6.4 Chemical Agent Refrigeration System:

These machines are based on the fact that a liquid can be vaporized at any desired temperature by changing its pressure. Further, heat is required to be added to the liquid during vaporization, when the liquid phase changes to the gaseous phase. Therefore, a vaporizing liquid can be used to produce refrigeration at any temperature. For instance, at a pressure of about 1 atm, ammonia boils at -33^0C, and at a pressure of about 5 atm, Freon-22 boils at 0^0C and Freon-12 at 1 atm, boils at -30^0C.

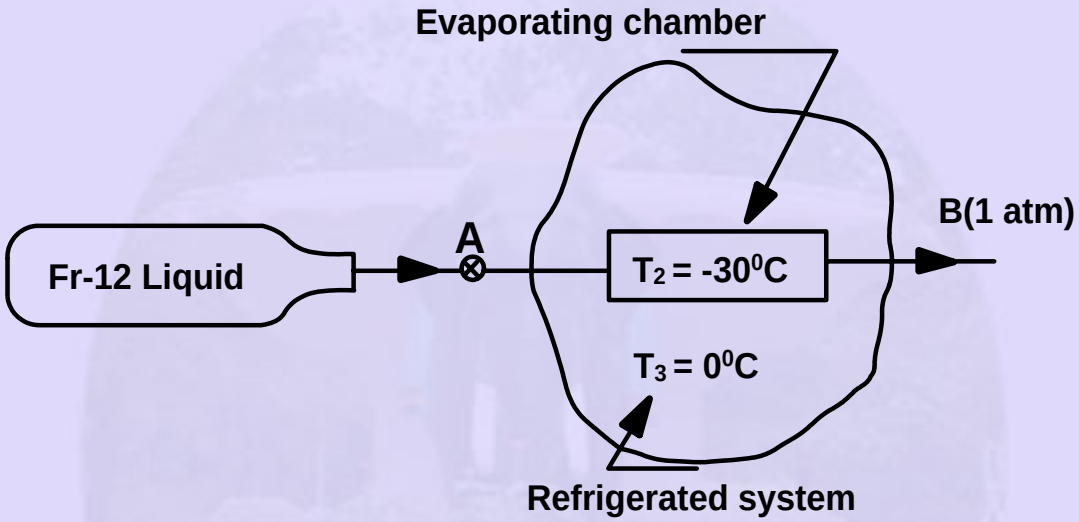

Fig.6.4. Refrigeration by using a chemical agent (Fr-12)

Hence, in an arrangement in which a system containing some refrigerant in liquid form at a certain pressure (corresponding to a temperature T_2) is exposed to another system at temperature T_3, the latter will be refrigerated, if $T_2 < T_3$. A simple scheme of such an arrangement is shown in Fig.6.4.

Liquid Fr-12 is supplied to the evaporating chamber through a valve at a pressure of about 1 atm. Since, the boiling temperature of Fr-12 at this pressure is -30^0C, heat flows from the sarrounding space at 0^0C and makes Fr-12 to boil. Thus, the space will be cooled as long as there is a supply of liquid Fr-12 to the evaporating chamber.

But, the above arrangement, however suffers from two important draw backs.

1. *The cost of replacing Fr-12 will be more as the evaporated vapor leaks out to the atmosphere.*
2. *If the system was to use some refrigerant like ammonia, it may become hazardous to life due to its discharge into atmoshphere, since it is a highly toxic and irritating fluid.*

To eliminate these drawbacks, it will be necessary to make the refrigerant work in a closed loop and be used again and again. Therefore, the vapor at B, the exit of the evaporating chamber, should be collected and be converted into liquid state again, so that it could be supplied to the chamber for re-evaporation. Hence, in reality such a mechanical refrigerating system will use refrigerant alternatively between vapor and liquid phases. To condense the vapor at state B, its condensing temperature (thereby its pressure) should be brought to the level higher than that of some freely available natural cooling medium like air or water. This arrangement is shown in Fig.6.4.1.

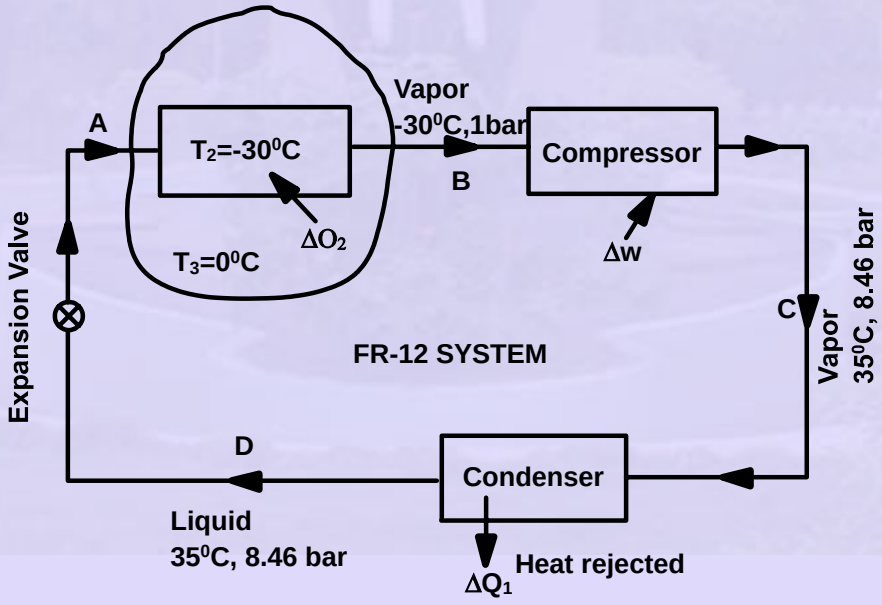

Fig.6.4.1. Closed cycle chemical agent refrigeration cycle

Depending upon the equipment employed in the system, the chemical agent refrigeration systems are classified into:

1. *Vapor compression refrigeration systems.*
2. *Vapor absorption refrigeration systems.*
3. *Steam jet refrigeration systems.*