Pranav.VK al. International Journal of Recent Research Aspects ISSN: 2349-7688, Vol. 4, Issue 4, Dec 2017, pp. 134-139

Fabrication of Year Round Air Conditioner by Using Solenoidal Valve

Pranav.VK [1], Gowrishankar.K [2], Balasubramanian.T [3], C.Ramesh Kumar[4]

[1,2,3] UG Scholar, [5] Assistant Prof

Department of Mechanical, Sengunthar College of Engineering

Abstract- **The purpose of year round air conditioner is to make two in one equipment at constant temperature irrespective of ambient temperature .The cold air producing at temperature of 19°C to 27°C for the person who is working in hot environment, by using the summer air conditioner. The hot air is producing at 24°C to 35°C for the people who are working at cold circumstances, using winter air conditioner. In this year round air conditioner machine, two weather conditions are possible and the conditions are operated by solenoid valve. It is a multipurpose unit and portable one .it work under normal VCR system. Thermostatic switch, which is used to controlled the refrigerant. An evaporator and blower are fixed in front of air conditioner. At the same time condenser and fan are equipped on the rear of air conditioner. Then solenoid valves are fixed as per requiring position. The capacity of air conditioner is 1.5 TR. The atmospheric air is observed by an air conditioner, and blowed out hot and cold air as per requisition. It can be used for domestic purpose. The power consumption of the system is very minimum and space is less.**

I. INTRODUCTION

Introduction to Air Conditioning

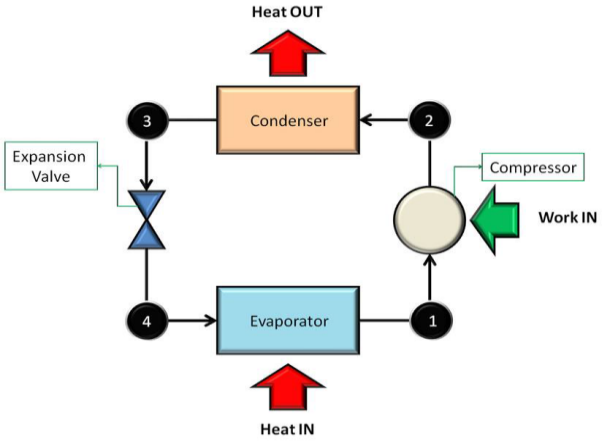
With the development of society and economy, living standard of people is improving, and higher living conditions are demanded. So, more attention is paid towards treating the indoor Air for the comfort of the occupants .Apart from comfort air conditioning required for comfort of persons, air conditioning is also used to provide conditions that some industrial processes Require. Merely lowering or raising the temperature does not provide comfort in general to the machines or its components and living beings in particular. In case of the machine Components, along with temperature, humidity also has to be controlled and for the comfort of human beings along with these two important parameters, air motion and cleanliness also play a vital role. Air conditioning, therefore, is a broader aspect which looks into the simultaneous control of all mechanical parameters which are essential for the comfort of human beings or animals or for the proper performance of some industrial or scientific process. The precise meaning of air conditioning can be given as the process of treating air in an internal environment to establish and maintain required standards of temperature, humidity, air movement and air cleanliness for the health and comfort of the occupants, for product processing, or both. In some applications, even the control of air pressure falls under the purview of air conditioning. Depending upon the requirement, air conditioning is divided into the summer air conditioning and the winter air conditioning. In the summer air conditioning, apart from cooling the space, in most of the cases, extra moisture from the space is removed, whereas in the winter air conditioning, space is heated and since in the cold places, normally the humidity remains low, moisture is added to the space to be conditioned. The summer air conditioning thus uses a refrigeration system and a dehumidifier. The winter air conditioning uses a heat pump (refrigeration system operated in the reverse direction) and a humidifier. Depending upon the comfort of the human beings and the control of environment for the industrial products and Processes, air conditioning can also be classified as comfort air conditioning and industrial air Conditioning. Comfort air conditioning deals with the air conditioning of residential Buildings, offices spaces, cars, buses, trains, airplanes, etc. Industrial air conditioning Includes air conditioning of the printing plants, textile plants, photographic products, computer rooms, etc.

Working Principle of Air Conditioning System

There are many methods to implement air conditioning, such as the vapour compression refrigeration process and the absorption refrigeration system. The most common method in practice is the vapour compression refrigeration process. Simple vapour compression refrigeration cycle consists of four main components, which are cooling coil or evaporator, compressor, condenser and an expansion valve as shown in figure.

In this process, warm air is forced to pass through an evaporator coil where air is cooled by a low-temperature two-phase refrigerant in the coil. If the evaporator surface temperature is lower than the air dew-point temperature, the air is dehumidified by the coil. The heat, which is transferred from warm air, changes the refrigerant from liquid to vapour. The compressor removes the low temperature and low pressure refrigerant vapour from the evaporator coil and discharges that vapour at a high temperature and high pressure to a condenser. In the condenser, the heat of the refrigerant is removed by a coolant, which often is water or air, causing the refrigerant to return to a liquid state at that high pressure. The high pressure liquid refrigerant passes through a throttling device and becomes a low pressure and low temperature two-phase, vapour plus liquid, state refrigerant. The refrigerant then passes into 5 the evaporator to cool and to dehumidify warm air. After heat and mass are transferred, the lower

temperature and lower humidity air is sent to the air conditioned space to balance heat and humidity load of air conditioned space. It should be observed that the system operates on a closed cycle. The system requires input in the form of mechanical work. It extracts heat from a cold space and rejects heat to a high temperature heat sink. This refrigeration system can also be used as a heat pump, in which the useful output is the high temperature heat rejected at the condenser. Alternatively, a refrigeration system can be used for providing cooling in summer and heating in winter.

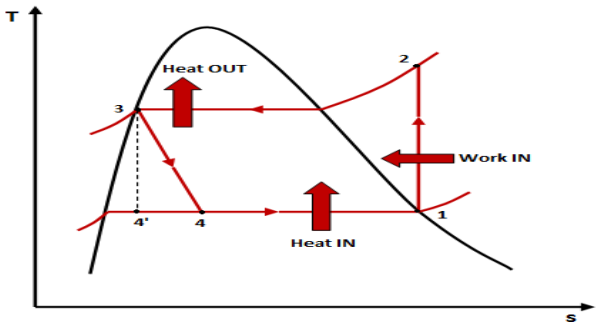


Schematic of a Vapour Compression Refrigeration Cycle

Based on figure ideal vapour compression refrigeration cycle consists of four processes:

1-2 isentropic compression in compressor
2-3 Constant-pressure heat rejection in a condenser
3-4 Throttling in an expansion device
4-1 Constant-pressure heat absorption in an evaporator

Figure shows the T-s diagram for the ideal vapour compression refrigeration cycle. The refrigerant enters the compressor at state 1 as saturated vapour and is compressed isentropically to the condenser pressure. During the isentropic compression process the temperature of the refrigerant increase to well above the temperature of the surrounding medium. The refrigerant then enters the condenser as superheated vapour at state 2 and leaves as saturated liquid at state 3, as result of heat rejection to the surrounding. The temperature of the refrigerant at this state is still above the temperature of the surroundings. The saturated liquid refrigerant at state 3 is throttled to the evaporator pressure by passing it through an expansion valve. During this process the temperature of the refrigerant drops below the temperature of the refrigerated space. The refrigerant enters the evaporator at state 4 as a low-quality saturated mixture, and it completely evaporates by absorbing heat from refrigerated space. The refrigerant leaves the evaporator as saturated vapour and reenters the compressor, completing the cycle.



T-s Diagrams for the Ideal Vapour Compression Refrigeration Cycle

Refrigeration Cycle

Vapour compression refrigeration cycle is the most widely used in the window air conditioning system. Figure shows the basic refrigeration cycle. Refrigeration is produced by continuously circulating, evaporating, and condensing a fixed supply of refrigerant in a closed system. The evaporation occurs at a low temperature and low pressure while the condensation occurs at a high temperature and high pressure. Thus it is possible to transfer heat from an area of low temperature (conditioned space) to an area of high temperature (outdoor space).

Beginning the cycle at the evaporator inlet, the low pressure liquid absorbs heat, and evaporates, changing to a low pressure vapour at the evaporator outlet. The compressor pumps this vapour from the evaporator, increases its pressure, and discharges the high pressure vapour to the condenser. In the condenser, heat is removed from the vapour as it condenses and becomes a high pressure liquid. Between the condenser and the evaporator, an expansion device is located. The flow of refrigerant into the evaporator is controlled by the pressure differential across the expansion device. As the high pressure liquid refrigerant enters the evaporator, it is subjected to a much lower pressure due to the suction of the compressor and the pressure drop across the expansion device. The refrigerant tends to expand and evaporate. In order to evaporate, the liquid must absorb heat from the air passing over the evaporator, and the cycle is repeated.

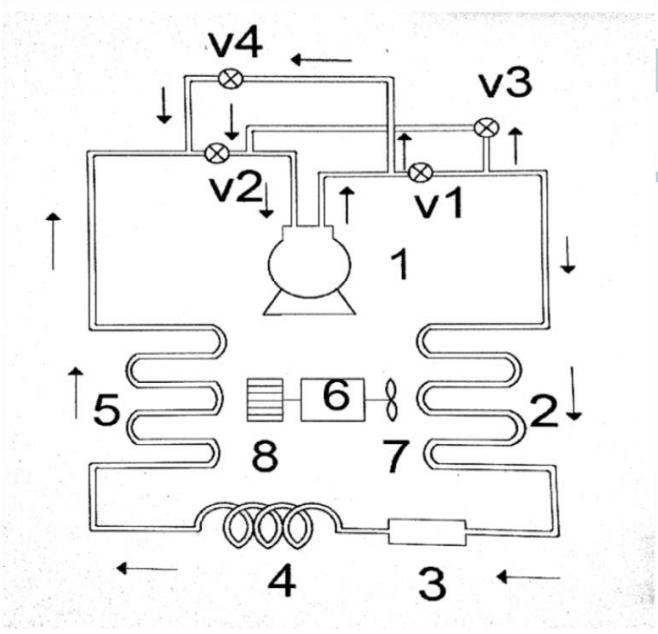
2. LITRERATURE REVIEW

S. C. Kaushik et al. (2011) proposed the idea of utilizing the waste heat from the industrial refrigeration and air conditioning system for drying or food processing sector by simply introducing a Canopus heat exchanger with existing system. There is a considerable amount
of low-grade heat available in large-capacity systems. To recover this low-grade heat, it is suggested to introduce a Canopus heat exchanger between compressor and condenser components. The system feasibility is studied with various operating parameters and its effect on heat recovery factor and overall COP of the system. It is shown that this CHE, in spite of increasing overall COP of the system, does not affect the COP of system. Hence, heat recovery through Canopus heat exchanger is feasible and can be maximized by selecting optimum water flow rate, inlet water temperature, suitable operating conditions, and working fluid. Also the parametric

results obtained for different eco-friendly working fluids, such as
R-134a and R-507a, have been presented. It is also concluded that for the same operating conditions, the R-134a yield better performance as compared to R-507a. The Canopus heat exchanger options for heat recovery for low evaporator temperature R-134a giving higher
heat removal factor whereas R-507a giving higher heat removal factor at higher temperature
Shankar Kumar et al 2014 worked on the actual position of equipment used in year round air conditioning system. They also studied about the parameters on which the systems depends.The performance of air conditioning equipment. They reported a full numerical model for the concurrent forecast of velocity, temperature and humidity of air flowing in air conditioning unit. The efficient methodology to design modified evaporative air cooler for winter air conditioning in Baghdad city. The performance is reported in terms of effectiveness, saturation efficiency, outlet temperature of air and cooling capacity. The technology of desiccant humidification and evaporative cooling. It evaluates the status of rotary desiccant dehumidification and air conditioning system in the following two aspects; (1) improvement of advanced desiccant materials and (2) optimization of system arrangement .The study about actual evaporating cooling method.

3. COMPONENTS AND DESCRIPTION

DESIGN LAYOUT



COMPONENTS

1. COMPRESSOR
2. CONDSER
3. FILTER
4. CAPILLARY TUBE
5. EVAPORATOR
6. MOTOR
7. CONDENSER FAN
8. AC BLOWER

(V1, V2, V3, V4)-Solenoid valves

COMPRESSOR:

The AC compressor's function is to transfer and compress gas from the low-pressure (intake) side of the ac system to the high pressure (discharge) side of the closed system. The ac compressor draw the refrigerant (while in gas state) from the ac evaporator, where it has gathered heat from your room interior. It then compresses the gas refrigerant under high pressure and sends it off to the ac condenser once the hot compressed gas enters the condenser.

Specification
Refrigerant: R22
Input Power: 1925W
Type: Rotary Compressor

CONDENSER:

The compressor generates compressed gas and sends it along to the top of the condenser, where the gas begins to cool. The gas continues to cool and condense as it makes it way through the serpentine-like coil arrangements, before exiting the bottom of the condenser as a high-pressure liquid. The condenser is usually located in backside of the air conditioner.

Specification
Style: Fin coil
Blue fin: Inner grooved copper tube
Dimension: 18x13x4 Inch

FILTER:

Air conditioning system utilizes a receiver drier to extract moisture from the system. The receiver drier is used on AC systems which make use of on expansion valve to control refrigerant flow and is located on the high-pressure side of the system, between compressor ad the condenser.
The receiver drier stores a portion of the system's refrigerant and contains moisture absorbing substance to remove any moisture the system may become contaminated.

Specification
Material: copper
Copper tube diameter: 1/8"

CAPILLARY TUBE:

Capillary tube regulates the amount of liquid refrigerant flowing from the condenser to the evaporator based upon the evaporator pressure. A thermal expansion valve will include a temperature sensor and meters the amount of refrigerant flowing to the evaporator.

Specification
Material: Brass
Shape: Round
Outside diameter: 1.5mm
Length: 90cm

EVAPORATOR:

The AC evaporator serves in multiple capacities, but it's function is to absorb heat which may have built upon a hot day inside your rooms interior. The evaporator contains cold Freon gas. The cold Freon gas passes through the evaporator and makes the evaporator very cold. The AC blower fan is located behind the evaporator and blows air across it and that cold air travels through the dash duct work and out the vents inside the room.

Specification

Style: Fin coil
Tube material: Copper
Dimension: 18x13x4 Inch

MOTOR:

In AC motor there is a ring of electromagnets arranged around the outside, which are design to produce a rotating magnetic field inside the stator, there is a solid metal action, a loop of wire, a coil, a squirrel gauge made of metal bars. The current flow around it in a loop, the coils is energized in pairs in sequence producing a magnetic field that rotates the outside of the motor.

Specification

Speed: 920 rpm
Power: 1/8 HP
Power supply: 230 volts, 1.0 A , 50HZ

CONDENSER FAN:

The AC condenser fans job is to assist in cooling the hot compressed gases supplied by the compressor as they pass through the condenser .The function of the condenser, is also to supply additional cooling. In the event the condenser fan is not operating as intended or ceased to function at all, your system will not operate efficiently. Air flow over the condenser is essential. Inoperative fans will cause higher than normal side pressure

Specification

Material: Plastic
Type: Axial fan
Dimension: 172x150x55 mm

AC BLOWER:

The ac blower motor works in conjunction with the evaporator to remove heat and cool your room interior. It is usually located underneath the dash and connected to the ducting where it pulls in the warm air from the interior and pushes it across the cool coils and fins of the evaporator and send the cold air back to the room interior.

Specifications

Material: Plastic
Type: Ring type
Noise level: 73-DBA

SOLENOID VALVE:

A solenoid is simply a type of electromagnet consisting of coil insulated copper wire. Solenoid valve are mostly used to control the flow of liquids or gases. A solenoid valve is controlled by electric current which is run through a coil. The coil is energized creating a magnetic field causing a plunger inside the coil to move. It is necessary to start or stop flow in the refrigerant circuit to automatically control the fluids in the system.

Specification

Size: 3/8 Inch, 2/2 way.
Pressure: 40 bar
Drive: AC solenoid

5. EXPERIMENTAL WORK

SELECTION OF SOLENOID VALVE:

Solenoid valve are mostly use to control the flow of liquid or gas. A solenoid valve is to controlled by electric current which is run through a coil. Each coil is energized by electrical power supply. Input and output port of the solenoid valves are connected to the system. Due to the connections of valve we attained the required output. For required temperature and pressure in the system are maintained using solenoid valve.

CONSTRUCTION AND WORKING:

At the exit of evaporator valve V2 is fixed. At the exit of the compressor valve V1 is fixed. From the outlet of valve V1 connected the input port of valve V3. From outlet port of valve V3 the copper tube is connected to the outlet port of valve V2. From the inlet port of valve V1 the copper tube is connected to the input port of valve V4. From the outlet of valve V4 the copper tube is connected to the inlet port of valveV2.the refrigerant is flows over this wall by operating the respective operations.

The window air conditioner is switched on . Foe summer air conditioning normal vapour compression refrigeration cooling cycle takes place i.e the low pressure low temperature refrigerant flows to the compressor from the evaporator then the compressor compress the refrigerant to high pressure , high temperature .Then the refrigerant flows to the condenser ,the heat is rejected and phase changes occurs. Then medium pressure low temperature refrigerant flows through capillary tube and here pressure is reduced. The refrigerant flows to evaporator here heat is absorbed, phase change occurs and cooling is given to the closed phase. For winter air conditioning the evaporator act as condenser and the condenser act as a evaporator by operating respective solenoid valves. It works under reverse vapour compressor cycle. The refrigerant flow in the system is controlled by open and closing of the solenoid valves which are operated by electrical power supply.

Solenoid valves V1 & V2 – open normal VCR cooling system.

Solenoid valve V3 & V4-open heating cycle.

MERITS:

Comparing with HVAC it is smaller in size
It occupy only mini-space.
Maintenance work of the system is a easiest one.
Electrical problem does not occur because mechanical solenoid valves are used.
Normal air conditioning part are not used so it leads to reduce the cost like,
PC board
Duct

Heating
Cooling coil
APPLICTION:
Hill stations
Homes resorts
Hospitals offices
Offices

6. CONCLUSION

After going through the thermo dynamic analysis of year round air conditioning system of solenoid valve the following conclusions are made. The analysis of year round air conditioning system depends up on operation of solenoid valves. The refrigerant is used in the system to make comfort and cool in closed space. By using the solenoid the required temperature is achieved. There main aim of the project is to reduce the cost and more economical it is simple process for manufacturing this type of air conditioner it is safe while comparing to another type of air conditioner current consumption is less. This type of air conditioner achieves the temperature near to the ordinary air conditioner it has two rival properties of cool air and hot air obtained in the system by controlling the valves. There is need of giving solenoid valve to obtained year round air conditioner as both purpose are solved in a single unit

REFERENCES

[1] Arora, C P. (2000). Refrigeration and air conditioning. West Patel Nagar: Tata McGraw-Hill Publishing Company Limited.

[2] Beshkani, A., Hosseni, R., Numerical modeling of rigid media evaporative cooler. Applied Thermal Engineering, 2007, vol(26),pp(636-643).

[3] Bhatti, M.S, 1999,"Evolution of Automation Air Conditioning," ASHRAE Journal, 30-49, September.

[4] Camrago, J. R., Ebinuma,C.D.,Siveria,J.L., Experimental performance of a direct evaporating cooler operating during summer in Brazilian city. International Journal of Refrigeration,2005,vol(28),pp(1124-1132).

[5] Dowdy, J.A., Karbash,N.S., Experimental determination of heat and mass transfer coefficient, in rigid impregnated cellulose evaporative media. ASHRAE transaction, 1987,vol (93), pp(382-395).

[6] Fatemech Esfandiari Nia, Dolf Van Paassen, Mohamad Hassan Saidi, Modeling and Simulation of desiccant wheel for air conditioning. Energy and Buildings,2006,vol(38),issue- 10,pp(1230-1239).

[7] Gomez,E.V.,Martinez,F.C.R.,Gonzalez,A.T.,The phenomena of evaporating cooling from a humid surface as an alternative method for air conditioning. International Journal of Energy and Environment, 2010,vol (1), pp (549-563).

[8] Hasson, Z.H., Hanash, Z.H., Experimental Investigation of Evaporative air cooler for winter air conditioning in Baghdad. Al-khwarizmi Engineering journal, 2012, vol (8), pp (62-73).

[9] Hosnoz, M., & Direk, M. (2006). "Performance evaluation of an integrated automotive air conditioning and heat pump system". Energy Conversion & Management, 47, 545-559.

[10] Jurinak,J.j.,Mitchell,J.W.,Beckman,W. A.,Open-cycle desiccant air conditioning as an alternative to vapour compression cooling in residential application. Transactions of the ASME,1984, vol(106),pp(252-258).

[11] Kang, T.S., Maclain-cross, I.L., High performance solid desiccant cooling cycles. Transaction of ASME,1989, vol(111),pp(176-183).

[12] Kulkarni, R.K., Rajput, S.P.S., Comparative performance of evaporating cooling pads of alternative materials. International journal of advanced engineering science and technology,2008, vol(10),pp(239-244).

[13] R. S. Khurmi, J. K. Gupta, Refrigeration And Air Conditioning, S Chand publications.

[14] La,D.,Dai.,Y.J.,Li.,Wang,R.L., Technical development of rotary desiccant dehumidification and air conditioning . A review, Renewable and sustainable energy reviews, vol(14),pp(130-147), (2010).

[15] Manohar Prasad,Refrigeration and Air conditioning,2nd ed ., New Age International(p) Limited,Publishers,New Delhi,2003.

[16] Mariappan.A.C, K.Krishnamoorthy and S.Mareeswaran, "An Examination Surface Morphology And In Situ Studies of Metal Dusting Leads To External Pits on Astm A516Gr 60 Steam Coil of Water Seal Drum Exposed To Flare Gas In Mtbe Plant"

International Journal of Advanced Research in Engineering & Technology (IJARET), Volume 4, Issue 4, 2013, pp. 84 - 95, ISSN Print: 0976-6480, ISSN Online: 0976-6499.

[17] Moukalled, F., Verma,S.,Darwish ,M.,The use of CFD for Predicting and optimizing the performance of air conditioning equipment. International journal of heat and mass transfer,2011, vol (54), pp (549-563).

[18] Gomez,E.V.,Martinez,F.C.R.,Gonzalez ,A.T.,The phenomena of evaporating cooling from a humid surface as an alternative method for air conditioning. International Journal of Energy and Environment, 2010,vol (1), pp (549-563).

[19] Nia,F.E.,Paasen ,Dolfvan.,Saidi,M.H., Modeling and simulation of desiccant wheel for air conditioning .Energy and building ,2006,vol(38),pp(130-147).

[20] Scofield, Paul C. (1949).Air Cycle Refrigeration. Refrigerating Engineers, 57, [558-563, 611-612].

[21] Shankar Kumar, S.P.S. Rajput, and Arvind Kumar, (2014). Thermodynamic Performance Analysis of Year Round Air Conditioning System. International Conference on Industrial, Mechanical and Production Engineering: Advancements and Current Trends(IC IMPACT-2014), November 27-29, Organized by MANIT Bhopal and Co-Sponsored by TEQIP-11

[22] Velasco Gomez.E, F.C. Rey Martinez, A. Tejero Gonzalez, The Phenomenon of evaporative cooling from a humid surface as an alternative method for air-conditioning. International Journal of Energy and Environment,2010, vol (1), pp (69-96).

[23] Waugaman, D.G., et al, A Review of Desiccant Cooling System. Energy Recourses Technology Journal,1993, vol (15), pp (1-8).

[24] Zhang, L.Z., Niu, J.L., Performance comparison of desiccant wheel for air dehumidification and enthalpy recovery. Applied Thermal Engineering,2002, vol (22), pp (1347-1367).

