3 IN 1 MANEUVER UTILIZING SINGLE VAPOR COMPRESSION REFRIGERATION CYCLE

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Abstract - The main objective of our paper is to perform combine refrigeration system simultaneously or individually as per the need arises from the users. Also in rural areas of India so many peoples in their houses use the Refrigerator and Air cooler only in summer season and after that they keep switch off for remaining two seasons because of highly electricity consumption and large space required. Even in the most of house it's seen that they use their refrigerator only for chill the water and it's really fact. So we considering this all facts we are going to fabricate such device which can be easily affordable as well as less space required unit.

Cooling systems like Refrigerator, air conditioning, Air Coolers, Water Cooler systems are high electric power consumption's; these systems also have huge impacts on the ecosystem. A proper use or choice with an energy saving plan should be considered in order to make the development of ecosystem sustainable so that a harmony between people and environment could be formed. The best Innovative work has done in 20th century was refrigeration where Refrigerator recognized and developed in earlier of 20th century and Air Conditioner is lately in that of 20th century. However it has become the prime necessity in 21st century. In over span of three decades, there is continuously increase in energy demand due to everlasting population increases in India. Refrigeration and air conditioning systems are responsible for roughly 30% of total energy consumption, therefore incontestably with a major impact on energy demand.

Key Word: Compressor, Condenser, Evaporator, capillary tube, Refrigerant etc.

I. INTRODUCTION

Cooling systems like air conditioning, Refrigerator, Air Coolers, Water Cooler systems are high electric power consumption's; these systems also have huge impacts on the ecosystem. A proper use or choice with an energy saving plan should be considered in order to make the development of ecosystem sustainable so that a harmony between people and environment could be formed. The best Innovative work has done in 20th century was refrigeration where Refrigerator recognized and developed in earlier of 20th century and Air Conditioner is lately in that of 20th century. However it has become the prime necessity in 21st century. In over span of three decades, there is continuously increase in energy demand due to everlasting population increases in India. This has led to increase in pollution and power cost that cannot be afforded by normal person. The continuous cycling Observed in those equipment’s reduces their lifetime and increases power requirement.
The need of proper energy consumption is a worldwide concern and the big question arises for reducing energy wasting included proper used of energy and also how to lower power consumption. Instead of all these aim must be achieved without compromising comfort and other advantages brought by the use of energy, and with same efficiency and quality of installations. The concept of this project explores the possibility of combining four units i.e. Refrigerator and Air-Conditioner, Air Cooler, Water Cooler into a single unit, such that the running cost should be reduced. This is how we are trying to make the environment and a common person comfortable. By this product a normal person could have a sound sleep so that his productivity for the next day increases.

II. REFRIGERATION
Refrigeration is the process of moving heat from the one location to another in controlled conditions. The work of heat transport is traditionally driven by mechanical work, but can also be driven by heat, magnetism, electricity, laser, or other means. Refrigeration has many applications, including, but not limited to: household refrigerators, industrial freezers, cryogenics, and air conditioning. Heat pumps may use the heat output of the refrigeration process, and also may be designed to be reversible, but are otherwise similar to air conditioning units. Refrigeration has had a large impact on industry, lifestyle, agriculture and settlement patterns.

The idea of preserving food dates back to at least the ancient Roman and Chinese empires. However, mechanical refrigeration technology has rapidly evolved in the last century, from ice harvesting to temperature-controlled rail cars. The introduction of refrigerated rail cars contributed to the westward expansion of the United States, allowing settlement in areas that were not on main transport channels such as rivers, harbors, or valley trails. Settlements were also developing in infertile parts of the country, filled with new natural resources. These new settlement patterns sparked the building of large cities which are able to thrive in areas that were otherwise thought to be inhospitable, such as Houston, Texas and Las Vegas, Nevada. In most developed countries, cities are heavily dependent upon refrigeration in supermarkets, in order to obtain their food for daily consumption. The increase in food sources has led to a larger concentration of agricultural sales coming from a smaller percentage of existing farms. Farms today have a much larger output per person. This has resulted in new food sources available to entire populations, which has had a large impact on the nutrition of society.

III. WORKING CYCLE
The vapor-compression uses a circulating liquid refrigerant as the medium which absorbs and removes heat from the space to be cooled and subsequently rejects the heat elsewhere. Figure 2 depicts a typical, single compressor, a condenser, a thermal expansion valve (also called a throttle valve), and an evaporator. The entire process can be summarized as following.

![Vapor Compression Refrigeration Cycle](image)

Fig. 1 Vapor Compression Refrigeration Cycle
Circulating refrigerant enters the compressor in the thermodynamic state known as a saturated vapor and is compressed to a higher pressure, resulting in a higher temperature as well. The hot, compressed vapor is then in the thermodynamic state known as a
superheated vapor and it is at a temperature and pressure at which it can be condensed with either cooling water or cooling air.

1. That hot vapor is routed through a condenser where it is cooled and condensed into a liquid by flowing through a condenser into a liquid by flowing through a coil or tubes with cool water or cool air flowing across the coil or tubes. This is where the circulating refrigerant rejects heat from the system and rejected heat is carried away by either the water or the air (whichever may be the case).

2. The condensed liquid refrigerant, in the thermodynamic state known as a saturated liquid, is next routed through an expansion valve where it undergoes an abrupt reduction in pressure. That pressure reduction results in adiabatic flash evaporation of a part of liquid refrigerant. The auto-refrigeration effect of the adiabatic flash evaporation lowers the temperature of the liquid and vapor refrigerant mixture to where it is colder than the temperature of the enclosed space to be refrigerated.

3. The cold mixture is then routed through the coil or tubes in the evaporator. A fan circulates the warm air in the enclosed space across the coil or tubes carrying the cold refrigerant liquid and vapor mixture. That warm air evaporates the liquid part of the cold refrigerant mixture.

4. At the same time, the circulating air is cooled and thus lowers the temperature of the enclosed space to the desired temperature. The evaporator is where the circulating refrigerant absorbs and removes heat which is subsequently rejected in the condenser and transferred elsewhere by the water or air used in the condenser.

5. To complete the refrigeration cycle, the refrigerant vapor from the evaporator is again a saturated vapor and is routed back into the compressor. Multipurpose device using single vapor compression cycle project is depend on the same cycle that so this is the working principle of our project.

IV. PART DESCRIPTION

Following are the main component that used in this project.

1. Compressor
2. Condenser
3. Capillary Tube
4. Evaporator
5. Axial Fan
6. Tap
7. Copper Tube
8. Thermostat

1. Compressor

The hermetically sealed reciprocating compressor is widely used for the refrigeration and air conditioning applications. You can find it in all the household refrigerators, deep freezers, window air conditioners, split air conditioners, most of the packaged air conditioners. In hermetically sealed compressor, the compressor and the motor are enclosed in the welded steel casing and the two are connected by a common shaft. This makes the 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 compressors in which the compressor and the motor are different entities and the compressor is connected to the motor by coupling or belt.

2. Condenser

In systems involving heat transfer, a condenser is a device or unit used to condense a substance from its gaseous to its liquid state, by cooling it. In so doing, the latent heat is given up by the substances designs and come in many sizes ranging from rather small (hand-held) to very large industrial-scale units used in plant processes. For example, a refrigerator uses a condenser to get rid of heat extracted from the interior
of the unit to the outside air. Condensers are used in air conditioning, industrial chemical processes such as distillation, steam power plants and other heat-exchange systems. Use of cooling water or surrounding air as the coolant is common in many condensers.

3. Capillary Tube
It reduces the high pressure liquid refrigerant to low pressure liquid refrigerant before being fed to the evaporator. It maintains the desired pressure difference between the high and low pressure sides of the system, so that the liquid refrigerant vaporizes at the designed pressure in the evaporator.

Fig. 2 Capillary Tube
At the time of project fabricating initially we install the capillary tube of 60 micron but it got fail because the desired output required to us didn’t get properly. So we replace this capillary tube from 60 micron to 40 micron thus we got desired output. This output was in the form of ice that forms over the evaporator coil. After that we conclude that the 40 micron capillary tube is needed for the 1 ton of compressor capacity.

4. Evaporator
The finned evaporators are the bare tube type of evaporators covered with the fins. When the fluid (air or water) to be chilled flows over the bare tube evaporator lots of cooling effect from the refrigerant goes wasted since there are fewer surfaces for the transfer of heat from the fluid to the refrigerant. The fluid tends to move between the open spaces of the tubing and does not come in contact with the surface of the coil, thus the bare tube evaporators are less effective. The fins on the external surface of the bare tube evaporators increases the contact surface of the of the metallic tubing with the fluid and increase the heat transfer rate, thus the finned evaporators are more effective than the bare tube evaporators.

5. Axial Fan
A fan is a machine used to create flow within a fluid, typically a gas such as air. The fan consists of a rotating arrangement of vanes or blades which act on the fluid. The rotating assembly of blades and hub is known as an impeller, a rotor, or a runner. Usually, it is contained within some form of housing or case. This may direct the airflow or increase safety by preventing objects from contacting the fan blades. In this project we use total 4 axial fans from which 2 fans are used for condenser and 2 fans are used for Air Conditioner as a blower. The speed of the Axial fan is 2800 RPM and 35 W.

6. Tap
As all of we know that our project is multipurpose so that for the water cooler purpose it is necessary to use the tap.

Fig. 3 Tap
This tap is connected to the left side of the refrigerator body in this project. It is easy to use the tap for water cooler usually seen in every water cooler, RO etc.

7. Copper Tube
Modern technology has successfully exploited the exceptional properties of copper and copper alloys during use of tube and pipe products. Copper tube is used widely as a means of conveyance of potable water in houses and buildings. Next to it, the second largest application of copper tubes is in refrigeration
and air-conditioning systems. Copper is mostly used for plumbing because of the following properties:
1. Resistant to corrosion
2. High level of heat transfer
3. Machinability
4. Consumption of less refrigerant
8. Thermostat
A thermostat is a component which senses the temperature of a system so that the system's temperature is maintained near a desired set point. A thermostat can often be the main control unit for a heating or cooling system, in applications ranging from ambient air control to such as automotive coolant control, but is also used in many other applications, such as an electric clothes iron.

Fig. 4 Thermostat
It is a "closed loop" control device, as it seeks to reduce the error between the desired and measured temperatures. Sometimes a thermostat combines both the sensing and control action elements of control system, such as in an automotive thermostat.

V. CALCULATION
From the observation we find out the temperature at various section of our project.

WHEN AIR CONDITIONER OFF:
1. Temperature of compressor output = 43\(^\circ\)C
2. Temperature of cooling coil = -11\(^\circ\)C
3. Temperature of compressor suction = 7\(^\circ\)C
4. Temperature of condenser output = 36.44\(^\circ\)C
5. Suction Pressure = 60psi
   = 4.14Bar

From the \textit{P-H} chart

1. Enthalpy at the Entrance of compressor \( h_1 = 240 \text{ kJ/kg} \)
2. Enthalpy at the Exit of compressor \( h_2 = 275 \text{ kJ/kg} \)
3. Enthalpy at the outlet of the condenser \( h_3 = 93 \text{ kJ/kg} \)

**COP Calculation**

\[ \text{COP} = \frac{(h_1 - h_3)}{(h_2 - h_1)} \]

\[ = \frac{(240-93)}{(275-240)} \]

\[ = 4.2 \ldots \text{(theoretical COP)} \]

VI. RESULTS AND DISCUSSIONS
1. As the Heat load is increases, the temperature and the pressure on the compressor increases.
2. The pressure and temperature is inversely proportion to the condensor output.
3. The device works stable on the total load.
4. The COP of our project is calculated by using the pressure enthalpy chart. The COP of refrigerator obtained is 4.12.
5. The refrigerating effect obtained by using the refrigerent R-22 is into the less time than the refrigerent R-134.
6. It has been observed that the multi-purpose device works well on a single VCR cycle. It is very economical and affordable. The output obtained is good.

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VII. REFERENCES


