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Panel Aislante con Caras de perfolado

proprio, proceso y aparato para la fabricación de
dicho panel

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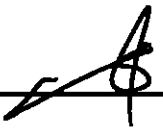
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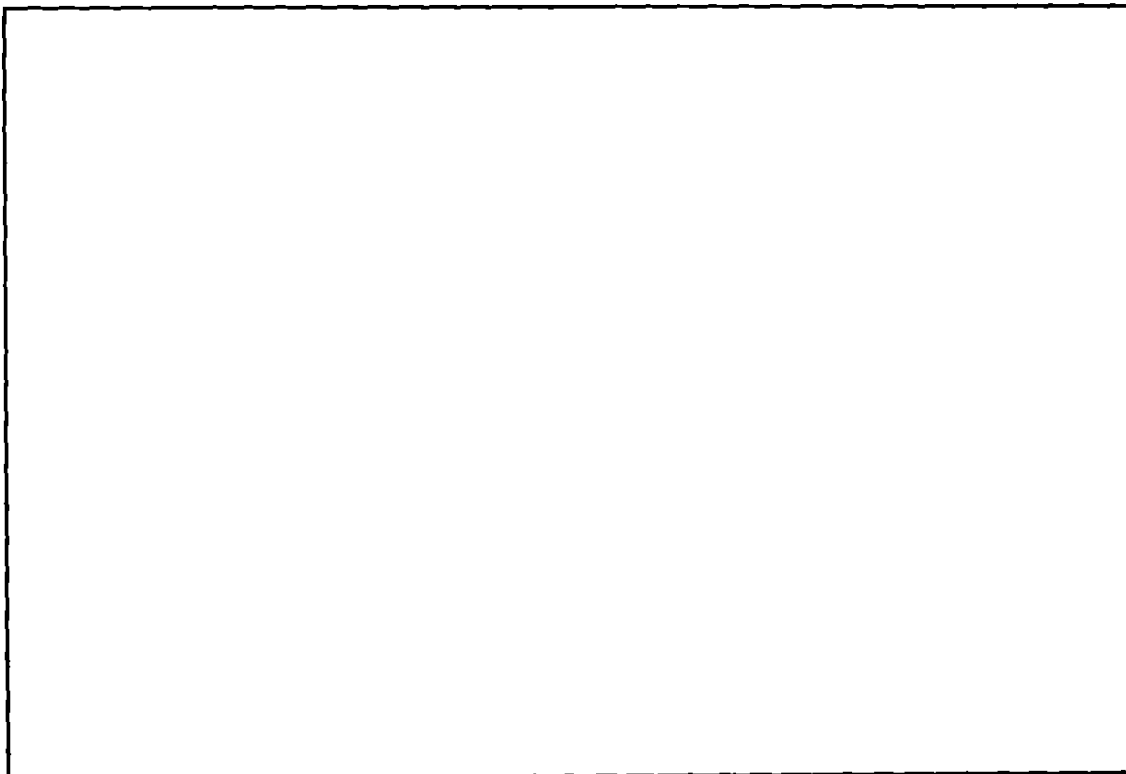
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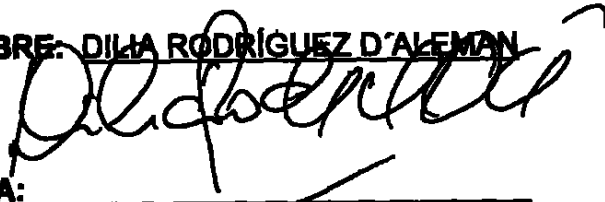
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- ☒ Comprobante de pago de la tasa de presentación de la solicitud
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- ☐ Poderes, si fuera el caso
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- ☐ Declaraciones
- ☒ Copia de la solicitud Internacional. (Resumen, descripción, reivindicación, Dibujos).
- ☒ Traducción de la solicitud internacional al castellano. (Resumen, descripción, reivindicación, Dibujos)
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- ☐ De ser el caso, información sobre otras solicitudes de patente o títulos obtenidos en el extranjero por el mismo titular o su causante, relacionados parcial o totalmente con la invención de esta solicitud.
- ☒ Otros
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11) FIGURA CARACTERÍSTICA:



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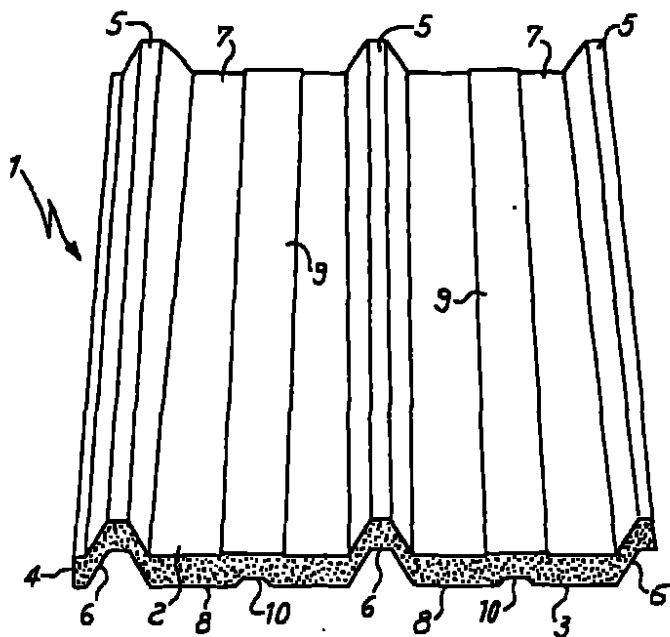
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(54) Title: INSULATING PANEL WITH DEEPLY PROFILED FACES, PROCESS AND APPARATUS FOR MANUFACTURING THEREOF



(57) Abstract: The invention relates to a novel insulating panel with composite structure manufactured continuously, which has both its outer faces (2, 3) deeply profiled. This panel is very much stronger, conditions being equal, than conventional panels in which only one of the outer faces is deeply profiled. The invention also includes a method for the continuous manufacturing of the panel and an apparatus for carrying out this method.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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**"Insulating panel with deeply profiled faces, process and apparatus for
manufacturing thereof"**

The invention relates to insulating panels of the type commonly used for
the construction of walls, doors, roofs and the like, of civil, industrial or other
5 kinds of buildings.

As is known, these panels have a composite structure, also called
"sandwich" structure, in which there is at least one insulating layer interposed
between two outer walls forming the faces at sight of the panel; the insulating
material is usually a foam made of polyurethane or the like (but could also be a
10 rock wool or other insulating material), while the faces are in most cases sheet
metal.

The latter is profiled with ribs in order to increase the rigidity of the
panels; many design are the possible for these ribs and for further details about
some of them as well as their manufacturing methods, reference may be made to
15 the disclosure of European patent applications No. 682159, 995594 or
International application PCT/EP95/03865.

In short, the panels described in these documents are continuously
manufactured using special apparatuses starting from two strips of sheet metal
which are unwound from respective coils: the two strips are fed along respective
20 converging paths until they are brought into the parallel horizontal condition
where the insulating material, be it polyurethane foam, rock wool or other, is
applied between them.

The semifinished product thus obtained is then cut transversely so that, at
the end of the apparatus, panels of predefined dimensions are obtained; the panels
25 may then be completed, if required, off line with finishing operations.

The profiling of the surfaces of the panels, however, constitutes a major limitation in current state of the art.

Indeed, the metal sheets having ribs deeper than 3 mm, generally have a rigidity such that it is practically impossible to bend them in the longitudinal (axial) direction; as a consequence the known panels, in fact, have only one face deeply ribbed because otherwise it would not be possible to produce them continuously as explained above.

It should be observed that in the known apparatuses, the deeply profiled strip advances in horizontal direction so as not to have to require changes in inclination during processing, while the other strip moves above it and is flat or slightly profiled with longitudinal ribs smaller than 3 mm, thereby resulting flexible enough to be bent a few degrees and to converge towards the bottom strip.

In this context it must be pointed out that, in the present description and in the appended claims, light profiling (or fretting) of the faces of a panel is understood as any type of rib or groove having a height such that the resultant flexural rigidity is negligible compared to that of the whole panel.

This rigidity will obviously also depend on the thickness of the sheet metal and on the characteristics of the metallic material (steel, aluminium, copper, etc.) used; however, from a general point of view it may be stated in accordance with the European standards on composite panels (ECCS), that light profiling should be regarded as the one obtained with ribs having a height (or depth, whichever applies) less than 3 mm.

On the other hand, deep profiling according to the ECCS standards should be regarded as the one formed by ribs having a height greater than 3 mm and, in

accordance with the Applicant's experience, preferably a height greater than 10 mm; the variability of these values depends furthermore on factors such as the thickness and type of metallic material used for the panel faces.

5 The fact that known panels have only one deeply profiled face for the reasons explained above, implies that in order to obtain a high structural strength it is necessary to produce panels which are thick and/or using sheet metal of considerable thickness, thereby resulting inevitably heavy.

10 In other words, the panels currently manufactured with continuous processes have limited structural strength properties compared to their weight: an improvement in their strength would therefore be desirable since, conditions being equal, an advantageous reduction in the materials used to produce them, and therefore lower costs, would be obtained among the other things.

15 The present invention aims therefore to improve this state of the art: namely, its object is that of providing an insulating panel to be produced continuously, having structural strength properties better than those of the currently known panels with only one profiled surface.

This object is achieved by a panel, whose features are stated in the claims which will follow.

20 The invention also comprises a method for producing the aforementioned panel and an apparatus for carrying out this method, whose features are also set out in the following claims.

In order to better understand the invention as a whole, a preferred but non-limiting embodiment thereof is described below, with reference to the accompanying drawings wherein:

25 - Fig. 1 shows a perspective view of a panel according to the invention;

- Fig. 2 shows schematically an apparatus for the continuous production of panels according to the invention;

- Fig. 3 shows in detail of a particular feature of the apparatus according to Fig. 2;

5 - Fig. 4 is a cross-section along the line IV-IV in Fig. 3;

- Fig. 5 illustrates the stacking of panels according to the invention;

- Fig. 6 shows another example of apparatus for the continuous production of panels according to the invention.

10 With reference to these figures, in the first of them numeral 1 denotes overall an insulating panel according to the invention.

As can be seen, this panel comprises two outer faces 2 and 3 at sight, between which an insulating layer 4 is present made in this case from polyurethane foam.

15 The outer faces 2 and 3 are both reinforced with deep profiling as explained further above, in the form of a series of respective longitudinal ribs 5, 6 with a trapezoidal profile, which extend in relief with respect to the intermediate portions 7 and 8; the latter are profiled slightly with low ribs 9 and 10, different between one side and the other of the panel.

20 Obviously the profile of the faces 2 and 3 may differ from that shown in the drawings, depending on the widely varying shapes of the ribs 5 and 6; what should be herein considered is the fact that both faces have deep profiling, greater than 10 mm, thereby providing the panel with high flexural rigidity even in the case of limited thickness of the insulating layer 4.

25 This important result is achieved by manufacturing the panel 1 continuously with the apparatus 21 which can be seen in Figure 2, starting from

two coils 22 and 23 of flat metallic strip material.

As can be seen, in this apparatus the upper coil 22 strip and the lower coil 23 strip are unrolled in a manner known per se and are then formed in respective profiling machines 24 and 25 arranged in succession; the latter have the function of profiling the strips so as to obtain the profile at sight of the faces 2 and 3 of the finished panels.

In particular, the strips which advance horizontally at different heights downstream of the profiling machines 24 and 25 are indicated by 2' and 3' respectively in Figure 2, according to what has been seen in connection with the panel of Fig. 1; this is done for the sake of simplicity of the description since, obviously, the outer faces of the panels may also be formed from the metal strips arranged in an inverted manner with respect to that of Fig. 2.

The profiling machine 24 is shown in detail in Fig. 3; it has a series of intermediate stages $S_1, S_2, S_3 \dots S_n$, in each of which a pair of shaped opposing rolls 25 and 26 of a type known per se is located.

These rolls are shaped in accordance with the profile to be formed in the strip 2' which passes through the profiling machine 24, and are mounted on corresponding frame supports $T_1-T'_1, T_2-T'_2, T_3-T'_3, \dots T_n-T'_n$, arranged at their ends.

The rolls 25 and 26 are operated by respective spindles 27 and 28, which are connected in turn to actuating motors not shown in the drawings; the heightwise position of the rolls may be adjusted by means of adjusting screws 29, 30, 31, 32 arranged in the frames of each stage, which act on the bearings 33, 34, 35 and 36 of the rolls.

The purpose of this adjustment facility, in addition to ensuring the normal

operating functions of the profiling machine 24 as already occurs in conventional machines, is to facilitate the passing movement of the lower strip 3' supplied by the first profiling machine 25.

Indeed, as can be seen, the already profiled strip 3' advances inside the
5 profiling machine 24 at a lower level than the roll 26, i.e. the bottom drum, of each stage S_1-S_n ; for this purpose the strip 3' is supported inside the profiling machine 24 by a series of idle rollers 38 which are located in a plane located underneath that of the rolls 26.

In accordance with this example of the invention, the profiling stages S_1-S_n
10 are fixed on base structures 40 formed with longitudinal members 41 joined by reinforcing cross-pieces 42; these structures are modular and rest on a main base 44 of the profiling machine 24, so that they can be removed for the operations of maintenance or replacement of the profiling equipment.

The second profiling machine 25 which is located upstream of that
15 considered above is similar to the latter, except that it does not have idle rollers arranged underneath the profiling stages; these rollers are in fact superfluous since the profiling machine does not have to be passed through longitudinally by another metal sheet, like the other machine.

For the sake of brevity, therefore, a specific description of the profiling
20 machine 25 is omitted and for further details reference should be made to what has already been stated above. It must be pointed, however, that since the profiling machine 25 is intended for working the lower strip 3, the passage line of the latter (the so-called "pass-line") defined by the nip between the shaped rolls is located at a lower level than the pass-line of the first profiling machine 24.

25 Consequently the positioning height of the shaped rolls of the second

profiling machine 25 in the respective support frames, will be different from that of the rolls shown in Figure 3; what is important, however, is that inside the apparatus 21, the upper and lower strips 2' and 3' advance horizontally parallel to each other towards the zone for application of the insulating material.

5 Nozzles 50, 51 operate in this zone, spraying onto one or both strips 2', 3' the polymer substances which are usually used to form the insulating layer 4 of the panels; downstream the nozzles a continuous belt press 55 known per se is located.

At the end of the apparatus, finally, there is a cutting station 60 where the
10 semifinished product continuously obtained, is cut transversely into pieces of the desired length, thus forming the panels 1; it must be pointed out, however, that the latter may undergo other processing operations off line, which are not considered in this example.

From what has been stated hitherto it is possible to understand operation of
15 the apparatus 21 and how it allows continuous manufacturing of panels according to the invention.

Indeed, by arranging the profiling machines 24 and 25 one downstream the other, it becomes possible to perform deep profiling of the flat metal strips supplied by the reels 22 and 23, keeping them in a position close to each other
20 which is later useful for injection of the insulating foam and, more generally, for any subsequent operation envisaged in the production cycle.

In other words, with this arrangement of the profiling machines, the strips 2' and 3' are not subject to significant incline variations along their travel path after they have been profiled: in this way it is thus avoided flexing them at angles
25 which would be incompatible with their deep profiling. It should be noted,

however, that the strip sections downstream of the coils 22, 23 do not raise these difficulties because they are flat.

In the apparatus thus configured it is therefore possible to introduce the two strips 2' and 3' in a substantially parallel condition into the continuous press
5 55.

Indeed, since the strips are profiled along respective levels located close to each other, downstream of the profiling machines 24 and 25 they may be conveyed towards the press 55 with a negligible inclination relative to the horizontal, actually less than 1-2°.

10 In practice this inclination is determined by the deformation camber of the strips 2' and 3' before entering the continuous press.

On the basis of this teaching it is not difficult to understand that it is possible to manufacture panels with any type of deep profiling on both faces at sight, whose example shown in Figure 1 represents only one of the possible
15 embodiments.

These panels achieve the object of the invention set forth initially.

It is indeed obvious that the double deep profiling increases substantially the structural properties of the panels, all other conditions being equal, without increasing substantially the weight (incidence of steel and insulating material per
20 square metre of panel); the outcome of this is therefore that the limitations of the known panels referred to above are completely overcome by the invention.

The latter also includes the method for the continuous production of the panels.

As explained farther before, the conventional apparatus are not suitable for
25 deeply profiling both faces of the panels because the spaced arrangement of the

profiling machines, such as for example that shown in European patent application No. 995594, involves necessarily bending angles of the upper strip in order to guide it towards the lower strip, which are incompatible with deep profiling.

5 With the manufacturing method according to the present invention it is possible to overcome this technological limitation.

 Indeed, the profiling of the strips now occurs along respective levels which are at distance substantially equal to the final thickness of the panels: it follows, therefore, that downstream of the profiling machines the upper strip does not have
10 to undergo significant deviations which may require longitudinal bending thereof about an axis transverse to the direction of feeding, which would be incompatible with deep profiling thereof.

 In particular, in apparatus 21 this result is achieved by arranging the profiling machines 24, 25 one after another and keeping the strips at a close
15 distance such that, downstream of the profiling machines, they may be conveyed towards the continuous press in a substantially parallel condition relative to each other.

 In practice, after the profiling machine 24, the strips 2' and 3' converge with an inclination which is preferably less than, or equal to, 1° until they reach a
20 distance between them, corresponding to the final thickness of the panel.

 Of course, variations of the invention with respect to the foregoing embodiment are possible.

 Reference has already been made to the possibility of varying, as required, the profile of the surfaces 2 and 3 depending on the type of ribs which are to be
25 formed thereon.

In this context, however, it should be emphasised that the trapezoidal profile of the ribs of the panel shown in Fig. 1, wherein the male ribs 5 have a tapered profile which can be combined with that of the female ribs 6 of a panel arranged on top (and vice versa), has the advantage of allowing stacking of the panels keeping to the minimum the empty spaces, as shown in Figure 5.

It should be noted that this advantage assumes particular importance in connection with the industrial transportation of panels where the maximum volume, instead of the maximum weight, transported is always a determining factor.

10 The known panels which have only one surface or side with deep profiling, while the other side is substantially flat, are usually transported turned over with respect to each other with the sides where ribs are formed being arranged facing one another.

Such a solution results in a considerable amount of empty spaces between the panels thereby, negatively affecting the transportation costs, since for a given loading volume, the number of panels which can be transported is inevitably limited by the empty spaces present between them.

On the other hand, panels with deep profiling on both sides in accordance with the invention may be stacked by combining the respective profiles, so as to reduce significantly the empty spaces for transportation.

20 It can be understood, however, that this effect may be obtained with ribs having a profile different from the trapezoidal profile of the example shown, since it is necessary only that their shape be of the male/female type which can be geometrically combined as explained above.

25 By way of a further possible variant of the invention it has also be

mentioned that the insulating layer must not necessarily consist of polyurethane foam, but might also be formed with any other suitable material such as, for example, rock wool, glass and the like.

It must however be remembered that for such an alternative, it is preferable to modify the panel production apparatus with respect to that shown in Fig. 2, because the application of the rock wool may be better performed between one profiling machine and the other, i.e. before the upper strip 2' is brought to a distance substantially equal to the final thickness of the panels, relative to the lower strip 3'.

For application of the rock wool it is nevertheless possible to use the normal systems known for this purpose, arranging the corresponding machinery between the two profiling machines 24, 25 which for this reason must therefore be located at a suitable distance.

It can moreover be understood that the presence of the insulating-wool application means between the two profiling machines is not incompatible with the polyurethane-foam injection means, since it would allow the formation of an apparatus of the dual-purpose type, i.e. capable of producing both foam-filled panels and wool-filled panels.

In this connection it must also be pointed that profiling of the strips could be performed in an inverse manner with respect to that described for the apparatus of Fig. 2, namely by processing first the upper strip and thereafter the lower strip, with the position of the profiling machines 24 and 25 being interchanged.

An example of this situation is shown in Fig. 6 where, for the sake of simplicity, numbering of the preceding embodiment has been maintained.

It just has to be pointed out that in this apparatus the upstream profiling

machine 24 which processes the upper strip 2', will no longer have idle rollers 38 for supporting the lower strip while on the other hand, the profiling machine 25 will be provided with such rollers which obviously will be positioned above the shaped rolls which profile the lower strip 3'.

5 All these variants nevertheless fall within the scope of the following claims.

CLAIMS

1. Composite panel comprising at least one insulating layer (4) interposed between two outer faces (2, 3), characterized in that both faces are formed by deeply profiled metal sheets.

5 2. Panel according to Claim 1, wherein the depth of the profiling of the outer faces (2, 3) is greater than 3 mm.

3. Panel according to Claim 2, wherein the depth of the profiling of the outer faces (2, 3) is greater than 10 mm.

10 4. Panel according to Claims 1 to 3, wherein said at least one insulating layer (4) is made of materials comprising: polymer foam or rock wool.

5. Panel according to any one of the preceding claims, wherein the outer faces (2, 3) are profiled with male ribs (5) and/or female ribs (6), fitting the conjugate ribs of similar panels in the stacked condition.

15 6. Panel according to Claim 5, wherein said male ribs (5) and female ribs (6) have a trapezoidal profile.

7. Method for the continuous manufacturing of panels according to any of Claims 1 to 6, comprising the following steps in combination:

- feeding longitudinally an upper metal strip (22, 2') and a lower metal strip (23, 3');

20 - profiling said strips in the longitudinal direction;

- applying an insulating layer (4) between the strips;

- compressing, in a continuous press (55), the semifinished product formed by the strips and by the insulating layer arranged therebetween, until the thickness of the panels to be produced is reached;

25 - transversely cutting said semifinished product in order to obtain panels of

predefined length;

characterized in that profiling of the upper strip (2') and lower strip (3') is performed along respective pass-lines located close to each other such that the profiled strips enter the continuous press (55) in a substantially parallel condition.

5 8. Method according to Claim 7, wherein the profiled strips (2', 3') enter the press (55), converging towards each other at an angle of less than 1°.

9. Method according to Claim 8, wherein the steps involving profiling of the strips (2, 3') are performed in succession along a common horizontal feeding direction.

10 10. Method according to Claim 9, wherein profiling of the strips (2', 3') is greater than or equal to 10 mm.

11. Method according to Claim 10, wherein the insulating layer (4) is obtained using a foam of polymer material applied between the strips (2', 3') during a step following profiling thereof.

15 12. Method according to Claim 10, wherein the insulating layer (4) is obtained using rock wool or the like applied during an intermediate step between the profiling of the strips (2', 3').

13. Apparatus for carrying out the method of Claims 7 to 12, comprising a first and a second profiling machine (24, 25) processing respectively
20 an upper strip (2') and a lower strip (3'), a continuous press (55) located downstream the profiling machines, characterized in that the strips are profiled along respective pass-lines close to each other and enter the continuous press in a substantially parallel condition.

14. Apparatus according to Claim 13, in which the profiled strips (2',
25 3') enter the continuous press (55), converging towards each other at an

inclination of less than 1°.

15. Apparatus according to Claim 14, in which the profiling machines (24, 25) are arranged in mutual succession in the direction of feeding of the strips (2', 3') such that the machine which is located downstream is passed through by the strip (2', 3') supplied by the other profiling machine and is equipped with means (38) for supporting this strip.

16. Apparatus according to Claim 15, wherein the means supporting the strip (2', 3') are idle rollers (38).

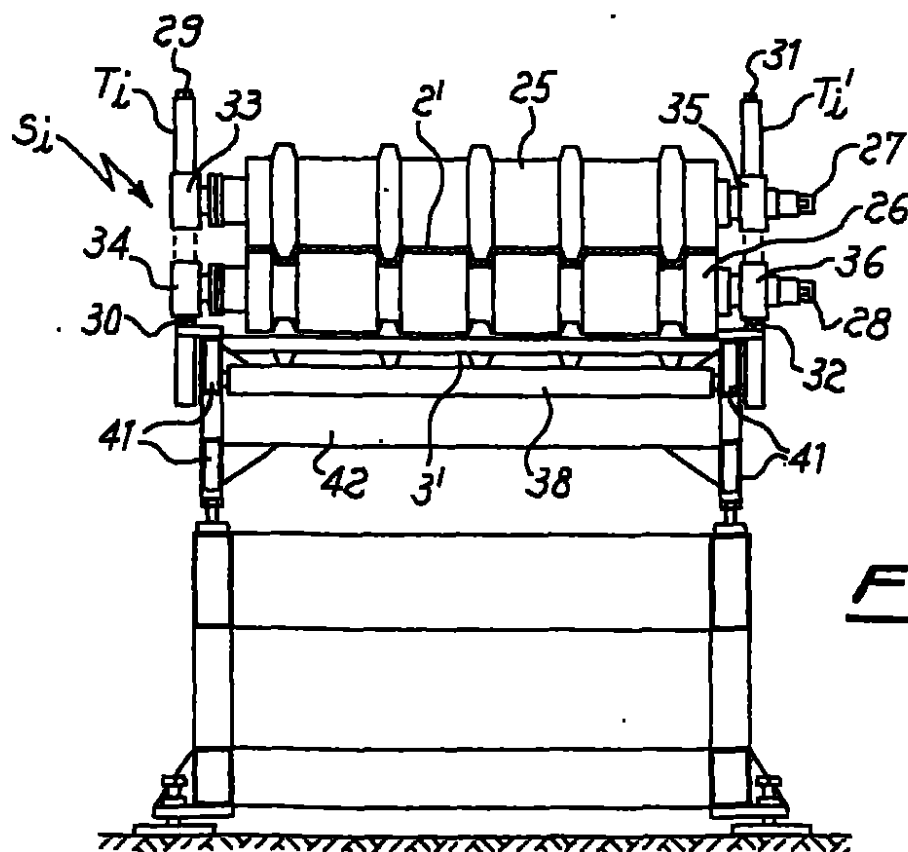
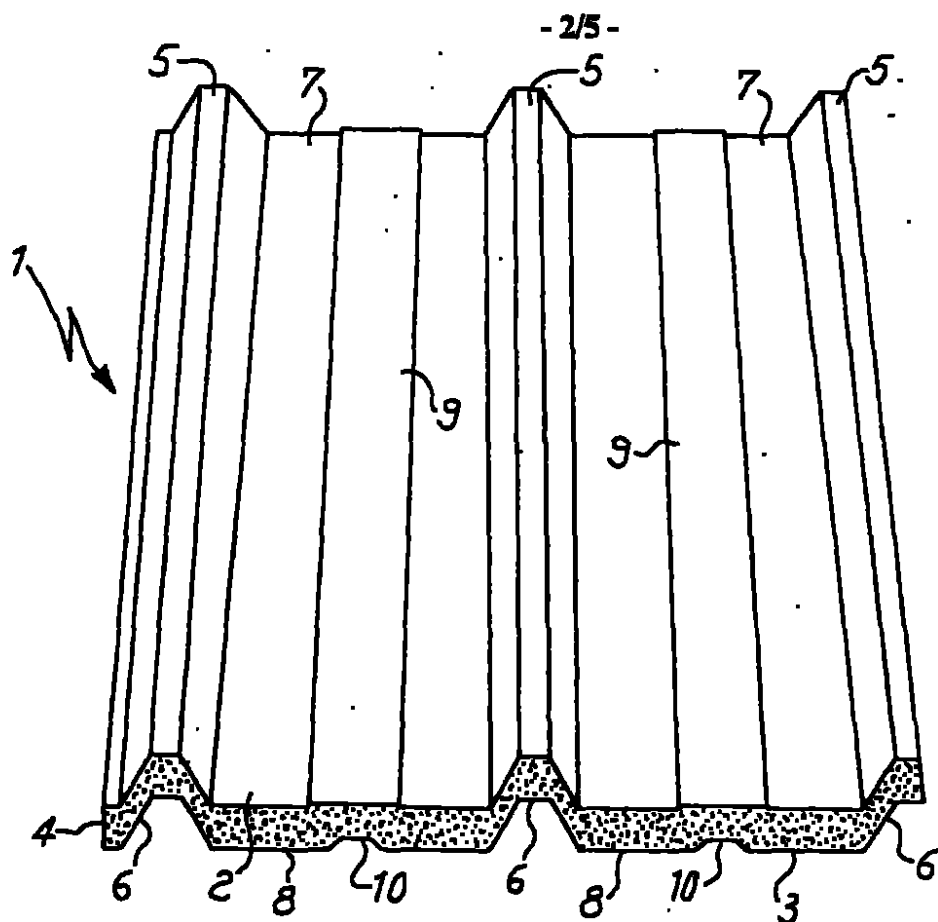


Fig. 2

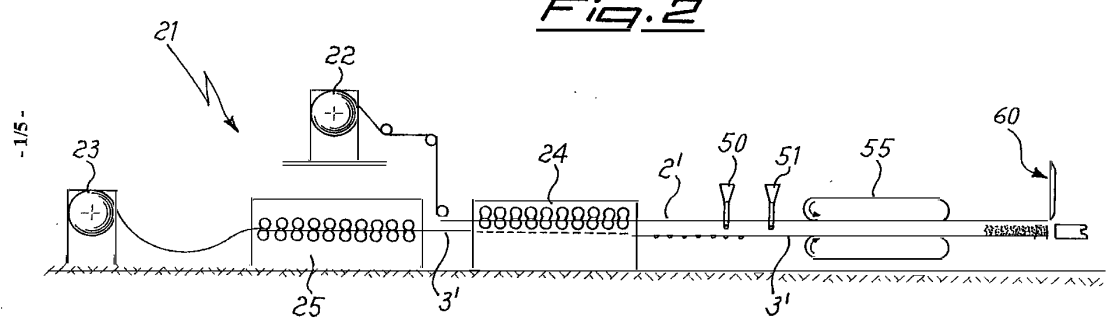
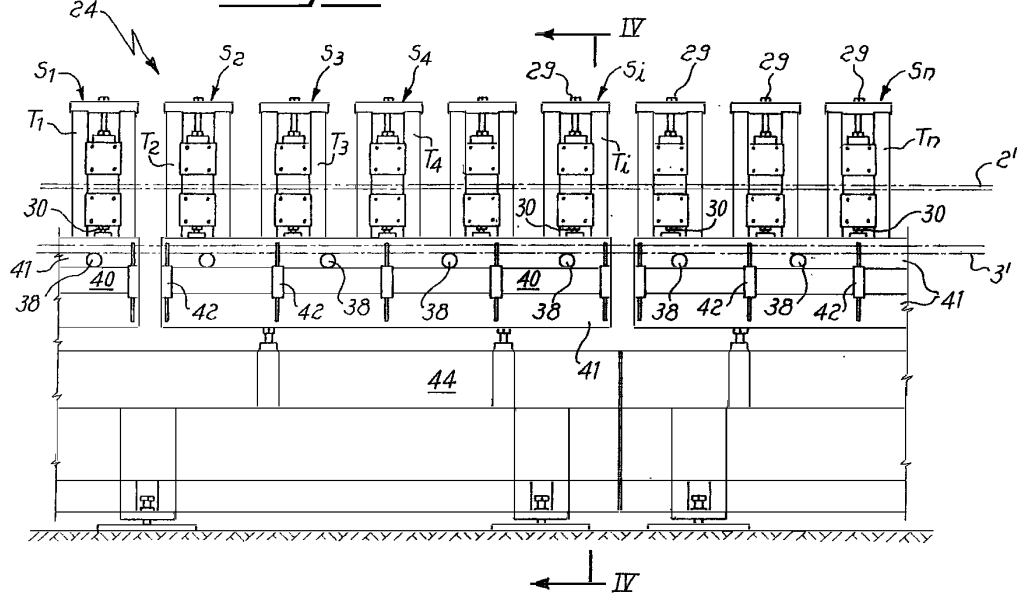


Fig. 3



24

- 4/5 -

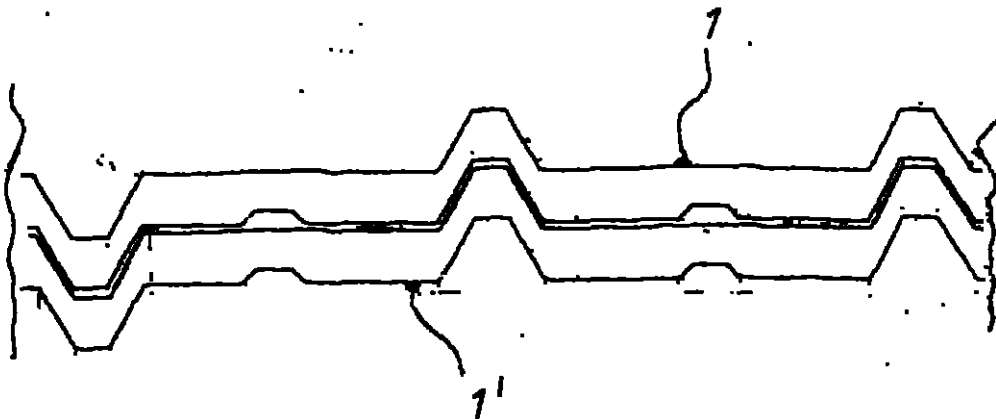
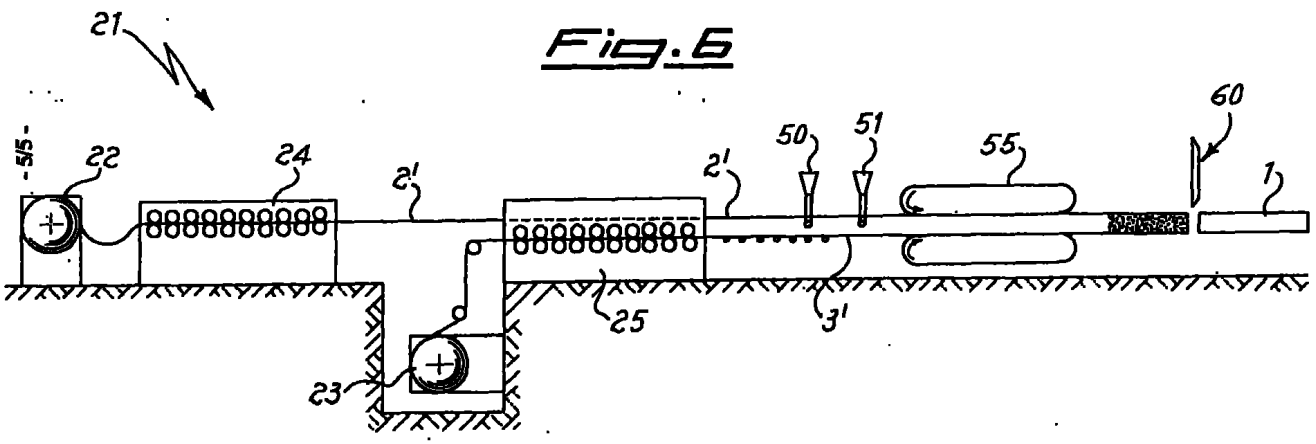


FIG. 5

2



A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E04C2/292 E04C2/32

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 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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 044 316 A (PRECISION METAL FORMING LTD.) 15 October 1980 (1980-10-15) the whole document	1-6
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Y	page 6, line 18 -page 9, line 21; figures 7,8	14-16
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A	page 14, line 17 -page 19, line 10; figure 1	8,9,12

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

PCT/IT 02/00162

27

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PCT/IT02/00162

**"Panel aislante con caras de perfilado profundo, proceso y aparato para la
fabricación de dicho panel"**

La invención se refiere a paneles aislantes del tipo que se utiliza comúnmente para la construcción de paredes, puertas, techos y similares en edificaciones civiles, industriales o de cualquier otra índole.

Como es bien conocido, estos paneles tienen una estructura combinada, también denominada estructura de "emparedado", en la cual hay por lo menos una capa aislante interpuesta entre dos paredes externas que conforman las caras del panel que se encuentran a la vista; el material aislante es, por lo general, una espuma de poliuretano o material similar (aunque también puede ser lana de roca o cualquier otro material aislante), mientras que las caras, en la mayoría de los casos, son láminas metálicas.

Este último material tiene un perfil estriado, cuya finalidad es aumentar la rigidez de los paneles; este estriado se puede dar en muchos diseños. Para mayores detalles acerca de algunos de ellos, así como de sus métodos de fabricación, se pueden consultar los enunciados de las solicitudes de patentes europeas Nos. 682159 y 995594 o el de la solicitud internacional PCT/EP95/03865.

Concretamente, los paneles descritos en estos documentos son fabricados en forma continua, empleando aparatos especiales que parten de dos tiras de lámina metálica que se desenrollan de sus respectivos carretes: las dos tiras se alimentan a lo largo de sus respectivas trayectorias convergentes hasta quedar en una condición horizontal paralela en la que el material aislante, bien sea de espuma de poliuretano, lana de roca u de otra clase se aplica entre ellas.

El producto semiterminado así obtenido se corta enseguida en sentido transversal para obtener los paneles de dimensiones predeterminadas en el extremo del aparato; a los paneles se les pueden luego dar un terminado fuera de línea, si se necesita, en las operaciones de acabado.

No obstante lo anterior, el perfilado de las superficies de los paneles constituye una gran limitante en el estado de la técnica actual.

De hecho las tiras metálicas con estrías cuya profundidad es superior a 3 mm por lo general presentan una rigidez tal que resulta prácticamente imposible doblarlas en la dirección longitudinal (axial); por consiguiente, los paneles conocidos no tienen sino un solo lado con estrías profundas pues, de lo contrario, no sería posible producirlos en forma continua, como se explicaba antes.

Se debe tener en cuenta que, en los aparatos conocidos, la tira de perfil profundo avanza en sentido horizontal, para que no exija cambios de inclinación durante su procesamiento, mientras que la otra tira se desplaza por encima de la primera y es plana o ligeramente perfilada con estrías longitudinales inferiores a 3 mm, por lo cual adquiere una flexibilidad suficiente como para poderse doblar unos pocos grados y converger hacia la tira inferior.

En este contexto cabe señalar que, tanto en la presente descripción como en las reivindicaciones adjuntas, se entiende por un ligero perfilado (o relieve) de las caras de un panel a cualquier tipo de estría o muesca cuya altura sea tal que la rigidez de flexura resultante es insignificante en comparación con la del panel completo.

Es evidente que esta rigidez también depende del espesor de la lámina de metal y de las características del material metálico (bien sea acero, aluminio,

cobre, etc.) que se utilice; no obstante, en términos generales, se puede afirmar que de acuerdo con los estándares europeos sobre paneles combinados (ECCS) un ligero perfilado se debe considerar como el que se obtiene con estrías cuya altura (o profundidad, según sea el caso) es inferior a 3 mm.

Por otra parte, según los estándares de ECCS, un perfilado profundo se debe considerar como el formado con estrías cuya altura es superior a 3 mm y, de acuerdo con la experiencia del solicitante, preferiblemente una altura superior a 10 mm; la variabilidad de estos valores depende además de factores tales como el espesor y el tipo de material metálico empleados en las caras de los paneles.

El hecho de que los paneles conocidos tienen una sola cara perfilada profunda por las razones explicadas anteriormente, implica que para lograr una alta resistencia estructural es preciso producir paneles que sean gruesos y/o que empleen una lámina metálica de considerable espesor, motivo por el cual resultan inevitablemente pesados.

En otras palabras, los paneles que en la actualidad se fabrican mediante procesos continuos ofrecen propiedades restringidas de resistencia estructural en relación con su peso: sería aconsejable, pues, conseguir una resistencia mejorada, dado que así, en igualdad de circunstancias, se obtendría una reducción beneficiosa en los materiales utilizados para producirlos y, por ende, una disminución en los costos, entre otras cosas.

La presente invención busca, por consiguiente, mejorar este estado de la técnica: en otras palabras, su objetivo es proporcionar un panel aislante que se produzca en un proceso continuo y cuyas propiedades de resistencia

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estructural sean mejores que las de los paneles de una sola superficie perfilada conocidos actualmente.

Este objetivo se logra mediante un panel cuyas características se describen en las reivindicaciones que se presentan más adelante.

La invención comprende, asimismo, un método para producir el panel antes mencionado y un aparato para ejecutar este método, cuyas características también se establecen en las siguientes reivindicaciones.

Para entender mejor la invención en su conjunto, a continuación se describe una realización preferible, aunque no limitante, de dicha invención, haciendo referencia a los dibujos que acompañan a este documento:

- La figura 1 ilustra una vista en perspectiva de un panel correspondiente a la invención;
- La figura 2 muestra el esquema de un aparato utilizado para la producción continua de paneles correspondientes a esta invención;
- La figura 3 muestra en detalle una característica propia del aparato correspondiente a la figura 2;
- La figura 4 es una sección transversal a lo largo de la línea IV-IV de la figura 3;
- La figura 5 ilustra el apilamiento de paneles correspondiente a la invención;
- La figura 6 muestra otro ejemplo de aparato para la producción continua de paneles correspondiente a la invención.

En relación con estas figuras, en la primera de ellas el numeral 1 denota, a grandes rasgos, un panel aislante correspondiente a la invención.

Como se puede apreciar, este panel comprende dos caras externas 2 y 3 a la vista, entre las cuales se encuentra una capa aislante 4, en este caso de espuma de poliuretano.

Tanto la cara externas 2 como la cara externa 3 están reforzadas con un perfilado profundo como el explicado anteriormente, en forma de una serie de estrías longitudinales respectivas 5 y 6 de perfilado trapecial, cuyo relieve se prolonga con respecto a las porciones intermedias 7 y 8; las últimas de éstas tienen un ligero perfil con estrías inferiores 9 y 10, que son diferentes entre un lado del panel y el otro.

Es evidente que el perfil de las caras 2 y 3 puede ser diferente al ilustrado en los dibujos, dependiendo de la amplia variedad de formas de las estrías 5 y 6; lo que se debe tener presente en este caso es que ambas caras tienen un perfil profundo, superior a 10 mm, por lo cual proporcionan un panel de gran rigidez flexural, incluso en el caso del espesor limitado de la capa 4.

Este importante resultado se logra fabricando el panel 1 en forma continua con el aparato 21 que se puede observar en la figura 2, partiendo de dos carretes de material plano de lámina metálica 22 y 23.

Como se puede apreciar, en este aparato la tira superior del carrete 22 y la tira inferior del carrete 23 se desenrollan de una manera ya conocida y luego se les da forma en las respectivas máquinas de perfilado 24 y 25 dispuestas en forma sucesiva; estas últimas cumplen la función de perfilar las tiras con el fin de obtener el perfil a la vista de las caras 2 y 3 de los paneles terminados.

En particular, las tiras que avanzan en sentido horizontal a diferentes alturas corriente abajo de las máquinas de perfilar 24 y 25 se encuentran indicadas por 2' y 3', respectivamente, en la figura 2, según lo explicado en relación con el

panel de la figura 1; esto se hace para simplificar la descripción ya que, como es obvio, las caras externas de los paneles también se pueden formar con tiras metálicas dispuestas en forma inversa a la de la figura 2.

La máquina de perfilar 24, que se muestra en detalle en la figura 3; tiene una serie de etapas intermedias $S_1, S_2, S_3 \dots S_n$, en cada una de las cuales se encuentra localizado un par de rollos formados opuestos 25 y 25 de un tipo ya conocido.

Estos rollos se forman de acuerdo con el perfil definido en la tira 2' que pasa por la máquina de perfilar 24, y se montan en soportes de estructura correspondientes $T_1-T'_1, T_2-T'_2, T_3-T'_3, \dots T_n-T'_n$, dispuestos en sus extremos.

Los rollos 25 y 26 avanzan operados por ejes respectivos 27 y 28, que van conectados a su vez a motores de accionamiento, que no aparecen ilustrados en los dibujos; la altura de la posición de los rodillos se puede ajustar mediante tornillos de ajuste 29, 30, 31 y 32, dispuestos en las estructuras de cada etapa, que actúan sobre los rodamientos 33, 34, 35 y 36 de los rodillos.

El objetivo de esta propiedad de ajuste, además de asegurar las funciones normales de operación de la maquinaria de perfilar 24, tal como ocurre ya en las máquinas convencionales, es facilitar el movimiento del paso de la tira inferior 3' suministrada por la primera máquina de perfilar 25.

Así pues, como se puede apreciar, la tira ya perfilada 3' avanza por dentro de la máquina de perfilar 24 a un nivel inferior al del rollo 26, es decir, el tambor inferior, de cada etapa S_1-S_n ; para este efecto, la tira 3' va soportada dentro de la máquina de perfilar 24 por una serie de rodillos locos 38, ubicados en un plano situado debajo de los rollos 26.

De acuerdo con este ejemplo de la invención, las etapas de perfilado S_1-S_n se fijan en estructuras de base 40 formadas con miembros longitudinales 41 unidas por travesaños 42; estas estructuras son modulares y reposan en una base principal 44 de la máquina de perfilar 24, de manera que se puedan quitar para las operaciones de mantenimiento o cambio de equipos de perfilado.

La segunda máquina de perfilar 25, que se encuentra localizada corriente arriba de la mencionada anteriormente, es semejante a esta última, salvo que no tiene rodillos locos dispuestos debajo de las etapas de perfilado; en realidad estos rodillos resultan sobrando, dado que no hace falta pasar por la máquina de perfilar otra lámina metálica en sentido longitudinal, como en el caso de la otra máquina.

Así pues, en aras de la brevedad, se omite una descripción específica de la máquina de perfilar 25 y, para obtener mayores detalles, se debe hacer referencia a las explicaciones ya presentadas. No obstante, es preciso señalar que, debido a que la máquina de perfilar 25 tiene como finalidad operar la tira inferior 3, la línea de paso de esta última (llamada precisamente "línea de paso"), que va definida por la línea de contacto entre los rollos formados, se encuentra ubicada a un nivel inferior al de la línea de paso de la primera máquina de perfilar 24.

Por consiguiente, la altura de colocación de los rollos formados de la segunda máquina de perfilar 25 en las respectivas estructuras de soporte es diferente de la de los rollos que se ilustran en la figura 3; sin embargo, lo que cuenta es que dentro del aparato 21 las tiras superior e inferior 2' y 3' avancen en sentido horizontal y de manera paralela entre sí hacia la zona de aplicación del material aislante.

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En esta zona operan las boquillas 50 y 51, que rocían hacia una o ambas tiras 2', 3' las sustancias poliméricas que se suelen utilizar para formar la capa aislante 4 de los paneles; corriente abajo de las boquillas hay una prensa de cinta continua 55 ya conocida.

Por último, al final del aparato se encuentra una estación de corte 60, en la que el producto semiterminado obtenido en forma continua se corta en sentido transversal en piezas de la longitud deseada, para formar así los paneles 1; debe aclararse, sin embargo, que estos últimos se pueden someter a operaciones de procesamiento fuera de línea, que no se mencionan en el presente ejemplo.

Según lo explicado hasta el momento, se puede entender cómo funciona el aparato 21 y en qué forma éste permite la fabricación continua de los paneles de acuerdo con esta invención.

En efecto, disponiendo las máquinas de perfilar 24 y 25 una tras la otra, es posible realizar un perfilado profundo de las tiras metálicas planas suministradas por los carretes 22 y 23, manteniéndolos en una posición próxima entre sí que, más adelante, resulta útil para la inyección de la espuma aislante y, más generalmente, para cualquier operación subsiguiente prevista en el ciclo de producción.

En otras palabras, al disponer en esta forma las máquinas de perfilar, las tiras 2' y 3' no quedan sujetas a variaciones significativas de inclinación a lo largo de su trayectoria de paso después de que han sido perfiladas: de esta manera se evita flexionarlas a ángulos que serían incompatibles con su perfilado profundo. Sin embargo, cabe tener en cuenta que las secciones de las tiras corriente

abajo de los carretes 22 y 23 no presentan estas dificultades debido a que son planas.

Por consiguiente, el aparato configurado en esta forma hace posible introducir las dos tiras 2' y 3' en la prensa continua 55 en una condición sustancialmente paralela.

En efecto, dado que las tiras son perfiladas a lo largo de niveles respectivos ubicados muy cerca uno de otro, corriente abajo de las máquinas de perfilar 24 y 25 se pueden transportar hacia la prensa 55 con una inclinación insignificante en relación con la horizontal, que en realidad resulta ser inferior a 1-2°.

En la práctica esta inclinación está determinada por una combadura de deformación de las tiras 2' y 3' antes de entrar a la prensa continua.

Con base en este conocimiento no es difícil entender que es posible fabricar paneles con cualquier tipo de perfilado profundo en las dos caras a la vista, cuyo ejemplo ilustrado en la figura 1 representa solamente una de las realizaciones posibles.

Estos paneles logran el objetivo de la invención establecido inicialmente.

Es evidente que el doble perfilado profundo mejora sustancialmente las propiedades estructurales de los paneles, en igualdad de condiciones, sin incrementar sustancialmente el peso (la incidencia del acero y del material aislante por metro cuadrado de panel); el resultado de esto es, pues, que las limitaciones de los paneles conocidos, mencionados anteriormente, quedan completamente superadas por la invención.

Esta última también incluye el método de producción continua de los paneles.

Como se explicaba antes, los aparatos convencionales no se prestan para el perfilado profundo de ambas caras de los paneles debido a la disposición de

separación espaciada de las máquinas de perfilar como, por ejemplo, la ilustrada en la solicitud de patente europea No. 995594, que implica necesariamente un ángulo de flexión de la tira superior con el fin de guiarla hacia la tira inferior, lo cual resulta incompatible con el perfilado profundo.

Con el método de fabricación correspondiente a la presente invención es posible superar esta limitante tecnológica.

En efecto, el perfilado de las tiras ahora se realiza a lo largo de niveles respectivos que se encuentran a una distancia sustancialmente igual al espesor final de los paneles: de esto se concluye que corriente abajo de las máquinas de perfilar la tira superior no tiene que sufrir desviaciones significativas que puedan obligar a una flexión longitudinal de la misma sobre un eje transversal a la dirección de la alimentación, lo cual sería incompatible con el perfilado profundo de la misma.

En particular, en el aparato 21 este resultado se logra disponiendo las máquinas de perfilar 24 y 25 una tras la otra y manteniendo las tiras a una distancia corta de manera que, corriente abajo de las máquinas de perfilar, puedan ser transportadas hacia la prensa continua en una condición sustancialmente paralela entre sí.

En la práctica, después de la máquina de perfilar 24, las tiras 2' y 3' convergen con una inclinación que es preferiblemente inferior o igual a 1°, hasta que alcanzan una distancia entre sí correspondiente al espesor final del panel.

Desde luego, es posible emplear diferentes variaciones de la invención con respecto a la realización recién descrita.

Ya se ha hecho referencia a la posibilidad de variar, según se necesite, el perfil de las superficies 2 y 3, dependiendo del tipo de estrías que se vayan a formar sobre dicha superficies.

Sin embargo, en este contexto se debe recalcar que el perfil trapecial de las estrías del panel que se ilustra en la figura 1, en el que las estrías macho 5 presentan un perfil ahusado que se puede combinar con el de las estrías hembra 6 de un panel dispuesto en la parte superior (y viceversa), ofrece la ventaja de que permite apilar los paneles y mantener en un mínimo los espacios vacíos, como lo muestra la figura 5.

Cabe anotar que esta ventaja cobra especial importancia en relación con el transporte industrial de los paneles, caso en el cual el máximo volumen transportado, y no el máximo peso, siempre constituye un factor determinante.

Los paneles conocidos que tienen una sola superficie o lado con perfilado profundo y el otro lado es sustancialmente plano, por lo general se transportan anverso contra reverso entre sí, enfrentando los lados en que se forman las estrías.

Este tipo de solución crea una cantidad considerable de espacios vacíos entre los paneles y, por lo tanto, afecta en forma negativa los costos de transporte, debido a que, para un cierto volumen de carga, el número de paneles que se puede transportar está restringido inevitablemente a los espacios vacíos presentes entre ellos.

Por otra parte, los paneles con perfilado profundo en ambos lados correspondientes a la presente invención se pueden apilar combinando los respectivos perfiles, lo cual reduce significativamente los espacios vacíos para efectos del transporte.

Sin embargo, se entiende que este efecto se puede obtener con estrías de un perfil diferente al trapecial del ejemplo ilustrado, ya que sólo es necesario que su forma sea del tipo machihembrado, el cual se puede combinar de manera geométrica en la forma antes explicada.

A modo de una posible variante de la invención también se ha planteado que la capa aislante no debe constar necesariamente de una espuma de poliuretano, sino que también puede formarse con cualquier otro material adecuado como, por ejemplo, lana de roca, vidrio o similares.

No obstante se debe tener presente que, para una alternativa de tales características, es preferible modificar el aparato de producción de paneles con respecto al ilustrado en la figura 2, debido a que la aplicación de la lana de roca se puede realizar de mejor modo entre una máquina de perfilado y la otra, es decir, de forma que la tira superior 2' se disponga a una distancia sustancialmente igual al espesor final de los paneles en relación con la tira inferior 3'.

Sin embargo, en el caso de la aplicación de la lana de roca, es posible utilizar los sistemas normales conocidos para este efecto, disponiendo la maquinaria correspondiente entre las dos máquinas de perfilar 24 y 25 que, por este motivo, deben ubicarse a una distancia adecuada.

De igual manera se puede entender que la presencia del medio de aplicación de lana aislante entre las dos máquinas de perfilar no es incompatible con el medio de inyección de espuma de poliuretano, dado que permitiría la formación de un aparato de doble propósito, es decir, que podría producir paneles de relleno tanto de espuma como de lana.

En relación con lo anterior cabe señalar que el perfilado de las tiras se podría efectuar de manera inversa con respecto al descrito para el aparato de la figura 2, o sea procesando primero la tira superior y luego la tira inferior, intercambiando la posición de las máquinas de perfilar 24 y 25.

Un ejemplo de esta situación se ilustra en la figura 6, en la cual, para simplificar, se ha mantenido la nomenclatura de la realización precedente.

Se acaba de indicar que en este aparato la máquina de perfilar 24 corriente arriba, que procesa la tira 2', ya no tendrá rodillos locos 38 para soportar la tira inferior, mientras que, por otro lado, la máquina de perfilar 25 sí estará provista de dichos rodillos que, como es evidente, irán colocados encima de los rollos formados que le imparten el perfil a la tira inferior 3'.

Con todo, estas variantes están incluidas dentro del alcance de las reivindicaciones siguientes.

REIVINDICACIONES

1. Panel combinado que comprende como mínimo una capa aislante (4) interpuesta entre dos caras externas (2, 3), caracterizado por el hecho de que ambas caras están formadas por láminas metálicas con perfilado profundo.
2. Panel correspondiente a la reivindicación 1, en el que la profundidad del perfilado de las caras externas (2, 3) es superior a 3 mm.
3. Panel correspondiente a la reivindicación 2, en el que la profundidad del perfilado de las caras externas (2, 3) es superior a 10 mm.
4. Panel correspondiente a las reivindicaciones 1 a 3, en el que la mencionada como mínimo una capa aislante (4) está fabricada con materiales que comprenden espuma de polímero o lana de roca.

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5. Panel correspondiente a cualquiera de las reivindicaciones anteriores, en el que las caras externas (2, 3) están perfiladas con estrías macho (5) y/o estrías hembra (6), en el que encajan las estrías conjugadas de paneles semejantes en la posición de apilamiento.
6. Panel correspondiente a la reivindicación 5, en el que las mencionadas estrías macho (5) y estrías hembra (6) tienen un perfil trapecial.
7. Método para la fabricación continua de paneles correspondientes a cualquiera de las reivindicaciones 1 a 6, que incluye la combinación de los siguientes pasos:
 - alimentación longitudinal de una tira metálicas superior (22, 2') y una tira metálica inferior (23, 3');
 - perfilado de dichas tiras en sentido longitudinal;
 - aplicación de una capa aislante (4) entre las tiras;
 - compresión en una prensa continua (55), del producto semiterminado formado por las tiras y por la capa aislante dispuesta entre ellas, hasta alcanzar el espesor de los paneles que se van a producir;
 - corte transversal de dicho producto semiterminado para obtener paneles de longitud predeterminada;

caracterizado por el hecho de que el perfilado de la tira superior (2') y el de la tira inferior (3') se llevan a cabo a lo largo de las respectivas líneas de paso ubicadas en proximidad una de otra, de tal manera que las tiras perfiladas entran a la prensa continua (55) en una condición sustancialmente paralela.

u2

8. Método correspondiente a la reivindicación 7, en el que las tiras perfiladas (2', 3') entran a la prensa (55), convergiendo entre sí a un ángulo inferior a 1°.
9. Método correspondiente a la reivindicación 8, en el cual los pasos que incluyen el perfilado de las tiras (2', 3') se lleva a cabo de manera sucesiva en un sentido de alimentación horizontal común.
10. Método correspondiente a la reivindicación 9, en el que el perfilado de las tiras (2', 3') es superior o igual a 10 mm.
11. Método correspondiente a la reivindicación 10, en el que la capa aislante (4) se obtiene utilizando un material de espuma de polímero aplicado entre las tiras (2', 3') durante un paso siguiente ha dicho perfilado.
12. Método correspondiente a la reivindicación 10, en el que la capa aislante (4) se obtiene utilizando lana de roca o similar, aplicada entre las tiras (2', 3') durante un paso posterior al perfilado de las mismas.
13. Aparato para ejecutar el método de las reivindicaciones 7 a 12, que comprende una primera y una segunda máquinas de perfilar (24, 25) que procesan, respectivamente, una tira superior (2'), una tira inferior (3') y una prensa continua (55) localizada corriente abajo de las máquinas de perfilar, caracterizadas por el hecho de que las tiras se perfilan a lo largo de las respectivas líneas de paso próximas una a otra y entran a la prensa continua en una condición sustancialmente paralela entre sí.
14. Aparato correspondiente a la reivindicación 13, en el que las tiras perfiladas (2', 3') entran a la prensa continua (55), convergiendo una con la otra a un ángulo inferior a 1°.

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15. Aparato correspondiente a la reivindicación 14, en el que las máquinas de perfilar (24, 25) están dispuestas en sucesión una de otra en la dirección de la alimentación de las tiras (2', 3') de modo que la máquina que está localizada corriente abajo es atravesada por la tira (2', 3') suministrada por la otra máquina de perfilar y se encuentra dotada con un medio (38) para soportar dicha tira.

16. Aparato correspondiente a la reivindicación 15, en el que los medios de soporte de la tira (2', 3') son rodillos locos (38).

Hoja de reemplazo (regla 26) Fig. 2

Hoja de reemplazo (regla 26) Fig. 3

Hoja de reemplazo (regla 26) Fig. 1, Fig. 4

Hoja de reemplazo (regla 26) Fig. 5

Hoja de reemplazo (regla 26) Fig. 6

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) 02 MR 23 E

Box No. I TITLE OF INVENTION INSULATING PANEL WITH DEEPLY PROFILED FACES, PROCESS AND APPARATUS FOR MANUFACTURING THEREOF	
Box No. II APPLICANT ☐ This person is also inventor	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.) METECNO SPA Via per Cassino 19 20067 TRIBIANO MILANO ITALY	
Telephone No.	
Facsimile No.	
Teleprinter No.	
Applicant's registration No. with the Office	
State (that is, country) of nationality: IT	State (that is, country) of residence: IT
This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box	
Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.) MORANDI MAURIZIO Via Raffaello Lambruschini 12 10143 TORINO ITALY	
This person is: ☐ applicant only ☒ applicant and inventor ☐ inventor only (If this check-box is marked, do not fill in below.)	
Applicant's registration No. with the Office	
State (that is, country) of nationality: IT	State (that is, country) of residence: IT
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box	
☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.	
Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE	
The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) FERRONI FILIPPO DRAGOTTI & ASSOCIATI SRL Galleria San Babila 4/C 20122 MILANO ITALY	
Telephone No. 02-76022077	
Facsimile No. 02-784427	
Teleprinter No.	
Agent's registration No. with the Office	
☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.	

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Box No. V DESIGNATION OF STATES

Mark the applicable check-boxes below; at least one must be marked.

The following designations are hereby made under Rule 4.9(a):

Regional Patent

- ☒ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZM Zambia, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT (if other kind of protection or treatment desired, specify on dotted line)
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH & LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, TR Turkey, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GQ Equatorial Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | | |
|---|--|--|
| ☒ AE United Arab Emirates | ☒ GM Gambia | ☒ NZ New Zealand |
| ☒ AG Antigua and Barbuda | ☒ HR Croatia | ☒ OM Oman |
| ☒ AL Albania | ☒ HU Hungary | ☒ PH Philippines |
| ☒ AM Armenia | ☒ ID Indonesia | ☒ PL Poland |
| ☒ AT Austria | ☒ IL Israel | ☒ PT Portugal |
| ☒ AU Australia | ☒ IN India | ☒ RO Romania |
| ☒ AZ Azerbaijan | ☒ IS Iceland | ☒ RU Russian Federation |
| ☒ BA Bosnia and Herzegovina | ☒ JP Japan | |
| ☒ BB Barbados | ☒ KE Kenya | ☒ SD Sudan |
| ☒ BG Bulgaria | ☒ KG Kyrgyzstan | ☒ SE Sweden |
| ☒ BR Brazil | ☒ KP Democratic People's Republic of Korea | ☒ SG Singapore |
| ☒ BY Belarus | ☒ KR Republic of Korea | ☒ SI Slovenia |
| ☒ BZ Belize | ☒ KZ Kazakhstan | ☒ SK Slovakia |
| ☒ CA Canada | ☒ LC Saint Lucia | ☒ SL Sierra Leone |
| ☒ CH & LI Switzerland and Liechtenstein | ☒ LK Sri Lanka | ☒ TJ Tajikistan |
| ☒ CN China | ☒ LR Liberia | ☒ TM Turkmenistan |
| ☒ CO Colombia | ☒ LS Lesotho | ☒ TN Tunisia |
| ☒ CR Costa Rica | ☒ LT Lithuania | ☒ TR Turkey |
| ☒ CU Cuba | ☒ LU Luxembourg | ☒ TT Trinidad and Tobago |
| ☒ CZ Czech Republic | ☒ LV Latvia | |
| ☒ DE Germany | ☒ MA Morocco | ☒ TZ United Republic of Tanzania |
| ☒ DK Denmark | ☒ MD Republic of Moldova | ☒ UA Ukraine |
| ☒ DM Dominica | ☒ MG Madagascar | ☒ UG Uganda |
| ☒ DZ Algeria | ☒ MK The former Yugoslav Republic of Macedonia | ☒ US United States of America |
| ☒ EC Ecuador | ☒ MN Mongolia | |
| ☒ EE Estonia | ☒ MW Malawi | ☒ UZ Uzbekistan |
| ☒ ES Spain | ☒ MX Mexico | ☒ VN Viet Nam |
| ☒ FI Finland | ☒ MZ Mozambique | ☒ YU Yugoslavia |
| ☒ GB United Kingdom | ☒ NO Norway | ☒ ZA South Africa |
| ☒ GD Grenada | | ☒ ZM Zambia |
| ☒ GE Georgia | | ☒ ZW Zimbabwe |
| ☒ GH Ghana | | |

Check-boxes below reserved for designating States which have become party to the PCT after issuance of this sheet:

- | | | |
|--------------------------------|--------------------------------|--------------------------------|
| ☐ | ☐ | ☐ |
| ☐ | ☐ | ☐ |

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

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Supplemental Box

If the Supplemental Box is not used, this sheet should not be included in the request.

1. If, in any of the Boxes, except Boxes Nos. VIII(i) to (v) for which a special continuation box is provided, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No." (indicate the number of the Box) and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:

Continuation of Box No. IV

- (i) If more than two persons are to be indicated as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;

DRAGOTTI GIANFRANCO
MICHELOTTI GIULIANO
PISTOLESI ROBERTO
DE ROS ALBERTO
AGOSTINI AGOSTINO

- (ii) If, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;

ALL OF

DRAGOTTI & ASSOCIATI SRL
Galleria San Babila 4/C
20122 MILANO ITALY

- (iii) If, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;

- (iv) If, in addition to the agent(s) indicated in Box No. IV, there are further agents: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;

- (v) If, in Box No. V, the name of any State (or OAPI) is accompanied by the indication "patent of addition," or "certificate of addition," or if, in Box No. V, the name of the United States of America is accompanied by an indication "continuation" or "continuation-in-part": in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;

- (vi) If, in Box No. VI, there are more than five earlier applications whose priority is claimed: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI.

2. If, with regard to the precautionary designation statement contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.

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Box No. VI PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application:* regional Office	international application: receiving Office
item (1)				
item (2)				
item (3)				
item (4)				
item (5)				

☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office) identified above as:

☐ all items ☐ item (1) ☐ item (2) ☐ item (3) ☐ item (4) ☐ item (5) ☐ other, see Supplemental Box

* Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(II)):

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA /

Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):

Date (day/month/year) Number Country (or regional Office)

Box No. VIII DECLARATIONS

The following declarations are contained in Boxes Nos. VIII (i) to (v) (mark the applicable check-boxes below and indicate in the right column the number of each type of declaration):

Number of
declarations

- | | | | |
|---|--|---|---------|
| ☐ Box No. VIII (i) | Declaration as to the identity of the inventor | : | |
| ☐ Box No. VIII (ii) | Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent | : | |
| ☐ Box No. VIII (iii) | Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application | : | |
| ☒ Box No. VIII (iv) | Declaration of inventorship (only for the purposes of the designation of the United States of America) | : | follows |
| ☐ Box No. VIII (v) | Declaration as to non-prejudicial disclosures or exceptions to lack of novelty | : | |

PCT

FEE CALCULATION SHEET

Annex to the Request

For receiving Office use only

International Application No.:

Date stamp of the receiving Office

Applicant's or agent's
file reference

02MR23E

Applicant

METECNO SPA

CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE 30,99 T

2. SEARCH FEE 945,00 S

International search to be carried out by

(If two or more International Searching Authorities are competent to carry out the international search, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

Basic Fee

Where item (b) of Box No. IX applies, enter Sub-total number of sheets }
Where item (b) of Box No. IX does not apply, enter Total number of sheets }

b1 first 30 sheets 444,00 b1

b2 $\frac{\text{number of sheets in excess of 30}}{\text{fee per sheet}} \times \text{fee per sheet} = \text{b2}$

b3 additional component (only if sequence listing part of description is filed in computer readable form under Section 801(a)(i), or both in that form and on paper, under Section 801(a)(ii)):

$400 \times \text{fee per sheet} = \text{b3}$

Add amounts entered at b1, b2 and b3 and enter total at B 444,00 B

Designation Fees

The international application contains ALL designations.

$\frac{5}{\text{number of designation fees payable (maximum 5)}} \times \frac{96}{\text{amount of designation fee}} = 480,00 D$

Add amounts entered at B and D and enter total at I 924,00 I

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D.)

4. FEE FOR PRIORITY DOCUMENT (if applicable) P

5. TOTAL FEES PAYABLE 1.899,99

Add amounts entered at T, S, I and P, and enter total in the TOTAL box

TOTAL

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

☐ authorization to charge
deposit account (see below)

☒ postal money order

☐ cash

☐ coupons

☐ cheque

☒ bank draft

☐ revenue stamps

☐ other (specify):

AUTHORIZATION TO CHARGE (OR CREDIT) DEPOSIT ACCOUNT

(This mode of payment may not be available at all receiving Offices)

☐ Authorization to charge the total fees indicated above.

☐ (This check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit) Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.

☐ Authorization to charge the fee for priority document.

Receiving Office: RO/

Deposit Account No.:

Date:

Name:

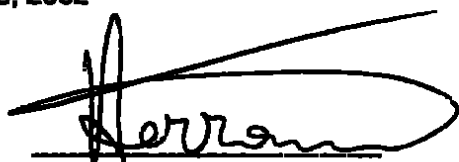
Signature:

Box No. IX CHECK LIST; LANGUAGE OF FILING		
This international application contains: (a) the following number of sheets in paper form: request (including declaration sheets) : 5 description (excluding sequence listing part) : 10 claims : 2 abstract : 1 drawings : 5 Sub-total number of sheets : 23 sequence listing part of description (actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (b) below) : _____ Total number of sheets : 23 (b) sequence listing part of description filed in computer readable form (i) ☐ only (under Section 801(a)(i)) (ii) ☐ in addition to being filed in paper form (under Section 801(a)(ii)) Type and number of carriers (diskette, CD-ROM, CD-R or other) on which the sequence listing part is contained (additional copies to be indicated under item 9(II), in right column): _____	This international application is accompanied by the following item(s) (mark the applicable check-boxes below and indicate in right column the number of each item): 1. ☒ fee calculation sheet : _____ 2. ☐ original separate power of attorney : _____ 3. ☐ original general power of attorney : _____ 4. ☐ copy of general power of attorney; reference number, if any: _____ : _____ 5. ☐ statement explaining lack of signature : _____ 6. ☐ priority document(s) identified in Box No. VI as item(s): _____ : _____ 7. ☐ translation of international application into (language): _____ : _____ 8. ☐ separate indications concerning deposited microorganism or other biological material : _____ 9. ☐ sequence listing in computer readable form (indicate also type and number of carriers (diskette, CD-ROM, CD-R or other)) (i) ☐ copy submitted for the purposes of international search under Rule 13ter only (and not as part of the international application) : _____ (ii) ☐ (only where check-box (b)(i) or (b)(ii) is marked in left column) additional copies including, where applicable, the copy for the purposes of international search under Rule 13ter : _____ (iii) ☐ together with relevant statement as to the identity of the copy or copies with the sequence listing part mentioned in left column : _____ 10. ☒ other (specify): Form. PCT/RO/125 : _____	Number of items
Figure of the drawings which should accompany the abstract: 1	Language of filing of the international application: ITALIAN	

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Milan, March 15, 2002



Filippo Ferroni

For receiving Office use only	
1. Date of actual receipt of the purported international application:	2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA /	
6. ☐ Transmittal of search copy delayed until search fee is paid	

For International Bureau use only
Date of receipt of the record copy by the International Bureau:

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 02 MR 23 E	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, Item 5 below.	
International application No. PCT/IT 02/00162	International filing date (day/month/year) 18/03/2002	(Earliest) Priority Date (day/month/year)
Applicant METECNO SPA		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of invention is lacking (see Box II).

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1
☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IT 02/00162

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E04C2/292 E04C2/32

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 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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 044 316 A (PRECISION METAL FORMING LTD.) 15 October 1980 (1980-10-15) the whole document	1-6
X	FR 2 007 531 A (HOESCH AKTIENGESELLSCHAFT) 9 January 1970 (1970-01-09) page 4, line 3 - line 32; claim 1	1-6
X	EP 0 143 159 A (METECNO S.P.A.) 5 June 1985 (1985-06-05)	7,10,11, 13
Y	page 6, line 18 -page 9, line 21; figures 7,8	14-16
Y	WO 99 45218 A (TRIMO) 10 September 1999 (1999-09-10)	14-16
A	page 14, line 17 -page 19, line 10; figure 1	8,9,12

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"Z" document member of the same patent family

Date of the actual completion of the international search

19 September 2002

Date of mailing of the international search report

27/09/2002

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

Mysliwetz, W

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IT 02/00162

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2044316	A	15-10-1980	NONE
FR 2007531	A	09-01-1970	DE 1759382 A1 27-01-1972
			BE 732036 A 24-10-1969
			CH 499700 A 30-11-1970
			FR 2007531 A5 09-01-1970
			IE 35202 B1 10-12-1975
			LU 58455 A1 22-06-1971
			NL 6905004 A ,B 28-10-1969
EP 143159	A	05-06-1985	IT 1172845 B 18-06-1987
			EP 0143159 A1 05-06-1985
			ES 288876 U 16-01-1986
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⑫ **EUROPEAN PATENT APPLICATION**

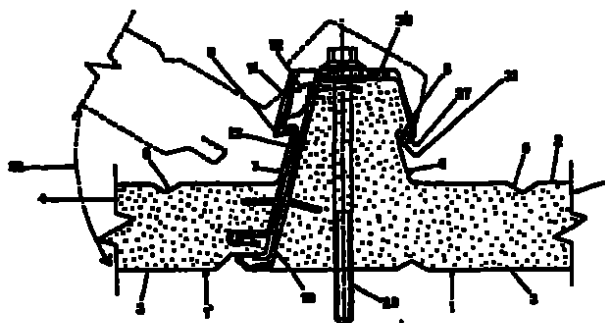
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Priority: 04.11.83 IT 8414883 Date of publication of application: 05.08.85 Bulletin 85/23 Designated Contracting States: CH DE FR GB IT LI	⑪ Applicant: METECNO S.p.A., Via Cassino 18, I-20087 Tribiano (Milano) (IT) ⑫ Inventor: Tognelli, Giorgio, c/o Metecno S.p.A., Tribiano (Milano) (IT) ⑬ Representative: Piovesana, Paolo, Corso del Popolo, 70, I-30172 Venezia-Mestre (IT)
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Deeply ribbed sandwich panel provided with a surrounding joint for adjacent panels, and a method for its manufacture.

The sandwich panel comprises a layer of expanded material which is interposed between two metal sheets and is provided on one of its two longitudinal ends with a rib clad with the corresponding metal sheet and coverable by a bent projecting longitudinal edge of the metal sheet of the adjacent panel. The rib comprises, on that side facing the interior of the panel, a step (8) engageable by the correspondingly bent lip (27) of the projecting edge (7), which covers the rib (6). Moreover, the longitudinal edges of the two sheets (2, 3) are joined together by rigid sections (10, 11) which cover the side edges of the layer of expanded material (4).



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This invention relates to a deeply ribbed sandwich panel provided with a surmounting joint for adjacent panels, and a method for its manufacture.

Sandwich panels are known constituted by two faces of profiled sheet metal, between which a layer of insulating material, preferably expanded plastics material, is interposed.

A method is also known for continuously forming said panels, in which two metal strips are passed through suitable forming machines which give them the required shape, in particular by forming longitudinal stiffening ribs. The strips are then advanced in such a manner as to keep them spaced apart by the distance corresponding to the thickness of the panel under formation, a plastics material being introduced between them and expanded to constitute the insulating layer of the panel. When the plastics material expansion process has terminated, the continuous panel thus formed is passed through a cutting station, where it is reduced into finished panels of the required length.

20 To prevent the expanded plastics material of the panel undergoing damage along its edges by mechanical or chemical action, or as a result of handling to which the panel is subjected before and during its assembly, it is

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also known to cover said edges with flexible adhesive tape applied during the manufacture of said panels.

Such panels are used for constructing roofs and walls. As the dimensions of said roofs and walls are always 5 greater than the width of the individual panels, it is necessary to dispose them side-by-side in the required number. For this purpose, known panels must be provided at their mutually contacting edges with joints which ensure mechanical stability, a seal against water and air, and a 10 satisfactory thermal insulation. All this is currently accomplished by suitable profiling of the two metal sheets which define each panel, in such a manner that the outer of each of them extends beyond the layer of insulating material and partially surmounts the metal sheet of the adjacent 15 panel. Fixing screws pass through the two panels in these partially overlapping zones of the sheets, and simultaneously join them to the common support structure.

A drawback of these known panels is that their overlapping always leads to a joining gap which besides 20 providing a finish of imperfect appearance, becomes a repository for dust, moisture and atmospheric suspensions. Because of the fact that the edge of the sheet is normally a simply cut edge without protection, any corrosion not only

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causes damage but emphasises the joining line in an unacceptable manner. On the other hand, it is unthinkable to apply a sealant along this joining line, because the result would be even more visible than the drawback that it overcomes, and would thus be aesthetically unacceptable.

A further drawback of known sandwich panels is that normally there is no rigid mechanical connection between the two sheets which define it, and thus the stability of said sheets is unsatisfactory, in that it is provided only by the adhesive and cohesive effect of the insulation interposed between them, or by the system for fixing the panels to the relative support structure.

An object of the invention is to provide a sandwich panel which enables it to be joined to other panels and to the common support structure without the line along which it is joined to adjacent panels being visible, and thus without the drawbacks related thereto.

A further object of the invention is to provide a sandwich panel which allows a sealing bead to be applied along the joining lines of two adjacent panels, which is completely hidden from view.

A further object of the invention is to provide a sandwich panel for which, even before being fitted to the

support structure, the insulating layer is guaranteed to remain unimpaired even as a result of repeated handling and/or stressing to which it can be subjected before and/or during its assembly.

5 A further object of the invention is to provide a sandwich panel which ensures a stable mechanical connection between the two metal sheets which bound it.

 These and further objects which will be apparent from the description given hereinafter are attained
10 according to the invention by a deeply ribbed sandwich panel provided with a surmounting joint for adjacent panels, of the type comprising a layer of expanded material which is interposed between two metal sheets and is provided on one of its two longitudinal ends with a rib clad with a
15 corresponding rib of sheet metal and coverable by a bent projecting longitudinal edge of the metal sheet of the adjacent panel, characterised in that said rib comprises, on that side facing the interior of the panel, a step engageable by the correspondingly bent lip of said
20 projecting edge, which covers said rib, the longitudinal edges of the two sheets being connected together by rigid sections which cover the side edges of the layer of expanded material.

Advantageously, at least one of the two sections which connect together the two metal sheets and which protect the side edges of the layer of expanded material can be provided with soft gaskets which, when the panels are coupled together, adhere to the corresponding section of the adjacent panel.

Again according to the invention, the rib of a panel can comprise a surface strip which is traversed by the screws for fixing to the support structure, and which is spaced-apart from the corresponding strip of the adjacent panel rib, to define with this latter a compartment for housing the head of said screws, which do not pass through said rib and are hidden from view thereby.

In a preferred embodiment, the side edges of each panel can have a profile suitable for their mutual insertion, whereby the edge of a panel which is not yet fixed to the support structure is engaged by the adjacent panel fixed to said structure, so that both panels are prevented from making movements orthogonal to the plane which contains them.

Some preferred embodiments of the present invention are described hereinafter by way of non-limiting example, with reference to the accompanying drawings, in which:

Figure 1 is a cross-section through two panels according to the invention joined together along their adjacent longitudinal edges;

Figure 2 is a detailed view of Figure 1 to a greater scale, showing the connection joint between the two panels;

Figure 3 shows a second embodiment in the same view as Figure 2;

Figure 4 shows a third embodiment in the same view as Figure 2;

Figure 5 shows a fourth embodiment in the same view as Figure 2;

Figure 6 shows a fifth embodiment in the same view as Figure 2;

Figure 7 is a diagrammatic side view showing the method for constructing the panels of Figures 1 to 6; and

Figure 8 is a diagrammatic plan view thereof.

As can be seen from the figures, the panel according to the invention, indicated overall by 1, is of the deeply ribbed type, ie with stiffening ribs having a height comparable with the thickness of the panel. It is constituted by two metal sheets 2 and 3, between which there is interposed a layer of expanded plastics material 4, of

known type. The sheets 2 and 3 of each panel 1 are provided with a plurality of internal longitudinal grooves 5 of small depth relative to the panel thickness, and the outer sheet 2, which on the drawings constitutes the upper sheet of the 5 panels 1, is also provided with two marginal end ribs 6 and 7 of height greater than the panel thickness. Although not expressly indicated on the drawings, other similar ribs can also be provided on the panel, between the ribs 6 and 7.

Although the marginal rib 6 which is shown on the 10 left in the drawings is completely filled with the same expanded material 4, the marginal right hand rib 7 is not, s as to make it possible to connect together two adjacent 1,1' by surmounting, as will be apparent hereinafter.

The overall cross-section through the two coupled 15 ribs 6 and 7 is substantially a trapezium, with the two inclined sides pertaining respectively to the two separate ribs 6 and 7 comprising a small step 8 and 9 respectively, which projects outwards.

At the two marginal ribs 6, 7, the panel according 20 to the invention is provided with two sections 10,11 of rigid plastics material, of suitable configuration for their stable engagement with the sheets 2 and 3, and arranged to perform various functions, these functions in particular

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being to contain the expanded material 4 during formation of the panel, to protect it during its storage, transportation and assembly, and to mechanically connect together the two sheets 2 and 3. As can be seen from the drawings, the section 10 engages the edges of the two sheets 2 and 3, whereas the section 11 engages the edge of the (lower) inner sheet 3 and the step 9 provided in the rib 7 of the outer sheet 2. This is because the lip of said sheet 2 must be free to engage the step 8 of the rib 6 of the adjacent 10 panel.

As stated, the sections 10 and 11 are constructed of rigid plastics material by a conventional extrusion process. They can also be provided with tubular portions 12 or hanging portions 13, co-extruded in soft plastics 15 material and arranged to ensure sealing against the corresponding respective section 11 or 10 of the adjacent panel.

In the manufacture of the panel according to the invention, shown diagrammatically in the two figures 7 and 20 8, two metal strips 14 and 15 are fed to two forming machines 16 and 17, from which they leave as continuous strips 2 and 3 comprising the grooves 5 and ribs 6 and 7. They are then made to converge until spaced-apart by a

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distance corresponding substantially to the thickness of the panel to be obtained, and defined by a press comprising forming belts 18, 19, driven at a speed equal to the feed speed of said strips 2 and 3. The press compartment bounded 5 upperly and lowerly by the forming belts 18 and 19 is bounded laterally by a further two vertical forming belts 20 and 21 driven at the same speed as the horizontal belts 18 and 19 and acting on the sections 10 and 11 which leave extruders 22 and 23 at the said speed.

10 Upstream of the parallelepiped compartment defined by the press forming belts 18, 19, 20, 21 there is introduced, by means of a conventional apparatus 24, a suitable chemical product able to expand within said strips. This chemical product is then made to expand preferably by 15 heating one of the strips 2 and 3, so that the expanding process becomes substantially completed within the press, from which leaves a continuous panel 25 bounded upperly and lowerly by the metal strips 2 and 3 and laterally by the sections 10 and 11. The continuous panel 25 is then cut into 20 required lengths in a cutting station indicated diagrammatically by 26 in Figures 7 and 8.

In order to form a roof or wall, each panel 1 is firstly rested against a support structure, the adjacent

panel 1' is then brought close, and while holding it inclined to the panel 1 (see dashed lines in Figure 2) the bent lip 27 of its rib 7 is made to engage with the step 8 of the rib 6 of the panel 1. It is then rotated in the direction of the arrow 28 of Figure 2 so that it becomes coplanar with the panel 1 in such a manner that its rib 7 completely covers the rib 6 of the adjacent panel 1. Having attained coplanarity between the two panels 1 and 1', in which state the gaskets 12 and 13 provided in one of the two sections 11 adhere elastically in a sealed manner to the adjacent section 10, both panels 1,1' are fixed to the support structure by applying screws 29 which pass through the two sheets 2 and 3 at the ribs 6 and 7 and through the expanded material covered by the rib 6. For stability of connection, it is preferable for the rigid section 10 which connects together the edges of the two sheets 2 and 3 at this rib, to extend in the form of a flange 30, which is also traversed by the screws 29. The same operations are then repeated with the next panel.

20 At the end of the operations, a bead of sealing material 31 can be applied along the bent lip 27 of each panel 1' engaged in the corresponding step 8 of the adjacent panel, in order to protect the cut edge of the outer sheet 2

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while at the same time being completely hidden from view.

It is thus apparent that the panel according to the invention represents substantial technical progress over currently known panels used for the same purposes, and in particular:

- it completely excludes from view the joining line between the outer sheets 2 and 3 of adjacent panels, while at the same time allowing the application of a bead of sealing material 31, which is also hidden from view;
- 10 - it ensures total unimpairing of the expanded material 4 during the storage and handling of the panels before their installation, by virtue of the total protection of said material both by the sheets 2 and 3, and by the sections 10 and 11 along its edges;
- 15 - it ensures a stable connection between the sheets 2 and 3, even along their edges, this connection being no longer entrusted merely to the forces of cohesion of the expanded material 4 and to the force of adhesion between the expanded material and the sheet metal, but instead
- 20 entrusted to the much more effective mechanical connection between the sections 13 and 14 and the sheets 2 and 3;
- if required, it allows the application, preferably by

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snap-fitting, of brackets 32 indicated by dashed lines in Figure 1, their purpose being to improve the stability of two adjacent panels in the portions between the screws 29;

- 5- it ensures an almost absolute seal at the joints between adjacent panels.

In the embodiment shown in Figure 3, the rib 6 has a strip of its horizontal surface slightly depressed relative to its summit, such that when the two ribs are 10 coupled together it defines, in cooperation with the horizontal surface of the rib 7, a compartment 33 which houses the head 34 of the screws 29. In addition to the advantages of the preceding embodiment, this embodiment offers the further advantage of completely hiding the head 15 34 of the screws 29 from view, so obtaining an undoubtedly effective result from the aesthetic viewpoint.

In the embodiment shown in Figure 4, the profile of the adjacent panels 1, 1' is chamfered so that they fit into each other, by which the panel 1' becomes rigidly locked to 20 the panel 1, and thus to the support structure, including along the edge not directly involved with the screws 29. This on the one hand makes it impossible to remove the panel from the support structure other than in the reverse order

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to that in which the panels were mounted to form the roof or wall, and on the other hand means that the connection between adjacent panels which are not simultaneously traversed by the screws 29 is not entrusted only to the engagement between the bent lip 27 of the panel 1 and the step 8 of the adjacent panel.

In this particular embodiment it can be advantageous, in order to further improve the connection between adjacent panels, to provide the two sections 10 and 11 with bands which are longitudinally toothed or comprise a saw-tooth or other profile suitable for mutual tangential engagement (see Figure 5).

In the embodiment shown in Figure 6, the overall cross-section through the two coupled ribs 6 and 7 is substantially in the form of an inverted trapezium. This allows more easy access to the zone below the step 8 by a conventional clinching machine which provides a more reliable connection between the bent lip 27 of the rib 7 and the rib 6.

C L A I M S

1. A deeply ribbed sandwich panel provided with a surmounting joint for adjacent panels, of the type comprising a layer of expanded material (4) which is interposed between two metal sheets (2, 3) and is provided on one of its two longitudinal ends with a rib clad with a corresponding rib (6) of sheet metal and coverable by a bent projecting longitudinal edge (7) of the metal sheet (2) of the adjacent panel (1'), characterised in that said rib (6) comprises, on that side facing the interior of the panel (1), a step (8) engageable by the correspondingly bent lip (27) of said projecting edge (7), which covers said rib (6), the longitudinal edges of the two sheets (2, 3) being connected together by rigid sections (10, 11) which cover the side edges of the layer of expanded material (4).
152. A panel as claimed in claim 1, characterised in that the projecting edge of the sheet (2) of each panel (1') is bent in such a manner as to form a rib (7) which completely covers the rib (6) of the adjacent panel (1) and forms a step (9) which is substantially symmetrical with the step (8) when the two panels (1,1') are coupled.
3. A panel as claimed in claims 1 and 2, characterised in that the section (11) which connects together the two

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sheets (2, 3) at the edge opposite the rib (6) engages with the edge of the sheet (3) and with the step (9) of the sheet (2).

4. A panel as claimed in claim 1, characterised in that at least one of the two sections (10, 11) which connect together the two sheets (2, 3) and protect the side edges of the layer of expanded material (4) are provided with soft gaskets (12, 13) which, when the panels are coupled together, adhere to the corresponding section (11, 10) of the adjacent panel.

5. A panel as claimed in claim 1, characterised in that the edges of the sheets (2, 3) and of the sections (10, 11) are of a configuration suitable for their mutual stable engagement.

6. A panel as claimed in claim 1, characterised in that the section (10) applied to the two sheets (2, 3) at the rib (6) of each panel (1) is provided with a flange (30) which can be traversed by the screws (29) which fix the panel or panels to the support structure.

7. A panel as claimed in claim 1, characterised by comprising brackets (32) which can be snap-fitted to the steps (8, 9) of adjacent coupled panels.

8. A panel as claimed in claim 1, characterised in

that the rib (6) comprises a surface strip which is traversed by the screws (29) for fixing to the support structure, and which is spaced-apart from the corresponding strip of the rib (7) of the adjacent panel (1') to define with this latter rib a compartment (33) housing the head of said screws (29), which consequently do not pass through said rib (7) and are hidden from view thereby.

9. A panel as claimed in claim 1, characterised in that the profile of its side edges has a configuration suitable for mutual insertion-fitting, whereby the edge of a panel (1') which is not yet fixed to the support structure is engaged by the adjacent panel (1) fixed to said structure, so that both the panels (1,1') are prevented from making movements orthogonal to the plane which contains them.

10. A panel as claimed in claims 1 and 2, characterised in that in the insertion-fitting zone, the mutually facing bands of the sections (10, 11) are longitudinally toothed, or of saw-tooth or other profile suitable for mutual tangential engagement.

11. A panel as claimed in claim 1, characterised in that, at least in the portion between the step (8) and the surface of the sheet (2), the face of the rib (6) is

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inclined in such a manner as to form an acute angle with said surface.

12. A method for constructing panels as claimed in one or more of claims 1 to 11, comprising the following stages:

- 5 - continuously feeding at the same speed a first and second profiled sheet metal strip (18, 19) designed to form respectively the outer and inner surface of a continuous panel (25), and causing them to approach each other until they are spaced-apart by a distance corresponding to the
10 final thickness of said panel (25) to be obtained,
 - introducing between the two approaching strips (18, 19) a chemical product able to expand,
 - causing the expansion of the chemical product between the approached strips (18, 19) so that it substantially fills
15 the interspace defined between them and forms the insulating layer (4),
 - simultaneously feeding the strips (18, 19) into a mobile press in order to determine a controlled thickness of the continuous panel (25),
- 20 - cutting the continuous panel (25) to size in order to obtain finished panels of the required length,
characterised by further comprising the following stages:
 - feeding, simultaneously with the two strips (18, 19) and

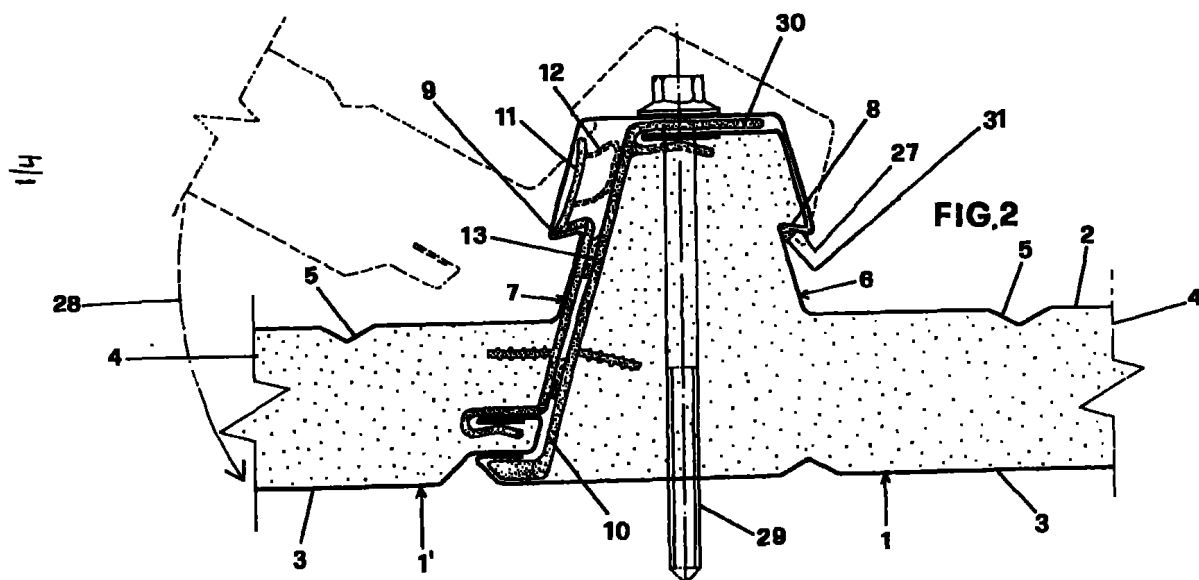
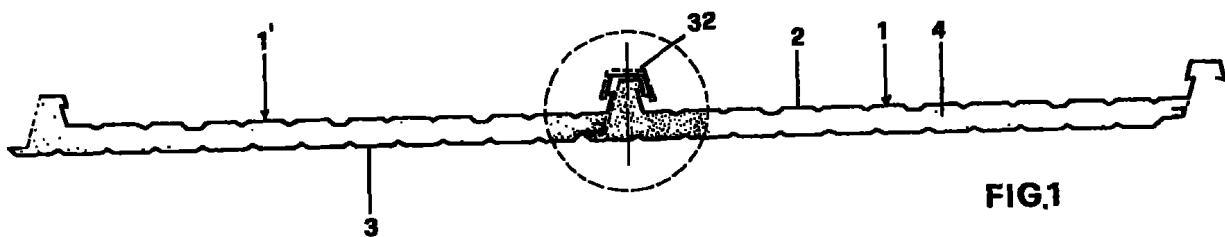
at the same speed whereas, two substantially rigid sections (10, 11) so that they approach each other until spaced-apart by a distance corresponding to the width of the continuous panel (25) to be formed, and

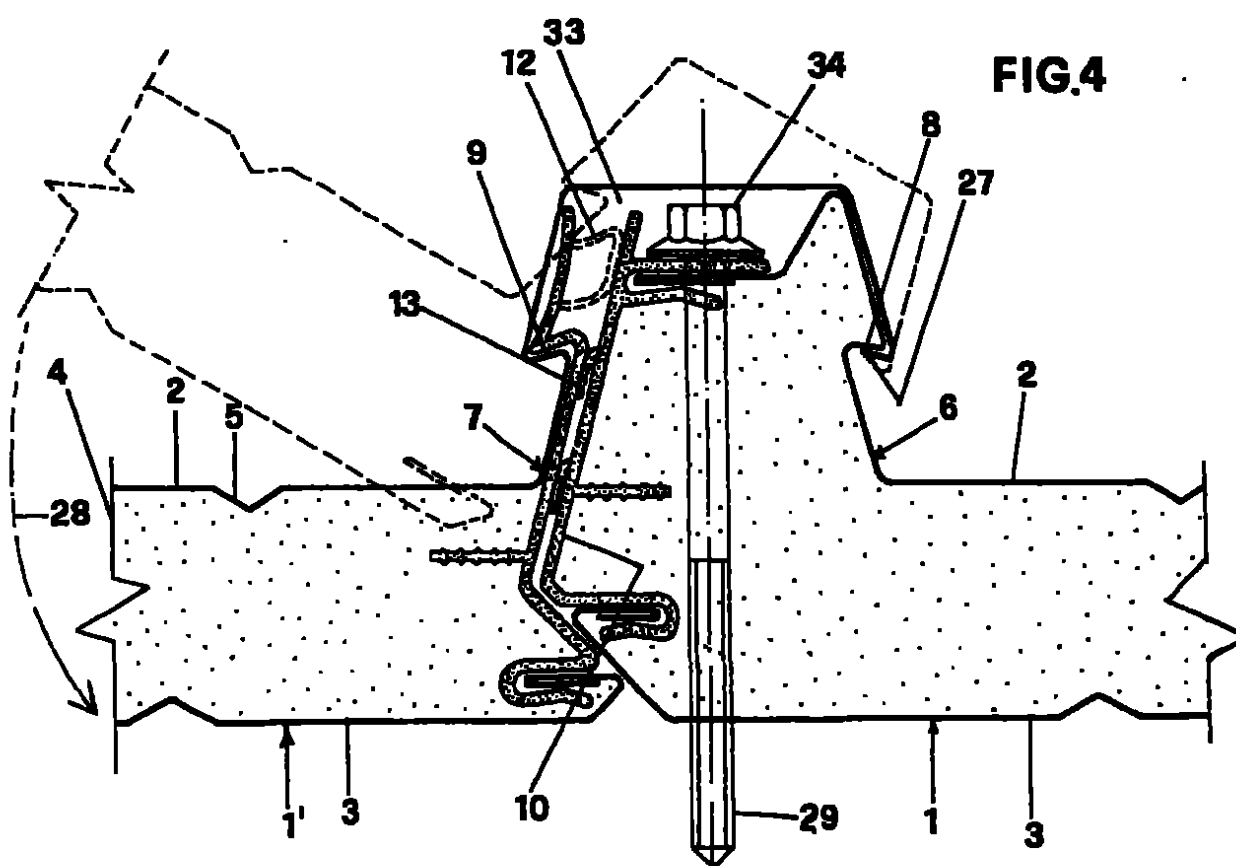
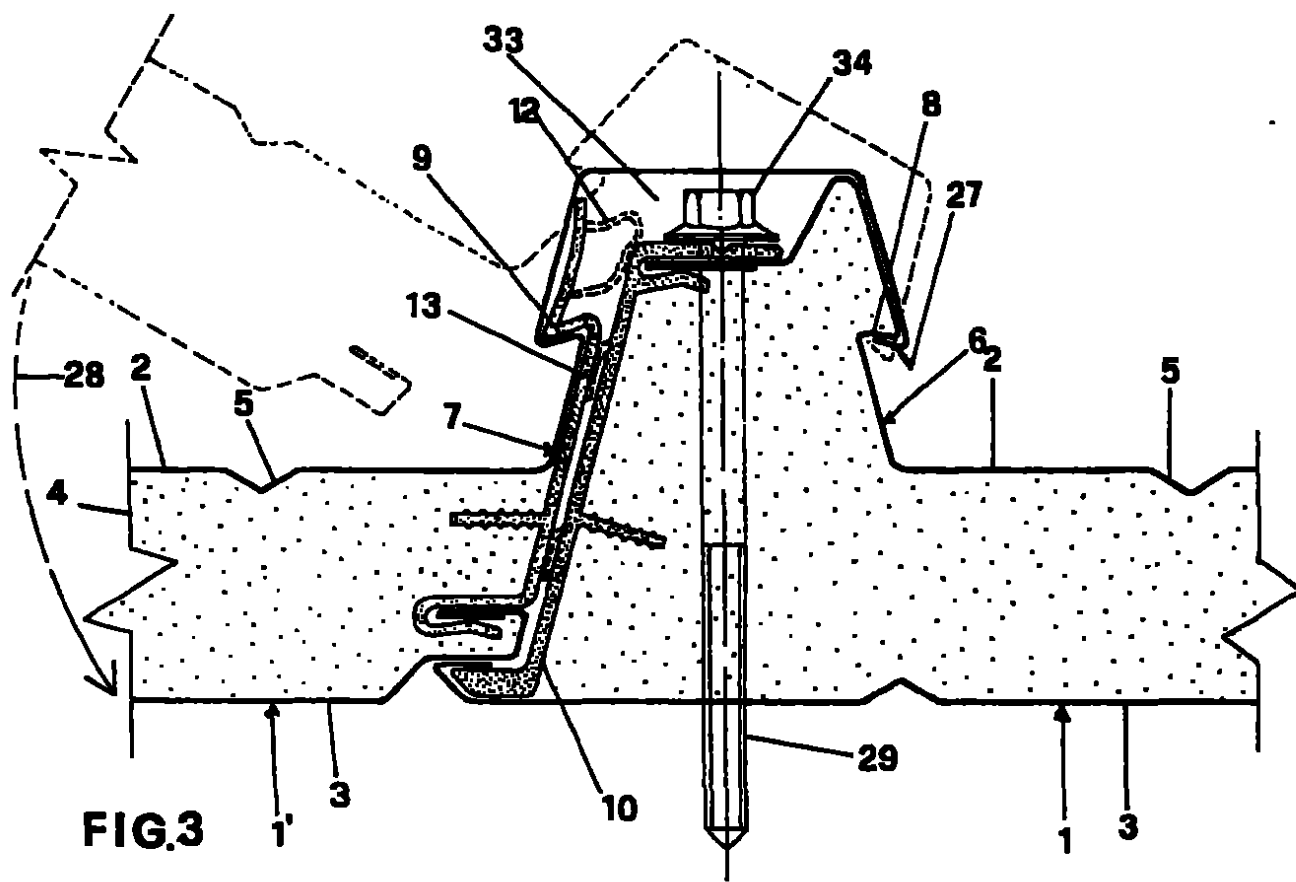
- 5 - engaging the edges of said sections (10, 11) with the corresponding edges of said strips (18, 19) in order to define a longitudinal cavity in which the formation of the layer of expanded plastics material takes place inside the press.

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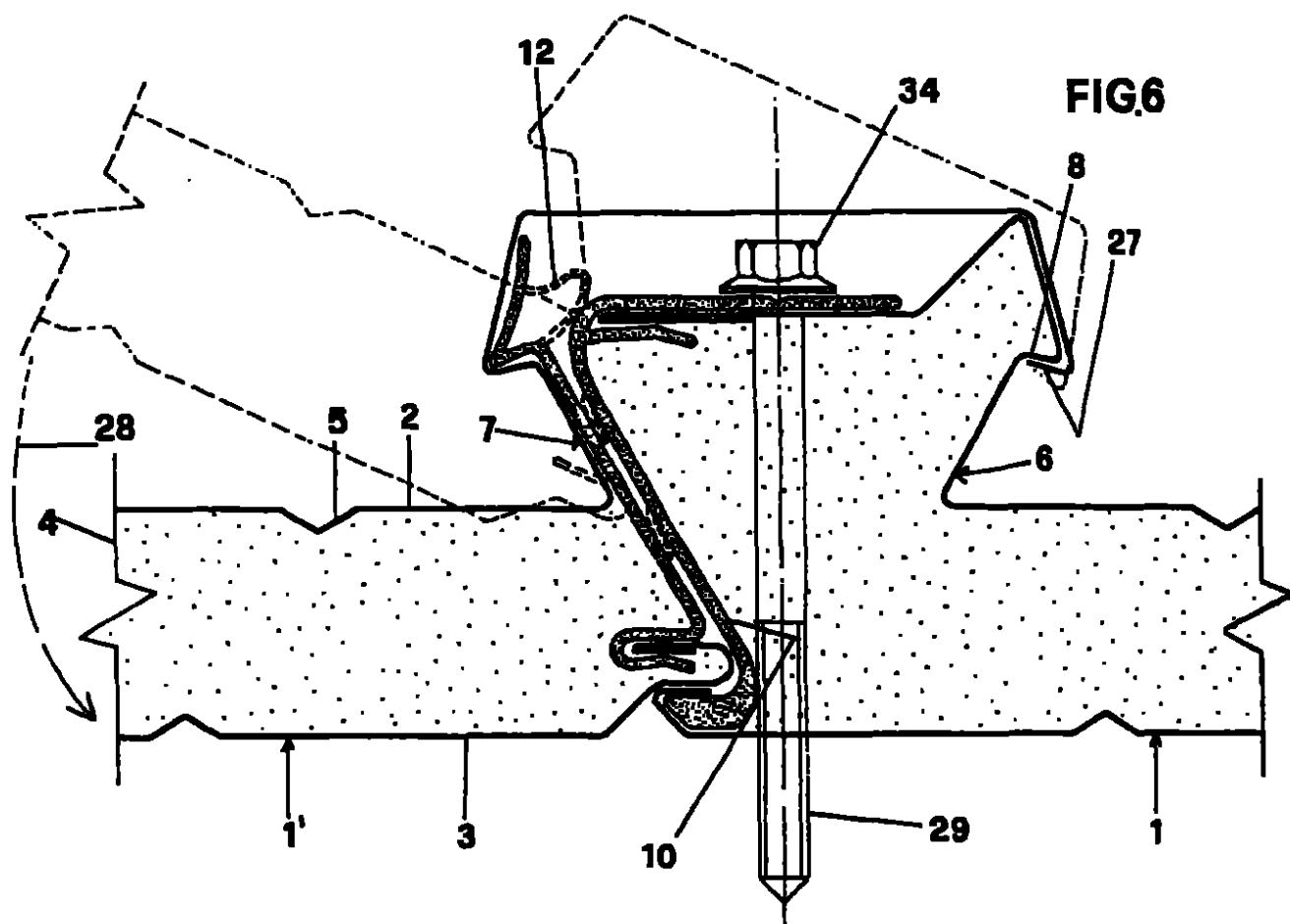
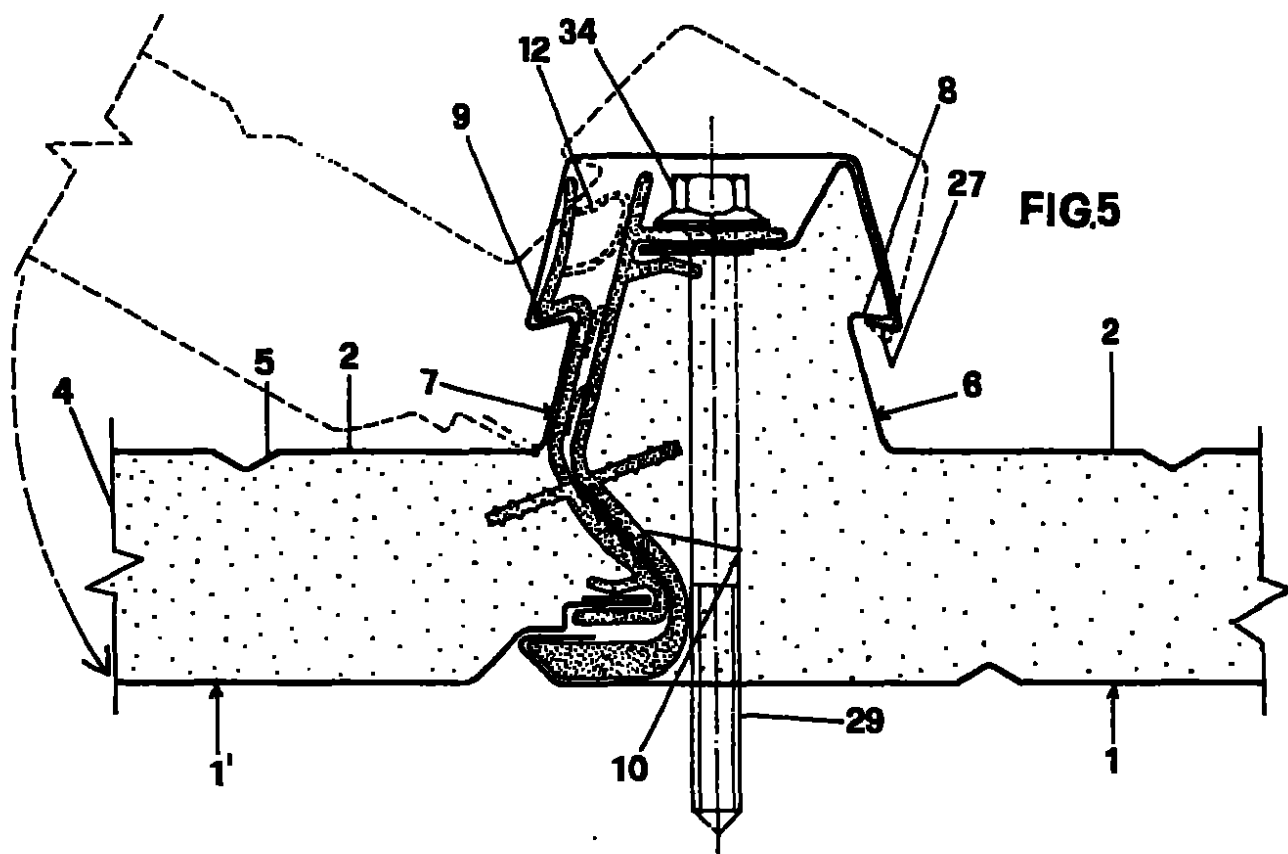




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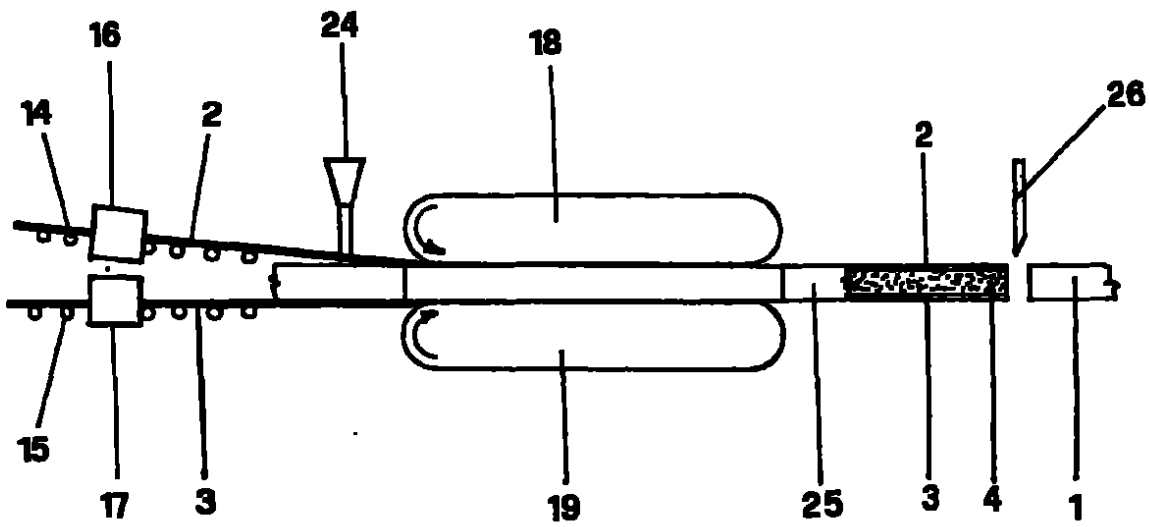


FIG. 7

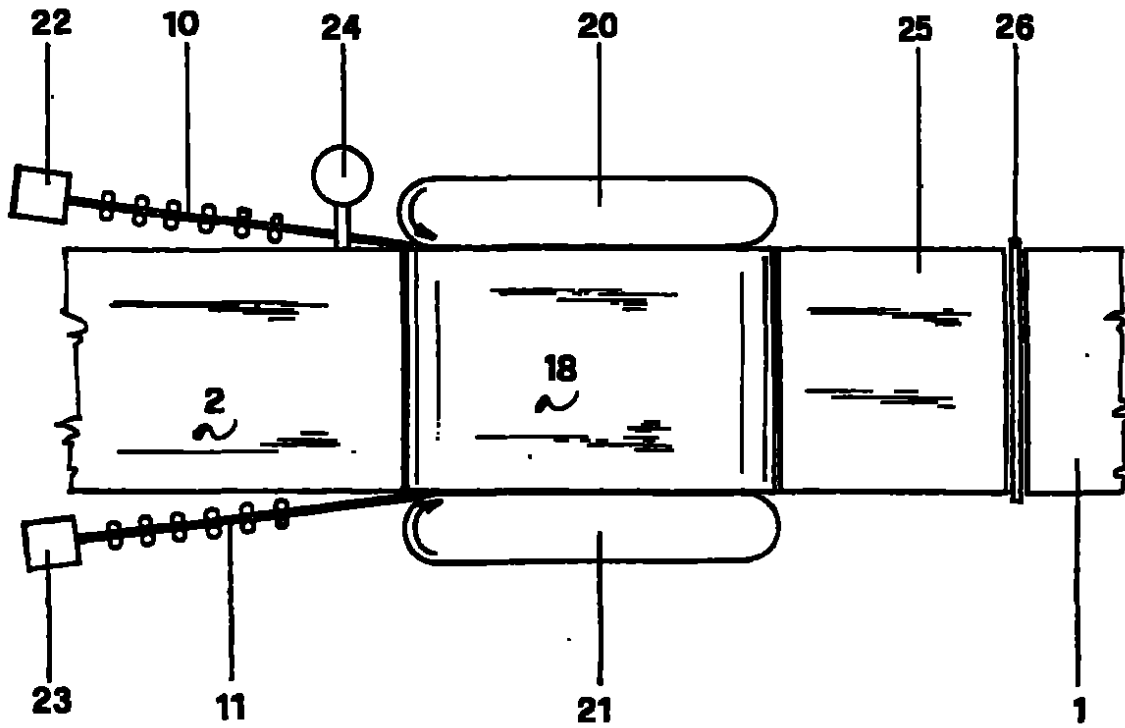


FIG. 8



European Patent
Office

EUROPEAN SEARCH REPORT

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Application number

EP 84 10 7623

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	GB-A-2 033 949 (CAPE) * page 2, line 88 - page 3, line 13; figures 4-6 *	1,2	E 04 C 2/26 E 04 D 3/363
A		3,4,5, 11,13	
A	--- GB-A-1 595 180 (CAPE) * page 2, lines 14-57; figures 2-5 * -----	1,6-9, 11,13	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			E 04 C E 04 D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 06-02-1985	Examiner VANDEVONDELE J.P.H.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons a : member of the same patent family, corresponding document	

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(56) Documents cited
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(60) Derived from application
No. 7909284 under section
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1977

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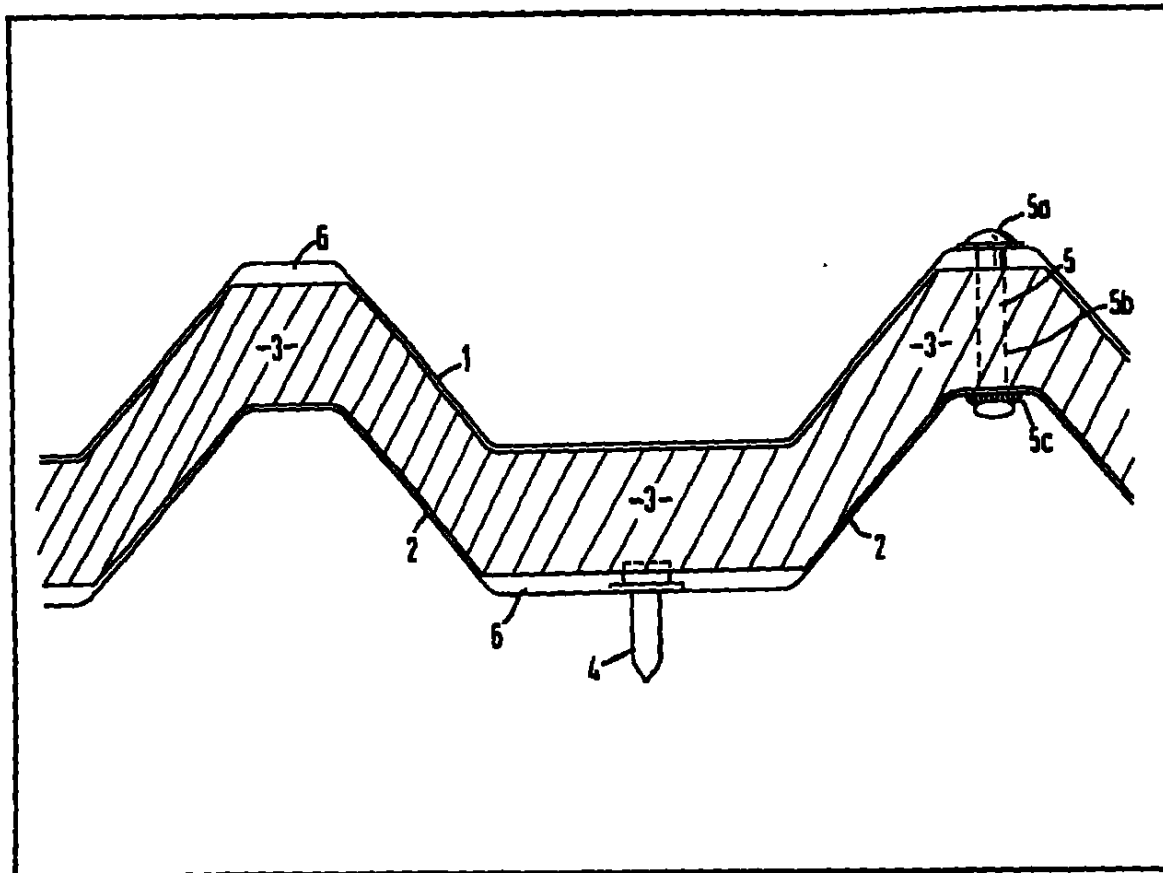
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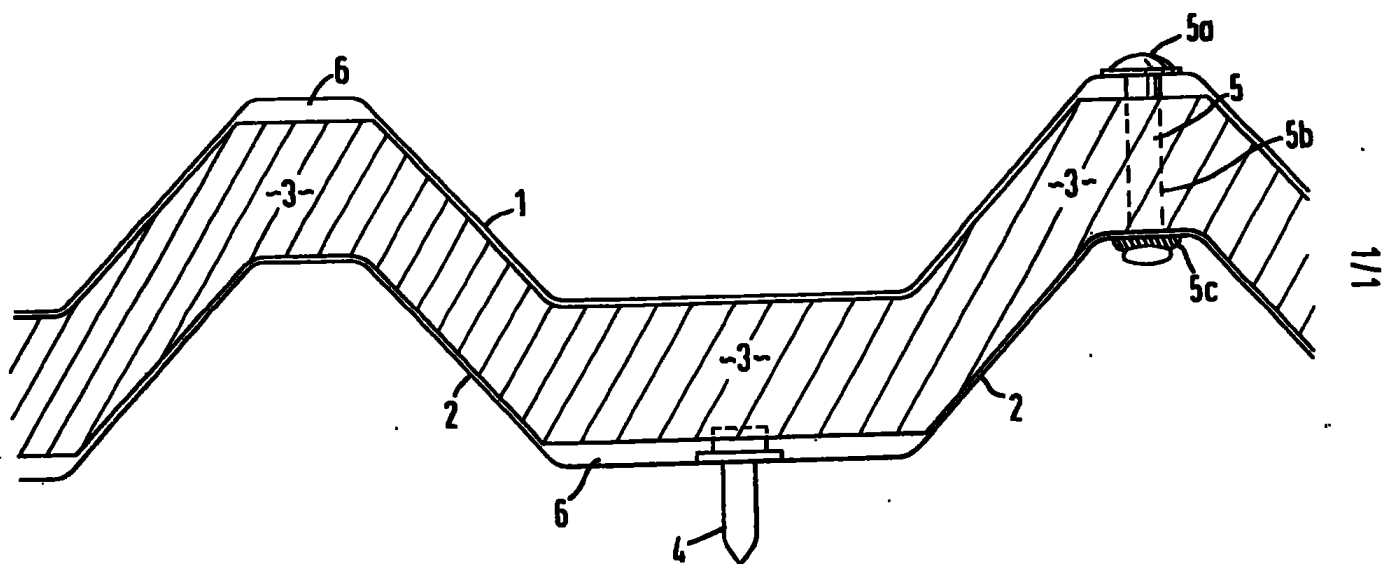
(54) Double-skin Wall or Roof Panel.

(57) The panel has inner and outer
skins (1) and (2) having between them
a substantially incompressible,

preformed thermally insulating
material (3). Skins 1 and 2 are of
corrugated or castellated sheet, and
material 3 is shaped so that it fits into
the corrugations or castellations.
Ventilation channels (6) may be
provided between the insulation and
the skin to reduce internal
condensation. The sheet may be
metal, asbestos cement, or plastics.
The insulating material may be foam
plastics, asbestos, or a mineral fibre or
particle board.



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SPECIFICATION
Improvements in or Relating to Double-skin
Wall or Roof Panels

This invention relates to roof or wall panels
 5 having a double skin, and a layer of insulating material between the two skins.
 It is well-known that double-skin walls with insulation between the skins can form an effective heat-flow barrier. The simplest form of such walls
 10 has two impervious skins with an air-gap between them, as in the familiar cavity wall. However, it is also known to insert flat sheets of insulation material between inner and outer skins of a wall or roof. Such insulation may be composed, for
 15 example, of fibreglass matting, polyurethane foam, or polystyrene. One of the problems encountered when such material is sandwiched between substantially flat metal plates is one of condensation of moisture, since it is very difficult
 20 to keep moist air out of the space between the skins and the outer skin will normally be appreciably colder than the inner one, so that moisture tends to condense on the inner surface of the outer skin and soak into the insulation material.
 25 Where the inner and outer skins are of corrugated (or castellated, i.e. flat-topped) sheet-metal, asbestos cement, or plastics material, then there is the additional problem of locating the insulating material so that it is not squashed
 30 between opposing ridges of the corrugated sheet metal or plastics.
 We have now devised a double-skin roof or wall panel for a sheet-metal, asbestos cement, or
 35 plastics clad building which substantially ameliorates the shortcomings referred to above.
 The invention consists of a double skin roof or wall panel for a building comprising inner and
 40 outer skins each formed of corrugated or castellated sheet and a substantially incompressible insulation material interposed between the inner and outer skins and shaped so that projecting ribs on the insulating material fit
 45 into the corrugations or castellations of the sheet material forming the skins.
 Preferably the ribs on the insulating material are spaced from troughs of the corrugated or
 50 castellated sheet to form continuous ventilation channels extending longitudinally with the corrugations or castellations. In this way, condensation is substantially reduced due to the ventilating effect of these air channels.
 The ribs may each be formed to provide a
 55 ventilation channel extending along the base of each corrugation or castellation.
 Preferably each corrugation or castellation formed on the outer skin is aligned with a
 60 corrugation or castellation formed on the inner skin.
 The inner and outer skins may be retained by compressive fixing means, for example by bolts or rivets passing through aligned corrugations or
 castellations of the inner and outer skins.
 Preferably the insulation material is preformed

65 to correspond to the internal profiles of the inner and outer skins.
 Preferably the corrugations (or castellations) of the sheet material run up and down the roof pitch, or vertically up and down side-walls.
 70 Preferably the profiled insulation material is composed of rigid or semi-rigid polyurethane, isocyanurate or polystyrene foam. Alternatively, it may be shaped asbestos, or other mineral fibre or particle boards or slabs.
 75 The corrugated or castellated sheet materials may be composed of metal, asbestos cement or plastics material.
 In this way it is possible to provide double-skin
 80 insulating cladding panels for the pitched roof or wall of a sheet-clad building, these having the ability to reduce condensation, and to drain away condensed moisture collecting between the two skins.
 Whilst such a panel can be fixed through a
 85 trough of an inner sheet into a purlin or sheeting rail forming the roof skeleton, an additional feature is the ability to provide a secondary fixing system based upon the joining of the outer sheet, through the insulation layer, into the inner. By
 90 means of a fastener incorporating a deformable inner washer, this secondary fixing avoids the compression problems inherent in such fixings which are normally located in the purlin or sheeting rail.
 95 The invention will be further described with reference to the accompanying single figure of diagrammatic drawing which shows a cross-section through a double-skin roof or wall panel according to the invention.
 100 With reference to the figure, outer an inner skins of castellated sheet material, preferably of coated steel, are indicated at 1 and 2 respectively. A profiled insulation material is indicated as 3. A fastener for fixing inner sheet 2 to a roof purlin or
 105 sheeting-rail is indicated at 4 and a secondary fastener for holding the insulating material in place and for joining the inner and outer skins together, passing through the insulation material is indicated at 5.
 110 A roof structure incorporating a double-skin panel according to the invention is assembled as follows:
 The inner skin of castellated sheet metal 2 is
 115 attached to an underlying purlin or sheeting-rail by means of fastener 4. The profiled pre-formed insulation material indicated at 3, is then placed on top of the inner skin so that ribs or projections of the insulating material fit into troughs or valleys
 120 of the castellated sheet 2 as shown. However the insulation material does not entirely fill such troughs or valleys and air gaps (indicated at 6) are left between the insulation material and the sheet material. These air gaps run, as channels, along the length of the castellation trough or valley. The
 125 outer skin 1 is then placed on top of the insulation material 3 and holes are drilled through the "sandwich" formed by 1, 2 and 3 to take the fastener 5. Fastener 5 has a head 5a, a shank 5b and a deformable washer 5c which ensures some

flexibility when the sandwich elements are clamped together by means of the fastener.

Claims

1. A double skin roof or wall panel for a building comprising inner and outer skins each formed of corrugated or castellated sheet and a substantially incompressible insulation material interposed between the inner and outer skins and shaped so that projecting ribs on the insulating material fit into the corrugations or castellations of the sheet material forming the skins.

2. A panel as claimed in Claim 1 wherein the ribs on the insulation material are spaced from troughs of the corrugated or castellated sheet to form continuous ventilation channels extending longitudinally with the corrugations or castellations.

3. A panel as claimed in Claim 2 wherein the ribs are each formed to provide a ventilation channel extending along the base of each corrugation or castellation.

4. A panel as claimed in any preceding Claim wherein each corrugation or castellation formed on the outer skin is aligned with a corrugation or castellation formed on the inner skin.

5. A panel as claimed in Claim 4 wherein the inner and outer skins are retained by compressive fixing means passing through aligned corrugations or castellations of the inner and outer skins to urge the skins into contact with the insulation material.

6. A panel as claimed in any preceding Claim in which the insulation material is preformed to correspond to the internal profiles of the inner and outer skins.

7. A panel according to any preceding Claim in which the insulation material consists of rigid or semi-rigid polyurethane, isocyanurate, polystyrene foam asbestos, or a mineral fibre or particle board.

8. A panel according to any preceding Claim in which the corrugated or castellated sheet material consists of metal, asbestos cement or plastics.

9. A building or structure when including in its construction a panel as claimed in any preceding Claim.

10. A building or structure as claimed in Claim 9 wherein the corrugations or castellations of the skin run up and down the roof pitch or vertically up and down the sidewalls.

11. A roof or wall panel substantially as described with reference to the accompanying drawing.

New Claims or Amendments to Claims filed on 27 March 1980.
Superseded Claim 8.

New or Amended Claims:—

1. A double skin roof or wall panel for a building comprising inner and outer skins each formed of corrugated or castellated sheet material and a substantially incompressible pre-formed insulation material interposed between the inner and outer skins and shaped so that projecting ribs on the insulating material fit into the corrugations or castellations of the sheet material forming the skins.

11. A method of roofing a building, comprising attaching an inner skin of corrugated or castellated sheet material to underlying purlins or sheeting-rails, placing a pre-formed sheet of substantially incompressible insulation material on top of said inner skin so that ribs of the insulation material fit into troughs of the sheet material, superimposing an outer skin or corrugated or castellated sheet material on the insulation material so that ribs of the insulation material fit into troughs of the outer skin and fastening all three layers together.

DEMANDE DE BREVET D'INVENTION

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de la demande

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(54) Panneau profilé auto-portant.

(72) Invention : Otto Jungeluth.

(30) Priorité conventionnelle :

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La présente invention concerne un panneau profilé auto-portant composé de deux couches extérieures, de préférence métalliques, entre lesquelles se trouve une couche de matière plastique cellulaire dure formée par moulage.

5 On connaît un panneau stratifié composé de deux couches extérieures métalliques et d'une couche d'appui rigide obtenue par moulage entre les couches extérieures et reliée rigide-
ment à celles-ci (demande allemande D.A.S. n° 1 049 075) dont les couches extérieures sont ondulées. Les ondulations
10 peuvent avoir une section en queue d'aronde afin d'améliorer l'adhérence entre la couche d'appui et les couches extérieures. Ce panneau stratifié à couches extérieures profilées présente une rigidité relativement faible. En outre, de tels pan-
neaux ne peuvent pas être posés individuellement, mais néces-
15 sistent un cadre particulier. De plus, les panneaux ne peuvent pas être posés avec recouvrement lorsqu'ils présentent un profil rectangulaire ou ce recouvrement est difficile et pro-
voque des détériorations des surfaces des panneaux car la
20 largeur des parties inférieures est tout au plus égale à celle des parties supérieures. La pose avec recouvrement est tota-
lement exclue lorsque les couches extérieures ont un profil en queue d'aronde. Un autre panneau stratifié connu (modèle
d'utilité allemand n° 1 948 155) comporte une tôle à ondu-
lations trapézoïdales comme élément de construction, une plaque
25 calorifuge et une tôle de recouvrement présentant des organes de fixation, mais les plaques calorifuges sont simplement posées sur la tôle à ondulations trapézoïdales se trouvant en
bas. Une pose avec recouvrement de plusieurs panneaux n'est
pas non plus possible. Bien que des agencements particuliers
30 aient été prévus dans la zone du recouvrement pour permettre la jonction de quatre panneaux, il reste néanmoins des joints entre les plaques calorifuges. Ces joints doivent être obturés à l'aide d'un mastic.

Les mêmes remarques peuvent être faites pour un autre
35 panneau de construction connu (modèle d'utilité allemand n° 1 885 029) qui est utilisé comme revêtement calorifuge sur des toits ou des parois en béton, etc., et qui se compose d'une

- plaque en mousse de résine synthétique présentant des ondulations des deux côtés, dont les deux faces sont recouvertes d'une couche d'étanchéification en carton ou en feuille goudronnée, d'une plaque pour la distribution de la pression superficielle et d'une couche d'étanchéification supplémentaire.
- 5 Les couches d'étanchéification ne jouent pratiquement aucun rôle dans la portance du panneau et la forme ondulée sert à la création de passages de diffusion. Les pressions superficielles sont trop élevées aux parties supérieures et inférieures
- 10 en raison de la faible surface d'appui, ce qui peut facilement conduire à des détériorations des couches d'étanchéification de sorte qu'une plaque de distribution de la pression ainsi qu'un appui sur toute la surface sont nécessaires si l'on désire pouvoir marcher sur les panneaux.
- 15 Le but de l'invention est de créer un panneau profilé auto-portant dans lequel la rigidité obtenue par la stratification est combinée avec celle que confère le profil, de sorte que la rigidité du panneau est relativement élevée tout en utilisant une assez faible quantité de matière et en réalisant un
- 20 calorifugeage suffisant. Le remplissage des joints entre les plaques avec des produits chimiques, qui peut conduire à des fuites au bout d'un certain temps, est remplacé par un recouvrement partiel aux jonctions ainsi que par des supports appropriés.
- 25 Le panneau selon l'invention est dérivé d'un panneau profilé auto-portant qui se compose de deux couches extérieures ondulées, de préférence métalliques, entre lesquelles on produit par moulage, une couche de matière plastique cellulaire dure. Un tel panneau se caractérise en ce que les couches extérieures
- 30 sont constituées par deux tôles à ondulations trapézoïdales dont la section est identique à l'exception de la partie recouvrant le joint ce qui permet un empilage facile et en ce que l'épaisseur de la couche de matière plastique cellulaire dure des flancs est comprise entre la moitié et les deux tiers de l'épaisseur des parties
- 35 supérieures, les bords longitudinaux des tôles à ondulations trapézoïdales étant conformés dans la zone du joint latéral de sorte que l'épaisseur totale des bords superposés des panneaux est approximativement identique à l'épaisseur normale des flancs et des

parties supérieures en dehors de la partie recouvrant le joint.

Le panneau profilé selon l'invention présente une rigidité notablement plus élevée que les éléments de construction connus à couches de recouvrement profilées. On assure en outre que l'isolement thermique ainsi que la rigidité statique sont suffisants et identiques à chaque endroit couvert par un ensemble de plusieurs panneaux, l'inclinaison choisie pour les flancs contribuant également à ce résultat.

La forme des panneaux selon l'invention permet en outre un empilage facile de plusieurs panneaux et la forme trapézoïdale évite, dans une large mesure, des détériorations de la surface. La pression par unité de surface est maintenue faible en raison de la surface d'appui relativement grande, même lorsqu'on marche sur les panneaux.

Selon une autre caractéristique de l'invention, on supprime l'obturation ultérieure des joints entre les panneaux, par le fait que la tôle supérieure recouvre la matière plastique cellulaire dure et la tôle inférieure sur une longueur qui correspond à la largeur du joint longitudinal sur l'une des faces transversales du panneau ainsi que, par le fait que lors du recouvrement des joints, on place tout d'abord les côtés longitudinaux des panneaux les uns contre les autres, puis les côtés latéraux. On obtient ainsi un recouvrement parfait des tôles à ondulations trapézoïdales dans la zone du joint longitudinal, ainsi que des bords des panneaux dans la zone du joint latéral, ce recouvrement étant encore amélioré au point de jonction de quatre panneaux.

On peut obtenir une meilleure protection contre la corrosion par le fait que les bords longitudinaux des tôles sont recourbés dans la matière plastique cellulaire dure.

D'autres caractéristiques et avantages de l'invention seront mieux compris à l'aide de la description détaillée qui va suivre et des dessins annexés sur lesquels :

- la figure 1 est une coupe partielle montrant un joint latéral ;

- la figure 2 est une coupe à plus petite échelle, montrant la disposition d'un panneau selon l'invention entre deux panneaux voisins ;

- la figure 3 est une vue en perspective des recouvrements des joints.

Les tôles 1, 2 à ondulations trapézoïdales, dont la section est identique à l'exception de la partie recouvrant les joints, sont maintenues à distance par la couche de matière plastique cellulaire dure obtenue par moussage. L'inclinaison des flancs 4 est choisie de sorte que l'épaisseur de la matière plastique cellulaire des flancs soit comprise entre la moitié et les deux tiers de l'épaisseur des parties supérieures.

Les arêtes 11 et 12, 21 et 22 des tôles 1 et 2 sont conformées dans la zone du joint latéral, de sorte que l'épaisseur totale des bords superposés 7, 8 correspond approximativement à l'épaisseur normale des flancs 4 et des parties supérieures 5, 6 en dehors de la partie recouvrant le joint.

Les bords longitudinaux 111 et 121, 211 et 221 sont recourbés à l'intérieur de la matière plastique cellulaire dure 3 et sont ainsi protégés contre la corrosion.

La figure 2 illustre l'assemblage avec les panneaux voisins et elle montre en particulier que les panneaux peuvent se recouvrir en partie en maintenant la même section dans les parties de recouvrement.

Comme cela ressort de la figure 3, la tôle supérieure 1 recouvre la matière plastique 3 et la tôle inférieure 2 dans une mesure qui correspond à la largeur du joint longitudinal sur l'une des faces transversales du panneau.

On obtient le recouvrement des joints des panneaux a, b, c, d en posant les panneaux tout d'abord avec leurs côtés longitudinaux les uns contre les autres de sorte que la tôle à ondulations trapézoïdales 1b recouvre la tôle 1a et que la tôle 1b recouvre la tôle 1c. On effectue ensuite le joint latéral en posant les bords 7c et 7d des panneaux sur les bords 8a et 8b.

Il est bien entendu également possible de poser les panneaux c et d l'un après l'autre.

REVENDICATIONS

1 - Panneau profilé auto-portant composé de deux couches extérieures, de préférence métalliques, entre lesquelles se trouve une couche de matière plastique cellulaire dure formée par moutage, caractérisé en ce que les couches extérieures sont
5 constituées par deux tôles à ondulations trapézoïdales dont la section est identique à l'exception de la partie recouvrant le joint, ce qui permet un empilage facile et en ce que l'épaisseur de la couche de matière plastique cellulaire dure des flancs est comprise entre la moitié et les deux tiers de l'épaisseur des
10 parties supérieures, les bords longitudinaux des tôles à ondulations trapézoïdales étant conformés dans la zone du joint latéral, de sorte que l'épaisseur totale des bords superposés des panneaux est approximativement identique à l'épaisseur normale des flancs et des parties supérieures en dehors de la partie
15 recouvrant le joint.

2 - Panneau selon la revendication 1, caractérisé en ce que la tôle supérieure recouvre la matière plastique cellulaire dure et la tôle inférieure sur une longueur qui correspond à la largeur du joint longitudinal sur l'une des faces transversales
20 du panneau.

3 - Panneau selon les revendications 1 et 2, caractérisé en ce que les côtés longitudinaux des panneaux sont tout d'abord placés les uns contre les autres, puis les côtés latéraux.

4 - Panneau selon les revendications 1 à 3, caractérisé
25 en ce que les bords longitudinaux des tôles à ondulations trapézoïdales sont recourbés dans la matière plastique cellulaire dure.

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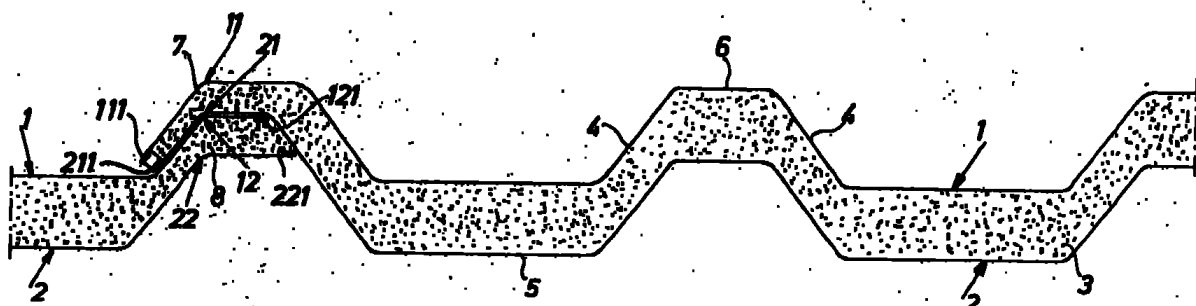


Fig. 1



Fig. 2

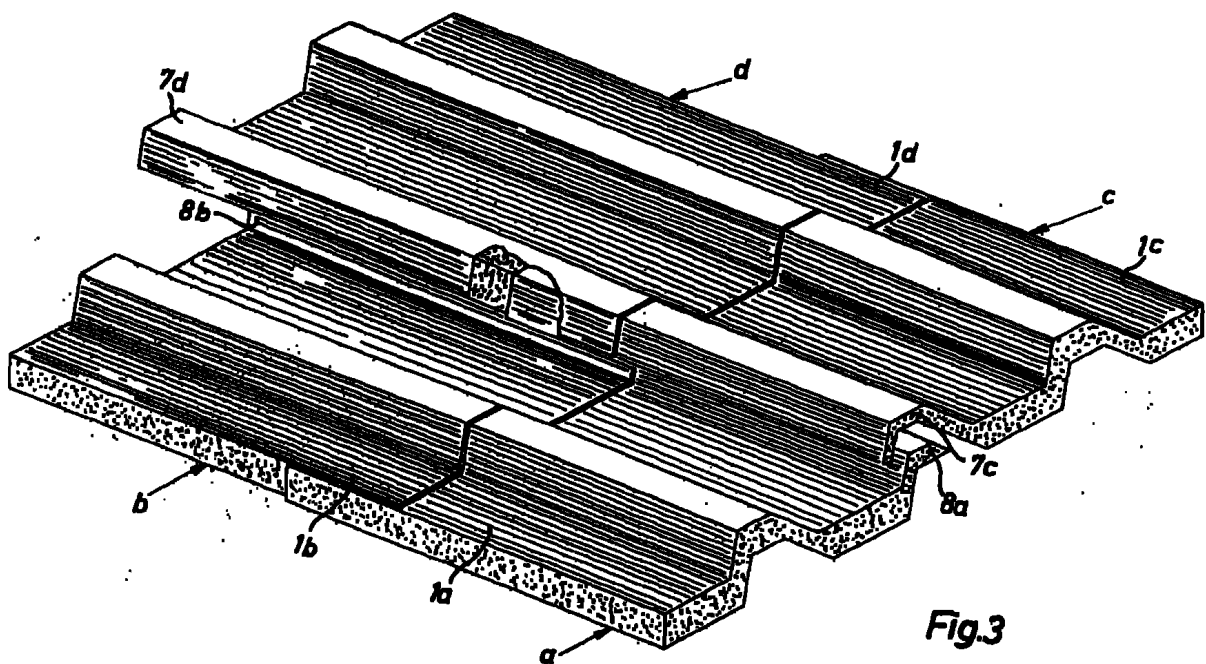
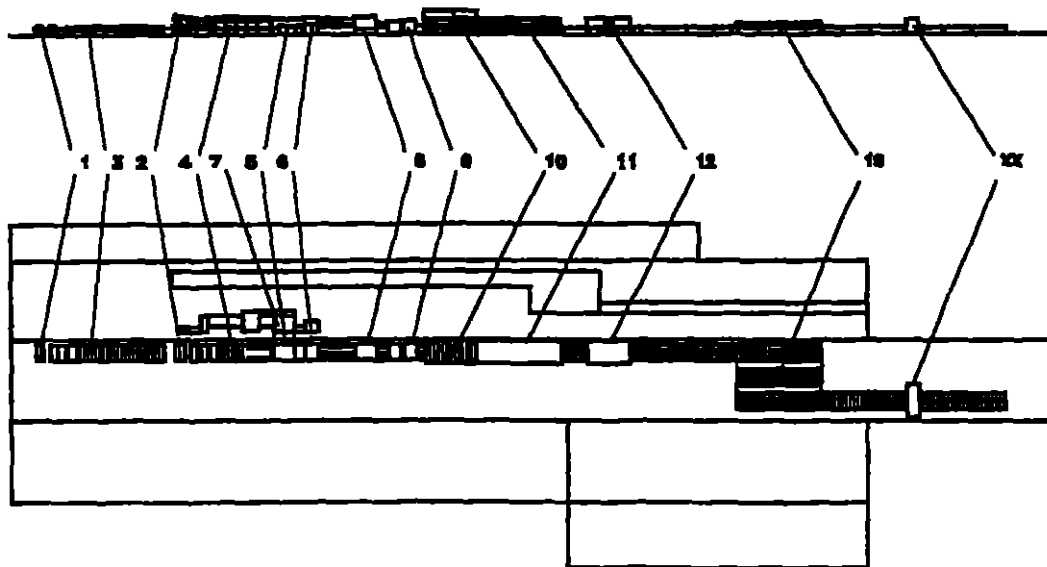


Fig.3

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(54) Title: **LIGHT BUILDING PANEL, PROCESS, AND APPARATUS FOR CONTINUOUS MANUFACTURING OF LIGHT BUILDING PANELS WITH MINERAL FILLING**



(57) Abstract

Subject of this invention is light building panel, process, and apparatus for continuous manufacturing of light building panels with mineral filling. The light building panel comprises the mineral filling made of lamellas of mineral filling, usually mineral wool, set out in parquet-like appearance and glued to upper and lower shielding layer usually made of sheet of metal. The process for its manufacturing comprises several phases starting with sheet of metal and band of mineral filling preparation, and continuing with assembly of the panel in a double band device to be concluded by cutting the band into individual panels. The apparatus for manufacturing of the panel is a device for performing the process of the light building panel manufacturing.

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**LIGHT BUILDING PANEL, PROCESS, AND APPARATUS FOR CONTINUOUS
MANUFACTURING OF LIGHT BUILDING PANELS WITH MINERAL FILLING**

Technical field

Light building panels; continuous process; production line; technology of fastening; integral production of building panels.

Technical problem to be solved

Technical problem solved by this invention is:

- tedious changing of thin colored or colorless layers of different materials during manufacturing of fireproof light building panels causing multiple delays;
- profiles of building panels which do not enable manufacturing of said panels with think layers of adhesives and hence lack of their fireproof ability, said panels manufactured with a filling or plurality thereof in one or multiple layered shell of colored or colorless layers;
- how to conduct change of tools and inlet materials without stopping the production line in the process of fireproof light building panels manufacturing;
- problems arising from classically built systems of fireproof light building elements;
- light building panels with inferior mechanical characteristics in view of their capability to withstand walking on them e.g. on roofs which are built using said panels;
- inferior cutting of filling lamellas of light building panels which does not permit thin layers of adhesives;

- impurities, in particular due to crushing of the fibers or lumps of fiber on the surface of light building panels fillings which prevent effective fusion of intact fibers of filling among themselves or between fillings with shell wall or plurality thereof;
- thickness and number of lamellas in existing systems for continuous production of fireproof light building panels do not allow production of several modular widths;
- existing systems of lamella sorting do not allow for automatic compensation of lamellas' lack of alignment due to existing fillings' tolerances;
- current systems require cutting and milling of side edge in singular phases causing existence of multiple sets of tools for different thicknesses;
- loss of heat due to imprecise alignment of two adjacent light building panels during their mounting;
- existing systems foresee guiding of lamellas using sliding guides causing delay of flank lamellas due to friction and subsequently loss of heat in finished products;
- existing calibrating systems of light building panels were developed for fillings of polyurethane hence their requirement for different side chains or spacers for each thickness;
- manual packing of finished products;
- cyclic regulation and synchronization of individual elements of apparatus;
- non uniform thickness of adhesive layers on the surface.

State of the art

Users of light building panels, i.e. the panels used in building to achieve thermal and hydro insulation or in function of separating walls, are well aware of solutions using polyurethane filling. However, due to request for fireproof ability these panels were replaced with those

using different kind of fillings, e.g. mineral wool. For the purposes of this application expressions mineral filling, mineral wool, rock wool, glass wool are to be used as describing the same material, known to the one skilled in the art of insulation. In addition, the users require of different fillings (e.g. mineral wool) additional benefits such as better ability to withstand fire, soundproof ability, ecological advantages during manufacturing, recyclability of built-in materials etc. depending on trends and regulations. The fillings which fulfill the above requirements are positioned within the shell, more precisely, between both outer layers of building panels in different ways, known to those skilled in the art. For example:

(a) sandwich design on the final destination - on facades by assembling sheets of metal which are profiled according to requests of the mode of assembly, spacers, mineral wool panels, profiled cover of thin profiled sheets of metal; on horizontal or up to 6° tilted roofs, however, this design comprises deep profiled sheets of metal, vapor barrier made of impermeable materials, panels of rigid mineral wool and final layer of flexible bands (e.g. bitumen, thin sheets of metal or of plastics); well known example of this type is so called Hoesch system.

(b) sandwich design away from the final destination - by assembling previously profiled sheets of metal and mineral wool using manual or semi-automatic processes for attaching using adhesives in moulds which is rather simple and discontinuous process, e.g. so called Paroc system described in SI 9110235 A; the characteristic of this process is staircase like scatter, lamellas which are glued together, cutting of preformed filling to desired length, coating of sheets of metal with adhesives and discontinuous pressing of sheets of metal coated

with adhesive onto the filling.

(c) sandwich design away from the final destination using continuous process comprised of cutting of mineral wool into lamellas, orientation of wool fiber perpendicularly to profiled sheets of metal (widely used and known from the reference buildings of the applicant and shown to the public on several fairs); well known continuous process is characterized mainly by side guiding using slide linear guides which causes scattering (lack of alignment) of flank lamellas and subsequent increased heat loss in finished products; the product manufactured using this system can be recognized due to its parquet-like appearance whereby the current technology does not foresee adjustments of possible scatter due to inaccuracy or system error of the process;

(d) manufacturing of suitably designed panels of mineral wool at mineral wool manufacturers which would enable assembly of sandwich design away from final destination without cutting; Rockwool corporation experiments are known.

Description of the invention

Subject of this invention is Light Building Panel, Process, and Apparatus for Continuous Manufacturing of Light Building Panels with Mineral Filling and solves the above described technical problem as shown below.

Fireproof light building panels, the subject of this invention, comprise at least three layers: upper of sheet of metal, central (middle) of filling which is mostly of mineral wool, and

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lower of sheet of metal. Both upper and lower layers can be profiled. Both outer (i.e. upper and lower) layers can be attached to the middle in permanent fashion, e.g. with use of appropriate adhesives.

Light building panes, the subject of this invention, comprise at least three layers: two outer layers, i.e. upper, and lower of which at least one is made of sheet of metal, and the other either of sheet of metal or of other kind of material (e.g. bitumen band, paper, aluminum, plastic, etc.), and of middle layer of filling, preferably mineral wool. Both lower and upper layer can be profiled.

The profile of either one of the outer layers profile comprises at least of side edge which is made by bending the material of the outer layer, said side edge limiting transversal (i.e. perpendicular to the direction of production of said panel) movement of the filling and provides said panel with strength.

The upper outer layer made of materials described above performs a function of upper shielding and/or forming means whereas the lower outer layer made of materials described above performs a function of lower shielding and/or formative means. For the purposes of this application the expressions upper outer layer and/or upper layer and/or upper sheet of metal refer to upper outer shielding and/or formative means whereas the expressions lower outer layer and/or lower layer and/or lower sheet of metal refer to lower outer shielding and/or formative means.

Manufacturers deliver thin colored sheets of metal, preferably steel or aluminum which may be coated with plastic layer coiled in rolls. Using decoiling drums the sheet of metal is straightened and is through the compensation loops known in the state of the art, shears for cutting, and rollers guided to the tools for profiling which are set within so called grooving machines. The word decoil in this application means to straighten that which was previously coiled.

The profile of the particular product manufactured in grooving machines depends on several factors, in particular on efficient use of material, appropriate design to customer's liking, and manufacturing of panes of sufficient quality. Depending on these factors one determines the size of rollers and the ratio between the use of material and strength of the finished product (panel) taking into account mechanical characteristics (e.g. elastic modulus) of the material.

The tools for profiling are set within the grooving machines using particular profiling pairs of tools or using cassettes characterized in that several profiling pairs of tools are positioned on particular platform ('cassette') which enables fast and simple change of the tools for profiling.

The change of materials during manufacturing is achieved using double decoiling drums, decoiling drum with double spindle, or double carriage and single decoiling drum, all of these solutions known to one skilled in the art of manufacturing light building panels with polyurethane filling. The control of inflow of material must be capable of accelerating new material to compensate for time lost changing said material.

The new solution to the technical problem of changing thin colored or colorless layers from different material in the process of manufacturing of fireproof light building panels while keeping the interruption of production to minimum is seen in combination of technology enabling fast change of tools and materials, described below in preferred embodiment.

The new solution of profile manufacturing of panels comprised of one or plurality of fillings in one or multiple shells from color or colorless layers of various materials in the process of manufacturing of fireproof light building panels solving the problem of thin coating of shell with adhesive (which is of utmost importance to fireproof ability of the panels) is characterized in a definition of profiles. The profiles in question should be either trapezoidal or linear or combination thereof.

The new solution pertaining to fireproof ability of the panels is demonstrated by using fillings of particular mineral wool with density at least 115 kg/m^3 . In particular, the mineral wool fillings of density between 115 kg/m^3 and 135 kg/m^3 is used for fireproof light building panels with appropriate mechanical characteristics (e.g. load capacity, pressure strength), and the mineral wool fillings of density between 135 kg/m^3 and 165 kg/m^3 used for light building panels for walkable flat roofs which should without permanent deformation withstand usual loading during exploitation and local pressure applications (walkability).

With the new technical solution fireproof light building panels of length ranging between 2000 mm and 14000 mm is foreseen, and thickness ranging from 60 mm to 200 mm. These thicknesses can be achieved using presented method and apparatus whereby the mineral wool

panels supplied in lengths of up to 1200 mm can be used. At the same time the apparatus can be adjusted to manufacture final panels of widths between 800 mm and 1200 mm based on thickness of supplied mineral wool panels ranging between 70 and 76 mm, and assuming even number of lamellas. For example, 14 lamellas of thickness of 72 mm provides for 1000 mm width of finished fireproof light building panel.

The supplied mineral wool panels must be cut into lamellas, and then lamellas joined in parquet-like system prior to light building panel assembly, this already known in the state of the art, in particular in buildings equipped by the applicant. This process comprises of cutting of panels of mineral wool into lamellas, turning these lamellas for 90°, forming sets of lamellas and rearranging lamellas within its set to parquet-like assembly. A longitudinal and side forces are applied to this parquet-like assembly to form continuous band of lamellas used in further manufacturing of light building panels.

Due to inaccuracies occurring during cutting of lamellas or due to nature of material of the lamellas irregularities in parquet-like arrangement may occur, particularly, the shift of a lamella or plurality thereof may occur resulting in change of overlap of adjacent lamellas. These are overcome by instituting a feedback loop for inserting a corrective lamella which is of appropriate length so by its insertion the parquet-like arrangement is restored.

This novel solution also provides for such quality of cut during production of lamellas that thin layer of adhesive can be applied to mineral filling in the process of its attachment to the other layers.

In addition, such system for milling and trimming (cutting) of mineral filling is foreseen to provide for milling and trimming of each edge of the band of lamellas in a single phase and using same set of tools regardless of the thickness of the band of lamellas.

To remove the remnants of cutting and milling, and to remove impurities of other sources prior to final assembly of the product the surfaces of the band of lamellas are cleaned using a suction system. Following that, a thin coat (layer) of adhesive is applied to appropriate band of lamellas surfaces in order to attach it to the outer layers in the assembly process. Both the characteristics of the adhesive and its application are important to achieve fireproof ability (within meaning of this word for the one skilled in the art of manufacturing light building panels). The adhesive should be applied uniformly in film or droplet form, or by spraying it over most of the band of lamellas.

The band of lamellas should be properly introduced between both outer layers. In this novel approach, introduction of said band of lamellas from the side is used. Then, the outer layers and the mineral filling are assembled in a double band device, however, prior to assembly the band of lamellas must be aligned as the previous process may have compromised the alignment of adjacent lamellas.

Within the double band device the outer layers and the mineral filling are assembled into a continuous light building panel band to be cut into light building panels of appropriate length upon exiting from the double band device. If appropriate, an eaves is manufactured. Then, the light building panels are inspected, and loaded for transport using novel loading process.

The process, subject of this invention, can be controlled by microprocessor, built into or connected to the control panel.

The subject of this invention is further described with help of embodiments presented below and by accompanying drawings whereby the drawings are part of this application and represent:

Fig. 1. shows the layout of an apparatus with decoiling drum for an upper layer (1), decoiling drum for a lower layer (2), a grooving machine for lower layer (3), a grooving machine for upper layer (3), a device for inserting ribs of mineral filling (5), mineral filling cutter (6), a device for sorting and inserting of mineral filling (7), a preheating chamber (8), adhesive application device (9), decoiler of flexible material band (10), a double band device (11), a bandsaw (12), an upper side chain (13), a lower side chain (16), a system for unloading (19), a packaging device (20).

Fig. 2 shows a roof building panel profile with an upper sheet of metal (21), a mineral filling (22), a lower sheet of metal (23), an adhesive layer (29).

Fig. 3 shows two interconnecting roof building panel profiles before and during interconnection with the upper sheet of metal (21), the mineral filling (22), the lower sheet of metal (23), the adhesive layer (29).

Fig. 4 shows a facade building panel profile with the upper sheet of metal (21), the mineral

filling (22), a lower sheet of metal (24), the adhesive layer (29).

Fig. 5 shows two interconnecting facade building panel profiles before and during interconnection with the upper sheet of metal (21), the mineral filling (22), the lower sheet of metal (23), the adhesive layer (29).

Fig. 6 shows details of the lower sheet of metal (23) of roof panel.

Fig. 7 shows details of the upper sheet (21) of roof and/or facade panel.

Fig. 8 shows a wavy roof building panel profile with the mineral filling (22), a lower sheet of metal (25), the adhesive layer (29).

Fig. 9 shows two interconnecting wavy roof building panel profiles with the mineral filling (22), the lower sheet of metal (25).

Fig. 10 shows sealing of the facade building panel using sealing band (30).

Fig. 11 shows sealing of the roof building panel using sealing band (30).

Fig. 12 shows two embodiments of cutting of mineral filling panels of width L and L_1 into lamellas of width h_1 and h_2 whereby plurality of lamellas (26), a set of circular saws (33), the mineral filling panels (81) are shown.

Fig. 13 shows the mineral filling panel (81) sliding on a feeder (32) toward set of n circular saws (33) and a panel comprising lamellas (26) from surface of which a suction head (39) removes particles, lumps and/or dust of mineral fibers.

Fig. 14 shows an accumulation station with the set of circular saws (33) and the accumulation station (82).

Fig. 15 shows change of lamellas direction in a direction changing station (83).

Fig. 16 shows separating into individual lamellas (26) or groups thereof with a sorting feeder (84) and turning of lamellas (26) for essentially right angle around the center using a turning table (85).

Fig. 17 shows a rearranging device (87) with even (26a), and odd (26b) lamellas, a set of lamellas (86), a side guiding belt (88), band of lamellas (89), a transverse roller (90).

Fig. 18 shows a panel comprised of lamellas (26) of mineral filling as a part of band of lamellas, shifted for an overlap in longitudinal direction for even (26a) and odd (26b) lamellas.

Fig. 19 shows a panel comprised of lamellas (26) and corrective lamellas (28) as a part of band of lamellas including even (16a) and odd (16b) lamellas.

Fig. 20 shows a panel of mineral filling (36) as a part of band of lamellas sliding on a feeder toward circular saws (35) for trimming (cutting) and milling tools (37) for milling of edges of a mineral filling panel (36) as a part of the band of lamellas and suction head (39) for removing parts, particles, and/or lumps of mineral fiber.

Fig. 21 shows mineral filling for roof (22a) panel or facade (22b) panel with milled off edges (38) for better conforming to the sheet of metal.

Fig. 22 shows entering of the band of lamellas into the double band device (11), the side guiding belt (88), the band of lamellas (89), the transverse roller (90), freely rotatable side roller guides (92) which shape conform to the shape of the edge of the band of lamellas (89).

Fig. 23 shows layout of connection between the preheating chamber (8), the adhesive application device (9), and the double band device (11).

Fig. 24 shows an application of adhesive coating onto the lower surface of the band of lamellas (89) using lower mixing head (41).

Fig. 25 shows an application of adhesive coating onto the upper surface of the band of lamellas (89) using upper mixing head (41) and lower mixing head (42) whereby the upper outer layer (21), the lower outer layer (23, 24), a radius of double bending R and uncontrolled horizontal shift d are shown.

Fig. 26 shows cross section across the double band device (11) with upper chain links of side chain (13, 14), and lower chain links of side chain (16, 17) whereby the upper layer (21), the band of the lamellas (89), and the lower layer (23, 24) are shown.

Fig. 27 shows a system for attachment of a flexible material band (45) decoiling from decoiling drum for flexible material (44) and travelling through a system for preheating of bands of flexible material (46) (a.k.a. heating, detachable chamber (46)) with a system for cooled air or gas suction (47) to be regenerated whereby the band of lamellas (89), the upper mixing head (41), the double band device (41) are shown.

Fig. 28 shows loading (padding) of the panels (finished products) whereby the pads (51), L_{SVB} a net distance between the pads (51), L_{pak} a length of the panels including predetermined tolerance of loading of at least two light building panels, L_{pad} a pad (51) length, N a number of pads (51) in the package, T_{pak} a distance of an edge of the pad from an edge of the panel are shown.

For straightening of the sheet of metal the decoiling drums of at least 2,000 kg capacity should be used enabling use of the sheet of metal up to 1.50 m in width and with roll diameter up to 1.5m.

The sheet of metal to be profiled is profiled in grooving machine, i.e. the upper sheet of metal in upper grooving machine (4), and the lower sheet of metal in lower grooving machine (3).

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The thickness of materials to be profiled in the upper grooving machine (4) ranges:

- colored steel sheet of metal 0.4 to 0.9 mm;
- plastic coated steel sheet of metal 0.4 to 0.8 mm;
- colored or colorless aluminum sheet of metal 0.5 to 0.9 mm;
- stainless steel 0.4 to 0.8 mm;
- surface treated steel 0.3 to 0.7 mm;
- copper sheet of metal 0.4 to 0.9 mm.

The thickness of materials to be profiled in the lower grooving machine (3) ranges, in the first preferred embodiment:

- colored steel sheet of metal 0.5 to 1.1 mm;
- plastic coated steel sheet of metal 0.5 to 0.9 mm;
- colored or colorless aluminum sheet of metal 0.5 to 1.1 mm;
- stainless steel 0.4 to 0.8 mm;
- surface treated steel 0.3 to 0.7 mm;
- copper sheet of metal 0.4 to 0.9 mm

The thickness of materials to be profiled in the lower grooving machine (3) ranges, in the second preferred embodiment:

- colored steel sheet of metal 0.4 to 1.35 mm
- plastic coated steel sheet of metal 0.4 to 0.8 mm;
- colored or colorless aluminum sheet of metal 0.5 to 1.35 mm;
- stainless steel 0.4 to 0.8 mm;

- surface treated steel 0.3 to 0.7 mm;
- copper sheet of metal 0.4 to 0.9 mm.

The combination of technology enabling fast change of tools and material while keeping the interruption of process to minimum is seen in the following combination of technology: one decoiler of the upper layer (2), and one decoiler of the lower layer (1) using double carriage which enables change of sheets of metal during production at lower speed. The tools are positioned on cassettes which can be changed simply and fast. The facade panel cassette, for example, comprises two tools and enables the change between two different pre-chosen profiles of facade panels without interruption and further change.

To permit the coating of the shell, be it either from one or multiple layers, with thin layer of adhesive (which is of utmost importance to fireproof ability of the panel), the profiles should be either trapezoidal, or linear, or combination thereof. In the preferred embodiment for manufacturing the panel used for roofing, in the way of example the applicant presents a panel comprising upper (21) and lower (23) sheet of metal and the mineral filling (22), all elements connected between themselves using layer of adhesive (29). Said panel features lower ribs or protrusions in periodic distances between themselves ranging from 200 to 300 mm and particular endings. These features, and two adjacent interconnecting profiles are seen in accompanying Figures 2, 3, 6, 7, 10. Further the applicant presents the preferred embodiment used for facades, in the way of example, a panel comprising the upper (21) and a lower (24) sheet of metal and the mineral filling (21). The novel solution of saving and optimization of the production due to (a) symmetry of the profiles of the upper and the lower

layers, and (b) equality between the upper profiles of both roofing and facade panels is seen in Figures 4, 5, 7, 11. Further the applicant presents the novel solution of wavy roofing panel comprising the filling (22) of either polyurethane or combination of polyurethane and mineral filling, and a lower sheet of metal (25), which can be seen in Figures 8, 9. The latter embodiment features combination of materials by alternately positioned materials one on the other. Accompanying drawings show a manner of interconnecting of two adjacent profiles in the way of partial overlapping. The drawings also show protrusions which add to the strength of the panels and endings which provide means for interconnecting between adjacent panels should there be no protrusions as the panels featuring protrusions should be interconnected by partial overlapping. In addition, the profiles (sheets of metal) of different material are attached to the mineral filling by applying thin layer of adhesive (29). As stated above, the technical details of these profiles are shown in Figures 2 through 9 and are hereby incorporated into the description as their description using the words would be too complicated. As mineral filling (22) the applicant in the way of example a band of lamellas (89) cut in appropriate length is foreseen, both expressions (mineral filling and the band of lamellas) describing the same arrangement for the purposes of this application.

The protrusions and/or ribs (23), referred to in the previous paragraph, are of trapezoidal cross section with width of narrower of both base sides ranging between 20 and 30 mm, inner trapezoidal angle ranging between 23° and 33° and height ranging between 33 and 40 mm, whereby the values at which particular savings were achieved are width of narrower of both sides of 25 mm, inner trapezoid angle of 25°, and height of 37 mm, all of which originates from 1250 mm total width of outside layer. Therein, the inner trapezoidal angle

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is defined as angle formed by either one of the sides of the trapezoid and the line perpendicular to both base sides of the trapezoid.

Further, in the preferred embodiment the applicant suggests use of vapor barrier between two adjacent panels in their lower junction, said barrier achieved using appropriate sealing band (e.g. O ring) (30) using standard materials. For less demanding applications this can superseded by overlapping of sheets of metal and wool layer in the junction.

The panels are manufactured using process in which the mineral filling is preprocessed and attached to the outer layers. The mineral filling is in preferred embodiment supplied in form of panels of filling (81) of width L and length $\tilde{S}$, whereby the filling is mineral wool. The panels (81) are cut into lamellas (26) using herewith described technology. The lamellas (26) are assembled into sets (86) comprising of plurality of adjacent lamellas, said lamellas adjoined along their longer sides. These sets of lamellas (86) are then rearranged in the parquet-like fashion and then connected into continuous body of parquet-like arranged lamellas (89), henceforth denoted band of lamellas (89).

Said panels (81) are first cut into lamellas (26) using set of at least two circular saws (33) so that lamellas of appropriate length, width, and thickness are obtained at the exit. In the way of example, for light building panel of width 1000 mm and thickness of 500 mm the set comprised of 9 circular saws (33) is used to manufacture lamellas which are 600 mm long, 150 mm wide and 72 mm thick. Then, the groups of lamellas are accelerated to accumulation station (82) and then to the direction changing station (83). The latter changes the direction

of lamellas movement from lengthwise to widthwise and facilitates the lamellas to move toward sorting feeder (84) which separates groups of lamellas in individual lamellas and feeds them synchronously onto a turning table (85) in such a fashion that each chamber of said turning table (85) is populated by one lamella (26). A transport of lamellas toward sorting feeder (84) is achieved by means of conveyer belt whose velocity is higher than accommodating velocity of sorting feeder (84) thereby achieving contact between the lamellas (26) in the direction of their movement. Actual number of lamellas which are used to form sets of lamellas from the turning table (85) depends on modular size of finished product. In the way of example for modulus of 1000 mm number of lamellas is 14 provided that the panel (81) thickness is 72 mm.

A group comprised of at least two lamellas (26) continuing their way from the turning table (85) is called a set of lamellas (86). This set is characterized in that lamellas are separated by means of separators such as guide tubes or similar and are moving along the length of the lamellas with similar velocity whereby the lamellas are essentially aligned in direction perpendicular to the direction of their movement (i.e. sidelong). The set of lamellas (a.k.a. lamella set) (86) is transported to the rearranging device (87) used only for start-up of the operation. Said rearranging device provides for rearrangement of the lamellas to form parquet-like appearance and is not needed following the start-up of the operation as lamellas are lengthwise connected thereby achieving rearrangement. Rearranging device is positioned at the end of separators, and after the rearranging device lamellas are no longer separated but connected at the sides. Using at least one side guiding belt (88) the side force is exerted on the lamellas (86) hence transforming separate sets of lamellas (86) into continuous band

of lamellas (89) characterized by its parquet-like appearance when observed from above. In the way of example, if lamellas are 600 mm long, the ideal rearrangement would consist of alternately shifted lamellas which partially overlap, said overlap of approximately 300 mm, i.e. for half of lamella's length. Said continuous band of lamellas (89) should be aligned in vertical direction by means of the transverse roller (90) positioned perpendicularly to the direction of the band of lamellas (89) movement. Said side guiding belt (88) is driven by means of an engine or an electromotor whereby its velocity is higher of that of band of lamellas (89) thereby ensuring lengthwise attachment between lamellas and protecting the parquet-like formation from disarranging. The velocity of the side guiding belt (88) exceeds that of the band of lamellas for 3 % to 20 %.

Due to inaccuracies occurring during the process the of lamellas (26) or due to nature of material of the lamellas irregularities in parquet-like arrangement may occur, particularly, the shift of a lamella or plurality thereof may occur resulting in change of overlap of adjacent lamellas. This novel solution provides for feedback loop to insert a corrective lamella (28) of different length when compared to the lamella (26). This insertion restores previously described overlap if the shift of the lamellas (26) exceeds that which is tolerated due to prescribed tolerances. In the way of example, if the lamella (26) length is 600 mm and required overlap approximately 300 mm, and further if the tolerance of the scatter is 100 mm then the overlap between adjacent lamellas (26) should not exceed 400 mm and be at least 200 mm. The overlap between adjacent lamellas changes due to mechanical characteristics of the filling and technological properties of the process (e.g. inaccurate cutting etc.). If in the way of example described overlap exceeds the tolerance, e.g. if the overlap exceeds 400

mm or is less than 200 mm then the invented process requires that the corrective lamella (28) or plurality thereof is inserted between two lengthwise adjacent lamellas, e.g. 100 mm long corrective lamella (28) so the overlap in the range 200mm to 400mm is restored. It should be stressed that these numerical examples only illustrate the inventive idea and should not be taken as limiting the use of invented technology. The applicant suggests that the length of the lamellas (26) should range between 300 mm and 1000 mm, and the length of the corrective lamellas should range between 50 mm to 300 mm.. The actual overlap is measured using optical probes. As a reference, a position of the lamella (26) in any arbitrary column of lamellas may be used. In the preferred embodiment, the lamella (26) position at the edge of the band of lamellas (89) is used.

Further, such quality of a cut while cutting the filling in a mineral filling cutter (6) is achieved that thin layer of adhesive can be successfully applied, said thin layer of importance to provide for fireproof ability of the finished product. A tolerance of the cut of ± 0.3 mm is suggested. In the preferred embodiment, the supplied mineral filling panel (81) of width L slides over a feeder (32) toward the set of n circular saws (33) whereby n is equal or greater than 2. The set of circular saws (33) provides for simultaneous cutting of said mineral filling panel (81) into lamellas (26) of width $L/(n+1)$.

The preferred embodiment also features novel system of milling and trimming (cutting) of the mineral filling using circular saws. The cutting is necessary to provide for appropriate width of the light building panel, and milling for good contact between side lamella and the outer layer of the light building panel. At least one circular saw (35), and usually at least two

circular saws (35) attached onto the same axle (coaxially) and width of the light building panel apart trims (cuts) edges of the band of lamellas (89) to the modular width (i.e. the width corresponding to particular size = modulus of the light building panel). The band of lamellas (89) thickness usually ranges between 60 to 200 mm. In addition, the saw (35) or plurality thereof breaks the cut-off (trimmed-off) edges of the band of lamellas (89) into pieces which are then removed by means of suction system described below. Thereby the normal of the plane of the circular saw (35) lies essentially perpendicular to the normal of the upper surface of the band of lamellas (89), however, other angles depending on the requirements of the final customer may be formed. The projection of the circular saw (35) plane onto the upper surface of the band of lamellas (89) plane lies is essentially parallel to the direction of the band of lamellas (89) movement. This solution addresses the technical problem of trimming requiring multiple sets of tools adjusted to different lamella sizes (thicknesses). Following the trimming, the band of lamellas (89) is transported to at least one milling station to have its edge or plurality thereof milled by at least one milling tool (37), usually in the case of facade light building panels at least two milling tools (37) on one (e.g. left) side and at least two milling tools (37) on another (e.g. right) side, and usually in the case of roof light building panels at least one milling tool (37) on one (e.g. left) side and at least one milling tool (37) on another (e.g. right) side. The milling tool (37) thereby forms appropriate profile (38) of the light building panel's edge in order to achieve proper connection between two adjacent light building panels during the mounting phase. As signified above, by using only four milling tools (mills) and/or milling tool forms (left and right milling tool for roof panels, left and right milling tool for facade panels) the whole spectrum of different dimensions for each type of roof or facade panels are covered.

The preferred embodiment of herein described process and apparatus provides of the cleaning of lumps or particles from the surfaces of the band of lamellas (89) following the trimming (cutting) and milling operation. The suction head (39) removes by means of suction various particles, fragments, and lumps from the surfaces of the band of lamellas (89) and thereby improves the mechanical characteristics of said surfaces to enable application of thin coat (layer) of adhesive means, e.g. glue. The coat is deemed to be thin if each coat (layer) of adhesive does not exceed 500 g/m^2 . Similar suction heads (39) are applied both following the trimming, and milling operations.

Special adhesives with appropriate characteristics applied in particular fashion enable manufacturing of fireproof light building panel. The adhesive should be uniformly applied in film or droplet fashion or sprayed over most of the surface of the band of lamellas (89) by the adhesive application device (9). This device ensures uniform coating of the adhesive on upper and/or lower side of the band of lamellas (89) by periodic or oscillatory moves essentially perpendicular to the movement of the band of lamellas (89). To (a) achieve sufficient strength of the union between the mineral filling and the outer layer or plurality thereof, and (b) increase fire resistance of the light building panel it is of utmost importance that quantities of applied adhesive (glue) remain locally within the suggested ranges of 90 to 110 g/m^2 . In the way of example, between 0.1 kg/m^2 and 0.5 kg/m^2 of adhesive is used for the panel of 1000 mm width, said adhesive mixed with up to 45 % total adhesive mass of water for connecting the band of lamellas (89) to the lower outer layer (23, 24, 25). The adhesive is applied to the upper surface of the band of lamellas (89) which is to be attached to the upper outer layer by upper mixing head (41), and to the lower surface of the band of

lamellas (89) which is to be attached to the lower outer layer by upper mixing head (42). Thereby the suggested velocity of the band of lamellas (89) is in the range between 4 to 8 m/min. In the way of example, the characteristics of the adhesive (glue) (preferably "Poliol-CO2 foamed" and "Isocyanate-MDI") are as follows: viscosity up to 2 Pas; density up to 1500 kg/m³, reaction time in the laboratory: open time 15-20s, alternative open time over 64 s and developing in a double band device (11) at temperature of up to 50°C for up to 3 minutes whereby "Poliol-CO2 foamed" and "Isocyanate-MDI" are mixed in ratio 1: (1.1 to 1.5) according to weight. In this particular embodiment the upper and the lower outer layer are made of sheet of metal.

Further the new technical solution is presented by side introduction of the band of lamellas (89), which are further guided from the side. The band of lamellas (89) is introduced into the double band device (11) using side roller guides (92) which shape conform to the shape of the edge of the band of lamellas (89), said side roller guides (92) freely rotatable. The double band device (11) facilitates the permanent (i.e. non-removable) attachment of the upper outer shielding and/or formative means and the band of lamellas (89) and the lower outer shielding and/or formative means and the band of lamellas (89) by vertically applying force, resulting structure denoted as continuous light building panel band. Said light building panel band is then cut into light building panels (finished product). However, prior to introduction of said band of lamellas (89) into the double band device (11) the lamellas within the band of lamellas (89) are aligned as they may have shifted because of double bending. The suggested angle of introduction from the side is in the range between 7° and 13° with best results expected between 9° and 10°. This angle of introduction enables

introduction of band of lamellas (89) of thickness ranging from 50 mm and 250 mm with best results between 60 mm and 200 mm. The band of lamellas (89) prior to introduction into the double band device (11) is not supported due to requirements of adhesive application device (9) (mixing heads) which must perform unobstructed so the introduction (guiding) is achieved by means of freely rotatable side rollers with shape conforming to the shape of the edge of the band of lamellas (89). Said side rollers provide predetermined side force and subsequently enough friction between lamellas to enable unsupported introduction of the band of lamellas (89) onto the lower outer sheet of metal.

Entering the double band device (11) in above described fashion present another technical problem which needs to be solved, namely double bending of the band of lamellas (89) whereby said double bending is seen in side-view perpendicular to the double band device (11) movement. Said double bending is needed to lower the level of the band of lamellas (89) from the level of arrangement of lamellas (26) onto the level appropriate for introduction into the double band device (11). Double bending with a radius R causes uncontrolled horizontal shift d of lamellas (26) upon entering into the double band device (11). This technical problem is solved by means of combining side and lengthwise (i.e. along axis or main direction of the band of lamellas movement) forces. The lengthwise force is achieved by increased velocity of the band of lamellas (89) and additional driving rollers positioned above the side (edge) lamellas at the milling station, said driving rollers compensating for additional friction caused by milling. The side force is achieved by applying pressure through preset side guiding rollers (92) which may be freely rotatable. The side force is necessary to (a) cause appropriate friction among adjacent lamellas (26) which prevent shifting of lamellas

and/or gap appearance, and (b) prevent piling of lamellas by increasing the lengthwise force. Before the first bend the band of lamellas (89) is aligned by at least one alignment roller (91) whereby the alignment roller (91) is positioned above the band of lamellas (89) after the first bend area in such a fashion that its centerline lies in a plane parallel to the band of lamellas (89) plane and its centerline is perpendicular to the band of lamellas (89) direction of movement. At the same time said alignment roller (91) limits vertical shift of adjacent lamellas (26) in the band of lamellas (89). In addition, the double band device (11) exerts sufficient vertical force to compensate for possible vertical shift among adjacent lamellas (26) by partially deforming the lamellas in vertical direction and partially squeezing of the adhesive into the lamellas. The condition for successful operation of one or more alignment roller (91) is locally reduced side force and subsequently locally reduced friction among lamellas.

Within the double band device (11) the band of lamellas (89) is guided by at least one side chain. The technical problem of side chain as known to the one skilled in the art is requirement of different side chain or spacer for each type (size) of the product. This technical problem is solved in this invention by using at least two synchronously operated side chains. Existing systems which were developed for products filled with polyurethane fillings consist of double band (as continuously operating device) and side chains for calibrating the finished product. The side chains as known to the one skilled in the art are continuous endless ribbon with the shape of desired profile of the finished product side which limits expansion of polyurethane and defines the side of polyurethane type of filling. The novelty of this application is shown in such a process and apparatus for manufacturing of

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fireproof light building panels which uses two separate simultaneously operated side chains which limit and guide the light building panel band in such a fashion that the contacting element (e.g. chain link) of an upper chain conforms to and by virtue of its shape limits and further via friction transmits own momentum on at least one upper edge of upper shielding and/or formative means which are comprised by the light building panel band. On the other hand, the contacting element of a lower chain conforms to and by virtue of its shape limits and further via friction transmits own momentum on at least one lower edge of lower shielding and/or formative means which are comprised by the light building panel band. The edges of upper and lower shielding and/or formative means comprised by the light building panel band which were formed prior to entering the double band device(11) using respective grooving machines (4,5) henceforth limits (restricts) the band of lamellas (89) and prevents the adhesive to expand outside the area restricted by the edge of upper and/or lower shielding and/or formative means. In the way of example, the upper sheet of metal (21) is guided using conforming elements (i.e. the contacting elements) of at least two upper side chains (13, 14) both of which can be adjusted in height to accommodate different thicknesses of particular fireproof light building panel and can be adjusted in width to accommodate different widths of particular fireproof light building panel. Thereby the conforming elements of the upper side chains (13, 14) are simplified negatives of profiles of edges of upper sheet of metal (21) and hence of upper edges of the light building panel band. In another way of example, the lower sheet of metal (23), or in the case of facade panels the lower sheet of metal (24), or in the case of wavy roof panels the lower sheet of metal (25), is guided using conforming elements of at least two lower side chains (16, 17) both of which can be adjusted in width to accommodate different widths of particular fireproof light building panel. Thereby the

conforming elements of the lower side chains (16, 17) are simplified negatives of profiles of edges of lower sheet of metal (23, 24, 25, respective on particular light building panel) and hence of lower edges of the light building panel band. Further, due do to similar profiles among the panels as described above (figure 2 through figure 9) the same upper side chains (13, 14) can be used so there is no need to change it during switching between manufacturing different types of panels. Further, the bitumen band or other flexible material (45) can be used instead of the upper sheet of metal in the same device (11).

On the side of the band of lamellas (89) and before entering of the band of lamellas (89) into the double band device (11) there is at least one device for attaching side protecting means. Said attaching is performed along the length of side surfaces (i.e. not base surfaces) of the band of lamellas (89) using polyethylene bands, PVC bands or bands of other type of material whereby these bands present technological protection of side chains against fouling by adhesive, fiber particles or other mechanical or chemical impurities while they present functional protection of finished product (i.e. light building panel) against humidity until the mounting of said panels. The widths of the bands are adjusted according to various thicknesses of light building panels.

Instead of sheets of metal one may use flexible bands such as bitumen, thin sheets of plastics, paper, or thin sheet of aluminum. In that case the presented system enables the attachment of lower surface of the band of lamellas (89) onto the lower sheet of metal while enabling the attachment of the upper surface of the band of lamellas (89) onto the natron paper, aluminum sheet, sheet of plastics, bitumen band (henceforth commonly referred to as

'flexible material'). The different materials can be switched without interrupting the process using accumulation loop and/or joining table. This system also requires device for preheating of the flexible material to soften said flexible material in order to achieve good attachment while not significantly reducing the strength or even tearing (severing) of said flexible material band. In the way of example, there is decoiling device for flexible material (44) positioned over the double band device (11) with decoiling drums (44) of capacity up to 2.000 kg, width of flexible material up to 1.3 m and diameter of roll of flexible material up to 1.2 m.

The attaching using adhesives in the embodiment using at least one flexible band is performed prior to entering the double band device (11) with at least two mixing heads (41) which are positioned on the oscillating devices, said mixing heads (41) by transversing motion in both directions uniformly coating the lower and/or upper side of mineral filling (22) by adhesive to ensure its attachment to the upper and/or lower outer layer (23, 24, 25) taking into the account the parameters discussed earlier.

In the way of example, from the decoiling device for flexible material (44) the flexible material band (45) is decoiled and led through the system for preheating of the flexible material bands (46). The band (45) is heated using hot air or other gas of temperature ranging between 100°C and 200°C whereby the band is between 1 mm and 5 mm thick and feeding velocity is between 3 m/min and 9 m/min so the band achieves the temperature ranging between 40°C and 75°C. The band (45) is heated in detachable chamber (46) which features the suction system (47) using which the cooled air or other gas is sucked and

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reheated (regenerated), said chamber being of closed or half-opened type. Following the treatment in the heating chamber (46) the band (45) is coated by adhesive using airless spraying uniformly across the whole width using, in the way of example, from 0.1 to 0.5 kg/m² for each individual layer (coating). The coat is applied to the upper side of the lower band (45). The adhesive is applied to preheated surface whereby the best results were achieved at temperatures of preheated surface ranging between 40°C and 50°C. The process of final reaction is performed within the double band device (11) at temperatures of up to 50°C, and the finished products are stocked for up to 24 hours at temperatures above 15°C.

In the case of the panels using flexible band a condensate shielding coating can be applied instead of mineral filling. In the way of example, a polyurethane coating can be used whereby the quantity of said condensate shielding coating should not exceed 1.5 kg/m². Thereby, the flexible band is used as technological protective cover for manufacturing of the light building panel with condensate shielding coating in the range of 2 to 10 mm, usually 8 mm. In the way of example, the condensate shielding coating can be applied by expansion of the adhesive between the upper layer of light building panel (e.g. flexible material band), and the lower sheet of metal. In that case the flexible material band serves as a barrier between the coating and the double band device (11), and has also aesthetic function.

In preferred embodiment the light building panel band or the fireproof light building panel band is manufactured using the above described process and apparatus. Said band is cut upon exiting from the double band device (11) into preset lengths using a bandsaw (12) with prescribed direction of cutting upward to turn the chip inside and removal of chip on the

upper sheet of metal using special cutter (knife). A surprising technical effect of final cut of high quality is thereby achieved due to damping of the vibrations. The opposite direction of cutting or cutting using circular saws would cause the vibrations because of softer middle layer of the light building panel with mineral filling. During the cutting the movements of the panel is restricted using special pressing and/or restricting elements to decrease the effect of vibrations, hence cut of higher quality is achieved. The preferred embodiment also includes production of eaves by previous separating the lower layer from either mineral filling or other middle layer material using separating means (e.g. fluid coating of separating means which prevents attachment of mineral filling and lower outer layer) and cutting of said middle layer material transversely to the direction of the light building panel band movement. The eaves for the purposes of this application denotes protruded part of light building panel's lower sheet of metal and can be used for either overlapping part during the mounting of adjacent panels or as the eaves of the roof. The production of eaves is performed using circular saw. In the way of example, when producing eaves ranging from 50 mm to 200 mm in length one first removes the upper sheet of metal and middle layer (i.e. filling between the upper and the lower sheet of metal) so the lower sheet of metal becomes longer than the upper sheet of metal and the filling. In this way the protruded portion of the lower sheet of metal serves as the eaves or overlap in extended roofs.

The manufactured panels are loaded on the pallets or other depositing surfaces (hereinafter pad). In the case of roof panels the panels are stacked in pairs, i.e. two panels form a single entity whereby the flat surfaces are turned outward, and wavy surfaces (presented on figures 2 through 9) inward (one toward another) as to protect the wavy surfaces from deformation

during transport and increase transport efficiency. The finished products are loaded on pads (51). The new solution is presented in the way of novel arrangement of pads (51) according to different packages length and different loads which are due to various combinations of materials built into the final product. Thereby the package comprises of at least vertically stacked (positioned one upon another) light building panels. The process (algorithm) for preferred embodiment is therefore as follows:

(i) there are at least two pads (51).

(ii) the pad (51) at the very end of the lowest panel (acting as a bottom surface of the package) is positioned outward from the edge of the lowest panel for a distance T_{pak} to be used for packaging and protection of panels whereby the T_{pak} ranges between 5 in 25 mm.

(iii) the distance between pads (51), on which the package rests, is calculated according to the following formula:

$$L_{gve} = ((L_{pak} + 2 * T_{pak}) - (N * L_{pod})) / (N - 1)$$

whereby the values are seen in figure 20 and

L_{gve} is the net distance between the pads (51)

L_{pak} is the length of the panels including predetermined tolerance of loading of at least two light building panels

L_{pod} is the pad (51) length

N is a number of pads (51) in the package

T_{pak} is shown in (ii)

(iv) the values for particular parameters depending on thickness dd of the panel and the density of the mineral filling r are summarized in the following table whereby all the values are in meters unless stated otherwise and the length refers to L_{pak} from (iii).

	medium $dd = 80 \text{ mm}$ $r = 100 \text{ kg/m}^3$		heavy $dd = 60 \text{ mm}$ $r = 150 \text{ kg/m}^3$		light $dd = 200 \text{ mm}$ $r = 60 \text{ kg/m}^3$	
Number of pads N	Length of panels (default) from to		Length of panels (max) from to		Length of panels (min) from to	
2	2.00	3.60	2.00	3.20	2.00	4.50
3	3.61	6.30	3.21	5.30	4.51	7.00
4	6.31	9.20	5.31	7.20	7.01	10.00
5	9.21	12.00	7.21	9.20	10.01	14.00
6	12.01	14.00	9.21	11.40	-	-
7	-	-	11.41	14.00	-	-

Based on this process the computer program performing the above described steps is executed. Three possibilities are can be chosen according to the loading, either light, medium, and heavy. The possibility taking into account larger or smaller number of pads (51) is hence chosen (e.g. by an operator of the disclosed apparatus) whereby the pads (51) which also perform a function of support are made of wood (pallets), polystyrene (styrofoam), and/or other suitable material.

In the way of example, the data for the panel of thickness 80 mm and density of the wool

100 kg/m³ will be taken from the table above, column "medium".

In addition, the preferred embodiment is controlled and regulated using control algorithm with a help of a microprocessor, built into or connected to control panel whereby the microprocessor uses the instructions whereby:

- it reads, regulates, and controls physical data on process operation;
- it directs and controls data on work-order comprising a size and type of particular product undergoing the process;
- regulates data on traceability of material built-into the product which is especially important in proving the conformity of built-into materials with tested product in order to obtain certificates necessary and/or licenses to sell the products;
- records the evidence of errors during process and pinpoints their origin as well as performs statistical analysis of errors by help of data acquisition and management.

It is self evident that the above described invention can be also used in other particular form not changing the substance of the invention.

CLAIMS

1. Light building panel, characterized in that it comprises at least one of the following:

- (a) shielding means for protection against environment;
- (b) formative means for giving form and strength;
- (c) a filling of mineral wool and/or glass wool and/or a combination of insulation materials;
- (d) connecting means for connecting shielding and/or formative means with filling.

2. An apparatus for continuous manufacturing of light building panels with mineral filling with mineral filling as an insulation whereby said panels are manufactured by cutting of continuous band of the light building panel, characterized in that it comprises decoiling means for decoiling of shielding and/or formative means, profiling means for profiling of said shielding and/or formative means, insertion means for insertion of ribs of mineral filling, preheating means for heating of elements of the band of light building panel, application means for application of connecting means, a double band device (11), cutting means, cutting and arranging means for cutting and sorting of lamellas (26) into a band of lamellas (89) and/or unloading transporting means for loading of the light building panels on the pads (51) and elements of the light building panels comprising shielding means, formative means and/or filling of mineral wool and/or combinations of insulation materials connected thereto.

3. A process for continuous manufacturing of light building panels with mineral filling with mineral filling as an insulation whereby said panels are manufactured by cutting of

continuous band of the light building panel, characterized in that it comprises assembling of a continuous band of the light building panel comprised of elements of the light building panel comprising shielding means, formative means and/or filling of mineral wool and/or combinations of insulation materials using processes comprising of decoiling of shielding and/or formative means, cutting and arranging of lamellas (26) into a band of lamellas (89), inserting ribs of mineral filling, heating of elements of the band of the light building panel, application of connecting means on the elements of the band of the light building panel;

connecting of the elements of the band of the light building panel within a double band device (11);

cutting of the band of the light building panel into the light building panels of predetermined length;

loading of finished light building panels on pads (51).

4. A process for continuous manufacturing of light building panels with mineral filling with mineral filling as an insulation whereby said panels are manufactured by cutting of continuous band of the light building panel, characterized in that it enables manufacturing of fireproof light building panels, light building panels of modulus ranging from 200 mm to 1200 mm, light building panels using mineral wool fillings with various characteristics, light building panels for essentially flat roofs with flexible material bands and condensate shielding coating.

5. An invention according to the claims 2 and/or 3 and/or 4, characterized in that it

comprises:

- (a) decoiling with at least one decoiler (2) of upper shielding and/or formative means;
- (b) decoiling with at least one decoiler (1) of lower shielding and/or formative means;
- (c) changing of sheets with a double carriage at reduced velocities of the band of lamellas (89);
- (d) positioning of tools on cassettes enabling fast and simple changing of tools.

6. An invention according to any of the previous claims, or combination thereof, characterized in that it comprises at least one of the following characteristics:

- (a) at least one surface of the light building panel is equipped with at least one protrusion and/or at least one rib in longitudinal direction;
- (b) the upper and the lower shielding and/or formative means are symmetrical with regard to longitudinal axis of the light building panel;
- (c) the shielding and/or formative means feature endings and/or protrusions to facilitate interconnecting between adjacent light building panels during mounting and/or overlapping with adjacent light building panels during mounting;
- (d) interconnection between adjacent building panels is facilitated using sealing means.

7. An invention according to any of the previous claims, or combination thereof, characterized in that the protrusions and/or the ribs on shielding and/or formative means feature trapezoidal cross sections with a width of narrower of both base sides of the trapezoid ranging from 20 mm to 30 mm, an inner angle of the trapezoid between 23° and 33°, and distance between both base, parallel, sides ranging from 33 mm to 40 mm.

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8. An invention according to any of the previous claims, or combination thereof, characterized in that the mineral wool, glass wool, and/or other insulation material comprises one of the following densities:

(a) between 115 kg/m³ and 135 kg/m³ for fireproof light building panels with appropriate mechanical characteristics;

(b) between 135 kg/m³ and 165 kg/m³ for light building panels used for walkable essentially flat roofs or for those panels which should withstand usual loading during exploitation and/or local pressure load.

9. An invention according to the claims 2, 3, 4, and/or 5, characterized in that it comprises:

(a) cutting of mineral filling panels (81) with a set of at least two circular saws (33) into lamellas (26);

(b) change of direction from essentially perpendicular to the longitudinal lamella (26) axis to essentially parallel to the longitudinal lamella (26) axis;

(c) separation into individual lamellas (26) or groups thereof using sorting feeder (84) and turning of individual lamellas (26) or groups thereof for essentially right angle around center of turning table (85);

(d) transport of individual lamellas (26) to sorting feeder (84) with velocity which exceeds accommodating velocity of sorting feeder (84) thereby ensuring longitudinal contact between individual lamellas.

10. An invention according to the claims 2, 3, 4, and/or 5, characterized in that it

comprises:

(a) formation of a set of lamellas (86) comprising at least two one from another separated yet sidelong aligned lamellas by means of separators whereby said set of lamellas (86) is transported:

- during a start-up until it reaches a rearranging device (87) whereby parquet-like assembly is assembled by rearranging of lamellas;

- during normal operation until it reaches previously assembled set of lamellas; resulting in sidelong shifted set of lamellas (86);

(b) establishment of continuous band of lamellas (89) comprising at least two adjacent and sidelong connected lamellas (26) whereby said band (89) is driven by at least one side guiding belt (88) which exerts side force and whereby the band of lamellas (89) features parquet-like appearance when observed from above;

(c) establishment of longitudinal force via means of the side guiding belt (88) velocity which exceeds velocity of the band of lamellas (89).

11. An invention according to the claims 2, 3, 4, and/or 5, characterized by insertion of a corrective lamella (26) to remedy corrupted parquet-like order.

12. An invention according to the claims 2, 3, 4, and/or 5, characterized in that a set of at least two circular saws (33) performs simultaneous cutting of mineral filling panel (81) into individual lamellas (26) of predetermined thickness.

13. An invention according to the claims 2, 3, 4, and/or 5, characterized in that the

trimming and milling process applied to the band of lamellas (89) comprises at least one of the following:

- (a) trimming using at least one circular saw (35) in longitudinal direction;
- (b) simultaneous trimming using at least two coaxially positioned circular saws (35), said saws (35) distanced for a width of the band of lamellas (89);
- (c) breaking of trimmed-off edges;
- (d) milling of at least one edge of the band of lamellas (89) with at least one milling tool (37).

14. An invention according to the claims 2, 3, 4, and/or 5, characterized in that the trimming is followed by suction of remnants from the surface of mineral filling using suction means.

15. An invention according to the claims 2, 3, 4, and/or 5, characterized in that an application of connecting means is performed in a thin layer whereby essentially uniformly applied quantity of connecting means does not exceed 500 g/m².

16. An invention according to the claims 2, 3, 4, and/or 5, characterized in that the application of connecting means is performed essentially uniformly in a film or droplets over essentially whole width of the band of lamellas (89) whereby the adhesive application device (9) applies a coating of the connecting means on upper and/or lower side of the band of lamellas (89) by periodic or oscillatory moves essentially perpendicular to the movement of the band of lamellas (89).

17. An invention according to the claims 2, 3, 4, and/or 5, characterized in that the connecting means is an adhesive, and:

(a) a quantity of applied adhesive ranges between 90 to 110 , or, alternatively

(b) the use of adhesive ranges between 0.1 to 0.5 kg/m² and further the use of water is up to 45 % (weight) of adhesive;

whereby the recited values are valid for individual layer of adhesive on one of the base surfaces of the band of lamellas (89) and whereby the adhesive features the following characteristics: viscosity up to 2 Pas; density up to 1500 kg/m³, reaction time in the laboratory: open time 15-20s, or, alternatively, open time over 64 s; developing in a double band device (11) at temperature of up to 50°C for up to 3 minutes.

18. An invention according to the claims 2, 3, 4, and/or 5, characterized in that the double band device (11) is comprised of two parallel bands of shielding and/or formative means supported and/or guided by supporting means and the band of lamellas (89) guided into between said parallel bands from the side whereby an angle formed by a projection of one of longitudinal edges of band of lamellas (89) onto a surface of the lower of two parallel bands and one of edges of one of both parallel bands ranges between 7° to 13° and whereby the band of lamellas (89) is unsupported at the bottom prior to entering said double band device (11).

19. An invention according to the claims 2, 3, 4, and/or 5, characterized in that the band of lamellas (89) before entering the double band device (89) performs a double bending and whereby consequences of said double bending on individual lamellas (26) comprising the

band of lamellas (89) are mitigated by use of at least one of the following elements: longitudinal pushing force realized by velocity difference between transporting means and the band of lamellas (89); side pushing force realized by side pressing means along the length of the double bending; at least one alignment roller (91) positioned in a plane parallel to the band of lamellas (89) surface plane whereby a centerline of said alignment roller (91) is perpendicular to the direction of the band of lamellas (89) movement and whereby said alignment roller (91) limits vertical shift of two adjacent lamellas (26) comprising the band of lamellas (89); vertical force exerted by the double band device (11) on the band of lamellas (89) which causes vertical deformation of individual lamellas (26) forming the band of lamellas (89) and/or squeezing of the adhesive into the band of lamellas (89).

20. An invention according to the claims 2, 3, 4, and/or 5, characterized in that at least two simultaneously operated side chains whereby a contacting element of an upper chain conforms to and by virtue of its shape limits and further via friction transmits own momentum on at least one upper edge of upper shielding and/or formative means which are comprised by the light building panel band, and a contacting element of a lower chain conforms to and by virtue of its shape limits and further via friction transmits own momentum on at least one lower edge of lower shielding and/or formative means which are comprised by the light building panel band.

21. An invention according to the claims 2, 3, 4, and/or 5, characterized in that the upper shielding and/or formative mean (21) is guided using the contacting elements of at least two upper side chains (13, 14) both of which can be adjusted in height to accommodate different

thicknesses of particular fireproof light building panel and can be adjusted in width to accommodate different widths of particular light building panel, and the lower shielding and/or formative mean (23, 24, 25) is guided using the contacting elements of at least two lower side chains (16, 17) both of which can be adjusted in width to accommodate different widths of particular light building panel whereby said contacting elements (13, 14, 16, 17) are simplified negatives of respective profiles of edges of shielding and/or formative means they are in contact with.

22. An invention according to the claims 2, 3, 4, and/or 5, characterized by attaching side protective means along the length of side surfaces of the band of lamellas (89) for protection of the double band device (11) against fouling and the finished light building panel against humidity.

23. An invention according to the claims 2, 3, 4, and/or 5, characterized in that the upper shielding and/or formative means comprise at least one of the following: natron paper, aluminum sheet, sheet of plastics, and/or bitumen band.

24. An invention according to the claims 2, 3, 4, and/or 5, characterized in that the upper shielding and/or formative means of flexible material (45) band are heated with hot air or other gas of temperature ranging between 100°C and 200°C whereby the band is between 1 mm and 5 mm thick and feeding velocity is between 3 m/min and 9 m/min resulting in the band temperature ranging between 40°C and 75°C, and whereby the band (45) is heated in detachable chamber (46) which features a suction system (47) for suction and/or regeneration

of said air and/or other gas, and whereby a coating is applied to the band (45), said coating comprising at least one of the following:

- (a) 0.1 to 0.5 kg/m² of adhesive for each individual layer;
- (b) up to 1.5 kg/m² of polyurethane coating;

whereby said coating is applied to the preheated band (45) surface with temperature ranging from 40°C to 50°C.

25. An invention according to the claims 2, 3, 4, and/or 5, characterized in that it comprises at least one of the following:

- (a) cutting of the band of the light building panel into the light building panels of predetermined length whereby the cutting is performed by at least one bandsaw (12) with the direction of cutting from the lower shielding and/or formative means toward upper shielding and/or formative means,
- (b) production of eaves by circular saw by previously applying separation means for prevention of the mineral filling and shielding and/or formative means attachment.

26. An invention according to the claims 2, 3, 4, and/or 5, characterized in that a supporting of packages comprised of vertically stacked light building panels on at least two pads (51) performing padding and/or supporting function comprises at least one of the following characteristics:

- the pad (51) at the very end of the lowest panel acting as the bottom surface of the package is distanced 5 mm to 25 mm from the edge of said lowest panel;
- a distance between adjacent pads (51) is computed using the following formula:

$$L_{ave} = ((L_{pak} + 2 * T_{pak}) - (N * L_{pad})) / (N - 1)$$

whereby

L_{ave} is a net distance between the pads (51)

L_{pak} is a length of the panels including predetermined tolerance of loading of at least two light building panels

L_{pad} is a pad (51) length

N is a number of pads (51) in the package

T_{pak} is a distance of an edge of the pad from an edge of the panel;

whereby an operator of said apparatus chooses L_{pak} according to the thickness dd of the panels and density r of the mineral filling.

27. An invention according to the claims 2, 3, 4, and/or 5, characterized in that the process of manufacturing of the light building panels is controlled using microprocessor regulating means and comprises: reading, regulating, and controlling of physical data on process operation; directing and controlling data on work-order comprising a size and type of particular product undergoing said process; regulating data on traceability of material built-into the product; recording the evidence of errors during said process.

28. An invention according to the claims 2, 3, 4, and/or 5, characterized in that a condensate shielding coating of thickness ranging from 2 mm to 10 mm is applied to the lower outer layer of the building panel by expansion of the adhesive between the upper band of flexible material (45) and the lower outer layer of the light building panel.

29. An invention according to any of the previous claims, or combination thereof, characterized in that the combination of the insulating materials is performed in at least two layers.

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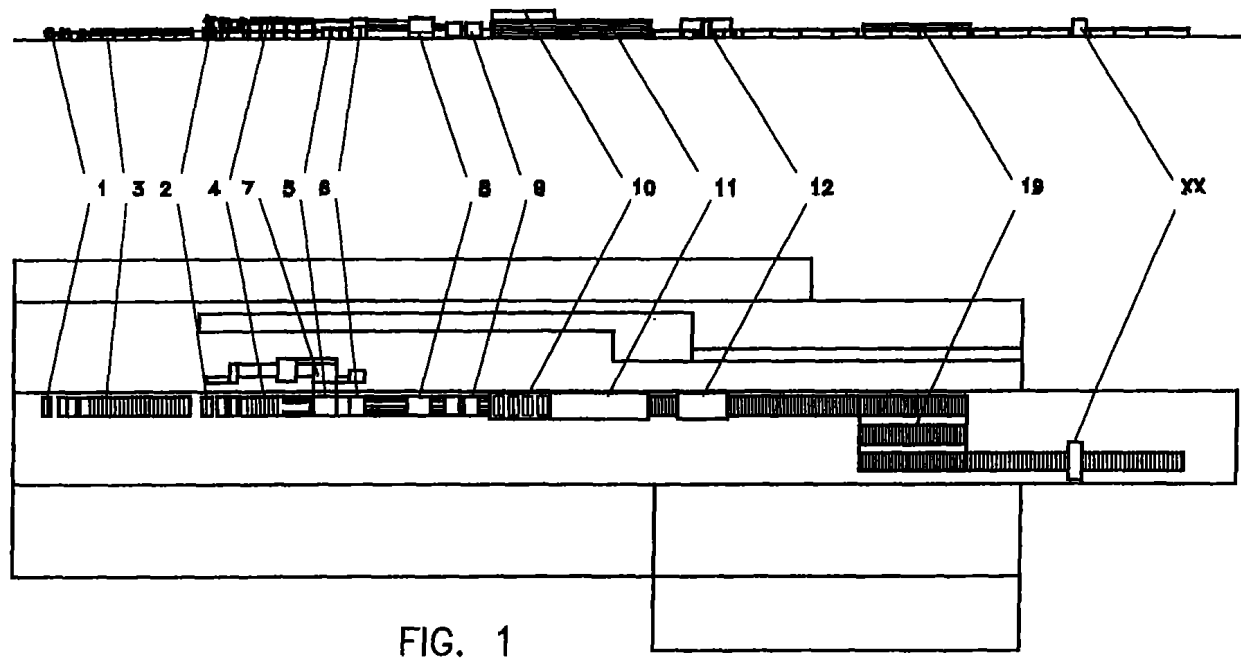


FIG. 1

13²⁷

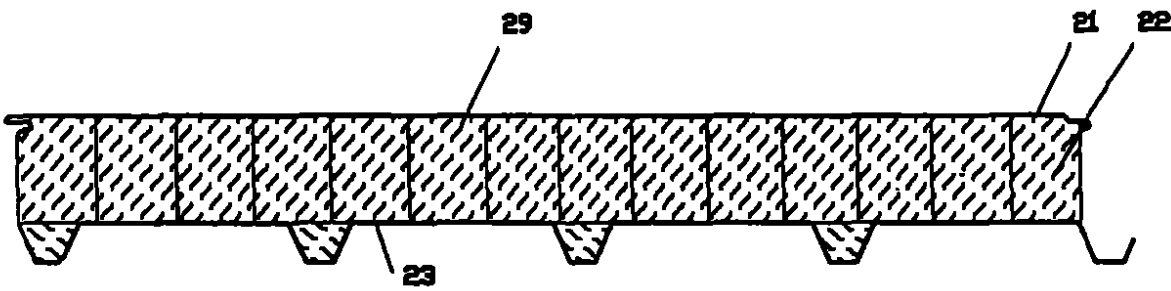


FIG. 2

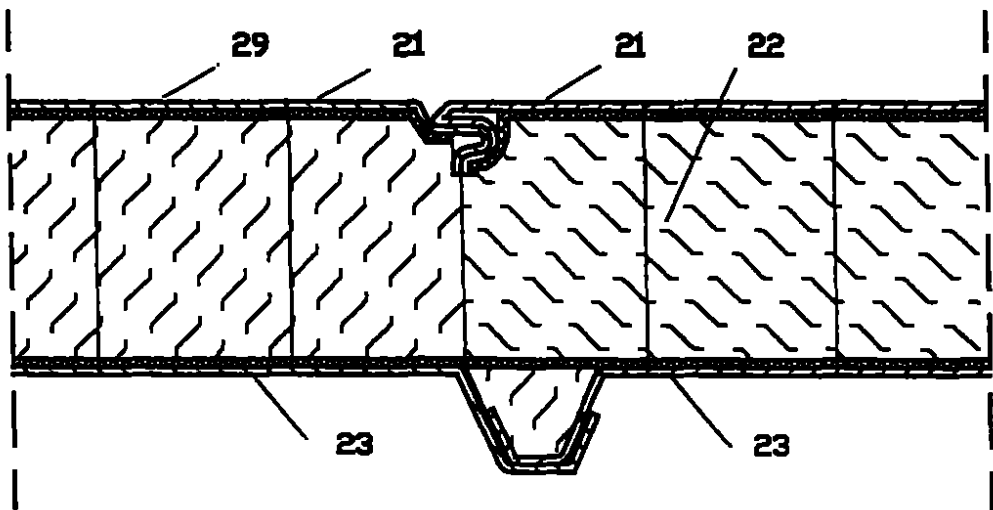
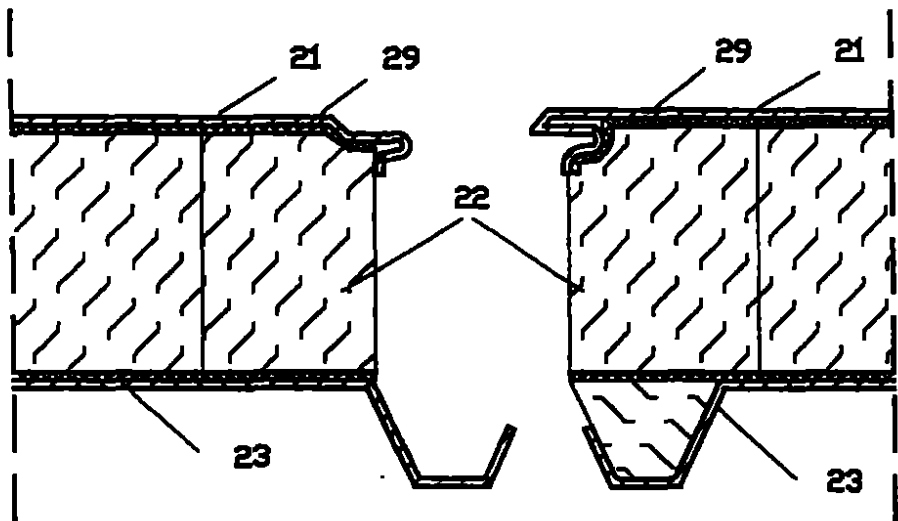


FIG. 3

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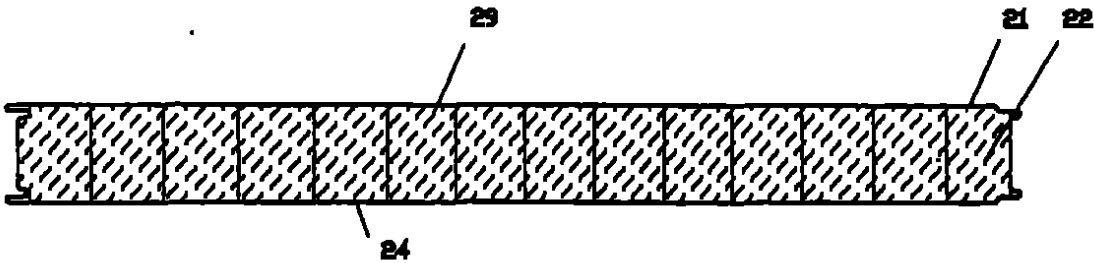


FIG. 4

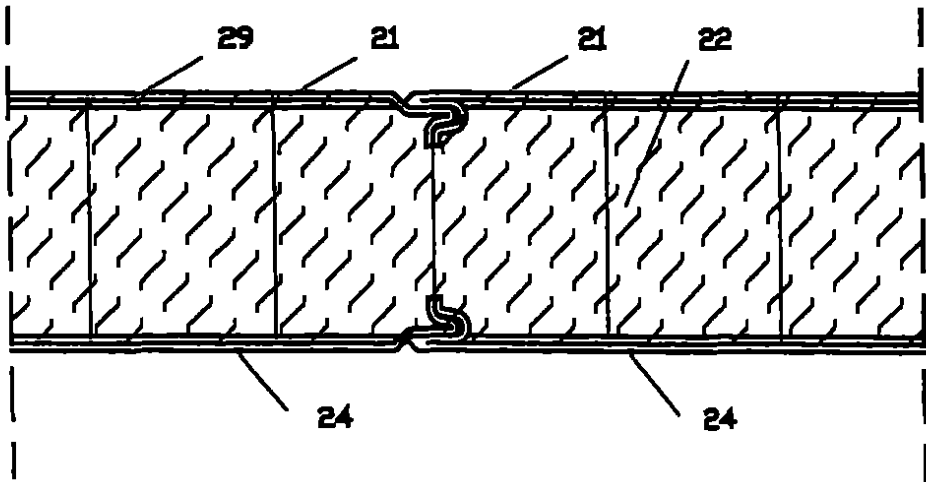
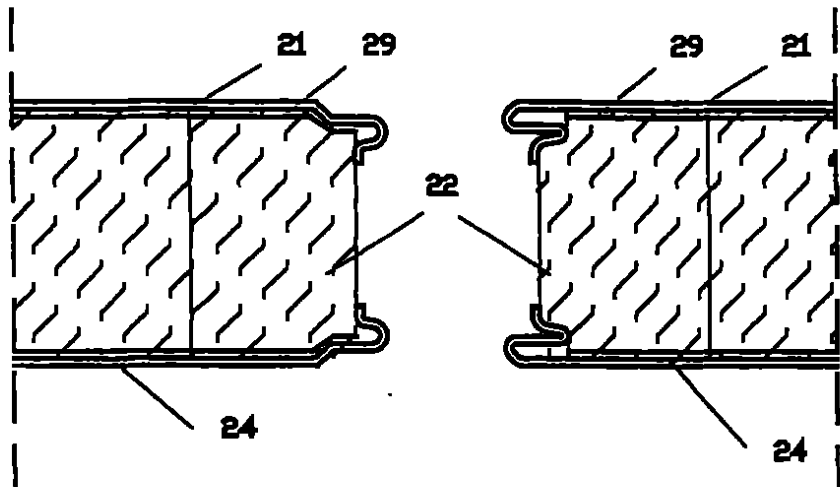


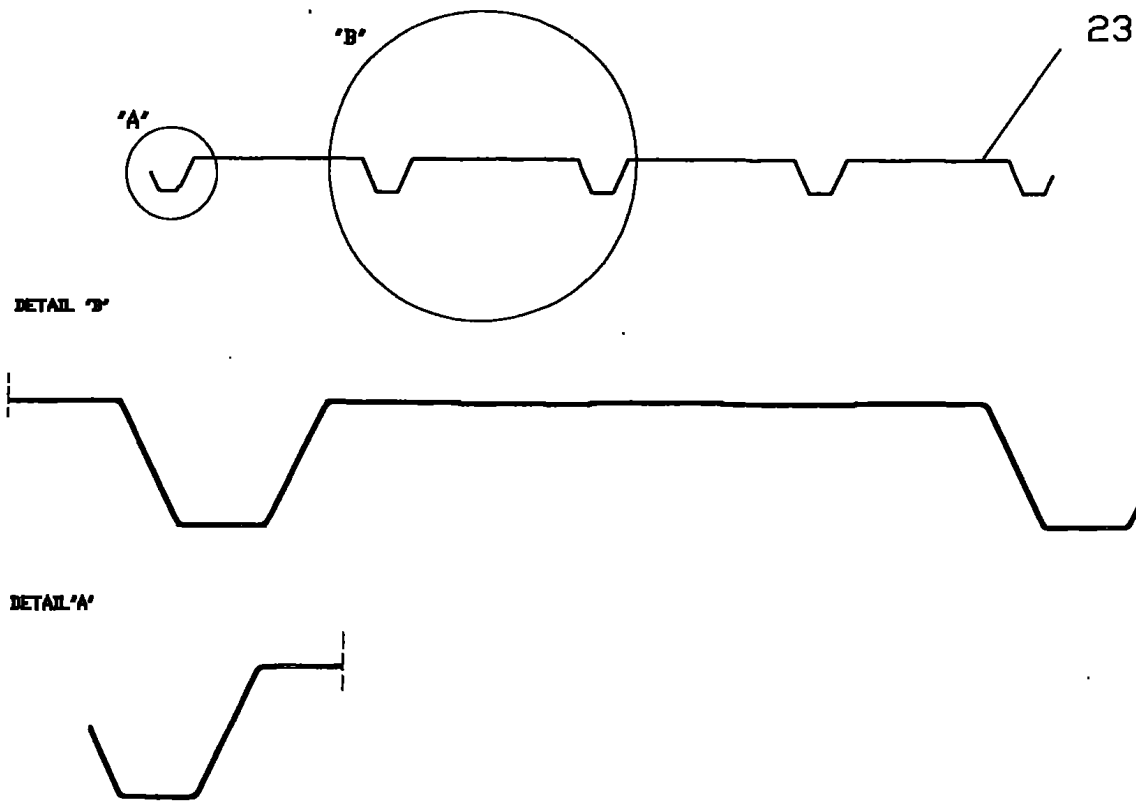
FIG. 5

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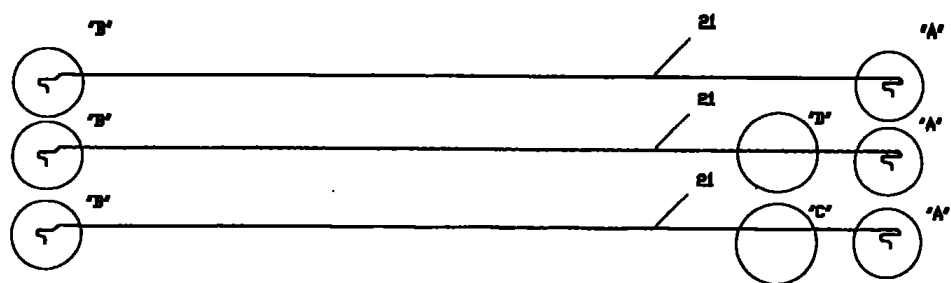
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DETAIL 'B' DETAIL 'A'

DETAIL 'C'

DETAIL 'D'



FIG. 7

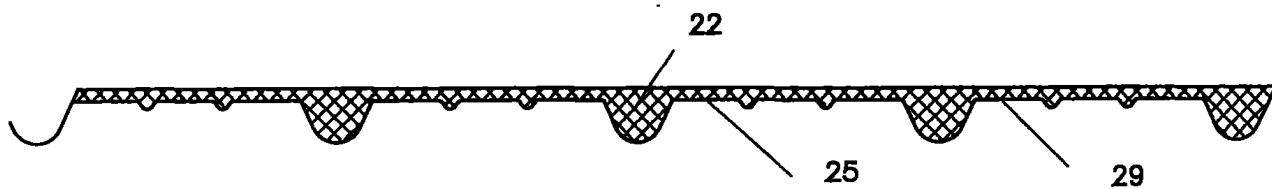


FIG. 8

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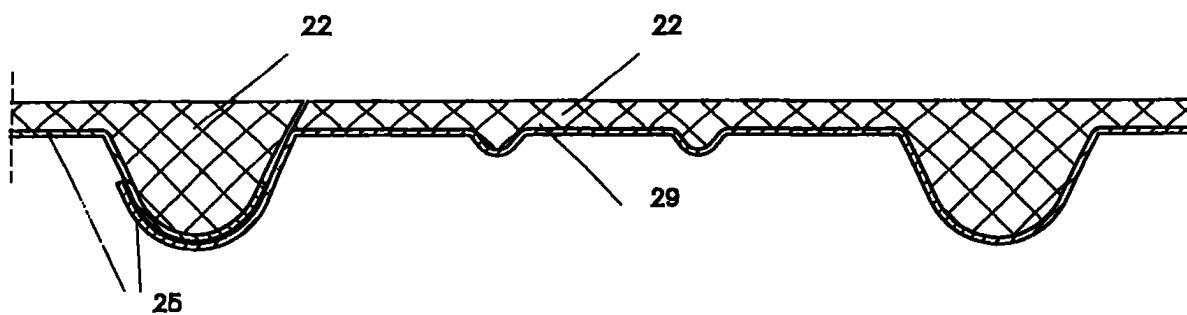


FIG. 9

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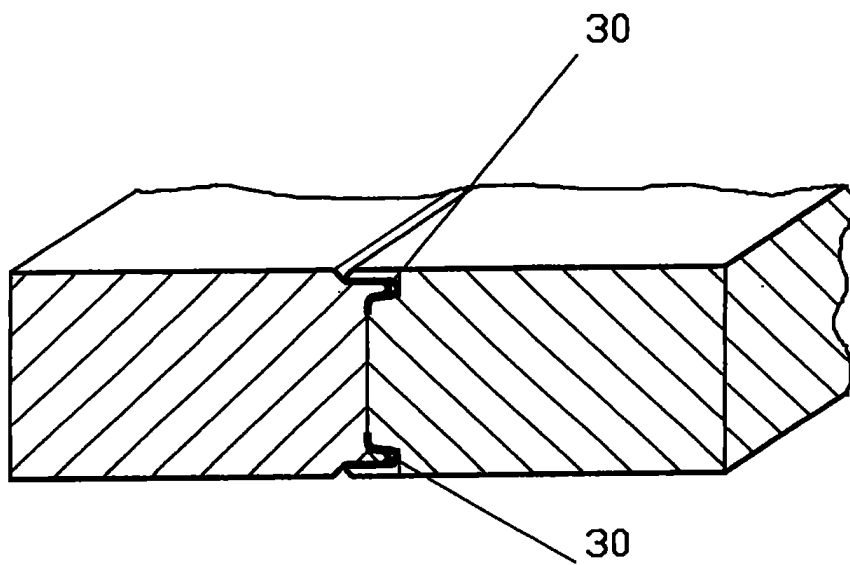


FIG. 10

144

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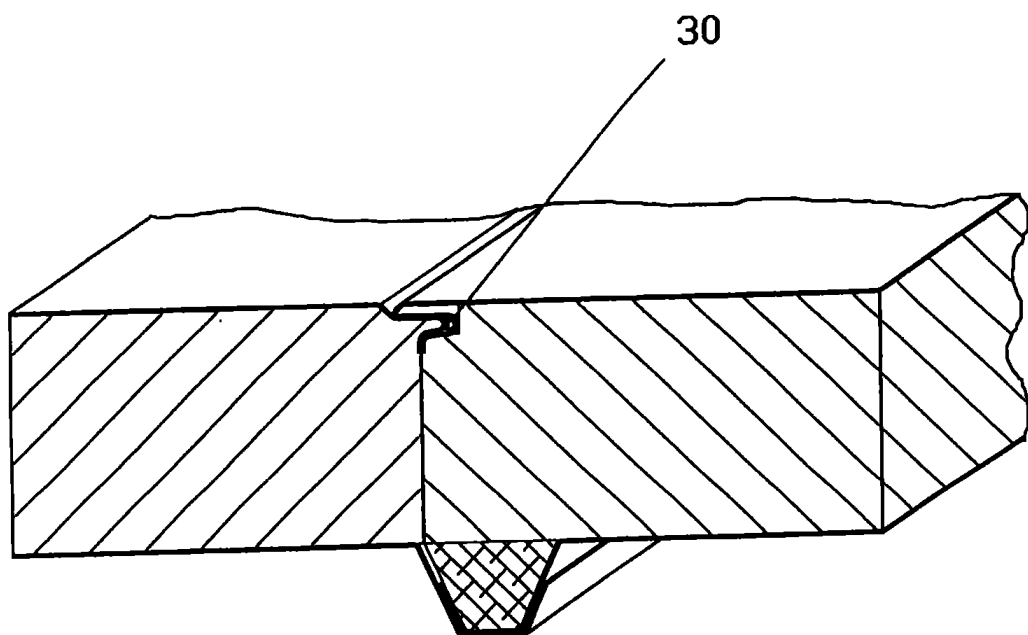


FIG.11

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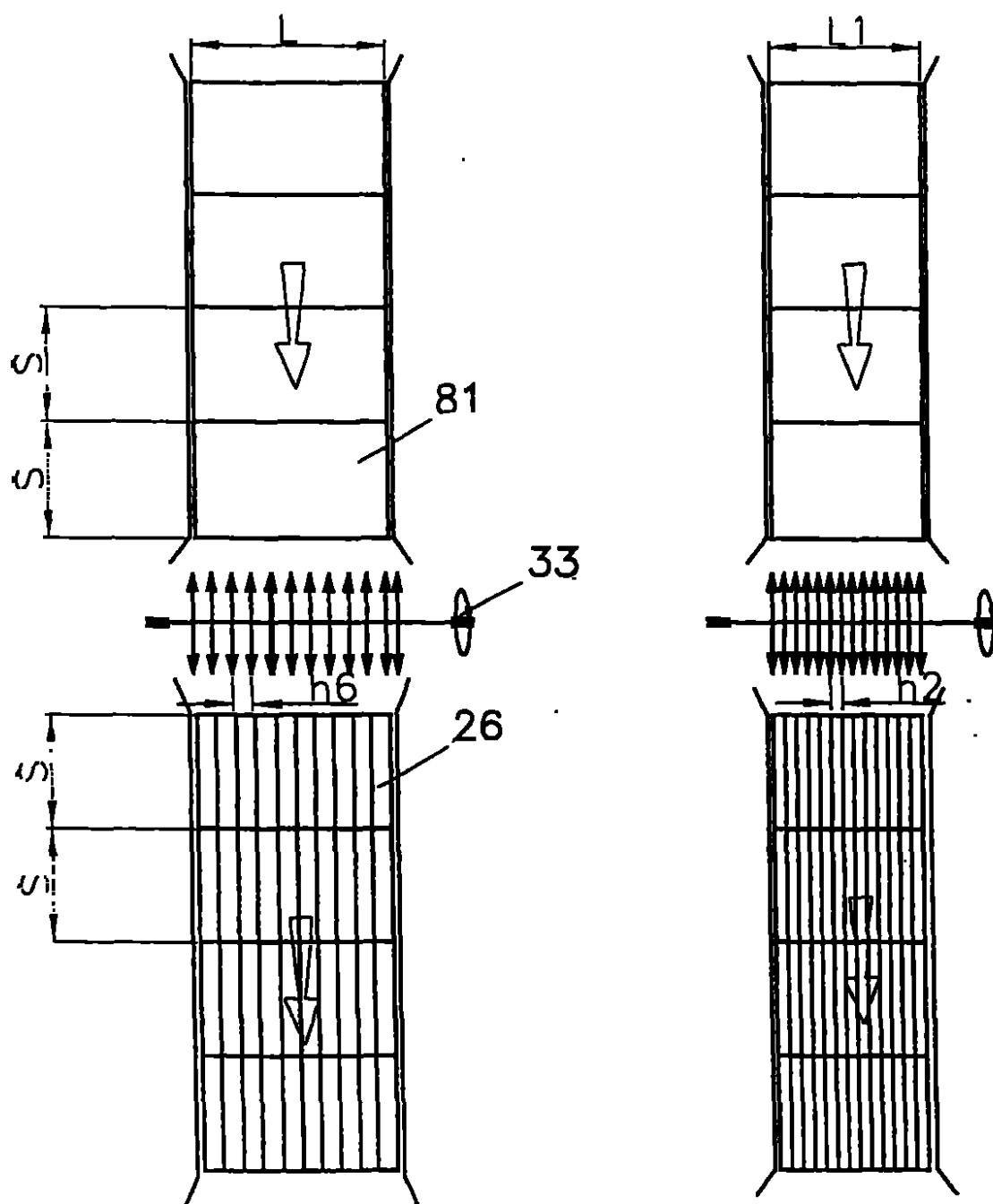


FIG.12

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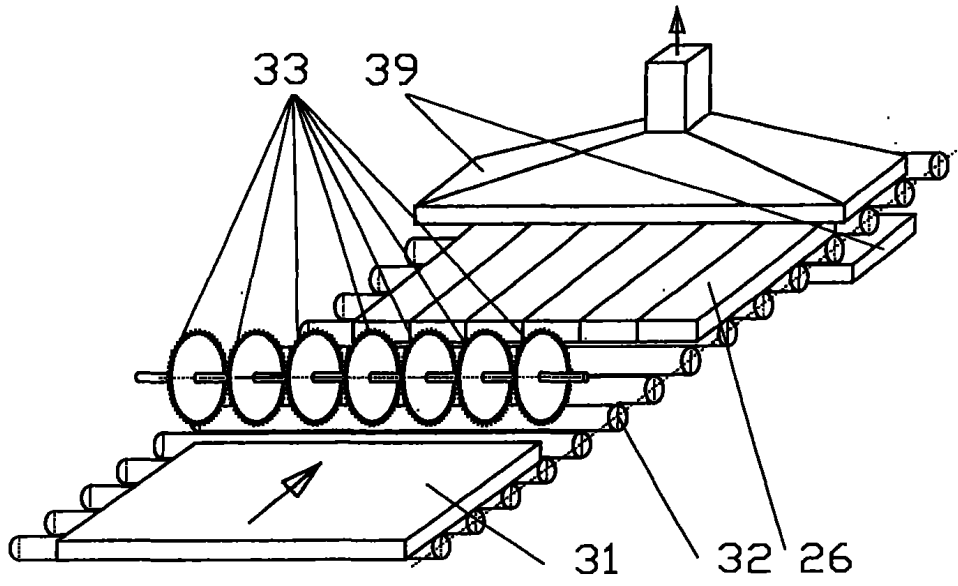


FIG. 13

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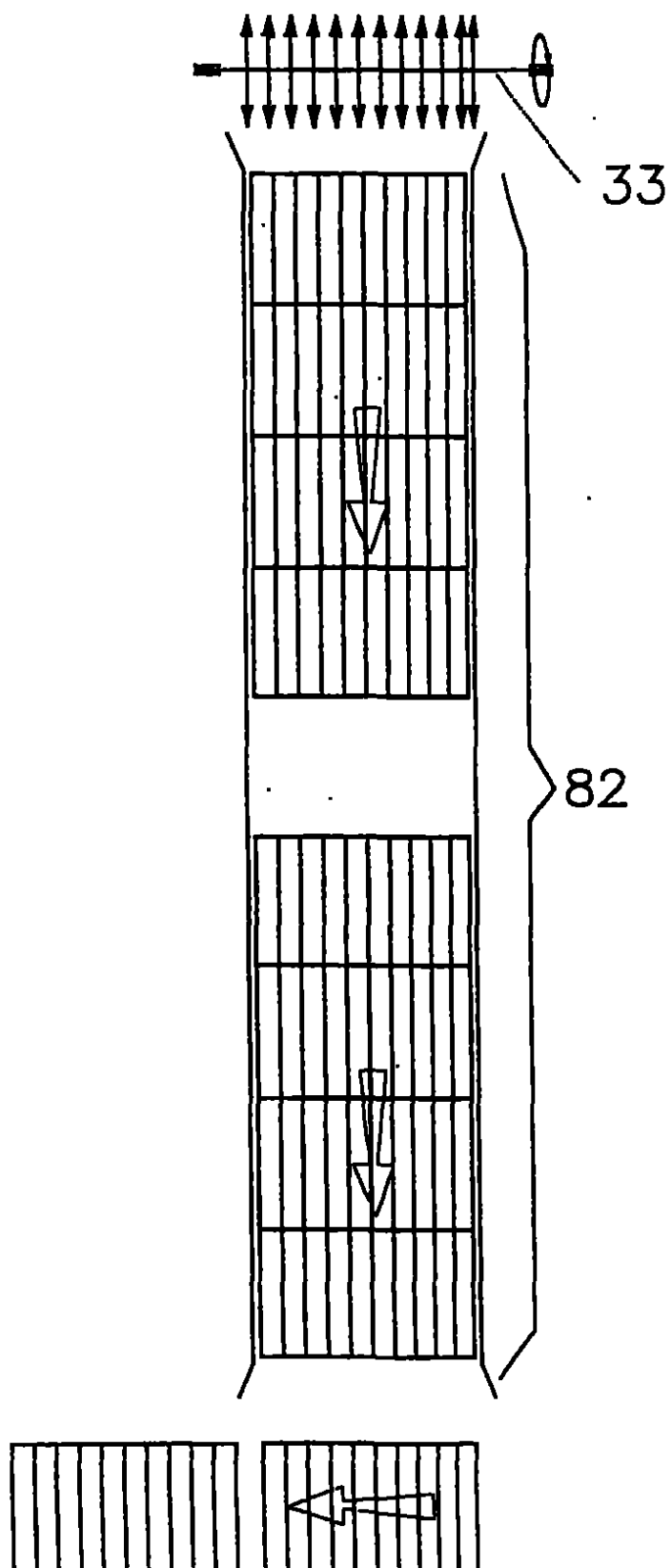


FIG.14

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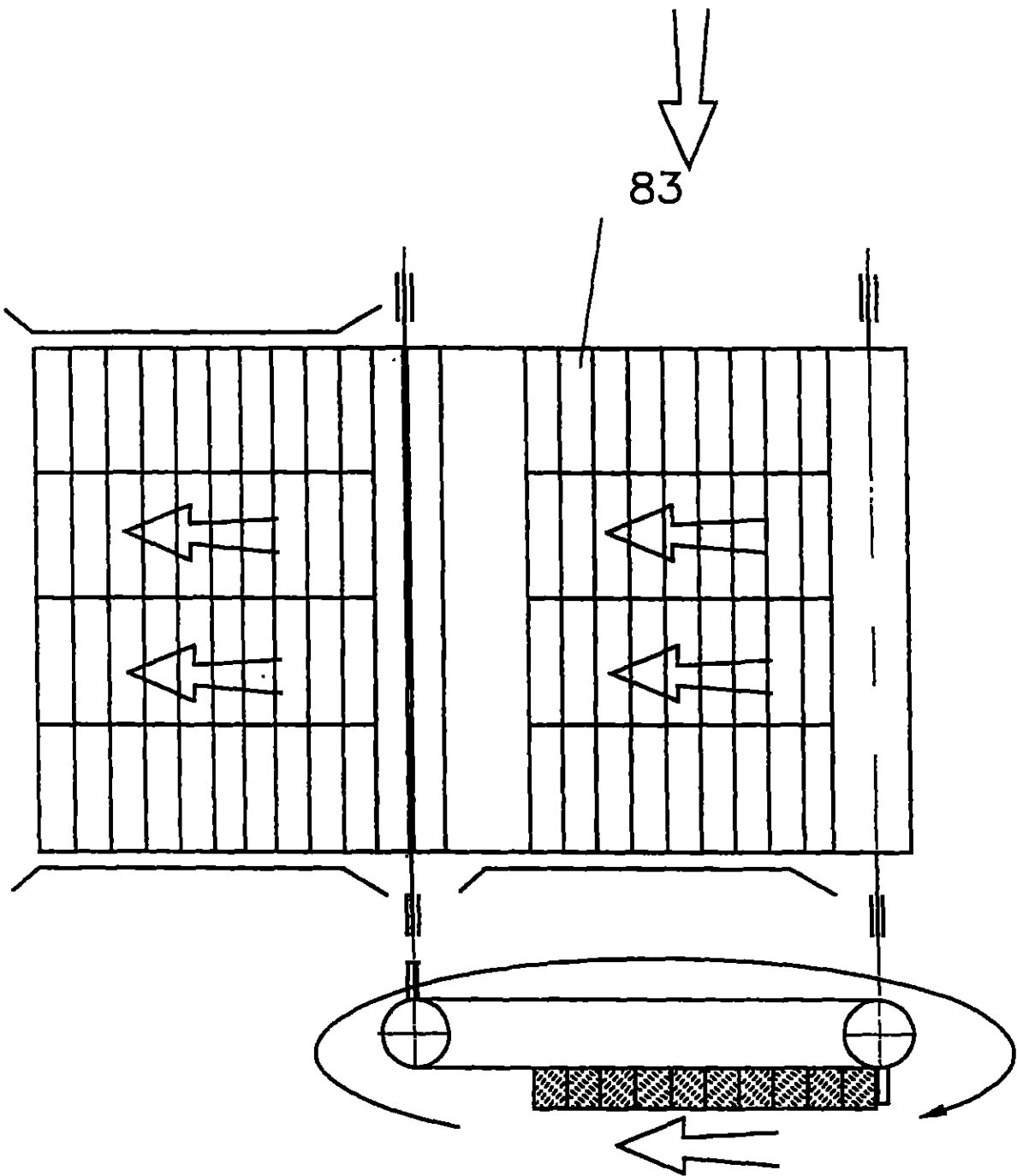


FIG.15

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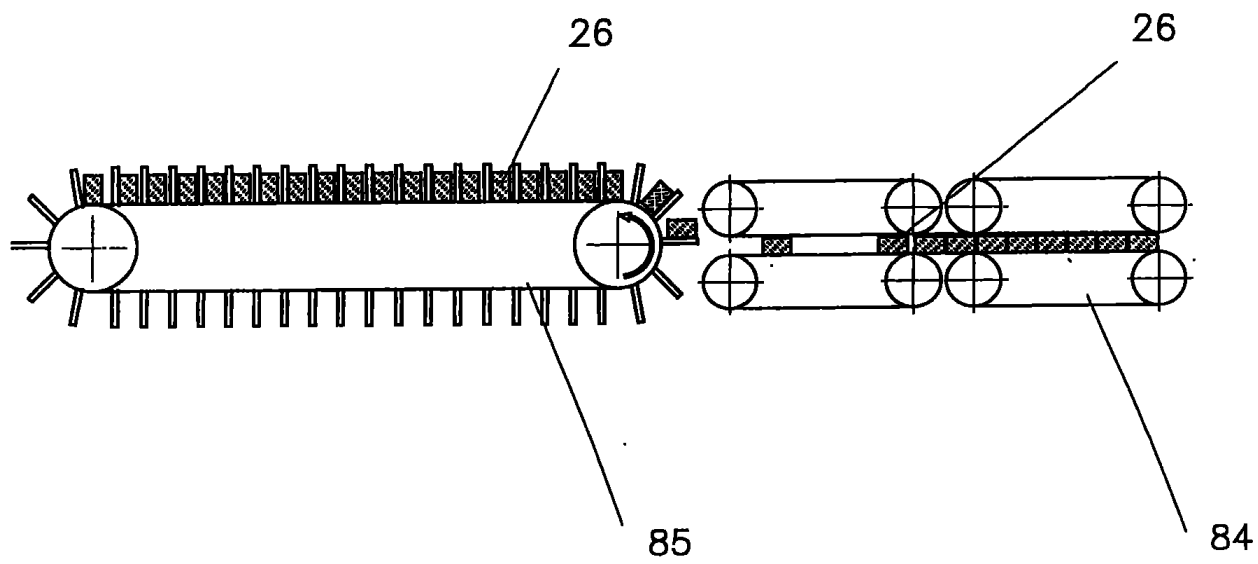


FIG.16

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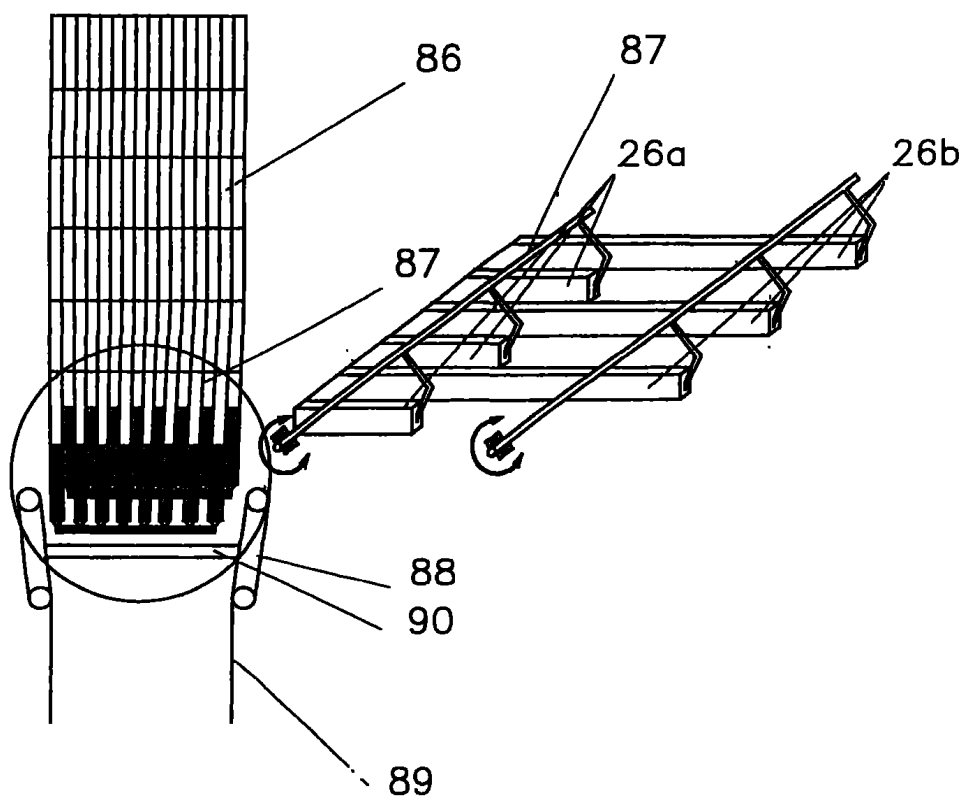


FIG.17

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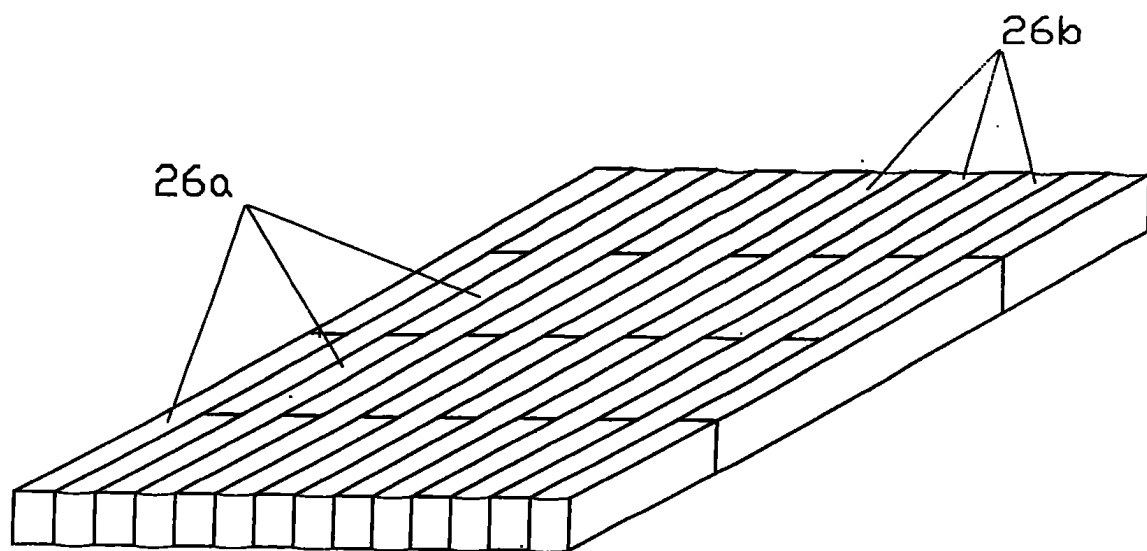


FIG.18

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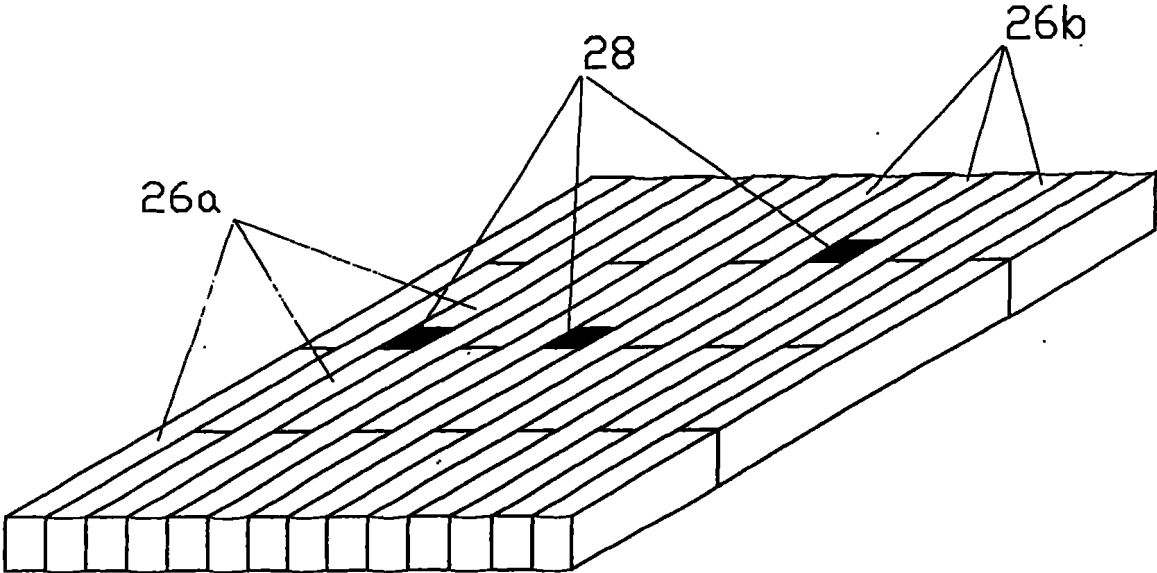
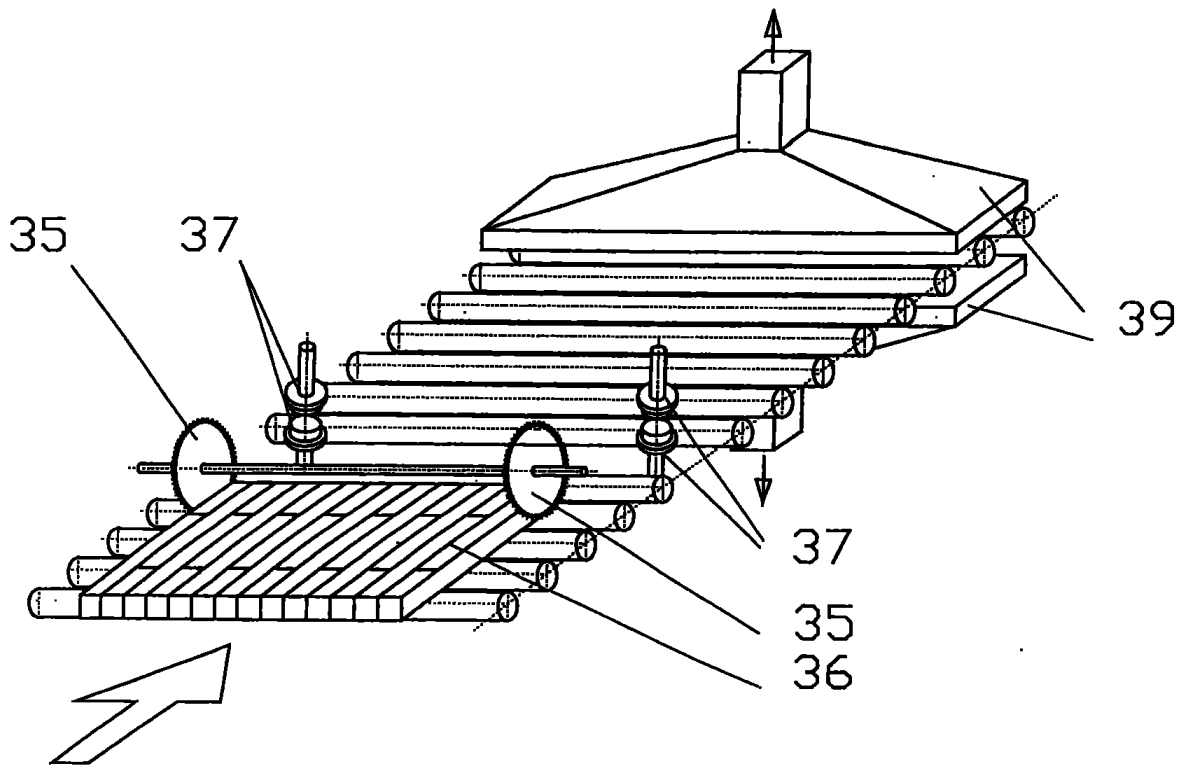


FIG.19

153



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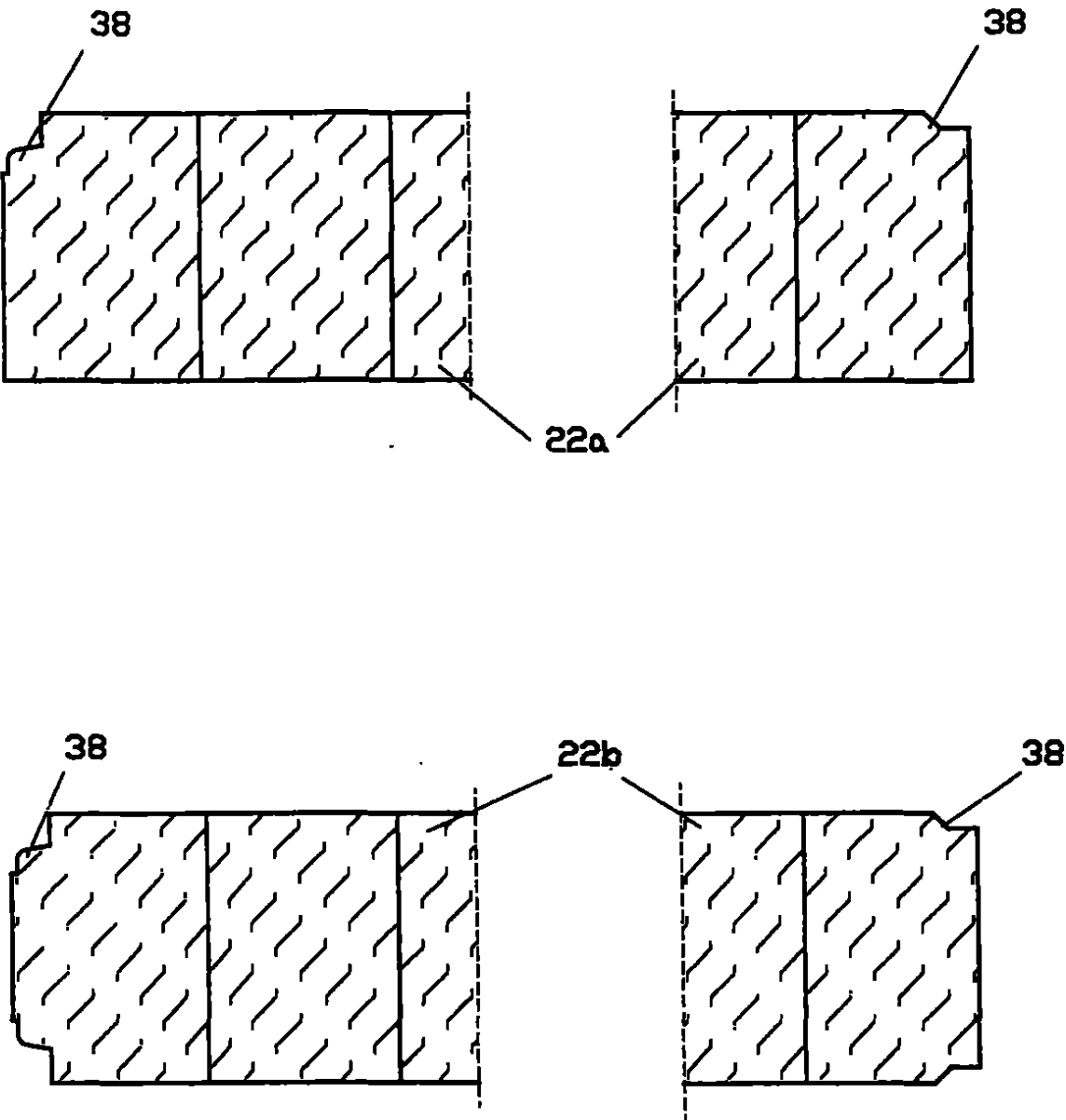


FIG. 21

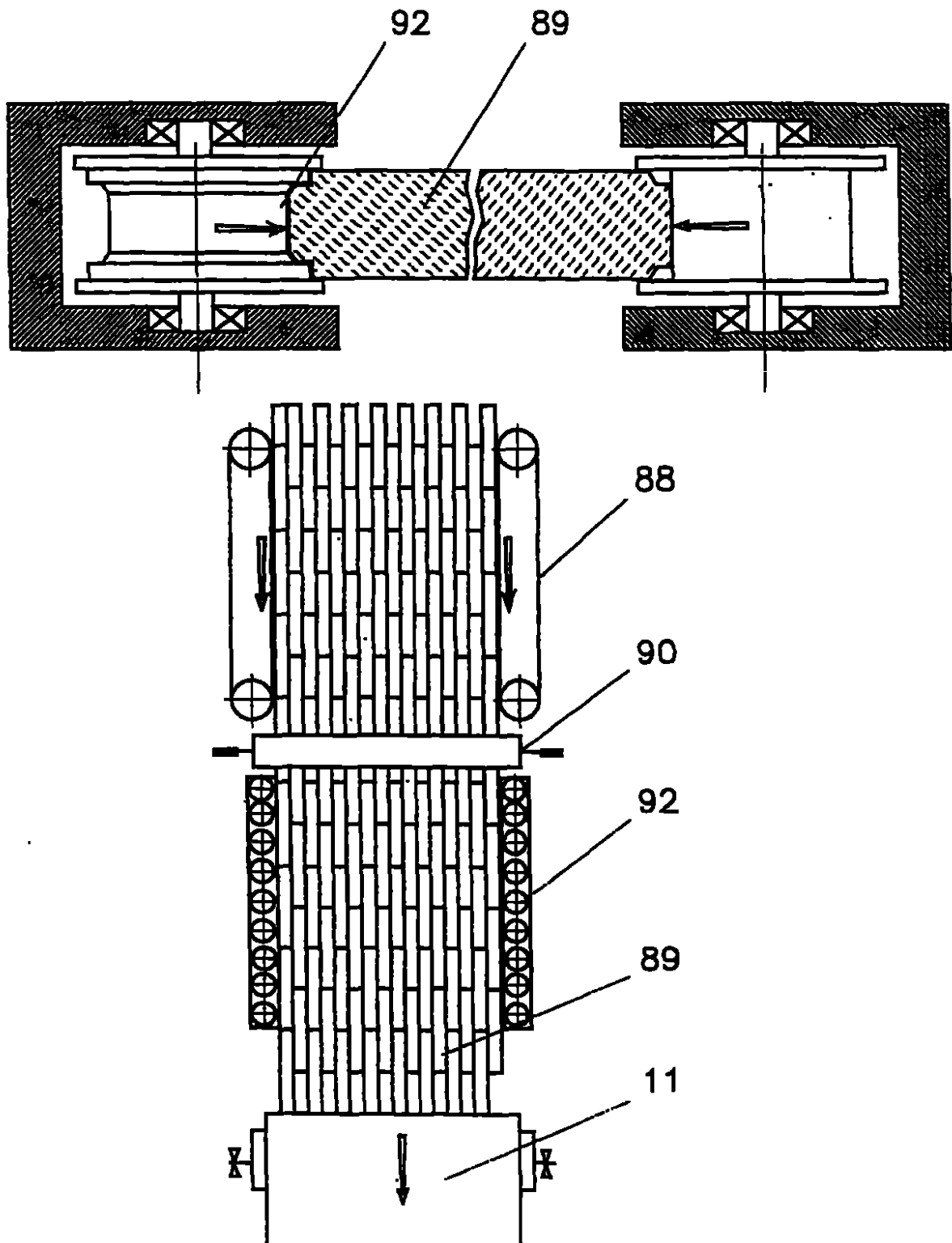


FIG.22

156

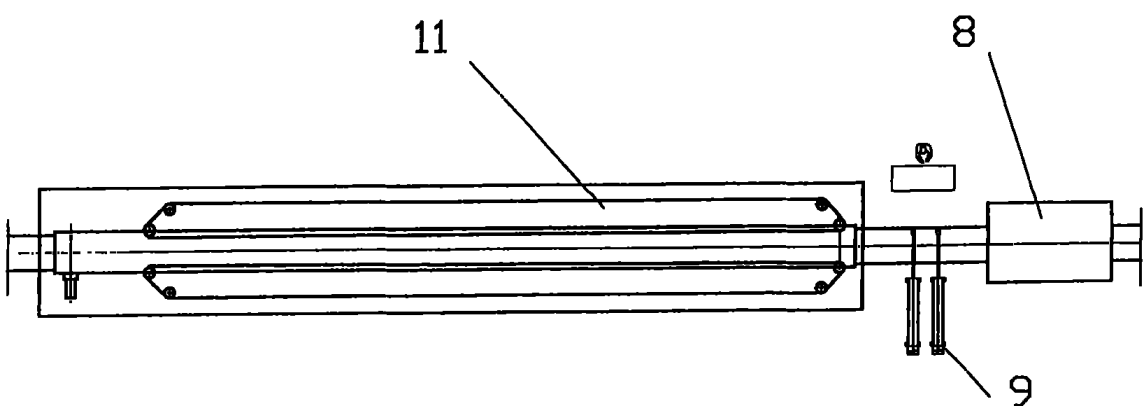


FIG.23

157

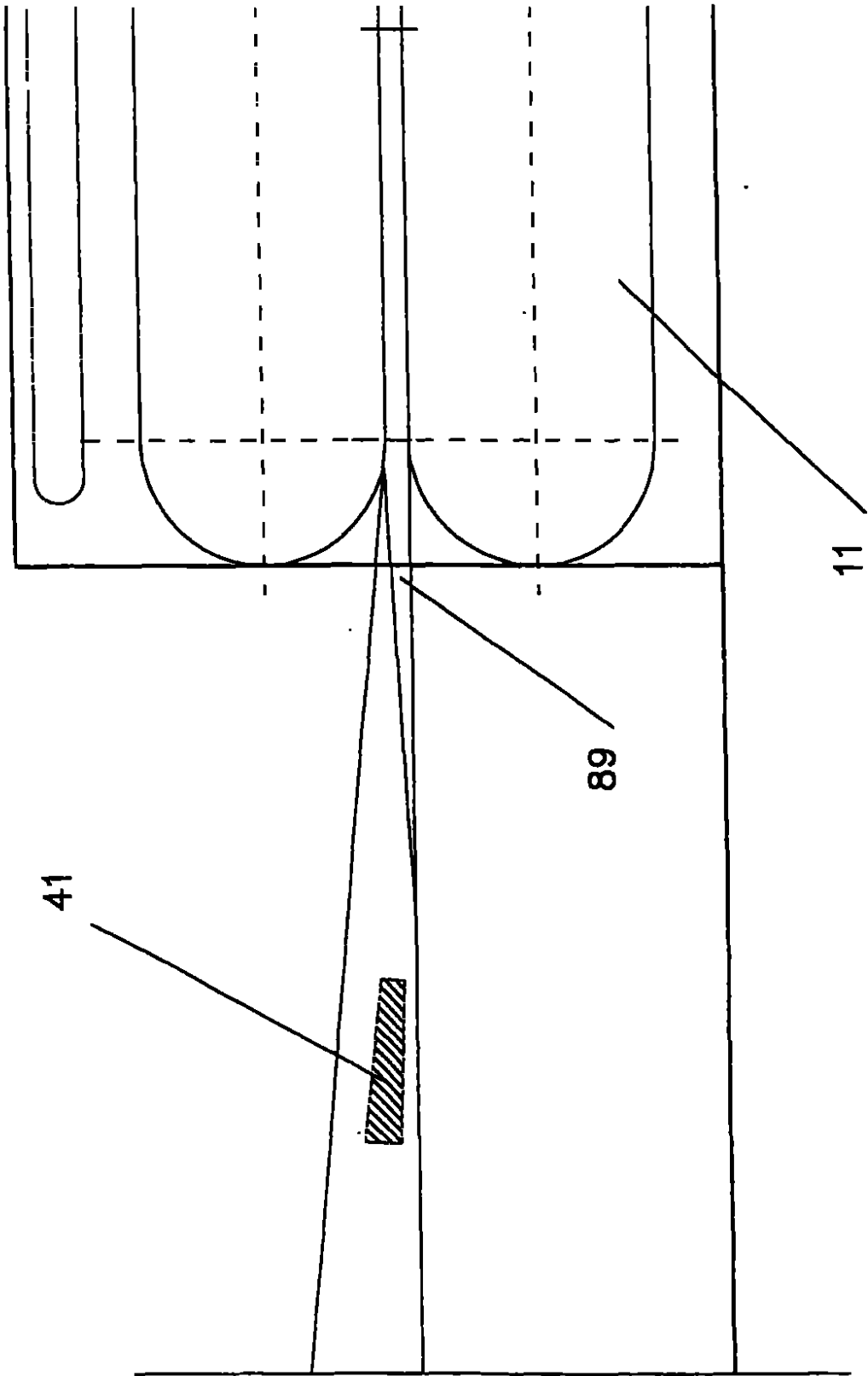


FIG.24

159

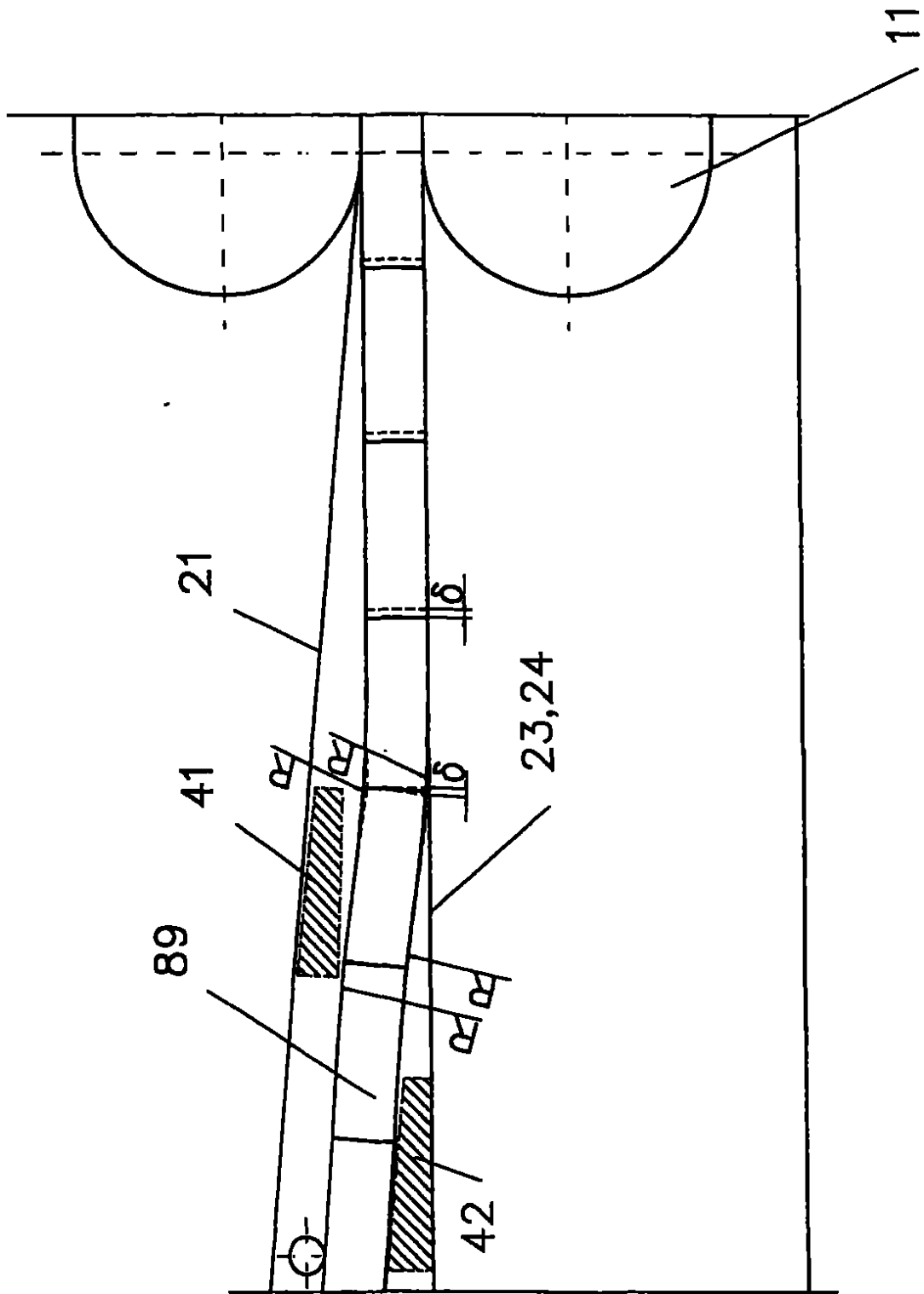


FIG.25

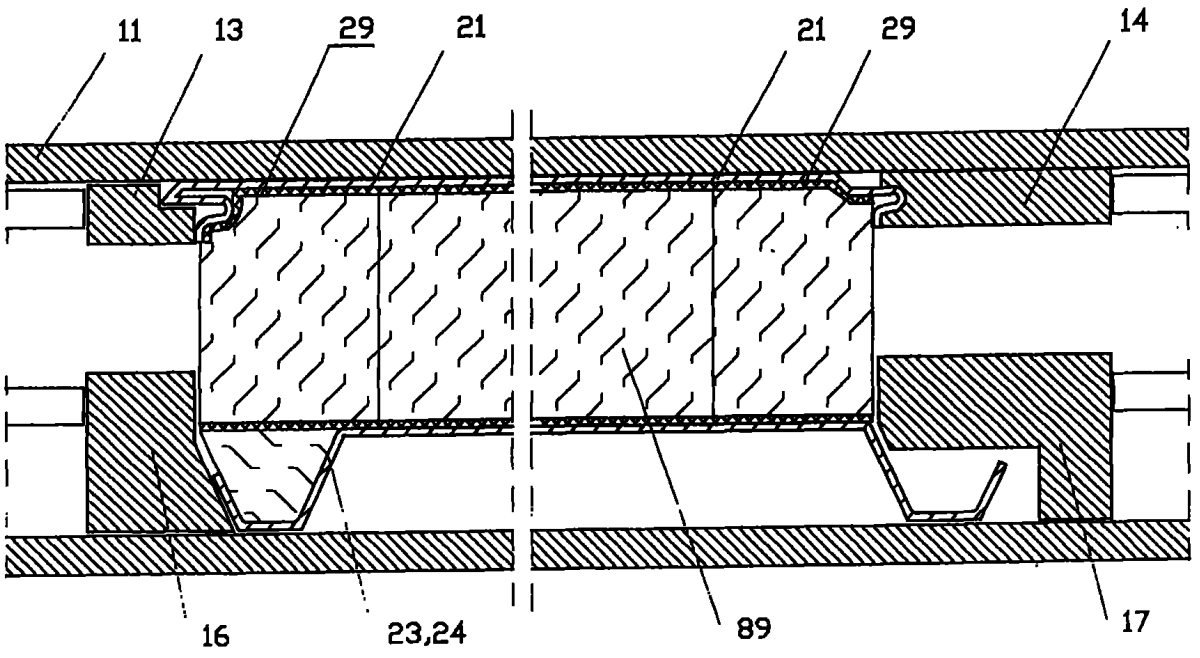
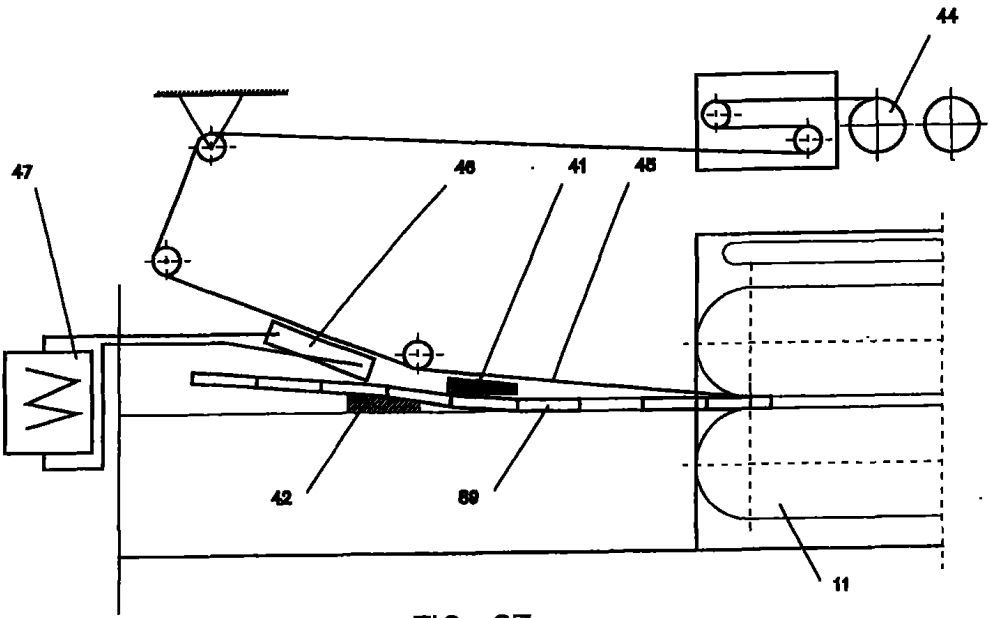


FIG.26

160



161

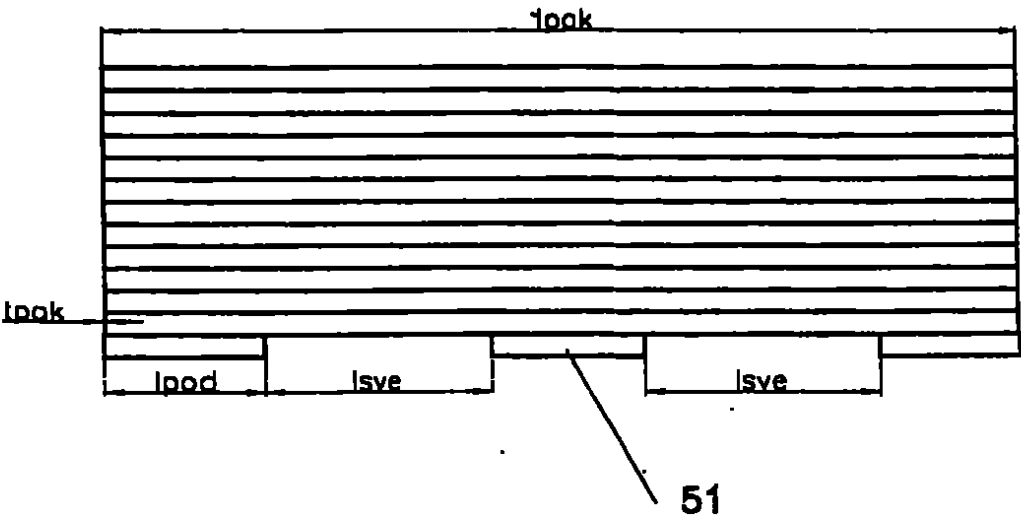


FIG.28

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/SI 99/00002

162

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 E04C2/292

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 6 E04C E04D B32B

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 682 159 A (METECNO) 15 November 1995 see column 2, line 30 - column 5, line 54; figures 1-8	1,6-8
A	FR 2 629 117 A (TRIMO) 29 September 1989 see the whole document	2-4, 15-17,24
A	EP 0 683 036 A (METECNO) 22 November 1995 see column 2, line 26 - column 6, line 7; figures 1-10	9-13,18, 19,23,27

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"B" document member of the same patent family

Date of the actual completion of the international search

21 April 1999

Date of mailing of the international search report

03/05/1999

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Authorized officer

Mysliwetz, W

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/SI 99/00002

163

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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SUPERINDUSTRIA Y COMERCIO
Radicacion : 04090227 00000000 Folios: 163
Fecha (IMP): 2004-10-01 16:42:28
Tramite : 011 PCT-PATENT 370 FASE INCI 411 PRESENTAC
Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

REQUISITOS NECESARIOS PARA PRESENTACION Y AGILIZACION DEL
TRAMITE

USUARIO RADICADOR

PATENTE DE INVENCION ☒ MODELO DE UTILIDAD ☐ ☒

- Indicacion de que se solicita la concesion de una patente ☐ ☒
- Datos de Identificacion del solicitante o de la persona que se presenta la solicitud. ☐ ☒
 - Descripcion de la invencion. ☐ ☒
 - Dibujos de ser estos pertinentes. ☒ ☒
 - Comprobante de Pago de las tasas establecidas. ☐ ☒

COMPLETA ☐ INCOMPLETA ☐ ☐

DISEÑO INDUSTRIAL ☐

- Indicacion de que se solicita el registro de Diseño Industrial ☐ ☐
- Datos de Identificacion del solicitante o de la persona que presenta la solicitud. ☐ ☐
- Representacion grafica o fotografica del Diseño Industrial o muestra del Material que incorpora el diseno. ☐ ☐
- Comprobante de pago de las tasas establecidas ☐ ☐

COMPLETA ☐ INCOMPLETA ☐ ☐

ESQUEMA DE TRAZADO ☐

- Indicacion de que solicita el registro de un Esquema de trazado. ☐ ☐
- Datos de Identificacion del solicitante o de la persona que presenta La solicitud. ☐ ☐
- Representacion grafica del esquema de trazado ☐ ☐
- Comprobante de pago de las tasas establecidas. ☐ ☐

COMPLETA ☐ INCOMPLETA ☐ ☐

Firma Responsable: Claudia M Neva

Fecha:

2020
Bogotá, D.C.,

Doctora:
DILIA MARIA RODRIGUEZ D'ALEMAN

Oficio N° 10050

ASUNTO:	Radicación N°	04-98227
	Solicitud internacional	PCT/IT02/00162
	Fecha inicio fase nacional	18/10/2004
	Trámite	011
	Evento	379
	Actuación	416
	Folios	001

Como resultado del examen de forma, realizado con fundamento en el artículo 38 de la Decisión 486 de la Comisión de la Comunidad Andina, artículo 27 del Tratado de Cooperación en Materia de Patentes (PCT), regla 51 bis del Reglamento y Circular Única de la Superintendencia de Industria y Comercio, se le comunica que:

- La solicitud no contiene la copia del documento en que consta la cesión del derecho a la patente del inventor al solicitante o a su causante. (Art. 26-k Decisión 486).
- La solicitud no contiene el poder debidamente otorgado, con el lleno de los requisitos exigidos por los artículos 63 y subsiguientes del Código de Procedimiento Civil. Adicionalmente, deberá presentar el documento que acredita la existencia y representación legal de la sociedad solicitante, cuando ésta fuere persona jurídica.

En cumplimiento de lo dispuesto por el artículo 39 de la Decisión 486, se le requiere para que dentro del término de dos meses siguientes a la fecha de notificación del presente oficio, complete los requisitos anteriormente enunciados. En caso de no dar cumplimiento al presente requerimiento, la solicitud se considerará abandonada y perderá su prelación.

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2, literal e), del capítulo quinto del título primero de la Circular Única N° 10 de 2001.

ALIX CARMENZA CESPEDÉS DE VERGEL
Jefe de la División de Nuevas Creaciones.

El anterior requerimiento fue notificado por fijación en lista de fecha, 29 Oct. 2004

202047

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