

LECTURE NOTES

ON

REFRIGERATION & A/C

ME C46I/ CHE C47I

EXPANSION DEVICE

PART- 8

BY

DR.A.M.SURENDRA KUMAR

FUNCTIONS

- This is one of the basic components of the refrigeration system.
- Functions:-
 1. It reduce the pressure & temperature of the refrigerant coming from the condenser as per the requirement of the system.
 2. It must regulate the flow(Metering) of refrigerant as per the load on the Evaporator.

TYPES OF EXPANSION DEVICES

- An expansion Device is essentially a restriction offering resistance to flow so that the pressure drops, resulting in a throttling process.
- Basically Two types of expansion devices.:
 - **1.** Variable-restriction Type
 - **2.** Constant restriction Type

VARIABLE RESTRICTION TYPE:

In this, the extent of opening area of flow keeps on changing depending on the type of control.

Three common types are

- A.** Automatic Expansion Valve (Pressure Control)
- B.** Thermostatic Expansion Valve
- C.** Float Valves

i) High side Float valve

In this it maintains the liquid at a constant level in the condenser.

ii) Low side Float valve

In this maintains the liquid at constant level in the Evaporator.

CONSTANT RESTRICTION TYPE:

Capillary Tube in which it is merely along tube with a narrow diameter bore.

AUTOMATIC EXPANSION VALVE

- This works in response to the pressure changes in the evaporator due to increase in load(pressure increase) or due to decrease in load(pressure decreases).
- This valve maintains a constant pressure throughout the varying load on the evaporator controlling the quantity of refrigerant flowing into Evaporator.
- This consists of a needle valve, a seat, a diaphragm and a spring as shown in figure.
- The opening of the valve in the seat is controlled by the two opposing forces.
- A. the tension in the spring B. The pressure in the evaporator acting on diaphragm.
- Once the spring is adjusted for a desired evaporator pressure and given load, the valve operates. Automatically with changing load conditions in the evaporator.

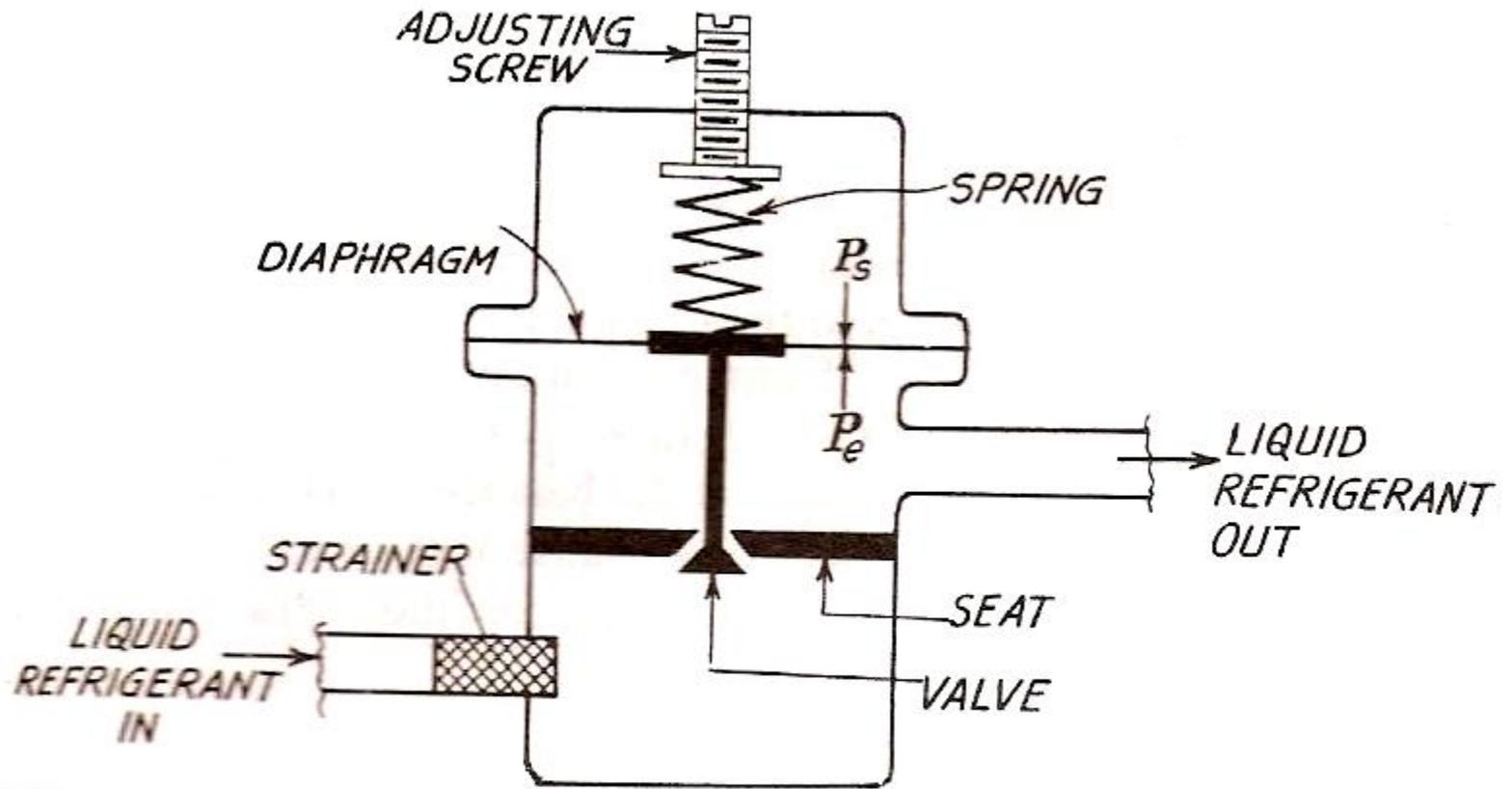


Fig. Automatic or Constant Pressure expansion valve.

- 
- Assume the spring is adjusted initially to maintain a pressure of 1.5 bar in the evaporator at a given load.
 - If the pressure falls below 1.5 bar due to decrease in load, the spring pressure will exceed the evaporator pressure and causes the valve to open more and increases the flow of refrigerant.
 - If the pressure in the evaporator increases due to increase in load above 1.5 bar, the evaporator pressure will exceed the spring tension and valve move in closing direction.
 - This reduces the quantity of refrigerant flow in the evaporator.

THERMOSTATIC EXPANSION VALVE

- Thermostatic expansion valve controls the flow of refrigerant through the evaporator in such a way that the quality of the vapour leaving the evaporator will always be in superheated condition.
- Its operation is used for maintaining a constant degree of superheat at the evaporator outlet.

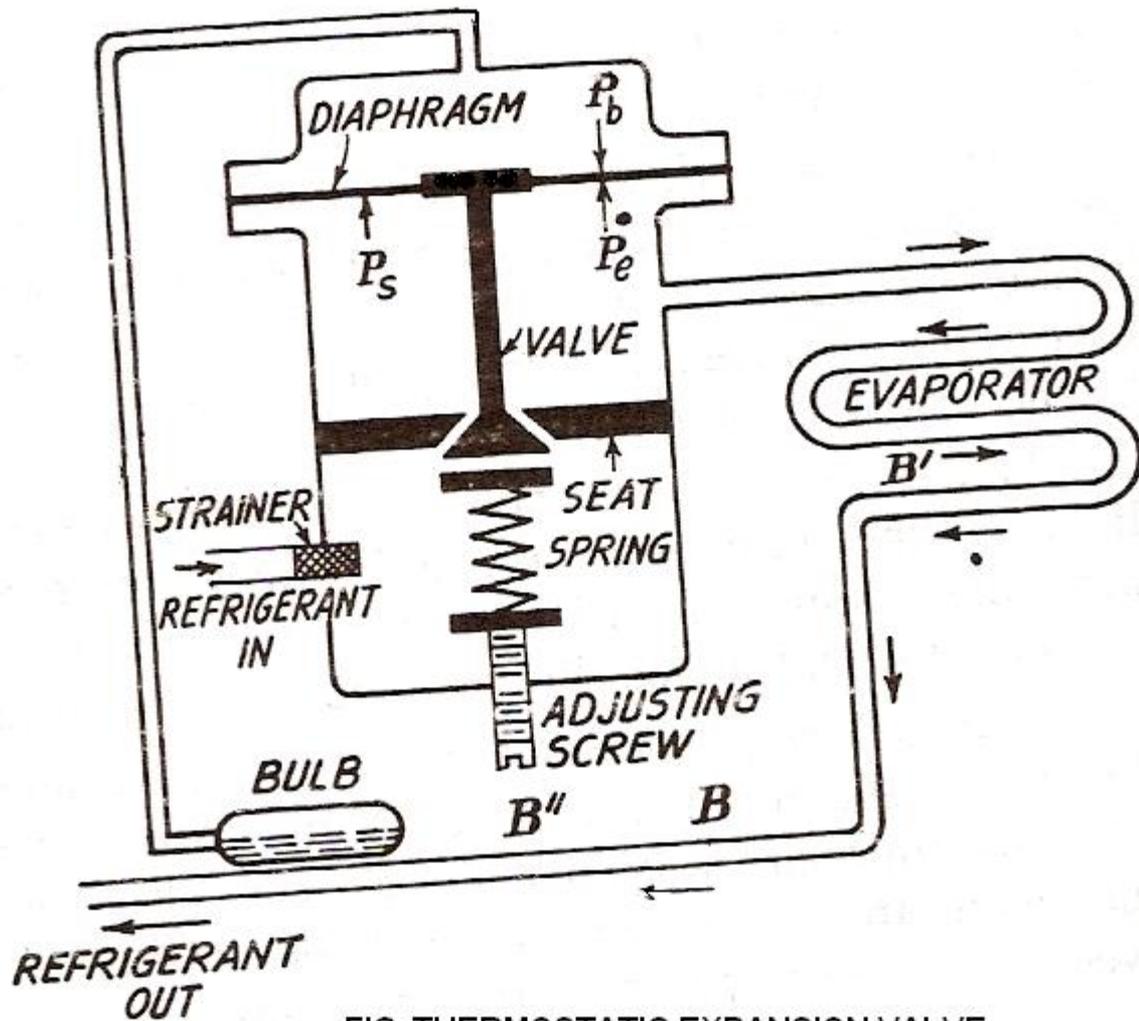
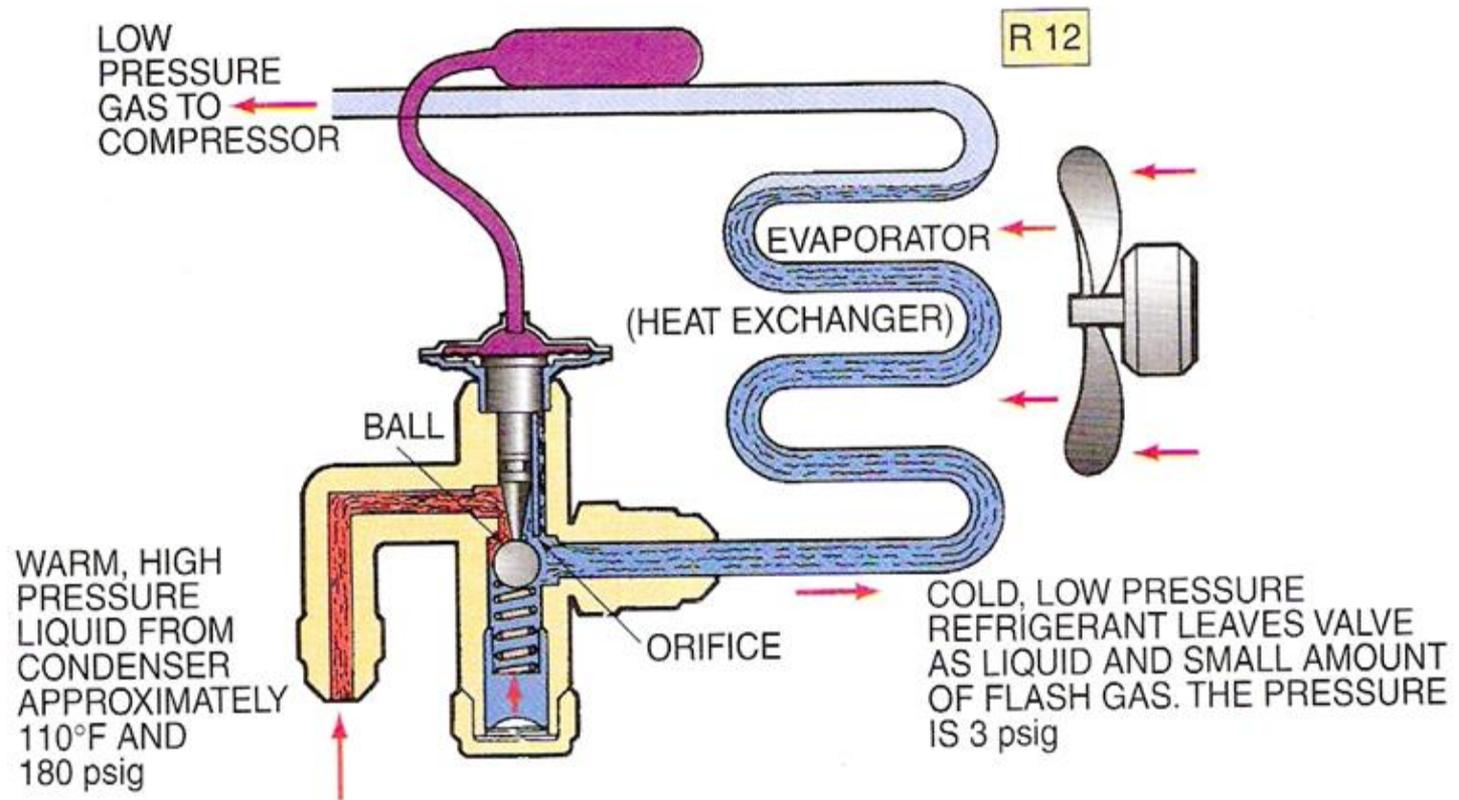
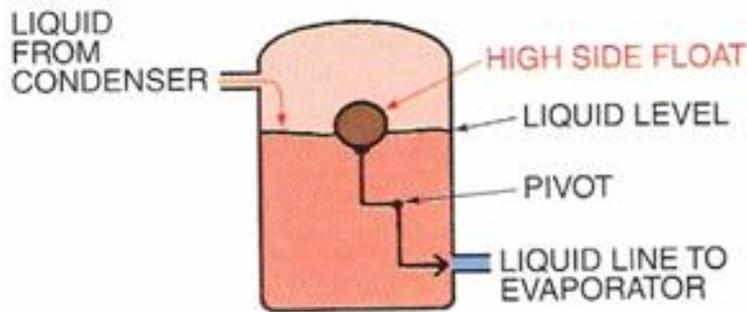


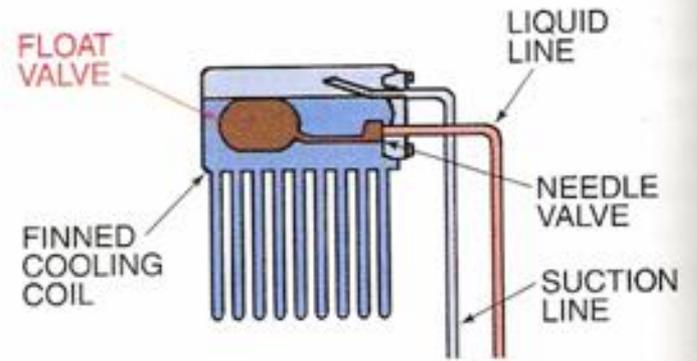
FIG. THERMOSTATIC EXPANSION VALVE



The expansion device has a dramatic temperature change from one side to the other. *Courtesy Parker Hannifin Corp.*



(A)



(B)



(C)



(D)



(E)

Figure Five metering devices: (A) High-side float. (B) Low-side float. (C) Thermostatic expansion valve. (D) Automatic expansion valve. (E) Capillary tube with liquid line drier. Courtesy (C) Singer Controls, Photo (D) by Bill Johnson, Courtesy (E) Parker Hannifin Corp.



(A)

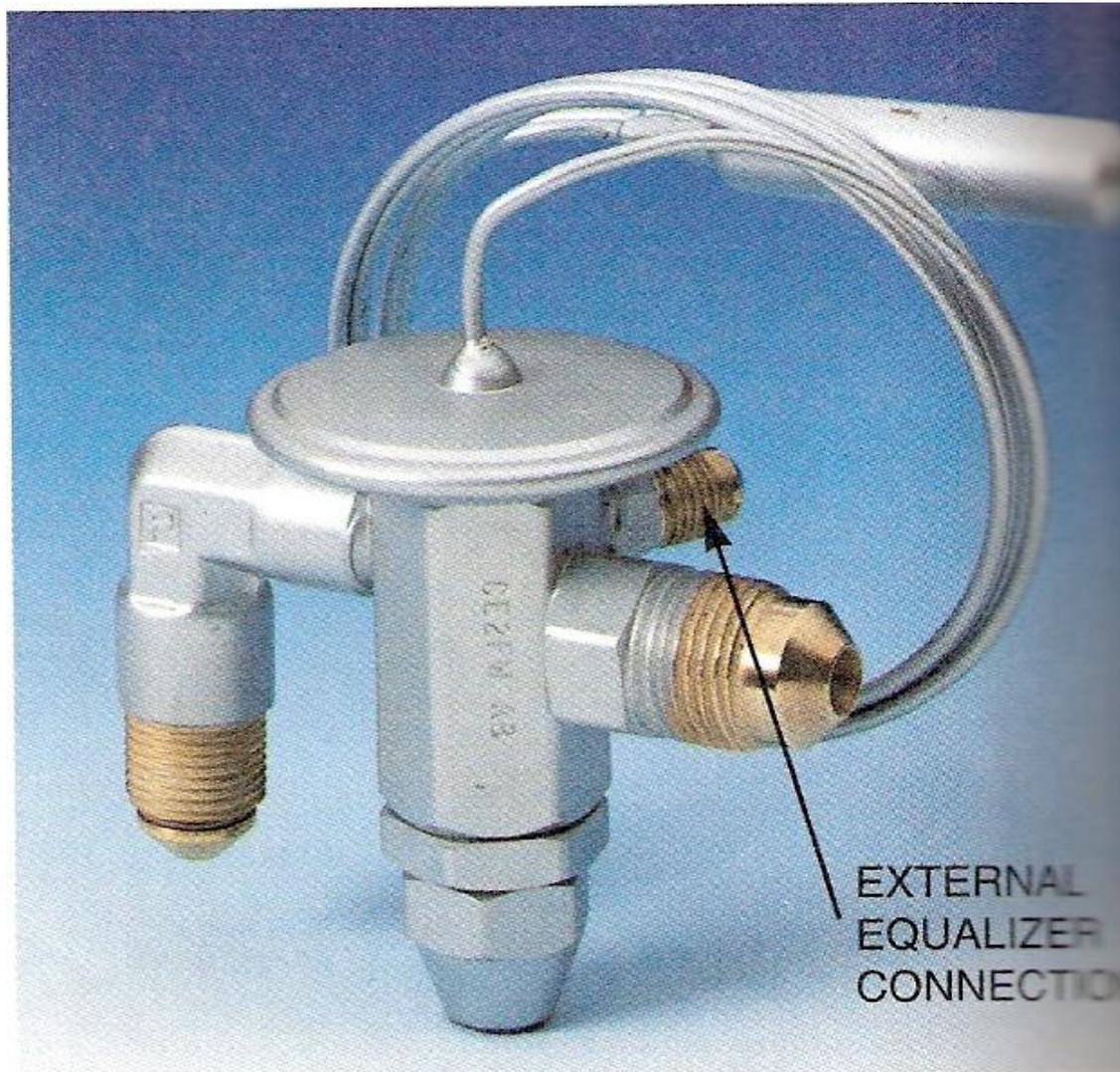
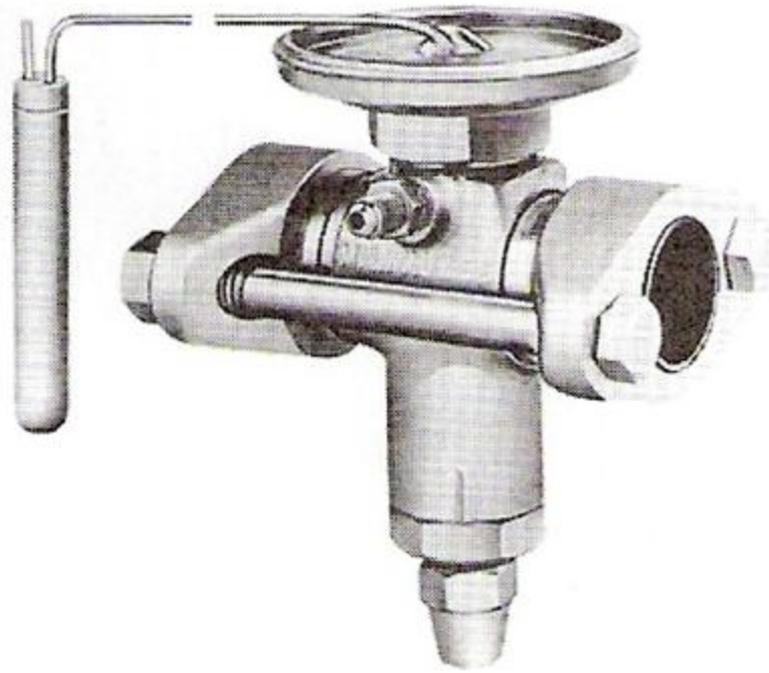
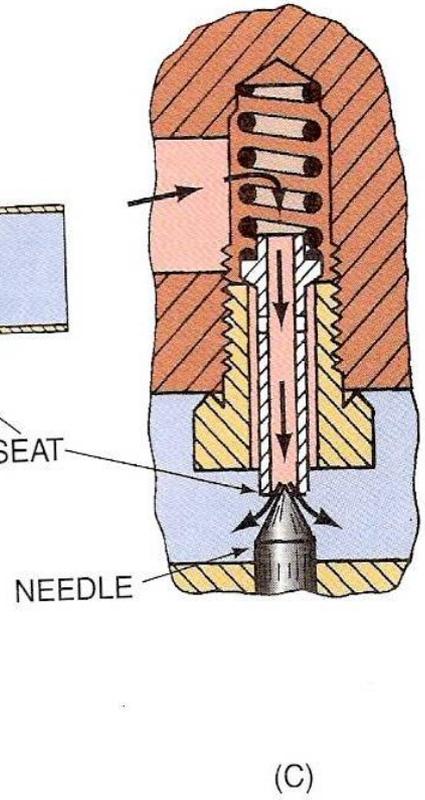
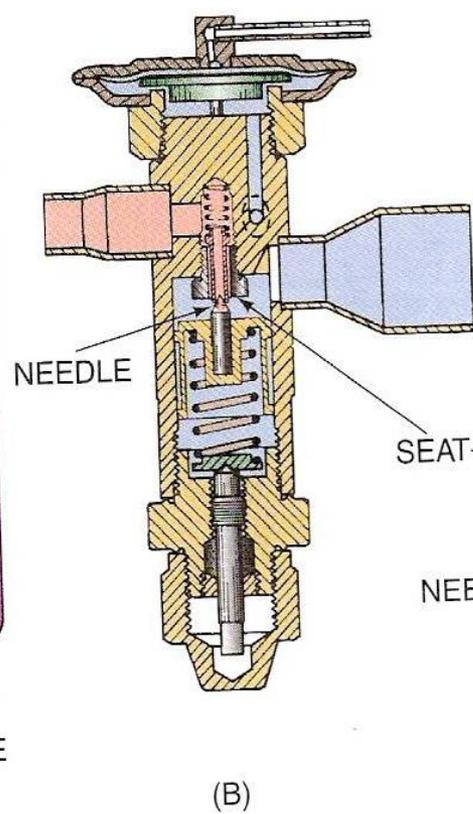
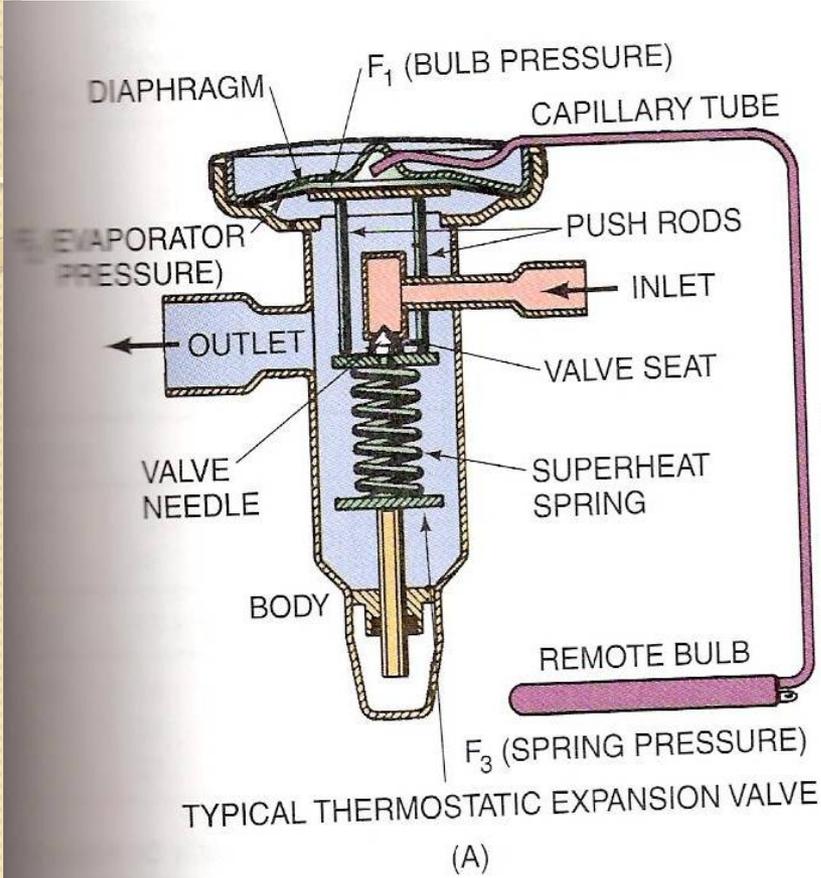


Figure 24–10 The third connection on this expansion valve is called the external equalizer. *Courtesy Parker Hannifin Corp.*



(B)

Figure (A) Flare and the (B) flange-type valve. It can be removed from the system and replaced easily when it is installed where it can be reached with wrenches. *Courtesy (A) Parker Hannifin Corp., (B) Singer Controls Division*



11-13 (A)–(C) Needle and seat devices used in expansion valves. Courtesy (A) Singer Controls Division, (B) and (C) Sporlan Valve Company

CAPILARY TUBES

- The capillary tube is a fixed restriction type device. It is along and narrow tube connecting the condenser directly to the evaporator.
- Its resistance to flow permits the capillary to be used as a pressure reducing device to meter the flow of refrigerant given to the Evaporator.
- The Pressure drop through the capillary tube is due to the following two factors;
 - i. Friction due to fluid viscosity, resulting in frictional pressure drop.
 - ii) Acceleration due to the flashing of the liquid refrigerant into vapour resulting in momentum pressure drop.
- The cumulative pressure drop must be equal to the difference in pressure at the two ends of the tube.

- For a given state of refrigerant, the pressure drop is directly proportional to the length and inversely proportional to the bore diameter of the tube..
- Capillary tube is the most commonly used expansion device in small refrigeration units, such as domestic refrigerators, window type air conditioners, water coolers etc.
- The advantage of a capillary tube are its simplicity , low cost and the absence of any moving parts.
- The disadvantages associated with this device is that the refrigerant must be free from moisture and dirt otherwise it will choke the tube and stop the flow of refrigerant.
- It cannot e used with high fluctuating load conditions.