

TROUBLE SHOOTING GUIDE

PROBLEM	PROBABLE CAUSE	REMEDY
Unit will not operate in either forward or reverse	<ol style="list-style-type: none"> Free wheeling valve open (Sundstrand Hydro models) System low on oil Plugged oil filter Faulty control linkage Hydro input shaft not turning Hydro unit not functioning 	<ol style="list-style-type: none"> Close valve Refill to proper level Replace filter Check linkage, correct problem Check input shaft key, replace if necessary Repair or replace hydro
Unit will operate in one direction only	<ol style="list-style-type: none"> Faulty control linkage One check valve stuck open 	<ol style="list-style-type: none"> Check linkage, correct problem Remove and inspect, clean or replace if needed
Loss of power	<ol style="list-style-type: none"> Low on oil Free wheeling valve partially open (Sundstrand Hydro models) Filter or suction line clogged Worn linkage Air in system Engine lugs down 	<ol style="list-style-type: none"> Check and add as necessary Close valve Replace filter, clean and refill system Replace or adjust Refill and check for leaks Check engine for proper power level
Unit operating hot	<ol style="list-style-type: none"> Oil level low Dirt on transmission Excessive load or high drawbar loading Fan not turning Partially plugged filter Internal damage to hydro 	<ol style="list-style-type: none"> Check for leaks and refill to proper level Clean external surface Reduce load or drawbar loading Check fan for proper operation Replace filter and oil Repair or replace hydro

PRINCIPLE OF HYDROSTATIC OPERATION

EATON

The Eaton Model 11 hydrostatic transmission is composed of four (4) major components; a charge pump; a variable displacement, radial ball-piston pump; a fixed displacement, radial ball-piston motor; and a system of valves located between the pump and motor.

The transmission converts mechanical energy at its input shaft into fluid flow under pressure from its

pump, transfers this fluid energy to its motor which in turn converts it back to mechanical energy at its output shaft. The purpose of this transformation is to provide variable output speed, with easy reversing, all with a constant input speed. In operation, the pressure of the fluid in the hydrostatic transmission closed loop varies as the "load" increases or decreases.

If the load increases, so does the pressure of the fluid in the transmission. This change in load and pressure automatically changes the torque output of the transmission. The greater the load (pressure), the more torque the transmission produces the match the load requirements. If the load is lessened, pressure decreases and torque output drops.

SUNDSTRAND

Engine power is transmitted to the pump input shaft of the transmission by the tractor drive shaft. Rotation of the input shaft causes the main pump block and the charge pump to turn, thus initiating the power transmitting function. Oil from the reservoir is drawn by the charge pump, through the inlet filter, and forced into the low pressure line by way of the low pressure check valves. Oil introduced into the low pressure line by the charge pump fills the area in back of the pistons in the pump section. When the variable swashplate is in the vertical or neutral position the pistons do not move in or out resulting in no oil flow to the pistons in the motor section. Thus the tractor will not move. By tilting the variable swashplate the pistons are forced in and out of the cylinder block, as they rotate across the angled swashplate forcing the oil from the cylinder block under high pressure. The further the swashplate is tilted the longer the stroke of the pistons, causing a greater volume of oil being pumped to the motor section, thus increasing the speed of the tractor. At the bottom of their stroke, the pistons pass again to the

low pressure side of the valving plate and are refilled by the charge pump and oil returning from the motor through the low pressure line. The high pressure oil travels through internal passages to the inlet side of the piston motor. In the motor section, high pressure oil acting on the back of the piston forces the piston "down the stationary tilted swashplate causing the cylinder block to rotate and turn the output shaft." When the variable swashplate is tilted in the opposite position, the pressures are reversed and the motor cylinder block will rotate in the opposite direction, thus reversing the direction of the tractor.

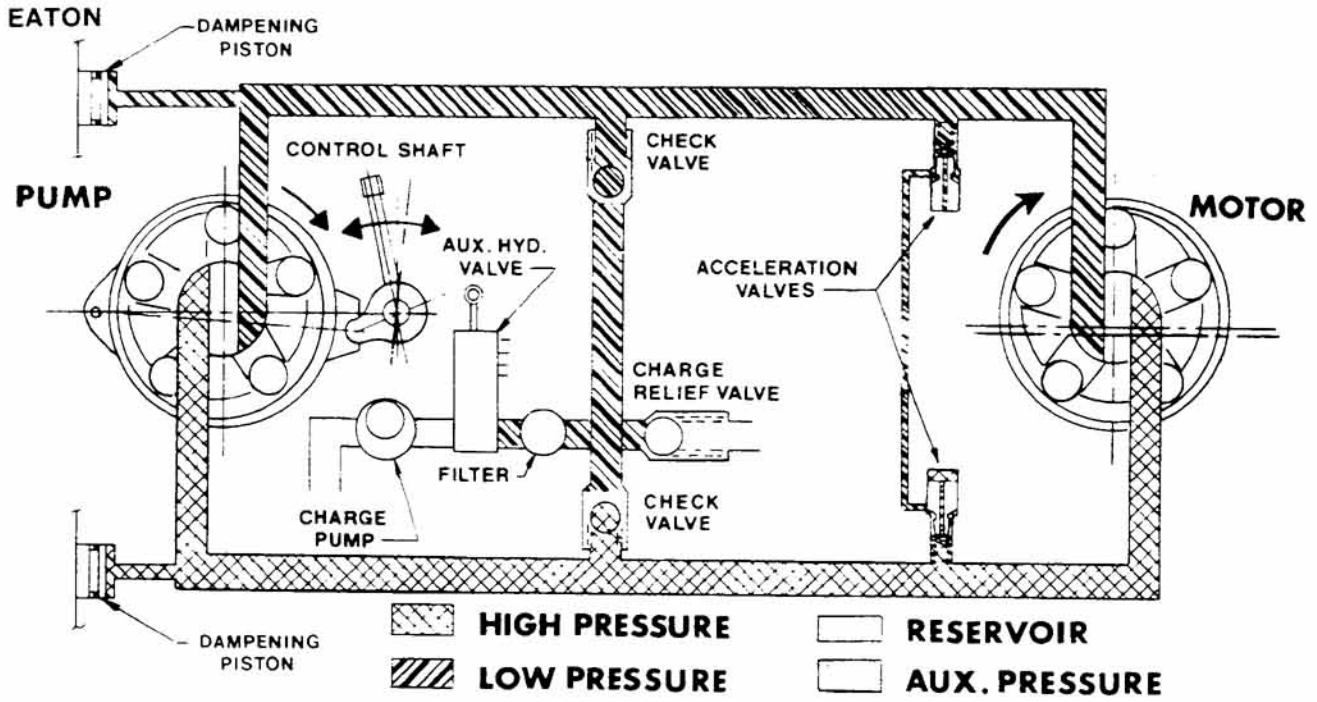
The acceleration valves are placed in the circuit to limit vehicle acceleration to a safe rate. With the control lever in neutral, oil is under low pressure throughout the circuit. When the control lever is advanced rapidly from the neutral to the forward position, the circuit pressure increases and the forward acceleration valve bleeds some of the high pressure oil to the low pressure side of the circuit thus limiting vehicle acceleration. As the vehicle con-

tinues to accelerate at the safe rate, high pressure oil leaking past the acceleration valve body forces the valve down against its seat, stopping the bleeding of oil to the low pressure side. The acceleration valve will remain in this position as long as the control lever position is unchanged. When the control lever is moved into reverse position, the reverse acceleration valve performs in the same way.

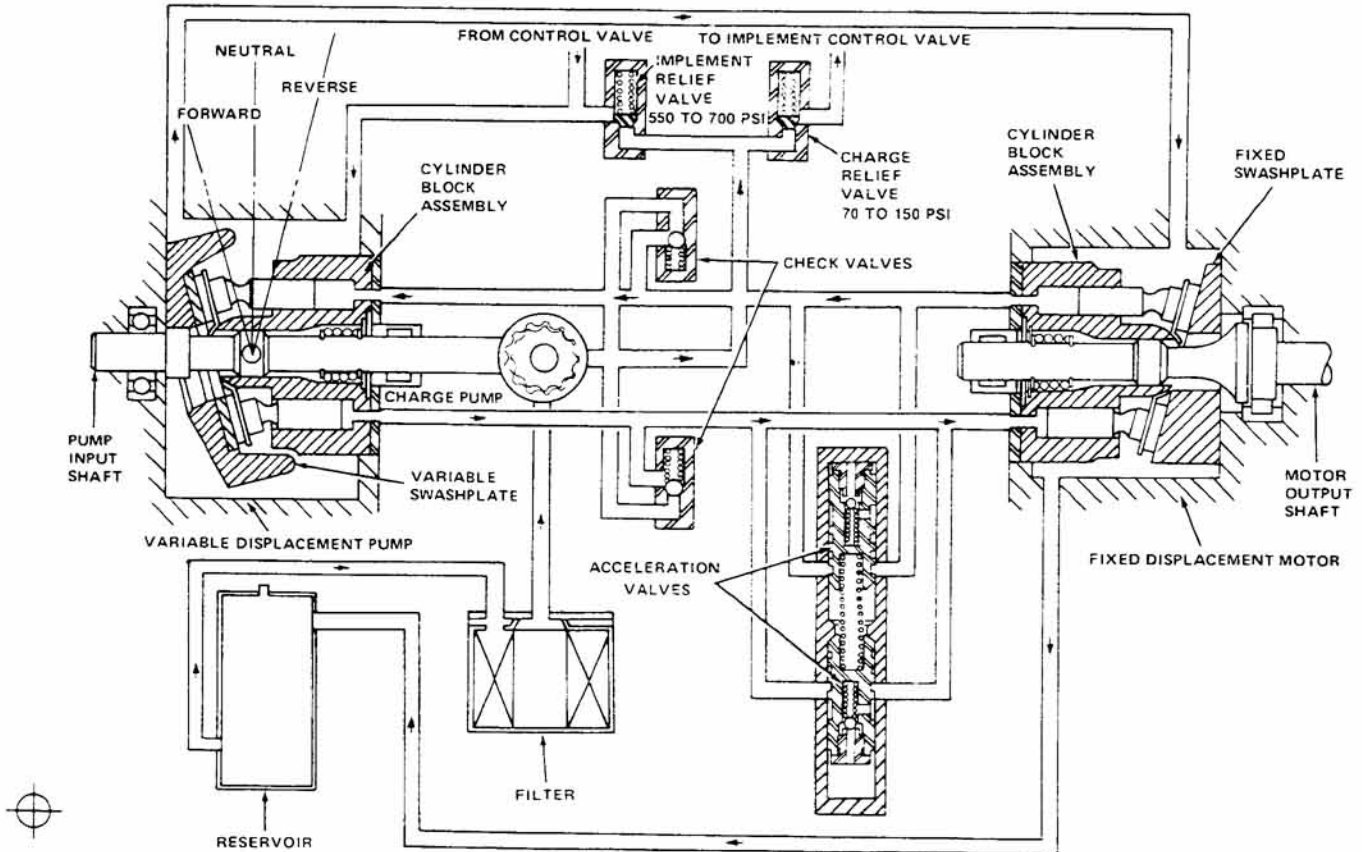
The charge pump relief valve is a simple spring loaded valve. The function of this valve is to regulate the supply of low pressure oil to the pistons in the pump section. The excess charge oil is bypassed by this valve to the implement circuit.

When implement hydraulic cylinders are actuated, the pressure supplied by the charge pump is limited by the implement relief valve. The reason for this is to permit the charge pump to supply high pressures for intermittent periods to permit sufficient pressures for implement cylinder actuation. When the implement relief valve opens, the oil is by-passed to the case and pumped into the transaxle.

HYDROSTATIC TRANSMISSION FLOW CHART



SUNDSTRAND



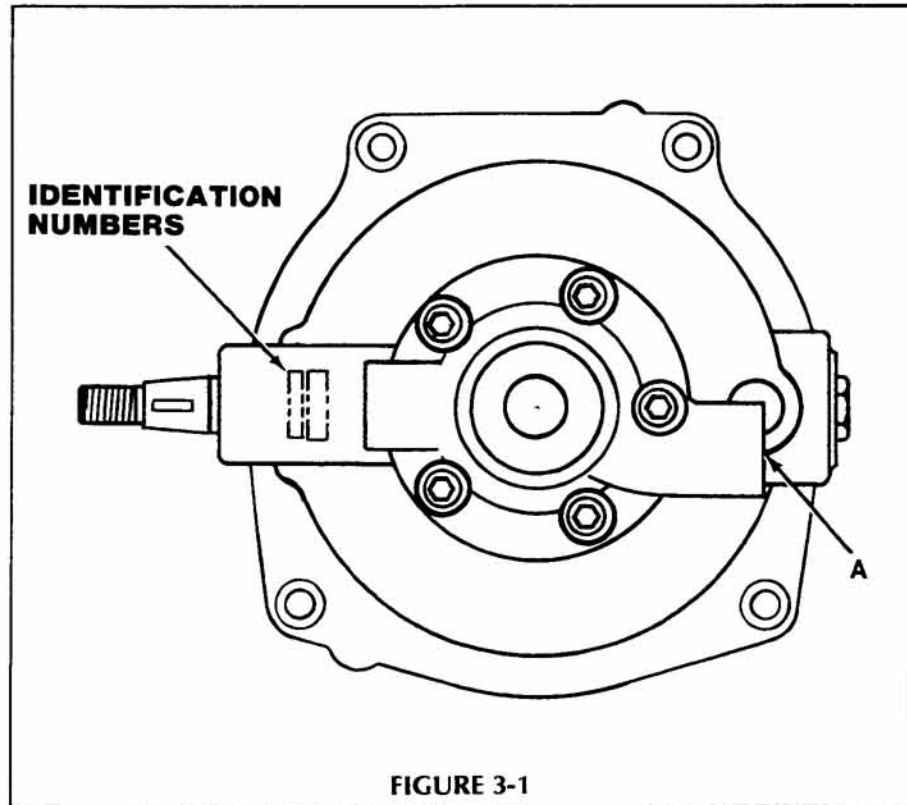
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IDENTIFICATION (EATON)

A Eaton Right Hand drive hydrostatic is used in the HT series tractor.

EATON

To identify, locate the Serial Number stamped in area specified.



IDENTIFICATION (SUNDSTRAND)

A Sundstrand Right Hand drive hydrostatic is used in the large frame tractor. There are three ways of identifying the Right Hand hydrostatic.

1. Model Number located on hydrostatic identification tag.
2. Charge pump housing should have the R.H. (Right Hand) casting marking up and above the input shaft.
3. Motor housing must have the straight casting mark up.

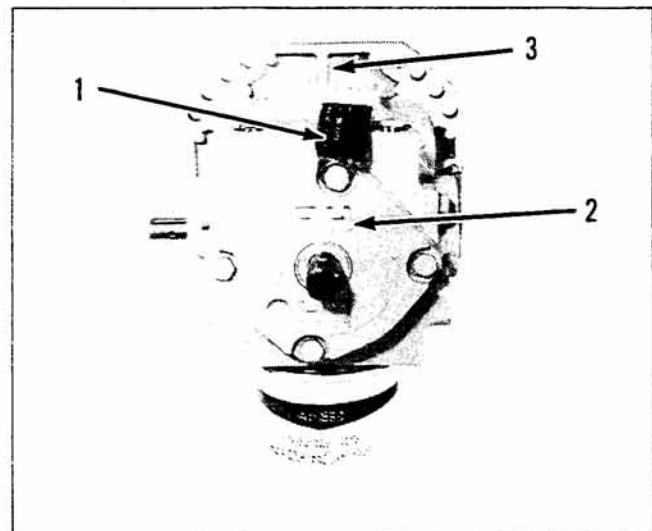


FIGURE 2-2

Hydrostatic valves which can be checked, repaired, or replaced with unit remaining in the tractor are identified in Fig. 3-3.

1. Reverse Acceleration Valve Assy.
2. Charge Pump Relief Valve Assy.
3. Acceleration Valve Spring.
4. Forward Acceleration Valve Assy.
5. Free Wheeling By-Pass Valve.
6. Implement Relief Valve Assy.

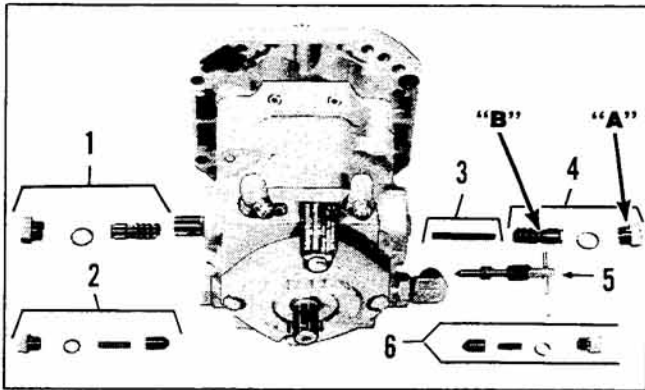


FIGURE 3-3

Right side of hydrostatic shows location of the charge pump relief valve assembly and the reverse acceleration valve. See Fig. 3-3.

Left side of hydrostatic shows location of the implement relief valve assembly, the free wheeling valve and the forward acceleration valve.

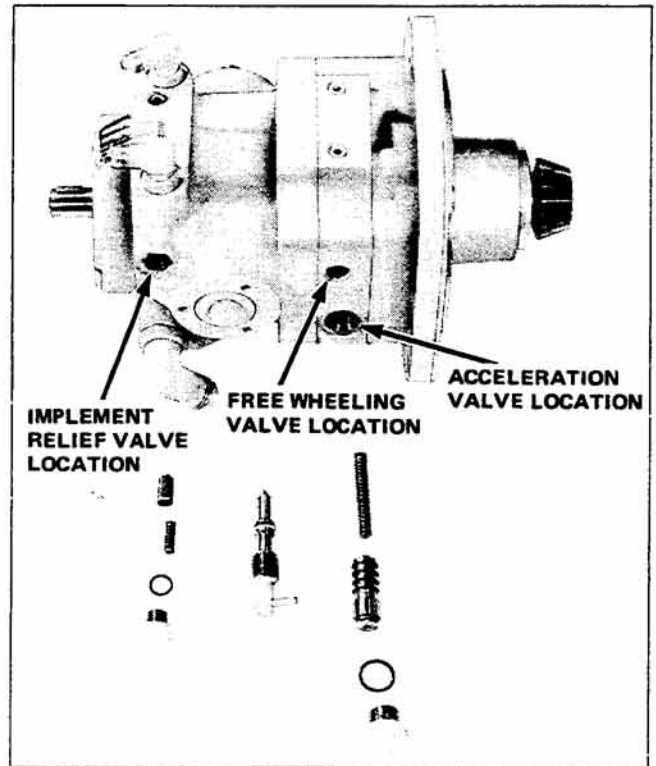


FIGURE 3-4

To check the acceleration valve the cap "A", Fig. 3-3 can be turned out of the body "B." The spring and ball can then be removed and inspected for dirt which could cause erratic shifting of the hydrostatic.

TESTING HYDRO (SUNDSTRAND)

The hydrostatic charge pump and implement pressure should be checked before the hydro unit is blamed for some other malfunctioning part in the drive train. A pressure gage which reads at least 1000 P.S.I. should be used for this test.

PROCEDURE FOR CHECKING BOTH CHARGE PUMP AND IMPLEMENT PRESSURE

1. To check the charge pump pressure, install the pressure gage into either of the two pipe fittings on the top of the hydro (fig. 3-7).
2. Start the engine and run at full R.P.M.
3. The gage (fig. 3-8) should register a pressure reading of 70 to 150 P.S.I. If the pressure reading is below 70 P.S.I. check the following.
 - A. The oil filter may be plugged. Replace if necessary.
 - B. The pickup tube may be plugged. Clean if necessary.
 - C. The charge pump relief valve (fig. 3-3) may be inoperative. Check the spring tension and valve seating. Replace the spring and valve if necessary.
4. If after completing these checks and making the necessary corrections the charge pressure is still below 70 P.S.I., the charge pump may be at fault.
5. To check the implement pressure, the gage should be installed in the same pipe fitting as for checking the charge pump pressure.
6. With the engine running at full R.P.M., hold the hydraulic lift valve lever in the lift position until the hydraulic lift cylinder reaches the end of its travel. The pressure reading should then be 550 to 800 P.S.I.
7. If the implement pressure is below 500 P.S.I., and the charge pump pressure is over 70 P.S.I., check the following:
 - A. A leak in the hydraulic system. Repair if necessary.
 - B. The implement relief valve (fig. 3-3) may be inoperative. Check the spring tension and valve seating. Replace the spring and valve if necessary.

NOTE: Shims are available to increase implement relief valve pressure. 1 Shim .012" in thickness will increase pressure approximately 50 psi.

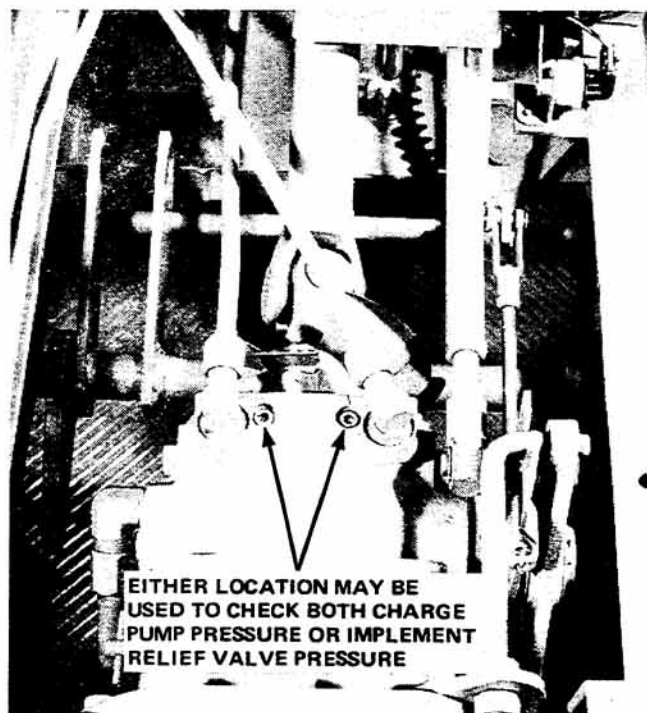
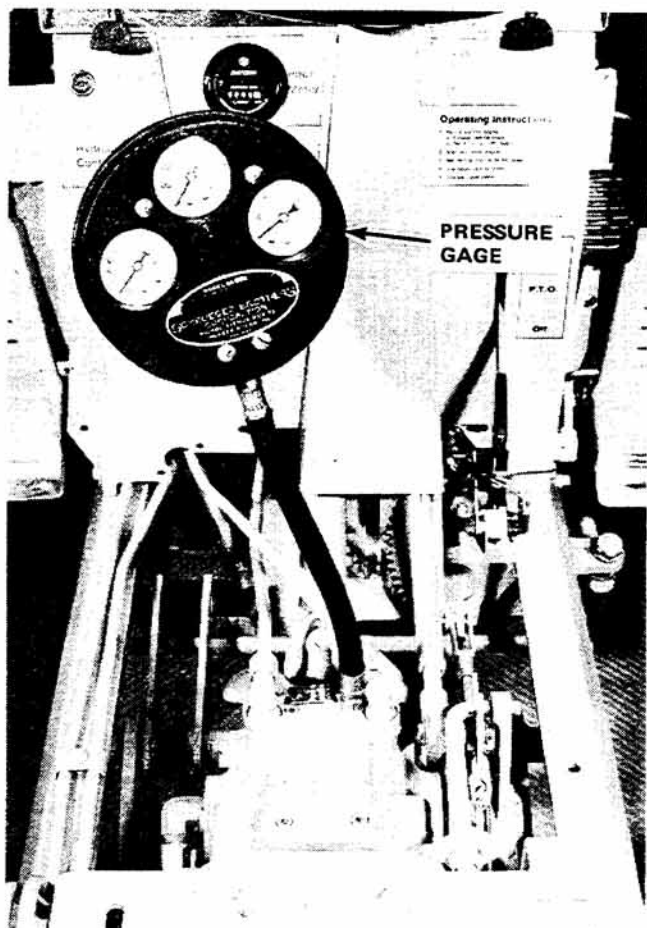


FIGURE 3-7



HYDRO REMOVAL

1. Drain fluid from Transaxle.

NOTE: DO NOT REUSE OLD FLUID.

2. Loosen set screw and remove bolt holding drive shaft on engine crankshaft. Slide shaft forward until it clears hydro input shaft.
3. Disconnect hydraulic lines (Reference "A" fig. 3-9).
4. Disconnect pick-up tube line (Reference "B" at hydro end).
5. Remove hydro oil filter.
6. Remove bolt holding neutral adjusting rod (Reference "C").
7. Drive out roll pin (Reference "A" fig. 3-12) holding linkage to control shaft. Remove linkage as an assembly.
8. Remove the remaining three bolts holding hydro.

NOTE: Hold hydro while removing last bolt to prevent it from dropping. Remove hydro from tractor.

9. Remove the two oil line fittings and the pick-up tube fitting from old hydro.
10. Remove roll pin from free wheeling valve.

HYDRO INSTALLATION

1. Remove protection cap from oil filter stud and stake stud to prevent it from turning further into hydro during filter installation.

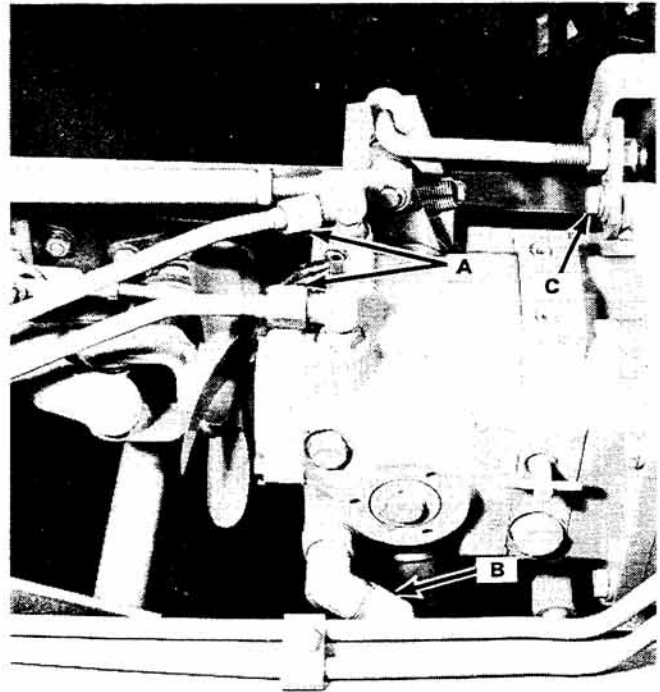


FIGURE 3-9

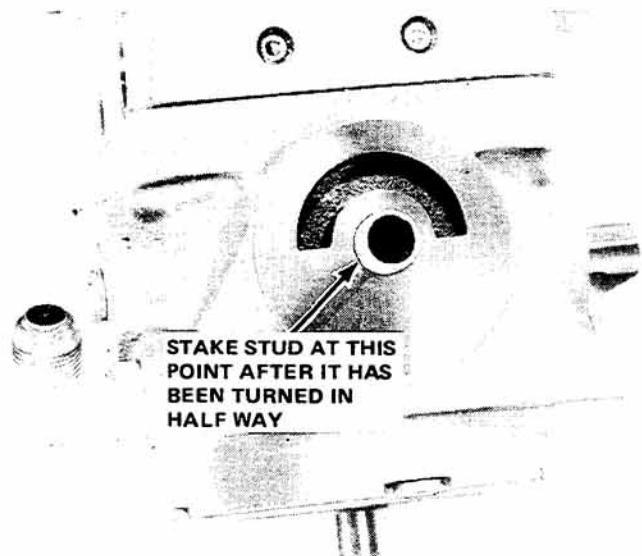


FIGURE 3-10

2. When replacing the hydro package the bevel output gear must be removed from the old hydro and installed on the new one. The bevel gear is held on with either an external snap ring (fig. 3-11) or a nut (fig. 3-11A). Make sure snap ring is properly installed in the groove. The snap ring should be replaced when it shows signs of weakness or distortion.

3. Install roll pin into free wheeling valve.

NOTE: BE CAREFUL NOT TO DAMAGE VALVE.

4. Install the two oil line fittings and pickup tube fitting (fig. 3-9). Do not tighten packing nuts so fittings can be adjusted to lines.
5. Install gasket onto hydro using grease to hold it in place.

NOTE: Refer to old hydro for bolt pattern to locate gasket.

6. Install hydro and the three shorter bolts. (Save longer bolt to attach neutral adjusting rod.)
7. Install linkage on control shaft and drive in roll pin to hold in place.
8. Install neutral adjusting rod and torque all four bolts to 31 ft. lbs.
9. Install pick-up tube and tighten packing nut.
10. Install the two hydraulic oil lines and tighten packing nuts.
11. Slide driveshaft onto hydro input shaft until hole lines up on engine crankshaft. Install bolt and nut and tighten. Tighten set screw. Check for 1/8" clearance between drive shaft and hydrostatic. Adjust engine mounts if necessary.
12. Fill a new oil filter with new hydrostatic fluid (type "F"). Grease filter "O" ring and install hand tight only.
13. Fill transaxle assembly with approximately 8 quarts of new hydrostatic fluid.
14. Loosen pick-up tube line at hydro end, (Reference "B" figure 3-9) until fluid leaks out. Retighten.
15. Install negative battery cable.
16. Remove spark plugs from engine and crank for approximately 15 seconds to fill hydro with fluid. Reinstall spark plugs.

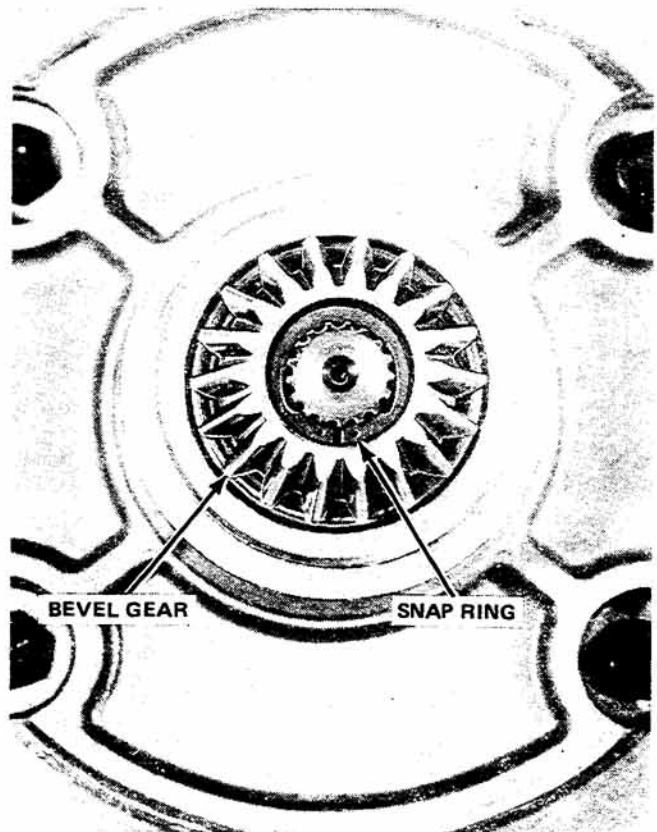


FIGURE 3-11

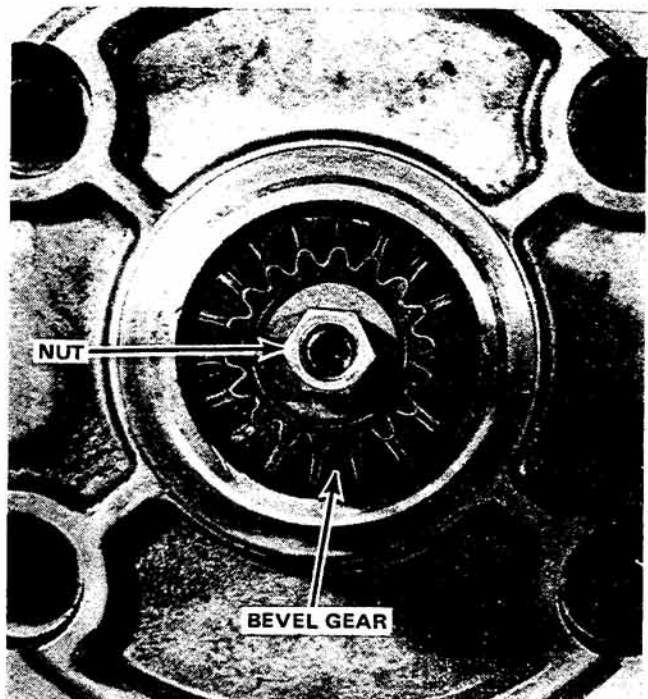


FIGURE 3-11A

17. Start unit and operate at low engine R.P.M. Actuate hydraulic lift lever to fill rest of system with fluid.
18. Securely block up rear of tractor. Make sure free wheeling valve is closed. Place travel pedal into the neutral position. Start the engine and release the brakes. If rear wheels creep forward, loosen nuts (Reference "B" Fig. 3-12) and shorten rod (Reference "C") until wheels stop creeping. If rear wheels creep backward lengthen rod (Reference "C") until wheels stop creeping. Retighten nuts (Reference "B").
19. Stop unit and check fluid level. Add fluid if necessary.

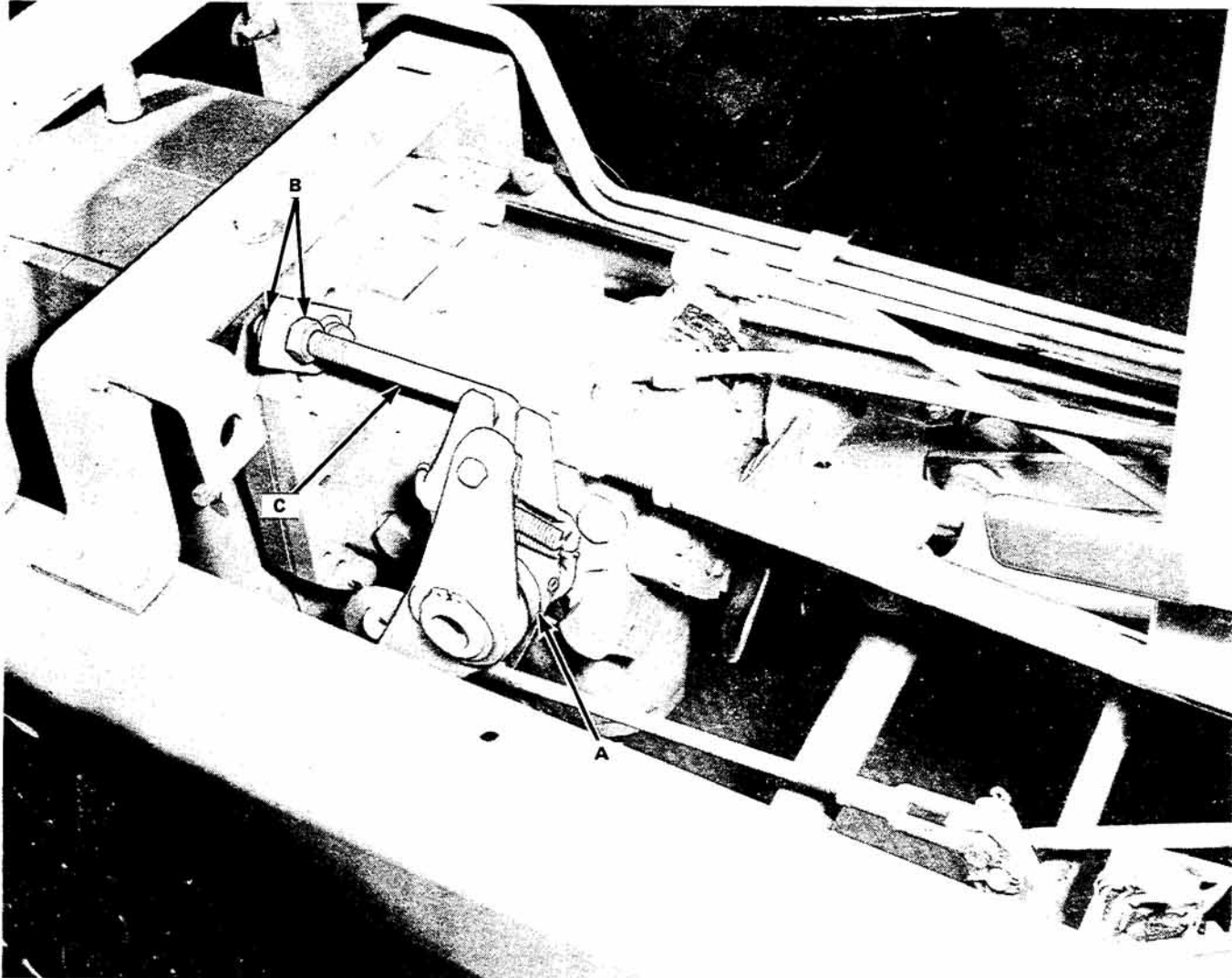


FIGURE 3-12

DRIVE TRAIN (Continued)

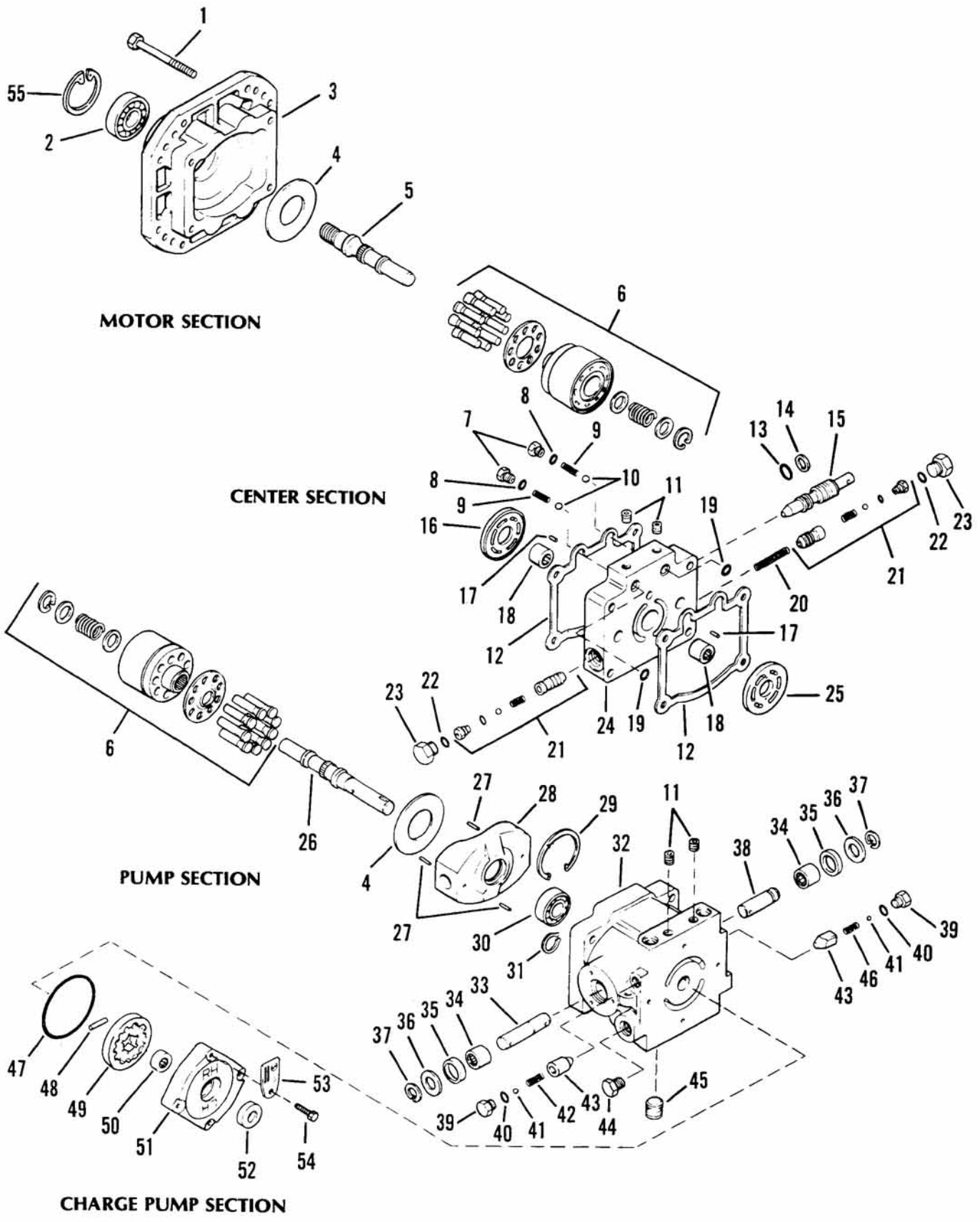


FIGURE 3-13 HYDROSTATIC EXPLODED VIEW

LEGEND FOR FIGURE 3-13

- | | | | |
|----|-----------------------------|----|-------------------------------|
| 1 | Cap Screw | 28 | Pump Swash Plate |
| 2 | Bearing | 29 | Snap Ring |
| 3 | Motor Housing | 30 | Bearing |
| 4 | Thrust Plate | 31 | Snap Ring |
| 5 | Motor Shaft | 32 | Pump Housing |
| 6 | Cylinder Block Assembly | 33 | Control Shaft |
| 7 | Check Valve Cap | 34 | Bearing |
| 8 | "O" Ring | 35 | Seal |
| 9 | Spring | 36 | Washer |
| 10 | Ball | 37 | Retaining Ring |
| 11 | Pipe Plugs | 38 | Trunnion Shaft |
| 12 | Gaskets | 39 | Hex Plug |
| 13 | "O" Ring | 40 | "O" Ring |
| 14 | Back Up Ring | 41 | Shim Pack |
| 15 | Free Wheeling Valve | 42 | Charge Relief Valve Spring |
| 16 | Motor Valve Plate | 43 | Poppet Valve |
| 17 | Pin | 44 | Hex Plug |
| 18 | Bearing | 45 | Filter Union |
| 19 | "O" Ring | 46 | Implement Relief Valve Spring |
| 20 | Acceleration Valve Spring | 47 | "O" Ring |
| 21 | Acceleration Valve Assembly | 48 | Drive Pin |
| 22 | "O" Ring | 49 | Charge Pump (Gerotor) |
| 23 | Hex Plug | 50 | Bearing |
| 24 | Center Section | 51 | Charge Pump Housing |
| 25 | Pump Valve Plate | 52 | Seal |
| 26 | Pump Shaft | 53 | Identification Tag |
| 27 | Roll Pins | 54 | Cap Screw |
| | | 55 | Snap Ring (Later Models) |

DRIVE TRAIN (Continued)

EATON MODEL 11 BREAKDOWN

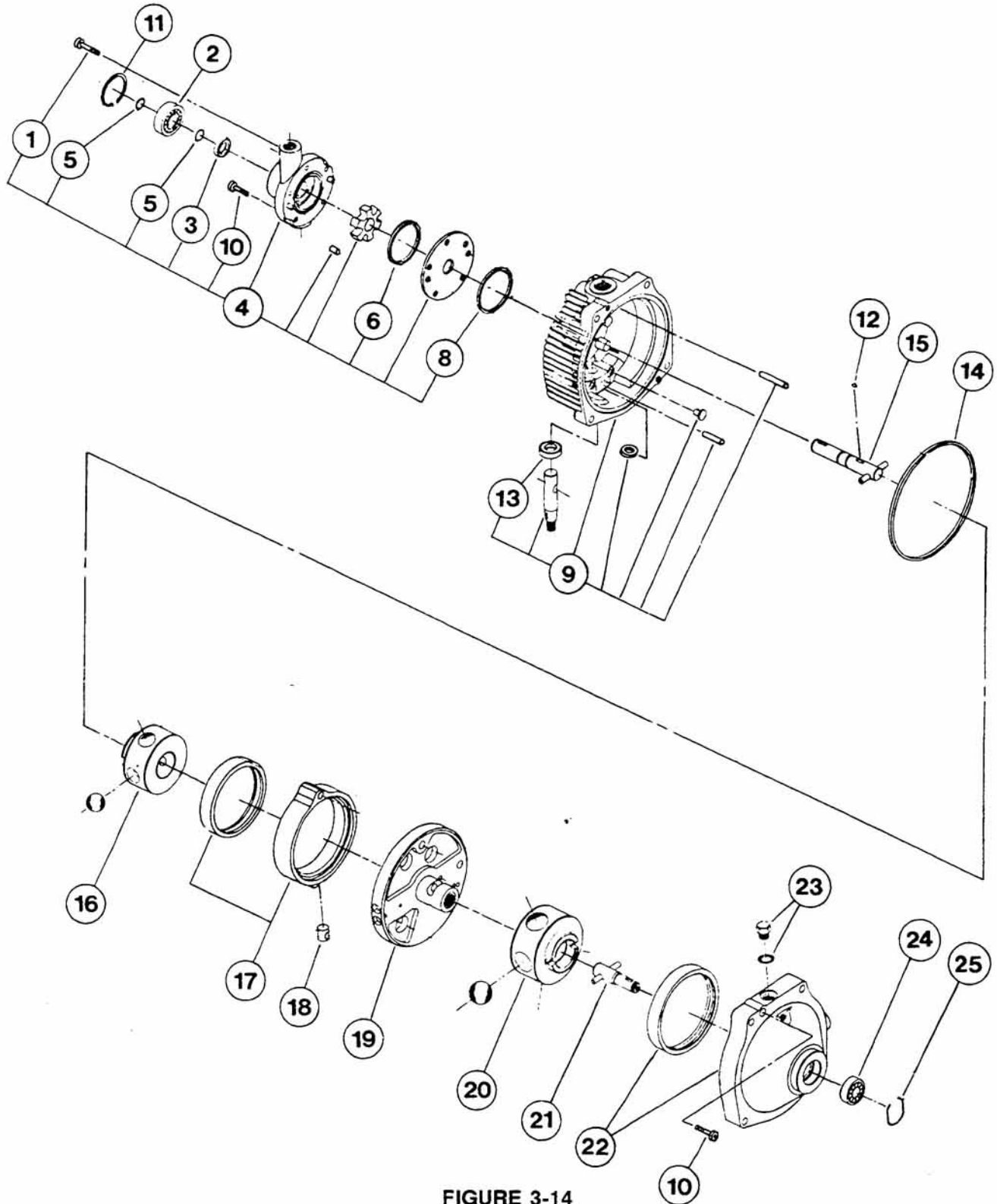


FIGURE 3-14

LEGEND FOR FIGURE 3-14

1		Socket Hd. Cap Screw 5/16-18 x 1-3/4 (Included with Ref. 4)	1
2	1744151	Ball Bearing (Input)	1
3	1724381	Oil Seal (Included with Ref. 4)	1
4	1744190	Charge Pump Kit (Includes Ref. 1, 3, 5, 6, 8, 10 & 12	1
5	1724375	Snap Ring (Included with Ref. 4)	1
6	1744155	Sq. Seal Ring (Incl. with Ref. 4)	1
8	1744157	Sq. Seal Ring (Incl. with Ref. 4)	1
9	1744154	Cover Sub Assy. (Includes Ref. 13)	1
10	Buy Local	Socket Hd. Cap Screw 5/16-18 x 1-1/4 (Included with Ref. 4)	6
11	1744171	Retaining Ring	1
12	1744159	Drive Pin (Included with Ref. 4)	1
13	1724376	Oil Seal (Included with Ref. 9)	1
14	1744185	Square Seal Ring	1
15	1744162	Input Shaft Sub Assy. (Keyed)	1
16	1744164	Pump Rotor & Ball Assy.	1
17	1744184	Cam Ring Assy.	1
18	1744176	Cam Ring Insert	1
19	1744167	Pintle Assy. (Includes internal parts)	1
20	1744177	Motor Rotor & Ball Sub Assy.	1
21	1744010	Output Shaft Sub Assy.	1
22	1744180	Body Assy. Includes Ref. 21, 24, 25	1
23	1744179	O-Ring Plug Sub Assy.	1
24	1104440	Ball Bearing (Output)	1
25	1724380	Retaining Ring	1

TESTING HYDROSTATIC

EATON HYDRO

The hydrostatic pressure can be checked using a pressure gauge which reads at least 1000 P.S.I. To check the hydrostatic pressure install the gauge into a tee hydraulic fitting between hydrostatic port (A) Figure 3-13A and existing hydraulic tube. Start engine and run for 5-10 minutes. At full RPM the pressure reading should be 140 P.S.I. \pm 50 (964 kPa).

NOTE: If the rear wheels will spin on a concrete surface when the tractor is against a barrier, the hydro is probably operating correctly. Caution must be used when performing this test to prevent damage or injury.

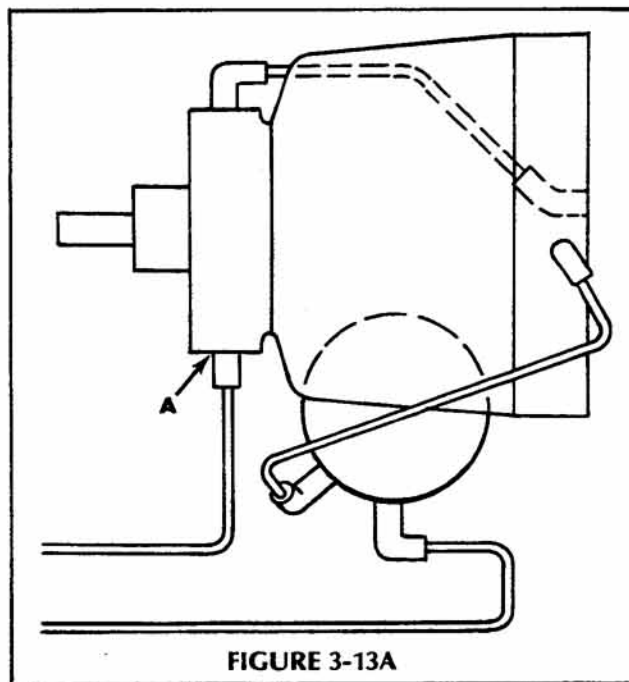


FIGURE 3-13A

EATON HYDRO REPAIR

AN EATON HYDROSTATIC REPAIR MANUAL IS AVAILABLE AT THE FACTORY. CONTACT YOUR BOLENS DEALER FOR ASSISTANCE.

NOTE: Before any repair work clean the area thoroughly.

1. "O" Ring (1) is replaceable.
2. To replace control shaft seal, item (2).

NOTE: We recommend removal of transmission from vehicle.

Remove control arm with approved tool (standard puller). **WARNING:** DO NOT attempt to pry or drive the control arm off the shaft, as internal damage can occur. Remove control shaft seal item (2). **NOTE:** A hook puller or screw driver may be used.

Wipe seal counterbore clean and examine for damaged surfaces. Install new double lip seal, item (2), with the steel retainer to the outside. Press or tap lightly until seal is bottomed. **CAUTION:** Over-travel of the seal will cut the rubber nose. Use a square-faced tube with the O.D. slightly smaller than the O.D. of the seal and the I.D. a slip fit over the shaft. Grease the seal lips before installation. Install control arm. **NOTE:** Lubricate the tapered portion of the shaft. Remove capscrew, item (3), and add hydrostatic fluid until unit is full. Replace and tighten capscrew, item (3).

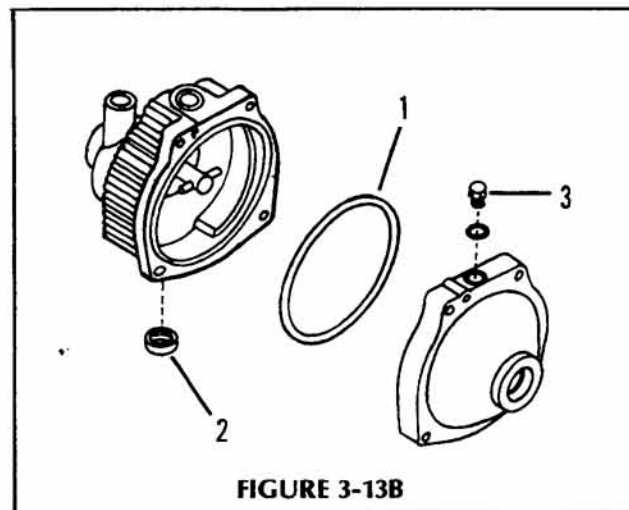


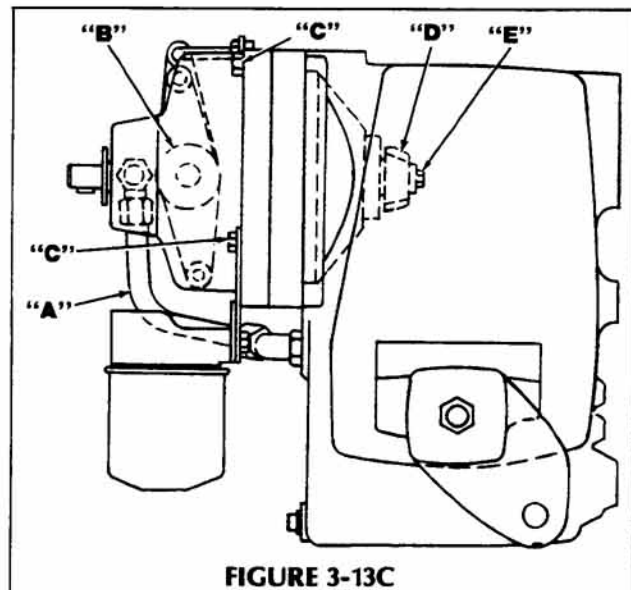
FIGURE 3-13B

EATON HYDROSTATIC REMOVAL

1. Remove the transaxle from the frame. See transaxle removal.
2. Tip the transaxle back and rest on a 6" block.
3. Remove any dirt or grease from hydraulic suction line (A) fittings.
4. Disconnect hydraulic suction line (A) and save.
5. Remove nut and washer on control shaft and slide control arm assembly (B) off and save.

NOTE: A puller may have to be used when removing the control arm.

6. Remove remaining 2 oil filter hydraulic lines at hydro.
7. Remove the four (4) mounting screws (C) securing the hydro and oil filter.
8. If replacing complete hydro, remove the three hydraulic tube fittings and install them into the new hydrostatic. Do not tighten.
9. If replacing complete hydro remove bevel gear (D) on output shaft. To disassemble, hold spacer (E) in place when loosening nut. Position bevel gear onto new hydrostatic and fasten. Torque nut to 24 ft. lbs. (32.5 N.m).



3

EATON HYDRO INSTALLATION

1. Tip the transaxle back and rest on a 6" (15 cm) block.
2. Install spacer, nut (E), and bevel gear (D) on output shaft. Torque nut to 24 ft. lbs. (32.5 N.m).
3. Install control arm assembly (B) to control shaft. Secure with nut and washer.
4. Install hydro to transaxle housing.
5. Install the four mounting screws (C) to secure the hydro and oil filter.
6. Install the three hydraulic tube fittings.
7. Connect hydraulic suction tube (A).

HYDROSTATIC REPAIR (SUNDSTRAND)

If trouble shooting and pressure checks indicate a need for disassembly of the hydrostatic for repair, the unit must be removed from the tractor. After removal, the open ports should be sealed off and the external surface thoroughly cleaned in a mild cleaning solvent. **IMPORTANT:** Do not use a cleaning solvent that is harmful to paint or rubber.

To simplify the repair of the hydrostatic it will be discussed in four basic sections:

1. Charge pump section
2. Pump section
3. Center section
4. Motor section

NOTE: Before disassembly of the various sections, a line should be scribed across the top of the transmission so the proper positions of the sections will be maintained during reassembly.

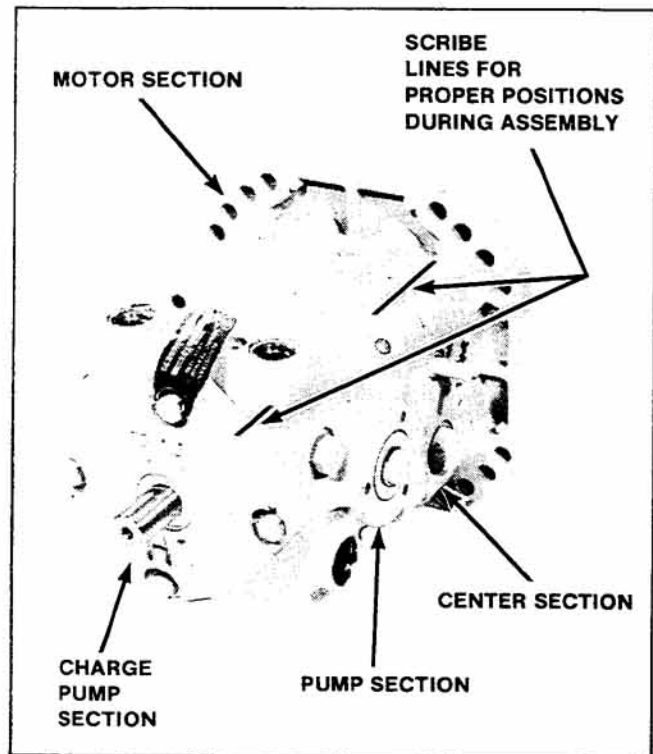


FIGURE 3-14

REMOVAL OF CHARGE PUMP

1. Before removing housing, inspect the input shaft especially the keyway, for burrs or sharp edges that could damage the lip seal.
2. Remove the four capscrews and pull housing off the input shaft.
3. The charge pump "O" ring, drive pin, gerotor assembly, bearing and seal can now be inspected and replaced if necessary.

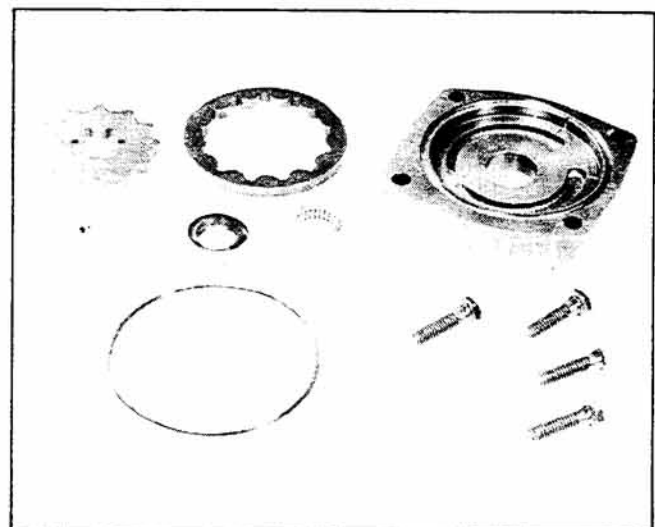


FIGURE 3-15

NOTE: Two different charge pumps were used on the hydrostatics. The 90-1118-02 and 03 charge pump used a ball bearing, larger diameter input shaft seal, and a non-hardened input shaft.

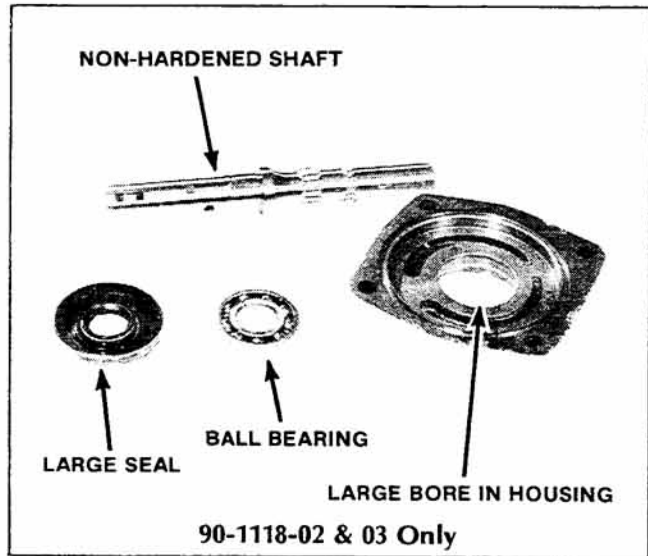


FIGURE 3-16

The 90-1118-04 & later models charge pump use a needle bearing, smaller diameter seal, and a hardened input shaft. The hardened input shaft is needed to provide the inner race for the needle bearing.

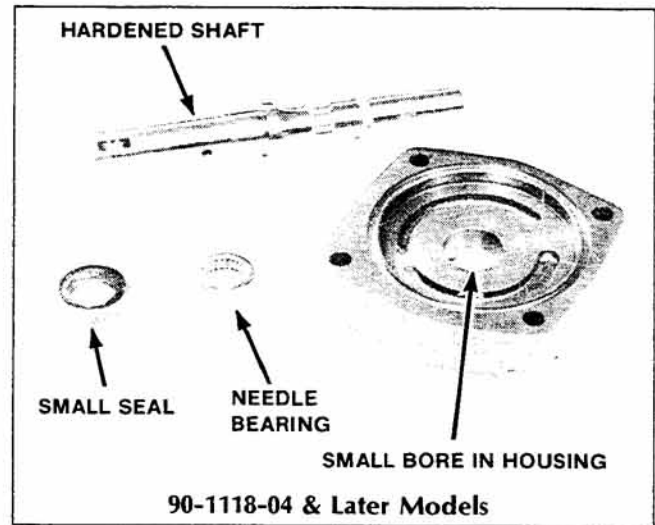


FIGURE 3-17

CHARGE PUMP INSPECTION

1. The gerotor surface should be inspected on both sides for grooves or pickup of foreign material.
2. The drive pin should be inspected for cracks or fatigue points.
3. The charge pump oil cavity lead-ins and inner housing surface should be inspected for damage or excessive wear.

Damaged or worn parts should be replaced.

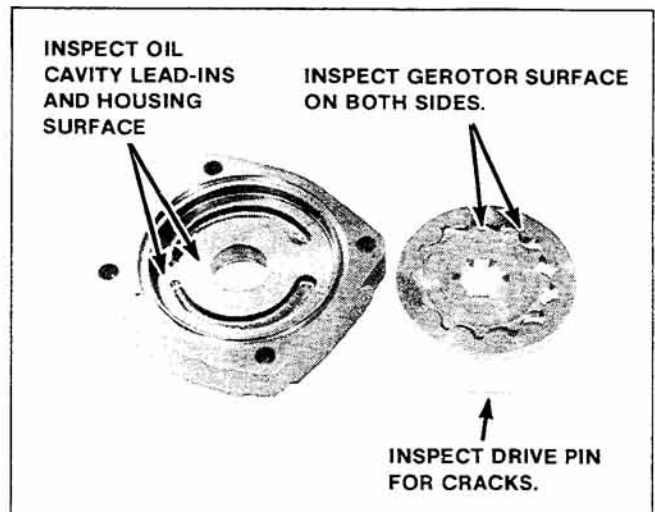


FIG 3-18

ASSEMBLY PROCEDURE OF CHARGE PUMP

Clean all parts and lubricate with new hydrostatic transmission fluid before assembly.

1. Install the input shaft bearing into the charge pump housing. Bearing must be installed from the inside and be flush to .005" below its bore, with the lettered side out.
2. Install the seal into the housing until seated. Press only on the outer edge.
3. Install new "O" ring into housing groove.
4. Install drive pin into hole in input shaft.
5. Install gerotor assembly over drive pin.
6. Install charge pump housing. Be careful not to damage lip seal. Torque capscrews to 20 ft. lbs.

SEPARATING PUMP, MOTOR AND CENTER SECTIONS

1. Set the hydrostatic pump end down on a soft wooden block with a center hole for the input shaft to extend into.
2. Remove the four capscrews located in the motor section which hold the 3 sections together. Remove all screws equally to prevent damage to threads or surfaces. The three sections are somewhat spring loaded so care must be taken to prevent the transmission from falling apart.
3. When the four capscrews have been removed, the transmission should separate into the three basic sections.

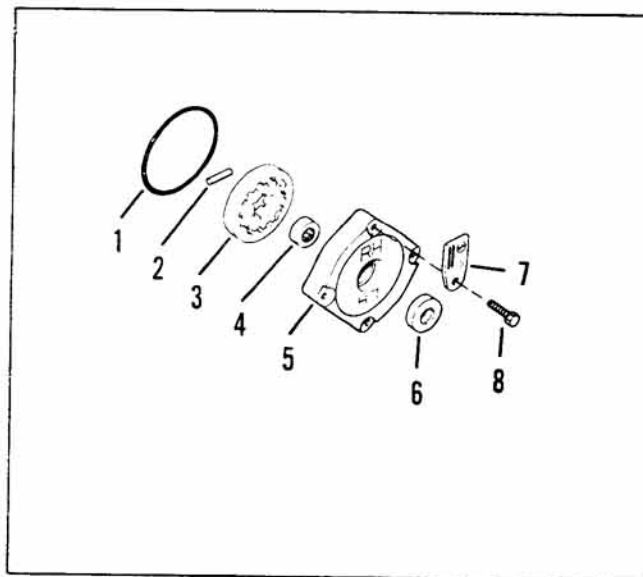


FIGURE 3-19

CHARGE PUMP SECTION

- 1 "O" Ring
- 2 Drive Pin
- 3 Charge Pump (Gerotor).
- 4 Bearing
- 5 Charge Pump Housing
- 6 Seal
- 7 Identification Tag
- 8 Cap Screw

DISASSEMBLY OF PUMP SECTION

1. Remove cylinder block assembly from pump housing.
2. Remove thrust plate from swashplate.
3. Remove pump variable swashplate.
 - A. Set pump housing, charge pump end down on a soft wooden block with a center hole for input shaft to extend into.
 - B. With a punch and light hammer tap spring roll pins through variable swashplate.

NOTE: Excessive heavy pounding may damage bearings.

- C. Push shafts from swashplate and housing and remove the swashplate.
 - D. Press the needle bearings from housing.
4. Remove pump driveshaft.
 - A. Remove snap rings.
 - B. Tap lightly on input end of pump shaft with a soft hammer to remove the bearing and shaft.
 - C. Press bearing from driveshaft.

INSPECTION OF PUMP SECTION

1. Inspect control and trunnion shaft bearings and seals.
2. Inspect thrust plate for scratches or wear. Replace all worn or damaged parts.

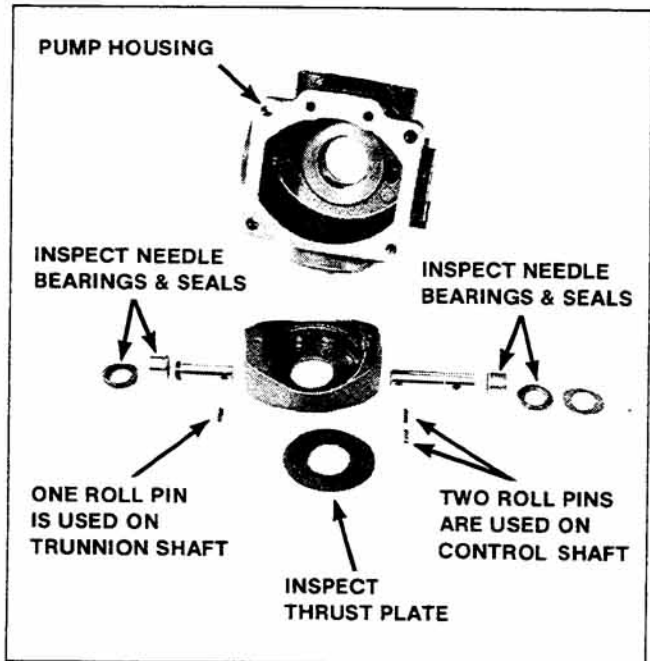


FIGURE 3-20

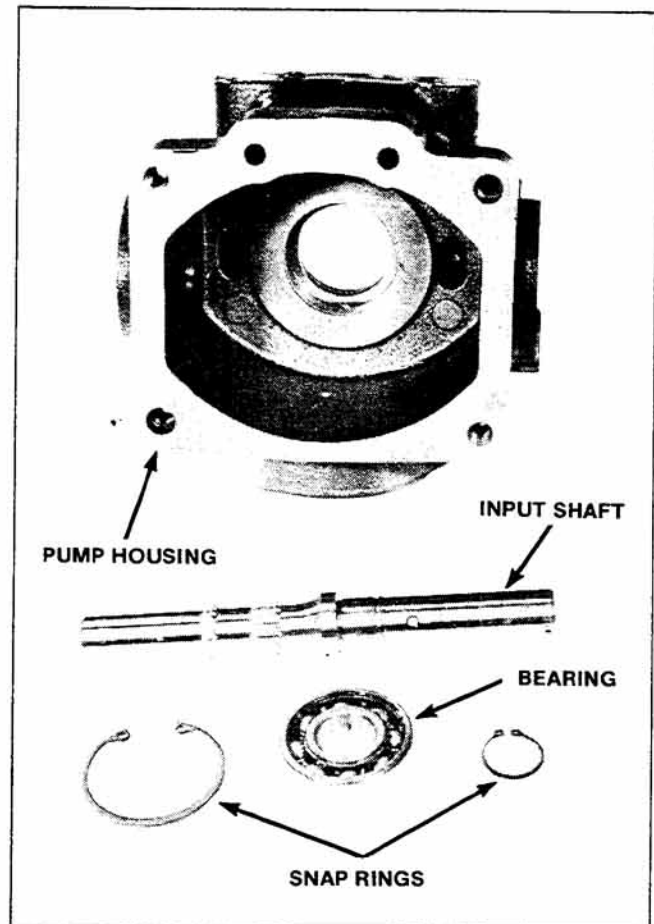


FIGURE 3-21

INSPECTING CYLINDER BLOCK ASSEMBLIES

The pump cylinder block and the motor cylinder block are identical.

1. Inspect the cylinder blocks for wear or pickup of foreign material.
2. Inspect the piston retainer for straightness. The retainer must be straight so the piston slipper surfaces will not wear uneven.
3. Inspect the piston assembly. The lubricant hole must be free of obstruction and the slipper surface even. If the slipper surface has more than 1/32" taper, the cylinder block assembly must be replaced.

Individual parts are not available for the cylinder blocks because of the close tolerances. If any problem is evident the complete cylinder block must be replaced.

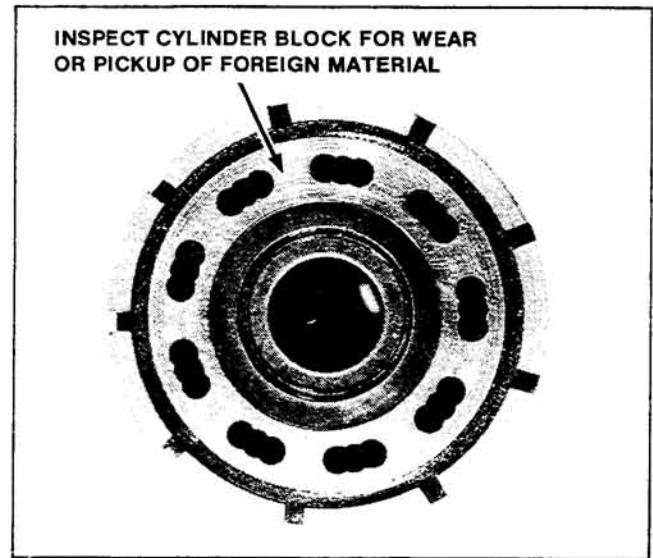


FIGURE 3-22

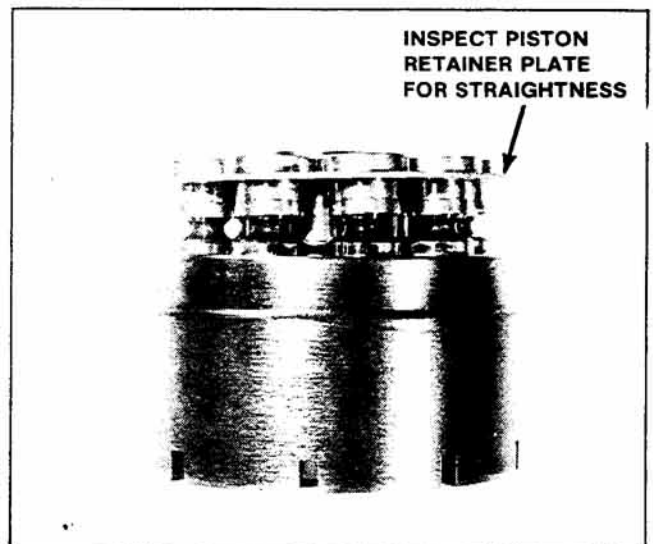
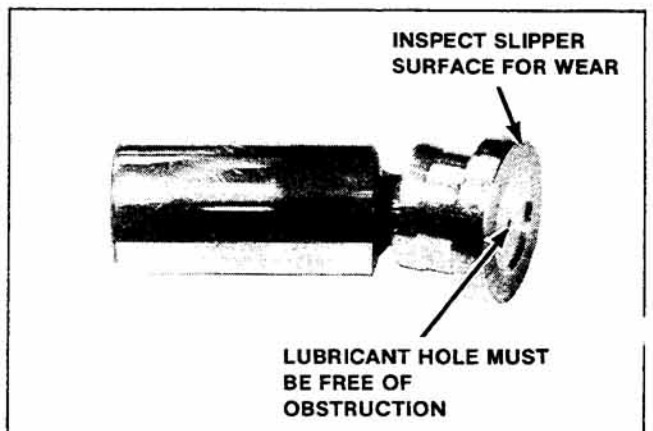


FIGURE 3-23



ASSEMBLY OF PUMP SECTION

1. Press bearings into housing, lettered edge out, until flush to .005 below lip seal recess of housing.
2. Press bearing on pump shaft to shoulder.
3. Install input shaft and bearing into housing.
4. Position pump housing with check valve passageways up.
5. Place swashplate over driveshaft into housing.
6. Insert shorter trunnion shaft into housing and swashplate from left side and longer control shaft (small hole end) into housing and swashplate from right side.
7. Install the spring roll pins. Two on control shaft side, one on trunnion shaft side. Proper installation is when pins are 1/4" into swashplate.
8. Install thrust plate to swashplate.
9. Align splines of cylinder block kit with input shaft splines and install into housing.

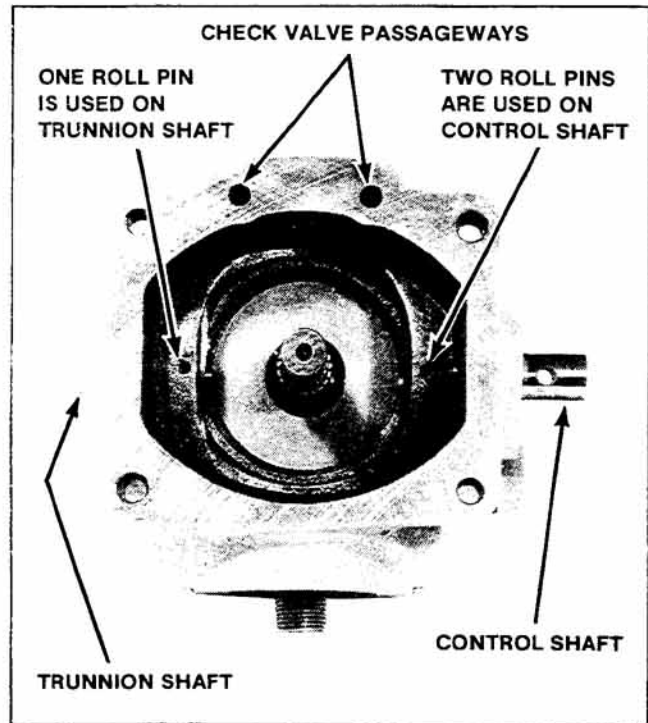


FIGURE 3-25

PUMP SECTION

- 1 Cylinder Block Assembly
- 2 Pump Shaft
- 3 Key
- 4 Thrust Plate
- 5 Pin
- 6 Pump Swashplate
- 7 Snap Ring
- 8 Bearing
- 9 Snap Ring
- 10 Pump Housing
- 11 Pipe Plugs
- 12 Control Shaft
- 13 Bearing
- 14 Seal
- 15 Washer
- 16 Retaining Ring
- 17 Trunnion Shaft
- 18 Hex Plug
- 19 "O" Ring
- 20 Shim Pack
- 21 Charge Relief Valve Spring
- 22 Poppet Valve
- 23 Implement Relief Valve Spring
- 24 Hex Plug
- 25 Filter Union
- 26 Poppet Valve

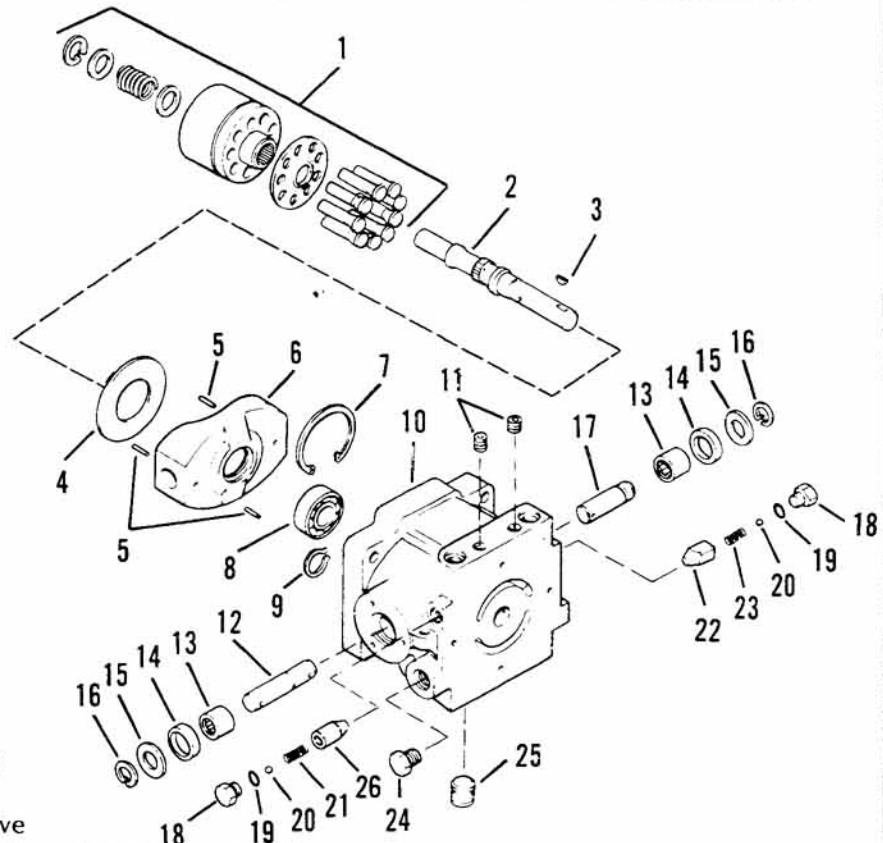


FIGURE 3-26

DRIVE TRAIN (Continued)

DISASSEMBLY OF CENTER SECTION

1. Remove valve plates and valve plate locating pins.
2. Remove gaskets.
3. Remove bearings.
4. Remove check valve "O" rings, pump side and check valves, motor side.

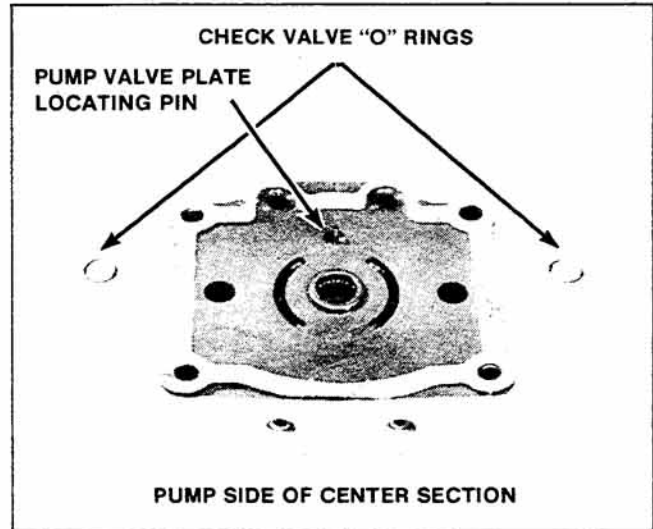


FIGURE 3-27

INSPECTION OF CENTER SECTION

1. Inspect bearings.
2. Inspect check valves and check valve seats. Make sure check valves operate freely.
3. Inspect back side of motor and pump valve plates for dirt or wear in the locating pin slots.

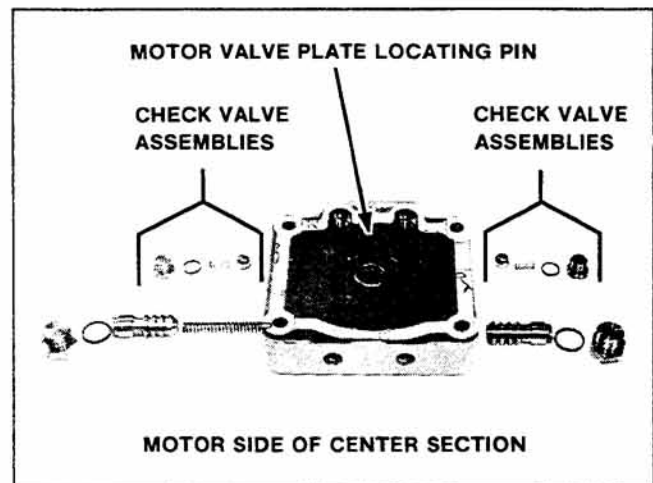
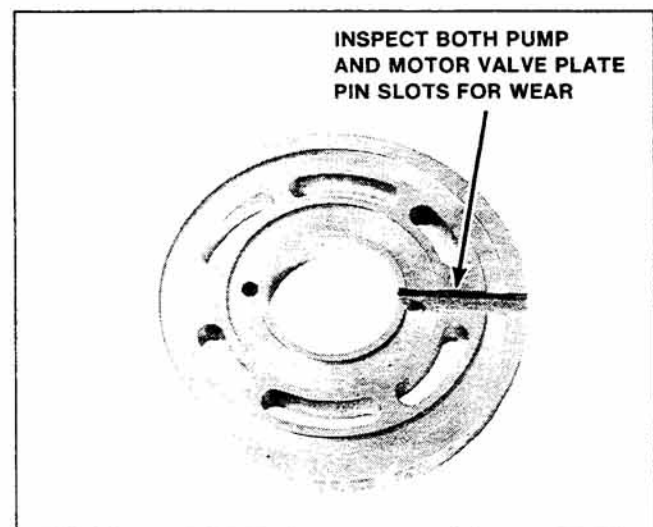


FIGURE 3-28



PUMP AND MOTOR VALVE PLATE IDENTIFICATION

Since the pump cylinder block assembly only turns in the right hand or clockwise rotation, the lead-ins on the pump valve plate are located for right hand rotation only. The motor cylinder block assembly turns in both directions thus the motor valve plate has lead-ins for both right and left hand rotation.

ASSEMBLY OF CENTER SECTION

1. Install bearings into center section. Bearings must protrude .100 inch from polished surface, printed end out.
2. Install check valves on motor side of center section. Torque check valves to 10 ft. lbs.
3. Install "O" rings to pump side of center section.
4. Install valve plate pins and valve plates. The pump valve plate has two lead-ins and goes on the pump side of center section and the motor valve plate has four lead-ins and goes to the motor side of center section.
5. Use new gaskets on both sides of center section.

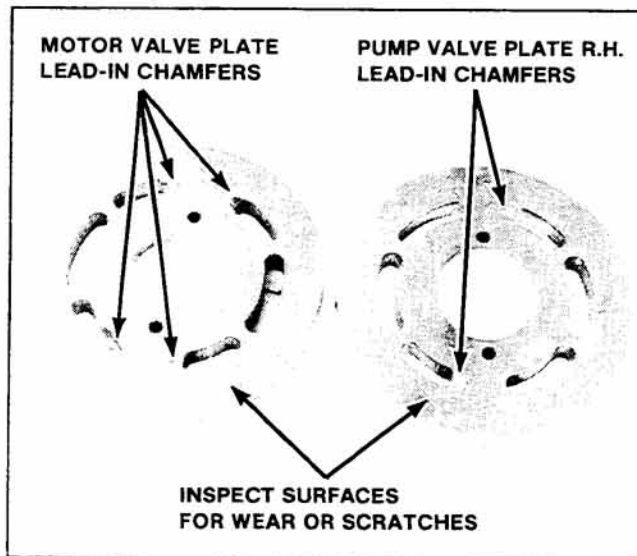


FIGURE 3-30

3

CENTER SECTION

- 1 Check Valve Cap
- 2 "O" Ring
- 3 Spring
- 4 Ball
- 5 Pipe Plugs
- 6 Gaskets
- 7 "O" Ring
- 8 Back Up Ring
- 9 Free Wheeling Valve
- 10 Motor Valve Plate
- 11 Pin
- 12 Bearing
- 13 "O" Ring
- 14 Acceleration Valve Spring
- 15 Acceleration Valve Assembly
- 16 "O" Ring
- 17 Hex Plug
- 18 Center Section
- 19 Pump Valve Plate

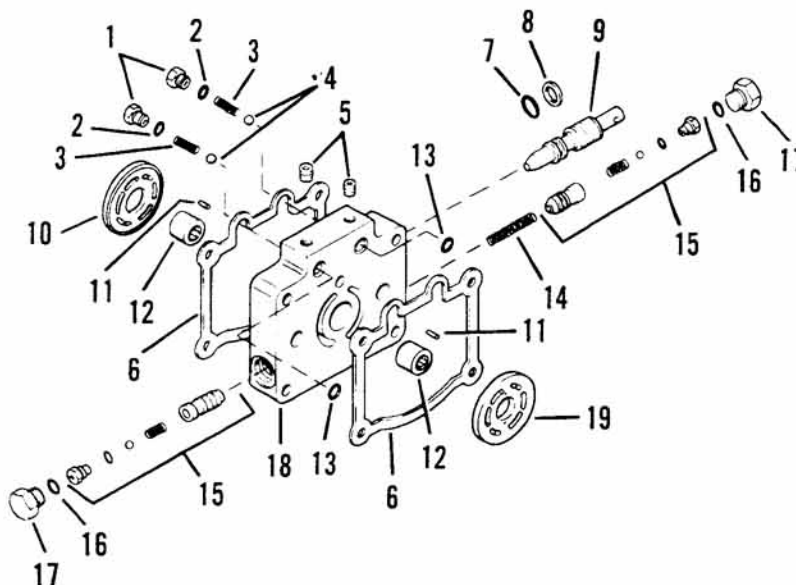


FIGURE 3-31

DRIVE TRAIN (Continued)

DISASSEMBLY OF MOTOR SECTION

1. Remove cylinder block assembly.
2. Remove thrust plate.
3. Remove Snap Ring (Later Models)
4. Tap on internal end of motor shaft to remove shaft and bearing from housing.
5. Press bearing from motor shaft.

INSPECTION OF MOTOR SECTION

1. Inspect thrust plate for scratches or wear. Replace all worn or damaged parts.

ASSEMBLY OF MOTOR SECTION

1. Press bearing to shoulder on motor shaft.
2. Install motor shaft and bearing into housing.
3. Install Snap Ring (Later Models)
4. Install thrust plate onto motor housing swash-plate.

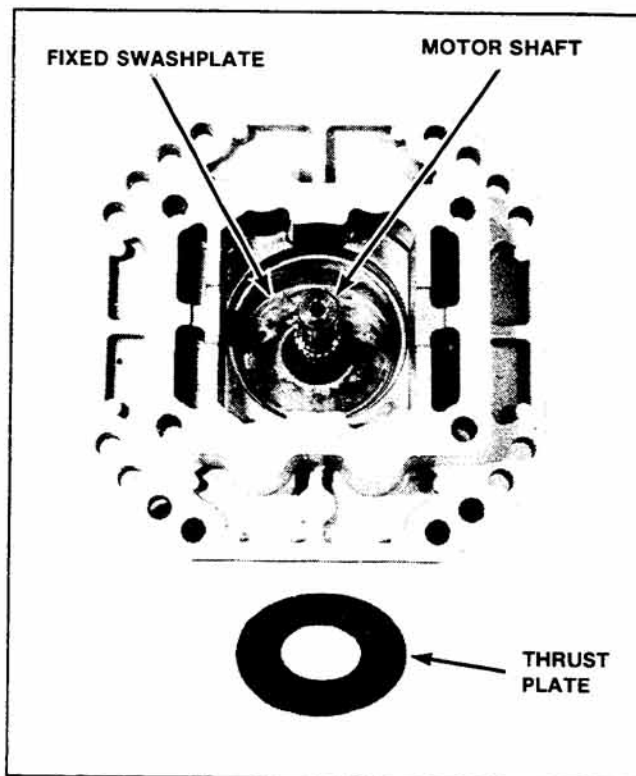


FIGURE 3-32

5. Align spines of cylinder block assembly with splines of motor shaft and install into housing.

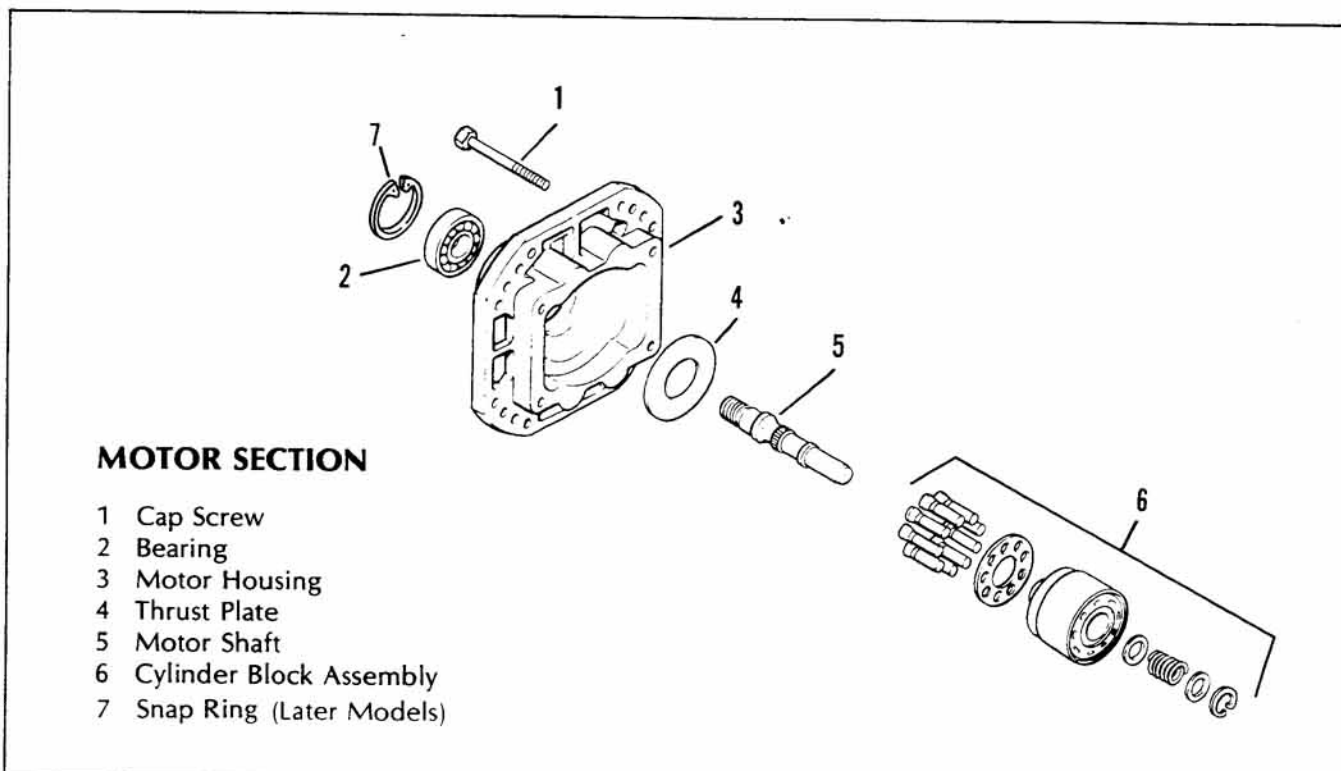


FIGURE 3-33

ASSEMBLY OF HYDROSTATIC

1. Align Pump, Center, and Motor sections properly.
2. Install the 4 capscrews and torque to 35 ft. lbs.
3. Check the torque needed to turn the input shaft, output shaft, and control shaft. Torque reading should not exceed 25 in. lbs.

NOTE: If torque exceeds this amount, hydro will have to be disassembled to locate binding.

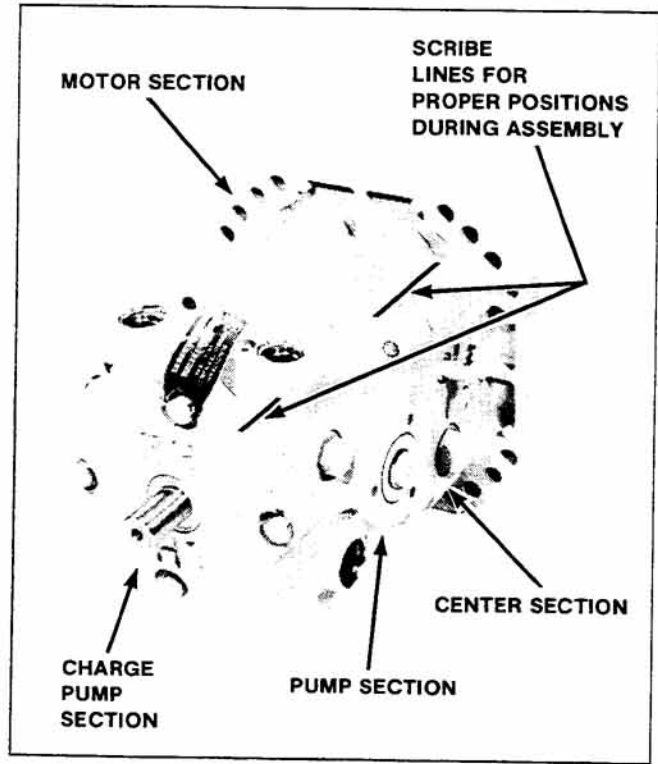


FIGURE 3-34

3

DRIVE TRAIN (Continued)

TRANSAXLE REMOVAL

Remove Seat and Fender assembly. Be careful to disconnect seat switch (A) wires under fender.

If transaxle is to be worked on, drain fluid and dispose.

Block up tractor at mid frame.

Remove right and left hand brake arms from cross shaft (B).

Remove right and left hand brake arm extensions (C) 2 bolts each.

Disconnect all hydraulic lines from hydro.

Disconnect hydro control rod (D) at foot pedal.

Remove cotter pin and disconnect quadrant control link (E) at brake cross shaft.

Remove the four screws securing the transaxle to the frame.

Remove the two top mounting screws (F).

Place one foot on the rear hitch or use a bar in rear hitch hole to balance the transaxle while removing.

Slowly roll complete transaxle and hydro assembly back and out of frame. **NOTE:** Driveline will slip off the hydro input shaft. Hold driveline temporarily to avoid damaging fan blades.

After transaxle assembly has cleared frame, tip transaxle back to rest on a 6" (15.2 cm) block.

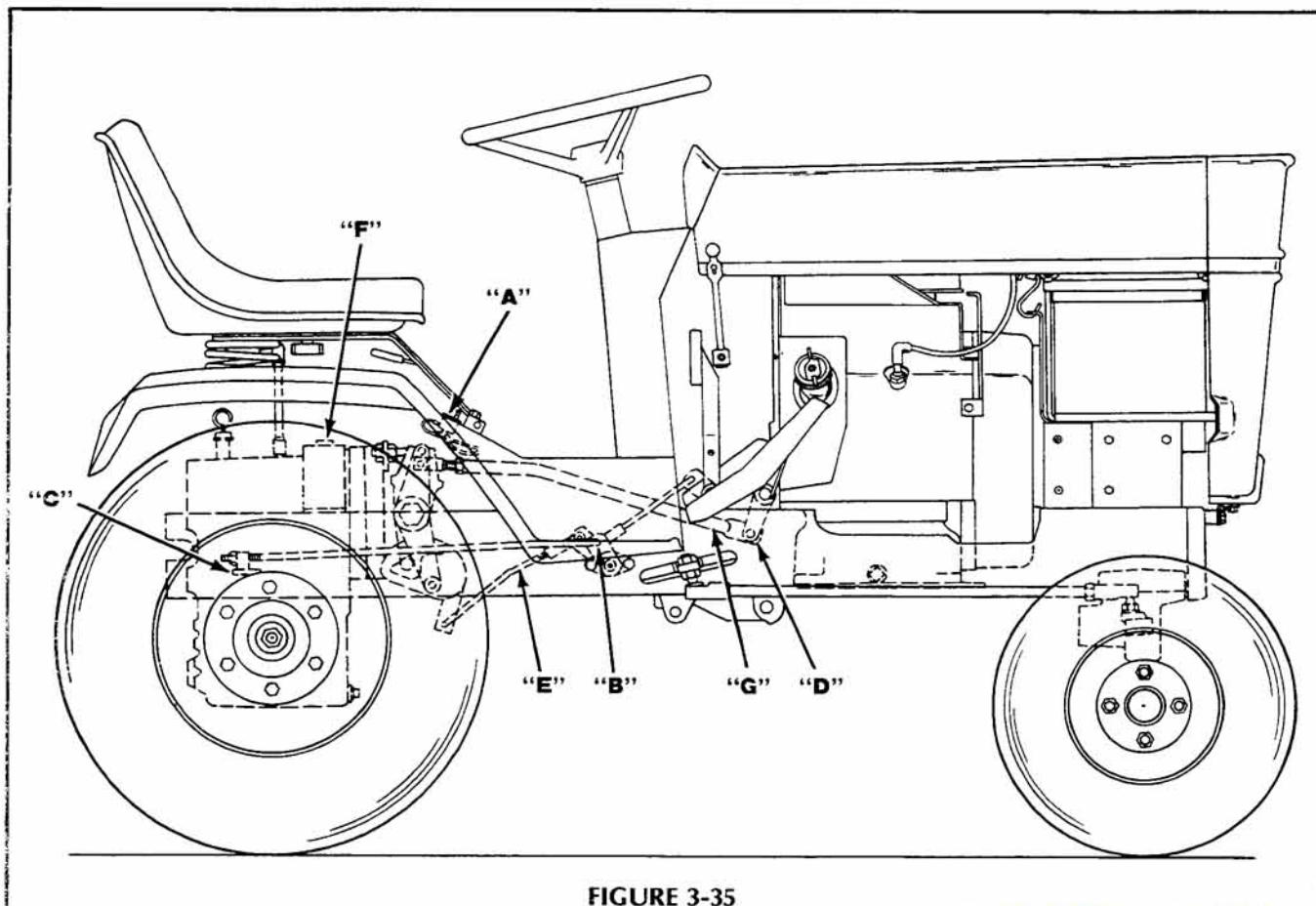


FIGURE 3-35

TRANSAXLE INSTALLATION

Position right and left hand brake rods on inside of frame rails.

Slowly roll transaxle between the two side frames. At the same time position the following:

1. Lay hydro control rod (G) over brake cross shaft and direct rod toward foot pedal arm (D).
2. Lay control link (E) over cross shaft.
3. Slide drive shaft onto hydro input shaft.

Install the two transaxle mounting bolts (F) finger tight.

Connect hydro control rod (G) to foot pedal arm with clevis pin and cotter pin.

Connect hydraulic lines to hydro.

Connect Quadrant control link (E) to brake cross shaft.

Line up transaxle to frame and install the four axle mounting screws. Torque to 60 ft. lbs. (81 Nm).

Torque two top transaxle bolts (F) to 23 ft. lbs. (30 Nm).

Install new hydraulic fluid, approx. 10 Qts. (9.5 liter).

NOTE: A new oil filter is recommended.

Tighten all hydraulic fittings.

Check for interference around driveshaft.

Remove spark plug from engine and motor engine for 15 to 20 seconds.

Reinstall spark plug. Start engine and run at low R.P.M. Actuate lift system.

Block up rear wheels. Restart engine; press pedal forward reverse, then back to Neutral. If wheels continue to creep forward when in neutral, shorten adjusting rod (H) Fig. 3-35A until wheels stop. Lengthen adjusting rod if wheels creep backward.

Recheck transaxle fluid level.

Position fender in place and connect the two wires to the seat switch and secure fender. See figure 3-35B for seat switch connection.

Reinstall seat.

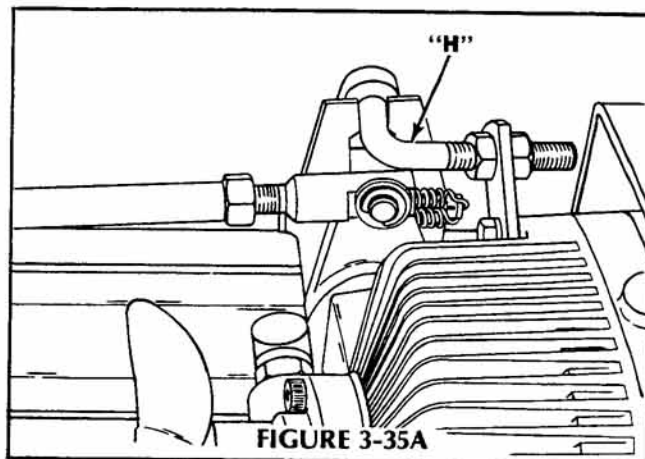


FIGURE 3-35A

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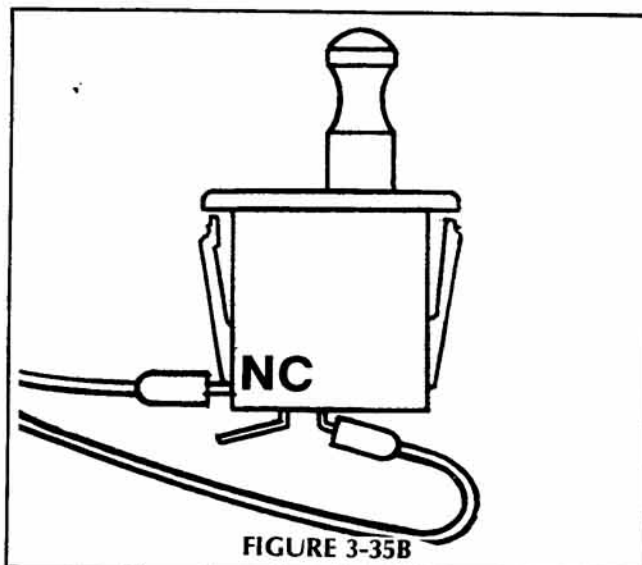
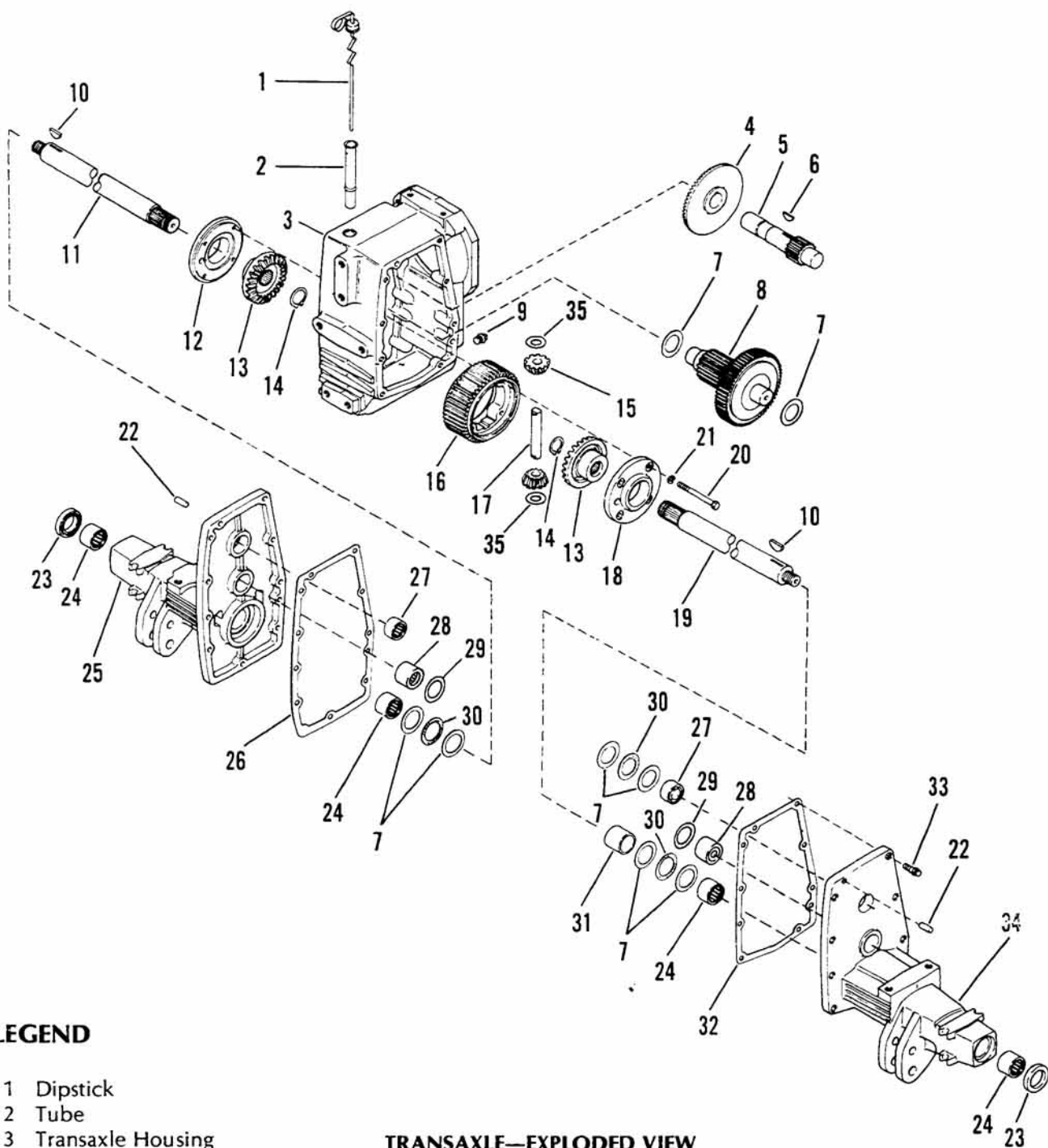


FIGURE 3-35B

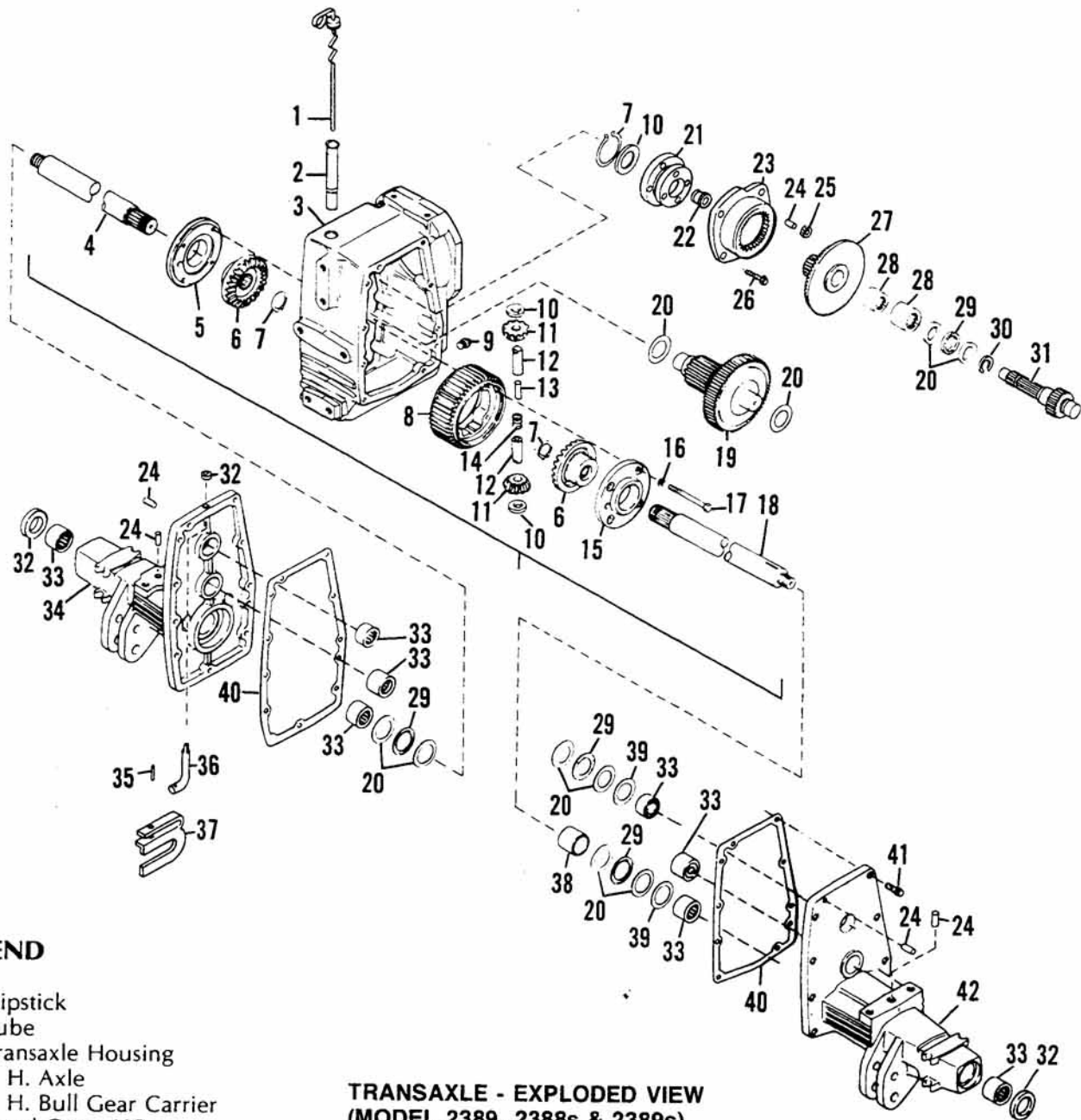
DRIVE TRAIN (Continued)



LEGEND

- | | | |
|---------------------|---------------------------------|--------------------------------|
| 1 Dipstick | 18 R.H. Bull Gear Carrier | 27 Needle Bearing (Closed End) |
| 2 Tube | 19 Right Hand Axle | 28 Needle Bearing (Closed End) |
| 3 Transaxle Housing | 20 Capscrew | 29 Shim |
| 4 Bevel Gear | 21 Lockwasher | 30 Thrust Roller Bearing |
| 5 Pinion Shaft | 22 Dowel Pin | 31 Spacer |
| 6 Woodruff Key | 23 Oil Seal | 32 R.H. Cover Gasket |
| 7 Thrust Race | 24 Needle Bearing | 33 Capscrew |
| 8 Cluster Gear | 25 L.H. Transaxle Housing Cover | 34 Needle Bearing (Open End) |
| 9 Pipe Plug | 26 L.H. Cover Gasket | 35 Pinion Shaft |

TRANSAXLE—EXPLODED VIEW
(MODELS 1886, 2086 & 2087)



3

LEGEND

- | | | |
|-------------------------------|---------------------------------------|--|
| 1. Dipstick | 23. Internal Ring Gear | 34. L. H. Transaxle Housing Cover |
| 2. Tube | 24. Pin | 35. Drive Pin |
| 3. Transaxle Housing | 25. Planet Gear | 36. Shifter Shaft |
| 4. L. H. Axle | 26. Counter Bore Screw
5/16-18 x 1 | 37. Shifter Plate |
| 5. L. H. Bull Gear Carrier | 27. Bevel Gear, 56T, 24T & 23T | 38. Spacer |
| 6. Bevel Gear, 22T | 28. Bearing | 39. Shim |
| 7. Retaining Ring | 29. Roller Bearing | 40. Cover Gasket |
| 8. Bull Gear 44T | 30. Positioning Ring | 41. Counterbore Capscrew
3/8-16 x 1 |
| 9. Pipe Plug | 31. Pinion Shaft 25T | |
| 10. Thrust Washer | 32. Oil Seal | |
| 11. Bevel Pinion, 10T | 33. Needle Bearing | |
| 12. Pinion Shaft | | |
| 13. Dowel Pin | | |
| 14. Compression Spring | | |
| 15. RH Bull Gear Carrier | | |
| 16. Lock Washer 5/16 | | |
| 17. Capscrews 5/16-18 x 3-1/2 | | |
| 18. R. H. Axle | | |
| 19. Cluster Gear, 16T & 45T | | |
| 20. Thrust Race | | |
| 21. Planet Gear | | |
| 22. Sliding Gear | | |

**TRANSAXLE - EXPLODED VIEW
(MODEL 2389, 2388s & 2389s)**

DRIVE TRAIN (Continued)

TWO SPEED TRANSAXLE DISASSEMBLY

1. Drain oil from transaxle.
2. Remove transaxle from tractor (refer to Page 3-21A).
3. Shift transaxle into low range.
4. Remove right axle nut, hub and key. Note: A wheel puller is necessary.
5. Carefully remove right axle housing. Note: location of shims and bearings inside cover.
6. Remove center section of transaxle.
7. Remove cluster gear (Ref. 8 page 3-23) noting location of shims and bearings.

HIGH AND LOW RANGE DISASSEMBLY (Refer to page 3-23)

1. Remove four (4) counter box screws securing internal ring gear to left axle housing. The complete pinion shaft assembly can now be removed.
2. Remove sliding gear from pinion shaft. Discard positioning ring.

ASSEMBLY PROCEDURE OF THE CARRIER AND AXLE

A snap ring is used to hold the side gears on the splined axle shafts.

MAKE SURE THE SNAP RING IS SEATED PROPERLY IN THE

CAUTION GROOVE.

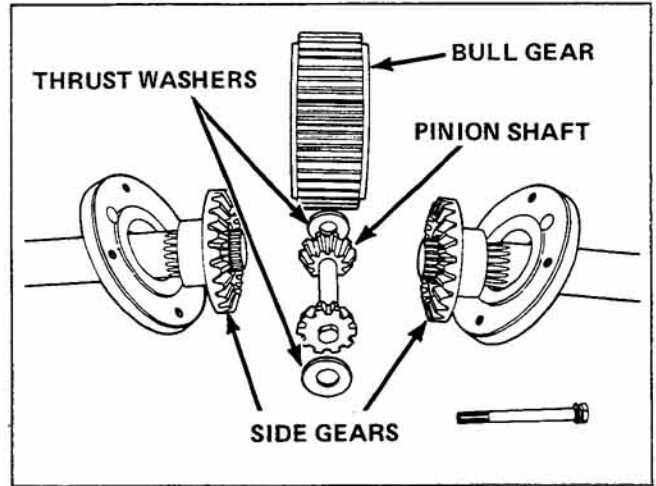


FIGURE 3-36

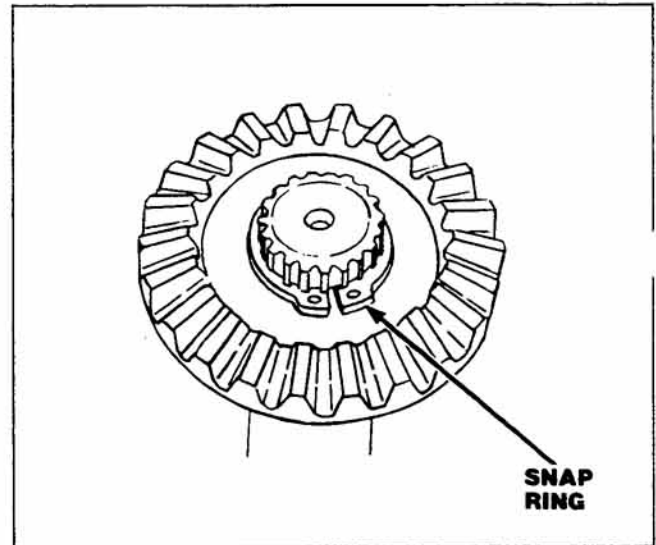


FIGURE 3-37

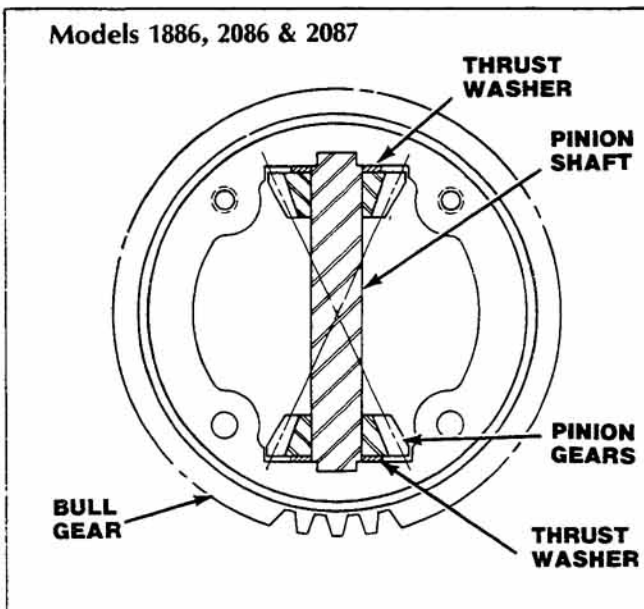
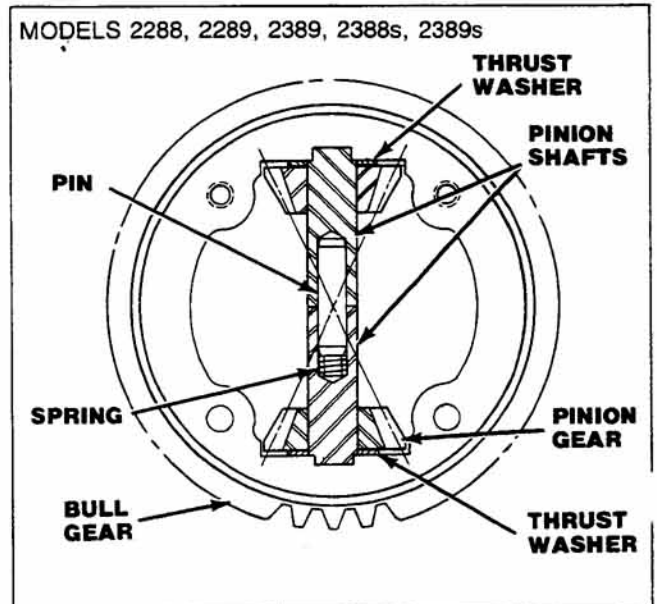


FIGURE 3-38



The two pinion gears and thrust washers slide on the pinion shaft or pinion shaft assembly and are held in position by the side gears when the carrier is assembled. (See Figures 3-38 and 3-38A.)

The pinion shaft is a slip fit into the machined grooves in the bull gear.

The carrier side plates hold the assembly together and are bolted with four 5/16-18 x 3-1/2" cap-screws. These four bolts should be torqued to 30 ft. lbs. (40 Nm).

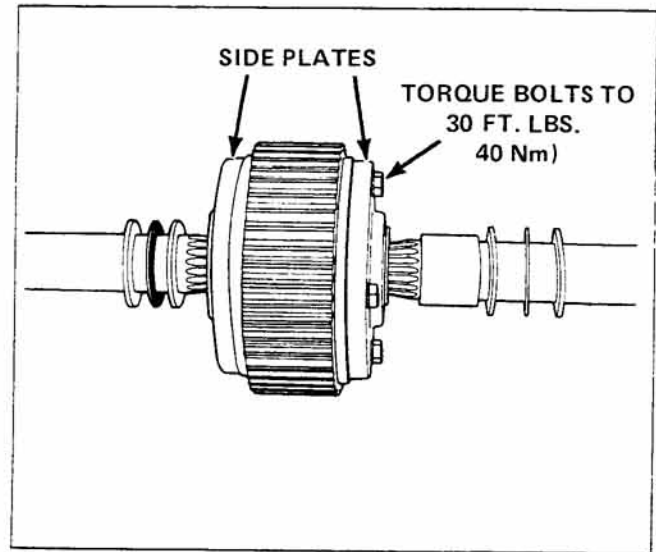


FIGURE 3-39

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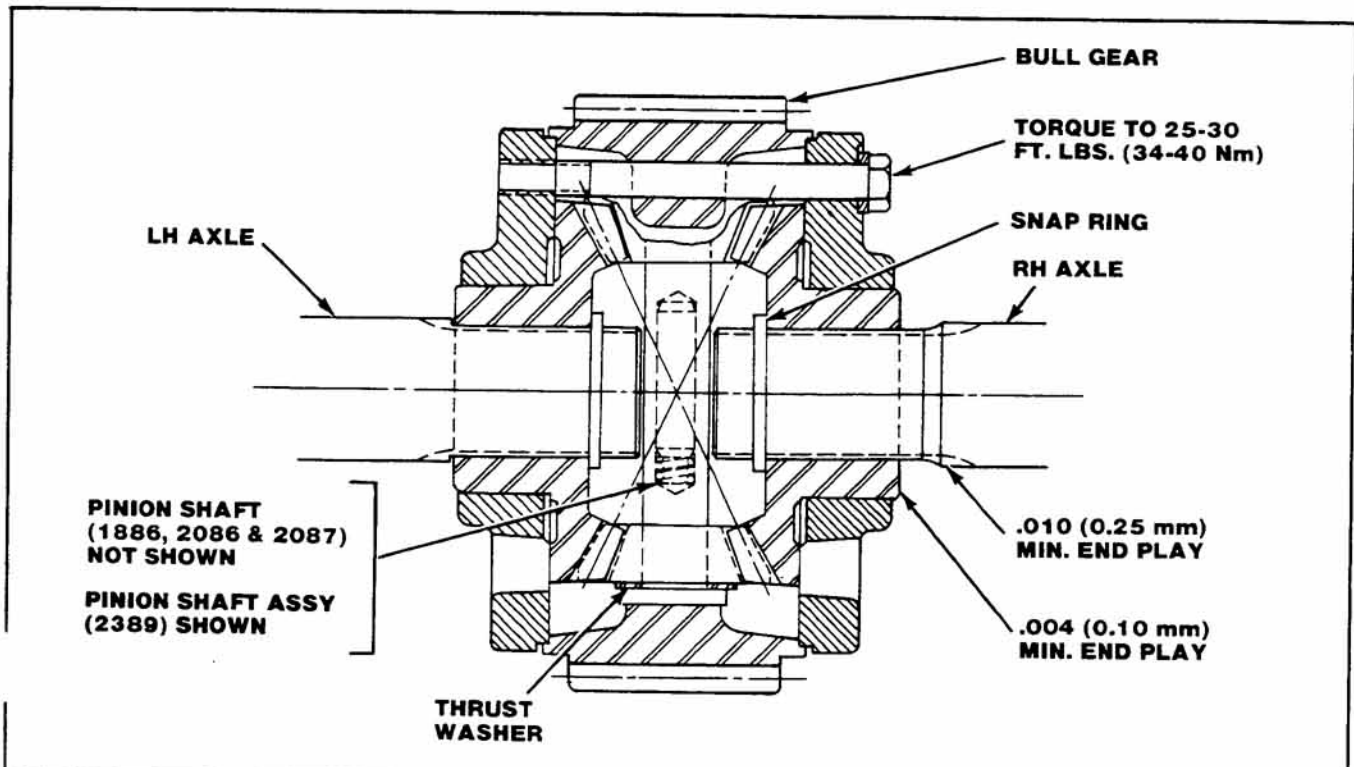
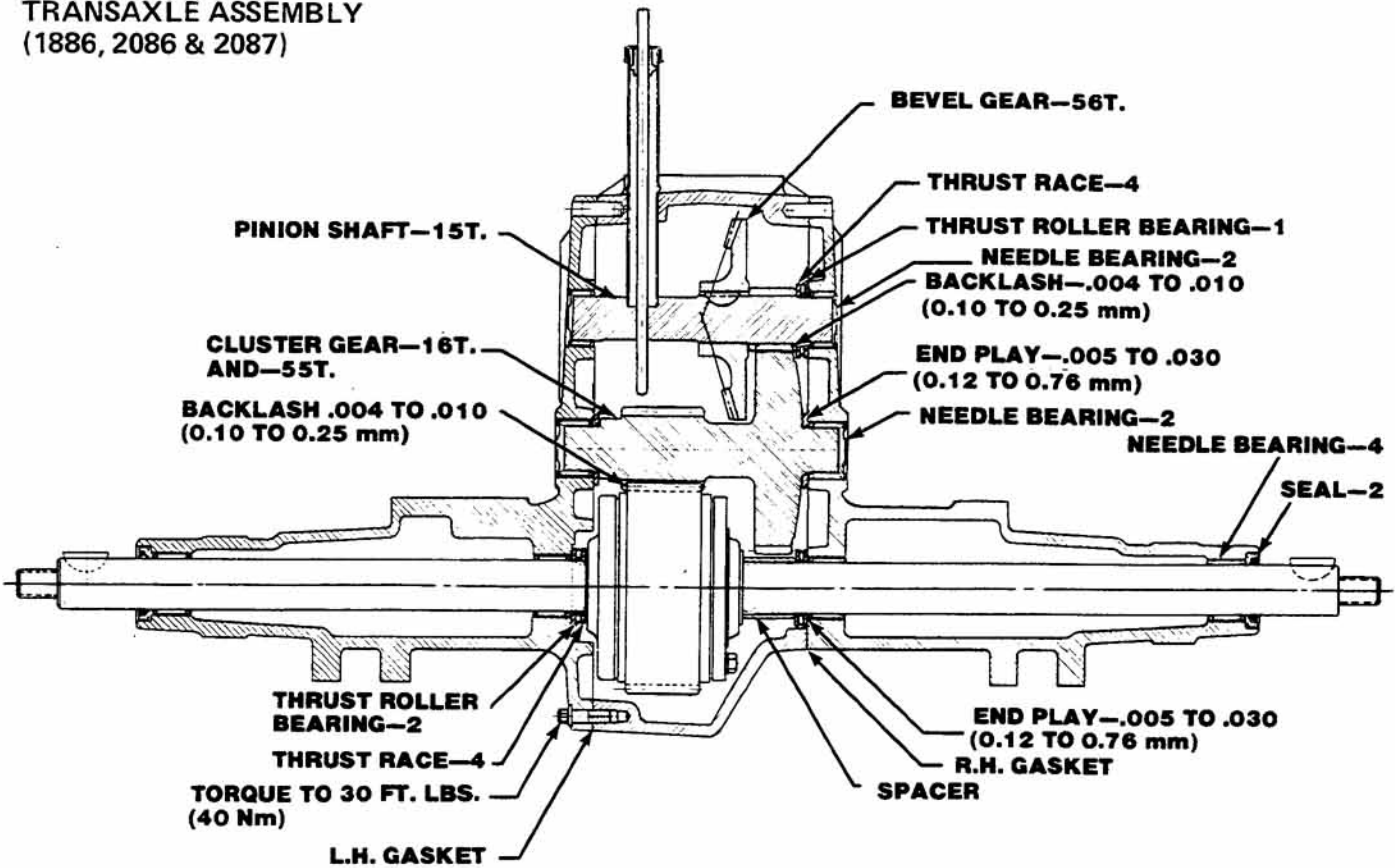


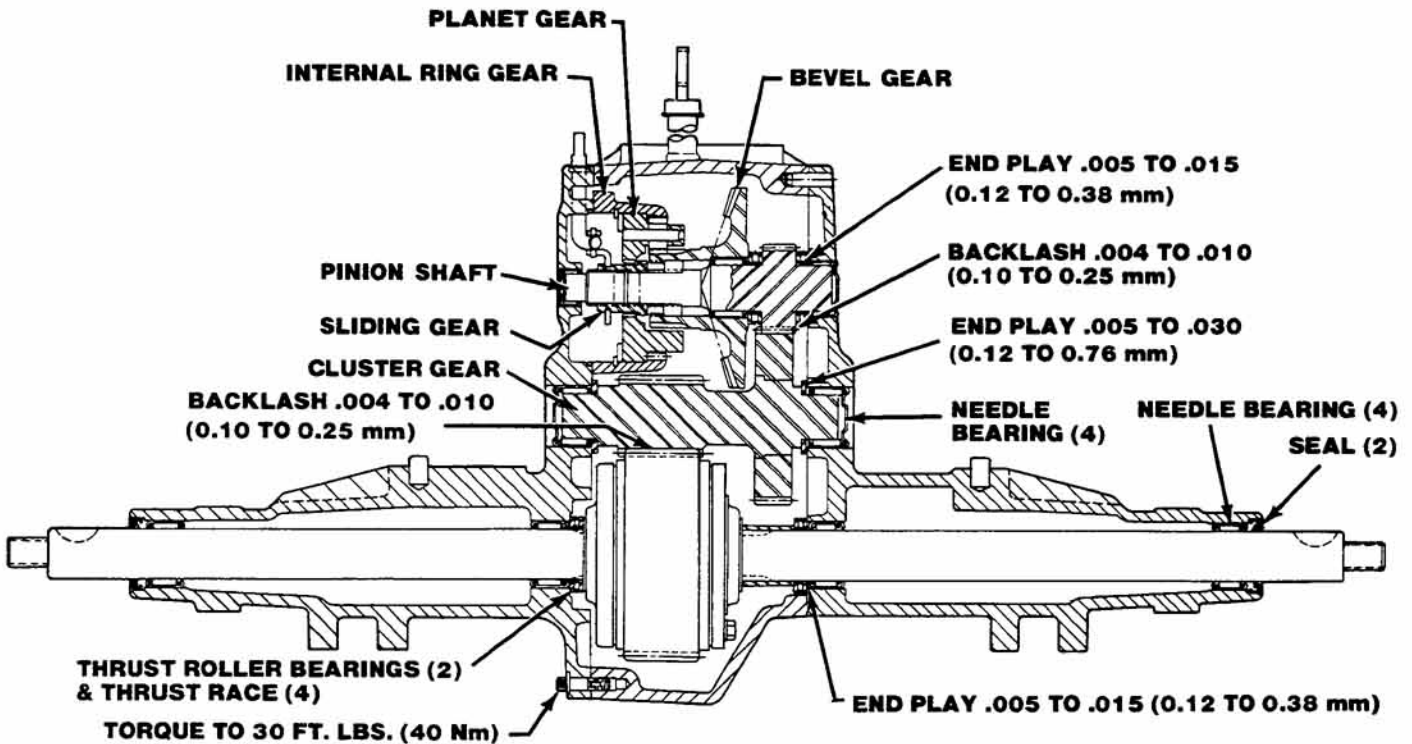
FIGURE 3-40

DRIVE TRAIN (Continued)

TRANSAXLE ASSEMBLY
(1886, 2086 & 2087)



TRANSAXLE ASSEMBLY
(2288, 2289, 2389, 2388s, 2389s)



CHECKING TRANSAXLE CLEARANCES

Check cluster gear and axle shaft end play. The end play should be .005 to .030 (0.12 to 0.76 mm) on cluster gear and .005 to .015" (0.12 to 0.38 mm) on axle shaft. If the clearance is greater, shims must be installed. The right housing must be removed and the correct number of shims installed until correct end play is reached.

Cluster gear and axle shaft end play can be checked between thrust washer and side of housing using a feeler gage. A dial indicator may also be used.

DRIVE TRAIN (Continued)

ASSEMBLY PROCEDURE OF TRANSAXLE

Check needle bearings in side housings. If needles show signs of pitting or any other damage replace them. Use a needle bearing driver and seat bearings to a depth of $1/32''$ to $1/16''$ below the machined surface.

NOTE: Always install the needle bearings with the stamped end (the end with identification markings) against the seal driving tool.

Needle bearings in end of axle housing should be seated $1/32''$ to $1/16''$ below counter bore for the axle seal.

Axle seals should be replaced whenever unit is repaired. Use a seal driver and drive seals until they bottom in axle housing counter bore.

Install carrier and axle assembly into the left side housing. Be careful not to damage axle seal in end of housing.

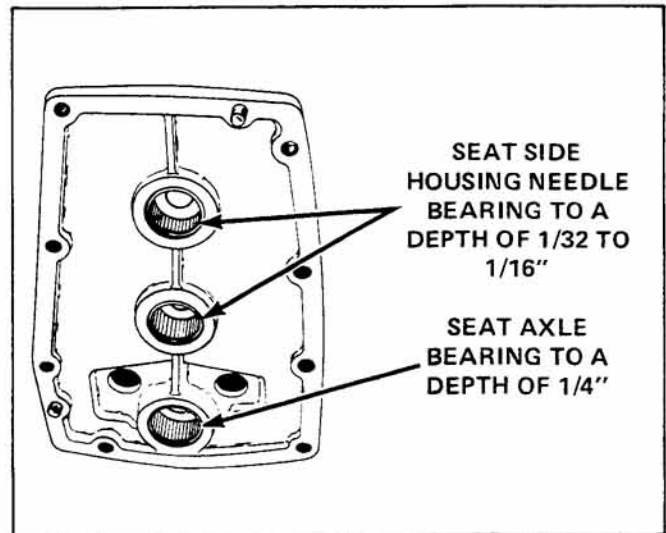


FIGURE 3-45

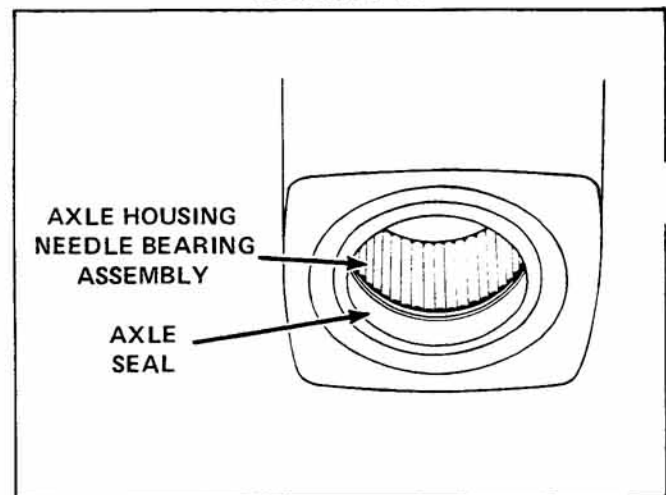
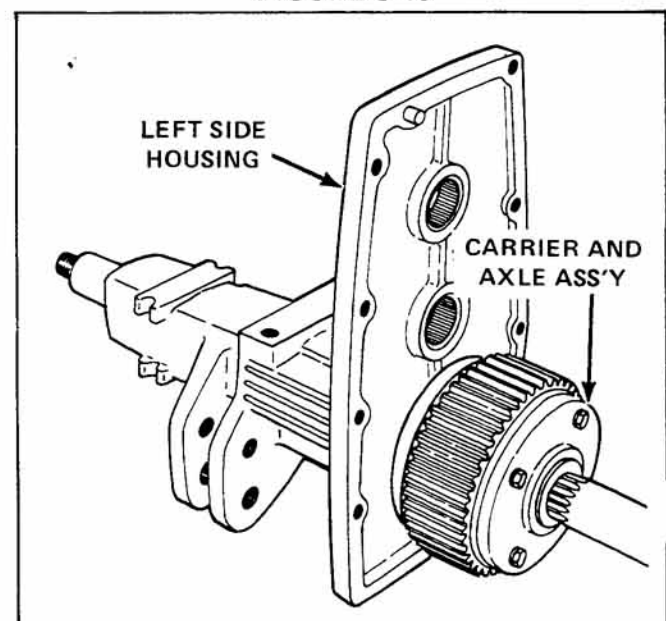


FIGURE 3-46



TRANSAXLE ASSEMBLY

1. Bolt left side housing with axle assembly to the center housing. Make sure new gasket has been installed and torque housing capscrews to 30 ft. lbs. (40 Nm).

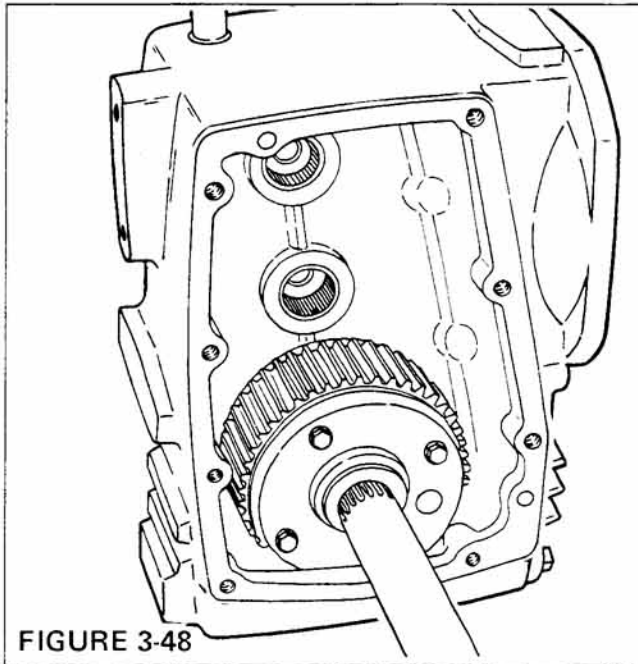


FIGURE 3-48

MODELS 1886, 2086, AND 2087 (STEPS 2 – 5 ONLY)

2. The gear can be removed from the shaft if replacement is necessary. A woodruff key is used to prevent the ring gear from turning on the shaft.
An arbor press should be used to press the ring gear on and off the shaft.

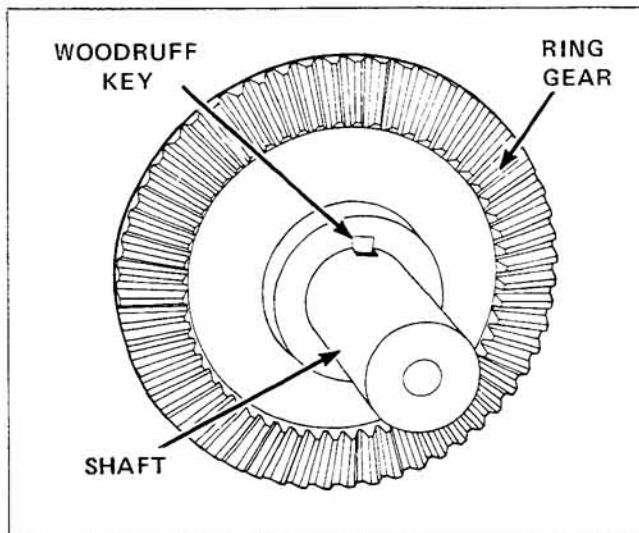


FIGURE 3-49

3. If the cluster gear or pinion gear is replaced, make sure part numbers are checked to assure proper gear ratio. A 55 tooth cluster gear and a 15 tooth pinion gear is used in the large frame transaxle.

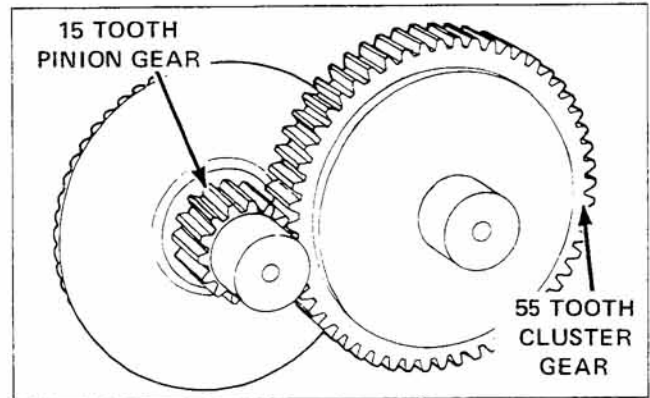


FIGURE 3-51

4. To install ring gear assembly and cluster gear they must be installed together in their normal position as they are meshed in the transaxle. Make sure thrust washer is installed on cluster gear, and slide shafts into the needle bearings.
5. See page 3-31 for final assembly.

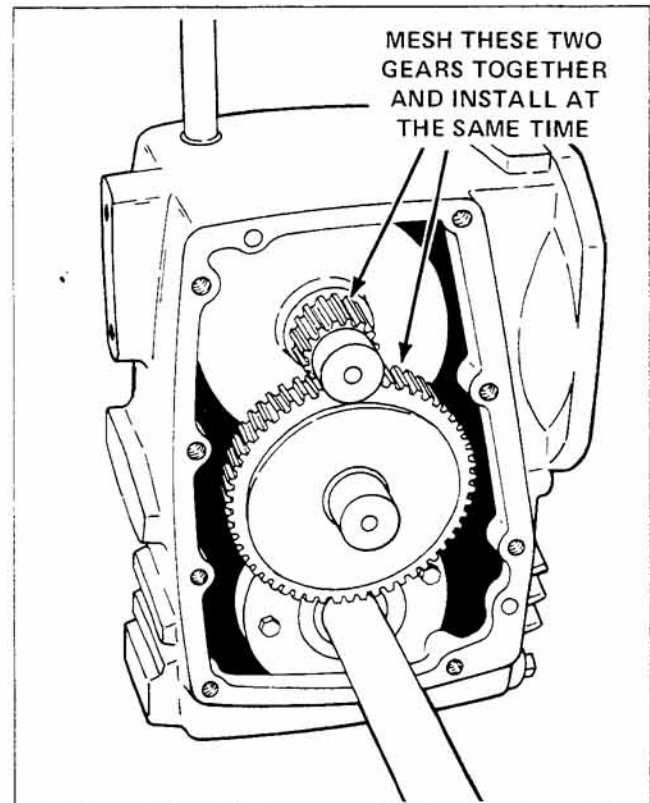


FIGURE 3-51

DRIVE TRAIN (Continued)

TWO SPEED TRANSAXLE ASSEMBLY - Model 2389, 2288, 2289, 2388s, 2389s

1. Speed thrust race, thrust bearing and another thrust race (A) Fig. 3-52 onto pinion shaft (B).
2. Place pinion shaft through roller and needle bearings (C) in bevel gear (D).
3. Carefully place positioning ring (E) in groove of pinion shaft. Be careful of over-stretching the ring.
4. Slide sliding gear (F) over the positioning ring into first detent. The groove for the shifter arm fork must be towards the end of the pinion shaft.
5. Place planetary gears (G) Fig. 3-53 into planetary carrier (H) and secure in place with roll pins. Place the planet carrier assembly into internal ring gear (I). Install the large thrust washer behind the planet carrier and secure the assembly with large retaining ring (J).
6. Install the pinion shaft assembly, Figure 3-52, into the planet gear assembly, Figure 3-53.
7. Before assembling, install roll pin into shifting arm (A), Figure 3-54 and fork.
8. Slide fork into groove of sliding gear (B). (Gently tap with a hammer until fork is completely in the groove.)
9. Install planetary carrier assembly & pinion shaft assembly into left axle housing by sliding shifting fork into hole in cover and rotating into position. Install four screws (C). Do not tighten until cluster gear is properly installed. Once cluster gear is properly installed with proper washers, torque four screws on planetary carrier to 18 ft. lbs. (24 Nm).

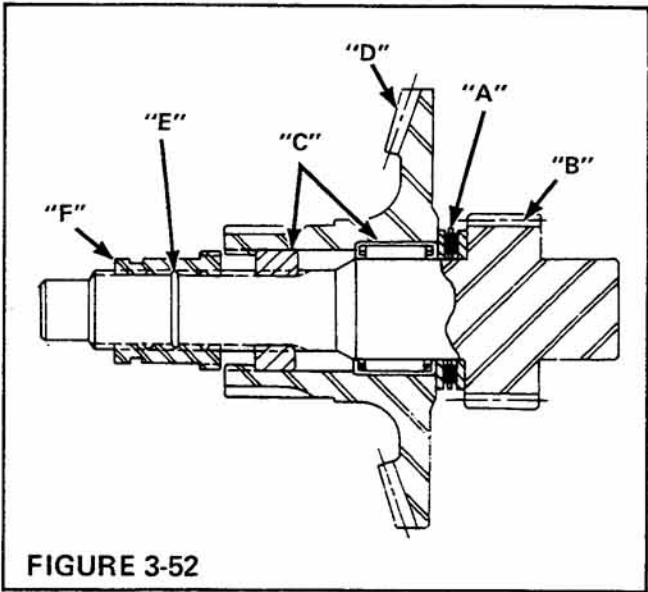


FIGURE 3-52

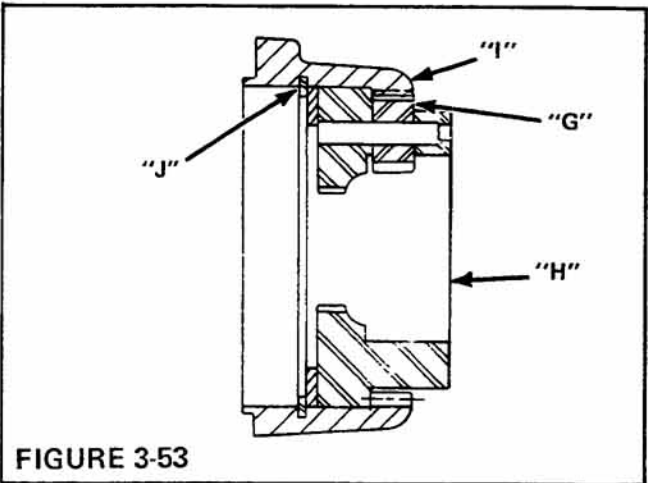


FIGURE 3-53

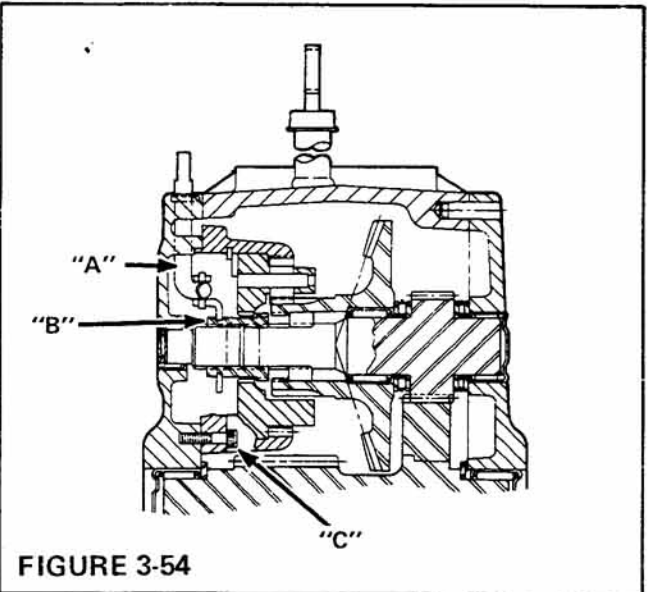


FIGURE 3-54

(ALL MODELS)

The right side of the bevel gear must have a torrington bearing assembly. The cluster gear must have a thrust washer and the axle shaft a spacer and torrington bearing assembly. After the bearings and spacers are installed, the right side housing can be bolted in place. Be careful not to damage axle seal. Use a new gasket and torque capscrews to 30 ft. lbs. (40 Nm).

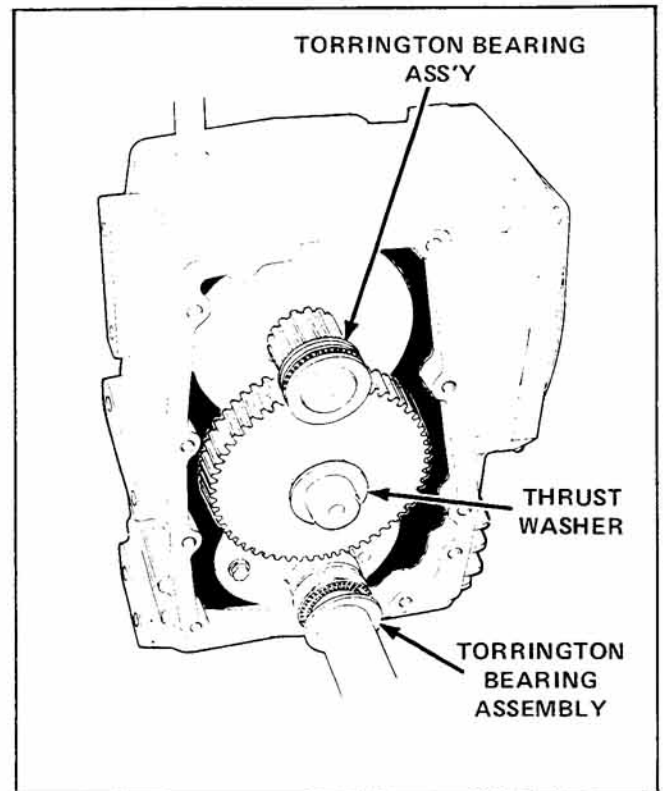


Figure 3-55