

(19)



(11)

EP 1 579 085 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

13.06.2007 Bulletin 2007/24

(51) Int Cl.:

E04B 1/348 (2006.01)

(21) Application number: **03778581.3**

(86) International application number:

PCT/GB2003/005270

(22) Date of filing: **03.12.2003**

(87) International publication number:

WO 2004/051017 (17.06.2004 Gazette 2004/25)

(54) **MECHANISM FOR SECURING TOGETHER BUILDING MODULES**

VERRIEGELUNGSMECHANISMUS FÜR MODULARE BAUEINHEITEN

MECANISME SERVANT A FIXER DES MODULES DE CONSTRUCTION LES UNS AUX AUTRES

(84) Designated Contracting States:

**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR**

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(43) Date of publication of application:

28.09.2005 Bulletin 2005/39

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Description

Field of the Invention

[0001] The invention relates to modular building units for use in the construction of largely prefabricated offices, hotels and apartment blocks, and buildings of a similar general nature. Such modular building units are box-like structures which can be manufactured and fitted-out off-site and then transported to a construction site for final assembly to form the internal rooms of a building. The building is assembled by stacking the individual modules in a horizontal and vertical array and securing them together to form a rigid structure. The invention provides a novel mechanism for securing the adjacent modules together.

[0002] A mechanism for securing together building modules is known from document BE-A-888354.

Background Art

[0003] Particularly in the construction of hotels, apartments and student accommodation it is known to construct the buildings from lightweight building modules each of which is a skeletal steel shell formed from lightweight structural steel sections welded into a box-like structure and lined with boarding such as plasterboard, plywood or oriented strand board (OSB). Each building module is made initially as such a lined shell, and is then fitted-out to the desired standard of internal decoration in a factory before being transported to the final building site for incorporation into a building.

[0004] Individual building modules for erection in a horizontal and vertical array into such a building are described and claimed in copending Patent Application No WO68004. Other building modules are known, made primarily from wood frames and wood boarding.

[0005] A difficulty arises in the securing together of the individual modules. A first module can be swung into position by crane and bolted or otherwise secured to the building foundations. A next module can then be swung into position alongside, but the edge that lies alongside the foundations immediately adjacent to the original secured module is obscured from access, and only the accessible sides of the base of the module can be secured to the foundations. Similarly with all subsequent storeys of the building, only the first module to be swung into position can be secured on all bottom edges. All subsequent modules have at least one bottom edge obscured by the adjacent module or modules, so securing is limited to those non-obscured edges.

The invention

[0006] The invention provides a mechanism for securing together room-sized building modules in the construction of a building as claimed in the claims herein. The mechanism can be used in the securing of the first course

of building modules to a foundation or base structure, or for the securing of any subsequent course to the course below. The resulting building is one in which each building module is secured along both long sides and preferably along all sides to the adjacent structure in both the vertical and horizontal directions.

Drawings

[0007]

Figure 1 is a schematic perspective view of eight building modules stacked in a 2x2x2 vertical and horizontal array typical of a part of a modular building constructed from such modules;

Figure 2 is a vertical section through a first embodiment of a securing mechanism according to the invention securing together four of the modules of Figure 1;

Figure 3 is a perspective view of a part of the securing mechanism of Figure 2;

Figure 4 is a vertical section through a second embodiment of a securing mechanism according to the invention for securing together two horizontally adjacent modules of Figure 1, although the side fixing of only one of those modules is shown in Figure 4 for clarity; and

Figure 5 is a perspective view of the mechanism of Figure 4.

[0008] Referring first to Figure 1, there is shown schematically a part of a building constructed from modular building units such as those, for example, described and claimed in copending Patent Application No WO68004.

The modules are shown in a 2x2x2 array, although in a complete building the array could be much larger. Rooms two deep are a common feature of such buildings, as the outside walls of the modules can be pre-fitted with external windows. The internal walls can be provided with connecting doors or corridor sections, to make up the floor plans familiar to all those aware of modern hotel bedroom layouts. The number of modules in each corridor is dependent on the size of the site only, and the height of the building is governed only by the strength of the individual units and the rigidity and load-bearing capacity of the lower units.

[0009] In Figure 1 three modules 1, 2 and 3 of the four modules of the ground floor are visible. A fourth ground floor module, which would have carried the reference 4, is hidden from view. On the floor above, however, all four modules 5, 6, 7 and 8 are shown.

[0010] If the individual modules were hoisted into position in the above numerical sequence, it will be appreciated that module 1 can be fixed to the foundations (or to the floor below if the illustration was at a higher level in the building) on all four of its base edges, because none of those edges is obscured by an adjacent module when module 1 is the only one on site. When module 2

is hoisted into position alongside, however, it cannot be secured to the foundations or lower course along its short bottom edge that abuts module 1. It has in the past been secured only at the other, exposed, bottom edges. Similarly module 3 has been secured only along two short and one long base edge; and module 4 would have been secured only along one long and one short edge. Exactly the same restrictions apply when hoisting modules 5 to 8 into position and securing them to modules 1 to 4.

[0011] Figures 2 and 3 show a fixing mechanism according to the invention which secures all of the modules along all of their edges or sides in both the vertical and horizontal directions. The four building modules shown are modules 1, 2, 5 and 6 of Figure 1, but of course any adjacent set of four modules could be connected together in the same way. The corner detail of the individual modules is as described and claimed in copending Patent Application No WO68005. Each of the mutually facing vertical walls of the individual modules is shown as being of double thickness, with the outermost wall of each module being given the reference 10. The showing of the walls as double thickness is of no relevance to this invention, and is merely a reflection of the fact that the individual building modules, which may be as described and claimed in copending Patent Application No WO68004, are made from a skeletal framework lined internally and finished by fitting-out before being transported to the building site.

[0012] What is of importance to this invention is that each module has secured to its outer wall a metal channel member 11 of top-hat section which extends around the outside of the module along each wall that in the finished building is to face the wall of an adjacent module. One such channel member 11 is secured around the top of each module as shown for the modules 1 and 2; and one is secured around the bottom of each module as shown for modules 5 and 6. Each individual module therefore has two such channel members 11 around its periphery or part of its periphery, one at a low level and one at a high level. Each channel member 11 is parallel to the adjacent corner of the module and spaced from that corner by a constant spacing d.

[0013] When the modules are stacked together there is a small but constant spacing between the adjacent vertical walls. This is a necessary requirement for acoustic insulation, and is utilized in the fixing mechanism of the invention. A link means 12 is inserted into the spacing left between the adjacent modules 1 and 2 as shown in Figure 2, and is then secured to the tops of those two modules before the modules 5 and 6 are swung into position. The link means 12, shown more clearly in Figure 3, comprises a base strip 13 of galvanized steel upstanding from which are a regular array, along the length of the base strip, of resiliently flexible legs 14 each having a detent flange 15 formed along its upper and outer edge. Below the base strip 13 is a symmetrically similar regular array of resiliently flexible legs 16 each having a detent flange 17 formed along its lower and outer edge. The

vertical spacing between base strip and the flanges 15 and 17 is the distance d.

[0014] When the link means 12 is inserted into the gap between the adjacent modules 1 and 2, the legs 16 flex inwardly until the flanges pass under the channel members 11, and then spring outwardly under their own resilience to hold the link means firmly down with its base strip 13 abutting the top surface of the adjacent modules 1 and 2. The base strip 13 is then secured along its long edges to the modules 1 and 2 below, for example by screws. Self-tapping screws into the structural steel framework of the modules gives a string fastening; or alternatively the base strip could be plug welded or seam welded to a peripheral channel in the top edges of the modules. Shown in Figure 3 at 18 are the locations of the screws or plug welds.

[0015] When secured as above, the modules 1 and 2 are fastened together along their top edges in both the vertical and horizontal planes by the link means 12. Moreover, the upstanding resiliently flexible legs 14 and detent flanges 15 are positioned to engage with the lower channel members 11 of the next level of modules 5 and 6 as they are hoisted into position. As each of the modules 5 and 6 is lowered into position onto the tops of the modules 1 and 2, the resiliently flexible legs flex and return with their detent flanges 15 engaging above the channel member 11 of the associated module, providing secure attachment of the next layer of modules around all edges of each module, top and bottom.

[0016] The base portion 13 of each insert 12 has another important function. It completely covers and closes the gap between adjacent modules. Therefore when the modules are being erected on site there is only a short time during which rain or dirt can travel down between adjacent modules, which is a highly desirable feature on the building site itself. Also, on completion of the building the creation of a continuous chimney or void from base to roof of the finished building is avoided, which is a great advantage from a fire security viewpoint. In Figure 3 the base strip 13 is shown flat. However a preferred form is to shape the base strip as a gutter, so that any rain falling on the building modules during erection of the building is channelled away to one end or the other of the building.

[0017] It will be understood that suitable acoustic insulation will be provided in practice between the adjacent modules and between the modules and the inserts 12, although none is shown in the drawings. For example, an acoustic barrier could be created between adjacent modules by placing a layer of acoustically insulating material such as neoprene foam between the outer walls 10 of each module and the channel members 11; or by covering the outer surface of the channel members 11 with similar material.

[0018] Figures 4 and 5 show an alternative securing mechanism according to the invention. Each module has on its outer wall 10 a series of guide channels 21. Each guide channel 21 is mounted on a fixing plate 22 which is secured to the outer wall 10 for example by welding or

by screwing or bolting through an acoustically insulating layer (not shown). Each guide channel 21 is offset outwardly from its fixing plate 22 by a distance d1 (Figure 4) in the direction of the adjacent modules in the building. The distance d1 is less than half of the spacing that is left between the adjacent modules when they are hoisted into position in the final building as illustrated in Figure 1, so that in the final building there is a space between the adjacent and mutually aligned guide channels 21.

[0019] Each guide channel has a guide slot 23 formed in its outer face, extending from a divergent jaw 24 to a parallel-sided cup portion 25. Secured at the bottom of the fixing plate 22, and lying inside the guide channel 21, is a resiliently deformable sheet of spring steel 26 which acts as a detent for a connecting pin 27 which will be described later. A circular aperture 28 in the spring detent 26 is positioned to lie alongside the bottom of the cup portion 25 of the guide channel 23 to receive an end of the connecting pin 27.

[0020] The connecting pin 27 is located on a lower end of an insert bar 29. When two modules of a single storey of a building are in their final positions adjacent one another as shown in Figure 1 for example, the guide channels 21 of those two modules are immediately adjacent on another. The insert bar 29 is lowered into the gap between the adjacent modules and the pin 27 is guided by the divergent jaws 24 into the cup portions 25 of the two adjacent guide channels 21. As the insert bar 29 is lowered, it bends the spring steel detents 26 inwardly, but springs back with the ends of the pin 27 received in the circular aperture 28. The spring steel detents 26 prevent the pin 27 from moving in the vertical direction, and shoulders 30 of the pin 27 engage behind the wall of the guide channels 21 defining the cup portions 25 to prevent lateral movement of one building module relative to the other.

[0021] The guide channels 21 may be provided at any location and at any height on the mutually facing outer sides of the building modules. If they are provided at a low level, near to the base of the modules, then it may be desirable to incorporate additional guide means to facilitate the engagement of the pin 28 in the guide channels 21 as the insert bar is lowered from the top of the adjacent modules.

[0022] Desirably as each level of the building is completed a cover strip of steel is secured over the small gap between adjacent modules, to keep out the weather on site before the building is finished and to act as a fire break in the finished building. Such a cover strip also assists in the securing together of the adjacent modules, as it connects together the top edges of the adjacent modules in the horizontal plane. The invention therefore embraces a building method in which such a metal sheet, with a gutter formed therein, is secured over the junctions between the tops of adjacent modular building units in the building at each storey. Preferably the gutters formed in those metal sheets conduct rain water and/or condensation to the outside of the building.

Claims

1. A mechanism for securing together room sized modular building units in the construction of a building, comprising mutually aligned channel means (11, 21) on the facing outside walls (10) of each pair of adjacent modular building units, link means (12, 27) to be lowered between two adjacent but mutually spaced modular building units in the final building and passing vertically into the mutually aligned channel means (11,21) for engaging with the mutually aligned channel means (11,21) to lock them together, **characterised by** resiliently biased latching means (14,26) permitting the link means (12,27) to pass vertically into the aligned channel means (11,21) to engage the channel means (11,21) but preventing movement in the return direction.
2. A mechanism according to claim 1, wherein the resiliently biased latching means comprises spring supports (16) for the link means (12) permitting the link means (12) to deflect and pass vertically into the channel means (11) as the link means (12) is lowered, and to spring back beneath a shoulder of the channel means (11) to prevent return movement.
3. A mechanism according to claim 2, wherein the link means comprise a pair of out-turned flanges (7) on the bottom edges of the spring supports (16), and the channel means (11) comprises a pair of channel members secured to the outside of the modules so that the flanges engage beneath shoulders of the channel members when the link means is lowered into the space between adjacent building modules.
4. A mechanism according to claim 3, wherein the spring supports depend from a base plate (13) which is wide enough to span the space between adjacent modules and which in use is secured to the tops of the building modules to prevent relative movement therebetween in the horizontal plane.
5. A mechanism according to claim 4, wherein a further pair of spring supports (14) extend upwardly from the base plate (13) to terminate in outwardly directed flanges (15) for engaging over the tops of a further pair of channel members (11) secured to the outside of the modules as the next layer of modules is moved into position to form the next storey of the building.
6. A mechanism according to claim 1, wherein the link means comprises a double headed pin member (27) extending transversely across, the space between adjacent building modules and supported by an insert bar (29) on which the pin member (27) can be lowered into the said space; and each channel means is a channel member on the outside wall of each building module comprising a guide channel

(21) for guiding an end portion of the pin member (27) while the heads of the pin member (27) engage with the mutually aligned channel means to lock them together

7. A mechanism according to claim 6, wherein the resilient means is a spring member (26) which includes an aperture (28) into which an end of the pin (27) can be received, so that lowering of the link means into the space between the building modules causes deflection of the spring member (26) until the end of the pin (27) is received in the aperture, whereupon the spring member (26) springs back to retain the pin member (27).
8. A method of constructing a building from a number of room sized modular building units, comprising, linking together adjacent modular building units using a mechanism according to any preceding claim, and securing over the horizontal junctions between the tops of adjacent modular building units a metal sheet in which is formed a gutter for conducting rain water or condensation from the top of each storey of modular building units in the building to the outside of the building.

Patentansprüche

1. Verriegelungsmechanismus für modulare Baueinheiten in Raumgröße beim Errichten eines Gebäudes, mit aufeinander ausgerichteten Kanalrichtungen (11, 21) auf den nach außen zeigenden Wänden (10) jedes Paares benachbarter modularer Baueinheiten, mit Verbindungseinrichtungen (12, 27), welche zwischen zwei benachbarten jedoch zueinander beabstandeten modularen Baueinheiten im fertigen Gebäude abgesenkt werden sollen und vertikal in die zueinander ausgerichteten Kanaleinrichtungen (11, 21) zur Verbindung mit den zueinander ausgerichteten Kanaleinrichtungen (11, 21) verlaufen, um diese zu verriegeln, **gekennzeichnet durch** eine elastisch vorgespannte Rasteinrichtung (14, 26), welche es ermöglicht, dass die Verbindungseinrichtungen (12, 27) vertikal in die ausgerichteten Kanaleinrichtungen (11, 21) gelangen, um die Kanaleinrichtungen (11, 21) zu verbinden, jedoch eine Bewegung in die entgegengesetzte Richtung verhindern.
2. Mechanismus nach Anspruch 1, wobei die elastisch vorgespannte Rasteinrichtung einen Federträger (16) für die Verbindungseinrichtung (12) aufweist, welches ermöglicht, dass die Verbindungseinrichtung (12) sich biegt und vertikal in die Kanaleinrichtung (11) hineinverläuft, wenn die Verbindungseinrichtung (12) abgesenkt wird, und hinter einer Schulter der Kanaleinrichtung (11) zurückfedert, um eine Rückwärtsbewegung zu verhindern.

3. Mechanismus nach Anspruch 2, wobei die Verbindungseinrichtungen ein Paar nach außen gebogener Flansche (17) an den Bodenkanten der Federträger (16) aufweist, und wobei die Kanaleinrichtung (11) ein Paar Kanalglieder aufweist, welche an der Außenseite der Module verriegelt sind, so dass die Flansche hinter den Schultern der Kanalelemente eine Verbindung eingehen, wenn die Verbindungseinrichtung in den Raum zwischen benachbarten Baumodulen abgesenkt wird.
4. Mechanismus nach Anspruch 3, wobei die Federträger von einer Basisplatte (13) abhängen, welche breit genug ist, um den Raum zwischen benachbarten Modulen zu überspannen, und welche im Einsatz mit den Oberteilen der Gebäudeeinheiten verriegelt ist, um eine Relativbewegung dazwischen in der horizontalen Ebene zu verhindern.
5. Mechanismus nach Anspruch 4, wobei sich ein weiteres Paar von Federträgern (14) von der Basisplatte (13) nach oben erstreckt, um in nach außen gerichteten Flanschen (15) zur Verbindung über den Oberteilen eines weiteren Paares von Kanalgliedern (11) zu enden, welche mit der Außenseite der Module verriegelt sind, während die nächste Lage von Modulen in Position gebracht wird, um das nächste Stockwerk des Gebäudes zu bilden.
6. Mechanismus nach Anspruch 1, wobei die Verbindungseinrichtung ein doppelköpfiges Stiftglied (27) aufweist, welches sich quer zu dem Raum zwischen benachbarten Gebäudemodulen erstreckt und von einem Einsatzstab (29), auf dem das Stiftglied (27) in den genannten Raum abgesenkt werden kann, getragen wird, und wobei jede Kanaleinrichtung ein Kanalglied auf der Außenwand jedes Gebäudemoduls ist, welches einen Führungskanal (21) zum Führen eines Endabschnitts des Stiftglieds (27) aufweist, während die Köpfe des Stiftglieds (27) mit den zu einander ausgerichteten Kanaleinrichtungen in Verbindung stehen, um diese miteinander zu verriegeln.
7. Mechanismus nach Anspruch 6, wobei die elastische Einrichtung ein Federglied (26) ist, welches eine Öffnung (28) aufweist, in welcher ein Ende des Stifts (27) aufgenommen werden kann, sodass ein Absenken der Verbindungseinrichtung in den Raum zwischen den Gebäudemodulen ein Verbiegen des Federglieds (26) verursacht, bis das Ende des Stifts (27) in der Öffnung aufgenommen ist, wobei das Federglied (26) zurückfedert, um das Stiftglied (27) festzuhalten.
8. Verfahren zum Konstruieren eines Gebäudes aus einer Anzahl von modularen Baueinheiten in Raumgröße, mit dem Schritt Zusammenbinden benach-

barter Gebäudemoduleinheiten unter Verwendung eines Mechanismus nach einem der vorhergehenden Ansprüche, und Verriegeln über die horizontalen Verbindungen zwischen den Oberseiten benachbarter modularer Gebäudeeinheiten, mit einer Metallplatte, in welcher eine Rinne zum Führen von Regenwasser oder Kondenswasser von der Oberseite jedes Stockwerks der modularen Gebäudeeinheiten in dem Gebäude zur Außenseite des Gebäudes geformt ist.

Revendications

1. Mécanisme pour fixer les unes aux autres des unités de construction modulaires de la taille d'une pièce dans la construction d'un bâtiment, comprenant des moyens formant canaux mutuellement alignés (11, 21) sur les parois faisant face vers l'extérieur (10) de chaque paire d'unités de construction modulaires adjacentes, des moyens de liaison (12, 27) devant être abaissés entre deux unités de construction modulaires adjacentes mais mutuellement espacées dans le bâtiment final et passant verticalement dans les moyens formant canaux mutuellement alignés (11, 21) pour venir en prise avec les moyens formant canaux mutuellement alignés (11, 21) afin de les verrouiller les uns aux autres, **caractérisé par** des moyens de verrouillage rappelés de façon élastique (14, 26) permettant aux moyens de liaison (12, 27) de passer verticalement dans les moyens formant canaux alignés (11, 21) pour venir en prise avec les moyens formant canaux (11, 21) mais empêcher le mouvement dans la direction de retour.
2. Mécanisme selon la revendication 1, dans lequel les moyens de verrouillage rappelés de façon élastique comprennent des supports à ressort (16) pour les moyens de liaison (12) permettant aux moyens formant liaisons (12) de défléchir et de passer verticalement dans les moyens formant canaux (11) alors que les moyens formant liaisons (12) sont abaissés, et de revenir élastiquement sous un épaulement des moyens formant canaux (11) pour empêcher le mouvement de retour.
3. Mécanisme selon la revendication 2, dans lequel les moyens de liaison comprennent une paire de brides tournées vers l'extérieur (17) sur les bords inférieurs des supports à ressort (16), et les moyens formant canaux (11) comprennent une paire d'éléments de canal fixés sur l'extérieur des modules de sorte que les brides viennent en prise sous les épaulements des éléments de canal lorsque les moyens de liaison sont abaissés dans l'espace entre les modules de construction adjacents.
4. Mécanisme selon la revendication 3, dans lequel les

supports à ressort dépendent d'une plaque de base (13) qui est suffisamment large pour couvrir l'espace entre les modules adjacents et qui, dans la pratique, est fixée aux parties supérieures des modules de construction pour empêcher leur mouvement relatif dans le plan horizontal.

5. Mécanisme selon la revendication 4, dans lequel une autre paire de supports à ressort (14) s'étend vers le haut depuis la plaque de base (13) pour se terminer dans des brides dirigées vers l'extérieur (15) pour venir en prise sur les parties supérieures d'une autre paire d'éléments de canal (11) fixés sur l'extérieur des modules alors que la couche suivante de modules est déplacée en position pour former l'étage suivant du bâtiment.
6. Mécanisme selon la revendication 1, dans lequel les moyens de liaison comprennent un élément de broche à double tête (27) s'étendant transversalement dans l'espace entre des modules de construction adjacents et supporté par une barre d'insert (29) sur laquelle l'élément de broche (27) peut être abaissé dans ledit espace ; et chaque moyen formant canal est un élément de canal sur la paroi extérieure de chaque module de construction comprenant un canal de guidage (21) pour guider une partie d'extrémité de l'élément de broche (27) alors que les têtes de l'élément de broche (27) viennent en prise avec les moyens formant canaux mutuellement alignés pour les verrouiller les uns aux autres.
7. Mécanisme selon la revendication 6, dans lequel les moyens élastiques sont un élément de ressort (26) qui comprend une ouverture (28) dans laquelle une extrémité de la broche (27) peut être reçue, de sorte que l'abaissement des moyens de liaison dans l'espace entre les modules de construction entraîne la déflexion de l'élément de ressort (26) jusqu'à ce que l'extrémité de la broche (27) soit reçue dans l'ouverture, moyennant quoi l'élément de ressort (26) fait ressort pour retenir l'élément de broche (27).
8. Procédé de construction d'un bâtiment à partir de plusieurs unités de construction modulaires de la taille d'une pièce, comprenant les étapes consistant à relier les unes aux autres des unités de construction modulaires adjacentes en utilisant un mécanisme selon l'une quelconque des revendications précédentes, et à fixer sur les jonctions horizontales entre les parties supérieures des unités de construction modulaires adjacentes une tôle dans laquelle est formée une gouttière pour conduire l'eau de pluie ou la condensation depuis la partie supérieure de chaque étage d'unités de construction modulaires dans le bâtiment vers l'extérieur du bâtiment.

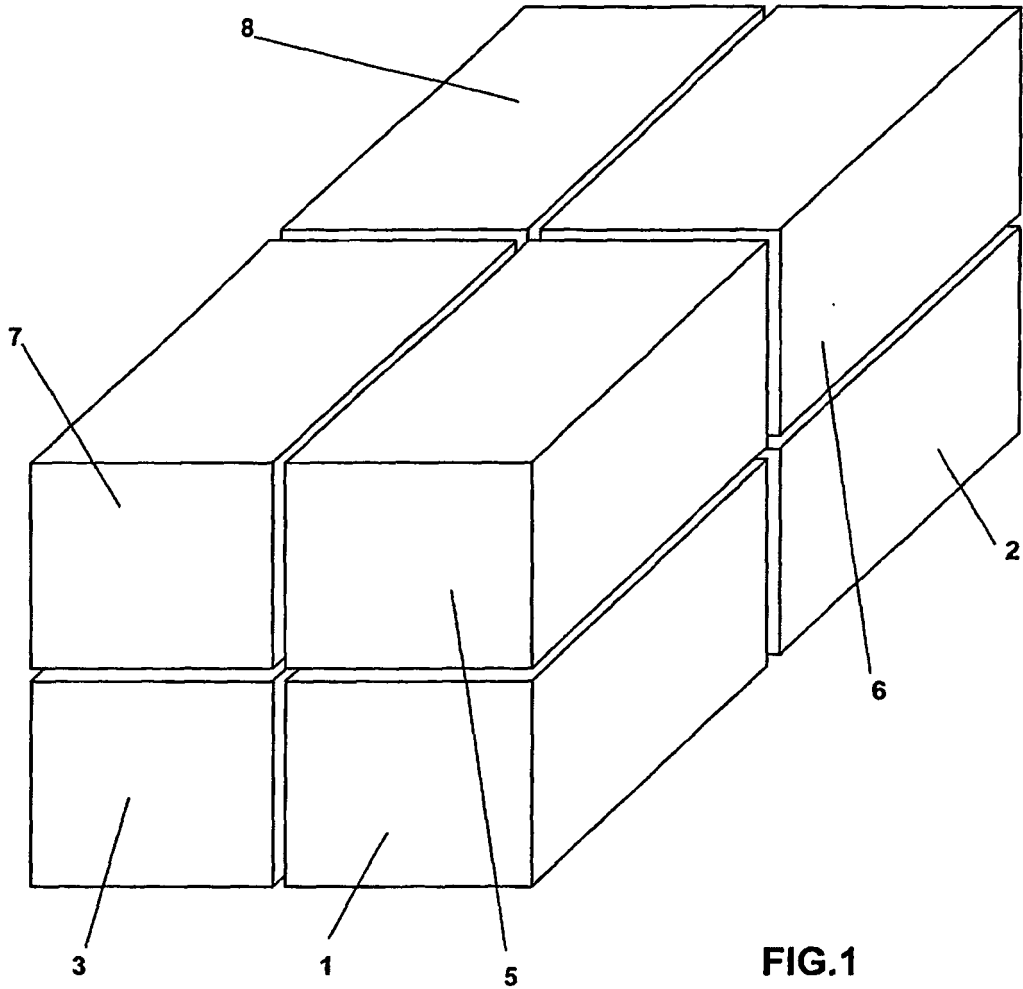


FIG.1

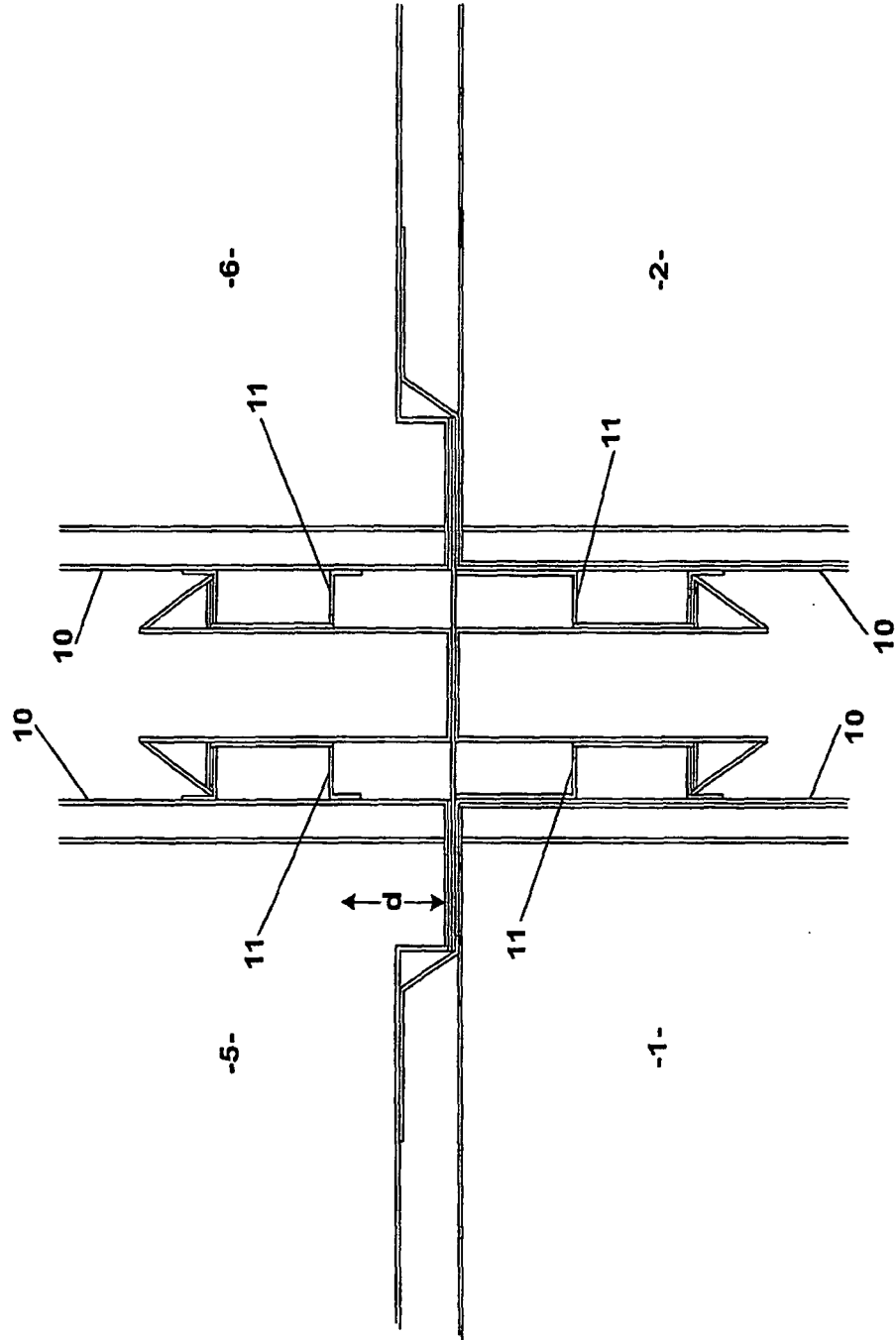


FIG.2

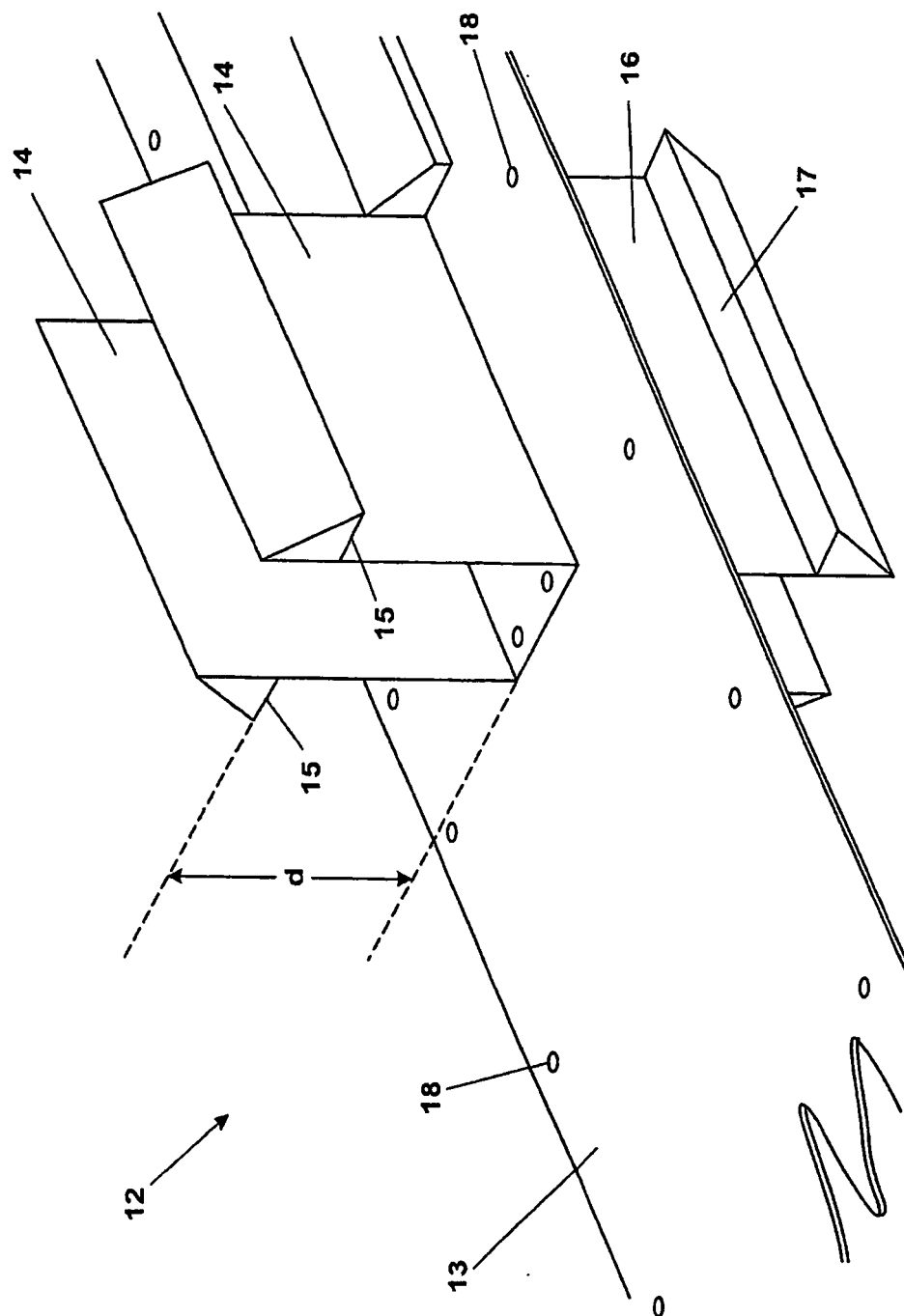


FIG.3

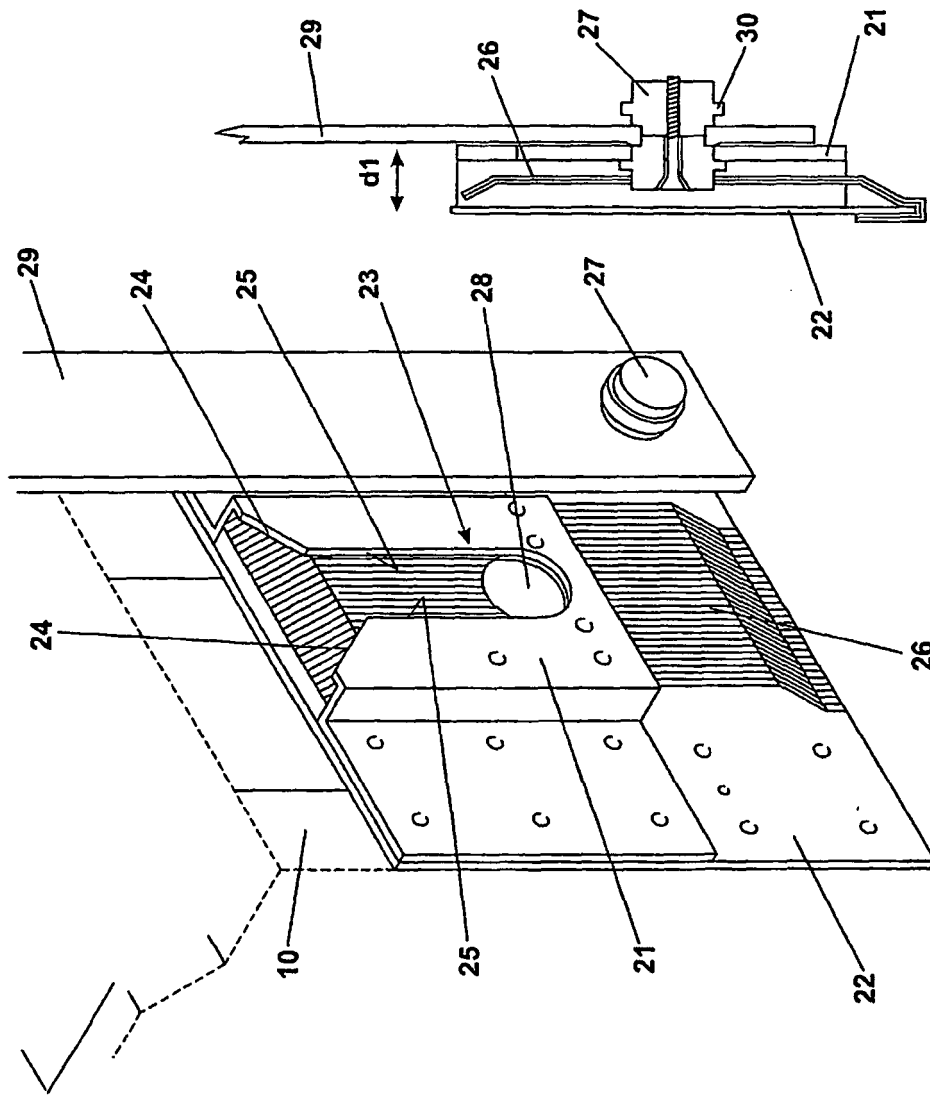


FIG.4

FIG.5

REFERENCES CITED IN THE DESCRIPTION

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