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ABSTRACT

In any developing country it is very hard to get all the amenities very easily for a common man because he/she can't simply afford it. Hence a trial has been made to derive a concept through which one can employ 3 different concepts in one setup so that the product offers 3 outputs. In this particular study we will be looking at several kinds of refrigerators using VCRS which have already been made worldwide so that they offer more than one output namely- refrigeration, air conditioning & heating if possible. Here, our primary aim would be to point out numerous methods to achieve what has already been cited above. If possible, we would also be looking at a new tentative method to achieve this feat too.

KEYWORDS: Refrigeration, Air Conditioning, Heating, VCRS system.

1. INTRODUCTION

Human nature has always been very keen observer of the natural happenings. It has always tried to derive results out of natural occurring & to use those results to the betterment of mankind. One such system derived by the scientists is VCRS which stands for “**Vapour Compression Refrigeration System**”. This phenomenon has been utilised in the development of refrigerators which as we all know is a household equipment used to keep the vegetables fresh. Same system has been utilised to bring up the concept of air conditioning. If these systems are being used separately then operating and initial costs associated with both of these products is higher. Hence there have been several attempts worldwide to come up with a single setup where both of these systems may be employed so that the overall cost of the apparatus is reduced. It is especially useful in developing countries where the living standard is still not up to the mark. So, the need in the current work is now to observe some concepts build worldwide where one system using VCRS is fully capable to operate as refrigerator, air conditioner & if possible, as heater too. We have put forth some research work already employed by the researchers all over the world in the next segment.

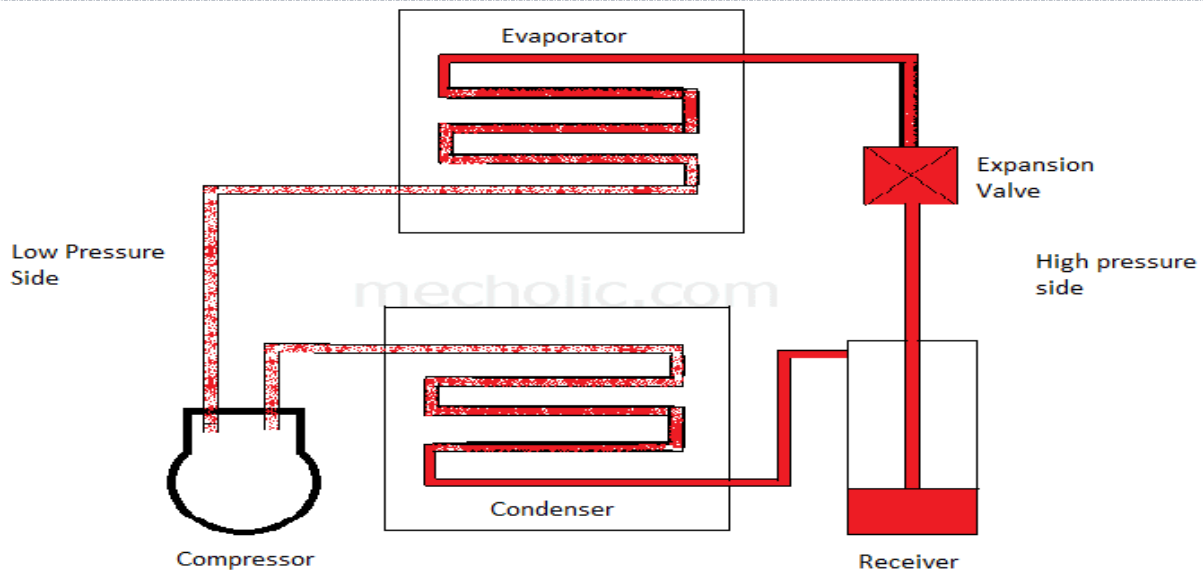


Fig. 1 A typical VCRS System

2. LITERATURE SURVEY

Pankaj Sayare et. al [1] studied about determination of the energy savings associated with improved utilization of waste heat from a domestic refrigerator. The continual operation of this equipment accounts more electrical energy consumption. Furthermore, a significant amount of waste heat is rejected by the condenser of refrigerator. The heat rejected by condenser is of low quality, meaning temperature is low. Thus, practical uses of waste heat from the domestic refrigerators are typically limited to space heating and water heating. The refrigeration cum air-conditioning cum water heater system 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. 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 Refrigerator cum Air-Conditioner cum water 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. 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. Normal refrigerator works on VCRS, extract heat from substance to be cooled and exert that heat to the atmosphere through the device called condenser. That refrigerator which is been previously made to exert a lot of heat through condenser is modified to overcome this wastage of heat. It saves a lot of space as 3 machines are combined in a single unit.

Hemanth Suvarna et. al [2] studied about developing the energy efficient, environment friendly direct evaporative air conditioning and forced heating system having low operating cost suitable for hot and dry regions and climates. To manufacture advanced 360-degree rotating air cooler& heater which rotates and provide air cooling and heating in all directions. 360-degree design air cooler& heater will allow person to sit in any direction during winter for heater and cooler for summer. Simple 360-degree evaporative cooling is achieved by direct contact of water particles & a moving air stream. When a hot and dry air is allowed to pass through a wet cooling pad, the temperature of incoming air is reduced with an increase in specific humidity as some water from the pad is evaporated taking the latent heat of vaporization from the incoming air. 360 degree heater, is forced convective heater that has an electric fan to speed up the air flow. In a convection heater, the heating element heats the air in contact with it by thermal conduction. Hot air is less dense than cool air, so it rises due to buoyancy, allowing more cool air to flow in to take its place. To achieve comfortable temperature either as heater or cooler.

A. S. Dhunde et. al [3] stated that The field of mechanical engineering has a theme word called change as its backbone. The new technological advancements and the needs of people have made us think about this experiment. In this paper a novel idea is to save precious water used in conventional air cooler with improved cooling efficiency of air cooler, again serve as water cooler to provide cooled water and refrigerator to provide necessary cooling to the refrigerator place. This unit would be an economic utility at all places to provide comfort conditions to the people also we concentrate on the compactness and efficiency so the system made is faster, lighter & smaller. The idea of this project explores the possibility of composite three units i.e. Refrigerator, Water cooler and Air-Conditioner in a single unit, such that the running costs reduce.

A. S. Dhunde et. al [4] stated that the invention of refrigerator and air conditioning has changed the lifestyle of people. In this work a refrigerator and air conditioning system are modified to serve the purposes as refrigerator, air conditioning, air cooler and water cooler suitable design and operation conditions were modified with a view to save space, initial cost and maintenance cost. The aim of this paper is to comparatively analyse of air cooler by using a refrigerant (R134a) over an Indian traditional cooler and Air Conditioners. In 21st century the world facing problem of electricity and water to overcome this problem worldwide many researches going on. Further cooler uses water so as cooling air, for this application much more quantity of water has been used every year. Also, to make these efficient woods product known as wood wool have been used which became a major reason of deforestation. The refrigerant R134a absorbs the heat from air and makes the cool air by getting vaporized in evaporator and then the cooled air is sent outward from the opening in the research model with help of fan running on motor and gives the cooling effect. This use of VCRS system with eco-friendly refrigerant reduces the consumption of the water, electricity consumption and tree which is used for making wood wool in conventional cooler. This ultimately reduces the global warming.

A. S. Dhunde et. al [5] studied about reducing the usage of electricity. To overcome this problem worldwide many researches are going on. Many of the world's largest growing industries as well as electricity producers' companies said that around 30% of electricity is consumption worldwide for the application of refrigeration and air conditioning. The manufacturers of refrigerants and refrigeration, air conditioning equipment, governmental agencies, and environmental groups continue working together toward the goal of reduced environmental impact via reduced emissions and improved energy efficiency. Examples of progress are presented for several sectors of refrigeration and air conditioning, followed by projections for further significant reductions. Although this paper will emphasize environmental impact for power reduction. Looking forward refrigeration has adverse effect on environment. Further cooler uses water so as to give cool air outside, for this application much more quantity of water has been used every year. Also, to make this efficient wood product known as „wood wool / khas“ have been used which became a major reason of deforestation. To restrict all these, an attempt is made to have an optimized unit of refrigeration cum air conditioning which will overcome the problem of electricity required for running both the application so far and again help to save water and wood, also maintain an ecological balance between people and surrounding. Both the system will run on single cost of refrigerator so that the normal person can afford the system and will have pleasure to take a pleasant comfort.

J.Preethiban[6] studied about The purpose of water cooler which is to make two in one equipment's at constant temperature irrespective of ambient temperature. They are meant to produce cold water at 5°C to 10°C for quenching the thirst of the people working in hot environment and by using the water cooler cum Air conditioner they feel comfort during summer seasons. This can be use in house. It is a multipurpose unit and portable one. It works under normal VCR system. The temperature of the cold water is controlled with the help of thermostatic switch. The evaporator with the fan is placed on the top of water cooler. The capacity of the tank is 10litre. The room air are sucked and cooled air are sent out. This type can be used as home appliances. The current consumption is less due to two in one and reduce the space.

Mohd. Wasi Baig [7] studied about focussing on high productivity, better quality and lower production cost with multipurpose home appliance. In this paper I have design and fabricated right hinge door refrigerator cum water purifier with advanced features, ergonomic designed multipurpose home appliance.

Sura Sankeerthan et. Al [8] studied about the project “WATER COOLER CUM AIR CONDITIONER SYSTEM” that makes the study of the development of a water-cooling system using a normal air conditioner.

The main aim behind developing this device is to develop a multifunctional unit which can provide cold water along with regular air conditioning cycle. The refrigerant is used as the medium which absorbs and removes heat from the space to be cooled and subsequently rejects that heat elsewhere. This heat of the refrigerant is used to cool the water, which can be then used for drinking purposes. The air cycle is the conventional vapor compression cycle.

Vinay Vishwanath et. Al [9] studied about this project “AIR CONDITIONING CUM WATER DISPENSER SYSTEM” which makes the study of the development of a water dispenser system using a normal air conditioner. The main aim behind developing this device is to develop a multifunctional unit which can provide hot water, cold water along with regular space/air conditioning cycle. The design mainly consists of compressor, condenser, evaporator, expansion valve, copper coil, temperature and pressure gauges. It comprises of air cycle and water cycle combined with a common compressor. In the air cycle, heat is transported from a colder location to a hotter area. An air conditioner is an example of such a system, as it transports the heat out of the interior and into its environment (i.e. the room). The refrigerant is used as the medium which absorbs and removes heat from the space to be cooled and subsequently rejects that heat elsewhere. This heat of the refrigerant is used to heat or cool the water, which can be then used for various purposes. The air cycle is the conventional vapor compression cycle whereas the water cycle is the adaptation of the same. It consists of five modes- water-heating only, space cooling and water heating, space heating and water heating, space cooling, space heating. They are controlled by means of valves. Systematic analysis after the completion of project was carried out. The readings obtained were noted down in a proper tabular column. Then calculations for determination of COP of air cycle, COP of water cycle, effectiveness of condenser and evaporator, heat transferred by evaporator and friction factor of capillary tube were carried out.

Satish Markad et. Al [10] studied about electricity. Many of the world’s largest growing industries as well as electricity producers’ companies said that around 30% of electricity is consumption worldwide for the application of refrigeration and air conditioning. The manufacturers of refrigerants and refrigeration, air conditioning equipment, governmental agencies, and environmental groups continue working together toward the goal of reduced environmental impact via reduced emissions and improved energy efficiency. Examples of progress are presented for several sectors of refrigeration and air conditioning, followed by projections for further significant reductions. Although this project will emphasize environmental impact for power reduction. Looking forward refrigeration has adverse effect on environment. Further cooler uses water so as to give cool air outside, for this application much more quantity of water has been used every year. Also, to make this efficient wood product known as „wood wool / khas“ have been used which became a major reason of deforestation. To restrict all these, an attempt is made to have an optimized unit of refrigeration cum air conditioning which will overcome the problem of electricity required for running both the application so far and again help to save water and wood, also maintain an ecological balance between people and surrounding. Both the system will run on single cost of refrigerator so that the normal person can afford the system and will have pleasure to take a pleasant comfort.

S.P. Mane et. Al [11] studied about Refrigerator. They stated that it is not only utilized to store food, vegetables, medicine but also used preserve them below atmosphere temperature for long time. It is also used obtain cool water, for cool water users frequently opens the door of refrigerator so that heap on it increases and its directly affects the COP (coefficient of performance) or execution of (it). But now days people buy separate chilled water container to obtain cool water. So, they buy separate water dispenser and Refrigerator, so cost and size of devices increases. The aim of this work is to study various types of water dispenser available in market with different refrigerants used in it and the cost of this refrigerator cum water dispenser, recycling of old refrigerator and contribution of refrigerants in GWP & ODP of environment and it concludes that the water dispenser is costly which is not economically suitable for middle class family, the refrigerants used in this dispenser are very harmful for environment and the recycling is very costly. There is provision of chilled water inside the refrigerator with small opening tap beside the refrigerator door. From literature survey it is conclude that this arrangement is very advantageous for the refrigeration COP of overall performance. Refrigerators manufactured since 1965 and there is more changes day by day in the refrigerator. There are various types of model available, but in 21st century because of higher technology these refrigerators become outdated and the recycling cost of this refrigerator also costly, hence it’s better to modify this refrigerator by slightly do changes in it and use.

S.P. Mane et. Al [12] studied about refrigerator which is used to store food, vegetables, medicine and preserve them for long time at very low temperature. At the same time refrigerator is used to obtain cool water, for cool water users frequently opens the door of refrigerator so that load on the refrigerator increases, its directly affects the COP (coefficient of performance) or performance of the refrigerator. But now days people used separate water cooler dispenser to obtain cool water. So, they buy separate water dispenser and Refrigerator so cost and size of devices increases. The aim of this work is to study different types of water dispenser available in market with different refrigerants used in it and the cost of this refrigerator cum water dispenser, and effect of ODP & GWP these refrigerants on environment and, it concludes that the cost of this water dispenser is very high which is not economically suitable for middle class family, the refrigerants used in this dispenser are very harmful for environment. There is provision of water cooler inside the refrigerator with small opening tap outside the refrigerator door. From literature survey it is found that this arrangement is very advantageous for the refrigeration COP of overall performance.

Kirti Singh et. Al [13] studied about The impact of on-going progress in Science and Technology which has created a variety of systems that can be used in the generation of power from Renewable Sources of energy and one of these is Solar Energy. The project which we have prepared utilizes solar energy with the use of Thermoelectric Module and Photovoltaic Module for generation of energy which we further use for cooling and heating effect. It is basically a portable cooler cum heater which is mainly designed for the convenience of the travelling people and the militaries. The most important utilization of this portable cooler is for the preservation of insulin in extreme conditions. The precise level of cooling power below which the thermoelectric method is preferable depends on a number of factors, but for most purposes it is ten watts and will remain in this region until there is a substantial improvement in the figure of merit of the thermo elements. A Thermoelectric module (TEM) is used instead of compressor so that it become portable, as it is based on the principles of Peltier effect. The use of Peltier effect is to create a heating side and a cooling side and also to maintain effectiveness. Thermoelectric cooler (TEC) is a solid-state heat pump which uses the semiconductor materials, by Peltier effect, to provide instantaneous cooling or heating. It has the advantage of having no moving parts and thus maintenance free. The solar thermoelectric avoids any unnecessary electrical hazards and provides a very environment friendly product and also the thermoelectric refrigerator does not produce chlorofluorocarbon (CFC). It is pollutant free-contains no liquids or gases, portable, compact, creates no vibration or noise because of the difference in the mechanics of the system. It is a prototype and its components are available commercially.

Jalli Musalaiah et. Al [14] studied about Refrigeration and air conditioning that has significant role in the daily activities of living species, particularly in the hot regions of the world. They are useful in the preservation of perishable items, storage of pharmaceutical drugs, or effective performance of a scientific process, controlling of an atmospheric environment either for human/animal thermal comfort. This investigation is aimed at the design, construction, performance evaluation of a dual-purpose domestic refrigeration system, that can simultaneously function as an air conditioner and as well as water cooler. The refrigeration system employed was a vapor compression system. The dual-purpose Air-Conditioner and Water cooler test setup is designed, fabricated to determine the performance of the system, and analyse the various parameters affecting its performance. The specifications of all the components are mentioned in the document. The performance of an air-conditioner is expressed in terms of co-efficient of performance. For Dual Purpose System i) Air-Conditioner with Water Cooler, COP is 2.07 ii) Air-Conditioner with Water Cooler is 2.28. and there is no much significance reduction of performance when the system is used for dual purpose.

Prashant S. Pathak et. al [15] studied about Energy crisis all over the world which has compelled us to take necessary steps to reduce energy consumption. Heat is energy, so energy saving is one of the key matters from view point of use of refrigerants and for the protection of global environment This waste heat will affect the environmental conditions because as heat in the environment will increases it will cause global warming and also not good for our ozone layer too. By saving energy we balance the demand & supply of electricity. So it is necessary that a significant and concrete effort should be made for conserving energy through waste heat recovery system. We have tried to make a cabinet to recover waste heat from condenser from refrigeration system by storing a heat in an insulated cabinet. This heat can be used for number of domestic and industrial purposes. In minimum constructional, maintenance and running cost, this system is more useful for domestic

purpose. Basically, domestic refrigerator is used to store perishable goods like vegetables, fruits, milk and other beverages etc. All domestic refrigerators use air cooled finned condenser on backside. As domestic refrigerators reject large heat inside room which make us uncomfortable in summer due to temperature rise inside the room. So it is now essential to store this heat inside an insulated cabinet to utilize it for different purposes. Stored heat is used for keeping food hot, heating water which may be used for different purposes.

M.A. Siddiqui et. al [16] studied about 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.

Dr. U. V. Kongre et. al [17] studied about developing the heat pumps for space conditioning and water heating. The earlier water heating pumps and air to water heating pumps gives only hot water and space conditioning. But in this air conditioning cum water dispenser we get hot and cold water with hot and cold air, thus the system becomes multifunctional. The actual cycles and operating conditions for air and water cycle present in this paper. The paper introduced basic design principles and the test analysis performed in the laboratory. The test results were found encouraging especially the parameters of dispenser output along with air conditioner. The paper also introduced comfort conditions and suitable coefficient of performance with respect to atmospheric condition, without sacrificing the air conditioning output.

Roshan Gonnade et. al [18] studied about determining 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.

I. Saichandu et. al [19] studied about creating a product which gives the user the comfort of two devices in one system. The basic advantage of the system is that two components run on a single compressor. The system is so formed that most of the refrigerant is moved to the air conditioning system and rest of the refrigerant is moved to cooling chamber thus producing maximum cooling through air conditioner and required cooling to the products through cooling chamber.

3. CONCLUSIONS

This paper undertook a review-based study into performance improvement Domestic Air-Cooled Refrigerator by recovering the heat from Condenser. This all work has great significant for developing new technologies related to heat recovery from a domestic refrigerator, in order to achieve heating at low energy cost, no harmful effect to environment and also having low initial cost. So, more attention is required in this area and lot of work has to be done. Domestic refrigerator consumes significant amount of energy in buildings like hospitals, hotels, multifamily buildings. By recovering part of energy for air conditioning effect energy can be saved. Since variation of outdoor air temperature is small in tropical countries, cooling is needed year-round. This is the best condition to perform combined effect of refrigerator and air conditioners for energy saving.

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