DESIGN AND MANUFACTURING OF VCR SYSTEM FOR ALL WEATHER CONDITIONS

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Abstract: In some countries we require cooling as well as heating due to sudden weather changes. So we use separate devices for heating and cooling purposes. For getting cooling effect in summer days we use air conditioning systems which work on vapour compression refrigeration cycle. For getting heating effect in winter we use heating device such as electric heating device. Thus it is not affordable to purchase two different devices for heating and cooling.

At present there is system that can provide both heating as well as cooling, which is suitable for all weathers, but the limitation is that the cost of that system is high. Thus we are designing and manufacturing a system which can provide us with cooling as well as heating effect & which will be efficient to use also. This project contains a system that will provide both processes using a single device. Thus we will use VCR cycle for cooling effect as well as for heating effect.

Keyword : Modified VCR, Air conditioning , Waste heat recovery ,spirally coiled condenser and evaporator.

I. INTRODUCTION

The rapid industrialization has led to unprecedented growth, development and technological advancement across the globe. Today global warming and ozone layer depletion on the one hand and increasing oil prices on the other hand have become main challenges. In the face of imminent energy resource crunch there is need for developing thermal systems which are energy efficient. Thermal systems like refrigerators and air conditioners consume large amount of electric power. The vapor compression refrigeration system is now-a days used for all purpose refrigeration. It is generally used for all industrial purpose from a domestic refrigerator to a big air conditioning plant.

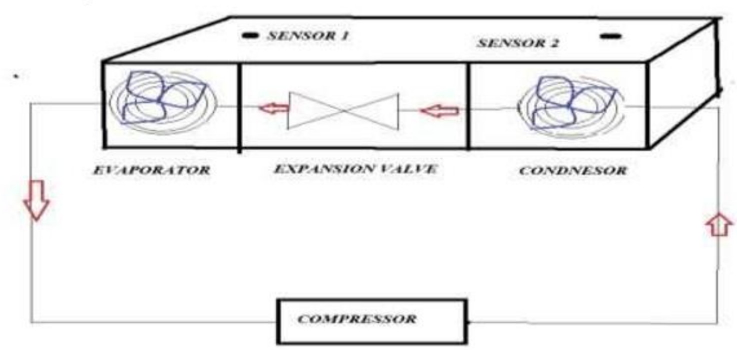

Fig 1. Block diagram of Modified AC

1.Compressor :

A compressor is the most import ant and often the costliest component (typically 30 to 40 percent of total cost) of any vapour compression refrigeration system (VCRS). The function of a compressor in a VCRS is to continuously draw the refrigerant vapour from the evaporator, so that a low pressure and low temperature can be maintained in the evaporator at which the refrigerant can boil extracting heat from the refrigerated space. The compressor then has to raise the pressure of the refrigerant to a level at which it can condense by rejecting heat to the cooling medium in the condenser. We are going to use 0.6 hp hermetically sealed compressor which readily available. Whenever we design any system we have to take any of system component as base. So we have taken 0.6 hp compressor as a base for design the whole VCC system.

2.Condenser:

Generally in any refrigerator or air conditioner the condenser used is evaporative condenser which consist of parallel spaced pipes. It can be used in refrigerator or in air condenser but requires more space. We are going to design condenser coil which will be spirally coiled such like as shown in Fig 8.So the specifications of some condenser coils.We are going to use condenser coil which is made of by using copper as a material & its size is 1/8 th inch diameter. Because copper has high conductivity & it is easily available also. Then we are going to change the shape of coil by making it spirally coiled. When we will make it as spirally coiled the surface area of the coil get increased & it will be same as that of fan's surface area which we are going to use & convection will increase.

3.Capillary tube:

A refrigerant capillary tube is a narrow bore tube constant diameter. It serves the purpose of reducing the pressure in a refrigeration system. The pressure reduction occurs showing to the following two factors: The refrigerant has to overcome the frictional resistance offered by the capillary tube walls. This leads to some pressure drop.

4.Evaporator

The design of evaporator will be same as condenser .evaporator also will be used of copper & its shape also spirally coiled.

Design and calculations:-

Work input W=H2-H1

Refrigerating effect N=H1-H4

Since, during the process 3-4, enthalpy is constant. Therefore enthalpy at 4(H4) is equal to enthalpy at 3(H3)

Refrigerating effect N=H1-H3 C.O.P=REF EFFECT /WORK INPUT=H1-H3/H2- H1

SELECTION OF COMPRESSOR

Motor H.P=1 H.P.

Cylinder specifications

No of cylinders = 1

Bore diameter = 63.5 mm

Stroke length = 762 mm,

Displacement = 4825 cm^3

DESIGN OF EVAPOURATOR

Inlet temperature of the evaporator coil (T1) = -1.6°C

Outlet temperature of evaporator coil (T2) = 3.4°C

Temperature difference between inside and outside of the evaporator= (3.4)+(1.6) = 5

The overall heat transfer, co-efficient "U" factor from data tables for copper = 400kcal/m2-hr-°C Load taken by the evaporator = AU ΔT

i.e. Refrigerating capacity = AU ΔT

Refrigerating capacity = load taken by Evaporator

= 1555 = AU ΔT

A = 1555/ U ΔT = 1555/ (400 x 5) = 0.77 m^2

Diameter of the coil (D) = 5mm

Then A = πDL

Length of the coil (L) = A/πD = 0.77/(π x 0.005) = 4.95m

Length of coil in one turn = 2(40+20) = 120 cm

Number of turns in the tank = 4950/120

= 4.125 turns, say 5 turns

Provide 10 mm gap between each turn of the coil. The evaporator coil should be arranged the side of the tank that will be easy for periodic cleaning.

Selection of condenser

The condenser load can be calculated by the following equation:

Heat transfer Q=m Cpl (T3-T2)

Load on the condenser = m Cpl (T3-T4)

Q = heat absorbed in evaporator + heat of compressor.

Heat absorbed in evaporator = 1555 k cal/h

Heat of compressor = v x 1

= 220 x 3

=640w

= 640 x 0.86

=550.4 kcal.

Q = 1555 + 550.4

= 2105.4 k cal

Q = UA ΔT

A = 2105.4/ 400 x 22

= 0.239 m^2

A = Πdl

d = 5mm

Length of coil (L) = 0.239 / 0.005
= 15.23m
LENGTH IN ONE TURN = (40 + 40) = 80cm
Number of turns required = 15.23 / 0.80
= 19.0389
= 20

IV. CONCLUSION

From the data it's very clear that performance of simple vapour compression refrigeration system can be improved. Also due to the replacement of general coiled, condenser and evaporator with spirally coiled condenser and evaporator respectively, the waste heat recovery can be done. Thus this system is capable of generating both the cooling and heating effects therefore, the need of using two different devices for these effects can be eliminated.

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