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(71) Applicant: **Polypiu' S.R.L.**
20013 Magenta (MI) (IT)

(72) Inventor: **Moretti, Andrea**
I-20013 Milano (IT)

(74) Representative: **Mignini, Davide Giuseppe et al Marietti, Gislon e Trupiano S.r.l.**
Via Larga, 16
20122 Milano (IT)

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(54) **Panel for forming skylights in roofing structures**

(57) A panel (1) is disclosed for forming skylights in roofing structures, comprising at least one first layer (2) of transparent material and at least one reinforcing layer (3) comprising at least one net, preferably a metal net, constrained to the surface (2a) of the layer of transparent material.

The panel further comprises constraining means (15) for the constraint to the roofing structure. The rein-

forcing layer (3) is constrained in contact with the surface (2a) of the at least one first layer (2) of transparent material, preferably by means of an adhesive. It is also described a method for the production of the panel (1), comprising the step of constraining at least one reinforcing layer (3) to the surface of at least one first layer (2) of transparent material.

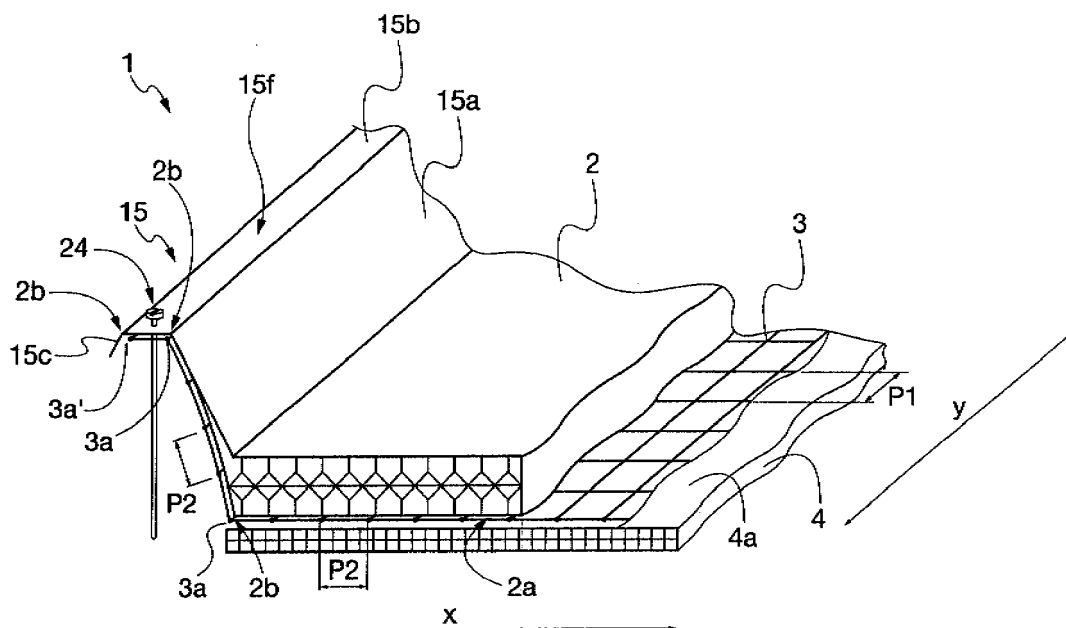


Fig. 1

Description

[0001] The present invention relates to a panel for roofing structures and the method for the production thereof. More in particular, the present invention relates to a panel made of a transparent material for forming skylights in roofing structures for example for industrial use, such as warehouses, storehouses and the like.

[0002] It has to be noted as of now that with the term "transparent material" herein and in the following a material is intended which allows light radiation passing through the same. Furthermore, the term "skylight" is intended to identify any area of the roofing structure intended for the light passing from the outside of the structure which is protected by means of the transparent panels.

[0003] In fact, in building industry and in particular in industrial field it is known providing areas of the roofing structures with panels made of transparent material in order to allow natural light to be admitted inside the structure.

[0004] Transparent panels comprise a single layer made of light material such as for example polycarbonate, or polyester, Plexiglas or other polymer materials.

[0005] Transparent panels are generally interleaved with the panels, preferably made of metal material, forming the roofing structure.

[0006] However, the transparent panels currently used despite being very light and relatively cheap to realize, do not feature breaking strength, or impact strength against bodies or objects, required in order to be employed in roofing structures.

[0007] In fact, the panels arranged in the roofing structures have to be able to resist to dropping bodies so to ensure suitable safety levels for the operators both inside the structure beneath the roofing structure, and for possible operators operating over ground constructions, for example concerning maintenance, on the roofing structure itself.

[0008] To deal with such requirements, at the areas of the roofing structure where the transparent panels are installed for forming the skylights, a reinforcing net shall be installed which allows the light passing through the same and therefore not covering the transparent panel, and at the same time holding possible bodies or objects which, upon impact with the transparent panel, would otherwise drop inside the structure. Nowadays, the implementation of safety measures of skylights of the roofing structures realized with panels made of transparent and light material such as the polycarbonate, provides a metal net being laid out at the opening of the roofing structure in which, afterwards, the transparent panels for forming the skylights will be installed.

[0009] The metal net is laid out on the roofing structure at the areas intended for forming the skylights and laterally constrained to the sheet-metal panels composing the roofing structure.

[0010] Afterwards, installation of transparent panels

shall be done over the metal net so that to complete the roofing structure with transparent material adapted to allow light passing through.

[0011] At the same time, the metal net arranged beneath the transparent panels allows preventing bodies or objects from passing, which could contact the surface of the transparent panel that, as mentioned, is made of a material unsuitable to withstand such impacts or the application of such forces.

[0012] However, the currently employed, and above briefly described, installation method entails many drawbacks in addition to long installation times.

[0013] In fact, firstly the operators have to lay out the metal net at the opening of the roofing structure intended to form the skylight with many risks. In fact, they will have to carry the metal net, which has generally a wounded form, and to lay it out along the entire length of the roofing structure opening intended to form the skylight.

[0014] In addition, the net shall be constrained to the roofing structure in order to ensure its effective fastening thereto and therefore to play its safety function of bodies restraining, preventing the drop thereof inside the structure.

[0015] This operation entails many risks and is complicated to carry out, in fact, sheet-metal panels composing the roofing structure are not provided with points or areas for constraining the metal net, which shall be therefore constrained according to the experience of the operator carrying out the work by trying to adapt on a case-by-case basis the metal net to the typology of the roofing structure, its shape and size. Furthermore, the operator shall try to identify zones of the roofing structure and in particular of the sheet-metal panels, and/or of the purlins and/or of the rafters, suitable to receive appropriate constraining means for the safety metal net.

[0016] The net shall be constrained to the roofing structure at regular, not too large, intervals under penalty of its ineffective resistance against impact and ineffective body restraining.

[0017] Actually, in many cases the safety provided by the protecting net is impaired by a bad or unsuitable installation of the same in the roofing structure.

[0018] For these reasons there is the need to improve and simplify the installation of transparent panels for forming skylights in the roofing structures.

[0019] For example, the document US8061092 describes a panel made of transparent material in which a metal reinforcing material is nested and provided with a plurality of openings.

[0020] Such a panel, while offering a higher strength since provided with a reinforcing material, still is hard to realize just because the reinforcing material has to be nested inside the transparent material.

[0021] Furthermore, the fact that the reinforcing material is nested inside the transparent material could impair the efficiency thereof in resisting to the impact with possible bodies and in restraining such dropping bodies.

[0022] Object of the present invention is to solve the

above briefly examined drawbacks complained in forming skylights on roofing structures.

[0023] Further object of the present invention is to provide a panel suitable for forming skylights in the roofing structures which is easy and cheap to realize while providing an effective strength against impacting bodies in addition to an effective restraining thereof.

[0024] These and other objects are achieved by means of a panel according to claim 1 which is realized by means of a method for the production according to claim 13.

[0025] The panel for forming skylights in roofing structures, according to the present invention, comprises at least one first layer of transparent material and at least one reinforcing layer constrained to the surface of the layer of transparent material. Advantageously, the reinforcing layer is constrained to the layer of transparent material so that the whole panel is easy and cheap to realize as well as particularly resistant. According to an aspect of the present invention, the reinforcing layer is constrained in contact with the surface of the at least one first layer of transparent material. In particular, according to an aspect of the present invention, the at least one reinforcing layer is constrained to the lower surface of the layer of transparent material, contacting the same.

[0026] According to a preferred aspect, the constraint occurs by means of an adhesive suitable for such a purpose, such as for example a bicomponent adhesive. It has to be noted that with the term "adhesive" any glue is meant suitable to allow the constraint of the reinforcing layer or layers to the first layer of transparent material and/or, as it will be shown, to at least one second layer of transparent material the panel according to the present invention will be provided with. Preferably, an adhesive of fluid type is used. In this way, the formation of a layer of transparent material and a reinforcing layer can be determined, both constrained in contact one with another, which can be advantageously installed concurrently in the roofing structure.

[0027] In addition, the presence of the at least one reinforcing layer constrained to the surface of the first layer of transparent material makes the panel resistant to possible impacts and load or force exerted by bodies or to possible objects which can impact on the outer surface of the panel.

[0028] Advantageously, according to an aspect of the present invention, the panel comprises as well at least one second layer of transparent material placed underneath the at least one reinforcing layer.

[0029] In other words, the second layer of transparent material is constrained in such a way that the reinforcing layer is interposed between the at least one first layer of transparent material and the at least one second layer of transparent material.

[0030] According to a preferred embodiment, the at least one second layer of transparent material is constrained in such a way that the reinforcing layer is contacting the upper surface of the second layer of transparent material.

[0031] By doing so, the reinforcing layer is in contact with the surfaces of the first and second layers of transparent material so as to form a particularly resistant sandwich structure, easy and cheap to produce and install on the roofing structure.

[0032] Preferably, the at least one first layer of transparent material and/or the at least one second layer of transparent material is/are made of polycarbonate, preferably honeycomb-structure polycarbonate.

[0033] In addition, according to a possible embodiment, the at least one reinforcing layer comprises at least one net, preferably a metal net. Of course the net mesh size and geometry can be changed according to use requirements of the panel. Preferably the reinforcing net is deformable, preferably plastically deformable, in such a way that it can be fitted to the shape of the panel it is constrained to.

[0034] According to an aspect of the present invention, the metal net is preferably welded, and in particular electrically welded. However, chain link nets (single twist), double twist nets, etc. can be used.

[0035] Furthermore, the net can have different mesh shapes, and preferably a rectangular or square mesh is used, that is to say formed by substantially straight wires and parallel one to another which substantially cross perpendicularly.

[0036] The mesh of the reinforcing net can have, for example, size comprised between 50X50 mm, and between 50X100 mm, wherein the first value is the pitch (P1) between the wires coming in succession lengthwise the panel and the second value is the pitch (P2) between wires coming in succession crosswise the panel. In particular, also the pitch of wires lengthwise the panel can be changed and take a value different from 50 mm.

[0037] The pitch (P2) of wires coming in succession crosswise the panel can be different in several points. In fact, the pitch of wires placed at the panel surface can be different from the pitch of wires at the panel constraining means. In particular, the pitch of wires crosswise the panel at the panel constraining means (in correspondence of the panel constraining means) can be adapted so that the wires, preferably parallel to the folds present in the panel constraining means, coincide with such folds.

[0038] As outlined, the panel according to the present invention further comprises constraining means for the constraint to the roofing structure and in particular to the panels, preferably made of metal material, constituting the structure.

[0039] The constraining means to the roofing structure are preferably shaped complementarily to the ends of the roofing structure panels they have to be constrained to, and they are preferably realized on the first layer of transparent material of the panel. However, according to further possible embodiments, the constraining means for constraining the panel to the roofing structure can be realized on the first layer of transparent material and/or on at least one second layer of transparent material with which, as it will be shown, the panel according to the

present invention can be provided.

[0040] According to a possible preferred embodiment, the at least one reinforcing layer extends at least partially at the constraining means (in correspondence of the constraining means) to constrain the panel to the roofing structure, however, according to further possible embodiments, the at least one reinforcing layer can extend only at the flat surface of the panel and thus at the flat surface of the first layer of transparent material. The arrangement of the reinforcing layer at the constraining means allows increasing the safety provided by the panel and in particular its effectiveness in body restraining. In fact, in contrast to what occurs in currently used panels, the reinforcing layer will be constrained to the roofing structure at the points constraining the panel to the roofing structure itself and thus safely and effectively.

[0041] According to a possible embodiment, the constraining means for constraining the panel to the roofing structure comprise at least one substantially U-shaped protruding portion. Preferably, the panel is provided with two U-shaped protruding portions extending on two opposite sides of the panel.

[0042] The reinforcing layer, and in particular the net, extends on the protruding and constraining portions, and on at least one surface of the at least one protruding and constraining portion. Preferably, the net comprises wires, preferably straight, which are arranged in parallel and/or at the at least one fold present between the panel surface and the at least one surface of the protruding and constraining portion, and/or between the folds present between the two or more surfaces of the protruding and constraining portion.

[0043] At the panel constraining means, preferably at an area on a surface of the protruding and constraining portion, screws or bolts are installed, or other similar connecting means. Lengthwise the panel, a plurality of connecting means, such as for example screws, will be installed with a variable pitch according to the constructive requirements.

[0044] The reinforcing layer, and in particular the net, is arranged on the panel constraining means in such a way that the connecting means (for example a screw) are inserted in at least one mesh of the net. In addition, according to a possible embodiment, at least one mesh is arranged externally with respect to the mesh wherein the connecting means are inserted. In other words the reinforcing layer, and in particular the net, extends over the panel constraining means, in such a way that upon the installation of the connecting means to the roofing structure (for example a screw), at least one wire, and preferably at least two wires of the net, preferably extending lengthwise the panel, remain outside the connecting means, or outside the area of the constraining means intended for the passage of the connecting means.

[0045] By doing so, the strength and safety provided by the panel can be increased. In fact, in case of bodies dropping on the panel, the net will be retained by the

means for connecting the panel to the roofing structure thereby providing higher safety. In case of load applied to the panel, and possibly of panel break, the net will be held in position as the wires placed externally with respect to the connecting means will be fastened by the same connecting elements, preventing the net from detaching from the roofing structure.

[0046] It has to be noted that the expression "substantially U-shaped protruding portion" is meant to intend that the panel constraining means, observed in cross-section, comprise three surfaces. It has to be noted that such surfaces can be arranged one to another according to different inclination angles.

[0047] According to a preferred embodiment, the substantially U-shaped protruding and constraining portions are realized according to a ribbed or corrugated design (also known as Greek fret), widely employed in the field of panels for roofing structures. Also, the panel according to the present invention comprises means for sealing the layers composing the panel. Such side-sealing means are selected from adhesives, tapes, C-shaped elements, protruding ends of the at least one first and/or at least one second layer of transparent material.

[0048] In fact, according to a possible embodiment, the sealing means comprise for example an adhesive which is applied laterally at the sides of the layers composing the panel, or tapes also laterally applied along one or more sides of the panel.

[0049] Furthermore, substantially C-shaped elements can be used which, in addition to laterally seal the panel layers, contribute to keep the various layers in contact one with another. Such C-shaped elements are applied along the sides of the panel, preferably along the sides free from the constraining means constraining to the roofing structure. According to a further possible embodiment, the sealing means can comprise protruding ends of the first and/or the second layer of transparent material which are subsequently welded and in case folded in order to constitute a side barrier for the layers composing the panel.

[0050] The present invention also relates to a method for the production of a panel for the realization of skylights in roofing structures of the above described type.

[0051] The method comprises the step of constraining at least one reinforcing layer to the surface of at least one first layer of transparent material.

[0052] Preferably, such a step of the production method is carried out by means of an adhesive which allows gluing and thus firmly constraining the reinforcing layer to the first layer of transparent material and/or to at least one second layer of transparent material the panel according to the present invention can be provided with.

[0053] As stated, the panel and preferably the first layer of transparent material (and/or in case the at least one second layer of transparent material), comprises constraining means for the constraint to the roofing structure, and the method comprises the further step of constraining the reinforcing layer to the surface of the layer of

transparent material in such a way that the reinforcing layer extends at least partially at the constraining means (in correspondence of the constraining means) to constrain the panel to the roofing structure.

[0054] The method can comprise the step of shaping, and in general fitting, the reinforcing layer, and in particular the reinforcing net, to the panel. In particular, the reinforcing layer is adapted (preferably upon a deformation thereof) to follow the profile of the constraining means, and in particular of the at least one protruding and constraining portion the panel. As it will be better evident in the following, the protruding and constraining portions comprise one or more surfaces, which can be tilted (inclined) one to another (if seen in cross section) and thus the method comprises the step of fitting the reinforcing layer in its extension on at least one surface of the at least one protruding and constraining portion of the panel.

[0055] However, as stated, according to further possible embodiments the at least one reinforcing layer can extend only at the flat surface of the panel and therefore at the flat surface of the first layer of transparent material.

[0056] Furthermore, the production method comprises the further step of constraining at least one second layer of transparent material to the panel, and in particular to the reinforcing layer.

[0057] By doing so, the reinforcing layer is interposed between the first and at least one second layer of transparent material.

[0058] As stated, by doing so a sandwich-shaped panel can be formed rapidly and cheaply which can be easily installed to the roofing structure while ensuring high safety levels in terms of breaking-resistant function and bodies restraint.

[0059] The method further comprises the step of laterally sealing the layers composing the panel.

[0060] As stated above, such an operation can be carried out by means of convenient sealing means, which can be selected from adhesives, tapes, C-shaped elements. Furthermore, the sealing of the panel layers can be carried out by means of the protruding ends of the at least one first and/or the at least one second layer of transparent material which can be welded one to another.

[0061] The panel according to the present invention can be advantageously realized by means of known production processes, and in particular by extrusion of plastic materials, such as for example the polycarbonate.

[0062] Advantageously, the reinforcing layer and preferably the reinforcing net, can be fitted to the shape of the panel and the protruding and constraining portions thereof, in a step subsequent its realization, for example by extrusion.

[0063] Further characteristics and advantages of the present invention will be more evident from the following description, made by way of non limiting example, referring to the accompanying figures, in which:

- figure 1 shows a partially sectional perspective view

of the panel according to the present invention;

- figure 1A shows a further possible embodiment of the panel according to the present invention according to a view similar to the view of figure 1;
- figure 2 shows a front sectional view of the panel according to the present invention, according to the plane A-A of figure 3, wherein metal panels of the roofing structure are also visible to which the panel according to the present invention is constrained;
- figure 3 shows a top plan view of a panel according to the present invention;
- figure 4 is a sectional view, according to the plane B-B of figure 3, of the side-sealing means of the panel layers according to the present invention;
- figure 5 shows a front sectional view of a further embodiment of the panel according to the present invention, wherein the first layer of transparent material is provided with a ribbed form in its center part.

[0064] Referring to the attached figures, the panel 1 for forming skylights in roofing structures according to the present invention comprises at least one first layer of transparent material 2 and at least one reinforcing layer 3 constrained to the surface of the layer of transparent material 2.

[0065] The panel 1 according to the present invention is particularly applied in forming skylights in structures for industrial use and the like, for example warehouses or storehouses, wherein the roofing structure is made by means of panels made of metal material, for example metal sheets constrained one to another and possibly provided with a layer of insulating material. In the cross sectional view of figure 1, a panel 1 according to the present invention is illustrated as constrained to metal panels 20 of the roofing structure and provided with a layer of insulating material 21.

[0066] The panel 1 according to the present invention, in addition to the reinforcing layer 3 it is provided with, preferably in form of a net, follows the requirements imposed by the UNI EN 14963:2007 regulation.

[0067] It has to be noted that, despite reference will be made in the following in a particular application to roofing structures realized with metal panels, and in particular metal sheets having a layer of insulating material, the use of the panel according to the present invention is not meant to be limited to roofing structures realized with such materials only.

[0068] Furthermore, it has to be noted that the panel according to the present invention can be used in making skylights on the roofing structure both in the ridge to eaves direction, and in the direction parallel to the ridge.

[0069] In this regard it has to be noted that the dimensions of the panel 1, and in particular its width X and its length Y (see figures 1 and 3) can be changed according to the installation requirements and in particular relating to the size of the opening in the roofing structure inside which the skylight should be realized.

[0070] In the present description reference will be

made in general to panel width and length in order to point out the two opposite sides, or one of the two opposite sides, of crosswise panel development, and to point out the two opposite sides, or one of the two opposite sides, of lengthwise panel development.

[0071] According to different possible embodiments, the panel length can reach up to 15 meters, preferably up to about 13 meters, whereas the panel width is usually of about one meter, preferably measured between the points in which the means for connecting to the structure (for example the screws 24) are installed.

[0072] As stated, the term "transparent material" is meant to indicate the property of allowing the light radiation passing through it and thus of being suitable for forming the skylights.

[0073] Preferably, the first layer of transparent material 2 is made of polycarbonate. Despite this, other materials can be used such as for example Plexiglas, or other polymer materials which, in addition to having high transparency, are also light and cheap to realize.

[0074] It has to be noted that the layer of transparent material can be made of polycarbonate also of honeycomb-structure type, such as in the embodiment of panel 1 shown in the attached figures, wherein the first layer of transparent material 2 is made of polycarbonate having a honeycomb-structure portion.

[0075] The panel 1 according to the present invention further comprises constraining means 15 for the constraint to the roofing structure and in particular to the panels, preferably made of metal material, constituting the same.

[0076] As already stated, in the embodiment shown in figures, the constraining means 15 for the constraint of the panel to the roofing structure are preferably made in a single piece with the same on the first layer of transparent material 2 of the panel 1. However, according to further possible embodiments, the constraining means 15 for the constraint of the panel to the roofing structure can be realized on the first layer 2 of transparent material and/or on at least one second layer 4 of transparent material, with which, as it will be shown hereinafter, the panel according to the present invention can be provided. At the constraining means 15, and in particular at the at least one area 15f of the constraining means 15, screws 24 or bolts are installed, or other similar connecting means which allow fastening the panel 1 to the roofing structure and in particular to the purlins and/or rafters of the roofing structure itself. The connecting means 24 are arranged lengthwise the panel in different points, with a pitch which can change according to the installation requirements.

[0077] In case the reinforcing layer 3, and in particular the net, extends on the constraining means 15, the connecting means 24 installed on the panel allow forming a plurality of points, or areas, connecting the reinforcing net 3 to the roofing structure and to the panel 1 itself, at the used connecting means 24.

[0078] For example, in figure 2, the panel 1 according

to the present invention is visible as constrained to a purlin 23 of the roofing structure by means of a screw 24 passing through the constraining means 15 of the panel 1.

[0079] The constraining means 15 for the constraint to the roofing structure are preferably shaped complementarily to the ends 20a of the panels 20 of the roofing structure to which they have to be constrained, and they are preferably realized on the first layer of transparent material 2 of the panel 1.

[0080] In the embodiment shown in figure 1, a further spacer element 25, also preferably made of polycarbonate and conveniently shaped, is flanked to the left panel 20 of the roofing structure to allow the constraint to the roofing structure of panel 1.

[0081] In the embodiment shown in figures, the constraining means 15 for the constraint to the roofing structure of panel 1 according to the present invention, comprise at least one substantially U-shaped, and in particular an upside-down-U shaped, protruding portion. Preferably, the panel is provided with two U-shaped protruding portions extending on two opposite sides of panel 1.

[0082] Hereinafter, the expression "substantially U-shaped" will be used to indicate that the protruding portions of the panel substantially have three surfaces 15a, 15b and 15c which, preferably, depart from the first layer of transparent material 2.

[0083] The three surfaces are substantially tilted (inclined) one to another and their size, their mutual tilt and their curvature can be changed as needed and in connection with the configuration of the roofing structure panels with whom they have to cooperate in order to ensure the effective constraint of the panel 1 to the roofing structure.

[0084] Of course, further possible embodiments of the constraining means 15 for the constraint of panel 1 to the roofing structure can be adopted.

[0085] In general, the constraining means 15 comprise at least one protruding portion comprising at least one surface 15a, 15b, 15c extending from said panel, preferably laterally.

[0086] For example, according to a possible embodiment not shown in the attached figures, the constraining means 15 for the constraint to the roofing structure of panel 1 can comprise at least one substantially L-shaped protruding portion. Such an expression means that the protruding portion/s constraining the panel, have substantially two surfaces which can be tilted one to another according to different angles and can have different extent, according to the shape of the roofing structure with which they have to cooperate. Furthermore, it has to be noted that the constraining means 15, and thus the at least one protruding portion, can also comprise only one surface 15a extending from the panel, and in particular from the first layer of transparent material.

[0087] In this case too, the only protruding surface 15a can be tilted with respect to the surface 2a of the panel. Furthermore, also the extent of the only surface of the

protruding and constraining portion 15 can have different size, and thus lateral extent, according to the requirements of use and connection with the roofing structure, and in particular with the other roofing structure panels.

[0088] As it will be better seen in the following, referring to the embodiment shown in figures, the reinforcing layer/s 3 can extend and be constrained only at the flat surface of the panel or else can extend only on a first surface of the constraining means, or on two surfaces of the constraining means (if any), or on three surfaces of the constraining means (if any). The constraining means 15, and in particular the protruding portions, can also comprise more than three surfaces.

[0089] Even if the protruding and constraining portion 15 comprises two or more surfaces, the reinforcing layer 3, and in particular the reinforcing net, can extend only on a first surface of the constraining means, or on two surfaces of the constraining means, or on three surfaces of the constraining means.

[0090] In the embodiment shown in the figures, the substantially U-shaped portions have a first tilted surface 15a, a second surface 15b parallel to the extension of the layer of transparent material 2 and thus of the panel 1, and a third surface 15c departing from the second surface 15b.

[0091] Such a configuration is usually identified in the field of roofing structures as ribbed or corrugated design (Greek fretted).

[0092] It has to be noted that the constraining means 15 for the constraint to the roofing structure, and in particular the U-shaped, preferably upside-down-U-shaped, protruding portions, preferably extend along the entire length of the sides of the panel on which they are realized.

[0093] Also in case the protruding and constraining portions are made according to other shapes, such as for example in case they comprise only one surface, or two surfaces, for the substantially L-shape, they will preferably extend along the entire length of the panel sides, and preferably along two opposite sides of the panel.

[0094] The protruding portions 15 are better visible in the front sectional view of figure 2. However other embodiments can be actually used in connection with the configuration of the roofing structure to which the panel 1 has to be constrained.

[0095] It has to be noted that despite a panel, having a center part substantially flat and substantially coincident with the surface 2a to which the reinforcing layer 3 is constrained, having been depicted in the attached figures, it can be provided with one or more folds intended for forming waves, or ribbed or corrugated forms, spaced one from each other.

[0096] In such a case it has to be noted that all the layers composing the panel, and therefore the first and the second layers of transparent material 2 and 4 and the reinforcing layer 3, can be shaped so as to take this shape.

[0097] Otherwise, according to further possible embodiment shown in figure 5, only the first layer of trans-

parent material 2 is provided in its center part with waves or a ribbed or corrugated portion, and the reinforcing layer 3 and the possible at least one second layer of transparent material 4 have a flat center part.

[0098] In addition, as stated, the panel 1 according to the present invention comprises at least one reinforcing layer 3 so as to make the panel resistant to possible impacts and to the possible load or force exerted by bodies or possible objects which can impact the outer panel surface. Therefore, the at least one reinforcing layer 3 of the panel 1 provides the latter with effective strength against breaking thus allowing the restraining of possible bodies or objects.

[0099] Advantageously, the reinforcing layer 3 is constrained to the first layer of transparent material 2 so that the panel is wholly easy and cheap to realize as well as particularly resistant.

[0100] Indeed, the fact that the reinforcing layer 3 is constrained to the surface of the first layer of transparent material 2 and in particular constrained in contact with the substantially flat surface 2a of the first layer of transparent material, allows obtaining a high breaking strength and thus in general strength against loads the panel can be subjected to, without effectively impairing the deformability features of the layer of transparent material. According to an aspect of the present invention, the at least one reinforcing layer 3 is constrained to the lower surface 2a of the layer of transparent material 2. Furthermore, as stated, the at least one reinforcing layer 3 is constrained in contact with the surface of the layer of transparent material 2.

[0101] It has to be noted that the constraint between the reinforcing layer or layers 3 and the surface of the layer of transparent material 2 can be obtained according to different modes.

[0102] According to a preferred aspect, the constraint occurs by means of an adhesive suitable for such a purpose, such as for example a bicomponent adhesive. The adhesive can be arranged only in some points or areas of the surface 2a of the layer of transparent material 2 or else it can be arranged on the entire surface 2a to which the reinforcing layer 3 has to be constrained. It has to be noted that with the term "adhesive", any glue is meant suitable to allow the constraint of the reinforcing layer/s to the first layer of transparent material. Preferably, a glue of fluid type is used.

[0103] In the embodiment shown in figures, the reinforcing layer/s 3 extend at least partially at the constraining means 15 for the constraint of panel 1 to the roofing structure, in other words, the reinforcing layer 3 extends at least partially at the constraining means 15 which are preferably realized on the first layer 2 of transparent material.

[0104] However, according to further possible embodiments, the at least one reinforcing layer 3 extends only at the flat surface of the panel and, in particular, at the flat surface 2a of the first layer of transparent material 2.

[0105] As stated, in the embodiment shown in the at-

tached figures, the panel and in particular the layer of transparent material 2, are provided with constraining means 15 for the constraint to the roofing structure comprising at least one protruding portion extending laterally and substantially U-shaped, suitable to cooperate with corresponding U-shaped portions of the roofing structure panel.

[0106] The reinforcing layer 3 advantageously extends at least partially at the constraining means 15 and in particular at least partially in the U-shaped protruding portions.

[0107] By doing so, therefore the layer of reinforcing material 3 is advantageously stiffened also at the constraining means for the constraint of the panel to the roofing structure. Furthermore, the reinforcing layer can be advantageously constrained to the roofing structure at the constraint of the panel 1 to the roofing structure itself, effectively overcoming the drawbacks currently found in installing the metal net.

[0108] In the embodiment shown in figures, wherein there are two protruding portions 15 realized on two opposite sides of the panel 1, the reinforcing layer 3 extends at both the protruding portions. In detail, the reinforcing layer 3 is shaped so as to follow the shape of the surface 2a of the layer of transparent material 2 to which it is constrained, in addition to the shape of the first and the second surface 15a and 15b of the protruding portions 15.

[0109] It has to be noted that, according to further possible embodiments, the at least one reinforcing layer 3 can extend only at the first surface 15a, or on all the three surfaces 15a, 15b, 15c of the embodiment of the constraining means 15 shown in figures.

[0110] In particular, figure 1A shows a possible embodiment wherein the reinforcing layer 3, and in particular the net, extends on three surfaces 15a, 15b and 15c of constraining means 15.

[0111] As regard to the typology of the reinforcing layer 3, it has to be noted that for this purpose any material can be used which provides a strength against loads and impacts higher than to the material used for realizing the layer of transparent material.

[0112] In general, according to the currently ongoing regulations in some countries, the panels used for forming skylights have to resist against breaking if subjected, for example, to the weight of an operator present on the roofing structure and passing over the panel itself.

[0113] Furthermore, some regulations also provide that the panel shall effectively restrain bodies and objects also at high temperature conditions, for example in case of fire.

[0114] At the same time, however the reinforcing layer has to allow the light radiation passing through so that the layer of transparent material is not obscured.

[0115] According to a preferred embodiment, the reinforcing layer 3 comprises a net, preferably made of metal material.

[0116] The net 3 is formed by a plurality of wires, preferably constrained one to another by welding.

[0117] In the present description reference will be made in particular to the wires 3a of the net, that is to say the preferably straight wires, extending lengthwise the panel (in the direction identifying the panel length Y). In other words, the wires 3a are the wires substantially extending parallel to the lengthwise development of the panel, and in particular to the opposite panel sides at which the constraining means 15 are arranged. Of course, the reinforcing layer and the net can be replaced by any other material, such as for example a plastic material, possibly reinforced with fibers, composite materials, etc., which at the same time allows light passing through and provides a strength against loads or impacts higher than the layer of transparent material of the panel. Advantageously, in the embodiment shown in figures, the metal net 3 is arranged in such a way that the wires 3a composing the same, are arranged at the folds 2b of the surface of the layer of transparent material 2, and at the protruding portions 15 which allow the constraint to the roofing structure. Preferably, the folds 2b are straight and extend substantially parallel to the lengthwise development of the panel, and in particular to the opposite sides of the panel at which the constraining means 15 are arranged.

[0118] In general the reinforcing layer, and in particular the reinforcing net 3, is shaped, preferably upon deformation thereof, so that to fit the panel shape, and in particular to the folds 2b thereof.

[0119] Preferably, the net is plastically deformed so that to fit the shape of the constraining means 15.

[0120] According to an advantageous aspect, the reinforcing net 3 is shaped to fit the constraining means 15, and in particular to the shape of the protruding and constraining portions 15 the panel is provided with.

[0121] According to an aspect of the invention, the net composing the reinforcing layer 3 comprises straight wires 3a which are arranged at the folds 2b of the surface of the layer of transparent material 2 and at the constraining means 15, so that to increase the provided strength. Preferably, the straight wires 3a of the net are arranged at the folds 2b of the panel, and preferably they extend parallel thereto, such as for example is shown in the attached figures.

[0122] In particular, the constraining means 15 and in particular the protruding portions, can comprise at least one surface. The at least one surface 15a, 15b, 15c of the constraining means 15 can form a fold 2b with respect to the surface 2a of the panel, and/or the two or more surfaces 15a, 15b, 15c of the constraining means 15 form a fold 2b therebetween. Preferably, the folds 2b extend longitudinally along the lengthwise panel extent.

[0123] The wires 3a that compose the net and extend, preferably straightly, following the panel length and which are thus arranged as following one another crosswise the panel, can have different pitch P2 in such a way that, in case the net extends at the constraining means 15, the wires 3a can be arranged at the folds 2b (change of tilt), between the surfaces of the constraining means 15

and the surface 2a of the panel, and/or at the folds 2b placed between the surfaces 15a, 5b, 15c of the constraining means.

[0124] In the embodiment illustrated in figures 1, 2, 4 and 5, the pitch P2 of the wires 3a following one another crosswise the panel is substantially constant. Conversely, in the embodiment illustrated in figure 1A, the pitch P2' of the wires 3a placed at the surface 2a of the panel is different from the pitch P2" of the wires 3a placed at the constraining means 15 and the surfaces 15a, 15b, 15c thereof, so as to fit their dimensions.

[0125] In particular, the pitch P2" of the wires 3a at the surface 15a of the constraining means 15 is such to provide wires 3a only at the folds 2b at the ends of the surface 15a. However embodiments can be provided, wherein several wires 3a are arranged along the extent of the surface 15a and not only at the folds 2b at its ends.

[0126] In general, the pitch of the wires 3a at the constraining means 15 can be such to allow the arrangement of the wires 3a only at the folds 2b between the surface 15a and the surface 2a of the panel, and the folds 2b among the two or more surfaces 15a, 15b and 15c of the constraining means 15.

[0127] As mentioned above, at the constraining means 15 of the panel, preferably at an area 15f of a surface of the protruding and constraining portion, screws or bolts are installed, or other similar connecting means 24.

[0128] In particular, in the embodiment shown in figures, the second surface 15b of the constraining means 15 is intended for allowing the installation of the connecting means 24, and in particular of screws.

[0129] In general, the constraining means 15 comprise an area 15f, preferably made on the at least one surface 15a, 15b, 15c of the protruding and constraining portion the panel is provided with, which is intended for allowing the passage of the connecting means 24. Along the lengthwise extent of the panel, a plurality of connecting means 24, such as for example screws, will be installed and have a variable pitch according to constructive requirements.

[0130] The reinforcing layer, and in particular the net 3, is arranged on the panel constraining means 15 in such a way that the connecting means 24 (for example a screw) are inserted in at least one mesh of the net, as visible in the embodiment illustrated in figures 1, 2 and 5 wherein the net meshes, arranged at the surface 15b of the constraining means, are engaged by the screws 24.

[0131] In addition, according to a possible embodiment, such as for example visible in figure 1A, at least one net mesh is arranged externally (on the left) with respect to the mesh in which the connecting means 24 are inserted. In fact, in the embodiment illustrated in figure 1A, the net also extends on the surface 15c of the constraining means, and the meshes arranged at such a surface 15c, remain outside (more on the left in figure 1A) with respect to the connecting means 24.

[0132] More generally, the reinforcing layer 3 and in particular the net, extends over the panel constraining

means 15, in such a way that upon the installation of the connecting means 24 to the roofing structure (for example a screw), at least one wire 3a, and preferably at least two wires 3a of the net (as in the embodiment of figure 1A), preferably extending lengthwise the panel, remain outside the connecting means 24, or the area 15f of the constraining means intended for the passage of the connecting means.

[0133] These wires are indicated in the figures by the referral 3a' for better distinguishing them from the other wires 3a.

[0134] By doing so, the strength and safety provided by the panel can be increased.

[0135] It has to be noted that the term "outside" or "externally" is used to indicate that the meshes, or the wires 3a', are placed laterally with respect to the connecting means 24, or with respect to the area 15f of the constraining means 15 for the connecting means, compared with the inner part of the panel comprising the surface 2a. In other words, for example referring to figure 1A, on the left of the connecting means 24 or the area 15f, there is the "outer" part wherein the wires 3a' are present, whereas on the right of the connecting means 24 or the area 15f, there is the "inner" part of the panel, that is to say the part wherein the panel extends.

[0136] In particular, in the embodiment illustrated in figures 1, 2, 5, a wire 3a' is placed externally with respect to the connecting means 24 and/or with respect to the area 15f of the constraining means 15 intended for the passage of the connecting means. Conversely, in the embodiment illustrated in figure 1A, two wires 3a' are placed externally with respect to the connecting means 24, and/or with respect to the area 15f of the constraining means 15 intended for passing the connecting means. In particular, the wires 3a' placed respectively at the fold between the surfaces 15b and 15c, and at the end of the surface 15c, are placed externally (more on the left in the view of figure 1A) with respect to the connecting means 24 or with respect to the area 15f of the constraining means 15 intended for the passage of the connecting means.

[0137] According to an aspect of the present invention, the panel 1 comprises as well at least one second layer 4 of transparent material placed underneath the reinforcing layer 3.

[0138] In other words, the second layer 4 of transparent material is constrained to the panel in such a way that the reinforcing layer 3 is interposed between the at least one first layer of transparent material 2 and the at least one second layer of transparent material 4.

[0139] According to a preferred embodiment, the at least one second layer 4 of transparent material is constrained in such a way that the reinforcing layer 3 is contacting the surface 4a of the second layer 4 of transparent material.

[0140] Advantageously, the at least one reinforcing layer 3 is contacting the surfaces of the first and the second layers 2 and 4 of transparent material so that to form

a particularly resistant sandwich structure.

[0141] It has to be noted that means can be provided for constraining the reinforcing layer to the at least one second layer of transparent material 4, similarly to what occurs for the constraint of the reinforcing layer 3 to the first layer 2 of transparent material.

[0142] For example, adhesive can be employed for this purpose.

[0143] Furthermore, according to a possible embodiment, the at least one reinforcing layer 3 can be constrained, for example by means of an adhesive, to the second layer of transparent material 4 rather than to the first layer of reinforcing material 2.

[0144] It has to be noted that the second layer 4 of transparent material can be made of the same material used for the first transparent layer 2. According to a preferred embodiment, also the second layer of transparent material 4 is made of polycarbonate. In the embodiment illustrated in figures, the second layer of transparent material 4 is made of honeycomb-structure polycarbonate.

[0145] It has to be noted that the second layer 4, still being transparent to allow light radiation passing through the same, can also show a coloration in order to prevent the reinforcing layer 3 from being visible from the inside of the structure on which the panel 1 for forming the skylight is installed.

[0146] It has to be noted that the coloration to which the layer 4, and according to some possible embodiments also the first layer 2, is subjected, does not impair the transparency of such layers which, as stated, shall allow the light radiation passing through the same.

[0147] In addition, the panel according to the present invention comprises sealing means 10 for sealing the layers composing the panel 1.

[0148] The sealing means 10 are used to laterally seal the layers composing the panel so that to prevent external agents, such as for example water, dust, dirt, etc., from infiltrating among the various layers.

[0149] By doing so the advantage is obtained also of keeping the reinforcing means 3, which are interposed between the two layers of transparent material 2, 4, protected inside the so-realized panel 1.

[0150] The sealing means 10 are applied along the sides of the layers composing the panel, and in particular along the sides of the panel which are free from the constraining means 15. In fact, usually the layers of the panels have to be sealed at the sides 1a wherein the constraining means 15 for the constraint to the roofing structure are not present.

[0151] In figure 3 the sides 1a of the panel are illustrated in which the constraining means 15 for the constraint to the roofing structure are not present, and in which the sealing means 10 are installed.

[0152] In such sides 1a, the openings of the honeycomb-structure of the layers 2 and 4 of transparent material made of polycarbonate are present.

[0153] According to possible embodiments, different sealing means 10 can be employed in the panel accord-

ing to the present invention.

[0154] According to a possible embodiment, the sealing means comprise an adhesive, for example, which is applied laterally to the sides 1a of the layers of which the panel is composed, or else by tapes also laterally applied along the sides 1a of the panel.

[0155] Furthermore, substantially C-shaped elements can be used which, in addition to laterally sealing the panel layers, contribute to keep the various layers in the sandwich structure contacting one to another. Such C-shaped elements are applied along the sides 1a of the panel which are free from the constraining means 15 to the roofing structure. According to a further possible embodiment, the sealing means 10 can comprise protruding ends of the first 2 and/or the second 4 layer of transparent material which are subsequently welded and, in case, folded in order to constitute a side barrier for the layers composing the panel 1.

[0156] In the embodiment wherein the panel 1 comprises at least one first 2 and at least one second 4 layer of transparent material, between which at least one reinforcing layer 3 is interposed contacting the same layers, the first or the second, or preferably both the layers of transparent material, comprise protruding ends 10a and 10b which are welded one to another, for example by hot welding, in an overlapped position in order to determine the lateral sealing of the panel.

[0157] In particular, in the embodiment illustrated in figures, the first and the second layer of transparent material 2, 4 are made of polycarbonate by leaving one or more ends 10a, 10b as protruding laterally which are subsequently welded one to another.

[0158] In the embodiment illustrated in figures, the first and the second layers of transparent material 2 and 4 are of honeycomb-structure type and the protruding ends 10a and 10b are realized in such a way to be thinner with respect to the honeycomb-structure of the layers 2 and 4.

[0159] Preferably, as illustrated in the detailed view of figure 5, the protruding end 10a of the first layer 2 of transparent material is realized at the lower surface 2a to which the reinforcing layer 3 is constrained. On the contrary, in the second layer 4 of transparent material the protruding end 10b is realized preferably at the upper surface 4a at which the reinforcing layer 3 is contacting with.

[0160] By doing so the two protruding ends 10a, 10b respectively of the first and the second layer 2, 4 of transparent material, can be advantageously welded one to another and possibly folded one over the other in order to realize the lateral sealing of the panel.

[0161] It has to be noted that the protruding ends are preferably realized on the sides 1a of the panel 1 which are free from the constraining means 15 for the constraint to the roofing structure. Preferably such protruding ends 10a and 10b are realized along the entire length of the sides 1a of the panel 1, in such a way that once welded they cause the effective sealing of the lateral part of the panel.

[0162] The present invention also relates to a method for the production of a panel 1 for the realization of skylights in roofing structures of the above described type.

[0163] The method comprises the step of constraining at least one reinforcing layer 3 to the surface of at least one first layer 2 of transparent material.

[0164] Preferably such a step of the production method is carried out by means of an adhesive which allows gluing and thus firmly constraining the reinforcing layer 3 to the first layer 2 of transparent material.

[0165] The panel 1, and in particular the layer of transparent material 2, comprises constraining means 15 for the constraint to the roofing structure, and the step of constraining the reinforcing layer 3 to the surface of the transparent layer 2 is carried out, preferably, in such a way that the reinforcing layer 3 extends at least partially on the constraining means 15 of the panel 1 which, as stated, are preferably realized on the first transparent layer 2.

[0166] As already stated, according to further possible embodiments, the at least one reinforcing layer 3 does not extend at the constraining means 15 for the constraint to the roofing structure of panel 1, but only at the flat surface of the panel.

[0167] Furthermore, the production method comprises the further step of constraining at least one second layer of transparent material 4 to the reinforcing layer 3, in such a way that the reinforcing layer 3 is interposed between the two layers 2 and 4 of transparent material.

[0168] By doing so a sandwich-shaped panel can be realized rapidly and cheaply, which can be simply installed to the roofing structure ensuring at the same time high safety levels in terms of breaking-resistant function and body restraint.

[0169] The method comprises the additional step of laterally sealing the layers composing the panel 1.

[0170] As stated above, the operation can be carried out by means of convenient sealing means 10, which can be selected from adhesives, tapes, C-shaped elements. Furthermore, the sealing of the layers of panel 1 can be carried out by means of the protruding ends 10a, 10b of the at least one first and/or at least one second layer 2, 4 of transparent material which can be welded.

[0171] As stated above, if the panel comprises only the first layer 2 of transparent material and the reinforcing layer 3, the sealing means 10 are used to seal such layers only one to another.

[0172] Conversely, if the panel 1 also comprises at least one second layer of transparent material 4, the method provides the step of laterally sealing all the layers 2, 3 and 4. The lateral sealing can be carried out by means of the protruding ends 10a, 10b of the panel.

[0173] In such a case, the production method provides the step of realizing the layer or the layers of transparent material 2, 4 with at least one protruding end 10a, 10b intended to be welded so as to form a lateral barrier for the panel 1.

[0174] Of course, in the assembling, the panel accord-

ing to the present invention can be shaped according to the installation requirements. For example, the panel surface can be partially curved to fit the curvature of the roofing structure and in particular of the metal panels composing the same.

[0175] Length and width also can be of course realized to fit the dimensions of the opening in the roofing structure in which the skylight has to be done.

Claims

1. Panel (1) for forming skylights in roofing structures, comprising at least one first layer (2) made of a transparent material and at least one reinforcing layer (3) constrained to the surface (2a) of said at least one first layer of transparent material (2), **characterized in that** said at least one reinforcing layer (3) comprises at least one net, preferably a metal net, and **in that** the panel comprises constraining means (15) for the constraint to said roofing structure.
2. Panel according to claim 1, **characterized in that** said at least one reinforcing net (3) extends at least partially at said constraining means (15) for the constraint to the roofing structure.
3. Panel according to claim 1 or 2, wherein said constraining means (15) for the constraint to the roofing structure are complementarily shaped to the ends of the panels of the roofing structure to which they are constrained.
4. Panel according to any one of the preceding claims, wherein said constraining means (15) comprise at least one protruding portion extending laterally from said panel and comprising at least one surface (15a, 15b, 15c).
5. Panel according to claim 4, wherein said at least one protruding constraining portion comprises one surface (15a) extending from said panel (1), or two surfaces (15a, 15b) according to a substantially L-shaped configuration of said protruding portion, or else three surfaces (15a, 15b, 15c) according to a substantially U-shaped configuration of said protruding portion.
6. Panel according to claim 4 or 5, wherein said at least one reinforcing net (3) extends on at least one surface (15a, 15b, 15c) of said at least one protruding constraining portion (15).
7. Panel according to any one of claims from 4 to 6, wherein said at least one reinforcing net (3) extends on only one surface (15a) of said protruding constraining portion (15), or on two surfaces (15a, 15b) of said protruding constraining portion (15), or on

three surfaces (15a, 15b, 15c) of said protruding constraining portion (15).

8. Panel according to any one of the preceding claims, **characterized in that** said constraining means (15) comprise at least one area (15f) for connecting means (24) for the connection to the roofing structure, the net (3) extending at least partially on said constraining means (15) comprise at least one wire (3a'), and preferably at least two wires (3a'), placed externally with respect to said at least one area (15f) for the passage of the connecting means (24) and/or externally with respect to said connecting means (24) when installed on the panel.

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9. Panel according to any one of the preceding claims, wherein said reinforcing net (3) comprises wires (3a), preferably straight wires, which are arranged at folds (2b) of the surface of said layer of transparent material (2), preferably at said constraining means (15), to increase the strength generated by said reinforcing net (3).

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10. Panel according to any one of the preceding claims, wherein said at least one reinforcing net (3) is shaped to fit the surface of said panel, preferably at said constraining means (15).

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11. Panel according to any one of the preceding claims, **characterized by** comprising at least one second layer (4) of transparent material, said at least one reinforcing layer (3) being interposed between said at least one first and at least one second layer (2, 4) of transparent material.

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12. Panel according to any one of the preceding claims, wherein said at least one first layer (2) of transparent material and/or said at least one second layer (4) of transparent material is made of polycarbonate, preferably honeycomb-structure polycarbonate.

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13. Method for the production of at least one panel (1) for forming skylights in roofing structures, according to any one of the preceding claims, comprising constraining means (15) for the constraint to said roofing structure, the method comprising the step of constraining at least one reinforcing layer (3), comprising at least one net, preferably a metal net, to the surface (2a) of at least one first layer (2) of transparent material.

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14. Method according to claim 13, comprising the further step of constraining the at least one reinforcing layer (3) to the surface of said first layer (2) of transparent material so that the reinforcing layer (3) extends at least partially at the constraining means (15) of the panel.

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15. Production method according to claim 13 or 14, comprising the further step of constraining at least one second layer (4) of transparent material to said panel, said at least one reinforcing layer (2) being interposed between said at least one first (2) and said at least one second (4) layer of transparent material.

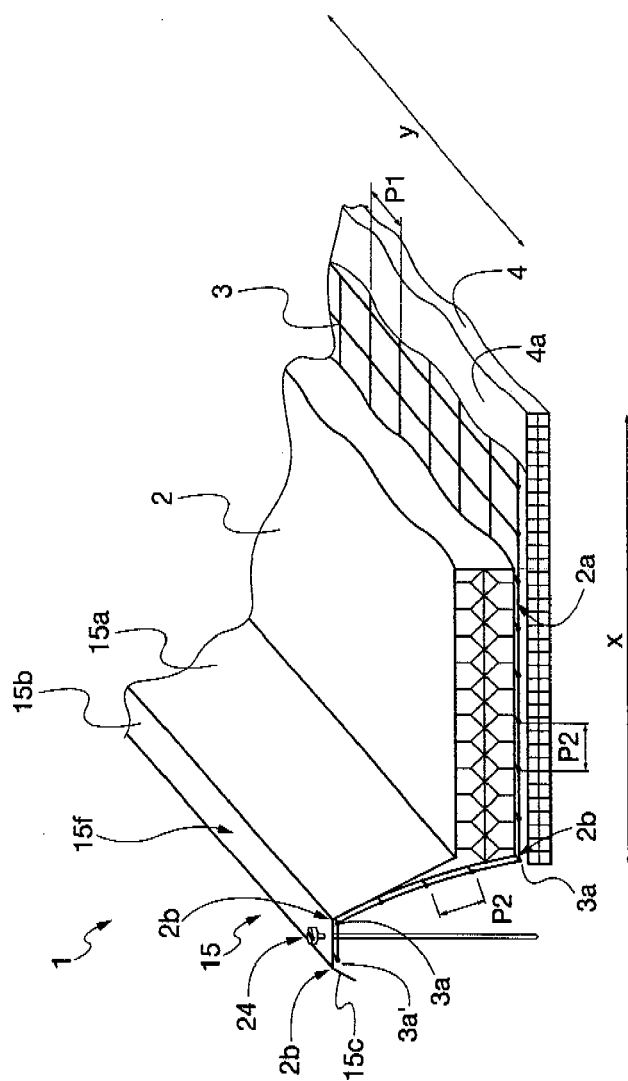


Fig. 1

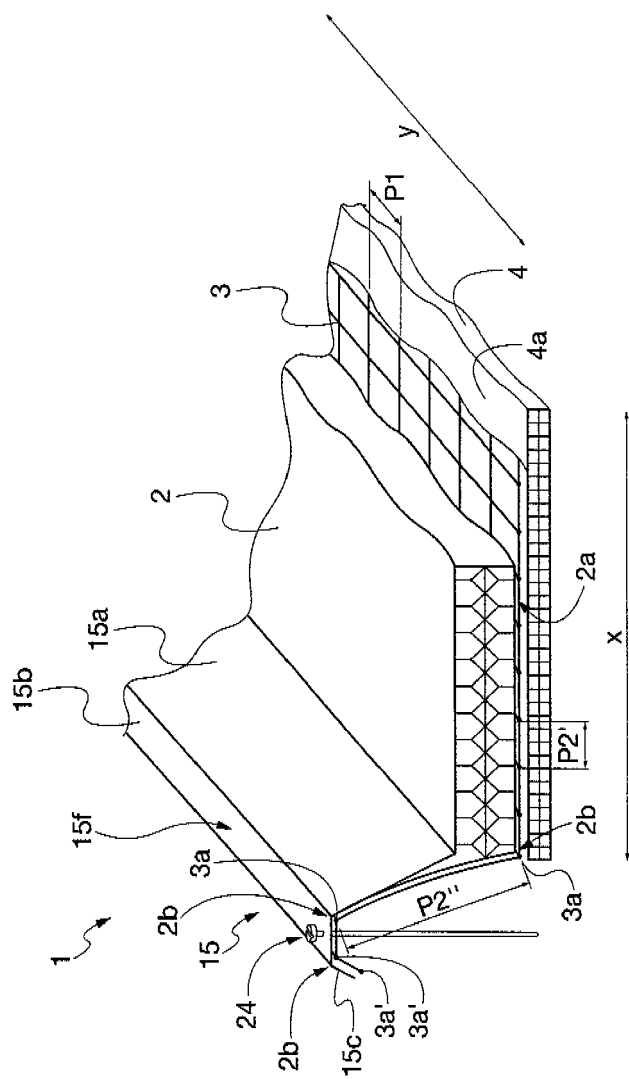


Fig. 1A

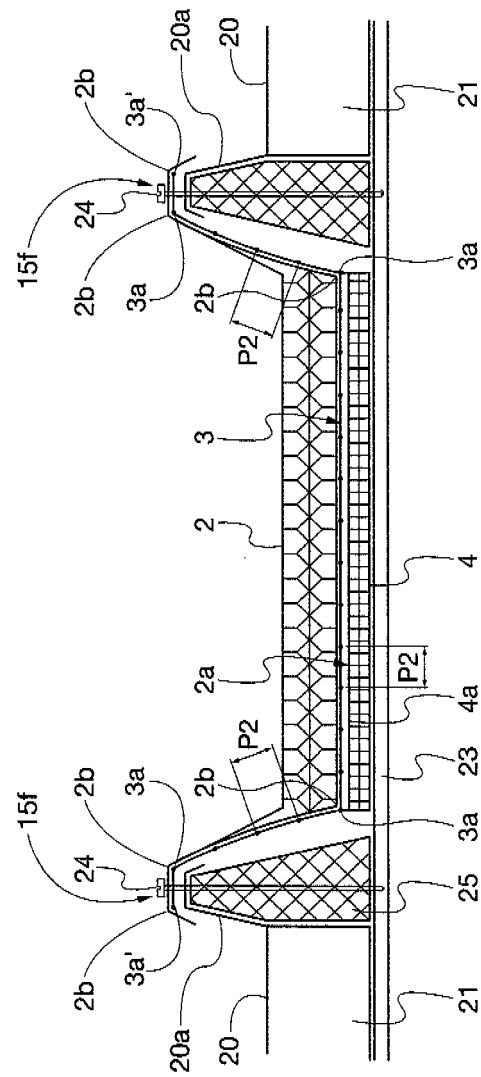


Fig. 2

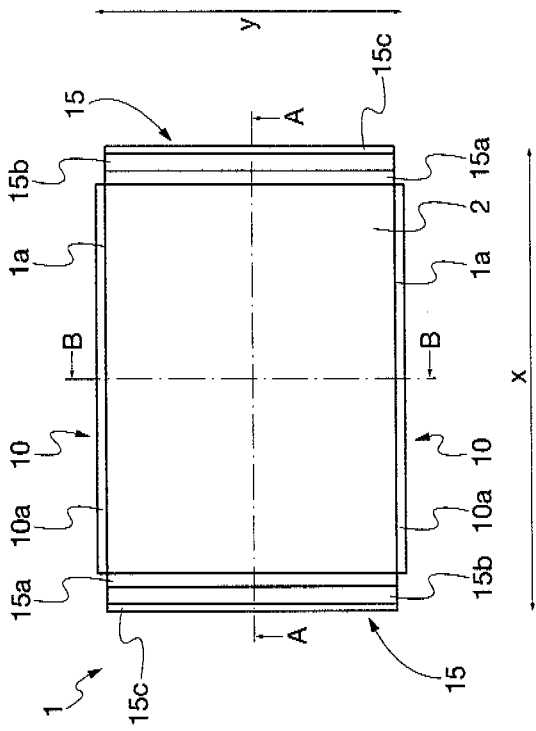


Fig. 3

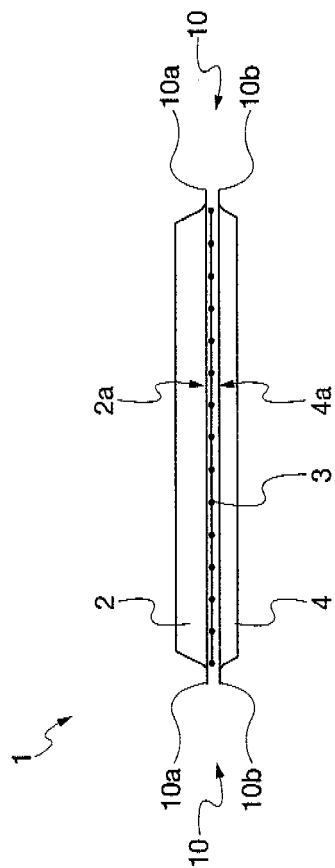


Fig. 4

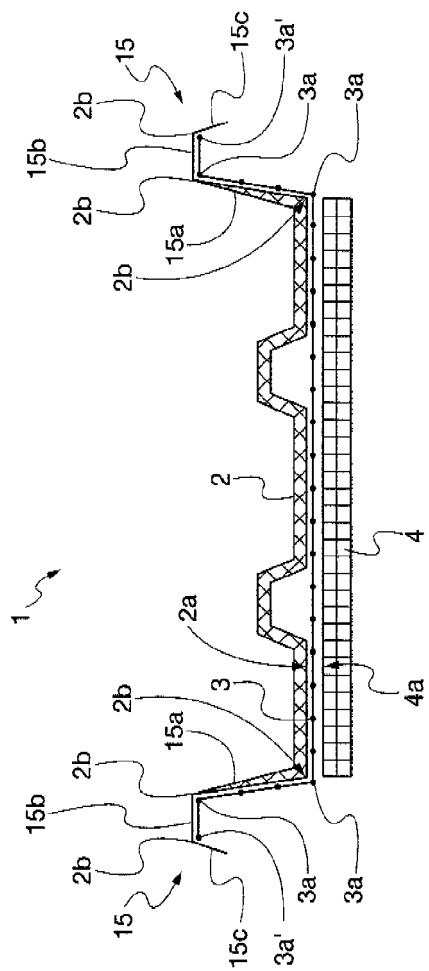


Fig. 5



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