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(71) Applicant *(for all designated States except US)*: **ISTITUTO RICERCHE PER LO SVILUPPO ECONOMICO E SOCIALE S.R.L.** [IT/IT]; Via Sicilia 50, I-00187 Roma (IT).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **BORGOMEO, Francesco** [IT/IT]; Viale del Tintoretto 302, I-00142 Roma (IT). **SANZI, Gianluca** [IT/IT]; Borgo Vittorio 31/A, I-00193 Roma (IT).

(74) Agents: **ROMANO, Giuseppe** et al.; Società Italiana Brevetti S.p.A., Piazza di Pietra 39, I-00186 Roma (IT).

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(54) **Title**: BUILDING COVER ELEMENT WITH AN INTEGRATED ENERGY PRODUCTION DEVICE

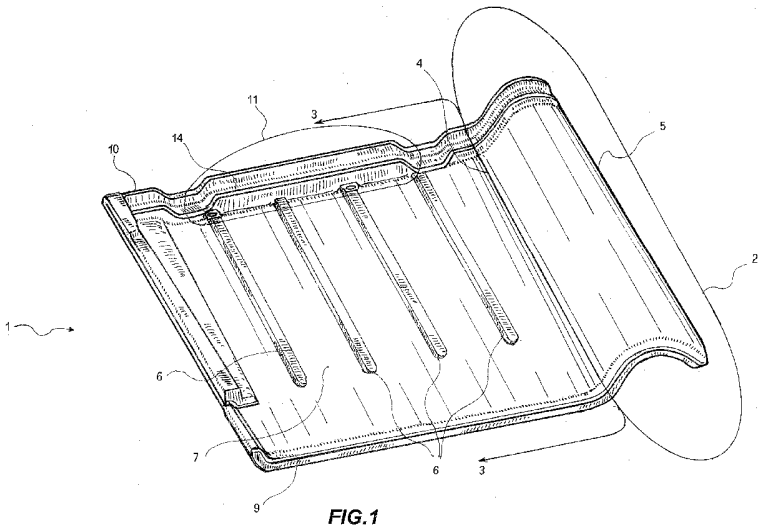

FIG.1

(57) **Abstract**: A photovoltaic tile (1), made of glazable ceramic material such as, e.g., gres, comprising a photovoltaic panel (101) which is held in an operating position of exposure to sunlight through a plurality of holding members (5, 6, 8, 13) which hold the panel (101) placed on a tile through the holding members (5, 6, 8, 13) of contiguous tiles. The photovoltaic panel (101) is comprised of two electrical circuits (17, 18) distinct and connected in parallel so as to guarantee illumination of at least part of one of the two for any direction of provenance (19) of the incident solar rays.

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BUILDING COVER ELEMENT WITH AN INTEGRATED ENERGY PRODUCTION DEVICE

DESCRIPTION

The present invention refers to a building cover element with an integrated energy production device; in particular, it refers to a tile for covering building roofs which comprises a photovoltaic panel for the transforming of solar energy into electrical energy.

Photovoltaic panels nowadays constitute a viable alternative to traditional energy sources and have a degree of technological maturity sufficient to justify their wide use. Besides allowing generation of electrical energy from the solar one, therefore at no cost save from the amortization of plant installation costs, photovoltaic panels prove particularly useful in contexts in which a reaching by the traditional power line would be uneconomical. Over the last years, wide attention has been addressed to photovoltaic solutions minimizing the environmental or aesthetical impact due to the presence of panels. In fact, installation of photovoltaic panels may be necessary in contexts that have architectural constrains inside urban areas, or landscape or naturalistic constraints. In these cases, the need to integrate the photovoltaic panels into other architectural elements is acutely felt. Therefore, the so-called “photovoltaic tiles” have been developed, which integrate photovoltaic panels of suitable shape positioned on tiles capable of accommodating them. This association between traditional building cover elements and photovoltaic panels gives added value to the building roof: if, on the one hand, it solves the problem of the top cover of buildings with elements very similar to traditional tiles, on the other hand it allows a considerable advantage on the level of the energy efficiency of the building itself.

Devices for the roof covering of buildings are known which integrate photovoltaic panels keeping them in their operating position (of exposure to sunlight according to what is envisaged at the design stage) under any atmospheric condition. Some design solutions proposed in the past envisage

the inserting of the photovoltaic panel below a see-through portion of the tile, so as to hold the panel itself in the operating position and allow its replacement when necessary. Other known solutions are based on the presence of holding members present in the tile itself, to which the panel is connected and by which the panel itself is constrained to remain in the operating position. Known solutions for securing the photovoltaic panel to the tile have in common the fact that each panel is fixed by suitable holding members belonging to the tile itself. Therefore, substantial modifications to the tile architecture have to be provided in order to envisage the presence of the holding members on the tile itself. Moreover, the solutions proposed to date provide panel integration on tiles made of traditional materials, typically of brick materials, which do not offer particularly efficient features of disposal of the heat produced by the electrical devices connected to the photovoltaic panel. Another feature widely adopted in known devices is to be sought in the fact that some parts, like e.g. the bent tile, are raised with respect to the substantially plane portion into which the photovoltaic panel is accommodated. Therefore, under some illumination conditions, raised portions of the tile may create shadow cones on the panel, thereby limiting its efficiency.

Therefore, the technical problem solved by the present invention is that of providing a building cover element with an integrated energy production device allowing to overcome the drawbacks mentioned above with reference to the known art.

Such a problem is solved by a cover element according to claim 1.

Preferred features of the present invention are set forth in the dependent claims thereof.

The present invention provides some relevant advantages. The main advantage lies in the fact that the subject-matter of the present invention allows a holding of the photovoltaic panel through holding members present on contiguous tiles. In other terms, the configuration of each tile is planned to hold the photovoltaic panel present in tiles located contiguously to that in

which there is the panel itself. Another advantage consists in the making of the tile with a ceramic material having improved heat disposal properties (e.g., gres) allowing to more easily eliminate heat produced by electrical devices. In addition, the subject-matter of the present invention is provided with a double photovoltaic panel. The presence of a double panel on each tile guarantees illumination of at least part of one of the two panels for any direction of provenance of the solar rays. Each panel is independently connected to the electric network, allowing power supply in the morning as well as the afternoon.

Other advantages, features and operation steps of the present invention will be made evident in the following detailed description of some embodiments thereof, given by way of example and not for limitative purposes. Reference will be made to the figures of the annexed drawings, wherein:

- Figure 1 shows a front perspective view of an embodiment of the photovoltaic tile according to the present invention;
- Figure 2 shows a front perspective view of four photovoltaic tiles assembled according to an embodiment of the photovoltaic tile according to the present invention;
- Figure 3 shows a section plane according to a top plan view of four photovoltaic tiles assembled according to an embodiment of the photovoltaic tile according to the present invention;
- Figure 4A is a perspective view, partially along section A-A, of the photovoltaic tile of Figure 2;
- Figure 4B is a perspective view, partially along section B-B, of the photovoltaic tile of Figure 2;

Referring initially to Figure 1, a photovoltaic tile 1 according to a preferred embodiment of the present invention is generally indicated by 1. The photovoltaic tile 1 is made of a glazable ceramic material, in particular gres. Therefore, the heat conductivity properties of said material will be appreciated; said properties allow a disposal of the heat produced by the

electrical devices, described hereinafter, present near the photovoltaic tile 1 itself.

The photovoltaic tile 1 may substantially be construed as composed of two main portions: a bent tile-shaped portion 2 and a substantially plane portion 3. These two portions are joined by an edge 4, substantially parallel to a direction parallel to a roof slope. The bent tile-shaped portion 2 is substantially a part shaped as a frustum-of-cone portion, characterized by two end generatrices 4, 5 substantially skew therebetween. In particular, the end generatrix 4 coincides with the aforementioned edge 4 which joins the bent tile-shaped portion 2 and the substantially plane portion 3. In the substantially plane portion 3 a plurality of spacers 6, 7 is present whose function will be described hereinafter. Such spacers 6, 7 comprise dorsal lines 6 which are raised with respect to channels 7.

Moreover, Figure 1 shows first longitudinal holding members 8, 13 apt, as will be better described hereinafter, to enable a connection between the photovoltaic tile 1 and an alike tile positioned contiguously thereto. In particular, in the preferred embodiment of the invention, the mentioned first longitudinal holding members 8, 13 comprise a first edge 9 of the substantially plane portion 3. Oppositely to the first edge 9 a second edge 10 is present, along which a coupling region 11 is made. Along the coupling region 11 a groove 14 is present, which is apt to allow water downflow.

Figure 2 shows a view of four photovoltaic tiles 1 with four respective photovoltaic panels 101 arranged in the respective operating positions thereof. The system for holding the photovoltaic panels 101 on the respective tiles 1 will be better appreciated by analyzing Figure 2. In fact, it may be observed how a connection box 13 connected to a photovoltaic panel 101 is arranged in a parallel manner to the groove 14. Moreover, sideways to the groove 14 a plurality of passage members 15 are present, suitable for passage of electrical connection cables 16 of the photovoltaic panel 101. In addition, it is understood that the plurality of spacers 6, 7 serves to allow a ventilation of the photovoltaic panel 101. In fact, for air it is possible to

provide a passage, for cooling purposes, between a face of the photovoltaic tile 1 and the photovoltaic panel 101. Figure 2 also shows how each photovoltaic panel 101 is partitioned into two distinct electrical circuits 17 and 18, independent therebetween and connected in parallel, which are arranged so that an at least partial exposure of the photovoltaic panel 101 is had for any direction of provenance 19 of the incident solar rays. Thus, also when the incident solar rays 19 do not impinge on both of the two distinct electrical circuits 17, 18, at least one of the two will be at least partially external to a shadow cone 20 created by the bent tile-shaped portion 2, guaranteeing anyhow power-supplying to the electric network connected to the photovoltaic panel 101.

As will be more evident from a reading of what is disclosed hereinafter, the photovoltaic tile 1 moreover has a plurality of holding members 5, 6, 8, 13 for holding the photovoltaic panel 101, apt to cooperate with analogous members of other alike and contiguous tiles in order to hold the respective photovoltaic panels 1 in the operating position when the photovoltaic tile 1 is inserted into the roof cover. This plurality of holding members comprises the aforementioned first longitudinal holding members 8, 13 and second transversal holding members 5, 6.

Figure 3 shows the second transversal holding members 5, 6 apt to hold the photovoltaic panel 101 in a parallel manner to the roof surface and in a direction perpendicular to the slope of the roof itself. These second transversal holding members 5, 6 comprise at least one edge 5 of the bent tile-shaped portion 2 which is apt to overlap to a portion of the photovoltaic panel 101 of a contiguous tile, by exploiting the fact that the end generatrices 4, 5 of the bent tile-shaped portion 2 are skew therebetween. In other words, the bent tile-shaped portion 2 is substantially a semicylinder having a base of diameter greater than the other one. Thus, part of the bent tile-shaped portion 2 of a tile overlaps at least partially to the photovoltaic panel 101 of another tile positioned contiguously to the first one.

Figure 4B shows a section B-B indicated in Figure 2. In Figure 4B it may be

appreciated how the bent tile-shaped portion 2 of a photovoltaic tile 1 has an edge 5 overlapping to the photovoltaic panel 101 placed in the operating position on an adjacent tile. Therefore, the photovoltaic panel 101 is fixed, on the one side, by the overhanging edge 5 of the contiguous tile and, on the other side, by the dorsal line 6 of the photovoltaic tile 1.

Figure 4A shows a section A-A indicated in Figure 2. In Figure 4A, the first longitudinal holding members 8; 13 make the coupling system between two contiguous tiles along the direction parallel to the roof slope. It is appreciated how a coupling tooth 8 arranged along the first edge 9 of a tile fits in with the coupling region 11 of the contiguous tile. Thus, a compartment 12 is created at the gap between the coupling tooth 8 of a tile and the coupling region 11 of the adjacent tile which is apt to accommodate and hold a connection box 13. In this manner, the connection box 13 remains fixed in between the coupling tooth 8 of a tile and the coupling region 11 of the adjacent tile, actually preventing the photovoltaic panel 101 from moving in a direction parallel to the roof slope. Moreover, it will be appreciated that the compartment 12 also performs a function of protecting the connection box 13 from atmospheric agents.

The present invention has been hereto described with reference to preferred embodiments thereof. It is understood that other embodiments might exist, all falling within the concept of the same invention, as defined by the protective scope of the claims hereinafter.

CLAIMS

1. A photovoltaic tile (1) made of glazable ceramic material, particularly suitable for the making of a building roof cover, comprising:

- a photovoltaic panel (101) apt to transform incident solar energy into electrical energy, having a connection box (13) containing the respective electrical connections, and set in an operating position on a portion of said photovoltaic tile (1);

- a plurality of holding members (5, 6, 8; 13) for holding said photovoltaic panel (101), apt to cooperate with holding members of other alike and contiguous tiles to hold the respective photovoltaic panels (101) in said operating position when said photovoltaic tile (1) is inserted into the cover of said roof.

2. The photovoltaic tile (1), according to claim 1, wherein said glazable ceramic material is gres.

3. The photovoltaic tile (1), according to any one of the preceding claims, wherein said plurality of holding members (5, 6, 8; 13) for holding said photovoltaic panel (101), comprises first longitudinal holding members (8; 13), apt to hold said photovoltaic panel (101) in a direction parallel to a slope of said roof, and second transversal holding members (5, 6), apt to hold said photovoltaic panel (101), in a parallel manner to the surface of said roof, and in a direction perpendicular to the slope of said roof.

4. The photovoltaic tile (1), according to any one of the preceding claims, wherein said photovoltaic tile (1) comprises a bent tile-shaped portion (2) and a substantially plane portion (3), said portions being connected therebetween by means of an edge ().

5. The photovoltaic tile (1), according to any one of claims 3 or 4, wherein said first longitudinal holding members (8; 13) comprise a coupling tooth (8) made along a first edge (9) of said plane portion and a coupling region (11) made along a second edge (10) of said plane portion, the coupling tooth (8) of a tile being apt to cooperate with said coupling region (11) of an adjacent

tile along the slope direction, creating a compartment (12).

6. The photovoltaic tile (1), according to the preceding claim, wherein said compartment (12) is apt to accommodate and hold said connection box (13) of said photovoltaic panel (101), in a manner such as to keep in said operating position said photovoltaic panel (101).

7. The photovoltaic tile (1) according to claims 5 or 6, wherein said compartment (12) is apt to contain said connection box (13), protecting the same from atmospheric agents.

8. The photovoltaic tile (1), according to any one claim 4 to 7, wherein said second transversal holding members (5, 6) comprise at least one edge of said bent tile-shaped portion (2), said edge being such as to overlap to a portion of a photovoltaic panel (101) of a contiguous tile.

9. The photovoltaic tile (1), according to any one claim 4 to 8, wherein said bent tile-shaped portion (2) has two end generatrices (4, 5) substantially skew therebetween.

10. The photovoltaic tile (1), according to any one claim 5 to 9, wherein said coupling region (11) comprises a groove (14) apt to allow water downflow.

11. The photovoltaic tile (1), according to any one of the preceding claims, wherein said photovoltaic panel (101) comprises at least two electrical circuits (17, 18) distinct and independent therebetween, their arrangement being such as to allow an at least partial exposure of said photovoltaic panel (101) for any direction of provenance (19) of incident solar rays, said at least two electrical circuits (17, 18) being connected in parallel.

12. The photovoltaic tile (1), according to any one of claims 5 to 11, wherein said coupling region (11) comprises a plurality of passage members (15) for the passage of electrical connection cables (16) of the photovoltaic panel (101).

13. The photovoltaic tile (1), according to any one of the preceding claims, wherein a plurality of spacers (6, 7) is present, apt to allow a ventilation of said photovoltaic panel (101) so as to prevent an overheating thereof.

14. The photovoltaic tile (1), according to the preceding claim, wherein said plurality of spacers (6, 7) comprises raised dorsal lines (6) alternating with channels (7) apt to allow air transit between a face of said photovoltaic tile (1) and said photovoltaic panel (101).

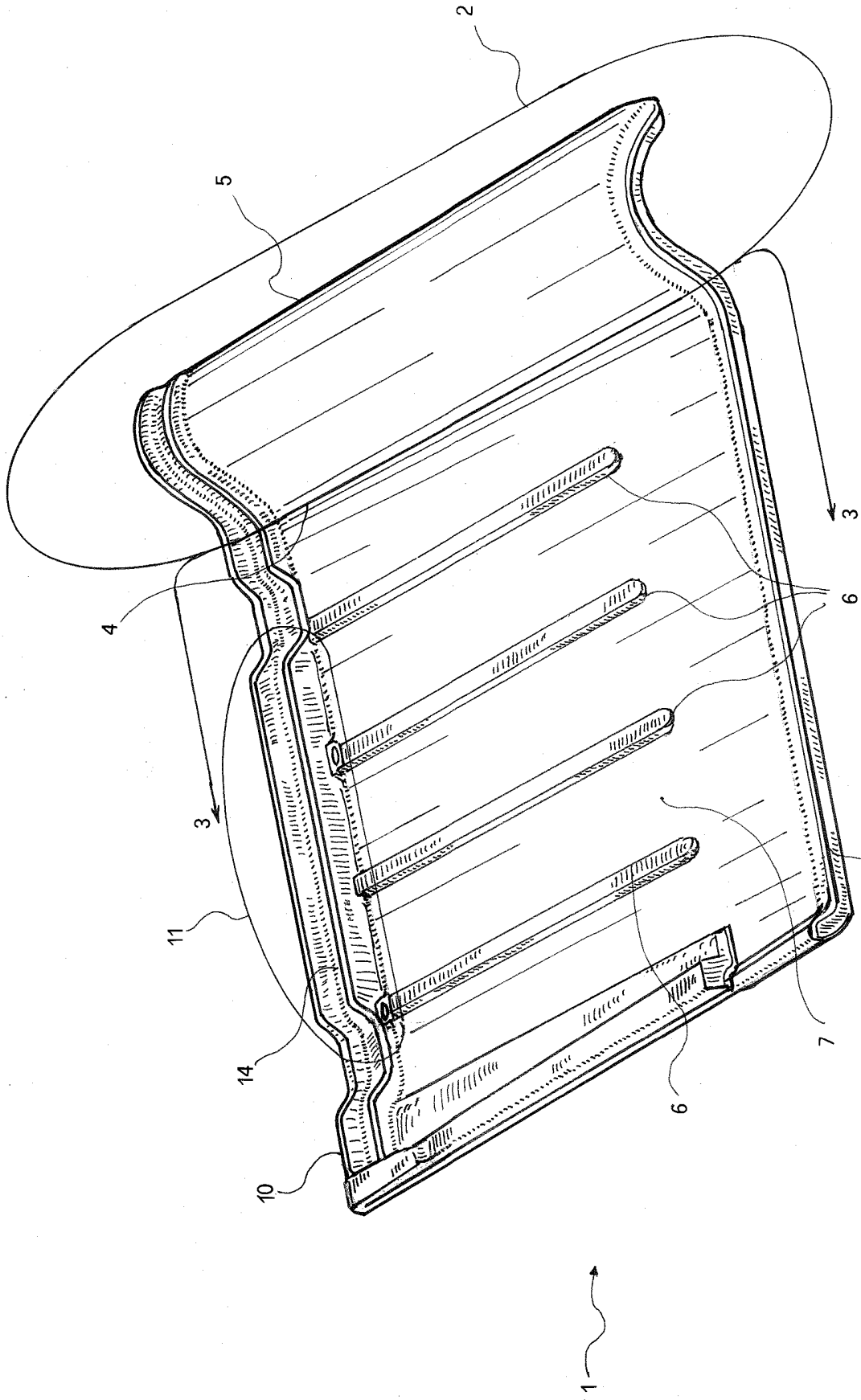

FIG.1

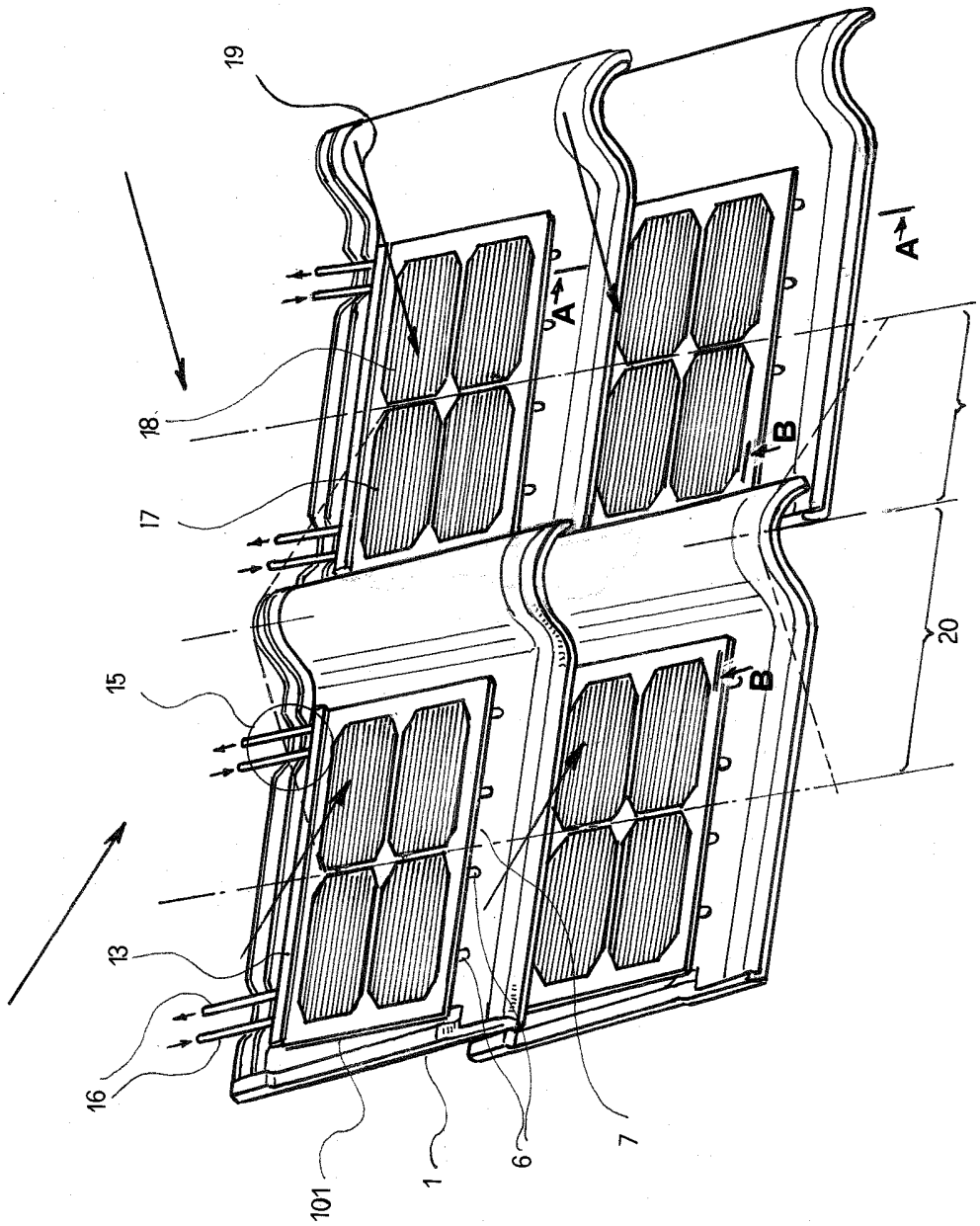

FIG.2

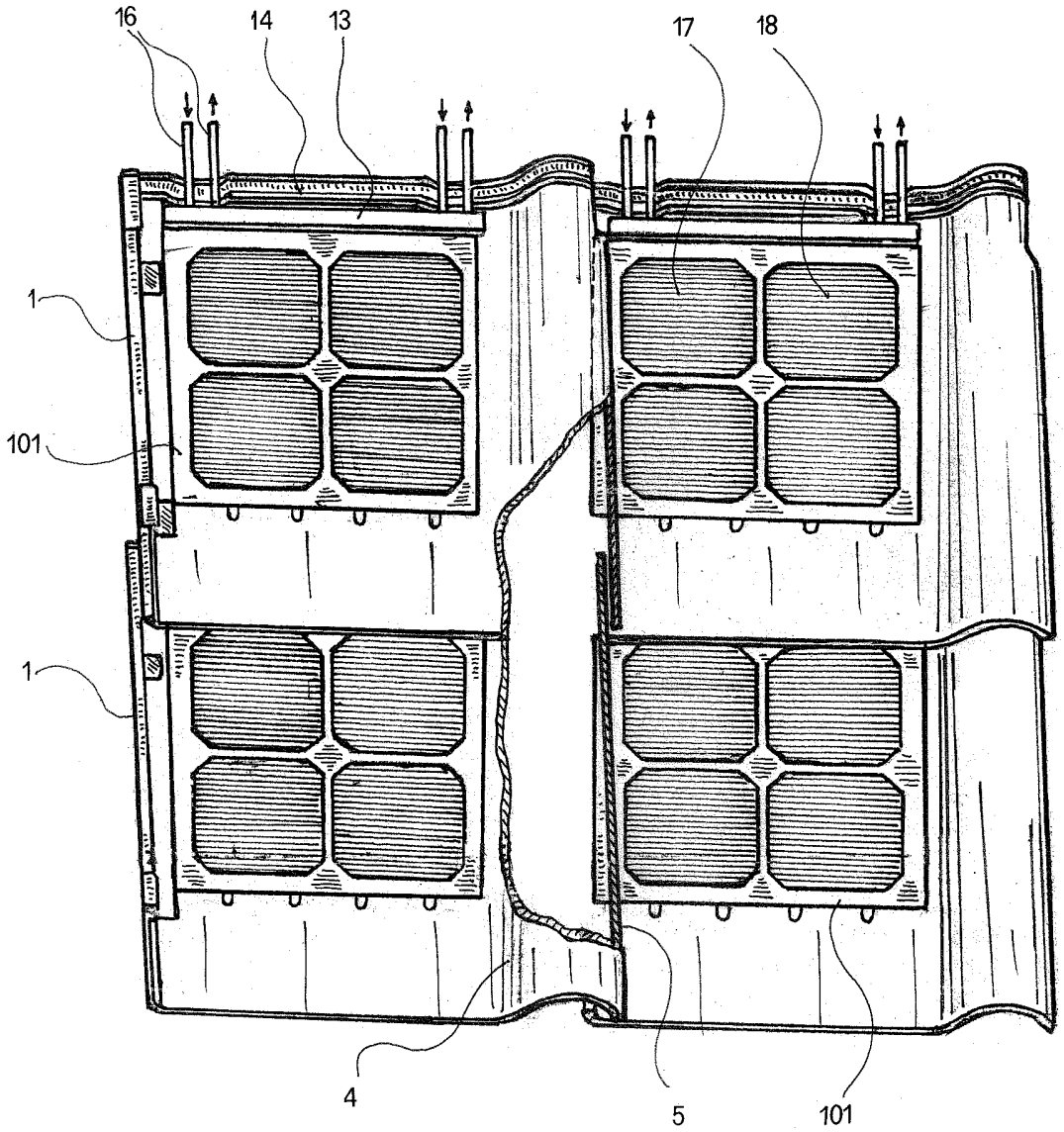

FIG.3

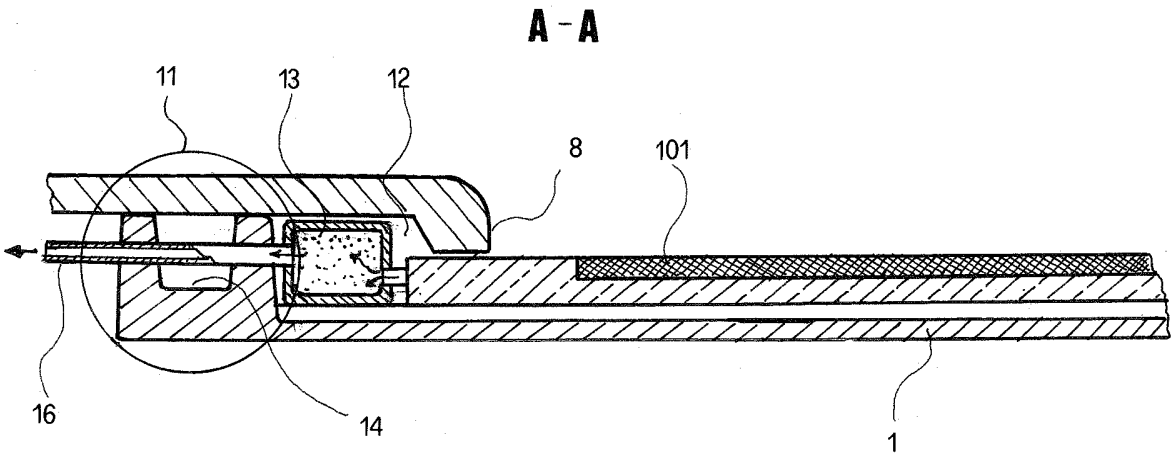

FIG.4A

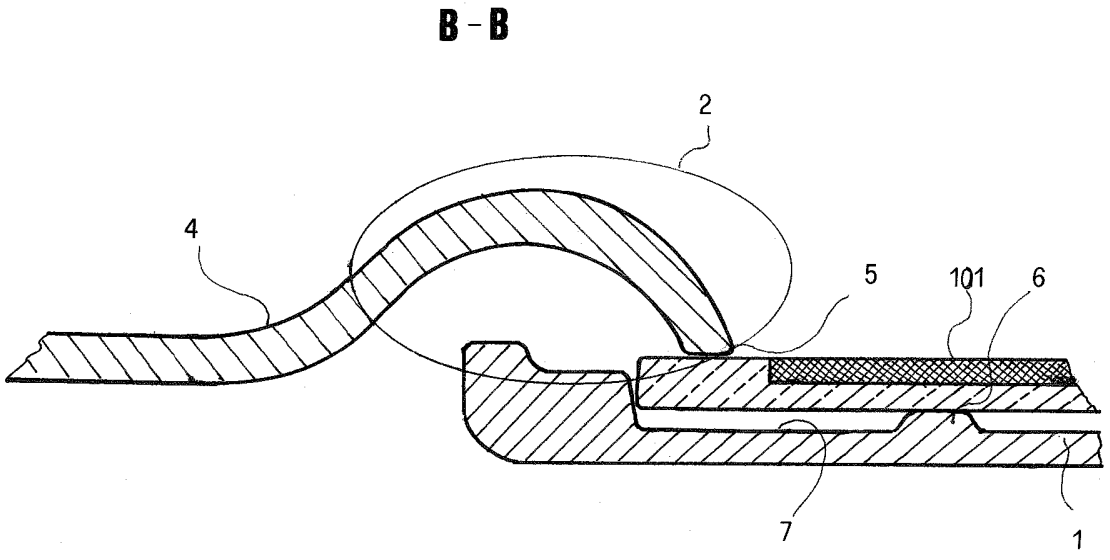

FIG.4B

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2010/052829

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04D1/30 F24J2/04 H01L31/048
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)
E04D F24J 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 practical, 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.
A	EP 0 547 285 A1 (RIETER WERKE HAENDLE [DE]) 23 June 1993 (1993-06-23) column 3, line 30 - column 4, line 27; claim 10; figures 1-6	1-14
A	EP 1 184 526 A1 (KANEKA CORP [JP]) 6 March 2002 (2002-03-06) Fig. 3 anre related text	1-14

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"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

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 March 2011	05/04/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Melodia, Andrea

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2010/052829

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0547285 A1	23-06-1993	DE 4141664 C1	01-07-1993
EP 1184526 A1	06-03-2002	WO 0075455 A1	14-12-2000
		US 2002036010 A1	28-03-2002