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Solar Plate Indexing To Improve Efficiency of Present Solar Power System

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***Abstract*: Although solar plate are being used from very long ago in the world for generation of power in non-conventional form, but still there is hording of improving efficiency of the currently available stationery solar plates. Solar plate indexing system is also one of such efforts made to improve efficiency of solar power extraction. Survey data say that very few days are left when the all reserves will nearly deplete i.e. till 2050 all the reserves of petroleum products which are available under earth will vanish. Therefore, human being is very much worried about the future energy sources. Aiming the improvement of the efficiency of current energy generating equipment's we have designed to index the solar plate according to the solar track so that perpendicular rays could fall on the plates. We have used 5 watt, 1550 rpm motor to rotate the shaft on which our solar plate is mounted. Electronic cyclic timers have been used to index the plate in the span of 120^0 in the duration if 8 hours a day. On-off switch have been used to start the cycle of rotation of plate. Sunrise and sunset limiting switches have been used to decide the pan of the solar plate. After testing the indexed plate solar system on the real ground we have found the result that current stationery plate after charging for 8 hours in the full sunny-day can give uses of 4 hour whereas our indexed plate on charging for the same duration can deliver 6 hour of service. This result is really encouraging and improving the efficiency of current solar plates**

Keywords: **solar panel, efficient non-conventional energy, indexing mechanism, Concentrator, Gear Train, Solar Tracking, Utilization of Solar Energy.**

I. INTRODUCTION

Energy is the capacity to do work; any kind of activity performed by anyone is governed by the energy. Energy is the major dominating factor in the development and progress of mankind. A nation which generates energy in different ways in large amount can attain high level of industrial growth. To attain high standard of living for the population the country must develop their energy sources. Every country uses variety of sources to meet with its energy needs. In the past few years the rate of consumption of fossil fuels like coal, oil and natural gas is increasing tremendously. The result is that there is fast depleting of fossil fuel resources as there is limited reserve of coal, oil and natural gas. The nuclear energy sources are very expensive and there are long term problems of disposal of radioactive waste, hence the man is searching for alternatives sources of energy. The primary solar energy technologies include photovoltaic, concentrating solar power, and solar heating and cooling systems. Significant developments have taken place in the last few years. New types of cells have been developed, innovative manufacturing process introduced, cost reduced and the volume of production steadily increased. The present annual world production of photovoltaic devices is already about 60MWp, while production in India is about 1.5MWp. As a result of the above developments, solar cells are now being used extensively in many consumer products and appliances, and it possible that in the future they may become one of the important sources of power for providing small amount of electrical energy for localized use, particularly in remote locations. Photovoltaic (PV) devices commonly called solar cells or modules, use semiconductor material to directly convert sunlight into

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electricity. Solar cells have no moving parts-power is produced when sunlight strikes the semiconductor material and creates an electric current is used to power residence and buildings cabins, satellites, highway signs, water pumps, communication stations, street lights, consumer electronics and much more. Since 1988 worldwide PV sales have increased six –fold –to more than 200 million watts in 1999.

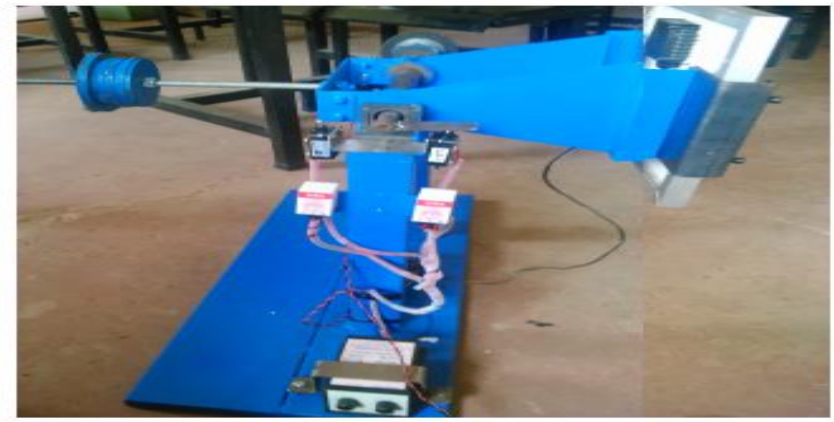
II. EXPERIMENTAL SET UP

The plate gets charged more effectively if it gets the more flux of radiation. That mean to get more flux we have to put our solar plate perpendicular to the radiation that is sun. For this we have to mountain the plate on a shaft and lime to rotate that according to the sun and for this porous we have to provide motor which will perform that task and to operate that motor we will use the solar energy.

Designing of this concept involved several steps. It will include the motor selection, reduction of rpm of motor to desired limit for the specific operation. Designing the timing circuit for the operation. Design of shaft, bearing and all related article like support, base etc. material selection is also very important aspect which is going to be consider during the design.

The solar track indexing mechanisms consist of the following main components:

- Solar panel with battery
- Drive
- Structure
- Operating electronic circuit



Photograph 1: Experimental Setup

A. Solar panel with battery:

Solar panel and CFL with battery is standard components in project. Specification for solar panel are as 10 W 12 V DC and battery. The electronic circuit is used in the battery circuit to isolate battery charging when output is taken from battery.

B. Drive:

The drive mechanism consists of following main components:

1. 12 V DC, 20 rpm P.M.D.C motor with Epicyclic gear for reduction
2. Driver gear
3. 3% Driven gear
4. Bearings with bearing holders
5. Panel mounting stand

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6. Panel 1OW12V DC
7. Bush
8. Counter balance
9. Shaft

A shaft is supported in the bearing. The panel mounting stand is fixed with shaft with the help of bush. At one end of shaft driven gear is fixed which is driven by driver gear, mounted on gear box output shaft. A motor with 20 rpm output Epicyclic gear speed reduction gear box is engaged through driver gear to shaft. Balance weight balances the panel weight at keep system in equilibrium.

C. Structure:

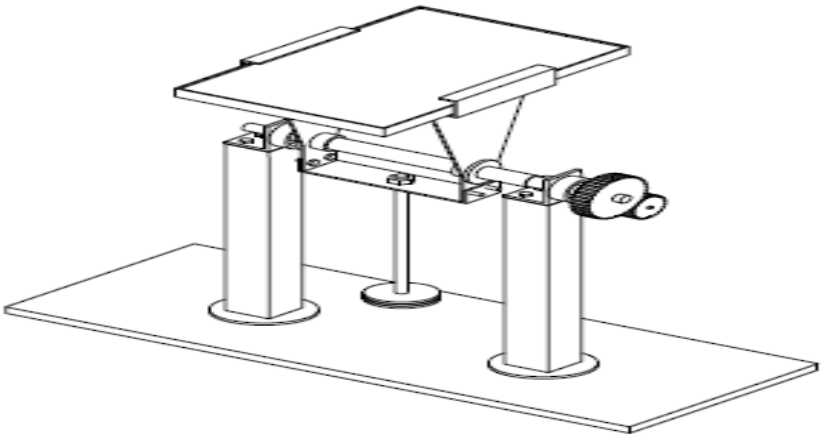

Figure 1: Schematic Diagram Solar Plate Indexing Mechanism.

D. Operating electronic circuit:

The operating electronic circuit is used to index solar panel periodically for required degree. Approximately we can say that the total 180° angle is divided in 12 parts i.e. 12 indexing deviations i.e. 15° per indexing. This achieved by on-off cyclic timer. The input voltage is 12V DC which is directly obtained by 12V DC battery.

Components:

1. 12 V DC motor with Epicyclic gear box for reduction.
2. Operating electronic circuit.
3. 12 V DC battery
4. Toggle switch
5. Drive
6. Shaft
7. Sunrise limit switch
8. Sunset limit switch

For starting the circuit we need to on the toggle switch and set the on-off cyclic timer for required on timing and off timing. The two limit switch are used for

1. Sunrise position and
2. Sunset position

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The sunrise position limit switch is operated at starting time and gives starting pulse to electronic circuit. The sunset position limit switch is operated at end time and gives reset pulse to electronic circuit. These two limit switches are operated by drive mechanism itself.

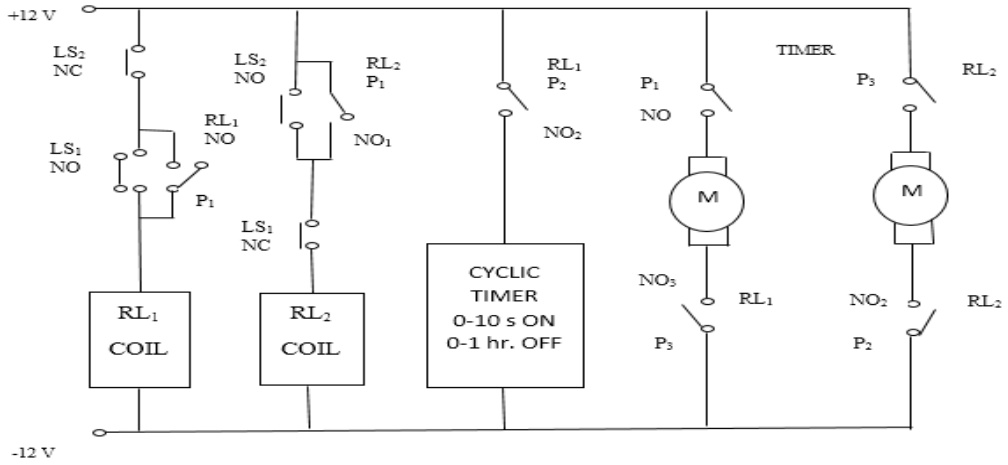

Figure 2: solar plate indexing circuit diagram

Testing Procedure:

1. To convince the result of proposed mechanism, the setup is set to compare the efficiency of our solar tracker with respective stationary or without solar tracking mechanism.
2. The Stationery and tracking mechanism readings are taken on same setup only, every intermediate day.
3. For Controlling the movement of solar tracker a cyclic timer (On-Off) is used.
4. The power measurement is taken by multi-meter and voltage readings of both panels the stationery and with tracker mechanism is acquired.
5. The testing mechanism or the solar tracking mechanism has movement of 15° per hour from 6 am to 6 pm.
6. Significant error were occurred only just after starting or before stopping the setup.
7. At the end of the cycle the setup resets to its original position which is towards the east direction
8. For voltage variation measurement, measure the voltage rating of panel each hour with multi-meter and plot the result observation table.
9. For discharge measurement we used a 12v 5w DC lamp and used it to discharge the battery completely
10. Efficiency was measured by calculation the discharge time per the time allotted for battery to charge.

III. DISCUSSION

1. The average reading of every hour is taken of both, it was found that the average power output of solar panel with tracking mechanism was more than stationary one.
2. Thus, increasing in the efficiency was calculated.
3. Constant angle between 80° to 100° with respect to sun rays was obtained.
4. A solar tracker was proposed, designed and constructed. The final design was successful, in that it achieved an overall power collection efficiency increase from only 30% for a fixed panel to over 60% for the same panel on the tracking device.
5. As per to show the variation and energy gains the graphs were plotted as per the results achieved during the tests.

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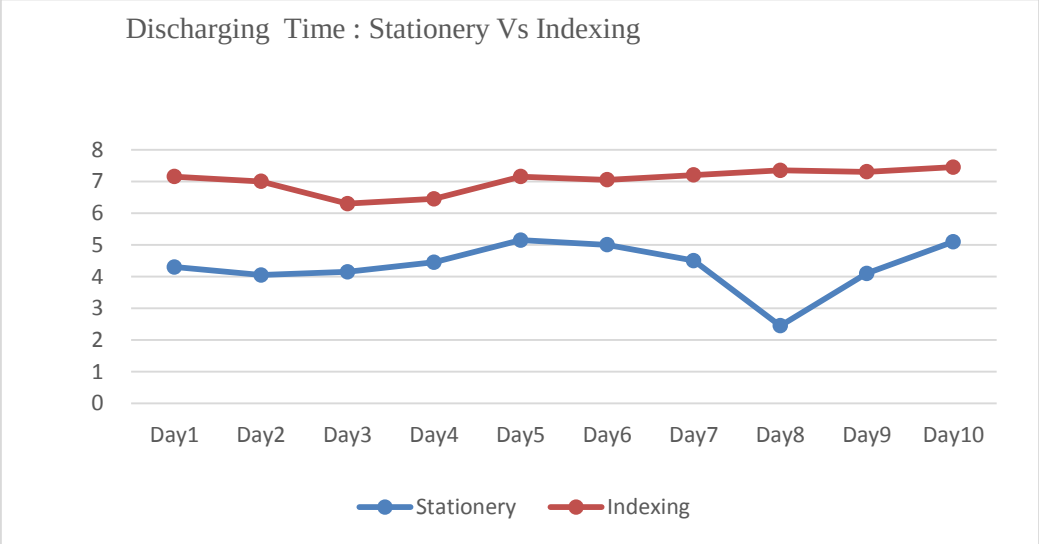
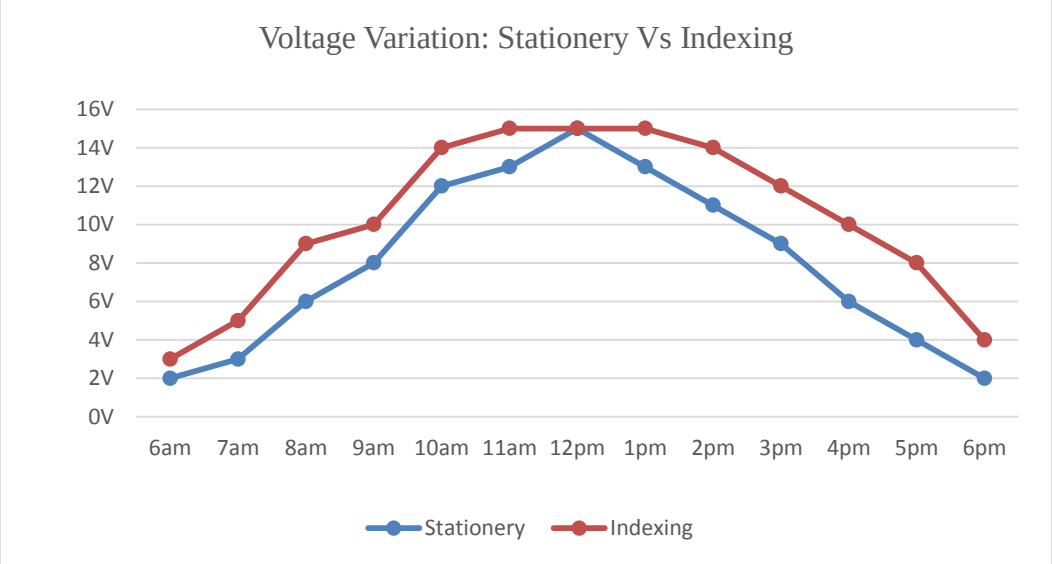
6. In terms of real value, this means that the overall cost of a system can be reduced significantly, considering that much more power can be supplied by the solar array coupled to a solar tracking device.
7. By extracting more power from the same solar panel, the cost per watt is decreased, thereby rendering solar power much more cost-effective than previously achieved using fixed solar panels.
8. A single axis tracker such as the one made offers a great power increase over a fixed solar panel, but a two-axis tracker would provide more power still. This could be a subject for further development.
9. Solar tracking is by far the easiest method to increase overall efficiency of a solar power system for use by domestic or commercial users.





IV. CONCLUSION

Upon completion of the solar plate indexing mechanism, it was tested to make sure that it met design requirements and specifications which were calculated theoretically. It functioned properly according to design calculations. Test showed that power used by plate indexing mechanism is less than the power gain by tracking the sun. The most important conclusion of this research is the total cost of construction of the solar plate indexing mechanism is very low. This means the system can be mass produced at lower cost and at affordable rate in the developing countries and can be used more for domestic purposes.

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