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CA 2403404 A1 2001/09/20

(21) 2 403 404

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2001/03/19
(87) Date publication PCT/PCT Publication Date: 2001/09/20
(85) Entrée phase nationale/National Entry: 2002/09/16
(86) N° demande PCT/PCT Application No.: GB 2001/001208
(87) N° publication PCT/PCT Publication No.: 2001/069006
(30) Priorité/Priority: 2000/03/17 (0006335.4) GB

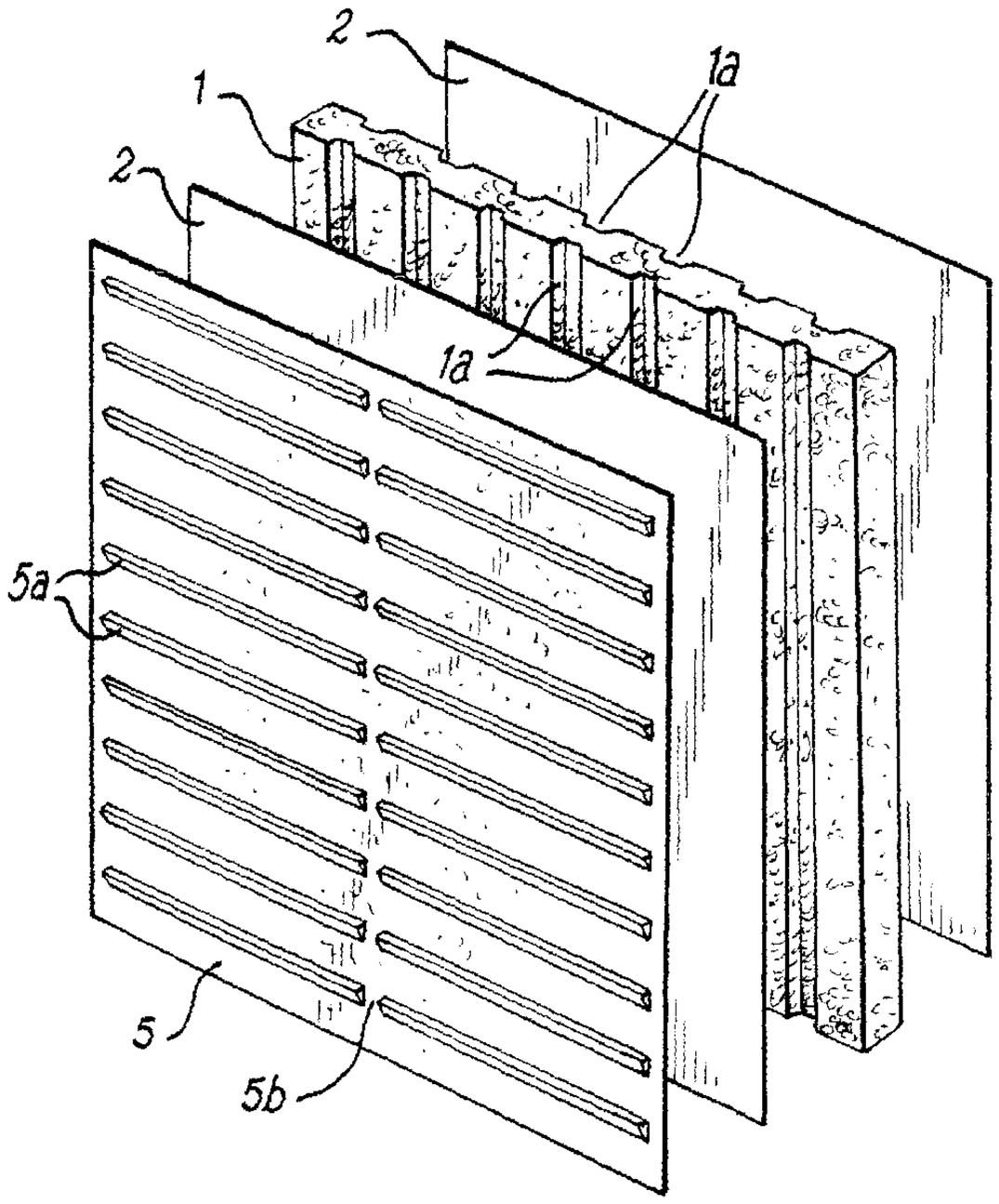
(51) Cl.Int.$^{7}$/Int.Cl.$^{7}$ E04F 13/14, E04F 13/08

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(54) Titre : PANNEAU
(54) Title: PANEL




(57) Abrégé/Abstract:
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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 September 2001 (20.09.2001)

PCT

(10) International Publication Number
WO 01/69006 A1

(51) International Patent Classification[7]: E04F 13/14, 13/08

(21) International Application Number: PCT/GB01/01208

(22) International Filing Date: 19 March 2001 (19.03.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0006335.4 17 March 2000 (17.03.2000) GB

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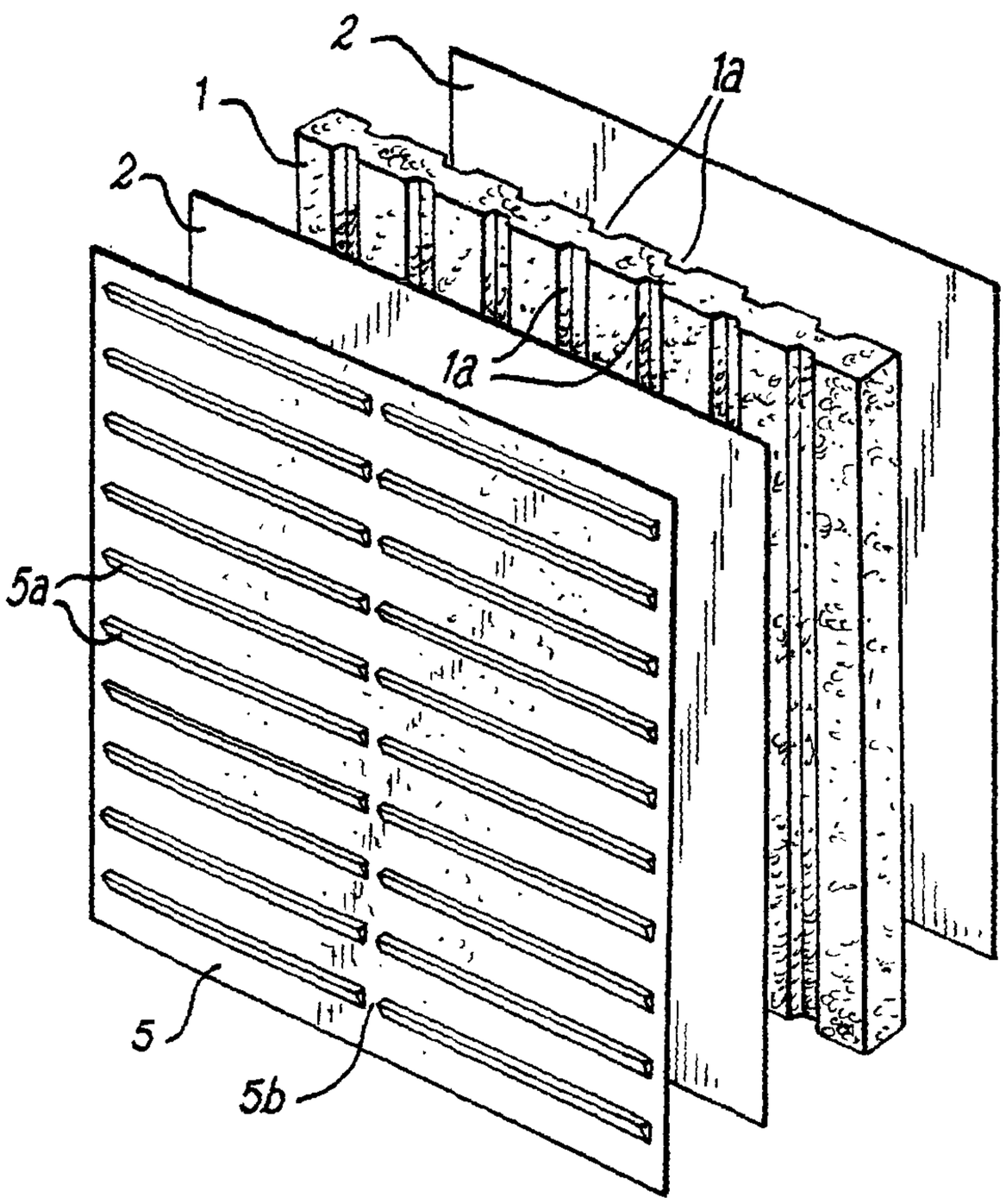
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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian

*[Continued on next page]*

(54) Title: PANEL




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# PANEL

The present invention relates to building panels.

A variety of building panels are known. The present invention seeks to improve over those panels.

According to the present invention there is provided a panel comprising a sheet of insulating material sandwiched between two metal sheets, the outside surface of one of the metal sheets comprising a plurality of building block supports.

Building blocks, for example brick slips, may therefore be supported on one side of the panel to give the appearance of a conventional brick wall.

The sheet of insulating material may comprise a sheet of foam material. Where this is the case the sheet of foam material preferably has a density of at least 15 $Kg/m^3$ or $30Kg/m^3$, but less than $45Kg/m^3$ and may comprise extruded polystyrene foam but could comprise polyurethane foam or another suitable material. The foam material preferably has a sheer modulus of at least 2500 KPa, but less than 16000 KPa, and particularly about 8000 KPa. An example of another insulating material that may be used is mineral wool.

The thickness of insulating material may be varied depending on the level of insulation (U value) required.

The sheets of metal are preferably at least 0.3mm thick, more preferably between 0.3 and 1mm thick and particularly about 0.7mm thick.

They may comprise steel sheet, may be treated to prevent corrosion, for example by galvanizing, and are preferably bonded to the sheet of insulating material with an adhesive. A two part polyurethane adhesive is suitable. The metal sheets are preferably substantially flat.

In an alternative arrangement the metal sheets could be positioned in a jig and an insulating material, particularly an expanding foam material such as a polyurethane foam material, injected between the two, and allowed to harden so that it bonds to the metal sheets.

Preferably one or both faces of the sheet of insulating material includes a plurality of spaced apart channels extending to at least one edge of the sheet. Such channels facilitate the escape of air and solvent from between the metal sheets and the insulating material during assembly, resulting in better adhesion of the insulating material and metal sheets.

One or more stiffening members may be provided between the metal sheets. These may comprise strips of material extending between the two metal sheets. Plastics and glass reinforced plastics materials are suitable; wood and metal could also be used. The stiffening members are preferably bonded to both metal sheets. The stiffening members may divide the sheet of insulating material into a number of separate pieces.

The building block supports may be formed separately to or unitarily with one of the metal sheets. In one embodiment they are provided by a moulded plastics sheet bonded to a metal sheet with an adhesive. Such a

plastics sheet is preferably corona arc discharge treated prior to bonding it to the metal sheet. This improves adhesion of the plastics sheet to the metal sheet. In another embodiment the metal sheet is pressed to form supports. In another embodiment the metal sheet includes outwardly projecting tabs formed by cutting and folding the sheet. An example of a metal sheet including unitarily formed building block supports is described in US 3533206.

Preferably a formation configured to engage with a similar formation is disposed along at least one edge, and preferably along each of two opposed edges, of the panel. This enables panels to be joined together, particularly stacked on each other, to form larger panels. The formations may each include both male and female cooperating parts. The formations may include a seal operative to form a seal with another formation. The formations preferably comprise glass fibre reinforced resin pulltrusions, but could also comprise metal, plastics or reinforced plastics extrusions or mouldings.

Where one or more edges of the panel are fitted with metal formations it is preferable to take steps to reduce the effect of cold bridging brought about because the formation provides a path for transfer of heat between opposite sides of the panel. In one embodiment this is achieved by adhering a resin to the formation and removing a part of the formation to provide a gap in the formation between opposite sides of the panel.

Formations comprised of plastics material are inherently better thermal insulators than metal ones, so extra steps need not be taken to prevent cold bridging when these materials are used.

The inclusion of metal sheets enables panels of greater strength than conventional building block support panels to be produced. The panels may therefore be used as structural components in buildings. Larger panels than have conventionally been the case can be constructed and the requirements of any supporting structure for them is reduced.

As the panels include an insulating layer they can be used to form single walled structures, with an interior finish being applied to the metal sheet facing the inside of the structure. Alternatively, panels could be used to form the outside wall of a cavity walled structure. They can, in particular, be used to form the outer wall of a timber or steel framed building.

In order that the invention may be more clearly understood embodiments thereof will now be described, by way of example, with reference to the accompanying drawings of which:

Figure 1 is an exploded perspective view of part of a panel according to the invention (without brick slips);

Figure 2 is a side view of two pulltrusions engaged with each other;

Figure 3 is a side view of an alternative embodiment of a pulltrusion;

Figure 4 is a side view of part of two panels according to the invention engaged with each other;

Figure 5 includes three cross-sectional views through a panel according to the invention mounted on a timber framed structure;

Figure 6 includes views similar to Figure 5 for a concrete structure;

Figure 7 includes views similar to Figure 5 for a steel structure;

Figure 8 is a perspective view of part of a timber framed building including a panel according to the invention;

Figure 9 is a plan view of two panels according to the invention mounted side to side; and

Figure 10 is a plan view showing how two panels according to the invention are joined at right angles to each other.

Referring to Figures 1 to 4 a panel comprises a 65mm thick sheet of extruded polystyrene foam 1 of density about 35Kg/$m^3$, sandwiched between two zinc coated 0.7mm thick steel sheets 2. The steel sheets 2 are bonded to the foam sheet 1 with a two-part polyurethane adhesive 4. A suitable adhesive is sold by Akzo-Nobel, under the designation 8243PUR.

The sides of the foam sheet 1 to which the steel sheets 2 are bonded include a plurality of spaced apart substantially parallel channels 1a running between opposite edges of the sheet 1. The purpose of the channels 1a is to allow any air or solvent trapped between the foam 1 and steel 2 sheets to escape to ensure that a satisfactory bond is achieved between the sheets.

A high impact polystyrene vacuum moulded building block support

sheet 5 is bonded to the outside surface of one of the steel sheets 2 with an adhesive 6. A similar adhesive as used to bond the steel sheets 2 to the foam sheet 1 is suitable. Prior to bonding the building block support sheet 5 to the metal sheet 1 the building block support sheet is preferably corona arc discharge treated. This results in better adhesion to the metal sheet 1.

The building block support 5 comprises a sheet having a series of substantially parallel evenly paced apart projecting ledges 5a extending laterally across its surface, but not all the way to the lateral edges of the sheet. As such, when two panels are placed adjacent to each other there is an upright gap in the ledges between the panels. One or more additional gaps 5b are provided along the length of each ledge to allow any trapped moisture to drain away. Having a gap in the ledges between panels helps to negate the effect of any misalignment between panels, although this is preferably avoided. The ledges themselves are provided by ribs of substantially triangular cross-section, but with one side open as they are formed by deforming a single sheet of material. Each rib has an upper surface for supporting building blocks which extends substantially perpendicularly outwardly from the plane of the sheet 5. The exposed surface of the sheet, other than where there are blocks, includes a relief pattern (not shown) to aid adhesion of building blocks thereto.

20mm thick brick slips 7 are supported on the ledges of the building block support sheet 5, and bonded to the building block support with an

adhesive 8. A suitable adhesive is supplied by Honeywell Speciality Wax and Adhesives Ltd under the designation Ralithane 810. The nominal height of the brick slips 7 is 65mm, 5mm less than the distance between adjacent ribs on the building block support. This allows for some tolerance in actual brick slip height. The pitch of the ribs of the building block supports is chosen to provide approximately 10mm of space between brick slips 7 on adjacent rows. The brick slips 7 are similarly spaced apart along each rib. The space between the brick slips is filled with mortar 8. The panel therefore has the appearance of a conventional brick wall with 10mm mortar beds. Other spacings could, of course, be chosen.

Glass fibre pulltrusions 9 are fitted to the upper and lower edges of the panel. The steel sheets 2 extend adjacent to and are bonded to the pulltrusions. Adhesive could, optionally, but not essentially, also be introduced between the facing surfaces of the pulltrusion 9 and foam sheet 1. The pulltrusions 9 are formed by drawing a fibre matrix through a resin bath and then through a heated die to form the desired cross-section. This process is known and will therefore not be described further. The pulltrusions 9 are generally L-shaped and each include a male 10 and a female 11 formation shaped to engage with respective female and male formations of a similar pulltrusion. The male formation 10 comprises a projection, and the female formation 11 a slot. The bottom of the slot includes a channel housing a resilient sealing member 12 operative to form

a substantially watertight seal with a male formation 10 received into the slot. The pulltrusions 9 each include two cavities 13 running along their length. This reduces the amount of material required to form the pulltrusion. By virtue of their L-shaped cross-section two engaged pulltrusions 9 also define a further cavity 14, which can accommodate a bolt head as will become apparent below.

The pulltrusions 9 enable panels to be stacked one on the other. When the pulltrusions 9 of two panels are engaged they prevent relative lateral movement of, and establish a substantially watertight seal between, the panels.

The lateral edges of the foam sheet 1 and pulltrusions 9 may optionally include a slot running parallel to and approximately mid-way between the steel covered faces of the panel. The position of this optional slot is indicated by crosshatching in Figure 2 and broken lines 15 and crosshatching in Figure 4. This slot facilitates joining of adjacent panels at right angles to each other. This is described further below.

Figure 3 shows an alternative embodiment of a pulltrusion. It is substantially similar to that shown in Figures 2 and 4 save that the female formation includes inwardly projecting shoulders 16 on opposite sides respectively which narrow the entry into the channel in the bottom of the slot. The shoulders are arranged to be received into channels extending on opposite sides of a resilient sealing member 17 to aid retention of the

sealing member 17 in the female formation.

The illustrated panels are intended to be used for construction of buildings. The brick slip covered surface provides the outside wall of the building. Inclusion of the foam sheet and use of pulltrusions gives the panel a U-value of 0.35. Inclusion of the metal sheets gives considerable strength.

In one building technique the panels are used to form the outside wall of a cavity walled building. Figure 5 shows three cross-sections at different heights through part of a wall of a timber framed building. The building comprises a concrete foundation 18. Supported on the foundation is a timber frame 19. Although not shown the frame would typically be boarded over with wooden boards to increase its rigidity. Plasterboard (not shown) is supported on the inside side of the wooden framework to provide inside walls of the building. Panels according to the invention 20,20a of the type illustrated in Figures 1,2 and 4 are mounted around the outside of and spaced apart from the timber frame 19 to form the outside wall of the building and a cavity between the panel 20 and frame 19.

A pulltrusion 9a is bolted to the concrete foundation 18 by means of an expanding bolt 21 passing through the pulltrusion 9a into the concrete. A layer of compressible packing material 22 is disposed between the pulltrusion 90 and the concrete to compensate for any irregularities in the surface of the concrete.

A pulltrusion 9b forming the lower edge of the panel 20 is engaged with the pulltrusion 9a bolted to the foundation 18. The upper edge of the panel 20 includes a further pulltrusion 9c. This pulltrusion 9c is bolted to the timber frame 18 by means of a bolt 23 extending laterally through the pulltrusion 23 and into the timber frame 19. A spacer 24 is disposed on bolt 23 between the pulltrusion 9c and the frame 19 to space apart the panel 2 and frame. A second panel 20b is supported on the first panel 20a. The lower edge of the second panel 20b includes a pulltrusion 9d which is engaged with pulltrusion 9c. The upper edge of the second panel 20b also includes a pulltrusion 9d which is bolted to the frame 19 in the same manner of the pulltrusion 9b at the top of the first panel 20a.

Any number of panels could be stacked, as required. The weight of the panels is taken by the concrete foundation 18 and the timber frame 19 supports the panel against lateral forces, for example due to wind.

Figure 6 shows how panels 20c,20d may be mounted on a concrete wall or pillar 25. The lower panel 20c is supported on a pulltrusion 9e which is supported on and bolted to an L-shaped bracket 26 which is, in turn, fastened to the concrete wall or pillar 25 by way of an expanding bolt 27 and nut 28. The laterally projecting arm of the L-shaped bracket 26 on which the pulltrusion 9e is supported includes a drainage aperture 30, to allow any water accumulating between the wall or pillar 25 and panels 20c, 20d to drain away.

The top of the panels 20c and 20d are fastened to the concrete wall or pillar by way of expanding bolts 31 with spacers 32, in a similar manner to the arrangement shown in Figure 5.

Figure 7 shows how panels may be mounted on an upright steel H-girder, such as might be used in the construction of a portal framed building. The method is the same as that shown in Figure 6, save that the bolts used to fasten the L-shaped bracket and protrusions to the pillar are of the ordinary rather than expanding type.

Figure 8 shows how panels are used to form a building. The building comprises a timber frame 33 supporting wooden panels 34 forming a stud wall. Brick slip faced panels 35 of the type shown in Figures 1,2 and 4 are supported as shown in Figure 5 spaced around the outside of the stud wall to leave a cavity 36. A window opening 37 is provided by an aperture cut in the panel 35 and a corresponding aperture in the adjacent stud wall. A cavity closer 38 is fitted around the periphery of the aperture 37. A further cavity closer 39 is fitted at the top of the cavity between the panel 35 and stud wall.

As described it is envisaged that two or more panels are stacked one on the other to form the walls of buildings. Depending upon the size of the panels used and the size of buildings it is desired to construct two or more panels may need to be installed side to side. Figure 9 shows two such panels 39. These are mounted adjacent each other so that there is a small

clearance between their respective ends. The space between the panels is filled with a length of compressible polyurethane foam 40. The foam 40 is formed with a circular cross-section with a diameter greater than the clearance between the panels. The foam is thus deformed when the panels are brought towards each other, effecting a seal. The remaining space between the foam 40 and the surface of the panels 39 is filled with mastic 41 to provide a weatherproof finish.

Corner joints between panels may be effected as shown in Figure 10. A first panel 42 is provided with an upright slot 43 in one lateral edge, as indicated by broken lines 15 in Figure 4. The lateral edge of a second panel 46, disposed substantially at right angles to the first panel, is capped with steel sheet 44 bonded to the panel. A length of L-section glass reinforced plastic (grp) 45 is bonded along the edge of the face of the second panel 46 facing the edge of the first panel 42 so that the projecting part of the grp section 45 is directed into the slot 43 in the first panel 42.

The joint is completed by applying a suitable mastic to the grp section 45 and inserting it into the slot 43 bringing the two panels 42,46 together.

In another embodiment of a panel one of the two metal sheets 2 includes formations for the support of blocks. This renders the moulded plastics sheet 5 superfluous. One of the metal sheets could be pressed to form it into the shape of the plastic panel or, alternatively, a number of outwardly extending tabs could be formed in the manner described in US

3533206.

The above embodiments confer a number of advantages over conventional insulated cladding panels and building block support panels. The use of metal sheets and high density foam material enables the panels to have considerably increased strength over conventional panels which allows them to become a structural member of a building of which they form part. The requirements of any supporting structure, for example a steel or wooden framework conventionally used to support cladding panel is considerably reduced or eliminated. Panels according to the invention are generally much lighter in weight than conventional brick walls. This reduces the requirements of any foundation intended to support them.

The inclusion of metal sheets also enhances the integrity of the panels. It is, for example, more difficult to pierce a hole through a panel including a steel sheet, than through a conventional brick wall.

The above embodiments are described by way of example only, many variations are possible without departing from the invention.

CLAIMS

1. A building panel comprising a sheet of insulating material sandwiched between two metal sheets, the outside surface of one of the metal sheets comprising a plurality of building block supports.

2. A panel as claimed in claim 1, wherein the insulating material comprises a foam material.

3. A panel as claimed in claim 2, wherein the insulating material comprises extruded polystyrene foam.

4. A panel as claimed in either claim 2 or 3, wherein the foam material has a density of at least 15Kg/$m^3$.

5. A panel as claimed in any of claims 2 to 4 wherein the foam material has a density of at least 30kg/$m^3$.

6. A panel as claimed in any of claims 2 to 5 wherein the foam material has a sheer modulus of at least 2500 KPa.

7. A panel as claimed in any of claims 2 to 6 wherein the foam material has a sheer modulus of less than 16000 KPa.

8. A panel as claimed in claim 1, wherein the insulating material comprises mineral wool.

9. A panel as claimed in any preceding claim, wherein the metal sheets are at least 0.3mm thick.

10. A panel as claimed in any preceding claim, wherein the metal sheets are galvanized steel sheets.

11. A panel as claimed in any preceding claim, wherein the metal sheets are bonded to the sheet of insulating material with an adhesive.

12. A panel as claimed in any preceding claim, wherein one or both faces of the sheet of insulating material includes a plurality of spaced apart channels extending to at least one edge of the sheet.

13. A panel as claimed in any preceding claim comprising one or more stiffening members extending between the metal sheets.

14. A panel as claimed in any preceding claim, wherein the building block supports are provided by a profiled plastics sheet bonded to one of the metal sheets.

15. A panel as claimed in any preceding claim comprising a formation disposed along at least one edge thereof, the formation being configured to engage with a similar formation.

16. A panel as claimed in claim 15 having formations running along opposite edges thereof.

17. A panel as claimed in either claim 15 or 16, wherein the formation or formations comprise fibre reinforced resin pulltrusions.

18. A panel as claimed in any of claims 15 to 17, wherein at least one formation includes a seal, operative to form a seal with another formation.

19. A building comprising one or more panels as claimed in any preceding claim.

20. A steel or timber framed building comprising one or more panels as claimed in any preceding claim.

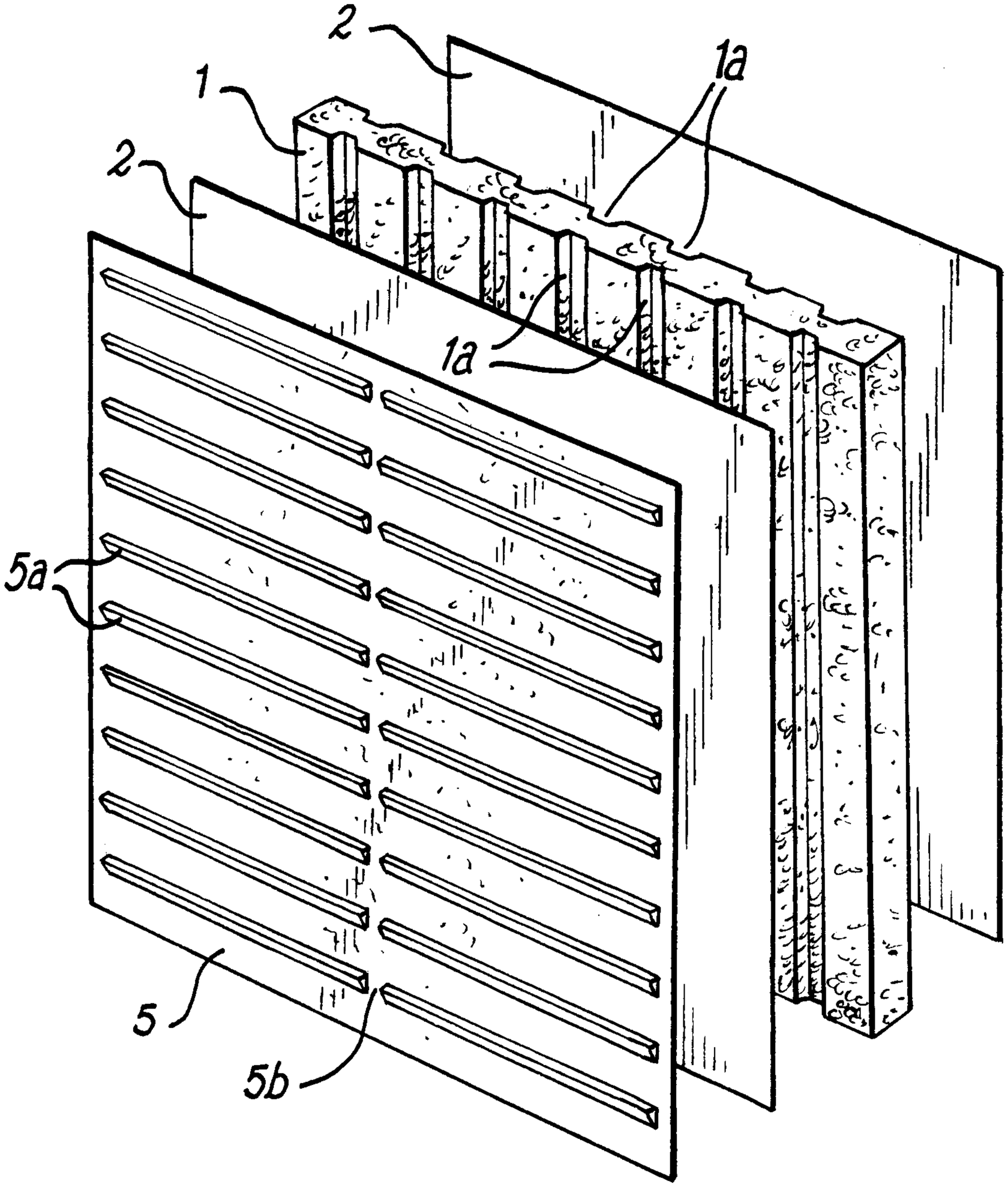



FIG. 1

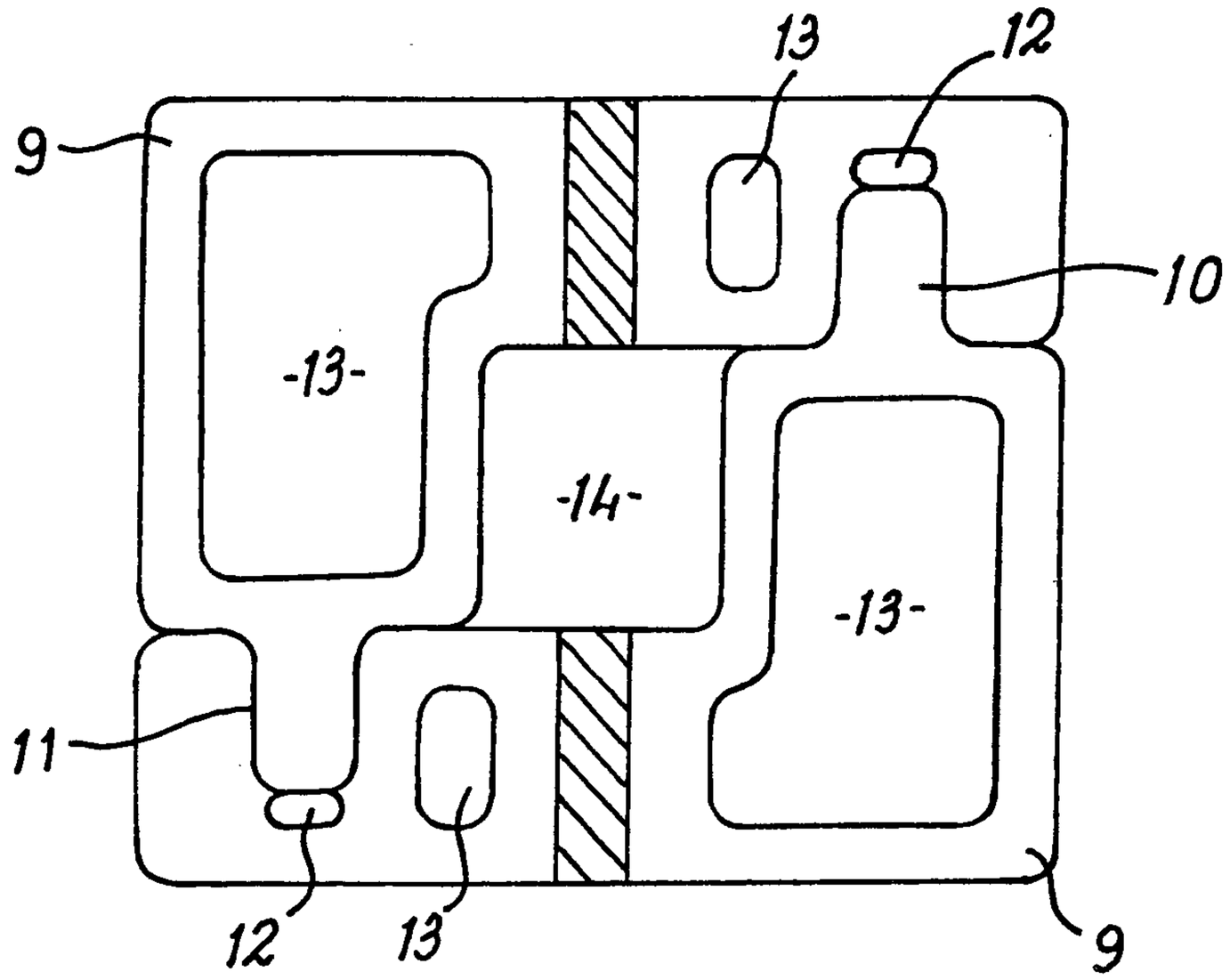



FIG. 2

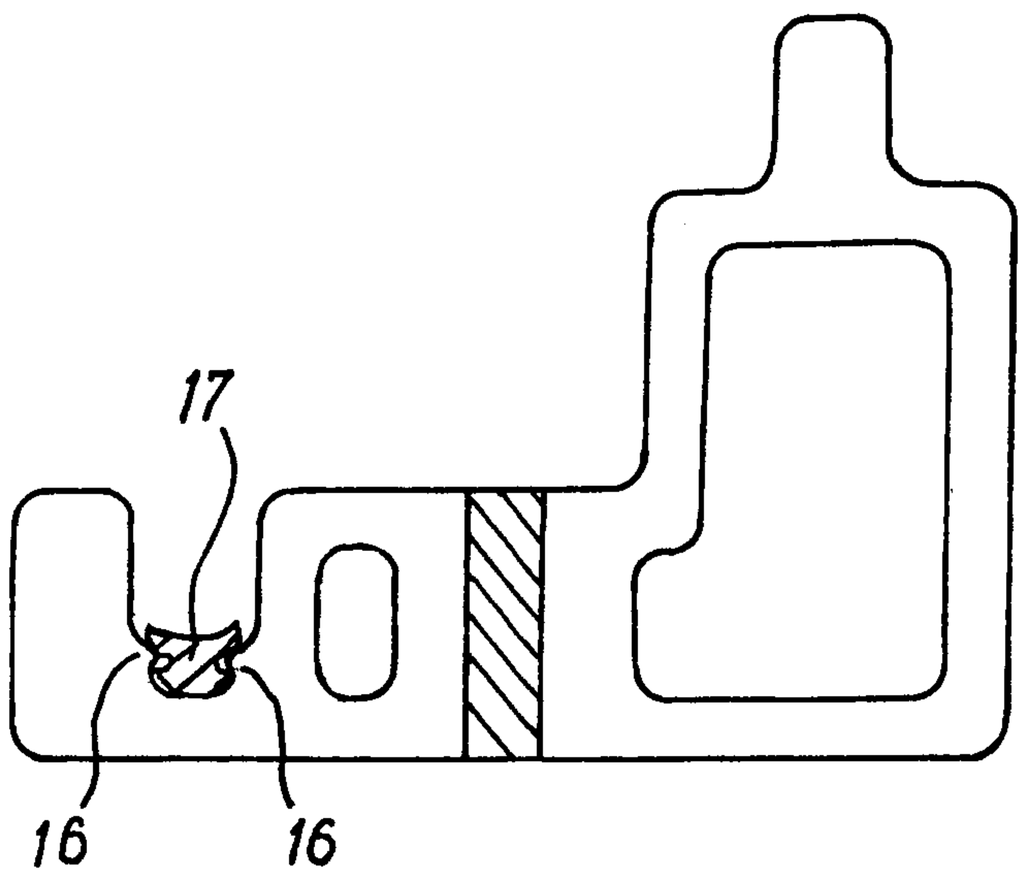



FIG. 3

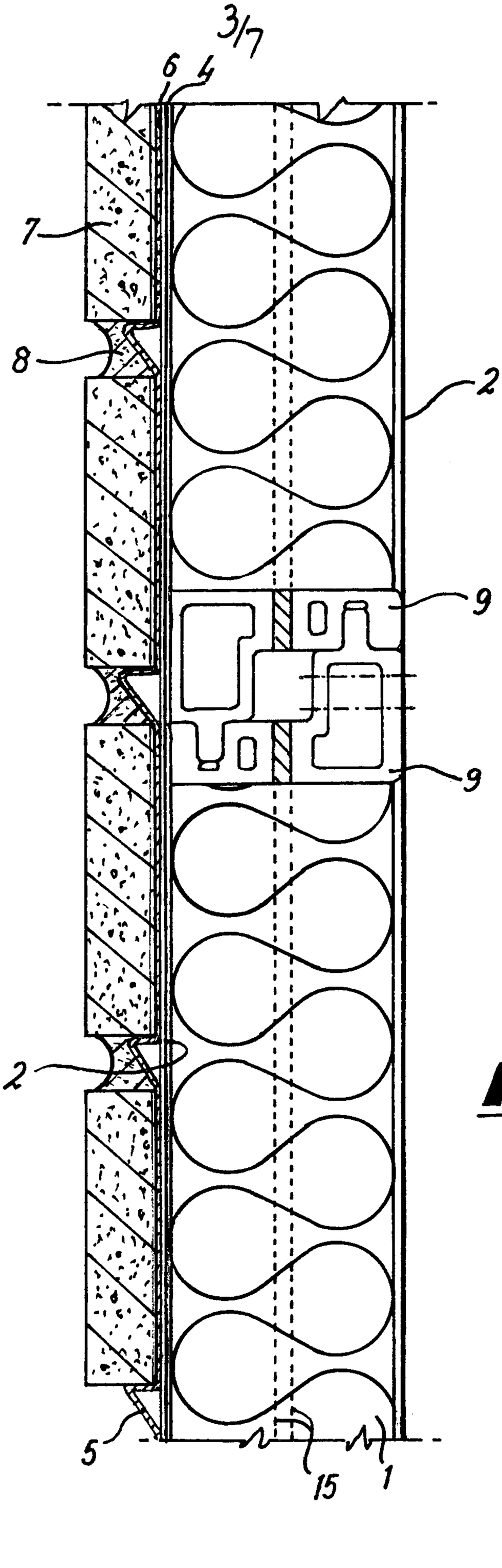



FIG.4

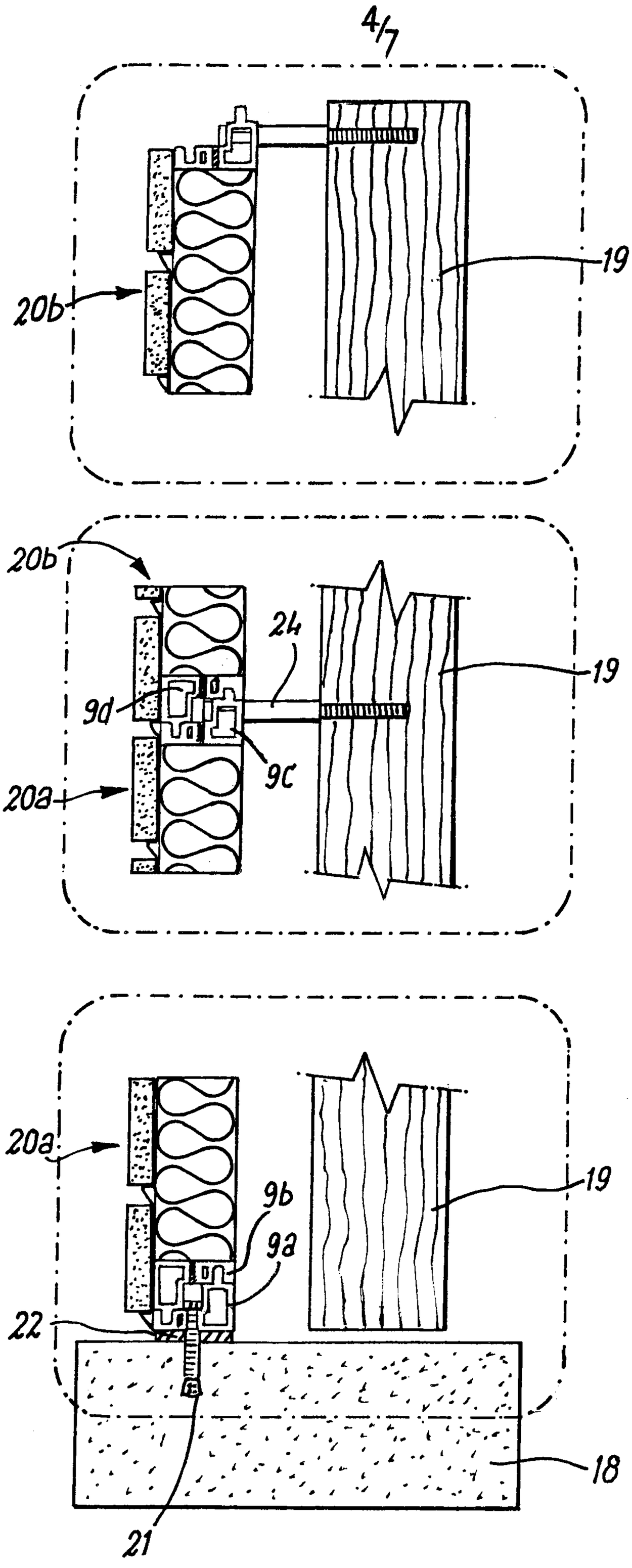



FIG. 5

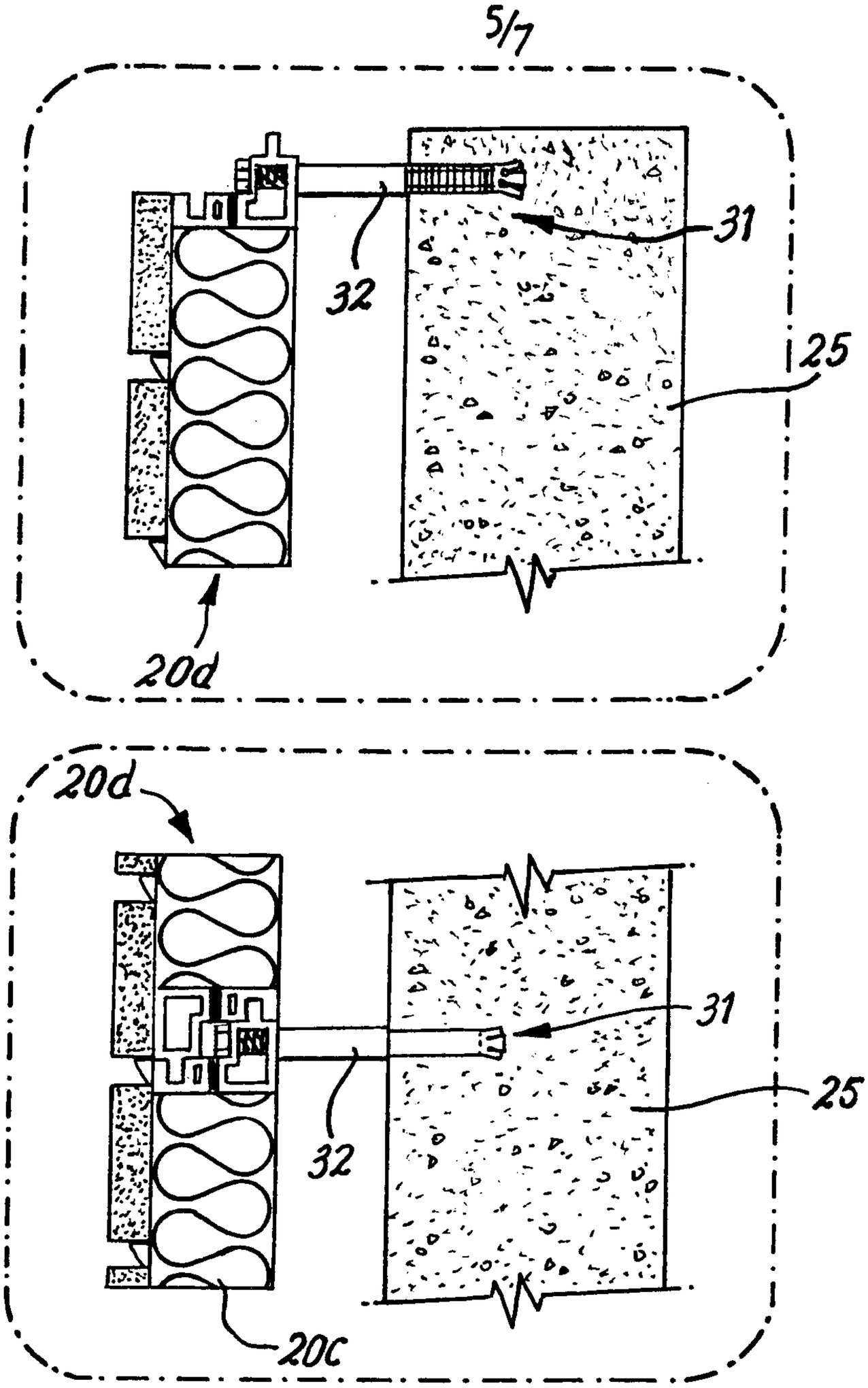



FIG. 6

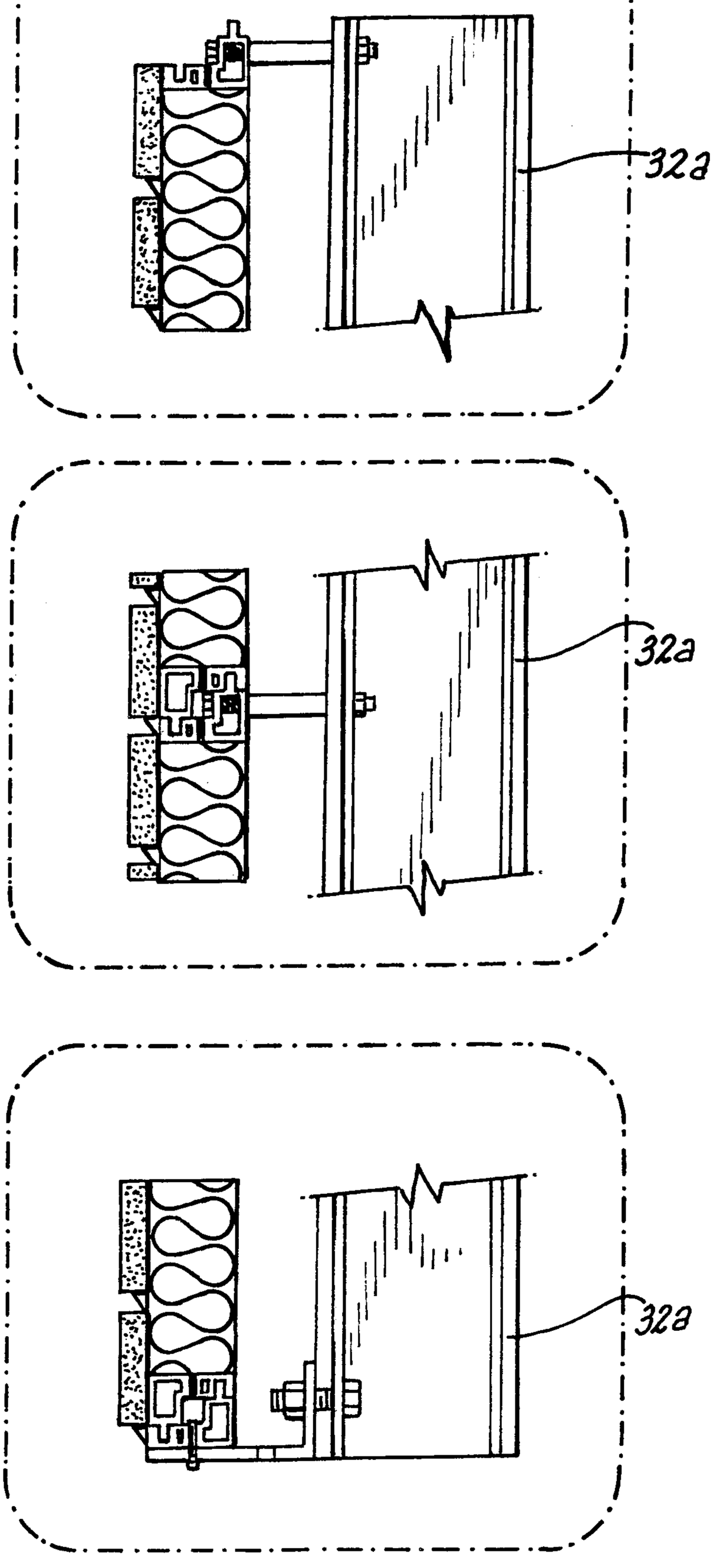



FIG. 1

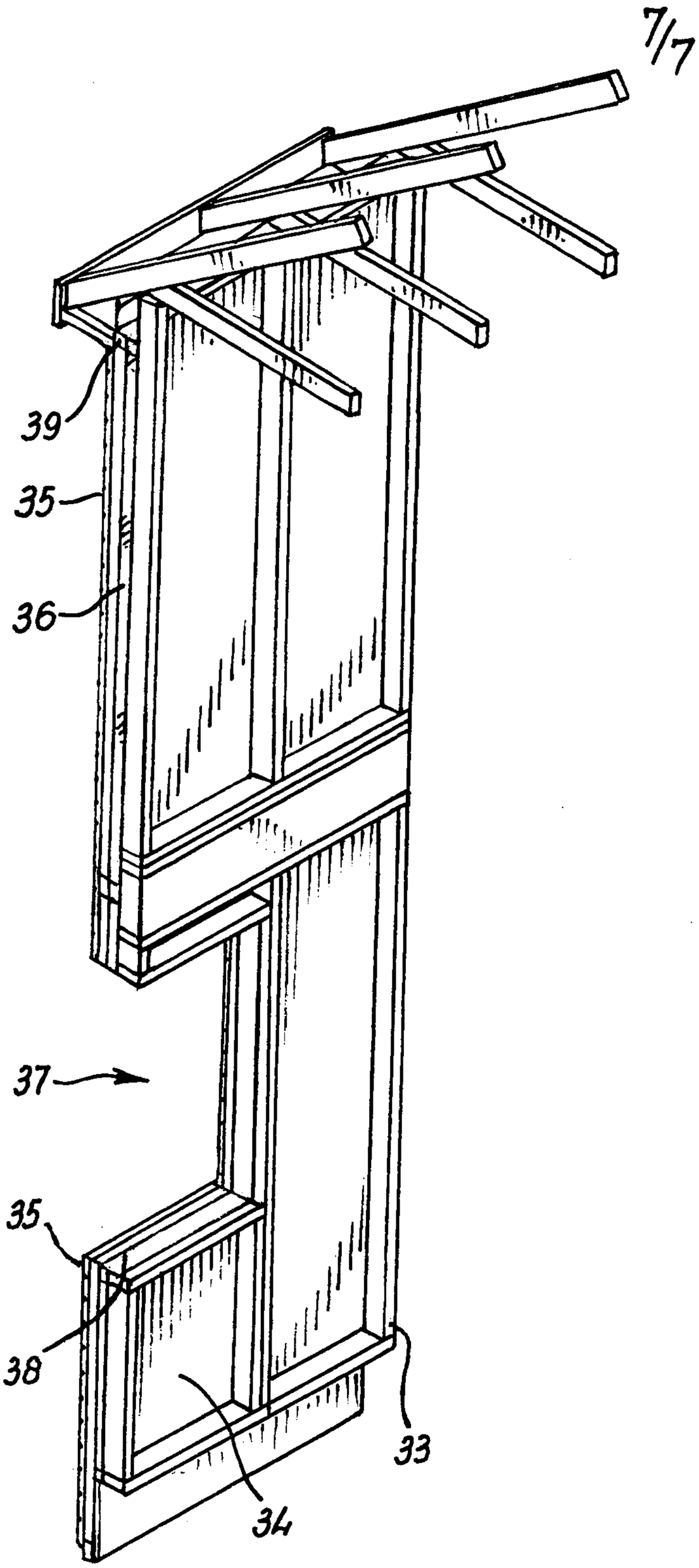



FIG. 8

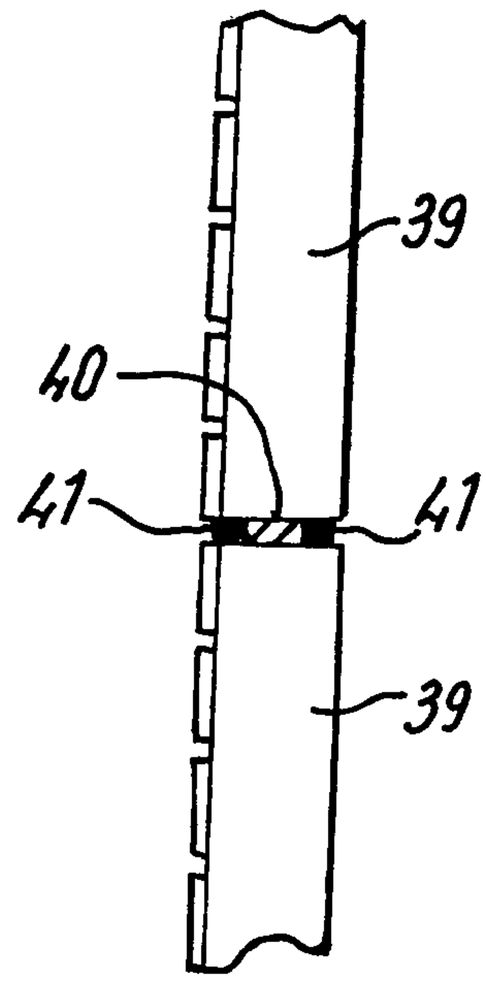



FIG. 9

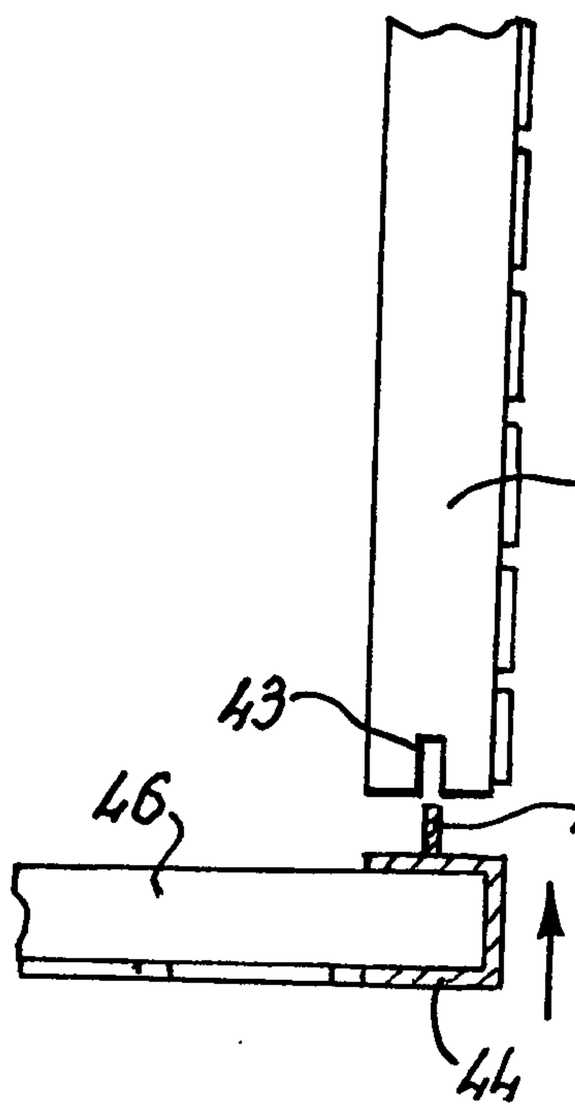
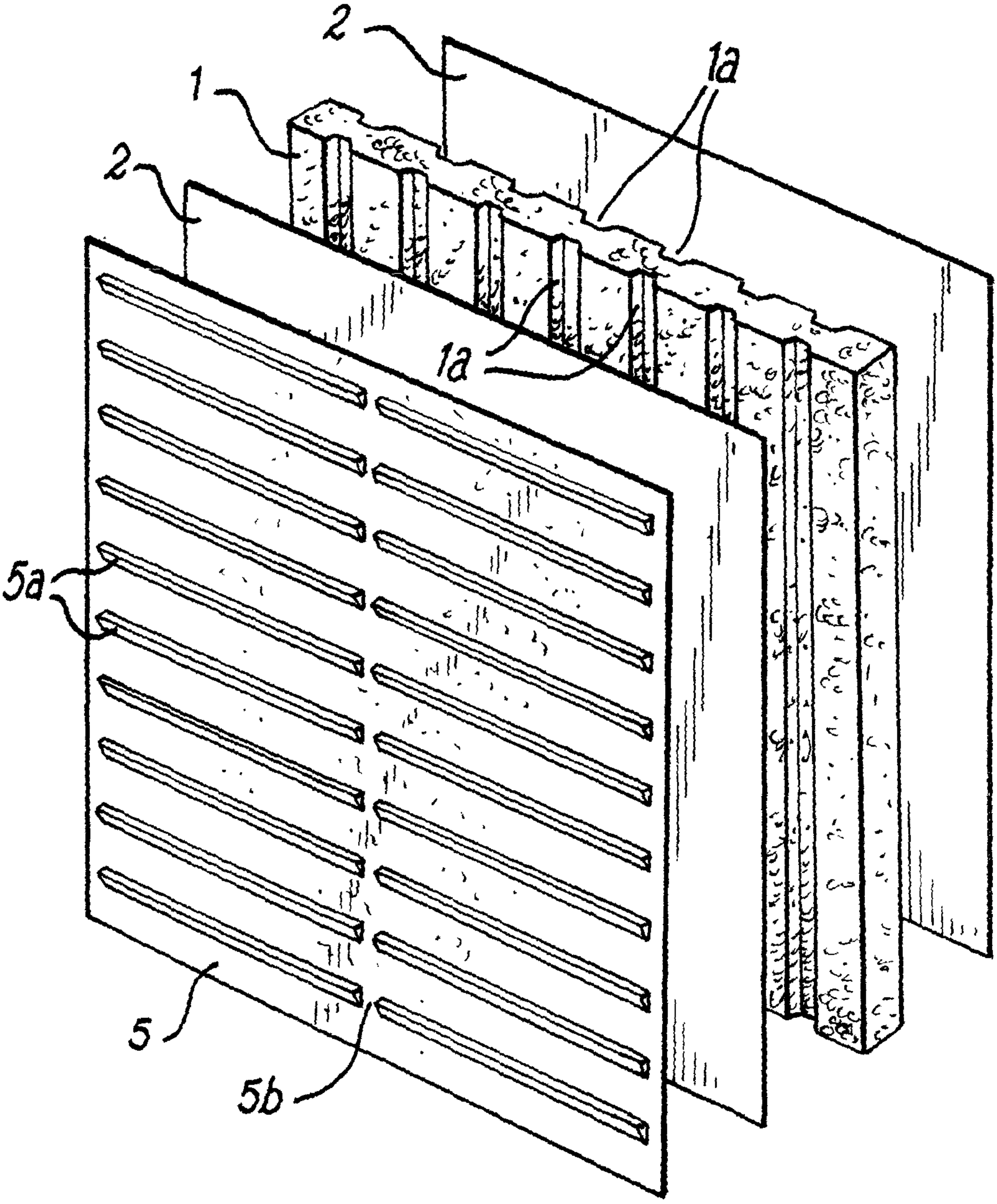



FIG. 10


2
1
1a
2
1a
5a
5
5b