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(71) Applicant: **Pujol Barcons, Salvador**
11408 Jerez de la Frontera (Cádiz) (ES)

(72) Inventor: **Pujol Barcons, Salvador**
11408 Jerez de la Frontera (Cádiz) (ES)

(74) Representative: **Espiell Volart, Eduardo Maria**
R. Volart Pons y Cia. S.L.
Pau Claris, 77, 2.o, 1.a
08010 Barcelona (ES)

(54) HIGH-PRECISION INTEGRAL MODULAR FORMWORK SYSTEM FOR THE CONSTRUCTION OF MONOLITHIC REINFORCED-CONCRETE STRUCTURES

(57) The system comprises: -formwork panels (1a, 1b, 1c, 1d, 1e, 1f and 1g) provided with an inner surface (2) that extends peripherally in the form of a perimeter flange (3) provided with holes (4) for the mounting of connection means, and which , together with the inner surface (2), forms a structure in the manner of a hollow box, that is open towards the exterior side and that , internally, has a frame of longitudinal and transverse reinforcements (5) constituted by folded plates, means for securing the successive formwork panels for forming a concreting mould and means for securing reinforcements inside the formwork.

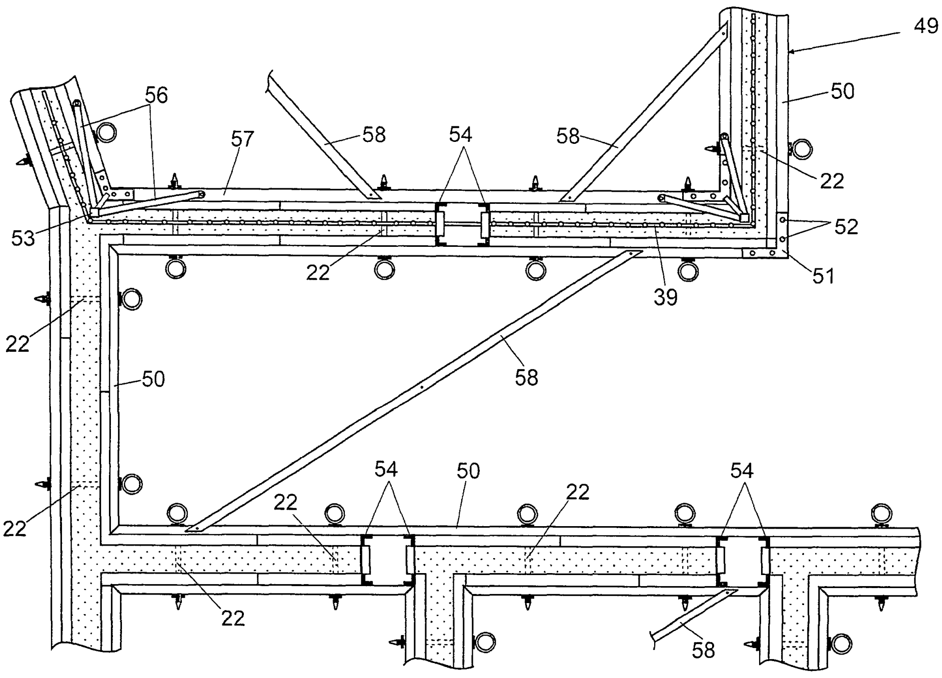

Fig. 47

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Description

OBJECT OF THE INVENTION

[0001] The present invention relates to a high-precision modular and integral formwork system for the construction of monolithic reinforced-concrete structures, of the type comprising: formwork panels, means for fixing the successive formwork panels for forming a concrete pouring moulds with a precision to the order of tenths of millimeters and framework fixing means inside the mould.

BACKGROUND OF THE INVENTION

[0002] Among manual formwork systems, we must highlight the previous existence of diverse patents belonging to the same applicant wherein the formwork system is based on the use of formwork panels that are positioned with the adequate separation and fixed by coupling means for the purpose of forming moulds for pouring a monolithic reinforced-concrete structure.

[0003] Specifically, Spanish invention patent of invention 9401135 (ES2120298B1) discloses enhancements to high-precision modular and integral formwork systems for the construction of reinforced-concrete structures: wherein said enhancements envisage the use of modular formwork panels having a face with integrated reticular reinforcements and perforated peripheral profiles for quickly establishing fixing elements such as cone-shaped spacers and self-centring staples, for forming, moulds or forms using said panels.

[0004] The enhancements in the aforementioned patent also envisage the use of complementary stabilisation and reinforcement parts, allowing the positioning of metal reinforcement frameworks and insulating material plates which are incorporated to the concrete mass that is poured and set inside the formwork.

[0005] Although the formwork system that is the object of the aforementioned Spanish patent of invention 9401135 (ES2120298B1) perfectly fulfils the objective for which it was designed, it has a complex assembly and installation process, especially in terms of correctly positioning the formwork panels in order to obtain high precision and consequently minimum tolerances in the construction of monolithic concrete structures.

[0006] Another reference worth mentioning is Spanish patent of invention P200202648 (ES2281212B1) belonging to the same inventor, filed on 18 November 2002, by SISTEMAS INDUSTRIALIZADOS BARCONS S.L. Said patent discloses enhancements to construction systems that use reinforced concrete or other materials using high-precision modular and integral formwork. The enhancements in this patent have construction peculiarities aimed at optimising handling of high-precision integral formwork based on the use of formwork panels and parts for coupling and fastening said panels, forming moulds or formwork for concrete pouring, thereby allowing industrialised building construction.

[0007] The enhancements in the aforementioned Spanish patent of invention P200202648 (ES2281212B1) are mainly focused on the use of a high-precision mould for making the foundation slab and on the use of wall templates for redefining partitions and enclosures with all of its installations.

[0008] Said enhancements also mainly envisage the use of improved means for the construction of details such as wall overlaps and the use of special tools for handling of panels and other constituent elements, in addition to the use of new types of specific-use panels, for example for use of blind boxes or similar.

[0009] The construction system for reinforced-concrete structures that is the object of the aforementioned Spanish patent P200202648 (ES2281212B1) basically uses panels practically identical to those used in Spanish patent 9401135 (ES2120298B1) mentioned earlier, said formwork panels comprising in both cases a surface or plate that forms the inner face of the panel, a profile or peripheral flange having orifices for assembling coupling elements and an outer reinforcement framework for rigidisation thereof and which maintains the dimensional stability of the formwork panels with high precision.

[0010] However, these rear frameworks, formed by means of solid rails, have a high manufacturing cost and a low panel weight/resistance ratio, which complicates handling thereof and limits the acceptable dimensions of the panels, which can reach dimensions of 100 x 50 cm. The weight of the formwork panels and possible impacts against the ground frequently determine the considerable deformation and deterioration thereof, especially taking into account that the formwork system has been designed to obtain high precision. During pouring, the concrete usually accesses the lower zone of the cavity or outer side of the formwork panels, setting inside these, which hampers subsequent cleaning and increases total panel weight.

[0011] On the other hand, the low resistance of these panels requires the use of a large number of spacing ties in order to guarantee mould stability. In practice, four spacing ties per square metre of panel are used.

[0012] Another drawback of the construction system that is the object of the aforementioned Spanish patent 200202648 (ES2281212B1) is that, given the large number of spacing ties to be used, the formwork panel had peripheral recesses for the passage of said spacing ties, which considerably complicated the use of panels of different sizes for forming formwork, taking into account that said spacing ties had to be positioned in the expansion joints of the formwork panels.

[0013] The aforementioned patent envisaged the use of a large number of accessory parts such as wedges, squares, screws, coupling staples or self-centring pins to stabilise the formwork moulds, entailing the use of a large number of screwing elements and a considerable amount of time for formwork assembly.

[0014] Said patent also envisaged the use of templates to correctly distribute the formwork panels and other construction elements such as installations of all kinds, in accordance with the floor geometry of the construction to be carried out. These redefinition and wall templates required a large number of anchorings and auxiliary parts for the correct fixing thereof, considerably complicating onsite assembly.

[0015] The aforementioned Spanish patent 200202648 has a system for installing the insulation and pouring the concrete wall at one time, but in practice does not fulfil construction regulations due to several problems that arise at the time of concrete pouring, the most important being decentring and breaking of the insulation plates due to the high pressure exerted by the concrete upon unbalancing of the level of both sides of the plate during the concrete pouring process.

DESCRIPTION OF THE INVENTION

[0016] The high-precision modular and integral formwork system for the construction of monolithic reinforced-concrete structures that is the object of the present invention, being of the aforementioned type, i.e. those based on the use of high-precision formwork panels, means for fastening the successive formwork panels for forming a concrete pouring mould and means for fixing the moulds formed by the formwork panels, having a series of construction peculiarities primarily aimed at providing said formwork panels with a structure that significantly simplifies manufacture thereof and considerably increases the panel resistance/weight ratio, allowing the manufacture of panels of substantially larger dimensions and, consequently, a considerable reduction in unions and labour required for formwork assembly.

[0017] Another objective of the invention is the definition of specific configurations in the formwork panels themselves, such as: wedge-shaped ends to facilitate disassembly of the formwork subsequent to concrete pouring or lateral extensions at right angles for defining corners by means of a single panel, considerably reducing the number of accessory parts required to carry out these formwork removal and corner definition definitions.

[0018] Another objective of the invention is the use of means for coupling together the formwork panels that allow absorption of the additional thickness formed by the concrete adhered to the peripheral flanges of the formwork panels, which represents a serious problem when using self-centring staples dimensioned so as to only embrace the two peripheral flanges of the annexed formwork panels, and to maintain a pressure on the panels during the action of said coupling means, preventing said union from loosening, for example due to the vibrations transmitted to the panels during concrete pouring or vibration.

[0019] Obviously, use of these coupling means, equipped with pressure means, substantially improves panel union, where said coupling means may be formed by pressure levers or tightening rods, depending on the frequency with which the formwork panels will be assembled and disassembled.

[0020] Another characteristic of this mould system is the incorporation of formwork panels having a curved configuration with different curvature radii, which satisfactorily resolve multiple curved architectures, with the aforementioned references that only used flat formwork panels.

[0021] The formwork system that is the object of the invention also comprises, for fastening formwork panels, non-telescopic struts formed by two end sections having two portions at their opposed ends, threaded in opposite directions for coupling an intermediate part, the rotation of which determines an increase or decrease in total strut length.

[0022] The construction of this type of strut is much simpler than that of telescopic struts and has an especially effective and fast assembly.

[0023] Another characteristic of the formwork system of the present invention is that the marking and redefinition templates are eliminated, in addition to the wall templates disclosed in the aforementioned Spanish patent of invention 200202648 (ES2281212B1), the assembly and disassembly of which was especially complex on requiring a high number of accessories for fixing thereof, in addition to a high manufacturing cost. These marking and redefinition templates have been substituted for an alignment device formed by independent joists with the triple function of positioning the walls, aligning these and supporting the pressure of the formwork panels during the concrete pouring process. Corner blocks having pivots for coupling and fixing the joists at a specific angle, which considerably simplifies assembly and disassembly of said joists, joist fastening ties for maintaining their squared attitude and the position of the walls during assembly of the mould and wall spacers for maintaining required wall thickness and forming the template.

[0024] Additionally, the aforementioned joists have other noteworthy characteristics, such as poles for centring the frameworks and installations inside the moulds, the incorporation of welded squares to delimit the exact measurements of the doors or openings, and instructions relative to the height and situation of the different elements to be assembled, such as frameworks, installations or centring pole fastening ties, all of which substitutes the complicated wall templates expounded in prior Spanish patent 200202648, with the consequent savings in mould assembly and manufacturing costs.

[0025] Another characteristic of the invention focuses on a series of elements such as folded abutments and unfolded abutments of different lengths for fastening frameworks inside the moulds during construction of double walls using formwork and successive concrete pours, said abutments establishing the union of the two concrete pours of the double wall. This system also comprises fixers for fixing thermal insulation plates inside the aforementioned double walls: said fixers having the adequate configuration to maintain the plates centred in place.

[0026] This system perfectly fulfils the thermal and acoustic regulations in force for the construction industry.

[0027] These and other characteristics of the invention, included in the claims, will be better understood by observing the example of embodiment shown in the figures attached hereto and which are listed below.

DESCRIPTION OF THE FIGURES

[0028] For the purpose of complementing this description and helping to better understand the characteristics of the invention, a set of drawings accompanies this specification wherein the following has been represented in an illustrative and non-limiting manner:

Fig. 1 shows an elevational view of an example of embodiment of a basic formwork panel;
Fig. 2 shows a partial profile view of the formwork panel of figure 1 divided along a vertical plane;
Fig. 3 shows a partial plan view of the formwork panel of figure 1;
Fig. 4 shows an elevational view of an example of embodiment of a formwork panel equipped with formwork removal wedges or bevels on two of its ends;
Fig. 5 shows a partial profile view of the formwork panel of figure 4;
Fig. 6 shows an upper plan view of the formwork panel of figure 4;
Fig. 7 shows an elevational view of an example of embodiment of a formwork panel equipped with a lower cover;
Fig. 8 shows a profile view of the formwork panel of figure 7 divided along a vertical plane and wherein the lower cover can be observed;
Fig. 9 shows an elevational view of a formwork panel equipped with extensions which extend out into squares on two of its sides, wherein one of said squares being laterally closed by a blind cover;
Fig. 10 shows a profile view of the formwork of figure 9;
Fig. 11 shows a profile view of the panel of figure 9 seen from the side equipped with a blind cover;
Fig. 12 shows a front view of a formwork panel wherein one of its ends extends out into a square;
Fig. 13 shows a profile view of the panel of figure 12;
Fig. 14 shows an elevational view of a formwork panel wherein one of its ends extends out into a square and an adjacent end has a front closing cover;
Fig. 15 shows a profile view of the formwork panel of figure 14;
Fig. 16 shows an elevational view of a curved formwork panel;
Fig. 17 shows a plan view of the formwork panel of figure 16;
Fig. 18 shows an elevational view of an example of embodiment of an overlap panel;
Fig. 19 shows a profile view of the overlap panel of figure 18 wherein the lateral wedge or shim of said overlap panel can be observed;
Fig. 20 shows an elevational view of an example of embodiment of one of the coupling levers of the formwork panels;
Fig. 21 shows an elevational view of an example of embodiment of a formwork panel coupling screw with the nut disassembled;
Fig. 22 shows a rear view of the coupling screw of figure 21, wherein the anti-rotation washer of said coupling screw can be observed;
Fig. 23 shows an elevational view of an example of embodiment of the spacing ties, with the tightening nut disassembled;
Fig. 24 shows an elevational view of a coupling lever and a coupling screw in use position, fixing together two adjacent formwork panels;
Fig. 25 shows an enlarged detail of the union of the two formwork panels joined together by a coupling lever;
Fig. 26 shows a detailed profile view of figure 25 wherein we can observe the backstop lever in contact, without possibility of rotation, with one of the panels to be coupled;
Fig. 27 shows a detailed profile view of figure 25 wherein we can observe the coupling lever during assembly thereof through the opposing orifices of the panels to be coupled together;
Fig. 28 shows a similar view to that of figure 27, with the lever rotated a quarter of a turn, in the coupling position of the formwork panels;
Fig. 29 shows an elevational view of an example of embodiment of a non-telescopic strut equipped with an intermediate thread- actuated part;
Fig. 30 shows a detail of an intermediate zone of the strut of figure 29, divided along a vertical plane, wherein we can observe the threaded assembly of the intermediate part at the opposing ends of the end sections of the strut;
Fig. 31 shows a schematic elevational view of an assembly wherein we can observe the strut of figure 29 and the overlap panel of figure 18 in their use position;
Fig. 32 shows a schematic view of an enlarged detail of figure 31, wherein we can observe the overlap panel being assembled on a concrete wall using tightening rods;
Fig. 33 shows a schematic view of formwork panels being assembled with the help of a hoisting trolley;
Fig. 34 shows a profile view of the hoisting trolley of the preceding figure;
Fig. 35 shows a rear elevational view of the hoisting trolley;
Fig. 36 shows an elevational view of an example of embodiment of a folded abutment used to fix

frameworks in the construction of thermally insulated double walls using the successive formwork and concrete pouring technique;

Fig. 37 shows an upper plan view of the folded abutment of figure 36;

Fig. 38 shows an elevational view of an example of embodiment of an unfolded abutment used to fix frameworks in the construction of thermally insulated double walls using the successive formwork and concrete pouring technique;

Fig. 39 shows an example of application of straight panels, panels with extensions which extend out into a square with formwork removal wedges and folded abutments for fastening frameworks during the first formwork for the construction of a thermally insulated double wall;

Fig. 40 shows a detail of the preceding figure, upon carrying out the first concrete pour of the double wall and wherein we can observe the fastening of a first framework by the folded abutments of figures 36 and 37;

Fig. 41 shows an example of application of the panels of the invention for fastening a second formwork in the embodiment of a double wall, and wherein we can observe the thermal insulation plates fixed to the first concrete pour by means of fixers assembled on the unfolded abutments for fastening the second frameworks;

Fig. 42 shows a front view of the insulation plates of the preceding figure, fixed by means of fixers;

Fig. 43 shows an enlarged elevational view of one of the thermal insulation plate fixers;

Fig. 44 shows an enlarged profile view of a detail of the intermediate zone of one of the fixers assembled on an unfolded abutment and fixing one of the thermal insulation plates, wherein we can observe the action of the oblique flanges of the fixer against the abutment;

Fig. 45 shows a schematic elevational view of a formwork and the inner framework, wherein we can observe the layout without interference of said framework and of the transverse formwork fixing elements, such as spacing ties;

Fig. 46 shows a floor plan of a construction to be carried out using the formwork of the invention, wherein a zone "A" has been referenced, the enlarged detail of which has been represented in figure 47;

Fig. 47 shows the layout of a device for aligning and supporting the formwork panels in zone "A" indicated in the preceding figure. In this figure we can observe the layout of the formwork panel alignment joists, the centring corner blocks for coupling and fixing the joists at a specific angle, the joist spacing ties and the framework and installation centring poles that form the alignment and support device;

Fig. 48 shows an elevational view of a framework centring pole in its use position, fixed by means of centring corner blocks and ties that can be folded to the joists of the device for aligning and supporting the formwork panels;

Fig. 49 corresponds to an upper plan view of figure 48 without the framework;

Fig. 50 shows a lower plan view of an example of embodiment of a centring corner block; and

Fig. 51 shows an elevational view of the central corner block of figure 50, wherein we can observe the pivots for coupling to the formwork panel alignment joists.

PREFERRED EMBODIMENT OF THE INVENTION

[0029] In figures 1 to 17 we can observe different embodiments of the formwork panels referenced as (1a, 1b, 1c, 1d, 1e, 1f and 1g) for differentiation thereof.

[0030] In general, said formwork panels have an inner surface (2) that extends peripherally towards the outer side in a peripheral flange (3) having an alignment of orifices (4) that extend longitudinally for assembly of the coupling means of the successive formwork panels during forming of a concrete pouring mould and the construction of monolithic structures.

[0031] The inner surface (2) of the formwork panels (1 a, 1b, 1 c, 1 d, 1 e, 1 f and 1g) define, together with the peripheral flange (3), a structure in the manner of a hollow box that is open towards the outer side and has a framework of longitudinal and transverse reinforcements (5).

[0032] In the different formwork panels (1a... 1g) the reinforcements (5) consist of folded metal sheets of small thickness, having an omega-shaped cross-section, the wings (6) of which are welded to the inner surface (2) of the panel, and the centre (7) of which has a decreasing cross-section towards the outer side of the panel.

[0033] This constitution and configuration of the reinforcements (5) gives high resistance and dimensional stability to the different formwork panels, which also have a high resistance/weight ratio, allowing the manufacture and use of formwork panels with dimensions in the order of 300 x 75 cm.

[0034] The use of these types of reinforcements (5) significantly reduces the number of spacing ties required per square metre of formwork panel, which can be reduced to a single spacing tie per square metre of formwork panel.

[0035] Another peculiarity of this formwork system is that the spacing ties, which are described in detail later in the text, do not have a specific positioning point in the panel, allowing the assembly of formwork panels of different sizes on the walls without need to previously observe the attachment point of a panel with respect to that of the opposite panel.

[0036] In the previously described general configuration, some of the formwork panels have characteristics aimed at facilitating and simplifying use thereof in the formwork system.

[0037] Specifically, in figures 4 to 6 we can observe formwork panels (1b) wherein the peripheral flange corresponding to at least one of the ends defines an angle other than 90° with the inner surface (2), defining a wedge-shaped (8) configuration in the aforementioned formwork panel (1b) ends destined for facilitating formwork removal.

[0038] In the example of embodiment shown in figures 7 and 8 we can observe formwork panels (1 c) having a cover (9) on their lower end which externally closes the cavity delimited between the peripheral flange (3) and the reinforcements (5) next to said peripheral flange.

[0039] The incorporation of this cover (9) in the formwork panels (1c) significantly increases panel resistance against blows, especially when in contact with the ground and, additionally, prevents concrete from accumulating in its interior, unnecessarily increasing the weight of the formwork panel with the set concrete.

[0040] The formwork panels (1d) represented in figures 9 to 11 have the peculiarity of extending out by one of their ends into a square (10) that frontally ends in a flange (3) having an alignment of orifices (4) that extend longitudinally, as in the rest of the peripheral flanges (3), and by an adjacent side in a similar square (10) laterally closed by a blind cover, as shown in figure 11. The orifices (4) allow coupling of the panels (1d) to successive formwork panels (1a,..., 1g), said formwork panels (1d) forming a corner of the concrete pouring mould.

[0041] Use of these formwork panels (1 d) considerably simplifies the configuration of the corners of the construction, which are defined by a single panel, without need to use the additional parts for forming said corners.

[0042] In the case of the formwork panels (1 e) represented in figures 12 and 13, only one of the ends extends out into a square (10).

[0043] In the case of figures 14 and 15, the panel (1f) has, in addition to the square (10), a cover (9) similar to that of the panels (1c).

[0044] Figures 16 and 17 show a formwork panel (1g) with the peculiarity of having a curved configuration and can be manufactured with different curvature radii, said formwork panel (1g) being especially interesting for resolving architectures with rounded configurations.

[0045] The formwork panels are coupled and fixed together by fastening means which can be used optionally or combined, depending on the needs of each mould.

[0046] One of these fastening means consists of coupling levers, represented in figure 20, having a rod (12) with a cone-shaped end having a helical pin (13) on its front zone and a backstop (14) on its rear zone for retaining the flexed washers (15) that maintain the pressure in the union of the formwork panels (1a... 1g) and an oblique actuation handle (16).

[0047] The aforementioned helical pin (13) has the adequate dimensions for being introduced in a specific position in the orifices (4) of the peripheral flanges (3) of the formwork panels, mutually opposed as shown in figure 27, tightening these by rotating the coupling lever (11) approximately a quarter of a turn, as shown in figure 28.

[0048] One of the main characteristics of these coupling levers is the incorporation of the flexed washers (15), which absorb the differences in thickness defined by the concrete adhered to the formwork panels and exert pressure on the union, preventing it from loosening, for example due to vibration.

[0049] These coupling levers are especially indicated for coupling together formwork panels (1 a... 1g) that are frequently assembled and disassembled.

[0050] Figures 21 and 22 represent alternative formwork panel fastening means, consisting of a coupling screw (17) having a thread (18) on its front zone for mounting a tightening nut (19) and, on its rear zone, an anti-rotation washer (20) and pressure washer (21).

[0051] Said pressure washer (21) has the same purpose as the flexed washers (15) of the coupling levers (11), allowing absorption of the differences in thickness of the union due to the adherence of concrete and exerting pressure on said union.

[0052] The anti-rotation washer (20) has, as can be observed in the attached figures, a polygonal configuration, in this specific case square, allowing it to laterally come into contact with the inner surface (2) of one of the formwork panels to be coupled together, avoiding rotation of the coupling screw (17) during actuation of the tightening nut (19).

[0053] Additional means for fastening the formwork panels (1a... 1g) consist of spacing ties (22), represented in figure 23, which allow opposed fastening of the formwork panels during wall formation.

[0054] Said spacing ties (22) comprise: a screw (23) having a front thread (24) and a rear head (25), a tube or outer casing (26) of plastic material and a tightening nut (27) having a tilting actuation pin (28).

[0055] The outer tube or casing (26) is arranged externally mounted on the screw (23), protecting it from the concrete and simultaneously forming a spacer that guarantees a constant separation between the opposing formwork panels and which, consequently, determines the thickness of the wall to be built.

[0056] In turn, the tilting pin (28), associated to the tightening nut (27), on being arranged in a folded position, forms a retention against the formwork panel or against an alignment joist, avoiding undesired rotation of the tightening nut (27).

[0057] Additional means for fastening the formwork panels (1a... 1g) consist of overlap panels (1 h), represented in figures 18 and 19, which are fixed to a bearing surface by tightening rods (29) as can be observed in figures 31 and 32, said overlap panels (1 h) being formed by means for adjusting and aligning upper formwork panels (1 a... 1g) with respect to said lower bearing surface.

[0058] The overlap panels (1 h) have a configuration similar to that of the formwork panels (1a... 1g) and also have, at the lower end of the inner surface (2) thereof, a shim or wedge (30) that exerts a lever action on the overlap panel (1 h) on fixing said overlap panel (1 h) to a surface or wall by means of tightening rods (29).

[0059] These overlap panels (1 h) are used, for example, to adjust and align upper formwork panels (1 a... 1 g) with a lower concrete pour.

[0060] In this case, the overlap panel (1 h) is fixed to the lower concrete poured by means of tightening rods (29) in such a manner that it is levelled with said lower concrete pour, as can be observed in figures 31 and 32.

[0061] The formwork system of the invention comprises additional means for fastening the formwork panels (1a... 1g) consisting of struts (31) represented in figure 29, which are not telescopic but rather formed by two end sections (32, 33) having two portions (35) at the ends threaded in opposite directions for coupling the opposing ends (35) of an intermediate part (36), the rotation of which in either direction increases or decreases total strut length.

[0062] In figure 29 we can observe one of the struts (31) in its entirety and, in figure 30, a detail of the coupling zone of the intermediate part (36) with the threaded portions (34) of the end sections (32, 33) of the strut.

[0063] Arranging the intermediate part (36) on the central part of the strut (31) facilitates manual adjustment thereof and, on not being telescopic, is cheaper to manufacture and faster to manoeuvre.

[0064] In order to facilitate installation of the panels (1 a... 1 g), the system comprises extendable trestles (44), represented in figures 33, 34 and 35, for supporting the panels during positioning thereof. Said extendable trestles (44) have an upper support (44a) that can be oriented and raised.

[0065] As can be observed in figures 36 to 38, this formwork system comprises folded abutments (37) and the same abutment unfolded (38) especially indicated for fastening first and second frameworks (39, 40) inside the moulds formed by formwork panels (1 a... 1g) during the construction of double walls by means of successive formwork and concrete pours, said abutments (38) establishing coupling means for the successive concrete pours.

[0066] As can be observed in figures 36, 37, 39 and 40, the folded abutments (37) consist of a metal rod with two end portions (41) having a plurality of folds for the centred support thereof between first and second formwork panels, and an intermediate portion (42) having at least one curved configuration for fastening a first framework (39) in a centred position between said first and second formwork panels.

[0067] In turn, the unfolded abutments (38), represented in figure 38, have a hook (43) on one end for fastening a second framework (40) between first and second formwork panels, being fixed to the first framework (39) by its end portion (41), embedded in the wall formed during the first concrete pour, as can be observed in figure 41.

[0068] The formwork system comprises fixers (45), represented in figure 43, destined for assembly thereof on the end of the hook (43) of the unfolded abutments (38) as can be observed in figures 41, 42, and 44, in order to fix the thermal insulation plates (46) inside the double wall built by means of successive formwork and concrete pours.

[0069] These thermal insulation plate (46) fixers (45) have a cross-shaped configuration with a central orifice (47) for assembly thereof on an unfolded abutment (38) and oblique retention flanges (48) radially arranged with respect to the central orifice.

[0070] Said oblique flanges (48) allow the fixers (45) to advance over the respective unfolded abutments (38) in the direction of imprisonment of the thermal insulation plates (46) against the first concrete pour, impeding, however, displacement thereof in the opposite direction on actuating with its free end on the rod of the aforementioned unfolded abutment (38).

[0071] This formwork system additionally comprises a device (49) for aligning and supporting the formwork panels during assembly of the mould, represented in figure 47, said device (49) comprising: - independent joists (50) for aligning and supporting the pressure on the formwork panels, - centring corner blocks (51) having pivots (52) for coupling and fixing the joists (50) at a specific angle, - spacing ties (22) for separating the joists (50) during mould assembly, and - poles for centering (53) frameworks and installations inside the moulds defined by the formwork panels.

[0072] The aforementioned centring corner blocks (51) allow rapid coupling of the joists (50), which are arranged externally with respect to the formwork panels of a wall, guaranteeing its alignment and collaborating towards supporting the pressure to which the formwork panels are subject during concrete pouring.

[0073] The aforementioned (50) joists comprise, in the embodiment shown in figure 47, welded squares (54) for delimiting the spaces destined for forming doors or openings in the concrete construction.

[0074] The centring poles (53), represented in figures 48 and 49, are fixed to the centring corner blocks (51), said centring poles (53) having folding fastening ties (56) for coupling to the formwork panel alignment and support joists (50).

[0075] The aforementioned joists (50) have instructions (57) relative to the height and situation of the frameworks, installations and spacing ties in order to facilitate and avoid errors in the assembly of said elements. Tubular ties (58), represented in figure 47, are used for fixing and maintaining the device (39) at a right angle.

[0076] Finally, it must be mentioned that in order to assemble the spacing ties (22) without interference of the frameworks arranged inside the formwork, both the formwork panels and the overlap panels and panel alignment and support joists (50) have mechanised orifices depending on the position that must be adopted by the aforementioned spacing ties (22), in accordance with the formwork to be carried out.

[0077] Having sufficiently described the nature of the invention, in addition to a preferred example of embodiment, we hereby state for such purposes that may arise that the materials, shape, size and arrangement of the elements described herein may be modified, provided that it does not imply an alteration of the essential characteristics of the invention that are claimed hereinafter.

Claims

1. High-precision modular and integral formwork system for the construction of monolithic reinforced-concrete structures, of the type comprising: - formwork panels (1 a, 1 b, 1 c, 1 d, 1 e, 1 f and 1 g) having an inner surface (3) that peripherally extends towards the outer side of a peripheral flange (3) having at least one alignment of orifices (4) that extend longitudinally for assembling the coupling means and that forms, together with the inner surface (2), a structure in the manner of a hollow box, open towards the outer side and which has an inner framework of longitudinal and transverse reinforcements (5), - means for fastening the successive formwork panels for forming a concrete pouring mould, and - means for fastening the frameworks inside the formwork; **characterised in that** the reinforcements (5) of the framework panels (1a, 1b, 1c, 1d, 1e, 1f and 1g) consist of folded metal sheets having an omega-shaped cross-section, the wings (6) of which are welded to the inner plate (2) of the panel and the centre (7) of which has a variable cross-section towards the outer side of the panel.

2. Formwork system, according to claim 1, **characterised in that** the peripheral flange (3) corresponding to at least one of the ends of the formwork panels (1 b) defines an angle other than 90° with the inner surface (2) of said panels, defining a configuration in the manner of a formwork removal wedge (8) on said panel ends.

3. Formwork system, according to any of the preceding claims, **characterised in that** the formwork panels (1 c) have a cover (9) on at least one of their ends that externally closes the cavity or cavities delimited between the peripheral flange (3) corresponding to the end of said formwork panel (1 c) and the reinforcements (5) next to said peripheral flange.

4. Formwork system, according to any of the preceding claims, **characterised in that** at least one of the ends of the formwork panels (1d) extends out into a square (10) that ends frontally in a flange (3) having an alignment of orifices (4) that extend longitudinally for coupling with successive formwork panels, wherein said panels that extend out into a square (10) form a corner of the concrete pouring mould.

5. Formwork system, according to any of the preceding claims, **characterised in that** one of the ends of the formwork panels (1d) extends out into a square (10) ending frontally in a flange (3) having an alignment of orifices (4) that extend longitudinally, and by an adjacent side in a similar square (10) laterally closed by a blind cover.

6. Formwork system, according to any of the preceding claims, **characterised in that** only one end of the formwork panels (1e) extends out into a square (10).

7. Formwork system, according to any of claims 1 to 6, **characterised in that** the formwork panels (1g) have curved configurations with different curvature radii.

8. Formwork system, according to any of the preceding claims, **characterised in that** the formwork panel (1a... 1g) fastening means comprise coupling levers (11) having a rod (12) with a helical end that has a helical pin (13) on its front end and, on its rear end, a backstop (14) having flexed washers (15) that maintain the pressure on the union of the formwork panels and an oblique actuation handle (16).

9. Formwork system, according to any of claims 1 to 7, **characterised in that** the means for fastening formwork panels (1a... 1g) comprise a coupling screw (17) having a thread (18) on its front zone for assembling a tightening nut (19) and, on its front rear end, an anti-rotation washer (20) having a polygonal configuration and a pressure washer (21).

10. Formwork system, according to any of claims 1 to 7, **characterised in that** the means for fastening formwork panels comprise spacing ties (22) for the opposed fastening of formwork panels (1a, ..., 1g) during wall formation; said spacing ties (22) comprising: a screw (23) having a front thread (24) and a rear head (25), an outer tube or casing (26) of plastic material for maintaining the thickness of the wall and protecting the screw (23) from the concrete and a tightening nut (27) having a tilting actuation pin (28).

11. Formwork system, according to any of claims 1 to 7, **characterised in that** the means for fastening the formwork panels (1a, ..., 1g) comprise overlap panels (1 h) destined for fixing to a bearing surface by means of tightening rods (29), said overlap panels forming means for adjusting and aligning formwork panels (1a, ..., 1g) with respect to said lower bearing surface.

12. Formwork system, according to claim 11, **characterised in that** the overlap panels (1 h) have a configuration similar to that of the formwork panels and also have, in correspondence to the lower end of its inner surface (2), a shim or wedge (30) that acts as

a lever on the overlap panel (1 h) fixed by means of tightening rods (29).

13. Formwork system, according to any of claims 1 to 7, **characterised in that** the means for fastening the formwork panels (1a, ... , 1g) comprise (non-telescopic) struts (31) formed by two end sections (32, 33) having on their opposing ends two portions (35) threaded in opposite directions for coupling the opposite ends (35) of an intermediate part (36), the rotation of which in either direction causes an increase or decrease in total strut (31) length.

14. Formwork system, according to any of the preceding claims, **characterised in that** it comprises folded abutments (37) and unfolded abutments (38) for fastening first and second frameworks (39, 40) inside the moulds formed using formwork panels during construction of double walls using successive formwork and concrete pours, and the union of said successive concrete pours.

15. Formwork system, according to claim 14, **characterised in that** the folded abutments (37) consist of a metal rod having two end portions (41) with a plurality of folds for being arranged in a centred position between first and second formwork panels, and an intermediate portion (42) having at least one curved configuration for fastening a first framework (39) in a centred position between said first and second formwork panels.

16. Formwork system, according to claim 14, **characterised in that** the unfolded abutments (38) have a hooked end (43) for fastening a second framework (40) between first and third formwork panels, and an end portion (41) for fixing thereof to a first framework (39).

17. Formwork system, according to claim 16, **characterised in that** the unfolded abutments (38) have a hooked end (43) for fastening respective thermal insulation plate (46) fixers (45) inside double walls built using successive formwork and concrete pours.

18. Formwork system, according to claim 17, **characterised in that** the thermal insulation plate (46) fixers (45) have a cross-shaped configuration with a central orifice (47) for assembly of the unfolded abutment, and oblique retention flanges (48) radially arranged with respect to the central orifice (47).

19. Formwork system, according to any of the preceding claims, **characterised in that** it comprises a device (49) for aligning and supporting the formwork panels, said device (49) comprising: independent joists (50) for aligning and supporting the pressure of the formwork panels, centring corner blocks (51) having coupling pivots (52) for fixing the joists (50) at a specific angle, spacing ties (22) for separating the joists (50) during mould assembly and poles for centring (53) frameworks and installations inside the moulds defined by the formwork panels.

20. Formwork system, according to claim 19, **characterised in that** the joists (50) comprise welded squares (54) for delimiting the exact dimensions of the doors or openings.

21. Formwork system, according to claim 19, **characterised in that** the centring poles (53) are fixed to the corner blocks (51) and have folding fastening ties (56) for coupling to the joists (50) for aligning and supporting the formwork panels.

22. Formwork system, according to claim 11, **characterised in that** the joists (50) have instructions (57) relative to the height and situation of the frameworks, installations and spacing ties.

23. Formwork system, according to claim 19, **characterised in that** the device (49) for aligning and supporting the formwork panels comprises tubular ties (58) for fixing and retaining these in their assembly position.

24. Formwork system, according to any of the preceding claims, **characterised in that** the formwork panels (1a, ..., 1g), overlap panels (1h) and "template joists (50) have orifices conveniently distributed for assembly of the spacing ties (22), without interfering with the frameworks.

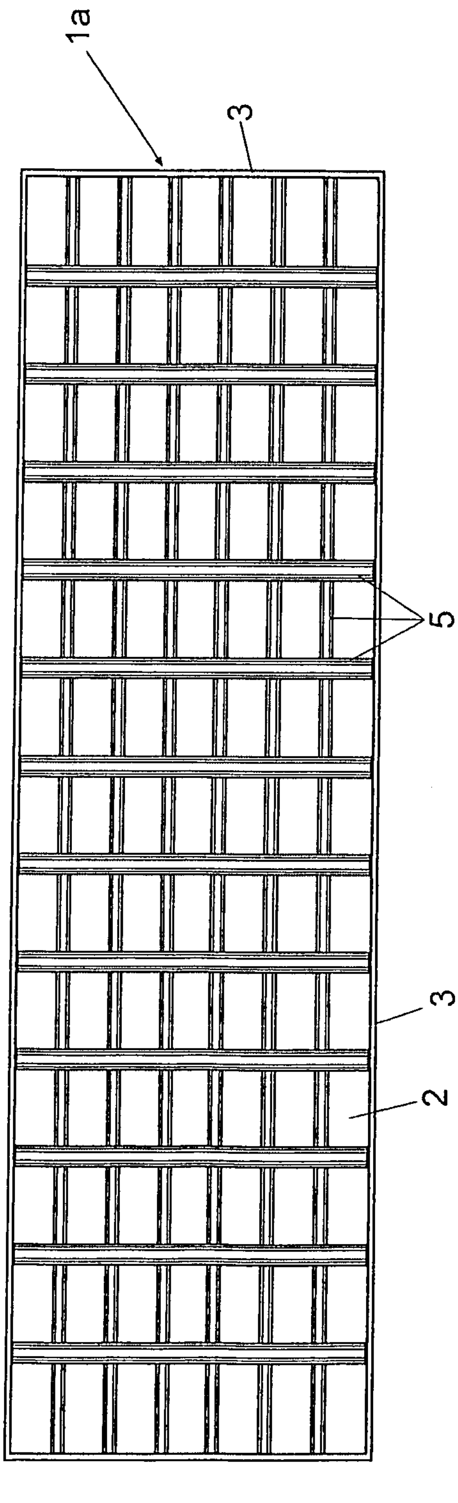


Fig. 1

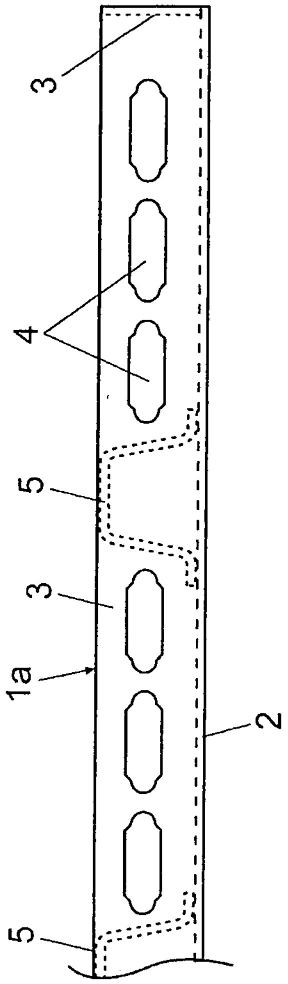


Fig. 3

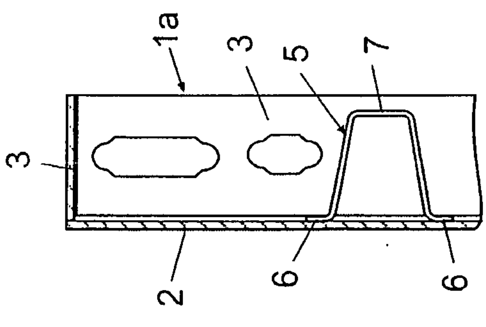


Fig. 2

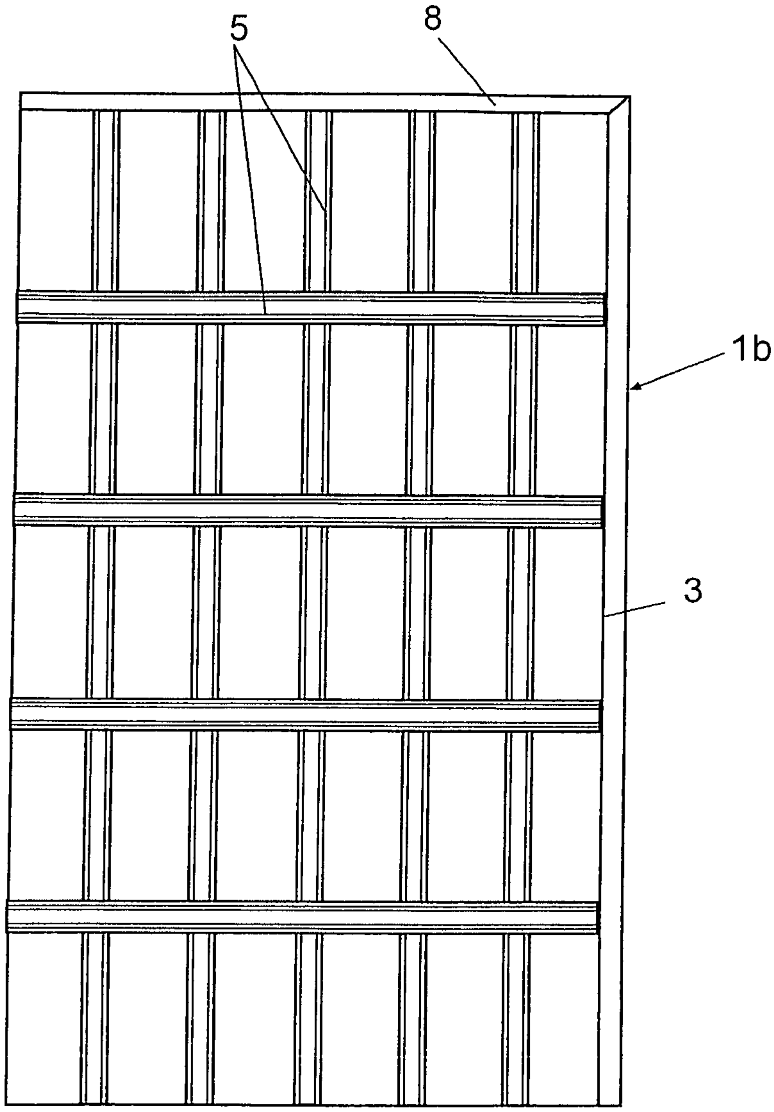


Fig. 4

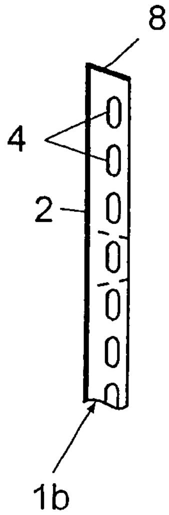


Fig. 5

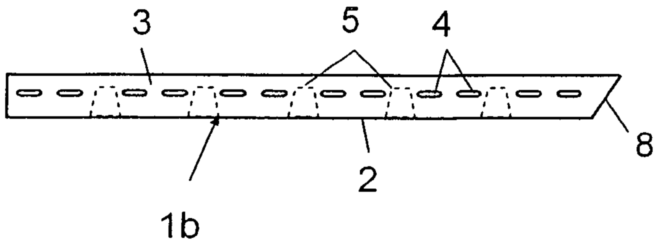
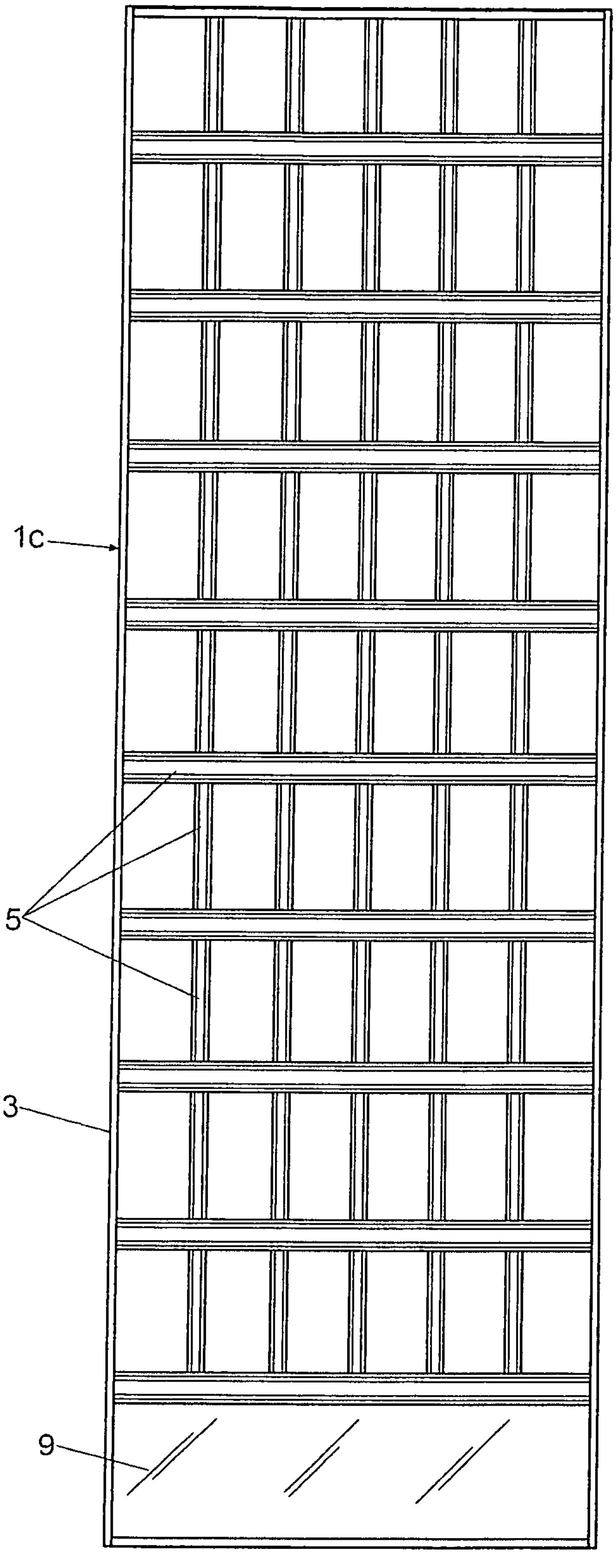


Fig. 6



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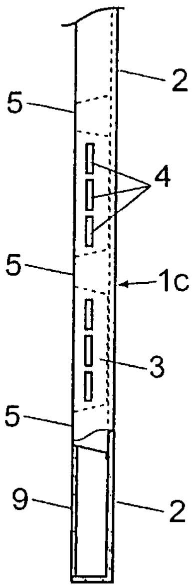

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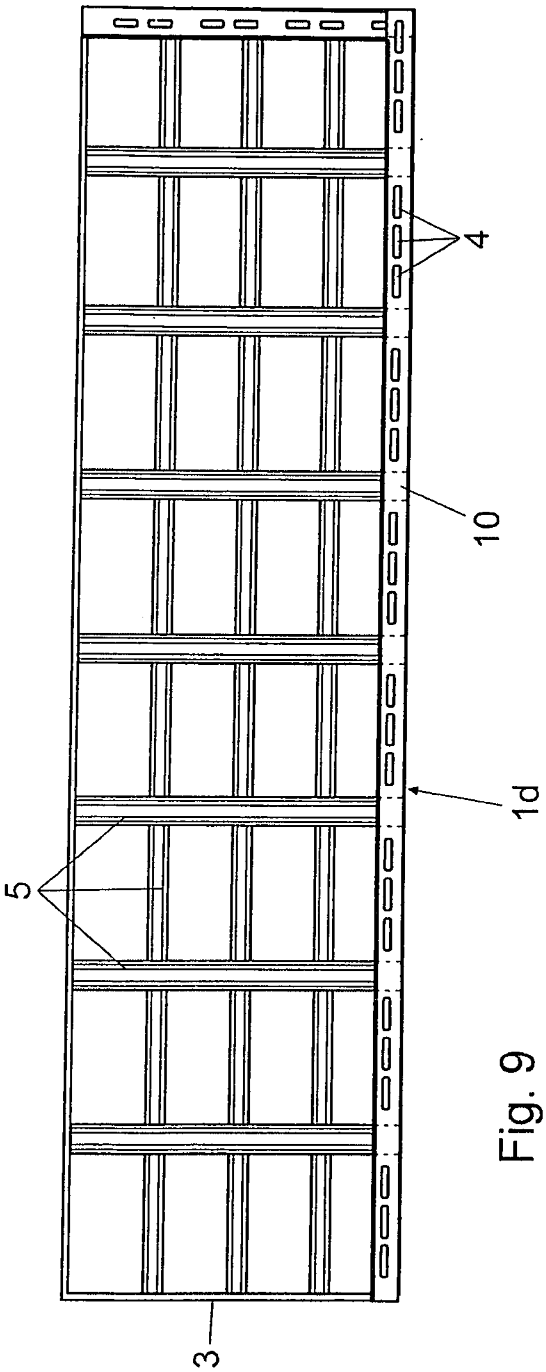

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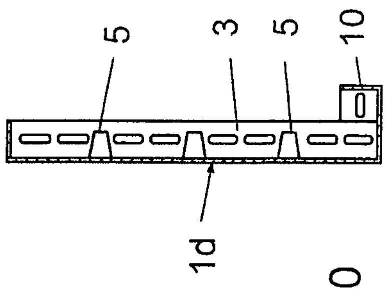


Fig. 10

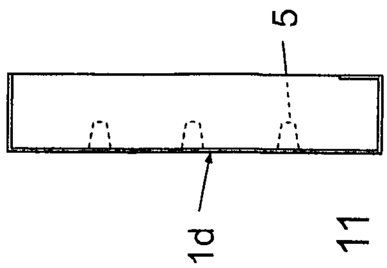


Fig. 11

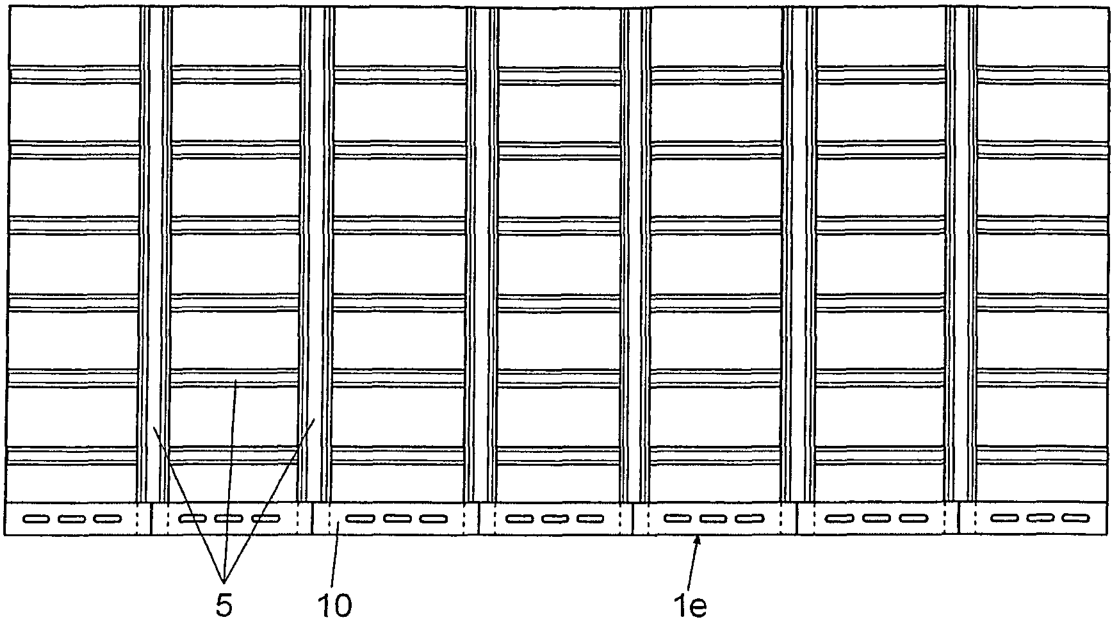


Fig. 12

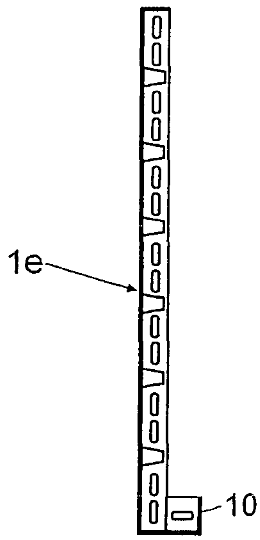


Fig. 13

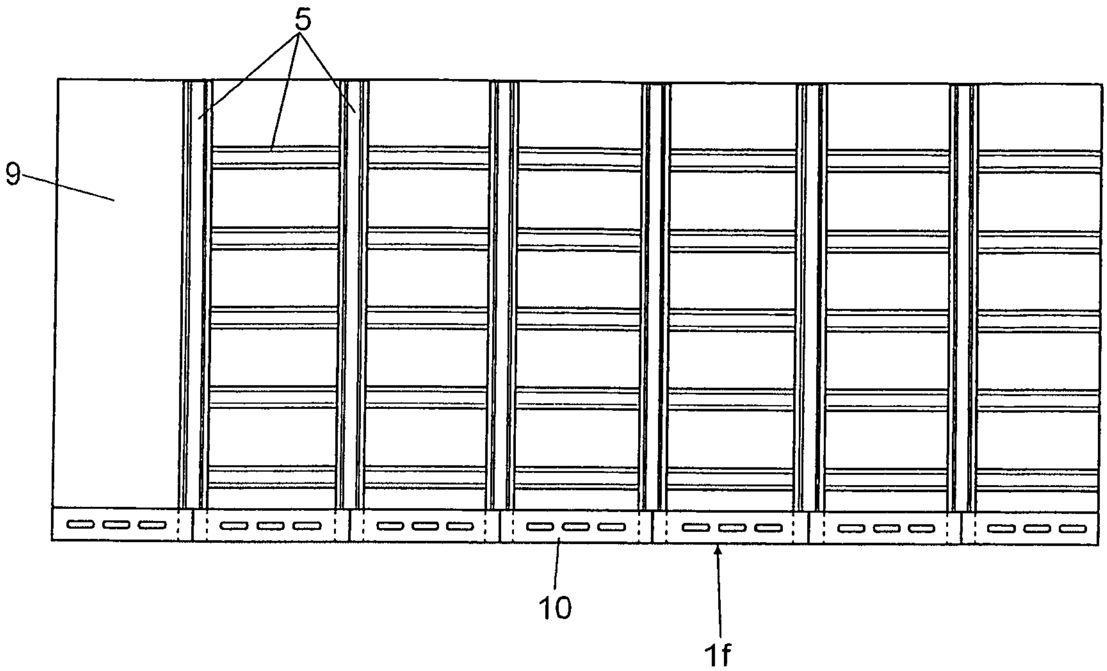
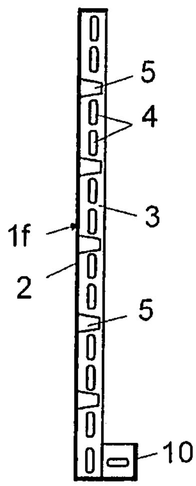


Fig. 14



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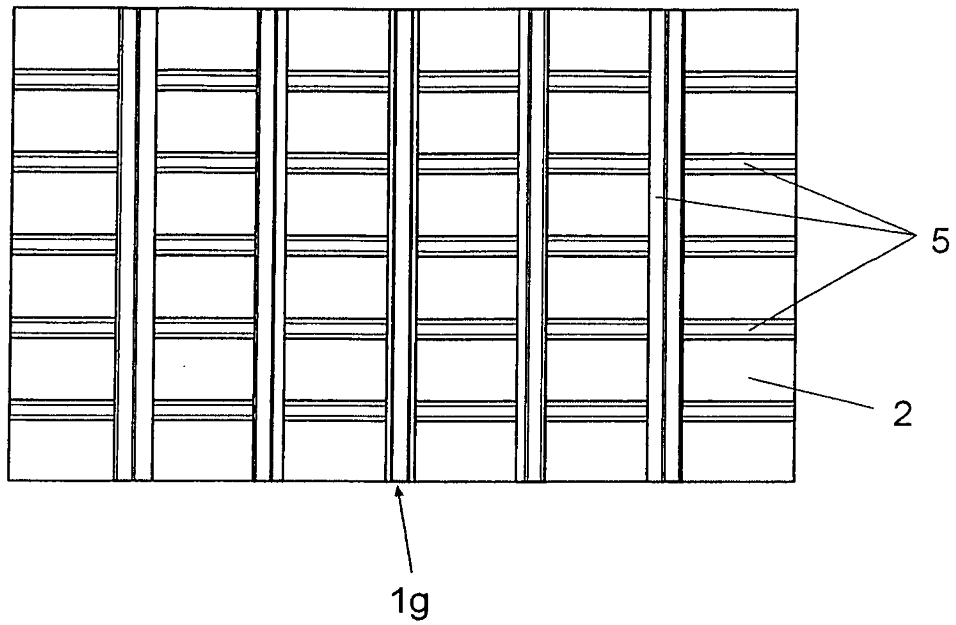


Fig. 16

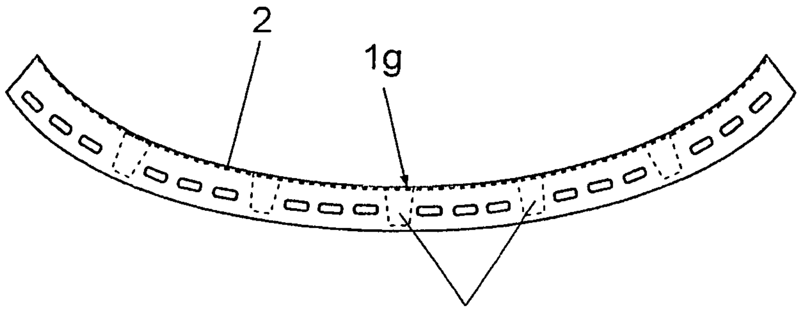


Fig. 17

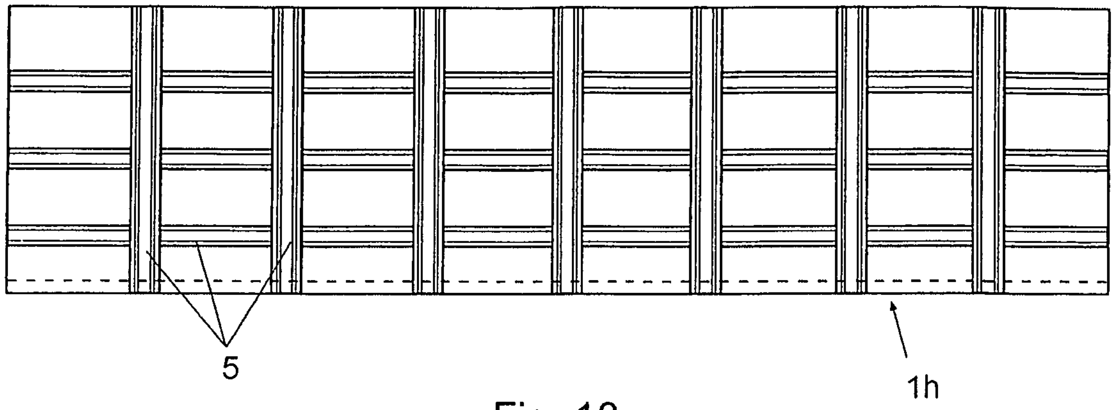


Fig. 18

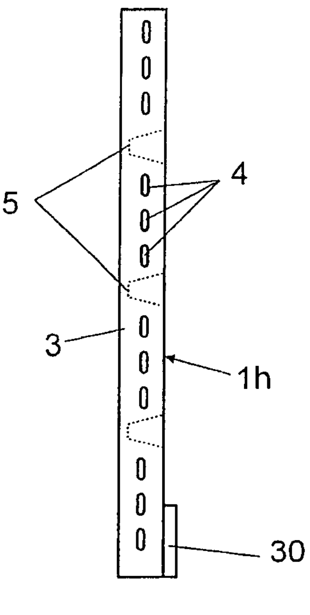


Fig. 19

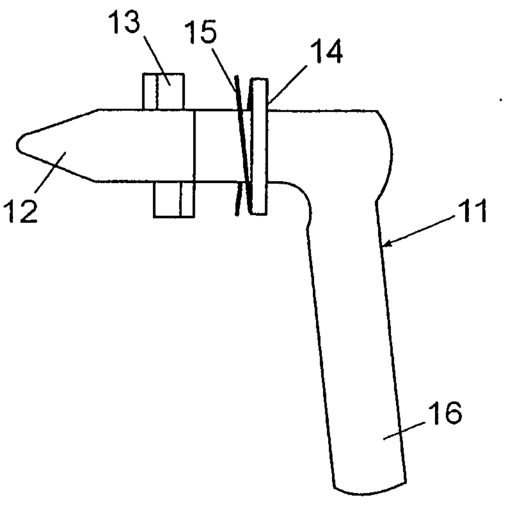
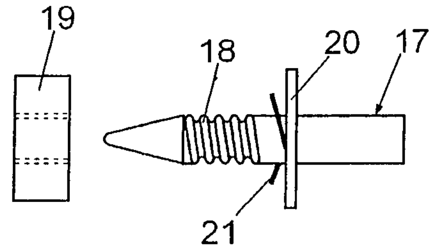


Fig. 20



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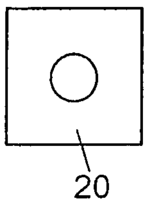

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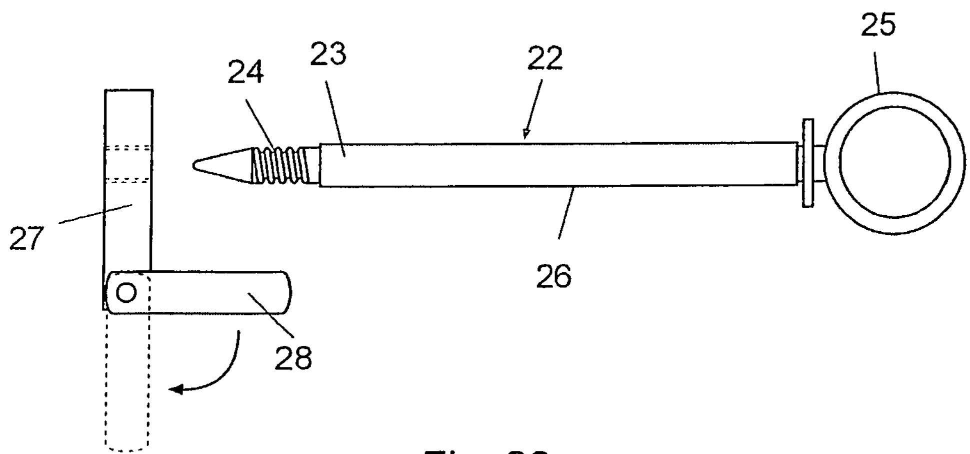


Fig. 23

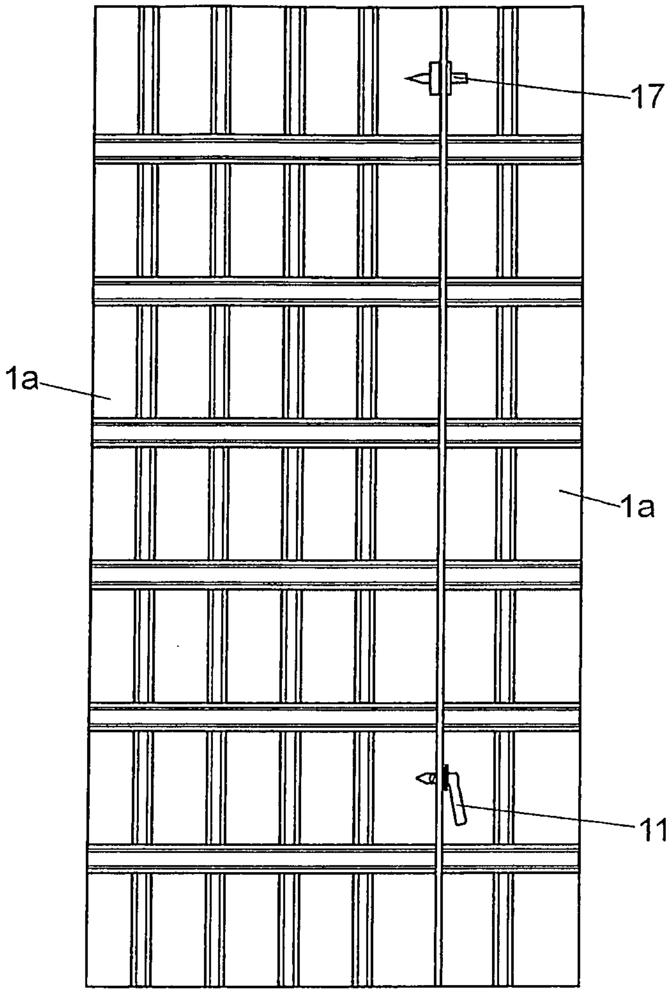


Fig. 24

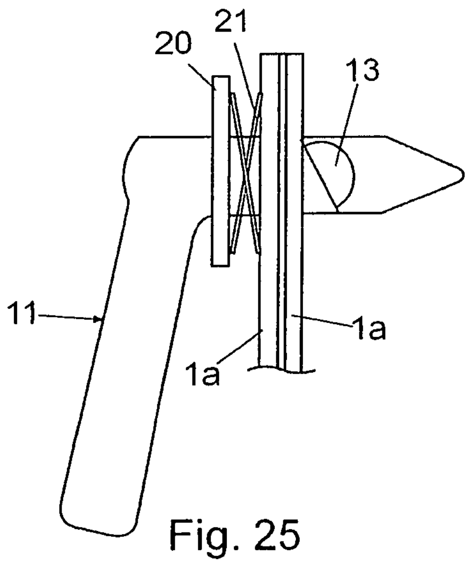


Fig. 25

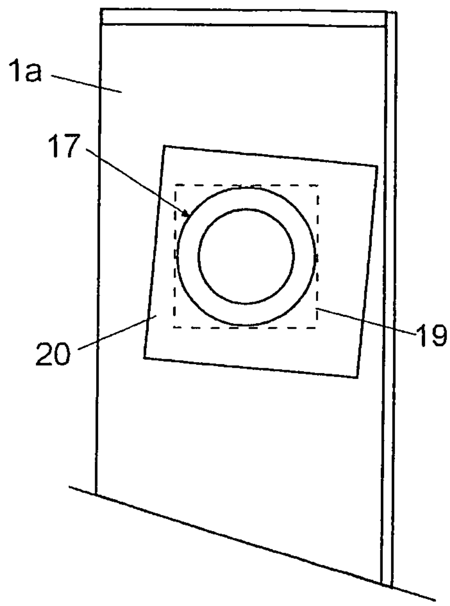


Fig. 26

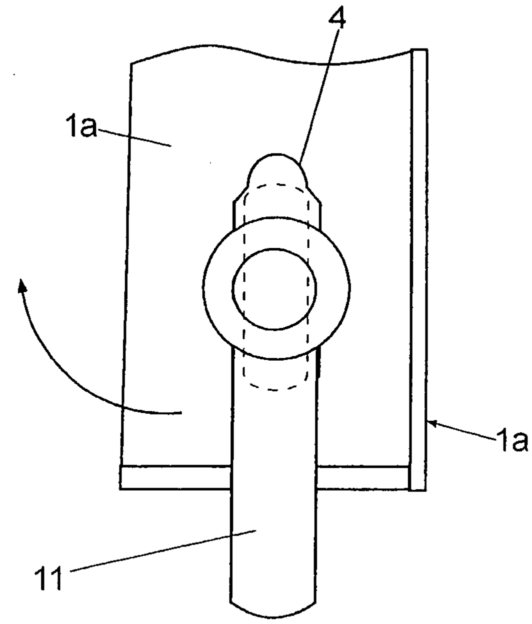


Fig. 27

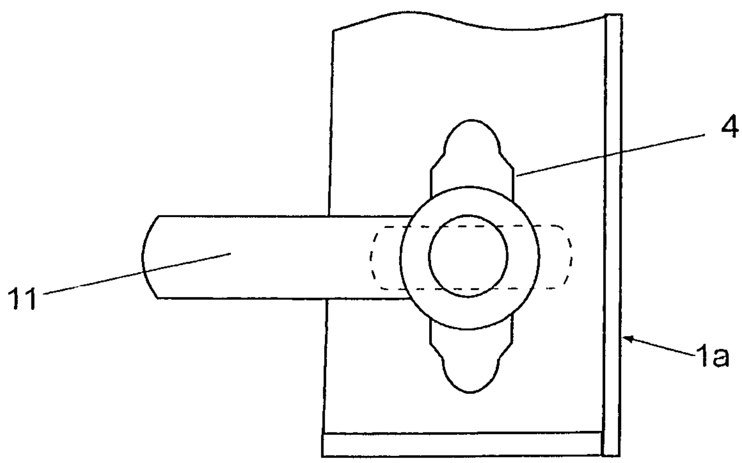


Fig. 28

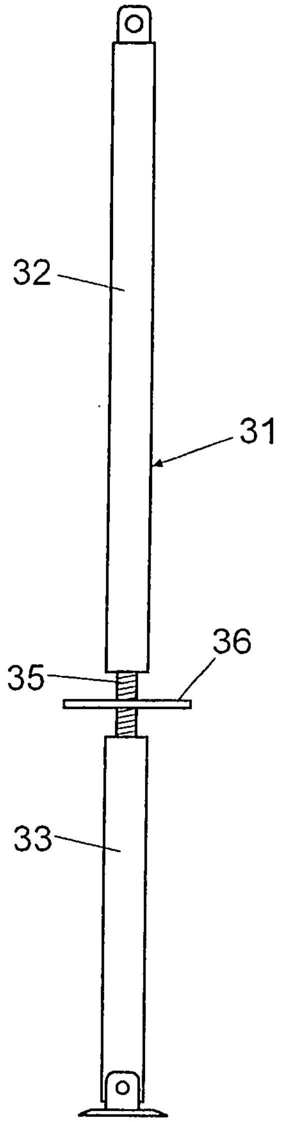


Fig. 29

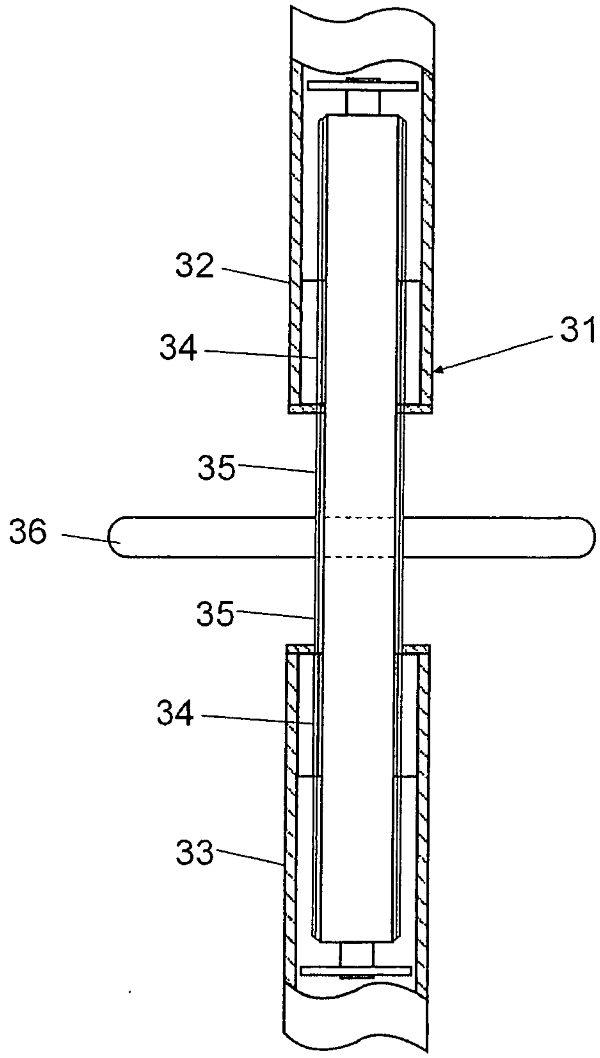


Fig. 30

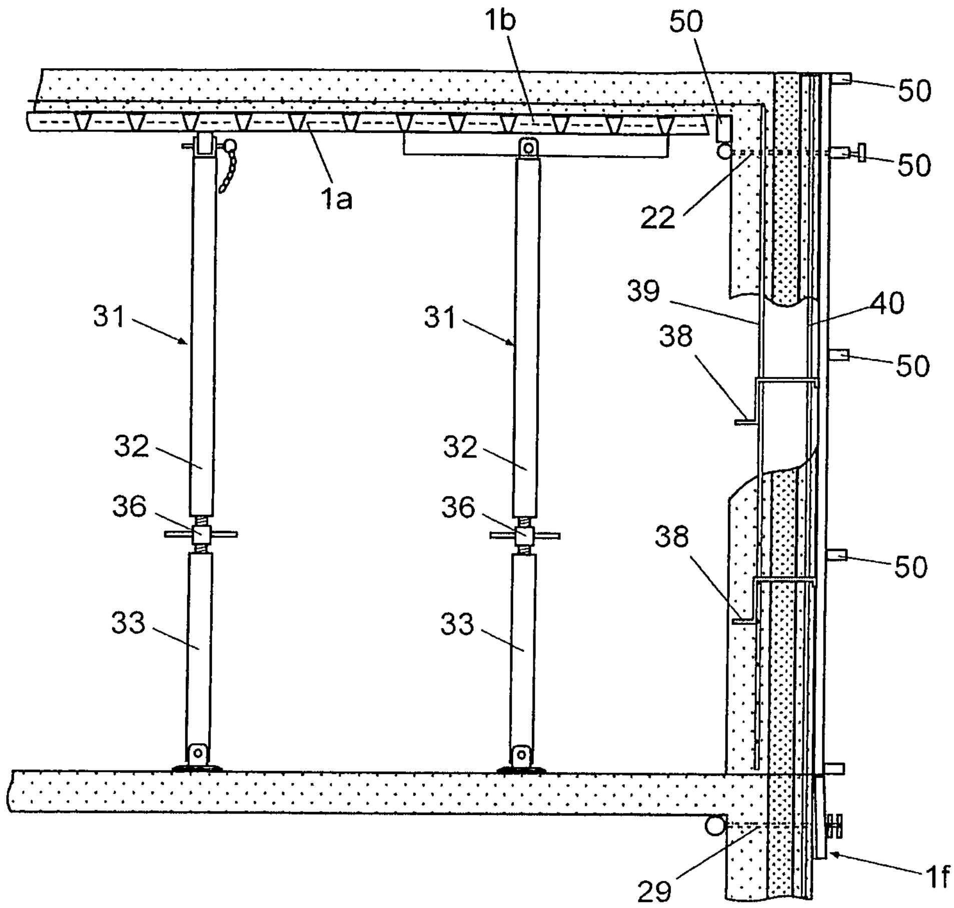


Fig. 31

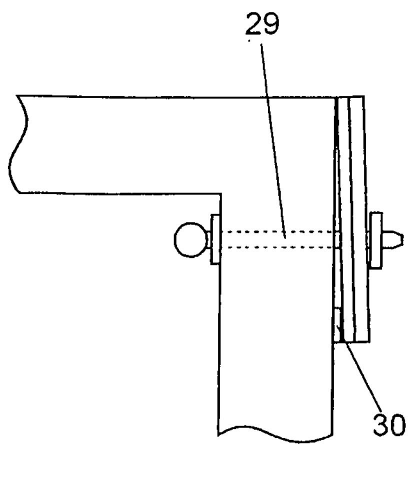


Fig. 32

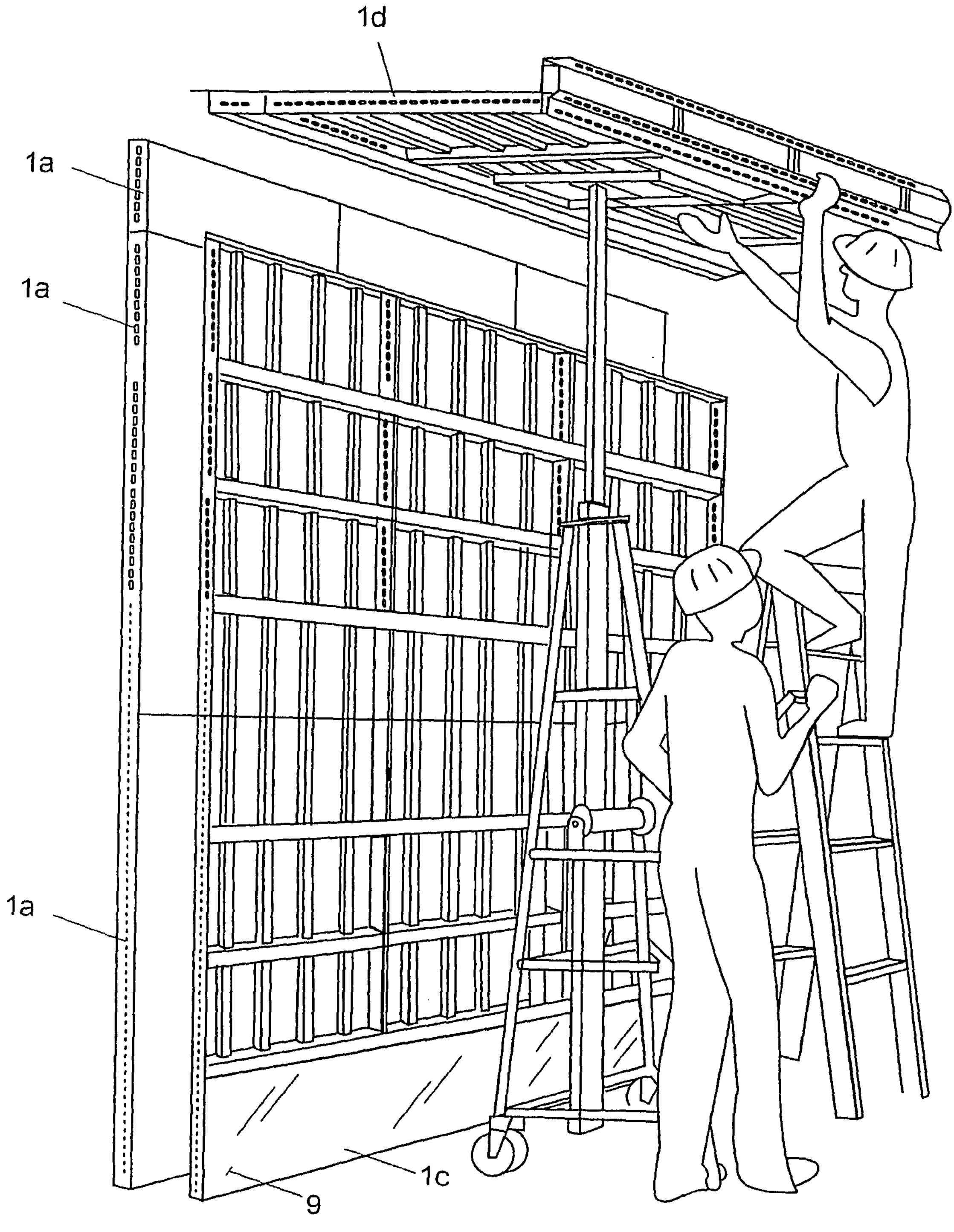


Fig. 33

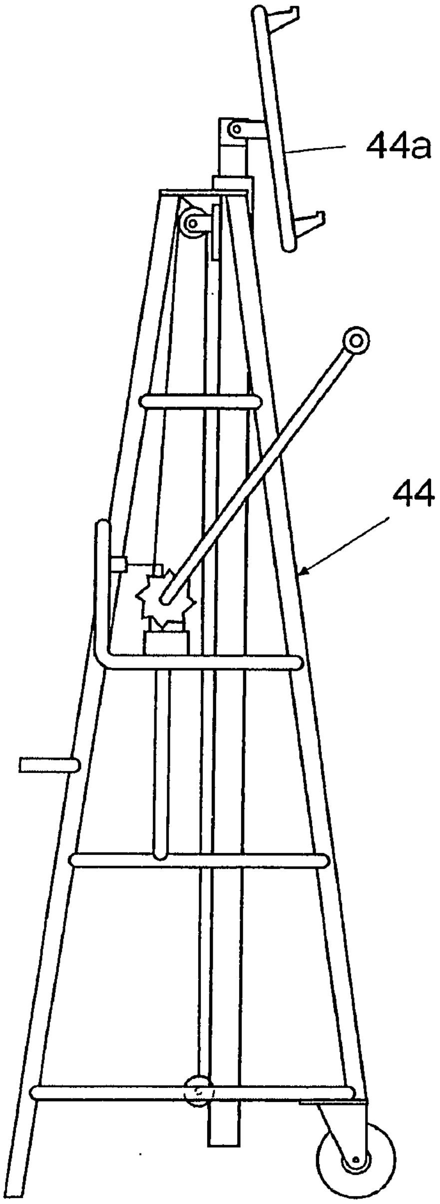
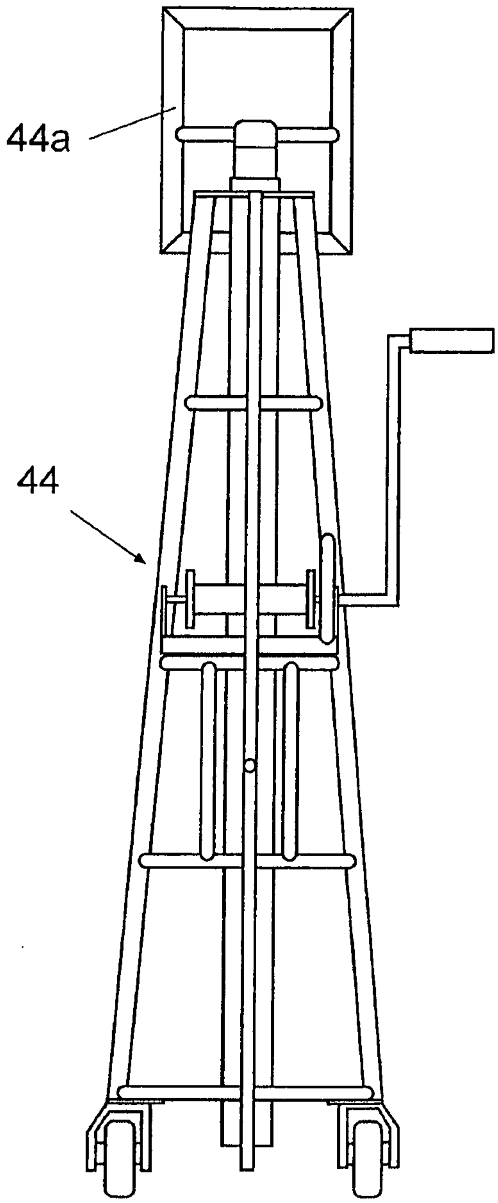


Fig. 34



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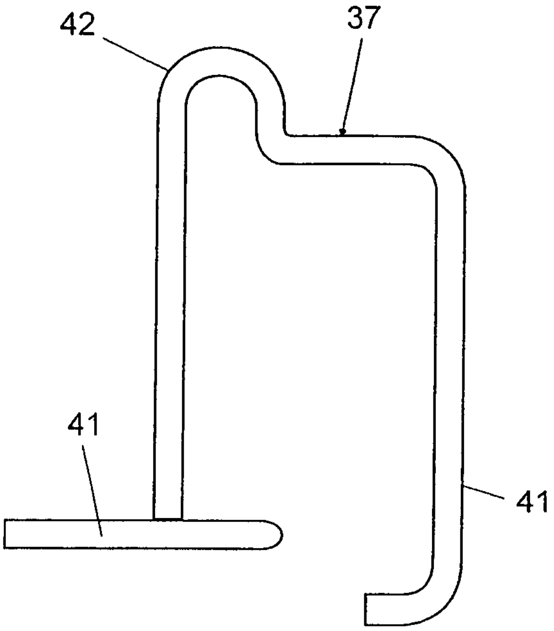

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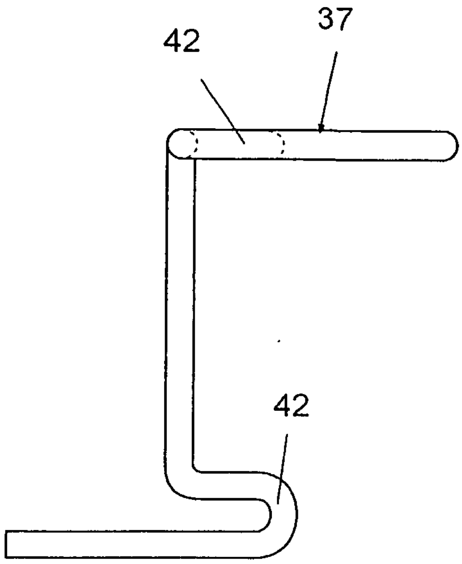

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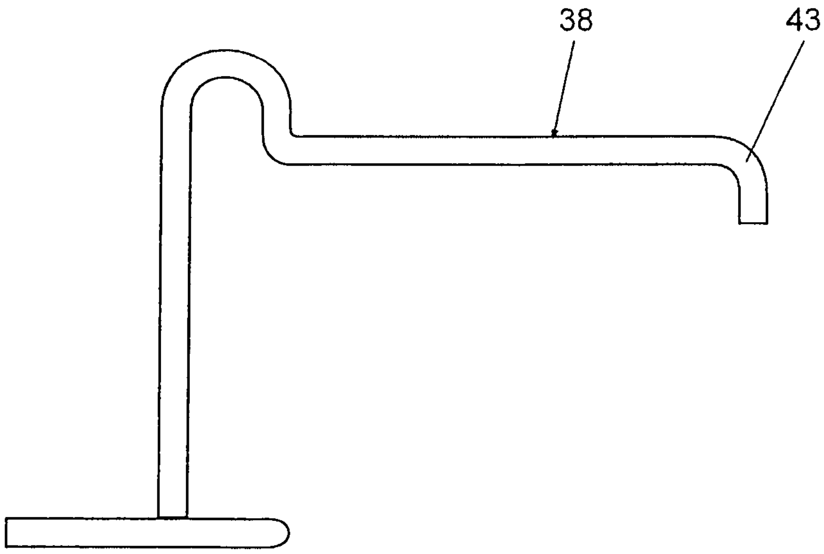

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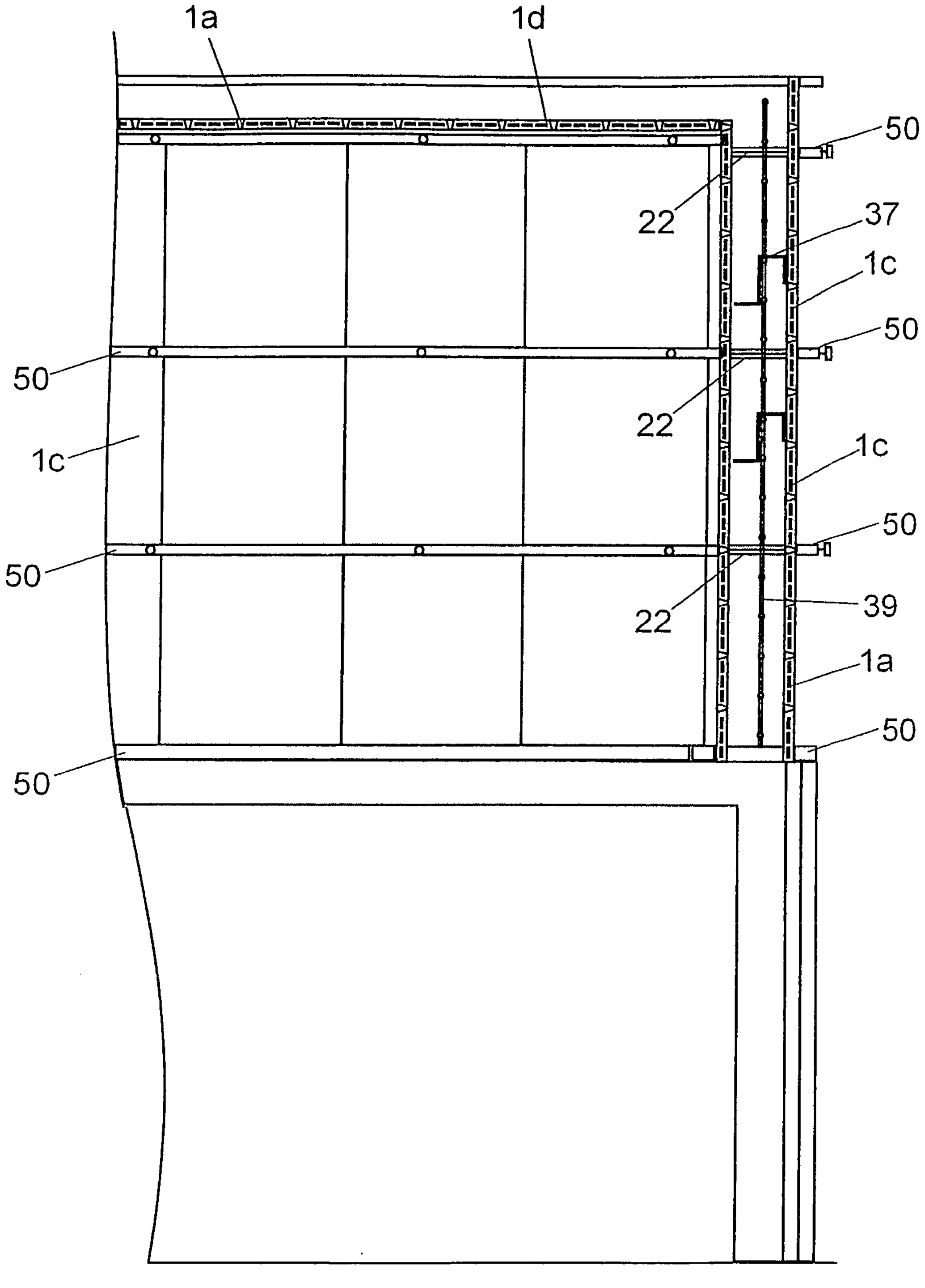

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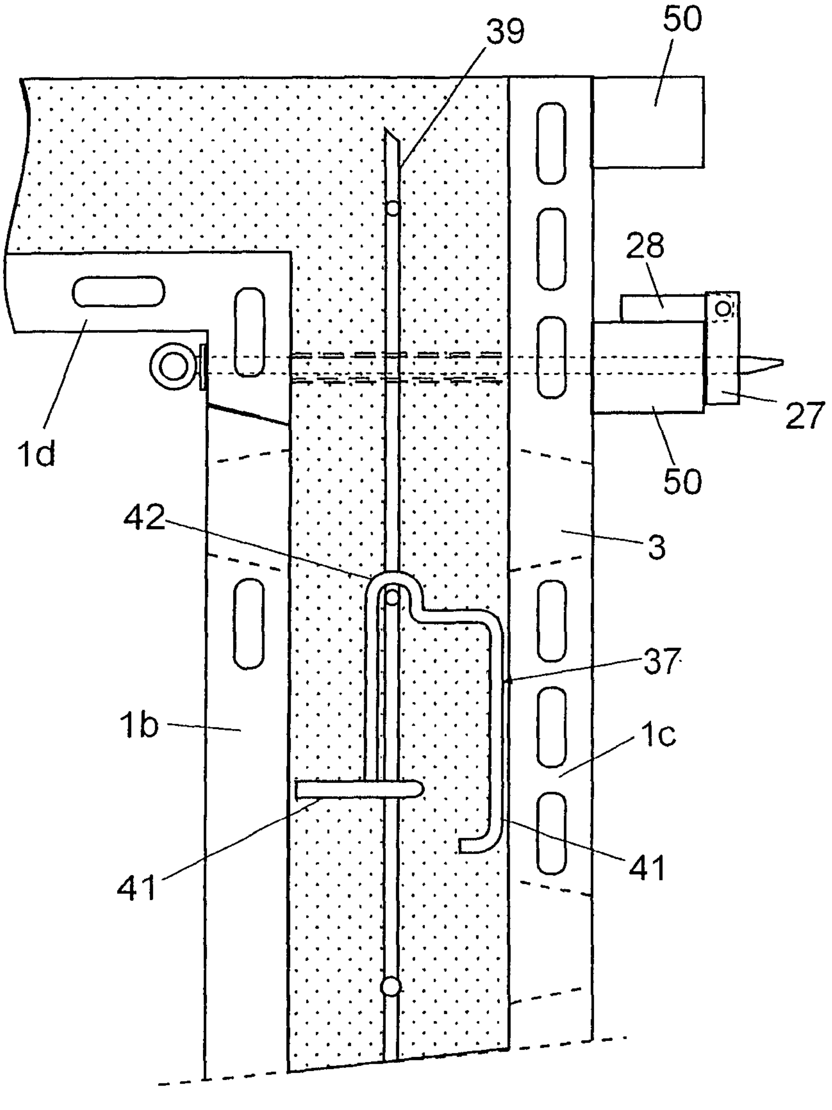
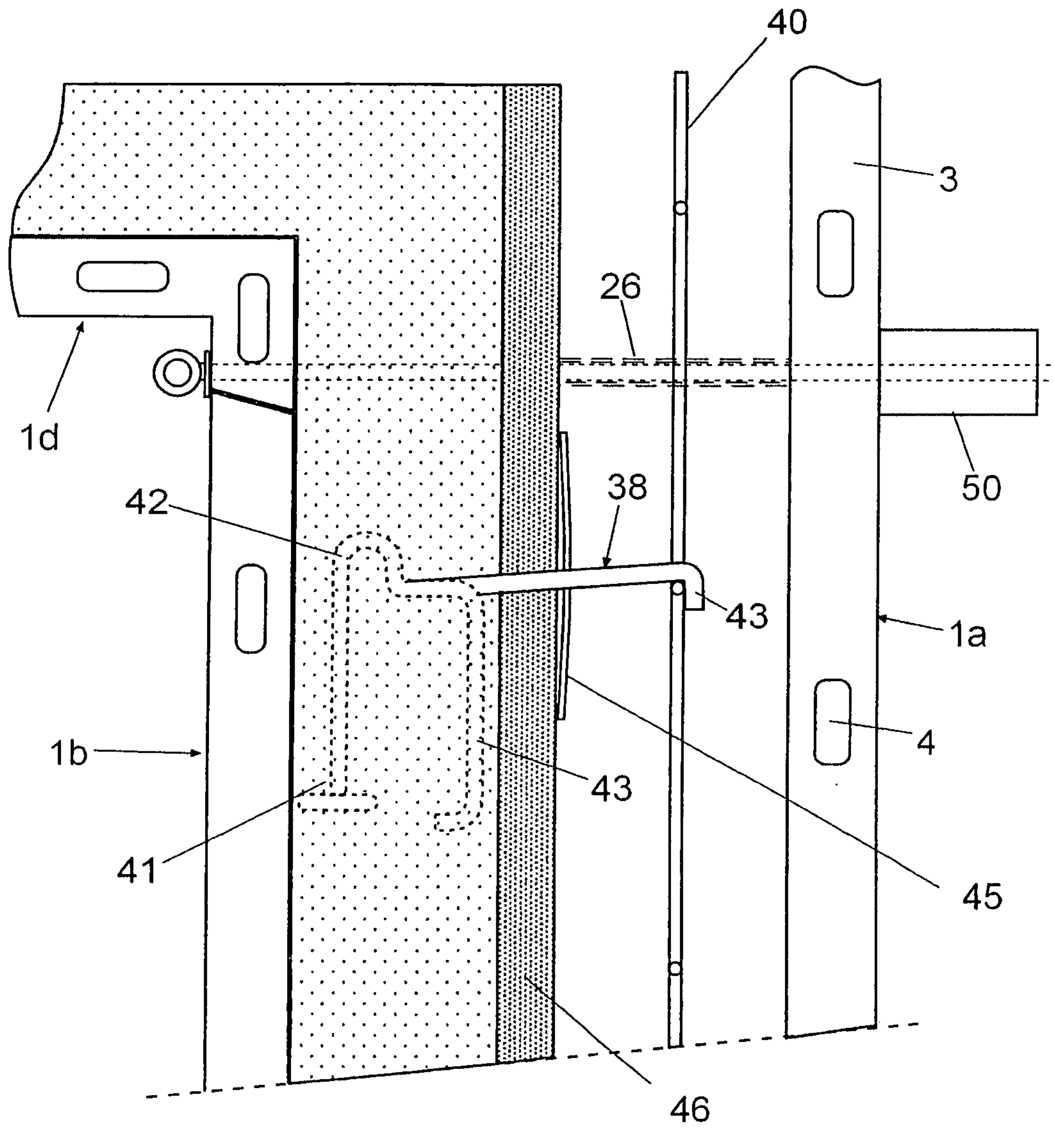


Fig. 40



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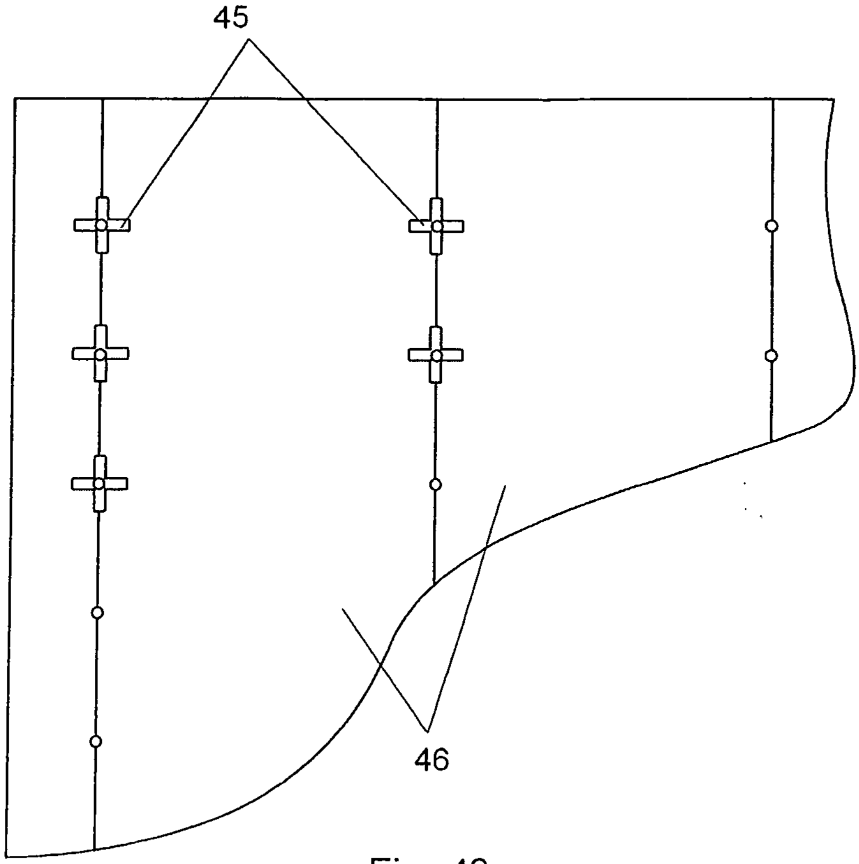

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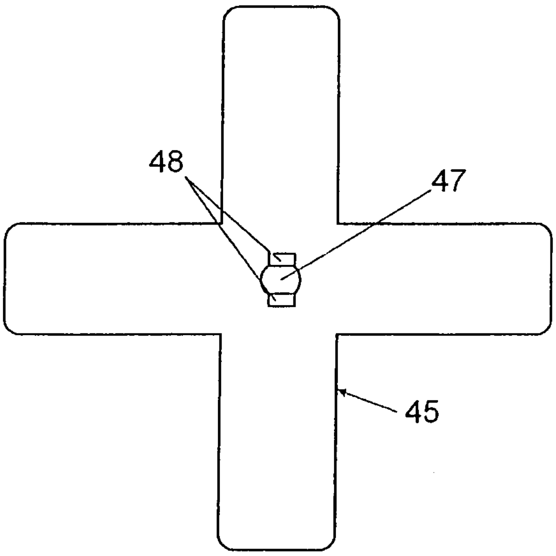


Fig. 43

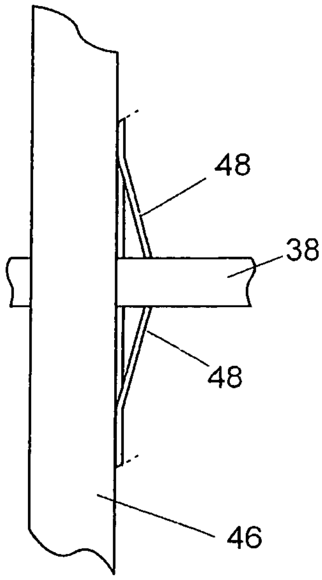


Fig. 44

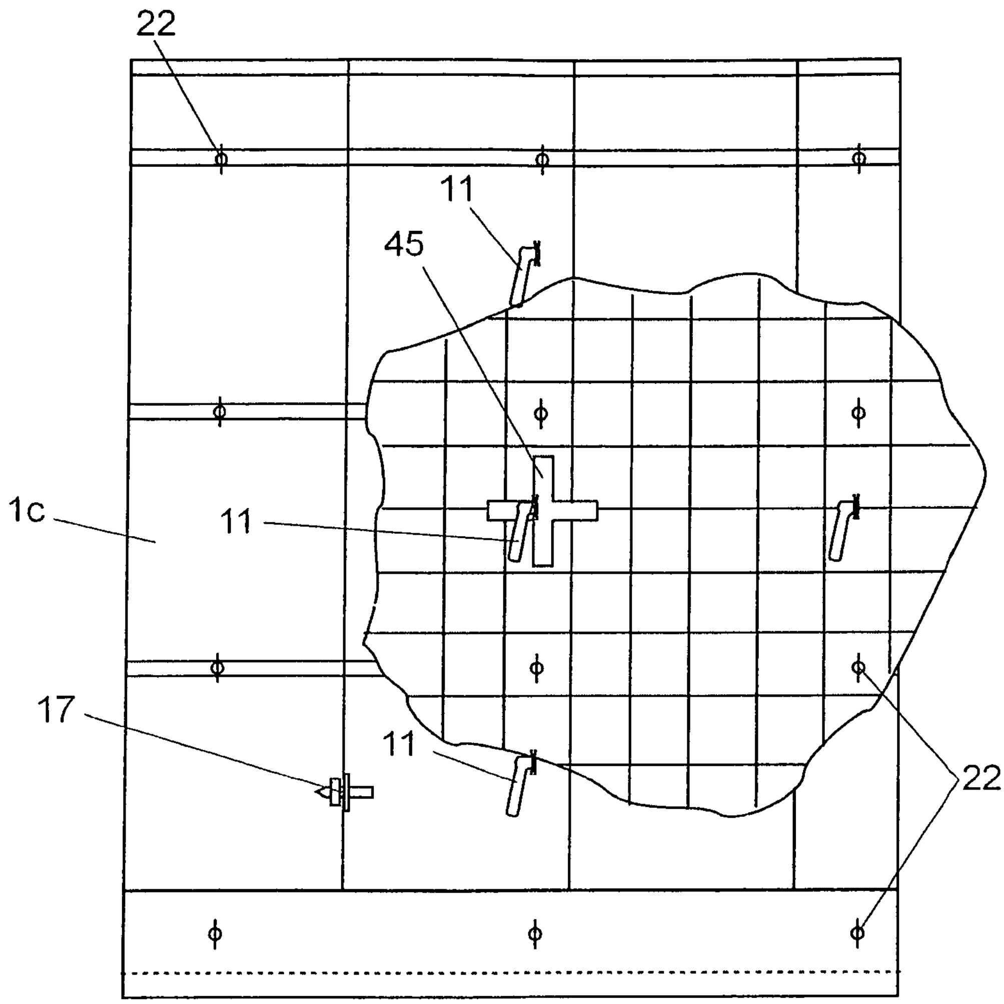


Fig. 45

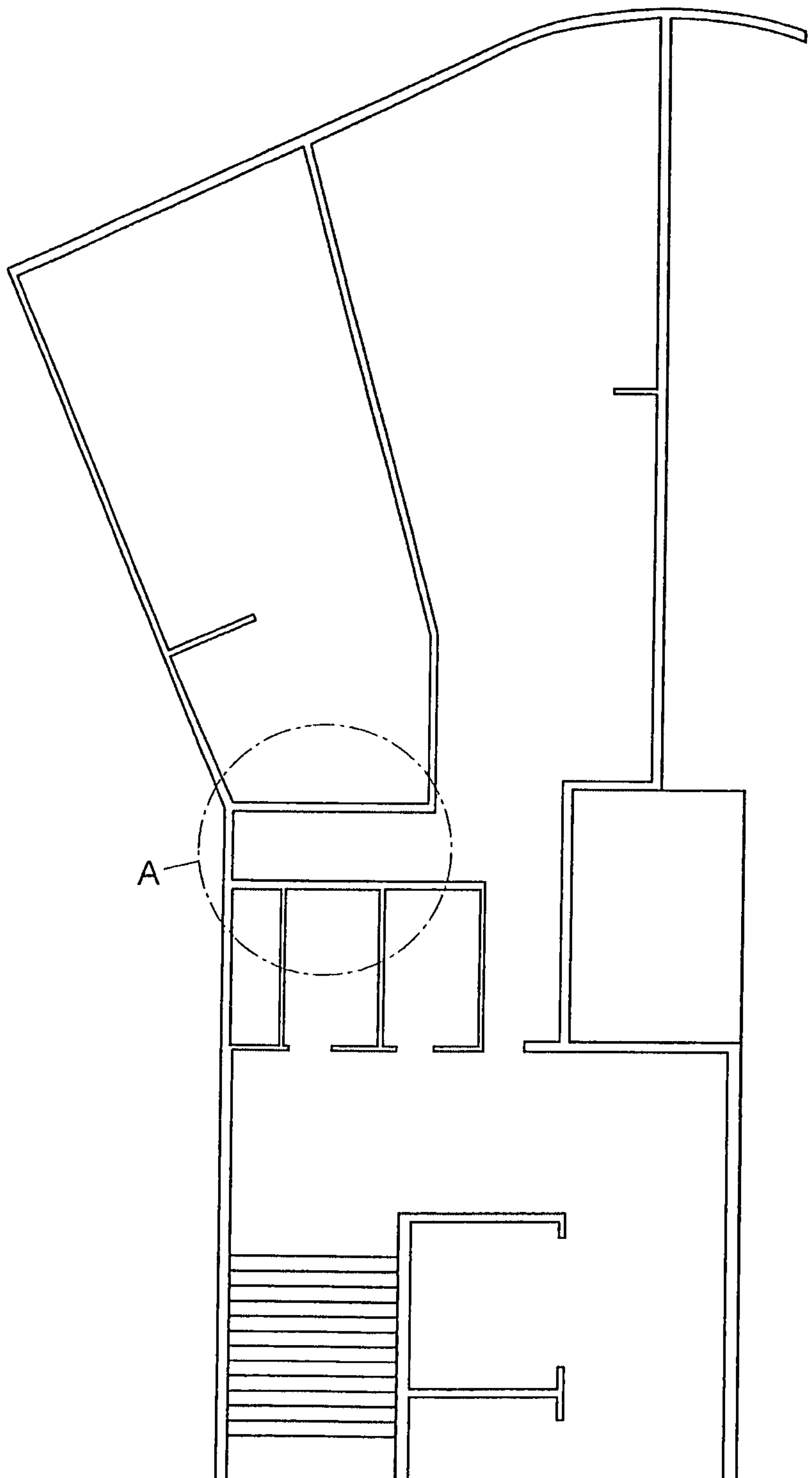


Fig. 46

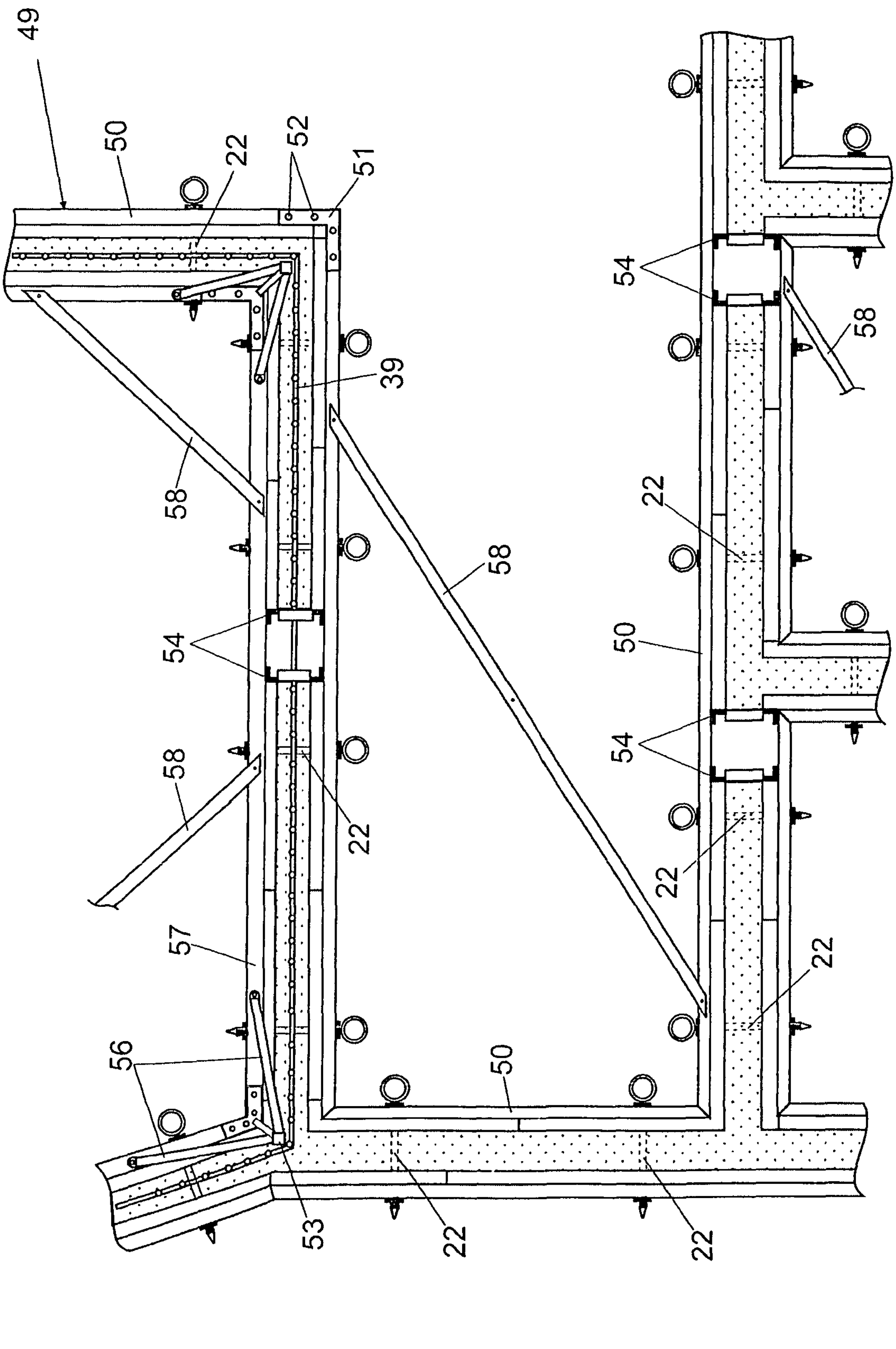
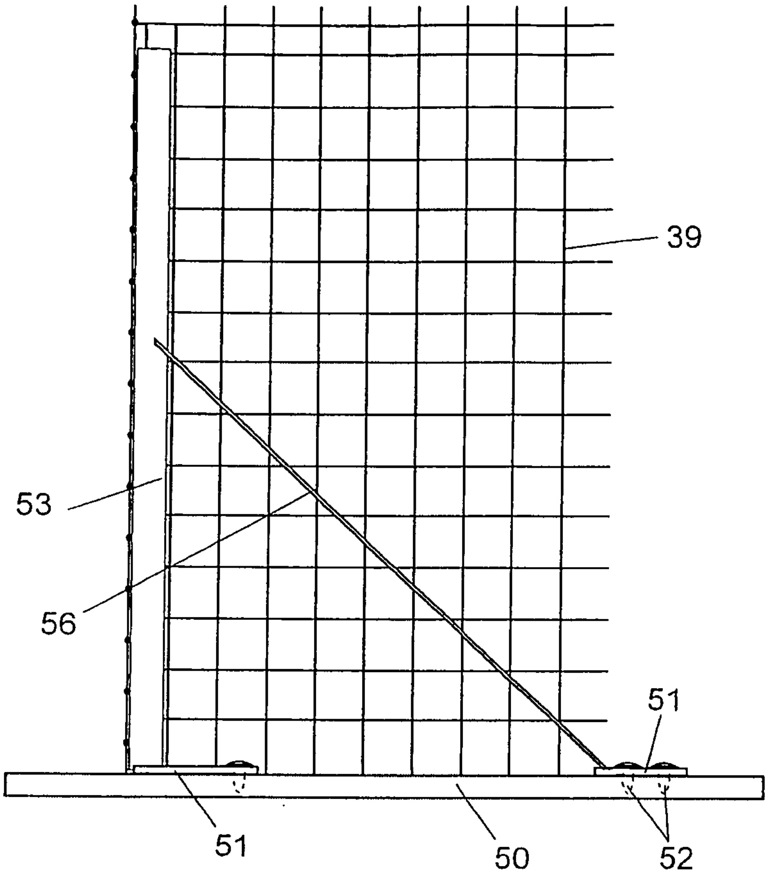


Fig. 47



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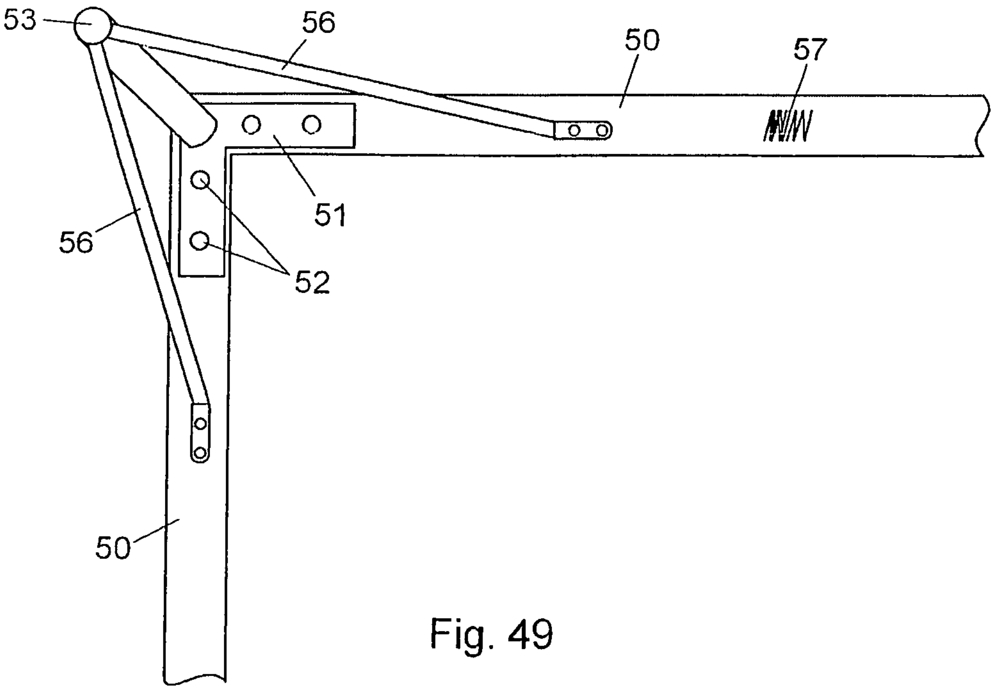

Fig. 49

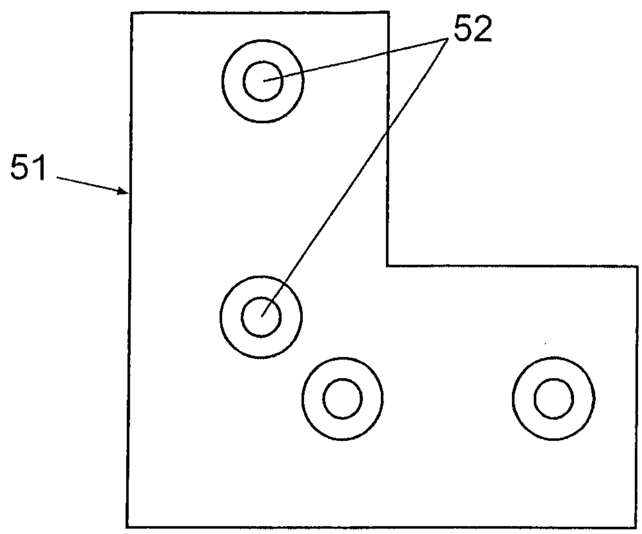

Fig. 50

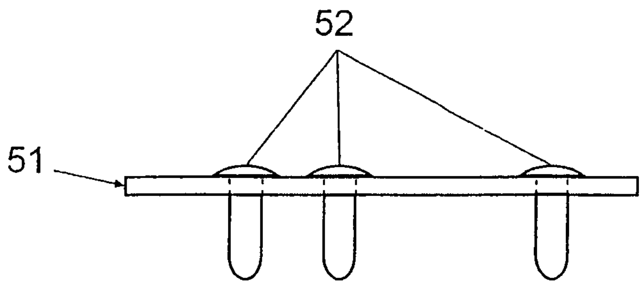

Fig. 51

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 2010/000118

A. CLASSIFICATION OF SUBJECT MATTER

see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04G, E04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

INVENES,EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	GB 705275 A (JOSEPH ARMSTRONG WHITTALL) 10.03.1954, page 1, line 80 - page 2, line 65; figures.	1,2,6,7,13 9
Y A	ES 2120298 A1 (PUJOL BARCONS SALVADOR) 16.10.1998, column 5, line 49 - column 11, line 30;column 13, line 65 - column 14, line 8; figures 1,3-6,13-18,25,26,40.	1,2,6,7,13 4,8,10,14
Y	US 6676102 B1 (HAMBELTON et al.) 13.01.2004, column 5, lines 25-27; figures 1-3,6.	6
A	GB 853278 A (KWIKFORM LTD) 02.11.1960, page 4, lines 54-58; figures 3,4.	1,2
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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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06 July 2010 (06.07.2010)	(07.07.2010)
Name and mailing address of the ISA/ O.E.P.M. Paseo de la Castellana, 75 28071 Madrid, España. Facsimile No. 34 91 3495304	Authorized officer S. Fernández de Miguel Telephone No. +34 91 349 54 37

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C (continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of documents, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3490729 A (LUCE et al.) 20.01.1970, column 2, lines 64-69; figures 2,3.	13
A	US 2007193166 A1 (RYAN et al.) 23.08.2007, paragraphs [0021-0022,0026]; figure 3.	1,14,15

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Information on patent family members

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CLASSIFICATION OF SUBJECT MATTER

E04G 9/02 (2006.01)
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- ES 200202648 **[0012] [0015] [0023] [0024]**