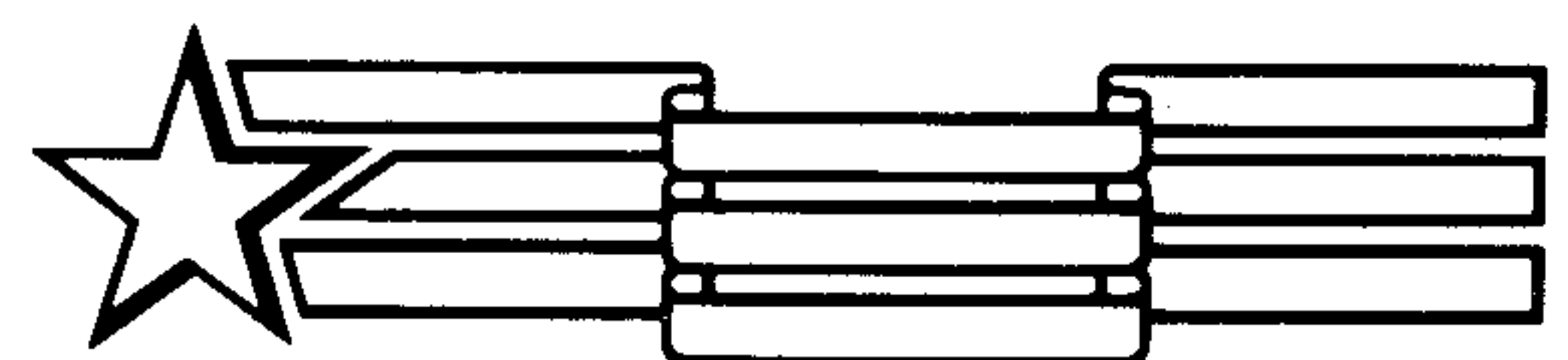


Ingersoll

**HYDRAULIC MOTOR
Service Manual 9-99644**



QUALITY IN THE AMERICAN TRADITION

Ingersoll Equipment Co., Inc.

Winneconne, Wisconsin 54986-9576



INTRODUCTION

This manual contains service information for hydraulic motors used on 200, 400, 600, 3000, 4000 and 6000 series tractors.

Consult the "Troubleshooting the Hydraulic System" and "Hydraulic Test Procedures" sections in this master service manual for troubleshooting and testing procedures.

Consult the parts catalog that pertains to your tractor for proper part numbers of the hydraulic motor assemblies, as well as, repair parts.

Consult your Ingersoll Equipment Warranty Policy Manual regarding warranty repair policies.

FOR TRACTORS: 220 Prior to P.I.N. 9649062
 222 Prior to P.I.N. 9647203
 442 Prior to P.I.N. 9632452



CAUTION: Drain gasoline into an approved container only. Do NOT smoke or expose gasoline to open flames.

REMOVAL

1. Remove drain plug to drain the transmission oil. Replace the plug when the oil has completed draining.
2. A. Models 220, 222, 442 Prior to P.I.N. 9646800
 Remove the four bolts holding the seat support assembly to the frame. Remove the seat support assembly while keeping the fuel tank in its original position.
- B. Models 220, 222, P.I.N. 9646800 AND AFTER
 Remove the fenders and the rear seat support panel. Loosen fuel tank mounting straps. Remove fuel hose at tank outlet elbow and drain fuel tank into a clean, approved, container. Remove the fuel tank, front seat support panel and seat.
3. Remove the two valve to motor port hydraulic tubes (manifold at motor).
4. Place a jackstand under the axle housing on the side to be removed.
5. Remove the four frame mounting bolts and transmission case cover screws.
6. Lift frame **slightly** and slide transmission cover from between frame and transmission case.

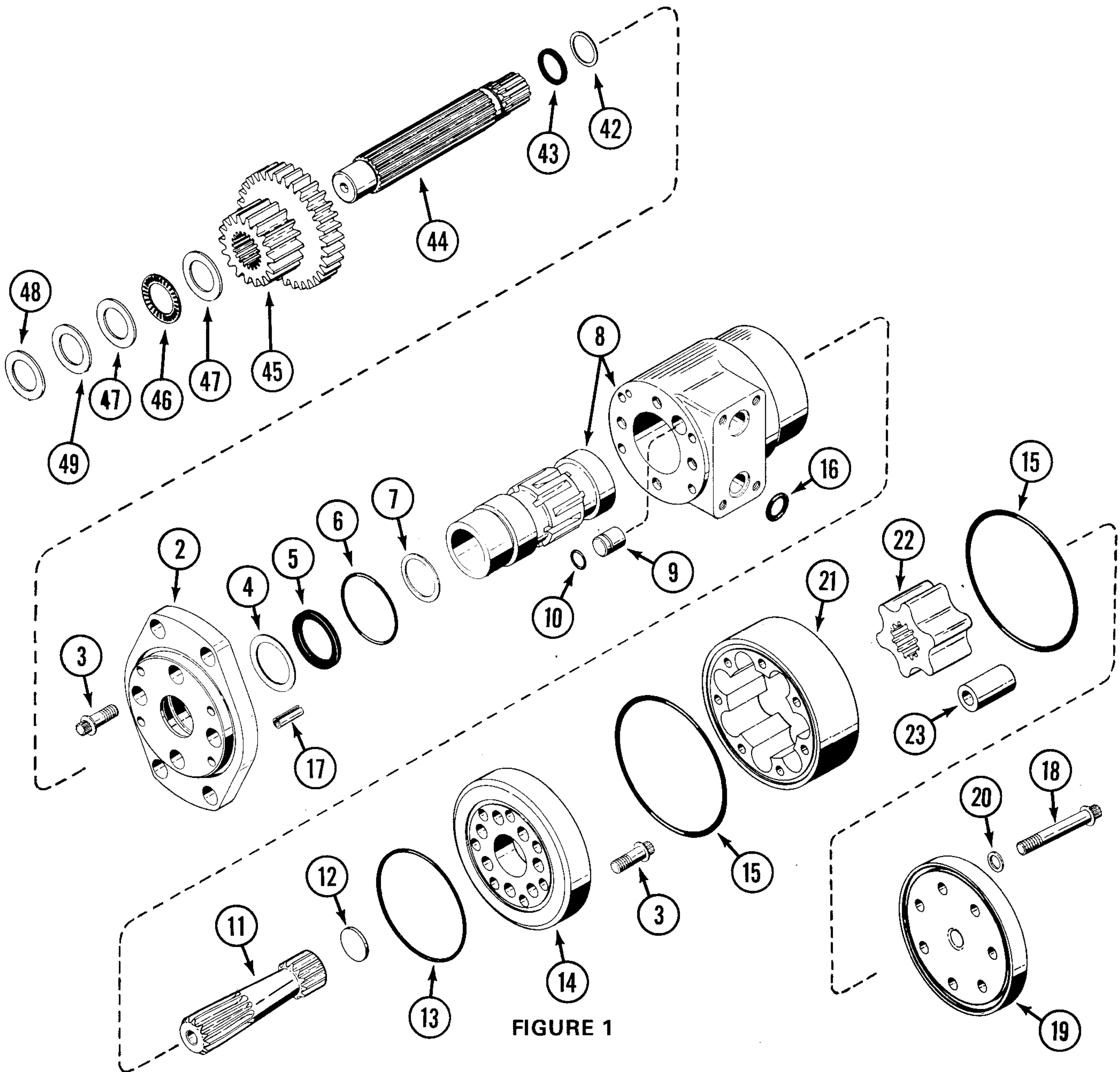


FIGURE 1

7. Remove the four cap screws which attach the hydraulic motor to the transmission case and remove the motor and input shaft (44) as an assembly.

When the input shaft is part way removed, slide off shims (48 & 49), thrust washers (47), bearing (46), and the drive gear (45) to prevent them from dropping. Pull out or gently tap the input shaft (16) from the hydraulic motor.

DISASSEMBLY

1. Clean the hydraulic motor before disassembly. Disassemble the motor in a clean work area.
2. Make reference marks across the:
 - a. geroler housing (21)
 - b. spacer plate (14)
 - c. main housing (8)
3. Make reference marks on the:
 - a. housing port side of the mounting flange (2)
 - b. front end of the spool bore
 - c. front end of the mounting flange bore
4. Remove the seven cap screws (18) and remove the end cap (19), "O" ring (15) and coupling spacer (12).
5. Carefully remove the geroler and housing assembly (21) so it remains intact. Remove "O" ring (15).
6. Remove the seven cap screws (3) from the spacer plate (14) and remove the plate (14), "O" ring (13) and drive coupling (11).
7. Remove the four cap screws (3) from the mounting flange (2) and remove the flange by tapping with a lead or leather mallet.
8. Remove back-up washer (4), quad ring (5), "O" ring (6) and thrust washer (7) from the flange.
9. Remove the plug (9) from the main housing (8) by inserting a small pin or screwdriver through holes in the opposite end of the housing. Remove the "O" ring (10) from the plug.

INSPECTION

Clean all parts in solvent and air dry. Be careful not to damage machined surfaces or remove reference marks.

Inspect all parts for scratches, scoring and excessive wear.

The spool and housing and geroler assembly should fit snugly and be free of wear spots.

A polished pattern on the spacer plate and end cap due to geroler action is normal but they should not be grooved.

If the geroler and roller thickness is more than .002" less than the thickness of the housing, install a new geroler kit.

Use all new seals and a new thrust washer (7) during assembly.

ASSEMBLY

1. Install the plug (9) with a new "O" ring (10). The "O" ring end of the plug is toward the outside.
 2. Install a new thrust washer (7), back up washer (4), quad ring (5), and "O" ring (6) in the mounting flange (2) in that order.
 3. Position the mounting flange on the main housing so the side marked is on the same side as the motor ports.
 4. Roll pins (17) must be drawn back through mounting flange (2) until they are flush with the inner side.
 5. Position the mounting flange on the main housing so the side marked is on the same side as the motor ports. Tap the mounting flange (2) onto the main housing with a lead or leather mallet and secure with four cap screws (3).
 6. Tighten the cap screws evenly to a torque of 215 inch pounds.
 7. Make certain the roll pins (17) do not protrude beyond the face of the mounting flange.
 8. Slide the spool into the housing (8) until it bottoms on the thrust washer (7) in the flange.
 9. Align the dye marks on the spool (8) and mounting flange (2).
 10. Place new "O" rings (13) and (15) on the spacer plate (14).
 11. Align the scribe marks on the spacer plate (14) and main housing (8) and secure the plate with "O" ring (13) toward housing with seven cap screws (3).
 12. Tighten the cap screws evenly to a torque of 175 inch pounds.
- NOTE:** If for any reason the alignment marks were not made or were removed while handling or cleaning, continue assembling and install the motor. Refer to the "Important" paragraph at the end of this instruction if the direction of tractor travel is incorrect.
13. Slide the drive coupling (11), longer splined end first, through the spacer and plate and into the spool.
 14. Recheck the alignment of the dye marks on the spool and flange and install the geroler assembly with the scribe marks in alignment and with the splined end of the geroler toward the end cap (19). Be careful not to allow the geroler and rollers to fall out of the housing.

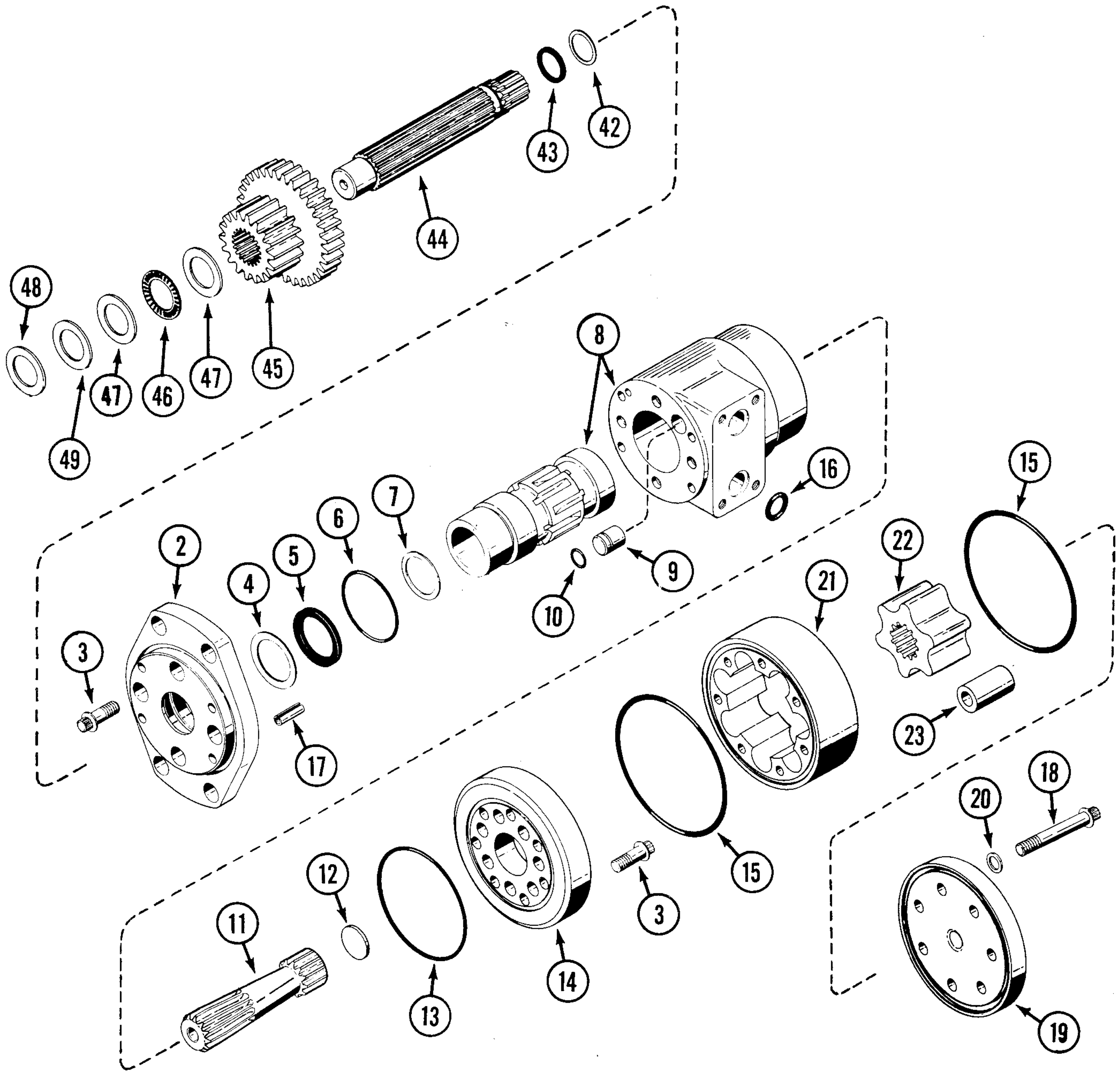


FIGURE 2

NOTE: It may be necessary to wobble the drive coupling to align the mounting holes between the geroler assembly and spacer plate (14). Do this by inserting a finger through the flange bore and moving the coupling slightly back.

15. With the geroler assembly properly aligned, stand the motor on its mounting flange and install the end cap (19) with the seven new washers (20) and original cap screws.
16. Tighten the cap screws evenly to a torque of 175 inch pounds.

INSTALLATION

1. Carefully install a new "O" ring (43) on the input shaft. Make sure it is not damaged during installation.
2. Install a new back up washer (42) on the input shaft.
3. When installed, the "O" ring must be positioned to the inside of the back up washer.
4. Carefully insert the shaft into the hydraulic motor until it bottoms. If necessary, tap the end of the shaft lightly with a plastic hammer.
5. Install a new "O" ring on the face of the hydraulic motor flange.
6. Start the assembled input shaft (44) into the case.
7. Slide the:
 - a. drive gear (45)
 - b. thrust bearing (46) and washers (47)
 - c. and shims (48) (49) with thicker shim next to bearing on the input shaft.
8. Place the yoke between the gears.
9. Slide the input shaft (44) into the needle bearing until the hydraulic motor flange is flush and tight against the machined face of the case.

10. Check the clearance between thrust washer (47) and shim (48). Clearance must not be less than .001" (.02 mm) and not more than .015" (.38 mm). If necessary, adjust the shim stack keeping a .030" (.76 mm) shim next to the needle bearing.
11. Install the four hydraulic motor cap screws using loctite and tighten to a torque of 110-125 foot pounds (149 - 168 Nm). Install new "O" rings on the hydraulic motor ports.
12. Install the tubes between the hydraulic motor and control valve. Refill the hydraulic system. Consult your tractor operator's manual or the decal by the reservoir for correct oil level and type.

IMPORTANT: Misalignment of the geroler will cause the direction of rotation of the motor to be incorrect. Use the following procedure to realign the geroler:

- a. Remove the end cap (19) and coupling spacer (12) without removing the hydraulic motor from the transmission.
 - b. Scribe mark the geroler housing (21) to the spacer plate (14).
 - c. Ink mark the geroler (22) to one of the splines on the drive coupling.
 - d. Slide the geroler assembly off the drive coupling.
 - e. Move it one tooth in either direction and slide it back on the drive coupling (11).
 - f. Install the end cap (19) using new washers (20) and original cap screws (18).
 - g. Tighten the cap screws evenly to a torque of 175 inch pounds.
13. Fill the transmission. See your tractor operator's manual for correct amount and type of oil.
 14. Reinstall the seat support, fuel tank and fenders following the reverse order of the removal procedure.

FOR TRACTORS:

- 220 P.I.N. 9649062 to 14107095
- 222 P.I.N. 9647203 to 14108205
- 224 Prior to P.I.N. 14109285
- 226 Prior to P.I.N. 14110325
- 442 P.I.N. 9632452 and after
- 444 Prior to P.I.N. 14111340
- 446 Prior to P.I.N. 14112435
- 448 Prior to P.I.N. 14113810
- 644 All
- 646 All
- 648 Prior to P.I.N. 14114835

REMOVAL

1. Remove drain plug to drain the transmission oil. Replace the plug when the oil has completed draining.

2. Remove the two valve to motor port hydraulic tubes.
3. Place the transmission in low range.
4. Place a jackstand under the left axle housing and remove the left rear tire and wheel.
5. Remove the four cap screws that hold the hydraulic motor.

On 400 and 600 series tractors, align one of the flats on the axle hub with the motor.

6. Slide the hydraulic motor and input shaft assembly from the transmission case. The high-low cluster gear will remain inside the case.

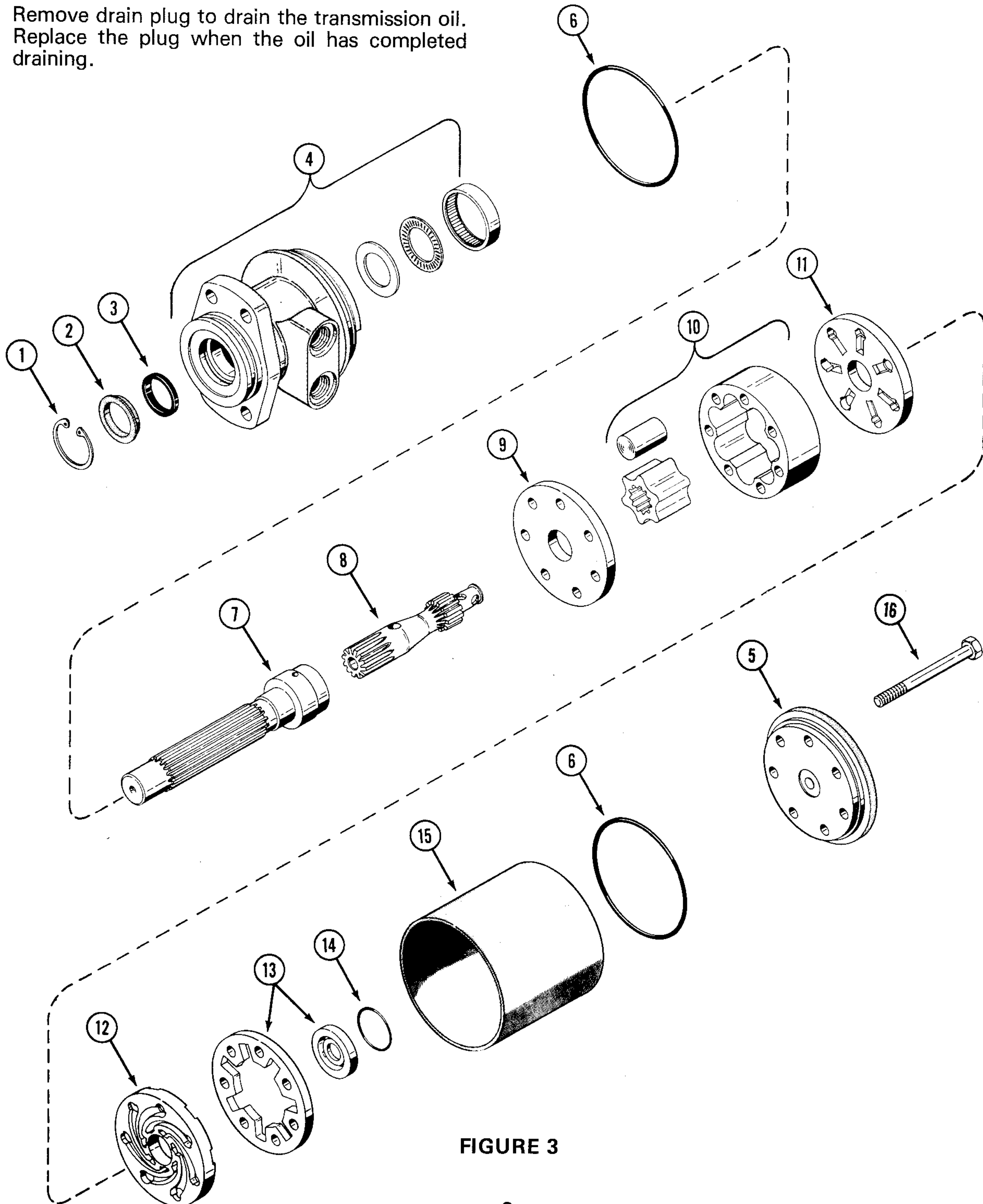


FIGURE 3

DISASSEMBLY

1. Clean the hydraulic motor before disassembly. Disassemble the motor in a clean work area.
2. Clamp the motor with the shaft down in a vice with soft jaws.
3. Remove the seven cap screws (16).
4. Remove the end cap (5) by using two large screwdrivers inserted 180° apart.
5. Remove the commutator and commutator ring (13) and place them flat on the end cap (5).
6. Pry the sleeve (15) off the housing (4) using two screwdrivers 180° apart.
7. Remove manifolds (11) and (12) by lifting them off the rotor section (10) and place them on top of the commutator assembly (13).
8. Remove the drive link (8) by lifting straight up with the wear plate (9) and rotor assembly (10), then place all three parts carefully on the workbench.

NOTE: Be careful when handling the rotor assembly (10) to keep the rollers and rotor intact with the housing.

9. Push the coupling shaft (7) up and out of the bearing housing (4).
10. Remove retainer ring (1), spacer (2) and oil seal (3).

NOTE: Since factory tooling and gauges are required to properly install the thrust and needle bearings in the housing (4), these items are not serviced.

INSPECTION

Clean all parts in solvent and air dry.

Be careful not to damage machined surfaces.

Do not use cloth to wipe off parts as lint may cause binding and sticking of closely fitted components.

Inspect the bearing housing (4) for nicks at the O.D. "O" ring (6) sealing surface. Check the rotor assembly (10) for finish.

The rotor and 3 rollers must be smooth and not show signs of galling or have nicks.

Check the wear plate (9) for excessive wear, or poor sealing surface for the rotor.

Check the wearing surfaces of the manifolds (11) and (12) for wear.

Inspect the commutator (13) at the sealing areas for excess wear.

Check the "O" ring (6) sealing areas of the sleeve (15) for smoothness.

Use all new seals during assembly.

ASSEMBLY

1. Carefully clamp the housing (4) in a padded vise with the seven tapped holes upward.
2. Insert the shaft (7) and drive link (8).
3. Lubricate the "O" ring (6) and slide into the groove on the housing.
4. If the rotor assembly was disassembled place the stator on the wear plate (9) and carefully insert the rotor and rollers.
5. Place the rotor assembly (10) and wear plate (9) over the drive link (8) and onto the housing, with the **rotor small counter bore facing upward**.

NOTE: Two cap screws, 3/8" x 4-1/2", with heads removed, can be used to align the seven holes in the housing with the holes in the wear plate (9), rotor assembly (10), manifolds (11) and (12) and the commutator (13).

6. Install the manifold plate (11) with the **slots toward the rotor**.
7. Install the manifold (12) over the plate (11) with the **swirl grooves toward the rotor and the diamond shaped holes upward**.
8. Place the commutator and commutator ring (13) onto the manifold with the **ring groove facing upward**. Place the ring (14) into the groove.
9. Place the sleeve (15) over the assembled components and carefully force down over the lubricated "O" ring (6) with arbor press or similar tool. Observe the "O" ring closely while the sleeve is being pressed over to make certain it is not nicked or rolled.
10. Lubricate the new "O" ring (6) and slide into the groove on the end cap (16). Carefully force the end cap into the sleeve with an arbor press or similar tool. Observe the "O" ring closely while pressing in the end cap to make certain it is not nicked or rolled.
11. Remove the line up bolts and insert the seven cap screws (16).
12. Use an alternating progressive sequence to tighten the seven cap screws to a torque of 50 foot pounds. Rotate the shaft between each tightening sequence to insure that no binding occurs.
13. Remove the motor from the vise and place it on the bench shaft end up. Lubricate the seal (3) and spacer (2) with grease and place onto the shaft. Seat the spacer and seal squarely into the housing using a tubular tool having an I.D. slightly larger than the shaft and O.D. slightly smaller than the housing bore.
14. Install the retaining ring (1).

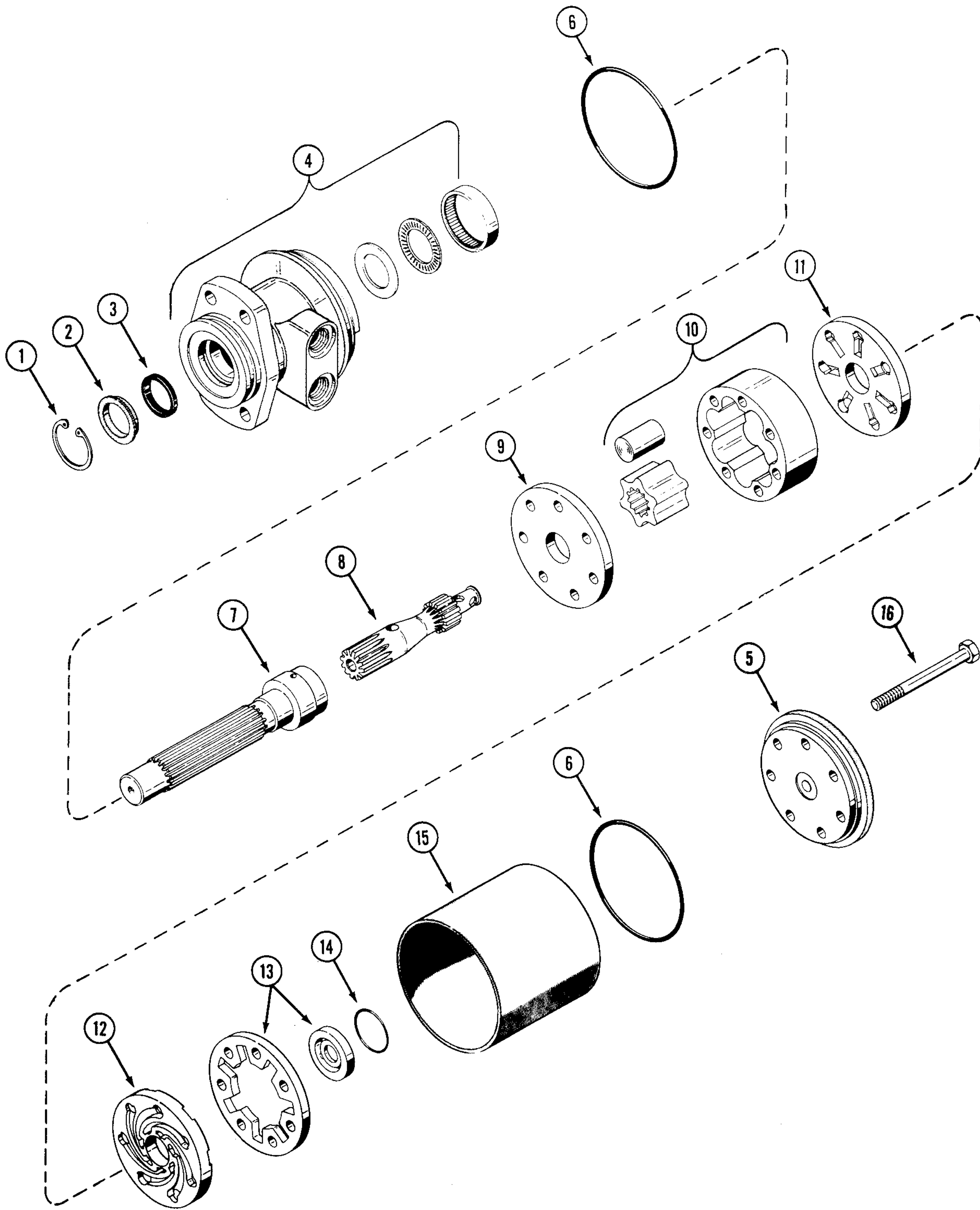


FIGURE 4

15. Lubricate the motor by putting oil into the ports. Turn the shaft several revolutions. Plug the ports to keep out foreign material unless motor is being reinstalled immediately.
16. Install a new "O" ring on the motor flange before installing to the transaxle.

INSTALLATION

1. Install a new "O" ring on the flange.
2. Slide the hydraulic motor into the transmission case and guide the input shaft into the high-low cluster gear and needle bearing.
3. Put a small amount of thread sealant on the four cap screws.
4. Install the four cap screws and tighten to a torque of 110 to 125 foot pounds.
5. Install the hydraulic tubes between the travel control valve and hydraulic motor.
6. Install the wheel.
7. Fill the transmission. See your tractor operator's manual for correct amount and type of oil.

SHAFT SEAL REPLACEMENT

Use the following procedure when only the shaft seal is being replaced.

1. Remove retaining ring (1).
2. Place the motor with the shaft down, over a clean can. Cover the open area on top of the can with clean shop towels.
3. Plug the motor "IN" port.
4. Apply pressurized air to the motor "OUT" port to dislodge the seal.
5. Remove the motor from the can and place it on the bench shaft end up. Lubricate the seal (3) and spacer (2) with grease and place onto the shaft. Seat the spacer and seal squarely into the housing using a tubular tool having an I.D. slightly larger than the shaft and O.D. slightly smaller than the housing bore.
6. Install the retainer ring (1).

FOR TRACTORS: 220 P.I.N. 14107095 and after
 222 P.I.N. 14108205 and after
 224 P.I.N. 14109285 and after
 226 P.I.N. 14110325 and after
 444 P.I.N. 14111340 and after
 446 P.I.N. 14112435 and after
 448 P.I.N. 14113810 and after
 648 P.I.N. 14114835 and after
 ALL 3010, 3012, 3014, 3016,
 3018, 4014, 4016, 4018,
 4020
 6018 ALL
 6018BH P.I.N. 14131993 and
 after

2. Remove the two valve to motor port hydraulic tubes.
3. Place the transmission in low range.
4. Place a jackstand under the left axle housing and remove the left rear tire and wheel.
5. Remove the four cap screws that hold the hydraulic motor.

On 400, 600, 4000 and 6000 series tractors, align one of the flats on the axle hub with the motor.

6. Slide the hydraulic motor and input shaft assembly from the transmission case. The high-low cluster gear will remain inside the case.

REMOVAL

1. Remove drain plug to drain the transmission oil. Replace the plug when the oil has completed draining.

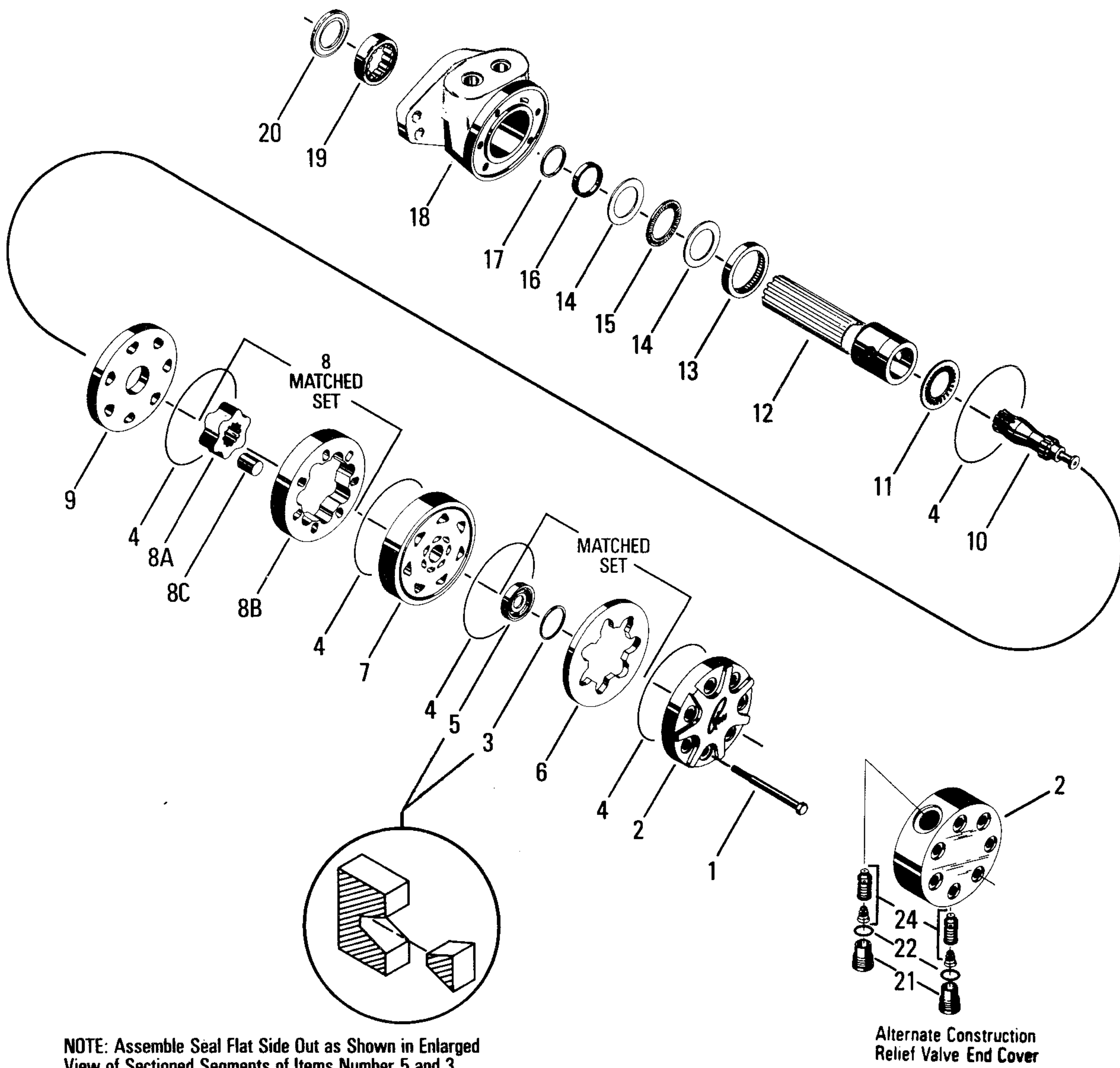


FIGURE 5

DISASSEMBLY

1. Clean the hydraulic motor before disassembly. Disassemble the motor in a clean work area.
2. Clamp the motor with the shaft down in a vice with soft jaws. Scribe a line down the entire side of the motor. Use this line for assembly.
3. Remove the seven cap screws (1).
4. Remove the end cap (2).

NOTE: Mark the top side of each component with etching ink or grease pencil for correct assembly position.

5. Remove the commutator (5) and commutator ring (6) and place them flat on the end cap (2).
6. Remove manifold (7) and place on top of the commutator assembly.
7. Remove the drive link (10) by lifting straight up with the wear plate (9) and rotor assembly (8) then place all three parts carefully on the workbench.
8. Remove thrust bearing (11) from top of coupling shaft.

NOTE: Be careful when handling the rotor assembly (8) to keep the rollers and rotor intact with the housing.

9. Push the coupling shaft (12) up and out of the bearing housing (18).
10. Remove inner seal (16) and back up washer (17). For access, unseat thrust washers (14) and thrust bearing (15) and position parallel to the housing (18) bore.
11. Rotate the housing (18). Use a seal puller to remove outer seal (20).

NOTE: Since factory tooling and gauges are required to properly install the thrust and needle bearings in the housing (18), these items are not serviced.

INSPECTION

Clean all parts in solvent and air dry.

Be careful not to damage machined surfaces.

Do not use cloth to wipe off parts as lint may cause binding and sticking of closely fitted components.

Inspect the bearing housing (18) for nicks at the O.D. "O" ring sealing surface.

Check the rotor assembly (8) for finish. The rotor and rollers must be smooth and not show signs of galling or have nicks. The clearance between rotor lobe and roller should be no more than .005" (0.13 mm).

Check the wearing surfaces of the manifold (7) for wear.

Inspect the commutator (5) and ring (6) at the sealing areas for excess wear.

Check the "O" ring (4) sealing areas of each part for smoothness.

Use all new seals during assembly. Lubricate all seals and rings with oil before assembly.

ASSEMBLY

1. Lubricate the outer seal (20). Press the seal into the outer bore of the housing (18) with the lip facing out. The seal must be flush with the end of the housing.
2. Carefully clamp the housing (18) in a padded vice with the seven tapped holes upward.
3. Insert back up washer (17) and inner seal (16) into housing (18) bore. Seal lip must face out. Unseat thrust washers (14) and thrust bearing (15). Rotate so bearing and washers are parallel to bore for access. Reseat thrust washers and bearing after seal is in place.

NOTE: Pack outer bearing (19) with grease before you install the coupling shaft.

4. Cover splined end of coupling shaft (12) with masking tape to protect seal. Install the shaft into the housing (18).
5. Install the thrust bearing (11) onto the end of coupling shaft (12). Approximately .100" (2.54 mm) space should be available at the end of the shaft for the bearing.

NOTE: Two 3/8" x 4-1/2" cap screws, with heads removed, can be threaded into housing (18) for alignment.

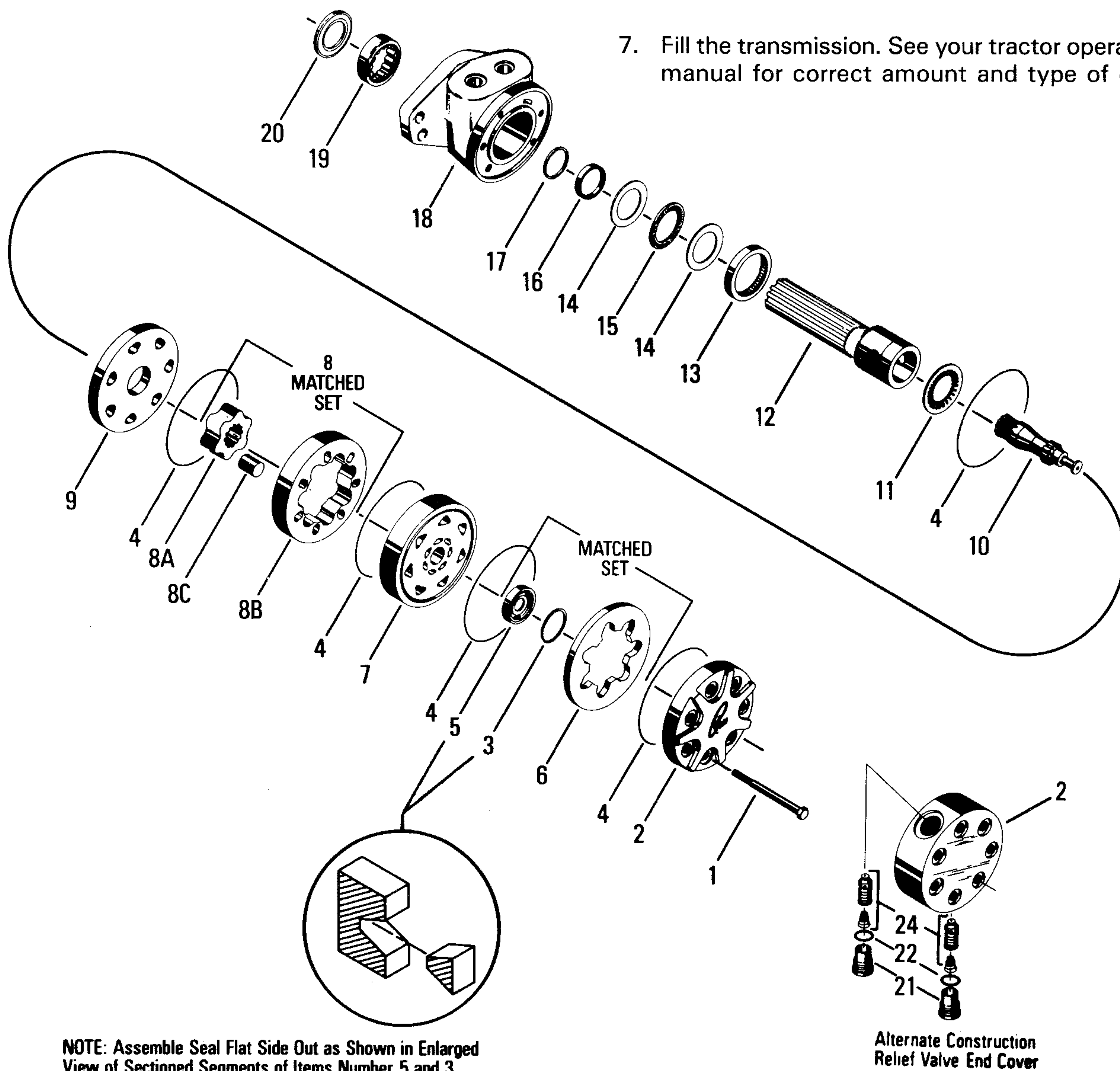
6. Install seal ring (4) into housing (18).
7. Insert the drive link (10) into the coupling shaft (12).
8. Assemble wear plate (9) onto housing (18).
9. Install seal ring (4) into groove on the rotor set (8). Install rotor set (8) with seal ring toward wear plate (9).

10. Install two seal rings (4) into grooves on manifold (7). Assemble manifold to the rotor set (8). The manifold will have a polished area on the side facing the rotor set (8).
11. Put the commutator ring (6) on the manifold.
12. Put a new seal ring (3) with the flat side up, into the commutator (5). Put the commutator (5) over the end of the drive link (10) and onto the manifold (7). The seal ring side must be up.
13. Install seal ring into groove in end cover (2). Put the end cover onto the commutator set.
14. Install the bolts and tighten to a torque of 50 ft. lbs. (70 Nm). Alternately and progressively tighten the bolts until the correct torque is reached. The coupling shaft (12) should rotate freely. No more than 50 ft. lb. (70 Nm) of torque should be required to rotate the shaft.

15. If motor is equipped with relief valves (24):
 - a. replace "O" ring seal (22) on plug (21).
 - b. tighten to a torque of 50 ft. lbs. (70 Nm).

INSTALLATION

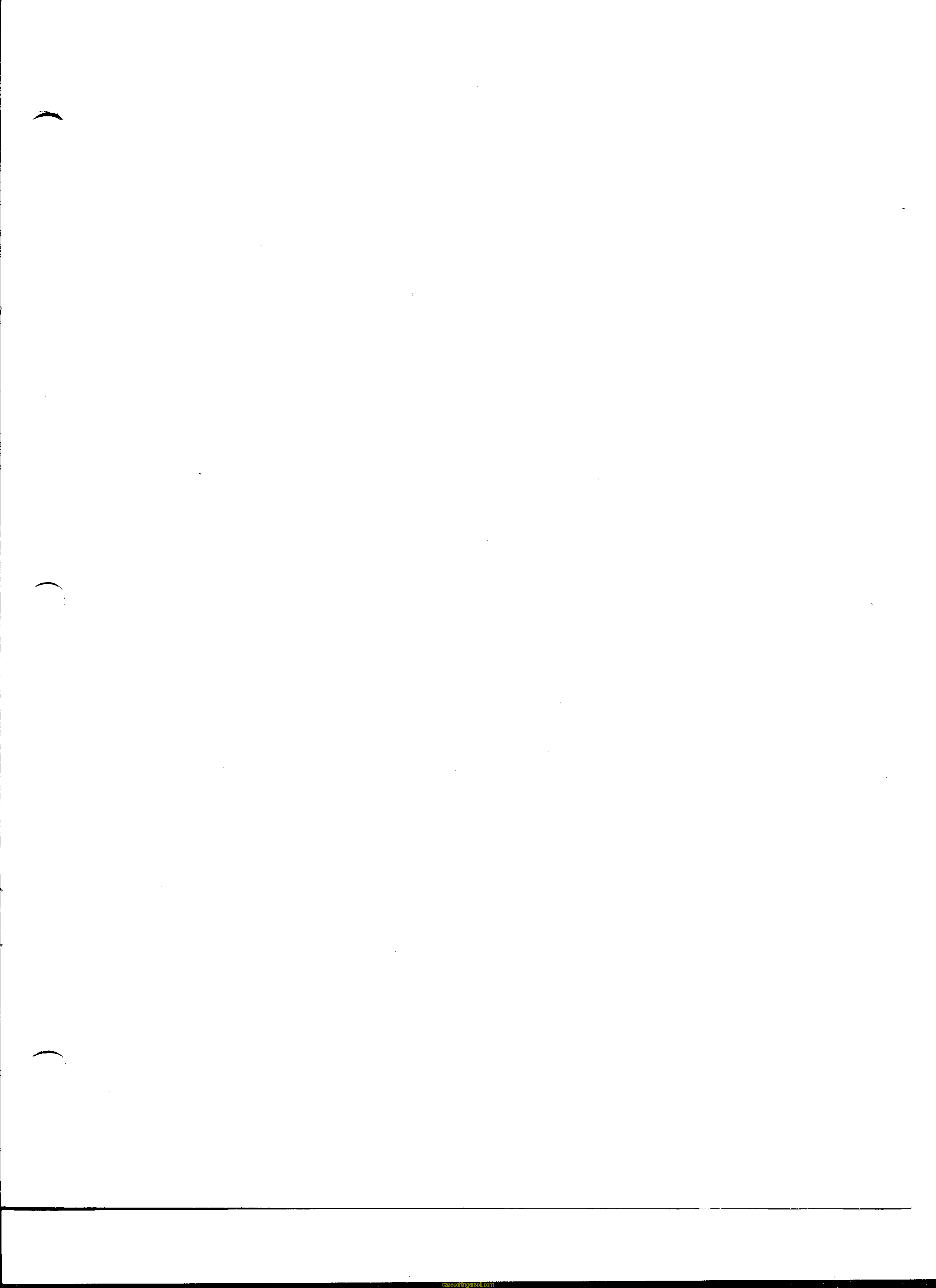
1. Install a new "O" ring on the flange.
2. Slide the hydraulic motor into the transmission case and guide the input shaft into the high-low cluster gear and needle bearing.
3. Put a small amount of thread sealant on the four cap screws.
4. Install the four cap screws and tighten to a torque of 110 to 125 foot pounds.
5. Install the hydraulic tubes between the travel control valve and hydraulic motor.
6. Install the wheel.
7. Fill the transmission. See your tractor operator's manual for correct amount and type of oil.



NOTE: Assemble Seal Flat Side Out as Shown in Enlarged View of Sectioned Segments of Items Number 5 and 3

Alternate Construction Relief Valve End Cover

FIGURE 6



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