Economical Evaporative Air Conditioner for Equatorial and Tropical Regions

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***Abstract*—** Global warming is the prime concern of human being. There are various types of side effects of global warming. Weather of Globe is changing drastically and in erratic manner. Countries on equator and on tropics are facing extreme heat condition due to green house effect. Concentration of greenhouse gases are due industrialization. Average mercury level also shoots up across the globe. To develop comfort condition to scour the heat wave a novel machine has designed which gives the desired comfort level at much lower cost, called an evaporative air conditioner for middle class and lower middle class people.

Keywords- *Evaporative, air conditioner, heat, comfort, air, velocity, flow***.**

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I. INTRODUCTION

Effect of Global warming leads to rise in average temperature of earth every year. Advanced and developed countries are jointly working to cope up with global warming. It takes long time to reach the objective of KYOTO protocol. However lot of research work is going on comfort air conditioner and air cooler. These research works is in the form of up-gradation of existing technology and improve the efficiency, however less attention to price factor. A person who lives on equatorial and tropical regions belongs to developing and under developed countries. So their economy standards are deferent than developed countries. Air conditioner is the luxury in this region. People cannot afford to buy and run this product when mercury shoots up. Ordinary ceiling fan and Air cooler are the only economical option available to the people in this region. Authors have studies this issue in detailed and conceptualized new alternative design which is call "Evaporative air conditioner".

II. PRESENT AVAILABLE TECHNOLOGIES

Well known brands producing comfort machineries/equipments across the globe. Two types of technology are being used now days (i) Evaporation of refrigerant in the closed tube by creating high pressure and low pressure conditions by compressor and expansion device. This is known as Air conditioner. (ii) Evaporation of water by sprinkle of water with pump on hay-pads and drawing air by using induced fan which draws the air through wetted hey-pads. This is known as Air cooler.

Both technologies are widely used by industries. However air-conditioner gives the desired comfort condition with control mechanism. However capital investment running cost is very high for Air conditioner. Air cooler is better option if compare with ceiling fan, however there is no humidity control in air cooler. This creates uncomforted condition. Humid condition also accelerates fungus growth and health issues. Capital and running cost of Air cooler is much lesser than Air conditioner.

Authors thought on this issues and conceptualize a solution which addresses both cost and humidity factor. A new conceptualized design called evaporative air conditioner, which fill the gap of humidity and cost issues.

III. WORKING PRINCIPLE OF AIR COOLER

An evaporative cooler (desert cooler) is a device that cools air through the evaporation of water. Evaporative cooling differs from typical air conditioning systems which use vapor-compression or absorption refrigeration cycles. Evaporative cooling works by employing water's large enthalpy of vaporization. The temperature of dry air can be dropped significantly through the phase transition of liquid water to water vapor (evaporation), which can cool air using much less energy than refrigeration. In extremely dry climates, evaporative cooling of air has the added benefit of conditioning the air with more moisture for the comfort of building occupants.

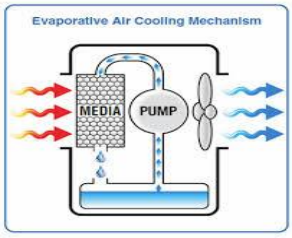

Figure1

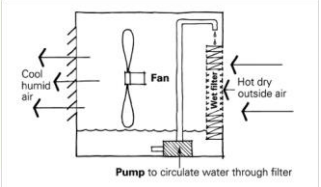

Figure 2

The cooling potential for evaporative cooling is dependent on the wet bulb depression, the difference between dry-bulb

temperature and wet-bulb temperature. In arid climates, evaporative cooling can reduce energy consumption and total equipment for conditioning as an alternative to compressor-based cooling.

IV. WORKING PRINCIPLE OF AIR CONDITIONER

In the refrigeration cycle, heat is transported from a colder location to a hotter area. As heat would naturally flow in the opposite direction, work is required to achieve this. A refrigerator 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.

Circulating refrigerant vapor enters the compressor and is compressed to a higher pressure, resulting in a higher temperature as well. The hot, compressed refrigerant vapor is now at a temperature and pressure at which it can be condensed and is routed through a condenser. Here it is cooled by air flowing across the condenser coils and condensed into a liquid. Thus, the circulating refrigerant rejects heat from the system and the heat is carried away by the air.

The condensed and pressurized liquid refrigerant is next routed through an expansion valve where it undergoes an abrupt reduction in pressure. That pressure reduction results in flash evaporation of a part of the liquid refrigerant, lowering its temperature. The cold refrigerant is then routed through the evaporator. A fan blows the warm air (which is to be cooled) across the evaporator, causing the liquid part of the cold refrigerant mixture to evaporate as well, further lowering the temperature. The warm air is therefore cooled. To complete the refrigeration cycle, the refrigerant vapor is routed back into the compressor.

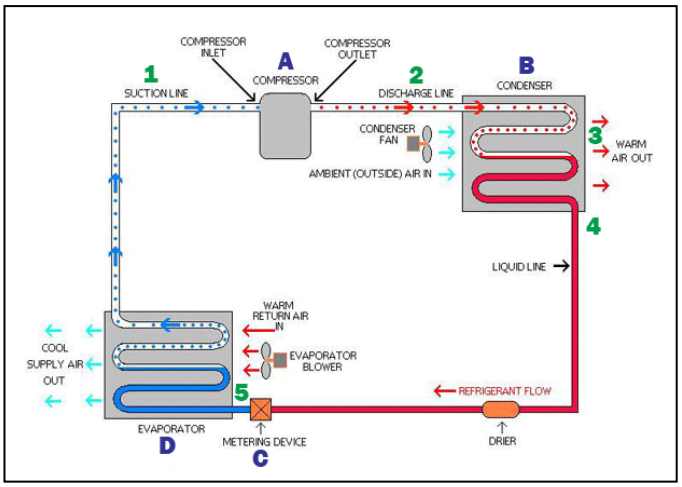

Figure3

V. WORKING PRINCIPLE OF EVAPORATIVE AIR CONDITIONER

Evaporative Air conditioner works on combine principle of Air cooler and air conditioner. In air cooler temperature of air reduces due to water's large enthalpy of vaporization however due to evaporation of water relative humidity (R.H) also increases. Increase in R.H. leads does discomfort. To overcome this undesirable situation, a small refrigerant compressor added in the system with VCR system, similar to refrigeration cycle. 0.3 ton Capacity of compressor is require compare to window A.C. Amalgamation of VCRS with Air cooler, reduces the R.H. of cooled air. Here purpose of evaporator in the system is not to cool the air but to condense the moisture of humid air, resulting in to cool and dry air. Hence capital cost as well as running cost of this Evaporative air conditioner is between Air cooler and Air conditioner. This is win-win situation to combat Relative Humidity of Air cooler and running cost issue of Air conditioner.

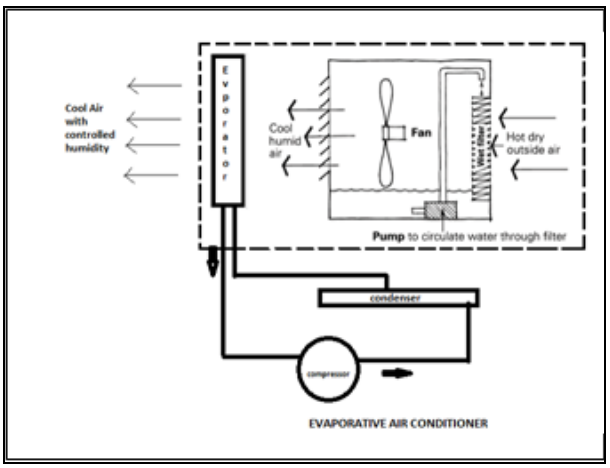

Figure4

VI. MODIFICATION IN AIR COOLER

In Air cooler air flows with high velocity. In Air conditioner the velocity of air is much lesser than air cooler. To develop the comfort condition and effective heat transfer, velocity of air cooler needs to be reduced by using gear box in blower assembly or by using regulator or by using D.C motor. This will reduce the speed of blower resulting in reduction in air velocity and reduced noise level. If air blows with reduced speed, then moisture of humid air will settle on evaporator fins and air enter in the room quietly just like air conditioner.

VII. CONCLUSION

Air cooler gives the cool and humid air. Humidity of air can be absorbed by amalgamation of evaporator at outlet of air cooler. This is chip and effective design conceptualization in

comfort application. Evaporative air conditioner is for all pockets in equator and tropical region of earth.

VIII. ACKNOWLEDGEMENT

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IX. REFERENCES

[1] Basic Refrigeration and Air conditioning by Ananthnarayan
[2] wikpedia.com
[3] Refrigeration and Air conditioning by R S Khurmi.
[4] Fundamentals of Electric Machines by Gupta, B.R.
[5] Heat & Mass Transfer by R.K.Rajput
[6] KYOTO Protocol