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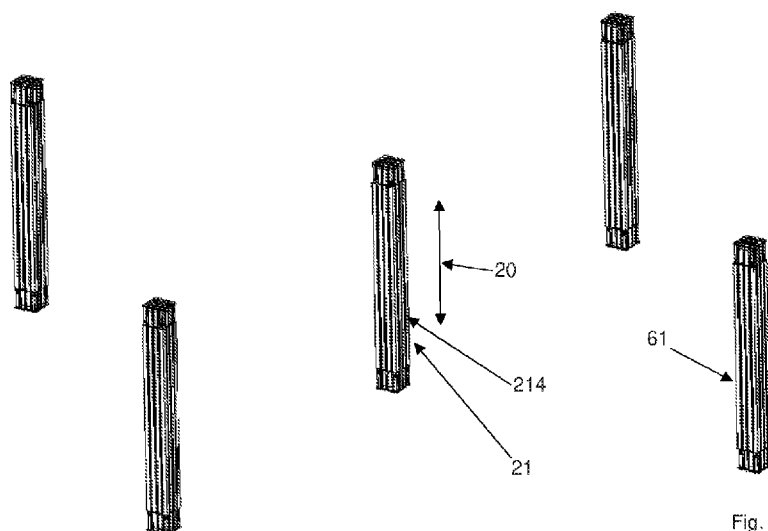


Fig. 1

(57) Abstract: A prefabricated building structure, comprising: -a first and a second pillar (21, 22) reciprocally stacked and having a preponderant longitudinal extension direction (20); an upper end (211) of the first pillar (21) being located at a lower end (221) of the second pillar (22); -a beam (3) extending substantially horizontally and having a first end (31) located at said upper end (211) and said lower end (221); -reciprocal fixing means (9) for reciprocally fixing the first pillar (21), the second pillar (22) and the beam (3); said reciprocal fixing means (9) being able to be at least partly incorporated in the first pillar (21), in the second pillar (22), in the beam (3). The reciprocal fixing means (9) comprises projecting means (91) and corresponding housing means (92) in which the projecting means (91) fits defining a joint. The projecting means (91) and the housing means (92) define male-female connections both between the first pillar (21) and the beam (3) and between the second pillar (22) and the beam (3).

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DESCRIPTION

PREFABRICATED BUILDING STRUCTURE

Technical field

The present invention relates to a prefabricated building structure.

Background art

- 5 Methods are known which allow the creation of prefabricated structures where the connections between the load-bearing elements can transfer moments. However, these methods become inefficient and very expensive when both vertical and horizontal elements are joined in the nodes. Furthermore, they do not allow an easy vertical insertion of wall elements.

10 **Disclosure of the invention**

In this context, the technical task underpinning the present invention is to provide a prefabricated building structure which obviates the drawbacks of the prior art as described above.

- In particular, it is an object of the present invention to provide a prefabricated
15 building structure which allows to optimise the speed and efficiency of the service while minimising the risk of errors. The stated technical task and specified objects are substantially achieved by a prefabricated building structure comprising the technical features set forth in one or more of the appended claims.

20 **Brief description of the drawings**

Further characteristics and advantages of the present invention will become more apparent from the indicative, and hence non-limiting, description of a preferred, but not exclusive, embodiment of a prefabricated building structure as illustrated in the appended drawings, in which:

- 25 - figures 1-9 show a sequence of steps for assembling the building structure;
- figure 10 shows a building structure having an alternative junction node with respect to that of figures 1-9.

Detailed description of the preferred embodiments of the invention

- In the appended drawings, reference number 1 indicates a prefabricated
30 building structure. Suitably, it is a prefabricated building structure in

concrete. Such a building structure therefore defines a building. It is of the prefabricated type and therefore the assembly of previously-made structural elements occurs on site.

Such a building structure 1 comprises a first and a second pillar 21, 22. The
5 first and the second pillar 21, 22 are reciprocally stacked. They have a preponderant longitudinal extension direction. The first and the second pillar 21, 22 extend preponderantly vertically. They are also stacked vertically.

An upper end 211 of the first pillar 21 is located at a lower end 221 of the second pillar 22. Suitably the upper end 211 and the lower end 221 are
10 facing each other. Suitably the upper end 211 of the first pillar 21 and the lower end 221 of the second pillar 22 are in reciprocal contact. The first pillar 21 is below the second pillar 22.

The structure 1 comprises a beam 3 extending substantially horizontally and has a first end 31 located at said upper end 211 and said lower end 221.

15 Suitably, the first pillar 21 and/or the second pillar 22 and/or the beam 3 is/are made of concrete.

The structure 1 comprises reciprocal fixing means 9 for reciprocally fixing the first pillar 21, the second pillar 22 and the beam 3 (see for example figures 9 and 10). The reciprocal fixing means 9 can be at least partly
20 incorporated in the first pillar 21, in the second pillar 22, in the beam 3.

Thereby, the first pillar 21, the second pillar 22 and the beam 3 define a junction area defining a node. Suitably, several beams can lie on the same node (such beams are typically transverse, in particular orthogonal to one another; suitably they lie on the same horizontal plane). The first and the
25 second pillar 21, 22 can therefore be in common between several incident vertical walls. The node is therefore a three-dimensional node. Suitably the node defines a hyperstatic joint.

The reciprocal fixing means 9 comprises projecting means 91 and corresponding housing means 92 in which the projecting means 91 fits
30 defining a joint (see for example figures 9 and 10). Suitably, the projecting means 91 and the housing means 92 are suitably counter-shaped. There

can be a minimum clearance (for example a few millimetres) to facilitate insertion.

The projecting means 91 and the housing means 92 define male-female connections both between the first pillar 21 and the beam 3 and between
5 the second pillar 22 and the beam 3.

Suitably, the projecting means 91 is obtained on both the first pillar 21 and on the second pillar 22. It fits in corresponding housing means 92 obtained on the beam 3.

Alternatively, the projecting means 91 (solution not shown) is obtained on
10 the beam 3 while the housing means 92 is obtained on both the first and on the second pillar 21, 22.

In a further solution not illustrated, the projecting means 91 is obtained partly on the beam 3 and partly on the first pillar 21 while the housing means 92 is obtained partly on the beam 3 and partly on the second pillar 22.

15 In a further solution not illustrated, the projecting means 91 is obtained partly on the beam 3 and partly on the second pillar 22 while the housing means 92 is obtained partly on the beam 3 and partly on the first pillar 21.

As exemplified in the accompanying figures, the projecting means 91 comprises:

- 20 -a first protrusion 213 located at said upper end 211 and associated to the first pillar 21;
-a second protrusion 223 located at said lower end 221 and associated to the second pillar 22.

The first and the second protrusion 213, 223 project transversally with
25 respect to the preponderant longitudinal extension direction 20. In particular the first and the second protrusion 213, 223 project horizontally. They can define flaps.

The housing means 92 comprises at a first end 31 of the beam 3 a slot 30. The first and the second protrusion 213, 223 at least partially fit in the slot
30 30 at the first end 31.

In an alternative solution not shown, the first and the second protrusion 213,

223 could fit in different slots of the beam 3.

In the preferred solution, the first pillar 21 comprises:

- a first element 215 comprising said first protrusion 213;
- a first support 214 to which the first element 215 is removably connected.

5 As exemplified in figure 10, the first element 215 is a head plate of the first support 214. Such a plate is horizontal. The first protrusion 213 is an edge of the plate or a part of the edge of the plate. Suitably the first and the second protrusion 213, 223 are reciprocally in contact within the slot 30.

As exemplified in figures 7-9, the first element 215 is an angle profile
10 comprising:

- a first arm 216 which connects to the first support 214 along a lateral flank 219 of the first support 214;
- a second arm 217 which projects away from the first support 214 and in which said first protrusion 213 is made.

15 Suitably the first and the second element 215, 225 (or the first and the second protrusion 213, 223) are not reciprocally in contact in the slot 30. They contact at least opposite surfaces of the slot 30. Between the first and the second element 215, 225 (or the first and the second protrusion 213, 223) there are interposed end plates 218 of the first and the second pillar
20 21, 22 which extend transversally to the preponderant extension direction 20.

Advantageously, the first protrusion 213 protrudes with respect to the first support 214 along a direction transverse (preferably orthogonal) to the direction 20 of greater extension of the first pillar 21.

25 The structure 1 also comprises threaded connecting means 4 which connects the first element 215 (or in any case the first protrusion 213) and the first support 214. The solution of figures 1-9 are schematically represented in figure 7. In the solution of figure 10, the means 4 is not displayed as it is hidden, but it is vertical screws which connect the first plate
30 element 215 with the first pillar 21.

The first support 214 advantageously comprises at least one threaded

housing forming part of the means 4; the first element 215 suitably comprises a through hole. The threaded connecting means 4 comprises at least a first screw 41 (advantageously a plurality of screws) which connects the first element 215 (and thus the first protrusion 213) to the first support 214. In this regard, preferably the first screw 41 transits in said through hole and comprises a threaded body which fits in said threaded housing. Suitably, the threaded connecting means 4 comprises a plurality of screws which transit in corresponding through holes of the first element 215 and fit in corresponding threaded housings of the first support 214.

Suitably what has been described with reference to the structure of the first pillar 21 can also be repeated for the second pillar 22.

Suitably the second pillar 22 comprises:

- a second element 225 comprising said second protrusion 223;
- a second support 224 to which the second element 225 is removably connected.

As exemplified in figure 10, the second element 225 is a head plate of the second support 224 (thus of the second pillar 22). Such a plate is horizontal. The second protrusion 223 is an edge of the plate.

In the solution in which several incident beams lie on the first and on the second pillar 21, 22 which lie on the same horizontal plane, the head plate (corresponding to the first element 215) of the first support 214 and the head plate (corresponding to the second element 225) of the second support 224 fit in both the slot 30 of the beam 3, but also in at least one other slot obtained on another of said incident beams (suitably each incident beam has its own slot in which the aforementioned head plates fit). Different peripheral edges of said head plates fit in the different slots. For example, such plates could be quadrilateral/polygonal and a first side of the quadrilateral fits in the slot 30 and a second side fits in a slot of another beam.

As exemplified in figures 7-9 the second element 225 is an angle profile comprising:

- a first section 226 connecting to the second support 224 along a lateral flank of the second support 224;
- a second section 227 which projects away from the second support 224 and in which said second protrusion 223 is made.

5 Advantageously, the slot 30 has a preponderant extension direction. Suitably, the slot 30 extends horizontally. Suitably, the slot 30 extends in width orthogonally to said preponderant longitudinal direction.

The first and the second protrusion 213, 223 are superposed one on the other and are joined in the width of the slot 30. In a particular embodiment
10 (see for example figure 10) the thickness of the first protrusion 213 added to the thickness of the second protrusion 223 is equal to the width of the slot 30.

Suitably the slot 30 accommodates only a peripheral flap of both the first and the second protrusion 213, 223.

15 Suitably, the beam 3 comprises an end plate 35 in which the slot 30 is obtained. The plate 35 is located in the first end 31.

The beam 3 (in particular the plate 35) comprises a plurality of holes 34; the structure 1 advantageously comprises threaded joining means 5 which crosses said holes 34 and inserts in threaded counter-shapings made in the
20 first and the second pillar 21, 22. The joining means 5 comprises a plurality of threaded elements which insert in the corresponding holes 34 and in the corresponding threaded counter-shapings. Preferably the threaded joining means 5 is stressed by pure traction. There are thus no shear loads. Suitably, in the solution of figures 1-9, the means 4 and the means 5
25 coincide. In the solution of figure 10, they are instead distinct.

As exemplified in figure 10, the structure 1 comprises enveloping means 8 which compresses said first pillar 21. It suitably exerts a post compression by winding. Thereby, the post-compression load can also be applied to the reciprocal fixing means 9. Suitably, the enveloping means 8 compresses
30 the first pillar 21 along the longitudinal extension direction. The enveloping means 8 overlaps two opposite ends of the first pillar 21. Suitably, the

enveloping means 8 can comprise a first enveloping 81 which transits in two bases and two opposite lateral flanks of the first pillar 21. The enveloping means 8 can comprise a second enveloping which affects the two bases and two further lateral flanks (distinct from the two mentioned just above) of the first pillar 21.

The enveloping means 8 can pass between the plate of the first element 215 and the first support 214.

The enveloping means 8 advantageously comprises a fibre-resin structure. In particular, it is a band. In the preferred solution the fibre is a glass fibre or a carbon fibre or a basalt fibre. Suitably, it is inert to corrosion and chemical attacks so that the durability of the elements is greatly increased.

The resin, for example, can be a polyester, vinyl ester, epoxy, polyurethane resin.

Suitably, the structure 1 can comprise enveloping means 80 which compresses the second pillar 22 (preferably along a preponderant extension direction). Suitably, the structure 1 can comprise enveloping means 800 which compresses the beam 3 (preferably along a preponderant extension of the beam 3).

Suitably, the first pillar 21, the second pillar 22 and the horizontal beam 3 are dry-connected without welds on site. They are also connected without having to make use of welds on site.

Suitably, the structure 1 comprises a wall 6 which lies in the plane identified by the first pillar 21 and by the beam 3. Such a wall 6 is suitably vertical. In particular, it is made of concrete. The wall 6 advantageously occludes (at least in part, preferably all) the space interposed between the first pillar 21 and the beam 3.

Suitably, the first pillar 21 has a lateral flank comprising parallel lateral flanks 62 which extend longitudinally along the preponderant direction 20 to house a portion of the wall 6. Suitably, the first pillar 21 has a quadrilateral shape and at each vertex of the quadrilateral it has longitudinal sides 62 which define four channels 63, one per flank. Suitably, the four channels 63 are

intended to house at least one portion of a corresponding wall.

Suitably, the building structure 1 is modular. In particular, it comprises a plurality of pillars, beams, walls assembled together. Advantageously, what has been described with reference to the first pillar 21 can advantageously
5 also be repeated for the second pillar 22. Suitably the first pillar 21 is identical to the second pillar 22.

Further subject matter of the present invention is a method for the assembly of a building structure 1 having one or more of the characteristics described previously. In particular, the method comprises the steps of:

- 10 -vertically positioning the first pillar 21 and an additional pillar 61, placing them at a predetermined distance from one another;
- positioning the wall 6 between the first pillar 21 and the additional pillar 61;
- positioning the beam 3 between the first pillar 21 and the additional pillar 61, placing it above the wall 6;
- 15 -positioning the second pillar 22 above the first pillar 21.

Suitably, the building structure 1 can be completed in the desired geometry, exploiting the modularity of the elements.

Suitably in the solution of figures 1-9 the method comprises the step of inserting the first and the second protrusion 213, 223 in the slot 30,
20 introducing two corresponding angle profiles comprising respectively the first and the second protrusion 213, 223 in cavities 64 which are between the first and the second pillar 21, 22 and the beam 3 already in position.

The present invention achieves important advantages.

Firstly, the nodes thus defined allow the transfer of very high specific
25 moments without having to resort to connection casts or welds on site.

Furthermore, the production of prefabricated elements (pillars, beams) is facilitated, as they are free from protrusions which require specific moulds.

The vertical loads supported by the horizontal beams can be transferred as compression and shear on the pillars. There are no shear loads on the
30 screws.

The structure 1 can be incorporated with the post-compression and thereby

the post-compression load is also applied to the fixing elements.

The invention as it is conceived is susceptible to numerous modifications and variants, all falling within the scope of the inventive concept characterised thereby. Furthermore, all the details can be replaced with
5 other technically equivalent elements. In practice, all the materials used, as well as the dimensions, can be any whatsoever, according to need.

CLAIMS

1. A prefabricated building structure, comprising:

- a first and a second pillar (21, 22) reciprocally stacked and having a preponderant longitudinal extension direction (20);

5 an upper end (211) of the first pillar (21) being located at a lower end (221) of the second pillar (22);

- a beam (3) extending substantially horizontally and having a first end (31) located at said upper end (211) and said lower end (221);

10 - reciprocal fixing means (9) for reciprocally fixing the first pillar (21), the second pillar (22) and the beam (3); said reciprocal fixing means (9) being able to be at least partly incorporated in the first pillar (21), in the second pillar (22), in the beam (3);

characterised in that the reciprocal fixing means (9) comprises projecting means (91) and corresponding housing means (92) in which the projecting

15 means (91) fits defining a joint;

said projecting means (91) and said housing means (92) defining male-female connections both between the first pillar (21) and the beam (3) and between the second pillar (22) and the beam (3).

2. The structure according to claim 1, characterised in that the projecting

20 means (91) comprises:

- a first protrusion (213) located at said upper end (211) and associated to the first pillar (21);

- a second protrusion (223) located at said lower end (221) and associated to the second pillar (22);

25 the first and the second protrusion (213, 223) projecting transversally with respect to said preponderant longitudinal extension direction (20);

the housing means (92) comprising at the first end (31) of the beam (3) a slot (30);

30 the first and the second protrusion (213, 223) at least partially fitting in the slot (30) at the first end (31).

3. The structure according to claim 2, characterised in that said first pillar

(21) comprises:

- a first element (215) comprising said first protrusion (213);
- a first support (214) to which the first element (215) is removably connected;

5 said second pillar (22) comprises:

- i) a second element (225) comprising said second protrusion (223);
- ii) a second support (224) to which the second element (225) is removably connected.

4. The structure according to claim 3, characterised in that the first element
10 (215) is a head plate of the first support (214) and the second element (225) is a head plate of the second support (224).

5. The structure according to claim 3 or 4, characterised in that the first element (215) is an angle profile comprising:

- a first arm (216) which connects to the first support (214) along a lateral
15 flank (219) of the first support (214);
- a second arm (217) which projects away from the first support (214) and in which said first protrusion (213) is made;

the second element (225) being an angle profile comprising:

- i) a first portion (226) which connects laterally to the second support (224);
- 20 ii) a second portion (227) which projects away from the second support (224) and in which said second protrusion (223) is made.

6. The structure according to any one of the preceding claims, characterised in that said slot (30) has a preponderant longitudinal direction and extending in width orthogonally to said preponderant extension
25 direction; the first and the second protrusion (213, 223) being superposed one on the other and being joined in the width of the slot (30).

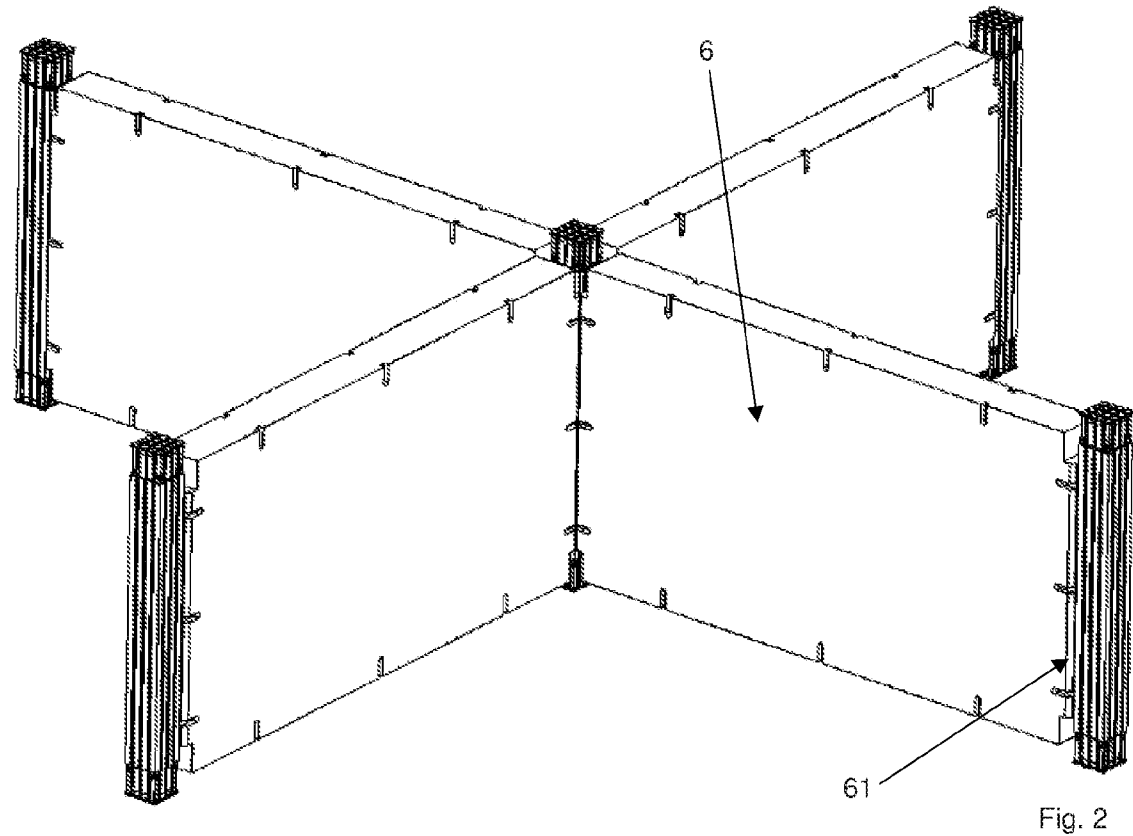
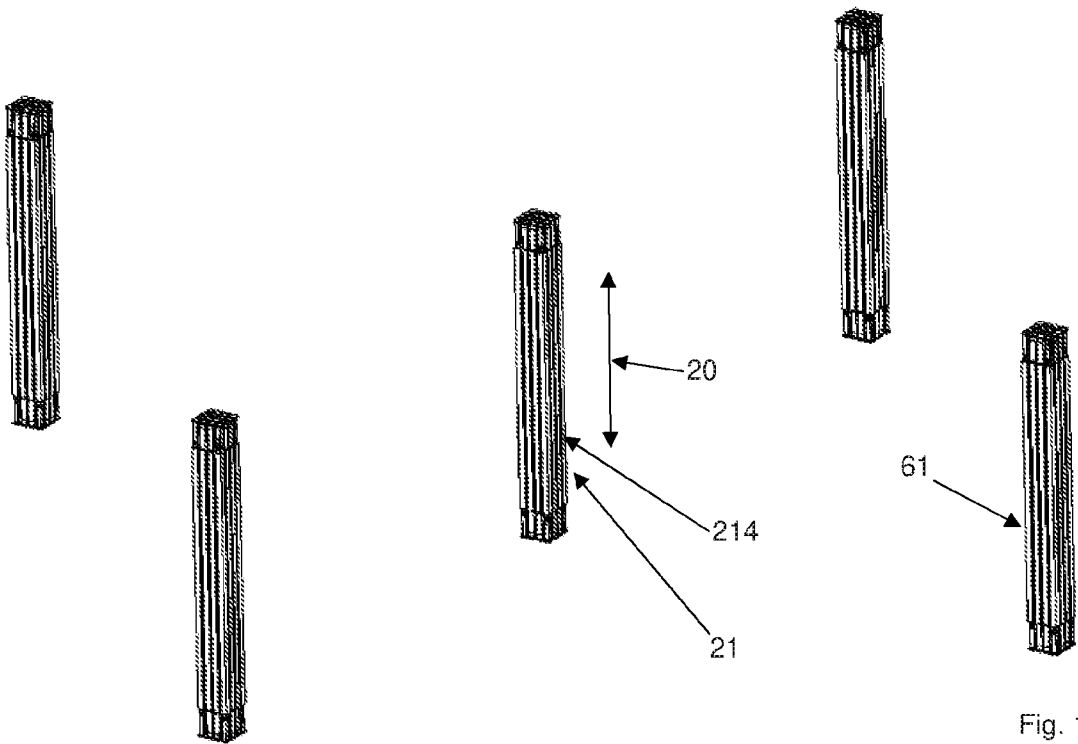
7. The structure according to any one of the preceding claims, characterised in that said beam (3) comprises a plurality of holes (34); said structure comprising threaded joining means (5) which crosses said holes (34) and
30 which inserts in threaded counter-shapings made in the first and the second pillar (21, 22); said threaded joining means (5) being stressed by pure

traction.

8. The structure according to any one of the preceding claims, characterised in that it comprises enveloping means (8) which compresses the first pillar (21) along the preponderant longitudinal extension direction (20).

5 9. The structure according to any one of the preceding claims, characterised in that the first pillar (21), the second pillar (22) and the horizontal beam (3) are dry-connected without welds.

10 10. The structure according to any one of the preceding claims, characterised in that it comprises a concrete vertical wall (6) which lies in the plane identified by the first pillar (21) and by the beam (3) and which occludes the space interposed between the first pillar (21) and the beam (3).



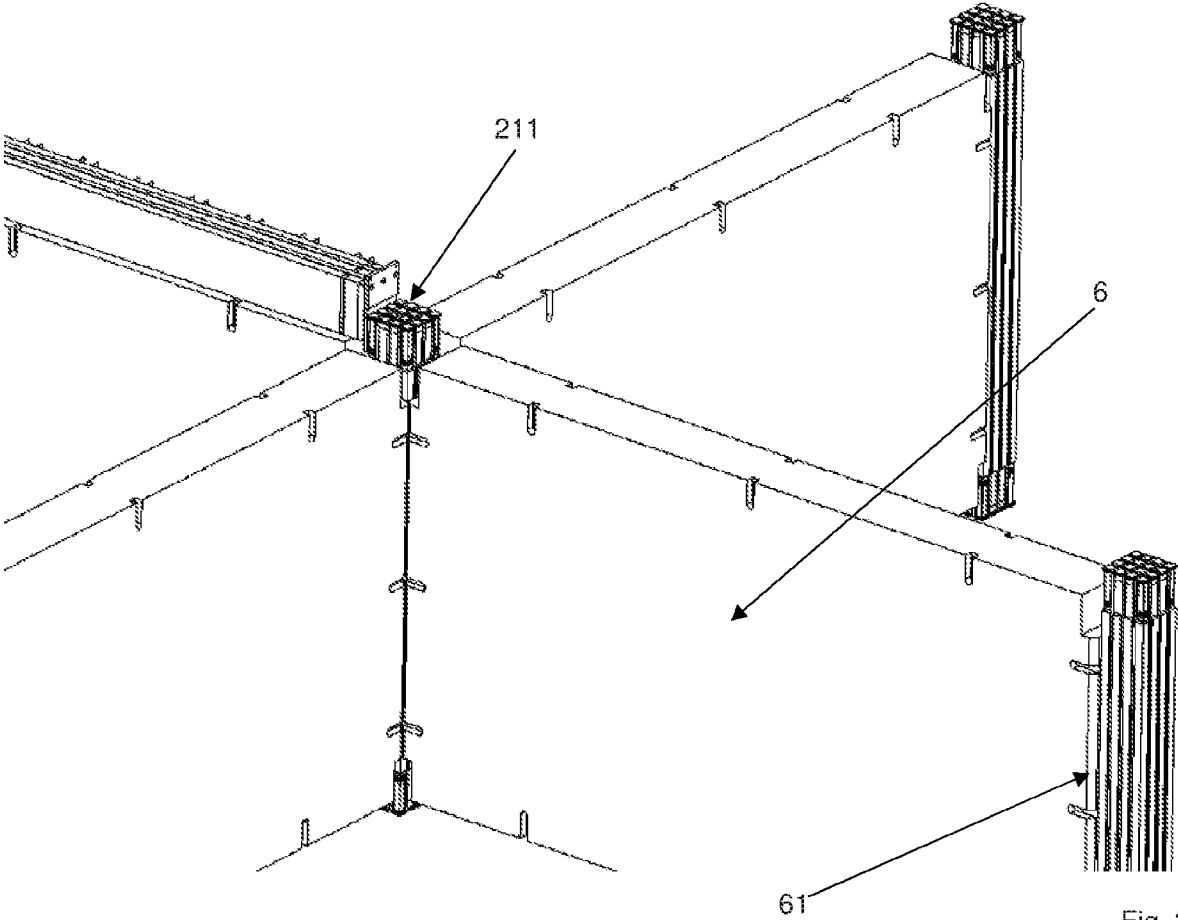


Fig. 3

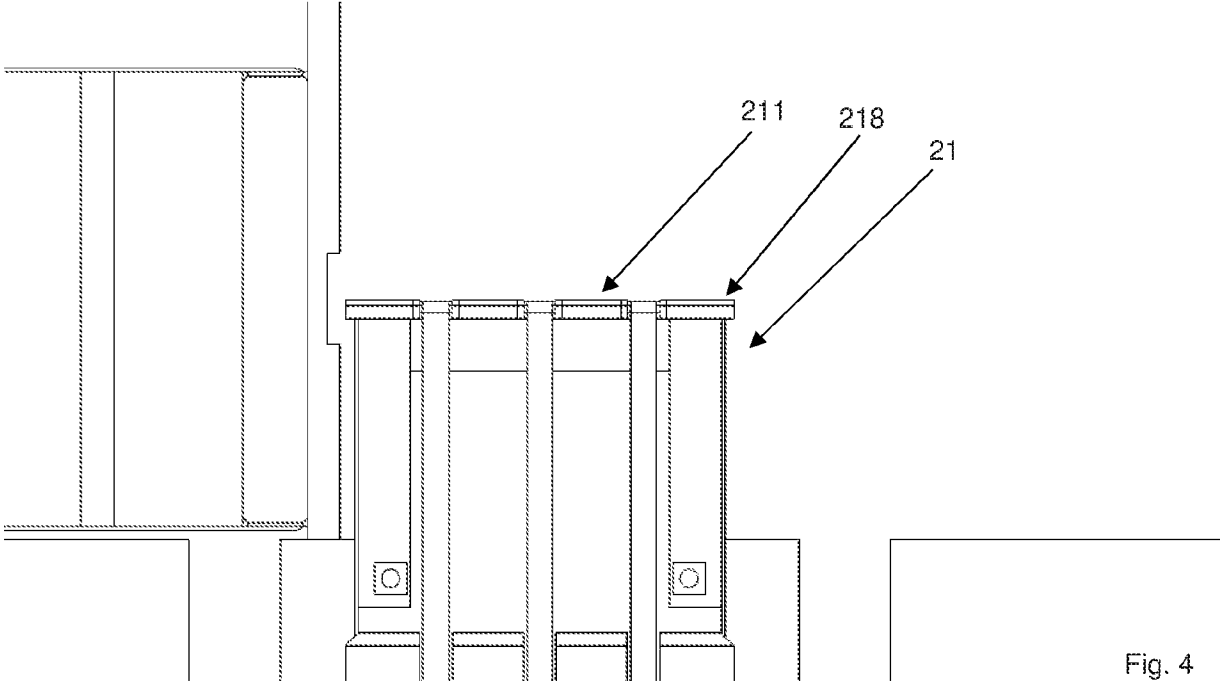


Fig. 4

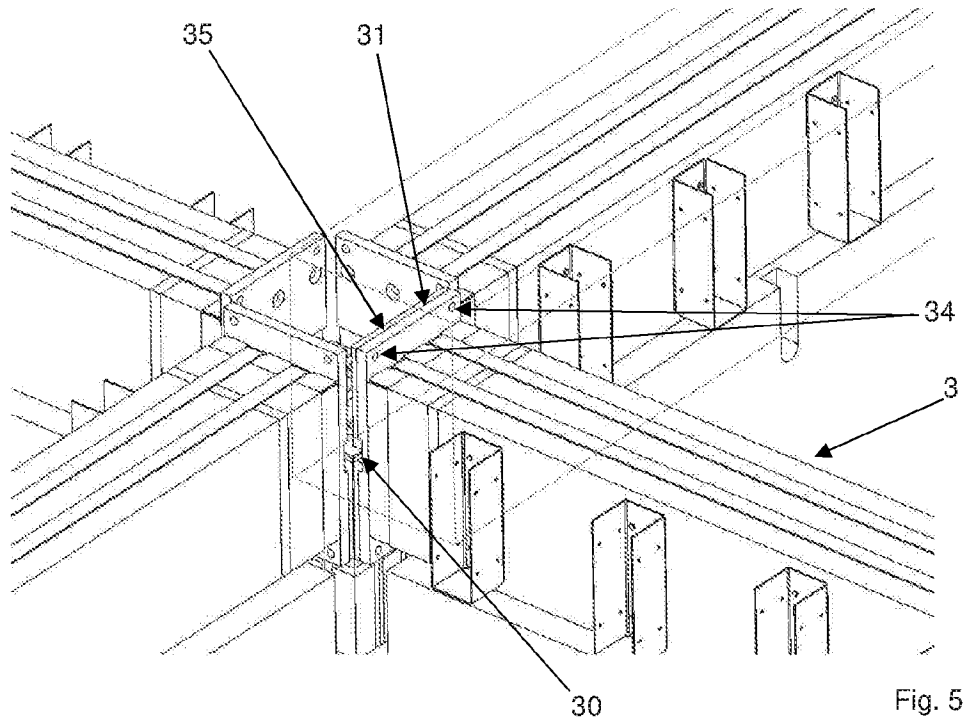


Fig. 5

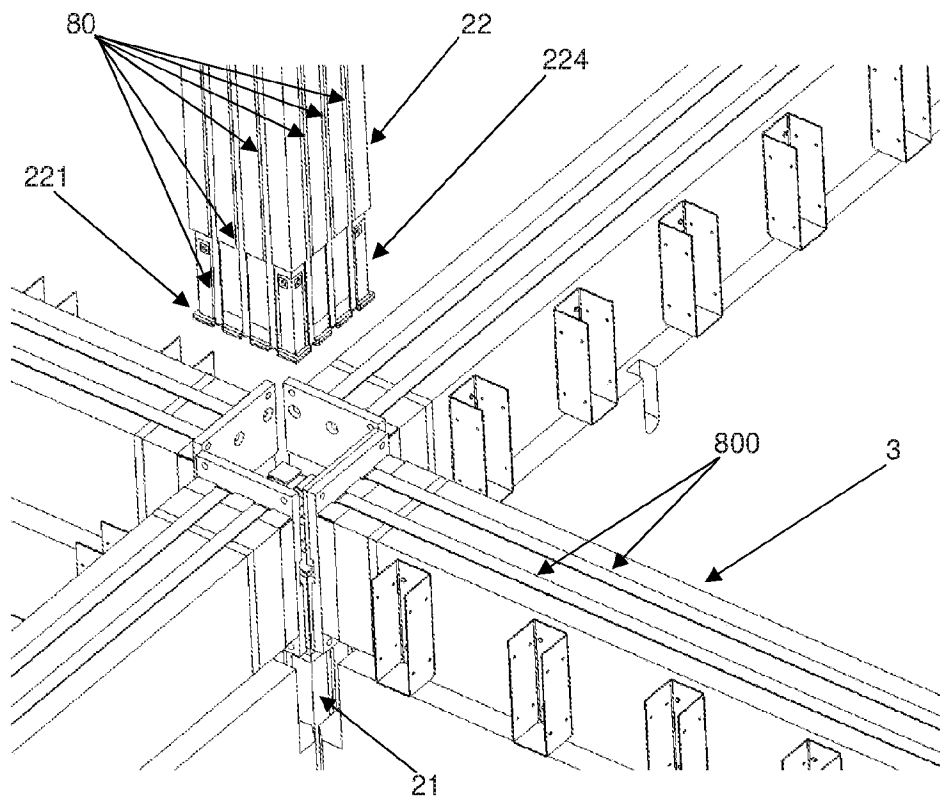


Fig. 6

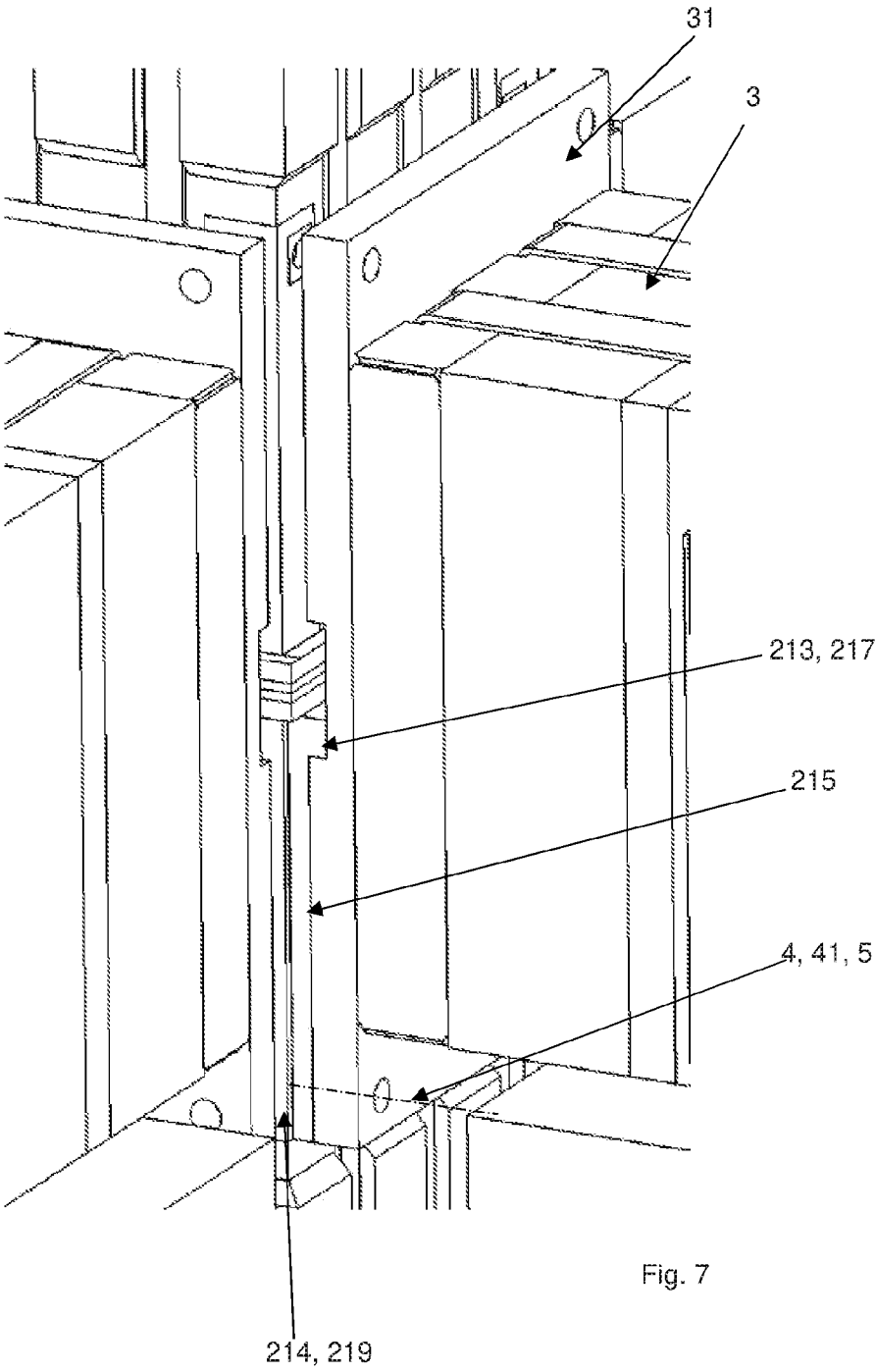


Fig. 7

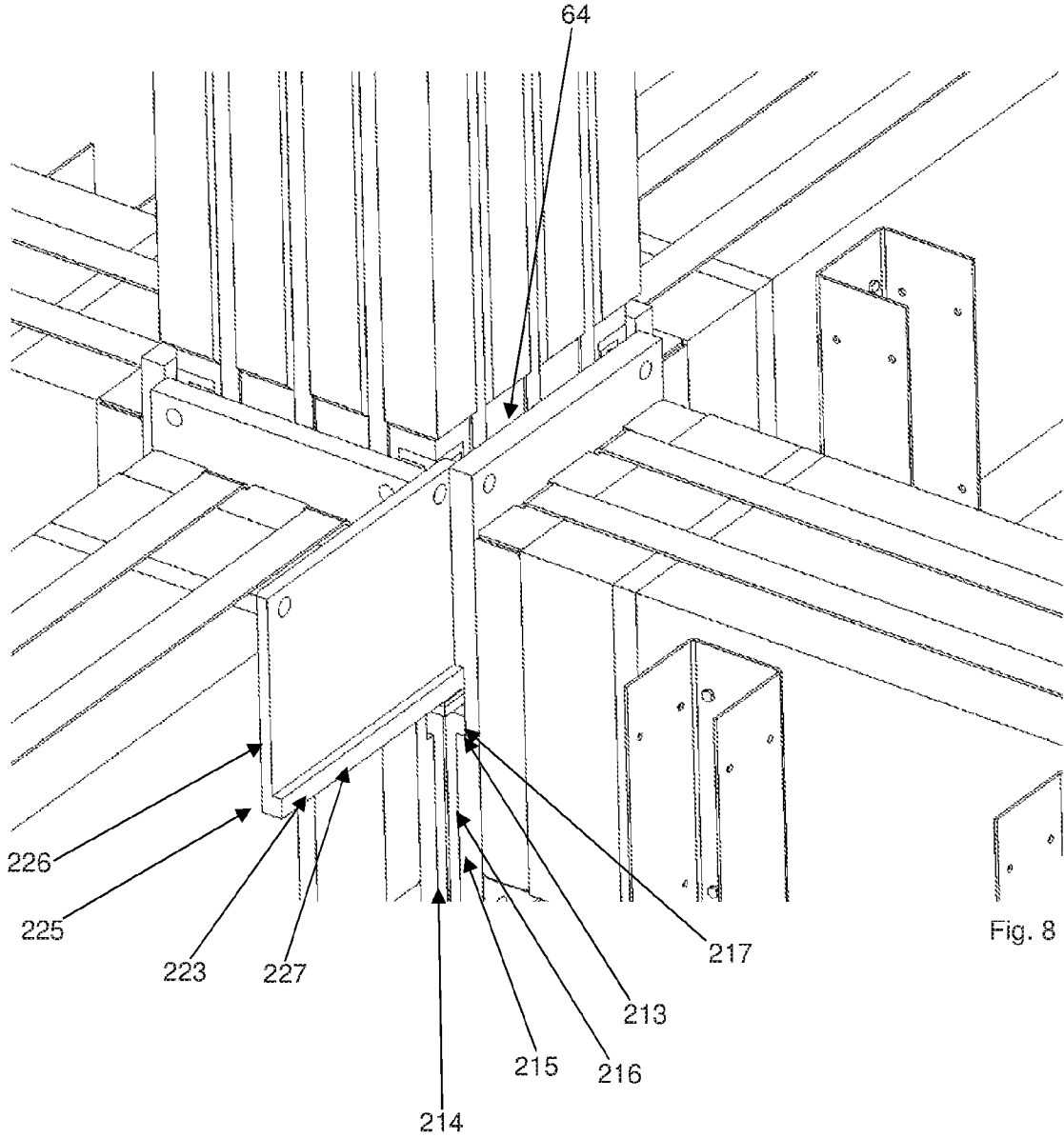


Fig. 8

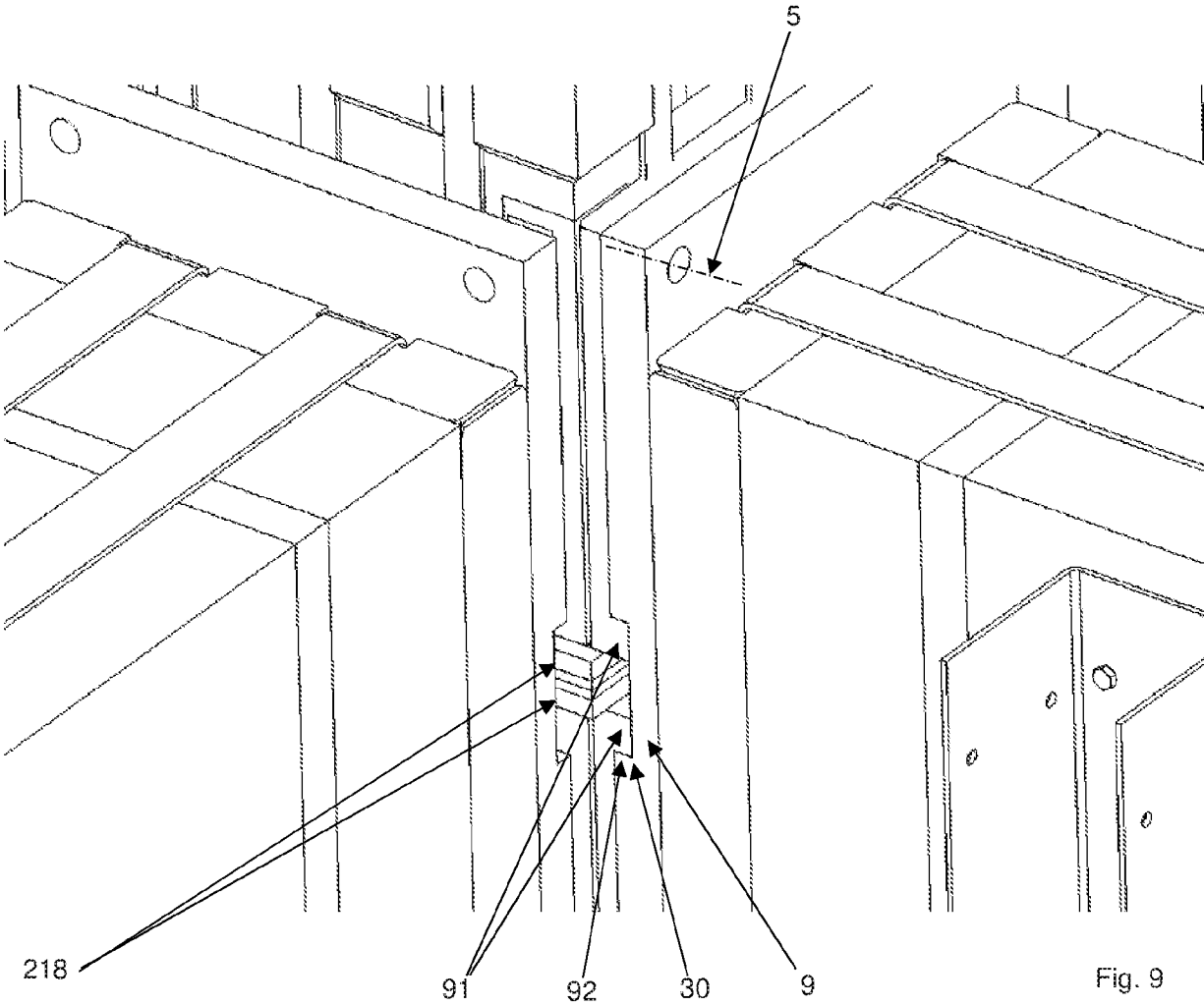


Fig. 9

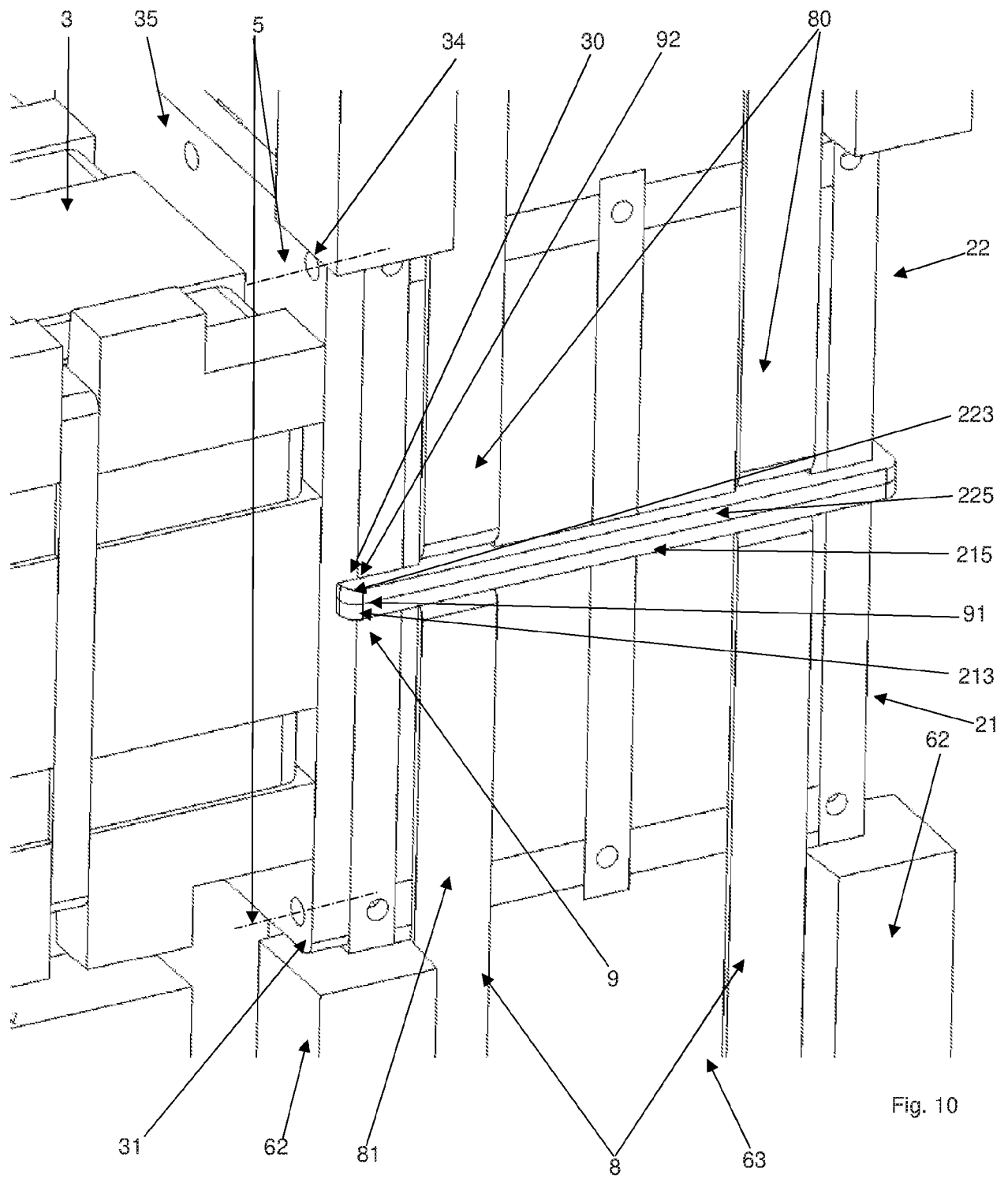


Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2022/057311

A. CLASSIFICATION OF SUBJECT MATTER INV. E04B1/21 ADD.		
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) 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) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 3 660 237 A1 (UNIV QINGDAO TECHNOLOGY [CN]) 3 June 2020 (2020-06-03) paragraphs [0021], [0025] - [0033]; figures 1-4 -----	1-10
X	FR 2 387 325 A1 (GEN BATIMENT [FR]) 10 November 1978 (1978-11-10) page 1, line 1 - line 4 page 2, line 2 - page 3, line 16; figures 1, 4, 6 -----	1, 9, 10
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search 29 August 2022		Date of mailing of the international search report 06/09/2022
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Melhem, Charbel

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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