Expansion Devices

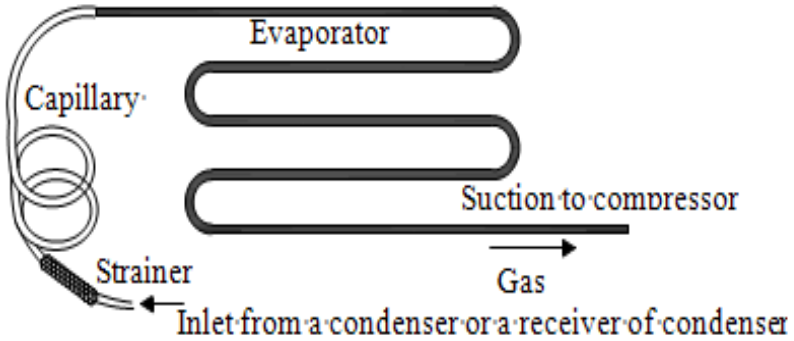
Functions of expansion devices

- It reduces the high pressure liquid refrigerant to low pressure liquid refrigerant
- It maintains the desired pressure difference between the high and low pressure sides of the system
- It controls the flow of refrigerant according to the load on the evaporator

Capillary tube

- Capillary tubes are widely used as expansion devices in small vapor compression refrigeration Systems, such as household refrigerators, room air conditioners, and small package air conditioning units.

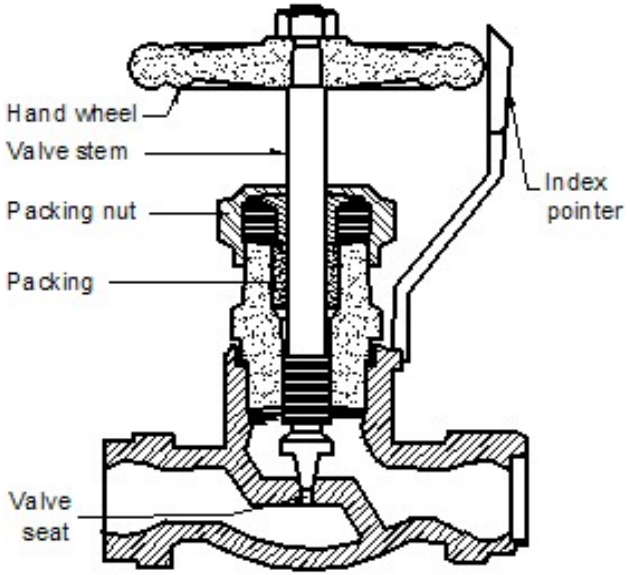
- In these system, the capillary tube is wound into with coils for direct expansion.
- The tube connects the outlet of condenser to the inlet of the evaporator.



Physically the capillary tubes are hollow tubes made with drawn copper, with internal diameters ranging between 0.51and 2 mm

Hand Operated Expansion Valves

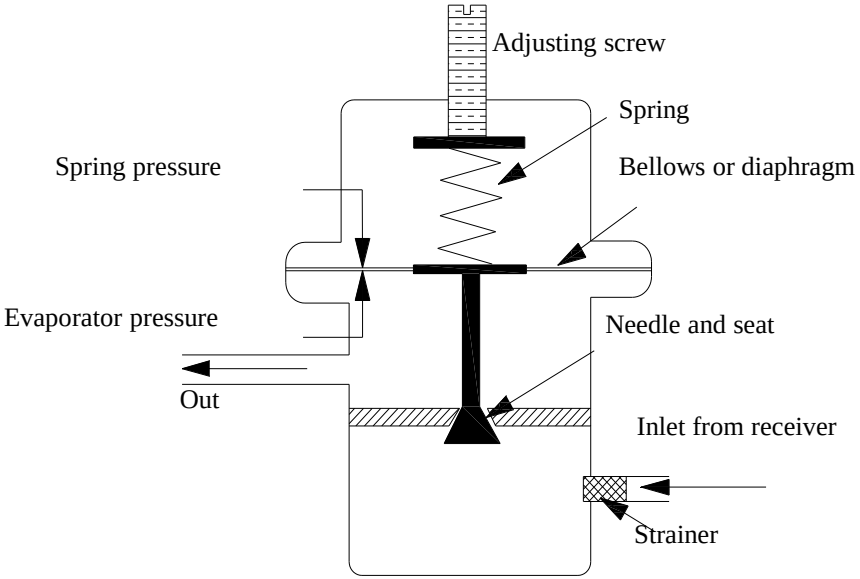
- Hand expansion valves are also called throttle valves.
- The structure of a hand expansion valve is shown in Fig.



- The expansion valve comprises of main body, valve seat, and hand wheel which is actuated to change the opening area around the valve seat to adjust the frictional resistance to the refrigerant flow.

- The advantage of the hand expansion valve is that it is unresponsive to changes in the system load and the disadvantage is the valve must be manually readjusted each time when the load on the system changes in order to prevent either starving or overfeeding of the evaporator.
- In addition, the valve must be opened and closed manfully each time when the compressor is cycled on and off.

Automatic Expansion Valves

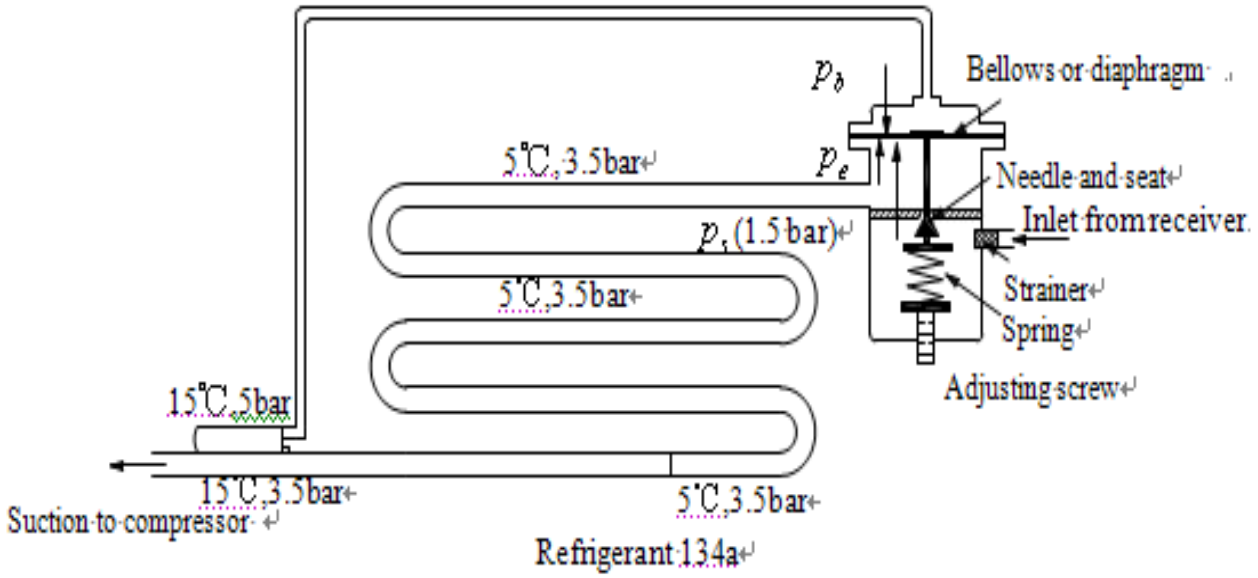


- Fig. is a schematic diagram of an automatic expansion valve showing the principal part of the valve, which includes a needle and seat, a pressure bellows or diaphragm and a spring, the tension of which is variable by means of an adjusting screw.

Thermostatic expansion Valves-Superheat Control

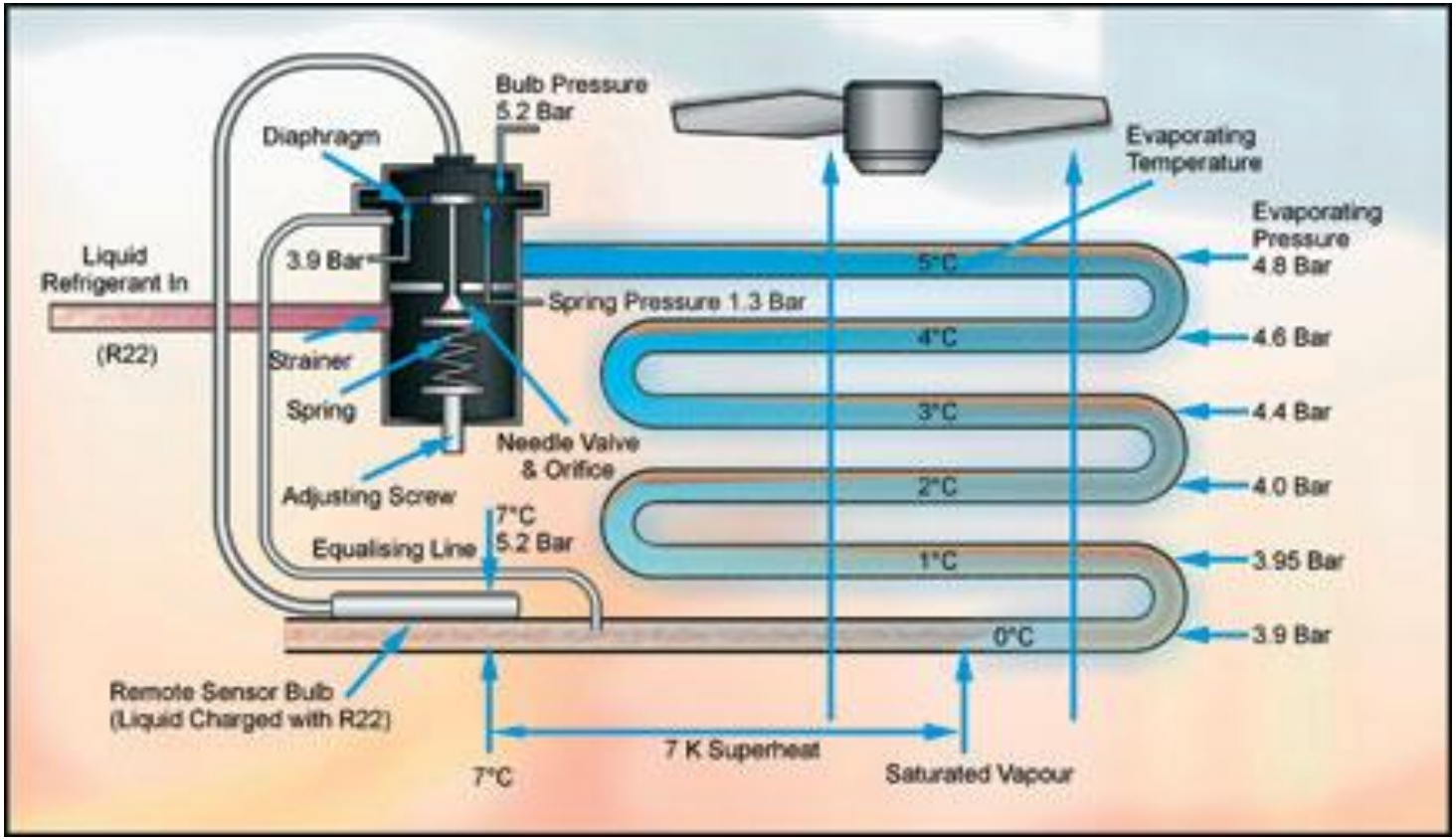
- At present, thermostatic expansion valve is probably the most widely used refrigerant flow control device because of its high efficiency and its ready adaptability to any type of refrigeration applications.
- The thermostatic expansion valve controls the mass flow rate of the refrigerant into the evaporator according to inspiration vapor degree of superheat, and at the same time throttles the liquid from condensing pressure to evaporation pressure.

- Fig. is an operation diagram of the internal equalizer thermostatic expansion valve, the main parts including: a needle and seat, a pressure bellows or diaphragm, a fluid-charged remote bulb, and a spring, the tension of which is usually adjustable by an adjusting screw.



- The bulb pressure p_b acts on the top of the diaphragm to open the valve.
- Besides the bulb pressure, there are two other pressures under the diaphragm to move the valve toward an open or closed position: the spring pressure p_s acts on the pin and the evaporator pressure p_e acts on the bottom of the diaphragm to close the valve.
- When the opening and closing pressures balance each other, the valve pin is in a stable fixed position.
- That is, when the valve is not opening or closing, the following balance of pressures exists:

$$p_b = p_s + p_e$$


Bulb Pressure
5.2 Bar
Diaphragm
Evaporating
Temperature
Evaporating
Pressure
4.8 Bar
Liquid
Refrigerant In
(R22)
3.9 Bar
Spring Pressure 1.3 Bar
5°C
4°C
4.6 Bar
3°C
4.4 Bar
2°C
4.0 Bar
1°C
3.95 Bar
0°C
3.9 Bar
Strainer
Spring
Needle Valve
& Orifice
Adjusting Screw
7°C
5.2 Bar
Equalising Line
Remote Sensor Bulb
(Liquid Charged with R22)
7°C
7 K Superheat
Saturated Vapour