

2.1 REFRIGERATION

Refrigeration is the science of producing and maintaining temperatures below that of the surrounding atmosphere. This means the removing of heat from a substance to be cooled. Heat always passes downhill from a warm body to a cooler one, until both bodies are at the same temperature. Not only perishables, today many human work spaces in offices and factory buildings are air-conditioned and a refrigeration unit is the heart of the system. Before the advent of mechanical refrigeration water was kept cool by storing it in semi-porous jugs so that the water could seep through and evaporate. The evaporation carried away heat and cooled the water. This system was used by the Egyptians and by the Indians in the Southwest. Natural ice from lakes and rivers was often cut during winter and stored in caves, straw-lined pits and later in saw-dust insulated buildings to be used as required. The Romans carried pack trains of snow from Alps to Rome for cooling the Emperor's drinks. Though these methods of cooling all make use of natural phenomena, they were used to maintain a lower temperature in a space or product and may properly be called refrigeration. Refrigeration means the cooling or removal of heat from a system. The equipment employed to maintain the system at a low temperature is termed as refrigerating system and the system which is kept at lower temperature is called refrigerated system.

DOMESTIC REFRIGERATOR

The common type of domestic refrigerator has a cabinet shaped with compressor, the condenser and receiver fitted in their basement. The expansion valve and evaporator coils are exposed in the storage cabinet with the piping's carrying liquid refrigerant passing through the body. Generally, methylene chloride, Freon-12, and Freon-11 are used as the refrigerants. Refrigeration is not only provided with double-walled cabinet packed with materials having high thermal insulation such as fiberglass, cork or expanded rubber but also all around the inside of door flap soft rubber seal is used which makes the cabinet airtight. Also the door is provided with automatic closing mechanism – door hinges are provided in such a way that door flap when left in open position automatically comes to closing position due to gravity and as it approaches closing position it is attracted by the magnetic strip fitted behind the sealing rubber ring and thus the door is closed with snap action. All this is done to prevent leakage of atmospheric heat inside the

cooling effect stops. After some time, when the temperature increases and reaches up to a predetermined value, thermostat operates again and connects the compressor motor to the supply. And the cooling process starts again. This cycle is repeated continuously to maintain the temperature in a predetermined temperature range. In this way, the refrigerant is circulated through the coils of the refrigerator to maintain the temperature in the required temperature range.

Electrical Circuit of a Refrigerator

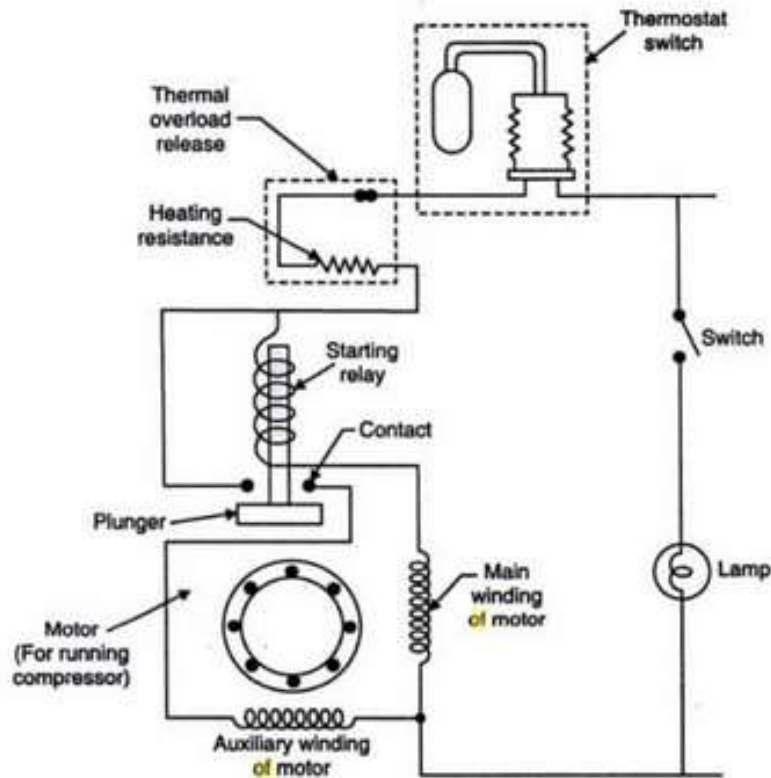


Figure 2.1.2 Electrical circuit of domestic refrigerator

[Source: "Utilisation of Electrical Power" by R. K. Rajput, Page: 164]

The electrical circuit of a refrigerator is shown in Figure. The refrigerator is provided with a door push switch, which closes on the opening of the refrigerator and puts the lamp on. Split-phase single phase induction motor is used in the sealed compressor unit to run the compressor. Thermal overload release is provided to protect the motor from damage against the flow of over-current. Thermostat switch is provided to control the temperature inside the refrigerator. The temperature inside the refrigerator can be adjusted using the temperature control screw. Greater the distance between contacts, the greater will be the temperature inside the refrigerator and vice versa. To protect the motor against the under-voltage use of automatic voltage regulator is essential since, in case of fall in

applied voltage, the motor will draw heavy current to develop the required torque and will become hot.

Vapor Compression System Parts

The refrigerant in this unit is circulated through the various components of the system with the help of a motor installed in the compressor unit where it undergoes a number of changes in its state or condition. Each cycle of operation consists of the four fundamental changes in the state of the refrigerant:

- (i) expansion
- (ii) vaporization
- (iii) compression
- (iv) condensation.

The vapor compression system of a domestic refrigerator consists of the following five essential parts:

Compressor: The low pressure and temperature vapor refrigerant from the evaporator is drawn into the compressor through the inlet or suction valve, where it is compressed to high pressure and temperature. The high pressure and temperature vapor refrigerant is discharged into the condenser through the delivery or discharge valve.

Condenser: The condenser or cooler consists of coils of pipe in which the high pressure and temperature vapor refrigerant is cooled and condensed. The refrigerant, while passing through the condenser, rejects its latent heat to the external surrounding air. Thus hot refrigerant vapor received from the compressor is converted into liquid form in the condenser.

Receiver: The condensed liquid refrigerant from the condenser is stored in a vessel, known as a receiver, from where it is supplied to the expansion valve or refrigerant control valve.

Expansion Valve or Throttle Valve: The function of this valve is to allow the liquid refrigerant under high pressure and temperature to pass at a controlled rate after reducing its pressure and temperature. Some of the liquid refrigerant evaporates as it passes through the expansion valve, but the greater portion is vaporized in the evaporator at the low pressure and temperature.

Evaporator: An evaporator consists of coils of pipe in which the liquid-vapor refrigerant at low pressure and temperature is evaporated and changed into vapor refrigerant at low pressure and temperature. During the evaporation process, the liquid-vapor refrigerant absorbs its latent heat of vaporization from the medium which is to be cooled (i.e. items placed in the refrigerator).

