Experiment No: 05

Aim: ***To Study the Working of Compressor Used in Refrigeration System.***

Theory: The compressor is the heart of vapour compression system. The compressor is used to reclaim the refrigerant vapour leaving the evaporator. The refrigerant must be compressed to the pressure corresponding to a saturation temperature higher then the temperature of the naturally available air or water. The compressor is also used to circulate the refrigerant through the system. The capacity of compressor determines the capacity of refrigeration system as a whole.The refrigeration compressor and gas or air compressor differs very much because the refrigerating compressor is integral part of the cycle and it is coupled to other components.

Classification of refrigeration compressors:

1. Reciprocating compressor.
2. Rotary compressor.
3. Screw Compressor.
4. Centrifugal and scroll compressor.

1. Reciprocating Compressor:

The reciprocating compressors are available in sizes as small as 1/12 hp up to about 150 hp for large capacity installation.

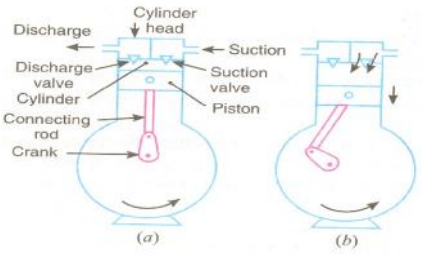

Fig.1 Open type Reciprocating Compressor

The reciprocating compressors are of two types.

a) Open type compressor. b) Hermetically sealed compressor.

a. Open type of compressor:

A compressor whose crankshaft extends through the compressor housing so that a motor can be externally coupled to the shaft is called open type compressor. The open type of compressor is flexible in the sense that the speed of compressor can be varied for obtaining different refrigeration capacities. It can be operated by any type of prime mover like electric motor, IC engine etc. In the field the motor can be easily charged in case of a motor burnout. The refrigeration system is not affected by burnouts. A disadvantage of the open type of compressor is that the shaft seal is most vulnerable point for leakage of refrigerant.

b. Hermetically sealed compressor:

In hermetic compressor there is no need for shaft seal. The compressor and motor are mounted on single shaft and whole assembly is fixed in a steel shell, the joint of which are welded. The losses due to drive package and shaft seal friction are also eliminated i.e. the power required per tone of refrigeration is less then that of the open type.

For sealed unit A. C. electric supply with particular voltage and frequency for which compressor is designed is needed to run the compressor. In the event of motor burnout, highly corrosive hydrochloric and hydrofluoric acids are formed. The system

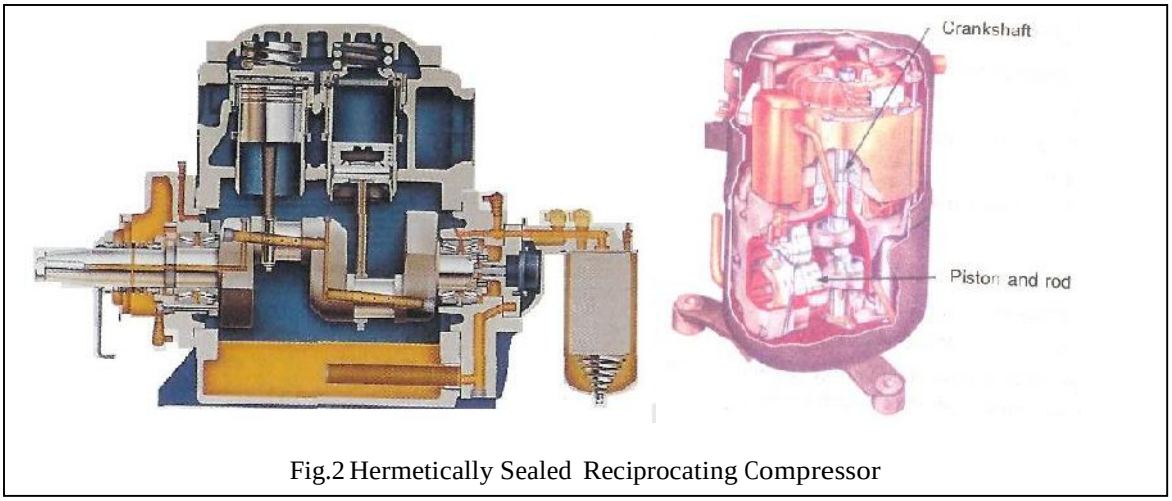

Fig.2 Hermetically Sealed Reciprocating Compressor

therefore gets contaminated. Before repairing or installing a new compressor assembly, the system has to be thoroughly flushed and cleaned.

In hermetic compressor the compressor assembly is suspended inside a steel shell, the winding and rotor cannot get natural cooling. The cold refrigerant vapour coming from the evaporator accomplishes the cooling of the winding and rotor. If there is minute leak in the system motor cooling will be affected.

Causes of Burn Outs:

1. Voltage fluctuation.
2. Low refrigerant charge.
3. Quality of oil and refrigerant.
4. High discharge pressure.

2. Rotary Compressor:

As the name implies, the displacement and compression of the refrigerant vapour is achieved due to circular or rotary motion instead of reciprocating motion.

There are two types of rotary compressor.

i) Rotating Blade Type Rotary Compressor

ii) Stationary Single Blade Type Rotary Compressor

i) Rotating Blade Type Rotary Compressor

The rotor is concealing with the shaft and rotates in a cylinder which is off capture with respect to the shaft and rotor. Multiple vanes are positioned in slots in the rotor, ride on the cylinder wall faction vapour entering the cylinder is trapped between successive vanes and gets compressed due to reduction in volume as the rotor rotates.

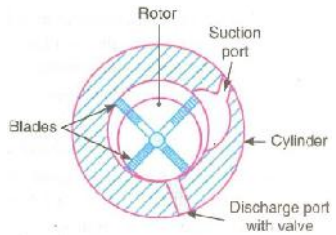

Fig.3 Rotating Blade Type Rotary Compressor

ii) Stationary Single Blade Type Rotary Compressor:

The main components of rotary compressor are cylinder, roller mounted eccentrically on motor shaft and a spring loaded shaft. The roller moves eccentrically on the driver shaft inside a stationary cylinder.

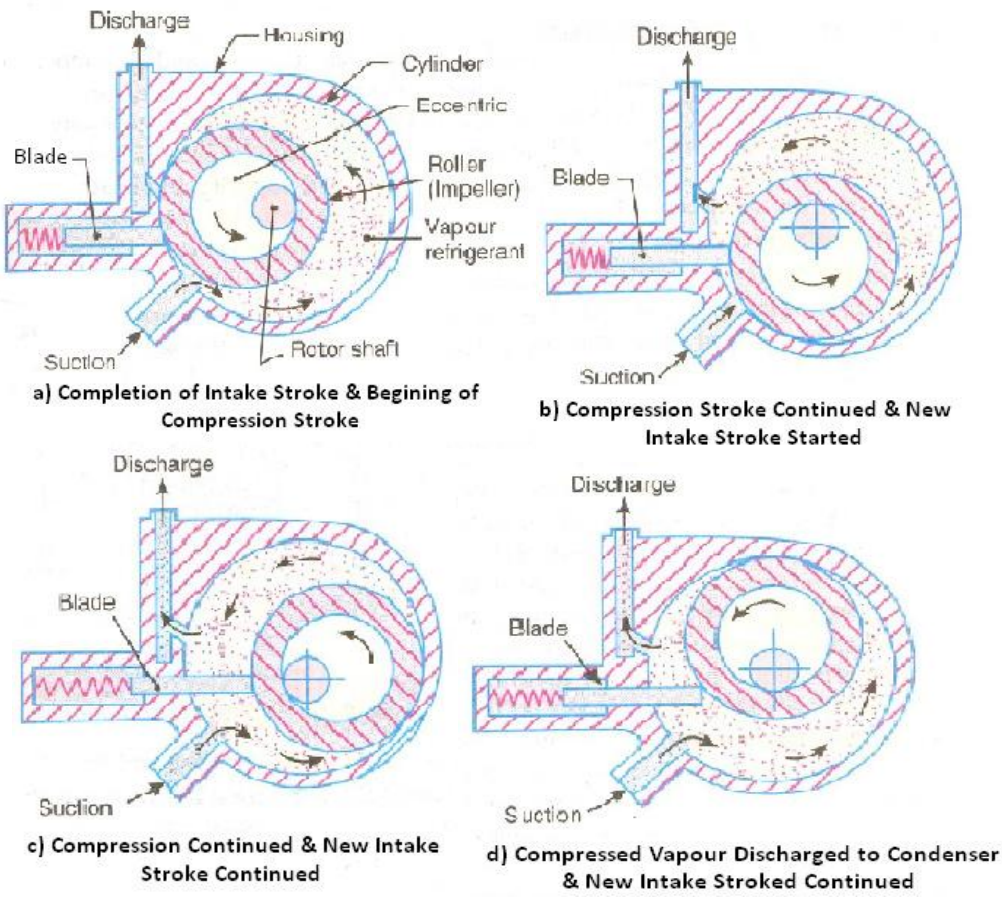

Fig.4 Stationary Single Blade Type Rotary Compressor

The vane moves up and down in the slot. This vane is dividing line between the suction and discharge of compressor. The suction and discharge ports of the compressor are located on either side of the vane. The suction vapour entering the cylinder gets compressed due to eccentric rotation of the rotor. It progressively reduces the volume of the annular space between cylinder and the rotor. The compressed vapor passes out of the discharge port.

iii) Screw Compressor:

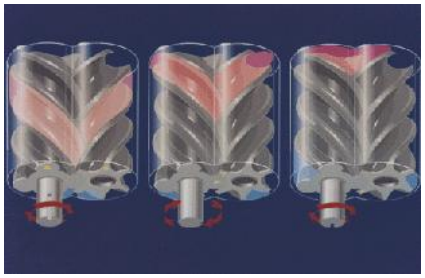

Fig. 5 Screw Compressor

Screw compressor is also known as helical rotary compressor. It consists of two meshing multistory helical grooved rotors with vary close tolerance clearance within a housing. Suction and discharge ports are provided at the either ends of the housing. The rotor whose shaft is connected to motor is called as male rotor and other as female. When the male rotor rotates, the female rotor in turn rotates, obviously in opposite direction.

iv) Centrifugal Compressor:

Centrifugal compressors are similar in construction to centrifugal pumps, the incoming fluid enters the eye of the spinning impeller and is thrown by centrifugal force to the periphery of the impeller. Thus the blades of the impeller imparts a high velocity to the gas and also build up the pressure. From the impeller the gas goes either into diffuser blades

or into a volute casing, where some of the kinetic energy is converted into pressure. The centrifugal compressors may be manufactured with only one wheel if the

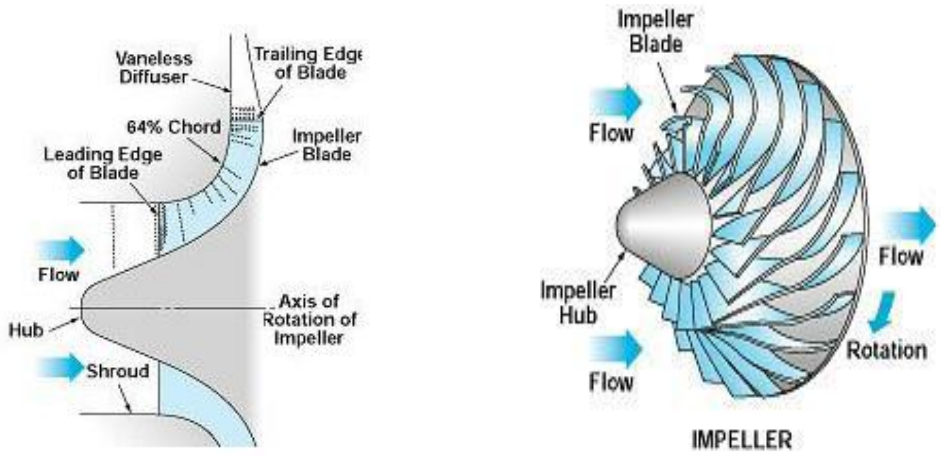

Fig.6 Centrifugal Compressor

pressure ratio is low, although the machines are generally multistage. Centrifugal compressors operate with adiabatic compression efficiency of 70 to 80%.

DIFFERENT PROTECTIVE DEVICES USED ON COMPRESSORS:

Protective devices are designed to protect the compressor against abnormal working conditions.

1. High pressure cutout switch.
2. Internal pressure relief value.
3. Low pressure switch
4. Motor winding thermal protector (Thermostat).
5. Time delay relays.

CONCLUSION:

The four types of compressor are studied in this experiment i.e. reciprocating, screw, and rotary, centrifugal. All these have different qualities, so each type of compressor has its own share of application where it has advantage over the other.

1. The reciprocating and screw compressors are best suited for use with refrigerants, which require relatively small displacement and condense relatively at high pressure such as R-12, R-22, Ammonia, etc.
2. Centrifugal compressor is generally suitable for handling refrigerants that require large displacement and operate at low condensing pressure. Such as R-11, R-113 etc. however R-12 is also employed for large capacity application and low temperature jobs.
3. The rotary compressor is most suitable for pumping refrigerants having moderate or low condensing pressure such as R-21 and R-114.