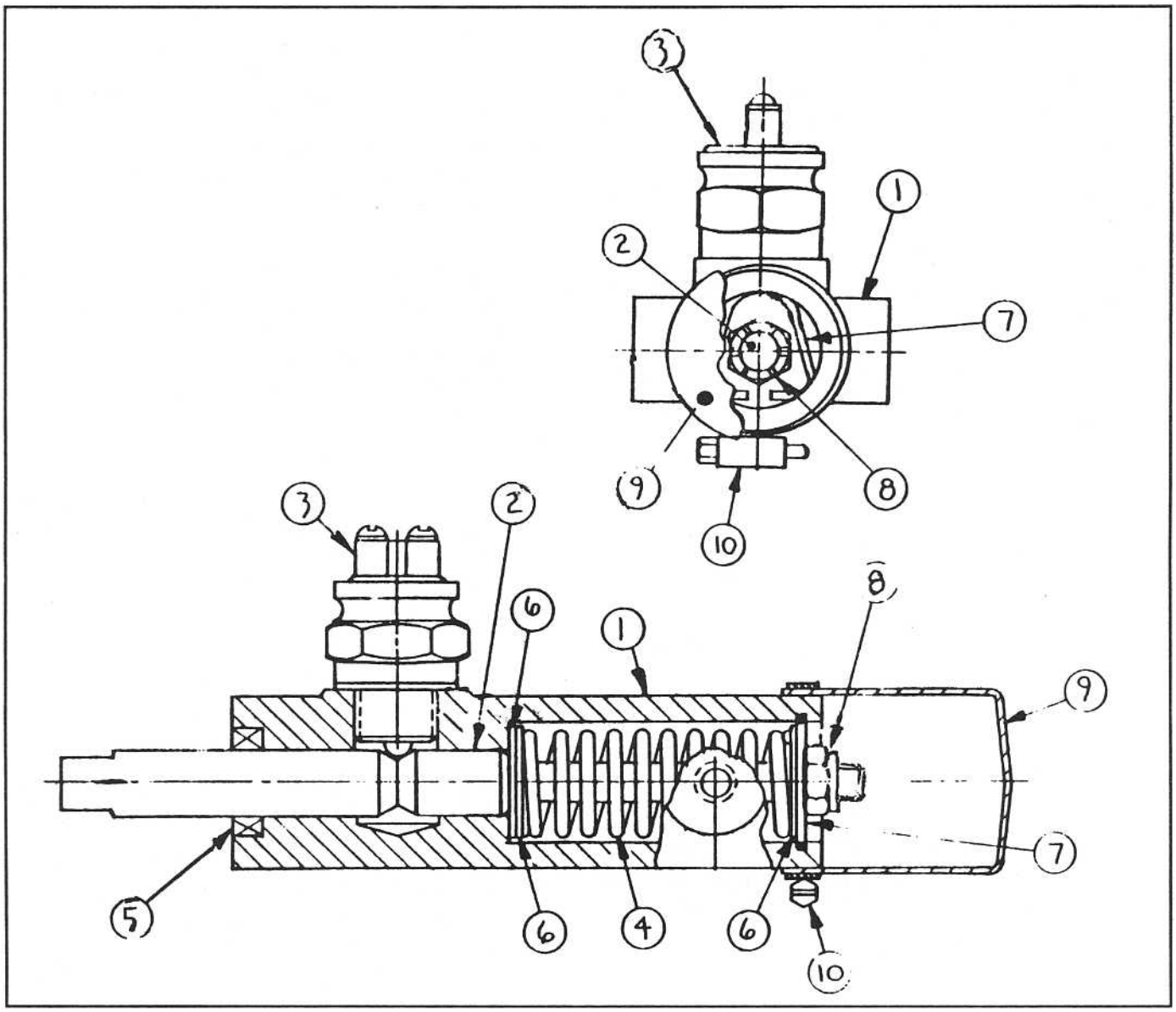
STEERING CONTROLS
NEUTRAL CENTERING DEVICE
Service and Repair

(NOTE: Refer to page 3-8 for diagram of Neutral Centering Device.)

1. After removal of device from unit, clamp wrench flat end of centering rod in vise (with casting upright).
2. Remove hose clamp, dust cap and neutral switch.
3. Lift "up" on assembly to compress spring and insert a 2 inch (50.8 mm) block between the housing and vise.
4. Remove snap ring using a needle nose pliers. (**Wear Safety Glasses** when removing snap ring to prevent eye injury.)
5. Remove 2 inch(50.8 mm) block to release spring tension.
6. Remove locking nut and disassemble. Note quantity and location of washers for reassembly.
7. Clean and inspect parts, replace as needed.
8. For seal replacement, please note the orientation of seal lip when pressing into housing ("U" side of seal goes to the outside of the housing).
9. Insert centering rod into housing being careful not to invert seal lip. Do not allow the wrench flats of rod to contact seal. The rod should not bind within the housing bore.
10. Install required washer(s) and spring. (If using new spring P/N 380-32390 install only one (1) washer at each end of spring.) Attach remaining washer and locking nut.
11. Clamp wrench flat end of centering rod into vise, lift "up" assembly and insert 2 inch (50.8 mm) block between housing and vise to compress the spring.
12. Using a needle nose pliers, install snap ring by inserting "V" end of ring into groove of housing first and then follow through by grasping each ear and inserting them into the groove. (**Wear Safety Glasses** when installing the snap ring to prevent eye injury.)
13. Remove 2 inch (50.8 mm) block.
14. Tighten locking nut only until no "free play" is noted between the washers, snap ring, rod and housing (check by moving assembly up and down between tightening intervals).
15. Lubricate assembly with General Purpose grease. Fill switch hole and pump 8-10 shots of grease from a grease gun into one of the 3/8 inch mounting holes on side of the housing.
16. Install and tighten neutral switch to 40 ft./lbs. (54.2 Nm)
17. Slip on dust cap, tighten hose clamp and install into unit. Be sure to install plastic cap in unused mounting hole to prevent contamination .

STEERING CONTROLS
NEUTRAL CENTERING DEVICES
Diagram



1. Neutral Centering Housing
2. Neutral Centering Rod
3. Neutral Start Switch
4. Compression Ring*
5. Seal
6. Flat Washer
7. Snap Ring
8. Lock Nut
9. Dust Cap
10. Hose Clamp

*All parts of Neutral Centering Devices are common between models except for the spring and quantity of washers. Be sure to refer to the parts manual for identification.

HYDRAULIC SYSTEM

The hydraulic system of the *MUSTANG* consists of a hydraulic pump, hydraulic control valve, lift and tilt cylinders, oil cooler, hydraulic oil reserve and miscellaneous plumbing.

Oil is drawn from the reservoir through a 100 mesh suction screen by a Vickers gear pump driven off the engine on a common drive shaft through the hydrostatic pump. Oil is fed to the triple spool - open center - single body Dukes Fluid Power control valve (Gresen - sectional triple spool on 940 after S/N 1425008 and 960 after S/N 9603401) where it is distributed to the lift, tilt and auxiliary circuits as determined by the foot controls (hand operated auxiliary). Return oil from the valve body and cylinders (attachment where used) is fed through an oil cooler, return line 7 micron filter and back to the reservoir.

The control valve has a mechanical lock system connected to the seat belt system. When the operator unlatches the seat belt, a spring loaded lock will engage the lift and tilt spools to prevent movement of the lift arm and bucket. To release the spools, the operator must fasten the safety belt around his waist snugly.

CAUTION! The seat belt lock-out is not meant to prevent movement of the Lift Arm when people are under it.ALWAYS USE THE LIFT ARM STOP FOR THIS PURPOSE.

HYDRAULIC SYSTEM
TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSE
Hydraulic action is slow or has jerky movement in either lift or tilt functions	Check Hydraulic fluid level Cold oil Check control pedals for binding interference Insufficient engine speed Oil leaking past cylinder packings (See procedure for checking cylinders on page 4-7, 8 & 9) Oil leaking within control valve Air leak in suction line Dirty hydraulic oil filter Restriction in suction line Hydraulic relief valve cartridge sticking, leaking internally, or pressure exceeds specification (See procedure for checking lift relief psi on page 4-4)
Hydraulic action in only one (1) circuit	Check control pedal linkage for binding or interference Check hydraulic cylinders for external damage and/or leakage (See checking procedure for cylinders on page 4-7, 8 & 9) Control valve or parts of valve may need replacement
No hydraulic action	Check hydraulic fluid level Pedal lock is holding pedals in "neutral" Check to see if auxiliary lever is in "detent" Check for loose or leaking suction hoses or filters Check for obstruction in oil lines or valve Control valve or parts of valve need replacement Hydraulic relief valve cartridge is sticking or leaking internally (see procedure for checking lift relief psi on page 4-4) Hydraulic pump malfunctioning

HYDRAULIC SYSTEM
TROUBLESHOOTING (continued)

SYMPTOM	POSSIBLE CAUSE
Oil overheats	Operator holds valves open too long, causing relief valve to open Incorrect system relief valve pressure (See procedure for checking lift relief on page 4-4) Contaminated oil Due to attachment connected to the auxiliary lines
Foot controls stick or work hard	Misalignment of control linkage or pedal linkage binding Contaminated valve Foreign matter in spool bore Scored valve bore or bent spool
Engine stalls while using hydraulics	Load beyond hydraulic system capacity Incorrect relief valve pressure (See procedure for checking lift relief psi on page 4-4) Operator holding valve over relief

HYDRAULIC SYSTEM
PRESSURE CHECK

A 7/8 inch (JIC) capped "T" fitting is installed at the outlet (pressure) port of the gear pump for pressure checks.

The hydraulic system outlet is the rear of the two (2) outlet ports on the top of the double gear pump (larger section of the gear pump).

1. Raise the lift arm and support with Lift Arm Stops or Cylinder Lock.

CAUTION! The seat belt lock-out is not meant to prevent movement of the Lift Arm when people are under it.ALWAYS USE THE LIFT ARM STOP FOR THIS PURPOSE.

2. Remove seat.

3. Remove test port cap and install a 0-3000 P.S.I. (206 bar.) gauge (7/8 inch JIC female adapter is required).

CAUTION! Escaping hydraulic fluid under pressure can have sufficient force to penetrate the skin, causing serious personal injury.

Fluid may be hot. Allow system to cool before servicing.

4. Start the engine and run at full RPM.

5. Activate the auxiliary hydraulics control lever to go over "relief," and compare pressure reading with specification listed. (See figure 4-1)

Model	Hydraulic Relief (+/- 50) (3.4 bar)
930	2000 P.S.I. (139.7 bar)
940/960	2400 P.S.I. (165.4 bar)

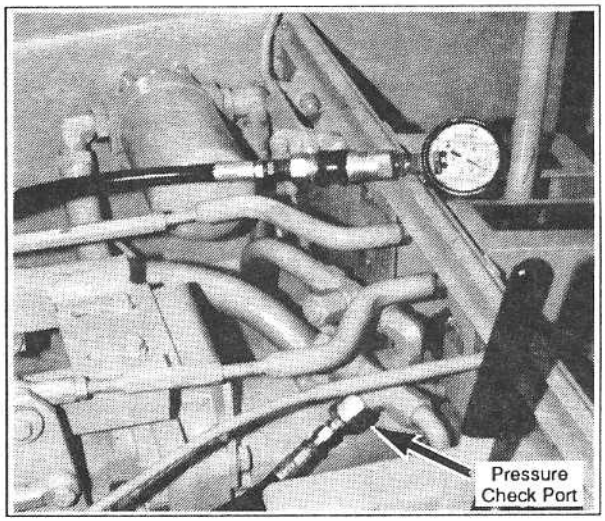


Figure 4-1

If the pressure reading is other than specified, one or more of the following conditions may exist:

1. The control valve relief cartridge is sticking or seals may be defective.

NOTE: The relief cartridge is located in the control valve on the pressure inlet side of the valve.

2. Relief cartridge is out of adjustment.

NOTE: The relief cartridge is **NOT** adjustable on units built after:

Model 940 S/N 9409303
Model 960 S/N 9603401

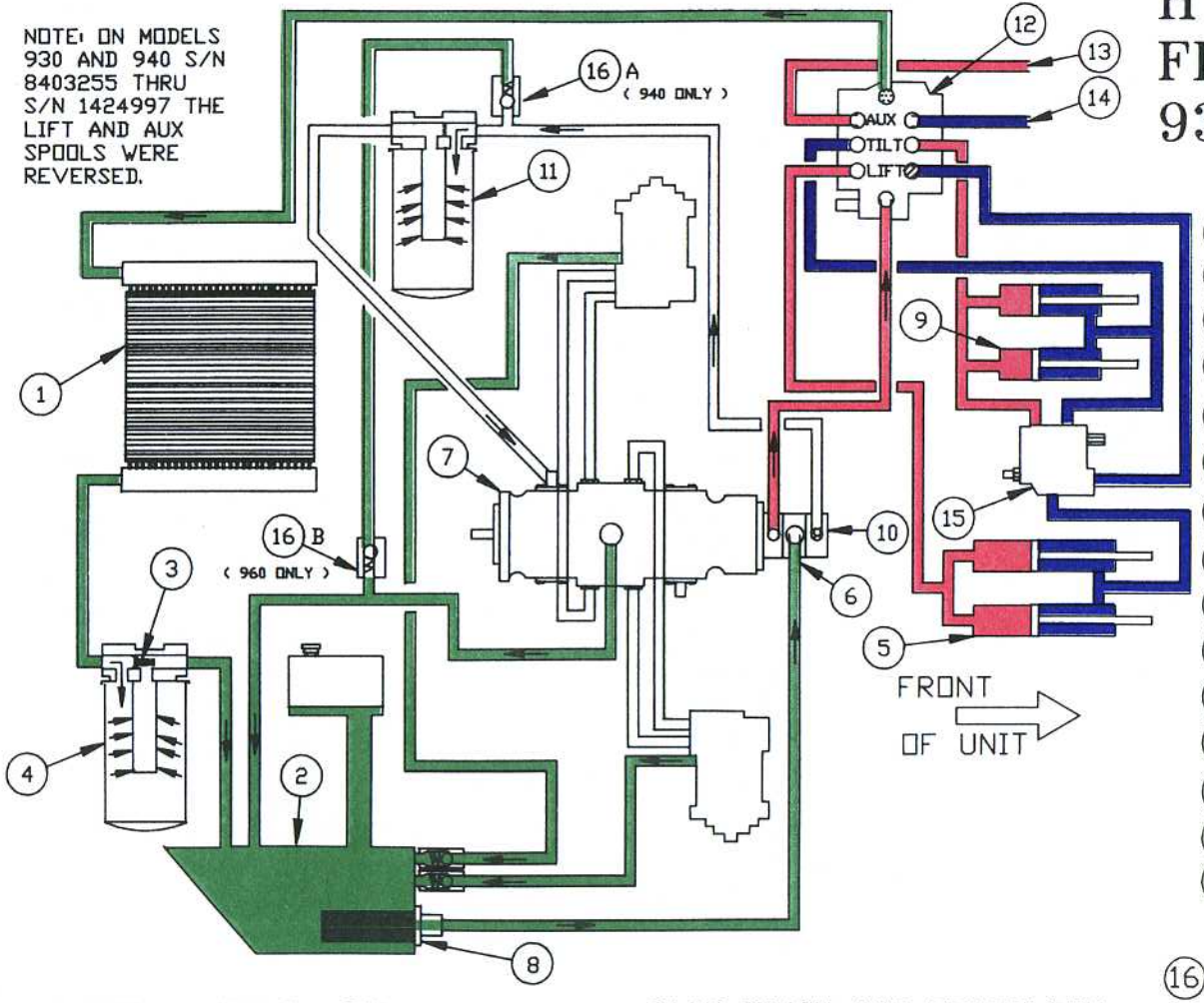
3. Hydraulic gear pump is malfunctioning.

A flow meter can be installed to check pump efficiency. If the flow rate is below 60% of rated capacity, the pump should be replaced. Be sure engine RPM is set properly. (See Specifications)

Model	Flow rated at 1000 PSI (69 bar)
930	12 GPM (45 L) at 2800 RPM
940	18 GPM (68 L) at 2900 RPM
960	18 GPM (68 L) at 2650 RPM
960	Hi-flow pump 100 L at 2650 RPM

NOTE: Some 940's built from S/N 8401002 to 8403255 may have a 14 GPM (68.5 L). See Service Bulletin 940-3.

HYDRAULIC FLOW CHART 930/940/960



1. OIL COOLER
2. RESERVOIR
3. BY-PASS VALVE 25 PSI (1.7 bar)
4. RETURN FILTER 7 MICRON
5. LIFT CYLINDERS
6. TEMPERATURE SWITCH HYDRAULIC OIL 225° F (107° C)
7. TANDEM PISTON PUMP
8. SUCTION SCREEN
9. TILT CYLINDERS
10. TANDEM GEAR PUMP
11. CHARGE FILTER 7 MICRON
12. CONTROL VALVE
13. AUXILIARY PORT
14. AUXILIARY PORT
15. SELF-LEVELING VALVE (OPTIONAL ON MODEL 940 AFTER S/N 1425008)
16. A COLD START RELIEF 940 (250 PSI)
16. B COLD START RELIEF 960 (250 PSI)

FACTS OR FALLACIES

1. Micron rating tells you everything that you need to know about a filter.
   T or F

2. Changing filters too often can be detrimental to machine life.
   T or F

3. A micron is more correctly called a micro meter, it is 1/1000 of 1 millimeter.
   T or F

4. All oil contaminants are spherical particles of various sizes.
   T or F

5. All filters that will fit a machine are equal.
   T or F

6. A human eye can see particles of about 40 microns.
   T or F

7. New oil is contamination free.
   T or F

8. Used oil can be recycled.
   T or F

9. A leak of 1 drop of oil every 10 seconds amounts to a loss of 40 gallons in a year.
   T or F

10. More damage is done to line connectors by over tightening than from any other cause.
    T or F

For answers, see page 5-4.

HYDRAULIC SYSTEM
LIFT CIRCUIT LEAK DOWN TEST

1. Install a 0-2000 PSI (0-137.9 bar) pressure gauge (Tee in) at cylinder base end circuit.
2. Roll the bucket all the way back. Raise the lift arm approximately 5 inches (127 mm) and shut engine off. Have a second person add weight to the bucket to obtain 1000 PSI (68.9 bar) on gauge. Measure the distance from the rod end of the cylinder barrel to cylinder lift arm pin. After ten minutes remeasure the distance and compare cylinder rod movement with the chart below:

RATE OF MOVEMENT IN 10 MINUTES

	930	940	960
Dukes Valve	1.245 in. 31.6 mm	1.245 in. 31.6 mm	.941 in. 23.9 mm
Gresen Valve	N/A-	.996 in. 25.3 mm	.768 in. 19.5 mm

If the rate of movement is less than the chart, the machine is within specifications and no further checks are necessary. If the rate of movement is greater than the chart, check out the cylinders, one at a time, following steps 3-7.

3. Jack up the lift arm so the cylinders have no pressure on them.
4. Remove one of the base end hoses and install 0-2000 PSI (0-137.9 bar) pressure gauge at the cylinder port. Plug or cap the hose.
5. Remove the jack. Add weight to the bucket until the gauge reads 1000 PSI (68.9 bar). Work the lift pedal back and forth to relieve any pressures in the rest of the system. Do this periodically to relieve any pressures which may build on cylinder not being tested.
6. Note movement of the cylinder. If the cylinder travels more than 1/4 inch (6.4 mm) in 10 minutes it is leaking excessively and should be repaired.
7. Repeat steps 3-6 to test the other cylinder.
8. If both cylinders check out within the specifications (1/4 inch per 10 minutes at 1000 PSI {68.9 bar}), and leak down rate is excessive, the control valve is at fault.

HYDRAULIC SYSTEM
TILT CIRCUIT LEAK DOWN TEST

1. Install (Tee-in) a 0-2000 PSI (0-137.9 bar) pressure gauge in rod end of tilt cylinder circuit.

2. With the lift arm fully down on its stop, roll the bucket all the way back, then let it down 4-6 inches at the cutting edge. Shut the engine off and add weight to the bucket until the gauge reads 1000 PSI (68.9 bar). Measure the distance between the rod end of the cylinder barrel and cylinder Fast-A-Tach pin. After ten minutes remeasure the distance and compare cylinder rod movement with the chart below:

RATE OF MOVEMENT IN 10 MINUTES

	930	940	960
Dukes Valve	1.086 in. 27.6 mm	1.086 in. 27.6 mm	1.086 in. 27.6 mm
Gresen Valve	N/A-	.887 in. 20 mm	.887 in. 20 mm

If the leak down rate is less than the chart, the machine is within specifications and no further checks are necessary. If the rate is greater than the chart, check out the cylinders, one at a time, as follows:

3. Jack up the front edge of the bucket just so the cylinders have no pressure on them.

4. Remove one of the lower hoses. Install a 0-2000 PSI (137.9 bar) pressure gauge at the cylinder port. Plug or cap the end of the hose.

5. Remove the jack. Add weight to the bucket until the gauge reads 1000 PSI (68.9 bar). Work the tilt pedal back and forth to relieve any pressures in the rest of the system. Do this periodically during the test to relieve any pressures which build up.

6. Note movement of the cylinder. If the cylinder travels more than 1-1/2 inches (38.1 mm) per hour (1/4 inch {6.4 mm} in 10 minutes) it is leaking excessively and should be repaired.

7. If the cylinder rod travel is less than 1/4 inch (6.4 mm) in 10 minutes it is within specifications. Remove the load from the bucket, jack the bucket up to relieve the pressure, and reinstall the hose.

8. Repeat steps 3-7 with the other tilt.

9. If both cylinders check out within the 1/4 inch (6.4 mm) per 10 minute, yet the leak down rate is excessive, the control valve is leaking excessively and should be repaired or replaced.

HYDRAULIC SYSTEM
HYDRAULIC CYLINDERS
Testing

TESTING LIFT CYLINDERS FOR LEAKING PISTON SEALS

1. Lower the lift arm all the way down.
2. Stop the engine. Activate all hydraulic controls to release the hydraulic pressure.
3. Disconnect the hydraulic hose at the base end of the lift cylinder. Put a plug in the hose.
4. Start the engine. Push the top (toe) of the lift pedal (left pedal).
5. If there is fluid leakage from the base end fittings, remove the cylinder(s) and make repairs.

TESTING TILT CYLINDERS FOR LEAKING PISTON SEALS

1. Remove bucket or (other attachment) and roll Fast-A-Tach in full back position.
2. Stop the engine. Activate the hydraulic controls to release the hydraulic pressure.
3. Disconnect the hose that goes to the base end of the tilt cylinder(s). Put a plug in the hose.
4. Start the engine and push the bottom (heel) of the tilt pedal (right pedal).
5. If there is leakage from the base end fitting, remove the cylinder(s) and repair.

CAUTION! Escaping hydraulic fluid under pressure can have sufficient force to penetrate the skin, causing serious personal injury.

Fluid may be hot. Allow system to cool before servicing.

HYDRAULIC SYSTEM
HYDRAULIC CYLINDERS
Service and Repair

NOTE: Refer to page 4-13 for diagram of hydraulic cylinder.

Nicks or burrs on a hydraulic cylinder shaft can cause seal damage in the cylinder gland which will cause external leaks. Occasionally check the cylinder shaft by running your hand up and down the length of it. This is particularly important when handling gravel, stone and scrap metal. Shaft inspection can detect damage early before it becomes large enough to cause damage to the seals. Minor damage to a cylinder shaft can be dressed to clean it up.

Pin holes at either of the cylinder ports can cause external oil leaks. These can be repaired by welding. When welding on the base end, extend the cylinder rod to prevent heat build up from damaging the seals. Loosen both fittings to relieve any pressure resulting from heat.

When welding on the rod end, disassemble the cylinder to prevent damage to the gland and seals.

The weld should start away from the hole and work across it. This will allow heat to burn oil out of the hole so a successful weld can take place.

BE SURE THERE IS NO PRESSURE IN THE CYLINDER!

When using an arc welder do not connect the ground clamp to the hydraulic cylinder shaft. This can cause an arc which will damage cylinder seals.

ALWAYS DISCONNECT THE BATTERY WHEN WELDING!

A dented cylinder barrel can cause the piston to be worn flat. This will result in internal damage and cause leaks. If this happens it is not economical to repair the cylinder.

ASSEMBLY OF SEALS TO CYLINDER GLAND

1. Inspect the gland and insure that it is free of nicks and burrs.
2. Clean the gland.
3. Assemble the rod seal into the rod seal groove the inner groove of the gland. The cup side of this seal is to be assembled away from the threaded end of the gland.

   This seal is difficult to assemble and is most easily assembled as follows:

   a. Bend seal into a "U" shape (easily done using a seal installation tool as shown in figure 4-2).

      NOTE: For P/N see special tools in Section 1.

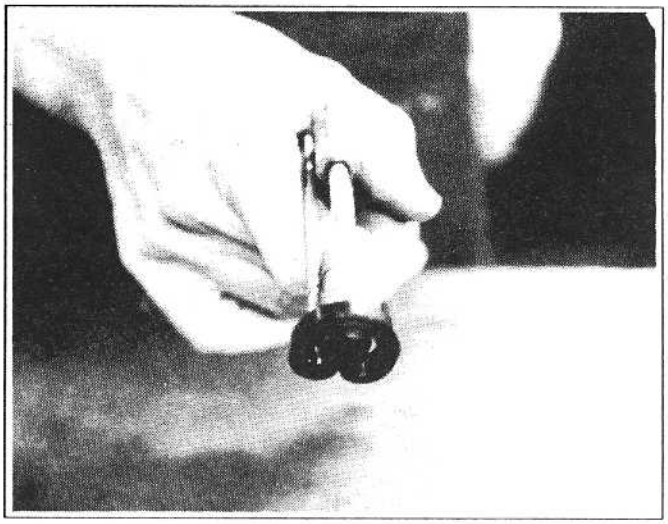


Figure 4-2

   b. Insert the seal into the gland and position it over the seal groove.

   c. Remove the tool allowing the seal to "snap" into the groove.

      NOTE: Seals may be soaked in warm oil or water or placed into a warm environment to "soften" them thereby making installation easier.

Assembly of Seals continued on next page

Assembly of Seals to Cylinder Gland
(Continued from previous page)

4. Assemble the rod wiper into the wiper groove (the outer groove in the gland). The lip side of the wiper is to face the outside when looking at the threaded end of the gland. This wiper can easily be assembled by hand (See figure 4-3)

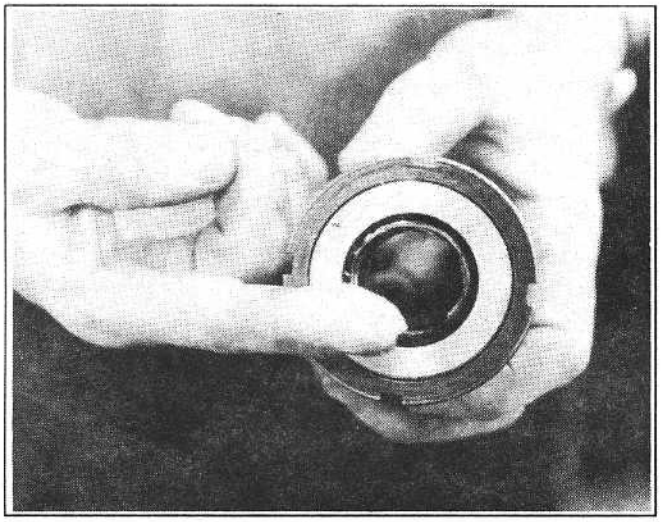


Figure 4-3

5. Assemble the backup ring into the outside groove of the gland. The backup ring should be placed in the groove as far toward the threaded end of the gland as possible.

6. Assemble the "O" ring into the outside groove on the gland. The "O" ring, when assembled, should be next to the groove side away from the threaded end of the gland. Make sure that the backup ring is not under the "O" ring after assembly. (See figure 4-4)

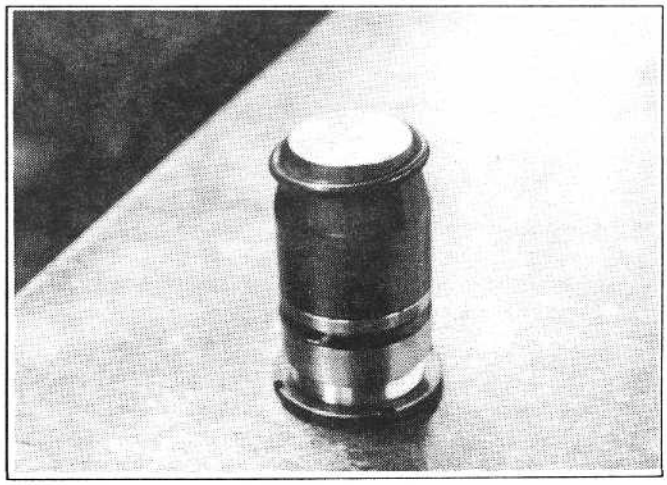


Figure 4-4

ASSEMBLY OF SEALS TO THE PISTON

1. Inspect the piston to insure that it is free of nicks and burrs.

2. Clean the piston.

3. Assemble the piston seal "O" ring into the piston seal groove (the narrow groove).

4. Assemble the piston seal into the piston seal groove (the narrow groove).

5. Assemble the wear ring into its groove on the O.D. of the piston. (See figure 4-5)

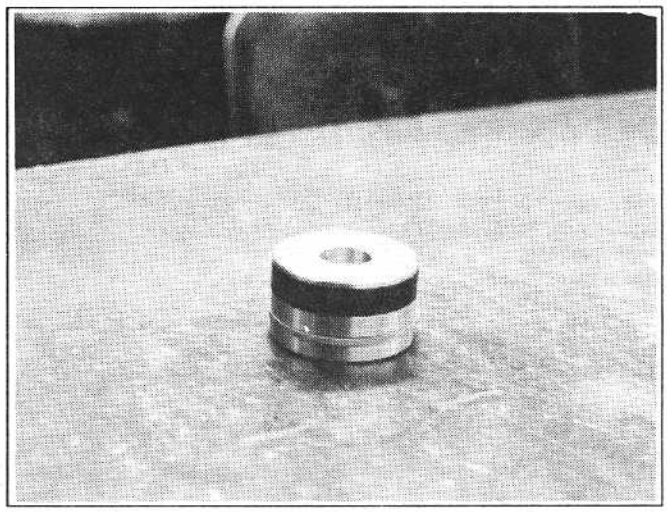


Figure 4-5

ASSEMBLY OF THE CYLINDER

1. Clean and inspect the cylinder rod to ensure it is free of nicks, burrs and scratches.
2. Secure the cylinder rod in a vise. **DO NOT** clamp on the cylinder rod itself (the chrome surface).
3. Assemble the gland locking nut onto the cylinder rod.
4. Apply lubricant and assemble the gland to the cylinder rod. BE CAREFUL not to damage the seals.
5. Install the "O" ring on the cylinder rod.
6. Apply lubricant and assemble the piston to the cylinder rod. BE CAREFUL not to damage the seals. (See figure 4-6)

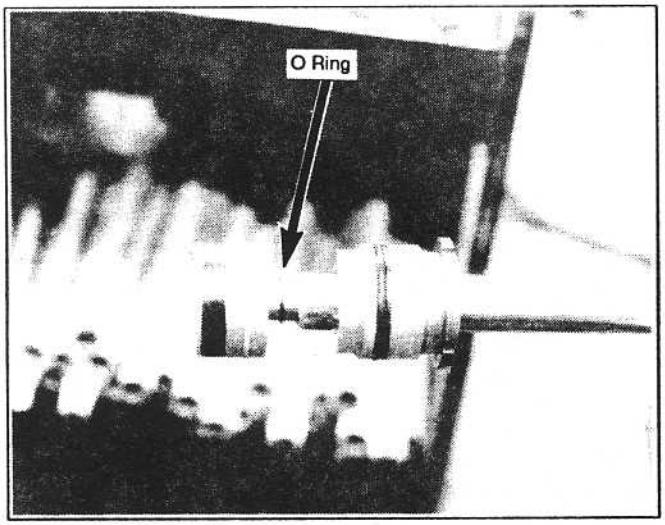


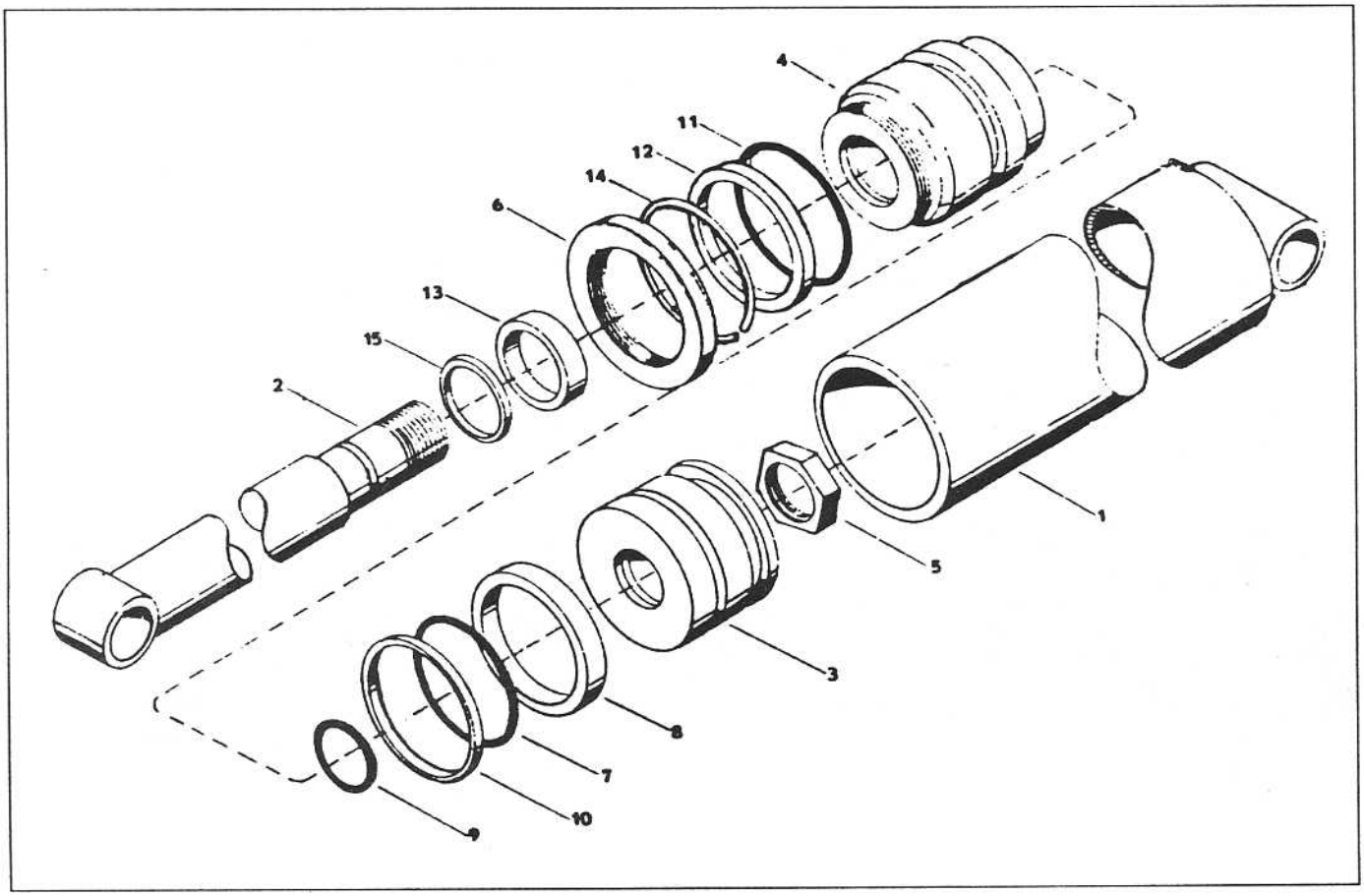
Figure 4-6

7. Install the locking nut, tighten to torque specifications listed below:

940	**Lift**	7/8-14NF 215-225 ft. lbs.(292-305 Nm)
	Tilt	1 - 14UNS 450-500 ft. lbs. (610-678 Nm)
960	**Lift**	7/8-14NF 215-225 ft. lbs. (292-305 Nm)
	Tilt	1 - 14UNS 450-500 ft. lbs (610-678 Nm)

8. Remove cylinder rod assembly from vise.
9. Clean cylinder barrel and inspect it to be sure it is free of nicks and burrs.
10. Secure the cylinder barrel in the vise.
11. Lubricate the cylinder barrel, piston and gland.
12. Slide the piston and gland into the barrel carefully to be sure that no seals are damaged. It probably will be necessary to tap gently on the cylinder rod. Push the gland in far enough so the snap ring can be installed.
13. Pull the cylinder rod out firmly so the gland seats against the snap ring.
14. Install the gland locking nut and torque to 80-100 Ft. lbs. (108-136 Nm). Be sure that the rod and gland do not turn while doing this.
15. Retract the cylinder rod and remove the assembly from the vise.

HYDRAULIC SYSTEM
HYDRAULIC CYLINDERS
Diagram



1. Barrel
2. Rod
3. Piston
4. Gland
5. Special Nut
6. Special Nut
7. "O" Ring
8. Wear Ring, Piston
9. "O" Ring
10. Seal, Piston
11. "O" Ring
12. Backup Seal
13. Seal, Rod
14. Snap Ring
15. Wiper, Rod

Exploded View of Hydraulic Cylinder

HYDRAULIC SYSTEM
CONTROL VALVE
Removal and Installation

1. With bucket removed, raise the lift arm and support with Lift Arm Stops or Cylinder Lock.

CAUTION! The seat belt lock-out is not meant to prevent movement of the Lift Arm when people are under it.ALWAYS USE THE LIFT ARM STOP FOR THIS PURPOSE.

2. Fully extend the tilt cylinders.
3. Remove linkage pins connecting control valve linkage to foot pedals and remove front floor plate.

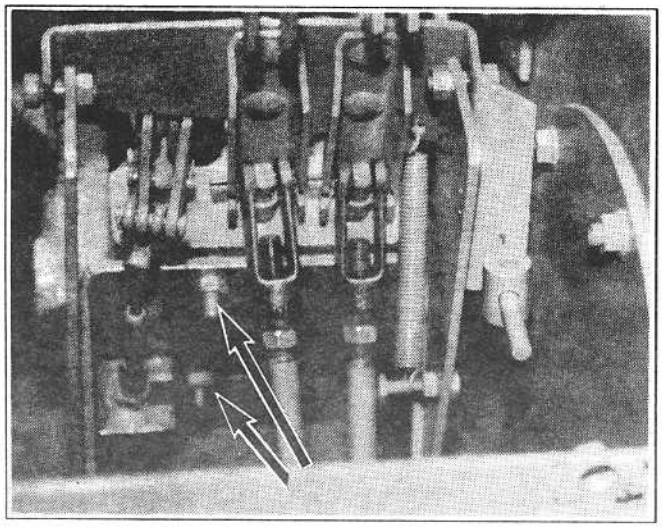
   NOTE: Model 940 starting with S/N 1425008 is equipped with a Gresen Model V20 control valve. The valve is located in the hydrostatic drive compartment, mounted to the left fender under the seat. Removal of the R.O.P.S. will increase access to the valve and reduce labor time required for valve R & R. Although the valve location has changed, the same procedures and tips for R & R should be used.

4. For proper reassembly, mark location of all hydraulic hoses and lines.
5. Remove hoses and lines (cap and plug all fittings and connections).
6. Disconnect auxiliary hydraulic control linkage at control valve.
7. Remove the mounting bolts securing the control valve to the mounting bracket. It is not necessary to remove bracket or control spool lockout assembly.

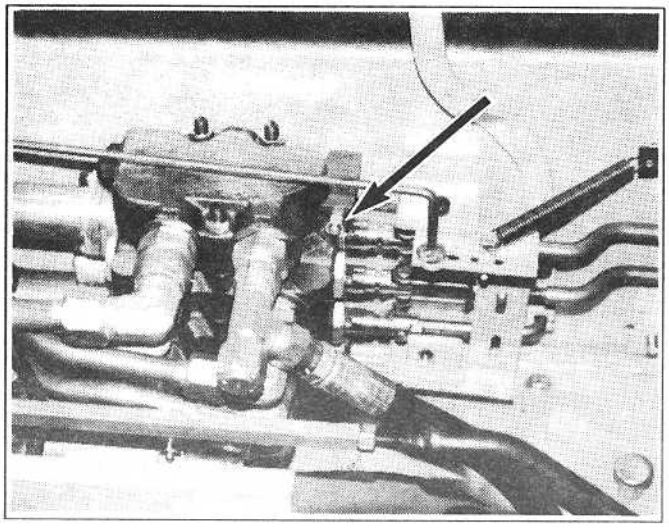
   NOTE: For service and repair of the Gresen valve, refer to Gresen model V20 Service and parts Manual.

8. When reinstalling valve, do not over tighten mounting bolts or binding of control spools may occur. Center lock nuts should be tightened only enough to keep valve from moving on mounting bracket. Do not tighten beyond snug contact to mounting bracket.

   NOTE: The control valve will expand and contract with the temperature of the hydraulic fluid. If the mounting bolts are over tightened, expansion of the valve will be restricted and the valve may warp causing binding or jerky controls (most noticeable at operating temperature).



940 with Dukes Valve



940 with Gresen Valve

HYDRAULIC SYSTEM
CONTROL VALVE
Service and Repair - Dukes Valve

RELIEF VALVE (See figure 4-7)

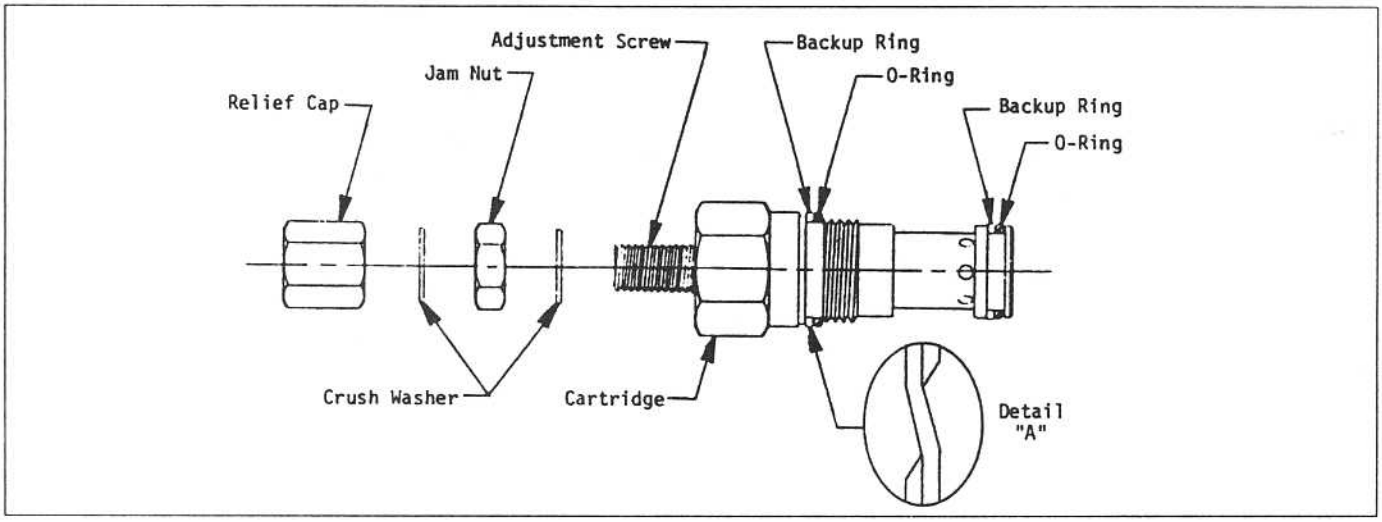


Figure 4-7

Procedure For Seal Replacement

1. Remove relief valve assembly from valve body. Remove and discard O-rings and backup ring from relief valve with a brass tool. Care must be taken not to scratch or nick relief valve cartridge.
2. Clean and dry the cartridge with a suitable solvent. Lubricate new O-rings and spiral-cut backup rings.
3. Install large backup ring over threaded area first. Detail "A" shows proper position of scarf - cuts of backup ring. This must be done to prevent backup ring from spiraling out of groove when installed. Next install large O-ring next to backup ring. Care must be taken not to cut or over stretch O-rings.
4. Install smaller backup ring in groove at end of cartridge as per instruction #3. Then install O-ring next to backup ring.
5. Insert cartridge in valve body and torque to 25-30 ft. lbs. (34-41 Nm).

Procedure for Crush Washer Replacement and Resetting Relief Valve Pressure

NOTE: Do not attempt without proper test equipment. This could result in damage to valve assembly or other components within the systems.

1. Remove relief cap, crush washer and jam nut. Discard old crush washer.
2. Install new crush washer over adjustment screw, screw on jam nut, but leave loose.
3. At this point, relief valve setting should be checked and readjusted if necessary. With 3/16" hex key, turn adjustment screw (clockwise to increase pressure setting, or counterclockwise to decrease setting) to proper setting.
4. After setting is reached, tighten down jam nut against crush washer and cartridge, using 3/16" hex key to prevent adjustment screw from turning. Torque jam nut to 16-20 ft. lbs (22-27 Nm).
5. Add the other crush washer and screw on the relief cap against crush washer and jam nut. Torque relief cap to 16-20 ft. lbs. (22-27 Nm). If oil leakage occurs, re-apply torque to jam nut and/or relief cap until leakage stops.

HYDRAULIC SYSTEM
CONTROL VALVE
Service and Repair - Dukes Valve

DETENTED SPOOL ACTION (See figure 4-8)

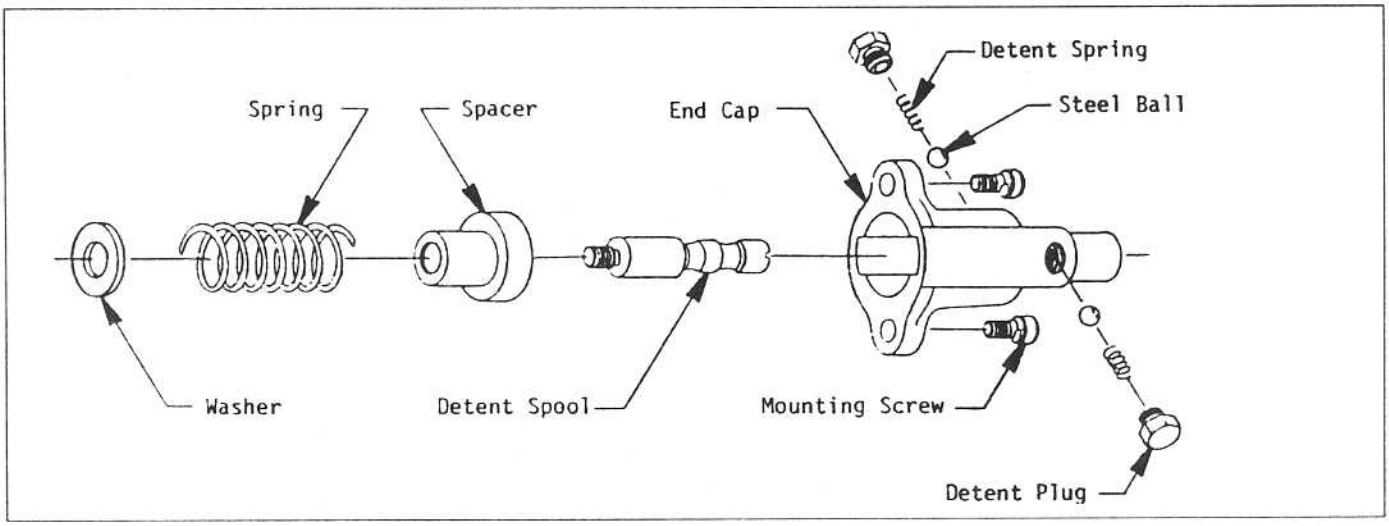


Figure 4-8

Disassembly

Tools required: Standard screwdriver, Phillips screwdriver, 3/32" or 5/32" hex wrench and liquid Loctite (included in kit).

1. Remove two detent plugs with 3/8" wrench. The balls and springs will now be free to drop from the end cap. Remove end cap by removing the two mounting screws.

2. To remove the detent spool, retain spool opposite cap end. Next take a screwdriver and remove the detent spool. Some of the detent spools may have a 3/32" or 5/32" hex.

   NOTE: This may require heavier than normal forces since this part is Loctited in place.

3. With the detent spool removed, now remove the spacer, spring and washer.

   CAUTION: Movement of valve spool in or out of the valve body will damage the O-rings.

4. If parts are to be reused, clean and dry them thoroughly using a suitable solvent making sure to remove old lubricant from within the end cap.

Reassembly

1. Install washer onto the end of the valve spool then reinsert the spacer onto the spring. Place one drop of Loctite on to the end of the threads of the detent spool.

   NOTE: Threads should be free of dirt and grease, in both the detent spool and valve spool. Refer to instructions with Loctite package.

2. Insert the detent spool through the spacer/spring and screw into place at a torque of 2-3 ft. lbs. (3-4 Nm). (Retain the opposite end of the valve spool to keep it from turning). Excess Loctite could hamper proper operation.

   CAUTION: Excessive valve spool travel into valve body will possibly damage the O-rings.

3. After assembly check the operation of spring center. Push down on detent spool. This should compress the spring and it should return when released. Apply a medium coating of lubricant (Lubriplate or similar) over the spring and detent spool.

Continued on next page

4. Place end cap over detent spool, align the mounting holes, install mounting screws finger tight.

5. Insert one ball into each of the holes on either side of the end cap. Place springs into detent plugs. Put one drop of Loctite onto the threads of the detent plugs (use sparingly). Screw detent plugs firmly into place using 3/8" wrench and tighten to 2-3 ft. lbs (3-4 Nm).

6. Firmly tighten (2-3 ft. lbs. - 3-4 Nm) mounting screws into place and check valve spool for correct operation.

NON-DETENTED SPOOL ACTION (See figure 4-9)

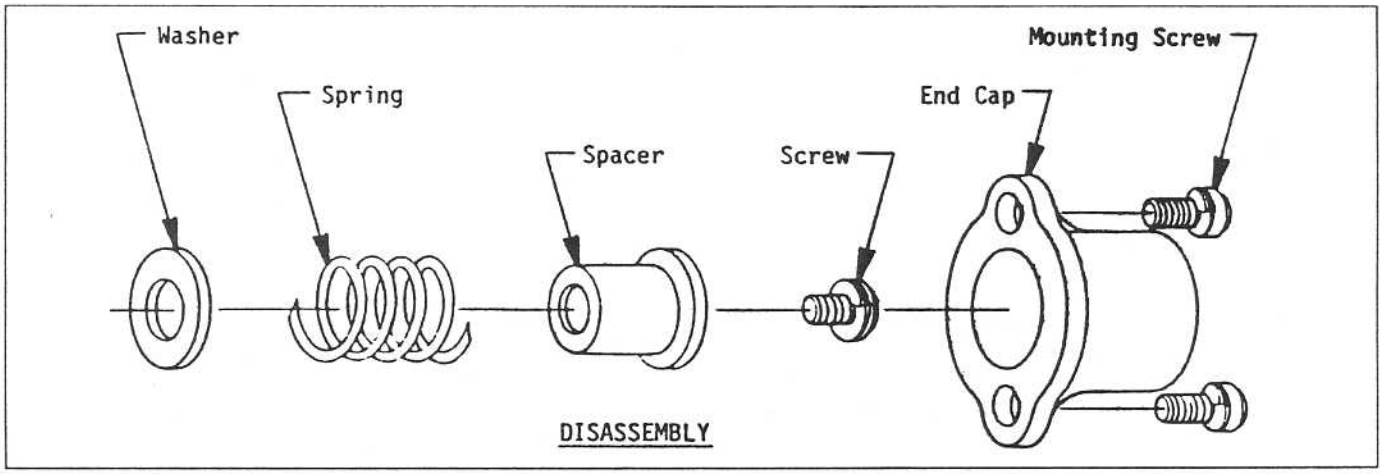


Figure 4-9

Disassembly

Tools required: Standard screwdriver, Phillips screwdriver, and liquid Loctite (included in kit).

1. Remove end cap by removing the two mounting screws.

2. To remove screw, retain spool, opposite cap end. Next take screwdriver and remove screw.

   NOTE: This may require heavier than normal forces since this part is Loctited in place.

3. With the screw removed, now remove the spacer, spring and washer.

   CAUTION: Movement of valve spool in or out of the valve body will damage the O-rings.

4. If parts are to be reused, clean and dry them thoroughly using a suitable solvent making sure to remove old lubricant from within the end cap.

Reassembly

1. Install washer onto the end of the valve spool then insert the spacer into the spring. Place one drop of Loctite on to the end of the threads of the screw.

   NOTE: Threads should be free of dirt and grease, in both the screw and valve spool. Refer to instructions with Loctite package.

2. Insert the screw through the spacer/spring and screw into place at a torque of 2-3 ft. lbs. (3-4 Nm). (Retain the opposite end of the valve spool to keep it from turning). Excess Loctite could hamper proper operation.

CAUTION: Excessive valve spool travel into valve body will possibly damage the O-rings.

3. After assembly check for operation of spring center. Push down on screw. This should compress the spring and it should return when released. Apply a medium coating of lubricant (Lubriplate or similar) over the spring and spacer.

4. Place end cap assembly, align the mounting holes, install mounting screws and torque to 203 ft. lbs. (304 Nm) and check valve for correct operation.

SPOOL SEAL REPLACEMENT
(See figure 4-10)

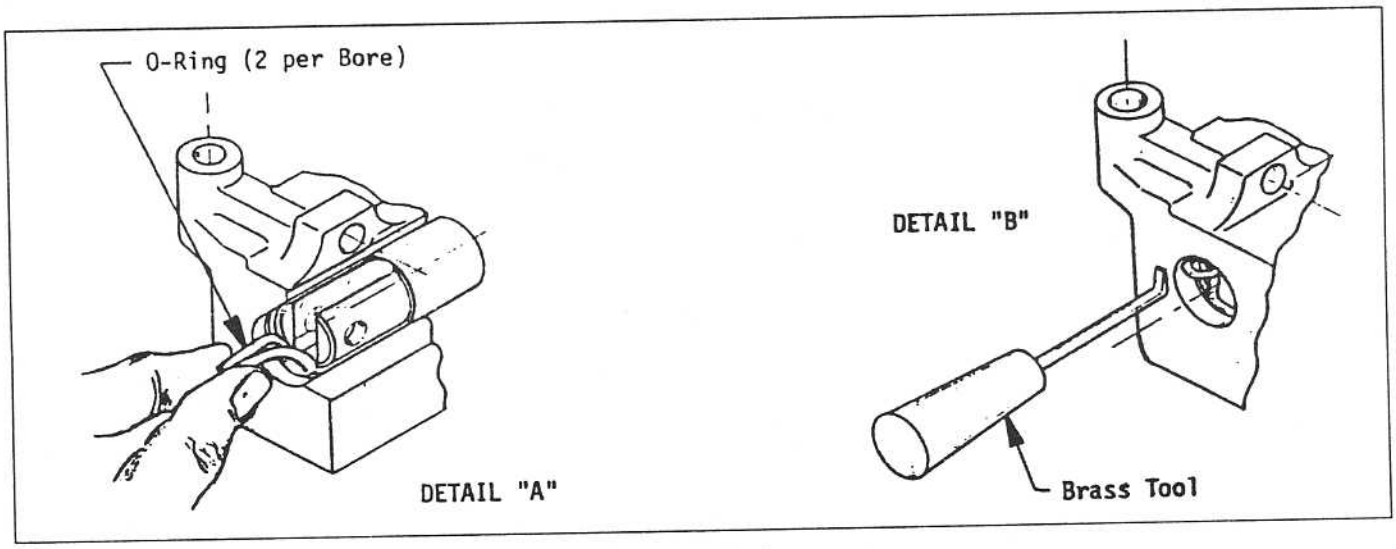


Figure 4-10

1. Remove end cap and spring assembly.

2. Remove valve spool from valve body.

3. Using a brass tool, remove O-rings from valve body. Care must be taken not to scratch the bore and not to contaminate the bore with any foreign matter. Now clean and dry the spool with a suitable solvent.

4. Insert clevis end (or tang) into back end of valve body until even with back end of O-ring groove on front of valve body. Now pinch lubricated O-ring so it can be inserted into body as per Detail "A." Take care not to cut or nick O-rings during installation. Insert part of O-ring into groove and let loose. Now with a brass tool help force O-ring into groove as per detail "B."

5. Rotate spool, pushing and pulling it until back edge of spool is in line with back edge of O-ring groove on cap end of valve. Repeat same procedure for installing O-ring as above. After the O-ring is installed, push and rotate spool until edge of spool is aligned with back surface of casting. Reassemble end cap assembly as per instructions on page 4-17.

HYDRAULIC SYSTEM
CONTROL VALVE
Service and Repair - Gresen Valve

PROCEDURE FOR REPLACING SECTION ASSEMBLIES

NOTE: For clarification, we shall call the inlet cover containing the main relief the left side of the valve assembly.

1. Remove valve from machine and clean thoroughly.
2. Before disassembly, it is suggested that each valve section be marked numerically to avoid incorrect reassembly.
3. Remove three assembly stud nuts from the left end section using a 9/16" thin wall socket.
4. Remove valve sections by sliding from assembly studs.
5. Thoroughly clean o-ring counterbores and ground surfaces of each section.
6. Replace the four o-rings.
7. Replace valve sections on assembly studs in the same order in which they were removed. O-ring counterbores should be to the left when facing port-end of valve.

   NOTE: Use care in replacing valve sections to avoid dislodging o-rings from counterbores.
8. When all valve sections are positioned on assembly studs, replace stud nuts and tighten evenly to 32 ft. lbs. (43 Nm) torque.

   CAUTION: If stud nuts are not tightened to the proper torque, valve spools may bind or stick, or cause section seals to extrude.

REPLACING SPOOL SEALS

1. Remove valve from machine and clean thoroughly.
2. Remove bonnet assembly parts from back of valves and keep in order of disassembly.
3. Remove retainer plate washers, back-up washers, and spool seals.
4. Thoroughly clean counterbore.
5. Lightly oil new seals. Slide over valve spool and insert in seal counter bore.

   NOTE: For internal threads on the spool, apply type II, grade N, thread locking compound (ref. Loctite No. 242, blue) and torque to 5 ft. lbs. (6, 8 Nm). Prevent spool from turning or moving by inserting a screw driver through clevis slot, or running a rod through the pin hole and using as a handle. DO NOT hold the spool with a wrench. This will destroy the finish.

2 (A) Port relief 960 tilt only
(B) Anti cavitation check assembly 940 tilt only

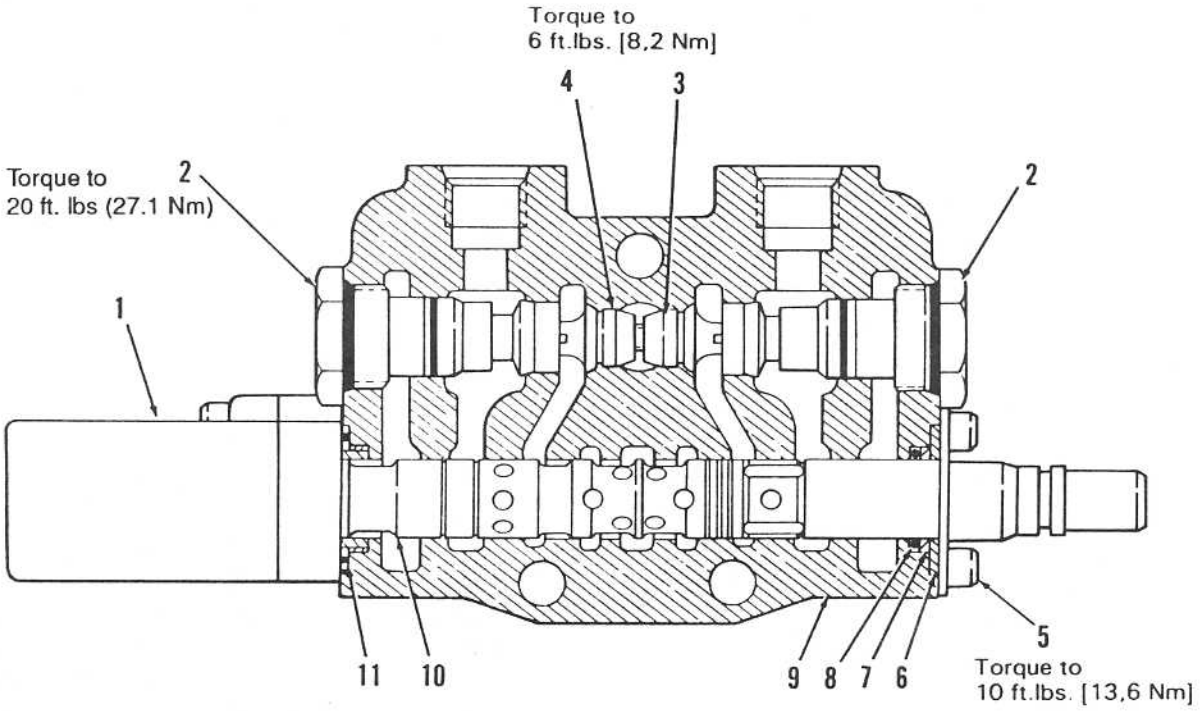


Figure 4-11, 4-Way, 4-Position Float, Series Valve Section.

4-WAY, 4-POSITION FLOAT, SERIES VALVE SECTION

Item No.	Description	Quantity Per Section
1	POSITIONER, Float Out (See Figure 4-12)	1
2	CHECK, Load	2
3	PLUG, Power Core } See Note 1	1
4	PLUG, Power Core } See Note 1	1
5	RETAINER ASSEMBLY	1
6	RETAINER, Plate Washer	1
7	WASHER, Back-Up } Not sold separately	1
8	SEAL, O-Ring } Not sold separately	1
9	HOUSING, V20 Series } See Note 1	1
10	SPOOL, Series, Float } See Note 1	1
11	SPOOL SEAL ASSEMBLY (See Figure 4-12)	1

NOTES:

1) These are matched parts and are not sold separately.

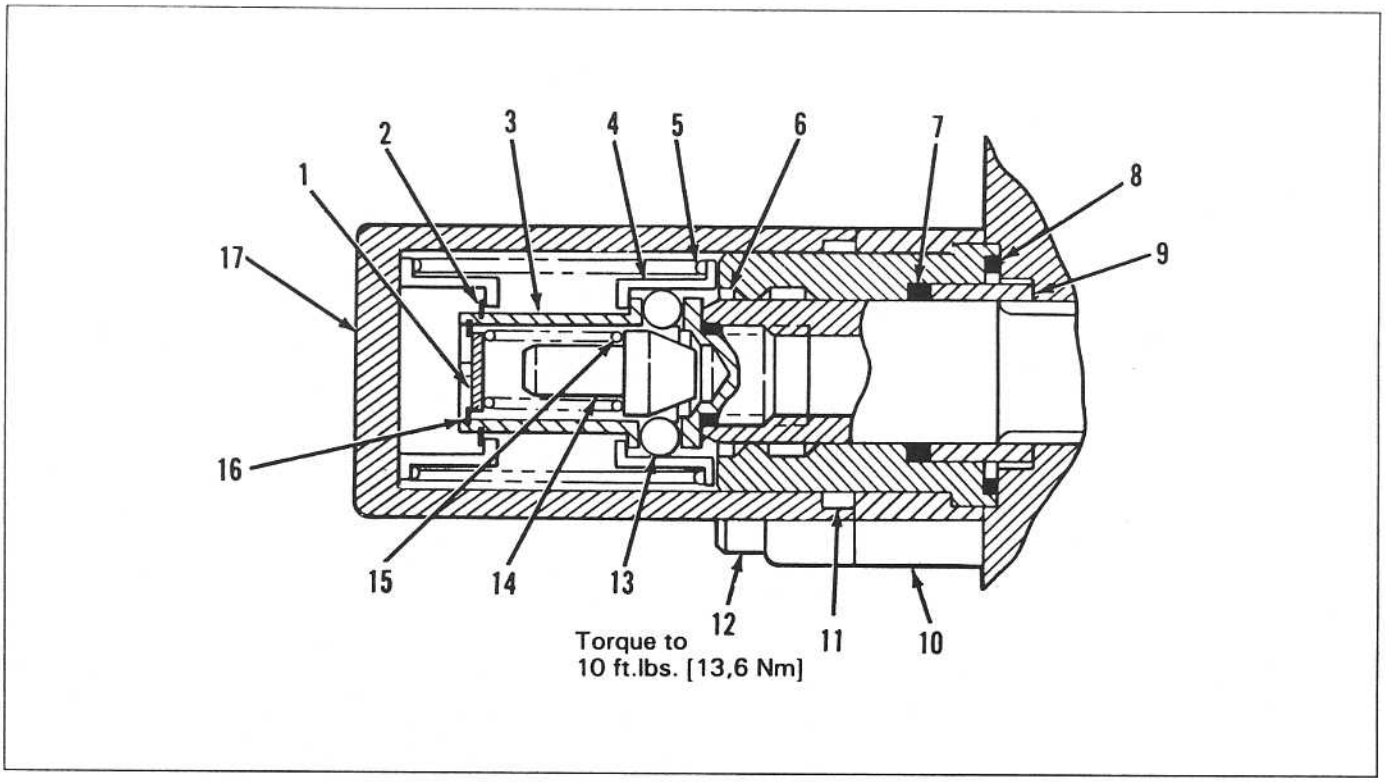


Figure 4-12, V20S 4-Way, 4-Position Float (out) Detent Positioner.

V20S 4-WAY, 4-POSITION FLOAT (OUT) DETENT POSITIONER

Item No.	Description	Quantity Per Section
	REPLACEMENT KIT (Contains all items listed below)	
1	SHIM	1
2	RING, Retaining	1
2	COLLAR, Spool	1
4	COLLAR, Spring	2
5	SPRING, Centering	1
6	SEAL, O-Ring	1
7	SEAL, Four Lobed	1
8	SEAL, O-Ring	1
9	SLEEVE, Retainer	1
10	SPACER, Bonnet	1
11	SLEEVE, Detent	1
12	SCREW, HSHC, 1/4 - 20 by 1 1/2 inch long	2
13	BALL, Detent	4
14	FOLLOWER, Ball	1
15	SPRING, Detent	1
16	RING, Retaining	1
17	BONNET	1

SELF-LEVEL VALVE

ADJUSTING THE SELF-LEVELING VALVE

If necessary, the degree of rollback controlled by the self-leveling valve may be adjusted.

1. Park the machine on a level surface, lower attachment to the ground, turn machine off.

WARNING: Do not touch hot engine parts and hydraulic components until adequately cooled or severe burns may result.

2. Open rear door and locate self-leveling valve inside left-hand upright. Remove plastic cap from adjusting screw. (See figure 4-13)

3. Hold adjusting screw with allen wrench while loosening jam nut.

WARNING: Do not attempt to adjust self-leveling valve while machine is running. Serious injuries or burns may result from working near a running engine.

4. Turning adjusting screw clockwise will result in a greater rollback angle at the top of the lift cycle (tilt cylinder will extend less). Turning screw counterclockwise will result in less rollback angle (tilt cylinder will extend more).

5. When degree of rollback is satisfactory, be sure to tighten jam nut while holding adjustment screw, and re-install plastic cap.

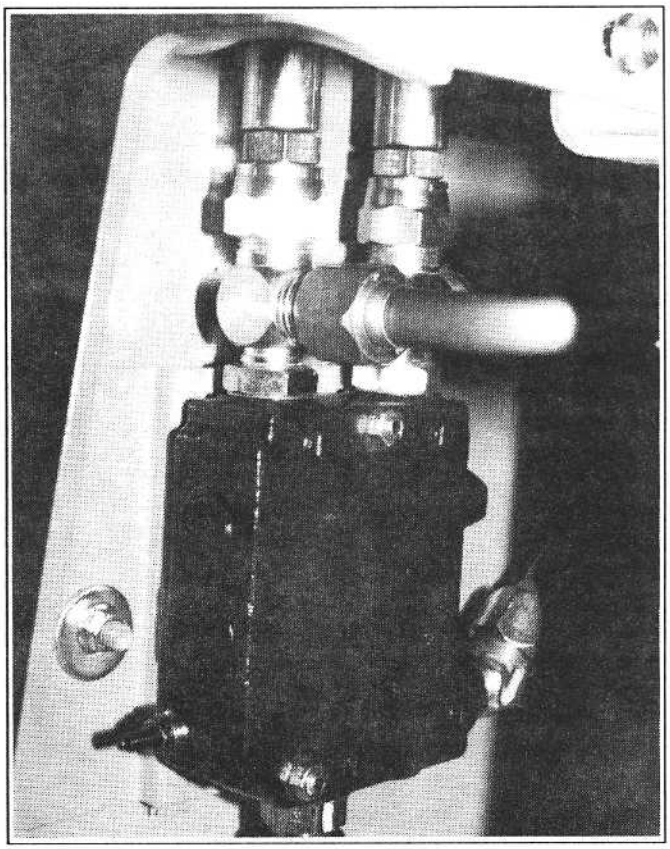
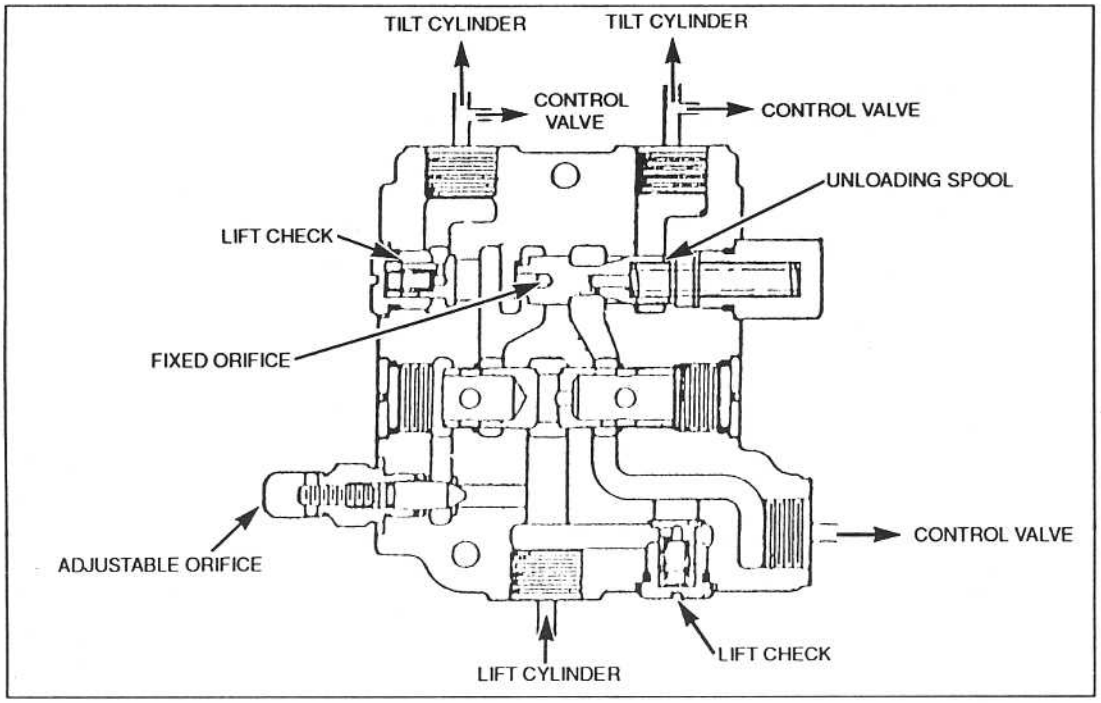


Figure 4-13



HYDROSTATIC DRIVE SYSTEM

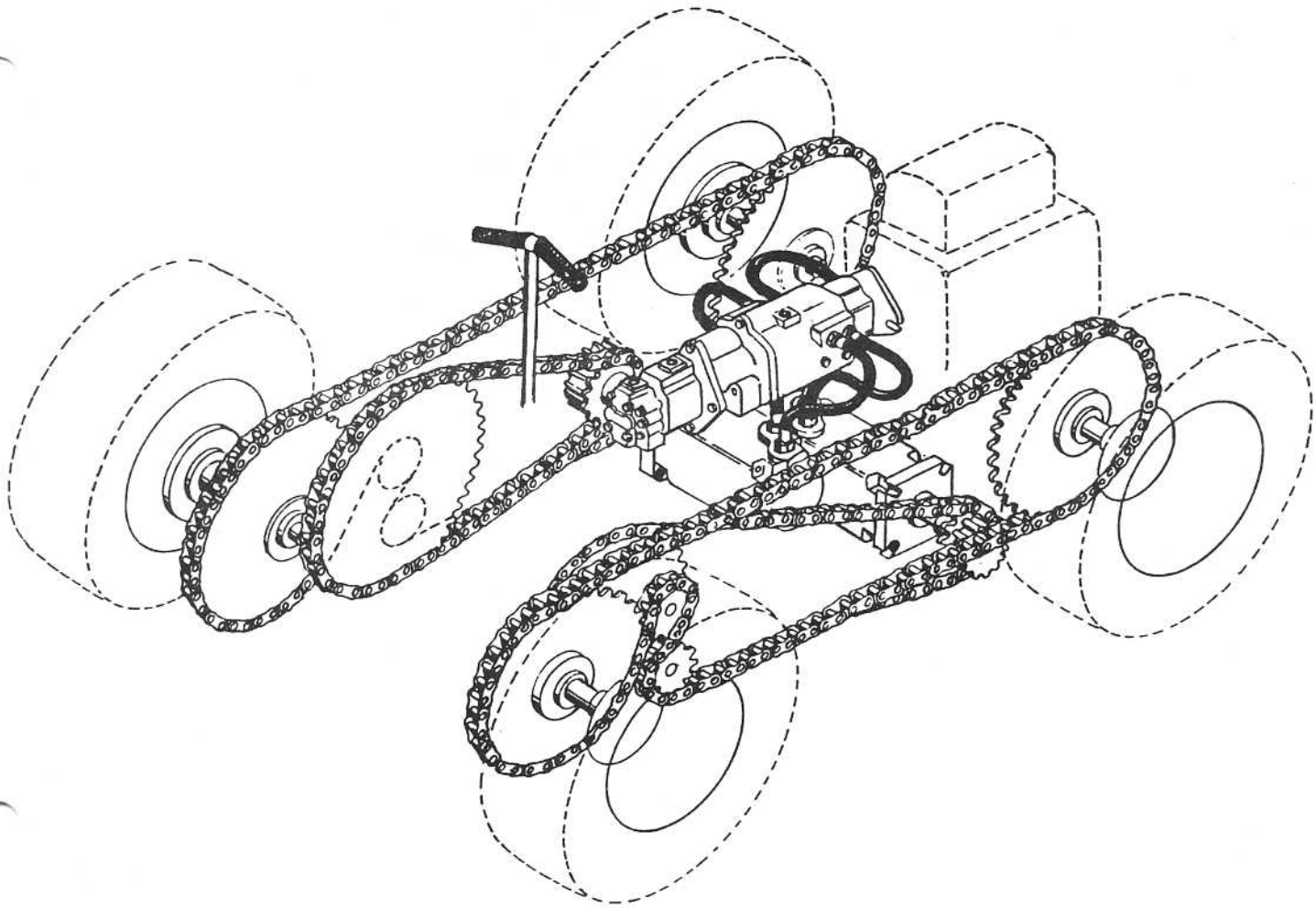
The hydrostatic drive system (transmission) propels the machine forward and backward. It also allows each set of drive wheels to be operated independently of each other. When one set of drive wheels is turning faster than the other, the machine will turn. (This is the steering system.)

The hydrostatic drive system consists of the following components: a tandem; reversible - variable displacement piston pump (Vickers TA 19-19); two Eaton geroller type 4000 series 9.9 cubic inch (162.3 ml) per revolution drive motors (one for each set of drive wheels) which also incorporate a hot oil shuttle valve for cooling and filtering the closed loop circuit oil; a charging circuit to maintain a positive pressure for lubrication and to prevent cavitation in the piston pumps; and a drain system to allow oil back to the reservoir from both pumps and both drive motors.

Each pump and motor set is connected by two high pressure lines and is called a closed loop circuit. This is needed to allow equal power in either direction (forward and reverse).

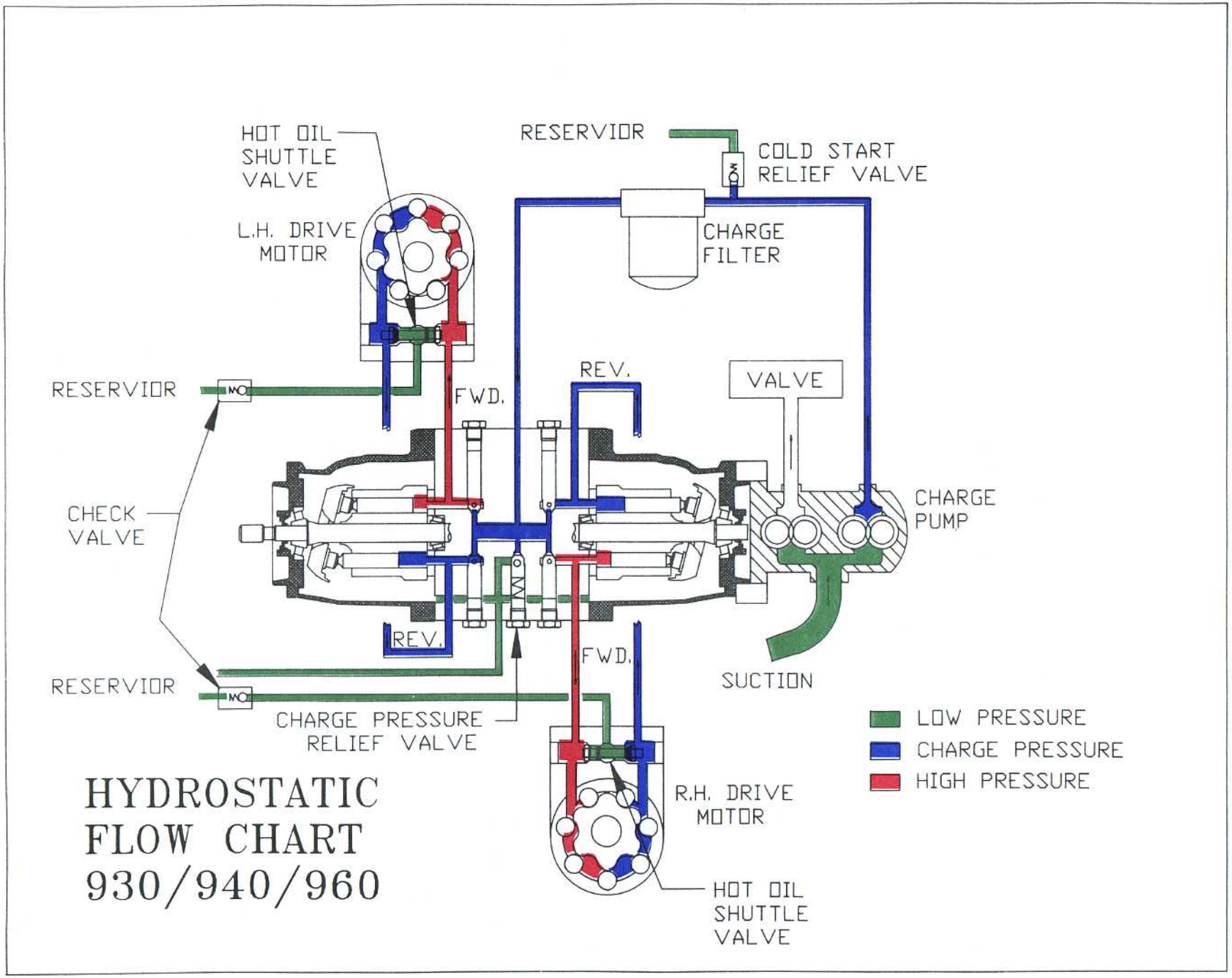
Leakage oil from the closed loop circuit is sent back to the tank for cooling and filtering via the drain system. This oil is replenished by filtered oil from the charge circuit.

There are no servo's or flow dividers in this closed loop circuit. Hydraulic fluid, as determined by the T-Bar, is simply directed to the drive motors causing them to rotate. The farther the T-Bar is moved from neutral, the greater the fluid output from the pumps and the faster the wheel turns.



HYDROSTATIC DRIVE SYSTEM
TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSE
No drive, both sides, either direction	Check hydraulic fluid level Check steering and control linkage Check charge pressure (See page 5-4) Check gear pump for damage Hydrostatic pump failure (See page 5-6) Drive motor failure
No drive, one side	Check hydraulic fluid level Check steering control linkages Inspect hydrostatic drive relief valves for damage (See page 5-5) Check drive chains for damage Shuttle valve in drive motor sticking Internal components of system damaged
Loader does not move in a straight line 5% drift is allowable. Example: 2.5 ft. (.75 m) in 50 ft. (15.2 m) of movement.	Low air pressure in tires Tires are not the same size Check steering control linkage Hydrostatic drive relief valve (See page 5-5) Internal wear in Hydrostatic drive system
Hydrostatic drive system overheating (Oil temperature light comes on) Temperature warning switch on 225-235° F (107-113° C)	Loader being operated at low R.P.M. Check hydraulic fluid level Sender unit defective Oil cooler has restriction (clean according to the operator's manual) Low charge pressure (See page 5-4) Hydrostatic drive relief valves bypassing Shuttle valve in drive motor not functioning properly


HOT OIL SHUTTLE VALVE
L.H. DRIVE MOTOR
RESERVIOR
COLD START RELIEF VALVE
CHARGE FILTER
RESERVIOR
FWD.
REV.
VALVE
CHECK VALVE
CHARGE PUMP
REV.
FWD.
SUCTION
RESERVIOR
CHARGE PRESSURE RELIEF VALVE
LOW PRESSURE
CHARGE PRESSURE
HIGH PRESSURE
R.H. DRIVE MOTOR
HOT OIL SHUTTLE VALVE
HYDROSTATIC FLOW CHART 930/940/960

HYDRAULIC FILTER FACTS:

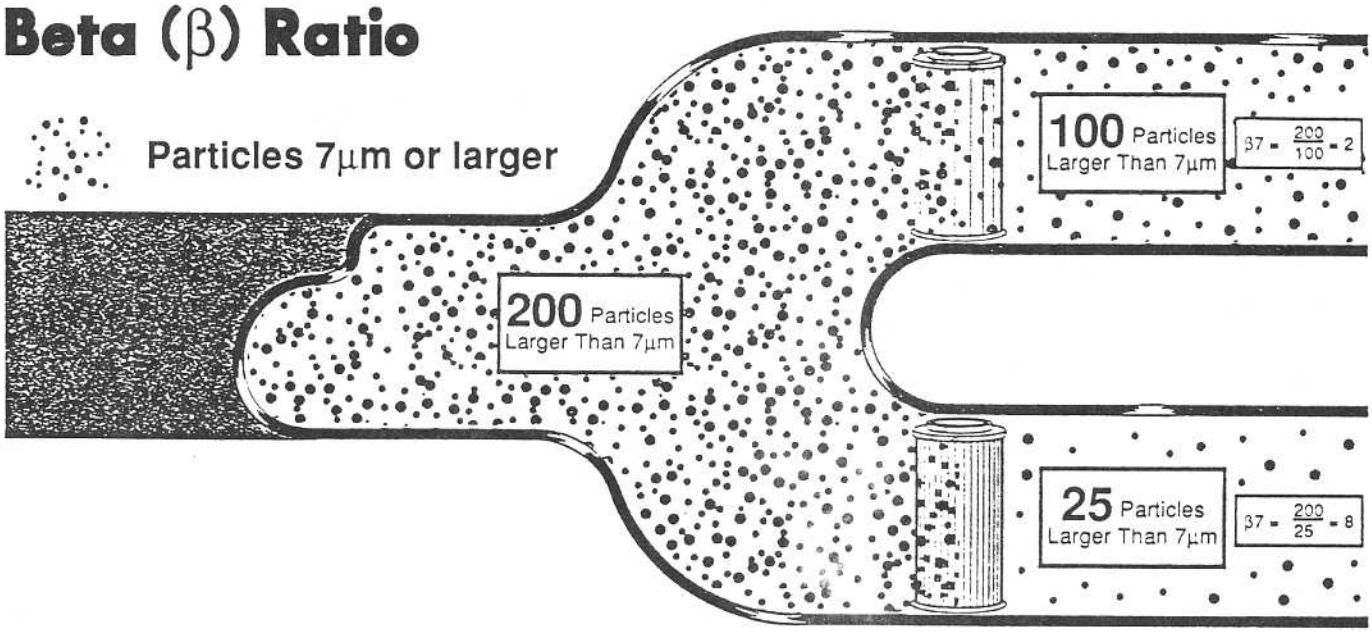
Micron Rating

Definition of Micron Rating: That a particular filter will remove XXX% of material larger than the specified Micron Rating. However, the Micron Rating DOES NOT tell you what percentage.

This is very deceiving because the percentage of efficiency is the critical part of filtration and this is the information that is not revealed in Micron Ratings.

Beta Rating

Beta Rating is the method used to determine efficiency of a filter. This is a direct measurement of how much material a given filter will remove from a hydraulic system.



$200 - 25 = 175$

$\frac{175}{200} = 87.5$ effiency

Answers to T/F Questions on page 4-6

1.	F	6.	T
2.	T	7.	F
3.	T	8.	T
4.	F	9.	T
5.	F	10.	T

HYDROSTATIC DRIVE SYSTEM
HYDROSTATIC SYSTEM CHECKS
Charge Pressure Checks

The charge pump supplies oil to the piston pumps to replace oil lost through the case drain. Output of the charge pump is greater than the case drain flow from the closed loop system. This creates pressure which prevents cavitation and freewheeling and provides lubrication of internal components. To prevent over pressure of the charge system, a relief valve is installed in the valve block of the piston pumps. As internal components wear or become damaged, case drain flow increases and charge pressure decreases. When the case drain exceeds charge pump output, the drive system will become sluggish and weak. Severe damage to the drive system will occur.

The charge pump is the forward most (closest to the T-Bar) section of the double gear pump. Pump output is rated at 9 GPM (34 L).

A 7/8 JIC test port "T" is installed in the plumbing circuit between the pump and charge filter. On most models this "T" is located at the outlet port of the charge pump. (On early 930 and 940 models this "T" is located in the engine compartment attached to the charge pressure filter.)

1. With the machine warm, shut engine off and install a 0-500 PSI (0-34.5 bar) gauge at the test port. a 7/8 inch JIC female adapter is required. (See figure 5-1)

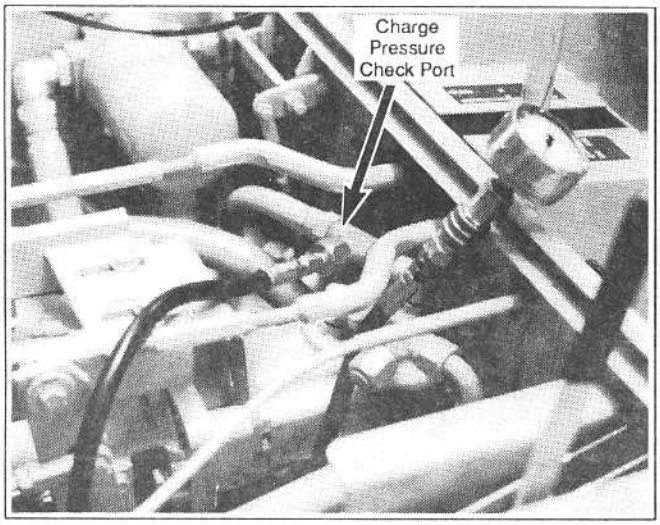


Figure 5-1

2. Tie the machine so the drive system can be stalled under load. (The brakes may or may not do this.)

3. Start the machine and run the engine at FULL R.P.M. Note charge pressure reading (180-200 PSI {12.4 - 13.8 bar} is normal with 145 PSI {10 bar} being minimum). If charge pressure is below specifications, check for suction leaks or restrictions and pump output before continuing charge pressure check. A faulty charge relief valve, or spring, or cold start relief valve may also cause a low pressure reading. See cold start relief valve page 5-14.

4. With the machine tied to stall the drive system and engine at FULL R.P.M., move the T-Bar SLIGHTLY to load the drive system and note charge pressure. A slight drop in pressure is normal. (See figure 5-2)

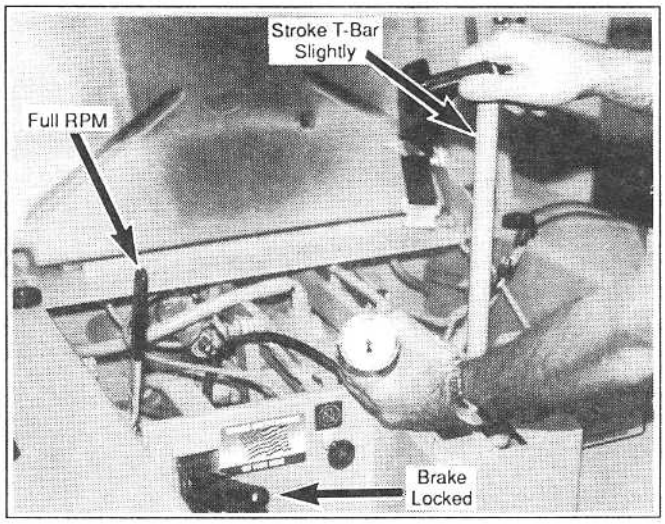


Figure 5-2

Charge Pressure should be steady at 180 PSI (+/- 50 psi {12.4 +/- 3.4 bar}). If charge pressure is below specifications, internal leakage to case drain is indicated. (See sections on "Directional Check/Relief Valve Checks, Piston Pump Checks, Drive Motor Checks.")

If charge pressure increases when T-Bar is stroked, it may indicate a check valve is stuck open (See "Directional Check Relief/Valve Checks").

HYDROSTATIC DRIVE SYSTEM
HYDROSTATIC SYSTEM CHECKS
Directional Check / Relief Valve Combination

Each directional check/relief valve in the Vickers hydrostatic pump performs two functions. The large coned end of the valve seats against a machined surface in the valve block and serves as a check valve directing charge pressure to the low pressure (inlet) side of the piston pump. The small center cone is the high pressure relief protecting the system from producing internal pressure greater than 4500 PSI (310.2 bar).

There are four directional check/relief valves located in the valve block of the hydrostatic piston pump, one for each of the outlet ports of the two piston pumps. Each port has a casting number for identification.

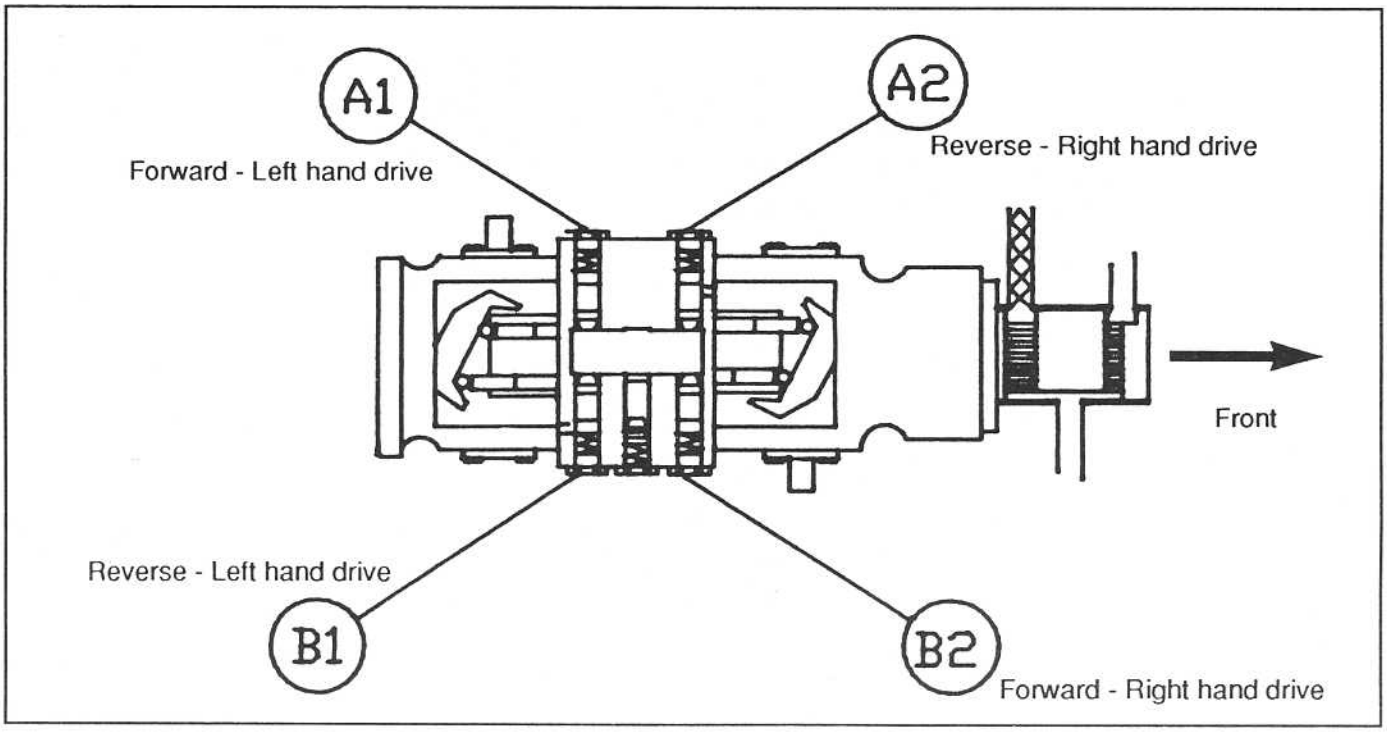
#	Direction	Side Driven
A-1	Forward	Left hand drive (rear pump)
B-1	Reverse	Left hand drive (rear pump)
B-2	Forward	Right hand drive (front pump)
A-2	Reverse	Right hand drive (front pump)

Loss of drive on one side of the unit indicates that one side of the hydrostatic drive system is not developing adequate pressure. Three reasons for loss of pressure are as follows:

1. One of the pressure relief valves protecting that side has failed.
2. Hot oil shuttle valve on the drive motor is sticking. (See Drive Motor Checks, page 5-7)
3. Excessive oil is being lost by internal leakage due to damage in the hydrostatic drive system.

If one relief valve fails, normally the machine will have good power in one direction but not the other (on one side of the machine). It is possible, but very rare, that two relief valves would fail at the same time. Such failure can be checked by simply switching relief valves from one side to the other.

If the machine will not move in either direction, oil may be going back to the reservoir through internal leakage from the hydrostatic pumps, or drive motors. It is also possible that a ruptured line may be causing external oil loss. All external leaks should be repaired prior to checking the internal workings of a hydrostatic drive system.



HYDROSTATIC DRIVE SYSTEM
HYDROSTATIC SYSTEM CHECKS

CLOSED LOOP

This check can be done when there is a total loss of drive (both sides) or when there is loss of drive on one side and the relief valves and hot oil shuttle valve have been checked to be sure they are not at fault. This check will aid you in determining if the failure is hydraulic or mechanical.

1. Block machine off the ground.
2. Lock parking brake (set so it takes 40-50 lbs. (18-23 kg) to engage.
3. Start machine and move T-Bar slightly forward and reverse.
4. If a smooth firm resistance is felt, it is a good sign that the hydrostatic drive system is functioning properly. Shut machine off and remove chain case covers for inspection.
5. If a soft erratic feeling is noticed, there probably is damage in the closed loop system. Shut unit down and perform the hydrostatic system pressure checks described in the following section.

PISTON PUMP

If charge pressure drops severely (see charge pressure check) when the drive system is put under load, a problem in the hydrostatic pump or motor is indicated. To isolate:

1. Remove both high pressure lines from suspect pump. KEEP EXTREMELY CLEAN!

CAUTION! Escaping hydraulic fluid under pressure can have sufficient force to penetrate the skin, causing serious personal injury.

Fluid may be hot. Allow system to cool before servicing.

2. Cap these ports with steel plugs. (See figure 5-3)

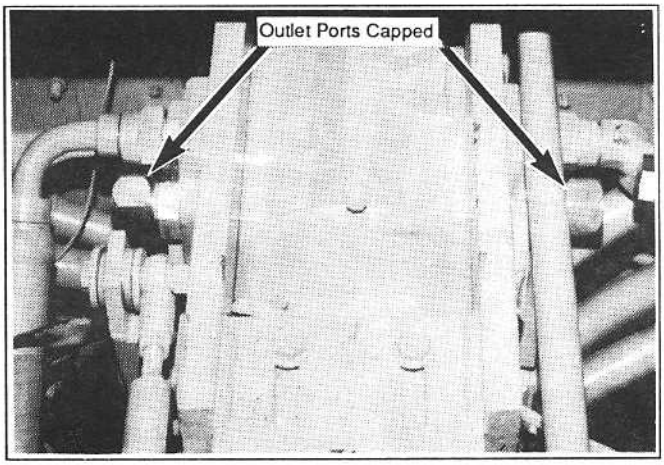


Figure 5-3

3. Run unit at full throttle. A very firm resistance to movement of the T-Bar should be felt in both directions.
4. If the T-Bar feels erratic, mushy or anything other than a steady, firm, hydraulic resistance, a problem in the pump is indicated.
5. If the pump checks okay, reconnect one of the high pressure lines to the hydraulic motor. Stroke the pump (T-Bar) to pressure the connected line. Observe the oil coming from the open motor port. This is oil bypassing internal motor components and not driving the wheels. A large amount of oil bypassing internally will cause severe lack of drive power. (See figure 5-4)

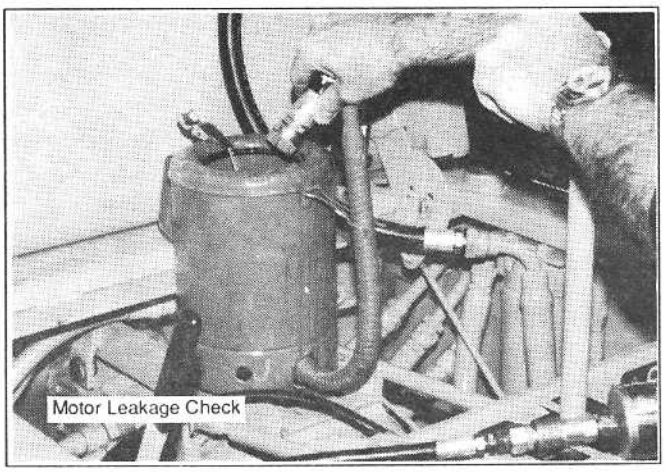


Figure 5-4

Piston Pump Continued:

6. Remove the suspect component for inspection. If contamination or damage is found, the corresponding component MUST be removed for inspection and repair if necessary. In most cases, the system has been run long enough to contaminate both pumps and both motors. Normally the total hydrostatic drive system must be dismantled for inspection, repair and cleaning. Any contamination found in one component goes directly to the other through the closed loop. If run long enough, it then also contaminates the total system.

HYDROSTATIC DRIVE MOTOR

If a problem is suspected with a drive motor, first check all mechanical linkage to the hydrostatic pump. Then if necessary check the drive chains to be sure they are not damaged and power test the pump (See hydrostatic pump checks) to determine whether the problem is in the hydrostatic pump or the drive motor, or both. If it is determined that the loss of drive is due to a failure in the drive motor, first check the hot oil shuttle valve.

The hot oil shuttle valve is a spring loaded spool valve located in the end cover of the drive motor. The purpose of the shuttle is to allow a small portion of the closed loop circuit oil back to the tank for cooling and filtering. (This is referred to as case drain oil.) Cooling oil must be taken from the low pressure side of the closed loop circuit. This is necessary to prevent loss of drive power. Since the motor is reversible, neither of the ports are continuously high or low pressure (they change depending on direction of travel). The spool then senses pressure differential and moves to block the high pressure port and open the low side to the tank. When sitting in neutral the spool is in the center position. There is also an orifice placed in the fitting of the drain line to control the amount of oil flow. (See figure 5-5)

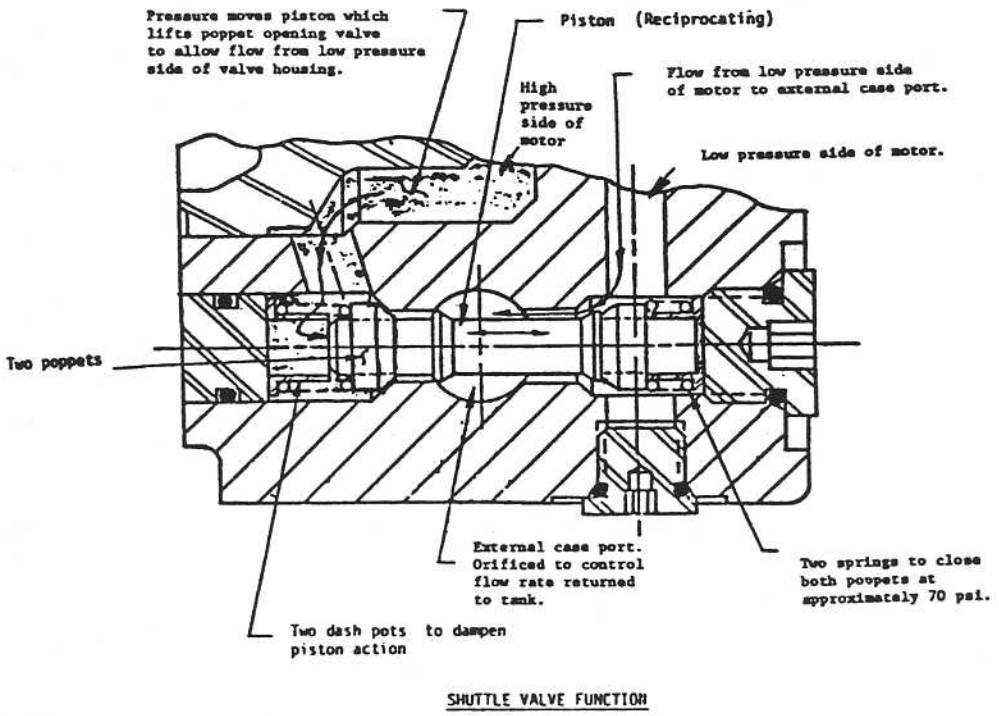


Figure 5-5

Hydrostatic Drive Motor Continued

If the shuttle valve sticks in one direction, the high pressure side of the reversible closed loop will be open to the tank and power will be lost. This will show up as a loss of power on one side and in one direction only. If you suspect a hot oil shuttle valve problem:

1. Remove the case drain line and fittings from the drive motor.

CAUTION! Escaping hydraulic fluid under pressure can have sufficient force to penetrate the skin, causing serious personal injury.

Fluid may be hot. Allow system to cool before servicing.

2. Using a small screwdriver or "O" ring pick, work through the open port and try to move the valve or determine if the valve is off center. It should be centered and snap back to center when the screwdriver is removed.

3. If you are not able to see the shuttle valve, simply plug the drain line and motor port. Run the machine and see if it operates properly. If it does, the problem is due to foreign material being lodged in the shuttle valve. Just moving the valve manually may remove it. If so the system can be put back into service.

4. If you are unable to free the shuttle valve, remove the hex cap and use a magnet to see if it can be freed and the material removed.

5. If these attempts fail, the motor will have to be removed and disassembled to find the fault.

   NOTE: Motor removal and disassembly is required to gain access to the complete valve. Only parts of it can be removed through the outside plug. (Refer to the Eaton Service Manual if this is necessary.)

   NOTE: It is acceptable to plug the motor drain for testing to see if the shuttle valve is at fault. Simply plug the drain hole (dead head with a steel plug) and run the unit to determine if the drive system oil is being lost through the drain system back to the tank. If power is not regained the shuttle valve is not at fault. THIS IS FOR TESTING PURPOSES ONLY. If the machine is run for an extended period with this port plugged the drive system may overheat.

If the shuttle valve is not at fault a power test of the drive motor can be done as follows:

1. Disconnect one of the high pressure closed loop hoses at the motor and plug with a steel plug.

2. Attach a line to the open port of the motor and run to a suitable container.

3. Tie the machine so that the drive system can be stalled under full load. (The brakes may or may not do this.)

4. Run engine at full throttle and move the T-Bar to put power into the motor and observe the open line. A motor in good condition may pass up to .5 GPM (2 L) when the motor is stalled. If the motor is allowed to turn, oil WILL flow out of the open line.

   NOTE: It should not be necessary to do this test for an extended period. Normally the motor will be well within specifications or well beyond. Drive motor replacement or rebuilding is required if the motor is passing an excessive amount of oil. (Refer to the Eaton Motor Service Manual.)

HYDROSTATIC DRIVE SYSTEM
START-UP PROCEDURES

The internal components of the hydrostatic pump and drive motor are lubricated by the hydraulic fluid.

The following steps should be taken to prevent damage caused by dry start (air in the system) after service or repair of the hydrostatic system:

NOTE: Machine must be blocked off ground.

1. Install all control linkage and fill reservoir to proper cold level on dipstick. Make sure new *MUSTANG* filters, charge pressure and return, have been installed.

CAUTION! Escaping hydraulic fluid under pressure can have sufficient force to penetrate the skin, causing serious personal injury.

Fluid may be hot. Allow system to cool before servicing.

2. Install 0-500 PSI (0-34.5 bar) gauge to charge pressure check port. (See charge pressure check for location.) (See figure 5-6)

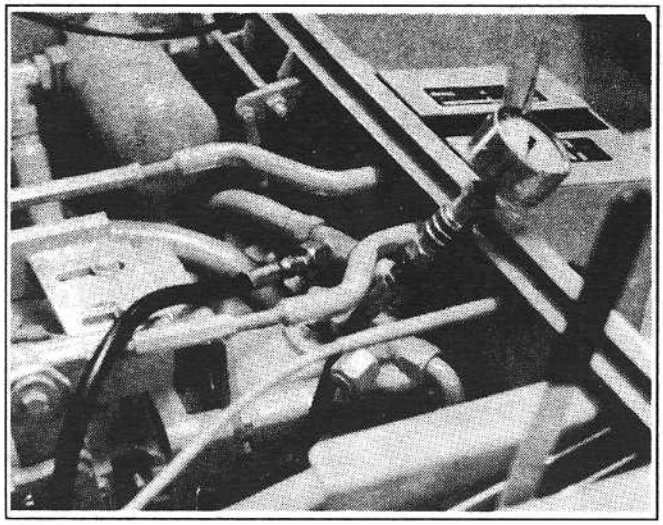


Figure 5-6

3. Remove the charge pressure relief valve spring and reinstall the plug. Location: Lower right hand side of pump valve block below b-1 check/relief valve.
4. Remove the case drain hose from the hydrostatic pump (located on top of the valve block section of the tandem pumps) and plug the hose.
5. Apply regulated (10-20 PSI maximum) (.7 - 1.4 bar) air pressure to hydraulic reservoir expansion tank. (See figure 5-7)

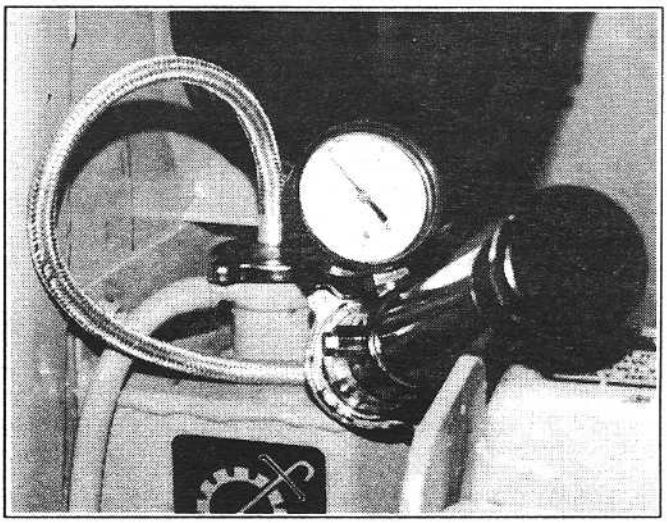


Figure 5-7

NOTE: To supply air pressure, use either a hand pump radiator test gauge or a radiator cap adapted to a pressure regulated air line.

6. Fluid will flow through the charge pressure circuit, fill the piston pumps, and flow out the case drain fitting.
7. If fluid does not flow out of the case drain fitting within 3 to 5 minutes check that air pressure has been maintained, then, jog starter periodically. DO NOT ALLOW ENGINE TO START.
8. Once a steady flow of fluid is obtained, remove air supply and reconnect the case drain hose. Reinstall charge relief valve spring.
9. Refill reservoir to proper level.

HYDROSTATIC DRIVE SYSTEM

START-UP PROCEDURES (continued)

10. Start engine at low RPM and check charge pressure. Gauge must show pressure within 5 seconds. If not, shut down and repeat steps 3-8.

11. If pressure is indicated on gauge, let engine run at low RPM, and activate T-Bar slowly with no load on motors until system responds. Shut unit off.

12. Check hydraulic fluid reservoir level and check all lines and fittings for leaks.

!! WARNING

HOT LIQUID UNDER PRESSURE, ALLOW TO COOL. REMOVE CAP SLOWLY OR SEVERE BURNS MAY RESULT

13. Start engine again. Charge pressure gauge should respond immediately. **If no charge pressure** is indicated, **DO NOT RUN ENGINE.**

14. Run engine at 1/2 throttle for 5 to 10 minutes with T-Bar stroked forward or reverse and no load on the drive motors. Recheck for leaks.

15. Set brakes and move T-Bar to load drive system slightly (use rubber strap to hold). This will open the hot oil shuttle valves to speed fluid exchange in the closed loop circuit. Run for 1/4 hour in forward then 1/4 hour in reverse.

16. Change charge pressure and return line filters. Check hydraulic oil level and recheck for leaks. Remove charge pressure gauge.

17. Remove blocks and lower machine to ground. Replace ROPS, seat and other items removed for access. Drive machine under light load, full RPM for 20-30 minutes.

18. Change charge pressure and return line filter. Check oil level and check for leaks one more time.

19. Run machine in normal operation for 15 minutes to assure proper operation.

20. When returning machine to service, send two new charge pressure filters with machine. Instruct the operator to change the first after 25 hours and use the second after an additional 25 hours. The machine can then be serviced at the regular hourly intervals listed in the maintenance section of this manual and of the operator's manual.

HYDROSTATIC DRIVE SYSTEM

HYDROSTATIC PUMP

Removal and Installation

The Hydrostatic Transmission Pump on all 900 Series *MUSTANGS* is mounted directly to, and supported by, the engine. In most cases, it is easier to remove the engine and hydrostatic pump as one assembly. For this procedure refer to Engine Removal Instructions.

When engine removal is not feasible, use the following procedures:

1. Block machine up. Drain 2 to 3 gallons of fluid from the hydraulic reservoir.

!! WARNING

HOT LIQUID UNDER PRESSURE, ALLOW TO COOL. REMOVE CAP SLOWLY OR SEVERE BURNS MAY RESULT

2. Remove seat and T-Bar assemblies.
3. Clean entire hydrostatic compartment to prevent additional contamination (power washing is recommended).
4. Disconnect and cap all hydraulic fittings to Hydrostatic Pump and Double Gear Pump. Remove suction line from bottom of Gear Pump and plug connections immediately after removal to prevent contamination to the system.

CAUTION! Escaping hydraulic fluid under pressure can have sufficient force to penetrate the skin, causing serious personal injury.

Fluid may be hot. Allow system to cool before servicing.

5. Disconnect the four (4) white electrical wires from the neutral start switches.
6. Support the hydrostatic pump while removing the six (6) mounting bolts at the engine flywheel housing.
7. Slide the pump assembly forward to disconnect the drive plate and flywheel housing. Remove support frame from the pump assembly.
8. For disassembly of the pumps, refer to the Overhaul Manual for units being worked on.

   NOTE: If a pump or motor has failed within the hydrostatic system, the corresponding component MUST be removed, checked for damage, and thoroughly cleaned! ALL connecting hoses and lines need to be removed and cleaned also. Failure to do this will cause serious damage to the new components when they are installed.

INSTALLATION

1. Coat the splines of the pump shaft with Molybdenum Disulfide "Moly" grease.
2. Install the hydrostatic pump assembly to the flywheel housing and tighten the two (2) 1/2 inch bolts.
3. Install the pump mounting frame to the flywheel housing and the hydrostatic pump.

SPECIAL NOTE: Tighten the mounting frame to the hydrostatic pump (at gear pump end) last. This will allow the mounting frame and pump assembly to self-align with engine and flexible drive plate.

4. Follow instructions for Hydrostatic Transmission start-up procedures. This is very important to prevent damage caused by dry start-up and cavitation. (See page 5-10.

HYDROSTATIC DRIVE SYSTEM

DRIVE MOTOR

Removal and Installation

Removal of the R.O.P.S. will greatly reduce the labor and time requirements to remove the hydrostatic drive motors (See R.O.P.S. Removal section for details.)

The drive motors are equipped with a nonretained splined output shaft. It is not necessary to disconnect or remove the primary drive chain to remove the motor. Loosening the primary drive chain will ease the tension on the motor output shaft to make removal and reinstallation easier. (See Chain Drive section.)

1. Raise the lift and support with Lift Arm Stops or Cylinder Locks.

CAUTION! The seat belt lock-out is not meant to prevent movement of the Lift Arm when people are under it.ALWAYS USE THE LIFT ARM STOP FOR THIS PURPOSE.

2.Remove seat, floor plate and T-Bar panel assembly.

3. Drain chain case below motor mounting hole.

4. Mark, remove and cap closed loop hoses and case drain hose from motor to be removed. Be sure to cap drive motor ports also to prevent contamination of the drive system.

   NOTE: Removal of the front drive motor is required prior to removing the rear if the hydrostatic pump has not been removed.

5a. 930 units prior to S/N 9301900, 940 units prior to S/N 9405759 and 960 units prior to S/N 9603401 have the brake system located outside of the chain case. (See figure 5-8) The drive motor is mounted to the brake housing with four (4) 1/2 inch flanged tooth lock nuts. DO NOT REUSE as the locking teeth usually do not hold after the nut has been removed.

   It may be necessary to remove one of the cover bolts from the brake housing on the opposite side of the machine to allow removal of the motor.

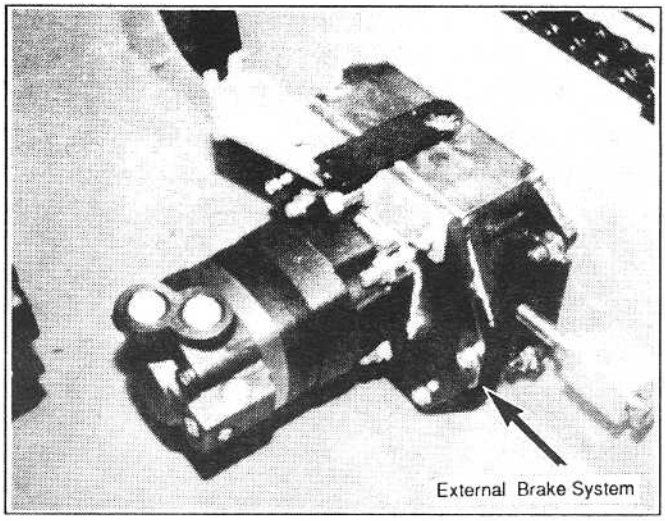


Figure 5-8

5b. 930 units after S/N 9301900, 940 units after S/N 9405795 and 960 units after S/N 9603401 have the brake system located inside the chain case. (See figure 5-9) Remove the four (4) 1/2 inch bolts from the drive motor and remove. (Removal of the brake actuating lever from the opposite side will allow more clearance for the R&R of the drive motor.) (See Brake section.)

   NOTE: The drive motor mounting surfaces are sealed with a silicone sealant. There are no gaskets or "O" rings between the drive motor and its mount.

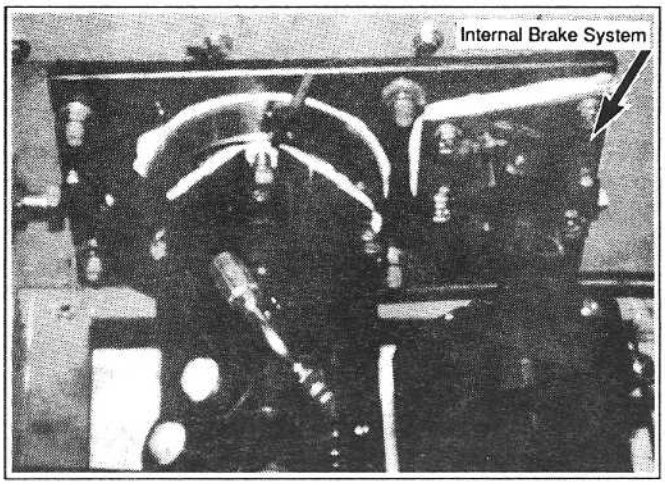


Figure 5-9

HYDROSTATIC DRIVE SYSTEM
DRIVE MOTOR
Removal and Installation (continued)

6. It is critical that all hoses and fittings be capped to prevent contamination of the drive system.
7. If the drive motor is to be reused, clean the mounting surface and apply silicone sealant to motor face before installing.
8. Install motor assembly. Install NEW flanged lock nuts and tighten evenly. Torque to 75 ft. lbs (102 Nm).
9. Remove caps and install hoses.
10. Fill chain case to level plug with Rykon #46, Mobil DTE #25 or equivalent universal hydraulic fluid.
11. Replace all other components removed and refer to the Hydrostatic Transmission Start-Up Procedures on pages 5-10.

COLD START RELIEF VALVE

Model 940 Start S/N 1432704
Model 960 Start S/N 1609408

The cold start relief valve is set at 250 PSI.

Model 940 cold start relief valve is located next to the charge filter underneath the floor plate. If you have low charge pressure and suspect the cold start relief valve, check the charge pressure as outlined on page 5-5. Remove and cap the hydraulic hose assembly that returns to the hydraulic reservoir.

Cap the cold start relief valve.

Re-check the charge pressure.

If the charge pressure returns to normal, the cold start relief valve is faulty and needs to be replaced.

Model 960 cold start relief valve is located to the right of the engine in the engine compartment. If you have low charge pressure and suspect the cold start relief valve, check the charge pressure as outlined on page 5-5. Cap the hydraulic hose assembly from the "T" fitting on the front of the double gear pump that goes to the cold start relief valve. The other hydraulic hose goes to the charge filter.

Cap the "T" fitting.

Re-check the charge pressure.

If the charge pressure returns to normal, the cold start relief valve is faulty and needs to be replaced.

CHAIN CASE
EXPLANATION

There are two separate chain cases which house the drive axles, bearings, reduction sprockets, drive chains and brakes. Power is transmitted from the hydrostatic drive system to the drive wheels by means of a double chain reduction system. The primary drive system uses a #60HK or 60SH heavy duty roller chain to transfer power from the hydrostatic drive motors, via the main input shaft, to the center reduction sprocket which is carried on a spindle shaft with tapered roller bearings. A small gear, which is part of the reduction sprocket, then drives a #80HK or 80 SH heavy duty roller chain which transmits power to the axle sprockets that are splined direct to the one piece forged axles. This makes up the secondary or final drive system. (See figure 6-1)

The primary drive chain is adjustable by moving the drive motor input shaft assembly. The secondary or final drive chain is adjustable by moving an idler sprocket. There is a disc brake system that utilizes a wet floating disc mounted on the main input shaft, and brass brake pucks enclosed in a machined housing. This brake system is designed for parking and emergency use only. Driving the machine with the brakes on will cause severe damage to the brake system in a very short time.

Both drive chain systems and the brake system are lubricated by oil bath in the enclosed chain case. Lubricating oil is separate from the hydraulic reservoir, but uses the same type of oil. Amoco Rykon #46, Mobil DTE #25 or an equivalent universal hydraulic fluid should be used.

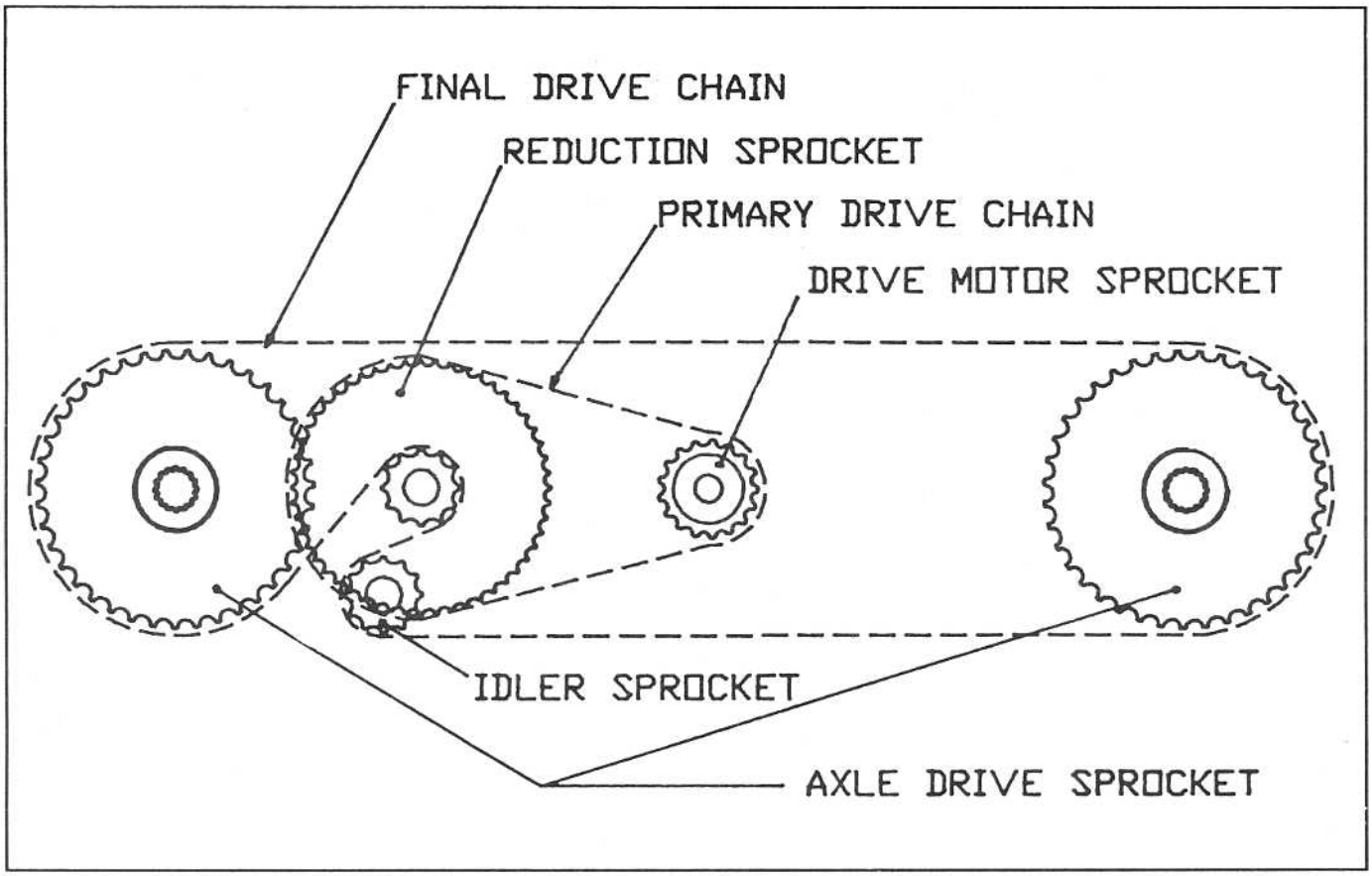


Figure 6-1

CHAIN CASE
TROUBLE SHOOTING

As the chain cases are completely separate of each other and of the hydraulic oil reservoir, a problem with a drive chain or axle bearings should be isolated to one side and to that system only.

Chain slapping, chain jumping or a sudden loss of drive power on one side after a snap or bang are signs of problems with a chain reduction system.

Both drive wheels on each side of the machine are connected to the reduction system by a large #80 chain.

The reduction sprocket is connected to the primary drive shaft and hydrostatic drive motor by the small (primary) #60 drive chain.

1. Block the machine off the ground. Attempt to turn the wheels by hand. If one wheel turns separately from the other, the final (large) drive chain has broken, or the axle sprocket spline has stripped out.
2. If the drive wheels turn together, and freely the primary (small) drive chain probably has broken.
3. Rotate one drive wheel back and forth rapidly. If you hear chain slap, the final drive chain needs adjusting.
4. If there is a lot of movement of the drive wheels without hearing chain slap, either the primary drive chain is excessively loose or there is wear between the axle drive sprocket and axle splines.
5. Movement of an axle, up and down, or in and out, indicates loose or failed axle bearings.