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(71) Applicant and
(72) Inventor: **COBERT, David, M.** [US/US]; 2700 Nielson Way, No. 1233, Santa Monica, CA 90405 (US).

(74) Agent: **SOKOLSKI, Edward, A.**; Law Office of Edward A. Sokolski, 3868 Carson Street, Suite 105, Torrance, CA 90503-6706 (US).

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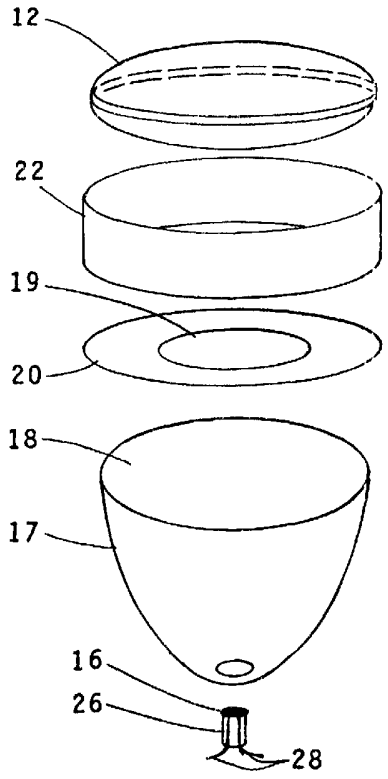
Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SOLAR ENERGY COLLECTION SYSTEM



(57) **Abstract:** Sunlight is localized at a solar cell (16) by means of a lens (12) in conjunction with a solar energy trap (17) with very low losses. The lens (12) is a standard magnifying lens which concentrates the sunlight to a spot which is a small percentage of the total area of the lens. The lens (12) is fixed at a tilt angle which is in accordance with the latitude of the site of the solar collection. The daily arc of the sun across the face of the lens (12) produces a smooth arc path of the spot in three dimensional spaces. At or near the smooth arc in space, a guide which may be a secondary mirror surface or an opening guides the light into a solar trap (17). The solar trap (17) is a fully mirrored enclosed space which permits light to enter but not leave the trap.

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SOLAR ENERGY COLLECTION SYSTEM

SPECIFICATION

This application claims the benefit of Provisional Application no. 60/387,731 filed June 11, 2002.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a system for generating electrical energy from solar energy and more particularly to such a system which employs a solar cell onto which solar light is concentrated.

2. Description of the Related Art

Devices for generating electric energy from solar energy are well known in the art and as described in patent no. 6,057,505 issued May 2, 2000 may employ a compartment, a "cusp" or trap having mirrored sides which receives the solar energy and by means of a lens located **within** the compartment or trap concentrates the received solar energy onto a solar cell within the compartment. Such prior art devices generally require the tracking of the sun both in longitude and latitude on a daily and seasonal basis to obtain the needed concentration of solar energy, increasing the complexity and cost while decreasing reliability. This is because if the sunlight is not concentrated **before** it enters

the compartment by tracking the sun, as mentioned above, it does not have the intensity in the compartment that is needed for proper operation of the system.

SUMMARY OF THE INVENTION

The device of the invention overcomes the shortcomings of the prior art in obviating the need for tracking the sun to provide the solar energy needed to excite the solar cell sufficiently to provide the needed electrical power. This end result is achieved by concentrating the sun's rays by means of a lens which is external of the compartment in which the solar cell is mounted. The sun's rays can thereby be concentrated by the lens to a spot on the mirrored wall of the compartment and reflected from the compartment wall onto the cell. The lens is fixed at a tilt in accordance with the latitude of the site. The daily arc of the sun across the face of the lens produces a smooth three dimensional arcuate path of the spot. Though the spot size and shape will change in accordance with the angle of the sun relative to the lens, the concentration will still remain substantial.

It is therefore an object of this invention to provide a simpler less complex and less expensive system for concentrating solar energy onto a solar cell to generate electrical energy;

It is a further object of this invention to provide a solar energy collection system in which the solar energy is focused onto the solar cell by means of a lens which is external to the compartment in which the solar cell is mounted thereby obviating the need to constantly adjust the positioning of the system with changes in the relative position of the sun.

Other objects of the invention will become apparent from following description taken in connection with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG 1 is a schematic drawing illustrating the operation of the system of the invention;

FIG 2 is a diagrammatic view of a preferred embodiment of the invention;

FIG 2A is diagrammatic view illustrating the operation of the mirror surface of the compartment of the preferred embodiment;

FIG 2B is a diagrammatic view illustrating the operation of the preferred embodiment with changes in the position of the sun; and

FIG 3 is an exploded perspective view of the preferred embodiment.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG 1, a schematic drawing illustrating the operation of the system of the invention is shown. The rays of the sun 11 strike lens 12, which is a standard magnifying lens and are focused onto a spot 13 which is within a compartment or trap. The lens is fixed at a tilt angle which is in accordance with the latitude of the site. The daily arc of the sun across the face of the lens produces a smooth arc path 14 in three dimensional space. At or near this arc path is either a secondary mirrored surface or an opening to guide the light into the solar trap.

Referring now to FIGS 2, 2A and 2B, a preferred embodiment of the invention is illustrated schematically. The solar light rays are focused by lens 12 onto spot 13 located within light trap or compartment 17. The insides walls of the light trap are mirrored so that the rays are reflected onto solar cell 16 which generates electrical energy. As previously pointed out, the focused spot moves along the arc path 14 of the sun during the day. At or near the "arc" formed in space is either an opening or a secondary mirror surface to guide the light into the light trap 17. The shape of the secondary mirror or opening will tend to adjust the concentration and direction of the light energy to optimize its use so as to increase efficiency and enable the use of a less expensive solar cell. The shape of the light trap 17 may be parabolic in cross section, spherical with a circular cross section or a modified hybrid shape such that the collection of light energy at the solar cell 16 is optimized. FIG 2A illustrates the reflection of light from the sides of the trap to the solar cell while FIG 2B illustrates the arc path 14 for the sun during summer and winter.

Referring now to FIG 3, a preferred embodiment of the invention is illustrated. Lens 12 is mounted on the very top of the assembly and concentrates the light energy from the sun through aperture 19 formed in circular plates 20. Aperture 19 has an optical coating thereover which permits the passage of light therethrough from above but partially reflects light coming back from the trap. This end result is achieved by means of an optical half wavelength optical coating beneath a dielectric plate which enhances reflection of light back into the trap and a quarter wavelength optical coating above the dielectric plate which tends to enhance the passage of light from the lens into the trap. Plate 20 has a light reflective mirrored bottom surface. The concentration of the light energy need not be at a focal point when entering the aperture. The lens may be a

standard magnifying lens, a Fresnel type lens or other type of light concentrating lens and may be round(as shown) elliptical , rectangular or irregular in general shape when looking in the direction of the light path. A covering plate may be employed to keep the lens surface clean.

A standoff 22 on which the lens is mounted holds the lens above plate 20 to allow some degree of light concentration before the light energy passes through aperture 19. Standoff 22 may be of metal or plastic and may have an inner reflective surface.

After the light energy has passed through aperture 19, it enters light trap or compartment 17 which has an inner mirrored surface 18. As previously noted the shape of the trap may be parabolic in cross section, spherical with a circular cross section, conical or a modified hybrid shape to optimize the collection of light energy by the solar cell. Trap 17 may be fabricated of a reflective metal with a polished interior or of a plastic or dielectric material with a mirrored inner surface. Light energy that does not hit the solar cell 16 directly on first pass will be reflected back towards the apertured plate 20 and will be reflected back by the mirrored bottom surface of the plate towards the solar cell. Partial reflection is also provided in the downward direction by the quarter wave optical coating covering aperture 19, as mentioned above.

The solar cell 16 is mounted on a clear plastic standoff 26 or in the alternative by a standoff made of glass, Plexiglas with liquid or gaseous cooling. The electric leads 28 can be connected to an inverter, to a device utilizing direct current or to a storage battery or the like.

While the invention has been described and illustrated in detail, it is to be understood that this is by way of illustration and example only and is not to be taken by

way of limitation, the spirit and scope of the invention being limited only by the terms of the following claims.

I CLAIM:

-1-

A system for generating electrical energy from solar energy comprising

a compartment having an open top portion and inner walls which have high light reflectivity;

a solar cell mounted within said compartment;

a lens being mounted above the open top portion of said compartment;

a standoff member for separating the lens from the compartment, the bottom end of said standoff member being opposite the open top portion of said compartment, the lens being mounted on the top end of said standoff member; and

a plate member having an aperture formed therein mounted between the bottom end of said standoff member and the open top portion of said compartment, the solar energy passing through said aperture;

solar energy being concentrated by said lens at a spot along the inner walls of said compartment and reflected from the inner walls of said compartment onto said solar cell, said solar cell thereby generating electrical energy.

-2-

The system of claim 1 wherein an inner wall of said plate member is light reflective

-3-

The system of claim 1 wherein the aperture of said plate member has an optical coating thereon which permits the passage of solar energy coming from said lens there through to said compartment and minimizes the escape of solar energy from said compartment.

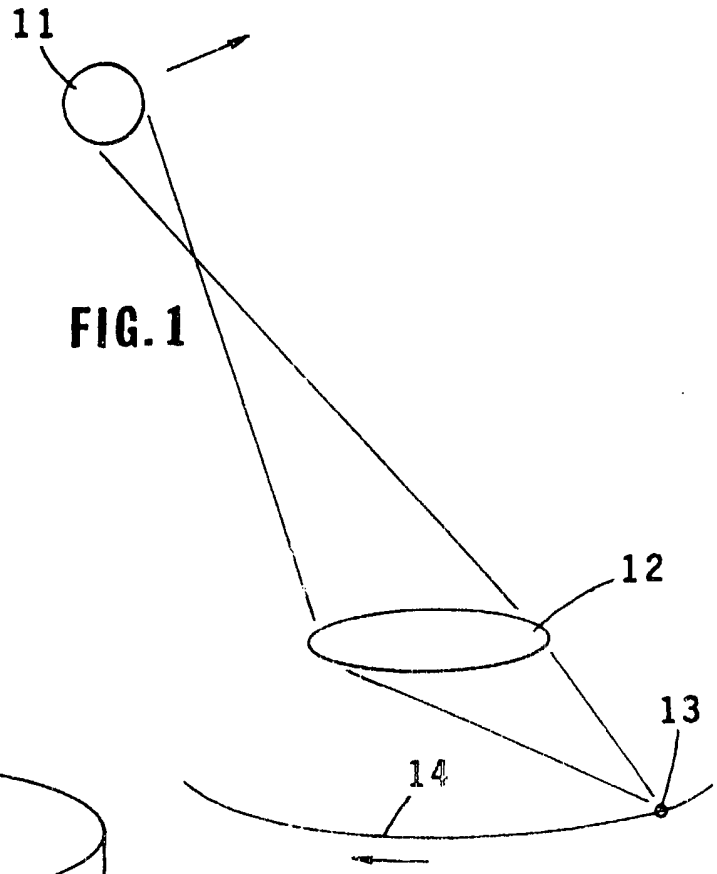

FIG. 1

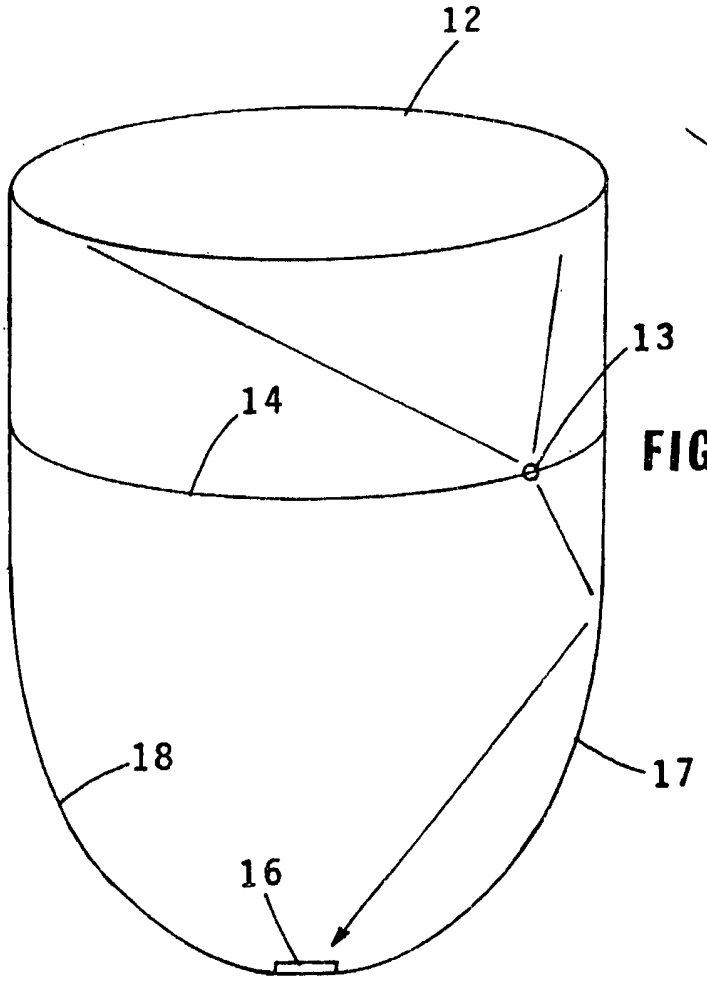

FIG. 2

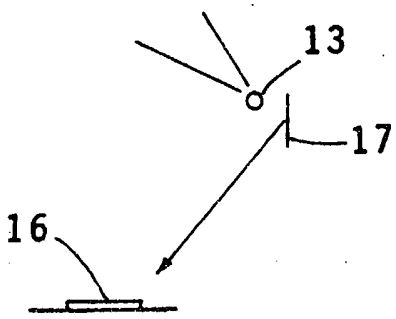

FIG. 2a

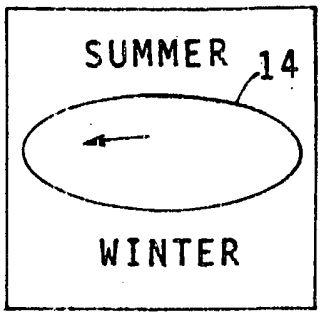

FIG. 2b

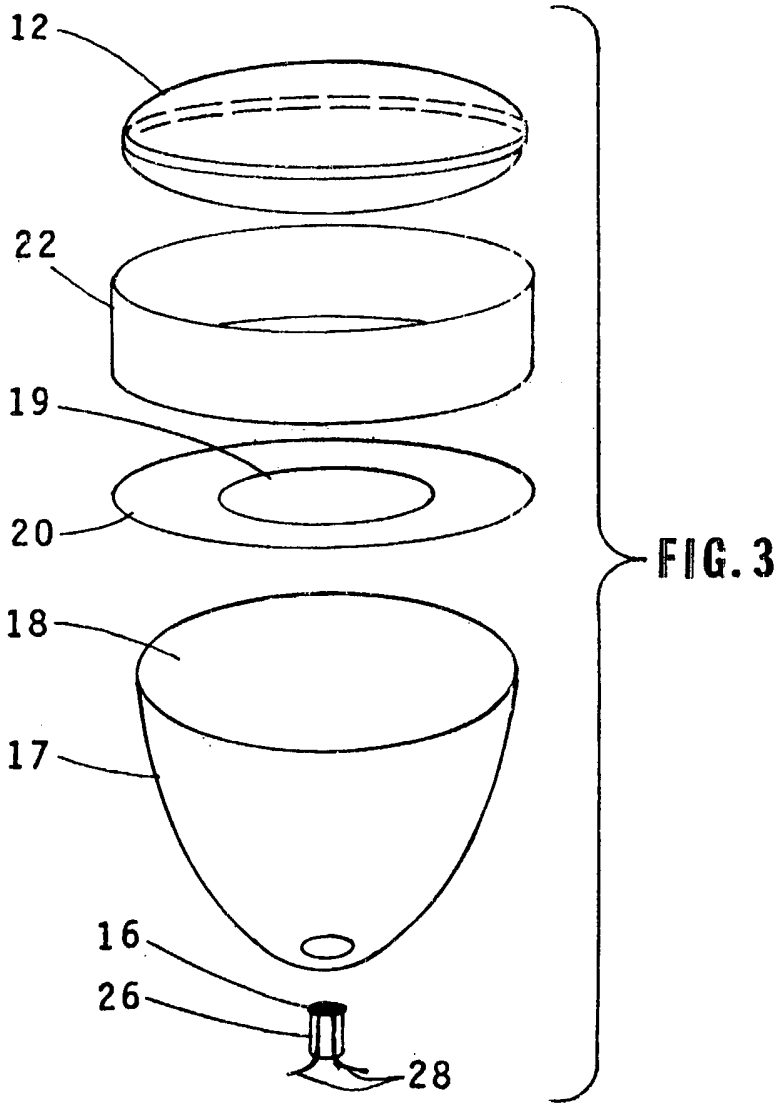

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US04/42508

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : H01L 31/052
US CL : 136/246, 251, 259; 257/432, 433; 126/683
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 136/246, 251, 259; 257/432, 433; 126/683

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,114,592 A (WINSTON) 19 September 1978 (19.09.1978).	1-3
A	US 5,409,550 A (SAFIR) 25 April 1995 (25.04.1995).	1-3
A	US 5,772,791 A (LAING) 30 June 1998 (30.06.1998).	1-3
A	US 5,971,551 A (WINSTON et al) 26 October 1999 (26.10.1999).	1-3
A	US 6,057,505 A (ORTABASI) 02 May 2000 (02.05.2000).	1-3
A	US 6,384,320 B1 (CHEN) 07 May 2002 (07.05.2002).	1-3
A	US 6,653,551 B2 (CHEN) 25 November 2003 (25.11.2003).	1-3
A	US 6,717,045 B2 (CHEN) 06 April 2004 (06.04.2004).	1-3

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
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Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
Facsimile No. (703) 305-3230

Authorized officer
Alan Diamond
Telephone No. 571-272-1700

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US04/42508

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.