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(54) **A method for making an opening in a floor**

(57) The invention describes a method for the making of an opening into a loadbearing floor. The method includes the stages: the dimensions of opening 2 to be cut are marked on the floor slab 1 and floor slab 1 is supported with temporary supports 3. Then the opening 2 is cut into floor slab 1. Loadbearing beams 9 are installed to the sides 7 of slabs 6 that are adjacent to opening 2. The hollows 13 of preserved panel sections 12 are cleaned and primed, and pulling anchors 15 are installed in the hollows. Connecting the beams and loadbearing beams results in a loadbearing framework, which will help in transferring the load of preserved slab sections 12 to the supporting surface 4 of loadbearing structure 5.

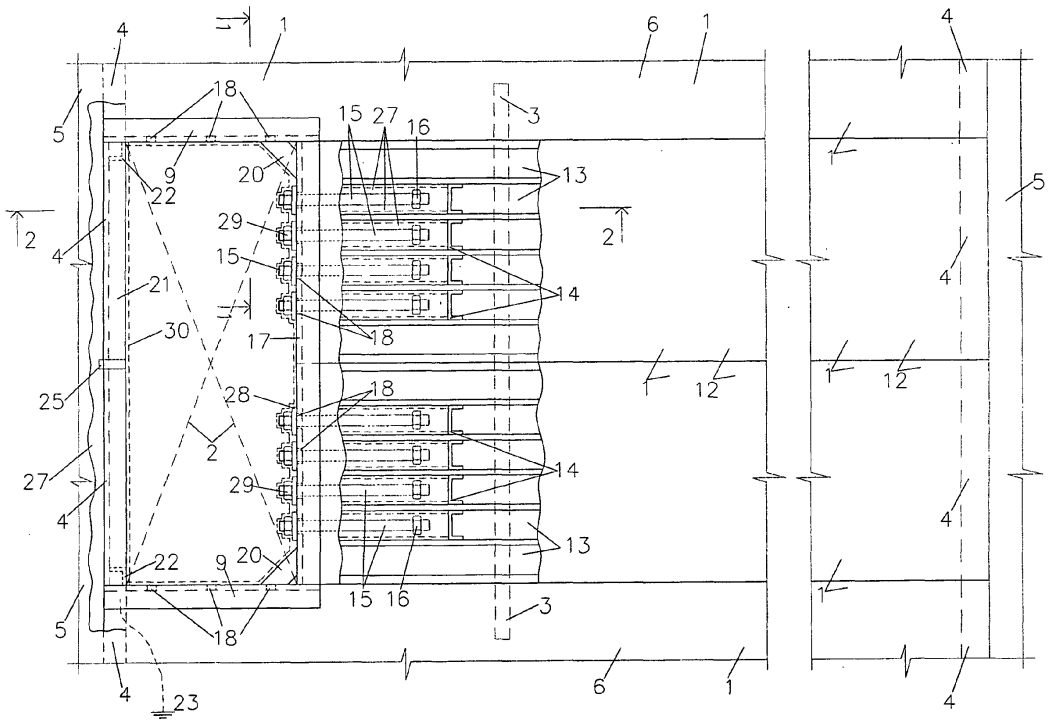

Fig 1

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Description

Technical field

[0001] The invention belongs in the construction field, treating more specifically a method for making an opening with a substantial size into a floor.

Prior art

[0002] When designing buildings it is necessary to create relatively large openings into loadbearing floors, such as for building additional shafts for the entrance of modern ventilation, water, sewage, heating, electrical cables, technical pipes, elevators and light.

[0003] In practice, a method is used in which the preserved parts of cut panels are supported on a beam, while the imposed load and the dead load of panels are transferred to adjacent panels (e.g. US2001005964, Hunter Douglas Inc., published on 06.08.2002). Such solution cannot be used in many cases, since the adjacent panels have been designed and built to prescribed loads. When imposing extra loads to the panels next to the opening, the panels can no longer be loaded with the rated load and therefore the designed service load should be reduced, which again reduces substantially exploitation possibilities. Also the adjacent panels could already be at the border condition of load endurance and no additional load can be imposed to the panels.

[0004] A known solution also provides a method (RU2197585, Kuban State University of Agriculture, published on 10.08.2002), in which a reconstructed building has short grooves cut into covering plates under hollows, and pulling anchors are installed into the grooves. The plates are fixed to walls by means of angle irons and bolt connections. This method does not allow making large openings.

[0005] A well-known solution is also the structural solution (JP9078745, Yoshino Gypsum Co, published on 25.03.1997) for reinforcing an opening in a floor, which is technically closest to the presented invention. In this solution the structure of the opening in a floor is reinforced, using a reinforcement element that contains a hollow that holds the edge of the opening in the floor, and the reinforcement element is installed to the edge of the opening. The reinforcement element includes a support part that reaches out into the opening in the floor and supports the opening. The structure includes a connection element for the connection with a cross-beam, locating between the cross-beam and the reinforcement element, while the base of the connection element is installed in the void of the cross-beam. The connection beam is fixed, using a tensioner. This solution is intended for the reinforcement of a floor slab with an existing opening and does not solve current problems.

Description of the invention

[0006] Before making an opening in the floor with the purpose of maintaining the existing load situation and 100% of the rated loadbearing capacity, the opening is created so that the load that acts on the preserved floor section is transferred to the supporting surface of the loadbearing structure (loadbearing wall or beam) of the removed section of the floor, using a special loadbearing framework from profiled steel, connected to the preserved floor section through pulling anchors. For this purpose, the dimensions of the opening are marked on the floor slab, and the slab is supported with temporary supports. This is followed by cutting the opening into the slab, the sides of slabs adjacent to the opening are cleaned and primed. Loadbearing beams are installed to the sides of the adjacent slabs. The hollows in the preserved slab sections are cleaned and primed, and pulling anchors are installed in the hollows. On the edge of preserved slab sections a slab with the width of the opening is installed, while connection elements are mounted to the corners of the slab and the adjacent loadbearing beams, beams are mutually connected from the corners, another beam is mounted between the ends of adjacent loadbearing beams and is connected to the loadbearing beams. This generates a loadbearing framework, which is connected to the preserved slab section by means of pulling anchors.

List of figures

[0007] Figures 1 to 3 present the floor structure that is obtained with the execution of the presented method.

Embodiment of the invention

[0008] When designing buildings it is necessary to create relatively large openings into loadbearing floors, such as for building additional shafts for the entrance of modern ventilation, water, sewage, heating, electrical cables, technical pipes, elevators and light. In most of the cases it would be necessary to cut through the existing loadbearing reinforced concrete slabs and to demolish entire slabs at the width of the opening, and to build a new loadbearing floor around the shaft. Such a solution is relatively costly and time-consuming and pollutes the environment due to the relatively large quantity of wastes.

[0009] The method for making an opening into a floor, with the created floor structure shown in figures 1 to 3, accordingly to the invention is executed as follows:

First the dimensions of opening 2 to be created are marked on slabs 1 of the floor. Then slabs 1 are supported from beneath with temporary supports 3. Supports 3 are installed from the opening 2 at the maximum distance of three times the height of slabs 1 and in the centre of the loadbearing opening of slabs 1. The width of supports 3 on both sides of

opening 2 is bigger than the height of slabs 2. To support slabs 1, slabs 1 are set in the horizontal position by means of supports 3, meaning that the flexible subsiding within the designed limits that occurs during use is temporarily eliminated. After supporting slabs 1, slabs 1 are cut vertically with a diamond cutter at the width of opening 2 and slabs 1 are removed from the area of opening 2. Slab sections are also removed from their supporting area 4 in loadbearing structure 5.

[0010] The sides 7 of slabs 6 adjacent to opening 2 are cleaned from dust and infirmly fixed parts and are primed with bonding agent 8. Then steel loadbearing box beams 9 are installed to the sides 7. The length of loadbearing beam 9 is selected so that it would reach to the support surface 4 of slabs 1 in loadbearing structure 5 and exceed the length of opening 2 by the double width of loadbearing beam 9. For the installation of loadbearing beam 9, first a respective horizontal opening is cut with a diamond cutter along the upper 10 and lower 11 surface of the adjacent slab 6 for the length of the supporting surface 4 of adjacent slab 6 and at the depth of the width of loadbearing beam 9 in loadbearing structure 5. Then the opening 2 is cut along the adjacent slabs 6 at the length of the width of loadbearing beam 9, vertical openings between the reserved panel sections 12 and the adjacent panels 6 of opening 2, and loadbearing beam 9 is installed symmetrically with opening 2 on both sides of the opening.

[0011] Then the hollows 13 of preserved panel sections 12 are cleaned of dust, are primed with bonding agent 8, and plastic plugs 14 are installed in the hollows 13 of preserved panel sections 12. In addition, pulling anchors 15 from threaded steel, which take the tensile stress, are installed in the hollows 13 of the preserved panel sections 12, while pulling anchors 15 include at the rear end a steel support 16, which holds the pulling anchor 15 in the horizontal position and anchors it. Pulling anchors 15 are located in the hollows 13 of preserved panel sections 12 at the height of anchor diameter, and from the cut edge of slab 1 at the minimum distance of the 30-times diameter of the pulling anchor. Prior to this, plastic plugs 14 are installed from the cut edge of slab 1 at the minimum distance of the 31-times diameter of the pulling anchor. Pulling anchors protrude from the hollows of preserved slab sections by the minimum length of the 15-times diameter of the pulling anchor. The quantity of pulling anchors 15, the strength and diameter of steel is selected so that the anchors would hold the tensile stresses occurring due to the bending moment of preserved slab sections 12 without substantial deformations in cases of maximum dead load and imposed load.

[0012] On the edge of preserved slab sections 12, at the width of opening 2, steel box beam 17 is installed, which contains holes 18 for pulling anchors 15 that protrude from hollows 13 of panel sections 12. The diameter of hollows 18 is the 1.5-times diameter of the pulling anchor.

[0013] Steel elements 19 that transfer the traction force arising from the bending moment and steel elements 20 that transfer the compressive force are installed in the corners of steel box beam 17 and adjacent loadbearing beams 9 by welding. The thickness of elements 19 and 20 is equal to the mean thickness of the side of beam 17, and the distance between elements 19 and 20 is at maximum the 5-times thickness of element 19. Elements 19 and 20 have the equal thickness and similar shape. Elements 19 and 20 are installed from bottom to top. In addition, beam 17 and loadbearing beam 9 are mutually connected by welding in the corners along the cross-section.

[0014] Steel box beam 21 is installed on the supporting surface 4 of slabs 1 in the loadbearing structure 5 between the ends of loadbearing beams 9, connected to adjacent loadbearing beams 9 by welding along the cross-section, and for supplementary rigidity an extra support 22 from angle iron is connected by welding. The resulting loadbearing framework from profiled steel is connected electrically with the equipotential bonding loop 23. The internal side of steel box beam 21 that is facing the shaft is filled with dense insulation material 24 (e.g. mineral wool) to isolate the impacts of sound and fire. In the central section of steel box beam 21, wedges 25 under the beam provide beam 21 with prestress, which in later casting and loading will ensure beam 21 with uniform pressure against supporting surface 4.

[0015] After the installation of the loadbearing framework from the profiled steel, holes 18 are drilled also in the vertical wall of loadbearing beam 9 at the base level of the upper ring of adjacent loadbearing beam 9. Holes 18 are drilled in the centre of loadbearing beam 9 and longitudinally at the distance of 1/6 width of opening 2 from the ends of loadbearing beam 9. Then holes 26 are drilled by hollows 13 of preserved slab sections 12. The diameter of holes 26 is 1/2 of the diameter of hollows 13 and holes 26 are located at the ends of pulling anchors 15 at the distance of the double height of hollows 13. Then the hollows 13 of the preserved slab sections 12 and the gaps between beams 9, 21 and slab sections 12 and loadbearing structure 5 are filled with fine-grain soldering concrete 27 with expansion rate of up to 0.5%.

[0016] After the hardening of soldering concrete 27, pins 28 and pressure nuts 29 are installed to the pulling anchors, tensioning the pulling anchors 15 by means of pressure nuts 29. Then the preserved slab sections 12 are released from the hog, temporary supports 3 are removed and the steel surfaces are covered with fire-proofing compound 30.

[0017] The final result will be opening 2 in floor slabs 1, while the preserved floor section 12, which surrounds opening 2, holds the initially designed load, adjacent slabs 6 are not overloaded and the load stresses to loadbearing structure 5 have not increased.

Claims

1. A method for making an opening in a floor, comprising the installation of a reinforcing structure to a floor slab with an opening, connection of slabs adjacent to the opening with the loadbearing beams, and the installation of a tensioning device, is **characterized in that** the method comprises the following stages:

   - measurements of the opening (2) are marked on the floor slab (1);
   - floor slab (1) is supported from beneath with temporary supports (3), which set the slabs (1) in the horizontal position, eliminating temporarily the flexible subsiding that has occurred in the slabs (1) during use;
   - after the installation of the temporary supports (3), the floor slabs (1) are cut vertically at the width of the opening (2);
   - floor slabs (1) in the area of the opening (2) and the sections of floor slabs (1) by their supporting surface (4) in the loadbearing structure (5) are removed;
   - the sides (7) of slabs (6) adjacent to the opening (2) are cleaned and primed;
   - loadbearing beams (9) are installed to the sides (7) of adjacent slabs (6), and for the purpose of this installation first a horizontal gap is cut along the upper (10) and lower surface (11) of the adjacent slab (6), and then vertical gaps are cut along the adjacent slabs (6) of the opening (2) between the preserved slab sections (12) and the adjacent slabs (6) of the opening (2), and the loadbearing beam (9) is installed symmetrically with the opening (2) on both of its sides;
   - the hollows (13) of the preserved slab sections (12) are cleaned and primed;
   - a plug (14) and a pulling anchor (15) that takes the tensile stress are installed to the hollows (13) together with a support (16);
   - a beam (17) with holes (18) are installed to the edge of preserved panel sections (12) at the width of the opening (2);
   - in the corners of the beam (17) and adjacent loadbearing beams (9), elements (19) that transfer the traction force arising from the bending moment and elements (20) that transfer the compressive force are installed, the beam (17) and loadbearing beam (9) are mutually connected in the corners along the cross-section;
   - on the supporting surface (4) of slabs (1) in the loadbearing structure (5), a beam (21) is installed between the ends of adjacent loadbearing beams (9), which is connected with loadbearing beams (9) along the cross-section and for supplementary rigidity is connected to a supplementary support (22), resulting in a loadbearing framework from profiled steel, which is connected electrically with the equipotential bonding loop (23);
   - the internal side of the beam (21) that is facing the opening is filled with insulation material (24) and in the central section of beam (21) the beam (21) is pre-tensioned by means of wedges (25) under the beam;
   - the installation of the loadbearing framework from profiled steel is followed by drilling holes (18) also in the vertical wall of the loadbearing beam (9) at the base level of the upper ring of the loadbearing beam (9) and then holes (26) are drilled by the hollows (13) of preserved slab sections (12), and the gaps between preserved slab sections (12), beams (9) and (21), slab sections (12) and the loadbearing structure (5) are filled with soldering concrete (27);
   - after the hardening of the soldering concrete (27), pins (28) and pressure nuts (29) are installed to pulling anchors (15), and the pulling anchors (15) are tensioned;
   - then the preserved slab sections (12) are released from the hog, temporary supports (3) are removed and the steel surfaces are covered with a fire-proofing compound (30).

2. Method accordingly to claim 1, **characterized in that** the supports (3) are installed from the opening (2) at the maximum distance of three times the height of the slabs (1) and in the centre of the loadbearing opening of the slabs (1), the width of supports (3) on both sides of the opening (2) is bigger than the height of the slabs (2).

3. Method accordingly to claim 1, **characterized in that** the sides (7) of adjacent slabs (6) are cleaned from dust and infirmly fixed parts, and are primed with a bonding agent (8).

4. Method accordingly to claim 1, **characterized in that** the loadbearing beams (9) are made from box steel and the length of the loadbearing beams (9) is selected so that the beams would reach on the supporting surface (4) of the slabs in the loadbearing structure (5) and the length would exceed the length of the opening (2) by two widths of the loadbearing beam (9).

5. Method accordingly to claim 1, **characterized in that** a horizontal gap is cut along the upper (10) and lower surface (11) of the adjacent slab (6), which is in the loadbearing structure (5) by the depth of the length of the supporting surface (4) of the adjacent slab (6) and the width of the loadbearing beam (9), and vertical gaps are cut along the adjacent slab (6) with the length equal to the width of the loadbearing beam (9).

6. Method accordingly to claim 1, **characterized in that** the hollows (13) of the preserved panel sections (12) are primed with a bonding agent (8) after cleaning from dust.

7. Method accordingly to claim 1, **characterized in that** a plug (14) is installed in the hollows (13), made from plastic and installed from the cut edge of the slab (1) at the minimum distance of the 31-times diameter of the pulling anchor (15).

8. Method accordingly to claim 1, **characterized in that** the pulling anchor (15) is produced from threaded steel, at the rear end of the pulling anchor (15) is a support (16); the pulling anchor (15) is mounted in the hollow (13) of the preserved slab (12) at the height of the diameter of the pulling anchor (15) from the bottom, and at the minimum distance of the 30-times diameter of the pulling anchor from the cut edge of the slab (1); the pulling anchor (15) protrudes from the hollow (13) of the slab section (12) by the three-times diameter of the pulling anchor (15) at minimum.

9. Method accordingly to claim 1, **characterized in that** the beam (17) is produced from box steel and the beam contains holes (18) for the pulling anchors (15) protruding from the hollows (13) of slab sections (12), while the diameter of the holes (18) is one-and-a half diameter of the pulling anchors (15).

10. Method accordingly to claim 1, **characterized in that** the elements (19) and (20) are produced from steel and are installed to the corners of beams (17) and (19) by welding, whereas the thickness of elements (19) and (20) is equal to the mean thickness of the side of the beam (17) and the mutual distance between elements (19) and (20) is the maximum of five times the thickness of element (19), while elements (19) and (20) have the equal thickness and similar shape..

11. Method accordingly to claim 1, **characterized in that** the elements (19) and (20) are installed from bottom to top.

12. Method accordingly to claim 1, **characterized in that** the beam (21) is produced from box steel, the supplementary support (22) is an angle iron, the beam (21) and supplementary support (22) are connected by welding.

13. Method accordingly to claim 1, **characterized in that** the holes (18) are drilled in the centre of the loadbearing beam (9) and longitudinally at the distance of 1/6 width of the opening (2) from the ends of the loadbearing beam.

14. Method accordingly to claim 1, **characterized in that** the diameter of holes (26) is 1/2 of the diameter of the hollows (13) and the holes (26) are located from the ends of the pulling anchors (15) at the distance of the double height of hollows (13).

15. Method accordingly to claim 1, **characterized in that** mineral wool is used as the insulation material (24).

16. Method accordingly to claim 1, **characterized in that** the soldering concrete (27) is fine-grained, expanding up to 0.5%.

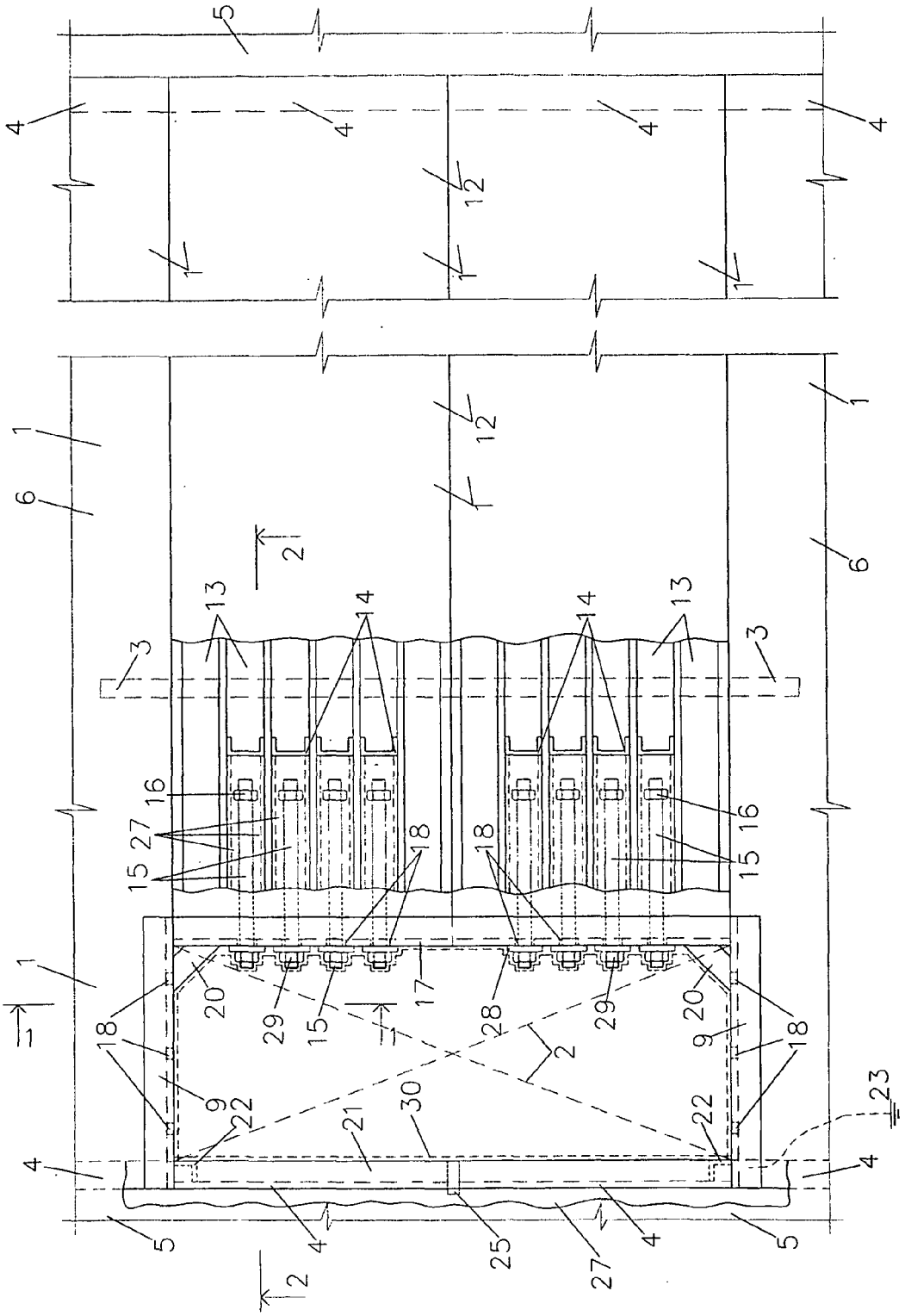

Fig 1

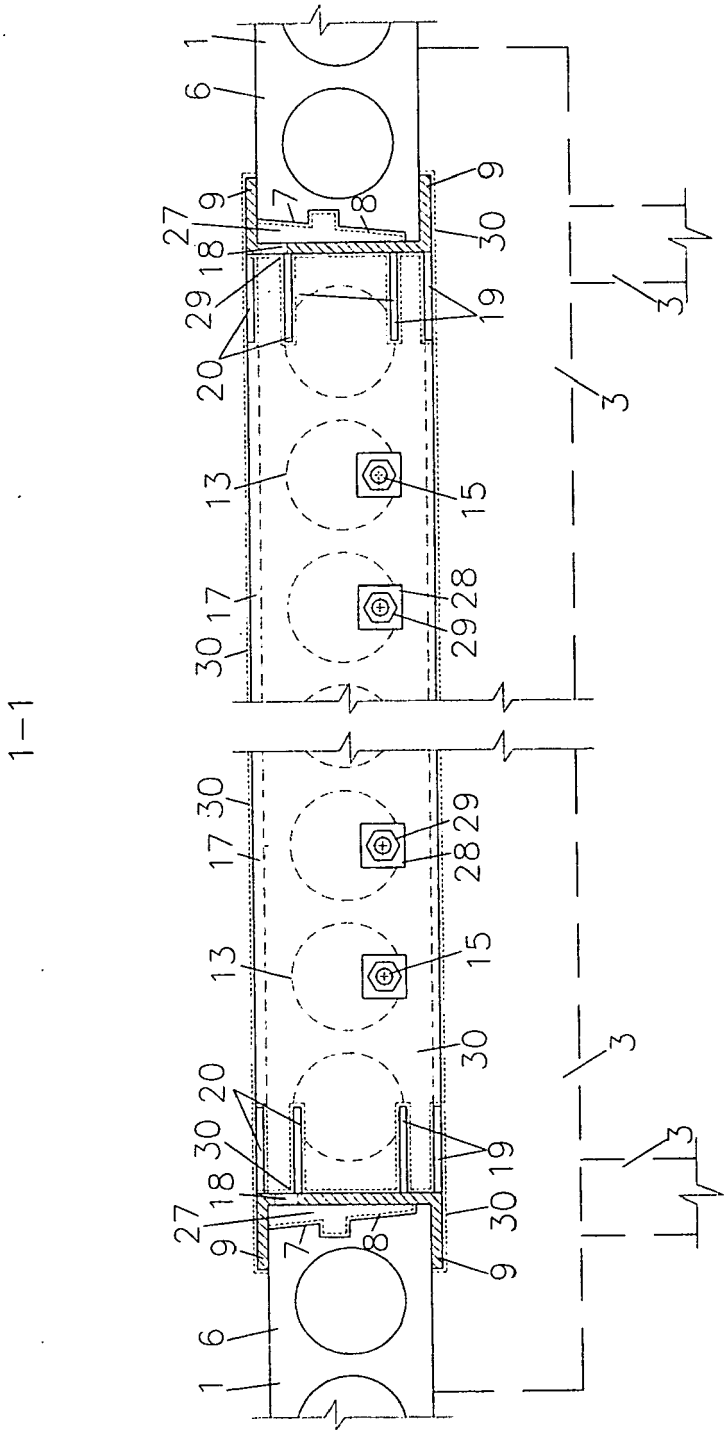

Fig 2

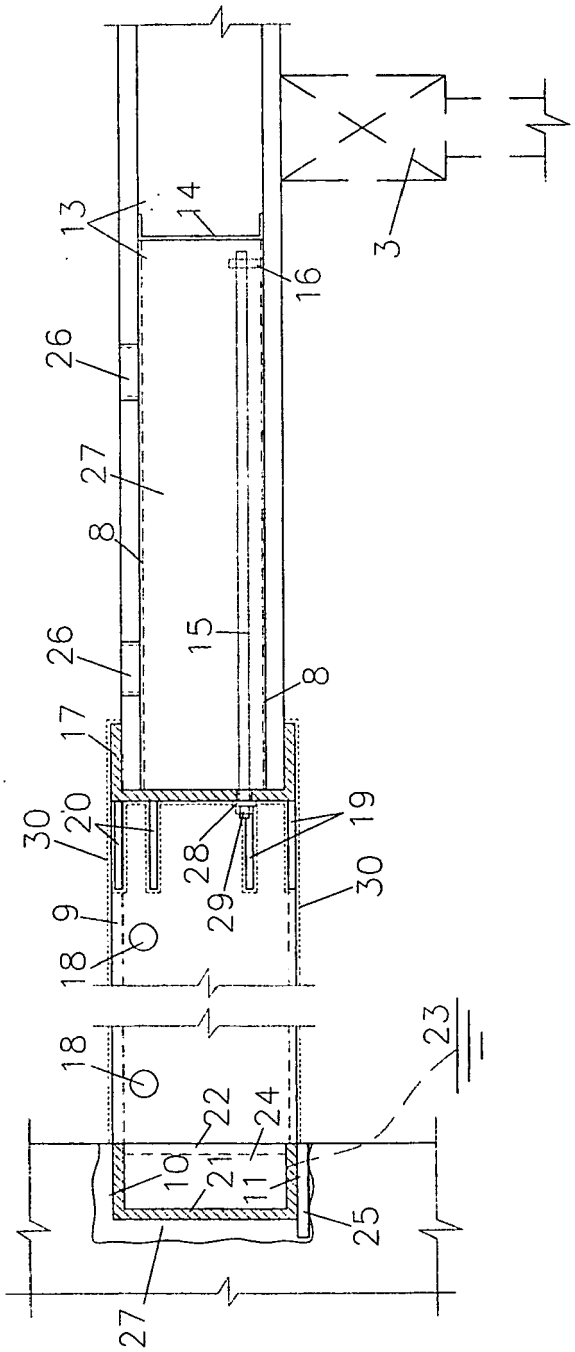

Fig 3

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EUROPEAN SEARCH REPORT

Application Number
EP 10 01 4117

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP 9 078745 A (YOSHINO GYPSUM CO) 25 March 1997 (1997-03-25) * abstract; figures 1-3 * -----	1	INV. E04G23/02

TECHNICAL FIELDS SEARCHED (IPC)

E04G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 May 2011	Khera, Daljit

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 01 4117

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26-05-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 9078745 A	25-03-1997	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2001005964 A **[0003]**
- RU 2197585 **[0004]**
- JP 9078745 B **[0005]**