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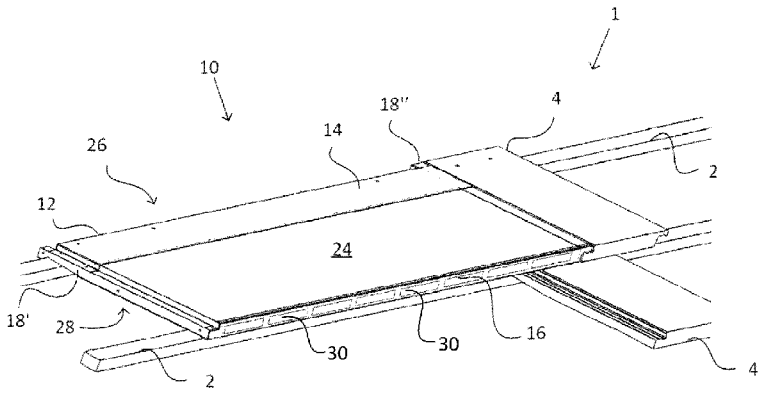

FIG. 1

(57) Abstract: The invention relates to a solar cell module, comprising a frame (12) with an upper elongated section (14), a lower elongated section (16), a first elongated side section (18') and a second elongated side section (18"); a first support layer (20) arranged in connection to the frame (12) and a solar cell layer (24) arranged on the first support layer (20), wherein the frame (12) surrounds the first support layer (20) and the solar cell layer (24) peripherally and wherein the first support layer (20) comprises at least one channel (25).

Solar cell module

TECHNICAL FIELD

The present invention relates to a solar cell module according to the preamble of claim 1.

BACKGROUND

Solar cell modules or photovoltaic cell modules are commonly used for converting the energy of light into electricity. A solar cell module comprises a plurality of solar cells connected in series. Multiple modules may be interconnected in order to form an array of solar cell modules or they may be used individually. Solar cell modules may be ground mounted or roof or wall mounted. Roof mounted solar cell modules may be arranged either on top of the roof or integrated with the roof. It is important that an integrated solar cell module have enough structural strength to resist both for example snow load and the weight of an adult. It is also important that an integrated solar cell module meets the same requirements for water runoff as a normal roof.

Solar cell modules mounted on roofs or walls may use wafer-based crystalline silicone cells which have a high strength. However, such solar cell modules are relatively heavy and may thereby be difficult to mount on a roof. It is therefore desirable to achieve a lightweight solar cell module suitable for integration with a roof construction, which has enough structural strength and desired efficiency.

SUMMARY OF THE INVENTION

An object of the present invention is to achieve a solar cell module which is lightweight and which facilitates mounting of the solar cell module.

Another object of the invention is to achieve a solar cell module which facilitates manufacture of the solar cell module.

A further object of the invention is to achieve a solar cell module with optimized efficiency.

A further object of the invention is to achieve a solar cell module which is suitable for integration with a roof or wall construction.

The herein mentioned objects are achieved by a solar cell module according to the herein disclosed independent claim.

According to an aspect of the present invention a solar cell module is provided, comprising a frame with an upper elongated section, a lower elongated section, a first elongated side section and a second elongated side section; a first support layer arranged in connection to the frame and a solar cell layer arranged on top of the first support layer, wherein the frame surrounds the first support layer and the solar cell layer peripherally and wherein the first support layer comprises at least one channel. The first support layer suitably comprises a plurality of channels. The at least one channel may extend substantially perpendicularly to the longitudinal extension of the upper section and the lower section of the frame. Alternatively, the at least one channel extends with an angle different from 90 degrees to the longitudinal extension of the upper section and the lower section of the frame. Where the first support layer comprises a plurality of channels the channels suitably extend in parallel with each other. The at least one channel may be formed as a groove, slot or similar. The first support layer suitably comprises a plurality of plastic channels. The first support layer may comprise a multiwall plastic sheet. The first support layer may alternatively comprise molded plastic channels. The first support layer may comprise a plurality of separate parts with channels. By arranging the solar cell layer on top of a layer comprising plastic channels, such as a multiwall plastic sheet, the solar cell module achieves enough structural

strength to resist both snow load and the weight of an adult. The first support layer thus enables the use of thin-film solar cells which have lower structural strength than the commonly known crystalline silicone cells. The support layer comprising at least one channel also results in a lightweight solar cell module, which facilitates mounting of the solar cell module on a roof or wall construction.

The solar cell module is suitably adapted to be mounted on a roof construction or a wall construction. It is therefore to be understood that roof tiles, roofing felt and similar expressions mentioned herein applies for both roof constructions and wall constructions.

A second support layer may be arranged underneath the first support layer. The second support layer preferably comprises at least one channel. The second support layer may comprise a plurality of channels extending substantially perpendicularly to the longitudinal extension of the upper section and the lower section of the frame. The second support layer suitably comprises a multiwall plastic sheet. This way, the structural strength of the solar cell module is increased while minimizing the weight of the solar cell module. The first support layer is suitably thicker than the second support layer. In the case where the first support layer and/or the second support layer comprise multiwall plastic sheets, the multiwall plastic sheets may have any profile, for example rectangular, honeycomb, latticework or similar. The cross-section of the channels of the first support layer and/or the second support layer may have any shape.

The solar cell layer preferably comprises a thin-film solar cell. The thin-film solar cell layer suitably comprises a thin film of photovoltaic material on a glass substrate. Alternatively, the thin film of photovoltaic material is sandwiched between two glass substrates. The glass substrate suitably consists of heat-treated or tempered glass. This way, roof tiles may overlap the solar cell module without damaging the solar cell layer. The solar cell layer is preferably

a rigid thin-film solar cell layer. The thin-film solar cell may comprise cadmium telluride or any other type of solar cells. By using a thin-film solar cell the thickness of the solar cell module is minimized which makes the solar cell module suitable for integration with a roof or wall construction. The at least one channel of the first support layer render the first support layer flexible. The first support layer comprising channels will thus provide a damping function when the solar cell module is subjected to loads. This way the thin-film solar cell layer can move and the risk that the solar cell layer cracks or breaks under load is minimized. Alternatively, the solar cell layer comprises crystalline silicon.

According to an aspect of the invention the solar cell module is adapted to constitute an integrated part of a roof or wall construction. This means that the solar cell module is adapted to be arranged flush with neighbouring roof tiles and thus constitute a part of the roof or the wall. The solar cell module is thus adapted to replace one or more roof tiles on a roof or wall construction. By using a thin-film solar cell the solar cell module is particularly suitable for integration with a roof or wall construction. Furthermore, the first side section and the second side section of the frame each suitably comprises a retention portion adapted to engage with a neighbouring roof tile. The first side section of the frame suitably comprises a retention portion adapted to engage with a right side of a roof tile. The second side section of the frame suitably comprises a retention portion adapted to engage with a left side of a roof tile. The retention portions of the respective side section are thus adapted to hold the solar cell module in place when being integrated with a roof or wall construction. This way, the solar cell module is retained in place by interaction with neighbouring roof tiles. The solar cell module is essentially flat and is thus suitable for engagement with essentially flat roof tiles. However, the retention portions of the solar cell module may be adapted to engage with any type of roof tile. The first side section of the frame suitably may comprise a lower retention portion which is adapted to engage with an upper part of the right side of a roof tile. The first side section thus comprises a retention portion

which is adapted to be arranged underneath a neighbouring roof tile. The second side section of the frame suitably may comprise an upper retention portion which is adapted to engage with a lower part of the left side of a roof tile. The second side section thus comprises a retention portion which is adapted to be arranged on top of a neighbouring roof tile.

The solar cell module suitably comprises a front side and a back side. The front side is suitably facing outwards, towards the sun. The back side is suitably facing inwards, away from the sun. The back side is suitably facing the battens and the roofing felt of a roof or wall construction. The solar cell layer is thus arranged on the front side and the first support layer is arranged on the back side.

According to an aspect of the invention the frame comprises at least one opening in fluid connection with the at least one channel of the first support layer. Suitably, the frame comprises at least two openings in fluid connection with the at least one channel of the first support layer. According to an aspect of the invention the frame comprises a plurality of openings in fluid connection with the channels of the first support layer. The upper section of the frame suitably comprises at least one opening in fluid connection with the at least one channel of the first support layer. Suitably, the upper section of the frame comprises a plurality of openings in fluid connection with the channels of the first support layer. The lower section of the frame suitably comprises at least one opening in fluid connection with the at least one channel of the first support layer. Suitably, the lower section of the frame comprises a plurality of openings in fluid connection with the channels of the first support layer. It is common knowledge that the efficiency of solar cells decrease when the temperature increases. It is therefore desirable to be able to cool the solar cell module. By arranging openings in fluid connection with the channels of the first support layer, air is able to flow through the solar cell module. Since the solar cell layer is arranged in contact with the first support layer the solar cell layer is cooled by the air flowing through the channels. A solar cell module with

improved efficiency is thereby achieved. Each channel of the first support layer suitably extends between an opening in the upper section of the frame and an opening in the lower section of the frame. The channels of the first support layer are thus adapted for cooling of the solar cell layer.

The upper section of the frame may further comprise attachment holes for attachment of the solar cell module to an underlying batten by means of fasteners.

The frame of the solar cell module is preferably essentially rectangular, where the upper section and the lower section are longer than the first and the second side section. The upper section and the lower section of the frame thus define the length of the solar cell module whereas the first and the second side section define the height of the solar cell module. The upper section and the lower section of the frame are arranged in parallel opposite each other and the first side section and the second side section are arranged in parallel opposite each other. The frame, and thus the solar cell module, suitably has the same size (length and height) as a plurality of adjacently arranged roof tiles. The solar cell module may have the size of one or more roof tiles arranged next to each other. This way, roof tiles may easily be replaced by the solar cell module.

The frame preferably comprises metal, such as steel, aluminium or similar. The frame may alternatively comprise a plastic material. The frame may further comprise a surface coating or similar for protection against corrosion. The upper section, the lower section, and the side sections are suitably adapted to mechanically hold the first support layer, the optional second support layer and the solar cell layer. The frame is thus not fixedly adhered to the various layers. The upper section, the lower section, the first side section and the second side section of the frame may comprise bent sheet metal, extruded metal or extruded plastic. Alternatively, the frame sections are molded as separate pieces which are mechanically attached to each other, or the frame sections are molded as one piece. For example, the frame may be a solid plastic frame

where the upper section, the lower section, the first side section and the second side section are molded as one piece. The frame may alternatively be a solid frame molded in one piece comprising the upper section, the lower section, the first side section, the second side section and a back section. The back section may be the first support layer or the second support layer integrated with the frame. By using a frame which is adapted to mechanically hold the various layers the manufacturing of the solar cell module is facilitated. The manufacturing is less time consuming and thus more cost-efficient. By using a metal frame to mechanically hold the different layers in place, vibrations between the different parts of the solar cell module may occur. Vibrations between the glass of the solar cell layer and the metal frame sections may cause undesired noise. However, since the support layers of the solar cell module comprise channels and thereby provide a damping function, the vibrations between the solar cell layer and the frame are minimized. Alternatively, silicone or similar may be applied between the metal frame and the solar cell layer in order to achieve a damping function. The occurrence of undesired noise is thereby minimized. Also, the support layer comprising plastic channels is flexible which enables the use of press fit between the support layer and the metal frame. The frame sections are suitably connected by rivets, particularly blind rivets. Alternatively, the frame sections are connected by screw joints. This way, the frame sections are mechanically connected to each other and recycling of worn out solar cell modules is facilitated. The rivets/screw joints may also act as spacers holding the different layers in place.

At least one support member may be arranged between the upper section and the lower section of the frame in order to retain the shape of the frame. The at least one support member thus extends between the upper section and the lower section of the frame, substantially perpendicularly to the longitudinal extension of the upper section and the lower section of the frame. The support member is suitably attached to the upper section and the lower section by

rivets. The support member may be arranged on the back side of the solar cell module.

The frame preferably comprises at least one hanging portion. The at least one hanging portion may be arranged on the upper section of the frame. The hanging portion may be a protruding portion on the back side of the upper section. Alternatively, the first side section and the second side section of the frame each comprise a hanging portion. The hanging portions may be arranged at the upper end of the respective side section, adjacent the upper section of the frame. Each hanging portion suitably comprises an upper portion protruding perpendicularly to the longitudinal extension of the respective side section. The protruding upper portions are on the back side of the solar cell module and are adapted for hanging the solar cell module on a batten. The protruding upper portions are thus adapted to abut an edge of a batten. When the solar cell module is integrated in a roof or wall construction the hanging portion is used to hang the solar cell module on a batten whereby the first support layer rests on the batten. The lower section of the solar cell module is adapted to rest on roof tiles arranged below the solar cell module. The first support layer and the lower section of the frame is thereby adapted to abut roof tiles arranged below the solar cell module. The first support layer is thus a load carrying layer.

According to an aspect of the invention the solar cell module comprises a connection box for electronics. The connection box may be arranged adjacent the first support layer underneath the solar cell layer. The connection box may be arranged adjacent the first side section or the second side section of the frame, adjacent the first support layer. Alternatively, the first support layer comprises two separate parts arranged in parallel, wherein the connection box is arranged between the two parts. Alternatively, the connection box is arranged in an opening in the first support layer. By arranging the connection box coplanar with the first support layer wires from the connection box are accessible on the back side of the solar cell module. This way, the solar cell

module may easily be connected to other solar cell modules. The connection box may alternatively be arranged coplanar with the solar cell layer, for example between the first support layer and the upper section of the frame.

In the case where a second support layer is arranged on the back side of the frame the second support layer is suitably shorter than the first support layer and shorter than the longitudinal extension of the side sections of the frame. The second support layer is preferably held by the lower section of the frame, the first side section and the second side section. The second support layer is thus not held by the upper section of the frame. The upper part of the second support layer may alternatively be adhered to the back side of the first support layer. The first support layer thus extends beyond the second support layer in direction towards the upper section of the frame. This means that when the solar cell module is integrated in a roof construction the first support layer still abuts the batten and is thus the load carrying layer. The second support layer functioning as a back layer suitably supports the first support layer and the connection box. By having a shorter second support layer, wires from the connection box are still easily accessible on the back side of the solar cell module.

The upper section of the frame preferably comprises a first elongated portion on the front side of the solar cell module, a second elongated portion on the back side of the solar cell module arranged in parallel with the first portion, and an upper end portion connecting the first and the second elongated portion. The upper section of the frame thus suitably comprises a first elongated portion abutting the solar cell layer on the front side of the solar cell module and a second elongated portion abutting the back side of the first support layer on the back side of the solar cell module. The first portion partly overlaps the solar cell layer on the front side of the solar cell module and holds the solar cell layer in place. The second portion partly covers the first support layer on the back side of the solar cell module. When the solar cell module is integrated in a roof or wall construction, roof tiles or similar might overlap the upper part of

the front side of the solar cell module. The first portion of the upper section of the frame may thereby be configured such that only the upper section of the frame is overlapped and not the uncovered solar cell layer. The upper section of the frame further comprises side portions adapted to be connected to the side sections. The cooling openings arranged in fluid connection with the channels of the first support layer are suitably arranged on the upper end portion. The lower section of the frame suitably comprises a U-section with two parallel portions and a lower end portion connecting the two parallel portions. The cooling openings arranged in fluid connection with the channels of the first support layer are suitably arranged on the lower end portion of the lower section of the frame.

The first side section and the second side section of the frame preferably each comprises a drainage portion. The drainage portion is adapted to lead water from the underlying roofing felt. The drainage portions of the first side section and the second side section respectively suitably comprises a drainage channel, through which water may be lead away from the solar cell module. The drainage portions are arranged on the back side of the solar cell module. The drainage portions may each comprise a bent/curved portion forming the drainage channel. The drainage portion of the first side section suitably comprises a drainage channel formed underneath the retention portion of the first side section. The drainage portion of the second side section suitably comprises a drainage channel formed underneath the first support layer. The lower section of the frame preferably comprises at least one drainage opening arranged in fluid connection with each drainage channel. This way, the water is lead away from the solar cell module.

Further objects, advantages and novel features of the present invention will become apparent to one skilled in the art from the following details, and also by putting the invention into practice. Whereas the invention is described below, it should be noted that it is not restricted to the specific details described. Specialists having access to the teachings herein will recognise

further applications, modifications and incorporations within other fields, which are within the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

For fuller understanding of the present invention and further objects and advantages of it, the detailed description set out below should be read together with the accompanying drawings, in which the same reference notations denote similar items in the various diagrams, and in which:

Figure 1 schematically illustrates a roof construction comprising a solar cell module according to an embodiment of the invention;

Figure 2 schematically illustrates a frame of a solar cell module according to an embodiment of the invention;

Figure 3a schematically illustrates a cross-section of a solar cell module according to an embodiment of the invention;

Figure 3b schematically illustrates a cross-section of a solar cell module according to an embodiment of the invention;

Figure 3c schematically illustrates cross-sections of a solar cell module according to an embodiment of the invention;

Figure 3d schematically illustrates an upper section of a frame of a solar cell module according to an embodiment of the invention;

Figure 3e schematically illustrates an upper section of a frame of a solar cell module according to an embodiment of the invention;

Figure 4 schematically illustrates the back side of a solar cell module according to an embodiment of the invention;

Figure 5a-b schematically illustrates a second side section of a solar cell module according to an embodiment of the invention; and

Figure 6a-b schematically illustrates a first side section of a solar cell module according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Figure 1 schematically shows a roof construction 1 comprising a solar cell module 10 according to an embodiment of the invention. The roof construction 1 may be a wall construction 1. The solar cell module 10 constitutes an integrated part of the roof construction 1 and is arranged on battens 2 arranged in parallel. The figure shows the solar cell module 10 in engagement with a roof tile 4 on the right side. Another roof tile 4 is arranged below the solar cell module 10 in order to illustrate how the solar cell module 10 overlaps the upper end of the roof tiles 4 arranged below the solar cell module 10. Instead of a roof tile 4 arranged below the solar cell module 10, there might be another solar cell module. The solar cell module 10 comprises a frame 12 with an upper elongated section 14, a lower elongated section 16, a first elongated side section 18' and a second elongated side section 18''; a first support layer 20 (not shown) arranged inside the frame 12 forming a back layer and a solar cell layer 24 arranged on top of the first support layer 20, wherein the frame 12 surrounds the first support layer 20 and the solar cell layer 24 peripherally. The first support layer 20 comprises at least one channel (not shown). The first support layer 20 preferably comprises a plurality of channels. The channels suitably extend substantially perpendicularly to the longitudinal extension of the upper section 14 and the lower section 16 of the frame 12. The first support layer 20 may comprise a multiwall plastic sheet with channels. The first support layer 20 may alternatively comprise moulded plastic channels. The first support layer 20 suitably comprises an arbitrary number of channels. The channels are illustrated in Figure 3c. The solar cell layer 24 may comprise a thin-film solar cell. A second support layer 22 may be arranged underneath the first support layer 20 and thus forming a back layer. The second support layer 22 may comprise channels extending perpendicularly to the longitudinal extension of the upper section 14 and the lower section 16 of the frame 12.

The solar cell module 10 comprises a front side 26 and a back side 28. The front side 26 is facing outwards, towards the sun and the back side 28 is facing

inwards, away from the sun. The back side 28 is thus facing the battens 2 and the roofing felt of the roof construction 1.

The frame 12 of the solar cell module 10 is essentially rectangular. The upper section 14 and the lower section 16 of the frame 12 thus define the length of the solar cell module 10 whereas the first and the second side section 18', 18'' define the height of the solar cell module 10. The first side section 18' may be on the left side of the solar cell module 10 and the second side section 18'' may be on the right side of the solar cell module 10 is arranged for use. The frame 12, and thus the solar cell module 10, may have the size of one or more roof tiles 4 arranged next to each other.

The frame 12 preferably comprises metal, such as steel, aluminium or similar. The frame 12 may alternatively comprise a plastic material. The upper section 14, the lower 16 section, and the side sections 18', 18''are suitably adapted to mechanically hold the first support layer 20, the optional second support layer 22 and the solar cell layer 24. The upper section 14, the lower section 16, the first side section 18' and the second side section 18'' of the frame 12 may comprise bent sheet metal, extruded metal or extruded plastic. The frame sections 14, 16, 18', 18'' are suitably connected by rivets, particularly blind rivets. Alternatively, the frame sections 14, 16, 18', 18'' are connected by screw joints. This way, the frame sections 14, 16, 18', 18'' are mechanically connected to each other and recycling of worn out solar cell modules is facilitated. The rivets/screw joints may also act as spacers holding the different layers in place. Alternatively, the frame sections 14, 16, 18', 18'' are moulded as a single piece.

The upper section 14 and the lower section 16 of the frame 12 suitably each comprises a plurality of openings 30 in fluid connection with the channels of the first support layer 20. By arranging openings 30 in fluid connection with the channels of the first support layer 20, air is able to flow through the solar cell module 10. Since the solar cell layer 24 is arranged in contact with the first

support layer 20 the solar cell layer 24 is cooled by the air flowing through the channels. Each channel suitably extends between an opening 30 in the upper section 14 of the frame 12 and an opening 30 in the lower section 16 of the frame 12. The solar cell module 10 will be further described in Figures 2-5.

Figure 2 schematically shows a top view of a solar cell module 10 according to an embodiment of the invention. The solar cell module 10 is configured as described in Figure 1, however, this figure does not show the solar cell layer 24, the first support layer 20 or the second support layer 22. The upper section 14 of the frame 12 may comprise attachment holes 31 for attaching the solar cell module 10 to a batten by means of fasteners.

Figure 3a and 3b schematically shows cross-sections of a solar cell module 10 according to embodiments of the invention. The solar cell module 10 is configured as described in Figure 1 and Figure 2 but the frame 12 is omitted, such that the layers of the solar cell module 10 are shown. Figure 3a shows a solar cell module 10 comprising a first support layer 20 and a solar cell layer 24. Figure 3b shows a solar cell module 10 comprising a first support layer 20, a second support layer 22 and a solar cell layer 24. The first support layer 20 may comprise one or more rows of channels. The first support layer 20 is thicker than the second support layer 22. The first support layer 20 is a load carrying layer. The second support layer 22 may comprise one or more rows of channels. The second support layer 22 prevents leakage on the underlying roofing felt and leads water away from the solar cell module 10. The channels of the first support layer 20 and the second support layer 22 may have any cross-section, for example rectangular, honeycomb, latticework or similar. This is however not shown in the figures. By using layers comprising channels the weight of the solar cell module 10 is reduced and the mounting of the solar cell module 10 is facilitated.

The solar cell module 10 further comprises a connection box 32 for electronics. The connection box 32 may be arranged adjacent the first support layer 20

underneath the solar cell layer 24. In the case where the solar cell module 10 comprises a second support layer 22 the connection box 32 may be arranged on top of the second support layer 22, coplanar with the first support layer 20, as shown in Figure 3b. The connection box 32 may be arranged in an opening in the first support layer 20. Alternatively, the first support layer 20 comprises two or more separate parts arranged in parallel, wherein the connection box 32 is arranged between two parts, underneath the solar cell layer 24. The connection box 32 may alternatively be arranged underneath the upper section 14 of the frame 12, coplanar with the first support layer 20 or coplanar with the solar cell layer 24. The solar cell layer 24 comprises a thin film of photovoltaic material on a glass substrate. Alternatively, the thin film of photovoltaic material is sandwiched between two glass substrates. The glass substrate suitably consists of heat treated or tempered glass. The solar cell layer 24 may be a rigid thin-film solar cell layer. The thin-film solar cells suitably comprise cadmium telluride. The first support layer 20 and the second support layer 22 comprising channels will both provide a damping function when the solar cell module 20 is subjected to loads. This way the thin-film solar cell layer 24 can move and the risk that the solar cell layer 24 cracks or breaks under load is minimized.

Figure 3c schematically shows cross-sections of a solar cell module 10 according to embodiments of the invention. The solar cell module 10 is configured as described in Figure 3a. The first support layer 20 comprises a plurality of channels 25 extending essentially perpendicularly to the longitudinal extension of the upper section 14 and the lower section 16 of the frame 12. The channels 25 may however extend with an angle to the upper section 14 and the lower section 16 of the frame 12. In the upper figure the first support layer 20 comprises a multiwall plastic sheet with channels 25. In the lower figure the first support layer 20 comprises moulded plastic channels 25. The moulded channels 25 of the first support layer 20 may lack a top portion and the solar cell layer 24 may thus rest on the walls of the channels 25. The first support layer 20 suitably comprises an arbitrary number of channels 25.

Figure 3d schematically shows an upper section 14 of a frame 12 of a solar cell module 10 according to an embodiment of the invention. The solar cell module 10 is configured as described in Figure 1, Figure 2 and/or Figure 3a-c. The upper section 14 of the frame 12 comprises a first elongated portion 40 arranged on the front side 26 of the solar cell module 10, a second elongated portion 42 arranged on the back side 28 of the solar cell module 10 and an upper end portion 41 connecting the first and the second portion 40, 42. When the solar cell module 10 is integrated in a roof construction 1, roof tiles 4 will overlap the upper part of the front side 26 of the solar cell module 10. The first portion 40 of the upper section 14 of the frame 12 may be configured such that only the upper section 14 of the frame 12 is overlapped and not the uncovered solar cell layer 24. The upper section 14 of the frame 12 further comprises side portions 44 adapted to be connected to the side sections 18', 18'' of the frame 12. The upper end portion 41 may comprise openings 30. The openings 30 are adapted to be in fluid connection with the channels 25 of the first support layer 20 for cooling of the solar cell layer 24.

Figure 3e schematically shows an upper section 14 of a frame 12 of a solar cell module 10 according to an embodiment of the invention. The solar cell module 10 is configured as described in Figure 1, Figure 2 and/or Figure 3a-d. The upper section 14 comprises a hanging portion 52 on the back side 28 of the solar cell module 10. The hanging portion 52 is adapted for hanging the solar cell module 10 on a batten 2.

Figure 4 schematically illustrates the upper part of a back side 28 of a solar cell module 10 according to an embodiment of the invention. The solar cell module 10 is configured as described in Figure 1, Figure 2, Figure 3a, 3c and/or Figure 3d. The first side section 18' and the second side section 18'' of the frame 12 each comprise a hanging portion 52. The hanging portions 52 are arranged at the upper end of the respective side section 18', 18'', adjacent the upper section 14 of the frame 12. Each hanging portion 52 suitably comprises an

upper portion 54 protruding perpendicularly to the longitudinal extension of the respective side section18', 18''. The protruding upper portions 54 are on the back side 28 of the solar cell module 10 and are adapted for hanging the solar cell module 10 on a batten 2. The protruding upper portions 54 thus abut an edge of a batten 2 when the solar cell module 10 is integrated in a roof or wall construction 1. Support members 58 are suitably arranged between the upper section 14 and the lower section 16 of the frame 12 in order to retain the shape of the frame 12. The support members 58 are suitably attached to the upper section 14 and the lower section 16 by rivets. The support members 58 are arranged on the back side 28 of the solar cell module 10 and are thus attached to the second elongated portion 42 of the upper part 14 of the frame 12.

Figures 5a and 5b schematically illustrate a second side section 18'' of a solar cell module 10 according to an embodiment of the invention. The solar cell module 10 is configured as described in Figure 1, Figure 2, Figure 3a, Figure 3c, 3d, 3e and/or Figure 4. Figure 5a shows the second side section 18'' of the frame 12 where the lower section 16 of the frame 12 is omitted. The second side section 18'' of the frame 12 comprises a retention portion 56 adapted to engage with a left side of a roof tile 4. The second side section 18'' of the frame 12 suitably comprises a retention portion 56 which is adapted to engage with a lower part of the left side of a roof tile 4 from above. The retention portion 56 of the second side section 18'' is thus adapted to be arranged on top of the left side of the roof tile 4. The retention portion 56 of the second side section 18'' may be shaped like a hook wherein the hook engages with grooves in the left side of the roof tile 4. The second side section 18'' also comprises a drainage portion 60'' for leading water away from the solar cell module 10. The drainage portion 60'' comprises a bent/curved portion 62'' forming a drainage channel 64'' on the back side 28 of the solar cell module 10. The drainage channel 64'' is thus formed between the bent portion 62'' and the first support layer 20. The bent portion 62'' may be a Z bend portion. Figure 5b shows the second side section 18'' as described in Figure 5a with the lower section 16 attached. The lower section 16 of the frame 12 comprises at least

one drainage opening 70 arranged in fluid connection with the drainage channel 64''. This way, water can be lead away from the solar cell module 10.

Figure 6a shows the first side section 18' of the frame 12 where the lower section 16 of the frame 12 is omitted. The first side section 18' comprises a retention portion 56 adapted to engage with a neighbouring roof tile 4. The first side section 18' of the frame 12 may comprise a retention portion 56 adapted to engage with a right side of a roof tile 4. The retention portion 56 of the first side section 18' is adapted to engage with an upper part of the right side of a roof tile 4 from underneath. The retention portion 56 of the first side section 18' is thus adapted to be arranged underneath the right side of the neighbouring roof tile. The first side section 18' also comprises a drainage portion 60' for leading water away from the solar cell module 10. The drainage portion 60' comprises a drainage channel 64'. The drainage portion 60' suitably comprises a bent/curved portion 62' forming the drainage channel 64' on the back side 28 of the solar cell module 10. The drainage channel 64' is suitably formed underneath the retention portion 56 of the first side section 18'. The bent portion 62' is suitably a Z bend portion. Figure 6b shows the first side section 18' as described in Figure 6a with the lower section 16 attached. The lower section 16 of the frame 12 comprises at least one drainage opening 70 arranged in fluid connection with the drainage channel 64'. This way, water can be lead away from the solar cell module 10.

The foregoing description of the preferred embodiments of the present invention is provided for illustrative and descriptive purposes. It is not intended to be exhaustive or to restrict the invention to the variants described. Many modifications and variations will obviously be apparent to one skilled in the art. The embodiments have been chosen and described in order best to explain the principles of the invention and its practical applications and hence make it possible for specialists to understand the invention for various embodiments and with the various modifications appropriate to the intended use.

Claims

1. A solar cell module, comprising a frame (12) with an upper elongated section (14), a lower elongated section (16), a first elongated side section (18') and a second elongated side section (18''); a first support layer (20) arranged in connection to the frame (12) and a solar cell layer (24) arranged on top of the first support layer (20), wherein the frame (12) surrounds the first support layer (20) and the solar cell layer (24) peripherally and wherein the first support layer (20) comprises at least one channel (25).

2. A solar cell module according to claim 1, wherein the at least one channel (25) extends substantially perpendicularly to the longitudinal extension of the upper section (14) and the lower section (16) of the frame (12).

3. A solar cell module according to claim 1 or 2, wherein the solar cell layer (24) comprises a thin-film solar cell.

4. A solar cell module according to any of the preceding claims, wherein the first support layer (20) comprises a multiwall plastic sheet with channels (25).

5. A solar cell module according to any of the preceding claims, wherein a second support layer (22) is arranged underneath the first support layer (20).

6. A solar cell module according to claim 5, wherein the second support layer (22) comprises a multiwall plastic sheet with channels extending substantially perpendicularly to the longitudinal extension of the upper section (14) and the lower section (16) of the frame (12).

7. A solar cell module according to any of the preceding claims, wherein the solar cell module (10) is adapted to constitute an integrated part in a roof or wall construction (1).

8. A solar cell module according to any of the preceding claims, wherein the frame (12) comprises at least one opening (30) in fluid connection with the at least one channel (25) of the first support layer (20).

9. A solar cell module according to any of the preceding claims, wherein a connection box (32) is arranged adjacent the first support layer (20).

10. A solar cell module according to any of the preceding claims, wherein the frame (12) is essentially rectangular, where the upper section (14) and the lower section (16) are longer than the side sections (18', 18'').

11. A solar cell module according to any of the preceding claims, wherein the first side section (18') and the second side section (18'') of the frame (12) each comprises a retention portion (56) adapted to engage with a neighbouring roof tile (4).

12. A solar cell module according to any of the preceding claims, wherein the frame (12) comprises metal.

13. A solar cell module according to any of the preceding claims, wherein the frame (12) comprises at least one hanger portion (52).

14. A solar cell module according to any of the preceding claims, wherein at least one support member (58) is arranged between the upper section (14) and the lower section (16) of the frame (12).

15. A solar cell module according to any of the preceding claims, wherein the first side section (18') and the second side section (18'') of the frame (12) each comprises a drainage portion (60', 60'').

16. A solar cell module according to claim 15, wherein the drainage portion (60', 60'') of each side section (18', 18'') comprises a drainage channel (64', 64'').

17. A solar cell module according to claim 16, wherein the lower section (16) of the frame (12) comprises at least one drainage opening (70) arranged in fluid connection with each drainage channel (64', 64'').

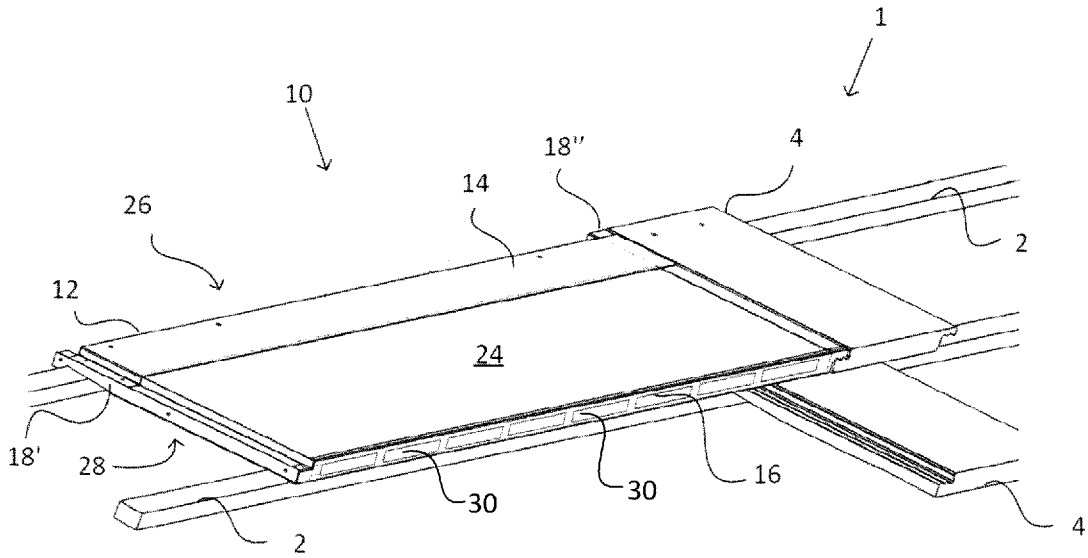

FIG. 1

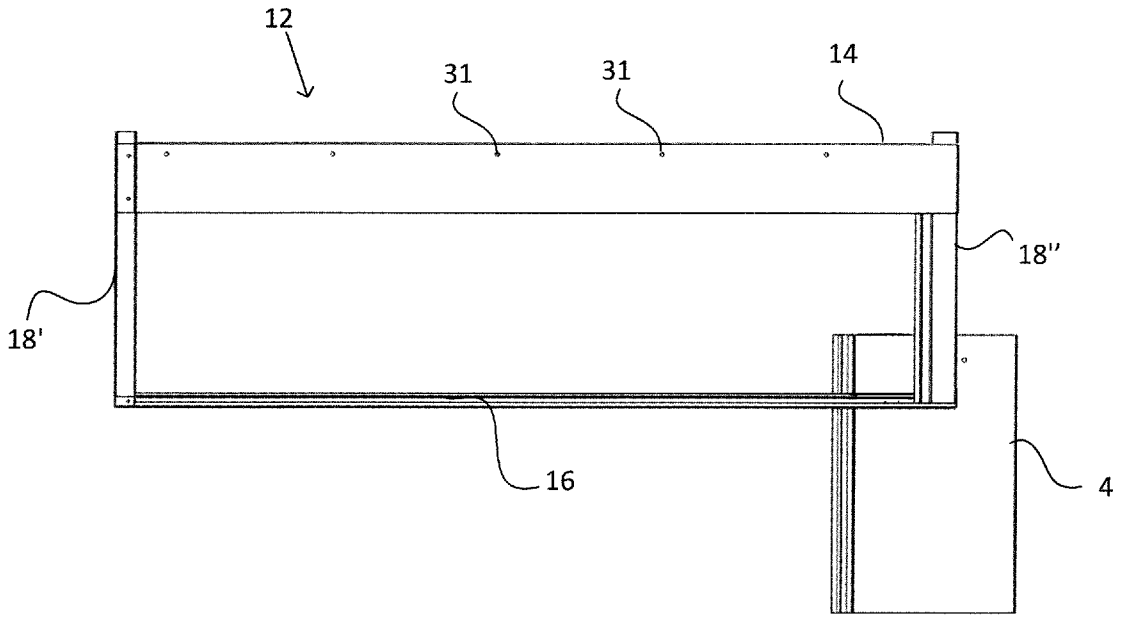

FIG. 2

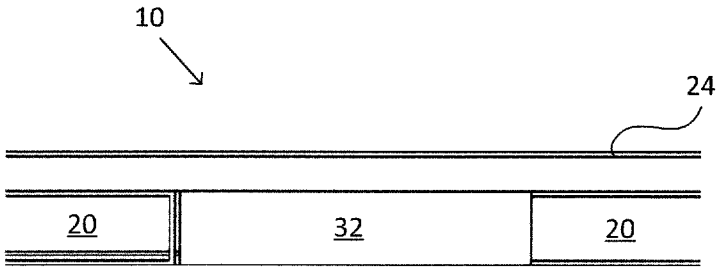

FIG. 3a

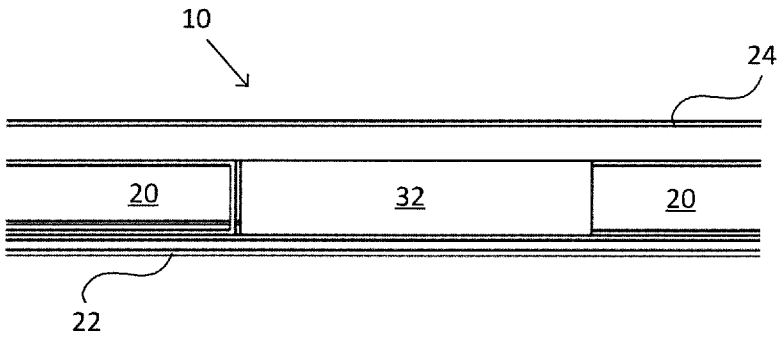

FIG. 3b

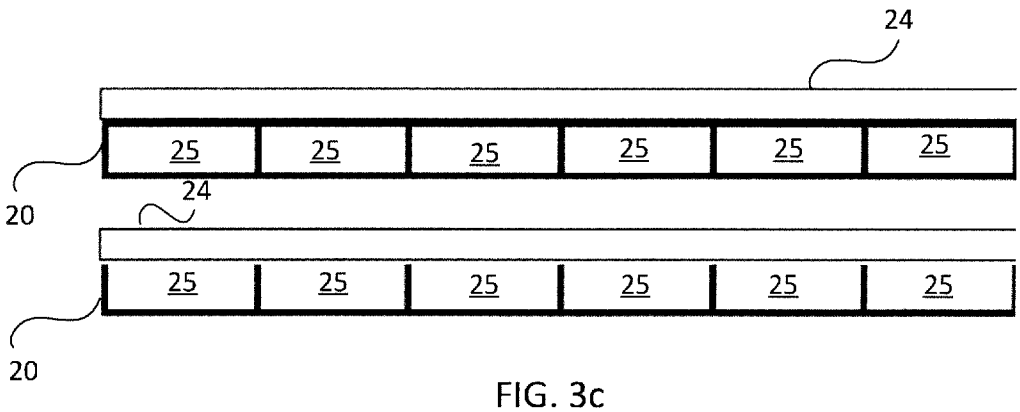

FIG. 3c

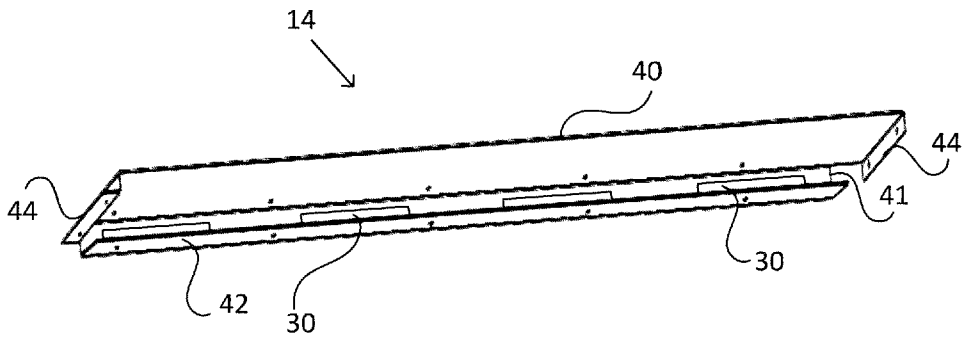

FIG. 3d

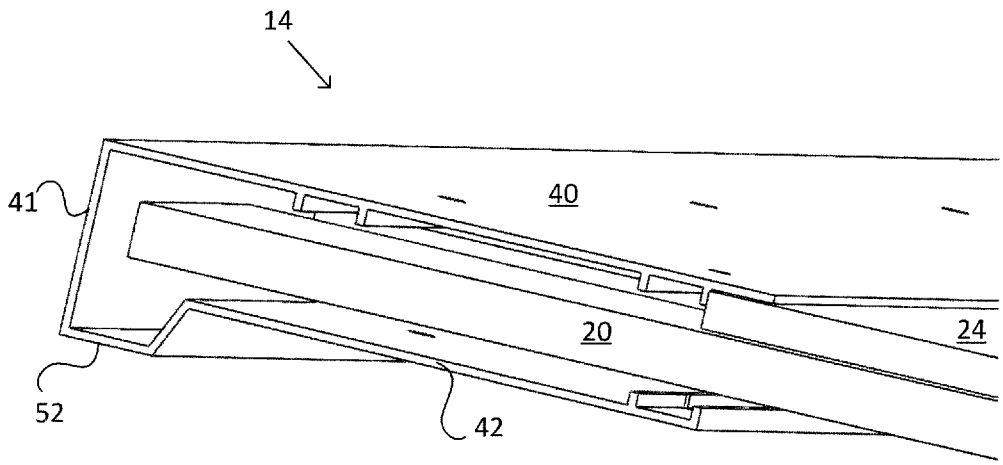

FIG. 3e

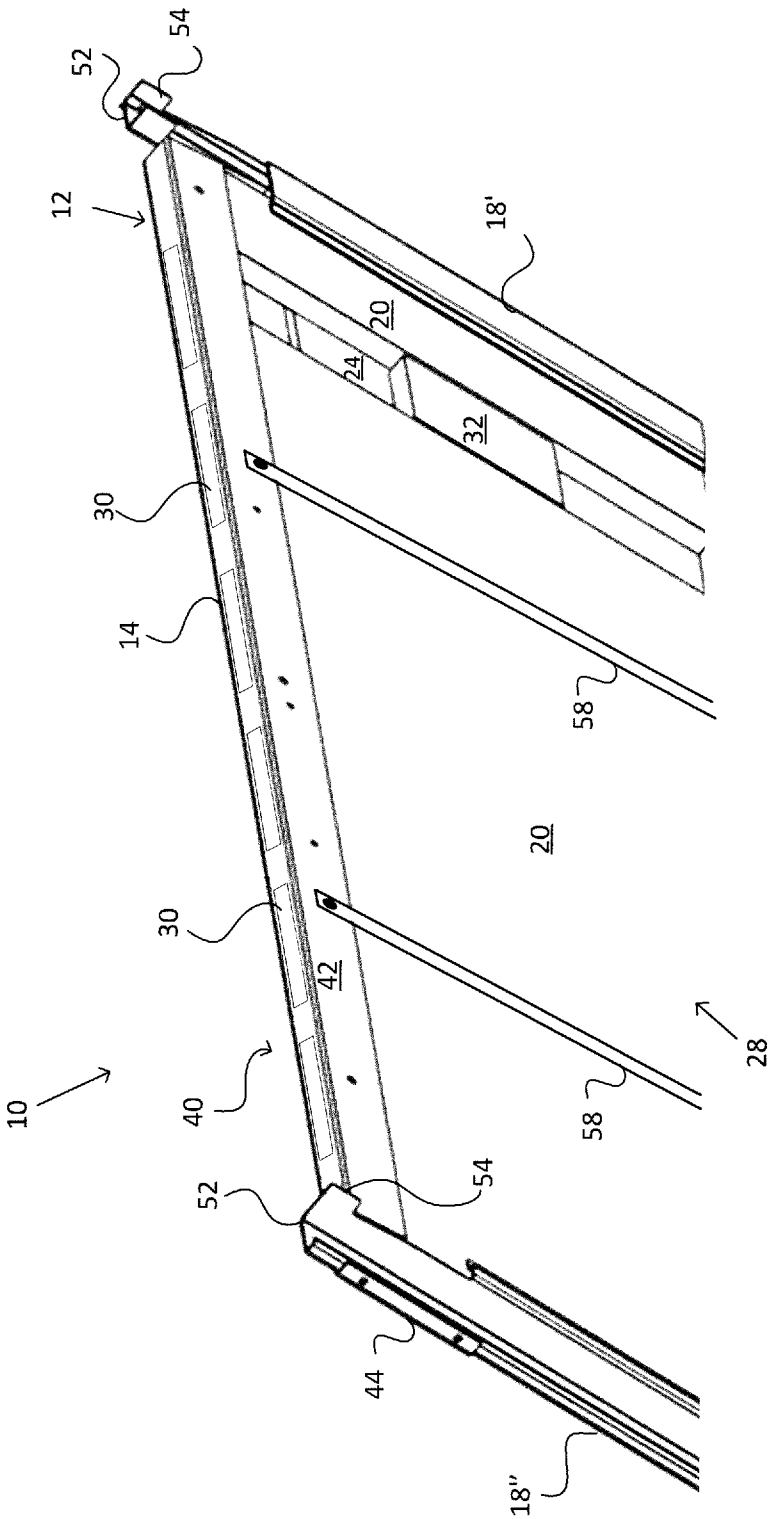

FIG. 4

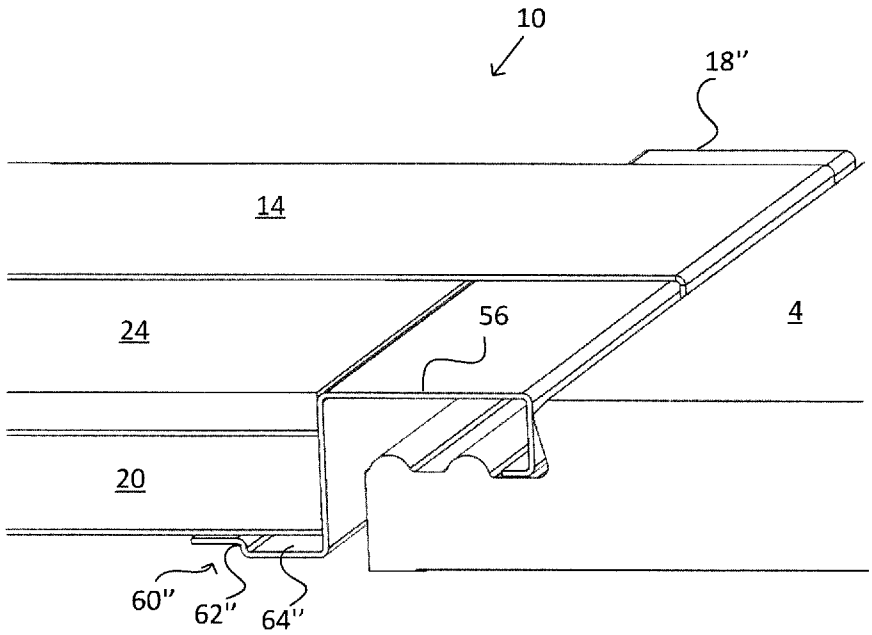

FIG. 5a

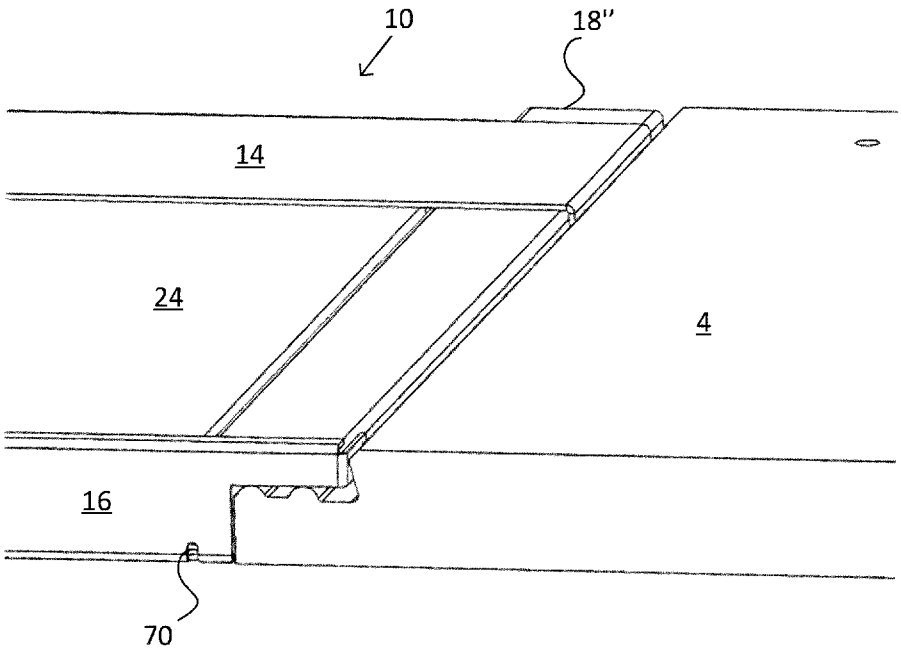

FIG. 5b

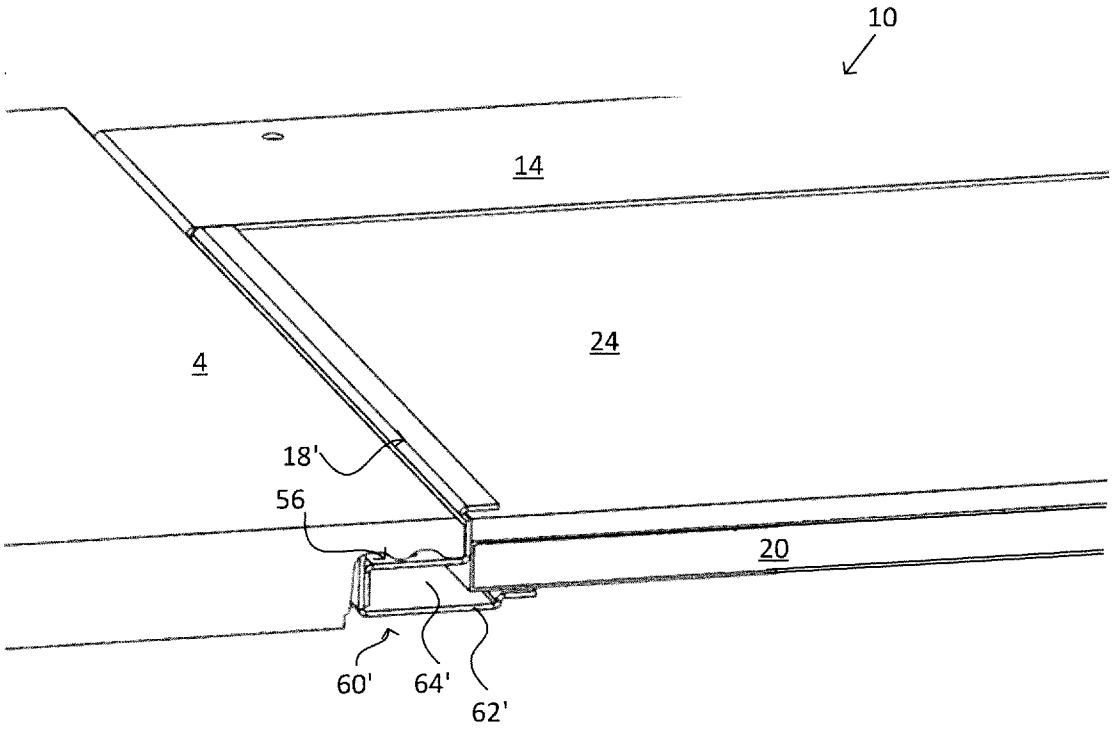

FIG. 6a

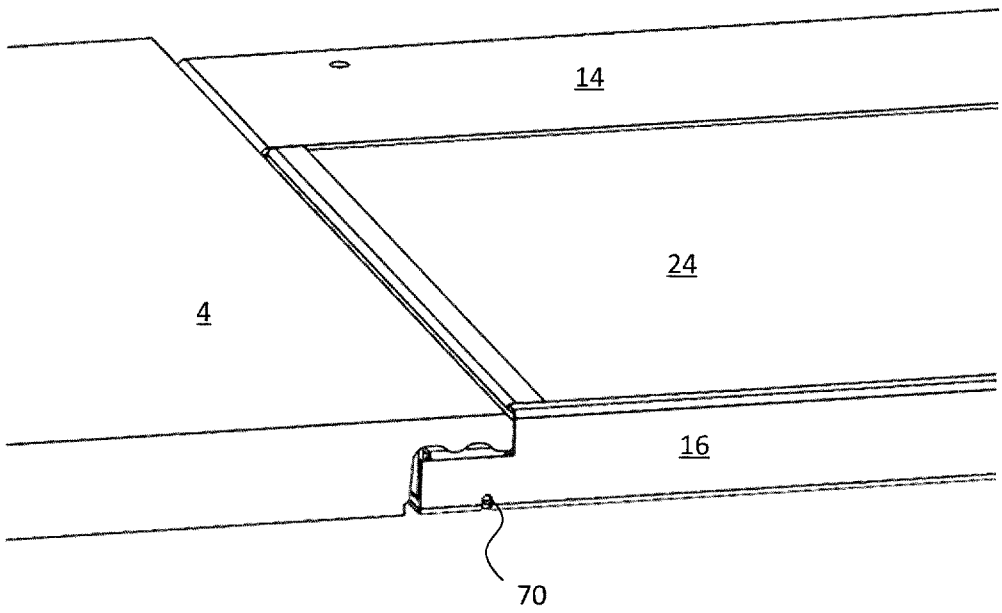

FIG. 6b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2016/050918

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: F24J, H02S

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, 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 20080135092 A1 (CORRALES EUGENIA M), 12 June 2008 (2008-06-12); paragraph [0008]; figures 1,2a,4	1-17
	--	
X	EP 2280422 A2 (SHS SOLAR HOUSE SYSTEMS GMBH), 2 February 2011 (2011-02-02); figures 11,12; 23,24,25 and 26 in figure 6	1-17
	--	
X	EP 2009704 A2 (SOLEYA SRL), 31 December 2008 (2008-12-31); paragraphs [0023]-[0024], [0026]; figure 2	1-17
	--	
A	US 20120262040 A1 (KARPOVICH JON ET AL), 18 October 2012 (2012-10-18); whole document	1-17
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☒ 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 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	Date of mailing of the international search report
14-12-2016	14-12-2016

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2016/050918

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 20130042905 A1 (STASSEN PETRUS PAULUS CAROLUS MARIA), 21 February 2013 (2013-02-21); whole document --	1-17
A	US 20120298188 A1 (WEST JOHN R ET AL), 29 November 2012 (2012-11-29); whole document --	1-17
A	EP 2026017 A2 (SOLAR CENTURY HOLDINGS LTD), 18 February 2009 (2009-02-18); whole document -- --------	1-17

International application No.
PCT/SE2016/050918

Continuation of: second sheet

International Patent Classification (IPC)

F24J 2/52 (2006.01)
H02S 20/23 (2014.01)

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EP	2280422	A2	02/02/2011	DE	202009010235	U1	01/10/2009
EP	2009704	A2	31/12/2008	IT	TV20070113	A1	26/12/2008
US	20120262040	A1	18/10/2012	US	20150318819	A1	05/11/2015
				US	9082913	B2	14/07/2015
US	20130042905	A1	21/02/2013	CA	2788769	A1	11/08/2011
				CN	102844889	A	26/12/2012
				EP	2532031	A1	12/12/2012
				NL	2004206	C	08/08/2011
				WO	2011096810	A1	11/08/2011
US	20120298188	A1	29/11/2012	US	9496821	B2	15/11/2016
				US	9461579	B2	04/10/2016
				US	9154074	B2	06/10/2015
				US	20140251431	A1	11/09/2014
				US	9300244	B2	29/03/2016
				US	20160043691	A1	11/02/2016
				US	20150068590	A1	12/03/2015
				US	20150033658	A1	05/02/2015
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				US	20090044850	A1	19/02/2009