6.2 Methods of Refrigeration:

a) Natural Method:

The natural method includes the utilization of ice or snow obtained naturally in cold climate. Ice melts at 0^0C. So when it is placed in space or system warmer than 0^0C, heat is absorbed by the ice and the space is cooled. The ice then melts into water by absorbing its latent heat at the rate of 324 kJ/kg. But, now-a-days, refrigeration requirements have become so high that the natural methods are inadequate and therefore obsolete.

b) Mechanical or Artificial Refrigeration:

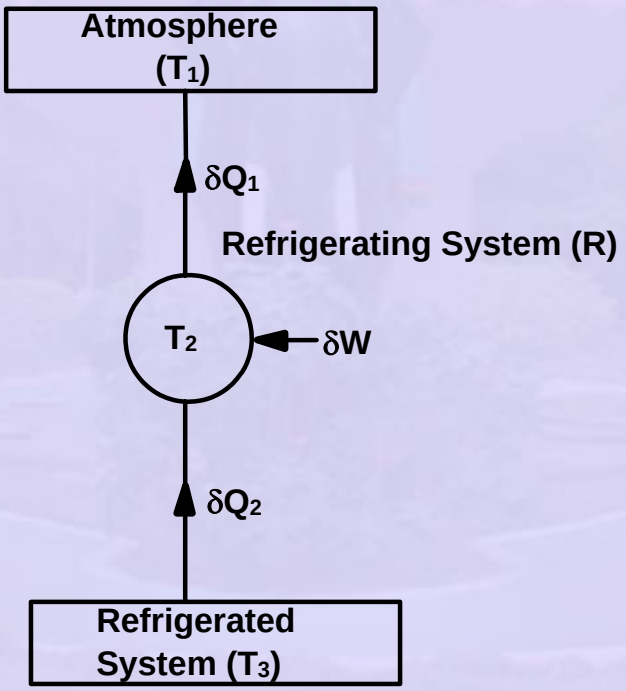

Fig.6.2. Reversed Carnot engine

A mechanical refrigeration system works on the principle of reversed Carnot cycle as shown in Fig.6.2. Work δw is delivered to the refrigerating system, causing it to remove

heat δQ_2 from the body or system (at lower temperature T_3) and to deliver it along with work, δw, to another body at higher temperature, T_1, so that,

$$\delta Q_1 = \delta w + \delta Q_2$$

There can be two methods by which the temperature $T_2 < T_3$ may be attained within the refrigerating system.

i) *By lowering the temperature of the working substance in the refrigerating system to the level of T_2. In this case, the heat will be absorbed due to temperature difference and T_3 will decrease as heat δQ_2 flows out.*
ii) *By evaporating some fluid at an appropriate pressure. In this case, a constant temperature T_2 will be maintained and latent heat of fluid will be absorbed as δQ_2.*

Depending upon the above method used, there are two types of mechanical refrigerating systems :

i) ***Air systems:*** *Uses air as a working fluid. Air does not undergo any change of phase, but absorbs heat due to temperature difference.*
ii) ***Chemical Agent Systems****: The working fluid changing its phase while boiling from liquid to vapor state, thereby it absorbs the latent heat.*

Unit of Refrigeration:

Capacity of refrigeration unit is generally defined in ton of refrigeration. A ton of refrigeration is defined as the quantity of heat to be removed in order to form one ton (1000 kg) of ice at 0^0C in 24 hrs, from liquid water at 0^0C. This is equivalent to 3.5 kJ/s (3.5 kW) or 210 kJ/min.