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Multipurpose Device using single Vapor Compression Refrigeration Cycle

[1]Farzan Ahmed, [2]Danish Khan, [3]Pratik Lambat, [4]P.S.Ghawade.

[1]Student, Dept of Mechanical Engineering Amravati University, Yavatmal, India.
[2] Student, Dept of Mechanical Engineering Amravati University, Yavatmal, India.
[3] Student, Dept of Mechanical Engineering Amravati University, Yavatmal, India.
[4] Professor, Dept of Mechanical Engineering Amravati University, Yavatmal, India.

Abstract - *Now a day it is very costly to afford the refrigerating units like Air Conditional, Refrigerator or water cooler individually. So, this research is the combination of all the three devices. Up to now we can see there is only combination of Air Conditioning and refrigerating unit but we find the need of combined all the three devices simultaneously into a single unit so that it is very efficient as well fulfill the required need on the time.*
The idea of this project explores the possibility of combining three units i.e. Refrigerator, Air-Conditioner and Water Cooler into a single unit, such that the running cost becomes zero or almost negligible. The problem of electricity required for running both the application so far, an again help to save electricity and money, also maintain an ecological balance between people and surrounding.

Key Words*: *Domestic Refrigerator, Air Conditioner setup, Thermostat valve, Capillary, Exhaust fan.

1. INTRODUCTION

The main objective of our paper is to perform combine refrigeration system simultaneously or individually as per the need arises from the users. Also in rural areas of India so many peoples in their houses use the Refrigerator and Air cooler only in summer season and after that they keep switch off for remaining two seasons because of highly electricity consumption and large space required. Even in the most of house it's seen that they use their refrigerator only for chill the water and it's really fact. So we considering this all facts we are going to fabricate such device which can be easily affordable as well as less space required unit.

Cooling systems like Refrigerator, air conditioning, Water Cooler systems are high electric power consumption these systems also have more impacts on the environment. However, it has become the prime necessity in 21st century. In over span of three decades, there is continuously increase in energy demand due to everlasting population increases in India. Refrigeration and air conditioning systems are responsible for roughly 30% of total energy consumption, therefore unquestionably with a major impact on energy demand. The need of proper energy consumption is a worldwide concern and the big question arises for reducing energy wasting included proper used of energy and also how to lower power consumption. The aim must be achieved without compromising comfort and other advantages brought using energy, and with same efficiency and quality of installations. However, benefits such as a better temperature control and a lower response time for abrupt thermal load changes were also mentioned.

2. WORKING PRINCIPLE

The vapor compression refrigeration cycle as shown the diagram.

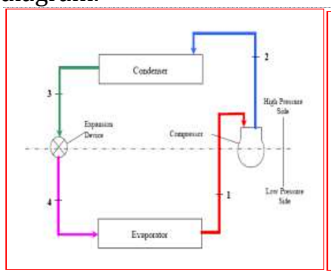

Fig. 1 Simple Vapour Compression system

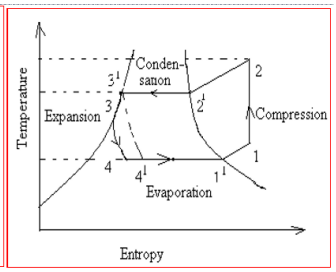

Fig.2 T-s plot with Sub-cooling and Super heating

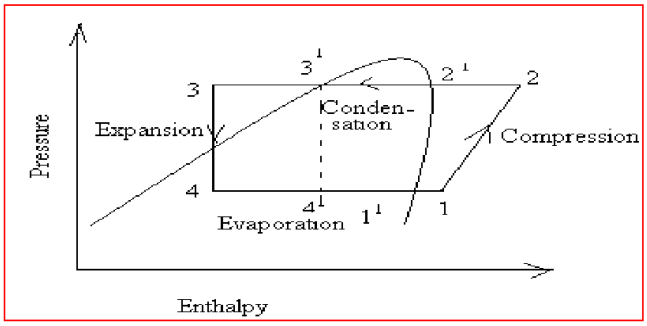

Fig. 3 P-h Plot with Sub-Cooling and super heating

Fig-1: VCR Cycle

Refrigeration is concerned with the absorption of heat from where it is objectionable plus its transfer to and rejection at a place where it is objectionable. The Vapor Compression Refrigeration Cycle System (VCRC) it is

shown in Fig. 1. The basic components of a Vapor Compression Refrigeration Cycle are Compressor, Condenser, Expansion Valve, Evaporator, Blower etc. The components of the cycle themselves represents the operations that carried like Compression, Condensation, Expansion and Evaporation. The working fluid or gas is a refrigerant. Generally refrigerant R 22 is used.
The vapor-compression uses a circulating liquid refrigerant as the medium which absorbs and removes heat from the space to be cooled and subsequently rejects the heat elsewhere. Figure 1 depicts a typical, single compressor, a condenser, a thermal expansion valve (also called a throttle valve), and an evaporator.

3. MODIFIED THEORETICAL ANALYSIS

The modified device is based on the single simple Vapor Compression Refrigeration Cycle VCRC. A little modification in the VCR cycle allows it to be operated for multiple functions. The cycle is shown in below in Fig. 4.

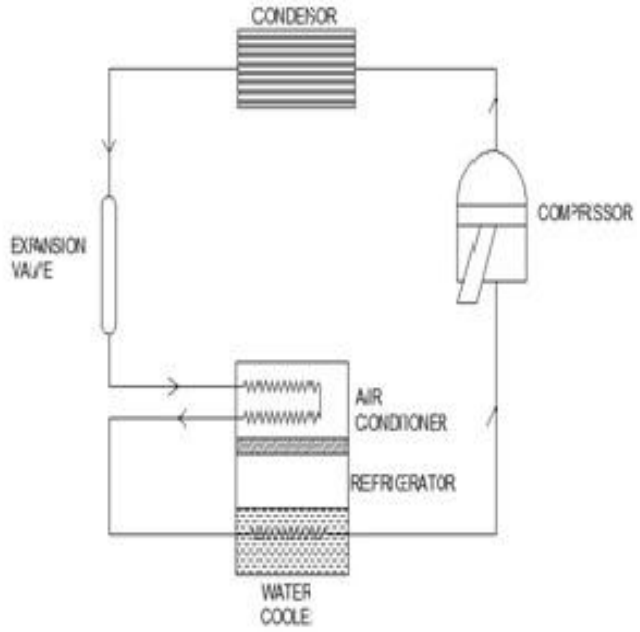

Fig-2: Project Circuit Diagram

The device designed to perform the function of an air conditioner, water chiller and a refrigerator. Refrigerator body is used to fabricate the complete setup. Here the cycle flows from compressor to condenser to expansion valve and then to the evaporator which is provided with the ventilation. From the evaporator, a tube is provided which carries water which is cooled due to the refrigeration effect. At the bottom of the body two fans are provided. These fans are used to provide the cool air. The cool air is obtained by the generation of cooling effect inside the refrigerator body which is transmitted with the help of fans. There is empty space which is useful for preservation of food.

4. PROCEDURE

1. Initially the refrigerant i.e. R-22 is pass to the compressor. The suction pressure that we maintain at 60 psi. The compressor compresses the refrigerant at high pressure and high temperature. The hermetically sealed reciprocating compressor is widely used for the refrigeration and air conditioning applications. In all the household refrigerators, deep freezers, window air conditioners, split air conditioners, most of the packaged air conditioners, the hermetically sealed reciprocating compressor is used.
2. This high pressure high temperature refrigerant enter the condenser. In our project condenser is used of a window air conditioner. The condenser decreases the temperature of refrigerant at constant pressure. Condenser is fitted with two Axial fans so this condenser is called as the force type condenser. Condenser used in this project is an condenser section of windows air conditioner so that we can possible to achieved desired output which is needed to us but we replace the blower which usually used to the domestic AC condenser by the two Axial Fan Our objective behind this project is also to save the electricity that we achieved by replacing the blower of 186 wt to 2 Axial Fan of 72 wt with more RPM than this blower. Thus we can increase the condenser efficiency with large saving of electricity.
3. Then this high-pressure refrigerant is passes through the capillary coil. Capillary tube having a dimension of 40 microns. In this capillary the temperature is drop slightly and the temperature is drop below the evaporator temperature. . This output was in the form of ice that forms over the evaporator coil. After that we conclude that the 40 micron capillary tube is needed for the 1 ton of compressor capacity.
4. After all, the refrigerant is passed into the evaporating coil. Evaporator section in which the heat is absorb by the refrigerant and the latent heat of evaporation take place. In our project evaporator is used of a window air conditioner. In our project Evaporator section is fitted in front side instead of back side and at the top section of the refrigerator so that suction air coming from suction hole which is provided to the door of refrigerator directly comes in contact with evaporator coil and passing through it thus the hot atmospheric air is converted into cooled air and then this cooled air pass ahead from the Axial fans that is attached at the bottom side of the refrigerator

5. CALCULATION

From the observation we find out the temperature at various section of our project.
WHEN AIR CONDITIONER OFF:
1. Temperature of compressor output = 43^0c
2. Temperature of cooling coil = -11^0c
3. Temperature of compressor suction = 7^0c
4. Temperature of condenser output = 36.44^0c

5. Suction Pressure = 60psi
= 4.14Bar

From the *P-H* chart
1. Enthalpy at the Entrance of compressor h_1 = 240 kj/kg
2. Enthalpy at the Exit of compressor h_2 = 275 kj/kg
3. Enthalpy at the outlet of the condenser h_3= 93 kj/kg

COP Calculation

= (h_1-h_3)/ (h_2-h1)
= (240-93)/ (275-240)
= 4.2 (therotical COP)

6. RESULTS AND DISCUSSIONS

1. As the Heat load is increases, the temperature and the pressure on the compressor increases.
2. The pressure and temperature is inversely proportion to the condenser output.
3. The device works stable on the total load.
4. The COP of our project is calculated by using the pressure enthalpy chart. The COP of refrigerator obtained is 4.12.
5. The refrigerating effect obtained by using the refrigerant R-22 is into the less time than the refrigerant R-134.
6. It has been observed that the multi-purpose device works well on a single VCR cycle. It is very economical and affordable. The output obtained is good.

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