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Fabrication of Solar Air Cooler for Remote Area

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Abstract:
Mechanical Engineering without production and manufacturing is meaningless and inseparable. Production and manufacturing process deals with conversion of raw materials inputs to finished products as per required dimensions, specification and efficiently using recent technology. The new developments and requirements inspired us to think of new improvements in air conditioning Engineering field. Nowadays air cooler is available in market. In our project, solar power is stored in a battery. This power is used to run the air collar whenever we required. Solar energy means all the energy that reaches the earth from the sun. It provides daylight makes the earth hot and is the source of energy for plants to grow. Solar energy is also put to two types of use to help our lives directly solar heating and solar electricity. Solar electricity is the technology of converting sunlight directly in to electricity. It is based on photo-voltaic or solar modules, which are very reliable and do not require any fuel or servicing. Solar electric systems are suitable for plenty of sun and are ideal when there is no main electricity. Our objective is to design and develop a solar system normally "solar air cooler".

Keywords: Electric Module, Solar Energy**,** Solar Cells, centrifugal pump, photovoltaic cell

I. INTRODUCTION

Human beings give off heat, around an average of 100 kcal per hour per person, due to what is known as 'metabolism'. The temperature mechanism within the human body maintains a body temperature of around 36.9 degree C (98.4degree F). But the skin temperature varies according to the surrounding temperature and relative humidity. To dissipate the heat generated by metabolism in order to maintain the body temperature at the normal level, there must be a flow of heat from the skin to the surrounding air. If the surrounding temperature is slightly less than that of the body, there will be steady flow of heat from the skin. But is the surrounding temperature is very low, as on a cold winter day the rate of heat flow from the body will be quite rapid, thus the person feels cold, on the other hand on a hot summer day, the surrounding temperature is higher than that of the body, and so there cannot be flow of heat from the skin to the surroundings, thus the person feels hot. In such a situation water from the body evaporates at the skin surface dissipating water from the body evaporates at the skin surface dissipating the heat due to metabolism. This helps in maintaining normal body temperature. But if the surrounding air is not only hot but highly humid as well, very little evaporation of water can take place from the skin surface, and so the person feels hot and uncomfortable[1].

II. LITERATURE REVIEW

Man has needed and used energy at an increasing rate for its sustenance and well being ever since he came on the earth a few million years ago. Primitive man required energy primarily in the form of food. He derived this by eating plants or animals, which he hunted. Subsequently he discovered fire and his energy needs increased as he started to make use of wood and other bio mass to supply the energy needs for cooking as well as agriculture. He added a few dimension to the use of energy by domesticating and training animals to work for him. With further demand for energy, man began to use the wind for sailing ships and for driving windmills, and the force of failing water to turn water wheels. Till this time, it would not be wrong to say that the sun was supplying all the energy needs of man either directly or indirectly and that man was using only renewable sources of energy. The industrial revolution, which began with the discovery of the steam engine (AD 1700), brought about great many changes. For the first time, man began to use a new source of energy, viz. coal, in large quantities. A little later, the internal combustion engine was invented (AD1870) and the other fossil fuels, oil and natural combustion engine extensively. The fossil fuel era of using non-renewable sources had begun and energy was now available in a concentrated form. The invention of heat engines and then use of fossil fuels made energy portable and introduced the much needed flexibility in mans movement. For the first time, man could get the power of a machine where he required it and was not restricted to a specific site like a fast-running stream for running a water wheel or a windy hill for operating a windmill. This flexibility was enhanced with the discovery of electricity the development of central power generating stations using either fossil fuels or waterpower.

III. OBJECTIVES:

- To make aware of non conventional energy sources to reduce environmental pollutions.
- This product preferably suitable for villages, because they face lot of power cut problems in summer (around 12 to 14 hrs in day). And for offices and schools which runs in day to which save energy.
- As air-conditioning and refrigeration consumes more power and mainly cost of refrigerating and air conditioning products are very high. So would like develop product which runs by solar energy and provide cooling effect for house hold food items at lower cost.

IV. CONSTRUCTION

- Solar Panel
- Battery (12 Volt D.C)
- Blower (D.C motor coupled with Impeller)
- Water Pump (D.C 12 Volt)

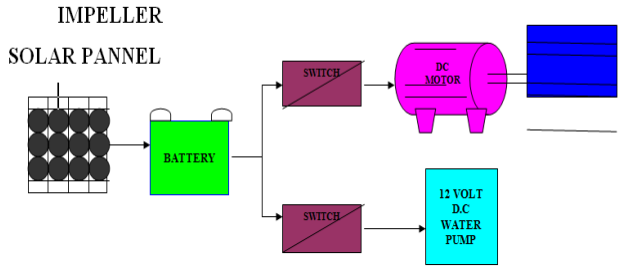

Figure.1. Fabrication of solar air cooler in remote area

TYPE OF CELL	SEMI-CONDUCTOR CONSTITUENTS	HIGHEST EFFICIENCY %(AMI)
Polycrystalline Homo-junction	Silicon	~8
Thin-film hetro-junction	p-CuαS/n-Cds	~9
	p-Cu_2Te_2/n-CdTe	~6
Thin-film hetro-junction	p-Cu In Se_2/n-Cds	~6
Thin-film hetro-junction	Silicon	~6
Thin-film amorphous semiconductor, schotty barrier		

1. SOLAR CELL:

A solar cell works on the principle of photo-voltaic principle, the photo-voltaic solar energy conversion is one of the most attractive non-conventional energy sources of proven reliability from the micro to the Megawatt level.

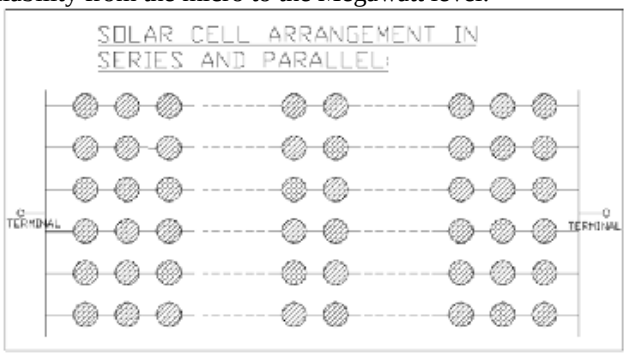

Figure.2. solar cell arrangement in series and parallel

Cells may be connected in parallel to achieve the desired voltage. The optimum operating voltage of a photo voltaic cell is generally about 0.45 volts at normal temperatures, and the current in full sunlight may be taken 0.270 amperes / sq. mm. If the exposed area of the cell is 40 square cm (6.2sq.in) or 40*10^-4 sq. m, the current and power are decreased or increased proportionately. By combining number of solar cells in series that is in a string, the voltage is increased but the current is unchanged. In this case, if one cell get damaged then the whole string would become inoperative, similarly by combining number of solar cells in parallel, the current is increased but the voltage is unchanged, in this change one cell get damaged than it does not affect the other cell in the string. To get a voltage of 0 to 36 V we require 72 cells to be connected in series so that we connected 72 cells in series to a required voltage, this connecting module is shown in figure2.

2. TYPES OF SOLAR CELLS

- p-n homo junction
- p-n hetro junction
- Schotty barrier
- Homo junction hetro structure
- MIS (metal insulator-semi conductor cell).
- SIS (semi-conductor-insulator semi-conductor cell).

2. BATTERIES

In isolated systems away from the grid, batteries are used for storage of excess solar energy converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage. In fact for small units with output less than one kilowatt. Batteries seem to be the only technically and economically available storage means. Since both the photo-voltaic system and batteries are high in capital costs. It is necessary that the overall system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with a particular combination of properties:

- Low cost
- Long life
- High reliability
- High overall efficiency
- Low discharge
- Minimum maintenance
    - Ampere hour efficiency
    - Watt hour efficiency

We use lead acid battery for storing the electrical energy from the solar panel for lighting the street.

1. LEAD-ACID WET CELL:

Where high values of load current are necessary, the lead-acid cell is the type most commonly used. The electrolyte is a dilute solution of sulfuric acid (H_2SO_4). In the application of battery power to start the engine in an auto mobile, for example, the load current to the starter motor is typically 200 to 400A. One cell has a nominal output of 2.1V, but lead-acid cells are often used in a series combination of three for a 6-V battery and six for a 12-V battery.

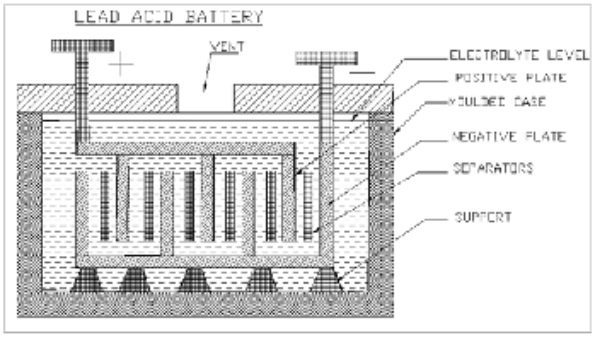

Figure.3. lead-acid wet cell

3. BLOWER

The fan (impeller) rotates inside the shell. The shell is so designed that the air is rushed out forcely. The blower consists of two main parts. They are

- D.C motor
- Impeller Blades(Fan)

The D.C motor is directly coupled with Impeller blades. The water pump is used to circulate the water to the blower. The cool air is rushed out forcely. The battery is connected to the D.C motor, so that D.C motor runs directly.

3.1 D.C MOTOR

The D.C motor is used to control the direction of hot air flow. In our project the hot air is distributed in all direction with the same rate by using D.C motor tilting mechanism.

3.2 IMPELLER:

Impeller consists of more number of blades. The number of blade increases the cold air rushed out forcely. The impeller blades are slightly bended, so that the cold air forcely transmitted to the outside.

4. WATER PUMP

Water pump is used to circulate the water. In our project, the 12 Volt D.C water pump is used. The battery is connected to the D.C water pump, so that D.C water pump runs directly[2].

5. PHOTO VOLTAIC METHOD

5.1 PHOTOVOLTAIC PRINCIPLES:

The photo-voltaic effect can be observed in nature in a variety of materials that have shown that the best performance in sunlight is the semiconductors as stated above. When photons from the sun are absorbed in a semiconductor, that create free electrons with higher energies than the created there must be an electric field to induce these higher energy electrons to flow out of the semi-conductor to do useful work. A junction of materials, which have different electrical properties, provides the electric field in most solar cells. To obtain a useful power output from photon interaction in a semiconductor, three processes are required.

1. The photon has to be absorbed in the active part of the material and result in electrons being excited to a higher energy potential.
2. The electron hole charge carriers created by the absorption must be physically separated and moved to the edge of the cell.
3. The charge carriers must be removed from the cell and delivered to useful load before they lose extra potential.

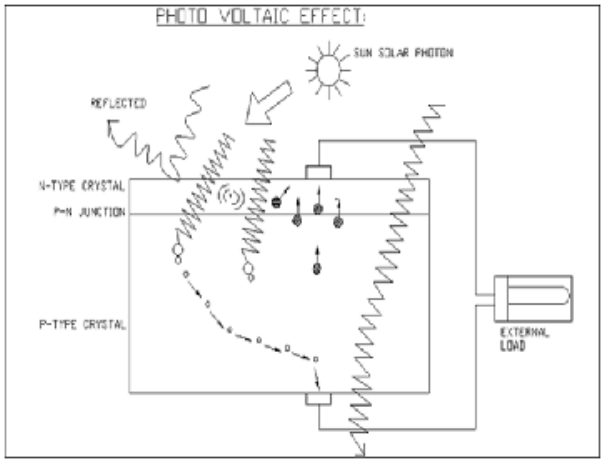

Figure 4: Photo voltaic effect [3]

For completing the above processes a solar cell consists of:-

(a) Semi-conductor in which electron hole pairs are created by absorption of incident solar radiation

(b) Region containing a drift field for charge separation

(c) Charge collecting fronts and back electrodes.

The photo-voltaic effect can be described easily for p-n junction in a semi-conductor. In an intrinsic semi-conductor such as silicon, each one of the four valence electrons of the material atom is tied in a chemical bond, and there are no free electrons at absolute zero. If a piece of such a material is doped on one side by a five valance electron material, such as arsenic or phosphorus, there will be an excess of electrons in that side, becoming an n-type semi-conductor. The excess electrons will be practically free to move in the semi-conductor lattice. When a three valence electron material, such as boron dopes the other side of the same piece, there will be deficiency of electrons leading to a p-type semi-conductor. This deficiency is expressed in terms of excess of holes free to move in the lattice. Such a piece of semi-conductor with one side of the p-type and the other, of the n-type is called p-n junction. In this junction after the protons are absorbed, the free electrons of the n-side will tends to flow to the p-side, and the holes of the p-side will tend to flow to the n-region to compensate for their respective deficiencies. This diffusion will create an electric field from the n-region to the p-region. This field will increase until it reaches equilibrium for V, the sum of the diffusion potentials for holes and electrons.

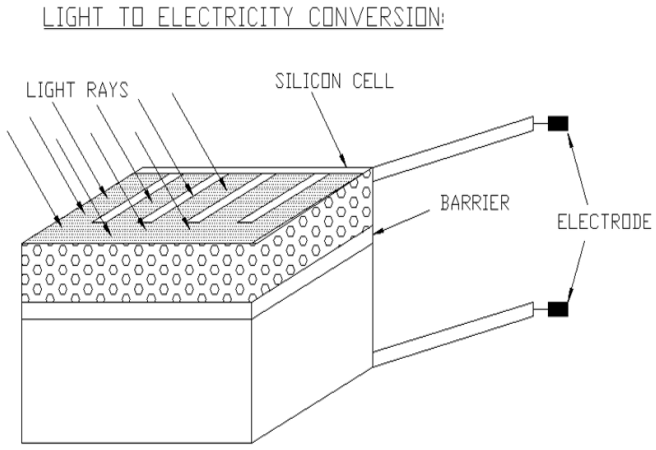

Figure.5. light to electricity

OPERATING PRINCIPLE OF THE FABRICATION OF SOLAR AIR COOLER IN REMOTE AREA

The solar panel is converting sun rays to the Electricity by "Photo-Voltaic Effect". This electrical power is stored in a 12-Volt battery. Battery D.C power is used to run the D.C motor and D.C water pump. Block diagram, Photo-voltaic Effect and major components of our project are already discussed above chapters. The D.C motor is coupled with impeller blades. The D.C motor runs during the air cooler button ON, the impeller blades starts rotating. The water pump is used to circulate the water to the blower unit. The forced air is flow through the water which is sprayed by water pump, so that the cold air produced. The solar panel stand and complete diagram are given below [4].

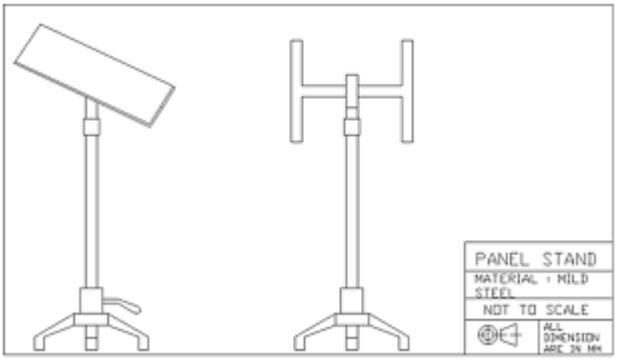

Figure.6. working principal of fabrication of solar air cooler in remote area

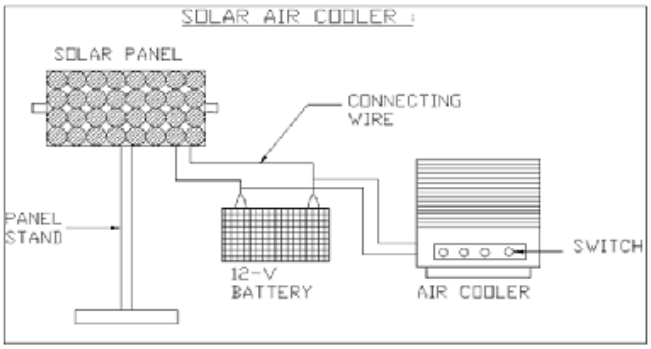

Figure.7. working principal of fabrication of solar air cooler in remote area

ADVANTAGES

- Simple in construction
- This system is noiseless in operation
- It is portable, so it can be transferred easily from one place to other place
- Power is stored in a battery
- Maintenance cost is low

DISADVANTAGES

- It does not purify air
- Initial cost is high
- Solar panel saves the energy during day only

APPLICATION

The solar air cooler with auto tracking is used in:

- Home
- Industries
- Meeting hall
- Seminar hall
- By adding control circuit, we can maintain the room temperature at required level.

SCOPE FOR FUTURE WORK

- **SCOPE OF IMPROVEMENT**

This project although fulfilling our requirement has further scope for improvements. Some of the improvements that could be made in this solar air cooler with auto tracking unit are listed below.

- By adding solar panel auto tracking system
- By adding some components to make solar heater cum cooler

6. CONCLUSION

By completing this project we have achieved a clear knowledge of comfort cooling system for human by using non-conventional energy. This project would be fruitful in both domestic & industrial backgrounds. We also know about non-conventional energy sources and utilization.

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