Chapter – 16 Refrigerant Flow Control Valves

Refrigerant flow control valves are used to ensure the refrigeration system is performed in accordance with the conditions as designed, particularly during partial load operation. All the valves have some undesirable side effect such as line pressure drop, except it is required by design such as throttling valve. Therefore, when making valve selection, it is important to select a valve that is producing less pressure drop. All the valves must be checked if it is designed and constructed for refrigeration duty.

Every valve used for the refrigeration system must serve the purpose and the duty as designated, regardless if it is manual valve or automatic control valve. Manual stop valves are for the purpose of providing the conveniences of services and maintenances. Manual valves also include the check valves and hand expansion.

Typical hand expansion valve is shown in Figure 16-1. Manual expansion valve or needle valve is used as a throttling orifice in application wherever is required.

All the valves used for system performance control or for system safety should be fully automatic. The common use automatic valves and its function are described as the following:

Solenoid Valve:

Solenoid valve is an electrical control on-off valve. It is for the automatic control of refrigerant flow for either vapor or liquid line; the valve can be either normally open or normally closed. The electrical power supply can be either 220 or 110 or even 24 volts.

Thermostatic Expansion Valve:

Thermostatic expansion valve is also referred to as direct expansion (DX) or dry expansion valve. The DX valve is used as the automatic control throttling valve for DX evaporator. DX valve has two important elements as shown in Figure 16-2; one is the external bulb which is to allow enough refrigerant flow for the refrigeration capacity requirement and the other element is the external equalization line which is to restrict the refrigerant flow just enough to provide a 10 to 15°F superheat at the outlet of the heat exchanger.

Low Pressure Float Valve:

Low pressure float valve is a throttling expansion device. It provides a seal between

the high side and the low side; it controls the refrigerant flow from the high side to the low side intercooler or flooded type heat exchanger, and to maintain a desired liquid level in that vessel.

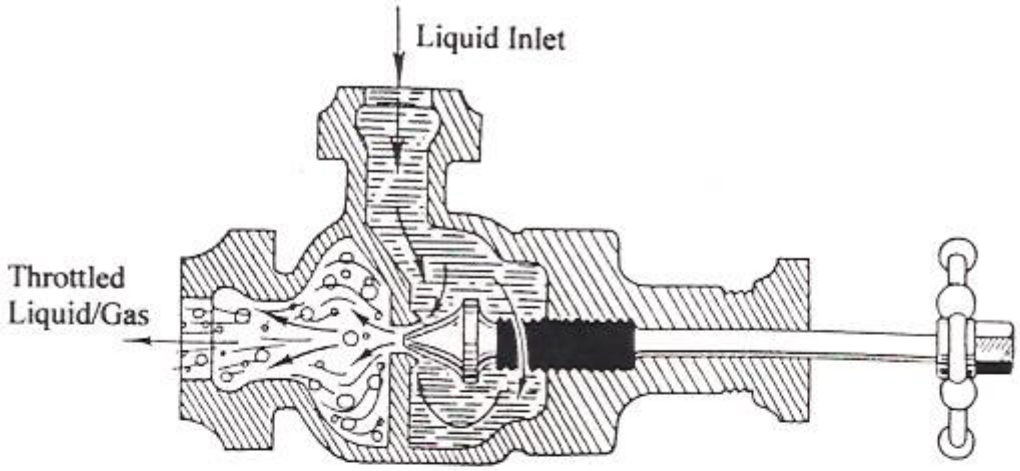


Figure 16-1 Typical Manual Expansion Valve

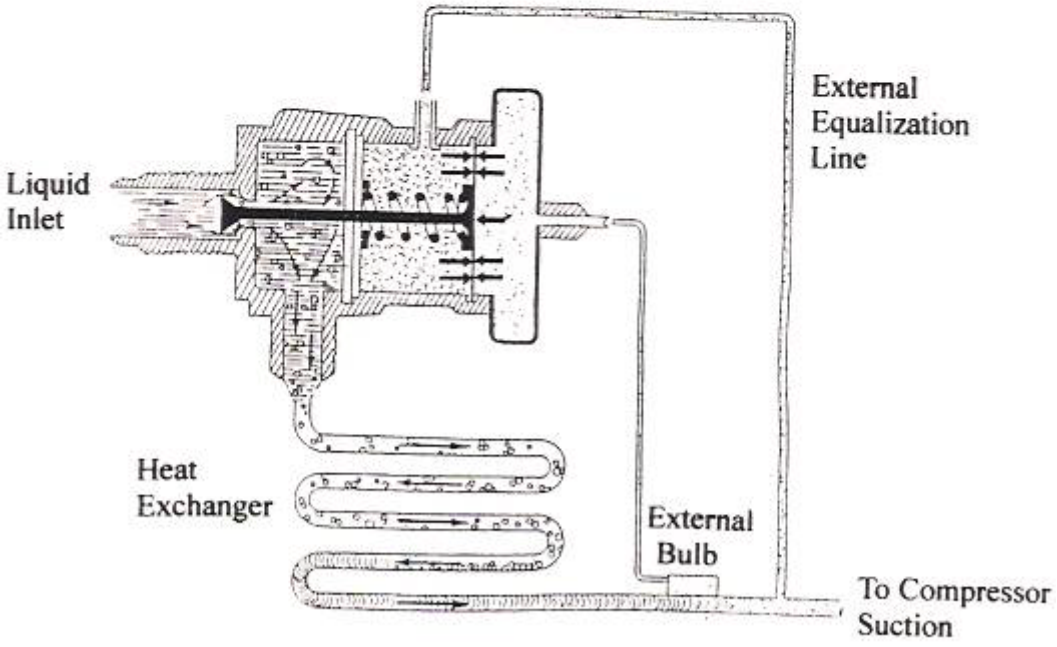


Figure 16-2 Thermostatic Expansion Valve

Figure 16-3 is the cross section of the low pressure float valve. The assembly consists of the float ball, the body and the valve.

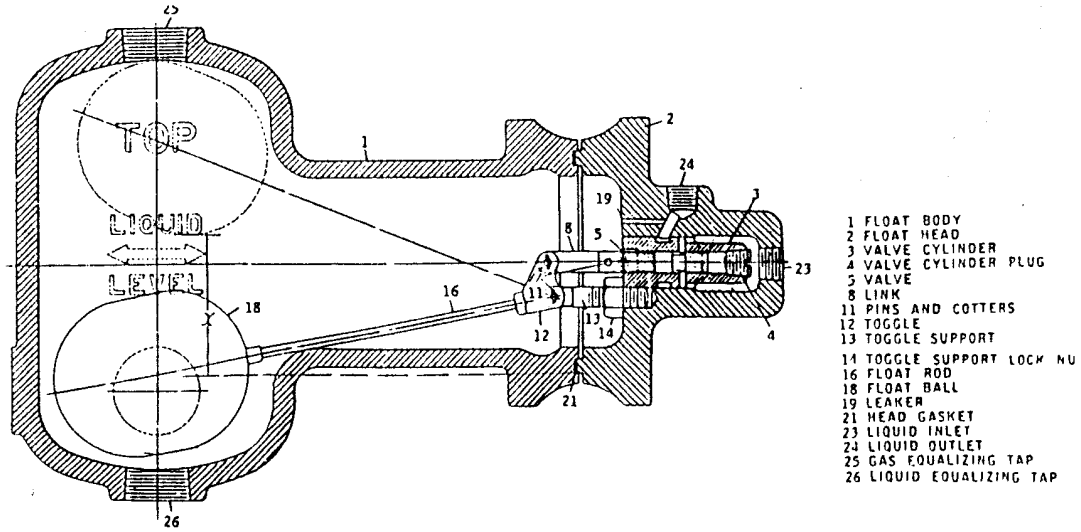


Figure 16-3 Cross Section of Low Pressure Float Valve

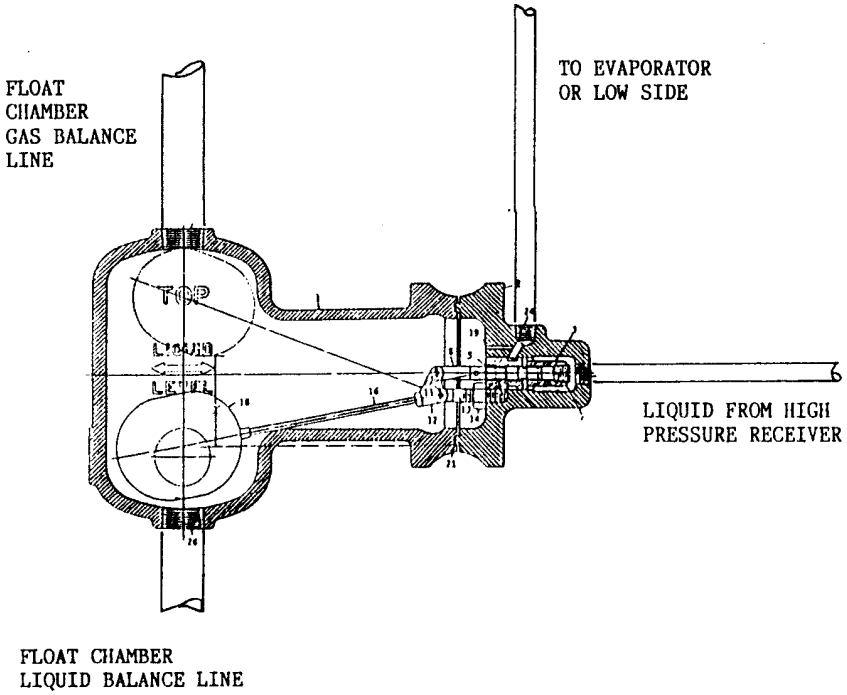


Figure 16-4 Low Pressure Float Valve Connections

Figure 16-4 shows the typical connections for the low pressure float valve. Liquid inlet is from high pressure receiver; liquid out is to evaporator or to low side. Gas balance line connects to the upper gas portion of the vessel and the liquid balance line connects to lower liquid portion of the vessel. The float ball inside of the float valve chamber controls the liquid level inside the vessel. The valve is open when the float ball is below the liquid line to allow more liquid flow into the vessel and the valve is close when the float ball is above the liquid level line.

Figure 16-5 is the typical application of the low pressure float valve for an intermediate flash intercooler; Figure 16-6 shows the typical connections of the low pressure float valve for an intercooler with a subcool coil. Figure 16-7 is a typical used of low pressure float valve for a half bundle design shell-and-tube evaporator.

Figure 16-8 shows another design of the low pressure float valve and Figure 16-9 is a pilot operated float liquid level control valve.

Low pressure float valve is generally used for larger capacity system. A high side received is needed to hold the refrigerant variation wherever a low pressure float valve is used.

Proportional Level Control Valve:

The function of a proportional level control valve is similar to the low pressure float valve, but it provides more accurate and positive control of the liquid level. The valve assembly consists of liquid level controller, control transmitter, valve positioner and the liquid control valve. This liquid level valve assembly requires pneumatic instrument air supply for the operation.

Diagram [B] of Figure 16-10 is the cut away of the level control caged displacer assembly of the Diagram [A]; Diagram [C] is the liquid level control valve with the valve operator, the “positioner”. The controller senses the liquid level in the vessel, it sends the output signal from the transmitter to the valve positioner to open or close the valve.

Figure 16-11 is a typical piping hookup for a flash type intercooler using a modulating level control valve. Figure 16-12 is a typical piping arrangement of the modulating valve for a half bundle shell-and-tube evaporator and the Figure 16-13 is the suggested piping hookup for a full bundle shell-and-tube flooded evaporator.

This proportional level control valve is an industrial grade product and is commonly used for heavy duty industrial refrigeration application. It is the more expensive than any other previous low pressure float valves.

High Pressure Float Valve:

High pressure float valve (Figure 16-14) is also referred to as liquid drain valve. The high pressure float valve is a seal between the high side and the low side. It is an expansion device to drain all the liquid from high side to an intercooler or a heat exchanger.

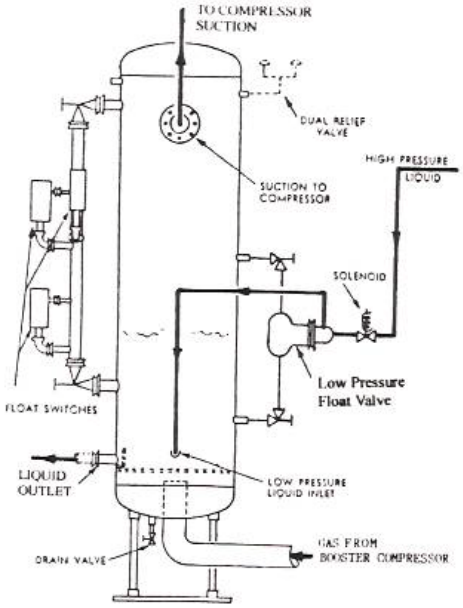


Figure 16-5 Low Pressure Float Valve for Intermediate Flash Intercooler

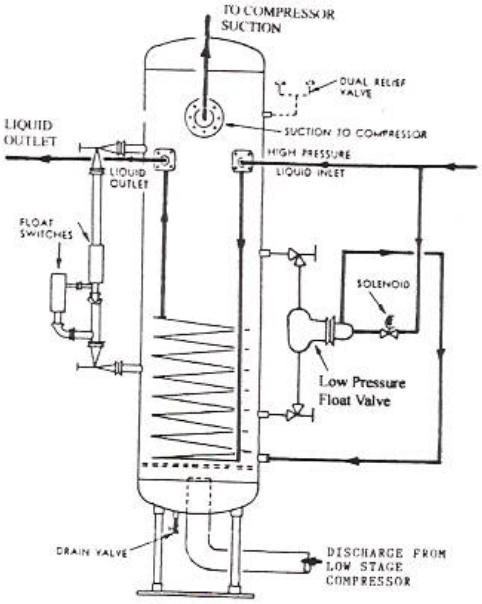


Figure 16-6 Low Pressure Float Valve for Intercooler with Subcool Coil

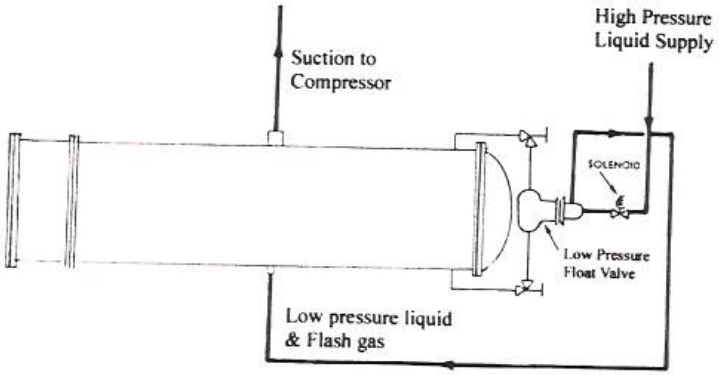


Figure 16-7 Low Pressure Float Valve with Shell-and-Tube Evaporator

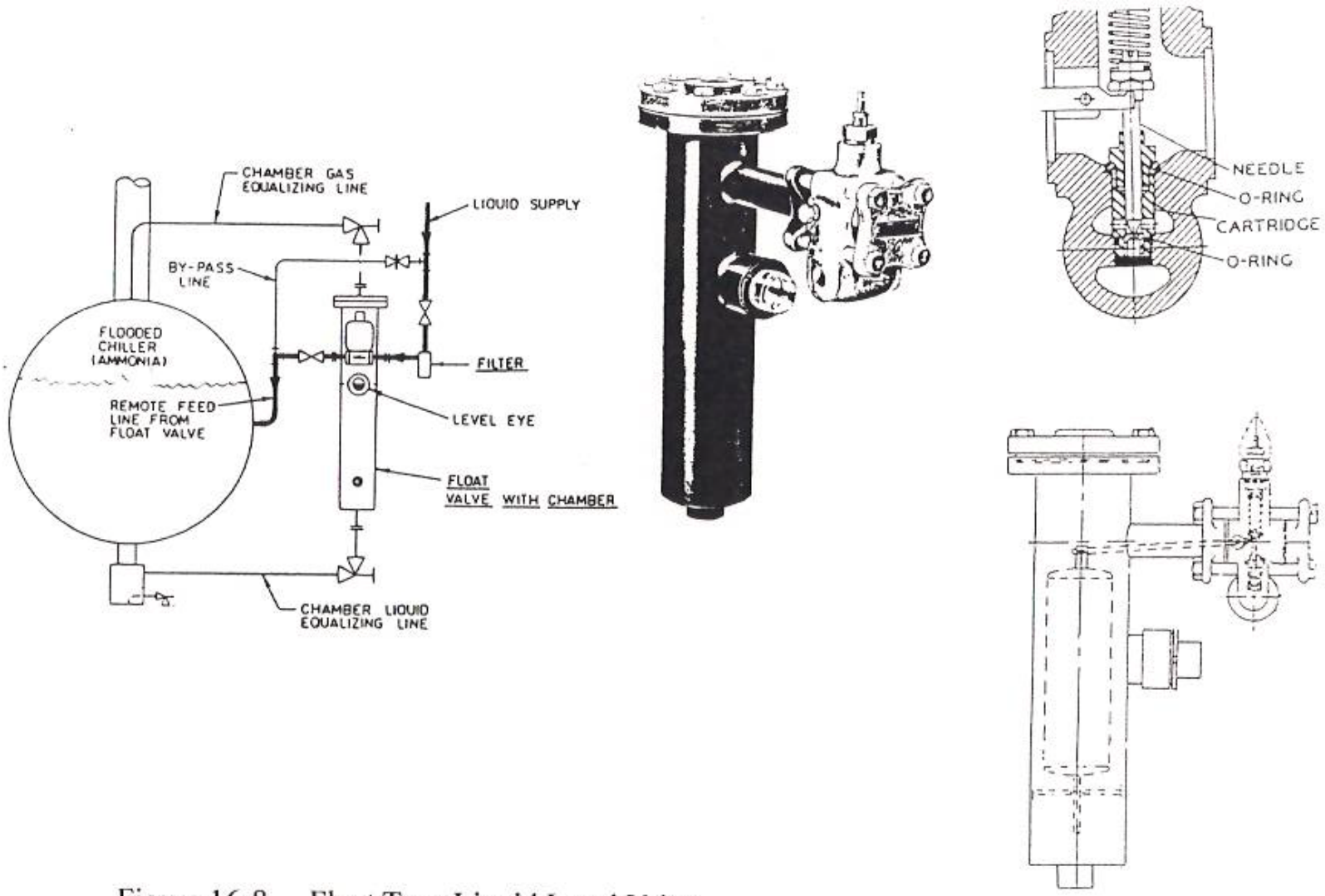
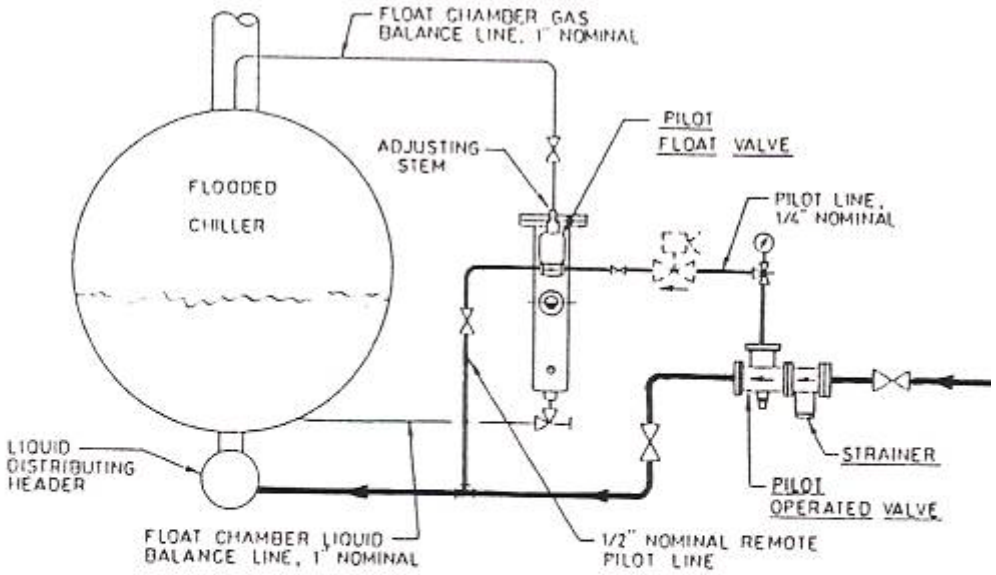


Figure 16-8 Float Type Liquid Level Valve



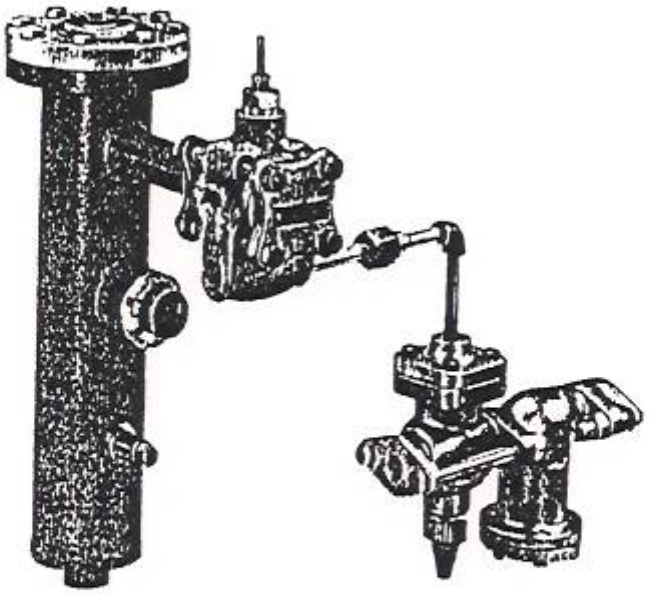
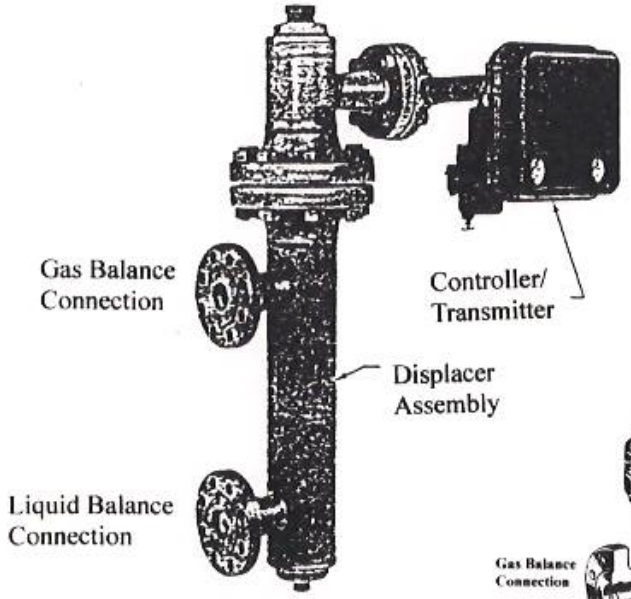
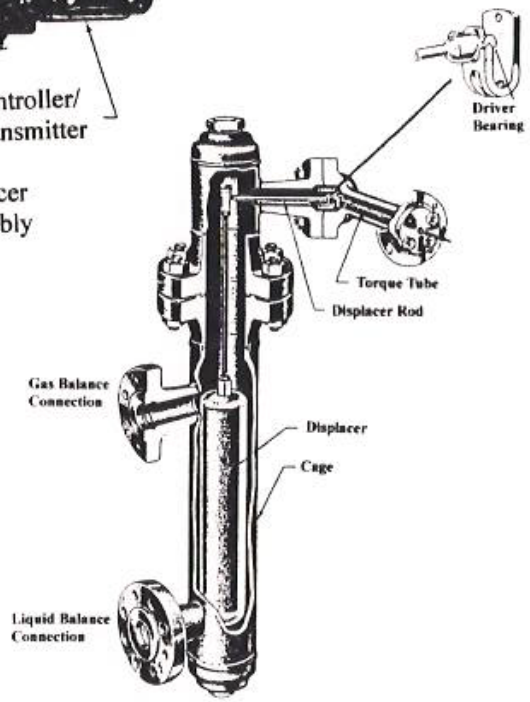


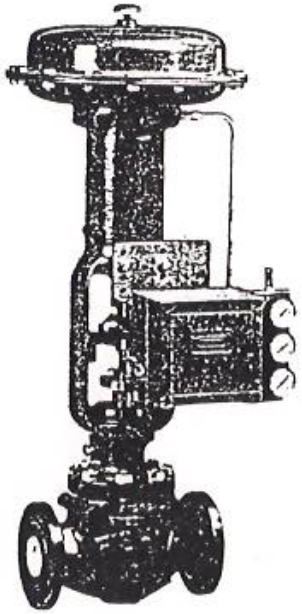
Figure 16-9 Pilot Operated Float Liquid Level Control Valve



[A] Level Control Controller & Transmitter



[B] Level Control Caged Displacer Assembly



[C] Liquid Control Valve & Valve Positioner

Figure 16-10 Modulating Proportional Liquid Level Control Valve

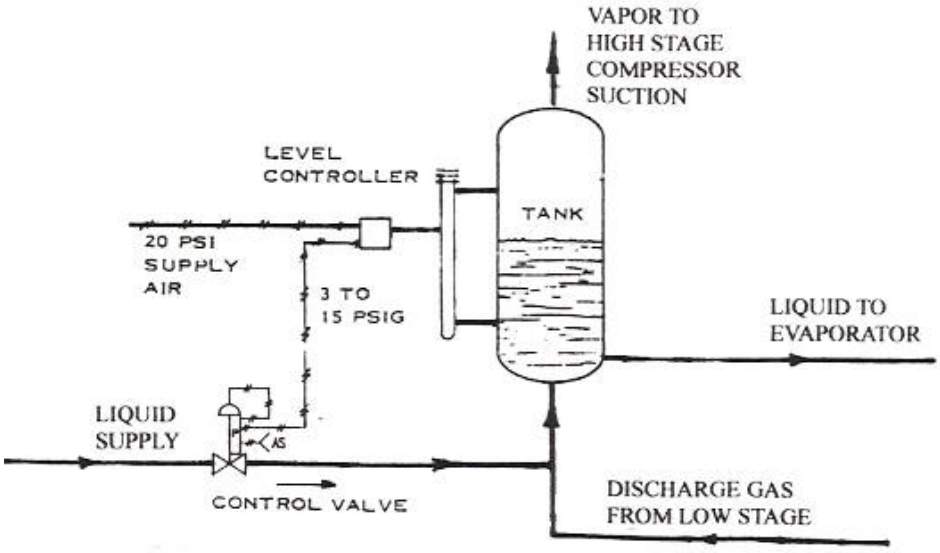


Figure 16-11 Modulating Proportional Level Control Valve & Flash Type Intercooler

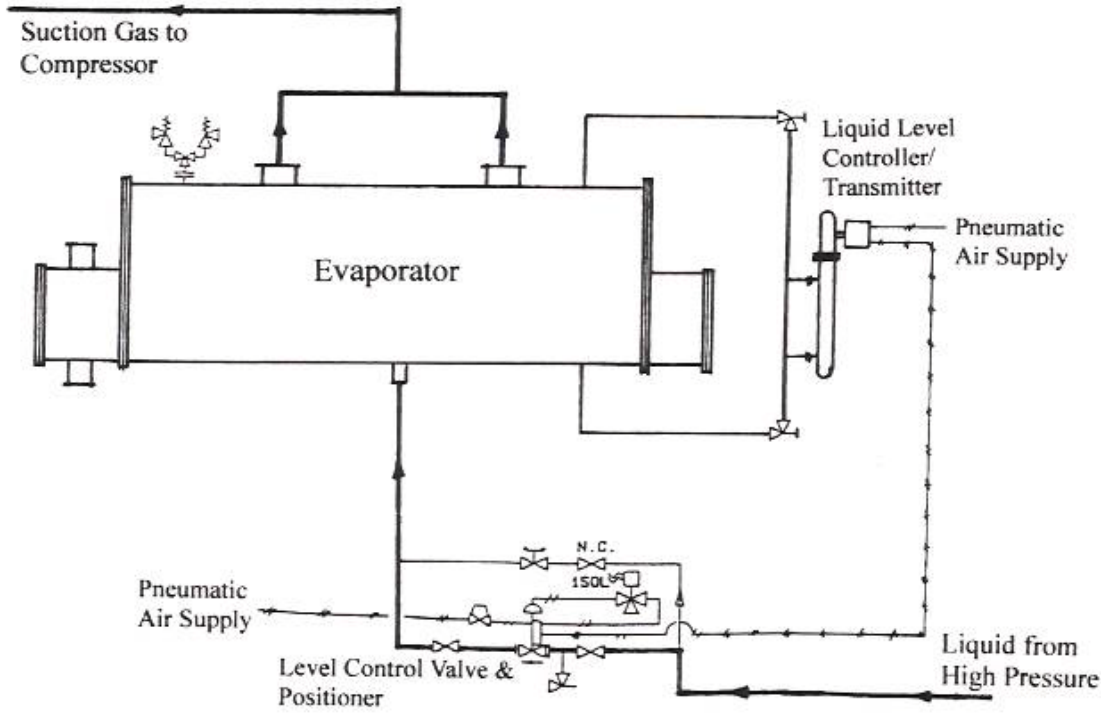


Figure 16-12 Typical Piping Hookup of Modulating Liquid Level Control Valve for Heat Exchanger

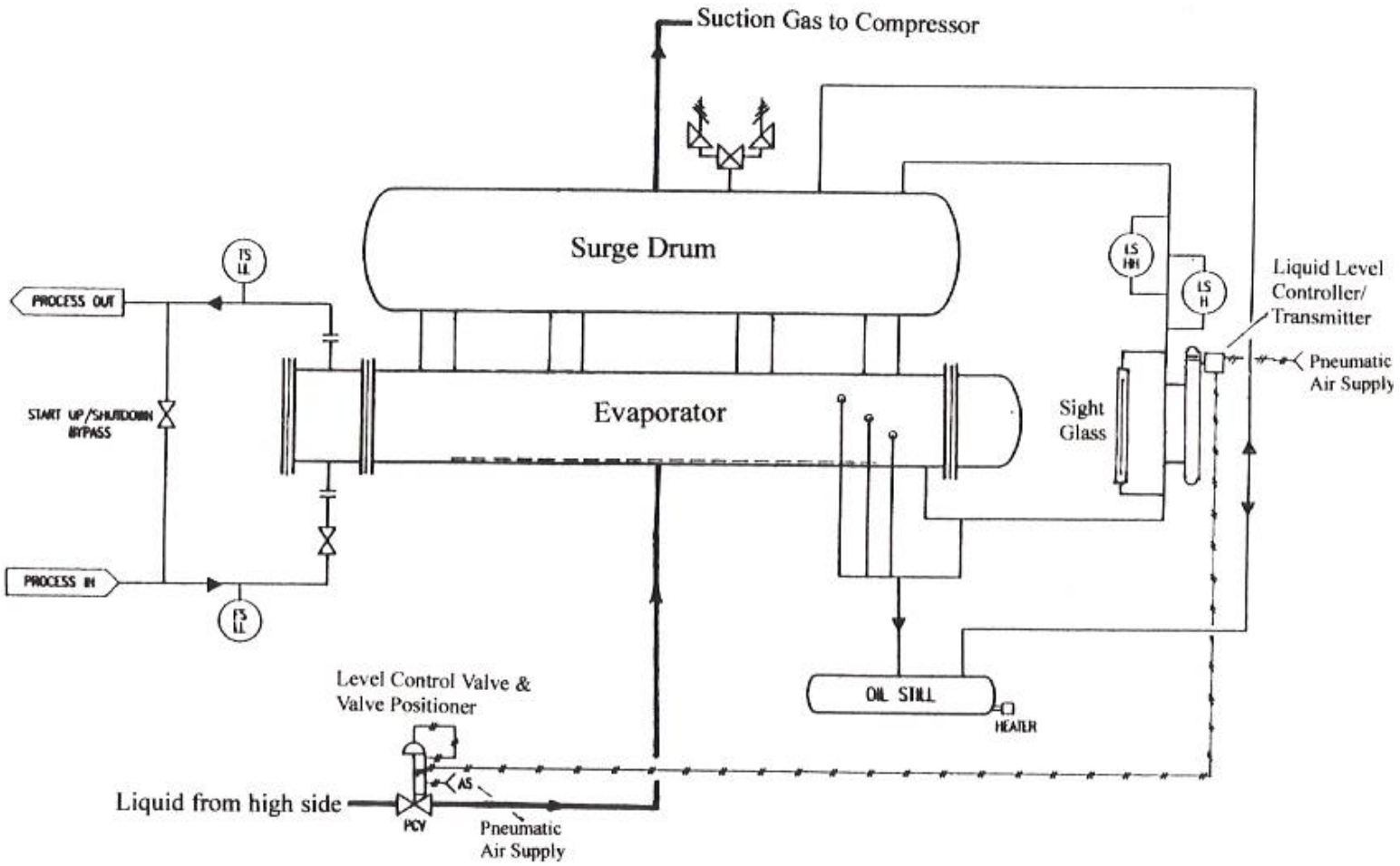


Figure 16-13 Typical Piping Hookup of Proportional Liquid Level Control Valve for Full Bundle Evaporator

The operation of the high pressure float valve is similar to low pressure float valve except that it has no liquid level control function; therefore, the low side vessel must be large enough to take care of the fluctuation of the liquid refrigerant and must be able to hold the entire critical charge (balance charge) of the refrigerant.

Figure 16-15 shows a typical connection for the high pressure float valve. The Figure 16-16 is the cross section diagram of another design of the high pressure float.

Liquid Level Float Switch:

The general construction of a refrigerant float switches are shown in Figure 16-17. Diagram [A] is a hermetically sealed float switch and Diagram [B] is mercury float switch. Typical use of liquid level switch is for high liquid level alarm and cutout, low liquid level alarm and cutout as shown in Figures 16-5 and 16-6.

Liquid level switch can be also used as the liquid level control for flooded evaporator such as shown in Figure 16-18, wherein, the liquid level switch controls the liquid inlet solenoid valve; the high pressure liquid is throttling through the hand expansion valve. This type of arrangement is the least expansive way of providing the liquid level control as compared to other liquid level control arrangement.

The liquid level float switch can be either normally open or normally closed. SPST, SPDT or DPDT.

Pressure Regulators:

Pressure regulators include the valve that controls inlet pressure, outlet pressure and differential pressure.

Inlet pressure control valve is shown in Diagram [A] of Figure 16-19 and is to control the upstream pressure of the valve; Outlet Pressure control valve is shown in Diagram [B] of Figure 16-19 and it is to control the down stream pressure of the valve. Outlet pressure control valve is also referred to as the back pressure regulating valve which is to throttle the suction pressure from a higher pressure level to a lower pressure.

Pressure Relief Valve:

Pressure relief valve is a safety valve; it is to be installed for pressure vessel as determined by the Safety Code. The cross section of the relief valve is shown in Diagram [A] of Figure 16-20. Diagram [B] is the single relief valve and the Diagram [C] is a dual pressure relief valves with a change over valve. The function of the changer over valve is to open one of the valves while closes the other relief valve for service.

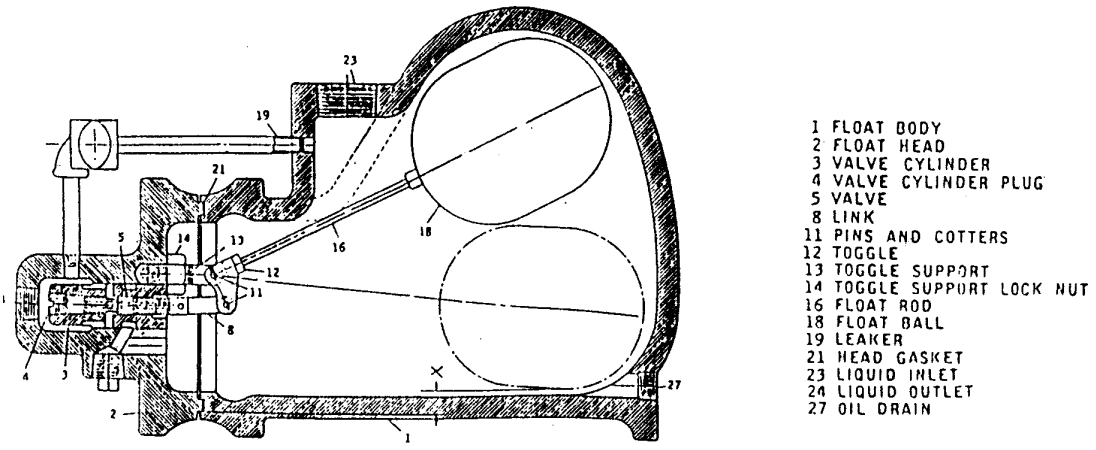


Figure 16-14 Cross Section of High Pressure Float Valve

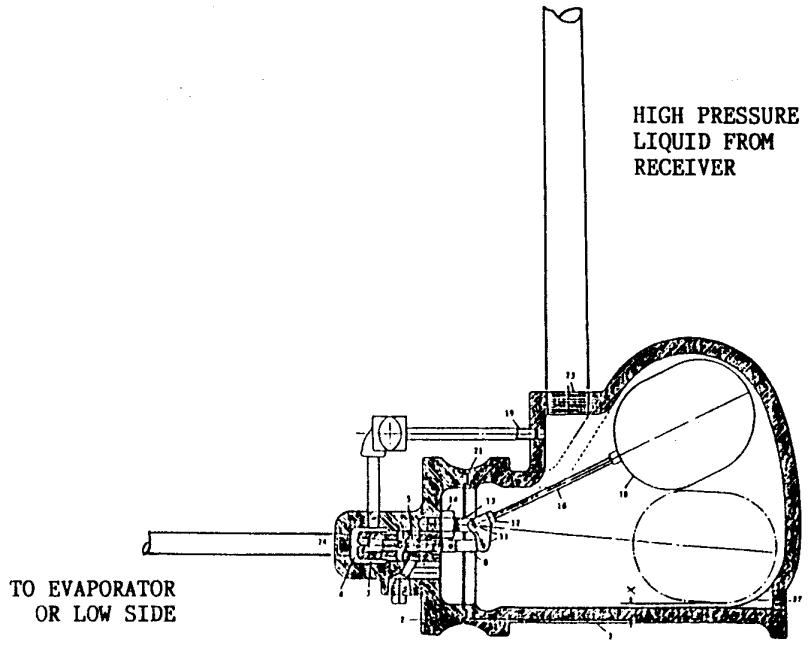


Figure 16-15 High Pressure Float Valve Connections

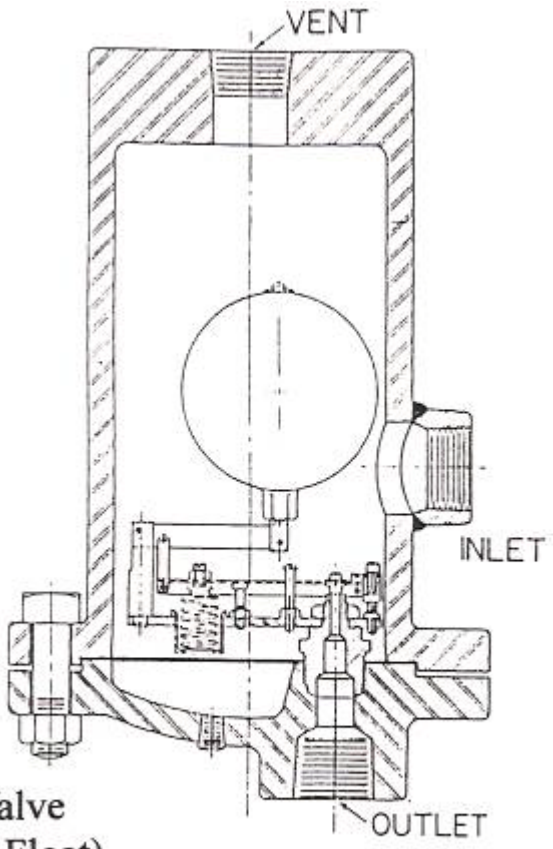
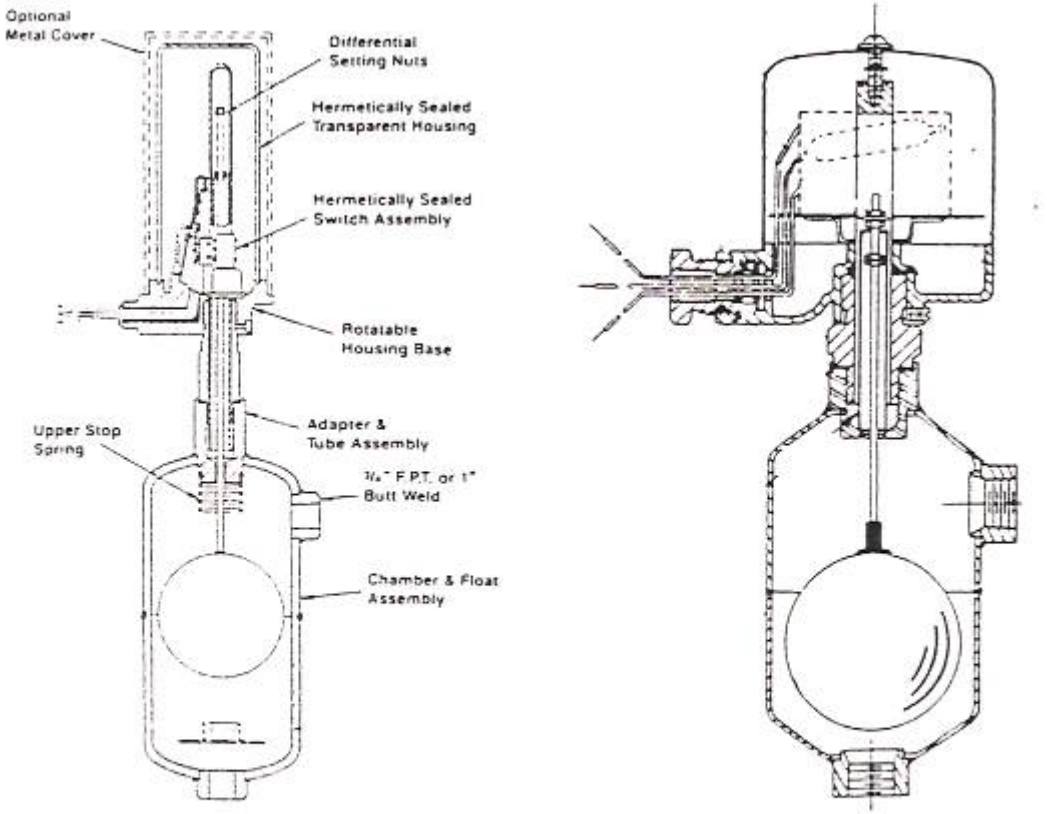


Figure 16-16 Liquid Drain Valve
(High Pressure Float)



[A] Hermetically Sealed Type

[B] Mercury Switch Type

Figure 16-17 Refrigerant Float Switches

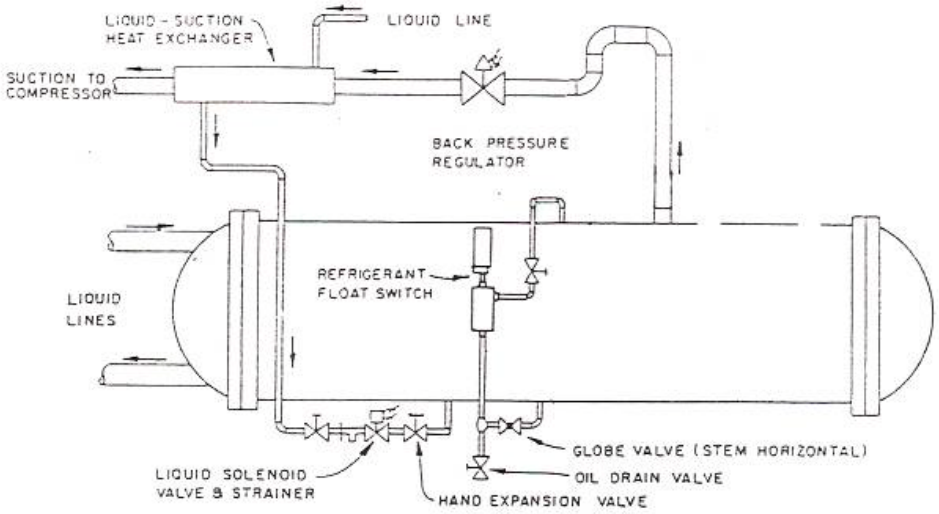
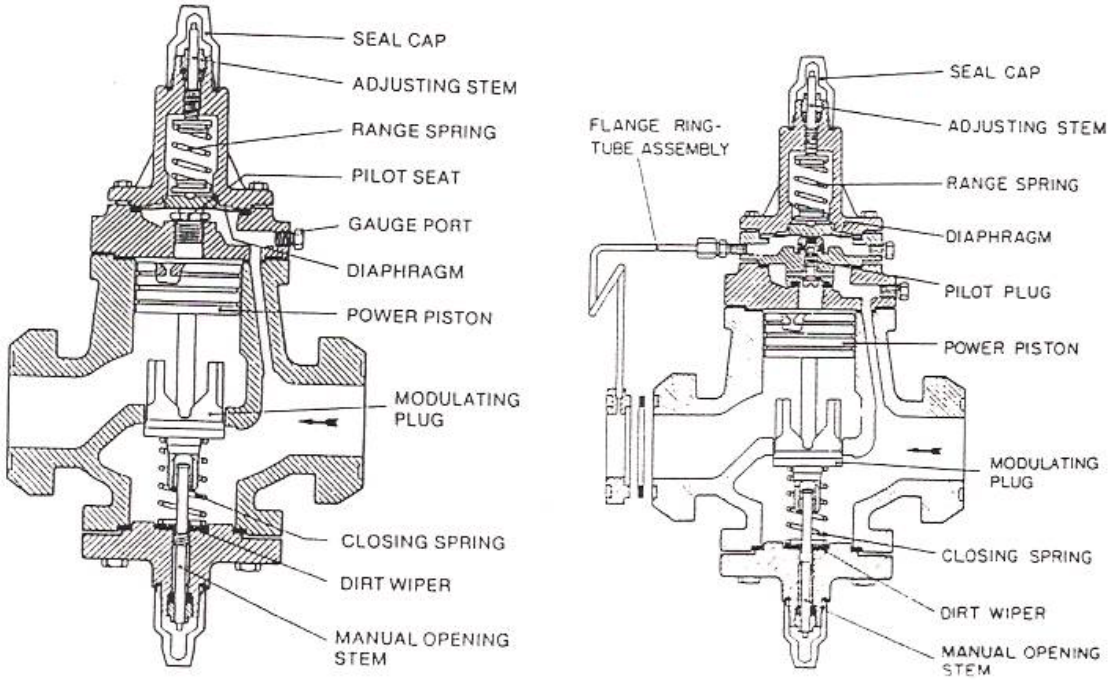
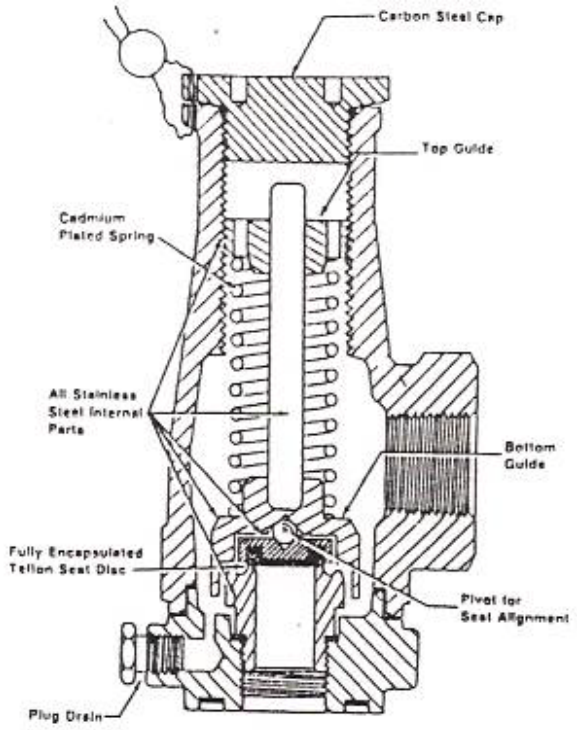


Figure 16-18 Liquid Level Control with Level Switch



[A] Inlet Pressure Regulator [B] Outlet Pressure Regulator

Figure 16-19 Pressure Regulators



[A] Cross Section of Pressure Relief Valve

[B] Single Relief Valve

[C] Dual Pressure Relief Valve with Change Over Valve

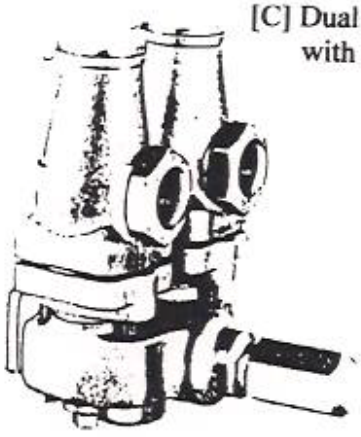


Figure 16-20 Pressure Relief Valves