# Review Paper On Direct A.C. Power Generator By Using Solar Cells

**Manojkumar G. Hirwani[1], Souras L. Ghotekar[2], Nikita Paliwal[3]**

[1]*PG Student, Electrical Engineering Department, Vidarbha Institute of Technology, Nagpur, Maharashtra, India*

[2]*Assistant Professor, Electrical Engineering Department, Vidarbha Institute of Technology, Nagpur, Maharashtra, India*

[3]*Assistant Professor, Electrical Engineering Department, Vidarbha Institute of Technology, Nagpur, Maharashtra, India*

## 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%.This paper deals with the design and execution of a solar tracker system dedicated to the PV conversion panels. The proposed single axis solar tracker device ensures the optimization of the conversion of solar energy into electricity by properly orienting the PV panel in accordance with the real position of the sun. The operation of the experimental model of the device is based on a DC motor intelligently controlled by a dedicated drive unit that moves a mini PV panel according to the signals received from two simple but efficient light sensors. The performance and characteristics of the solar tracker are experimentally analyzed.*

**Keywords:** *Solar energy, Solar cells, AC solar generator, DC motor, Series opposition connection, Electric load, Solar panel, Spinning disk, pwm, PVC, Solar tracker system, design and execution, experimental investigations.*

## 1. 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. The technology cannot however increase generation of power when the sun is not aligned with the system. Solar tracking is a system that is mechanized to track the position of the sun to increase power output by between 30% and 60% than systems that are stationary. It is a more cost effective solution than the purchase of solar panels. There are various types of trackers that can be used for increase in the amount of energy that can be obtained by solar panels. Dual axis trackers are among the most efficient, though this comes with increased complexity. Dual trackers track sunlight from box axes. They are the best option for places where the position of the sun keeps changing during the year at different seasons. Single axis trackers are a better option for places around the equator where there is no significant change in the apparent position of the sun. The level to which the efficiency is improved will depend on the efficiency of the tracking system and the weather. Very efficient trackers will offer more efficiency because they are able to track the sun with more precision. There will be bigger increase in efficiency in cases where the weather is sunny and thus favorable for the tracking system.

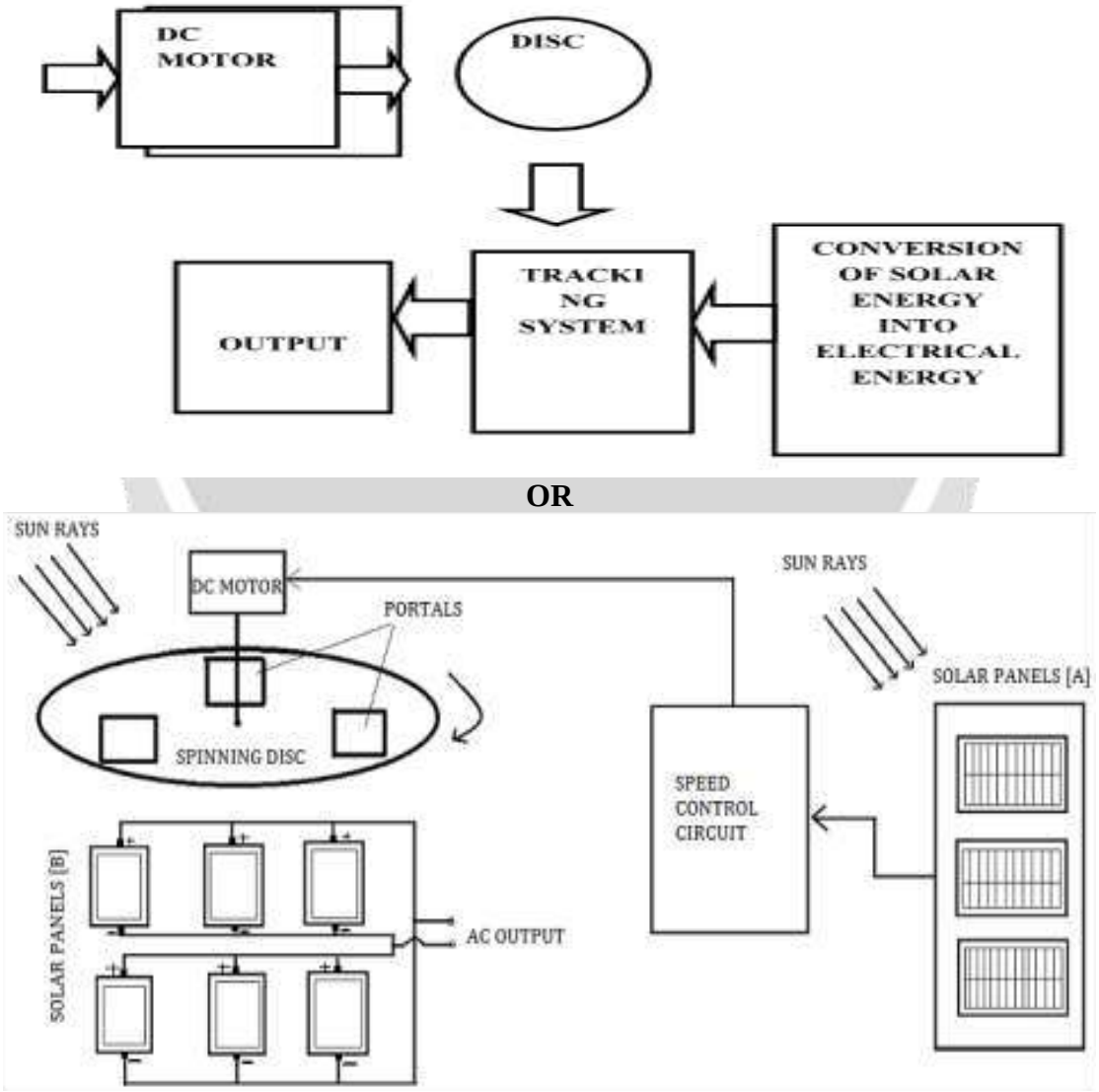


**Fig.** 1.1 Block Diagram of AC Solar Generator

## 2. Literature Survey

The present invention is a system, device and method for directly generating alternating current electricity from photovoltaic cells. The system, device and method mechanically gradually exposes and shades photovoltaic cell pairs connected in anti-parallel to sunlight to generate alternating current electricity at an AC junction of the solar cell pairs. Gradually and alternately exposing and shading the two anti-parallel connected solar cells of each solar cell pair causes the amplitude and polarity of the electricity at the AC junction to gradually rise and fall to produce alternating current electricity. The gradual, alternating exposure and shading of the two anti-parallel solar cells is accomplished by mechanically covering and exposing the solar cell pairs. In particular, while one solar cell of an anti-parallel connected solar cell pair undergoes gradual exposure to sunlight from 0% exposure (100% shaded) of the solar cell electricity generating area to 100% exposure (0% shaded) of the solar cell electricity generating area, the other solar cell of the solar cell pair undergoes gradual shading from sunlight from 0% shaded (100% exposure) to 100% shaded (0% exposure). Such gradual, alternating exposure and covering of each solar cell of each anti-parallel connected solar cell pair is periodic. The rate of exposure and shading determines frequency. In one form, a rotating disc situated over the solar cell pairs has spaced apart openings forming coverings between each opening to alternately expose and shade the solar cell pairs during rotation. A direct current motor is utilized to rotate the segmented disc. The motor is preferably powered by separate solar cells. The present invention also provides a phase synchronizer for maintaining a desired alternating current frequency. The phase synchronizer controls the motor to control rotation of the segmented disc. The present invention makes solar energy a viable, cost effective, environmentally friendly option for residential and/or commercial use. The present invention is capable of being used on a minute, small or large scale through appropriate scaling the solar cell ac electricity generating and/or the use of a plurality thereof. Solar cell AC electricity generation arrays can easily produce the power equivalent to an average power plant today, while being environmentally friendly enough to be located proximate a playground, school or in any urban environment. Large scale solar cell AC electricity generating arrays can be easily set up even in the most remote places in the world.

## 3. System Development

### 3.1 Solar Panel (A)

Solar panels (A) produce the DC power to drive the DC motor and it acts as source to speed control circuit.

**Fig.** 3.1.1 Solar Panel (A)

### 3.2 Speed Control Circuit

Speed control circuit consisting of different electronics components such as Transistor TIP122 for switching purpose, Regulator IC 7805 for constant voltage regulation, Op-amp IC LM358.

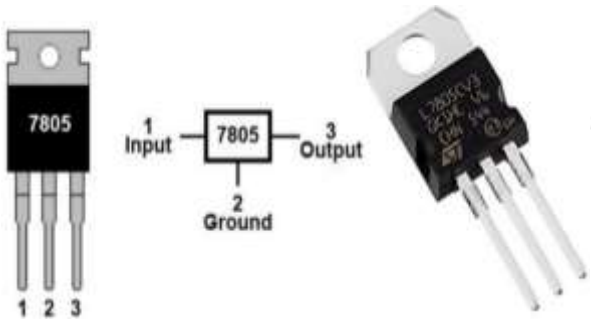


**Fig.** 3.2.1 Regulator IC 7805

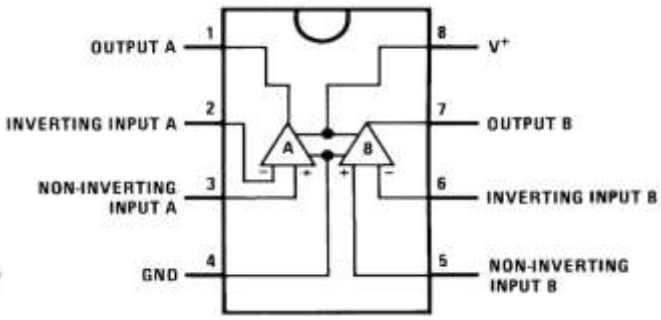


**Fig.** 3.2.2 Op-amp IC LM358

### 3.3 DC Motor and Spinning Disc

The permanent magnet dc motor is used for the rotation of disc. Which is mounted above the solar panels is a spinning disc. The dc motor gets its power from three solar panels mounted in the corner on the based. The disc has the three portals cut into it allowing light to passing through to every other solar panels below it. As the disc spins each of the banks of solar panel half way between the two panels, the voltage cancel and drop to zero, the resulting voltage is sinusoidal or AC.

**Fig.** 3.3.1 DC Motor

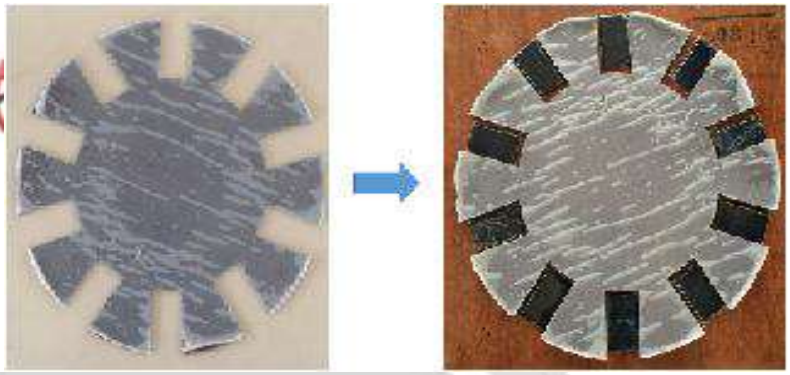

**Fig.** 3.3.2 Spinning Disc

### 3.4 Solar panels (B)

The six solar panels (B) are installed on the based and arranged in a circular shape, below the above disc. Each of three solar panels are connected in parallel with an angle of 120 degree. These two parallel pair of solar panels are connected in Anti-parallel. So that these anti-parallel connection of solar panels produces the resulting voltage is in the form of sinusoidal or AC.

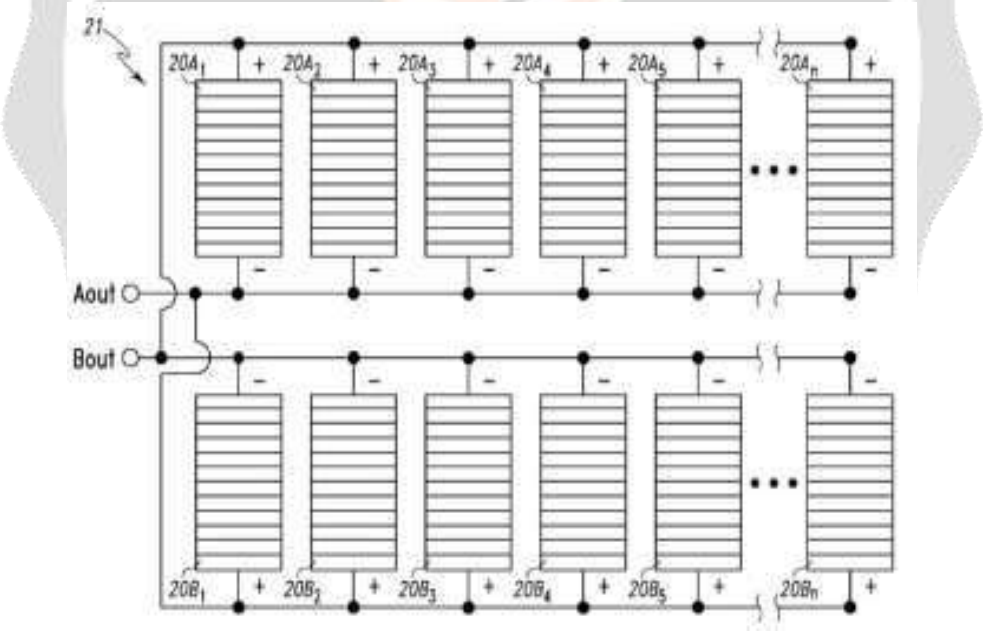


**Fig.** 3.4.1 Solar Panels (B)

### 3.5 Light Dependent Resistor (LDR)

An LDR or light dependent resistor is also known as photo resistor, photocell and photo conductor. It is a one type of resistor whose resistance varies depending on the amount of light falling on its surface. When the light falls on the resistor, then the resistance changes. These resistors are often used in many circuits where it is required to sense the presence of light. These resistors have a variety of functions and resistance. For instance, when the LDR is in darkness, then it can be used to turn ON a light or to turn OFF a light when it is in the light.

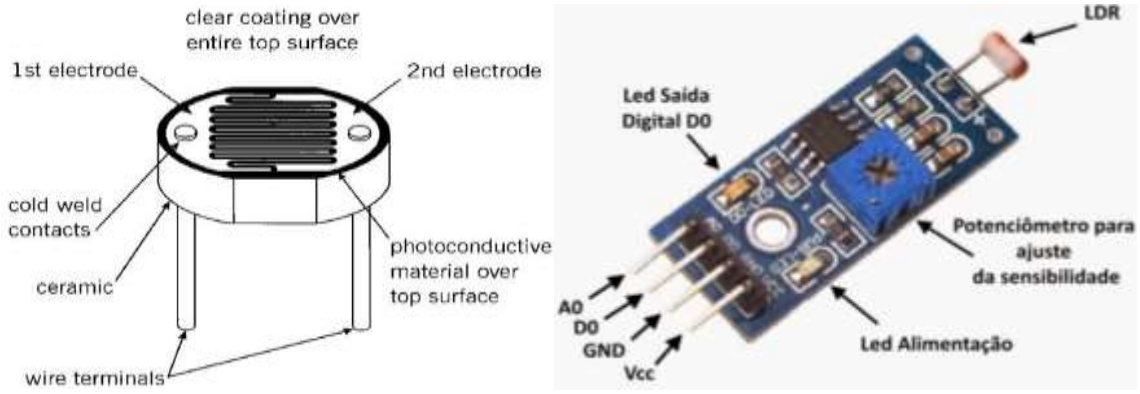


**Fig.** 3.5.1 Light Dependent Resistor

### 3.6 Motor Driver L293D

A L293D is an integrated circuit chip which is usually used to control motor. L293D or Motor driver act as an interface between 89C51 and the motor. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor. We will referring the motor driver IC as L293D only. The L293D is a 16 pin IC, with eight pins, on each side, dedicated to the controlling of a motor. There are 2 INPUT pins, 2 OUTPUT pins and 1 ENABLE pin for each motor.

**Pin No. - Pin Characteristics**

1 - Enable 1-2, when this is HIGH the left part of the IC will work and when it is low the left part won't work.
2 - INPUT 1, when this pin is HIGH the current will flow though output 1
3 - OUTPUT 1, this pin should be connected to one of the terminal of motor
4, 5 - GND, ground pins
6 - OUTPUT 2, this pin should be connected to one of the terminal of motor
7 - INPUT 2, when this pin is HIGH the current will flow though output 2
8 - VCC2, this is the voltage which will be supplied to the motor.
16 - VCC1, this is the power source to the IC. So, this pin should be supplied with 5 V
15 - INPUT 4, when this pin is HIGH the current will flow though output 4
14 - OUTPUT 4, this pin should be connected to one of the terminal of motor
12, 13 - GND, ground pins
11 - OUTPUT 3, this pin should be connected to one of the terminal of motor
10 - INPUT 3, when this pin is HIGH the current will flow though output 3
9 - Enable 3-4, when this is HIGH the right part of the IC will work and when it is low the right part won't work.

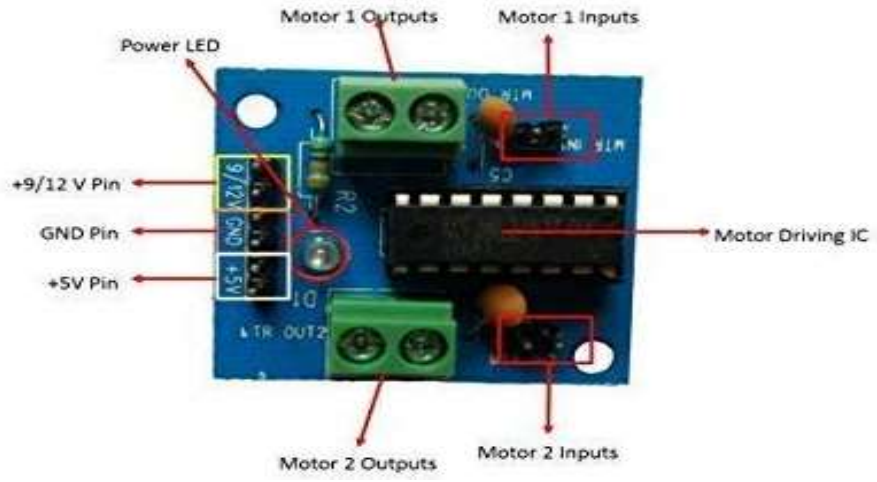


**Fig.** 3.6.1 Motor Driver L293D Circuit

## 4. Circuit Diagram and Description

The circuit actually utilizes the power from the solar panel (A). The main working of circuit is to control the speed of DC motor. This can be achieved by operating op-amp IC LM358 in an inverting mode and variable resistor from non-inverting terminal is such set to make the speed constant at variable intensity of light. The transistor TIP122 conducts more when the intensity of light is lower and vice versa. The circuit operates through constant regulation provided by regulator IC 7805 as well as it provides constant voltage to the DC motor.

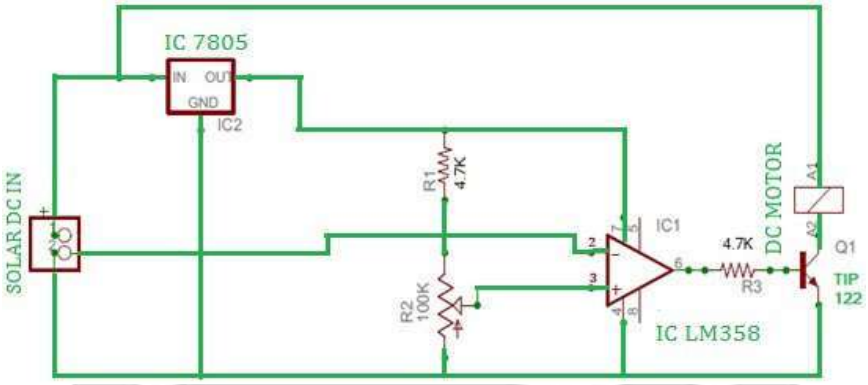


**Fig.** 4.1 Circuit Diagram of DC Motor Speed Control

### 4.1 Circuit Component Description

**Components Values**

OP-AMP (IC1) LM358
Regulator (IC2) 7805
Transistor (Q1) TIP122
Resistor (R1) 4.7kΩ
Resistor (R2) 100kΩ (variable)
Resistor (R3) 4.7kΩ
DC Motor 1000 RPM, 12 Volt, 200mA.

### 4.2 Hardware Description

#### 4.2.1 Photovoltaic/Solar Cells

The arrangement has been done such that the solar cells have been placed in a circular form such that each pair of anti-parallel connected photovoltaic cells of each photovoltaic cell pair progressively and alternately get exposed and shaded producing the amplitude and polarity so as to generate alternating current.

A solar cell, or photovoltaic cell, is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect. 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 panels. Solar cells are described as being photovoltaic irrespective of whether the source is sunlight or an artificial light. They are used as a photo detector (for example infrared detectors), detecting light or other electromagnetic radiation near the visible range, or measuring light intensity. The operation of a photovoltaic (PV) cell requires 3 basic attributes:

- The absorption of light, generating either electron-hole pairs or exactions.
- The separation of charge carriers of opposite types.
- The separate extraction of those carriers to an external circuit.


**Fig.** 4.2.1.1 Arrangement of Solar cells

**4.2.2 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.

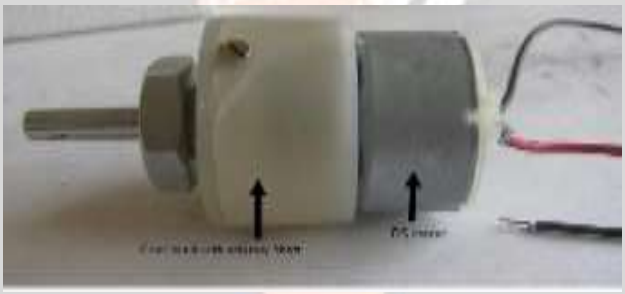

**Fig.** 4.2.2.1 DC Motor

**4.2.3 Spinning/Rotating Disc**

The spinning disc has three portals each 120 degree apart from each other. This disc is coupled to the DC motor shaft and mounted over the solar panel (B). 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. 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. When disc rotates, its portal cuts the sun rays allowing light to pass through it and follow onto the every other solar panels. As the disc spins each of the solar panels are 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.

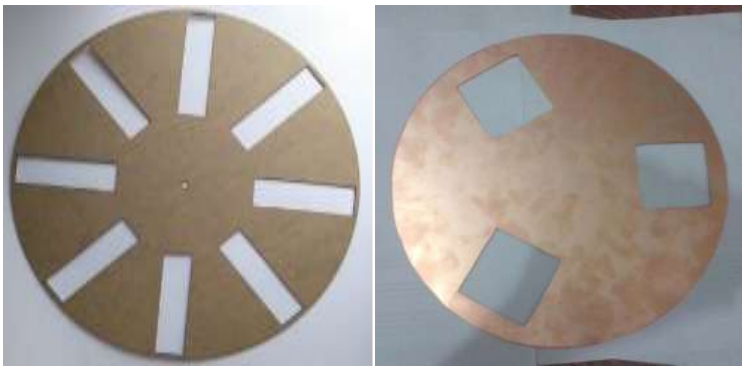

**Fig.** 4.2.3.1 Spinning/Rotating Disc

**4.2.4 Solar Tracker**

A Solar tracker is a device that keeps track of the sun. It follows the path of the sun throughout daytime with the help of sensors. Since the sun's position in the sky changes with time and the altitude angle and azimuth angle varies continuously, solar trackers are used to align the energy collecting system. Solar trackers are used for solar panels in solar power plants where energy generation is desirable up to maximum limit. So, in solar tracking systems, solar panels are mounted on a structure which moves to track the movement of the sun throughout the day. Concentration of heat energy by optical devices (mirror, prism and lens) also requires solar tracking.

**Types of Solar Tracker**

Solar tracking system is classified by its degrees of rotation. According to degrees of rotation trackers can be grouped into two primary categories-

- Single Axis Solar Tracker
- Dual Axis Solar Tracker

- **Single Axis Solar Tracker**

A single axis solar tracker follows the movement of sun either horizontally or vertically. As the name suggests, this type of tracker has only one axis for rotation. The horizontal type solar tracker is used in tropical regions where the sun gets very high at noon, but the days are short. On the other hand, the vertical type solar tracker is used in areas with high latitudes where the sun does not get very high, but summer days can be very long. In concentrated solar power applications, single axis trackers are used with parabolic and linear Fresnel mirror designs.

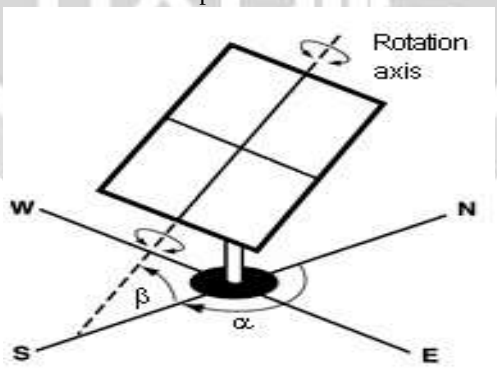


**Fig.** 4.2.4.1 Single-Axis Solar Tracking System

- **Dual Axis Solar Tracker**

A dual axis solar tracker has two degrees of rotation. It can track sun both horizontally and vertically. This type of tracker can be used anywhere in the world and ensures maximum efficiency in gaining solar energy. Concentrated Solar Power (CSP) applications using dual axis tracking include solar power towers and dish systems. Dual axis tracking is extremely important in solar power tower applications because the angle error is crucial for longer distances between the mirror and the central receiver located in the tower structure. Design for dual axis tracking

system is complex than single axis tracking and operation is more energy consuming. However, for large scale solar energy production dual axis tracking is more economic.

- **Advantages of Solar Tracker**

The main advantage of using solar tracker is that it increases the availability of solar power from a location. A feasibility study was performed through an experiment prior to the design of solar tracker and it is found that power generation increased distinctively.

## 5. Result Analysis

### 5.1 Stepwise Experimental Analysis on CRO

In the first diagram, a sequence of representative diagrams illustrating the manner of generating AC electricity from a photovoltaic cell pair of a photovoltaic cell pair array of the photovoltaic AC electricity generation as shown in Fig. 5.1.1.

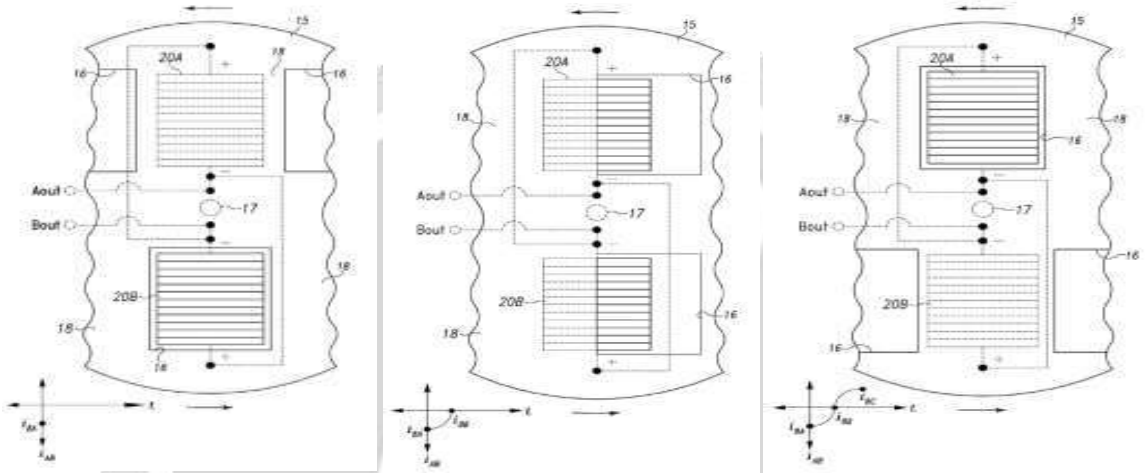


**Fig.** 5.1.1 Output Generation Step 1 **Fig.** 5.1.2 Output Generation Step 2 **Fig.** 5.1.3 Output Generation Step 3

In the second diagram, the sequence of representative diagrams illustrating the manner of generating AC electricity from a photovoltaic cell pair of a photovoltaic cell pair array of the photovoltaic AC electricity generation, as shown in Fig. 5.1.2. In the third diagram, the sequence of representative diagrams illustrating the manner of generating AC electricity from a photovoltaic cell pair of a photovoltaic cell pair array of the photovoltaic AC electricity generation as shown in Fig. 5.1.3. In the fourth diagram, the sequence of representative diagrams illustrating the manner of generating AC electricity from a photovoltaic cell pair of a photovoltaic cell pair array of the photovoltaic AC electricity generation as shown in Fig. 5.1.4. In the fifth diagram, the sequence of representative diagrams illustrating the manner of generating AC electricity from a photovoltaic cell pair of a photovoltaic cell pair array of the photovoltaic AC electricity generation as shown in Figure 5.1.5.

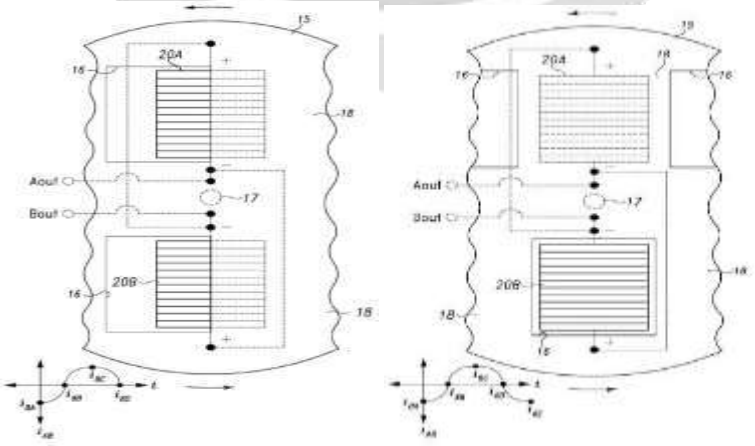


**Fig.** 5.1.4 Output Generation Step 4 **Fig.** 5.1.5 Output Generation Step 5

**5.2 Experimental output**
**5.2.1 Observation table**

Instrument used: Digital Multimeter and CRO

| Day hours | Output Voltage (AC) | Output Current (AC) | Output Power (Watt) |
|---|---|---|---|
| 09:00 – 11:59 | 3.8V (average) | 370mA (average) | 1.41 W |
| 12:00 – 14:59 | 5.8V (average) | 600mA (average) | 3.48 W |
| 15:00 – 17:00 | 5.9V (average) | 620mA (average) | 3.66 W |

**5.2.2 Waveform obtained**

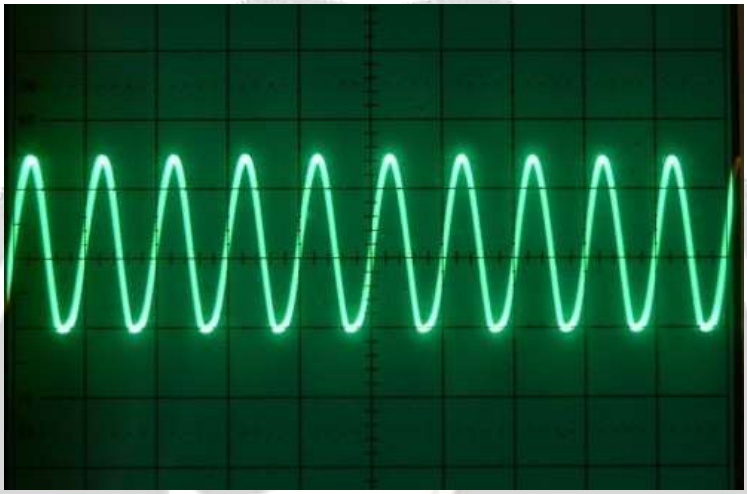

**Fig.** 5.2.2.1 Practically Observed Output Waveform on CRO

## 6. Conclusion

This is truly a transforming technology. The AC solar generation has the potential to reduce the use of fossil fuels tremendously by installing photovoltaic solar power centers around the country generating supplemental power for the grid. By use of this technique, the use of fossil fuels will be reduced as they are limited sources of energy and could not recover. So it is important to redevelop such project that generates power using renewable energy sources. Existing technology requires solar energy to be converted from direct current (DC) to alternating current (AC) before it is compatible with the nation's power grid. The AC Solar Generation seeks to achieve the same result at a lower cost and with less energy loss by producing alternating current directly instead of relying on additional equipment. This invention, when commercialized, will make the cost of solar power more practical and affordable. We have heard about the promise of cheap solar energy now for decades. We would think by now that at least in the world's sunniest areas all the cities would be supplementing their power with clean renewable solar power. In this project a modification in the existing photovoltaic set up is suggested that generates AC power without DC-AC conversion. The losses that take place in this conversion may be reduced by using this technique. 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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