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A Review on Refrigerator cum Air Conditioner

M. A. Siddiqui [1], Aaftab A. Farooqui [2], Mazaroddin Sheikh [3]
Faizan Momin [4], Fahim Shaikh [5]
Department Of Mechanical Engineering
Everest College Of Engineering & Technology
Aurangabad - India

ABSTRACT
This paper gives a review on a working model of Refrigerator cum Air conditioner by combining the two units i.e. domestic Refrigerator and Air-Conditioner into a single unit. This working model refrigerator cum air conditioner is a device that performs both task at same time i.e. cooling refrigeration cabin and room. By this method the energy and cost can be reduced from the cost of individual equipment. In minimum construction, maintenance and running cost, this attempt is quite useful for domestic purpose thus those who cannot afford an Air Conditioner can have the comfort of Air Conditioner. Refrigerator has become a necessity of all households in 21st Century. In all metropolitan cities, environment degradation due to automobile & other factors is on the rise, therefore the requirement of air-conditioner has already been felt. The motivation for the project comes from rising energy demands and hence its cost. As we all know that we are lacking of power resources, so this project will help us in tackling this problem as we are trying to make a personalized cooling system which will run at a very low cost that can be afforded by a common man. Since all energy cost are on a rise, therefore this project is a way forward in realizing the economic as well as environmental demands. On the other hand, the common man can have the comfort of Air conditioner.
Keywords :— Domestic Refrigerator, Air conditioner, Affordable, Productivity, Portability, Environment Degradation.

I. INTRODUCTION

In nature, heat transfer occurs from higher temperature to lower temperature without requiring any external devices. The reverse process cannot occur by itself. The transfer of heat from lower temperature to higher temperature requires special devices called refrigerators. Refrigeration and air conditioning play a very important role in modern human life for cooling and heating requirements. It covers a wide range of applications starting from preservation of perishable food products to the thermal comfort to human beings by means of air conditioning and hence living standards of people. The utilization of refrigerators and air conditioners in homes, hospitals, offices, vehicles and industries provides for thermal comfort in living or working environment and hence plays a very important role in increased industrial production of any country. The increasing demand of energy primarily for refrigeration, air conditioner and Heat Pump applications is around 26–30%, which degrades environment, produces global warming and depletes ozone layer, etc.

Therefore, to overcome these aspects, we are making a working model of Refrigerator cum Air conditioner by combining the two systems i.e., Domestic Refrigerator and Air conditioner into a combined system, which performs both task at same time i.e. cooling refrigeration cabin and surroundings such that the running cost becomes negligible and the power consumption will reduce. Because of its minimum construction and running cost, and portability this working model is quite useful for domestic purpose thus those who cannot afford an air conditioner can have the comfort of air conditioner. This is how we are trying to make the environment and a common man comfortable. By this product, a common man could have a sound sleep so that his productivity for the next day increases.

II. LITERATURE REVIEW

A. Prof. S. K. Gupta

The paper reported about the attempt he made to merge Domestic Refrigerator and Air conditioner into a combined system by which the power consumption will reduced, cost and space will be minimum. BECAUSE OF ITS MINIMUM construction, space and cost an ordinary man can afford it easily. After experimentation he conclude that a common man can have comfort of air conditioner at very low running cost or zero cost, which would prepare him for better productivity for the next day.

B. M. Fande, A. M. Andhare

This paper is about the experimental investigation of the effect of HFC refrigerant R134a on a vapour compression refrigeration system by using two expansion devices with the conservation of energy by waste heat recovery system. He used two different evaporators for air-cooling and water chilling respectively and a water-cooled condenser is used to produce hot water. The existing system can be easily retrofitted as a waste heat recovery device and R134a can replace the existing R22 refrigerant with minor modifications. After experimentation, the maximum temperature achieved in water tank with 50 litres of water is 45 C during 3 to 4 working hour. After that, performance of system decreases so it needs a regular use of that hot water which can be further used for household and industrial purposes.

III. EXPERIMENTAL PLAN

A. Experimental Setup

The figure 1 shows the schematic of refrigerator cum air conditioner system which has two parts the upper part is for air conditioner and the lower part is for refrigerator. This system consists of a single compressor, single condenser, a refrigerating evaporator (evaporator 1), an air-conditioning evaporator (evaporator 2), and individual expansion valve.

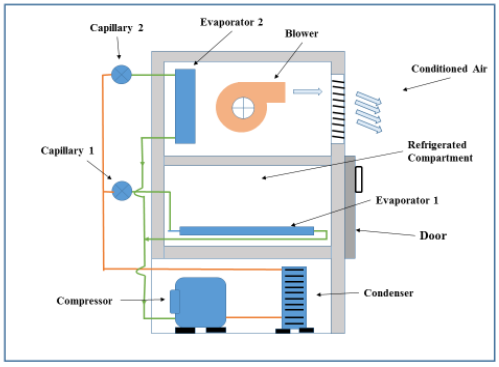

Fig.1: Schematic of refrigerator cum air conditioner system

The fan and blower is used in an air conditioner for pumping and circulating the air through the entire duct system and the conditioned space. It is usually located at the inlet of the air conditioner. A fan essentially consists of a rotating wheel, which is surrounded by a stationary member known as housing. There are many types of refrigerants available for getting cooling effect. We are using a tetra fluoro-ethane (R-134a) as a refrigerant to get cooling effect because it does not contain chlorine and its ozone depleting potential is zero. This system can be move from one place to another place by providing the wheel. In past, to operate such a unit two different refrigeration cycles were used which increases cost and also require more space and power but in this case by using a multi evaporator refrigeration system we can operate the total unit in minimum cost, space and power.

B. Data Processing

The arrangement, as shown in figure 2, consists of two evaporators, evaporator I and evaporator II operating at different temperatures with single compressor. This system also uses individual expansion valves EV-1 and EV-2 and pressure regulating valve. The corresponding p-h diagram is shown in figure 3.

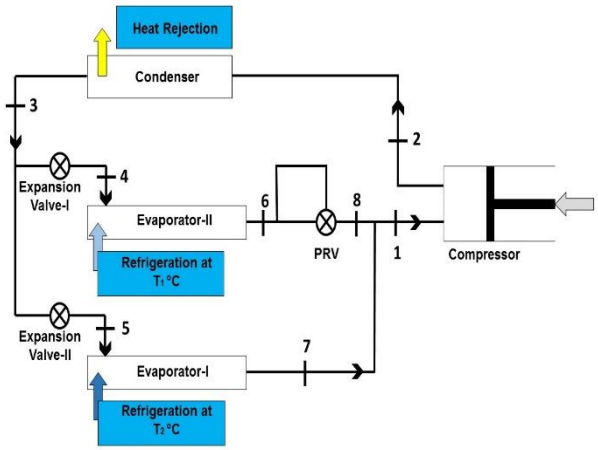

Fig. 2: A multi-evaporator system with single compressor

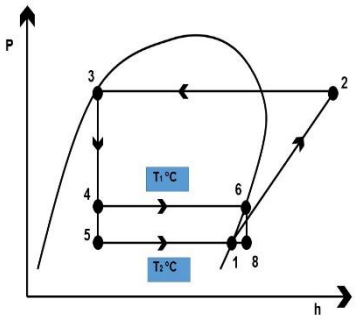

Fig.3: P-h diagram of multi evaporator system

From figure 2, we see that the pressure of refrigerant coming out of the high temperature evaporator i.e. evaporator II at high pressure is regulated by a pressure-regulating valve (PRV) at point 8. Now the refrigerant leaving the PRV at pint 8 are mixed with the refrigerant leaving the Evaporator I at point 7, at the pressure of Evaporator I, which is the suction, pressure of the compressor. This system offers the advantage of higher refrigeration effect at the high temperature

evaporator [(h_6-h_4) against (h_7-h_5)]. However, this advantage is counter balanced by higher specific work input due to the operation of compressor in superheated region. Thus, ultimately there may not be any improvement in system COP due to this arrangement. It is easy to see that this modification does not result in significant improvement in performance due to the fact that the refrigerant vapor at the intermediate pressure is reduced first using the PRV and again increased using compressor. Obviously, this is inefficient. However, this system is still preferred to the earlier system due to proper operation of high temperature evaporator.

The COP of the above system is given by:

$$COP = \frac{Q_{eI} + Q_{eII}}{W_c} = \frac{m_I(h_7 - h_5) + m_{II}(h_6 - h_4)}{(m_I + m_{II})(h_2 - h_1)}$$

Where m_{II} and m_{II} are the mass flow rates of refrigerant through evaporator I and II respectively. They are given by,

$$m_I = \frac{Q_{eI}}{(h_7 - h_5)}$$

$$m_{II} = \frac{Q_{eII}}{(h_6 - h_4)}$$

Enthalpy at point 2 i.e. inlet to compressor is obtained by applying mass and energy balance to the mixing of two refrigerant streams, i.e.

$$h_2 = \frac{m_I h_7 + m_{II} h_8}{m_I + m_{II}}$$

If the expansion across PRV is isenthalpic, then specific enthalpy h_8 will be equal to h_6,

IV. NOMENCULATURE

Symbols	Description	Units
COP	Co-efficient of Performance	
Q_{eI} & Q_{eII}	Add Heat at Evaporator-I & II	kj/s
W_c	Work done by the Compressor	W
m_I & m_{II}	Mass at Evaporator I & II	Kg
h_n	Enthalpy at respected points	kj/kg

V. SUMMARY

This paper study about the attempt to make a working model of Portable Refrigerator cum Air conditioner system to reduce power consumption, space and cost such that to make the environment and a common man comfortable. In Ac cum refrigerator system, different temperatures are required to be maintained for refrigerator and air conditioning. In such cases, their own evaporator cools refrigerator and air conditioner in order to obtain more satisfactory control of the condition. There will be easy control of fluctuations in loads by controlling individual evaporator. To fulfilled the aim of the project in minimum construction, maintenance and running cost, we will made an attempt which is quite useful for domestic as well as industrial purpose so that those who cannot afford an Air Conditioner can have the comfort of Air Conditioner would be completed.

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