



# SERVICE MANUAL

## Section 6 \_\_\_\_\_ HYDRAULIC SYSTEMS

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	a. CHAR-LYNN ORBITROL SERVICE MANUAL, No. 7-204	
	b. MICO POWER BRAKE CYLINDER SERVICE MANUAL, No. 84-001-002	





## 6-1. GENERAL

This section contains functional description and overhaul instructions for the major components of the hydraulic steering, brake and bucket (implement) systems. Overhaul instructions include removal, disassembly, cleaning, inspection, reassembly and installation procedures. System and component checks and adjustment procedures are given at the beginning of this section.

Complete preventive maintenance procedures are provided in Section 2 of this manual.

Whenever feasible, the component manufacturer's service information is given as a supplement to the Eimco Service Manual.

## 6-2. SYSTEM DESIGN SPECIFICATIONS

ITEM	DESIGN DATA	ITEM	DESIGN DATA
BUCKET HYDRAULIC SYSTEM		BUCKET HYDRAULIC SYSTEM (CONT'D)	
<b>LOADER MOTION TIMES</b> (Average, All systems at Operating Temperature and Pressure, Bucket Full)		<b>Oil Filtration:</b> Suction Strainer	100 Mesh Screen
Raised to Full Lift	5.0 Seconds	Transmission Suction Filter	3 Micron Nominal
Dump	3.0 Seconds	Transmission High Pressure Line Filter	12 Micron Absolute
Lowered from Full Lift	3.0 Seconds	Oil Return Line Filter	10 Micron Nominal
To Working Position from Traveling Position	2.0 Seconds	<b>IMPLEMENT PUMP</b>	
<b>LOAD UNIT PERFORMANCE</b>		Type	Vane Type, Double Pump
Rated Load Capacity (Maximum Lifting)	7000 lbs. (3175 kg)	Shaft Rotation	Counterclockwise (As viewed from Shaft End)
SAE Ejection Bucket Capacity Rated:		Maximum Pressure	2000 PSI (138 bars)
Heaped	1.0 cu. yd. 9.78 cu m)	Flow Capacity (Bucket Circuit)	7 GPM (26.4 liters) @ 1200 RPM
Struck	22.0 cu.ft. (.62 cu m)	<b>MAIN RELIEF VALVE</b>	
<b>HYDRAULIC TANK</b>		Type	Cartridge Valve, Installed in Bucket Control Valve.
Capacity	10 Gal. (37.8 liters)	Setting	2000 PSI (138 bars)
Oil Type	Hydrostatic Transmission Fluid or ATF Type F.	<b>CYLINDER RELIEFS</b>	
		Quantity	Two, raise and rollback circuits
		Type	Cartridge valve, Installed in Bucket Control Valve
		Setting	2250 PSI (155 bars)





## 6-3. TROUBLE ANALYSIS TABLES (SHEET 1 OF 2)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
<b>STEERING SYSTEM</b>		
Steering wheel does not center	Binding in valve.	Realign.
	Broken centering springs.	Replace.
No response when steering wheel is turned slowly	Dirt in system.	Drain, flush and refill with clean oil.
	Oil level is low.	Fill to proper level.
Slow or hard steering	Dirt in system.	Drain, flush and refill.
	Wear on sleeve and spool.	Replace.
	Oil level low.	Fill to proper level.
	Trouble in pump	Check and correct.
	Trouble in lines or filter.	Check and correct.
Wrong response to steering wheel	Lines hooked up to wrong parts.	Reconnect.
	Orbit gear misaligned.	Realign.
Continuous steering wheel rotation	Dirty fluid.	Drain, flush and refill.
	Broken centering springs.	Replace.
	Burr on sleeve or spool.	Repair.
No response	Sleeve and spool locked.	Disassemble, repair or replace.
	Pump failure.	Check and correct.
	Hose or filter clogged.	Check and correct.
	Relief valve stuck.	Clean or replace
<b>BRAKE SYSTEM</b>		
No service brakes	Brake lining worn.	Replace lining.
	Brake lines plugged.	Remove restriction.
	Defective master cylinder.	Repair or replace master cylinder.
	Hydraulic lines or fittings leaking.	Check for leaks and repair.
Insufficient brakes	Oil or grease on linings.	Clean or install new lining.
	Defective master cylinder.	Repair or replace master cylinder.
	Brake lines bent or plugged.	Replace lines or remove restriction.
	Low on fluid.	Fill master cylinders





6-3. TROUBLE ANALYSIS TABLES (SHEET 2 OF 2)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
<b>BRAKE SYSTEM (CONT'D)</b>		
Brakes grab	Defective brake head and linings.	Repair or replace brake head; replace lining.
	Defective master cylinder.	Repair or replace master cylinder.
	Wet brake linings.	Dry out or replace linings.
Spongy operation	Air in lines.	Bleed lines.
Locked brakes	Park brake engaged.	Release park brake.
	Increase in temperature causing sufficient thermal expansion to prevent brakes from being unlocked.	Bleed off a few drops of brake fluid.
<b>BUCKET HYDRAULIC SYSTEM</b>		
Oil leaks at either end of spool.	Defective O-rings in valve body.	Replace O-rings.
Spring-centered spools do not return to neutral	Broken springs.	Replace springs.
	Foreign particles.	Clean system and valve.
	Misalignment of operating linkage.	Checks linkage for binding condition.
Detent type spools will not stay in detent position	worn detent.	Replace detent.
	Weak or broken detent spring.	Replace detent spring.
No motion; slow or jerky action of hydraulic system	Relief valve not properly set, or stuck in base and/or worn.	Repair, clean and adjust.
	Dirt or foreign particles lodged between relief valve control poppet and seat.	Disassemble, clean and reassemble.
	Spool not moved to full stroke.	Check travel.
No relief valve action (high pressure)	Small particle of dirt plugging orifice in relief valve subassembly.	Remove relief valve and check hole. If blocked, clear hole.
Load will not hold	Oil by-passing between spool and body.	Replace valve.
	Oil by-passing piston in cylinder.	Repair or replace cylinder.
	Spool not centered.	Refer to above spool remedies.
Load drops when spool is moved from neutral to a power position	Dirt or foreign particles lodged between check valve poppet and seat.	Disassemble, clean and reassemble.
	Scored or sticking check valve poppet.	Replace poppet.





## 6-4. CHECKS AND ADJUSTMENTS

### A. Steering System Functional Check

(1) The steering unit is specifically designed for use with automatic transmission fluid, Type F. All standard units--unless otherwise specifically ordered--have synthetic seals which are compatible with ATF-F at temperatures up to over 200°F (94°C). (See Figure 6-1).

(2) A normal periodic functional check of the entire loader power steering system will generally be adequate to ensure satisfactory service. The oil level of the hydraulic tank that supplies the system is MOST IMPORTANT. If the oil level drops appreciably over short periods of use, it will be wise to search for a leak in the system.

(3) A black accumulation of dirt at a fitting can indicate a leakage point. Before disconnecting fitting, clean off any debris from the immediate area and any dirt accumulation above the area so that contamination will not enter the system while the connection is open.

### CAUTION

**NEVER USE FLUID SYSTEM 'STOP LEAK' ADDITIVES TO ATTEMPT TO SEAL FLUID LEAKAGE. MANY GOOD POWER STEERING SYSTEMS HAVE BEEN RUINED BY SUCH ATTEMPTS.**

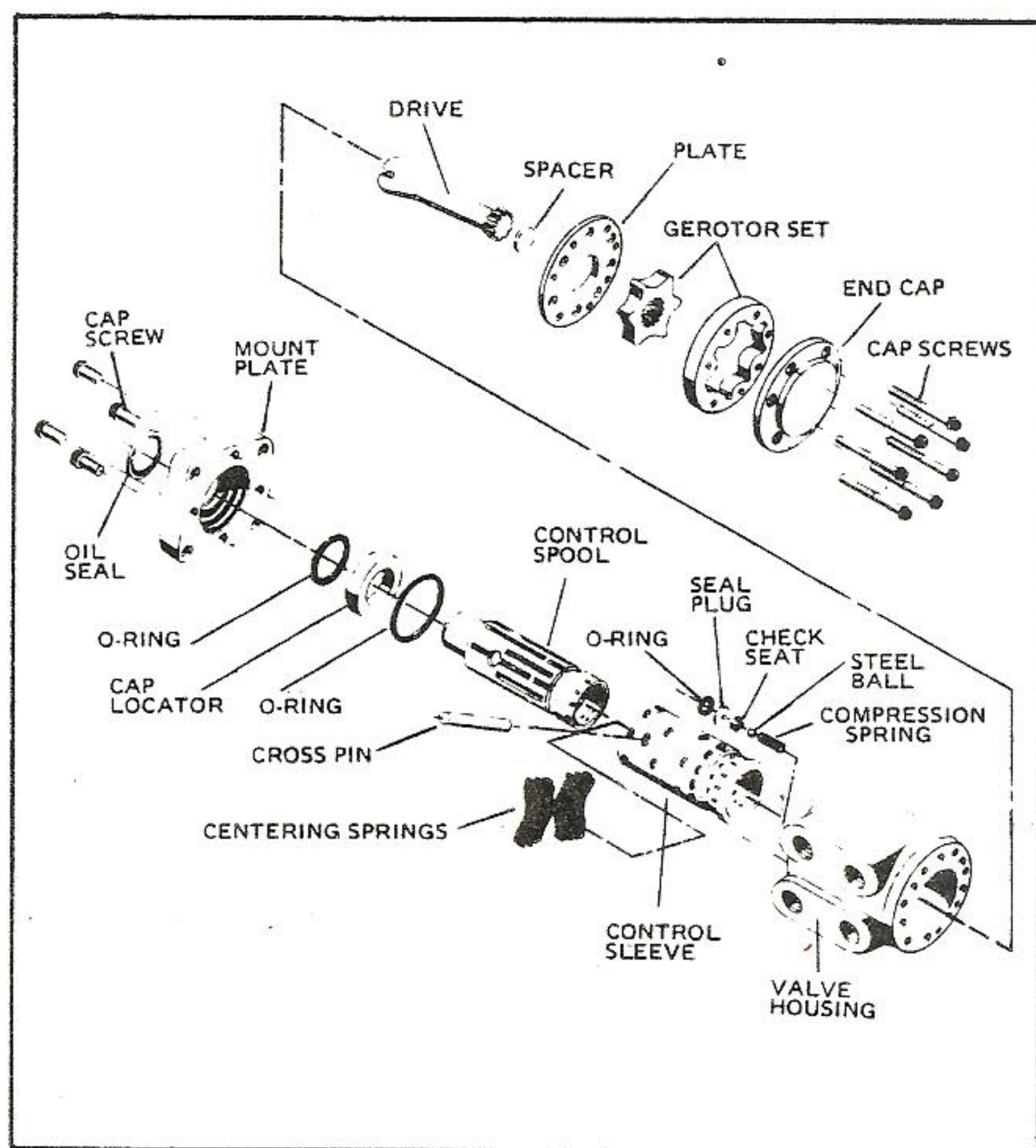


FIGURE 6 - 1. STEERING UNIT

(4) To continue the functional check of the system, turn the steering wheel through the full travel with the machine running. Do this at both engine idle and full throttle with the machine standing still, the front end on dry concrete, and the machine turning slowly. Note any speed irregularities or sticky sensation. These may indicate dirt in the fluid. If under any of these conditions the steering wheel continues to rotate when started and released, a condition known as 'motoring' exists. This may also indicate dirty fluid in the system.

(5) If dirty fluid is suspected, replace the filter element in the system. This is attached to the tank. Drain and refill the tank; turn the steering wheel through the full travel to exhaust oil from the steering unit and cylinder. Do not forcibly rotate the steering wheel if dirty fluid is suspected. Run the system briefly, recheck and refill as necessary to maintain proper fluid level. Operate the system for a short time to determine whether the problem has been corrected. It is sometimes less costly to rinse and reclean the system twice than to completely tear down and reassemble a unit and the clean fluid will definitely protect all of the components of the system.

(6) If there is an indication of "hard steering", this can indicate either a reduced oil flow to the control or a reduced system relief pressure. Adequate oil flow under all conditions can best be checked by timing the full travel of the cylinder with the bucket unloaded and loaded. If there is a great difference at low engine speed and a slight difference at high engine speed, this may indicate a defective pump drive. Adequate oil pressure can only be determined by connecting a pressure gauge (2000 PSI full scale recommended) at the pump outlet port or at the "IN" port of the steering unit. With the engine running at a medium speed, turn the steering wheel to one end of the travel and hold the cylinder at the travel limit briefly - just long enough to read the pressure gauge. Never hold a system at relief pressure for more than a few seconds at a time. Longer operation at relief pressure can over heat most systems quite rapidly. The pressure relief valve is a protection for all of the various parts of the steering system. There is no pressure relief in the steering unit. The relief valve, located in the steering pump cover, should not have to be readjusted once it is adjusted correctly. Adding shims to the relief valve plug will raise the system pressure. Removing shims will lower the system pressure.

(7) If the system is reported to operate extremely hot, connect a pressure gauge as above and operate the engine at near full throttle. Ro-





tate the steering wheel slowly in each direction and bring the wheel to the position that shows the lowest pressure reading. This places the control section of the unit in neutral. Then turn the steering wheel to a limit stop and hold it there for one to two seconds. Release the steering wheel gently and watch the gauge. If the pressure does not drop to very nearly the same neutral pressure as measured when placing the control in neutral deliberately, a binding control shaft or dirt between the spool and sleeve of the steering unit can be the cause of difficulty.

(8) If the recentering characteristic as measured above is erratic and if the control feels slightly sticky through most of the travel, connect the pressure gauge in the "OUT" line of the steering gear. This return line pressure should be below 30 PSI (2 bars) during all periods of normal operation. Check this "downstream" line to ensure that no fittings are obstructed. A higher return line pressure may indicate that the filter needs replacing.

#### **B. Brake System Bleeding Instructions**

(1) All brakes are fitted with bleeder valves which seal securely when turned in tight, but will allow air or fluid to pass out through the hole in the nipple end of the valve when loosened. Check all fluid line connections before bleeding and check frequently to see that the fluid level in the master cylinder reservoir is well up at all times. Add hydraulic brake fluid as necessary. Proceed as follows:

#### **NOTE**

**THE FRONT BRAKE SYSTEM AND REAR BRAKE SYSTEM ARE INDEPENDANT OF EACH OTHER AND MUST BE BLED INDIVIDUALLY. BOTH SYSTEMS ARE OPERATED BY A COMMON BRAKE PEDAL.**

(a) Disconnect the master cylinder of the rear brake system at the brake pedal pivot point.

(b) Remove the cap from the reservoir of the front brake system master cylinder.

(c) Attach a flexible bleeder tube to the nipple of the front brake bleeder valve. Place the other end of the tube in a jar containing a small portion of clean fluid. The end of the tube must be below the surface of the fluid to prevent ingestion of air. Loosen the valve one turn.

(d) Depress the brake pedal slowly. Observe air bubbles rising in the fluid as the air is expelled.

(e) Repeat step (d) above until all air bubbles disappear and only fluid escapes, indicating that no more air is left in the brake

system. Check the reservoir fluid level to avoid accidentally pumping air into the line at the master cylinder.

(f) Tighten the bleeder valve as the pedal is being depressed. Check the system carefully for leaks.

#### **NOTE**

**TO ASSIST THE BLEEDING OPERATION, A RAWHIDE Mallet MAY BE USED TO TAP THE CALIPER WHILE FLUID IS FLOWING.**

#### **CAUTION**

**DO NOT POUR ANY OF THE PURGED FLUID BACK INTO THE RESERVOIR SINCE IT IS AERATED AND THE AIR TRAPPED WITHIN IT WILL AGAIN ENTER THE SYSTEM. DO NOT PERFORM THE BLEEDING OPERATION WITH A CALIPER REMOVED FROM THE DISC.**

(g) Reconnect the rear brake master cylinder.

(h) Fill the reservoir to within 1/8 inch (3 mm) from the top and securely replace the cap.

(i) Repeat the above procedures with the opposite master cylinder to bleed the rear brake system.

### **6-5. SYSTEM DESCRIPTIONS**

#### **A. Steering System**

##### **(1) Physical Description (See Figure 6-2 and 6-6)**

The steering system is a hydrostatic system consisting primarily of a steering control unit, steering cylinder, nonsteerable axle assembly and a power steering pressure relief valve located in the end of the implement pump.

##### **(2) System Operation (See Figure 6-3 thru 6-5)**

(a) A pressure relief valve is used to protect all of the various parts of the steering system. The relief valve should open at 1750 PSI (121 bars).

(b) Oil necessary for the operation of the steering system is drawn from the hydraulic tank by a double vane type pump. Power supply fluid from the pump is delivered to the "IN" port of the steering unit assembly. Entering this, it closes the check valve and flows through the neutral control passages in the sleeve and spool to the interior of the spool, and primarily through this to the control end fluid passage from which it is returned to the "OUT" port for return directly back to the hydraulic tank. This system carries the fluid through the control elements at a very low pressure drop in this condition. (See Figure 6-4.)



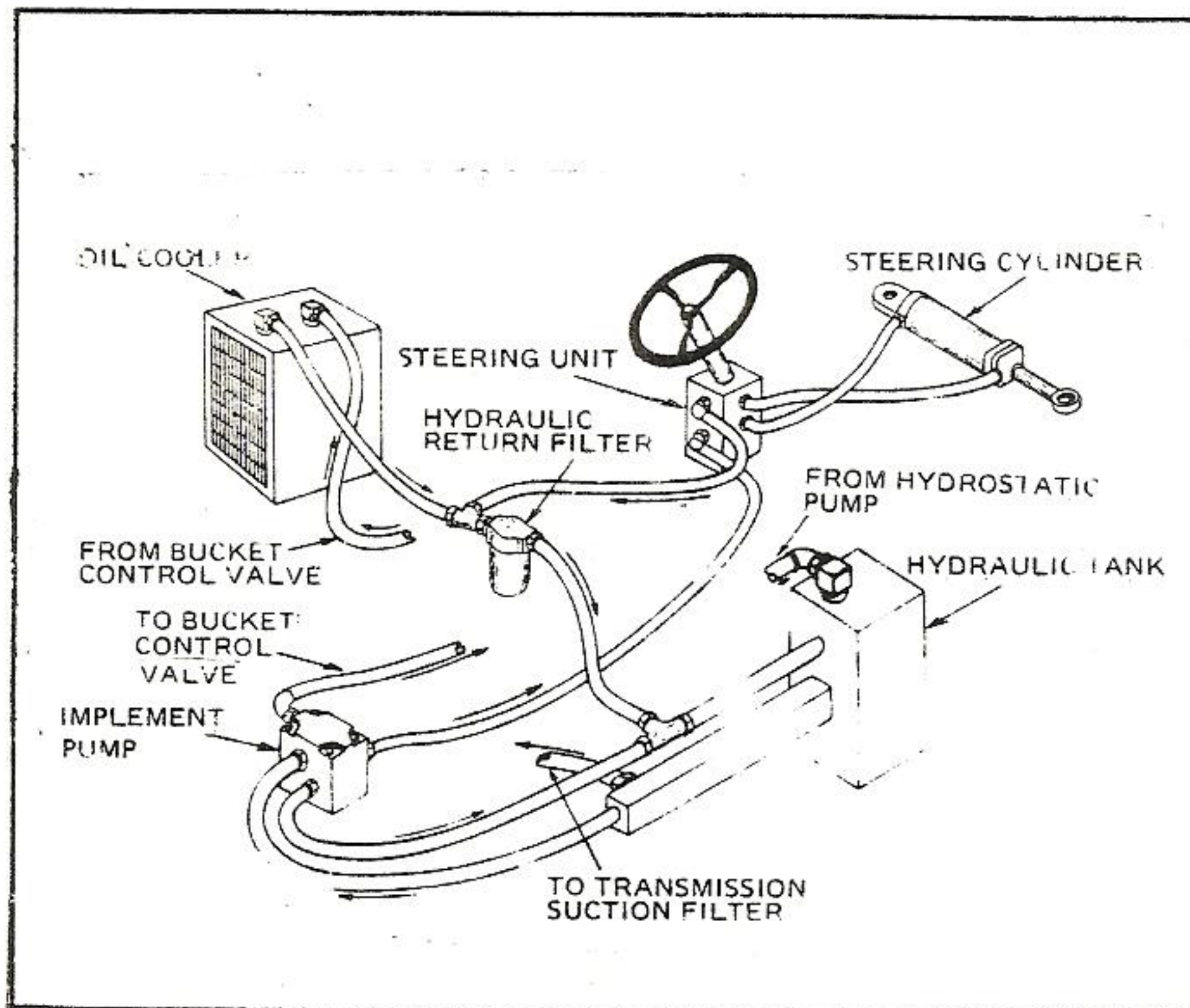


FIGURE 6 - 2. STEERING SYSTEM

(c) When steering action is initiated by rotation of the steering wheel, the control spool is rotated by direct connection from the input shaft. Since the control sleeve is maintained in relative position by engagement through the drive with the meter gear star, the spool action closes the neutral porting while opening ports directing fluid feed to the meter section of the unit. The fluid displaced by the meter is then ported to feed the proper actuator control port. In this action the alternate actuator port is simultaneously coupled to return displaced steering actuator fluid to the hydraulic tank.

(d) Figure 6-5 shows the fluid path for a right or left turn at full input deflection. This occurs when steering at a rapid rate equivalent to displacement of the power supply GPM. For slower steering speeds when only a part of the fluid supplied is required for steering, partial valve deflection allows only that volume demanded by the meter section to be delivered to the steering cylinder and the balance is returned to the tank port.

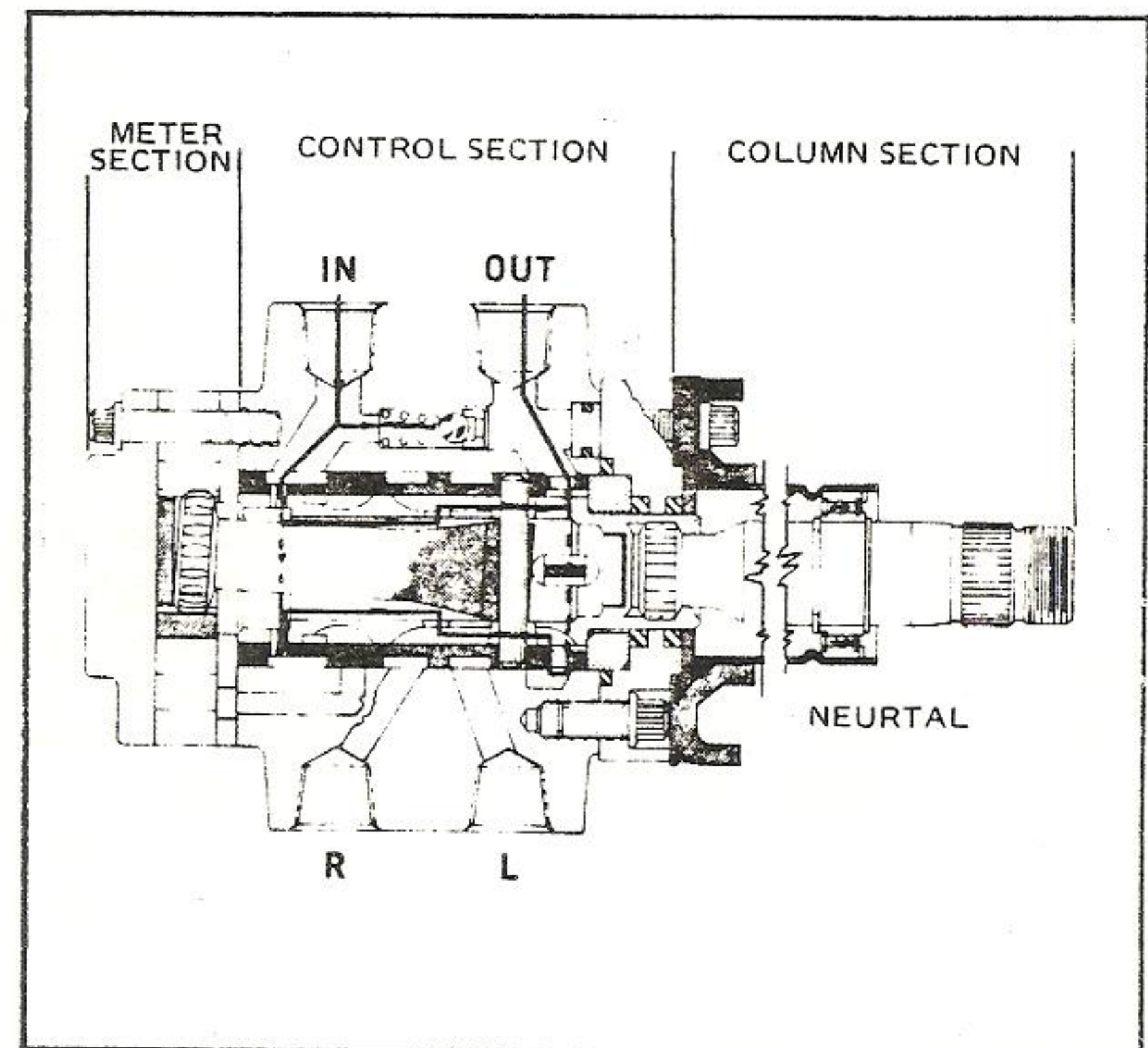


FIGURE 6 - 4. STEERING UNIT (NEUTRAL POSITION)

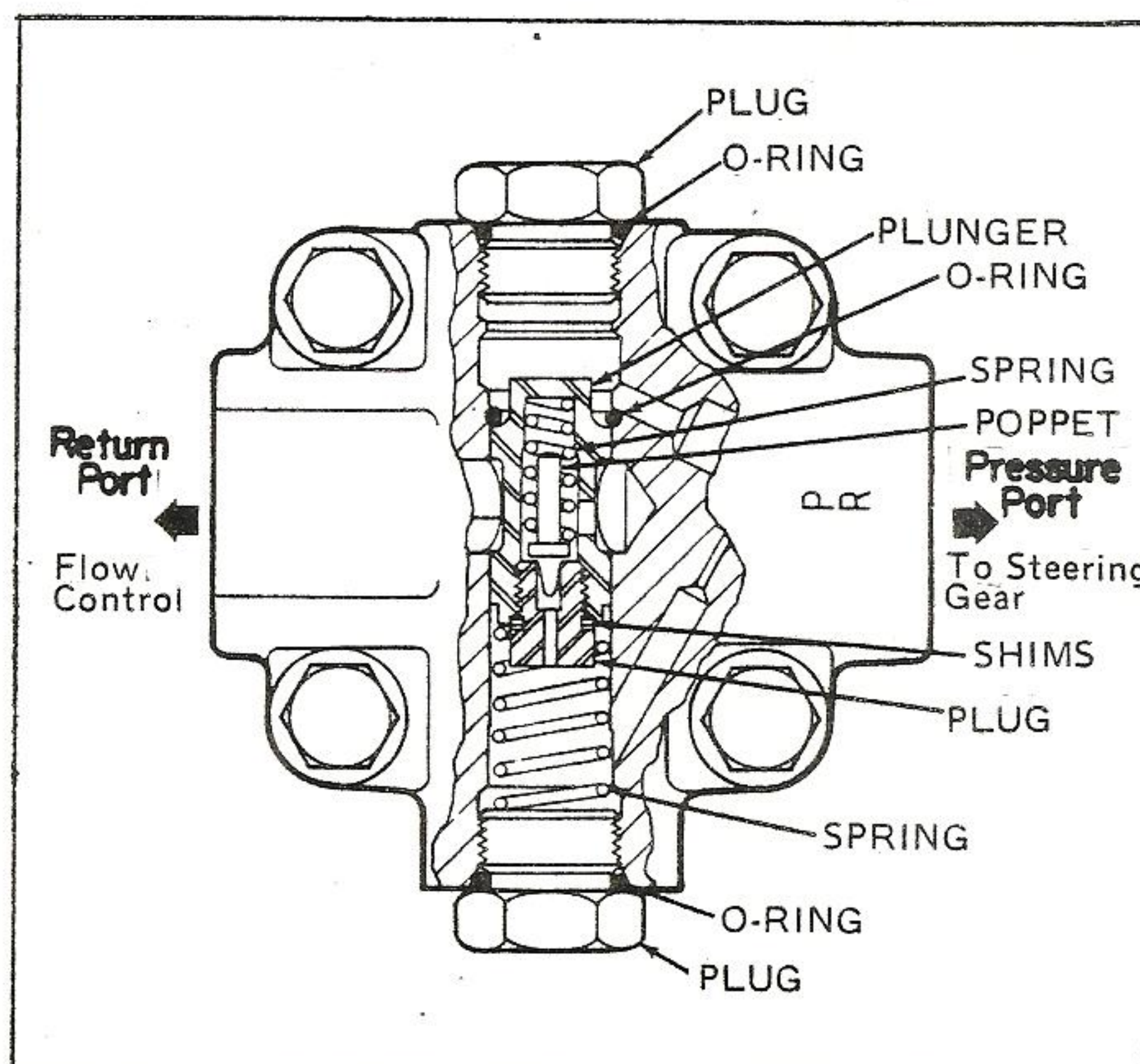


FIGURE 6 - 3. CROSS SECTION OF STEERING SYSTEM RELIEF VALVE (LOCATED IN IMPLEMENT PUMP)

(e) While measuring fluid for steering, the meter gear star is in motion. This motion is fed back within the unit to reposition the control sleeve and provide the continuous rotary follow-up action of the steering wheel. The direct action coupling of the steering wheel shaft to the primary control valve and the direct fluid line connections to the steering cylinder offer an optimum opportunity to reduce total system looseness to a minimum.

(f) In the event of engine failure, the steering control unit automatically reverts to a manual steering control. In this condition, the fluid metering section becomes a rotary hand pump and directs fluid to move the cylinder in either direction when the steering wheel is manually rotated. A check valve within the unit allows recirculation of the fluid within the remote system.



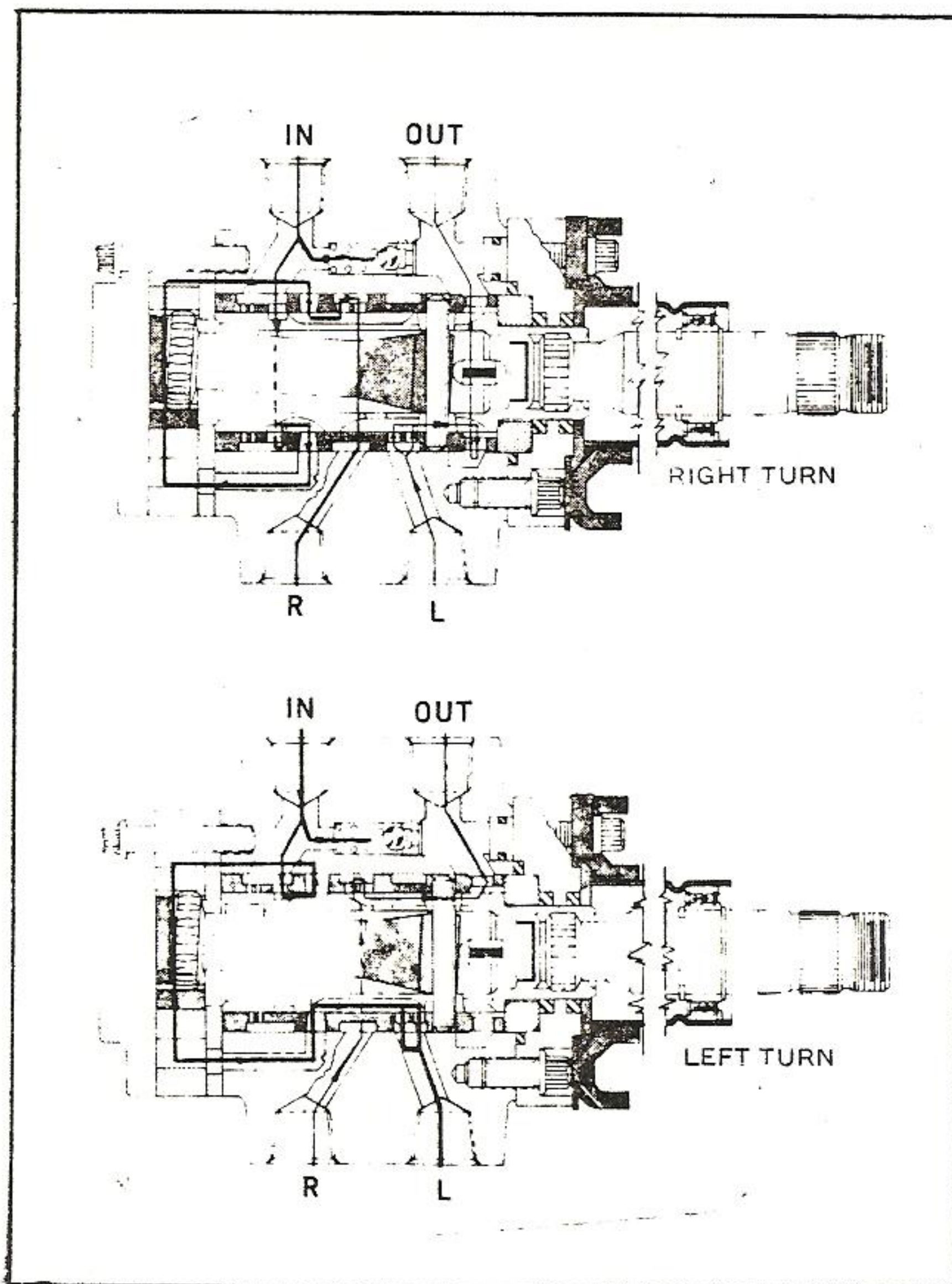


FIGURE 6 - 5. STEERING UNIT (RIGHT AND LEFT TURN POSITION)

## B. Brake System (See Figures 6-7 and 6-8)

### (1) Physical Description

(a) The brake System is an automotive type hydraulic system consisting primarily of a foot brake pedal, two master cylinders and 4 disc brake caliper assemblies.

(b) The disc brake caliper assemblies are located on each end of the drive axles.

### (2) System Operation

(a) Depressing the foot brake pedal actuates the master cylinders, which in turn, exert hydraulic force on the disc brake cylinder and applies pressure against the disc. (Refer to Subsection 6-12).

(b) When the foot brake pedal is completely releases, fluid is at master cylinder pressure throughout the brake system.

## C. Bucket Hydraulic System (See Figure 6-9)

### (1) Physical Description

(a) The bucket hydraulic system controls the action of the bucket. The system consists of a hydraulic tank, implement pump,

control valve, lift cylinder, dump cylinder, return cooler and a oil filter. The system is controlled by two control levers on the right of the operator's compartment. The left control lever controls the digging and dumping action of the bucket. The right control lever controls the vertical movements of the bucket and arms.

(b) When all the controls are in neutral, oil is drawn from the tank through a suction screen by the implement pump. (The inner section of the double pump supplies oil for the hydraulic system and the outer section delivers oil to the steering system.) When the controls are in neutral, oil is circulated through a center passage of the control valve and then returns to the hydraulic tank through a return cooler and filter. All oil for the hydraulic and steering system passes through the same return filter.

### (2) System Operation

(a) Hydraulic Tank. The hydraulic tank is located at the right forward corner of the engine end frame. It contains oil which is used in the hydraulic system, steering system, and the hydrostatic transmission system. A baffle in the lower part of the tank divides the tank into two compartments. An oil level sight glass is located on the front of the tank in the upper right hand corner. The sight glass is above the inner baffle and shows the oil level for both compartments. The tank capacity is 10 gallons (37.8 liters). Incorporated in the tank is a suction screen for the hydraulic and steering system, and an air pressure relief valve. The relief valve opens at approximately 7 PSI (0.4 bars) to allow excessive pressure to escape. It is also designed to admit air into the tank whenever a vacuum develops. Air pressure should be released whenever any of the hydraulic systems are being worked on. To release the air pressure from the tank, Push the red button on the filler cap.

(b) Implement Pump. (See Figures 6-11 & 6-12.) The implement pump is a vane type double pump. The outer pump section supplies oil for the steering system and the shaft end section supplies oil to the bucket hydraulic system.

The pump consists principally of a flow control cover (contains steering system relief valve), pressure plates, inlet body, outlet body, drive shaft, and two pump cartridges. The components of the pump cartridges are: elliptical ring, rotor, vanes fitted to the rotor slots, and O-rings.

1. Principles of Operation. The flow is developed in the pumping cartridge. The action of this cartridge is illustrated in



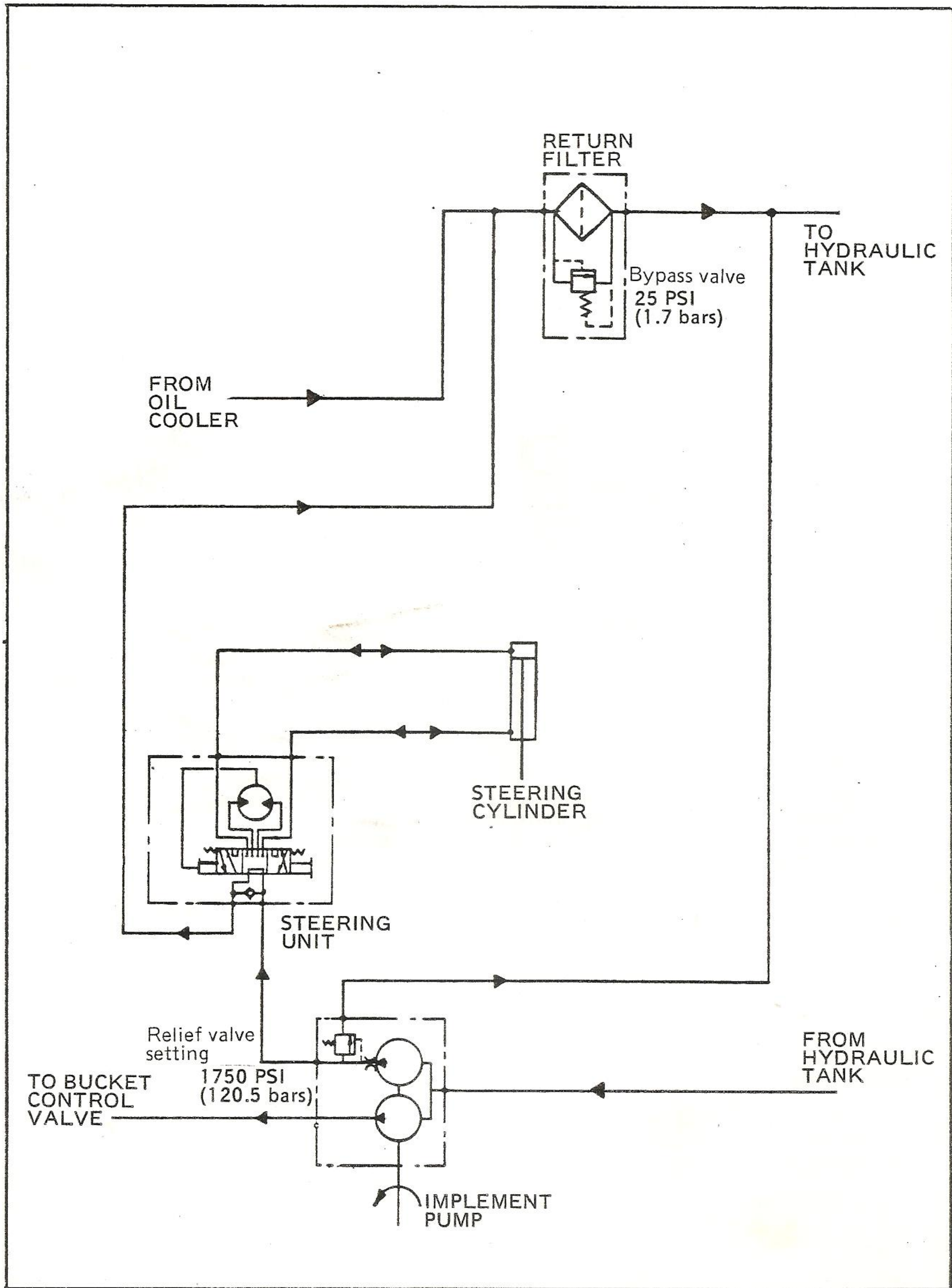


FIGURE 6 - 6. STEERING SYSTEM HYDRAULIC SCHEMATIC



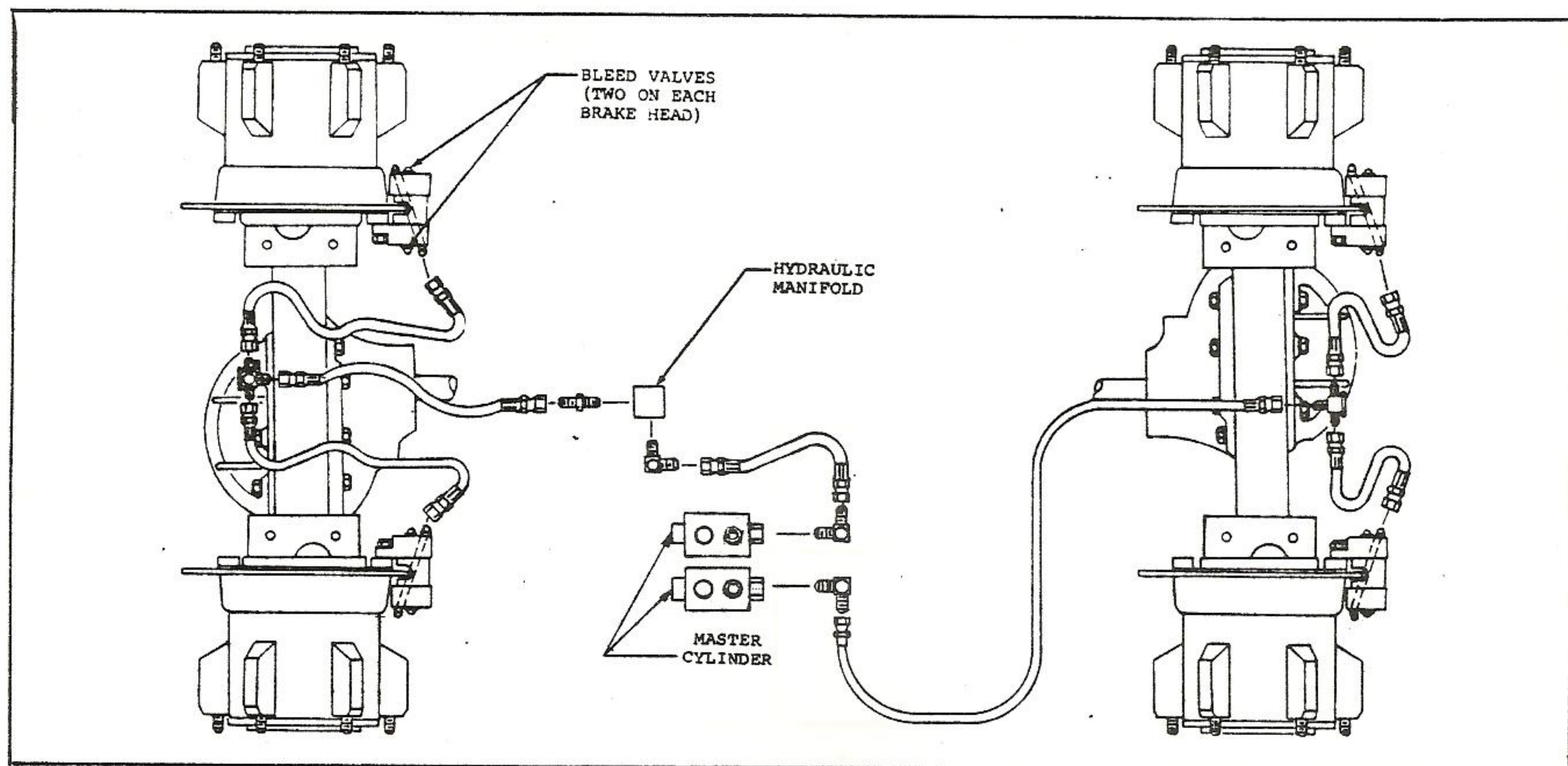


FIGURE 6 - 7. BRAKE SYSTEM

Figure 6-11. The rotor is rotated inside the elliptical ring by the drive shaft, which is coupled to the pump drive. As the rotor turns, centrifugal force on the vanes force them to follow the elliptical inner surface of the ring. The ring is shaped so two opposing pump chambers are formed. A pocket is created between the adjoining vanes, pressure plate, ring, and inlet body. As the vanes are rotated past the inlet chamber, oil is picked up by these pockets and is carried over to the outlet chamber. Because of the cam shaped internal surface of the cam ring, the pockets decrease in size and force the oil out into the system.

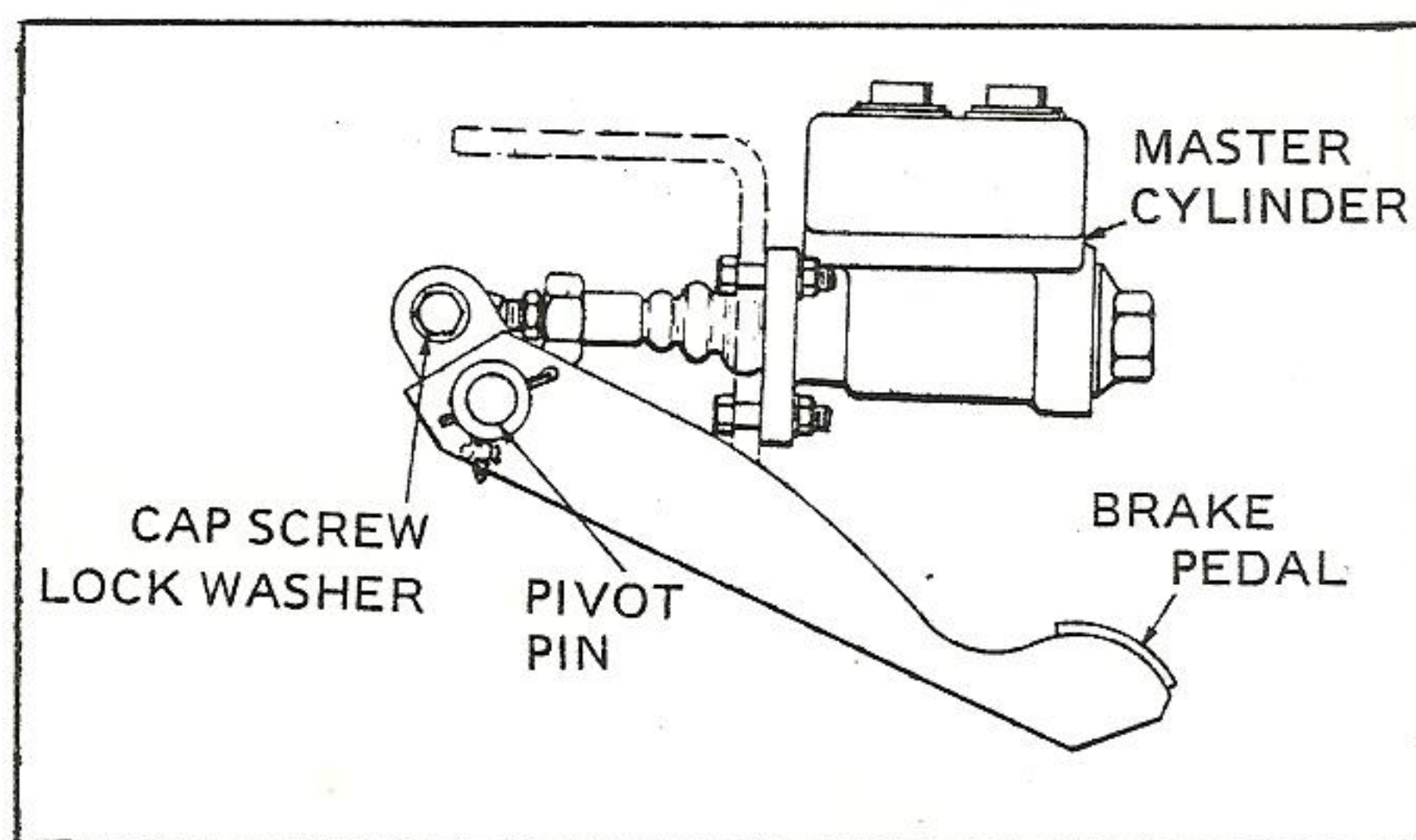


FIGURE 6 - 8. HYDRAULIC BRAKE CYLINDER ASSEMBLY

2. Flow Control and Steering System Relief Valve. Maximum delivery and maximum system pressure for the steer-

ing system are determined by the integral flow control and relief valve in the outer cover. The relief valve controls the steering pressure at 1750 PSI (121 bars).

The flow control feature is never used because it has an 8 GPM orifice and the maximum output capacity of the steering pump section never exceeds 8 GPM.

#### NOTE

THE INNER PUMP SECTION FOR THE BUCKET HYDRAULIC SYSTEM DELIVERS 7 GPM (26.4 LITERS/MIN.) @ 1200 RPM AND THE RELIEF VALVE FOR THIS SYSTEM IS LOCATED IN THE CONTROL VALVE.

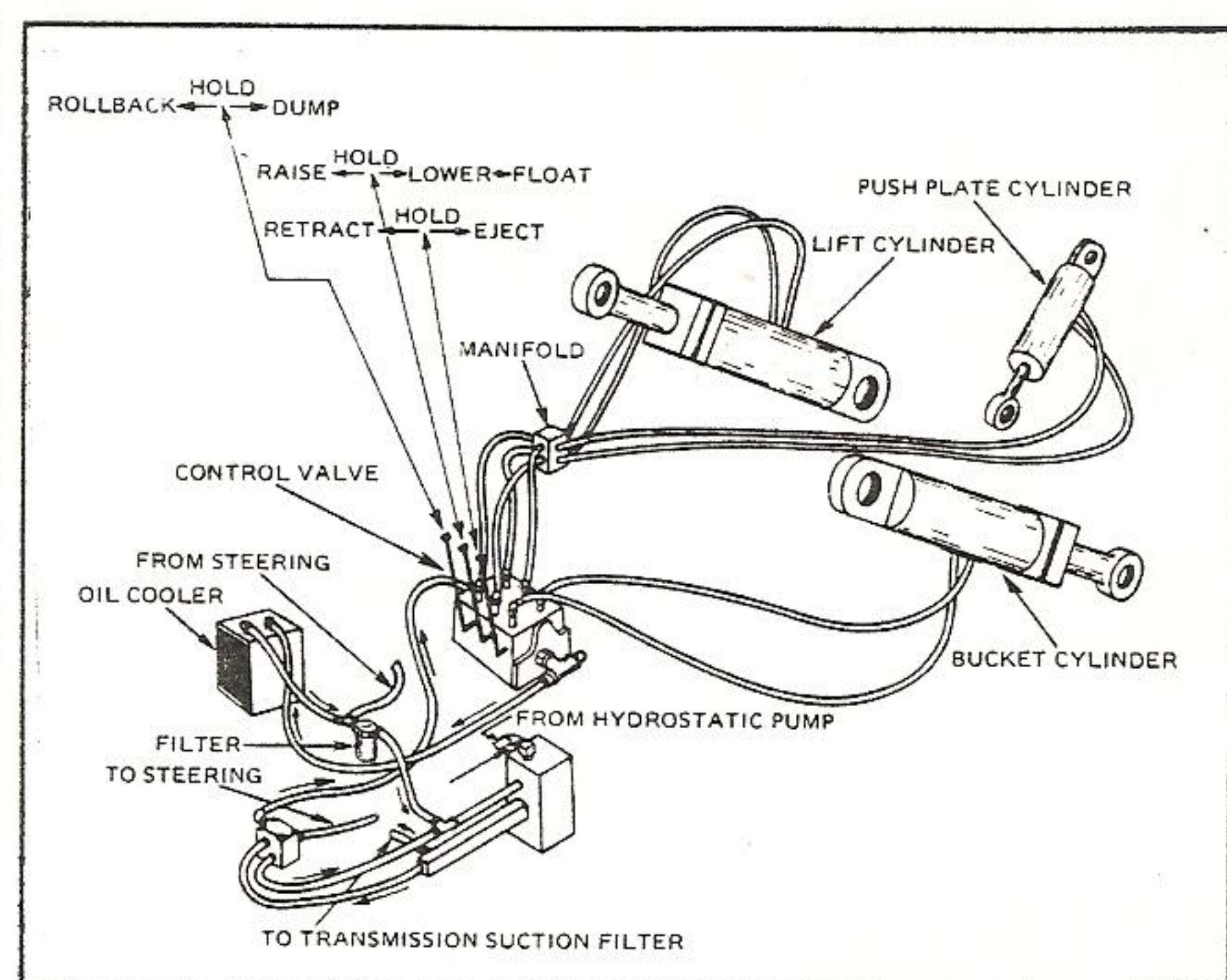


FIGURE 6 - 9. BUCKET HYDRAULIC SYSTEM (PUSH-PLATE SYSTEM IS OPTIONAL)



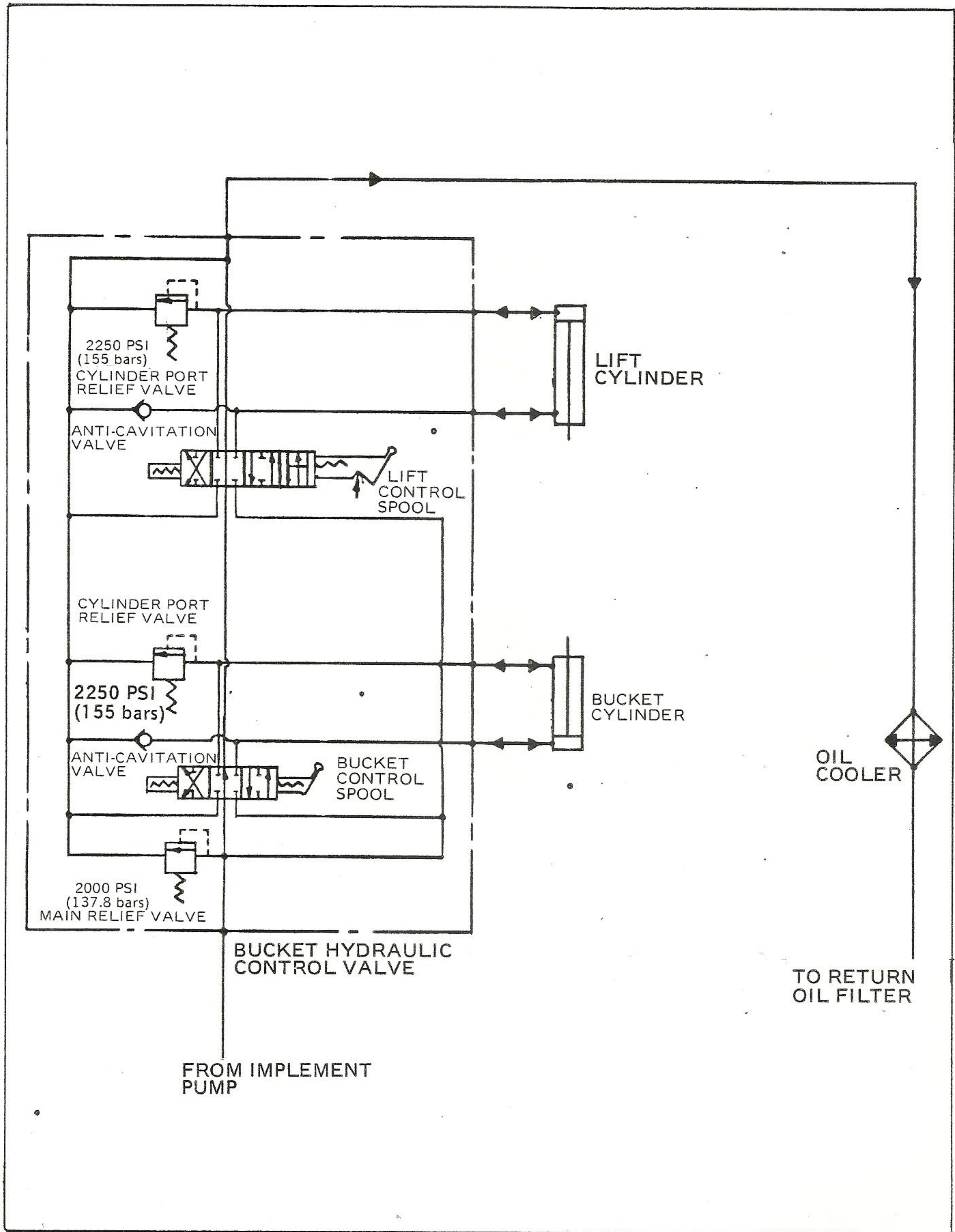


FIGURE 6-10. BUCKET HYDRAULIC SYSTEM SCHEMATIC



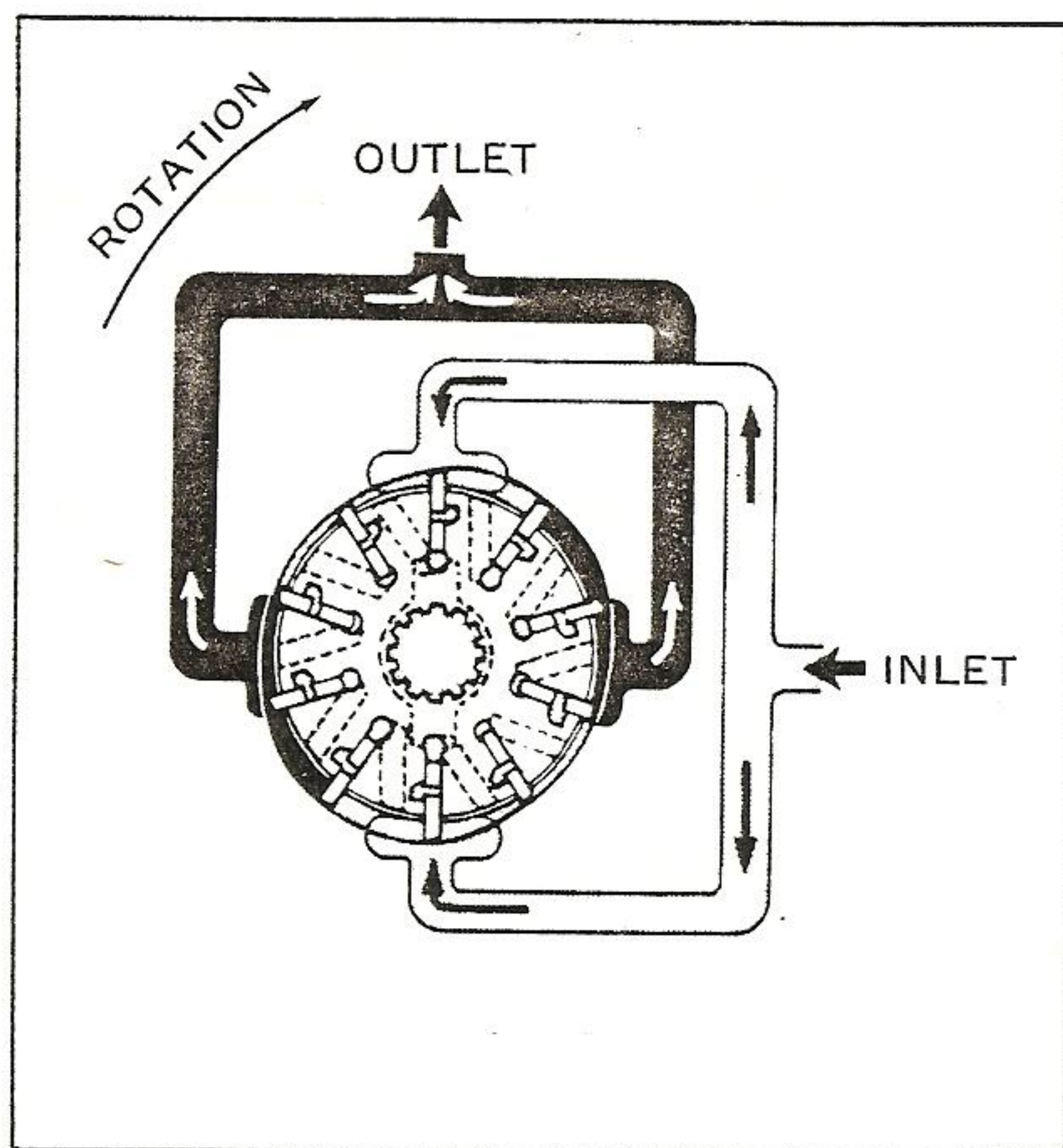


FIGURE 6 - 11. ACTION OF THE CARTRIDGE

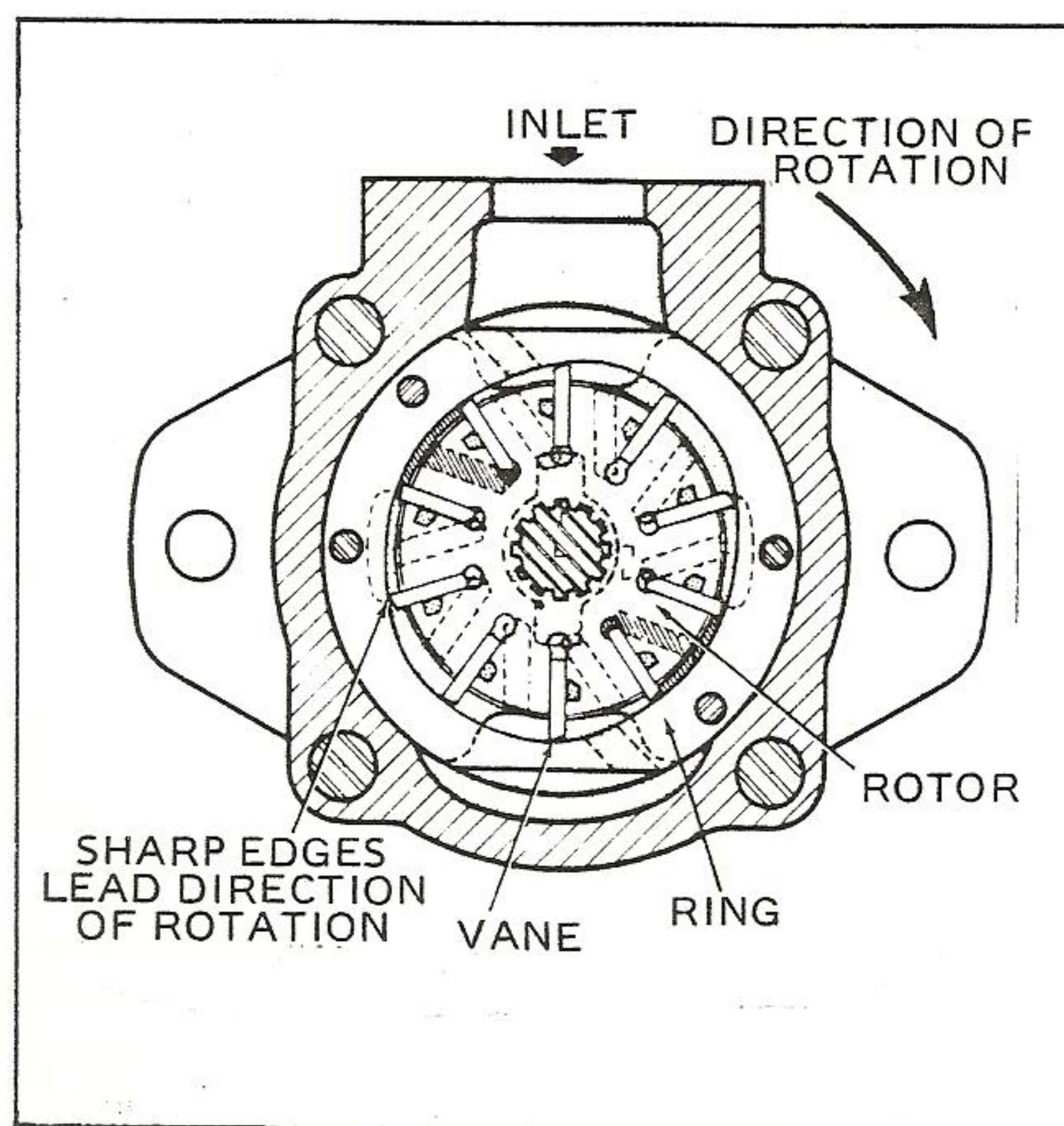


FIGURE 6 - 12. CORRECT VANE INSTALLATION

## 6-6. HYDRAULIC PUMPS

### A. Implement Pump Removal

- (1) Park the machine with the motor end and bucket end in line.
- (2) Open the engine hood and access door.
- (3) Remove the cap screws that attach the right side cover to the engine compartment and remove the cover.
- (4) Push the button on the hydraulic tank filler cap to deplete the hydraulic pressure.
- (5) Work through the access door opening and the right side cover opening to disconnect the implement pump.
- (6) Disconnect the hydraulic line to the bucket control valve, steering unit, pressure relief return line and the suction line from the implement pump.

### CAUTION

TAG AND CAP ALL DISCONNECTED HYDRAULIC LINES FOR PROPER REASSEMBLY.

- (7) Remove the two cap screws that attach the implement pump to the pump drive housing and remove the pump from the engine compartment.

### B. Implement Pump Disassembly (See Figure 6-13)

### CAUTION

BEFORE REMOVING UNIT OR PARTS OF UNIT TO BE SERVICED BE CERTAIN THE UNIT IS NOT SUBJECT TO HYDRAULIC PRESSURE.

### NOTE

DO NOT DISASSEMBLE A PUMP FURTHER THAN IS NECESSARY TO CORRECT A MALFUNCTION. DURING DISASSEMBLY, SPECIAL ATTENTION SHOULD BE GIVEN TO IDENTIFICATION OF PARTS FOR PROPER REASSEMBLY. THIS IS ESPECIALLY IMPORTANT IN RETURNING CARTRIDGE PARTS TO THEIR PROPER RELATIONSHIP IN ROTATION. PLACE ALL DISASSEMBLED PARTS ON A CLEAN, LINT-FREE SURFACE FOR INSPECTION. CAREFULLY CLEAN ALL PARTS EXCEPT "O" RING SEALS IN A CLEAN MINERAL OIL SOLVENT. AFTER DRYING THOROUGHLY, LAY THE PARTS ON A CLEAN, LINT-FREE SURFACE. ALL INTERNAL OIL PASSAGES OF THE PUMP COVER, HOUSING AND BODY MUST BE THOROUGHLY CLEANED.





## CAUTION

NEVER USE AN AIR HOSE ON OR NEAR THE EXPOSED PARTS BECAUSE OF THE PRESENCE OF WATER AND DIRT IN THE AIR SYSTEM. ALL "O" RINGS, BACK-UP RINGS AND THE SHAFT SEAL SHOULD BE REPLACED FOR REASSEMBLY. ALL SEALS SHOULD BE SOAKED IN HYDRAULIC FLUID BEFORE BEING USED.

- (1) Place pump in a machinist's vise, being certain to use protective jaws. Clamp vise on flats of mounting flange to prevent damage to body. Remove key from shaft.
- (2) Remove four cap screws that secure the outlet cover to the body sub-assembly. Remove cover and spring. Note position of outlet port of the cover with reference to inlet port of the body subassembly before removal so cover may be returned to its proper position at reassembly.
- (3) Remove O-ring, pressure plate and spring.
- (4) Remove ring from outside diameter of cartridge, then remove the cartridge.
- (5) Remove the four cap screws that connect the body sub-assembly of the pump to the inner body and separate the two parts.
- (6) Lift cartridge from shaft by rotating shaft to break cartridge free.
- (7) Remove O-rings and back-up ring from hub and outside diameter of cartridge.
- (8) Remove lock ring by engaging a small screwdriver in a slot. Remove shaft and bearing assembly. Be certain that key has been removed from shaft to prevent damage to seal. Rotate shaft with bearing held in hand. Check for roughness and excessive wear in bearing. If in doubt, always replace bearing.
- (9) Inspect oil seal surfaces on shaft for scoring. Inspect splined areas and bushing areas for wear and scoring. If bearing or shaft is to be replaced, remove snap ring and remove bearing from the shaft in an arbor press. Be certain to support inner race of bearing when pressing new bearing on shaft or bearing may be damaged. Install snap ring.
- (10) Remove bearing and shaft seal spacer. Drive out shaft seal and wiper from outer side of body.

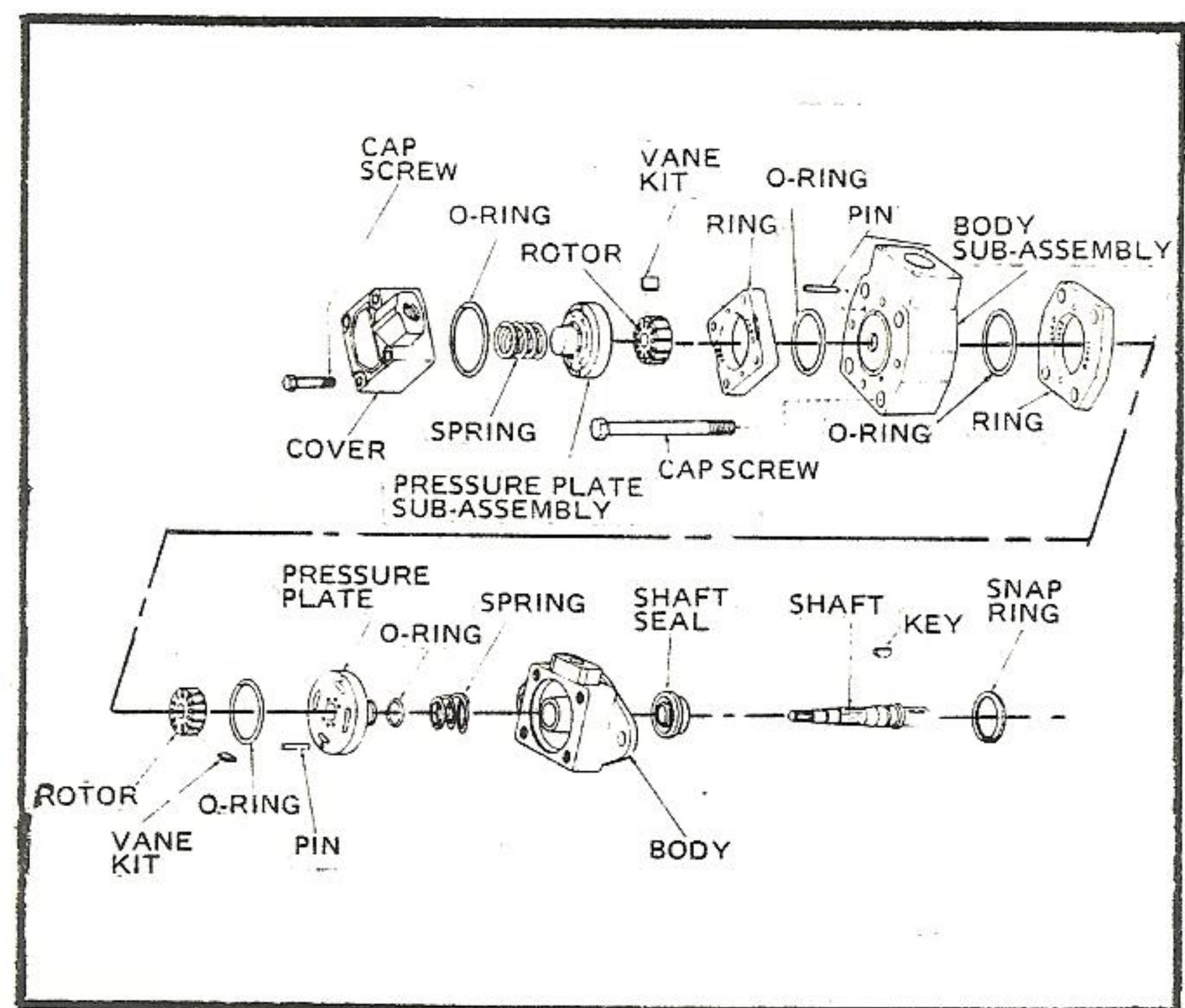


FIGURE 6 - 13. HYDRAULIC IMPLEMENT PUMP

## C. Reassembly

### NOTE

IMMERSE ALL PARTS IN CLEAN HYDRAULIC OIL TO FACILITATE REASSEMBLY AND PROVIDE INITIAL LUBRICATION.

- (1) Install a new shaft seal and felt wiper. Soak wiper and seal in hydraulic oil before installing.
- (2) Install spacer. (Replace if worn or scored by a damaged bearing). Lubricate the shaft oil seal surfaces with petroleum jelly or grease. Be certain to lubricate chamfered edge of shaft. With tape around end of shaft to protect seal, install shaft and bearing. The assembly should be pressed by hand, but light tapping with a plastic headed, chip-free hammer may be necessary. Do not use excessive force. If gentle seating can not be accomplished, check for improper seating of the wiper, seal and spacer.
- (3) Install lock ring to secure bearing assembly. Install back-up ring and "O" ring on hub of cartridge pressure plate. Back-up ring must be on the bearing side.
- (4) Install "O" ring in shaft and body. Install large back-up ring and "O" ring on cartridge. Back-up ring must face inlet housing of pump.





(5) Carefully install shaft end cartridge in body so the inlet sectors of cartridge line up with inlet housing ports and the locating pins engage in mating holes. Tighten the four cap screw snugly. Tighten to 80 ft.-lbs. (11 kg-m).

(6) Be certain that inlet housing mating surfaces are free of nicks and scoring. Install inlet housing so that shaft end outlet is in the desired position. Make certain that cartridge locating pins engage mating holes in inlet housing.

(7) Install straight vane cover end cartridge. Make certain the locating pins engage mating holes in inlet housing. Install back-up ring on cartridge facing toward inlet housing. Install "O" ring. With spring in outlet cover, install "O" ring in outlet cover. Use light grease to hold it in place. Install cover in desired position and hold firmly in place to prevent "O" rings and back-up rings from slipping out of place. Tighten the four cap screws snugly. Tighten to 40 lbs.-ft. (6 kg-m). Rotate shaft by hand to check for free rotation.

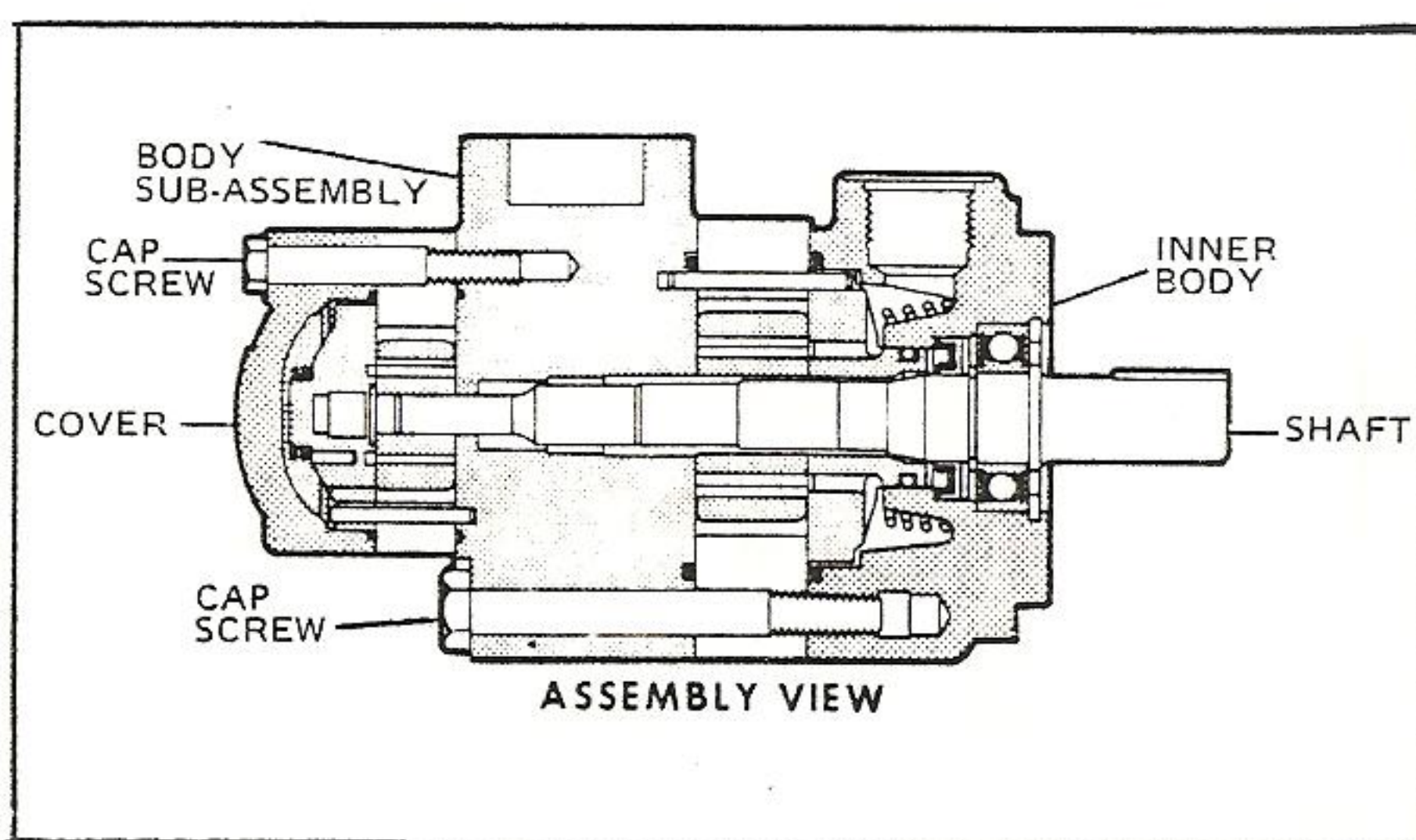


FIGURE 6 - 14. IMPLEMENT PUMP

(8) A pilot diameter on the mounting flange of the pump (See Figure 6-15) assures correct mounting and shaft alignment. The pilot must be firmly seated in the accessory pad of the pump housing.

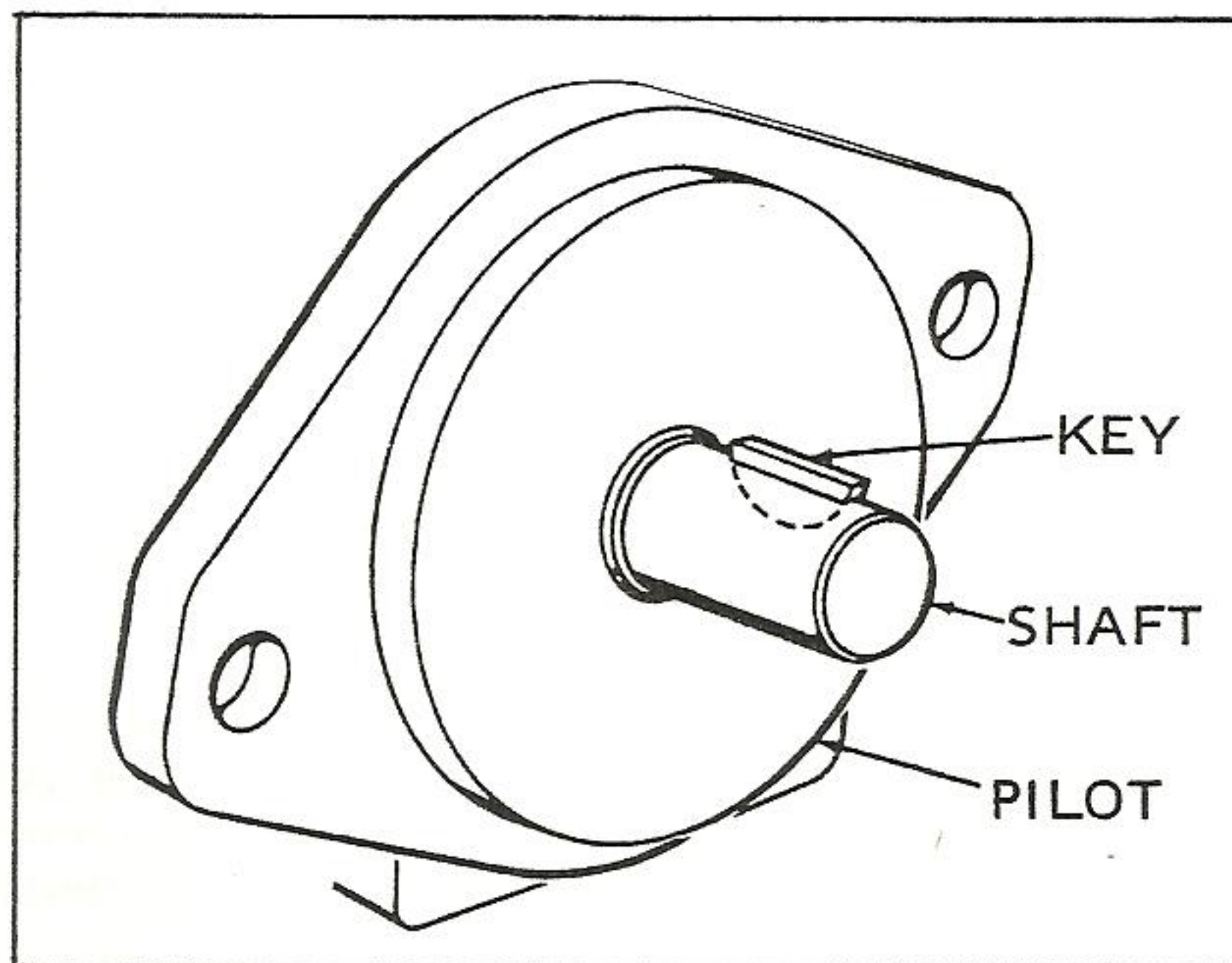


FIGURE 6 - 15. PUMP MOUNTING FLANGE

(9) Before installing the pump to the pump housing, lubricate pump shaft with cup grease.

(10) Use a light grease to hold the O-ring on the pilot diameter of the mounting flange before installing pump.

(11) Be sure key is properly seated on the pump shaft to avoid slippage and possible shearing.

(12) Care should be exercised to be certain all flange screws are tightened evenly to prevent misalignment of shaft connections.

(13) Reconnect the suction, steering and bucket valve lines to the pump.

## 6-7. STEERING UNIT

### A. Removal (See Figure 6-15)

(1) Relieve the air pressure in the hydraulic tank by removing the filler cap.

(2) Remove the steering wheel nut.

(3) Pull the steering wheel with a wheel puller.

(4) Disconnect, tag and cap the four hoses from the steering unit.

(5) Remove the four cap screws that hold the steering unit bracket to the machine structure.

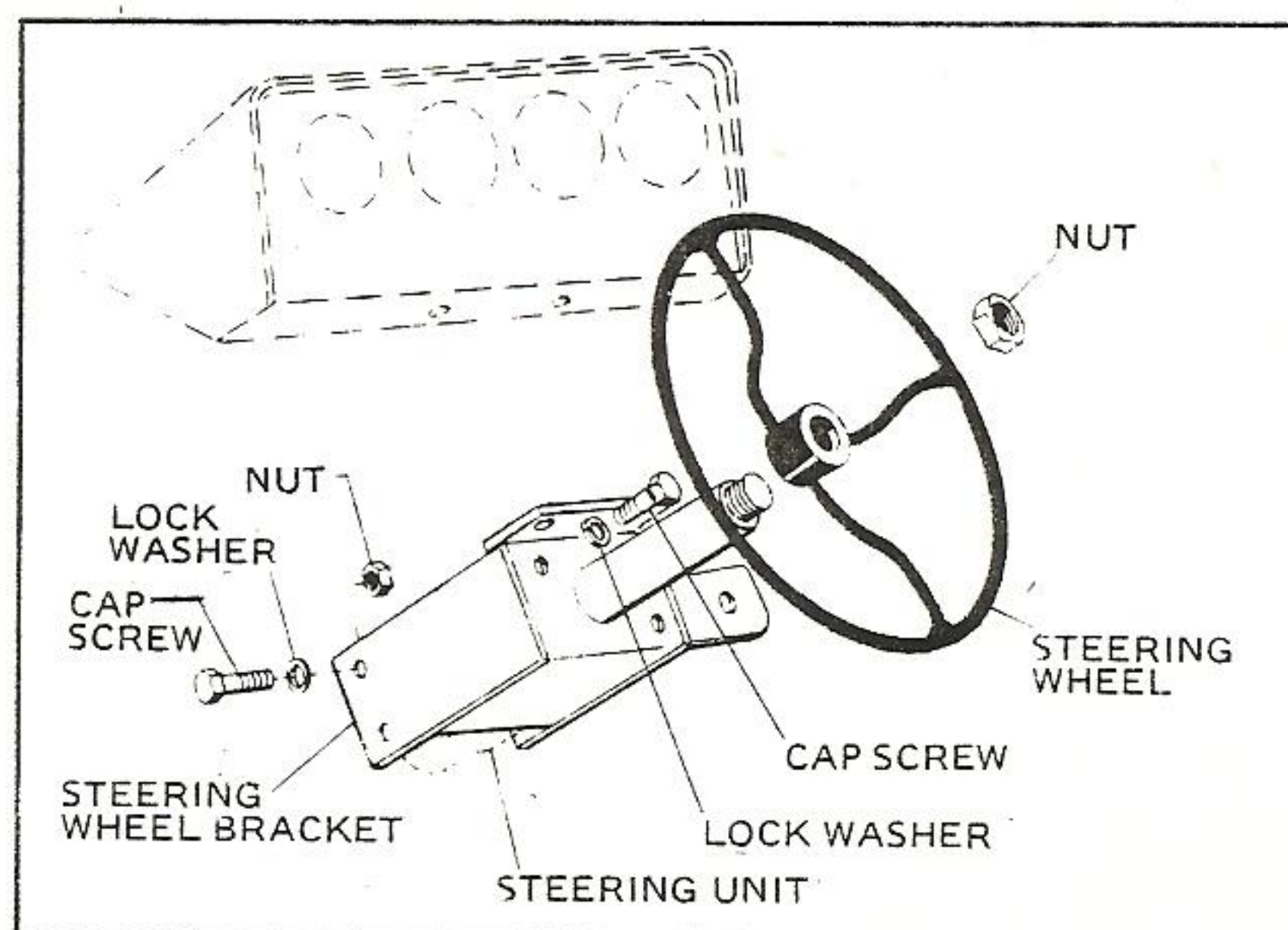


FIGURE 6 - 16. STEERING UNIT ASSEMBLY





## NOTE

IT IS NOT NECESSARY TO REMOVE THE INSTRUMENT PANEL.

(6) Remove the two cap screws that hold the steering unit to the bracket and remove steering unit.

(7) For disassembly and reassembly instructions for the steering unit, refer to the end of this section.

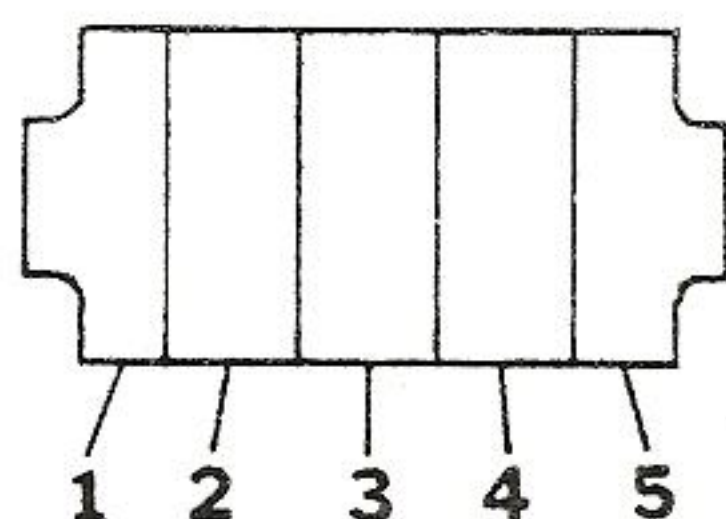
## B. Installation

Installation of the steering unit is basically the reverse of the removal procedures.

## 6-8. VALVES

### A. Valve Description

(1) The bucket control valve assembly consists of two spool valves, one inlet cover and one outlet cover (there is an optional third spool valve for the push-plate). The sections are identified as:



- 1 - INLET COVER
- 2 - BUCKET DUMP SECTION
- 3 - BUCKET HOIST SECTION
- 4 - PUSH PLATE SECTION (OPTIONAL)
- 5 - OUTLET COVER

All sections are held together by three tie rods, and the levers are spring-centered to the "HOLD" position until manually moved.

(2) Section 1 is the cover for the inlet side of the valve. It contains the hydraulic system pressure relief valve.

(3) Section 2 controls the Rollback and Dump movements of the bucket. It also contains an adjustable combination cylinder relief and anti-cavitation check valve.

(4) Section 3 controls the Raise, Lower and Float movements of the bucket. A ball-type detent holds the spool lever in the "FLOAT" position until it is manually moved. This section also contains an adjustable combination cylinder relief and anticavitation check valve.

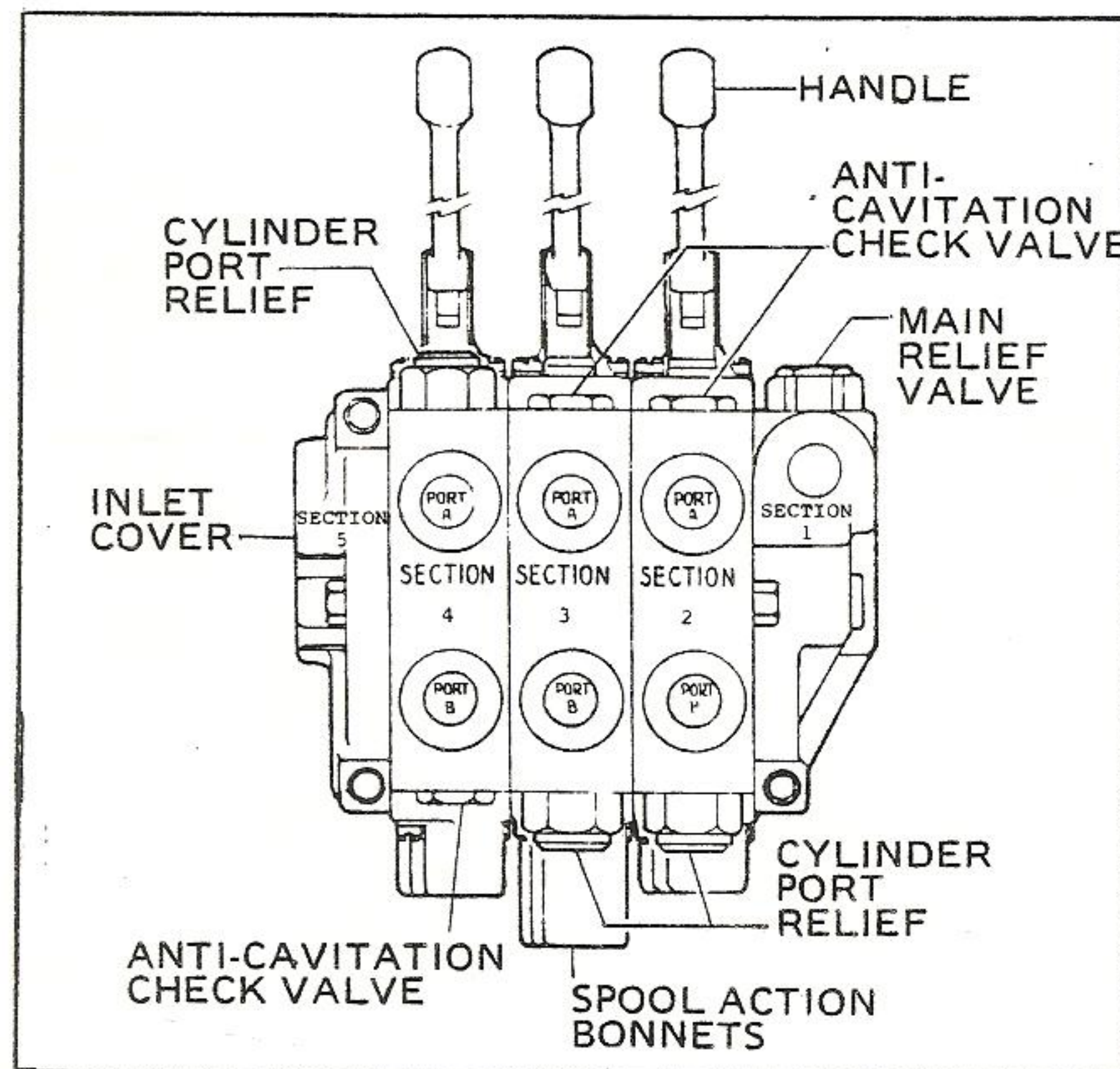


FIGURE 6 - 17. BUCKET CONTROL VALVE

(5) Section 4 (optional) controls the Retract and Eject movements of the push-plate, and it also contains an adjustable combination cylinder relief and anti-cavitation check valve.

(6) Section 5 is the cover for the outlet side of the valve.

(7) When all spool control levers are in the "HOLD" position, oil flow is from the pump to the inlet section of the valve, past the system relief valve, through the open-center passages of the valve, through the cooler and filter and back to the tank.

(8) When one of the spool control levers are moved, the connected spool in the valve blocks the center passage and diverts the pressure oil to the selected end of the cylinder. At the same time, another passage at the opposite end of the control spool opens and allows oil from the low pressure end of the cylinder to return to the tank.





## B. Main Relief Valve (See Figure 6-18)

(1) The main hydraulic system relief valve is located in the inlet section of the control valve. The relief valve protects the system from high pressure. The relief valve will open whenever pressure rises above the relief valve setting. The relief valve will also operate as an anti-cavitation valve. The pressure at which the relief valve opens is controlled by the spring tension behind the valve.

(2) Adjustment Procedure: Connect a 3000 PSI (207 bars) gauge to the pressure port in the "RAISE" outlet port of the bucket control valve. Start the engine and allow oil to warm to normal operating temperature. With the oil

warm and the engine running at full throttle, hold the lever in the "RAISE" position until the cylinder reaches its end of travel and observe the gauge. Normal relief pressure is 2000 PSI (138 bars). If the relief valve needs adjusting, remove nut on relief valve end. Adjust pressure by removing shims to lower, and adding shims to increase. Replace the relief valve nut.

## C. Combination Cylinder Port Relief and Anti-cavitation Valves

(1) The "Raise" and "Rollback" circuits have a combination relief and anti-cavitation valve. All other circuits rely on the system relief valve for protection from high pressure, (the other circuits have anti-cavitation valves).

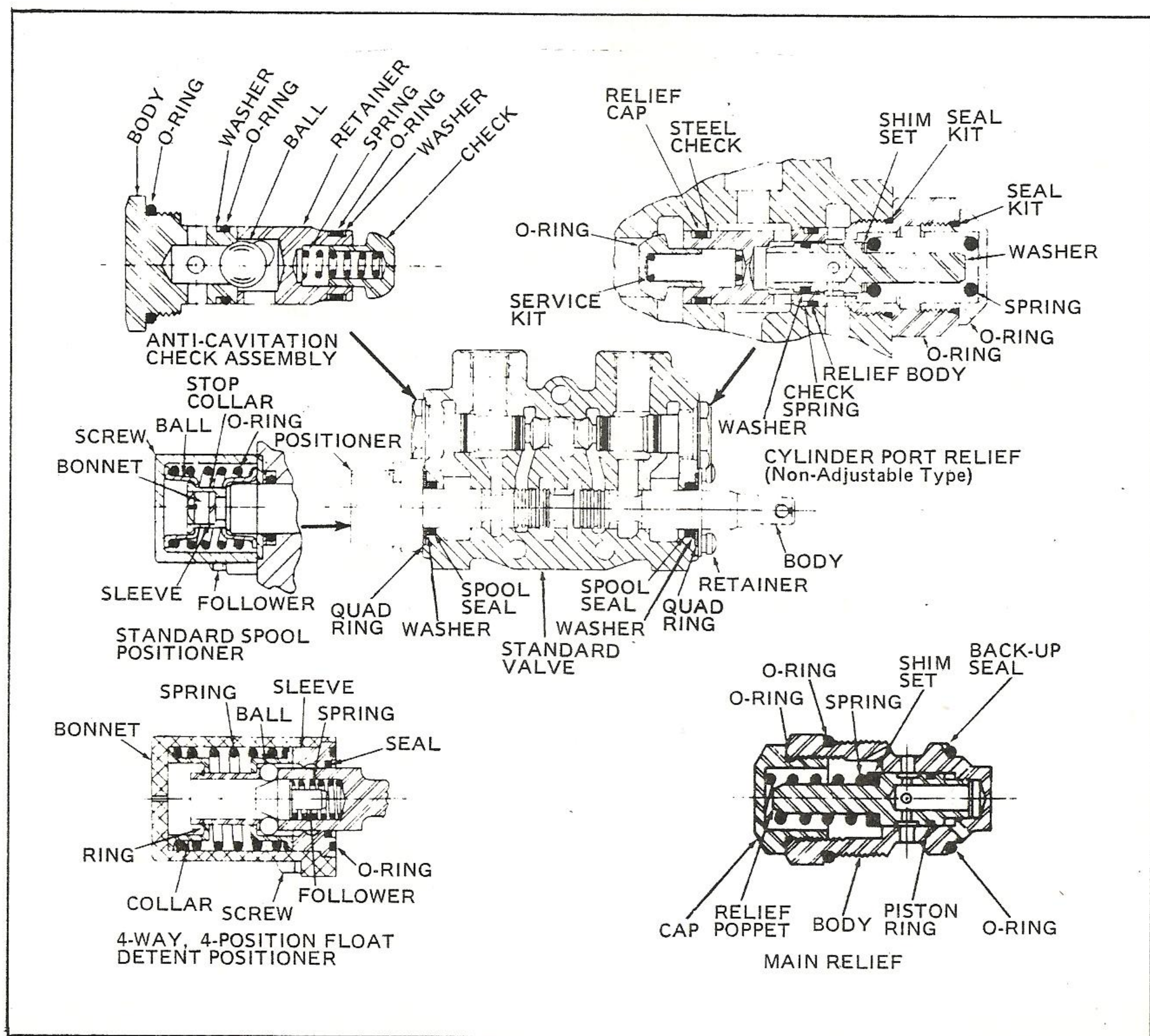


FIGURE 6 - 18. 4-WAY, 3 POSITION VALVE SECTION





(a) Cylinder Port Relief Valve. The cylinder port relief valve will open whenever the pressure in the "Raise" and "Rollback" circuits reaches the relief valve setting, which is 2250 PSI (155 bars) while the control levers are in the neutral position.

#### NOTE

**BEFORE CYLINDER RELIEF VALVES CAN BE ADJUSTED, THE SYSTEM PRESSURE RELIEF VALVE MUST BE RE-ADJUSTED TO APPROXIMATELY 2500 PSI (172 BARS).**

(2) Adjustment Procedure: Install a 3000 PSI (207 bars) gauge and adjust the main system relief valve to 2500 PSI (172 bars).

(3) With the hydraulic oil and engine heated to normal operating temperature and the engine running at full throttle, check the cylinder port relief pressure in the "Raise" and "Rollback" circuits

(a) Raise circuit: Move the right control lever to the "Raise" position and hold it there while observing gauge. Normal cylinder port relief valve setting in the raise cylinder circuit is 2250 PSI (172 bars).

(b) Rollback circuit: Move the lift control lever to the "Rollback" position and hold it there while observing gauge. Normal cylinder port relief valve setting in the bucket cylinder circuit is 2250 PSI (172 bars).

(4) Reset the hydraulic system pressure relief valve back to 2000 PSI (138 bars). Remove gauge and install pressure tap plug (if equipped).

#### D. Anti-cavitation Valves

The anti-cavitation valves will allow oil to flow from the return chamber to the cylinder port, but will not allow oil to flow from the cylinder port to the return chamber. The anti-cavitation valves will open and allow low pressure oil to enter the pressure chamber whenever a vacuum is created in the cylinder circuits. For example, if the hoist control lever is moved to the lower position with a heavily loaded bucket in the air, the bucket will tend to move downward faster than the pump can supply oil to the cylinders. This creates a vacuum in the cylinder port which will open the anti-cavitation valve and allow return oil to enter the pressure chamber to keep the cylinders full of oil.

#### E. Removal (See Figure 6-19)

(1) Release the air pressure in the hydraulic tank by loosening the filler cap.

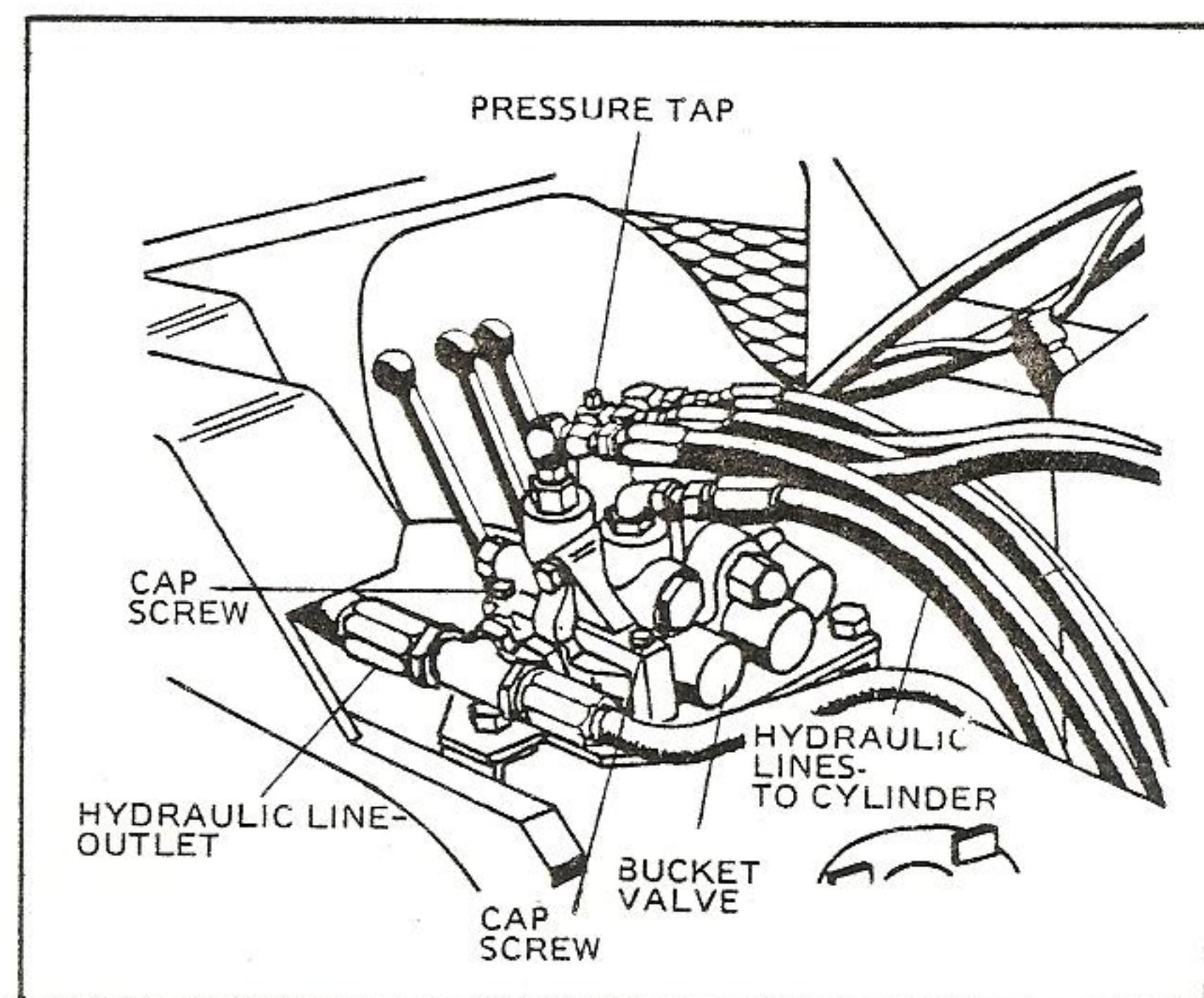


FIGURE 6 - 19. BUCKET CONTROL VALVE

(2) Disconnect, cap and tag four hydraulic bucket hoses (six hoses if push-plate is employed), one oil inlet and oil outlet hose from the bucket valve.

(3) Remove the three cap screws that secure the valve to the valve mounting plate.

(4) Remove the valve from the mounting plate.

(5) Cap valve ports with dust covers.

#### F. Disassembly (See Figure 6-20)

##### CAUTION

**BEFORE DISASSEMBLY, MARK EACH VALVE NUMERICALLY TO AVOID INCORRECT REASSEMBLY.**

(1) Remove three stud nuts from either side of the valve.

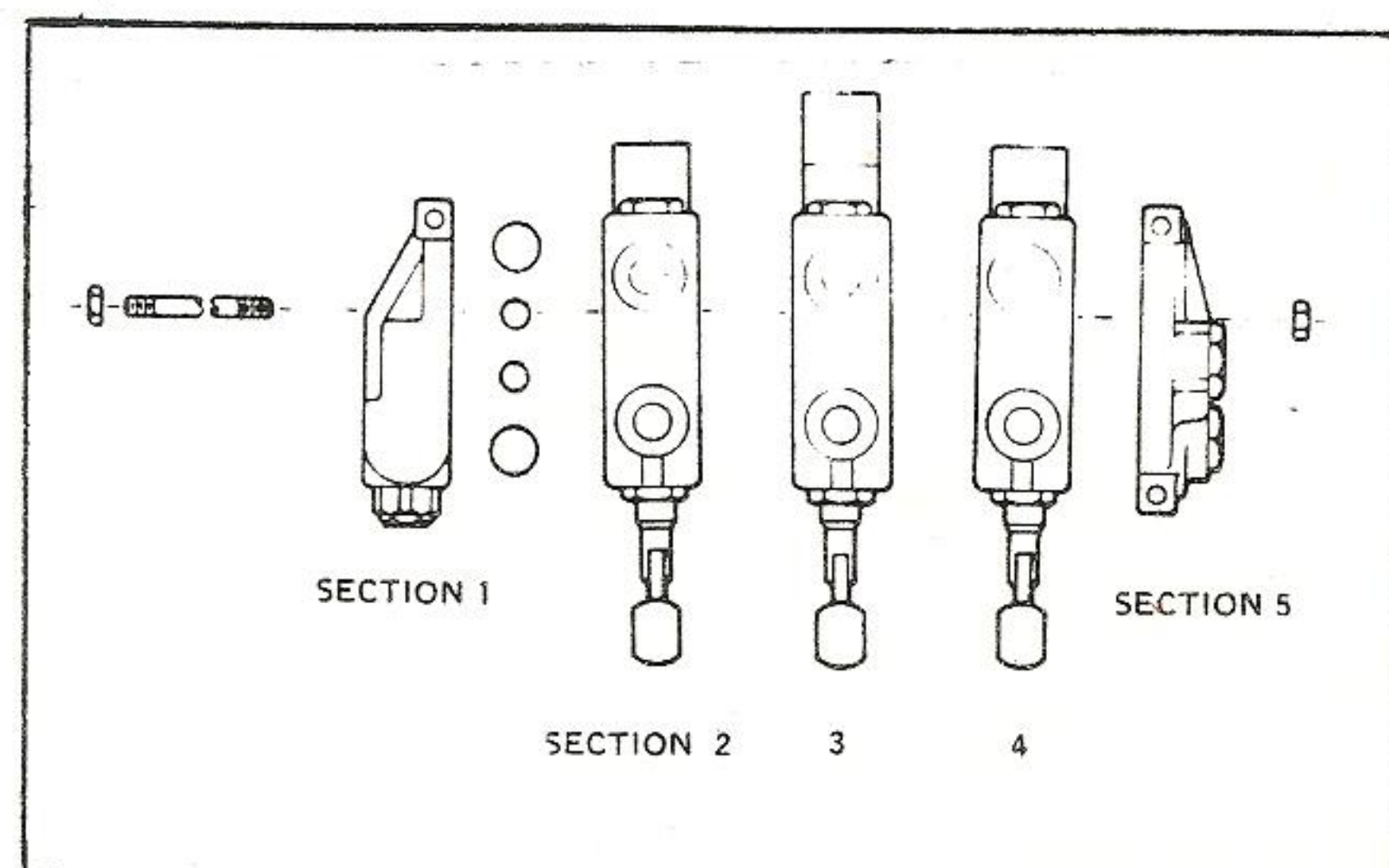


FIGURE 6 - 20. BUCKET CONTROL VALVE DISASSEMBLY





#### NOTE

NO LOCK WASHERS ON STUDS. ALL STUDS ARE STRESS-PROOF MATERIAL AND SHOULD BE REPLACED ONLY WITH ORIGINAL EQUIPMENT REPLACEMENT PARTS.

(2) Remove valve sections by sliding from assembly studs.

#### G. Reassembly

(1) Thoroughly clean O-ring counterbores and ground surface of each section.

(2) Replace all the O-rings.

#### NOTE

USE CARE IN REPLACING VALVE SECTIONS TO AVOID DISLODGING O-RINGS FROM COUNTERBORES.

(3) Replace valve sections on assembly studs in the same order in which they were removed.

(4) When all valve sections are positioned on assembly studs, replace stud nuts and tighten evenly to 20 ft.-lbs. (3 kg-m) torque.

#### CAUTION

IF STUD NUTS ARE NOT TIGHTENED TO THE PROPER TORQUE, VALVE SPOOLS MAY BIND OR STICK, OR CAUSE SECTION SEALS TO EXTRUDE.

(5) Replacing Valve Spool Seals (See Figure 6-21)

(a) Remove bonnet assembly parts from back of valves and keep in order of disassembly.

(b) Remove all parts connected to the spool on the front of the valve, either the complete handle bracket assembly or the seal retainer assembly if a handle bracket is not furnished.

#### NOTE

DO NOT REMOVE THE SPOOL AS THE

SEALS CAN BE REPLACED EXTERNALLY. PREVENT SPOOL FROM TURNING OR MOVING BY INSERTING A SCREWDRIVER THROUGH THE PIN HOLE AND USING AS A HANDLE. DO NOT HOLD THE SPOOL WITH A WRENCH. THIS WILL DESTROY THE FINISH.

(c) Remove retainer plate, retainer plate washer, back-up washer and spool seal.

(d) Thoroughly clean counterbore.

(e) Lightly oil new seals. Slide over valve spool and insert in seal counterbore.

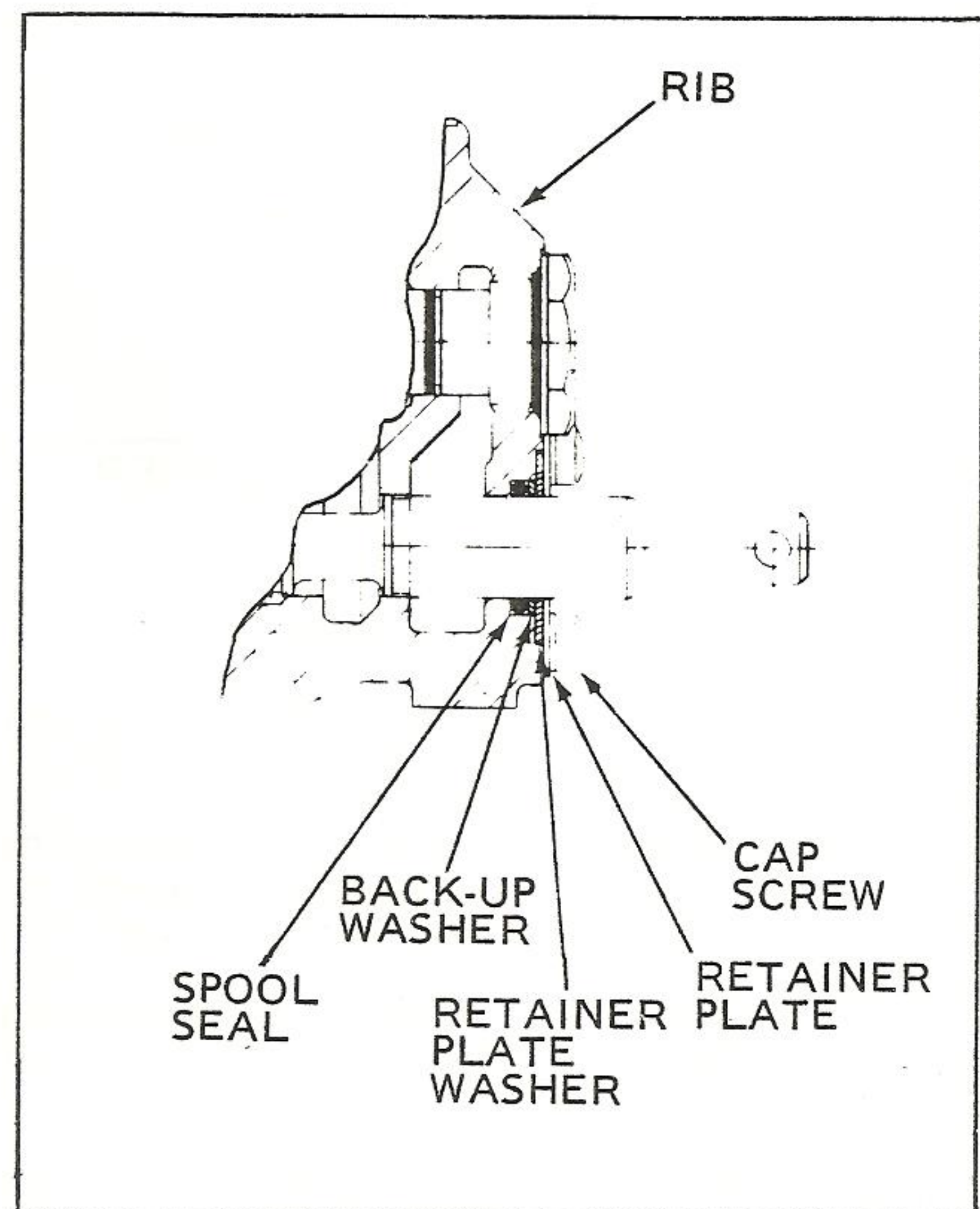


FIGURE 6 - 21. SPOOL SEAL ASSEMBLY

#### H. Bucket Control Valve Installation

Installation of the valve is basically the reverse of the removal procedures.

### 6-9. CYLINDERS

#### A. Steering Cylinders

(1) Removal (See Figure 6-22)

(a) Position the steering wheel in a neutral position (no pressure being exerted on the cylinder).

(b) Release the air pressure in the hydraulic tank by removing the filler cap.

(c) Disconnect, tag and cap two hoses from the steering cylinder.

(d) Remove cap screws and lockplates that secure the two cylinder pin assemblies.





(e) Remove pin assemblies.

(f) Remove steering cylinder from the machine.

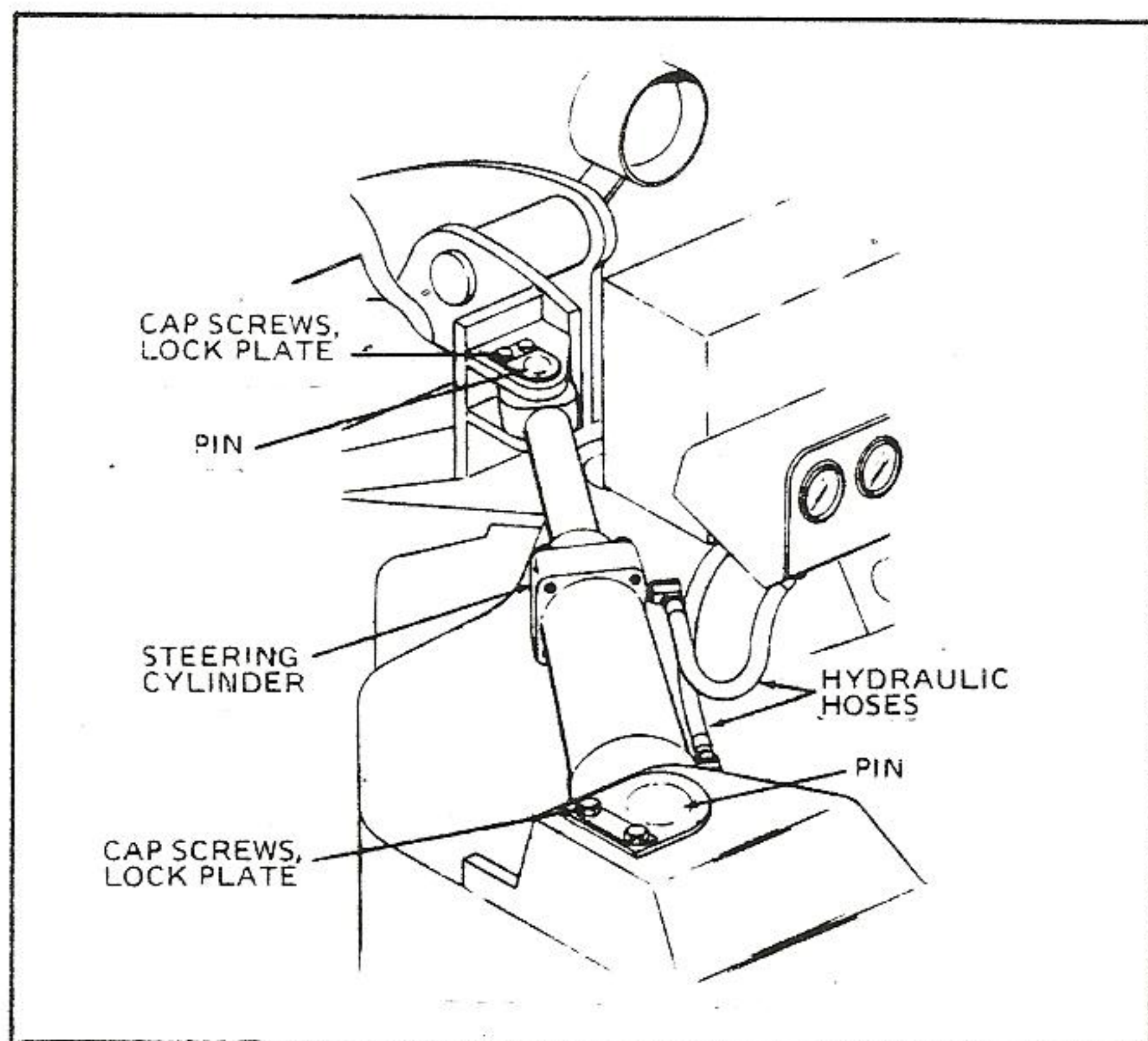


FIGURE 6 - 22. STEERING CYLINDER INSTALLATION

(2) Disassembly (See Figure 6-23)

(a) Remove lockwire from the 4 cap screws that attach the gland to the tube assembly.

(b) Remove the cap screws. Separate the gland from the tube assembly, thereby removing the rod assembly from the tube.

(c) Remove the roll pin from the rod end and remove the nut. Next, slide piston off the rod end.

(d) Pull rod through the gland and remove the O-ring, wiper and seal from the gland.

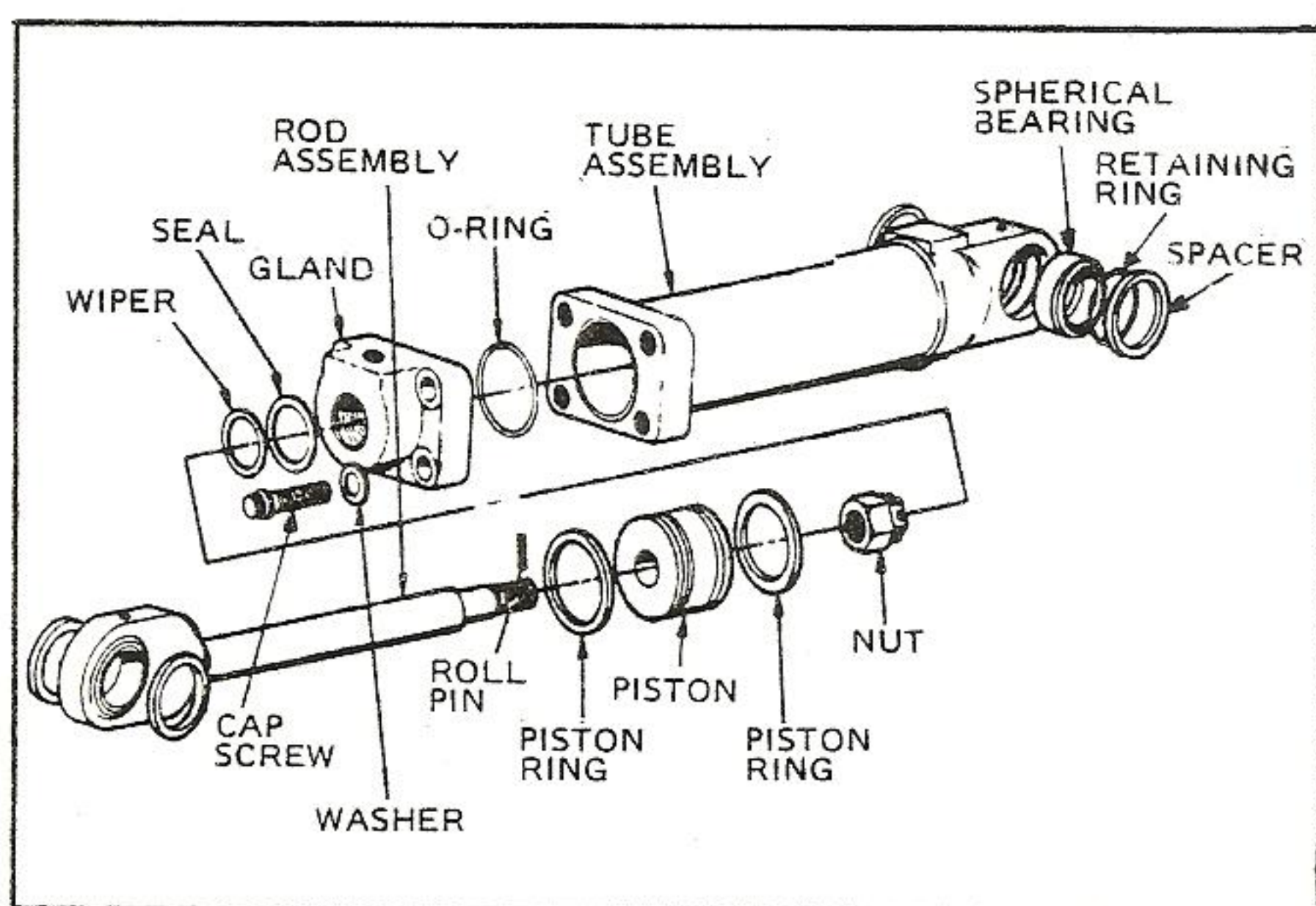


FIGURE 6 - 23. STEERING CYLINDER

(3) Reassembly (See Figure 6-24)

(a) Inspect cylinder and its constituent parts for wear and other defects and replace as necessary. Verify all parts are free of dirt and other foreign matter.

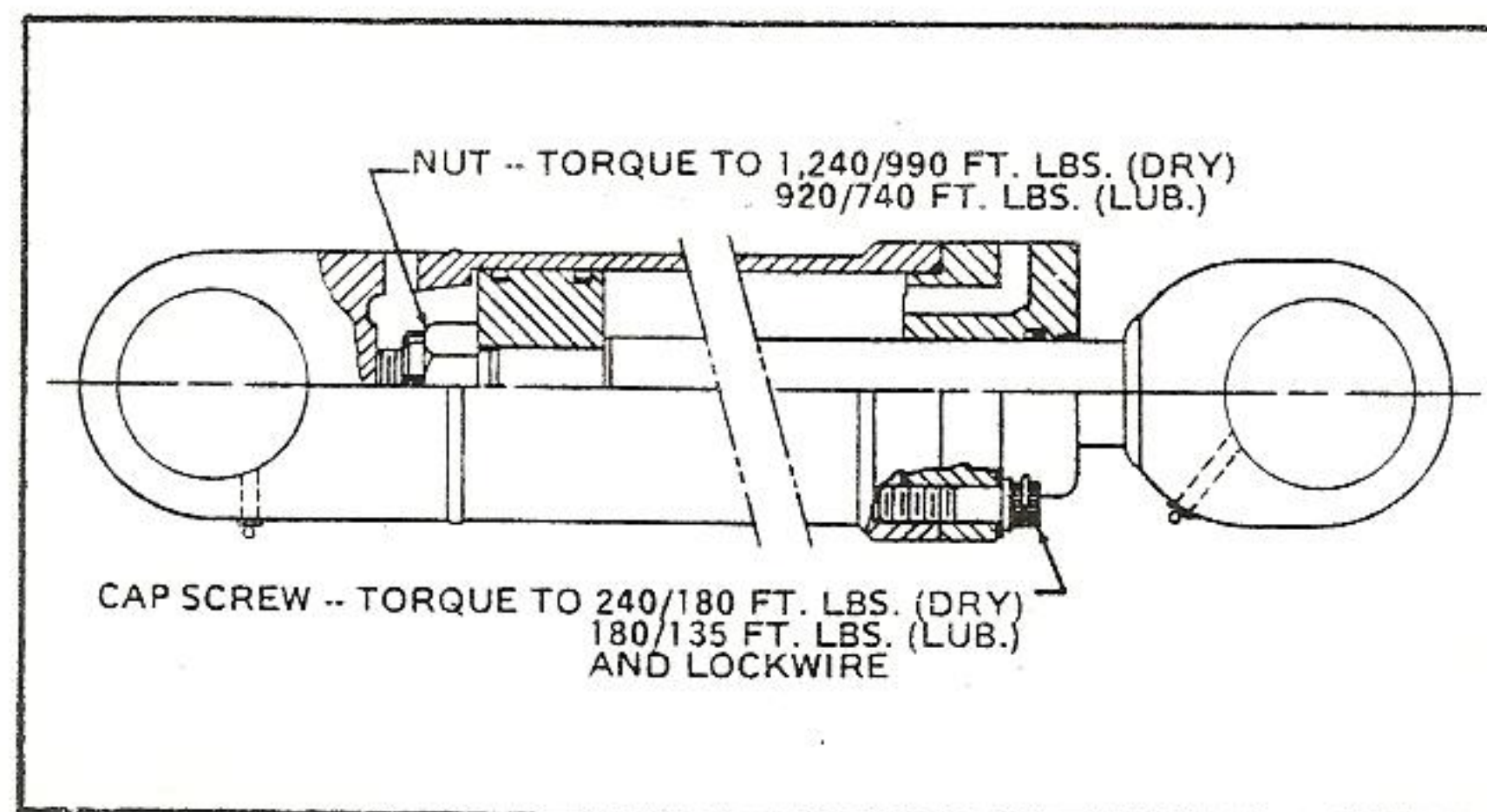


FIGURE 6 - 24. STEERING CYLINDER

(b) Reassembly of the cylinder is basically the reverse of disassembly. (See Figure 6-24.)

NOTE

TO REMOVE THE SPHERICAL BEARINGS FROM THE CYLINDER ASSEMBLY, PROCEED AS FOLLOWS: (SEE FIGURE 6-23.)

1. WITH A SLOT SCREWDRIVER, PRY OFF THE RETAINING RING THAT RETAINS THE SPHERICAL BEARING IN ITS LOCATION.

2. REMOVE THE SPACER AND SPHERICAL BEARING.

REASSEMBLY OF THE SPHERICAL BEARINGS IS BASICALLY THE REVERSE OF DISASSEMBLY.

(4) Installation

Installation of the steering cylinder is basically the reverse of the removal procedures.

B. Lift Cylinders (See Figure 6-25)

(1) Cylinder Description

(a) There are two double acting hydraulic cylinders in the hydraulic system; the bucket Tilt cylinder and the Lift cylinder.

(b) Bucket tilt cylinder. When the tilt lever is moved to the "Dig" position, the connected control valve spool blocks the return passage and opens a pressure passage in the valve which allows oil to flow to the rod end of the tilt cylinder. As the oil pressure acts on the piston, the piston rod is forced in.





This rotates the bucket upward which causes it to fill. Low pressure oil from the piston (anchored) end of the cylinder returns to the tank through the valve, cooler and filter. When the tilt lever is moved to the "Dump" position, pressure oil will be directed to the piston (anchored) end of the cylinder. This extends the piston rod which dumps the bucket.

(c) Lift cylinder. When the lift lever is moved to the "Raise" position, the connected control spool blocks the return passage and opens a pressure passage in the control valve which allows oil to flow to the piston (anchored) end of the lift cylinder. As the oil pressure acts on the piston, the piston rod is forced out raising the bucket and arms. Low pressure in the rod end of the cylinder returns to the tank through the valve.

When the lift control lever is moved to the "Lower" position, pressure oil will be directed to the rod end of the lift cylinder which retracts the cylinder rod and lowers the bucket and arms.

To place the bucket in a float position, push the control lever all the way forward into "Detent". The bucket will then fall to ground level at a speed dictated by the load of the bucket.

## (2) Lift Cylinder Removal (See Figure 6-25)

(a) Raise the lift arm up and prop arm with a suitable support.

(b) Tip the bucket all the way forward.

(c) Relieve the air pressure in the hydraulic tank by loosening the filler cap, and move control levers back-and-forth to make certain all pressure is released in cylinder.

(d) Remove the left hand light support.

(e) On the rod end of the cylinder, remove the lock plate and two cap screws that secure the pin.

### CAUTION

**SUPPORT THE ROD END OF THE CYLINDER BEFORE REMOVING THE PIN (USE OF OVERHEAD CRANE SUGGESTED).**

(f) With a mallet and soft drift, drive out the pin.

(g) Lift up on the rod end of the cylinder, for access to the hydraulic lines.

(h) Disconnect, cap and tag the two hydraulic lines to the lift cylinders.

(i) With the rod end of the cylinder well supported, remove the lock plate and cap screws that secures the anchor end of the cylinder.

(j) With a mallet and soft drift, drive out the pin.

(k) Remove the cylinder from the machine.

## (3) Lift Cylinder Disassembly (See Figure 6-25)

(a) Remove the four cap screws that secure one end of the manifold assembly to the rod end of the cylinder.

(b) Remove lock wire on cap screws that attach the live end of the cylinder, remove the cap screws.

(c) Remove the rod and live end from the cylinder tube assembly.

(d) Remove lock wire on cap screws that attach the piston to the rod assembly.

(e) Remove the piston from the rod end.

(f) Slide O-rings and live end off the rod assembly.

(g) Remove the ring wiper and seal from the live end.

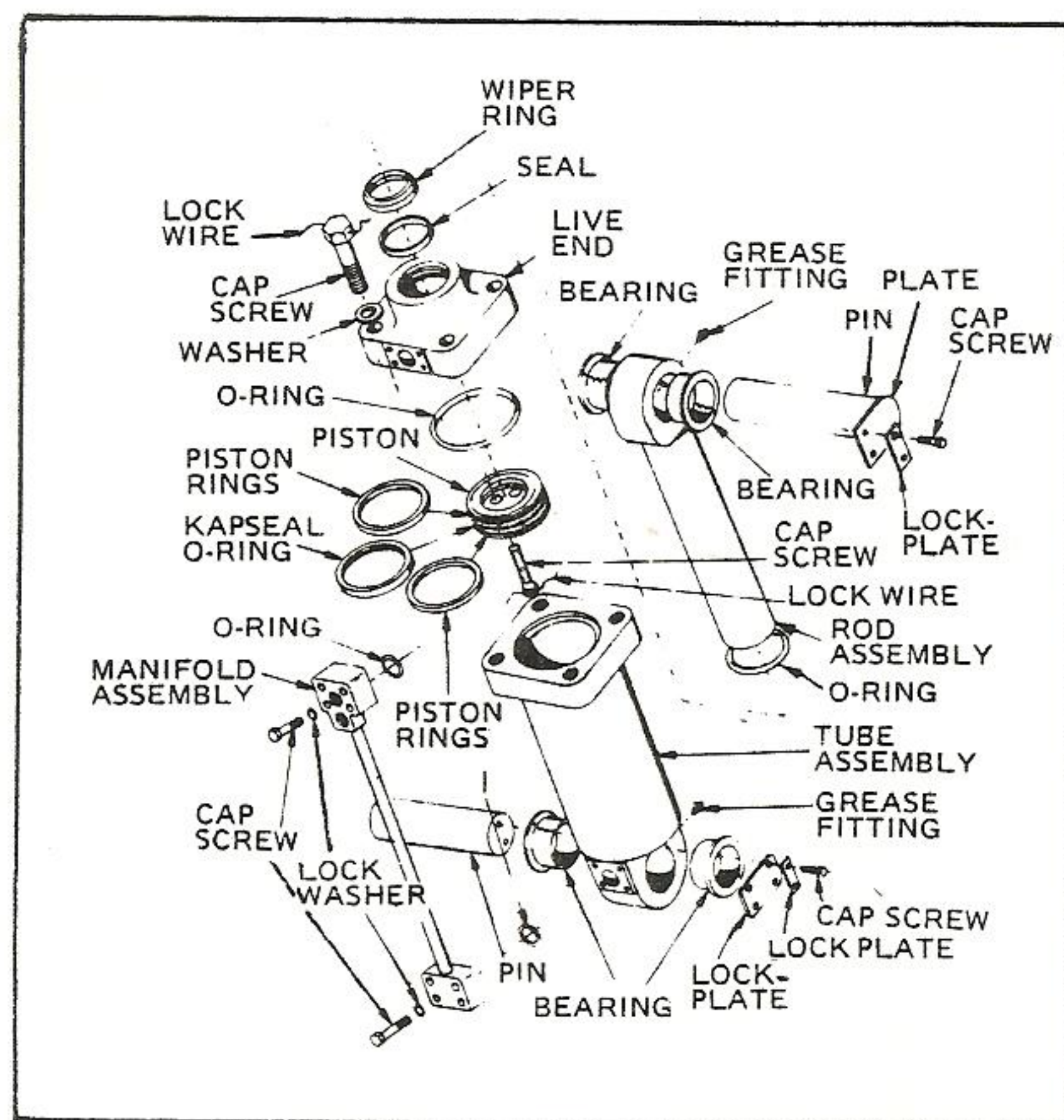


FIGURE 6 - 25. LIFT CYLINDER DIS-ASSEMBLY





(4) Lift Cylinder Reassembly (See Figure 6-26)

(a) Torque piston hold-down cap screws to 650 ft.-lb. (90 kg-m) (Dry) and 490 ft.-lb. (68 kg-m) (Lubed).

(b) Tighten the live end hold-down cap screws to the same torque as in (1).

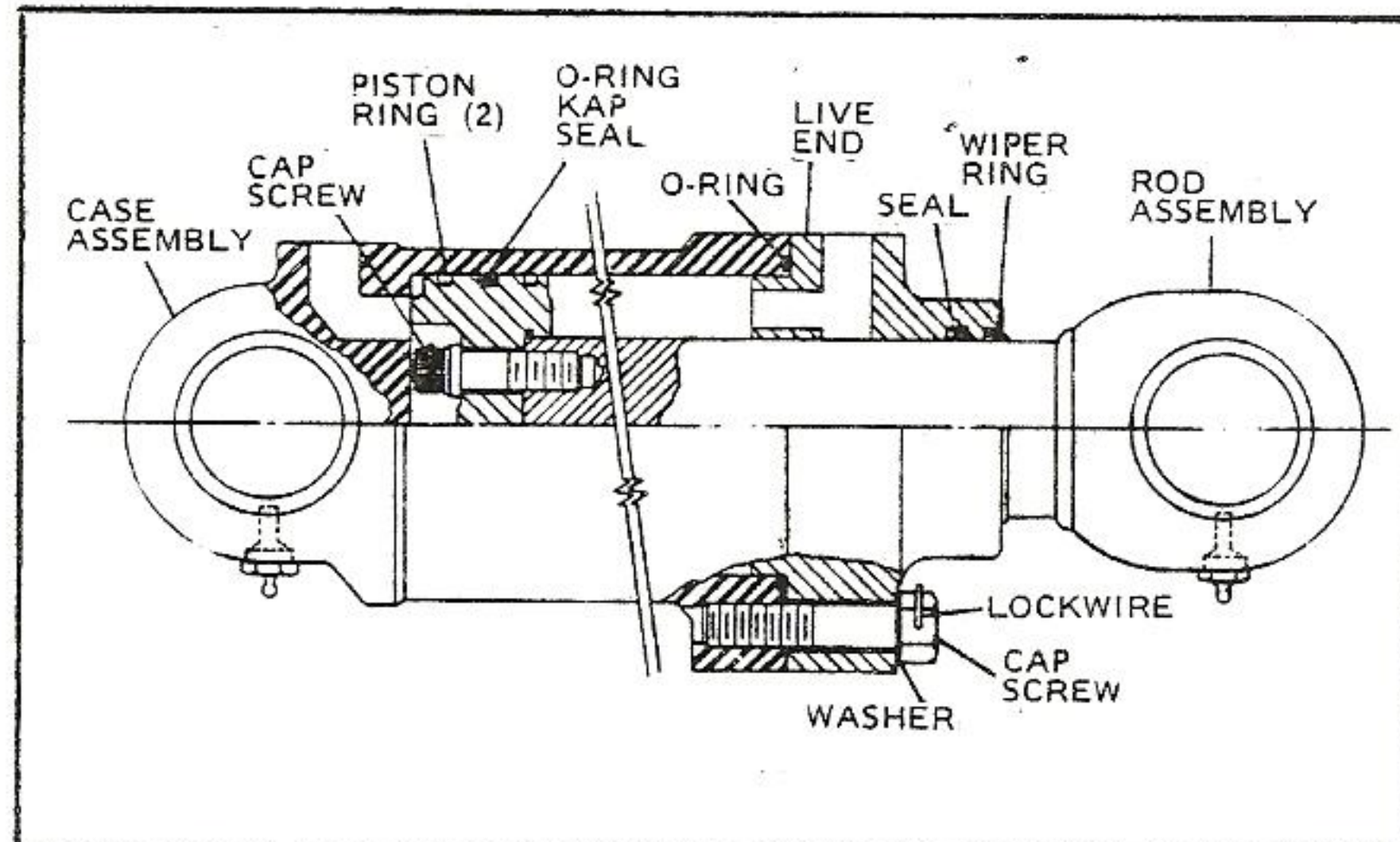


FIGURE 6 - 26. HYDRAULIC CYLINDER CROSS SECTION

(5) Lift Cylinder Installation

Installation of the cylinder is basically the reverse of the removal procedures.

**C. Bucket Cylinder**

(1) Bucket Cylinder Removal (See Figure 6-27)

(a) Lower the bucket to its full travel position to ground level.

(b) Relieve the air pressure in the hydraulic tank by loosening the filler cap. Also, move the control levers back-and-forth to be certain all pressure is released in cylinders.

**CAUTION**

**SUPPORT THE ROD END OF THE CYLINDER BEFORE REMOVING THE ATTACHED PIN. (USE OF OVERHEAD CRANE SUGGESTED).**

(c) Remove the lock bolt pin at the cylinder rod end.

(d) With a mallet and soft drift, drive out the pin, thereby, disconnecting the cylinder rod end from the dump lever.

(e) Lift up on the rod end of the cylinder, for access to the hydraulic hoses.

(f) Disconnect, cap and tag the two hydraulic hoses; cap the cylinder ports.

(g) Remove the right hand light bracket assembly.

(h) Remove the cap screws and lock plate that secure the pin at the cylinder's anchor end.

(i) With a mallet and soft drift, drive out the pin, thereby disconnecting the cylinder from the lift arm.

(j) Remove the cylinder from the machine.

(2) Bucket Cylinder Disassembly (See Figure 6-27).

(a) Position the cylinder in a suitable position for disassembly.

(b) Remove the cap screws that attach the hydraulic manifold assembly at the rod end.

(c) Remove the lock wire and cap screws that secure the live end to the case assembly.

(d) Extract the rod assembly from the case assembly.

(e) Remove the lock wire and cap screws that attach the piston to the rod assembly. Slide the piston off the rod.

(f) Slide O-rings off the rod assembly and extract the rod from the live end.

(g) Remove the kapseal and ring wiper from the live end.

(3) Bucket Tilt Cylinder Reassembly (See Figure 6-28).

(a) Reassembly of the cylinder is basically the reverse of the disassembly procedures.

1. Torque piston hold-down cap screws to 650 ft.-lb. (90 kg-m) (Dry) and 490 ft.-lb. (68 kg-m) (Lubed).

2. Tighten the live end hold-down cap screws to the same torque as in (1).

(4) Bucket Cylinder Installation

Cylinder installation is basically the reverse of the removal procedures.

**D. Push-plate Cylinder**

(1) Push-plate Cylinder Removal (See Figure 6-29)

(a) With bucket rolled back in a traveling position, tilt bucket forward until the lift arm is in a horizontal position. Then roll bucket until the cutting lip contacts ground level. Eject push-plate to full travel.





#### WARNING

PLACE A STURDY SUPPORT UNDER THE LIFT ARM.

(b) Release the air pressure in the hydraulic tank by loosening the filler cap. Also, move control levers back-and-forth to make certain all pressure is released.

(c) Disconnect, cap and tag the two hydraulic lines to the cylinder. Cap the open port on the hydraulic cylinders.

#### CAUTION

SUPPORT THE ROD END OF THE CYLINDER (USE OF OVERHEAD CRANE SUGGESTED).

(d) Remove the cap screws and lock plate that secure the pin assembly on the rod end of the cylinder.

(e) With a mallet and a soft drift, tap out the pin assembly.

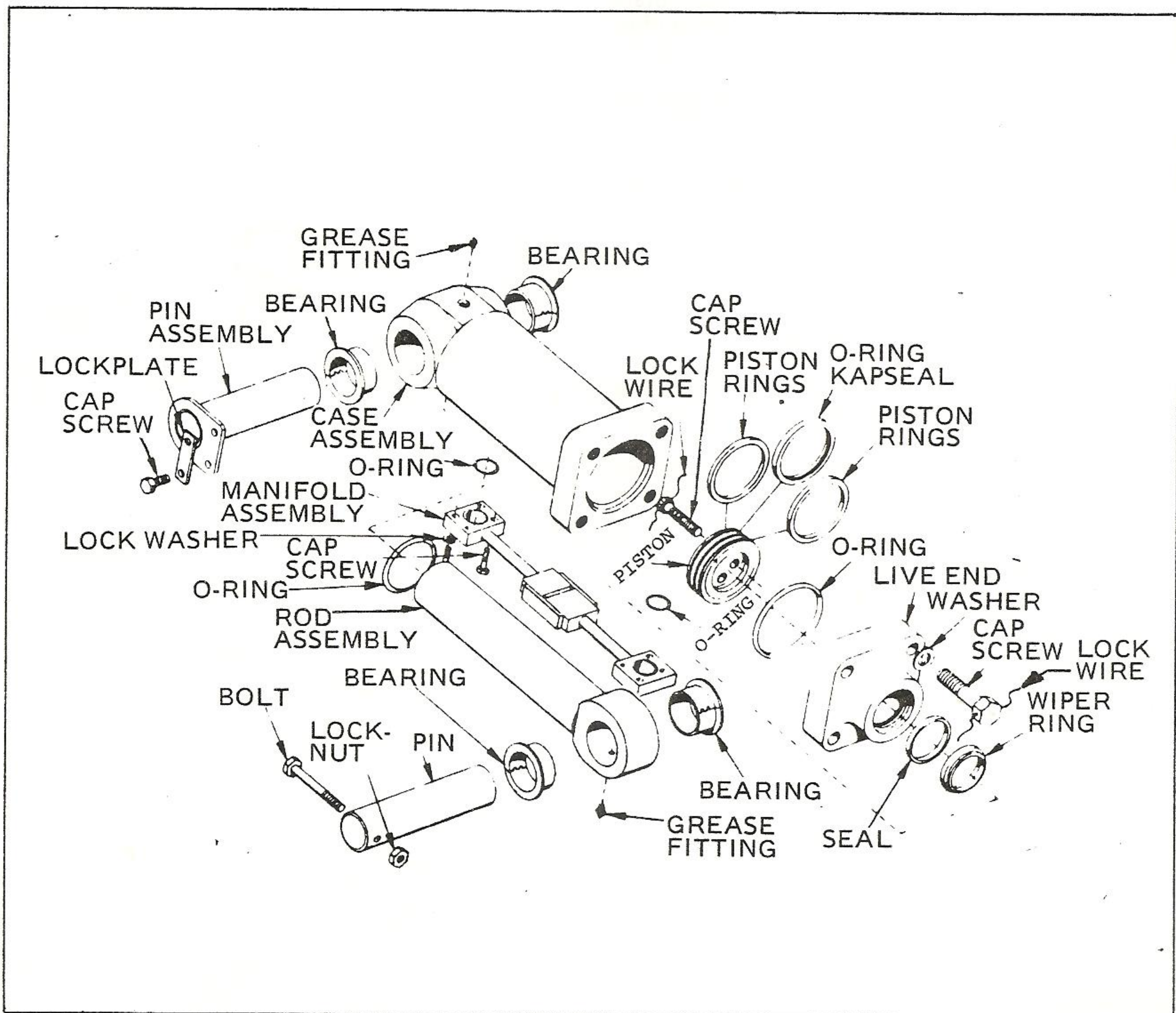


FIGURE 6 - 27. BUCKET TILT CYLINDER DISASSEMBLY



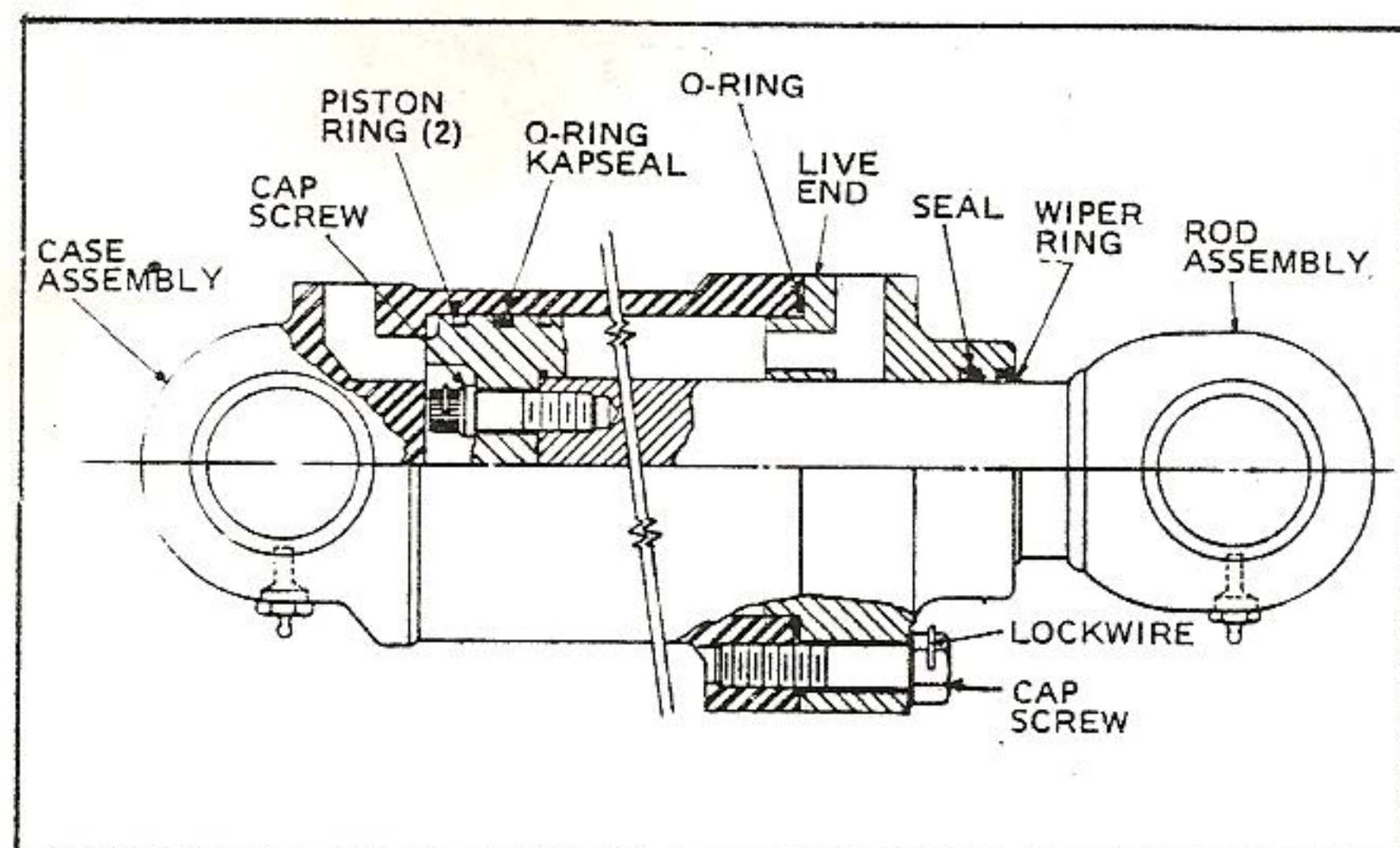


FIGURE 6 - 28. HYDRAULIC CYLINDER CROSS SECTION

(f) Remove the cap screws and lock plate that secure the pin assembly on the anchor end of the cylinder.

(g) With a mallet and a soft drift, tap out the pin assembly.

(h) Remove the cylinder through the bottom opening in the bucket.

(2) Push-plate Cylinder Disassembly (See Figure 6-29)

(a) Drain oil from the cylinder.

(b) Remove the cap screws that secure the hydraulic manifold assembly to the cylinder.

(c) Remove the lock wire and cap screws that attach the live end of the cylinder to the tube assembly.

(d) Separate the rod assembly from the tube assembly.

(e) Extract the roll pin that secures the rod nut to the rod, and remove the rod nut.

(f) Slide the piston and O-ring off the rod.

(g) Separate the rod assembly from the live end.

(h) Remove the O-ring, back-up ring and seal wiper from the live end.

(3) Push-plate Cylinder Reassembly

Reassembly of the cylinder is basically the reverse of the disassembly procedures.

(4) Push-plate Cylinder Installation

Installation of the cylinder is basically the reverse of the removal procedures.

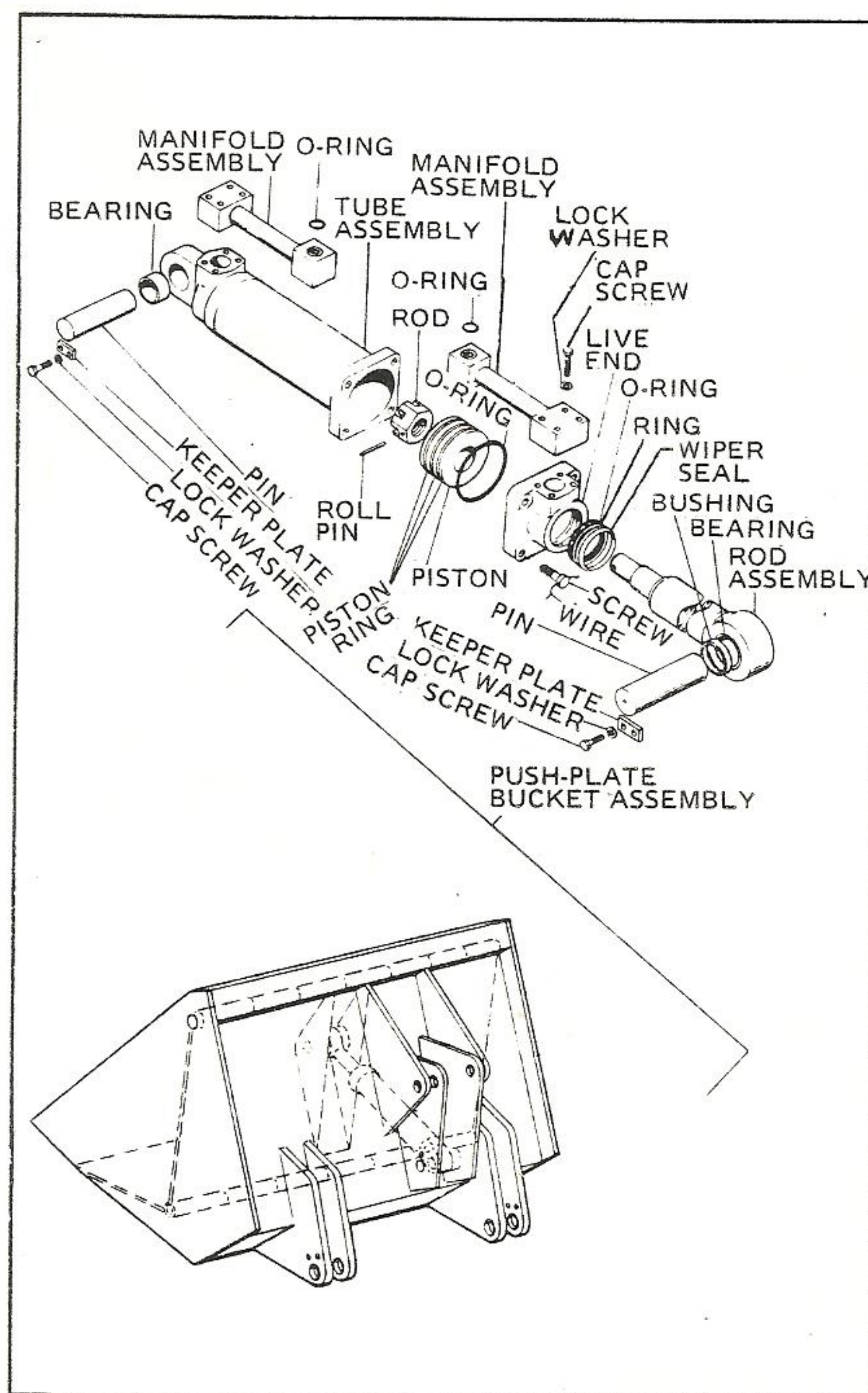


FIGURE 6 - 29. PUSH-PLATE CYLINDER





## 6-10. OIL COOLER

### A. Removal

- (1) Release the air pressure in the hydraulic tank by loosening the filler cap.

### CAUTION

IDENTIFY ALL PARTS AS REMOVED FOR PROPER REASSEMBLY.

- (2) Remove the inlet air ducting to the cooler.
- (3) Disconnect, cap and tag the two hydraulic

lines to the cooler. Cap the inlet and outlet ports of the cooler.

- (4) Remove the four cap screws that anchor the cooler to the pump drive housing.

- (5) Remove cooler.

### B. Installation

Installation of the bucket hydraulic system oil cooler is basically the reverse of the removal procedures.

## 6-11. RETURN FILTER

All oil returning from the control valve and cylinders goes through the oil cooler and return filter before returning to the tank.

## 6-12. ATTACHMENTS

A. CHAR-LYNN ORBITROL SERVICE MANUAL, NO. 7-204

B. MICO POWER BRAKE CYLINDER SERVICE MANUAL, NO. 84-001-002