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(54) A prefabricated composite structure for forming a pitched roof

(57) A prefabricated composite structure (1) for forming a pitched roof comprises an outer support panel (2) and an underlying layer (3) of insulating material, and is suitable for fixing to a load-bearing structure of the roof juxtaposed similar prefabricated composite structures to form a first covering of the roof. The support panels (2) of the respective prefabricated composite structures of the covering are fitted together with overlapping portions and comprise at least one seat (14) extending in a direction substantially perpendicular to an eaves line of the roof in order to house projecting counter-battens (15) of the secondary frame, to which battens of the secondary frame of the roof, extending parallel to the eaves line and supporting discontinuous covering elements, are fixed in a manner such that the battens are kept spaced from the support panel (2) by a predetermined distance which is variable in dependence on design data, the architecture of the roof, and local hygrothermometric values.

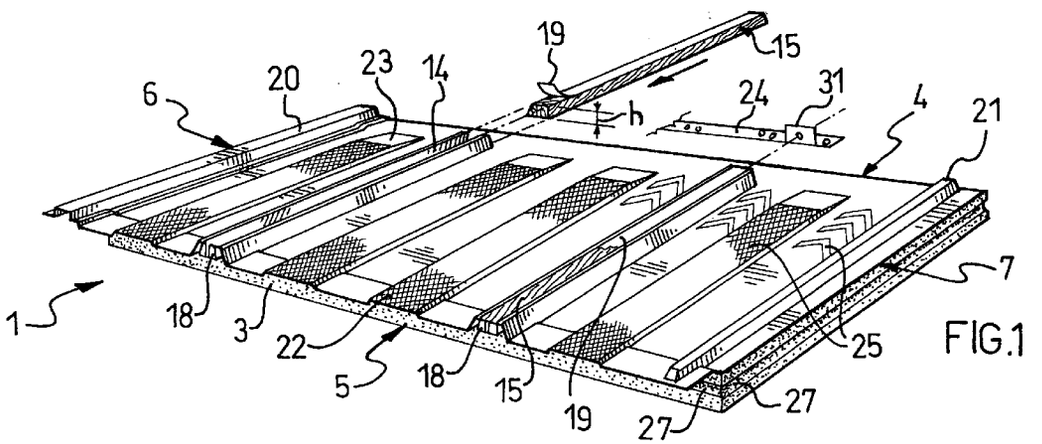

FIG.1

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Description

The present invention relates to a prefabricated composite structure for forming a pitched roof, comprising an outer support panel and an underlying layer of insulating material, and suitable for fixing to a load-bearing structure of the roof juxtaposed identical prefabricated composite structures with the respective support panels fitted together with overlapping portions, and suitable for the mounting thereon of a secondary roof frame supporting discontinuous covering elements.

It is known that pitched roofs can be covered with discontinuous covering elements, such as, for example, tiles and stone or concrete slabs juxtaposed and partially overlapping one another to prevent water penetration. These coverings are supported by the load-bearing structure of the roof which, in the case of a discontinuous load-bearing structure, is formed by the primary or main roof frame and by the secondary roof frame which comprises battens or laths. The battens, which are generally made of wood, extend parallel to the eaves line and are spaced apart in the direction perpendicular to the eaves line in accordance with the spacing of the discontinuous covering elements so as to enable these to be hung and held in position.

However, although these coverings provide optimal ventilation of the loft area, they cannot ensure complete protection against water penetration. In fact, they are subject to the risk of water penetration between the discontinuous elements of the covering as a result of imprecise positioning thereof, accidental breakage of the covering elements during maintenance operations, or even their displacement by wind or snow. Moreover, these coverings cannot provide thermal insulation for the loft area or the underlying floor and this has to be achieved by subsequent applications of insulating materials which increase the final cost of the covering.

At present, to prevent the aforesaid problem and to satisfy the requirement to ensure thermal insulation of the loft area, use is made of coverings which are formed by insulating panels positioned with or without an overlap and to which a waterproofing layer is applied, additional battens and laths being nailed thereto for the support and positioning of the discontinuous covering elements. These coverings have the disadvantage that the formation of the covering takes a long time and requires skilled labour. Moreover, it must be borne in mind that, during the formation stage, the floor underlying the covering is exposed to atmospheric agents without any protection.

Coverings comprising prefabricated insulating panels arranged to be fixed to the primary roof frame by nailing or an equivalent system, and shaped so as to form ribs or other structurally similar elements parallel to the eaves line for the support and positioning of the discontinuous covering elements, are also known.

However, although these coverings can be formed quickly, they have the disadvantage that, between the upper surfaces of the panels and the discontinuous covering elements, there is a space of limited depth in which the air stagnates since it is not possible to ensure effective ventilation therein from the eaves to the ridge. During hot weather this causes an accumulation of heat with consequent radiation towards the loft area and, during the cold weather the formation of condensation, mildew and stagnation of moisture. In fact, although holes are formed in the ribs of the panels for the passage of air, the ventilation is effective only close to the eaves and the ridge of the covering, the central regions of the covering being completely without ventilation. Moreover, since the distance between the ribs in the direction perpendicular to the eaves line of the roof is constant, these prefabricated panels cannot be adapted to discontinuous covering elements having different distances between support points.

None of the systems currently available on the market, particularly prefabricated systems, can simultaneously ensure complete waterproofing (a function supplementary to the primary waterproofing provided by the discontinuous covering elements such as flat and bent tiles), adequate ventilation (a volume of air in motion beneath the discontinuous covering elements which is variable according to the hygrothermometric values of the climatic zone) and effective and adequate hygrometric equilibrium (no risk of condensation).

Moreover, it is appropriate to stress that, even if the use of a flexible or bituminous waterproofing element is envisaged, its waterproofing function is irremediably compromised because of the holes formed due to the nailing to its outer surface of the strips or battens (the secondary roof frame) for supporting the discontinuous covering elements. Another problem is that the presence of a membrane or bituminous layer positioned on the outer surface of the thermal insulating element may cause condensation.

The problem upon which the present invention is based is that of devising a prefabricated composite structure for forming a pitched roof which has structural and functional characteristics such as to ensure the waterproofing and thermal insulation of the loft area, to permit adequate and effective ventilation, and to prevent condensation, while avoiding the aforementioned problems.

This problem is overcome by a prefabricated composite structure for forming a pitched roof of the type specified which is characterized in that first elements of the secondary roof frame are connected to the support panel projecting therefrom, and second elements of the secondary roof frame supporting the discontinuous covering elements are fixed thereto in a manner such that the second elements are kept spaced from the support panel.

The support panel preferably comprises at least one seat extending in a direction substantially perpendicular to an eaves line of the roof and defined by opposed side walls projecting from the support panel away from the layer of insulating material, and the first element of the secondary roof frame comprises a coun-

ter-batten fitted in the seat.

Further characteristics and the advantages of the composite structure according to the present invention will become clear from the following description of a preferred embodiment thereof, given by way of non-limiting example, with reference to the appended drawings, in which:

Figure 1 is an exploded, perspective view of a prefabricated composite structure according to the invention,

Figure 2 is a partially-sectioned, perspective view of the prefabricated composite structure of Figure 1 taken at a different angle,

Figure 3 is a plan view of the prefabricated composite structure of Figure 1,

Figure 4 is a side view of the prefabricated composite structure of Figure 1,

Figure 5 is a perspective view of the prefabricated composite structure of Figure 1 juxtaposed and partially overlapping identical prefabricated composite structures,

Figure 6 is a section taken on the line VI-VI of Figure 5,

Figure 7 is a section taken on the line VII-VII of Figure 5, and

Figure 8 is an exploded, perspective view of a roof incorporating prefabricated structures of Figure 1.

With reference to the appended drawings, a prefabricated, composite structure according to the invention, generally indicated 1, comprises a support panel 2, beneath which a layer 3 of insulating material is connected by, for example, gluing. The support panel 2 is formed by a thin, substantially rectangular sheet, preferably of impact-resistant polystyrene (HIPS) having an upper end 4, a lower end 5, and two opposed sides, indicated 6 and 7, respectively. Alternatively, the support panel 2 may be made of different materials such as galvanized steel, aluminium sheet or other metal materials in general.

The prefabricated composite structure 1 is intended to be fixed to the load-bearing structure of a pitched roof 8 juxtaposed identical composite structures to form a first covering of the roof 8, the respective support panels 2 being fitted together with overlapping portions.

The load-bearing structure of the roof 8 comprises a main or primary roof frame 9 of known type, comprising a ridge beam 10, a timber plate 11 extending along the eaves line X-X of each side of the roof 8, parallel to the ridge beam 10, purlins 12 parallel to the eaves line X-X, and rafters 13 extending perpendicular to the eaves line X-X between the ridge beam 10 and each timber plate 11 (Figure 8).

The prefabricated composite structure 1 is nailed to the rafters of the main roof frame 9 so that the upper and lower ends 4 and 5 of the support panel 2 are parallel to the eaves line X-X and face towards the ridge beam 10 and towards the timber plate 11, respectively, as will become clearer from the following description.

Two seats 14 formed integrally in the support panel 2 extend in a direction Y-Y parallel to the sides 6 and 7 from the lower end 5 of the support panel 2 to a predetermined distance L from the upper end 4. The seats 14 are intended to house counter-battens 15 of the same length and each seat is defined by a base 17 and opposed side walls 16. The side walls 16 extend in the direction Y-Y and project from the support panel 2, away from the layer 3 of insulating material, with a predetermined height H. The seats 14 are open at the top end facing towards the upper end 4 of the support panel 2 but are closed by an end wall 18 at their opposite ends. Each end wall 18 has a hole for the drainage from the respective seat 14 of any water which has penetrated. The side walls 16 of the seats 14 converge so as to form an undercut, preferably of the dovetail-shaped type.

The counter-battens 15 are formed with profiles complementary to those of the seats 14 so that they can be slid into the seats from the open top ends until they abut the end walls 18. It should be stressed that the coupling formed between the profiles of the counterbattens 15 and of the seats 14 prevents the counterbattens 15 from coming out of the seats 14 upwardly.

A flat bar 24 preferably extends along the upper end 4 of the support panel 2 so as to be disposed beside the top ends of the seats 14. The flat bar 24 has a portion 31 projecting at right angles adjacent each seat 14 so as to face the top ends of the counter-battens 15 fitted in the seats 14. The portions 31 of the flat bar 24 are fixed to the top ends of the counter-battens 15 by nailing or a similar system so that the counter-battens 15 of the same prefabricated composite structure 1 are connected to one another. The flat bar 24 comprises a plurality of holes 32 suitably spaced apart axially to enable the prefabricated composite structure 1 to be fixed mechanically by nailing to the rafters 13 of the main frame 9 of the roof 8.

In the embodiment described, the thickness h of the counter-battens 15 is equal to the depth H of the seats 14, but thicker counter-battens may be used so that, once they are fitted in the seats 14, they project a certain distance upwardly therefrom. Advantageously, and for reasons which will become clearer from the following description, the upper surfaces of the counter-battens 15 may be covered by a layer 19 of rubber or neoprene which performs a sound insulation function by interrupting vibrations due to atmospheric precipitation such as rain and hail striking the covering of the roof 8.

The support panel 2 comprises first and second parallel projections, indicated 20 and 21, extending along the side 6 and the side 7 of the support panel 2,

respectively and facing away from the layer 3 of insulating material so as to project from the upper surface of the support panel 2. The cross-section of the first projection 20 is homologous with the cross-section of the second projection 21 and can be superimposed thereon to enable the side 6 of the support panel 2 of one prefabricated composite structure 1 to overlap the side 7 of the support panel 2 of a similar and juxtaposed prefabricated composite structure 1 of the roof 8 with an overlap T (Figure 6), so that the first projection 20 of one support panel 2 engages the second projection 21 of the other, ensuring watertightness.

The support panel 2 is shaped so as to form a plurality of channels, in the embodiment shown, there are four channels, indicated 22, extending parallel to the sides 6 and 7 between a first open end, positioned at the lower end 5 of the support panel 2, and a second closed end 23 spaced from the top end 4 of the support panel 2 by the distance L. The channels 22 face towards the layer 3 of insulating material and their bases are spaced from the layer 3 of insulating material so as to form therewith a space 28 which is open towards the lower end 5 of the support panel 2 and has the function of allowing the removal of water vapour.

The upper surface of the support panel 2 has corrugations 25 which roughen it, making it less slippery.

The layer 3 of insulating material has a predetermined thickness S, is made of sintered or extruded expanded polystyrene, is substantially rectangular, and is connected to the support panel 2 by gluing or heat sealing, two sides of the layer 3 of insulating material being arranged flush with the upper end 4 and the side 7 of the support panel 2, whereas, on the two remaining sides of the layer 3 of insulating material the lower end 5 of the support panel 2 projects by a distance equal to the distance L and the side 6 of the support panel 2 projects by a distance equal to the overlap T.

The sides of the layer 3 of insulating material include, within their thickness S and throughout their lengths, a projection 26 or a complementary recess 27 so that the two opposite sides of the layer 3 have, respectively, a projection 26 and a recess 27 which are complementary and opposed. The projections 26 and the recesses 27 of the layers 3 of insulating material of identical juxtaposed prefabricated composite structures 1 of the roof 8 can thus engage one another with a known male-female coupling to form a continuous layer of insulating material without cracks at the joints and thus without any thermal bridges. Alternatively, the projections 26 and the recesses 27 may be formed with complementary stepped profiles to enable the projections 26 and the recesses 27 of the layers 3 of insulating material of identical and juxtaposed prefabricated composite structures 1 of the roof 8 to overlap.

The prefabricated composite structures 1 are preferably arranged with the counter-battens 15 inserted in the seats 14 and with the portions 31 of the flat bars 24 connected to the top ends of the counter-battens 15 by means of screws or nails before installation. Clues or the like may be used to achieve better fixing of the counter-battens 15 in their seats 14.

When they are installed, all of the prefabricated composite structures 1 are oriented in the same manner to form a first covering of the roof 8 and are fixed by nailing or an equivalent system to the rafters 13 of the primary frame 9 of the roof 8 only at their upper ends 4.

The prefabricated composite structures 1 are fitted together so that, from the ridge beam 10 to the timber plate 11, the lower ends 5 of the support panels 2 overlap the upper ends 4 of lower juxtaposed support panels 2, relative to the eaves line X-X, with an overlap equal to the distance L. The prefabricated composite structures 1 are nailed to the main roof frame 9 in a manner such that the nail holes are formed in the upper regions of the support panels 2 which are intended to be overlapped so that it is not necessary to seal these holes after fixing. The holes 32 in the flat bar 24 are preferably used for this nailing operation so that the counter-battens 15 are simultaneously also connected to the primary frame 9 of the roof 8.

Similarly, the prefabricated composite structures 1 are juxtaposed laterally with the side 7 of one support panel 2 overlapped, with an overlap T, by the side 6 of the other (Figures 5 and 6). The first projection 20 of one support panel 2 thus engages the second projection 21 of the other support panel 2.

The aforementioned juxtaposed arrangement of the prefabricated composite structures 1 causes the sides of the layers 3 of insulating material of juxtaposed prefabricated composite structures 1 disposed beside one another partially to overlap one another both parallel and perpendicular to the eaves line X-X, the projections 26 of one being engaged in the corresponding recesses 27 of the other, as described above. The overlap achieved along the joining line between adjacent layers 3 of insulating material of two juxtaposed prefabricated composite structures 1 advantageously allows a continuous layer of insulating material to be formed without gaps at the joints.

The overlap formed between the support panels 2 of the prefabricated composite structures 1 juxtaposed as described above ensures that the covering of the roof 8 is completely waterproof.

Once the first covering of the roof 8 with the prefabricated composite structures 1 has been completed, battens 29, otherwise known as laths, which, together with the counter-battens 15, form the secondary frame of the roof, are fixed to the counter-battens 15 by nailing or an equivalent system. The battens 29 extend parallel to the eaves line X-X and enable discontinuous covering elements 30 such as flat tiles or bent tiles or the like, with which the covering of the roof 8 is completed (Figure 8), to be supported and hung or fixed mechanically by means of nails or screws.

Clearly, the distance between the battens 29 in the direction perpendicular to the eaves line X-X is established in dependence on the distance between the support points of the discontinuous covering elements 30

used.

Advantageously, the distance at least equal to H which separates the battens 29 from the upper surface of the support panels 2 allows effective ventilation to be set in motion from the eaves to the ridge, beneath the discontinuous covering elements 30. Moreover, the use of counter-battens 15 having a thickness h greater than the depth H of the seats enables the battens 29 to be supported at a greater distance from the upper surfaces of the support panels 2, when necessary, to increase the volume of air in motion from the eaves to the ridge As can be appreciated from the foregoing description, the prefabricated composite structure for forming a pitched roof has structural and functional characteristics such as to achieve waterproofing, ventilation and hygrostatic equilibrium of the roof covering and thermal insulation of the loft area without having the disadvantages referred to. In fact, the overlap formed between the support panels of the prefabricated composite structures juxtaposed to form the first covering of the roof ensures a complete seal against any water penetration between the discontinuous covering elements, whereas the layer of insulating material ensures good thermal insulation of the loft area, without breaks in continuity.

The prefabricated composite structure according to the invention enables a pitched roof to be covered with discontinuous covering elements beneath which effective ventilation is set in motion from the eaves to the ridge and is variable in dependence on design data, the architecture of the roof and local hygrothermometric values. Moreover, this prefabricated composite structure can be adapted to discontinuous covering elements having different distances between bearing points.

Another advantage of the prefabricated composite structure according to the invention lies in the fact that it can be installed quickly and easily so that the loft area can be covered quickly to protect it from atmospheric agents. It is appropriate to stress that the fixing of the battens and the laying of the discontinuous covering elements may even be carried afterwards since it is not essential for ensuring the waterproofing of the loft area.

A further advantage of the prefabricated composite structure according to the invention lies in the fact that it can be used both with continuous load-bearing structures and with discontinuous load-bearing structures having different spacings between the rafters so that its use is also advantageous for reconstructing old roofs.

A further advantage of the prefabricated composite structure according to the invention lies in the fact that it is simple and cheap to produce so that the costs of producing the roof covering can be limited.

Naturally, to satisfy contingent and specific requirements, an expert in the art may apply to the prefabricated composite structure described above many modifications and variations all of which, however, are included within the scope of protection of the invention as defined in the following claims.

Thus, for example, the seats in which the counter-battens are fitted may converge at a predetermined limited angle so that, after the fixing of the battens, any sliding of the battens in the seats due to the loading of the discontinuous covering elements is prevented.

The prefabricated composite structures may differ from those shown in the drawings in that they may be longer vertically than parallel to the eaves line.

The seats of the support panels may be without end walls to allow a longer counter-batten to connect several seats aligned in the direction perpendicular to the eaves line of the roof, of juxtaposed prefabricated composite structures.

If the spacing between the rafters is large, it is possible to use prefabricated composite structures in which one or more grooves extend in the layer of insulating material, parallel to the lower end of the support panel, beams being inserted therein and bearing on the rafters of the load-bearing structure of the roof, preventing the prefabricated composite structures from bending.

Claims

1. A prefabricated composite structure for forming a pitched roof (8), comprising an outer support panel (2) and an underlying layer (3) of insulating material, suitable for fixing to a load-bearing structure of the roof (8) juxtaposed identical prefabricated composite structures with the respective support panels (2) fitted together with overlapping portions, and suitable for the mounting thereon of a secondary frame of the roof supporting discontinuous covering elements (30), characterized in that first elements (15) of the secondary roof frame are connected to the support panel (2), projecting therefrom, and second elements (29) of the secondary roof frame, supporting the discontinuous covering elements (30), are fixed thereto in a manner such that the second elements (29) are kept spaced from the support panel (2).

2. A composite structure according to Claim 1, in which the support panel (2) comprises at least one seat (14) extending in a direction substantially perpendicular to an eaves line (X-X) of the roof (8) and defined by opposed side walls (16) projecting from the support panel (2) away from the layer (3) of insulating material, and in which the first element of the secondary frame of the roof (8) comprises a counter-batten (15) fitted in the seat (14).

3. A composite structure according to Claim 2, in which the seat (14) is formed integrally with the support panel (2).

4. A composite structure according to Claim 2, in which the opposed side walls (16) of the seat (14) converge so as to form an undercut, and in which the counter-batten (15) is formed with a profile complementary to that of the seat (14).

5. A composite structure according to Claim 4, in which the seat (14) and the counter-batten (15) are formed with complementary dovetail-shaped profiles.

6. A composite structure according to Claim 2, in which the support panel (2) comprises a lower end (5) and an upper end (4) intended, respectively, to overlap the support panels (2) of identical prefabricated composite structures of the roof (8) juxtaposed in higher and lower positions relative to the eaves line (X-X), and to be overlapped thereby, with a predetermined overlap, the seat (14) being spaced from the upper end (4) of the support panel (2) by a distance (L) at least equal to the predetermined overlap.

7. A composite structure according to Claim 6, comprising a flat bar (24) extending along the upper end (4) of the support panel (2) and having a portion (31) projecting at right angles, facing the top end of the counter-batten (15) and fixed firmly thereto, the flat bar (24) comprising a plurality of holes (32) for the fixing of the prefabricated composite structure (1) to the load-bearing structure of the roof (8).

8. A composite structure according to Claim 6, in which the end of the seat (14) facing the lower end (5) of the support panel (2) is closed by an end wall (18) having an opening for the drainage of water which has penetrated.

9. A composite structure according to Claim 6, in which the support panel (2) is shaped so as to form a plurality of channels (22), in relief, extending between a first, open end positioned at the lower end (5) of the support panel (2) and a second, closed end (23) spaced from the upper end (4) of the support panel (2) by a distance at least equal to the distance (L), the channels (22) facing away from the layer (3) of insulating material to form spaces (28) between the layer (3) of insulating material and the support panel (2).

10. A composite structure according to Claim 6, in which the support panel (2) comprises a first and a second parallel projection (20, 21) extending, respectively, along a first and a second side (6, 7) of the support panel (2), and in which the first projection (20) has a cross-section which is homologous with the cross-section of the second projection (21) and can be superimposed thereon to allow the first side (6) of the support panel (2) to overlap the second side (7) of the support panel (2) of a juxtaposed and identical composite structure of the roof (8), the first projection (20) of one support panel (2) engaging the second projection (21) of the other.

11. A composite structure according to any one of the preceding claims, the support panel (2) of which comprises a surface portion which is intended to overlap the support panels of similar juxtaposed composite structures, the layer (3) of insulating material being connected solely to the remaining surface of the support panel (2).

12. A composite structure according to Claim 11, in which opposite sides of the layer (3) of insulating material comprise, within their thickness (S), at least one projection (26) and one respective complementary and opposed recess (27), so that the projections (26) and the recesses of adjacent sides of the layers (3) of insulating material of identical and juxtaposed prefabricated composite structures of the roof (8) can engage one another.

13. A composite structure according to Claim 12, in which the projection (26) and the recess (27) are formed with complementary male and female profiles.

14. A composite structure according to Claim 1, in which the support panel (2) is made of impact-resistant polystyrene (HIPS).

15. A composite structure according to Claim 1, in which the layer (3) of insulating material is expanded polystyrene.

16. A composite structure according to Claim 1, in which the second elements (29) of the secondary frame of the roof (8) comprise battens or laths extending parallel to an eaves line (X-X) of the roof (8) for the support and/or hanging of discontinuous covering elements (30) of the roof (8).

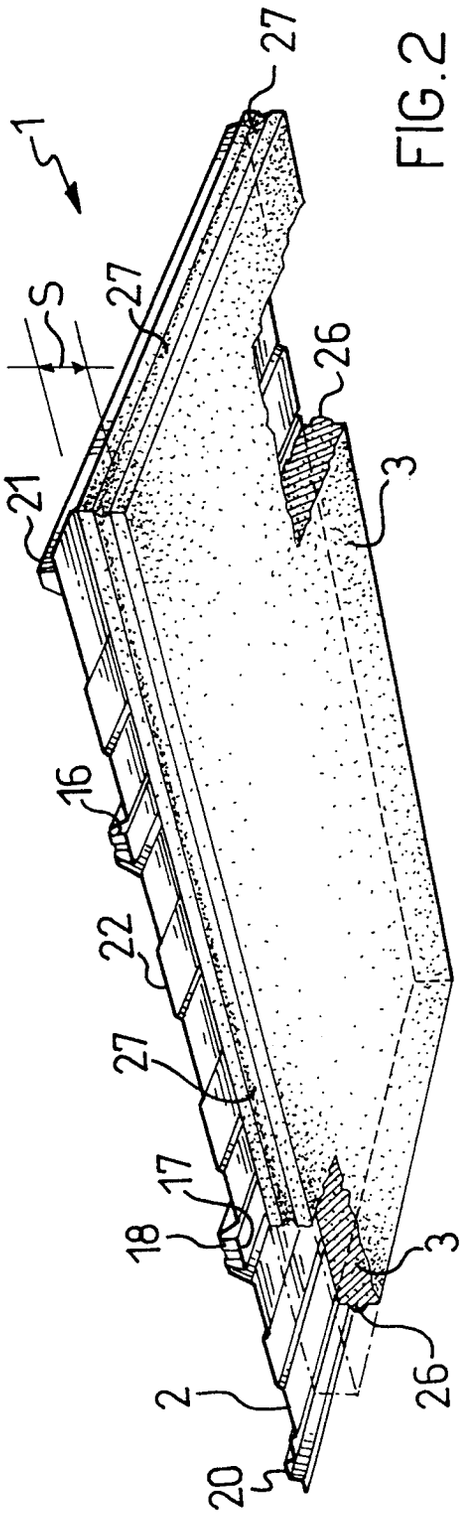
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FIG.2

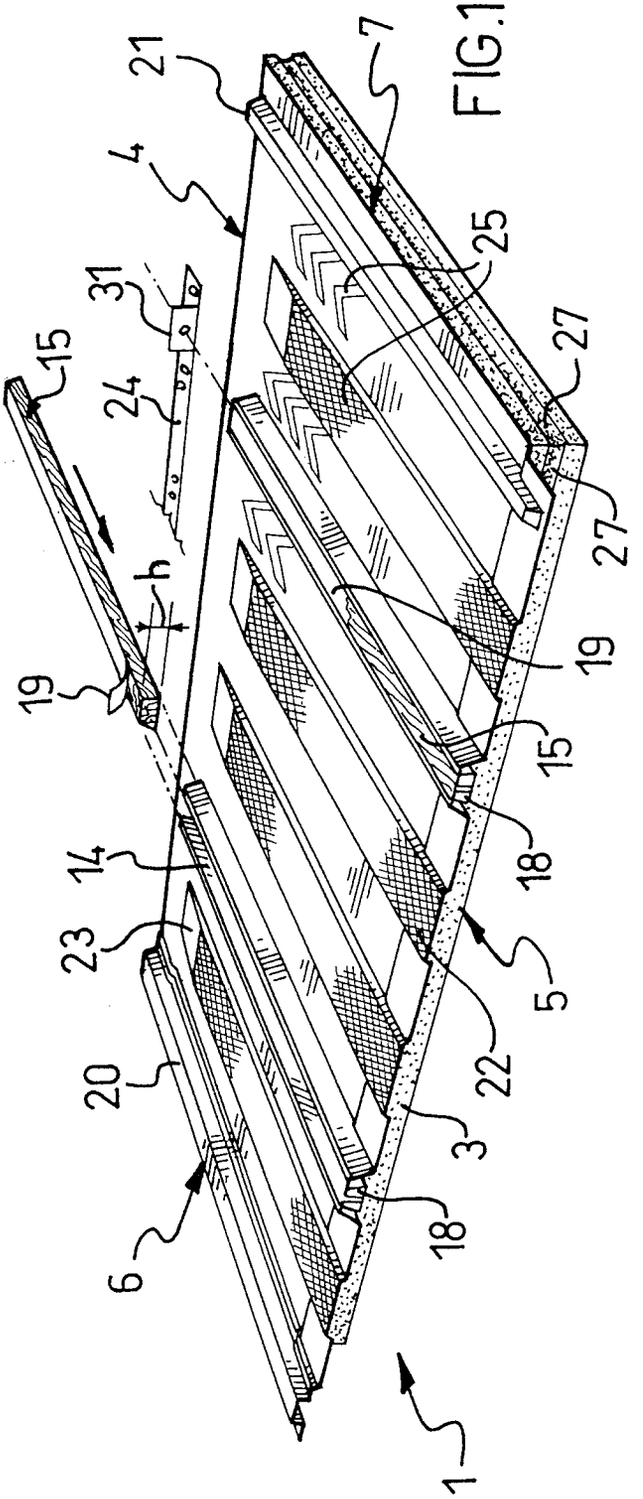
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FIG.1

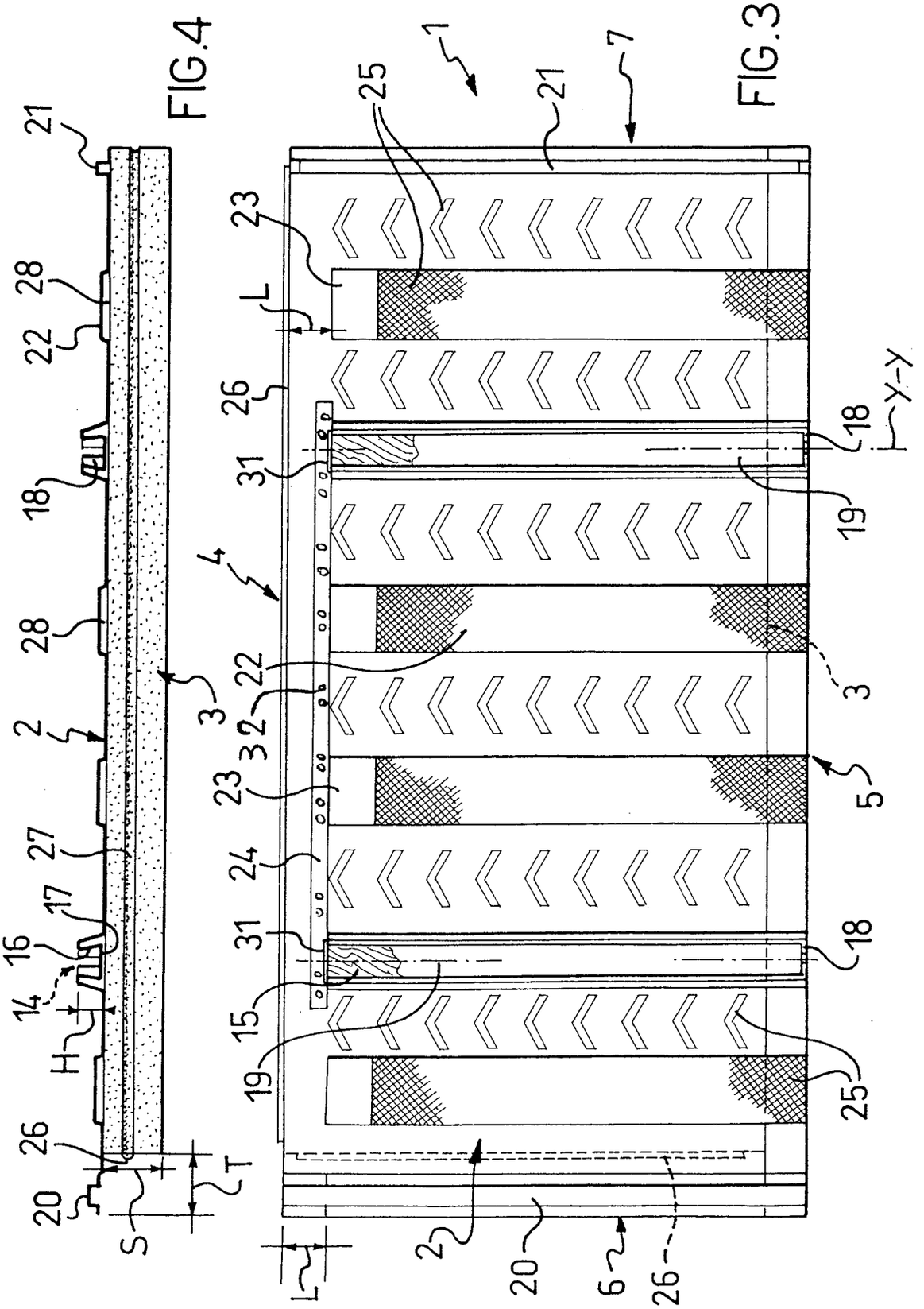
FIG.4
FIG.3
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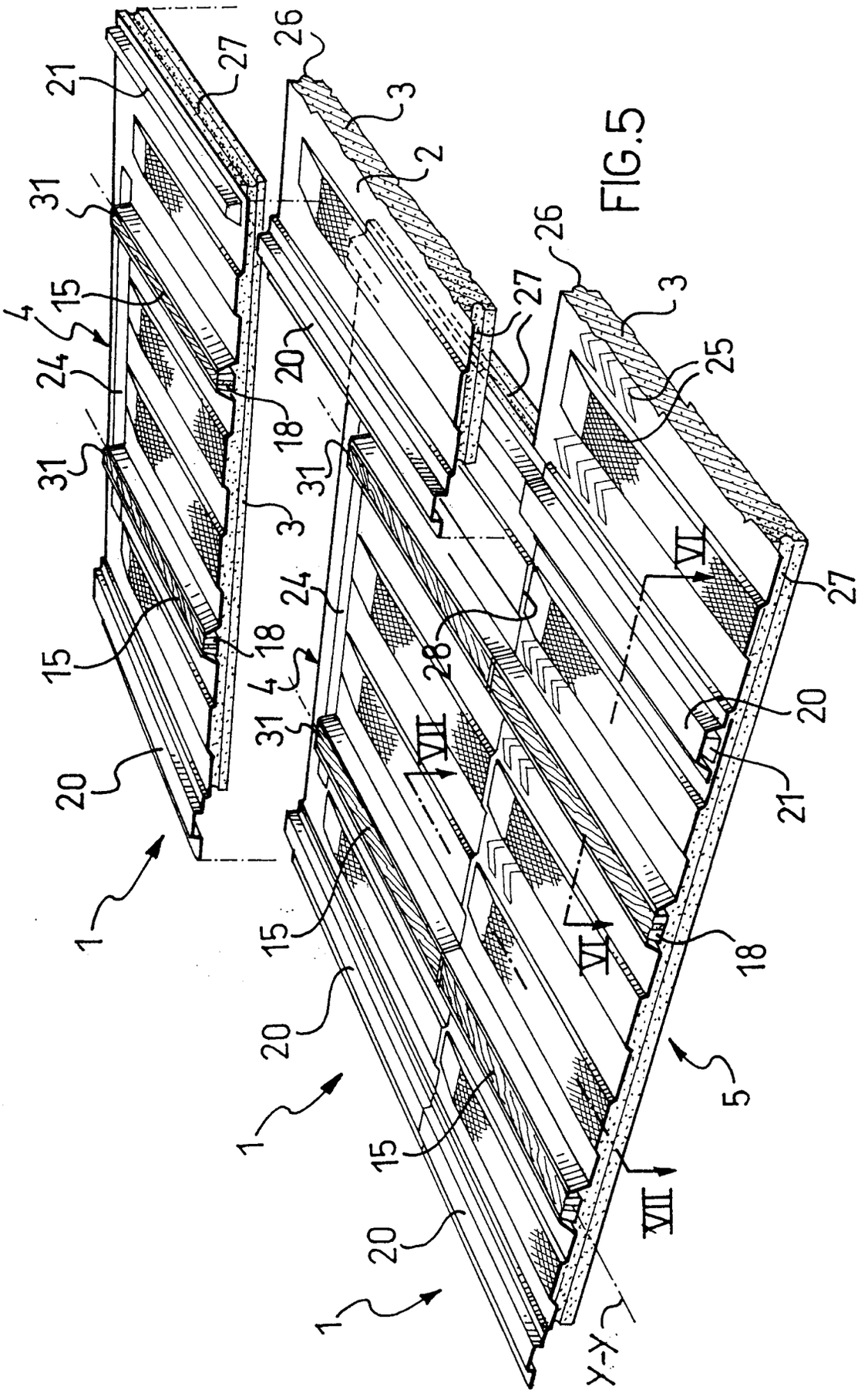

FIG.5

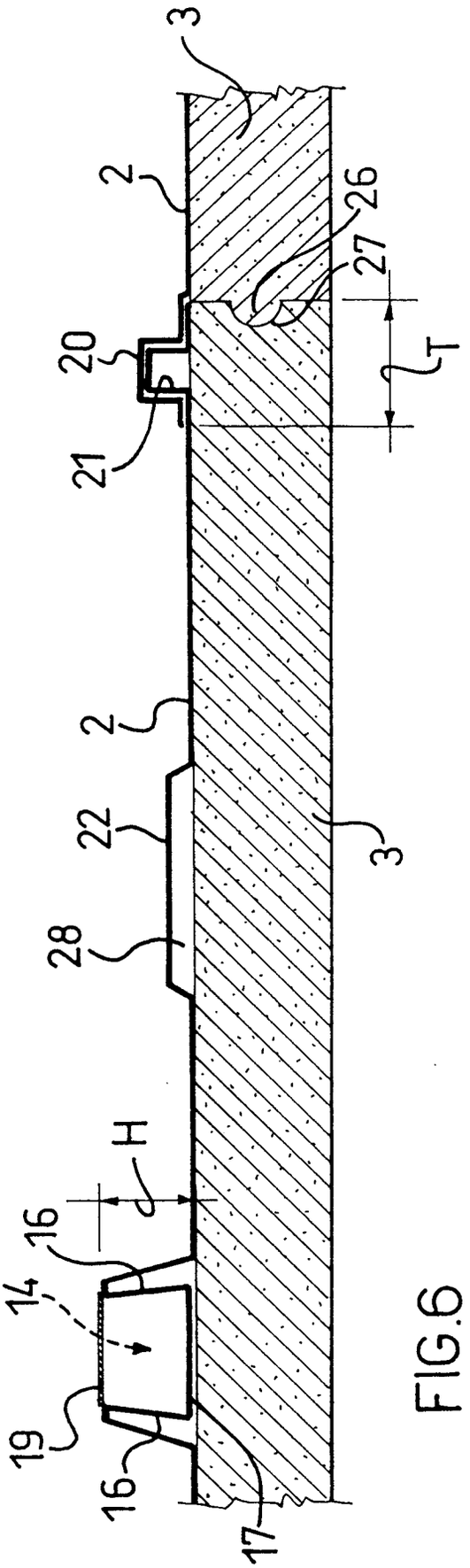

FIG.6

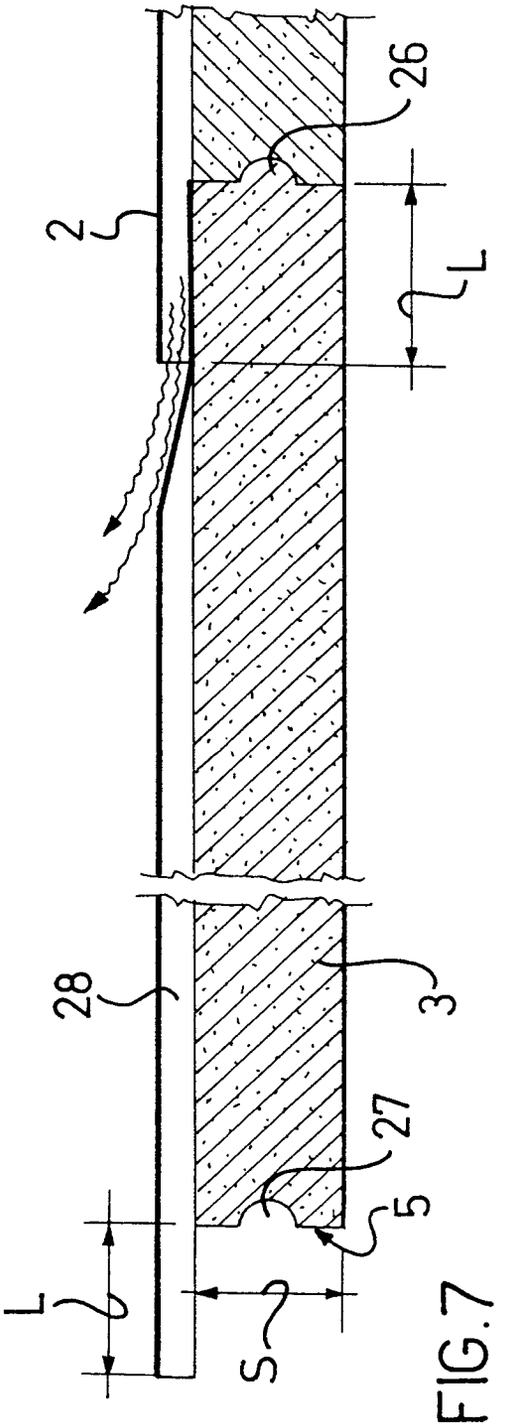

FIG.7

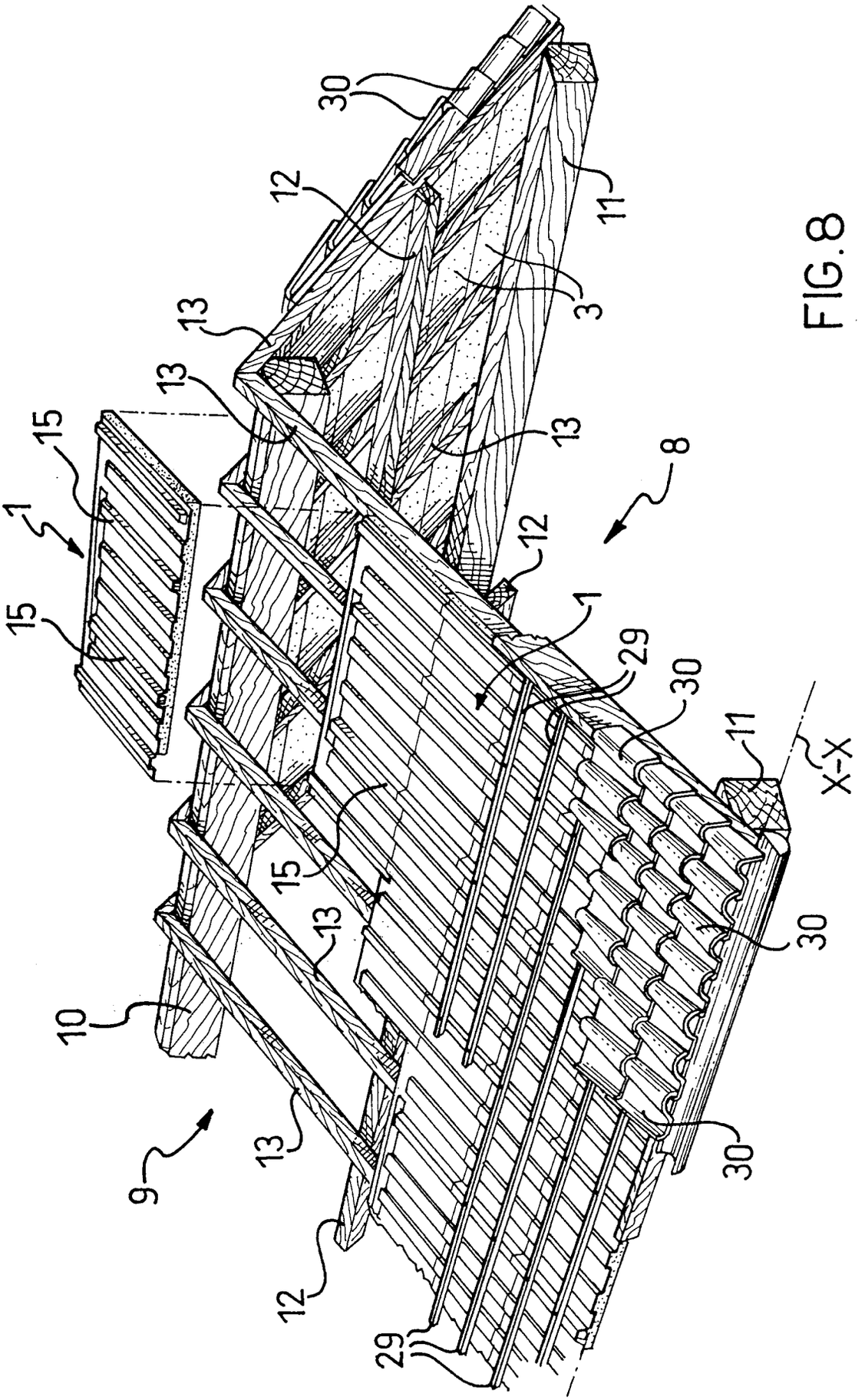

FIG.8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0359

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.6)
X Y A	CH-A-618 229 (MONDIALIN-DUNSPAN) * page 2, column 2, line 10 - page 3, column 2, line 28; figures * ---	1,15,16 11-13 2,14	E04B7/20 E04D13/16
Y A	CH-A-612 239 (KELLER AG) * page 2, column 2, line 27 - line 68; figures * ---	11-13 1,6,16	
A	GB-A-2 182 960 (SPRINGVALE) * page 1, line 73 - line 85; figures * ---	1,10,15	
A	DE-A-30 11 159 (JUNGBLUTH ET AL.) * page 6, paragraph 4 - paragraph 6; figure 4 * ---	1,9,15,16	
A	FR-A-2 469 509 (FRICKER) * page 1, last paragraph - page 2, paragraph 6; figures * ---	1,14,16	
A	US-A-3 979 867 (SOWINSKI) * the whole document * ---	1,12,13,16	TECHNICAL FIELDS SEARCHED (Int.Cl.6) E04B E04D
A	EP-A-0 123 710 (RHINOLITH) * figures * ---	2-4	
A	GB-A-2 283 084 (KINGSPAN RESEARCH) * abstract; figures 1,2 * ---	10	
A	FR-A-1 450 097 (MILLIARD) * page 1, column 1, last paragraph - page 1, column 2, paragraph 1; figures * --- -/--	14	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 December 1996	Righetti, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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P : intermediate document

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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0359

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.6)
A	FR-A-931 527 (EBERLE) * figure 4 * -----	5	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 December 1996	Righetti, R

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