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SOLAR AIR COOLER

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ABSTRACT:

The natural increase or decrease in the temperature of the surroundings makes human uncomfortable. So for human comfort the invention of air-conditioner, cooler, heater took place. The present cooling and heating methods require large amount of electricity, which results in excess depletion of Non–renewable resources. Depending completely on electric source for cooling and heating effect is risky as there might be a power short circuit which would in return lead to damage of the device. But completely stopping the use of cooling or heating devices is not feasible. The room occupants also add heat to room since normal body temperature is much higher than Room temperature. So there's need to use such a source which is abundantly available in nature (here solar energy). Solar energy is never ending source as long as there's sun in nature. The effective use of same device for cooling as well as heating is done. This project reviews the solar powered cooler cum heater at domestic level.

1. Introduction:

This paper reveals the comfort conditions achieved by the device for the human body. In summer, the hot and humid conditions feel uncomfortable because of hot weather and heavy humidity. So it is necessary to maintain thermal comfort conditions. Thermal comfort is determined by the room's temperature, humidity and air speed. Radiant heat gained (hot surfaces) or radiant heat loss (cold surfaces) are also important factors for thermal comfort. Relative humidity (RH) is a measure of the moisture in the air, compared to the potential saturation level. Warmer air can hold more moisture. When you approach 100% humidity, the air moisture condenses – this is called the dew point. The temperature in a building is based on the outside temperature and sun loading plus whatever heating or cooling is added by the HVAC or other heating and cooling sources. Room occupants also add heat to the room since the normal body temperature is much higher than the room temperature. Need of such a source which is abundantly available in nature, which does not impose any bad effects on earth[1]. That is the emissions of Chloro-Fluro-Carbon into atmosphere leads to depletion of ozone layer. There is only one thing which can come up with these all problems solution is solar energy.

History of Solar Energy

- **1767, First Solar Collector**

In the year 1767 a Swiss scientist named Horace-Benedict de Saussure created the first solar collector – an insulated box covered with three layers of glass to absorb heat energy. Saussure's box became widely known as the first solar oven, reaching temperatures of 230 degrees fahrenheit.

- **1839, Photovolataic Effect Defined**

In 1839 a major milestone in the evolution of solar energy happened with the defining of the photovoltaic effect. A French scientist by the name Edmond Becquerel discovered this using two electrodes placed in an electrolyte. After exposing it to the light, electricity increased.

- **1873, Photo Conductivity of Selenium**

In 1873, Willoughby Smith discovered photoconductivity of a material known as selenium. The discovery was to be further extended in 1876 when the same man discovered that selenium produces solar energy. Attempts were made to construct solar cells using selenium. The cell did not work out well but an important lesson was learned – that solid could convert light into electricity without heat or moving parts. The discovery laid a strong base for future developments in the history of solar power.

- **1883-1891 Light Discoveries and Solar Cells**

During this time several inventions were made that contributed to the evolution of solar energy use. First in 1893 the first solar cell was introduced. The cell was to be wrapped with selenium wafers. Later in 1887 there was the discovery of the ultraviolet ray capacity to cause a spark jump between two electrodes. This was done by Heinrich Hertz. Later, in 1891 the first solar heater was created.

- **1908, Copper Collector**

In 1908 William J. Baileys invented a copper collector which was constructed using copper coils and boxes. The copper collector was an improvement of the earlier done collector but the only difference was the use of copper insulation. The improvements of the invention are being used to manufacture today's equipments.

- **1916, Photoelectric Effect**

With Albert Einstein publishing a paper on photoelectric effect in 1905 still there was no experimental evidence about it. In 1916 a scientist known as Robert Millikan evidenced the photoelectric effect experimentally.

- **1947, Solar Popularity in the US**

Following the Second World War, solar power equipment started being popular among many people in the USA. There was a huge demand of solar energy equipment.

- **1958, Solar Energy In Space**

Solar power was used to power space exploration equipment such as satellites and space stations. This was the first commercial use of solar energy.

- **1959-1970, Efficiency of Solar Cells and Cost**

During the period between 1959 and 1970 there was major discussion about the efficiency of solar cells and reduction of costs. Up to that time the efficiency of the solar cells was only 14% and was not comparable to the high cost of producing cells. However in the 1970′s, Exxon Corporation designed an efficient solar panel which was less costly to manufacture. This was a major milestone in the history of solar energy.

- **1977 Governments Embrace Solar Energy**

In 1977 the US government embraced the use of solar energy by launching the Solar Energy Research Institute. Other governments across the world soon followed.

- **1981, Solar Powered Aircraft**

In 1981, Paul Macready produced the first solar powered aircraft. The aircraft used more than 1600 cells, placed on its wings. The aircraft flew from France to England.

- **1982, Solar Powered Cars**

In the year 1982 there was the development of the first solar powered cars in Australia.

- **1986-1999 Solar Power Plants**

Evolution of large scale solar energy plants with advancement being made in each phase. By the year 1999 the largest plant was developed producing more than 20 kilowatts.

- **1999, Breakthroughs in Solar Cell Efficiency**

The most efficient solar cell was developed, with a photovoltaic efficiency of 36 percent.

- **2008, Subsidy Reduction in Spain**

Due to the global financial crisis in the year 2008, the Spanish government reduced subsidies on ongoing solar power production in the country. This had a negative effect on the industry across the world.

- **2010, Evergreen Solar and Solyndra Fail**

Two leading solar companies failed. This was due to lack of market for their high technology produced products

- **2012, Record Breaking Solar Plants**

The past few years have seen enormous investment in utility-scale solar plants, with records for the largest frequently being broken. As of 2012, the history's largest solar energy plant is the Golmud Solar Park in

China, with an installed capacity of 200 megawatts. This is arguably surpassed by India's Gujarat Solar Park, a collection of solar farms scattered around the Gujarat region, boasting a combined installed capacity of 605 megawatts.

Renewable Energy Sources

Solar Energy

Solar energy has the greatest potential of all the sources of renewable energy and if only a small amount of this form of energy could be used, it will be one of the most important supplies of energy specially when other sources in the country have depleted energy comes to the earth from the sun. This energy keeps the temperature of the earth above than in colder space, causes current in the atmosphere and in ocean, causes the water cycle and generate photosynthesis in plants.·Worldwide power demand of all needs of civilization is 10 Watts. Therefore the sun gives us 1000 times more power than we need. If we can use 5% of this energy, it will be 50 times what the world will require. Electricity can be produced from the solar energy by photovoltaic solar cells, which convert the solar energy directly to electricity. The most significant applications of photovoltaic cell in India are the energisation of pump sets for irrigation, drinking water supply and rural electrification covering street lights, community TV sets, medical refrigerators and other small power load

Wind Energy

Wind energy, which is an indirect source of solar energy conversion, can be utilized to run windmill, which in turn drives a generator to produce electricity. Wind can also be used to provide mechanical power such as for water pumping. In India generally wind speeds obtainable are in the lower ranges. Attempts are, therefore, on the development of low cost, low speed mills for irrigation of small and marginal farms for providing drinking water in rural area. The developments are being mainly concentrated on water pumping wind mill suitable for operation in a wind speed range of 8 to 36 km per hour. In India high wind speeds are obtainable in coastal areas of Saurashtra, western Rajasthan and some parts of central India. Among the different renewable energy sources, wind energy is currently making a significant contribution to the installed capacity of power generation, and is emerging as a competitive option. India with an installed capacity of 3000 MW ranks fifth in the world after Germany, USA, Spain and Denmark in wind power generation. Energy of wind can be economically used for the generation of electrical energy.

Biomass and Biogas Energy

The potential for application of biomass, as an alternative source of energy in India is large. We have plenty of agricultural and forest resources for production of biomass. Biomass is produced in nature through photosynthesis achieved by solar energy conversion. As the word clearly signifies Biomass means organic matter. In simplest form, the process of photosynthesis is in the presence of solar radiation. Biomass energyco-generation programme is being implemented with the main objective of promoting biomass power generation potential, estimated at 19500 MW. The technologies being promoted include combustion, gasification and cogeneration, Either for power in captive or grid connected modes, or for heat applications.

Tidal Energy

The tides in the sea are the result of the universal gravitational effect of heavenly bodies like sun and moon on the earth. Due to fluidity of water mass, the effect of this force becomes apparent in the motion of water, which shows a periodic rise and fall in levels which is in synthesis with the daily cycle of rising and setting of sun and moon. This periodic rise and fall of the water level of sea is called tide. These tides can be used to produce electrical power which is known as tidal power. When the water is above the mean sea level, it is called flood tide and when the level is below the mean sea level, it is called ebb tide. To harness the tides, a dam is to be built across the mouth of the bay. It will have large gates in it and also low head hydraulic reversible turbines are installed in it. A tidal basin is formed, which gets separated from the sea by dam. The difference in water level is obtained between the basin and sea. By using reversible water turbines, turbines can be run continuously, both during high tide and low tide.

Most of the increase in the area of irrigated land in the world has been through the increasing use of engine-driven pumps. However, the increasing price of oil-based fuel has reduced the margin to be gained by farmers from irrigation, since food prices have generally been prevented from rising in line with energy costs. Despite present short-term fluctuations in oil prices, conventional oil-based engine-driven power sources and mains electricity are expected to continue to increase in the longer term. If we are to decrease our dependence on imported oil, we have to find methods for energizing irrigation pumps that are independent of imported oil or centralized electricity. Solar radiation as a source of energy is. Of course, the epitome of the clean. sustainable energy technology. except for residues possibly arising out of the manufacture of solar component (e.g. semiconductors), solar technology have very low environmental impacts. The environmental impacts of solar system in operation are very low and the source is, for us inexhaustible.

The designer should specify components in the following order:

- Choose place and mounting method for modules, select modules.
- Estimate of the electricity Demand.
- Estimate the overall system losses.
- Prepare full list of parts and tools to order.

Small Comparison between Solar PV & Diesel and gasoline pumps:

Type	Advantages	Disadvantages
Solar PV	Unattended operation	High capital costs
	Low maintenance	Water storage is require for cloudy periods
	Easy installation	Repair often require skilled technicians
	Long life	
Diesel and Gasoline Pumps	Quick and easy to install	Fuel supplies erratic and expensive
	Low capital costs	High maintenance costs
	Widely used	Short life expectancy
	Can be portable	Noise and fume pollution

Components of the System

Photovoltaic panels:

A solar-powered water pumping system is made up of two basic components. The first component is the power supply consisting of photovoltaic (PV) panels (Figure.1). The smallest element of a PV panel is the solar cell.

Figure 1: Photovoltaic (PV) panels.

Each solar cell has two or more specially prepared layers of semiconductor material that produce direct current (DC) electricity when exposed to light. This DC current is collected by the wiring in the panel. It is then supplied either to a DC pump, which in turn pumps water whenever the sun shines, or stored in batteries for later use by the pump. Manufacturers normally rate voltage (volts) and current (amps) output from PV panels under peak power conditions. Peak power (watts=volts x amps) is the maximum power available from the PV panel at 1000 W/m² solar irradiance (amount of sunshine) and a specified temperature, usually 25 C (77 F). Typical output from a 60-watt PV panel is shown in Table 2. The amount of DC current produced by a PV panel is much more sensitive to light intensity striking the panel than is voltage generated. Roughly speaking, if you halve the light intensity, you halve the DC current output, but the voltage output is reduced only slightly.

Working of Solar Air Cooler

First start the pump which sucks water from bottom tank which was already filled with water. Water goes on stationery pad which are placed on backside of two side door, through delivery pip .After that, the exhaust fan starts & sucks the atmospheric air, which is passed through wet pad(jute or grass). In this process cooling is achieved by direct contact of water particles & moving air stream. In complete contact process the air would become saturated at WBT of entering air. In other words sensible heat of air is carried by water in the form of latent heat, when it is brought intimate contact with water. After some time air may be sufficiently cooled by evaporative process, which results in considerable increase of humidity. For better effect add ice cube or chilled water in bottom tank. For heating purpose the supply of water is stopped by pump and the heating coil

is in ON condition. As the coil goes on heating the air stream temperature also increases. The convection process is said to occur due to which the hot air comes out.

1.2 Problems Regarding to cooling and heating(Air-conditioner and heater) :

1. Fossil fuels contain radioactive materials, mainly uranium and thorium which are released into the atmosphere which in return increases the smog and acidic rain , emission of carbon di oxide.
2. Longer power cuts problem during summer condition in rural areas.
3. High Cost of Cooling and Heating Products.
4. Mechanical Wear and Tear.
5. Unusual motor noises.
6. Water leaks.

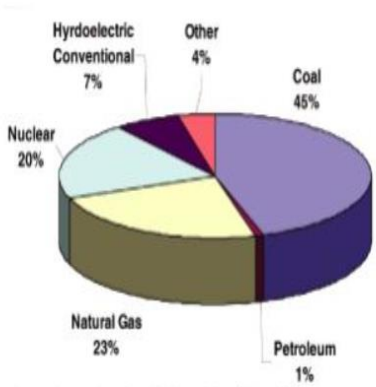


FIG 1.2: Production of electricity from different sources

1.3 Solar energy Conversion :

Solar energy conversion requires battery, inverter and charge controller. Whenever solar light falls on panel it has large amount of photon energy which is controlled by charge controller. The charge controller charges the battery. The battery is directly connected to the inverter. Inverter is needed only when there is use of AC loads type instruments.

2. Problem Definition:

- The main aim of this project is to design and fabricate an air conditioning system working on Peltier Effect and running on solar energy.
- Basic function of air-cooler to maintain pleasant temperature inside the workspace by controlling temperature and humidity of the surrounding.

Today we are dealing various problems in air cooling and heating

- Extreme weather conditions

In desert areas where temperature changes during night time as well as day time the need of air conditioning is more requirement than a luxury. The increase in the relative humidity makes the air too humid and uncomfortable for human sustainability.

- Shortage of Electricity

In some areas there is no power supply and longer power cut problems can ultimately relate to breakdown conditions. The people can't use basic devices.

- Low Refrigerant

The leaks in the refrigerant line results in the low efficiency of air cooling due to which the temperature of air required is not achieved.

- Condenser problems

Sometimes the condenser gets dirty, sooty which makes it grimy and result in the interference of heat transfer due to with the whole system needs to work harder and wears it out faster. This consumes excess power units.

- Refrigerants

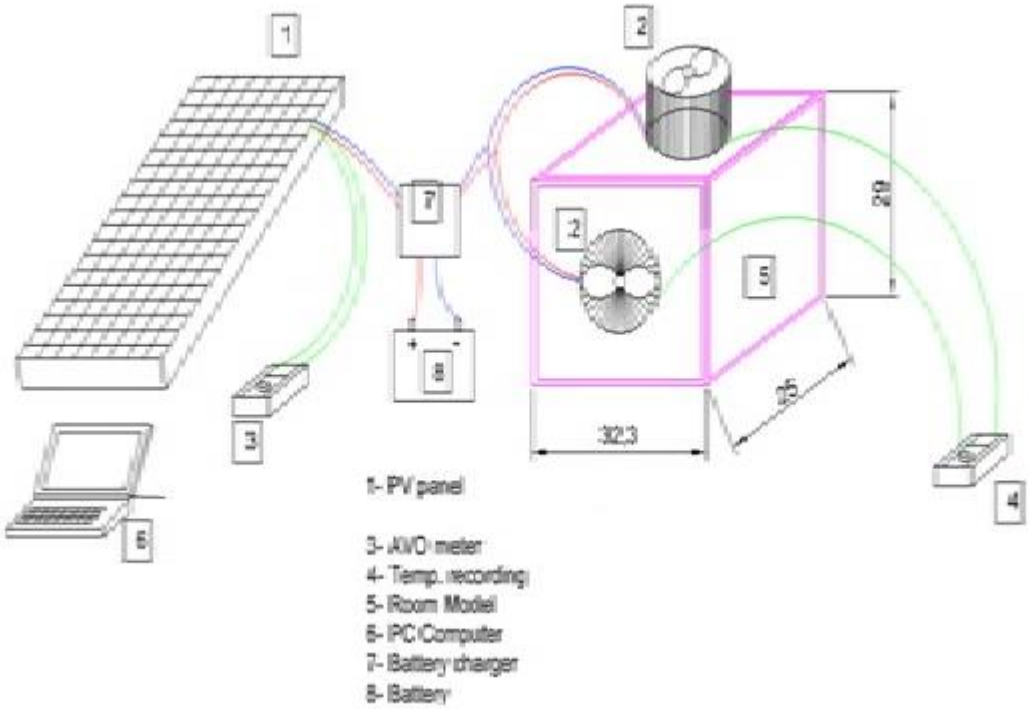
The working fluid sometimes have negative impact on the environment. Some contribute to global warming and also result in the depletion of ozone layer.

3. Objectives :

The specific objectives of our project are as follows

- To develop a simple, cheap and portable cooling and heating system which does not require much maintenance and can be easily carried wherever necessary.
- To find out the system applicability, depending on climate which helps heating in winter and cooling in summer.
- To minimize investments in the system costs so it can be cost effective.
- To reduce the energy requirement and also use renewable resources to run the system as maximum energy gets into dehumidifying the air.
- To reduce the use of refrigerants that are harmful and non-eco-friendly. These refrigerants can contribute to global warming and also result in the depletion of ozone layer.

BLOCK DIAGRAM :



4. Literature Review :

Adarsh Mohan Dixit, Arjit Raj Sahu (student) (2013)," Water Cooler Double purpose: To produce hot and cold water simultaneously". Evaporator & condenser are used in this simultaneously. Evaporator in the water cooler is not used when condenser is removed and it is replaced by another exchanger. Heat is released on the level of condenser is 3 to 4 times the electric power used by the compressor. Hence in this project they coupled the water cooler to the water heater in order to rise its temperature to an acceptable threshold. During cool weather condition the water cannot be heated sufficiently. Hence we recourse to electric supplement but it also cannot satisfy 90% of our annual needs. In this device the outgoing gas from the compressor will transfer its heat to the water of cumulus to a place that doesn't have ambient air. Then the hot gas goes towards the pressure reducer which is followed by an evaporator and at the end it returns to the compressor to start a new cycle. From this project the refrigeration COP is 3 and the thermal COP is 4 so they deduce that the total COP of the system is 7.They concluded that adding the regenerator of heat on the level of condenser and evaporator will result in increased performance. [5]

Akhilesh Yadav, Rajatkumar Bachan, Dattaprasad Tendolkar, Sankesh Torashkar (2018),"Design & Fabrication of 360 Cooler Cum Heater " As we are in need of heating and cooling simultaneously in many of the rural area in India. This paper helps us to understand the process of evaporative cooling. In this they have created a 360o simple evaporative air cooler in which cooling is achieved by direct contact between the water particles and air stream. In which the minimum outdoor temperature required for successful 360o evaporative cooling is about 35o C and even lower than that. The 360o evaporative cooler depends on the outdoor temperature as well as relative humidity, dry bulb temperature and low wet bulb temperature. This can't be used where relative humidity is high. This system doesn't dehumidify the air but on contrary further humidify air. The working of this system can be explained as followed:

Initially we start the pump which sucks the water from the bottom tank then this water is then passed on the stationary pads/grass of the two side door through various delivery pipes. Now due to capillary action this water is passed to the neighbouring grass/pads. Now we turn on the exhaust fan which is a centrifugal fan which sucks the air from these wet pads/grass and throws on the opposite side due to which there is a convective heat transfer between air and water and thus temperature of the air which is thrown by the centrifugal fan is reduced. Hence in this order by direct contact between the air and water particle cooling is achieved.[2]

Vijay Kumar Kalwa, R Prakash , 2012, "Design & development of solar power air cooler". This research paper gives the information about the problems faced by the excess usage of the non-renewable resources. Room occupants also add the heat to the room since the normal body temperature is much higher than the room temperature. Hence the solution to the problem can be solved by the requirement of the sources which are abundantly available in nature that's Solar Energy. They provided information, Calculations, Analysis on Solar Energy conversion. Components Used are:

- Solar Panel
- Battery
- Charge Controller
- Inverter
- Blower
- Ceramics Slabs

The converted Energy is used to run the Centrifugal Fan. Blower is surrounded by cooling pads through which continuous water supply is provided. When Blower is switched ON it sucks atmospheric air into cabin through cooling pads, so that the cooling effect is introduced into the room. They selected Solar panel of 40W & Battery of 40Ah. [1]

Maneesh Bhardwaj (2012), "Solar Air Cooling", They stated the major disadvantages of the solar cooler that is ; High cost of manufacturing , low conversion efficiencies & need for continual streams of photons to produce power. The peak output from solar panel can be obtained during Noon hours. [4]

S.A.Abdalla, Kamal N. (2016), "A radiant air-conditioning system using solar driven liquid desiccant evaporative water cooler". They described that the solar driven liquid "desiccant" evaporative cooling system & method used for investigating

it's performance is providing cold water for radiant air-conditioning system in Khartoum. For more than decades, Air-conditioning is considered as the reliable & efficient source due the popularity gained by the Vapour Compression Machines. But the air-conditioners produces harmful effects on the ozone layer due to presence of Halogenated Hydrocarbons. In liquid Desiccant Evaporative Cooling process, air is used, dehumidified by desiccant solution to cool water by direct evaporative cooling. It's considered to be modified version of the direct evaporative cooling that can cater for different climatic conditions. They concluded that the system is environmental friendly as it requires low high grade input & improves indoor air quality substantially in energy efficient manner radiant air- conditioning.[3]

R.Sai.Lavanya, Dr. B.S.R.Murthy (2008), "Design of solar using aqua-ammonia absorption refrigeration system", The system invented here works on Ammonia Absorption System which provides refrigeration effect by using two fluids & some quantity of heat input, rather than electrical input as in more familiar vapour compression cycle. In Absorption system, Secondary fluid is used to circulate refrigerant because temperature requirement for cycle falls into low to moderate temperature range. Usage of Absorbent depends on the temperature:

o Above 32O F - Lithium Bromide as absorbent & water as refrigerant.

- Below 32O F – Ammonium as refrigerant & water as absorbent. [6]

5. Methodology :

This project mainly consist of two sections: i. Solar Energy Conversion ii. Cool air generated by Axial Flow fan

i. Solar Energy Conversion:

Solar energy conversion is done by using battery, inverter and charge controller. As sun light falls on solar panel, which converts into electrical energy by photoelectric effect. This electrical energy stored in battery in the form of chemical energy. Charge controller is employed in between solar panel and battery which prevents overcharging Figure 2: Solar energy conversion process and may protect against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk. The stored energy directly can use for DC loads or else need to be converted AC (alternate current) by the help of inverter.

Cool air generation by Axial Flow fan The converted energy is used to run the Axial Flow fan. This fan covered with cooling pads, through which water is passed at a specific rate. As the fan sucks the hot air through cooling pads, heat transfer occur between air and water thus generated cool air enters into the room.

Methodology of working process

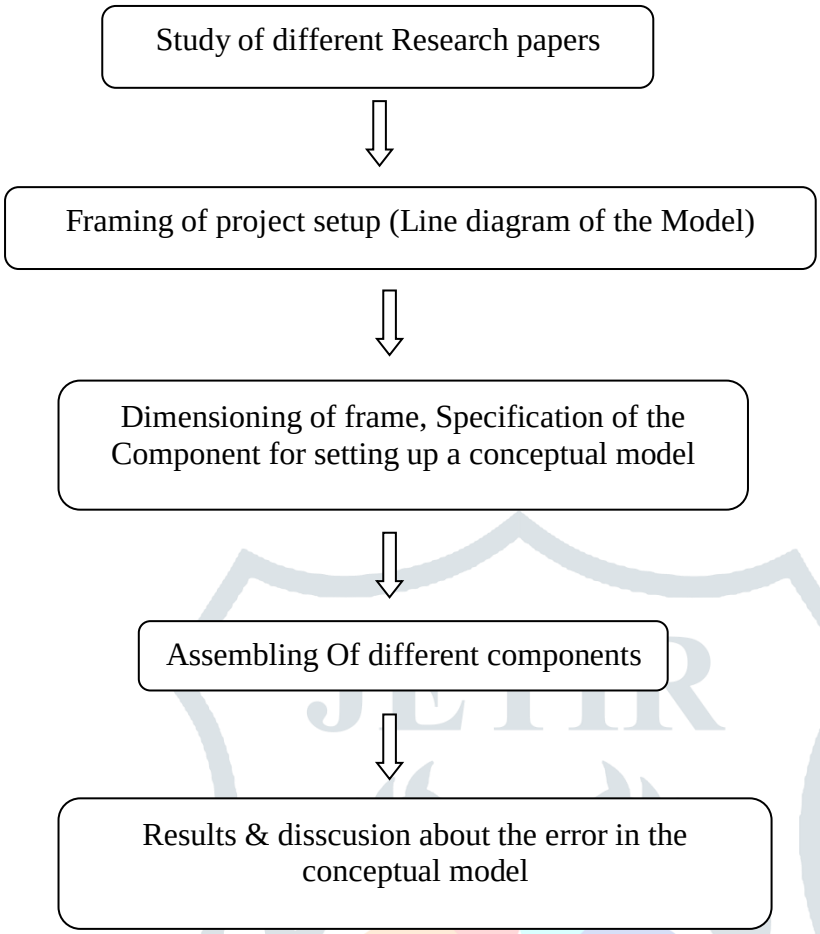


Fig. 5 Flow Chart For Working Process

MATERIAL SELECTION & METHODOLOGY.

1.1 Material Selection

The proper selection of material for the different part of a machine is the main objective. In the fabrication of machine. For a design engineer it is must that he be familiar with the effect, which the manufacturing process and heat treatment have on the properties of materials. The Choice of material for engineering purposes depends upon the following factors:

1. Availability of the materials.
2. Suitability of materials for the working condition in service.
3. The cost of materials.
4. Physical and chemical properties of material.
5. Mechanical properties of material.

The mechanical properties of the metals are those, which are associated with the ability of the material to resist mechanical forces and load. We shall now discuss these properties as follows:

A. Strength B. Elasticity
C. Stress D. Plasticity
E. Stress F. Ductility
G. Brittleness H. Malleability
I. Toughness J. Resilience

When a part is subjected to a constant stress at high temperature for long period Of time, it will undergo a slow and permanent deformation called creep. This property is considered in designing internal combustion engines, boilers and turbines.

Hardness

It is a very important property of the metals and has a wide verity of meanings. It embraces many different properties such as resistance to wear scratching, deformation and mach inability etc. It also means the ability of the metal to cut another metal. The
hardness is usually expressed in numbers, which are dependent on the method of making the test.

The hardness of a metal may be determined by the following test.

1. **Brinell hardness test**
2. **Rockwell hardness test**
3. **Vickers hardness (also called diamond pyramid) test and**
4. **Share scaler o scope.**

In engineering practice, the machine parts are subjected to various forces, which may be due to either one or more of the following.

1. **Energy transmitted**
2. **Weight of machine**
3. **Fictional resistance**
4. **Inertia of reciprocating parts**
5. **Change of temperature**
6. **Lack of balance of moving parts**

The selection of the materials depends upon the various types of stresses that are set up during operation. The material selected should with stand it. Another criterion for selection of metal depends upon the type of load because a machine part resist load more easily than a live load and live load more easily than a shock load.

Selection of the material depends upon factor of safety, which in turn depends upon the following factors.

1. Reliabilities of properties
2. Reliability of applied load
3. The certainty as to exact mode of failure

4. The extent of simplifying assumptions
5. The extent of localized
6. The extent of initial stresses set up during manufacturing
7. The extent loss of life if failure occurs
8. The extent of loss of property if failure occurs

SYSTEM DESIGN

In system design we mainly concentrated on the following parameters: -

1) System selection based on physical constraints

While selecting any machine it must be checked whether it is going to be used in a large-scale industry or a small-scale industry. In our case it is to be used by a small- scale industry. So space is a major constrain. The system is to be very compact so that it can be adjusted to corner of a room.

The mechanical design has direct norms with the system design. Hence the foremost job is to control the physical parameters, so that the distinctions obtained after mechanical design can be well fitted into that.

2) Arrangement of Various Components:

Keeping into view the space restrictions the components should be laid such that their easy removal or servicing is possible. More over every component should be easily seen none should be hidden. Every possible space is utilized in component arrangements.

3) Components of System:

As already stated the system should be compact enough so that it can be accommodated at a corner of a room. All the moving parts should be well closed & compact. A compact system design gives a high weighted structure which is desired.

4) Man Machine Interaction:

The friendliness of a machine with the operator that is operating is an important criterion of design. It is the application of anatomical & psychological principles to solve problems arising from Man – Machine relationship.

5) Chances of Failure

The losses incurred by owner in case of any failure are important criteria of design. Factor safety while doing mechanical design is kept high so that there are less chances of failure. Moreover periodic maintenance is required to keep unit healthy.

6) Servicing Facility

The layout of components should be such that easy servicing is possible. Especially those components which require frequents servicing can be easily disassembled.

7) Scope of Future Improvement

Arrangement should be provided to expand the scope of work in future. Such as to convert the machine motor operated; the system can be easily configured to required one.

8) Height of Machine from Ground

For ease and comfort of operator the height of machine should be properly decided so that he may not get tired during operation.

9) Weight of Machine

The total weight depends upon the selection of material components as well as the dimension of components. A higher weighted machine is difficult in transportation & in case of major breakdown; it is difficult to take it to workshop because of more weight.

MOTOR SELECTION:

This section describes certain items that must be calculated to find the optimum motor for a particular application. Selection procedures and examples are given.

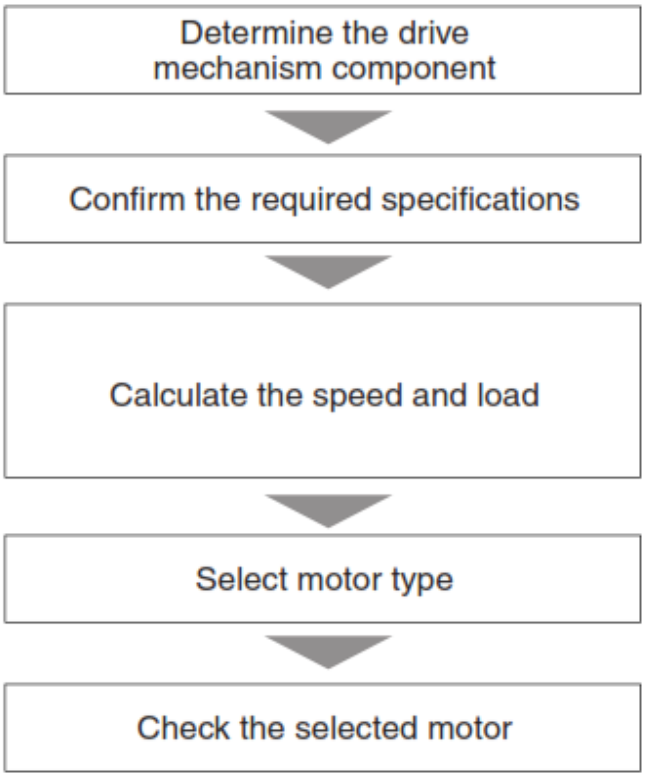


Figure 01 Motor Selection Flow Chart

● First, determine certain features of the design, such as drive mechanism, rough dimensions, distances moved, and positioning period.

● Confirm the required specifications for the drive system and equipment (stop accuracy, position holding, speed range, operating voltage, resolution, durability, etc.).

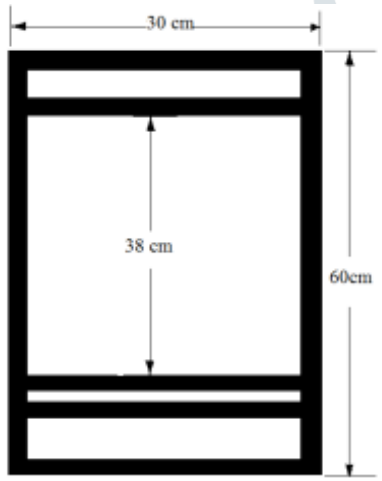
● Calculate the value for load torque, load inertia, speed, etc. at the motor drive shaft of the mechanism. Refer to page 3 for calculating the speed, load torque and load inertia for various mechanisms.

● Select a motor type from AC Motors, Brushless DC Motors or Stepping Motors based on the required specifications.

● Make a final determination of the motor after confirming that the specifications of the selected motor/gearhead satisfy all of the requirements (mechanical strength, acceleration time, acceleration torque etc.).

7.4 Design of Frame

The Frame fabricated for our project which is made up of M.S.It is welded accordingly for arrangement of the system components. The Frame along with dimension is shown in figure below:



Frame Specification:

- Size of Frame: 1000 x 350 mm
- Material of Frame: Mild Steel
- Unloaded Weight of Frame: 2.65 kg o
- Loaded weight of frame: 9.7 kg

3.2 Force Calculation

By lever principal: 32 × 1.9 = 8 x A 60.8 ÷ 8 = A

A = 7.6 kg A = 74.556 N.

Applying Pascals law:

i.e., “Pressure exerted on a confined liquid is transmitted undiminished in all directions and acts at right angles with equal force on all areas of the container”.

P = F ÷ A

P = 74.556 † [(π/4) × (12.7)2]

P = 0.588 N/mm2

Cantilever Beams are members that are supported from a single point only; typically with a Fixed Support. In order to ensure the structure is static, the support must be fixed; meaning it is able to support forces and moments in all directions.

Sample Cantilever Beam equations can be calculated from the following formulae, where:

Bending stress formula

$$\sigma = \frac{My}{I}$$

Where , σ = bending stress

M = bending moment (which is calculated by multiplying a force by the distance between the point of interest and the force),

y= The distance from the neutral axis

I= Moment of inertia.

1.Cantilever Beams at square section

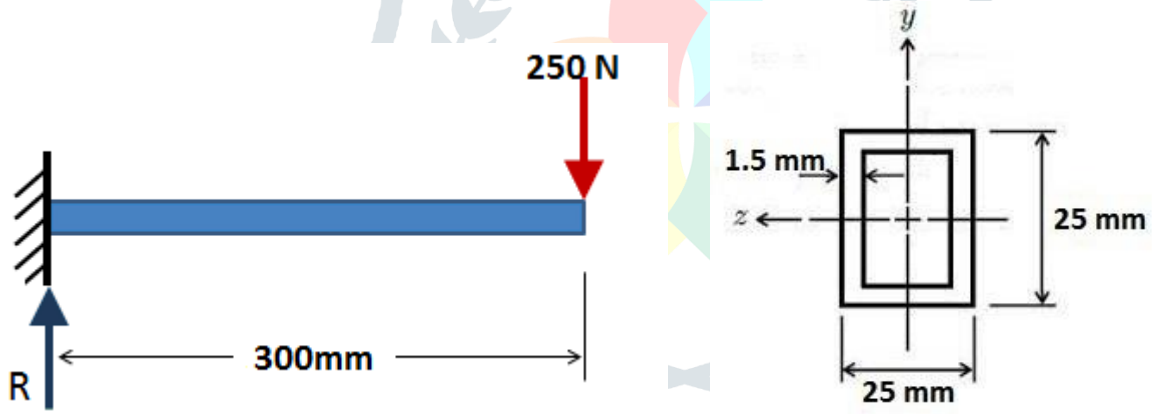


Fig.Cantilever Beams at square section

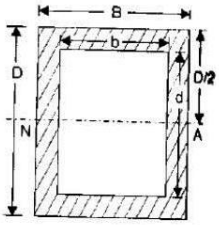
- Load(W) = 250N
- Member Length(L) =300 mm
- Thickness(T) = 1.5 mm
- The distance from the neutral axis (y) =12.5 mm
- Width (B) = 25 mm
- Depth (D) = 25 mm

For Circular hollow section

$$I = \frac{BD^3}{12} - \frac{bd^3}{12}$$

$$y_{max} = \left(\frac{D}{2}\right)$$

$$Z = \frac{1}{6D}\left[BD^3 - bd^3\right]$$



$$I = \frac{25 * 25^3}{12} - \frac{22.5 * 22.5^3}{12}$$

$$I = 390625 - 256289.0625$$

I=11419.6614

Y=12.5 mm

M_A -250*300 =0

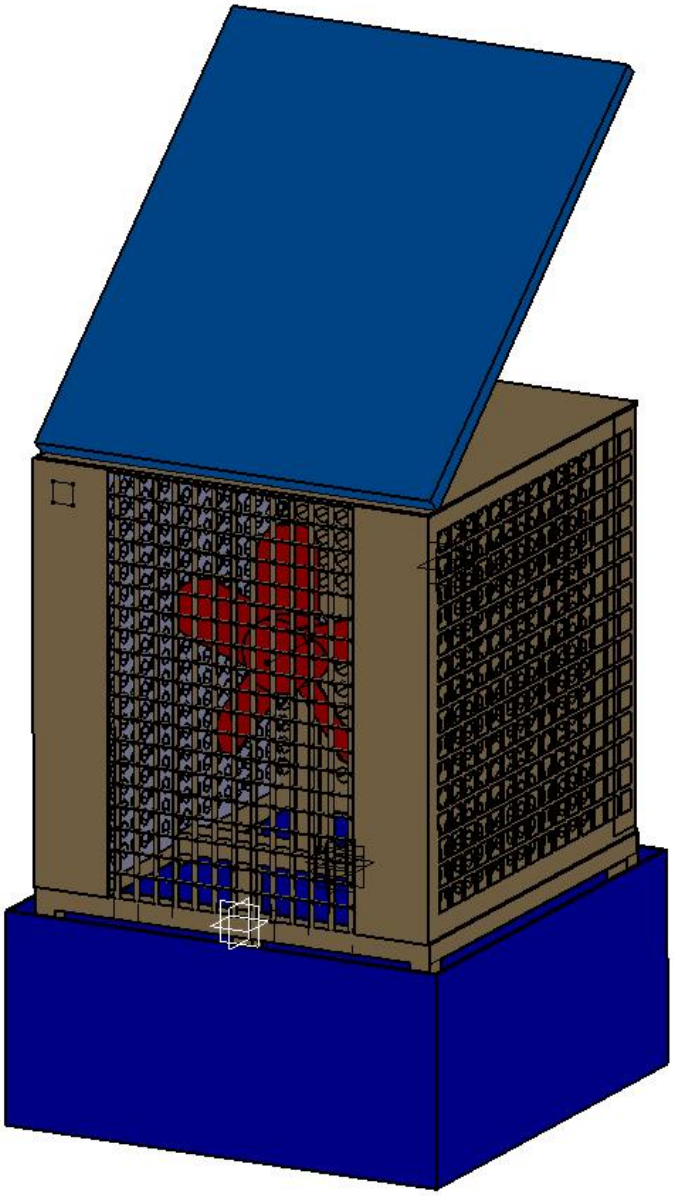
M_A= 75000 N.mm

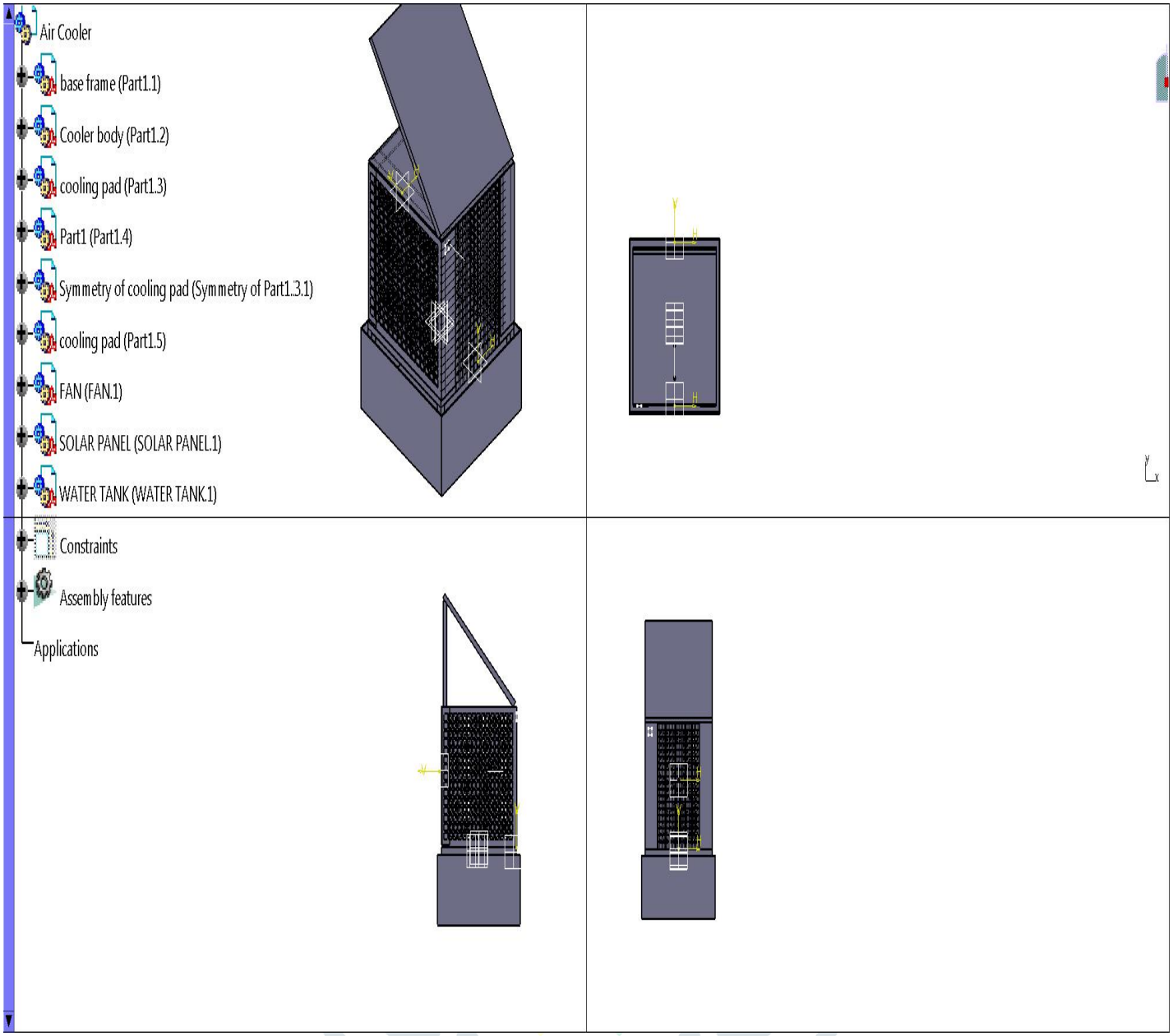
$$\sigma = \frac{My}{I}$$

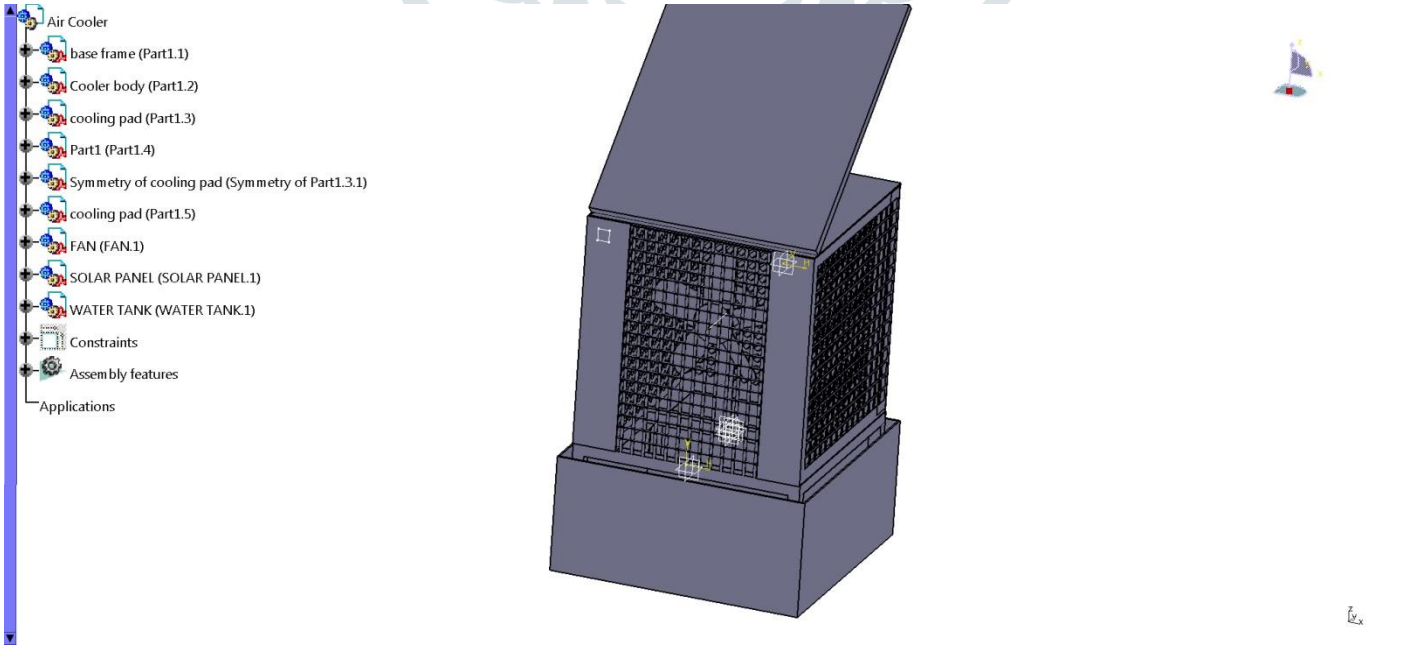
$$\sigma = \frac{75000 * 12.5}{11419.6614}$$

$\sigma = 82.09$ N/mm^2

1)




Air Cooler
base frame (Part1.1)
Cooler body (Part1.2)
cooling pad (Part1.3)
Part1 (Part1.4)
Symmetry of cooling pad (Symmetry of Part1.3.1)
cooling pad (Part1.5)
FAN (FAN.1)
SOLAR PANEL (SOLAR PANEL.1)
WATER TANK (WATER TANK.1)
Constraints
Assembly features
Applications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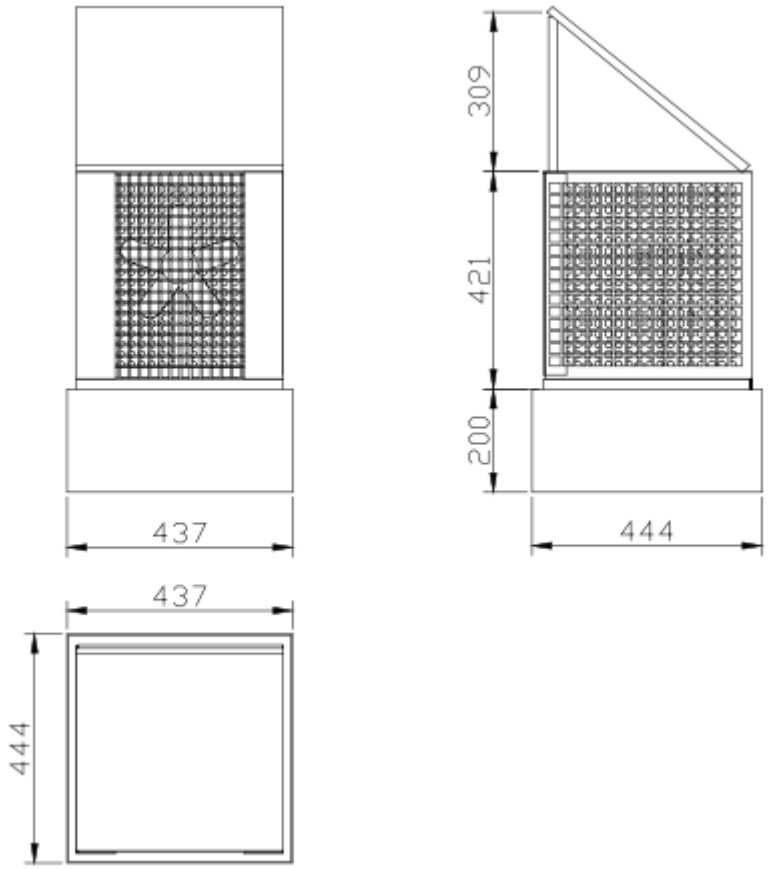
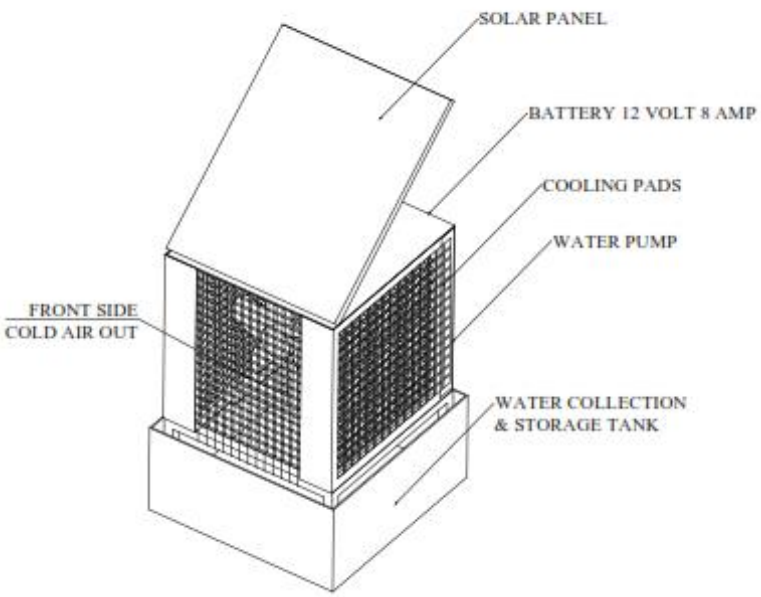




Working Model of the Project:

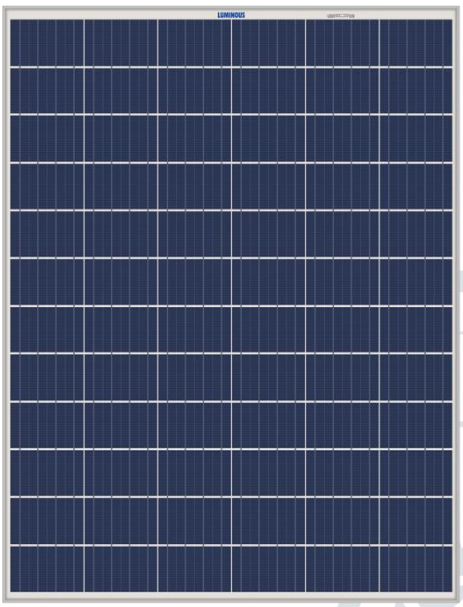
This concept is driven by solar energy. Components involved in this concept are solar panel, battery, charge controller, battery, inverter, blower, ceramic slabs and cooling pads. Solar panel is employed to convert sun light into electrical energy by means of photovoltaic effect. The generated electrical energy is supplied to the battery for storage purpose through charge controller which prevents from power fluctuations. As AC blower is used for cooler, so need to convert DC load from the battery to AC load by the help of inverter. Inverter converts DC load to AC. Load, now AC power can be supplied to the blower. This blower is surrounded by cooling pads through which continuous water supply is provided. When the blower is switched

ON, blower sucks atmospheric air into the cabin through the cooling pads, mean time heat transfer occur between water and air, so the cool air enters into the room thus providing required thermal comfort conditions.

COMPONENT OF ATTACHMENT:

The main components of the solar powered grass cutter are,

1. **Solar panels**



Photovoltaic solar panels absorb sunlight as a source of energy to generate electricity. A photovoltaic (PV) module is a packaged, connected assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications.

The most common application of solar energy collection outside agriculture is solar water heating systems.

Theory and construction

Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. The majority of modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can either be the top layer or the back layer. Cells must also be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available. The cells must be connected electrically in series, one to another.

A PV junction box is attached to the back of the solar panel and it is its output interface.Externally, most of photovoltaic modules use MC4 connectors type to facilitate easy weatherproof connections to the rest of the system. Also, USB power interface can be used.

Module electrical connections are made in series to achieve a desired output voltage or in parallel to provide a desired current capability (amperes). The conducting wires that take the current off the modules may contain silver, copper or other non-magnetic conductive transition metals. Bypass diodes may be incorporated or used externally, in case of partial module shading, to maximize the output of module sections still illuminated.

Some special solar PV modules include concentrators in which light is focused by lenses or mirrors onto smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way.

Solar panels also use metal frames consisting of racking components, brackets, reflector shapes, and troughs to better support the panel structure.

LEAD–ACID BATTERY

The **lead–acid battery** was invented in 1859 by French physicist Gaston Planté and is the oldest type of rechargeable battery. Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, its ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile starter motors.

As they are inexpensive compared to newer technologies, lead–acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities. In 1999 lead–acid battery sales accounted for 40–45% of the value from batteries sold worldwide excluding China and Russia, and a manufacturing market value of about $15 billion.[8] Large-format lead–acid designs are widely used for storage in backup power supplies in cell phone towers, high-availability settings like hospitals, and stand-alone power systems. For these roles, modified versions of the standard cell may be used to improve storage times and reduce maintenance requirements. *Gel-cells* and *absorbed glass-mat* batteries are common in these roles, collectively known as VRLA (valve-regulated lead–acid) batteries.

The electrical energy produced by a discharging lead–acid battery can be attributed to the energy released when the strong chemical bonds of water (H_2O) molecules are formed from H^+ ions of the acid and O^{2-} ions of PbO_2.[9] Conversely, during charging the battery acts as a water-splitting device, and in the charged state the chemical energy of the battery is mostly stored in the acid.

ELECTROCHEMISTRY

Discharge

In the discharged state both the positive and negative plates become lead(II) sulfate ($PbSO_4$), and the electrolyte loses much of its dissolved sulfuric acid and becomes primarily water. The discharge process is driven by the pronounced reduction in energy when 2 H^+(aq) (hydrated protons) of the acid react with O^{2-} ions of PbO_2 to form the strong O-H bonds in H_2O (ca. -880 kJ per 18 g of water).[9] This highly exergonic process also compensates for the energetically unfavorable formation of Pb^{2+}(aq) ions or lead sulfate ($PbSO_4$(s)).[9]

Negative plate reaction

$Pb(s) + HSO^-_4(aq) \rightarrow PbSO$

$_4$(s) + H^+

(aq) + $2e^-$ The release of two conducting electrons gives the lead electrode a negative charge

As electrons accumulate they create an electric field which attracts hydrogen ions and repels sulfate ions, leading to a double-layer near the surface. The hydrogen ions screen the charged electrode from the solution which limits further reaction unless charge is allowed to flow out of electrode.

Positive plate reaction

PbO

$_2$(s) + HSO^-

$_4$(aq) + $3H^+$

(aq) + $2e^-$ → PbSO

$_4$(s) + 2H

$_2$O(l)

taking advantage of the metallic conductivity of PbO

$_2$. The total reaction can be written as

Pb(s) + PbO

$_2$(s) + 2H

$_2$SO

$_4$(aq) → 2PbSO

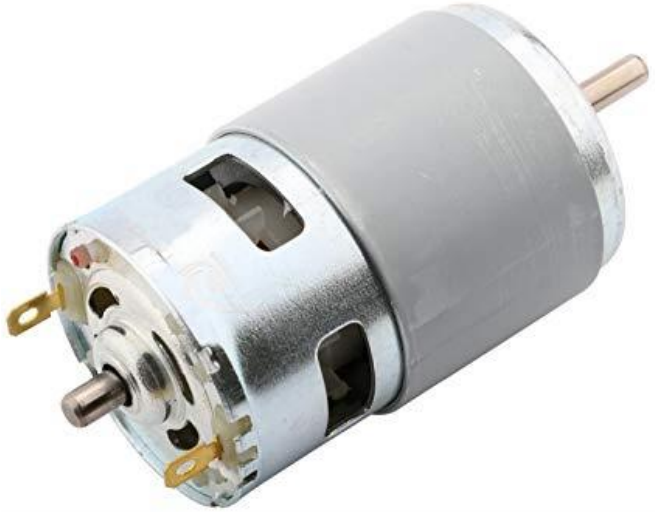
$_4$(s) + 2H

$_2$O(l) = 2.05 V

The net energy released per mol (207 g) of Pb(s) converted to PbSO $_4$(s), or per 36 g of water formed, is ca. 400 kJ. The sum of the molecular masses of the reactants is 642.6 g/mol, so theoretically a cell can produce two faradays of charge (192,971 coulombs) from 642.6 g of reactants, or 83.4 ampere-hours per kilogram (or 13.9 ampere-hours per kilogram for a 12-volt battery). For a 2 volts cell, this comes to 167 watt-hours per kilogram of reactants, but a lead–acid cell in practice gives only 30–40 watt-hours per kilogram of battery, due to the mass of the water and other constituent parts.

High speed DC Motor Type – 12 volt geared DC motor:

DC motor is any of a category of electrical machines that converts electricity wattage into mechanical power. The foremost common varieties have confidence the forces made by magnetic fields.



Metal frame

OPERATIONS PERFORMED

11.1 GRINDING

Grinding is an abrasive machining process that uses a grinding wheel as the cutting tool.

A wide variety of machines are used for grinding:

- Hand-cranked knife-sharpening stones (grindstones)
- Handheld power tools such as angle grinders and die grinders
- Various kinds of expensive industrial machine tools called grinding machines
- Bench grinders

Grinding practice is a large and diverse area of manufacturing and tool making. It can produce very fine finishes and very accurate dimensions; yet in mass production contexts it can also rough out large volumes of metal quite rapidly. It is usually better suited to the machining of very hard materials than is "regular" machining (that is, cutting larger chips with cutting tools such as tool bits or milling cutters), and until recent decades it was the only practical way to machine such materials as hardened steels. Compared to "regular" machining, it is usually better suited to taking very shallow cuts, such as reducing a shaft's diameter by half a thousandth of an inch or 12.7 µm.

Fig. 11.1 Grinding Machine

Grinding is a subset of cutting, as grinding is a true metal-cutting process. Each grain of abrasive functions as a microscopic single-point cutting edge (although of high negative rake angle), and shears a tiny chip that is analogous to what would conventionally be called a "cut" chip (turning, milling, drilling, tapping, etc]. However, among people who work in the machining fields, the term cutting is often understood to refer to the macroscopic cutting operations, and grinding is often mentally categorized as a "separate" process. This is why the terms are usually used separately in shop-floor practice. Lapping and sanding are subsets of grinding.

11.2 WELDING

Welding is a fabrication or sculptural process that joins materials,usually metals or thermoplastics, by causing fusion, which is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal. In addition to melting the base metal, a filler material is typically added to the joint to form a pool of molten material (the weld pool) thatcools to form a joint that, based on weld configuration (butt, full penetration, fillet, etc.), can be stronger than the base material (parent metal). Pressure may also be used in conjunction with heat, or by itself, to produce a weld. Welding also requires a form of shield to protect the filler metals or melted metals from being contaminated or oxidized.

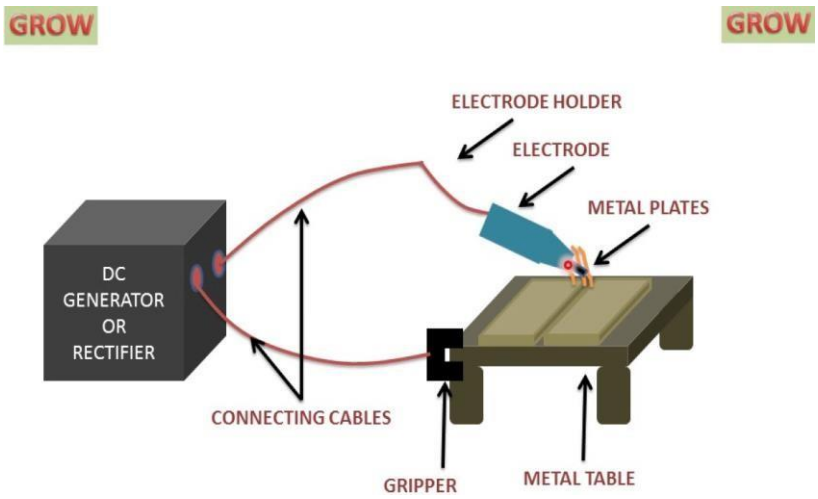


Fig. 11.2 Welding Process

Although less common, there are also solid state welding processes such as frictionwelding in which the base metal does not melt.

Some of the best known welding methods include:

- Oxy-fuel welding – also known as oxyacetylene welding or oxy welding, uses fuel gases and oxygen to weld and cut metals.
- Shielded metal arc welding (SMAW) – also known as "stick welding" or "electric welding", uses an electrode that is coated in flux to protect the weld puddle. The electrode holder holds the electrode as it slowly melts away. Slag protects the weld puddle from atmospheric contamination.
- Gas tungsten arc welding (GTAW) – also known as TIG (tungsten, inert gas),uses a non-consumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by an inert shielding gas suchas argon or helium.
- Gas metal arc welding (GMAW) – commonly termed MIG (metal, inert gas), usesa wire feeding gun that feeds wire at an adjustable speed and flows an argon- based shielding gas or a mix of argon and carbon dioxide (CO_2) over the weld puddle to protect it from atmospheric contamination.
- Flux-cored arc welding (FCAW) – almost identical to MIG welding except it usesa special tubular wire filled with flux; it can be used with or without shielding gas,depending on the filler.
- Submerged arc welding (SAW) – uses an automatically fed consumable electrode and a blanket of granular fusible flux. The molten weld and the arc zone are protected from atmospheric contamination by being "submerged" under the flux blanket.
- Electro slag welding (ESW) – a highly productive, single pass welding processfor thicker materials between 1 inch (25 mm) and 12 inches (300 mm) in avertical or close to vertical position.
- Electric resistance welding (ERW) – a welding process that produces coalescence of lying surfaces where heat to form the weld is generated by the electrical resistance of the material. In general, an efficient method, but limited to relatively thin material.

Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. While often an industrial process, welding may be performed in many different environments, including in open air, under water, and in outer space. Welding is a hazardous undertaking and precautions are required to avoid burns, electric shock, vision damage, inhalation of poisonous gases and fumes, and exposure to intense ultraviolet radiation.

11.3 DRILLING

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross- section in solid materials. The drill bit is usually a rotary cutting tool, often multi- point. The bit is pressed against the work-piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work- piece, cutting off chips from the hole as it is drilled.

Fig 11.3 Drilling Machine

In rock drilling, the hole is usually not made through a circular cutting motion, thoughthe bit is usually rotated. Instead, the hole is usually made by hammering a drill bit into the hole with quickly repeated short movements

ADVANTAGES

1. Low cost.
2. Improves parking experience in hills.
3. Very compact.
4. Emergency stop and start is possible.
5. Sensing can be easily done using sensors.
6. Reduces the manual interaction.

COST ESTIMATION

Sr. No	COMPONENT NAME	COST
1.	Solar panel watt	1250
2.	Battery 12 volt 8 amp	180
3.	High Speed dc Motor	450
4.	Fan	110
6.	Heat sink	350
7.	Wiring	125

CONCLUSION

In this overview, we built up a Green AC working effect.

The prepared model of solar cell driven cooling system was designed and tested experimentally. The following valuable information regarding an environmental friendly cooling device is obtained.

- This air conditioning unit does not produce any harmful green house and ozone depleting gasses.
- It uses solar energy as a power source so it does not need conventional electricity which is produced from polluting thermal power plants.
- This system is compact as compared to conventional air conditioning system.
- This system is free from bulky components like condenser and evaporator as this air condition unit does not run on conventional thermodynamic cycles.
- Noiseless operation and can be used as both winter and summer air conditioning unit

6. Conclusions :

We would conclude that, The Solar Air Cooler Cum Heater is a model of minimum investment providing both heating and cooling effect as required. The easy displacement of the model can be achieved. The use of renewable resources like solar energy helps in maintaining eco-friendly atmosphere.

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