UNIT-IV

COMPONENTS OF REFRIGERATOR

ESSAY QUESTIONS

Q. 2. What are the types of Air Compressors?

Air compressors are some of the most necessary appliances found at construction sites, as they can be used as a power source for electric tools. There are many different types of air compressors, each with their own unique capabilities and drawbacks.

Air compressors are categorized as either positive displacement or dynamic displacement, based on their internal mechanisms. The four most common types of air compressors you will see are:

1. Rotary Screw Compressor
2. Reciprocating Air Compressor
3. Axial Compressor
4. Centrifugal Compressor

Positive displacement compressors encompass a variety of different air compressors that generate power via air

displacement. Air compressors in this category work with different internal mechanisms, but the principle for each is the same. A cavity inside the machine stores the air brought from outside and then slowly compresses the cavity to increase the air pressure and potential energy.

1. Rotary Screw Compressors :

A common type of displacement compressor, rotary screw compressors are some of the easiest types of air compressors to take care of, as they are equipped with an internal cooling system and don't require much maintenance. They are typically large, industrial-sized machines that can be either lubricated with oil or run oil-free.

Rotary screw air compressors generate energy via two internal rotors that turn in opposite directions. The air gets trapped between the two opposing rotors and builds up pressure within the housing. Because of the internal cooling system, these air compressors are designed for continuous use and range in power from 5 horsepower up to 350 horsepower.

2. Reciprocating Compressors :

Another popular type of displacement compressor is the reciprocating compressor. These are typically found at smaller work sites such as garages and home construction projects. Unlike the rotary screw compressor, the reciprocating compressor is not designed for continuous use. A reciprocating air compressor has more moving parts than a rotary screw compressor and these parts are lubricated with oil for smoother movement.

These types of air compressors work via a piston inside a cylinder, which compresses and displaces the air to build pressure. Reciprocating compressors can come in single or

multi-stage variations, which affects the pressure ranges they can achieve.When you need more power, the **multi-stage compressor** is the way to go. While single-stage compressors will get the job done for smaller projects such as wood working and metal working, multi-stage compressors provide the power needed for intense construction, such as auto assembly and maintenance. Multi-stage reciprocating compressors can reach up to 30 horsepower.

Dynamic Compressors :

Dynamic air compressors generate horsepower by bringing in the air with rapidly rotating blades and then restricting the air to create pressure. The kinetic energy is then stored as static within the compressor.

3. Axial Compressors :

Axial air compressors are not typically used in construction projects but are instead found in high-speed engines on ships or planes. They have a high-efficiency rate but are much more expensive than other types of air compressors and can get up to many thousands of horsepower, which is why they are mainly reserved for aerospace research.

4. Centrifugal Compressors :

Centrifugal air compressors slow and cool the incoming air through a diffuser in order to build up potential energy. Because of the multi-phase compression process, centrifugal compressors are able to produce a high amount of energy in a relatively small machine.

They require less maintenance than the rotary screw or reciprocating compressors and some types can produce oil-free air. They are typically used for more demanding construction sites such as chemical plants or steel manufacturing centres, as they can reach around 1,000 horsepower.

Q. 3. What is Evaporator and how it works?

Evaporator is an important component together with other major components in a refrigeration system such as compressor, condenser and expansion device. The reason for refrigeration is to remove heat from air, water or other substance. It is here that the liquid refrigerant is expanded and evaporated. It acts as a heat exchanger that transfers heat from the substance being cooled to a boiling temperature.

There are two types of evaporator :

(i) Forced Convection type uses a fan or pump to force the liquid being cooled over the evaporats.

(ii) Natural Convection type has the liquid being cooled flows naturally to the evaporator due to the density differences of the chilled and warm liquid.

Evaporator Construction Types :

There are three types of evaporator construction that are commonly being used today:

(i) Bare-Tube and Plate Surface construction have the entire surface in contact with the evaporating refrigerant inside.

(ii) Finned construction are bare-tube coils upon which fins(metal plates usually Aluminium) are being installed. A more detailed discussion on this type of design will be provided here.

Finned Evaporator :

The fins are added to the bare-tube to increase the heat transfer capability. They act as heat collector that pick-up heat from the surrounding air and conduct it to the refrigerant inside the tube hence improving the efficiency in cooling the air of the surrounding. They are best used in the air-cooling

space where the temperature is around 34°F. Having fins mean the surface area for heat transfer has been extended. This means that the finned coils can have more compact in design compared to the bare-tube type of similar capacity.

Thermal Contact and Fin Spacing :

Good thermal contact between the fins and tubes is a must to ensure efficient heat transfer. They can be soldered together. The other more practical method is to expand the fins by pressure such that they bite into the tube surface hence a good thermal contact is established.The spacing of the fin depend on the operating temperature of the coil. Low temperature application uses only 1 fin. In air conditioning application, 14-16 fins per inch may be used as long it is designed in such a way that frost does not accumulates in the coils. Excessive finning may reduce the capacity of the evaporator by restricting the flow of air over the coil hence the design engineers must do a proper system calculation and simulation at design stage.

Evaporator Design Factors :

There are 3 main factors to consider in designing an evaporator.

(I) **Pressure Drop :** The evap. must have sufficient space for the circulation of the refrigerant without too much pressure drop between the outlet and the inlet.

(ii) **Temperature :** The evaporator must have enough surface to absorb the required heat load in order to ensure the temperature difference between the substance being cooled and the refrigerant is not excessive.

(iii) **Liquid and Refrigerant Vapor :**

(iv) **The evaporator :** must have enough space for the liquid refrigerant and the vapor to separate from the liquid.

SHORT ANSWER QUESTIONS

Q. 1. What is Coefficient of Performance of Refrigerator?

The coefficient of performance, COP, of a refrigerator is defined as the heat removed from the cold reservoir Q_{cold}, (i.e., inside a refrigerator) divided by the work W done to remove the heat (i.e., the work done by the compressor).

$$COP = \frac{Q_{cold}}{W}$$

As can be seen, the better (more efficient) the refrigerator is when more heat $\mathbf{Q_{cold}}$ can be removed from the inside of the refrigerator for a given amount of work. Since the first law of thermodynamics must be valid also in this case ($Q_{cold} + W = Q_{hot}$), we can rewrite the above equation:

$$COP = \frac{Q_{cold}}{W}$$

For an ideal refrigerator (without losses and irreversibilities) can be derived that:

$$COP = \frac{Q_{cold}}{W}$$

These formulas are applied also for an **air conditioner**, which works very much like a refrigerator.

Q. 3. What is Energy Efficiency Ratio (EER)?

Energy Efficiency Ratio (EER) :

The Energy Efficiency Ratio (EER) of a piece of heating or cooling equipment is the ratio of the heat output (measured in BTU) to the power input (measured in watt-hour) whilst the system is in operation.The higher the ratio of an air conditioning unit compared with other systems, the more efficient it is.

Calculation of EER :

The Energy Efficiency Ratio of a heating or cooling system is usually calculated by dividing the heat output of the system by the power input.

EER = Heat Output / Power Input

Benefits of EER :

In areas where heating and cooling systems are in high demand – such as offices and industrial workplaces – high EER ratings can quickly convert into large financial savings. Not only that, the low maintenance and long-lasting qualities of such systems means that less money is spent on repairs, replacement or maintenance costs.

VERY SHORT ANSWER QUESTIONS

Q. 1. What is performance coefficient mean?

The coefficient of performance or COP (sometimes CP or CoP) of a heat pump, refrigerator or air conditioning system is a ratio of useful heating or cooling provided to work (energy) required. Higher COPs equate to higher efficiency, lower energy (power) consumption and thus lower operating costs.

Q. 4. What is compressor explain?

A compressor is a device that increases the pressure of a substance (usually a gas) by reducing the volume of the substance. Compressors are used in many applications, most of which involve increasing the pressure inside a gas storage container, such as: Compression of gases in petroleum refineries and chemical plants.