



- (51) **International Patent Classification:**
H01L 31/052 (2006.01)
- (21) **International Application Number:**
PCT/IB2012/001743
- (22) **International Filing Date:**
7 September 2012 (07.09.2012)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
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- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,

BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

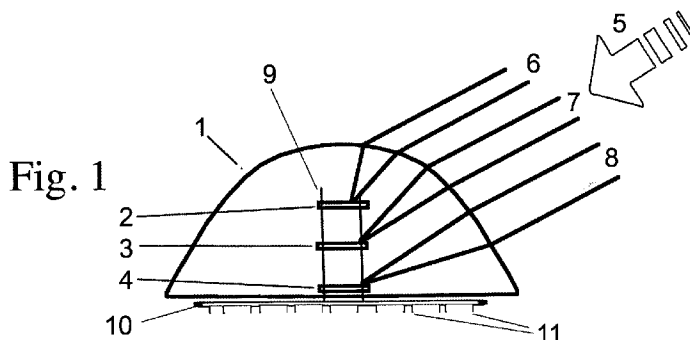
(84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— with international search report (Art. 21(3))



WO 2014/037757 A1

(54) **Title:** CONCENTRATOR SYSTEM FOR CONVERTING LIGHT INTO ELECTRICAL ENERGY



(57) **Abstract:** For generation of solar energy on limited space, like those on cars and airplanes, a system of multi-staged targets, encapsulated in a parabolic shaped lentil or mirror system is disclosed, wherein impinging light from different directions are directed on a stack of solar converting chips. These are embedded in a heat-transferring optical medium so to avoid overheating, whereas the parabolic capsule may consist of glass or glass-clear plastics, as e.g. polycarbonate copolymers.

CONCENTRATOR SYSTEM FOR CONVERTING LIGHT INTO ELECTRICAL ENERGY

FIELD OF THE INVENTION

The invention relates to photovoltaic energy generation, particularly on small surfaces, and more specifically to solar electric generation in small concentrator units with vertically arranged stacks of solar cells, embedded in a heat transfer medium.

BACKGROUND OF THE INVENTION

~~Energy recovery on small areas, as on cars and airplanes, get to be mandatory for keeping up the charging of storage means.~~

Particularly electric and hybrid cars rely on batteries that need to be loaded and the charging be sustained. Solar energy can do a good part of it - particularly for the latter - if high efficiency compensates for the limited amount of impinging light.

PROBLEM TO BE SOLVED

Suitable solar cells with high recovery rates, as such with aluminium-gallium arsenide alloys, tend to be sensitive to overheating and therefore are critical in combination with concentrator units.

The inventive step in the here disclosed invention therefore is to design the array in a way, which would combine highly efficient optical concentration of impinging light from all surrounding directions, as well as cooling the solar cells efficiently by heat transfer to a greater surface.

PRIOR ART

There had been some solutions disclosed for arranging solar cells, which could be applied to irregular curved surfaces, as in US 4.311.869, whereas it will be difficult there to arrange the reflecting means effectively due to changing curvatures.

Single concentrator units, as in US 2009 231 739 (A1), are as well known, but not meant for building up clusters of small units - moreover in this case are impractical for layouts on whatever kind of surface, due to its open structure.

Moreover, quite a few solar arrays are known, having multiple single solar cells

and concentrators, mostly Fresnel lenses, as in US 5.123.968, or combination of Fresnel and conventional lenses, as in US 6.804.062 B2, or mirrors and lenses as in WO 03/054317 A2 - but none of those suited for mounting it on curved surfaces.

Other possible solutions, like thin-film solar cells mounted on flexible wire bases, as known from Odersolar (www.odersolar.de) have lower efficiency, which is particularly disadvantageous, when only small surfaces can be applied for energy recovery.

SUMMARY OF THE INVENTION

For to overcome the afore mentioned problems, the here disclosed system comprises a parabolic lenticular concentrator for gathering light from all directions to direct it to an stack of embedded solar electricity converting chips.

Each single unit is relatively small (radius is about 20 mm) and therefore can be mounted on curved surfaces.

Said chips are interconnected by a tiny scaffold of electric wires, that connects the electrical current from each unit through to a base grid of pins, that can be plugged into a printed board.

Thereon electric components may be arranged to interconnect and transform the resulting electrical current as to the required purposes.

In quite some cases, as e.g. when mounting these units onto metal bodies of cars and airplanes, the printed board may be replaced by electrically insulating materials of high heat-transfer rates, like Ceramics as Al_2O_3 , so to use the body for further heat dissipation.

However, the parabolic shape of the encapsulating lens system already offers a surface that will be about 200 times the light-impinged surface and therefore will provide good heat dissipation.

Moreover, the medium itself –be it water, highly transparent industrial oil or gels– will buffer and disperse the punctually concentrated thermal energy, whereas the conditioning of the lenses surface will block the infrared component of incoming radiation, which is not suited for energy conversion within these kinds of solar cells.

DESCRIPTION OF THE INVENTION ALONG TO THE DRAWINGS

Fig. 1 shows the lens body 1 together with three vertically stacked targets 2, 3, 4 with basic incidence of light 5 from one side. As to optical laws, the light entering the top third of the parabolic lens 6 is directed to the top target 2, whereas the middle section incidence 7 is guided to the middle target 3 and the low section 8 to the low target 4 - whatever their horizontal angle of impingement may be.

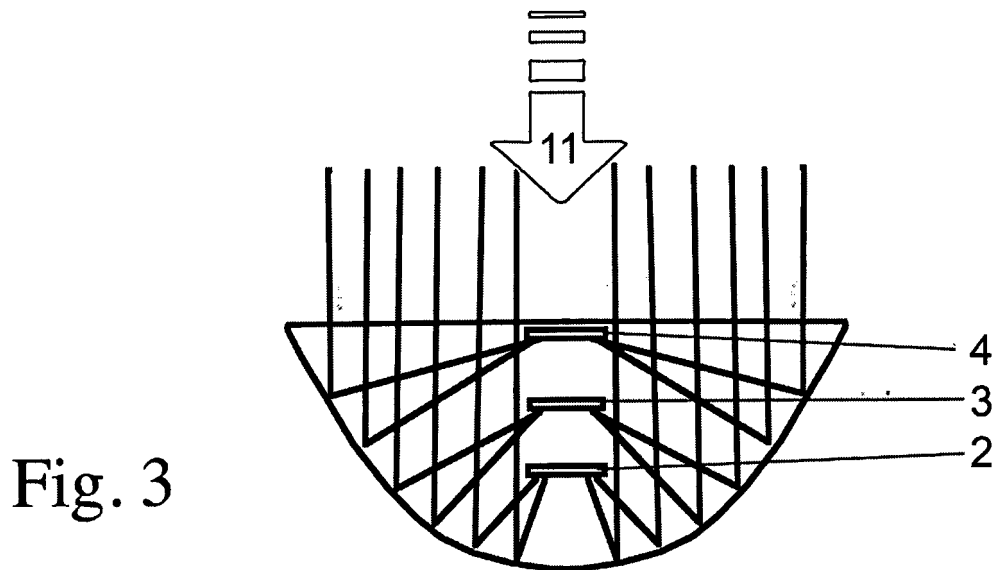
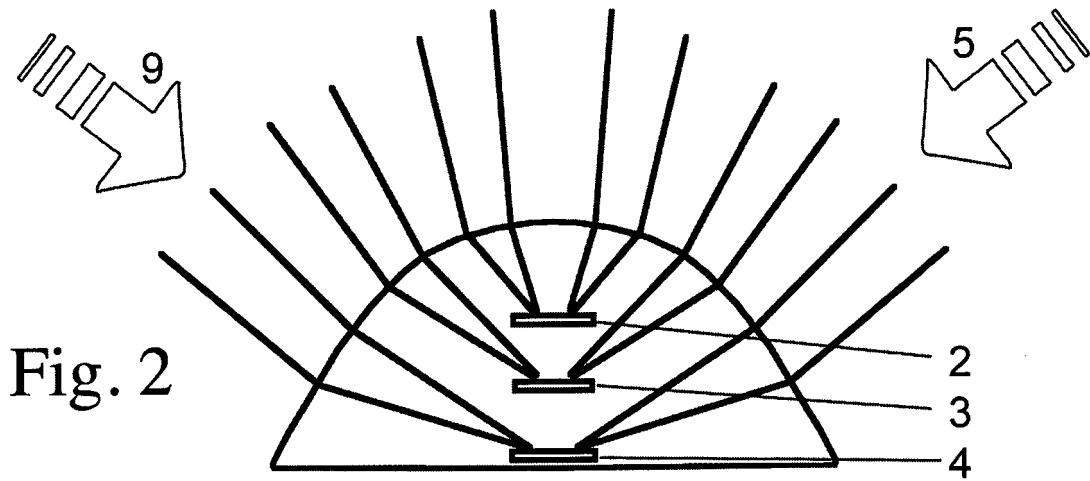
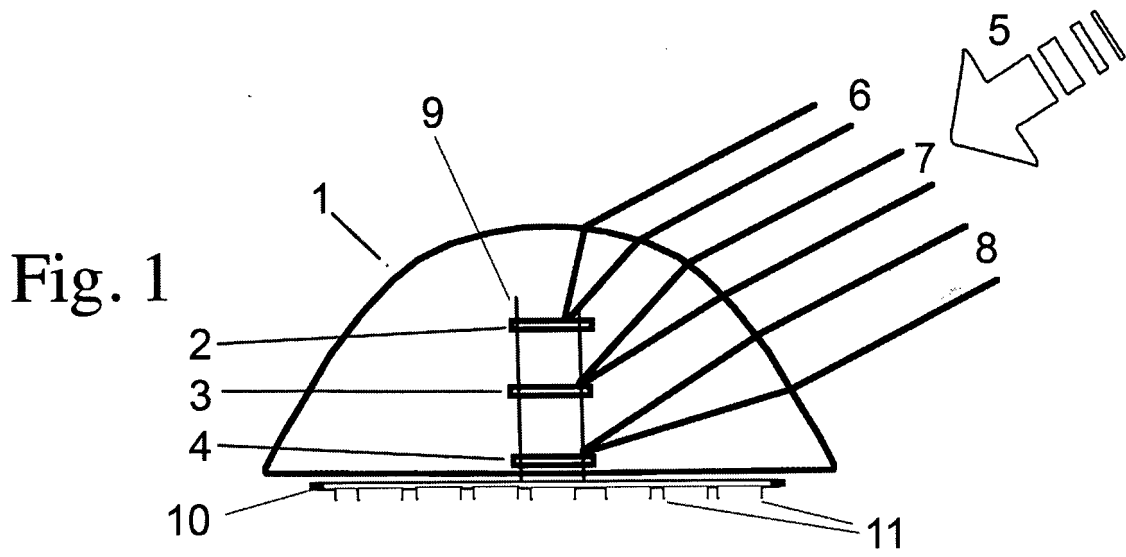
The targets 2, 3, 4 are interconnected by a scaffold of electrical wires 9, that lead to a printed board 10, comprising connecting pins for further wiring.

Fig. 2 demonstrates the distribution of light coming from different vertical directions 5 - 9. It is seen, how these are as well efficiently directed to the three stacked targets 2 - 4.

Fig. 3 shows exemplarily the mounting of above mentioned chips 2-4 for an inverted system, that used the parabolic shape as a mirror 10 to concentrate plainly entering light 11 to the afore mentioned three targets 2-4.

What is claimed is:

1. A concentrator system for converting light into electrical energy, wherein the light from different direction is concentrated on a stack of multiple solar cells, vertically arranged within a parabolic lens or parabolic mirror system.
2. Concentrator system as to claim 1, wherein the solar cells are of gallium-arsenide type
3. Concentrator system as to claim 1 and 2, wherein the cells are arranged on a miniature scaffold of electrical wires.
4. Concentrator system as to claim 3, wherein the scaffolding wires transfer the collected solar electric energy through to a base plate with further wiring.
5. Concentrator system as to claim 4 wherein the base plate is a printed board, that contains electronic circuitry for conditioning the electric energy according to the desired purposes.
6. Concentrator system as to claim 4, wherein the base plate offers high thermal conductivity.
7. Concentrator system as to claim 1, wherein the parabolic lens consists of a glass or polycarbonate hull and is filled with optical refractive and thermally conductive medium.
8. Concentrator system as to claim 7, wherein the lens is coated with an IR-blocking overlay.
9. Concentrator system as to claim 1 and 2, wherein the stack of solar cells are arranged along to the focus points of a parabolic mirror system.



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/001743

A. CLASSIFICATION OF SUBJECT MATTER INV. H01L31/052 ADD.		
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) H01L		
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) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/089436 A1 (WATTERS GEORGE M [US]) 15 April 2010 (2010-04-15) paragraph [0056] paragraphs [0028], [0030], [0033], [0050], [0051], [0052], [0053], [0058] - [0061]; figure 4	1,2,8,9
X	----- US 2010/012186 A1 (PARK YOON-DONG [KR] ET AL) 21 January 2010 (2010-01-21) paragraph [0009] - paragraph [0024] paragraph [0036] - paragraph [0038] paragraph [0043] paragraph [0049] - paragraph [0051] paragraph [0054] paragraph [0041] ----- -/--	1-7,9
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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 but 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 <p align="center">14 February 2013</p>		Date of mailing of the international search report <p align="center">20/02/2013</p>
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer <p align="center">Chao, Oscar</p>

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/001743

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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