Fabrication of Hybrid Air Cooler by Using Vapour Compression Refrigeration System

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Abstract— In summer season, thetemperature of Nagpur reaching up to 450 to 500.At this temperature air cooler unable to perform that much amount of cooling effect and it is not properly dealing with temperature. To solve this problem, we are trying to make a Hybrid cooler using vapour compression refrigeration system. We are also providing small cooling cabinet for preservation of foods or any other thingso, weare use R-134a as refrigerant because it's eco-friendly to atmosphere as well as not affected on ozone layer and reduce global worming. Component of Hybrid cooler arecompressor, expanssion valve, evaporator, fan, motor, copper tube, etc. Middle class family can't afford AC because of its very costly and its electricity consumption also high. Our aim is making the Hybrid cooler after considering above point and problem and Try to over come it.

Key words: Cooling cabinet, compressor, condenser, evaporator, expansion valve, electric fan

I. INTRODUCTION

In India middle class and poor family does not afford the all type refrigeration system like air conditioner, refrigerator, etc. According to this we see the problem is that they do not afford the air conditioner so we are making or implementing this type of concept it is called hybrid air cooler. Hybrid means combination of air conditioner and domestic air cooler domestic. In this we are including the parts of domestic air cooler and air conditioner in that we are use compressor, condenser, expansion valve, evaporator, capillary tube, fan, motor, etc.

In this we are using concept of VCRS for solving the problem of cooling. Refrigeration is a technology which absorbs the heat at low temperature and maintain below the surrounding temperature by rejecting heat to the surrounding at high temperature.

II. COMPONENTS

A. Compressor:-

Compressor compresses the refrigerant at low pressure gas from the evaporator and converts it into high pressure gas. As mentioned earlier, as the gas is compressed, the temperature rises. We are use hermetically sealed compressor. In hermetically sealed compressor, the compressor and motor are welded in steel casing and they are connected by a common shaft. This makes whole compressor and the motor a single compact and portable unit that can be handled easily. The hermetically sealed compressor is very different from the traditional open type of compressor.

Specification**:-**Inlet pipe 6 mm, 220/50Hz, 1 PH, thermally protected, capacity 1 TR.

Fig. 1: Compressor

B. Condenser:-

The condenser is a heat exchanger that rejects all the heat from the refrigeration system. This includes not only the heat absorbed by the evaporator but also the heat energy to the compressor. The condenser accept hot, high pressure refrigerant, usually superheated gas from the compressor and reject heat from the gas to some cooler substance, usually air and water.

Specification**:-**Height 240 mm, Length 255 mm, condenser pipe 10 mm, width 40 mm.

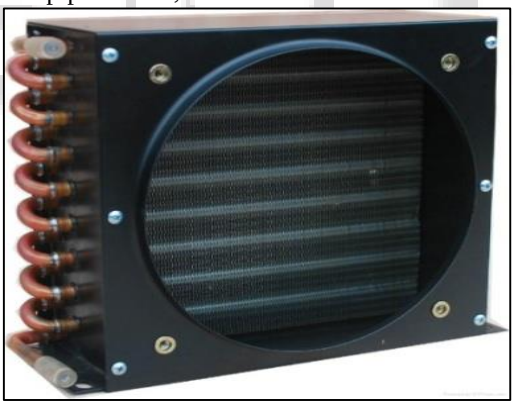

Fig. 2: Condenser

C. Expansion Valve:-

The function of expansion valve to allow the low temperature and high pressure liquid enters with the restricted area, and they can be leave from the expansion valve with low pressure and temperature in form of mixture of vapour and liquid, and then keep the evaporator active. Expansion process one of the main factor responsible for energy loss in VCR cycle. Length of capillary tube 1300 mm. No of turns 11.

Fig. 3: Expansion Valve

D. Evaporator:-

For the purpose of compression, evaporator part also suggested. The evaporator has number of circular tube inside it as shown in figure bellow, and is manufactured to yield same pressure drop as the original one. The number and diameter of the tubes are selected iteratively to obtain the same design requirements, such as, heat load, pressure drop, at the inlet and exist condition.

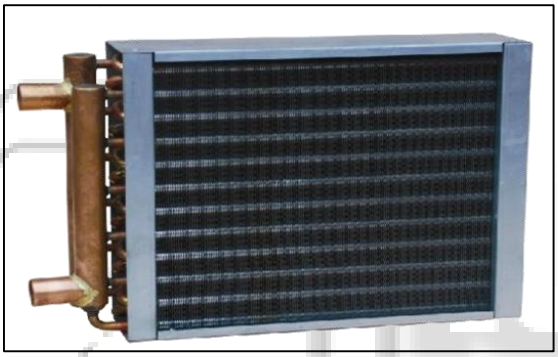

Fig. 4: Evaporator

E. Fan:-

An apparatus rotates blades that create a current of air for cooling or ventilation.
Specification: - Blade diameter is 234 mm. Angle is 23^0.

Fig. 5: Fan

F. Motor:-

Electric motor is used to convert electrical energy into mechanicalenergy. Electric motors are used to produce linear and rotary forces (torque).This motor runs at 1500 rpm & 1.5 HP.We used copper winding motor.

Fig. 6: Motor

G. Refrigerant:-

In this project we are use a refrigerant is R-134a. It is also known as tetrafluroethane (CH3CH2F) from the family of HFC refrigerant. The CFCs and HCFCs refrigerants produce more affects to ozone layer. hence we are used to R134a and concluded that energetic defect occurred in compressor was highest as compare to the other refrigerant through their analysis it has been found that instead of 145g of R134a if 60g of R600a is use in consider system gave same performance which ultimately result in economical advantages.

Fig. 7: Refrigerant R-134a

Properties of R-134a:-

No	Properties	R-134a
1	Boiling Point	-14.9°F or -26.1°C
2	Auto-Ignition Temperature	1418°F or 770°C
3	Ozone Depletion Level	0
4	Solubility In Water	0.11% by weight at 77°F or 25°C
5	Critical Temperature	252°F or 122°C
6	Cylinder Color Code	Light Blue
7	Global Warming Potential (GWP)	1200

Table 1:

III. WORKING CONCEPT

The ideal vapour-compression cycle consists of four processes are as follow:-

1) Constant pressure heat addition in the evaporator
2) Isentropic compression
3) Constant pressure heat rejection in the condenser
4) Throttling in an expansion valve

Hybrid cooler is the transfer of heat from a cooler area to a wormer area through the process of mechanically pumping a refrigerant in the compressor that will transfer the energy, reffered to claussius-Rankin cycle. Below is a very simplified explaination, with some illustration to help out. A low boiling refrigerant R-134a is moved around a closed loop system. See the fig. below. The refrigrsnt properties are changed from a liquid to a gas vapour in the system and back again. It is these phase change that allow for the transfer of energy. First the vapour is compressd, raising the pressure. The high pressure liquid is then allow to condence, where the refrigerant gives up the heat it took in from the inside of the refrigerant compartment.

Next the liquid is pushed through an expanssion valve and allowed to expand. This is where the change from liquid to vapour is facilited. The evaporating gas then goes through the evaporating coil where heat from the inside of the cooler cabinet is absorbed by the vapour. The heated vapour is then compressed and the cycle repeats.

In the front of evaporator the fan is placed. When the fan is in on condition that time the cooled air is pass to the room with the help of fan and reduce tempreture of the room. VCRS cycle is shown by T-S and P-H Diagram are as below:-

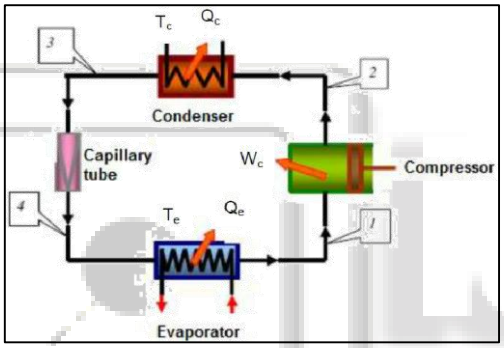

Fig. 8: VCRS Cycle

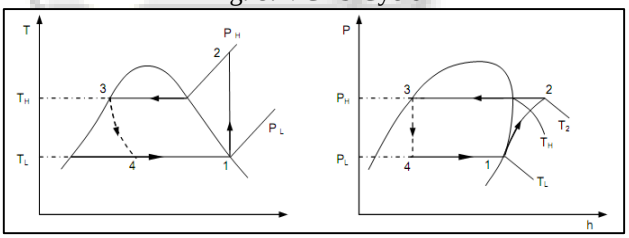

Fig. 9: T-S and P-H diagram

IV. DESIGN OF HYBRID AIR COOLER

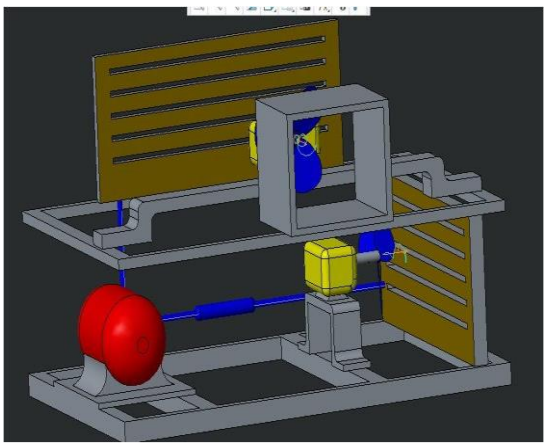

Fig. 10:

V. LITERATURE REVIEW

- Taliv Hussain ,Arjun Sharma, "Effect Of Sub-cooling in VCRS Cycle and Compared to simple VCRS System" , ELK Asia Pacific Journal ,Punjab 978-81-930411-4-7.
- According to this paper, Decreasing the consumption of power in a vapors compression air conditioning system with increase in refrigeration effect and reduction of compressor work is a major concern and challenging problem especially in the area where extreme weather conditions of about 50°C exists.Experimental results show that the use of sub-cooling by heat exchanger will improve the COP.
- G Venkatarathnam , S Srinivasa Murthy," Refrigerants for Vapour Compression Refrigeration Systems", General Article on Feb 2012.
- In this article, various issues related to this changeover of refrigerants being used in vapor compression refrigeration systems are discussed. This paper Discuss the mandate of Montreal Protocol banning ozone depleting substances, and Kyoto Protocol later on curtailing the use of substances which contribute to global warming, conventional refrigerants are to be replaced by environment friendly working fluids.
- R. T. Saudagar, U. S. Wankhede, "Experimental Analysis of Vapor Compression Refrigeration System with Diffuser at Condenser Inlet", International Journal of Engineering and Advanced Technology (IJEAT) on April 2013.
- This concept reduces size of condenser to achieve the same system efficiency. This paper discusses design and testing of diffuser at condenser inlet in vapors compression refrigeration system.
- K. Nagalakshmi , G. MarurhiprasadYadav, "The Design and Performance Analysis of Refrigeration System Using R12 & R134a Refrigerants", Int. Journal of Engineering Research and Applications Feb on 2014.
- In this report, the design and performance analysis of refrigeration system using R12 & R134a refrigerants are presented. The design calculations of the suitable and necessary refrigerator equipment and their results are also reported here.

VI. RESULT

- Power consumption is low.
- Affordable to middle class family.
- It is more efficient than other cooling devices like water cooler, sealing fan, etc
- It gives high performance.

VII. CONCLUSION

The concept of this project explores the possibility of combining four units so for reducing such large consumption of trees, water, electricity, which ultimately leads to wealth consumption. This research project includes to provide the cooling effect of air as such like air conditioners without using water, wood wool, and by consumption of low amount of electricity. This ultimately leads to reducing the monthly tariff and also having very less effect to the environment.

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