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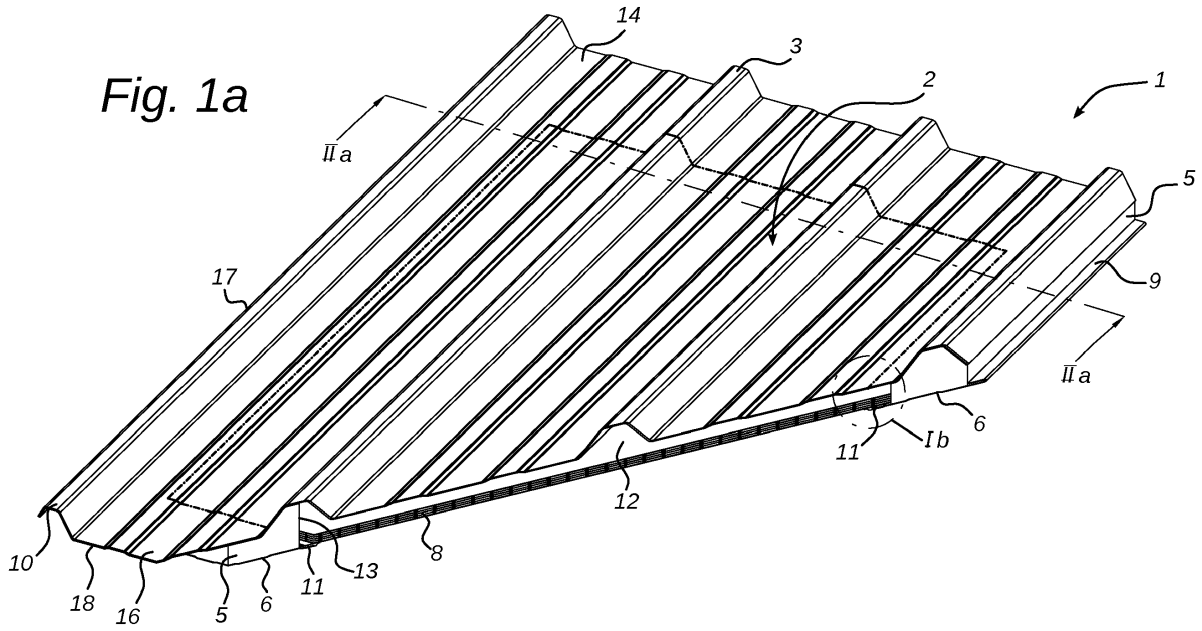
(54) **LIGHT TRANSMITTING ROOF PANEL**

(57) A roof panel (1) comprises a base plate (6), a top plate (4), a thermally insulating layer (5) between the base plate and the top plate, and a translucent top sheet (3), thus forming a layered structure. An opening (19) extends through the top plate and the base plate to provide a window portion (2), the translucent top sheet (3) closing the opening at the top plate. The translucent top sheet (3) extends in at least one direction beyond the opening (19) over the top plate (4), thus defining an overlap region (14) in which the translucent top sheet (3) is spaced apart from the top plate (4) to form at least one moisture outlet channel.

Fig. 1a



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a light transmitting roof panel, in particular a profiled roof panel through which daylight can pass. The invention further relates to a method for manufacturing such a roof panel.

[0002] In commercial and industrial buildings flat, curved or inclined roofs are more and more constructed with thermally insulated roof panels, also called sandwich panels. A top side of the insulated roof panels is usually a profiled corrugated steel plate and the bottom side is usually a flat or slightly profiled steel plate, aluminium foil or polyester plate. Between the top side and the bottom side a thermally insulating layer of polyurethane (PUR) foam, polyisocyanurate foam (PIR), mineral wool or any other thermally insulating material, may be provided.

[0003] The transmission of daylight through the roof is preferred in most industrial or agricultural buildings, like stables. Translucent roof panels with a similar profile as the sandwich panels can be used to provide daylight transmission. For constructional purposes, it is desired that the translucent roof panels and the sandwich panels can be connected in a water- and wind tight manner. This can be achieved by using translucent profiled roof panels. A disadvantage of using single layer roof panels is that the insulation properties of the roof as a whole will decrease. Alternatively, double layered roof panels with improved thermal insulation properties in relation to single layer roof panels are improved. Additionally, such double layered roof panels can be adjusted to have a similar thickness as the sandwich panels.

[0004] The translucent roof panels can be arranged in a window arrangement, in which the translucent roof panel is embedded at three or four sides within an arrangement of opaque roof panels. Alternatively, the translucent roof panels in the ridge-to-gutter arrangement are embedded at a maximum of two sides between parallel opaque roof panels. In both arrangements, the translucent roof panels and the opaque roof panels are connected and sealed with respect to each other.

[0005] French patent FR 2 660 683 describes a double layered roof panel to allow light transmission, having a rigid foam frame to reinforce the panel. The rigid frame has profiled longitudinal members and wedges mounted on transverse members to constitute the reinforcement of the panel. An upper translucent sheet is adhesively bonded to the longitudinal members and to the wedges which engage in the corresponding ribs of the sheet and a lower translucent sheet is adhesively bonded to the base of the frame.

[0006] Such a light transmitting double layered roof panel has a number of disadvantages. First, relatively thin upper and lower translucent sheets are used, such that the thermal insulation of the roof decreases at the location of the light transmitting double layered roof panel. Second, in order to have a watertight connection between the profiled upper sheet and the frame, the profiled longitudinal members and the wedges on the transverse members should have a perfect fit with the profile of the upper sheet. Third, a watertight and draught-proof connection between the known light transmitting double layered roof panel and opaque roof panels is not easy to achieve, as in practice it is difficult to achieve a perfect match between the upper and lower sheets of the adjacent light transmitting and opaque roof panels, respectively. Due to this disadvantage, light transmitting roof panels are sometimes abandoned to secure a draught-proof roof construction. Additionally, if the described light transmitting roof panel is used in a window arrangement, it is desired that the transverse members of the frame and the beams of the roof frame coincide in order to have good connection between the roof panels and the roof frame. A further disadvantage of such translucent roof panels is that the rigid foam frame may not give sufficient rigidity for use in a ridge-to-gutter arrangement or when relatively long panels with a width to length ratio of at least 1:2 up to 1:12 or higher are used.

[0007] Even if the roof panel parts are perfectly sealed, condensation may still occur underneath the transparent roof panel part. Water drops may form and cloud the view, while a prolonged presence of moisture may give rise to moulding. Conventional roof panels fail to address the moisture problem.

[0008] German patent application DE 3 832 995 discloses a roof panel comprising a translucent element arranged in an opening, supported by shoulders provided in the base plate. The top plate is said to have at least one air opening, but the location of this air opening is unclear. There is no provision for draining off moisture in this known roof panel.

[0009] British patent application GB 2 455 632 discloses a composite roof panel having an opening with a translucent panel mounted on an upstand frame. There is thus a substantial height difference between the translucent roof panel part and the surrounding opaque roof panel part. Although one embodiment of this known roof panel allows water ingress from an upstand to run off, there is no provision for the draining off of moisture accumulating underneath the translucent roof panel part.

[0010] It would therefore be desirable to provide an insulated light transmitting roof panel that alleviates at least some of the perceived inconveniences of the prior art.

SUMMARY OF THE INVENTION

[0011] According to the invention there is provided a roof panel, comprising a base plate, a top plate, a thermally insulating layer between the base plate and the top plate, forming a layered structure, and a translucent top sheet, wherein an opening extending through the top plate and the base plate provides a window portion, the translucent top sheet closing the opening at the top plate, which roof panel is characterized in that the translucent

top sheet extends in at least one direction beyond the opening over the top plate, thus defining an overlap region, and in that in the overlap region, the translucent top sheet is spaced apart from the top plate to form at least one moisture outlet channel.

[0012] The roof panel is a thermally insulating panel comprising a layered structure having a base plate, a top plate and a thermally insulating layer in between the base plate and the top plate. Usually, such roof panels are opaque and therefore do not allow light, in particular daylight, to pass through a roof made of such panels.

[0013] An opening is provided within the layered structure, the opening forming a through-hole from the base plate to the top plate. The opening has a peripheral edge and is enclosed by the layered structure along the entire periphery. The layered structure, and in particularly the thermally insulating layer, can be provided with a peripheral rim, which can hide at least the thermally insulating layer from view. The opening can be closed with at least a translucent top sheet, and preferably with a translucent base sheet as well, to form a window portion in the roof panel. The translucent top sheet and translucent base sheet are preferably separate sheets connected to the layered structure. Alternatively, the top and base sheets can be opposite surfaces of an integral translucent panel, such as a multiwall polymer panel, provided within the opening. The thermally insulating layer can comprise a thermally insulating material, such as mineral wool, but preferably a thermally insulating foam, such as PUR or PIR. Translucent means that the material comprises in the translucent base and top sheet is able to transmit light, i.e. does not fully block incoming light, such as an opaque material, up to being transparent.

[0014] The advantage of a window portion in the roof panel is that the window portion is surrounded by the opaque layered structure. When a roof panel with a window portion is connected to a second roof panel having a similar layered structure, with or without a window portion, the top plates and base plates of the respective roof panels will match. In addition, the thermally insulating layer can comprise a thermally insulating material at least at the outer peripheral edge of the roof panel, such that upon connection to the second roof panel, the thermally insulating material at the peripheral edges may abut. Hereby, it is achieved that a watertight and draught-proof connection between the roof panels can be established and additionally that a light transmitting window portion is provided in the roof panel.

[0015] The window portion or opening can have any shape, such as a circle or a polygon, such as a square or a triangle, with or without rounded corners. Additionally, the peripheral edge can be substantially perpendicular to the top and base plates, respectively, or have an angle with at least one of the top and base plate, for example either a converging peripheral edge towards the base plate or a diverging peripheral edge towards the base plate, as seen from the top plate.

[0016] According to the present invention, the translucent top sheet extends in at least one direction, such as the longitudinal direction of the roof panel, beyond the opening. It is preferred that the translucent top sheet extends in two directions, that is, both the longitudinal and the transversal direction, beyond the opening, to provide an overlap region surrounding the opening. Such an overlap region may serve several purposes, such as preventing the ingress of dirt and moisture into the opening, connecting the translucent top sheet and the top plate, but also providing a channel for draining off moisture, as will be explained below. In a preferred embodiment, the translucent top sheet extends over the whole surface of the top plate.

[0017] In accordance with the present invention, the translucent top sheet and the top plate are spaced apart, thus forming at least one moisture outlet channel. That is, the spacing created between the top plate and the translucent top sheet is used to drain off moisture. In this way, the moisture problem is solved by draining off moisture directly from the translucent top sheet. The moisture outlet channels can extend from the opening to an edge of the roof panel, preferably in the longitudinal direction of the roof panel (where the longitudinal direction typically coincides with the slope of the roof when the roof panel is in use). Although only a single moisture outlet channels may be provided, preferably two or more are provided, preferably in parallel. In some embodiments, the moisture outlet channels extend both from the opening to one edge and from the opening to the opposite edge of the roof panel in order to collect and drain off moisture from an adjacent similar roof panel.

[0018] The translucent top sheet may be spaced apart from the top plate by spacer elements. These spacer elements may not only serve to define the spacing and hence the height of the moisture outlet channel or channels, but also to connect the translucent top sheet and the top plate. To this end, the spacer elements may comprise adhesive material, and may comprise adhesive strips. The spacer elements may be shaped so as to guide moisture through the moisture outlet channel or channels, and may for example provide funnel-shaped openings of the channel.

[0019] The top plate of the roof panel is preferably provided with a first extending part, which part extends beyond the thermally insulating layer at least at one side, preferably at least at a first longitudinal side and a first transversal side. The first extending part acts as an overlay with other similar roof panels, such that a watertight and draught-proof connection between the roof panels is facilitated. Additionally, the base plate can be provided with a second extending part extending beyond the thermally insulating layer at least at one side, preferably a second longitudinal side opposite the first longitudinal side. In some embodiments, the translucent top sheet covers the whole top plate including the extending parts, while in other embodiments the translucent top sheet does not cover the extending parts while covering most, or all, of the remainder of the top sheet.

[0020] Preferably, the translucent base sheet does not extend beyond the surface of the base plate. The top plate can be a steel plate, preferably a profiled corrugated steel plate. The base plate can be a flat or slightly profiled steel sheet, aluminium foil or polyester plate. Between the top plate and the base plate a thermally insulating layer comprising at least one of polyurethane (PUR) foam, polyisocyanurate foam (PIR), mineral wool and any other thermally insulating material, is provided.

[0021] According to an embodiment, between at least one of the base plate and translucent base sheet, and the top plate and the translucent top sheet, a sealing element is provided to prevent environmental contaminants to enter a space between the translucent sheets.

[0022] The translucent top sheet and translucent base sheet can be separated by a space, preferably filled with a gas, such as air. To avoid ingress of environmental contaminants, such as moisture, dirt or insects, and thereby avoiding a decrease of the translucency of the window portion, between at least one of the base plate and translucent base sheet, and the top plate and the translucent top sheet is provided with a sealing element.

[0023] According to a further embodiment, the translucent base sheet is a multiwall polymer plate.

[0024] A multiwall polymer plate is used to enhance the thermal insulation properties of the roof panel at the location of the window portion. The thermal insulation properties of the multiwall polymer plate depend on the material of choice, the thickness of the plate and the wall structure within the plate. The thickness of the multiwall polymer plate is limited by the minimum thickness of the layered structure along surface of the top plate, especially when the top plate is a corrugated plate having a profile, such that the multiwall base plate does not extend beyond the top plate at any location of the top plate.

[0025] Preferably a polycarbonate multiwall plate is used. Alternatively, a multiwall poly(methyl methacrylate) (PMMA) plate. The walls of the multiwall plates can either be parallel and/or perpendicular to the surface of the plate. Furthermore, it is possible to use honeycomb structures with vertical channels made from translucent polypropylene (PP) film or cellophane. Alternatively, multiwall glass plates, such as double-glazed panels, can be used.

[0026] The translucent top sheet can either comprise or be constructed from a translucent foil with suitable mechanical properties and a good resistance against environmental circumstances. An example of such a foil is bi-orientated polyethyleneterephtalate (BOPET), having a thickness up to 1.0 mm, preferably around 0.1 mm.

[0027] The roof panel, in particular the layered structure without the first extending and second extending parts, can have a first width dimension and a first length dimension with a width to length ratio of 1:1 to 1:12 or higher, where the first width dimension preferably ranges from 0.50 to 2.0 meter, such that the first length dimension can range from 0.50 to 24 meter or longer. The opening is enclosed by a frame of the layered structure extending from the peripheral edge of the opening to a longitudinal and/or transverse side of the roof panel. The opening can have a second width and/or second length dimension of up to 75-90%, preferably about 80%, of the first width and/or first length dimension of the roof panel, respectively. The frame formed of the layered structure has a third width dimension, which preferably is at least 5% of the first width and/or first length dimension of the roof panel, preferably about 10%, to ensure sufficient rigidity of the roof panel and a maximised window opening for transmitting light through the roof panel. When roof panels with a longitudinal and/or transverse first extending part as described above, are used, the third width dimension of the frame is preferred to be at most equal to a length of the first extending part of an adjacent roof panel, thereby preventing overlap of the first extending part with the window portion of the roof panel. The length of the first extending part is measured from the side of the roof panel to an end of the first extending part. Preferably, the length of the first extending part is between 50 to 150 mm.

[0028] In case it is desired to have multiple window openings in a longitudinal direction and/or a transverse direction, the window openings can be separated by a transverse part and/or a longitudinal part. These parts, extending between the peripheral edges of two neighbouring openings, can have a similar or larger width dimension as the third width dimension of the roof panel, such that these parts have sufficient rigidity and strength to support the weight of at least the translucent base plate. Multiple window openings can be used for relatively long roof panels to ensure sufficient rigidity, or to provide better connection of the roof panel to beams of a roof construction at the transverse and/or longitudinal part in combination with optimal transmission of light through the roof panel.

[0029] The roof panel can also have a thickness dimension, which is mainly defined by the thickness of the thermally insulating layer. The thickness of the thermally insulating layer is defined as the smallest distance between the base and top plate in the layered structure, in particular when at least one of the top plate and the base plate are a profiled plate. The thickness depends on the desired insulating properties of the roof panel and the thermally insulating material used and can range from 30 up to 150 mm.

[0030] The translucent base sheet can have a flat surface facing away from the top plate. Alternatively, the surface facing away from the top plate can be a profiled surface. The translucent top sheet can comprise a polycarbonate sheet.

[0031] According to an embodiment, the base plate is provided with at least one outlet element to allow moisture to exit the space between the translucent base sheet and translucent top sheet. Water vapour can enter the space between the translucent top sheet and the translucent base sheet in several ways. In particular, water vapour can enter the channels of the translucent multiwall base sheets, especially when polycarbonate permeable to wa-

ter, is used. Water vapour can condensate under certain thermal conditions to visible drops of water. In inclined roof panels these drops of water will flow downwards to the lowest part of the window panel. The roof panel according to the invention allows evaporation or drainage of the above described condensed water drops by at least one outlet element, such as small holes or a valve element, provided at the base plate of the layered structure, preferably in the support flange of the base plate supporting the translucent base sheet.

[0032] According to a preferred embodiment, the base plate has a support flange extending inwardly into the opening to support the translucent base sheet. To facilitate the connection between the base plate and the translucent base sheet, a support flange is provided to support the translucent base sheet, such that the translucent base sheet can be connected to the support flange. When such a support flange is provided, it is preferred that the above described the outlet element is provided in the support flange.

[0033] It is preferred that the top plate is a corrugated plate having a profile. Additionally, the translucent top sheet can comprise a overlap region extending at least partially beyond the peripheral edge of the opening, wherein the overlap region connects the translucent top sheet and the top plate of the layered structure. The translucent top sheet can have a flat surface facing away from the roof panel, preferably having a overlap region that overlaps with the top plate such that connection between the translucent top sheet and the top plate is facilitated.

[0034] According to a further embodiment, the translucent top sheet has a similar profile to the top plate along at least the overlap region, such that the overlap region and the top plate have a form fit connection. Preferably, the translucent top sheet has a similar profile to the top plate across the surface facing away from the top plate, including the overlap region, to provide for a form fit connection with the top plate. Alternatively, the translucent top sheet can have flat surface facing away from the top plate at the location of the opening in the layered structure and a profiled overlap region to establish a form fit connection with the top plate. The connection between the top plate and the overlap region can further be established by any suitable connection element, such as an adhesive. This can be additional to the form fit connection.

[0035] The invention also relates to a method for manufacturing a roof panel as described above, comprising:

- providing a layered structure comprising a base plate, a top plate; and a thermally insulating layer between the base plate and the top plate;
- providing an opening in the layered structure through the top plate, base plate and thermally insulating layer, the opening defining a peripheral edge;
- closing the opening with at least a translucent top plate at the top plate of the layered structure, thereby forming a window portion in the layered structure.

[0036] According to an embodiment of the method, the opening can be made in a ready-made roof panel having a layered structure by cutting a first shape having a first size in the top plate. Subsequently, a second shape having a second size is cut in the base plate, while being centred with respect to the first shape. Then the cut out shapes of both the top plate and the base plate are removed, while also removing the thermally insulating layer between the top plate and base plate.

[0037] According to another embodiment, the opening can be made while manufacturing the layered structure forming the roof panel. In that case, a first opening, having a first size and forming a first shape, is provided in a first plate forming the top plate, and a second opening, having a second size and forming a second shape, is provided in a second plate forming the base plate. The second plate and the first plate can be placed at a distance different from zero with respect to each other, thereby centring the first and second openings with respect to each other. To this purpose, the base plate and top plate can be provided in a mould, such that the first and second openings are centred with respect to each other. The thermally insulating material can then be provided between the top plate and base plate by injecting a foam inside the mould. Alternatively, a layer of thermally insulating material already having an opening or in which an opening can be cut similar in shape and size as the openings in the top plate can be provided between the top plate and base plate.

[0038] The first shape and the second shape used in the above described embodiments of the method, can be similar in form and size. Preferably, the second size is smaller than the first size, such that the supporting flange can be formed from the base plate. Additionally, the peripheral edge of the formed opening can be adjusted by cutting or sawing the thermally insulating layer at the peripheral edge thereof.

[0039] Preferably, the method comprises closing the opening with a translucent base sheet at the base plate of the layered structure.

[0040] According to a further embodiment, the method comprises

- providing an inwardly extending support flange into the opening at the base plate of the layered structure to support the translucent base sheet,
- connecting the translucent base sheet to the support flange.

[0041] According to another embodiment, the translucent top sheet comprises a overlap region extending beyond the peripheral edge of the opening, the method comprising connecting the overlap region to the top plate of the layered structure. The connection between the top plate and the translucent top sheet is facilitated by the use of a overlap region at the translucent top sheet extending beyond the peripheral edge of the opening. The connection can then be established by connecting the

overlapping overlap region of the translucent top sheet to the top plate by a connecting element, such as bolts, nails or the like, or an adhesive. An adhesive could also have the function of sealant between the top plate and the translucent top sheet.

[0042] According to a further embodiment of the method, the top plate is a corrugated plate having a profile and the translucent top sheet has a similar profile to the top plate along at least the overlap region, the method comprising establishing a form fit connection between the top plate of the layered structure and the translucent top sheet through an overlap of the overlap region and the top plate.

[0043] According to another embodiment, the method comprises providing a sealing element between at least one of the base plate and translucent base sheet, and the top plate and the translucent top sheet, to prevent environmental contaminants to enter a space between the translucent sheets.

[0044] According to another embodiment, the method comprises providing the base plate with at least one outlet element to allow moisture to exit the space between the translucent base sheet and translucent top sheet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0045] The features and advantages of the invention will be appreciated upon reference to the following drawings of a number of exemplary embodiments, in which:

Figure 1a shows, in perspective, a schematic drawing of an embodiment of a roof panel according to the invention.

Figure 1b shows a detail of Fig. 1a.

Figure 2a shows a cross section of the roof panel of fig. 1a along line II-II.

Figure 2b shows a detail of Fig. 2a.

Figures 3a-c show, in perspective, an embodiment of the method for manufacturing the roof panel of Fig. 1.

Figures 4a and 4b show, in perspective, another embodiment of a roof panel according to the invention.

Figure 5a shows, in a cross-sectional view, another embodiment of a roof panel according to the invention.

Figure 5b shows a detail of Fig. 5a.

Figure 6a shows, in a cross-sectional view, another embodiment of a roof panel according to the invention.

Figure 6b shows a detail of Fig. 6a.

Figure 7 shows, in a perspective view, the embodiment of Figure 5a when assembled.

Figure 8 shows, in a perspective view, the main constituent parts of the embodiment of Figure 5a.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0046] Figure 1a and b show a schematic drawing of an embodiment of a roof panel 1 according to the invention. The roof panel 1 comprises a layered structure of a top plate 4, a thermally insulating layer 5 and a base plate 6. A window portion 2 is provided within the layered structure as an opening through the top plate 4, insulating layer 5 and base plate 6, the opening defining a peripheral edge 13. The opening is closed with a translucent base sheet 8 at the base plate 6, and with a translucent top sheet 3 at the top plate 4. The translucent top sheet 3 and the top plate 4 are both corrugated sheets having a similar profile. As the translucent top sheet 3 overlays the top plate 4, the profiles of the translucent top sheet 3 and the top plate 4 provide for a form fit connection. Additionally, the connection between the translucent top sheet 3 and the top plate 4 can be secured with an adhesive or other connective element.

[0047] The translucent base plate 8 can have various thicknesses, ranging from a thin single walled sheet to a multiwall plate having a thickness comparable to the thickness of the insulating layer 5. Preferably, the translucent base plate 8 is a multiwall plate made of a translucent polymer material, preferably polycarbonate. Due to the use of a profiled translucent top plate, a space 12 is created within the opening.

[0048] The translucent base plate 8 is connected to the layered structure at the base sheet 6 via a support flange 11 protruding into the opening of the window portion 2. Between the support flange 11 and the translucent base plate 8 a sealing element 7 is provided to have a sealing connection between the support flange 11 and the translucent base plate 8. The translucent base plate 8 can be connected to the sealing element 7 with an adhesive. Alternatively, the translucent base plate 8 can be pressed against the sealing element 7 by means of relatively rigid clamping elements (not shown) provided within the space 12 between the translucent base plate 8 and the translucent top plate 3.

[0049] The support flange 11 is provided with at least one outlet element 15 to allow moisture to exit the space 12 between the translucent base sheet 8 and translucent top sheet 3. Water vapor can enter the space 12 between the translucent top sheet 3 and the translucent base sheet 8 via the channels of the translucent multiwall base sheet 8, especially when the translucent base sheet 8 is made of polycarbonate, which is permeable to water. Water vapor can condensate under certain thermal conditions to visible drops of water. When the roof panel 1 is used in an inclined orientation in a roof, these drops of water can flow downwards to the lowest part of the window portion 2. The roof panel 1 allows evaporation or drainage of the above described condensed water drops by at least one outlet element 15, such as small holes or a valve element, preferably a one-way valve, provided in the support flange 11 of the base plate 6 supporting the translucent base sheet 8 and more preferably in at least the part of the support flange 11 at the lowest part of the window portion 2 when the roof panel 1 is positioned in an inclined orientation.

[0050] The top sheet 4 has a first extending part 10, acting as an overlay, extending beyond the insulating layer 5 at a longitudinal side 17. Additionally, the top sheet 4 has an overlay 16 extending beyond the insulating layer at a transversal side 18. The overlay 10, 16 facilitates the connection between two roof panels in either a longitudinal or transverse direction, as the overlay 10, 16 has a similar profile as the top plate of the subsequent roof panel.

[0051] At the base plate 6, a second extending part 9 can be provided at a longitudinal side opposite the longitudinal overlay 10 of the top plate. The second extending part 9 ensures a watertight and draught-proof connection between two subsequent roof panels in a roof.

[0052] Figure 2a and b show a cross-section of the roof panel of fig. 1 along line II-II. It is shown that the translucent top sheet 3 has a similar profile to the top plate 4, at least along a overlap region 14 extending at least partially beyond the peripheral edge of the opening. The overlap region 14 connects the translucent top sheet and the top plate of the layered structure at least by a form fit. Additionally, an adhesive or other suitable connection means can be provided to secure and/or seal the connection between the translucent top sheet 3 and the top plate 4.

[0053] Figure 3a-c show an embodiment of the method for manufacturing the roof panel 1 of fig. 1. A roof panel 1 has a layered structure comprising a base plate 6, a top plate 4 and a thermally insulating layer 5 between the base plate 6 and the top plate 4. The roof panel 1 is provided with an opening 19 within the layered structure through the top plate 4, base plate 6 and thermally insulating layer 5, the opening 19 defining a peripheral edge 13. The opening 19 is provided with an inwardly extending support flange 11 into the opening 19 at the base plate 6 of the layered structure to support and connect a translucent base sheet 8.

[0054] The opening is closed with a translucent top sheet 3 at the top plate 4 of the layered structure, thereby forming a window portion 2 in the layered structure, as shown in Fig. 1a. The opening is furthermore closed with the translucent base sheet 8 at the base plate 6 of the layered structure. The translucent top sheet 3 comprises a overlap region 14 extending beyond the peripheral edge 13 of the opening 19. The overlap region 14 is used to connect the translucent top sheet to the top plate of the layered structure.

[0055] Figure 4a and b show another embodiment of a roof panel according to the invention. Fig. 4a shows a roof panel 1 having a top plate 4, a base plate 6 and an insulating material 5 in between. The roof panel 1 has an opening 19 and a further opening 20 through the layered structure. The openings 19 and 20 are both provided with a peripheral edge 13 and a support flange 11. In between the opening 19 and the further opening 20, a transverse part 22 is provided. This transverse part 22 separates the opening 19 and the further opening 20, but also provides a connection area for connection to a roof beam (not shown) of a roof construction. In addition, such a transverse part 22 improves the rigidity and strength of the roof panel 1 in relation to a similar roof panel having one large opening.

[0056] Fig. 4b shows the construction of a window portion within each opening 19, 20. The opening 19 is closed at the base plate 6 by a translucent base sheet 8, that is supported by and connected to the support flange 11. The further opening 20 is closed at the base plate 6 by a further translucent base sheet 21, which is supported by and connected to the support flange 11 within further opening 20. The openings 19, 20 are closed at the top plate 4 by a translucent top sheet 3, which also covers the transverse part 22. Alternatively, the top sheet 3 can be separated into a first top sheet to close the opening 19 and a second top sheet to close the further opening 20 (not shown).

[0057] Another embodiment of a roof panel according to the invention is schematically shown in Figs. 5a & 5b. The roof panel of Figs. 5a & 5b is drawn at an angle to illustrate its application in a slanted roof.

[0058] The embodiment of Figs. 5a & 5b also comprises a top plate 4, a base plate 6, a thermally insulating layer 5, a translucent top sheet 3 and a translucent base sheet 8. The roof panel 1 has a window portion 2 where a space 12 exists between the translucent top sheet 3 and the translucent base sheet 8. In this embodiment, the base plate 6 is not provided with an integral support flange 11. Instead, a chair-shaped profile 28 is mounted on the base plate 6 using for example glue. The legs of the chair-shaped profile 28, which serves as a support elements, are spaced so as to receive the translucent base plate 8 between them.

[0059] The space 12 may contain moisture such as water vapour, which may have penetrated the translucent base sheet 8, for example by diffusion. This moisture may result in condensation against the translucent top sheet 3, where water drops may form. In this embodiment, the translucent top sheet 3 and the top plate 4 are spaced apart so as to form a moisture outlet channel 30, as illustrated in Fig. 5b. Under the influence of gravity, the moisture will be leave the space 12 through this channel, as will later be explained with reference to Fig. 7. In addition to the moisture outlet channel 30, an outlet element or outlet opening 15 (see Fig. 1b) may be present in the profile 28. A sealing element, for example a sealant or a sealing strip, may be present between the profile 28 and the base plate 6.

[0060] The embodiment of Figs. 6a & 6b is similar to the embodiment of Figs. 5a & 5b and also has a moisture outlet channel (30 in Fig. 5b) provided between the translucent top sheet 3 and the top plate 4. Instead of the chair-shaped profile 28 shown in Fig. 5b, the embodiment of Fig. 6b has an alternative chair-shaped profile (support element) 29 as illustrated in Fig. 6b. The legs of this profile 29 are spaced further apart to leave an opening between the lower leg of the profile and the bottom surface of the translucent base sheet 8. This opening, in addition to the

curved edge of the lower leg, provides a moisture collection area 27 in the profile 29. Condensation originating from the translucent base sheet 8 may, under the influence of gravity, collect in this moisture collection area. An optional ridge protruding from the upper leg of the profile 29 provides a spacing between the edge of the translucent base plate 8 and the base of the profile, and thus allows moisture to leave the translucent base plate and collect in the moisture collection area 27 of the profile 29, where the moisture can evaporate. Suitable end caps (not shown) can be provided to close off the profile 29 at its ends so as to contain the moisture. A sealing element, for example a sealant or sealing strip, may be present between the profile 29 and the base plate 6.

[0061] Fig. 7 schematically illustrates the flow of moisture M through the moisture outlet channels (30 in Fig. 5b) when the roof panel 1 is arranged at a non-zero angle relative to a horizontal plane. In the embodiment shown, the translucent top sheet 3 is corrugated, which contributes to collecting moisture in certain areas of the roof panel.

[0062] In Fig. 7, the translucent top sheet 3 is spaced apart from the top plate 4 (see also Fig. 8) by spacer elements 31. These spacer elements 31 are in the embodiment shown constituted by longitudinal strips which not only serve to space the sheet 3 and the plate 4 apart, but also guide the moisture M. As can be seen in Figs. 7 & 8, the longitudinal strips 31 close off the area of the opening (19 in Fig. 8) of the roof panel 1 on two sides (at the raised parts of the corrugated top plate) while leaving inlet openings and outlet openings at the two other sides (at the lowered parts of the corrugated top plate 4). In addition, the longitudinal strips 31 are arranged to provide funnel-shaped inlet openings at the "higher" side and also funnel-shaped outlet openings at the "lower" side (seen in the direction of the flow of the moisture M). As illustrated in Fig. 8, the outlet openings (as well as the inlet openings) have a width D which is chosen so as to allow a free flow of moisture (in particular, water) while limiting the ingress of dirt. The width D may, for example, be chosen to be approximately half the width of the lowered part of the corrugated profile, but other widths are also possible, for example a width of at least 2 cm or 5 cm.

[0063] The spacer elements 31 may not only serve to space the translucent top sheet and the top plate apart, and to guide any moisture, but also to connect the translucent top sheet 3 and the top plate 4. To this end, the spacer elements 31 may comprise adhesive material. More in particular, the spacer elements 31 may be constituted by adhesive strips or by strip-like quantities of adhesive material. Additionally, or alternatively, other fastening means may be provided to connect and fasten the translucent top sheet 3 and the top plate 4, such as nuts and bolts. Similarly, additional or alternative spacer elements may be provided, such as metal or plastic elements and/or suitable protrusions of the translucent top sheet 3 and/or of the top plate 4.

[0064] It can be seen in Figs. 7 & 8 that in the embodiment shown, the translucent top sheet 3 and the top plate 4 have the same length and the same width. As a result, the peripheral edges of the translucent top sheet 3 and the top plate 4 are substantially flush, and the translucent top sheet 3 can be said to extend over the whole surface of the top plate 4. This embodiment has the advantage that a uniform roof panel is obtained which can readily be used to replace roof panels without a window section. It will be understood that in some embodiments the translucent top sheet 3 and the top plate 4 will not have the same length and/or the same width and that the resulting overlap region will therefore be smaller.

[0065] It will further be understood by those skilled in the art that the present invention is not limited to the embodiments mentioned above and that many additions and modifications are possible without departing for the scope of the invention as defined in the appending claims.

LIST OF PARTS

[0066]

1. Roof panel
2. Window portion
3. Translucent top sheet
4. Top plate
5. Thermally insulating layer
6. Base plate
7. Sealing element
8. Translucent base sheet
9. Base plate extending part
10. Top sheet extending part (longitudinal)
11. Support flange
12. Space
13. Peripheral edge
14. Overlap region
15. Outlet element
16. Top sheet extending part (transversal)
17. Longitudinal side
18. Transverse side
19. Opening
20. Further opening
21. Further translucent base sheet
22. Transverse part
27. Moisture collection area
28. Support element / profile (1st embodiment)
29. Support element / profile (2nd embodiment)
30. Moisture outlet channel
31. Spacer element

Claims

1. Roof panel (1), comprising

- a base plate (6);
- a top plate (4);
- a thermally insulating layer (5) between the

base plate and the top plate, forming a layered structure; and
- a translucent top sheet (3);

wherein an opening (19) extending through the top plate and the base plate provides a window portion (2), the translucent top sheet (3) closing the opening at the top plate; **characterized in that**

- the translucent top sheet (3) extends in at least one direction beyond the opening (19) over the top plate (4), thus defining an overlap region (14), and **in that**
- in the overlap region (14), the translucent top sheet (3) is spaced apart from the top plate (4) to form at least one moisture outlet channel (30).

2. Roof panel according to claim 1, wherein the translucent top sheet (3) is spaced apart from the top plate (4) by spacer elements (31) which connect the translucent top sheet and the top plate.

3. Roof panel according to claim 1 or 2, wherein the spacer elements (31) are shaped so as to guide moisture through the moisture outlet channel (30).

4. Roof panel according to claim 2 or 3, wherein the spacer elements (31) connect the translucent top sheet (3) and the top plate (4).

5. Roof panel according to claim 4, wherein the spacer elements (31) comprise adhesive material, preferably adhesive strips.

6. Roof panel according to any of the preceding claims, wherein the opening (19) is closed by a translucent base sheet (8) at the base plate (6), and wherein preferably a sealing element (7) is provided between the base plate (6) and the translucent base sheet (8) and/or between the base plate (6) and a support element (28, 29) extending inwardly into the opening to support the translucent base sheet (8), to prevent environmental contaminants to enter a space (12) between the translucent sheets (3, 8).

7. Roof panel according to claim 6, wherein the translucent base sheet (8) is a multiwall polymer plate.

8. Roof panel according to claim 6 or 7, wherein a sealing element (7) is provided between the top plate (4) and the translucent top sheet (3) to prevent environmental contaminants to enter a space (12) between the translucent base sheet (8) and the translucent top sheet (3).

9. Roof panel according to any of claims 6 to 8, wherein the base plate (6) is provided with at least one outlet element (15) to allow moisture to exit the space (12) between the translucent base sheet (8) and the translucent top sheet (3).

10. Roof panel according to any of claims 6 to 9, wherein the base plate (6) is provided with an integral support flange (11) and/or with the support element (28, 29).

11. Roof panel according to claims 9 and 10, wherein the outlet element (15) is provided in the support flange (11) and/or in the support element (28, 29).

12. Roof panel according to any of the preceding claims, wherein the top plate (4) comprises a corrugated plate having a profile.

13. Roof panel according to claim 12, wherein the translucent top sheet (3) has a similar profile to the top plate (4) along at least the overlap region (14), such that the overlap region and the top plate have a form fit connection.

14. Roof panel according to any of the preceding claims, wherein the top plate (4) and the top sheet (3) have substantially the same length and the same width, and wherein the peripheral edge of the top sheet (3) preferably is flush with the peripheral edge of the top plate (4).

15. Method for manufacturing a roof panel according to any of the preceding claims, comprising the steps of:

- providing a layered structure comprising a base plate (6), a top plate (4), and a thermally insulating layer (5) between the base plate and the top plate;
- providing an opening (19) in the layered structure through the top plate, the base plate and the thermally insulating layer;
- closing the opening (19) with at least a translucent top sheet (3) at the top plate, thereby forming a window portion (2) in the layered structure, which translucent top sheet (3) extends in at least one direction beyond the opening (19) over the top plate (4), thus defining an overlap region (14); and
- in the overlap region (14), spacing the translucent top sheet (3) apart from the top plate (4) to form at least one moisture outlet channel (30); and preferably
- closing the opening with a translucent base sheet (8) at the base plate of the layered structure.

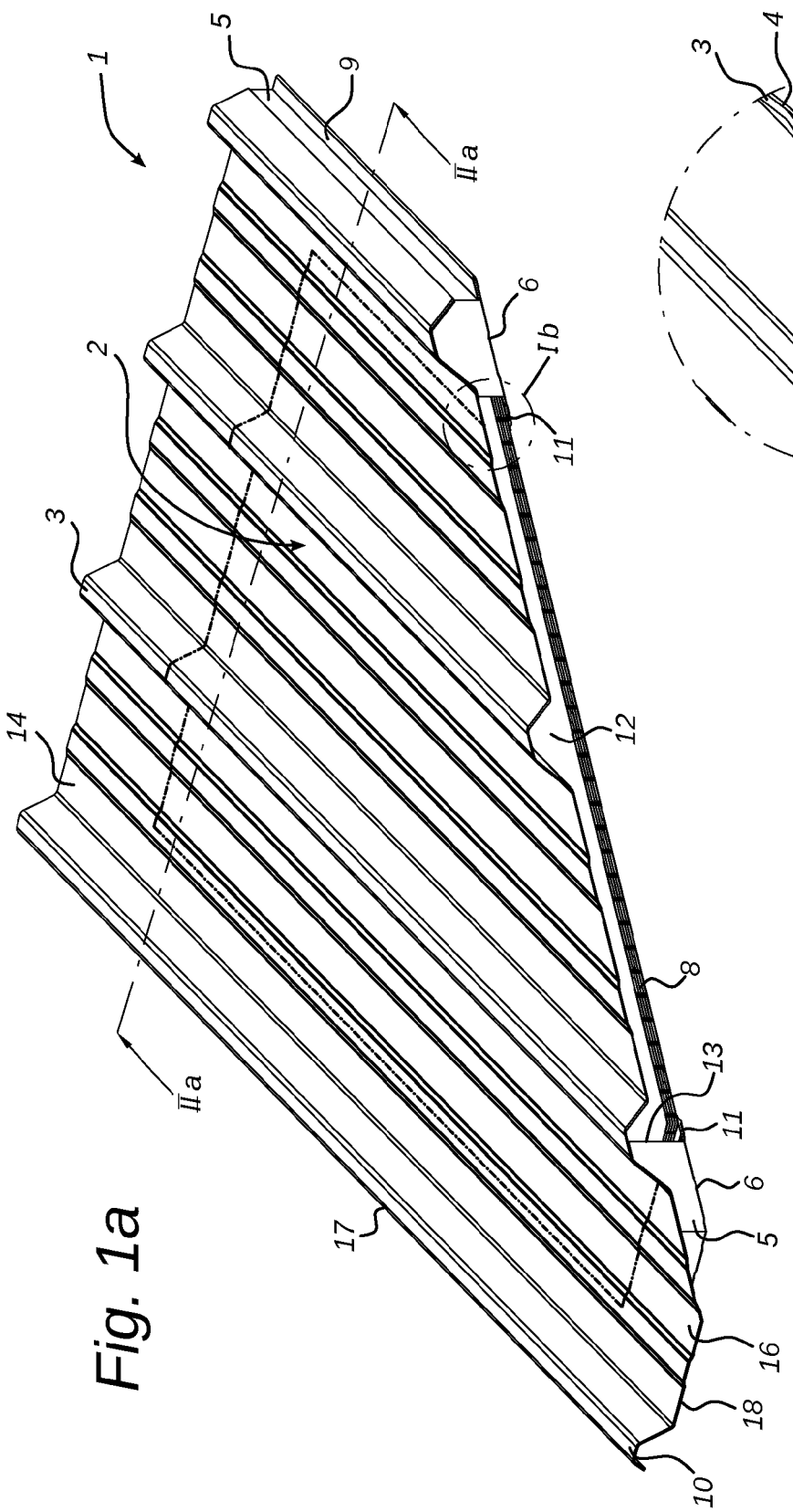


Fig. 1a

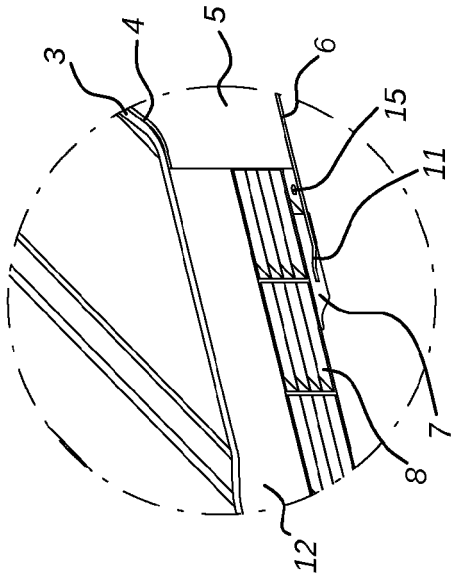


Fig. 1b

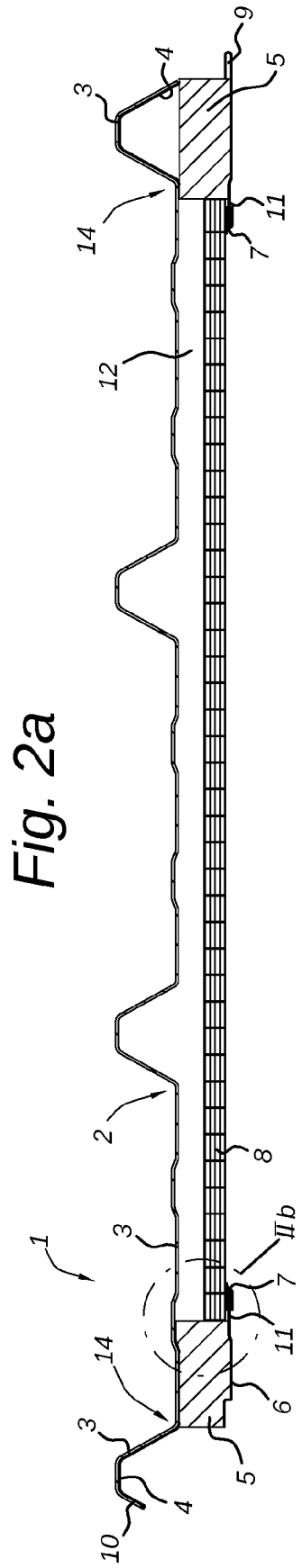


Fig. 2a

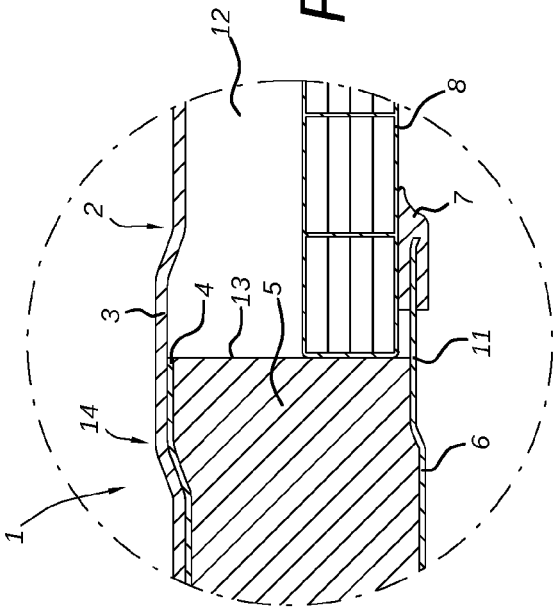


Fig. 2b

Fig. 3a

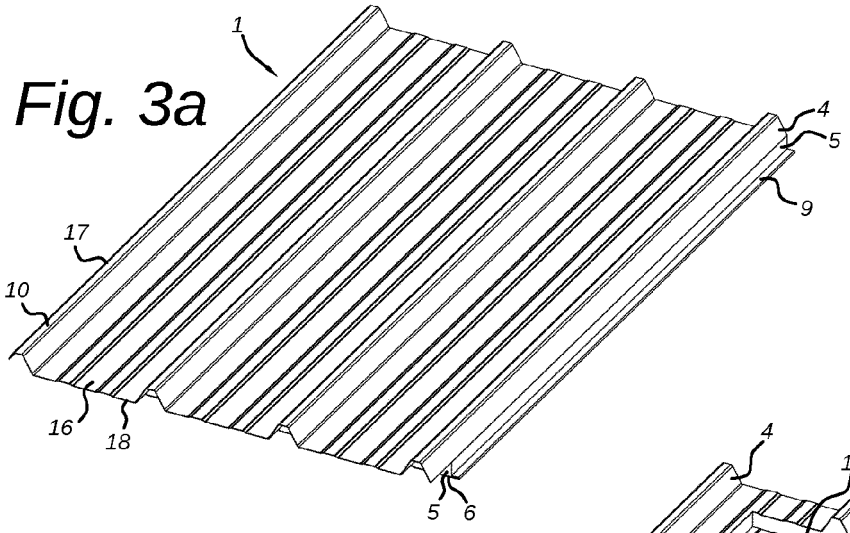


Fig. 3b

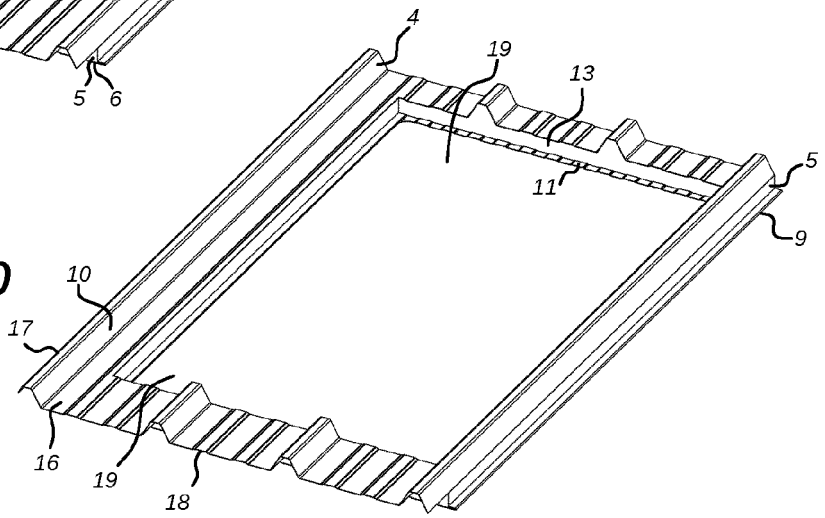


Fig. 3c

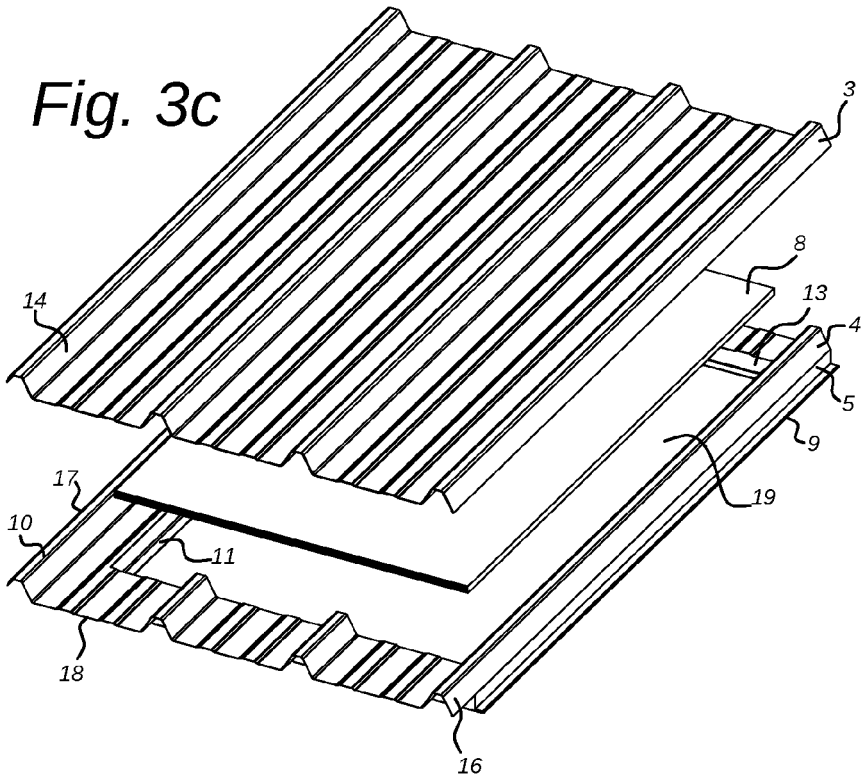


Fig. 4a

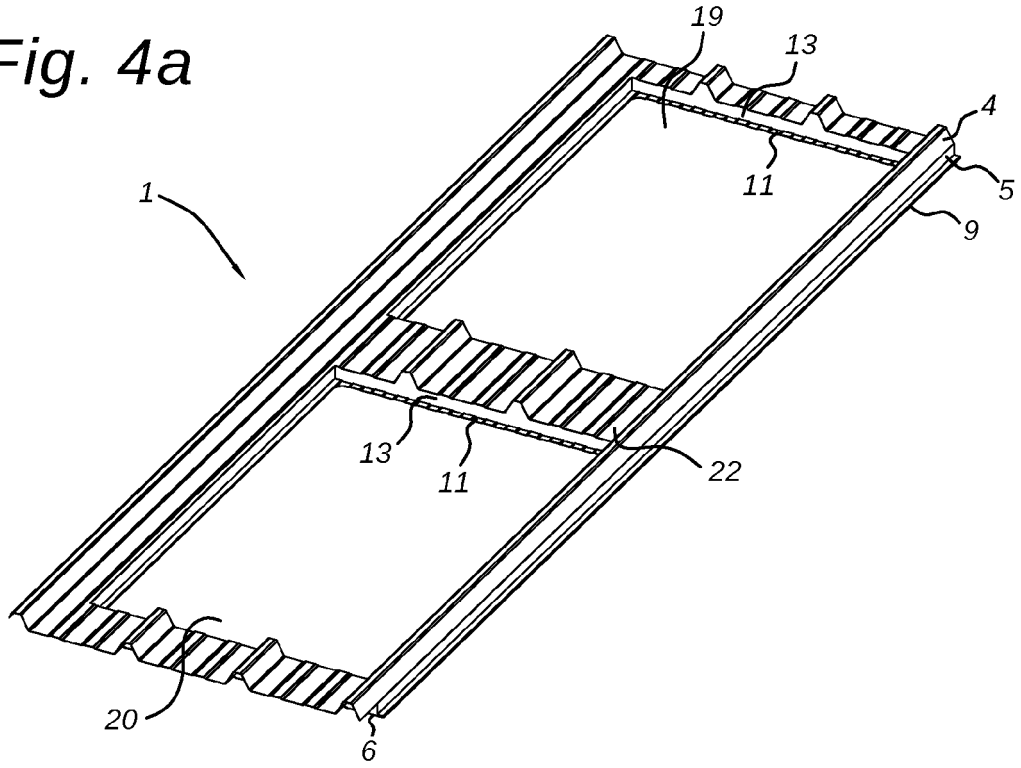
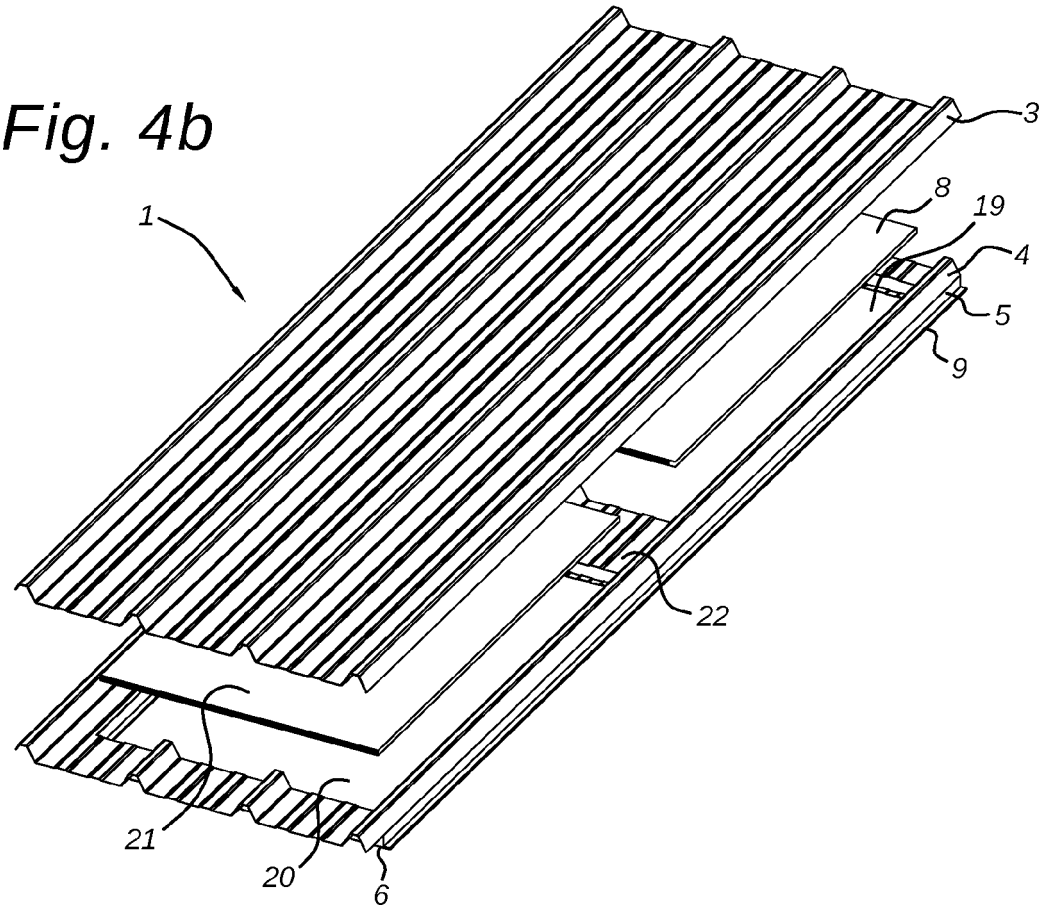


Fig. 4b



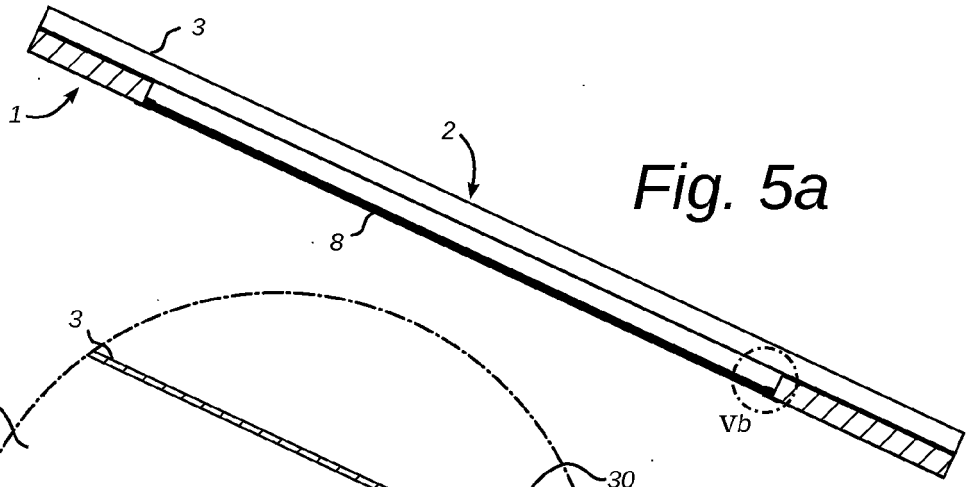


Fig. 5a

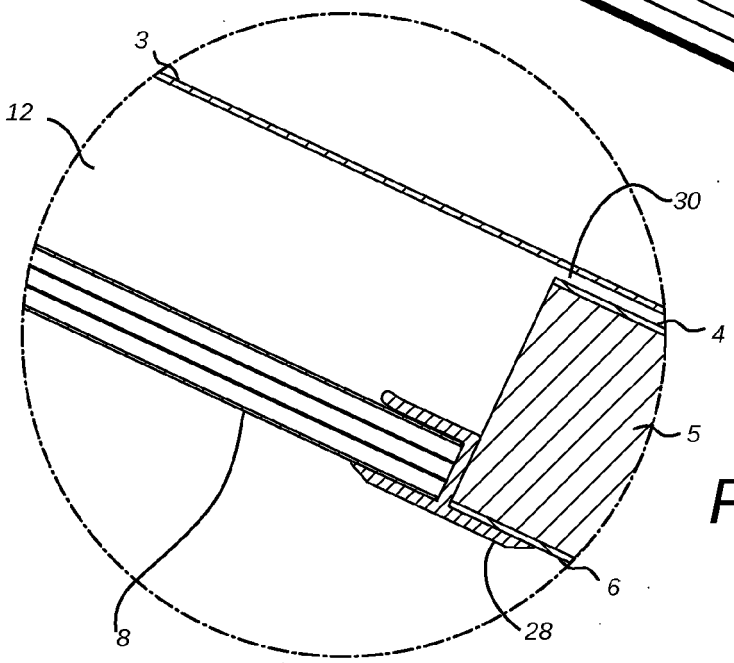


Fig. 5b

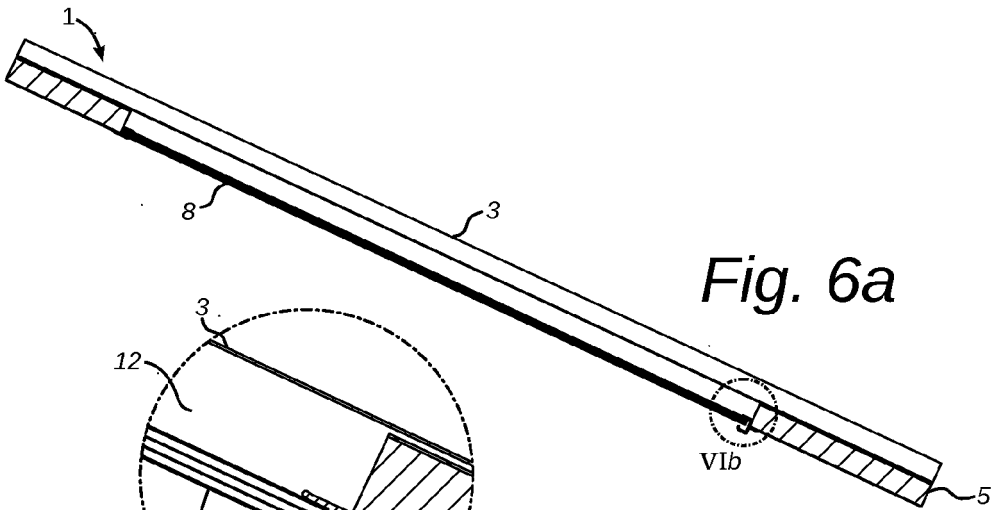


Fig. 6a

Fig. 6b

Fig. 7

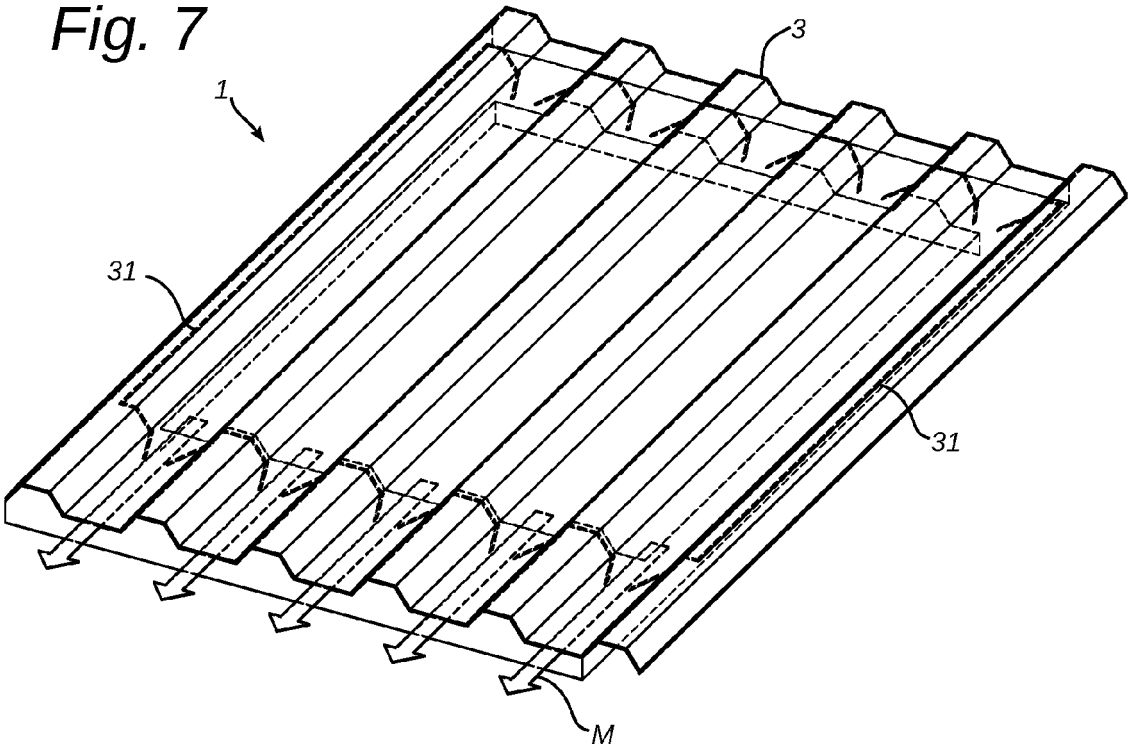
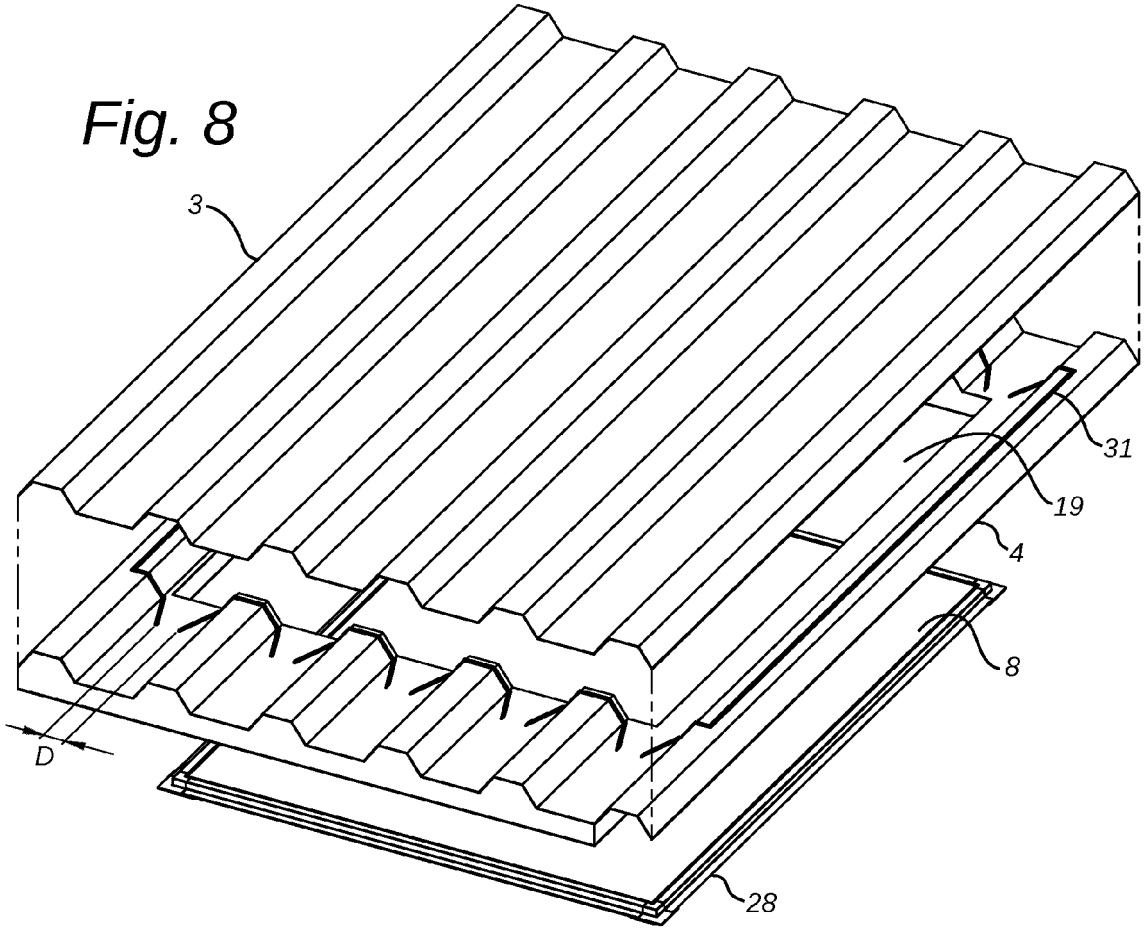


Fig. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 15 17 8763

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	DE 38 32 995 A1 (BUESSGEN HERBERT [DE]) 23 November 1989 (1989-11-23) * figures * -----	1-15	INV. E04D3/28 E04D3/35 E04D13/03
A,D	FR 2 660 683 A1 (HARAS IND [FR]) 11 October 1991 (1991-10-11) * figures * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

E04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 January 2016	Tran, Kim Lien

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06-01-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3832995 A1	23-11-1989	NONE	
FR 2660683 A1	11-10-1991	EP 0456530 A2	13-11-1991
		FR 2660683 A1	11-10-1991

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Patent documents cited in the description

- FR 2660683 **[0005]**
- DE 3832995 **[0008]**
- GB 2455632 A **[0009]**