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(54) **Structure of an arched and thermally and acoustically insulated monolithic panel, particularly useful for the roofing of industrial and civil buildings and the like**

Aufbau einer Wärme- und Schallisolierenden monolithischen gebogenen Platte, insbesondere nützlich zur Eindeckung von Zivil- und Industriegebäuden

Structure d'un panneau monolithique courbe thermiquement et acoustiquement isolant, particulièrement utile pour recouvrir des bâtiments civils ou industriels

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Description

[0001] The present invention relates to an arched monolithic panel (or plate) structure, of the type constituted of two sheets from key-patterned or micro-staved metal plate with the interposition from thermally insulating material and provided with means of high sound-absorption and sound-insulation acoustic capacity, such as to render the panel particularly useful for the roofing of industrial and civil buildings and the like.

[0002] As is known, at present the arched or curved monolithic panels for the roofing of buildings are constituted of an external sheet from key-patterned plate from steel, aluminum or other alloys and an internal sheet from metallic plate, also key-patterned or micro-staved, between which a layer from thermally insulating material, usually expanded or rigid polyurethane foam, is interposed.

[0003] It is also known that, in order to form the required roofing with all the key-patterns so oriented as to allow the downflow of water, the coupling of each panel with the adjoining one is realized in the upper part by the overlapping of the terminal high key-patterns present in the upper layers and, in the lower part, by the bearing of the flat edges emerging from the lower key-patterned or micro-staved sheets on each other.

[0004] These types of curved and key-patterned panels are assembled by fastening through screws the opposite ends to bearing structures which are usually constituted of two parallel beams positioned in a direction transversal to the panel key-patterns.

[0005] In practice, the assembly of the acoustic or curved panels involves for the operator special care and special equipment in the adjustment of the position of each panel relatively to the position of the adjoining panel, in order to prevent the creation, between the flat edges of each couple of adjoining panels, of an irregular fissure throughout the length of the joint lines; said fissure involves the drawback, after the fastening of the panels, of causing the passage of air not only between the planes in touch with each other, but also between the inclined walls of the key-patterns overlapping each other of each couple of adjoining panels.

[0006] US-A-3,290,845 discloses an insulated roof panel system. Each panel is of rectangular configuration and is curved or bent in an arcuated form. The panel has an outer skin and an inner skin. Between said skins a central insulating core of foamed plastic is provided, which is bonded to the outer and inner skins. During joining of the panels fissures are formed which become air tight by means of using gaskets between the joining inner skins and foam cores.

[0007] An object of the invention is to realize a structure of arched monolithic panel of the type constituted of two key-patterned and/or micro-staved metal sheets, which panel incorporates a thermally insulating material, said structure being so designed and structured as to impart the panel a high sound-absorption and sound-insulation acoustic capacity.

[0008] A further object of the invention is to realize an arched monolithic panel of the above specified type incorporating means for stiffening the ends of said panel such as to ensure a correct and suitable fastening of the panel to the bearing structure, as well as an increase in the bearing capacity of said panel.

[0009] A not least object is to realize an arched and key-patterned monolithic panel of easy realization and assembly and high reliability in the time.

[0010] These and still other objects that will be more clearly stressed in the following are achieved by a structure of an arched monolithic panel suitable for the realization of building roofing, of the type constituted by an external or upper sheet from key-patterned metal plate, an internal or lower sheet from micro-staved metal plate substantially shaped as a small tank or tray lower tray-shaped sheet, and a thermally insulating material interposed between said plate sheets, said panel structure comprising, according to the present invention, air-tight closing means to prevent the passage of air through fissures created by the coupling by the overlapping of each panel of the roofing structure on the adjoining one, said closing means being constituted by at least a gasket from elastically yielding material inserted between the end of the flat edge protruding from the lower sheet of each panel and the flat edge of the lower sheet of the adjoining panel intended for the ledge-overlapping on said end of the flat edge of the adjoining panel, so as to seal the fissure created after the stable coupling between said two adjoining panels, preventing in this way the passage of air also between the superposed faces of the key-patterns of each couple of adjoining panels, there being also provided, between the bottom at least partly micro-holed of said lower tray-shaped sheet and the thermally insulating material, at least a layer or gasket from sound-absorbing and sound-insulating material selected from open-cell expanded materials and/or rigid materials, such as mineral wool, rock wool and the like, said structure of arched monolithic panel being also provided, in the inside of said lower tray-shaped sheet, with stiffening elements, substantially C-shaped rectilinear metal element having a length allowing their positioning at the opposite ends of the panel, in the direction transversal to the key-patterned line, in order to ensure a suitable fastening to the bearing structure, to improve the mechanical resistance and the bearing capacity of the panel and to prevent screws fastening said panel to the bearing structure from causing tears of the lower tray-shaped sheet during the permanence of said panel and to prevent an undesired compression of the insulating materials.

[0011] More particularly, said air-tight means preventing the passage of air through said fissure are constituted by the combination of said gasket from yielding material, inserted between said flat edges ledge-overlapped of each couple of adjoining panels, and of a like gasket from yielding material interposed between the in-

trados of the high part of the key-pattern of the upper sheet in a panel and the extrados of the high part of the upper key-pattern of the adjoining panel after the coupling by overlapping of the two panels.

[0012] Besides, said sound-absorbing and sound-insulating material is positioned above or close to the lower sheet or tray of each panel, in the form of pads or spaced-band gaskets or also in the form of a continuous gasket; in this way, also the bottom of said tray may be realized as a separate-band micro-holed bottom, said bands corresponding to the widths of the overlying pads.

[0013] Further characteristics and advantages of the present invention will be more clearly stressed by the following detailed description made with reference to the attached drawings, included only by way of non limiting indication, wherein:

Figure 1 shows, in perspective view, an arched monolithic panel of a known type, suitable to realize the roofing of buildings in general;

Figure 2 shows, in a schematic form, two like arched panels shown in cross-section transversally to the key-patterned lines, always according to line II-II of Figure 1, and coupled to each other according to a first embodiment of the present invention;

Figure 3 shows, always in cross-section but on a greater scale, the same embodiment of Figure 2, for the sake of a better clarification;

Figures 4 and 5 show two different embodiments of each arched monolithic panel, also shown in cross-section transversally to the key-patterns and hooked to each other according to what is illustrated in Figures 1 and 3;

Figure 6 shows, in a perspective view, a panel realized according to what is illustrated in the preceding figures but provided, at the opposite ends, with a reinforcement metal element suitable to ensure a suitable fastening of the panels to the supporting structure in both cases of a plane or a micro-holed sheet; while

Figures 7 and 8 show, always in cross-section, two different systems of stable hooking of a panel to the bearing structure, utilizing a reinforcement or stiffening metal element located at the opposite ends of the arched panel.

[0014] With reference to said figures and in particular to Figures 1-3, the structure of arched panel realized according to the present invention utilizes an arched monolithic panel of a known type, for instance the one shown in Figure 1, wherein there is indicated by 1 the key-patterned external or upper support panel, substantially a sheet from key-patterned plate, by 2 there is indicated the internal or lower plate sheet either micro-staved or key-patterned according to a key- pattern different from that of the external or upper sheet 1, while by 3 there is indicated a thermally insulating material of either the expanded or the rigid type, such as expanded polyurethane or mineral wool; said insulating material 3 is substantially contained in a tray obtained by shaping the internal or lower metal sheet 2.

[0015] Besides, in order to allow the joining by overlapping of the lower sheet of a panel on the lower sheet of the adjoining panel, each arched panel, indicated as a whole by P in the various figures, has a flat edge 2a that protrudes from the lower sheet 2 parallel to the key-patterned lines of the external or upper supporting sheet 1 (see p. 1). Besides, the flat edge 2a protruding from the lower sheet 2 has usually a length 2b (Fig. 1) bent up until it tilts on plane 2a.

[0016] The structure of monolithic panel that constitutes the object of a first embodiment of the present invention utilizes a panel P of a known type and realizes the coupling with an adjoining like panel P1 (Figs. 2 and 3) according to the known technique, namely by overlapping, on the upper side, of the arched side key-patterns 1a and 1b of the two adjoining panels and, on the lower side, by ledge-bearing of the flat edge 2c of the adjoining panel P1 on the protruding flat edge 2a of panel P (Figs. 2-3).

[0017] The ledge-bearing of said two flat edges 2a-2c creates, as is known, between the two edges a fissure which is the more accentuated the more irregular are the parallelism between the faces of the flat edges and the accuracy employed during the assembly of the two adjoining panels.

[0018] In order to obviate the drawback of an undesired passage of air through said fissure and also between the faces in touch of the key-patterned lines of the two panels, which air passage would affect adversely the effect created by the thermal insulating material 3, the present invention provides the interposition between said flat edges 2a-2c of the two coupled panels of a compressible air-tight gasket 4 (Fig. 3) from open-cell expanded material or the like; said gasket may be stably anchored, during the production of the panel, to the internal face of either flat edge of the panels to be coupled; besides, instead of a gasket from expanded material, the air-tightness through said fissure may be realized by means of a silicon band or the like.

[0019] Moreover, a like gasket 5 may be inserted also between the two high key-patterns 1a and 1b, overlapping each other.

[0020] According to another embodiment, also object of the present invention, the structure of monolithic panel is realized as shown in Figures 4 and 5, i.e., by interposing between the lower sheet 2 having the shape of a tray with alternated-band micro-holes in the lower part, as indicated by 2d in Figure 4, or also for its whole development as indicated by 2e in Figure 4, and the thermally insulated material 3, an acoustic barrier, substantially a gasket 6 from open-cell expanded material or also a rigid material, such as mineral wool, rock wool or the like, suitable to impart the panel advantageous sound-absorbing and sound-insulating characteristics.

[0021] Lastly, always according to the present inven-

tion, in order to allow a correct fastening of the panels - both those with a solid tray (Fig.3) and those with a micro-holed bottom (Figs. 4 and 5) - to the underlying support structure, in each arched panel a stiffening element 7 (Fig. 6) is inserted which is substantially a metal sheet, suitably sized and so bent as to have a cross-section shaped as a capital "C", and of a length allowing to position said stiffening element at the opposite ends of the panel, transversally to the development of the key-patterned lines 1.

[0022] In practice, said stiffening element 7 increases the mechanical resistance and the bearing capacity of the panel, and prevents screws 8 fastening said panel to the underlying bearing structure 9 (Figs. 7 and 8) from causing tears of the lower sheet 2 during the permanence of said panel and an undesired compression of thermal 3 and acoustic 6 insulating materials.

[0023] Figure 7 shows the anchoring system of a panel 1 provided with a stiffening element 7 onto a fixed support 9 where the fastening screw 8 is inserted in the panel from the innermost side of the key-pattern 1; in both realizations there are in practice obtained the same results of stable anchoring, without strains of the gaskets and/or pads interposed between the upper key-patterned sheet and the lower one or tray, independently on whether the latter is solid or micro-holed.

[0024] Obviously, in the practical realization, structurally and functionally equivalent modifications and variants may be introduced in the invention as described and illustrated according to preferred embodiments of practical implementation, without falling outside the protection scope of the appended claims.

Claims

1. A structure of an arched monolithic panel for the roofing of industrial and civil buildings, of the type constituted of an external or upper sheet from key-patterned plate (1), an internal or lower sheet from key-patterned or micro-staved plate (2) substantially tray-shaped, hereinafter called lower tray-shaped sheet, and by a thermally insulating material (3) interposed between said two plate sheets (1, 2), said monolithic panel structure comprises air-tight means (4) against air passage through fissures created by the coupling by overlapping of each panel of the roofing structure on the adjoining one, constituted by at least a gasket (4) from elastically yielding matter inserted between the end of the flat edge protruding from the lower sheet of each panel (2a) and the flat edge of the lower sheet of the adjoining panel (2c), intended for the ledge-overlapping on said end of the flat edge of the adjoining panel, so as to seal the fissure created after the stable coupling between said two panels, preventing in this way the passage of air also between the overlapping faces of the key-patterns (1a, 1b) of each couple of adjoining panels, **characterized in that** there is also provided, between the at least partly micro-holed bottom (2e) of said lower tray-shaped sheet (2) and the thermally insulating material (3), at least a layer or gasket (6) from sound-absorbing and sound-insulating material selected from open-cell expanded materials and/or rigid materials, such as mineral wool or rock wool, said structure of arched monolithic panel comprising also, in the inside of said lower tray-shaped-sheet substantially C-shaped rectilinear metal stiffening elements (7) having a length allowing their positioning at the opposite ends of the panel, in a direction transversal to the key-patterned lines, in order to ensure a suitable fastening to a bearing structure (9), to improve the mechanical resistance and the bearing capacity of the panel and to prevent screws (8) fastening said panel to the bearing structure (9) from causing tears of the lower tray-shaped sheet (2) during the permanence of said panel and to prevent an undesired compression of the insulating materials (3, 6).

2. The panel structure according to claim 1, **characterized in that** it comprises, in combination with said gasket (4) intended for air-tightness against the passage of air through said fissure, a further gasket (5) from elastically yielding material, inserted between the intrados of the high part of the key-pattern (1a) of the upper sheet of a panel and the extrados of the high part of the key-pattern (1b) of the adjoining panel, after the coupling by overlapping of said two panels.

3. The panel structure according to claim 1, **characterized in that** said sound-absorbing and sound-insulating material (6) is shaped like a gasket or a pad and is positioned close to or above the tray-shaped lower sheet (2), between the bottom of said tray (2e) and said thermally insulating material, the bottom of said tray being micro-holed with alternate and equidistant bands of a width equal to that of the pads.

4. The panel structure according to claim 1, **characterized in that** said bottom of said tray (2e) is continuously micro-holed throughout its length.

5. The panel structure according to one or more of the preceding claims, **characterized in that** it comprises at the opposite ends of the panel a stiffening element (7) having a cross-section shaped like a capital "C", and of a width such as to house in its inside both the layer of thermally insulating material (3) and the sound-adsorbing and/or sound-insulating one (6).

6. The panel structure according to the preceding claims, **characterized in that** said air-tight gasket

(4, 5) against the passage of air through said fissures is stably anchored during the production to the internal face of either flat edge of the panels to be coupled.

Patentansprüche

1. Aufbau einer gebogenen einstückigen Tafel zum Eindecken von Zivil- und Industriegebäuden, des Typs, bestehend aus einer äußeren oder oberen Platte aus keilprofiliertem Blech (1), einer inneren oder unteren Platte aus keilprofiliertem oder mikroprofitieftem Blech (2), die im wesentlichen wannenförmig ist, nachstehend "untere wannenförmige Platte" genannt, sowie einem Wärme isolierenden Werkstoff (3), der zwischen den genannten zwei Blechplatten (1, 2) eingesetzt ist, wobei der genannte einstückige Aufbau der genannten einstükkigen Tafel luftdichte Mittel (4) gegen den Durchzug von Luft durch Spalten umfasst, die durch das Verbinden jeder Tafel des Dach deckenden Aufbaus mit der benachbarten Tafel durch Überiappen entstehen, wobei die luftdichten Mittel zumindest eine Dichtung (4) aus einem elastisch nachgebenden Material umfassen, die zwischen dem Ende des flachen Randes, der von der unteren Platte jeder Tafel (2a) hervorragt, und dem flachen Rand der unteren Platte der benachbarten Tafel (2c) eingesetzt wird und für die Randüberlappung an dem genannten Ende des flachen Randes der Nachbartafel bestimmt ist, um den Spalt, der nach dem stabilen Verbinden der genannten zwei Tafeln entstanden ist, abzudichten, um auf diese Weise auch den Durchzug von Luft zwischen den überlappenden Flächen des Keilprofils (1a, 1b) jedes Paares von benachbarten Tafeln zu verhindern, **dadurch gekennzeichnet, dass** zwischen dem zumindest teilweise mikrogelochten Boden (2e) der genannten unteren wannenförmigen Platte (2) und dem Wärme isolierenden Werkstoff (3) zumindest eine Lage oder Dichtung (6) aus Schall absorbierendem und Schall isolierendem Werkstoff vorgesehen ist, der aus offenporigen Schaumwerkstoffen und/oder steifen Werkstoffen, wie zum Beispiel Mineralwolle oder Steinwolle, ausgewählt ist, wobei der Aufbau der gebogenen einstückigen Tafel darüber hinaus an der Innenseite der genannten unteren wannenförmigen Platte im wesentlichen C-förmige geradlinige Versteifungselemente (7) aus Metall umfasst, die eine Länge aufweisen, die es gestattet, sie an den entgegengesetzten Enden der Tafel in einer Richtung anzuordnen, die quer zu den keilprofilierten Linien verläuft, um eine geeignete Befestigung an einer Trägerkonstruktion (9) sicher zu stellen, um die mechanische Festigkeit und Tragkapazität der Tafel zu verbessern und um zu verhindern, dass Schrauben (8), die die genannte Tafel an der Trägerkonstruktion (9) befestigen, Risse in der unteren wannenförmigen Platte (2) während der Lebensdauer der genannten Tafel verursachen und um ein-unerwünschtes Zusammendrücken der Isolierwerkstoffe (3, 6) zu verhindern.

2. Aufbau der Tafel nach Anspruch 1, **dadurch gekennzeichnet, dass** er in Kombination mit der genannten Dichtung (4) zum luftdichten Abschießen gegen den Durchzug von Luft durch den genannten Spalt eine weitere Dichtung (5) aus einem elastisch nachgebendem Werkstoff umfasst, die zwischen der inneren Bogenfläche des erhöhten Teils des Keilprofils (1a) der oberen Platte einer Tafel und der äußeren Bogenfläche des erhöhten Teils des Keilprofils (1b) der Nachbartafel nach dem Verbinden der beiden Tafeln durch Überlappen eingesetzt ist.

3. Aufbau der Tafel nach Anspruch 1, **dadurch gekennzeichnet, dass** der Schall absorbierende und Schall isolierende Werkstoff (6) wie eine Dichtung oder ein Polster geformt ist und nahe an oder über der wannenförmigen unteren Platte (2) zwischen dem Boden der genannten Wanne (2e) und dem genannten Wärme isolierenden Werkstoff positioniert ist, wobei der Boden der genannten Wanne eine Mikrolochung aufweist, die sich in gleichen Abständen mit Streifen abwechselt, die die gleiche Breite haben wie die Polster.

4. Aufbau der Tafel nach Anspruch 1, **dadurch gekennzeichnet, dass** der genannte Boden der genannten Wanne (2e) durchgehend über seine gesamte Länge mikrogelocht ist.

5. Aufbau der Tafel nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** er an entgegengesetzten Enden der Tafel ein Versteifungselement (7) umfasst, das einen Querschnitt in der Form des Großbuchstabens "C" hat und eine solche Breite aufweist, dass in seinem Innem sowohl die Schicht des Wärme isolierenden Werkstoffs (3) als auch die des Schall absorbierenden und/oder Schall isolierenden Werkstoffs (6) aufgenommen werden kann.

6. Aufbau der Tafel nach den vorhergehenden Ansprüchen, **dadurch gekennzeichnet, dass** die genannte luftdichte Dichtung (4, 5) gegen den Durchzug von Luft durch die genannten Spalten während der Herstellung der Innenfläche jedes flachen Randes der zu verbindenden Tafeln stabil verankert ist.

Revendications

1. Structure en panneau monolithique courbe, destinée à la couverture de toiture de bâtiments indus-

triels et civils, du type constitué d'une feuille extérieure ou supérieure en plaque clavetée (1), d'une feuille intérieure ou inférieure en plaque clavetée ou micro-structurée (2) essentiellement en forme de plaque, appelée ci-dessous feuille inférieure en forme de plaque, et d'un matériau (3) thermiquement isolant situé entre lesdites deux feuilles (1, 2) en forme de plaque, ladite structure en panneau monolithique comprenant un moyen (4) qui empêche l'air traverser des fissures créées par l'accouplement par superposition de chaque panneau de la structure de couverture de toiture sur le panneau adjacent, ce moyen étant constitué d'au moins un joint d'étanchéité (4) formé d'un matériau élastiquement déformable inséré entre l'extrémité du bord plat qui déborde de chaque feuille inférieure de chaque plaque (2a) et le bord plat de la feuille inférieure de la plaque adjacente (2c) et qui est destiné à la superposition des bords à ladite extrémité du bord plat de la plaque adjacente pour fermer de manière étanche les fissures créées après l'accouplement stable desdites deux plaques, ce qui empêche également de cette manière l'air de passer entre les faces superposées des clavettes (1a, 1b) de chaque paire de plaques adjacentes, **caractérisée en ce qu'**on prévoit également, entré la partie inférieure (2e) au moins partiellement micro-perforée de ladite feuille inférieure (2) en forme de plaque et le matériau (3) thermiquement isolant, au moins une couche ou un joint d'étanchéité (6) formés d'un matériau acoustiquement isolant et absorbant sélectionné parmi les matériaux expansés à cellules ouvertes et/ou les matériaux rigides, par exemple la laine minérale ou la laine de roche, ladite structure en panneau monolithique courbe comprenant également à l'intérieur de ladite feuille inférieure en forme de plaque des éléments métalliques rectilignes (7) de renfort essentiellement en forme de C dont la longueur permet de les positionner sur les extrémités opposées du panneau et dans la direction transversale aux lignes clavetées pour garantir une fixation appropriée sur une structure (9) de support, pour améliorer la résistance mécanique et la capacité de support du panneau et pour empêcher les vis (8) qui fixent ledit panneau sur la structure (9) de support de provoquer des déchirures dans la feuille inférieure (2) en forme de plateau pendant la durée de vie dudit panneau et pour empêcher la compression indésirable des matériaux isolants (3, 6).

2. Structure en panneau selon la revendication 1, **caractérisée en ce qu'**elle comprend, en combinaison avec ledit joint d'étanchéité (4) qui empêche l'air de passer à travers lesdites fissures, un autre joint d'étanchéité (5) formé d'un matériau élastiquement déformable et inséré entre l'intrados de la partie supérieure de la clavette (1a) de la feuille supérieure d'un panneau et l'extrados de la partie supérieure de la clavette (1b) du panneau adjacent après l'accouplement desdits deux panneaux par superposition.

3. Structure en panneau selon la revendication 1, **caractérisée en ce que** ledit matériau (6) acoustiquement absorbant et isolant est configuré en joint d'étanchéité ou en tampon et **en ce qu'**il est positionné à proximité ou au-dessus de la feuille inférieure (2) en forme de plaque, entre la partie inférieure de ladite plaque (2e) et ledit matériau thermiquement isolant, la partie inférieure de ladite plaque étant micro-perforée et présentant des bandes alternées et équidistantes dont la largeur est égale à celle des tampons.

4. Structure en panneau selon la revendication 1, **caractérisée en ce que** ladite partie inférieure de ladite plaque (2e) est micro-perforée en continu sur toute sa longueur.

5. Structure en panneau selon une ou plusieurs des revendications précédentes, **caractérisée en ce qu'**elle comprend sur les extrémités opposées du panneau un élément de renfort (7) dont la section transversale est configurée en "C" majuscule et dont la largeur est telle qu'il peut loger la couche de matériau thermiquement isolant (3) et le matériau acoustiquement absorbant et/ou isolant (6).

6. Structure en panneau selon les revendications précédentes, **caractérisée en ce que** pendant la production, ledit joint d'étanchéité (4, 5) qui empêche l'air de passer à travers lesdites fissures est ancré de manière stable sur la face intérieure de l'un des bords plats des panneaux à accoupler.

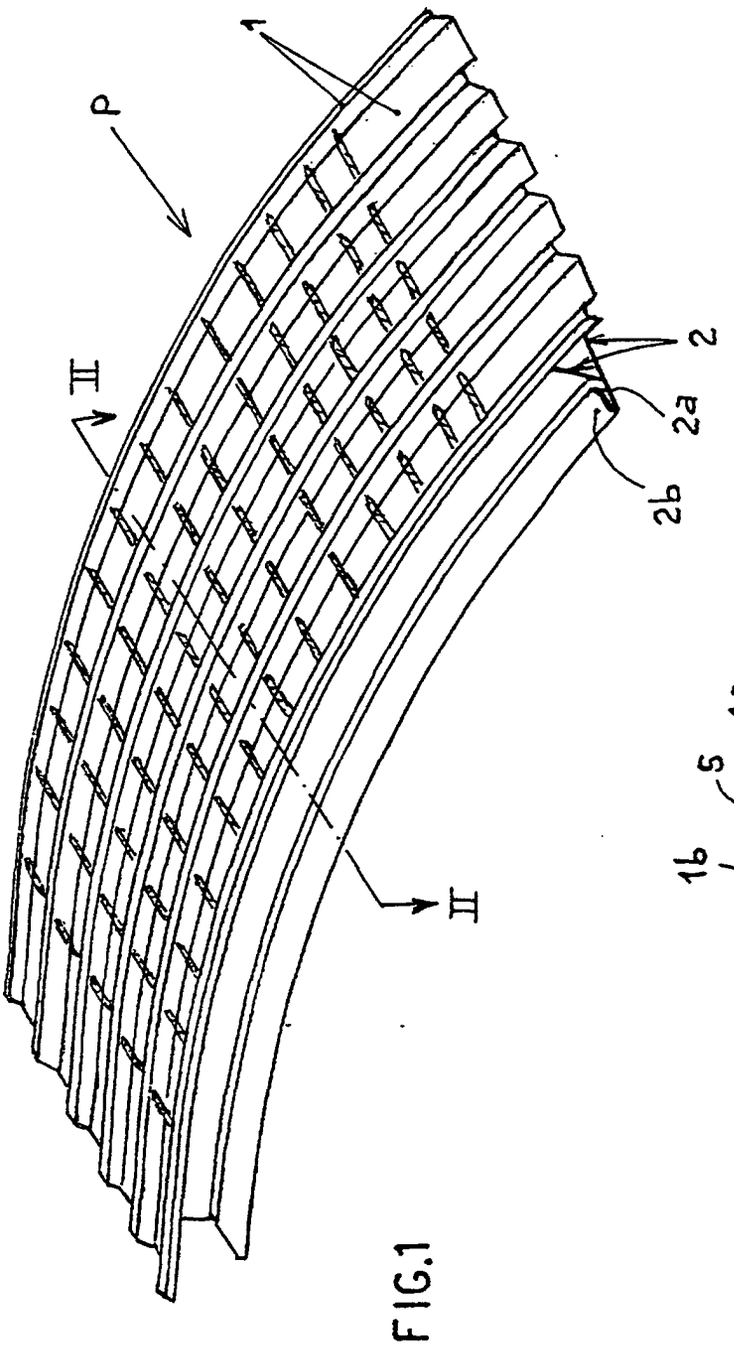

FIG.1

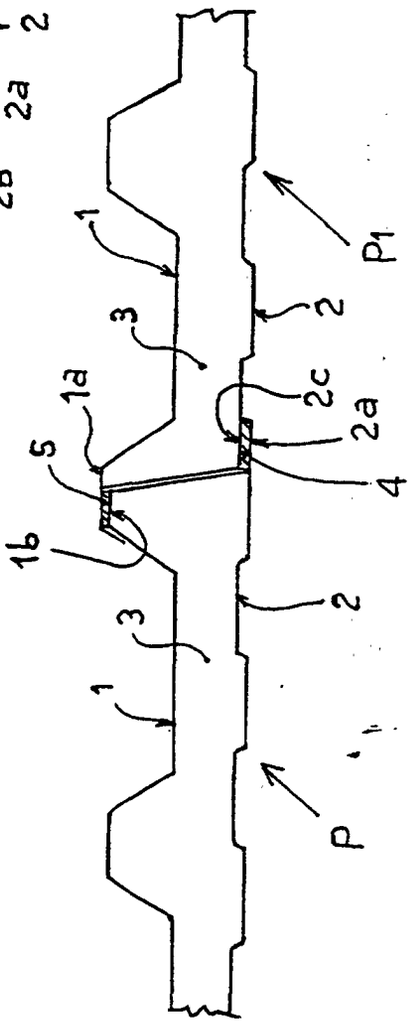

FIG.2

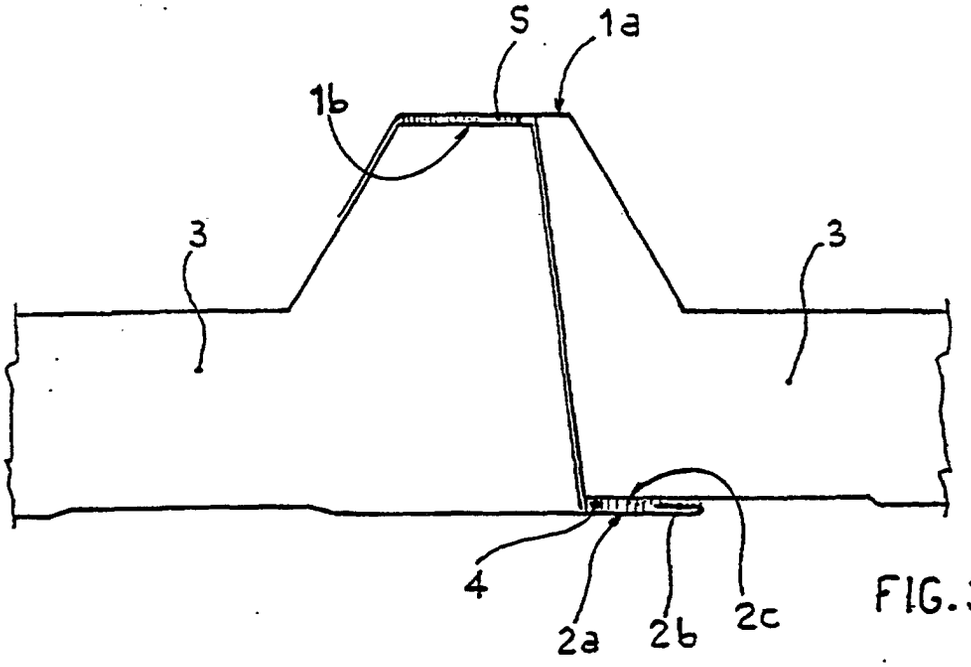

FIG.3

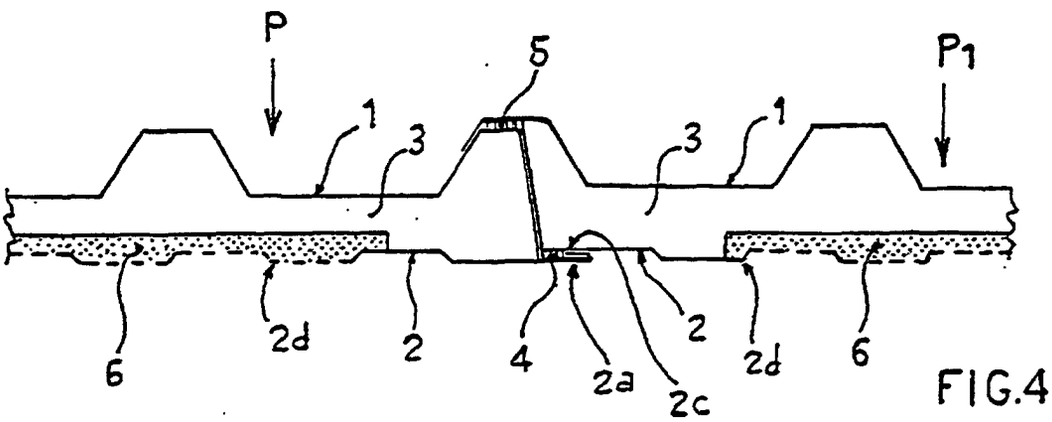

FIG.4

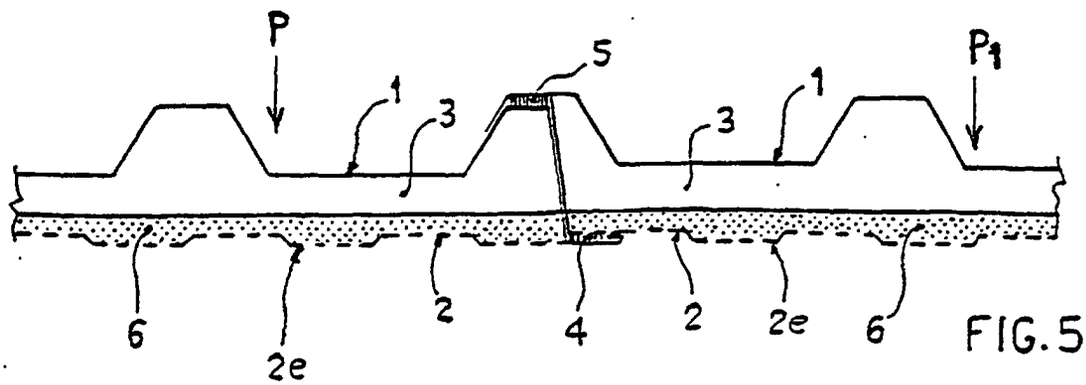

FIG.5

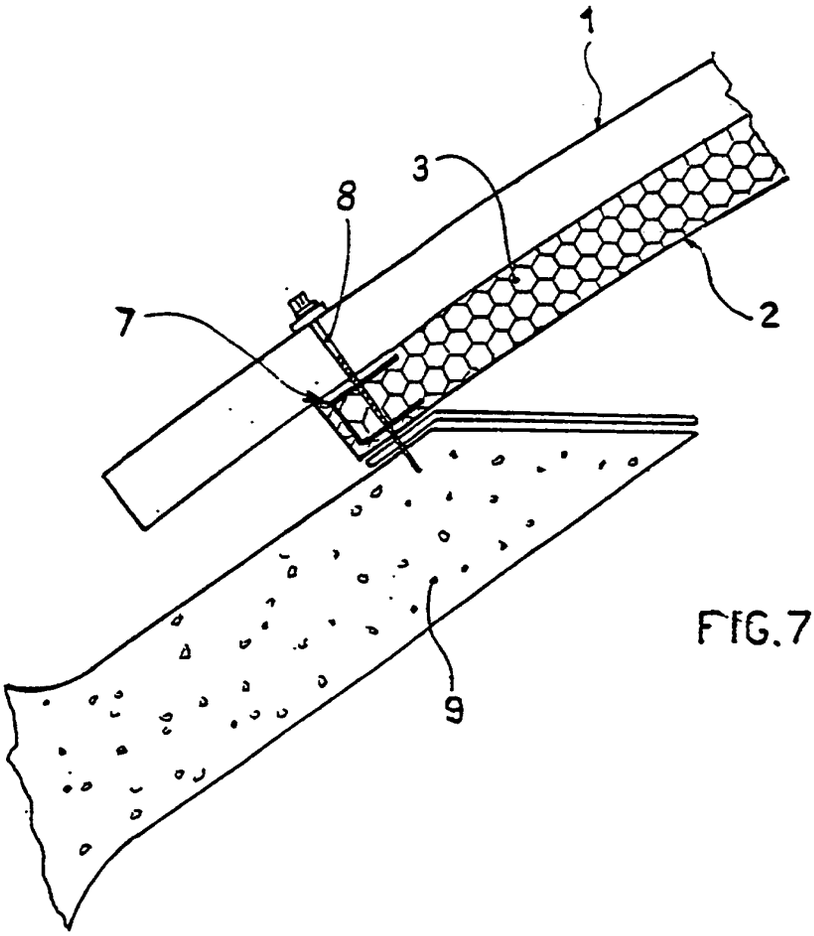

FIG.7

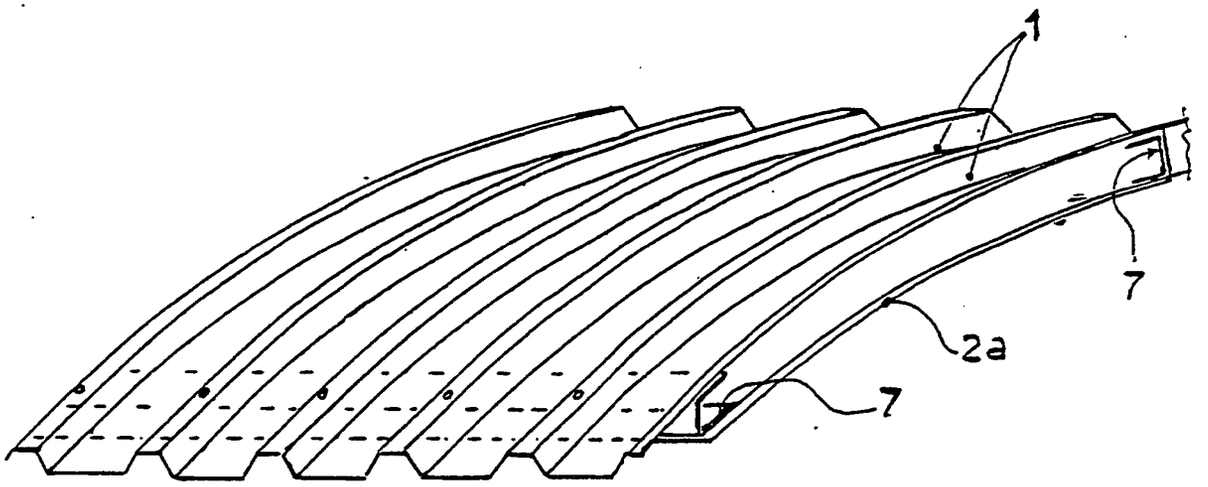

FIG.6

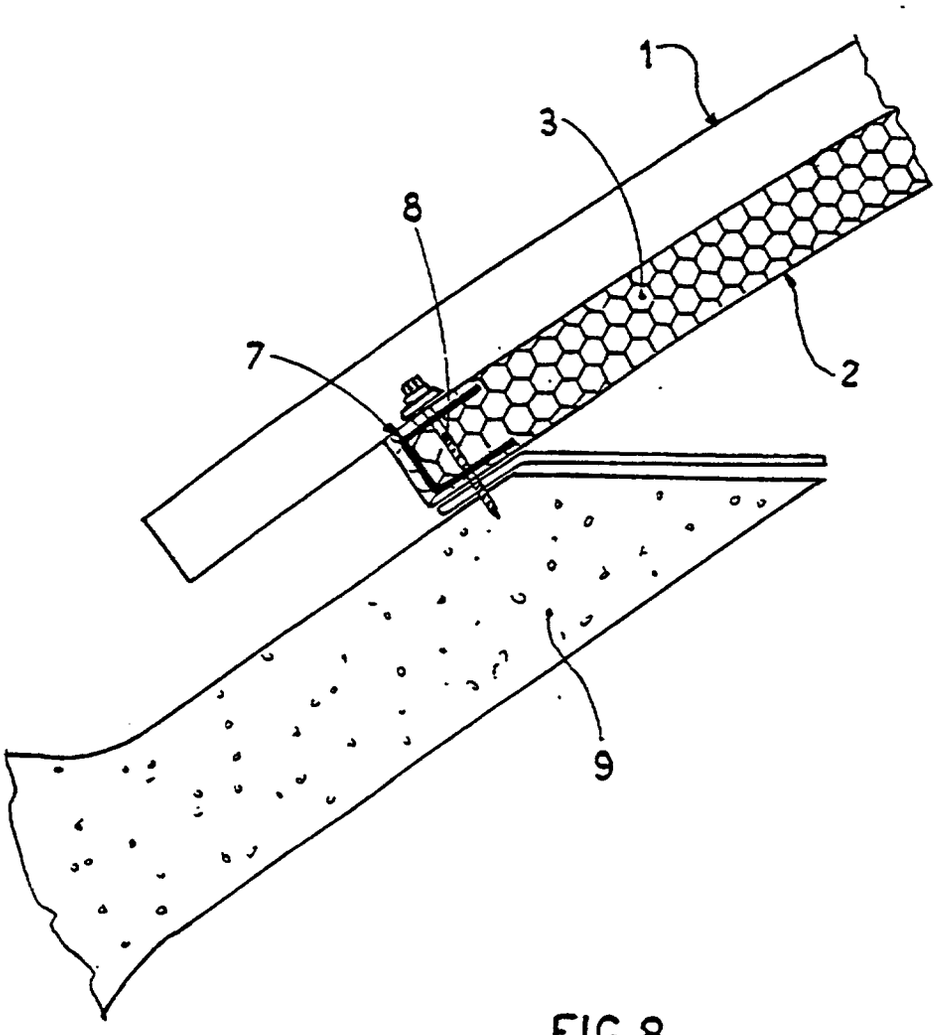

FIG.8