PNS SCHOOL OF ENGINEERING & TECHNOLOGY

LAB MANUAL

RAC LAB

5TH SEM MECHANICAL

PREPARED BY

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EXPERIMENT NO : 01

AIM OF THE EXPERIMENT:

To study the construction features of domestic refrigerator.

APPARATUS REQUIRED:

SL NO	EQUIPMENT	SPECIFICATION	QUANTITY
01	Domestic Refrigerator		1

THEORY :

A vapor compression refrigeration system is now days used for all purpose of refrigeration. It uses a refrigerant sealed in air tight and leak proof mechanism. The refrigerant is circulated through the system and undergoes a number of changes in its state while passing through various parts of the system. The refrigerant (R-12) absorbs heat from one place and releases it to other place.

MECHANISM OF DOMESTIC REFRIGERATOR:

A domestic refrigerator consists of 5 essential parts.

1. COMPRESSOR :

The low pressure and temp. Vapor refrigerant from evaporator is drawn into the compressor through the inlet or suction valve, where it is compressed to a high pressure and temp..This high pressure and temp. vapour refrigerant is discharged into the condenser through the delivery valve.

2. CONDENSOR:

The condenser or cooler consists of coils or pipes in which the high pressure and temp. vapor refrigerant is cooled and condensed. The refrigerant while passing through the condenser, gives up its latent heat to the surrounding condensing medium which is normally air or water.

3. RECEIVER:

The condensed liquid refrigerant from the condenser is stored in a vessel is known as receiver from where it is supplied to the evaporator through the expansion valve.

4. EXPANSION VALVE:

It is also called throttle valve or refrigerant control valve. The function of the expansion valve is to allow the liquid refrigerant under high pressure and low temp. to pass at a controlled rate after reducing its pressure and temp.

5. EVAPORTAOR:

An evaporator consists of coils of pipe in which the liquid vapour refrigerant at low pressure and temp. is evaporated and changed into vapor refrigerant at low pressure and temp. During evaporating the liquid vapor refrigerant absorbs its latent heat of vaporization from the medium which is used to be cooled.

WORKING PRINCIPLE :

The low pressure vapor in dry state drawn from the evaporator during the suction stroke of the compressor. During compression, the pressure and temp.is increased. When the high pressure refrigerant vapor enters the condenser, heat flows from condenser to cooling medium, thus allowing the vaporized refrigerant to return to the liquid state.

After condensation, the liquid refrigerant is stored in the liquid receiver. Then it is passed through the expansion valve, where the pressure is reduced sufficiently to allow the vaporization of the liquid at a low temp. The low pressure refrigerant vapor after expansion enters the evaporator where heat is absorbed by it and the cycle is completed.

CONCLUSION :

We successfully studied about the construction features of domestic refrigerator.

EXPERIMENT NO : 02

AIM OF THE EXPERIMENT :

To determine the COP of simple vapor compression refrigeration tutorsystem.

APPARATUS REQUIRED :

SL NO	EQUIPMENT	SPECIFICATION	QUANTITY
01	Refrigerator Tutor	Vapor Compression	1

THEORY :

The vapor compression refrigeration system is now a days used for all purpose of refrigeration. It uses a refrigerant sealed in air tight an leak proof mechanism through the system and the refrigerant is circulated through the system and under goes a number of changes in its state. While passing through various parts of the system, the refrigerant absorbs heat from one place to another.

CONSTRUCTION:

A simple vapor compression refrigeration system mainly consists of a compressor, condenser, receiver, expansion valve and evaporator. The compressor consists of an arrangement in which an electric motor is provided. The condenser is made in a coil shaped receipt refrigerant. A storage tank in which the liquid vapor refrigerant at a pressure is evaporated.

WORKING : PROCEDURE

The low pressure vapor in dry state drawn from the evaporator during the suction stroke of the compressor. During compression, the pressure and temperature is increased. When the high pressure refrigerant vapor enters intothe condenser, heat flows from condenser to cooling medium, thus allowing the vaporized refrigerant to return to the liquid state.

After condensation, the liquid refrigerant is stored in the liquid receiver. Then it is passed through the expansion valve, where the pressure is reduced sufficiently to allow the vaporization of the liquid at a low temp. The low pressure refrigerant vapor after expansion enters the evaporator where heat is absorbed by it and the cycle is completed.

TABULATION :

SL NO	Pressure in PSI		Temperature (^{0}C)				Mass flow rate (Kg/min)
	P_1	P_2	T_1	T_2	T_3	T_4	

CALCULATION :

T_1 ,P_1 = Compressor inlet temp and pressure.

T_2 ,P_2 = Compressor outlet temp and pressure.

T_3 ,P_3 = Condenser outlet temp and pressure.

T_4 = Evaporator temperature.

Relative COP =

$(COP)_{actual}$= **Q/W**

Q = Heat extracted in the evaporator in KJ

= $m_w X C_{pw} X (T_{4\ initial} – T_{4\ final})$

Where m_w= Mass of water taken in the evaporator in Kg

C_{pw}= Sp. Heat of water = 4.187 KJ/Kg K

W = Work input in KJ.

W can be directly found from the energy meter reading after 30 min. of running.

We get the meter reading after 30 min is 0.2 Kwh = 0.2 K X J/S X 3600 Sec

= KJ.

COP_{Actual}= Q/W

$(COP)_{theoretical}$=

From Pressure gauge we get

P_1 =

P_2 =

1 bar = 14.5 psi1 psi = 1/14.5 bar

By using these two pressure we can get h_1 , h_2 , $h_{f3} = h_{f4}$ from P-h chart is as follows.

PSI = Pound per Square Inch

CONCLUSION :

We successfully studied about the

EXPERIMENT NO : 03

AIM OF THE EXPERIEMENT :

To study the construction features of water cooler.

APPARATUS REQUIRED :

Sl no	Equipment	Specification	Quantity
01	Model of water cooler		1

THEORY :

The purpose of water cooler is to make water available at a constant temp. irrespective of ambient temp. .

They are meant to produce cold water at about 7^0 C to 13 ^{0}C (280K to 286K) for quenching the thirst of the people working in hot environment.

The temp.of the cold water is controlled with the help of a thermostatic switch set with in 7^0 C to 13 ^{0}C range.

There are two types of water cooler.

- Storage type water cooler
- Instantaneous type water cooler

STORAGE TYPE WATER COOLER :

- The evaporator coil is soldered onto the wall of the storage tank of the cooler.
- The tank may be galvanized steel or stainless steel sheets. The water level in the tank is maintained by float valve.
- In this type of water cooler, the machine will run for a long period to bring down the temp. of the mass of the water in storage tank.
- When the water is drawn from the cooler and an equal amount of fresh water is allowed in the tank, the temp. will rise up slowly and the machine starts again.

INSTANTANEOUS TYPE WATER COOLER:

- In this type of water cooler the evaporator consists of two separate cylindrical wound coil made up of copper or stainless steel tube.
- The evaporating refrigerant is in one of the coil and the ater to be cooled is in the other coil.
- The water cooled by the refrigerantIn evaporator by conduction.

- These water cooler are further classified as (a) Bottle type (b) Pressure type (c) Self contained remote type .

CONCLUSION : We have successfully studied about water cooler.

EXPERIMENT N0-4

AIM OF THE EXPERIMENT:

To study the construction features of Window Air Conditioning

APPARATUS REQUIRED:

Sl No	Equipment	Specification	Quantity
01	Window A.C	1 Ton Cap.	1

THEORY :

The working of window air conditioner can be explained (refer the figures given below)by separately considering the two cycles of air: room air cycle and the hot air cycle. The compartments of the room and hot air are separated by an insulated partition inside the body of the air conditioner. The setting of thermostat and its working has also been explained in the discussions below.

Room Air Cycle

The air moving inside the room and in the front part of the air conditioner where the cooling coil is located is considered to be the room air. When the window AC is started the blower starts immediately and after a few seconds the compressor also starts. The evaporator coil or the cooling gets cooled as soon as the compressor is started.

The blower behind the cooling coil starts sucking the room air, which is at high temperature and also carries the dirt and dust particles. On its path towards the blower, the room air first passes through the filter where the dirt and dust particles from it get removed.

The air then passes over the cooling coil where two processes occur. Firstly, since the temperature of the cooling coil is much lesser than the room air, the refrigerant inside the cooling coil absorbs the heat from the air. Due to this the temperature of the room air becomes very low, that is the air becomes chilled.

Secondly, due to reduction in the temperature of the air, some dew is formed on the surface of the cooling coil. This is because the temperature of the cooling coil is lower than the dew point temperature of the air. Thus the moisture from the air is removed so the relative humidity of the air reduces. Thus when the room air passes over the cooling coil its temperature and relative humidity reduces.

This air at low temperature and low humidity is sucked by the blower and it blows it at high pressure. The chilled air then passes through small duct inside the air conditioner and it is then thrown outside the

air conditioner through the opening in the front panel or the grill. This chilled air then enters the room and chills the room maintaining low temperature and low humidity inside the room.

The cool air inside the room absorbs the heat and also the moisture and so its temperature and moisture content becomes high. This air is again sucked by the blower and the cycle repeats. Some outside air also gets mixed with this room air. Since this air is sent back to the blower, it is also called as the return room air. In this way the cycle of this return air or the room air keeps on repeating.

Hot Air Cycle

The hot air cycle includes the atmospheric air that is used for cooling the condenser. The condenser of the window air conditioner is exposed to the external atmosphere. The propeller fan located behind the condenser sucks the atmospheric at high temperature and it blows the air over the condenser.

The refrigerant inside the condenser is at very high temperature and it has to be cooled to produce the desired cooling effect. When the atmospheric air passes over the condenser, it absorbs the heat from the refrigerant and its temperature increases. The atmospheric air is already at high temperature and after absorbing the condenser heat, its temperature becomes even higher. The person standing behind the condenser of the window AC can clearly feel the heat of this hot air. Since the temperature of this air is very high, this is called as hot air cycle.

The refrigerant after getting cooled enters the expansion valve and then the evaporator. On the other hand, the hot mixes with the atmosphere and then the fresh atmospheric air is absorbed by the propeller fan and blown over the condenser. This cycle of the hot air continues.

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Setting the Room Temperature with Thermostat

The temperature inside the room can be set by using the thermostat knob or the remote control. If your window AC has knob, you would see some numbers or the round scale round the knob that will enable setting the temperature desired in the room. If your AC has come with the remote control, then you will see the room temperature on the digital indicator placed in the control panel of the window AC. You would probably also see the temperature on the small screen of the remote control. With the buttons provided on the remote control you can easily set the temperature inside the room.

When the desired temperature is attained inside the room, the thermostat stops the compressor of the

AC. After some time when the temperature of the air becomes higher again, the thermostat restarts the compressor to produce the cooling effect. One should set the thermostat at the required temperature and not keep it at very low temperature to avoid high electricity bills.

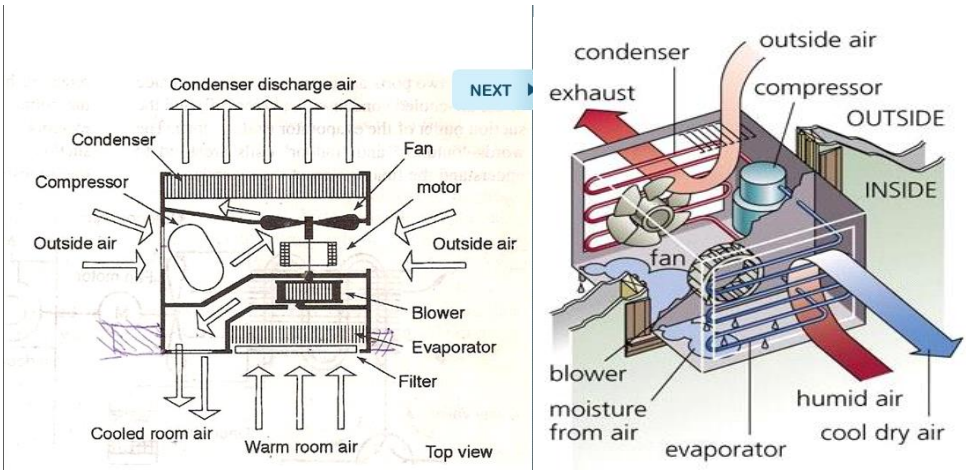
Setting the Speed of the Air

The Speed of the air can be set by the fan motor button provided on the control panel. If your AC has the remote control you can see the fan speed button on it. The motor of the blower is of multispeed that type that enable changing the speed or the flow of air inside the room.

Important Part of the Window AC: Air Filter

The filter is a very important part of the AC since it cleans the air before it enters the room. For proper functioning of the filter it is very important to clean it every two weeks. If this is not done the filter will get choked and it won't be able to clean the air. Soon the dirt will also enter the evaporator coil and choke it. If this happens the AC will stop functioning and cleaning the evaporator becomes a very tedious process. Cleaning the filter hardly takes five minutes, do it regularly and enjoy the comforts of window AC on long-term basis.

Figure :



CONCLUSION :

We have successfully studied the windows air conditioning.