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(71) Applicant *(for all designated States except US)*: **METECNO SPA** [IT/IT]; Via per Cassino 19, I-20067 Tribiano (IT).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **MORANDI, Maurizio** [IT/IT]; Via Raffaello Lambruschini, 12, I-10143 Torino (IT).

(74) Agents: **FERRONI, Filippo** et al.; Dragotti & Associati S.r.l., Galleria San Babila, 4/C, I-20122 Milano (IT).

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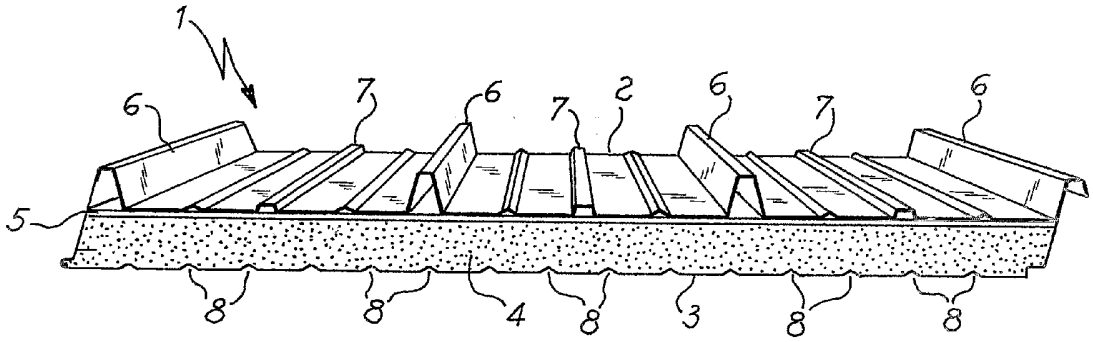
(54) Title: AERATED INSULATING PANEL AND PROCESS FOR MANUFACTURING THEREOF



(57) Abstract: The invention relates to an insulating panel (1) for building structures in general, in which a core (4) of expanded polymeric resin is arranged between two outer faces (2, 3). A sheet (5) of metal or plastic is applied onto one of the faces (2), thereby sealing the ribs (6, 7) projecting from the it; the ribs are internally hollow so that they serve as ventilation channels for the panel. Advantageously the panel thus configured is suitable for being manufactured easily, in a continuous manner.

WO 2004/090255 A1

"Ventilated insulating panel and process for manufacturing thereof"

According to a more general aspect, the invention relates to insulating panels used to construct walls, roofs and the like in civil, industrial or other kinds of building structures.

As is known, these panels have a composite or "sandwich" structure comprising an insulating core arranged between two walls which define the outer faces of the panel; the insulating material is generally a polyurethane foam or the like (but may also be mineral wool or some other insulating material), while the outer faces are in most cases made of sheet metal.

In order to increase the rigidity of the panels, the outer faces are profiled with ribs; these ribs may have numerous designs and for a more detailed description of one of them, reference can be made to the disclosure of European patent applications Nos. 682159 or 995594.

According to a more specific aspect, the present invention relates to insulating panels with ventilation channels.

Since a long time it has been known to manufacture for certain particular applications, insulating panels provided inside with channels in which air circulates by means of a convection effect; an example of these panels is described in British patent application published under No. 2,044,316.

In short this latter document describes a panel wherein a hollow space is defined between the trapezoidal ribs of the outer sides and the material of the insulating core: a circulation of hot air rising upward can be established inside this hollow space, thereby producing a ventilation system capable of removing moisture and/or heat.

Reference can be made, for example, to roofs built by assembling panels of this type in an inclined position, so that the heat due to the sun irradiation can be removed by means of convection, by air which rises up along the hollow spaces.

The abovementioned British prior document does not explain how the panel referred to can be produced on an industrial scale; however, since the material used for the insulating core is a rigid or semi-rigid foam of polyurethane, polyisocyanate or polystyrene, it may be inferred that manufacturing of the panel is performed by assembling the rigid or semi-rigid layer of foam with the two outer faces.

This requires to produce separately as semi-finished products the rigid or semi-rigid layers of insulating material, and then joining them to the outer faces using adhesives or other means along the production line.

It therefore follows that for this type of panel, it is not possible to perform the common continuous manufacturing process used for ordinary insulating panels, wherein two strips of sheet metal unrolled from respective reels are fed until they are brought into the horizontal condition, so that the polymeric resin can be applied between them, said resin then expanding to form the insulating foam.

Indeed it is obvious that in the case of this process, the foam expands and fills the whole space inside the ribs, thus preventing the formation of the ventilation hollow spaces.

The technical problem underlying the present invention is that of improving this state of the art: namely, the invention aims at providing a ventilated panel with an insulating core which includes a layer of polymer foam,

which may be manufactured continuously, in a manner similar to that which occurs for normal insulating panels.

This problem is solved by a panel whose characteristing features are set out in the claims appended to the present description.

The invention further comprises a process for manufacturing this panel, whose features are also stated in the claims.

The invention will result more clearly from the description provided hereinbelow with non-limiting intentions, of two insulating panels and of the method for manufacturing them, illustrated in the accompanying drawings wherein:

- Figs. 1 and 2 show respective panels according to the invention;

- Fig. 3 is a diagram of the plant for the continuous manufacturing of the panel according to Fig. 1;

- Fig. 4 is a detail of the plant in Fig. 3.

With reference to the first figure, numeral 1 denotes overall an insulating panel for roofs of buildings, manufactured in accordance with this invention.

Such panel comprises an upper face 2 and a bottom face 3 opposite each other and between which an insulating core 4 formed by polyurethane foam or other expanded resin is arranged; the upper face 2 forms the surface of the panel which is exposed externally when the roof is laid in place, while the bottom face 3 forms the surface directed towards the inside of the under-roofing.

Both faces of the panel are made of profiled sheet metal, the upper face being profiled in a more marked manner while the bottom face is only "micro-ribbed", namely is lightly ribbed to allow it to be bent as will be described more

fully below.

In accordance with the invention, a sheet 5 of aluminium or other equivalent material is applied onto the upper face 2 and adheres to its flat portions, sealing underneath the high ribs 6 with a trapezoidal shape projecting from the said face: these ribs are internally hollow and therefore form ventilation channels for the panel as explained farther above.

In this example secondary ribs 7, lower than the high ones and serving as air flow channels, are also present on the upper face 2 of the panel.

As mentioned farther above, the bottom face 3 is "micro-ribbed", i.e. it is provided with shallow grooves 8 which ensure that it remains plane during processing.

The panel 1 is manufactured in a continuous manner using the plant shown in Figure 3, which comprises two reels 10 and 11 from which respective metal strips 12 and 13 are unwound, the first strip being fed at a lower level than the second strip.

The strips 12 and 13 have the function of respectively forming the upper face 2 and the bottom face 3 of the panel 1, likewise it occurs in the production of conventional panels; the different numbering is intended to indicate the difference between the semi-finished product formed along the plant and the finished product with its components shown in Fig. 1.

The higher ribs, namely the ribs 6 and 7 of panel 1, are formed on the strip 12 which advances horizontally at a lower level.

This is due to the fact that, once the high ribs have been formed on the strip 12, the latter can no longer be bent so as to deviate its feeding path because it

is too rigid; the strip 13, on the other hand, being only lightly ribbed, may be bent along its path as can be seen in Fig. 3.

The strips 12, 13 therefore pass into respective profiling machines 14, 15 where the ribs 6, 7 are formed on the first strip, while the lightly ribbed grooves 8 are formed on the second strip.

Downstream of the profiling machine 14 there is a gluing station 16 inside which a foil 18 of aluminium is fixed onto the profiled strip 12; the sheet 5 of the finished panel shown in Fig. 1 is obtained from the foil 18, which for this purpose is unwound from a reel 19 and fixed to the strip 12 using a suitable adhesive.

It should be pointed out however, that the foil could consist of a material other than aluminium and also be of non-metallic nature, such as a plastic film or the like; it must also be mentioned that the foil or thin sheet may be fixed in a way other than gluing, for example in the case of a metal sheet it would be possible to use spot welding or continuous-seam welding.

The first strip 12 together with the foil 18 applied thereon and the second strip 13 which converges from above, enter then into a preheating oven 20 which carries out their heating in a manner known per se, so as to promote the reaction of the polyurethane resin applied afterwards with a device 21, also known in the art.

In this connection it must be observed that the resin is applied between the foil 18 and the strip 13 so that after the subsequent expansion, it provides to the semi-finished product the desired panel thickness.

The expansion step is performed in a continuous press 25 which is known per se and wherein the continuous semi-finished product formed by the strip 12

(together with the foil 18) and strip 13, with the resin applied therein, passes between two continuous surfaces 26, 27, arranged one below and the other above; these surfaces are formed by transverse elements 28 connected together in an articulated manner and having superficial reliefs 29 (in Fig. 4 only those of the upper surface are visible), which engage inside the grooves 8 (or the ribs 6, 7 of the strip 12).

Surfaces 30 similar to those seen above (but narrower) are also arranged along the sides of the semifinished product, to block laterally the expansion of the polyurethane resin; it just has to be added that in accordance with what is already known in the art, strip-like seals 32 are applied onto the sides of the semi-finished product.

At the outlet of the press 25, the continuous semi-finished product is cut by a shearing device 33, thereby obtaining panels 1 of the desired length.

From the foregoing description it is possible to understand how the panel 1 according to this invention solves the technical problem underlying the latter.

Indeed the sheet 5 applied onto the upper face 2 performs a dual function: the first one is that of sealing the ribs 6 and 7, thereby defining the air flow channels inside the panel, whereas the second one is that of forming a partition which prevents the resin from expanding inside the ribs.

It is obvious that if the sheet 5 were not present, the foam would spread into the ribs and therefore the ventilation channels would no longer exist.

The present invention allows therefore to manufacture insulating panels carrying out the steps of applying the resin and subsequent expansion thereof directly between its profiled faces 2 and 3, instead of having to assemble the latter

with a rigid or semi-rigid core of expanded resin formed separately beforehand, as it occurs in the prior art considered.

In this way the manufacturing time may be reduced, in particular if the panel so configured is manufactured continuously as explained above.

In this connection it must be emphasised that the panel 1 is suitable for being produced also with pre-existing plants, since the operating cycle described above does not require particular modifications to the production lines used for conventional panels: basically it is only a matter of adding the station 16 for applying of the foil 18.

Obviously variations of the invention with respect to what explained heretofore are possible.

It has already been explained how the sheet 5 applied onto the upper face 2 of the panel may be made of various materials; it must be stressed, however, that this sheet could also be advantageously formed by a layer of mineral wool, as shown in Figure 2.

The latter figure, in which the same numbering as in Figure 1 has been retained, shows a panel 1 on the upper face 2 thereof a layer 50 of mineral wool of suitable thickness is applied, so as to limit the expansion of the polyurethane resin 4.

The panel thus obtained has the same ventilation properties and the same advantages as the preceding panel, with an improved fire resistance in view of the presence of the mineral wool.

This panel may also be manufactured in a similar manner to that already explained, using mineral wool wound on reels or fed continuously.

The fire-prevention properties of such a panel could also be improved by applying onto the upper face 2 a sheet of aluminium, as referred to above; in this way a panel having characteristics formed by a combination of those of the individual panels shown in Figs. 1 and 2, would be obtained.

By way of a further possible modification, it is worth to mention the fact that in order to seal the ribs 7 of the panel, alternatively to the single element consisting of the sheet 5 or the layer of mineral wool 50 applied onto the face 2, a plurality of adhesive strips attached opposite said ribs could be used.

A panel so constructed would be equivalent to those of the examples previously seen and would only require a minor modification to the gluing station 16 of the plant illustrated in Fig. 3, in order to be manufactured continuously.

It is also evident that panels having ventilation ribs on both faces may be made; in these cases the latter will be provided with respective metal, plastic or other sheets, or with layers of mineral wool, in accordance with what explained above.

All of these variants nevertheless fall within the scope of the claims which follow.

CLAIMS

1. Insulating panel comprising a first and a second face (2, 3) arranged opposite each other, wherein at least one of them is provided with ribs (6, 7) projecting outwards the panel, an insulating core arranged between said faces which includes an expanded polymeric resin (4), characterized in that it comprises a layer of sheet-like material (5, 50) applied in connection with the ribs so as to separate them from the expanded resin, and in that these ribs are internally hollow thereby allowing the circulation of air inside them.

2. Panel according to Claim 1, wherein said layer of sheet-like material is a sheet (5) of metal or plastic material, juxtaposed to the face (2) with the ribs (6, 7).

3. Panel according to Claim 2, wherein the sheet (5) is fixed onto the face (2) with the ribs (6, 7).

4. Panel according to Claim 3, wherein the sheet (5) is fixed to the face (2) with the ribs (6, 7) by means of welding or gluing.

5. Panel according to Claim 4, wherein the sheet (5) is made of aluminium and a layer of mineral wool is present between it and the expanded resin (4).

6. Panel according to Claim 1, wherein the layer of sheet-like material (50) juxtaposed to the face (2) with the ribs (6, 7), is made of mineral wool.

7. Panel according to Claim 6, wherein the layer (50) of mineral wool is fixed onto the face (2) with the ribs (6, 7).

8. Panel according to Claim 7, wherein the layer (50) of mineral wool

is fixed by means of gluing.

9. Panel according to Claim 1, wherein the layer of sheet-like material comprises a plurality of adhesive strips applied in connection with the ribs (6, 7).

10. Panel according to the preceding claims, wherein at least the face (2) with the ribs (6, 7) is made of sheet metal.

11. Process for the continuous manufacturing of a panel according to Claims 1 to 5, comprising the steps of:

- feeding a first and a second metal strip (12, 13) one above the other along a predefined direction;

- longitudinally profiling at least one of the strips with ribs (6, 7) projecting from its outer side with respect to the other strip;

- applying a foil (18) onto the profiled strip (12) with the projecting ribs (18);

- applying a layer of expandable polymeric resin (4) onto the foil (18);

- causing both strips (12, 13) and the foil (18) with the polymeric resin applied thereon to converge inside a continuous press (25), until the thickness of the panels to be produced is achieved;

- transversely cutting the continuous semi-finished product formed at the outlet of the continuous press, thereby obtaining panels of a predefined length.

12. Process according to Claim 11, wherein the foil (18) is glued or welded onto the strip (12) profiled with the projecting ribs (6, 7).

13. Process according to Claims 11 and 12, wherein the foil (18) is obtained from a strip of metallic or plastic material.

14. Process according to the preceding claims, wherein the foil (18) lines substantially the strip (12) profiled with projecting ribs (6, 7).

15. Process according to Claims 11 to 13, wherein the foil comprises a plurality of adhesive strips attached in connection with the ribs.

16. Process according to the preceding claims, comprising a further step of applying a layer of mineral wool onto the foil (18).

17. Process for the continuous manufacturing of a panel according to Claims 6 to 8, comprising the steps of:

- feeding a first and a second metal strip (12, 13) one above the other along a predefined direction;

- longitudinally profiling at least one of the strips with ribs (6, 7) projecting from its outer side with respect to the other strip;

- applying a layer (50) of mineral wool onto the profiled strip (12) with the projecting ribs;

- applying an expandable polymeric resin (4) onto the layer of mineral wool (50);

- causing the strips (12, 13) with the layer of wool (50) and the polymeric resin applied thereon to converge inside a continuous press (25), until the thickness of the panels to be produced is achieved;

- transversely cutting the continuous semi-finished product formed at the outlet of the continuous press, thereby obtaining panels of a predefined length.

Fig.1

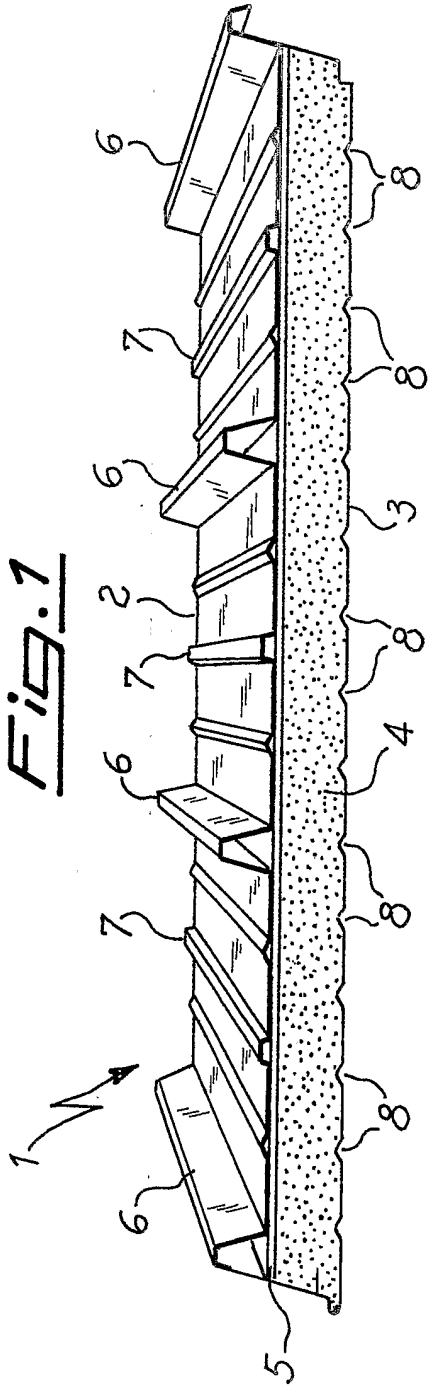


Fig.2

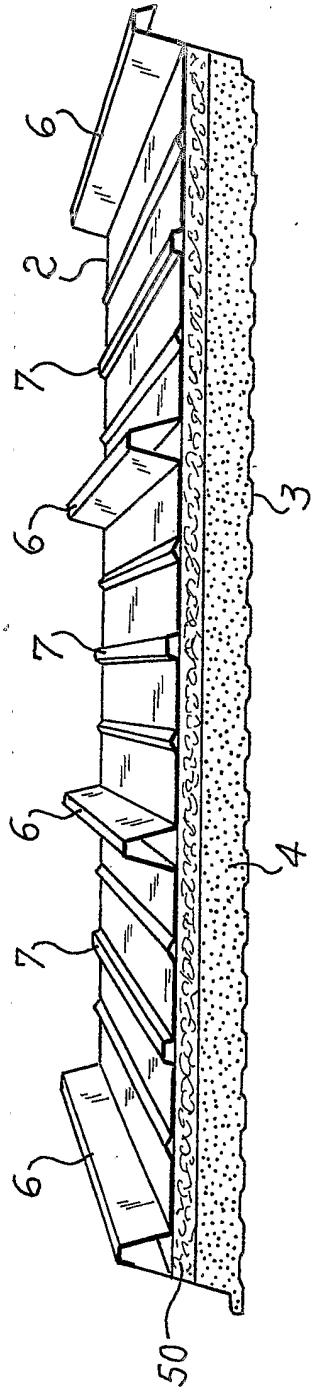
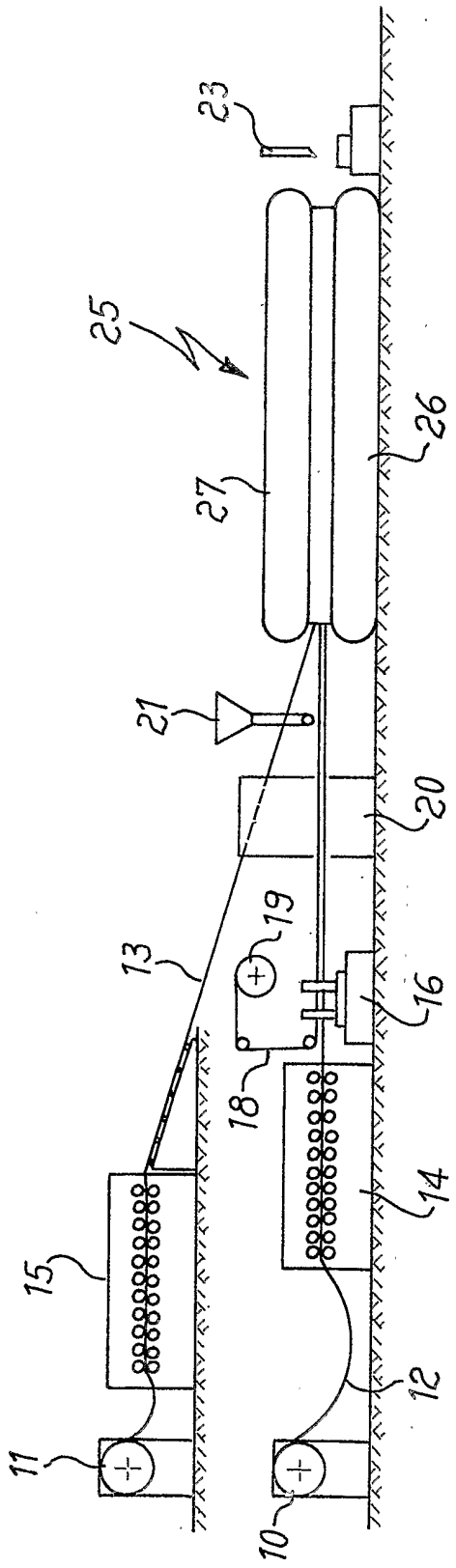


Fig. 3



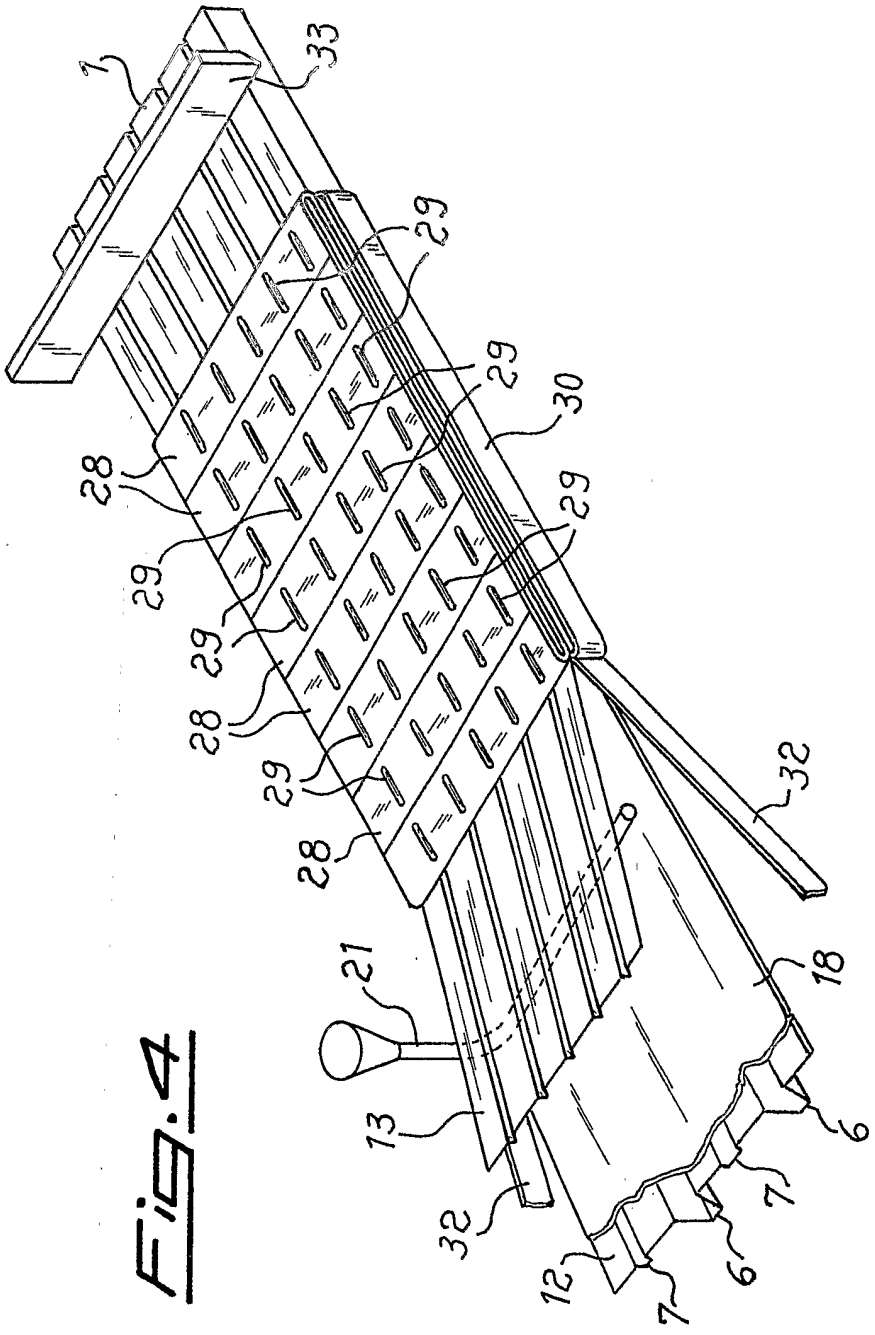


Fig.4

INTERNATIONAL SEARCH REPORT

Internatio[redacted]Application No
PCT/IT 03/00210

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E04D3/35

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E04D E04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	DE 19 13 409 A (V.D.HEIDE) 24 September 1970 (1970-09-24) page 4, paragraph 1 -page 6, paragraph 3; figures	1-10

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents:

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Date of the actual completion of the international search	Date of mailing of the international search report
25 November 2003	02/12/2003
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Authorized officer Righetti, R

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INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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