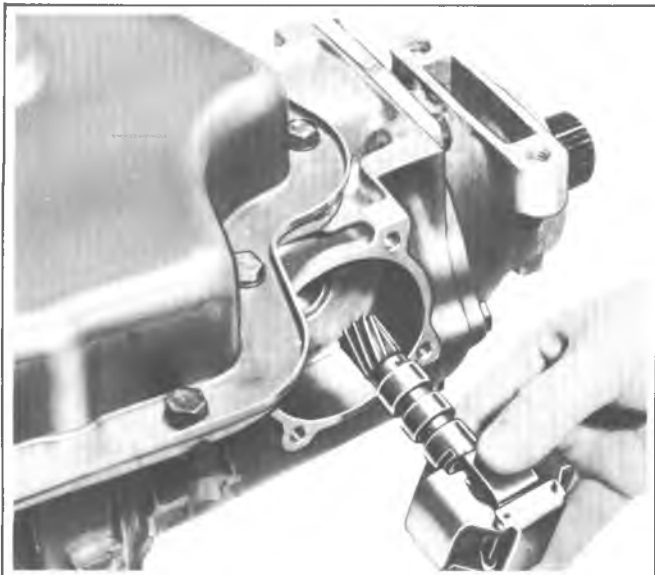


Fig. 7A-187C--Installing Governor Assembly

**NOTE:** Models CB, CC and CK use a modulator that is different than the modulator used on the other models. Refer to parts catalog book for correct usage.

4. Install modulator retainer and attaching bolt. Torque bolt 18 ft. lbs.

### INSTALLATION OF GOVERNOR ASSEMBLY

1. Install governor assembly into case (Fig. 7A-187C).
2. Attach governor cover and gasket with four (4) attaching bolts. Torque bolts to 18 ft. lbs.

### INSTALLATION OF SPEEDOMETER DRIVEN GEAR ASSEMBLY

1. Install speedometer driven gear assembly (Fig. 7A-188C).
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 CB, CD, CF, CL, CM and CT models has six (6) mounting lugs.



Fig. 7A-188C--Installing Speedometer Driven Gear and Sleeve



## SPECIFICATIONS

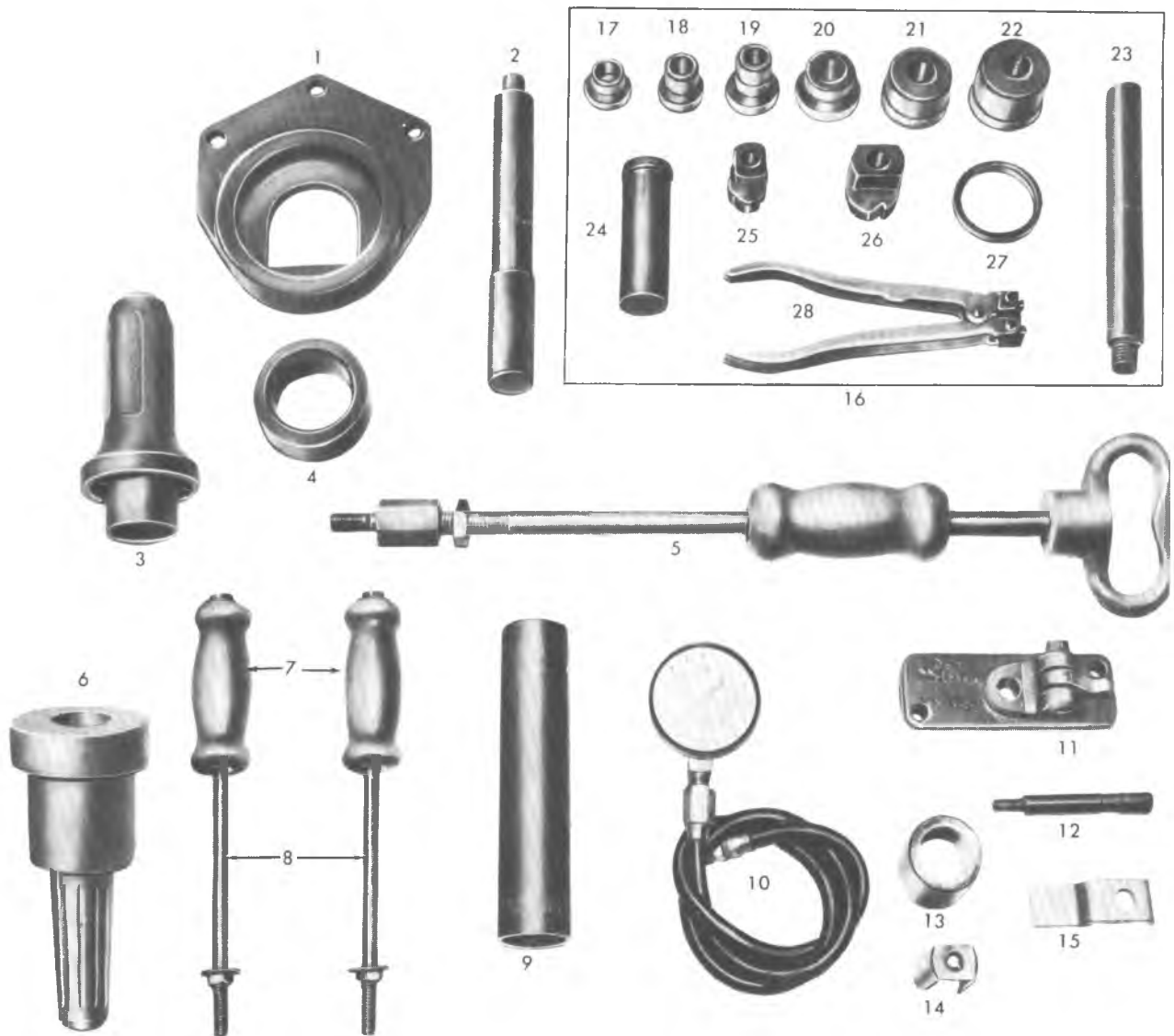
### TURBO HYDRA-MATIC—375/400

#### TORQUE SPECIFICATIONS

Pump Cover Bolts . . . . .	18 ft. lbs.
Parking Pawl Bracket Bolts . . . . .	18 ft. lbs.
Center Support Bolt . . . . .	23 ft. lbs.
Pump to Case Attaching Bolts . . . . .	18 ft. lbs.
Extension Housing to Case Attaching Bolts . . . . .	23 ft. lbs.
Rear Servo Cover Bolts . . . . .	18 ft. lbs.
Detent Solenoid Bolts . . . . .	7 ft. lbs.
Control Valve Body Bolts . . . . .	8 ft. lbs.
Bottom Pan Attaching Screws . . . . .	12 ft. lbs.
Modulator Retainer Bolt . . . . .	18 ft. lbs.
Governor Cover Bolts . . . . .	18 ft. lbs.
Manual Lever to Manual Shaft Nut . . . . .	8 ft. lbs.
Manual Shaft to Inside Detent Lever . . . . .	18 ft. lbs.
Linkage Swivel Clamp Nut . . . . .	43 ft. lbs.
Converter Dust Shield Screws . . . . .	93 ft. lbs.
Transmission to Engine Mounting Bolts . . . . .	35 ft. lbs.
Converter to Flywheel Bolts . . . . .	32 ft. lbs.
Rear Mount to Transmission Bolts . . . . .	40 ft. lbs.
Rear Mount to Crossmember Bolt . . . . .	40 ft. lbs.
Crossmember Mounting Bolts . . . . .	25 ft. lbs.
Line Pressure Take-Off Plug . . . . .	13 ft. lbs.
Strainer Retainer Bolt . . . . .	10 ft. lbs.
Oil Cooler Pipe Connectors to Transmission	
Case . . . . .	28 ft. lbs.
Oil Cooler Pipe to Connector . . . . .	10 ft. lbs.
Gearshift Bracket to Frame . . . . .	15 ft. lbs.
Gearshift Shaft to Swivel . . . . .	20 ft. lbs.
Manual Shaft to Bracket . . . . .	20 ft. lbs.
Downshift Switch to Bracket . . . . .	30 in. lbs.

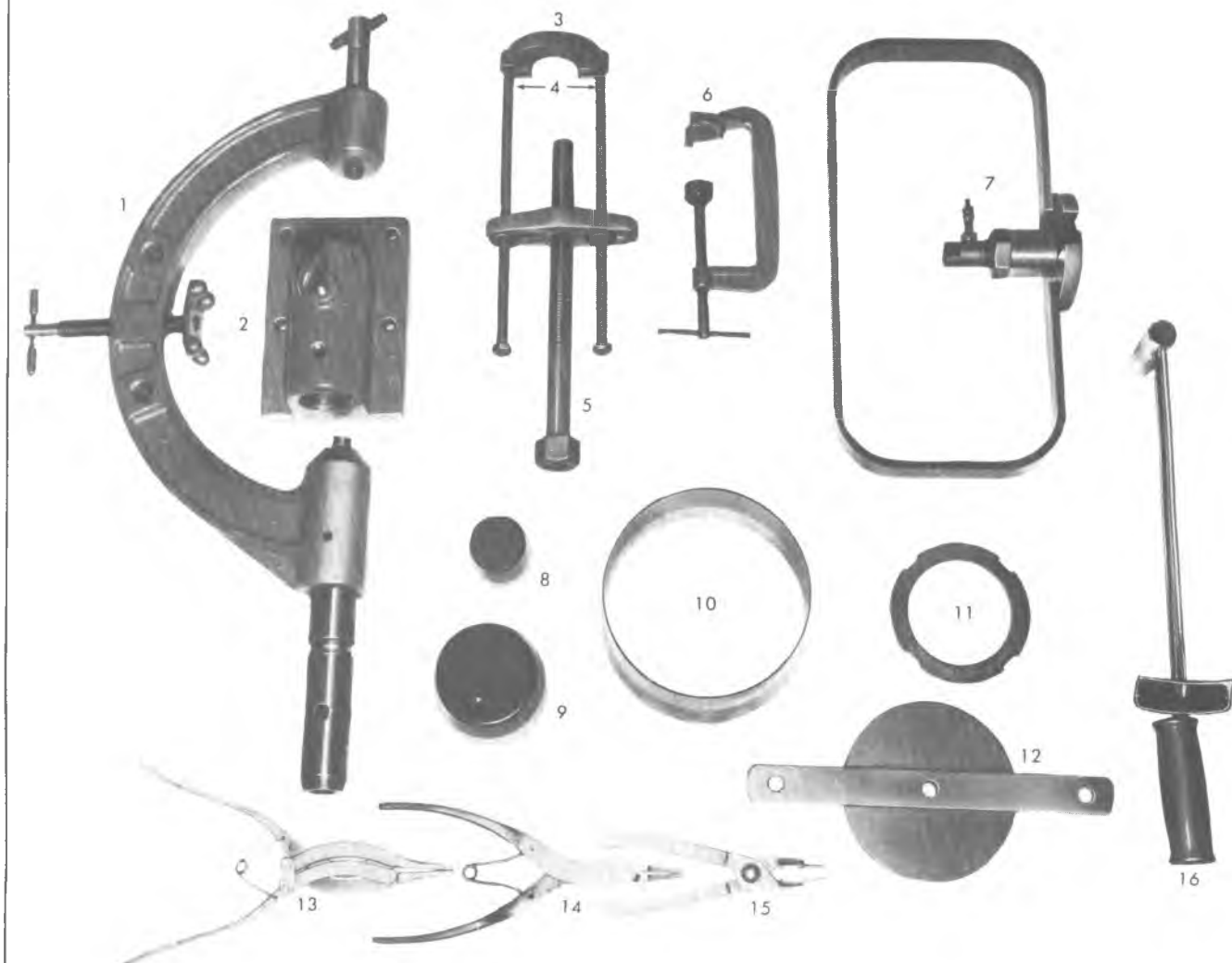


# SPECIAL TOOLS



- |               |  |                |   |
|---------------|--|----------------|---|
| 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. 7A-1ST--THM 400 Special Tools



- |               |  |                 |   |
|---------------|--|-----------------|---|
| 1. J-8763     | Transmission Holding Fixture                       | 11. J-21664     | Clutch Spring Compressor                          |
| 2. J-3289-14  | Holding Fixture Base                               | 12. J-4670      | Adapter Ring                                      |
| 3. J-21427-1  | Speedo Gear Remover                                | 13. J-8059      | Clutch Spring Compressor                          |
| 4. J-9539     | Side Hammer Bolts (3/8" - 16 Threads)              | 14. J-5586      | Snap Ring Pliers                                  |
| 5. J-8105     | Speedo Gear Remover Puller                         | 15. J-5403      | Snap Ring Pliers                                  |
| 6. J-22269-01 | Accumulator Piston Remover and Installer           | 16. J-1313      | Torque Wrench 0-140 Ft. Lbs.                      |
| 7. J-21369    | Converter Pressure Check Fixture                   | Not Illustrated |   |
| 8. J-21362    | Seal Protector - Forward and Direct Clutch - Inner | J-24684         | Pressure Regulator                                |
| 9. J-21363    | Seal Protector - Intermediate Clutch - Inner       | J-24675         | Valve Compressor                                  |
| 10. J-21409   | Seal Protector - Forward Clutch - Outer            |                 | Accumulator Piston Adapter (Used with J-22269-01) |

Fig. 7A-2ST-THM 400 Special Tools

## SECTION 7B

# MANUAL TRANSMISSION

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## 3-SPEED 76MM TRANSMISSION

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### DISASSEMBLY OF TRANSMISSION (FIG. 7B-1A)

1. Remove side cover attaching bolts and side cover assembly.
2. Remove drive gear bearing retainer and gasket.
3. Remove drive 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 (Fig. 7B-2A). 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 speedometer driven gear from extension.
5. Remove extension to case attaching bolts.
6. Remove the reverse idler shaft "E" ring (Fig. 7B-3A).
7. Remove drive gear, mainshaft and extension assembly together through the rear case opening. Remove drive gear, needle bearings and synchronizer ring from mainshaft assembly.
8. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (Fig. 7B-4A) and remove the extension.
9. Using J-22246 at the front of the countershaft, drive the shaft and its woodruff key out the rear of the case (Fig. 7B-5A). Tool J-22246 will now hold the roller bearings in

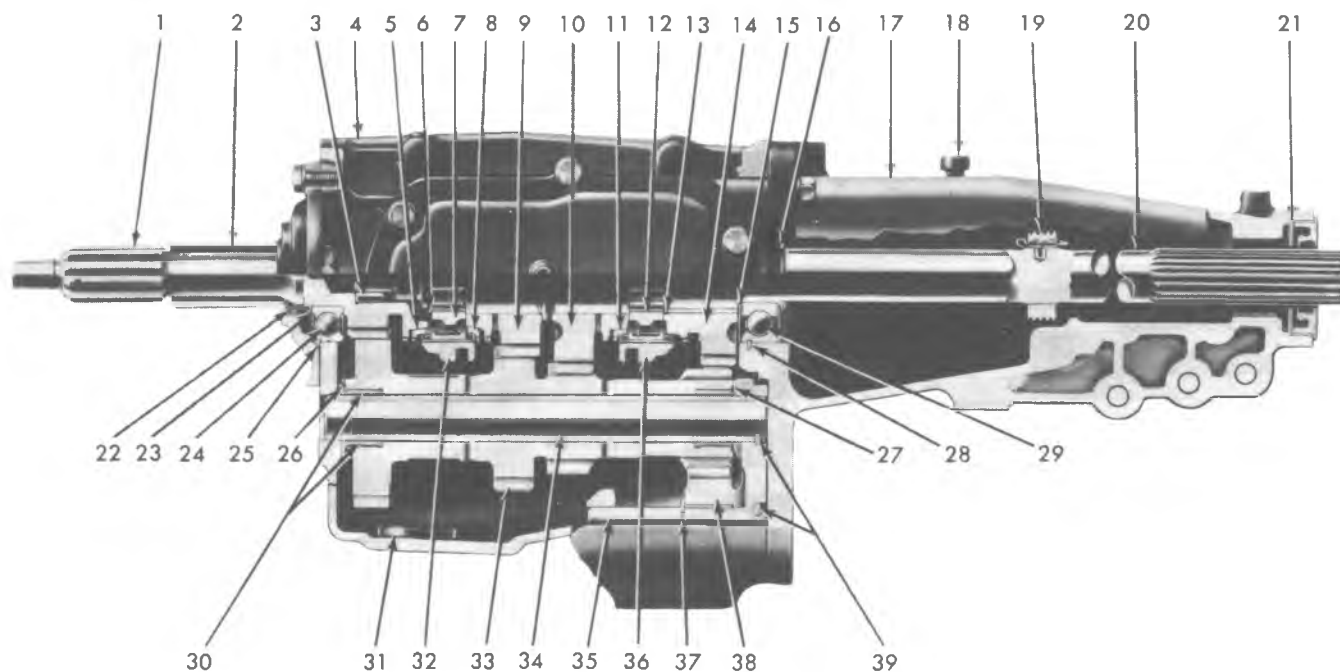
position within the countergear bore. Remove the gear, bearings and thrust washers.

10. 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. 7B-6A).

### 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. See Fig. 7B-7A.
2. Depress speedometer retaining clip and slide or tap gear from mainshaft.
3. Remove rear bearing snap ring from mainshaft groove. See Fig. 7B-8A.
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. See Fig. 7B-9A.
5. Remove the 1st and Reverse sliding clutch hub snap ring from the mainshaft and remove the clutch assembly, 1st speed blocker ring and first speed gear from rear of the mainshaft.

**NOTE:** Under certain tolerance conditions, it may be necessary to press the synchronizer hub and gear from the mainshaft.



- |                           |  |                                     |                                    |                             |
|---------------------------|--|-------------------------------------|------------------------------------|-----------------------------|
| 1. Clutch Gear            | 10. 1st Speed Gear                         | 16. Snap Ring-Bearing to Mainshaft  | 24. Clutch Gear Bearing            | 31. Magnet                  |
| 2. Bearing Retainer       | 11. 1st Speed Blocker Ring                 | 17. Extension                       | 25. Snap Ring-Bearing to Case      | 32. 2-3 Synch. Sleeve       |
| 3. Pilot Bearings         | 12. 1st Speed Synch. Hub                   | 18. Vent                            | 26. Thrust Washer-Front            | 33. Countergear             |
| 4. Case                   | 13. 1st Speed Synch. Snap Ring             | 19. Speedometer Drive Gear and Clip | 27. Thrust Washer-Rear             | 34. Counter Shaft           |
| 5. 3rd Speed Blocker Ring | 14. Reverse Gear                           | 20. Mainshaft                       | 28. Snap Ring-Bearing to Extension | 35. Reverse Idler Shaft     |
| 6. 2-3 Synch. Snap Ring   | 15. Reverse Gear Thrust and Spring Washers | 21. Rear Oil Seal                   | 29. Rear Bearing                   | 36. 1st Speed Synch. Sleeve |
| 7. 2-3 Synch. Hub         |  | 22. Retainer Oil Seal               | 30. Countergear Roller Bearings    | 37. "E" Ring                |
| 8. 2nd Speed Blocker Ring |  | 23. Snap Ring-Bearing to Gear       |                                    | 38. Reverse Idler Gear      |
| 9. 2nd Speed Gear         |  |                                     |                                    | 39. Woodruff Keys           |

Fig. 7B-1A-3-Speed 76mm Transmission Cross-Section

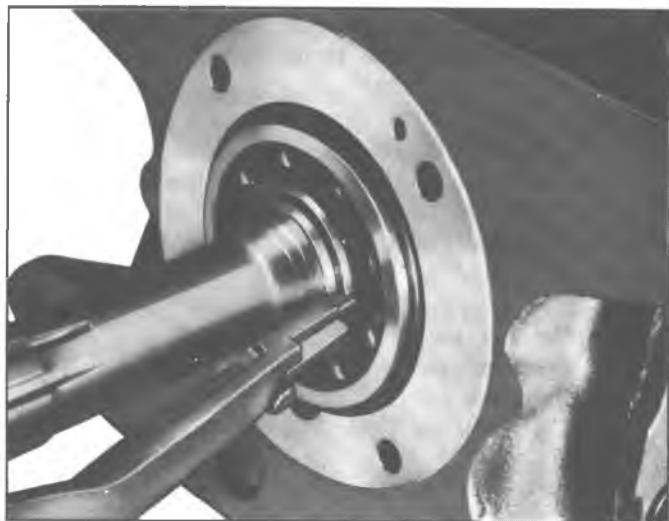


Fig. 7B-2A--Removing Clutch Gear Bearing Retaining Ring



Fig. 7B-5A--Removing Counter Gear Shaft

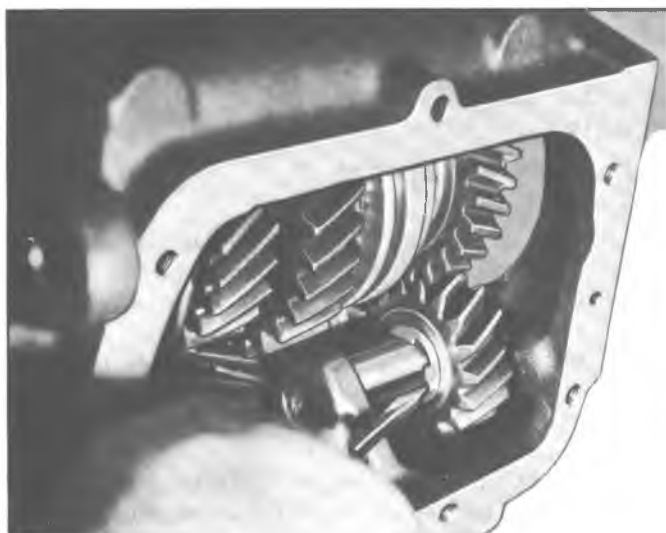


Fig. 7B-3A--Removing Reverse Idler Shaft "E" Ring

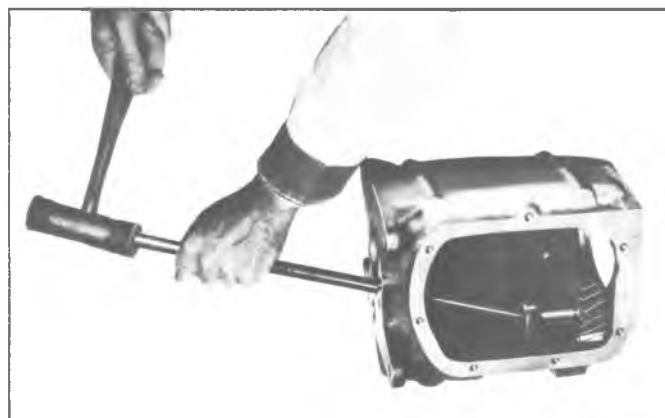


Fig. 7B-6A--Removing Reverse Idler Shaft

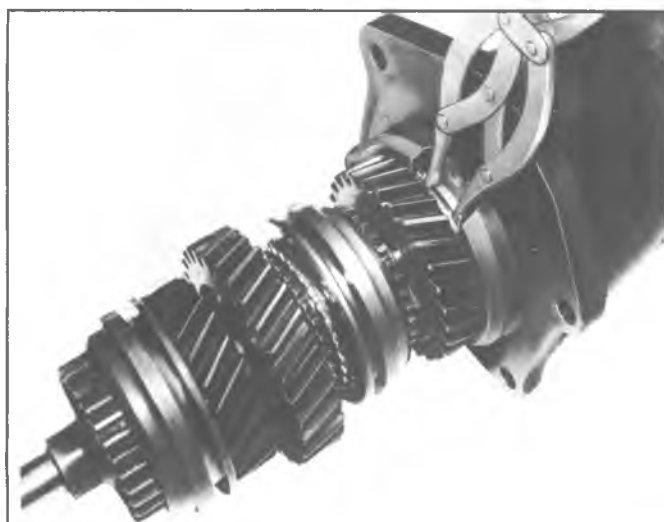


Fig. 7B-4A--Removing Rear Extension From Main Shaft

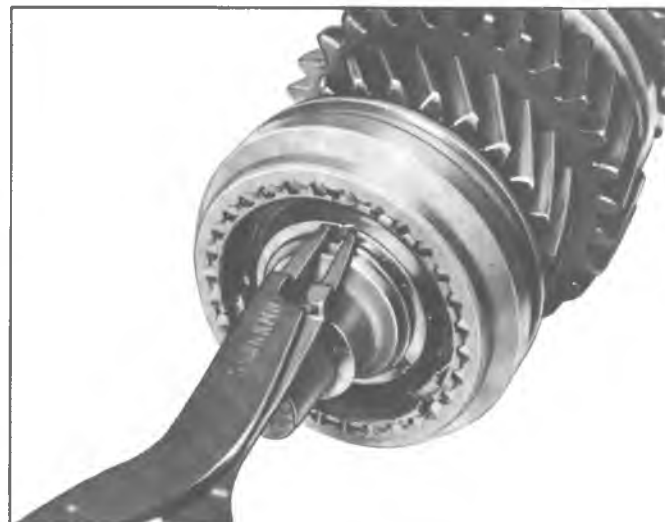


Fig. 7B-7A--Removing 2nd-3rd Clutch Hub Retaining Ring

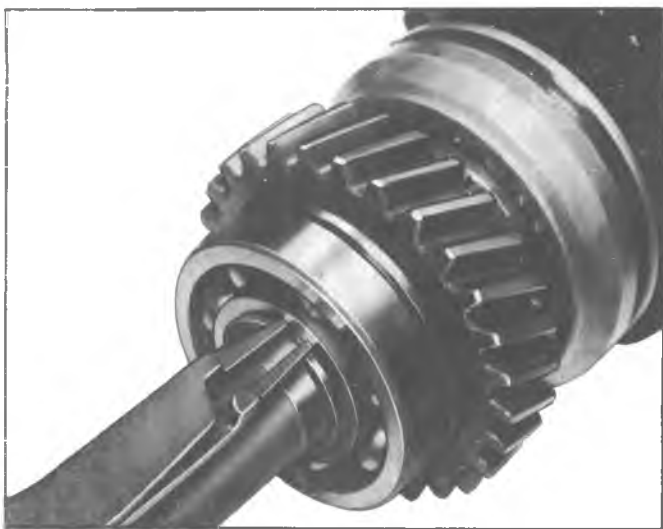


Fig. 7B-8A--Removing Rear Bearing Retaining Ring

## 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 may damage the race and balls.

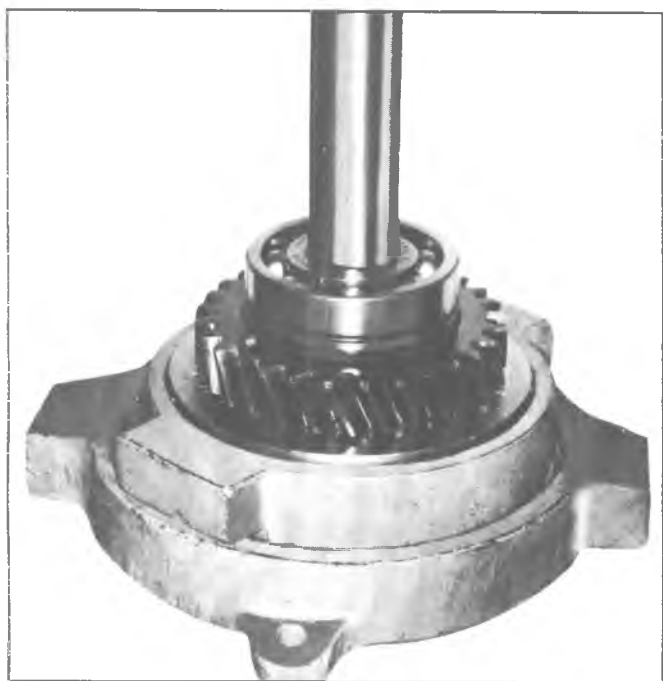


Fig. 7B-9A--Removing Rear Bearing From Mainshaft

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.

## 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 that 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. 7B-10A). The tanged end of each synchronizer

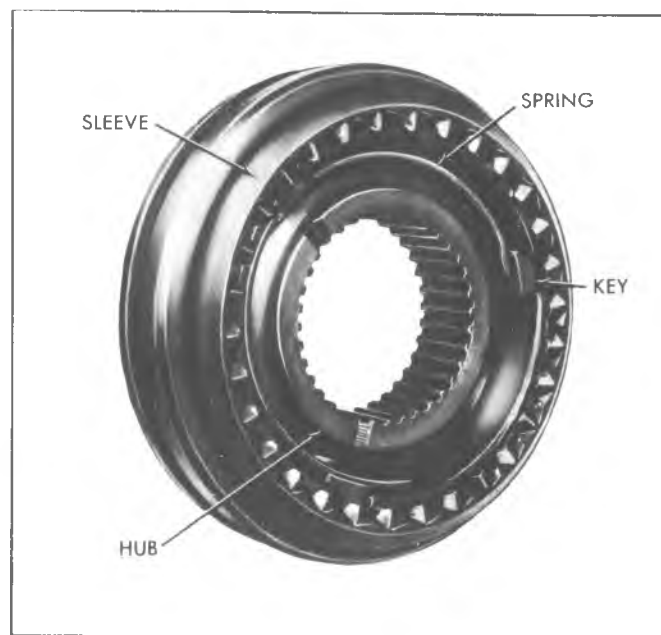


Fig. 7B-10A--Synchronizer Assembly

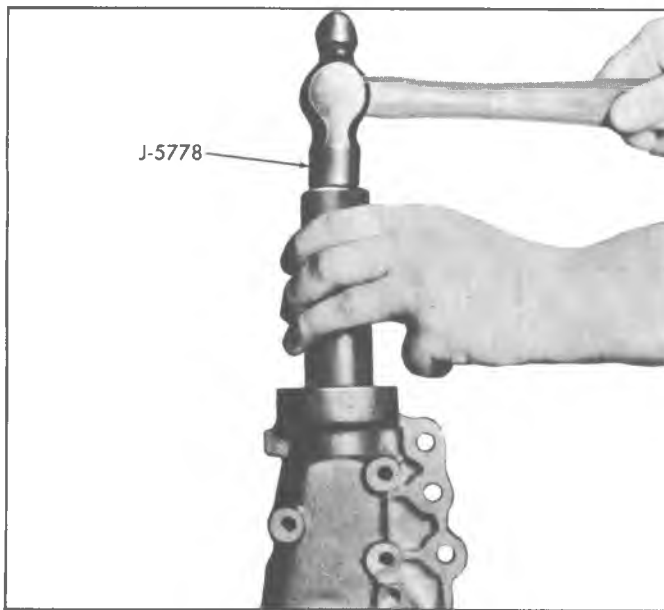


Fig. 7B-11A—Removing or Installing Rear Extension Bushing

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 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. 7B-11A). 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-21426 or J-5154 (Fig. 7B-12A).

### Clutch Bearing Retainer Oil Seal

If the lip seal in the reatiner needs replacement; pry the

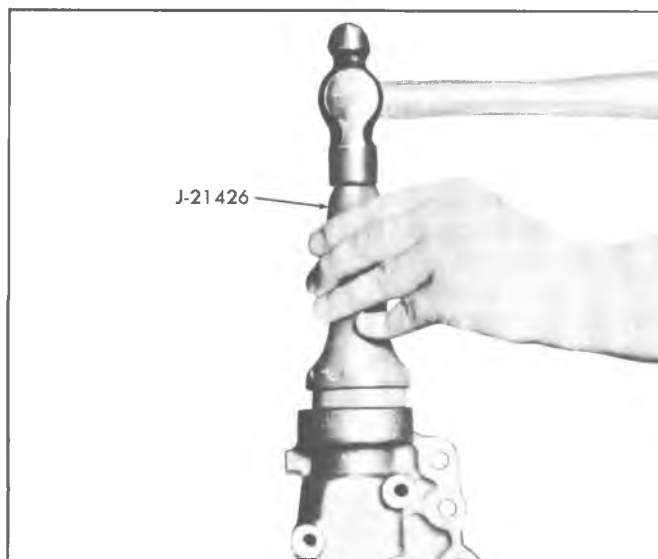


Fig. 7B-12A—Installing Rear Extension Seal

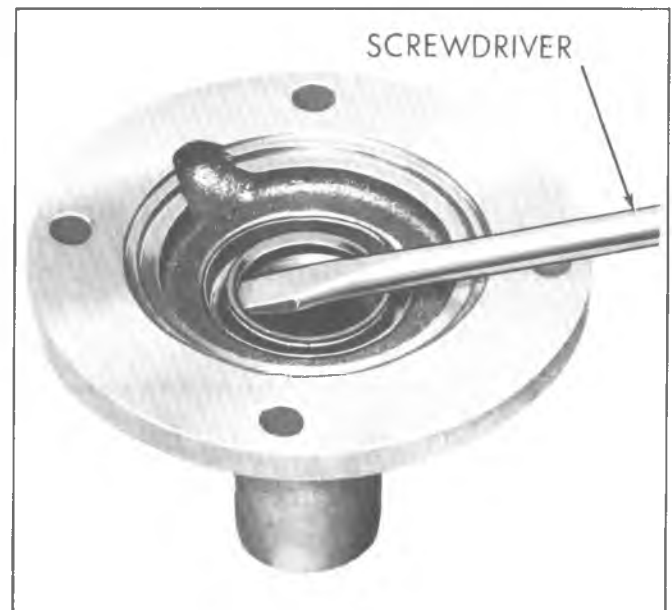


Fig. 7B-13A—Removing Drive Gear Bearing Retainer Seal

old seal out (Fig. 7B-13A) and replace with a new seal using Installer Tool J-23096, or similar tool, until seal seats in its bore (Fig. 7B-14A).

### ASSEMBLY OF MAINSHAFT (FIG. 7B-15A)

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 ubtt 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.

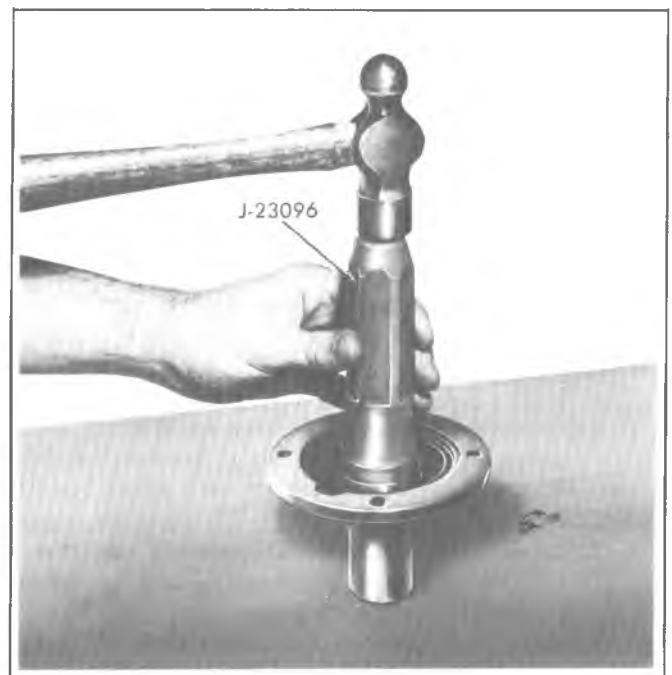


Fig. 7B-14A—Installing Clutch Gear Bearing Retainer Seal



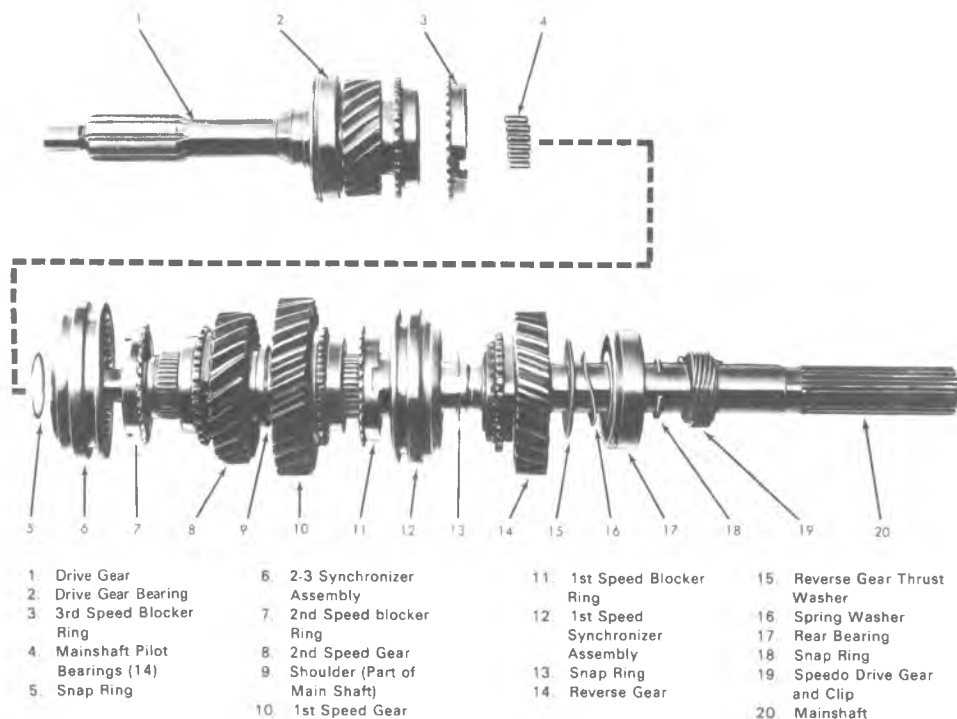


Fig. 7B-15A--Clutch Gear and Mainshaft Assembly

3. Install the second and third synchronizer assembly with the fork slot downward; press it onto splines on the mainshaft until it bottoms out. Both synchronizer assemblies used in this transmission are identical. (If sleeve becomes removed from 2-3 hub; notches on hub O.D. face forward end of mainshaft.)

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

4. Install snap ring retaining synchronizer hub to mainshaft. Both synchronizer snap rings are identical. 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; push it onto splines on the mainshaft.

8. Install synchronizer hub to mainshaft snap ring.

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

9. Install reverse gear with clutching teeth downward.

10. Install reverse gear thrust washer (steel).

11. Install reverse gear spring washer.

12. Install rear ball bearing with snap ring slot downward; press onto mainshaft.

13. Install rear bearing to mainshaft snap ring.

14. Install speedometer drive gear and retaining clip.

#### ASSEMBLY OF TRANSMISSION (FIG. 7B-18A)

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. 7B-16A).

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. 7B-4A).

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.

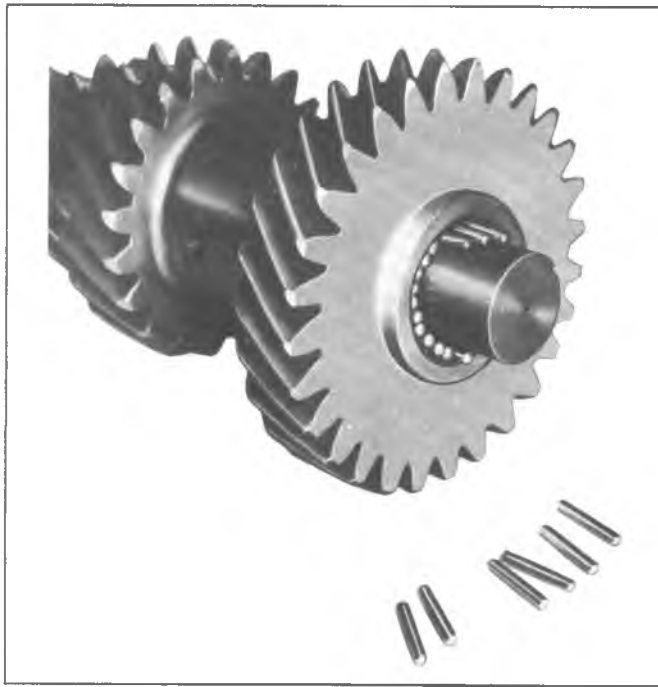


Fig. 7B-16A--Loading Countergear

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.

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.

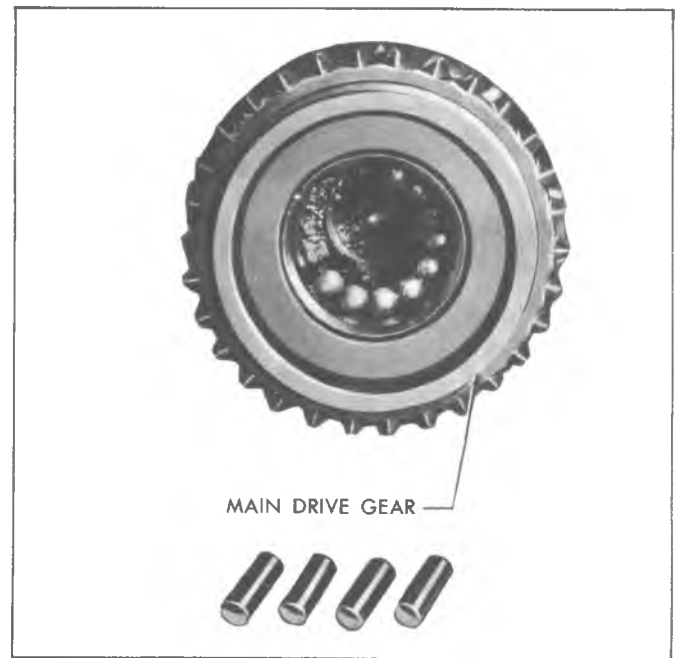


Fig. 7B-17A--Loading Pilot Bearings

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.

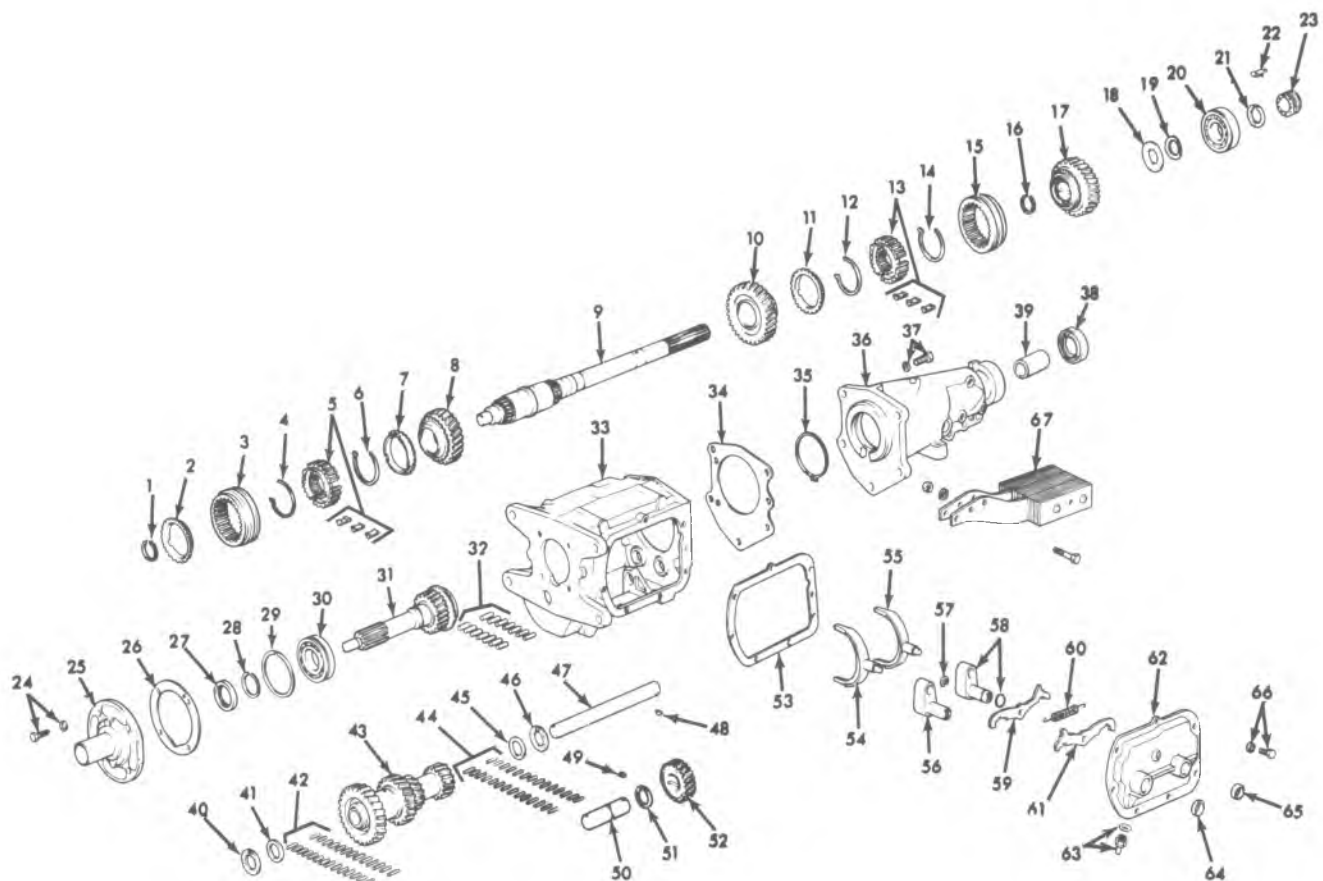
11. Install reverse idler gear retainer "E" ring to shaft.

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. Install speedometer driven gear in extension.

14. Tighten all bolts to specified torque.

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



- |                               |   |                                       |
|-------------------------------|---|---------------------------------------|
| 1. Snap Ring                  | 24. Bearing Retainer Bolts and Washers (4)        | 46. Thrust Washer                     |
| 2. Synchronizer Ring          | 25. Front Bearing Retainer                        | 47. Countergear Shaft                 |
| 3. 2-3 Synchronizer Sleeve    | 26. Bearing Retainer Gasket                       | 48. Countergear Shaft Key             |
| 4. Synchronizer Key Spring    | 27. Bearing Retainer Oil Seal                     | 49. Idler Shaft Key                   |
| 5. Synchronizer Hub and Keys  | 28. Snap Ring                                     | 50. Reverse Idler Shaft               |
| 6. Synchronizer Key Spring    | 29. Bearing Snap Ring                             | 51. Snap Ring                         |
| 7. Synchronizer Ring          | 30. Front Bearing                                 | 52. Reverse Idler Gear                |
| 8. Second Gear                | 31. Drive Gear                                    | 53. Side Cover Gasket                 |
| 9. Main Shaft                 | 32. Pilot Bearings                                | 54. 2-3 Shift Fork                    |
| 10. First Gear                | 33. Case  | 55. 1-Rev Shift Fork                  |
| 11. Synchronizer Ring         | 34. Extension to Case Gasket                      | 56. 2-3 Shifter Shaft                 |
| 12. Synchronizer Key Spring   | 35. Rear Bearing to Extension Retaining Ring      | 57. Retaining "E" Ring                |
| 13. Synchronizer Hub and Keys | 36. Rear Extension                                | 58. 1-Rev Shifter Shaft with "O" Ring |
| 14. Synchronizer Key Spring   | 37. Extension to Case Retaining Bolts and Washers | 59. 2-3 Detent Cam                    |
| 15. 1-2 Synchronizer Sleeve   | 38. Rear Extension Bushing                        | 60. Detent Cam Spring                 |
| 16. Snap Ring                 | 39. Rear Seal                                     | 61. 1-Rev Detent Cam                  |
| 17. Reverse Gear              | 40. Thrust Washer                                 | 62. Shift Cover                       |
| 18. Thrust Washer             | 41. Spacer  | 63. TCS Switch and Gasket             |
| 19. Waved Washer              | 42. Countergear Shaft Bearings                    | 64. Shifter Shaft Seal                |
| 20. Rear Bearing              | 43. Countergear                                   | 65. Shifter Shaft Seal                |
| 21. Snap Ring                 | 44. Countergear Shaft Bearings                    | 66. Shift Cover Bolts and Washers     |
| 22. Speedometer Gear Clip     | 45. Spacer  | 67. Damper Assembly                   |
| 23. Speedometer Drive Gear    |   |                                       |

Fig. 7B-18A-3-Speed, 76mm, Transmission Exploded View

## 3 SPEED 77MM TRANSMISSION

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### TRANSMISSION DISASSEMBLY

1. Remove lower extension housing bolt and drain transmission (Fig. 7B-3B).

2. Remove top cover and gasket from case.

3. Remove long spring that retains the detent plug in the case (Fig. 7B-4B). Remove the detent plug with a small magnet.

4. Remove extension housing and gasket.

5. Press down on speedometer gear retainer and remove speedometer drive gear and retainer from output shaft.

6. Remove fill plug from right side of case (Fig. 7B-3B). Working through the plug opening drive out countergear roll pin with a 3/16 inch pin punch that has been chamfered slightly.

**NOTE:** Do not attempt to retrieve pin at this time. Pin can easily be retrieved after output shaft assembly is removed.

7. Insert dummy shaft tool J-25232 into bore at front of case, tap lightly on tool to push countershaft out rear of case (Fig. 7B-5B).

**NOTE:** With countershaft removed, allow countergear to lie at bottom of case.

8. Punch alignment mark in front bearing retainer and transmission case to ensure correct assembly and remove front bearing retainer and gasket (Fig. 7B-6B).

9. Remove large locating snap ring from front bearing and smaller snap ring from clutch gear shaft.

10. Remove clutch shaft front bearing using tool J-6654-01 and tool J-8433-1 (Fig. 7B-7B).

**NOTE:** It may be necessary to alternate the tightening of the bolts between tools J-6654-01 and J-8433-1 to remove the front bearing.

11. Remove large locating snap ring from rear bearing and smaller retaining snap ring from output shaft.

**NOTE:** It may be necessary to place a screwdriver or a piece of bar stock between the case and the first-reverse sleeve and gear assembly. This will hold the output shaft assembly in place while removing the rear bearing.

12. Remove rear bearing from output shaft using tool J-8157-01 (Fig. 7B-8B).

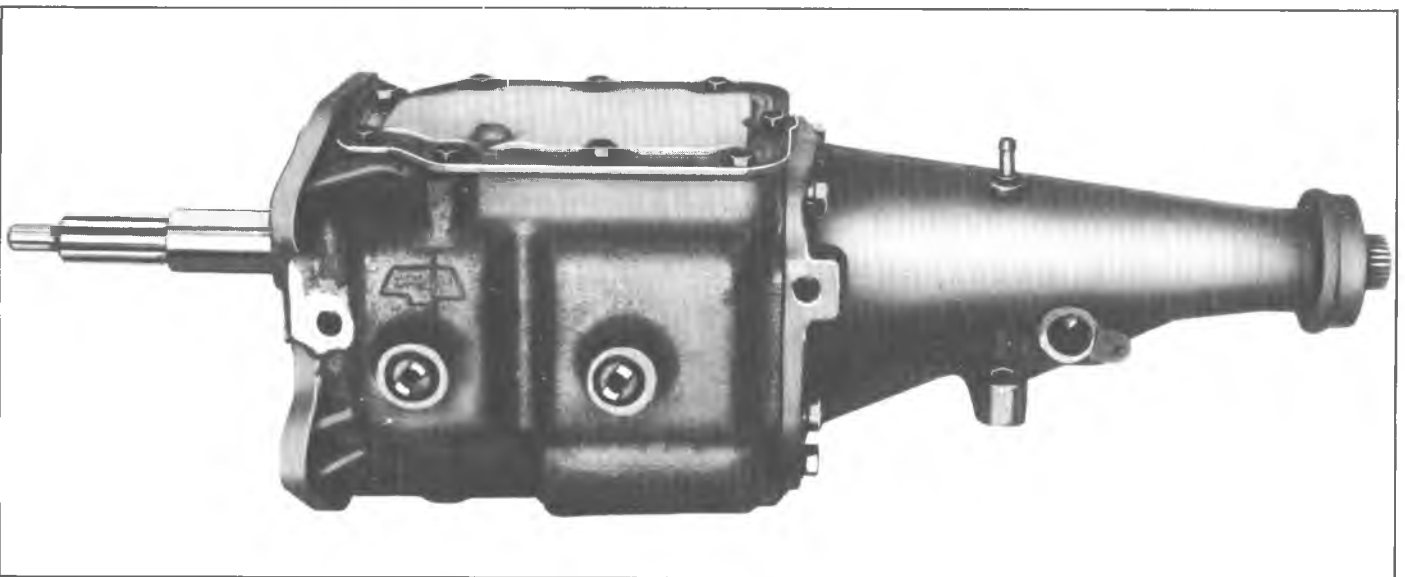
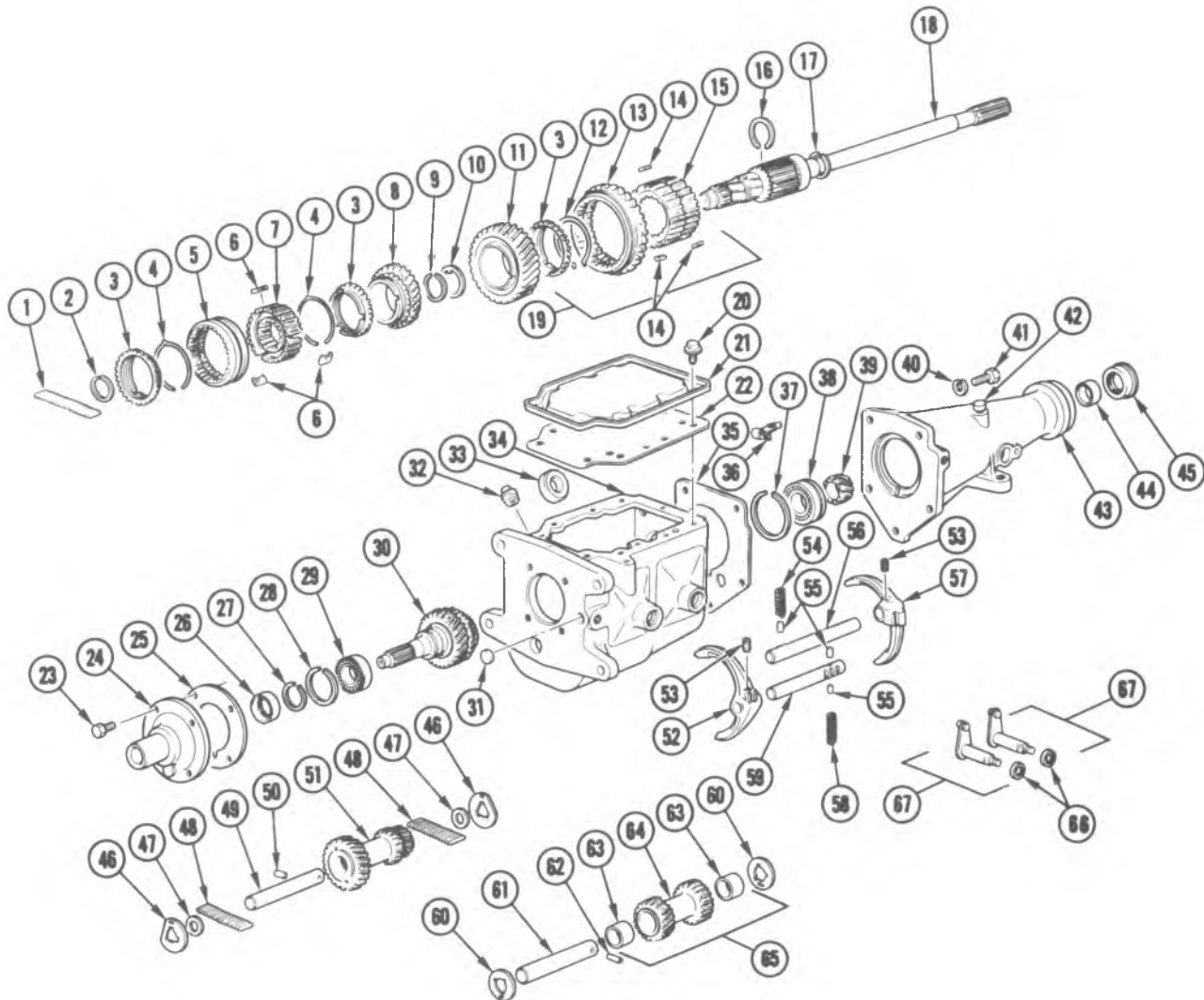


Fig. 7B-1B-3-Speed 77mm Transmission



- |  |   |
|--|---|
| 1. MAINSHAFT ROLLER BEARINGS                     | 35. EXTENSION HOUSING TO CASE GASKET            |
| 2. 2ND & 3RD SYNCHRONIZER RETAINING RING         | 36. SPEEDOMETER DRIVER GEAR RETAINING CLIP      |
| 3. SYNCHRONIZER BLOCKER RINGS                    | 37. TRANSMISSION REAR BEARING LOCK RING         |
| 4. 2ND & 3RD SYNCHRONIZER SPRING                 | 38. MAINSHAFT BEARING ASSEMBLY                  |
| 5. 2ND & 3RD SYNCHRONIZER SLEEVE                 | 39. SPEEDOMETER DRIVE GEAR                      |
| 6. 2ND & 3RD SYNCHRONIZER KEYS                   | 40. EXTENSION TO CASE WASHER                    |
| 7. 2ND & 3RD SYNCHRONIZER HUB                    | 41. EXTENSION TO CASE BOLT                      |
| 8. SECOND SPEED GEAR                             | 42. TRANSMISSION EXTENSION VENTILATOR ASSEMBLY  |
| 9. 1ST SPEED GEAR RETAINING RING                 | 43. EXTENSION HOUSING ASSEMBLY                  |
| 10. 1ST SPEED GEAR TABBED WASHER                 | 44. EXTENSION HOUSING BUSHING                   |
| 11. 1ST SPEED GEAR                               | 45. EXTENSION HOUSING OIL SEAL ASSEMBLY         |
| 12. REVERSE SYNCHRONIZER SPRING                  | 46. COUNTERGEAR THRUST WASHER                   |
| 13. 1ST & REVERSE SYNCHRONIZER SLEEVE & GEAR     | 47. COUNTERGEAR SPACER                          |
| 14. REVERSE SYNCHRONIZER KEYS                    | 48. COUNTERGEAR ROLLER BEARINGS                 |
| 15. 1ST & REVERSE SYNCHRONIZER HUB               | 49. COUNTERGEAR SHAFT                           |
| 16. 1ST & REVERSE SYNCHRONIZER RETAINING RING    | 50. COUNTERGEAR SPRING PIN                      |
| 17. REAR BEARING RETAINING RING                  | 51. COUNTERGEAR                                 |
| 18. TRANSMISSION MAINSHAFT                       | 52. 2ND & 3RD SHIFTER FORK                      |
| 19. REVERSE SYNCHRONIZER ASSEMBLY                | 53. SHIFTER LOCKING SCREW                       |
| 20. ACCESS COVER BOLTS                           | 54. 1ST & 2ND SHIFTER INTERLOCK SPRING          |
| 21. ACCESS COVER                                 | 55. SHIFTER INTERLOCK PIN                       |
| 22. ACCESS COVER GASKET                          | 56. 1ST & REVERSE SHIFT RAIL                    |
| 23. BEARING RETAINER - TO CASE BOLTS             | 57. 1ST & REVERSE SHIFTER FORK                  |
| 24. BEARING RETAINER - CLUTCH GEAR               | 58. 2ND & 3RD SHIFTER INTERLOCK SPRING          |
| 25. GASKET - CLUTCH GEAR BEARING RETAINER        | 59. 2ND & 3RD SHIFTER RAIL                      |
| 26. SEAL ASSEMBLY - CLUTCH GEAR BEARING RETAINER | 60. REVERSE IDLER GEAR THRUST WASHER            |
| 27. CLUTCH GEAR BEARING RETAINING RING           | 61. REVERSE IDLER GEAR SHAFT                    |
| 28. CLUTCH GEAR BEARING LOCK RING                | 62. SPRING PIN IDLER GEAR SHAFT                 |
| 29. CLUTCH GEAR BEARING ASSEMBLY                 | 63. REVERSE IDLER GEAR BUSHING                  |
| 30. CLUTCH GEAR                                  | 64. REVERSE IDLER GEAR                          |
| 31. EXPANSION PLUG                               | 65. REVERSE IDLER GEAR ASSEMBLY                 |
| 32. FILLER PLUG                                  | 66. SEAL TRANSMISSION SHIFTER                   |
| 33. TRANSMISSION CASE MAGNET                     | 67. TRANSMISSION SHIFTER SHAFT & LEVER ASSEMBLY |
| 34. CASE   |   |

Fig. 7B-2B--Exploded View - 3 Speed 77mm Transmission

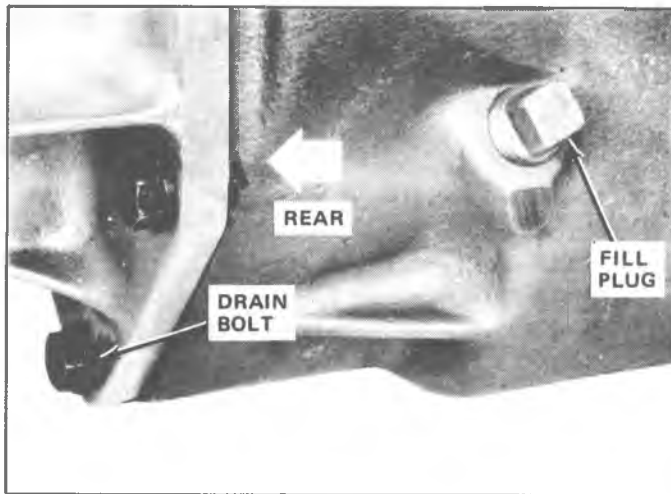


Fig. 7B-3B--Drain Transmission

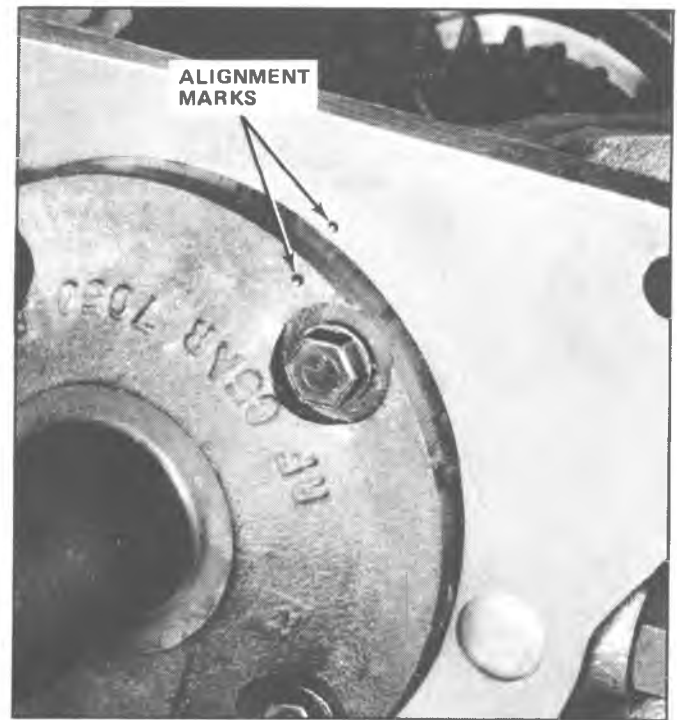


Fig. 7B-6B--Removing Front Bearing Retainer

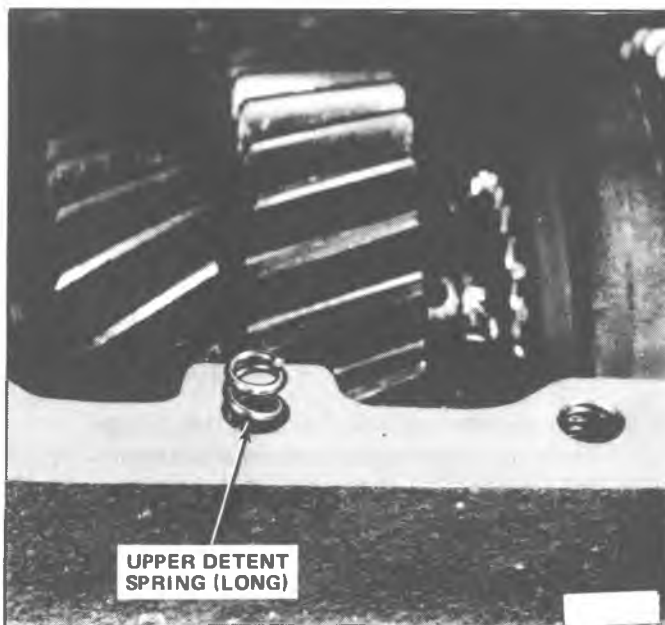


Fig. 7B-4B--Location of Upper Detent Spring

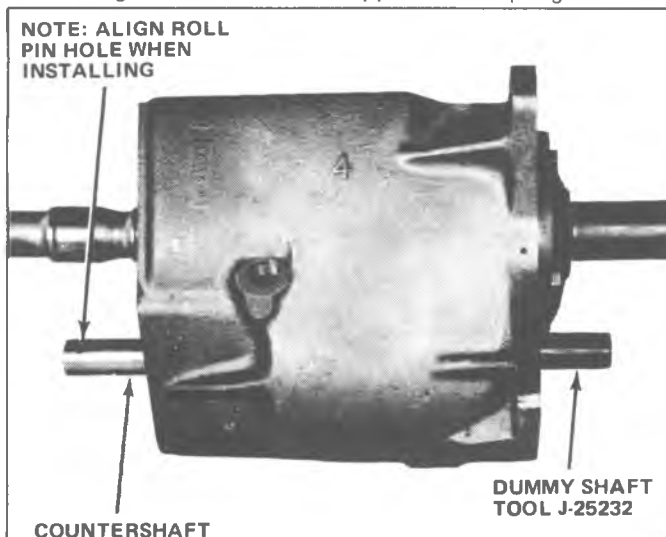


Fig. 7B-5B--Removing Countershaft

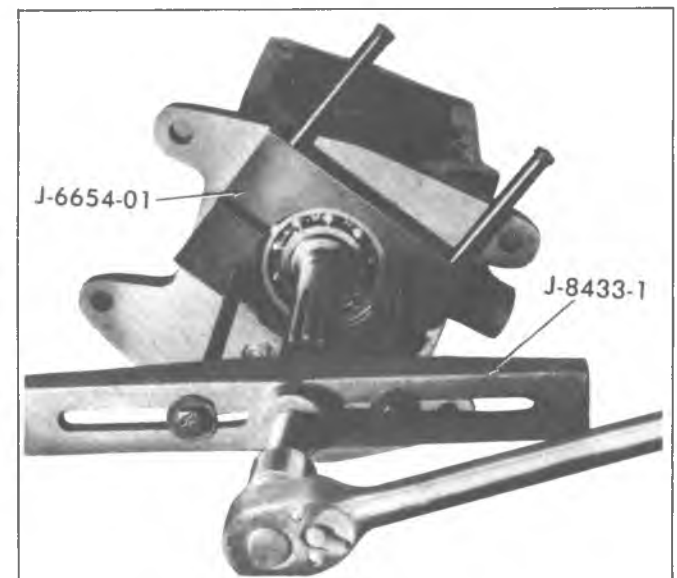


Fig. 7B-7B--Removing Front Bearing

13. Remove set screw from First-Reverse shifter fork and slide shift rail out rear of case.

14. Shift First-Reverse sleeve and gear all the way forward and rotate First-Reverse shifter fork upward and out of case. Remove First-Reverse Detent plug from case.

15. Shift Second-Third Shifter fork rearward to gain access to setscrew, remove setscrew, rotate shift rail 90° with pliers to clear bottom detent plug and remove interlock plug with magnet (Fig. 7B-9B).

16. Using a long thin punch (1/4 inch diameter or less) insert through access hole in rear case to drive out shift rail and expansion plug located in shift rail bore at front of case.

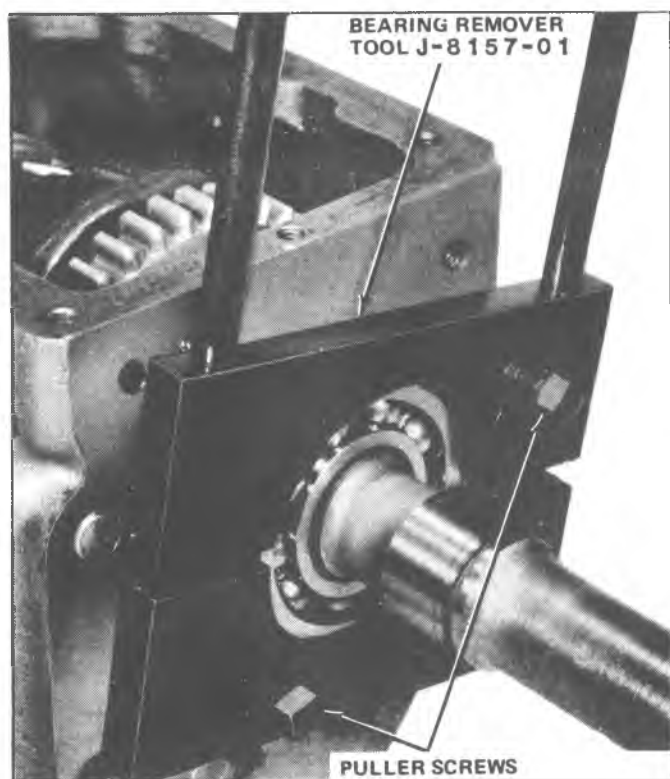


Fig. 7B-8B--Removing Rear Bearing

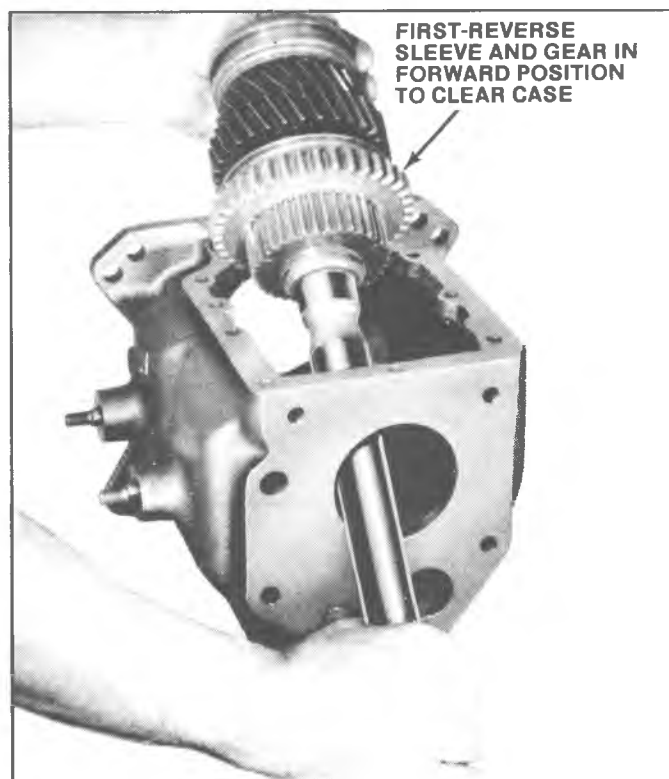


Fig. 7B-10B--Removing Output Shaft Assembly

17. Rotate second-third shifter fork upward and out of case.

18. Remove the bottom detent plug and short detent spring from case.

19. Separate clutch gear from output shaft and remove output shaft assembly (Fig. 7B-10B); tilt spline end of shaft downward and lift gear end upward and out of case.

**NOTE:** First and reverse sleeve and gear must pass through notch at right rear end of case.

20. Remove clutch gear through top of case.

21. Remove both shifter fork shafts (Fig. 7B-11B).

22. Remove countergear (with tool in place), thrust washers and roll pin.

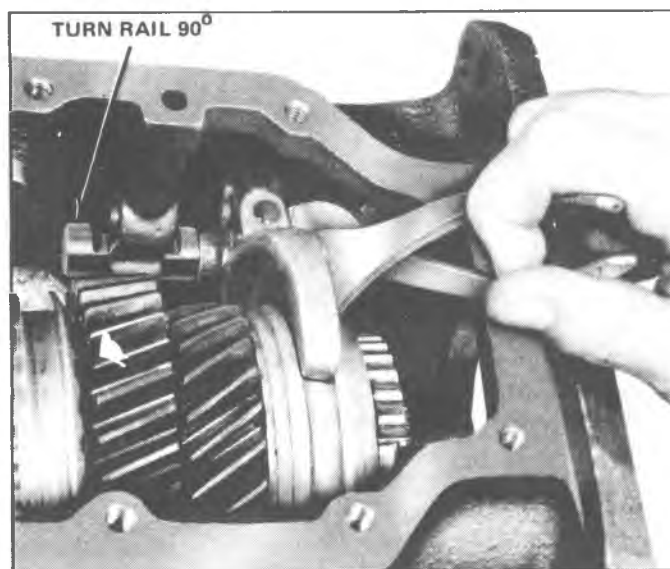


Fig. 7B-9B--Rotating Shift Rail

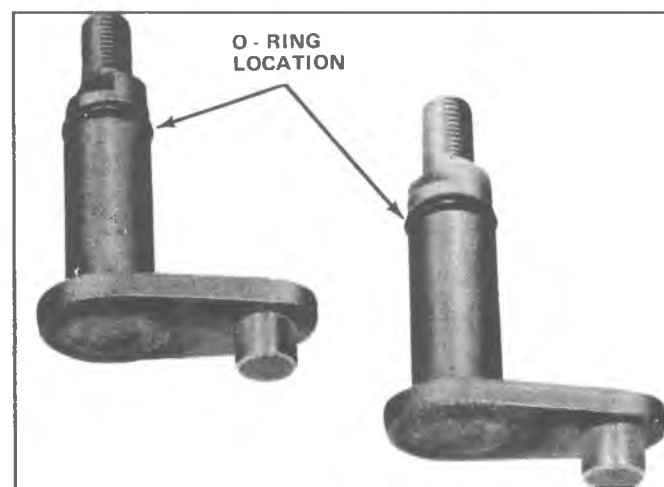


Fig. 7B-11B--Shift Fork Shafts



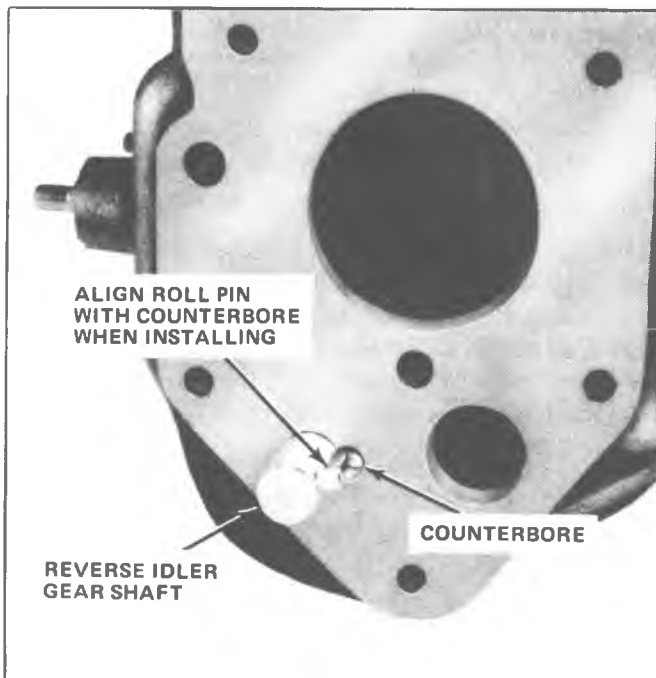


Fig. 7B-12B--Removing Reverse Idler Gear Shaft

23. Remove reverse idler gear and thrust washers by tapping shaft with hammer until end of idler gear shaft (end with roll pin) clears counterbore in rear of case and remove shaft (Fig. 7B-12B).

24. From the bottom of the case retrieve, clutch shaft roller bearing or countergear needle bearing that may have fallen into case during disassembly.

### MAINSHAFT DISASSEMBLY

1. Remove snap ring from front of output shaft and remove Second-Third synchronizer assembly and second gear. Mark hub and sleeve for correct assembly.

2. Remove snap ring and tabbed thrust washer from shaft and remove first gear and blocking ring.

3. Remove First-Reverse hub retaining snap ring.

**NOTE:** Observe position of spring and keys before removal, also, mark hub and sleeve for correct assembly.

4. Remove sleeve and gear, spring and three keys from hub (Fig. 7B-13B).

5. Using an arbor press, remove hub from output shaft.

### 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 may damage the race and balls.

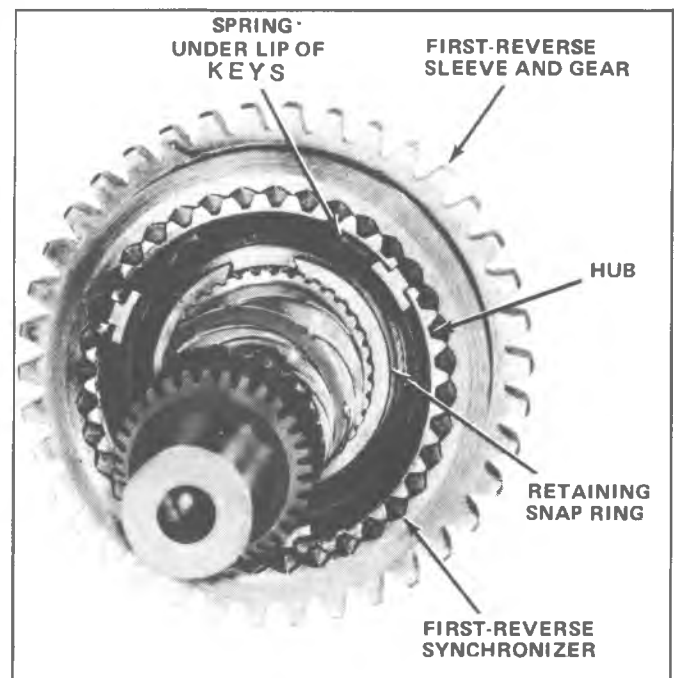


Fig. 7B-13B--First-Reverse Synchronizer Hub

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 countershaft 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.

### REPAIRS

#### Synchronizer Keys and Spring

##### Replacement

1. Mark hub and sleeve so they can be matched upon reassembly.

2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.

3. Install one spring into second-third hub. Be sure spring covers all three key slots in hub. Align second-third sleeve to hub using marks made during disassembly, and start sleeve onto hub.

4. Place the three keys into hub slots and on top of spring, then push sleeve fully onto hub to engage keys in sleeve (Fig. 7B-14B).

5. Install remaining spring in exact same position as first spring. Ends of both spring must cover same slots in hub and not be staggered.

**NOTE:** Keys have small lip on each end. When correctly installed, this lip will fit over spring (Fig. 7B-14B).

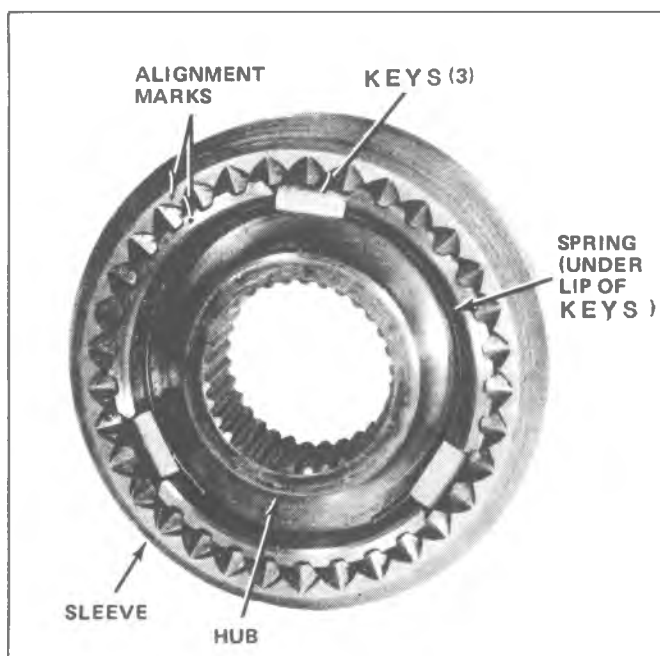


Fig. 7B-14B--Second-Third Synchronizer Assembly

### 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 (Fig. 7B-15B). 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. 7B-16B).

### 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-25233, or similar tool, until seal seats in its bore (Fig. 7B-17B).

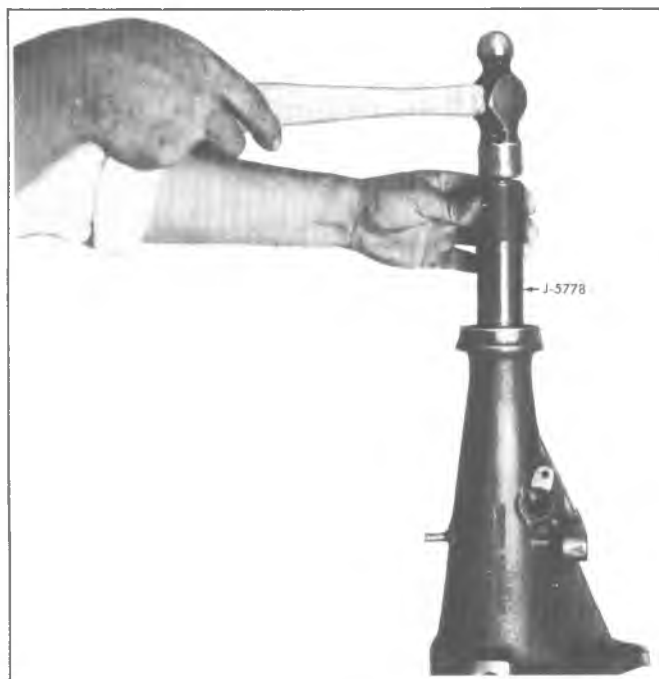


Fig. 7B-15B--Installing Extension Housing Bushing

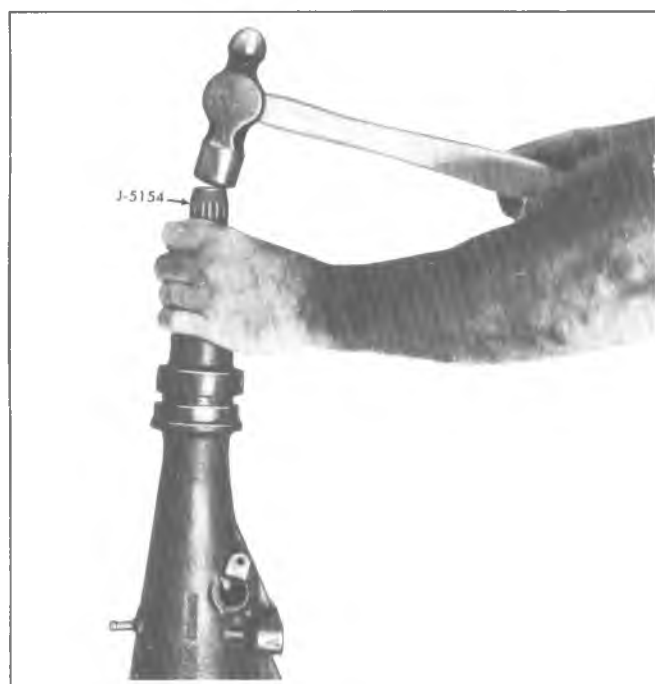


Fig. 7B-16B--Installing Extension Housing Seal

### ASSEMBLY OF MAINSHAFT

1. Install First-Reverse synchronizer hub on output shaft splines by hand. Slotted end of hub should face front of shaft. Use an arbor press to complete hub installation on shaft and install retaining snap ring (in most rearward groove).

**CAUTION:** *DO NOT attempt to drive hub onto shaft with hammer. Hammer blows will damage hub and splines.*

2. Install First-Reverse sleeve and gear half-way onto hub with gear end of sleeve facing rear of shaft. Index sleeve to hub with marks made during disassembly.



Fig. 7B-17B--Installing Clutch Bearing Retainer Seal

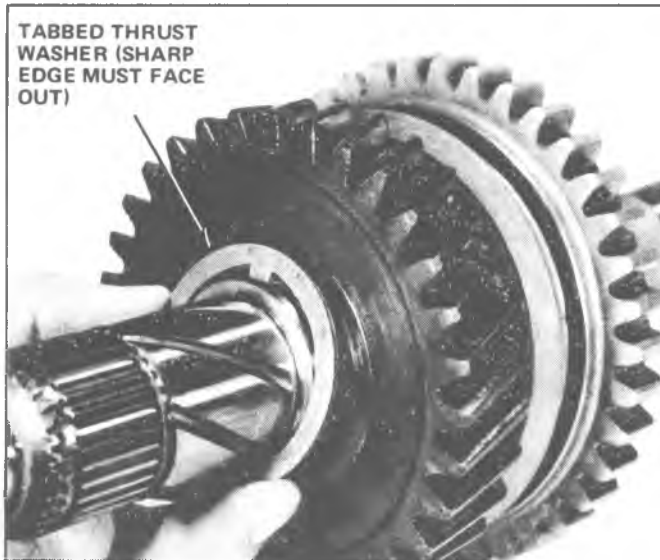


Fig. 7B-18B--Installing Tabbed Thrust Washer

3. Install spring in First-Reverse hub. (Make sure spring is bottomed in hub and covers all three key slots.) Position three synchronizer keys in hub, with small ends in hub slots and large ends inside hub. Push keys fully into hub so they seat on spring. Then slide First-Reverse sleeve and gear over keys until the keys engage in the synchronizer sleeve (Fig. 7B-13B).

4. Place first gear blocking ring on tapered surface of gear. Install First gear on output shaft. Rotate gear until notches in blocking ring engages keys in First-Reverse hub.

5. Install tabbed thrust washer (sharp edge facing out) and retaining snap ring on output shaft (Fig. 7B-18B).

6. Place second gear blocking ring on tapered surface of gear and install second gear on output shaft with tapered surface of gear facing front of output shaft (Fig. 7B-19B).

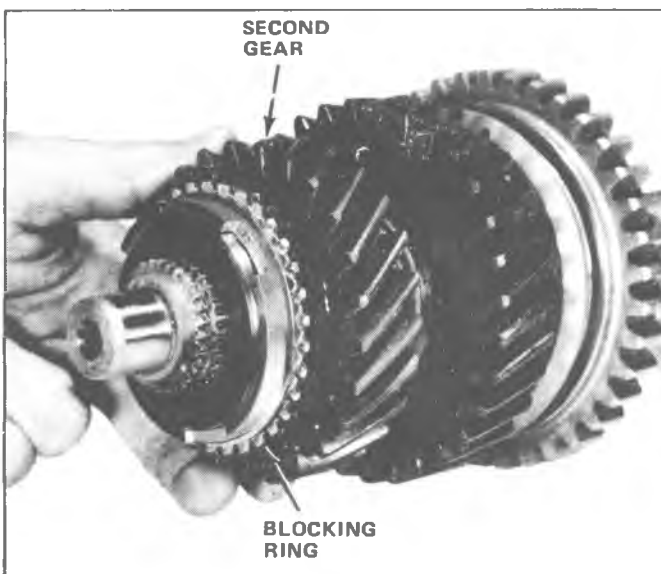


Fig. 7B-19B--Installing Second Gear

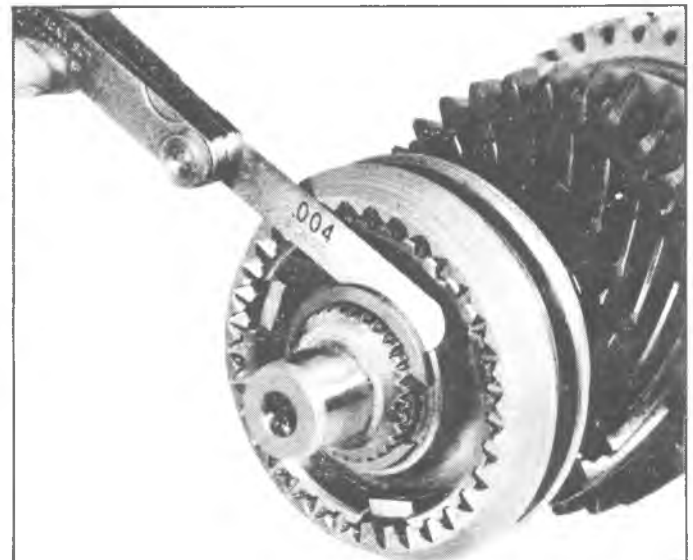


Fig. 7B-20B--Measuring Output Shaft End Play

7. Install Second-Third synchronizer assembly with flat portion of synchronizer hub facing rearward on output shaft. Rotate Second gear until notches in blocking ring engages keys in Second-Third synchronizer assembly.

**NOTE:** It may be necessary to tap synchronizer with a plastic hammer to ease assembly.

8. Install retaining snap ring on output shaft and measure end play between snap ring and Second-Third synchronizer hub with feeler gauge (Fig. 7B-20B). End play should be 0.004 to 0.0014 inch. If end play exceeds 0.014 inch, replace thrust washer and all snap rings on output shaft assembly.

## ASSEMBLY OF TRANSMISSION

1. Coat transmission case reverse idler gear thrust washer surfaces with Vaseline (or equivalent) and position thrust washer in case.

**NOTE:** Be sure to engage locating tabs on thrust washers in locating slots in case.

2. Install reverse idler gear with helical cut gear towards front of case. Align gear bore, thrust washers, case bores, and install reverse idler gear shaft from rear of case.

**NOTE:** Be sure to align and seat roll pin in shaft into counterbore in rear of case.

3. Measure reverse idler gear end play by inserting feeler gauge between thrust washer and gear. End play should be 0.004 to 0.018 inch. If end play exceeds 0.018 inch, remove idler gear and replace thrust washer.

4. Install shaft tool J-25232 in bore of countergear and load a row of needle bearing (25) in each end of gear. Use heavy grease or equivalent to hold them in place. Install one needle bearing retainer on each end of gear.

5. Position countergear thrust washer in case, use vaseline or equivalent to hold washers in place.

**NOTE:** Be sure to engage locating tabs on thrust washer in locating slots in case.

6. Insert countershaft into bore at rear of case just far enough to hold rear thrust washer from being displaced when the countergear is installed.

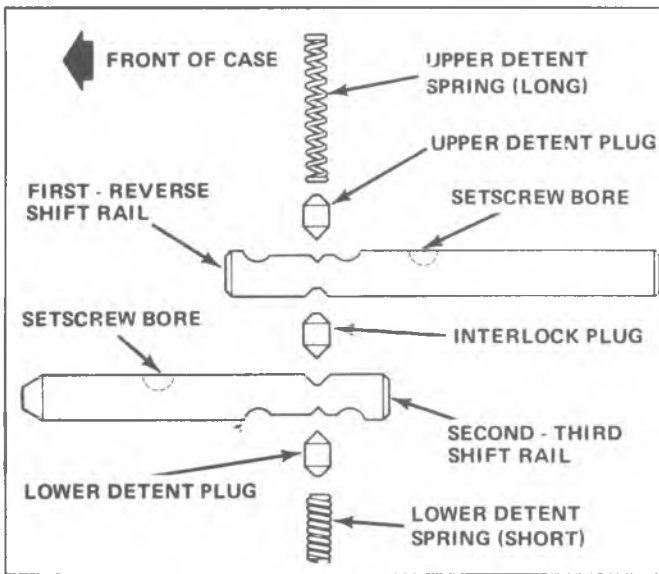


Fig. 7B-21B--Installation Sequence - Detent Plugs and Springs

7. Align bore in countergear with countershaft and front thrust washer, then start countershaft into countergear. Before countershaft is completely installed make sure that roll pin hole in countershaft is aligned with hole in case. When holes are aligned, tap countershaft into place, remove tool J-25232 (Fig. 7B-5B).

8. Measure countershaft end play by inserting feeler gauge between thrust washer and countergear. End play should be 0.004 to 0.018 inch. If end play exceeds 0.018 inch, remove gear and replace thrust washers.

9. After correct end play has been obtained, install roll pin in case.

10. Lower shorter detent spring in detent bore in case (Fig. 7B-21B). Allow spring to drop into place at bottom of Second-Third shift rail bore. Insert lower detent plug in detent bore on top of spring.

11. Install shifter fork shafts in their case bores with the pivot lug facing up.

**NOTE:** Shifter fork shafts are interchangeable.

12. Install (15) roller bearings in clutch shaft bore. Use vaseline (or equivalent) to hold bearings in place.

**CAUTION:** Do not use chassis grease or a similar "heavy" grease in clutch shaft bore. Heavy grease will plug the lubricant holes in the shaft and prevent proper lubrication of the roller bearing.

13. Install blocking ring on clutch gear and place clutch gear through top of case and position in front case bore.

14. Install output shaft assembly in case. Be sure First-Reverse sleeve and gear is in Neutral (centered) position on hub so gear end of sleeve will clear notch in top of case when output shaft assembly is installed.

15. Assemble the clutch gear to the output shaft.

16. Move Second-Third sleeve rearward to Second gear position and position Second-Third shifter fork in groove of sleeve. Be sure setscrew hold in shifter fork is facing up.

**NOTE:** Second-Third fork is the smaller of the two shifter forks.

17. Engage Second-Third shifter fork in shifter fork shaft and insert Second-Third shift rail through front case bore and into shifter fork.

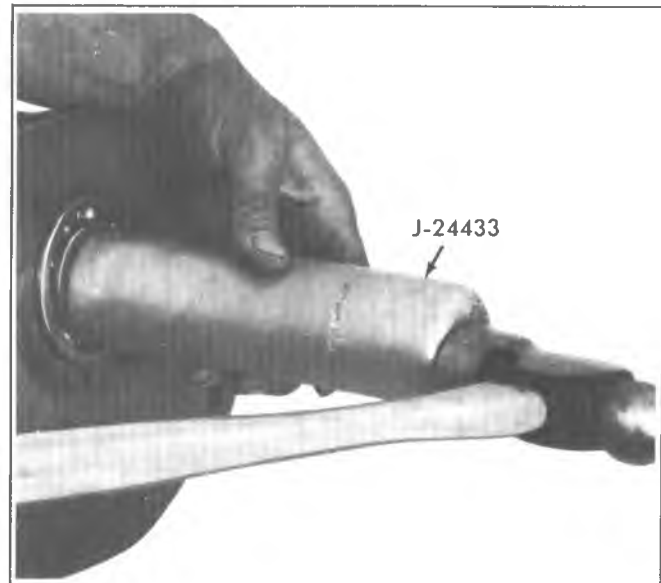


Fig. 7B-22B--Installing Front Bearing

**NOTE:** Tapered end of rail faces front of case.

18. Turn shift rail until detent notches in rail face bottom of case. Insert a phillips screwdriver in detent bore to depress lower detent plug and push shift rail into rear bore. Move rail inward until detent plug engages forward notch in shift rail (second gear position).

19. Secure fork to rail with setscrew and move second-third synchronizer to Neutral (centered) position.

20. Install interlock plug in detent bore. With Second-Third synchronizer in Neutral position, top of plug will be slightly below surface of First-Reverse shift rail bore.

21. Move first reverse synchronizer forward to first gear position. Place First-Reverse shifter fork in groove of sleeve. Be sure setscrew hole in fork is facing up. Rotate fork into position in case, engage fork in shifter fork shaft, and insert First-Reverse shift rail through rear case bore and shifter fork.

22. Turn shift rail until detent notches in rail face

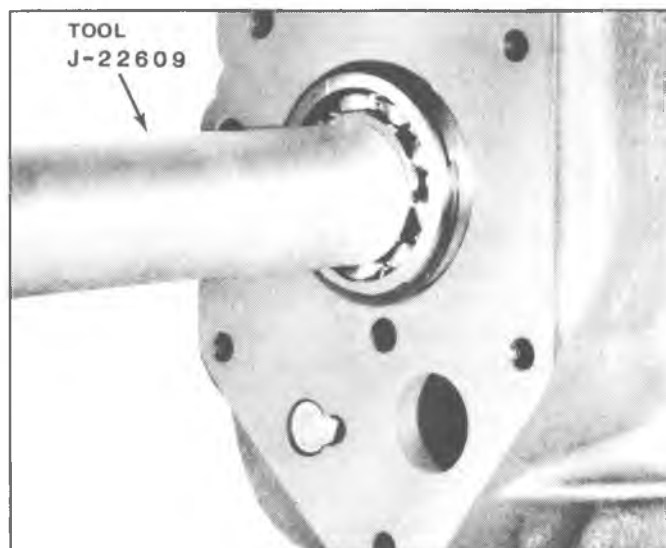


Fig. 7B-23B--Installing Rear Bearing

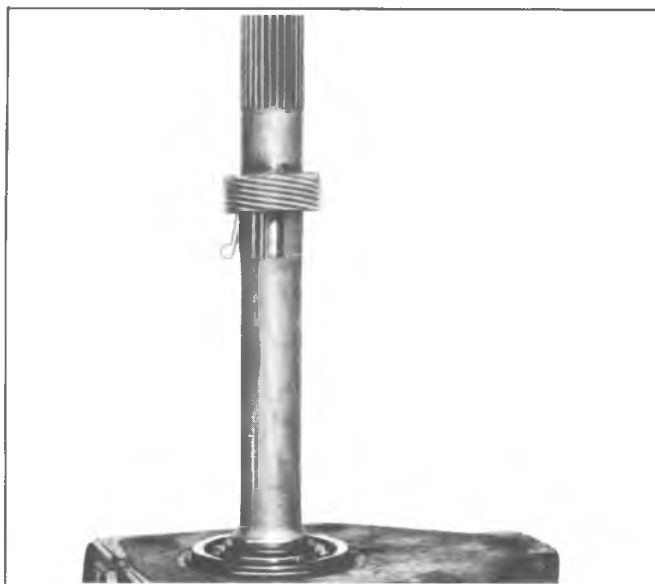


Fig. 7B-24B--Installing Speedometer Retainer and Gear

upward. Move rail inward until setscrew hole in fork and setscrew bore in shift rail are aligned. Secure fork to rail with setscrew and place First Reverse sleeve and gear into Neutral (centered) position (Fig. 7B-20B).

23. Install large snap ring on front bearing.

24. Install front bearing on clutch gear shaft by hand drive bearing on clutch gear shaft using tool J-24433 (Fig. 7B-22B).

25. Install smaller snap ring on clutch gear shaft.

26. Position bearing retainer gasket on case. Be sure cut-out in gasket is aligned with oil return hole in case.

27. Install front bearing retainer and tighten attaching bolts to 30 to 36 foot-pounds of torque. Be sure to index cap to case with alignment marks, and that oil return slot in cap is aligned with oil return hole in case.

28. Install large snap ring on rear bearing.

29. Install rear bearing on output shaft by hand. Drive bearing onto shaft and into case with tool J-22609, make sure snap ring groove is facing rear of shaft (Fig. 7B-23B).

30. Install smaller snap ring on output shaft to hold rear bearing in place.

31. Engage speedometer gear retainer in hole provided in output shaft, with retainer loop forward, slide speedometer gear over output shaft and into position (Fig. 7B-24B).

32. Position extension housing gasket on case and install extension housing to case. Tighten bolts to 42 to 50 foot pounds torque.

33. Install expansion plug in Second-Third shift rail bore in front of case. Be sure plug is fully seated in bore and is approximately 1/16 inch below front face of case.

34. Install upper detent plug in detent bore, then install long detent spring on top of plug. Install transmission fill plug and tighten 10 to 20 foot pounds torque.

35. Install top cover and gasket on case and secure with attaching bolts. Tighten bolts 20 to 25 foot pounds torque.

## 4-SPEED 76MM TRANSMISSION

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### DISASSEMBLY OF TRANSMISSION (Fig. 7B-1J)

1. Remove side cover attaching bolts and remove side cover assembly.

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 screwdriver or other suitable tool can be inserted between bearing, large snap ring and case to complete removal (Fig. 7B-2J). 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 clutch gear, mainshaft and extension assembly together through the rear case opening (Fig. 7B-3J).

6. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (Fig. 7B-4J) 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 counter gear bore. Remove the gear and bearings (Fig. 7B-5J).

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. 7B-6J).

### 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 (Fig. 7B-7J).

2. Depress speedometer retaining clip and slide gear from mainshaft.

3. Remove rear bearing snap ring from mainshaft groove (Fig. 7B-8J).

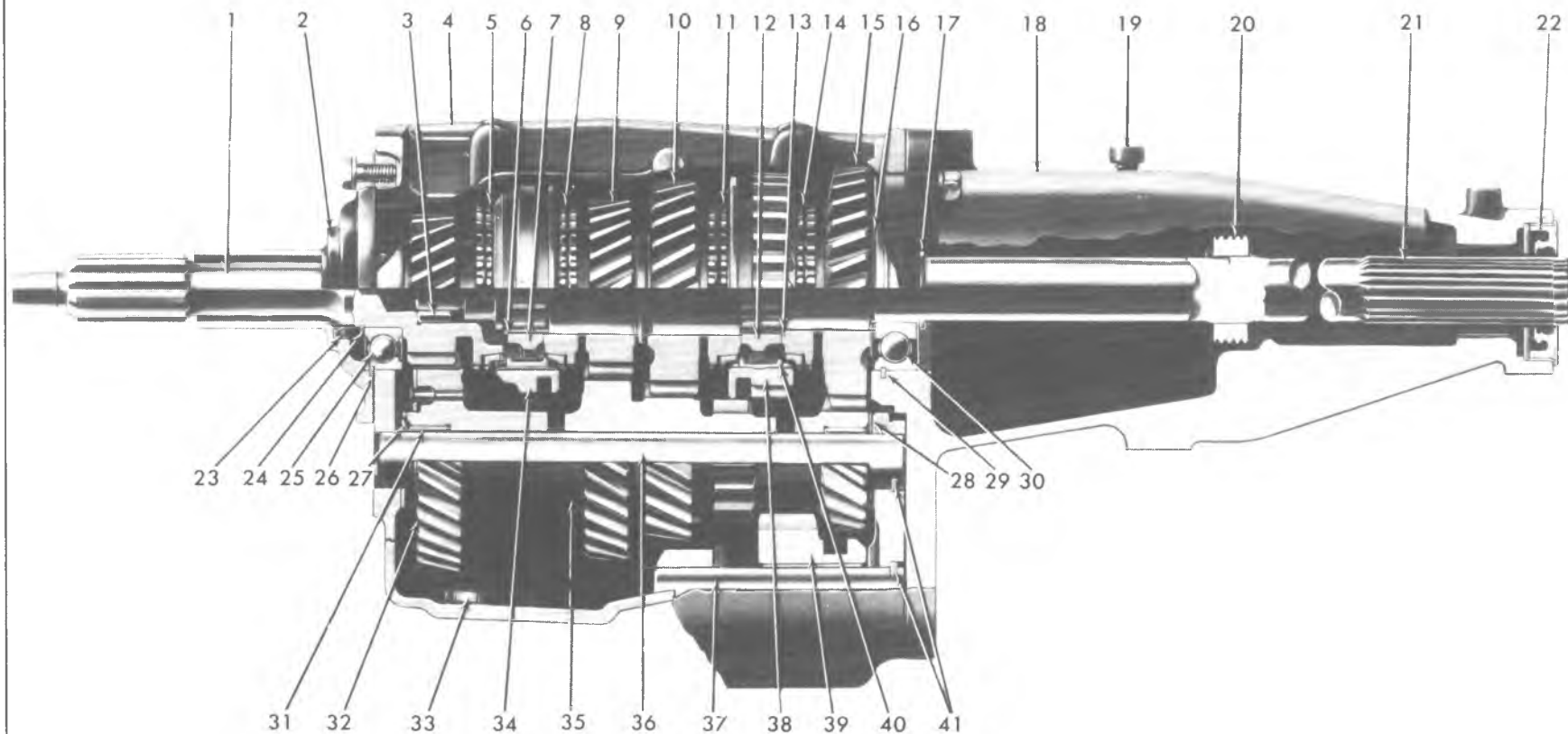


Fig. 7B-1J-4-Speed 76mm Transmission Cross Section

- |                           |  |                                     |                                    |  |
|---------------------------|--|-------------------------------------|------------------------------------|--|
| 1. Drive Gear             | 11. 2nd Speed Blocker Ring                 | 18. Extension                       | 27. Thrust Washer-Front            | 35. Countergear Assembly                     |
| 2. Bearing Retainer       | 12. 1-2 Speed Synch. Hub                   | 19. Vent                            | 28. Thrust Washer-Rear             | 36. Counter Shaft                            |
| 3. Pilot Bearings         | 13. 1-2 Speed Synch. Snap Ring             | 20. Speedometer Drive Gear and Clip | 29. Snap Ring-Bearing to Extension | 37. Reverse Idler Shaft                      |
| 4. Case                   | 14. 1st Speed Blocker Ring                 | 21. Mainshaft                       | 30. Rear Bearing                   | 38. 1-2 Speed Synch. Sleeve and Reverse Gear |
| 5. 4th Speed Blocker Ring | 15. First Gear                             | 22. Rear Oil Seal                   | 31. Countergear Roller Bearings    | 39. Reverse Idler Gear (Sliding)             |
| 6. 4-3 Synch. Snap Ring   | 16. Reverse Gear Thrust and Spring Washers | 23. Retainer Oil Seal               | 32. Anti-Lash Plate Assembly       | 40. Clutch Key                               |
| 7. 4-3 Synch. Hub         | 17. Snap Ring-Bearing to Mainshaft         | 24. Snap Ring-Bearing to Gear       | 33. Magnet                         | 41. Woodruff Key                             |
| 8. 3rd Speed Blocker Ring |  | 25. Drive Gear Bearing              | 34. 4-3 Synch. Sleeve              |  |
| 9. 3rd Speed Gear         |  | 26. Snap Ring-Bearing to Case       |                                    |  |
| 10. 2nd Speed Gear        |  |                                     |                                    |  |

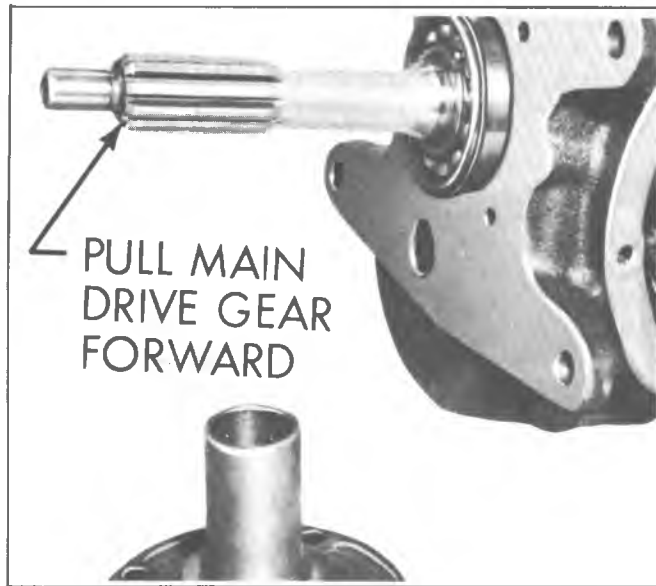


Fig. 7B-2J--Removing Clutch Gear Bearing



Fig. 7B-5J--Removing Countershaft

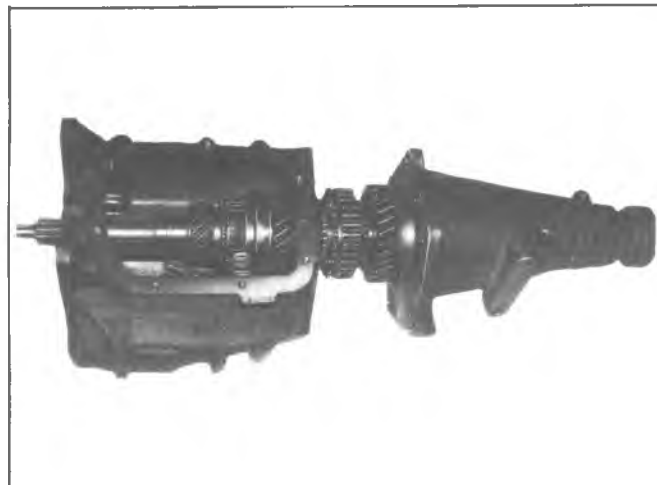


Fig. 7B-3J--Removing Clutch Gear and Mainshaft

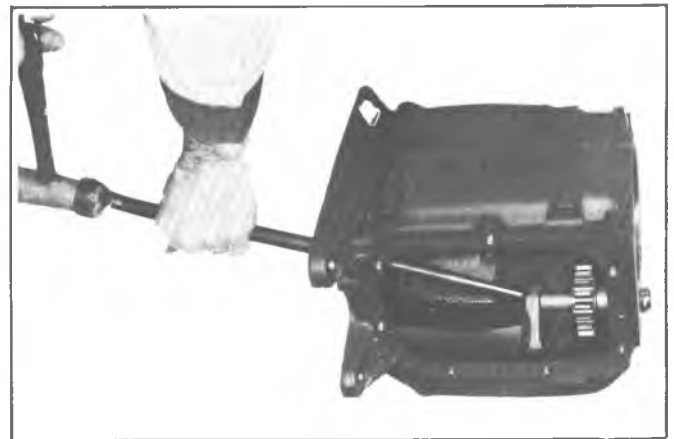


Fig. 7B-6J--Removing Reverse Idler Gear Shaft

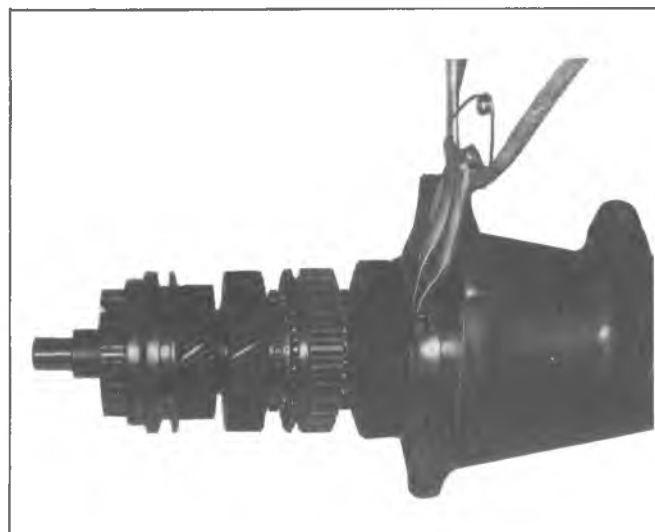


Fig. 7B-4J--Removing Extension to Rear Bearing Snap Ring

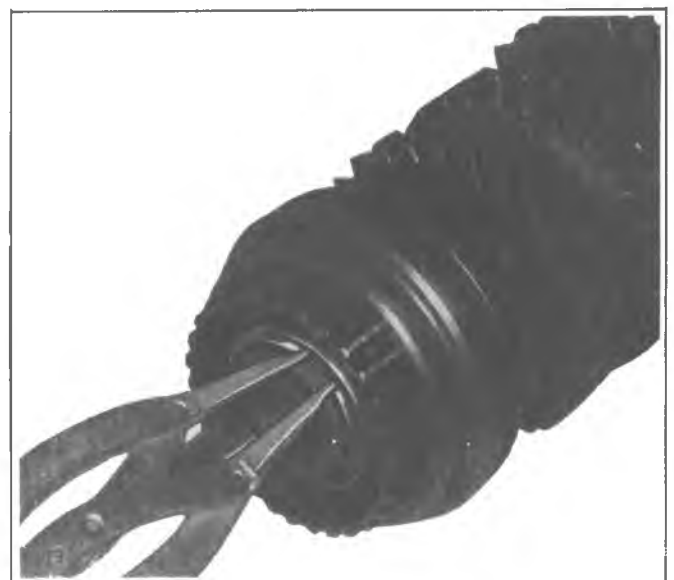


Fig. 7B-7J--Removing 3rd and 4th Synchronizer Snap Ring





Fig. 7B-8J--Rear Bearing to Mainshaft Snap Ring

4. Support first gear with press plates and press on rear of mainshaft to remove first gear, thrust washer, spring washer and rear bearing from rear of mainshaft (Fig. 7B-9J).

5. Remove the 1st and 2nd sliding clutch hub snap ring from the mainshaft and remove the clutch assembly, 2nd speed blocker ring and 2nd speed gear from the rear of the mainshaft (Fig. 7B-10J).

## 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.

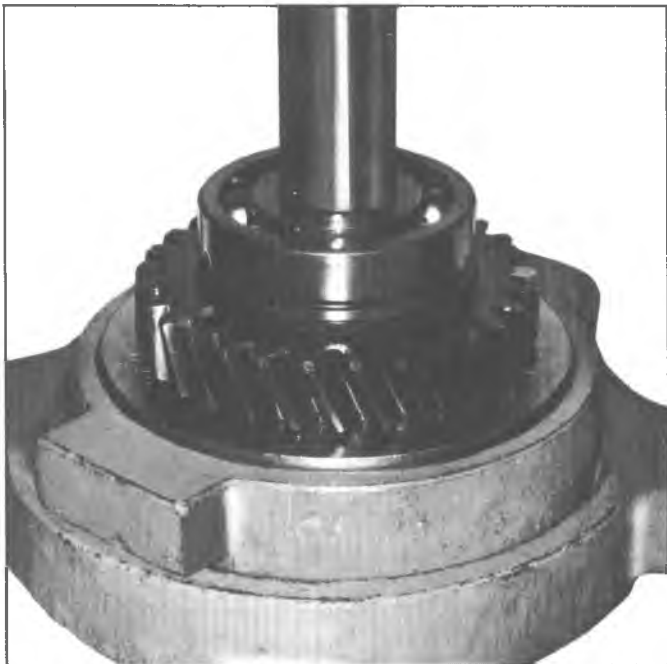


Fig. 7B-9J--Removing Rear Bearing and 1st Speed Gear

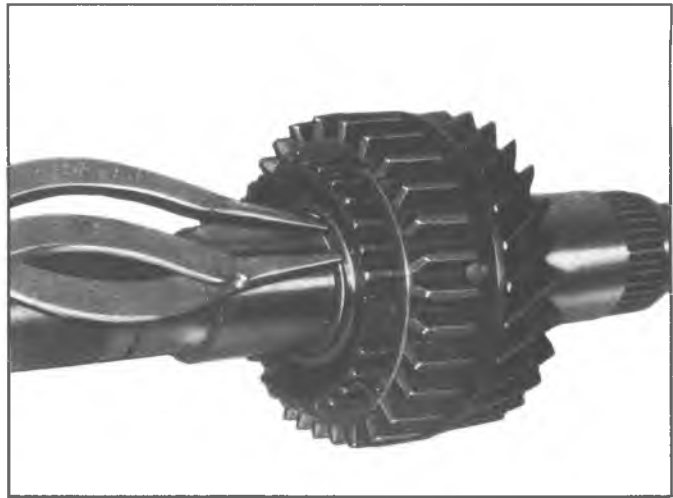


Fig. 7B-10J--Removing 1st and 2nd Synchronizer Snap Ring

## 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 may 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.

## REPAIRS

### Clutch Keys and Springs

**NOTE:** The clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

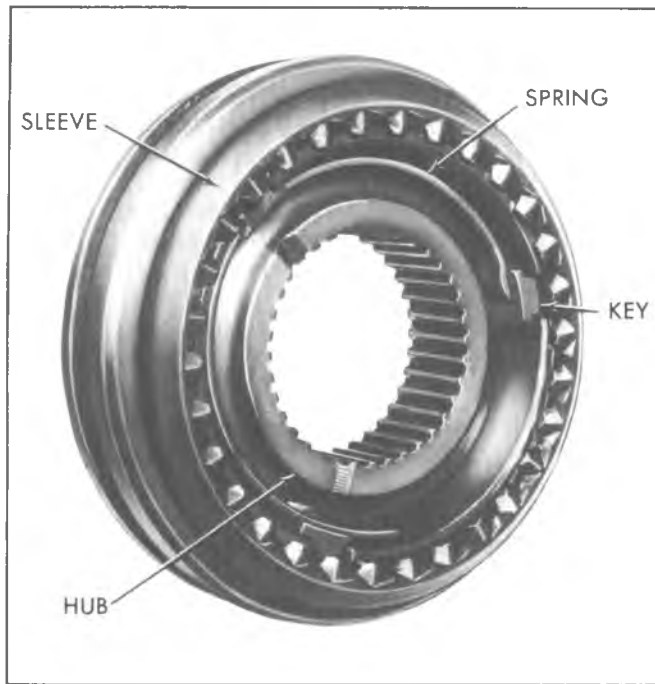


Fig. 7B-11J--3-4 Synchronizer Assembly

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. 7B-11J). 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, for the 3-4 synchronizer. However, for the 1-2 synchronizer, the groove is at the same end as the fork slot. This groove indicates the end of the hub with a 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. 7B-12J). 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. 7B-13J).

### 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. 7B-14J and 7B-15J).

**NOTE:** Lip of seal must face rear of bearing retainer.

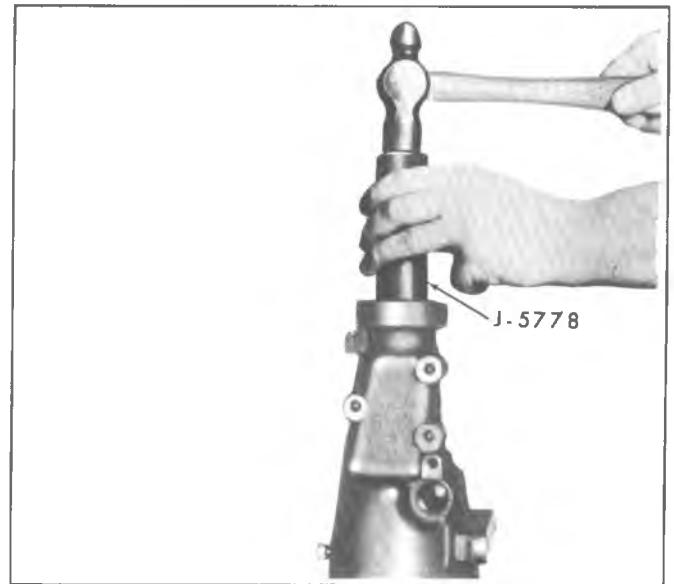


Fig. 7B-12J--Extension Bushing Replacement

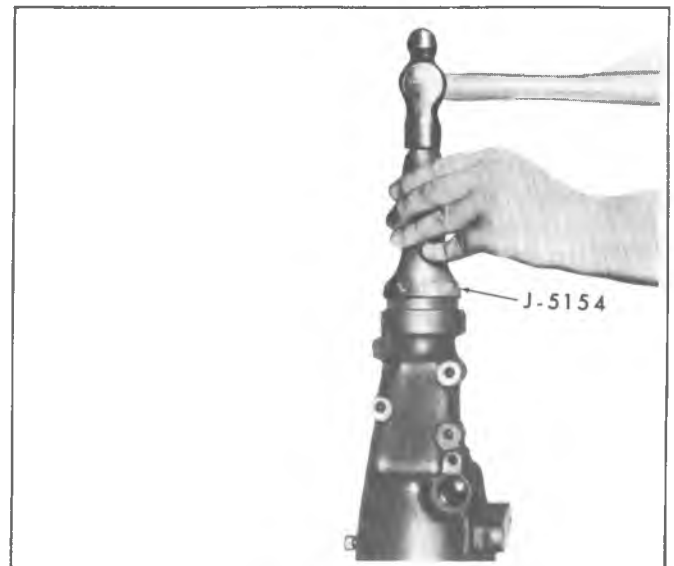


Fig. 7B-13J--Installing Extension Oil Seal



Fig. 7B-14J--Removing Bearing Retainer Oil Seal

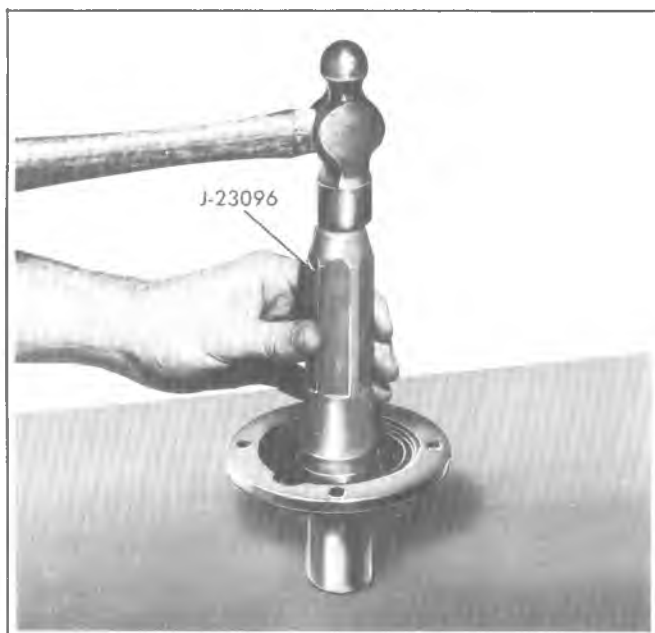


Fig. 7B-15J--Installing Bearing Retainer Oil Seal

**ASSEMBLY OF MAINSHAFT (Fig. 7B-16J)**

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 on the mainshaft until it bottoms out against flange.

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

4. Install synchronizer hub to mainshaft snap ring (Fig. 7B-7J). 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 downwards.

8. Install synchronizer hub to mainshaft snap ring (Fig. 7B-10J).

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).

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

12. Install first gear spring washer.

13. Install rear ball bearing with snap ring slot downward; press onto mainshaft (Fig. 7B-17J).

14. Install rear bearing to mainshaft snap ring (Fig. 7B-8J).

15. Install speedometer drive gear and clip.

This completes the assembly of the mainshaft.

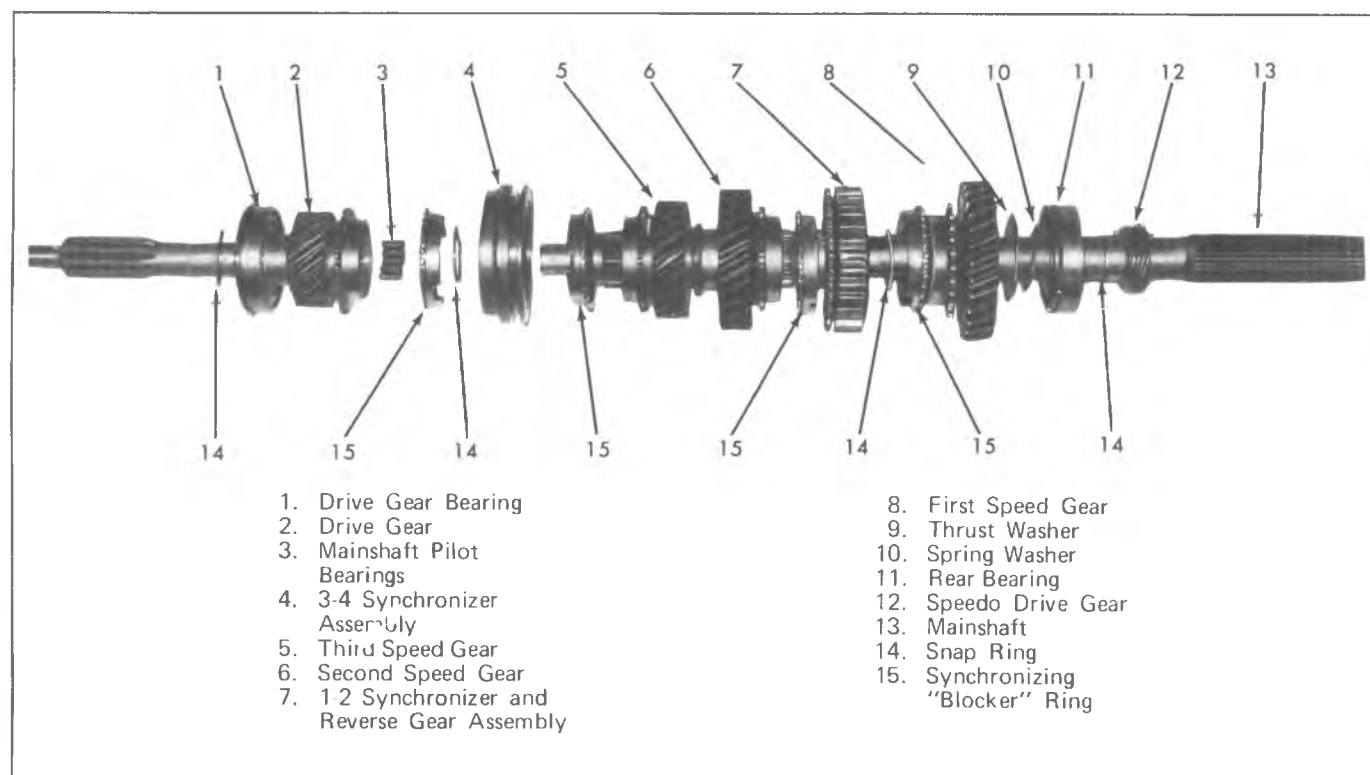


Fig. 7B-16J--Clutch Gear and Mainshaft Details



Fig. 7B-17J—Installing Rear Bearing

#### ASSEMBLY OF TRANSMISSION (Fig. 7B-18J)

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. 7B-19J).

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. 7B-4J).

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. 7B-20J).

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.

9. Install front bearing outer snap ring to bearing and position bearing over stem of drive gear and into front case bore.

10. Install snap ring to drive gear stem, and drive gear bearing retainer and gasket to case.

**NOTE:** The retainer oil return hole should be at the bottom.

11. Shift synchronizer sleeves to neutral positions and install cover, gasket and fork assembly to case. Be sure forks align with their synchronizer sleeve grooves.

12. Tighten all bolts to specified torque.

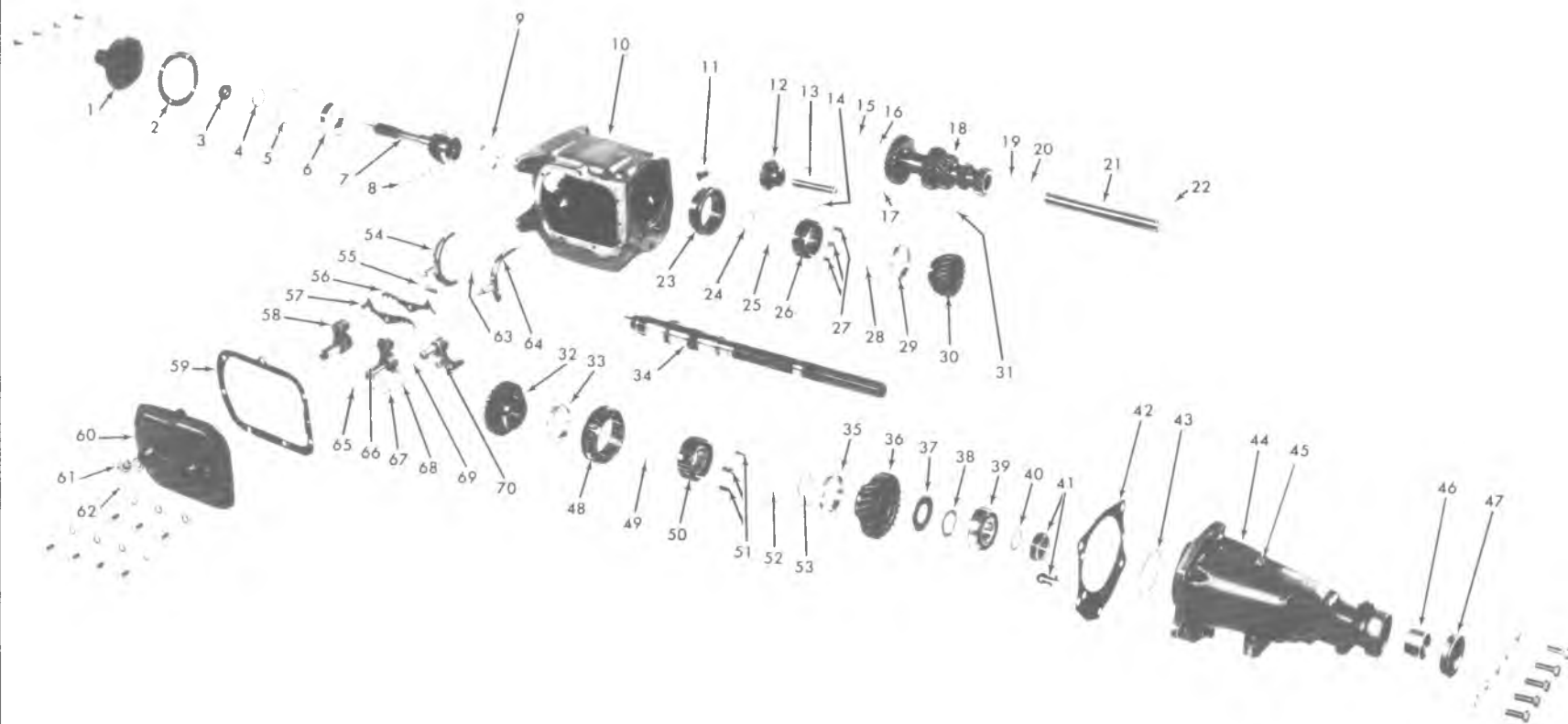


Fig. 7B-18J-4-Speed 76mm Transmission-Exploded View

- |                               |                              |                                |  |                                    |
|-------------------------------|------------------------------|--------------------------------|--|------------------------------------|
| 1. Bearing Retainer           | 15. Thrust Washer-Front Gear | 29. 3rd Speed Blocker Ring     | 42. Gasket-Extension to Case                 | 55. Detent Spring                  |
| 2. Gasket-Retainer to Case    | 16. Needle Retainer Washer   | 30. 3rd Speed Gear             | 43. Snap Ring-Extension to Rear Bearing      | 56. 3-4 Detent Cam                 |
| 3. Oil Seal                   | 17. Needle Bearings          | 31. Needle Bearings            | 44. Extension                                | 57. 1-2 Detent Cam                 |
| 4. Snap Ring-Bearing to Shaft | 18. Countergear              | 32. Second Speed Gear          | 45. Vent                                     | 58. 3-4 Shifter Shaft              |
| 5. Snap Ring-Bearing to Case  | 19. Needle Retainer Washer   | 33. 2nd Speed Blocker Ring     | 46. Bushing                                  | 59. Gasket-Cover to Case           |
| 6. Drive Gear Bearing         | 20. Thrust Washer-Rear Gear  | 34. Mainshaft                  | 47. Oil Seal                                 | 60. Cover                          |
| 7. Drive Gear                 | 21. Countershaft             | 35. 1st Speed Blocker Ring     | 48. 1-2 Synchronizer Sleeve and Reverse Gear | 61. TCS Switch and Gasket          |
| 8. Mainshaft Pilot Bearings   | 22. Woodruff Key             | 36. First Speed Gear           | 49. Key Retainer                             | 62. Lipseal                        |
| 9. 4th Speed Blocker Ring     | 23. Synchronizer Sleeve      | 37. Thrust Washer              | 50. 1-2 Synchronizer Hub                     | 63. Detent Cam Retainer            |
| 10. Case                      | 24. Snap Ring-Hub to Shaft   | 38. Wave Washer                | 51. Clutch Keys                              | 64. 1-2 Shift Fork                 |
| 11. Filler Plug               | 25. Key Retainer             | 39. Rear Bearing               | 52. Key Retainer                             | 65. "O" Ring                       |
| 12. Reverse Idler Gear        | 26. 3-4 Synchronizer Hub     | 40. Snap Ring-Bearing to Shaft | 53. Snap Ring-Hub to Shaft                   | 66. 1-2 Shift Shaft                |
| 13. Reverse Idler Shaft       | 27. Clutch Keys              | 41. Speedo Drive Gear and Clip | 54. 3-4 Shift Fork                           | 67. Spring                         |
| 14. Woodruff Key              | 28. Key Retainer             |                                |  | 68. Ball                           |
|                               |                              |                                |  | 69. "O" Ring                       |
|                               |                              |                                |  | 70. Reverse Shifter Shaft and Fork |

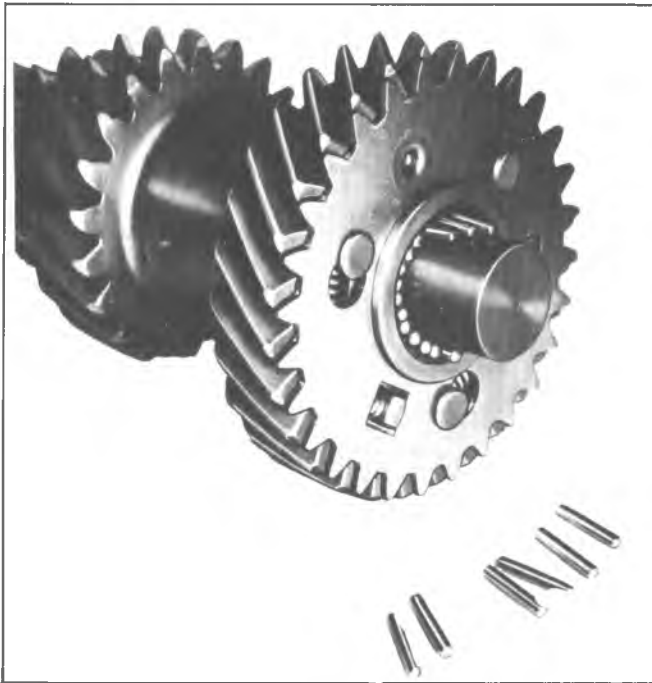


Fig. 7B-19J--Loading Countergear Bearing



Fig. 7B-20J--Loading Mainshaft Bearings

## 4-SPEED 83MM TRANSMISSION

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### DISASSEMBLY OF TRANSMISSION

**NOTE:** Sectional and exploded view of the transmission are provided in Figures 7B-1K and 7B-2K to assist in the disassembly of the transmission.

1. Thoroughly clean the exterior of the transmission assembly.
2. Shift transmission into second gear, remove drain plug from lower right of case and drain lubricant from transmission.
3. Remove nine (9) shift cover attaching bolts, cover assembly and gasket. Remove both shift forks.
4. Remove four (4) drive gear bearing retainer bolts, retainer and gasket from front of transmission.
5. Remove lock pin from reverse shifter lever boss (Fig. 7B-3K) and pull shifter shaft partially out to disengage the reverse shifter fork from the reverse gear.
6. Remove five (5) rear extension attaching bolts, tap extension rearward with a soft hammer to start removal. Slide extension rearward until reverse idler shaft is clear of reverse idler gears. Then rotate extension to the left to free shift fork from collar of reverse gear and remove the case extension. Remove and discard gasket.

7. Remove speedometer gear outer snap ring (Fig. 7B-4K). Tap or slide speedometer gear from mainshaft, then remove second snap ring.

8. Slide the reverse gear from the mainshaft (Fig. 7B-5K), and slide the rear portion of the reverse idler gear from the transmission case.

9. Remove four (4) front bearing retainer bolts, gasket, and front bearing retainer from case.

10. Remove front bearing snap ring selective fit snap ring and spacer washer.

11. Using Tool J-6654-01, remove front main drive gear bearing from transmission case (Fig. 7B-6K).

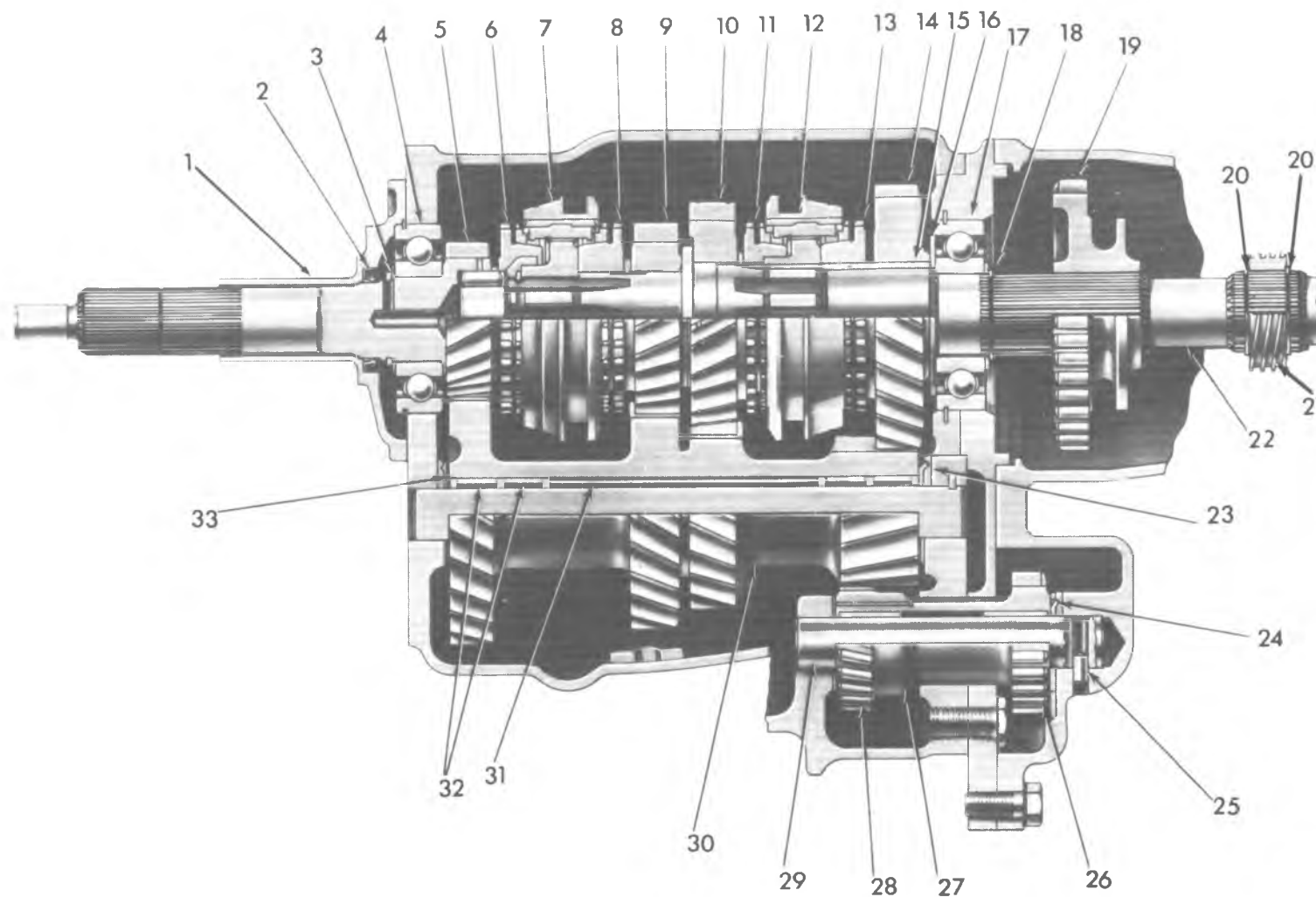
12. Remove the rear retainer lock bolt.

13. Shift first-second and third-fourth clutch sliding sleeves forward to permit adequate clearance for mainshaft removal. Remove mainshaft and rear bearing retainer assembly from the transmission case.

14. Remove front reverse idler gear and thrust washer from case.

**NOTE:** Gear teeth face toward front of transmission.

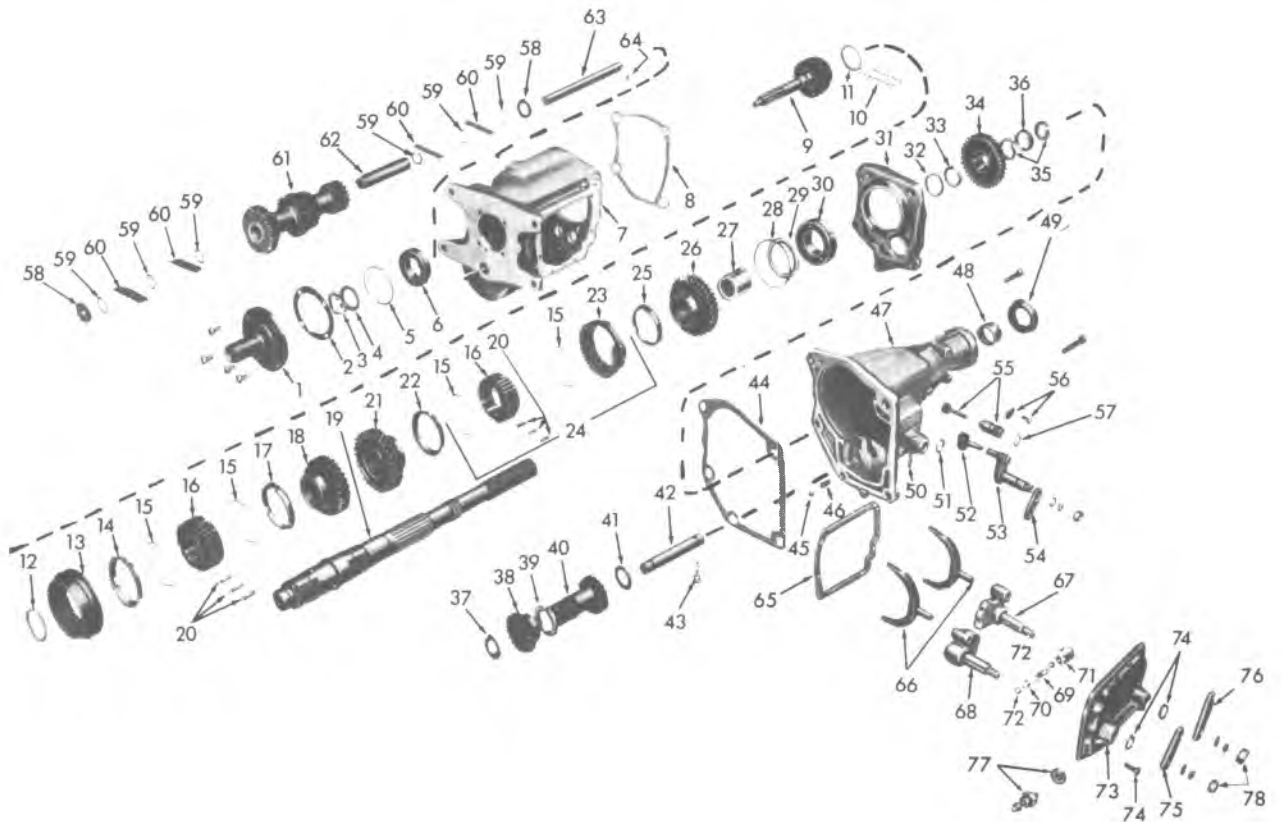
15. Using a dummy shaft J-24658 drive countergear shaft out of countergear (Fig. 7B-7K) and remove



- |                                |                                 |                                |
|--------------------------------|---------------------------------|--------------------------------|
| 1 Clutch Gear Bearing Retainer | 12 1st & 2nd Speed Clutch Assy. | 23 Thrust Washer               |
| 2 Retainer Lip Seal            | 13 1st Speed Synchro Ring       | 24 Thrust Washer               |
| 3 Snap Ring and Washer         | 14 1st Speed Gear               | 25 Idler Shaft Roll Pin        |
| 4 Clutch Gear Bearing          | 15 1st Speed Gear Bushing       | 26 Rear Idler Gear             |
| 5 Clutch Gear                  | 16 Spacer                       | 27 Spacer                      |
| 6 4th Speed Synchronizer Ring  | 17 Rear Main Bearing            | 28 Front Idler Gear            |
| 7 3rd & 4th Speed Clutch Assy. | 18 Snap Ring and Washer         | 29 Reverse Idler Shaft         |
| 8 3rd Speed Synchronizer Ring  | 19 Reverse Gear                 | 30 Countergear                 |
| 9 3rd Speed Gear               | 20 Snap Rings                   | 31 Countergear Sleeve          |
| 10 2nd Speed Gear              | 21 Speedometer Gear             | 32 Countergear Bearing Rollers |
| 11 2nd Speed Synchronizer Ring | 22 Mainshaft                    | 33 Thrust Washers              |

Fig. 7B-1K--Sectional View of 4-Speed 83mm Transmission





- |  |  |  |  |
|--|--|--|--|
| 1. Bearing Retainer                              | 23. First and Second Speed Clutch Sliding Sleeve | 44. Rear Bearing Retainer To Case Extension Gasket | 63. Countershaft   |
| 2. Gasket  | 24. First and Second Speed Clutch Assembly       | 45. Reverse Shifter Shaft Detent Ball              | 64. Countershaft Woodruff Key                                  |
| 3. Selective Fit Snap Ring                       | 25. First Speed Gear Synchronizing Ring          | 46. Reverse Shifter Shaft Ball Detent Spring       | 65. Gasket   |
| 4. Spacer Washer                                 | 26. First Speed Gear                             | 47. Case Extension                                 | 66. Forward Speed Shift Forks                                  |
| 5. Bearing Snap Ring                             | 27. First Speed Gear Sleeve                      | 48. Extension Bushing                              | 67. First and Second Speed Gear Shifter Shaft and Detent Plate |
| 6. Main Drive Gear Bearing                       | 28. Rear Bearing Snap Ring                       | 49. Rear Oil Seal                                  | 68. Third and Fourth Speed Gear Shifter Shaft and Detent Plate |
| 7. Transmission Case                             | 29. Thrust Washer                                | 50. Reverse Shifter Shaft Lock Pin                 | 69. Poppet Spring  |
| 8. Rear Bearing Retainer Gasket                  | 30. Rear Bearing                                 | 51. Reverse Shifter Shaft "O" Ring Seal            | 70. Interlock Pin  |
| 9. Main Drive Gear                               | 31. Rear Bearing Retainer                        | 52. Reverse Shift Fork                             | 71. Interlock Sleeve   |
| 10. Bearing Rollers (16)                         | 32. Washer                                       | 53. Reverse Shifter Shaft and Detent Plate         | 72. Detent Balls   |
| 11. Washer                                       | 33. Selective Fit Snap Ring                      | 54. Reverse Shifter Lever                          | 73. Transmission Side Cover                                    |
| 12. Snap Ring                                    | 34. Reverse Gear                                 | 55. Speedometer Driven Gear and Fitting            | 74. Lip Seals  |
| 13. Third and Fourth Speed Clutch Sliding Sleeve | 35. Snap Ring                                    | 56. Retainer and Bolt                              | 75. Third and Fourth Speed Shifter Lever                       |
| 14. Fourth Speed Gear Synchronizing Ring         | 36. Speedometer Drive Gear                       | 57. "O" Ring Seal                                  | 76. First and Second Speed Shifter Lever                       |
| 15. Clutch Key Spring                            | 37. Reverse Idler Front Thrust Washer (Flat)     | 58. Washer (Tanged)                                | 77. T.C.S. Switch and Gasket                                   |
| 16. Clutch Hub                                   | 38. Reverse Idler Gear (Front)                   | 59. Spacer (.050")                                 | 78. Lever Attaching Nuts                                       |
| 17. Third Speed Gear Synchronizing Ring          | 39. Snap Ring                                    | 60. Bearing Rollers (28)                           |  |
| 18. Third Speed Gear                             | 40. Reverse Idler Gear (Rear)                    | 61. Countergear                                    |  |
| 19. Mainshaft                                    | 41. Thrust Washer (Tanged)                       | 62. Countergear Roller Spacer                      |  |
| 20. Clutch Keys (3)                              | 42. Reverse Idler Shaft                          |  |  |
| 21. Second Speed Gear                            | 43. Reverse Idler Shaft Lock Pin and Welch Plug  |  |  |
| 22. Second Speed Gear Synchronizing Ring         |  |  |  |

Fig. 7B-2K--Exploded View of 4-Speed 83mm Transmission

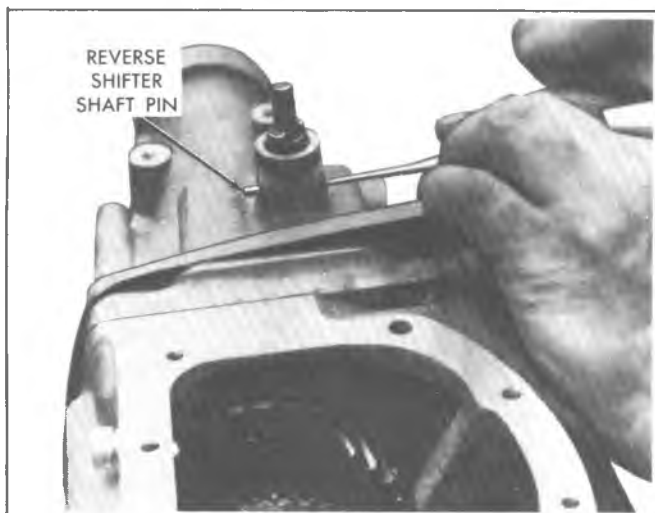


Fig. 7B-3K--Removing Reverse Shifter Shaft Lock Pin

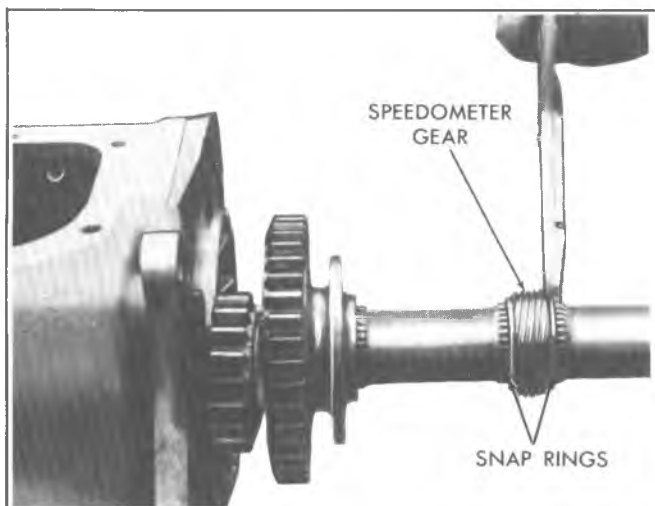


Fig. 7B-4K--Speedometer Gear and Retaining Rings

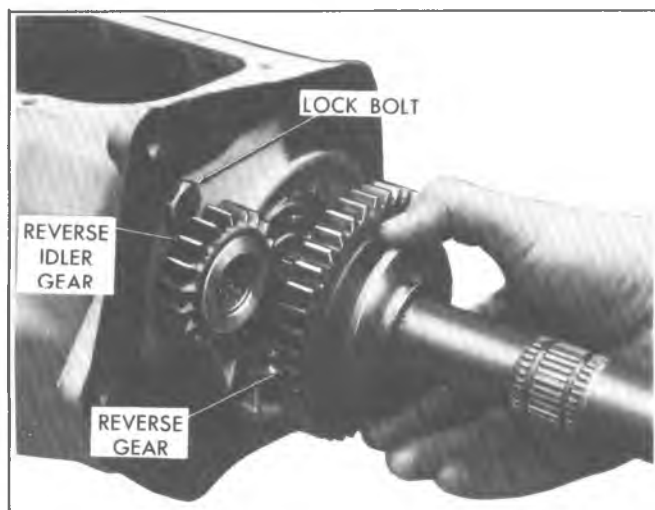


Fig. 7B-5K--Removing Reverse Gear

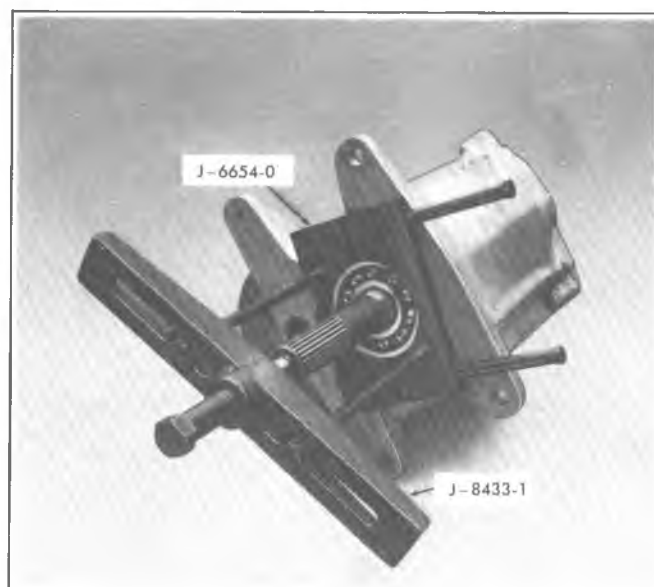


Fig. 7B-6K--Removing Main Drive Gear Bearing

countergear and tanged thrust washers from case. Check bottom of case for pilot bearings or other loose components.

#### DISASSEMBLY OF MAINSHAFT (Fig. 7B-8K)

1. Using snap ring pliers, remove 3-4 clutch assembly retaining ring at front of mainshaft (Fig. 7B-9K). Slide washer, synchronizer and clutch assembly, synchronizer ring 3rd speed gear from mainshaft.
2. Spread rear bearing retainer snap ring (Fig. 7B-10K) and slide retainer from mainshaft.
3. Remove rear bearing-to-mainshaft snap ring (Fig. 7B-11K).
4. Support mainshaft under 2nd gear and press mainshaft from rear bearing, 1st gear and sleeve, 1-2 clutch and synchronizer assembly, and the second gear (Fig. 7B-12K).

#### 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.

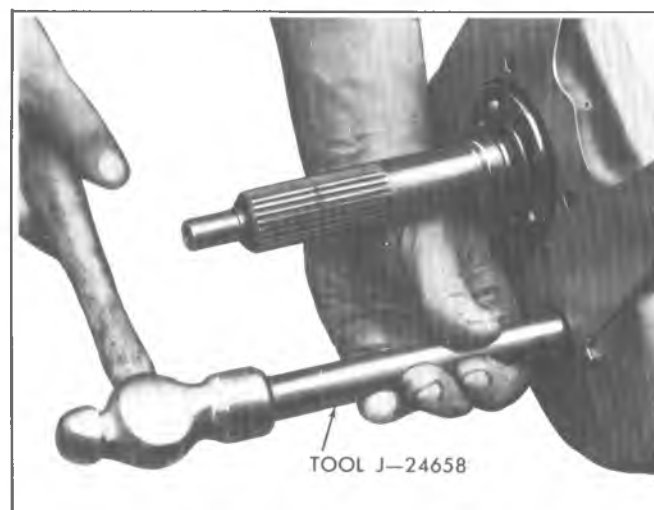


Fig. 7B-7K--Removing Countergear Shaft

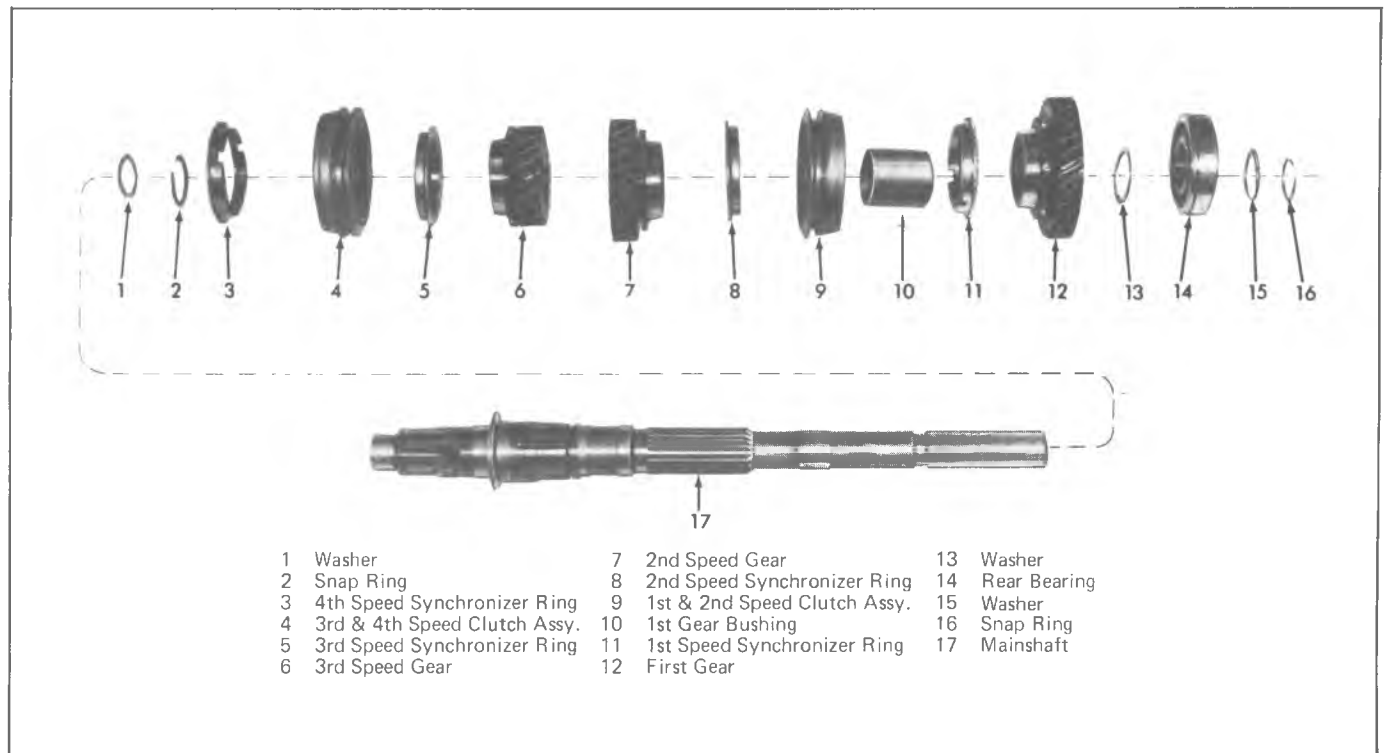


Fig. 7B-8K--Mainshaft Assembly Components

3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

### Roller Bearings and Spacers

All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft and reverse idler shaft at the same time, replace if necessary. Replace all worn spacers.

### 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 (reverse gear bushing is not serviced separately).

3. Check both clutch sleeves to see that they slide freely on their hubs.

### Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.

2. Blow out bearings with compressed air.



Fig. 7B-9K--Removing 3-4 Clutch Assembly Retainer

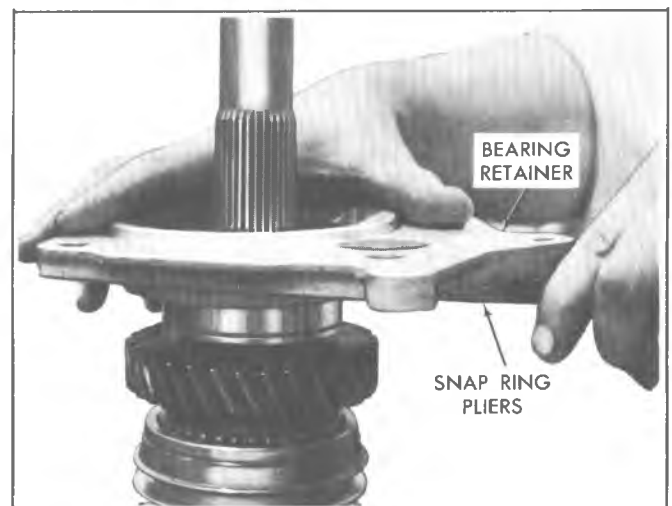


Fig. 7B-10K--Removing Rear Bearing Retainer

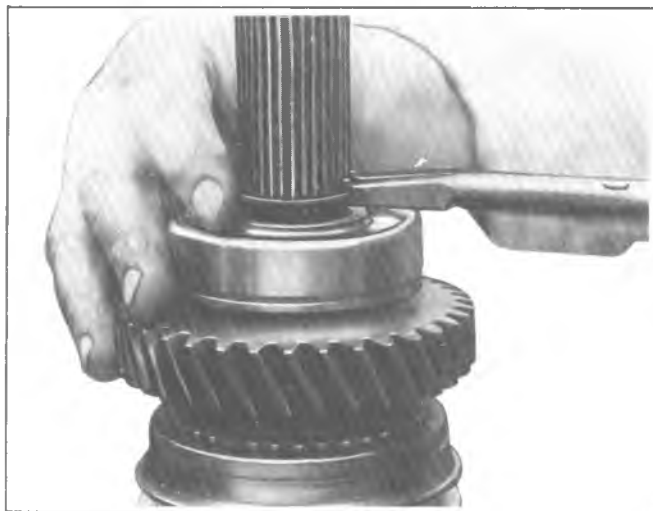


Fig. 7B-11K--Removing Rear Bearing Snap Ring

**CAUTION:** Do not allow the bearings to spin. Turn them slowly by hand. Spinning bearings may damage the race and balls.

## REPAIRS

### Synchronizer Keys and Springs Replacement

The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

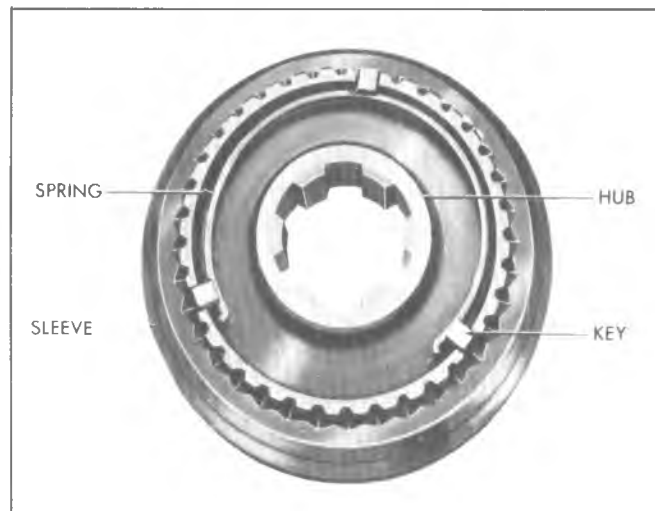


Fig. 7B-13K--Synchronizer Assembly

1. If relation of hub and sleeve are not already marked, mark for assembly purposes.

2. Push the hub from the sliding sleeve; the keys will fall free and the springs may be easily removed.

3. Place the two springs in position (one on each side of hub), so all three keys are engaged by both springs (Fig. 7B-13K).

Place the keys in position and while holding them in place, slide the sleeve onto the hub, aligning the marks made before disassembly.

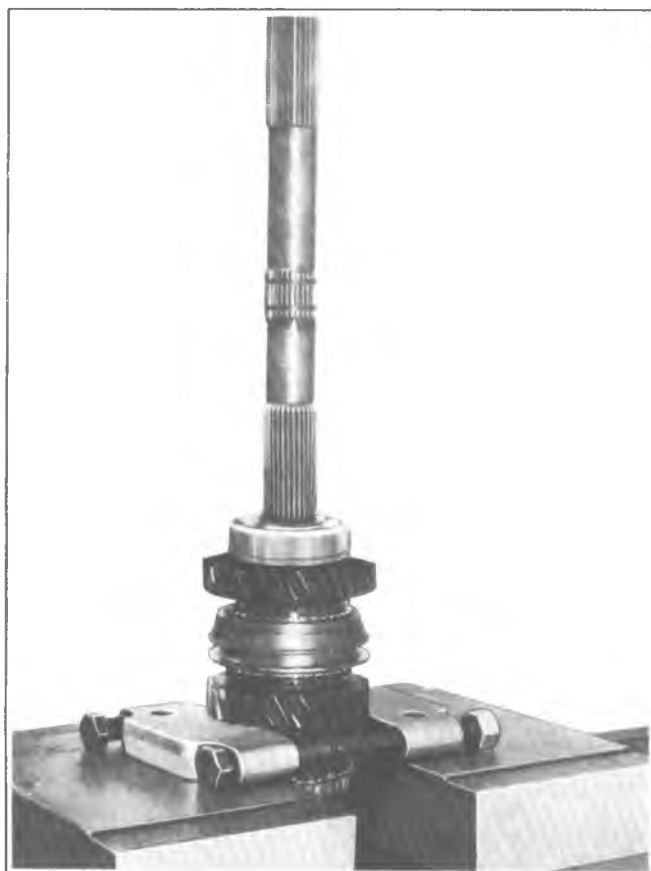


Fig. 7B-12K--Pressing Rear Bearing From Mainshaft



J-21465-17  
W/HANDLE  
J-8092

Fig. 7B-14K--Removing Rear Extension Bushing

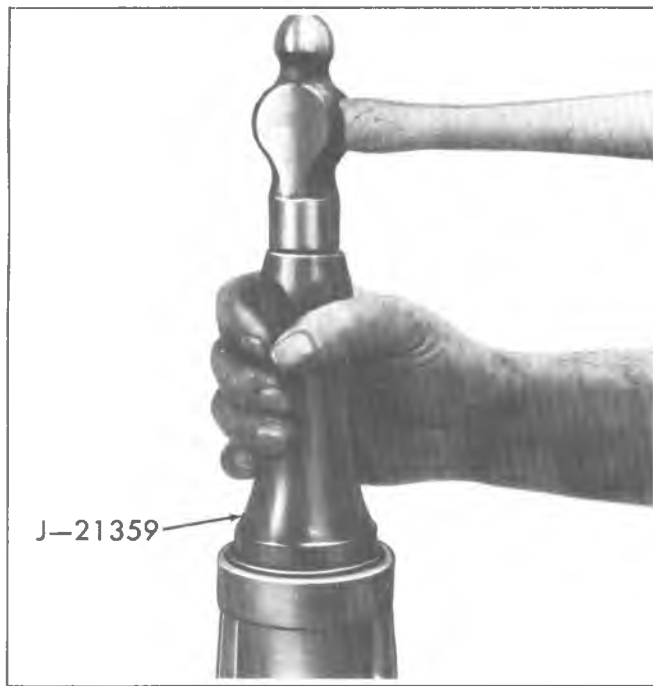


Fig. 7B-15K--Installing Rear Extension Seal

### Extension Oil Seal and/or

#### Bushing Replacement

1. Pry seal from rear of extension.
2. Remove bushing using Tool J-21465-17 with Handle J-8092. Drive bushing from rear of extension housing (Fig. 7B-14K).
3. Using a new bushing and Tool J-21465-17 with Handle J-8092, press bushing into extension from rear of extension.
4. Coat I.D. of bushing and seal with transmission lubricant. Install new seal using Tool J-21359 (Fig. 7B-15K).

### Drive Gear Bearing Retainer Oil

#### Seal Replacement

1. Pry out old seal.
2. Using a new seal, install new seal into retainer using Tool J-21359 until it bottoms in bore (Fig. 7B-16K). Lubricate I.D. of seal with transmission lubricant.

### Reverse Shifter Shaft and/or

#### Seal Replacement

1. With case extension removed from transmission the reverse shifter shaft lock pin will already be removed. (see Step 5 under Transmission Disassembly).
2. Remove shift fork.
3. Carefully drive shifter shaft into case extension, allowing ball detent to drop into case. Remove shaft and ball detent spring. Remove "O" ring seal from shaft.

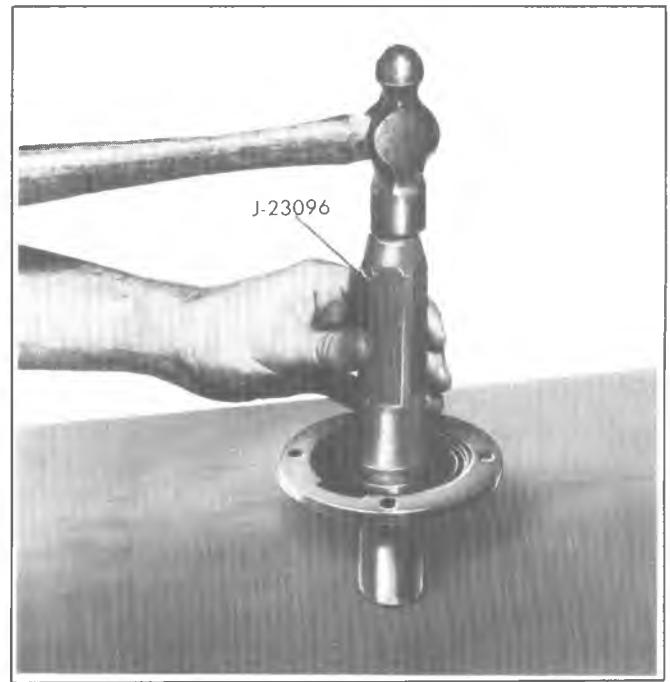


Fig. 7B-16K--Installing Drive Gear Bearing Retainer Seal

4. Place ball detent spring into detent spring hole and start reverse shifter shaft into hole in boss.
5. Place detent ball on spring and while holding ball down, push the shifter shaft into place and turn until the ball drops into place in detent on the shaft detent plate.
6. Install "O" ring seal on shaft.
7. Install shift fork.

**NOTE:** Do not drive the shifter shaft lock pin into place until the extension has been installed on the transmission case.

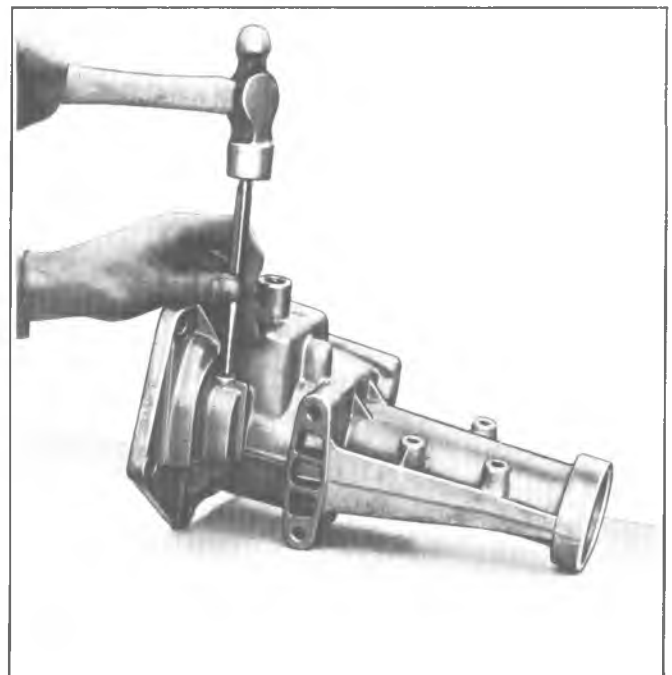


Fig. 7B-17K--Removing Reverse Idler Shaft Roll Pin

## Reverse Idler Shaft

### Replacement

1. Place a small punch into hole in extension's reverse idler shaft boss and drive the welch plug and pin into the shaft (Fig. 7B-17K) until the shaft can be pulled from rear extension.

2. Insert new idler shaft into extension until hole in shaft lines up with hole in boss.

3. Insert roller pin in transmission boss opening and drive the pin into the extension until the shaft is securely locked in place. Install new welch plug, with sealer, in boss opening.

### Transmission Side Cover

Although service of the side cover is covered here, the transmission does not have to be removed to perform these operations. To remove the side cover on-the-vehicle, simply drain the transmission, disconnect the 1st/2nd cross shaft and 3rd/4th linkage and remove the attaching bolts.

1. Remove the outer shifter lever nuts and lockwasher and pull levers from shafts.

2. Carefully push the shifter shafts into cover, allowing the detent balls to fall free, then remove both shifter shafts.

3. Remove interlock sleeve, interlock pin and poppet spring.

4. Replace necessary parts (Fig. 7B-18K) and assembly by reversing Steps 1-3.

### ASSEMBLY OF COUNTERGEAR

1. Install roller spacer in counter gear (if removed).

2. Using heavy grease to retain rollers, install spacer, rollers, spacer, rollers, and spacer in either end of counter gear. Repeat in other end of counter gear (Fig. 7B-19K).

3. Insert a dummy shaft or loading Tool J-24658 into counter gear.

### CHECKING COUNTERGEAR END PLAY

1. Rest the transmission case on its side with the side cover opening toward the assembler. Put counter gear tanged thrust washers in place, retaining them with heavy grease, making sure the tangs are resting in the notches of the case.

2. Set counter gear 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 counter gear (pushing loading Tool J-24658 out front of case) until woodruff key slot is in its relative installed position (do not install key).

5. Attach a dial indicator as shown in Fig. 7B-20K and check end play of the counter gear. If end play is greater than .025", a new thrust washers must be installed.

### ASSEMBLY OF MAINSHAFT

1. From rear of mainshaft, assemble the 2nd speed gear (with hub of gear toward rear of shaft).

2. Install 1st-2nd synchronizer clutch assembly (sliding clutch sleeve taper toward rear, hub to front) on the mainshaft together with a synchronizer ring on both sides of the clutch assemblies.

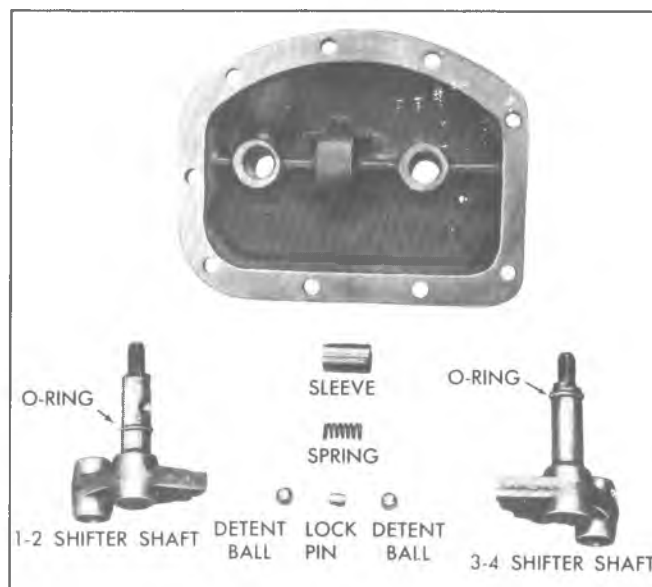


Fig. 7B-18K--Shift Cover Assembly

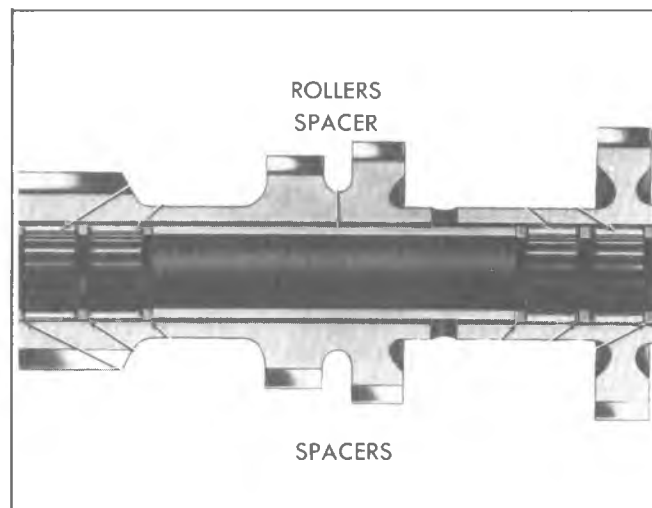


Fig. 7B-19K--Counter gear Cross Section

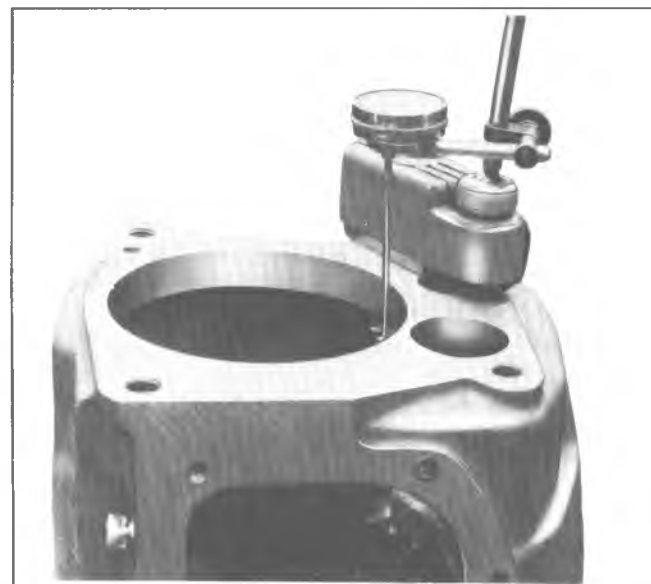


Fig. 7B-20K--Checking Counter gear End Play

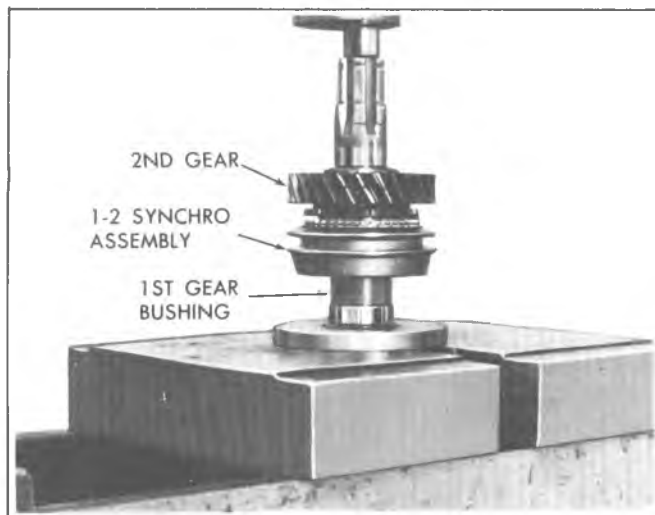


Fig. 7B-21K--Installing 1st Gear Sleeve

3. Position the 1st gear sleeve on the shaft and press the sleeve onto the mainshaft until the 2nd gear, clutch assembly and sleeve bottom against the shoulder of the mainshaft (Fig. 7B-21K).

4. Install 1st speed gear (with hub toward front) and supporting inner race, press the rear bearing onto the mainshaft with the snap ring groove toward front of the transmission (Fig. 7B-22K).

5. Install spacer and new correct selective fit (thickest that will assemble) snap ring in mainshaft behind rear bearing.

6. Install the 3rd speed gear (hub to front of transmission) and the 3rd speed gear synchronizing ring (notches to front of transmission).

7. Install the 3rd and 4th speed gear clutch assembly (hub and sliding sleeve) with taper toward the front making sure that the keys in the hub correspond to the notches in the 3rd speed gear synchronizing ring.

8. Install new selective fit snap ring (thickest that will install) in the groove in mainshaft in front of the 3rd and 4th speed clutch assembly.

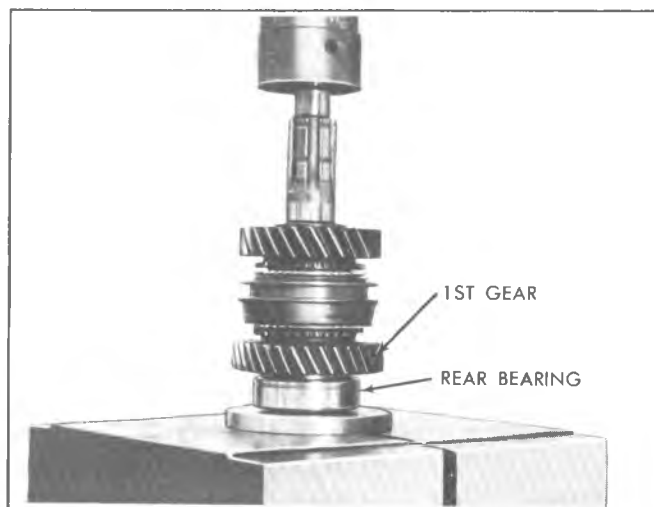


Fig. 7B-22K--Installing Rear Bearing

9. Install the rear bearing retainer over end of mainshaft. Spread the snap ring to drop around the rear bearing. Release snap ring when it aligns with groove in rear bearing.

10. Install the reverse gear (shift collar to rear).

11. Install a snap ring, the speedometer drive gear and a second snap ring, onto the mainshaft.

### ASSEMBLY OF TRANSMISSION

1. Place the transmission case on its side with the shift cover opening toward the assembler. Position the countergear tanged washers in place, using a heavy grease to retain them.

**NOTE:** Be sure the tangs are in the notches of the thrust face.

2. Install the countergear in the case, aligning the bore of the countergear with the case opening. With the thrust washers in place, slide the loading tool to the front of the case and install the countergear shaft from the rear of the case. Install the woodruff key and tap shaft into gear until shaft is flush with rear face of transmission case.

3. Install front reverse idler gear (teeth forward) and thrust washer in case. Use a heavy grease to hold thrust washer in position.

4. Using a heavy grease install sixteen (16) roller bearings and washer into main drive gear. Mate main drive gear with mainshaft assembly. Position 3rd-4th clutch sliding sleeve forward. This will provide clearance for installation as well as hold the assembly together.

5. Position new rear bearing retainer to case extension gasket on rear of case. Install mainshaft and drive gear assembly into case.

6. Align rear bearing retainer with transmission case. Install retainer to case locating pin and retainer locking bolt. Torque to recommended specifications.

7. Place bearing snap ring on front main bearing. Position front main bearing to case opening and with a hollow shaft, or tool J-5590, tap bearing into case (Fig. 7B-23K). Install spacer washer and selective fit snap ring to secure main drive bearing.

8. Install front bearing retainer and gasket. Apply sealer to bolts and torque to recommended specification.

9. Install rear reverse idler gear engaging the splines with the portion of the gear within the case.

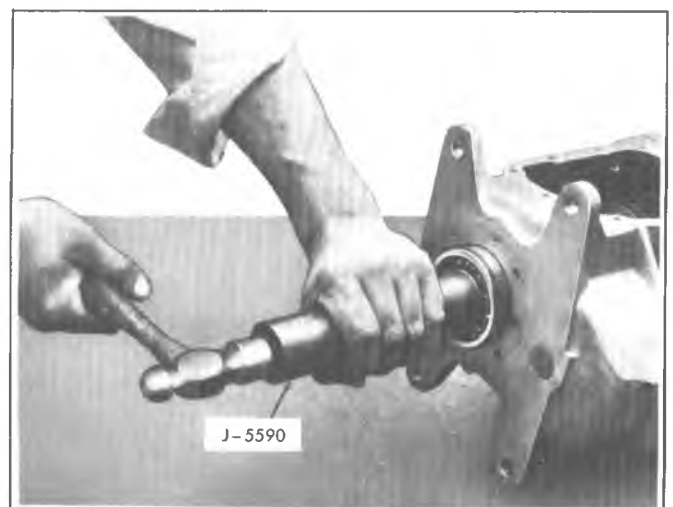


Fig. 7B-23K--Installing Front Main Bearing



10. Place new rear bearing retainer to case extension gasket into position on rear face of bearing retainer. Slide reverse gear on shaft. Install speedometer gear and two selective fit snap rings.

11. Install idler shaft into extension until hole in shaft lines up with hole in boss. Insert reverse idler shaft lock pin in transmission boss opening and drive the pin into the extension until the shaft is securely locked in place. Install new welch plug, with sealer, in boss opening.

12. Install reverse shifter shaft and detent plate into extension. Locate reverse shift fork in reverse shifter shaft. Use a heavy grease to hold reverse shift fork in position.

**NOTE:** Be sure reverse shifter shaft "O" ring is placed on reverse shifter shaft after the shaft has been installed in the extension housing.

13. Install tanged thrust washer on reverse idler shaft with tang of washer in notch of idler thrust face of extension.

14. Place the 1st-2nd speed and 3rd-4th speed clutch sliding sleeve in neutral position. Pull reverse shift shaft partially out of extension and reverse shift fork as far forward in as possible. Start the extension onto the mainshaft while pushing in on the shifter shaft to engage the shift fork with the reverse gear shift collar. When the fork engages, rotate the shifter shaft to move the reverse gear rearward permitting the extension to mate against the transmission case.

15. Install reverse shifter shaft lock pin.

16. Install rear extension housing-to-case bolts. Install rear extension to rear bearing retainer bolts (short bolts). Torque all bolts to recommended specification.

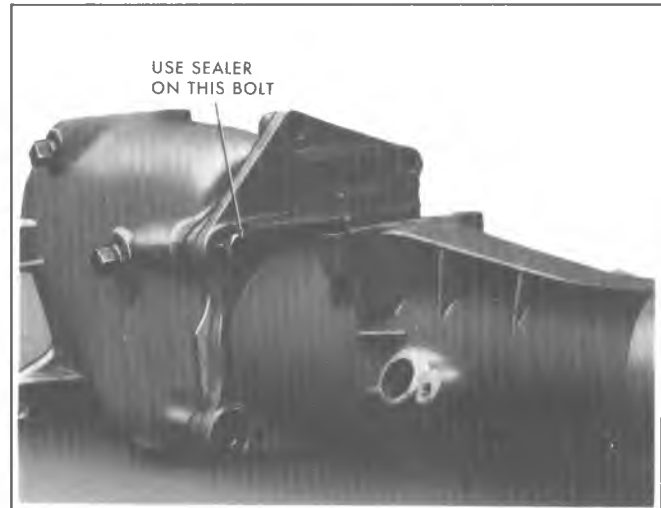


Fig. 7B-24K—Extension Bolt

**NOTE:** It is essential that sealer be used on the extension bolt as indicated in Fig. 7B-24K.

17. Position 1st-2nd speed clutch sliding sleeve into 2nd gear and 3rd-4th speed clutch sliding sleeve into neutral. Position forward shift forks in sliding sleeves.

18. Position 1st-2nd speed gear shifter shaft and detent plate into 2nd gear position and using a sealer, install cover gasket and side cover assembly to transmission.

19. Check operation of transmission.

## 4-SPEED 117MM TRANSMISSION

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### DISASSEMBLY OF TRANSMISSION

#### Refer to Figures 7B-1L and 7B-2L

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. 7B-26L).

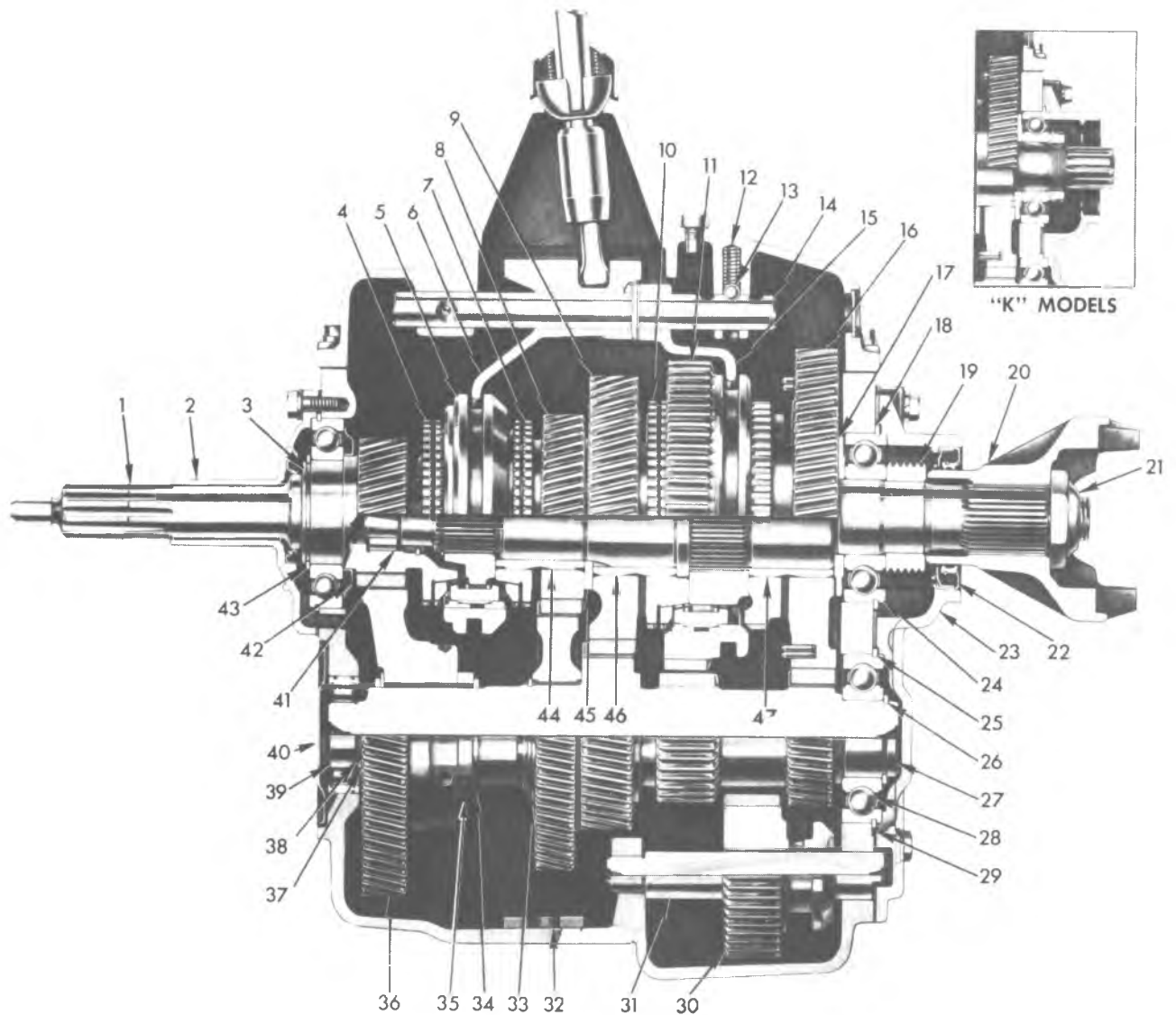
3. Remove parking brake and brake flange plate assembly on models equipped with propeller shaft parking brake. Refer to Section 5, Truck Service Manual.

4. Remove rear bearing retainer and gasket.

5. Slide speedometer drive gear off mainshaft.

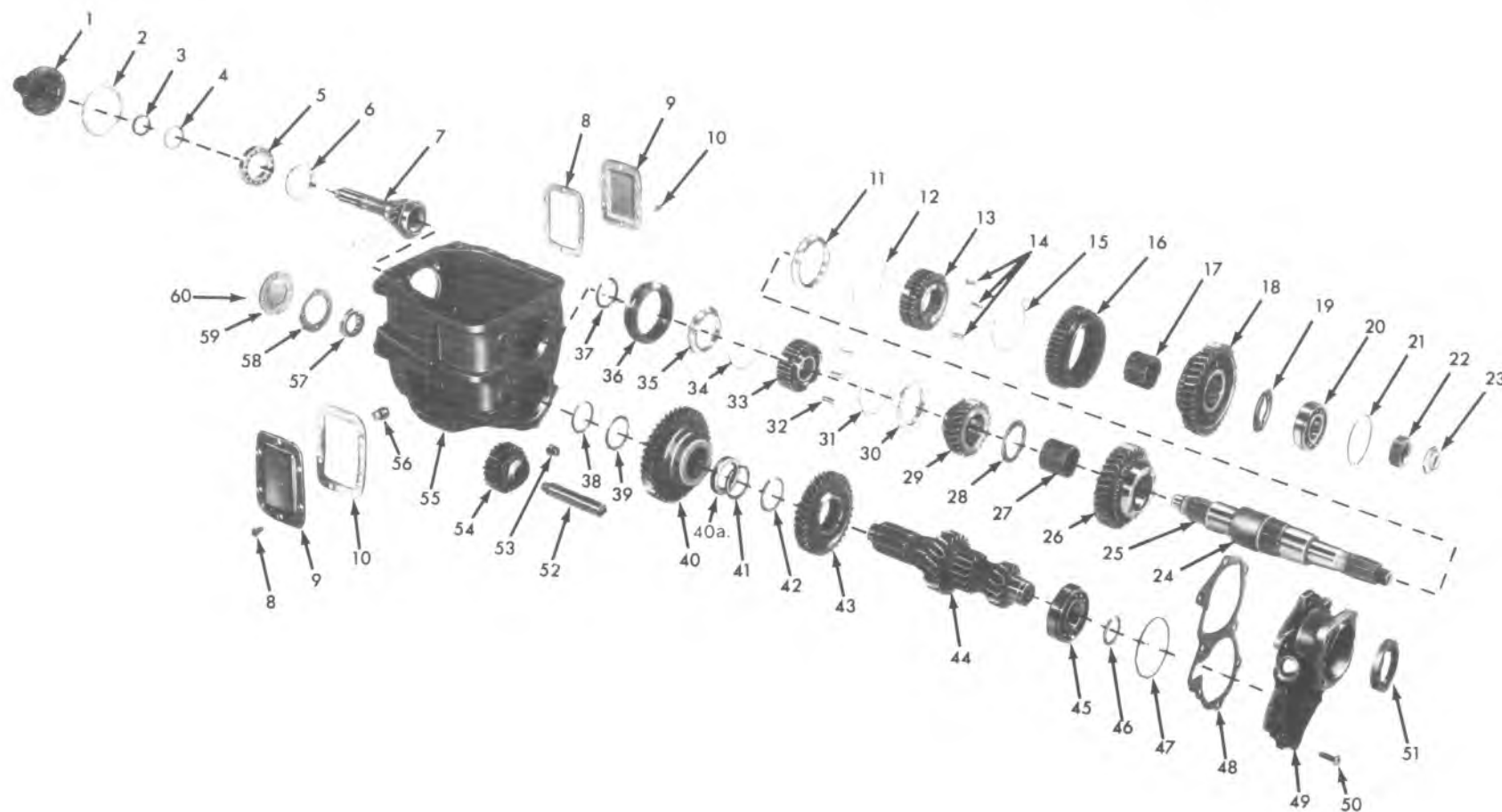
6. Remove drive gear bearing retainers and gasket.

7. Remove countergear front bearing cap and gasket.



- |  |                                    |                               |                                |
|--|------------------------------------|-------------------------------|--------------------------------|
| 1. Main Drive Gear                     | 11. Reverse Driven Gear            | 24. Mainshaft Rear Bearing    | 37. Thrust Washer              |
| 2. Drive Gear Bearing Retainer         | 12. Poppet Spring                  | 25. Rear Bearing Snap Ring    | 38. Snap Ring                  |
| 3. Snap Ring-Outer                     | 13. Poppet Ball                    | 26. Snap Ring                 | 39. Front Countershaft Bearing |
| 4. 3rd and 4th Synchronizer Ring       | 14. Shift Rail                     | 27. Countershaft Bearing      | 40. Countergear Front Cover    |
| 5. 3rd and 4th Synchronizer Collar     | 15. 1st and 2nd Shift Fork         | 28. Countershaft Rear Bearing | 41. Pilot Bearing Rollers      |
| 6. 3rd and 4th Shift Fork              | 16. 1st Speed Gear                 | 29. Bearing Snap Ring         | 42. Clutch Gear Oil Slinger    |
| 7. 3rd and 4th Speed Synchronizer Ring | 17. Thrust Washer                  | 30. Reverse Idler Gear        | 43. Snap Ring                  |
| 8. 3rd Speed Gear                      | 18. Bearing Snap Ring              | 31. Reverse Idler Shaft       | 44. 3rd Speed Gear Bushing     |
| 9. 2nd Speed Gear                      | 19. Speedometer Drive Gear         | 32. Case Magnet               | 45. Thrust Washer              |
| 10. 1st and 2nd Synchronizer Assembly  | 20. Output Yoke                    | 33. Snap Ring                 | 46. 2nd Speed Gear Bushing     |
|  | 21. Flange Nut                     | 34. Snap Ring                 | 47. 1st Speed Gear Bushing     |
|  | 22. Rear Bearing Retainer Oil Seal | 35. Spacer                    |                                |
|  | 23. Rear Bearing Retainer          | 36. Countergear               |                                |

Fig. 7B-1L-4-Speed 117mm Transmission Assembly--Cross Section



- |                                  |                                    |                                       |                              |                               |
|----------------------------------|------------------------------------|---------------------------------------|------------------------------|-------------------------------|
| 1. Drive Gear Bearing Retainer   | 13. 1st-2nd Speed Synchronizer Hub | 26. 2nd Speed Gear                    | 37. Snap Ring                | 48. Rear Retainer Gasket      |
| 2. Retainer Gasket               | 14. Synchronizer Keys              | 27. 3rd Gear Bushing                  | 38. Snap Ring                | 49. Rear Retainer             |
| 3. Lip Seal                      | 15. Synchronizer Spring            | 28. Thrust Washer                     | 39. Thrust Washer            | 50. Retainer Bolts            |
| 4. Snap Ring                     | 16. Reverse Driven Gear            | 29. 3rd Speed Gear                    | 40. Clutch Countergear       | 51. Retainer Lip Seal         |
| 5. Drive Gear Bearing            | 17. 1st Gear Bushing               | 30. 3rd Speed Blocker Ring            | 40a. Spacer                  | 52. Reverse Idler Shaft       |
| 6. Oil Slinger                   | 18. 1st Gear                       | 31. Synchronizer Spring               | 41. Snap Ring                | 53. Drain Plug                |
| 7. Drive 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          | 21. Bearing Snap Ring              | 34. Synchronizer Spring               | 44. Countergear Shaft        | 56. Fill Plug                 |
| 10. Retaining Screws             | 22. Speedometer Gear Nut           | 35. 3rd-4th Speed Blocker Ring        | 45. Countergear Rear Bearing | 57. Countergear Front Bearing |
| 11. 1st-2nd Speed Blocker Ring   | 23. Rear Mainshaft Lock            | 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. 7B-2L-4-Speed 117mm Transmission Exploded View

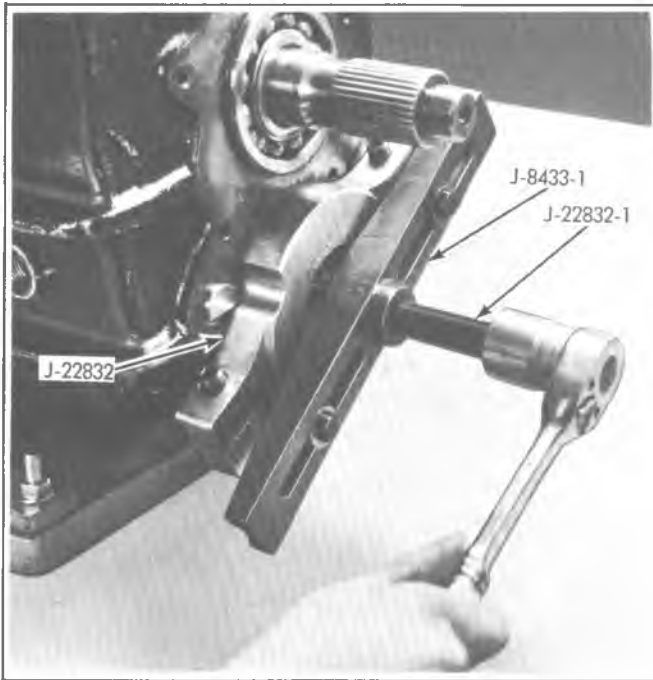


Fig. 7B-3L--Removing Countergear Rear Bearing

8. Pry countergear front bearing out by inserting a two-pronged puller through the 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. 7B-3L). This will allow countergear assembly to rest on bottom of case.

**CAUTION:** Make sure Tool J-22832 engages full circumference of groove in bearing to prevent tool damage.

10. Remove drive gear bearing outer race to case retaining ring.

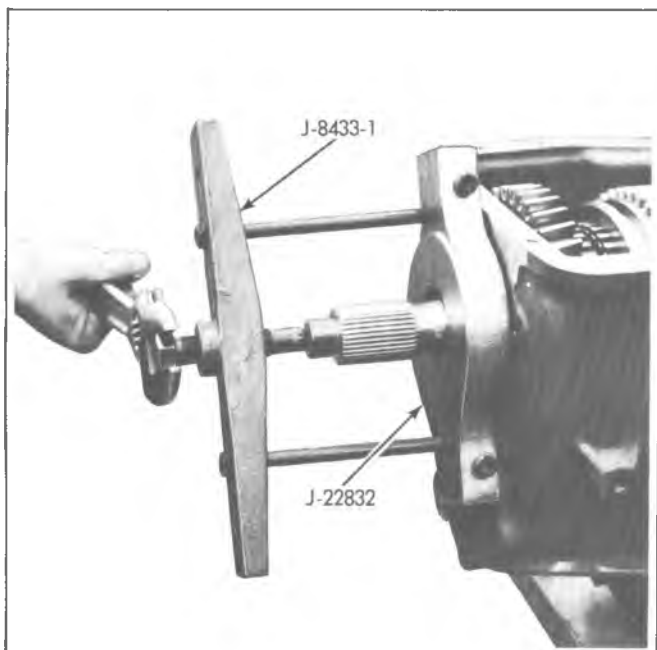


Fig. 7B-4L--Removing Mainshaft Rear Bearing

11. Remove drive gear and bearing by tapping gently on bottom side of drive gear shaft and prying directly opposite against the case and bearing snap ring groove at the same time. Remove 4th gear synchronizer ring.

**CAUTION:** Index cut out section of drive gear in down position with countergear to obtain clearance for removing clutch gear.

12. Remove rear mainshaft bearing retainer ring (snap ring) and using Tool J-22832 and J-8433-1, remove bearing from case (Fig. 7B-4L). Slide 1st speed gear thrust washer off mainshaft.

13. Raise rear of mainshaft assembly and push rearward in case bore, then swing front end up and lift from case. Remove synchronizer cone from shaft.

14. Slide reverse idler gear rearward and move countergear rearward until front end is free of case, then lift to remove from case.

15. To remove reverse idler gear, drive reverse idler gear shaft out of case from front to rear using a drive. Remove reverse idler gear from case.

## SUBASSEMBLY OPERATIONS

### TRANSMISSION COVER

#### Disassembly (Fig. 7B-5L)

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.

**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.

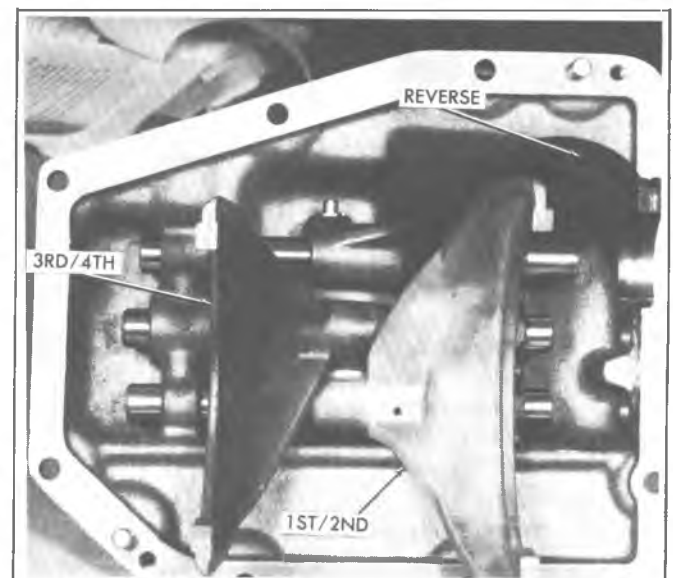


Fig. 7B-5L--Cover Assembly

**CAUTION:** Exercise extreme care during shaft removal since detent balls are under spring tension in the rear rail boss holes.

### Assembly (Fig. 7B-6L)

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. 7B-7L, namely, reverse, 3rd-4th, and 1st-2nd. Fig. 7B-6L illustrates the difference in the shafts.

2. Place fork detent ball springs and balls in position in holes in cover.

3. Start shifter shafts into cover; depress detent balls with small punch and push shafts on over balls. (See Fig. 7B-7L). Hold reverse fork in position and push shaft through yoke. Install split pin in fork and shaft; then, push fork in neutral position.

4. Hold 3rd and 4th fork in position and push shaft through yoke, but not through front support bore.

5. Place two (2) interlock balls in cross-bore in front support boss between reverse and 3rd and 4th shifter shaft. Install the interlock pin in the 3rd and 4th shifter shaft hole. Apply grease to hold in place. Push 3rd and 4th shaft through fork and cover bore, keeping both balls and pin in position between shafts until retaining holes line up in fork and shaft. Install retaining pin and move to neutral position.

6. Place two (2) interlock balls between the 1st and 2nd shifter shaft and 3rd and 4th shifter shaft in the cross-bore of the front support boss. Hold 1st and 2nd fork in position and push shaft through cover bore in fork until retainer hole and fork line up with hole in shaft. Install retainer pin and move to neutral position.

7. Install new shifter shaft hole expansion plugs and expand in place.

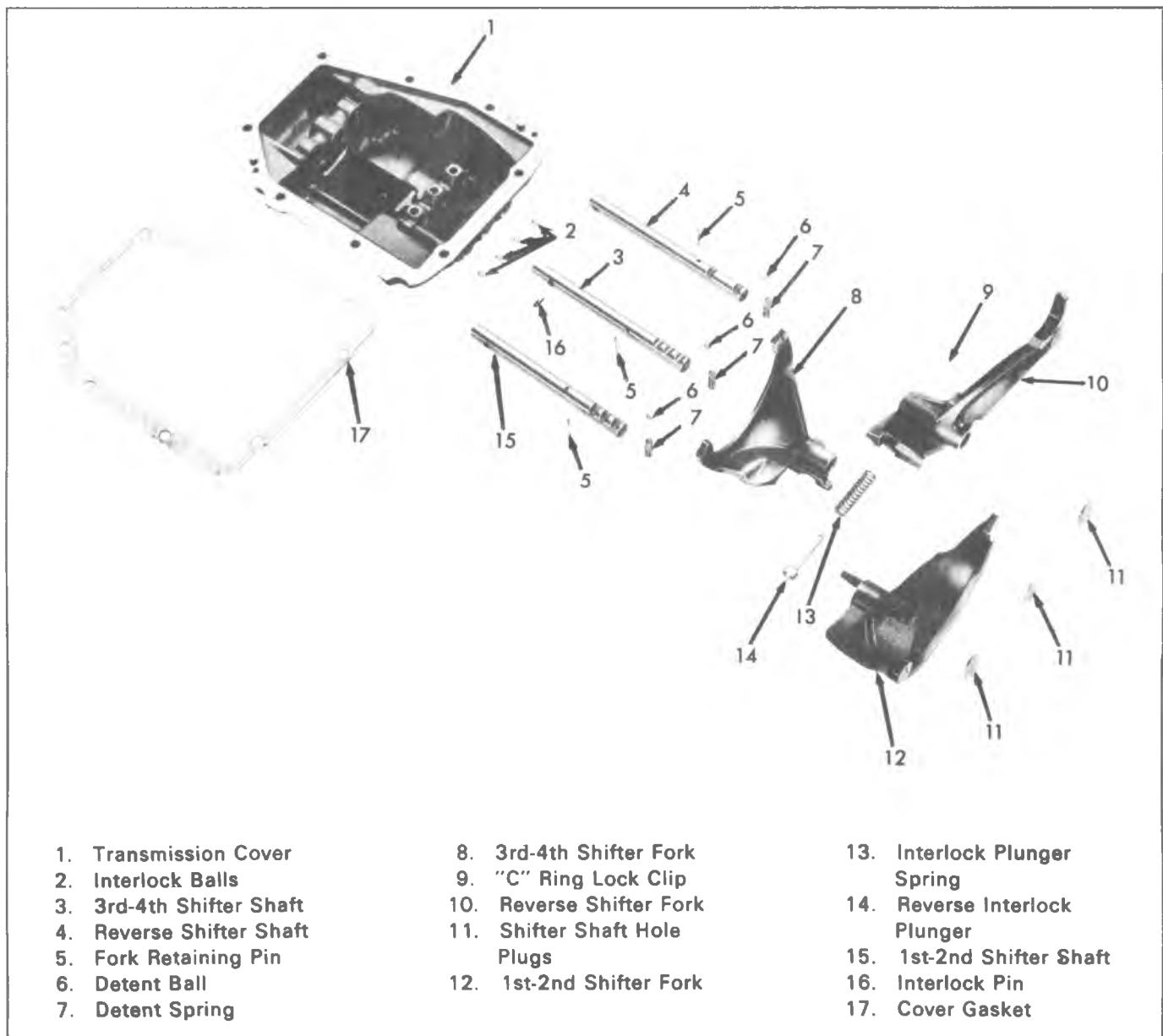


Fig. 7B-6L--Cover Assembly Exploded View

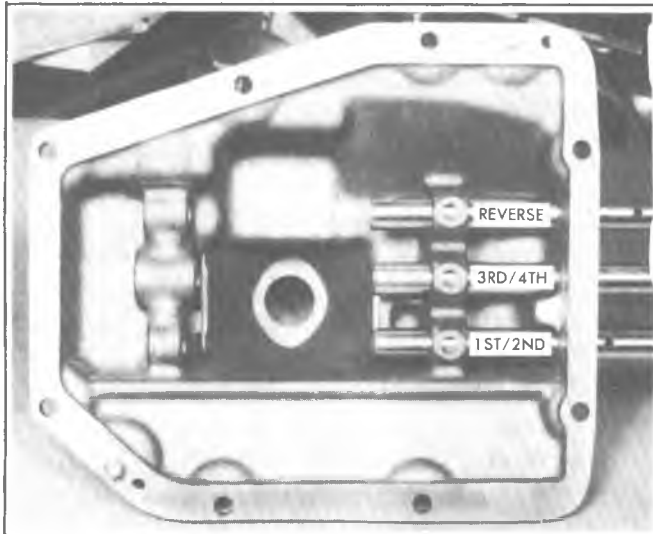


Fig. 7B-7L--Shifter Shaft Installation

## DRIVE GEAR (FIG. 7B-8L)

### Disassembly

1. Remove mainshaft pilot bearing rollers (17) from drive gear if not already removed, and remove roller retainer. Do not remove snap ring on inside of drive gear.
2. Remove snap ring securing bearing on stem of drive gear.
3. To remove bearing, position Tool J-22872 to the bearing (Fig. 7B-9L) and using an arbor press and Tool J-0358 press gear and shaft out of bearing (Fig. 7B-10L).

### Inspection

1. Wash all parts in clearing solvent.
2. Inspect roller bearings for pits or galling.
3. Inspect bearing diameter in shaft recess for galling.

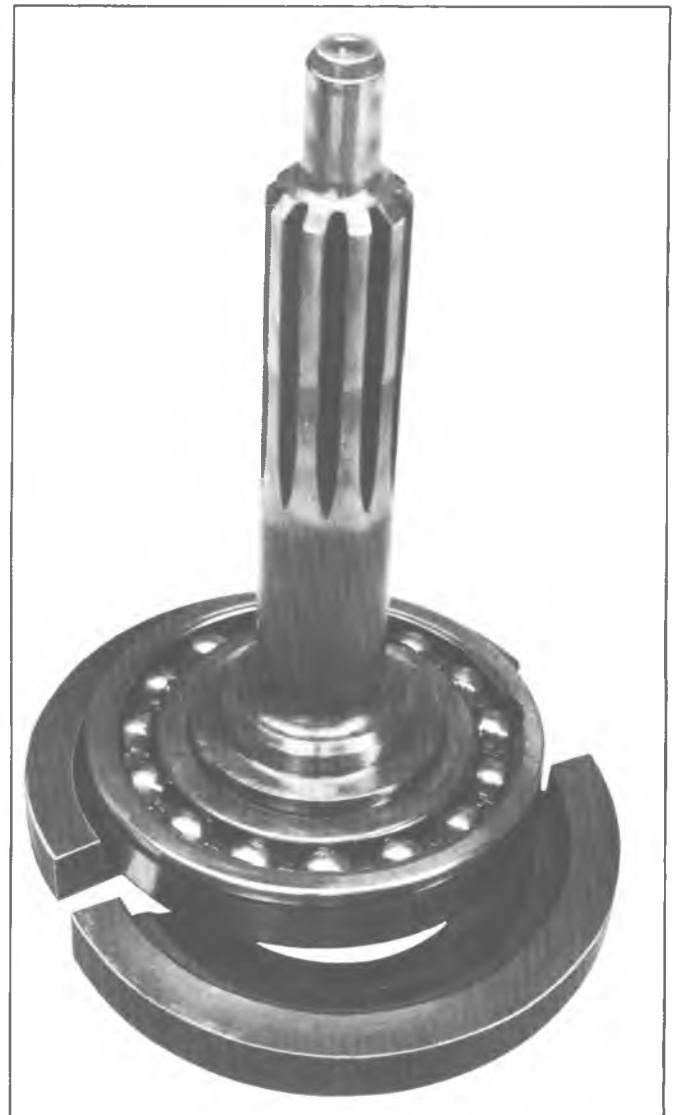


Fig. 7B-9L--Positioning Tool J-22872 to Drive Gear

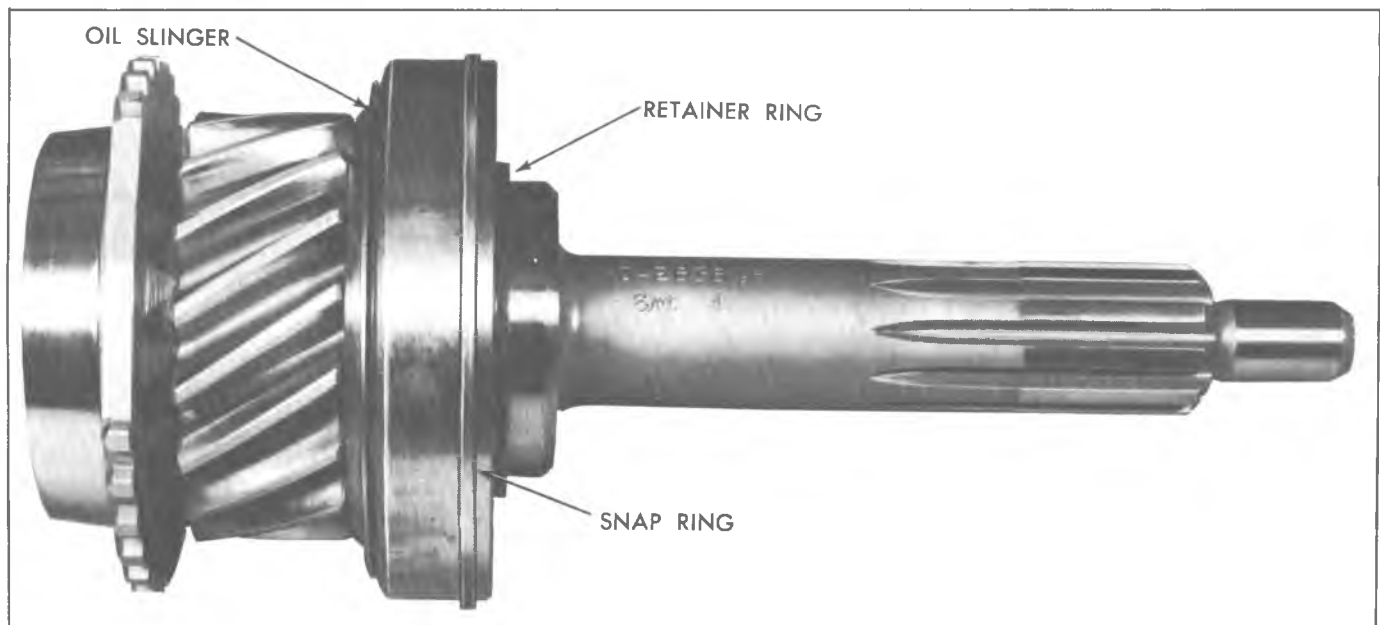


Fig. 7B-8L--Drive Gear Assembly

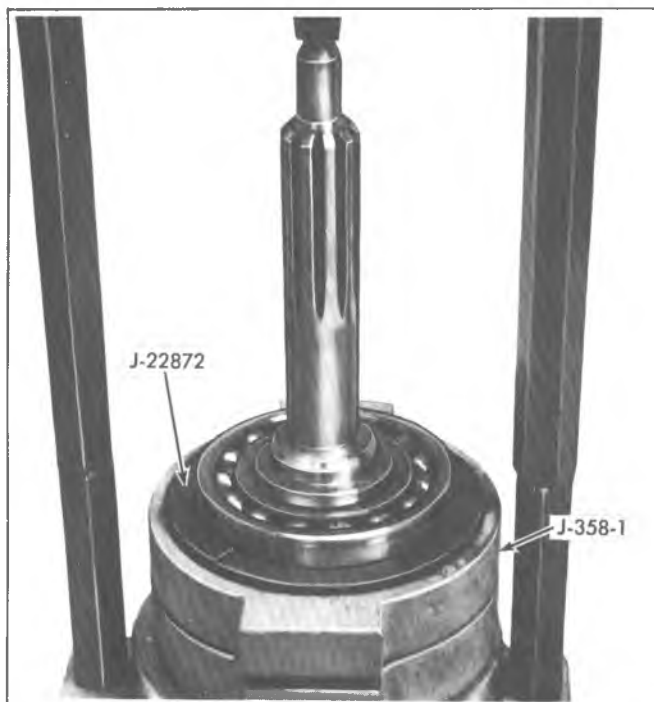


Fig. 7B-10L--Removing Drive Gear Bearing

4. Inspect gear teeth for excessive wear.
5. Inspect clutch shaft pilot for excessive wear.
6. Re-oil bearing, then rotate drive gear bearing slowly by hand and check for roughness.

### Assembly

1. Press bearing and new oil slinger onto drive gear shaft using Tool J-22872 (Fig. 7B-11L). Slinger should be located flush with bearing shoulder on drive gear. See Figure 7B-8L for direction of slinger installation.

**CAUTION:** Exercise care to prevent distortion of the oil slinger.

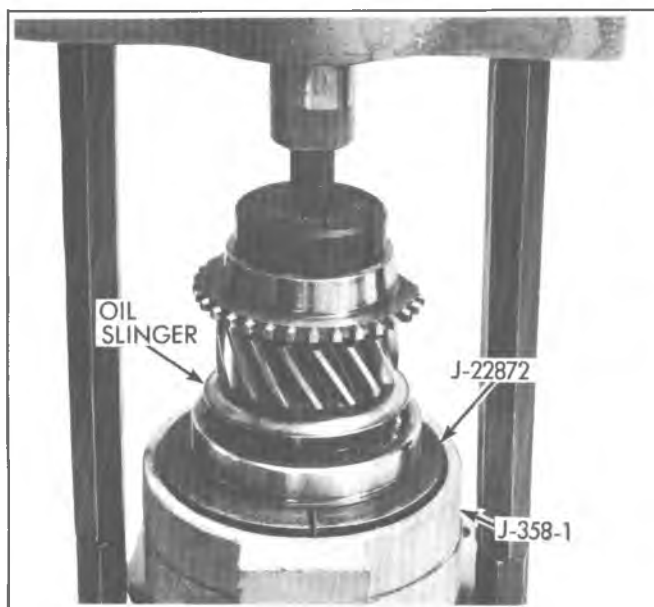


Fig. 7B-11L--Replacing Drive Gear Bearing

2. Install snap ring to secure bearing on drive gear shaft.

3. Install bearing retainer ring in groove on O.D. of bearing.

**CAUTION:** The bearing must turn freely, after it is installed on the shaft.

4. Install snap ring on I.D. of mainshaft pilot bearing bore in clutch gear (if previously removed).

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. 7B-12L).

**NOTE:** This roller bearing retainer holds bearing in position and in final transmission assembly is pushed forward into recess by mainshaft pilot.

### DRIVE GEAR BEARING RETAINER OIL SEAL

#### Replacement

1. Remove retainer and oil seal assembly and gasket.
2. Pry oil seal out of retainer.
3. Install new seal on Tool J-22833 with lip of seal toward flange of tool.
4. Support front surface of retainer in press, start seal and tool in retainer bore and drive seal into retainer until flange of tool bottoms on retainer (Fig. 7B-13L).
5. Install new gasket on retainer and install retainer on transmission case (when assembling transmission).

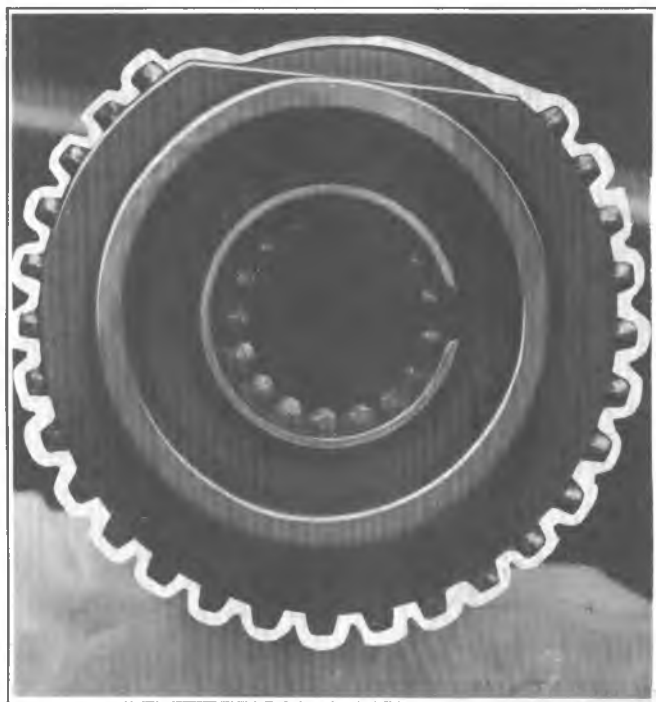


Fig. 7B-12L--Pilot Roller Bearing Installed



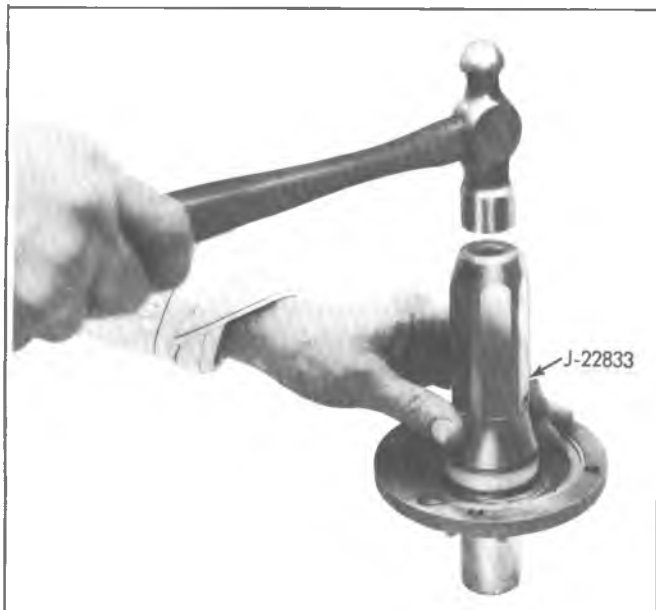


Fig. 7B-13L--Installing Bearing Retainer Oil Seal

**MAINSHAFT ASSEMBLY****Disassembly (Fig. 7B-14L)**

1. Remove first speed gear and thrust washer.
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. 7B-15L).
5. Remove 2nd speed synchronizer ring.
6. Supporting 2nd speed synchronizer hub at front face, press mainshaft through removing 1st speed gear bushing and 2nd speed synchronizer hub.
7. Split 2nd speed gear bushing with chisel and remove bushing from shaft.

**CAUTION:** Exercise care not to damage mainshaft.

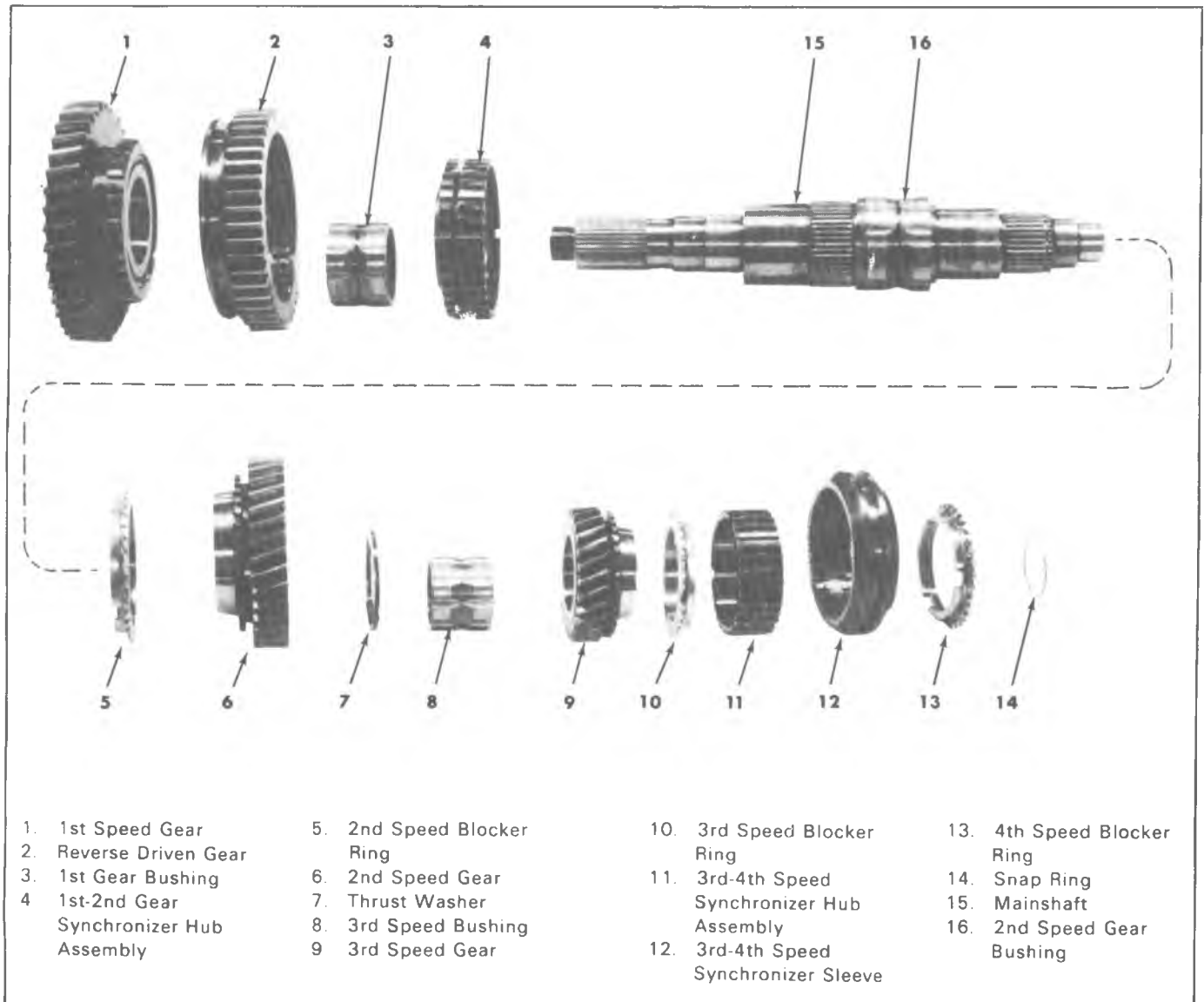


Fig. 7B-14L--Mainshaft Assembly Exploded View

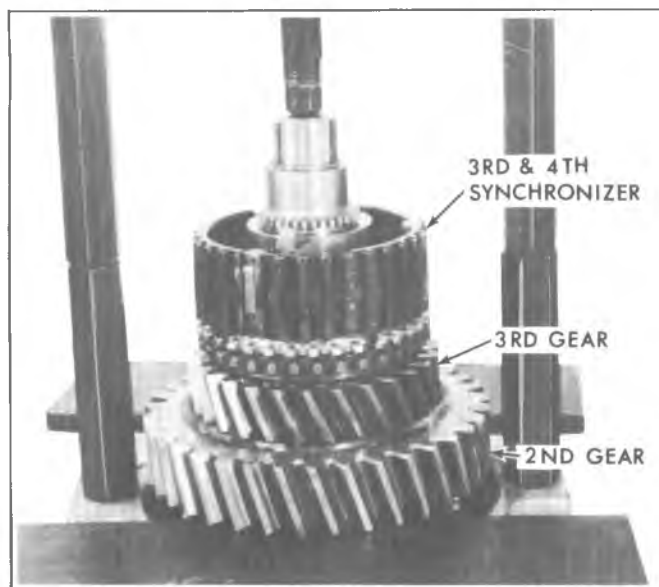


Fig. 7B-15L--Disassembly of Mainshaft

### 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

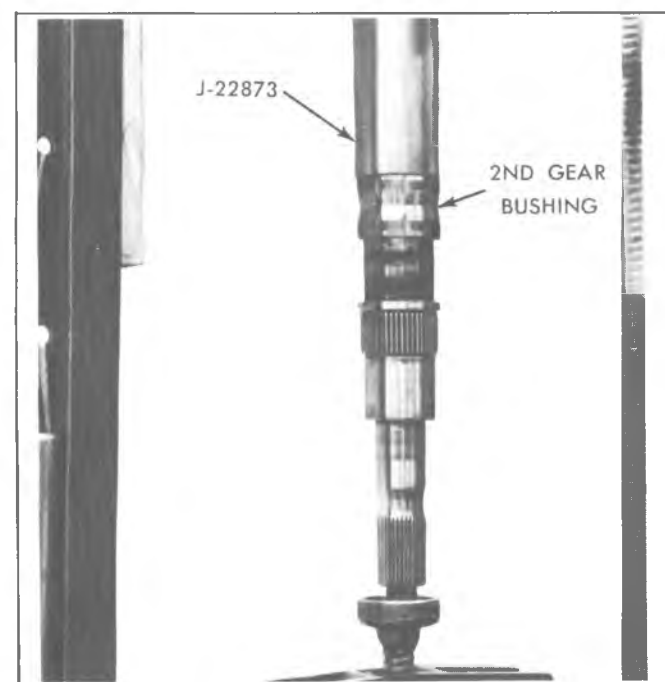


Fig. 7B-16L--Installing 2nd Speed Gear Bushing

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. 7B-16L).

**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.

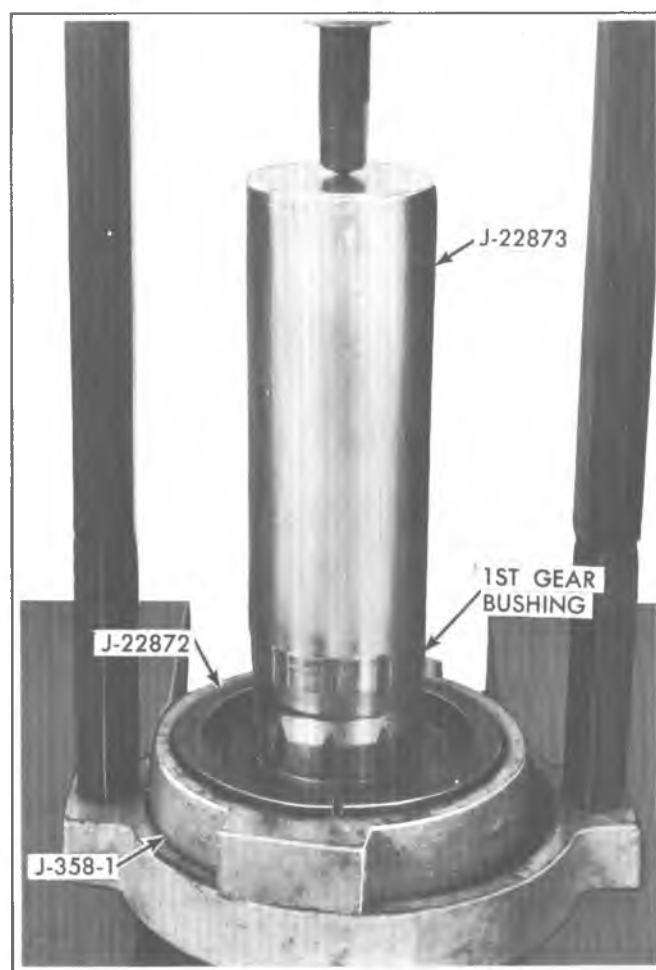


Fig. 7B-17L--Installing 3rd Speed Gear Bushing

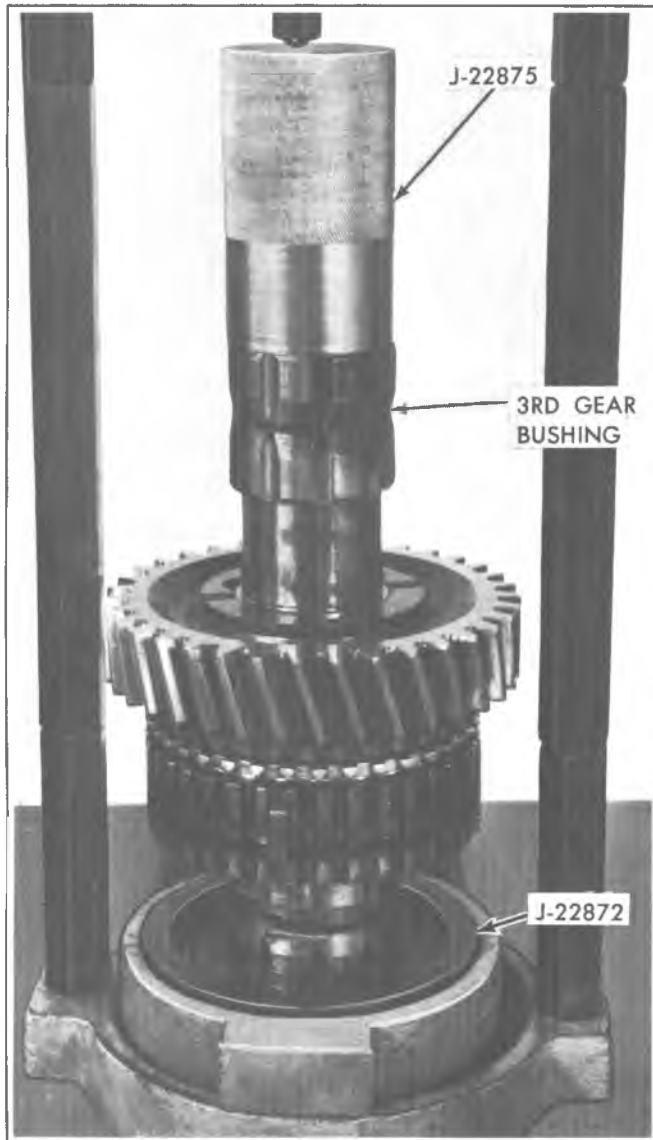


Fig. 7B-18L--Installing 3rd Speed Gear Bushing

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. 7B-17L).

**NOTE:** Lubricate all bushings 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. 7B-18L).

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 press 3rd and 4th synchronizer assembly onto mainshaft using Tool J-22875 and against 3rd speed gear bushing thrust face toward 3rd speed gear (Fig. 7B-19L). Retain synchronizer assembly with snap ring.

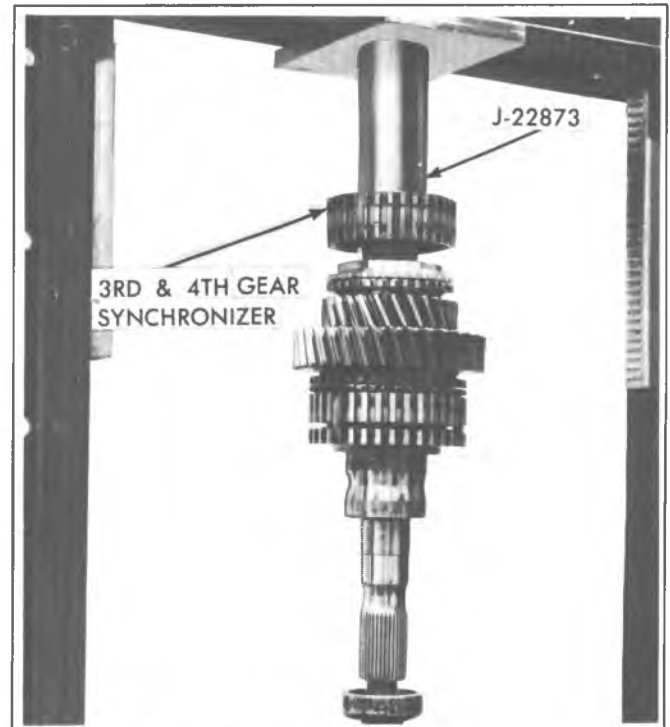


Fig. 7B-19L--Installing 3rd and 4th Gear Synchronizer

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.

2. Install Tool J-22832 or suitable press plates on countershaft, open side to spacer, (Fig. 7B-20L); support assembly in an arbor press and press countershaft out of clutch countergear assembly.

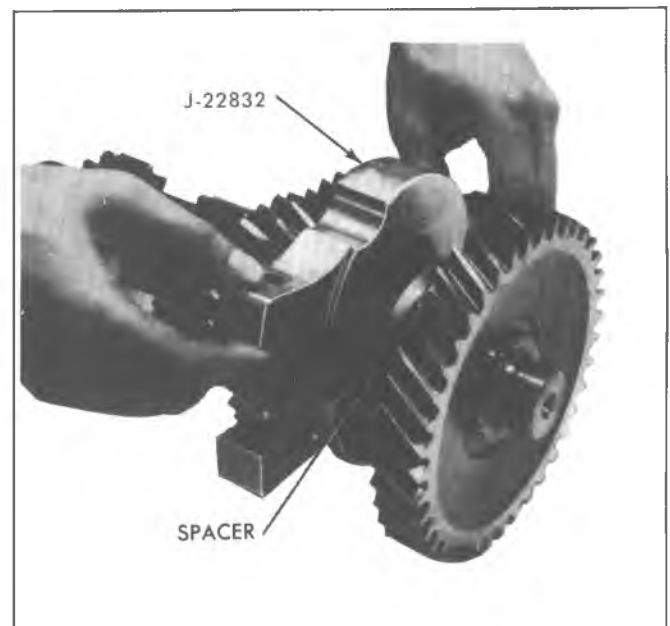


Fig. 7B-20L--Positioning Tool J-22832 on Countershaft

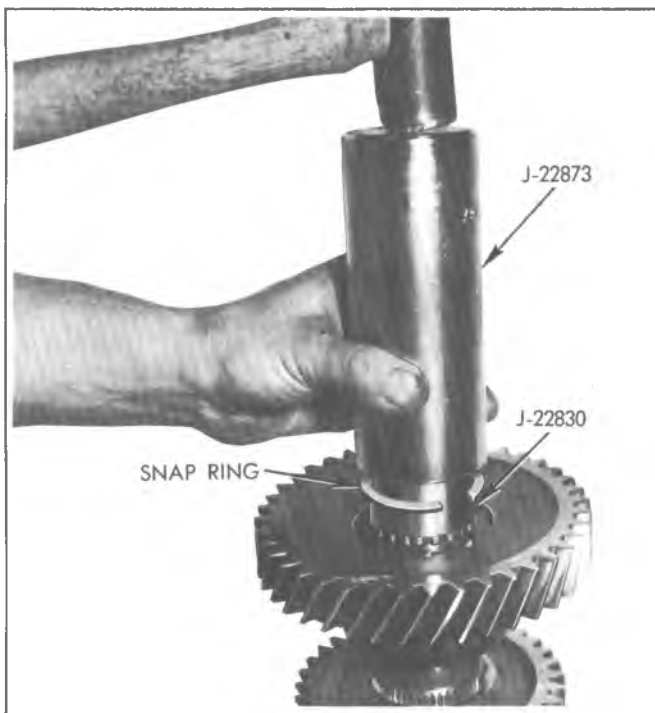


Fig. 7B-21L--Installing Counter Gear Snap Ring

**NOTE:** Countergear is a slip fit and pressing may not be required.

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.

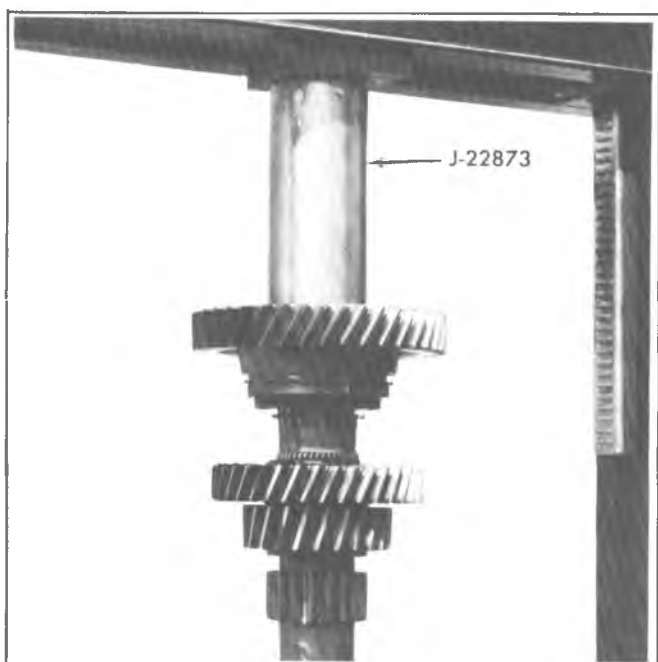


Fig. 7B-22L--Installing Clutch Countergear

**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. 7B-21L). 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. 7B-22L).

**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. 7B-21L).

**CAUTION:** Do not over stress snap ring. Ring should be tight in groove without side play.

### ASSEMBLY OF TRANSMISSION

1. Lower the countergear into the case until it rests on bottoms of case.

2. Place reverse idler gear in transmission case with gear teeth toward the front. Install idler gear shaft from rear to front, being careful to have slot in end of shaft in facing down. Shaft slot face must be at least flush with case.

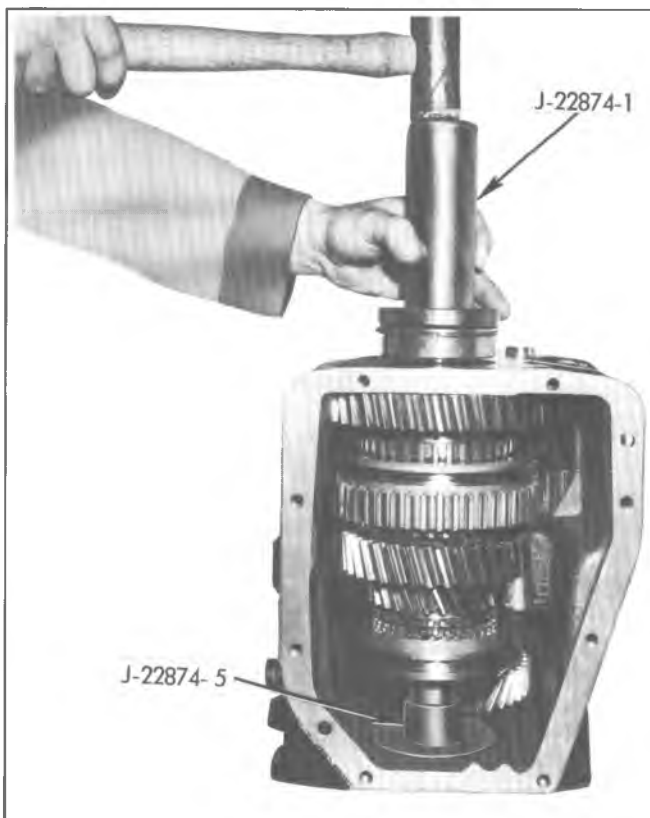


Fig. 7B-23L--Installing Mainshaft Rear Bearing

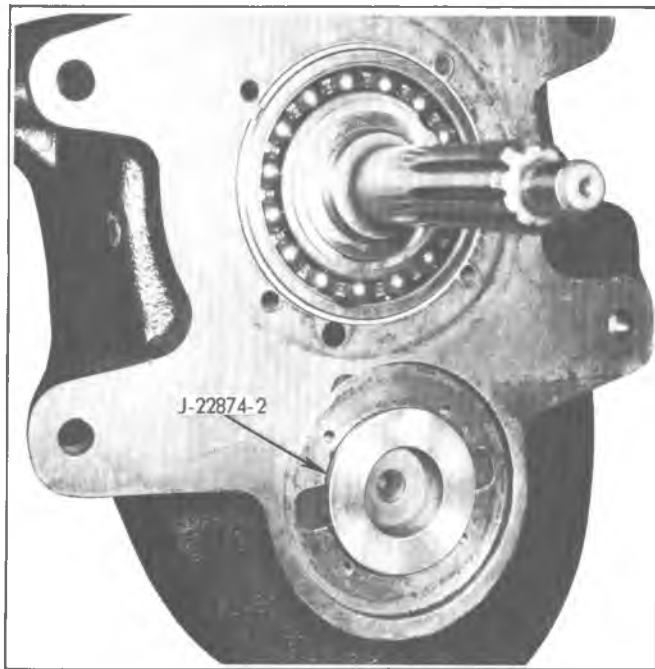


Fig. 7B-24L—Counter gear Front Support Tool

3. Install mainshaft assembly into case with rear of shaft protruding out rear bearing hole in case. Position Tool J-22874 in clutch gear case opening and engaging front mainshaft (Fig. 7B-23L). 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. 7B-23L). 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.



Fig. 7B-25L—Installing Counter gear Rear Bearing

6. Install snap ring on drive gear bearing O.D. Index cut out portion of drive gear teeth to obtain clearance over countershaft drive gear teeth, and install clutch gear assembly onto case. Raise mainshaft to get clutch gear started and tap bearing outer race with plastic tip hammer.

7. Install drive gear bearing retainer using a new gasket. Install bolts and tighten to 15-18 ft. lbs.

8. Install appropriate tool in countergear front bearing opening in case to support countergear and rotate case onto front end. (Fig. 7B-24L).

9. Install snap ring on countergear rear bearing O.D., position bearing on countergear and using Tool J-22874-1, drive bearing into place (Fig. 7B-25L). Rotate case, install snap ring on countershaft at rear bearing and then remove Tool J-22874-1.

10. Tap countergear front bearing assembly into case.

11. Install countergear front bearing cap and new gasket. Torque 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. 7B-26L). 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 3/8 of an inch (leading edge of reverse idler gear teeth 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.

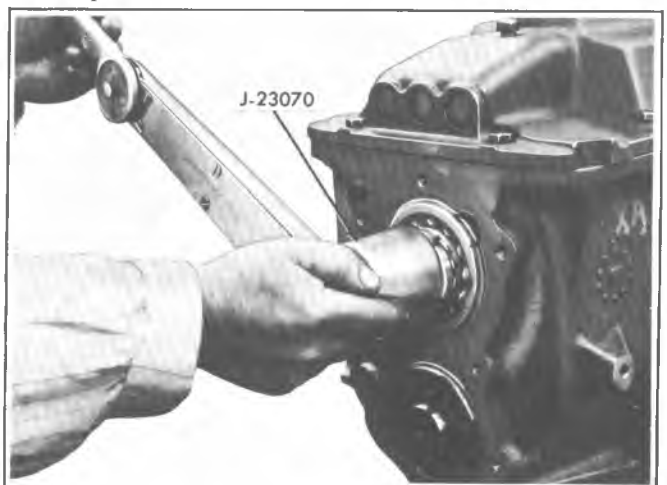
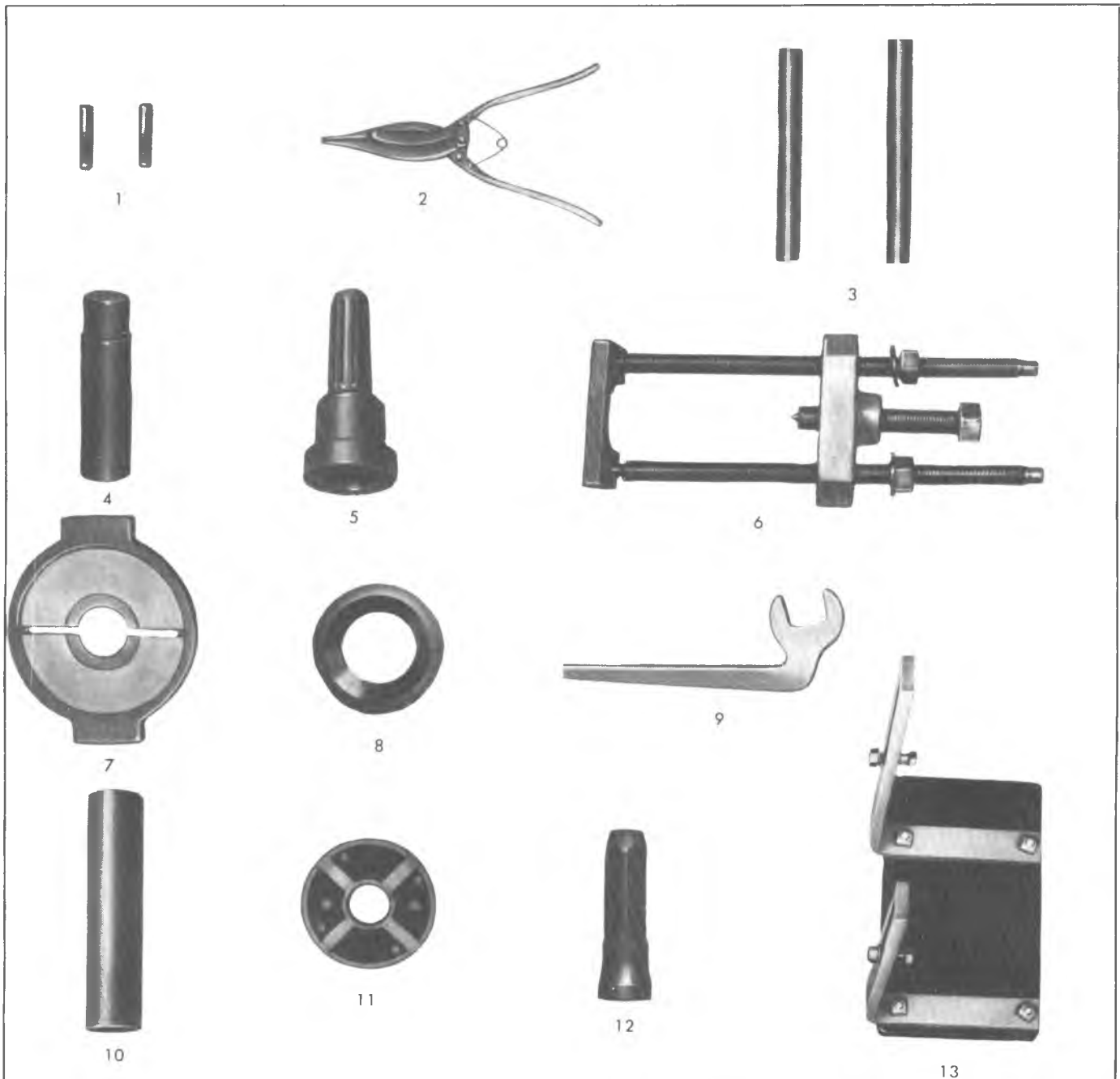


Fig. 7B-26L—Installing Mainshaft Rear Bearing Lock Nut (4-Wheel Drive only)

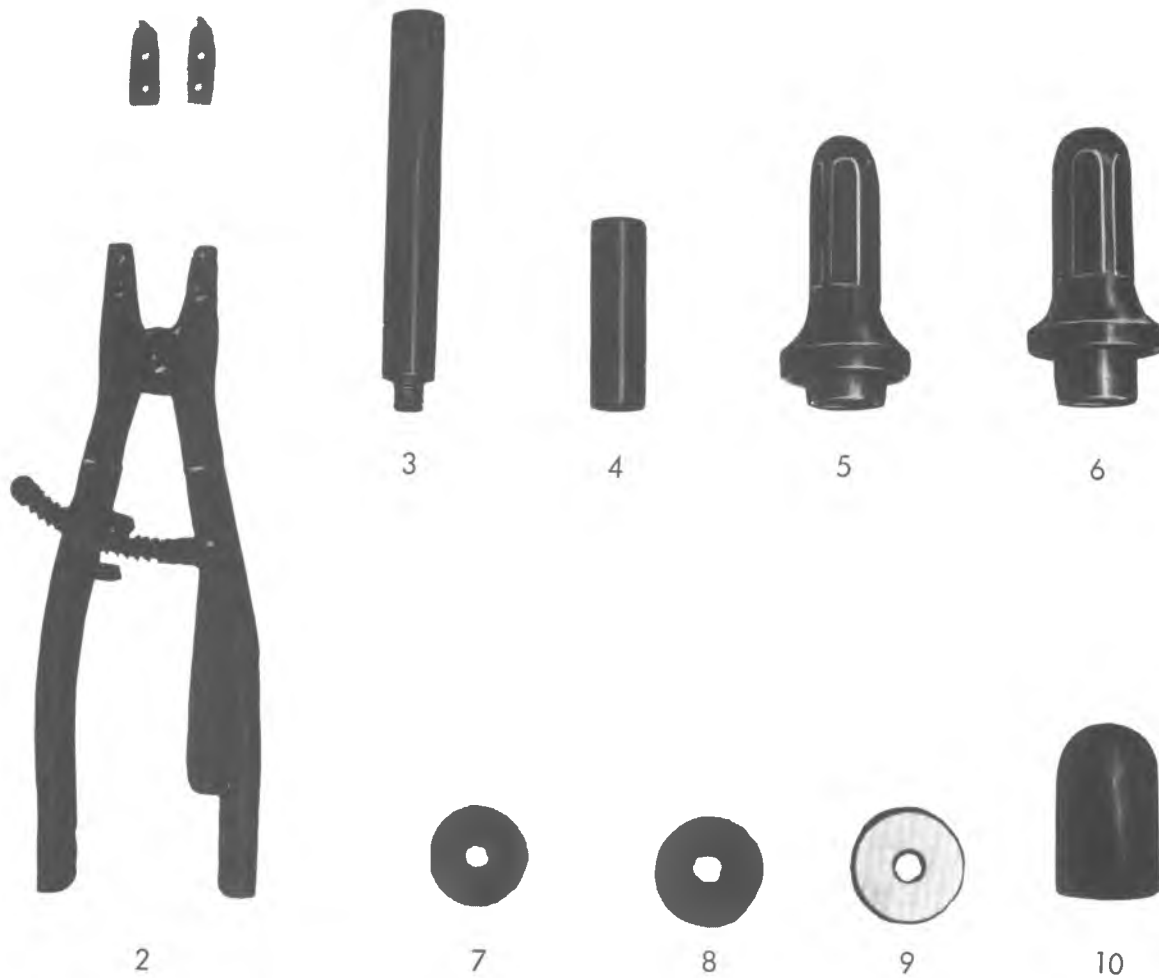
## SPECIFICATIONS

## SPECIAL TOOLS



- |                    |  |              |  |
|--------------------|--|--------------|--|
| 1. J-1126          | Transmission Guide Pins                              | 7. J-1453-01 | Speedometer Drive Gear Press Plates and Press Plate Holder J-358-1 |
| 2. J-8059          | Retainer Snap Ring Pliers                            | 8. J-2228    | Rear Bearing Press Plates  |
| 3. J-22246/J-22379 | Countergear Loading Tool                             | 9. J-933     | Main Drive Gear Wrench   |
| 4. J-5778          | Extension Bushing Remover and Installer              | 10. J-5590   | Clutch Gear Bearing Installer                                      |
| 5. J-5154          | Extension Seal Installer                             | 11. J-9772   | Clutch Gear Bearing Installer                                      |
| 6. J-5814-01       | Speedometer Drive Gear Remover and Adapter J-5814-15 | 12. J-23096  | Clutch Gear Retainer Seal Installer                                |
|                    |  | 13. J-5752   | Transmission Holding Fixture                                       |





- |              |  |
|--------------|--|
| 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.                |

## SECTION 7C

# CLUTCHES

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Single Plate Coil Spring Clutch .....	7C-3
Special Tools .....	7C-7

## SINGLE PLATE DIAPHRAGM CLUTCH

### INDEX

Disassembly .....	7C-1
Inspection .....	7C-1
Assembly .....	7C-2
Pilot Bearing Replacement .....	7C-3

#### DISASSEMBLY (FIG. 7C-3A)

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

1. Remove three drive-strap to pressure plate bolts and retracting springs and remove pressure plate from clutch cover.

2. The clutch diaphragm spring and two pivot rings are riveted to the clutch cover. Spring, rings and cover should be inspected for excessive wear or damage and if there is a defect, it is necessary to replace the complete cover assembly.

#### INSPECTION

1. Check drive straps for looseness at the clutch cover and evidence of looseness at pressure plate bolt holes.

2. Wash all parts, except driven disk and throwout bearing, in cleaning solvent.

**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

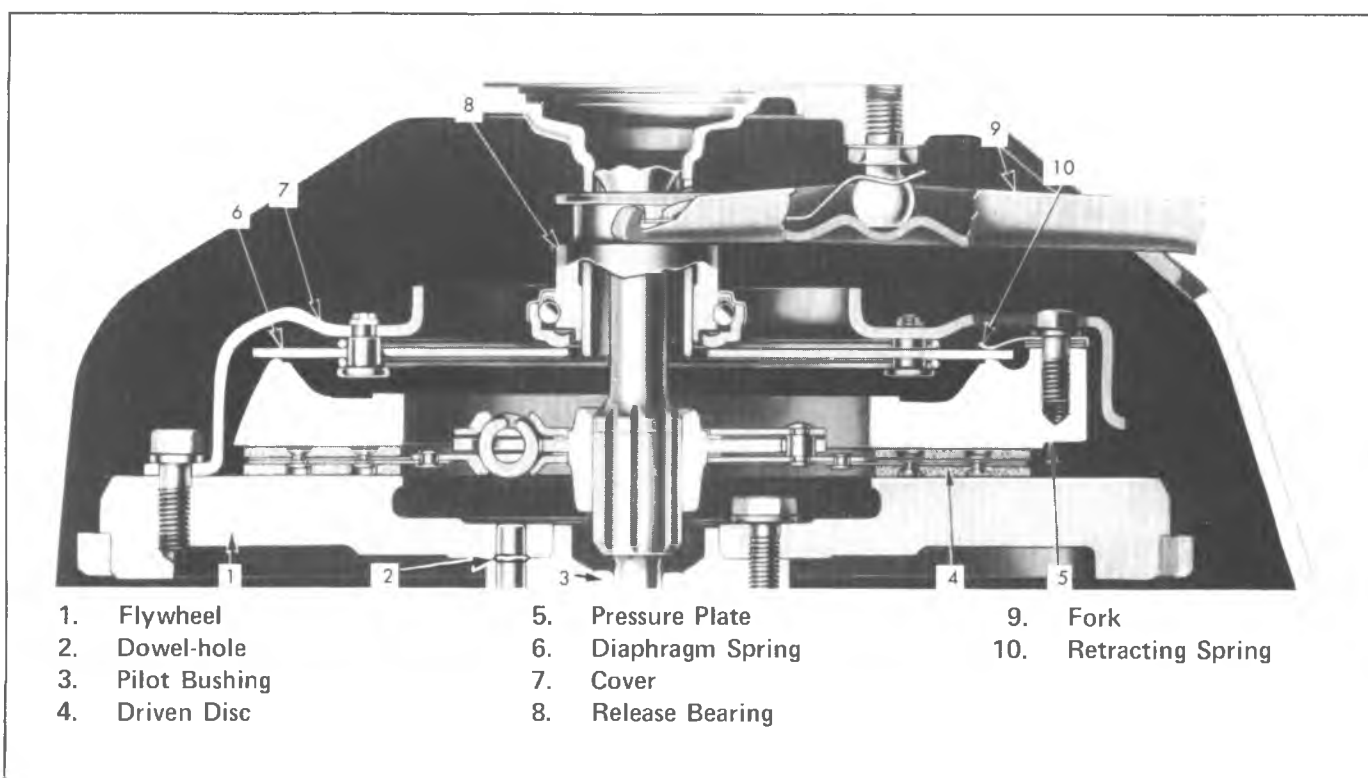


Fig. 7C-1A--Flat Finger Clutch Cross-Section (Typical)

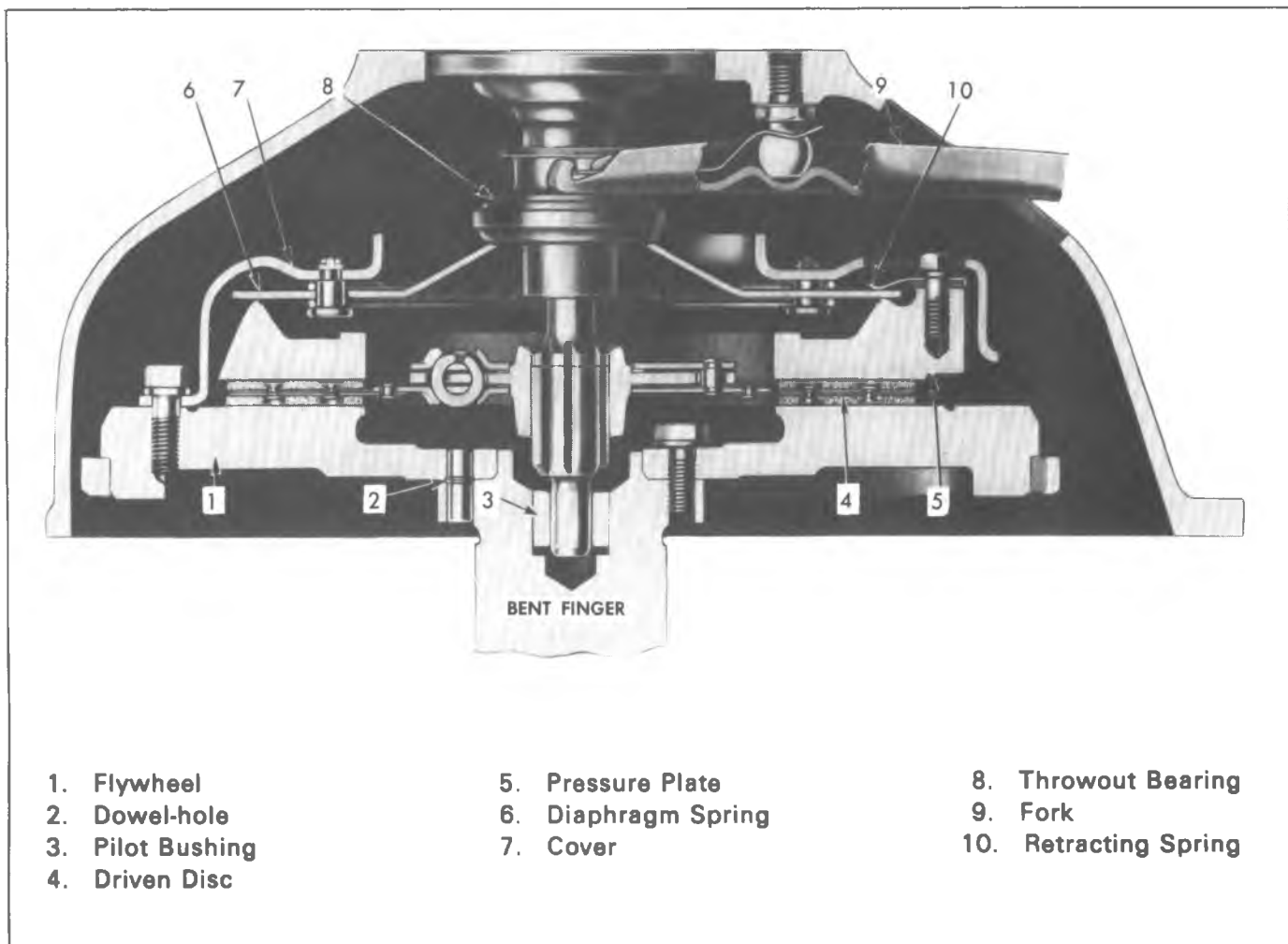


Fig. 7C-2A--Bent Finger Clutch Cross-Section (Typical)

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.

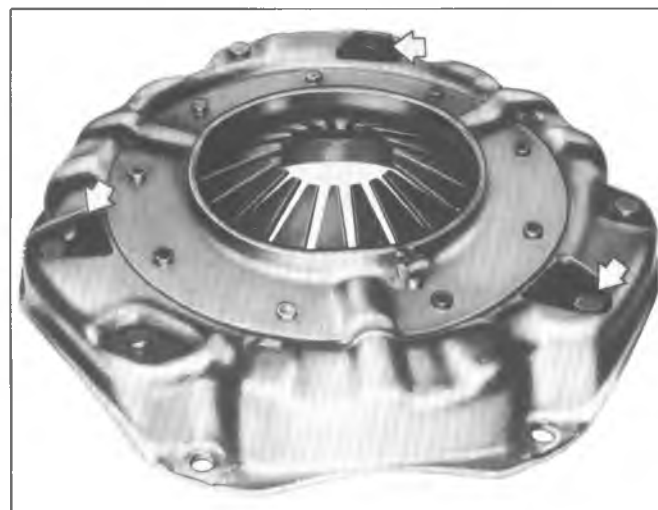


Fig. 7C-3A--Retracting Spring Location (Typical)

### ASSEMBLY

1. Install the pressure plate in the cover assembly, lining up the punch marks on the edge of the pressure plate with the punch marks on the edge of the cover.

2. Install pressure plate retracting springs and drivestrap to pressure plate bolts and lock washers and tighten to 11 ft. lbs. torque. The clutch is now ready to be installed.

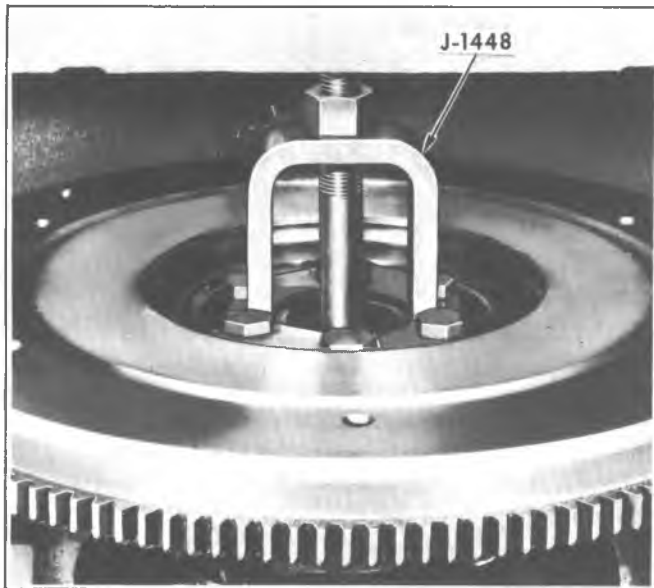


Fig. 7C-4A--Clutch Pilot Bearing Removal (Typical)

### PILOT BEARING REPLACEMENT

The clutch pilot bearing is an oil impregnated type bearing pressed into the crankshaft. This bearing requires attention when the clutch is removed from the vehicle, at which time it should be cleaned and inspected for excessive wear or damage and should be replaced if necessary.

To remove, install Tool J-1448 and remove bearing from crankshaft, as shown in (Fig. 7C-4A). In replacing this bearing, use Tool J-1522. Place bearing on pilot of tool with radius in bore of bearing next to shoulder on tool and drive into crankshaft. Lubricate with several drops of machine oil.

## SINGLE PLATE COIL SPRING CLUTCH

### INDEX

Disassembly .....	7C-3
Inspection .....	7C-3
Assembly .....	7C-3
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### DISASSEMBLY

1. Place the cover assembly on the bed of an arbor or drill press with a block under the pressure plate so arranged that the cover is left free to move down.
2. Place a block or bar across the top of the cover with the spindle. Hold compressed while the adjusting nuts are removed, as shown in Fig. 7C-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. 7C-3E.
4. To remove levers grasp lever and eyebolt between thumb and fingers as shown in Figure 7C-4E, so that inner end of lever and upper end of eyebolt are close together, keeping eyebolt pin seated in its socket in lever.
5. Lift strut over ridge on end of lever, as in Fig. 7C-5E.
6. Lift lever and eyebolt off pressure plate.

**NOTE:** It is important to replace all parts which show wear.

### INSPECTION

In addition to applicable items listed under Diaphragm Clutch Inspection, check the following items.

1. Check driving lugs for wear.
2. Check clutch cover for distortion or cracks.
3. Check release levers for wear or cracks.

### ASSEMBLY

1. Lay the pressure plate on the block in the press and coat the lugs with a thin film of approved lubricant such as lubriplate. See Fig. 7C-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 Fig. 7C-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, as in Fig. 7C-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, as shown in Fig. 7C-4E.
6. Assemble the pressure springs, on the small bosses of the pressure plate in accordance with Fig. 7C-8E in order to retain original balance.

**NOTE:** If there are spaces for more springs than specified for the particular assembly, or if two different colors of springs are used, Fig. 7C-8E shows the proper sequence. It is very important that each group be arranged in like sequence.

7. Assemble anti-rattle springs in cover. See Fig. 7C-9E. The spring to the left is in operating position.
8. Lower the cover on top of the assembled parts, as in Fig. 7C-10E. Be sure that the anti-rattle springs are in correct position and also that the punch marks made before

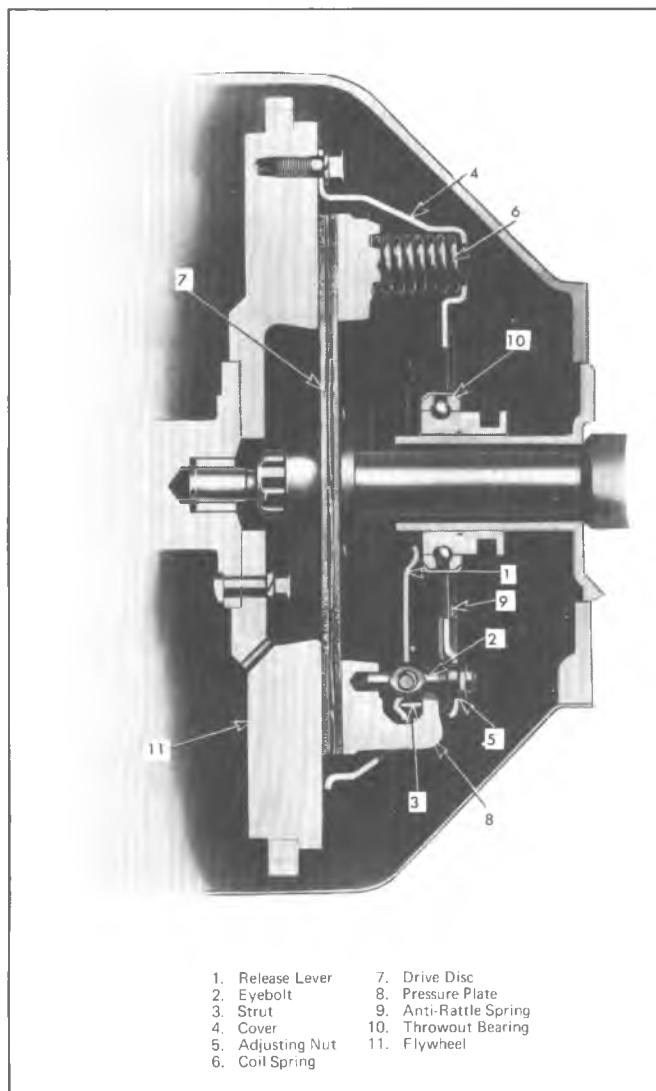


Fig. 7C-1E--Coil Spring Clutch Cross-Section (Single Plate)

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



Fig. 7C-2E--Compressing Clutch

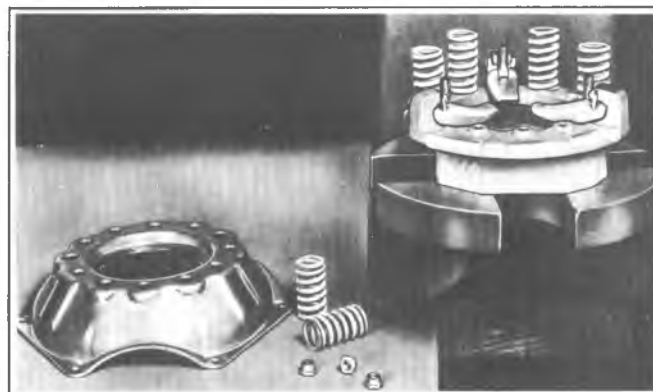


Fig. 7C-3E--Disassembly of Clutch

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 rebuild to insure uniform clutch application. To obtain exactly the same adjustment at each release lever, use gauge plate J-1048 and release lever height gauge J-6456 as follows:

1. Place gauge plate J-1048 on the flywheel in position normally occupied by driven plate. See Fig. 7C-11E.

**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.

3. Depress each lever several times with a hammer handle to settle all parts into working position, as shown in Fig. 7C-12E.

4. Position height gauge J-6456-01 on the hub of the gauge plate and the bearing surface of one lever. Refer to Fig. 7C-13E. Turn adjusting nut until lever is flush with the 12" step of J-6456-01. Adjust remaining levers in same manner.

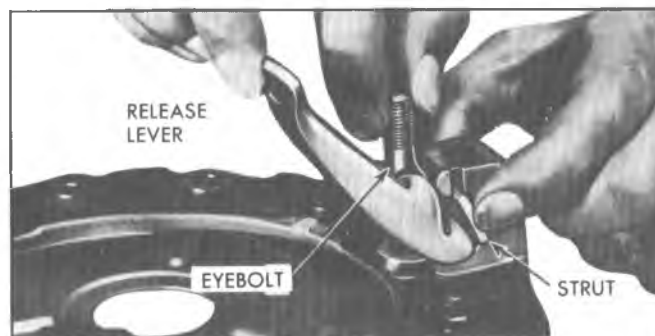


Fig. 7C-4E--Grasping Lever and Strut



Fig. 7C-5E--Removing or Installing Lever



Fig. 7C-6E--Greasing Lug

5. Stake adjusting nut, as shown in Fig. 7C-14E, to eyebolt with a dull punch to lock adjustment.

6. Loosen the cover to flywheel bolts a turn or two at a time and in rotation until spring pressure is relieved to allow clutch and gauge plate to be removed.

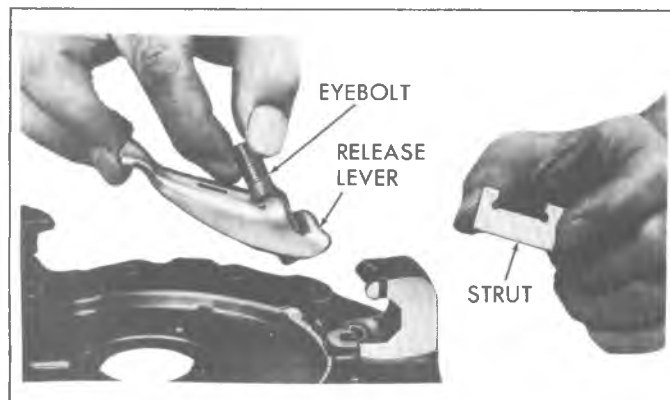


Fig. 7C-7E--Installing Lever

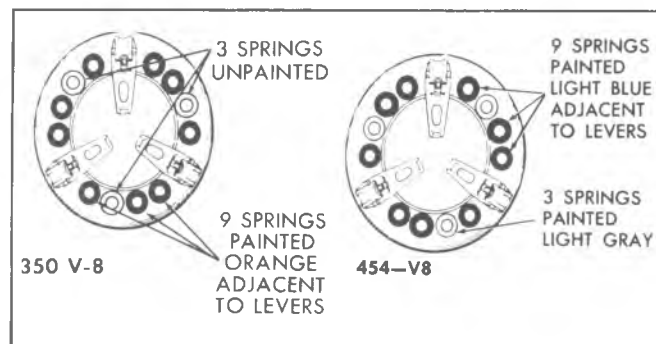


Fig. 7C-8E--Spring Arrangement Diagram

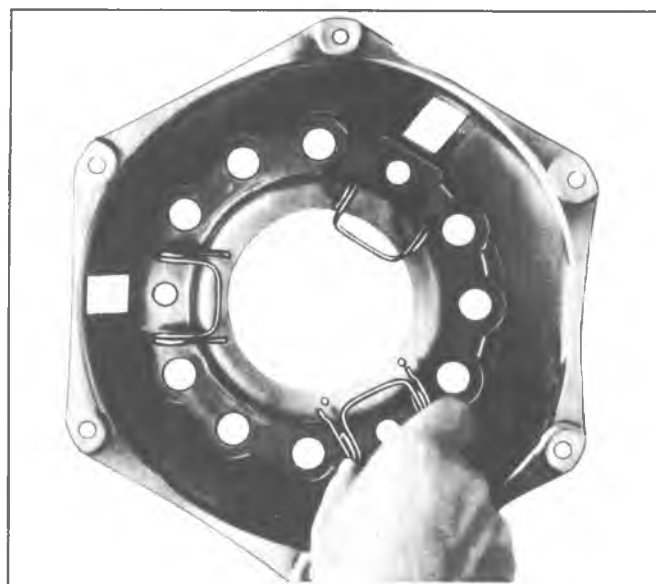


Fig. 7C-9E--Installing Anti-Rattle Spring



Fig. 7C-10E--Assembling Cover and Pressure Plate

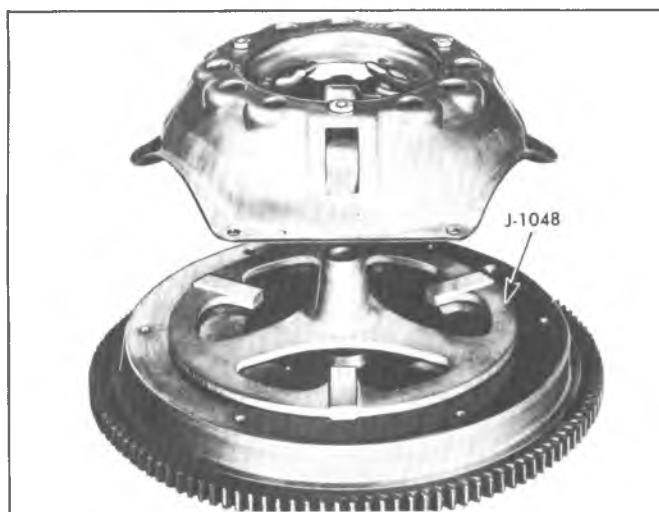


Fig. 7C-11E--Gauge Plate Position

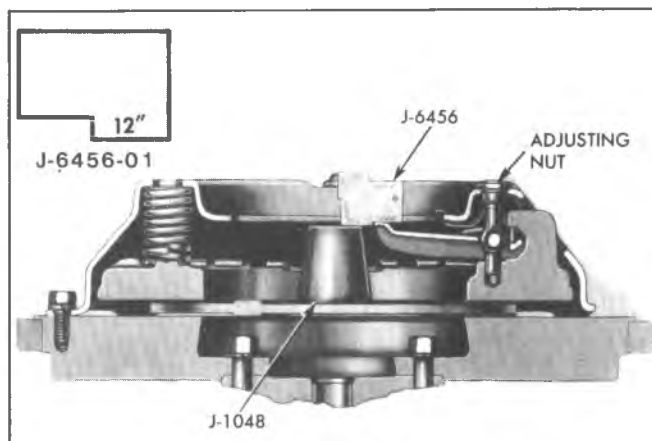


Fig. 7C-13E--Coil Spring Clutch Adjustment



Fig. 7C-12E--Depressing Lever

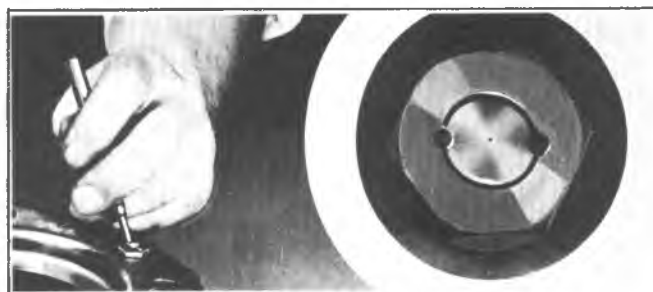


Fig. 7C-14E--Staking Nut



## SPECIAL TOOLS

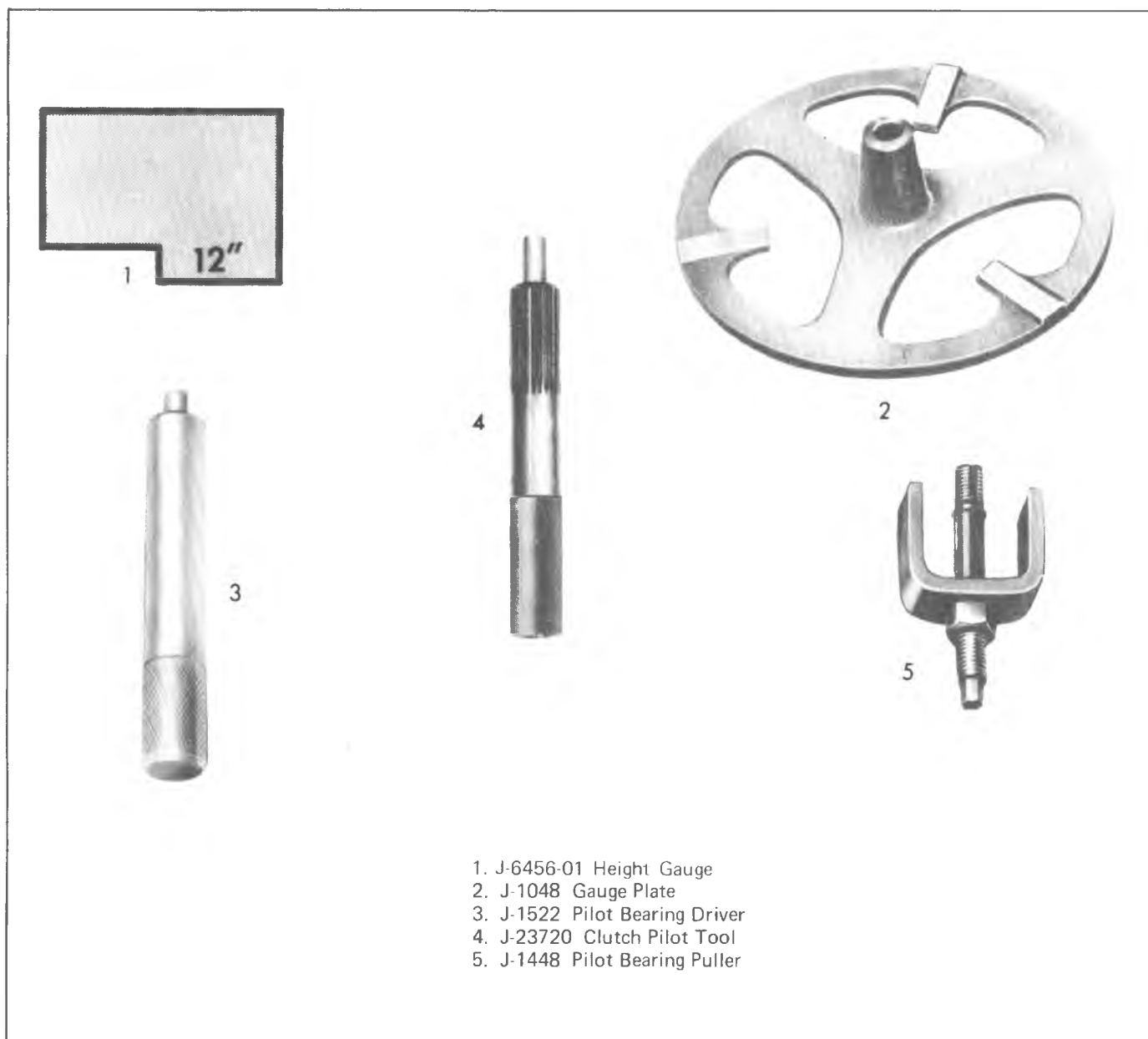
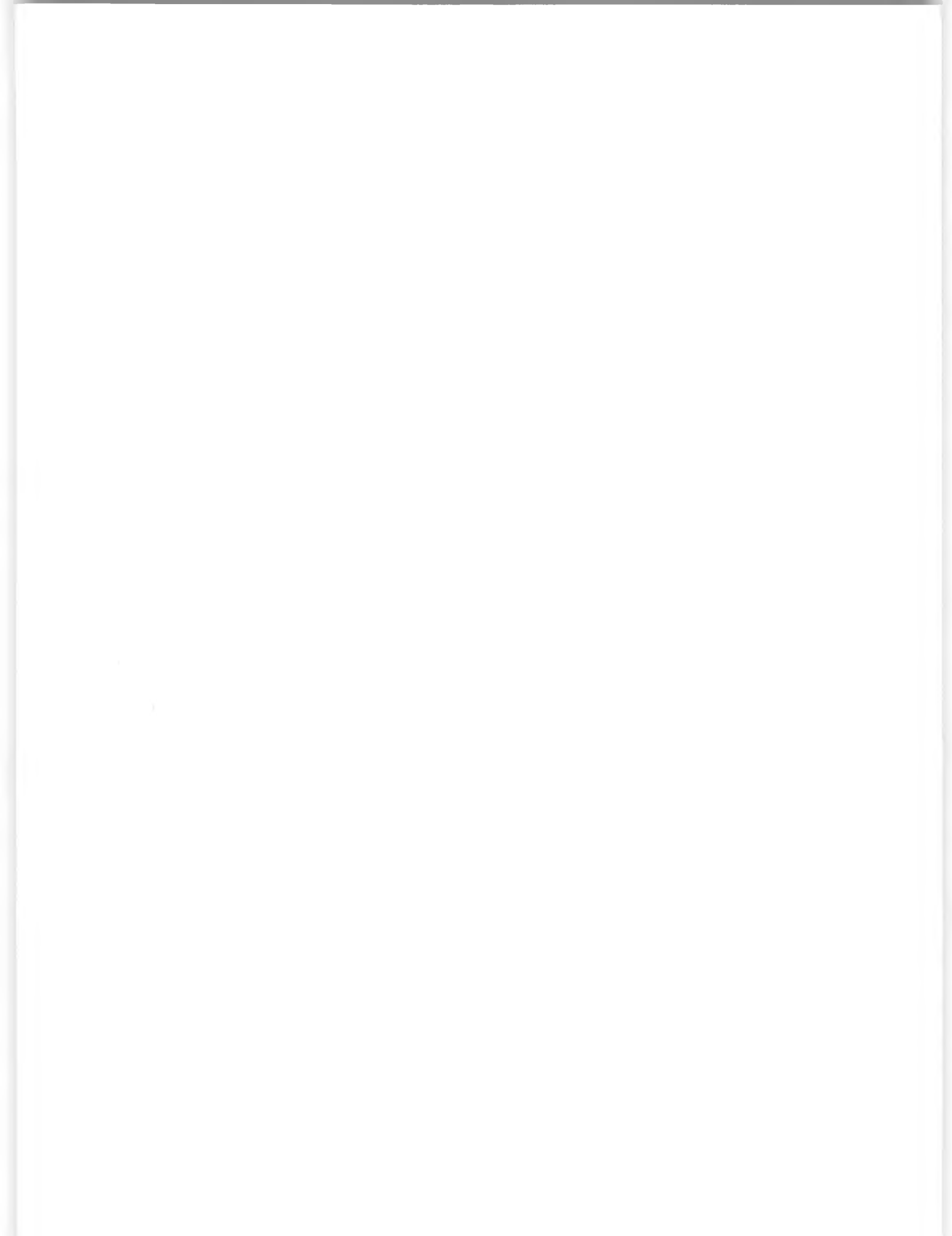


Fig. 7C-1ST--Clutch Special Tools



## SECTION 7D

# TRANSFER CASES

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## MODEL 205 (PART TIME) TRANSFER CASE

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Shift Rail and Fork Assemblies.....	7D-3	Front Output Shaft Assembly.....	7D-6
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### DISASSEMBLY OF TRANSFER CASE

(FIG. 7D-4R)

#### Rear Output Shaft and Yoke Assembly

(Fig. 7D-2R)

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.

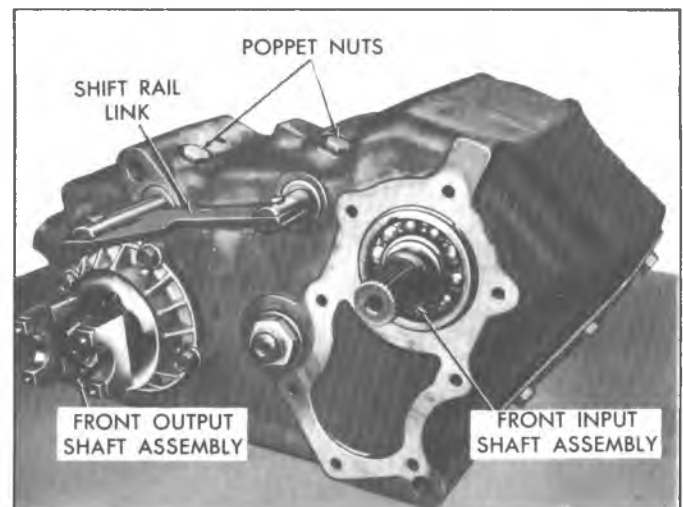


Fig. 7D-2R--Front View of Transfer Case

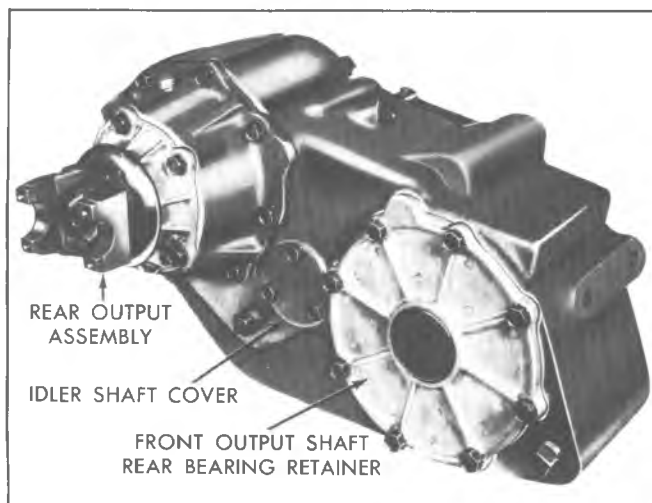


Fig. 7D-1R--Rear View of Transfer Case

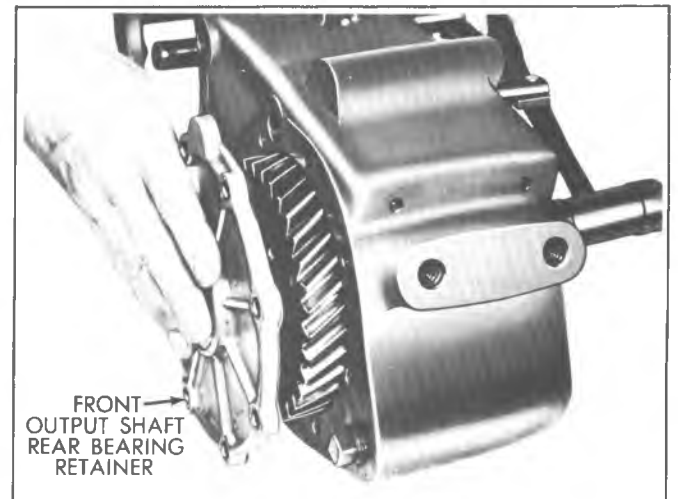
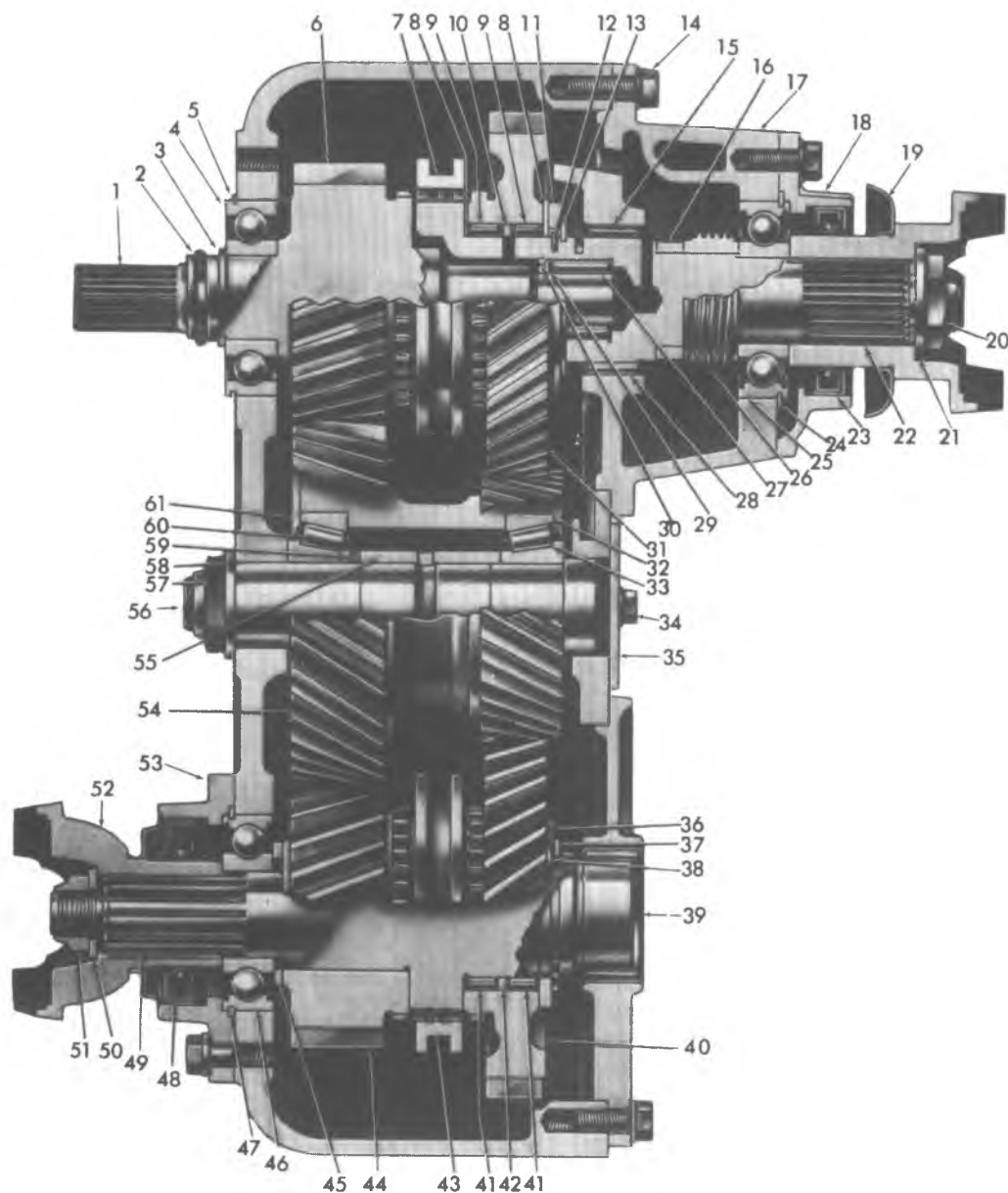


Fig. 7D-3R--Removing Front Output Shaft Rear Bearing Retainer



- |                                |                                     |  |                         |
|--------------------------------|-------------------------------------|--|-------------------------|
| 1. Input Shaft                 | 18. Rear Bearing Retainer           | 32. Idler Gear Shaft Bearing Cup                 | 43. Sliding Clutch      |
| 2. "O" Ring                    | 19. Rear Yoke Assembly              | 33. Idler Shaft Bearing Cone                     | 44. Front Wheel Hi-Gear |
| 3. Snap Ring                   | 20. Locknut                         | 34. Idler Shaft Cover Bolts and Lockwasher       | 45. Spacer              |
| 4. Bearing                     | 21. Washer                          | 35. Idler Shaft Gear Cover and Gasket            | 46. Bearing             |
| 5. Snap Ring                   | 22. Rear Output Shaft               | 36. Thrust Washer                                | 47. Snap Ring           |
| 6. Input Shaft Gear            | 23. Bearing Retainer Seal           | 37. Snap Ring                                    | 48. Seal                |
| 7. Sliding Clutch              | 24. Snap Ring                       | 38. Thrust Washer Pin                            | 49. Front Output Shaft  |
| 8. Tanged Bronze Thrust Washer | 25. Bearing                         | 39. Rear Bearing Retainer and Output Shaft Cover | 50. Washer              |
| 9. Roller Bearings             | 26. Speedometer Gear                | 40. Front Wheel Drive Low Gear                   | 51. Locknut             |
| 10. Spacer                     | 27. Pilot Bearings                  | 41. Roller Bearings                              | 52. Output Yoke         |
| 11. Thrust Washer              | 28. Rear Output Shaft Front Bearing | 42. Spacer                                       | 53. Bearing Retainer    |
| 12. Thrust Washer Pin          | 29. Washer                          |  | 54. Idler Gear          |
| 13. Snap Ring                  | 30. Bearing Retainer                |  | 55. Idler Gear Spacer   |
| 14. Bolt and Lockwasher        | 31. Rear Wheel Drive Low Gear       |  | 56. Idler Shaft         |
| 15. Needle Bearings            |                                     |  | 57. Locknut             |
| 16. Spacer                     |                                     |  | 58. Washer              |
| 17. Rear Output Shaft Housing  |                                     |  | 59. Bearing Cone        |
|                                |                                     |  | 60. Bearing Cup         |

Fig. 7D-4R--Model 205 Transfer Case Cross Section

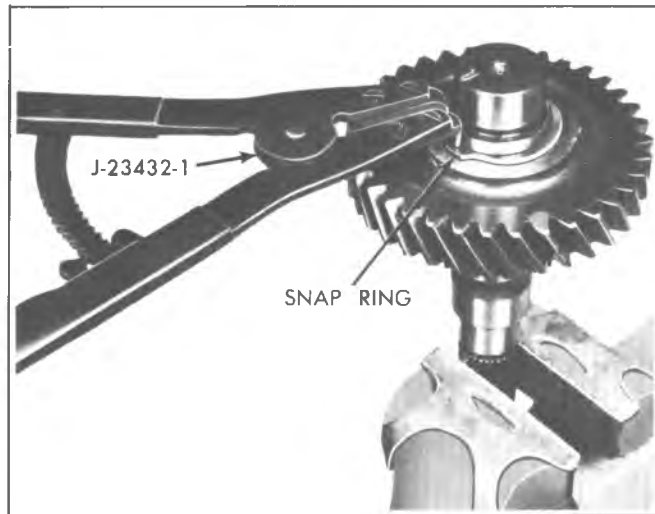


Fig. 7D-5R--Removing Gear Retaining Ring

9. Remove oil seal retainer, ball bearing, speedometer gear and spacer. Discard all gaskets. Press out bearing as required.

10. Remove oil seal from the retainer.

### Front Output Shaft Assembly (Fig. 7D-3R)

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. 7D-4R) 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. 7D-5R) 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.

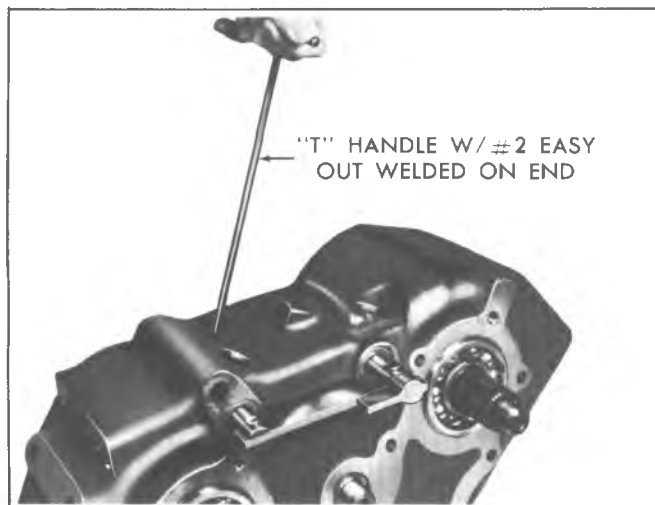


Fig. 7D-6R--Removing Shift Fork Pins

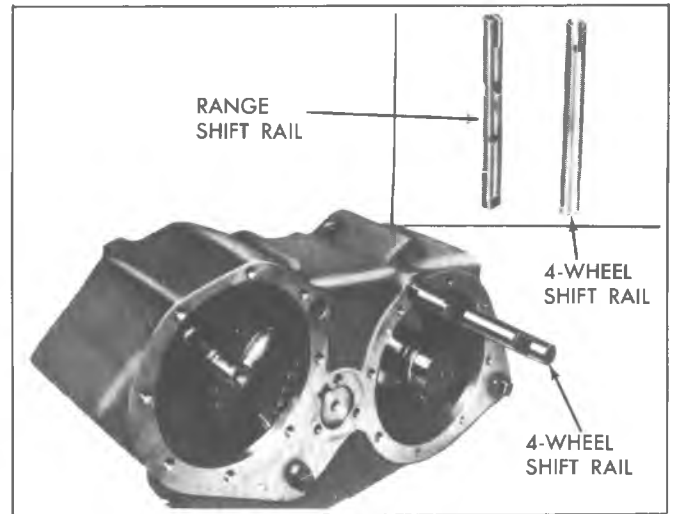


Fig. 7D-7R--Shift Rail Removal

Position new bearing to outside face of cover and using a piece of pipe or wood to cover outside diameter of bearing, press bearing into cover until flush with opening.

### Shift Rail and Fork Assemblies

1. Remove the two poppet nuts on top of case, two poppet springs, and using a magnet, remove the poppet balls.

2. Drive cup plugs into case using a 1/4 inch punch.

3. Position both shift rails in neutral and using a long, narrow punch, drive shift fork pins through shift rails into the case (Fig. 7D-6R).

4. Remove clevis pins and shift rail link.

5. Remove shift rails (Fig. 7D-7R), upper (range) rail first, then lower (4-wheel) rail.

6. Remove shift forks and sliding clutch from case.

7. Remove the front output high gear, washer, and bearing from the case. Remove the shift rail cup plugs and pins from the case.

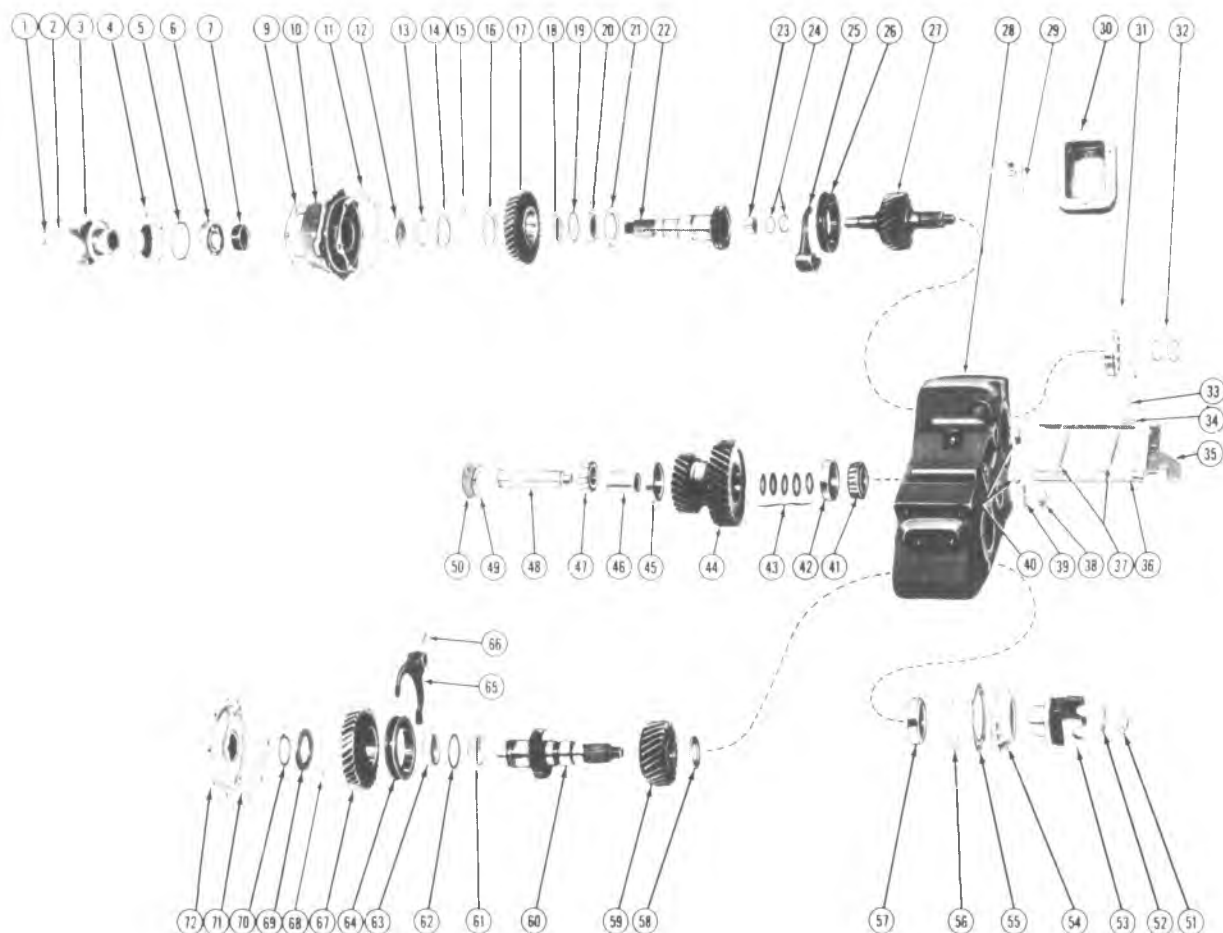
### Input Shaft Assembly

8. Remove snap ring in front of bearing. Using a soft hammer, tap shaft out rear of case. Tap bearing out front of case.

9. Tip case on P.T.O. and remove two interlock pins from inside of case.



Fig. 7D-8R--Removing Idler Gear Shaft



- |                                      |                                      |                               |
|--------------------------------------|--------------------------------------|-------------------------------|
| 1 Rear Output Shaft Locknut          | 26 Sliding Clutch                    | 49 Cover Gasket               |
| 2 Washer                             | 27 Input Shaft                       | 50 Rear Cover                 |
| 3 Yoke                               | 28 Transfer Case                     | 51 Front Output Shaft Locknut |
| 4 Bearing Retainer and Seal Assembly | 29 Poppet Plug, Spring and Ball      | 52 Washer                     |
| 5 Snap Ring                          | 30 P.T.O. Gasket and Cover           | 53 Yoke                       |
| 6 Bearing                            | 31 Input Shaft Bearing and Snap Ring | 54 Bearing Retainer and Seat  |
| 7 Speedometer Gear                   | 32 Snap Ring and Rubber "O" Ring     | 55 Gasket                     |
|                                      | 33 Shift Link Clevis Pin             | 56 Snap Ring                  |
| 9 Gasket                             | 34 Range Shift Rail                  | 57 Front Bearing              |
| 10 Housing                           | 35 Shift Rail Connector Link         | 58 Thrust Washer              |
| 11 Gasket                            | 36 Front Wheel Drive Shift Rail      | 59 Front Wheel High Gear      |
| 12 Bearing                           | 37 Interlock Pins                    | 60 Front Output Shaft         |
| 13 Snap Ring                         | 38 Rear Idler Lock Nut               | 61 Needle Bearings            |
| 14 Thrust Washer                     | 39 Washer                            | 62 Spacer                     |
| 15 Thrust Washer Lock Pin            | 40 Shift Rail Seals                  | 63 Needle Bearing             |
| 16 Thrust Washer (Tanged)            | 41 Idler Shaft Bearing               | 64 Sliding Clutch Gear        |
| 17 Low Speed Gear                    | 42 Bearing Cup                       | 65 Shift Fork                 |
| 18 Needle Bearings                   | 43 Shims                             | 66 Roll Pin                   |
| 19 Spacer                            | 44 Idler Gear                        | 67 Front Output Low Gear      |
| 20 Needle Bearings                   | 45 Bearing Cup                       | 68 Thrust Washer Lock Pin     |
| 21 Tanged Washer                     | 46 Spacer                            | 69 Thrust Washer              |
| 22 Rear Output Shaft                 | 47 Idler Shaft Bearing               | 70 Snap Ring                  |
| 23 Needle Bearings                   | 48 Idler Shaft                       | 71 Rear Cover Gasket          |
| 24 Washer and Retainer               |                                      | 72 Rear Cover and Bearing     |
| 25 Shift Fork                        |                                      |                               |

Fig. 7D-9R--New Process Model 205 Transfer Case Exploded View

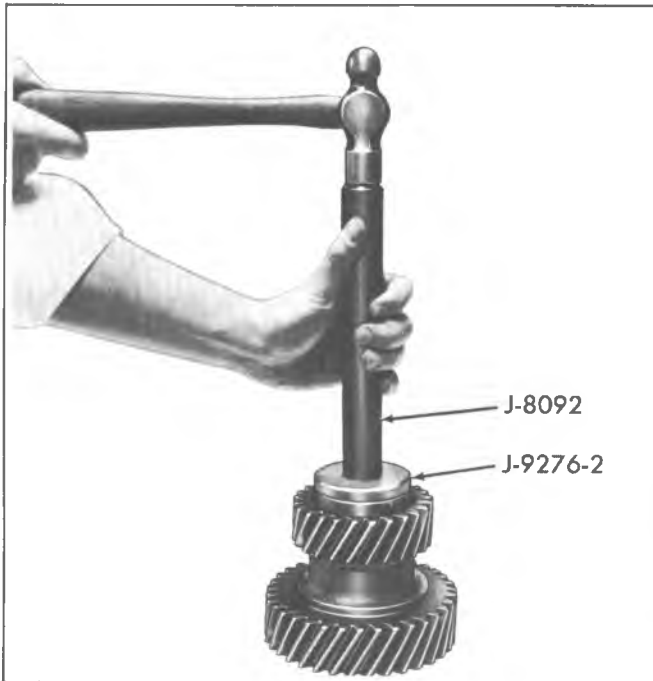


Fig. 7D-10R--Installing New Bearing Cups

### 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. 7D-8R).
4. Roll idler gear to front output shaft hole and remove from case.
5. Remove bearing cups (2) as required from idler gear.

### CLEANING AND INSPECTION

**Bearings** --Place all bearings and rollers in cleaning solution and allow to remain long enough to loosen all accumulated lubricant. Bearings should be slogged up and down and turned slowly below surface of solution to remove

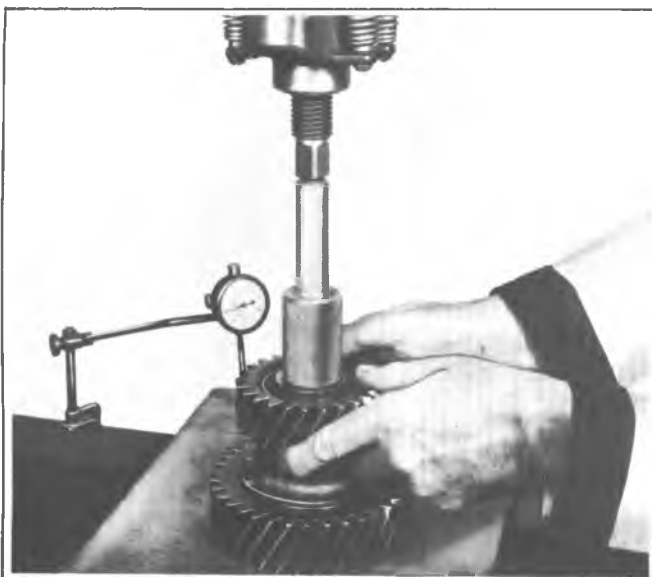


Fig. 7D-11R--Checking Idler Gear End Play

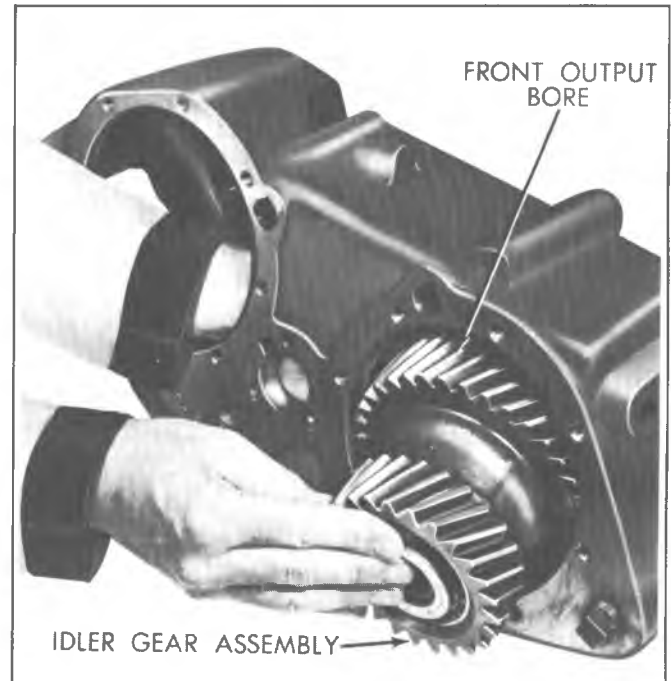


Fig. 7D-12R--Installing Idler Gear

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 surface 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. 7D-9R)

#### 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. 7D-10R).

2. Assemble the two bearing cones, spacer, shims and idler gear on dummy shaft J-23429 with bore up. Check end play (Fig. 7D-11R). Limits are .001 to .002 inch.

3. Install idler gear assembly with dummy shaft into case through front output bore, large end first (Fig. 7D-12R).



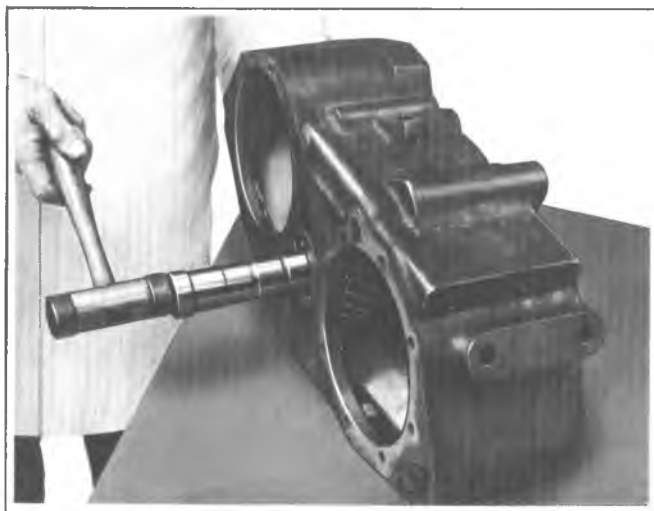


Fig. 7D-13R--Installing Idler Shaft

4. Install idler shaft from large bore side and drive through using a soft hammer (Fig. 7D-13R).

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. 7D-14R).

### 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, with poppet notches up.

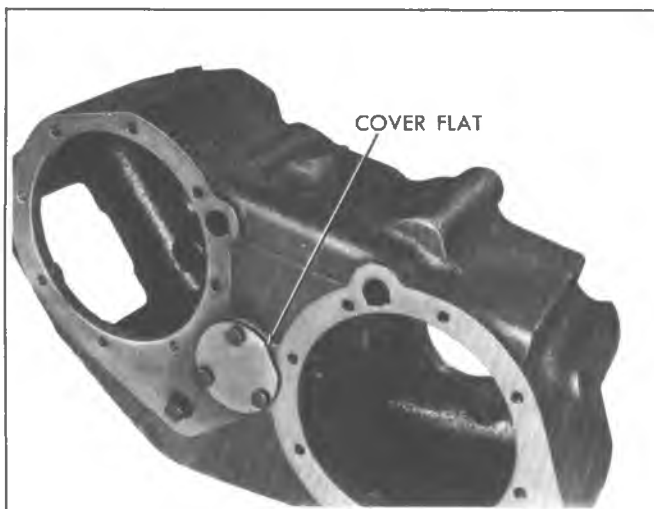


Fig. 7D-14R--Installing Idler Shaft Rear Cover

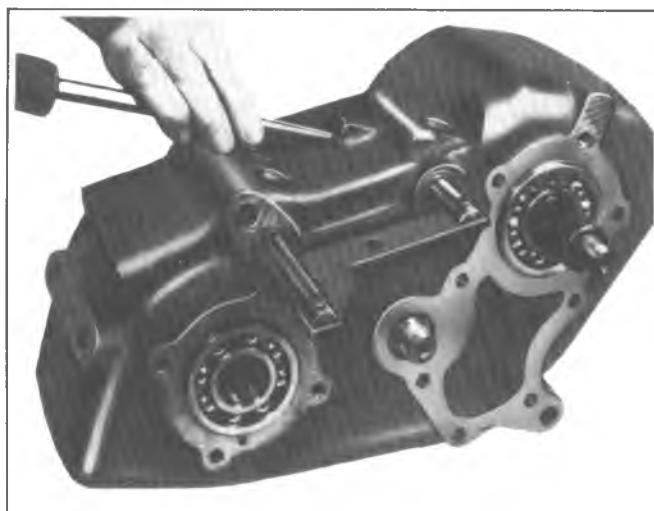


Fig. 7D-15R--Installing Shift Rail Lock Pins

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. 7D-15R).

**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 reatin 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.



Fig. 7D-16R--Installing Front Output Bearing Retainer Seal

3. Position front wheel hi-gear and washer in case. Install sliding clutch in the shift fork, then put fork and rail in the front wheel drive (4-Hi) position with the clutch teeth in mesh with the teeth of the front wheel hi-gear.

4. Line up washer, high gear, and sliding clutch with bearing bore. Insert front output shaft and low gear assembly through the high gear assembly.

5. Install new seal in bearing retainer using Tool J-22836 (Fig. 7D-16R) 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.

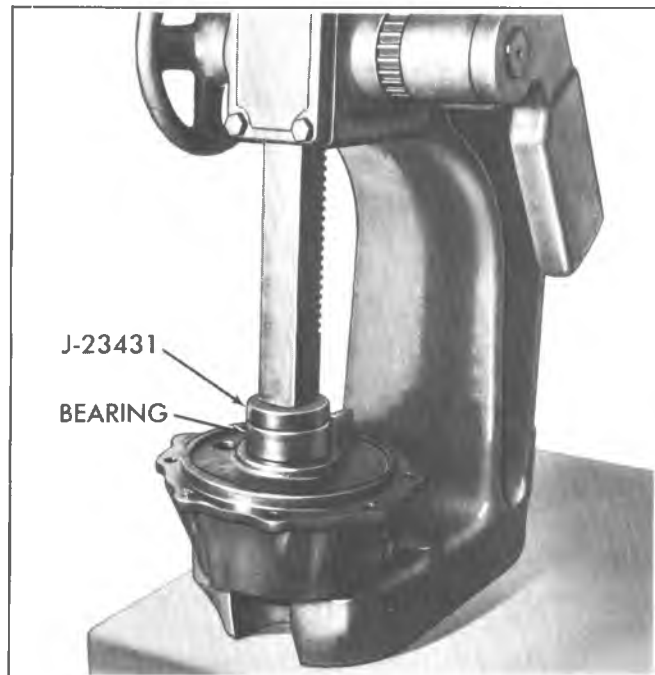


Fig. 7D-17R--Installing Rear Output Shaft Housing Bearing

## 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.

5. Clean, grease, and install new bearing in retainer housing using Tool J-23431 (Fig. 7D-17R).

6. Install housing onto output shaft assembly, install spacer and speedometer gear, then install bearing (Fig. 7D-18R).

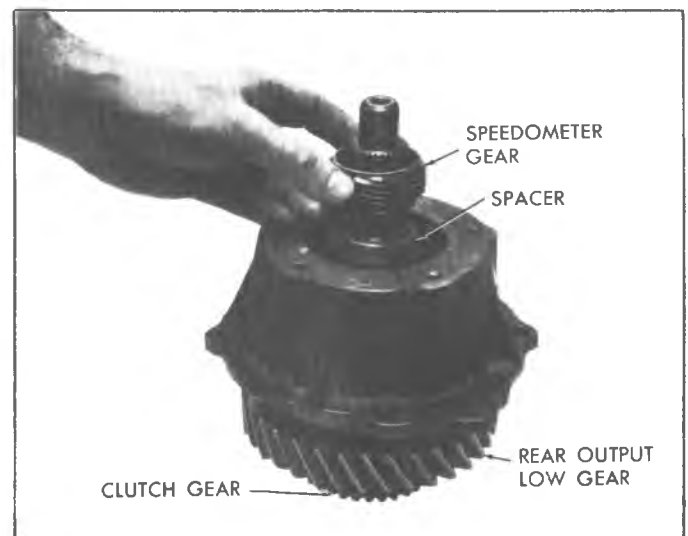


Fig. 7D-18R--Installing Rear Output Shaft Spacer and Speedometer Gear

7. Install rear bearing retainer seal using Tool J-21359 or J-22834-2 (Fig. 7D-19R).

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.

### Miscellaneous

1. Install P.T.O. cover and gasket. Torque bolts to 15 ft. lbs.

2. Install and seal cup plugs at rail pin holes, if not previously done.

3. Install drain and filler plugs and torque to 30 ft. lbs.

4. Install shift rail cross link, clevis pins and lock pins.

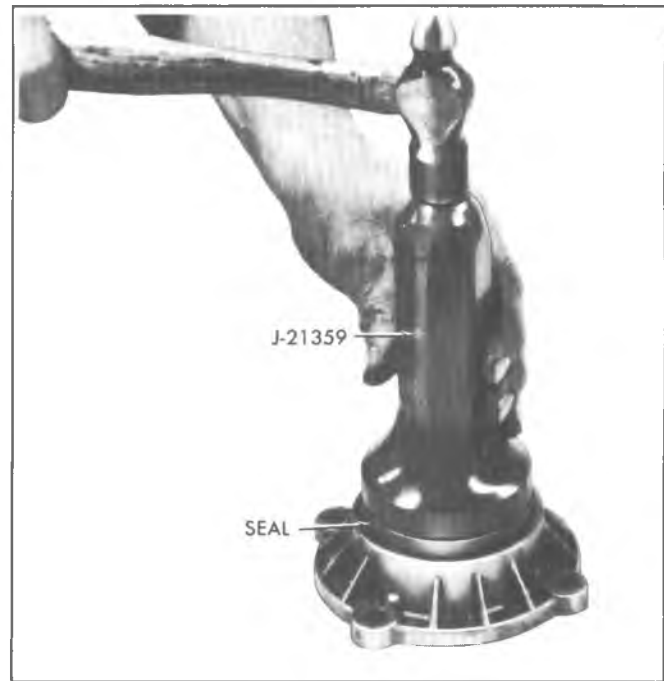


Fig. 7D-19R—Installing Rear Bearing Retainer Seal

## MODEL 203 (FULL TIME) TRANSFER CASE

### INDEX

Disassembly of Transfer Case .....	7D-8	Input Gear Bearing Replacement .....	7D-15
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### DISASSEMBLY OF TRANSFER CASE

Refer to Figs. 7D-10S, 7D-11S and 7D-12S for cross sectional and exploded views of the transfer case.

1. Position transfer case on work bench or suitable work table.

**NOTE:** If lubricant was not drained from unit prior to removal from vehicle, remove front output rear cover and P.T.O. cover lower bolts and drain lubricant into waste container.

2. Using Tool J-8614-1, loosen rear output shaft flange retaining nut (Fig. 7D-3S).

3. Using Tool J-8614-1, remove front output shaft flange retaining nut, washer and flange.

**NOTE:** Tap dust shield rearward on shaft (away from bolts) to obtain clearance to remove bolts from flange and allow installation of Tool J-8614-1.

4. Remove bolts retaining front output shaft front bearing retainer (Fig. 7D-4S). Remove bearing retainer and gasket from transfer case. Discard gasket.

5. Using a hoist or other suitable lifting tool, position assembly on blocks (Fig. 7D-5S).

6. Remove bolts retaining rear section of rear output housing from front section of rear output housing, and disengage. Remove shims and speedometer gear from output shaft.

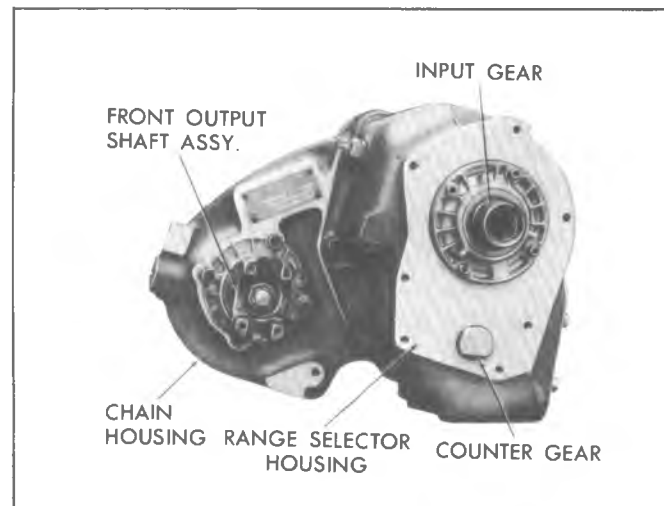


Fig. 7D-1S—Front View of Transfer Case

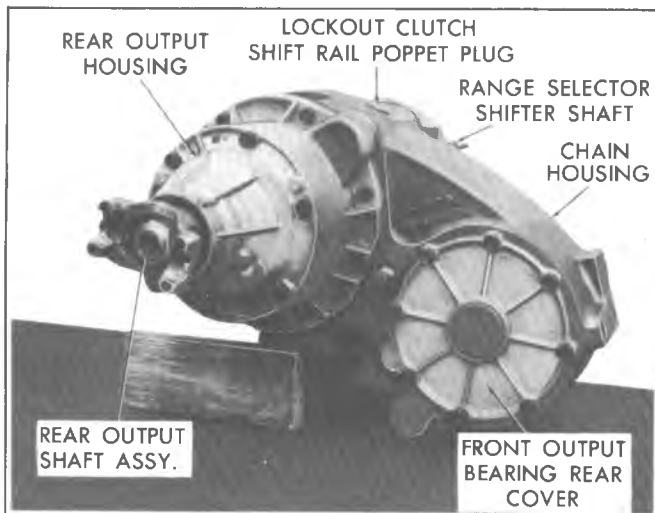


Fig. 7D-2S-Rear View of Transfer Case

a. Remove bolts retaining front section of rear output housing assembly from transfer case. Remove housing from case.

b. Remove "O" ring seal from front section of rear output housing and discard.

c. Disengage rear output shaft from differential carrier assembly.

7. Slide carrier unit from shaft.

**NOTE:** A 1-1/2" to 2" water hose band type clamp may be installed on the input shaft at this time to prevent loosening bearings when removing input shaft assembly from the range box.

8. Raise shift rail and drive out pin retaining shift fork to rail (Fig. 7D-6S).

9. Remove shift rail poppet ball plug, gasket spring and ball from case (Fig. 7D-7S). A small magnet may be used to remove ball from case.

10. Push shift rail down, lift up on lockout clutch and remove shift fork from clutch assembly.

11. Remove bolts retaining front output shaft rear bearing retainer to transfer case. Tap on front of shaft or carefully pry retainer away from case. Remove retainer from shaft and discard gasket. Recover any roller bearings which may fall from rear cover.

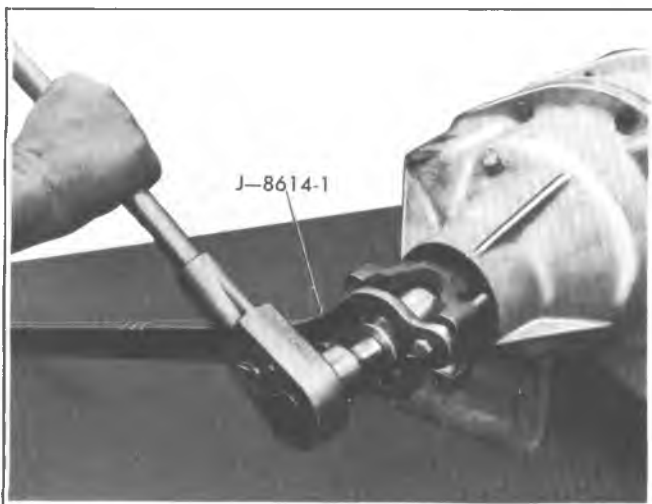


Fig. 7D-3S-Removing Rear Output Shaft Flange Nut

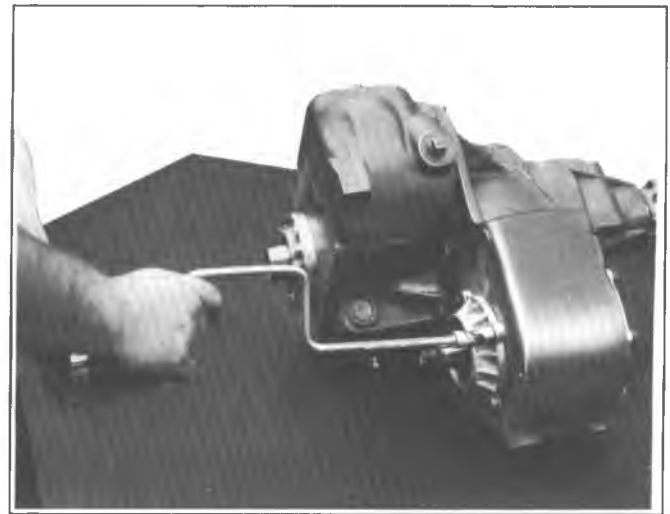


Fig. 7D-4S-Removing Front Output Shaft Front Bearing Retainer

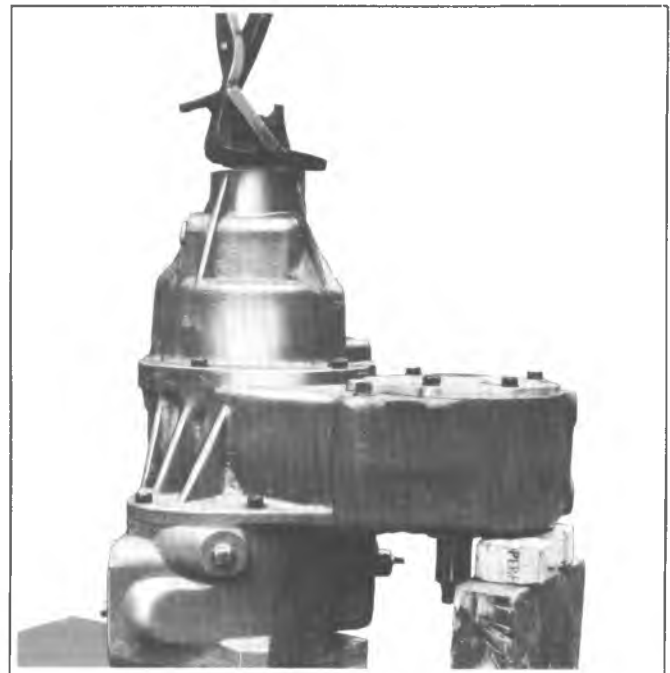


Fig. 7D-5S-Positioning Transfer Case for Disassembly

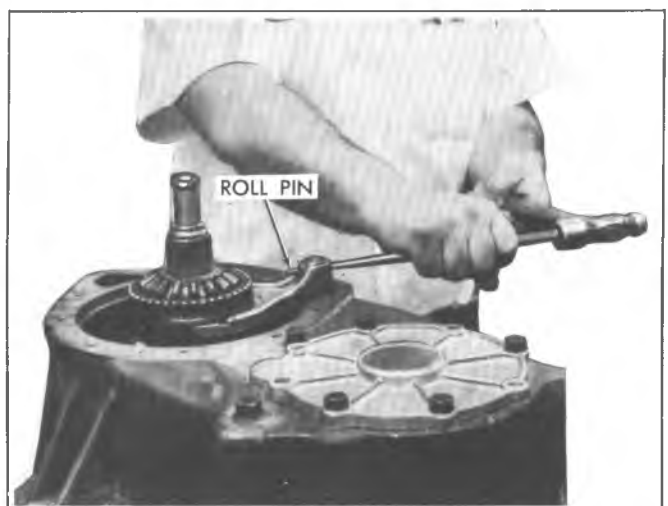


Fig. 7D-6S-Removing Shift Fork Retaining Pin

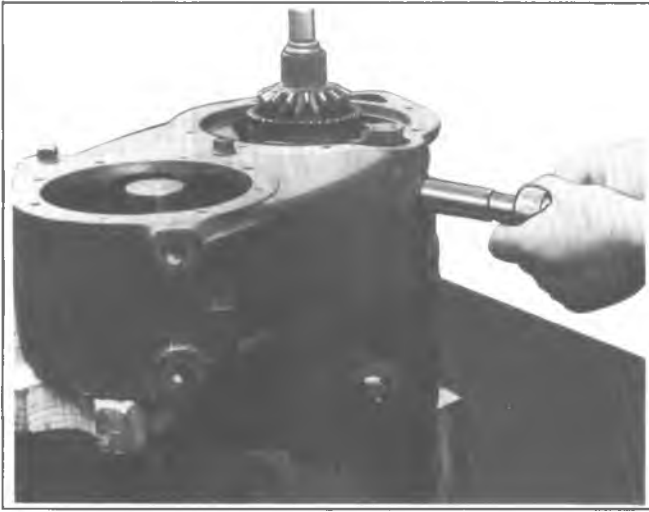


Fig. 7D-7S--Removing or Installing Poppet Ball Plug

**NOTE:** If necessary to replace rear bearing, support cover and press bearing from cover. Position new bearing to outside face of cover and press bearing into cover with a .06 inch overhang.

12. From lower side of case, remove (pry) output shaft front bearing.

13. Disengage front output shaft from chain and remove shaft from transfer case (Fig. 7D-8S).

14. Remove bolts attaching intermediate chain housing to range box. Lift or using a chain hoist, remove intermediate housing from range box (Fig. 7D-9S).

15. Remove chain from intermediate housing.

16. Remove lockout clutch, drive gear and input shaft assembly from range box.

**NOTE:** A 1 1/2" to 2" hose clamp may be installed on end of the input shaft to prevent losing the roller bearings (123) which may fall out of clutch assembly if it is pulled off the input shaft.

17. Pull up on shift rail and disconnect rail from link.

18. Remove (lift) input shaft assembly from range box.

**NOTE:** At this point the transfer case is completely disassembled into its subassemblies. Each of these subassemblies should then be disassembled for cleaning and inspection.



Fig. 7D-8S--Removing Front Output Shaft

## CLEANING AND INSPECTION

**BEARINGS**--Place all bearings and rollers in cleaning solution and allow to remain long enough to loosen all accumulated lubricant. Bearings should be sloshed up and down and turned slowly below surface of solution to remove as much lubricant as possible. Remove bearings and blow dry with compressed air, being careful to direct air across bearing so that bearings do not spin.

**SHAFTS AND GEARS**--Clean all shafts and gears in cleaning solution to remove all accumulations. Dry with compressed air.

**CASE, COVER AND HOUSINGS**--Transfer case, cover, and housings must be thoroughly cleaned in solution to remove all accumulation of lubricant and dirt. Remove all trace of gaskets from surfaces where used.

**INSPECTION**--Carefully inspect all bearings and rollers for evidence of chipping, cracks, or worn spots that would render bearing unfit for further service. Bearings are non-adjustable and if worn or damaged, must be replaced with new parts. Inspect shaft splines drive chain and gears. If any indication of failure, such as chipped teeth or excessive wear, is indicated, those parts should be replaced with new parts.

## SUBASSEMBLY REPAIRS

**NOTE:** Refer to Figure 7D-12S for exploded view of subassemblies.

### Differential Carrier Assembly (Fig. 7D-12S)

#### Disassembly

1. Remove bolts from carrier assembly and separate carrier sections.

2. Lift the pinion gear and spider assembly from carrier.

**NOTE:** Observe that undercut side of pinion gear spider faces toward front side gear.

3. Remove the pinion thrust washers, pinion roller washers pinion gears and roller bearings from the spider unit.

4. Clean and inspect all components. Replace all worn or broken parts.

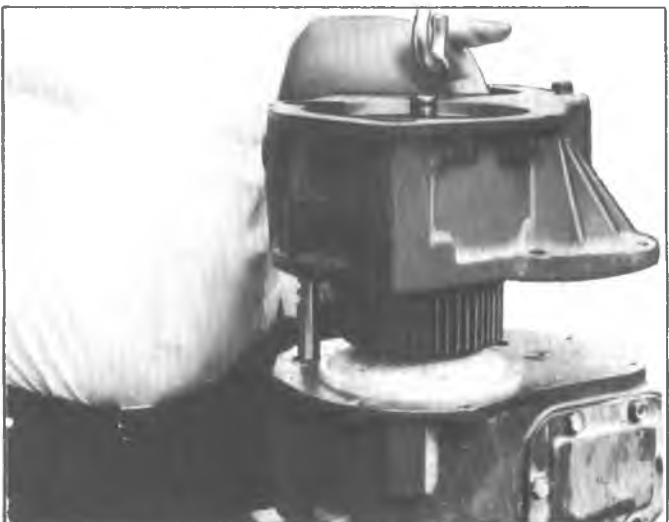


Fig. 7D-9S--Removing Intermediate (Chain) Housing

## Assembly

1. Using a petroleum jelly, load roller bearings in pinion gears (132 required, 33 each pinion).
2. Install pinion roller washer, pinion gear, roller washer and thrust washer on each leg of spider.
3. Place the spider assembly in the carrier (front half) with undercut surface of spider thrust surface facing downward or toward gear teeth.
4. Align marks on carrier sections and position carrier halves together. Install retaining bolts and tighten to specifications.

## Lockout Clutch Assembly (Fig. 7D-11S)

### Disassembly

1. Remove front side gear from input shaft assembly and remove thrust washer, roller bearings (123) and spacers from front side gear bore. Note position of spacers to facilitate reassembly.
2. Using snap ring pliers, remove the snap ring retaining drive sprocket to clutch assembly. Slide the drive sprocket from the front side gear.
3. Using snap ring pliers, remove lower snap ring.
4. Remove sliding gear, spring and spring cup washer from front side gear.
5. Clean and inspect all components. Replace all worn or defective parts.

### Assembly

1. Install spring cup washer, spring and sliding clutch gear on front side gear.
2. Install snap ring retaining sliding clutch to front side gear.
3. Using a petroleum jelly, load roller bearings (123) and spacers in the front side gear.
4. Install thrust washer in gear end of front side gear.
5. Slide drive sprocket on to clutch splines and install retaining ring.

## Input Shaft Assembly (Fig. 7D-11S)

### Disassembly

1. Slide thrust washer and spacer from shaft.
2. Using snap ring pliers, remove snap ring retaining input bearing retainer assembly to shaft (Fig. 7D-13S) and remove bearing retainer assembly from shaft.
3. Support low speed gear (large gear) and tap shaft from gear and thrust washer.

**NOTE:** Observe thrust washer pin(s) located in shaft (Fig. 7D-11S).

4. Using a screw driver, pry behind open end of large snap ring retaining input bearing in bearing retainer (Fig. 7D-14S) and remove ring from retainer. Tap bearing from retainer.

5. Remove pilot roller bearings (15) from end of input shaft.

6. Remove "O" ring from end of shaft and discard.
7. Clean and inspect all components. Replace as required.

### Assembly

1. Position bearing to retainer and tap or press into place. Ball loading slots should be toward concave side of retainer.

2. Install large snap ring securing bearing in retainer.

**NOTE:** Snap ring is a select fit. Use size A, B, C or D as required to provide tightest fit.

3. Install low speed gear on shaft with clutch end toward gear end of shaft.

4. Position thrust washers on shaft, aligning slot in washer with pin in shaft. Slide or tap washer into place.

5. Position input bearing retainer on shaft and install snap ring, holding bearing in place on shaft.

**NOTE:** Snap ring is a select fit. Use size A, B, C or D as required to provide tightest fit.

6. Slide spacer and thrust washer onto shaft. Align spacer with locator pin.

7. Using a heavy grease, install roller bearings (15) in end of shaft.

8. Install new rubber "O" ring on end of shaft.

## Range Selector Housing (Range Box)

### Disassembly (Fig. 7D-11S)

#### Removing Shifter Assembly

1. Remove poppet plate spring, plug and gasket. Discard gasket.
2. Disengage sliding clutch gear from input gear and remove clutch fork and sliding gear from case.
3. Remove shift lever assembly retaining nut and upper shift lever from shifter shaft.
4. Remove shift lever snap ring and lower lever.
5. Push shifter shaft assembly downward and remove lockout clutch connector link.

**NOTE:** Long end of connector link engages poppet plate.

6. Remove shifter shaft assembly from case and separate the inner and outer shifter shafts. Remove and discard "O" rings.

7. Inspect poppet plate for damage. If necessary to remove, drive pivot shaft from case. Remove poppet plate and spring from bottom of case.

#### Removing Input Gear Assembly

8. Remove input gear bearing retainer and seal assembly. Discard gasket.
9. Remove large snap ring from bearing outer diameter.
10. Tap input gear and bearing from case.
11. Remove snap ring retaining input shaft bearing to shaft and remove bearing from input gear.

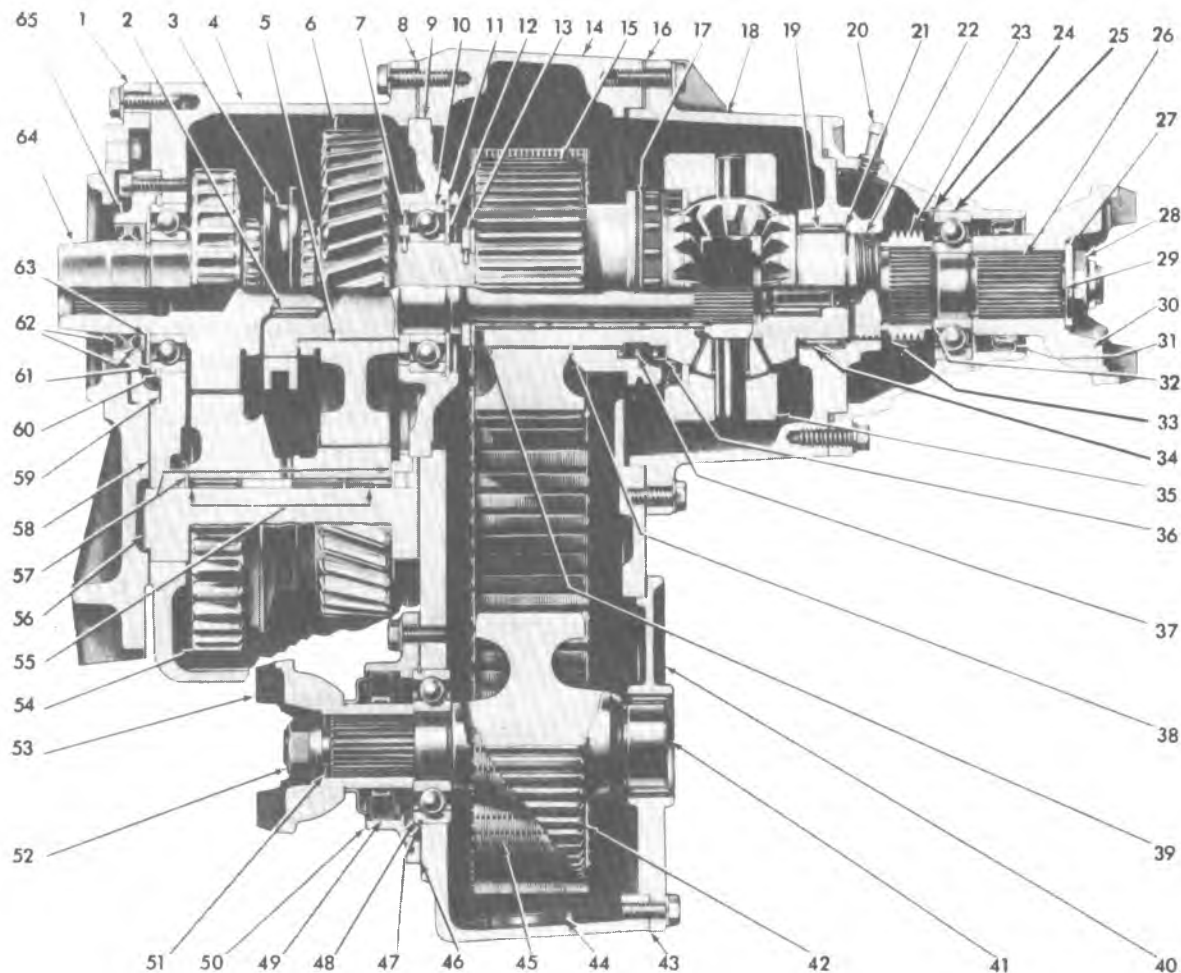
**NOTE:** This is a select fit snap ring. Snap rings, size A, B, C, and D are released for service. Select tightest fit.

#### Removing Cluster Gear Assembly (Fig. 7D-15S)

12. From intermediate case side, remove counter shaft from cluster gear and case using Tool J-24745. Remove cluster gear assembly from case.

**NOTE:** Recover roller bearings (72 required) from gear case and shaft.

13. Remove cluster gear thrust washers from case.



- |  |                                   |                                   |
|--|-----------------------------------|-----------------------------------|
| 1. Adapter   | 22. Oil Pump                      | 44. Magnet                        |
| 2. Input Drive Gear Pilot Brgs.                              | 23. Speedometer Drive Gear        | 45. Drive Chain                   |
| 3. Range Selector Sliding Clutch                             | 24. Brg. Retainer Ring            | 46. Gasket                        |
| 4. Range Selector Housing                                    | 25. Rear Output Rear Brg.         | 47. Brg. Outer Ring               |
| 5. Low Speed Gear Bushing                                    | 26. Rear Output Shaft             | 48. Front Output Front Brg.       |
| 6. Low Speed Gear  | 27. Washer                        | 49. Front Output Shaft Seal       |
| 7. Thrust Washer & Locating Pin                              | 28. Locknut                       | 50. Front Output Brg. Retainer    |
| 8. Gasket  | 29. Rubber Spline Seal            | 51. Rubber Spline Seal            |
| 9. Input Brg. Retainer                                       | 30. Rear Output Yoke              | 52. Locknut                       |
| 10. Input Brg.   | 31. Rear Output Seal              | 53. Front Output Yoke             |
| 11. Brg. Outer Ring  | 32. Shims                         | 54. Countergear                   |
| 12. Brg. Retaining Ring                                      | 33. Input Shaft "O" Ring          | 55. Countergear Spacers and Brgs. |
| 13. Thrust Washer, Locating Pin, Lubricating Washer & Spacer | 34. Input Shaft Pilot Bearings    | 56. Countergear Shaft             |
| 14. Intermediate (Chain Housing)                             | 35. Differential Carrier Assembly | 57. Countergear Thrust Washer     |
| 15. Drive Shaft Sprocket                                     | 36. Spring Washer Cup             | 58. Gasket                        |
| 16. Gasket   | 37. Lockout Clutch Spring         | 59. Brg. Retainer Gasket          |
| 17. Sliding Lock Clutch                                      | 38. Snap Ring                     | 60. Brg. Outer Ring               |
| 18. Rear Output Housing                                      | 39. Snap Ring                     | 61. Input Gear Brg.               |
| 19. Rear Output Front Brg.                                   | 40. Front Output Rear Brg. Cover  | 62. Input Gear Seals (2)          |
| 20. Vent   | 41. Front Output Rear Brg.        | 63. Brg. Snap Ring                |
| 21. Oil Seal   | 42. Front Output Drive Sprocket   | 64. Input Gear                    |
|  | 43. Gasket                        | 65. Input Gear Brg. Retainer      |

Fig. 7D-10S-Model 203 Transfer Case, Cross Sectional View



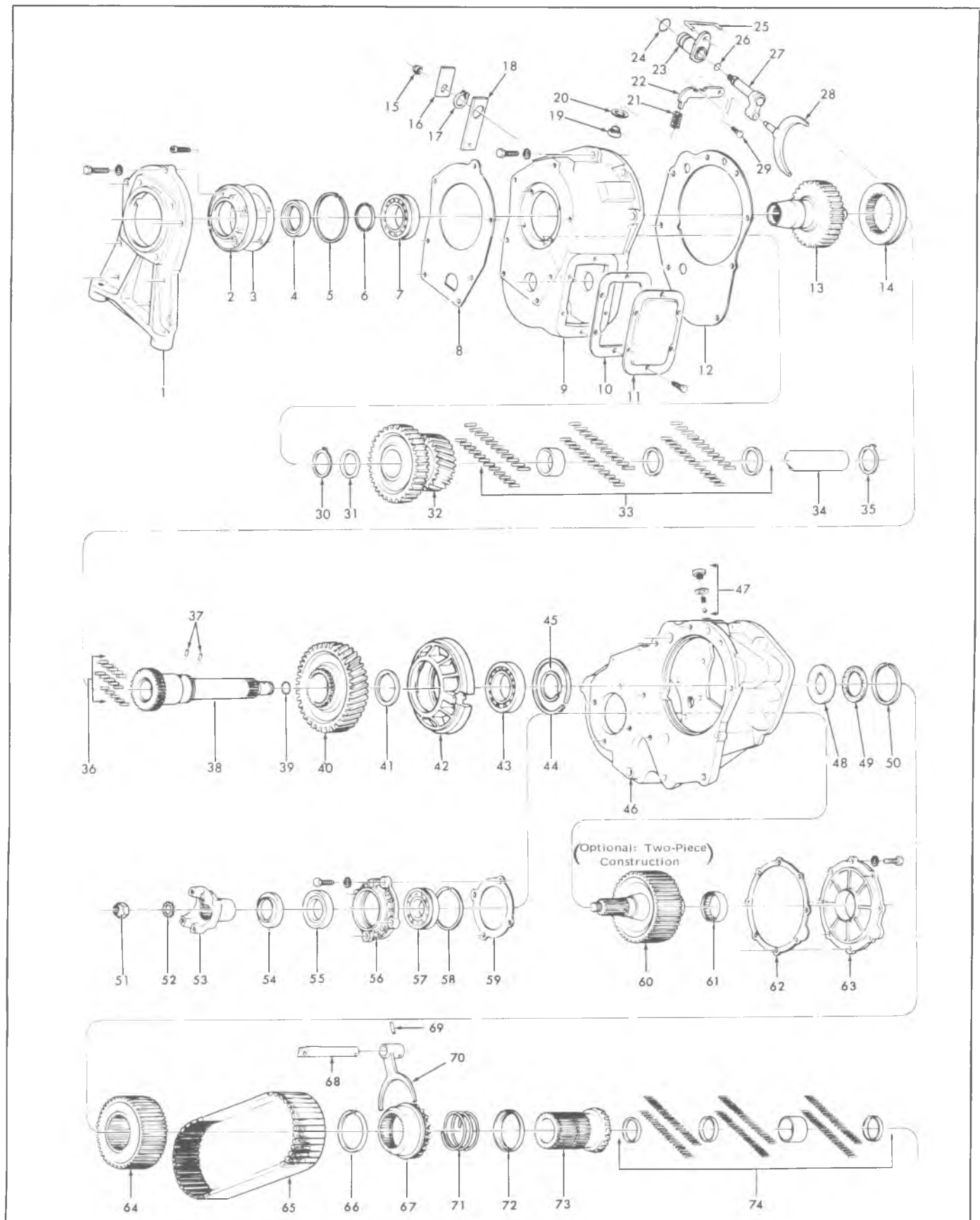
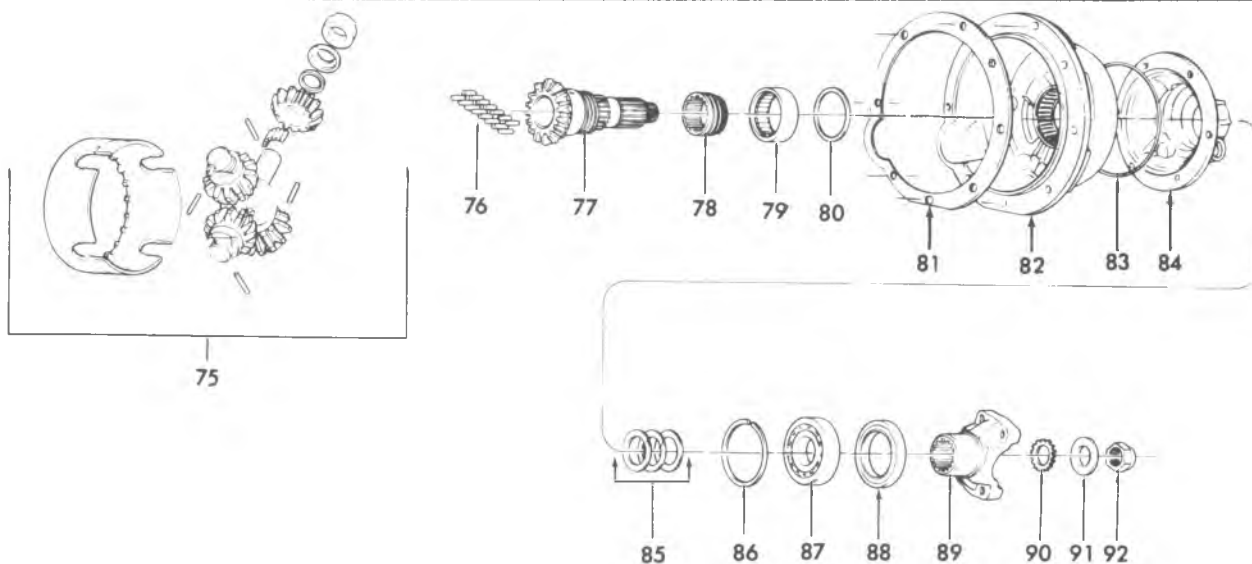


Fig. 7D-11S--Model 203 Transfer Case Exploded View



1. Adapter
2. Input Gear Bearing Retainer
3. Input Gear Bearing Retainer Gasket
4. Input Gear Seals
5. Bearing Outer Ring
6. Bearing to Shaft Retaining Ring
7. Input Gear Bearing
8. Adapter to Selector Housing Gasket
9. Range Selector Housing (Range Box)
10. P.T.O. Cover Gasket
11. P.T.O. Cover
12. Selector Housing to Chain Housing Gasket
13. Main Drive Input Gear
14. Range Selector Sliding Clutch
15. Shift Lever Lock Nut
16. Range Selector Shift Lever
17. Shift Lever Retaining Ring
18. Lockout Shift Lever
19. Detent Plate Spring Plug
20. Detent Plate Spring Plug Gasket
21. Detent Plate Spring
22. Detent Plate
23. Lockout Shifter Shaft
24. "O" Ring Seal
25. Lockout Shaft Connector Link
26. "O" Ring Seal
27. Range Selector Shifter Shaft
28. Range Selector Shift Fork
29. Detent Plate Pivot Pin
30. Thrust Washer
31. Spacer (short)
32. Range Selector Counter Gear
33. Countergear Roller Bearings and Spacers (72 Bearings Req'd.)
34. Countergear Shaft
35. Thrust Washer
36. Input Shaft Roller Bearings (15 Req'd.)
37. Thrust Washer Pins (2 Req'd.)
38. Input Shaft
39. "O" Ring Seal
40. Low Speed Gear and Bushing
41. Thrust Washer
42. Input Shaft Bearing Retainer
43. Input Shaft Bearing
44. Input Shaft Bearing Retaining Ring (Large)
45. Input Shaft Bearing Retaining Ring
46. Chain Drive Housing
47. Lockout Shift Rail Poppet Plug, Gasket, Spring and Ball.

48. Thrust Washer
49. Lubricating Thrust Washer
50. Retaining Ring
51. Flange Lock Nut
52. Seal
53. Front Output Yoke
54. Dust Shield
55. Front Output Shaft Seal
56. Front Output Shaft Bearing Retainer
57. Front Output Shaft Bearing
58. Bearing Outer Ring
59. Bearing Retainer Gasket
60. Front Output Shaft
61. Front Output Shaft Rear Bearing
62. Front Output Rear Bearing Retainer Cover Gasket
63. Front Output Rear Bearing Retainer
64. Drive Shaft Sprocket
65. Drive Chain
66. Retaining Ring
67. Sliding Lock Clutch
68. Lockout Shift Rail
69. Shift Fork Retaining Pin
70. Lockout Shift Fork
71. Lockout Clutch Spring
72. Spring Washer Cup
73. Front Side Gear
74. Front Side Gear Bearing and Spaces (123 Bearings Req'd.)
75. Differential Carrier Assembly (132 Bearings Req'd.)
76. Rear Output Shaft Roller Bearings (15 Req'd.)
77. Rear Output Shaft
78. Speedometer Drive Gear
79. Rear Output Shaft Front Roller Bearing
80. Oil Pump "O" Ring Seal
81. Rear Output Housing Gasket
82. Rear Output Housing (Front)
83. "O" Ring Seal
84. Rear Output Housing (Rear)
85. Shim Pack
86. Bearing Retainer
87. Rear Output Rear Bearing
88. Rear Output Shaft Seal
89. Rear Output Flange
90. Rear Output Shaft Rubber Seal
91. Washer
92. Flange Nut

Fig. 7D-12S--Model 203 Transfer Case Exploded View Continued

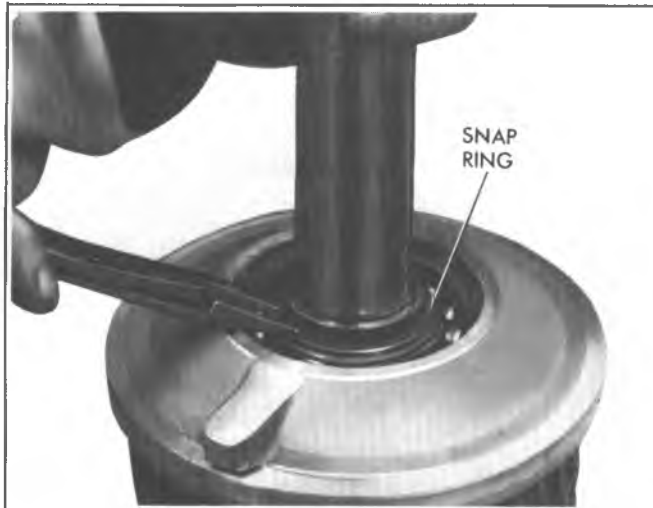


Fig. 7D-13S--Removing Input Shaft-to-Bearing Snap Ring

14. Clean and inspect all components. Replace worn and defective parts.

### Assembly (Fig. 7D-11S)

#### Installing Countergear Assembly

1. Using Tool J-24745 and a heavy grease, install roller bearings (72 required) and spacers in clustergear bore.
2. Using a heavy grease, position countershaft thrust washers in case. Engage tab on washers with a slot in case thrust surface.
3. Position cluster gear assembly in case and install countershaft through front face of range box into gear assembly. Countershaft face with flat should face forward and must be aligned with case gasket.

#### Installing Input Gear Assembly

4. Install bearing (without large snap ring) on input gear shaft positioning snap ring groove outward and install new retaining ring on shaft. Position input gear and bearing in housing.

**NOTE:** The retaining ring is a select fit. Use service ring size A, B, C or D as required to provide tightest fit.

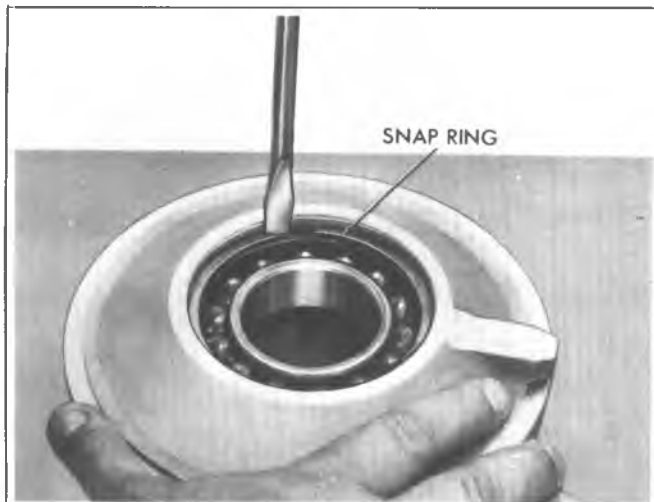


Fig. 7D-14S--Removing Input Shaft Bearing-to-Retainer Snap Ring

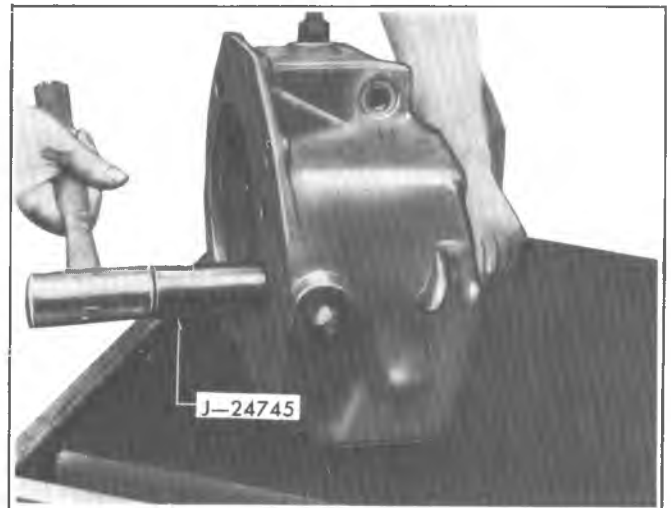


Fig. 7D-15S--Removing Cluster Gear Shaft

5. Install snap ring in outside diameter of bearing.

6. Align oil slot in retainer with drain hold in case and install input gear bearing retainer, gasket and retaining bolts. Tighten bolts to specifications.

#### Installing Shifter Shaft Assembly

7. If removed, install poppet plate and pivot pin assembly in housing. Use sealant on pin.
8. Install new "O" rings on the inner and outer shifter shafts. Lubricate "O" rings and assemble inner shaft in the outer shaft.
9. Push the shifter shafts into the housing, engaging the long end of the lockout clutch connector link to the outer shifter shaft before the shaft assembly bottoms out.
10. Install lower shift lever and retaining ring.
11. Install upper shift lever and shifter shaft retaining nut.
12. Install shift fork and sliding clutch gear. Push fork up into shifter shaft assembly to engage poppet plate, sliding clutch gear forward onto the input shaft gear.
13. Install poppet spring, gasket and plug in top of housing. Check spring engagement with poppet plate.

### Input Gear Bearing Replacement

1. Remove bearing retainer attaching bolts, retainer and gasket from housing. Discard gasket.
2. Using snap ring pliers, remove snap ring retaining bearing on shaft. Discard snap ring.
3. Using a screwdriver or other suitable tool, pry the bearing from case and remove it from the shaft.

**NOTE:** Inspect input gear for defects such as burrs, scoring, heat discoloration, etc. Inspect seal in bearing retainer. Replace as required.

4. Install new bearing with snap ring on input gear shaft. Position bearing to case and tap into place with a soft hammer.

**NOTE:** Select service ring, size A, B, C or D, that will provide tightest fit.

5. Install new snap ring to retain bearing on the shaft.
6. Position new gasket and the bearing retainer to housing. Install retaining bolts, tightening to specifications.

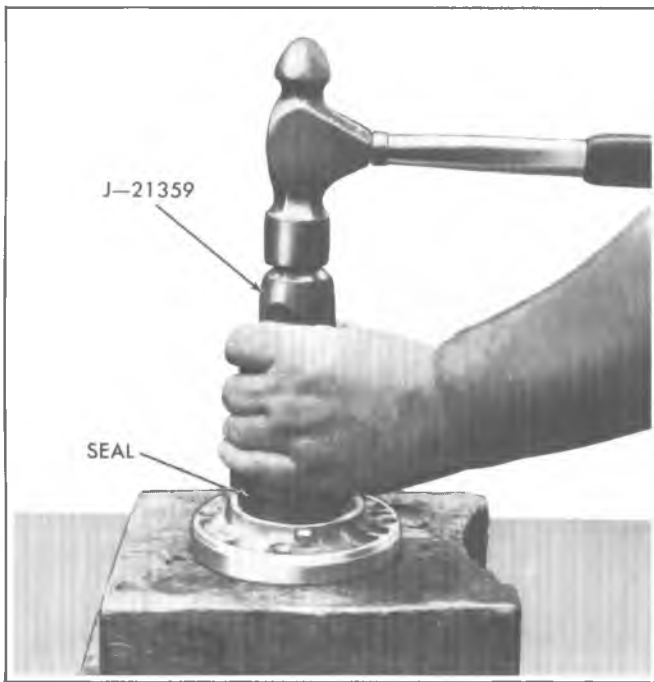


Fig. 7D-16S--Installing Input Shaft Bearing Retainer Seal

### Input Gear Bearing Retainer Seal Replacement

1. Remove bearing retainer attaching bolts, retainer and gasket from housing. Discard gasket.
2. Pry seal out of retainer and discard.
3. Position new seal to retainer and install using tool J-21359 (Fig. 7D-16S).

4. Position bearing retainer and gasket to housing. Install attaching bolts and tighten to specifications.

### REAR OUTPUT SHAFT HOUSING (REAR)

#### Disassembly

1. Remove speedometer driven gear from rear section of rear output housing.
2. Pry old seal out of bore, using screwdriver or other suitable tool.
3. Using a screwdriver, pry behind open ends of snap ring and remove snap ring retaining rear bearing in housing (Fig. 7D-17S).
4. Pull or tap bearing from housing.
5. To remove the front bearing, insert a long drift through rear opening and drive the bearing from the housing (Fig. 7D-18S). Remove and discard rubber seal.

#### Assembly

1. Position rear bearing in housing and tap into place.
  2. Install snap ring retaining bearing to case.
- NOTE:** Retaining ring is a select fit. Use service ring size A, B, C or D as required to provide tightest fit.
3. Position rear seal to bore and drive into place using tool J-22388 (Fig. 7D-19S) or other suitable tool until approximately 1/8" to 3/16" below housing face.
  4. If the vent seal falls out or is knocked out during disassembly, reinstall new seal or thoroughly clean and dry the area and re-cement the old seal in place.

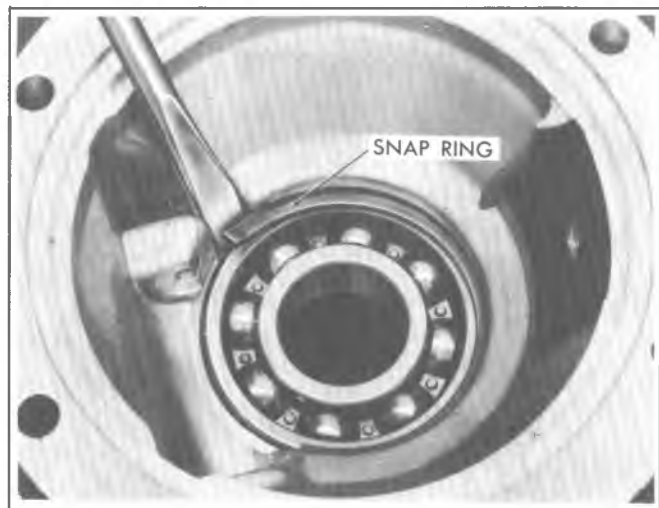


Fig. 7D-17S--Removing Rear Output Bearing Retaining Ring

### REAR OUTPUT SHAFT HOUSING (FRONT)

#### Disassembly

1. Remove "O" ring from rear output shaft housing (front) and discard.
2. To remove roller bearings from housing, insert a long drift through rear opening and drive bearing from housing (Fig. 7D-18S). Remove and discard rubber seal.

#### Assembly

1. Position rubber seal in bearing bore. Use grease to hold in place. Position roller bearing in bore and press into place until bearing bottoms out in housing.
2. Position new "O" ring on housing.



Fig. 7D-18S--Removing Rear Output Shaft Front Bearing



Fig. 7D-19S--Installing Rear Output Shaft Seal

### Front Output Shaft Bearing Retainer Seal Replacement (Fig. 7D-20S)

1. Pry or drive out existing seal from retainer bore.
2. Clean and inspect retainer.
3. Apply sealer to outer diameter of new seal.
4. Position seal to retainer bore and using Tool J-22836 or equivalent, install seal in retainer.

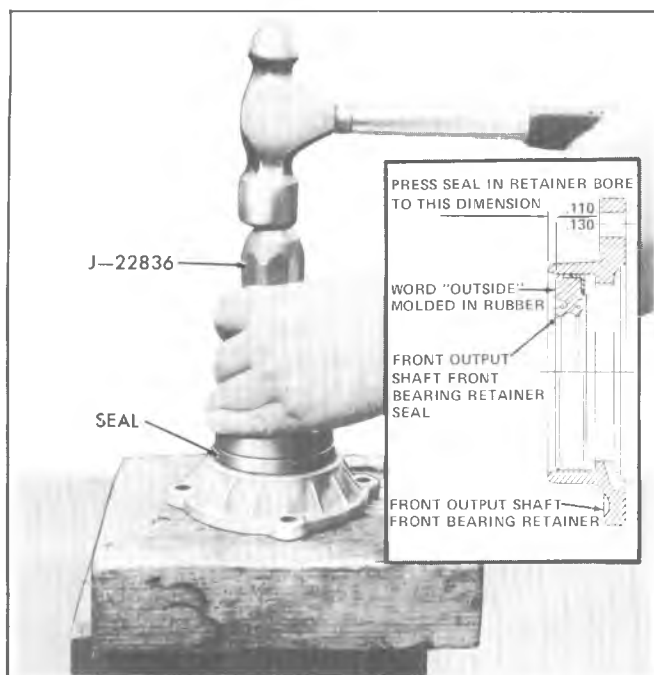


Fig. 7D-20S--Installing Front Output Bearing Retainer Seal

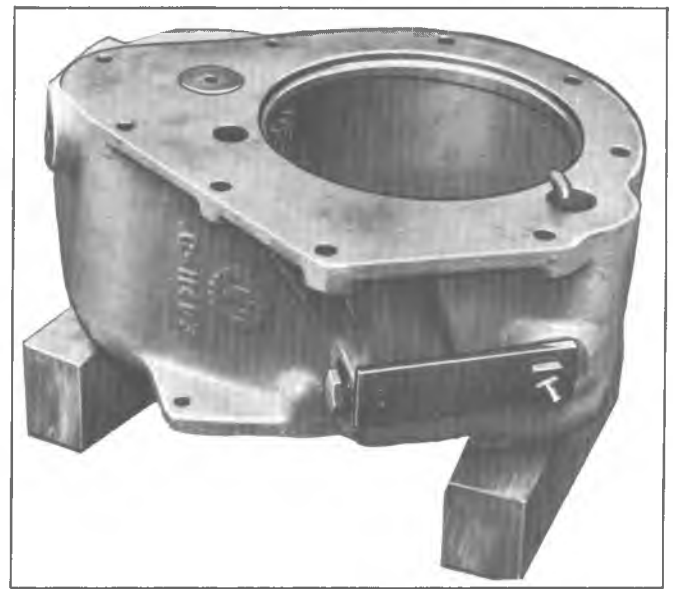


Fig. 7D-21S--Positioning Range Box for Assembly

### Front Output Shaft Rear Bearing Replacement

1. Remove rear cover from transfer case. Remove gasket and discard.
2. Support rear cover and press bearing from cover.
3. Position new bearing to outside face of cover and using a piece of wood to cover bearing, press bearing into cover until flush with opening.
4. Position gasket and cover to transfer case and tap into place.
5. Install cover retaining bolts and torque to specifications.

### ASSEMBLY OF TRANSFER CASE (FIGS. 7D-10S and 7D-11S)

1. Place range box on blocks, with input gear side toward bench (Fig. 7D-21S).
  2. Position range box-to-transfer case housing gasket on input housing.
  3. Install lockout clutch and drive sprocket assembly on the input shaft assembly.
- NOTE:** A 2" band clamp may be installed on end of shaft to prevent loosening bearings from clutch assembly.
4. Install input shaft, lockout clutch and drive sprocket assembly in the range box, aligning tab on bearing retainer with notch in gasket.

5. Connect lockout clutch shift rail to the connector link and position rail in housing bore (Fig. 7D-22S). Rotate shifter shaft while lowering shift rail into the housing, to prevent the link and rail from being disconnected.
6. Install drive chain in chain housing, positioning the chain around the outer wall of the housing.

7. Install the chain housing on the range box (Fig. 7D-23S), engaging the shift rail channel of the housing to the shift rail. Position chain on the input drive sprocket.

8. Install the front output sprocket in the case, engaging the drive chain to the sprocket. Rotate clutch drive gear to assist in positioning chain on the drive sprocket.

9. Install the shift fork on the clutch assembly and the shift rail, then push the clutch assembly fully into the drive sprocket. Install roll pin retaining shift fork to shift rail.

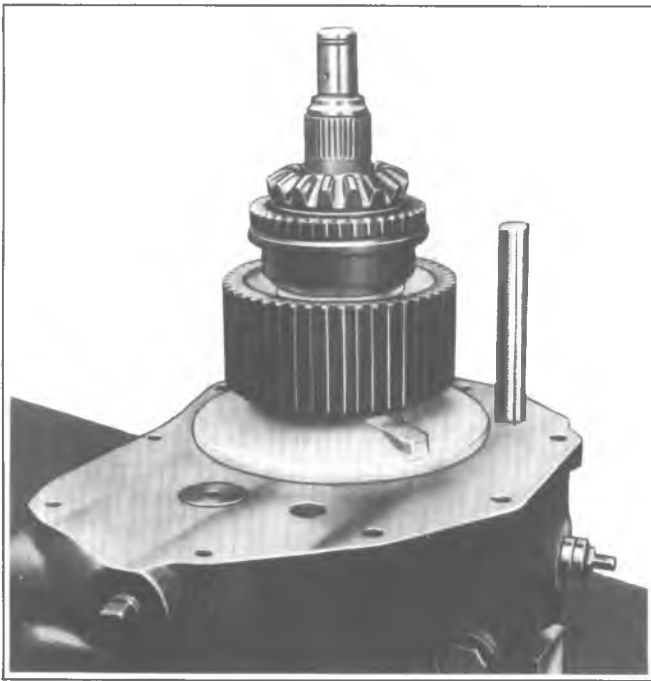


Fig. 7D-22S--Drive Gear and Lockout Clutch Assembly Installed

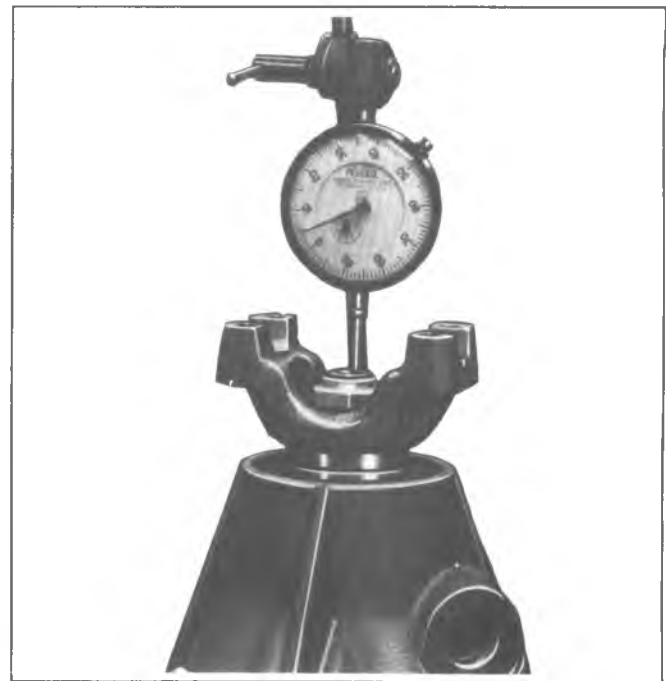


Fig. 7D-24S--Checking Rear Output Shaft End Play

10. Install front output shaft bearing.

11. Install front output shaft bearing retainer, gasket and retaining bolts.

12. Install the front output shaft flange, gasket, seal, washer and retaining nut. Tap dust shield back in place after installing bolts in flange.

13. Install front output shaft rear bearing retainer, gasket and retaining bolts.

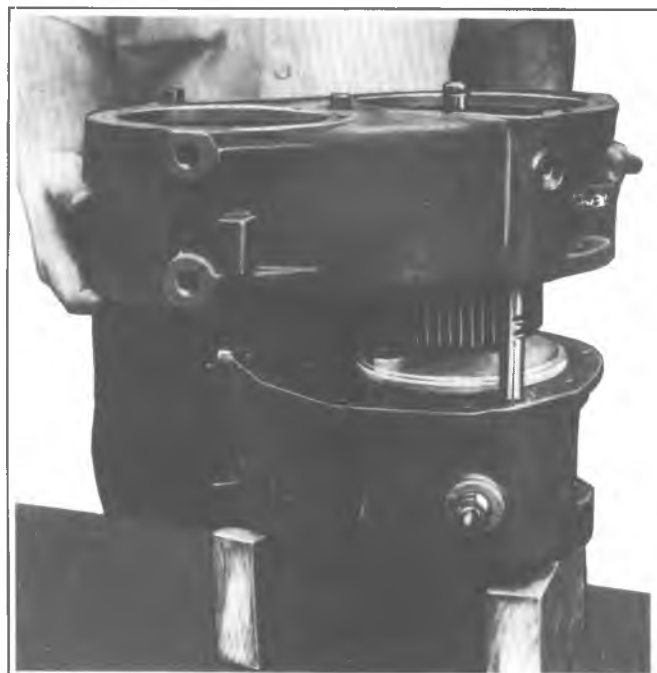


Fig. 7D-23S--Installing Intermediate Housing to Range Box

**NOTE:** If rear bearing was removed, position new bearing to outside face of cover and press into cover until bearing is flush with opening.

14. Install differential carrier assembly on the input shaft. Carrier bolt heads should face rear of shaft.

15. Position rear output shaft to differential carrier assembly (load bearings in pinion shaft).

a. Install rear output housing (front) assembly, gasket, and retaining bolts.

b. Install speedometer gear and shims (approximately .050 inch thickness) on output shaft.

c. Position rear output housing (rear) assembly to rear output housing (front). Be sure "O" ring is in proper position on front section of output housing.

**NOTE:** Be sure vent is in upward position.

d. Install flange, washer, and retaining nut. Leave nut loose (approximately .060 inch) until shim requirements are determined.

16. Install shim pack onto shaft, in front of rear bearing, to control end play to within .001" to .005". Hold rear flange and rotate front output shaft to check for binding of the rear output shaft (Fig. 7D-24S).

17. Install speedometer driven gear in housing.

18. Install lockout clutch shift rail poppet ball, spring and screw plug in case.

19. Install poppet plate spring, gasket and plug, if not installed during reassembly of range box.

20. Install shift levers on the range box shifter shaft, if not left on linkage in vehicle.

21. Torque all bolts, locknuts and plugs (except filler plug) to specifications.

22. Fill transfer case to proper level with specified lubricant.

23. Install and tighten filler plug to specifications.

## ADAPTER ASSEMBLIES

### ADAPTERS USED WITH MANUAL TRANSMISSIONS

#### Disassembly of Adapter

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. 7D-2T.

### ADAPTERS USED WITH AUTOMATIC TRANSMISSIONS

Adapters used with automatic transmissions do not require service since there are no internal components such as seals, sleeves or bearings.

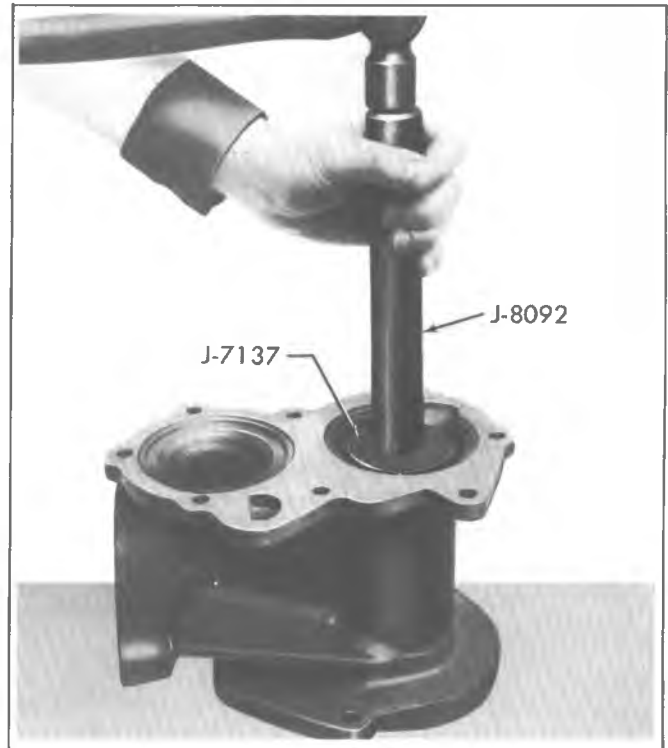


Fig. 7D-2T--Installing Adapter Seal

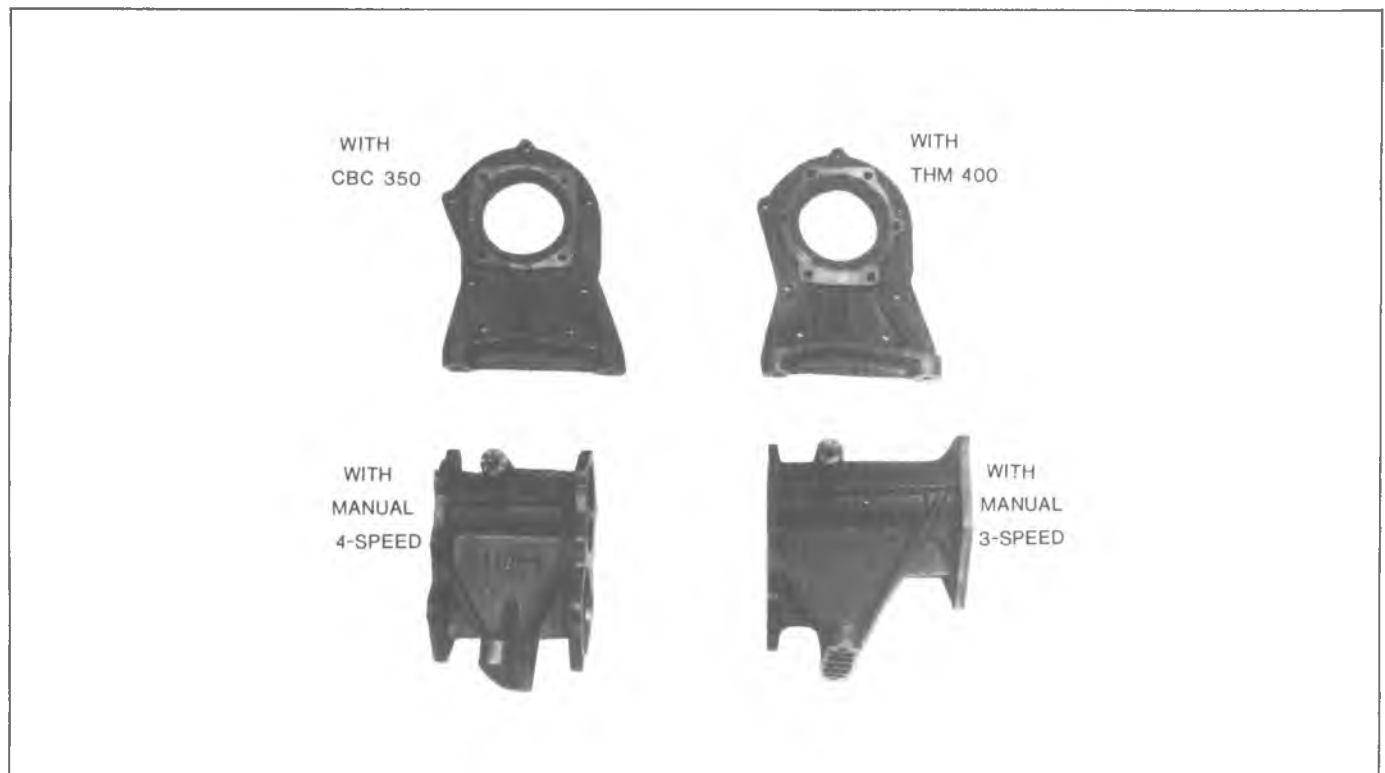


Fig. 7D-1T--Adapter Assemblies Used With Manual Transmissions

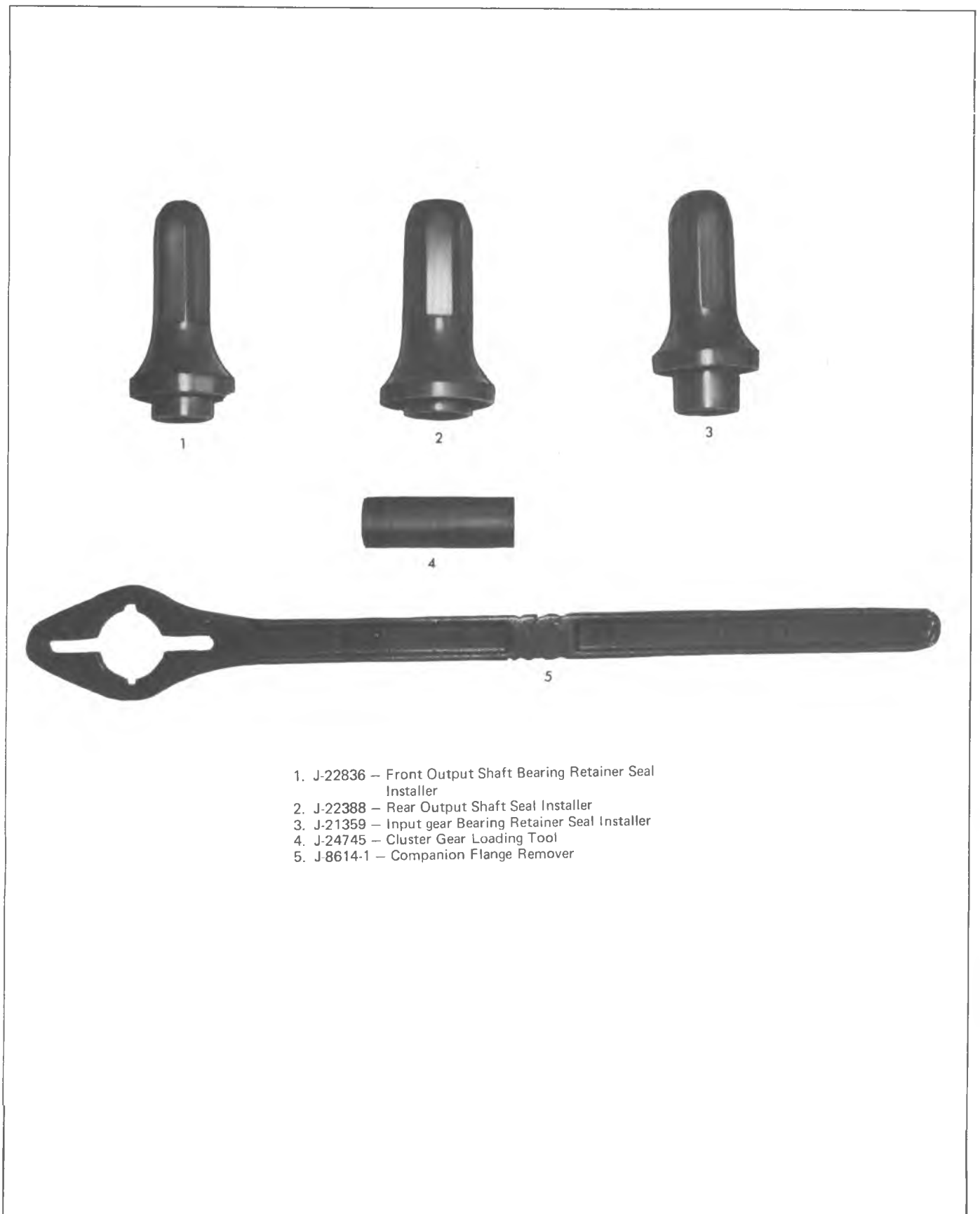


## SPECIFICATIONS

	N·m	
	Model 203	Model 205
Nut, Shift Lever-to-Shifter Asm	34-48	—
Nut, Knob Asm-to-Shift Lever	14-20	26-40
Bolt, Shifter Asm-to-Transfer Case	46-54	120-140
Nut, Shift Arms-to-Case	14-20	14-20
Screw, Shift Lever Boot Retainer	2.2-3.2	2.2-3.2
Bolt, Adapter-to-Transmission	48-60	26-34
Bolt, Adapter-to-Transfer Case	46-54	27-41
Filler Plug	41-48	41-48
Bolts P.T.O. Cover	20-24	20-24
Nut, Skid Plate-to-Crossmember	55-70	55-70
Bolt, Support Strut Rod		
- Transmission End	40-54	—
- Transfer Case End	150-200	—

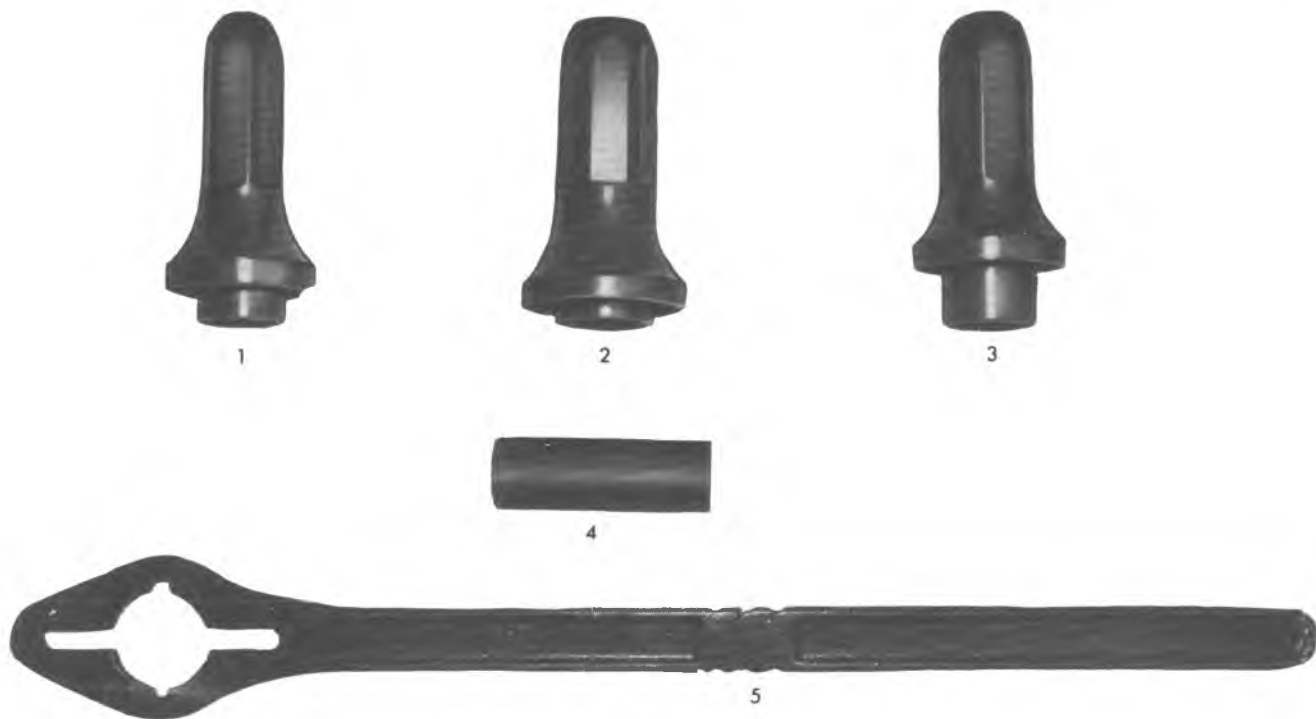
Model No.	205 (Part-Time)	203 (Full Time)
Availability	K10-30 (Manual Trans)	K10-30 (Automatic Trans)
Ratios: Hi Range Lo Range	1.00 to 1 1.96 to 1	1.00 to 1 2.00 to 1
Lever Positions	4-Lo (All wheel underdrive) N (Neutral) 2-Hi (Rear wheel drive) 4-Hi (All wheel direct drive)	4-Lo (Lock-all wheels locked - underdrive) 4-Lo (All wheels underdrive) N (Neutral) 4-Hi (All wheels direct drive) 4-Hi (Lock - all wheels locked - direct drive)
Lever Location	Rear of trans. shift lever	Floor, right of center
Power Take-Off Data: Opening & Location	SAE 6-bolt; Left side	
Lubricants: Oil capacity	5.2 pints	8.2 pints
Type, grade	See Owner's Manual	

## SPECIAL TOOLS



1. J-22836 – Front Output Shaft Bearing Retainer Seal Installer
2. J-22388 – Rear Output Shaft Seal Installer
3. J-21359 – Input gear Bearing Retainer Seal Installer
4. J-24745 – Cluster Gear Loading Tool
5. J-8614-1 – Companion Flange Remover

Fig. 7D-1ST--Model 205 (Part Time) Transfer Case Special Tools



1. J-22836 – Front Output Shaft Bearing Retainer Seal Installer
2. J-22388 – Rear Output Shaft Seal Installer
3. J-21359 – Input gear Bearing Retainer Seal Installer
4. J-24745 – Cluster Gear Loading Tool
5. J-8614-1 – Companion Flange Remover

Fig. 7D-2ST--Model 203 (Full Time) Transfer Case Special Tools





**CHEVROLET**

**SERVICE**