CONVERSION OF A SIMPLE BLADELESS STANDING FAN INTO A SPLIT AIR CONDITIONER

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Dedication

We dedicate this project work and constructions to our **PARENTS**

Acknowledgement

In the name of Allah (S.W.T,) the Most Gracious and the Merciful. Praise is to Allah, Lord of the Universe and Peace; Prayers be upon to His Final Prophet and Messenger Muhammad (S.A.W.)

We would like to take this opportunity to sincerely express our highest gratitude to our supervisor **Prof. Dr. Md. Nurul Absar Chowdhury** for his patience, guidance, personal materials and ideas through the completeness of this project.

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Finally, special thanks extended to our beloved family who had given us moral support and prayers for our success.

Certification

This is to certify that the thesis entitled conversion of a simple bladeless standing fan into a split air conditioner submitted by "Mustapha Murtala and Othman Alnajjar" to the Islamic University of Technology for the award of the degree of Bachelor of Science. It is a bona fide record of project work carried out by them under my supervision. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

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Abstract

In this project, Conversion of a simple blade less standing fan into a split air conditioning system is aimed, A split air conditioning imply means that the condenser (or sometimes referred to as the “outdoor unit”) is separated from the “indoor unit”, thus the term “split”. The separation of the two different part, splitting or bisecting the units into two: for the fan section it consist of (i) small vents at the base where air is being sucked (ii) the air is propelled through 3mm and slit in the frame 55mph. (iii) air passes over and airfoil is shaped ramp which channels it is direction, air intake. (iv) as it is pushed out at the surrounding air is drawn into the airflow in making the volume because there are no motor blades. For the air conditioning section, a copper connection pipe and electrical wiring connects the indoor unit to the outdoor unit of the split air conditioning. Gas refrigerant is pumped from the outdoor condenser coil and compressor through the connection pipe to the indoor unit or units. A fan then quietly distributes cool air drawn across the unit's evaporator coil. The main objective of this project is to convert a simple bladeless standing fan into a split air conditioning system and make use of it perfectly without any obstructions, High Electric supply and convenient to be moving around from one place to another comfortably.

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CHAPTER I

INTRODUCTION

Air conditioning system is the process of altering the properties of air (primarily temperature and humidity) to more favorable conditions. More generally, air conditioning can refer to any form of technological cooling, heating, ventilation or disinfection that modifies the condition of air.

An air conditioner (often referred to as air con, AC or A/C and not to be confused with the abbreviation for alternating current).

It is a major home appliances or mechanism designed to change the air temperature and humidity within an area (used for cooling and sometimes heating depending on the air properties at a given time).

The cooling is typically done using a simple refrigeration circle but sometimes evaporation is used commonly for comfort cooling in buildings and motor vehicles. In construction a complete system of heating ventilation and air conditioning is referred to as “HVAC”.

Air conditioning can also be provided by a simple process called free cooling which uses pumps to circulate a coolant (typically heat sink for the energy that is removed from the cooled space).

Free cooling system can have a very high efficiency and are sometimes combined with seasonal thermal energy storage (S.T.E.S) so the cold of the winter can be used for summer air conditioning. Common storage mediums are deep aquifers or natural underground rock mass accessed via cluster of small diameter, heat exchanger equipped boreholes. Sometimes with small storages are hybrids, using free cooling early in the cooling season and later employing a heat pump to chill the circulation temperature of the storage gradually increase during the cooling season, thereby declining in effectiveness free cooling and hybrid system are mature technology.

The cost consists of the initial construction cost and later on the maintenance and operating cost which usually increases with time due to failure or fall of efficiency or replacement of parts.

The intention of this project was to study and learn the working principles, design and construction of a split air conditioning system so as to present a comprehensive working knowledge on it from both design and practical points of view.

The construction of split air conditioning system involves various lab activities such as fabrication, welding, etc.

Initially the required material, machinery and devices had been listed and purchased. Then a spacious and secure open space was selected where the system was to be constructed. Next the system components were assembled together and they were all connected and joined to form the complete and air conditioning system.

Types of air conditioner

1. Window air conditioner
2. Split air conditioner
3. Packaged air conditioner
4. Central air conditioner

1.1 Split air conditioner

A split air conditioning imply means that the condenser (or sometimes referred to as the “outdoor unit”) is separated from the “indoor unit”, thus the term “split”. i.e. The separation of the two different parts, splitting or bisecting the units into two

1.1.1 Advantages of a split air conditioner

1. Controllable comfort
2. Reduction of humidity
3. Silent operation
4. Banishments of nuisance insects
5. Eliminate external noise pollution
6. Improvement of security from outdoor activities
7. Improvement of air quality
8. Reduction of energy bills
9. Convenient heat exactly when you need it
10. Air-conditioning systems can promote the growth and spread of microorganisms

1.2 Brief history of air conditioning system

The basic concept behind air conditioning is to have been applied in the ancient Egypt where reeds were hung in the windows and were moistened with trickling water. The evaporation of water blowing through the window, this process also made the air more humid (also beneficial in dry desert climate).

In ancient Rome water from aqueducts was circulated through the walls of certain houses to cool them down. Other techniques in medieval Persia involved in using cisterns and wind towers to cool buildings in hot seasons.

Modern air conditioning advances in chemistry during the 19th century and the first large-scale electrical air was invented and used in 1902 by Willis Haviland Carrier.

The introduction of residential air conditioning is done in the 1920's helped enable the great migration to the Sun Belt in the US.

The 2nd century chemist inventor Ding Huan (FL 180) of the Hung Dynasty invented a rotary fan for air conditioning with 7 wheels 3m (9.8ft) in due and manually powered.

They continued with (Liang Tian) to build imperial palace which tang yulin describes having water powered fan wheels for air conditioning system.

In 17th century Cornelis Drebbel demonstrated turning summer into winter for James I of England by adding salt to water.

In 1758 Benjamin Franklin and John Henley a chemistry professor of Cambridge conducted an experiment to explore the principle of evaporation as a means of rapid cooling an object. They confirmed that evaporation of highly volatile liquids such as alcohol and ether could be used to drive down the temperature of air, object past the freezing point of water.

Moreover base on mechanical cooling, In 1820, British scientist and inventor Michael Faraday discovered that compressing and liquefying ammonia could chill air when the liquefied ammonia was allowed to evaporate. In 1842, Florida physician John used compressor technology to create ice, which he used to cool air for his patients in his hospital in Apalachicola, Florida. He hoped eventually to use his ice-making machine to regulate the temperature of buildings. He even envisioned centralized air conditioning that could cool entire cities. Though his prototype leaked and performed irregularly, Gorrie was granted a patent in 1851 for his ice-making machine. His hopes for its success vanished soon afterwards when his chief financial backer died; Gorrie did not get the money he needed to develop the machine. According to his biographer, Vivian M. Sherlock, he blamed the "Ice King", Frederic Tudor, for his failure, suspecting that Tudor had launched a smear campaign against his invention. Dr. Gorrie died impoverished in 1855, and the idea of air conditioning faded away for 50 years

James Harrison's first mechanical ice-making machine began operation in 1851 on the banks of the Barwon River at Rocky Point in Geelong (Australia). His first commercial ice-making machine followed in 1854, and his patent for an ether vapor-compression refrigeration system was granted in 1855. This novel system used a compressor to force the refrigeration gas to pass through a condenser, where it cooled down and liquefied. The liquefied gas then circulated through the refrigeration coils and vaporized again, cooling down the surrounding system. The machine employed a 5 m (16 ft.) flywheel and produced 3,000 kilograms (6,600 lb) of ice per day.

Though Harrison had commercial success establishing a second ice company back in Sydney in 1860, he later entered the debate over how to compete against the American advantage of unrefrigerated beef sales to the United Kingdom. He wrote Fresh Meat frozen and packed as if for a voyage, so that the refrigerating process may be continued for any required period, and in 1873 prepared the sailing ship Norfolk for an experimental beef shipment to the United Kingdom. His choice of a cold room system instead of installing a refrigeration system upon the ship itself proved disastrous when the ice was consumed faster than expected. Then Electromechanical is In 1902, the first modern electrical air conditioning unit was invented by Willis Carrier in Buffalo, New York. After graduating from Cornell University, Carrier, a native of Angola, New York, found a job at the Buffalo. While there, Carrier began experimenting with air conditioning as a way to solve an application problem for the Sackett-Wilhelms Lithographing and Publishing Company in Brooklyn, New York, and the first "air conditioner", designed and built in Buffalo by Carrier, began working on 17 July 1902.

Designed to improve manufacturing process control in a printing plant, Carrier's invention controlled not only temperature but also humidity. Carrier used his knowledge of the heating of objects with steam and reversed the process. Instead of sending air through hot coils, he sent it through cold coils (ones filled with cold water). The air blowing over the cold coils cooled the air, and one could thereby control the amount of moisture the colder air could hold. In turn, the humidity in the room could be controlled. The low heat and humidity helped maintain consistent paper dimensions and ink alignment. Later, Carrier's technology was applied to increase productivity in the workplace, and The Carrier Air Conditioning Company of America was formed to meet rising demand. Over time, air conditioning came to be used to improve comfort in homes and automobiles as well. Residential sales expanded dramatically in the 1950s.

In 1906, Stuart W. Cramer of Charlotte, North Carolina was exploring ways to add moisture to the air in his textile mill. Cramer coined the term "air conditioning", using it in a patent claim he filed that year as an analogue to "water conditioning", then a well-known process for making textiles easier to process. He combined moisture with ventilation to "condition" and change the air in the factories, controlling the humidity so necessary in textile plants. Willis Carrier adopted the term and incorporated it into the name of his company. The evaporation of water in air, to provide a cooling effect, is now known as evaporative cooling.

Evaporative cooling was the first real air-conditioning and shortly thereafter the first private home to have air conditioning (The Dubose House) was built in Chapel Hill, North Carolina. Realizing that air conditioning would one day be a standard feature of private homes, particularly in the South, DuBose designed an ingenious network of ductwork and vents, all painstakingly disguised behind intricate and attractive Georgian-style open moldings. Meadowmont is believed to be one of the first private homes in the United States equipped for central air conditioning.

1.3 Objectives of the Project

The main objective of this project is to convert a simple bladeless standing fan into a split air conditioning system and make use of it perfectly without any obstructions, High Electricity supply and convenient to be moving around from one place to another comfortably.

CHAPTER II

REVIEW OF RELEATED LITERATURE

2.1 Refrigeration and Air Conditioning System

Refrigeration and air conditioning system is one of the greatest engineering achievements of the 20th century. Air conditioning is the heating, cooling, dehumidification, humidification, ventilation, and sterilization of air. The refrigeration process removes heat from an enclosed space to reduce and maintain the temperature for the contents of that space. While air conditioning regulates the air in a large building, refrigeration solely cools and is generally used in a smaller space. Both innovations make the human population, including myself, significantly more comfortable and happy. So now we know air conditioning system and refrigeration system are similar.

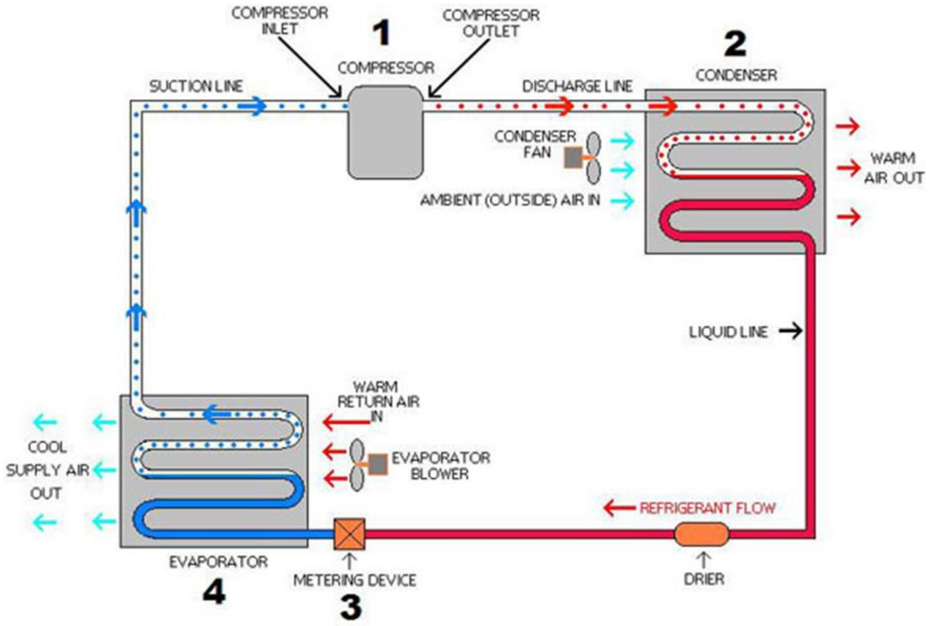


Figure 2.1: Air Conditioning System

The most common, and arguably most important, use for refrigeration is food preservation. It used to be that people had to go to a market every day and buy fresh groceries before they perished. Early methods of food preservation such as cold cellars and salting were expensive, difficult to regulate, and didn’t maintain the same quality as what we are used to today. After the discovery of bacteria the importance of refrigeration became clear. Low temperatures slow chemical and biological processes including bacterial growth which spoils food. Modern refrigeration provides an environment too cold for harmful bacteria to flourish, keeping people healthy.

With contemporary refrigeration units I can buy lunch meat on Sunday and have it last all week long. A reliable method for keeping foods cold means I have to shop less frequently. It also allows for foods to be frozen and eaten out of season. Even if I ran out of my frozen fruits and vegetables, I could also buy out-of-season edibles from a place where they are in-season. Foods can be refrigerated and transported across the country and across the world. This means that I can now have a more diverse diet than what is grown in my area. Current refrigeration technology has changed our diets and lifestyles to be more diverse and healthy.

Refrigeration, especially at very low temperatures, has had an incredible impact on the medical world as well. Human tissue deteriorates quickly when it is not supported by a body. Organ transplants have had a much higher success rate since we started cooling the transported organs. Sperm and egg donation wouldn’t be possible without a way to preserve the cells. My dad is a doctor, and works at a sperm bank. Without refrigeration he wouldn’t have a job and there would be many potential parents without children. Many modern technologies rely on the ability to cool products.

Industry uses cooling in several processes. Many of the metallic products I use every day are hardened through a cooling refrigeration process. The forks I eat with, the car components I drive, the hole punchers, fan blades, containers, hinges, and so many other helpful products are solidified by refrigeration. Industry also liquefies gases and controls reaction time of chemical processes with refrigeration. It is used for many purposes that enhance my day to day life.

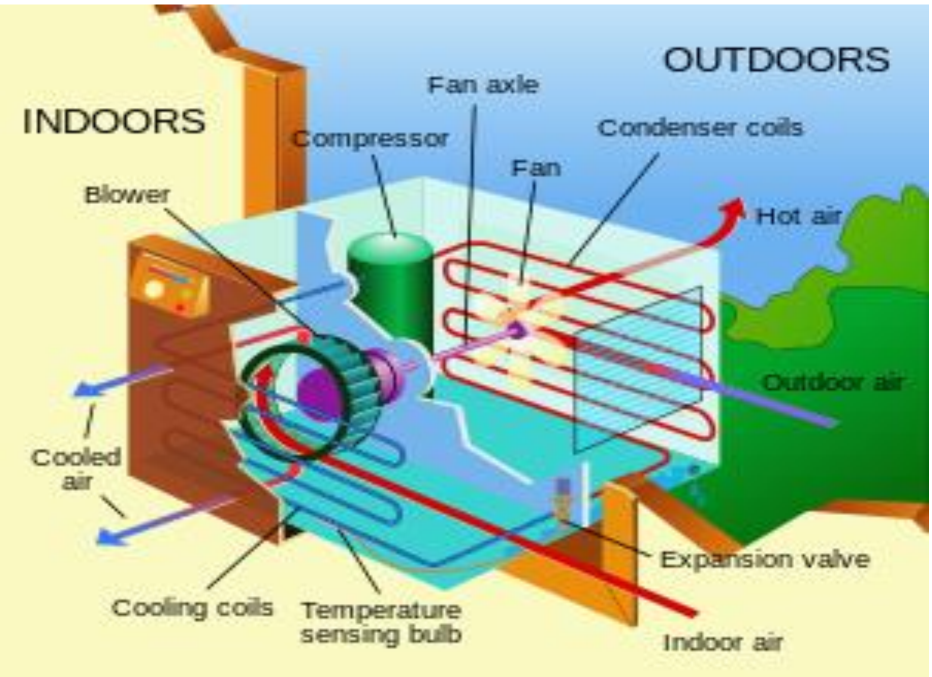
With modern air conditioning the temperature of a room, building, or structure can be easily modified. The most important implication of this ability is that it allows people to live more comfortably in harsh climates. I grew up in Boston where there is constant snow on the ground all winter long. Personally, I enjoy a temperature of about 72° F, no matter the season. With present day systems I can inexpensively maintain such a temperature in my house. During summer months, air cooling preserves the technical devices that I use. Air temperature systems are also crucial aboard both the airplanes I fly in and the space craft that make discoveries I am interested in. At high altitudes or with the lack of an atmosphere temperatures drop significantly. If it weren’t for air temperature control I wouldn’t be comfortable in my New England home or traveling to far away destinations.

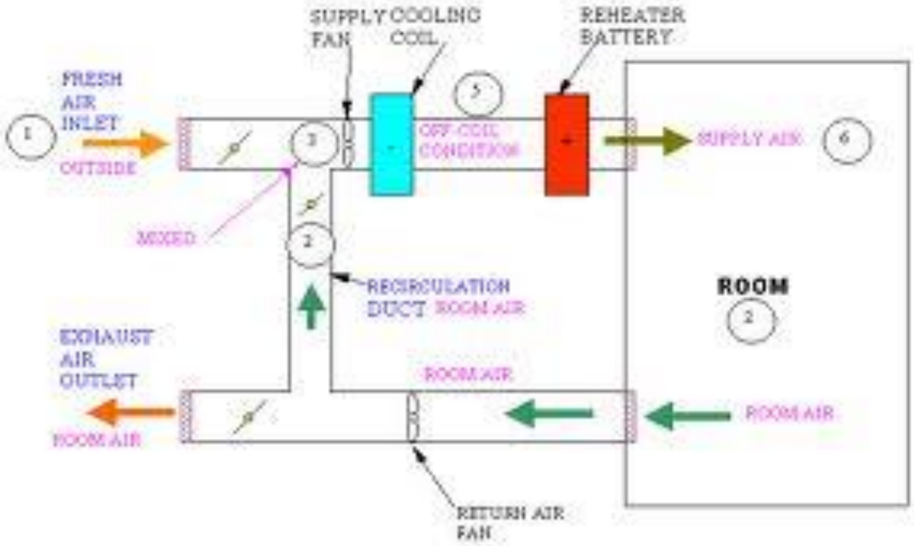
Humidity is another air condition that people sense very easily. A more humid environment makes me feel better when I am sick and have a congested nose. It also keeps skin hydrated. At other times, it is important to reduce air moisture as much as possible. Most museums I go to preserve sensitive artifacts in dry spaces. Moisture can damage fragile papers and fabrics. Regulating humidity can relieve symptoms of sickness and protect creations we appreciate.

The development of ventilation seriously improved indoor air quality. Good ventilation is important to remove dangerous fumes. When I painted the bookshelves in my room we let the ventilation system clear out the smell until it was safe to be in there. Moving air prevents the build-up and growth of molds that can be dangerous to people's health. New ventilation procedures also changed the 20th century's architecture. Contemporary buildings have become taller, gone underground, and require fewer windows than they used to. Fresh new air is crucial for a pleasurable environment and it is now much more available.

Not only does air conditioning bring in new air, but it also cleans that air. People living in crowded cities experience air pollution frequently. A filtration system removes pollution, along with other .burdens from outdoors. For people with allergies, such as myself, it is incredibly helpful to have an air conditioning unit that removes pollen. Some modern air conditioning systems filter out these allergens and pollution. A simple filter can do a lot. The lack of pollen and pollution is a difference I can feel and greatly appreciate.

Air conditioning and refrigeration definitely belong in the most important engineering achievements of the 20th century. The comfort, ease, and happiness they bring to our everyday lives is immeasurable. Food preservation, medicine, and industry would not be what they are today without refrigeration. Air conditioning brings a comfort and environmental flexibility that has impacted people more than they realize. Both technologies make the lives of others and myself far more comfortable and enjoyable.





2.2 Air conditioning system and Refrigeration system

The term refrigeration may be defined as the removing heat from a substance under controlled conditions. It includes the process of reducing and maintaining of a body temperature below the general temperature of it surroundings. In other words the refrigeration means continued extraction of heat from a body whose temperature is already of its surroundings. In a refrigerator, heat is virtually pumped from a lower temperature. According to

2nd law of thermodynamics, this process can only be performed with the aid of some external work. If this is obvious that supply power is regularly required to drive a refrigerator. Theoretically is a reversed heat engine or a heat pump which to extract heat from cold body to deliver it to hot body is known as refrigerant.

In refrigeration. System though it includes industrial refrigeration such as food preservation, Chemical, and process industries.

This includes the following:

- Air conditioning of medium sized and large buildings.
- Industrial air conditioning.
- Residential air conditioning.
- Air conditioning of vehicles.
- Food storage and distribution.
- Food processing some foods needs operation to addition freezing and refrigerated storage.
- Chemical and process industries
- Many other uses of air conditioning and refrigeration span sizes and capacities from small appliances to large industrial scale.

The air conditioning and refrigeration industry are characterized by steady growth. It is a stable industry in which replacement markets join with new applications to to contribute to its health.

The T-s diagram for a vapor-compression refrigeration cycle is shown below.

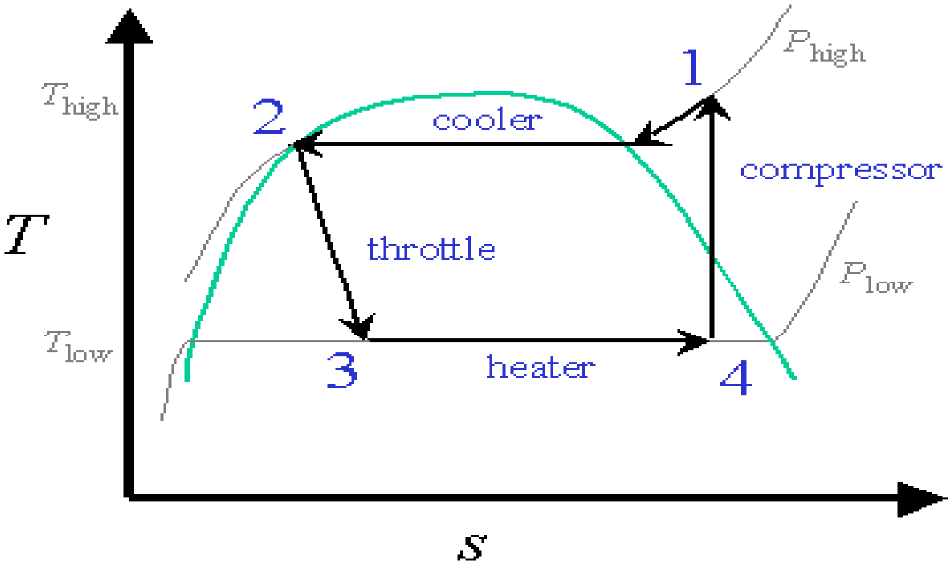


Figure 2.2: vapor-compression refrigeration cycle

An ideal refrigeration cycle looks much like a reversed Carnot heat engine or a reversed Rankine cycle heat engine. The primary distinction being that refrigeration cycles lack a turbine, using a throttle instead to expand the working fluid. (Of course, a turbine **could** be incorporated into a refrigeration cycle if one could be designed to deal with liquids, but the useful work output is usually too small to justify the cost of the device.)

The cycle operates at two pressures, P_{high} and P_{low}, and the state points are determined by the cooling requirements and the properties of the working fluid. Most coolants are designed so that they have relatively high vapor pressures at typical application temperatures to avoid the need to maintain a significant vacuum in the refrigeration cycle.

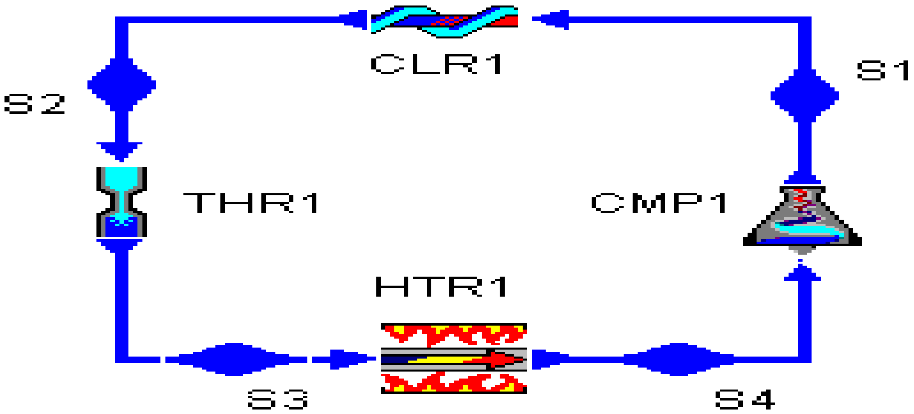


Figure 2.3:

Example Design Constraints

Cooling requirements

For purposes of illustration, we will assume that a refrigeration system used to cool air for an office environment. It must be able cool the air to 15.5°C (about 60°F) and reject heat to outside air at 32°C (90°F).

The working fluid

We have several working fluids available for use in refrigeration cycles. Four of the most common working fluids are available in Cycle Pad: R-12, R-22, R-134, and ammonia. (Nitrogen is also available for very low temperature refrigeration cycles.) We will choose R-22 for this example.

Description of Cycle Stages

We will examine each state point and component in the refrigeration cycle where design assumptions must be made, detailing each assumption. As we can see from the example design constraints, very few numbers need be specified to describe a vapor-compression refrigeration cycle. The rest of the assumptions are determined by applying reasoning and background knowledge about the cycle. The two principle numerical design decisions are determining P_{high} and T_{low}, at the cooler outlet and the compressor inlet.

Cooler (Condenser) inlet (S1)

This state need not involve any design decisions, but it may be important to come back here after the cycle has been solved and check that T_2, which is the high temperature of the cycle, does not violate any design or safety constraints. In addition, this is as good a place as any to specify the working fluid.

Cooler (Condenser): Heat Rejection (CLR1)

The cooler (also known as the condenser) rejects heat to the surroundings. Initially, the compressed gas (at `S1`) enters the condenser where it loses heat to the surroundings. During this constant-pressure process, the coolant goes from a gas to a saturated liquid-vapor mix, then continues condensing until it is a saturated liquid at state 2. Potentially, we could cool it even further as a subcooled liquid, but there is little gain in doing so because we have already removed so much energy during the phase transition from vapor to liquid.

Cooler (Condenser) outlet (S2)

We cool the working fluid until it is a saturated liquid, for reasons stated above. An important design question arises at this state: how high should the high pressure of the cycle be?

We choose P_{high} so that we can reject heat to the environment. P_{high} is the same as P_2, and P_2 determines the temperature at state `S2`, T_2. (T_2 is just the saturation temperature at P_{high}). This temperature must at least be higher than that of the cooling source, otherwise no cooling can occur.

However, if T_2 is too high (that is, higher than the critical temperature T_C for the working fluid), then we will be beyond the top of the saturation dome and we will loose the benefits of the large energy the fluid can reject while it is being cooled. Furthermore, it is often impractical and unsafe to have very high pressure fluids in our system and the higher P_2 we choose, the higher T_1 must be, leading to additional safety concerns. To find an applicable pressure, use the saturation tables to find a pressure which is somewhere between the saturation pressure of the warm air yet still in the saturation region.

For reference, T_C for our four working fluids are given below.

Critical Temperatures of some refrigerants	
substance	T_C (°C)
R-12 (CCL_2F_2)	111.85
R-22 ($CHCLF_2$)	96.15
R-134a (CF_3CH_2F)	101.05
ammonia (NH_3)	132.35

For our example using R-22, we must be able to reject heat to air that is 32°C. We can choose if T_2 to be anywhere between that number and the 96°C T_C. We'll choose it to be 40°C for now.

Figure 3: Vapor-Compression Refrigeration Cycle
COP versus T_{high} in the cooler

The figure above gives a general idea of the improvements we can expect with lower temperatures in the cooler. Keep in mind that the practical limitation here is heat transfer to the surrounding air. While lower temperatures will make the cycle more efficient theoretically, setting T_{high} too low means the working fluid won't surrender any heat to the environment and won't be able to do its job.

2.2.1 Throttling (THR1)

The high-pressure, saturated liquid is throttled down to a lower pressure from state `S2` to state `S3`. This process is irreversible and there is some inefficiency in the cycle due to this process, which is why we note an increase in entropy from state `S2` to `S3`, even though there is no heat transfer in the throttling process. In theory, we can use a turbine to lower the pressure of the working fluid and thereby extract any potential work from the high pressure fluid (and use it to offset the work needed to drive the compressor). This is the model for the Carnot refrigeration cycle. In practice, turbines cannot deal with the mostly liquid fluids at the cooler outlet and, even if they could, the added efficiency of extracting this work seldom justifies the cost of the turbine.

2.2.2 Heater (Evaporator): Heat Absorption (HTR1)

The working fluid absorbs heat from the surroundings which we intend to cool. Since this process involves a change of phase from liquid to vapor, this device is often called the evaporator. This is where the useful "function" of the refrigeration cycle takes place, because it is during this part of the cycle that we absorb heat from the area we are trying to cool. For an efficient air conditioner, we want this quantity to be large compared to the power needed to run the cycle.

The usual design assumption for an ideal heater in a refrigeration cycle is that it is isobaric (no pressure loss is incurred from forcing the coolant through the coils where heat transfer takes place). Since the heating process typically takes place entirely within the saturation region, the isobaric assumption also ensures that the process is isothermal.

Compressor Inlet (S4)

Where do we want S4?

Typically, we want state S4 to be right at the saturated vapor side of the saturation dome. This allows us to absorb as much energy from the surroundings as possible before leaving the saturation dome, where the temperature of the working fluid starts to rise and the (now non-isothermal) heat transfer becomes less efficient.

Of course, we would get the same isothermal behavior if we were to start the compression before the fluid was completely saturated. Further, there would seem to be a benefit in that state point S1 (see Figure 2.3) would be closer to the saturation dome on the P_{high} isobar, allowing the heat rejection to be closer to isothermal and, therefore, more like the Carnot cycle.

It turns out that, for increased efficiency, we can choose S4 such that S1 is on the saturation dome, instead of outside of it in the superheat region. Figure 4 shows the T-s diagrams for two refrigeration cycles, one where S4 is a saturated vapor and the other (in light green) where S4 has been moved further into the saturation dome to allow S1 to be a saturated vapor.

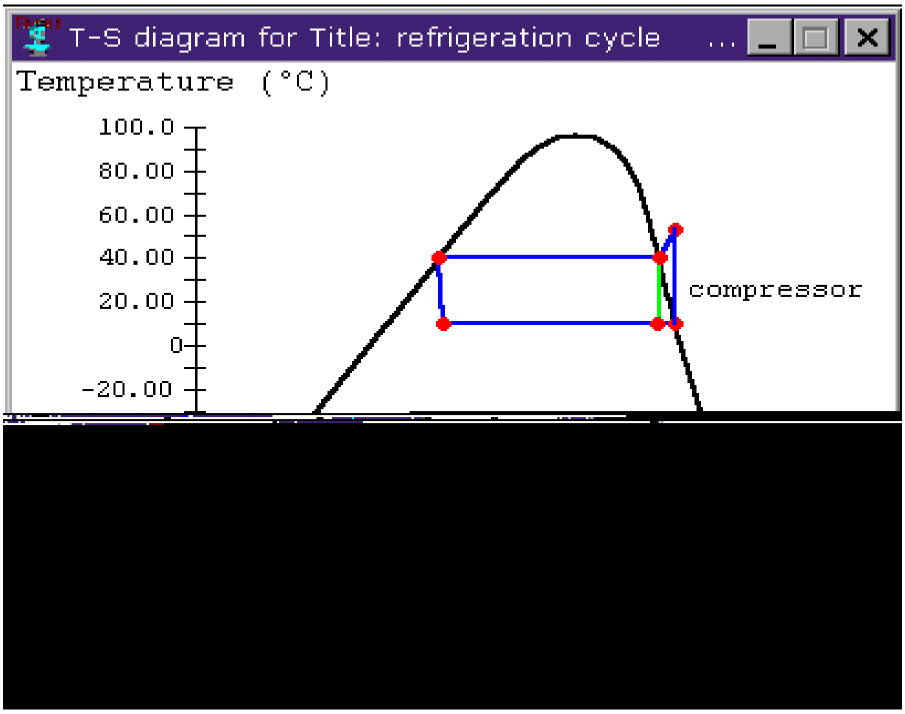


Figure 2.4: T-s diagram for different compressor conditions

The advantage in the second case is that we have reduced the compressor work. We have also reduced the heat transfer somewhat, but the reduced compressor work has a greater effect on the cycle's coefficient of performance. Figure 6 shows the cycle's COP versus the quality of `S4`. We note that the change in COP is noticeable, but not terribly impressive.

Figure 2.5: COP versus compressor inlet quality

However, in setting `S4` below the saturated vapor line, we assume our compressor can work with fluid that is substantially liquid at statepoint `S4`. Since the liquid part of the fluid is incompressible, this is likely to damage the compressor. It is for this reason that we choose the inlet to the compressor to be completely saturated vapor, ensuring that the compressor can do its work entirely in the superheat region. When we are told we have compressors capable of dealing with fluids whose quality is slightly less than 100% (these are sometimes available), we can adjust the position of `S4` to improve cycle efficiency.

2.2.2.1How to choose T_{low}

This brings us to another design issue: Now that we know that `S4` is on the saturated vapor line, where on the line is it? In other words, how low can T_{low} go?

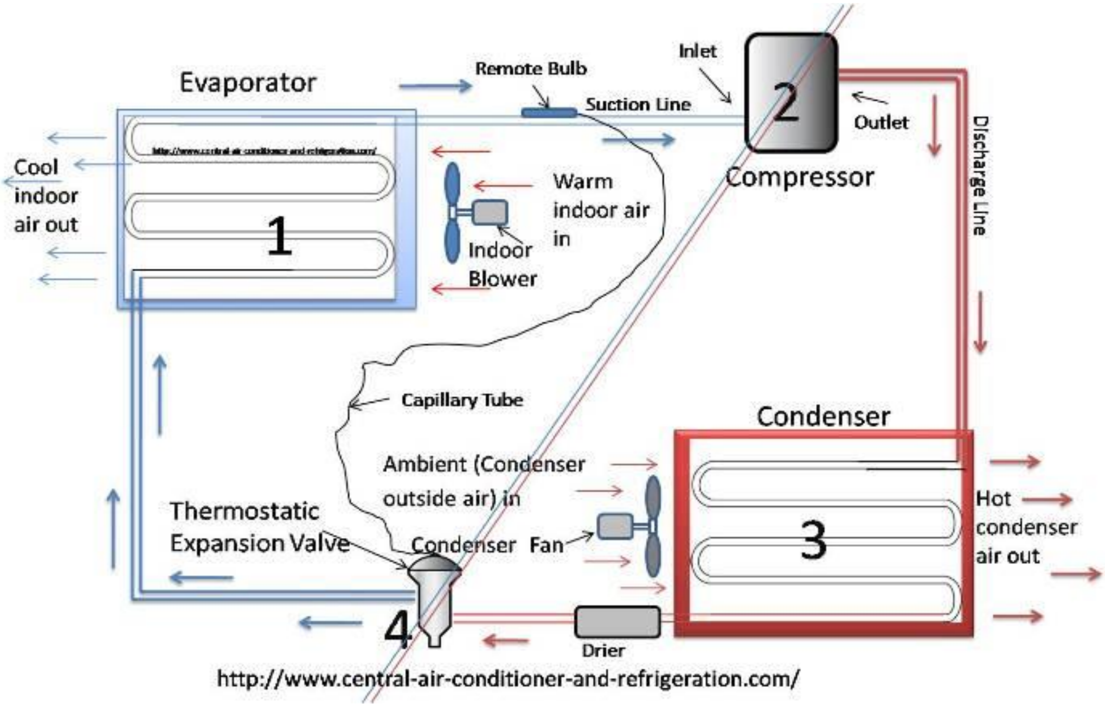
T_{low} occurs within the saturation dome, so it determines P_{low} as well. We know that T_{low} must at least be cooler than the desired temperature of the stuff we wish to cool, otherwise no cooling will occur. An examination of the saturation tables for our refrigerants shows that setting T_{low} at, for instance 15C, still allows for fairly high pressures (4 to 7 atmospheres, typically). So, while this tells us how low P_{low} must be, it does not tell us how low it can be.

There are several major practical considerations limiting P_{low}. Fundamentally, we must concern ourselves with the properties of our working fluids. Examination of the saturation table for R-22 shows that at atmospheric pressure, the saturation temperature is already very cold (about -40°C). For small-scale air-conditioning applications, we have no desire to create a stream of extremely cold air, both due to safety concerns and because cold air holds very little moisture and can be uncomfortably dry. For larger-scale applications, this is less of a concern because we can always mix the cold, dry air with warmer, wetter air to make it comfortable.

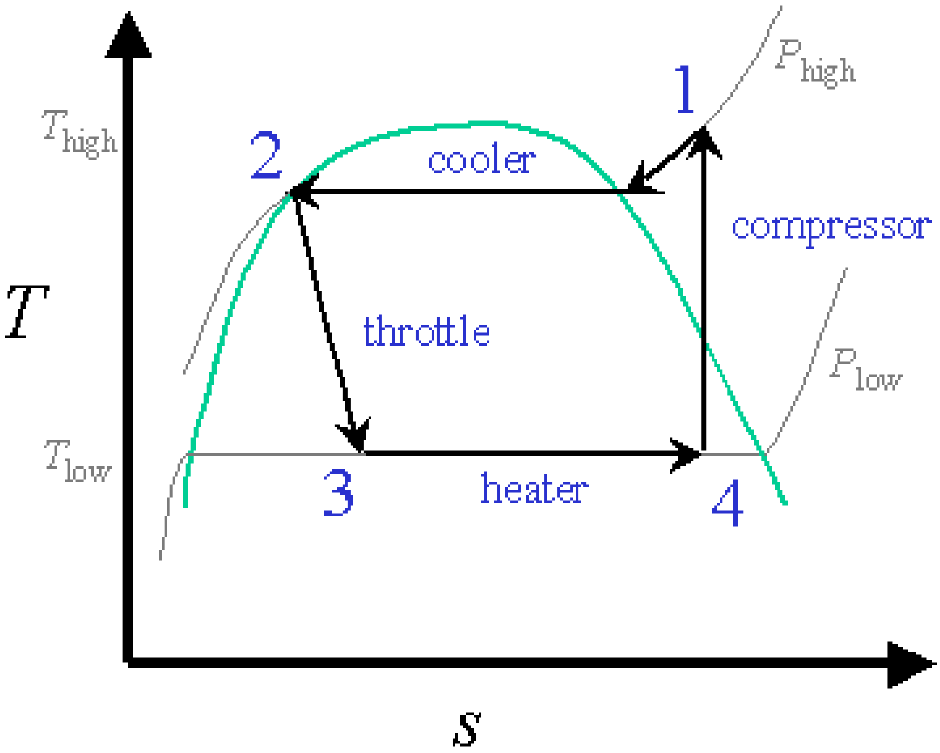
Another hardware consideration is that it is fairly difficult to maintain a very low-pressure vacuum using the same compressor that will achieve high pressure at its outlet. Choosing a T_{low} that results in a P_{low} of 0.1 atmospheres is probably not practical if we intend to have $_{high}$ up near 10 atmospheres.

This brings us to the other reason we cannot make T_{low} too small. Examining Figure 1 again, we see that the lower P_{low} is, the further out to the right (higher entropy) the saturated vapor will be

And in the other hand the T-S diagram of air conditioning is:



Pressure volume diagram is given by



How air conditioning system normally works

A window air conditioner unit implements a complete air conditioner in a small space. The units are made small enough to fit into a standard window frame. You close the window down on the unit, plug it in and turn it on to get cool air. If you take the cover off of an unplugged window unit, you'll find that it contains the following:

- A compressor
- An expansion valve
- A hot coil (on the outside)
- A chilled coil (on the inside)
- Two fans
- A control unit

The fans blow air over the coils to improve their ability to dissipate heat (to the outside air) and cold (to the room being cooled).

When you get into larger air-conditioning applications, its time to start looking at split-system units. A split-system air conditioner splits the hot side from the cold side of the system, as in the diagram below.

The cold side, consisting of the expansion valve and the cold coil, is generally placed into a furnace or some other air handler. The air handler blows air through the coil and routes the air throughout the building using a series of ducts. The hot side, known as the condensing unit, lives outside the building.

The unit consists of a long, spiral coil shaped like a cylinder. Inside the coil is a fan, to blow air through the coil, along with a weather-resistant compressor and some control logic. This approach has evolved over the years because it's low-cost, and also because it normally results in reduced noise inside the house (at the expense of increased noise outside the house). Other than the fact that the hot and cold sides are split apart and the capacity is higher (making the coils and compressor larger), there's no difference between a split-system and a window air conditioner.

In warehouses, large business offices, malls, big department stores and other sizeable buildings, the condensing unit normally lives on the roof and can be quite massive. Alternatively, there may be many smaller units on the roof, each attached inside to a small air handler that cools a specific zone in the building.

In larger buildings and particularly in multi-story buildings, the split-system approach begins to run into problems. Either running the pipe between the condenser and the air handler exceeds distance limitations (runs that are too long start to cause lubrication difficulties in the compressor), or the amount of duct work and the length of ducts becomes unmanageable. At this point, it's time to think about a chilled-water system.

Air conditioners use refrigeration to chill indoor air, taking advantage of a remarkable physical law: When a liquid converts to a gas (in a process called **phase conversion**), it absorbs heat. Air conditioners exploit this feature of phase conversion by forcing special chemical compounds to evaporate and condense over and over again in a closed system of coils.

The compounds involved are **refrigerants** that have properties enabling them to change at relatively low temperatures. Air conditioners also contain fans that move warm interior air over these cold, refrigerant-filled coils. In fact, central air conditioners have a whole system of ducts designed to funnel air to and from these serpentine, air-chilling coils.

When hot air flows over the cold, low-pressure **evaporator coils**, the refrigerant inside absorbs heat as it changes from a liquid to a gaseous state. To keep cooling efficiently, the air conditioner has to convert the refrigerant gas back to a liquid again. To do that, a compressor puts the gas under high pressure, a process that creates unwanted heat. All the extra heat created by compressing the gas is then evacuated to the outdoors with the help of a second set of coils called **condenser coils**, and a second fan. As the gas cools, it changes back to a liquid, and the process starts all over again. Think of it as an endless, elegant cycle: liquid refrigerant, phase conversion to a gas/ heat absorption, compression and phase transition back to a liquid again.

It's easy to see that there are two distinct things going on in an air conditioner. Refrigerant is chilling the indoor air, and the resulting gas is being continually compressed and cooled for conversion back to a liquid again. On the next page, we'll look at how the different parts of an air conditioner work to make all that possible.

2.3 The Parts of an Air Conditioner

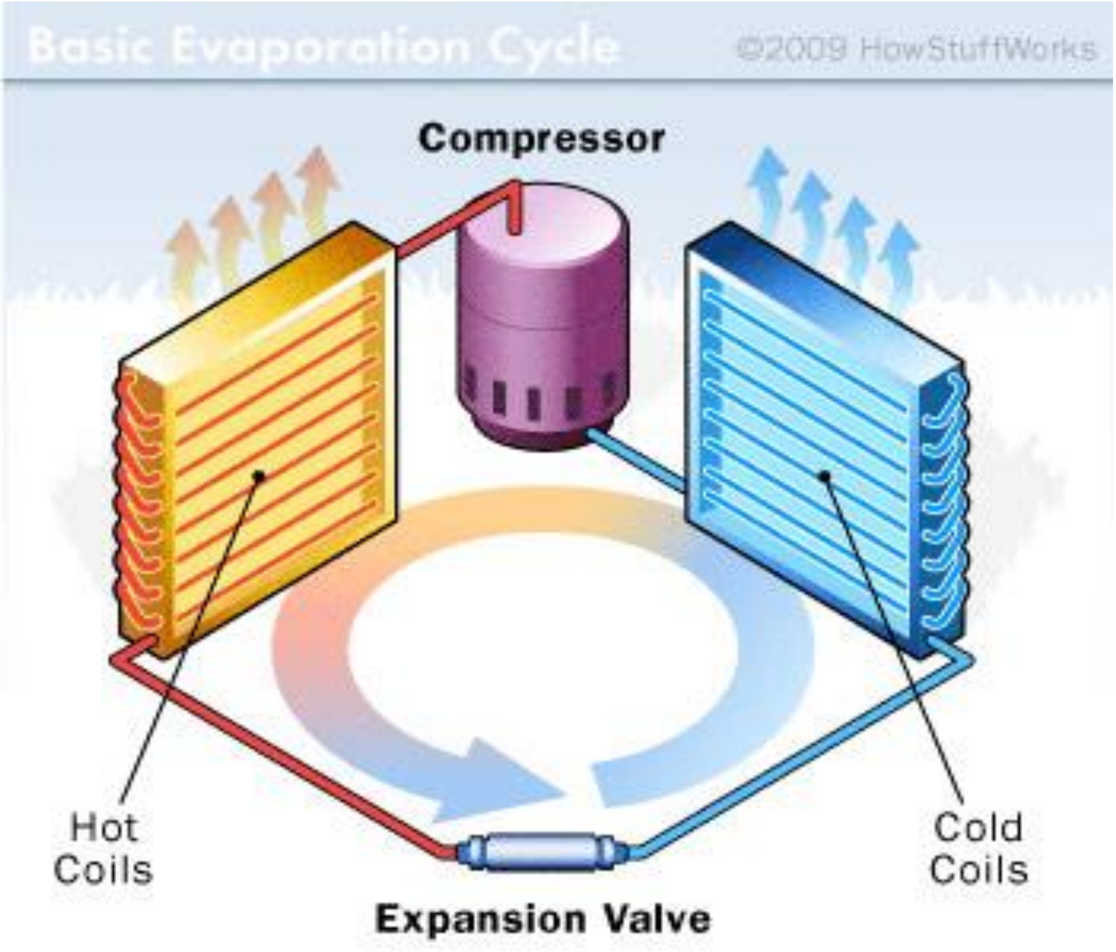
Let's get some housekeeping topics out of the way before we tackle the unique components that make up a standard air conditioner. The biggest job an air conditioner has to do is to cool the indoor air. That's not all it does, though. Air conditioners monitor and regulate the air temperature via a thermostat. They also have an onboard filter that removes airborne particulates from the circulating air. Air conditioners function as dehumidifiers. Because temperature is a key component of relative humidity, reducing the temperature of a volume of humid air causes it to release a portion of its moisture. That's why there are drains and moisture-collecting pans near or attached to air conditioners, and why air conditioners discharge water when they operate on humid days.

Still, the major parts of an air conditioner manage refrigerant and move air in two directions: indoors and outside:

- **Evaporator -** Receives the liquid refrigerant
- **Condenser -** Facilitates heat transfer
- **Expansion valve -** regulates refrigerant flow into the evaporator
- **Compressor -** A pump that pressurizes refrigerant

The cold side of an air conditioner contains the evaporator and a fan that blows air over the chilled coils and into the room. The hot side contains the compressor, condenser and another fan to vent hot air coming off the compressed refrigerant to the outdoors. In between the two sets of coils, there's an **expansion valve**. It regulates the amount of compressed liquid refrigerant moving into the evaporator. Once in the evaporator, the refrigerant experiences a pressure drop, expands and changes back into a gas. The **compressor** is actually a large electric pump that pressurizes the refrigerant gas as part of the process of turning it back into a liquid. There are some additional sensors, timers and valves, but the evaporator, compressor, condenser and expansion valve are the main components of an air conditioner.

Although this is a conventional setup for an air conditioner, there are a couple of variations you should know about. Window air conditioners have all these components mounted into a relatively small metal box that installs into a window opening. The hot air vents from the back of the unit, while the condenser coils and a fan cool and re-circulate indoor air. Bigger air conditioners work a little differently: Central air conditioners share a control thermostat with a home's heating system, and the compressor and condenser, the hot side of the unit, isn't even in the house. It's in a separate all-weather housing outdoors. In very large buildings, like hotels and hospitals, the exterior condensing unit is often mounted somewhere on the roof.



As we now already know or learn much about Air conditioning system now we go back to our primary target of this project split air conditioning system.

Mini Ductless system:

Ductless, mini split-system air-conditioners (mini splits) have numerous potential applications in residential, commercial, and institutional buildings. The most common applications are in multifamily housing or as retrofit add-ons to houses with "non-ducted" heating systems, such as hydraulic (hot water heat), radiant panels, and space heaters (wood, kerosene, propane). They can also be a good choice for room additions and small apartments, where extending or installing distribution ductwork (for a central air-conditioner or heating systems) is not feasible.

Like central systems, mini splits have two main components: an outdoor compressor/condenser, and an indoor air-handling unit. A conduit, which houses the power cable, refrigerant tubing, suction tubing, and a condensate drain, links the outdoor and indoor units.

2.3.1.1Advantages

The main advantages of mini splits are their small size and flexibility for zoning or heating and cooling individual rooms. Many models can have as many as four indoor air handling units (for four zones or rooms) connected to one outdoor unit. The number depends on how much heating or cooling is required for the building or each zone (which in turn is affected by how well the building is insulated). Each of the zones will have its own thermostat, so you only need to condition that space when it is occupied, saving energy and money.

Ductless mini split systems are also often easier to install than other types of space conditioning systems. For example, the hook-up between the outdoor and indoor units generally requires only a three-inch (~8 centimeter [cm]) hole through a wall for the conduit. Also, most manufacturers of this type of system can provide a variety of lengths of connecting conduits. So, if necessary, you can locate the outdoor unit as far away as 50 feet (~15 meters [m]) from the indoor evaporator. This makes it possible to cool rooms on the front side of a building house with the compressor in a more advantageous or inconspicuous place on the outside of the building.

Since mini splits have no ducts, they avoid the energy losses associated with ductwork of central forced air systems. Duct losses can account for more than 30% of energy consumption for space conditioning, especially if the ducts are in an unconditioned space such as an attic.

Compared with other add-on systems, mini splits offer more flexibility in interior design options. The indoor air handlers can be suspended from a ceiling, mounted flush into a drop ceiling, or hung on a wall. Floor-standing models are also available. Most indoor units have profiles of about seven inches (~18 cm) deep and usually come with sleek, high-tech-looking jackets.

Many also offer a remote control to make it easier to turn the system on and off when it's positioned high on a wall or suspended from a ceiling. Split-systems can also help to keep your home safer, because there is only a small hole in the wall. Through-the-wall and window mounted room air-conditioners can provide an easy entrance for intruders.

2.3.1.2Disadvantages

The primary disadvantage of mini splits is their cost. Such systems cost about $1,500 to $2,000 per ton (12,000 Btu per hour) of cooling capacity. This is about 30% more than central systems (not including ductwork) and may cost twice as much as window units of similar capacity.

The installer must also correctly size each indoor unit and judge the best location for its installation. Oversized or incorrectly located air-handlers often result in short-cycling, which wastes energy and does not provide proper temperature or humidity control. Too large a system is also more expensive to buy and operate.

Some people may not like the appearance of the indoor part of the system. While less obtrusive than a window room air conditioner, they seldom have the built-in look of a central system. There must also be a place to drain condensate water near the outdoor unit.

Qualified installers and service people for mini splits may not be easy to find. In addition, most conventional heating and cooling contractors have large investments in tools and training for sheet metal duct systems. They need to use (and charge for) these to earn a return on their investment, so they may not recommend ductless systems except where a ducted system would be difficult for them to install.

CHAPTER III

METHOD AND PROCEDURE

Which refers to as the system and the materials needed for the conversion of a simple bladeless standing fan into a split air conditioner which are as follows:

- 1. Condenser
- 2. compressor 1/6 or 1/8 HP
- 3. Evaporator fan motor with blade
- 4. copper tube for evaporator ¼
- 5. ¼ Insulation pipe, 2 needed
- 6. Capillary tube 15ft. .031
- 7. filter drier
- 8. Miscellaneous
- 9. Fuel 12 gas. 1.5kg.
- 10. Box

In this chapter we are going to explain and prove with figures how the conversion of a simple bladeless standing fan into a split air conditioner.

Initially the condenser was parallel flat, and then we make it round shape by using roller machine up to when it can be calculated in diameter or radius.

* Then we make a stand using rectangular channel and mild steel sheet, it is fixed using nuts and bolts. As it will be shown below:

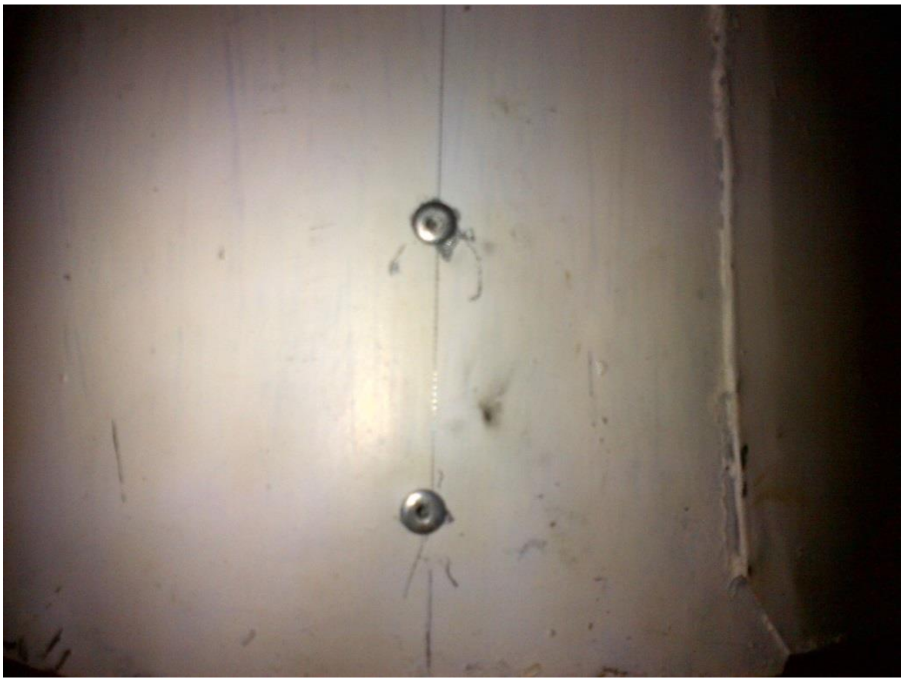
Then at the opposite side of the stand, that is at the top of the condenser we fixed a compressor as shown below which we believe will withstand the weight of the compressor, and both the stands will not tilt due to estimation of measurement we did of the stand, therefore thermodynamically we can say the stand is in equilibrium position and will never tilt or fall down and when it comes to falling down we make sure that will never happen because it is fixed with bolts and nuts using some washers to hold them tight.:

We make evaporator ¼ by the copper tube and later we fix the evaporator inside the hollow pipe by clamp and rivet.

Here is the hollow pipe we used below:

Now we are going to see evaporator ¼ by the copper tube fixed with clamp and rivet surrounding the hollow pipe but without allowing it to be touching any part of the hollow pipe or itself:

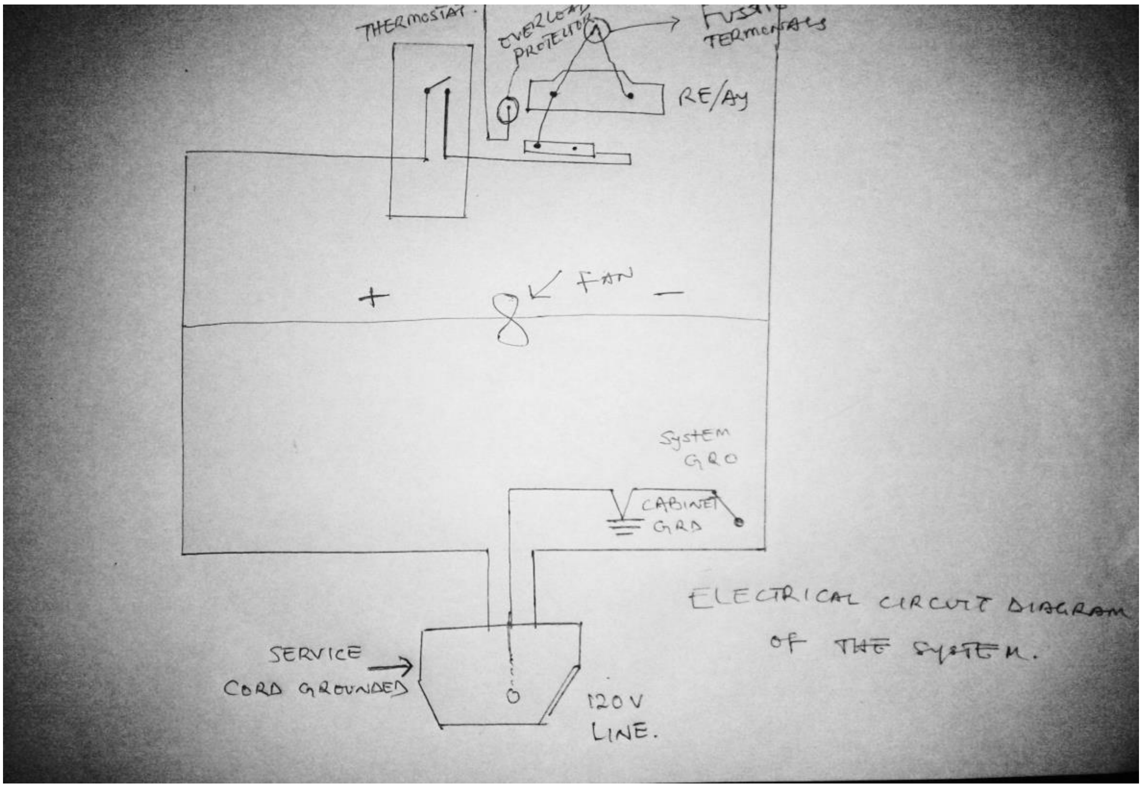
And here is an example of the rivet diagram below:



And from then we are using miscellaneous to round over the hollow which the evaporator which cover every part of the work being done and here is a picture sample of miscellaneous cotton or gum tape pop rivet. Below:

After that then we put a filter drier 2 are required to give pump refrigerant and pure liquid as shown in the diagram below:

Silver brazing rod and electrical wire, plug for power supply and then clamp.


THERMOSTAT.
OVERLOAD PROTECTOR
TERMINALS
RE/AY
+
FAN
−
System GRD
CABINET GRD
SERVICE CORD GROUNDED
120V LINE.
ELECTRICAL CIRCUIT DIAGRAM OF THE SYSTEM.

CHAPTER IV

DATA INTERPRETATION

Materials needed or estimated materials that are needed for the completion of the above mentioned project work which is conversion of a simple bladeless standing fan into a split air conditioning system

- 1. Condenser
- 2. compressor 1/6 or 1/8 HP
- 3. Evaporator fan motor with blade
- 4. copper tube for evaporator ¼
- 5. ¼ Insulation pipe, 2 needed
- 6. Capillary tube 15ft. .031
- 7. filter drier
- 8. Miscellaneous
- 9. Fuel 12 gas. 1.5kg.
- 10. Box

For the compressor we use exactly 1/6 Hp.

1Hp= 746/6= 124.333

For the filter drier ≈ 140

Voltage = 220-240 = 190

Capillary tube size = 0.31

That is 4ft by length.

Plug for the power supply, clamp

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