HYDRAULIC SYSTEM INFORMATION — MF 52A AND MF 54A

Major variations, as well as similiarities, exists between the Backhoes. No attempt will be made to list either in detail ... however, *some* variations (and similiarities) may be pointed out. The hydrulic components can usually be identified by the Massey-Ferguson part number stamped on the exterior of the component ... or by visual examination. Refer to the appropriate parts book (concerning the particular Backhoe) for additional information and when ordering replacement parts.

SYSTEM FLOW

These Backhoes are dependent upon the Loader hydraulic system for their oil supply. They use the Loader's main relief valve to control the maximum pressure within their systems. It is therefore important that the Loader's pump, reservoir, filter and main relief valve be checked to insure that they are operating correctly before "blaming" a malfunction on the Backhoe ... see "Tests and Adjustments" and/or "Trouble-Shooting" pertaining to the Loaders.

Figures 1 and 2 illustrates the Backhoes' hydraulic systems. Fig. 3 explains the meanings of some of the graphic symbols used ... as an aid to those servicemen that do not know, but wish to learn, this form of reading. The graphic symbols are meant to illustrate the FUNCTION of a component rather than its construction; however, certain values have been included so as to aid in trouble-shooting.

COMPONENT OPERATING CHARACTERISTICS

1. RESERVOIR, PUMP AND LOADER CONTROL VALVE ... see "Loader" section for description.

2. 6-SPOOL CONTROL VALVE ... is an open-center, stack type valve containing an anti-cavitation return plate (which works in conjunction with a one-way check valve installed in the inlet port plate of this valve). Overload (circuit) reliefs are installed in the boom section of the valve (to protect the rod and the head end of the boom cylinder) ... this section also contains an anti-cavitation check poppet. The dipperstick section of the valve contains a circuit relief to protect the head end of the dipper cylinder against overloads. Load checks are installed in each of the 6 working sections of the valve.

3. ANTI-CAVITATION RETURN PLATE ... diverts the oil returning from the non-pressurized end of a cylinder to supplement the pump flow to the opposite end of a cylinder. This action is accomplished as follows ... see Fig. 4:

a. When the control valve spools are in "Neutral", the oil passes through the open center of the valve, enters the anti-cavitation return plate and fills the passages and spring area (which is identified as shade key "A" and "C" in Fig. 4) around the replenishing spools. (This oil also returns to the reservoir.) The area (identified as shade key "B") between the plungers is also filled and is at the same pressure as the oil in shade key "A".

b. When the cylinder begins to move at a rate that exceeds the capacity of the pump (as during a fast drop cycle of the boom cylinder), the pressure at the control valve inlet port begins to drop.

c. When the pressure (at the inlet port) drops below 300 psi, the spring-loaded replenishing spools move inward, forcing the plungers toward the center of the return plate. The pressure in shade key "B" is the same as the control valve inlet pressure.

d. Movement of the replenishing spools inward closes off the oil in shade key "C" preventing its return to the reservoir. (This is the oil in the "working section" return passage.) The pressure in shade "C" builds up to open the one-way check valve installed in the inlet port of the control valve. The oil returning from one end of the double-acting cylinder combines with the pump flow to the opposite end of the cylinder, preventing cavitation.

e. When the pump's capacity catches up with rate of cylinder movement, pressure begins to build-up at the control valve inlet port.

f. Pressure build-up at the inlet port flows through the orifice in the plunger sleeve and forces the plunger outward, in turn, overcoming the spring action against the replenishing spools and opening the oil in shade key "C" to shade key "A". This oil flows to the reservoir.

g. The pressure against the one-way check valve at the inlet port drops. This valve is closed by its spring and the pump flow is prevented from entering the return passage in the valve "work-sections". It is either directed to the cylinder (due to spool movement), or flows through the "open center" of the valve (if spool is in "Neutral").

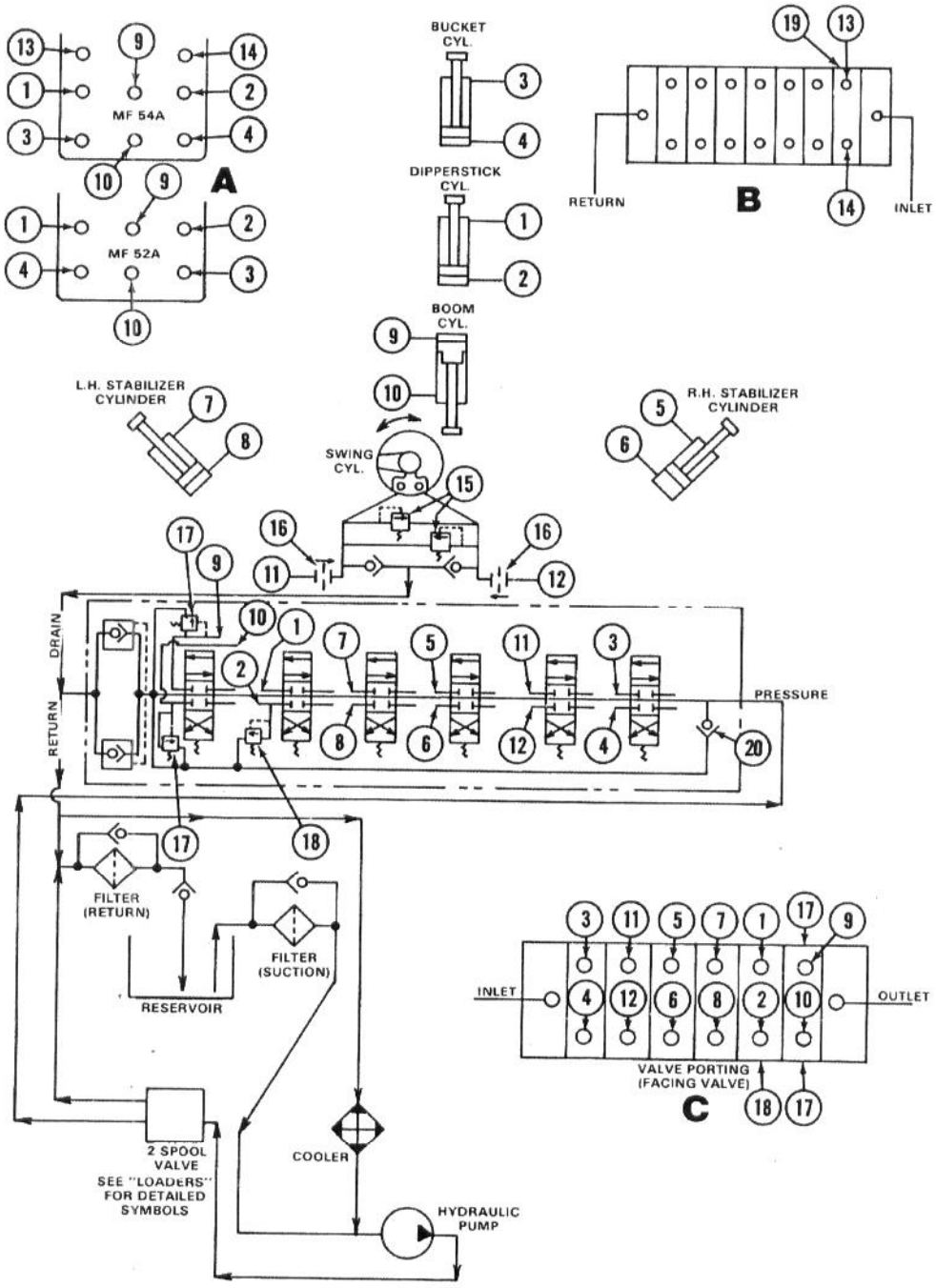

Fig. 1 — Illustration Typical of Backhoe Hydraulics* — Six Control Levers

A. Line Routing at Boom Channel Area (Looking Toward Dipper)
B. Extra Valve Section Used with Extendable Dipper (Located between Valve Inlet and First Work Section)
C. Port Identification Facing Valve Work Ports

*NOTE: Graphic Symbols for Backhoe control valve, swing cylinder with internal dampening (MF 54A) and stabilizer cylinders (internal lock valve) are not complete ... also, the lines between valve and cylinder ports are not shown connected. Valve working sections are with "Ford" control levers ONLY ... see Fig. 2 for "Standard" 4-lever and 6-lever controls.

1. Dipperstick — Out (Rod-End)
2. Dipperstick — In (Head-End)
3. Bucket — Uncurl (Rod-End)
4. Bucket — Curl (Head-End)
5. Right Hand Stabilizer — Up (Rod-End)
6. Right Hand Stabilizer — Down (Head-End)
7. Left Hand Stabilizer — Up (Rod-End)
8. Left Hand Stabilizer — Down (Head-End)
9. Boom — Down (Head-End)
10. Boom — Up (Rod-End)
11. Swing — Right
12. Swing — Left
13. Dipper (Digmor) — In
14. Dipper (Digmor) — Out
15. Swing Circuit Reliefs (2125 PSI — MF 54A; 1875 PSI — MF 52A)
16. Orifice Plates (0.109") — MF 52A Only
17. Boom Circuit Reliefs (2875 PSI)
18. Dipper Circuit Relief (2875 PSI; Head-End)
19. Circuit Relief (2250 PSI — Digmor)
20. 300 PSI (Check Valve)

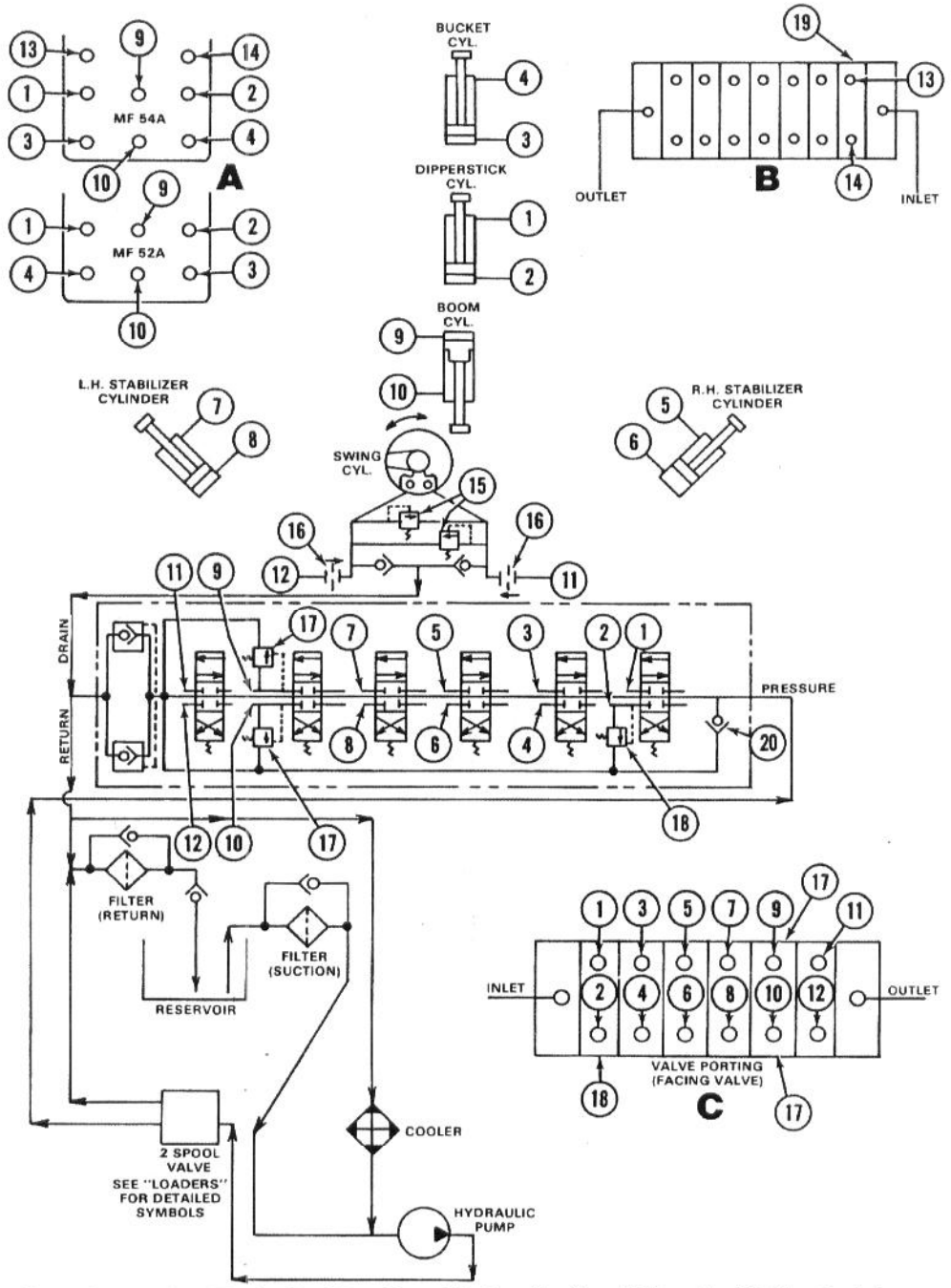

Fig. 2 — Illustration Typical of Backhoe Hydraulics* — "Standard" Control Levers

A. Line Routing at Boom Channel Area (Looking Toward Dipperstick)
B. Extra Valve Section Used with Extendable Dipper (Located Between Valve Inlet and First Work Section)
C. Port Identification Facing Valve Work Ports

*NOTE: Graphic Symbols for Backhoe control valve, swing cylinder with internal dampening (MF 54A), stabilizer cylindrs (internal lock valve) and boom cylinder dampening are not complete ... also, lines between valve and cylinder ports are not shown connected. Valve working sections are with "Standard" 4-control levers and 6-control levers.

1. Dipperstick — Out (Rod-End)
2. Dipperstick — In (Head-End)
3. Bucket — Curl (Head-End)
4. Bucket — Uncurl (Rod-End)
5. Right Hand Stabilizer — Up (Rod-End)
6. Right Hand Stabilizer — Down (Head-End)
7. Left Hand Stabilizer — Up (Rod-End)
8. Left Hand Stabilizer — Down (Head-End)
9. Boom — Down (Head-End)
10. Boom — Up (Rod-End)
11. Swing — Left
12. Swing — Right
13. Dipper (Digmor) — In
14. Dipper (Digmor) — Out
15. Swing Circuit Reliefs (2125 PSI — MF 54A; 1875 PSI — MF 52A)
16. Orifice Plates (0.109") — MF 52A Only
17. Boom Circuit Reliefs (2875 PSI)
18. Dipper Circuit Relief (2875 PSI; Head-End)
19. Circuit Relief (2250 PSI — Digmor)
20. 300 PSI (Check Valve)

"WORKING" LINES	
"PILOT" LINES	
CONNECTING LINES	
NON-CONNECTING LINES	
PLUGGED PORT	
DIRECTION OF FLOW	

FIXED DISPLACEMENT PUMP	

FILTER OR STRAINER	
COOLER	
RESERVOIR-PRESSURIZED	
RESERVOIR - VENTED TO ATMOSPHERE	
PRESSURE GAUGE	

DOUBLE-ACTING CYLINDER	

ENCLOSURE	
SPRING	
PEDAL OR TREADLE OPERATED	
DETENTED SPOOL (w/POSITION OF DETENT)	
MANUALLY OPERATED SPOOL	
PUSH-PULL LEVER OPERATED SPOOL	
CHECK VALVE	
PRESSURE RELIEF VALVE	
FIXED RESTRICTION	
VARIABLE RESTRICTION	
ORIFICE PLATE (FREE FLOW)	
BASIC: 3-POSITION SPOOL (4-WAY)	
TANDEM CENTER SPOOL	
CLOSED CENTER SPOOL	
OPEN-CENTER SPOOL	
FLOAT SECTION OF SPOOL	

Fig. 3 — Meanings of Graphic Symbols Used to Explain Circuit Diagrams

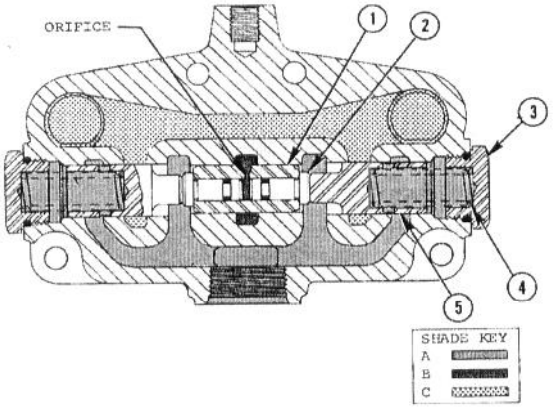

Fig. 4 — Principal of Flow of Anti-Cavitation Return Plate During "Replenishing"

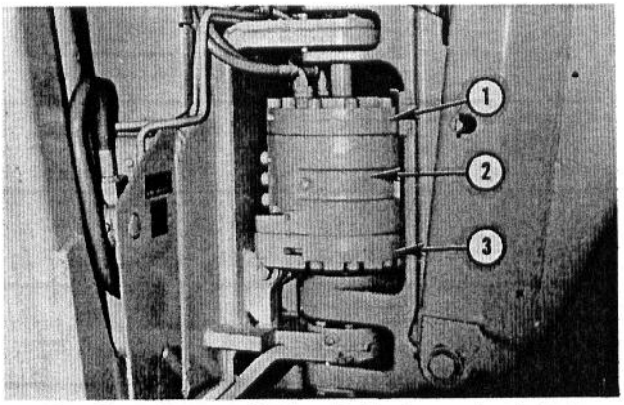

Fig. 5 — Rotary Swing Cylinder — Installed on MF 54A Backhoe

1. Top Plate Assembly
2. Barrel (and Vane) Assembly
3. Bottom Plate Assembly

4. BOOM, DIPPER, BUCKET AND STABILIZER CYLINDERS ... are all double-acting (single rod) type but vary in bore and stroke. The cylinders connect to the valve ports as illustrated in Figs. 1 and 2. The boom cylinder contains a dampening sleeve which acts to cushion it at the extension of its stroke (i.e.: when lowering) ... for this sleeve to work correctly, the cylinder must be installed so that the words "Port Side", stamped on the clevis end of the rod, faces the same side as the cylinder's hydraulic line connection. Both stabilizer cylinders contain a lock-out valve, installed into the head of the cylinders ... these valves "lock" the pressure into the cylinder so as to prevent settling of the Backhoe.

5. ROTARY CYLINDER ... is used to swing the Backhoe, see Fig. 5. This cylinder is divided into two (2) compartments by a moving vane and a stationary vane. The top plate of the cylinder contains two adjustable circuit reliefs (which prevent overloads when swinging in either direction) and anti-cavitation poppet valves. Refer to the servicing procedures pertaining to the cylinder ... identified by its MF Part Number ... for additional information.

6. EXTENDABLE DIPPERSTICK ("Digmor") ... may be found installed on some models of the MF 54A. This dipperstick has an internal sliding member which is lengthened (and shortened) by a double-acting hydraulic cylinder. When this dipperstick is installed, the Backhoe control valve will contain 7 (seven) "working" sections ... this extra valve section is installed between control valve inlet plate and first normal "working" section.

TROUBLE-SHOOTING

Efficient and effective trouble-shooting depends upon knowledge of the system and its functioning components. When possible, perform operational checks and tests to isolate the problem before attempting to remove, or disassemble the components. Always check the easiest things first.

TROUBLE-SYMPTOMS

Select the symptom *most like* the problem encountered. Check that reservoir oil level is correct and the recommended type oil is being used.

CAUTION: Before attempting to connect testing equipment into the system (or any circuit) make certain that all pressure is relieved by operating the control levers back and forth several times (with engine not running).

1. ALL BACKHOE OPERATIONS TOO SLOW

A. Oil too cold, or engine speed too slow ... allow oil to heat to its normal temperature and operate engine at its recommended rpm.

B. Low oil supply, improper type of oil in system, or oil is contaminated ... fill reservoir to correct level and use only the recommended type oil in the system. If oil is contaminated, change oil and filter.

C. Restriction in pressure line between pump and Loader control valve, or between Loader and Backhoe control valve ... check for kinked or damaged hoses. If "quick couplers" are used, be sure they are of the proper flow rate capacity and do not restrict the oil flow.

D. Restriction in pump suction line, air in system, or filter element dirty ... check for damaged or obstructed suction line and make sure connections are tight. Make certain that filter element is not clogged and is of the correct micron size.

E. Hydraulic pump worn, or damaged pump drive ... test pump for efficiency. Make certain that pump drive shaft is not damaged.

F. Check valve (used with anti-cavitation return plate) in pressure inlet plate of Backhoe valve not seating properly ... Remove valve cartridge, clean and inspect seat of poppet. Replace if necessary.

G. Main relief valve malfunctioning ... check relief valve opening pressure (located in Loder control valve). Replace or adjust relief valve, if necessary.

2. ALL BACKHOE OPERATIONS LACK POWER

A. Low oil supply, improper type of oil in system, or oil is contaminated ... fill reservoir to correct level and use only the recommended type oil in the system. If oil is contaminated, change oil and filter.

B. Restriction in pressure line between pump and Loader control valve, or between Loader and Backhoe control valve ... check for kinked or damaged hoses. If "quick couplers" are used, be sure they are of the proper flow rate capacity and do not restrict the oil flow.

C. Restriction in pump suction line, air in system, or filter element dirty ... check for damaged or obstructed suction line and make sure connections are tight. Make certain that filter element is not clogged and is of the correct micron size.

D. Hydraulic pump worn, or damaged pump drive ... test pump for efficiency. Make certain that pump drive shaft is not damaged.

E. Check valve (used with anti-cavitation return plate) in pressure inlet plate of Backhoe valve not seating properly ... Remove valve cartridge, clean and inspect seat of poppet. Replace if necessary.

F. Main relief valve malfunctioning ... check relief valve opening pressure. Replace or service relief valve, if necessary.

3. LOSS OF POWER IN ONE CIRCUIT ONLY (Other Circuits Normal)

A. Circuit relief valve malfunctioning ... check relief pressure setting and make certain its "O"-rings are not damaged. Adjust as necessary to the correct pressure setting. Replace relief valve, if required.

B. Cylinder packing (or seals) badly worn ... if test indicates, service cylinder as necessary.

4. SWING CYLINDER "DRIFTS" WITH CONTROL VALVE IN NEUTRAL

A. Circuit relief valve malfunctioning ... check relief pressure setting and make certain its "O"-rings are not damaged. Adjust as necessary to the correct pressure setting. Replace relief valve, if required.

B. Cylinder packing (or seals) badly worn ... if test indicates, service cylinder as necessary.

C. Anti-cavitation poppets not seating ... remove upper end plate and replace poppets, Check for broken or weak poppet springs.

D. Control valve spool not returning to "Neutral" ... check that spool linkage is not binding, centering spring is not broken and that control valve tie bolts are not causing spool to bind.

E. Worn control valve spool (excessive clearance) ... if test indicates, replace valve working section (for circuit).

F. Anti-cavitation type swing spool malfunctioning ... remove spool and check that integral

checks are seating correctly. Replace parts as necessary.

5. BACKHOE OVERSWINGS AFTER CONTROL LEVER IS RELEASED

A. Control valve spool not returning to "Neutral" ... check that spool linkage is not binding, centering spring is not broken and that control valve tie bolts are not causing spool to bind.

B. Circuit relief valve malfunctioning ... check relief pressure setting and make certain its "O"-rings are not damaged. Adjust as necessary to the correct pressure setting. Replace relief valve, if required.

C. Restrictors are reversed, or damaged ... position restrictors (orifice plates) properly. Replace restrictors as necessary.

D. Anti-cavitation type swing spool malfunctioning ... remove spool and check that integral checks are seating correctly. Replace parts as necessary.

6. CYLINDER(S) "SETTLES" WITH CONTROL VALVE IN NEUTRAL

A. Circuit relief valve malfunctioning ... check relief pressure setting and make certain its "O"-rings are not damaged. Adjust as necessary to the correct pressure setting. Replace relief valve, if required.

B. Cylinder packing (or seals) badly worn ... if test indicates, service cylinder as necessary.

C. Control valve spool not returning to "Neutral" ... check that spool linkage is not binding, centering spring is not broken and that control valve tie bolts are not causing spool to bind.

D. Worn control valve spool (excessive clearance) ... if test indicates, replace valve working section (for circuit).

7. BOOM DROPS WHEN CONTROL VALVE IS "FEATHERED"

A. Lift check (integral to control valve) malfunctioning ... repair or replace as necessary.

8. SWING DOES NOT START, OR STOP SMOOTHLY (Also See Numbers 4,5 and 9)

A. Mechanism not properly adjusted ... adjust swing cushioning.

B. Dampening mechanism damaged, or stuck ... repair mechanism as necessary.

c. Oil too cold, or engine speed too slow ... allow oil to heat to its normal temperature and operate engine at its recommended rpm.

D. Main relief valve malfunctioning ... check relief valve opening pressure. Adjust or replace relief valve, if necessary.

E. Control valve spool not returning to "Neutral" ... check that spool linkage is not binding, centering spring is not broken and that control valve tie bolts are not causing spool to bind.

9. SWING (CONTAINING HYDRAULIC DAMPENING) DOES NOT DAMPEN PROPERLY

A. Mechanism not properly adjusted ... adjust swing cushioning.

B. Dampening mechanism damaged, or stuck ... repair mechanism as necessary.

C. Restrictors are reversed, or damaged ... position restrictors (orifice plates) properly. Replace restrictors as necessary.

10. BOOM RAISES SLOWLY AND DROPS TOO FAST

A. Anti-cavitation return plate malfunctioning ... service return plate section of valve.

B. Restrictors (if used) are reversed, or damaged ... position restrictors (orifice plates) properly. Replace restrictors as necessary.

11. BOOM AND DIPPERSTICK HESITATE WHEN DROPPED RAPIDLY (Other Cylinders Function Properly)

A. Anti-cavitation return plate malfunctioning ... service return plate section of valve.

B. Anti-cavitation type swing spool malfunctioning ... remove spool and check that integral checks are seating correctly. Replace parts as necessary.

12. BOOM CYLINDER CHATTERS AS IT IS LOWERED

A. Anti-cavitation return plate malfunctioning ... service return plate section of valve.

B. Check valve (used with anti-cavitation return plate) in pressure inlet plate of Backhoe valve not seating properly ... Remove valve cartridge, clean and inspect seat of poppet. Replace if necessary.

C. Oil too cold, or engine speed too slow ... allow oil to heat to its normal temperature and operate engine at its recommended rpm.

13. CYLINDER(S) CAVITATE

A. Low oil supply, improper type of oil in system, or oil is contaminated ... fill reservoir to correct level and use only the recommended type oil in the system. If oil is contaminated, change oil and filter.

B. Restriction in pressure line between pump and Loader control valve, or between Loader and Backhoe control valve ... check for kinked or damaged hoses. If "quick couplers" are used, be sure they are of the proper flow rate capacity and do not restrict the oil flow.

C. Restriction in pump suction line, air in system, or filter element dirty ... check for damaged or obstructed suction line and make sure connections are tight. Make certain that filter element is not clogged and is of the correct micron size.

D. Hydraulic pump worn, or damaged pump drive ... test pump for efficiency. Make certain that pump drive shaft is not damaged.

E. Restrictors (if used) are reversed, or damaged ... position restrictors (orifice plates) properly. Replace restrictors as necessary.

F. Anti-cavitation return plate malfunctioning ... service return plate section of valve.

14. STABILIZER CYLINDER CHATTERS WHEN RAISED

A. Restrictors (if used) are reversed, or damaged ... position restrictors (orifice plates) properly. Replace restrictors as necessary.

B. Oil too cold, or engine speed too slow ... allow oil to heat to its normal temperature and operate engine at its recommended rpm.

C. Malfunctioning lockout valve section (of cylinder) ... repair as needed.

15. EXCESSIVE FAILURE OF CYLINDERS

A. Main relief valve malfunctioning ... check relief valve opening pressure. Repair or replace relief valve, if necessary.

B. Circuit relief valve malfunctioning ... check relief pressure setting and make certain its "O"-rings are not damaged. Adjust as necessary to the correct pressure setting. Replace relief valve, if required.

C. Cylinders not properly reassembled ... cylinders should be serviced per recommended instructions.

16. CYLINDER(S) OPERATE INCORRECTLY (Cylinder Moves In Wrong Direction)

A. Hoses between valve and cylinder ports connected wrong ... reconnect hoses to correct valve ports.

17. EXCESSIVE BREAKAGE OF HOSES

A. Hoses not properly installed ... install hoses so they are not twisted or kinked.

B. Main relief valve malfunctioning ... check relief valve opening pressure. Repair or replace relief valve, if necessary.

18. VALVE SPOOL(S) DO NOT RETURN TO NEUTRAL (Sticking Spools)

A. Misaligned or binding linkage, centering spring broken, foreign material in spool bore, and/or tie bolts improperly torqued ... service valve as required.

19. EXTERNAL LEAKAGE AROUND CONTROL VALVE

A. Tie bolts not properly tightened, damaged seals between sections, on plugs or in spool bore, and/or damaged seals in valve working ports ... repair as necessary.

20. HYDRAULIC PUMP NOISY (Also See "Loader" Section of Manual)

A. Check valve (used with anti-cavitation return plate) in pressure inlet plate of Backhoe valve not seating properly ... Remove valve cartridge, clean and inspect seat of poppet. Replace if necessary.

B. Refer to "Loader" trouble-shooting section of manual for additional possible causes.

TESTS AND ADJUSTMENTS

The following information should be obtained to determine the specific cause of a malfunction ... record and compare all readings with those specifications appropriate to the Backhoe:

1. Operational check of Backhoe (performance check).

2. Pump gpm ... check per recommended procedures detailed under "Tests and Adjustments" in "Loader" section of this Manual.

3. Location and pressure setting of main relief valve ... see "Tests and Adjustments" in "Loader" section of this Manual.

4. Location and pressure settings of all circuit relief valves ... see "Testing Circuit Reliefs" within THIS section of the Manual.

The Backhoe hydraulic system may be tested with a pressure gauge (the gauge should be capable of reading at least 3000 psi ... DO NOT USE A SMALLER CAPACITY GAUGE THAN THE ONE RECOMMENDED). Internal leakage past the control valve spools and the cylinder packing may be checked by observing certain operations.

CAUTION: Make certain that removal of a plug or disconnection of a line will not cause injury to anyone working on, or around the machine.

OPERATIONAL CHECK OF BACKHOE

If possible, an operational check of the Backhoe should be performed to obtain an indication of its condition. The following characteristics should be observed:

1. The control valve should maintain a POSITIVE CONTROL over all Backhoe operations ... check circuit reliefs, "load checks", spool leakage and spool travel (if condition is in doubt) ...

a. It should be possible to operate more than one circuit at the same time without losing pressure within the circuits ... a malfunction usually indicates a faulty "load check".

b. The valve spools are to return to neutral position when the control levers are released ... failure of a spool to return to neutral may be due to a broken spool centering spring, binding of the control lever, or misaligned linkage.

c. Spool travel, from neutral, should be 7/16" (0.44") into and out of the "working section".

d. When the control levers are in neutral, the cylinders should hold their position ... spool leakage will allow cylinders to "settle", or drift (faulty cylinder packing, or circuit reliefs, will also cause this condition).

2. The boom should "dampen out" towards the end of its lowering cycle without evidence of cavitation ...

a. If cylinder does not "dampen out", check that "Port Side" stamping at rod clevis is facing downward (i.e.: at the same side of the cylinder as its port connections).

b. If cylinder appears to be cavitating, check the anti-cavitation poppet in the boom working section of the control valve for damage. Also check the condition of the internal parts within the anti-cavitation return plate of the valve.

3. The stabilizers should hold without allowing the Backhoe to "settle" and there should be no chatter when they are raised ...

a. If stabilizers do not hold, check their internal lockout valves for damage.

b. Chattering may be caused by damaged lockout valves.

4. The Backhoe should not "drift" to either side when it is raised clear of the ground ... see "Operational Check of Swing".

5. If all Backhoe operations seem generally slow, check the hydraulic pump for efficiency.

6. If the Backhoe seems to have a lack of power ...

a. A faulty main relief valve will usually cause a general lack of power within ALL circuits. A general lack of power can also be caused by a bad check valve within the inlet port plate (used in conjunction with the anti-cavitation return port plate).

b. A faulty circuit relief, or worn cylinder packing, will usually cause a lack of power within ONE circuit only.

7. There should be no evidence of cylinder cavitation during any of the Backhoe operations ...

a. Cavitation of *more than one* cylinder may indicate a malfunctioning anti-cavitation return plate (or a worn pump).

b. Cavitation of *only one* cylinder may be due to reversed restrictors that may be installed in the circuit.

8. Slow, or jerky, operation may be caused by a malfunctioning anti-cavitation return plate, or a worn pump ... also see No. 5.

OPERATIONAL CHECK OF SWING

1. Start engine and use system pressure to raise the boom.

CAUTION: The Backhoe may begin to swing as the bucket clears the ground, if the Backhoe is not level and the swing cylinder is cavitating.

2. Lock the boom in transport position and extend the dipperstick (and bucket) to shoulder height. Shut off engine.

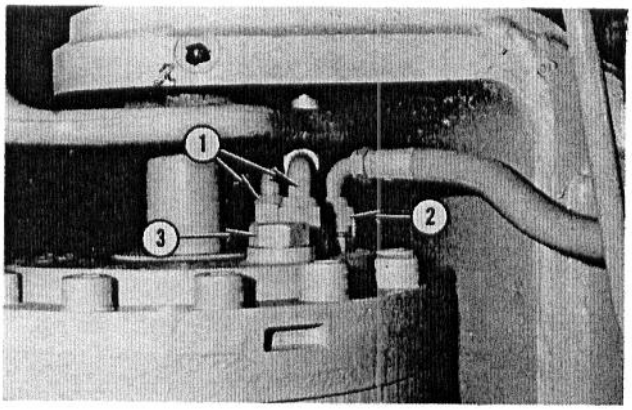

Fig. 6 — Lines Connected to Top of Rotary Cylinder — MF 54A Cylinder Shown

1. "Pressure" Lines
2. Drain Line
3. Circuit Relief — For Right Swing Only (Left Swing Not Shown)

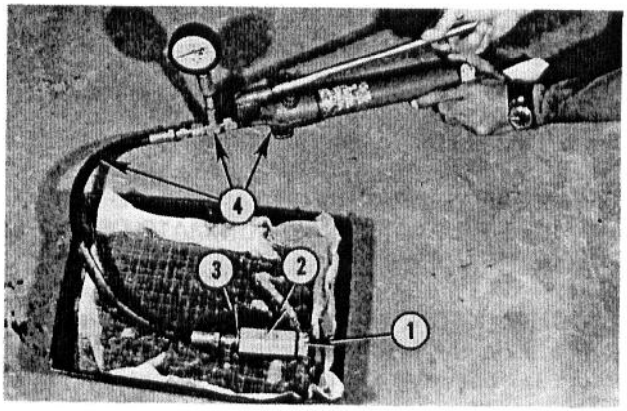

Fig. 7 — Checking Circuit Relief Opening Pressure with Hand Pump

1. Circuit Relief
2. Special Tool Fitting — MFN-50 CSB
3. Speical Fitting — Item No. 13*
4. Hand Pump with Pressure Gauge and Hose Connected

*NOTE: From Test Kit ND-112

3. Disconnect swing cylinder drain line from return line ... see Fig. 6.

4. Push manually against the Backhoe bucket in one direction while observing the disconnected drain line to see if oil is escaping. Push the bucket in the opposite direction and again observe the drain line.

CONCLUSION: If oil escapes and boom can be rotated by hand (with control valve in neutral) either the circuit relief valve, or the anti-cavitation poppets (within swing cylinder) is the source of trouble.

5. If oil is escaping from the drain line (during procedures in step No. 4), isolate the trouble as follows:

a. Remove the circuit relief valves from the swing cylinder and either install plugs in their place, or *new* circuit reliefs KNOWN to be "good".

b. Again perform step No. 4. Any indication of leakage from the drain line will indicate malfunctioning anti-cavitation poppets (within swing cylinder). If there is no leakage from the drain line with new valves (or plugs) installed in the cylinder, proceed to step No. c before blaming the "old" reliefs ... also perform step No. 7.

c. Disconnect the pressure lines from the swing cylinder and cap the cylinder's port fittings. Push manually against the bucket to rotate the boom. If the boom swings (with ports capped) an internal leak inside of the cylinder is indicated. If the boom does not swing, reconnect the two pressure lines and proceed to step No. 6.

6. After all of step No. 5 has been concluded as satisfactory, push against bucket while observing drain line.

CONCLUSION: If boom swings and no oil is escaping from the drain line (and it has been determined in step 5C, that there are no internal leaks in the cylinder) the control valve may be the source of trouble ... which should be indicated by oil leaking from the valve return line at the point where the rotary cylinder drain line connects.

7. If the circuit reliefs (within swing cylinder) are suspected as being faulty, check their pressure settings as follows:

a. With the system returned to normal operating condition, connect a 3000 psi gauge into the test ports at both sides of the cylinder.

b. Run the engine and swing the Backhoe in both directions until the reliefs "blow" ... record the maximum pressure.

CONCLUSION: If swing cylinder MF Part Number 729 829 M91 is installed (MF 54A) the valves should relieve at 2125 psi. If swing cylinder MF Part Number 708 714 M92 is installed (MF 52A) the valves should relieve at 1875 psi.

c. These circuit reliefs may also be checked with MFN50-CSB (now 0072) test fitting, item No. 13 (fitting No. D1) from ND-112 test kit and a hand pump ... remove relief cartridge from rotary cylinder, install in test fitting and pressurize with a hand pump, see Fig. 7.

8. If Backhoe boom overswings after control lever is released (MF 52A) check that restrictors located in rotary cylinder ports are the correct size *and* are installed in the correct position ... slotted side of restrictors downward (i.e.: toward cylinder).

CHECKING AND ADJUSTING SWING CUSHIONING — MF 54A ONLY

1. Check the swing cushioning as follows:

a. Load the bucket with dirt and extend the boom.

b. Swing the boom through its travel arc ... WHILE LISTENING FOR A "HISSING" NOISE DURING THE LAST 30° (APPROXIMATE) OF TRAVEL AT BOTH SIDES.

CONCLUSION: If the "Hissing" noise is not heard on the last approximate 30° of arc ... or is noticeable at an arc greater than 30° ... the swing adjustment should be made per step No. 2.

c. Use the stabilizers to tilt the Backhoe to one side.

d. With boom extended and bucket loaded, swing the boom from side-to-side ... WHILE LISTENING FOR A "HISSING" NOISE DURING THE LAST 90° OF TRAVEL AS THE BOOM MOVES TOWARD THE LOW SIDE.

CONCLUSION: If the "hissing" noise is not heard when performing step No. d ... the adjusting screws should be loosened 1/4 of a turn ... see step No. 2.

2. Adjust the swing cushioning mechanism as follows ... adjustment to clockwise rotation is made in the right-hand port, adjustment to counterclockwise rotation is made in the left-hand port:

a. To gain access to the adjusting screws, the pressure lines that attach to the cylinder ports and their corresponding fittings must be removed from the rotary cylinder, see Fig. 6.

b. After the fittings are removed, the tubular stop must be taken out.

c. When the foregoing procedures are completed, loosen the adjusting screw until the spring beneath it is free to move. (Spring must not rub against screw.)

d. Tighten adjusting screw until contact is *just* made with the spring. After contact is made, turn adjusting screw IN one full turn.

e. Reinstall the tube, fittings and lines ... THEN REPEAT STEP No. 1a, and 1b. Tighten the adjusting screw 1/4 turn (at a time) until the hissing noise disappears on all but the last 30° of swing arc (on both sides). Repeat steps No. 1c and 1d to check final adjustment.

NOTE: The tube installed in both of the pressure ports must be positioned so that the flared end of the tube is upward. The fittings in both pressure ports must be installed so that they extend into the cylinder port 1/2" (± 1/32") approximate.

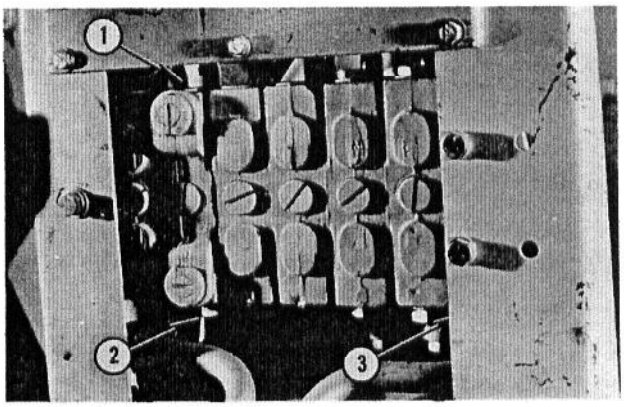

Fig. 8 — Location of Circuit Reliefs In Boom and Dipperstick Working Sections of Control Valve — Dress Console Removed

1. Boom Head-End Circuit Relief
2. Boom Rod-End Circuit Relief
3. Dipper Head-End Circuit Relief (Hidden From View)

CHECKING SYSTEM MAIN PRESSURE

The system's main relief valve is located within the Loader's control valve ... see "Loader" section of this Manual for detailed procedures and pressure settings.

TESTING CIRCUIT RELIEFS

1. The circuit reliefs installed in the swing cylinder may be checked per step No. 7 under the sub-heading "Operational Check of Swing". The reliefs installed in swing cylinder — MF Part Number 729 829 M91 (MF 54A) may be disassembled, adjusted and reassembled per the procedures for "Adjustable Type 32042 Relief Valve" (under sub-heading "Adjusting Circuit Reliefs"). If swing cylinder MF Part Number 708 714 M92 is installed, refer to "Circuit Reliefs In — MF 708 714 M92" for procedures.

NOTE: These reliefs may also be tested per step No. 2c, under THIS sub-heading (procedures for checking circuit reliefs in control valve "working" sections ... but different settings.)

2. The circuit reliefs installed in the boom and dipperstick working sections of the Backhoe control valve, see Fig. 8, and the extendable dipperstick ("Digmor") working section may be checked as follows (perform No. A and No. B, or No. C):

EITHER

a. Connect a suitable hand pump with pressure gauge into the circuit containing the relief to be checked. If boom circuit, connection to be made in line to cylinder at boom area ... if dipperstick circuit, connection may be made at external line

connection to dipperstick cylinder ... if extendable dipper (i.e.: "Digmor") connection to be made in external line to "extension" cylinder.

NOTE: Cylinder to be disconnected from line and hand pump connected to line leading back to controlling circuit relief ... see Figs. 1 and 2.

b. With the controlling spool in neutral, pressurize the port. Record the opening pressure of the relief. When the relief opens, the pressure gauge reading will begin to decrease.

OR

c. Remove circuit relief from valve "working" section (see Figs. 1 and 2) ... then install relief in test fitting 0072 (formerly MFN 50-CSB) and connect hand pump (with pressure gauge) to test fitting using item No. 13 (fitting No. D1) from ND-112 test kit, see Fig. 7. Use hand pump to pressurize circuit relief and record opening pressure indicated on gauge.

CONCLUSION: The prssure setting of these reliefs should be 2800-2925 psi, if used in boom, or dipperstick ... and 2175-2300 psi if used in extendable dipperstick working section. These reliefs may be disassembled, adjusted and reassembled per the procedures for "Adjustable Type 32042 Relief Valve" (under sub-heading "Adjusting Circuit Reliefs").

ADJUSTING CIRCUIT RELIEFS

The adjustable category of circuit relief valves may be identified by the design of the cartridge, or by a series of numbers stamped on the head of the valve. Identification of relief valve category by design characteristics may be made by removing the valve from its port and observing the large crossholes through the cartridge (nearest the "cap" end). If a large spring is visible, the valve may be adjusted.

The circuit reliefs installed in control valve "working" sections and in rotary cylinder MF Part No. 729 829 M91 (for MF 54A) are Adjustable "type 32042" ... the circuit reliefs installed in rotary cylinder MF Part No. 708 714 M92 (for MF 52A) are also adjustable type. Check service bulletins and parts book for *current* application.

ADJUSTABLE "TYPE 32042" RELIEF CARTRIDGE

If the numbering series stamped on the head of the valve is "32042" the valve may be identified as adjustable. (Information: Two letters may also appear

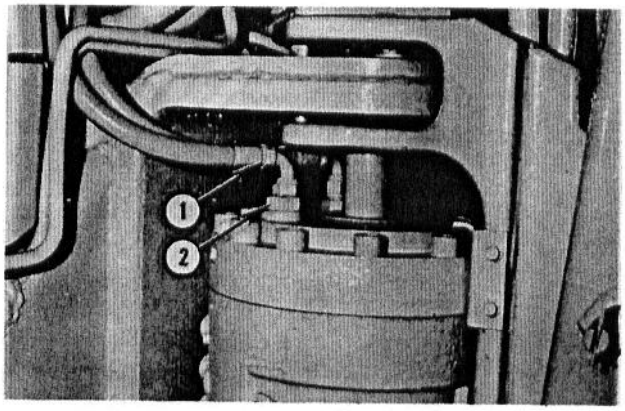

Fig. 9 — Circuit Relief at Right Side of Vane — MF 54A Rotary Cylinder

1. Line to Right Side of Vane (Left Swing)
2. Circuit Relief (Left Swing)

after the identifying number of the valve. The last letter designates the flow rate capacity of the valve. If the letter "A" is the last suffix letter, the valve has a 3 gpm rating; if the last letter is "B", the valve has a 15 gpm rating, and if the last letter is "C", the valve has a 6 gpm rating. In some cases, a letter then a number will appear after the identifying number of the valve — the last number denotes gpm rating. Stamped under the identifying number of the valve will be its pressure setting.) Use only the recommended relief valve, see Figs. 8, 9 and 10.

1. Thoroughly clean the relief valve cartridge with a suitable solvent and blow dry with compressed air.

2. Disassemble this relief valve as follows ... see Fig. 11.

IMPORTANT: Carefully note the sequence of parts (and their relationship to the "hex" end

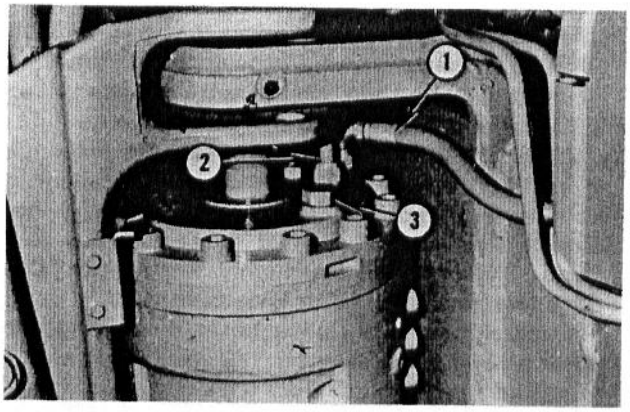

Fig. 10 — Circuit Relief at Left Side of Vane — MF 54A Rotary Cylinder

1. Drain Line
2. Line to Left Side of Vane (Right Swing)
3. Circuit Relief (Right Swing)

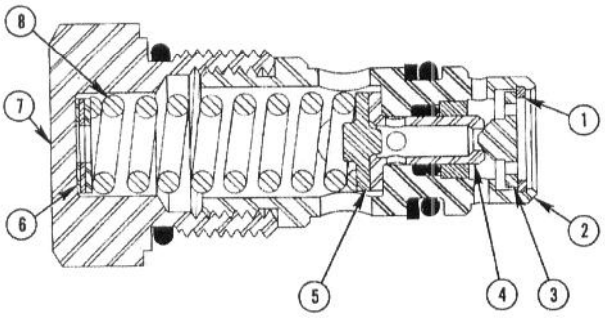

Fig. 11 — Cutaway Typical of "32042" Relief Valve

1. Snap Ring
2. Plug Assembly
3. Relief Valve Poppet
4. Poppet Seat
5. Spring Guide (Seat)
6. Shims
7. Main Cartridge
8. Spring

of the main cartridge) as they are removed from the valve. This will aid in correct reassembly of the valve.

a. Remove snap ring, then remove poppet from plug assembly.

b. Carefully unscrew plug assembly from main cartridge (a small spanner wrench may be used).

CAUTION: Plug assembly is spring-loaded — use care when removing.

c. Remove the poppet seat, which may remain with either the plug assembly or on top of the spring guide.

d. Remove the "O"-ring and back-up washer from inner bore of plug assembly.

e. Remove spring guide, spring and shims from main cartridge. (Count the number of shims removed, as this same number and thickness of shims is to be reinstalled, *unless* the valve is to be adjusted. Adding shims increases, and removing shims decreases, the pressure setting of the valve.)

3. Reassemble this relief valve as follows:

a. Inspect the poppet and its seat for evidence of pits, or other damage, that may prevent it from seating properly. Check that spring is not broken. Replace all worn or damaged parts and clean all metal parts thoroughly. Replace all "O"-rings and back-up washer with new parts.

b. Install new back-up washer and "O"-ring into inner bore of plug assembly. "O"-ring is to be next to poppet side of plug.

c. Insert shims (the same ones that were removed, unless valve is being adjusted) into main cartridge — then insert spring into cartridge and place spring guide on top of spring.

d. Insert poppet seat into inner bore of plug assembly — then screw plug assembly firmly into main cartridge.

e. Insert poppet into open end of plug assembly with the "button" end (i.e.: conical side) of poppet towards its seat. Secure with snap ring. (The slightly beveled side of snap ring is to be towards poppet.)

f. Install new "O"-ring onto main cartridge ... then install new back-up washers and "O"-ring into their outer groove on plug assembly.

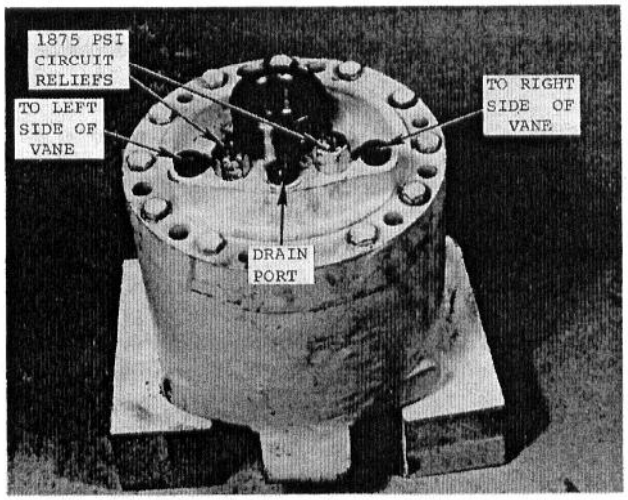

Fig. 12 — Location of Circuit Reliefs in Rotary Cylinder MF Part No. 708 714 M92 (For MF 52A)

CIRCUIT RELIEFS IN MF PART NO. 708 714 M92 (MF 52A ROTARY CYLINDER)

See Fig. 12 for location of relief cartridges.

1. Thoroughly clean the relief valve cartridge and blow dry.

2. Disassemble this relief valve as follows: ... see Fig. 13:

a. Unscrew plug with "O"-ring from cartridge.

b. Tip plug end of cartridge downward to allow shims (if used), poppet guide, spring and poppet to drop out. Separate these parts.

3. Inspect the poppet and its seat (within cartridge) for evidence of pits, or other damage, that may pre-

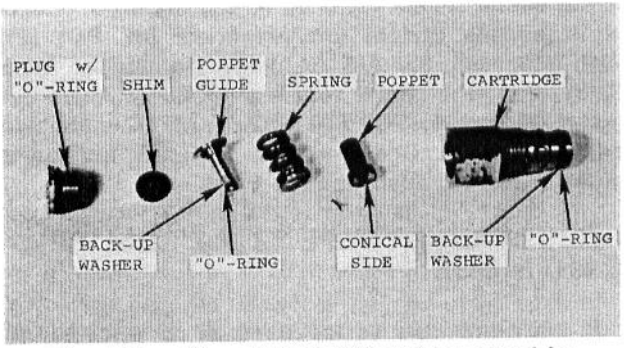

Fig. 13 — Circuit Relief Cartridge Used In MF Part No. 708 714 M92

vent it from seating properly. Replace seals and worn, or damaged parts.

4. Reassembly of the circuit relief is basically the reverse of disassembly ... however the following points should be observed:

a. Reinstall the same number and thickness of shims, *unless* the valve is to be adjusted. Adding shims increases, and removing shims decreases, the pressure setting.

b. The conical side of the poppet is to face inward (to cartridge).

c. Preassemble the poppet, spring and poppet guide ... then insert them into cartridge ... using care to prevent damage to the "O"-ring and back-up washer on the guide.

TESTING "LOAD CHECKS"

The Backhoe control valve has "load checks" for each working section (i.e.: 6 or 7). These checks may be tested by the following procedures.

1. Run the engine at a low rpm (without stalling) and slowly move the control lever to operate the circuit to be checked. Pressurize the cylinders in the direction that requires the greatest amount of force against the mechanical leverage of the Backhoe, (i.e.: raise boom, etc.)

EITHER

2. Operate one of the other circuits while still slowly activating the one being checked and observing the action of its cylinder.

OR

3. Shut off engine and continue to move control lever to pressurize cylinder in same direction as in step No. 1.

CONCLUSION: If circuit being checked, loses pressure (indicated by a "settling" of the cylinder), the "load check" is faulty. Checking for this pressure loss may also be done with a 3,000 psi gauge in the suspected circuit. If the "load check" is bad, the gauge should indicate a pressure drop, but may quickly recover if engine is running ... this is because pump gpm will soon catch up with the activated circuits.

TESTING FOR VALVE SPOOL LEAKAGE AND CHECKING SPOOL TRAVEL

1. Valve spool travel may be measured from neutral position and should be 7/16" (0.44") into and out of the valve working section.

2. Valve spool leakage may be checked as follows:

EITHER

a. Operate the Backhoe in such a manner as to cause an external load on the spool circuit to be checked (i.e.: raise, boom, etc.). IF SWING CIRCUIT IS BEING CHECKED, PROCEED TO STEP NO. C.

b. Return spool to neutral, *shut-off engine* then carefully disconnect the return line between the Backhoe valve and the reservoir.

CONCLUSION: Oil leakage past the spools will be evident by leakage at the valve return line as the cylinder "settles" ... however, the trouble could be faulty circuit reliefs, therefore these should be checked. If the cylinder "settles" but no oil is leaking from the return line, the trouble could be faulty cylinder packings ... see "Testing for Internal Cylinder Leakage" for additional information.

c. Lower one stabilizer to "cock" Backhoe. Shut-off engine and carefully disconnect the swing cylinder's *drain* line from the return line.

CONCLUSION: Oil leakage from the DRAIN line usually indicates a faulty swing cylinder. Oil leakage from the RETURN line indicates leakage past the valve spool. See "Operational Check of Swing" for additional information (and procedures).

TESTING FOR INTERNAL LEAKAGE OF DOUBLE-ACTING CYLINDERS

The double-acting hydraulic cylinders may be checked for internal leakage (past the seals) through the following procedures:

1. Operate the cylinder and observe its rod for either settling into, or coming out of, the barrel. (It is possible for internal leakage to be in one direction only. Therefore, operate cylinder in both directions and allow enough time for evaluation at each extreme of travel.)

2. If it is determined that cylinder may be faulty, actuate the suspected cylinder until it is *fully extended* (i.e.: rod is extended from barrel).

CAUTION: If operation of cylinder has raised any attached equipment (i.e.: boom, dipper, etc.,) support it adequately.

3. Shut off engine then *carefully* disconnect the hose from the ROD END port of the suspected cylinder.

CAUTION: Use care when disconnecting the hose ... make sure that the correct one is being disconnected. Take all necessary precautions to avoid possible injury.

4. Operate engine and continue to actuate cylinder in SAME DIRECTION (i.e.: *extend* cylinder rod) while observing the rod-end port of the cylinder ... from which the hose was disconnected.)

CONCLUSION: If oil comes out the disconnected port, the cylinder packing is faulty. If no oil comes out the port, but the rod enters the cylinder barrel due to the applied external load of boom, etc.) the trouble may be due to a faulty circuit relief, or a "bad" valve spool.

5. Shut off engine and reconnect the hose to the cylinder's rod-end port.

6. Run engine and actuate cylinder until it is *fully retracted* (i.e.: rod is collapsed into barrel).

CAUTION: See Caution under step No. 2.

7. Shut off engine then *carefully* disconnect the hose from the HEAD-END port of the suspected cylinder.

CAUTION: See Caution under step No. 3.

8. Operate engine and continue to actuate cylinder in SAME DIRECTION (i.e.: retract cylinder rod) while observing the head-end port of the cylinder ... from which the hose was disconnected.

CONCLUSION: If oil comes out the disconnected port, the cylinder packing is faulty. If no oil comes out of the port, but the rod comes out of the cylinder barrel (due to the applied external load of attached equipment) the trouble may be due to a faulty circuit relief, or a "bad" valve spool.

CONTROL VALVE — SERVICING

Many of the servicing procedures (disassembly, adjustments, etc.) may be performed while the valve remains in its mounted position. It will require the judgment of the person performing the servicing to determine the necessity for complete removal of the valve and the extent of disassembly to be done. Make sure that the exterior of the valve is thoroughly clean before disconnecting any lines, or performing other service procedures ... It is good practice to identify the line connections with their appropriate valve ports for ease of proper routing.

CAUTION: Observe all safety precautions (listed at the beginning of this Manual) so as to prevent injury. The control valve weighs approximately 85 pounds and should be adequately supported, especially if it is to be removed from its mounting.

SERVICE INFORMATION

1. Check the position and location of restrictors (if used). Make sure they are installed into their original location and position (if removed).

2. The following service operations may be performed without separating the valve "working sections". (In some instances these procedures do not require complete removal of the control valve from its mounting position. This will depend upon accessibility to the valve.), see Figs. 14 and 15.

a. Main Relief Valve — Replace or repair. This valve is installed in the Loader Control Valve. Refer to "Loader" section for instructions.

b. Circuit Relief Valves — Replace, clean or adjust. Refer to "Adjusting Circuit Relief Valves" under "Tests and Adjustments" to determine identification of valve used and instructions for servicing.

c. "Working Section" spools, spool seals and spool centering spring — Removal. Refer to Figs. 14 and 15 which show typical spool construction.

NOTE: Spools and "working sections" are matched sets. Do not interchange spools.

d. Lift Check Cage, poppet and seals — remove, clean or replace. Figs. 14 and 15 identifies location (installed in each "working section") and shows components of lift check assembly.

e. Anti-cavitation plungers — Replace or clean. This plunger assembly is normally installed in the boom "working section" (towards the center spring end), see Fig. 15.

3. To replace seals between valve "working sections", or to replace complete "working section" with matching spool assembly, or to replace either end plate assembly, it is recommended that the valve be removed from its mounting position. Refer to Figs. 14 and 15 which identifies "working sections" and end plate assemblies. The end plate used as an inlet port plate contains a "one-way" check valve assembly. The end plate used as return port plate contains anti-cavitation valves to be serviced.

DISASSEMBLY OF CONTROL VALVE

See Figs. 14, 15, 16, 17, 18 and 19.

1. "Working section" spools and seals are to be serviced as follows:

The "working section" spools, spool seals (within spool bore), the spool centering spring and the spool itself can usually be removed from the valve, while the valve remains in its mounting position. (It is necessary to disconnect the linkage from the clevis end of the spool.) However, care must be taken to prevent contamination from entering the spool bore, and against the possibility of switching spools.

NOTE: Spools and "working sections" are matched sets. Identify each spool with its respective bore. Do not interchange spools. Do not disassemble spool unless absolutely necessary (i.e.: centering spring broken, etc.).

a. Thoroughly clean control valve assembly.

b. Remove cap from "working section" to expose spring end of spool.

c. Carefully remove the capscrew, which retains centering spring to spool.

d. Remove the retaining washers, spring and seals from the spring end of spool, while noting their sequence and directional relationship to each other. (This will aid in correctly reassembling the spool.)

e. Rotate (twist) spool slightly while withdrawing it from its bore. (Remove spool from clevis end.)

f. Inspect the spool and its bore within the valve "working section" for pits and scratches (or other damage) which will prevent the correct operation of the valve. The valve spools are "matched" to their bores and the only servicing that should be performed around the areas of the "lands" is the careful removal of any burrs. The ends of the valve spools may be polished (to the first "land" only).

g. Remove the seals within the "working section" spool bore and replace with new parts.

h. Carefully insert spool into its matching bore (insert through clevis end of "working section").

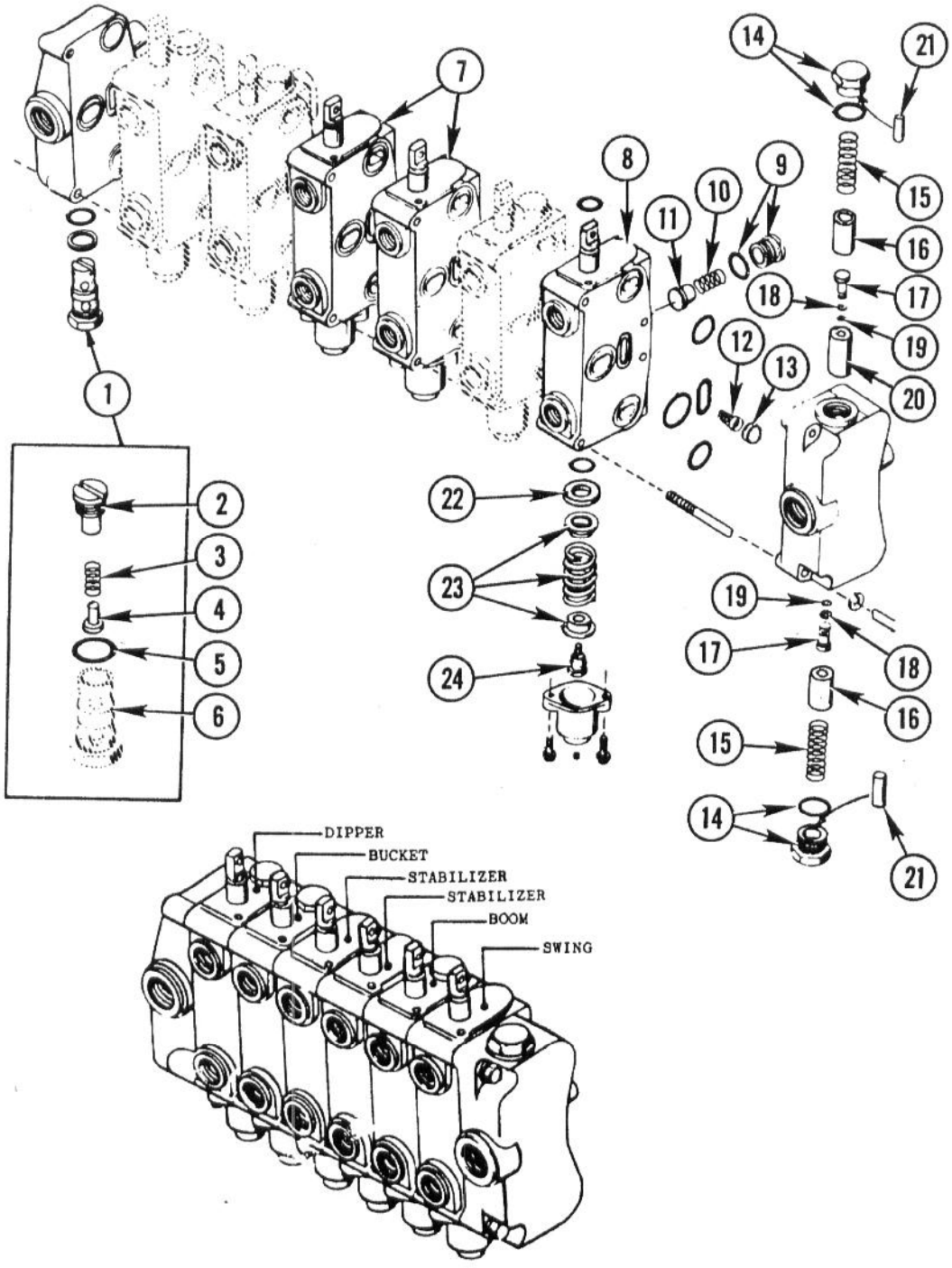

Fig. 14 — End Plates, Swing and Stabilizers Sections of Control Valve

1. One-Way Check Valve
2. Plug
3. Spring
4. Plunger
5. "O"-Ring
6. Cartridge
7. Stabilizer "Working" Sections
8. Swing "Working" Section
9. Load Check Cage (With "O"-Ring)
10. Spring
11. Poppet (Load Check)
12. Filter Screen
13. Orifice Plate (.0135")
14. Plugs (With "O"-Ring)
15. Springs
16. Replenishing Spools
17. Plungers
18. Back-Up Washers
19. "O"-Rings
20. Sleeve
21. Dowel Pins
22. "O"-Ring Retainer (Washer)
23. Centering Springs and Retainers
24. Screw (Spool End)

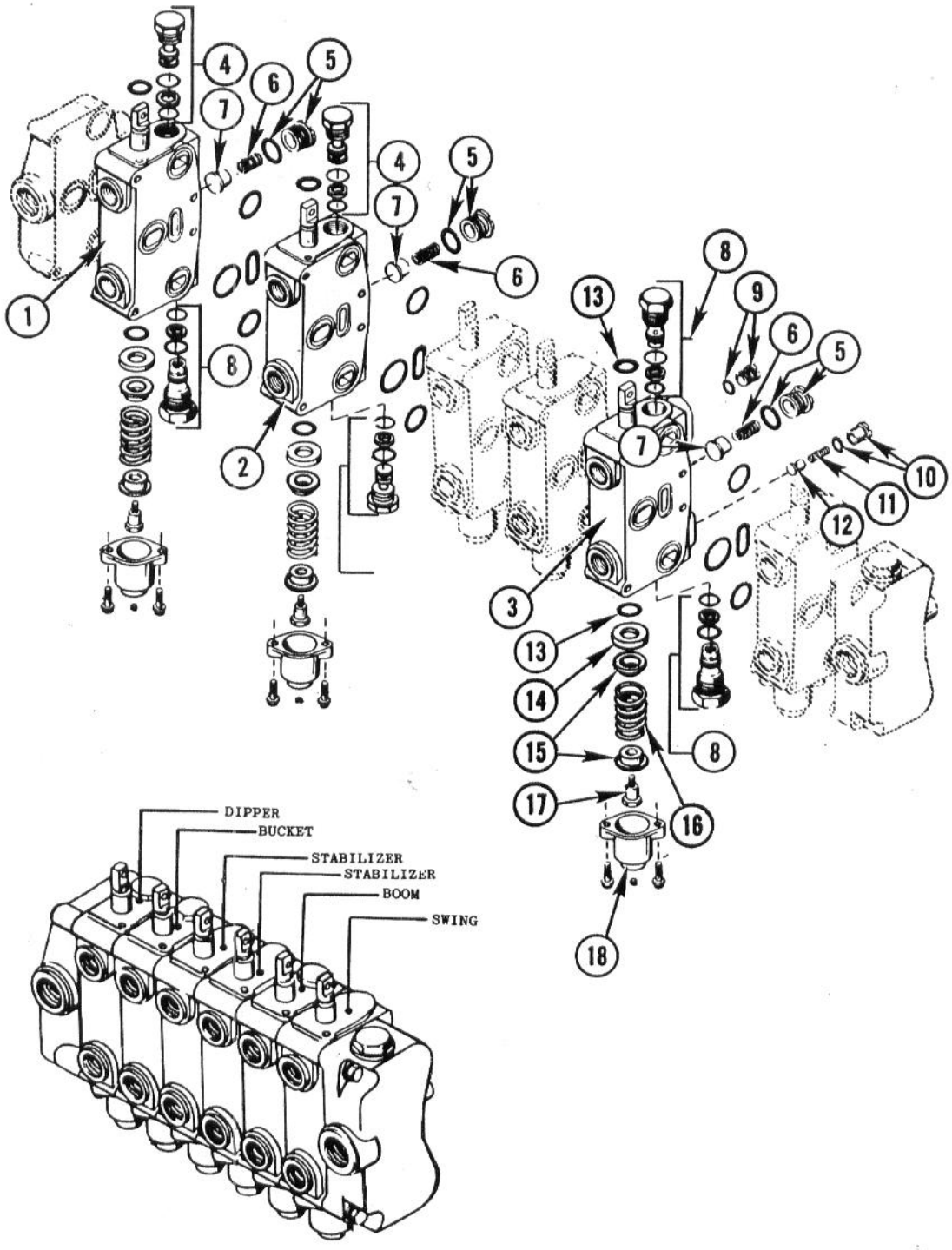

Fig. 15 — Dipperstick, Bucket and Boom Sections of Control Valve

1. Dipperstick "Working" Section
2. Bucket "Working" Section
3. Boom "Working" Section
4. Plug Assembly (With "O"-Rings and Back-Up Washers)
5. Load Check Cage (With "O"-Ring)
6. Spring
7. Poppet (Load Check)
8. Circuit Relief Cartridges
9. Plug (With "O"-Ring)
10. Plug (With "O"-Ring)
11. Spring (Anti-Cavitation)
12. Plunger (Anti-Cavitation)
13. "O"-Rings (Spool)
14. Retainer (Washer)
15. Centering Spring Retainers
16. Centering Spring
17. Screw (Spool End)
18. End Cap

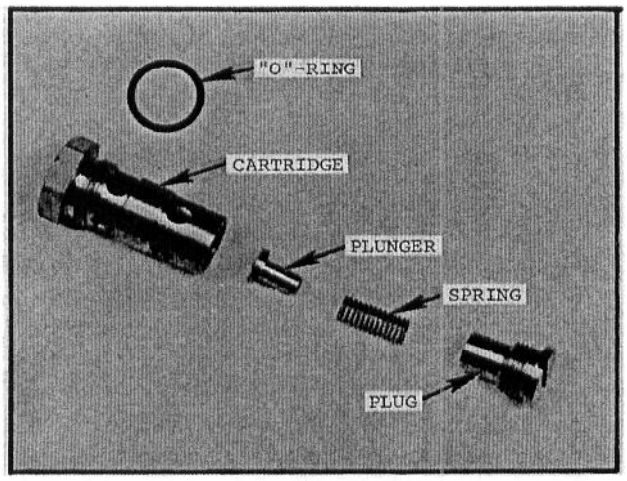

Fig. 16 — Disassembled One-Way Check Valve

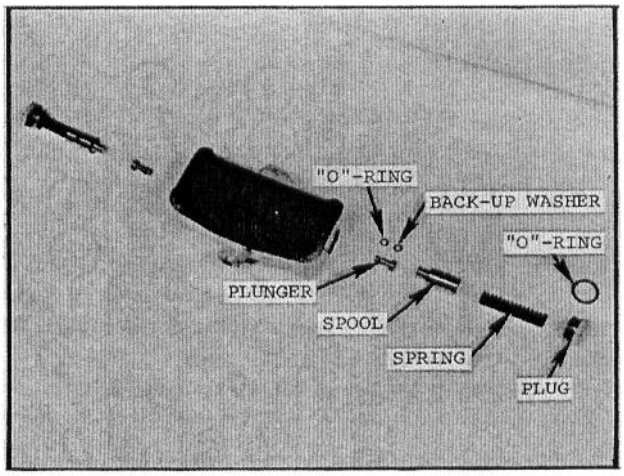

Fig. 18 — Anti-Cavitation Return Plate — Identification of Parts

i. Install the seals, centering springs and retaining washers in their proper sequence and in their correct directional relationship (as noted during their removal).

j. Secure centering spring with its capscrew. Apply "Loctite" (screw lock, identifying color — purple) to threads and tighten capscrew to 5-8 ft.-lbs. torque.

k. Reinstall the end cap to the "working section".

2. Service the one-way check valve installed in inlet port plate as follows ... see Fig. 16:

a. Thoroughly clean the valve cartridge.

b. Carefully unscrew plug from main cartridge.

c. Remove spring and plunger from cartridge.

d. Inspect the plunger and its seat (within main cartridge) for pits or scratches that may prevent plunger from seating properly.

e. Check that spring is not broken.

f. Drop plunger into main cartridge and position spring around plunger — then screw plug firmly into main cartridge.

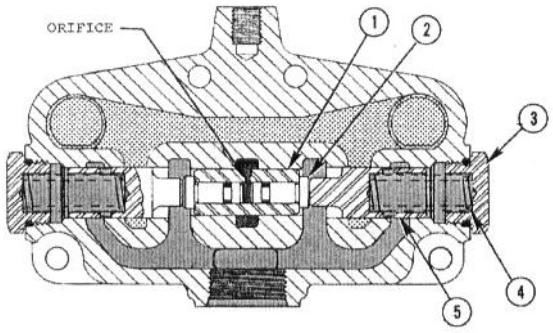

Fig. 17 — Cutaway Illustration of Anti-Cavitation Return Plate

1. Sleeve
2. Plunger
3. Plug
4. Spring
5. Replenishing Spool

g. Install new "O"-ring around main cartridge (near hex end).

3. Service the anti-cavitation return port plate as follows ... see Figs. 17 and 18.

a. Thoroughly clean the outside of the plate to prevent dust and/or dirt from entering the valve.

b. Carefully unscrew the plugs at both ends of the return plate.

CAUTION: Plugs are spring-loaded — take care when removing.

c. Remove spring(s) from inner bore of return plate.

d. Remove replenishing spool(s) from inner bore. If valve is mounted on Backhoe, a brass welding rod (bent to form a hook on one end) may be used to remove replenishing spools.

e. Remove plunger(s) from sleeve. (Plungers may be removed from sleeve while return plate remains bolted to control valve. This may be accomplished by using an approximately 6" length of 1/2" inner diameter (5/8" outer diameter) copper tubing. Use a drift punch to slightly flare one end of the copper tube then "pinch" it approximately 1/2" from the end. This will enable the tube to grip the plunger sufficiently to overcome the "drag" created by the plunger seals. Insert modified copper tube into bore of return plate until it contacts the end of the plunger. Tap lightly on protruding end of the copper tube to "grip" the plunger then extract the tube and plunger from the return plate.)

f. Inspect the bore in return plate for scoring, nicks and scratches.

NOTE: The sleeve is permanently installed within bore of return plate and contains an orifice through which oil flows to "reset" the

replenishing spools after cavitation has been aleviated. If sleeve becomes damaged (or worn) to the extent that oil can escape around the plungers (this would be evidenced by failure of the replenishing spools to reset), it will be necessary to replace the entire return plate assembly.

g. Check that the springs are not broken, the replenishing spools contain no nicks, or scratches, to prevent their correct operation, and that plungers are not excessively worn or damaged. Clean all metal parts thoroughly.

NOTE: The removal of orifice plate and/or filter screen illustrated in Fig. 14 ... requires separation of return plate from valve "working section". See Note under Step No. 3f.

h. Install new back-up washer and new "O"-ring into groove on plungers. Back-up washer is to be closest to the large "head" of plunger.

i. Insert plunger(s) into sleeve bore. (The modified piece of copper tubing may be used to install plungers.) Wedge the "head" of the plunger slightly into the copper tube. Insert plunger and tube into bore until the plunger enters the sleeve. Twist the copper tube slightly while withdrawing it from the plate bore. The plunger should remain inside the sleeve.

j. Insert the replenishing spool(s) into the return plate with its reduced diameter toward the plunger — then insert spring(s) into replenishing spool(s).

k. Install new "O"-ring on plug(s) and screw plug(s) firmly into the threaded end of plate bore(s).

4. Service the "load check" poppet valves as follows ... see Figs. 14 and 15:

a. Remove check cage (plug) from "working section".

b. Carefully remove the remaining parts of the "load check" assembly while making note of the sequence in which they are removed, as well as their directional relationship to the cage. (The plunger will seat internally to the "working section".)

c. Inspect the check plunger and its seat for pits and scratches which will allow passage of oil around plunger (or nylon ball, if used). If in doubt, replace plunger with new part. Check that spring is not broken.

d. Replace "O"-rings on check plug.

e. Reassemble the lift check assembly into the valve "working section" while making certain that their directional relationship to the cage (as noted in previous step No. b) is correct.

5. Service the circuit relief valves (within "working sections") as follows ... see Fig. 19:

a. Remove circuit relief cartridge from control valve and separate components as shown in Fig. 19.

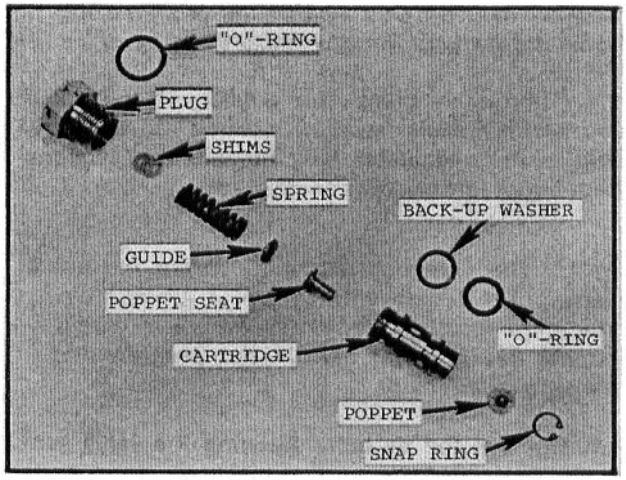

Fig. 19 — Disassembled "32042" Circuit Relief Valve

b. Inspect all components for wear and damage. Replace "O"-rings and back-up washer with new parts. Dip all parts into clean hydraulic oil before installing.

c. Insert shims (the same ones that were removed, unless valve is being adjusted) into main cartridge. Insert spring into cartridge and place guide on top of spring so the larger protrusion is next to spring.

NOTE: Adding shims increases pressure. Removing shims decreases pressure.

d. Insert poppet seat into plug (stem is to be nearer snap ring) and screw the plug assembly firmly into the main cartridge.

e. Insert poppet into plug (with "button" end toward spring) and install snap ring.

f. Install new back-up washer into outer groove on plug. Install new "O"-ring onto main cartridge and into outer groove on plug. ("O"-ring is to be nearer snap ring.)

6. Separate the control valve "working sections" and end plates as follows ... see Figs. 14 and 15:

INFORMATION: This control valve is made up of various types of "working sections" and end plates. These "working sections" are "sandwiched" between end plates and are held in place by tie bolts. Seals are installed between the "working sections" and the end plates to prevent leakage. When any of these seals begin to leak (as evidenced by oil on the exterior of the valve from between the mating surfaces of the "working sections") it is necessary to remove the complete valve assembly from the Backhoe, separate the valve and install new seals. New seals should always be installed be-

tween each "working section" at any time the valve is separated (for any reason).

a. Thoroughly clean the outside of the valve and identify each "working section" in relationship to the end plates (i.e.: number the sections from either left or right, as desired).

NOTE: The "working sections" within the assembly are designed to control a specific circuit of the Backhoe. If these sections are switched, the Backhoe may not function properly and damage could result.

b. Remove the tie bolts securing the valve sections and carefully separate the sections from each other.

c. Remove filter screen and orifice plate from anti-cavitation return plate. Check that screen is not damaged and orifice is not plugged ... orifice size is 0.0135".

d. Inspect the machined surfaces of the valve sections for pits or scratches (or other damage) which may prevent proper sealing between these two surfaces.

e. Remove the seals from between the sections. Thoroughly clean and blow dry the machined surfaces.

NOTE: Do not use a cloth, that may leave lint, to dry these machined surfaces.

f. Apply a light coating of petroleum jelly to the section seals and install seals into their respective grooves.

g. Place inlet port plate, with machined surface "up", flat on work bench. Install a dowel rod slightly longer than the valve "tie bolts" into tapped holes in port plate and carefully stack working sections (in their correct sequence) over "dowel rod" while making certain that the seals do not slip out of their respective grooves.

h. Install orifice plate (large counterbore side out) ... into machined surface of anti-cavitation return plate then press filter screen into orifice plate.

i. Place the return port plate in position against its respective "working" section — install tie bolts (with washers) but tighten only as necessary to hold valve sections in assembly order.

j. Remove "dowel rod" and install remaining tie bolts and washers. Tighten all tie bolts to 25-30 ft.-lbs.

SWING CYLINDER REMOVAL AND INSTALLATION

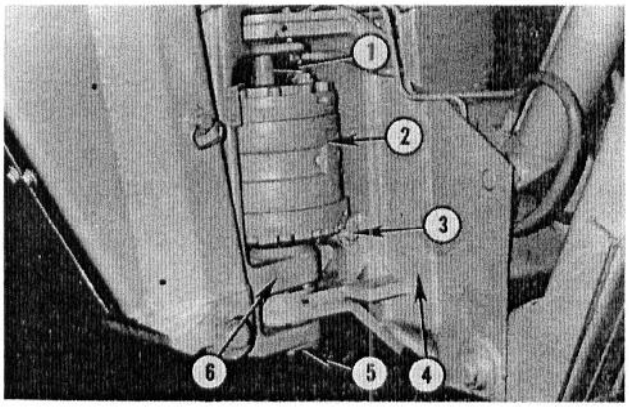

Fig. 20 — Swing Cylinder Installed — MF 54A Backhoe Shown

1. Pin Assembly
2. Rotary Swing Cylinder
3. Cylinder Mounting Bolt (Flat Washers, Nut and Shims as Required)
4. Back Frame (Main Frame)
5. Lower Pivot Pin Assembly
6. Swing Port (Pivot Casting)

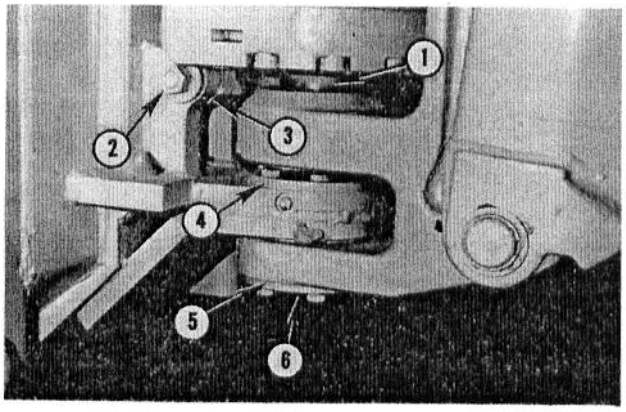

Fig. 21 — Swing Cylinder Lower Pivot Area Mounting

1. Splines on Rotary Cylinder Shaft
2. Retaining Bolt, Flatwashers and Nut (300-350 ft.-lbs.)
3. Shim Area (If Required to Reduce Mounting Clearance)
4. Retainer Plate (Lower Ball Bushing)
5. Lower Pivot Pin
6. Shaft Retaining Bolt and Lockwasher

These cylinders are "cradled" by the main frame (i.e.: back frame) and swing post assemblies (i.e.: pivot casting) as shown in Figs. 20 and 21. The vane shaft (of rotary cylinder) has splines which fit into mating splines in pivot casting ... A bolt is used to secure the vane shaft (at lower end). A pin assembly is installed through the top of pivot casting and back frame assemblies ... This pin protrudes downward into top of rotary cylinder shaft vane. A large bolt, nut and two flatwashers secure the rotary cylinder to the back frame assembly (shims are used between rotary cylinder and weld on back frame to reduce clearance), see Fig. 22.

Orifice plates (restrictors) are installed beneath the inlet fittings of the rotary cylinder used on the MF 52A. These restrictors are used to prevent cavitation (such as when swinging downhill) ... by restricting the oil flow FROM the cylinder (i.e.: slotted side of restrictors to be installed downward ... away from fitting).

A cushioning mechanism is installed in both cylinder inlet ports of the MF 54A Backhoe. Swing cushioning on these Backhoes is accomplished by controlling the inlet pressure to the rotary cylinder ... see "Operation of Cushioning Mechanism ... MF Part No. 729 829 M91" for additional information.

REMOVING ROTARY SWING CYLINDER

Complete removal of the rotary cylinder may not be necessary, depending upon the servicing to be performed. Refer to "Servicing the Rotary Cylinder in Place" for the MF part number cylinder to be serviced.

1. Place the boom, dipperstick and bucket in a "tripod" position at an angle approximately 30° to right of center.

2. Relieve system pressure by operating the control levers back and forth several times with the engine shut off.

3. Thoroughly clean the top of the cylinder, pressure lines and fittings.

4. Disconnect the lines and remove fittings from the top of the cylinder. Plug cylinder ports to keep system clean.

5. Remove the shaft retaining bolt ... then the barrel retaining bolt, see Figs. 20 and 21.

6. Remove the two bolts (with washers) securing the top in assembly in the pivot casting. Carefully pry this pin from the top of the cylinder UNTIL THE BOTTOM EDGE OF THE PIN IS JUST EVEN WITH THE BOTTOM OF ITS HOLE THROUGH THE PIVOT CASTING.

CAUTION: The pin assembly also secures the top of the pivot casting to the main frame, and if removed completely, pivot casting may "tip" forward.

7. Attach a suitable hoist to top of rotary cylinder, and insert special tool MFN 976, wedge between

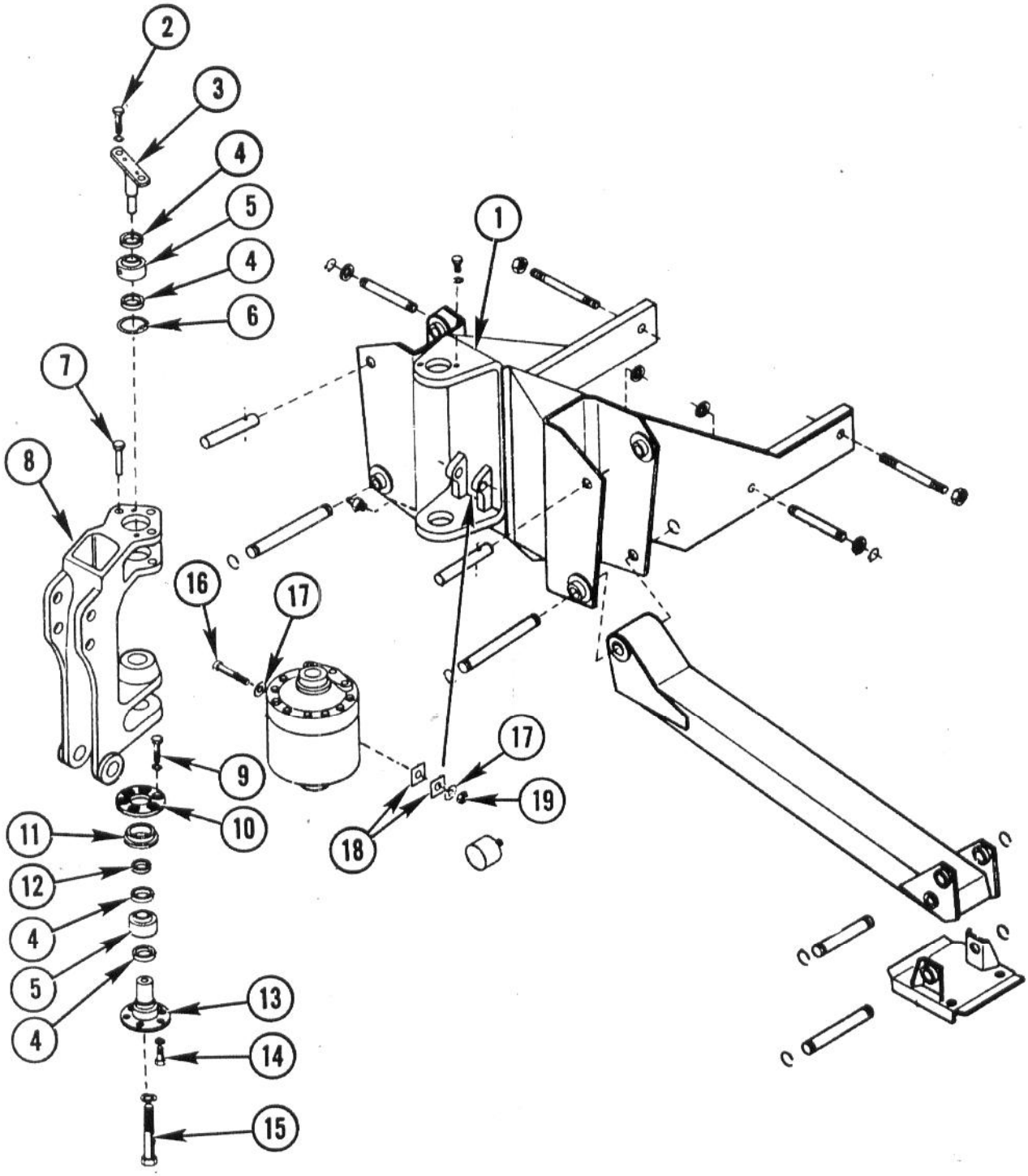

Fig. 22 — Back Frame, Pivot Casting and Rotary Cylinder

1. Back Frame (i.e: Main Frame)
2. Retaining Bolt (With Lockwasher)
3. Pin Assembly — Upper
4. Seals
5. Ball Bushings
6. Retaining Ring
7. Clevis Pin
8. Pivot Casting (i.e.: Swing Post)
9. Capscrews with Lockwashers
10. Retainer Plate
11. Pivot Spacer
12. Spacer
13. Pin Assembly — Lower
14. Capscrew with Lockwashers
15. Bolt and Lockwasher (Shaft Retaining)
16. Retaining Bolt
17. Flatwashers
18. Shims
19. Nut

bottom of cylinder and pivot casting. (Capscrew may be removed from top of cylinder to allow for attaching of a suitable lifting "eye" of chain.)

8. Support the cylinder with the hoist and drive special tool wedge to force splined shaft from pivot casting. Remove cylinder from Backhoe.

INSTALLING ROTARY CYLINDER

1. If rotary cylinder, MF Part Number 729 829 M91 (MF 54A) is being serviced, perform an initial adjustment to the swing mechanism as follows:

a. Carefully remove the tubular stops from the cylinder inlet ports.

b. Loosen the adjusting screws (within inlet ports) until the spring underneath is free to move without rubbing the screw. (A welding rod, bent and flattened to form a hook at one end, may be used to "feel" the point JUST WHERE THE SPRING BECOMES FREE.

c. Tighten the adjusting screw until it JUST CONTACTS the spring, then continue to tighten this screw ONE FULL TURN ONLY.

d. Reinstall the tubular stops into the cylinder's inlet ports ... WITH THEIR FLARED END UPWARD (toward fitting).

e. Perform operations "a" through "d" to both dampening mechanisms ... and install plugs in cylinder ports.

2. Use a suitable hoist to position the rotary cylinder over its mounting adapter, aligning the splines on the cylinder shaft with mating splines in the pivot casting.

NOTE: Apply a good grade of molybdenum disulfide lubricate to splines of shaft.

3. Lower the cylinder into pivot casting, then remove lifting hoist.

4. Push top pin, assembly down until it is against top of pivot casting and inserted into rotary cylinder shaft.

5. Install retaining bolts (with washers) to secure top pin.

6. Install shaft retaining bolt, and tighten to 300-350 ft.-lbs.

7. Install cylinder barrel retaining bolt, flatwasher and self-locking nut and tighten to 300-350 ft.-lbs.

NOTE: Be sure that shaft bolt is tightened before cylinder bolt ... use shims as required between cylinder barrel and weld "cradle" on back frame to reduce clearance to minimum.

8. Install fittings into their respective ports at top of rotary cylinder ... AFTER INSTALLING ORIFICE PLATES IN MF PART NO. 708 714 M92.

NOTE: Fittings installed in MF Part No. 729 829 M91 (MF 54A) must extend approximate 1/2" into inlet ports of cylinder for proper operation of swing cushioning mechanism. Orifice plate (restrictors) must be installed in MF Part No. 708 714 M92 (MF 52A) ... with flat, smooth side of restrictor outward (i.e.: toward port fittings).

9. Connect the pressure and drain lines to their respective fittings.

10. Perform an operational check of swing as follows:

a. Check the oil level in the reservoir and operate engine.

b. With the Backhoe resting level on its stabilizers, raise the boom slightly. If the Backhoe begins to swing, due to the lack of oil in the rotary cylinder, operate the swing control lever until the swing is corrected.

CAUTION: Do not allow anyone to stand near the Backhoe while the boom is being raised. If the Backhoe is not level and there is no oil in the rotary cylinder, the Backhoe may begin to swing as the bucket clears the ground.

c. Operate the swing control lever to swing the Backhoe slowly, but fully, in both directions, allowing the relief valve to open at both ends of the swing.

d. Check the lines for leakage, tighten as necessary and check the reservoir for correct fluid level.

11. If necessary, perform "Checking and Adjusting Swing Cushioning (MF 54A)" to rotary cylinder MF Part No. 729 829 M91.

ROTARY CYLINDER MF PART NO. 729 829 M91

A cushioning mechanism is installed in both inlet ports to the cylinder (and internal of barrel vane) and operates in conjunction with orifice plates located at both sides of shaft vane. This cushioning mechanism controls oil pressure INTO the cylinder ... providing a cushioning action.

OPERATION OF CUSHIONING MECHANISM

This cylinder contains two spring-loaded spools designed to provide a cushioning effect during swing cycle. The cylinder also incorporates two internal swing relief valves and two anti-cavitation poppets.

Cushioning is accomplished by relieving the pump input oil (pressure) at one side of the vane through the port (return) at the other side of the vane. This is done by pressurizing a small, closely fitted dowel pin (by restricting the oil at the "return side" of the cylinder vane). The oil is restricted by an orifice plate attached to the moving vane. The restricting of the "return" oil causes the dowel pin to actuate the cushioning spool ... so as to open an internal passage and allow the pump input to be directed to the "return port" of the cylinder (instead of continuing to increase pressure build-up at the inlet port). The cushioning spool is held on its seat by a spring, which may have its tension adjusted so as to either lengthen, or shorten, the duration of the cushioning cycle.

The cushioning mechanism is located integral to the stationary vane, and is accessible through the working ports of the cylinder.

An example of cushioning is as follows ... see Figs. 23, 24 and 25:

1. To swing the boom to the left ... oil enters the right port of the cylinder and causes the moving vane (and shaft assembly) to swing to the left.
2. As the moving vane approaches the last 30° of its arc, the orifice plate at the left side of the vane begins to close the port within the left chamber (of the cylinder).
3. The inlet oil (from the pump), plus the momentum of the boom swing, causes the oil pressure within the left chamber to increase ... as the orifice plate

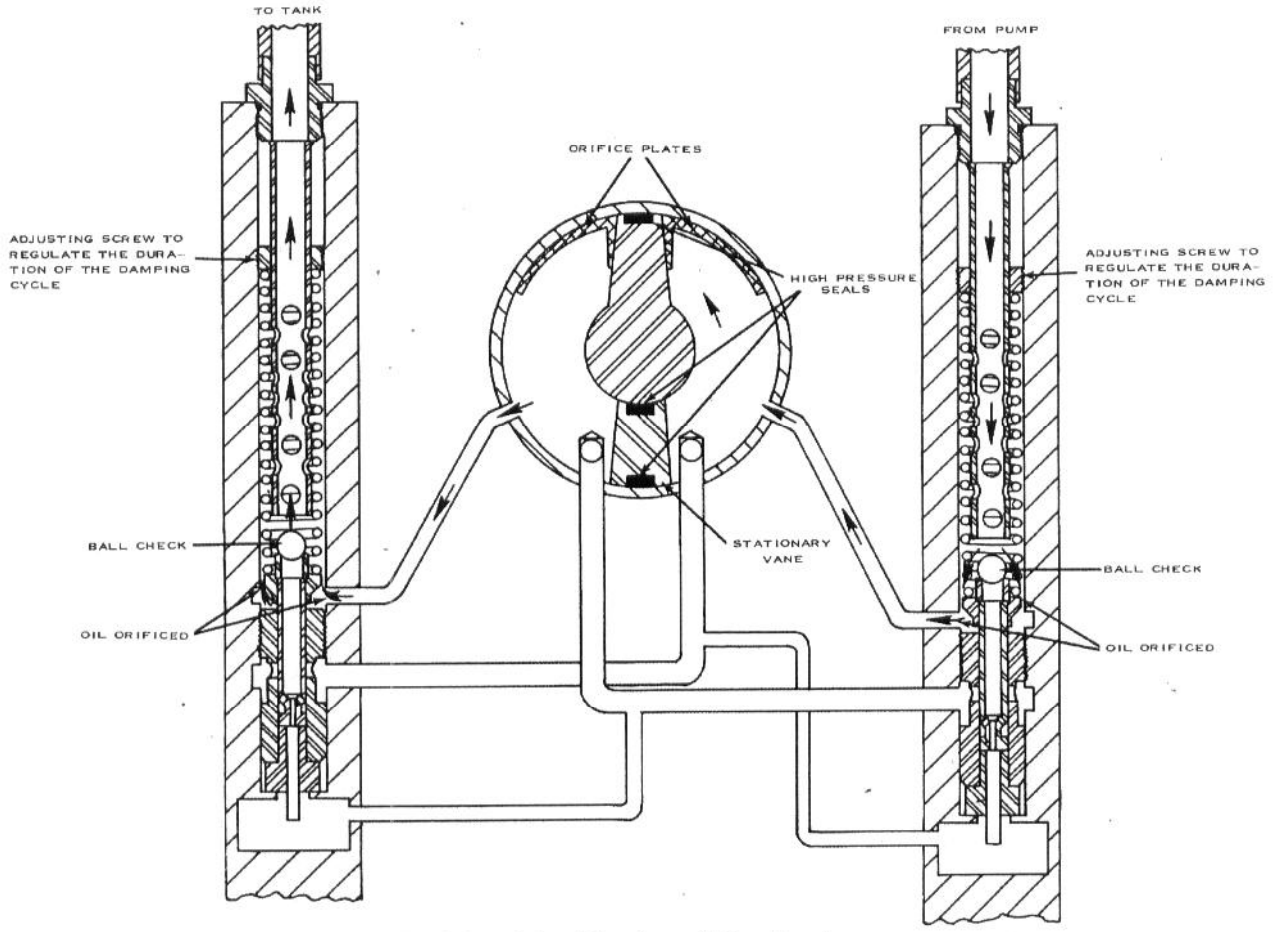

Fig. 23 — Identification of Cushioning Mechanism — MF Part No. 729 829 M91

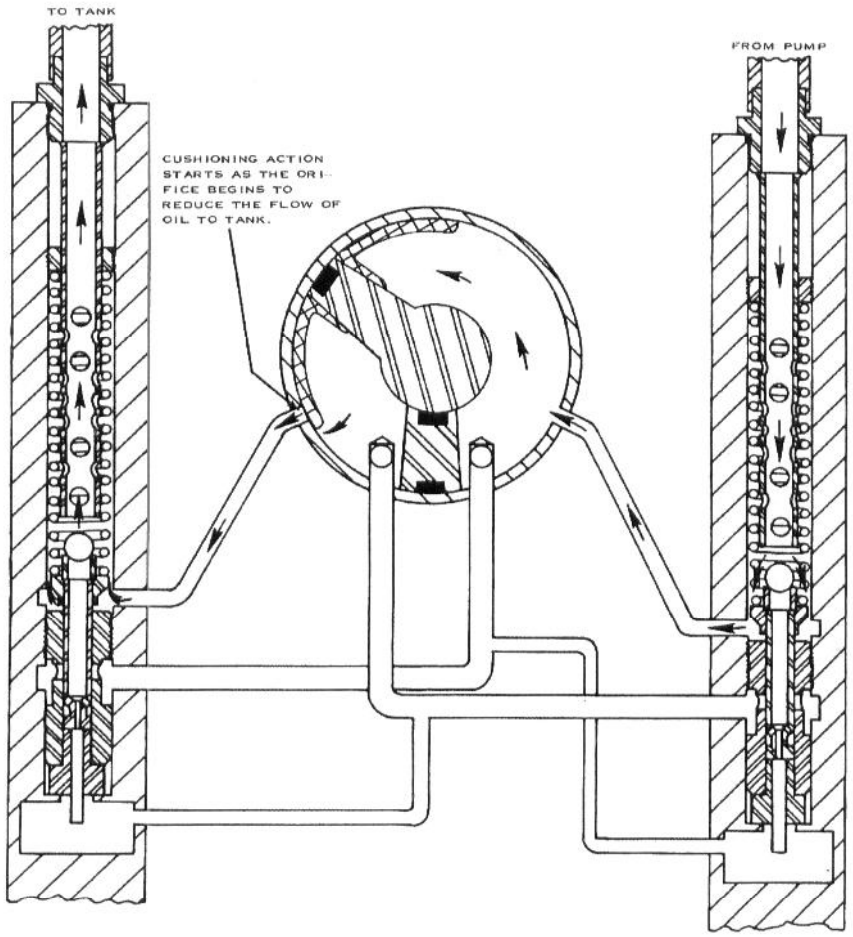

Fig. 24 — Beginning of Cushioning Cycle — MF Part No. 729 829 M91

closes the outlet port.

4. This pressure (in the left chamber) is directed to the closely fitted dowel pin ... which then acts as a piston to move the cushioning spool.

5. As the cushioning spool comes off its seat, it uncovers a passage that is connected to the right chamber of the cylinder ... and allows pump oil (into the cylinder) to "bleed" into the left (outlet) port ... and then to reservoir.

The opposite action takes place when the Backhoe is swung to the right. If the swing is suddenly reversed in mid-cycle ... pressure is relieved by the swing relief valve and is directed to the opposite side of the moving vane.

The orifice plate located at both sides of the moving vane are hinged and spring-loaded. This allows the plate to be moved away from the port (it previously restricted) when the swing is reversed ... so that the full volume of the pump can be used to start the swing in the opposite direction.

A steel ball is located on top of the cushioning spool (within a tube that restricts its travel), and is used as a back-flow check. This prevents pressurized oil into the work port from going through the cushioning spool (at the inlet port) and out the opposite work port.

SERVICING ROTARY CYLINDER IN PLACE — MF PART NO. 729 829 M91

IF COMPLETE OVERHAUL OF THE CYLINDER IS TO BE ACCOMPLISHED, refer to "Complete Servicing of Rotary Cylinders — MF Part No. 729 829 M91.

NOTE: Cleanliness must be observed when servicing the rotary cylinder. If dirt is allowed to enter the cylinder, damage will result.

IF CIRCUIT RELIEF VALVES ARE TO BE SERVICED, remove relief valves from the rotary cylinder top plate, taking care not to allow dirt to enter the cylinder. Refer to procedures for "32042" circuit reliefs under "Adjusting Circuit Reliefs", "Tests and Adjustments".

IF REPLACING (OR CLEANING) OF THE ANTI-CAVITATION POPPET VALVES, is to be accomplished without complete removal of cylinder from Backhoe, proceed as follows:

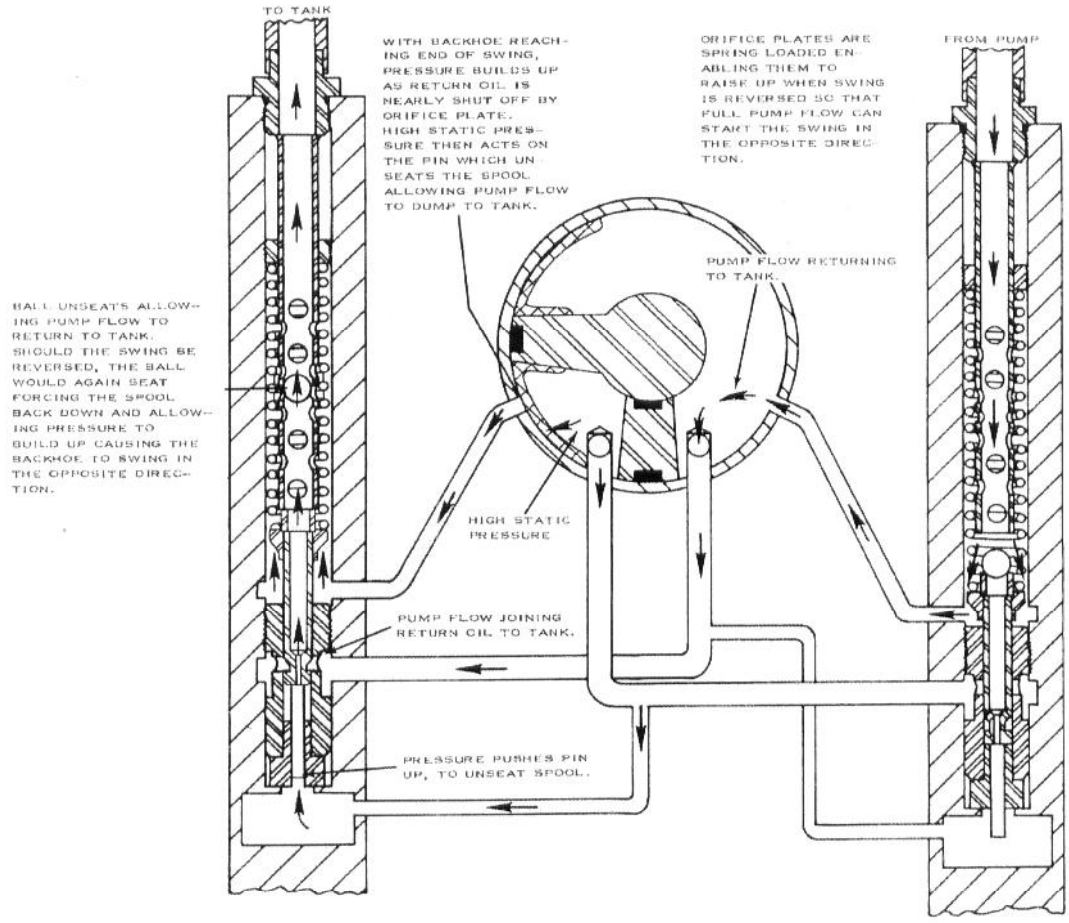

Fig. 25 — Swing Cushioned (Inlet Oil Bypassed to Return) — MF Part No. 729 829 M91

1. Place the boom, dipperstick and bucket in a "tripod" position at an angle approximately 30° to right of center.
2. Lower stabilizers and position boom slightly clear of ground ... shut off engine.

CAUTION: When working on cylinder with boom clear of ground use extreme care to avoid injury.

3. Thoroughly clean the top of the cylinder, return line, pressure lines and fittings.
4. Disconnect the lines and remove fittings from the top of the cylinder ... then remove tubular stops from both ports. Plug cylinder ports to keep system clean.

NOTE: Lift tubular stop upward and at an angle through center hole in pivot casting. Push boom until hole in casting aligns with hole in back frame and remove tubular stop. Repeat for other tubular stop, see fig. 26.

5. Remove the two bolts (with washers) securing the top pin assembly in the pivot casting. Carefully pry this pin from the top of the cylinder UNTIL THE BOTTOM EDGE OF THE PIN IS JUST EVEN WITH THE BOTTOM OF ITS HOLE THROUGH THE PIVOT CASTING.

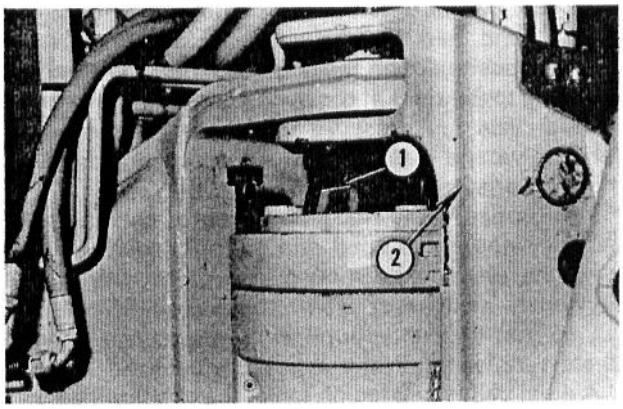

Fig. 26 — Removing/Installing Tubular Stops

1. Tubular Stop
2. Pivot Casting

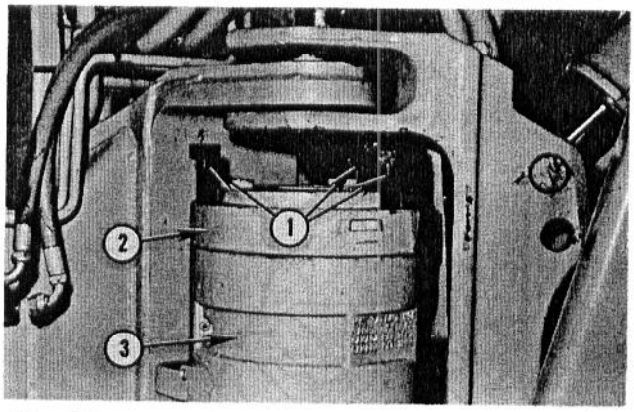

Fig. 27 — Special Tool "Pusher Bolts" (Tool No. 7236) Installed in Top Plate

1. Special Tool 7236
2. Top Plate
3. Barrel Assembly

CAUTION: The pin assembly also secures the top of the pivot casting to the main frame, and if removed completely, pivot casting may "tip" forward.

6. Remove the capscrews securing the top plate to rotary cylinder barrel ... then drop 1/2" x 3" dowel pins into the three bolt holes threaded through top plate.

7. Install the three special tool "pusher bolts" (tool No. 7236) into threaded holes in top plate as shown in Fig. 27. Thread these bolts into top plate until they contact dowel pins ... continue to tighten these "pusher bolts" EVENLY to separate top plate from barrel (and shaft). Remove dowel pins from barrel and "pusher bolts" from top plate ... place wooden block between top plate and barrel.

8. Carefully rotate top plate slightly for access to anti-cavitation poppets. After servicing has been performed, realign top plate with barrel ... install bolts and pull top plate into place. Tighten bolts to 165-175 ft.-lbs. and complete installation. (If cushioning adjusting screws have been turned, or if adjustment is desired ... refer to "Checking and Adjusting Swing Cushioning (MF 54A)" under "Tests and Adjustments".

COMPLETE SERVICING OF ROTARY CYLINDER — MF PART NO. 729 829 M91

DISASSEMBLY OF CYLINDER

1. Plug ports and clean outside of cylinder thoroughly.

2. Clamp cylinder in suitable fixture, or block up securely on the floor.

3. Remove large dowel pin from bottom end plate (drive pin out shaft side).

4. Remove port fittings (if not previously removed) ... or plugs.

5. Remove tubular stop from both inlet ports. (If you do not want to disturb the cushioning adjustment ... then do not remove the adjusting screw on top of the spring. The parts of the cushioning

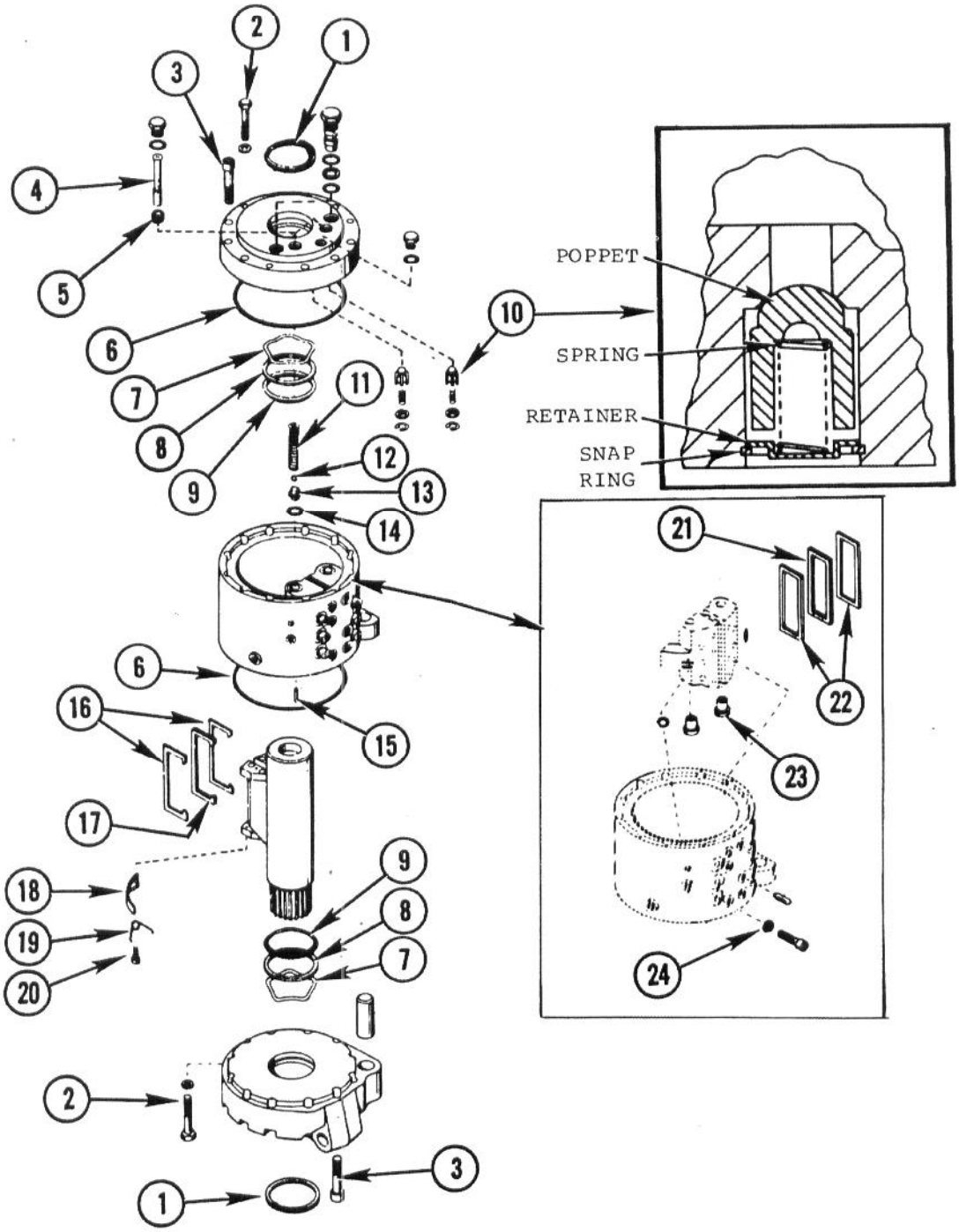

Fig. 28 — Parts Identification of Rotary Cylinder MF Part No. 729 829 M91

1. Shaft Seal (Outer)
2. Capscrews with Washers (3 used each Plate)
3. Capscrews without Washers (9 at Top; 7 at Bottom)
4. Tubular Stop
5. Adjusting Screw (Swing Cushioning)
6. "O"-Ring Seals
7. Wave Washers
8. Spirol Rings
9. Wedge Seals
10. Anti-Cavitation Poppet Valves
11. Spring
12. Steel Ball
13. Spool Guide
14. "O"-Ring (Barrel Vane)
15. Pin (Dowel)
16. Back-Up Washers
17. Seal (Moving Vane)
18. Orifice Plate
19. Spring
20. Capscrew
21. Seal (Barrel Vane)
22. Back-Up Washers
23. Pin Guide
24. Dyna-Seal Washers

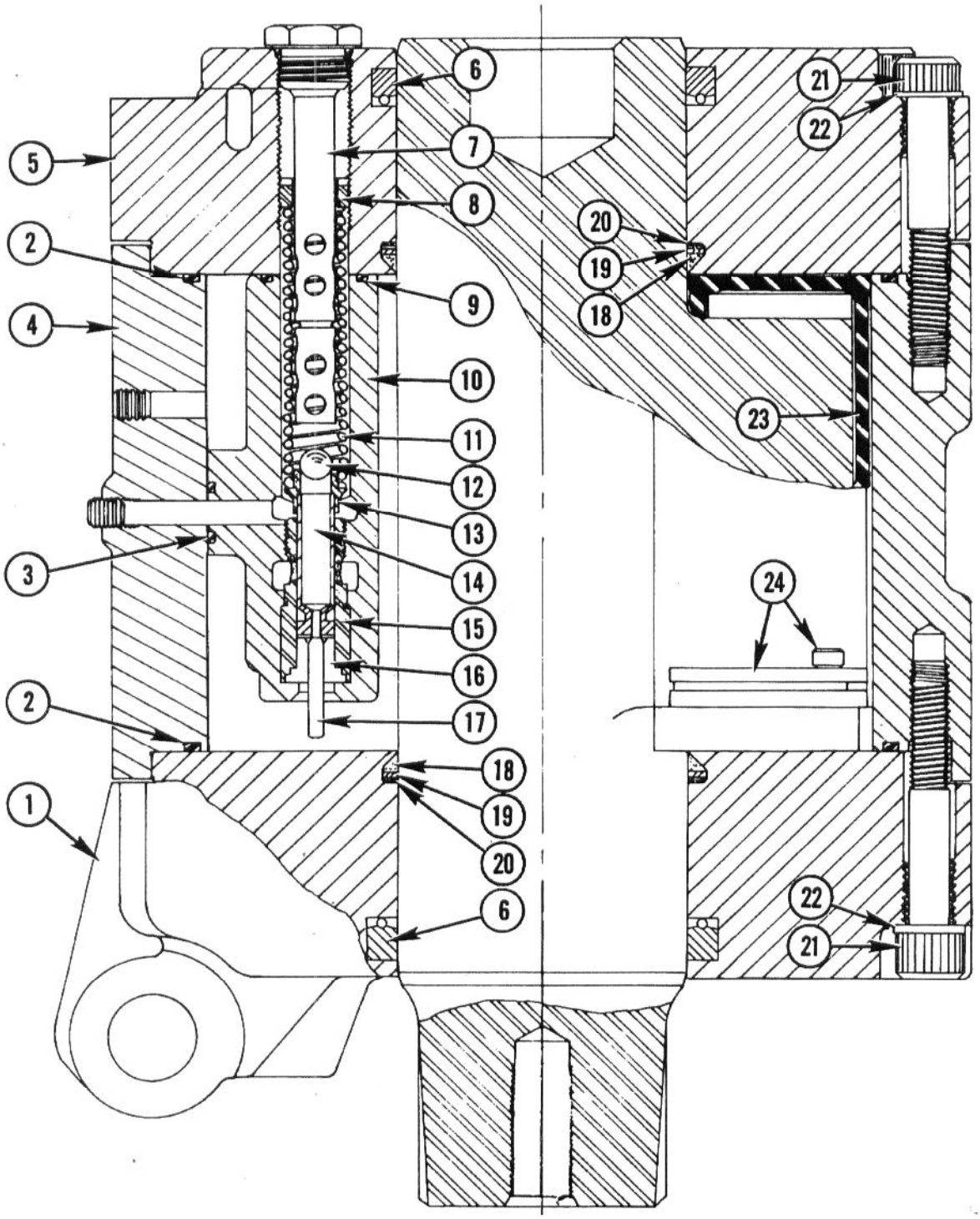

Fig. 29 — Cutaway of Rotary Cylinder MF Part No. 729 829 M91 — Relationship of Seals and Cushioning Mechanism Shown

1. Bottom Plate
2. "O"-Rings (Barrel to End Plates)
3. "O"-Rings (Vane to Barrel)
4. Barrel Assembly
5. Top Plate
6. Shaft Seal (Outer)
7. Tubular Stop
8. Adjusting Screw
9. "O"-Rings (Vane to Top Plate)
10. Barrel Vane
11. Spring
12. Steel Ball
13. Spool Guide
14. Dampening Spool
15. Sleeve
16. Dowel Pin Guide
17. Dowel Pin
18. Wedge Seal
19. Spirol Ring
20. Wave Washer
21. Capscrew
22. Washer (3 used at Top and Bottom)
23. Moving Vane Seal and Back-Up Washers
24. Shoulder Bolt and Orifice Plate

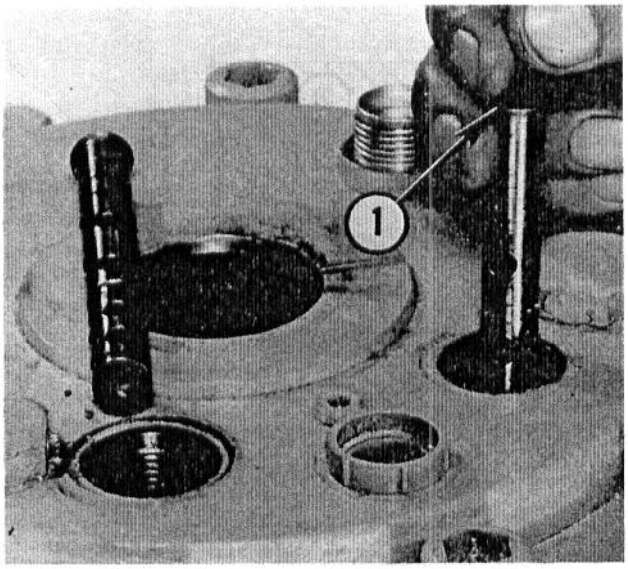

Fig. 30 — Removing/Installing Tubular Stops

1. Flared End

mechanism can be removed after the top plate is separated from the barrel.) See Fig. 30.

6. Remove the circuit relief valves from top endplate.

7. Remove capscrews securing top plate to barrel assembly . . . then drop 1/2" x 3" dowel pins into the three bolt holes containing capscrews with washers (see Fig. 26.)

8. Install the three special tool "pusher bolts" (tool No. 7236) into threaded holes in top plate (over dowel pins . . . see Fig. 27). Tighten these "pusher bolts" EVENLY to separate top plate from barrel and shaft. Remove the three dowel pins from barrel.

NOTE: Do not allow shaft assembly to come out with the top plate.

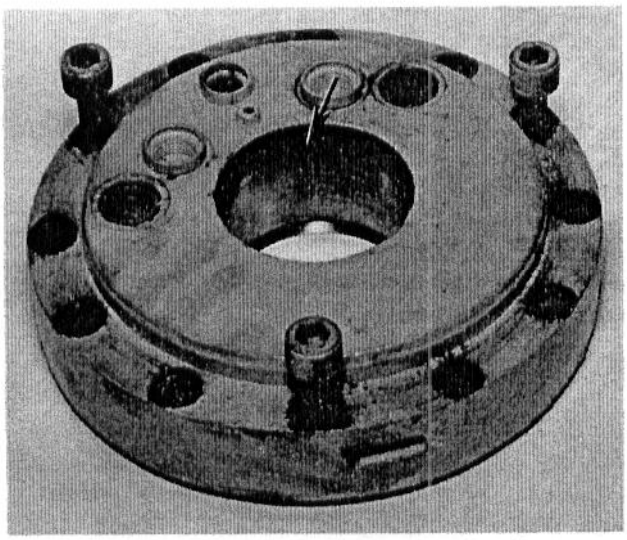

Fig. 31 — Shaft Seal Groove in Top Plate

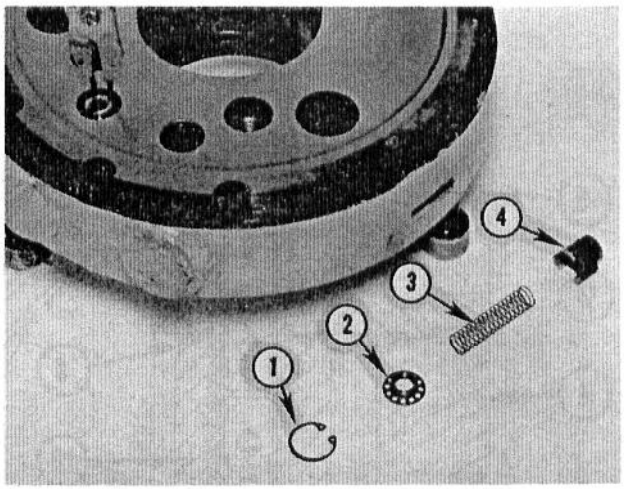

Fig. 32 — Removing/Installing Anti-Cavitation Poppets*

1. Snap Ring
2. Retainer
3. Spring
4. Poppet

*NOTE: Design of Poppets may not be exactly as shown

9. Place the top plate on a clean work bench, and disassemble as follows:

a. Remove outer shaft seal from groove, see Fig. 31.

b. Remove snap ring, retainer, spring and anti-cavitation poppets, see Fig. 32.

c. Remove wedge seal, spiral ring and wave washer, see Fig. 33.

10. Remove dampening springs from the barrel vane.

11. Remove moving vane shaft as follows:

a. Carefully tap protruding end of vaned shaft to start it from the lower end plate, see Fig. 34.

b. Position vaned shaft as shown in Fig. 35, then carefully remove it from the barrel.

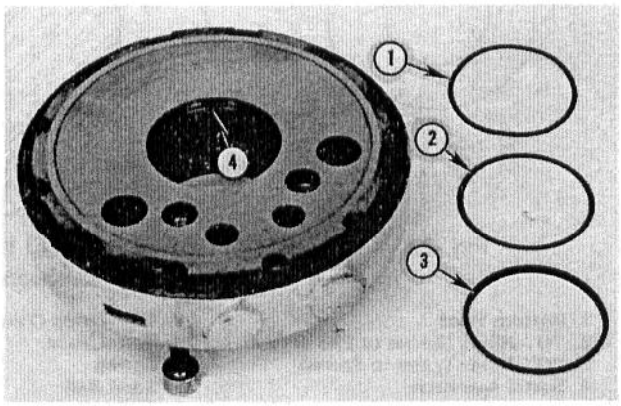

Fig. 33 — Wedge Seal and Related Parts Removed From Top Plate

1. Wave Washer
2. Spirol Ring
3. Wedge Seal
4. Seal Groove

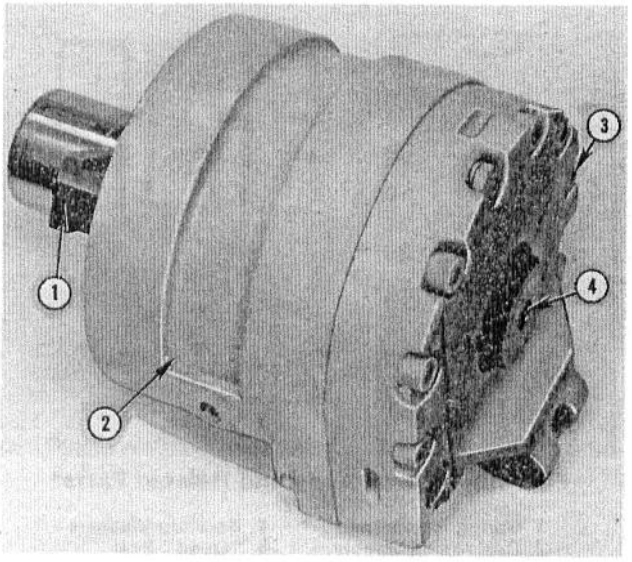

Fig. 34 — Vaned Shaft "Started" From Barrel

1. Seals on Moving Vane
2. Barrel Assembly
3. Bottom Plate
4. Splined End of Vaned Shaft

NOTE: Turn shaft slightly ... but do not allow orifice plates (attached to moving vane) to catch under the barrel vane, see Fig. 36.

12. Disassemble the moving vane shaft as follows:
a. Remove the "quad" seal and back-up seals. See Fig. 37.

NOTE: Do not remove the small plates at both ends of the moving vane.

b. Remove the shoulder bolt, orifice plate and spring at both sides of vane shaft.

13. To remove barrel (stationary) vane, proceed as follows ... see Fig. 38.

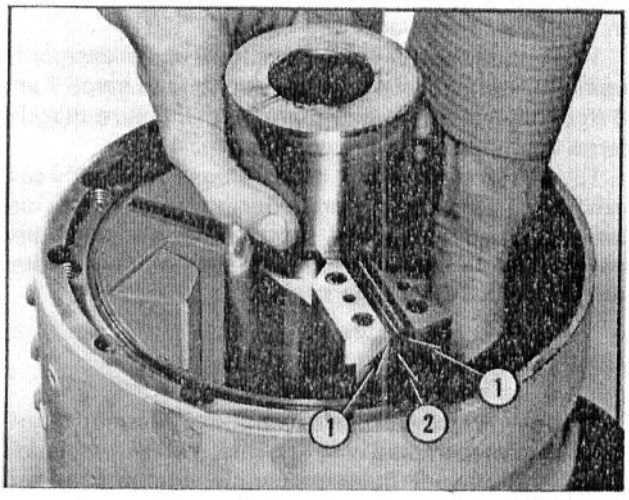

Fig. 35 — Removing/Installing Vaned Shaft

1. Back-Up Washers
2. "Quad" Seal

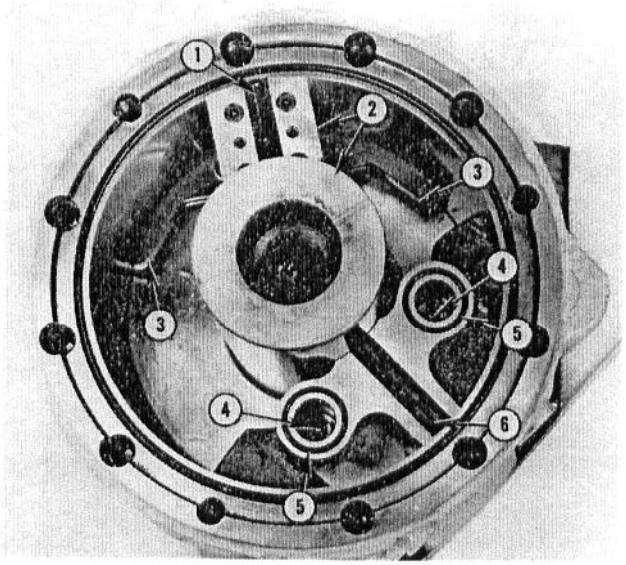

Fig. 36 — Shaft Vane Turned Slightly

1. Vane Seals
2. Vaned Shaft
3. Orifice Plates
4. Steel Balls
5. "O"-Rings
6. Barrel Vane Seals

a. Hold barrel in fixture (or block up on floor) and remove the six external pipe plugs which cover the six dowel pins installed through the barrel and barrel vane.

b. Remove the special flush pipe plug from the barrel vane. This pipe plug is accessable from inside the cylinder barrel and has "Loctite" hydraulic sealant applied.

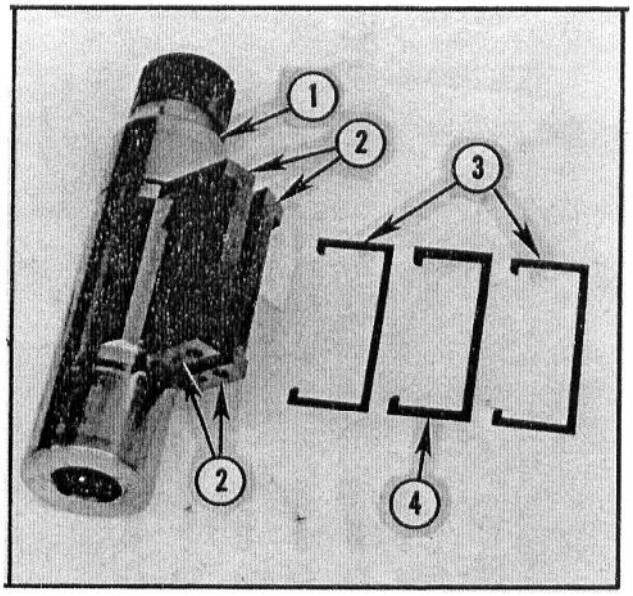

Fig. 37 — Vaned Shaft and Seals — Orifice Plates Removed

1. Vaned Shaft
2. Plates
3. Back-Up Washers
4. "Quad" Seal

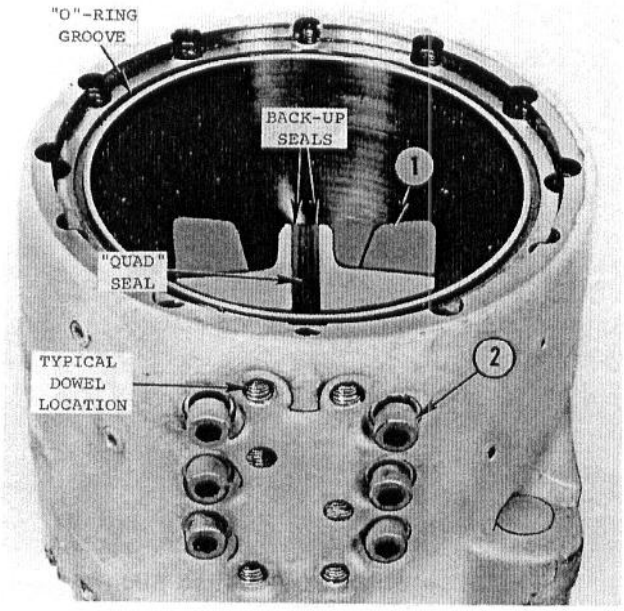

Fig. 38 — Location of Barrel Vane Dowel Pins

1. Barrel Vane
2. Capscrew with Dyna-Seal Washers

c. Loosen the six capscrews, which hold the barrel vane in place. Do not remove capscrews at this time.

d. Using a punch, drive the six dowel pins toward the inside of the barrel, catching the dowel pins to prevent them from hitting the inner surface of the barrel. (See Fig. 39.)

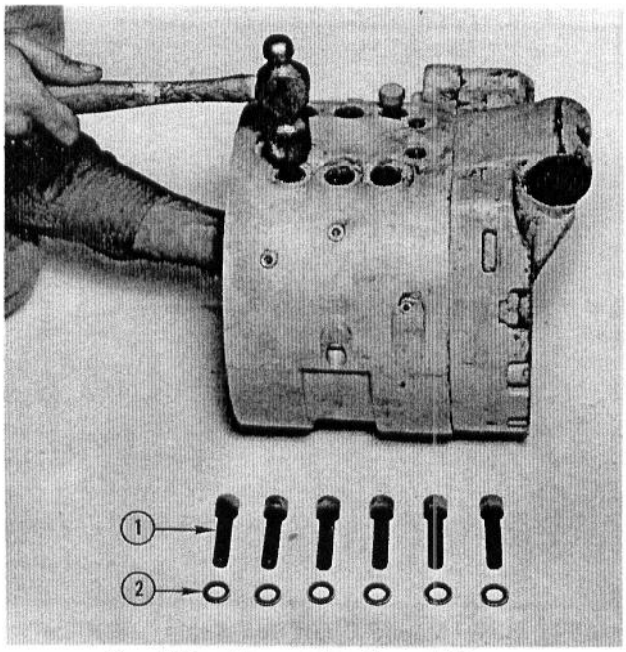

Fig. 39 — Removing Barrel Vane

1. Capscrews
2. Dyna-Seal Washers

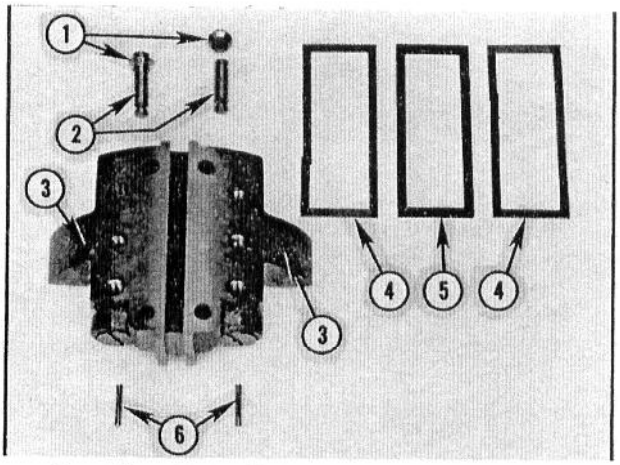

Fig. 40 — Barrel Vane and Related Parts*

1. Spring Retainers
2. Cushioning Spools
3. "O"-Ring Grooves
4. Back-Up Washers
5. "Quad" Seal
6. Dowel Pins

*NOTE: Design of Barrel Vane may not be exactly as shown

NOTE: Be sure to catch the dowel pins to prevent them from damaging the inner machined surface of the barrel assembly.

e. Remove the six capscrews and dynaseal washers then place barrel vane on a clean work bench.

14. Remove the steel balls, "O"-rings, spring retainer, cushioning spools and dowel pins ... see Figs. 36 and 40.

NOTE: Keep the parts from the two bores matched and separated.

15. Remove the seals from the barrel vane as shown in Fig. 41.

16. Remove the shaft seals from their grooves in the lower end plate. See Fig. 29.

17. Remove bottom end-plate from barrel assembly, using the same procedure as described in steps 7 and 8 (for removal of top end-plate), making sure that the large dowel pin is removed. See Fig. 42.

18. Do not remove any of the plugs not already covered in the foregoing procedures, unless they are leaking, or damaged in some way. All plugs and orifices in the barrel assembly have been assembled with "Loctite" hydraulic sealant.

INSPECTION OF CYLINDER

1. Clean and dry all parts. The barrel vane capscrews have been assembled with "Loctite" hydraulic sealant. (Also the special flush pipe plug and orifice plate shoulder bolts.) Be sure to remove all the old "Loctite" and thoroughly clean and degrease the parts before reassembly.

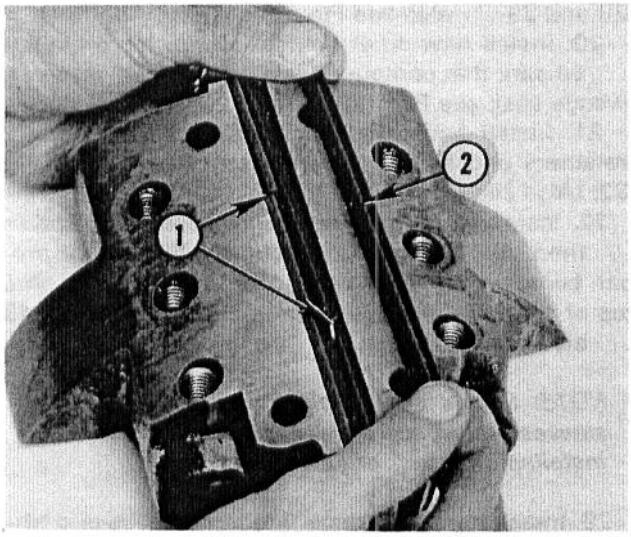

Fig. 41 — Removing/Installing Barrel Vane "Quad" Seal and Back-Up Washers

1. "Split" in Back-Up Washers
2. "Quad" Seal

2. Remove nicks and burrs from all parts with emery cloth.

3. Inspect bore and machined surface of end plates for scoring or excessive wear.

4. Inspect shaft for cracked splines, scoring or excessive wear at bearing points.

5. Inspect inside of barrel for scoring or wear.

6. Inspect orifice plates for damage.

7. It is not necessary to inspect "O"-rings, back-up washers, stationary vane seals, stationary vane back-ups, shaft selas, wedge seals, wave washers, spiral retaining rings, anti-cavitation poppets, or dynaseal washers, as these items should be replaced with new parts.

8. Disassemble relief valves and clean thoroughly. Be sure to keep the parts separated so as not to change the pressure setting. The pressure can be adjusted by adding shims to increase, or removing shims to decrease the pressure.

9. Inspect cushioning mechanism for wear, scoring or other evidence of damage.

REASSEMBLY OF THE CYLINDER

NOTE: "Loctite" sealant is to be applied per manufacturer's recommendation, whenever its use is recommended during reassembly.

1. Thoroughly clean then degrease the barrel assembly, stationary vane and retaining capscrews.

2. Apply "Loctite" hydraulic sealant to the special flush pipe plug, then install this plug into the barrel vane.

3. Install new vane seals on the barrel vane, see Figs. 40 and 41.

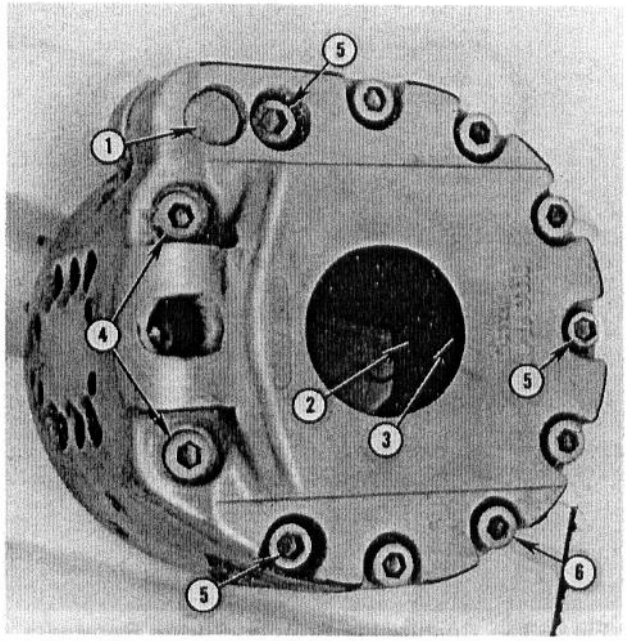

Fig. 42 — Bottom Plate Assembled to Barrel

1. Dowel Pin
2. Wedge Seal Groove in Bottom Plate
3. Outer Seal Groove in Bottom Plate
4. Capscrews — 2 used (5/8" x 2-3/4")
5. Capscrews with Washers (5/8" x 3-1/4")
6. Capscrews without Washers (5/8" x 3-1/4")

4. Install new "O"-rings into grooves on vane (surface that mates with barrel assembly).

5. Position barrel vane inside barrel assembly.

6. Slide dyna-seal washers over the six Allen head capscrews that secure the barrel vane to the barrel and apply "Loctite" hydraulic sealant to the threads.

7. Install the six capscrews. Draw up evenly to just snug, but do not tighten.

8. Apply STP, or similar lubricant, to the six barrel vane dowel pins and drive the pins in until they are down 1/2" from the external surface of the barrel.

9. Install the pipe plugs in the dowel pin holes.

10. Tighten the six Allen head capscrews to 85-95 ft.-lbs. torque.

11. Allow "Loctite" hydraulic sealant to cure. Placing barrel assembly in a 200° F. oven will speed curing ... be sure to allow barrel assembly to cool before completing reassembly.

12. Install new wave washer, spiral washer and wedge seal in bottom end-plate in the order shown in Figs. 28 and 29 ... also see Fig. 42.

13. Install new outer shaft seal into bottom end-plate ... be sure that countoured side of shaft seal is toward wedge seal, see Figs. 28, 29 and 42.

14. Slide cushioning dowel pins into their respective guides in barrel vane. Check pins for freedom of movement.

NOTE: Pins must slide freely within their guides but there should be no noticeable side clearance.

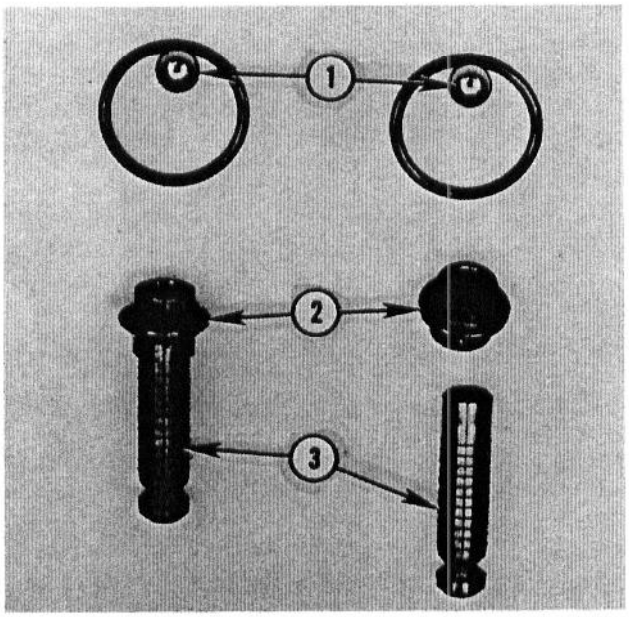

Fig. 43 — Cushioning Spools, Spring Retainers and Steel Balls

1. Steel Balls
2. Spring Retainers
3. Cushioning Spools

15. Install large "O"-ring in its barrel groove at bottom end-plate side ... then position bottom plate to barrel and install *lubricated* capscrews just snugly. Install large dowel pin through bottom plate and into barrel. Tighten capscrews to 165-175 ft.-lbs.

NOTE: Install capscrews in locations indicated in Fig. 42 ... dowel pin to be inserted through bottom plate and into barrel. Capscrews with washers to be installed in holes that are threaded through bottom plate.

16. Assemble the moving vane seal and back-up seals to the shaft assembly, see Fig. 37.

17. Install orifice plates and springs to both sides of vaned shaft. Apply "Loctite" AAV to threads of shoulder bolts. (Be sure "Loctite" has had time to set before filling cylinder with oil.)

18. Lubricate I.D. of bottom end-plate and CAREFULLY install shaft assembly. Shaft assembly can be installed easier if vane is turned sideways, see Figs. 34, 35 and 36.

19. Install new wave washer, spiral washer and wedge seal in top plate in the order shown in Figs. 28 and 29 ... also see Fig. 33.

20. Install new outer shaft seal into top end-plate ... be sure that contoured side of shaft seal is toward wedge seal, see Figs. 28, 29 and 31.

21. Install anti-cavitation poppets, springs, spring retainers and snap rings into top plate ... see Fig. 32. (Also see Fig. 28.)

22. Install spring retainers onto cushioning spools ... then install spools (and retainers) into their proper bores in barrel vane and drop steel balls onto top of spring retainers (in vane). See Figs. 36 and 43 ... also see Fig. 29.

NOTE: Spools are matched to their respective sleeves within barrel vane ... be sure they are installed into their original bores.

23. Install new "O"-rings into top grooves of cushioning bores (in barrel vane, see Fig. 36 ... then install large "O"-ring into its barrel groove (at top plate mating surface).

24. Install springs into cushioning bores in barrel vane ... making sure that springs fit into their retainers, see Figs. 29 and 36.

25. Lubricate top plate seals then align top end-plate over shaft ... making sure that port openings are over bores in barrel vane. Push top plate downward against barrel assembly and install *lubricated* capscrews ... tighten capscrews evenly to 165-175 ft.-lbs.

NOTE: Capscrews with washers to be installed in holes that are threaded through top plate (i.e.: "pusher holes").

26. Install new seals in circuit relief valves ... then install these reliefs into top plate.

27. If adjustment screws for swing cushioning (located in top plate) have been turned, proceed as follows:

a. Thread the cushioning adjusting screw into the inlet ports of top plate until they JUST CONTACT the cushioning springs.

b. Turn (tighten) cushioning adjusting screw ONE FULL TURN ONLY. (This is initial adjustment.)

28. Install tubular stop into inlet ports with flared end up ... see Figs. 29 and 30.

29. Make certain all plugs and new "O"-rings are installed in cylinder. Install hydraulic plugs in cylinder port openings to prevent foreign materials from entering the barrel assembly.

ROTARY CYLINDER MF PART NO. 708 714 M92

Restrictors (orifice plates) are installed in both inlet ports of this cylinder to provide a cushioning EFFECT by restricting return oil flow from the cylinder (back to valve). Diameter of drilling through restrictor is 0.109" ... restrictor to be installed so that its flat, smooth side (Not slotted side) is toward inlet fitting.

SERVICING ROTARY CYLINDER IN PLACE — MF PART NO. 708 714 M92

If complete overhaul of the cylinder is to be performed, refer to the appropriate heading for procedures.

NOTE: Cleanliness must be observed when servicing the cylinder. If dirt is allowed to enter the cylinder, damage will result.

1. If circuit relief valves are to be serviced:
   a. Remove these cartridge valves from the top of the cylinder.
   b. Refer to "Testing Circuit Reliefs" and "Adjusting Circuit Reliefs" (under heading "Tests and Adjustments") and follow the recommended procedures for "Circuit Reliefs in MF Part No. 708 714 M92". (Information: "Cracking" pressure of these circuit reliefs should be approximately 1750 psi. Full opening pressure to be 1875 psi.)
2. If replacing, or cleaning the anti-cavitation poppet valves is to be performed without complete removal of cylinder from Backhoe, proceed as follows:
   a. Place boom, dipperstick and bucket in a "tripod" position ... approximate at a 30° angle to right of center.
   b. Lower stabilizers and raise boom slightly clean of ground ... shut off engine.
   c. Thoroughly clean the top of cylinder, return line, pressure lines and fittings ... then disconnect lines and remove fittings. Install plugs in cylinder ports to keep system clean.

CAUTION: Use extreme care when working around Backhoe with boom clear of ground ... avoid injury.

d. Remove the two bolts (with washers) securing top pin assembly into pivot casting ... carefully pry this pin from top of cylinder UNTIL PINS BOTTOM EDGE IS JUST EVEN WITH THE BOTTOM OF ITS HOLE THROUGH PIVOT CASTING.

CAUTION: This pin assembly also secures the top of pivot casting to the back frame ... if it is removed completely, pivot casting may "tip" forward.

e. Remove capscrews securing top plate to rotary cylinder barrel.

f. Use three of the previously removed capscrews threaded into the puller holes in the top cover to carefully separate this cover from the barrel assembly. Spacers may have to be placed between the capscrews and the barrel (after maximum separation with capscrews alone has been obtained) in order to lift the cover free of the dowel pins installed in the mating flange of the barrel. Tighten the "puller" capscrews evenly so that separation of cover is even.

g. Rotate top plate until anti-cavitation poppets are accessible. After servicing is completed, realign top plate with barrel assembly.

h. Use three of the capscrews that secure top cover to barrel (threaded into the holes BETWEEN THE SIX DOWEL PIN HOLES) ... to *carefully* pull the cover downward onto barrel.

NOTE: Tighten these three capscrews ALTERNATELY AND EVENLY until the cover is approximately .024" from barrel surface. DO NOT EXCEED 100 FT.-LBS. TORQUE WHEN TIGHTENING BOLTS.

i. Thread the remaining cover-to-barrel capscrews into barrel. Tighten bolts ALTERNATELY AND EVENLY TO 100 FT.-LBS. TORQUE WHILE MAINTAINING A GAP OF .005"-.024" between the mating surfaces of the cover and the barrel.

NOTE: OVERTIGHTENING bolts may cause the cover to crack.

j. Install new seals on the circuit relief valves ... then install these reliefs into their ports in the top cover assembly.

k. Reconnect pressure and return lines then complete reinstallation of cylinder.

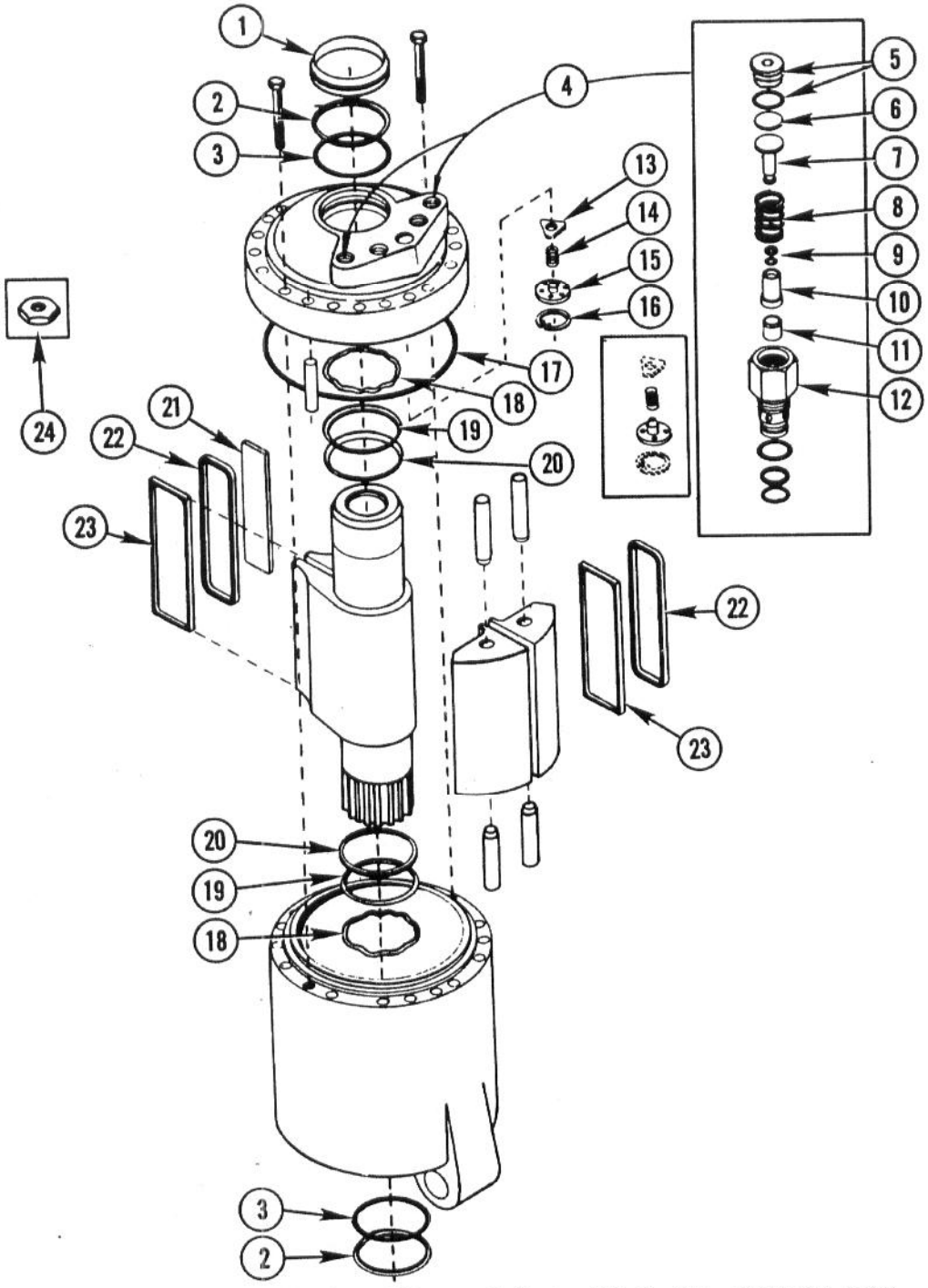

Fig. 44 — Parts Identification of Rotary Cylinder MF Part No. 708 714 M92

1. "V"-Ring
2. Shaft Seals
3. "O"-Rings
4. Circuit Reliefs
5. Plug with "O"-Ring
6. Shim
7. Poppet Guide
8. Spring
9. Back-Up Washer and "O"-Ring
10. Poppet
11. Poppet Seat
12. Cartridge with Seals
13. Poppet
14. Spring
15. Guide
16. Snap Ring
17. "O"-Ring
18. Wave Springs
19. Metal Back-Up Rings
20. Shaft Seals
21. Spacer
22. Back-Up Seals
23. Teflon Seals
24. Restrictors

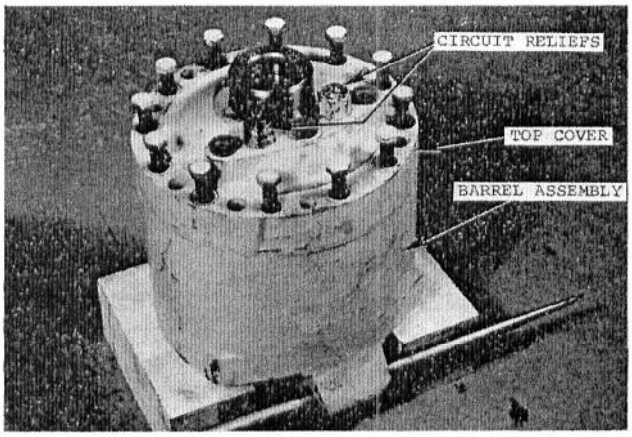

Fig. 45 — MF Part No. 708 714 M92 Cylinder on Blocks for Servicing

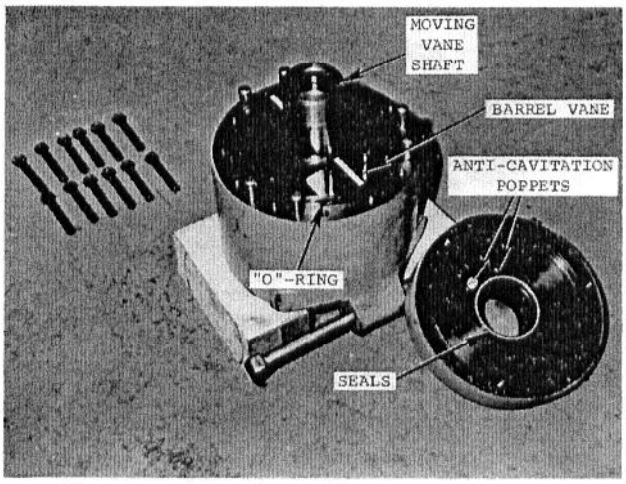

Fig. 47 — Top Cover Removed Exposing Interior of Cylinder

COMPLETE SERVICING OF ROTARY CYLINDER — MF PART NO. 708 714 M92

The procedures under this heading are written assuming that the cylinder has been removed from the Backhoe. Make sure that the outside of the cylinder has been thoroughly cleaned and that the ports are plugged.

DISASSEMBLY OF CYLINDER — MF PART NO. 708 714 M92

1. Block cylinder securely on the floor so that the splined shaft is not touching, then remove the capscrews securing the top cover to the barrel assembly ... see Fig. 45.

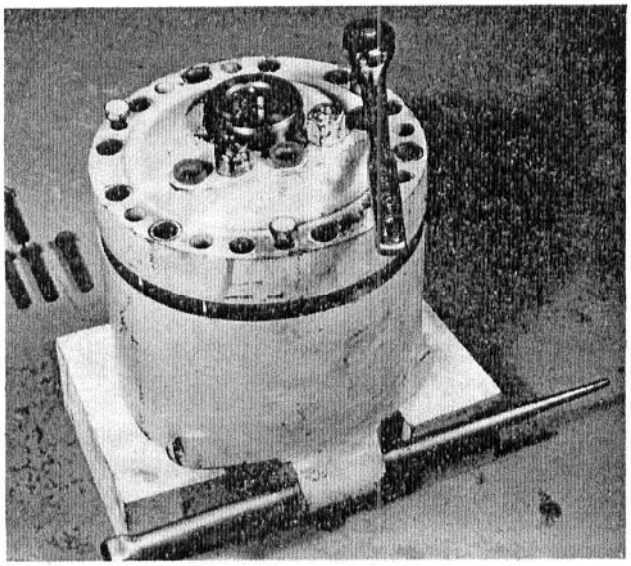

Fig. 46 — Removing Top Cover From Barrel

CAUTION: The cylinder assembly weighs approximately 170 lbs., so use care to prevent personal injury.

2. Use three of the previously removed capscrews threaded into the puller holes in the top cover to carefully separate this cover from the barrel assembly ... see Fig. 46. Spacers may have to be placed between the capscrews and the barrel (after maximum separation with capscrews alone has been obtained) in order to lift the cover free of the dowel pins installed in the mating flange of the barrel. Tighten the "puller" capscrews evenly so that separation of cover is even.

3. Carefully remove top cover then remove large "O"-ring from the barrel ... see Fig. 47.

4. Disassemble the top cover as follows:

a. Remove the circuit relief cartridges and the shaft seats from cover ... see Fig. 48.

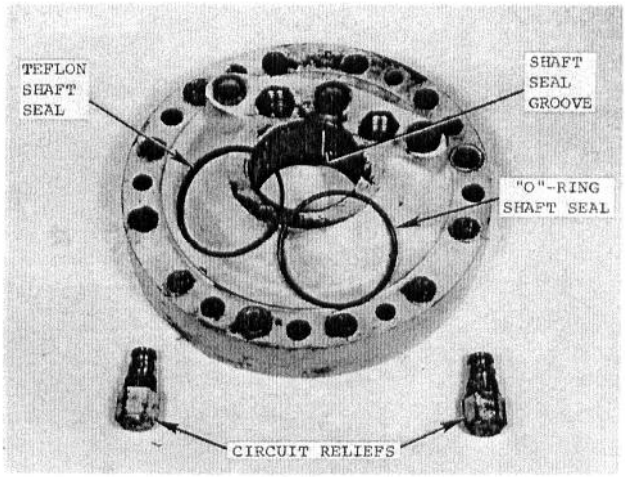

Fig. 48 — Circuit Reliefs and Shaft Seals Removed From Top Cover

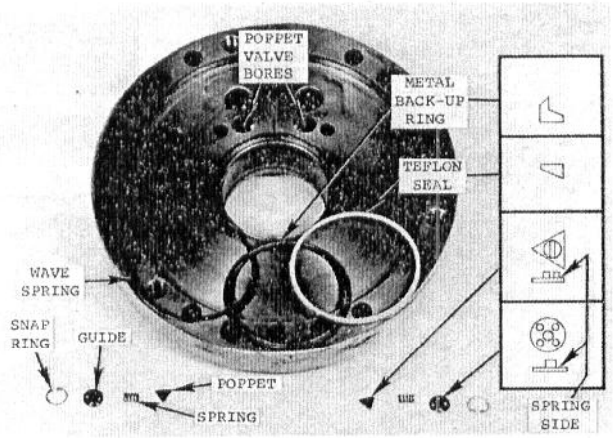

Fig. 49 — Hub Seal (with Related Parts) and Anti-Cavitation Poppets Removed From Top Cover

b. Remove hub seal, metal back-up ring, wave spring and both anti-cavitation poppets from the cover ... see Fig. 49.

5. Rotate the moving vane shaft until the vane is approximately 90° from the centerline of the barrel vane ... see Figs. 50 and 51.

6. Use a suitable bolt and puller crosshead, similiar to the manner shown in Fig. 52, and carefully remove the vane shaft from the barrel.

NOTE: Use a straight even pull when removing the vane shaft. Do not allow the vane seals and spacer to drop into the inner surface of the barrel, and do not allow the shaft to cock during removal (otherwise the sharp edges on the barrel may be damaged and cause internal leakage of the cylinder. Sharp edges are also necessary on the vane shaft at the area of hub diameter.)

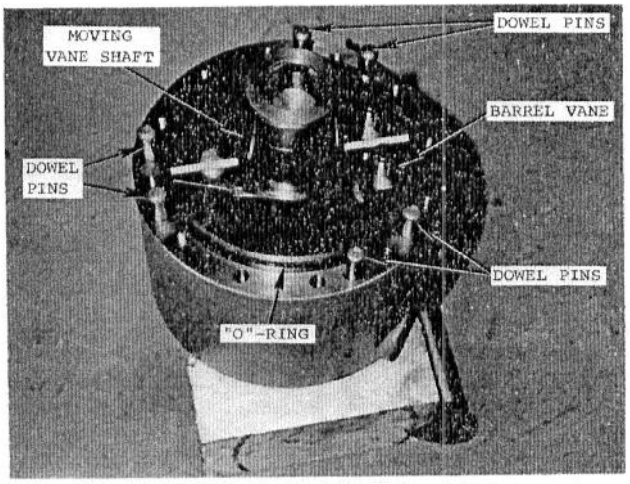

Fig. 50 — Moving Vane in Line with Barrel Vane

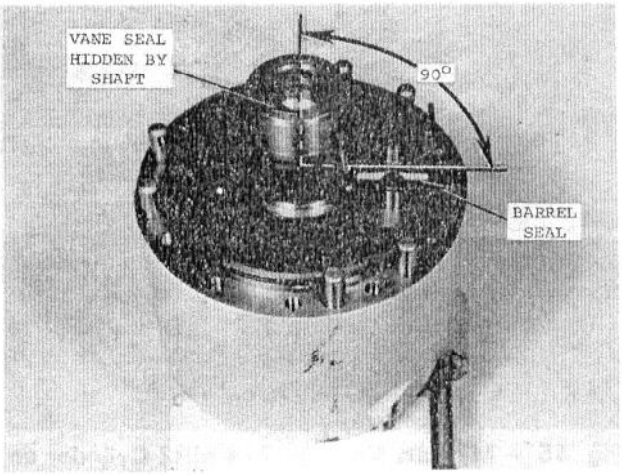

Fig. 51 — Moving Vane Positioned 90° to Barrel Vane

7. Remove the seals and spacer from the slot in the moving vane ... see Fig. 53.

8. Carefully remove the barrel vane with related seals, the hub seal, metal back-up ring, wave spring, the teflon shaft seal (and "O"-ring) from the barrel assembly ... see Figs. 54 and 55.

NOTE: Do not damage internal surface of barrel, or its sharp edges.

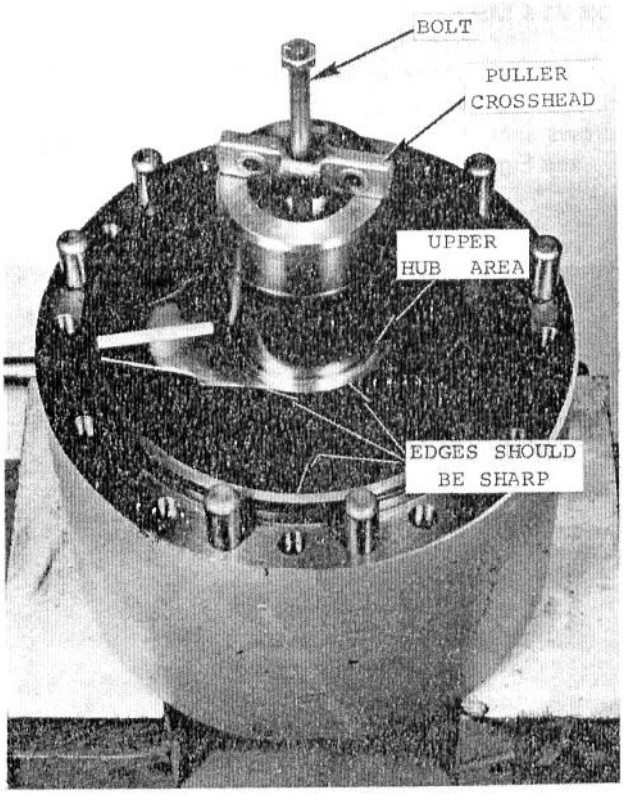

Fig. 52 — Removing/Installing Moving Vane Shaft

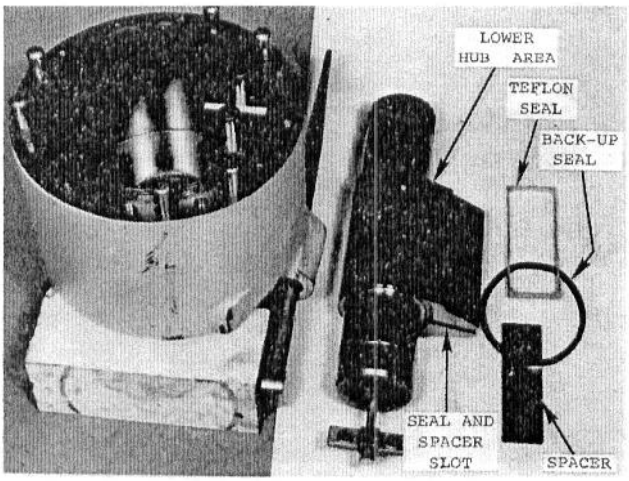

Fig. 53 — Moving Vane Shaft (and Related Parts) Removed From Cylinder

INSPECTION OF CYLINDER — MF PART NO. 708 714 M92

1. Carefully clean and air-dry all metal parts of the cylinder.

2. Inspect the moving vane shaft as follows . . . see Figs. 52 and 53:

a. Check the ground finish surface at the hub diameter areas for proper mating with the barrel vane seal. (If barrel vane seal has been damaged . . . this surface may be damaged.) The ends of the hub diameters should have sharp corners at the point of contact with the hub seals. (Nicks, dents, rounded edges, etc., can cause internal leakage and damage to the hub seal.)

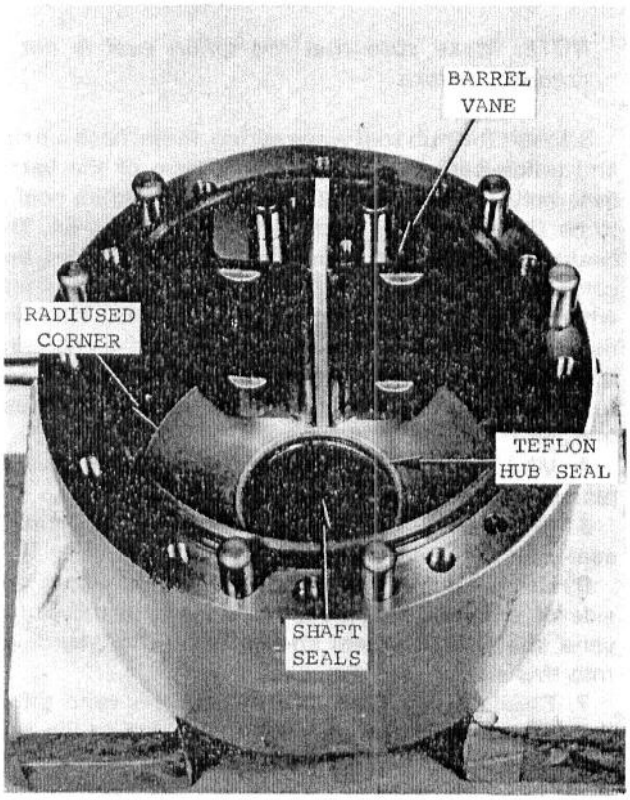

Fig. 54 — Barrel Vane Relationship to Barrel (Vane Shaft Removed)

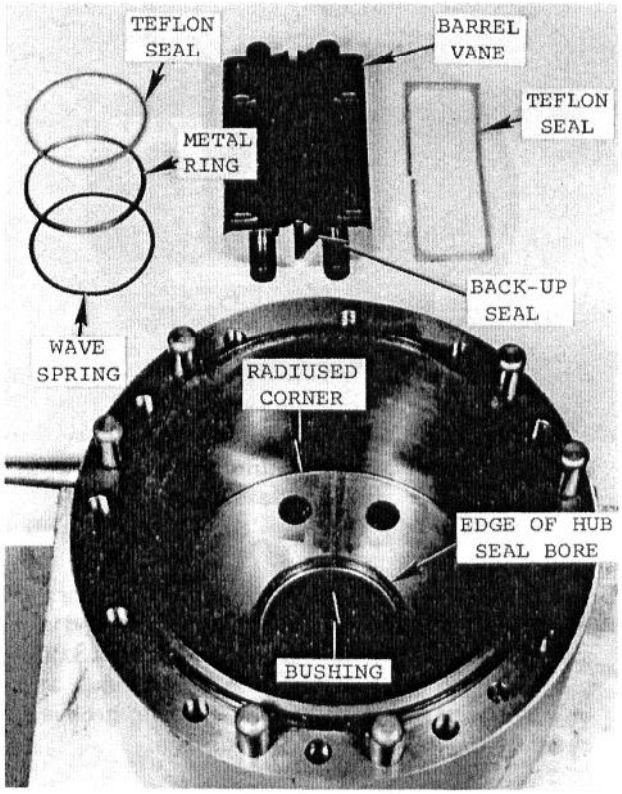

Fig. 55 — Barrel Vane (With Related Parts) and Hub Seals Removed From Cylinder

b. Check both ends of the shaft for signs of wear, or damage, within the areas of the bushing and the shaft seal.

c. Check the ends of the vane for possible galling, or other damage due to excessive thrust loading. (A 0.003" step is maintained at both ends of the vane, near the hub diameter, for contacting the cover and barrel surfaces.)

3. Inspect the barrel assembly as follows . . . see Figs. 50, 52,54 and 55:

a. Check the inner surface for damage. (Scratches, or surface finish damage will cause internal leakage . . . and possible damage to the moving vane seal.)

b. Check the edges of the top lip surface . . . which forms a metal-to-metal surface with the top cover when cylinder is assembled. (Nicks, or scratches on this surface may damage the moving vane seal and cause internal leakage.)

c. Check that edge of the hub seal bore is sharp. (Nicks, dents or a rounded edge may cause leakage.)

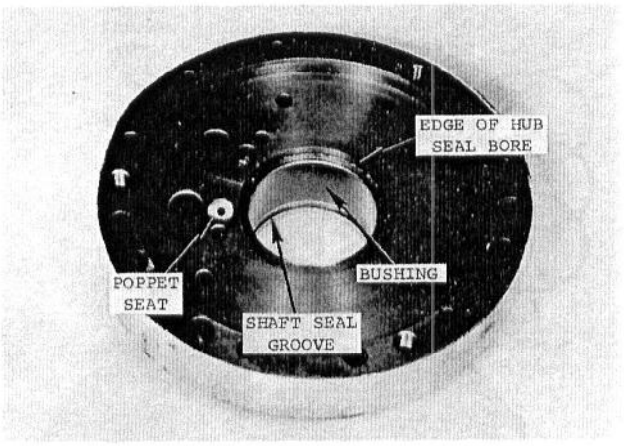

Fig. 56 — Inspecting Bushing and Poppet Seat in Top Plate

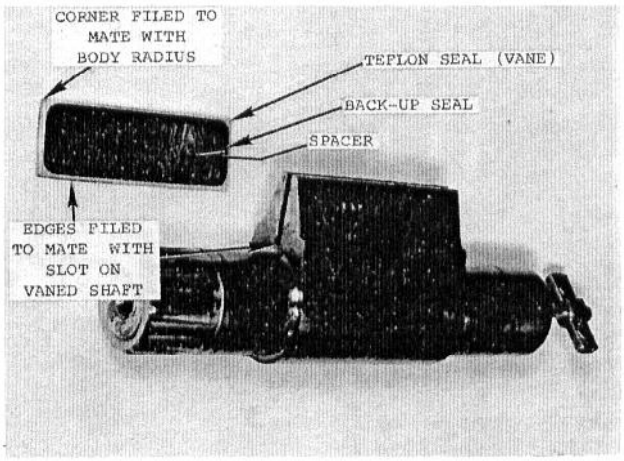

Fig. 57 — Shaping Teflon Seal for Moving Vane Shaft

d. Check the I.D. of the bushing for wear, or damage. (This diameter is 3.004"/3.005" new and is considered excessively worn when it measures 3.007".)

e. Check the large "O"-ring seal groove at top of barrel and check the shaft "O"-ring groove (located below the bushing) for damage.

NOTE: Minor scratches, or burrs, may be removed by hand stoning the affected areas ... profiding that a leakage path is not formed.

4. Check the barrel vane's seal groove for damage to its surface (or edges).

5. Inspect the top cover as follows ... see Fig. 56:

a. Check the anti-cavitation poppet seats for damage. (These seats MUST be free of all defects to prevent leakage into the return line ... causing the cylinder to cavitate.)

b. Check the machined surfaces for scratches, nicks or unusual wear. (Internal leakage, damage to the moving vane seal, or external leakage between the cover and the barrel, may result if test surfaces are damaged.)

c. Check that edge of the hub seal bore is sharp. (Nicks, dents or a rounded edge may cause leakage.)

d. Check the I.D. of the bushing for wear, or damage. (This diameter is 3.004"/3.005" new and is considered excessively worn when it measures 3.007".)

e. Check the shaft seal ("O"-ring) groove for damage.

f. See note under step 3e.

6. Check the general condition of all seals so as to obtain an indication as to the over-all condition of the rotary cylinder.

REASSEMBLY OF CYLINDER — MF PART NO. 708 714 M92

1. Replace all seals with new parts, apply a light coat of petroleum jelly ... or hydraulic oil to all metal parts of the cylinder ... EXCEPT THE SPLINE AREA OF THE MOVING VANE SHAFT.

2. Install the shaft seal "O"-ring into its groove within barrel assembly ... then install the teflon seal over the "O"-ring. CAREFULLY smooth the teflon seal with a screwdriver handle ... see Fig. 54 ... then lightly grease this seal. (The teflon seal is designed to fit around the shaft and to be "loaded" by the "O"-ring. The "O"-ring should not contact the shaft.)

NOTE: Make sure that the teflon seal is not crimped, or torn.

3. Insert the hub seal wave spring, metal back-up ring and teflon seal into the hub seal bore of the barrel assembly ... see Figs. 49 and 55. (The teflon seal is to be fitted into the metal ring ... see Fig. 54. The sealing surface is the one that faces outward and contacts the end of the hub diameter of the vane shaft, when the seal is installed in the bore cavity. This seal must be free of all damage ... especially at its corners. It should fit snug into its bore but still be free enough to move when depressed. A tight hub seal can cause leakage.)

4. Wrap the splined end of the vane shaft with plastic (electrical) tape and grease lightly.

5. Preassemble the back-up seal and vane teflon seal onto the vane spacer ... see Fig. 57.

6. Use a suitable file to SHAPE the edges on one side of the vane teflon seal to mate with the slot in vane shaft ... the seal should fit all the way down into this slot ... see Fig. 57.

7. Carefully file ONE CORNER of the vane teflon seal so that it mates with the radius inside the barrel assembly ... see Figs. 54,55 and 57.

NOTE: The other three corners of this seal must be sharp, or leakage will occur.

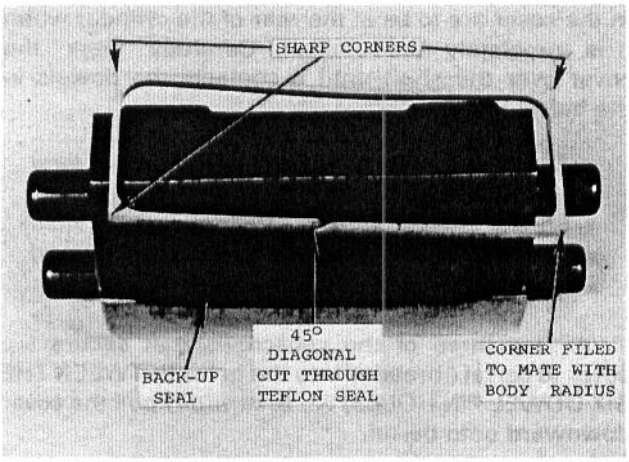

Fig. 58 — Shaping Teflon Seal for Barrel Vane

8. Carefully insert the spacer, with seals installed, into its slot in the vane shaft. Make sure that the SHAPED side of the teflon seal is correctly positioned into the slot and that the ROUNDED SHAPED corner is nearer the splined end of the shaft (and will correctly mate with the radiused corner of the barrel when the shaft is installed) . . . see Figs. 54,55 and 57.

9. Place a piece of heavy gauge plastic (such as a bag used to protect operator's manual), or a 0.005" piece of shim stock, against the face of the vane seal that will contact the barrel assembly.

10. Use the bolt and puller crosshead to position vane shaft to the barrel . . . then (while using the plastic, or shim stock, to protect the vane seal) *carefully* lower the vaned shaft into the barrel assembly. Keep the vane seals and spacer within the slot in the vane shaft . . . also make certain that the plastic (or shim stock) protects between the edge of the seal and the sharp top lip of the barrel. After the vane seals (and vane shaft) are approximately 2/3 inside the barrel . . . CAREFULLY remove the plastic (or shim) making sure that the vane seals REMAIN within the slot.

NOTE: Do not allow the vane seal to be scratched, cut or shaved during installation . . . or leakage will result. Also make sure that the teflon shaft seal in the barrel is not damaged by the splined end of the shaft.

11. Continue to push the vane shaft (with seals in its slot) downward into the barrel until it is in its assembled position. Rotate the shaft until the vane is positioned approximately 90° from the center-line of the barrel vane (when barrel vane is installed) . . . see Figs. 51 and 52.

12. Install a back-up seal into the groove on the barrel vane.

13. CAREFULLY file ONE CORNER of the barrel vane teflon seal to SHAPE it so that it mates with the radiused corner of the barrel . . . see Fig. 58. Also see Fig. 55. Make a 45° DIAGONAL CUT through the LONG side of the seal . . . between the rounded corner and a sharp corner similar to that shown in Fig. 58. (This cut should be half-way between the corners of the seal and will be positioned between the barrel vane and the barrel when assembly is completed . . . see Fig. 54.)

NOTE: Make certain that the plastic (or shim stock) protects between the shaft and the teflon seal . . . and between the barrel and the teflon seal. Also make sure that the diagonal cut on this teflon seal is positioned between the barrel and the barrel vane . . . see Figs. 54 and 58.

17. After the barrel vane (and installed seals) is approximately 3/4 of the way inside the barrel . . . CAREFULLY REMOVE THE PLASTIC (OR SHIM STOCK) PROTECTING THE SEAL.

18. Continue to CAREFULLY slide the barrel vane into place . . . making sure that the teflon seal remains within its groove. It may be necessary to lightly tap the top of the barrel vane to make sure its dowels fully engage the holes in the bottom of the barrel.

NOTE: If the teflon seal is scratched, cut or shaved during installation . . . leakage will result.

19. Position the large "O"-ring into its groove at top of barrel . . . see Fig. 50. Lightly oil this "O"-ring.

20. Install the upper shaft seal "O"-ring into its groove in the top cover . . . then install the teflon seal over this "O"-ring. CAREFULLY smooth the teflon seal with a screwdriver handle, then lightly grease this seal . . . see Fig. 59. (The teflon seal is designed to fit around the shaft and to be "loaded" by the "O"-ring. The "O"-ring should not contact the shaft.)

NOTE: Make sure that teflon seal is not cut or torn.

21. Install the anti-cavitation poppet, spring and guide into their respective bores in the top cover . . . then secure in place with snap ring. (The spring side of the poppet is the side that has the slotted "button". The flat side of the guide is to be next to the snap ring.)

NOTE: Make sure that snap rings fit properly into their grooves and that the poppets lift freely from their seats (on top cover).

22. Insert the hub seal wave spring, metal back-up ring and teflon seal into the hub seal bore of the top cover . . . see Figs. 49 and 59. (The teflon seal is to be fitted into the metal ring. The sealing surface is the one that faces outward and contacts the end of the hub diameter of the vane shaft, when the seal is installed in the bore cavity. This seal must be free

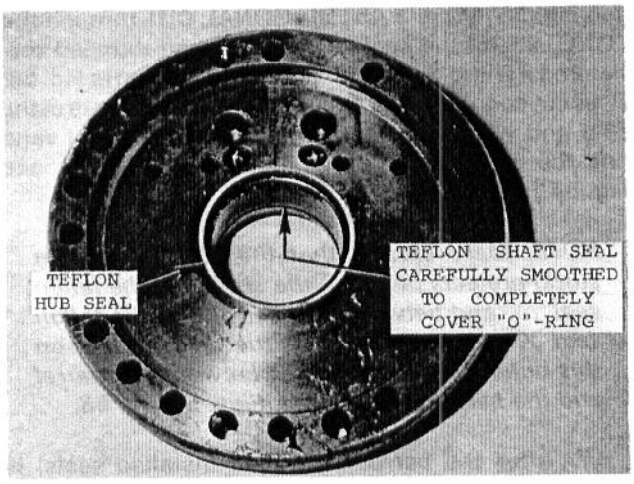

Fig. 59 — Preassembled Top Plate Prior to Assembly onto Barrel

of all damage ... especially at its corners. It should fit snug into its bore, but still be free enough to move when depressed. A tight hub seal can cause leakage.)

NOTE: Apply a heavy grease to the hub seal (and related parts) so they will not fall out when the cover is inverted and positioned over the shaft and barrel assembly. Also lightly oil the shaft seal teflon ring (in top cover) and the top of the vane shaft.

23. CAREFULLY POSITION the top cover over the vane shaft (and barrel assembly) while aligning the dowel pins in the barrel with their respective holes in the cover ... see Figs. 46 and 47: (The port cavities in the cover are to be at the rear of the cylinder when it is completely reassembled.) Carefully "work" the cover over the shaft until it contacts the dowels in the barrel rim.

NOTE: Make certain that the hub seal (and related parts) does not fall from cavity during assembly of the top cover to the barrel. Also make sure that the teflon shaft seal (in cover) is not crimped, torn, etc.

24. Use three of the capscrews that secure top cover to barrel (threaded into the holes BETWEEN THE SIX DOWEL PIN HOLES) ... to *carefully* pull the cover downward onto barrel.

NOTE: Tighten these three capscrews ALTERNATELY AND EVENLY until the cover is approximately .024" from barrel surface. DO NOT EXCEED 100 FT.-LBS. TORQUE WHEN TIGHTENING BOLTS ... and make sure that the cover's hub seal does not fall from its cavity.

25. Thread the remaining cover-to-barrel capscrews into barrel. Tighten bolts ALTERNATELY AND EVENLY TO 100 FT.-LBS. TORQUE WHILE MAINTAINING A GAP OF .005"-.024" between the mating surfaces of the cover and the barrel.

NOTE OVERTIGHTENING bolts may cause the cover to crack.

26. Install new seals on the circuit relief valves ... then install these reliefs into their ports in the top cover assembly, see Fig. 45.

DOUBLE-ACTING CYLINDERS

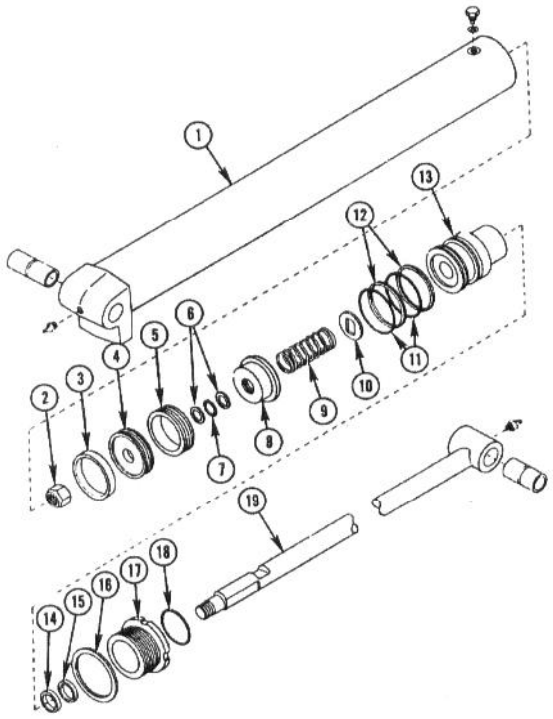

Fig. 60 — Identification of Parts Typical of MF Part Nos. 707 413 M91, 1605 161 M91 and 1605 162 M91

1. Barrel Assembly
2. Piston Nut
3. Ring (Wear)
4. Piston (Wear)
5. Piston Seals
6. Back-Up Washers
7. "O"-Ring
8. Piston
9. Spring
10. Washer
11. "O"-Ring
12. Back-Up Washers
13. Bearing
14. Seal
15. Seal
16. Washer (Retainer)
17. Nut
18. "O"-Ring
19. Rod Assembly

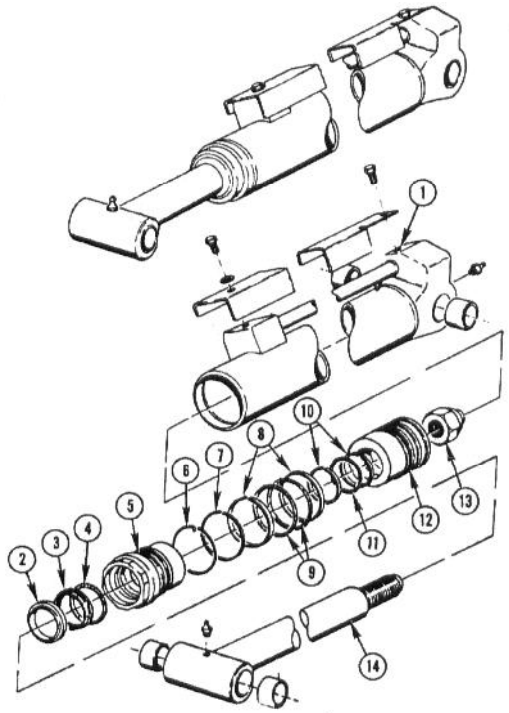

Fig. 61 — Identification of Parts Typical of MF Part No. 1605 013 M94

1. Barrel Assembly
2. Wiper Seal
3. Bearing Seal
4. "O"-Ring (Bearing)
5. Bearing
6. Wire Retaining Ring
7. Back-Up Washer
8. Guide Rings (Piston)
9. Seals (Piston)
10. Back-Up Washers
11. "O"-Ring (Piston Inner)
12. Piston
13. Piston Locknut
14. Rod Assembly

The recommended procedures to be used when repairing a particular cylinder may be found by referring to service information (listed by MF Part Number) ... then to the BASIC instructions, WHILE ALSO OBSERVING ANY SERVICE NOTES THAT MAY APPLY.

Basic instructions for cylinder servicing are divided into two sub-headings ... one pertaining to cylinders that utilize a wire retaining ring for securing cylinder bearing into barrel, the other pertains to a crimped washer that secures bearing after recommended torquing to barrel (i.e.: cylinders without wire retainer).

The MF Part Number is usually found stamped on the exterior of the cylinder and should be used as a means of identification.

NOTE: Servicing instructions of Extendable Dipperstick and Cylinder is under a separate main heading.

SERVICE INFORMATION

MF Part No. 707 413 M91 — Refer to Fig. 60 as a guide. Bearing nut and staked washer used to retain bearing.

MF Part No. 1605 013 M94 — Refer to Fig. 61 as a guide. Wire retaining ring used to retain bearing.

MF Part No. 1605 020 M92 — Refer to Fig. 62 as a guide. Wire retaining ring used to retain bearing.

MF Part No. 1605 022 M92 — Refer to Fig. 63 as a guide. Wire retaining ring used to retain bearing.

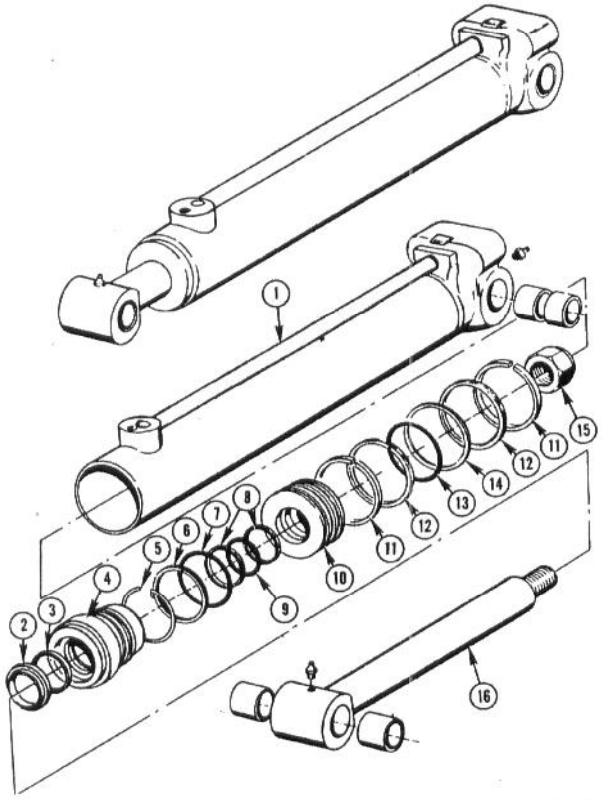

Fig. 62 — Identification of Parts Typical of MF Part No. 1605 020 M2

1. Barrel Assembly
2. Wiper Seal
3. Bearing Seal
4. Bearing
5. Wire Retaining Ring
6. Back-Up Washer
7. "O"-Ring
8. Back-Up Washers
9. "O"-Ring
10. Piston
11. Guide Rings
12. Back-Up Rings
13. "O"-Ring
14. Friction Ring
15. Piston Locknut
16. Rod Assembly

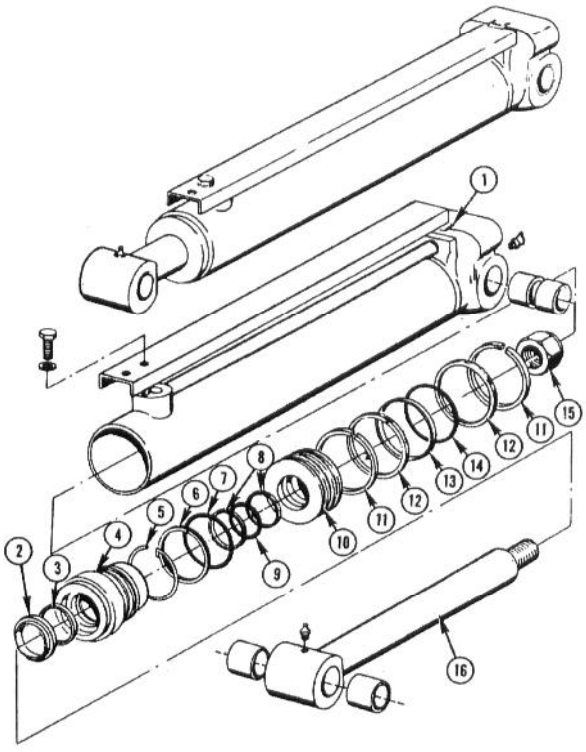

Fig. 63 — Identification of Parts Typical of MF Part Nos. 1605 022 M92 and 1605 176 M92

1. Barrel Assembly
2. Wiper Seal
3. Bearing Seal
4. Bearing
5. Wire Retaining Ring
6. Back-Up Washer
7. "O"-Ring
8. Back-Up Washers
9. "O"-Ring
10. Piston
11. Guide Rings
12. Back-Up Rings
13. Friction Ring
14. "O"-Ring
15. Piston Locknut
16. Rod Assembly

MF Part No. 1605 079 M93 — Refer to Fig. 64 as a guide. Staked washer used to retain bearing.

MF Part No. 1605 081 M93 — Refer to Fig. 64 as a guide. Staked washer used to retain bearing.

MF Part No. 1605 161 M91 — Refer to Fig. 60 as a guide. Bearing nut and staked washer used to retain bearing.

MF Part No. 1605 162 M91 — Refer to Fig. 60 as a guide. Bearing nut and staked washer used to retain bearing.

MF Part No. 1605 174 M91 — Refer to Fig. 65 as a guide. Wire retaining ring used to retain bearing.

MF Part No. 1605 176 M92 — Refer to Fig. 63 as a guide. Wire retaining ring used to retain bearing.

CYLINDERS WITH WIRE RETAINING RING

Refer to "Service Information" and MF Part Number that pertains to cylinder being serviced ... then as directed to the TYPICAL illustration to be used as a GUIDE to cylinder construction.

CAUTION: When removing cylinders make certain that all hydraulic system pressure is relieved by operating control levers back-and-forth several times ... be especially careful when removing stabilizer cylinders as they contain lockout valves that may trap pressure in the system. Clean around cylinder ports before disconnecting lines.

1. Clean exterior of cylinder, drain trapped oil ... then place cylinder in a holding fixture (or place head-end of barrel over a fixed pin on bench).
2. Disassemble cylinder as follows:

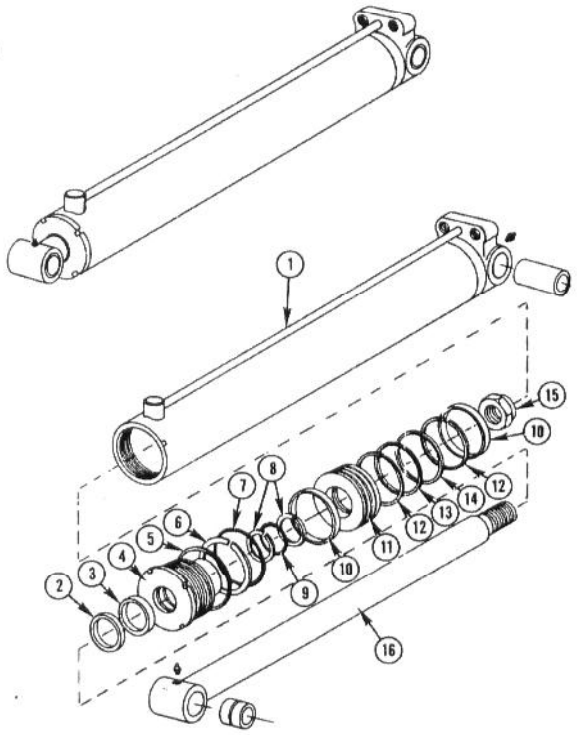

Fig. 64 — Identification of Parts Typical of MF Part Nos. 1605 079 M93 and 1605 081 M93

1. Barrel Assembly
2. Wiper Seal
3. Bearing Seal
4. Bearing
5. Washer Retainer
6. Back-Up Ring
7. "O"-Ring
8. Back-Up Washers
9. "O"-Ring
10. Guide Rings
11. Piston
12. Back-Up Rings
13. "O"-Ring
14. Friction Ring
15. Piston Locknut
16. Rod Assembly

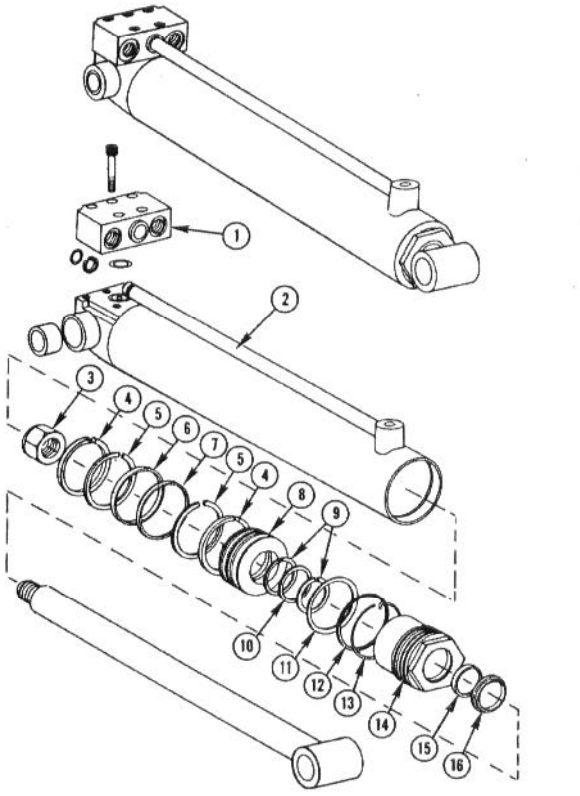

Fig. 65 — Identification of Parts Typical of MF Part No. 1605 174 M91

1. Lockout Valve Assembly
2. Barrel Assembly
3. Piston Locknut
4. Guide Rings
5. Back-Up Rings
6. Friction Ring
7. Seal (Piston Outer)
8. Piston
9. Back-Up Washers
10. "O"-Ring
11. "O"-Ring (Bearing Outer)
12. Back-Up Washer
13. Wire Retainer
14. Bearing
15. Bearing Seal
16. Wiper Seal

a. Remove wax (or grease) from hole in barrel ... over bearing wire retainer at rod-end of barrel assembly.

b. Rotate bearing clockwise (as viewed from bearing end of barrel) ... until BEVELED END of wire retainer is visible at hole in barrel, see Fig. 66.

NOTE: If bearing is rotated in opposite direction, "hooked-end" of wire retaining ring may break. If "hooked-end" of wire is broken, bearing may turn without causing wire ring to turn. Should this occur, follow instructions in Step No. C.

c. If wire retaining ring is broken and will not turn ... carefully center punch wire (through hole in barrel) then CAREFULLY drill through wire and slightly into bearing, see Figs. 67 and 68. Insert a piece of wire same SIZE as retaining wire (or a "drive lug") into drilled hole ... But with a length the same depth as drilled hole. Check that wire piece (or "drive lug") will not damage barrel when bearing is turned ... if necessary, grind wire so that it will clear barrel. Rotate bearing until end of wire retainer is visible at hole in barrel ... continue to rotate bearing (to remove broken ring) then proceed to step No. d.

d. Insert a small screwdriver through hole in barrel ... and under beveled end of wire retainer. Reverse direction of bearing rotation while guiding wire retainer from hole in barrel, see Fig. 68.

e. Remove wire retainer when "hooked end" reaches barrel hole. If wire is broken (step No. c) make sure that ALL of wire retainer has been removed.

f. Pull end of rod to force bearing from cylinder barrel ... using a "sliding hammer" motion.

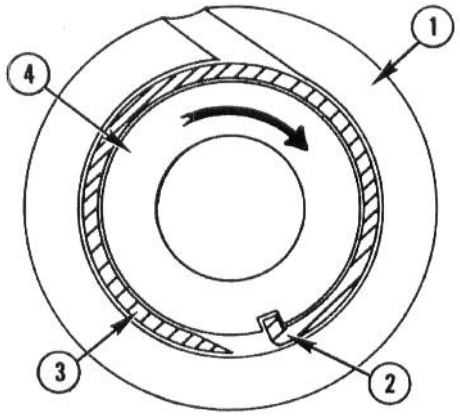

Fig. 66 — Direction of Bearing Rotation for Access to Wire Retaining Ring

1. Barrel
2. "Hooked" End of Wire Retainer
3. "Beveled" End of Wire Retainer
4. Bearing

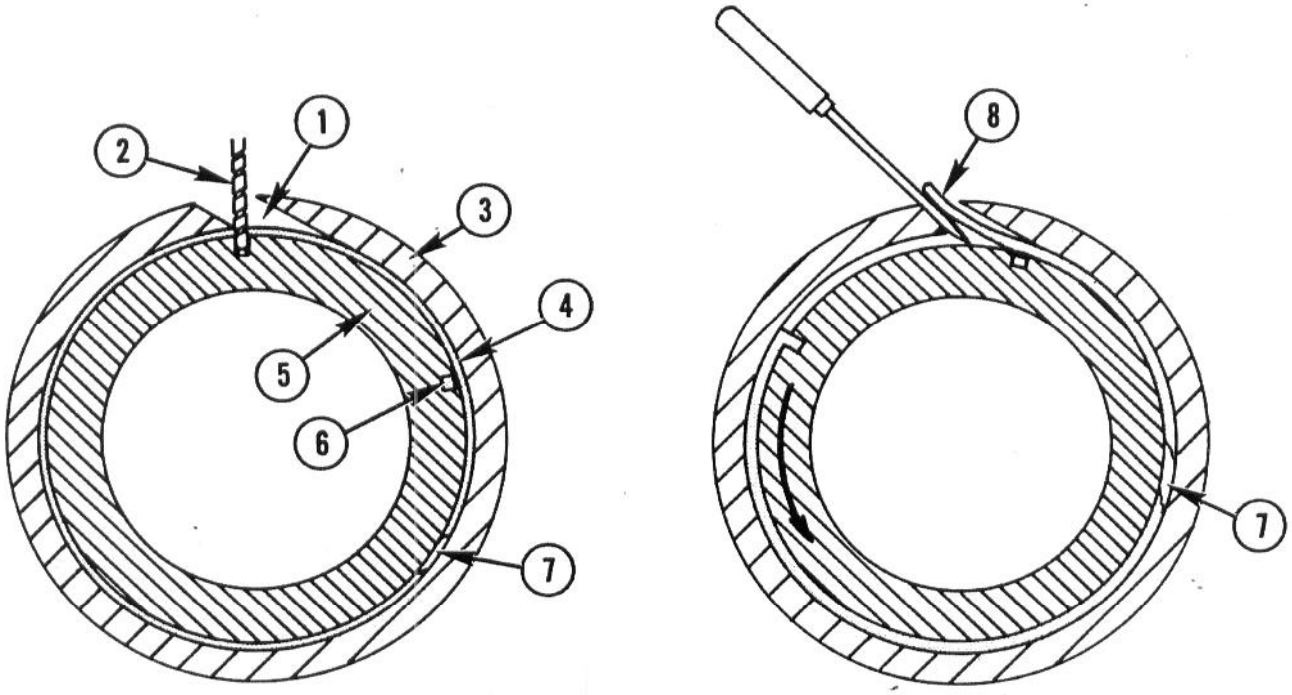

Fig. 67 — Drilling Through and Starting Wire Retaining Ring for Removal of Broken Ring

1. Hole Through Barrel
2. Drill
3. Barrel
4. Wire Retaining Ring
5. Bearing
6. Broken "Hooked-End" of Wire
7. Wire Break (Nut at "Hook-End")
8. End of Wire Cut by Drilling
9. Wire Piece Insert (or "Drive Lug")

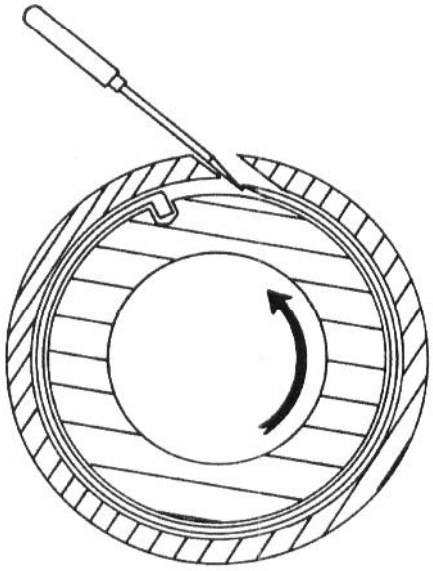

Fig. 68 — Removing Wire Retainer Ring

CAUTION: If wire retainer groove in bearing (or barrel) is distorted, it may be necessary to use hydraulic pressure supplied by a hand pump to force bearing from cylinder. Use extreme care to make sure that no one can be injured should air be trapped in cylinder . . . DO NOT use air pressure to remove bearing from barrel.

g. Slide piston (with seals) and rod assembly from barrel.

h. Remove piston nut (if used) then slide piston from rod . . . remove all piston seals.

i. Slide bearing assembly from rod . . . remove all seals from bearing, see Fig. 69.

3. Thoroughly clean all metal parts, air dry and inspect cylinder as follows:

a. Inspect inner side of barrel assembly for pits and scratches, and cylinder ports for burred threads and obstructions. Remove any burrs or obstructions found. If pits or scratches are sufficient to damage seals (or allow oil to leak past seals) it may be necessary to replace cylinder.

b. Inspect head-end of barrel assembly for cracks, or distortion.

c. Inspect piston and bearing for nicks and scratches.

d. Inspect rod assembly for alignment, cracks and scratches (that may damage bearing seals).

e. Inspect rod cross-head for damage or excessive wear and remove all paint from rod assembly.

4. Install new seals into piston and bearing as follows:

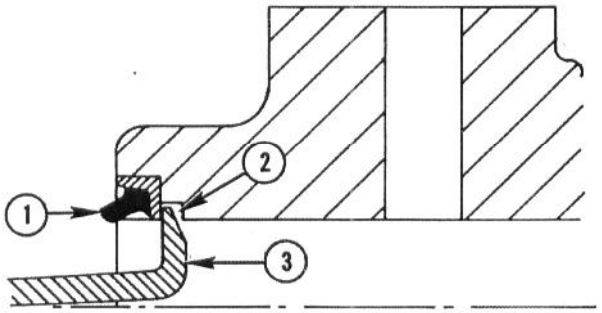

Fig. 69 — Removing Metallic Shell Wiper Seal

1. Wiper Seal
2. "Extractor Groove" In Bearing
3. "Hooked-End" of Extractor Tool

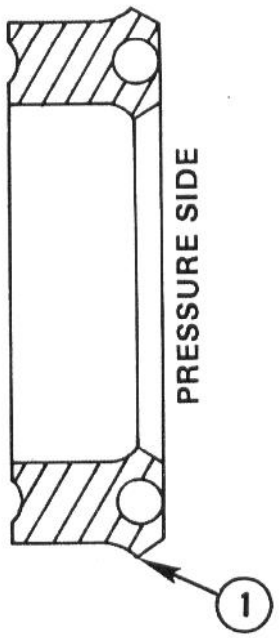

Fig. 70 — Lip Side of Typical Rod Seal (To be Directed Toward Pressure in Cylinder)

1. Seal Lip

NOTE: If necessary, seals that are not split type or spirol should be preheated to 200° F. for 5-10 minutes in clean oil. This will allow seal to be stretched SLIGHTLY for easier installation. Seals should be allowed to cool to room temperature (or may be chilled by applying ice) before installation of piston, or bearing to barrel. If seals are stretched too much, they may not return to normal shape . . . this will require use of a suitable ring compressor to prevent cutting seal during assembly into barrel.

a. Install rod seal, see Fig. 70, into I.D. of bearing with lip of seal away from dust seal . . . install dust seal (wiper) into bearing with lip side of seal out-

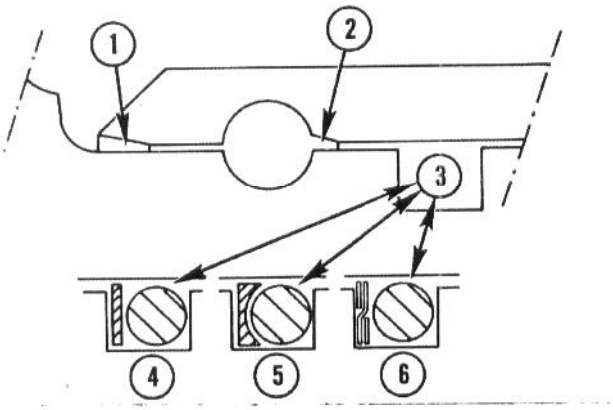

Fig. 71 — Installation of Static Seals and Back-Up Washers in OD Groove of Bearing

1. Chamfer on Barrel End
2. Chamfer on Inner Groove of Barrel (Near Wire Retainer)
3. Groove on Bearing OD
4. "O"-Ring and Plain "Flat" Washer
5. "O"-Ring and "Profiled" Washer
6. "O"-Ring and "Spiral" Washer

ward (away from rod seal). Use care to prevent damage to lips of seals during installation.

b. Install back-up washer and "O"-ring into groove on O.D. of bearing . . . back-up washer to be nearest "hex side" of bearing, see Fig. 71.

NOTE: "Profiled" type washers must be installed with concave side next to "O"-ring. "Spiral" type washers must be installed so that beveled cuts FACE center coil (not outward of coil) . . . see Fig. 72. Make sure that back-up washers fit entirely into bearing groove . . . otherwise, they may be cut when bearing is installed in barrel.

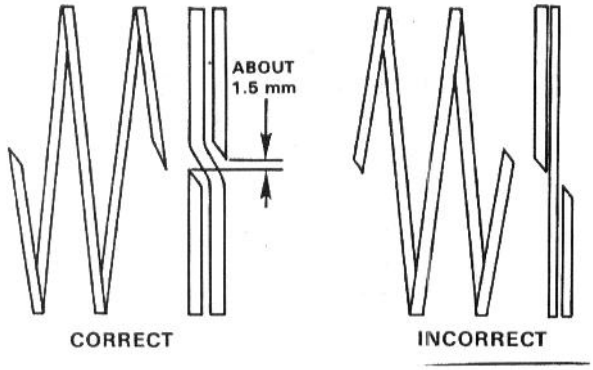

Fig. 72 — Positioning Beveled Cuts of "Spiral" Type Back-Up Washers

c. Install "O"-ring (or seal) into outer center groove of piston then install friction ring on top of "O"-ring.

d. Install wear ring seals into piston outer grooves . . . one on each side of friction ring and "O"-ring.

e. Apply clean hydraulic oil to bearing seals . . . then slide bearing over rod so that its wiper seal will be nearest rod clevis (i.e.: outward).

NOTE: Use care to prevent damage to bearing seals during installation onto rod assembly.

f. If piston is NOT part of rod assembly (i.e.: piston is retained by locknut) . . . install one back-up washer into inner piston groove followed by "O"-ring and remaining back-up washer. Be sure back-up washers are positioned similar to procedures for installing them in bearing outer groove . . . see note under step No. b. Apply clean hydraulic oil to piston seals then slide piston over threaded end of rod . . . counterbore on piston to fit over "step" on rod. Install new piston locknut.

5. Reassemble piston and bearing into cylinder as follows:

NOTE: If seals on piston, or bearing have been stretched . . . use a suitable ring compressor when inserting piston (or bearing) into cylinder barrel. Use care to prevent cutting seals.

a. Apply clean hydraulic oil to inside of barrel, piston and bearing seals.

b. Carefully insert piston completely into barrel . . . then place piston at about mid-stroke position.

c. Insert bearing into barrel just to point where wire retaining ring groove (on bearing) is visible through hole in barrel.

d. Rotate bearing until hole in bearing (for "hooked end" of wire retainer) is visible at barrel hole.

e. Insert "hooked-end" of new wire retainer into hole in bearing groove . . . then rotate bearing until *beveled end* of wire retainer is drawn into bearing groove. Continue to rotate bearing approximately one-half turn, see Fig. 73.

f. Fill wire retainer hole through BARREL with wax, or grease to prevent entry of water, etc.

CYLINDERS WITHOUT WIRE RETAINING RING

Refer to "Service Information" and MF Part Number that pertains to cylinder being serviced . . . then as directed to the TYPICAL illustration to be used as a GUIDE to cylinder construction.

CAUTION: When removing cylinders make certain that all hydraulic system pressure is relieved by operating con-

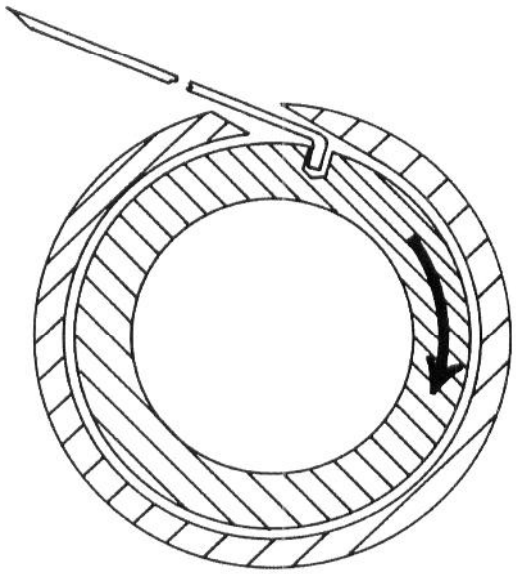

Fig. 73 — Installing Wire Retaining Ring to Secure Bearing

trol levers back-and-forth several times ... clean around cylinder ports before disconnecting lines.

1. Disassemble cylinder as follows:

a. Place the cylinder in a holding fixture, or place clevis end of cylinder barrel over a fixed pin on the bench. (If a vise must be used, clamp on barrel portion of the cylinder only, and do not use excessive clamping pressure.)

b. Straighten the "staked" retaining washer ... then unscrew bearing OR bearing nut from cylinder barrel.

c. Insert a large "drift" pin through rod crosshead and pull the rod sharply to strike piston against bearing assembly. (Entire rod assembly may be removed from the cylinder barrel with a few sharp strokes.) If bearing does not release, a suitable hand pump may be used to apply hydraulic pressure to the head end port of the cylinder.

CAUTION: Do not use air pressure to release bearing. Air will compress and may cause the rod assembly to release suddenly.

d. Place crosshead of rod over a fixed pin on the bench (or secure crosshead in a vise) and remove locknut to release piston assembly.

e. Slide entire piston assembly (with its seals and retainer) from the rod assembly while carefully noting the parts relationship. (This will assist in correct reassembly of the cylinder.)

f. Slide the entire bearing assembly (will all seals in place), the retaining washer and bearing nut from the rod assembly.

g. Remove the wear rings (if used), the piston seals, the bearing seals (i.e.: packing). All seals and wear rings are to be replaced with new parts.

h. Clean all metal parts of the cylinder in a suitable solvent and dry thoroughly.

2. Inspection of cylinders is as follows:

NOTE: It is not necessary to inspect "O"-rings, back-up washers, piston packing, bearing seals, etc. ... These parts should be removed and replaced with new items. Clean all other parts of the cylinder thoroughly.

a. Inspect inner side of barrel assembly for scoring or excessive wear. Check the cylinder ports for burred threads or obstructions. Use crocus cloth to remove any nicks or burrs that might be on barrel. (Polish in circular motion only.) If desired, and engine cylinder deglazing tool may be used to remove scores and scratches from the barrel. Work tool carefully in a cross-patch pattern.

b. Inspect weld areas for cracks. Check cylinder barrel and rod crossheads for damage or excessive wear.

c. Inspect piston and bearing for nicks and scratches may be removed by using crocus cloth. (Polish in circular motion only.) If nicks or scratches are sufficient to allow oil passage around the seals, replacement is necessary.

d. Check rod assembly ro cracks, scratches, dents, scoring and alignment.

e. Inspect crosshead bushings for damage, or wear. If bushings are to be replaced, remove grease fitting(s) before removing bushings.

f. Inspect grease fitting for free movement of its ball check valve and for obstructions.

3. Refer to the illustration typical of cylinder constructions and reassemble as follows:

a. Reverse the order of disassembly ... to reassemble the cylinder.

b. Replace all packing, wear rings, seals, "O"-rings, back-up washers, etc., AND WORN PARTS with new items.

c. Apply a light coating of clean hydraulic oil to all metal parts before reassembly.

d. Correctly install all seals, etc., and other related parts onto the bearing and piston. Make sure that the lips of the seals are facing in the right direction.

INFORMATION: Normally, the piston packing is positioned so that sealing lips face toward bearing, inner bearing packing (or seals) face toward piston, wiper seal faces rod clevis. See illustrations for positioning of "O"-rings and back-up washers.

e. Slide bearing nut retainer (if used) and washer over rod assembly.

f. Carefully slide preassembled bearing (and its related parts) then the piston (correctly preassembled) over the rod ... taking care to prevent damage to seals and making sure that bearing and piston are correctly positioned.

g. Use a new piston locknut.

h. Use care when inserting piston, bearing and rod into barrel. If necessary a "C" clamp may be used to CAREFULLY "form" barrel so that these parts will enter easier. After the bearing has been started into the barrel ... the "C" clamp is to be removed before securing bearing to its specification.

i. After the cylinder has been completely reassembled ... AND REINSTALLED ON THE LOADER ... Pressurize the head-end of the cylinder and retighten the bearing or bearing retainer, (according to cylinder construction). Stake washer to cylinder barrel and to bearing.

EXTENDABLE DIPPERSTICK

There will always be a slight amount of galling or flaking of bearing material (bearing strips on extension) during operation ... until bearing strips and plates have seated to the housing.

DIPPERSTICK ASSEMBLY

See Fig. 74.

1. With the inside tube extended completely, inspect the dipperstick for cracks. It may be necessary to steam-clean telescoping portion to detect cracks or unusual wear.

NOTE: The bearing strips and plates on extension, will wear because of the friction of main parts sliding across each other. When the unit is new, there will be some scoring, or galling until the bearings have seated. Once the bearings are in full contact, this should decrease.

2. Check all bearing plates and strips. Make sure they are tight and that they are at least 3/32" thick. To determine if they are loose, run the extension in and out a few inches in rapid succession. If there is movement of the bearing plates, they must be tightened.

3. To tighten plates, it is necessary to remove the collar from the end of the housing. After tightening the screws, stake with a center punch to prevent them from working loose. Replace all missing screws. Reinstall the collar assembly.

NOTE: The head of the screw must be flush (or below) the surface of bearing plate, otherwise they may shear off when extension is operated.

4. Inspect all pivot pins for wear and replace as necessary.

5. Clean and lubricate all slide bearing surfaces.

CYLINDER ASSEMBLY

See Fig. 75.

1. Clean exterior of cylinder, drain trapped oil ... then place cylinder in a holding fixture (or place head-end clevis over a fixed pin on bench).

2. Disassemble cylinder as follows:

a. Remove roll pin from rod clevis then remove clevis from rod. (It may be necessary to wrap a piece of fine grade sandpaper and use a strap wrench on rod to remove clevis ... use care to prevent damage to rod.)

b. Remove nylon set screw securing lock ring ... then remove lock ring from barrel. (Tapping *lightly* on barrel, around lock ring area will loosen sealer around lock ring threads ... making removal easier.)

c. Pull rod sharply to strike piston against bearing ... until piston and bearing are free of barrel. If bearing does not release easily, a suitable hand pump may be used to apply hydraulic pressure to head-end port of cylinder.

CAUTION: Do not use air pressure to release bearing. Air will compress and may cause the rod to release suddenly.

d. Secure rod and remove piston locknut ... it may be necessary to heat nut to break "Loctite" seal.

NOTE: Do not damage rod assembly.

e. Slide parts from rod then remove all seals.

3. Thoroughly clean all metal parts, air dry and inspect cylinder as follows:

a. Check cast iron rings for scores, cracks, chips and breakage ... replace if any of these conditions exists.

b. Check bronze bearings (on rod) for excessive play ... bearing inside diameter should not be more than 0.008" greater than rod outer diameter.

c. Check piston for wear and damage ... also inner side of barrel assembly for evidence of scoring, or excessive wear.

d. Check rod assembly for cracks, scratches, dents, scoring AND alignment.

e. Lubricate all new seals PRIOR to reinstallation.

4. Reassemble cylinder as follows ... see Fig. 75:

a. Install new "O"-ring into pistons center groove ... then install cast iron rings. Start cast iron rings, one end at a time and work them into piston grooves.

NOTE: Use care to prevent breaking or chipping cast iron rings. Do not try to spread cast iron rings too far.

b. Install new "O"-rings onto rod and cushion. Install cushion (flanged-end first) so that spring will seat over cushion.

c. Install cushion return spring onto rod ... followed by piston assembly. Grooved end of piston toward spring ... be sure spring seats into piston.

d. Install and tighten new piston locknut. Apply "Loctite" sealant (per manufacturer's recommendation) to locknut threads ON ROD.

e. Apply clean hydraulic oil to piston (seals and rings) ... then carefully insert piston and rod assembly into cylinder barrel. (Approximately 3/4 distance into barrel.)

NOTE: Use a suitable ring compressor to install piston into barrel and prevent damage to rings and seals (by barrel's internal threads).

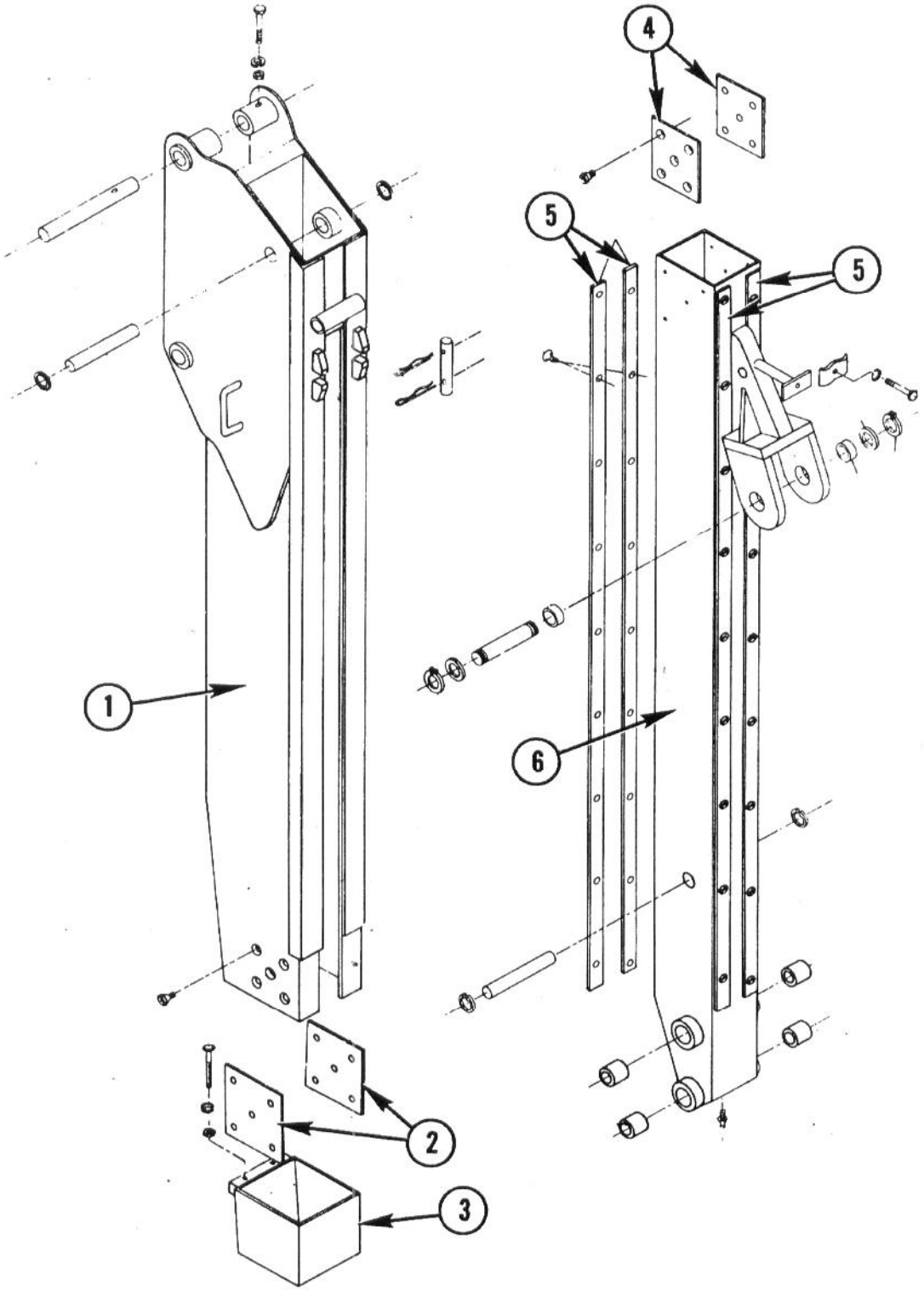

Fig. 74 — Extendable Type Dipperstick — Relationship of Parts

1. Outer Housing Assembly
2. Side Bearing Plates (Housing)
3. Housing Collar
4. Side Bearing Plates (Extension)
5. Bearing Strips (Extension)
6. Telescoping Extension

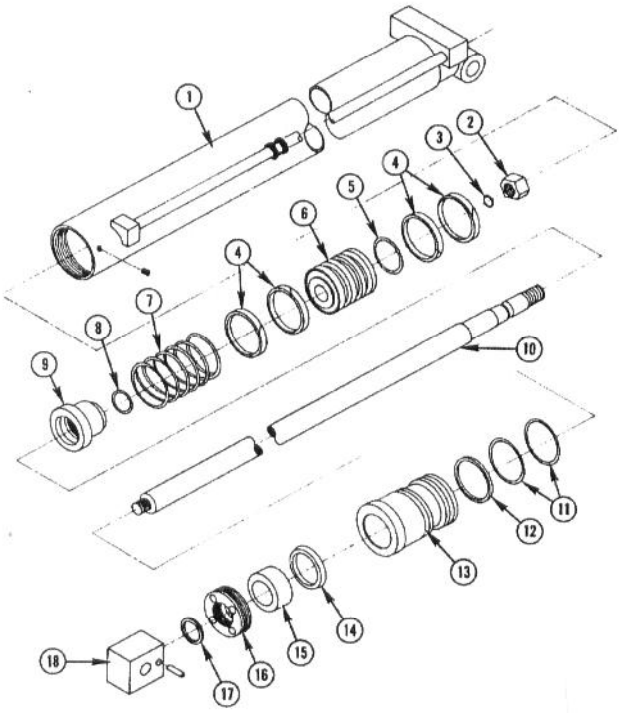

Fig. 75 — Identification of Cylinder Parts — for Dipperstick Extension

1. Barrel Assembly
2. Piston Locknut
3. "O"-Ring
4. Guide Rings (Piston)
5. "O"-Ring (Piston)
6. Piston
7. Spring (Cushion Return)
8. "O"-Ring (Cushion)
9. "Cushion"
10. Rod
11. Bearing "O"-Rings
12. Back-Up Ring
13. Bearing
14. Rod Seal (Bearing)
15. Bearing
16. Bearing Lock Ring
17. Wiper Seal
18. Rod Clevis

f. Install new back-up ring then new "O"-rings into outer groove of "inner bearing" (i.e.: gland ... see No. 13, Fig. 75).

g. Lubricate and install "inner bearing" while being careful to prevent damage to its outer seals by cylinder port opening.

h. Carefully install new rod seal ("O"-ring side first) over rod ... followed by "outer bearing". Insert these items into barrel assembly.

i. Install new wiper seal into lock ring ... then slide lock ring over rod (spanner holes outward) and into barrel. Thread lock ring into barrel, using "Loctite" sealant on threads (applied per manufacturers recommendation).

j. Install new nylon set screw to secure lock ring.

k. Install clevis into rod assembly and secure with roll pin.

NOTES