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(54) **Heat sink panel for a photovoltaic panel**

(57) A first aspect provides a heat sink panel for receiving thermal energy from a photovoltaic panel. The heat sink panel comprises a shaped metal sheet, wherein at least part of the metal sheet is shaped into substantially parallel gutters. When attached to the photovoltaic panel, the gutters form channels between the heat sink panel and the photovoltaic panel. The gutters range from a proximal gutter end to a distal gutter end and the distal end and the proximal end comprise openings enabling an air flow through the gutters. Whereas known heat sinks comprise protrusions like parallel oriented fins, they do are not arranged to provide more or less closed channels at the back of the photovoltaic panel to enable a stream of air to flow through the channel. Channels do not have to be fully closed, smaller openings may be provided. An airflow may be provided by a chimney effect.

P114615NL00

Title: Heat sink panel for a photovoltaic panel

TECHNICAL FIELD

The various aspects and embodiments thereof relate to the field of heat sinks for photovoltaic panels.

BACKGROUND

As photovoltaic panels - solar panels - are placed in sunlight as much and as long as possible and because they are arranged to reflect as little sunlight as possible, they heat up. And because these panels usually comprise an active layer comprising semiconductor material, the heat affects the efficiency of the photovoltaic panel in a negative way.

Various cooling efforts are known, including liquid cooling and placement of heat sinks. Use of passive cooling is preferred, as photovoltaic panels are usually placed at remote and/or difficult to reach places. Therefore, a low-maintenance / low cost cooling application is preferred.

SUMMARY

It is preferred to provide more efficient passive cooling for a photovoltaic panel.

A first aspect provides a heat sink panel for receiving thermal energy from a photovoltaic panel. The heat sink panel comprises a shaped metal sheet, wherein at least part of the metal sheet is shaped into substantially parallel gutters. When attached to the photovoltaic panel, the gutters form channels between the heat sink panel and the photovoltaic panel. The gutters range from a proximal gutter end to a distal gutter end and the distal end and the proximal end comprise openings enabling an air flow through the gutters.

Whereas known heat sinks comprise protrusions like parallel oriented fins, they do are not arranged to provide more or less closed

channels at the back of the photovoltaic panel to enable a stream of air to flow through the channel. Channels do not have to be fully closed, smaller openings may be provided in the channels.

The mere availability of a channel and wind already provides a flow of air through the channel. Alternatively or additionally, the panel may be provided under angle relative to the earth surface, i.e. in a configuration wherein one end of the channel is lower than another, opposite end. By virtue of heating of the air in the channel, air will flow from the lower end to the higher end due to unforced natural convection. The channel may provide functionality as a kind of chimney. Such flow of air in a closed spaced can provide more efficient cooling as compared to a heat sink having open channels between fins.

In an embodiment, sides of the gutters comprise partial cut out areas formed by a single line cut having a first cut end and a second cut end defining a substantially straight folding line from the first cut end to the second cut end.

Such embodiments provides openings in walls of the channel that may be opened by providing the flaps under an angle with the wall of the channel, by folding the flaps over the folding line. Tests have shown this provides more efficient cooling. In such embodiment, more exposure is provided to cooler air surrounding the heatsink by the turbulence generated by the flow around the flaps increasing mixing of hot air with cooler air.

In another embodiment, the folding line is substantially perpendicular to the length of the gutters. This means that in such embodiments, the flaps provide an opening in a direction pointing towards and end of the gutter. Tests have shown this provides more efficient cooling.

In a further embodiment, the cut out areas are grouped in a first group in which the folding line is located at a proximal side of the gutter and the cut is located at a distal side; and a second group in which the folding

line is located at a distal side of the gutter and the cut is located at a proximal side. Tests have shown this provides more efficient cooling.

In yet another embodiment, the sheet comprises substantially flat areas between the gutters, the flat areas being located in one and the same imaginary plane. And advantage of this embodiment is that a surface is provided for connecting or attaching the heat sink to a photovoltaic panel and to the back side in particular.

In yet a further embodiment, the sheet has a thickness of 0.5 millimetres or less, 0.2 millimetres or less and preferably 0.1 millimetres or less. With such thickness, even at 0.1 millimetres, the heat sink panel provides enough stability and rigidity to known photovoltaic panels that a frame around the panel may be omitted. This allows for weight and cost reduction of a photovoltaic panel.

The various embodiments provide, as sole embodiment and in particular combined, an optimum for providing cooling of the panel, rigidity to the photovoltaic panel, material use and cost price.

A second aspect provides a photovoltaic panel comprising a photovoltaic laminate for converting at least part of received solar radiation to electrical energy and the heat sink according to any of the preceding claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The various aspects and embodiments thereof will now be discussed in further details in conjunction with drawings. In the drawings,

Figure 1: shows a heat sink panel having triangular gutters;

Figure 2 A: shows a heat sink panel having rectangular gutters;

Figure 2 B: shows a heat sink having half-round gutters

Figure 2 C: shows a heat sink having trapezium shaped gutters

Figure 3: shows a heat sink panel having cut-out flaps in walls of a gutter folded perpendicularly to the gutter length;

Figure 4: shows a heat sink panel having cut-out flaps in walls of a gutter folded parallel to the gutter length;

Figure 5: shows a photovoltaic panel with a heat sink panel; and

Figure 6: shows a heat sink panel comprising two sub-sinks skewed relative to one another.

Figure 7 A: shows a first solar power production setup; and

Figure 7 B: shows a second solar power production setup.

DETAILED DESCRIPTION

Figure 1 shows a heatsink panel 100. The heatsink panel 100 is arranged to be attached to an object having a substantially flat area for receiving thermal energy from the object. The heatsink panel comprises gutters 110 that are provided substantially parallel to one another. Between the gutters 110, connecting lanes 120 are provided. In this embodiment, the connecting lanes 120 have substantially the same width as the gutters 110, but other dimensions, wider or narrower, may be envisaged as well.

The connecting lanes, as flat areas provided in one and the same imaginary plane, provide a connecting area for connecting the heat sink panel 100 to the object. In one embodiment, the connecting lanes may be omitted and the heat sink panel 100 is connected to the object via the upper ridges of the gutters 110.

The gutters 110 have a triangular cross-section and are shaped by substantially parallel folds provided in the sheet material comprised by the

heatsink panel 100. The top angle of the triangular shape may be between 25° and 60° and preferably between 35° and 45°, where a value of 40° is preferred. The depth of the gutter 110 is preferably 4 centimetres, with a top angle of 40° this results in a width of the gutter of approximately 3 centimetres.

The sheet material comprised by the heatsink panel 100 as shown by Figure 1 preferably comprises thermally conductive material and a metal in particular. Aluminium is highly preferred, due to its cost and its resistance against corrosion - once a protective corroded layer is provided at the outside. The aluminium sheet material preferably has a thickness of less than 0,5 millimetres, more preferably less than 0.2 millimetres and most preferably equal to or less than 0.1 millimetres. The outer surface of the heatsink panel may be smoot or, alternatively, roughed. The roughening may be provided by brushing aluminium - or another metal - by means of a hard brush or equivalent tool, by pitting, by grinding, any patterning, for example in a three-dimensional diamond shape or another three-dimensional shape, or a combination thereof.

Whereas a triangular cross-section of the gutters 110 as shown by Figure 1 is preferred, differently shaped gutters may be envisaged as well. Figure 2 A shows another heatsink panel 100 having gutters 110 with a substantially rectangular, square cross-section that are connected via connecting lanes 120. Differently shaped gutters, having curved shapes, for example trapezoid as depicted by Figure 2 B, (semi-)circular as depicted by Figure 2 C, elliptical or sinusoidal, may be envisaged as well.

Figure 3 shows a further embodiment of the heat sink panel 110. In a first wall 112 of the gutter 110, a first group 430 of first cut-out flaps 342 is provided. Next to the first group 430, a second group 350 of second cut-out flaps 352 is provided. In this embodiment, each group comprises four cut-out flaps, but other numbers may be envisaged as well, like two, three, five, six, seven or eight.

The set of two groups may be repeated along the length of the gutter 110, dependent on the size of the cut-out flaps and the length of the gutter 110. Flaps having a width of 1 centimetre, spaced apart 1 centimetre and a height of approximately 3 centimetres are preferred. More preferably, the flaps are 10 millimetres wide, 8 millimetres spaced apart and 28 millimetres high. The distance between the groups may be about 2 centimetres and is preferably 18 millimetres.

In the first group 340 of first cut-out flaps 342, the cut-out flaps 342 formed by adjacent three cuts forming a rectangular shape. Of the rectangular shape, at one side no cut along the full length of the rectangular flap is provided. In this way, the cut-out flap 342 is connected to the first wall 112. As shown by Figure 3, the first cut-out flap 342 is folded outwardly over the first not fully cut side 344 of the rectangle. The angle of the fold may be between 30° and 60°, preferably between 40° and 50° and most preferred at 45°.

With the first group 430, the first not fully cut side 344 is provided at a proximal end of the first cut-out flap and with the second group 350, a second not fully cut side 354 of the second flap 342 is provided at a distal end of the second cut-out flap 352. Also the second cut-out flap 352 is folded outwardly.

The first not fully cut side 344 and the second not fully cut side 354 are provided substantially perpendicular to the length of the gutter 110. Substantially perpendicular is in this embodiment to be understood as strictly perpendicular with a deviation of at most 5°, preferably not more than 4°. Alternatively, the cut-out flap is provided under an angle of more than 5°, preferably not more than 10 ° deviating form the normal of the length of the gutter 110. In another embodiment, the not fully cut sides of the cut-out flaps are only provided at the distal side or at the proximal side of the cut-out flaps. Preferably, cut-out flaps are provided at a second wall 114 of the gutter 110 as well, preferably opposite of the cut-out flaps at the

first wall 112 of the gutter 110. The cut-outs flaps in the second wall 114 preferably have their not fully cut sides located at the same side as the not fully cut sides at the first wall 112.

Figure 4 shows yet another embodiment of the heat sink panel 100. The gutters 110 have a substantially triangular cross-section. In the first wall 112 and preferably also in the second wall 114, horizontally oriented cut-out flaps 442 are provided. Preferably, one, two or three cut-out flaps are provided above one another in the first wall 112, in a first group 440. The cut-out flap 442 as shown by Figure 4 have a not fully cut side 444 provided at a proximal side relative to the bottom of the gutter 110. The cut-out flap 442 is folded outwardly over the not fully cut side 444. In another embodiment, the not fully cut side 444 is provided at a distal side relative to the bottom of the gutter 110, at the side of the connecting lane 120. Figure 4 shows multiple groups of horizontally oriented cut-out flaps along the length of the gutter 110.

In the embodiments discussed above, the cut-out flaps have a substantially rectangular shape. Whereas this is preferred, the cut-out flaps may also have a square, circular, elliptical, trapezoid or otherwise polygon or curved shape. For all these shapes, it is preferred the flap is at least at some point connected to the wall of the gutter 110 and folded outward from the gutter over the connecting part.

In the embodiments shown, the cut-out flaps are folded over the line from the first end of the cut to the second end of the cut, with a straight fold over a straight line. In another embodiment, folding of the flaps is not constituted by folding them over a straight and sharp line, but by bending them over the line from the first end of the cut to the second end of the cut.

As an option to this embodiment, the cut defining a, for example, a substantially rectangularly defined cut-out flap, does not have to cover more than half the cut-out flap. In one particular embodiment, a rectangular flap is defined by a cut covering two sides and the cut-out flap is

folded over a bend along a diagonal of the flap, from the first end of the cut to the second end of the cut. In this embodiment, a first cut line is preferably provided near the top of the triangle - or the bottom of the gutter - and a second cut perpendicular to the first cut line, towards the connecting lane 120.

An advantage of folding the flaps by bending, rather than folding them over a straight line, is that the heat sink panel 100 may be stacked in a more convenient way, in particular with the specific embodiment discussed directly above.

Furthermore, it is preferred the connection between the cut-out flaps and the wall is per group of cut-out flaps provided one the same side of the cut-out flaps. The group can comprise all cut-out flaps on a wall or a specific number of cut-out flaps, as discussed above.

Figure 5 shows the heat sink panel 100 connected to a photovoltaic panel 500. The photovoltaic panel 500 comprises an active layer 504, comprising semiconductor material of a first conductivity type and semiconductor material of a second conductivity type such that a junction between both types of materials is provided over a large area of the active layer 504 for converting received solar radiation to electricity. Op top of the active layer 502, a protective and for at least some solar radiation substantially transparent protective layer 502 is provided. The protective layer 502 may comprise sub-layers, for example for providing rigidity, for reducing reflection, for other purposes, or for a combination of these purposes.

Below the active layer 504, a support layer 506 is provided. The support layer 506 is provided for the purpose of providing some rigidity to the photovoltaic panel 500, for protecting the rear side or the bottom side of the active layer 504, for conducting thermal energy from the active layer 504 to the heat sink 100, other purposes or a combination of these purposes.

The support layer may comprise a polymer and a polyolefin in particular, as commonly used for photovoltaic panels. In another embodiment, the support layer 506 comprises a thermally highly conductive material and preferably a metal layer in particular, for example comprising aluminium. An issue with metal is that it may not provide sufficient electrical isolation of the active layer 504. Therefore, the support layer 506 may comprise a electrically isolating sub-layer 508 and a thermally highly conductive sub-layer 510. The electrically isolating sub-layer 508 preferably has suitable thermally conductive properties as well, though electrically isolating properties are more important in order to isolate the active layer 504 from the heat sink 100 and the highly conductive sub-layer 510.

With the highly conductive sub-layer 510 provided at the back side of the photovoltaic panel 500, channels are formed by the gutters 110 in the heat sink 100 and the highly conductive sub-layer 510 that have highly conductive material at all sides. This allows for improved heat removal - removal of thermal energy - compared to embodiments in which the photovoltaic panel 500 has a conventional polymer support layer 506.

The heat sink panel 100 is connected to the outer side of the support layer 506. The connection may be provided by means of an adhesive, screws, rivets, nails, bolts, snap-fit connections, other, or a combination thereof.

The heat sink panel 100 is preferably connected to the photovoltaic panel 500 via a thermally conductive connection. This connection may be provided by providing a direct contact between the heat sink panel 100 and the photovoltaic panel 500 or by providing a conductive material in between. In the latter case, such material may be a heat conducting adhesive or other preferably fluid material that may harden out and/or cure after application.

Figure 5 shows the heat sink 100 being provided at substantially the full area of the backside of the photovoltaic panel 500. In another

embodiment, the heat sink 100 is provided at only a part of the backside of the photovoltaic panel. In such embodiment, more than one heat sinks 100 may be provided, a complementary areas of the backside of the support layer 506 - so at the backside of the photovoltaic panel 500.

In the description above and the Figures discussed so far, the heat sink 100 has been discussed as comprising the gutter 110 that range from a first side of the heat sink 100 to a second, opposite side of the heat sink 100. And in all embodiments discussed and shown thus far, the gutters 110 have been shown to run substantially perpendicular to the sides at which they debouch. In another embodiment, the gutters may be placed under an angle relative to the sides at which they debouch. Furthermore, alternatively from running from end to end, gutters may be provided running over only a part of the heat sink 100 or only part of the photovoltaic panel 500. Figure 6 shows an embodiment in which the gutters do not run from end to end.

Figure 6 shows a compound heatsink 100 comprising a first sub-sink 102 and a second sub-sink 104. The first sub-sink 102 comprises first gutters 130 and the second sub-sink 104 comprises second gutters 150. Between the first gutters 130, first connecting lanes 140 are provided and between the second gutters 150, second connecting lanes 160 are provided. In this embodiment, the lanes are as wide as the gutters, for both sub-sinks. The first sub-sink 102 is skewed by half a pitch relative to the second sub-sink 104 such that a first gutter is provided in extension of a second connecting lane.

In another embodiment, a compound heatsink is envisaged in which the gutters of the individual heatsinks are provided substantially in extension of one another.

Standard photovoltaic panels have, at the filing date of this application, dimensions of 1 metre by 1.6 metre. The gutters may be provided over either the length or the width of the photovoltaic panel 500 (Figure 5), depending on the orientation of the photovoltaic panel 500

during use. As the channels provided between the gutters 110 and the support layer 506 are intended to provide a chimney effect for channelling air for removing thermal energy, it is important the channels are in use oriented from a lower edge of the panel to a higher edge of the panel, rather than from edges of the panel having substantially the same height.

Figure 7 A shows a first solar power production setup 700. The first solar power production setup 700 comprises a first support frame comprising an upper support beam 722 and a bottom support beam 724 for supporting the photovoltaic panel 500 with the heatsink 100. The support beams are supported by vertical support poles 710. The photovoltaic panel 500 is provided on the support beams such that the gutters 110 run from high to low, perpendicularly to the support beams.

Figure 7 B shows a second solar power production setup 750. The second solar power production setup 750 comprises a second support frame comprising a left support beam 772 and a right support beam 774 for supporting the photovoltaic panel 500 with the heatsink 100. The support beams are supported by vertical support poles 760. The photovoltaic panel 500 is provided on the support beams such that the gutters 110 run from high to low, perpendicularly to the support beams.

With the first solar power production setup 700, the support beams provide additional support to the photovoltaic panel 500 perpendicular to support provided by the gutters 110. This means that, in operation, rigidity is provided in two substantially perpendicular directions.

With the second solar power production setup 750, the support beams provide additional support to the photovoltaic panel 500 parallel to support provided by the gutters 110. This means that, in operation, rigidity is provided in two substantially parallel directions - and limited support is provided over a direction perpendicular to the gutters 110. Therefore, the system of the photovoltaic panel 500 and the heat sink 100 is provided with panel support beams 780 that run perpendicular to the length of the gutters

110. The panel support beams 780 do not interrupt the channels provided by the gutters 110 and the back of the photovoltaic panel. The panel support beams 780 may be provided with indentations in which the gutters 110 fit. Alternatively or additionally, the panel support beams are provided on top of the gutters 110 such that they extend from the heat sink beyond the extremities of the gutters 110.

An advantage of a compound heatsink is that this allows the heatsink to be connected to the photovoltaic process by means of a lamination process. Optionally, the photovoltaic laminate, including the heatsink, may be manufactured in one single process step.

As the thermal extension coefficients of aluminium - or another suitable material - are significantly different, connecting one single heatsink with substantially the same size as the photovoltaic panel by means of a lamination process using heat will result in a bent end product. By using multiple smaller heatsinks as one large compound heatsink having substantially the same size as the photovoltaic panel, the impact of this issue is at least reduced. In case one large heatsink is preferred, for example, in view of preferred rigidity of the total product, the heatsink is connected to the photovoltaic in an adhesion process not employing heat or employing reduced heat compared to lamination. In one embodiment, an adhesive, like glue, another adhesive or a combination thereof, is used. The adhesive preferably conducts thermal energy in an efficient way from the photovoltaic panel to the heatsink.

Other embodiments may be envisaged in which the gutters and the connecting lanes do not have the same width. Yet, it is preferred the pitch - the total width of one gutter and one connecting lane - have substantially the same width.

In the description above, it will be understood that when an element such as layer, region or substrate is referred to as being “on” or “onto” another element, the element is either directly on the other element,

or intervening elements may also be present. Also, it will be understood that the values given in the description above, are given by way of example and that other values may be possible and/or may be strived for.

Furthermore, the invention may also be embodied with less components than provided in the embodiments described here, wherein one component carries out multiple functions. Just as well may the invention be embodied using more elements than depicted in the Figures, wherein functions carried out by one component in the embodiment provided are distributed over multiple components.

It is to be noted that the figures are only schematic representations of embodiments of the invention that are given by way of non-limiting examples. For the purpose of clarity and a concise description, features are described herein as part of the same or separate embodiments, however, it will be appreciated that the scope of the invention may include embodiments having combinations of all or some of the features described. The word 'comprising' does not exclude the presence of other features or steps than those listed in a claim. Furthermore, the words 'a' and 'an' shall not be construed as limited to 'only one', but instead are used to mean 'at least one', and do not exclude a plurality.

A person skilled in the art will readily appreciate that various parameters and values thereof disclosed in the description may be modified and that various embodiments disclosed and/or claimed may be combined without departing from the scope of the invention.

It is stipulated that the reference signs in the claims do not limit the scope of the claims, but are merely inserted to enhance the legibility of the claims.

Conclusies

1. Warmteafvoerpaneel voor ontvangen van thermische energie van een fotovoltaïsch paneel, het warmteafvoerpaneel omvattende een gevormd metalen plaat, waarbij ten minst een deel van de metalen plaat is gevormd in hoofdzakelijk parallelle goten voor het vormen van, als het warmteafvoerpaneel aan het fotovoltaïsch paneel is bevestigd, kanalen tussen het warmteafvoerpaneel en het fotovoltaïsche paneel, waarbij de goten zich uitstrekken van een proximaal gooteinde naar een distaal gooteinde en het distale gooteinde en het proximale gooteinde openingen omvattende welke een luchtstroom in staat stellen om door de kanalen te stromen.

2. Warmteafvoerpaneel volgens conclusie 1, waarbij de goten zijn gevormd door in hoofdzaak parallelle vouwen.

3. Warmteafvoerpaneel volgens conclusie 1 of conclusie 2, waarbij de goten schuine zijden omvatten.

4. Warmteafvoerpaneel volgens een van de voorgaande conclusies, waarbij de zijden van de goten een gedeeltelijke uitsnijding omvatten gevormd door een snede omvattende een eerste snede-einde en een tweede snede-einde welke een in hoofdzaak rechte vouwlijn definiëren van het eerste snede-einde tot het tweede snede-einde.

5. Warmteafvoerpaneel volgens conclusie 4, waarbij de vouwlijn in hoofdzaak parallel aan de goten is.

6. Warmteafvoerpaneel volgens conclusie 4, waarbij de vouwlijn in hoofdzaak loodrecht op de goten staat.

7. Warmteafvoerpaneel volgens conclusie 6, waarbij de uitgesneden gebieden zijn gegroepeerd in:

- Een eerste groep waarbij de vouwlijn zich bevindt aan een proximale zijde van de goot en de snede zich bevind aan een distale zijde; en
- Een tweede groep waarbij de eerste vouwlijn zich aan een distale zijde van de goot bevindt en de snede zich bevindt aan een proximale zijde.

8. Warmteafvoerpaneel volgens conclusie 7, waarbij de eerste groep en de tweede groep afwisselend zijn verdeeld van de proximale kant van de plaat naar de distale zijde van de plaat.

9. Warmteafvoerpaneel volgens conclusie 4 tot en met 8, waarbij de uitgesneden gebieden een in hoofdzaak rechthoekige of driehoekige vorm hebben.

10. Warmteafvoerpaneel volgens een van de conclusies 4 tot en met 9, waarbij de uitgesneden gebieden vanuit de goot naar buiten zijn gevouwen.

11. Warmteafvoerpaneel volgens een van de voorgaande conclusies, waarbij de plaat in hoofdzaak vlakke gebieden omvat tussen de goten, welke vlakke gebieden zich in een denkbeeldig vlak bevinden.

12. Warmteafvoerpaneel volgens een van de voorgaande conclusies, waarbij de goten driehoekig zijn gevormd.

13. Warmteafvoerpaneel volgens een van de voorgaande conclusies, waarbij het metaal aluminium is.

14. Warmteafvoerpaneel volgens een van de voorgaande conclusies, waarbij de plaat een dikte heeft van 0.5 millimeter or minder, 0.2 millimeter of minder en bij voorkeur 0.1 millimeter of minder.

15. Fotovoltaïsch paneel omvattende;

- een fotovoltaïsch paneel omvattende een actieve laag voor omzetten van ten minste een deel van ontvangen zonnestraling naar elektrische energie en een steunlaag voorzien voor ondersteunen van de actieve laag; en
- Het warmteafvoerpaneel volgens een van de voorgaande conclusies, voorzien op de steunlaag.

16. Fotovoltaïsch paneel volgens conclusie 15, waarbij de steunlaag een thermisch hoog geleidende sub-laag omvat in thermisch geleidend contact met het warmteafvoerpaneel.

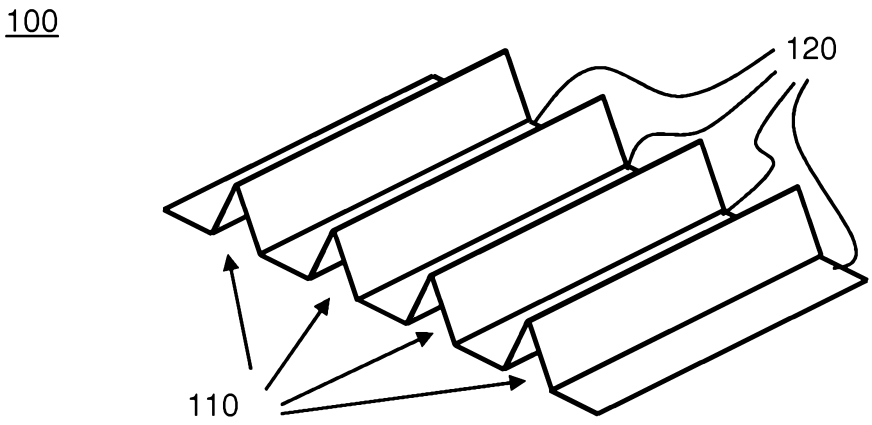


Fig. 1

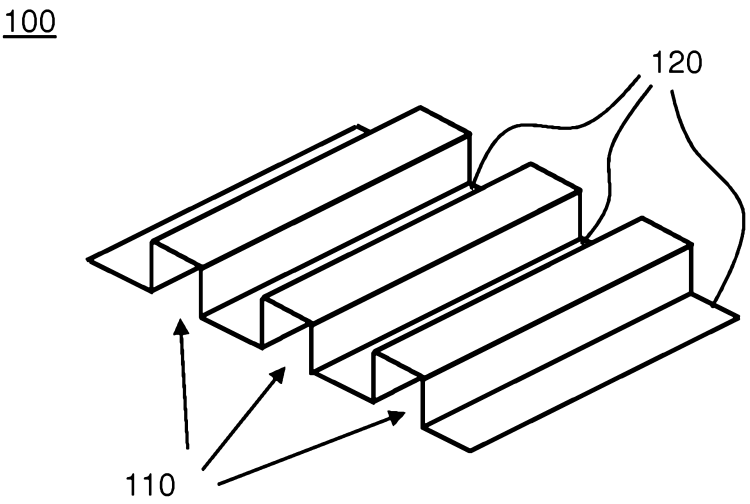


Fig. 2 A

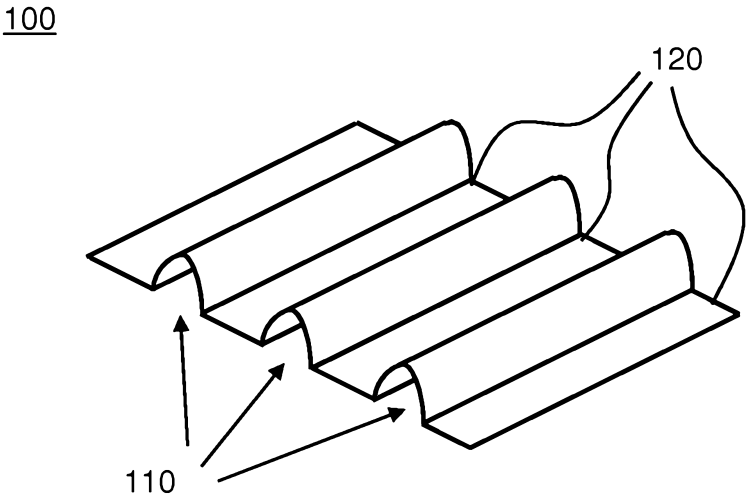


Fig. 2 B

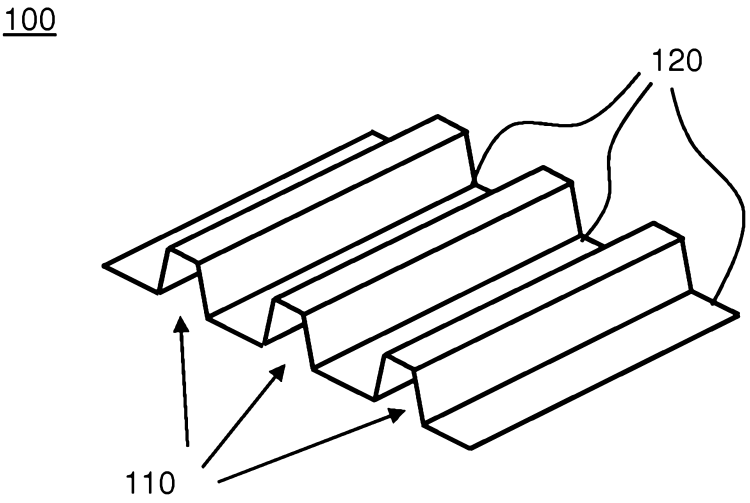
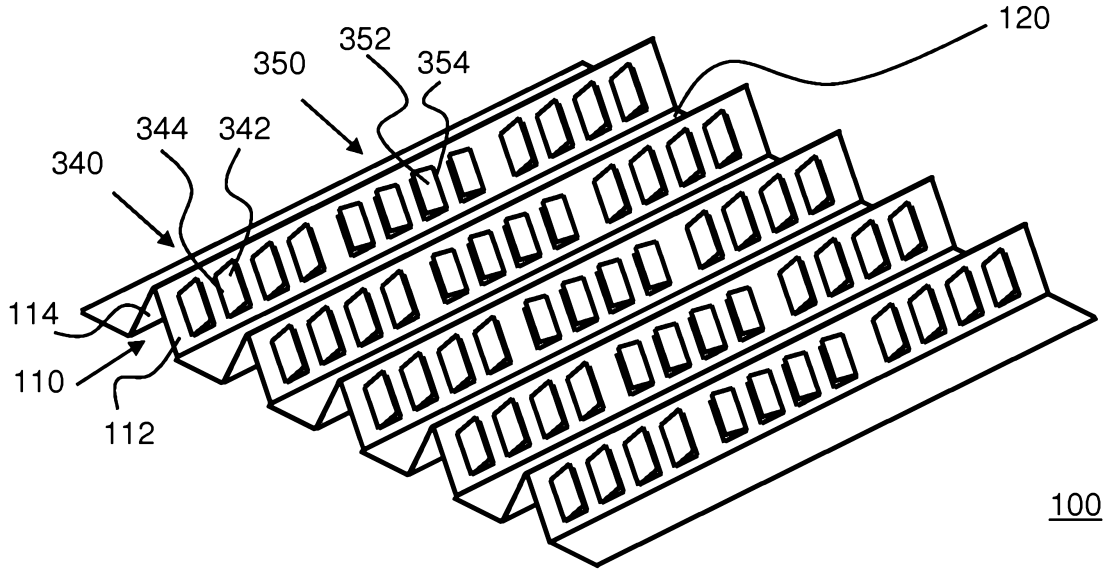


Fig. 2 C

v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344
342
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Fig. 3

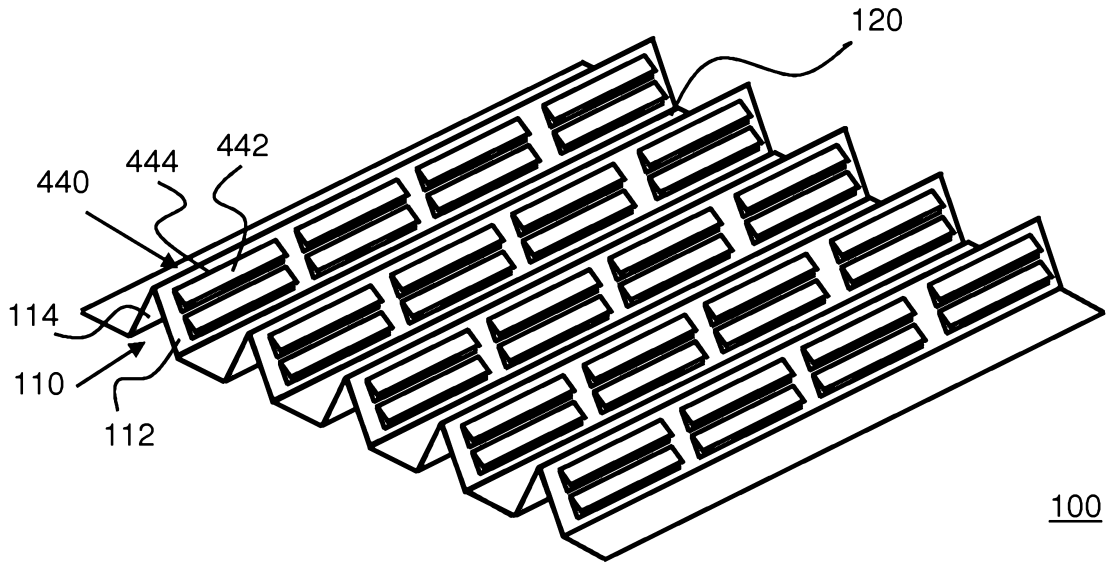
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Fig. 4

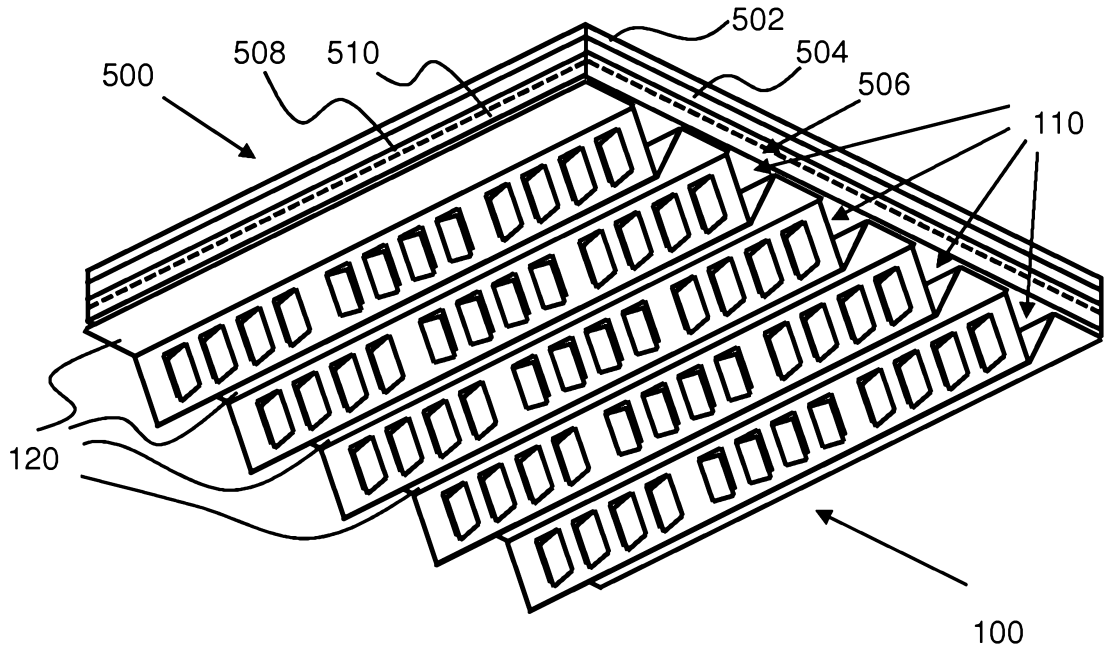

Fig. 5

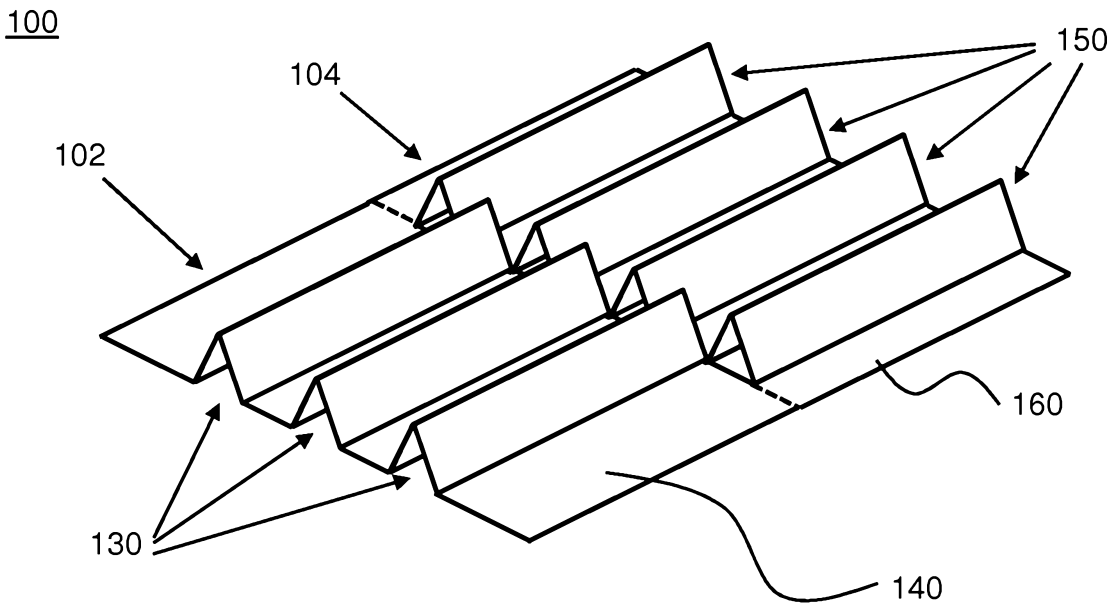

Fig. 6

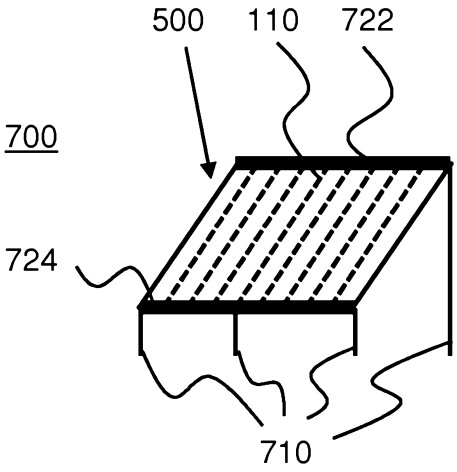

Fig. 7 A

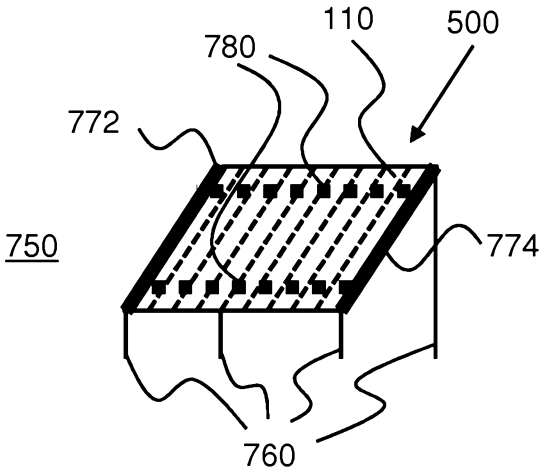

Fig. 7 B

Title: Heat sink panel for a photovoltaic panel

Abstract

A first aspect provides a heat sink panel for receiving thermal energy from a photovoltaic panel. The heat sink panel comprises a shaped metal sheet, wherein at least part of the metal sheet is shaped into substantially parallel gutters. When attached to the photovoltaic panel, the gutters form channels between the heat sink panel and the photovoltaic panel. The gutters range from a proximal gutter end to a distal gutter end and the distal end and the proximal end comprise openings enabling an air flow through the gutters. Whereas known heat sinks comprise protrusions like parallel oriented fins, they do are not arranged to provide more or less closed channels at the back of the photovoltaic panel to enable a stream of air to flow through the channel. Channels do not have to be fully closed, smaller openings may be provided. An airflow may be provided by a chimney effect.

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	P114615NL00
Nederlands aanvraag nr. **2019040**	Indieningsdatum **09-06-2017**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **OPTIXOLAR Holding B.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **08-07-2017**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN69279**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

H02S40/42

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie

Classificatiesysteem	Classificatiesymbolen
IPC	**H02S**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III.	☐ **GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES**	(opmerkingen op aanvullingsblad)
IV.	☐ **GEBREK AAN EENHEID VAN UITVINDING**	(opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2019040

A. CLASSIFICATIE VAN HET ONDERWERP
INV. H02S40/42
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimum documentatie (classificatie gevolgd door classificatiesymbolen)
H02S

Onderzochte andere documentatie dan de minimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal, WPI Data

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie *	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X Y A	US 2005/161074 A1 (GARVISON PAUL [US] ET AL) 28 juli 2005 (2005-07-28) * alineas [0024] - [0033]; figuren 1-3 * -----	1-3, 11-13, 15,16 4,5,9,10 6-8
X A	DE 36 11 543 A1 (REMSCHEID VOLKSBANK [DE]) 8 oktober 1987 (1987-10-08) * het gehele document * -----	1-3,11, 13-16 6-8
Y	FR 2 923 082 A1 (ARCELOR COSNTRUCTION FRANCE [FR]) 1 mei 2009 (2009-05-01) * bladzijde 7, regels 26-29; figuur 9 * -----	4,5,9,10

☐ Verdere documenten worden vermeld in het vervolg van vak C.

☒ Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

* Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
16 januari 2018	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Persat, Nathalie

Formulier PCT/ISA/201 (tweede blad) (januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2019040

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
US 2005161074 A1	28-07-2005	AU 2004300179 A1	30-06-2005
		CN 1894804 A	10-01-2007
		EP 1697964 A1	06-09-2006
		JP 2007514088 A	31-05-2007
		US 2005161074 A1	28-07-2005
		WO 2005059963 A1	30-06-2005
DE 3611543 A1	08-10-1987	GEEN	
FR 2923082 A1	01-05-2009	FR 2923082 A1	01-05-2009
		WO 2009090347 A2	23-07-2009

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN69279	09.06.2017		NL2019040

International Patent Classification (IPC)
INV. H02S40/42

Applicant
OPTIXOLAR Holding B.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the application
- ☐ Box No. VIII Certain observations on the application

Examiner
Persat, Nathalie

Application number

WRITTEN OPINION

NL2019040

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	4-10
	No:	Claims	1-3, 11-16
Inventive step	Yes:	Claims	6-8
	No:	Claims	1-5, 9-16
Industrial applicability	Yes:	Claims	1-16
	No:	Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 2005/161074 A1 (GARVISON PAUL [US] ET AL) 28 juli 2005 (2005-07-28)

D2 DE 36 11 543 A1 (REMSCHEID VOLKSBANK [DE]) 8 oktober 1987 (1987-10-08)

D3 FR 2 923 082 A1 (ARCELOR COSNTRUCTION FRANCE [FR]) 1 mei 2009 (2009-05-01)

2 The present application does not meet the criteria of patentability, because the subject-matter of claim 1 is not new.

D1 discloses (Figs. 1-3C, par. [0024]-[0033])

Warmteafvoerpaneel (support substrate 15) voor ontvangen van thermische energie van een fotovoltaïsch paneel (5), het warmteafvoerpaneel omvattende een gevormd metalen plaat (par. [0024], "the support substrate is made by bending or otherwise shaping a sheet of metal, such as a sheet of steel, to form the desired ridges and troughs"), waarbij ten minst een deel van de metalen plaat (15) is gevormd in hoofdzakelijk parallelen goten (30) voor het vormen van, als het warmteafvoerpaneel (15) aan het fotovoltaïsch paneel (5) is bevestigd, kanalen (30) tussen het warmteafvoerpaneel (15) en het fotovoltaïsch paneel (5), waarbij de goten (30) zich uitstrekken van een proximaal gooteinde naar een distaal gooteinde en het distale gooteinde en het proximale gooteinde openingen omvatten welke een luchtstroom in staat stellen om door de kanalen te stromen (par. [0026], par. [0041] "heat can also be removed by passing air through the spaces 30 and 32 as shown in, for example, FIGS. 1-3. The air can be passed through the spaces by convection").

3 The present application does not meet the criteria of patentability, because the subject-matter of claim 1 is not new.

D2 discloses (Figs. 1-2)

Warmteafvoerpaneel ("Trägerschicht 5 aus gewelltem Aluminium", see col. 2) voor ontvangen van thermische energie van een fotovoltaïsch paneel (1), het warmteafvoerpaneel (5) omvattende een gevormd metalen plaat (5a), waarbij ten minst een deel van de metalen plaat is gevormd in hoofdzakelijk parallelen goten (6) voor het vormen van, als het warmteafvoerpaneel (5) an het fotovoltaïsch paneel (1) is bevestigd, kanalen (6) tussen het warmteafvoerpaneel (5) en het fotovoltaïsch paneel (1), waarbij de goten (6) zich uitstrekken van een proximaal gooteinde naar een distaal gooteinde en het distale gooteinde en het proximale gooteinde openingen omvattend welke een luchtstroom in staat stellen om door de kanalen te stromen ("Aber auch bei der Ausführung nach Fig. 1 wird die Wärme nicht nur durch die unterste Schicht 5c nach aussen abgegeben, sondern die innerhalb der Aluminiumschicht befindlichen Kanäle 6 sind zu beiden Stirnseiten hin offen, so dass Luft hindurchströmen kann und kühlend wirkt.", see cols. 2-3).

4 Dependent claims 2-5, 9-16 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of novelty and/or inventive step, see documents D1, D2 and D3.

Claims 2, 3: see D1, Figs. 3A, 3B;

Claims 4, 5, 9, 10: see D3 (Fig. 9), disclosing a roof ridge (24) provided with partial cut out areas (25) formed by a single line cut having a first cut end and a second cut end defining a substantially straight folding line from the first cut end to the second cut end. The openings 25 are provided for air cooling purposes (ventilation). The folding lines extend in parallel with the roof ridge and have a rectangular shape. The cut out areas are opened towards the outside. It would be obvious for the person skilled in the art to provide the gutters known from D1 with the ventilation openings disclosed by D3, Fig. 9;

Claim 11: see D1, Fig. 3B;

Claim 12: see D1, Fig. 3A;

Claim 13: see D2, disclosing that the sheet 5a is aluminum;

Claim 14: see D2, col. 2, disclosing that the thickness of the aluminum plate 5a is between 0.1 mm and 0.5 mm;

Claims 15-16: see D2, Figs. 1-2, showing supporting sheet 7.

5 The combination of the features of dependent claims 6-8 is neither known from, nor rendered obvious by, the available prior art. The reasons are as follows: the prior art neither discloses nor suggests to provide cut out areas having a folding line substantially perpendicular to the lengths of the gutters. Thereby, a more efficient cooling is achieved.