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(54) ATTACHMENT JOINT FOR COUPLING BETWEEN STRUCTURAL MODULES OF TOWER CRANES

(57) A structural section (2) of a tower crane consisting of latticework with vertical beams (10), crosspieces (11) and diagonals (12) with an attachment joint comprising a coupling (1) for coupling to a contiguous structural section (2'). Said coupling (1) comprises a flat base (3) fixed to a connection block (4) welded at the end of each vertical beam (10) of the structural section (2), the flat base (3) covering a perimeter of the projection of said connection block (4).At least two ends of the connection block (4) protruding with respect to the projection of the vertical beam (10). Each of said ends of the connection block (4) comprises a through hole for the introduction of a screw for attachment with a connection block (4') of the contiguous structural section (2'). The flat surface of the flat base (3) of a structural section (2) remains in the assembly position in direct contact with the flat base (3') of the adjacent structural section (2').

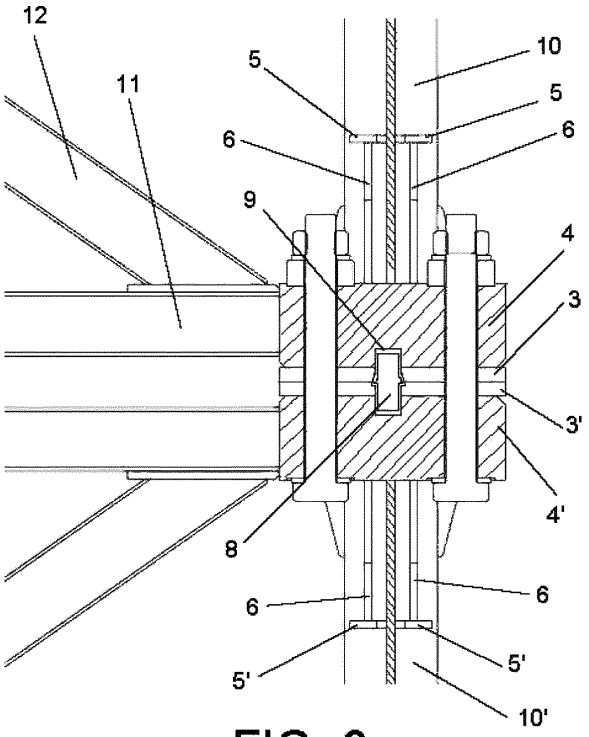

FIG. 8

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Description

Technical field

[0001] The present invention is related to high-rise tower cranes that are normally used in the construction of buildings, referring specifically to a joint system for attaching the couplings between structural sections making up the tower of said tower cranes, achieving joints that improve the distribution of stresses generated in the assembly couplings of the crane structure.

State of the art

[0002] In broad terms, the structure and functionality of an industrial crane are known; however, depending on the application for which it is intended, the type of crane changes completely, being classified into two large groups, which are fixed cranes and mobile cranes.

[0003] The first group, that is, fixed cranes, are installed inside industrial buildings to transport loads from one side of said buildings to the other, while the second group, that is, mobile cranes, are used outdoors.

[0004] Within the group of mobile cranes, a type of crane is known that is used mainly for the construction of buildings. These cranes are called tower cranes and can reach height dimensions that require assembly in phases and sections. A component part of said tower cranes is the tower or mast, which is a vertical lattice structure made up of columns, generally with an H-shaped section and crosspieces, generally with a U-shaped section, said structure being assembled on an anchoring base in a composition by means of joining successive structural sections, until the desired height is reached.

[0005] The coupling techniques known up until now for joining the component structural sections of the tower of tower cranes are generally based on joint systems by means of bolts, although there are also systems based on joints by means of screws.

[0006] For example, document CN204980942 discloses a joint system using through screws and nuts, in which joining pieces are welded in the lateral areas of the ends of the columns of the structural sections making up the crane tower to be formed. Said joining pieces are in the form of bushings with through axial through holes, in such a way that the attachment between the structural sections to be joined is done by inserting attachment screws through the mentioned bushings, for which the screw bushings of the structural sections being joined must be precisely aligned in order to insert the attachment screws.

[0007] The underlying problem in this solution is that the position of the screw bushings is critical, since if they are not welded in the exact position it is not possible to insert the attachment screws when aligning the crane sections. In addition, the fact that the screw bushings are fixed by welding can pose a risk of breakage in the case of a bad weld, which implies possible delays in the assembly and additional costs in the construction of the tower cranes used. These welds represent a low degree of reliability, so if a weld is defective, there is a risk that the entire structure of the tower crane will collapse once it is assembled, with the consequent danger to operators and objects around the crane installation.

[0008] In the case of joints between sections with bolts, there are similar problems, since the bolts have to be inserted through perforated plates, requiring great precision in the perforations and the positioning of the plates to insert the bolts. Reliability problems also arise in the fastening of the plates, which are fixed by welding, so that any defect or inaccuracy can cause undesired stresses with the consequent fracture of the area of the attachments and the danger of collapse of the structure of applicable tower cranes.

[0009] It is based on all of the above that it is necessary to develop a solution that eliminates the risks and drawbacks that currently exist and improves assembly times and guarantees in the construction of large structures of tower cranes.

Object of the invention

[0010] In order to achieve the objectives of improving assembly times and reliability, eliminating the risks of inaccuracy and dangers of breaking the coupling areas between the component structural parts of tower cranes and, in particular, between structural sections making up the tower of said cranes, the present invention proposes a structural section of a tower crane consisting of latticework with an attachment joint that distributes the stresses and strains efficiently at the critical points of the connections between the structural sections that are coupled together.

[0011] To this end, the structural crane section object of the invention comprises a attachment joint that is arranged in the coupling of the ends of the vertical beams of the structural sections to be joined. Said coupling comprises a flat base fixed to a connection block, the flat base covering a perimeter of said connection block, the block being fixable by welding on the end of each vertical beam of the structural section to be attached, at least two ends of the connection block protruding with respect to the projection of the column, said ends comprising a through hole for the introduction of a screw for attachment with a connection block of a contiguous structural section, the flat surface of the flat base of a structural section remaining in the assembly position in direct contact with the flat base of the adjoining structural section.

[0012] This set of elements intends to avoid the concentration of stress in the main profile and a transition of stress in the rigidity of the support, avoiding the breakages that could be generated as a result of the aforementioned stress.

[0013] The connection block provides more material for the distribution of and resistance against stress through screwing.

[0014] In turn, the base plate, preferably polygonal, provides a greater contact surface between couplings than the connection block, improving the distribution of stresses as there is a greater contact surface between base plates of crane sections in the coupling thereof. The pressure cone of the screwed joint and its corresponding distribution coefficient are improved. And on the other hand, it allows greater control of assembly tolerances between sections, since it is easier to machine this contact surface between sections to ensure assembly tolerances and joint flatness.

[0015] In this arrangement, according to one embodiment, the protruding ends of the connection block, protruding being understood as the fact that in a cross-section of the vertical beam they protrude perpendicularly from the projection of said vertical beam, said protruding ends preferably being rectangular in shape. Said ends are those that comprise holes for fixing with attachment screws.

[0016] According to an alternative embodiment when, due to characteristics inherent to the design of the crane, the stresses in the coupling are greater, said block comprises four protruding ends forming a cross-shaped configuration, also with holes at said ends for the inclusion of the attachment screws.

[0017] On the other hand, the attachment joint is complemented by reinforcements, comprising fixed to each side of the web of the vertical beam a transverse U-shaped plate fixed laterally to the flanges and at its bottom to the web of the vertical beam, remaining in a position transverse to the beam.

[0018] This reinforcement allows the transition of stresses in the interior reinforcements to be homogeneous.

[0019] Preferably, the attachment joint comprises an additional reinforcement in the form of a vertical plate that is fixed to the vertical beam between the connection block and the transverse U-shaped plate, fixed with its sides on the inner surface of the flanges of the vertical beam parallel to its web. This vertical plate provides rigidity to the beam profile, which will preferably be an HEB profile, providing rigidity in the direction with less rigidity due to the different thicknesses of the HEB profile. The transverse reinforcement, in this case, prevents stress peaks from being generated at the upper end of the vertical plate.

[0020] Additionally, it is provided that the attachment joint of the structural section comprises a plurality of side plates that are fixed to the sides of the protruding ends of the connection block and to the vertical beam.

[0021] Said lateral reinforcements will preferably have a curved transition from the vertical to the horizontal plane that allows the transfer of stresses, with the reinforcements being stressed instead of loading the welds, which are always the weakest parts of any structure.

[0022] According to another aspect of the invention, the attachment joint of the crane section comprises a central alignment hole in the assembly consisting of the flat base and the connection block which, by introducing an alignment piece, allows the assembly to be aligned by means of inserting said part into each central alignment hole corresponding to each crane section to be joined.

[0023] This entire set of elements that make up the attachment joints according to the invention allows a behavior of the joints with a higher level of reliability and safety, since each element helps to better dissipate and distribute the mechanical stresses and strains that occur in the joint couplings between the structural sections of applicable tower cranes, both in the working state and in the rest state.

[0024] In addition, the base plate of the joints facilitates the correct assembly of the joint couplings between the structural sections being joined, allowing assembly times to be reduced and, consequently, cost savings.

[0025] In conclusion, with the attachment joint object of the present invention, important advantages are achieved over conventional techniques for joining component structural sections in tower cranes, making the assembly of said cranes more functional and safer.

Description of the figures

[0026] The description is accompanied by a set of non-limiting drawings to help understand the functionality of the invention.

Figure 1 schematically shows a front view of an exemplary tower crane.

Figure 2 shows a perspective view of the structural section making up the tower of the crane of the previous figure.

Figure 3 is a detailed isometric view of the coupling between two sections of the crane tower of a first exemplary embodiment.

Figure 4 is a top view of a cross-section of the coupling between two sections of the crane tower according to the example of Figure 3.

Figure 5 shows an enlarged view of the coupling of Figure 4.

Figure 6 is a detailed isometric view of the coupling between two sections of the crane tower of another exemplary embodiment.

Figure 7 is a top view of a cross-section of the coupling between two sections of the crane tower according to the example of Figure 6.

Figure 8 is a sectional view of the attachment of the coupling joint between two structural sections of a crane tower according to the invention.

Detailed description of the invention

[0027] The object of the invention relates to a coupling (1) to join structural sections (2) making up a tower (14) in tower cranes that are generally used in the construction of building which, as shown in Figure 1, comprise a tall tower (14), which is arranged on an anchoring base (13), with a slewing ring (15) being incorporated in the upper part of the tower (14), on which there is incorporated a jib (16) with a gripping device (19) for hanging the loads that have to be moved with the crane, and in the opposite part a counter-jib (17) provided with counterweights (18) to level the structure of the crane in the vertical mounting position and in the working function. The tower (14) consisting of a lattice structure made up of columns, normally consisting of H-shaped section profiles, which are joined together by crosspieces consisting of profiles generally having a U-shaped section.

[0028] Given the working height of said tower cranes, they need a tower (14) of great length to support the functional assembly at the hoisting height of the loads to be moved, therefore said tower (14) is formed by means of joining successive structural sections (2) (Figure 2), up to the necessary length, conventionally joining the component structural sections (2) by means of couplings (1) in which fastening attachments are established by means of bolts or screws with nuts that are arranged through bushings fixed by external welding on the columns of the structural sections (2).

[0029] Compared to conventional attachment solutions using through bolts or screws through bushings welded externally to the columns of the structural sections (2), the invention proposes a structural section (2) with an attachment joint that allows a more homogeneous distribution of stresses and strains that occur at the critical junction points between the structural sections (2) of the crane tower (14) that is formed by means of joining successive structural sections (2).

[0030] The joint between the structural sections (2) in the couplings (1) of the lattice nodes, is carried out by said attachment joint of the structural section (2) object of the invention. This joint is established by means of screwing that is established between the ends of the vertical beams (10) of the structural sections (2) to be joined. Said attachment joint has a flat base (3) and a connection block (4) that are preferably fixed together by welding, to later fix the corresponding vertical beam (10) on the connection block (4).

[0031] As can be seen in a first exemplary embodiment of Figures 3 and 4, said connection block is rectangular in shape, with protruding ends that include through holes in which the attachment screws are arranged. In this way, the flat base (3) of a crane section (2) is arranged in contact with the flat base (3') of a contiguous crane section (2') to later join both sections (2, 2') in its coupling (1) by means of screwing. Therefore, it results in an easy-to-assemble embodiment, which further allows the flat base (3) to be machined for adaptation to irregularities in the ground or to different manufacturing tolerances.

[0032] Additionally, as can be seen in Figure 3 and in more detail in Figure 5, reinforcing elements are incorporated into said attachment joints. It therefore comprises a transverse U-shaped plate (5) that is fixed to the vertical beam (10) with its sides fixed by welding to the flanges of the vertical beam (10) and its bottom fixed to the web of the vertical beam (10). Subsequently, a vertical plate (6) is fixed to the inside of the flanges of the vertical beam (10) parallel to the web and between the connection block (4) and the aforementioned U-shaped transverse plate (5). This vertical plate (6) preferably comprises an upper termination with a relevant U-shaped groove so as not to accumulate mechanical stress.

[0033] In addition, for greater reinforcement, there are arranged, welded together, stress reducing side plates (7) which are fixed to the sides of the connection block (4) and on the outer surface of the vertical beam (10) of the structural section (2).

[0034] These side plates (7) preferably comprise a curved transition from the vertical to the horizontal plane that allows stress to be transferred.

[0035] According to another embodiment, as shown in Figures 6 and 7, in the case of tower cranes that are very tall and/or intended to move very heavy loads, the assembly of the flat base (3) and the connection block (4) of the couplings (1) are cross-shaped. Through holes are arranged in each of the arms of the cross to introduce four attachment screws in the joints, thereby ensuring more resistant joints, when establishing the attachment with a greater number of screws. Likewise, the corresponding reinforcements (5, 6 and 7) will be arranged in this embodiment.

[0036] In both embodiments, the method of assembling the attachment joints in the couplings (1) between the structural sections (2) to be joined is the same, in such a way that the flat base (3) and the connection block (4) are welded together, and then the vertical beam (10) and corresponding crosspiece (11) of the structural section (2) are welded to the connection block (4). Subsequently, the vertical plate (6) is welded on the connection block (4) and to the column of the structural section (2), in the inner part of the profile of the vertical beam (10) of the structural section (2), to then weld the transverse U-shaped plate (5) on the column of the structural section (2) at the end of the vertical plate (6).

[0037] Finally, the stress reducing plates (7) are welded to the vertical beam (10) of the structural section (2) on the sides of the protruding ends of the connection block (4).

[0038] The incorporation of an alignment piece (8) is also foreseen, said piece being included through a central hole (9) of the assembly consisting of the flat base (3) and the connection block (4), to guarantee that the structural sections (2, 2') that are joined together are correctly aligned in the coupling (1) between them, as shown in Figure 8. The use of said alignment piece (8) can be critical at the joints between the structural sections (2,

2'), in applications in which large weights have to be handled with the applicable tower crane and when the tower crane is exposed to adverse weather conditions, for example, strong winds, or if the supporting ground suffers from vibrations.

[0039] Although the attachment joint according to the invention has been described in particular for the attachment coupling between structural sections (2) of the longitudinal composition of a crane tower, this attachment joint can also be used for other joint couplings between parts of a structural assembly, such as the attachment joint between the tower (14) and the anchoring base (10) of a crane or other similar joints, within the same concept of the invention.

Claims

1. A structural section (2) of a tower crane consisting of latticework with vertical beams (10), crosspieces (11) and diagonals (12) with an attachment joint comprising a coupling (1) for coupling to a contiguous structural section (2'), **characterized in that** said coupling (1) comprises a flat base (3) fixed to a connection block (4) welded at the end of each vertical beam (10) of the structural section (2), the flat base (3) covering a perimeter of the projection of said connection block (4), at least two ends of the connection block (4) protruding with respect to the projection of the vertical beam (10), each of said ends of the connection block (4) comprising a through hole for the introduction of a screw for attachment with a connection block (4') of the contiguous structural section (2'), a flat surface of the flat base (3) of a structural section (2) being configured to remain in the assembly position in direct contact with the flat base (3') of the contiguous structural section (2').

2. The structural section (2) of a tower crane according to the first claim, **characterized in that** the protruding ends of the connection block (4) have a quadrangular prismatic shape.

3. The structural section (2) of a tower crane according to any one of claims 1 or 2, **characterized in that** the connection block (4) comprises four protruding ends forming a cross-shaped configuration.

4. The structural section (2) of a tower crane according to any of the preceding claims, **characterized in that** it comprises, at its attachment joint, fixed to each side of a web of the vertical beam (10), a transverse U-shaped plate (5) fixed on the flanges and the web of the vertical beam (10).

5. The structural section (2) of a tower crane according to claim 4, **characterized in that** it comprises a vertical plate (6) that is fixed to the vertical beam (10) between the connection block (4) and the transverse U-shaped plate (5), being fixed with its sides on the inner surface of the flanges of the vertical beam (10) parallel to its web.

6. The structural section (2) of a tower crane according to any one of the preceding claims, **characterized in that** it comprises a plurality of side plates (7) that are fixed to the sides of the protruding ends of the connection block (4) and to the vertical beam of the structural section (2).

7. The structural section (2) of a tower crane according to any one of the preceding claims, **characterized in that** the elements of the attachment joint and the structure of the structural section (2) are fixed by means of welding.

8. The structural section (2) of a tower crane according to any one of the preceding claims, **characterized in that** the assembly consisting of the flat base (3) and the connection block (4) comprises a central alignment hole (9) in which an alignment piece (8) insertable in a central hole (9') of the contiguous structural section (2') is introduced.

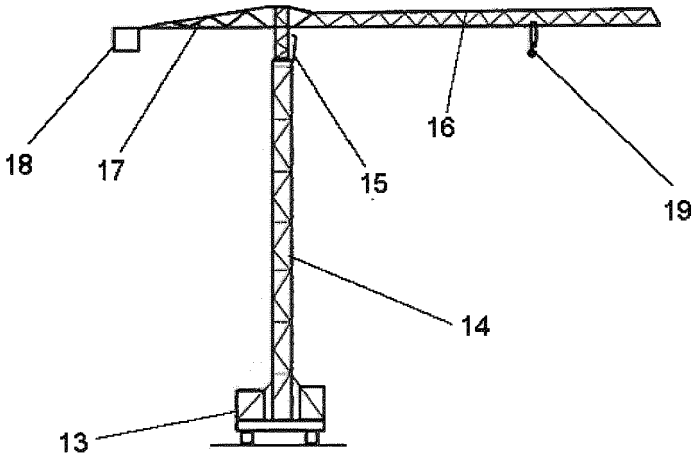

FIG. 1

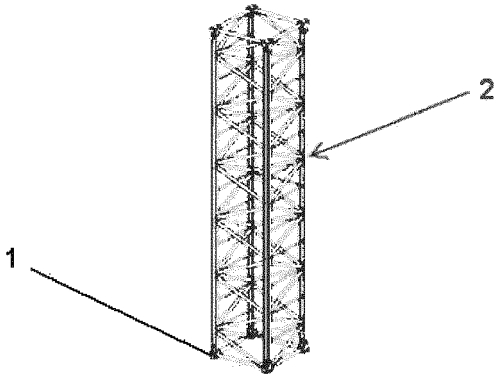

FIG. 2

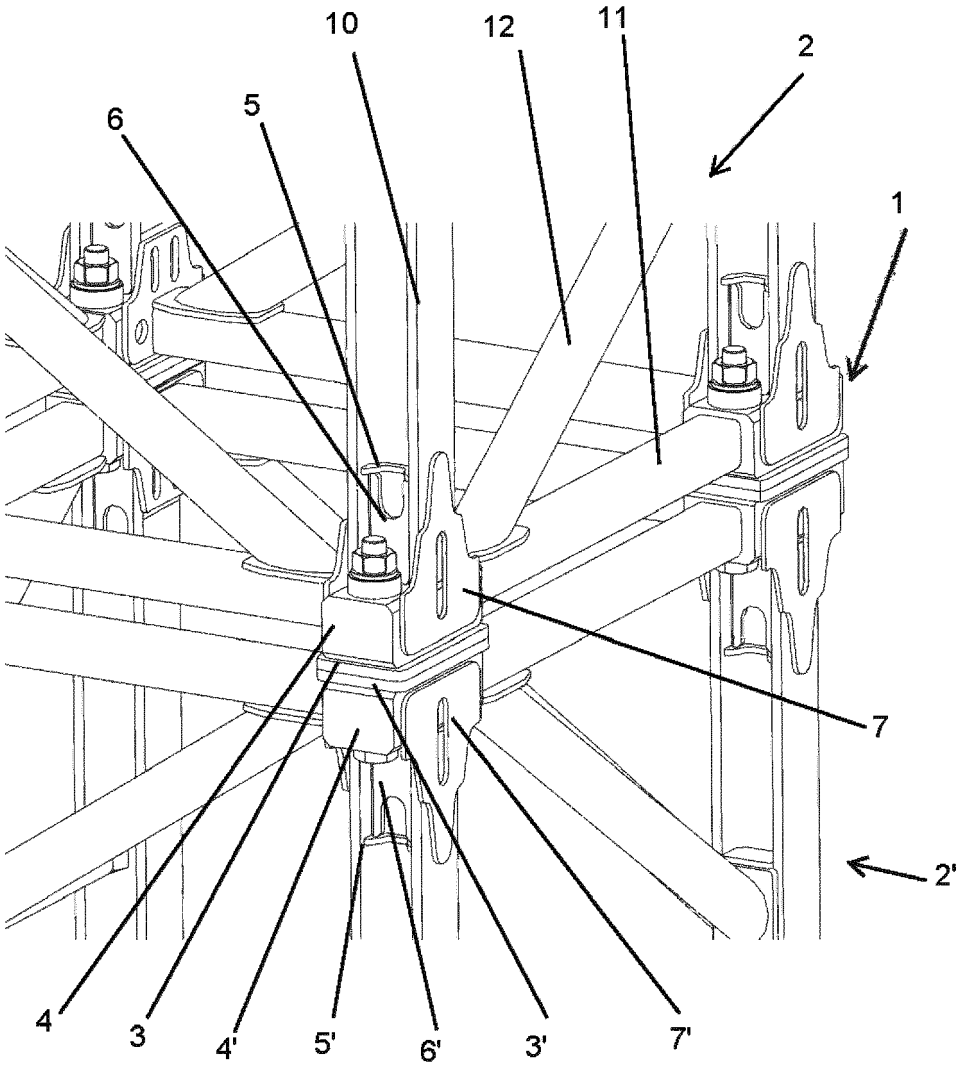

FIG. 3

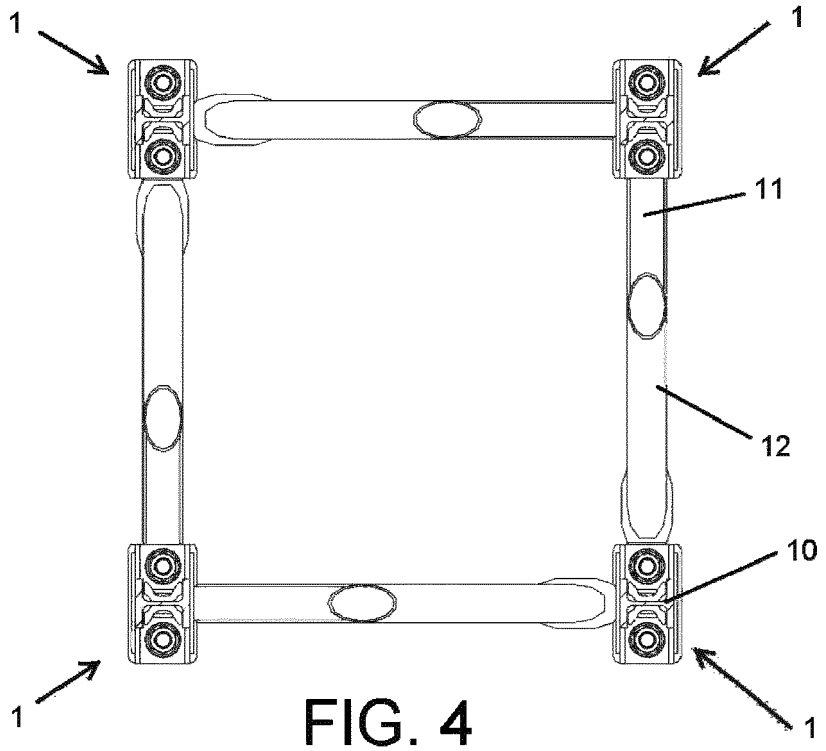

FIG. 4

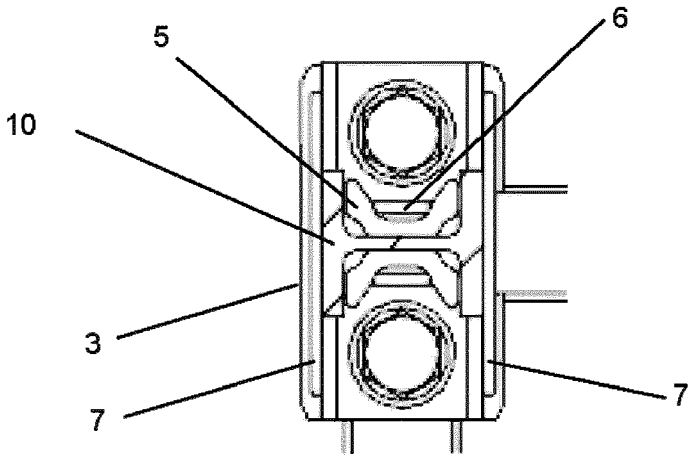

FIG. 5

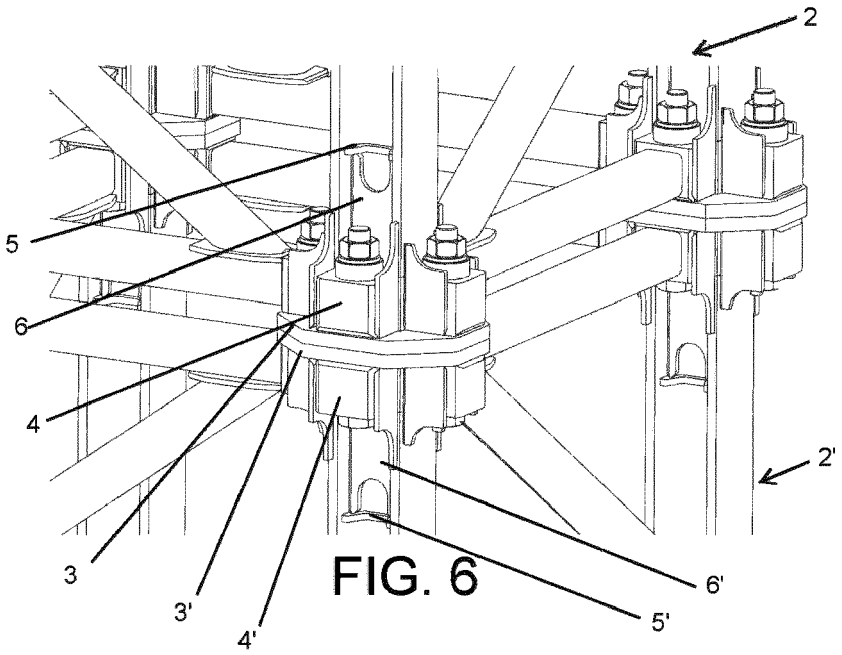

FIG. 6

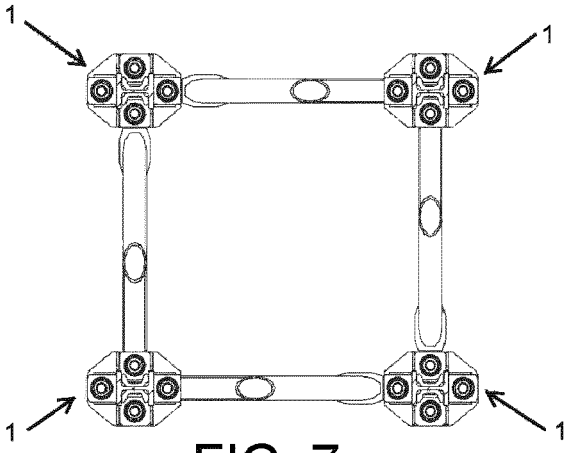

FIG. 7

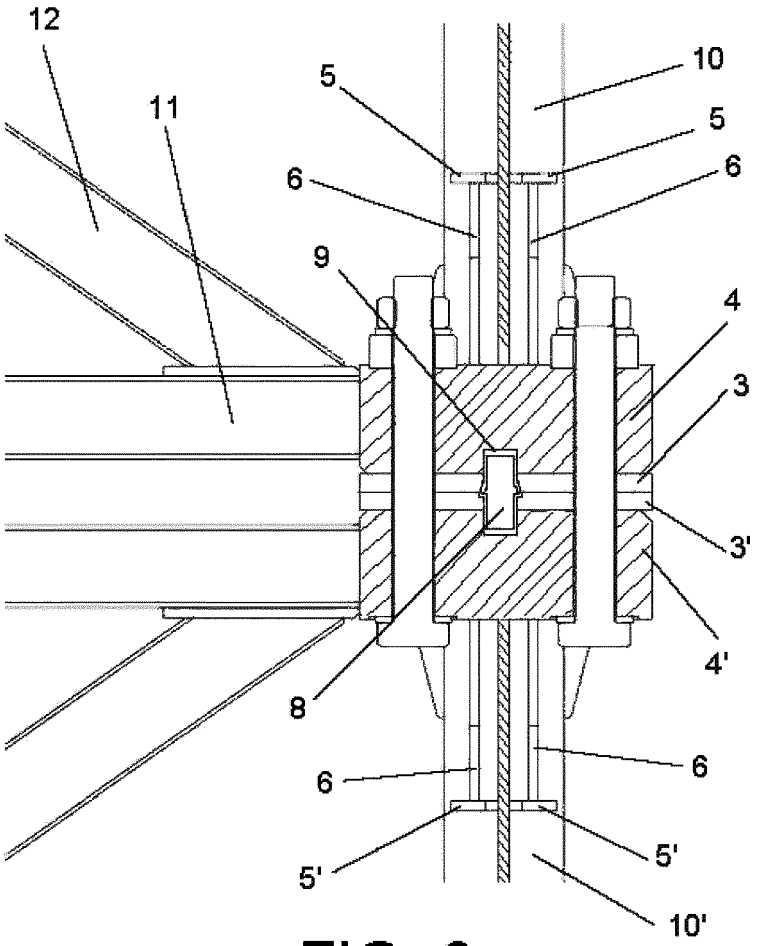

FIG. 8

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 January 2024	Güzel, Ahmet

CATEGORY OF CITED DOCUMENTS

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