SERVICE MANUAL for HUSCO CONTROL VALVES

Koehring
HUSCO Division
Waukesha, Wisconsin 53186

ASC Form No. 80-271

SECTION I GENERAL INFORMATION

Disassembly and repair procedures are included in this Manual for the different types of relief valves, plunger styles, check valves, and special devices incorporated in the HUSCO control valves. All parts are available for replacement except the valve housing and plungers. The plungers are custom fit to the respective bore with extremely close tolerances AND ARE NOT INTERCHANGEABLE. Whenever excessive wear or damage occurs to the plunger or bore, return valve to factory for rebuilding or replacement.*

NOTE

Remove valve from machinery and thoroughly clean the exterior before attempting any disassembly. Disassemble on an area that is free of dirt and corrosive material.

When servicing or rebuilding a valve, it is important to lubricate disassembled parts to prevent corrosion. The following lubricants are recommended:

Lubriplate No. 105 ..... coating seals and "O" Rings.
Lubriplate No. 630 AA ..... springs, detent parts, plunger end assemblies and any parts not normally immersed in the hydraulic oil.

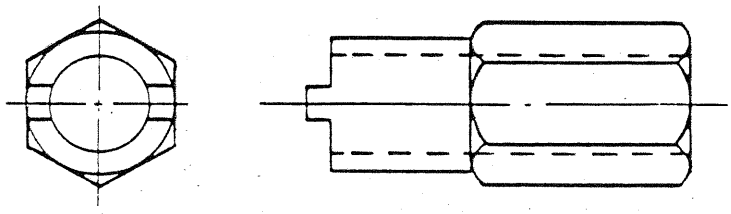
MINIMUM AND MAXIMUM LEAKAGE RATES (Reference only. Rates might vary depending upon application)			
DIA. OF SPOOL	MINIMUM	STANDARD	MAXIMUM
3/4"	1/4"	3/4"	1-1/4"
1	1/2	1-1/8	1-3/4
1-1/4	1	2	3-1/2
1-5/8	2	3-1/2	5
2	3-1/2	5-1/4	7

Plunger leakage allowance is tabulated in cubic inches per minute for a five minute average. Oil temperature of 80° F. with a viscosity of 145 to 155 S.U.S. of 100° F., and viscosity index of 95. Pressure constant at 1000 p.s.i.

If leakage exceeds maximum, the valve should be returned for factory rebuilding or replacement.*

NOTE: ALL DYNAMIC SEALS ARE MADE OF SPECIAL COMPOUNDS AND SHOULD BE PURCHASED FROM HUSCO OR AN APPROVED SOURCE.

*See Section V for emergency plunger and housing repairs.



Special Spanner Socket used for adjusting main relief valve poppet.

Figure 1

SPANNER SOCKET TOOL NUMBERS				
WITH RELATION TO VALVE NUMBERS FOR ADJUSTING MAIN RELIEF VALVE POPPET				
VALVE NO.	3200 & 3700 4300 & 4500 4600 & 5500	3300 & 3400 4170 & 4400	3800 4700	3900 4800
TOOL NO.	J407-A	J565	J602	J563

TORQUE SPECIFICATIONS FOR PIPE PLUGS							
PIPE THREAD SIZE	1/8	1/4	3/8	1/2	3/4	1	1-1/4
TORQUE FOOT POUNDS	8-12	10-15	15-20	25-30	45-50	75-80	100-110

TORQUE SPECIFICATIONS FOR PLUNGER CAP SCREWS		
VALVE MODEL	THREAD SIZE	RECOMMENDED TORQUE VALUES
5000 & 3500	5/16-24	5-7 ft. lb.
3300 & 4400	3/8-16	10-15 ft. lb.
3200 & 4500	5/8-18	70-80 ft. lb.

SECTION II TROUBLE SHOOTING

Trouble	Probable Cause	Remedy
Sticking plungers	1. Excessively high oil temperature.	Eliminate restriction in pipe lines and filtering system.
	2. Dirt in oil.	Change oil - clean system.
	3. Pipe fittings too tight.	Check torque.
	4. Valve warped from mounting.	Loosen valve and check.
	5. Excessively high pressure in valve.	Check with gauge on inlet and cylinder lines.
	6. Handle or linkage binding.	Free up linkage.
	7. Plunger bent.	Replace valve.*
	8. Return spring damaged.	Replace faulty parts.
	9. Spring or detent cap binding.	Loosen cap, re-center and re-tighten.
	10. Valve not at thermal equilibrium.	Let system warm up.
Leaking seals	1. Paint on or under seal.	Remove and clean.
	2. Excessive back pressure.	Open or enlarge line to reservoir.
	3. Dirt under seal.	Remove and clean.
	4. Scored plunger.	Replace valve.*
	5. Loose seal plates.	Clean and tighten.
	6. Cut or scored seal.	Replace faulty parts.
Detent control fails to hold	1. Worn detent cam.	Replace worn parts.
	2. Spring or ball broken or deformed.	Replace damaged parts.
	3. Excessive vibration.	Insulate valve and handle linkage.
	4. Plunger stroke restricted.	Check linkage.
	5. Weight of lever excessive.	Check linkage and mechanism.
Unable to move plunger in or out.	1. Dirt in valve.	Clean and flush out.
	2. Plunger cap full of oil.	Replace seals.
	3. Bind in linkage.	Free up linkage.

*See Section V for emergency plunger and housing repairs.

Trouble	Probable Cause	Remedy
Load will not hold	1. Cylinder leaking or worn.	Check cylinders.
	2. Oil bypassing valve plunger.	Replace valve.*
	3. Port relief valve not holding.	Remove and clean.
Load drops when plunger moved from neutral	1. Dirt in check valve.	Disassemble and clean.
	2. Scored check valve poppet or seat.	Replace poppet or lap poppet to seat.
Poor hydraulic system performance or failure.	1. Defective pump.	Check pressure or replace.
	2. Dirt in relief valve.	Disassemble and clean.
	3. Relief valve defective.	Check as per instructions.
	4. Worn cylinders.	Repair or replace.
	5. Load too heavy.	Check line pressure.
	6. Internal valve crack.	Replace valve.*
	7. Plunger not at full stroke.	Check movement and linkage.
	8. Reservoir low on oil.	Add oil.
	9. System filter clogged.	Clean or replace.
	10. Line restricted.	Check lines.

*See Section V for emergency plunger and housing repairs.

SECTION III MAINTENANCE PROCEDURES

A. RELIEF VALVES

Relief Valves incorporated in HUSCO Control Valves are of several types, as identified on the following illustrations:

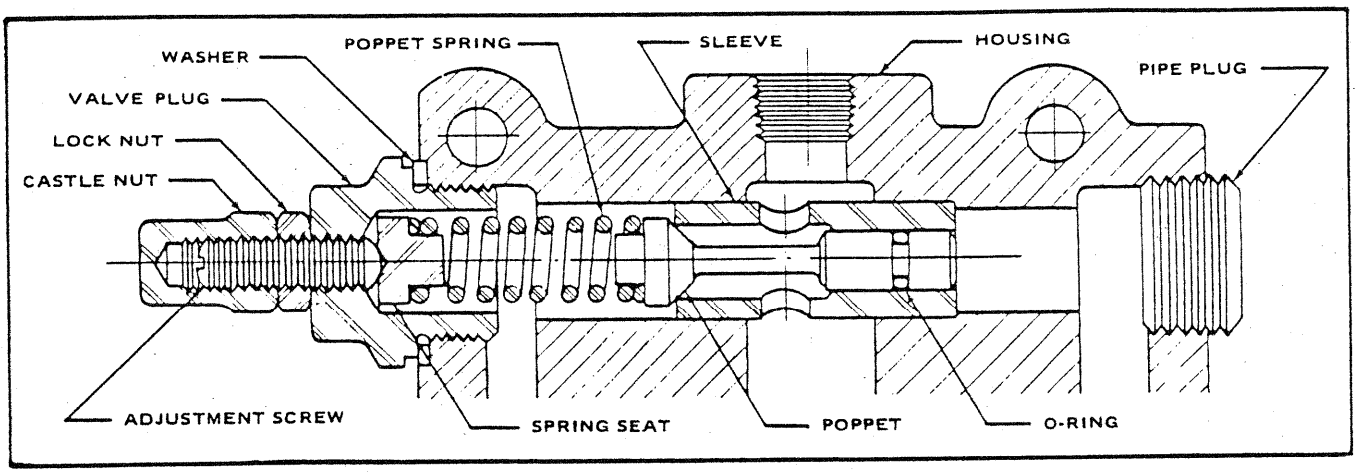


Figure 2. 3500 Relief Valve - Differential Type

The relief valve shown in Figure 2 is a differential area type. The oil pressure of the hydraulic system is introduced into the relief valve sleeve through radially drilled holes. Oil pressure is exerted on the inner end of the poppet. Both outer ends of the poppet are open to the reservoir pressure.

Sleeve is designed so that the oil pressure acts upon a greater area of the poppet at the seat end, producing a force which tends to unseat the poppet. The amount of oil pressure required to unseat poppet is determined by the setting of the adjustment screw.

DISASSEMBLY

It is not recommended that the relief valve sleeve be removed unless it is to be replaced as it is very difficult to achieve a satisfactory pressure seal between the sleeve and bore when the original sleeve is reinstalled. Remove castle nut and lock nut from adjustment screw. Remove relief valve plug and adjustment screw from housing as a unit. NOTE: Retain copper washer. Remove spring seat and spring. Remove relief poppet using needle nose pliers. Grasp end of the poppet with the pliers, and, using a twisting motion, slowly withdraw poppet.

If it is necessary to remove the sleeve, disassemble as follows: Remove Permatexed pipe plug from housing. Using a brass drive rod and press, press sleeve from housing. If a press is not available, the sleeve may be carefully driven from the bore, taking care not to score the bore or mar the sleeve ends.

INSPECTION AND REPAIR

NOTE: THE MOST COMMON CAUSE OF RELIEF VALVE FAILURE IS DAMAGED OR FATIGUED O-RINGS. IT IS, THEREFORE, RECOMMENDED THAT NEW O-RINGS BE INSTALLED.

Clean all parts in solvent and dry with compressed air. Remove O-ring and replace if damaged or deteriorated. Inspect ground seating surface of poppet for nicks and excessive wear. The seating edge of the sleeve should be sharp and free from nicks. Inspect the sleeve bore for scores or roughness. Replace parts found to be faulty.

Omitting O-ring, insert the poppet fully into sleeve bore and test for fit. Poppet should fit snugly without binding through a complete revolution.

ASSEMBLY

Apply a light coating of lubricant to the outside of sleeve. Start sleeve straight into housing bore and tap lightly until engaged. Using a suitable drive rod having a perfectly flat face and a diameter slightly less than that of the sleeve, press or carefully drive sleeve into bore until it is seated at the bottom of the counter bore. Assemble O-ring on poppet. Stretch O-ring into position (do not roll). Avoid cutting or twisting. Coat O-ring with lubricant and insert poppet into sleeve. Replace spring and spring seat. Replace copper washer and relief valve plug with adjustment screw. Permatex the pipe plug, replace and tighten to proper torque value. Replace lock and castle nut after relief valve is adjusted.

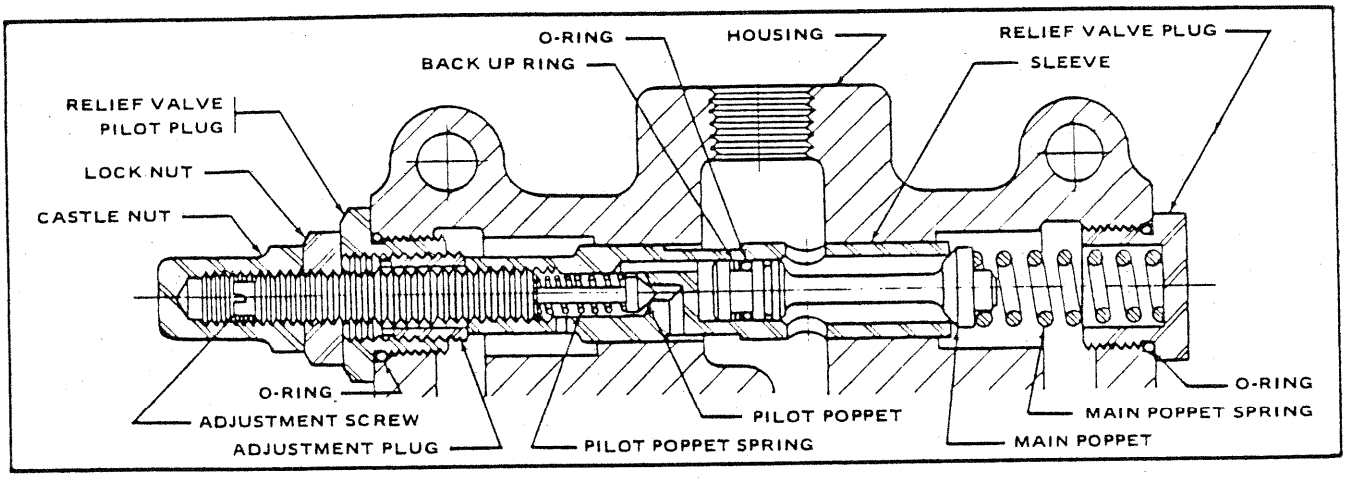


Figure 3. Relief Valve - Pilot Operated (External Adjustment)

The relief valve shown in Figure 3 is of the differential area type and is pilot operated for constant settings at all flow rates. The main spring resists the oil pressure acting on the differential area of the main poppet, and is set at 150 to 250 p.s.i. higher than the pilot spring setting. When oil pressure reaches the setting of the pilot spring, the pilot poppet opens, allowing oil under pressure to enter the area behind the main poppet. This additional pressure immediately unseats the main poppet and relieves the oil pressure.

DISASSEMBLY

Unscrew castle nut and lock nut from adjust screw. Unscrew relief valve pilot plug with relief valve adjust screw from the housing. Unscrew relief valve plug from the opposite side of housing. Main spring may now be removed. The sleeve is not pressed into the housing but is a sliding fit.

The sleeve may be readily removed as an assembly from either side of the housing by lightly tapping on the opposite end of the sleeve. The sleeve may now be dismantled by withdrawing the main poppet and unscrewing the adjust screw and shaking out the pilot spring and pilot poppet. To complete disassembly, remove the O-ring and back-up ring from the main poppet.

INSPECTION AND REPAIR

NOTE: THE MOST COMMON CAUSE OF RELIEF VALVE FAILURE IS DAMAGED OR FATIGUED O-RINGS. IT IS, THEREFORE RECOMMENDED THAT NEW O-RINGS BE INSTALLED.

Remove O-ring and spiral back-up ring from poppet. Clean all parts in solvent and dry with compressed air. Inspect the seating surface of pilot poppet for nicks and excessive wear. The seating edge of the sleeve should be sharp and free from nicks. Inspect the sleeve bore for scores or roughness; make sure all oil passages are free from dirt and obstructions. With a bright light or mirror, inspect pilot seat. Pilot seat should be clean and sharp. Replace parts found to be faulty.

Omitting O-ring, insert the poppet fully into sleeve bore and test for fit. Poppet should fit snugly without binding through a complete revolution.

ASSEMBLY

Place pilot spring over stem of the poppet; insert this assembly into the pilot end of the sleeve. Turn adjustment screw in (clockwise) until adjustment screw just seats against pilot poppet spring. Assemble O-ring and back-up ring to poppet and locate as shown in Figure 3. Stretch O-rings into position (do not roll). Coat O-ring with lubricant and insert poppet into sleeve. Insert sleeve assembly into valve housing. Replace main spring over end of main poppet; replace relief valve plug, using new O-ring.

Using special Spanner Socket (Figure 1) back off adjustment plug a few turns (see Figure 3).

Using new O-ring on pilot plug, insert pilot plug into housing.

Replace lock and castle nuts after relief valve is adjusted.

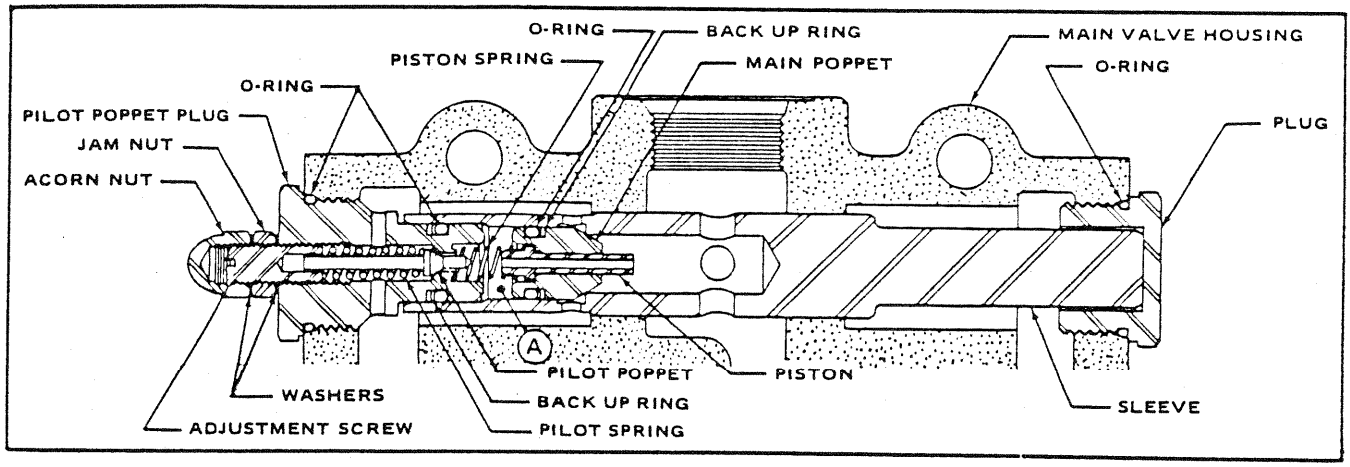


Figure 4. Relief Valve - Pilot Operated (External Adjustment)

The Cartridge relief valve shown in Figure 4 is of the differential area type. When fluid enters the relief valve through the hole in the piston, an unbalanced condition in this area keeps main poppet and piston tightly seated.

As system pressure exceeds the relief valve setting, the pilot poppet is unseated, allowing oil to flow around the pilot poppet stem through the holes in the pilot poppet plug and into the low pressure area. This oil flow reduces the pressure in area (A) allowing the piston to seat against the pilot poppet. The seating of the piston shuts off the oil flow through the sensing hole in the piston. Oil pressure in area (A) is greatly reduced thus allowing the main poppet to unseat. System fluid is then dumped instantaneously to low pressure. (For detailed theory of operation see page 8).

DISASSEMBLY

Remove pilot poppet plug assembly and plug from housing. Remove piston spring and piston from sleeve. Using brass rod, carefully drive sleeve out through valve plug end of housing. Main poppet can then be removed by tapping sleeve into palm of hand. Pilot poppet in the pilot poppet plug assembly is preset at the factory; further disassembly will alter this setting and is not recommended. If, however, it is necessary to disassemble, remove acorn nut, lock nut and the two washers from the adjustment screw. Remove all O-rings and spiral back up rings.

INSPECTION AND REPAIR

NOTE: THE MOST COMMON CAUSE OF RELIEF VALVE FAILURE IS DAMAGED OR FATIGUED O-RINGS. IT IS, THEREFORE, RECOMMENDED THAT NEW O-RINGS BE INSTALLED.

Clean all parts in solvent and dry with compressed air. Inspect seating surfaces of poppets and piston for nicks, grooves and excessive wear. The seating edge of the sleeve must be sharp and free from nicks. Check the sensing hole in the piston, hole in the pilot poppet plug assembly, and holes in the sleeve for obstructions. Assemble piston to the main poppet. It is essential that the piston move freely through the hole in the main poppet. Any parts found to be faulty must be replaced.

ASSEMBLY

Assemble and position all O-rings and spiral back up rings as shown in Fig. 4. Stretch O-rings into position (do not roll). Insert pilot poppet and pilot poppet spring into valve plug and install the adjustment screw. Lubricate main poppet with hydraulic oil and insert it with piston and piston spring into sleeve. Lubricate this assembly and mate with sleeve. Install this assembly in the valve housing. Because the sleeve is a honed fit, gentle tapping may be required to install. Care must be exercised to avoid damaging the control valve's internal lands. Install plug to valve housing. Acorn nut, lock nut, and washers can be assembled after relief cartridge is adjusted.

MAINTENANCE PROCEDURES - RELIEF VALVES

A combination cylinder port relief valve and anti-void unit is illustrated in Figures 5—8. The service port relief valve is designed to control the maximum pressure obtained in the circuit. By discharging oil to the low pressure return passage, the service port relief valve provides maximum structural protection of circuit components. It will function whether the plunger is in the neutral or operate position.

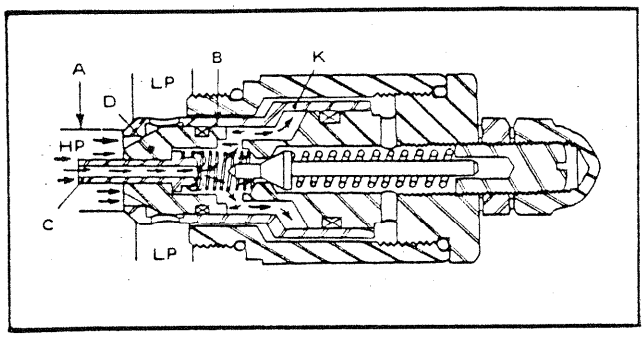


Figure 5 Step 1

The normal operating sequence for the cylinder port relief is as follows - the relief valve is in communication between the cylinder port "HP" and low pressure "LP". Oil is admitted through the hole in piston "C" and because of the differential area between diameters "A" and "B" main poppet "D" and check valve poppet "K" are tightly seated. (See Fig. 5)

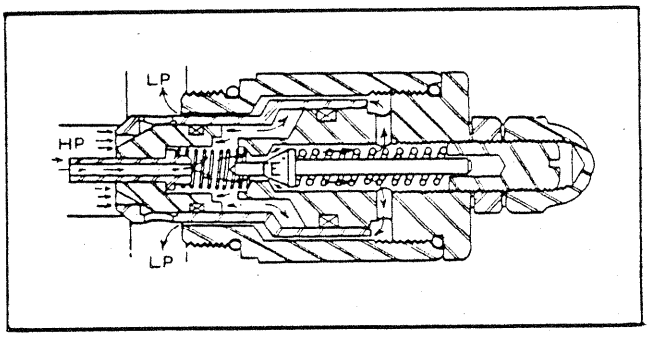


Figure 6 Step 2

The oil pressure in the cylinder port "HP" has reached the setting of the pilot poppet spring force and unseats the pilot poppet "E" and oil flows around the poppet - through the cross drilled holes and to the low pressure area "LP". (See Fig. 6)

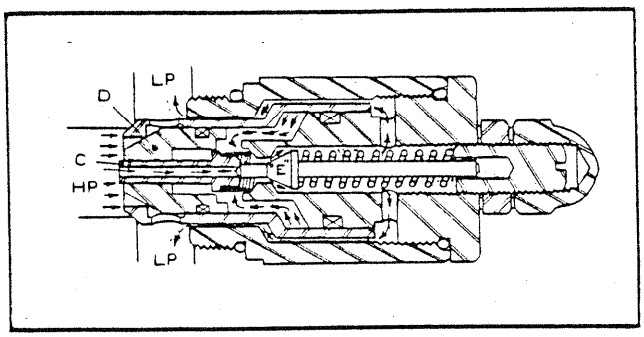


Figure 7 Step 3

The loss of oil behind piston "C". effected by the opening of pilot poppet "E", causes piston "C" to move back and seat against pilot poppet "E". This shuts off the oil flow to the area behind main poppet "D", and causes a low pressure area internally. (See Fig. 7)

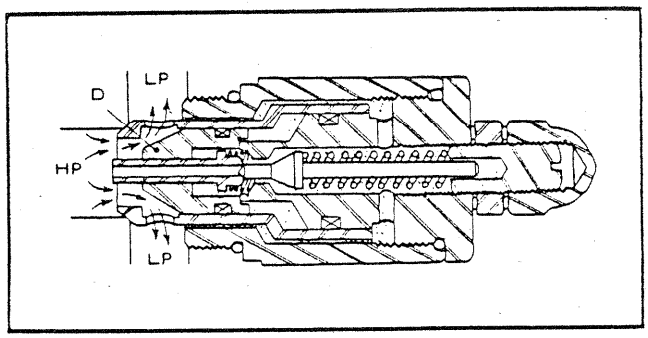


Figure 8 Step 4

The imbalance of pressure on the inside as compared to that of the cylinder port "HP", forces the main poppet "D" to open and relieve the oil directly to the low pressure chamber "LP" in the valves. (See Fig. 8)

MAINTENANCE PROCEDURES - RELIEF VALVES

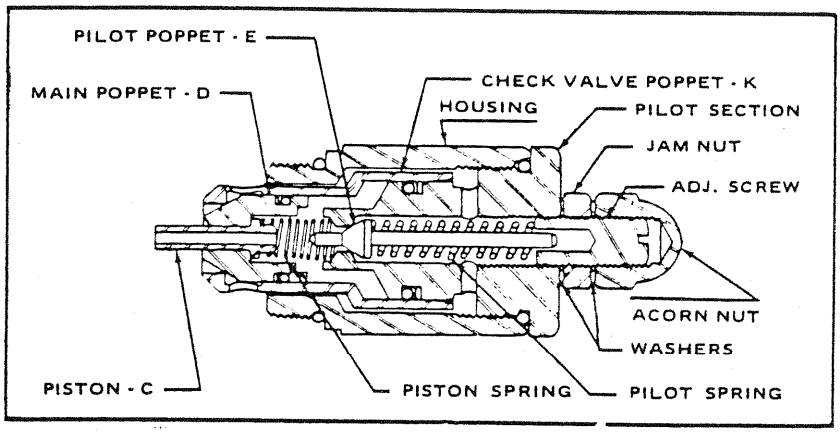


Figure 9. Service Port Relief Cartridge

DISASSEMBLY

The cartridge type service port reliefs used in the Husco valves are of the pilot poppet type with external adjustment. Any malfunctioning is usually the result of foreign matter lodging between the piston, relief valve poppet, and check valve.

To service, clean the surrounding area and remove the complete relief valve cartridge.

The design of the pilot poppet and pilot poppet seat provides positive seating and seldom requires any maintenance. Therefore, the pilot section, check valve poppet and other internal parts, can be removed from the cartridge without disturbing the valve setting. Disassemble these parts and examine for foreign matter.

INSPECTION AND REPAIR

Examine the seat in the main valve housing, if grooves or ridges are present, the valve must be returned to Husco for re-machining.

All seats and seating surfaces should be smooth and free of nicks, scratches or grooves. Examine O-rings and back-up washers for any damage. Replace damaged or faulty parts. All moving parts should slide freely, with only seal friction present.

If operating difficulties indicate that the pilot poppet is leaking or sticking, remove internal parts of the pilot section and follow same procedure as above.

ASSEMBLY

After inspecting and cleaning, immerse all parts in hydraulic oil and re-assemble. Since pressure setting was not disturbed, unit can be tested for proper functioning under actual working conditions.

There are several variations to the service port relief. However, all are similar in nature regarding service and repair (see Maintenance Procedure Relief Valves, Page 7).

TROUBLE SHOOTING - SERVICE PORT RELIEF CARTRIDGE

TROUBLE	PROBABLE CAUSE	REMEDY
Can't get pressure.	1. Poppet D, E or K stuck open or dirt under seat.	Check for foreign matter between poppets D, E or K and their mating members. Members must slide freely.
Erratic pressure	1. Pilot poppet seat damaged. 2. Poppet C sticking in D.	Replace damaged parts. Clean dirt and remove surface marks for free movement.
Pressure setting not correct	1. Wear due to dirt. 2. Lock nut & adj. screw loose.	See "How to set pressure on service port relief" (Fig. 27, Page 26).
Leaks	1. Damaged seats. 2. Worn O-rings. 3. Parts sticking due to dirt.	Replace worn or damaged parts. Inspect for free movement of components. Check seats for scratches, nicks or other marks.

B. PLUNGERS

Several styles of plungers are used in HUSCO Control Valves. The design and appearance of the plungers used to operate a single acting cylinder are different from that used to operate a double acting cylinder or to operate a hydraulic motor. The maintenance procedures for all plungers are the same, however, and double acting plungers are used for all illustrations in this section.

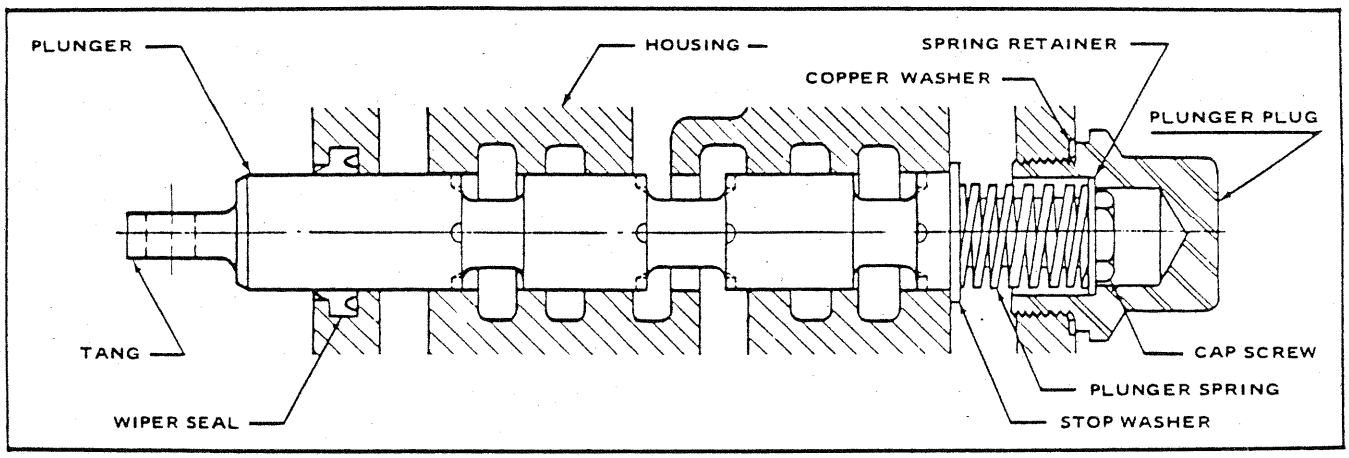


Figure 10. 3/4" Dia. Double Acting - Spring Centered Plunger (Hydraulically Unbalanced)

SEAL REPLACEMENT

The seal at the rear of the valve on the unbalanced plunger is accomplished by a copper washer under the plunger plug. A combination wiper and seal of molded rubber is used to effect a dynamic seal at the front of the plunger. To replace this seal, remove plunger plug and washer from valve housing. Slide plunger back through seal until tang is clear. Carefully remove seal from groove with pliers. Clean seal groove thoroughly. Seal groove must be smooth and completely free of dirt, pits and metal particles. Examine sealing and wiping lips of new seal for damage or mars. Insert seal into housing and press firmly around the circumference to seat seal properly. Do not use a sharp tool to install seal; seal may be damaged and leak as a result. Apply a thin coating of lubricant to seal and slowly push plunger back through seal. Examine copper washer and replace if damaged or marred. Apply a thin coating of gasket cement to both sides of washer and set in place. Install plunger plug into housing and tighten.

DISASSEMBLY

NOTE: DURING DISASSEMBLY PLUNGERS MUST BE TAGGED TO ASSURE REASSEMBLY TO THE SAME BORE.

Remove plunger plug and plug gasket, and slide the plunger from valve housing. Handle plunger carefully to avoid damage. Clamp tang end of plunger in vise and remove the plunger cap screw. Remove spring retainer, plunger spring and stop washer. Remove wiper seal from housing.

INSPECTION AND REPAIR

Clean all parts with solvent and dry with compressed air. Examine wiper seal for cuts, nicks, deterioration and hardening. Replace if necessary. Examine plug gasket. Replace if marred or distorted. Replace spring if broken or distorted. Examine threads on plunger cap screw and plunger plug. Replace parts if threads are worn or damaged.

ASSEMBLY

Clamp tang end of plunger in vise and slide stop washer, spring and spring retainer over end of plunger; install plunger cap screw. Clean seal groove thoroughly and install wiper seal. Coat seal wiper lips with lubricant. Insert tang end of plunger into bore at plug end and slide through housing. Work plunger through wiper seal carefully. Replace copper washer if marred or distorted. Coat both sides of washer with gasket cement. Install washer and plunger plug to housing and tighten.

MAINTENANCE PROCEDURES - PLUNGERS

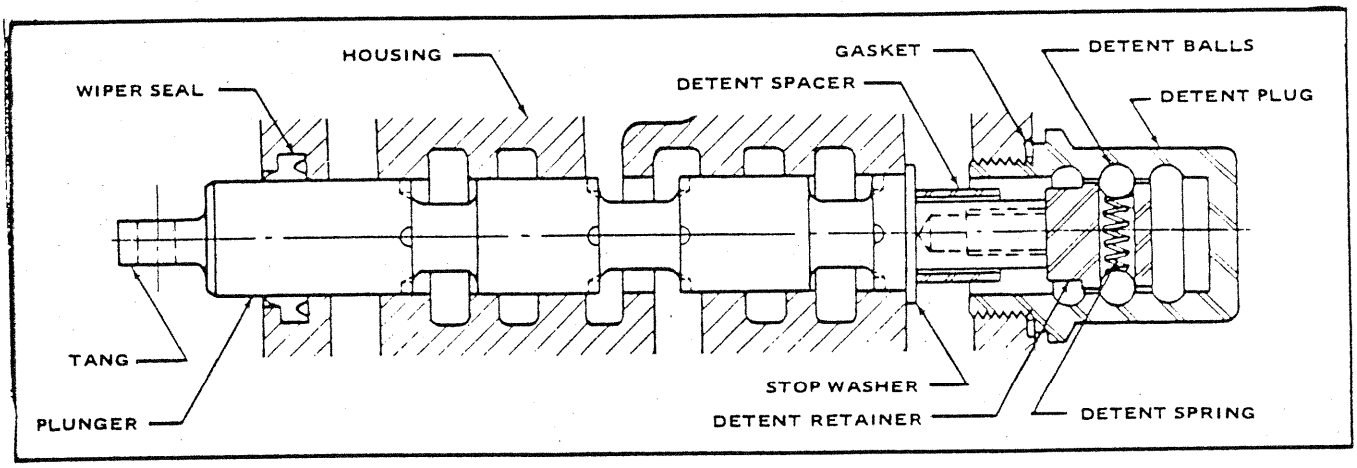


Figure 11. 3/4" Dia. Double Acting - Detent Positioned Plunger (Hydraulically Unbalanced)

SEAL REPLACEMENT (Detent)

The seal at the plug end of the valve on the unbalanced plunger is accomplished with a copper gasket under the detent plug. A combination wiper and seal of molded rubber is used to effect a dynamic seal at the tang end of the plunger. To replace this seal, loosen detent plug and slowly withdraw plunger and plug from housing as a unit. (Avoid pulling detent cap away from plunger.) Withdraw plunger until tang end clears wiper seal. Carefully remove seal from groove with pliers. Clean seal groove thoroughly. Seal groove must be smooth and completely free of dirt, pits and metal particles. Examine sealing and wiping lips of new seal for damage or mars. Insert seal into housing and press firmly around the circumference to seat seal properly. Do not use a sharp tool to install seal; seal may be damaged and leak as a result. Apply a thin coating of lubricant to seal and slowly push plunger back through seal. Examine copper gasket and replace if damaged or marred. Apply a thin coating of gasket cement to both sides of gasket and set in place. Tighten detent plug into housing.

DISASSEMBLY

NOTE: DURING DISASSEMBLY PLUNGERS MUST BE TAGGED TO ASSURE REASSEMBLY TO THE SAME BORE.

Loosen detent plug and slowly withdraw plunger and detent plug from the housing as a unit. (Avoid pulling detent cap away from plunger.) Handle plunger carefully to avoid damage. Clamp tang end of plunger in vise. Wrap a clean shop rag around detent plug and carefully remove from plunger, using rocking and pulling motion simultaneously, being careful to catch detent balls in the cloth as the plug is being removed. Remove detent spring and insert a pin through the cross holes in the detent retainer and remove detent from plunger. Remove detent stop spacer and stop washer from end of plunger. Remove wiper seal and copper gasket from housing.

INSPECTION AND REPAIR

Clean all parts in solvent and dry with compressed air. Examine wiper seal for cuts, nicks, deterioration or hardening. Replace detent spring if broken or distorted. Replace plunger plug and detent retainer if threads are worn or damaged. Examine grooves in detent plug for wear or scoring.

ASSEMBLY

Clamp tang end of plunger in vise and slide stop washer and detent stop spacer over end of plunger. Replace detent retainer into end of plunger and tighten securely, using a pin through cross hole. Coat detent spring and balls with lubricant. Insert detent spring in detent. Place ball at each end of detent spring, keeping balls in place with forefinger and thumb. Slightly depress detent spring by applying pressure on the balls and slide detent plug into position. A sharp rap with the heel of the hand will set the detent plug in place. Clean seal groove thoroughly and install wiper seal. Coat the seal wiper lips with lubricant. Coat both sides of gasket with gasket cement and set in place in housing. Insert tang end of plunger into bore at detent plug end of plunger and slide through housing. Work plunger carefully through wiper seal. Install detent plug into the housing and tighten.

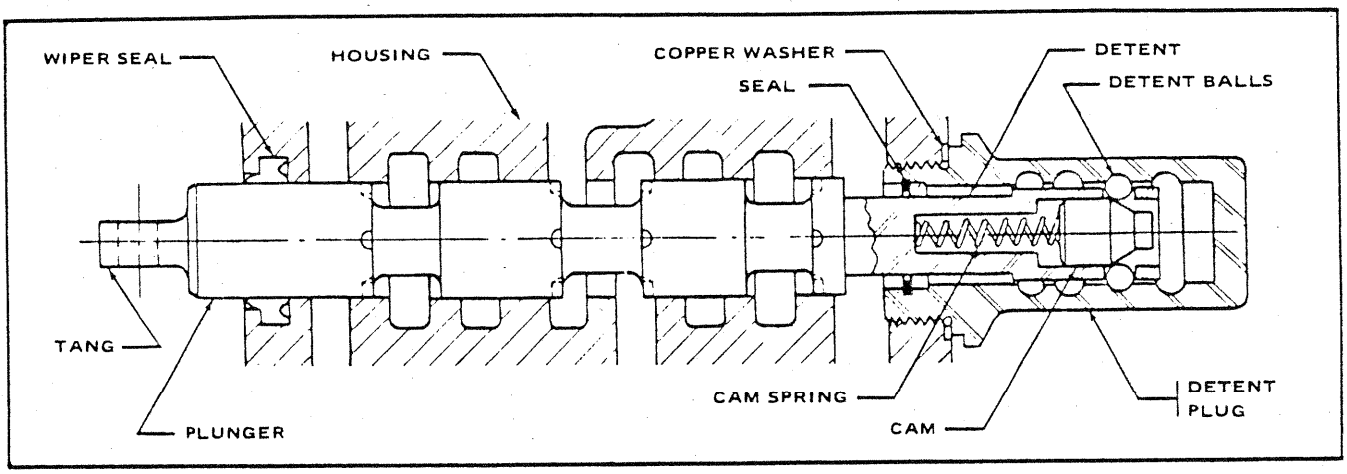


Figure 12. 3/4" Double Acting Plunger (Axially Hydraulically Unbalanced)

The plunger illustrated in Figure 12 is not spring centered, and is positioned by a ball and cam spring loaded detent. Service this plunger in accordance with the instructions given for the plunger shown in Figure 11.

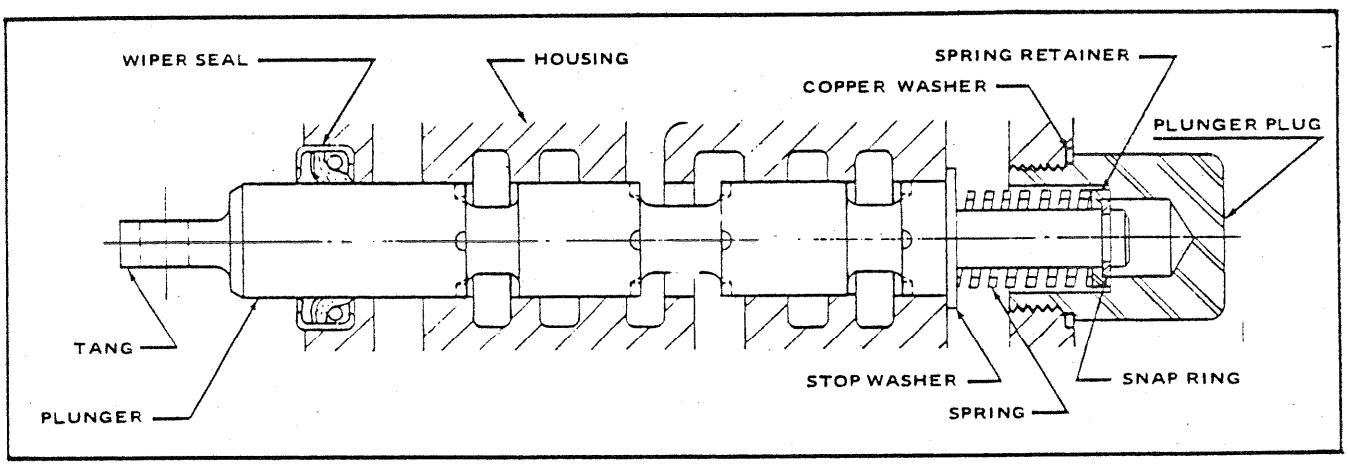


Figure 13. 1" Double Acting - Spring Centered Plunger (Axially Hydraulically Unbalanced)

SEAL REPLACEMENT

The seal at the cap end of the valve on the unbalanced plunger is accomplished with a copper washer under the plunger plug. A cartridge type lip seal and wiper is used to effect a dynamic seal at the tang end of the plunger. To replace this seal, remove plunger plug and copper washer from cap end of valve. Slide plunger back through valve until tang end of plunger is clear. Carefully remove seal from housing. Examine sealing and wiping lips of new seal for damage or mars. Coat outer surface of new seal with gasket cement and insert into housing and press frimly around the circumference to seat seal properly. Do not use a sharp tool to install seal; seal may be damaged and leak as a result. Apply a coating of thin oil to seal and slowly push the plunger back through the seal. Examine copper washer and replace if damaged or marred. Apply a thin coating of gasket cement to both sides of washer and install plunger plug into housing.

DISASSEMBLY

NOTE: DURING DISASSEMBLY PLUNGERS MUST BE TAGGED TO ASSURE REASSEMBLY TO THE SAME BORE.

Remove plunger plug and slide plunger from valve housing spring end first. Handle plunger carefully to avoid damage. Remove plug gasket. Clamp tang end of plunger in a vise and compress plunger spring enough to expose snap ring. Remove snap ring, spring retainer, spring and stop washer from end of plunger. Remove seal from housing.

MAINTENANCE PROCEDURES - PLUNGERS

INSPECTION AND REPAIR

Clean all parts in solvent and dry with compressed air. Examine wiper seal for cuts, nicks, deterioration or hardening. Replace if necessary. Examine plug gasket. Replace if marred or distorted. Replace plunger spring if broken or distorted. Examine threads on plunger plug. Replace if threads are worn or damaged.

ASSEMBLY

Clamp tang end of plunger in vise and slide stop washer, spring and spring retainer over end of plunger. Compress plunger spring and install snap ring. Coat seal with gasket cement and insert into housing. Examine copper washer and replace if damaged or marred. Apply a thin coating of gasket cement to both sides of copper washer and set in place in housing. Install plunger plug to housing and tighten.

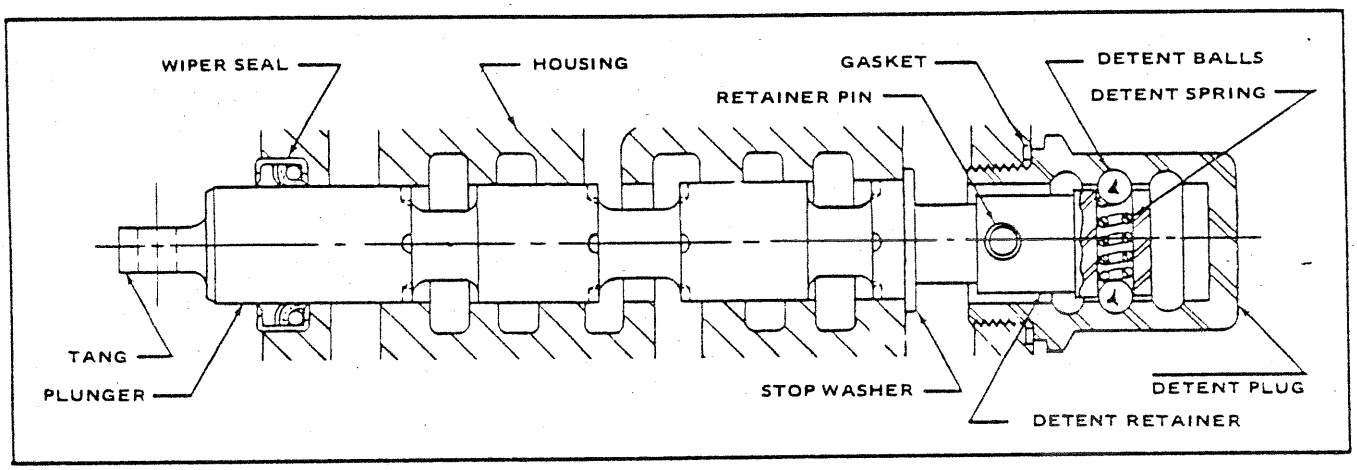


Figure 14. 1" Double Acting - Detent Positioned Plunger (Axially Hydraulically Unbalanced)

The plunger illustrated in Figure 14 is similar to the 1" Dia. double acting plunger - spring centered (see Figure 13), except that it is positioned by a ball detent.

SEAL REPLACEMENT

Same as for plunger shown in Figure 13.

DISASSEMBLY

NOTE: DURING DISASSEMBLY PLUNGERS MUST BE TAGGED TO ASSURE REASSEMBLY TO THE SAME BORE.

Remove detent plug and slowly withdraw plunger and detent plug from the housing as a unit. (Avoid pulling detent plug from plunger.) Handle plunger carefully to avoid damage. Remove gasket. Clamp tang end of plunger in vise. Wrap a clean cloth around detent plug and carefully remove from plunger, using rocking and pulling motions simultaneously, being careful to catch detent balls in cloth as the plug is removed. Remove detent spring. Grind off peened over end of retainer pin and drive from detent retainer. Remove detent retainer and stop washer from plunger. Remove seal from housing.

INSPECTION AND REPAIR

Clean all parts in solvent and dry with compressed air. Examine wiper seal for cuts, nicks, deterioration or hardening. Replace if necessary. Examine plug gasket. Replace if marred or distorted. Replace detent spring if broken or distorted. Examine thread on detent plug. Replace if damaged or marred. If grooves in detent plug are worn or scored, replace the plug.

ASSEMBLY

Clamp tang end of plunger in vise and slide stop washer over plunger. Position detent retainer on plunger with retainer pin holes in line. Drive retainer pin in holes and peen over at ends. Coat detent spring and

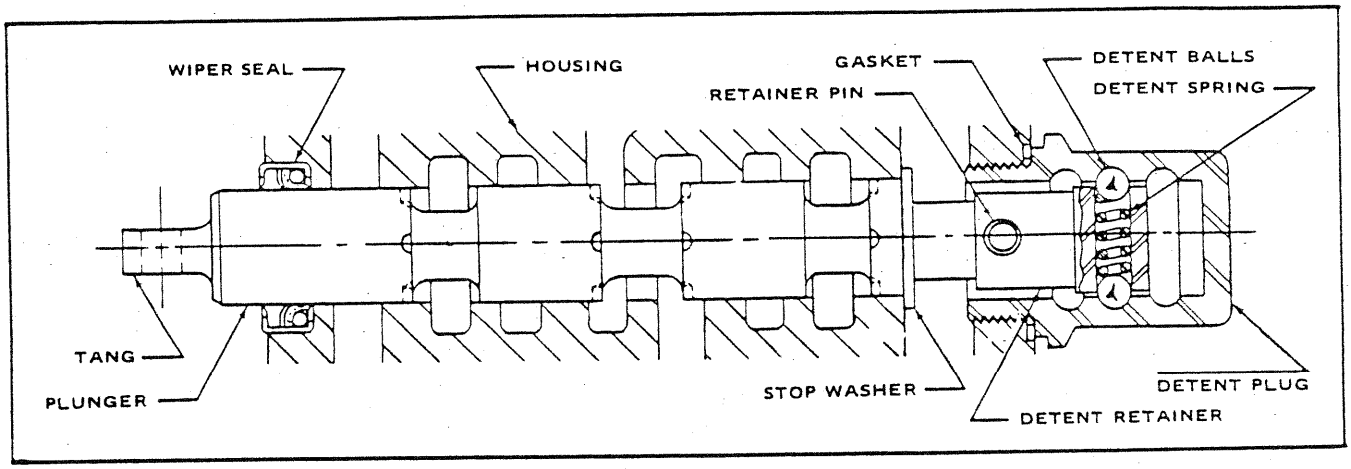


Figure 14. (Cont.) 1" Double Acting - Detent Positioned Plunger (Axially Hydraulically Unbalanced)

balls with grease. Insert the detent spring in the cross hole with ball at each end. Hold spring compressed with thumb. Keeping balls in place with forefinger, push detent plug into position over the balls. A sharp rap with the heel of the hand will set the detent plug in place. Coat outer surface of new seal with gasket cement and insert into housing. Coat seal wiper lips with clean oil. Slide plunger through housing from plug end, carefully working through seal. Examine gasket and replace if damaged or marred. Install detent plug into the housing and tighten.

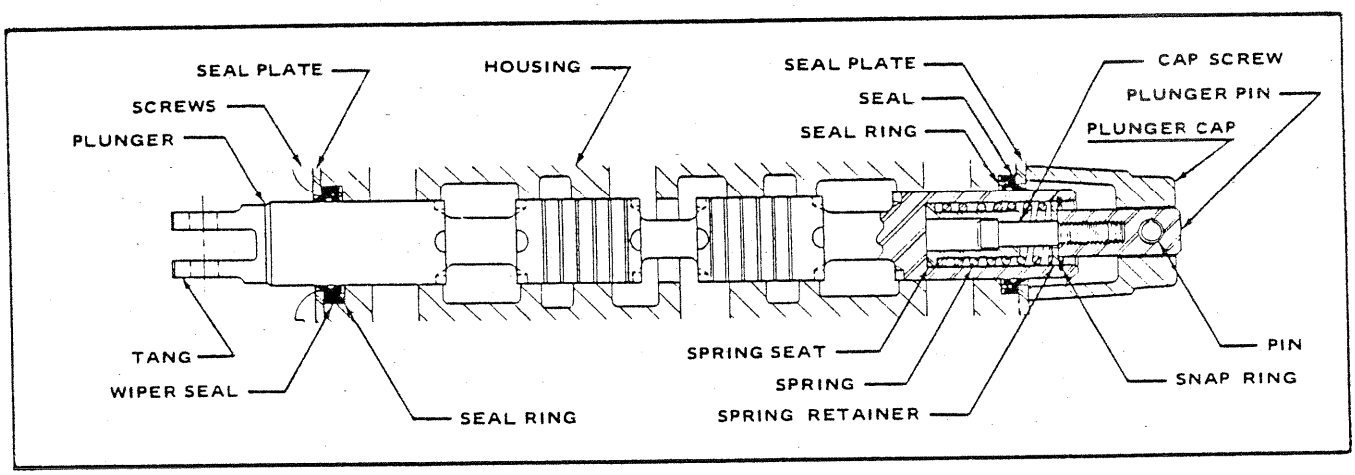


Figure 15. Double Acting - Spring Centered Plunger (Hydraulically Balanced)

SEAL REPLACEMENT

A one piece molded combination wiper and seal is used at each end of the plunger. The seals are positioned with a seal ring and retained by seal plates. To replace seal at tang end of plunger, remove screws and seal plate from housing. Carefully remove seal and seal ring from housing. Seal groove must be smooth and completely free of dirt, pits and metal particles. Examine lip of new seal for damage or mars. Replace seal ring and press seal firmly in place with a blunt tool (seal ring must fit in molded recess of seal to seat properly). Replace seal plate with round head screws.

To service seal at cap end of plunger, drive pin from plunger cap with a small punch and remove the two cap screws. Remove cap and seal plate. Carefully remove seal and seal ring from housing. Seal groove must be smooth and completely free of dirt, pits and metal particles. Examine lips of new seal for damage or mars. Replace seal ring and press seal firmly in place with a blunt tool (seal ring must fit in molded recess of seal to seat properly). Replace seal plate and cap. Insert cap screw through cap and plate; tighten to housing, aligning hole in plunger and cap and inserting pin through cap to secure plunger.

MAINTENANCE PROCEDURES - PLUNGERS

DISASSEMBLY

NOTE: DURING DISASSEMBLY PLUNGERS MUST BE TAGGED TO ASSURE REASSEMBLY TO THE SAME BORE.

Remove round head screws, seal plate, seal and seal ring from tang end of housing. Drive pin from plunger cap. Remove cap screws, cap and seal plate from housing. Carefully remove plunger from housing, tang end first. Remove seal and seal ring from cap end of housing. Clamp tang end of plunger in vise. Compress plunger spring slightly by forcing plunger pin inward; remove snap ring. Remove plunger pin, plunger spring, cap screw and spring seat as an assembly. The plunger pin and cap screw are staked during assembly; to disassemble, clamp plunger pin in vise and remove cap screw from plunger pin.

INSPECTION AND REPAIR

Clean all parts with solvent and dry with compressed air. Examine wiper seal for cuts, nicks, deterioration or hardening. Replace if necessary. Replace plunger spring if broken or distorted.

ASSEMBLY

Replace spring seat, spring and spring retainer to cap screw and insert into plunger pin. Tighten securely. Stake together by indenting plunger pin with a punch. Insert this assembly into the end of plunger and secure in place with snap ring. Thoroughly clean sealing surface of housing and install seal and seal ring at end of plunger. Replace seal plate. Coat the seal wiper lips with clean oil. Insert plunger into housing, tang end first from cap end. Working plunger carefully through seal, install seal and seal ring at cap end of plunger. Assemble seal plate and cap to housing. Secure with cap screws. Align pin hole and plunger, and drive pin through cap to secure plunger.

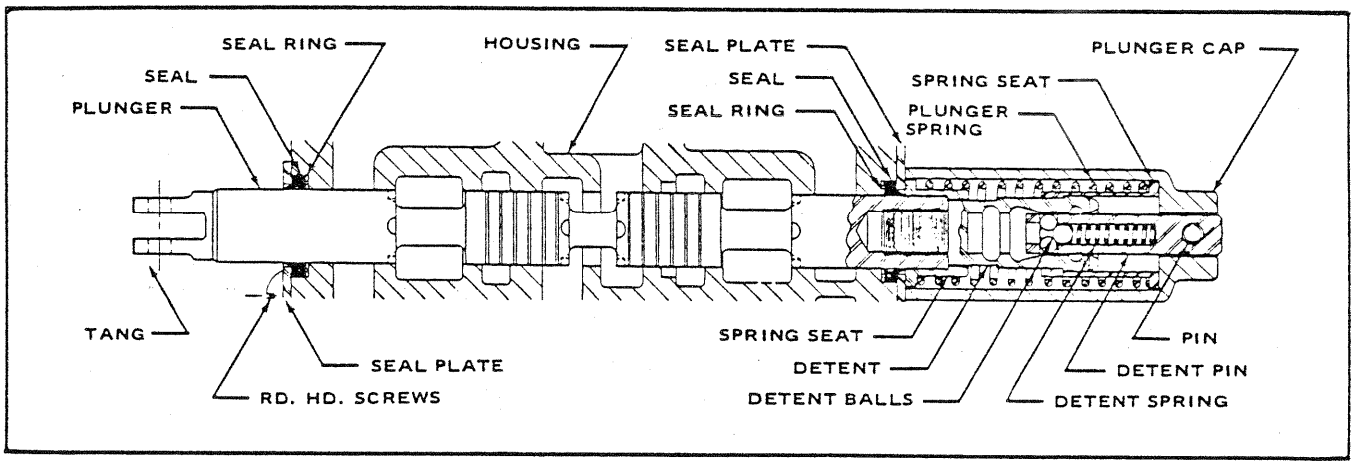


Figure 16. Double Acting - Spring Centered - Detent Positioned Plunger (Hydraulically Balanced)

SEAL REPLACEMENT

The seal at the tang end of this plunger is serviced in accordance with instructions given for Figure 15.

To service seal at cap end, drive pin from plunger cap with a small punch and remove the two cap screws. Remove plunger cap from end of plunger. The detent end is removed from the plunger as a subassembly using a special spanner wrench (Fig. 1). To prevent the plunger from turning, insert a pin through the tang and into an adjacent plunger. As the detent end disengages from the plunger, release the spring tension slowly. With detent end removed, service seal according to instructions for spring centered plunger.

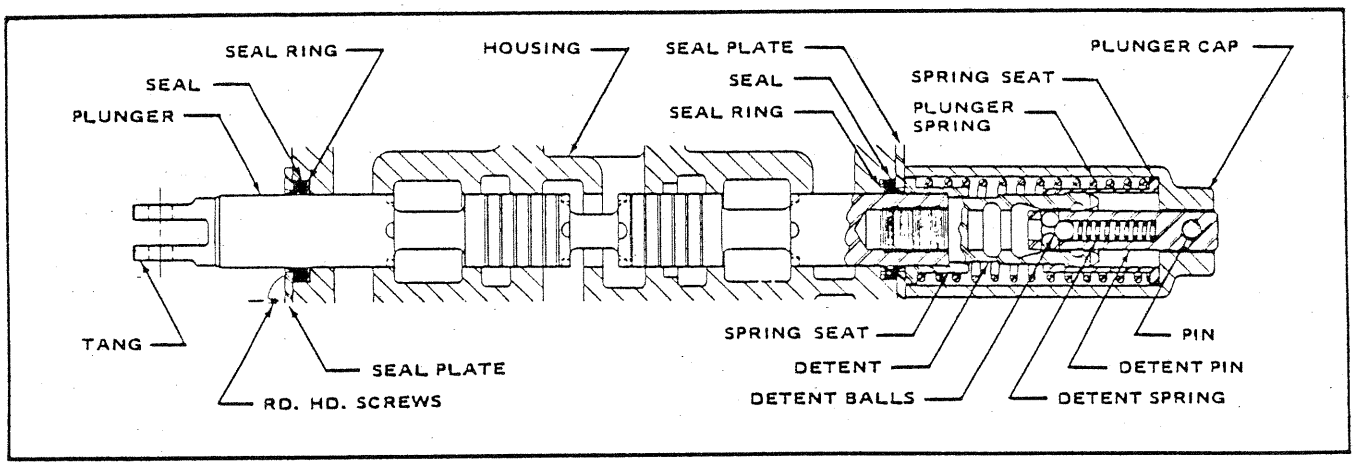


Figure 16. (Cont.) Double Acting - Spring Centered - Detent Positioned Plunger (Hydraulically Balanced)

DISASSEMBLY

NOTE: DURING DISASSEMBLY PLUNGERS MUST BE TAGGED TO ASSURE REASSEMBLY TO THE SAME BORE.

Remove round head screws, seal plate, seal and seal ring from tang end of housing. Drive pin from plunger cap and remove cap screws and cap from housing. Remove detent from plunger using special spanner socket (Fig. 1). Remove spring seats and plunger spring. Remove seal plate, seal and seal ring. Withdraw plunger from housing.

To disassemble detent, clamp detent pin in vise, wrap a clean cloth around detent to catch detent balls and carefully pull the two pieces apart. Remove spring from detent pin.

INSPECTION AND REPAIR

Clean all parts with solvent and dry with compressed air. Examine wiper seal for cuts, nicks, deterioration or hardening. Replace detent balls if worn. Replace plunger and detent springs if broken or distorted.

ASSEMBLY

Apply a thin coating of grease to detent spring, detent pin and balls and the bore and grooves of detent. Assemble spring and one ball to detent. Compress spring by pushing down on the center ball with a small punch. Assemble remaining two balls in the cross holes of detent. Slip ring over detent holes and carefully remove punch (see Fig. 17). Assemble detent pin to detent end of plunger, holding the two parts in alignment and giving end of detent a sharp tap.

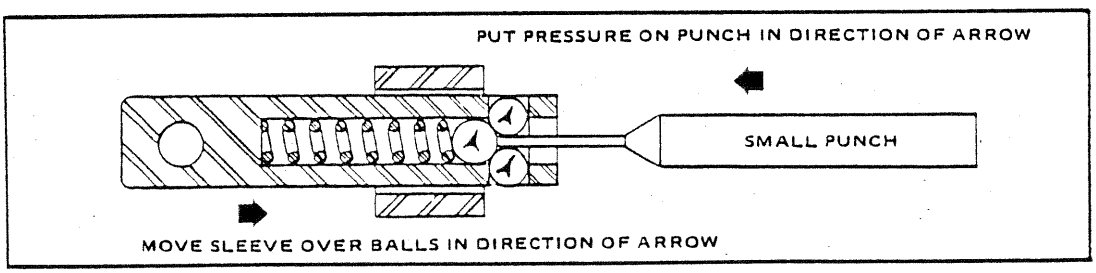


Figure 17. Assembly - Spring and Detent Balls

Clean seal grooves thoroughly; install seal and seal ring at tang end of plunger; assemble seal plate to housing. Coat the seal wiper lips with clean oil. Insert plunger into housing, tang end first from cap end. Work carefully through seal. Install seal, seal ring and seal plate at cap end of housing. Insert a pin through hole of tang and through tang hole of an adjacent plunger to prevent the plunger from turning. Install inner spring seat, plunger spring and outer spring seat. Using special spanner socket (Fig. 1), assemble detent to plunger. Assemble cap to housing with cap screws. Align pin holes and drive pin through cap to secure plunger.

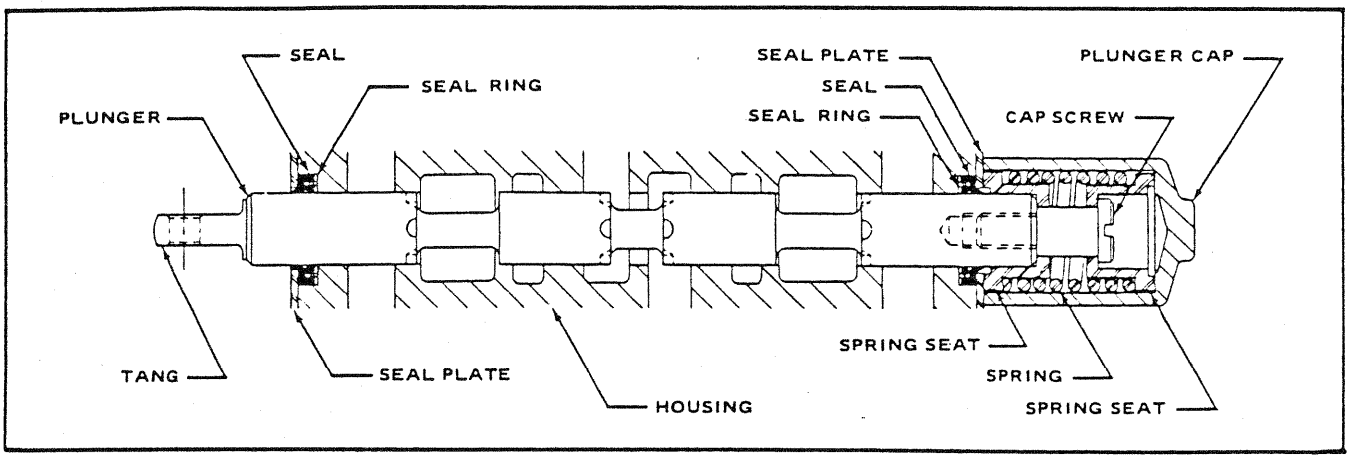


Figure 18. Double Acting - Spring Centered Plunger (Hydraulically Balanced)

SEAL REPLACEMENT

A one-piece molded combination wiper and seal is used at each end of the plunger. The seals are positioned with a seal ring and retained by seal plates. To replace seal at tang end of plunger, remove screws and seal plate from housing. Carefully remove seal and seal ring from housing. Seal groove must be smooth and completely free of dirt, pits, and metal particles. Examine lip of new seal for damage or mars. Replace seal ring and press firmly in place with a blunt tool (seal ring must fit in molded recess of seal to seat properly). Replace seal plate and round head screws.

To service seal at cap end of plunger, remove plunger cap from housing. Insert a pin through hole of tang and through tang hole of an adjacent plunger to prevent plunger from turning. Remove cap screw from end of plunger. Remove spring seats, plunger spring and seal plate from end of plunger. Remove seal and seal ring from housing. Seal grooves must be smooth and completely free of dirt, pits, and metal particles. Examine lip of new seal for damage or mars. Replace seal ring and press seal firmly in place with a blunt tool (seal ring must fit in molded recess of seal to seat properly). Assemble seal plate, inner spring seat, spring and outer spring seat to plunger with cap screw. Assemble plunger cap to housing.

DISASSEMBLY

NOTE: DURING DISASSEMBLY PLUNGERS MUST BE TAGGED TO ASSURE REASSEMBLY TO THE SAME BORE.

Remove round head screws, seal plate, seal and seal ring from tang end of housing. Remove plunger cap. Insert pin through hole of tang and through tang hole of an adjacent plunger to prevent plunger from turning. Remove cap screw from end of plunger. Remove spring seats, plunger spring and seal plate. Carefully withdraw plunger from housing, tang end first. Remove seal and seal ring.

INSPECTION AND REPAIR

Clean all parts with solvent and dry with compressed air. Examine wiper seal for cuts, nicks, deterioration or hardening. Replace if necessary. Replace plunger spring if broken or distorted.

ASSEMBLY

Thoroughly clean sealing surfaces of housing. Install seal ring at tang end and press seal firmly in place with a blunt tool (seal ring must fit in molded recess of seal to seat properly). Replace seal plate. Coat the seal wiper lips with clean oil. Insert plunger into housing, tang end first from cap end. Work plunger carefully through seal. Assemble seal ring and seal to cap end of plunger. Press seal firmly in place with a blunt tool (seal ring must fit in molded recess of seal to seat properly). Replace seal plate, inner spring seat, spring and outer spring seat to plunger with cap screw. Insert pin through hole of tang and through tang hole of an adjacent plunger to prevent plunger from turning; tighten cap screw. Assemble plunger cap to housing.

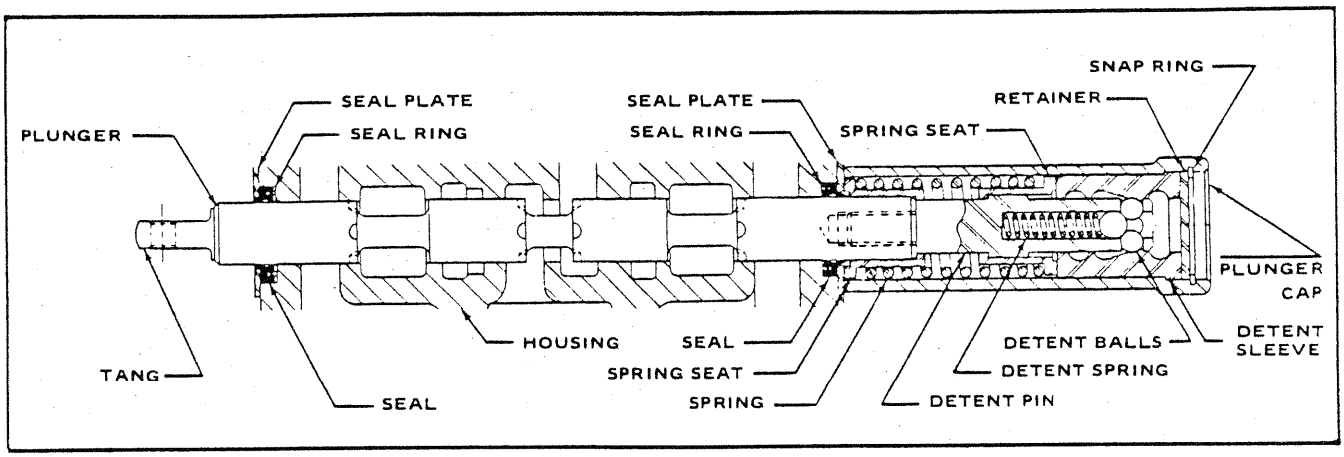


Figure 19. Double Acting - Spring Centered Detent Positioned Plunger (Hydraulically Balanced)

SEAL REPLACEMENT

A one piece molded combination wiper seal is used at each end of the plunger. The seals are positioned with a seal ring and retained by seal plates. To replace seal at tang end of plunger, remove round head screws and seal plate from housing. Carefully remove seal and seal ring from housing. Seal groove must be smooth and completely free of dirt, pits and metal particles. Examine lip of new seal for damage or mars. Coat with clean oil. Replace seal ring and press seal firmly in place with a blunt tool (seal ring must fit in molded recess of seal to seat properly). Replace seal plate with round head screws.

To service seal at cap end of plunger, remove cap screws; carefully remove plunger cap, detent assembly, plunger, seal plate, seal and seal ring from housing as an assembly. Clamp tang end of plunger in vise and remove snap ring and retainer from plunger cap. Slide plunger cap, seal plate, seal and seal ring along plunger far enough to expose the detent sleeve. Pull sleeve sharply from end of plunger being careful to retain the balls. Remove balls and spring from detent pin. Insert a pin through the cross holes of the detent pin and disassemble it from plunger, keeping pressure against pin as it is removed, releasing spring tension slowly. Remove spring seat, plunger spring, seal plate, seal and seal ring from the plunger. Seal groove must be smooth and completely free of dirt, pits and metal particles. Examine lip of new seal for damage or mars. Coat seal with a thin coat of oil. Place seal ring, seal and seal plate over plunger. Assemble spring seats and plunger spring to plunger with detent pin. Place plunger cap over spring and plunger so that cross holes in detent pin are exposed. (Push seal ring, seal and seal plate along plunger to accomplish this.) Assemble detent spring and center ball to detent pin. Depress center ball with small punch and insert remaining balls to cross holes. Retain balls in position with thumb and forefinger and slide detent sleeve in position over detent pin. Assemble retainer to cap and install snap ring. Work seal back on plunger, avoid damage to seal lips. Carefully slide plunger into housing leaving about 1/2 inch between plunger cap and housing. Work seal ring and seal into housing. Press firmly in place with blunt tool (seal ring must fit in molded recess of seal to seat properly). Assemble plunger cap and seal plate to housing with cap screws.

DISASSEMBLY

NOTE: DURING DISASSEMBLY PLUNGERS MUST BE TAGGED TO ASSURE REASSEMBLY TO THE SAME BORE.

Remove round head screws, seal plate, seal and seal ring from tang end of housing; remove cap screws. Carefully remove plunger cap, detent assembly, plunger, seal plate, seal and seal ring from housing as an assembly. Clamp tang end of plunger in vise and remove snap ring and retainer from plunger cap. Slide plunger cap, seal plate, seal and seal ring along plunger far enough to expose the detent sleeve. Pull sleeve sharply from end of plunger being careful to retain the balls. Remove balls and spring from detent pin. Insert a pin through the cross holes of the detent pin and disassemble it from plunger, keeping pressure against pin as it is removed, releasing spring tension slowly. Remove spring seat, plunger spring, seal plate, seal and seal ring from the plunger.

ASSEMBLY

Clamp tang end of plunger in vise. Coat parts with a thin coating of lubricant. Assemble spring seats and plunger spring to plunger with detent pin. Place plunger cap over spring and plunger so that cross holes in detent pin are exposed. (Push seal ring, seal and seal plate along plunger to accomplish this.) Assemble detent spring and center ball to detent pin. Depress center ball with small punch and insert remaining balls to cross holes. Retain balls in position with thumb and forefinger and slide detent sleeve in position over detent pin. Assemble retainer to cap and install snap ring. Work seal back on plunger, avoid damage to seal lips. Carefully slide plunger into housing leaving about 1/2 inch between plunger cap and housing. Work seal ring and seal into housing. Press firmly in place with blunt tool (seal ring must fit in molded recess of seal to seat properly). Assemble plunger cap and seal plate to housing with cap screws. Assemble seal, seal ring and seal plate to tang end of plunger. (Seal ring must fit in molded recess of seal to seat properly). Secure seal plate with round head screws.

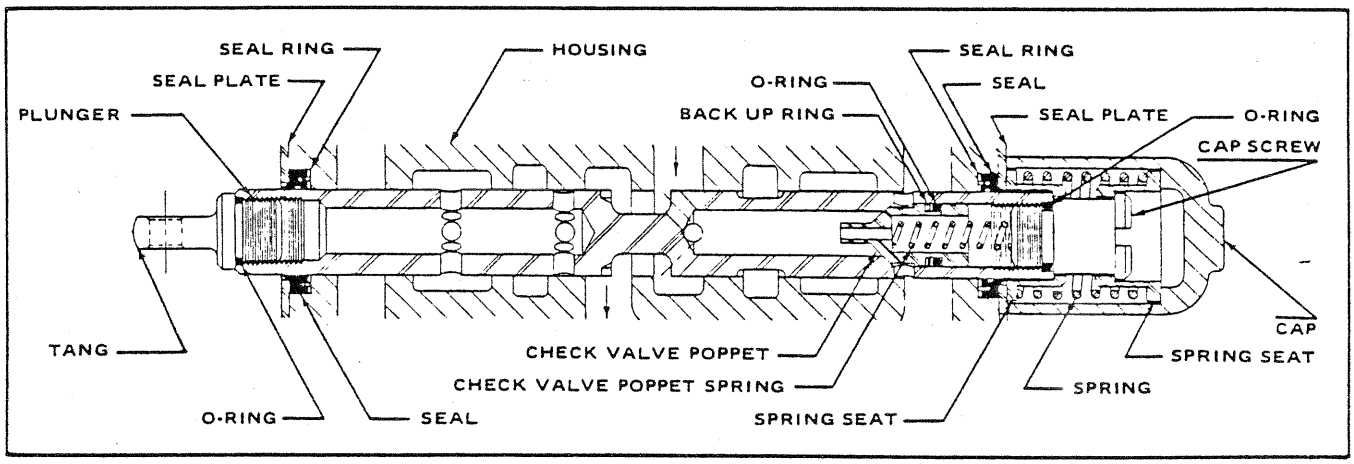


Figure 20. Double Acting Series - Spring Centered Plunger (Hydraulically Balanced)

SEAL REPLACEMENT

Same as Double Acting - Spring Centered Detent Positioned Plunger (Hydraulically Balanced). See seal replacement under Figure 19.

DISASSEMBLY

NOTE: DURING DISASSEMBLY PLUNGERS MUST BE TAGGED TO ASSURE REASSEMBLY TO THE SAME BORE.

Remove plunger cap. Withdraw plunger approximately one inch through housing. Remove seal and seal ring from housing. Carefully remove plunger from housing. Clamp plunger in vise at center undercut. Insert a pin through hole of tang and remove tang from plunger; remove O-rings. Remove cap screw from cap end of plunger. Remove plunger spring and spring seats from plunger. Remove check valve poppet and check valve poppet spring from plunger. Remove seal plate, seal and seal ring from housing. Remove O-rings and back up ring from check valve poppet.

INSPECTION AND REPAIR

Clean all parts in solvent and dry with compressed air. Examine wiper seals and O-rings for cuts, nicks, deterioration or hardening. Replace if necessary. Examine plunger and poppet springs. Replace if broken or distorted. Examine check valve poppet for scratches or nicks on the seating surface. If check valve poppet is scratched or nicked, poppet should be lapped to seat properly in plunger.

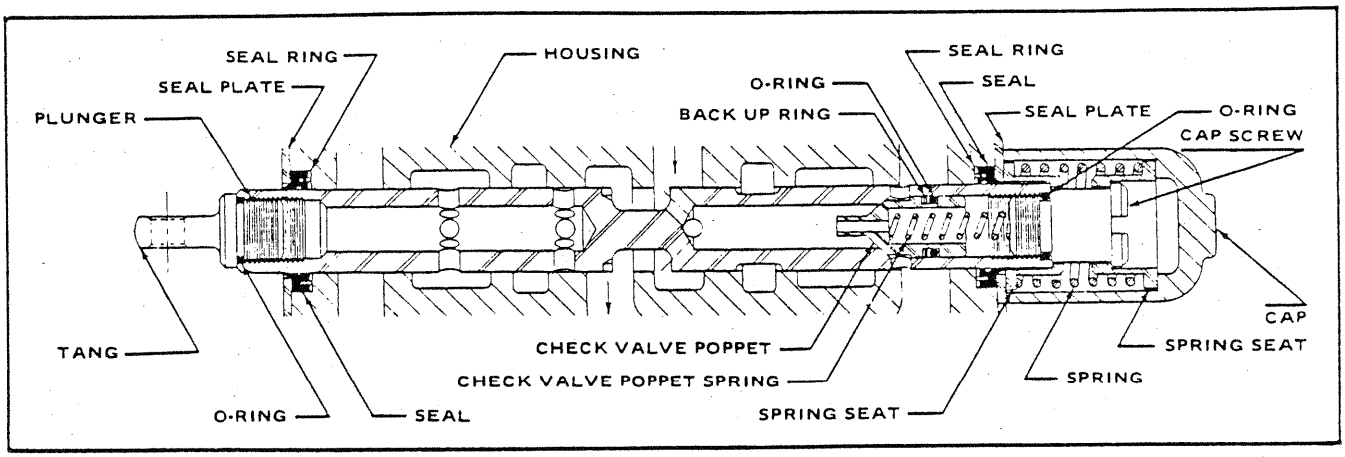


Figure 20 (cont.) Double Acting Series - Spring Centered Plunger (Hydraulically Balanced)

ASSEMBLY

NOTE: WHEN INSTALLING O-RINGS, STRETCH, DO NOT ROLL IN PLACE.

Install back up ring and O-ring on check valve poppet. Make sure that back up ring is located on correct side of O-ring (Fig. 20). Insert check valve poppet and check valve poppet spring into plunger. Coat O-ring with a thin coating of oil, assemble to tang, and install to plunger. Clamp plunger in vice at center undercut. Coat O-ring with a thin coating of oil and assemble to cap screw. Coat seal with a thin coating of oil and slip seal in over plunger. Assemble seal ring at cap end of plunger. Assemble seal plate, inner spring seat, plunger spring and outer spring seat to plunger with cap screw. Thoroughly clean sealing surface of housing and install seal ring, seal and seal plate at tang end of plunger. Carefully insert plunger, tang end first from cap end. Slide plunger through housing and attach cap and seal plate with cap screws.

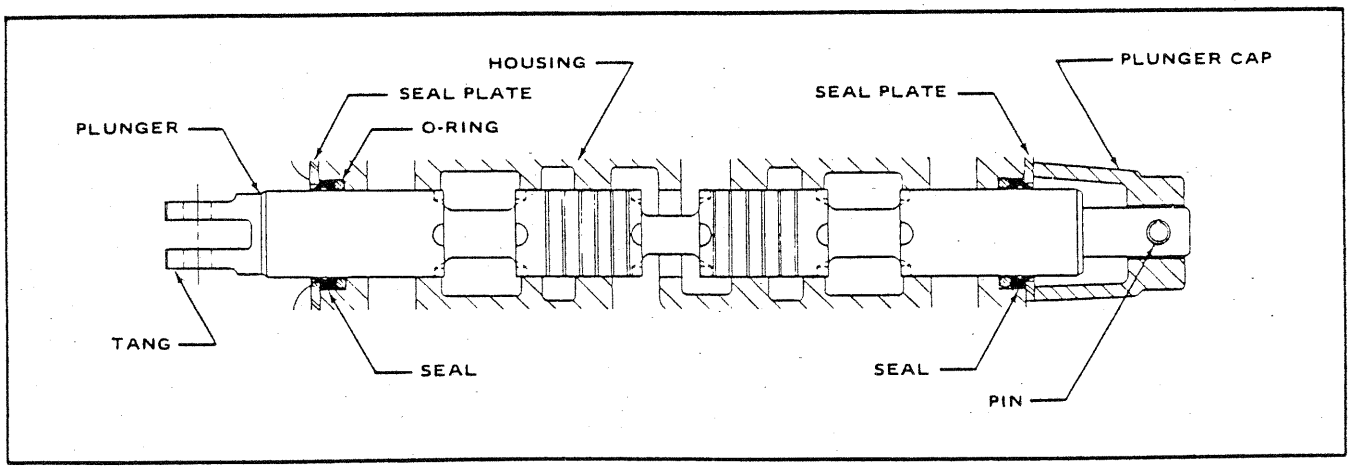


Figure 21. Double Acting Plunger.

The above plunger is designed with metering grooves. Seals are of the O-ring and wiper type retained by a seal plate. Instructions for servicing a combination wiper seal as shown on Figure 19 applies to this type of seal also.

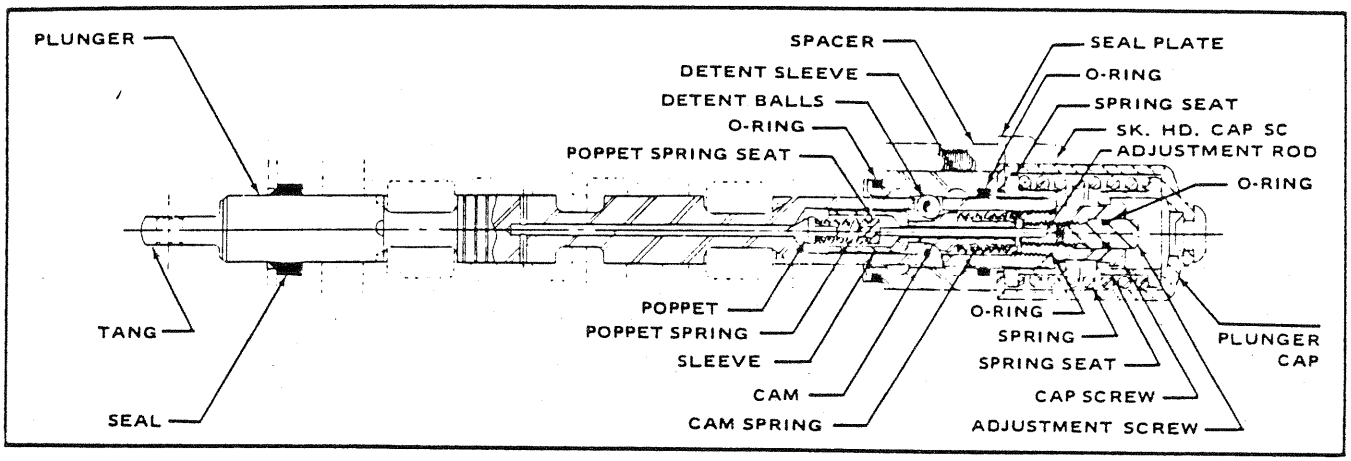


Figure 22. Automatic Kickout Plunger

A one piece molded combination wiper and seal is used at the tang end of this plunger.

SEAL REPLACEMENT

Same as for Double Acting Spring Centered Plunger (see Figure 15).

DISASSEMBLY

NOTE: DURING DISASSEMBLY PLUNGERS MUST BE TAGGED TO ASSURE REASSEMBLY TO THE SAME BORE.

Remove socket head screws, spacers and plunger cap. Insert a rod through hole of tang and adjoining plunger to prevent plunger from turning. Using Special Spanner Socket (Fig. 1), remove cap screw from the plunger. Remove spring seats, spring and seal plate from plunger. With a firm hold on detent sleeve, slowly rotate sleeve, at the same time pulling sleeve away from plunger. As the detent sleeve is slowly removed from the plunger, catch detent balls in your free hand. Remove the rod from the tang of the plunger and rotate plunger slowly, catching any balls that may have remained in the plunger. Slowly remove plunger from housing. Tip plunger on end, remove cam spring, adjustment rod, cam, sleeve, poppet spring, poppet and spring seat from plunger. Tip these parts into your free hand or onto a clean cloth.

INSPECTION AND REPAIR

NOTE: THE MOST COMMON CAUSE OF FAILURE OF THE AUTOMATIC KICKOUT PLUNGER IS DUE TO DAMAGED OR FATIGUED O-RINGS. IT IS, THEREFORE, RECOMMENDED THAT NEW O-RINGS BE INSTALLED. WHEN INSTALLING O-RINGS, STRETCH, DO NOT ROLL IN PLACE.

To replace the O-ring on the detent sleeve insert plunger through the detent sleeve until plunger is even with the bottom edge of the inner O-ring groove. Lubricate O-ring and gently insert into the O-ring groove.

To replace O-ring on cap screw, assemble O-ring slightly over the edge of the threaded end and hold in place with thumb. Insert a small diameter tool under the O-ring and with a slow circular motion stretch O-ring over the threads to the O-ring seat.

To replace O-ring on adjustment screw remove adjustment screw from cap screw. Replace O-ring to adjustment screw. Coat O-ring with a light coating of oil and assemble adjustment screw to cap screw.

Clean all parts in solvent and dry with compressed air. Inspect adjustment rod; if bent or marred, replace. Check face of poppet and poppet seat. If poppet face or seat is marred or shows wear, gently lap until poppet face and seat fit snugly. Use a fine grade lapping compound. REMOVE ALL LAPPING COMPOUND FROM POPPET AND PLUNGER.

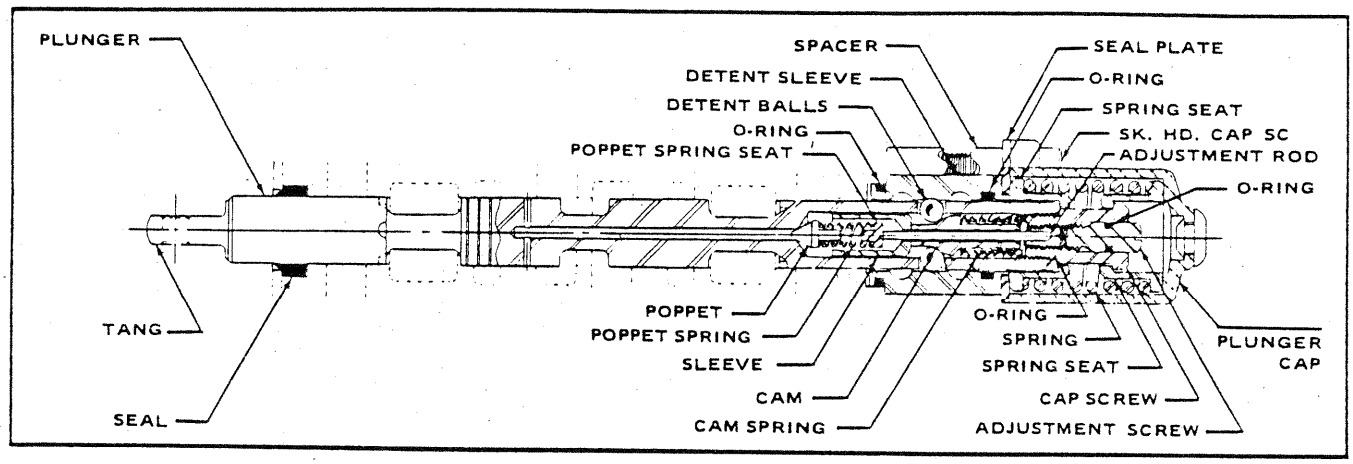


Figure 22 (cont) Automatic Kickout Plunger

To replace nylon insert of the adjustment screw, ream out old nylon insert (use a drill smaller than the diameter of the nylon insert). Install new insert. Be sure insert fits snug and does not protrude past the threads on the adjustment screw.

Pilot hole of plunger must be free of obstructions - clean if required. Cross hole at the bottom of the pilot hole must also be unobstructed. Blow clean with compressed air if necessary.

ASSEMBLY

Assemble poppet spring and poppet spring seat to poppet. Assemble these parts to the poppet sleeve. Insert adjustment rod through the hole in the end of the sleeve. Slide cam over adjustment rod and slide kickout spring over cam. Assemble these parts in the plunger keeping all parts in alignment. Apply a small amount of grease to the holes in the plunger. Assemble balls to plunger, hold in place with fingers. Keeping balls in place, slip detent sleeve slowly over plunger. As detent sleeve moves over the balls, slowly remove fingers. When sleeve is in place, apply a little pressure to the cam spring and gently move sleeve until balls snap into position.

Dip tang end of plunger in oil and gently assemble into the housing so that detent sleeve just touches the counterbore of the housing. Keeping sleeve in this position, gently push sleeve and plunger until the O-ring on the detent sleeve is seated in the counterbore (do not force O-ring into the counterbore).

Insert a pin through tang and through tang of an adjacent plunger to prevent the plunger from turning. Assemble spacer, seal plate, inner spring seat, plunger spring, outer spring seat to the plunger, secure with cap screw. Using Special Spanner Socket (Fig. 1), tighten all parts together (make sure that all parts are aligned before tightening). Brush a light coating of grease on plunger spring, assemble plunger cap and secure with cap screws. Remove rod from plunger and rotate plunger from tang end. If plunger binds re-adjust cap screws. Assemble linkage to tang and move plunger in and out to make sure detent action and spring return are functioning properly.

If adjustment screw has been turned or removed, kickout pressure must be reset. The kickout plunger must never be set higher than the main relief valve or it will not function automatically. To reset the kickout plunger, install a pressure gauge in the valve inlet. Remove rubber plug from end of cap. Place the plunger in operating position with engine running. Turn the adjustment screw counter-clockwise until plunger kicks out. Continue to operate the plunger and make adjustments until plunger kicks out at desired pressure. Reinstall rubber plug.

NOTE: Do not apply excessive force to the adjustment screw or poppet spring seat may be damaged.

C. LOAD CHECK VALVES

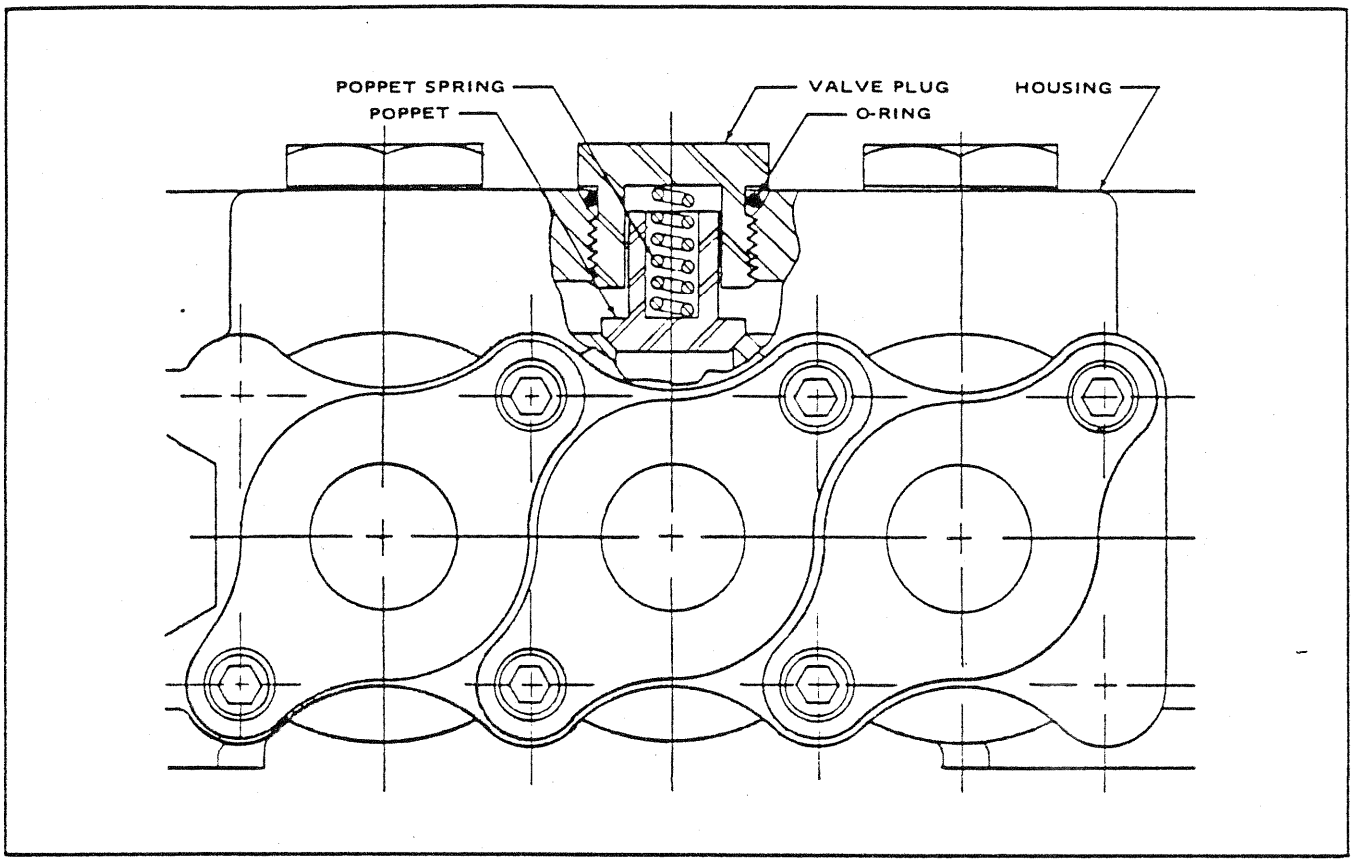


Figure 23. Load Check Valve

Load check valves used on HUSCO control valves normally do not require servicing; malfunction is usually the result of foreign matter lodging between the seat and poppet.

DISASSEMBLY

Remove valve plug, poppet spring and poppet.

INSPECTION AND REPAIR

Clean parts with solvent and blow dry with compressed air. Examine poppet and poppet seat for nicks or scratches. Minor nicks or scratches can be removed by lapping poppet and seat with a fine grade lapping compound.

CAUTION: DO NOT ALLOW LAPPING COMPOUND TO REMAIN IN VALVE.

Replace O-ring if damaged or deteriorated. Replace spring if weak or distorted.

ASSEMBLY

Assemble poppet and poppet spring to housing. Replace O-ring to valve plug and assemble valve plug to housing.

SECTION IV FIELD TESTING PROCEDURE

Special testing facilities are required to completely test and adjust control valves. It is possible, however, to perform several tests while the valve is mounted on the equipment.

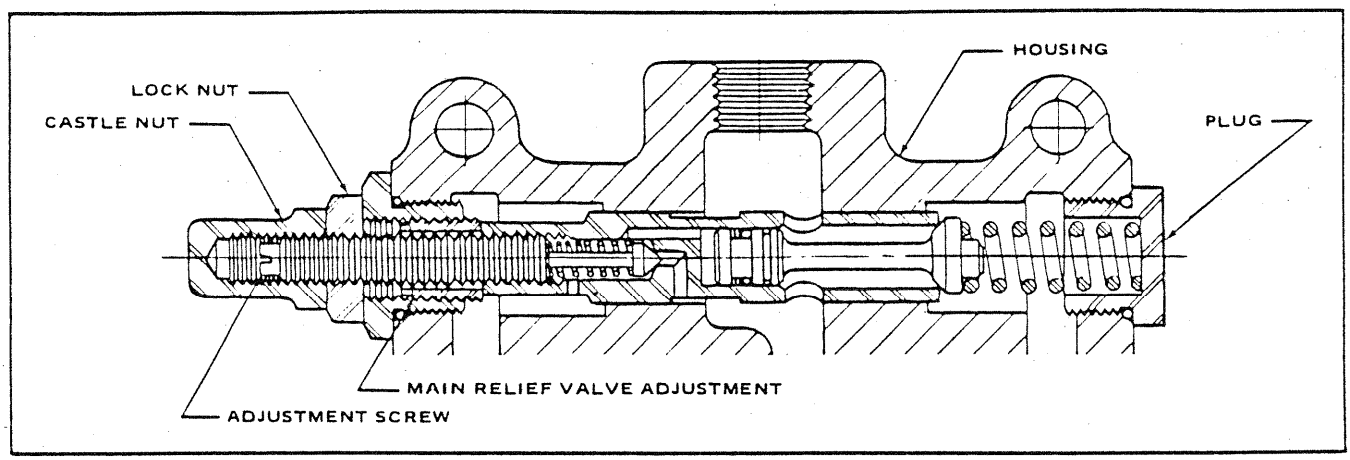


Figure 24. Pilot Operated Relief Valve

To set pilot operated relief valve, install a pressure gauge in the inlet line and proceed as follows:

Remove castle nut and lock nut.

Tighten pilot relief valve adjustment screw until it just seats against pilot poppet.

Using Special Spanner Wrench (Fig. 1), set main relief valve adjustment screw as follows:

1. Run pump at low operating speed (approximately 1/4 full engine RPM).
2. Hold plunger at extreme position until a pressure reading is observed on the gauge.
3. Adjust main relief valve so that pressure is set at 150 to 250 PSI above the required setting.

Run engine at high RPM and back off valve adjustment screw several turns and set to the required pressure setting (150 to 250 PSI lower than the previous setting).

Assemble lock nut and castle nut to valve.

NOTE: THE ABOVE SETTING WILL PRODUCE A RELATIVELY CONSTANT RELIEF VALVE SETTING ACROSS FULL ENGINE RPM.

CAUTION: IF THE ADJUSTMENT SCREW IS TURNED IN TOO TIGHT, THE ENTIRE SLEEVE MAY TURN. TO FREE THE ADJUSTMENT SCREW, PARTIAL DISASSEMBLY OF THE VALVE IS REQUIRED.

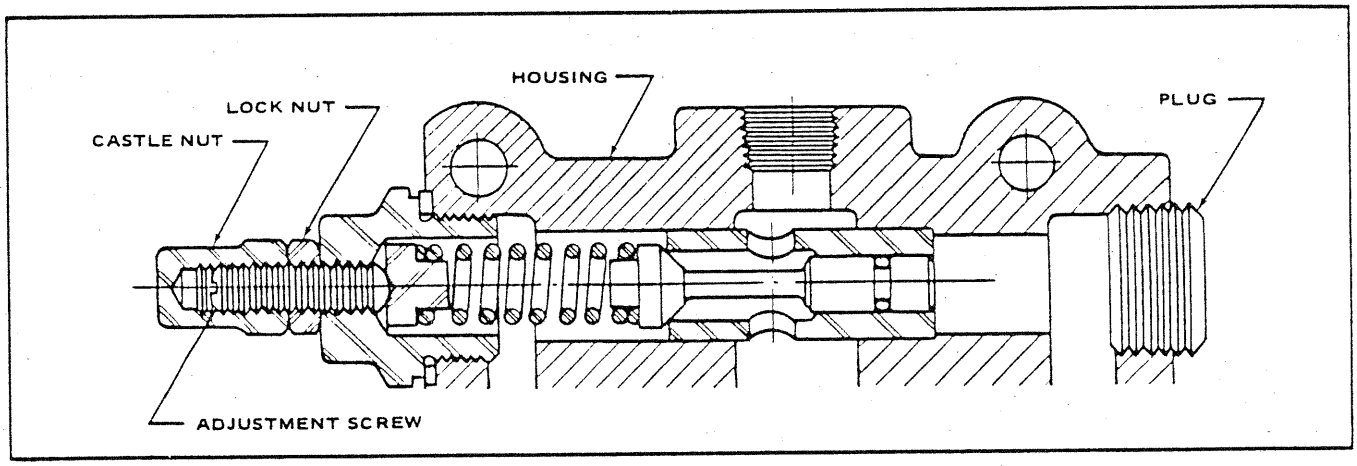


Figure 25. 3500 Relief Valve

To set main relief valve pressure, install a pressure gauge in inlet line and set pressure gauge as follows:

Remove castle nut and lock nut.

Run engine at operating RPM, check relief valve setting by actuating the plunger. Reset adjustment screw.

Repeat sequence until desired setting is obtained.

Replace lock nut and castle nut.

To check leakage rate of the plungers, install a pressure gauge in the cylinder port line controlled by the plunger to be tested.

Actuate the plunger until full relief valve pressure is obtained.

Return plunger to neutral.

The rate at which the pressure drops indicates the leakage past the plunger. Cylinder drift is also an indication of plunger leakage.

NOTE: IN INTERPRETING THE ABOVE RESULTS, LEAKAGE PAST THE CYLINDER PACKING MUST BE CONSIDERED.

Load check valves are checked in the same manner. With full relief pressure in the cylinder port and plunger in the operating position - stop the pump and observe the rate of pressure drop in the cylinder port.

NOTE: THIS PRESSURE DROP NOT ONLY REFLECTS LEAKAGE PAST THE RELIEF VALVE, BUT ALSO PAST THE CYLINDER PACKING AND LEAKAGE AROUND THE PLUNGER.

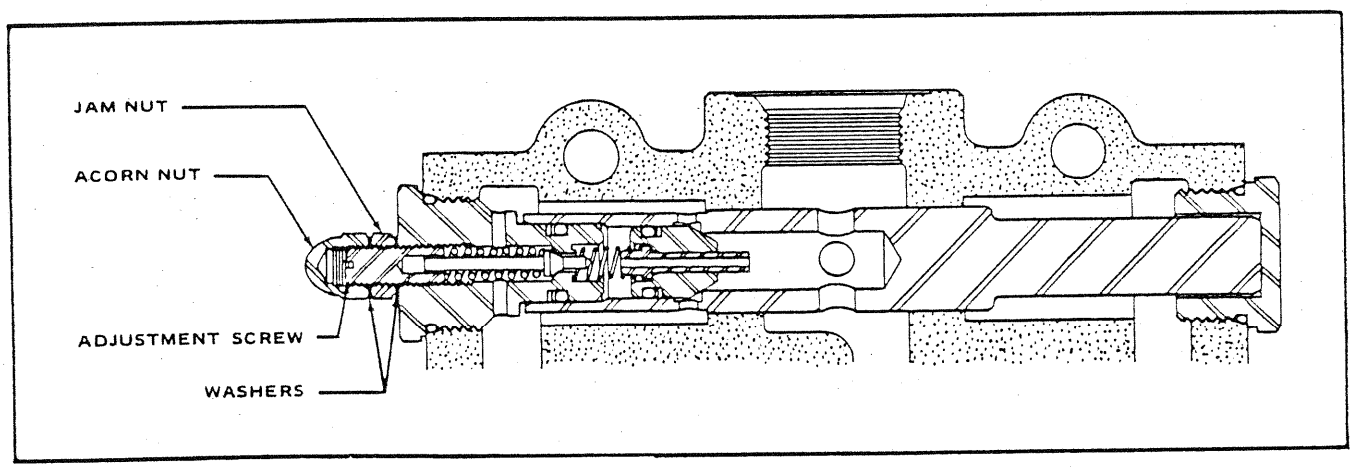


Figure 26. Pilot Operated - Sleeve Type Main Relief Valve

To set main relief valve pressure, install a pressure gauge in the inlet line and set pressure as follows:

Remove acorn nut and loosen jam nut.
Back off pilot adjustment screw and reset so that pilot adjustment screw just seats against pilot poppet.
Run engine at normal operating speed.
Operate one plunger of the control valve at the extreme position until a pressure reading is observed.
Reset adjustment screw until desired pressure is obtained.
Holding adjustment screw at this setting, tighten jam nut and install acorn nut.
Retest to check pressure setting.

NOTE: THE ABOVE SETTING WILL PRODUCE A RELATIVELY CONSTANT RELIEF VALVE SETTING ACROSS FULL ENGINE RPM.

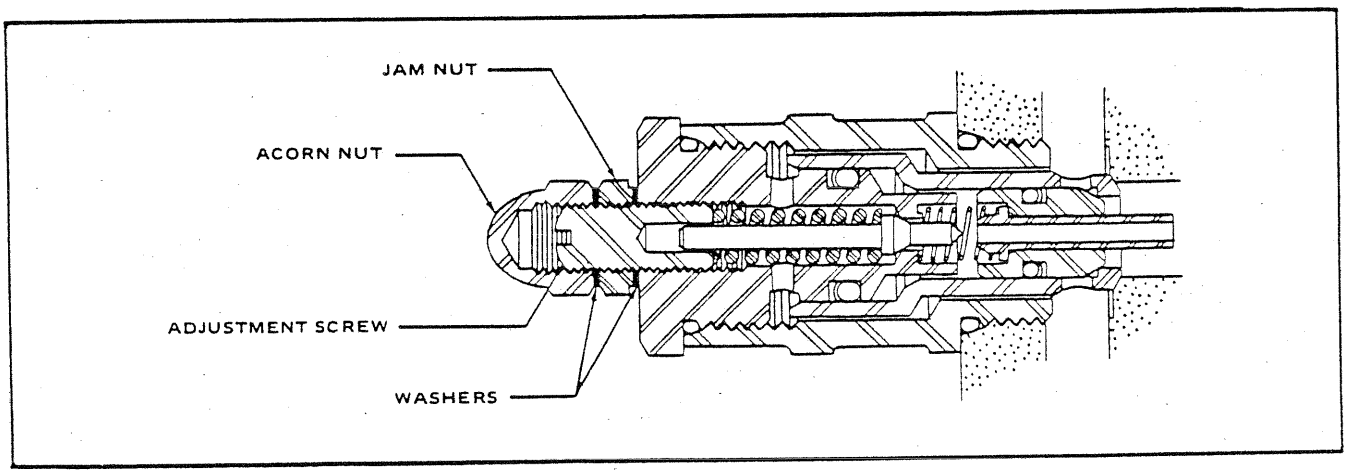


Figure 27. Cartridge Type - Main Relief Valve (identical in design to service port relief valve).

To set pressure on the Service Port Relief Valve, install a good pressure gauge in the line which is in communication with the Service Port Relief Valve. Apply a load to reach the set pressure of the Service Port Relief unit. Then proceed as outlined for Fig. 26 (See Above).

NOTE: THE VOID CONTROL FEATURE IS DESIGNED TO OPERATE WHENEVER THE CYLINDER PORT PRESSURE IS LOWER THAN THE RESERVOIR PRESSURE AND IS NOT ADJUSTABLE.

SECTION V EMERGENCY PLUNGER AND HOUSING REPAIR

To manufacture a high quality control valve having a minimum amount of leakage, each plunger is honed to fit its respective bore. It is, therefore, recommended that the valve be returned to the factory for repair or replacement.

Should a situation require rebuilding the valve, we recommend the following procedures:

Remove valve from the equipment and thoroughly clean all external surfaces.

Disassemble valve, tagging plungers to assure reassembly to the same bore. Do not damage plunger seals during disassembly.

Clean all internal parts with solvent and blow dry with compressed air.

Plate plunger .001 to .002 with crack-free chrome plate.

Refinish plated plunger to within .0002 of being straight and round with a surface finish of 12 RMS or greater.

Hone valve bore until plunger fits bore smoothly. Permissible clearance between bore and plunger is .0002 to .0005.

Thoroughly flush valve housing, grease detents and other sliding parts and reassemble valve. During assembly do not damage plunger seals.

If a new plunger is required, refit new plunger to the respective bore using the same procedure as for a rebuilt plunger.

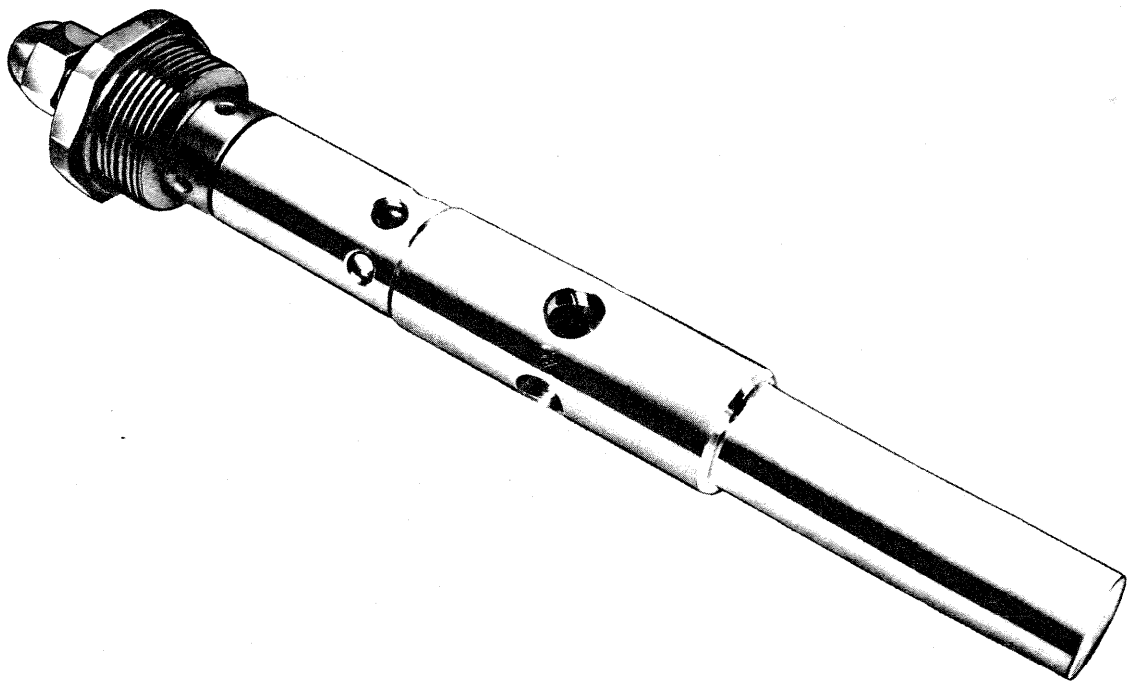
NOTE: HUSCO IS NOT ABLE TO PERFORM FACTORY REPAIR SERVICE WITHOUT WRITTEN AUTHORIZATION FROM THE ORIGINAL EQUIPMENT MANUFACTURER.

Returned valves will be held at HUSCO until authorization is obtained. All billing will be mailed to the original manufacturer. The manufacturer will, in turn, bill the owner of the equipment.

Valves will be shipped directly to the owner of the equipment unless otherwise instructed.

SERVICE BULLETIN for HUSCO

CARTRIDGE TYPE MAIN RELIEF VALVE



SERVICE INFORMATION FOR HUSCO
CARTRIDGE TYPE MAIN RELIEF VALVE

The cartridge relief shown on opposite page is of the differential area type. When system pressure exceeds the preadjusted relief setting, caused for example by a cylinder reaching the end of its stroke, the sequence of operation would be as follows: Pressurized system fluid is present in the main poppet area (A) having entered through holes in the sleeve (15). Fluid is admitted to the valve area (B) through the hole in the piston (11). The area at (B) is greater than area (A). This area differential creates a pressure imbalance causing the main poppet (12) to remain firmly seated. When system pressure equals the relief setting (compression set on the (9) pilot spring), the pilot poppet (6) is unseated. The relieved oil then flows around the pilot poppet (6) to low pressure through the cross drilled holes in the plug (16). This oil flow (to low pressure) reduces the pressure in area (B), allowing the piston (11) to move back until it seats against the pilot poppet (6). Seating action shuts off oil flow through the piston (11) but oil continues to flow around it. Because the pressure in area (B) is greatly reduced, the main poppet (12) unseats. When the main poppet (12) unseats, system fluid is dumped instantaneously to low pressure, thus relieving pressure and preventing damage to associated circuit components.

DISASSEMBLY

The steps for disassembly of the main relief cartridge are as follows:

(A) To remove the main relief cartridge from the control valve housing, remove relief valve plug (16) and plug (19). The spring (8) and piston (11) are then removed from sleeve (15).

(B) A brass rod should be inserted in orifice opposite relief valve bore and gently tap out sleeve (15). Poppet (12) is removed by tapping sleeve (15) into palm of hand.

(C) It is not recommended that plug (16) be disassembled, as preset factory pressure setting will be altered. If, however, the plug (16) is to be disassembled, proceed by removing the acorn nut (14), jam nut (4), and two copper sealing washers (5) from the adjust screw (7). Remove the adjust screw (7) and tip plug (16) into palm of hand, spring (19) and poppet (6) should drop out.

(D) The O-rings (1) (2) (3) and back up rings (10) (13) should be removed only when replacement is required. The disassembly is completed by removing O-rings (1) (2) (3) and back up rings (10) (13) from plug (16) and main poppet (12).

INSPECTION

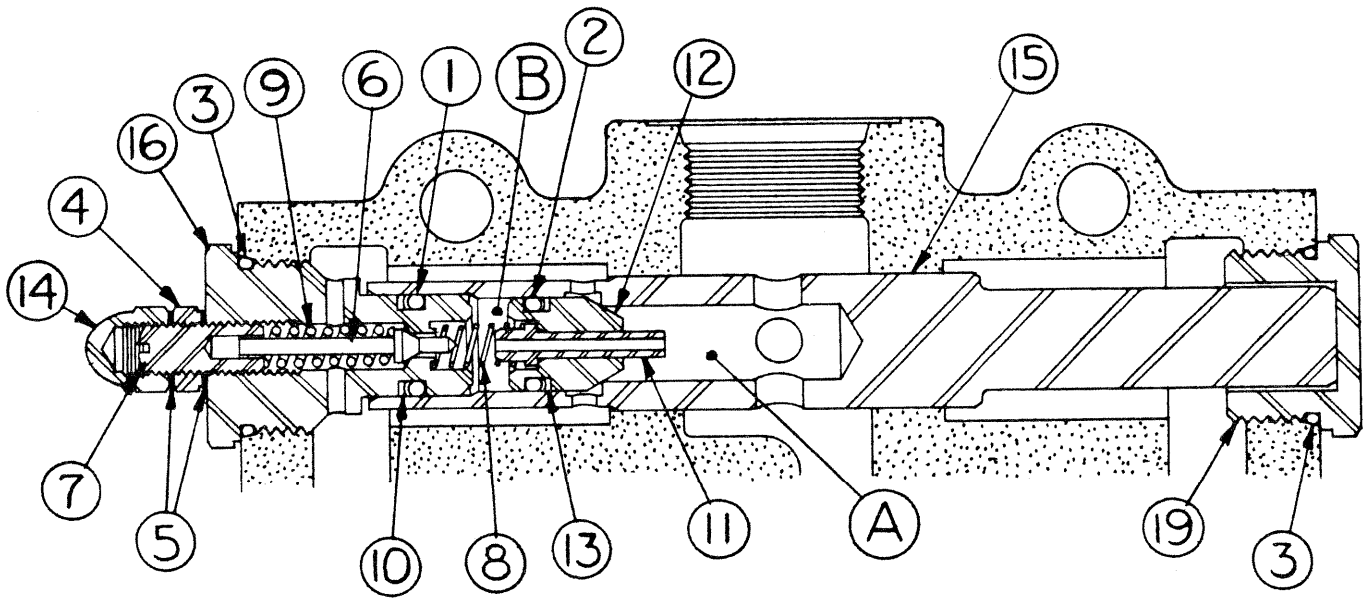
Clean all parts in solvent and blow dry with compressed air.

Inspection of the main cartridge relief is accomplished as follows:

(A) The poppet seating surfaces of the sleeve (15) and plug (16) must be inspected. These seating surfaces must be sharp, clean, and free of nicks or excessive wear. Inspect the main poppet (12) and pilot poppet (6) for nicks or grooves.

(B) Examine the three O-rings (1) (2) (3) and two back up rings (10) (13) for damage or deterioration. The most common cause of relief valve failure is damaged or worn O-rings (1) (2) (3) and, therefore, it is recommended to replace them.

(C) The small sensing hole through the piston (11) must be inspected for obstructions. It is essential that the piston (11) moves freely through the hole in the main poppet (12). Any parts found to be faulty must be replaced.



ASSEMBLY

To assemble the relief cartridge components after they have been thoroughly cleaned, proceed by:

(A) Position the O-rings (1) (2) (3) and backup rings (10) (13) as shown in the drawing. They are installed by stretching (do not roll) them to fit in their respective retaining grooves.

(B) Lubricate the main poppet (12) with hydraulic oil and insert it into the sleeve (15). The piston (11) and spring (8) are inserted into poppet (12).

(C) Insert poppet (6) and spring (9) into the plug (16) and install the adjust screw (7). Lubricate 0-rings (1) (3) and backup ring (10) on the plug (16) with hydraulic oil. The plug (16) and sleeve (15) are mated.

(D) Install relief cartridge and plug (19) in the valve housing. The relief cartridge is a honed fit, and may require gentle tapping to install. Care must be taken, however, to avoid damaging the control valve's internal lands. The acorn nut (14), lock nut (4), and copper sealing washers (5) can be left off until the relief cartridge is to be adjusted.

INSTRUCTIONS FOR SETTING HUSCO PRESSURE RELIEF VALVES

SETTING PRESSURE

A good pressure gauge must be installed in the inlet line. Then follow these steps:

Remove acorn nut (14) and loosen jam nut (4), make sure several threads on adjusting screw (7) are engaged in pilot section.

Use a screwdriver and set adjusting screw as follows:

(A) Run engine at normal operating speed so that pump is developing required flow.

(B) Operate one plunger of control valve at its extreme position long enough to get a pressure reading on the gauge.

(C) Turn adjusting screw clockwise until desired pressure setting is obtained.

(D) Holding adjusting screw, tighten jam nut and install acorn nut.

(E) Retest to check pressure setting.

NOTE: Results of the above settings will indicate a relatively constant relief setting across full engine R.P.M.

HUSCO

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