

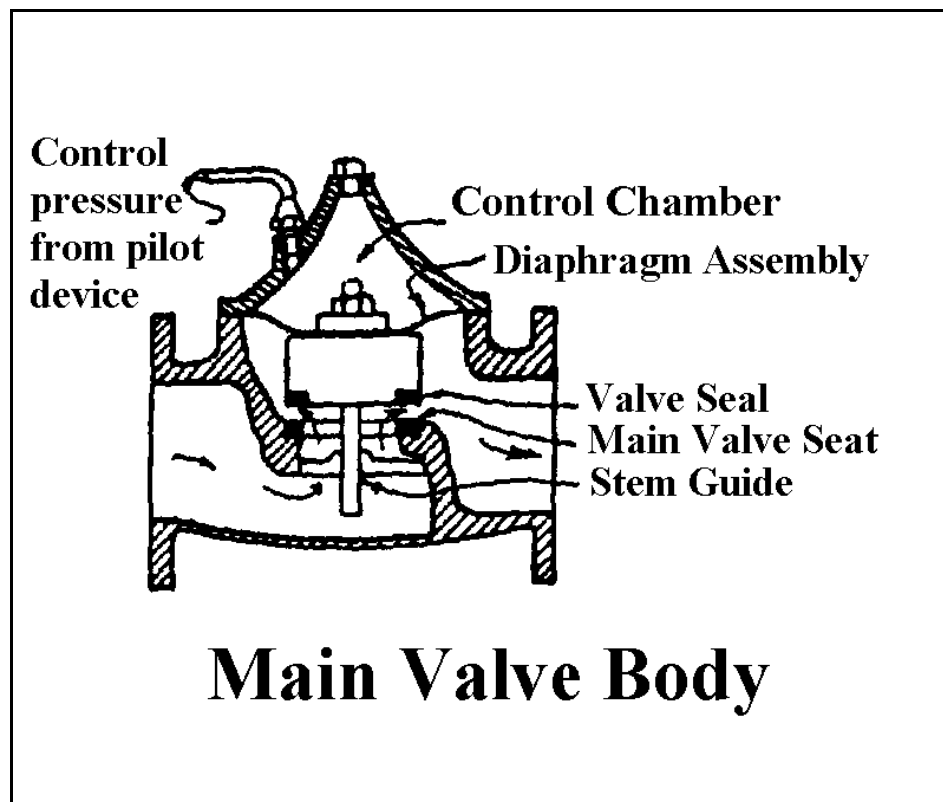
## HOW TO DO STUFF: CHAPTER 3

### DISTRIBUTION SYSTEM CONTROL VALVES

In distribution systems, situations develop that require control of pressures or flows in certain areas of the system. In low areas pressures may exceed the pressure ratings of the piping, requiring pressure reduction and pressure relief. Storage tanks must be isolated when they are full to prevent overflow of tanks at lower elevations. Flows must be limited in some areas so that pressures can be sustained in other areas. Pump flows must be gradually introduced into transmission lines to avoid pressure surges and water hammer that can damage piping. Control valves are used to deal with all of these situations.

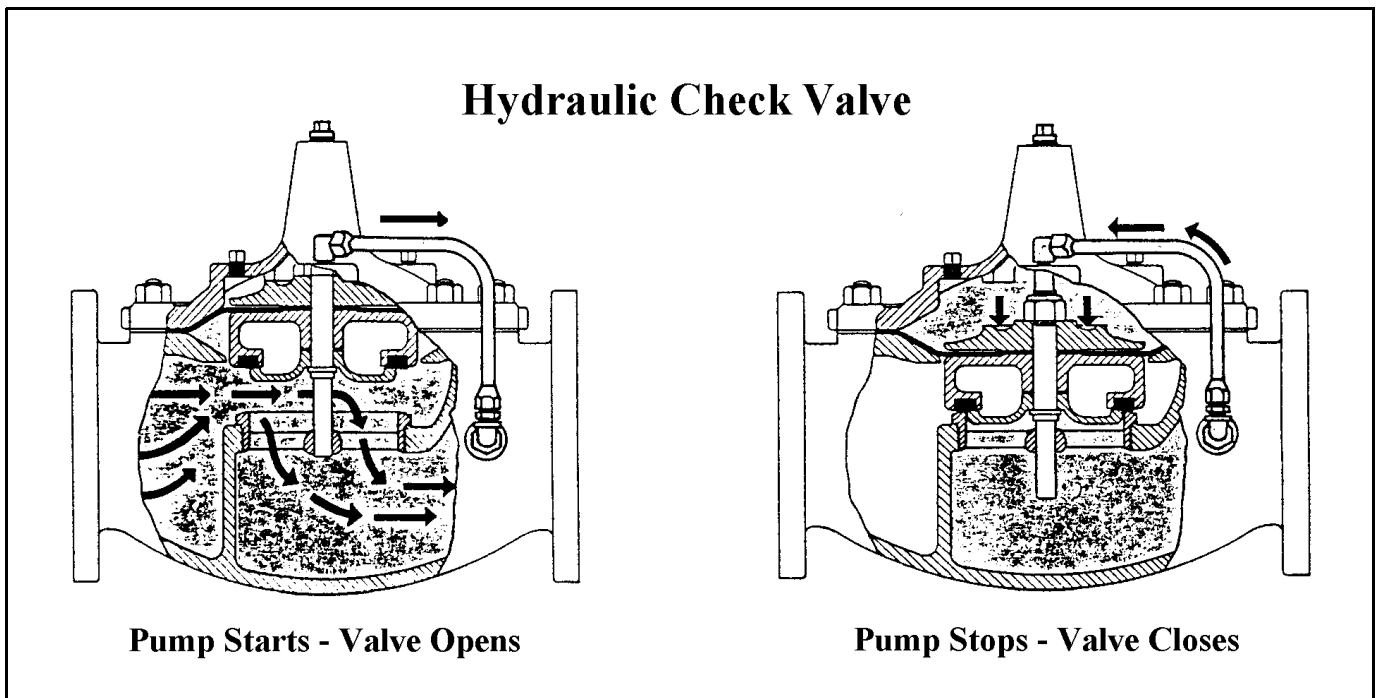
#### CONTROL VALVES

Control valves are usually one of the least understood components of a water system. They are designed to control the flow of water by reacting to changes in the system and automatically opening or closing the valve to compensate. They are globe valves. They share the same basic design as a hose bib valve. The difference is these valves are hydraulically operated, diaphragm actuated, globe valves. The type of pilot or control mechanism that is placed on the valve determines the specific use of a control valve. A control valve can be used as a pump control valve, a pressure reducing valve, a pressure relief valve, a pressure sustaining valve, an altitude valve, or a check valve.



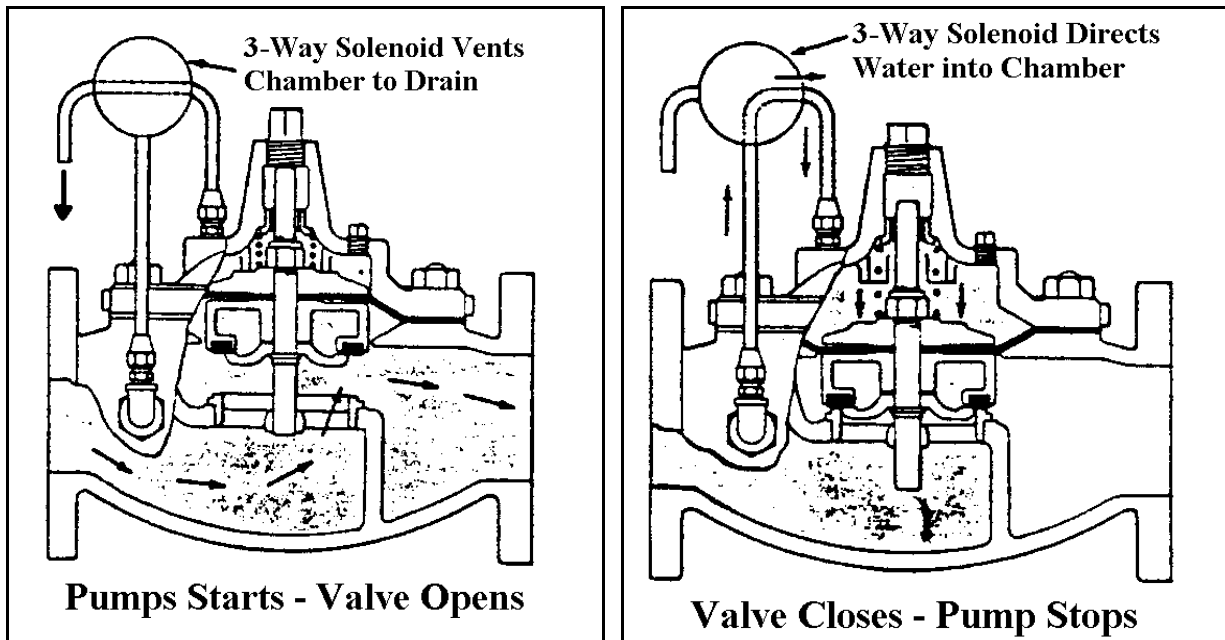
## HYDRAULIC CHECK/PUMP CONTROL VALVES

The hydraulic check valve is the simplest form of control valve. It is unique because it is the only application that requires the valve to be turned around backwards so that the flow is over-and-under instead of under-and over the main valve seat. The control piping is simply a line from the downstream side of the valve. When the pump starts, the higher inlet pressure pushes water out of the control chamber. This opens the valve. When the pump stops, the higher outlet pressure closes the valve by putting water in the control chamber.



Pump control valves are found on large high-pressure booster pumps. They act as check valves and provide surge protection for the system. A booster pump that moves several hundred gallons a minute to a storage tank can cause severe pressure surges (water hammer) in the distribution system. The water in the main is coming toward the pump from the tank before the pump starts. The pump will reach its rated flow in about 2 seconds. If that flow hits the flow coming down from the tank at full force it can easily develop enough energy to burst the pipe.

A pump control valve is shut when the pump starts and opens slowly to gradually introduce the flow into the line over 30-90 seconds. When the pump is turned "Off", the control valve closes slowly and the pump stops after the valve is closed. A 3-way solenoid valve is used to operate a single chamber pump control valve.



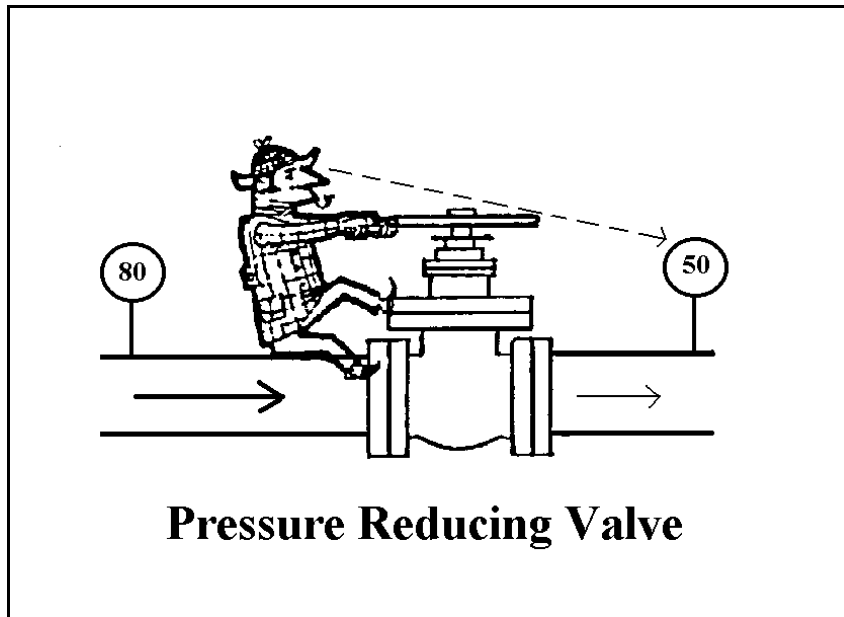
## Single Chamber Pump Control Valve w/3-Way Solenoid

When the pump starts the solenoid directs water from the control chamber to drain and the valve opens. Before the pump is stops, the system pressure is applied to control chamber to close the valve. Flow controlling needle valves are installed on the vent and fill lines to adjust the opening and closing speeds of the valve. A drop check valve feature is available on many models. It allows the disc to slide down the shaft and close the valve like a normal check valve. This closes the valve quickly if a power failure shuts the pump down first.

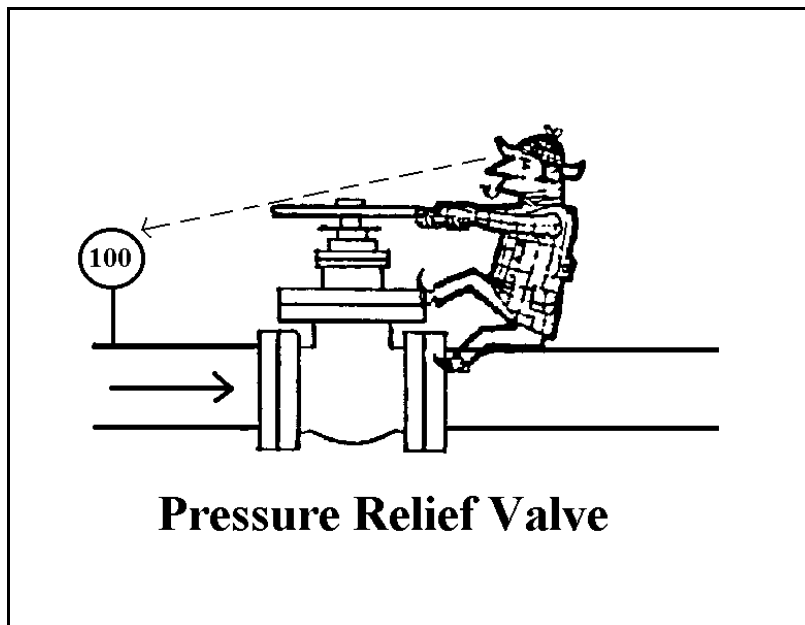
### AUTOMATIC CONTROL VALVE APPLICATIONS

Other common applications for control valves in water systems involve adjusting valve positions based on changing conditions in the system. A pilot control is mounted on the main valve and is used to reduce pressures, relieve pressures, sustain upstream pressures, or prevent overflow of storage tanks. The pilot control will direct water into and out of the control chamber to open and close the main valve. The control pressure or setpoint is maintained as the main valve position modulates. The setpoint can be adjusted to tune the valve to specific conditions for a particular part of the system

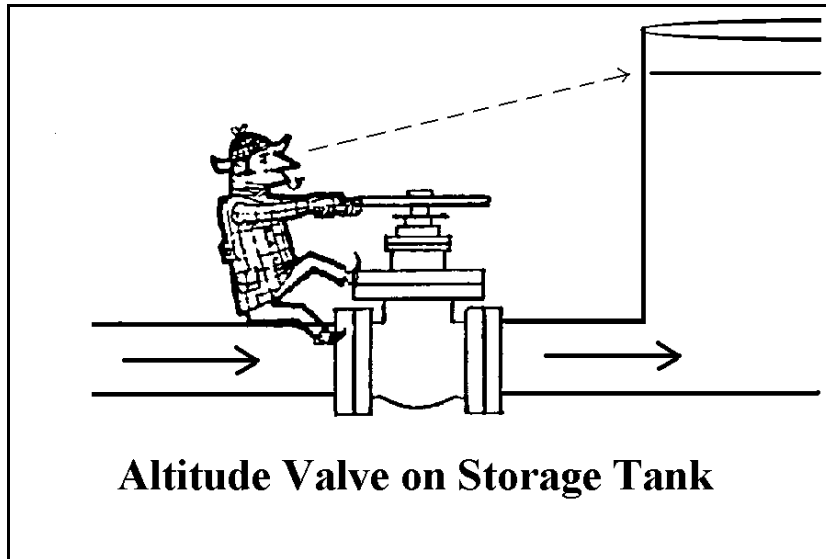
In order to understand the principles behind the operation of each type of valve, let's remove the hydraulic pilot control and hire a person to do the job of controlling the valve operation. We can call him "Pilot".



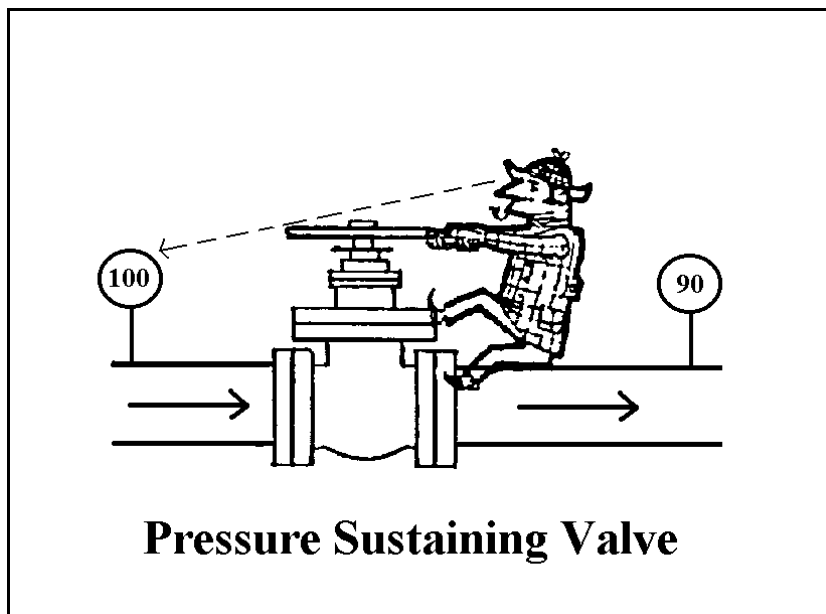
If pressure reduction is needed, Pilot will have to keep an eye on the downstream pressure gauge. His job, in this case, is to keep the downstream pressure at 50 psi. If the pressure is 50 psi, he doesn't have to do anything. The upstream pressure is 80 psi and the main valve stays in some partly closed position to create about 30 psi of pressure drop across the valve. If the downstream pressure drops below 50 psi, he will need to open the valve until it rises back up to setpoint. If the pressure goes up, he'll close the main valve until it drops back down.



When we need pressure relief, Pilot will need to keep an eye on the upstream pressure gauge. As long as the upstream pressure is below the 100 psi setpoint, he will make sure the valve is closed. When the pressure gets above 100 psi, he'll have to open the valve just enough to drop it back down to 100. When the pressure drops below 100 psi again, he'll close the valve completely.

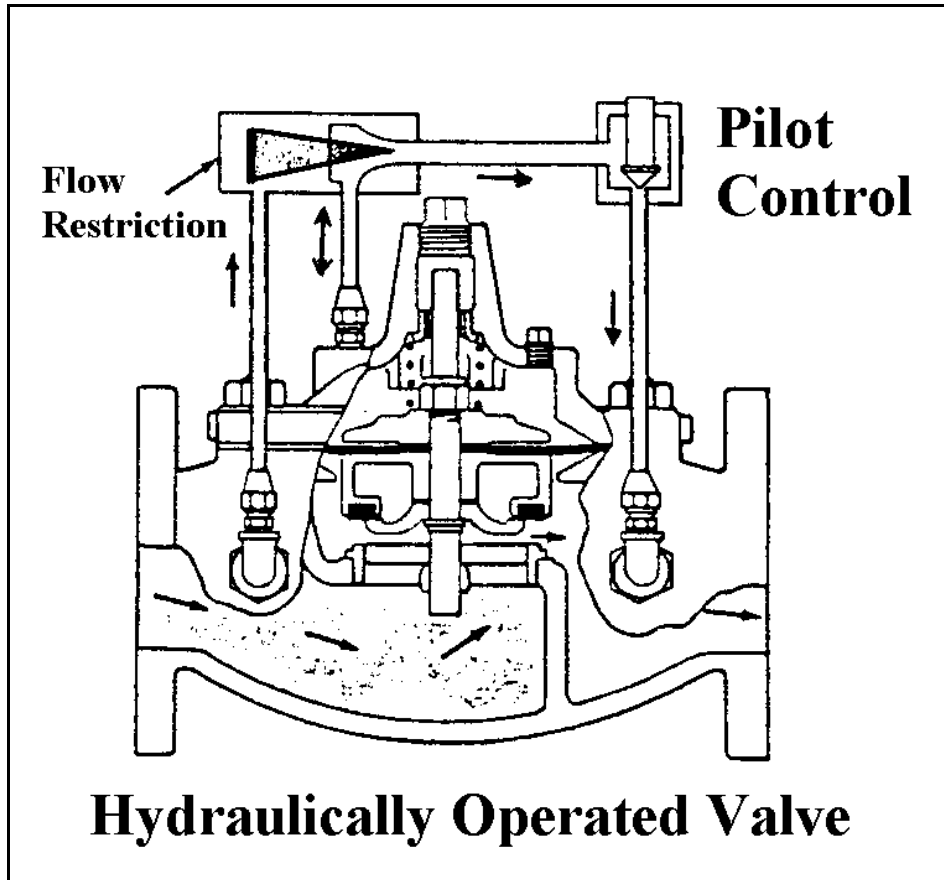


An altitude valve prevents a storage tank from overflowing. Pilot will need to pay attention to the water level in the tank. As long as the level is below the setpoint level he'll keep the valve open. When the tank is full he'll close the valve.



A pressure sustaining valve is needed when downstream use threatens to drop upstream pressures below acceptable levels. Pilot will have to focus on the upstream pressure gauge again. As long as the upstream pressure is above the 100 psi setpoint, he'll leave the valve wide open. He'll close the valve, limiting downstream flow, to prevent the pressure upstream from dropping below setpoint.

There are hydraulic pilot controls that serve the same function as our "Pilot". They are designed to sense upstream or downstream pressures and react to changes that occur in the system. A typical pilot control assembly will pipe water from the upstream side of the valve to the downstream side of the valve. A "tee" will connect the piping to the control chamber. A flow restriction is located upstream of the tee to the control chamber and the pilot device is located on the downstream side of the tee.

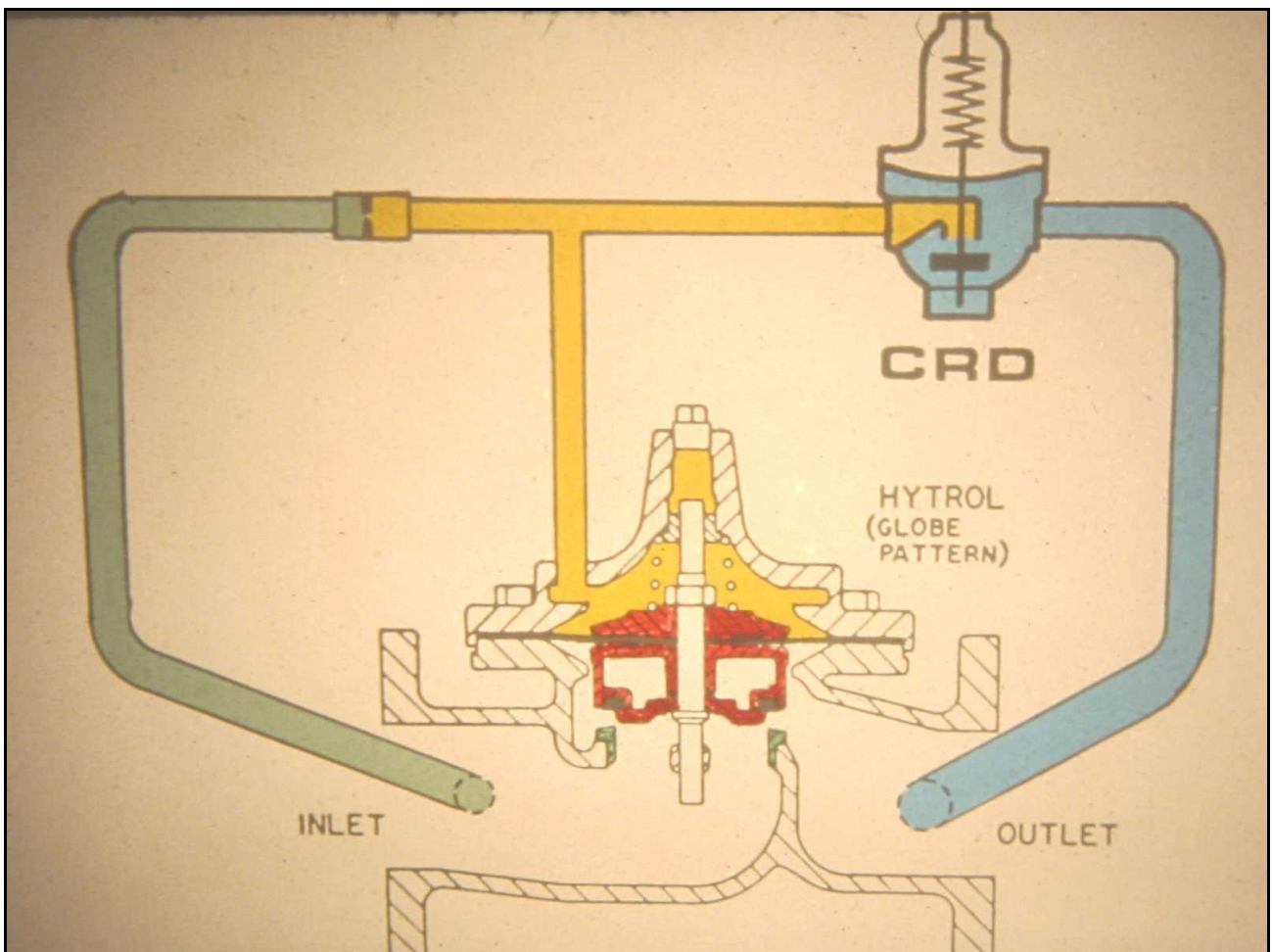


Depending on the conditions the pilot control will do one of three things:

- 1 - It will let water out of the control loop at a higher rate than it comes in. The "extra" water that leaves will come out of the main valve control chamber and the valve will open. The flow restriction located on the upstream side of the control loop makes this possible. Without it, the valve will always be closed.
- 2 - It will let water out of the control loop at a lower rate than it comes in. The "extra" water that comes in will go into the main valve control chamber and the valve will close.
- 3 - It will let water out of the control loop at the same rate as it comes in. When "in" and "out" are equal the valve will remain in the same, modulated position.

## PRESSURE REDUCING VALVES

Pressure reducing valves are used in areas where system pressures can exceed the pressure rating of the piping. The pilot is normally open and closes as the downstream pressure rises. This closes the valve and creates additional head loss to drop the downstream pressure. As the pressure drops, it opens and allows the main valve to come open to raise the downstream pressure. The setpoint for the downstream pressure can be increased and decreased by tightening and loosening the pilot adjusting screw. This changes the spring force on the diaphragm and the pressure required affecting a change in the pilot position.



## Typical Pressure Reducing Valve Control Piping

There is a maximum and minimum flow that a PRV can handle. When the flow drops too low the valve will chatter or start slamming open and closed. This will create severe water hammer problems. To avoid this problem, PRV's are sometimes installed in pairs with a small valve in parallel with the larger valve. The small valve is set at a higher pressure. This will allow it to handle the low flows and keep the large valve shut so it doesn't chatter.

<b>C</b>	<b>CLAYTON automatic VALVES</b>	<b>PARTS LIST</b>																																																																																																								
<b>PRESSURE REDUCING CONTROL</b>		<i>Clayton</i> <b>CRD</b>																																																																																																								
		STOCK NUMBERS																																																																																																								
		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">SIZE</th> <th style="width: 40%;">SPRING RANGE</th> <th style="width: 45%;">NUMBER</th> </tr> </thead> <tbody> <tr> <td>3/8"</td> <td>10-40 PSI</td> <td>C-2514</td> </tr> <tr> <td>3/8"</td> <td>20-80 PSI</td> <td>34975</td> </tr> <tr> <td>3/8"</td> <td>30-110 PSI</td> <td>C-2515</td> </tr> <tr> <td>3/8"</td> <td>50-150 PSI</td> <td>C-3453</td> </tr> <tr> <td>3/8"</td> <td>90-200 PSI</td> <td>C-2516</td> </tr> </tbody> </table>	SIZE	SPRING RANGE	NUMBER	3/8"	10-40 PSI	C-2514	3/8"	20-80 PSI	34975	3/8"	30-110 PSI	C-2515	3/8"	50-150 PSI	C-3453	3/8"	90-200 PSI	C-2516																																																																																						
		SIZE	SPRING RANGE	NUMBER																																																																																																						
3/8"	10-40 PSI	C-2514																																																																																																								
3/8"	20-80 PSI	34975																																																																																																								
3/8"	30-110 PSI	C-2515																																																																																																								
3/8"	50-150 PSI	C-3453																																																																																																								
3/8"	90-200 PSI	C-2516																																																																																																								
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">ITEM</th> <th style="width: 30%;">DESCRIPTION</th> <th style="width: 20%;">MATERIAL</th> <th style="width: 40%;">PART NUMBER</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>HOUSING, ADJ. SCREW</td> <td>BRASS</td> <td>C-1795</td> </tr> <tr> <td>2</td> <td>ADJUSTING SCREW</td> <td>NAVAL BRASS</td> <td>C-6666</td> </tr> <tr> <td></td> <td>1/4" CRD PSI RANGE 90-300</td> <td>BRASS</td> <td>35088</td> </tr> <tr> <td>3</td> <td>JAM NUT A.S.R. 3/8" - 16</td> <td>BRASS</td> <td>67801-01</td> </tr> <tr> <td>4</td> <td>MACHINE SCREW FILL, HD.-8 REQ. 10-32 X 1/2</td> <td>BRASS</td> <td>67578-05</td> </tr> <tr> <td>5</td> <td>COVER</td> <td>BRASS</td> <td>C-2544</td> </tr> <tr> <td>6</td> <td>DRIVE SCREW</td> <td>STEEL-CAD. PL.</td> <td>67999</td> </tr> <tr> <td>7</td> <td>DATA PLATE</td> <td>BRASS</td> <td>C-22</td> </tr> <tr> <td>8</td> <td>SPRING GUIDE</td> <td>STAINLESS STEEL</td> <td>C-1510</td> </tr> <tr> <td>9</td> <td>SPRING</td> <td></td> <td></td> </tr> <tr> <td></td> <td>PSI RANGE 10-30</td> <td>CHROME VANADIUM</td> <td>TV-5654</td> </tr> <tr> <td></td> <td>PSI 20-80</td> <td>302 S.S.</td> <td>32447</td> </tr> <tr> <td></td> <td>PSI 30-110</td> <td>MUSIC WIRE</td> <td>TV-5695</td> </tr> <tr> <td>10</td> <td>PSI 50-150</td> <td>MUSIC WIRE</td> <td>C-1124</td> </tr> <tr> <td></td> <td>PSI 90-200</td> <td>MUSIC WIRE</td> <td>TV-6515</td> </tr> <tr> <td>10</td> <td>DIAPHRAGM</td> <td>BRASS</td> <td>TV-5911</td> </tr> <tr> <td>11</td> <td>DIAPHRAGM NUT</td> <td>BRASS</td> <td>TV-5910</td> </tr> <tr> <td>12 *</td> <td>DIAPHRAGM WASHER</td> <td>FAIRPRENE</td> <td>C-1796</td> </tr> <tr> <td>13</td> <td>PLUG</td> <td>BRASS</td> <td>TV-5653</td> </tr> <tr> <td>14 *</td> <td>GASKET (JL-174)</td> <td>FIBER</td> <td>40174</td> </tr> <tr> <td>16 *</td> <td>DISC RETAINER ASSEMBLY</td> <td>BRASS-RUBBER</td> <td>C-5256</td> </tr> <tr> <td>17</td> <td>YOKE</td> <td>BRONZE</td> <td>TV-6951</td> </tr> <tr> <td>18 &amp;</td> <td>BODY &amp; SEAT ASSEMBLY</td> <td></td> <td></td> </tr> <tr> <td></td> <td>1/4" IPS BODY W/SEAT IN PLACE</td> <td>BRASS &amp; S.S.</td> <td>39843</td> </tr> <tr> <td></td> <td>3/8" IPS BODY W/SEAT IN PLACE</td> <td>BRASS &amp; S.S.</td> <td>39847</td> </tr> </tbody> </table>			ITEM	DESCRIPTION	MATERIAL	PART NUMBER	1	HOUSING, ADJ. SCREW	BRASS	C-1795	2	ADJUSTING SCREW	NAVAL BRASS	C-6666		1/4" CRD PSI RANGE 90-300	BRASS	35088	3	JAM NUT A.S.R. 3/8" - 16	BRASS	67801-01	4	MACHINE SCREW FILL, HD.-8 REQ. 10-32 X 1/2	BRASS	67578-05	5	COVER	BRASS	C-2544	6	DRIVE SCREW	STEEL-CAD. PL.	67999	7	DATA PLATE	BRASS	C-22	8	SPRING GUIDE	STAINLESS STEEL	C-1510	9	SPRING				PSI RANGE 10-30	CHROME VANADIUM	TV-5654		PSI 20-80	302 S.S.	32447		PSI 30-110	MUSIC WIRE	TV-5695	10	PSI 50-150	MUSIC WIRE	C-1124		PSI 90-200	MUSIC WIRE	TV-6515	10	DIAPHRAGM	BRASS	TV-5911	11	DIAPHRAGM NUT	BRASS	TV-5910	12 *	DIAPHRAGM WASHER	FAIRPRENE	C-1796	13	PLUG	BRASS	TV-5653	14 *	GASKET (JL-174)	FIBER	40174	16 *	DISC RETAINER ASSEMBLY	BRASS-RUBBER	C-5256	17	YOKE	BRONZE	TV-6951	18 &	BODY & SEAT ASSEMBLY				1/4" IPS BODY W/SEAT IN PLACE	BRASS & S.S.	39843		3/8" IPS BODY W/SEAT IN PLACE	BRASS & S.S.	39847
ITEM	DESCRIPTION	MATERIAL	PART NUMBER																																																																																																							
1	HOUSING, ADJ. SCREW	BRASS	C-1795																																																																																																							
2	ADJUSTING SCREW	NAVAL BRASS	C-6666																																																																																																							
	1/4" CRD PSI RANGE 90-300	BRASS	35088																																																																																																							
3	JAM NUT A.S.R. 3/8" - 16	BRASS	67801-01																																																																																																							
4	MACHINE SCREW FILL, HD.-8 REQ. 10-32 X 1/2	BRASS	67578-05																																																																																																							
5	COVER	BRASS	C-2544																																																																																																							
6	DRIVE SCREW	STEEL-CAD. PL.	67999																																																																																																							
7	DATA PLATE	BRASS	C-22																																																																																																							
8	SPRING GUIDE	STAINLESS STEEL	C-1510																																																																																																							
9	SPRING																																																																																																									
	PSI RANGE 10-30	CHROME VANADIUM	TV-5654																																																																																																							
	PSI 20-80	302 S.S.	32447																																																																																																							
	PSI 30-110	MUSIC WIRE	TV-5695																																																																																																							
10	PSI 50-150	MUSIC WIRE	C-1124																																																																																																							
	PSI 90-200	MUSIC WIRE	TV-6515																																																																																																							
10	DIAPHRAGM	BRASS	TV-5911																																																																																																							
11	DIAPHRAGM NUT	BRASS	TV-5910																																																																																																							
12 *	DIAPHRAGM WASHER	FAIRPRENE	C-1796																																																																																																							
13	PLUG	BRASS	TV-5653																																																																																																							
14 *	GASKET (JL-174)	FIBER	40174																																																																																																							
16 *	DISC RETAINER ASSEMBLY	BRASS-RUBBER	C-5256																																																																																																							
17	YOKE	BRONZE	TV-6951																																																																																																							
18 &	BODY & SEAT ASSEMBLY																																																																																																									
	1/4" IPS BODY W/SEAT IN PLACE	BRASS & S.S.	39843																																																																																																							
	3/8" IPS BODY W/SEAT IN PLACE	BRASS & S.S.	39847																																																																																																							
<p>MINIMUM CHARGE \$5.00      PRICES SUBJECT TO CHANGE WITHOUT NOTICE * F O B. NEWPORT BEACH, CALIFORNIA      *RECOMMENDED SPARE PARTS</p> <p>When ordering parts specify:      • All nameplate data      • Description      • Part Number             • Item Number     • Material</p> <p style="font-size: small;">PATENTS ISSUED AND/OR PENDING      LITHO IN U.S.A.      <b>CLA-VAL CO.</b> Newport Beach, California</p>																																																																																																										

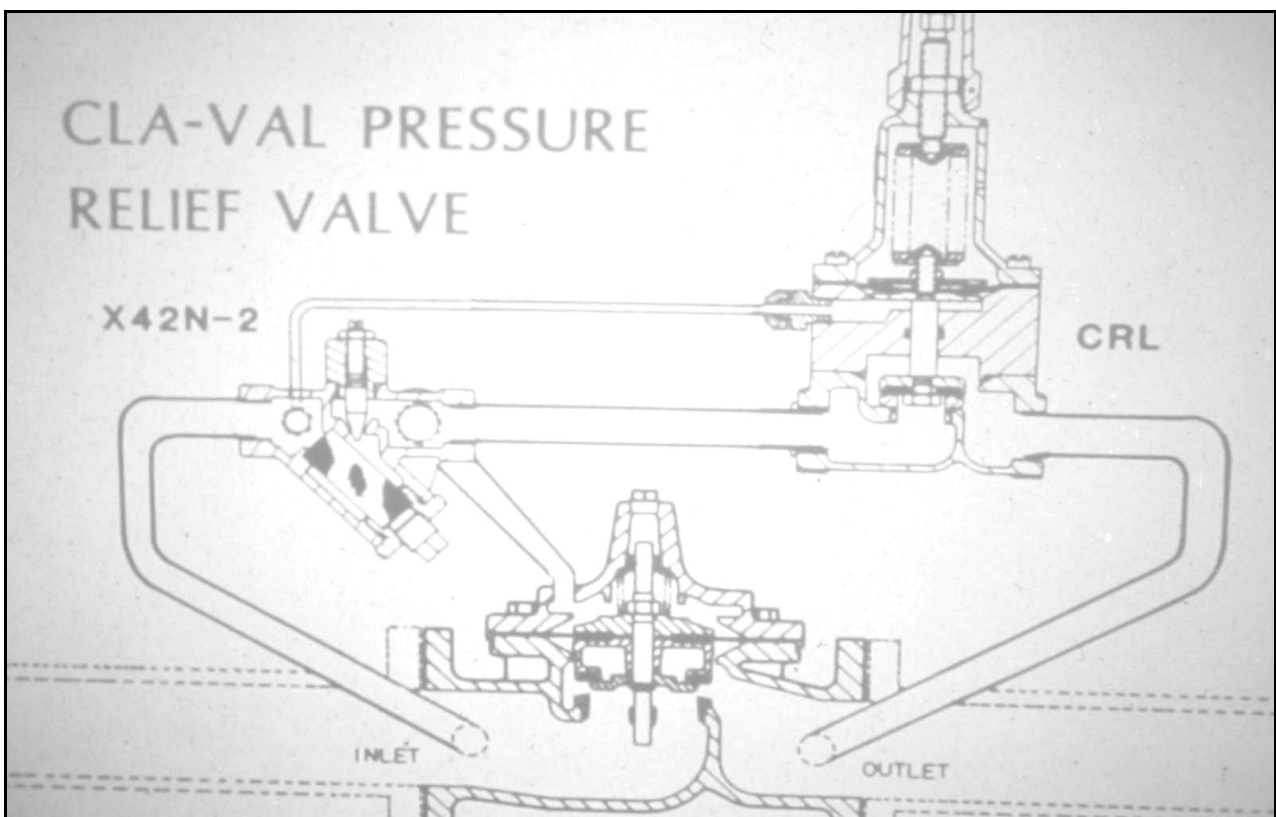
The Clay Valve Company produces the market share of the control valves used in water systems. There are several other manufacturers of these valves though. Their pilot controls may look slightly different but they will operate on the same principles. Three constants with regards to troubleshooting these units are:

- A) Water leaking from the vent hole in the housing indicates a diaphragm leak.
- B) Leakage through the unit when it is supposed to be closed indicates a valve seal failure.
- C) Failure to open far enough to allow the main valve to open indicates the valve guide, located in the plug, is clogged or the disc retainer assembly is bent.

## PRESSURE RELIEF VALVES

Pressure relief valves are used to provide protection against high pressures that may develop in the system. They should be located in any part of the system where pressure is controlled by a pressure reducing valve. They are also used at booster pump stations and on wells that discharge directly to distribution. When the valve senses a high pressure upstream, it will open to pass enough water to drop the pressure back down to setpoint. The water is usually discharged to a storm sewer or ditch. If the pressure upstream drops, it will close automatically.

Tightening the adjusting screw (clock-wise) will raise the relief setpoint and loosening the screw lowers the setpoint. The setpoint should be about 10-15 psi higher than the normal system pressure at that location. This is accomplished by lowering the setpoint until the valve comes open at normal system pressure and then tightening the adjusting screw one full turn.



## Typical Pressure Relief Valve Control Piping

The relief pilot is normally closed. A sensing line extends back upstream of the flow restriction. As the pressure upstream is applied to the bottom of the pilot diaphragm, it lifts the seat and opens the pilot. This action releases water from the control chamber and opens the main valve. As the upstream pressure drops, the diaphragm spring force closes the pilot and the main valve.

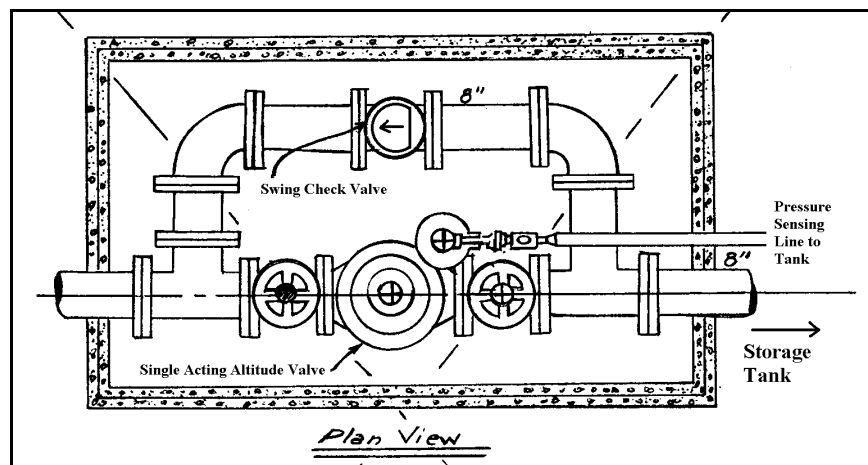
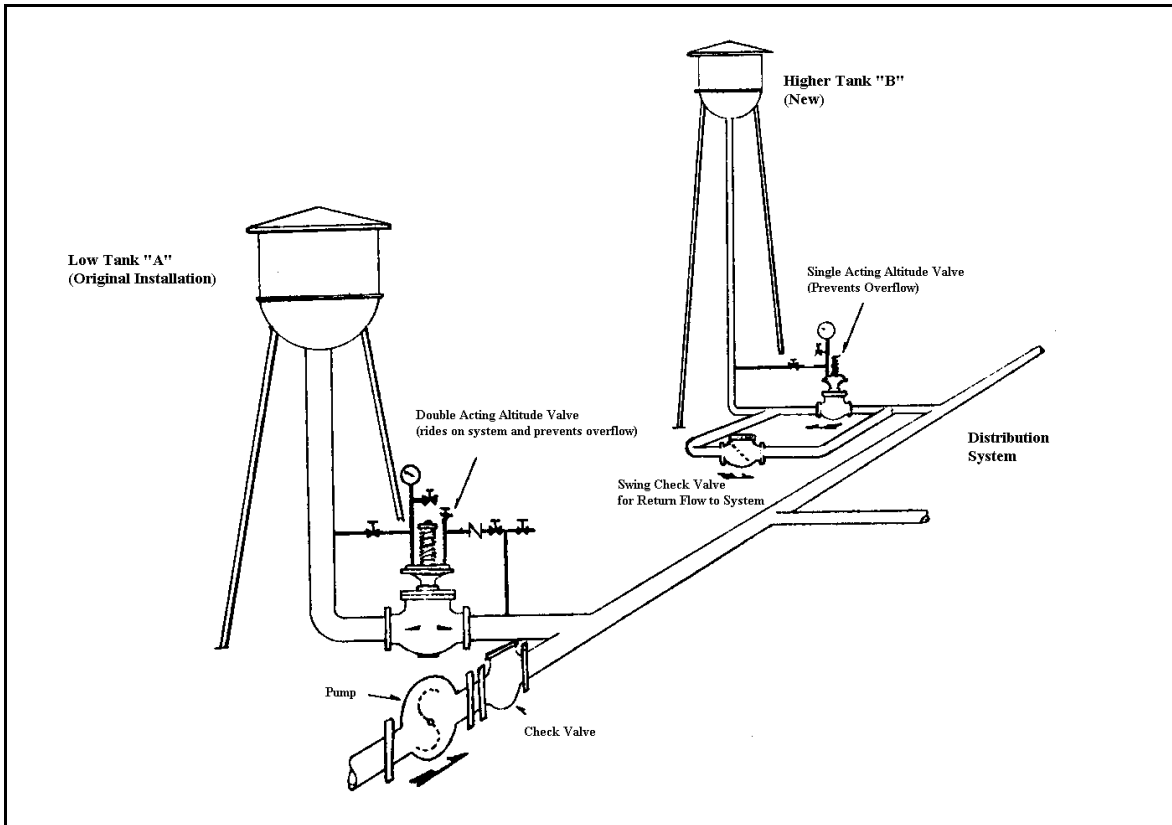
<b>C</b> <b>CLAYTON automatic VALVES</b>		<b>PARTS LIST</b>																																																																																																					
<b>PRESSURE RELIEF CONTROL</b>		<i>Clayton CRL5</i>																																																																																																					
		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3" style="text-align: center;">STOCK NUMBERS</th> </tr> <tr> <th style="text-align: center;">SIZE</th> <th style="text-align: center;">SPRING RANGE</th> <th style="text-align: center;">NUMBER</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">1/2"</td><td style="text-align: center;">0-7 PSI</td><td style="text-align: center;">C-9289</td></tr> <tr><td style="text-align: center;">1/2"</td><td style="text-align: center;">5-25 PSI</td><td style="text-align: center;">C-9292</td></tr> <tr><td style="text-align: center;">1/2"</td><td style="text-align: center;">10-60 PSI</td><td style="text-align: center;">34974</td></tr> <tr><td style="text-align: center;">1/2"</td><td style="text-align: center;">20-80 PSI</td><td style="text-align: center;">C-9290</td></tr> <tr><td style="text-align: center;">1/2"</td><td style="text-align: center;">50-150 PSI</td><td style="text-align: center;">C-9288</td></tr> <tr><td style="text-align: center;">1/2"</td><td style="text-align: center;">65-180 PSI</td><td style="text-align: center;">C-9291</td></tr> <tr><td style="text-align: center;">3/4"</td><td style="text-align: center;">0-7 PSI</td><td style="text-align: center;">43352</td></tr> <tr><td style="text-align: center;">3/4"</td><td style="text-align: center;">5-25 PSI</td><td style="text-align: center;">C-9295</td></tr> <tr><td style="text-align: center;">3/4"</td><td style="text-align: center;">20-80 PSI</td><td style="text-align: center;">C-9293</td></tr> <tr><td style="text-align: center;">3/4"</td><td style="text-align: center;">50-150 PSI</td><td style="text-align: center;">41924</td></tr> <tr><td style="text-align: center;">3/4"</td><td style="text-align: center;">65-180 PSI</td><td style="text-align: center;">C-9294</td></tr> </tbody> </table>		STOCK NUMBERS			SIZE	SPRING RANGE	NUMBER	1/2"	0-7 PSI	C-9289	1/2"	5-25 PSI	C-9292	1/2"	10-60 PSI	34974	1/2"	20-80 PSI	C-9290	1/2"	50-150 PSI	C-9288	1/2"	65-180 PSI	C-9291	3/4"	0-7 PSI	43352	3/4"	5-25 PSI	C-9295	3/4"	20-80 PSI	C-9293	3/4"	50-150 PSI	41924	3/4"	65-180 PSI	C-9294																																																													
STOCK NUMBERS																																																																																																							
SIZE	SPRING RANGE	NUMBER																																																																																																					
1/2"	0-7 PSI	C-9289																																																																																																					
1/2"	5-25 PSI	C-9292																																																																																																					
1/2"	10-60 PSI	34974																																																																																																					
1/2"	20-80 PSI	C-9290																																																																																																					
1/2"	50-150 PSI	C-9288																																																																																																					
1/2"	65-180 PSI	C-9291																																																																																																					
3/4"	0-7 PSI	43352																																																																																																					
3/4"	5-25 PSI	C-9295																																																																																																					
3/4"	20-80 PSI	C-9293																																																																																																					
3/4"	50-150 PSI	41924																																																																																																					
3/4"	65-180 PSI	C-9294																																																																																																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">ITEM</th> <th style="text-align: center;">DESCRIPTION</th> <th style="text-align: center;">MATERIAL</th> <th style="text-align: center;">PART NUMBER</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">1</td><td>HOUSING (ADJ. SCREW)</td><td style="text-align: center;">BRASS</td><td style="text-align: center;">C-1795</td></tr> <tr><td style="text-align: center;">2</td><td>JAM NUT 1/4"</td><td style="text-align: center;">SIL. BRZ.</td><td style="text-align: center;">67801-01</td></tr> <tr><td style="text-align: center;">3</td><td>ADJUSTING SCREW</td><td style="text-align: center;">BRASS</td><td style="text-align: center;">C-6666</td></tr> <tr><td style="text-align: center;">4</td><td>FIL. HD. SCREW 10/32 x 1 1/4 (8 REQ.)</td><td style="text-align: center;">SIL. BRZ.</td><td style="text-align: center;">67578-68</td></tr> <tr><td style="text-align: center;">5</td><td>COVER</td><td style="text-align: center;">BRASS</td><td style="text-align: center;">C-2544</td></tr> <tr><td style="text-align: center;">6</td><td>SPRING GUIDE (2 REQ.)</td><td style="text-align: center;">S.S.</td><td style="text-align: center;">C-1510</td></tr> <tr><td style="text-align: center;">7</td><td>SPRING GUIDE (2 REQ.-USED WITH 0-7 PSI SPRING ONLY) * SPRING RANGE</td><td style="text-align: center;">S.S.</td><td style="text-align: center;">C-568</td></tr> <tr><td style="text-align: center;">8</td><td>DIAPHRAGM WASHER-UPPER</td><td style="text-align: center;">BRASS</td><td style="text-align: center;">TV-6137</td></tr> </tbody> </table>		ITEM	DESCRIPTION	MATERIAL	PART NUMBER	1	HOUSING (ADJ. SCREW)	BRASS	C-1795	2	JAM NUT 1/4"	SIL. BRZ.	67801-01	3	ADJUSTING SCREW	BRASS	C-6666	4	FIL. HD. SCREW 10/32 x 1 1/4 (8 REQ.)	SIL. BRZ.	67578-68	5	COVER	BRASS	C-2544	6	SPRING GUIDE (2 REQ.)	S.S.	C-1510	7	SPRING GUIDE (2 REQ.-USED WITH 0-7 PSI SPRING ONLY) * SPRING RANGE	S.S.	C-568	8	DIAPHRAGM WASHER-UPPER	BRASS	TV-6137	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">ITEM</th> <th style="text-align: center;">DESCRIPTION</th> <th style="text-align: center;">MATERIAL</th> <th style="text-align: center;">PART NUMBER</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">9</td><td>* DIAPHRAGM</td><td style="text-align: center;">SYN. RUBBER</td><td style="text-align: center;">C-1505</td></tr> <tr><td style="text-align: center;">10</td><td>DIAPHRAGM WASHER-LOWER</td><td style="text-align: center;">BRASS</td><td style="text-align: center;">TV-6136</td></tr> <tr><td style="text-align: center;">11</td><td>BODY-POWERTROL</td><td style="text-align: center;">BRASS</td><td style="text-align: center;">C-8698</td></tr> <tr><td style="text-align: center;">12</td><td>STEM</td><td style="text-align: center;">S.S.</td><td style="text-align: center;">C-1508</td></tr> <tr><td style="text-align: center;">13</td><td>* "O" RING</td><td style="text-align: center;">SYN. RUBBER</td><td style="text-align: center;">00746</td></tr> <tr><td style="text-align: center;">14</td><td>DISC. RETAINER</td><td style="text-align: center;">BRASS</td><td style="text-align: center;">C-1509</td></tr> <tr><td style="text-align: center;">15</td><td>* DISC.</td><td style="text-align: center;">SYN. RUBBER</td><td style="text-align: center;">C-1506</td></tr> <tr><td style="text-align: center;">16</td><td>DATA PLATE</td><td style="text-align: center;">BRONZE</td><td style="text-align: center;">C-22</td></tr> <tr><td style="text-align: center;">17</td><td>* GASKET-BODY TO BODY</td><td style="text-align: center;">SYN. RUBBER</td><td style="text-align: center;">TV-6911</td></tr> <tr><td style="text-align: center;">18</td><td>SEAT</td><td style="text-align: center;">S.S.</td><td style="text-align: center;">C-1507</td></tr> <tr><td style="text-align: center;">19</td><td>BODY - 1/2"</td><td style="text-align: center;">BRASS</td><td style="text-align: center;">C-7928</td></tr> <tr><td style="text-align: center;">19</td><td>BODY - 3/4"</td><td style="text-align: center;">BRASS</td><td style="text-align: center;">C-9083</td></tr> <tr><td style="text-align: center;">20</td><td>PIPE PLUG - 1/4" NPT (3 REQ.)</td><td style="text-align: center;">BRASS</td><td style="text-align: center;">67660-01</td></tr> <tr><td style="text-align: center;">21</td><td>"O" RING</td><td style="text-align: center;">SYN. RUBBER</td><td style="text-align: center;">00902</td></tr> <tr><td style="text-align: center;">22</td><td>DRIVE SCREW</td><td style="text-align: center;">ST. STEEL</td><td style="text-align: center;">67999</td></tr> </tbody> </table>		ITEM	DESCRIPTION	MATERIAL	PART NUMBER	9	* DIAPHRAGM	SYN. RUBBER	C-1505	10	DIAPHRAGM WASHER-LOWER	BRASS	TV-6136	11	BODY-POWERTROL	BRASS	C-8698	12	STEM	S.S.	C-1508	13	* "O" RING	SYN. RUBBER	00746	14	DISC. RETAINER	BRASS	C-1509	15	* DISC.	SYN. RUBBER	C-1506	16	DATA PLATE	BRONZE	C-22	17	* GASKET-BODY TO BODY	SYN. RUBBER	TV-6911	18	SEAT	S.S.	C-1507	19	BODY - 1/2"	BRASS	C-7928	19	BODY - 3/4"	BRASS	C-9083	20	PIPE PLUG - 1/4" NPT (3 REQ.)	BRASS	67660-01	21	"O" RING	SYN. RUBBER	00902	22	DRIVE SCREW	ST. STEEL	67999
ITEM	DESCRIPTION	MATERIAL	PART NUMBER																																																																																																				
1	HOUSING (ADJ. SCREW)	BRASS	C-1795																																																																																																				
2	JAM NUT 1/4"	SIL. BRZ.	67801-01																																																																																																				
3	ADJUSTING SCREW	BRASS	C-6666																																																																																																				
4	FIL. HD. SCREW 10/32 x 1 1/4 (8 REQ.)	SIL. BRZ.	67578-68																																																																																																				
5	COVER	BRASS	C-2544																																																																																																				
6	SPRING GUIDE (2 REQ.)	S.S.	C-1510																																																																																																				
7	SPRING GUIDE (2 REQ.-USED WITH 0-7 PSI SPRING ONLY) * SPRING RANGE	S.S.	C-568																																																																																																				
8	DIAPHRAGM WASHER-UPPER	BRASS	TV-6137																																																																																																				
ITEM	DESCRIPTION	MATERIAL	PART NUMBER																																																																																																				
9	* DIAPHRAGM	SYN. RUBBER	C-1505																																																																																																				
10	DIAPHRAGM WASHER-LOWER	BRASS	TV-6136																																																																																																				
11	BODY-POWERTROL	BRASS	C-8698																																																																																																				
12	STEM	S.S.	C-1508																																																																																																				
13	* "O" RING	SYN. RUBBER	00746																																																																																																				
14	DISC. RETAINER	BRASS	C-1509																																																																																																				
15	* DISC.	SYN. RUBBER	C-1506																																																																																																				
16	DATA PLATE	BRONZE	C-22																																																																																																				
17	* GASKET-BODY TO BODY	SYN. RUBBER	TV-6911																																																																																																				
18	SEAT	S.S.	C-1507																																																																																																				
19	BODY - 1/2"	BRASS	C-7928																																																																																																				
19	BODY - 3/4"	BRASS	C-9083																																																																																																				
20	PIPE PLUG - 1/4" NPT (3 REQ.)	BRASS	67660-01																																																																																																				
21	"O" RING	SYN. RUBBER	00902																																																																																																				
22	DRIVE SCREW	ST. STEEL	67999																																																																																																				
<small>MINIMUM CHARGE \$5.00      PRICES SUBJECT TO CHANGE WITHOUT NOTICE • F.O.B. NEWPORT BEACH, CALIFORNIA      *RECOMMENDED SPARE PARTS</small>		<b>When ordering parts specify:</b> <ul style="list-style-type: none"> <li style="margin-right: 10px;">• All nameplate data</li> <li style="margin-right: 10px;">• Description</li> <li style="margin-right: 10px;">• Part Number</li> <li style="margin-right: 10px;">• Item Number</li> <li style="margin-right: 10px;">• Material</li> </ul>																																																																																																					
<small>PPL-CRL5 (R1) PATENTS ISSUED AND/OR PENDING</small>		<b>CLA-VAL CO.</b> <i>Newport Beach, California</i>																																																																																																					

Pressure relief pilots are designed to operate under the same basic principle. Troubleshooting the relief pilot is similar to the pressure reducing pilot:

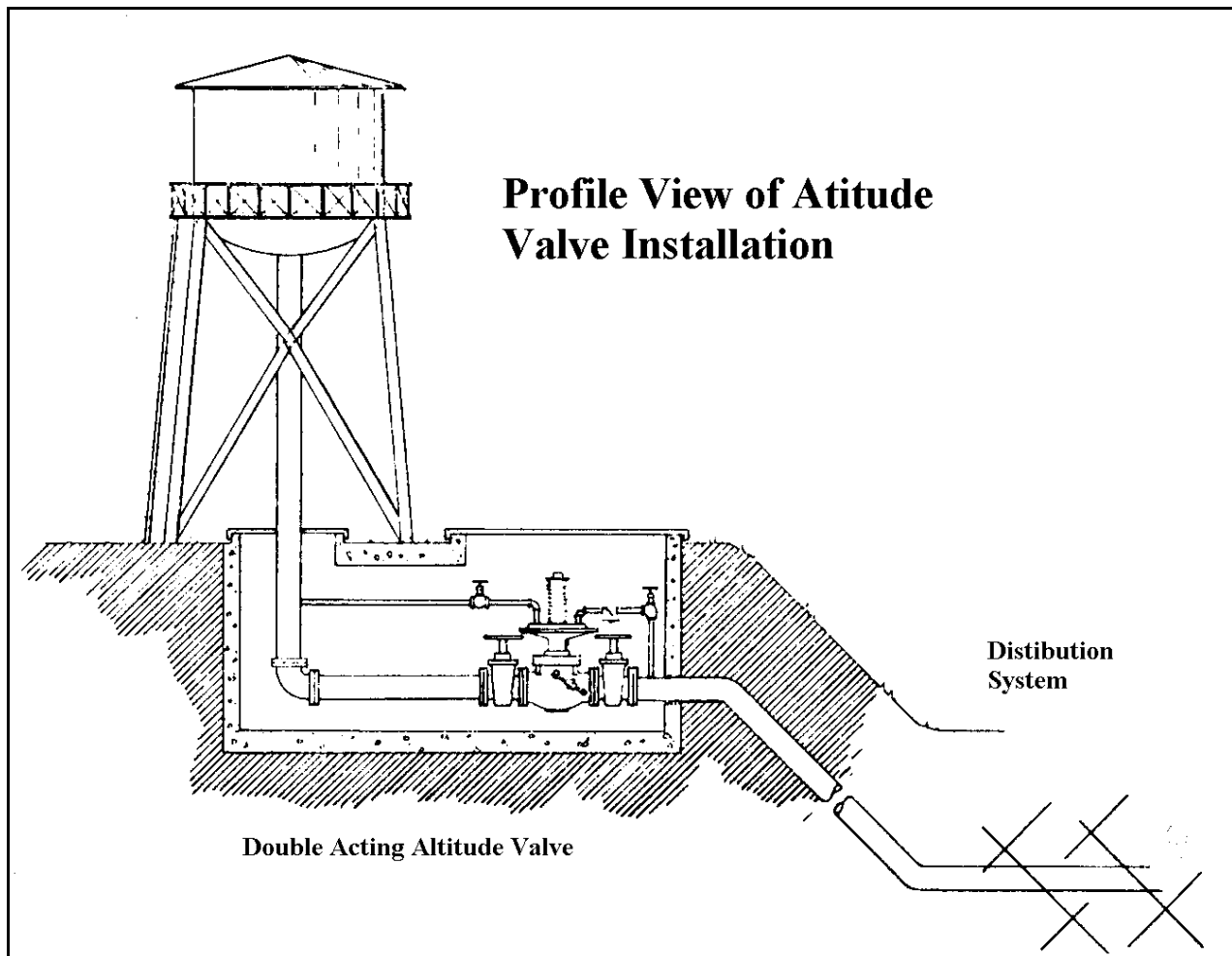
- A) Water leaking from the vent hole in the housing indicates a diaphragm leak.
- B) Leakage through the unit when it is supposed to be closed indicates a valve seal failure.

## ALTITUDE VALVES

An altitude valve is a control valve that is designed to close when an elevated storage tank is full. They are needed when there are several storage tanks at different elevations in a system. Altitude valves will be used on the lower tanks to prevent them from overflowing. Each valve will isolate its tank so that the top tank can be filled and not overflow the lower tanks. A single acting altitude valve will allow the tank to fill and isolate it. But it will not let the water out. A check valve must be installed around the altitude valve to let the water back out of the tank.

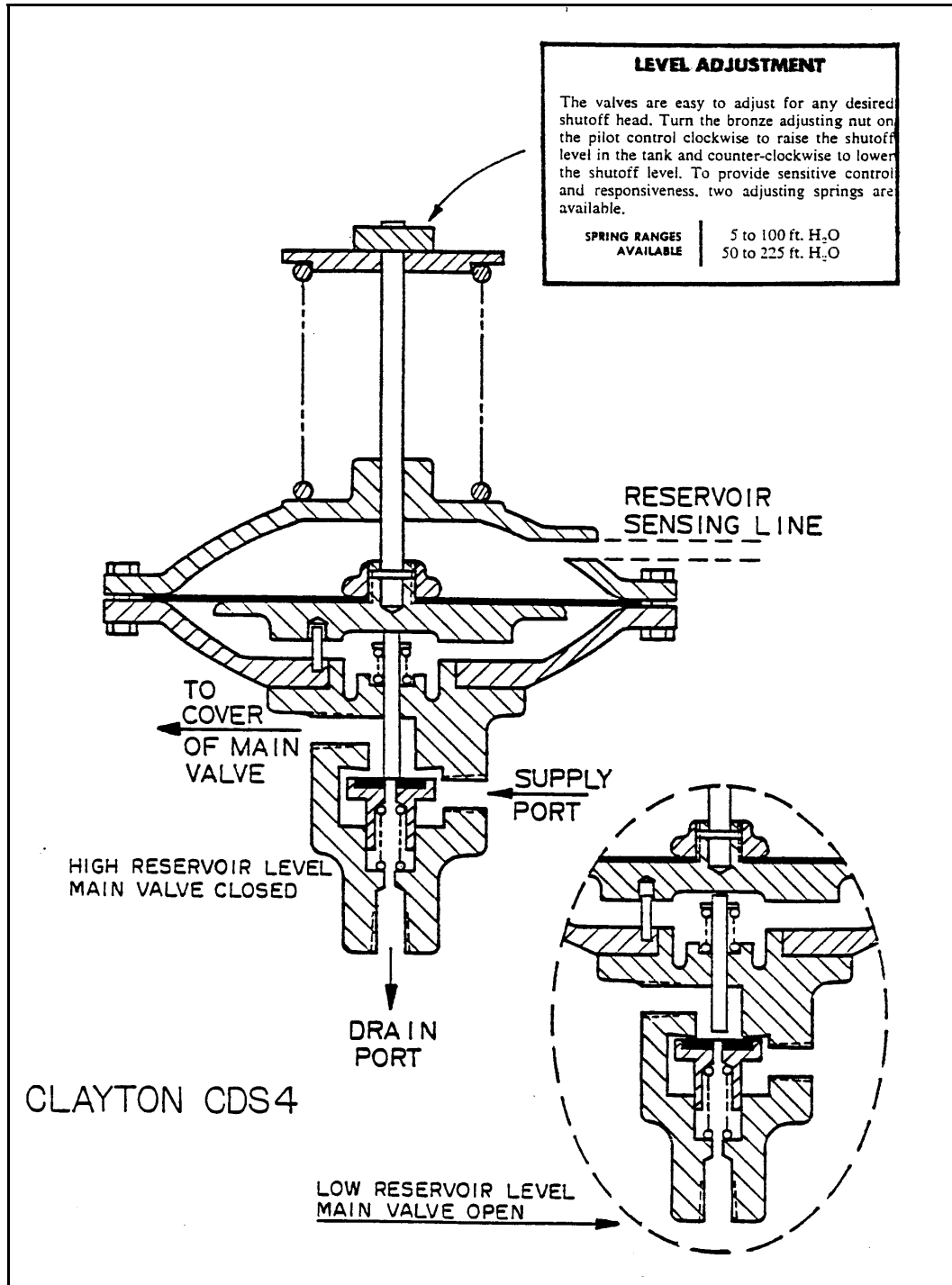


A double acting altitude valve will fill and isolate the tank. But it will open again when the distribution pressure is less than the tank pressure.



The height of the water in the tank can be adjusted by turning the adjustment nut or screw on top of the pilot mechanism. Tighten the nut down to raise the water level and loosen it to lower the level. Adjustments should be made in very small increments and several adjustments may be necessary before the proper level is maintained. It is usually a good idea to adjust the pilot setpoint on a lower elevation late at night when flows are low and the tank will fill more quickly.

Altitude valves are also used where there is only one tank but it is difficult to get telemetry on tank levels back to the pump. Small systems face this problem because they rely on a pressure switch at the pump to turn off the pump before the tank overflows. But the pressure switch is not very accurate and the tank overflows anyway. The installation of the altitude valve will prevent tank overflows. When it closes, the pressure against the pump will increase and the pressure switch will stop the pump.



## **PRESSURE SUSTAINING VALVES**

In some systems there are areas of very heavy water demand that can sometimes "rob" the pressure from upstream areas. A pressure sustaining valve will react to maintain the desired upstream pressure during these conditions and throttle the flow of water to the area of heavy demand. A pressure sustaining valve is actually a pressure relief valve that has a setpoint below the normal system pressure. When the pressure is above setpoint the valve is open. As the upstream pressure drops, the relief pilot closes to throttle the flow in the main valve and maintain the pressure upstream at setpoint.

## **TROUBLESHOOTING PRESSURE REDUCING VALVES**

The following procedures can be used when troubleshooting a pressure reducing valve. The valve must have isolation petcocks on the pilot piping and isolation valves upstream and downstream of the main valve. (See illustration on next page.)

### **I. VARY THE ADJUSTMENT**

#### **A. Increase the setpoint slowly - Turn adjusting screw clockwise**

1. Mark where you start
2. Always count turns
3. Check for change in the downstream pressure

#### **B. Slowly return adjusting screw to the original setting**

This will help identify a burred or bent shaft and give some indication of proper pilot operation. If the pressure rises and falls with the adjustment, proceed to the next step.

### **II. VARY THE FLOW**

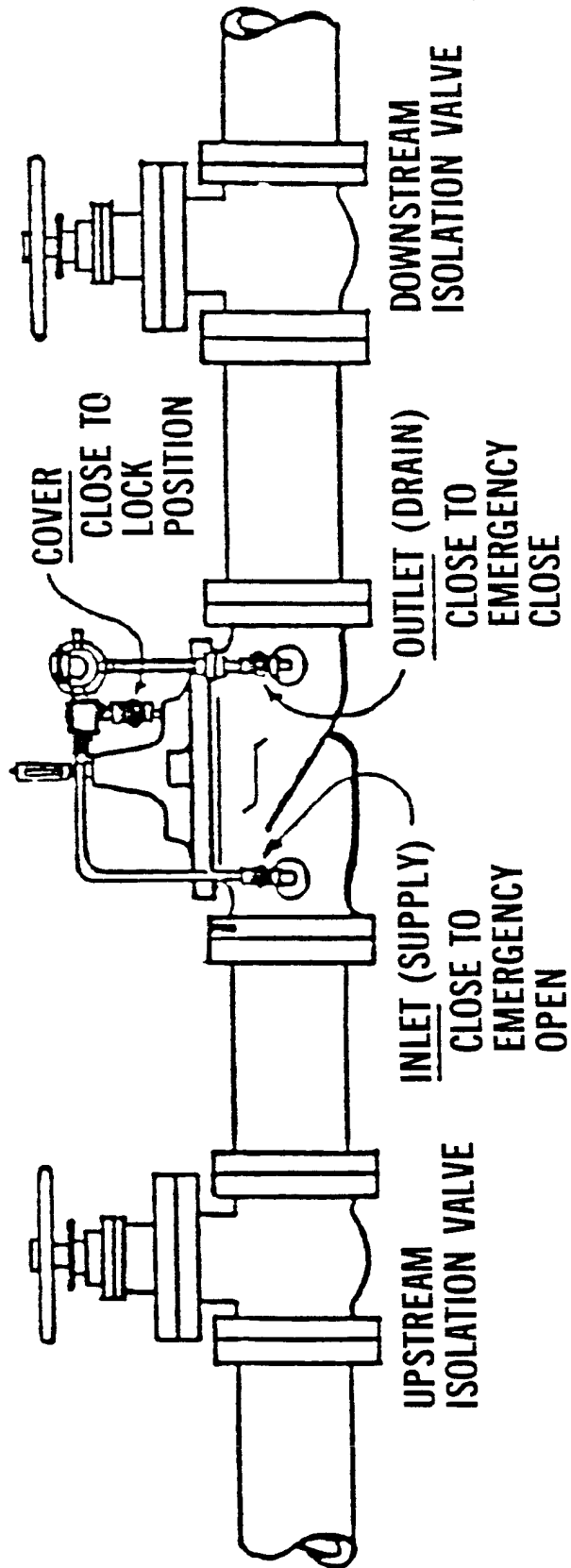
#### **A. Increase the flow**

1. Locate fire hydrant downstream
2. Slowly open the hydrant to increase downstream demand
3. Check the downstream pressure
4. Slowly close the hydrant

Erratic operation can again indicate a shaft problem. If the valve has problems coming open, the yoke on the pilot may be hanging up. If the valve has problems closing, the flow retraction may be clogged.

# TESTING

## WITH PILOT SYSTEM ISOLATION VALVES



B. Decrease the flow

1. Slowly close the downstream isolation valve
2. Remove the gauge or otherwise bleed pressure from the downstream side of the valve and replace
3. Observe valve outlet pressure

The pressure should slowly rise to 5-10 psi greater than the setpoint. If the pressure equalizes with the upstream pressure it can mean one of three things. The main valve seat or diaphragm leaks or the pilot valve seat leaks. Isolate the pilot by closing all three isolation petcocks and replace the seat. Bleed the air and open all of the petcocks. Repeat II.B. If pressures still equalize proceed to III.

III. MANIPULATE THE ISOLATION PETCOCKS

A. Check the main valve seat and diaphragm

1. Slowly close outlet petcock
2. Close downstream isolation valve
3. Bleed the pressure from downstream side of the valve

If the pressure builds back up to the inlet pressure, either the seat or the diaphragm is bad. If the pressure builds back up to the downstream pressure, the downstream isolation valve leaks.

B. Check the main valve diaphragm (full open)

1. Close the downstream isolation valve (from III.A.2)
2. Close the inlet and outlet isolation petcocks
3. Slowly loosen/remove plug on control chamber and bleed pressure from cover
4. Main valve should come full open

If water continues to vent from the cover after the valve is completely open, the diaphragm is ruptured.

C. Check main valve shaft (full closed)

1. Replace plug in cover
2. Open inlet isolation petcock
3. Valve should go closed
4. Check stem travel if indicator is present

If the valve will not go closed, isolate pilot system and clean flow restriction.

# CLAYTON POWERROL STEM TRAVEL CHART

## STEM TRAVEL (FULLY OPENED TO FULLY CLOSED)

VALVE SIZE		TRAVEL	
INCHES	MM	INCHES	MM
1	25	0.3	8
1-1/4	32	0.4	10
1-1/2	40	0.4	10
2	50	0.6	15
2-1/2	65	0.7	18
3	80	0.8	20
4	100	1.1	23
6	150	1.7	43
8	200	2.3	58
10	250	2.8	71
12	300	3.4	86
14	350	3.9	99
16	400	4.5	114

## **TROUBLESHOOTING PRESSURE RELIEF VALVES**

Pressure relief valves are normally closed and don't see the kind of wear that occurs in other valves. They should still be checked annually. Use the following procedure check a relief valve.

### **I. VARY THE ADJUSTMENT**

A. Decrease the setpoint slowly - 1/4 turn at a time

1. Mark where you start
2. Count turns
3. Listen for the valve to come open

The valve should operate smoothly as setpoint is slowly lowered. Sudden surges could indicate shaft problems.

B. Return to original setting

1. Increase setpoint slowly in 1/4 turn increments
  2. After each adjustment wait for valve to stabilize
  3. When closed continue to raise setpoint to original setting or 1 full turn past closed

**CAUTION:** Adjustments must be made very slowly to avoid water hammer.

### **II. VALVE LEAKS**

A. Isolate the pilot

1. Close outlet isolation petcock
2. Valve should close.

If valve still leaks, refer to Sect. III.C. of the pressure reducing troubleshooting guide. If the leak stops, repair the pilot valve seat.