Design And Fabrication Portable AC With Cooling Chamber

[1]i.Saichandu, [2]Mr. K. Sainath ,[3]T. Kishen Kumar Reddy, [4]Suresh Akella
[1]M.Tech. Student, Department of CAD/CAM, Sreyas Institute of Engineering & Technology, Hyderabad
[2]Assistant Professor, Department of Mechanical Engineering, Sreyas Institute of Engineering & Technology, Hyderabad
[3]Professor of Mechanical Engg& Former Rector Jawaharlal Nehru Tech University Hyderabad
[4]Principal & amp; Professor in MED, Author Sreyas Institute of Engg&Technology, Nagole,Hyderabad

Abstract- *The current project looks into creating a product which gives the user the comfort of two devices in one system. The basic advantage of the system is that two components run on a single compressor. The system is so formed that most of the refrigerant is moved to the air conditioning system and rest of the refrigerant is moved to cooling chamber thus producing maximum cooling through air conditioner and required cooling to the products through cooling chamber.*

Keywords- Compressor, Condenser, Evaporator, Coefficient of Performance, compressor inspection, cooling chamber.

I. INTRODUCTION

The present dissertation is aimed at manufacture and assembly of vertical portable air conditioner. Nowadays people are facing problem of using restricted air conditioner which is confined to single room like split air conditioner so we have develop a solution in which the air conditioner can be move one place to another place conveniently without much effort. Also we have an advantage of just rotating and adjust back frame in order make it work as heat pump which can be changed accordingly to the season or place where climatic conditions are unpredictable.

The use of air conditioners, popularly known as AC, has become almost compulsory in number of homes and houses. In fact there are number of people who just can't live without AC, they will need AC in their room, office, car, theatre and almost everywhere as there are a number a number of heat sources like electric equipments, also the heat generated by our body due to the metabolic activity and to maintain purity of air, humidity content in order to meet human comfort conditions.

The heat extracted from the air is vented through an air duct that you install in an open window. The unit also condenses water from the air while cooling, collecting this in a tank or draining it away via a tube. Dryer air feels more comfortable and enhances the cooling effect. A venting kit is included so you can seal the gap around the duct to stop the cool air escaping.

II. LITERATURE SURVEY

Heat as always been a problem in every country such as india. Doing work in a hot summer day can be tiring and are prone to make silly and unwanted mistakes. Vertical Mobile air conditioning systems are used across all transport modes including cars, buses, trucks and trains to keep drivers comfortable and cool while driving safely. This product is design with wheel which make it easier to move and install. With the simplest installation procedure, anyone can easily install the air conditioner to wherever they are desired [1]

Air-Conditioning cum Water dispenser system is a unique combination of air-cycle and water-cycle into a single unit. The project is mainly developed to modify the multifunctional unit which can provide cold water and hot water by using regular air conditioning system. Here we are using the refrigerant as the medium which is used to absorb & removes heat from the space which is to be cooled and rejected heat is arrested by condenser and it is used to heat the water i.e. geyser. This system may consist of compressor, condenser, evaporator, expansion valve, solenoid valve, reversing valve, copper tubes, heating and cooling thermostats. Here we used a single compressor to compress air cycle and water cycle. [2]

Now-are-days air conditioners are very commonly used. The AC produces comfort conditions in which the human beings tend to feel highly comfortable. In these conditions the working efficiency of the human beings becomes maximum. Broadly it is very easy to understand that we need AC because the surrounding temperature is very high. We used roll bond evaporator, also known as surface plated evaporators in our experiment to lower the temperature as this creates the cooling effect in the air conditioner. We used r-134a, r-22 refrigerants to compare the cooling effect in the refrigerant. [3]

A Mobile air conditioner is features component that designed vertically. Vertical air conditioner is portable and also used in windows that give cooling to the entire room. It observes the air from outside. They are sometime referred to as “casement” unit and refer to freestanding industrial units that are typically used in office building. Vertical air conditioner is designed to cool the person and small room also. Portable air conditioner is an innovation product originally from standard air conditioner that is limited to be used in room or inside building. Then, it is design to make it easier to move from one place to another. This product is design looks like a decoration tree which people mostly use it as an decoration in outdoor event such as wedding and talk. As we all notice that Malaysia has a tropical rainforest climate due to its proximity to the equator. It is hot and humid country all year round, with an average temperature of 27 °C (80.6 °F) and almost no variability in the yearly temperature.[4]

III. COMPONENTS

Air Conditioner

Air conditioners often use a fan to distribute the conditioned air to an occupied space such as a building or a car to improve thermal comfort and indoor air quality. Electric refrigerant-based AC units range from small units that can cool a small bedroom, which can be carried by a single adult, to massive units installed on the roof of office towers that can cool an entire building. The cooling is typically achieved through a refrigeration cycle, but sometimes evaporation or free cooling is used. Air conditioning systems can also be made based on desiccants (chemicals which remove moisture from the air) and subterraneous pipes that can distribute the heated refrigerant to the ground for cooling.

Air conditioning cycle

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. The refrsigerant is used as the medium which absorbs and removes heat from the space to be cooled and subsequently rejects that heat elsewhere.

Modern air conditioning systems are not designed to draw air into the room from the outside; they only recirculate the increasingly cool air on the inside. Because this inside air always has some amount of moisture suspended in it, the cooling portion of the process always causes ambient warm water vapour to condense on the cooling coils and to drip from them down onto a catch tray at the bottom of the unit from which it must then be routed outside, usually through a drain hole. As this moisture has no dissolved minerals in it, it will not cause mineral buildup on the coils. This will happen even if the ambient humidity level is low. If ice begins to form on the evaporative fins, it will reduce circulation efficiency and cause the development of more ice, etc. A clean and strong circulatory fan can help prevent this, as will raising the target cool temperature of the unit's thermostat to a point that the compressor is allowed to turn off occasionally. A failing thermistor may also cause this problem. Refrigerators without a defrost cycle may have this same issue. Dust can also cause the fins to begin blocking air flow with the same undesirable result: ice.

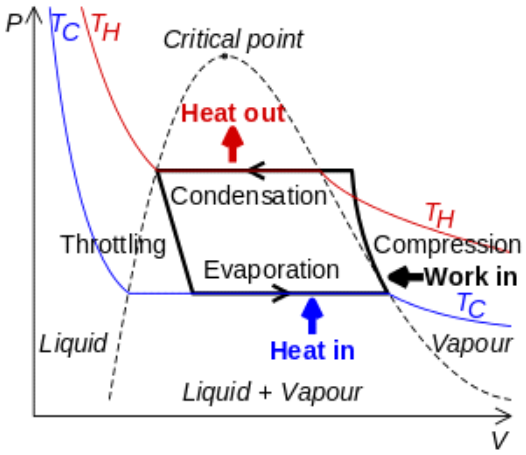

Figure 1: PV Diagram of VCRS

Part1: Compression

In this stage, the refrigerant enters the compressor as a gas under low pressure and having a low temperature. Then, the refrigerant is compressed adiabatically, so the fluid leaves the compressor under high pressure and with a high temperature.

Part 2: Condensation

The high pressure, high temperature gas releases heat energy and condenses inside the "condenser" portion of the system. The condenser is in contact with the hot reservoir of the refrigeration system. (The gas releases heat into the hot reservoir because of the external work added to the gas.) The refrigerant leaves as a high pressure liquid.

Part 3: Throttling

The liquid refrigerant is pushed through a throttling valve, which causes it to expand. As a result, the refrigerant now has low pressure and lower temperature, while still in the liquid phase. (The throttling valve can be either a thin slit or some sort of plug with holes in it. When the refrigerant is forced through the throttle, its pressure is reduced, causing the liquid to expand.)

Part 4: Evaporation

The low pressure, low temperature refrigerant enters the evaporator, which is in contact with the cold reservoir. Because a low pressure is maintained, the refrigerant is able to boil at a low temperature. So, the liquid absorbs heat from the cold reservoir and evaporates. The refrigerant leaves the evaporator as a low temperature, low pressure gas and is taken into the compressor again, back at the beginning of the cycle.

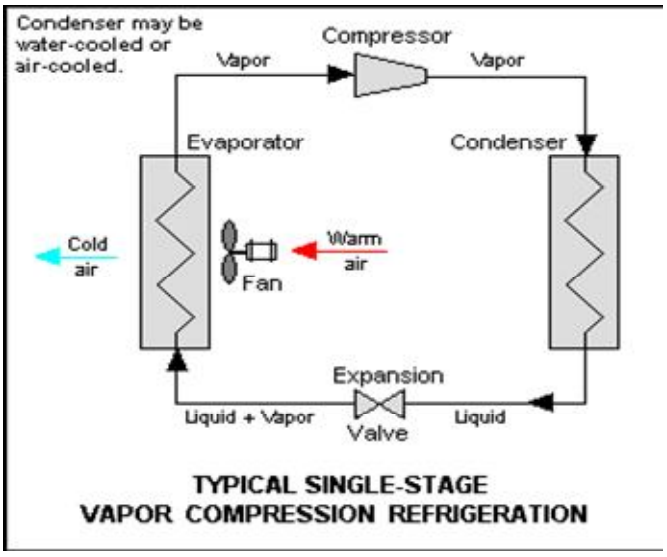

Figure 2: Typical single stage VCRS

Components and inspection

Rotary compressors are 'high pressure shell' type compressors. The suction on these compressors is taken directly into the compression chamber. Gas compressed in the compression chamber is discharged into the compressor casing. It should be noted that from a cold start-up, high pressure shell type compressors take longer to reach their normal operating pressure in the compressor shell. This is partly due to the larger volume of the compressor casing and partly as a result of refrigerant being trapped in the oil. Any refrigerant in the oil has to completely evaporate before condensing pressure can reach its operating level.

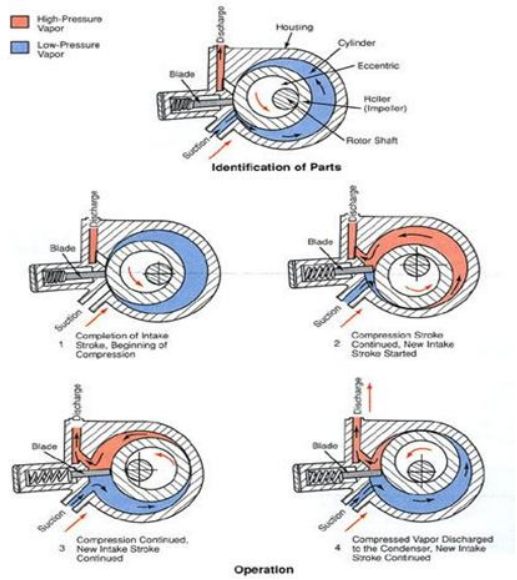

Figure 3: Operation of rotary compressor

Roll bond evaporator

Roll bonding is a solid state, cold welding process, obtained through flat rolling of sheet metals. In roll bonding, two or more layers of different metals are passed through a pair of flat rollers under sufficient pressure to bond the layers. The pressure is high enough to deform the metals and reduce the combined thickness of the clad material. The mating surfaces must be previously prepared (scratched, cleaned, degreased) in order to increase their friction coefficient and remove any oxide layers. The process can be performed at room temperature or at warm conditions. In warm roll bonding, heat is applied to pre-heat the sheets just before rolling, in order to increase their ductility and improve the strength of the weld. The strength of the rolled bonds depends on the main process parameters, including the rolling conditions (entry temperature of the sheets, amount of thickness reduction, rolling speed, etc.), the pre-rolling treatment conditions (annealing temperature and time, surface preparation techniques, etc.) and the post-rolling heat treatments

Evaporator

Evaporators are one of the main reasons why refrigeration, and therefore air conditioning, became practical for use in both home and industrial cooling. Simply put, an evaporator allows a contained pressurized liquid to turn into a gas. Evaporators allow a contained pressurized liquid into gas.

Analysis of Roll bond evaporator

Analysis of roll band evaporator ANSYS provides a complete simulation workflow for the design of composite structures. This process is very similar to the manufacturing process:

- Definition of base materials, fabrics and predefined stackups [layups]
- Intuitive definition of material orientation based on geometric attributes
- Global and local ply definition as when fabrics are laid onto a mold
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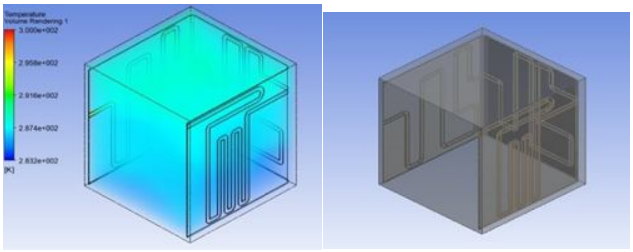


Once the model has been setup, loads and boundary conditions are defined on the geometry and composite failure solutions can be computed. Then specific tools are available to analyze the potential failure of the product being designed:

Finally, the impact of design changes such as geometric variations can be easily investigated to understand the sensitivity of a design to such variations.

Mounting of compressor

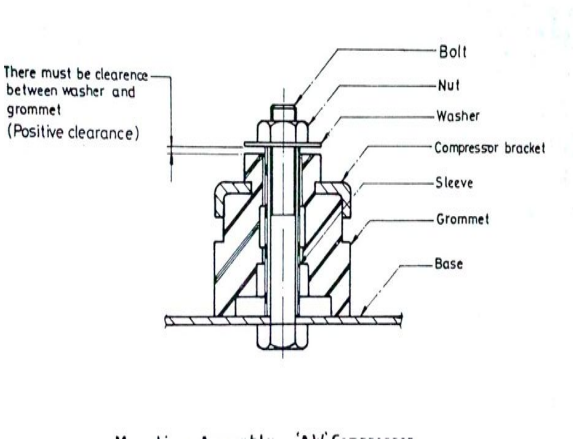


Figure : Mounting Of Compressor

It is therefore recommended that only correct type of grommets & sleeves be used. Use of grommets without sleeves will defeat the purpose of keeping the compressor floating. This will result in the transmission of compressor vibration to the appliance.

The internal spring suspension provide in Tecumseh AW compressors absorbs most of the vibration of the reciprocating mass. However, it is necessary to provide specially designed rubber grommets on compressor legs to absorb the residual vibrations

The arrangement shown below ensures that the compressor remains floating after mounting in position.

IV. TESTING OF THE SYSTEM

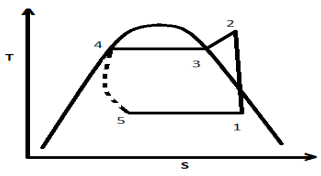
Leak testing of coils

Due to severe jolts in transportation there is every possibility of leaks developing in the brazed joints of coils. In order to detect these leaks & rectify them before further processing, leak test under a pressure of 20-25kg/cm with dry/commercial nitrogen has to be done. As these condenser/evaporator coils are small in size, it is suggested that the pressurised coil is dipped in clear water to detect leaks. The coils are to be kept immersed in water for at least 1minute to detect minute leaks. If no leaks are found the coil is then processed further.

Operating Instructions

Use vacuum-pump oil in the pump when new. After 5 to 10 h of running time, change the oil. Make sure all of the original oil is removed from the pump. Thereafter, change the oil after every 30 h of operation when the oil becomes dark due to suspended solids drawn into the pump. Such maintenance will ensure peak efficiency in the pump operation.

If the pump has been operated for a considerable time on regular pump oil, drain the oil and replace with dual-purpose vacuum-pump oil. Drain the oil and re- place with dual purpose after 10 h of operation. The oil will probably be quite dark due to sludge removed from the pump. Operate the second charge of oil for 10 h and drain again. The second charge of oil may still be dark. However, it will probably be lighter in colour than the oil drained after the first 10 h.



T-S diagram of the system

Below is technical data observed from refrigeration cycle data book based on the readings.

Pressure	v_f	v_g	h_f	h_g	h_{fg}	S_f	S_g
4.37	0.000771	0.0536	40.19	25.30	210.11	0.1591	0.9396
11.690	0.000849	0.0200	82.96	261.37	178.41	0.3069	0.8977

Technical data

Readings got from testing the system

Test readings

As observed the discharge gas is in super-heated region so the calculations are base on the superheated region

$h_2 = h_3 + C_{pg}(T_2-T_3)$

$= 150.37+1.142\ (325-302)$

$h_2 = 176.636$ kj/kg

$S_1 = S_2$

$S_{f1} + x_1 S_{fg} = S_{g2} + C_{pg} \log_e (T_2/T_1)$

$0.159+X_1\ (0.93-0.15) = 0.89+1.14\ (325/295)$

$0.159+ X_1\ (0.78) = 0.89 +1.25$

$X_1 = 0.93$ (dryness fraction)

$h_1 = 176.636+0.93\ (250.3-40.1) = 372.122$ kj/kg

Work done $= h_2 – h_1$

$= 372.122-176.636$

$= 195.486$ kj/kg

Refrigeration effect $= h_2 – h_5$

$= 176.636- 82.96$

$= 93.676$ kj/kg

Refrigeration effect $= h_1-h_5$

$= 372.122-82.97$

$= 289.162$ kj/kg

$$\text{Coefficient of performance} = \frac{\text{Refrigeration effect}}{\text{Work done}}$$

$= 289.$

C.O.P = 3.08

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