IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
National Conference on Emerging Trends in Renewable Energy NCETRE 2016
Dhirajlal Gandhi College of Technology, Salem
Vol. 4, Special Issue 3, April 2016

Solar Energy Collection using Spherical Sun Power Generater

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Abstract: This paper suggests a new concept of solar collection that prints the solar cells directly onto a spherical surface, or a balloon. It can be used for substitution of the depleting of fossil fuels in thermal applications and electricity generation through thermal route. Usually the concentrated solar power means focusing the sun's energy from a large area into a smaller area, which generates a lot of heat that can be used to produce electricity. Solar power is the conversion of sunlight into electricity, either directly using photovoltaic (PV), or indirectly using concentrated solar power (CSP). Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaic convert light into an electric current using the photovoltaic effect.

Keywords: Spherical surface; electricity; photovoltaic; concentrated solar power.

I. INTRODUCTION (SPHERICAL SUN POWER GENERATOR)

The Sun is the main energy source of the Earth. All fossil fuels used today are indirect forms of solar energy. Most of the renewable energy sources, such as winds and ocean waves, also exist because of the sun. Therefore, collecting energy directly from the sun is an intuitive approach. Currently, photovoltaic (PV) based solar module development started with rigid silicon solar cells. Therefore, flat-panel type solar energy collectors have their technology advantages in manufacturing and installation.

However, in city or residential areas, the flat-panel solar collector has its limitations. For examples, the solar panels should always face true south if they are in the northern hemisphere. But the space for an ideal installation may not always be available. Even if they can face the right direction, nearby higher buildings may block the sunrays from that direction. Additionally, the sun's angles in the sky vary according to the days in the year and the inclination of the panel can only be made optimal in certain times during the year. To most solar collectors, the sun-tracking system is too expensive and impractical, and some cannot even adjust their inclinations manually.

A new idea can solve the above problems: forming the solar cells onto a spherical thin shell and enveloping it around a balloon. When the balloon is raised to a certain height, it will not be blocked by the surrounding buildings and can receive the sunrays from all directions in all seasons. The term "solar balloon" has two different meanings. One is a balloon that absorbs solar energy to heat the air inside the balloon and increase its buoyancy. It is just one type of the hot-air balloons and it has a long history. Recently, its usage has been expanded to space missions[1-4].

The second definition of solar balloon refers to a balloon that is used to collect solar energy for other applications. This type of balloon is also called a "solar collector".

One example of a solar collector is the solar turbine suggested by Papageorgiou—using a floating "solar chimney" to generate hot air and drive a turbine [5]. Another concept has been developed by Cool Earth Solar [6] that uses a large balloon with one side clear so that the sunray can enter the shiny inside of the balloon serving as a mirror that focuses the solar energy to a photovoltaic cell, thus generating electric power.

II. OVERVIEW

A. Renewable Energy

Renewable energy is energy generated from natural resources-such as sunlight, wind, rain, tides and geothermal heat-which are renewable (naturally replenished). Renewable energy technologies range from solar power, wind power, hydroelectricity/micro hydro, biomass and biofuels for transportation.

B. Spherical-Surface Solar Collector

The spherical coordinate system (r, θ, φ) is used, where the radius r is a constant, θ is the azimuthal angle in the x-y plane, and φ is the zenith angle from the positive z-axis, as shown in Fig.1.

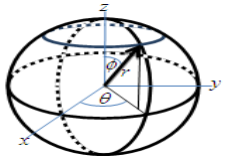

Fig.1Spherical Coordinate System

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At any point on the spherical surface, the unit normal vector is given by n n = (cosθ sinφ)i + (sinθ sinφ)j + (sinφ)k, where (i, j, k) are the unit vectors of the x-y-z coordinate system.
Because of the symmetry of a sphere, the sunrays can come in any direction and will not affect the results. Assuming the sunrays come in along the x-axis, the coefficient of incident at (r, θ, φ) is given by

$$\cos\lambda = \cos\theta \sin\varphi \qquad (1)$$

III.SPHERICAL SUN POWER GENERATOR

A. Concept
Spherical sun power generator is the recent technique employed using solar energy. German Architect Andre Broessel believes that he 'can squeeze more juice out of the Sun'. Even during night hours and in low light regions, resulting in the creation of this new type generator.

Combines spherical geometry principle with dual axis tracking system. Allowing twice yield of conventional. Fully rotational and suitable for inclined surfaces, walls.

B. Advantages of Spherical Shape
• **Larger Exposition to the Sun Rays:** As power plant has spherical shape, its larger area is always exposed to sun rays. Due to this large amount of electricity can be produced leading to maximum use of power plant. Also this leads to proper utilization of equipments. Due to this maintenance cost of power plant is reduced comparatively as power plant with other shape.

• **Gravitation Inside:** Due to the continuous periodic rotation of solar power plant gravitation inside it can be maintained much effectively. The main advantage for spinning of power plant is to create gravitation inside it.

C. Structure
The typical structure of Spherical Sun Power Generator is shown in Fig.2.

Fig.2 Structure of Spherical Sun Power Generator

According to the designer the transparent sphere is able collect and concentrate diffuse where traditional devices cannot and as well as providing an efficiency boost, they can be used in far more locations than their flat, fixed counterparts. It's also claimed that by concentrating the sun's light in one area, which reduces the solar cell surface required to just 1 percent of that required by a traditional panel.

D. Working
The working of Spherical Sun Power Generator is shown in Fig.3.

Fig.3Working of Spherical Sun Power Generator

"The beta Ray comes with a hybrid collector to convert daily electricity and thermal energy at the same time. While reducing the silicon cell area to 25% with the equivalent power output by using our ultra-transmission Ball Lens point focusing sun, solar panels tend to be aesthetically uninspiring.
The operation of Spherical Sun Power Generator is shown in Fig.4.

Fig.4 Operation of Spherical Sun Power Generator

Solar start-up Raw lemon aims concentrator; it operates at efficiency levels of nearly 57% in hybrid mode. At night time the Ball Lens can transform into a high-power lamp to illuminate your location, simply by using a few LED's. The station is designed for off grid conditions as well as to supplement buildings' consumption of electricity and thermal circuits like hot water."

E. Special Features
- Designed for off-grid conditions as well as to supplement building's consumption of electricity
- Modular collector system charges and stores energy during daylight hours
- Can even collect energy from the moon during night hours

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- Suitable anywhere with access to the sky
- Multi Junction Cells are used-making suitable for different wavelength
- Size of Solar Panel is reduced. Independent of the position the Sun

F. Advantages
- Electrical output is twice the conventional
- Effective use of Solar Energy
- Efficiency is 57%
- Less number of LED's used
- Usage of silicon cells are 25% reduced

G. Disadvantages
- Cost of Lens is high
- Materials required to design will be more

H. Applications
- Can even be used as an electric car charging station
- Motors are operated using electrical energy stored in the Rechargeable batteries

Fig.5Application of Spherical Sun Power Generator

IV. CONCLUSION

Based on the above analysis, the following conclusions can be reached:

1. Due to the seasonal changes of the sun position in the sky and only a shorter time in a day that the flat-panel collector can see the sun, the advantage of the flat-panel collector is not that much.
2. The back-side of the spherical surface can collect significant amount of scattered radiation and reflected solar energy that makes it as efficient as the flat panel without occlusion.
3. Considering the occlusion factor, the spherical-surface collector can be the better choice in certain situations.

Besides the efficiency consideration, the balloons coated with the PV solar collectors have other features that make them attractive.

For example:

1. It is light and portable.
2. It is easier to be taken in bad weather.
3. It can be decorated and made a beautiful scene.

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BIOGRAPHIES

M. Devaraj was born in Salem on June18, 1997. Currently he is pursuing UG degree in Electrical and Electronics Engineering at Dhirajlal Gandhi College of Technology, Salem. He has received awards/prizes for innovative projects and circuit debugging event etc., His research interest involves in electronics, electrical machines, renewable energy resources.

S. Shanmuga Priyan was born in Salem on January 26, 1989. He received the Diploma in Electrical and Electronics Engineering in 2007 from Thiagarajar Polytechnic College, Salem. He received the B.E degree in Electrical and Electronics Engineering in 2010 from Arunai Engineering College, Tiruvannamalai, Anna University – Chennai and received the M.E degree in Power Electronics and Drives in 2013 from K.S.Rangasamy College of Technology, Tiruchengode, Anna University - Chennai. Currently he is working as an assistant professor in the department of EEE at Dhirajlal Gandhi College of Technology, Salem. He has received workshop grant from ISTE. He has published 13 papers in international/national conferences, journals. His research interest involves in power electronics, control of electrical machines, inverter fed drives.