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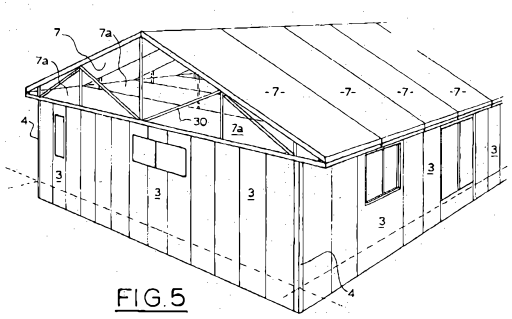

FIG.5

(57) Abstract: A building construction system comprises modular cellular floor, wall and roof panels which are joined by fasteners and may be further strengthened by pouring structural material or insulating material within the cells of the panels before or after they are Installed. The panels are of a honeycomb construction with cells formed by interlocking slats which have holes to allow the ingress of poured materials throughout the panel, said slats being enclosed by sheets of building material on both sides. The panels are joined by studs in their perimeter which engage mating keyholes in the perimeter of the adjoining panel. The ground floor panels are supported by posts screwed into the ground or alternatively by screw jack members secured to footings and accessed for screwing adjustment through holes in the top of the panel.

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MODULAR BUILDING SYSTEM

FIELD OF THE INVENTION

This invention relates to modular building systems incorporating honeycomb grid building panels and novel building solutions for construction purposes. The invention also relates to buildings and construction systems employing vertical wall panel elements, .horizontal floor panel elements, horizontal ceiling panel elements and angular roofing panel elements that may use structural benefits of honeycomb grid design.

The invention particularly relates, but is not necessarily limited, to hollow building panels constructed with high density board or a reinforced board which may be filled with structural materials to meet structural strength, thermal- barrier and acoustic-barrier standards, and to buildings and construction systems employing such panels.

BACKGROUND OF THE INVENTION

In prior art as set out below, are existing systems relating to wall panels only.

Many factory formed panels are used in the building industry to construct floors, walls and roofs for buildings, which are required to meet specific strength, thermal-barrier and acoustic-barrier standards. Examples of commercially successful panels are disclosed in AU-B-26656/96 (671947) and AU-B-59414/96 (694048), both in the name of Building Solutions Pty Ltd.

While such panels have proven successful, they can always be improved. For example, the need for joiner panels required inventory of two panels for a given height/ width/thickness combination. In addition, the panels may not be easily varied in thickness; and do not employ waste materials in their construction: some panels may not be manufactured from a minimum number of basic components.

U.S. Pat. No. 6,161,361 ("Ehrenkrantz") discloses a composite structural member comprising parallel flanges and a plurality of thermally insulative web connectors intermittently disposed between the web connectors. While the description outlines spreading the walls of the flanges apart and allowing them to spring back, the planar finish to abutting surfaces of the flanges and ends would be inadequate for use in concrete pouring into the panel.

Considerable pressure is generated by wet concrete flow and settlement. Should a web connector release a flange, the panel would bow resulting in distortion of the outer wall. Other methods to strengthen the bond, such as use of adhesives or arms nesting in recesses in the web connector, are also disclosed. However, these methods add a layer of complexity in use and/or production. Ehrenkrantz is directed to drywall construction wherein loading and strength requirements are not as high as in concrete filled wall production.

U.S. Pat. No. 5,609,006 ("Boyle") discloses a wall stud comprising C-shaped frame members and core elements. The core elements may be located at the top and bottom of the stud, are rigid and accept nails and screws. Additional core elements may be slidably mounted between the top and bottom and are easily adjustable to a desired height to accommodate electrical outlets and switches. The core elements are retained within the frame members by keepers extending inwards from the frame members to ride in slits in the core members.

The sliding core members must be secured by punching through side walls of the frame member. This system may also include upper and lower tracks. Boyle is also directed to dry wall construction. The core elements must be slid along the length of the frame members and, in relation to the intermediate core elements, are not self-retaining. They must be punched into position.

U.S. Pat. No. 3,900,996 ("Yohe") discloses a hollow wall structure with wall panels having slits in opposite vertical edges which slidably receive channel shaped margins of elongated fastener strips. Clip elements are also provided to

lock a panel in place with a channel shaped wall stud. This system is relatively complex and is designed for demountable hollow wall construction.

WO 96/27057 ("Chicago Metallic") discloses structural elements for walls comprising clamping profiles and connecting pieces slidable in the clamping profiles. Resilient wings of the clamping profiles engage flanges extending from a panel. Connecting pieces may then be used to connect clamping profiles. This is a relatively complex arrangement for use in dry wall formation.

Reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that this prior art forms part of the common general knowledge in any country.

OBJECT OF THE INVENTION

It is therefore an object of the present invention to;

1. To manufacture structural modular panels offsite
2. Provide a modular building system which allows time saving and simple erection of a structure on site.
3. Minimize the requirement for skilled labor and tools.
4. To utilize a new construction method which minimizes the use of multiple non recyclable construction materials to reduce waste materials.
5. To use reclaimed materials from the manufacture of the building panels which can be 100% recycled and reused in the construction of the modular building system.
6. Or at least to provide an alternative to existing prefabricated buildings.

STATEMENT OF THE INVENTION

One embodiment of the present invention provides a building panel which can be manufactured in a range of heights, widths and/or thicknesses from a minimum

number of different components. A preferred embodiment may also provide such a panel which has minimal thermal bridging, for improved thermal-barrier characteristics.

The preferred embodiment may provide a building panel which minimizes corrosion by separating dissimilar metals. The building panel may use off-cuts from the facing sheets and for connector elements in the building panel to minimize waste.

In a first aspect, the invention resides in a honeycomb grid for use in building panel construction. The building panel comprises a slotted perimeter frame to be bonded and/or fastened to the inner faces of associated facing sheets, vertically and horizontally spaced opposed grid connectors forming a honeycomb grid structure.

The grid connectors may incorporate dovetail or similar pattern to engage a rebate formed on the internal surfaces of the high density facing boards . The grid connectors are preferably interlocking with fill holes and conduit holes for services.

The internal connectors can be formed from high density board such as but not limited to magnesium oxide board, fiber cement board, reinforced board or other suitable materials. It is preferable that the internal perimeter connectors be formed from a structural material similar but not limited to reinforced high density board bonded to steel channel.

Preferably, the facing sheets are formed of fire- resistant, or fire-retardant materials, such as Magnesium Oxide reinforced board, fibre-cement sheeting, aluminium sheeting, polymer sheeting or the like. Facing sheets may have a pre-finished outer face, or be coated with suitable materials such as, but limited to paint, plaster or other coatings or finishes.

In a further aspect, the invention may reside in a new building system incorporating the use of the modular building panels. The system will comprise of vertical wall panel elements, .horizontal floor panel elements, horizontal ceiling

panel elements and angular roofing panel elements that may use structural benefits of honeycomb grid design.

In a first aspect, the invention resides in a **HORIZONTAL FLOOR PANEL** construction, the modular floor panel comprising of reinforced precast concrete. This could be prestressed, post tentioned or conventionally reinforced.

In a second aspect, a horizontal floor panel element , resides in a honeycomb grid for use in floor panel construction, the floor panel comprising a slotted perimeter steel frame to be bonded and/or fastened to the inner faces of associated facing sheets, vertically and horizontally spaced opposed grid connectors forming a honeycomb grid structure.

In a further aspect, the invention may reside in a building system for use in panel form work for solid filled floors, but unlike prior art, it is not necessary to fill with structural material. The structural integrity of the panel is created with the honeycomb grid configuration of connectors.

The honeycomb grid connectors may be formed from reinforced magnesium oxide reinforced board, medium density fiberboard, high density fiberboard, fiber cement board, steel, aluminium or other suitable materials. The grid connectors may incorporate "dovetail" or similar pattern to engage a rebate formed internally on both . The grid connectors are preferably interlocking with fill holes and conduit holes for services. Facing sheets may have a pre-finished outer face, or be adapted to be surfaced eg. by tiles, carpet or other suitable finishes.

An aperture may be formed in the grid connector element and dimensioned to allow passage of one or both of reinforcing materials, void forms, conduits and utility services such as plumbing, electrical lines and communication lines.

Unlike prior art, reinforcement is not integral to structural design due to the honeycomb grid design, but may be used in some areas such as earthquake

and high wind areas. If required, hole locations are omitted or installed to direct flow of structural fill material. This allows panels faces to provide permanent formwork, thereby, reducing labor and resources.

The horizontal floor panel may further comprise perimeter elements having a channel to receive a bottom, sides or top edge of a facing board around the perimeter.

The perimeter channel elements can be formed by an extrusion of steel, aluminium, polyethylene or as a fabrication of any suitable tensile or reinforced material. The perimeter channel elements may have pressed flanges to form a connection to engage internal honeycomb grid connectors on the perimeter of the horizontal floor panel.

In a further aspect, hole locations are omitted or installed to direct flow of fill material if required allowing module panel edges to provide permanent formwork for beam configuration. (Figure 17, Reference13 and 1)

The horizontal floor panel element may comprise one or more "keyhole" locking elements (Figure 27) These may be simple connectors or infill bolts in core fill situation to attached vertical wall panel elements (Figure 3)

The horizontal floor panel element may comprise one or more jacks. (Figure 18, Reference 10)

The horizontal floor panel element may be prefabricated and modular in sizes to suit house designs and in increments that suit appropriate structural grid connector spacings, or a similar size dictated by structural engineer or testing authority.

The horizontal floor panel element is the first element to be installed with the use of leveling jacks.(Figure 19, Reference 10) These jacks may be used only as a temporary support to level building floor panel element and hold wall panel elements prior to placement of concrete.

Alternatively, a concrete perimeter footing may be adopted or a bored pier may be used. Alternatively, a screw pile (Figure 24, Reference 20) may be used, negating need for concrete footing structures. Tie down to the earth is then achieved by connection of screw pile to floor panel element bracket. This arrangement is still leveled with jack system as per previous methods.

In a further aspect, the horizontal floor panel element may be utilized in structural suspended floors. (Figure 6, Reference 1a) The bottom facing sheet may be used as the ceiling of the level below. (Figure 6, Reference 1a)

In a first aspect, a **VERTICAL WALL PANEL** element can be use as form work for solid filled walls, but unlike prior art, it is not necessary to fill with structural material. The structural integrity of the panel is created by the bonding of the honeycomb grid connectors to the two facing boards.

The honeycomb grid connectors may be formed from reinforced magnesium oxide reinforced board, medium density fibreboard, high density fibreboard, fibre cement board, steel, aluminium or other suitable materials.

An aperture may be formed in the grid connector element and dimensioned to allow passage of one or both of reinforcing materials, void forms, conduits and utility services such as plumbing, electrical lines and communication lines.

Unlike prior art, reinforcement is not integral to structural design due to the honeycomb grid design, but may be used in some areas such as earthquake and high wind areas. If required, hole locations are omitted or installed to direct flow of structural fill material. This allows panels faces to provide permanent formwork, thereby, reducing labour and resources.

Window, door and void openings can then be cut out after fill materials are installed. It is preferable that this removed material is cut up and recycled as granular aggregate for insulation, recycled to manufacture board or recycled to manufacture geopolymer concrete or other suitable materials.

The vertical wall panel may further comprise end elements having a channel to receive a bottom, sides or top edge of a facing sheet around perimeter.

The perimeter channel elements can be formed by an extrusion of steel, aluminium, polyethylene or as a fabrication of any suitable tensile or reinforced material. The perimeter channel elements may have pressed flanges to form a connection to engage internal honeycomb grid connectors on the perimeter of the vertical wall panel.

The vertical wall panel element may comprise one or more keyhole locking elements. These may be simple connectors or infill bolts in a core fill situation. The vertical wall panel element may have bottom fins open to allow concrete footing placement.

The vertical wall panel element also incorporates flush mounted clips to allow easy placement of steel reinforcement if required. Horizontal steel bar may be used, alternatively, steel or poly fibre concrete may be used. See detail on Figure 16 detailing the clip that positions the reinforcement.

The vertical wall system (Figure 7 elevation) further comprises one or more vertical structural elements (Figure 21, Reference 4 plan view) to form corners and intersections. These may be manufactured in sheet layers of magnesium reinforced board, or similar high density board or other suitable non compressible material.

The vertical structural element may incorporate holes to house structural ferrules (Figure 21, Reference 15 plan view) and various connectors. This ferrule may accept simple connectors or concrete anchor connectors (Figure 21, Reference 14 plan view) for core fill applications. A washer may be placed between connector and panel for material separation and ease of construction.

The building system further comprises more than one type of high density board joist and bearer types. These may be fabricated with dovetailed connectors and teeth bonded connections in pieces of magnesium reinforced board, similar high density board or other building material. (Figure 23,23a)

In a second aspect, a composite joist may be manufactured from a high tensile material similar to steel(Figure 22, Reference 17) which may be bonded to high density board (Figure 22, Reference 18) or similar material to increase the strength of the joist.

In a third aspect, a bearer may be fabricated with dovetailed connectors and teeth bonded connections to form a truss like member in pieces of magnesium reinforced board, similar high density board or other building material. (Figure 37)

One embodiment of the present invention may provide a horizontal floor panel which can be manufactured in a range of lengths, widths and/or thicknesses from a minimum number of different components.

One embodiment of the present invention may provide a **HORIZONTAL CEILING PANEL** which can be manufactured in a range of lengths, widths and / or thicknesses from a minimum number of different components.

In a first aspect, the invention resides in a honeycomb grid for use in horizontal ceiling panel construction, the ceiling panel comprising a slotted perimeter steel frame to be bonded and/or fastened to the inner faces of associated facing sheets, vertically and horizontally spaced opposed grid connectors forming a honeycomb grid structure.

In a further aspect, the invention may reside in a building system which uses horizontal ceiling panels, whereby the structural integrity of the panel is created with the honeycomb grid configuration of connectors.

The honeycomb grid connectors may be formed from reinforced magnesium oxide reinforced board, medium density fibreboard, high density fibreboard, fibre cement board, steel, aluminium or other suitable materials. The grid connectors may incorporate "dovetail" or similar pattern to engage a rebate formed internally on both facing sheets . The grid connectors are preferably interlocking with fill holes and conduit holes for services.

Facing sheets may have a pre-finished outer face, or be adapted to be surfaced eg. by paint, or other suitable finishes.

The horizontal ceiling panel may further comprise perimeter elements having a channel to receive a bottom, sides or top edge of a facing board around the perimeter.

The perimeter channel elements can be formed by an extrusion of steel, aluminium, polyethylene or as a fabrication of any suitable tensile or reinforced material. The perimeter channel elements may have pressed flanges to form a connection to engage internal honeycomb grid connectors on the perimeter of the horizontal ceiling panel.

In a further aspect, the invention may reside in a building roof system to incorporate horizontal ceiling panel element only to provide walking platform, perimeter soffits of building (by overhang) and lined ceiling for dwelling. From this platform, a conventional light weight framed roofing structure may be erected. (Figure 5, Reference 7a)

The horizontal ceiling panel may comprise one or more "keyhole" locking elements. These may be simple connectors or may allow the modular ceiling panel elements to "click" and engage to connectors from vertical wall panel elements. (Figure 32)

These horizontal ceiling modules would comprise of ceiling panel element (to satisfy external soffit of dwelling, internal ceiling lining and walking platform for services installation in roof void. (Figure 5, reference 7a)

One embodiment of the present invention may provide an **ANGULAR ROOFING PANEL** element which can be manufactured in a range of lengths, widths and / or thicknesses from a minimum number of different components.

In a first aspect, the invention resides in a honeycomb grid for use in angular roofing panel construction, the angular roofing panel comprising a slotted perimeter steel frame to be bonded and/or fastened to the inner faces of

associated facing sheets, vertically and horizontally spaced opposed grid connectors forming a honeycomb grid structure.

In a further aspect, the invention may reside in a building system which uses angular roofing panels, whereby the structural integrity of the panel is created with the honeycomb grid configuration of connectors.

The honeycomb grid connectors may be formed from reinforced magnesium oxide reinforced board, medium density fibreboard, high density fibreboard, fibre cement board, steel, aluminium or other suitable materials. The grid connectors may incorporate "dovetail" or similar pattern to engage a rebate formed internally on both facing sheets . The grid connectors are preferably interlocking with fill holes and conduit holes for services.

The angular roofing panel may further comprise perimeter elements having a channel to receive a bottom, sides or top edge of a facing board around the perimeter.

The perimeter channel elements can be formed by an extrusion of steel, aluminium, polyethylene or as a fabrication of any suitable tensile or reinforced material. The perimeter channel elements may have pressed flanges to form a connection to engage internal honeycomb grid connectors on the perimeter of the angular roofing panel.

Top and bottom facing sheets may have a pre-finished outer face, or be adapted to be surfaced by manufactured board profiles eg. by roofing tiles profiles, metal roof profiles, Expanded Polystyrene shaped or other architectural profiles and shapes.

Alternatively, the high density facing sheet may be cladded with metal roofing profiles, concrete tile profiles of any other conventional roof cladding.

An aperture may be formed in the grid connector element and dimensioned to allow passage of one or both of structural or insulation materials, void forms,

conduits and utility services such as plumbing, electrical lines and communication lines.

The perimeter channels used on angular roof panel elements can be formed as an extrusion from steel, aluminium, polyethylene or as a fabrication of any suitable tensile or reinforced material. The perimeter channels used on angular roof panel elements may have pressed flanges to form a connection to engage internal honeycomb grid connectors on the perimeter of the panel.

The angular roof panel element may comprise one or more "keyhole" locking elements. These may be simple connectors or may allow the angular roof panel elements to "click" and engage to connectors from wall panel elements.

In a further aspect, these angular roofing panel elements connect to the horizontal ceiling panel elements to create a hinged roof truss element. (Figure 30, Reference 7 and 7a) In addition, hinged truss elements (Figure 30, Reference 30) connects horizontal ceiling panel to angular roofing panel to provide a structural component of a truss.

Preferably flat packed modules would be assembled in a factory for minimal space requirement for transportation. (Figure 31)

In a further aspect, the angular roof panel element may be utilized in structural suspended roofing element. (Figure 6, Reference 7) The bottom facing sheet may be used as the ceiling of the level below. (Figure 6, Reference 7)

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the invention is now described by way of example only with reference to the accompanying drawings in which:

Fig 1 shows a horizontal floor panel element in situ on a building site
Fig 2 shows vertical wall panel elements being assembled

Figs 3 shows vertical wall panel elements being connected together and assembled on horizontal floor panel elements.

Fig 4 shows the addition of vertical wall panel elements and horizontal floor panel elements.

Fig 5 shows a single level house constructed from modular panels

Fig 6 is a cross section of a three level house constructed from modular panels

Fig 7 shows a vertical wall panel in elevation

Fig 8a shows the internal structure of a modular panel in elevation

Fig 8b is a side elevation corresponding to Fig 8a

Fig 8c is a plan corresponding to Fig 8a

Fig 9 shows detail W of Fig 8

Fig 10 shows detail Y of Fig 8

Fig 11 shows detail Z of Fig 8

Fig 12 shows detail X of Fig 8

Fig 13 is a cut away view of the panel of Fig 8

Fig 14 is a cross section of a floor wall junction construction

Fig 15 shows the foot of the wall of Fig 14 secured in a concrete (or similar) footing

Fig 16 shows a clip (Ref 11)securing reinforcing bar (Ref 12)in the foot of the wall

Fig 17 is a cross section of an alternative perimeter floor and wall junction construction

Fig 18 is a cross section of the junction of an internal floor and wall junction

Fig 19 shows the junction of Fig 18 with a concrete (or similar) footing poured

Fig 20 shows the junction of Fig 18 with concrete (or similar) poured in the junction

Fig 21 is a cross section of the junction of three vertical wall elements to a vertical structural member for a non corefill application.

Fig 21a is a cross section of the junction of three vertical wall elements to a vertical structural member for a corefill application.

Fig 22 is a cross section of a joist.

Fig 22a is a side elevation of joist in Fig 22

Fig 23 is a cross section of a composite structural joist.

Fig 24 shows a horizontal floor panel element supported by a screw footing
Fig 25 shows an alternative floor wall joining system
Fig 26 shows the fastener detail of Fig 25
Fig 27 illustrates the fastener head slotting detail of Fig 25
Fig 28 is a cross section of a floor leveling screw jack
Fig 29 shows the jack of Fig 28 mounted on a pier
Fig 30 is an elevation of a modular roof and ceiling panel
Fig 31 illustrates the erection of the panel of Fig 30
Fig 32 is a typical house plan view showing roof panel setout from the panels in Fig 30
Fig 33 shows an alternative construction of Figure 12 which adds Reference 31.
Fig 34 is a alternative of the panel construction of Fig 13
Fig 35 shows dove tailing panel construction alternative
Fig 36 shows dove tailing panel perimeter construction and
Fig 37 shows a box beam construction with dovetail connections

DETAILED DESCRIPTION OF THE INVENTION

The bearing capacity of the ground may vary from site to site. A structural connection is required to connect the modular building system to the ground. These connection details will vary with site requirements.

The construction of the modular building system (house or similar) in accordance with the present invention may adopt a modular floor panel 1 and reinforcing trench 2 in Fig 1.

In a further aspect, screw pile 20 in Fig 24 may be an alternative to reinforcing trench 2 in Fig 1. In a further aspect, bored piers with jacks, figure 29 may be used as alternative to reinforced trench 2, Fig 1.

Modular wall panels 3 are then erected with their lower ends in trench 2 as shown in Fig 2 . Where no trench is required (Fig 24 and Fig 29), wall panel 3 is not engaged in trench 2.

Wall panels 3 can connect by engaging key holes 5, with bolts 6 as shown in Fig 3.

Vertical structural elements 4 are used at corners as shown in Fig 4 or intersections as shown on Fig 7.

The building is extended by joining floor panels 1 and wall panels 3 as shown in Fig 4, or alternatively as shown in Fig 24 and 29. Accordingly a dwelling is assembled with panels 3 including with cut out sections to form doors and windows and modular roof panels 7 forming the roof as shown in fig 5. Multi storey dwelling as shown in Fig 6 can also be constructed from the same modular panels 1,suspended floor panel 1a, 3,7 and 7a.

Panels 1,suspended floor panel 1a, 3, 7 and 7a may be prefabricated with high density board, or reinforced board. Preferably, these panels are prefabricated from sheets of magnesium oxide board or similar which is a low cost, high strength, insulating, fireproof material. It is water resistant, sound insulating and is easily machined and glued to form structural panels and beams.

Fig 7 shows wall panels 3 which have been fabricated from high density board or similar with recesses to accommodate openings.

Detailed fabrication of panels is shown in Figs 8a to 13 wherein internal honeycomb grid connectors 8 are slotted to interlock and are bonded to each other and to facing sheets 8a and perimeter channels 8b. Holes 9 are cut in honeycomb grid connectors 8 so that concrete or structural foam or insulating material can be poured into the panels for additional strength especially at junctions as described below.

Fig 14 shows wall panels 3 attached to floor panels 1 which are leveled by screw jacks 10 shown in detail in Figs 28 and 29. The lower section of wall panels 3 have clips 11 shown in Fig 16 to hold lengths of reinforcing rod 12. Accordingly wall panels 3 are secured by pouring concrete footings in trench 2. Fig 17 shows concrete also poured through hole 13 into floor panel 1 and wall panel 3 to reinforce their junction and create a structural perimeter beam 13a.

In Fig 18 two floor panels 1 are shown attached to internal wall panel 3 and in Fig 19 concrete is poured through holes 13 to form a footing in trench 2. Concrete can also be used to fill the floor wall junction as shown in Fig 20. In Fig 21 wall panels 3 are shown attached to vertical structural element 4 by bolts 6 screwed into ferrule 15. Again concrete can be poured into panels 3 to secure the wall post junction. In Fig 21a wall panels 3 are shown attached to vertical structural element 4 by bolts 14 screwed into ferrule 15 for non structural applications.

Flanges 16 and web 18 of joist in Fig 22 and 22a are also fabricated from high density board or similar. Figure 23 shows a composite joist with web 18 is reinforced with bonded steel sheet or similar 17 to increase structural strength. Web 18 may incorporate "dovetail" or teeth type profiles (Fig 35,36 and 37) to engage Web 18 with flanges 16.

Accordingly where floors are required to carry abnormal loads, Fig 35, Fig 36 and Fig 37 shows a structural beam. The structural capacity is derived from the angular placement of the internal connectors which a bonded with dovetail and rebated connections to perimeter panels and facing sheets 8a.
Figure 24 illustrates alternative construction method where screw pile 20 connects to Bracket 20 which connects floor panel 1. Wall panel 3 connects to floor panel 1, thereby negating requirement for trench 2 and concrete reinforcing footing.

Fig 25 illustrates an alternative fastener 21 for joining wall panels 3 to floor panels 1 which are fitted over nut 23 and lowered onto fastener 21 as illustrated in Fig 27 via key hole slots 5. Hex head tool 22 is then used to tighten nut 23 onto fastener 21 thus clamping panel 3 to panel 1.

Fig 28 shows screw jack 10 which is adjusted by lever 24 which turns screw 25 in ferrule 26. Screw 25 rotates about spherical mount 27 which rests in trench 2 or is mounted on pile 28 as shown in Fig 29.

Figs 30 and 31 illustrate how roof panels 7 are erected from ceiling panels 7a by rotating struts 30 and locked to form roof sections which span wall panels 3 and are joined in a continuous roof as shown in Fig 32. It will be obvious that roof panels 7 together with ceiling panels 7a form a sealed roof which also provides overhanging eaves.

Figure 31 illustrates flat pack for ease of transport to site.

Figs 33 and 34 illustrate an alternative panel construction in which honeycomb grid connectors 8 have lugs 31 which slot into mating slots in the facing sheets 8aand perimeter edges 8b. Fig 35 illustrates a dove tail panel construction, Fig 36 illustrates a dove tail connection method with slotted channel for panel edge reinforcement.

Fig 37 illustrates a dove tail box beam construction.

ADVANTAGES

It will be apparent that the building system of the present invention has many advantages over prior art systems. The modular panels are lightweight and are transported on site in flat pack form. Joining panels is a simple process which is done quickly and requires few tools.

The provision of foundations and pouring of footings is simplified and concrete can also be used to fill panels to increase weight and strength especially at junctions. Accordingly high integrity building ratings can be achieved as are required for example in cyclone prone areas.

Some advantages of the present invention include but are not limited to;

1. To manufacture structural modular panels offsite
2. Provide a modular building system which allows time saving and simple erection of a structure on site.
3. Minimize the requirement for skilled labour and tools.
4. To utilize a new construction method which minimizes the use of multiple non recyclable construction materials to reduce waste materials.
5. To use reclaimed materials from the manufacture of the building panels which can be 100% recycled and reused in the construction of the modular building system.
6. Or at least to provide an alternative to existing prefabricated buildings.

VARIATIONS

It will be realized that the foregoing has been given by way of illustrative example only and that all other modifications and variations as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of the invention as herein set forth. Throughout the description and claims of this specification the words "comprise" and variations of that word such as "comprises" and "comprising" are not intended to exclude other additives components integers or steps.

CLAIMS

1. A building construction system comprising modular cellular floor, wall and roof panels which are joined by fasteners and may be further strengthened by pouring structural material or insulating material within the cells of the panels before or after they are installed.

2. The system of claim 1 in which the panels are of a honeycomb construction with cells formed by interlocking slats which have holes to allow the ingress of poured materials throughout the panel, said slats being enclosed by sheets of building material on both sides.

3. The system of claim 1 in which the panels are joined by studs in their perimeter which engage mating keyholes in the perimeter of the adjoining panel.

4. The system of claim 1 in which the ground floor panels are supported by posts screwed into the ground which floor panels support the wall panels prior to the pouring of footings for the walls.

5. The system of claim 1 in which the ground floor panels are supported and leveled by screw jack members secured to footings and accessed for screwing adjustment through holes in the top of the panels which floor panels support the wall panels prior to the pouring of footings for the walls.

6. The system of claim 1 wherein the wall panels are bolted to the floor panels by bolts which are accessed for tightening through holes in the side of the wall panel.

7. The system of claim 1 in which the foot of the wall panels are fixed in concrete footings.

8. The system of claim 7 in which the concrete poured in the footing flows into the cells of the wall panel through holes in the panel.

9. The system of claim 6 in which concrete is also poured into the wall and floor panels around their junction through holes in the panels.

10. The system of claim 9 in which the junction is reinforced by structural members.

11. The system of claim 1 in which upper floor panels are joined to a junction member which also joins the top of a lower floor wall and the foot of the next floor wall by means of bolts which screw into the junction member and are tightened through holes in the wall and floor panels.

12. The system of claim 1 in which the roof is formed by modular sections comprising a roof beam to which is hinged two cellular panels which meet at the apex of the roof when erected and are supported by struts hinged to the beam and the panel in the configuration of a roof truss.

13. The system of claim 12 in which the beam has a box construction.

14. The system of claim 13 in which the box beam has an internal reinforcing channel section running the length of the beam.

15. The system of claim 12 in which the box beam has internal reinforcing webs running the length of the beam.

16. A modular construction panel formed by interlocking slats with communicating holes which form cells said cells being enclosed by sheets of building material.

17. The panel of claim 16 wherein the panel is partially or completely filled with structural or insulating material poured through external holes.

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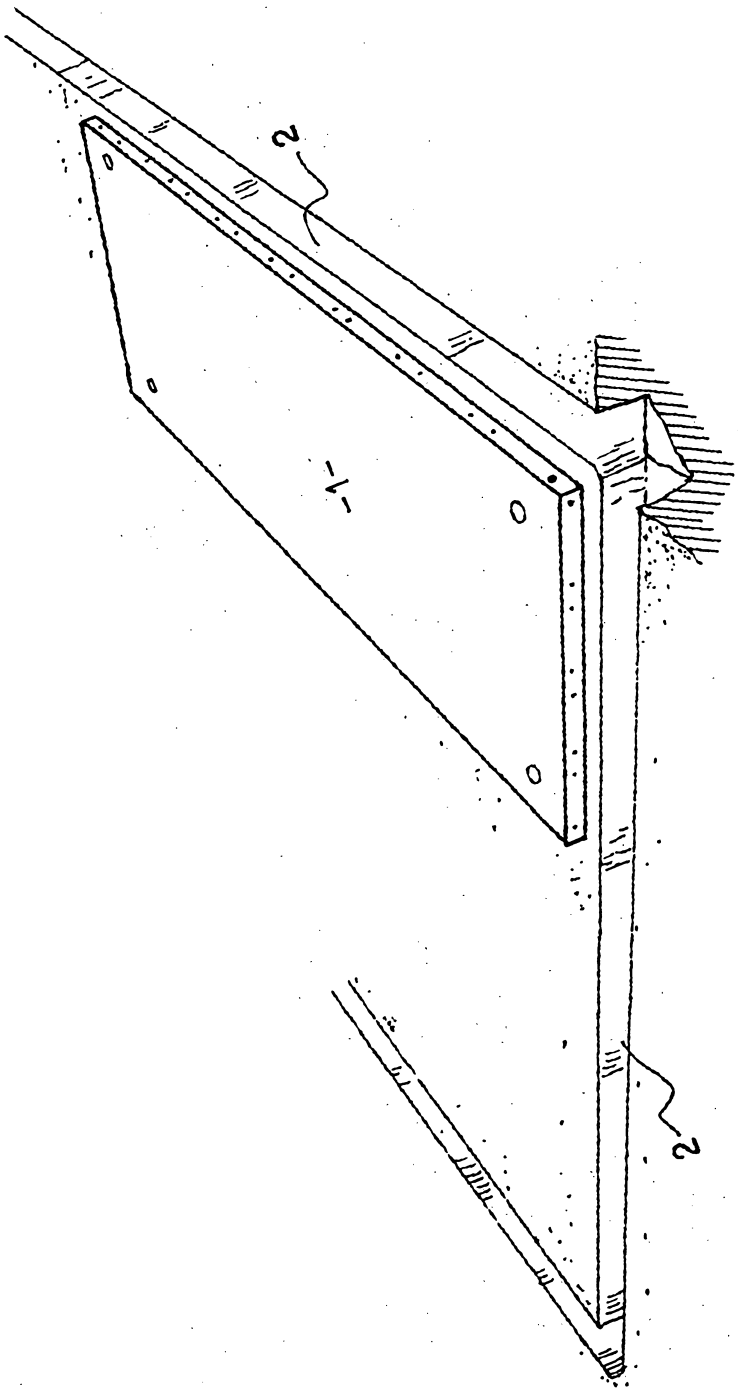

FIG.1

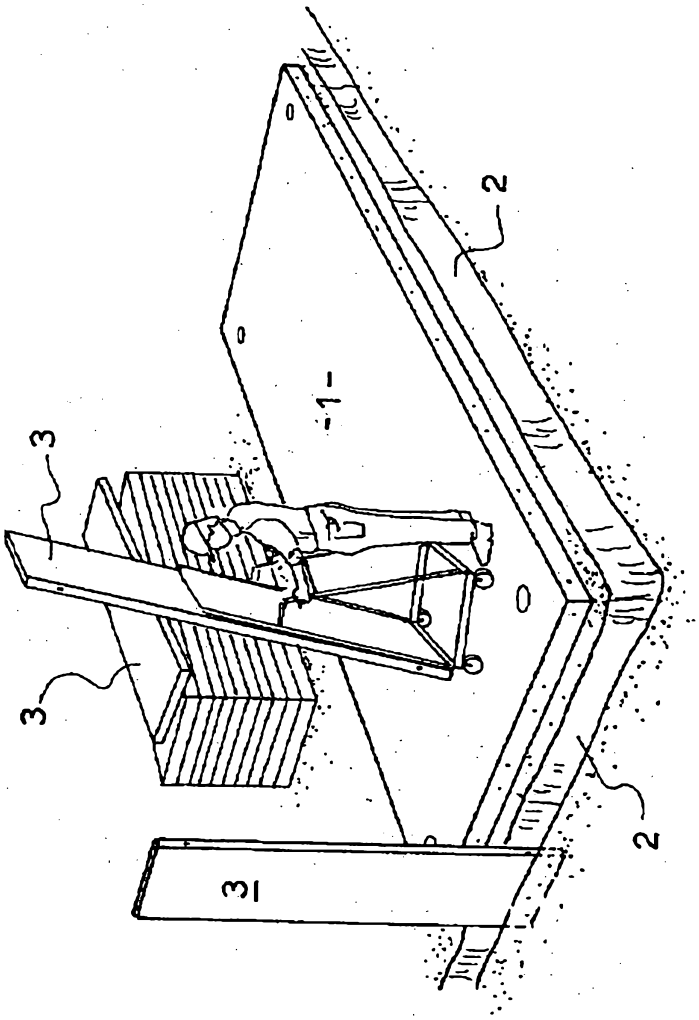

FIG.2

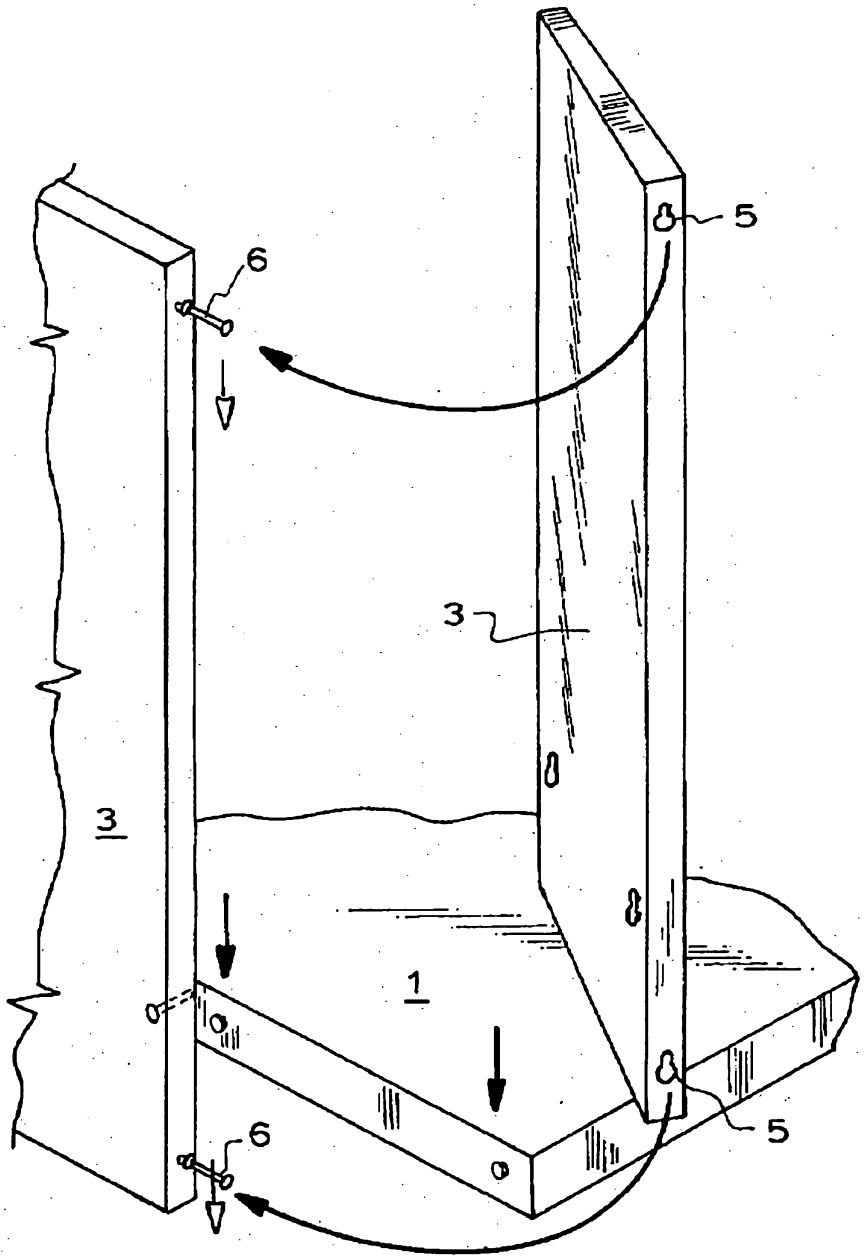

FIG. 3

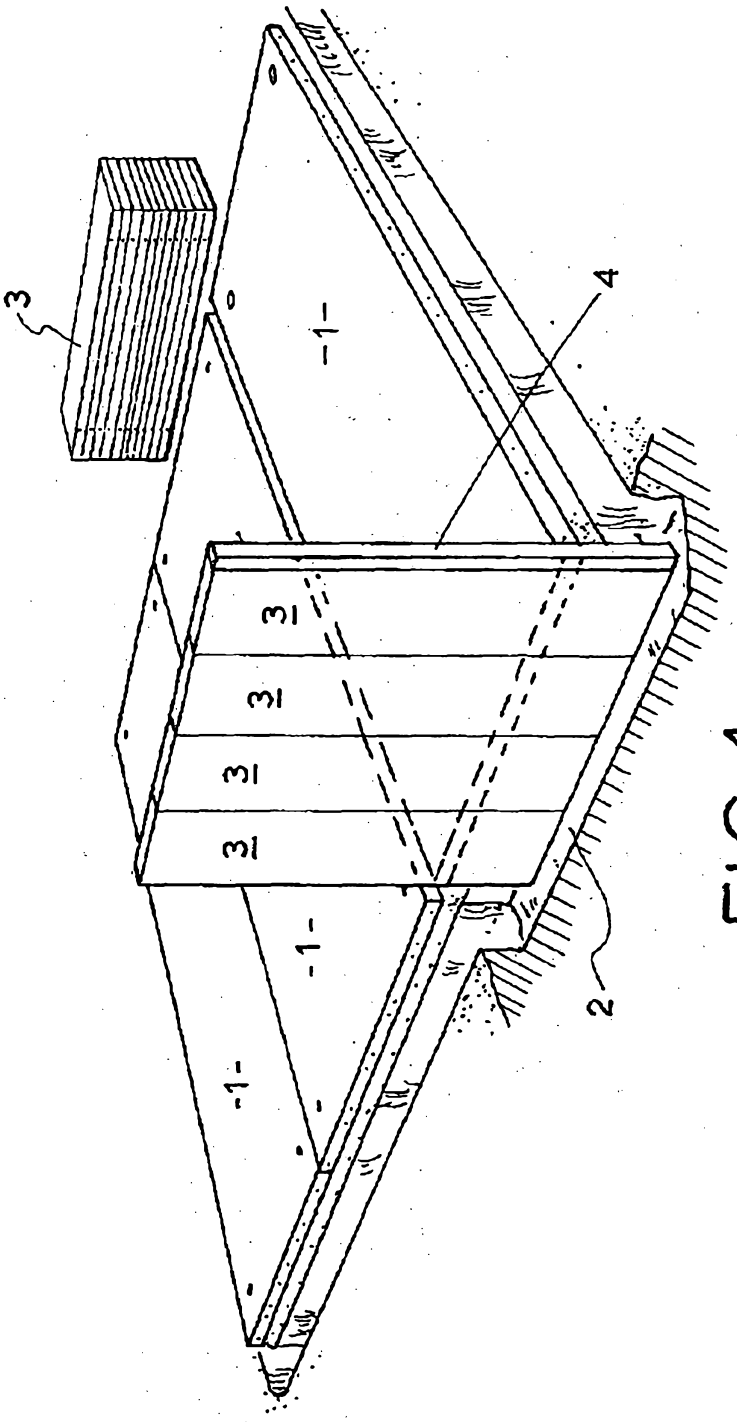

FIG.4

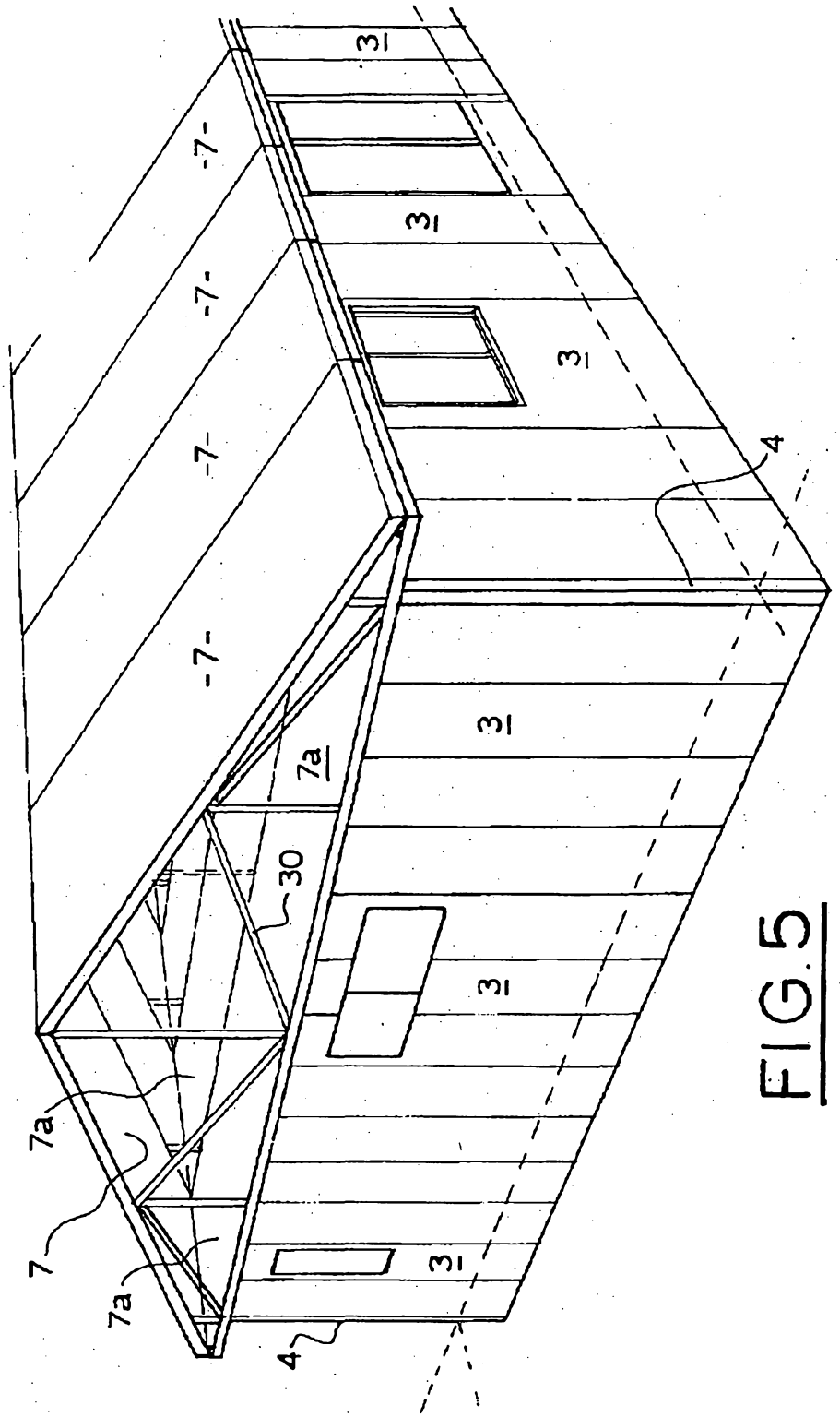

FIG.5

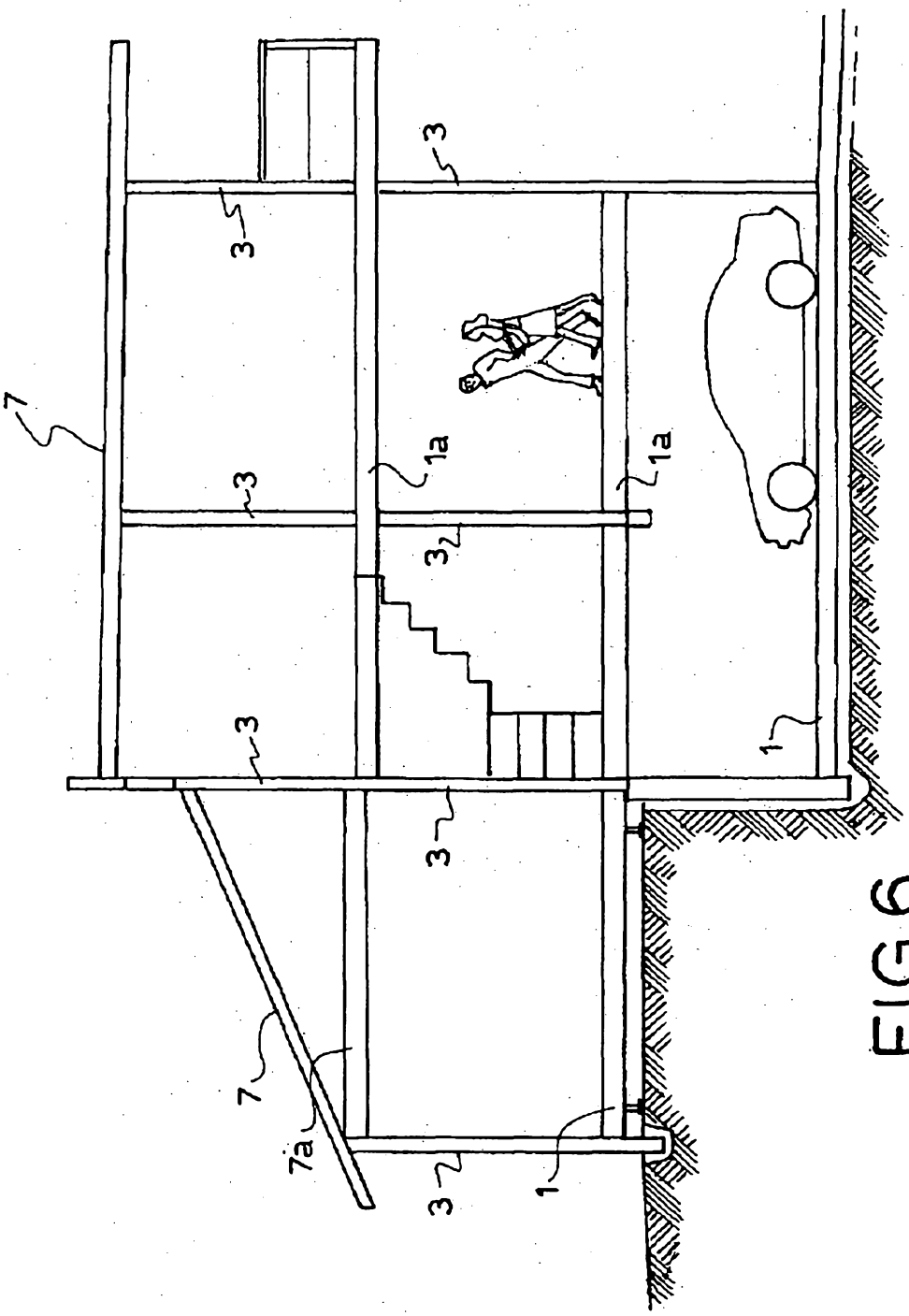

FIG.6

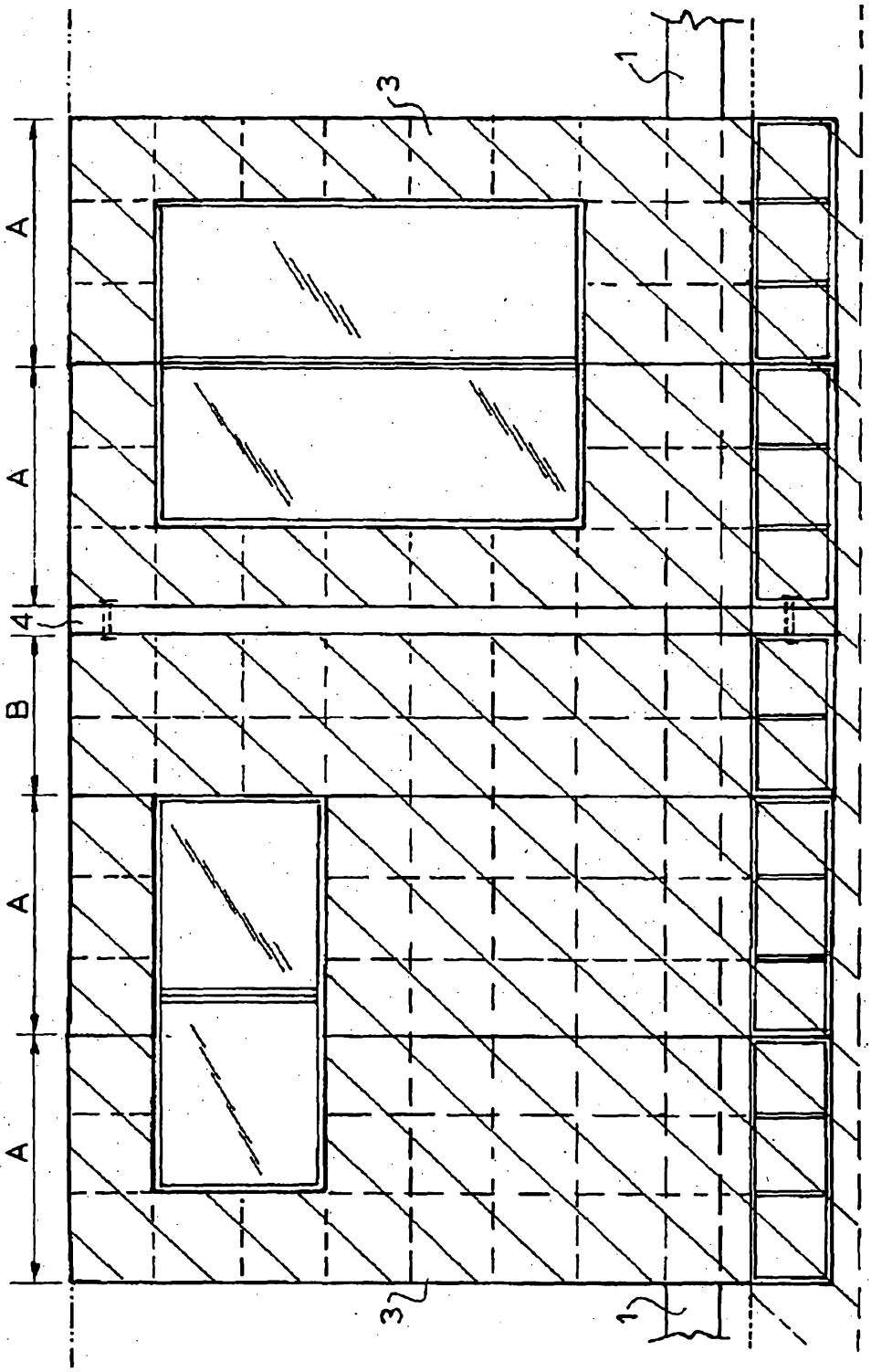

FIG.7

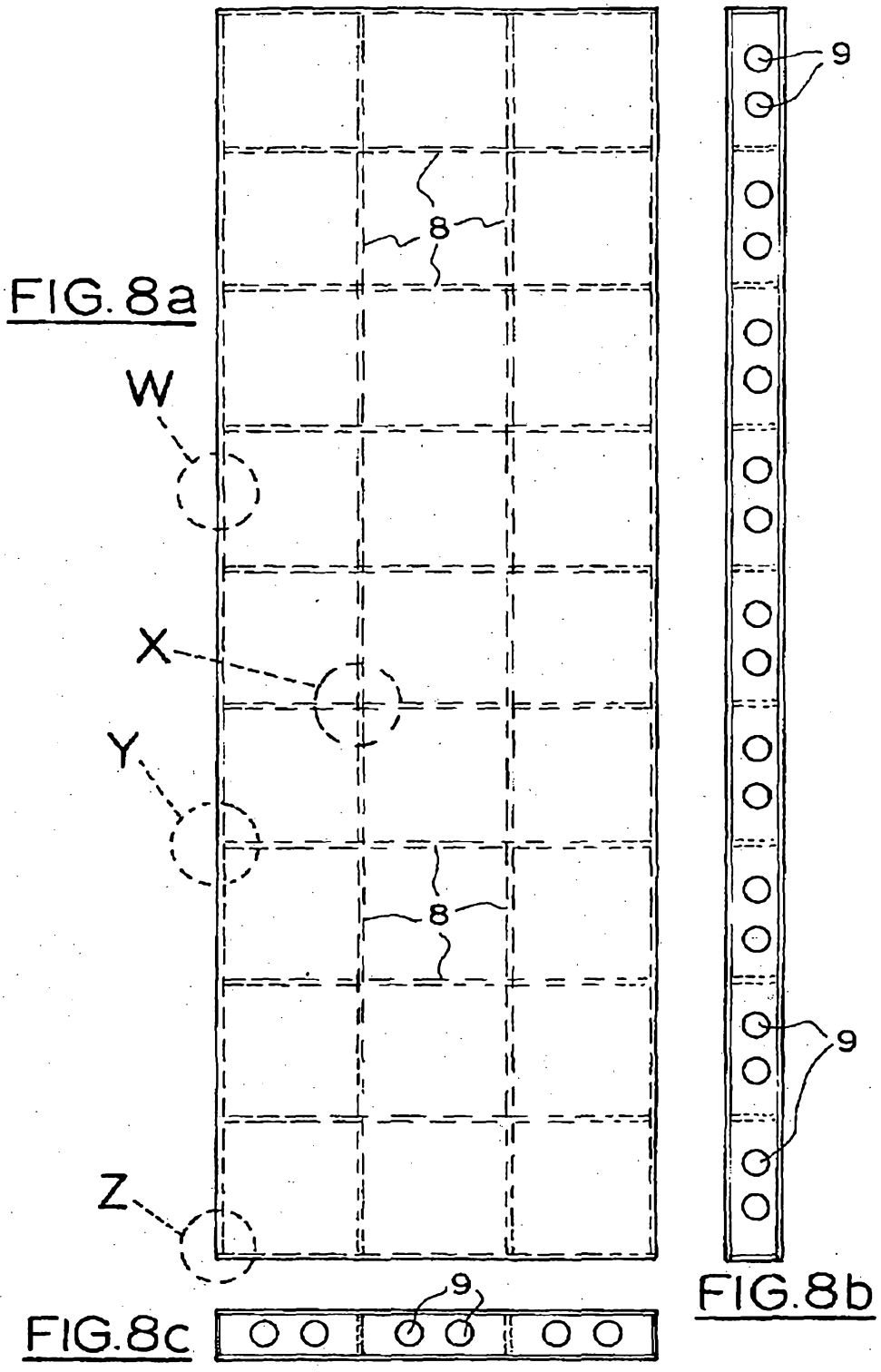

FIG.8a

FIG.8b

FIG.8c

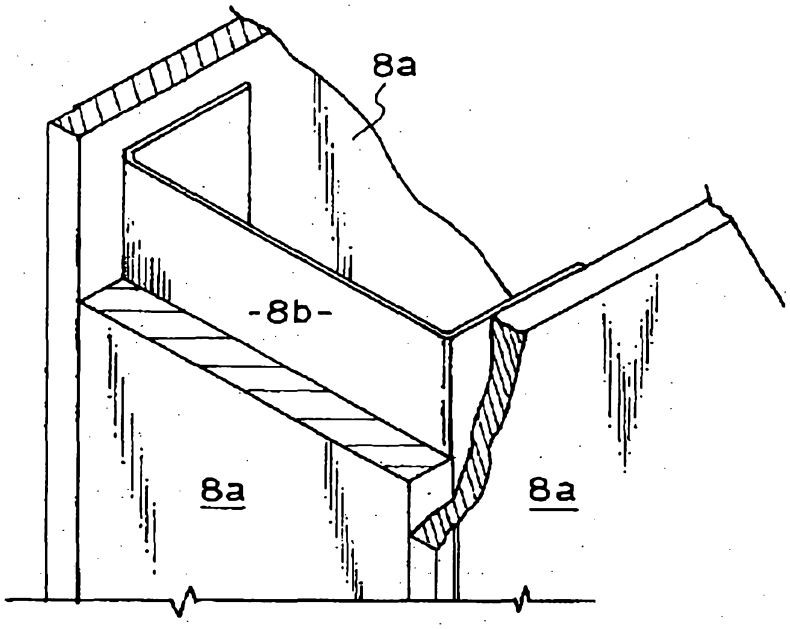

FIG.9

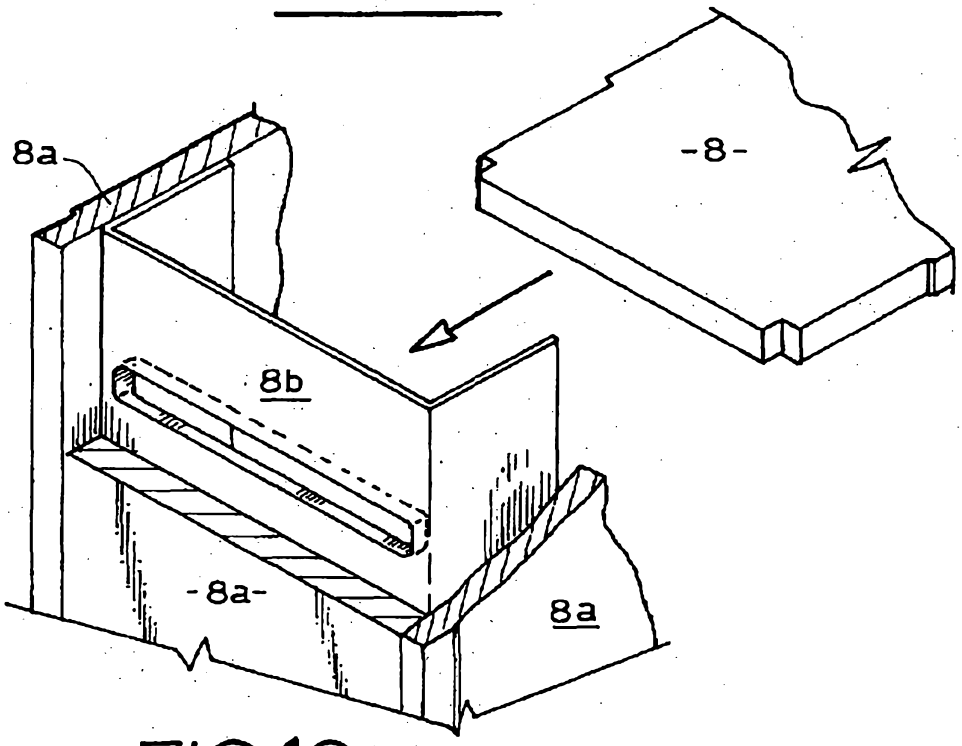

FIG.10

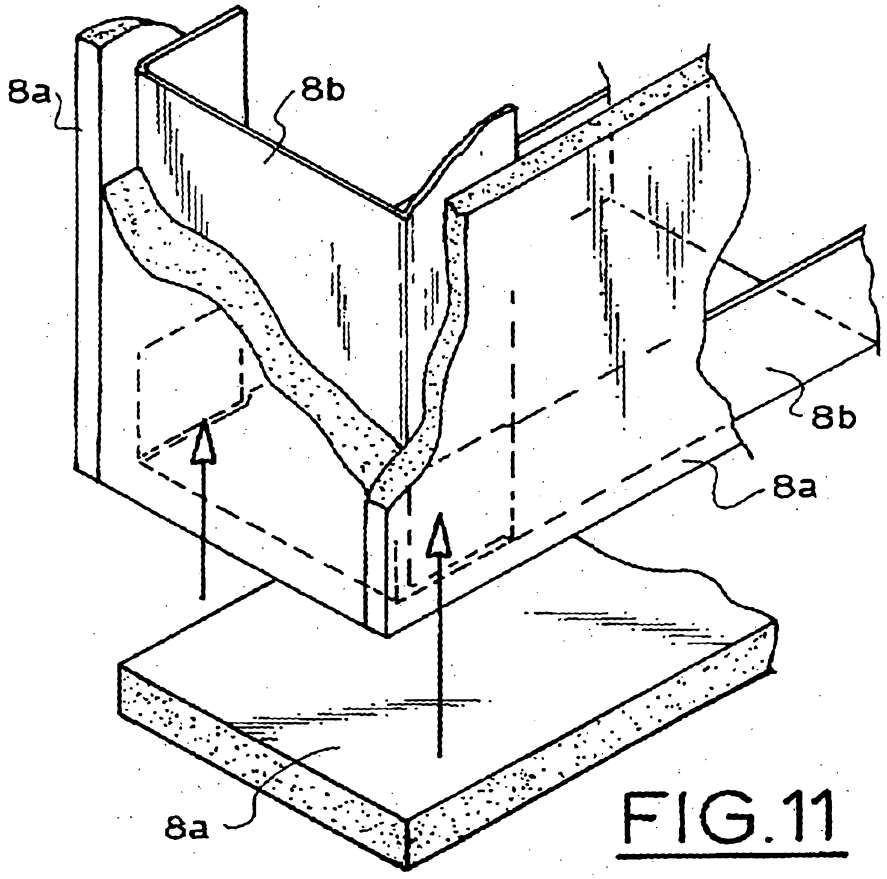

FIG.11

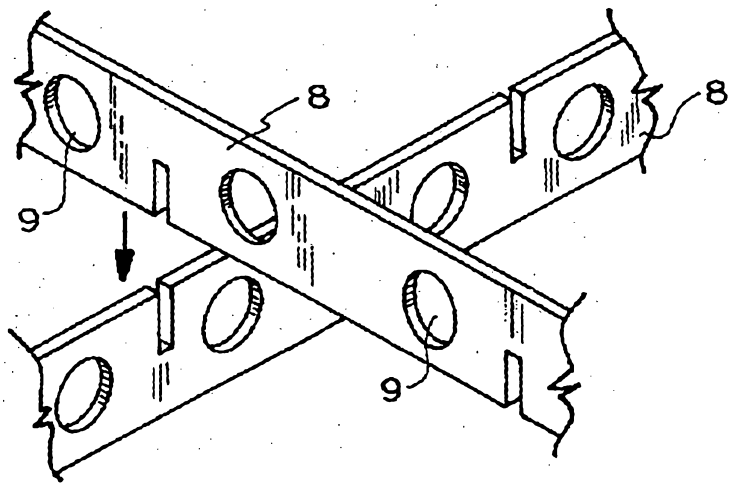

FIG.12

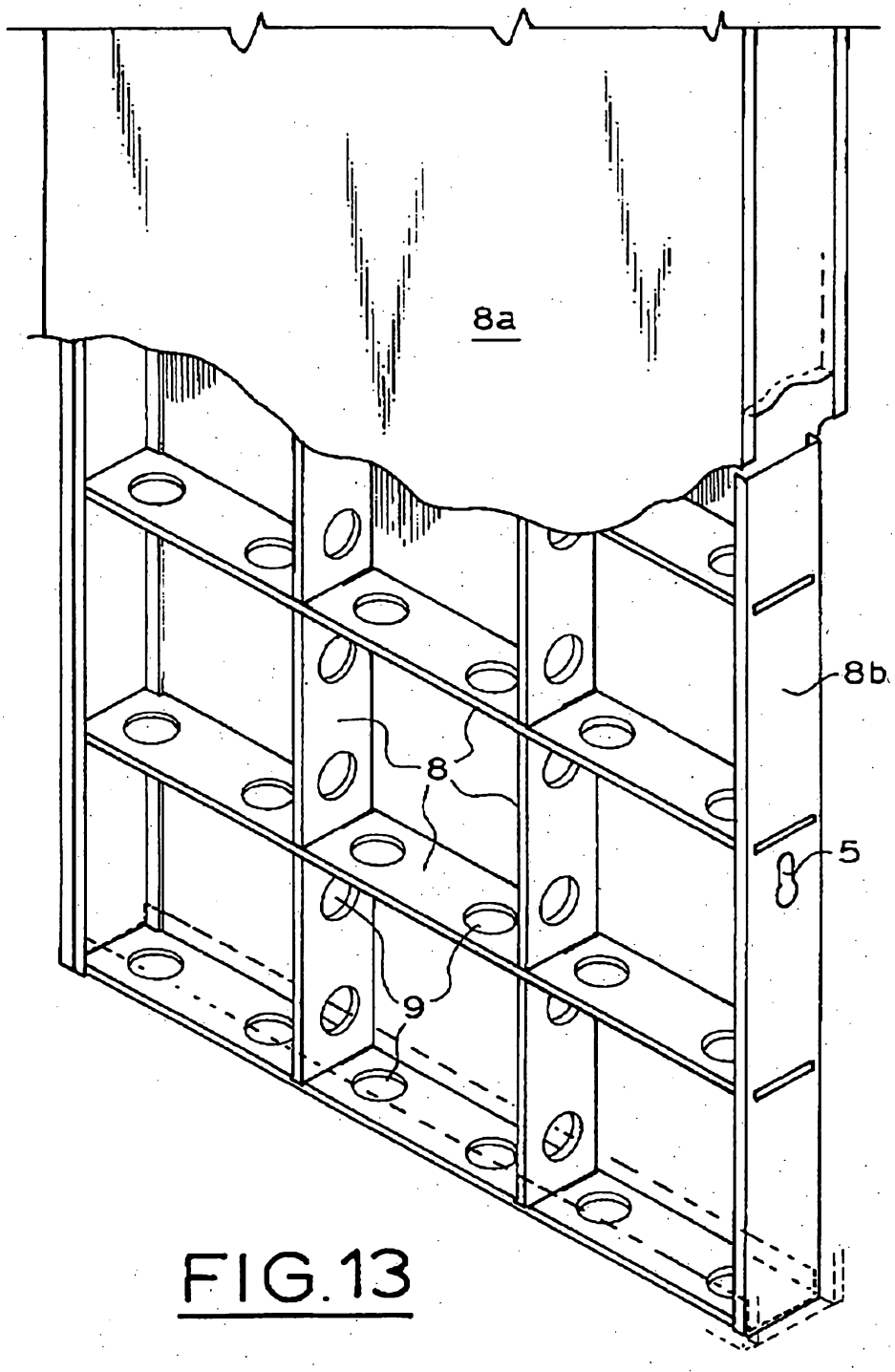

FIG.13

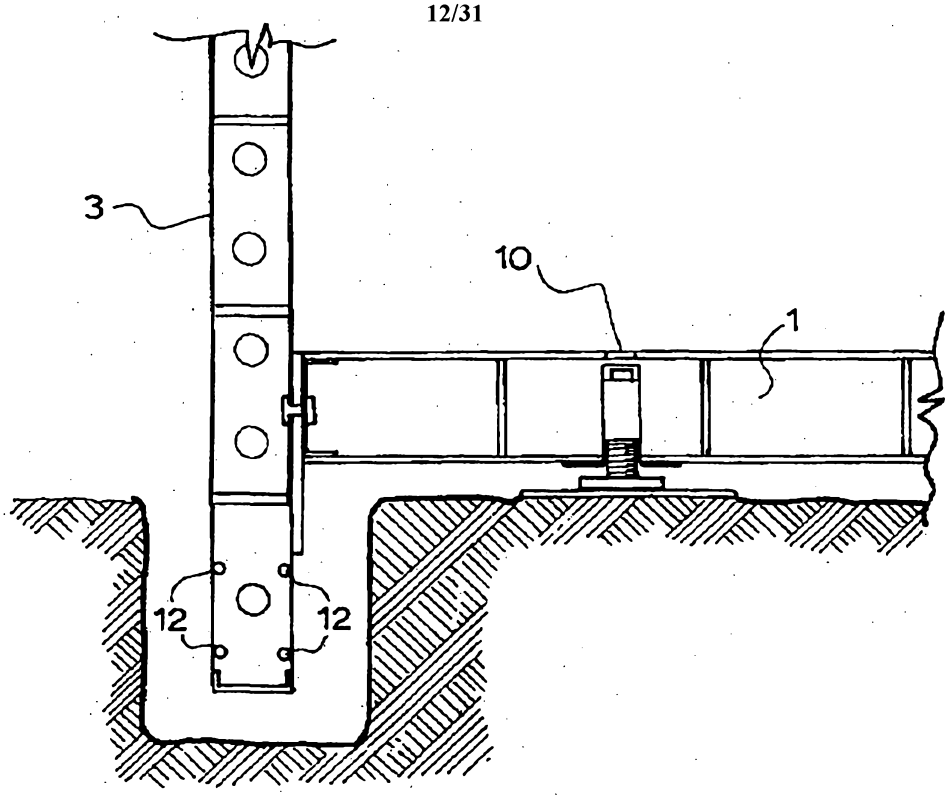

FIG.14

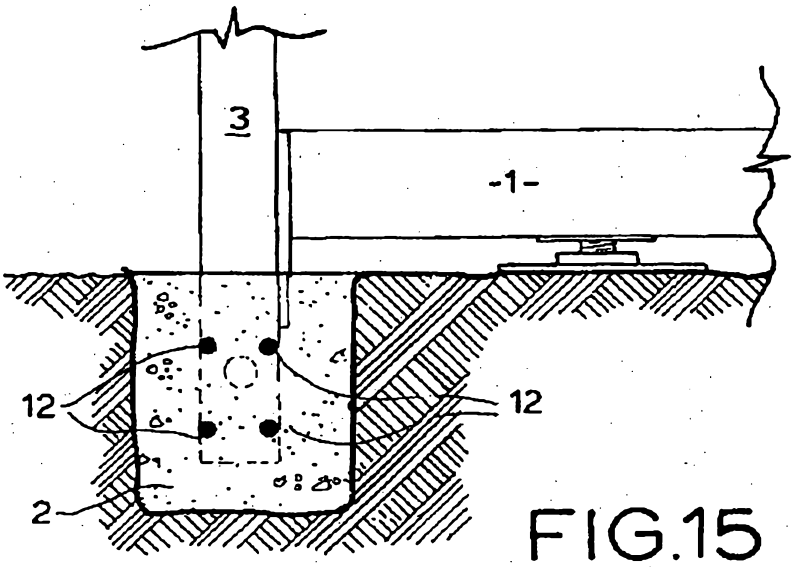

FIG.15

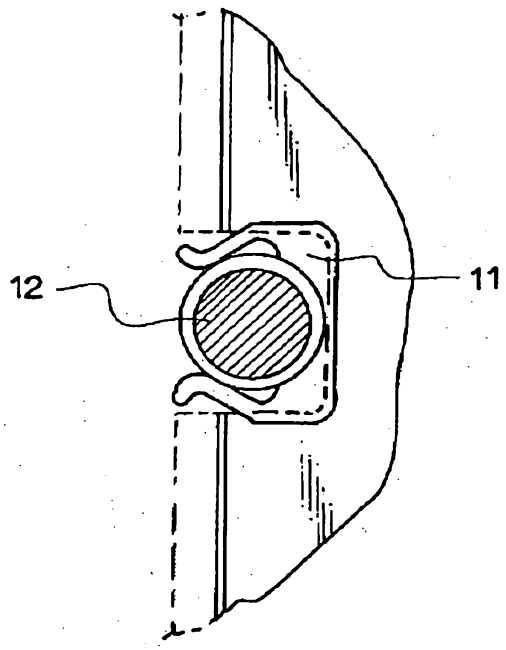

FIG.16

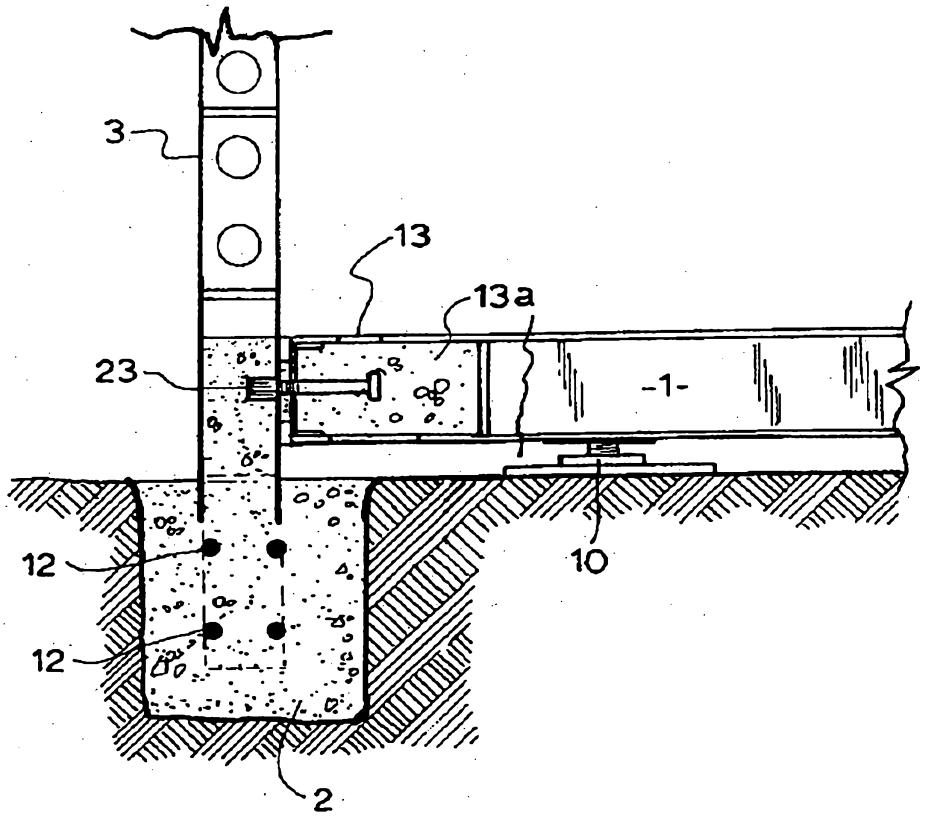

FIG.17

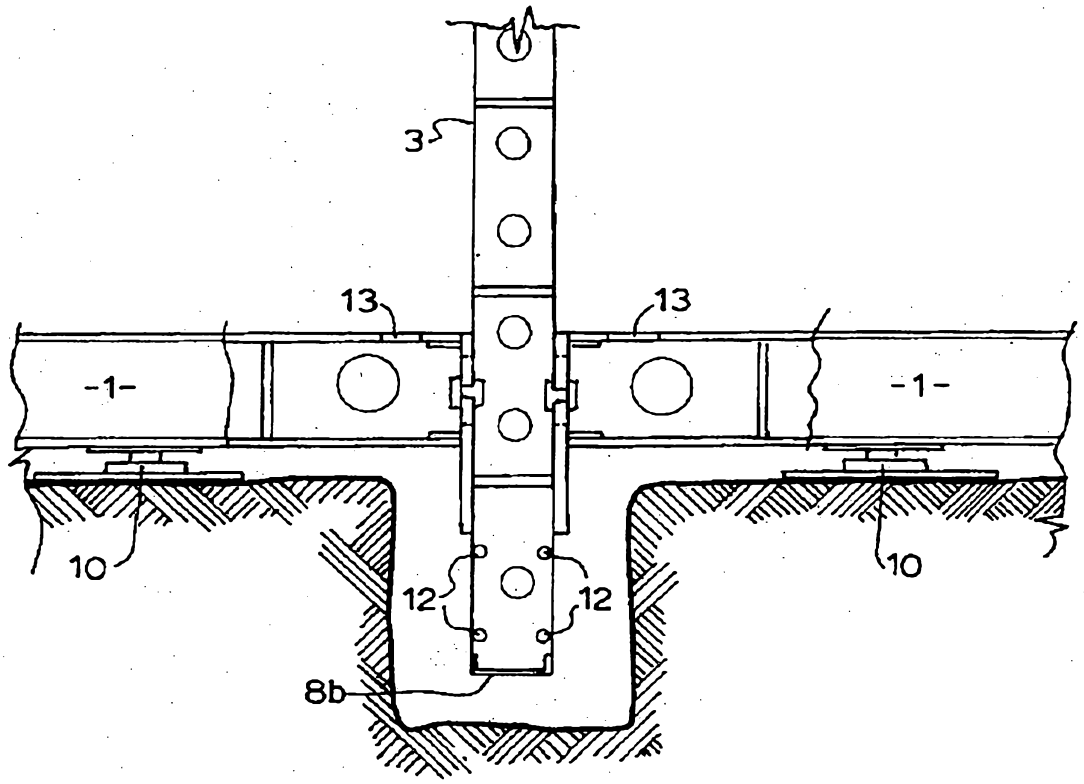

FIG.18

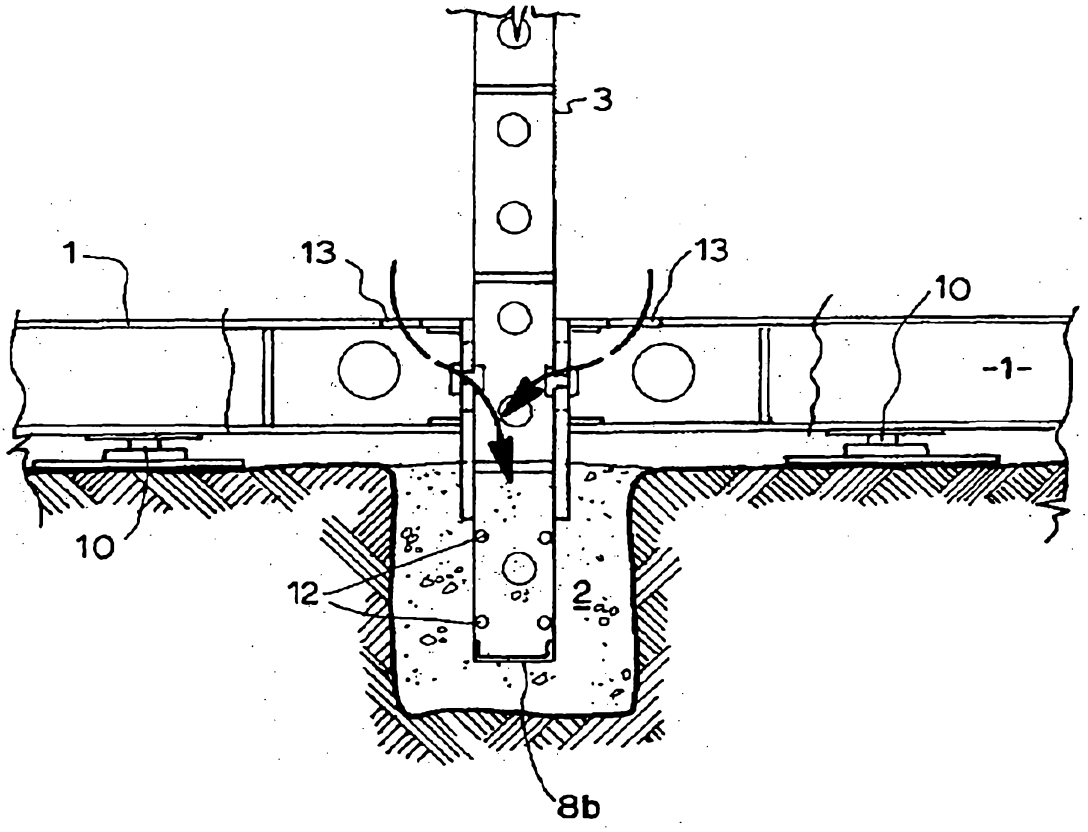

FIG.19

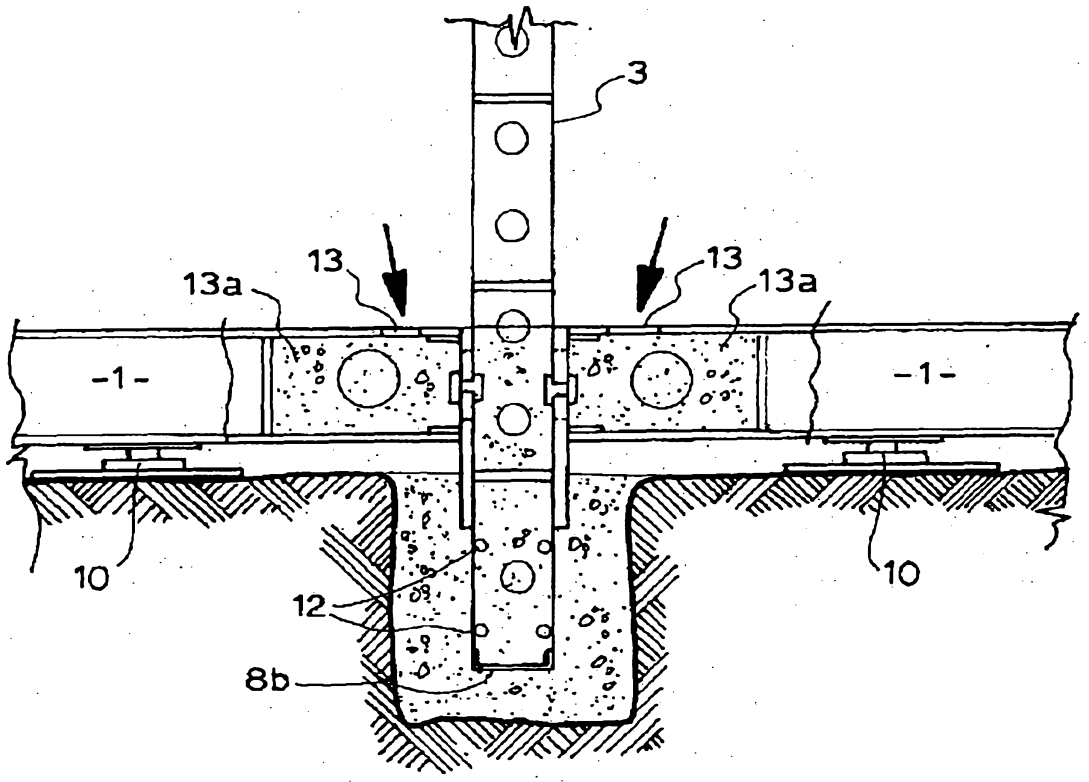

FIG.20

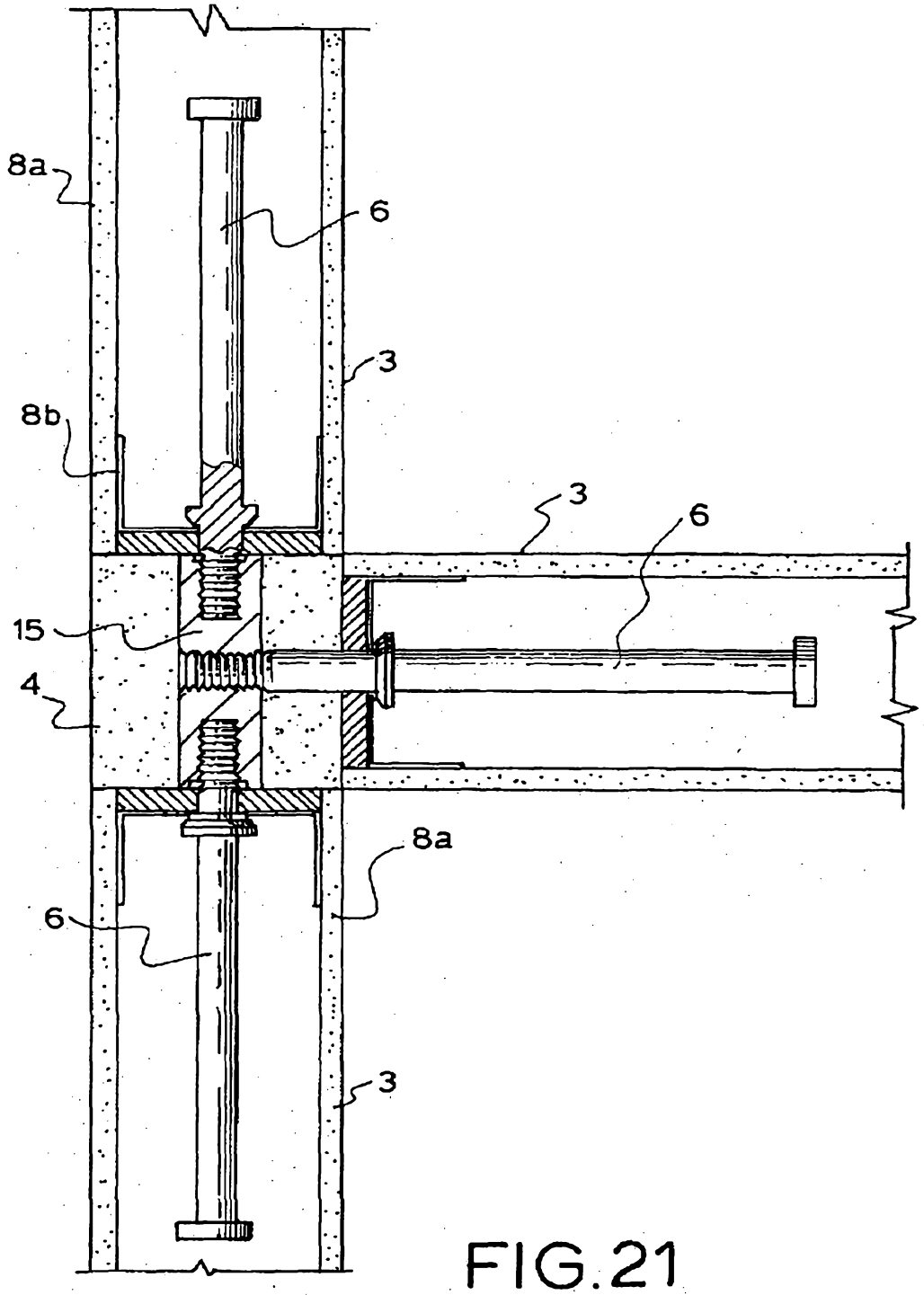

FIG.21

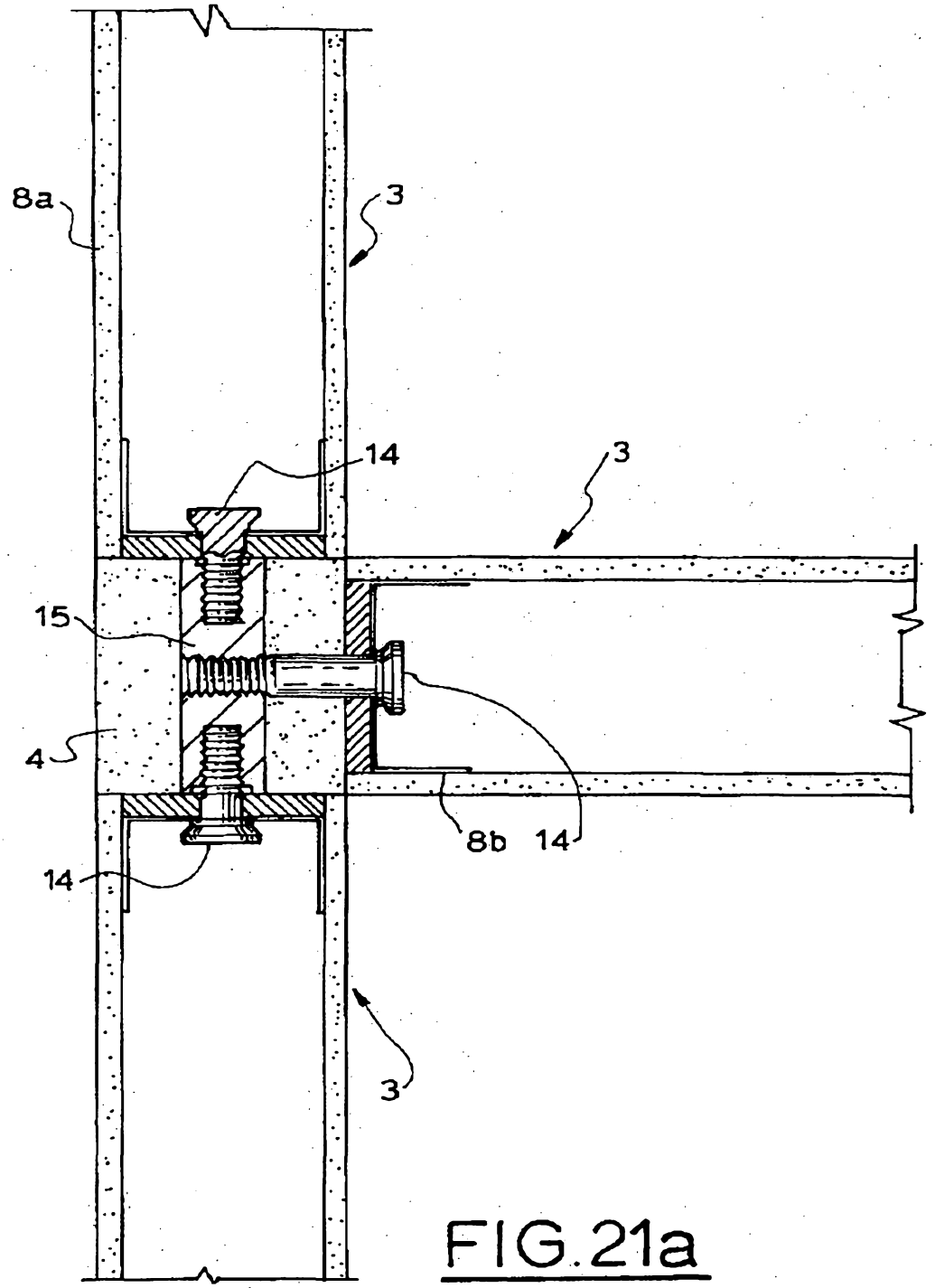

FIG.21a

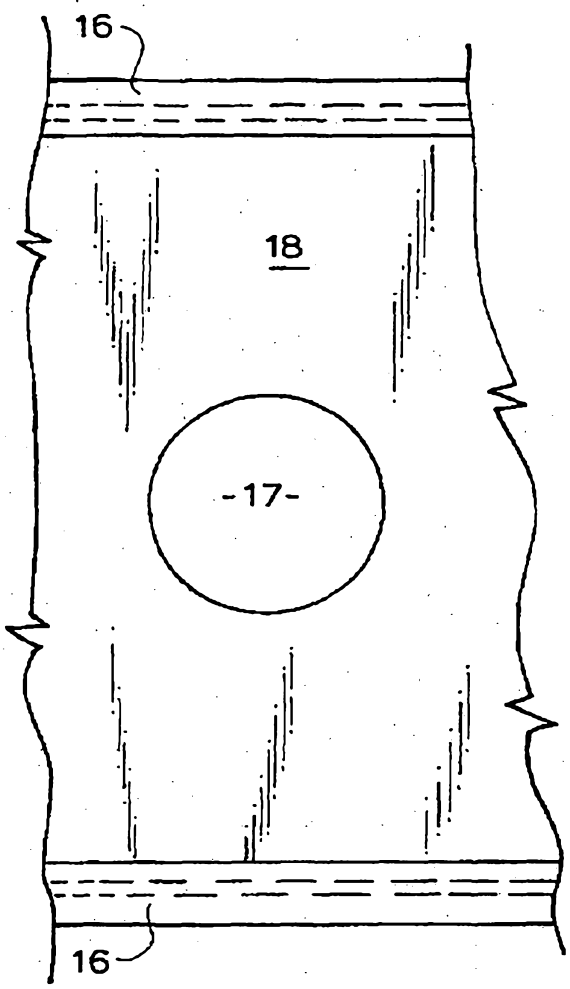

FIG. 22a

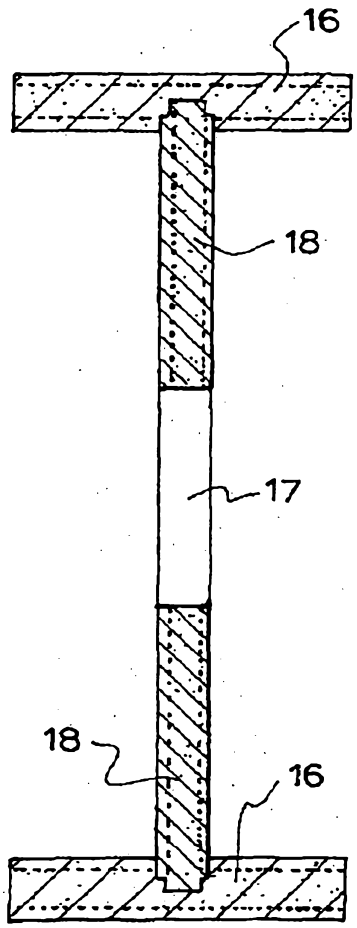

FIG. 22

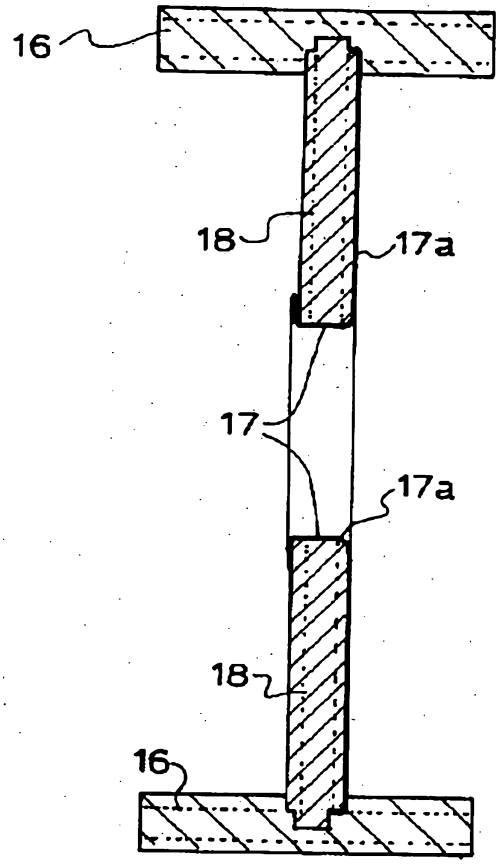

FIG.23

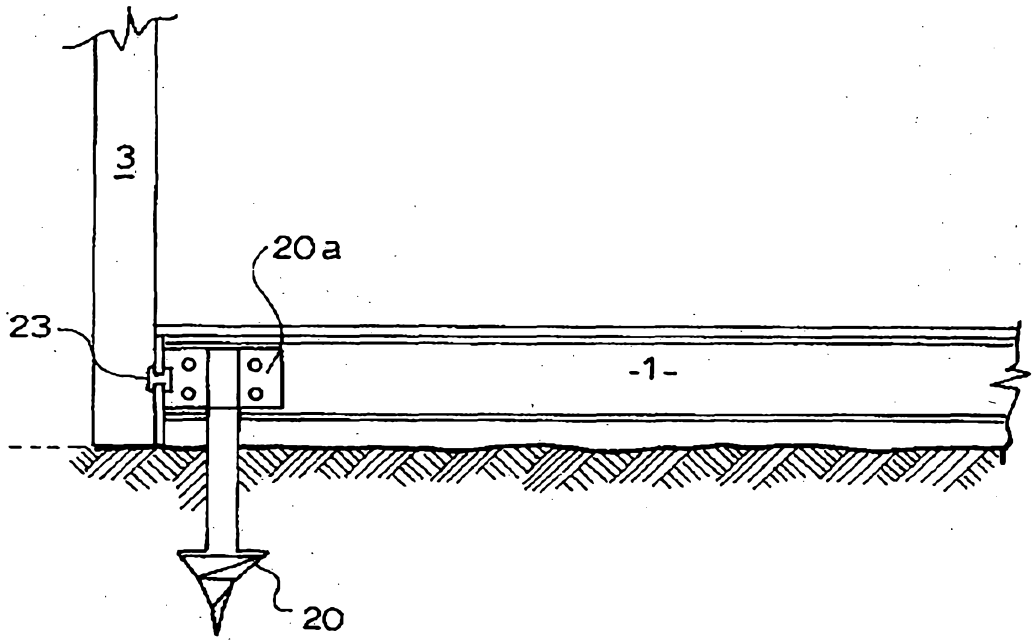

FIG.24

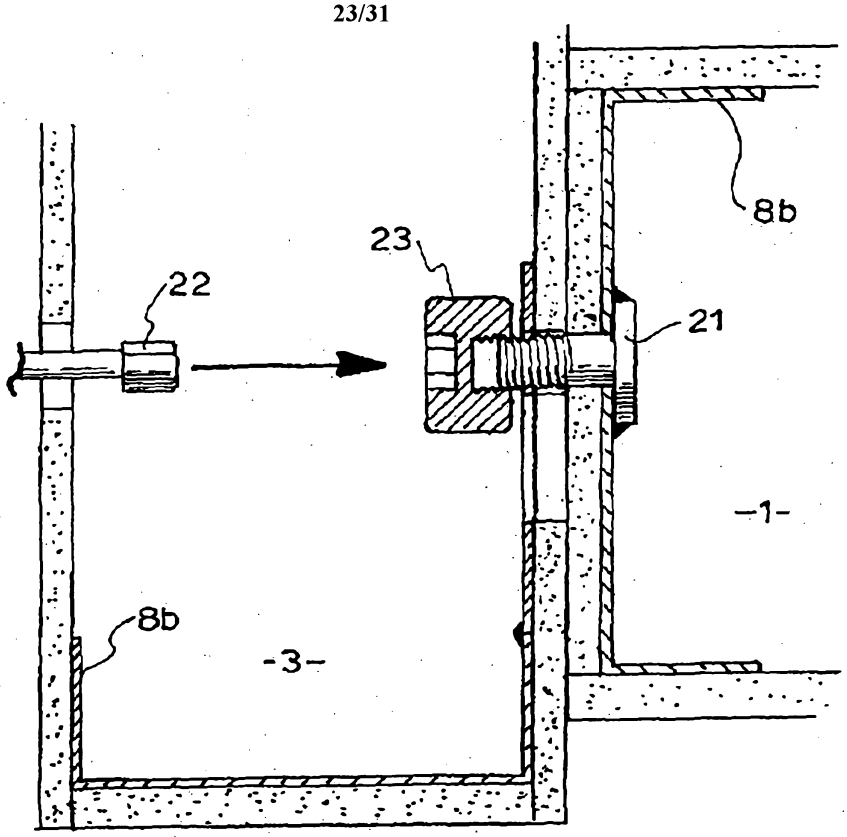

FIG.25

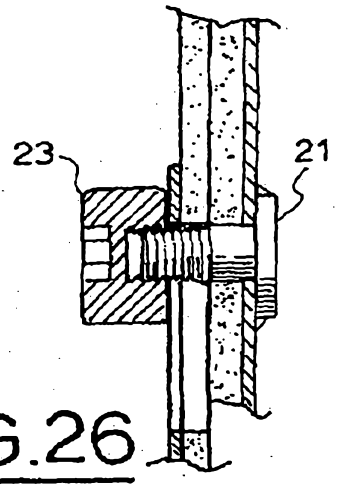

FIG.26

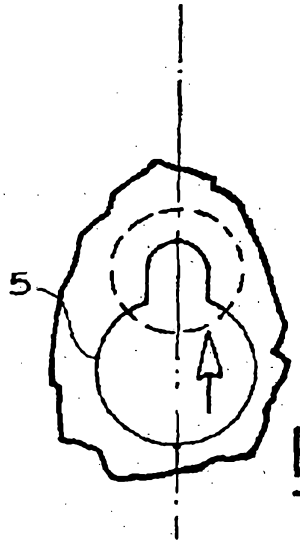

FIG.27

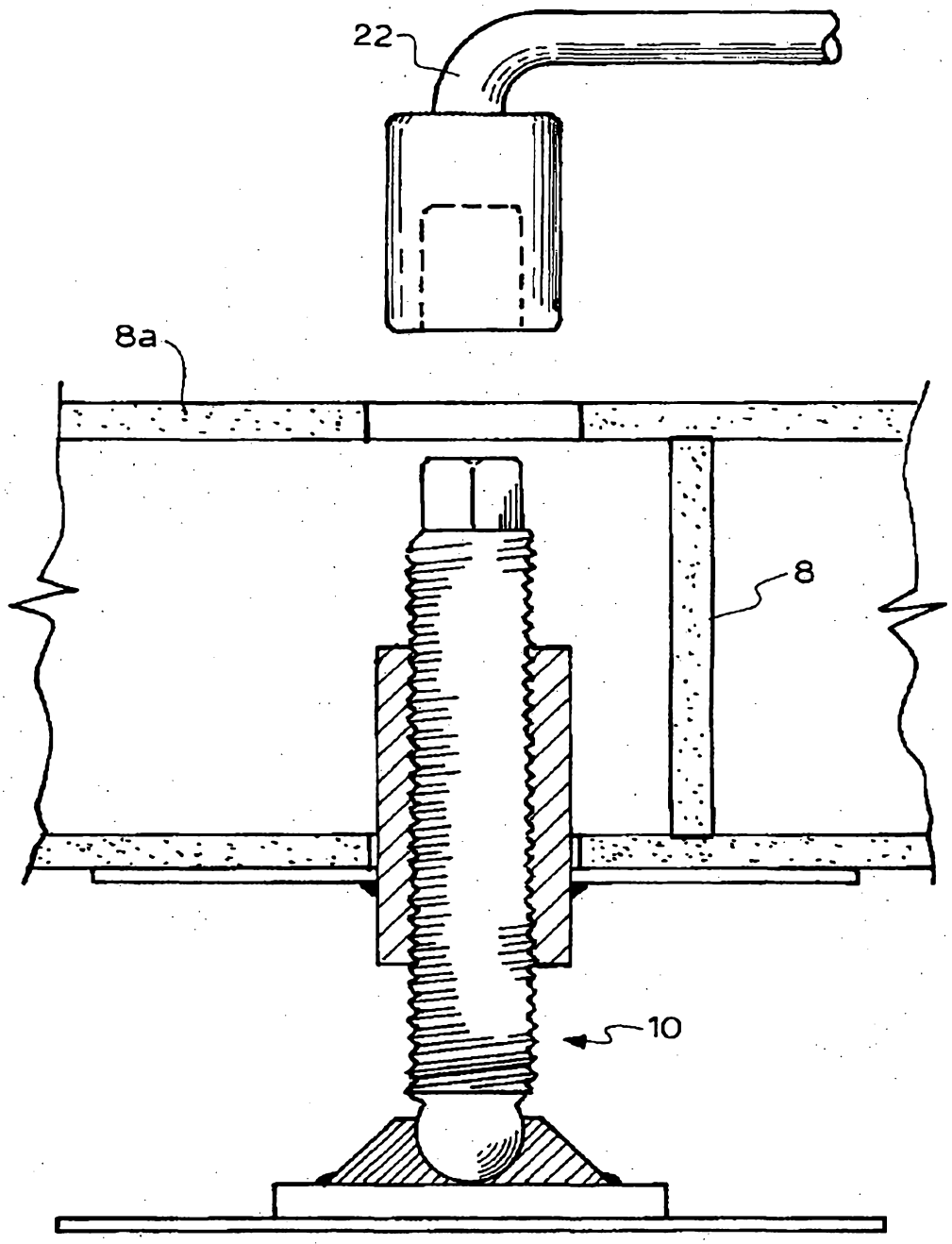

FIG. 28

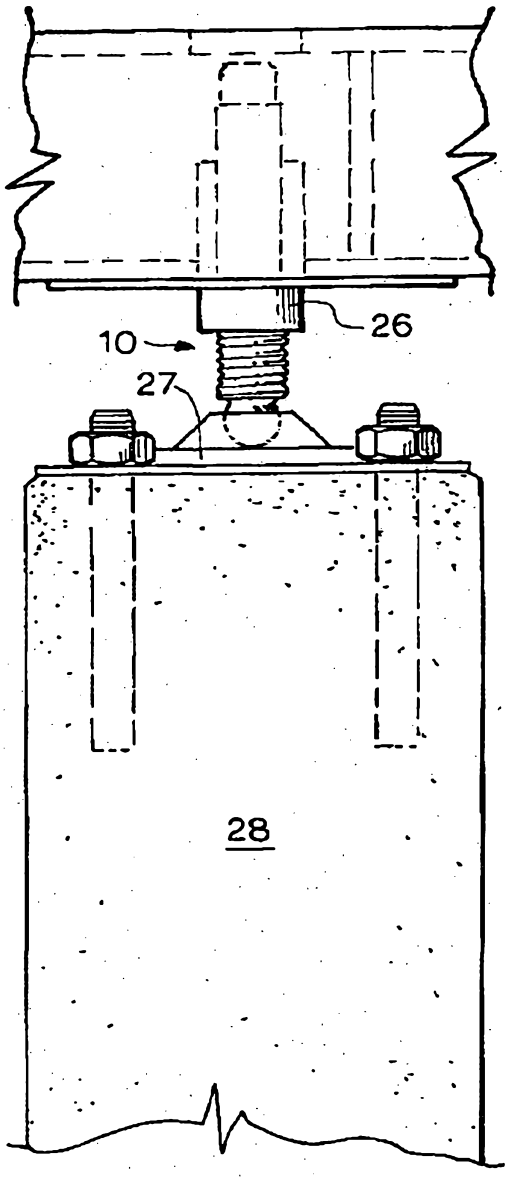

FIG. 29

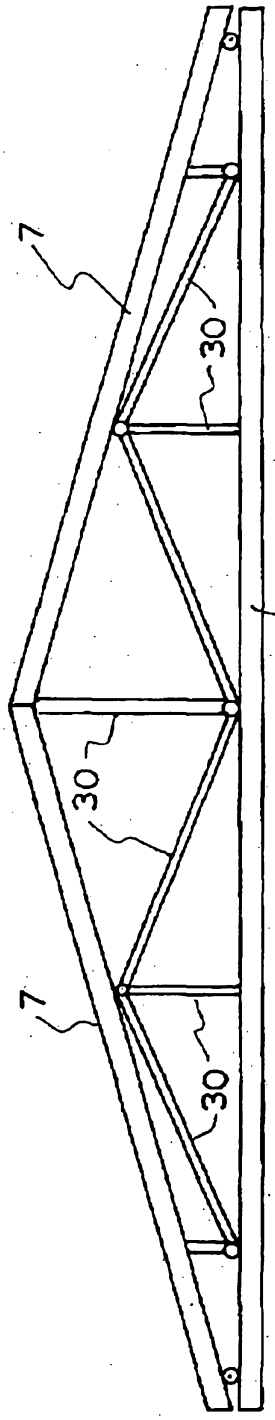

FIG.30

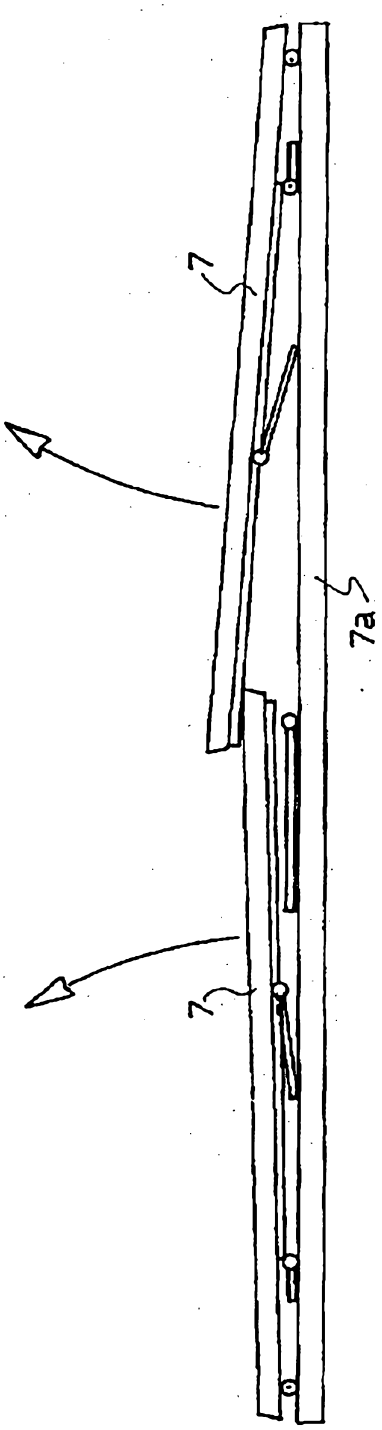

FIG.31

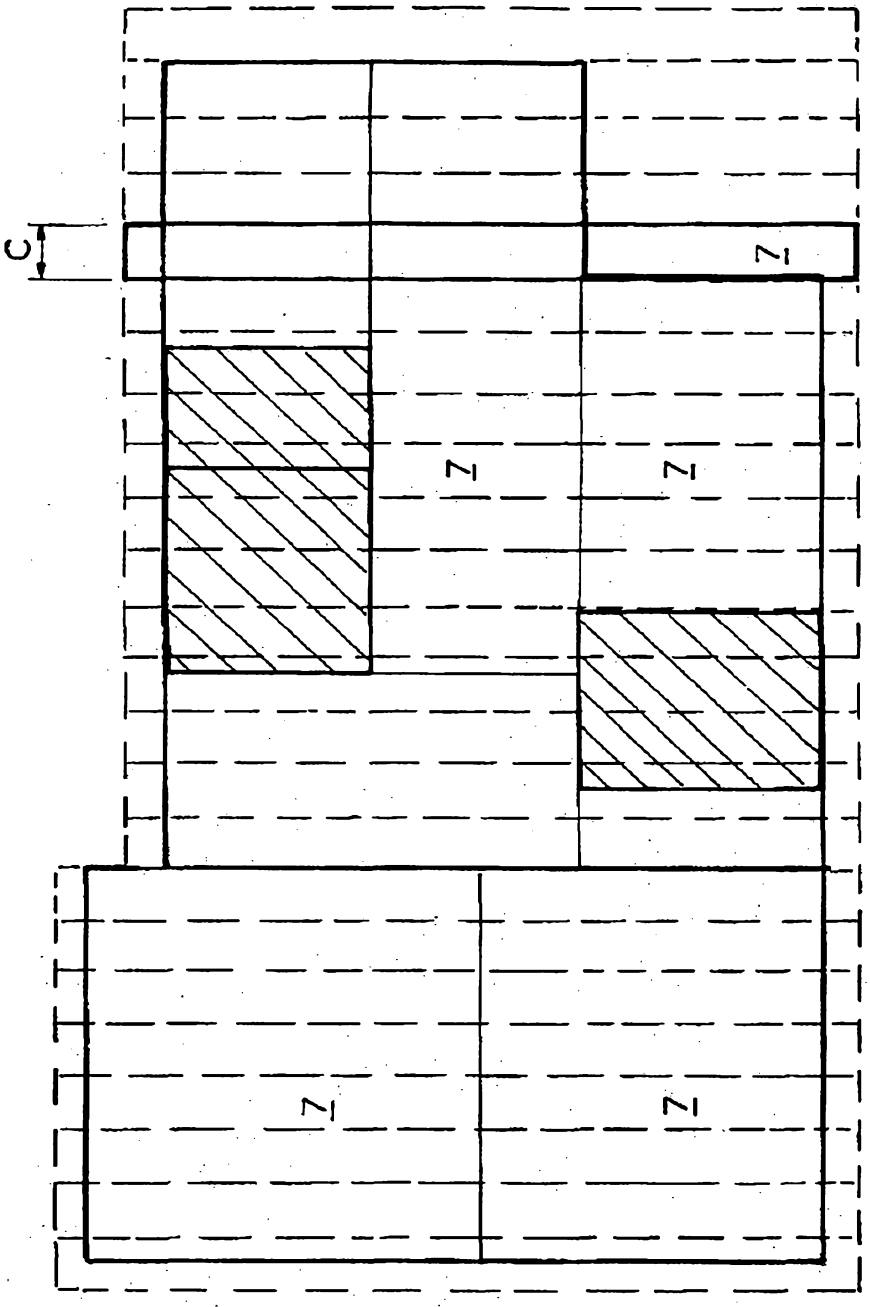

FIG.32

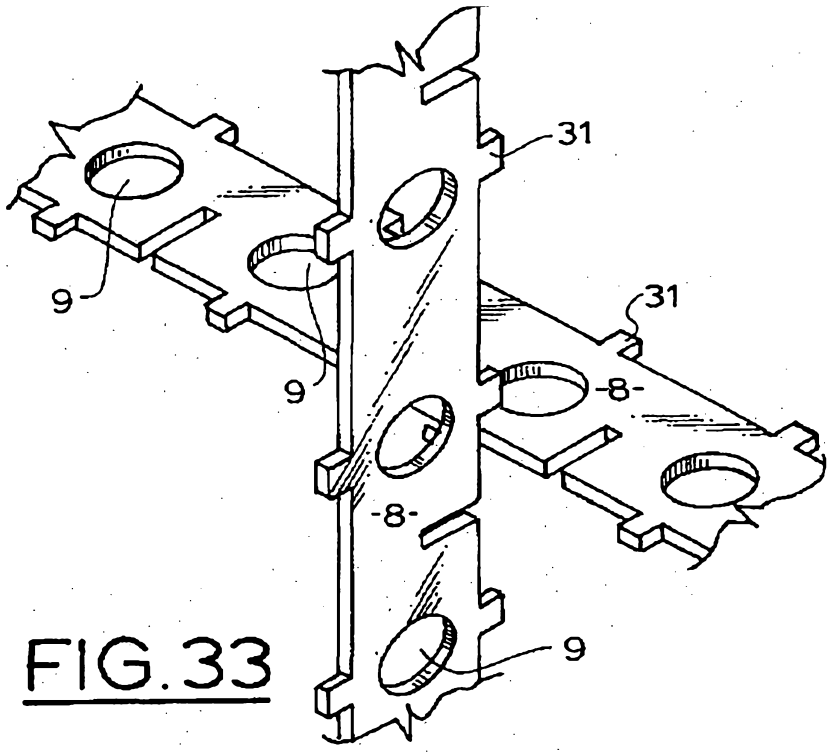

FIG.33

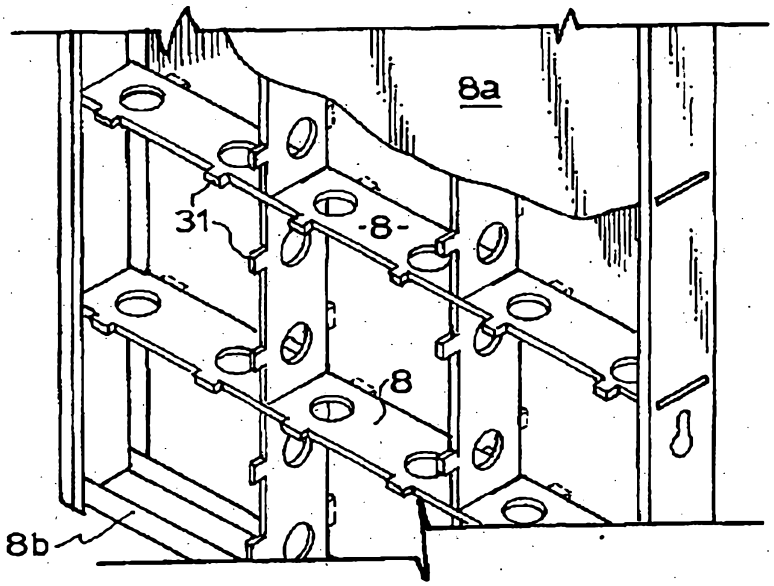

FIG.34

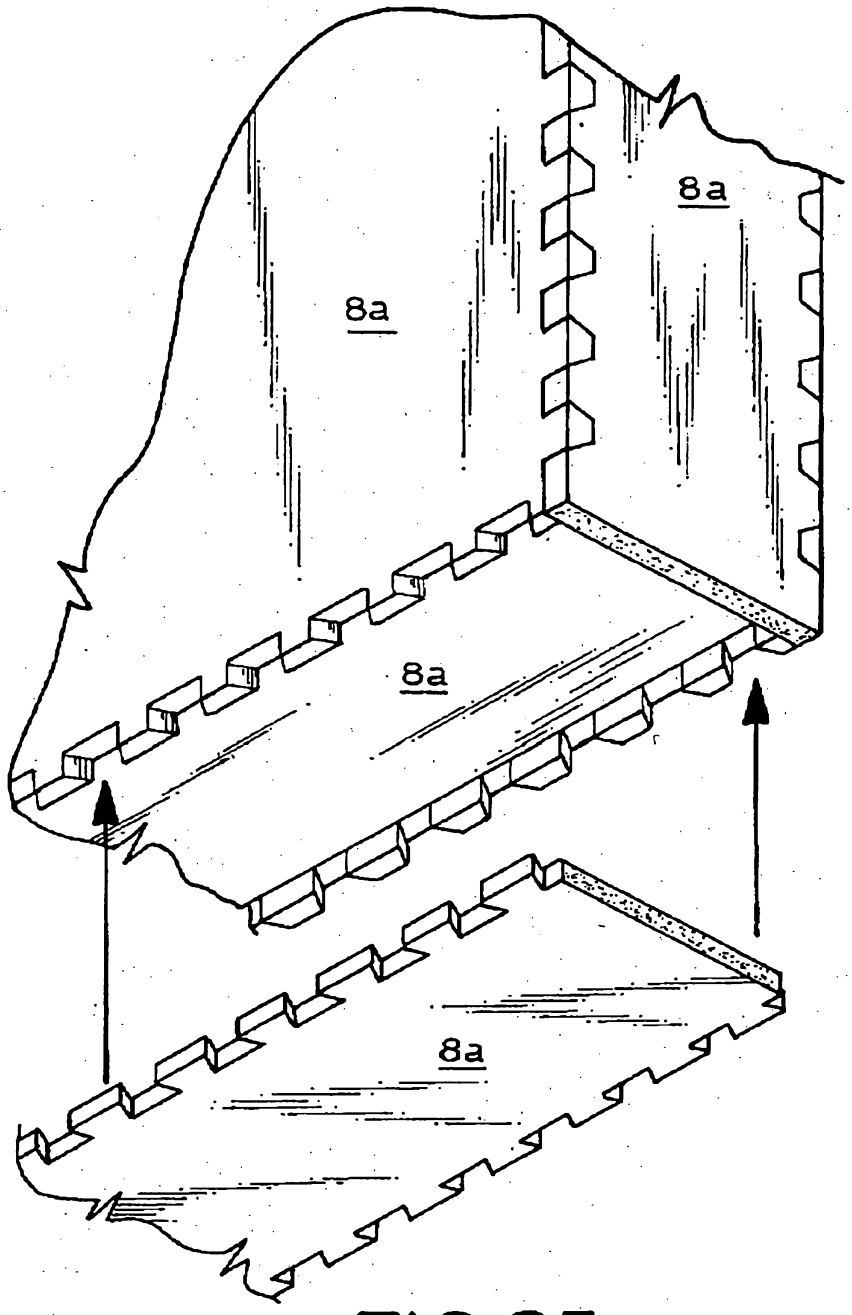

FIG.35

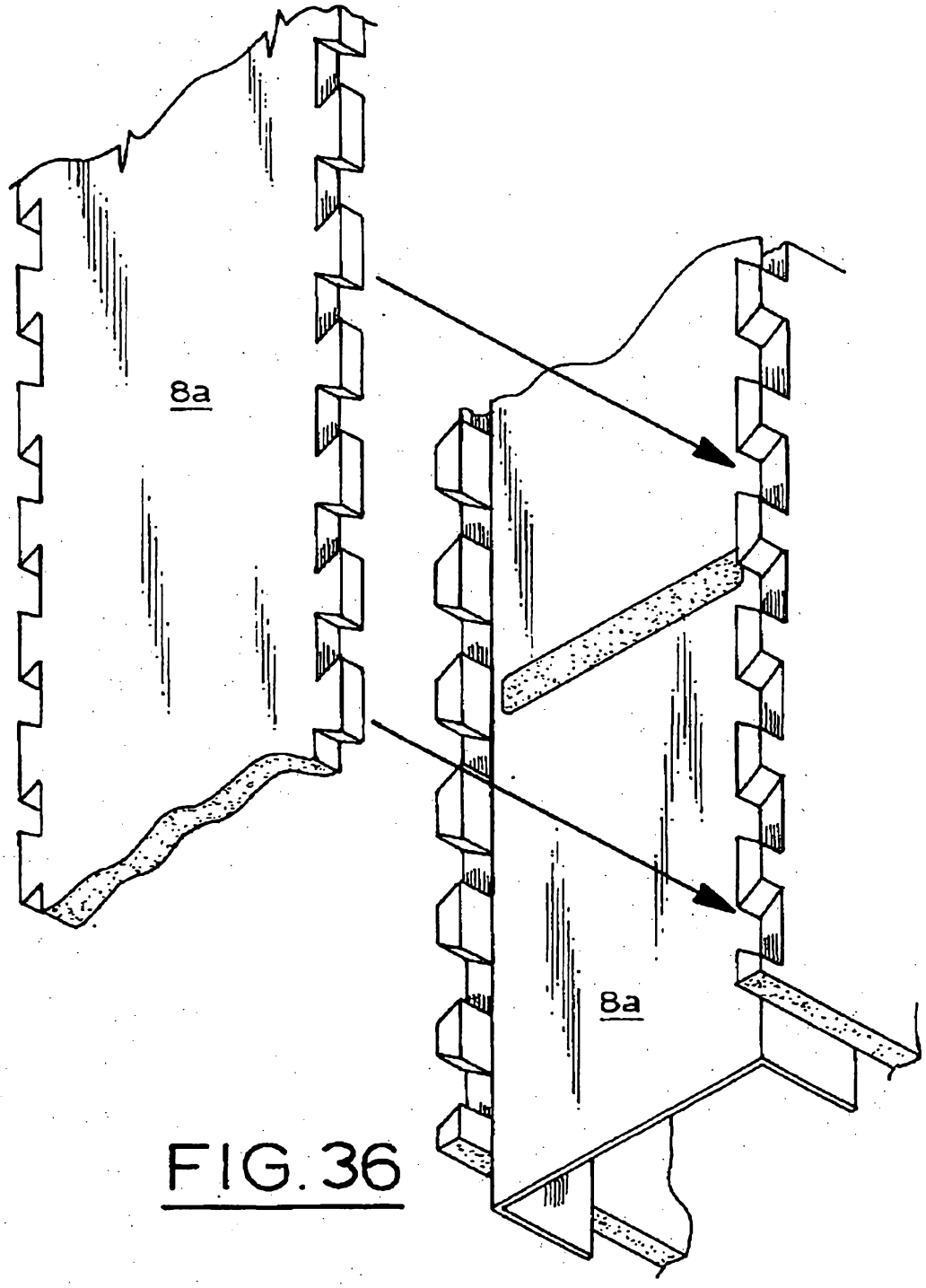

FIG. 36

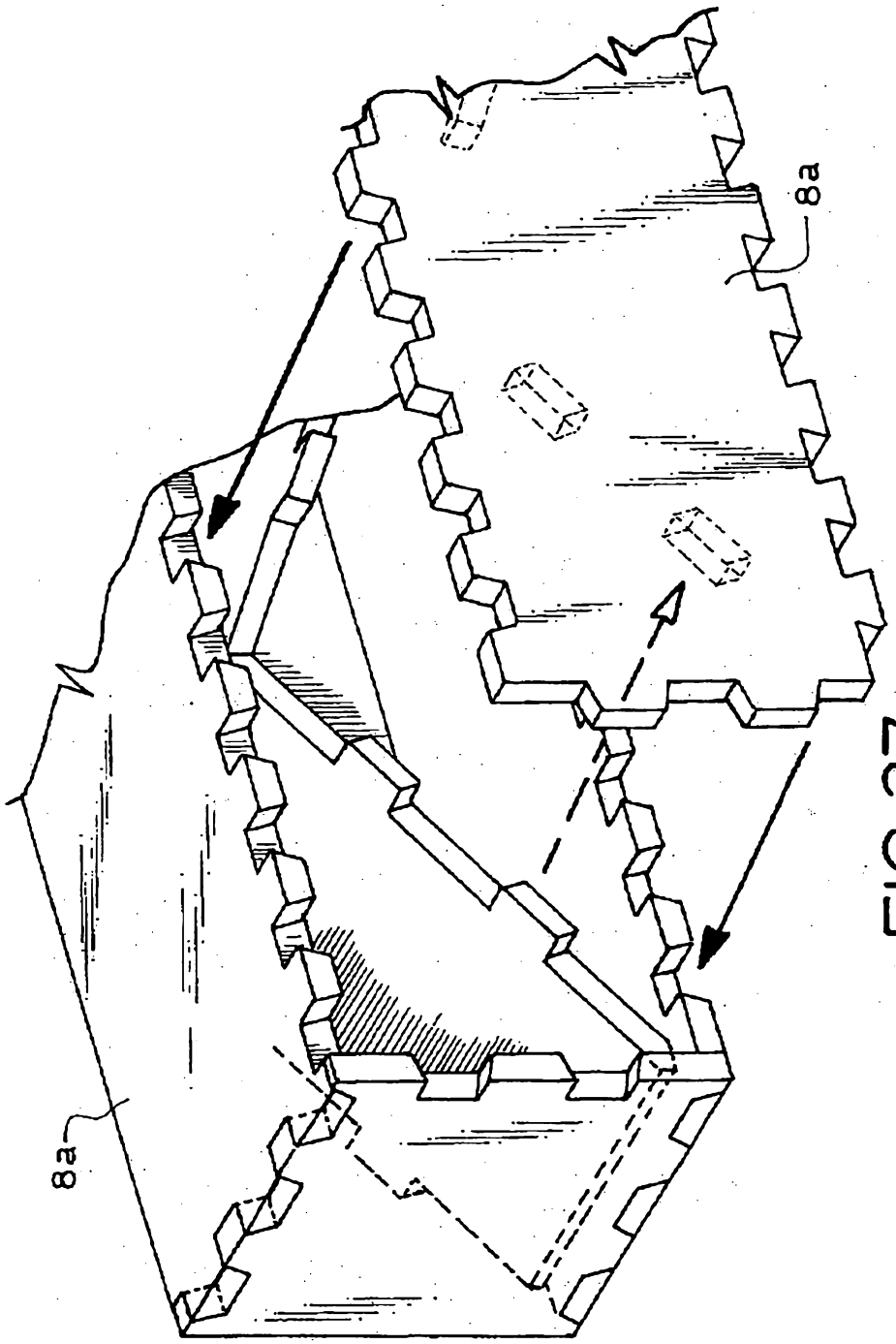

FIG.37