Review Paper on Direct A.C. Power Generator by Using Solar Cells

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***Abstract*: AC Solar Generator works on a very simple principle. It consists of standard solar cells arranged in circular pattern mounted on a base. Half of the cells are wired in one circuit and half in another circuit. Mounted above the solar cells is a spinning disc powered by a DC electric motor. The DC motor gets its power from four small DC solar cells mounted in the corners of the base. The disc has portals cut into it allowing light to pass through to every other solar cell below it. As the disc spins each of the banks of solar cells is alternately exposed to light and alternately produce power. When the portal is half way between the two cells the voltage cancels and drops to zero. The resulting voltage is sinusoidal or AC. Thus there is no need of conversion equipment's such as inverters, phase synchronizers, etc. This makes the overall concept quite simple yet effective and economical as well as compared to the current trend of extracting the solar energy in the market. Due to the tracking system the efficiency of the overall project increases by 10% to 30%.**

***Keywords:* Solar energy, Solar cells, AC solar generator, DC motor, Series opposition connection, Tracking system, Electric load, Solar panel, Spinning disk, pwm.**

Introduction

There is a current global need for clean and renewable energy sources. Fossil fuels are non-renewable and require finite resources, which are dwindling because of high cost and environmentally damaging retrieval techniques. So, the need for cheap and obtainable resources is greatly needed. An efficient and more feasible alternative option is solar energy. Solar energy is a more practical type of energy due to its plentiful availability; it is derived directly from the sun. One of the problems which hinder the use of solar energy extensively is the cost of extracting the energy and then converting it into suitable form according to its applications. The price of solar panels combined with the price of inverters, phase synchronizers, installation and maintenance has made the price of solar prohibitive. Add to that the loss of power from the different components used in the DC to AC conversion process and it becomes even more unattractive. AC Solar Generator eliminates the problem of converting DC to AC. It uses solar as its input and with the help of a motor-disc arrangement it converts the DC power of solar cells directly to AC without use of any conversion equipment's. The resulting output voltage is thus sinusoidal or AC. Thus there is no need of conversion equipment's such as inverters, phase synchronizers, etc. This makes the overall concept quite simple yet effective and economical as well. The sun which is the never ending source of energy and which is readily available is used as an input. This reduces the ever increasing demand for fossil fuels such as coal, petroleum, diesel etc. AC Solar Generator works on a very simple principle. It consists of standard solar cells arranged in circular pattern mounted on a base. Half of the cells are wired in one circuit and half in another circuit. Mounted above the solar cells is a spinning disc powered by a DC electric motor. The DC motor gets its power from four small DC solar cells mounted in the corners of the base. The disc has portals cut into it allowing light to pass through to every other solar cell below it. As the disc spins each of the banks of solar cells is alternately exposed to light and alternately produce power. When the portal is half way between the two cells the voltage cancels and drops to zero. The resulting voltage is sinusoidal or AC. Thus there is no need of conversion equipment's such as inverters, phase synchronizers, etc. This makes the overall concept quite simple yet effective and economical as well. The control of the motor can be done in either of the two ways. One way is using an electronic system to calculate the astronomical position of the sun at the particular location and accordingly rotate the solar panel at an orientation perpendicular to the sun at preset time intervals. Another of control is using a sensor arrangement to sense the brightness in the sky and accordingly rotate the panel at right angles to the orientation of the sun.

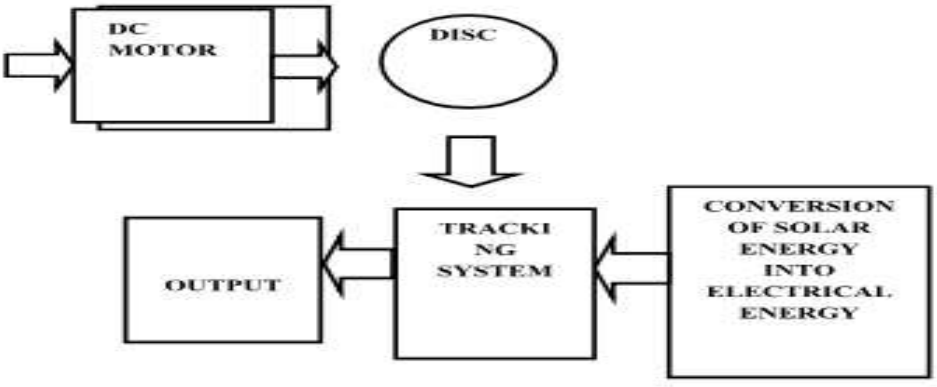

Fig. Block Diagram of AC Solar Generator

Solar cell

Solar cell is main building block of our project. Different rated solar cells are available in market depending upon requirement from few mill volts to several volts.

In this project,16 solar plate of rating 3V, 150mA and 3V, 150mA are used for trial and error basis .A solar cell, or photovoltaic cell solar battery is an electrical device that converts the energy of light directly into electricity by the photovoltaic cell which is a physical and chemical phenomenon. It is a form of photoelectric cell, defined as a device whose electrical characteristics, such as current, voltage, or resistance, vary when exposed to light. Solar cells are the building blocks of photovoltaic modules, otherwise known as solar panel.

Fig. Solar Cell

Rotating Disc

A rotating disc is a circular sheet made up of any hard and light weight thin material which can easily rotated by a DC motor when it is mounted on DC motor shaft. Rectangular windows are made on this disc as shown in a figure below. These windows are made according to our requirement. For X number of plates, number of windows will be X/2.

Fig. Rotating Disc

DC Motor

A different rating DC motor is available in market as per customer requirement in dc motor speed varies proportional to voltage and current rating if we need a high speed motor we have to choose a motor with higher rating of voltage and current and supplied it by high voltage and current.

Here we require 325 RPM motor to produce an Ac power hence we choose motor of 1000 Rpm, 12 volt 200mA.

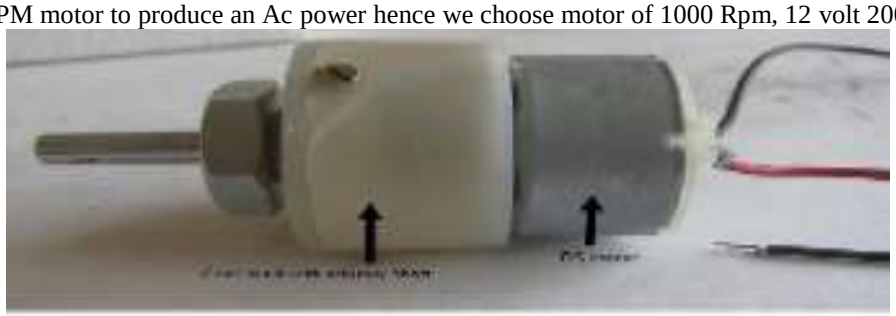

Fig. DC Motor

Technique of conversion of solar energy into AC power

There are two layers of sheet fixed one over another. On lower sheet, solar modules are fixed permanently which is of low thickness. Another sheet having more thickness is used to make slots each of size exactly equal to size of a single solar module. Number of slots is equal to the number of solar modules i.e. 16 slots are made over upper

sheet. Arrangement of fixed solar module is shown in the figure All the modules have two connections drawn out at the bottom of the base. The plates are so arranged that they are connected in series alternately leaving one plate in between two consecutive plates.

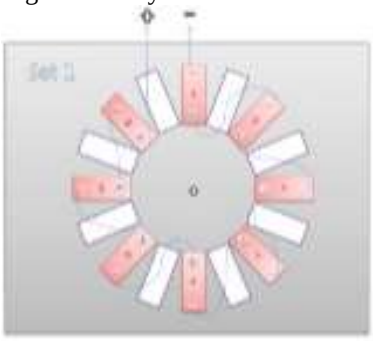

Fig. Set1

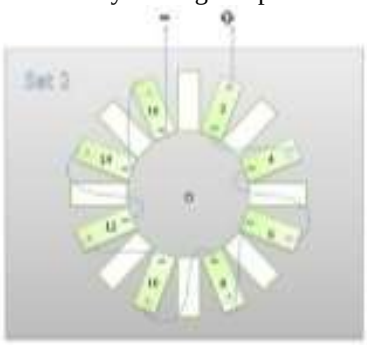

Fig. Set2

+ve terminal of set1 is connected to –ve terminal ofset2 and –ve terminal of set1 is connected to +ve terminal of set2. Thus giving out only two terminals of both +ve and –ve polarities on each terminal.

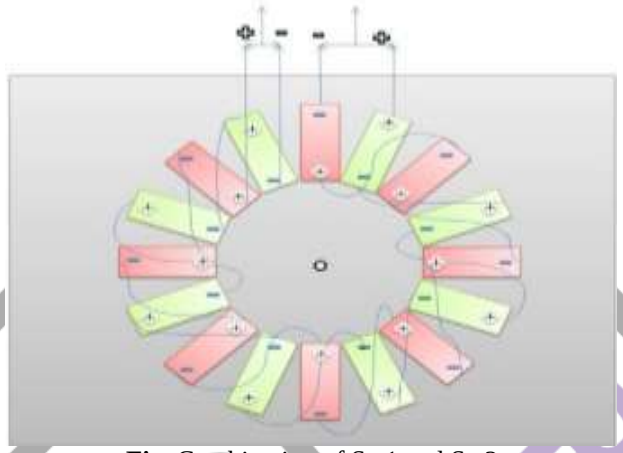

Fig. Combination of Set1 and Set2

Working of AC Solar Generator

There are four cases of operation in an instant of complete cycle of a sine wave.

Case1- At first when window is on set1, it allow sun rays to fall on plates in set1 causing +ve charge on one terminal and –ve charge on another terminal.

Case2- At the instant, when window is at intermediate state between two sets i.e. set1 is partially open and set2 also partially open. At this state, window allows sun rays to fall on both cells at their half portion which cause cancellation of currents at output terminals. Voltage at both the cells has equal magnitude but opposite in direction,
hence cancellation of voltage and current happens there.

Case3- In this case as disc rotates window is on set2, allowing sun rays to fall on plates in set2 causing +ve charge on one terminal and –ve charge on another terminal but with reversed order as in case1.

Case4- Again case4 is similar to case2 where window is at intermediate state between two sets i.e. set1 is partially open and set2 also partially open. But at this state, cycle completes meeting zero magnitude at this instance.

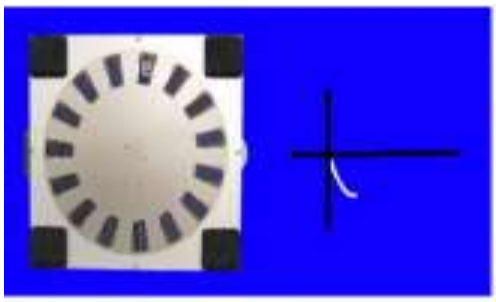

Fig. Case1

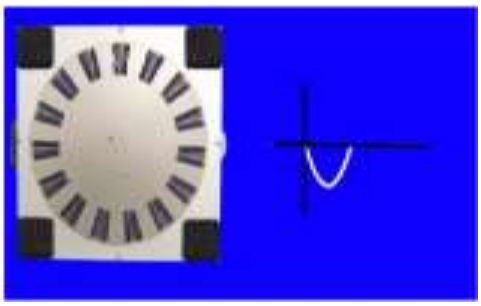

Fig. Case2

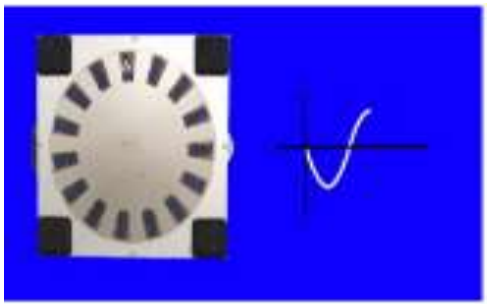

Fig. Case3

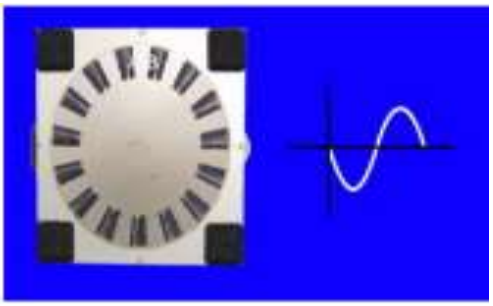

Fig. Case4

While performing the experiment we got the sinusoidal waveform on the CRO screen as shown in figure. It clearly shows that we got the output in AC form without using any converting equipment.

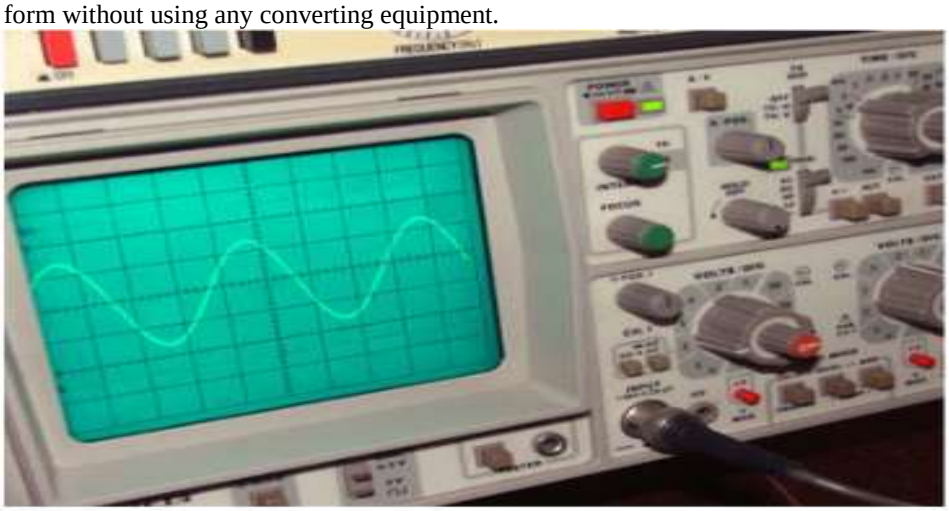

Fig. Sinusoidal AC Waveform

Tracking system

The threat of global warming is getting more and more serious every year, making the use of natural energy sources very crucial. Natural sources of energy, such as sun and wind are readily available. Electric linear actuators are designed to use these sources more efficiently. These solar tracking actuators can have multiple mounting options. To track the solar energy and make the most out of it, solar trackers are used. This helps improve the efficacy or productivity of solar power plants. As the name implies, a solar tracker are fitted with solar panels that are oriented towards the sun. Unlike a stationary solar panel mount, solar tracker, with the help of linear actuators, follows the sun throughout the day to capture as much energy as possible. This helps maximize the output. The position of the sun with respect to the solar panel is not fixed due to the rotation of the earth. For an efficient usage of the solar energy, the solar panels should absorb energy to maximum extent. This can be done only if the panel are continuously placed towards the direction of the sun. So, solar panel should continuously rotate in the direction of sun.

Principle of Sun Tracking Solar Panel

The Sun tracking solar panel consists of two LDRs, solar panel and a servo motor and AT89s52 Micro controller. Two light dependent resistors are arranged on the edges of the solar panel. Light dependent resistors produce low resistance when light falls on them. The servo motor connected to
the panel rotates the panel in the direction of Sun. Panel is arranged in such a way that light on two LDRs is compared and panel is rotated towards LDR which have high intensity i.e. low resistance compared to other. Servo motor rotates the panel at certain angle. When the intensity of the light falling on right LDR is more, panel slowly moves towards right and if intensity on the left LDR is more, panel slowly moves towards left. In the noon time, Sun is ahead and intensity of light on both the panels is same. In such cases, panel is constant and there is no rotation. Out of these flat plate collectors are most widely used. An example being a solar panel. A solar panel is a cluster of solar cells arranged in matrix. These panels can gather power between 10 to 300W.A solar cell is a two layered semiconductor device which is used to absorb the radiation. It works on the principle of photovoltaic, which implies generation of voltage through incident light. When light falls on the layers, it excites the electrons, causing them to jump from one layer to another, forming an electrical charge. The factors which affect the output or the efficiency of the solar panel are as follows:

Direction: Incase of the location being Northern Hemisphere, the panels should face due north and the location being Southern Hemisphere, the panels should face due south.

Tilt or Orientation: Solar Panels must have a tilt equal to the latitude of their location. As the tilt of the earth rotation changes, the solar panels need to be adjusted to get maximum light.

Type of surface: A broader surface is mostly preferred, as it receives maximum amount of sunlight.

To make efficient mounting of the panels, so that they receive adequate sunlight, devices called Trackers are used which point the panels towards the earth.

There are two types of trackers:

1) Active Tracker 2) Passive Tracker
In our solar modified solar AC generator we are using active solar tracking system.

Active Tracker:
An Active Tracker usually consists of motors like a Servo Motor or a Stepper motor to rotate the panel. Ideally solar radiation strikes the panel at 90^0 angles. The motor maintains the panel at that angle, so as to receive the maximum radiation. The control of the motor can be done in either of the two ways. One way is using An electronic system
to calculate the astronomical position of the sun at the particular location and accordingly rotate the solar panel at an orientation perpendicular to the sun at preset time intervals. Another of control is using a sensor arrangement to sense the brightness in the sky and accordingly rotate the panel at right angles to the orientation of the sun. The stepper motor is controlled using the microcontroller 8051, through the relay driver IC ULN2003A. It consists
of the low power panel on its shaft and provides a rotation of 0 to 180^0 rotations in steps of 5 sec interval each. This rotation of the stepper motor corresponds to earth's rotation around the sun, which accounts for 180^0 change in the earth's direction with respect to the sun. The stepper motor is programmed so as to provide 90^0 rotation in most of the time.

Fig. Circuit Diagram of Solar Tracking System

As the static pixel tracking does not change we get the maximum output only when the sun rays are perpendicular to the plates .it is accurate because of less use of technology. In case of dynamic pixel tracking, dynamic pixel can be made to change by an outside influence. Due to that we are able to catch the maximum sunrays all the time so we get the maximum output for all time as shown in the below graph. But the disadvantage of this system is that there are so many possibilities of wrong reports due to small issues may cause collection of wrong data.

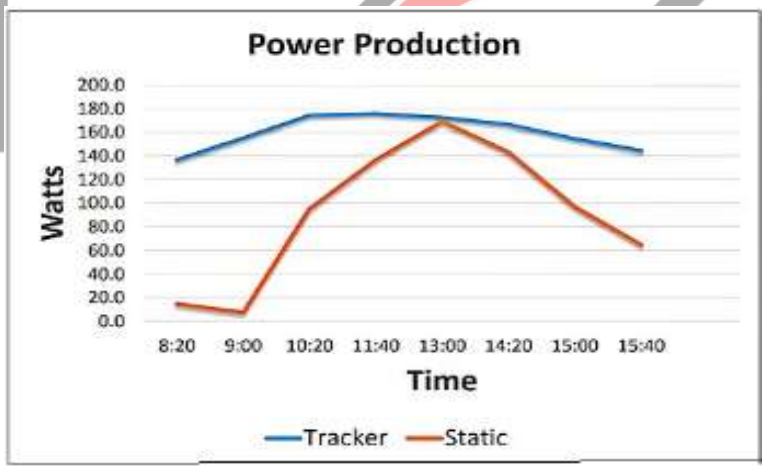

Fig. Static versus Dynamic

	Tracker			Static		
Time	Volts	Amps	Watts	Volts	Amps	Watts
8:20	21.0	6.5	136.5	20.0	0.7	14.6
9:00	22.0	7.0	154.9	21.0	0.3	7.1
10:20	22.0	7.9	174.2	21.0	4.5	94.9
11:40	21.0	8.4	175.6	21.0	6.5	136.5
13:00	21.0	8.2	172.2	21.0	8.1	169.1
14:20	21.0	7.9	166.3	21.0	6.8	142.8
15:00	22.0	7.0	154.2	21.0	4.6	96.6
15:40	21.0	6.9	144.3	21.0	3.1	64.5
17:00	21.0	4.9	102.9	21.0	0.6	11.6
Average	21.3	7.2	153.5	11.7	82.0	82.0
Difference	75 Watts					

Table: Static versus Dynamic

Conclusion

Considering the ever increasing demand of electricity, it has become a need of an hour to encourage the use of renewable sources of energy. Considering their advantages of low cost per unit of generation, less maintenance, reliability, etc. these renewable energy sources are the best alternative for the currently in use nonrenewable source of energy for power generation which are feared of becoming extinct in near future. MODIFIED SOLAR AC SOLAR GENERATOR WITHOUT INVERTER WITH TRACKING SYSTEM provides one such solution.

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