Desuperheating Valves

Thermostatic expansion valves are also used for desuperheating the discharge gas between stages of compound multistage refrigerating systems. Refrigerant is injected directly into the interstage line. Similarly, suction gas in a single stage system can be desuperheated by injecting liquid into the suction line when discharge gas bypass is used for compressor capacity control. Adequate line length, the use of baffles, or both, must be provided upstream of the bulb location, for mixing the injected refrigerant with the interstage or suction gas.

CONSTANT PRESSURE EXPANSION VALVES

The constant pressure expansion valve is operated by the evaporator or valve outlet pressure to regulate the mass flow rate of liquid refrigerant entering the evaporator and thereby maintain this pressure at a constant value. Although this valve was first used as a liquid refrigerant expansion valve, other applications are discussed here.

Operation

Fig. 12 shows a schematic cross-section of a constant pressure expansion valve. The valve has an adjustable spring which exerts its force on top of the diaphragm in an opening direction, and a spring beneath the diaphragm which exerts its force in a closing direction. Evaporator pressure is admitted beneath the diaphragm, through either the internal or external equalizer passage, and the combined forces of the evaporator pressure and the closing spring act to counterbalance the opening spring pressure.

With the valve set and feeding refrigerant at a given pressure, a small increase in the evaporator pressure will act beneath the diaphragm, force it upward, and cause the valve pin to move in a closing direction, thereby restricting the refrigerant flow and limiting the evaporator pressure. When the evaporator pressure, because of a decrease in load, drops below the valve setting, the top spring pressure moves the valve pin in an opening direction, thereby increasing the refrigerant flow in an effort to raise the evaporator pressure to the balanced valve setting. This valve controls the evaporation of the liquid refrigerant in the evaporator at a constant temperature.

Constant pressure expansion valves automatically adjust the flow of liquid refrigerant to the evaporator to balance compressor pumping capacity. When this balance is established, evaporator pressure remains constant during the remainder of the running phase of the refrigeration cycle. This low side pressure balancing point is selected by turning the valve adjuster to the desired pressure setting. The valve setting should be selected to utilize evaporator surface effectively when the heat load on the system is at the minimum, to avoid floodback to the compressor during the low heat load periods. When the heat load on the system is at a maximum, the increase in evaporator pressure causes the valve to partially close. This prevents the pressure from rising further and overloading the compressor.

For reasons of operation and adjustment, constant pressure expansion valves are most effective on applications which have a constant heat load. When the compressor stops at the end of the running phase of the cycle, standard constant pressure expansion valves close to prevent off-cycle refrigerant flow.

With the use of split-phase and other low-starting-torque type motors in condensing units, it becomes necessary to use some type of fixed orifice expansion device to provide system unloading from high to low side during the *off* cycle. Standard type constant pressure expansion valves cannot be used, because they close off at the end of the running phase of the cycle to maintain pressure differentials between the high and low sides of the system.

To adapt constant pressure expansion valves for use with this type of motor, the designer must select a valve which will provide system unloading. This type of valve is the *bleed type*, occasionally referred to as a slotted orifice or a drilled *bypass* valve. It is a standard constant pressure expansion valve with the addition of a small slot or drilled hole in the valve seat or valve pin to prevent complete valve close-off when the compressor shuts down.

Due to the bleed slot or hole, the valve does not close completely when the unit stops operating, but permits refrigerant to continue to flow at a small rate until high and low side pressures are equalized.

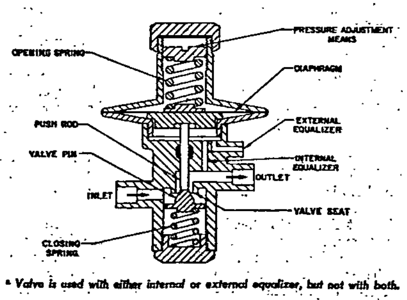
Selection

The constant pressure expansion valve, for liquid refrigerant expansion service, should be selected for the required capacity and system refrigerant at the lowest expected pressure drop across the valve and should have an adjustable pressure range to provide the required evaporator (valve outlet) pressure. The decision as to whether the valve should be a bleed type or a standard expansion valve depends upon the system design.

Application

In general, the constant pressure expansion valve, when applied as a liquid refrigerant expansion valve, is suitable only on constant load applications and, therefore, its use is limited. Ordinarily, only one such liquid expansion valve is used on each system. When used on a variable load application, this valve will starve the evaporator at the high load and overfeed it at the low load, with possible compressor damage resulting in the latter case. Because of the difference in the operating principles of the constant pressure expansion valve and the thermostatic expansion valve, they generally cannot both be used in the same system as liquid refrigerant expansion valves, unless provision has been made in the design and construction of the system.

The constant pressure expansion valve is used for the pilot valve in some of the large suction pressure regulating valves.



* *Valve is used with either internal or external equalizer, but not with both.*

Fig 12 .... Constant Pressure Expansion Valve*

The constant pressure expansion valve may be used alone, or as the pilot valve on a modified suction pressure regulator, to bypass compressor discharge gas in refrigeration systems. Such applications may arise from the requirement for a reduction in compressor capacity, or from the requirement for a low limit control of either the evaporator, the suction pressure, or both. After passing through the valve, the hot gas may be introduced directly into the suction line, in which case some additional desuperheating means may be required, or it may be introduced at the evaporator inlet, where it mixes with the cold refrigerant and is desuperheated before it reaches the compressor.

Some applications suitable for constant pressure expansion valves are drink dispensers, food dispensers, water coolers, ice cream freezers, and self-contained room air-conditioning units.

EVAPORATOR PRESSURE REGULATORS

The evaporator pressure regulator (back pressure regulator) regulates the evaporator pressure (pressure entering the regulator) at a constant value. It is used in the evaporator outlet or suction line wherever low-limit control of the evaporator pressure or temperature is required.

Operation

In operation (Fig. 13), evaporator pressure is admitted beneath the diaphragm or bellows through the internal equalizer passage. When the evaporator pressure rises above the force exerted by the pressure spring, the valve moves in the opening direction. When the evaporator pressure drops below the force exerted by the pressure spring, the valve moves in the closing direction. In system operation, the valve assumes a throttling position depending on the load.

This change in pressure acting upon the diaphragm or bellows to operate it is known as *differential*. The total valve *differential* is the difference between the pressure at which the valve operates at rated stroke and the pressure at which the valve just starts to open.

Pressure drop is the difference between the pressure at the valve inlet and the pressure at the valve outlet. It is important with this type of valve to understand the difference between differential and pressure drop, when determining the proper valve size for a given set of load conditions.

In operation (Fig. 14), when the evaporator pressure rises above the pressure setting of the pilot, the pilot valve moves in an opening direction increasing the pressure above the piston. This increase in pressure moves the piston downward, thereby moving the main valve in an opening direction and causing the evaporator pressure to drop back to the pressure setting of the pilot.

When the evaporator pressure starts to drop below the pressure setting of the pilot, the pilot valve moves in a closing direction, allowing the pressure above the piston to decrease. Then the main spring moves the main valve in the closing direction, thereby preventing the evaporator pressure from falling below the pressure setting of the pilot. In operation, the pilot valve and the main valve assume intermediate or throttling positions, depending on the load.

Selection

The evaporator pressure regulator should be selected for the required capacity and system refrigerant, at the required evaporator (regulator inlet) pressure and the lowest pressure drop across the regulator, consistent with good regulator performance and economical compressor operation, unless otherwise dictated by special system requirements.

Application

Evaporator pressure regulators are used on finned-coil evaporators when frosting is to be prevented or where evaporator pressure must be maintained constant and higher than the suction pressure to prevent dehumidification.

These regulators are used on water and brine chiller applications to prevent *freeze-up* of the chillers under low load conditions.

On multievaporator installations, as shown in Fig. 15, evaporator pressure regulators (direct acting or pilot) can be installed to provide control of the evaporator pressure and temperature in each unit. The regulators prevent lowering of the desired evaporator temperature in the warmer units, while the compressor continues operating to satisfy the cold-

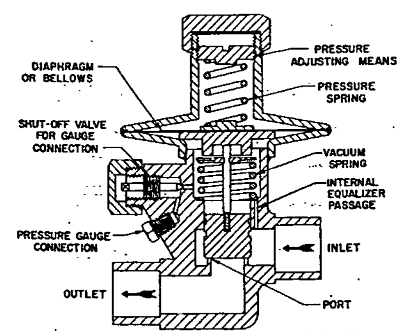
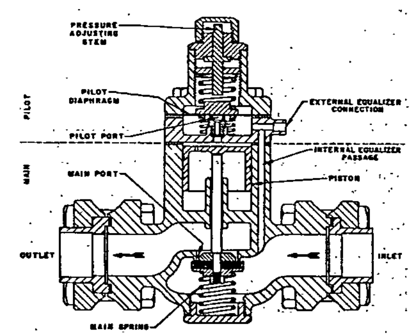


Fig. 13 .... Direct-Acting Evaporator Pressure Regulator



* *Used with either internal or external equalizer, but not with both.*

Fig. 14 .... Pilot-Operated Evaporator Pressure Regulator*