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Service and Parts Bulletin

Model V42

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Sectional Body Directional Control Valve

⚠ WARNING

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Parker Hannifin Corporation
Hydraulic Valve Division
Elyria, Ohio, USA

Contents

List of Illustrations

SECTION I
INTRODUCTION

This manual contains pertinent, step-by-step maintenance instructions plus parts ordering information and a complete part and service kit listing for Gresen's Model V42 Directional Control Valve.

If further assistance is required, contact: Your Gresen Distributor or Representative

SECTION II
DESCRIPTION

Gresen's Model V42 Directional Control Valves are available with five different types of work sections, plus various options to meet specific job specifications.

The following paragraphs describe the five work sections and options with reference to the parts illustrations in Section IV in this manual.

3-WAY, 3-POSITION WORK SECTION (Refer to Figure 4-2).
Provides control of single acting cylinders or start and stop of non-reversible hydraulic motors where free-wheeling of motor is NOT required. The cylinder port is blocked in neutral position.

4-WAY, 3-POSITION WORK SECTION (Refer to Figure 4-3).
Provides control of double acting cylinders without the floating action plus hydraulic motor start, stop, and reverse control where free-wheeling is NOT required. Cylinder ports are blocked in neutral position.

4-WAY, 4-POSITION FLOAT WORK SECTION (Refer to Figure 4-4).
Provides control of double-acting cylinders requiring a floating action such as: loaders, dozers, snowplows, etc. Incorporated into the work section is a 4-position float positioner. Three positions are standard double-acting with spring return to neutral. The fourth position is detented to hold in float position (both cylinder ports open to tank).

4-WAY, 4-POSITION REGENERATIVE WORK SECTION (Refer to Figure 4-5).
Same as 4-way, 3-position work section except that the fourth "regeneration" position provides a large volume of oil for fast cylinder action, but with little force.

4-WAY, 3-POSITION WORK SECTION WITH PRESSURE DETENT RELEASE (Refer to Figure 4-6).
Provides automatic return to neutral position as soon as work cycle is completed. The spool is held in either power position by a detent assembly until released by predetermined pressure setting in the power circuit. Spool returns to neutral.

MID-INLET CONVERSION SECTION (Refer to Figures 4-7 thru 4-9).
Provides an inlet port for a secondary pump downstream in the valve assembly. Conversion sections are available in split flow, combined flow, and a two-position section for two-speed split or combined flow application.

SPOOL ACTIONS OPTIONS

SPRING RETURN TO NEUTRAL (Standard) (Refer to Figure 4-12).
Spool will return to neutral position from A or B power position when handle is released.

SPRING EXTENDED SPOOL, "A" Option (Refer to Figure 4-13).
Eliminates spring return to neutral. Spring returns to the spool "OUT" position only. Usually used for cam operation of spool.

INTERNAL HYDRAULIC DETENT RELEASE, "KO" Option (Refer to Figure 4-17).
Automatically returns spool to a neutral position as soon as work cycle is completed.

ROTARY SPOOL ACTUATOR, "W" Option (Refer to Figure 4-16).
Movement of spool is controlled by a rotary movement of the handle. Allows 90° rotation of spool in each direction from center.

3-POSITION DETENT, "D" Option (Refer to Figure 4-14).
Valve spool remains in any of three detented positions. No spring return to neutral.

1-POSITION SPOOL "IN" DETENT, "R" Option (Refer to Figure 4-18).
Work port "B" remains open to tank in detent position. Allows a single-acting cylinder to float. Spring returns spool to neutral.

REGENERATIVE SPOOL (Refer to Figure 4-19).
Regeneration position provides a large volume of hydraulic oil to cylinders for fast action, but with little force.

SOLENOID CONTROL (Refer to Gresen's Service and Parts Manual No. SC-1252).

HYDRAULIC CONTROL, "HRO," or "HRH" Option (Refer to Gresen's Service and Parts Manual No. SC-1253).

HANDLE ASSEMBLIES (Refer to Figures 4-20 thru 4-24). Provides a choice of either horizontal or vertical handle assemblies and coated with either red or black plastic or plain.

INLET and OUTLET COVERS (Refer to Section III, Parts Ordering Information).

RELIEF VALVES and WORK PORT CHECKS (Refer to Figures 4-25 thru 4-34).

SECTION III
MAINTENANCE

REPLACING, ADDING OR REMOVING WORK SECTIONS ASSEMBLIES

NOTE

For clarification, the side containing the inlet cover (the cover containing the main relief valve) will be called the left end of the valve assembly. Refer to 3-1.

1. Before disassembly, it is suggested that each work section be marked numerically to avoid incorrect reassembly.

2. Remove four hex nuts (Item 29, Figure 4-1) from the right end of the valve assembly using a 9/16" socket wrench. If the valve assembly consists of only one or two work sections, bolts and lock washers must be removed instead.

3. Remove the outlet cover and each section by sliding from assembly studs (Item 29, Figure 4-1).

4. If work sections are to be added or subtracted from the valve assembly, the four studs must be removed from the inlet cover and replaced with studs of proper length. Refer to Table 3-1.

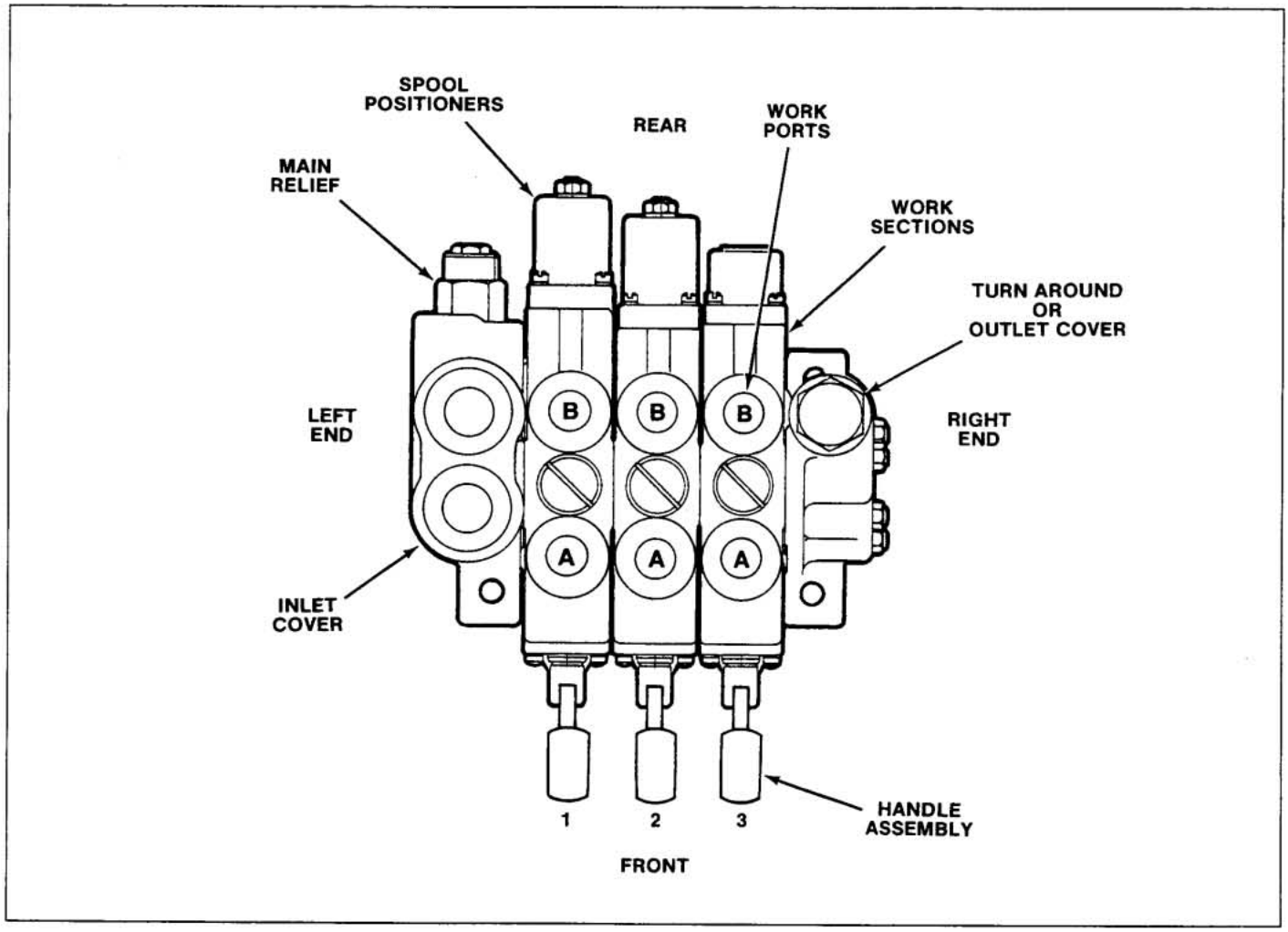


Figure 3-1. Schematic View of a Typical Model V42 Control Valve Assembly.

Table 3-1. Bolt and Stud Part Numbers

NO. OF WORK SECTIONS	OUTLET COVERS (RIGHT SIDE)		DESCRIPTION	
	PART NO. 8090- TOP OUTLET	PART NO. 8091- END OUTLET		
1	3732-127	3732-122	Bolt	Use Lock Washers
2	3732-130	3732-128	Bolt	Part No. 1039-001
3	3493-001	1672-001	Stud	
4	3493-002	1673-002	Stud	
5	3493-003	1674-001	Stud	Use Stud Nuts
6	3493-004	1675-001	Stud	Part No. 9310-106
7	3493-005	1755-001	Stud	No lock washers required
8	3493-006	1756-001	Stud	
9	3493-007	3493-008	Stud	

NOTE

Use stud nuts, part no. 9310-106, four required, with all assembly studs. Except for valve assemblies containing only one or two work sections, NO LOCK WASHERS required. Studs are of stress-proof material and should be replaced only with original equipment replacement parts. If the valve assembly contains only one or two work sections, assembly bolts with lock washers, part no. 1039-001, are used.

5. Thoroughly clean O-ring counterbores and ground surfaces of each section.

6. Replace the three O-ring seals, two part no. 21733-001 and one part no. 21735-001. Buna-N seals are standard. For optional Viton Seals, see Cross- Reference Chart on page 4-31.

7. Replace work sections on assembly studs in the same order in which they were removed. O-ring counterbores (with O-rings in place) should be to your left when facing the "A" port or front side of the valve assembly.

NOTE

Use care in replacing work section to avoid dislodging O-rings from counterbores.

8. When all work sections and the outlet cover are positioned on the assembly studs, replace stud nuts and tighten evenly to 24-26 foot pounds [33-35 Nm].

CAUTION

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

REPLACING SPOOL SEALS

Figure 3-2 shows spool assembly — less the complete handle assembly. When the handle bracket is furnished, retainer plate and retainer screws are not used. Seal assembly is retained by handle bracket and its attaching parts.

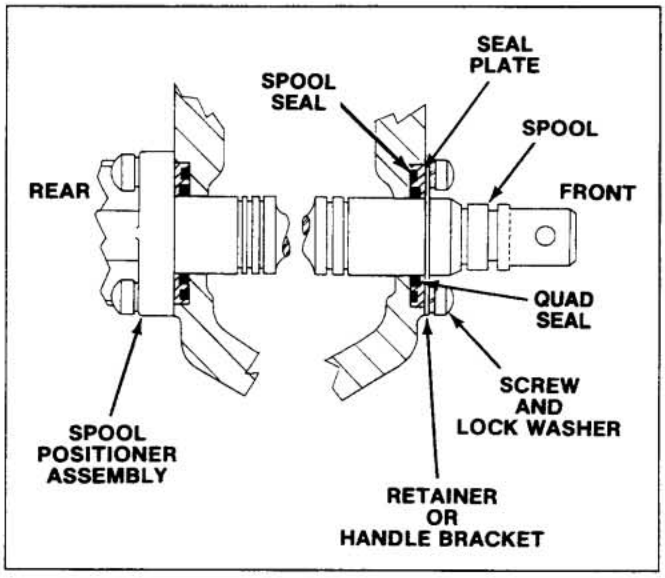


Figure 3-2. Spool Seal Assembly

1. Remove spool positioner assembly from rear of work section. Keep in order of disassembly.

2. Remove complete handle bracket assembly or retainer and retainer screws from front of work section.

3. Remove seal plate from each end of work section.

4. Remove quad seals and spool seals from seal plates and thoroughly clean plates.

5. Lightly oil new seals. Insert them into grooves in seal plate.

6. Slide the seal plates over each end of the spool into the counterbore in the work section.

7. Reassemble parts in reverse order of disassembly.

8. Torque bonnet screws and handle bracket or seal retainer screws to 8-10 foot pounds [11-14 Nm].

PARTS ORDERING INFORMATION

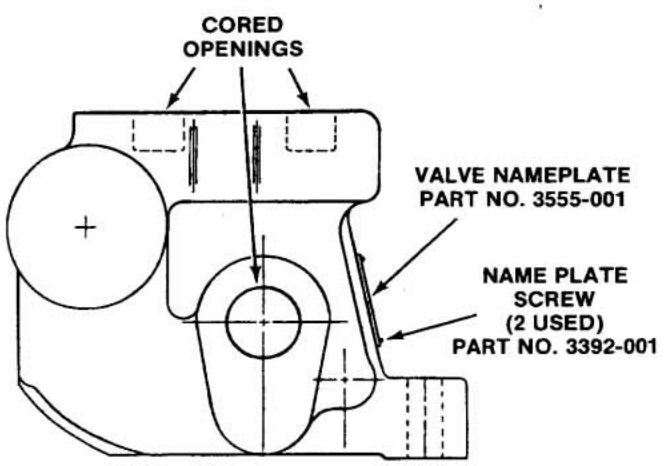
As of January 1, 1991 a product improvement was made to the section seal design of Model V42 control valves.

The old design utilized standard .010" cross section o-rings. Tests have shown that increasing the o-ring thickness to .103" will substantially lengthen (almost double) the life to these section seals.

This product improvement will require larger section seal grooves in the valve sections/covers, which will require in two different sizes i the field. A date stamp of A91 (January, 1991) or later on the section/cover will be the external indication that this section/cover requires the .103" section seals.

New valve sections/covers will be interchangeable and may be used to replace damaged or won sections/covers in the field. Because of the different machining, section seals are not interchangeable between the new and old housings.

As of January 1, 1991, all V42 valves are manufactured with the new, larger o-rings and section seal grooves. The existing Service Kits will be revised to include both the old and new section seals. These kits will also include an instruction sheet to explain the presence of the extra seals.



INLET COVER
Part No. 8089-

Al inlet covers are machined to accept Models KC, RP60 or NR plug. If the outlet port is not machined, then the outlet port in the right or outlet cover must be used for a tank return line. The inlet cover may be machined with several different combinations of port sizes and locations.

Use the following porting chart to determine the proper machining modification number. NPT and SAE threads cannot be intermixed in the same casting.

PORT LOCATION	NPT**	SAE				
End In*	1-1/4"	16	16	20	16	20
Top In*	1-1/4"	16	16	20	16	20
End Out	1-1/4"	—	—	—	20	20
Top Out*	1-1/4"	16	20	20	20	20
Machining Modification Number	-030	-001	-004	-005	-007	-006

* These port locations are cored and will be plugged if not required.

** Ports with NPT pipe threads are limited to 2000 PSI [136 bar] max.

Ordering Example For Inlet Covers

*Specify:

1. Model number of relief valve to be used. (See Figures 4-25 and 4-26).
2. Relief setting required. Crack pressure is setting when relief is passing 1 GPM [3.8 litres/min.]. Full flow is pressure setting when relief is passing specified GPM [litres/min].
3. "NR" (no relief) if plug is to be installed.
4. If "With no relief assembly or "NR" plug installed" is specified, relief cavity will be plugged with only a plastic shipping plug.

OUTLET COVERS

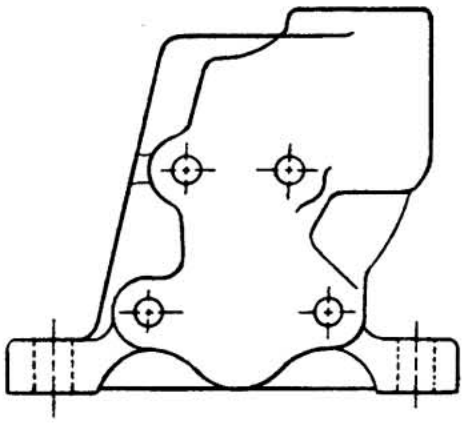
A choice of two outlet covers for the Model V42 is available: top outlet, part no. 8090-; and end outlet, part no. 8091-.

Top Outlet Cover, Part No. 8090—

Standard machining provides a top outlet port for open center applications. When the top outlet port is plugged to provide a turnaround outlet flow, the outlet port must be located in the inlet cover.

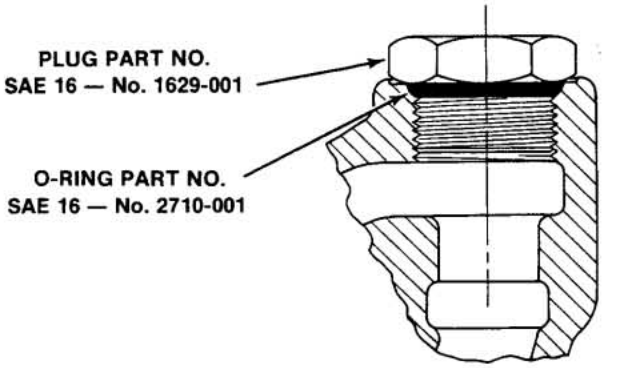
Two options are available for the no. 8090 top outlet cover . . . power beyond and closed center applications. For power beyond, the core between the open center and exhaust passages is tapped and plugged. The top outlet port becomes the power beyond port. The tank outlet port must be located in the inlet cover.

Top Outlet Cover, Part No. 8090—

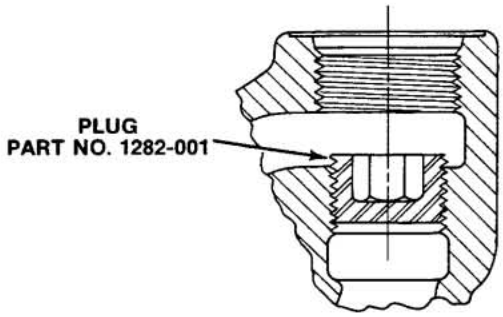


When the top power beyond port is plugged, the Valve Assembly may be used in a closed center application. For future conversion from standard open center to either power beyond or closed center applications, the outlet cover may be ordered with the core tapped but not plugged (for field conversion machining).

Options For The No. 8090 Outlet Cover



Turnaround plug option.

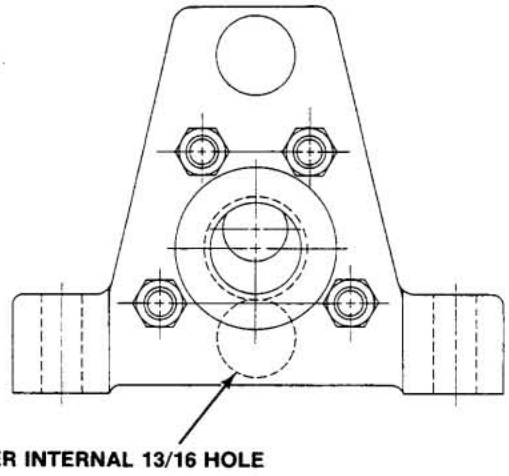


Power beyond option.

Use the following porting chart to determine the proper machining modification number for the no. 8090 outlet cover. NPT and SAE threads cannot be intermixed in the same casting.

PORT LOCATION	NPT	SAE	
Top Outlet		16	—
Power Beyond or Closed Center Option	1"—11-1/2	—	16
Machining Modification Number	-005	-006	-002

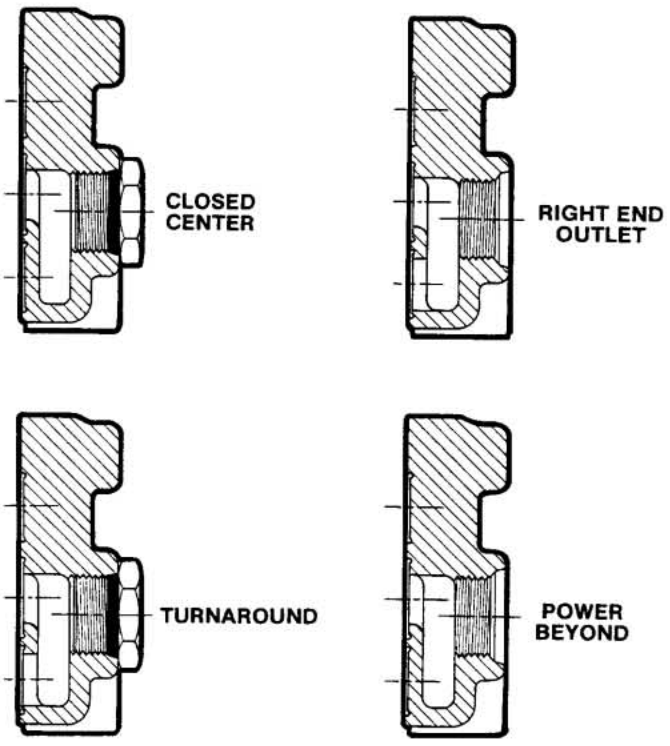
End Outlet Cover. Part No. 8091



Standard machining provides an end outlet port for open center applications. When the end port is plugged to provide for a turnaround outlet flow, the outlet port must be located in the inlet cover.

Two options are available for the no. 8091 end outlet cover ... power beyond and closed center applications. When the lower 13/16 inch hole (located on the inside) connecting the open center and exhaust passage is eliminated, the outlet port may be used for power beyond. When the power beyond port is plugged, the cover may be used for closed center applications.

Options For The No. 8091 — Outlet Cover



When the lower internal 13/16 inch hole is provided, the cover will operated in open center hydraulic circuits as a standard end port, or as a turnaround section when the outlet port is plugged.

When the power beyond or the closed center portion is used, an outlet to tank must be provided on the left end section of the valve.

Use the following porting chart to determine the proper machining modification number for the no. 8091 outlet cover.

PORT LOCATION	NPT		SAE			
Standard Outlet or Turnaround	1"	1-1/4"	16	20	—	—
Power Beyond or Closed Center	—	—	—	—	16	20
Machining Modification Number	-008	-002	-006	-004	-007	-035

Ordering Example For Outlet Covers

8090 — 006 — Plug Outlet Port

Basic Casting Part No.

Machining Modification Number

Option Details

WORK SECTIONS

The following information is necessary for proper specification for each Model V42 work section:

1. Function of section
2. Options
3. Work port sizes
4. Work port "A" options
5. Work port "B" options
6. Handle end options

The chart shown on the following page will help in identifying options available and the information needed for proper ordering. Refer to Catalog No. PC-1201 for complete information on available options.

FUNCTION OF SECTION*	Check one for each situation ☐ 3-Way, Casting No. 8045, see Figure 4-2. ☐ 4-Way, Casting No. 8045, see Figure 4-3. ☐ 4-Way Float, Casting No. 8046, see Figure 4-4. ☐ 4-Way Regenerative, Casting No. 8138, see Figure 4.5.
OPTIONAL FEATURES	☐ 3-Way, Free Flow ☐ 4-Way, Free Flow ☐ _____
WORK PORT SIZES "A" and "B" WORK PORTS	☐ SAE 12 (1-16" — 12 UN) Standard ☐ SAE 16 (1-15/16" — 12 UN) ☐ 3/4" — 14 NPT ☐ 1" — 11-1/2NPT Ports with NPT threads are limited to 2000 psi [136 bar] max.
WORK PORT OPTIONS	Specify for "A" and "B" work ports ☐ Anti-Cavitation Check, A-C ☐ Upper Option Plug ☐ Lower Option Plug ☐ Work Port Relief, Model WH, _____ ☐ Work Port Relief, Model RP51, _____ *Specify relief setting*
HANDLE-END OPTIONS*	☐ Standard Steel Retainer Assembly, LCHA ☐ Vertical Handle, CVHA ☐ Horizontal Handle, CHHA ☐ Spool Boot Assembly ☐ Less Handle Only, includes link assembly, LHO ☐ Handle Bracket Only, less link assembly, HBO

*Each spool is fitted to its work section housing at the factory and neither part can be purchased separately. O-ring grooves are machined on the left side (when viewed from the "A" work port end) of each work section housing.

MID-INLET CONVERSION SECTION

The following information is necessary for proper specification when ordering a mid-inlet conversion section:

1. Type of section
2. Port size
3. Relief valve type and setting

FUNCTION OF SECTION	☐ Combined Flow ☐ Split Flow ☐ 2-Position, combined or split flow
PORT SIZES	☐ SAE 16 (1-15/16" — 12 UN) Standard ☐ 1" — 11-1/2 NPT Ports with NPT pipe threads are limited to 2000 PSI [136 bar] max.
RELIEF VALVE OPTIONS	For split or combined flow sections only ☐ Model WH, _____ ☐ Model RP60, _____ FOR 2-POSITION SELECTIVE SECTIONS ONLY ☐ Model WH, _____ ☐ Model RP51, _____ _____ Specify relief setting

SECTION IV
PARTS LISTING

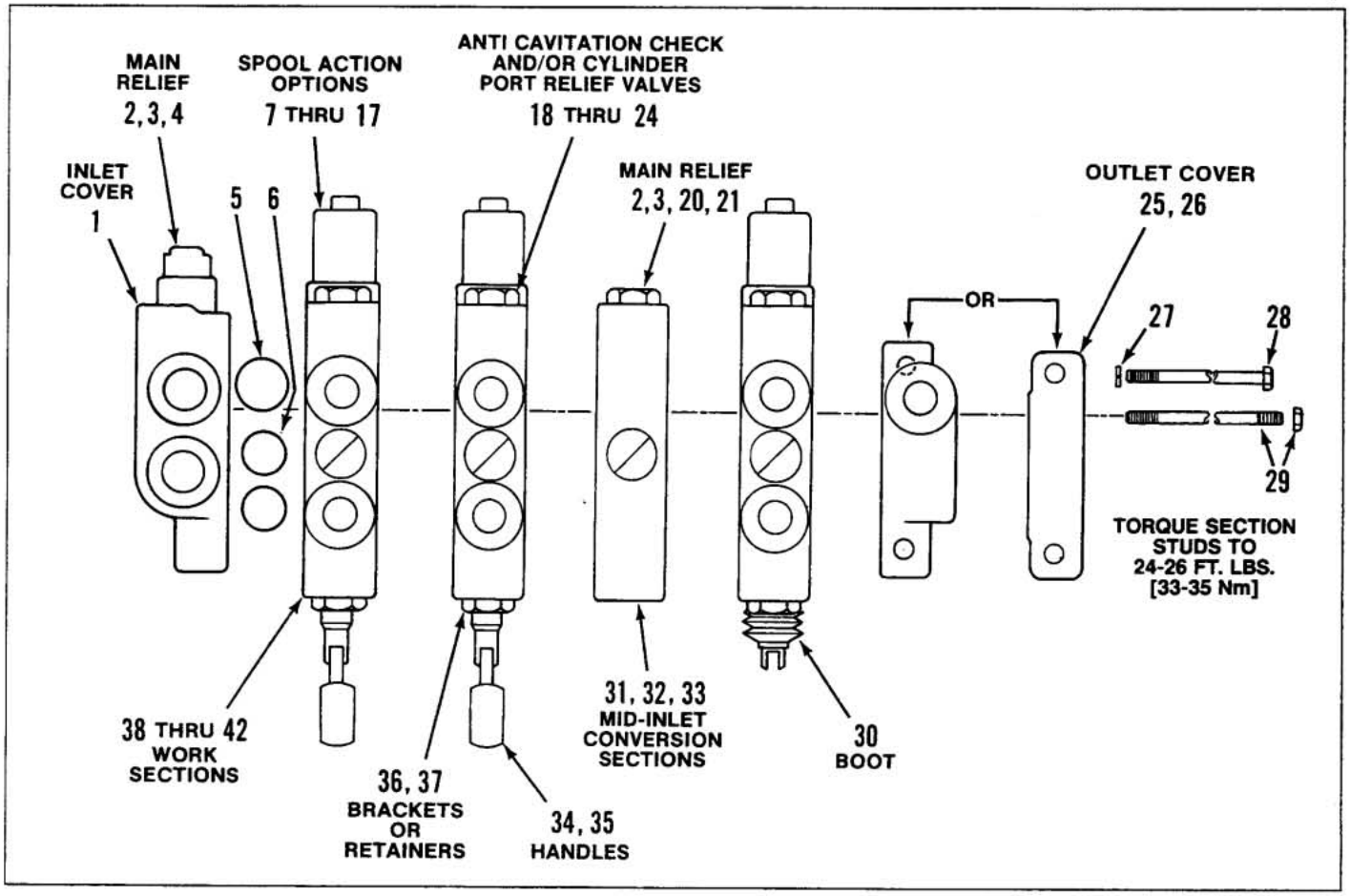


Figure 4-1. Model V42 Directional Control Valve, Typical Main Assembly

MODEL V42 DIRECTIONAL CONTROL VALVE ASSEMBLY, TYPICAL MAIN ASSEMBLY

Item No.	Part No.	Description	Quantity Per Assembly
1	8089	COVER, Inlet (Refer to page 3-2)	1
2		RELIEF, RP60, (See Figure 4-25)	A/R
3		RELIEF, KC (See Figure 4-26)	A/R
4	K-7014	PLUG, No Relief (NR) (See Figure 4-27)	A/R
5	21735-001	O-Ring, Large (old)	1 plus 1 per section
6	21733-001	O-Ring, Small (old)	2 plus 2 per section
7	K-28060	POSITIONER, Spring Return to Neutral (See Figure 4-12)	A/R
8		POSITIONER, Spring Extended Spool (See Figure 4-13)	A/R
9	K-28025	POSITIONER, 3-Position Detent, "D" (See Figure 4-14)	A/R
10	K-28061	POSITIONER, Float (See Figure 4-15)	A/R
11	K-28103	POSITIONER, Rotary, "W" (See Figure 4-16)	A/R
12		POSITIONER, Internal Pressure Detent Release, "KO" (See Figure 4-17)	A/R

MODEL V42 DIRECTIONAL CONTROL VALVE ASSEMBLY, TYPICAL MAIN ASSEMBLY (Continued)

Item No.	Part No.	Description	Quantity Per Assembly
13	K-28027	POSITIONER, Spool "IN" Detent Spring Return to Neutral "R" (See Figure 4-18)	A/R
14	K-28059	POSITIONER, Regenerative (See Figure 4-19)	A/R
15		POSITIONER, Hydraulic Remote (Refer to Catalog No. SC-1253)	A/R
16		POSITIONER, Hydraulic Remote (Refer to Catalog No. SC 1253)	A/R
17		POSITIONER, Solenoid Control (Refer to Catalog No. SC 1252)	A/R
18	K-28065	CHECK, Anti-Cavitation, Upper (See Figure 4-28)	A/R
19	K-28064	CHECK, Anti-Cavitation, Lower (See Figure 4-29)	A/R
20		RELIEF, Model RP51 (See Figure 4-30)	A/R
21		RELIEF, Model WHA (See Figure 4-31)	A/R
22		RELIEF, Model WH (SEE FIGURE 4-32)	A/R
23		PLUG, Lower Anti-Cavitation (See Figure 4-33)	A/R
24		PLUG, Upper Anti-Cavitation (See Figure 4-34)	A/R
25	8090—	COVER, Top Outlet (See Page 3-3)	1
26	8091—	COVER, End Outlet (See Page 3-4)	1
27	1039-001	WASHER, Lock (for 1 or 2 work sections only)	4
28		BOLT (See Table 3-1)	4
29		STUD and STUD NUT ASSEMBLY (See Table 3-1)	4
30		BOOT ASSEMBLY (See Figure 4-24)	A/R
31		MID-INLET SECTION, Split Flow (See Figure 4-7)	A/R
32		MID-INLET SECTION, Combined Flow (See Figure 4-8)	A/R
33		MID-INLET SECTION, 2 Position (See Figure 4-9)	A/R
34		HANDLE ASSEMBLY, Vertical (See Figure 4-20)	A/R
35		HANDLE ASSEMBLY, Horizontal (See Figure 4-21)	A/R
36		RETAINER, Standard (See Figure 4-22)	A/R
37		BRACKET, Handle (See Figure 4-23)	A/R
38		WORK SECTION, 3-Way, 3-Position (See Figure 4-2)	A/R
39		WORK SECTION, 4-Way, 3-Position (See Figure 4-3)	A/R
40		WORK SECTION, 4-Way, 4-Position Float (See Figure 4-4)	A/R
41		WORK SECTION, 4-Way, 4-Position Regenerative (See Figure 4-5)	A/R
42		WORK SECTION, 4-Way, 3-Position With Pressure Detent Release (See Figure 4-6)	A/R

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

**A date stamp of A91 (Jan., 1991) or later on the section/cover will be the external indication that the new section seals are required. Because of the different machining, section seals are not interchangeable between the old and new section seals. Both old and new section seals are included in the service kit.

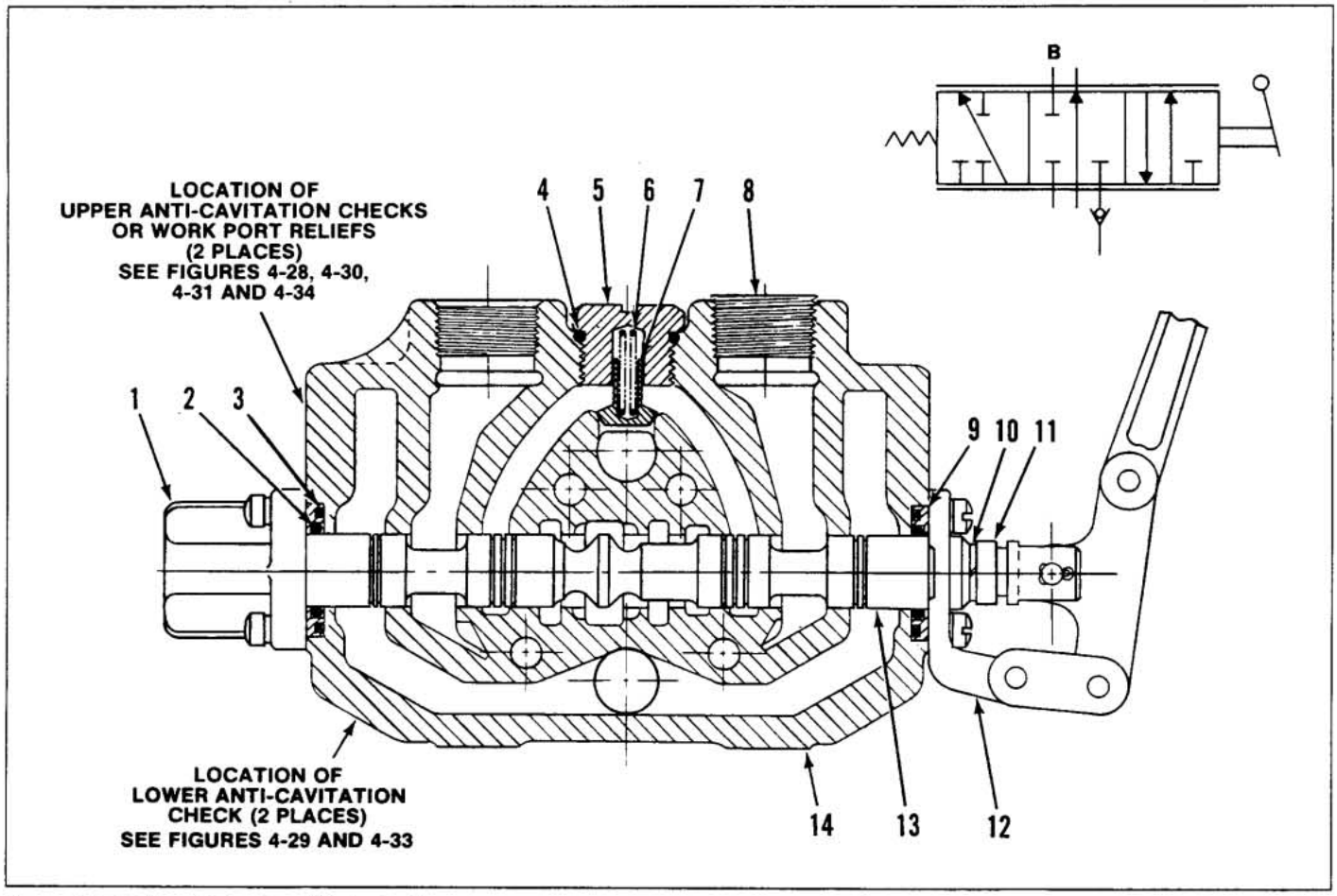


Figure 4-2. 3-Way, 3-Position Work Section

3-WAY, 3-POSITION WORK SECTION

Item No.	Part No.	Description	Quantity Per Assembly
	K-28029*	SEAL KIT (Contains Items 2, 3, 4 and 9 plus section seals)	
	K-7018*	SERVICE KIT (Contains Items 4 thru 7)	
1	K-28060	POSITIONER, Standard (See Figure 4-12)	1
2	20163-001*	SEAL, Quad } Not Sold Separately. Order K-28106*	2
3	20164-001*	SEAL, Square-cut } Not Sold Separately. Order K-28106*	2
4	2709-001*	SEAL, O-Ring	1
5	7790-001	PLUG, Load Check } Not Sold Separately. Order K-7018*	1
6	2796-001	SPRING } Not Sold Separately. Order K-7018*	1
7	7791-001	POPPET } Not Sold Separately. Order K-7018*	1
8		PLUG (See Table 4-3 for part number)	1
9	12172-001	PLATE, Seal	2
10	1039-001	WASHER, Lock	1
11	8351-001	ADAPTER, Clevis	1
12		HANDLE, BRACKET or RETAINER (See Figure 4-20 thru 4-24)	1
13	12350-001	SPOOL, 3-Way } See Note	1
14	8045-XXX	HOUSING, 3-Way } See Note	1

NOTE: These are matched parts and are not sold separately. See page 3-2 for ordering information.
*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

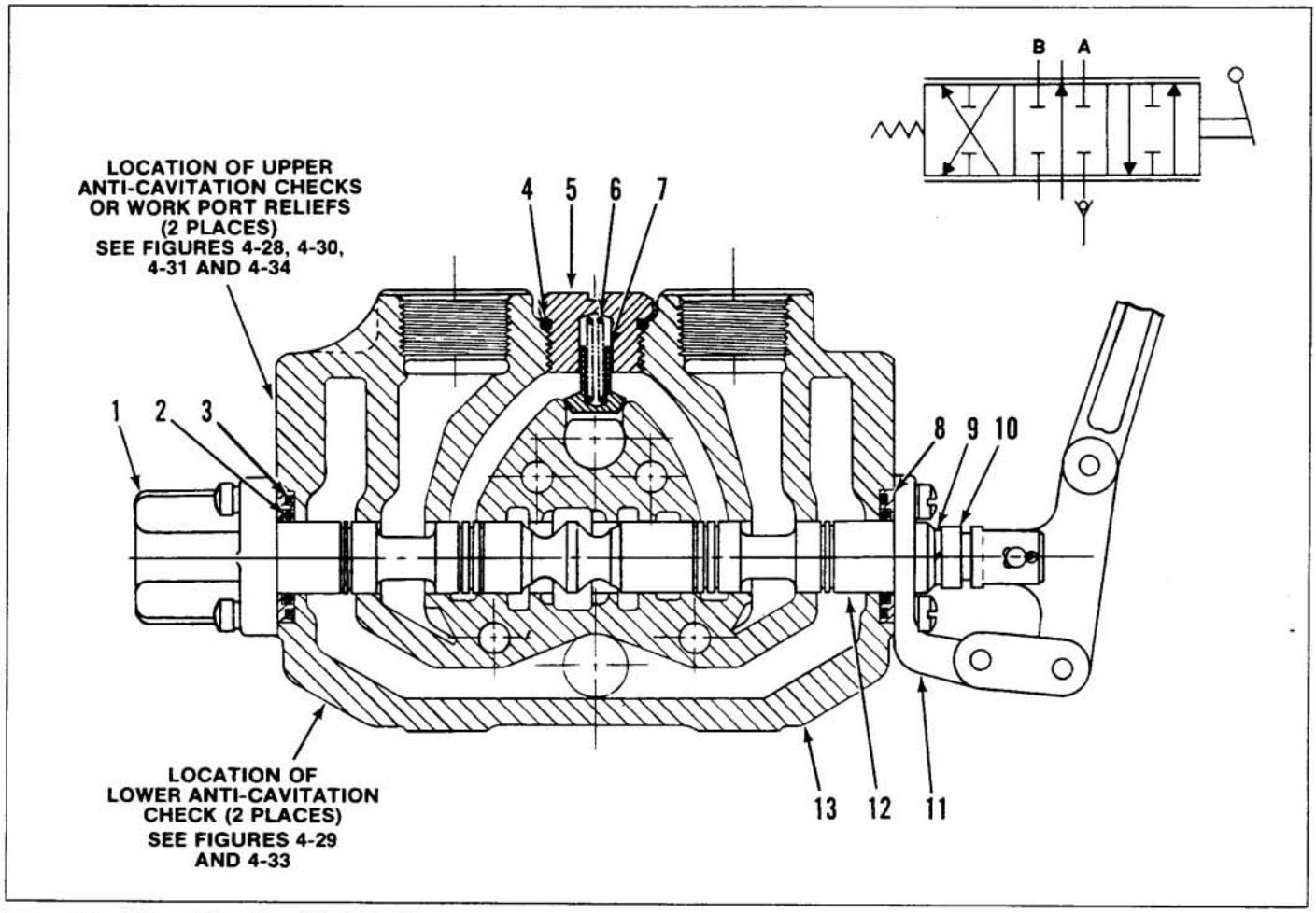


Figure 4-3. 4-Way, 3-Position Work Section

4-WAY, 3-POSITION WORK SECTION

Item No.	Part No.	Description	Quantity Per Assembly
	K-28029*	SEAL KIT (Contains Items 2, 3, 4 and 8 plus section seals)	
	K-7018*	SERVICE KIT (Contains Items 4 thru 7)	
1	K-28060	POSITIONER, Standard (See Figure 4-12)	1
2	20163-001*	SEAL, Quad } Not Sold Separately. Order K-28106*	2
3	20164-001*	SEAL, Square-cut } Not Sold Separately. Order K-28106*	2
4	2709-001*	SEAL, O-Ring	1
5	7790-001	PLUG, Load Check } Not Sold Separately. Order K-7018*	1
6	2796-001	SPRING } Not Sold Separately. Order K-7018*	1
7	7791-001	POPPET } Not Sold Separately. Order K-7018*	1
8	12172-001	PLATE, Seal	2
9	1039-001	WASHER, Lock	1
10	8351-001	ADAPTER, Clevis	1
11		HANDLE, BRACKET or RETAINER (See Figures 4-20 thru 4-24)	1
12	12351-001	SPOOL, 4-Way } See Note	1
13	8045-XXX	HOUSING, 4-Way } See Note	1

NOTE: These are matched parts and are not sold separately. See page 3-2 for ordering information.
*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

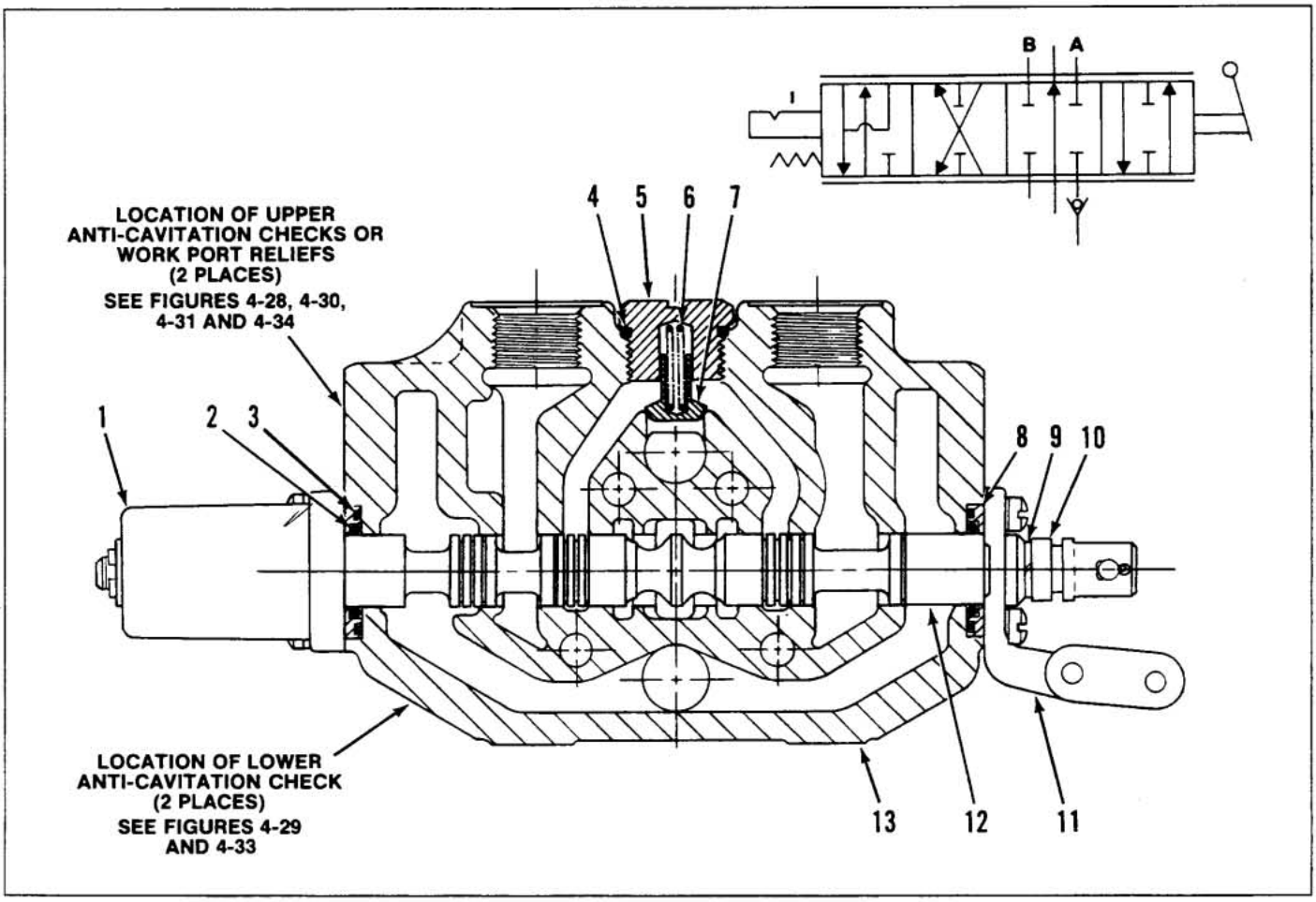


Figure 4-4. 4-Way, 4-Position Float Work Section

4-WAY, 4-POSITION FLOAT WORK SECTION

Item No.	Part No.	Description	Quantity
	K-28029*	SEAL KIT (Contains Items 2, 3, 4 and 8 plus section seals)	
	K-7018*	SERVICE KIT (Contains Items 4 thru 7)	
1	K-28061	POSITIONER, Float (See Figure 4-15)	1
2	20163-001*	SEAL, Quad } Not Sold Separately. Order K-28106*	2
3	20164-001*	SEAL, Square-cut } Not Sold Separately. Order K-28106*	2
4	2709-001*	SEAL, O-Ring	1
5	7790-001	PLUG, Load Check } Not Sold Separately. Order K-7018*	1
6	2796-001	SPRING } Not Sold Separately. Order K-7018*	1
7	7791-001	POPPET } Not Sold Separately. Order K-7018*	1
8	12172-001	PLATE, Seal	2
9	1039-001	WASHER, Lock	1
10	8351-001	ADAPTER, Clevis	1
11		HANDLE, BRACKET or RETAINER (See Figures 4-20 thru 4-24)	1
12	12352-001	SPOOL, Float } See Note	1
13	8046-XXX	HOUSING, 4-Way Float } See Note	1

NOTE: These are matched parts and are not sold separately. See page 3-2 for ordering information.
*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

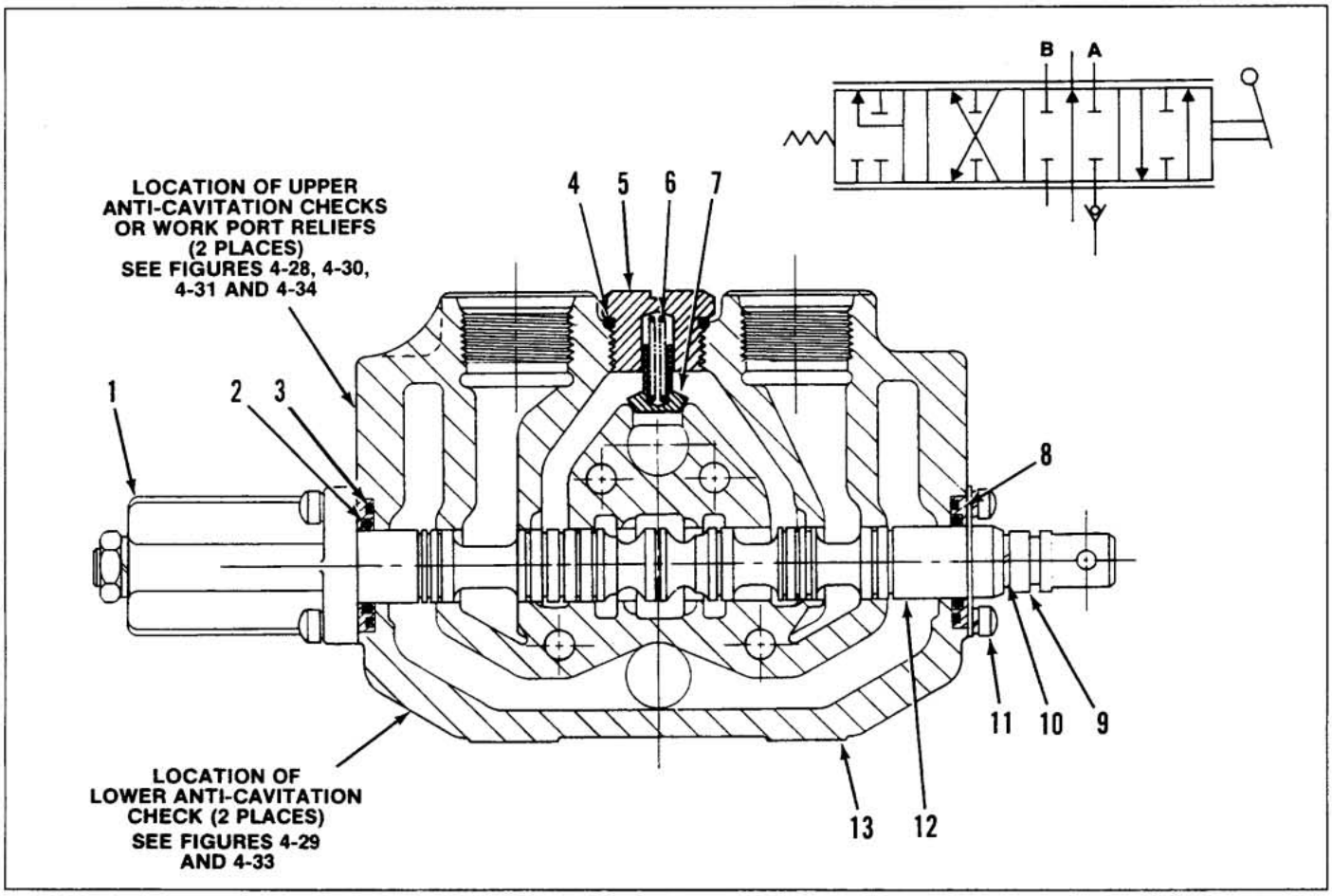


Figure 4-5. 4-Way, 4-Position Regenerative Work Section

4-WAY, 4-POSITION REGENERATIVE WORK SECTION

Item No.	Part No.	Description	Quantity
	K-28029*	SEAL KIT (Contains Items 2, 3, 4 and 8 plus section seals)	
	K-7018*	SERVICE KIT (Contains Items 4 thru 7)	
1	K-28059	POSITIONER, Regenerative (See Figure 4-19)	1
2	20163-001*	SEAL, Quad } Not Sold Separately. Order K-28106*	2
3	20164-001*	SEAL, Square-cut } Not Sold Separately. Order K-28106*	2
4	2709-001*	SEAL, O-Ring	1
5	7790-001	PLUG, Load Check } Not Sold Separately. Order K-7018*	1
6	2796-001	SPRING } Not Sold Separately. Order K-7018*	1
7	7791-001	POPPET } Not Sold Separately. Order K-7018*	1
8	12172-001	PLATE, Seal	2
9	8351-001	ADAPTER, Clevis	1
10	1039-001	WASHER, Lock	1
11		HANDLE, BRACKET or RETAINER (See Figures 4-20 thru 4-24)	1
12	12353-001	SPOOL, Regenerative } See Note	1
13	8138-XXX	HOUSING, 4-Way, Regenerative } See Note	1

NOTE: These are matched parts and are not sold separately. See page 3-2 for ordering information.
*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

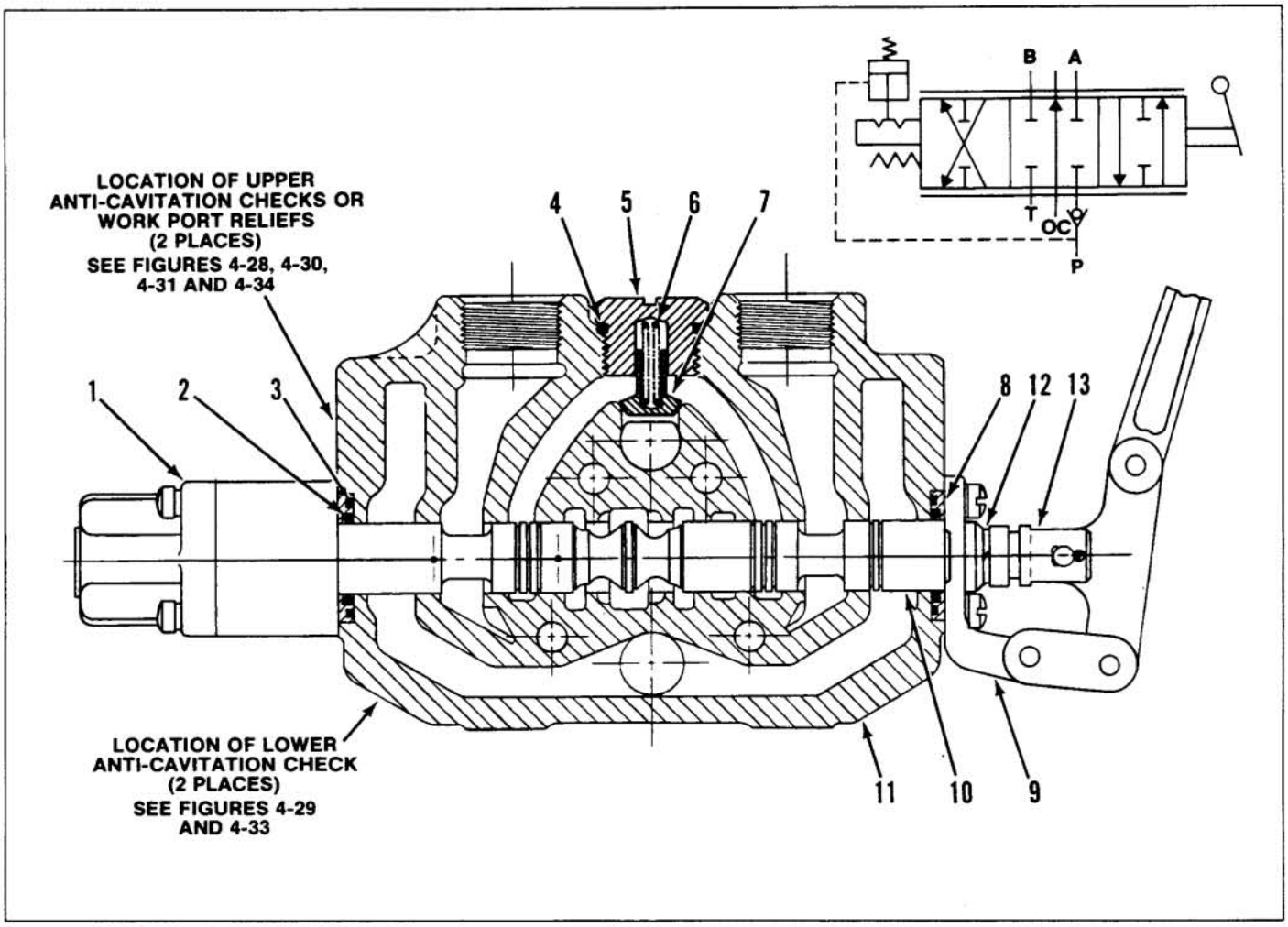


Figure 4-6. 4-Way, 3-Position Work Section With Pressure Detent Release

4-WAY, 3-POSITION WORK SECTION WITH PRESSURE DETENT RELEASE

Item No.	Part No.	Description	Quantity
	K-28029*	SEAL KIT (Contains Items 2, 3, 4 and 8 plus section seals)	
	K-7018*	SERVICE KIT (Contains Items 4 thru 7)	
1		POSITIONER, Pressure Detent Release (See Figure 4-17)	1
2	20163-001*	SEAL, Quad } Not Sold Separately. Order K-28106*	2
3	20164-001*	SEAL, Square-cut }	2
4	2709-001*	SEAL, O-Ring	1
5	7790-001	PLUG, Load Check } Not Sold Separately. Order K-7018*	1
6	2796-001	SPRING	1
7	7791-001	POPPET	1
8	12172-001	PLATE, Seal	2
9		HANDLE, BRACKET or RETAINER (See Figures 4-20 thru 4-24)	1
10	12367-001	SPOOL, Pressure Detent Release } See Note	1
11	8045-XXX	HOUSING, 4-Way	1
12	1039-001	WASHER, Lock	1
13	8351-001	ADAPTER, Clevis	1

NOTE: These are matched parts and are not sold separately. See page 3-2 for ordering information.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

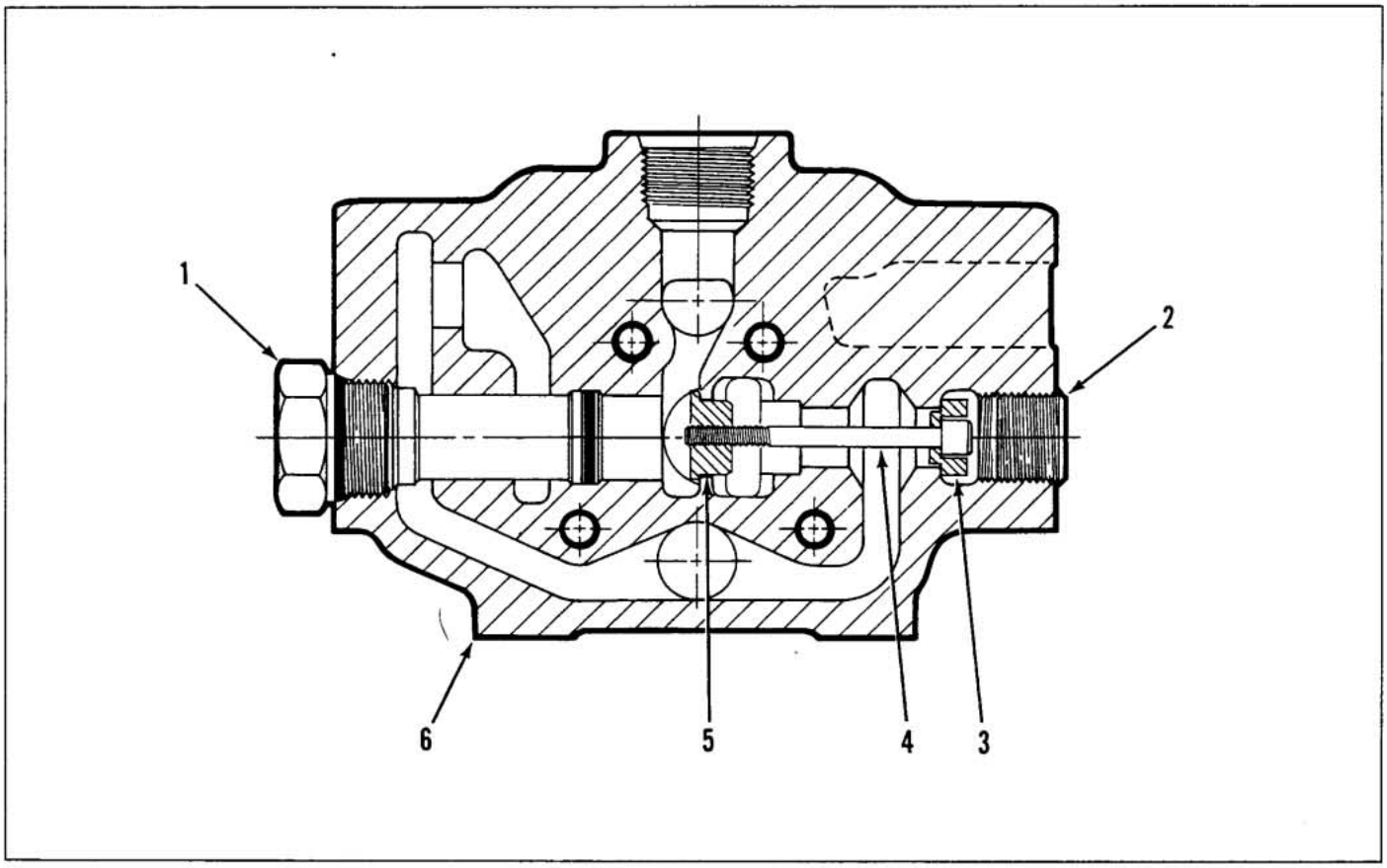


Figure 4-7. Split Flow Mid-Inlet Section

SPLIT FLOW MID-INLET SECTION

Item No.	Part No.	Description	Quantity
1		RELIEF VALVE (See Figures 4-25 thru 4-27)	1
2	0947-001	PLUG	1
3	8011-001	ADAPTER	1
4	3731-111	SCREW	1
5	8012-001	PLUG, Split Flow	1
6	3953-XXX	HOUSING	1

NOTE: Mid-Inlet Sections may be changed from split flow to combined flow in the field by replacing Items 3, 4 and 5. Order: K-7026 Combined Flow Conversion Kit

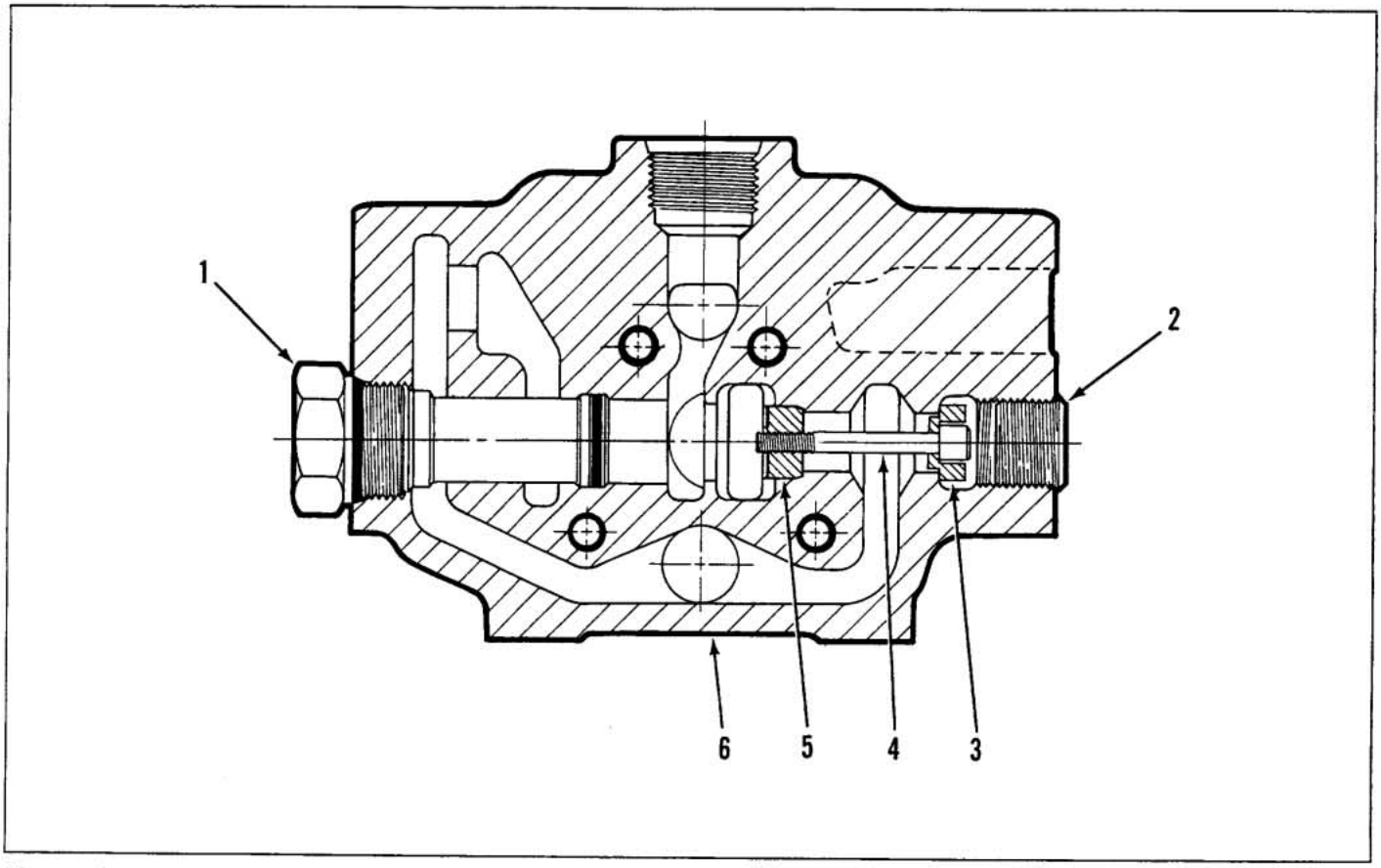


Figure 4-8. Combined Flow Mid-Inlet Section

COMBINED FLOW MID-INLET SECTION

Item No.	Part No.	Description	Quantity
1		RELIEF VALVE (See Figures 4-25 thru 4-27)	1
2	0947-001	PLUG	1
3	8011-001	ADAPTER	1
4	3731-108	SCREW	1
5	8013-001	PLUG, Split Flow	1
6	3953-XXX	HOUSING	1

NOTE: Mid-Inlet Sections may be changed from combined flow to split flow in the field by replacing Items 3, 4 and 5. Order: K-7025 Split Flow Conversion Kit

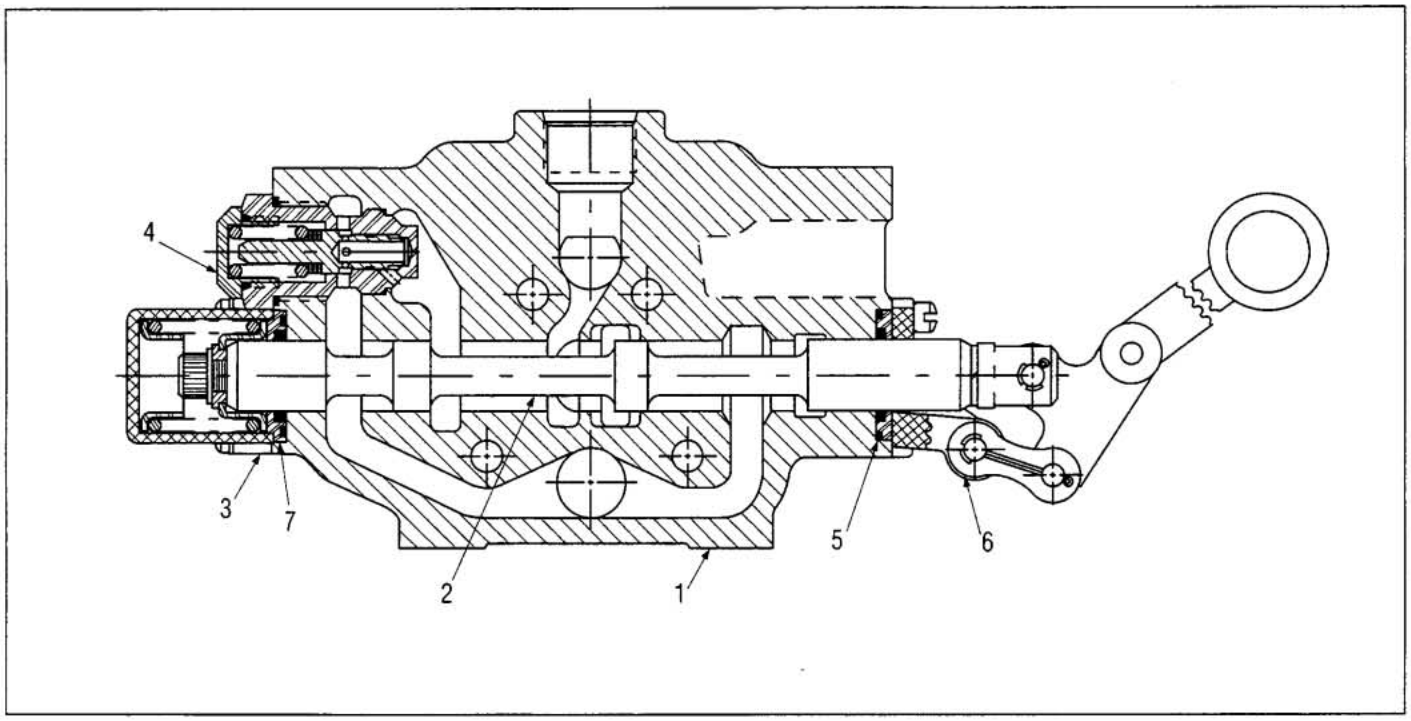


Figure 4-9. 2-Position Mid-Inlet Section

2-POSITION MID-INLET SECTION

Item No.	Part No.	Description	Quantity
1	03953002	Housing, Mid Inlet 40P	1
2	03969001	Spool, Selective Mid Inlet	1
3	06404001	Position, Neutral-In, 40P	1
4	06532015	Relief, WH-SS	1
5	06689001	Seal, Spool	1
6	03521001	Handle, Vertical	1
7	07404001	Seal, Spool	1

NOTE: These are matched parts and are not sold separately.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

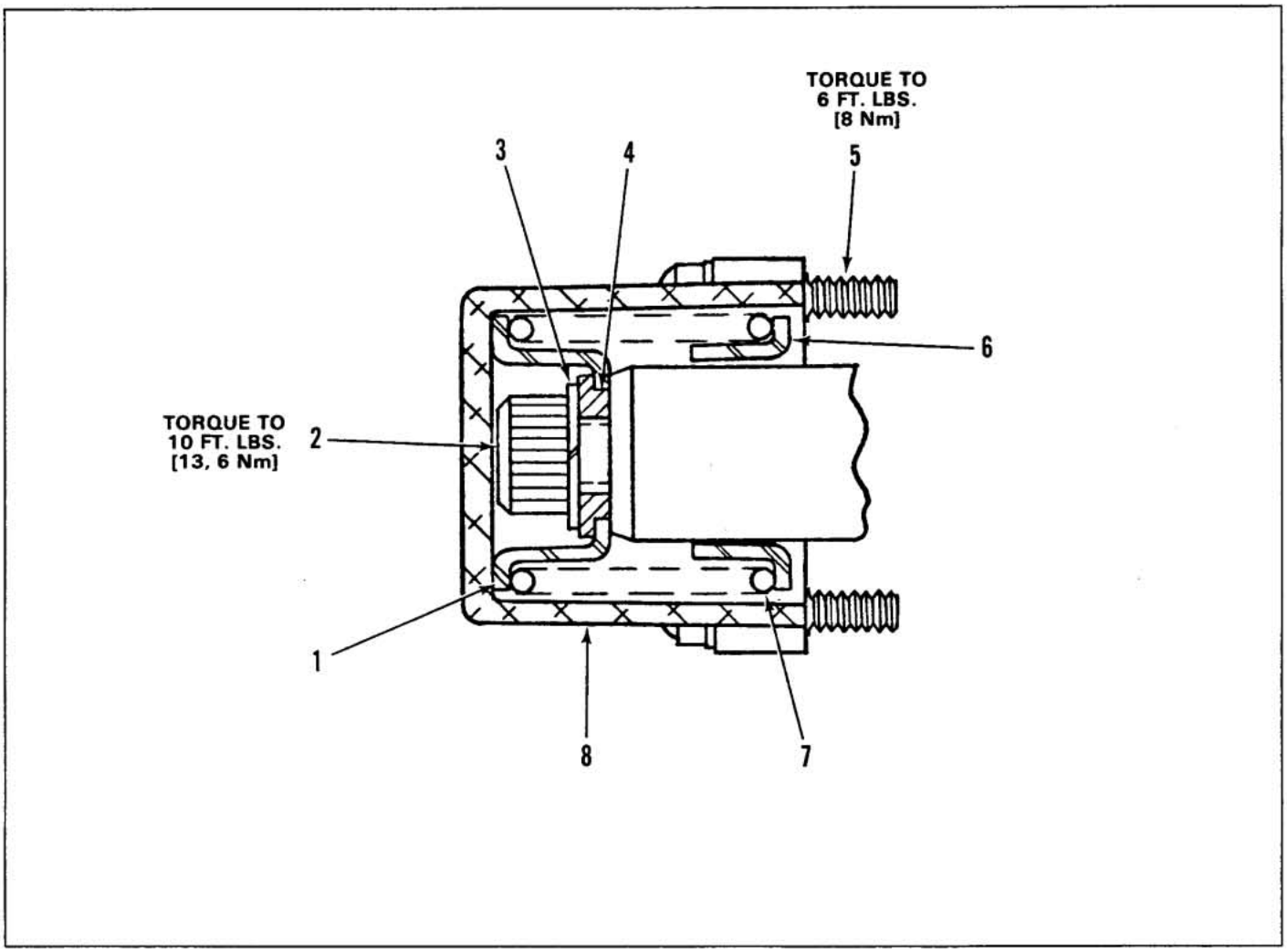


Figure 4-10. Spring Load To Split Flow Positioner

SPRING LOAD TO SPLIT FLOW POSITIONER

Item No.	Part No.	Description	Quantity
1	1609-001	COLLAR, Stop	1
2	3731-196	SCREW, Hex Soc Hd, 3/8–16 by 3/4 inch long	1
3	1039-001	WASHER, Lock	1
4	3967-001	SPACER, Spool	1
5	3731-101	SCREW, Fil. Hd, 1/4–20 by 1 inch long	4
6	3966-001	COLLAR, Stop	1
7	1625-001	SPRING, Centering	1
8	3481-001	BONNET	1

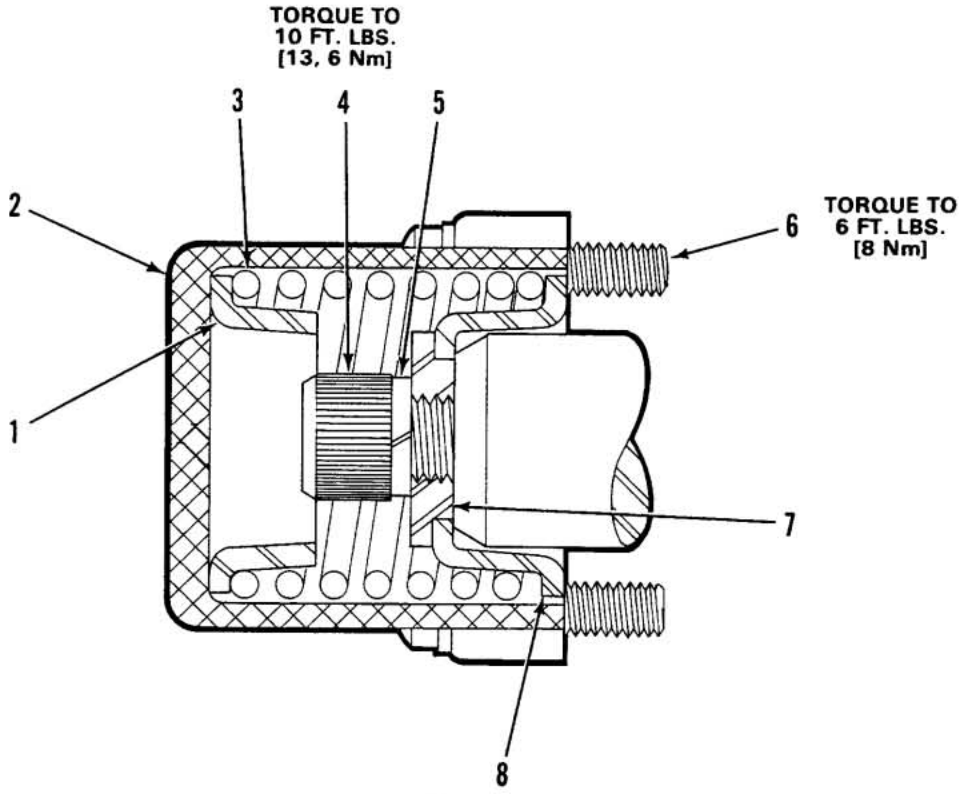


Figure 4-11. Spring Load To Combined Flow Positioner

SPRING LOAD TO COMBINED FLOW POSITIONER

Item No.	Part No.	Description	Quantity
1	3966-001	COLLAR, Stop	1
2	3481-001	BONNET	1
3	1625-001	SPRING	1
4	3731-196	SCREW, Hex Soc Hd, 3/8–16 by 3/4 inch long	1
5	1039-001	WASHER, Lock	1
6	3731-101	SCREW, Fil Hd, 1/4–20 by 1 inch long	4
7	3967-001	SPACER	1
8	1609-001	COLLAR, Spring	1

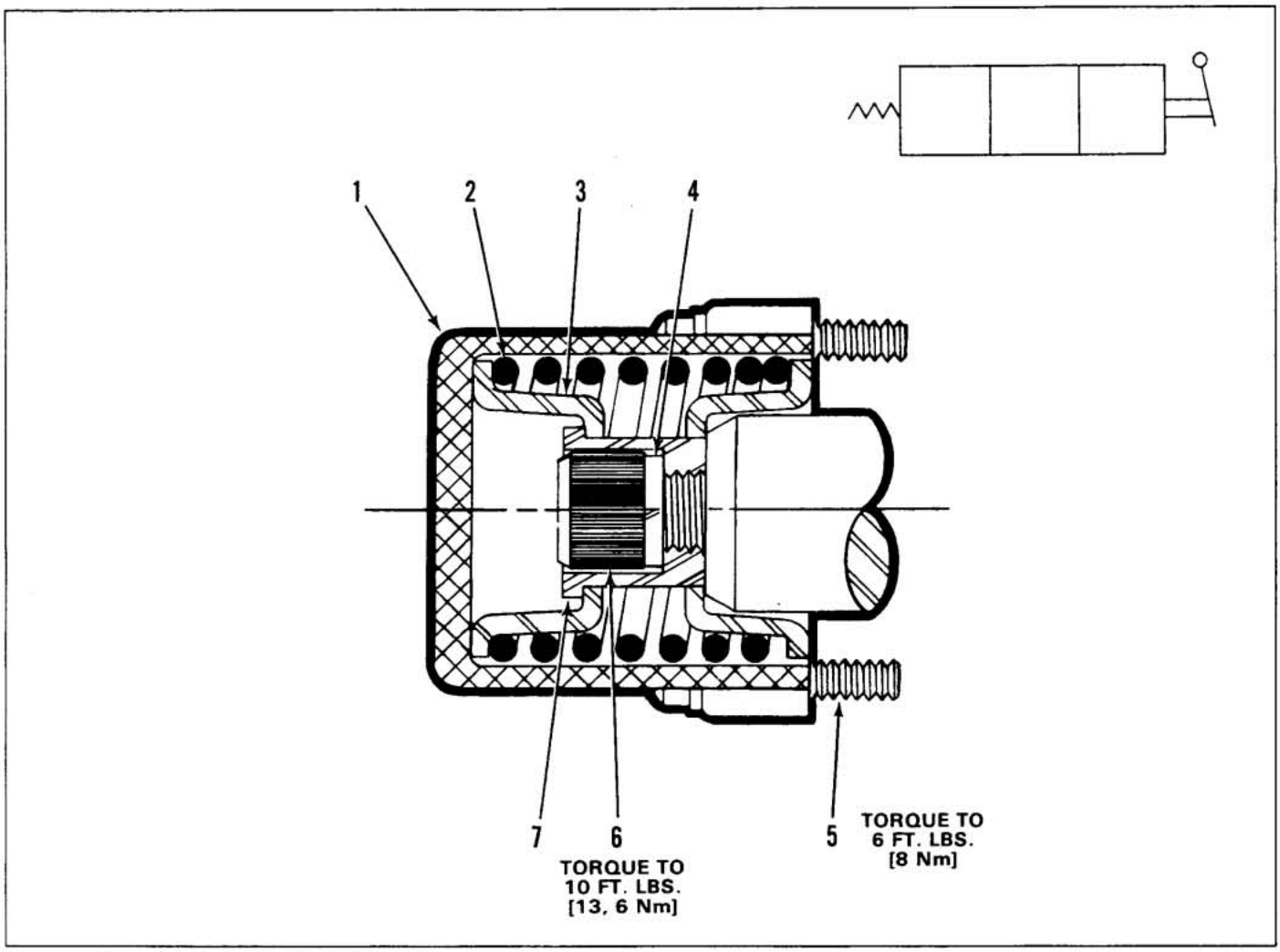


Figure 4-12. Spring Return to Neutral Positioner

SPRING RETURN TO NEUTRAL POSITIONER

Item No.	Part No.	Description	Quantity
	K-28060	REPLACEMENT KIT (Contains all Items listed below)	
1	3481-001	BONNET	1
2	1608-001	SPRING	1
3	1609-001	COLLAR, Stop	2
4	1291-001	WASHER, Lock	1
5	3731-101	SCREW, Fil Hd, 1/4–20 by 1 inch long	4
6	3731-196	SCREW, Hex Soc Hd, 3/8–16 by 3/4 inch long	1
7	3533-001	COLLAR, Spool	1

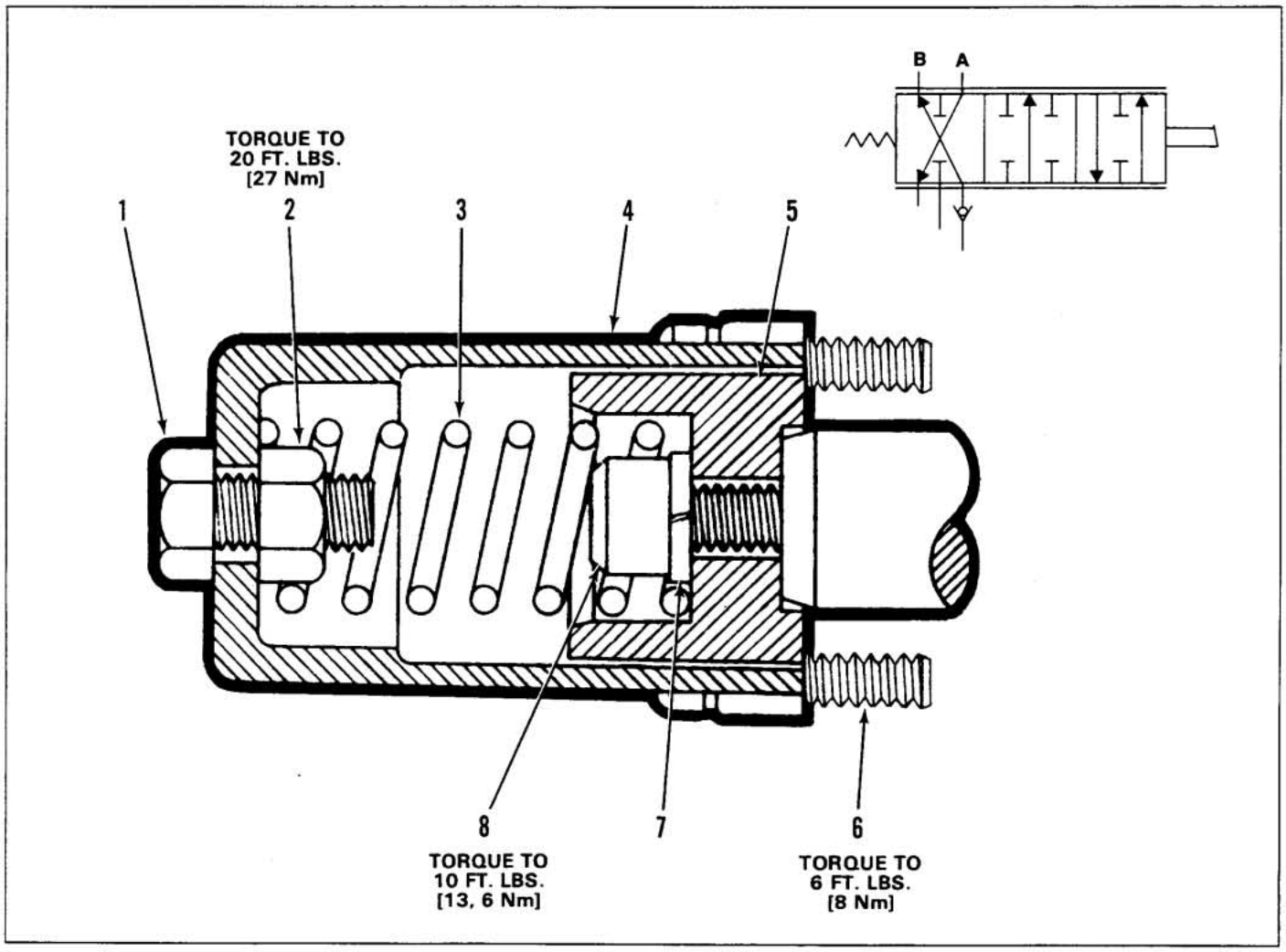


Figure 4-13. Spring Extended Spool Positioner

SPRING EXTENDED SPOOL POSITIONER

Item No.	Part No.	Description	Quantity
1	3732-108	SCREW	1
2	9310-106	NUT, Hex	1
3	1761-001	SPRING	1
4	3482-001	BONNET	1
5	3588-001	COLLAR, Stop	1
6	3731-101	SCREW, Fil Hd, 1/4–20 by 1 inch long	4
7	1291-001	WASHER, Lock	1
8	3731-198	SCREW	1

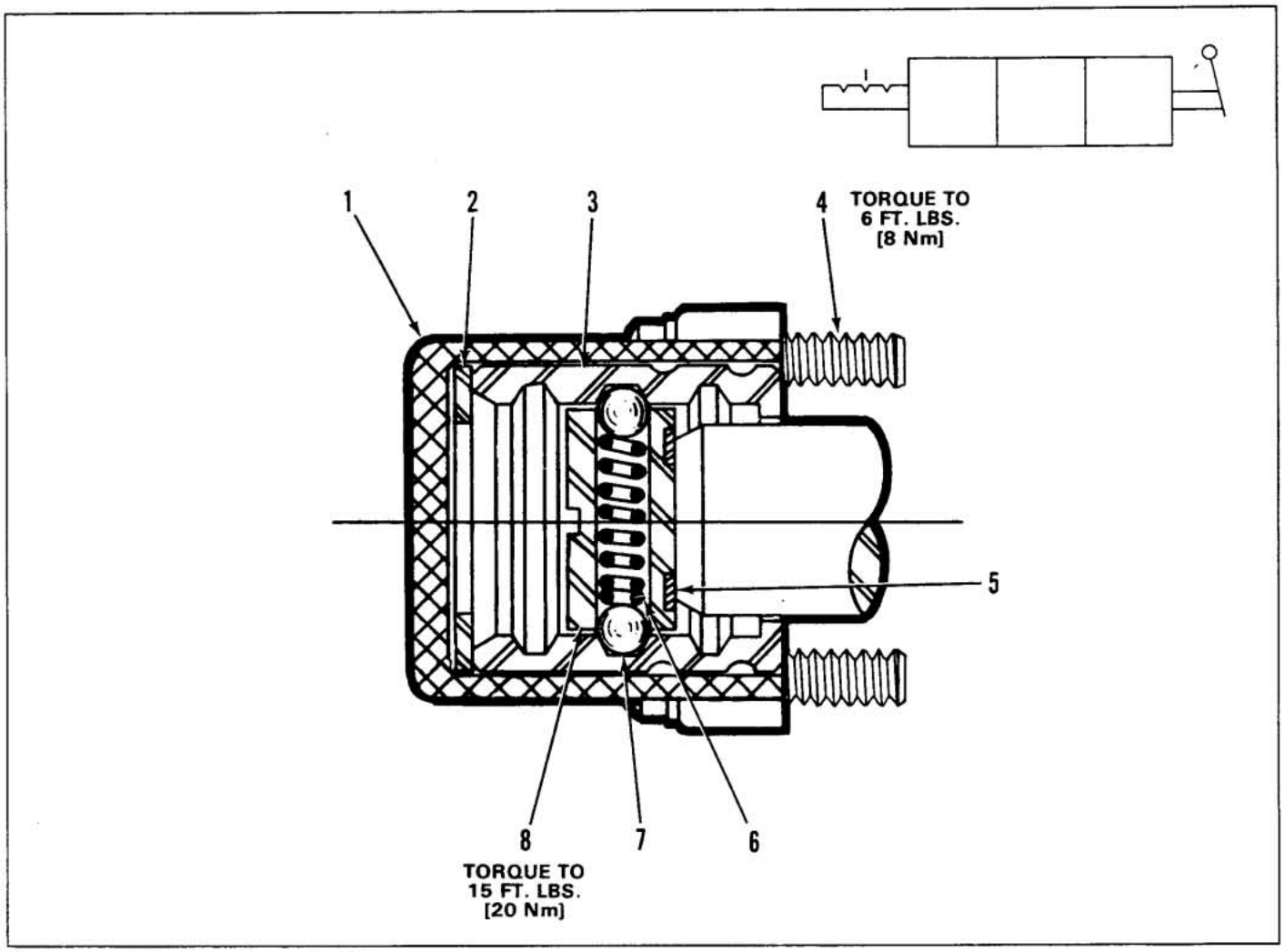


Figure 4-14. 3-Position Detent Positioner

3-POSITION DETENT POSITIONER

Item No.	Part No.	Description	Quantity
	K-28025	REPLACEMENT KIT (Contains all Items listed below)	
1	3481-001	BONNET	1
2	3593-001	WASHER, Detent Stop	1
3	3583-001	SLEEVE, Detent	1
4	3731-101	SCREW, Fil Hd, 1/4–20 by 1 inch long	4
5	1039-001	WASHER, Lock	1
6	1634-001	SPRING, Detent	1
7	0514-001	BALL	2
8	1627-001	HOLDER, Detent	1

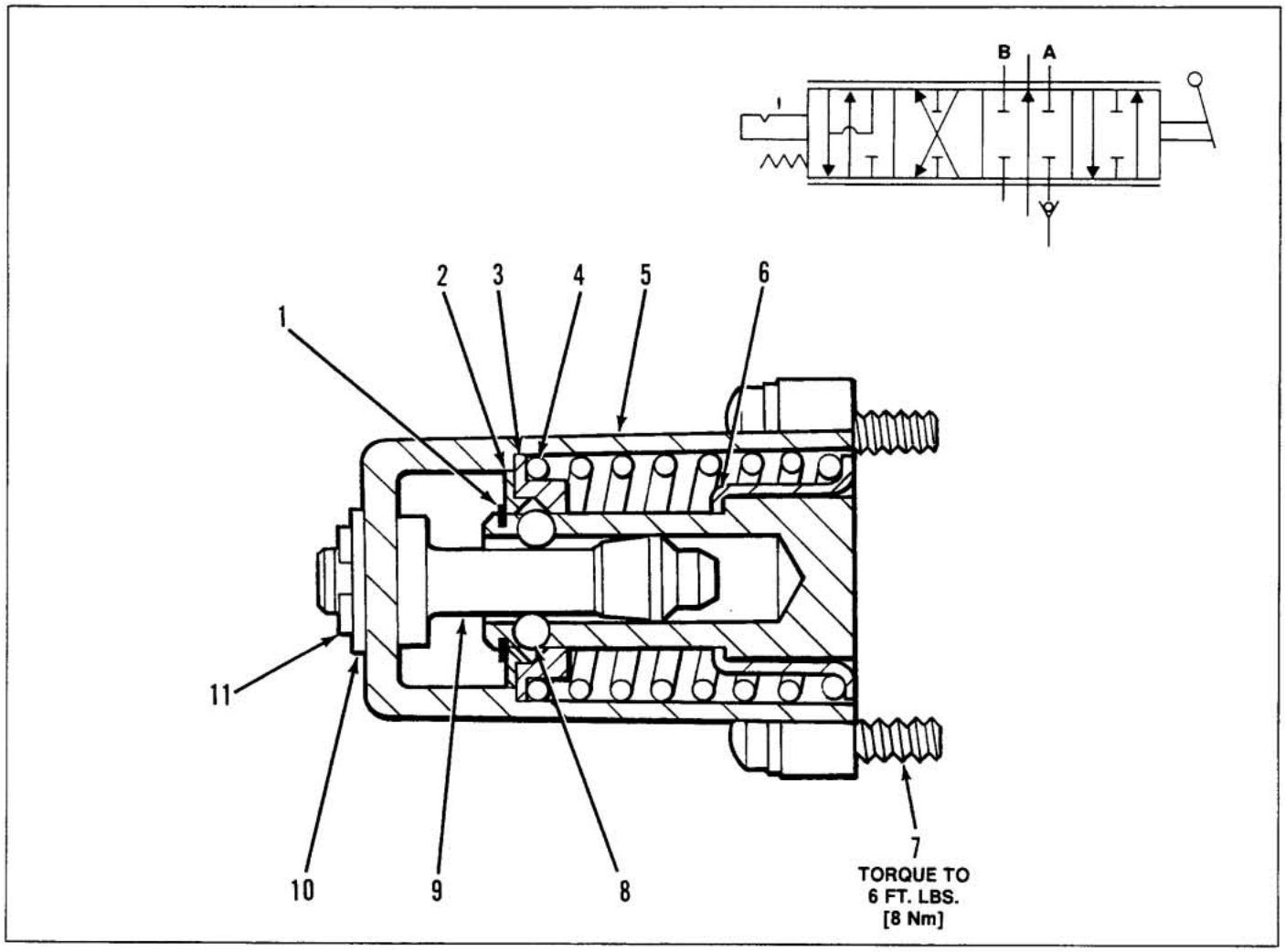


Figure 4-15. Float Positioner

FLOAT POSITIONER

Item No.	Part No.	Description	Quantity
	K-28061	REPLACEMENT KIT (Contains all Items listed below)	
1	1741-001	RING, Retaining	1
2	1738-001	RETAINER, Detent Ball	1
3	1737-001	COLLAR, Spring	1
4	7711-001	SPRING	1
5	3482-001	BONNET	1
6	3535-001	COLLAR, Spring	1
7	3731-101	SCREW, Fil Hd, 1/4–20 by 1 inch long	4
8	1700-001	BALL	4
9	12175-001	ADAPTER, Float Detent	1
10	509-001	WASHER	1
11	7442-001	RING, Retaining	

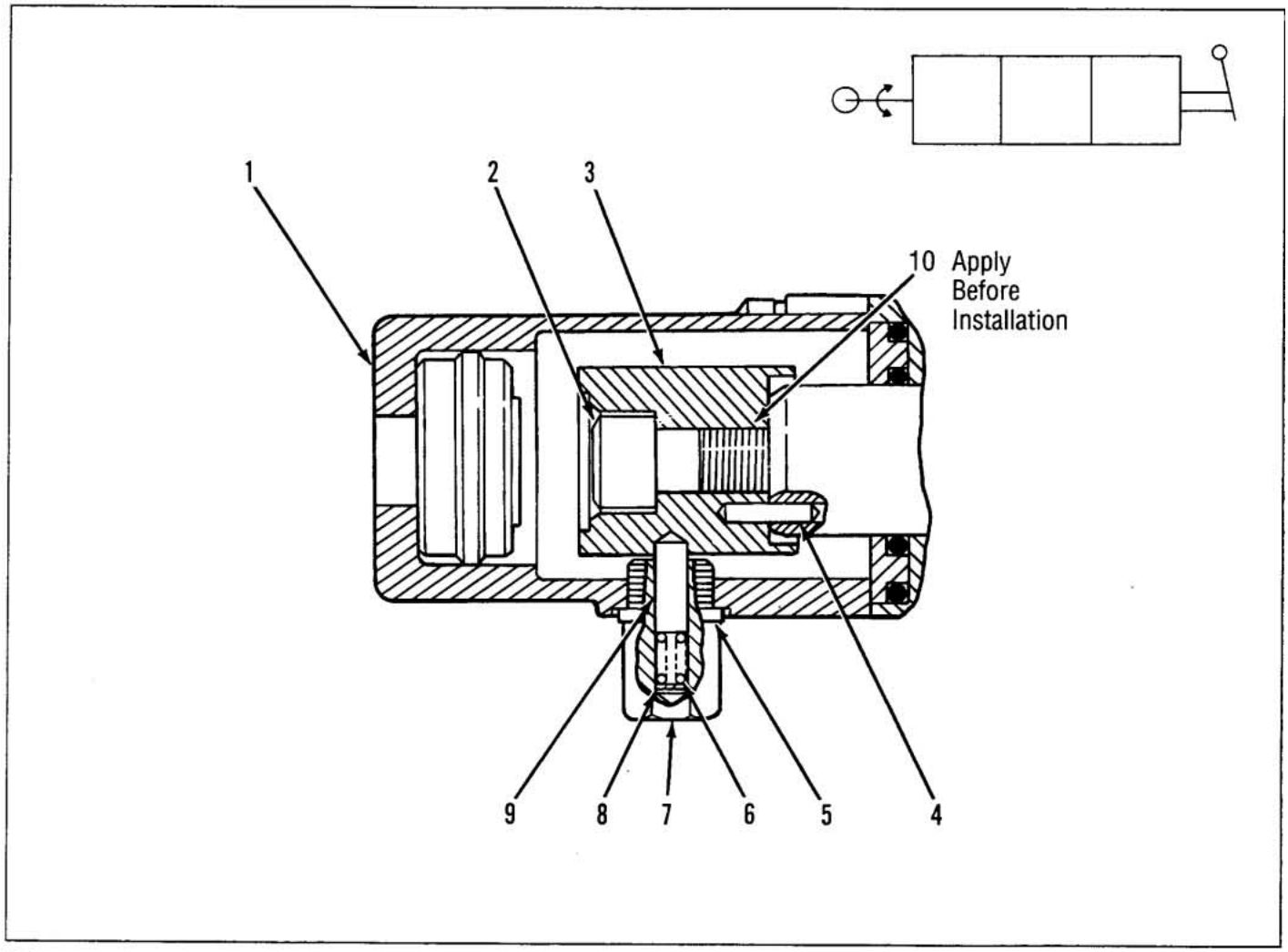


Figure 4-16. Option "W" Rotary Spool Positioner

OPTION "W" ROTARY SPOOL POSITIONER

Item No.	Part No.	Description	Quantity
	CK-28103	REPLACEMENT KIT (Contains all Items listed below)	
1	11624-002	BONNET	1
2	3731-199	SCREW, HSHC	1
3	11580-001	BODY, Rotary Cam	1
4	0888-001	PIN, lock	1
5	8743-001	WASHER	1
6	8808-001	SPRING	1
7	8744-001	CAP, Rotary Detent	1
8	8653-001	SHIM (.020 inch [0,5mm] thick)	1
	8653-002	SHIM (.040 inch [1,0mm] thick)	1
9	2676-001	PIN, Detent	1
10	8006-001	ANAEROBIC ADHESIVE	1

NOTE: Valve Assemblies manufactured prior to June, 1985, will not readily accept new Rotary Positioner (shown above) without replacing or modifying valve spool. For more information, contact the factory.

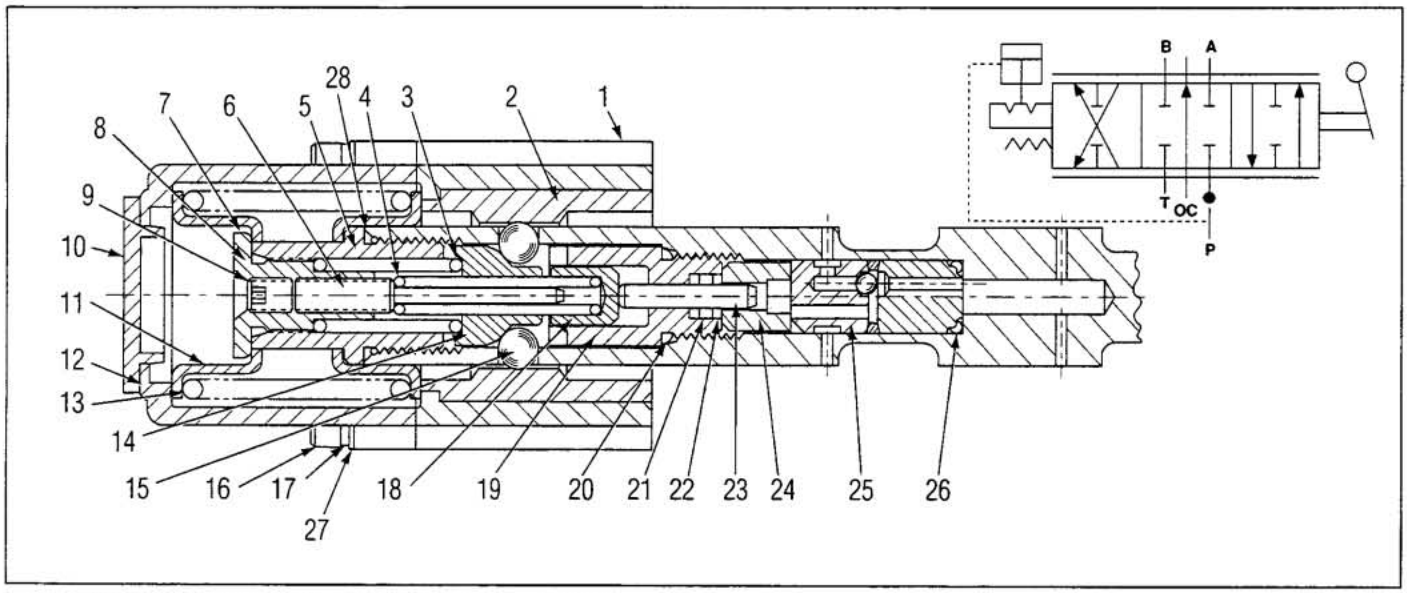


Figure 4-17. Internal Pressure Detent Release Positioner

INTERNAL PRESSURE DETENT RELEASE POSITIONER

Item No.	Part No.	Description		Quantity
	K-28088*	SEAL KIT (Contains Items 17 thru 20)		
	K-28107	RETROFIT KIT (Contains Items 1 thru 11)		
1	1-21378-001	BUTTON PLUG		1
2	9275-404	SCREW, Hex Set		1
3	0449-001*	SEAL, O-Ring		1
4	20849-001	COLLAR, Adjustment	Retro Fit Kit.	1
5	20848-001	ADAPTER, Spool		1
6	20829-001	GUIDE, Spring	Order K-28107.	1
7	6839-001*	SEAL, O-Ring		1
8	8538-001	SPRING	See Note.	1
9	12674-001	SPRING		1
10	20883-001	RAMP, Detent		1
11	0023-001	BALL, Steel		4
12	7540-001	SLEEVE, Detent		1
13	7539-001	SLEEVE, Detent		1
14	7944-001	ROLLER, Needle		1
15	7945-001	RETAINER, Seal		1
16	7946-001	CHECK, Knockout		1
17	6884-001*	SEAL, O-Ring	Not Sold Separately. Order K-28088	2
18	7907-001	RING, Backup		1
19	3328-001*	SEAL, O-Ring		1
20	2705-001*	SEAL, O-Ring		1
21	7943-001	PLUG, Seal Retainer		1
22	7942-001	PLUNGER		1
23	7904-001	PLATE, Bearing		4
24	0563-001	WASHER, Lock		4
25	3731-001	SCREW, HSHC, 1/4–20 x 2.5 long		4
26	1609-001	COLLAR, Spring		2
27	1625-001	SPRING		1
28	3481-002	BONNET		1

*Buna-N seals are standard for Gresen valve assemblies. For Viton seals, contact the factory.

NOTE: Retro Fit Kit required to convert all positioners manufactured prior to 10/1/88 to current design.

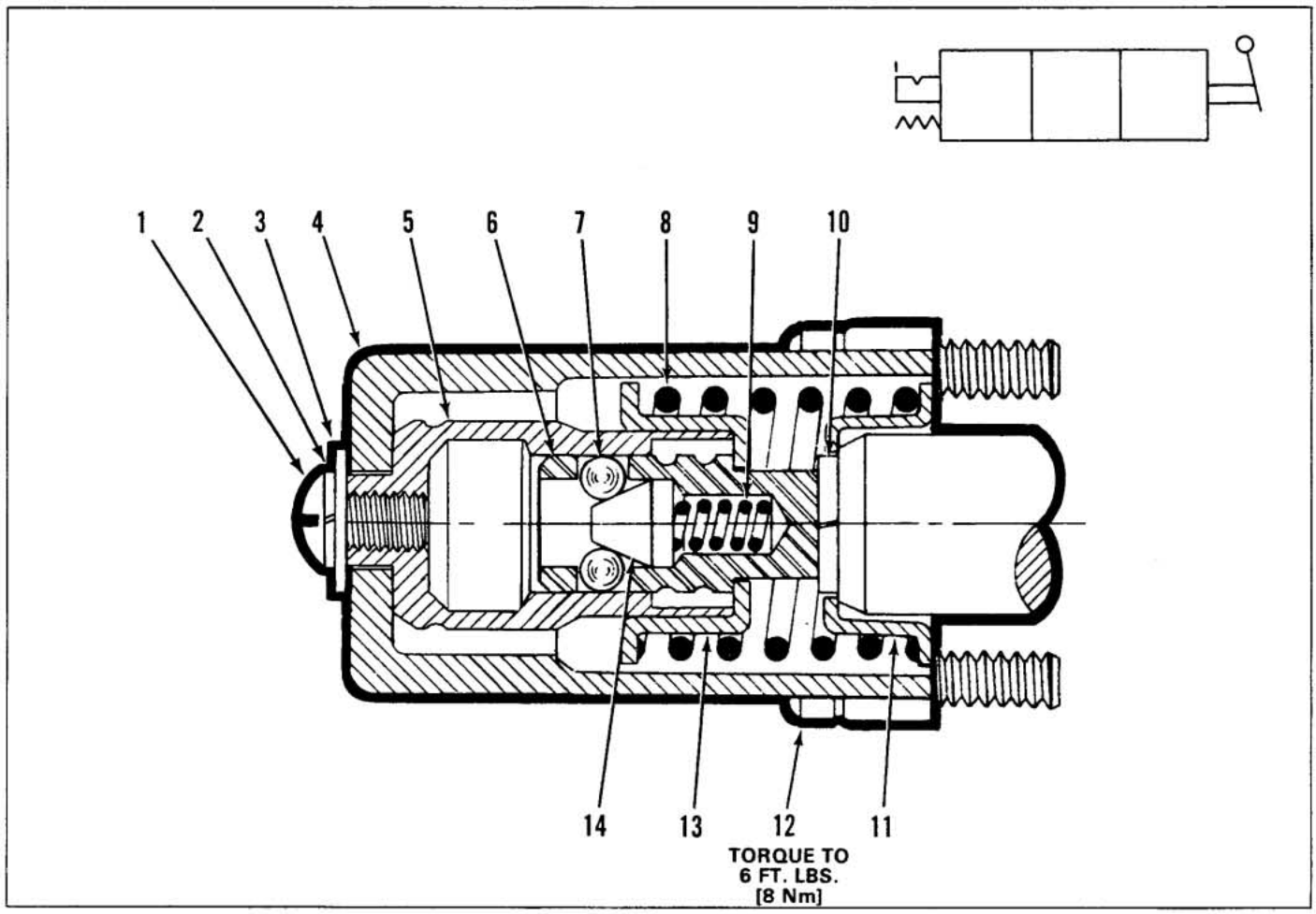


Figure 4-18. Option "R" Detent with Spring Return To Neutral Positioner

OPTION "R" DETENT WITH SPRING RETURN TO NEUTRAL POSITIONER

Item No.	Part No.	Description	Quantity
	K-28027	REPLACEMENT KIT, Spool "IN" (Contains all Items listed below)	
	K-28091	REPLACEMENT KIT, Spool "OUT" (Contains all Items listed below)	
	K-28092	REPLACEMENT KIT, Spool,"IN and OUT" (Contains all Items listed below)	
1	0510-001	SCREW, Machine, Rd Hd, 1/4–20 by 1/2 inch long	1
2	0564-001	WASHER, Lock	1
3	3163-001	WASHER, Flat	1
4	3482-001	BONNET	1
5	7760-001	SLEEVE, Detent, Spool "IN" (Shown)	1
	7762-001	SLEEVE, Detent, Spool "OUT" (Not Shown)	1
	7761-001	SLEEVE, Detent, Spool "IN and OUT" (Not Shown)	1
6	3585-001	HOLDER, Detent	1
7	1700-001	BALL	4
8	6013-001	SPRING, Centering	1
9	1634-001	SPRING, Detent	1
10	1039-001	WASHER, Lock	1
11	1609-001	COLLAR, Stop	1
12	3731-101	SCREW, Fil Hd, 1/4–20 by 1 inch long	4
13	1774-001	COLLAR, Detent	1
14	1773-001	FOLLOWER, Detent	1

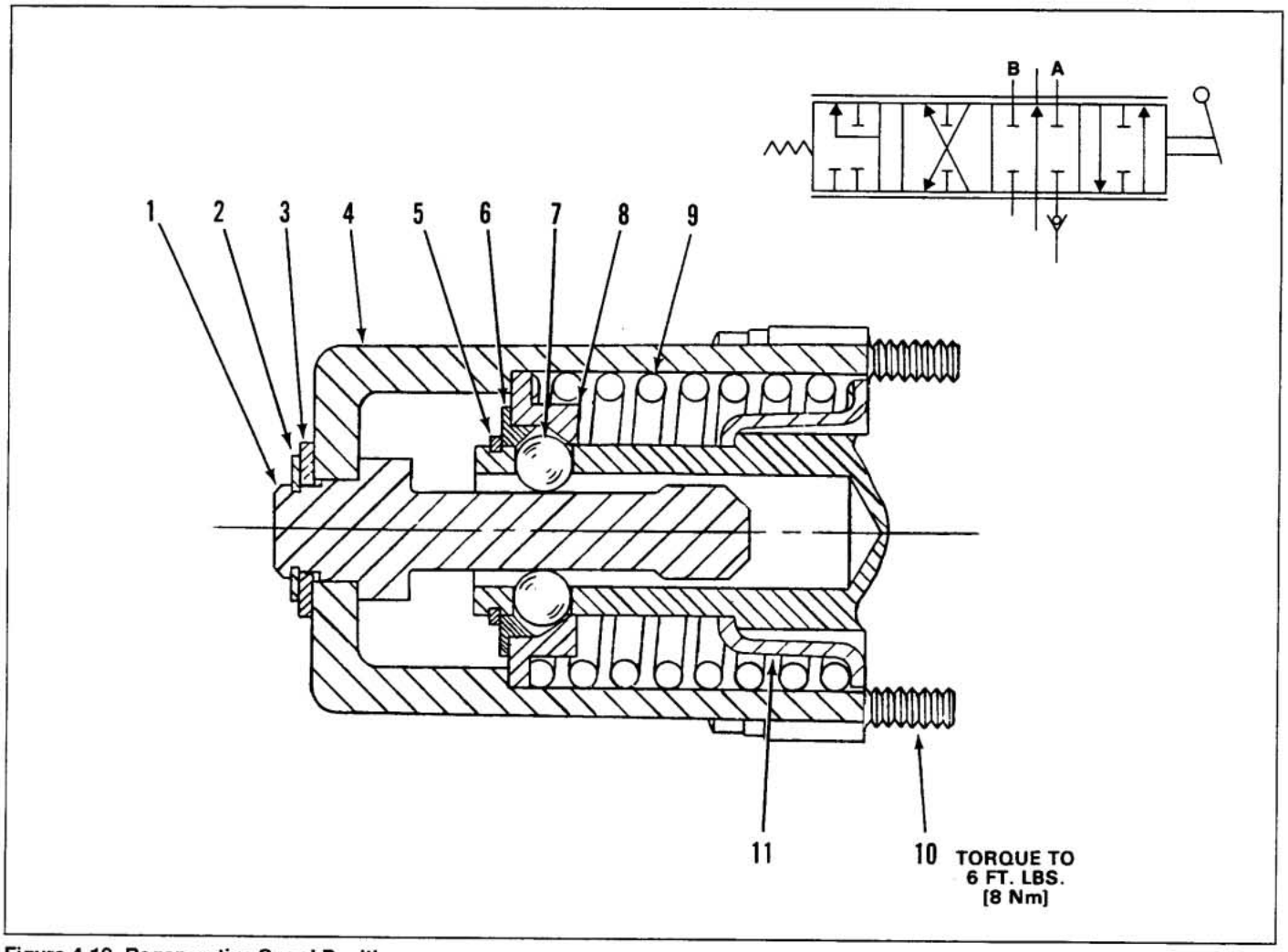


Figure 4-19. Regenerative Spool Positioner

REGENERATIVE SPOOL POSITIONER

Item No.	Part No.	Description	Quantity
	K-28059	REPLACEMENT KIT (Contains all Items listed below)	
1	8554-001	POSITIONER	1
2	7442-001	RING, Retaining	1
3	0509-001	WASHER, Plain	1
4	3482-001	BONNET	1
5	1741-001	RING, Retaining	1
6	1738-001	ADAPTER	1
7	1700-001	BALL	4
8	3534-001	COLLAR, Detent	1
9	7170-001	SPRING	1
10	3731-101	SCREW, Fil Hd, 1/4–20 by 1 inch long	4
11	3535-001	COLLAR, Stop	1

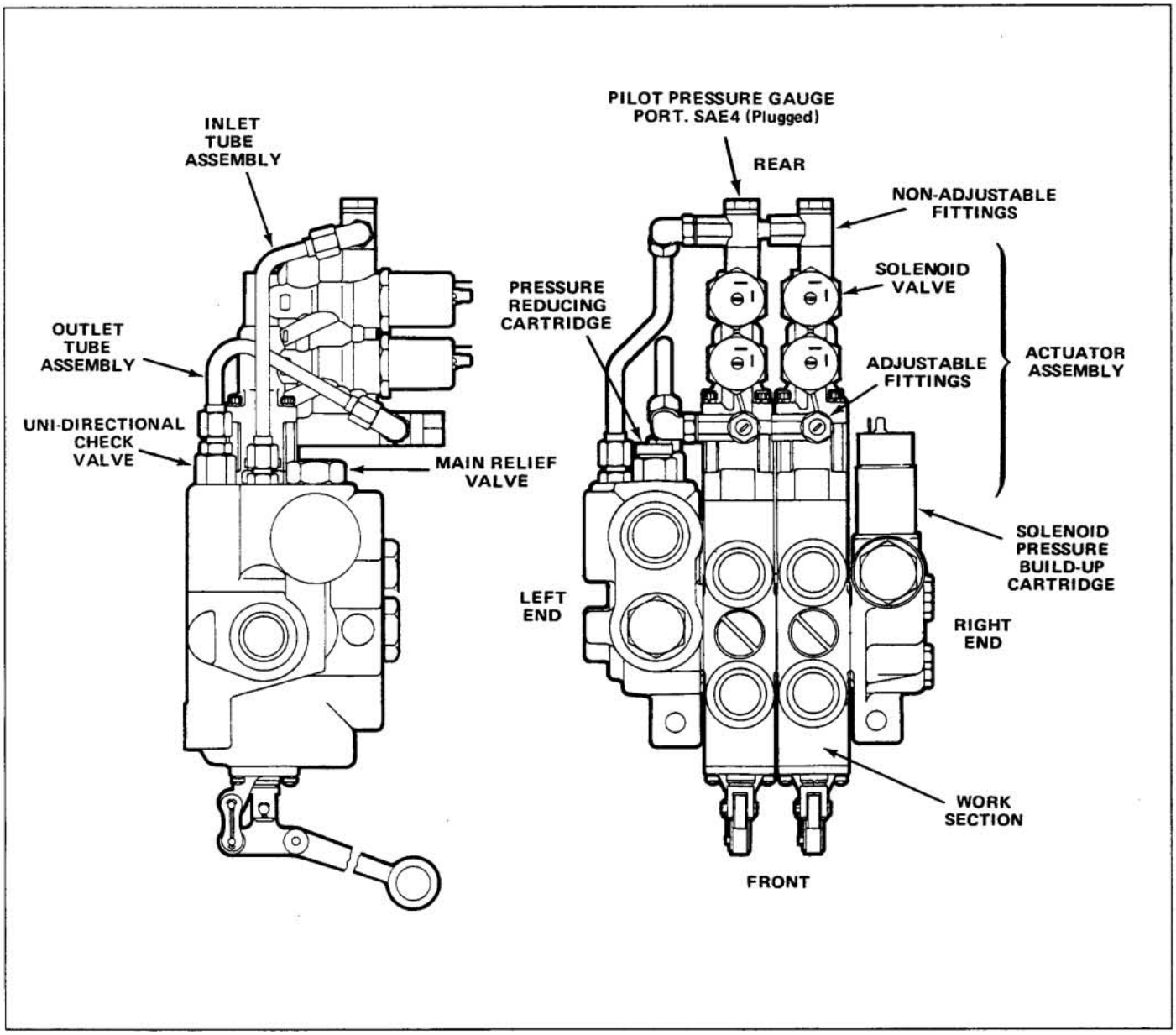


Figure 4-20. Schematic View of Typical Model V42 Directional Control Valve Assembly With Solenoid Control.

DESCRIPTION OF V42 SOLENOID CONTROLLED DIRECTIONAL CONTROL VALVE

Gresen's on-off, solenoid-controlled, pilot-operated actuators are designed to provide remote operation of the Model V42 Directional Control Valves having 3-position spools. The solenoid-controlled actuator assembly contains two, 3-way, normally closed, solenoid-operated valves and a pilot-operated piston mounted directly to the control valve spool. Solenoids are available for either 12 VDC or for 24 VDC. When a solenoid is energized, the solenoid valve opens, pilot pressure (300 PSI) [21 bar] is applied to one side of the piston causing the spool to shift from its neutral position. When both solenoids are de-energized, both sides of the piston are open to exhaust and the spool is spring-returned to neutral.

A needle valve, externally adjustable, adjusts the exhaust pilot flow to control the spool's rate of travel.

A pilot source of 2 to 4 GPM at 300 PSI [8 to 15 litres/min at 21 bar] is required to operate each actuator. Gresen has provided for a self-contained pilot source to eliminate the need for external pilot lines as follows:

A Solenoid-Operated Pressure Build-Up Valve (Kit No. CK-6177 for 12 VDC or Kit No. CK-6178 for 24 VDC) is installed in a special outlet cover and must be wired in parallel with each solenoid-controlled actuator. Because of the low open center pressure drop through the Directional Control Valve, the pressure build-up valve is necessary to increase the oil pressure required to shift the valve spools.

For closed center applications, the pressure build-up valve is not required. However, the system must have a stand-by pressure of 300 PSI [21 bar] above back pressure.

A Pressure Reducing Valve (Kit No. CK-28096) is installed in a special inlet cover and reduces oil pressure to the solenoid actuator to 300 PSI at 2 to 4 GPM [21 bar at 8 to 15 litres/min].

Uni-Directional Check Valve (Part No. K-6062) must be installed in the solenoid-controlled actuator return or exhaust port to prevent system shock peaks from affecting the actuator.

CUSTOMER-SUPPLIED EXTERNAL PILOT SOURCE

Gresen's self-contained pilot source option is not required if the hydraulic system has a 2 to 4 GPM, 300 PSI [8-15 litres/min, 21 bar] pilot source available. Pilot tubing must be a minimum of 3/8-inch tubing with SAE No. 6 (9/16-18) fittings. The pilot exhaust line should be plumbed directly back to the reservoir. If teed into the control valve return line, a one-way check valve must be installed in the pilot line to prevent shock peaks from affecting the actuators.

OPTIONAL ACCESSORIES

A power beyond, right end cover can be used with Model V42 Solenoid Valves if the pressure build-up valve is installed in the outlet cover of the downstream valve.

Optional Spacer Tube Assembly is available to allow installation of a manually operated section or a mid-inlet section between two solenoid-controlled sections. See Figure 4-21.

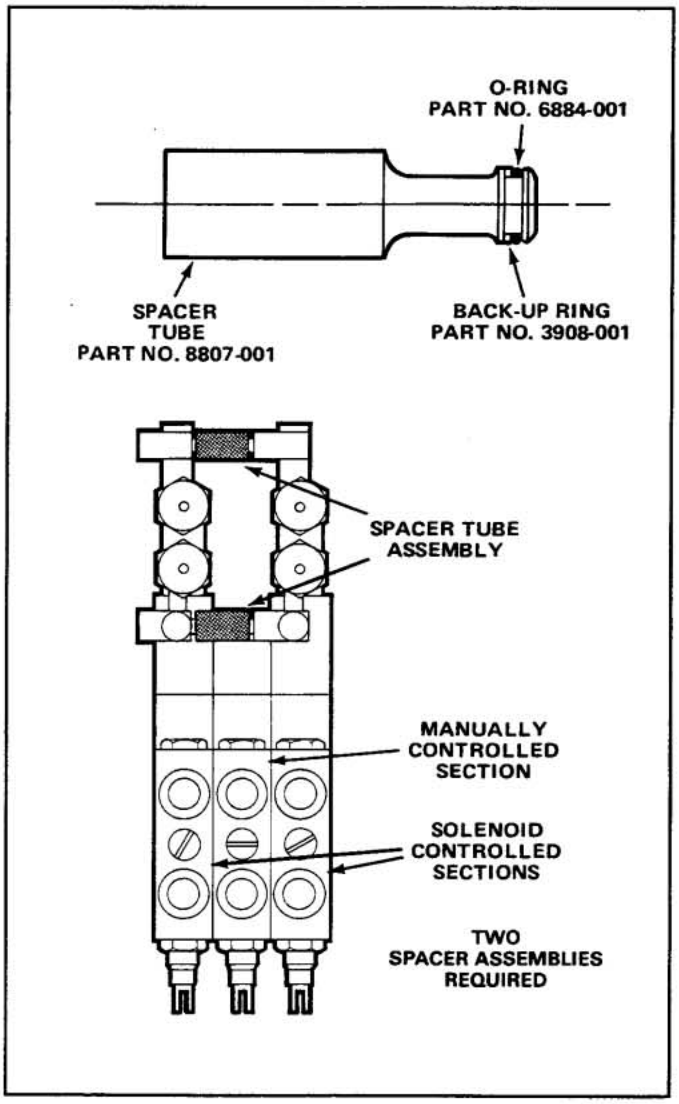


Figure 4-21. Optional Spacer Tube Assembly.

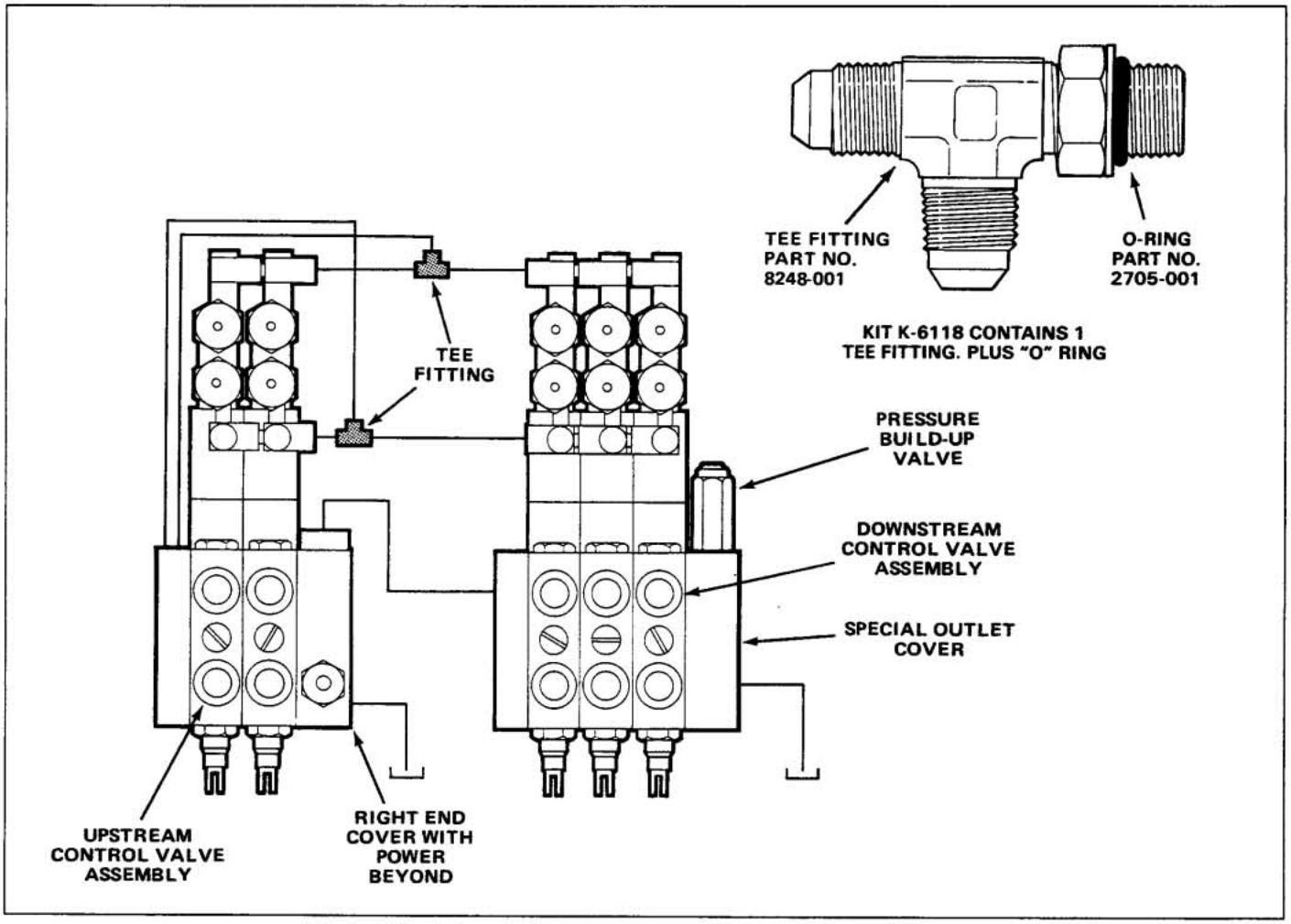


Figure 4-22. Optional Tee Fitting.

Optional Tee Fitting (Part No. K-6118) is available to connect an upstream control valve assembly and a downstream control valve assembly to one special inlet cover. A power beyond, right end cover must be used in the upstream valve assembly and a pressure build-up valve must be used in the outlet cover of the downstream valve assembly. See Figure 2-2.

REMOVAL OF ACTUATOR FROM WORK SECTION

In order to remove an actuator assembly from a valve work section, all pressure connections, return line connections, and electrical connections must be disconnected.

Refer to Figure 3-1 and proceed as follows:

1. Remove four housing screws. The actuator housing can now be removed from the work section. This will expose the centering spring assembly, large spacer, piston rod guide, and piston assembly.

2. Slide piston rod guide and large spacer away from spring centering assembly. This will expose spool screw.

3. Remove piston rod from head of spool screw.

4. Using either a screwdriver or a rod inserted through clevis end of spool to prevent spool from turning, remove spool screw and centering spring assembly. Clean internal threads in valve spool and external threads on spool screw to remove all residue of Loctite.

To replace actuator assembly:

5. Assemble spring centering assembly and install spool screw. Apply a small amount of Loctite, grade 222, to screw threads before installing. Torque to 3-7 foot pounds [4-9 Nm].

6. Replace piston rod guide and large spacer on piston rod.

7. Insert piston rod into spool screw.

8. Replace actuator housing.

NOTE

Make sure that all seals are lubricated before slipping housing over piston and rod guide.

9. Secure actuator housing to work section with four housing screws. Torque to 8-10 foot pounds [11-14 Nm].

10. Re-connect all pressure and return line connections to actuator assembly.

11. Re-connect all electrical connections.

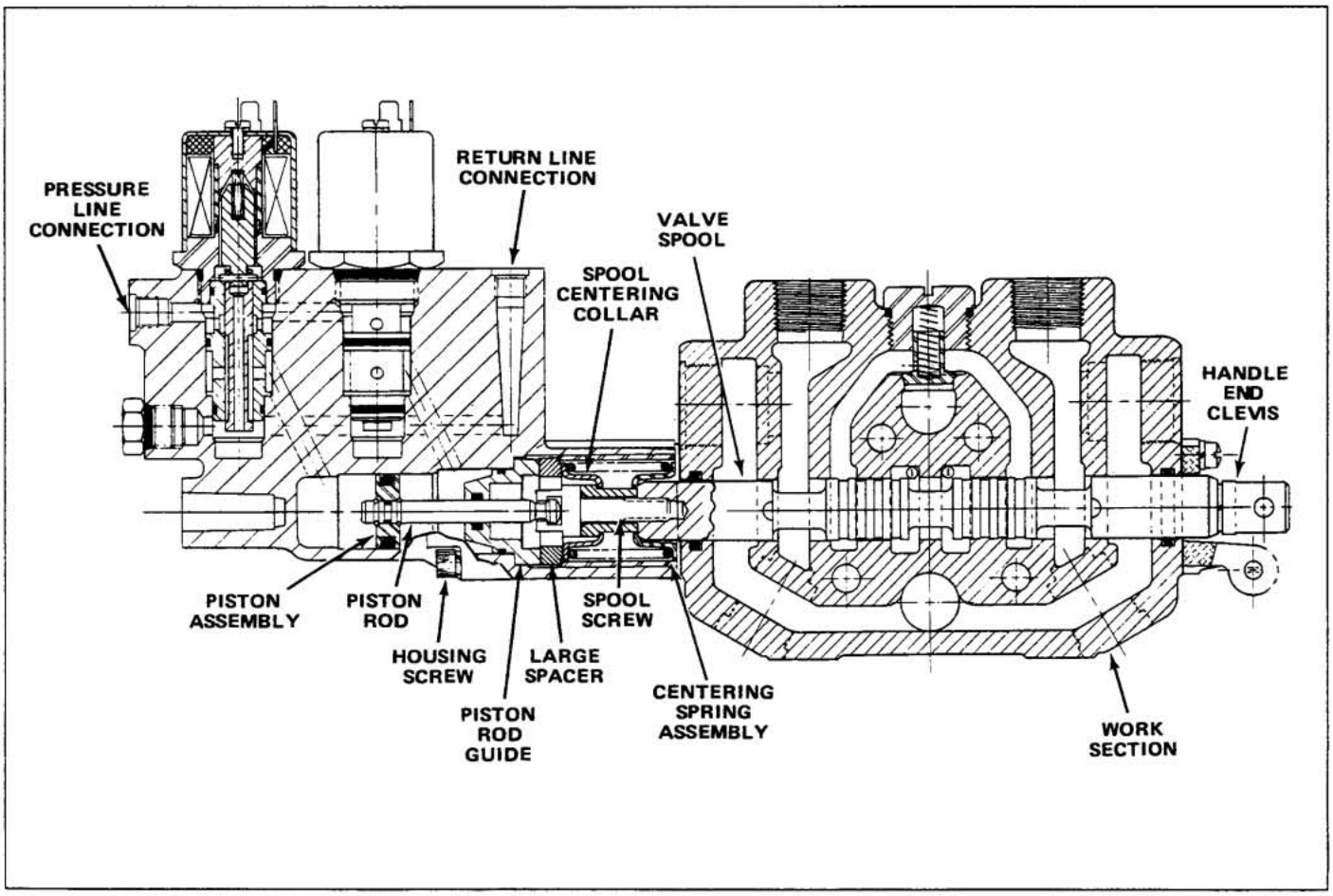


Figure 4-23. Actuator Assembly and 4-Way, 3-Position Work Section.

SEAL REPLACEMENT

The following instructions cover seal replacement in the actuator assembly only.

Seal Replacement in Actuator Assembly

Refer to Figure 3-2 and proceed as follows:

1. Complete steps 1 thru 3 described in "Removal of Actuator Assembly From Work Section."

2. Remove Piston. All seals are now exposed and can be changed. Refer to Parts Listing, Figure 4-4, for ordering information. Use a good grade of hydraulic oil to lubricate seals when re-assembling.

To re-assemble actuator assembly:

3. Complete steps 6 thru 11 described in "Removal of Actuator Assembly From Work Section."

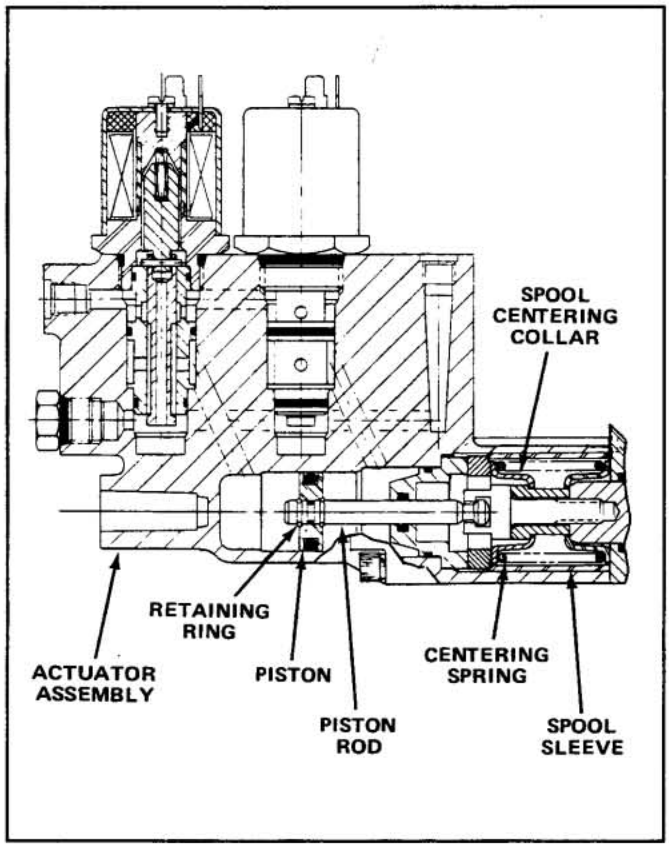


Figure 4-24 Seal Replacement.

PARTS LISTING

The following parts ordering information covers only those parts and components directly related to the actuator assembly portion of the entire directional control valve assembly.

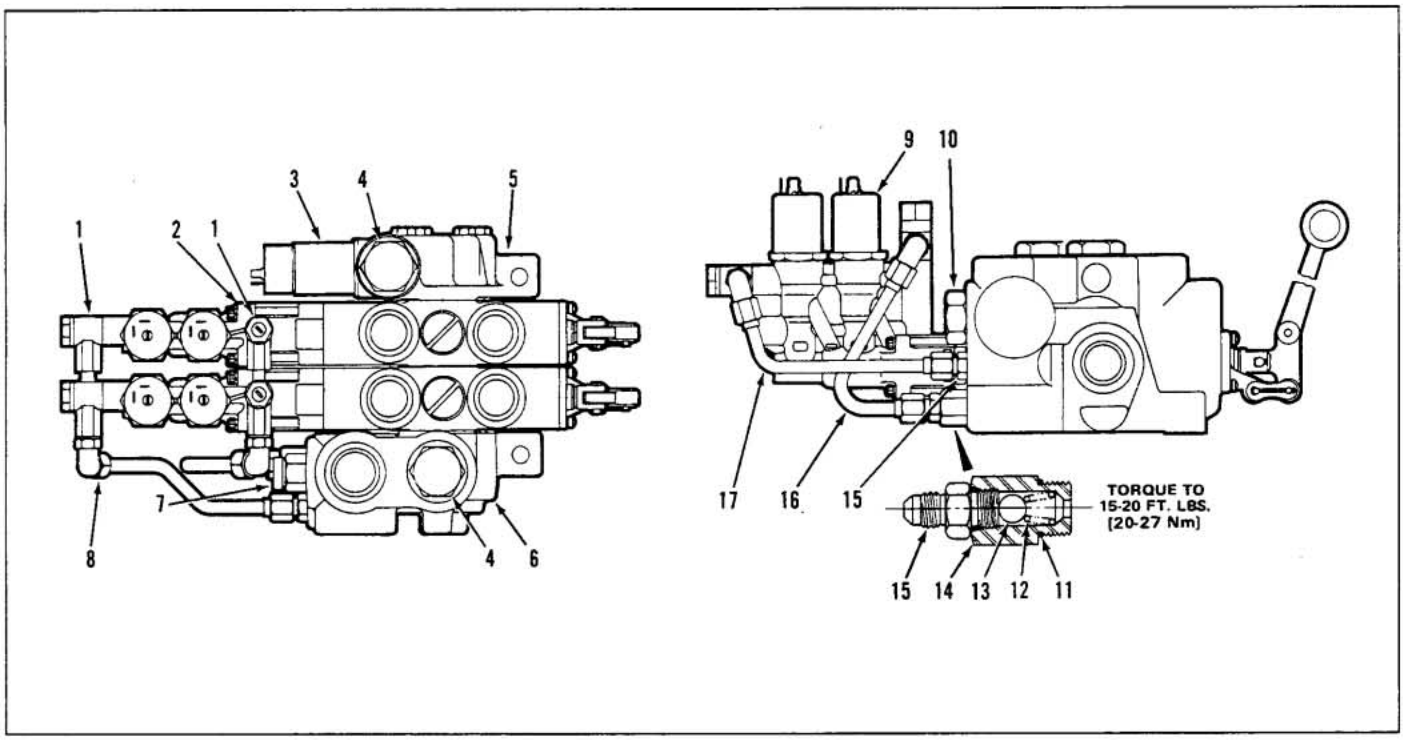


Figure 4-25. Model V42 Solenoid-Controlled Directional Control Valve Assembly.

MODEL V42 SOLENOID-CONTROLLED DIRECTIONAL CONTROL VALVE ASSEMBLY

Item No.	Part No.	Description	Quantity
	K-6071	SEAL KIT (Contains all seals necessary for tubing and fittings)	
	K-6062	REPLACEMENT KIT, Check Valve (Contains Items 11, 12, 13, 14 and 15)	
	K-28076	REPLACEMENT KIT, Tube Assembly (Contains Items 16 and 17)	
1		FITTING (See Figure 4-2 and 4-3)	A/R
2		ACTUATOR ASSEMBLY (See Figure 4-4)	A/R
3		CARTRIDGE, Solenoid Pressure Build-Up Valve (See Figure 4-6)	1
4		PLUG, As Required	A/R
5	8287-	COVER, Outlet — Specify Port Size and Location	1
6	8288-	COVER, Inlet — Specify Port Size and Location	1
7		CARTRIDGE, Pressure Reducing (See Figure 4-5)	1
8	7869-001	FITTING, 90°, Straight Thread, With O-Ring	2
9		CARTRIDGE, Solenoid Valve (See Figure 4-7)	2 per Actuator
10		MAIN RELIEF VALVE (For parts listing, refer to Service and Parts Manual No. SC-1202)	1
11	2706-001	SEAL, O-Ring — Not Sold Separately, Order Replacement Kit No. K-6062	1
12	7833-001	SPRING — Not Sold Separately, Order Replacement Kit No. K-6062	1
13	3269-001	BALL, Steel — Not Sold Separately, Order Replacement Kit No. K-6062	1
14	7832-001	BODY, Check — Not Sold Separately, Order Replacement Kit No. K-6062	1
15	7867-001	FITTING, Short, With O-Ring — Not Sold Separately, Order Replacement Kit No. K-6062	2
16	8306-001	TUBE ASSEMBLY, Outlet — Order Replacement Kit K-28076	1
17	8305-001	TUBE ASSEMBLY, Inlet — Order Replacement Kit K-28076	1

ADJUSTABLE AND NON-ADJUSTABLE FITTINGS

In order to make the proper pressure and return line connections between the actuator assembly and the inlet cover, special fittings are used – adjustable speed control fittings, Figure 4-2, and non-adjustable fittings, Figure 4-3.

Adjustable speed control fittings are installed in the actuator housing and are connected to the return line to the inlet cover. They enable the operator to adjust the speed of the spool shift in the section in which they are installed. Four configurations are available depending on application.

Non-adjustable fittings are installed in the actuator pressure line to make connections between each actuator and between the last actuator and the inlet cover. Non-adjustable fittings may also be used as an optional fitting where the adjustable feature in the actuator return line is not desired. Four configurations are available.

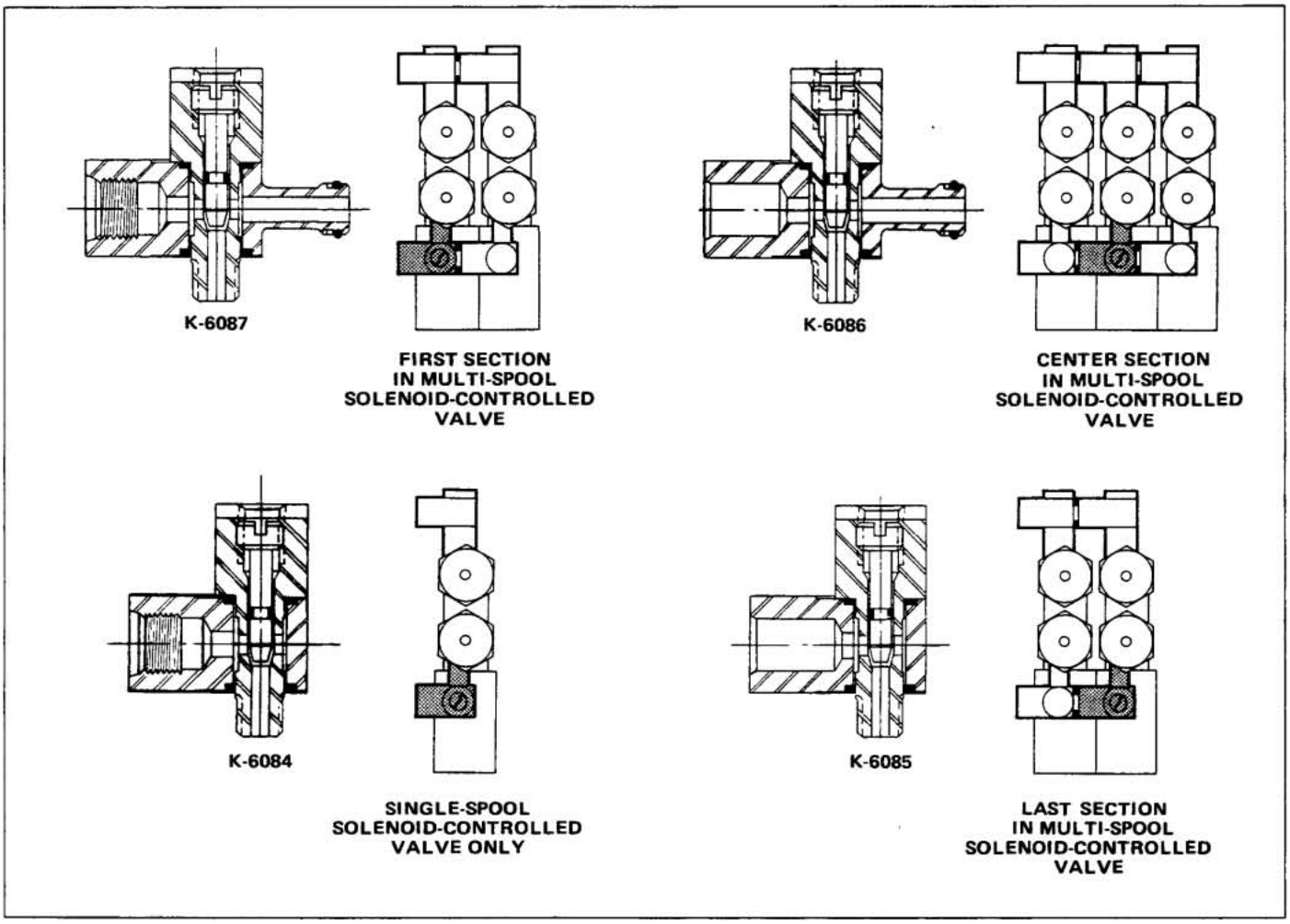


Figure 4-26. Adjustable Speed Control Fittings.

ADJUSTABLE SPEED CONTROL FITTINGS

Item No.	Part No.	Description	Quantity
	K-6072	SEAL KIT (for Items 1, 2, 3 or 4)	
1	K-6085	FITTING ASSEMBLY, Adjustable	1
2	K-6084	FITTING ASSEMBLY, Adjustable	1
3	K-6086	FITTING ASSEMBLY, Adjustable	1
4	K-6087	FITTING ASSEMBLY, Adjustable	1

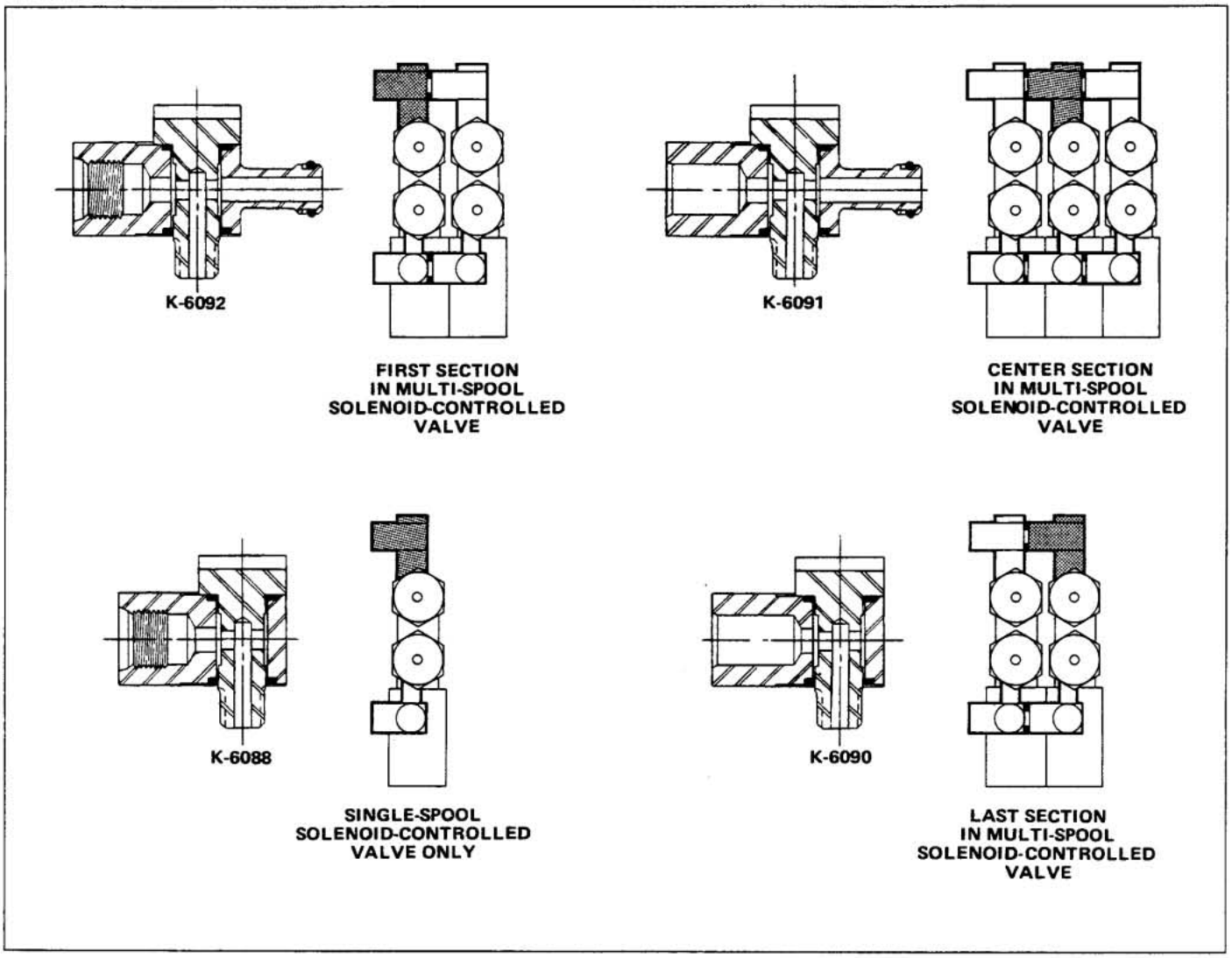


Figure 4-27. Non-Adjustable Fittings.

NON-ADJUSTABLE FITTINGS

Item No.	Part No.	Description	Quantity
	K-6073	SEAL KIT (For Items 1, 2, 3 or 4)	1
1	K-6090	FITTING ASSEMBLY, Non-Adjustable	1
2	K-6088	FITTING ASSEMBLY, Non-Adjustable	1
3	K-6091	FITTING ASSEMBLY, Non-Adjustable	1
4	K-6092	FITTING ASSEMBLY, Non-Adjustable	1

ADJUSTABLE/NON-ADJUSTABLE FITTING KITS

Each Kit contains one adjustable speed control fitting assembly and one non-adjustable fitting assembly for one actuator assembly.

K-6101 For the first section (closest to valve inlet) in a multi-spool solenoid valve.

K-6100 For the center sections in a multi-spool solenoid valve.

K-6099 For the last section (closest to outlet cover) in a multi-spool solenoid valve.

K-6102 For single-spool solenoid valve.

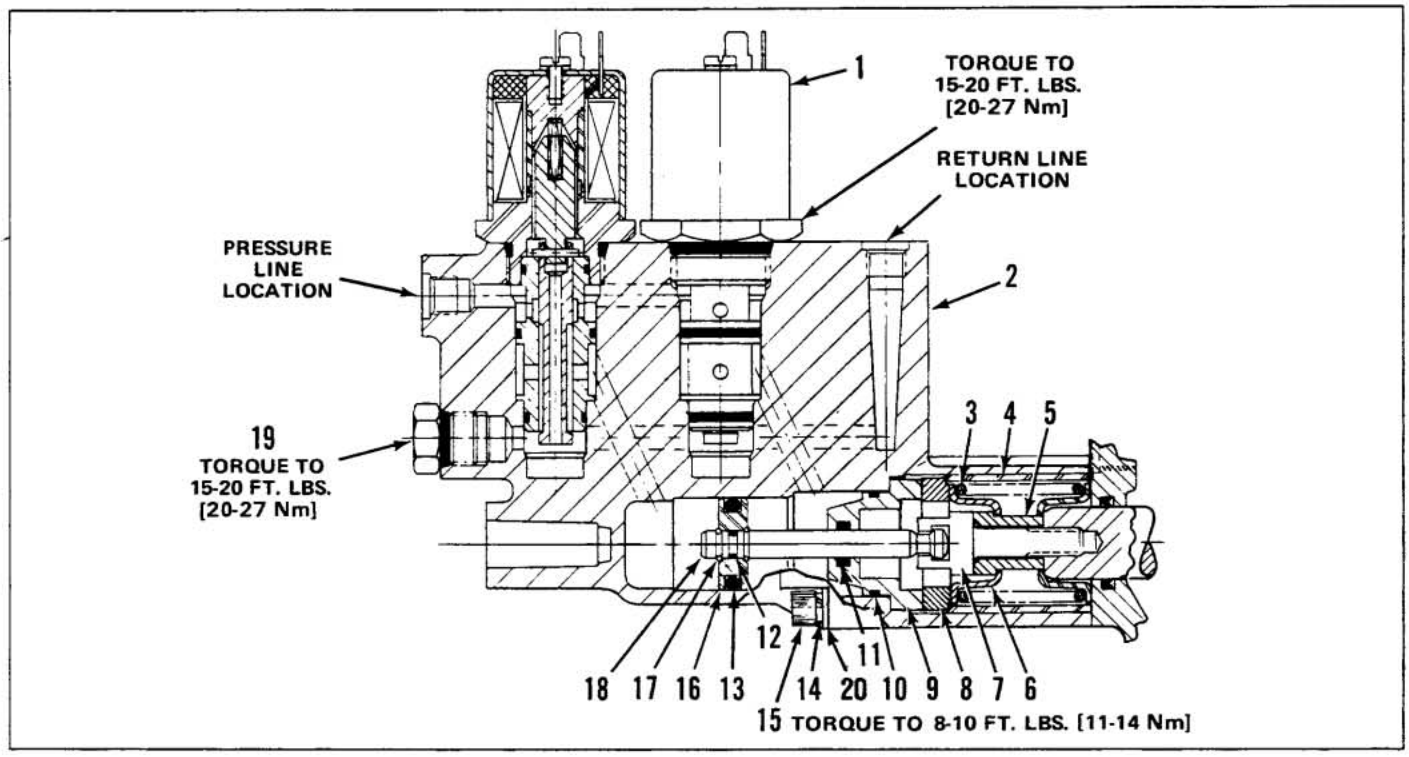


Figure 4-28 Actuator Assembly.

ACTUATOR ASSEMBLY

Item No.	Part No.	Description	Quantity
	CK-28077	REPLACEMENT KIT, Model V42 only (Contains Items 2 thru 20)	
	K-6074	SEAL KIT (Contains Items 10 thru 13)	
1	CK-6083	CARTRIDGE, Solenoid Valve, 12 VDC (See Figure 4-7)	2
	CK-6093	CARTRIDGE, Solenoid Valve, 24 VDC (See Figure 4-7)	2
2	8289-004	HOUSING, Actuator (V42)	1
3	8300-001	SPRING	1
4	8298-001	SPACER	1
5	10820-001	SPACER (Model V42 only)	1
6	10819-001	COLLAR, Spring	2
7	8297-001	SCREW, Spool	1
8	8301-001	SPACER (Model V42 only)	1
9	7858-001	GUIDE, Piston Rod	1
10	7028-002	SEAL, O-Ring	1
11	7854-001	SEAL, O-Ring — Not Sold Separately	1
12	3191-001	SEAL, O-Ring — Order Seal Kit No. K-6074	1
13	7700-001	SEAL, O-Ring	1
14	0563-001	WASHER, Lock	4
15	3731-110	SCREW, Socket Head Cap, ¼ – 20 x 3.00 inches long (V42)	4
16	7856-001	PISTON	1
17	7855-001	RING, Retaining	2
18	7857-001	ROD, Piston	1
19	3637-001	PLUG, SAE 6 (With O-Ring)	1
20	7904-001	PLATE, Bearing	4

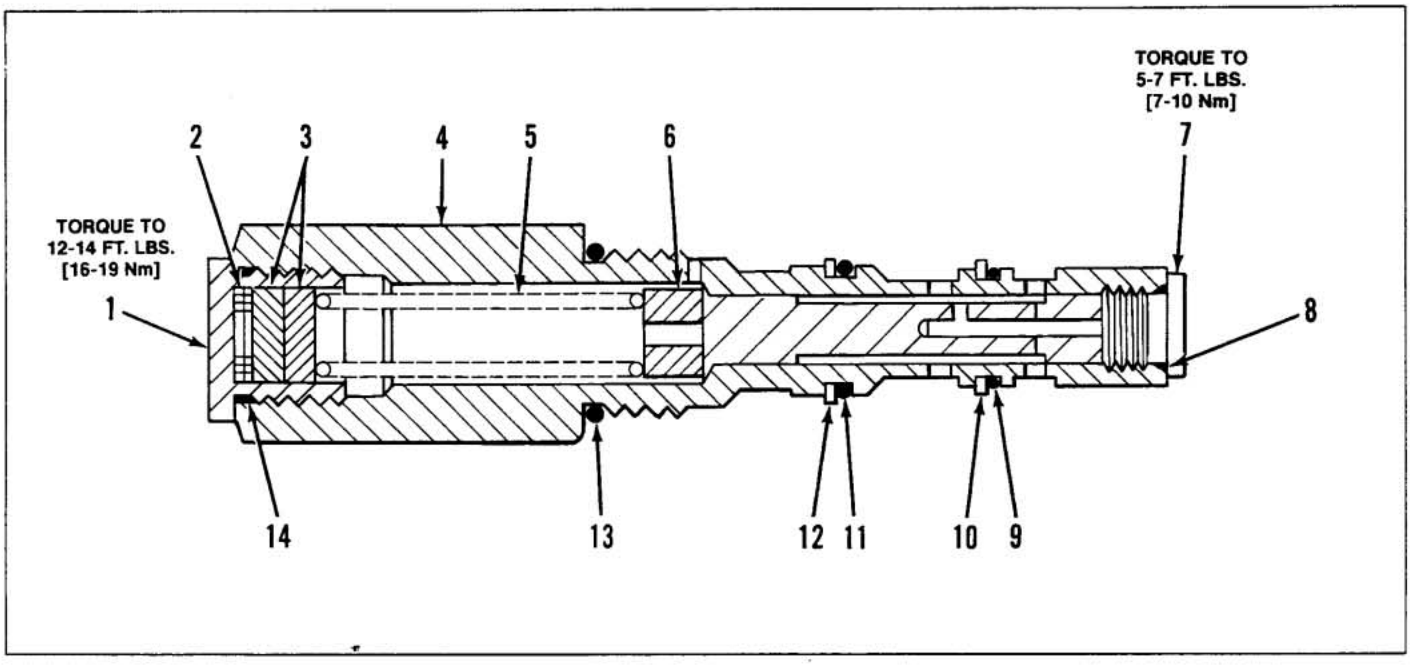


Figure 4-29. Pressure Reducing Cartridge Assembly.

PRESSURE REDUCING CARTRIDGE ASSEMBLY

Item No.	Part No.	Description	Quantity
	CK-28096	REPLACEMENT KIT, 300 PSI (Contains all items listed below)	
	K-28078	SEAL KIT (Contains Items 8 thru 14)	
1	11381-001	PLUG, SAE 8	1
2	0462-001	SHIM (.010 inch [0,25 mm] thick)	A/R
	0459-001	SHIM (.010 inch [0,25 mm] thick)	A/R
3	11417-001	SPACER (Not required for 300 PSI assembly)	A/R
4	11384-001	BODY ASSEMBLY	1
5	3458-001	SPRING	1
6	11383-001	SPACER	1
7	9435-104	PLUG, SAE 4	1
8	7830-001*	SEAL, O-Ring	1
9	1091-001*	SEAL, O-Ring	1
10	0682-001	RING, Back-up, Cut	1
11	7829-001*	SEAL, O-Ring — Not Sold Separately. Order K-28078	1
12	3092-001	RING, Back-Up Cut	1
13	2707-001*	SEAL, O-Ring	1
14	2706-001*	SEAL, O-Ring	1

*Buna-N seals are standard for all Gresen valve assemblies. For Viton seals contact the factory.

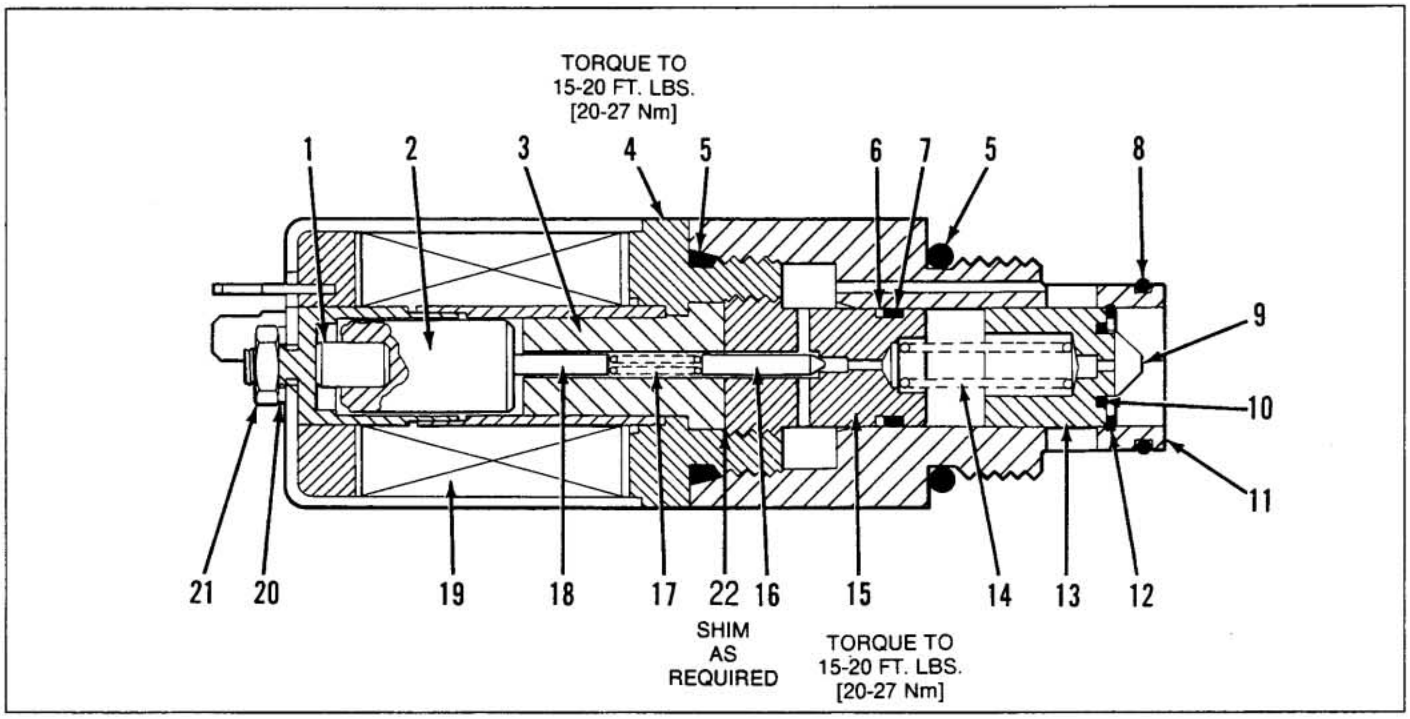


Figure 4-30. Solenoid Operated Pressure Build-Up Valve Assembly.

SOLENOID OPERATED PRESSURE BUILD-UP VALVE ASSEMBLY

Item No.	Part No.	Description	Quantity
	CK-6177	REPLACEMENT KIT, 12 VDC (Contains all items listed below)	
	CK-6178	REPLACEMENT KIT, 24 VDC (Contains all items listed below)	
	K-6184	SEAL KIT (Contains Items 5 thru 10)	
1	10723-001	PIN	1
2	10724-001	PLUNGER, Flat Faced	1
3	10725-001	POLE, Solenoid	1
4	10718-001	CORE, Solenoid	1
5	6277-001*	SEAL, O-Ring	2
6	0682-001	RING, Back-Up, Cut	1
7	9002-014*	SEAL, O-Ring	1
8	9002-018*	SEAL, O-Ring	1
9	11671-001	SCREEN, Filter	1
10	11199-001	RING, Retaining	1
11	11804-001	BODY	1
12	1649-001	RING, Retaining	1
13	11803-001	PISTON	1
14	1266-001	SPRING	1
15	11805-001	SEAT	1
16	10727-001	POPPET	1
17	8417-001	SPRING	1
18	10728-001	PIN	1
19	8512-001	COIL, 12 VDC	1
	8511-001	COIL, 24 VDC	1
	11430-001	COIL, 120 VAC	1
20	7837-001	WASHER, Lock	1
21	9300-003	NUT, Hex Jam, #10-32	1
22	8040-001	SHIM (.010 inch [0.25 mm] thick)	A/R
	8039-001	SHIM (.020 inch [0.5 mm] thick)	A/R
	8040-002	SHIM (0.50 inch [1,27 mm] thick)	A/R

Not Sold Separately. Order K-6184 (Items 5 thru 10)

*Buna-N seals are standard for all Gresen valve assemblies. For Viton seals contact the factory.

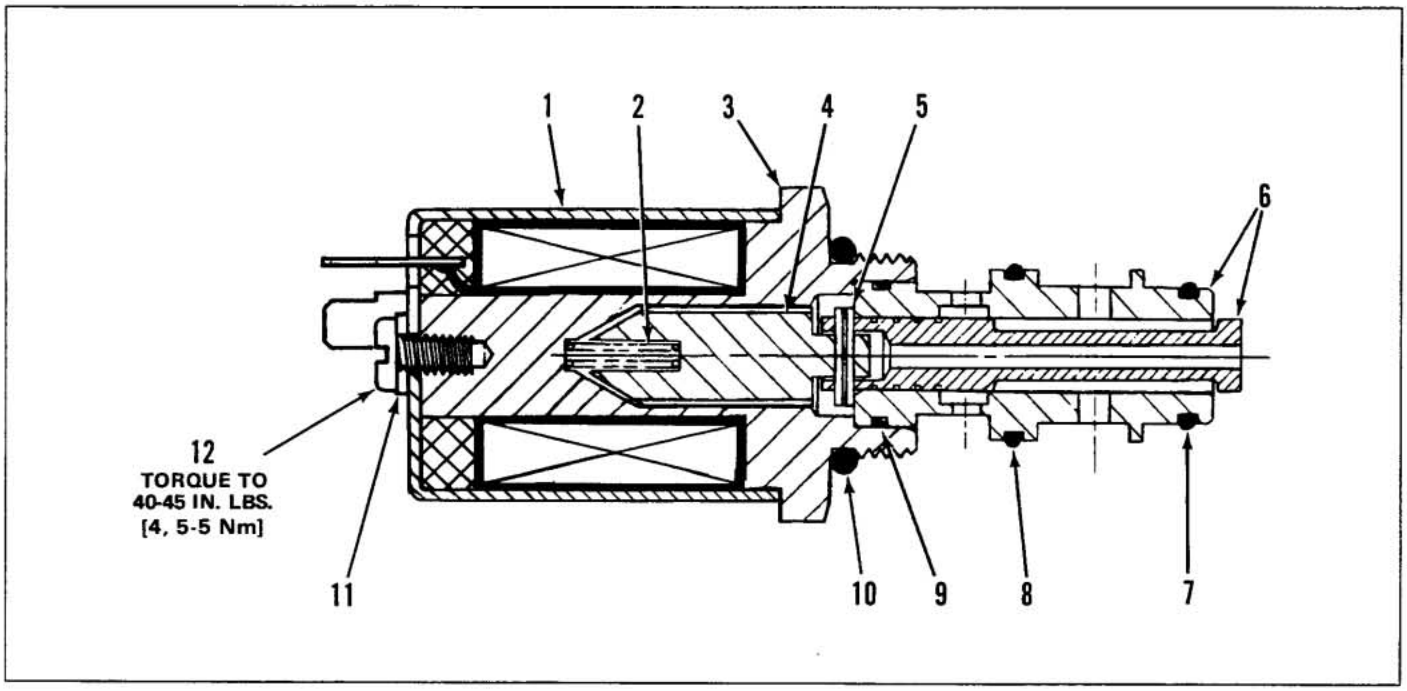


Figure 4-31. Solenoid Valve Cartridge Assembly.

SOLENOID VALVE CARTRIDGE ASSEMBLY

Item No.	Part No.	Description		Quantity
	CK-6169	REPLACEMENT ASSEMBLY, 120VAC (Contains all items listed below)		
	CK-6083	REPLACEMENT ASSEMBLY, 12 VDC (Contains all items listed below)		
	CK-6093	REPLACEMENT ASSEMBLY, 24 VDC (Contains all items listed below)		
	K-6077	SEAL KIT (Contains Items 7 thru 10)		
1	8512-001	COIL, Solenoid, 12 VDC	See Note	1
	8511-001	COIL, Solenoid, 24 VDC		1
2	7838-001	SPRING		1
3	7840-002	CORE, Solenoid		1
4	8515-001	PLUNGER, Solenoid		1
5	7846-001	PIN, Spring		1
6	8507-001	SPOOL and SLEEVE ASSEMBLY		1
7	7829-001	SEAL, O-Ring	Not Sold Separately. Order Seal Kit No. K-6077	1
8	1910-001	SEAL, O-Ring		1
9	6839-001	SEAL, O-Ring		1
10	2708-001	SEAL, O-Ring		1
11	7837-001	WASHER, Lock		1
12	7836-001	SCREW, Pan Head, no. 10 – 24 x .31 inch long		1

Note: All parts, other than seals and solenoid coil, are matched parts and are not sold separately.

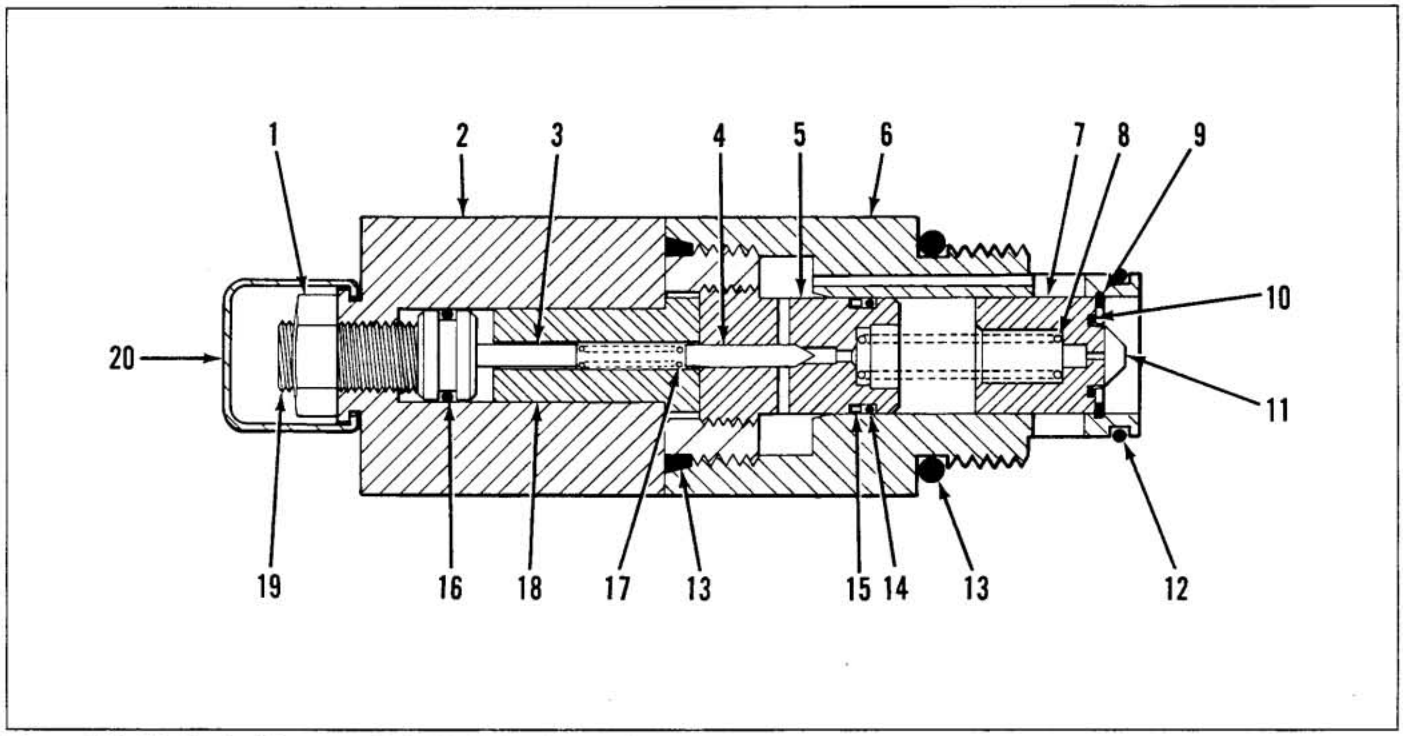


Figure 4-32. Mechanical Pressure Build-Up Valve Assembly.

MECHANICAL PRESSURE BUILD-UP VALVE ASSEMBLY

Item No.	Part No.	Description		Quantity
	CK-6179	REPLACEMENT KIT, Adjustable (Contains all items listed below except Item 20)		
	K-6188	SEAL KIT (Contains Items 10 thru 16)		
1	9302-006	NUT, Hex Jam, 3/8-24		1
2	11138-001	BODY		1
3	10728-001	PIN		1
4	10727-001	POPPET		1
5	11805-001	SEAT		1
6	11804-001	BODY		1
7	11803-001	PISTON		1
8	1266-001	SPRING		1
9	1649-001	RING, Retaining		1
10	11199-001	RING, Retaining		1
11	11671-001	SCREEN, Filter		1
12	9002-018*	SEAL, O-Ring		1
13	6277-001*	SEAL, O-Ring	Not Sold Separately. Order K-6188	2
14	9002-014*	SEAL, O-Ring		1
15	0682-001	RING, Back-Up, Cut		1
16	6884-001*	SEAL, O-Ring		1
17	8417-001	SPRING		1
18	10725-001	POLE		1
19	11816-001	PISTON, Adjusting		1
20	10034-001	COVER, Tamperproof (Used on tamperproof model only)		1

*Buna-N seals are standard for all Gresen valve assemblies. For Viton seals contact the factory.

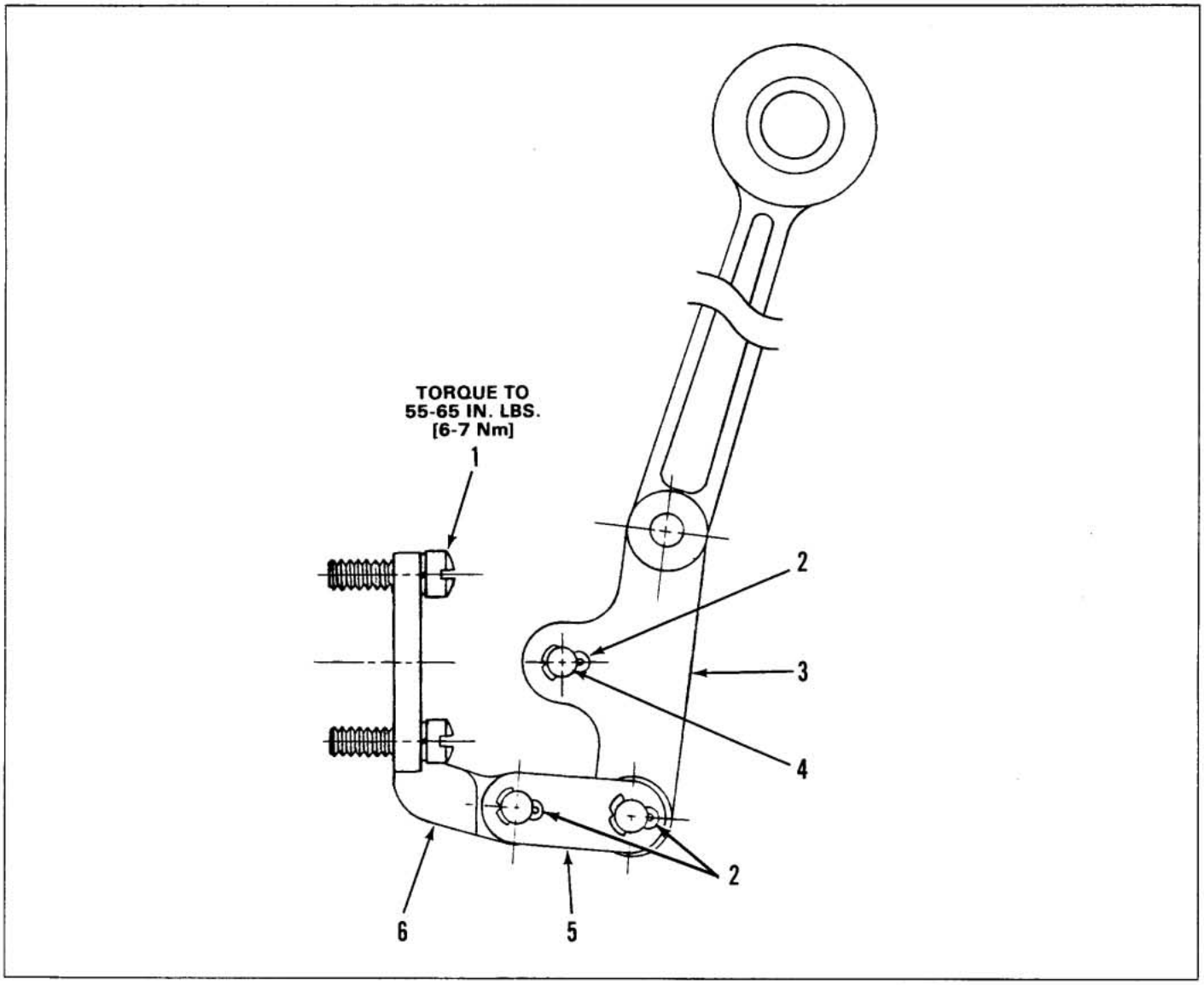


Figure 4-33. Vertical Handle

VERTICAL HANDLE

Item No.	Part No.	Description	Quantity
		REPLACEMENT KIT (Contains all Items listed below)	
	K-28080	Replacement Kit With Black Plastic Coated Handle (Standard)	
	K-28082	Replacement Kit With Plain Handle	
1	3731-099	SCREW, Fil Hd, 1/4–20 by 3/4 inch long	4
2	0086-001	PIN, Cotter, 0.078 by 0.50 inch long	3
3	8349-001	HANDLE, Vertical, Black Plastic Coated (Standard)	1
	8349-003	HANDLE, Vertical, Plain (Optional)	1
4	1857-001	PIN, Clevis	1
5	11393-001	PIN, Link } Not Sold Separately. Order 928-001.	1
	11392-001	SIDE PLATE, Link } Not Sold Separately. Order 928-001.	1
6	11824-001	BRACKET, Handle	1

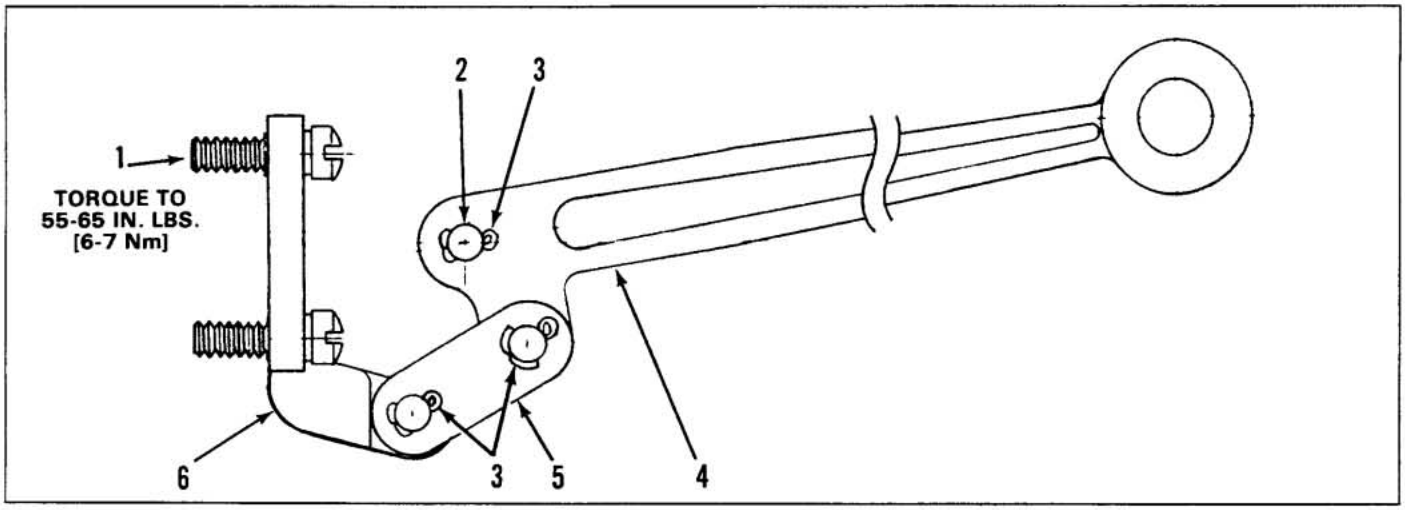


Figure 4-34. Horizontal Handle

HORIZONTAL HANDLE

Item No.	Part No.	Description	Quantity
		REPLACEMENT KITS (Contains all Items listed below)	
	K-28083	Replacement Kit With Black Plastic Coated Handle (Standard)	
	K28085	Replacement Kit With Plain Handle	
1	1620-001	SCREW, Fil Hd, 1/4–20 by 3/4 inch long	4
2	1857-001	PIN, Clevis	1
3	0086-001	PIN, Cotter, 0.078 by 0.50 inch long	3
4	3249-001	HANDLE, Horizontal, Black Plastic Coated (Standard)	1
	3249-003	HANDLE, Horizontal, Plain (Optional)	1
5	11393-001	PIN, Link } Not Sold Separately. Order 982-001.	1
	11392-001	SIDE PLATE, Link }	1
6	11824-001	BRACKET, Handle	1

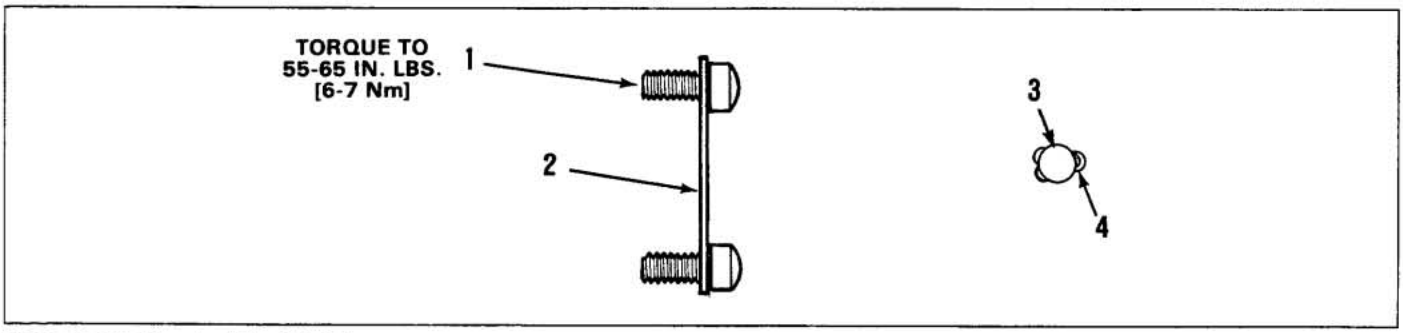


Figure 4-35. Standard Seal Retainer

STANDARD SEAL RETAINER

Item No.	Part No.	Description	Quantity
	K-28022	REPLACEMENT KIT (Contains Items 1, 2, 3 and 4)	
1	3731-098	SCREW, Button Hd, 1/4–20 UNC by 5/8 inch long	4
2	11825-001	PLATE, Retainer	1
3	1857-001	PIN, Clevis	1
4	0086-001	PIN, Cotter, 0.078 by 0.50 inch long	1

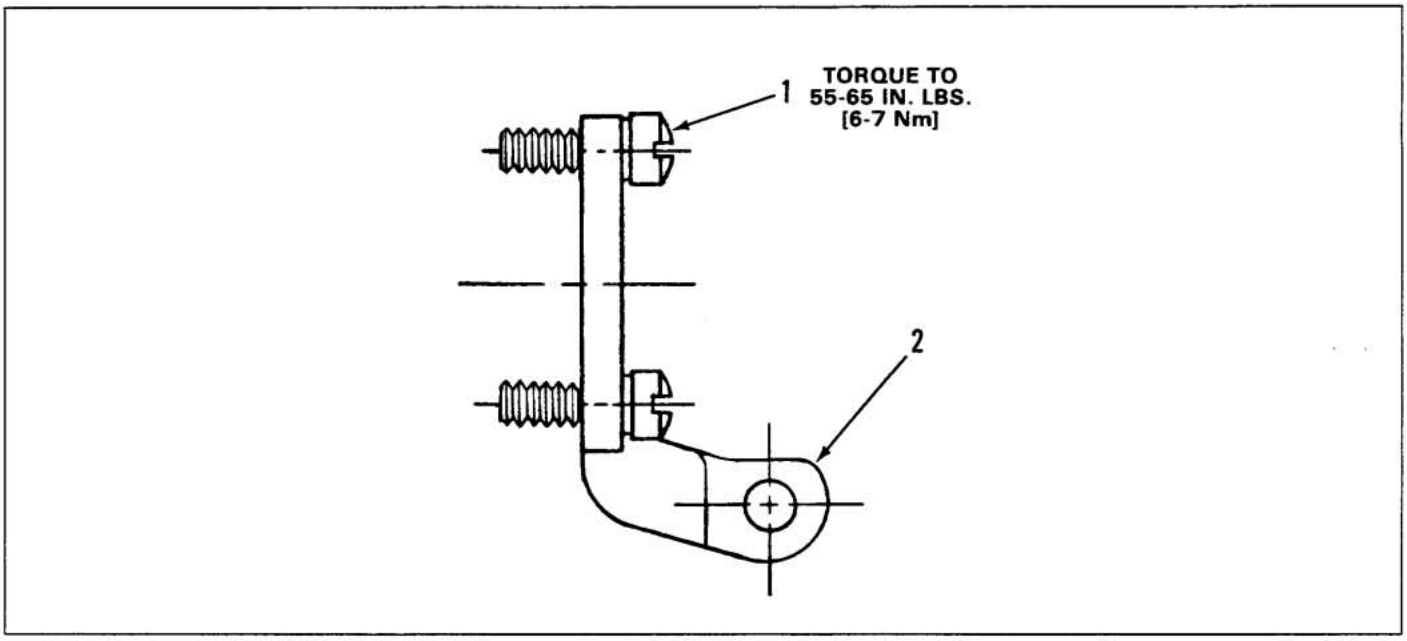


Figure 4-36. Handle Bracket

HANDLE BRACKET

Item No.	Part No.	Description	Quantity
	K-28086	REPLACEMENT KIT (Contains Items 1 and 2)	
1	3731-099	SCREW, Button Hd, 1/4–20 by 3/4 inch long	4
2	11824-001	BRACKET, Handle	1

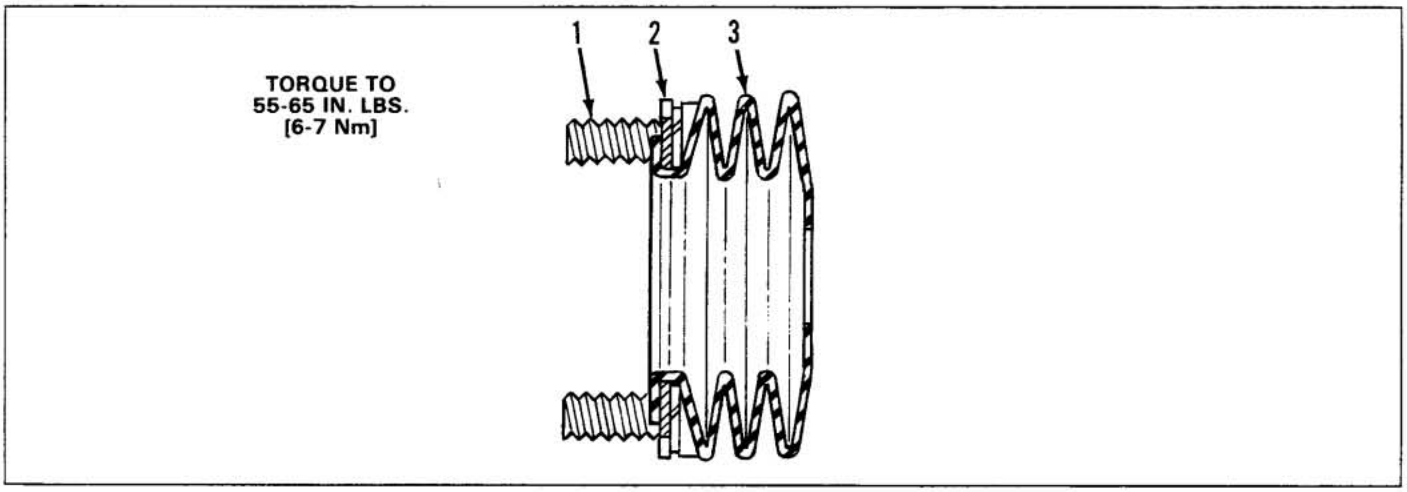


Figure 4-37. Spool Protective Boot

SPOOL PROTECTIVE BOOT

Item No.	Part No.	Description	Quantity
	CK-7021	REPLACEMENT KIT (Contains Items 1 thru 3)	
	K-28104	SPOOL BOOT/HANDLE BRACKET KIT (Contains Boot, Bracket and 4 Screws)	
1	3731-099	SCREW, Fil. Head, 1/4–20 x 5/8 inch long	4
2	11825-001	RETAINER, Boot	1
3	12118-002	BOOT, Dust	1

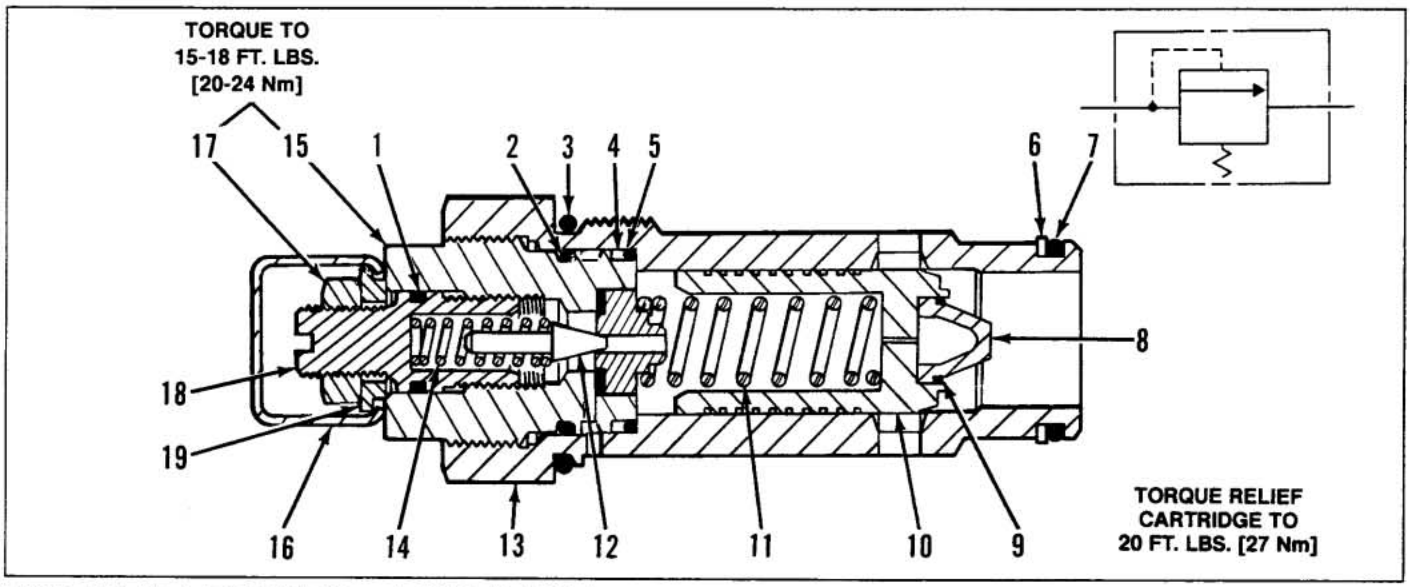


Figure 4-38. Model RP60 Pilot-Operated Main Relief Valve

Model RP60 Pilot-Operated Main Relief Valve

Item No.	Part No.	Description		Quantity
	K-19004*	SEAL KIT (Contains Items 1 thru 7)		
1	6884-001*	SEAL, O-Ring	Not Sold Separately Order K-19004*	1
2	6814-002*	SEAL, O-Ring		1
3	2709-001*	SEAL, O-Ring		1
4	9020-019	RING, Back-Up		1
5	1660-001*	SEAL, O-Ring		1
6	1783-001	RING, Back-Up		1
7	1698-001*	SEAL, O-Ring		1
8	12675-001	FILTER		1
9	10298-001	RING, Retaining		1
10	12676-001	POPPET, Main		1
11	12674-001	SPRING		1
12	8475-001	POPPET, Relief		1
13	10071-001	BODY, Relief		1
14	10059-001	SPRING		1
15	11059-001	BODY, Pilot Assembly		1
16	10034-001	COVER, Tamperproof (RP60N only)		1
17	9302-006	NUT, Hex Jam, 3/8" - 24		1
18	8956-001	SCREW, Adjustment		1
19	10035-001	WASHER, RP60N (Shown)		1
	10852-005	WASHER, ID, RP60A (Not Shown)		1

NOTE

Due to close tolerances on working parts, Model RP60 is not field serviceable. If service other than seal replacement is required, contact the factory.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

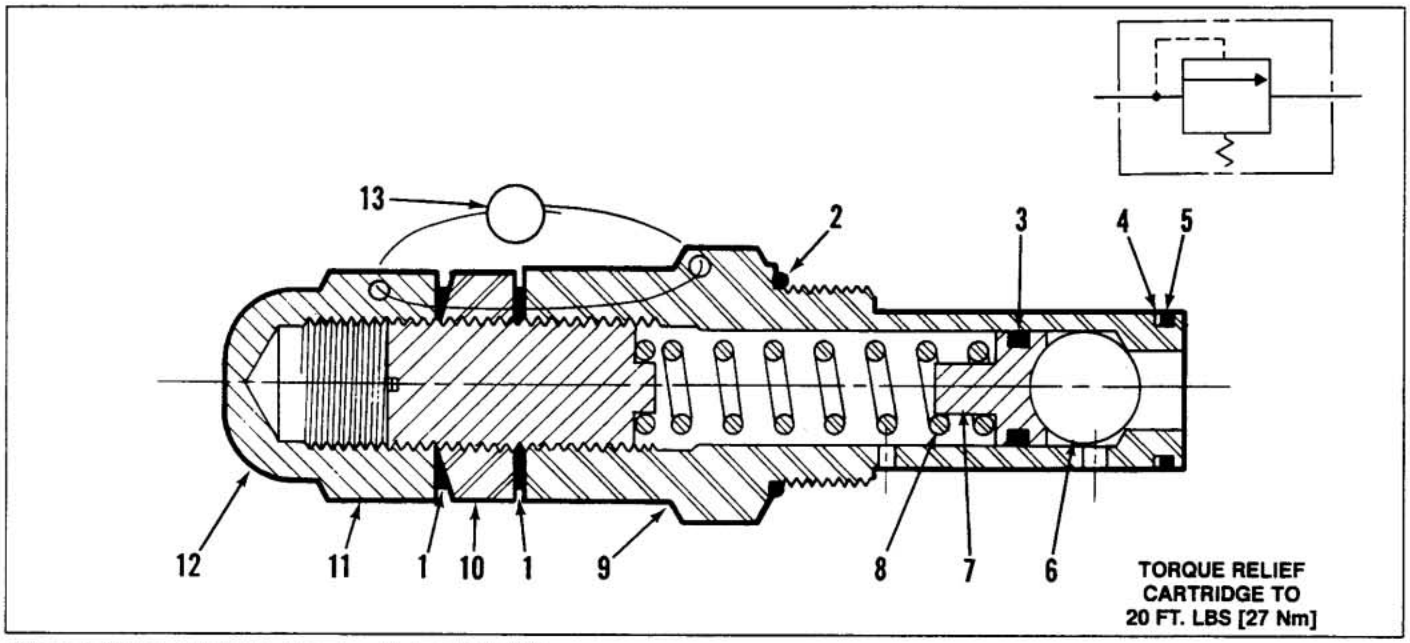


Figure 4-39. Model KC Ball/Spring Main Relief Valve

Model KC Ball/Spring Main Relief Valve

Item No.	Part No.	Description	Quantity
	K-21001*	SERVICE KIT, Standard (Contains Items 1, 2, 3, 4, 5, 6, 7 and 8, Spring 1296-001)	
	K-21002	SERVICE KIT, High Pressure (Contains Items 1, 2, 3, 4, 5, 6, 7 and 8, Spring 1233-001)	
	K-7004*	SEAL KIT (Contains Items 1, 2, 3, 4 and 5)	
1	1295-001	WASHER, Screw Seal	2
2	2709-001*	SEAL, O-Ring, Relief Body } Not Sold	1
3	1136-001*	SEAL, Ball Guide } Separately	1
4	1783-001	WASHER, Back-Up } Order K-7004*	1
5	1698-001*	SEAL, O-Ring	1
6	1268-001	BALL, 3/4 inch diameter	1
7	1269-001	GUIDE, Ball	1
8	1233-001	SPRING (High Pressure, 1501-2000PSI) } See Note	1
	1269-001	SPRING (Low Pressure, 400-1500PSI) } See Note	1
	3230-001	SPRING, Stainless (1400-2000PSI) } See Note	1
9	1798-001	BODY, Relief, without hole for lockwire (Standard)	1
	2942-001	BODY, Relief, with hole for lockwire (Optional)	1
10	1273-001	NUT, Jam	1
11	1271-001	SCREW, Adjusting	1
12	1274-001	CAP, Acorn, Relief, without hole for lockwire (Standard)	1
	1222-001	CAP, Acorn, Relief, with hole for lockwire (Optional)	1
13	1234-001	LOCKWIRE AND LEAD SEAL (Optional)	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

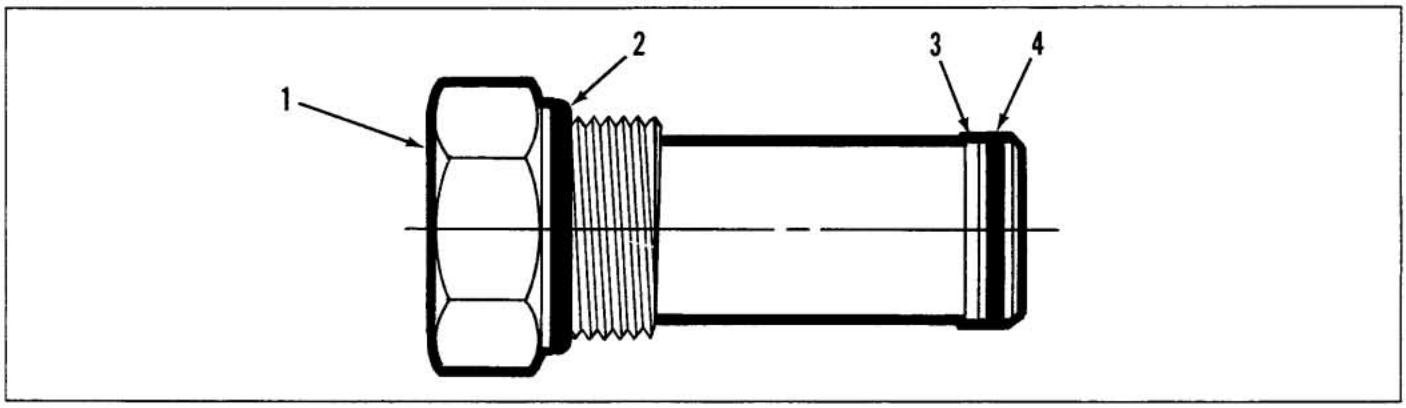


Figure 4-40. No Relief "NR" Plug (Main Relief)

NO RELIEF "NR" PLUG (MAIN RELIEF)

Item No.	Part No.	Description	Quantity
	K-7014	REPLACEMENT KIT (Contains all Items listed below)	
1	2952-001	PLUG, Relief	1
2	2709-001*	SEAL, O-Ring	1
3	1783-001	WASHER, Backup	2
4	1698-001*	SEAL, O-Ring	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

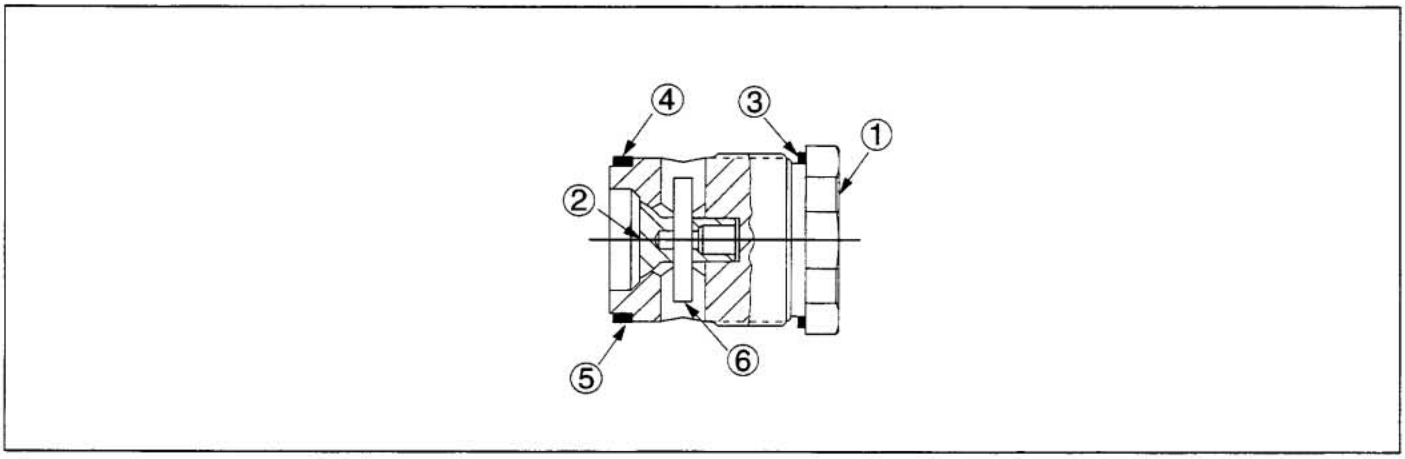


Figure 4-40. Upper Anti-Cavitation Check Valve

UPPER ANTI-CAVITATION CHECK VALVE

Item No.	Part No.	Description	Quantity
1	22006-001	BODY, A/C Upper	1
2	22069-001	POPPET, Anti-Cavitation	1
3	01615-001	SEAL, O-Ring – A8023, 90	1
4	01718-001	SEAL, O-Ring – A6022,90	1
5	09020-022	RING, Backup – A6022, CO	1
6	22031-463	PIN, Spring Coiled	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

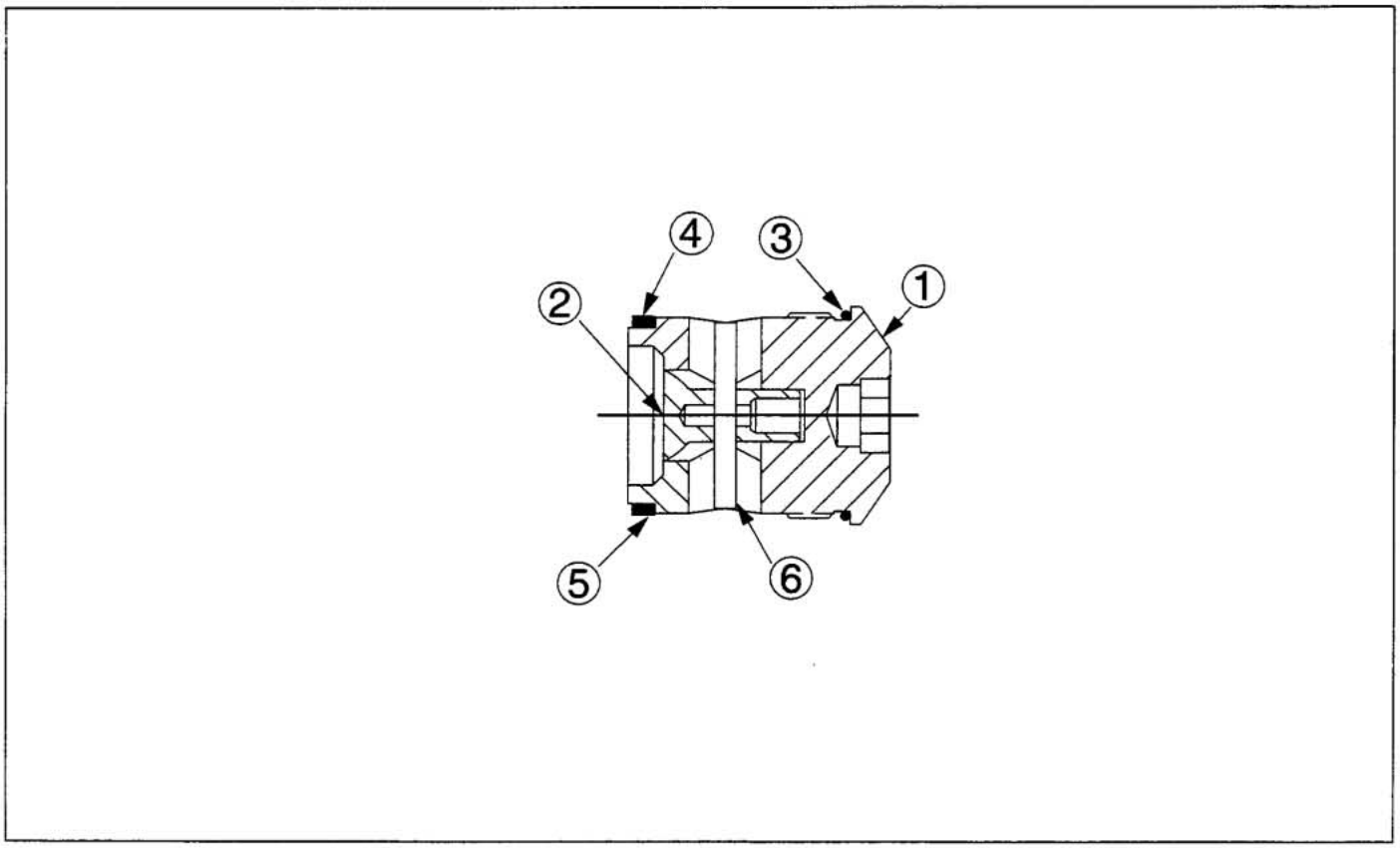


Figure 4-42. Lower Anti-Cavitation Check Valve

LOWER ANTI-CAVITATION CHECK VALVE

Item No.	Part No.	Description	Quantity
1	21978-001	BODY, A/C Lower	1
2	22069-001	POPPET, Anti Cavitation	1
3	1698-001	SEAL, O-Ring – AS020, 90	1
4	01660-001	SEAL, O-Ring – AS019, 90	1
5	06527-001	RING, Backup-Continuing	1
6	22031-463	PIN, Spring Coiled	1

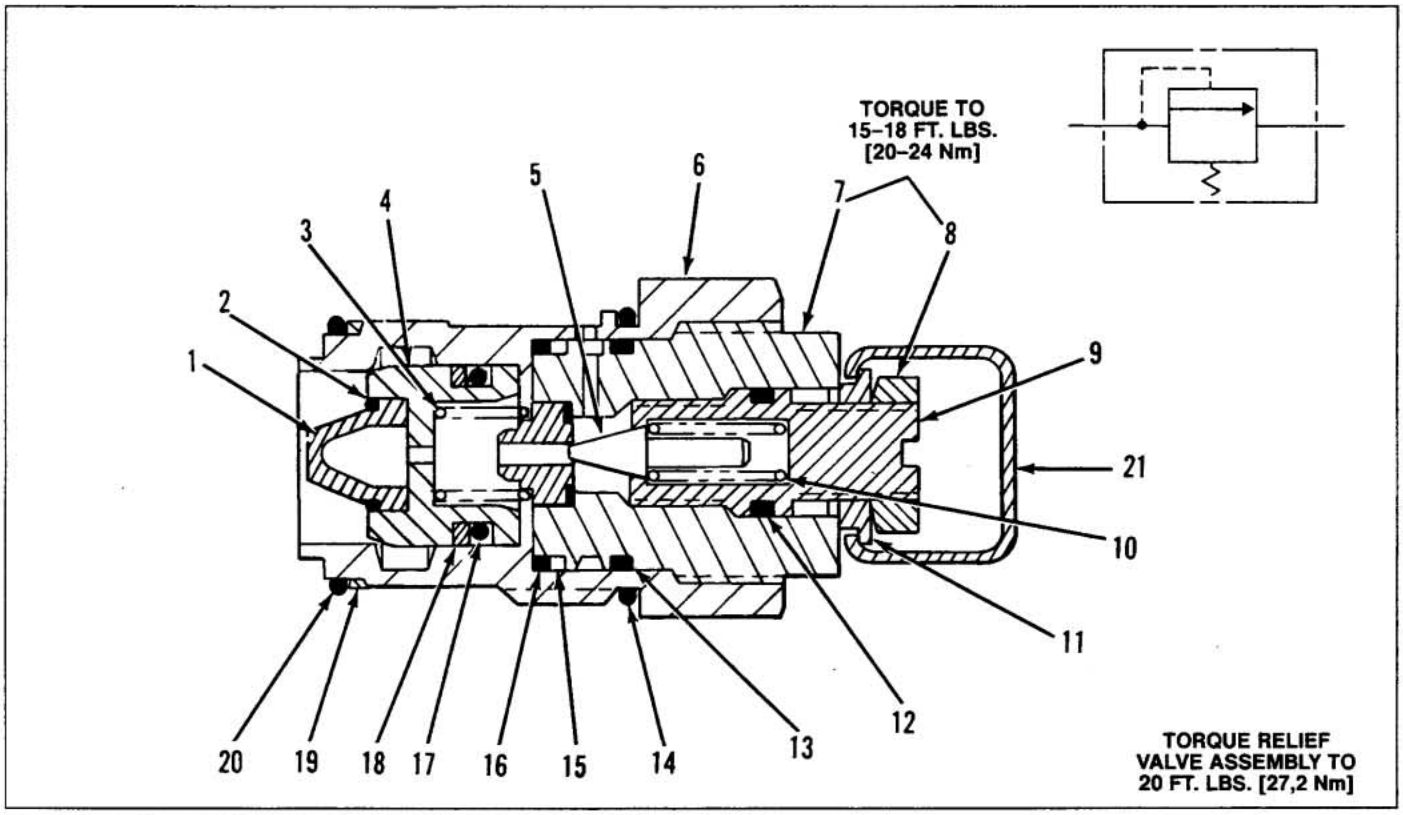


Figure 4-43. Model RP51 Pilot-Operated Work Port Relief Valve

MODEL RP51 PILOT-OPERATED WORK PORT RELIEF VALVE

Item No.	Part No.	Description	Quantity
	K-19005*	SEAL KIT (Contains Items 12 thru 20)	
1	12675-001	FILTER	1
2	10298-001	RING, Retaining	1
3	20254-001	SPRING	1
4	20209-001	POPPET, Main	1
5	8475-001	POPPET, Relief	1
6	8954-001	BODY, Relief Valve	1
7	11059-001	BODY, Pilot Assembly	1
8	9302-006	NUT, Hex Jam	1
9	8956-001	SCREW, Adjustment	1
10	10059-001	SPRING, Pilot	1
11	10035-001	WASHER, RP51-N (Shown)	1
	10852-001	WASHER, ID, RP51-A (Not Shown)	1
12	6884-001*	SEAL, O-Ring	1
13	6814-002*	SEAL, O-Ring	1
14	1615-001*	SEAL, O-Ring	1
15	9020-019	RING, Back-Up	1
16	1660-001*	SEAL, O-Ring	1
17	9000-113*	SEAL, O-Ring	1
18	20903-001	RING, Back-Up	1
19	9020-022	RING, Back-Up	1
20	1718-001*	SEAL, O-Ring	1
21	10034-001	COVER, Tamperproof (RP51-N only)	1

Not sold separately. Order K-19005

NOTE

Due to close tolerances on working parts, Model RP51 is not field serviceable. If service other than seal replacement is required, contact the factory.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

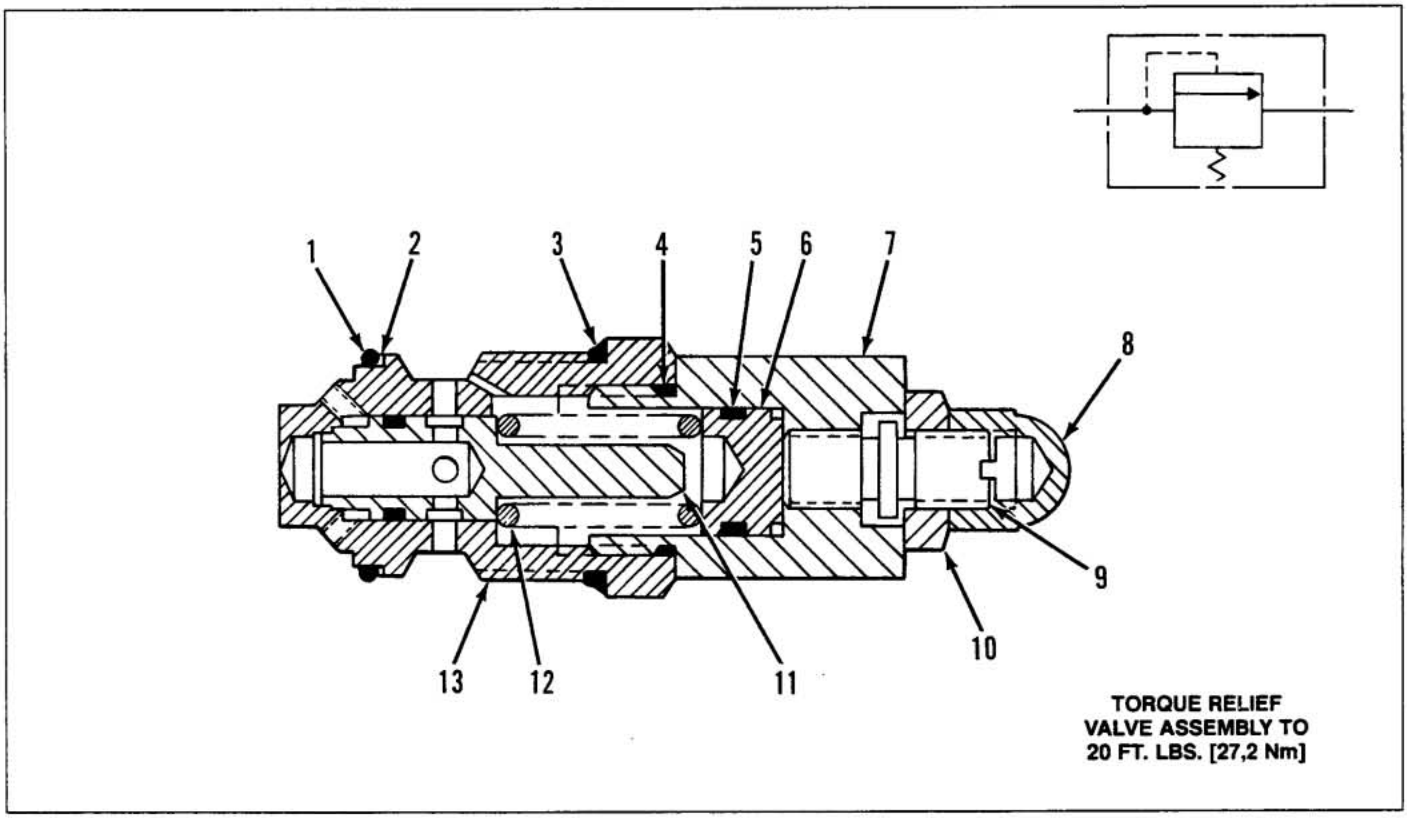


Figure 4-44. Model WHA Differential Poppet Work Port Relief Valve (Adjustable within the spring range)

MODEL WHA DIFFERENTIAL POPPET WORK PORT RELIEF VALVE (ADJUSTABLE WITHIN THE SPRING RANGE)

Item No.	Part No.	Description	Quantity
	K-19012*	SEAL KIT (Contains Items 1 thru 5)	
1	1718-001	SEAL, O-Ring (Not sold separately. Order K-19012)	1
2	9020-022	RING, Back-Up (Not sold separately. Order K-19012)	1
3	1615-001*	SEAL, O, Ring (Not sold separately. Order K-19012)	1
4	2707-001*	SEAL, O-Ring (Not sold separately. Order K-19012)	1
5	1818-001*	SEAL, O-Ring (Not sold separately. Order K-19012)	1
6	3495-001	PISTON	1
7	3498-001	CAP	1
8	3497-001	NUT, Acorn	1
9	3496-001	STEM, Adjusting	1
10	3500-001	NUT, Hex Jam	1
11	3936-001	POPPET	1
12	7638-001	SPRING, S.S., 750-1500 PSI [52-103 bar] Crack	1
	7078-001	SPRING, S.S., 1250-2000 PSI [86-138 bar] Crack	1
	1870-001	SPRING, S.S., 1500-2500 PSI [103-172 bar] Crack	1
	7497-001	SPRING, S.S., 2000-3000 PSI [138-207 bar] Crack	1
13	6533-001	BODY, WH Relief	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

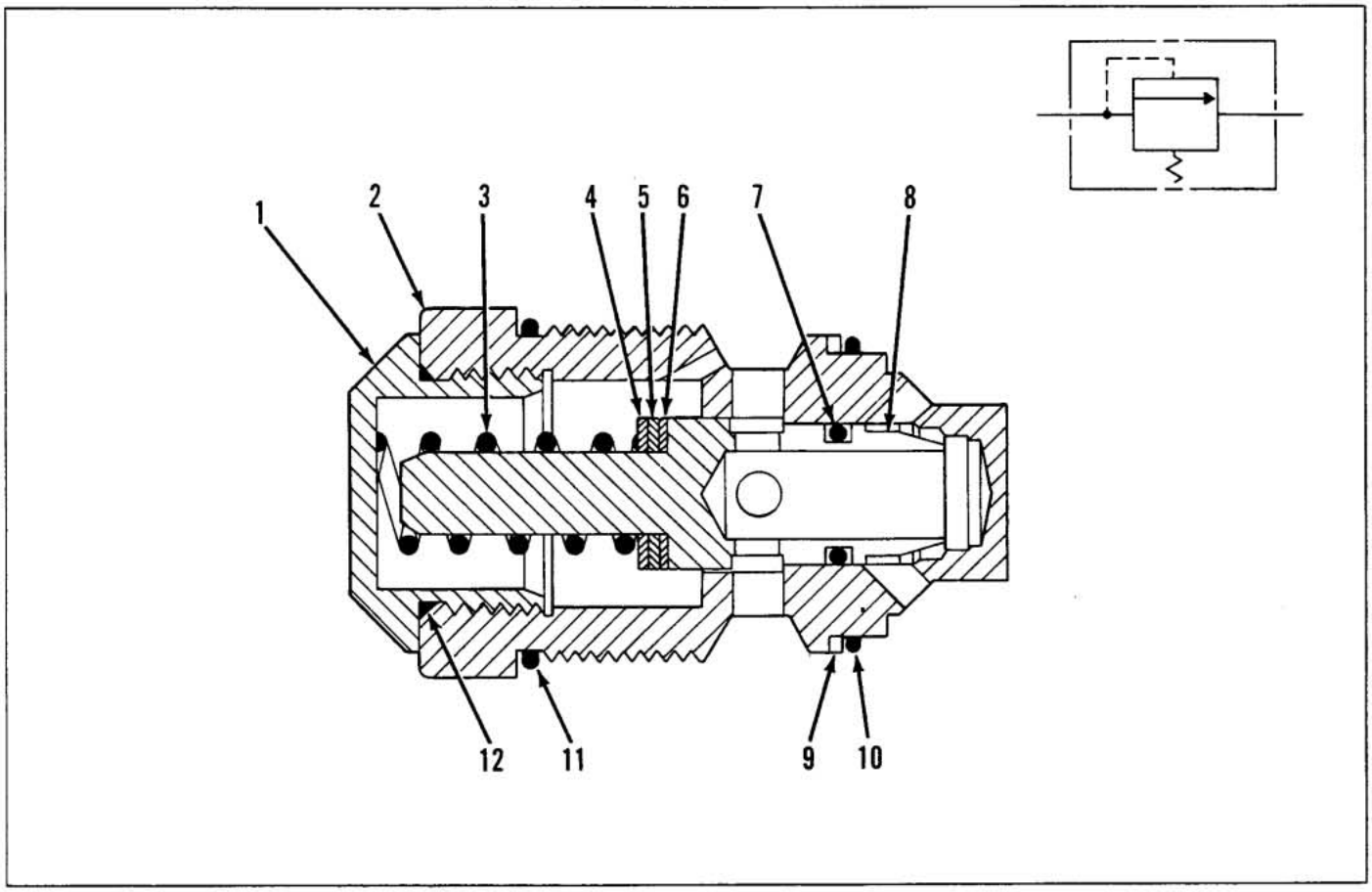


Figure 4-45. Model WH Differential Poppet Work Port Relief Valve (Non-Adjustable)

MODEL WH DIFFERENTIAL POPPET WORK PORT RELIEF VALVE (NON-ADJUSTABLE)

Item No.	Part No.	Description	Quantity
	K-19002	SEAL KIT (Contains Items 7 thru 8)	
	K-19003	SEAL KIT (Contains Items 9 thru 12)	
1	1880-001	CAP, Relief	1
2	6533-001	BODY	1
3	1450-001	SPRING, 500-1350 PSI [34-93 bar]	1
	1864-001	SPRING, 1351-1750 PSI [94-121 bar]	1
	1451-001	SPRING, 1751-2000 SPI [122-138 bar]	1
	1865-001	SPRING, 2001-2600 PSI [138-179 bar]	1
	1870-001	SPRING, S.S., 2001-2600 PIS [138-179 bar]	1
	7497-001	SPRING, S.S, 2601-3200 PSI [180-221 bar]	1
4	0458-001	SHIM (.040 inch) [1,02mm]	A/R
5	0459-001	SHIM (.020 inch) [0,51mm]	A/R
6	0462-001	SHIM (1.10 inch) [0,25mm]	A/R
7	1883-001	RING, Piston } Not Sold Separately. Order K-19002	1
8	1881-001	POPPET, Relief } Not Sold Separately. Order K-19002	1
9	9020-022	WASHER, Backup	1
10	1718-001	SEAL, O-Ring	1
11	1615-001*	SEAL, O-Ring } Not Sold Separately. Order K-19003	1
12	2707-001*	SEAL, O-Ring	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

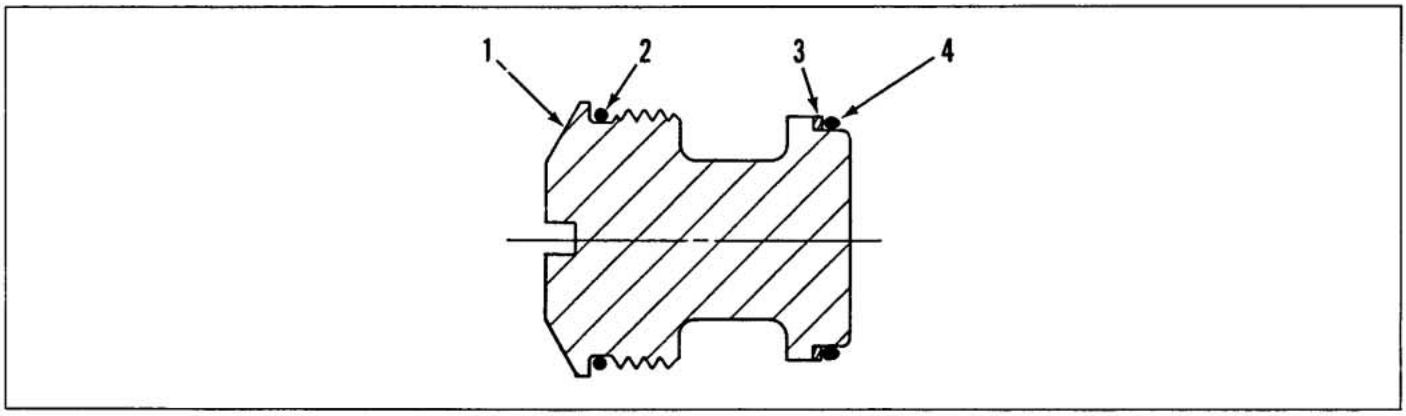


Figure 4-46. Lower Anti-Cavitation Plug

LOWER ANTI-CAVITATION PLUG

Item No.	Part No.	Description	Quantity
	K-28087	REPLACEMENT KIT (Contains all Items listed below)	
	K-28063	SEAL KIT, (Contains Items 2, 3 and 4)	
1	6759-001	PLUG	1
2	1698-001*	SEAL, O-Ring	1
3	6527-001	WASHER, Backup } Not Sold Separately. Order K-28063	2
4	1660-001	SEAL, O-Ring	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

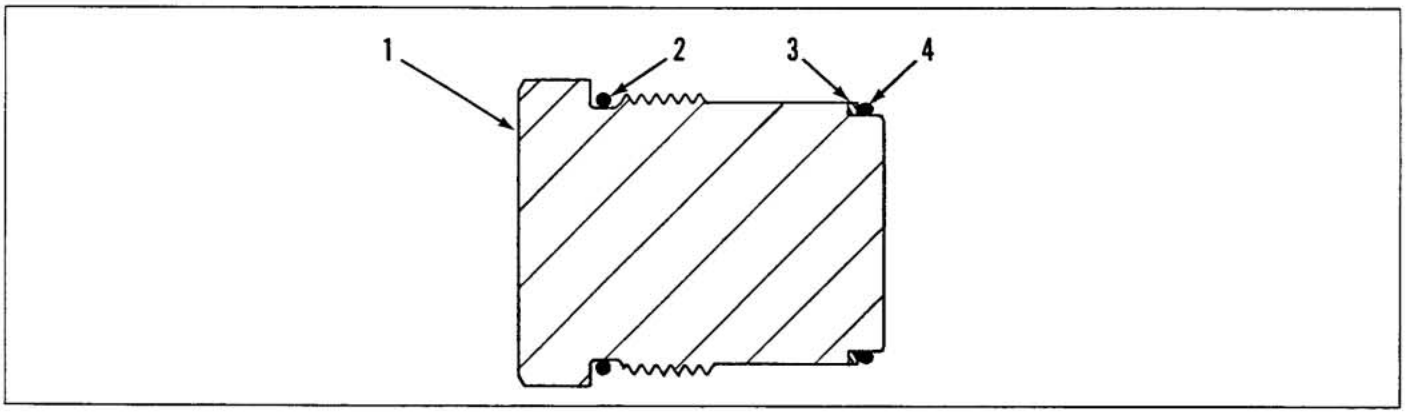


Figure 4-47. Upper Anti-Cavitation Plug

UPPER ANTI-CAVITATION PLUG

Item No.	Part No.	Description	Quantity
	CK-6132	REPLACEMENT KIT (Contains all Items listed below)	
	K-28062	SEAL KIT (Contains Items 2, 3 and 4)	
1	6760-001	PLUG	1
2	1615-001*	SEAL, O-Ring	1
3	9020-022	WASHER, Backup } Not Sold Separately. Order K-28062	1
4	1718-001	SEAL, O-Ring	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available.

Standard Buna-N Seals and O-Rings

All standard Gresen products utilize Buna-N seals which are compatible with petroleum base, water-in-oil emulsions, and water-glycol fluids. Phosphate-ester type fire-resistant fluids will cause Buna-N seals to swell. This swelling is not normally detrimental to static seals, but will be a problem for dynamic seals such as valve spool seals. Swelling of these seals can result in binding. The temperature range of Buna-N seals is -40° F to +200° F [-40° C to +93° C].

Table 4-48. Cross-Reference for Seals and O-Rings Buna-N to Viton

Buna-N Part No.		Application
0926-001		Relief Seal
1615-001		Relief and Check Seal
21733-001	N/A	Large Section Seal
21735-001	N/A	Small Section Seal
1660-001	N/A	Check Seal
1698-001		Relief and Check Seal
1718-001	N/A	Relief and Check Seal
2707-001		Relief Seal
2709-001		Relief Plug Seal
6814-001		Relief Seal
7877-001	N/A	Piston Seal
7951-001	N/A	Piston Seal

Optional Viton Seals and O-Rings

Viton seals are recommended for most applications that use phosphate-ester type fluids. Viton seals are also recommended for applications that have a continuous operating temperature of +200° F [+93° C] or more. Viton seals are available for Gresen Model V42 Valves.

Table 4-49 Cross-Reference For Seal Kits. Buna-N to Viton

Buna-N Part No.	Viton Part No.	Application
K-7014	K-28033	No Relief "NR" Plug Kit
K-7018	K-7020	Check Plug Kit
K-28029	K-28032	Spool and Section Seals

Table 4-50. Cylinder Port Plugs and Seals for 3-Way Work Sections

Part No.	Application
1282-001	Cylinder Port Plug (3/4" NPTF)
1288-001	Cylinder Port Plug (1" NPTF)
1726-001	Cylinder Port Plug (SAE 12)
1629-001	Cylinder Port Plug (SAE 16)
2708-001	O-Ring for SAE 12 Plug
2701-001	O-Ring for SAE 16 Plug

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8. Buyer's Property: Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property, Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Taxes: Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. Indemnity For Infringement of Intellectual Property Rights: Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. Patents, U.S. Trademarks, copyrights, trade dress and trade secrets (hereinafter 'Intellectual Property Rights'). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights. If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgments resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

11. Force Majeure: Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'Events of Force Majeure'). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

9/91-P

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