

Parts of refrigeration systems (Expansion devices)

Expansion devices

The expansion device is an important device that divides the high pressure side of a refrigerating system. It is connected between the receiver and the evaporator. The expansion device performs the following functions:

- It reduces the high pressure liquid refrigerant to low pressure liquid refrigerant before being fed to the evaporator.
- It maintains the desired pressure difference between the high and low pressure sides of the system, so that the liquid refrigerant vaporizes at the designed pressure in the evaporator.
- It controls the flow of refrigerant according to the load on the evaporator.

Types of metering device:

- There are six main types of refrigerant control devices
- Hand operated expansion valve
- Low and high pressure side float valve
- Automatic expansion valve
- Thermostatic expansion valve
- Capillary tube.

3.4.1. Hand operated expansion valve

As the name indicates this valve is operated manually and is adjusted by an operator to fill a definite quantity of refrigerant to the system. The valve is controlled manually to maintain the required flow of refrigerant to the system. This valve is used in cold storage, ice plant, warehouses where there is an almost constant load. This valve is not suitable for installation where the load varies and the compressor runs intermittently to maintain a constant temperature. The valve is needed to be adjusted by hand at all times & it is very difficult also it is not used in small installations.

3.4.2. Automatic Expansion valve

The automatic expansion valve is also called constant pressure controlled expansion valve. Evaporation used with automatic expansion valve are called expansion evaporator. The automatic expansion valve consists of a needle valve, valve seat, diaphragm spring, strainer etc.

Here two types of forces (Pressures) on the diaphragms. One is the spring pressure and other evaporator pressure. The spring pressure exerted on the top of the diaphragm in the opening direction of the valve and the evaporator pressure acts beneath the diaphragm in the closing direction of the valve. Thus both the evaporator and spring pressure acts to counter balance each other.

The liquid refrigerant enters through the inlet strainer up to the orifice and needle. If the evaporator pressure is reduced to the setting pressure of the spring. The pressure of the spring increased and the valve opens more and more liquid refrigerant reaches in to the evaporator coils. Once the vaporization rate increases resulting in more pressure developed than the spring pressure setting the valve closes when by the flow of evaporator pressure equal to the spring

pressure.

From the above point it is clear that this valve keeps the pressure constant in the evaporator coils so its also called constant pressure expansion valve this valve is used n domestic refrigeration systems.

3.4.3. Thermostatic expansion valve

This valve controlling the liquid refrigerant is very prevalent. This works with the temperature and pressure. This valve is a precision device that it regulates the rate of flow of liquid refrigerant into the evaporator in exact proportion to the rate of evaporation of liquid refrigerant which is according to the heat load. This also regulates the quantity of refrigerant vapour exhaled by evaporator. This works according to the temperature of the refrigerant vapour leaving the evaporator and pressure in the evaporator. In its construction it consists of needle valve, diaphragm, remote feeler bulb, controlling spring, adjusting screw etc.

Here three pressures are acting one is remote bulb pressure on the top pf diaphragm, second and third is spring pressure and evaporator pressure acting beneath the diaphragm. The spring exerts its force beneath the diaphragm through the needle valve in the closing direction of the valve. This pressure can be made or less by adjusting screw. The evaporator pressure is also act against the beneath diaphragm in the closing direction of the valve. The pressure of the remote bulb is equal to the sum of pressure of the spring and evaporator. The valve opens due to remote bulb pressure but the valve starts to closing due to spring and evaporator pressure.

Spring pressure has got to be adjusting to balance the super heat quantity. It has got the following three functions in the refrigeration system.

- Throttling action : It reduces the pressure
- Modulating action: It sends liquid refrigerant in the evaporator in proper quantity
- Keeps the necessity of load change in order

This valve not only set to keep a constant superheat and temperature pressure in the evaporator but it also used for variable heat load of the system so this valve is most commonly used in commercial refrigeration and air- conditioning system.

3.4.4. Capillary Tube

The capillary tub is used as an expansion devices in small capacity hermetic sealed refrigeration unit such as domestic refrigeration, water coolers, room air conditioner and freezer

It is a copper tube of small internal diameter and of varying length depending upon the application. The inside diameter varies from 0.5mm to 2.25 mm and length varies 0.5m to 5m. It is installed in the liquid line between condenser and evaporator. In its operation the liquid refrigerant from the condenser enters the capillary tube. Due to the frictional resistance offered by a small diameter tube, the pressure drops. Since the frictional resistance directly proportional to the diameter. Therefore longer the capillary tube and smaller its inside diameter greater is than pressure drop created in the refrigerant flow In other words, greater pressure difference between the condenser and evaporator is needed for a given flow of refrigerant. The diameter and length of the capillary tube once selected for a given set of conditions and load can not operate at other conditions.

Advantages

- The cost of capillary is less than the other forms of expansion devices.

- When the compressor stops, the refrigerant continues to flow into the evaporator and equalizes the pressure between the high side and low side of the system. This considerably decreases the starting load on the compressor
- A low starting torque motor can be used to drive the compressor.

Disadvantages

- Refrigerant charge in a capillary tube system is critical
- Capillary tube cannot be used in large refrigeration system because capacity control is not possible.