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(54) **AN INTERCONNECTION AND FIXING SYSTEM FOR INTERCONNECTING AND FIXING MODULAR TRAFFIC DIVIDERS**

(57) The present invention relates to an interconnection and fixing system (1000) for interconnecting and fixing modular traffic dividers. The system (1000) comprises a connection upright (100, 100', 100'') having an H-shaped cross-section, a base sleeve (300) inserted into the ground, two guides (200) fixed to the respective modules to be coupled and to said connection upright, and removable locking means (400). The present invention also relates to an interconnection and fixing system (1000) for interconnecting and fixing modular traffic dividers even different from one another.

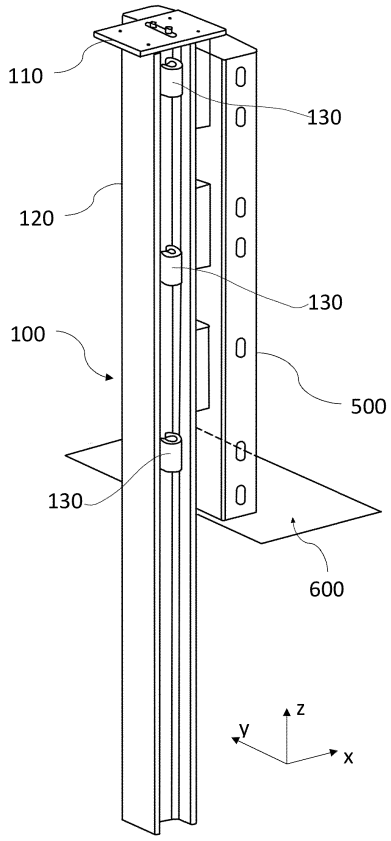

fig.2

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Description

[0001] The present invention relates to an interconnection and fixing system for interconnecting and fixing modular traffic dividers.

Background art

[0002] The present invention relates to an interconnection and fixing system for interconnecting and fixing modular traffic dividers to the ground.

[0003] As known, traffic dividers are essential for ensuring road safety and, to this end, they must be made of high-quality materials and comply with national and European regulations.

[0004] In accordance with current Italian legislation, traffic dividers and other retaining devices are installed to ensure acceptable safety conditions for the users of a road, taking into account the particular configuration of the latter. The role of these devices is to contain and redirect vehicles, which might veer off the carriageway, absorbing part of the kinetic energy thereof and limiting the effects of the collision on passengers as much as possible.

[0005] For the design of these road elements, it is necessary to consider not only the compliance with the current regulations, but also look at the specific needs of the context in which they are installed. For this reason, a holistic approach is needed, which takes into account the geometry of the road, the type of vehicles traveling thereon, and the environmental conditions, in order to ensure maximum safety for road users and by-passers.

[0006] In order to classify the traffic dividers, a hierarchical division into varying energy resistance classes is used, as provided by European regulation EN 1317. Said division ranges from class H1, indicating the minimum resistance, to class H4, indicating the maximum resistance.

[0007] In order to evaluate the dynamic performance of the traffic dividers, two fundamental parameters are considered: the operating width Wm and the dynamic deflection Dm. The operating width represents the distance between the points in which the collision is absorbed by the barrier, while the dynamic deflection indicates the maximum flection endured by the barrier following the collision.

[0008] Two parameters are also used to describe the reaction of the traffic dividers in the case of an impact: the *Acceleration Severity Index (ASI)*, which takes into account the acceleration of the vehicle after the impact, and an index indicating the theoretical impact velocity on the driver's head (*THIV*, *Theoretical Head Impact Velocity*).

[0009] Finally, another important parameter is the reference scale T, N, L and H, which allows evaluating the containment level following the impact with a heavy vehicle and the severity of the collision following the impact with a light vehicle.

[0010] Today, for roads with dual lanes and highways, it is common to find traffic dividers made of reinforced concrete or steel, used to delimit the traffic division and ensure maximum safety for road users.

[0011] These traffic dividers are usually spaced apart by dividing gaps, which are open areas allowing drivers to change lane in the case of emergency or if necessary. In particular, the opening span of such dividing gaps is usually of about 40 linear meters, however the installation frequency thereof depends on several factors, such as the presence of exits or tunnels and the environmental conditions. In order to ensure maximum road safety, the installation distance of the dividing gaps is generally of about 2 km from one another. These discontinuities are a critical factor for the road safety since they generate interruptions in the barriers which, in addition to causing accidents due to crossing, can also create dangerous points for the drivers. In view of the importance of road safety, it is essential to provide protection systems which are suitable for these discontinuities in order to prevent potential accidents and ensure maximum safety for road users.

[0012] The barrier in patent document US2019284773A1 is also known, where the barrier has a first vertical support and a second vertical support. A first wall panel is arranged between the first vertical support and the second vertical support. A second wall panel is arranged between the first vertical support and the second vertical support above the first wall panel. An I-beam is arranged between the first wall panel and the second wall panel. The I-beam includes a first flange and a second flange extending into the first wall panel and into the second wall panel. A rope is arranged between the first wall panel and the second wall panel. The I-beam includes a ridge around the rope. A grounding wire is connected to the I-beam. The first wall panel comprises a first channel extending over a length of the first wall panel. A first strip of soundproof material is arranged in the first channel. A traffic divider is arranged beneath the first wall panel.

[0013] These road containment systems require, today more than ever, not only a design in accordance with the national and European standards, but also an installation process which ensures the correct execution thereof.

Purpose and object of the invention

[0014] It is the object of the present invention to provide a system which completely or partially overcomes the problems of the prior art.

[0015] A system according to the appended claims is the subject of the present invention.

Detailed description of embodiments of the invention

List of figures

[0016] The invention will now be described by way of nonlimiting example, with particular reference to the figures in the accompanying drawings, in which:

- figure 1 shows a partial perspective view of an embodiment of the interconnection and fixing system according to the present description, used for coupling two traffic divider modules;
- figure 2 shows a perspective view in which the connection upright according to an embodiment of the present description is highlighted;
- figure 3 shows three sectional views at different heights of the connection upright, according to an embodiment of the present description;
- figure 4 shows in (a) a perspective view in which the guide is highlighted, and in (b) a sectional view of the guide, according to an embodiment of the present description;
- figure 5 shows a perspective view in which the base sleeve according to an embodiment of the present description is highlighted;
- figure 6 shows a partial top perspective view of the base sleeve, according to an embodiment of the present description;
- figure 7 shows in (a) a perspective view and in (b) a further detailed, partial perspective view of the anchoring bar, according to an embodiment of the present description;
- figure 8 shows in (a) a perspective view of the initial insertion position ("unlocked") of the bar inside the retaining element, and in (b) a perspective view of the final insertion position of the bar inside the retaining element ("locked");
- figure 9 shows in (a) a perspective view of an embodiment of the interconnection and fixing system according to the present description (without the guides, not shown), and in (b) a detailed perspective view of the head plate;
- figure 10 shows in (a) a perspective view of the base sleeve according to an embodiment of the present description, and in (b) a detailed perspective view of the retaining element;
- figure 11 shows a detailed perspective view of the upper portion of the connection upright, according to an embodiment of the present description;
- figure 12 shows a partial perspective view of an embodiment of the interconnection and fixing system according to the present description (without the guides, not shown);
- figure 13 shows two partial perspective views of a third embodiment of the interconnection and fixing system according to the present description, in which in (a) the base sleeve is highlighted, and in (b) the connection upright is inserted into the base sleeve;
- figure 14 shows a partial perspective view of a third embodiment of the interconnection and fixing system according to the present description, in which the connection between the base sleeve and the connection upright is shown;
- figure 15 shows a partial perspective view of an embodiment of the interconnection and fixing system according to the present description, used for coupling two traffic divider modules;
- figure 16 shows two partial perspective views of two portions of the interconnection and fixing system in figure 15;
- figure 17 shows a partial perspective view of the elements of an embodiment of the interconnection and fixing system according to the present description, used for coupling two traffic dividers;
- figure 18 shows two partial perspective views of two steps of the interconnection process by means of the system in figure 17; and
- figure 19 shows a partial top perspective view of a further embodiment of the interconnection and fixing system in figure 17.

[0017] It is here specified that elements of different embodiments can be combined to provide further embodiments, without restrictions, by respecting the technical concept of the invention, as those skilled in the art will effortlessly understand from the description.

[0018] The present description also makes reference to the prior art for the implementation thereof in relation to the detail features not described, such as elements of minor importance usually used in the prior art in solutions of the same type.

[0019] When an element is introduced, it is always understood that there can be "at least one" or "one or more".

[0020] When a list of elements or features is given in this description, it is understood that the finding according to the invention "comprises" or alternatively "consists of" said elements.

[0021] When listing features within the same sentence or bullet list, one or more of the single features can be included in the invention without connection with the other features on the list.

Embodiments

[0022] With reference to Fig. 1, an interconnection and fixing system 1000 for interconnecting and fixing modular traffic dividers is shown.

[0023] The traffic divider is of the modular type, i.e., it consists of a plurality of modules 500 placeable side by side in a direction parallel to the main direction of the road stretch, so that it is possible to form a traffic divider with a varying length.

[0024] In the accompanying drawings, the road surface 600 is a plane parallel to the reference plane x-y, perpendicular to a vertical reference axis z, along which

the traffic divider extends in height. The main direction of the road stretch is parallel to the reference axis x.

[0025] Said interconnection and fixing system 1000 is configured to:

- couple two consecutive modules 500 to each other so as to make them integral; and
- fix the traffic divider to the ground.

[0026] The interconnection and fixing system 1000 comprises a connection upright 100 having an H-shape in the cross-section.

[0027] Said connection upright 100, shown in Fig. 2, extends in height along an axis parallel to the reference axis z, and since it is also configured to directly connect to the ground, it is dimensioned with a height equal to the height of the modules 500 added to the ground fixing depth.

[0028] As shown in Fig. 2, the connection upright 100 comprises a body 120 having an H shape in the cross-section and, optionally, a head plate 110 and a plurality of guide rings 130, the latter arranged inside the body 120, symmetrically to a centerline plane parallel to the reference plane x-z (on either side of said perpendicular portion 121), adapted to house and align the successive anchoring systems (optional) as described below.

[0029] Fig. 3 shows the cross-section of the connection upright 100 at three different heights. In particular, in (a)the cross-section of the head plate 110 is shown; in (b) the cross-section of the body 120 with the guide rings 130 is shown, and in (c) the cross-section of only the body 120 is shown.

[0030] As shown in Fig. 3(a), said head plate 110 has a substantially quadrangular plan shape and an oval-shaped slot or recess 111 is obtained centrally therein, where the major axis is parallel to the reference axis y and the minor axis is parallel to the reference axis x. Note that the periphery of the slot 111 circumscribes the area where the guide rings 130 are present at the bottom, shown in Fig. 3(b).

[0031] In the plane parallel to the x-y plane shown in Fig. 3(c), the H-shaped cross-section of the body 120, comprises a central core 121 or perpendicular portion of the H, extending along a direction parallel to the reference axis x and two parallel segments or flanges 122, 123, extending in a direction parallel to the reference axis y. In practice, the H is formed by the two parallel segments transversely joined by the perpendicular portion.

[0032] As shown in fig. 4(a), the interconnection and fixing system 1000 according to the present description further comprises two guides 200, placed on the respective two modules 500, to be coupled and configured to house the connection upright 100. The two guides 200, with extension along the reference axis z, are fixed to the respective two modules 500 and configured to receive, along the same axis z, the two parallel segments 122,123 of the upright 100, respectively, so as to couple the two modules 500 together.

[0033] Fig. 4(b) shows an embodiment of the cross-section of the guides 200 in a plane parallel to the reference plane x-y, which comprises:

- a first side 201 parallel to the reference axis y, comprising a first end 201_1 and a second end 201_2;
- two sides 202, 203 parallel to the reference axis x, extending from the first 201_1 and second 201_2 ends of the first side 201, respectively;
- two further sides 204, 205 parallel to the reference axis y, extending from the opposite end of the two sides 202, 203 with respect to the first 201_1 and second 201_2 ends of the first side, respectively, so as to leave an open central space 206 therebetween.

[0034] The interconnection and fixing system 1000 further comprises a base sleeve 300, shown in Fig. 5. Said base sleeve 300 is completely buried in the ground and is adapted to contain the connection upright portion 100 which is inserted therein.

[0035] The base sleeve 300 extends in height along an axis parallel to the reference axis z and comprises a plate-like portion 310, a rectangular parallelepiped-shaped body 320, and a lower portion 330, preferably frustoconical in shape, with the tip facing downwards.

[0036] As said, such an interconnection and fixing system 1000 also allows anchoring the whole traffic divider to the ground, avoiding the modules 500 from being free to translate vertically and thus, during the collision, uncoupling from the base sleeve buried in the ground.

[0037] In fact, it is important to make a coupling system not only between the upper modules, but also between each upper element and the relates founding element.

[0038] In this respect, the interconnection and fixing system 1000 comprises removable locking means 400 for locking the connection upright 100 and the base sleeve 300 to each other. It is thus possible to avoid the traffic divider from lifting off the ground in the case of a collision.

[0039] As shown in Fig. 6, according to a preferred embodiment of the present description, inside said base sleeve 300 and close to the plate-like portion 310, two retaining elements 420 are symmetrically welded, having an upper U-shaped surface 421, positioned so that said upper surface 421 lies on the same plane as the upper surface of the plate-like portion 310. The function of the retaining elements will be described below.

[0040] Advantageously, the locking means 400 can use two cylindrical anchoring bars 410 (similar to that shown in Fig. 7(a)), having one or more "teeth" 411 (extending over an arc of a circle of the bar section), adapted to interlock in respective stops located on the base sleeve 300 and on the connection upright 100, by a 90° rotation. Fig. 7(b) shows, in greater detail, the "teeth" 411 located on each anchoring bar 410.

[0041] Advantageously, as shown in Fig. 7(a), each anchoring bar 410 has a head nut 412 at the top and an outer cross-section washer 413 larger than the circular

section of the bar 410.

[0042] Fig. 8 shows two operating positions of the operation of mounting each anchoring bar 410: in particular, in Fig. 8(a), once the toothed anchoring bar 410 has been inserted from above through the slot 111 made on the head plate 110 of the connection upright 100 and passed through the different guide rings 130, it is positioned inside the base sleeve 300. Fig. 8(b) shows the locking position after a 90° rotation of the anchoring bar 410, in which the "tooth" 411 is in contrast on the lower surface of the retaining element 420, even when the latter is the above U-shaped element.

[0043] Advantageously, the same type of interlocking can also be repeated close to some guide rings 130 of the connection upright 100, to improve the anchoring bar 410 being integral with the connection upright 100.

[0044] Advantageously, as shown in Fig. 9(a), plates 112, 113 and a stop 430 or "retaining lug" are welded onto the head plate 110 and the head nut 412, respectively, freely extending along the plane xy from the other end, adapted to limit the rotation of the bar 410 by 90° and move from the "open" position to the "closed" position and vice versa.

[0045] Advantageously, it is possible to make holes on both the head nut 412 and the plates 112, 113 to allow inserting pins or cotter pins in order to block the rotation of the bar 410.

[0046] Fig. 9(b) shows the interconnection and fixing system of the present description according to an embodiment. All the elements forming the system are depicted in the figure, except for the two guides 200 fixed to the respective modules 500 (also not shown).

[0047] Advantageously, with reference to a further embodiment, each retaining element 420, as shown in Figs. 9(a) and 9(b), can have an inner threaded surface 440, obtained, for example, by welding an anchor bolt nut. Fig. 10(b) shows the retaining element 420 inside the base sleeve 300. The retaining element 420 it can be a bar 410.

[0048] Moreover, as shown in Fig. 11, the connection upright 100' comprises a quadrangular head plate 110', in which two circular holes 111' are obtained, having a diameter such as to be crossed by two anchoring bars 410' (shown in Fig. 12). The insertion of the anchoring bars 410' into the two circular holes 111' also has the function of limiting the movement of the modules 500 upwards.

[0049] Each bar 410' is inserted from above and configured to be screwed into the cores with inner thread of the respective retaining element 420.

[0050] Fig. 12 shows the interconnection and fixing system according to a further embodiment of the present description. All the elements forming the system are depicted in the figure, except for the two guides 200 fixed to the respective modules 500.

[0051] With reference to a further embodiment, the locking means 400 advantageously comprise, as shown in Figs. 13(a) and 13(b), two load rings 450. Said load rings 450 can rotate about a horizontal axis parallel to the reference axis x. Like the retaining elements 420, each load ring 450 is welded in the area which remains empty inside the base sleeve 300 when the connection upright 100'' is inserted therein.

[0052] The rotation of said load rings 450, from a first closed position in the plane x-y to a second open position in the plane x-z, allows them to be lifted during the anchoring and lowered into the cavity with gap removed. The rings 450 are thus concealable once the gap is removed, so as not to obstruct the passage of vehicles.

[0053] Advantageously, the core of the connection upright 100'' is perforated close to the foot coaxially to the two load rings 450, to house a threaded fixing bar, along with suitable connection elements, such as plates and nuts, shown in Fig. 14.

[0054] The operation can easily be carried out by the operator on site during the mounting operation, since the free space between the modules placed side by side is wide enough to leave a usable space for a hand to be inserted.

[0055] According to a preferred embodiment, shown in Fig. 15, a non-tensioned rope 460 can be installed between each load ring 450 and the respective side of the head plate 110, to reinforce the fixing of the traffic divider modules with respect to the ground, and limit the vertical movement of the base sleeve 300, alternatively to the anchoring bar or to the above threaded bar.

[0056] Figure 16 (a) shows the detail of the upper connection between the non-tensioned rope 460 and the head plate 110. In particular, the rope 460 is connected to the head plate 110 by means of a hook or carabiner 461 fixed to a threaded and bolted terminal 462, which also possibly allows the rope 460 to be tensioned.

[0057] Figure 16 (b) shows the detail of the lower connection between the non-tensioned rope 460 and the load ring 450. In particular, the rope 460 is connected to the load ring 450 by means of a further hook or carabiner 461 directly fixed to the load ring 450. With reference to Figs. 17-19, a further embodiment of the interconnection and fixing system according to the present description is shown. In particular, the objective is to provide a system 1000' adapted to connect two traffic dividers even different from each other, e.g., a modular divider 500 of the type described above and a further traffic divider 500', preferably a New Jersey barrier. This system can be added to that described above when the connected traffic dividers are more than two in number, thus there will be the connection with the H-bar between two or more modules and one or more connections described below between at least two modules (instead of the other connection system for the connection between these two modules).

[0058] As shown in Fig. 17, said system comprises a first connection upright 100a fixed to a specific guide (not shown in the figure) of the first traffic divider 500, a second connection upright 100b fixed to a specific guide (not shown in the figure) of the second traffic divider 500' and a cylindrical interconnection pin 700. The connection up-

rights are H-shaped, as described above. The guides 200 above are also present in the modules.

[0059] The first connection upright 100a and the second connection upright 100b each comprise two hinges 140, installed in mutually offset positions, so that when the two uprights 100a and 100b approach each other, the respective hinges 140 are aligned with respect to the same vertical axis z'.

[0060] Fig. 18 shows two steps of the interconnection process by means of the system of the invention: in (a) the two traffic dividers 500, 500' are mutually brought together until they are coaxial with respect to an axis z' between the hinges 140 of the respective connection uprights 100a, 100b; in (b) the final assembly position is shown, in which the cylindrical pin 700 is inserted into the hinges along the axis z'.

[0061] Advantageously, the cylindrical pin 700 (generally speaking, removable hinge locking means) has a length such as to be buried, terminating inside a base compass, previously fixed to the ground (not shown in figure).

[0062] When the mounting operation is complete, it is possible to rotate the module 500' or 500 about the axis z', in order to allow temporarily opening a road gap.

[0063] According to a particularly advantageous embodiment, shown in Fig. 19, it is possible to use four further transverse pins 800, one for each hinge 140.

[0064] Each transverse pin 800 is transversely inserted into the direction z passing through the hinge 140 and the cylindrical interconnection pin 700. The crossing is at least on one point of the cylindrical circumference of these elements, but preferably in two diametrically opposite points. Obviously, in this case, both the pin 700 and the hinge 140 are pre-perforated, so that when the pin 700 is completely inserted into the hinges 140, a coaxial hole is present between each hinge 140 and the pin 700.

[0065] In this case, the pins 800 prevent the relative rotation of the two traffic dividers 500, 500'.

[0066] Generally speaking, there will be removable hinge locking means 700,800 configured to mutually lock said respective hinges 140 aligned with respect to the reference axis z, regardless of the particular embodiments.

[0067] Two or more of the parts (elements, devices, systems) described above can be freely associated and considered as a part kit according to the invention.

Advantages of the invention

[0068] The system according to the invention allows removably interconnecting and fixing modular traffic dividers to the ground.

[0069] The modularity allows adapting the size of the traffic divider at will, depending on the particular needs of the single road stretch.

[0070] The system according to the invention also allows uncoupling the divider from the ground and the single modules from one another, allowing for the creation of gaps which can quickly be removed if required. Moreover, the elements forming the system according to the invention are concealable once the gap is removed, not obstructing the passage of the vehicles.

[0071] Preferred embodiments have been described above and variations of the present invention have been suggested, but it should be understood that those skilled in the art may make modifications and changes without departing from the related scope of protection, as defined by the appended claims.

Claims

1. An interconnection and fixing system (1000) for interconnecting and fixing modular traffic dividers, wherein said traffic divider consists of a plurality of modules (500) placeable side-by-side in a longitudinal direction parallel to a reference axis x lying in a horizontal reference plane x-y, the system (1000) comprising:

   - a connection upright (100,100',100") , extending in height along an axis parallel to a reference axis z, perpendicular to the horizontal reference plane x-y, the upright comprising a body (120) having a cross-section in the plane x-y in the shape of two parallel segments (122,123) joined by a perpendicular portion (121);
   - two guides (200) with extension along the reference axis z, fixed to the respective two modules (500) and configured to receive, along the same axis z, the two parallel segments (122,123) of the upright (100,100',100"), respectively, so as to couple the two modules (500) together;
   - a base sleeve (300), extending in height along the reference axis z and comprising a plate-like portion (310) and an elongated body (320), said base sleeve (300) being configured to be buried and receive a portion of the connection upright (100,100',100"); and
   - removable locking means (400) configured to lock the connection upright (100,100',100'') and the base sleeve (300) to each other.

2. A system (1000) according to claim 1, wherein the removable locking means (400) comprise:

   - two anchoring bars (410,410') with cylindrical extension, each having a head nut (412) at the top and a washer (413) with a larger diameter than the diameter of the bar (410) itself and, in a same direction parallel to the reference axis z along said cylindrical extension, a plurality of teeth (411) extending along an arc of a circle; and

- two retaining elements (420) fixed inside the base sleeve (300), configured to partially receive the two anchoring bars (410) and lock them, in use, upon rotation of the anchoring bars (410), by interference along the reference axis z with two respective teeth of said plurality of teeth (411),

wherein:

- the connection upright (100) further comprises:

o a plurality of guide rings (130), symmetrically arranged on either side of said perpendicular portion (121), adapted to receive and align said anchoring bars (410) locking them, in use, upon rotation of the anchoring bars (410), by interference of respective teeth (411) of said plurality of teeth (411) along the reference axis z; and
o a head plate (110,110'), having a substantially quadrangular shape on which at least one recess (111, 111') is obtained for inserting the two anchoring bars (410).

3. A system (1000) according to claim 2, wherein the retaining elements (420) have a U-shaped upper surface (421) and are positioned so that said upper surface (421) lies on the same plane as the upper surface of the plate-like part (310) and interlocks the respective teeth (411) of the anchoring bars (410), in use, below the upper surface (421) of the retaining elements (420).

4. A system (1000) according to claim 2 or 3, wherein:

- a retaining lug (430) freely extending along the plane xy is fixed to the head nut (412); and
- the head plate (110) comprises two pairs of plates (112, 113), each pair of plates (112, 113) being arranged perpendicularly so that said retaining lug (430) and said plates limit the rotation of the head nut (412), and therefore of the anchoring bar (410), by 90°.

5. A system (1000) according to claim 2, wherein the retaining elements (420) have a threaded inner surface (440) and the two anchoring bars (410) are configured to be screwed into the threaded inner surface of the retaining elements (420).

6. A system (1000) according to claim 1, wherein the removable fixing means (400) comprise two load rings (450) configured to rotate about a horizontal axis parallel to the reference axis x from a first closed position in the plane x-y to a second open position in the plane x-z, said perpendicular portion (121) of the connection upright (100") comprising a hole being coaxial to the two load rings (450) in the open position for receiving a threaded fixing bar.

7. A system (1000) according to claim 1, wherein the removable fixing means (400) comprise two non-tensioned ropes (460).

8. A system according to one of claims 1 to 7, wherein at least two modules of said plurality of modules (500) and at least one additional module (500') are present, installed in sequence in said longitudinal direction, wherein the system (1000) comprises a further connection system (1000') between one of said two modules and said at least one additional module (500'), the further connection system (1000') comprising:

- a first connection upright (100a) and a second connection upright (100b), each upright extending in height along an axis parallel to a reference axis z, perpendicular to the horizontal reference plane x-y, the first and second uprights each comprising:

o a body (120) having a cross-section in the plane x-y in the shape of two parallel segments (122,123) joined by a perpendicular portion (121); and
o at least two hinges (140) installed in mutually offset positions, so that as the first and second uprights approach each other, in use, said respective hinges (140) are aligned with respect to the reference axis z;

- two guides (200) with extension along the reference axis z, fixed to one of said two modules and to said at least one additional module (500'), respectively, and configured to receive, along the same axis z, the two parallel segments (122,123) of the first (100a) and second (100b) uprights, respectively, so as to couple the one of said two modules and said at least one additional module (500') together; and
- hinge removable locking means (700,800) configured to mutually lock said respective hinges (140) aligned with respect to the reference axis z.

9. A system according to claim 8, wherein the removable locking means (700,800) comprise a cylindrical interconnection pin (700) configured to be inserted into the hinges (140) along the axis z'.

10. A system according to claim 9, wherein the removable locking means (700,800) further comprise a plurality of transverse pins (800), said cylindrical pin (700) comprising a plurality of holes substantially perpendicular to the direction z, each hole of said

plurality of holes being coaxial to a respective hole on the respective hinge (140), for receiving said transverse pins (800) passing therethrough.

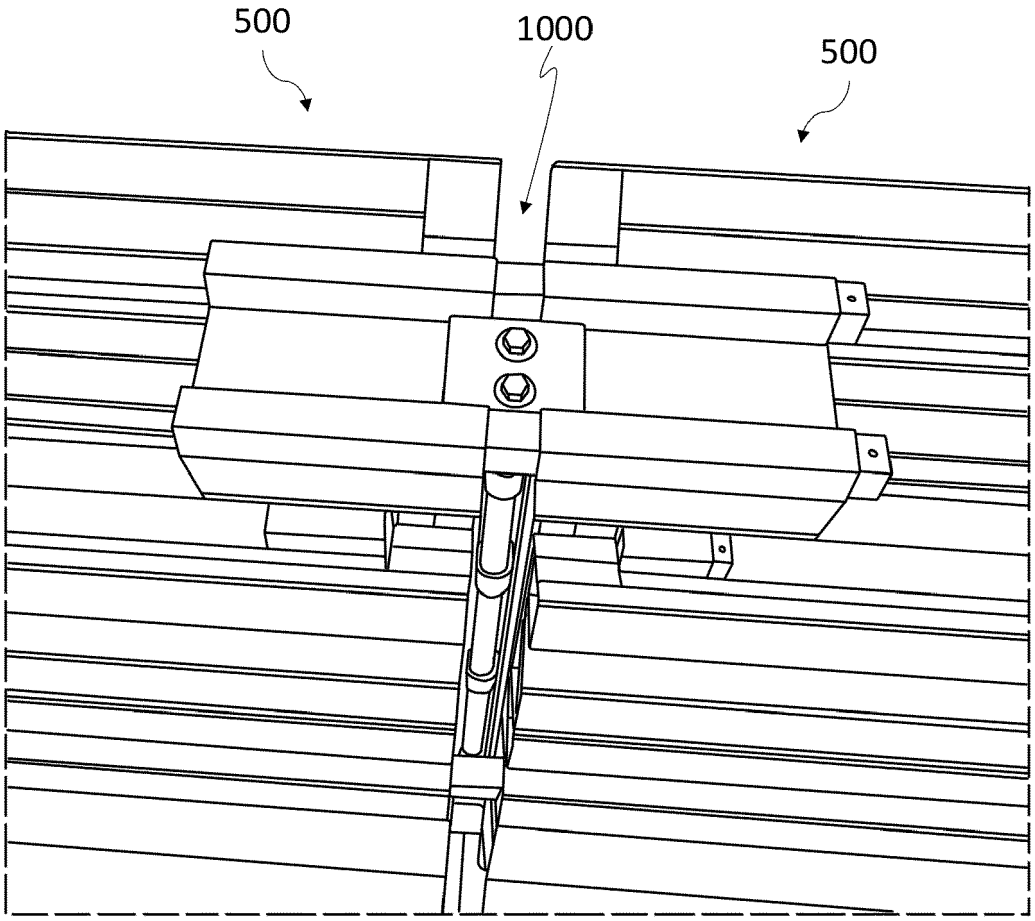


fig.1

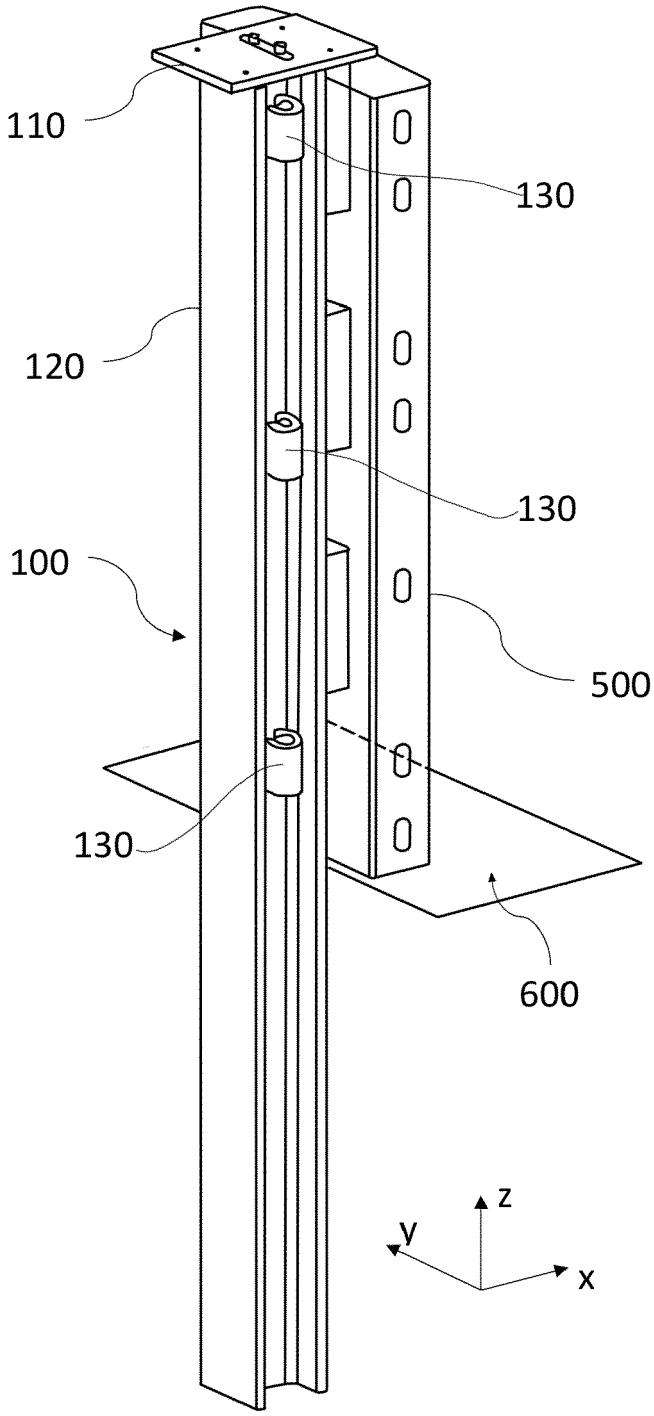


fig.2

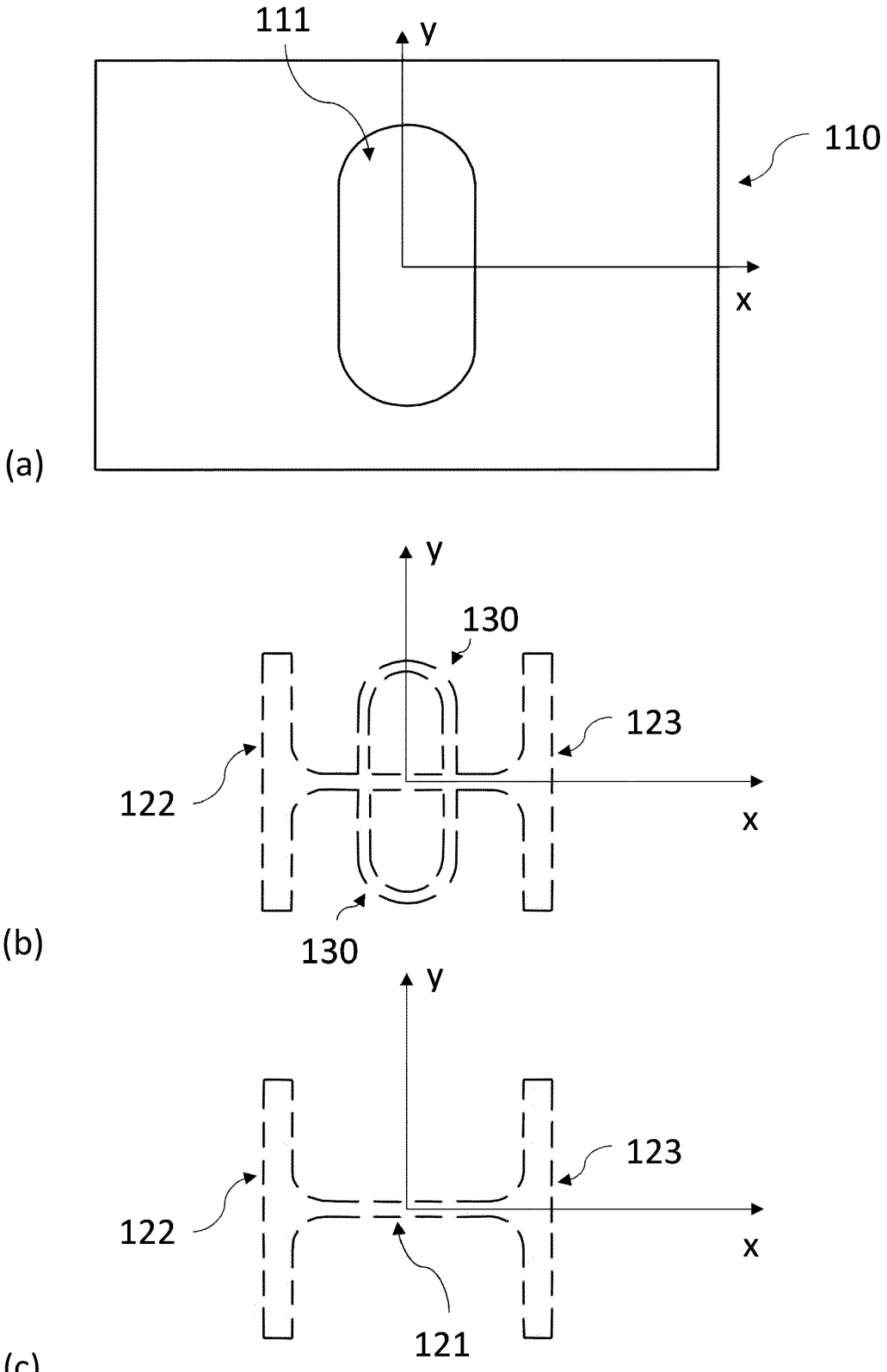


fig.3

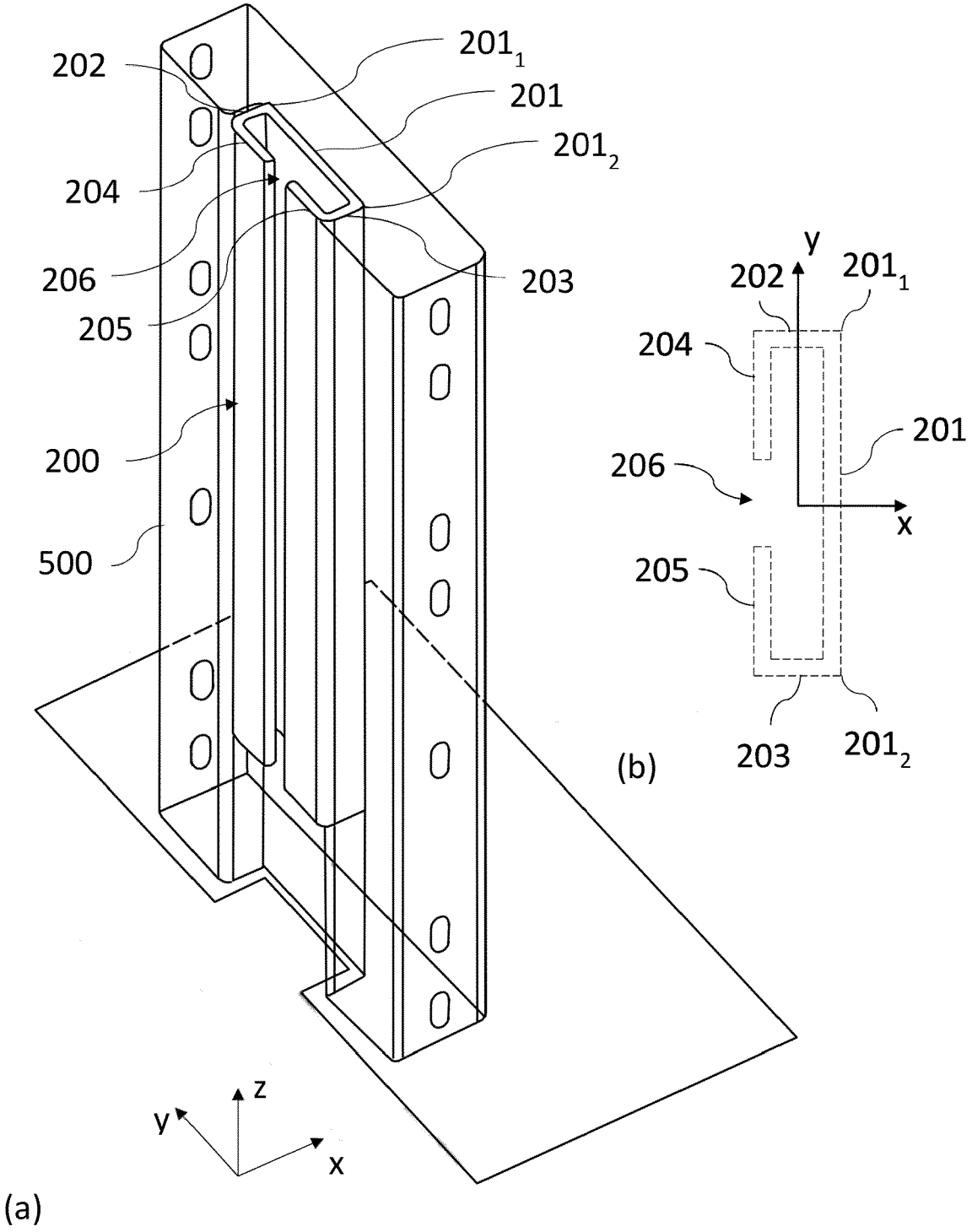

202
201$_1$
201
201$_2$
204
206
205
203
200
500
z
y
x
(a)
y
202
201$_1$
204
201
206
x
205
203
201$_2$
(b)

fig.4

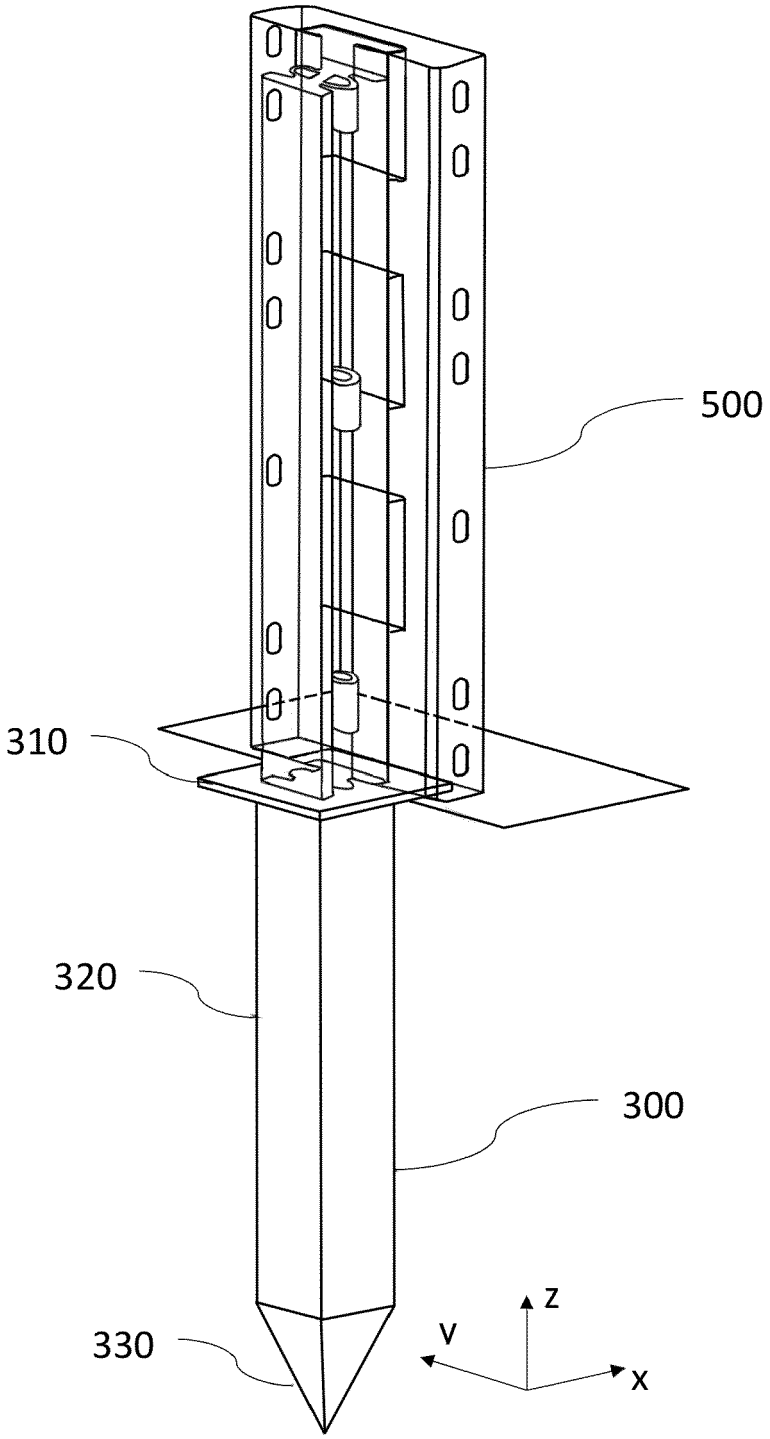


fig.5

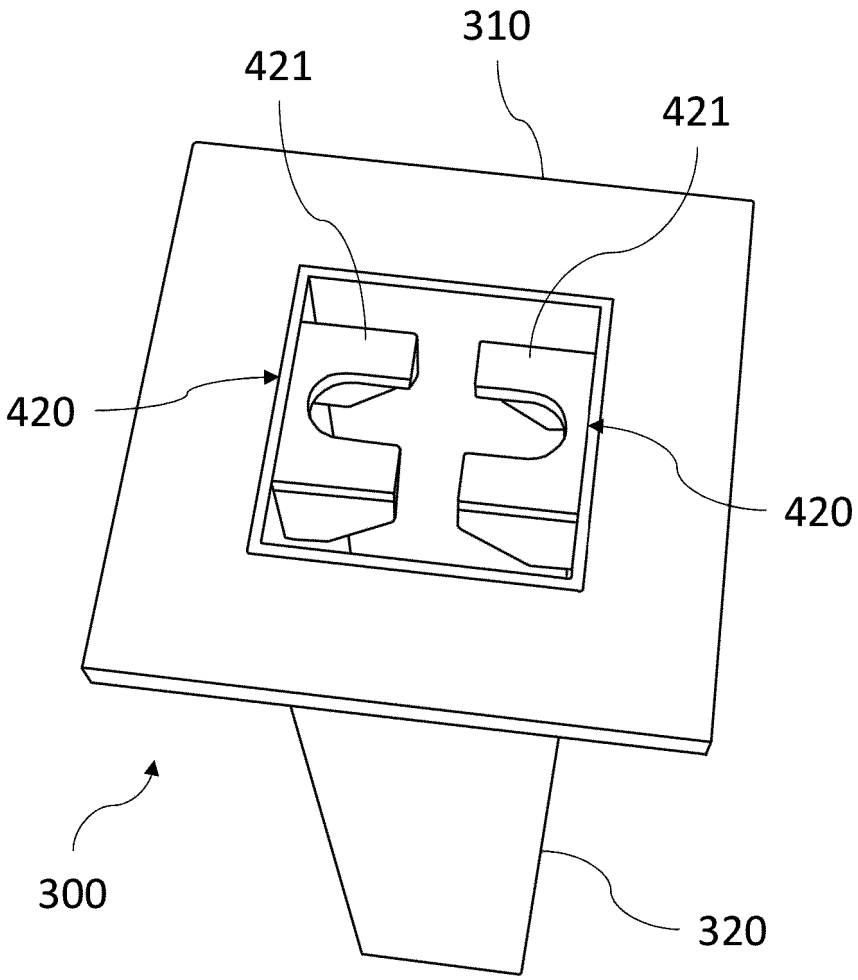


fig.6

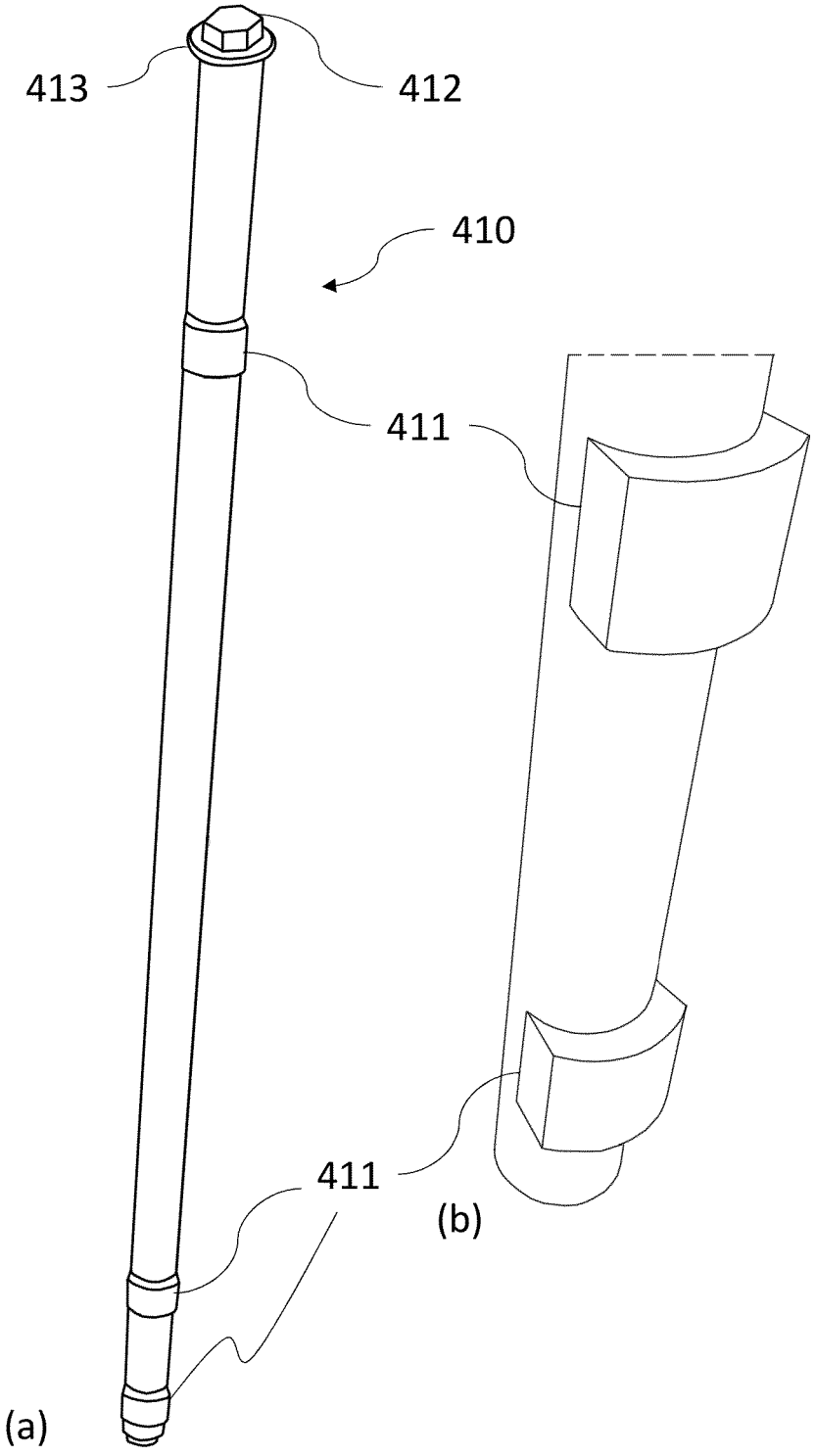
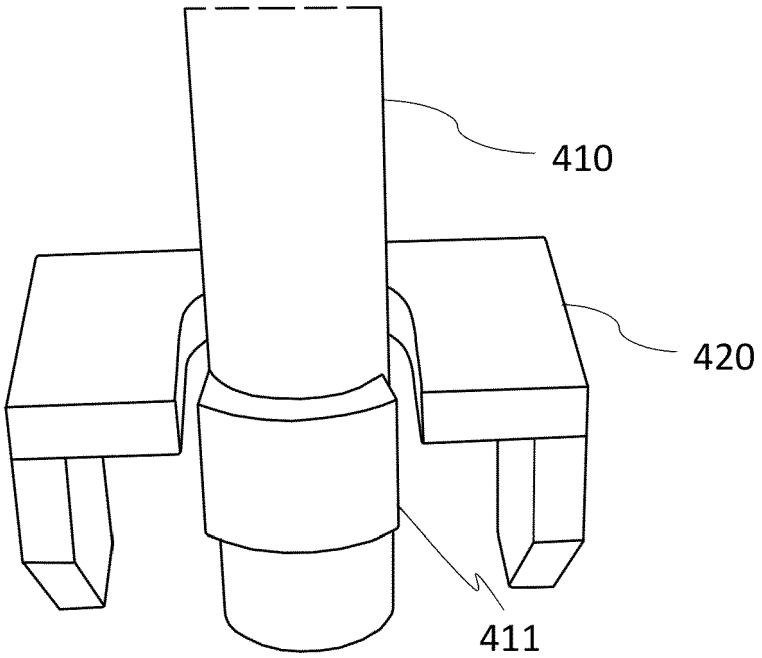
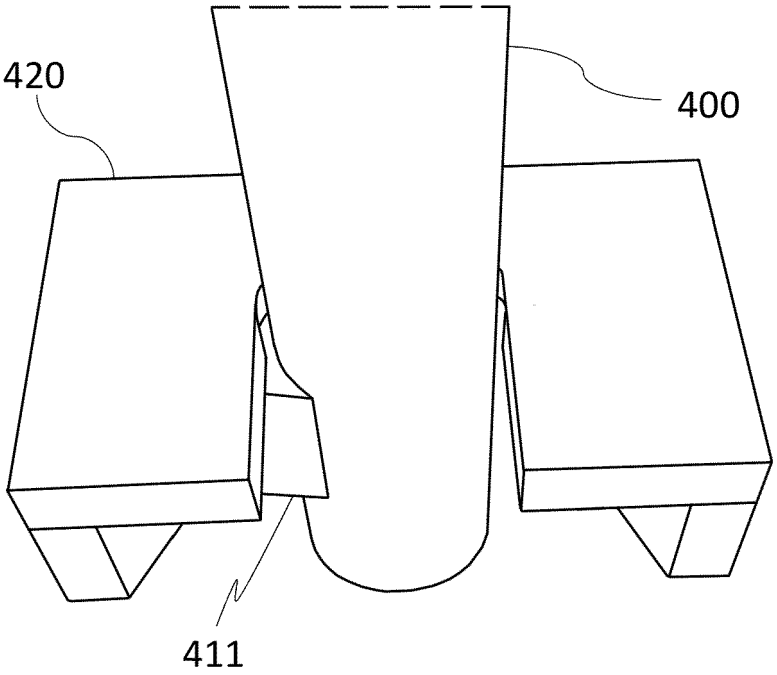


fig.7

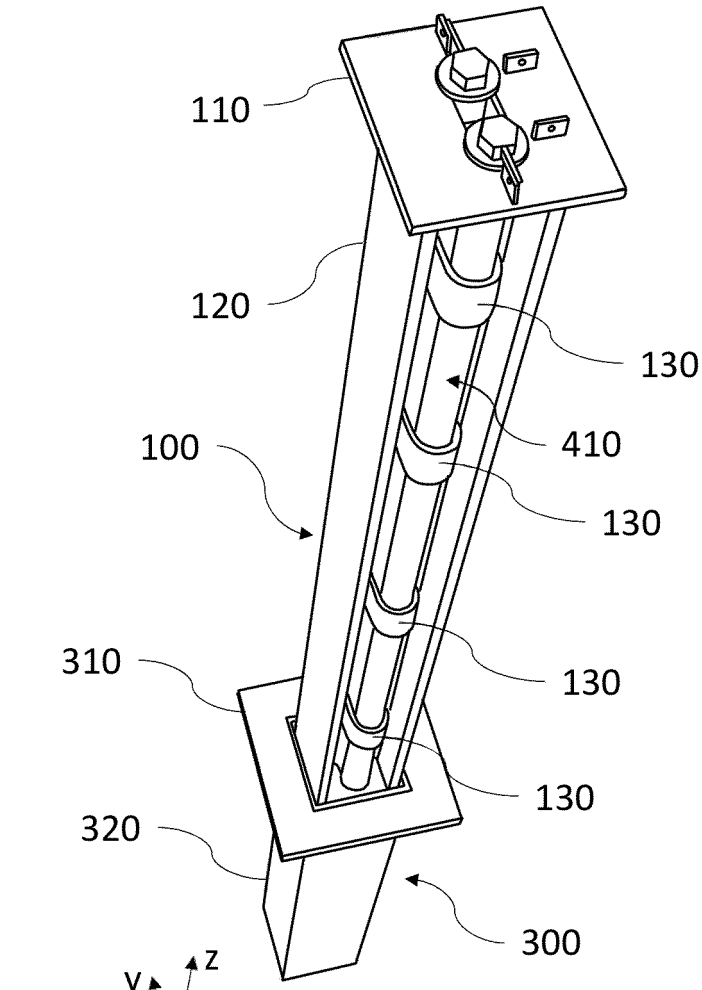


(a)



(b)

fig.8


110
120
130
100
410
130
310
130
130
320
300
y
z
x
(b)

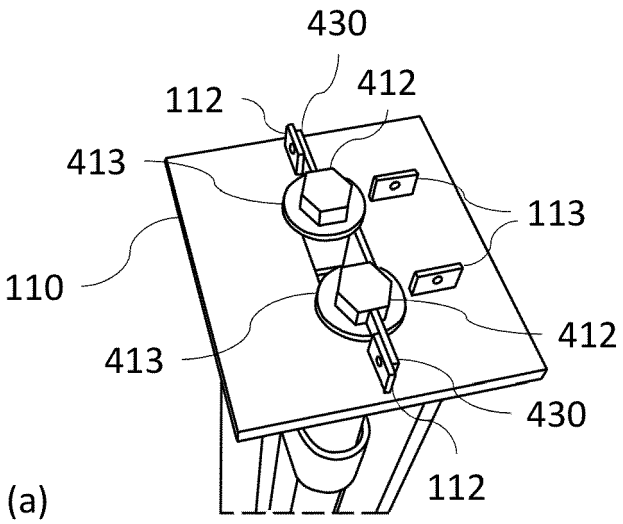

430
412
112
413
113
110
412
413
430
112
(a)

fig.9

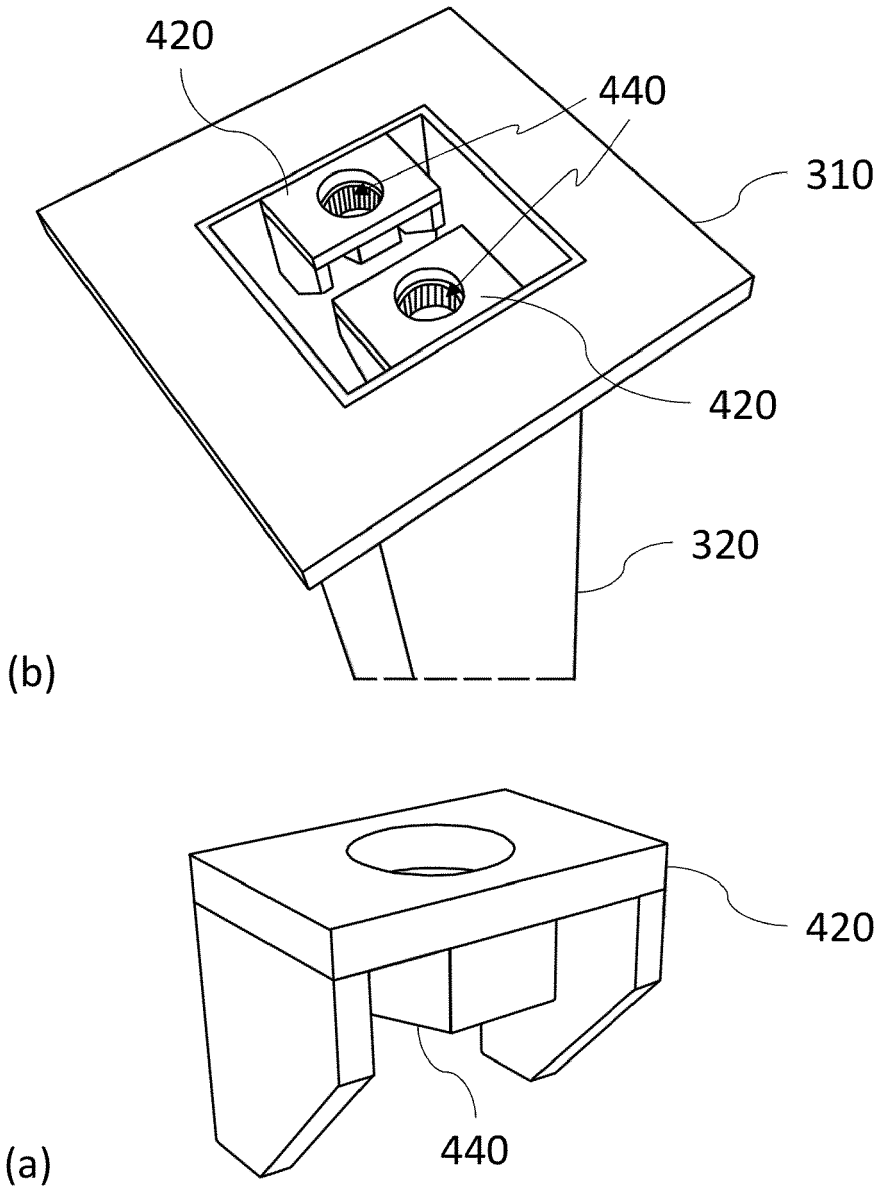


fig.10

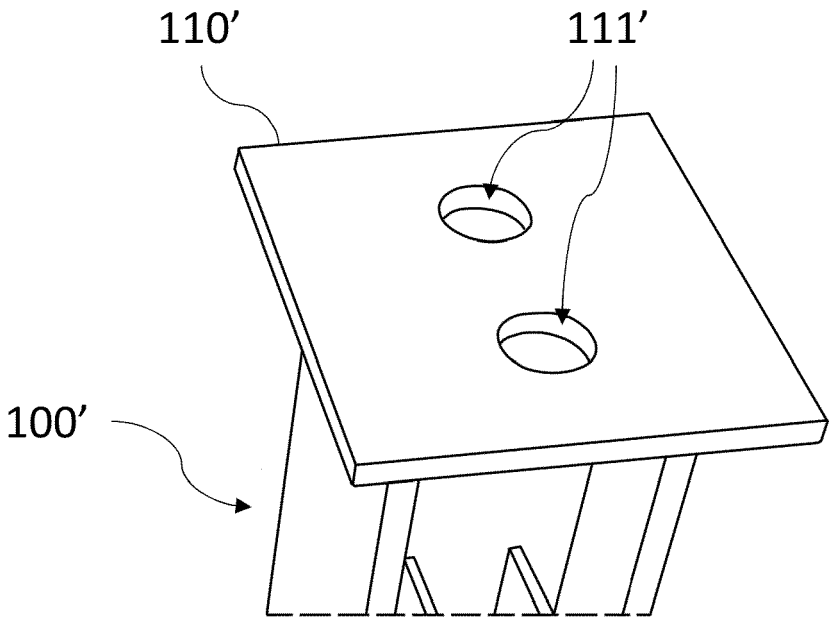


fig.11

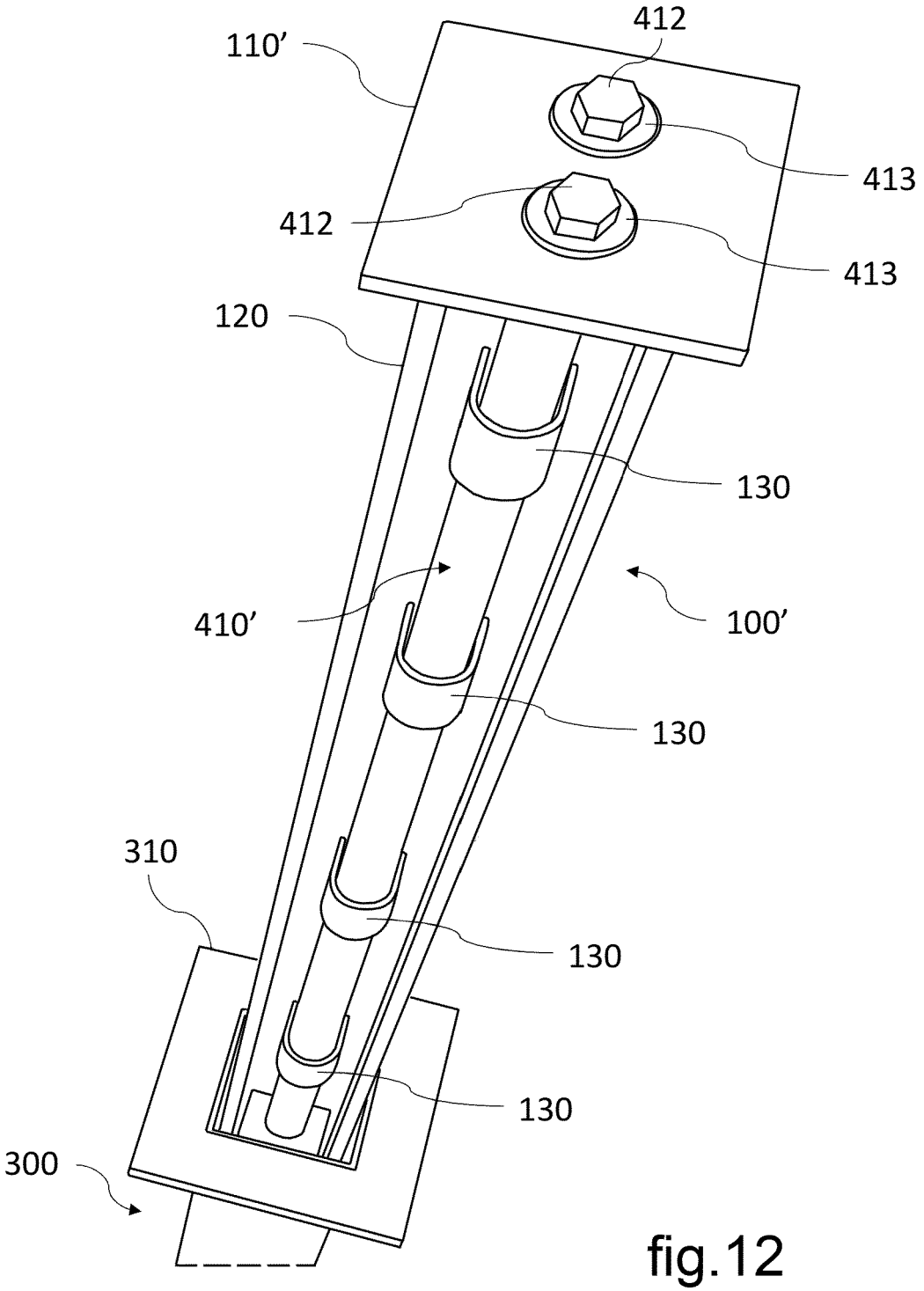


fig.12

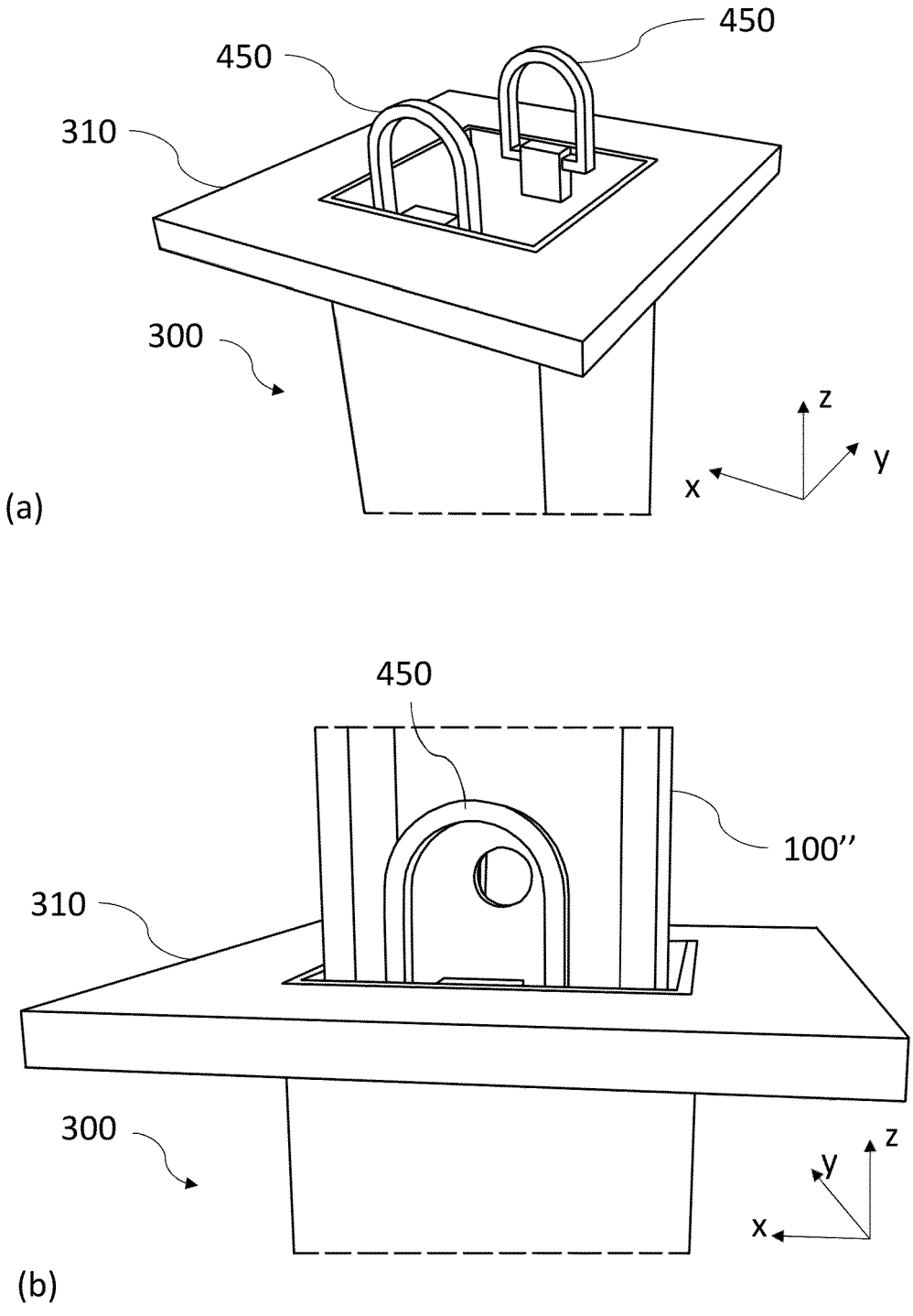


fig.13

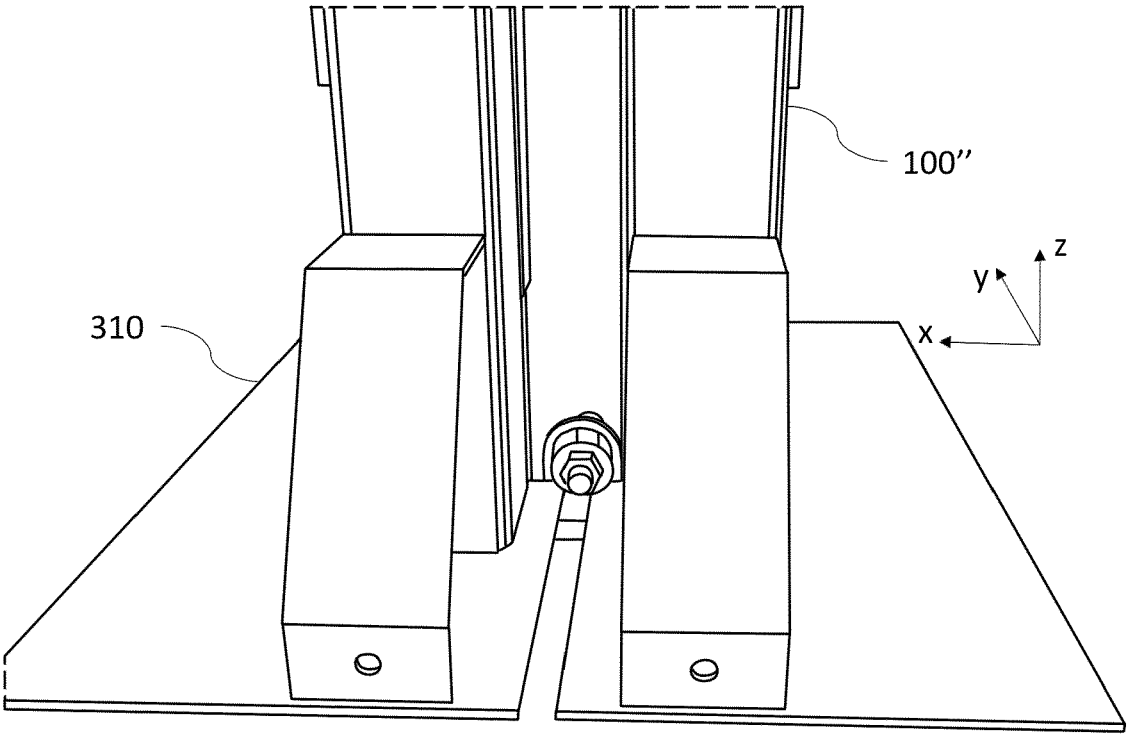


fig.14

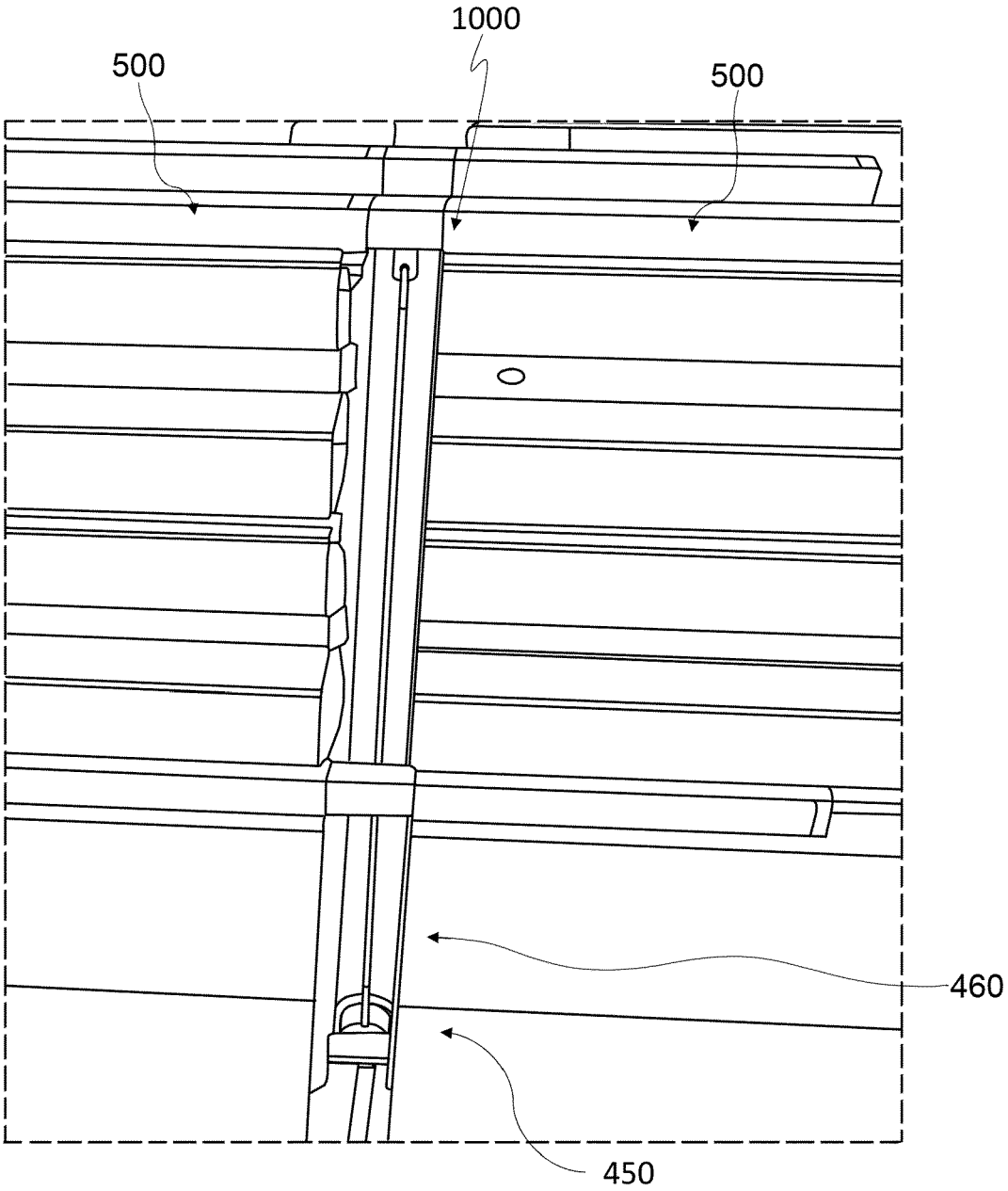


fig.15

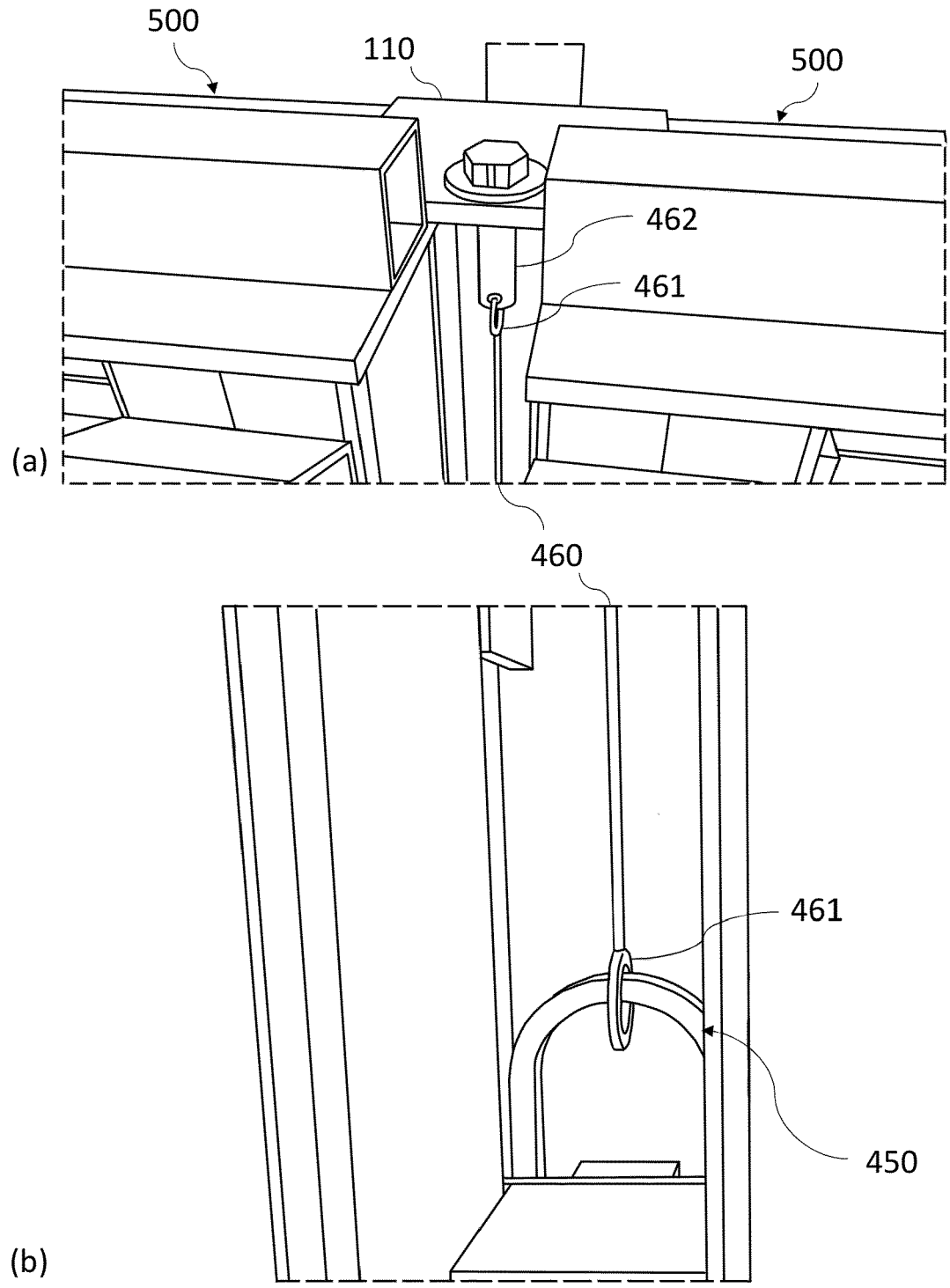


fig.16

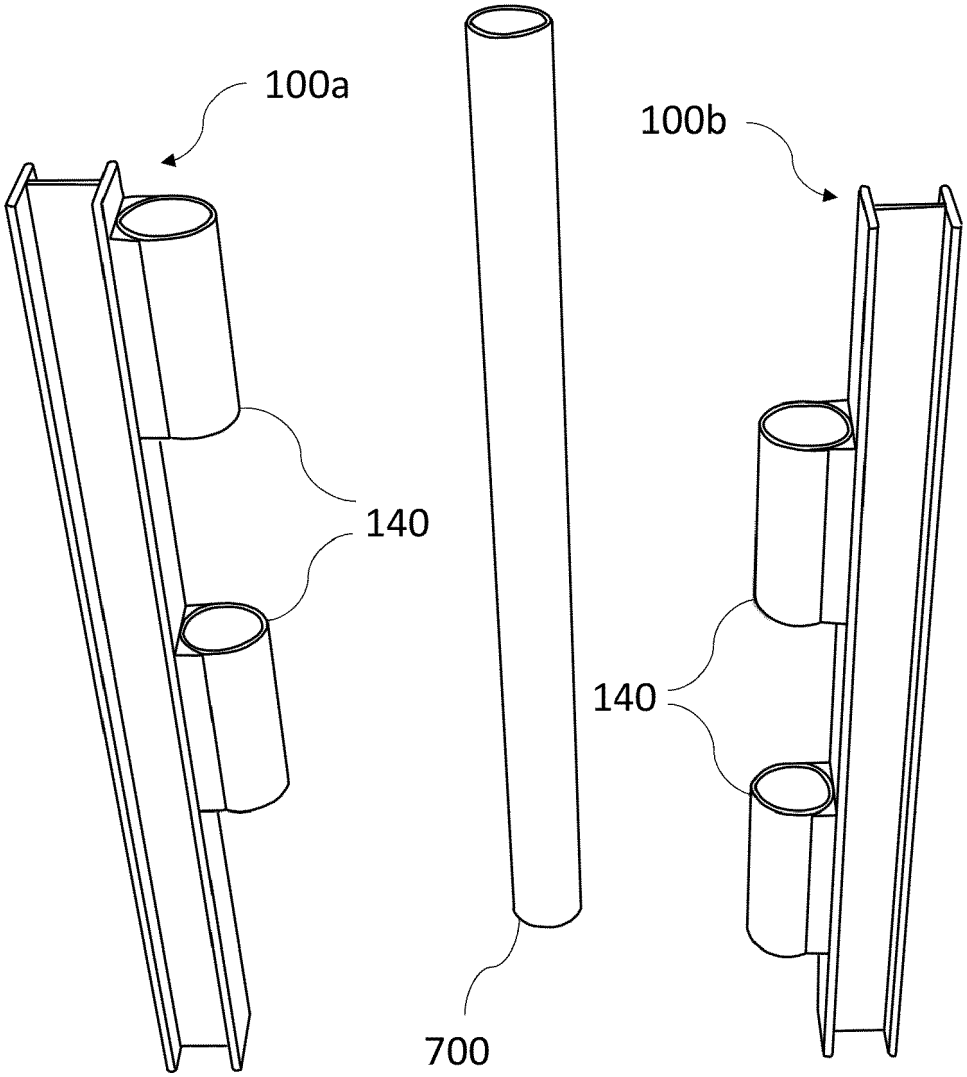


fig.17

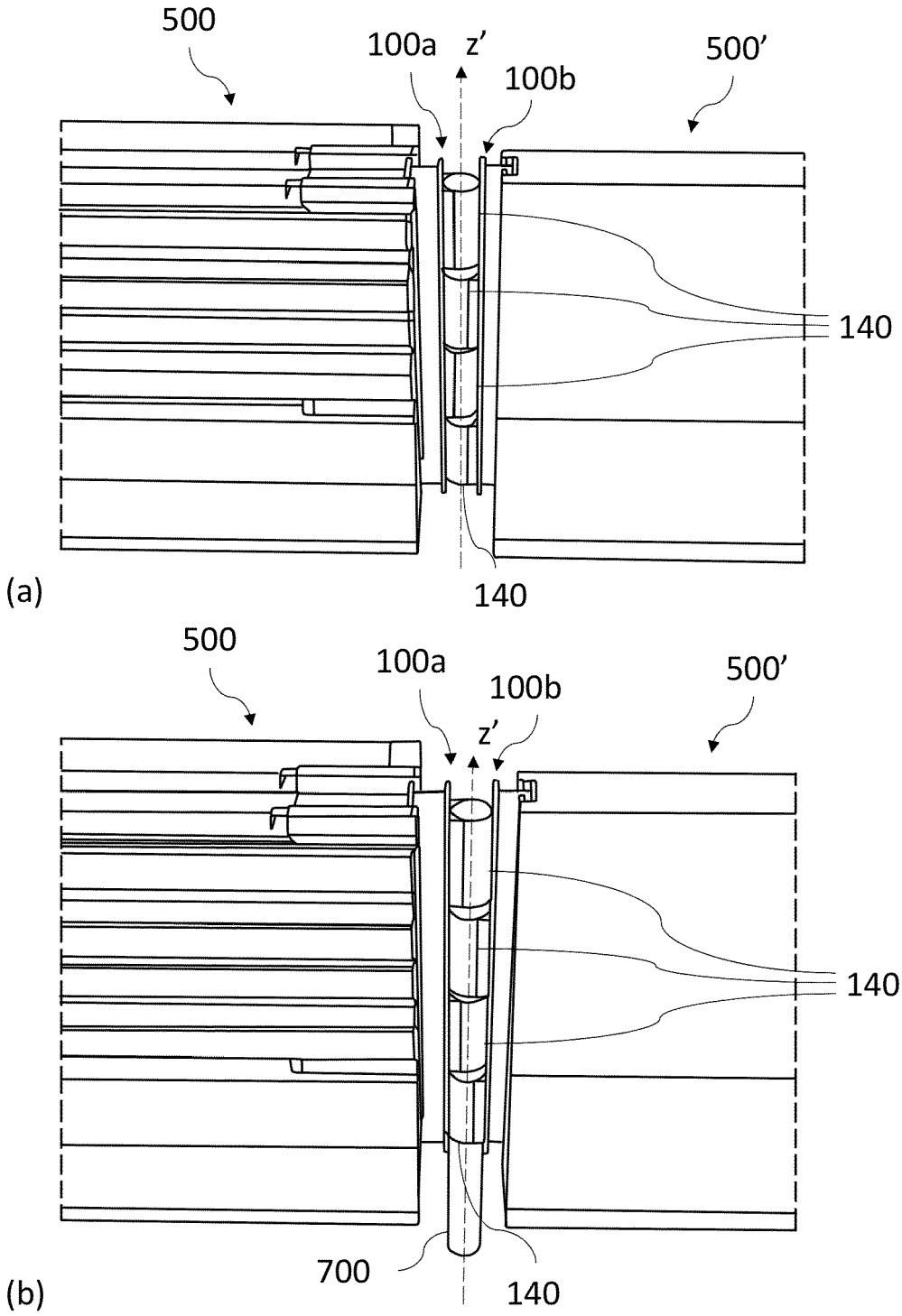


fig.18

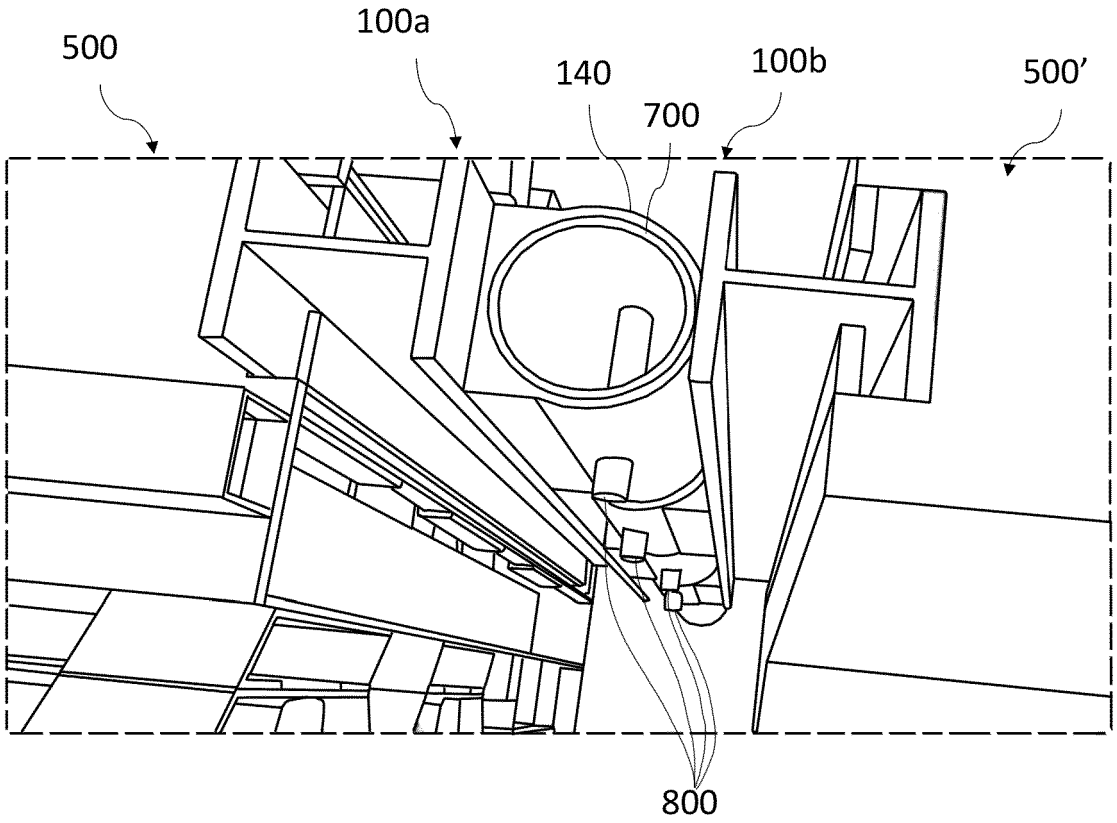


fig.19

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EUROPEAN SEARCH REPORT

Application Number
EP 24 17 0729

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	US 2019/284773 A1 (SANDERS KEITH A [US] ET AL) 19 September 2019 (2019-09-19) * column 7, line 25 - column 8, line 35; figures 6a-6d *	1-10	INV. E01F15/08
A	US 2015/225912 A1 (NUNES RODRIGO PEREIRA [PT] ET AL) 13 August 2015 (2015-08-13) * paragraph [0062] - paragraph [0094]; figures 1-8 *	1-10	
A	AU 2021 221 795 A1 (ROBOS INTERNATIONAL LTD [NZ]) 16 March 2023 (2023-03-16) * figures 1-3 *	1-10	
A	DE 20 2013 103079 U1 (LUTHER HORST [DE]) 22 July 2013 (2013-07-22) * the whole document *	1-10	
A	AT 11 483 U1 (KIRCHDORFER FERTIGTEILHOLDING [AT]) 15 November 2010 (2010-11-15) * figures 1-4 *	1-10	TECHNICAL FIELDS SEARCHED (IPC) E01F
A	WO 2023/084462 A1 (KATECH S R L [IT]) 19 May 2023 (2023-05-19) * figures 1-4a *	1-10	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	29 May 2024	Giannakou, Evangelia

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29-05-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2019284773 A1	19-09-2019	CA 3093801 A1	19-09-2019
		EP 3765673 A1	20-01-2021
		US 10400402 B1	03-09-2019
		WO 2019177694 A1	19-09-2019
US 2015225912 A1	13-08-2015	CN 104831651 A	12-08-2015
		PT 108018 A	19-01-2015
		US 2015225912 A1	13-08-2015
		US 2017296941 A1	19-10-2017
AU 2021221795 A1	16-03-2023	NONE	
DE 202013103079 U1	22-07-2013	NONE	
AT 11483 U1	15-11-2010	AT 11483 U1	15-11-2010
		BR MU9002694 U2	08-04-2014
		RU 122665 U1	10-12-2012
		WO 2010144932 A1	23-12-2010
WO 2023084462 A1	19-05-2023	CA 3233005 A1	19-05-2023
		WO 2023084462 A1	19-05-2023

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Patent documents cited in the description

- US 2019284773 A1 **[0012]**