Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

Increased Coefficient of Performance of a Window Air Conditioner using a Flash Chamber

Theodore Williams A[1,]
Department of Manufacturing Engineering ,
CSI College of Engineering[1],
The Nilgiris, India

Prashanth M[2]
Professor,
CSI College of Engineering[2],
The Nilgiris, India

***Abstract-* Air conditioners are widely used all around in the present day world. Air conditioners not only conditions the air but also controls and maintains the space's temperature, humidity, air movement and cleanliness and to give comfort to the occupants. Conditioning the air in a particular space depends upon the capacity of an air conditioner. The capacity of an air conditioner is calculated by "Ton", and the efficiency of an air conditioner is calculated as coefficient of performance. This paper proposes a new methodology that helps in increasing the coefficient of performance of the air conditioner by adding a flash chamber where an air conditioner with less COP can be used in the place of higher COP air conditioner.**

Keywords: - Air conditioning, Window air conditioner, Flash chamber, coefficient of performance, increased COP.

I INTRODUCTION

Air conditioning is done based on the following three categories [1].

A. Summer air conditioning

In most of the places, the summer season is hot and humid. Hence, in order to provide comfortable conditions to the occupants during summer, it is required to supply cold and dry air to the occupied space. This requires systems wherein the hot and humid air can be cooled to temperatures lower than the dew point temperature, so that the water vapour in air can be removed by condensation, and the resulting cold and dehumidified air supplied to the conditioned space in required quantity for providing thermal comfort.

B. Winter air conditioning

In winter season the outdoor conditions may be low in some places. In such cases heating is required to achieve comfort in this season. In winter air conditioning, comfort conditions are 24˚C, 60 % Relative humidity. The outdoor conditions may be less than 100C in some places. In such cases heating is required generally heat pump is used for winter air conditioning.

C. Year round air conditioning system

As the name implies year round air conditioner is used throughout the year. Year round air conditioning system is used in both winter and summer. In summer season ordinary Air conditioner is used for cooling and dehumidification. In winter heat rejected in the condenser is utilized for heating. Using solenoid valves, we can change the direction of flow of refrigerant. In winter air conditioning the heating condition is done in the room side by rejection of heat from the evaporator. So, heating is done. In such a way year round air conditioner is used.

II TYPES OF AIR CONDITIONERS

A. Window Air Conditioner

Window air conditioner is the most commonly used air conditioner for single rooms. In this air conditioner all the components, namely the compressor, condenser, expansion valve or coil, evaporator and cooling coil are enclosed in a single box. This unit is fitted in a slot made in the wall of the room, or often a window sill. In window air conditioners both the indoor unit and the outdoor units are assembled as a single unit. Such air conditioners have to be fitted in the wall in such a way that the condensing unit is facing the atmosphere so that the heat taken from the room can be dumped into the atmospheric air. It has to be fixed like half the portion to be inside the room and the other half to be outside the room.

B. Split Air Conditioner

The split air conditioner comprises of two parts: the outdoor unit and the indoor unit. The outdoor unit, fitted outside the room, houses components like the compressor, condenser and expansion valve. The indoor unit comprises the evaporator or cooling coil and the cooling fan. For this unit you don't have to make any slot in the wall of the room. Further, the present day split units have aesthetic looks and add to the beauty of the room. The split air conditioner can be used to cool one or two room.

III COMPONENTS OF AN AIR CONDITIONER

A. Compressor

In air conditioning systems, the condenser coil is where the heated refrigerant gas is cooled to a liquid state (usually outdoors) before being cycled back to the evaporator coil inside the vehicle/building where it can absorb more heat to be carried back outside to the condenser coil in a repeating cycle. The condenser receives hot high pressure gas refrigerant from the air conditioning compressor. It cools this gas (it looks like a radiator) turning the gas into a cooler liquid.

B. Condenser

Refrigerant enters an air conditioner compressor as a low-pressure gas and decreases in size so the fluid molecules will compact and increase in energy and

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

temperature. The refrigerant then leaves the compressor and enters the condenser, which cools it and changes it to a high-pressure liquid to cool the air that enters your home or car. The refrigerant gives off heat in the condenser and this heat is transferred to a medium having a lower temperature. The amount of heat given off is the heat absorbed by the refrigerant in the evaporator plus the heat created by compression input.

C. Expansion Valve

Liquid from the condenser runs to a collecting tank (the receiver). This can be connected to the tank on the evaporator. Pressure in the receiver is much higher than the pressure in the evaporator because of the compression (pressure increase) that has occurred in the compressor. To reduce pressure to the same level as the evaporating pressure a device must be inserted to carry out this process, which is called throttling or expansion. Such a device is therefore known either as a throttling device or an expansion device

D. Evaporator

Evaporators use the heat around it to produce the cool air coming out of the vents. When the refrigerant, a fluid used throughout many cooling systems, leaves from the compressor, it goes through a tiny hole as a liquid. The low pressure of the evaporator allows the refrigerant to expand and cool down, becoming a gas. As this is happening, a fan is blowing warmer air from around the cooling system over the coils filled with the cooler gas. The gas catches the heat molecules, creating condensation on the coils. As the air blows over the coils and through the vents, the air becomes much cooler. The gas in the evaporator coils continues to the front of the cooling system and repeats the process until the set temperature is reached.

IV REFRIGERANT

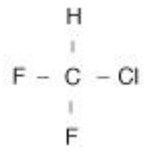
The refrigerant is a heat carrying medium, which during their cycle in the refrigeration system to absorb heat from a low temperature system and discard the heat to absorb a higher temperature system. Suitability of a refrigerant for a certain application is determined its physical, thermodynamic, chemical properties and by varies physical properties. We have selected R22 for this system.

A. Properties

R-22 is prepared from chloroform.
$HCCl3 + 2\ HF \rightarrow HCF2Cl + 2\ HCl$

1. Boiling point = -41˚C at atm
2. Freezing point = -160˚C at atm
3. Critical temperature = 96˚ C
4. Critical pressure = 49.38 bar
5. Latent heat of vaporization= 216.5 KJ/Kg K at -15˚C

B. Chemical structure



C. Chemical Formula

$CHClF_2$

D. Common Name

Chloroflouromethane

V FLASH CHAMBER

Flash chamber is a separator that is placed in between the expansion valve and the evaporator. The flash chamber separates the liquid and the vapour. The separator separates the liquid and sends it to the evaporator and the small amount of water vapour is sent directly to the compressor, so that the increased passage of refrigerant in the evaporator results in the high phase conversion, which automatically increases the efficiency of the air conditioners. Flash chamber is a highly insulated tank. Insulation is made in a way such that the surrounding temperature cannot affect the refrigerant inside the tank. Here we are using a ordinary cylinder of 2kg as Flash chamber which has 3 valves as shown in the line diagram Fig 5.1. Here flash chamber is used as a separator. The main purpose of the separator is to separate the liquid and vapour which is exhausted from the condenser/expansion valve. After the separation process, the liquid refrigerant is sent to the evaporator and the vapour refrigerant is sent directly to the compressor, so that the refrigerant in the evaporator coil is purely liquid and hence has the ability for higher phase transition.

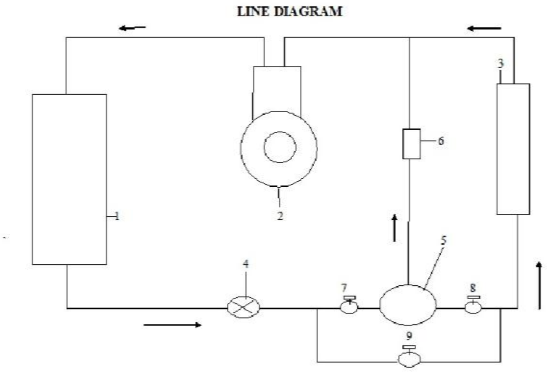


Fig 5.1 Line Diagram

WHERE,

1 = Condenser
2 = Compressor
3 = Evaporator
4 = Expansion device
5 = Flash Chamber
6 = Non Return Valve
7 = By-Pass Valve 1
8 = By-Pass Valve 2
9 = By-Pass Valve 3

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

VI WORKING OF MODIFIED CYCLE

In this cycle operation in the compressor, evaporator and expansion device are as in the normal cycle. During this cycle, valve 1 is closed and the valves 2, 3, &4 are opened.The low temperature, low pressure refrigerant is passed to the flash chamber after expansion through valve 2. In the flash chamber liquid and vapour created during the throttling process in the expansion valve is separated. The vapour is directly passed to the compressor suction line through a Non Return Valve, so that the refrigerant does not comes back to flash chamber due to the back pressure.

VI p-H AND T-s DIAGRAMS

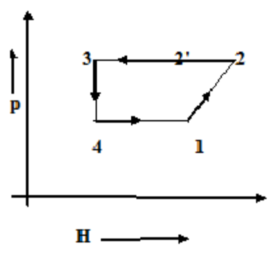


Fig no 6.1 p-H Diagram

P2 = P2'= P3; H3 =H4
P1 =P4

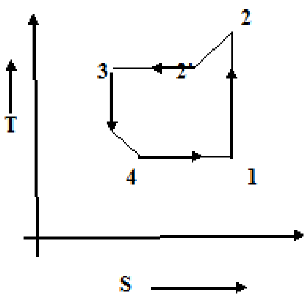


Fig 6.2 T-S Diagram

T1 = T4; S1 = S2
T3 = T2'

VII SAMPLE CALCULATIONS

SL.NO	COMPRESSOR INLET TEMPERATURE T_1 °C	COMPRESSOR OUTLET TEMPERATURE T_2 °C	CONDENSER OUTLET TEMPERATURE T_3 °C	COP
1.	28	72	36	**4.820**
2.	26	71	35	**4.708**
3.	29	72	38	**5.05**

Table 7.1
Normal Cycle

MEAN COP IN NORMAL CYCLE= 4.860

SL.NO	COMPRESSOR INLET TEMPERATURE T_1 °C	COMPRESSOR OUTLET TEMPERATURE T_2 °C	CONDENSER OUTLET TEMPERATURE T_3 °C	COP
1.	28	67	37	**5.49**
2.	27	65	35	**5.45**
3.	25	64	36	**5.64**

Table 7.2
Modified Cycle

MEAN COP IN MODIFIED CYCLE= **5.524**

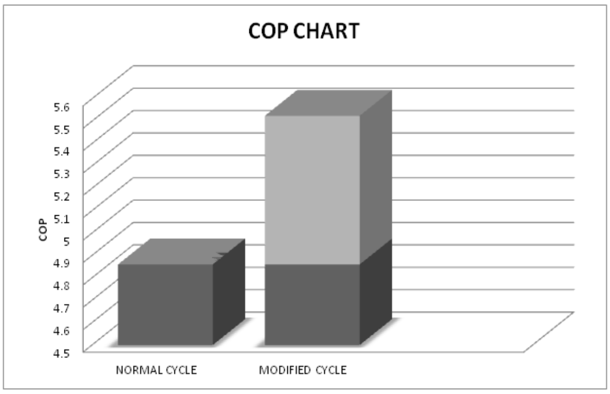
VIII RESULT COMPARISION

A. Table

AIRCONDITIONER BASED ON WORKING	CO-EFFICIENT OF PERFORMANCE (COP)
NORMAL CYCLE	4.860
MODIFIED CYCLE	5.524

Table 8.1

B .Chart



IX ADVANTAGES

1. Since the efficiency increases, lower capacity AC with the flash chamber can be used in place of higher capacity.
2. Use of flash chamber doesn't end up in increased cost where the costs of other equipments are reduced.
3. The time taken for a single cyclic process reduces by the use of flash chamber.
4. By introducing the flash chamber, we've increased the phase transition in the compressor, and hence automatically the efficiency of the air conditioner increases.

CONCLUSION

Thus, we conclude by saying that we have proved our Air Conditioner of 1 Ton is having higher efficiency than that of ordinary 1Ton Air Conditioner. While we are using a higher capacity Air conditioner, and by implementing our project, we are sure that it will have a very higher efficiency than the normal same capacity Air conditioner.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

FUTURE ENHANCEMENT

Thus it has been proved that the co efficient of performance of a window air conditioner has been increased by using flash chamber and further such flash chamber can be used in split air conditioners in order to increase their performance.

REFERENCES

[1] Different types of Air Conditioning by Tony Evans
[2] Principles of Air Conditioning DHI Book 02, Chapter 1.
[3] Refrigeration – an introduction to basics by Danfoss publication http://www.danfoss.com/BusinessAreas/RefrigerationAndAirConditioning
[4] Air conditioning and Refrigeration By C.P.Arora.
[5] Thermodynamic properties of DuPont™ Freon® 22 (R-22) ($CHClF_2$)
[6] Air Conditioning Working By Williams C Whitman.
[7] HVAC and Coefficient of performance by Daniel Stiller
[8] Multi Pressure Refrigeration system edition 2.5 by stoecker and jones
[9] Air Conditioning By Rex Miller & Mark Miller.
[10] Thermal engineering by Benzol.