Design And Fabrication Of Portable Airconditioner

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Abstract **- Air conditioning is defined as the simultaneous control of temperature, humidity, cleanliness and air motion depending upon the requirement, air conditioning is divided into summer air conditioning and winter air conditioning. It provides heating and cooling of air. The portable air conditioning system should satisfy the need of user at most economical cost. The selection of system depends upon many factors. The main objective of this project cooling coil performance of portable air conditioner and improves efficiency of summer air conditioner unit. R 134-a refrigerant as a working fluid and to find refrigerant effect of cooling coil and measure the different temperatures to find the energy consumption.**

keywords **- Keywords: compressor, condenser, comfort chart, refrigerant (R134-a)**

INTRODUCTION

Air conditioning is the process of removing heat and moisture from the interior of an occupied space, to improve the comfort of occupants. Air conditioning can be used in both domestic and commercial environments. This process is most commonly used to achieve a more comfortable interior environment; however, air conditioning is also used to cool/dehumidify rooms filled with heat-producing electronic devices, such as computer servers, power amplifiers, etc.A portable air conditioner can be easily transported inside a home or office. They are currently available with capacities of about 5,000–60,000 BTU/h (1,500–18,000 W) and with or without electric-resistance heaters.

PORTABLE AIR CONDITIONERS*:*

Portable air conditioners are either evaporative or refrigerative. The compressor-based refrigerant systems are air-cooled, meaning they use air to exchange heat, in the same way as a car radiator or typical household air conditioner does. Such a system dehumidifies the air as it cools it. It collects water condensed from the cooled air and produces hot air which must be vented outside the cooled area; doing so transfers heat from the air in the cooled area to the outside air.

SIMPLE VAPOR-COMPRESSION CYCLE

Vapour-compression refrigeration or vapour-compression refrigeration system (VCRS) in which the refrigerant undergoes phase changes is one of the many refrigeration cycles and is the most widely used method for air-conditioning of buildings and automobiles. It is also used in domestic and commercial refrigerators, large-scale warehouses for chilled or frozen storage of foods and meats, refrigerated trucks and railroad cars, and a host of other commercial and industrial services. Oil refineries, petrochemical and chemical processing plants, and natural gas processing plants are among the many types of industrial plants that often utilize large vapor-compression refrigeration systems. Refrigeration may be defined as lowering the temperature of an enclosed space by removing heat from that space and transferring it elsewhere. A device that performs this function may also be called an air conditioner, refrigerator, air source heat pump, geothermal heat pump or chiller (heat pump).

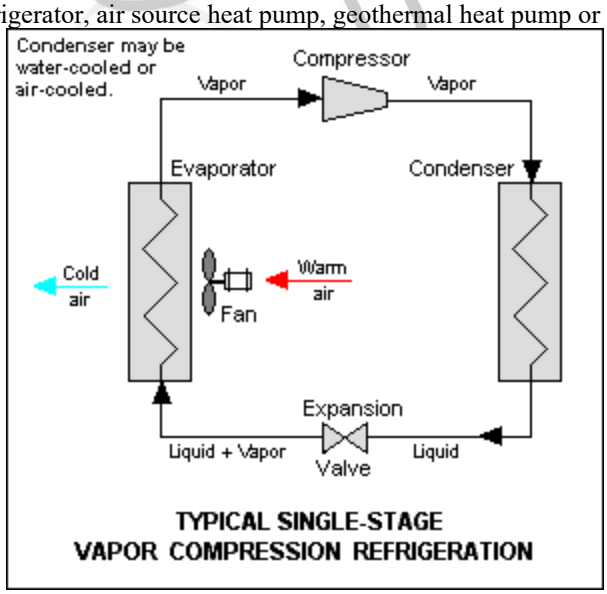

Fig.1 Simple Vapour Compression

COMPONENTS OF A SIMPLE AIR CONDITIONING UNIT

a. Evaporator - Receives the liquid refrigerant
b. Condenser - Facilitates heat transfer
c. Compressor - A pump that pressurizes refrigerant
d. Flow control device - regulates refrigerant flow into the evaporator.

Portable Units:
A portable air conditioner can be easily transported inside a home or office. They are currently available with capacities of about 5,000–60,000 BTU/h (1,500–18,000 W) and with or without electric-resistance heaters. Portable air conditioners are either evaporative or refrigerative. The compressor-based refrigerant systems are air-cooled, meaning they use air to exchange heat, in the same way as a car radiator or typical household air conditioner does. Such a system dehumidifies the air as it cools it. It collects water condensed from the cooled air and produces hot air which must be vented outside the cooled area; doing so transfers heat from the air in the cooled area to the outside air..

DESIGN SPECIFICATIONS
The basic design specification of the designed air conditioner is 1.5 x 1.5 feet with a height of 4 feet. We have used a compressor of capacity 0.6 tonne which is basically used in refrigerators. Copper coils of diameter 10 mm for condenser coils. A cooling fan with a speed of 1425 rpm. A motor of 1/85 HP. It cools an area of 8x8 ft.

THE MAIN COMPONENTS USED IN THE FABRICATION OF THE UNIT ARE:

EVAPORATOR:
Evaporator absorbs heat from the surrounding location or medium which is to be cooled by means of the refrigerant. The refrigerant enters the evaporator where it boils and changes into vapor. The temperature in the evaporator must always be less than that of the surrounding medium so that heat flows to the refrigerant.

CONDENSOR:
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 substance and transferred to the surrounding environment. Condensers can be made according to numerous 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.

COMPRESSOR:
It is the machine which is used to compress the vaporous refrigerant from the evaporator and to raise its pressure so that the corresponding saturation temperature is higher than that of the cooling medium. It also continually circulates the refrigerant through the refrigeration system. Since the refrigeration of the system requires some work to be done on it, therefore must be driven by some prime mover.

Expansion Valve:
Device feeds liquid refrigerant into the evaporator such as an expansion valve, capillary tube or an orifice. It also controls the flow of refrigerant. It separates the high pressure side of the refrigeration system from the low pressure side, as the cool, high pressure liquid leaves the condenser, it approaches the metering device. As the liquid passes through the metering device it undergoes a drop in pressure. It then moves in to the evaporator in the form of low pressure liquid. As the cool high pressure side liquid leaves the condenser, it approaches the metering device, as the liquid refrigerant flows through the metering device. It undergoes a drip in pressure. It then moves into the evaporator in the form of low-pressure liquid.

REFRIGERANT R-134a (TETRAFLUROETHANE):
Tetrafluoroethane (also known as norflurane (INN), R-134a, Freon 134a, Forane 134a, Genetron 134a, Florasol 134a, Suva 134a, or HFC-134a) is a hydrofluorocarbon (HFC) and haloalkane refrigerant with thermodynamic properties similar to R-12 (dichlorodifluoromethane) but with insignificant ozone depletion potential and a somewhat lower global warming potential (1,430, compared to R-12's GWP of 10,900). It has the formula $CH2FCH3$ and a boiling point of −26.3 °C (−15.34 °F) at atmospheric pressure. R-134a cylinders are colored light blue. Attempts at phasing out its use as a refrigerant with substances that have lower global warming potential, such as HFO-1234yf, are underway.

Tetrafluoroethane is a non-flammable gas used primarily as a "high-temperature" refrigerant for domestic refrigeration and automobile air conditioners. These devices began using tetrafluoroethane in the early 1990s as a replacement for the more environmentally harmful R-12 and retrofit kits are available to convert units that were originally R-12-equipped. Other uses include plastic foam blowing, as a cleaning solvent, a propellant for the delivery of pharmaceuticals (e.g. bronchodilators), wine cork removers, gas dusters, such as Dust-Off, and in air driers for removing the moisture from compressed air. Tetrafluoroethane has also been used to cool computers in some overclocking attempts. It is the refrigerant used in plumbing pipe freeze kits. It is also commonly used as a propellant for airsoft air guns. The gas is often mixed with a silicone-based lubricant.

R134a is also known as Tetrafluoroethane ($CH2FCH3$) from the family of HFC refrigerant. With the discovery of the damaging effect of CFCs and HCFCs refrigerants to the ozone layer, the HFC family of refrigerant has been widely used as their replacement.

It is now being used as a replacement for R-12 CFC refrigerant in the area of centrifugal, rotary screw, scroll and reciprocating compressors. It is safe for normal handling as it is non-toxic, non-flammable and non-corrosive.
Currently it is also being widely used in the air conditioning system in newer automotive vehicles. The manufacturing industry uses it in plastic foam blowing. Pharmaceuticals industry uses it as a propellant. It exists in gas form when expose to the environment as the boiling temperature is -14.9°F or -26.1°C.
This refrigerant is not 100% compatible with the lubricants and mineral-based refrigerant currently used in R-12. Design changes to the condenser and evaporator need to be done to use this refrigerant. The use of smaller hoses and 30% increase in control pressure regulations also have to be done to the system.

Fabrication process is as follows:

Fig -2 Condenser

Fig- 3 Compressor

Fig-4 Cooling Fan

Fig-5 Portable Air conditioner

The ultimate effect of the under-cooling is to increase the value of COP under the same set of conditions.

CALCULATIONS:

a. capacity of the system:
Refrigerating effect per minute = mR ($h1 - hf3$)
Therefore, capacity of system = refrigerating effect1 TR
b. power required:
Work done during compression of the refrigerant = $mR(h2 - h1)$
Therefore, power required = work done during compression60
c. C.O.P:
C.O.P. =refrigerating effect work done
d. heat rejected to condenser:
Heat rejected to condenser =$mR(h2 - hf3)$
e. refrigeration efficiency:
(C.O.P.)carnot = T_1- T_2 / T_1

Therefore, refrigeration efficiency =(C.O.P.)cycle(C.O.P.)carnot

RESULTS:

1. For the present portable Air conditioner mass flow rate of the refrigerant is 8.65 Kg/min.
2. Total Capacity of the system is 7.085 TR.
3. Work done by compressor is 1512.898 KJ/min.
4. Power required is 25.214 KW.
5. C.O.P obtained is 0.9334.
6. Total Heat rejected to condenser is 3000.75 KJ/min

CONCLUSION

The portable air conditioning system satisfies the need of the user at the most economical cost. The portable air conditioner is having very low manufacturing and maintenance cost. Its cooling power is comparable to wall air conditioner. It provides transportability, can be moved anywhere easily. It can be used in our bedroom and drawing rooms. It is completely non-polluting.

REFERENCES:

[1] https://en.wikipedia.org/wiki/Air_conditioning
[2] https://en.wikipedia.org/wiki/Vapor-compression_refrigeration

[3] https://home.howstuffworks.com/ac2.htm
[4] https://en.wikipedia.org/wiki/Evaporator
[5] https://en.wikipedia.org/wiki/Condenser_(heat_transfer)
[6] https://en.wikipedia.org/wiki/Compressor
[7] https://en.wikipedia.org/wiki/Refrigerant
[8] https://en.wikipedia.org/wiki/1,1,1,2-Tetrafluoroethane
[9] https://www.airconditioning-systems.com/R134a.html
[10] https://en.wikipedia.org/wiki/Air_conditioning
[11] https://en.wikipedia.org/wiki/Air_conditioning
[12] P. Dasthagiri and H. Ranganna, "Fabrication and Analysis of Refrigerator cum Chilled Water Dispenser" Advanced Engineering and Applied Sciences: An International Journal, ISSN 2320–3927.
[13] S.M. Shaikh, "Performance Investigation of Window Air Conditioner" IOSR Journal of Civil and Mechanical Engineering (IOSR-JMCE) sISSN: 2278-1684, PP: 32-37www.iosrjournals.org Second.
[14] Himanshu, "Feasibility Study and Development of Refrigerator cum Air Conditioner" International Journal of Scientific and Research Publications, Volume 4, Issue 12, December 2014 1 ISSN 22503153.
[15] Dr. U. V. Kongre and A. R. Chiddarwar, "Testing and Performance Analysis on Air Conditioner cum Water Dispenser" International Journal of Engineering Trends and Technology (IJETT) - Volume4Issue4- April 2013