Design & Fabrication of Combination of Air Conditioning, Refrigerator & Water Heater

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***Abstract*-The objective of this project is to determine the energy savings associated with improved utilization of waste heat from a domestic refrigerator. The combination of air-conditioner, refrigerator & heater works on basic cooling cycle - vapour compression refrigeration cycle (VCRs). The system operates on a single compressor and performs both the refrigeration and air conditioning functions. It is an energy efficient system as it offers the triple benefits. This can be used for the commercial as well as domestic purposes.**

***Index Terms*-combining three units, refrigerator cum air-conditioner cum water heater, vapour compression refrigeration cycle.**

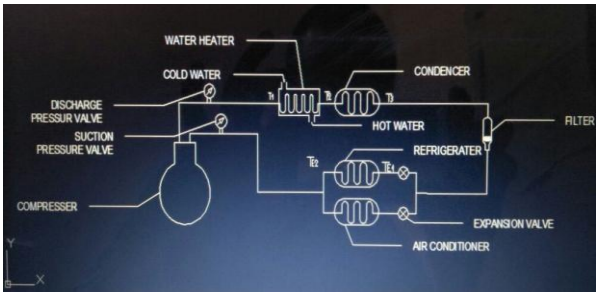
I. INTRODUCTION

The idea of this project explores the possibility of combining three units i.e. Refrigerator, air-conditioner and water heater into a single unit, such that the device saves energy and the lot of space. The name of the device is termed as combination of air-conditioner, refrigerator & heater where all are working on the cost of only refrigerator. This is how we can try to make the environment and a common man comfortable. This project is about attempt to merge domestic refrigerator and air conditioner into a combined system. It is an energy efficient system as it offers the triple benefits. This can be used for the commercial as well as domestic purposes. Due to the increase in temperature of the earth due to global warming, the use of air conditioners has drastically increased. Waste heat from air conditioners may be used to produce hot water. The benefits of doing this are threefold. One is elimination of the need to install an electric water heater, and the other is saving of electrical energy otherwise used in the electric air conditioning, refrigerator and water heater. At present, water heaters using waste heat from small split type air conditioners are commercially available in India and are generally mechanically made to the specific requirements of the users. Even though split type air conditioners with water heaters are successfully used, their performance and system design for application in India have not been fully investigated, especially when both cooling and heating effects are desirable

II. CONSTRUCTION

The main components of combination of air-conditioner, refrigerator & water heater are as follows,

1. Compressor
2. Water heater (condenser)
3. Air condenser
4. Filter & expansion valve
5. Evaporator



BASIC CYCLE WORKING PROCEDURE

COMPRESSION:The refrigerant being sucked to the compressor through the suction line. Afterward the

refrigerant compressed into the compressor and the compressed refrigerant being discharged to the condenser unit through the discharge line.

CONDENSATION: When the high pressure refrigerant vapour enters the condenser heat flows from condenser to cooling medium thus allowing vaporized refrigerant to return to liquid state.

EXPANSION: After condenser the liquid refrigerant is stored in the liquid receives until needed. From the receiver it passes through an expansion value where the pressure is reduced sufficiently to allow the vaporization of liquid at a low temperature of about –10 degree centigrade.

VAPORIZATION:The low pressure refrigerant vapour after expansion in the expansion valve enters the evaporator on refrigerated space where a considerable amount of heat is absorbed by it and refrigeration is furnished.

III. WORKING

- Principle: - it works on the principle of VCRs system. The refrigerator is compressed i.e. the low pressure and low temperature refrigerant increase to high pressure and high temperature then the refrigerant is used for further working.

I. Working of air-conditioning refrigerator and water heater system is similar to that of the air-conditioning system with an additional VCRs cycle associated with it.
II. Initially R22 refrigerant of 1.35 kg is inserted into the compressor pin valve.
III. Copper coils of 10turns are made and inserted in the drum that acts as a water condenser for condensation of refrigerant and transfer of heat to water and it acts like a water heater. The copper coils of 15 turns are made for the evaporator in order to get the refrigerating effect and this section act like a refrigerator
IV. The condenser and evaporator of the VCRs cycle are connected to the outlet and the inlet of the compressor.
V. A filter is placed between condenser and capillary tube in order to prevent clogging of impurities in the setup.
VI. Capillary tubes are used in order to enable expansion under constant enthalpy process
VII. Valves are here used in order to regulate and control the refrigerant and VCRs cycles independently
VIII. When the system is started the refrigerant flows to both air cycle and the VCRs cycle
IX. The compressed refrigerant flows through the condenser coils where condensation of the refrigerant occurs causing heating of the water in the hot water chamber and then it is passed through the expansion valve leading to a drop of temperature of the refrigerant and then it is passed to the evaporator in the form of liquid at a very low temperature where heat exchange occurs between water at room temperature and the refrigerant leading to cooling of the water and heating of the refrigerant thus cold water is obtained from cold water chamber.
X. The refrigerant from the evaporator enters the compressor and thus the cycle continues.
XI. Temperatures at the inlet and outlet of the condenser, inlet outlet temperatures of evaporator, pressures at the inlet and outlet of compressor is noted down and calculations related to COP, mass-flow rates, efficiencies are determined.
XII. Finally a combined system of air cycle and VCRs cycle is obtained with increased efficiency is thus obtained

IV. COEFFICIENT OF PERFORMANCE

The coefficient of performance is the ratio of heat extracted in the refrigerator to the work done on the refrigerant mathematically,

C.O.P = Q/W

Q = Amount of heat extracted in the refrigerator

W = Amount of work done

V. CALCULATION

Heat extracted = Mass*Specific heat * Rise in temperature
Density of water = 1000 kg/m3,
Volume of water = 1litre
Mass of water = Volume * Density
= 1/1000 m3* 1000 kg/m3 = 1 kg
Specific heat of water = 4.187 kj/kg-k
Rise in temperature = T2- T1
T1 = Normal water temperature =20°C =293 k
T2 =Hot water temperature =60°C =333k
Work done = 1/12 kw
Time taken to raise the temperature from,
T1to T2 = 10 min
Heat extracted (Q) = 1kg*4.187 kj /kg-k*(333-293) = 167.48 kj
Work done (W) = 1/12 kj/sec*10*60 sec
=50 kj
C.O.P = Q/W =167.48/50 =3.349

PROJECT DESIGN AND FABRICATION

WATER HEATER CHAMBER

FRONT VIEW OF PROJECT

VI. ADVANTAGES OF THE SYSTEM

- The system saves the energy
- Noiseless in operation
- It contains a compact unit
- Low initial cost
- Low maintenance cost

VII. APPLICATION

- Domestic uses
- Office and Bank
- Industrial purposes

SIDE VIEW WITH COMPRESOR

TOP VIEW WITH PRESSURE GAUGES

VIII. CONCLUSION

- An effective integrated air-conditioner, refrigeration and heating system is suggested.
- A simple working model of the system is fabricated and tested.
- The heating unit in the system utilizes heat lost through the condenser and There by Save energy

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Basically We Belongs To Nagpur District Of Maharashtra. Now We Are In Final Semester Of B.E. Mechanical, Kdk Engineering College Umrer, Nagpur. And Our Final Semester B.E. Project Topic Is "DESIGN & FABRICATION OF COMBINATION OF AIR-CONDITIONING, REFRIGERATOR & WATER HEATER".