F-1028-3

WATEROUS COMPANY
South St. Paul, MN 55075
January 1983

TALKING POINTS

ON THE RELIEF VALVE

This is a pretty good-sized hunk to bite off for one TALKING POINTS sheet. It is a doubly hard task because there are as many types of relief valves as there are pump manufacturers, so feature comparisons are tough to make.

The WATEROUS relief valve does have some "exclusive features," of course, because it is a little different from any other now on the market.

Rather than try to make comparisons, though, this bulletin will show you how the valve works. You may wish to use this TALKING POINTS bulletin to show your prospects how the WATEROUS relief valve works, since the sales spec sheet we now have on the valve does not go into method of operation.

First, perhaps we should discuss the differences between a relief valve and other pressure control systems. Again, this is probably old stuff to most of you, but it's best to start at the beginning anyhow. Basically, all types of fire pump relief valves do the same thing: they prevent pressures from going above the desired setting by bypassing water from discharge back to suction. In other words, a relief valve keeps both the pump and engine under a constant load.

For example, if you were taking two hose lines off the pump, each at, say, 250 gpm at 150 psi, then suddenly shut down one line, you'd have a pretty good pressure surge on the other line without a relief valve. With a relief valve set at 150 psi, the pressure on the remaining line doesn't jump because the water from the shut down line is now being by-passed from the discharge back to pump suction. The pump and engine are running at the same speed and are really pumping 500 gpm at 150, but you're only using half of it at a constant pressure, 150 psi--the pressure at which you set the relief valve. The rest is bypassed and recirculated through the pump. Of course, the quantity of water bypassed varies greatly under different circumstances, depending on hydrant pressure, etc.

The other common pressure regulator systems, on the other hand, control the throttle setting of the truck. In the same situation discussed before, where you shut down one line, a tube from the discharge side of the pump transmits the resulting pressure rise to some sort of device (there are half a dozen different ones) which, in turn, cuts back the throttle (either the regular or an auxiliary throttle). The engine and pump are now running slower--just fast enough to supply the remaining line 250 gpm at 150 psi. Personal preferences for one system or another usually depend on two things: 1) conditions of operation, and 2) how well the present system works under these conditions. A discussion of the relative merits of the two types of systems would be a subject for a sheet in itself, so we'll leave it at that for now.

lo doubt you are already quite familiar with the way a simple, spring loaded relief valve /orks. Everything depends on the force of the spring holding the valve closed.

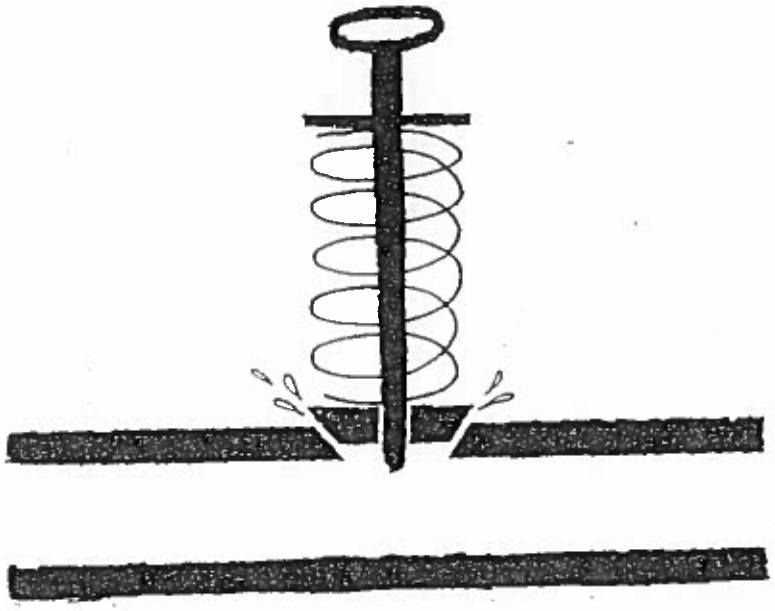


Figure 1

Say we had an ordinary pipe with this kind of relief valve on it as shown in Figure 1. The spring tension can be varied by turning a handle in and out. You set the spring so 100 psi can compress it enough to open the valve. When water pressure in the pipe reaches 100 psi, the valve opens, bypassing water and relieving the pressure. You can see, though, in order to bypass more water, it's going to take more pressure inside the pipe to open the valve farther, because the further you compress the spring, the more resistance it offers.

A simple device like this is all you need sometimes; but, for a more exacting control, especially at higher pressures and capacities, the spring alone won't do. You must add a device which can control pressures by using hydraulic force, too.

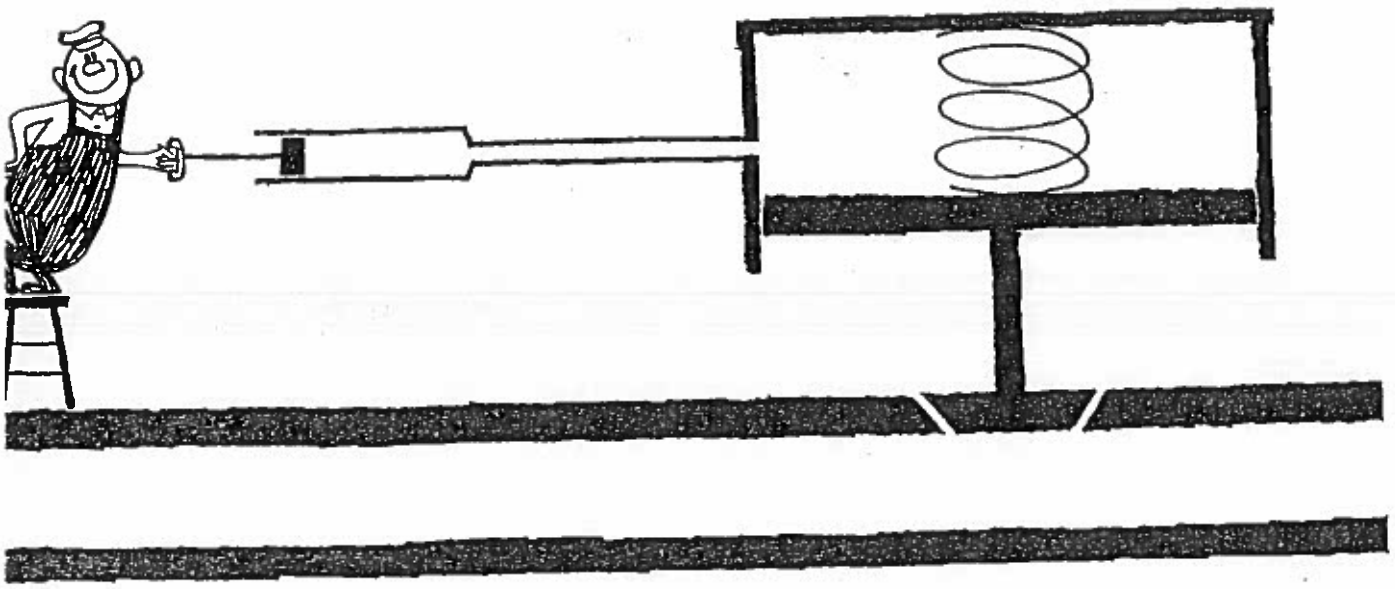


Figure 2

Suppose we add two hydraulic cylinders to the system as shown in Figure 2. By pushing in a small piston (upper left) you apply the same pressure to the much larger area on top of the cylinder in the big relief valve. The small cylinder gives you a big hydraulic advantage in controlling the main valve--just like hydraulic brakes in a car. This means you can set the valve to bypass large volumes of water with only a slight pressure rise, by greatly reducing the pressure behind the piston in the main valve (top). But the control is strictly manual at this point. To increase the force against the top of the big cylinder you must push harder on the piston on the small cylinder; to decrease the force you must ease up on the small piston. In other words, this system demands constant attention to the pilot control.

Why not use the water pressure or hydraulic force from the pipe to operate the whole system? We also need a system which will at the same time bypass large quantities of water with only a small pressure rise in the pipe. How do you do it? Take a look at Figure 3. A tube from the main pipe with a constriction in it is connected to the back (top) of the large relief valve cylinder. If we left it at that, the valve would always stay closed, because water at the same pressure as that in the pipe is also pushing against the much larger area on the back or top side of the big relief valve. There is, however, another tube added to this system to permit water to flow out of the system or "dump."

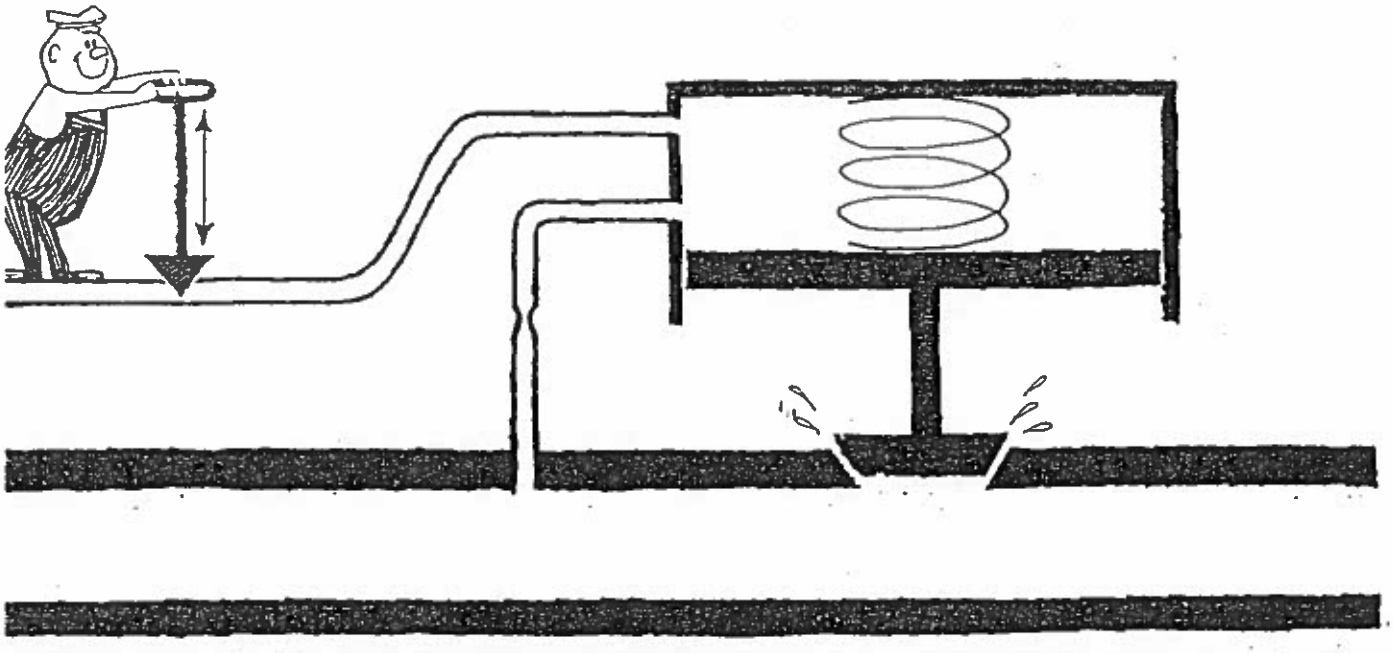


Figure 3

Water is metered through the constriction into the pressure chamber of the relief valve and let out through the other pipe. Notice, though, that this second pipe has a needle valve on it to control the rate of escape. In fact, this valve can be set so that water can escape from the cylinder more easily than it can enter through the constriction. Now, suppose we set the needle valve this way so water is flowing through the constricted pipe to the backside of the piston at a rapid rate. The faster the water flows through the constriction, the greater the pressure drop there, and the lower the pressure behind the piston in the large relief valve.

Merely by adjusting the needle valve setting (thus the rate at which water is "dumped") you can greatly vary the hydraulic force behind the piston, so the relief valve will open part way or all the way at any predetermined pressure in the pipe.

The system is still manual in this example, though. Our man must keep a sharp eye on his gauges, and keep adjusting the needle valve to compensate for pressure changes in the pipe.

In the pilot or control valve of the WATEROUS relief valve system, the modulating of the needle valve which "dumps" water to pump suction is done automatically by changes in discharge pressure. But the principle operation is roughly the same.

The spring in the main relief valve plays only a small part now. The hydraulic force behind the main valve does most of the job, and this force is controlled by the amount of water "dumped".

In our system the relief valve proper is mounted on the pump between suction and discharge, and the pilot or control valve is mounted on the operator's panel of the truck. This separation of the two valves makes the whole system more flexible and adapts easily to most any mounting situation. The pilot valve and its 4-way valve control the operation of the relief valve.

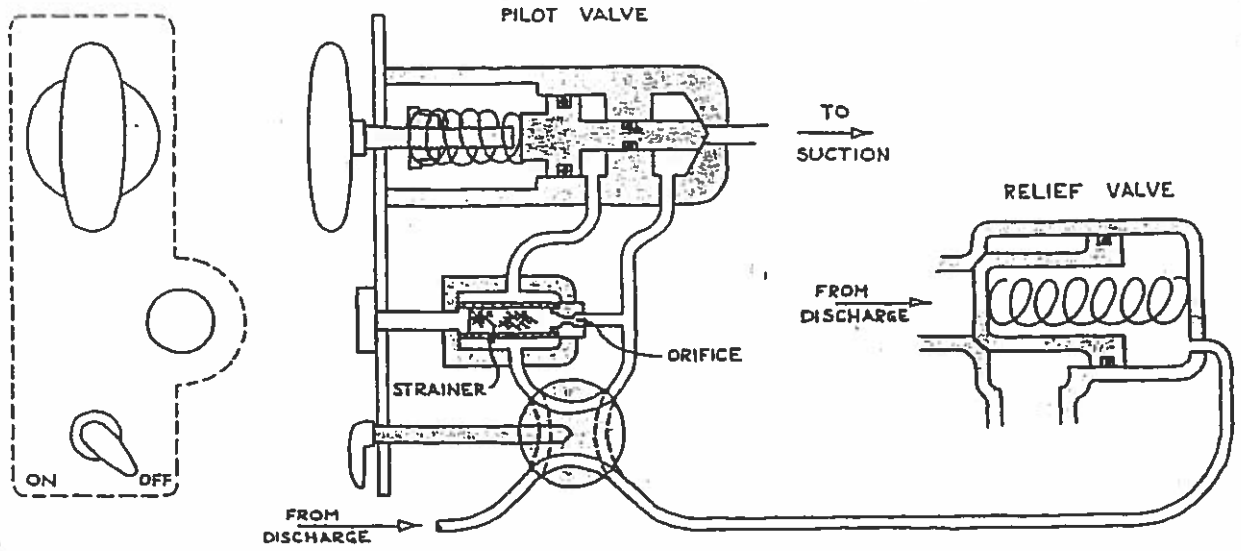


Figure 4

Figure 4 shows you the entire system. The pilot valve on the left is shown in two views so you can get a better look at the 4-way or "ON-OFF" valve. The relief valve is shown at the right. The constriction consists of an orifice in the flow passage out of the strainer. Notice that the needle valve can move away from its seat (to the left) in response to an increase in discharge pressure, to allow water to flow back to suction.

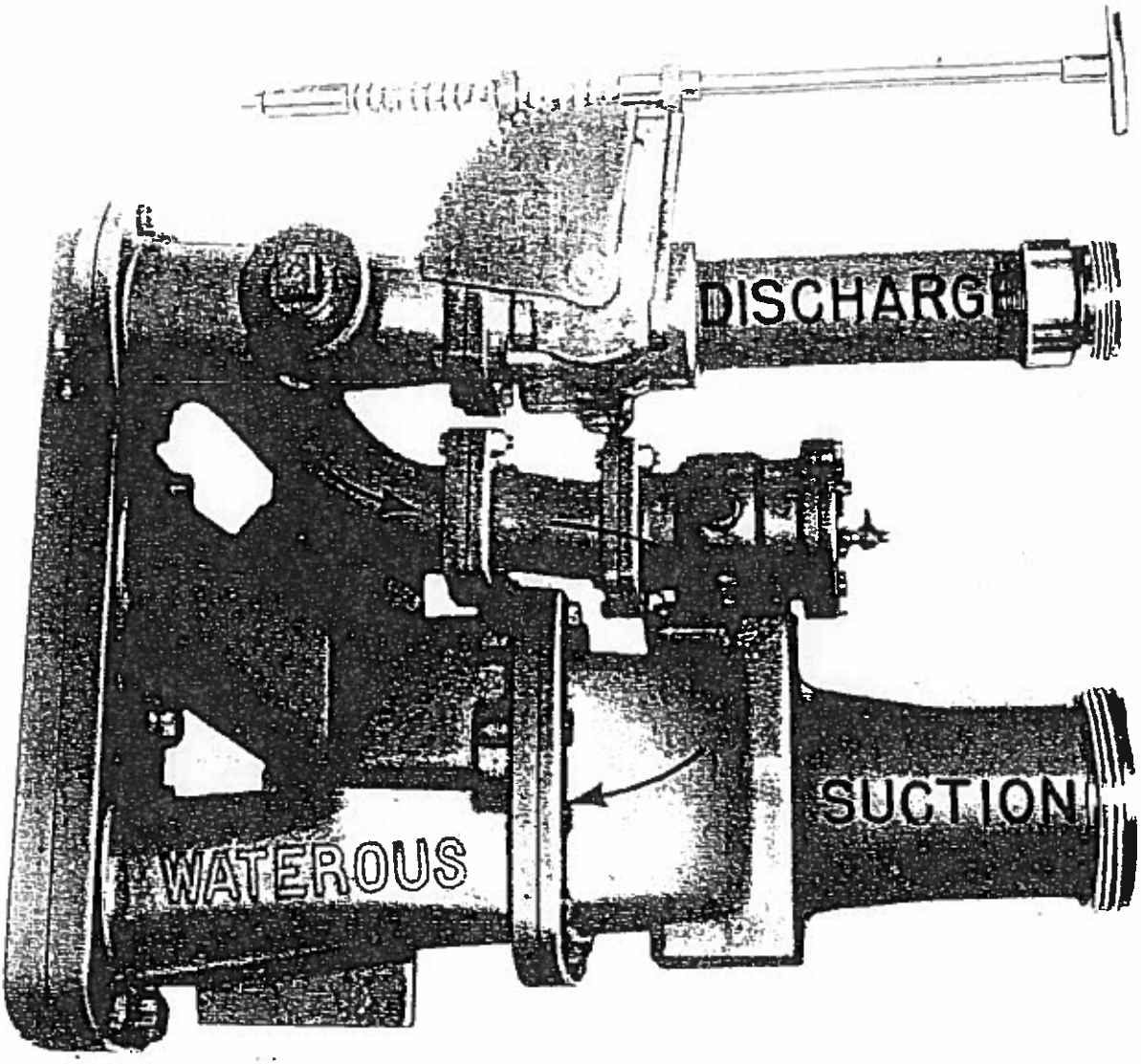


Figure 5

Figure 5 shows how the relief valve fits on the pump between suction and discharge. The arrows show the direction of water flow when the valve is open and bypassing. (This is a 2-inch relief valve, the 3-inch valve is similar but is installed under the suction fitting.)

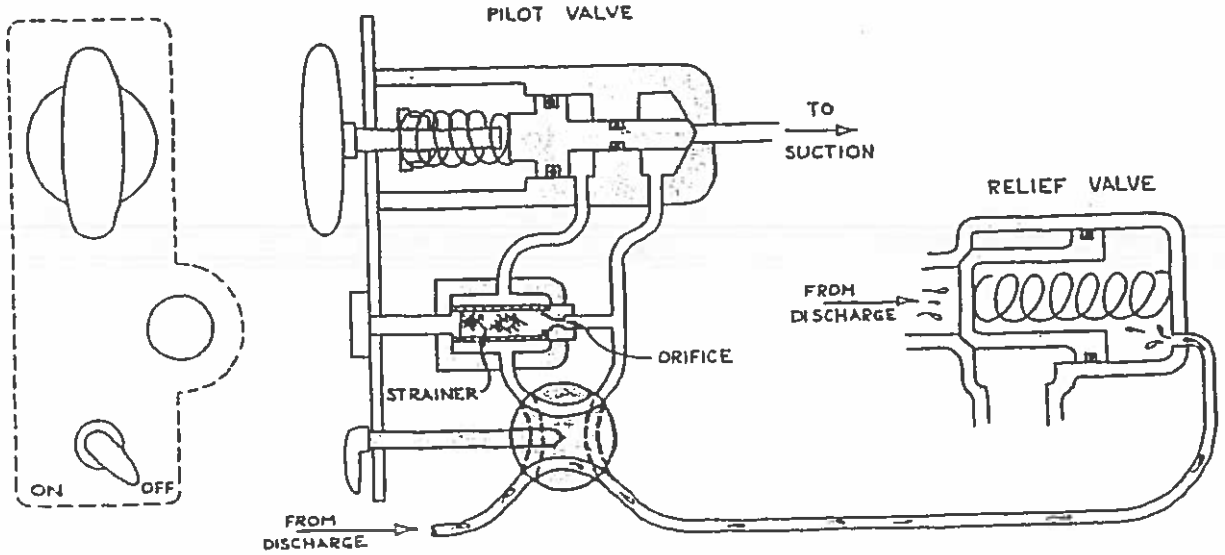


Figure 6

Figure 6 (previous page) shows what happens when the 4-way valve is turned to OFF position. This takes the entire relief valve system out of operation, which you will want to do if you need pressures above 300 psi. Water from pump discharge goes directly through the 4-way valve to the main valve chamber, which is the right hand side of the main valve in this illustration. The pressure is the same on both sides of the main valve, but the area is greater on the main valve chamber end (right), so the force is greater from that end. This greater force, plus the force of the spring, keeps the valve closed so there is no flow back to pump suction.

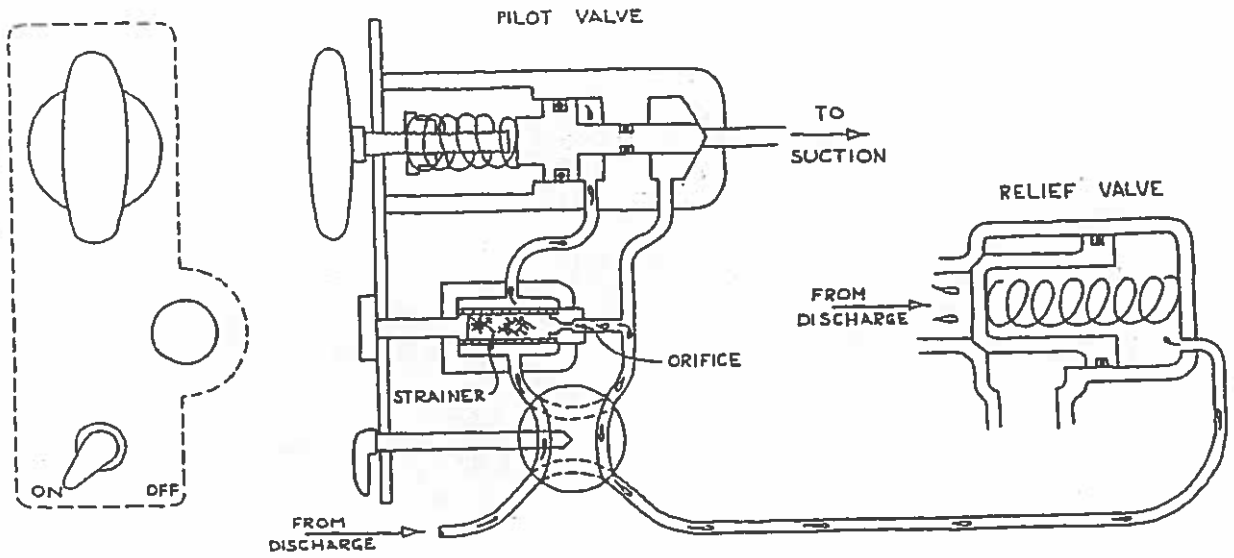


Figure 7

Figure 7 shows what happens when pump discharge pressure is lower than the pilot valve setting. In this illustration the 4-way valve is ON so the entire system is in operation.

This time the water flows from pump discharge to the pressure chamber of the pilot valve on the left. The piston end of the needle valve has discharge pressure pushing it to the left, opposed by pressure exerted by a spring pushing it to the right. You regulate the spring force by turning the handle of the pilot valve. As long as the hydraulic force on the piston is less than the spring force the needle valve stays closed, and water cannot flow rapidly through the orifice, but water at discharge pressure can reach the main relief valve chamber (on the right) and keep the main valve closed.

Figure 8 (next page) shows you what happens when the pressure rises above the "setting."

When hydraulic force on the piston of the pilot valve becomes greater than the spring force, the needle valve moves to the left and allows water to flow back to suction. This increases the flow rate so that there is a significant drop in pressure across the orifice, and lowers the pressure in the main relief valve chamber. The force on the small end of the main valve (left) is now greater than the force at the large end so the main valve opens so part of the water being pumped by-passes back to suction, reducing the discharge pressure. The main valve opens just enough to reduce discharge pressure to the pilot valve setting.

If the discharge pressure drops below the set pressure, the pilot valve reseats, pressure builds up behind the large end of the main valve, and closes it.

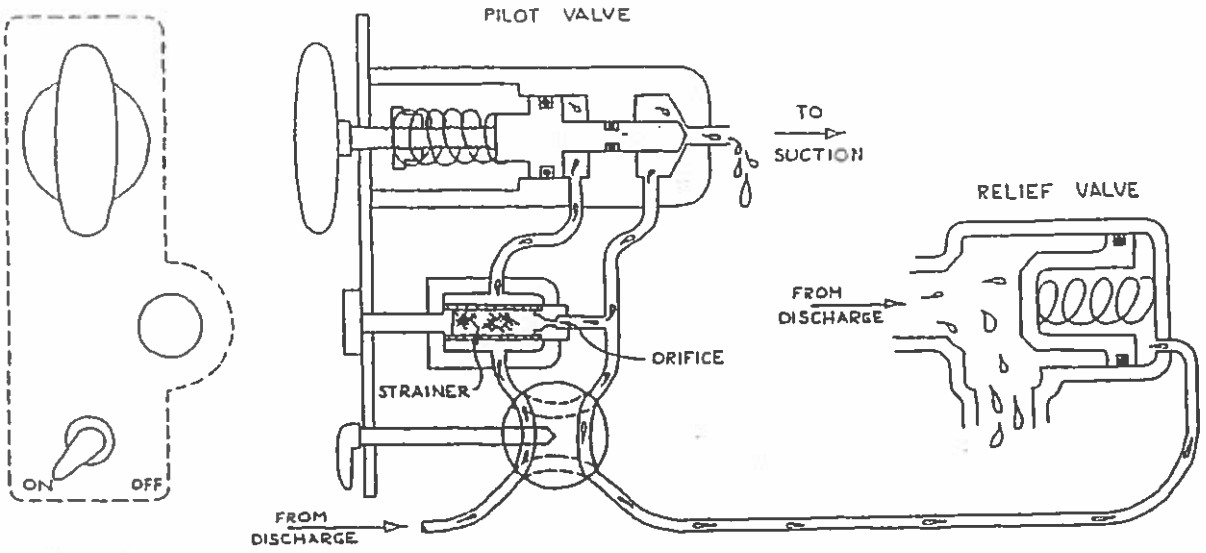


Figure 8

The WATEROUS relief valve system is also available with indicating lights which show whether the relief valve is open or closed. A micro-switch, actuated by a sliding rod in the main valve, controls an amber and a green light mounted on the truck operator's panel. The green light is on when the relief valve is closed.

When the relief valve opens, the rod in the valve switches the micro-switch to turn the green light off and the amber light on. An operator can tell at a glance whether the relief valve system is balanced at "set" pressure.

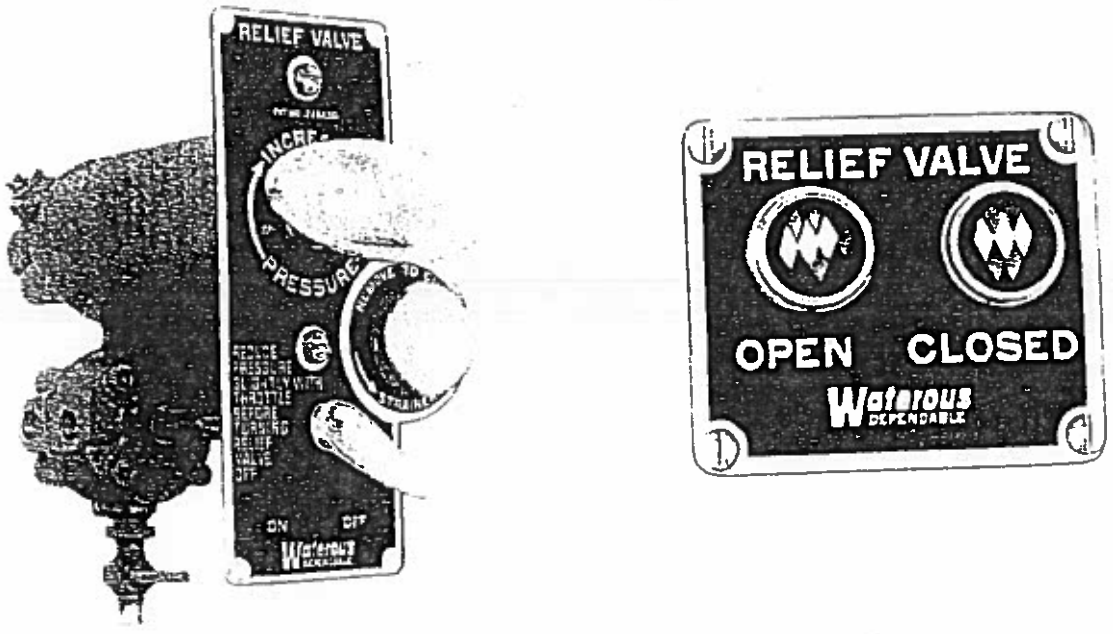


Figure 9

HAT'S HOW IT WORKS;

NOW . . .

WHAT MAKES THE WATEROUS RELIEF VALVE SYSTEM SO DEPENDABLE?

ere is a list of reasons for this dependability.

Working parts of the relief valve proper are all bronze, and so are the pilot valve arts which regulate the flow of water, so there is no corrosion of the working parts of ne system.

A removable strainer in the pilot valve housing prevents sand, sediment, and other oreign matter from entering the orifice. The strainer can be removed and cleaned any time he 4-way valve is in the "OFF" position, even with the pump operating.

. Under normal pumping conditions you need clean up the pilot valve only once a year- if that often! The main relief valve normally needs NO maintenance, except in rare cases vhere there is an unusual amount of sand or sediment in the water.

4. The relief valve and pilot valve are separate assemblies, so the position of the panel control is not dictated by the position of the relief valve on the pump.

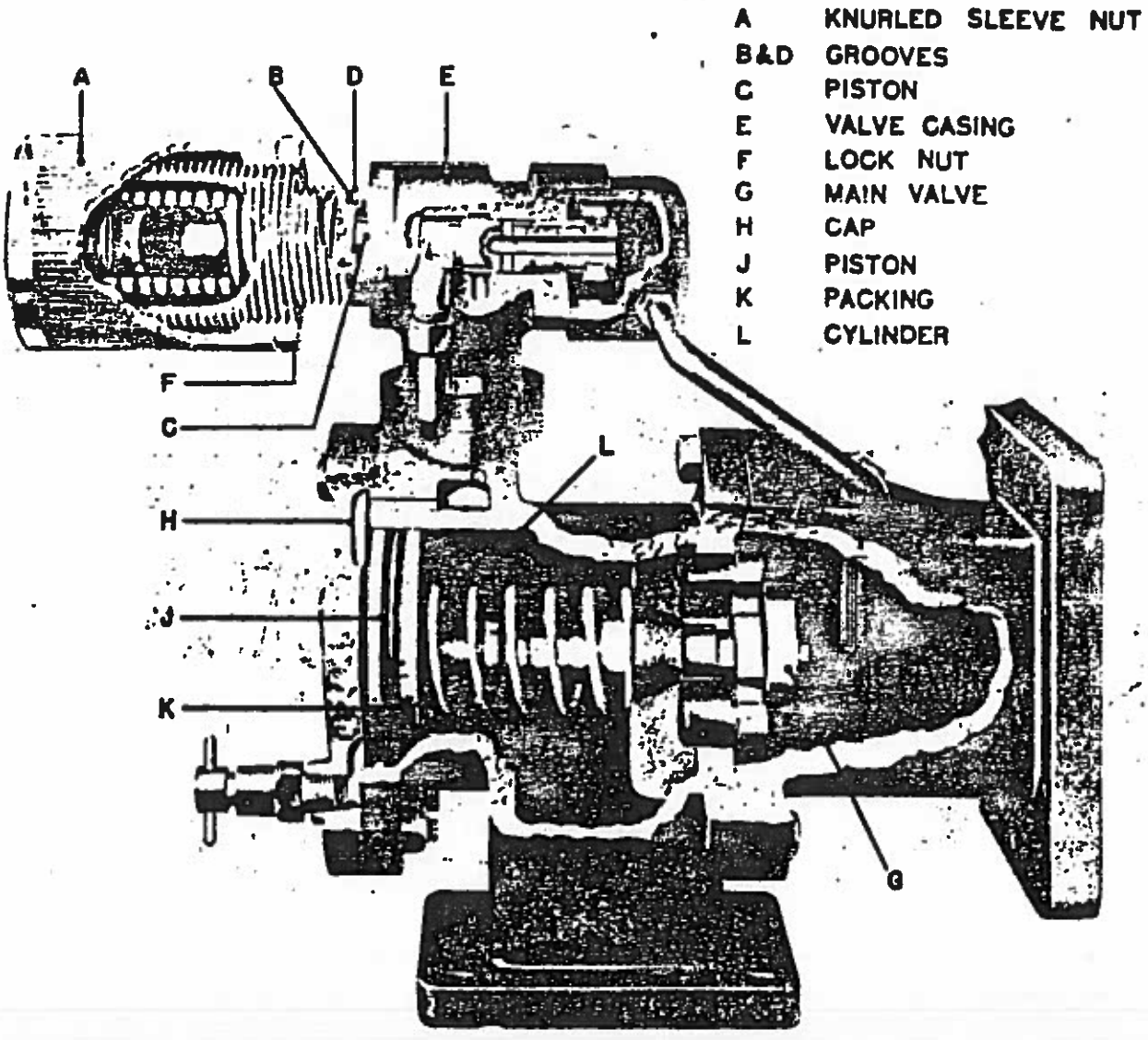
5. The 4-way valve lets you put the entire system in or out of operation without affecting the original pressure setting which is determined by the spring tension on the pilot valve. Once you achieve the desired setting, you needn't touch the handle - even when you shut down.

6. Indicating lights (optional) show position of main valve at all times. One light shows green whenever main valve is closed. When the valve opens, the green light goes off and amber light comes on.

7. The sensitive, fast action of this valve is uncanny. We receive many compliments on it from our users, and this is, after all, what counts in any pressure regulating system: Does it work? Our users tell us it does!

STUDENT INFO

HALE IDEAL RELIEF VALVE



A	KNURLED SLEEVE NUT
B&D	GROOVES
C	PISTON
E	VALVE CASING
F	LOCK NUT
G	MAIN VALVE
H	CAP
J	PISTON
K	PACKING
L	CYLINDER

Taking Care of Your Discharge Relief Valve System

The discharge relief valve system is one of the most important safety features on your Waterous fire pump. The relief valve is designed to keep dangerous pressure surges from injuring firefighters on hoselines. The system consists of two components: the pilot valve, which is mounted to the pump panel; and the relief valve, which is mounted between the pump intake and discharge fittings. The pilot valve manages the system by sensing discharge pressure and controls the opening and closing of the relief valve. The relief valve directs water from the discharge of the pump back into the intake of the pump when pressure surges occur.

Do you have a discharge relief valve that is sluggish or seems to stick open or closed? Chances are the relief valve is not worn out, it actually hasn't been used enough. Just like the human body, a relief valve needs to be exercised in order to stay in good shape. It doesn't take a lot of time. In about ten minutes per month, you can perform some easy exercises that will help keep your relief valve system working and keep your firefighters safe.

Just follow these simple steps:

1. Engage the pump, begin circulating water, and increase pump discharge pressure to 150 psi.
2. With the pilot valve OFF, remove the strainer assembly. Then clean the strainer and the orifice in the end of the strainer rod.
3. Turn the pilot valve ON and OFF several times. Water should flow from the opening in the ON position and stop in the OFF position.
4. Check the strainer o-rings and replace if damaged.
5. With the pilot valve in the OFF position, replace the strainer assembly (finger tight only).
6. With the pilot valve OFF, turn the large pilot valve handle counterclockwise until it stops.
7. Slowly turn the pilot valve ON. The relief valve should open (amber light) and pump discharge pressure should drop below 90 psi.
8. Slowly turn the pilot valve OFF. The valve should close (green light) and pump discharge pressure should rise back to 150 psi. Repeat steps 7 and 8 until the system responds quickly when turned ON and OFF.
9. Reset the pilot valve to the desired setting and decrease engine speed to idle.

Something else that you can do to help keep your relief valve and other pump systems operating well is to drain the pump and flush it with clean water once a month. This will help flush deposits of sand or other foreign materials out of the pump and help prevent the premature failure of moving parts and seals. By performing some very simple maintenance on a monthly basis, you can see how easy it is to keep your Waterous fire pump and accessories running like a well-trained athlete.

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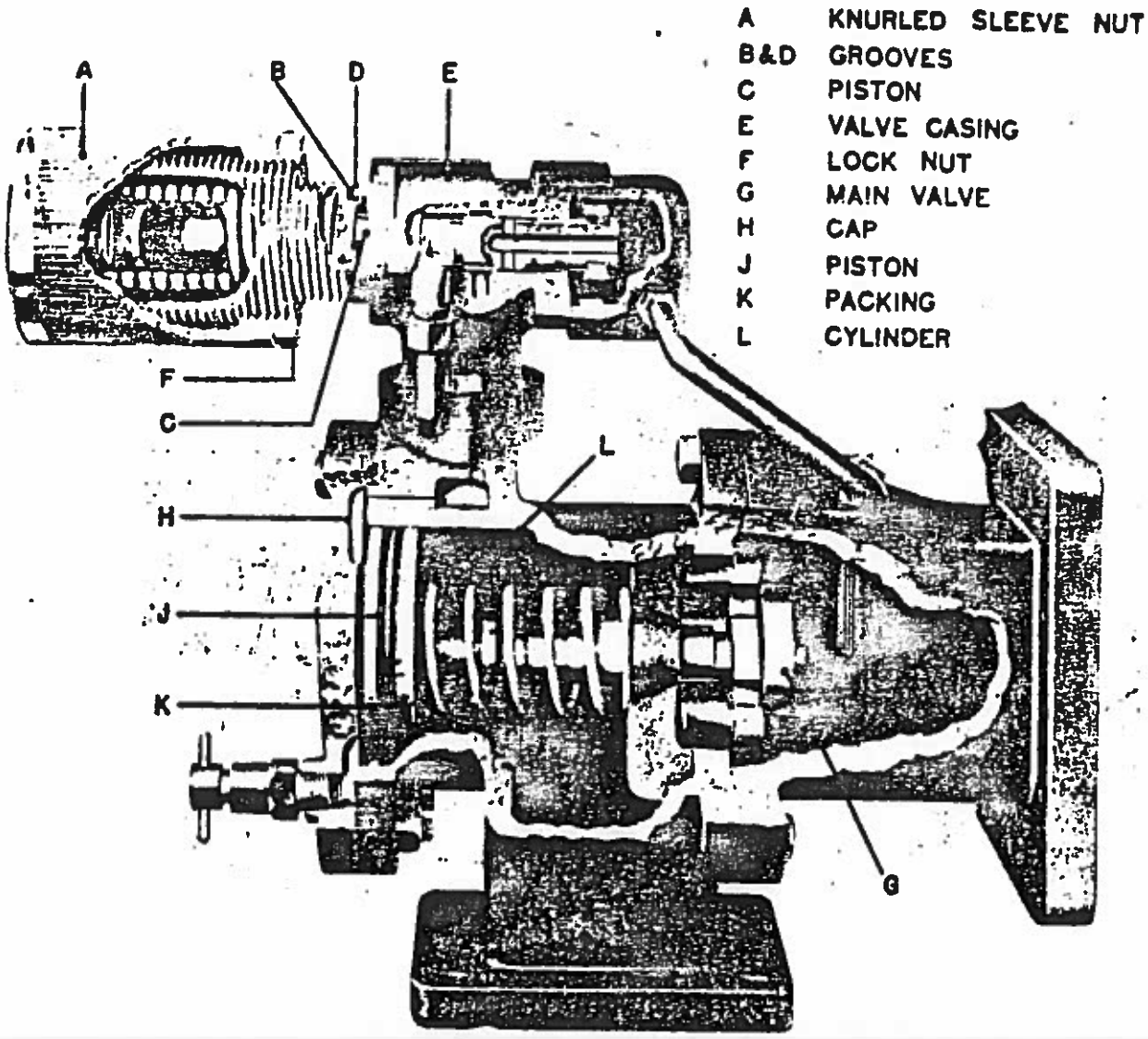

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