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Technical Paper

Waste energy recovery in window air conditioning system

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Abstract

"Faster, mightier & smaller" is still the keyword for every invention and development. In day-to-day world we concentrate on the compactness and efficiency of every product. Keeping this in thought, the "Waste Energy Recovery in Window Air conditioning System" is designed and fabricated in an economical manner. "Human comfort is that condition of mind, which expresses itself with the thermal environment". In this two rival properties of cool water and heat water are obtained. This system can be used continuously. By using this system there is no need of going for a separate air conditioner or water heater and water cooler. As both purposes are served by a single system, the cost is also lowered to a considerable level.

Keywords: *Waste Energy, Window Air Conditioning System.*

1. Introduction

Air conditioning system was considered a luxury item in old days. Now-a-days, air conditioning systems become popular necessary for industrial and public buildings such as offices, halls, cinemas, etc. The cooling is typically done using a simple refrigeration cycle. Air conditioning provides and maintains internal temperature must be less then atmosphere. The comfort condition required in an air conditioned space is 24°C dry bulb temperature and 60% relative humidity.

A compound stage expansion valve for make use of in an air conditioning system of an automotive vehicle including multiple stage flow control orifices located in between a refrigerant condenser and a refrigerant evaporator, the high pressure side of the refrigerant gas compressor being in fluid communication with the inlet side of the condenser, the low pressure side of the compressor being connected to the outlet side of the evaporator through a suction throttling valve device, said expansion device comprising multiple stage orifice valves defined in part by a movable piston that responds to the pressure differential across the expansion device to establish optimum refrigerant flow through the air conditioning system during operation at high load, for establishing a comparatively high fluid flow restriction during operation at low and moderate loads, and for establishing a moderate fluid flow restriction during operation at high loads and low compressor speeds [1]. Many methods were offered for lowering the energy inspired during air conditioning of buildings. Some of the strategies can be implemented during the initial design stage; others can be used to retrofit existing AC systems; and still some others can be applied with scarcely any changes on existing equipment. The methods that are discussed include heat recovery and utilization, absorption refrigeration systems, thermal cool storage, liquid (refrigerant) pressure amplification, reprogramming of the AC control systems, economical methods of removal of moisture from the air and initiation of alertness programs for the conservation of A/C energy [2].

Hybrid air conditioning systems defined by chemical dehumidification were characterized by high energy efficiency and low environmental impact. Besides, they can result gainful if compared to traditional air conditioning systems [3-5]. The moist air chemical dehumidification has been used for long time, mostly in the U.S.A., (industrial and military fields), in ice arenas and, within the commercial fields, in high latent load environments, like supermarkets [6-9]. However, the trend to expand this technique to other applications is obvious, such as commercial and residential fields, integrating it with standard and innovative systems [10-14].

The unit consists of the refrigeration system, control system (thermostat and selector switch), electrical protection system (motor overload switches and winding protection thermostat), air circulation system (fan motor, centrifugal evaporator blower and propeller fan for air-cooled condenser) and exhaust system. The room air conditioners are designed to operate on 230 volts single phase A.C supply and are available from 0.5 to 3 tone capacity. It consists of cooling, heating; ventilation modifies the condition of air.

2. Experimental details

This is working under the principle of temperature conduction in metals. In this there are two different types of temperatures to achieve our goal therefore to transfer those energies two different pipelines were installed in between the circuit of the gas flow line.

The copper tubes are coiled inside the stainless steel tanks for achieving the conduction of heat and cold from the condenser coil and the evaporator unit. When the ac starts to run then automatically the two different parts of tubes will transfer the temperature to the liquids (water) which is filled in the stainless steel tank.

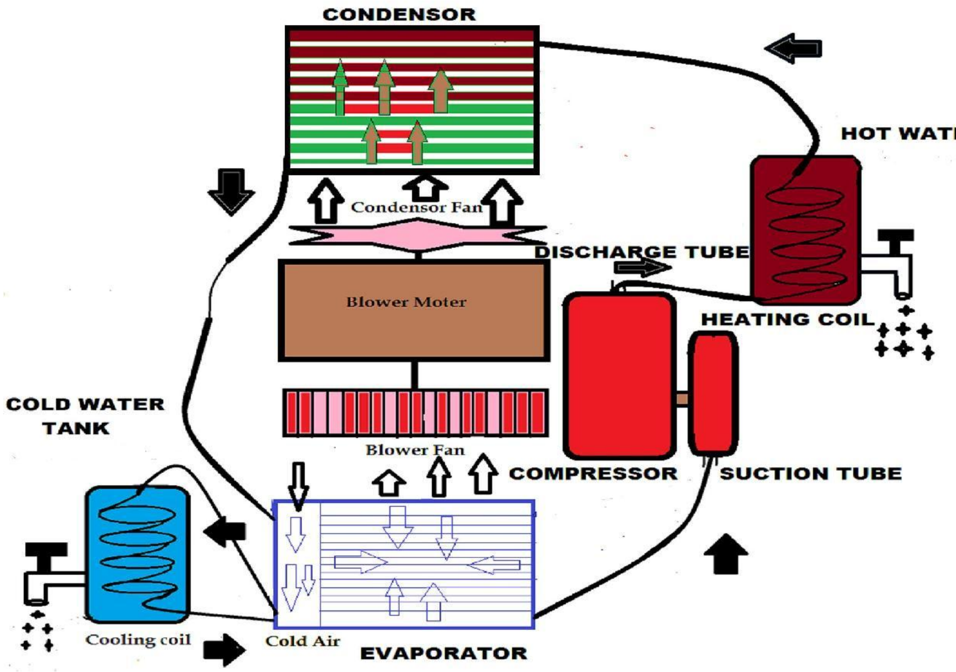

Fig. 1: Block Diagram

3. Working concept

In this system the gas get compressed with the help compressor due to high compression the gas get heated and becomes pressurized, then the hot high compressed gas passes through the heating coil which is present inside the hot water stainless steel container, in that container the water absorb some amount of heat and then the hot compressed gas passes through the condenser.

Inside the condenser condensation of the gas takes place, due to condensation the hot compressed gas get cooled and get semi liquefied, this semi liquefied cool pressurized gas passes through the expansion bulb.

Inside the expansion bulb the high pressurized gas undergoes sudden expansion due to sudden expansion the gas get further cooled. Then the cool gas gets liquefied and passes through the cooling coil which is present inside the cooling tank and through the evaporator.

The blower fan helps to blow the cool air from the evaporator to the room after this process the cool gas get heated to certain temperature and passes into the compressor for compress the gas, then the process get repeated. In this process the gas is carried out with the help of 1/8 inch copper pipe.

4. Heating and cooling calculations

4.1. Cooling capacity

Step 1: Find the volume of your room in cubic feet. This is done by measuring the length, width and height of the room in feet and multiplies all the three dimensions together.
Volume = Width×Length×Height (cubic feet)
Width = 10 feet
Length = 10 feet
Height = 10 feet
Volume = 1000 cubic feet

Step 2: Multiply volume by 6 because every time the on/off type of compressor starts to run, its power consumption is 6 times higher than when it is running steadily.
C1 = volume×6
C1 = 1000×6
C1 = 6000 BTU/hr

Step 3: Estimate the number of people is N that will usually occupy this room. Each person produces about 500BTU/hr of heat for normal office related places
Consider N= 6
C2 = N×500BTU/hr
C2 = 6×500BTU/hr
C2= 3000BTU/hr

Step 4: Estimated cooling capacity needed = C1+C2 (BTU/hr) = 6000+3000 = 9000 BTU/hr.

4.2. Existing air conditioner calculation

4.2.1. Cop calculations

Condenser inlet temperature = 80°C
Condenser outlet temperature = 60°C
Evaporator inlet temperature = 5°C
Evaporator output temperature = 15°C

4.2.2. COP heating

$$\text{COP heating} = \frac{T_{hot}}{T_{hot} - T_{cold}}$$

$$= \frac{(80+273)^{\circ}\text{C}}{(80+273)-(5+273)}$$

$$= 4.706$$

$$\text{COP cooling} = \frac{T_{cold}}{T_{hot} - T_{cold}}$$

$$= \frac{(5+273)^{\circ}\text{C}}{(80+273)-(5+273)}$$

$$= 3.7066$$

4.3. Relation between COP, EER and SEER

EER = COP × 3.413
SEER = COP × 3.792
SEER = EER ÷ 0.9

4.3.1. Energy efficient ratio

EER = COP ×3.413
= 3.706 ×3.413
= 12.648

4.3.2. Seasonal energy Efficient Ratio

SEER = EER ÷ 0.9
= 12.648 ÷ 0.9
= 14.053

4.4. Modified air conditioning calculation

4.4.1. Cop calculations

Condenser inlet temperature = 78°C
Condenser outlet temperature = 56°C
Evaporator inlet temperature = 8°C
Evaporator output temperature =13°C

4.4.2. COP heating

$$\text{COP Heating} = \frac{T_{hot}}{T_{hot} - T_{cold}}$$

$$= \frac{(78+273)^{\circ}C}{(78+273)-(8+273)}$$

$$= 5.014$$

4.4.3. COP cooling

$$\text{COP cooling} = \frac{T_{cold}}{T_{hot} - T_{cold}}$$

$$= \frac{(8+273)^{\circ}C}{(78+273)-(8+273)}$$

$$= 4.014$$

4.5. Energy efficient ratio

EER= COP ×3.413
=4.014×3.413
=13.699

4.6. Seasonal energy efficient ratio

SEER= EER ÷ 0.9
=13.699 ÷ 0.9
=15.221

Table 1: Comparison between Existing and Modified A/C

S. No	Elements To Be Calculated	Existing Air Conditioner Values	Modified Air Conditioning Values
1	Cop Heating	4.706	5.014
2	Cop Cooling	3.706	4.014
3	Eer	12.648	13.699
4	Seer	14.053	15.221

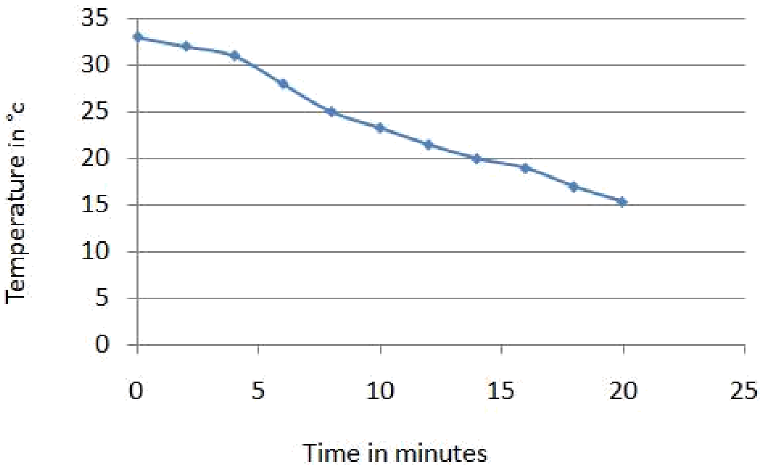

Fig. 2: Cooling Effect of Water

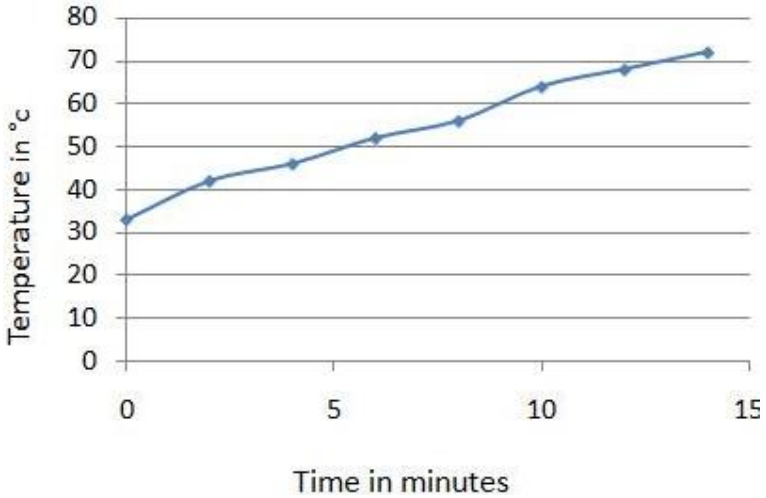

Fig. 3: Cooling Effect of Water

Fig. 4: Model

5. Conclusion

This system helps in power consumption of future generation because of three in one process used to avoid unwanted power consuming machines in the large scale industries. It can be easily used in all small scale industries, shopping malls, Theaters, hospitals etc. The temperature of Hot water can be produced 75°C at 20minutes as well as Cold water can be produced 15°C at 20minutes. By using “Waste Energy Recovery in Window Air Conditioning System” Co-efficient of performance increased from 3.706 to 4.014

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