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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

(57) Structure of an arched monolithic panel for the roofing of industrial and civil buildings and the like, constituted of a sheet from key-patterned external metal plate (1), a sheet from internal metal plate (2), key-patterned or micro-staved, and the interposition between said sheets of a thermally insulating material (3), comprising at least a gasket (4) from yielding material to close, on the passage of air, the fissure created between the flat borders of the lower sheets of two panels coupled through the overlapping of a side key-pattern of a panel on that of the adjoining panel, a like gasket (5) interposed between the high parts of said key-patterns overlapping each other, as well as a sound-insulating and sound-absorbing acoustic barrier (6), interposed between the micro-staved and micro-holed bottom of said lower sheet and said thermally insulated material. Said structure comprises also a stiffening, substantially C-shaped element located at the opposite ends of the panel, transversally with respect to the key-patterns of said panel.

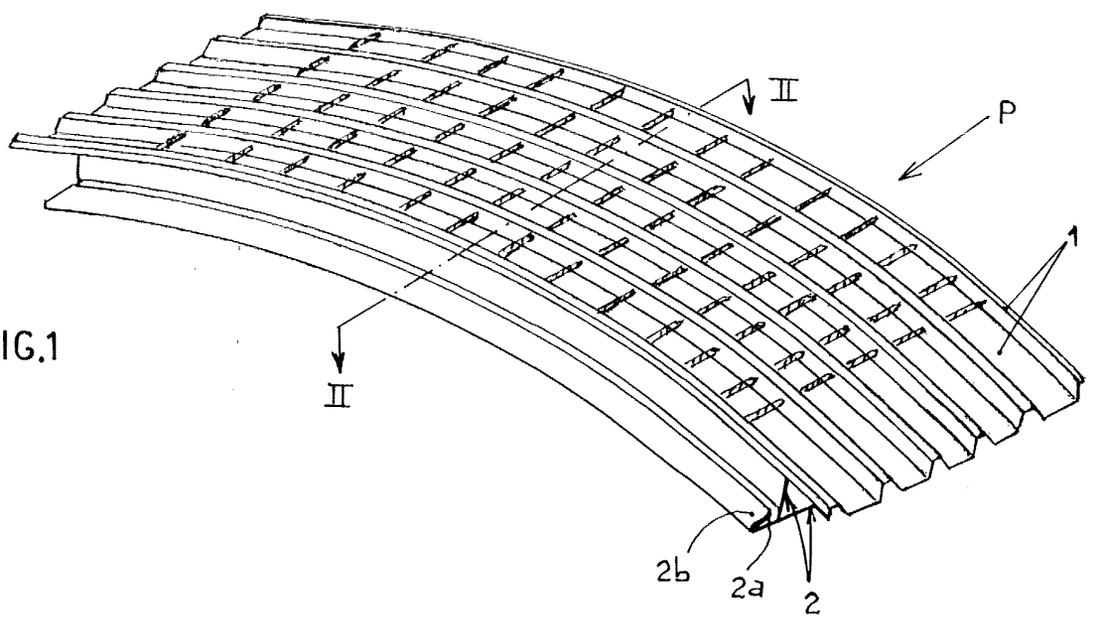


FIG.1

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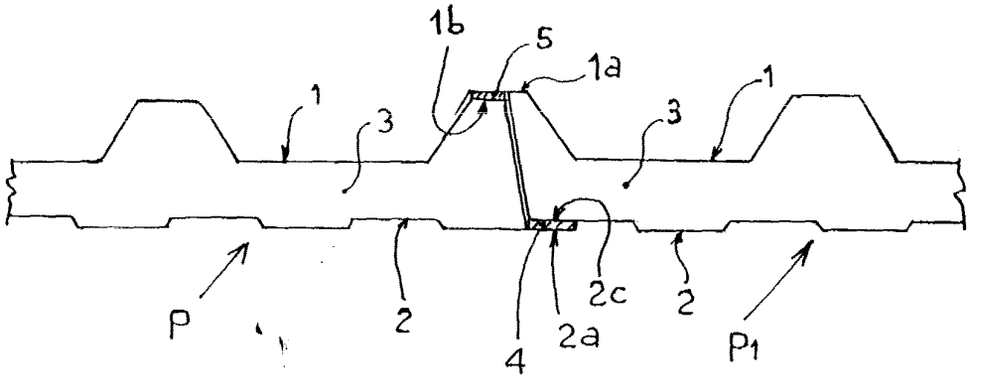


FIG.2

## 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 soundabsorption and sound-insulation acoustic capacity, such as to render the panel particularly useful for the roofing of industrial and civil buildings and the like. 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.

**[0002]** 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.

**[0003]** 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.

**[0004]** 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.

**[0005]** Object of the present invention is especially that of eliminating in a complete and lasting manner the drawback caused by the fissures that unavoidably create after the assembly of curved monolithic panels for roofing in general, eliminating the passage of air through said fissures through simple and safe means, imparting in this way to each panel a higher thermal insulation.

**[0006]** Another 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.

**[0007]** 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.

**[0008]** 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.

**[0009]** 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 a sheet from key-patterned external metal plate, a sheet from micro-staved internal metal plate substantially shaped as a small tank or tray, 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 tray-like lower 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 tray, with stiffening elements, substantially C-shaped rectilinear metal elements or the like, located 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.

**[0010]** 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 intrados 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.

**[0011]** 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.

**[0012]** 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.

**[0013]** 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 support panel, substantially a sheet from key-patterned plate, by 2 there is indicated the internal plate sheet either micro-staved or key-patterned according to a key- pattern different from that of the external 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 metal sheet 2.

**[0014]** 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 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.

**[0015]** 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 la 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).

**[0016]** 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.

**[0017]** 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.

**[0018]** Moreover, a like gasket may be inserted also between the two high key-patterns la and 1b, overlapping each other.

**[0019]** 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.

**[0020]** Lastly, always according to the present invention, 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.

**[0021]** 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.

**[0022]** 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.

**[0023]** 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 invention.

## Claims

1. A structure of an arched monolithic panel for the roofing of industrial and civil buildings and the like, of the type constituted of an external sheet from key-patterned plate, an internal sheet from key-patterned or micro-staved plate substantially tray-shaped and by a thermally insulating material interposed between said two plate sheets, characterized in that it comprises air-tight means 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 from elastically yielding matter 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 panels, preventing in this way the passage of air also between the overlapping 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-like sheet and the thermally insulating material, at least a layer or gasket from soundadsorbing 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 comprising also, in the inside of said panel, stiffening elements, substantially C-shaped rectilinear metal elements or the like, located at the opposite ends of the panel, in a direction transversal to the key-patterned lines, in order to ensure a suitable fastening to the bearing structure, to improve the mechanical resistance and the bearing capacity of the panel.

2. The panel structure according to claim 1, characterized in that it comprises, in combination with said gasket intended for air-tightness against the passage of air through said fissure, a further gasket from elastically yielding material, inserted between the intrados of the high part of the key-pattern of the upper sheet of a panel and the extrados of the high part of the key-pattern 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 is shaped like a gasket or a pad and is positioned close to or above the tray-shaped lower sheet, between the bottom of said tray 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 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 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 and the soundadsorbing and/or sound-insulating one.

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

7. The panel structure according to the preceding claims, characterized in that it is realized for the purposes and the utilization specified above, according to what has been described and illustrated.

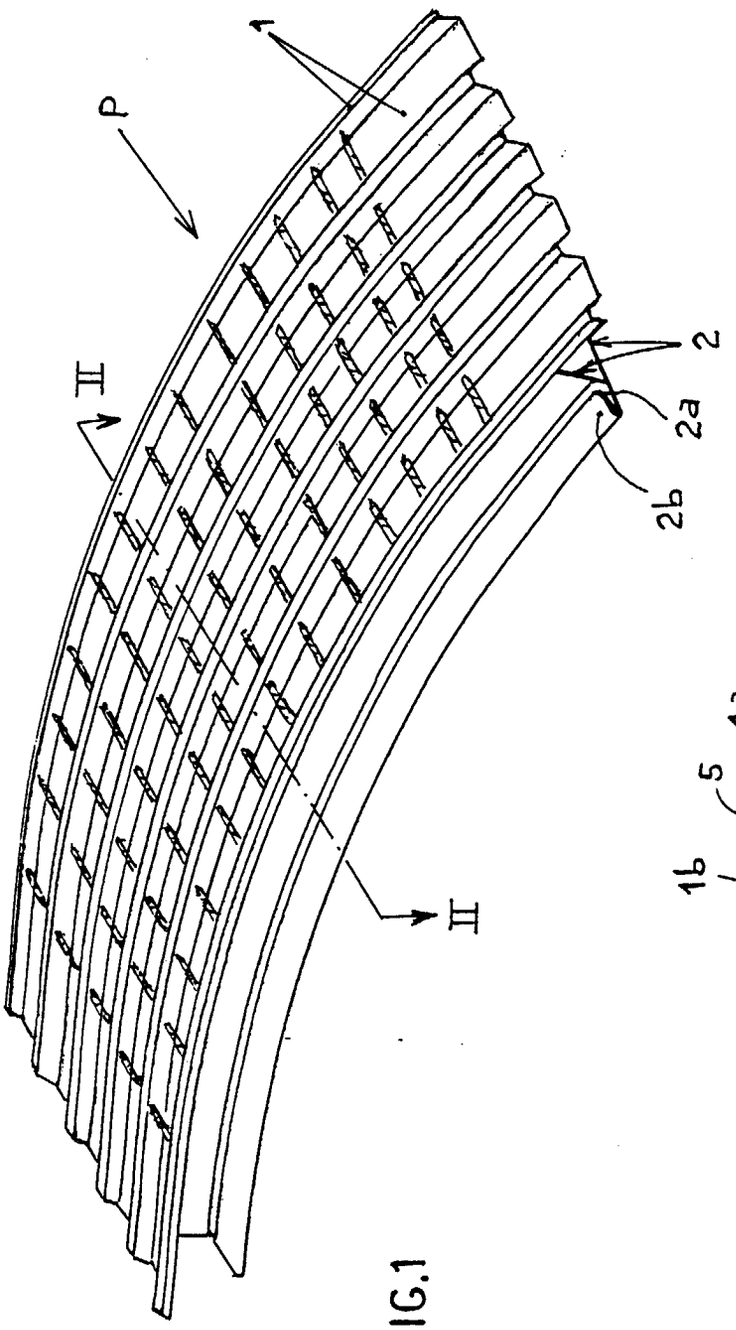


FIG.1

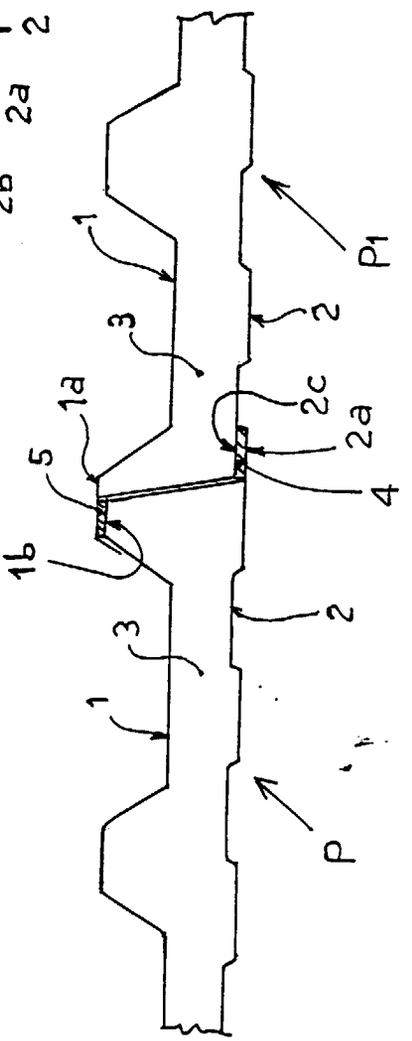


FIG.2

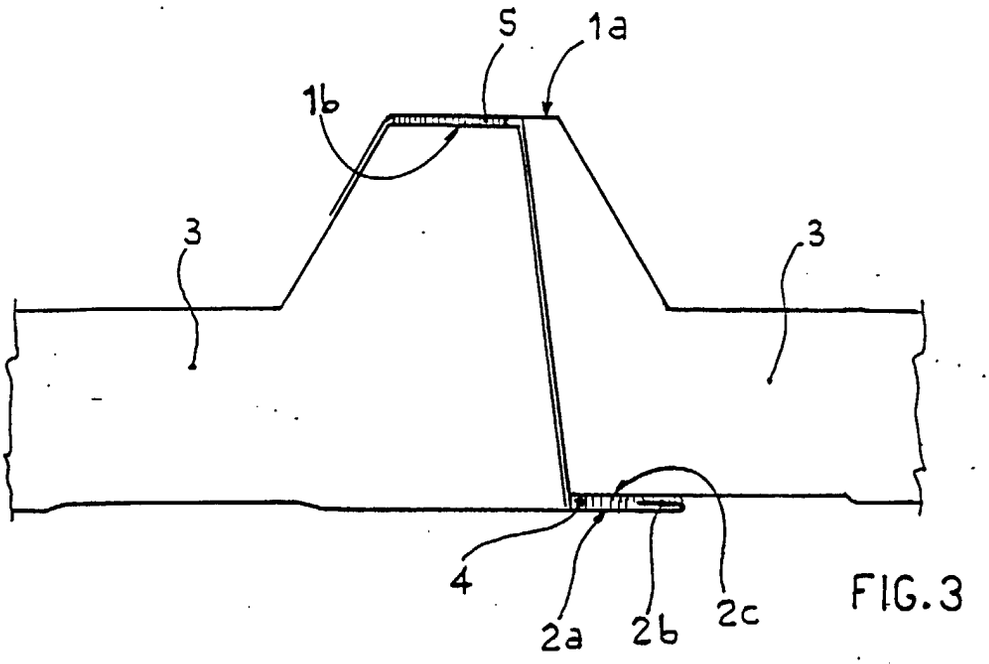


FIG.3

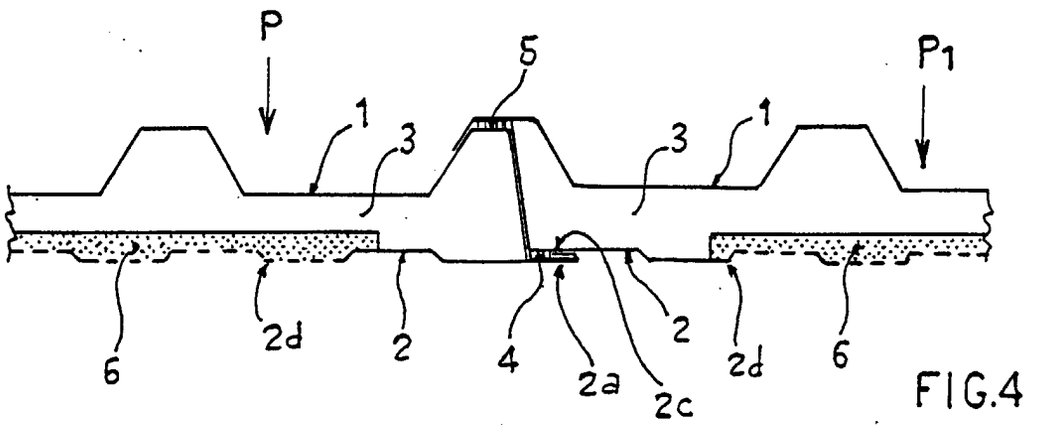


FIG.4

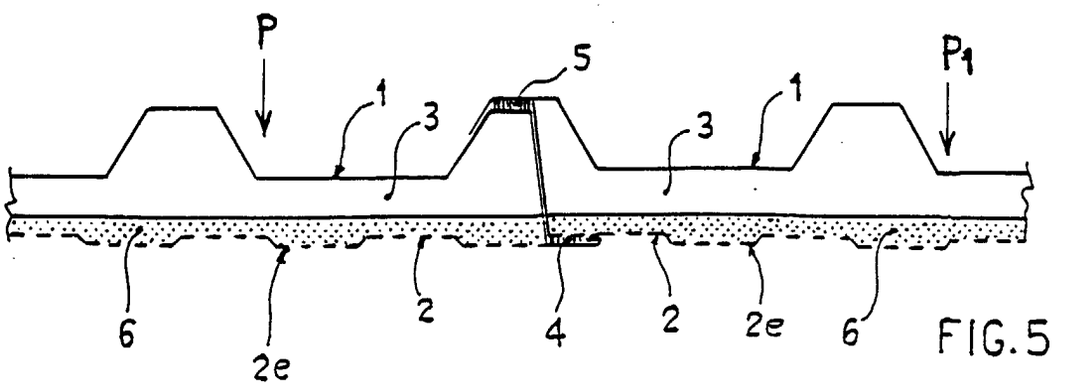


FIG.5

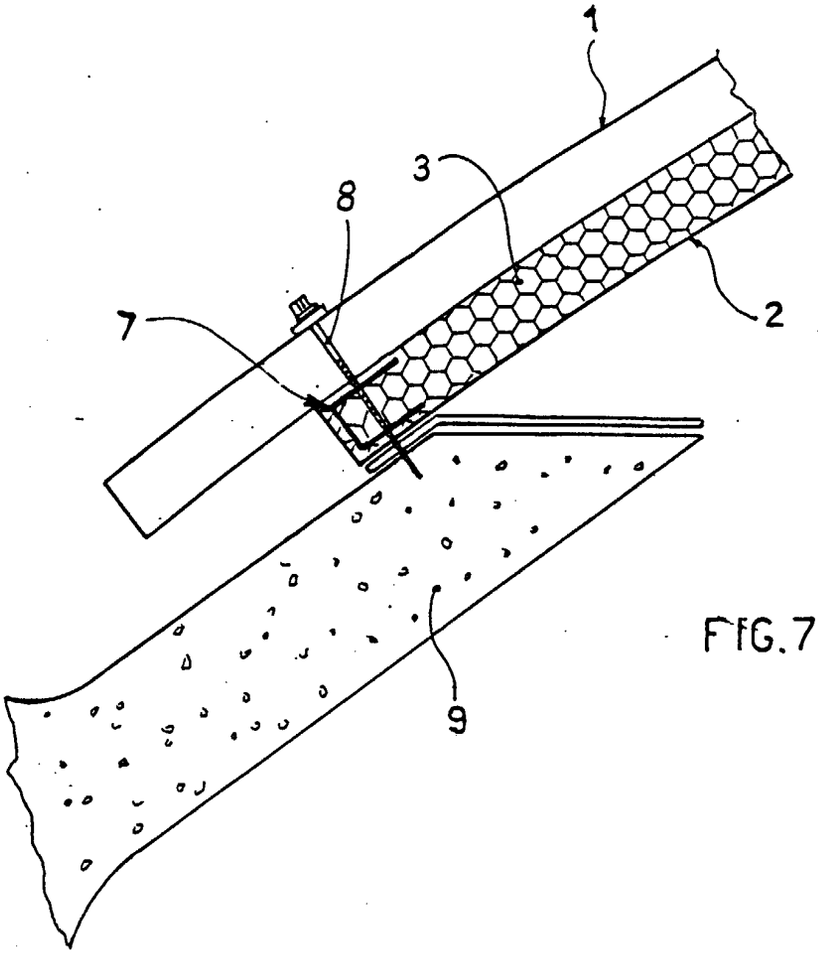


FIG.7

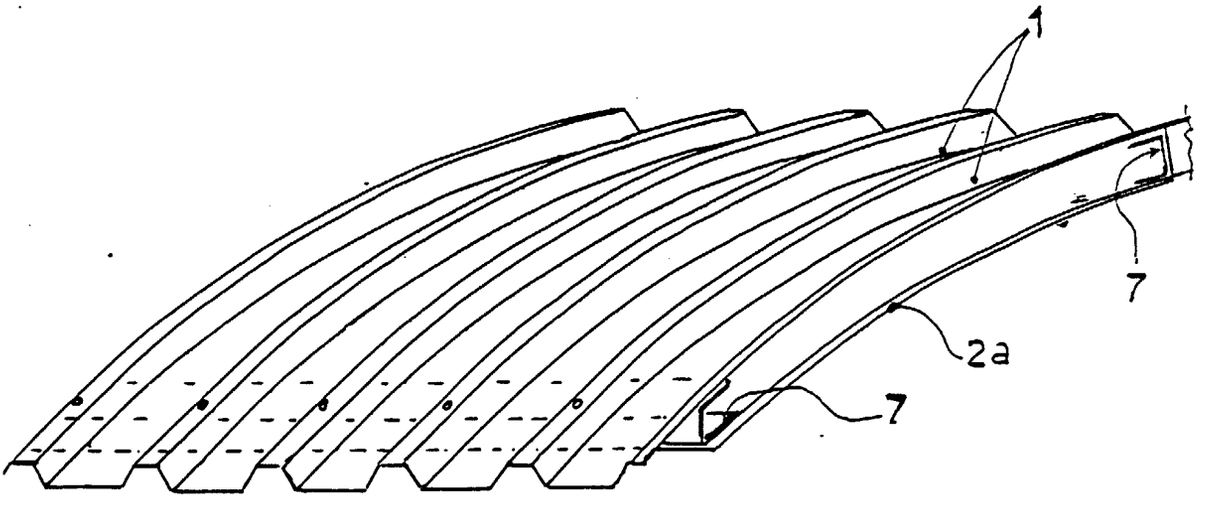


FIG.6

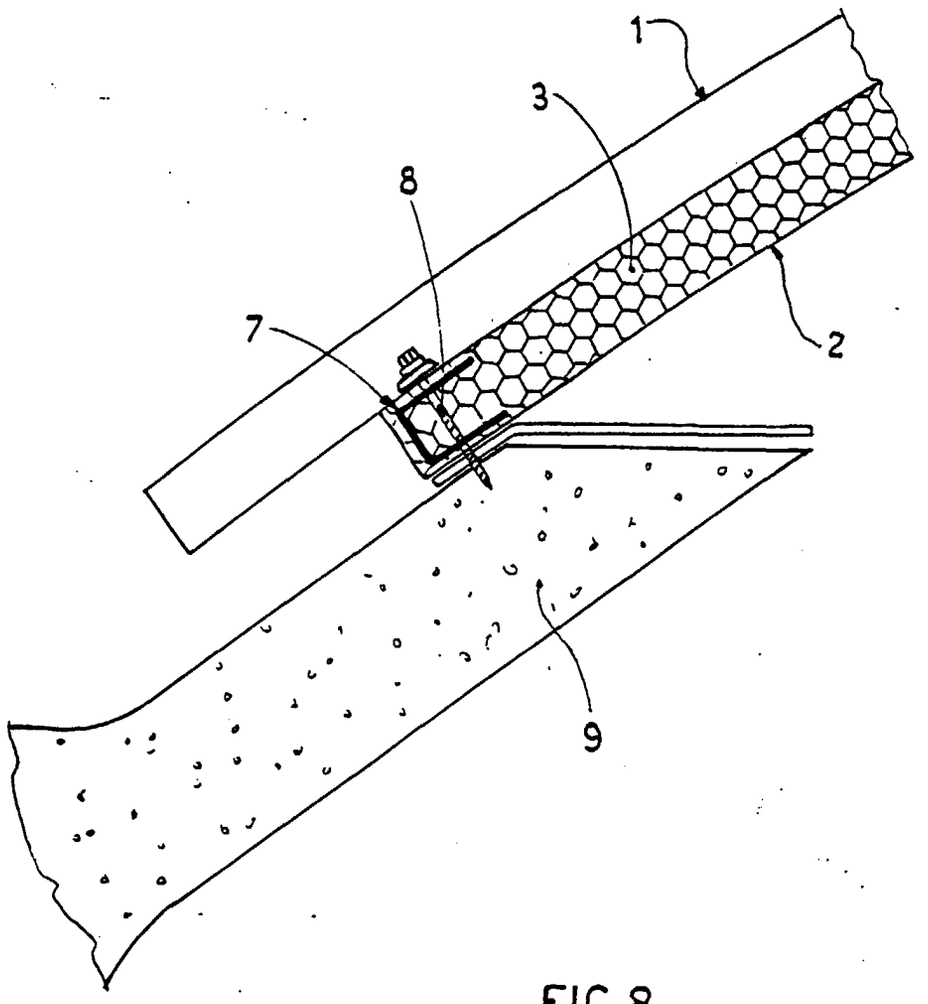


FIG.8