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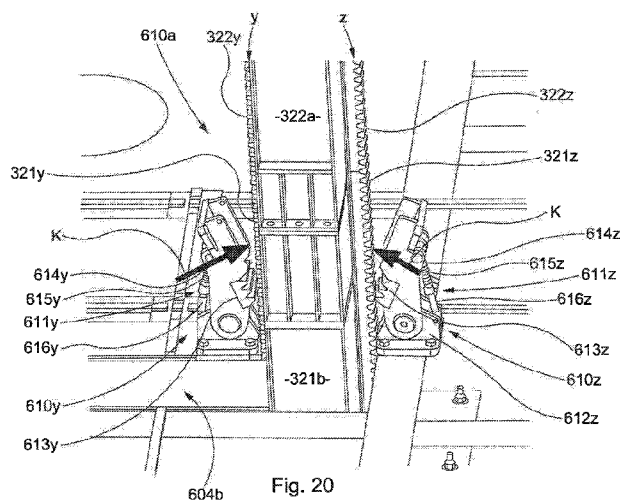
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- (54) **Title:** METHOD OF ELEVATING A SECTION OF A DERRICK, RELATED LOWERING, AND APPARATUS



- (57) **Abstract:** There is described a method of elevating at least one section of a derrick and a related method of lowering the section, a method of installing a rig or a derrick and a related method of disassembly, and related apparatus. In various embodiments, a carrier comprising lifting devices in the form of hydraulic actuators may be provided and then positioned in a substructure below a drilling deck with sections of the derrick placed upon the carrier. The sections of the derrick may then be moved upward using the hydraulic actuators on paths adapted to limit lateral movement of the sections, whilst locking devices on the drilling deck may be applied so as to allow the sections of the derrick to be locked relative to the substructure against downward movement.



METHOD OF ELEVATING A SECTION OF A DERRICK, RELATED LOWERING, AND APPARATUS

Technical field

The present invention relates to the installation of rigs and derricks. In particular, it relates
5 to a method of elevating at least one section of a derrick, related lowering of an elevated section of the derrick, and apparatus.

Background

In the oil and gas exploration and production industry, rigs of various types are commonly
10 employed. Such rigs may for instance assist with various operations in the construction, operation and servicing of wells. Different rig types may be used for different operations. This can include drilling, well intervention, workover, and/or plug and abandonment.

Some rigs, in particular those used for well construction such as for performing drilling or
15 casing operations, generally include a derrick and a travelling assembly, where the travelling assembly is mounted on the derrick so that it can move along the derrick. The derrick typically comprises an elongate framework of columns and cross-members, extending upward from a base structure. The derrick extends to a substantial height to allow elongate structures comprising sections of tubing and/or other tools to be accommodated. For
20 example, in a drilling operation, sections of drill pipe, or drill pipe stands consisting of multiple sections of drill pipe connected together, may be inserted into a drill string in the derrick and be supported at an upper end by the travelling assembly while drilling is performed. As the drilling progresses and the drill string progresses into the subsurface, the travelling assembly travels together with the drill string downward along the derrick.

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For cost and efficiency purposes, it can be desirable to install temporary rigs on existing infrastructure such as a platform or another structure. After a period of time, when the rig is no longer needed, it may be removed leaving the existing structure in place for possible future use. Temporary rig solutions of various kinds are known.

However, not all sites are equally suited for installation of a rig and/or a derrick, and this can limit the type of rig and methods of installation at a particular site. Space can often be tight at candidate sites. This may particularly be so on existing structures such as a platform or the like at a well location. Space for accessing sites may also be tight, presenting challenges to the installation of derricks and/or rigs. Offshore locations can be particularly challenging due to harsh wind and wave conditions.

Other site limitations may also exist and may impact upon whether or not a particular rig can be installed and/or the manner in which that can be done. Due to their substantial height and weight, erecting a derrick safely and in adherence with requirements for the site in question is of primary importance. In particular, safety regulations can be significantly more stringent if wells are "live" and temporarily abandoned, than if the wells are permanently abandoned.

There is a need for rig and derrick installation solutions to address and overcome the limitations of various such sites. A lack of suitable techniques can result in operations being postponed or replaced, or more expensive alternatives being pursued.

One known technique for installing a derrick involves swinging the derrick up from a horizontal to a vertical position. Various "bottom-up" modular assembly techniques have also been proposed. However, previously proposed installation schemes may not be practical or efficient, and/or may not sufficiently satisfy site requirements. Indeed many proposals may never actually be implemented in practice.

Summary

There is a need identified in providing a rig and/or a derrick safely and securely at offshore sites, whilst doing so in a safe and efficient manner.

Accordingly, in a first aspect of the invention, there is provided a method of elevating at least one section of a derrick, the method comprising the steps of:

- (a) providing a base structure and at least one locking device thereupon;
- (b) placing said section of the derrick on a carrier, the carrier being provided with at least one lifting device;
- (c) positioning the carrier and the lifting device within the base structure;

(d) moving said section of the derrick upward using the lifting device, whereby the section is moved on a path adapted to limit lateral movement of the section; and

(e) applying the locking device to lock said section of the derrick to the base structure for preventing downward movement.

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The section may comprise first and second sections of the derrick. The steps (a) to (e) may be performed to elevate the first section of the derrick. The method may further comprise any one or more of the following steps:

- i. disconnecting the lifting device from the first section;
- 10 ii. holding the first section of the derrick in the elevated position by the locking device on the base structure while the lifting device of the carrier is disconnected from the first section;
- iii. moving the carrier away from the base structure;
- iv. providing a second section on the carrier;
- 15 v. connecting said lifting device to the second section;
- vi. re-positioning the carrier within the base structure to align the second section below the first section;
- vii. moving the second section of the derrick upward using the lifting device, whereby the second section is moved on a path adapted to limit lateral movement of the second section;
- 20 viii. connecting the second section to the first section, the connected first and second sections being locked to the base structure against downward movement via the locking device; and
- ix. moving the combined first and second sections upward using the lifting device, whereby the connected first and second sections are moved on a path adapted to limit lateral movement of the connected sections.

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Preferably, the locking device is operative to automatically lock if the lifting device fails or if the lifting device is not being operated. Once operative therefore, the locking device is preferably active during movement of sections upward to provide locking if the lifting device fails without requiring further intervention from personnel (e.g. to activate the locking device). When locked, the section of the derrick can thus be held in place relative to the base structure. Lifting of sections for erection of the derrick can thus take place in a safe and secure manner.

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Accordingly, the locking device may preferably be arranged so that when active or operative during the movement upward of the section of the derrick, the locking device may permit upward movement but prevent downward movement, e.g. prevent undesired movement downward of the section of the derrick relative to the base structure if the lifting device should fail or is not being operated. The locking device may have a profile or surface positioned or configured when active or operative so that the upward movement is allowed, while downward movement is substantially not allowed, e.g. by mechanically blocking the section from downward movement.

10 The locking device may typically comprise a ratchet. The locking device and/or ratchet may typically be arranged in engagement with a portion of the section of derrick being moved upward on the path.

When operative, the locking device may lock, e.g. automatically if the lifting device fails, by an engaging profile or surface of the locking device being pushed or urged against said section of the derrick, e.g. a surface of a tooth of a tooth rack on said section of the derrick. When locked, a surface of the locking device may engage a surface of the section of the derrick or of the tooth rack, e.g. of a tooth thereof, to mechanically block movement downward of the section of the derrick. The locking device may permit upward movement while an engaging profile or surface of the locking device is biased or urged against, e.g. in engagement and contact with, said section of the derrick, or a surface or a tooth rack thereof, at the location of the locking device.

The method may further comprise providing a top frame. The top frame may be moved upward by performing step (d).

The lifting device may preferably comprise at least one hydraulic actuator. The hydraulic actuator may thus be operable using hydraulic fluid. The hydraulic actuator may comprise an actuator arm. The hydraulic fluid may be applied to move the actuator arm, e.g. in or out of an actuator housing.

The lateral movement of the section may preferably be limited by at least one surface on either or both of the carrier and the base structure.

The path may be provided through at least one gap in a deck within the base structure. The gap may have at least one surface configured to limit lateral movement of the section at the gap.

- 5 The path may be within a foot print of the base structure.

The base structure may comprise an operations deck and a substructure below the operations deck. The locking device may preferably be mounted on the operations deck. The locking device may be mounted on a sub-deck, below the operations deck. The sub-deck
10 may be provided with processing equipment such as shale-shaker equipment. The operations deck may be a drilling deck, which may comprise a drill floor.

The section may comprise at least one tooth rack. The locking device may be configured to engage with the tooth rack in order to lock the section to the base structure.

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The section may comprise at least one tooth rack and the lifting device may be configured to engage with the tooth rack to lift the section upward.

The method may further comprise fastening, e.g. locking and/or securing, the carrier to
20 the base structure. The carrier may be fastened by a locking pin.

The section may comprise at least one column. The step of placing the section on the carrier may then comprise providing the column on the carrier in an upright, e.g. vertical, configuration. The step of moving the section upward may then comprise moving the col-
25 umn upward in the upright configuration.

It can be noted that the method may be performed to elevate first sections and second sections of the derrick, e.g. in pairs. Thus, the first sections may comprise a first pair of sections and the second sections may comprise a second pair of sections. Accordingly,
30 the steps (a) to (e) may be performed to elevate the first sections, e.g. as a pair. Advantageously, the first sections may then be elevated simultaneously and/or in parallel. Again, the second sections, e.g. as a pair, may then be elevated, for example simultaneously and/or in parallel. Accordingly, the method may further comprise any one or more of the steps: disconnecting the lifting device from the first sections; holding the first sections of
35 the derrick in elevated position by the locking device on the base structure while the lifting device of the carrier may be disconnected from the first sections; moving the carrier away

from the base structure; providing the second sections on the carrier; connecting said lifting device to the second sections; re-positioning the carrier within the base structure to align the second sections below the respective first sections; moving the second sections of the derrick upward using the lifting device, whereby the second sections can move on
5 paths adapted to limit lateral movement of the second sections; connecting the second sections to the first sections, respectively, the connected first and second sections being locked to the base structure against downward movement via the locking device; and moving the respective connected sections upward using the lifting device, whereby the connected sections may be moved on paths adapted to limit lateral movement of the re-
10 spective connected sections.

The derrick may typically comprise a frame having upright side frames or columns, for instance two opposing upright, typically vertical, side frames or columns. The upright side frames or columns may be spaced apart. The frame of the derrick may further include a
15 cross frame, typically comprising a horizontal beam, e.g. a top frame, which may be connected between the side frames or columns for bracing them. Accordingly, the section may comprise a side frame section of the derrick. The first sections may comprise opposite side frame sections, whereby the first sections may form part of the opposing sides of the frame of the derrick. Similarly, the second sections may comprise opposite side frame
20 sections, whereby the second sections may form part of the opposing sides of the frame of the derrick.

The derrick may have a longitudinal axis. The longitudinal axis may extend longitudinally along the derrick between an upper end and a lower end of the derrick. The longitudinal
25 axis may extend from a top end to a bottom end of the derrick. The longitudinal axis may preferably be vertical. The section may preferably be moved upward in parallel with the longitudinal axis. The path, gap and/or surface thereof may be adapted to limit movement of the section laterally, e.g. radially, with respect to the longitudinal axis.

30 The section, or a portion, of the derrick being elevated may also have a longitudinal axis, which may be co-axial or parallel with the longitudinal axis of the derrick. The section or portion may preferably be moved upward in parallel with that axis of the section or portion.

According to a second aspect of the invention, there is provided a method of elevating at
35 least one section of a derrick, the method comprising the steps of:

- providing a base structure and at least one locking device thereupon;

- placing said section of the derrick on a carrier, the carrier being provided with at least one lifting device;
- positioning the carrier and the lifting device within the base structure;
- moving said section of the derrick upward using the lifting device; and
- 5 - applying the locking device to lock said section of the derrick to the base structure for preventing downward movement.

At least one surface may be provided for supporting or stabilizing the section laterally, e.g. before, during and/or after movement upward. The section may be moved upward on a path comprising the surface. The surface may be a lateral surface. The surface may be provided by at least one gap, which may for example be a slot, cut-out, recess or the like. The surface may be configured to position or stabilize the section with respect to the base structure. The path may be a laterally confined path. Thus, the section may be free to move upward, but may not be free laterally. The gap may be configured to be spaced apart from the locking device, e.g. along the section or vertically. The gap may be spaced by a distance for stabilizing the section with respect to the base structure, and/or avoiding damage e.g. by imparted forces, e.g. moment forces, as may be expected during elevation of the sections.

20 According to a third aspect of the invention, there is provided apparatus for elevating at least one section of a derrick, the apparatus comprising:

- a base structure comprising at least one locking device; and
- a carrier comprising at least one lifting device and being arranged to carry a section of the derrick thereupon, wherein the lifting device is configured to move said section of the derrick upward such that the section is moved on a path adapted to limit lateral movement of the section, the locking device being operable to lock said section relative to the base structure against movement downward.

According to a fourth aspect of the invention, there is provided apparatus for elevating at least one section of a derrick, the apparatus comprising:

- a base structure comprising at least one locking device; and
- a carrier comprising at least one lifting device and being arranged to carry a section of the derrick thereupon, wherein the lifting device is configured to move said section of the derrick upward, the locking device being operable to lock said section relative to the base structure against movement downward.

According to a fifth aspect of the invention, there is provided a method of installing a rig by performing the method according to the first or second aspect.

According to a sixth aspect of the invention, there is provided a derrick comprising at least one section elevated by performing the method according to the first or second aspect, or by using the apparatus according to the third or fourth aspect.

According to a seventh aspect of the invention, there is provided a rig comprising the derrick according to the sixth aspect.

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According to an eighth aspect of the invention, there is provided apparatus for installing the derrick according to the sixth aspect, or the rig according to the seventh aspect.

According to a ninth aspect of the invention, there is provided a method of lowering at least one section of a derrick elevated by performing the method according to the first or second aspect, or using the apparatus according to the third or fourth aspect, the method comprising the steps of:

(f) moving the section of the derrick downward under control using the lifting device of the carrier, the carrier and the lifting device being positioned within the base structure, said section being moved on a path adapted to limit lateral movement of the section; and

(g) operating the locking device to allow the downward movement under control; wherein uncontrolled downward movement is prevented.

According to a tenth aspect of the invention, there is provided a method of disassembling a rig or a derrick by performing the method according to the ninth aspect.

According to an eleventh aspect of the invention, there is provided a disassembled section of a rig or a derrick, being disassembled by the method according to the tenth aspect.

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According to a twelfth aspect of the invention, there is provided apparatus for disassembling the derrick according to the sixth aspect or the rig according to the seventh aspect.

According to a thirteenth aspect of the invention, there is provided a method of elevating at least one section of a derrick, the method comprising the steps of:

(a) providing a base structure and at least one locking device thereupon;

(b) placing said section of the derrick on a carrier, the carrier being provided with at least one lifting device;

(c) positioning the carrier and the lifting device within the base structure;

(d) moving said section of the derrick upward using the lifting device, whereby
5 the section is moved on a path adapted to limit lateral movement of the section, wherein the locking device is operative to lock said section of the derrick to the base structure for preventing downward movement if the lifting device fails or if the lifting device is not being operated.

10 The term "lock" or "locking" is used herein to refer to a lock or locking which is secured. By way of being secured, a conscious and/or deliberate action is needed for unlocking. In addition, such locking is required to be positively verifiable, e.g. visibly and measurably.

Any of the aspects of the invention may include further features as described in relation to
15 any other aspect, wherever described herein. Features described in one embodiment may be combined in other embodiments. For example, a selected feature from a first embodiment that is compatible with the arrangement in a second embodiment may be employed, e.g. as an additional, alternative or optional feature, e.g. inserted or exchanged for a similar or like feature, in the second embodiment to perform (in the second embodiment)
20 in the same or corresponding manner as it does in the first embodiment.

Embodiments of the invention can be advantageous in various ways as will be apparent from throughout the specification. In particular embodiments, a controlled vertical movement of sections of the derrick can be obtained where sections are secured laterally and
25 vertically during elevation, where a "safe position" for the sections being elevated can be achieved at all times, so as to satisfy regulatory requirements. In addition, embodiments can be advantageous in that elevation of sections of the derrick can take place with sections arranged in a consistent orientation, facilitating simple force vectors and predictable and calculable forces. Further advantages of embodiments include the ability for sections
30 to be elevated without needing to perform complex lifts and without producing moments. The resulting derrick may advantageously be formed by connected sections aligned for providing a frame for the derrick which is "tidy" and has a simple and predictable force distribution. Particular embodiments can provide versatility for meeting the challenges of different kinds of installation sites, e.g. easy installation in compliance with requirements,
35 including where wells are "live" and/or "dead".

Description and drawings

There will now be described, by way of example only, embodiments of the invention with reference to the accompanying drawings, in which:

- 5 Figure 1 is a representation of a rig according to an embodiment of the invention;
- Figures 2 to 5 are representations illustrating the installation of lateral positioners in a method according to an embodiment of the invention;
- Figures 6 to 9 are representations illustrating a substructure and sequential steps
10 in the method whereby the substructure is installed;
- Figures 10 to 14 are representations illustrating a carrier and sequential steps in the method whereby sections of the derrick are prepared using the carrier;
- Figures 15 to 19 are representations illustrating further sequential steps in the method whereby a top part of the derrick and travelling assembly is assembled;
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- Figures 20 to 22 are representations illustrating further sequential steps in the method whereby the upper part of the derrick is elevated;
- Figures 23 to 28 are representations illustrating further sequential steps in the method whereby further sections are added to the derrick; and
20
- Figures 29 to 34 are representations illustrating further sequential steps in the method whereby various further components of the rig are installed.

Rig

- 25 With reference to Figure 1, a rig 200 is depicted in the form of a drilling rig. The rig 200 is installed offshore at an installation site 1 on a platform. The rig 200 has a derrick 300 which is elevated above a base structure and locked in place. The base structure includes an operations deck in the form of a drilling deck 600 comprising a drill floor, and a substructure 500 below the drilling deck 600. The derrick 300 has a vertical longitudinal
30 axis L and projects tower-like upward from the drill floor. The substructure 500 provides support for the rig 200 on the platform. As will be described further below, the substructure 500 is movably mounted on the platform such that the rig 200 can be moved laterally in respective orthogonal directions for positioning the rig 200 appropriately, e.g. to align the rig 200 with a selected well slot.

The rig 200 further includes apparatus comprising a carrier 700 equipped with lifting devices for elevating sections of the derrick 300 during installation of the rig 200. In addition, the rig 200 includes set-back apparatus 800 for storing drill pipe stands nearby the derrick 300, a cabin in the form of a driller's cabin 820 for allowing trained personnel to view and control operations on the drilling deck 600, supply apparatus 840 including mud tanks and pumps, pipe preparation apparatus 860 including drill pipe sections and a crane for lifting pipe sections onto a catwalk, and a control room 880 for operating a blow-out preventer (BOP).

10 The installation of the rig 200, including the derrick 300, and a method of elevating sections of the derrick 300, will be described in the following.

The derrick 300 is shown in Figure 1 ready for use, e.g. in an operation such as drilling, having been erected by elevating multiple sections of the derrick, including sections 301a, 301b and 302a, 302b. These sections are connected and arranged end-to-end along the derrick 300. The derrick 300 has a first side comprising aligned columns along which tooth racks k, l and tooth racks m, n run continuously from the top to the base of the derrick, and a second side comprising columns along which tooth racks w, x and tooth racks y, z likewise run from the top to the base of the derrick. The columns are perpendicular to the drill floor, parallel with the longitudinal axis L of the derrick. These tooth racks are built up from sectional tooth racks which are aligned with one another upon end-to-end connection of the sections. A travelling assembly 330 is coupled to the tooth racks k-n, w-z so as to be able to travel up and/or down along the derrick from one section to another on the tooth racks k-n, w-z.

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Providing base structure

With reference firstly to Figures 2 to 5, initial installation of the base structure is illustrated. The base structure has a movable base upon which the substructure 500 is provided. The movable base includes a first lateral positioner 10 (see Figure 4) for positioning the rig 200 laterally along skid beams 9a, 9b at the installation location 1 for the rig 200. The skid beams 9a, 9b run in parallel on a foundation structure 7 of the host platform, with various well slots 8 in different lateral positions extending through the foundation structure 7 for access below the platform. Supports 11a, 11b are provided on the skid beams 9a, 9b. The supports 11a, 11b are engagable with actuators 12a, 12b so that the supports 11a, 11b can be moved along the skid beams 9a, 9b by operating the actuators 12a, 12b.

Grippers (not shown) may also be provided to hold the supports 11a, 11b in place on the skid beams 9a, 9b once positioned.

The supports 11a, 11b are provided with connectors 13a, 13b, and supporting beams 14
5 are fitted to respective pairs of the connectors 13a, 13b. The beams 14 bridge a gap between the supports 11a, 11b and are fixed to the connectors 13a, 13b, e.g. by bolts or other fasteners. The gap is dependent upon the gauge between skid beams 9a, 9b. The beams 14 can be easily and advantageously be adapted for installations with different gauges between skid beams while utilizing the same connectors 13a, 13b and/or supports
10 11a, 11b. The beams 14, and indeed the first lateral positioner 10 as a whole, are dimensioned to be able to withstand and bear the total weight of the rig 200 on the foundation structure 7 once installed. The first lateral positioner 10 is movable as one along the skid beams 9a, 9b in order to obtain different lateral positions.

15 The movable base includes a second lateral positioner 20 which is provided upon the first lateral positioner 10 in order to allow the rig 200 to be positioned laterally across the skid beams 9a, 9b. The second lateral positioner 20 and the first lateral positioner 10 can move laterally in mutually orthogonal directions. The first and second lateral positioners 10, 20 allow the rig 200 to be moved in orthogonal directions laterally. The second lateral
20 positioner 200 has supports 21a, 21b on respective beams 14, and actuators 22a, 22b which are operable to move the supports 21a, 21b slidingly along the beams 14. Grippers (not shown) may be provided to hold the second lateral positioner 20 in position relative to the first lateral positioner 10.

25 With further reference now to Figures 6 to 9, further steps in the installation of the base structure are depicted, whereby the substructure 500 and drilling deck 600 are provided. Firstly, as seen in Figure 6, a first part of the substructure 500 in the form of a first box frame 510 is provided on the supports 21a, 21b of the second lateral positioner 20, and connected thereto by suitable fasteners. The first box frame 20 is lowered as a unit into
30 position. The first box frame 510 has four corner columns 511a-d, and cross-bracing 512a-c between the columns on three of the sides of the first box frame 510. On a fourth side, an access opening 514 is provided for allowing access to the inside of the substructure 500 for inserting sections of the derrick in order to elevate the derrick, as will be further explained below. The access opening 514 is defined on the fourth side of the frame
35 between adjacent corner columns 511a, 511d and top bracing 513t.

In Figure 7, a second, upper part of the substructure 500 in the form of a second box frame 520 is provided on top of the first box frame 510, by lowering it as a unit into position, and is connected thereto by suitable fasteners. The second box frame 520 has corner columns 531a-d with cross-bracing 532 therebetween. The corner columns 531a-d of the second box frame 520 are aligned with the corner columns of 511a-d of the first column, which are in turn aligned with respective members on supports 21a, 21b of the second lateral positioner 20. Vertical force components can thus be accommodated and transmitted through the columns 511a-d, 531a-d, onto the skid beams 9a, 9b, and distributed into the structure of the platform below.

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In Figure 8, a sub-deck 540 is provided on, e.g. lowered onto, the second box frame 520, at the base of the second box frame 520. The sub-deck 540 includes equipment 550 for processing drilling fluid and cuttings returning to the rig from the wellbore. The equipment 550 includes for example shale shakers and associated equipment. Cut-outs 544a, 544b in the sub-deck 540 provide slots through which sections of the derrick 300 can pass to elevate the sections. Side surfaces 545a, 545b in the respective slots restrict lateral movement of sections of the derrick as they pass on a path upward through the slots. In this way, the cut-outs 544a, 544b can be configured to give the sections little or no freedom of movement laterally. The cut-outs are sized to closely match the dimensions of the sections.

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In Figure 9, a drilling deck 600 is provided on top of the second box frame 520 of the substructure 500. The drilling deck 600 is lowered into this position. The drilling deck 600 is provided with slots 604a, 604b therethrough. The drilling deck 600 includes a drill floor 601f. Sections of the derrick can be moved through the slots 604a, 604b to elevate the sections above the drilling deck 600, as will be explained further below. The slots 604a, 604b have side surfaces 605a, 605b which act to restrict lateral movement of the sections as they pass upward through the slots 604a, 604b. In this way, the slots 604a, 604b can also be configured to give the sections little or no freedom of movement laterally. The slots are sized to closely match the dimensions of the sections. As can be seen, the slots 604a, 604b in the drilling deck 600 are aligned correspondingly with the slots of the cut-outs 544a, 544b in the sub-deck 540 below. The sections of the derrick are moved on respective paths through the cut-out 544a and slot 604a and through the cutout 544b and slot 605b. By virtue of the slots 604a, 604b and cut-outs 544a, 544b and side surfaces 545a, 545b and 605a, 605b restricting lateral movement at both the level of the sub-deck 540 and the drilling deck 600, moment arms along the sections are limited. Thus, moment

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forces such as may occur due to movements of the sea or other external disruptions can be safely handled and the sections of the derrick can be kept securely positioned on the path whilst being elevated. Four pairs of locking devices 610k-n, 610w-z, are installed on the drilling deck 600 for engaging with sections of the derrick as the sections are raised
5 upward through the slots 604a, 604b. The locking devices 610k-n, 610w-z are configured to allow upward movement of the sections whilst preventing movement downward, as will be described in further detail below.

Preparing sections of derrick for elevation

10 After providing the base structure as described above, the derrick 300 is erected. Initial steps for erecting the derrick are now described with further reference now to Figures 10 to 14.

As can be seen in Figure 10, to facilitate elevating sections of the derrick, a carrier 700 is
15 provided on the first lateral positioner 10. More specifically, the carrier 700 is coupled to a track 24 on the first lateral positioner 10 that runs parallel along the beams 14 of the first lateral positioner 10. The carrier 700 is movably mounted to the track 24 so as to be movable relative to the beams 14. The carrier 700 is movable laterally toward and away from the substructure 500. In particular, the carrier 700 is movable through the access
20 opening 514 into the substructure 500. The carrier 700 comprises a frame having four corner columns 711a-d, supported by a bracing sub-frame 712 positioned centrally for bracing the columns 711a-d. Hydraulic actuators 718a-d are provided on respective corner columns 711a-d, each of the hydraulic actuators 718a-d having one end fixed to the relevant column and a movable extender arm arranged to extend the reach of the actuator
25 upward. As will be shown, ends of the extender arms are configured to attach to sections of the derrick so as allow the sections of the derrick to be driven and moved upwards by operating the hydraulic actuators 718a-d.

The frame includes surfaces 719a-d upon which a section of the derrick can stand when
30 inserted onto the carrier 700, and members 717a-d providing surfaces at upper ends of the corner columns 711a-d for preventing movement of the section laterally. The members 717a-d may also help to guide the sections downward into location on the carrier 700 by way of angled guiding surfaces.

35 In Figure 11, first sections 301a, 301b of the derrick 300 are being placed on the carrier 700. The first sections 301a, 301b may for example be lowered using a crane, onto the

carrier 700. The sections 301a, 301b are arranged in upright position on the carrier 700, so as to be aligned in their "in use" orientation, such that when the derrick is erected for use in an operation, e.g. drilling or another operation in the well, the sections 301a, 301b have the same orientation in the erected derrick. Indeed, as will be seen, this "in use" orientation is maintained throughout the process of elevating the derrick. No rotation of the sections 301a, 301b is needed. The first sections 301a, 301b are configured to provide opposing side sections in the derrick 300 when installed. The first sections 301a, 301b are lowered so that the lower end of the section 301a rests against the surfaces 719b, 719c and the lower end of the section 301b rests against the surfaces 719a, 719d. Once lowered, the first sections 301a, 301b are secured in place on the carrier 700 by locking the extender arms of the hydraulic actuators 718a-d onto the first sections 301a, 301b.

The first sections 301a, 301b each comprise two columns along which tooth racks extend. The section 301a has a first column comprising tooth racks 310k, 310l, and a second column comprising tooth racks 310m, 310n. The section 301b has a first column comprising tooth racks 310w, 310x, and a second column comprising tooth racks 310y, 310z. The tooth racks 310k-n and 310 w-z run continuously from the top to the bottom of the relevant columns, and are used for running a travelling assembly downward and upward in the derrick once erected, for example to facilitate insertion into and removal of a drill string from a wellbore when the rig is in use. However, the tooth racks 310k-n, 310w-z are also utilized in the installation of the rig 200 as will be apparent in the following. In particular, as is seen in Figure 12, some of the tooth racks 310k-n, 310w-z are used in order to lock and secure the first sections 301a, 301b in place upon the carrier 700.

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With reference to Figure 12, an extender arm 720c of the actuator 718c has an engaging device 721a which is operable by a hydraulic locking actuator 722c. The arm 720c is locked onto the section 301a by activating the hydraulic locking actuator 722c. The engaging device 721c is then urged by the hydraulic locking actuator 722c against a portion of the tooth rack 310k of the section 301a. The engaging device 721c has a surface which is profiled comprising teeth to complementarily engage with the teeth in the tooth rack 310k, so that the extender arm 720c is locked onto the section 301a and movement between the extender arm 720c and the section 301a is prevented. It can be noted that the extender arm 720c is further provided with a bracket 723c which is slidable in a track along the corner column 711c for keeping the end of the extender arm 720c aligned. The other corner columns 711a, 711b, 711d and their hydraulic actuators 718a, 718b,

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718d are configured and operate in the same way as that of the corner column 711c and the hydraulic actuator 718c described here.

The corner columns 711a-d of the carrier 700 are also provided with hydraulically operable pins 725a-d (see Figure 10) for locking the carrier 700 to the substructure 500 when inserted therein. The hydraulically operable pins 725a-d can be retracted for insertion of the carrier 700 or extended (as illustrated by pin 725d in Figure 12) to engage with complementary sockets or recesses in the framework of the substructure 500 for locking the carrier 700 in place.

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Referring now to Figures 13 and 14, once the first sections 301a, 301b are locked and secured on the carrier 700, the carrier 700 is moved into the substructure 500 through the access opening 514, and the hydraulically operable pins 725a-d are engaged as explained above to lock the carrier 700 to the substructure 500. The first sections 301, 301b are arranged in an upright position and are aligned underneath the slots 604a, 604b, and underneath the cut-outs 544a, 544b, so as to be ready to be moved on a path upward from the carrier through the cutouts 544a, 544b and the slots 604a, 604b upon operating the hydraulic actuators 718a-d on the carrier 700. In Figure 14, the engagement of the hydraulically operable pin 725d in a recess of the framework of the substructure 500 is illustrated after hydraulic activation of the pin 725d.

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Before the first sections 301a, 301b are moved upward, some further preparatory steps are taken as illustrated now with reference to Figures 15 to 19, in which a derrick upper assembly is constructed. As seen in Figure 15, with the first sections 301a, 301b located on the carrier 700, first upper sections 321a, 321b are lowered into the substructure 500 from above. The first upper sections 321a, 321b are lowered through the cutouts 544a, 544b and the slots 604a, 604b, into the position as shown and are connected with the first sections 301a, 301b, by suitable fasteners such as bolts, or another suitable fastener. Thereafter, as seen in Figure 16, second upper sections 322a-d are connected on top of the first upper sections 321a, 321b which protrude upward slightly from the drilling deck 600. When connected, the respective second upper sections 322a-d each comprises a column which is aligned on top of a corresponding column in the structure of the first upper sections 321a, 321b.

In Figure 17, a travelling assembly 330 is installed. The travelling assembly 330 is connected onto the second upper sections 322a-d. The travelling assembly 330 has a first

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movable carriage 331a connected to respective tooth racks running along the columns of two of the upper assembly sections 322c, 322d, and a second movable carriage 331b connected via gear wheels to tooth racks running along the columns of the other two upper assembly sections 322a, 322b. The carriages 331a, 331b are motorized by electric
5 motors to turn the gear wheels which engage with the tooth racks so as to be movable up and down the tooth racks of the second upper sections 322a-d (and those of connected sections below). In Figure 18, a connecting frame 333 of the travelling assembly 330 is provided on the first and second movable carriages 331a, 331b and connected thereto. By doing so, the first and second movable carriages 331a, 331b and the connecting frame
10 333 are coupled as one, such that the travelling assembly as a unit can move up and down in the derrick along the tooth racks k-n, w-z by operation of motors on the first and second carriages 331a, 331b.

In Figures 18 and 19, a third upper section in the form of a top frame 323 of the derrick
15 300 is mounted on the second upper sections 322a-d, and connected by suitable fasteners such as bolts or any other suitable kind of fastener. The top frame 323 is lowered into position. The top frame 323 bridges the gaps between the second upper sections 322a-d for bracing those sections 322a-d, and the sections below to which the sections 322a-d are connected, in position.

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Elevating derrick sections

Once the upper assembly of the derrick 300 is in place, a first portion 300a of the derrick 330 is constructed ready to be elevated. Figures 20 to 23 further illustrate the procedure. Firstly, the locking devices 610k-n, 610w-z on the drilling deck 600 are activated to en-
25 gage with the first portion 300a of the derrick to be elevated. The configuration of the locking devices 610k-n, 610w-z can be seen in closer detail in Figure 20 which illustrates in particular the pair of locking devices 610y, 610z. The locking device 610y is arranged to engage with the "y" tooth rack formed by the columnar alignment of sectional tooth racks 321y, 322y on the respective sections 321b, 322a and tooth rack 310y on section
30 301b (not visible in Figure 20). Similarly, the locking device 610z is arranged to engage with the "z" tooth rack formed by the columnar alignment of sectional tooth racks 322z, 321z on sections 321b, 322a and tooth rack 310z on section 301b (not visible in Figure 20). The locking devices 610y, 610z have respective engaging profiles 613y, 613z comprising teeth which are arranged to contact against surfaces of the teeth on the y and z
35 tooth racks. The locking devices 610y, 610z include biasing devices in the form of springs 614y, 614z for urging the engaging profiles 613y, 613z against the y and z tooth racks.

It can be seen that the springs 614y, 614z are mounted on hydraulic actuators 611y, 611z. The hydraulic actuators 611y, 611z include actuator arms 615y, 615z extending from respective cylinder housings 616y, 616z. More specifically, the springs 614y, 614z
5 are provided on the actuator arms 615y, 615z and respectively act between a shoulder of the housing and an end of the arm. The ends of the actuator arms 615y, 615z are pivotally coupled to the locking profiles 613y, 613z. The actuators 611y, 611z, in particular the cylinder housings 616y, 616z thereof, are mounted to the drilling deck 600 via a bracket 612y, 612z. The engaging profiles 613y, 613z are pivotally movable relative to the bracket 612y, 612z allowing the engaging profiles to accommodate movement upward whilst
10 being secured against movement downward by the springs 614y, 614z, urging the engaging profiles 613y, 613z toward the y and z tooth racks, as indicated by the arrows K. The hydraulic actuators 611y, 611z can be operated for releasing the locking device by application of hydraulic fluid in the housings 616y, 616z. In doing so, the engaging profiles
15 613y, 613z are pivoted in the opposite sense to the arrows K, by the piston arms 616y, 616z retracting into the housing and pulling against the bias of the springs 614y, 614z to compress them. This functionality is used for lowering the derrick under disassembly, as will be described further below. When engaged by the engaging profiles 613y, 613z, the locking devices 610y, 610z interlock with the tooth racks such that the sections of the derrick upon which the tooth racks are mounted cannot move downwards. Thus, the first
20 portion 300a of the derrick is secured against movement downward by the locking devices.

Although downward movement is prevented, the locking devices 610y, 610z still permit
25 upward movement. The locking devices 610y, 610z when activated act as ratchets in this respect. The springs 614y, 614z bias the engaging profiles 613y, 613z against the tooth racks. The profiles 613y, 613z abut tooth surfaces on the y and z tooth racks so as to mechanically block the tooth rack against movement downward by downward components of force, and so that the tooth rack is unblocked by movement upward when applying upward components of force. The profiles 613y, 613z of the locking devices 610y, 610z are
30 biased so as to automatically lock the tooth racks at each tooth along the tooth rack, by operation of the springs 614y, 614z. Upward movement is permitted automatically whilst the profiles 613y, 613z are biased against the tooth racks by movement upward. When movement upward is taking place, the engaging profiles 613y, 613z are moved against
35 the springs 614y, 614z causing them to compress sufficiently to allow the movement. If the hydraulic actuators 718a-718d on the carrier 700 fail for example, the locking devices

610y, 610z automatically lock by way of the engaging profiles 613y, 613z being pushed by the springs 614y, 614z against the tooth racks, such that a safe position is immediately obtained. The other locking devices are configured to operate correspondingly.

5 In Figures 21 and 22, the first portion 300a of the derrick is elevated by activating the hydraulic actuators 718a-d on the carrier 700. The hydraulic actuators 718a-d drive the first portion 300a upward as indicated by the arrow A, by extending the extender arms 720a-d, the extender arms 720a-d being attached to the first sections 301a, 301b, as described above. As seen in Figure 22, the first portion 300a has been moved upward into an elevated position. All of the locking devices 610k-n, 610w-z are activated and now in engagement with the tooth racks on the first sections 301a, 301b so as to lock the elevated first portion 300a of the derrick against movement downward. The first sections 301a, 301b are restricted from movement laterally by surfaces in the slots 604a, 604b and the cut-outs 544a, 544b. In addition, the hydraulic actuators 718a-d additionally support and
15 lock the first portion of the derrick 300a at the lower end. The frame of the carrier 700 is also configured to provide lateral support. In practice, the stroke lengths of the hydraulic actuators 718a-d are limited such that in order to lift the first sections 301a, 301b into the elevated position as shown in Figure 22, the hydraulic actuators 718a-d are used multiple times to lift the sections upwards. Typically, three strokes are needed. When the extender arms 720a-d of the hydraulic actuators 718a-d have been extended to full stroke, the
20 extender arms 720a-d are disconnected from the first sections 301a, 301b, and are retracted and re-connected lower down along the columns of the first sections 301a, 301b.

While the hydraulic actuators 718a-d are disconnected, the first sections 301a, 301b, and
25 indeed the first portion 300a of the derrick as a whole, are held in position by the locking devices 610k-n, 610w-z, which remain locked and act to prevent downward movement of the first portion 300a of the derrick. The first sections 301a, 301b are laterally supported and restricted from movement laterally by surfaces in the slots 604a, 604b and the cut-outs 544a, 544b. The first portion 300a is thus held in a stable position. The locking devices 610k-n, 610w-z, the slots 604a, 604b, and the cut-outs 544a act at positions which
30 are spaced apart along the first portion 300a of the derrick for helping to stabilize the elevated first portion 300a. In particular, space constraints laterally upon the sections 301a, 301b at the slots 604a, 604b and the cut-outs 544a, 544b facilitate stabilization and alignment of the sections 301a, 301b and the first portion 300a of the derrick. Accordingly, moment forces or moments which could otherwise be damaging to the structure are not
35 allowed to develop. Once reconnected via the engaging devices 721a-d, the hydraulic

actuators 718a-d of the carrier 700 are applied to perform another stroke, moving the first sections 301a, 301b, and the first portion 300a of the derrick, a further distance upward. Although Figures 21 and 22 indicate that the travelling assembly 330 is held in place on the sections 322a-d and is elevated by virtue of moving the first portion 300a of the derrick upward, the travelling assembly 330 may in other variants remain at the drilling deck 600 while the rest of the first portion 300a is moved upward. The travelling assembly 330 may then be driven up to the top of the derrick 300 in a separate step.

Once in the desired elevated position as shown in Figure 22, further sections of the derrick are added to the elevated first portion 300a. Figures 23 to 28 illustrate steps in which such further sections are added. In Figure 23, the hydraulic actuators 718a-d are disconnected from the first sections 301a, 301b, while the first portion 300a of the derrick 300 is held in the elevated position by way of the locking devices 610k-n, 610w-x installed on the drilling deck 600. The carrier 700 is moved out of the substructure 500 for loading such further sections onto the carrier 700. In Figure 24, two further sections 302a, 302b are lowered onto the carrier 700 and the extender arms of the actuators 718a-d are connected to the further sections 302a, 302b in the same way as for the first sections 301a, 301b as described above. The further sections 302a, 302b are identical to the first sections 301a, 301b. Thus, the engaging members on the extender arms of the actuators 718b, 718c grip onto tooth racks 320k, 320n respectively, and the engaging members on the arms of the actuators 718a, 718d grip onto the tooth racks 320z, 320w respectively. With the further sections 302a, 302b secured on the carrier 700, the carrier 700 is moved back into the substructure 500 through the access opening 514 as indicated by arrow I, to align the further sections 302a, 302b with the first sections 301a, 301b, as seen in Figure 25. In Figure 26, the carrier 700 is locked to the substructure 500 to keep it positioned therein, ready for lifting the further sections 302a, 302b. The further sections 302a, 302b are arranged below the first sections 301a, 301b respectively.

In Figure 27, the further sections 302a, 302b are raised up a short distance until upper ends of the further sections 302a, 302b meet lower ends of the first sections 301a, 301b. When the ends are arranged adjacent to one another, they are coupled together to connect the further sections 302a, 302b to the first sections 301a, 301b and fastened e.g. by suitable fasteners such as bolts or any other suitable fastener. In this way, the further sections 302a, 302b are added to the elevated first portion 300a of the derrick to provide an extended, second portion 300b of the derrick. Once connected as shown in Figure 28, the extended, second portion 300b of the derrick with the further sections 302a, 302b in-

corporated, is driven upward by operating the hydraulic lifting actuators 718a-d on the carrier 700. Again, multiple strokes of the hydraulic actuators 718a-d, requiring disconnection and reconnection of the extender arms to the further sections 302a, 302b are used to lift the extended, second portion 300b of the derrick upward on the path through
5 the slots 604a, 604b and cut-outs 544a, 544b, whereby lateral movement is limited, for keeping the second portion 300b stable, e.g. in the event of disruptive forces. The locking devices 610k-n, 610w-z are operated to engage with the tooth racks to lock the extended, second portion 300b of the derrick against movement downward as it is moved upward, and to hold the extended, second portion 300b of the derrick securely in position during
10 disconnection.

Yet further sections of the derrick are added as required. They are added in the same way as the further sections 302a, 302b by repeating the steps illustrated in Figures 23 to 28, until the derrick 300 is fully extended and erected to a desired height, as shown in
15 Figure 1. The first sections 301a, 301b and further sections 302a, 302b form side sections in the frame of the derrick, and can be added as described until a required or desired height is reached, ready for drilling operations. The yet further sections can be configured in the same way as the first sections 301a, 301b and the further sections 302a, 302b, whereby they provide parts of the sides of the frame of the derrick. The resulting derrick
20 300 as seen in Figure 1 provides a straightforward and solid inverted U-frame with columnar sides braced and stiffened by the orthogonal top frame. The frame of the derrick is securely fastened and locked to the base structure at the drilling deck 600 by virtue of the locking devices 610k-n, 610w-z which engage the tooth racks. The "in use" orientation of first sections 301a, 301b, further sections 302a 302b or yet further sections is maintained
25 throughout, e.g. before, during and after the movements upward (and/or downward in the case of disassembly and lowering as further described below) of those sections and/or the portions 300a, 300b of the derrick. The movements upward (and/or downward) are parallel with the longitudinal axis L.

30 With reference to Figure 29, the control room 880 is provided on first protruding supports 24a, 24b of the second lateral positioner 20, so as to be positioned on the outside of the first box frame 510 of the substructure 500. An access stairway 640 is provided between the drilling deck 600 and the sub-deck 540, on the outside of the second box frame 520 of the substructure 500. The carrier 700 is positioned within the substructure (by insertion
35 via the passageway) with the BOP supported on the carrier 700.

In Figure 30, the set-back apparatus 800 is installed. The set-back apparatus 800 is supported on second protruding supports 25a, 25b of the second lateral positioner 20, on the outside of the first and second box frames 510, 520 and of the drilling deck 600. The set-back apparatus 800 contains drill pipe stands 801 in upright orientation with lower ends of the stands 801 positioned below the drilling deck 600 in the lower part of the substructure 500, and upper ends of the stands 801 above the drilling deck 600 for facilitating access and placement in the derrick when adding the stands 801 to a drill string or removing the stands therefrom.

10 In Figure 31, support forks 16a, 16b are connected onto the first lateral positioner 10, followed by a framework 17 comprising beams and cross beams between the forks 16a, 16b, as seen in Figure 32.

In Figure 33, the supply apparatus 840 is installed. In this case, the supply apparatus 840 includes mud tanks 841 in individual frames that are lowered into place on the framework 17. A storage facility 850 is installed above the supply apparatus 840 including a storage deck 851 for containers or the like, and a deck-supporting frame 852 for supporting the storage deck 851 on the frame work 17 of the lower lateral positioner 10. The deck-supporting frame 852 is installed around the supply apparatus 840. The storage deck 852 is then lowered as a unit onto the frame 852 and connected.

A pipe preparation deck 854 is arranged above the storage deck 852, and is supported by a further frame 853 installed on the storage deck. The pipe preparation deck 854 is lowered onto the frame 853 and connected. Thereafter, pipe preparation apparatus 860 is provided on the pipe preparation deck 854. The pipe preparation apparatus 860 includes racks 861 for storing sections of drill pipe in a horizontal orientation and a crane 862 for maneuvering the pipe sections as required. The pipe preparation deck 854 is connected to the drilling deck 600 by a cat-walk by which sections of drill pipe from the racks 861 may be transported onto the drilling deck 600 for use in operations. Stairways 855 are provided for access from the pipe preparation deck 854 to levels below, such as to the storage deck 852 and to the mud tanks 841.

It can be noted that the derrick 300 can readily be installed in an alternative configuration in which the derrick 300 is rotated laterally (i.e. about a vertical axis) with respect to the base structure. This can be done by placing the second box frame 520 of the substructure 500 onto the first box frame 510 in an orientation whereby the second box frame 520

is rotated laterally by 90 degrees from that shown in for example Figure 7. The sub deck 540 and drilling deck 600 are then added in a correspondingly rotated fashion. Accordingly, the slots and cutouts in the drilling deck 600 and sub deck 540 are provided along the other two sides of the substructure 500. The carrier 700, and/or the frame thereof, is
5 likewise rotated 90 degrees laterally so that the sections of the derrick on the carrier are rotated to align with the slots and cutouts. The frame 712 may for example be disconnected from a base part of the carrier 700 and turned 90 degrees.

Disassembly

10 In order to disassemble the rig, and the derrick, the steps for installing the rig and elevating the derrick as illustrated through Figures 1 to 34 can be reversed, although in order to lower the derrick and/or sections thereof, the locking devices 610k-n, 610w-z and hydraulic actuators 718a-d of the carrier 700 are applied somewhat differently. Referring to the components shown in close-up in Figure 20, during the descent (along the same path
15 through the substructure 500 as when elevating sections of the derrick), the hydraulic actuators 611y, 611z in the locking devices 610y, 610z can be controlled against the springs 614y, 614z to move the locking profiles 613y, 613z away from the tooth racks to allow movement downward. The portion of the derrick being lowered, and or sections thereof, e.g. the first sections 301a, 301b or the further sections 302a, 302b, are supported by the
20 hydraulic actuators 718a-d, and the hydraulic actuators 718a-d are operated to control the downward movement, e.g. at a suitable rate. In the event of failure of the hydraulic actuators 718a-d on the carrier 700, the hydraulic actuators 611y, 611z of the locking devices 610y, 610z can disengage such that the springs 614y, 614z bias the locking profiles 613y, 613z into the y and z tooth racks to lock and secure the sections in a safe position. The
25 locking devices 610k-n, 610w, 610x may operate correspondingly. In other variants however, an additional independent safety locking device (not shown) may be employed, e.g. at the drilling deck 600, which can automatically prevent uncontrolled downward movement of sections of the derrick.

30 It will be appreciated that although the description above is made with reference to an offshore rig, the rig could in other cases be an onshore rig. The described platform could be a fixed or floating platform. In addition, although the rig is described as a drilling rig the techniques described can equally be applied for any kind of rig. In certain variants, the derrick may be applied for operations such as casing, well intervention, workover, plug
35 and abandonment, or other operations. The rig can be readily fitted with auxiliary equipment, e.g. on the operations deck in order to support such operations.

Advantages

Various advantages are provided by embodiments of the invention. In particular, the locking devices 610k-n, 610w-z and provision of slots 604a, 604b and cut-outs 544a, 544b preventing downward and lateral movement while allowing movement of the sections of the derrick upward during elevation provides for a safe and secure procedure for installing the derrick. Hydraulic actuators 718a-d on the carrier 700 can facilitate a controlled elevation and lowering of sections of the derrick. Utilization of tooth racks for connecting the hydraulic actuators 718a-d to the sections of the derrick, and for locking the sections using the locking devices 610k-n, 610w-z at the drilling deck can reduce the need for installing auxiliary structures to lock off the sections against the base structure during the installation. A framed derrick 300 can be efficiently installed facilitated for example by the side sections of the derrick in pairs. The techniques described involve an installation from modules which individually are limited in weight such that handling using light-weight lifting equipment is facilitated. The size of modules is limited to allow a substantial part of the installation to take place within the foot print of the base structure, allowing efficiencies in the use of space. Indeed, elevation of sections of the derrick can take on a path within the foot print of the installed rig, the substructure, and the drilling deck. Sections for the derrick can advantageously be prepared in a "ready to go" upright configuration on the carrier, away from the substructure. Positioning sections on the carrier and elevating sections in their "in use" orientation so that they have the same orientation as they do when the derrick is erected, with columns parallel with the longitudinal axis L, can also be advantageous in terms of efficiency and use of space. In particular variants, two carriers may be provided with one carrier loaded with further sections whilst the other is inserted in the substructure for lifting sections of the derrick upward. The derrick using these installation techniques can reduce need for complex lifts, and can be suited to sites with producing wells without needing to close them down during installation.

Various modifications and improvements may be made without departing from the scope of the invention herein described.

CLAIMS

1. A method of elevating at least one section (301a, 301b, 302a, 302b) of a derrick
5 (300), the method comprising the steps of:

(a) providing a base structure and at least one locking device (610k-n, 610w-z)
thereupon;

(b) placing said section (301a, 301b, 302a, 302b) of the derrick (300) on a car-
rier (700), the carrier (700) being provided with at least one lifting device (718a-d);

10 (c) positioning the carrier (700) and the lifting device (718a-d) within the base
structure;

and being characterized by:

(d) moving said section (301a, 301b, 302a, 302b) of the derrick (300) upward
using the lifting device (718a-d), whereby the section is moved on a path adapted to limit
15 lateral movement of the section, the locking device (610k-n, 610w-z) being operative to
automatically lock if the lifting device (718a-d) fails; and

(e) applying the locking device (610k-n, 610w-z) to lock said section (301a,
301b, 302a, 302b) of the derrick (300) to the base structure for preventing downward
movement.

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2. A method as claimed in claim 1, wherein the locking device (610k-n, 610w-z) locks
automatically by an engaging profile (613y, 613z) of the locking device being pushed
against a tooth rack (310y, 310z) of said section of the derrick (300).

25 3. A method as claimed in claim 1 or 2, wherein the locking device (610k-n, 610w-z)
permits upward movement while an engaging profile (613y, 613z) of the locking device is
biased against a tooth rack (310y, 310z) of said section of the derrick (300).

4. A method as claimed in any preceding claim, wherein the locking device (610k-n,
30 610w-z) is arranged so that when operative during the movement upward of the section
(301a, 301b, 302a, 302b) of the derrick (300), the locking device (610k-n, 610w-z) permits
upward movement but prevents undesired downward movement if the lifting device (718a-
d) should fail.

5. A method as claimed in any of claims 1 to 3, wherein steps (a) to (e) are performed to elevate a first section (301a, 301b) of the derrick (300), and wherein the method further comprises:

- i. disconnecting the lifting device (718a-d) from the first section (301a, 301b);
5 and
- ii. holding the first section (301a, 301b) of the derrick in the elevated position by the locking device (610k-n, 610w-z) on the base structure, while the lifting device (718a-d) of the carrier (700) is disconnected from the first section (301a, 301b).

10

6. A method as claimed in any preceding claim, performed to elevate first and second sections (301a, 301b, 302a, 302b) of the derrick (300), wherein steps (a) to (e) are performed to elevate the first section (301a, 301b) of the derrick, and wherein the method further comprises:

- 15 iii. moving the carrier (700) away from the base structure;
- iv. providing the second section (302a, 302b) of the derrick on the carrier (700);
- v. connecting said lifting device (718a-d) to the second section (302a, 302b);
- vi. re-positioning the carrier (700) within the base structure to align the second
20 section (302a, 302b) below the first section (301a, 301b); and
- vii. moving the second section (302a, 302b) of the derrick (300) upward using the lifting device (718a-d), whereby the second section (302a, 302b) is moved on a path adapted to limit lateral movement of the second section.

25 7. A method as claimed in any preceding claim, performed to elevate first and second sections (301a, 301b, 302a, 302b) of the derrick (300), wherein steps (a) to (e) are performed to elevate the first section (301a, 301b) of the derrick, and wherein the method further comprises:

- viii. connecting the second section (302a, 302b) to the first section (301a,
30 301b), the connected first and second sections being locked to the base structure against downward movement via the locking device (610k-n, 610w-z); and
- ix. moving the connected first and second sections (301a, 301b, 302a, 302b) upward using the lifting device (718a-d), whereby the connected first and second sections (301a, 301b, 302a, 302b) are moved on a path adapted to limit lateral movement of the
35 connected sections.

8. A method as claimed in any preceding claim, wherein the path is provided through a gap (544a, 544b, 604a, 604b) in at least one deck (540, 600) within the base structure, and the gap has at least one surface (545a, 545b, 605a, 605b) configured to limit lateral movement of the section (301a, 301b, 302a, 302b) at the gap.

5

9. A method as claimed in any preceding claim, wherein base structure comprises an operations deck (600) and a substructure (500) below the operations deck (600).

10. A method as claimed in claim 8, wherein the locking device is mounted on the operations deck.

11. A method as claimed in any preceding claim wherein the locking device (610k-n, 610w-z) comprises a ratchet.

12. A method as claimed in any preceding claim, wherein the locking device (610k-n, 610w-z) is configured to engage with a tooth rack (k-n, w-z) on the section (301a, 301b, 302a, 302b) of the derrick, in order to lock the section (301a, 301b, 302a, 302b) to the base structure.

13. A method as claimed in any preceding claim, wherein the section (301a, 301b, 302a, 302b) comprises at least one tooth rack (k-n, w-z) and the lifting device (718a-d) is configured to engage with the tooth rack to lift the section (301a, 301b, 302a, 302b) upward.

14. A method as claimed in any preceding claim, wherein the lifting device (718a-d) comprises at least one hydraulic actuator (718a-d).

15. A method as claimed in any preceding claim, which further comprises locking the carrier (700) to the base structure.

30

16. A method as claimed in any preceding claim, wherein the section (301a, 301b, 302a, 302b) comprises at least one column, and the section (301a, 301b, 302a, 302b) is placed on the carrier (700) such that the column is positioned in an upright configuration, and wherein the step of moving the section (301a, 301b, 302a, 302b) upward comprises moving the column upward in the upright configuration.

35

17. A method of elevating at least one section (301a, 301b, 302a, 302b) of a derrick (300), the method comprising the steps of:

(a) providing a base structure and at least one locking device (610k-n, 610w-z) thereupon;

5 (b) placing said section (301a, 301b, 302a, 302b) of the derrick (300) on a carrier (700), the carrier (700) being provided with at least one lifting device (718a-d);

(c) positioning the carrier (700) and the lifting device (718a-d) within the base structure;

characterized by

10 (d) moving said section (301a, 301b, 302a, 302b) of the derrick (300) upward using the lifting device (718a-d), whereby the section (301a, 301b, 302a, 302b) is moved on a path adapted to limit lateral movement of the section, wherein the locking device (610k-n, 610w-z) is operative to lock said section (301a, 301b, 302a, 302b) of the derrick to the base structure for preventing downward movement if the lifting device (718a-d) fails.

15

18. A method as claimed in any preceding claim, which further comprises lowering at least one section (301a, 301b, 302a, 302b) of the derrick (300) which has been elevated by performing the steps of any of the preceding claims, the section being lowered by:

(f) moving the section (301a, 301b, 302a, 302b) of the derrick (300) downward
20 under control using the lifting device (718a-d) of the carrier (700), the carrier (700) and the lifting device (718a-d) being positioned within the base structure, said section (301a, 301b, 302a, 302b) being moved on a path adapted to limit lateral movement of the section; and

(g) operating the locking device (610k-n, 610w-z) to allow the downward
25 movement under control; wherein uncontrolled downward movement is prevented.

19. Apparatus for elevating at least one section (301a, 301b, 302a, 302b) of a derrick (300), the apparatus comprising:

a base structure comprising at least one locking device (610k-n, 610w-z);

30 and

a carrier (700) comprising at least one lifting device (718a-d) and being arranged to carry a section (301a, 301b, 302a, 302b) of the derrick (300) thereupon, wherein the lifting device (718a-d) is configured to move said section of the derrick upward such that the section (301a, 301b, 302a, 302b) is moved on a path adapted to limit
35 lateral movement of the section, the locking device (610k-n, 610w-z) being operable to lock said section (301a, 301b, 302a, 302b) relative to the base structure against move-

ment downward, characterized in that the locking device (610k-n, 610w-z) is further operable to lock automatically if the lifting device (718a-d) fails or is not being operated.

1 / 20

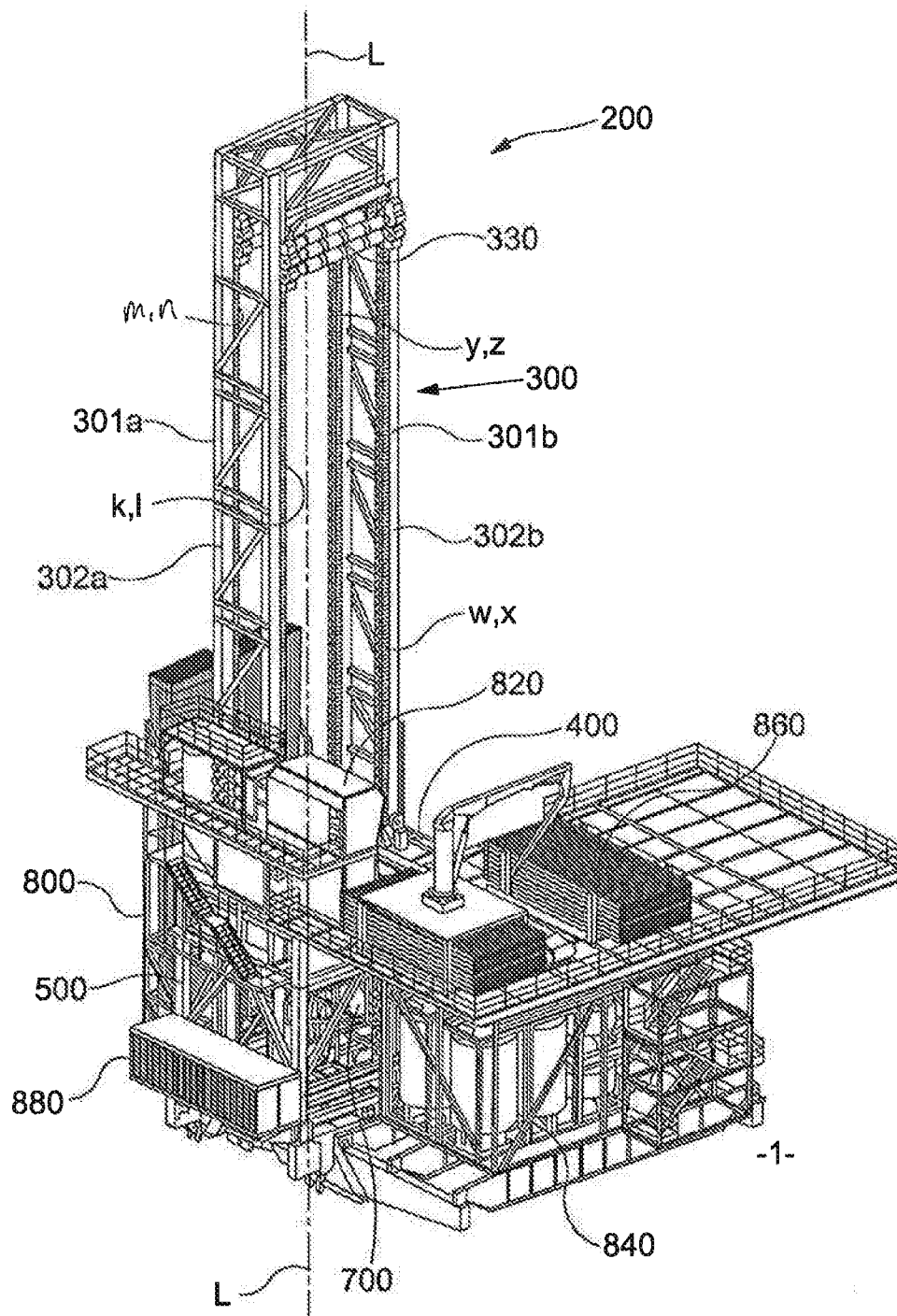


Fig. 1

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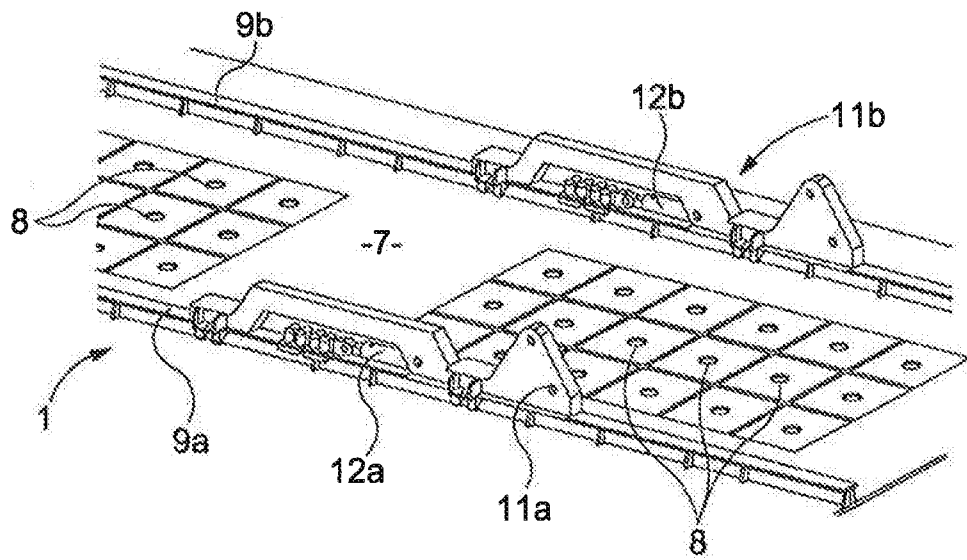


Fig. 2

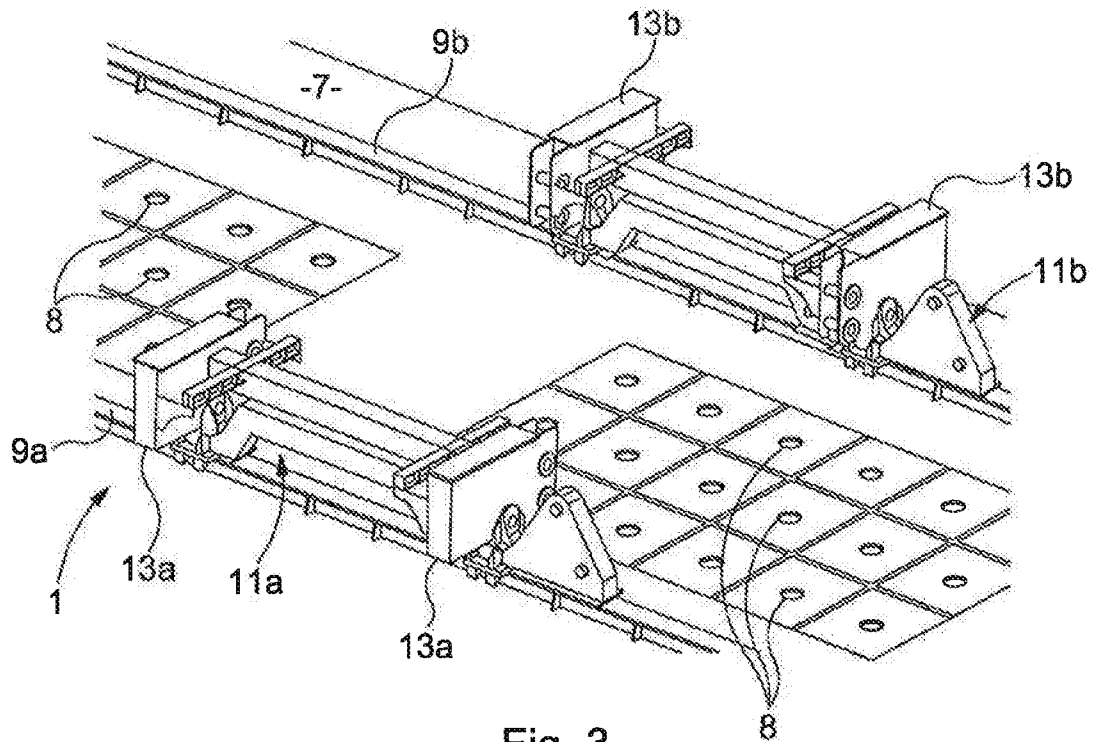


Fig. 3

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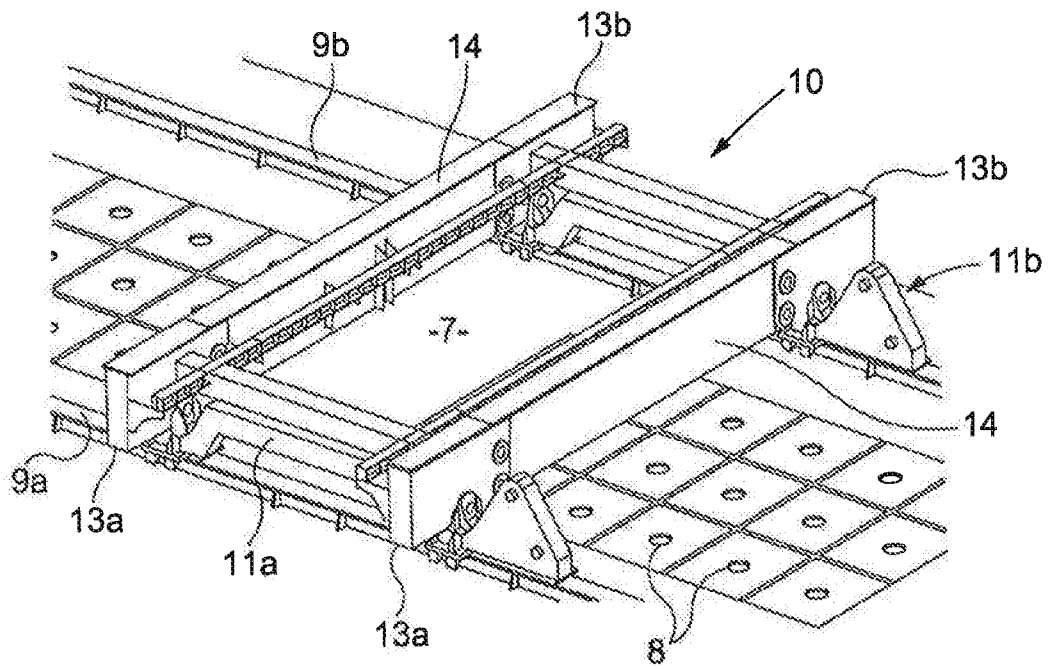


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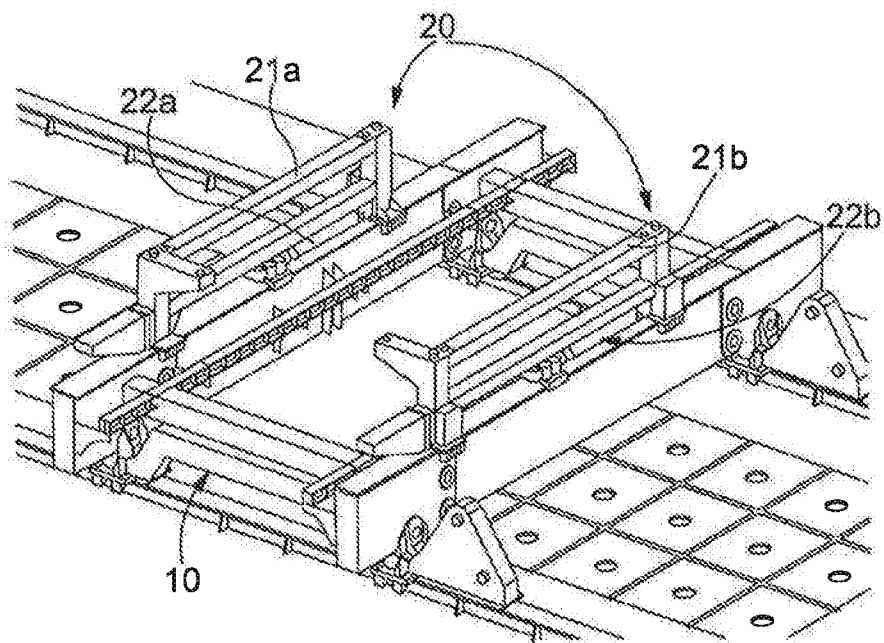


Fig. 5

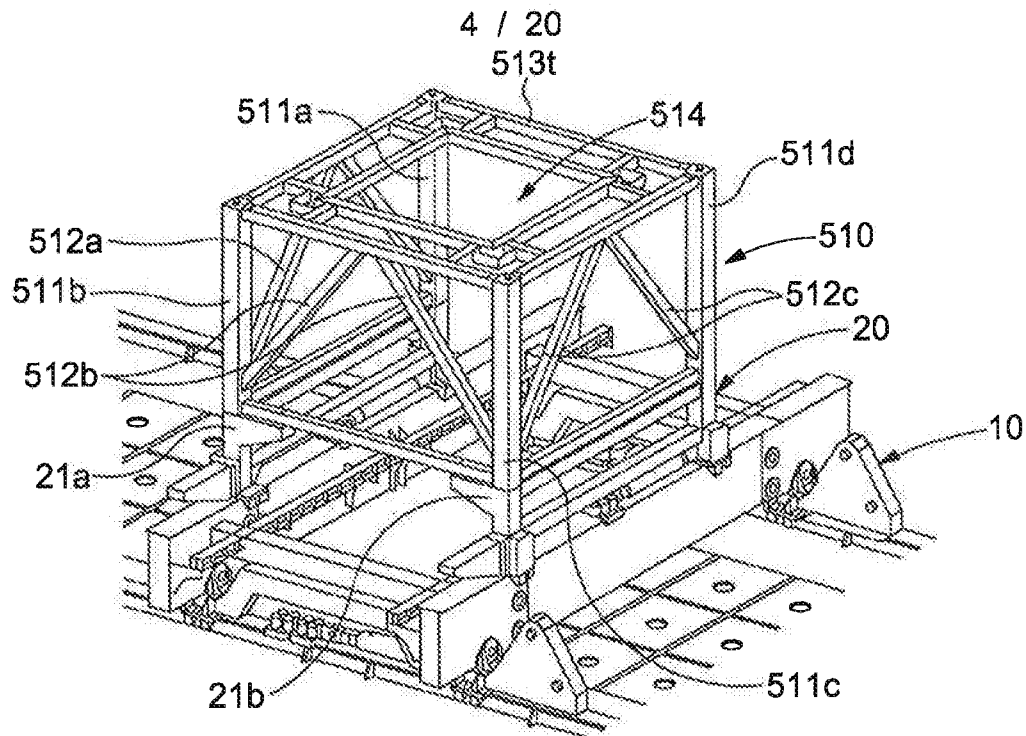


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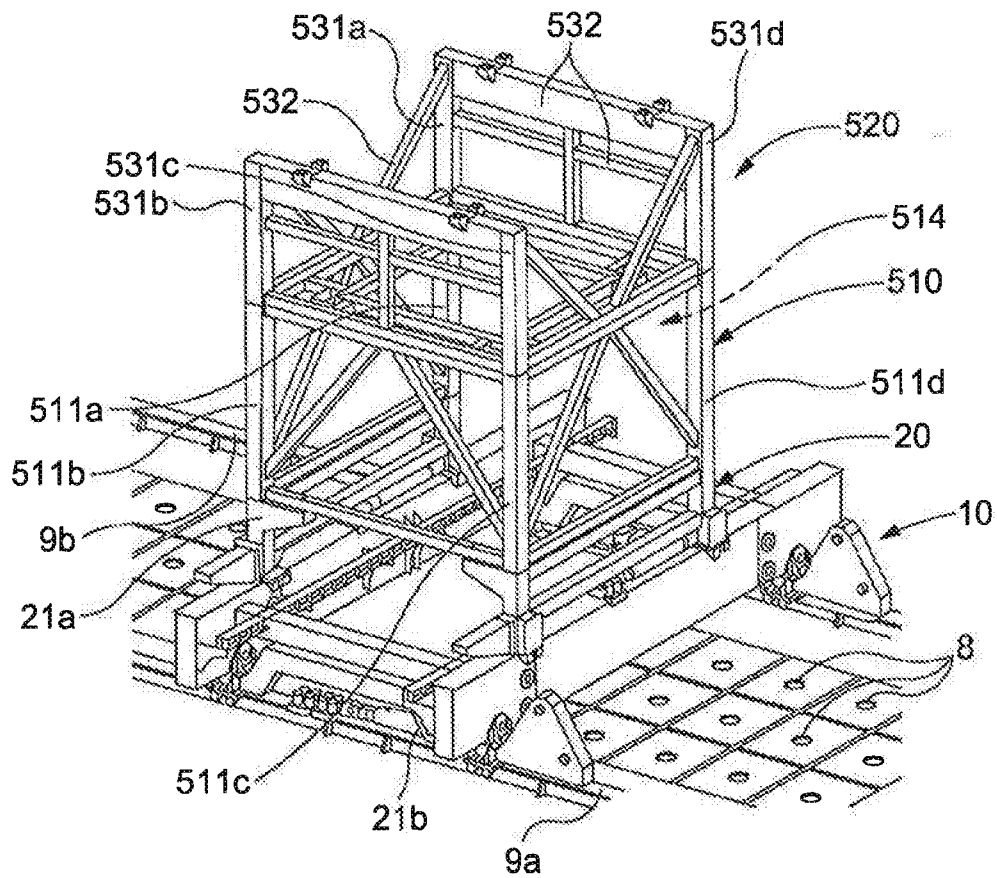


Fig. 7

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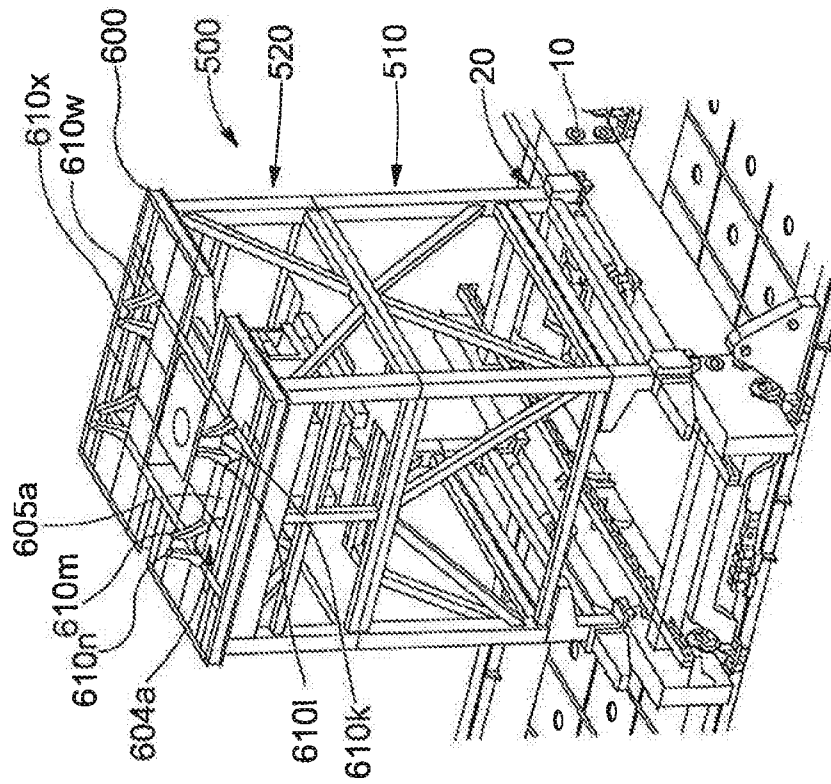


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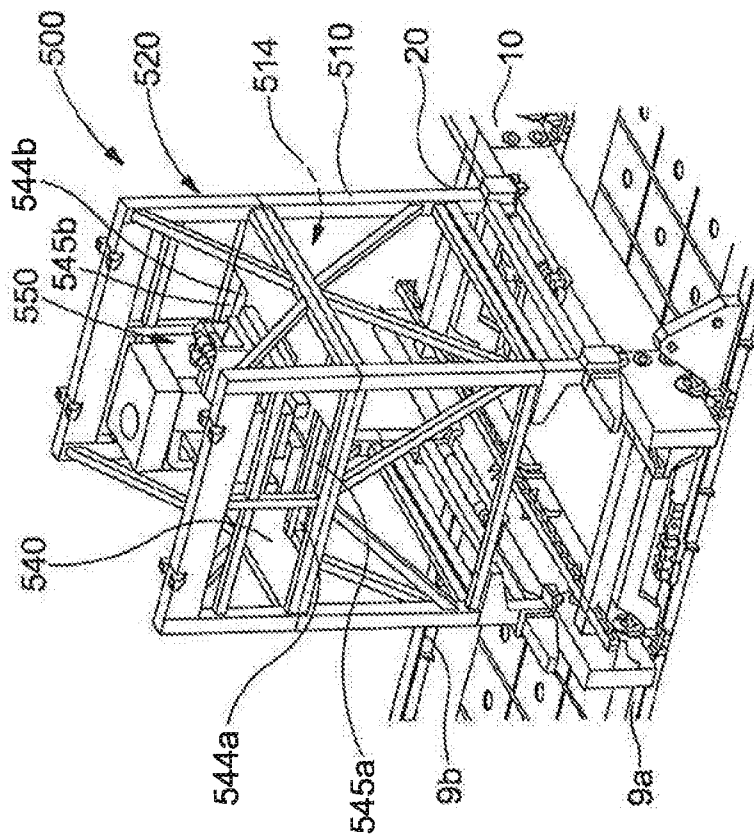


Fig. 8

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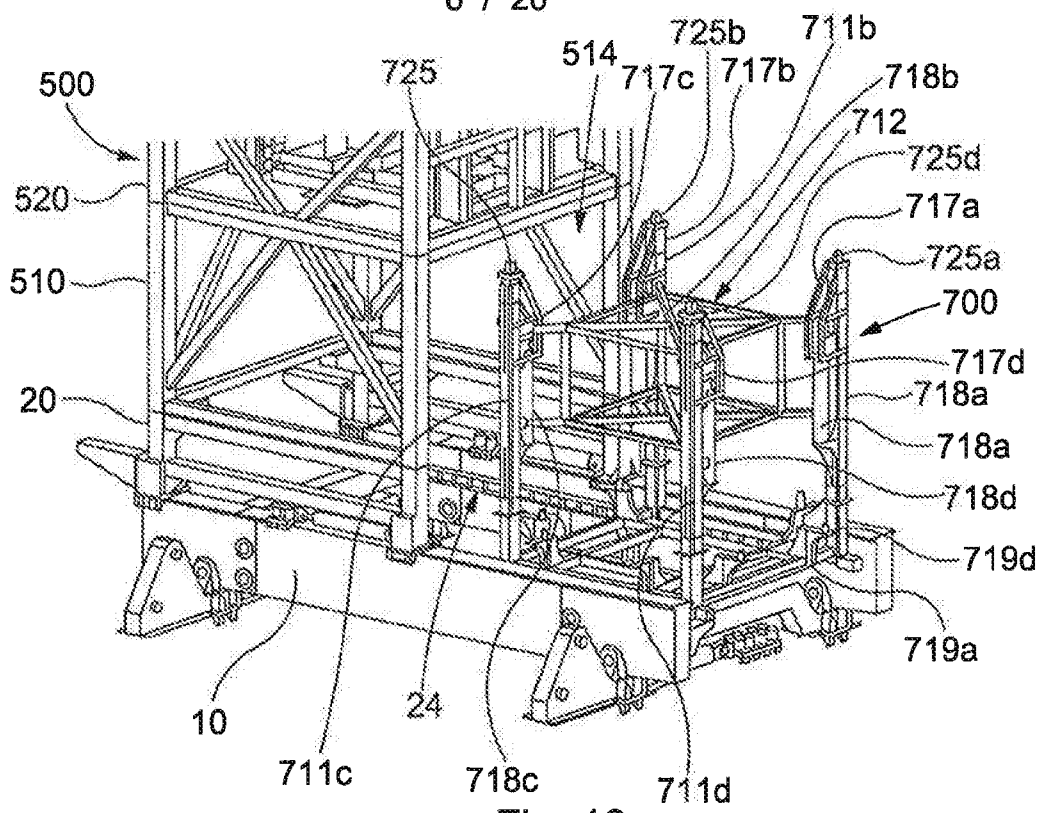


Fig. 10

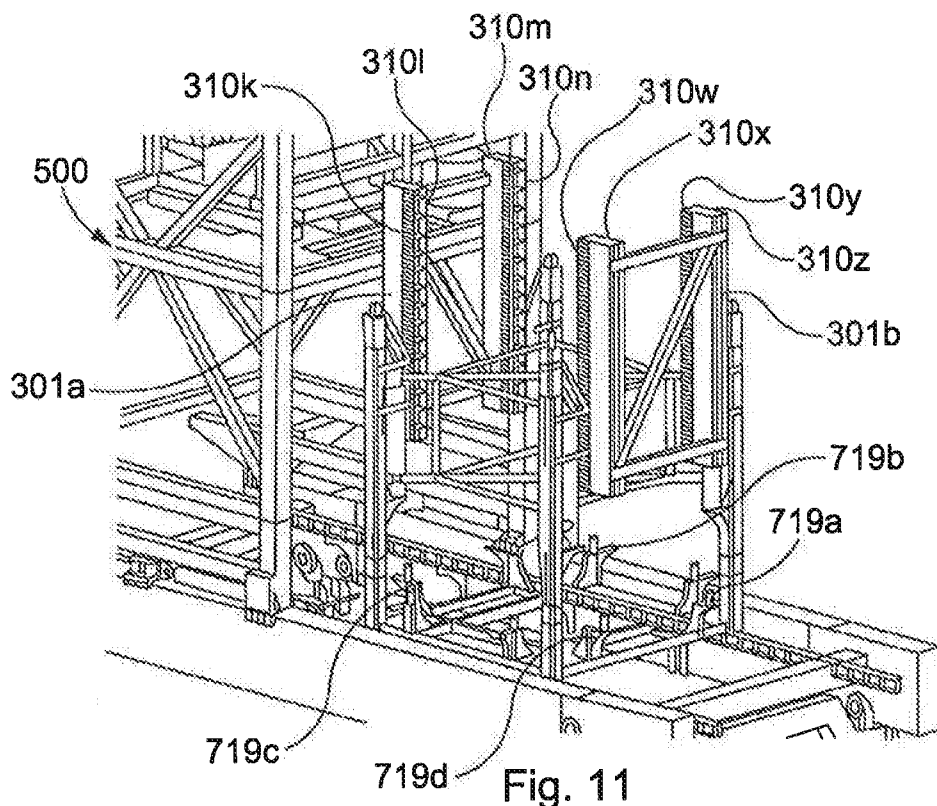


Fig. 11

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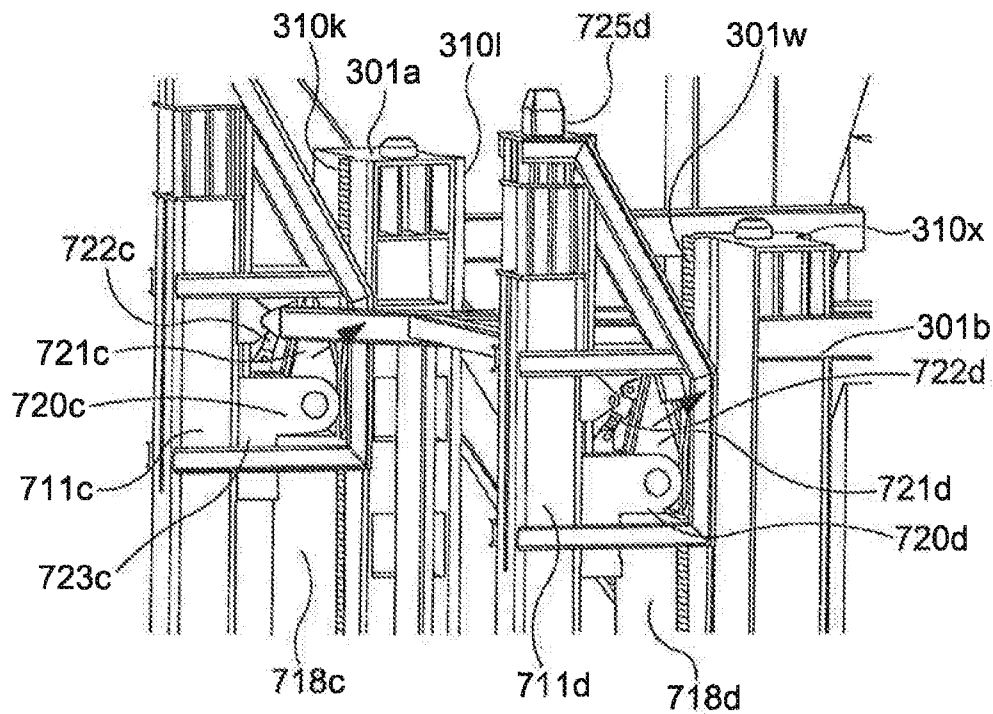


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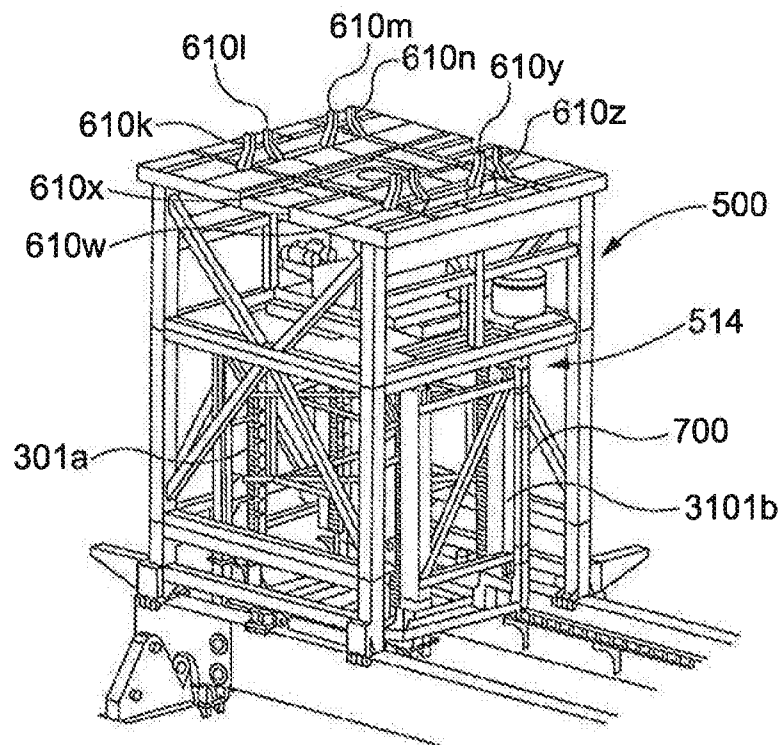


Fig. 13

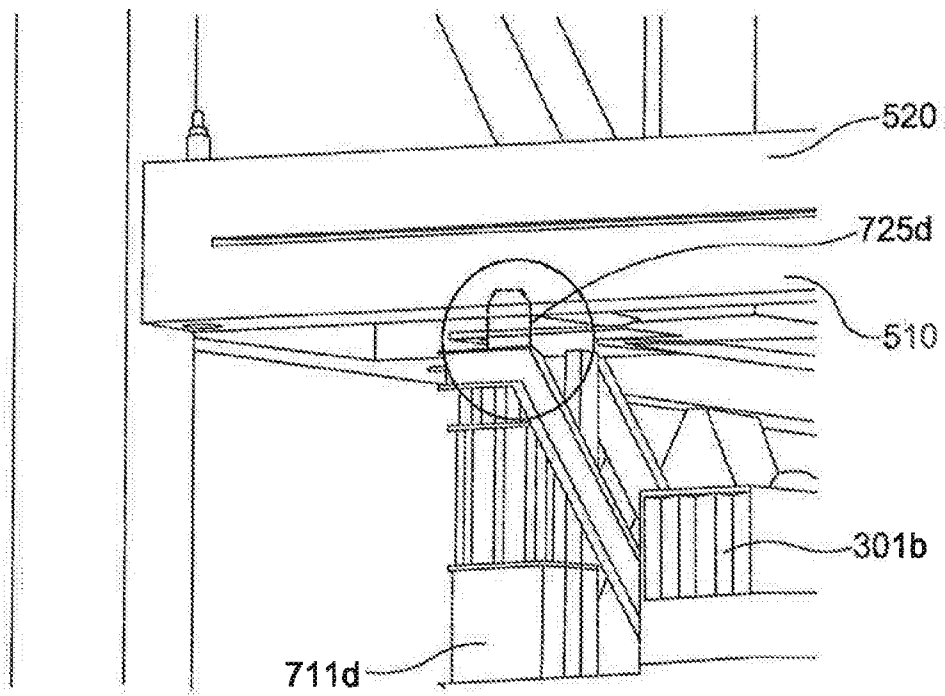


Fig. 14

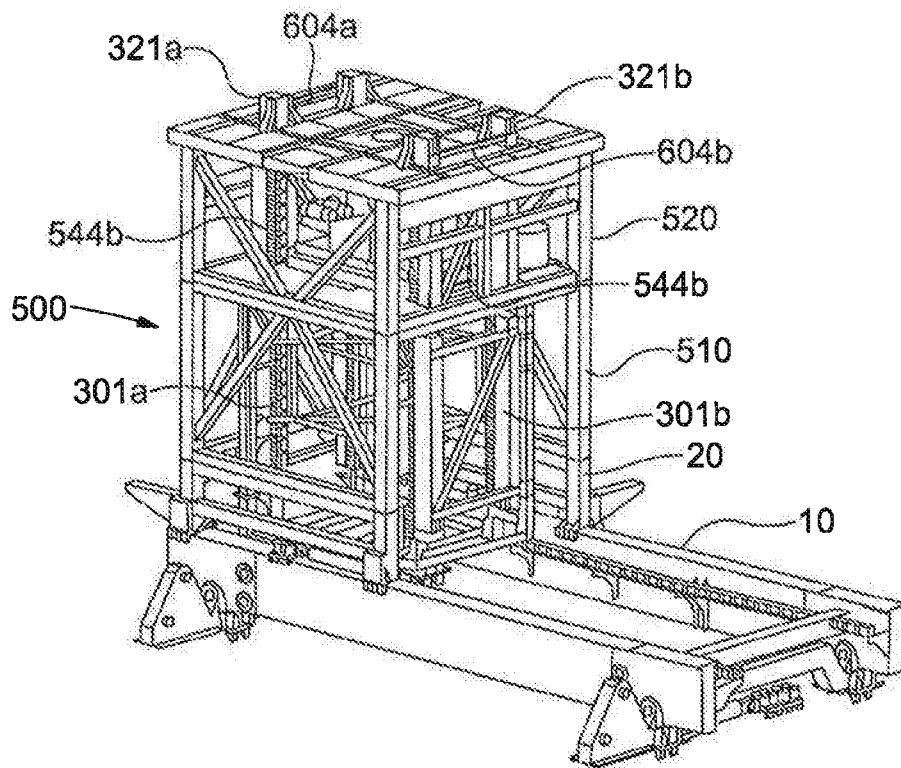


Fig. 15

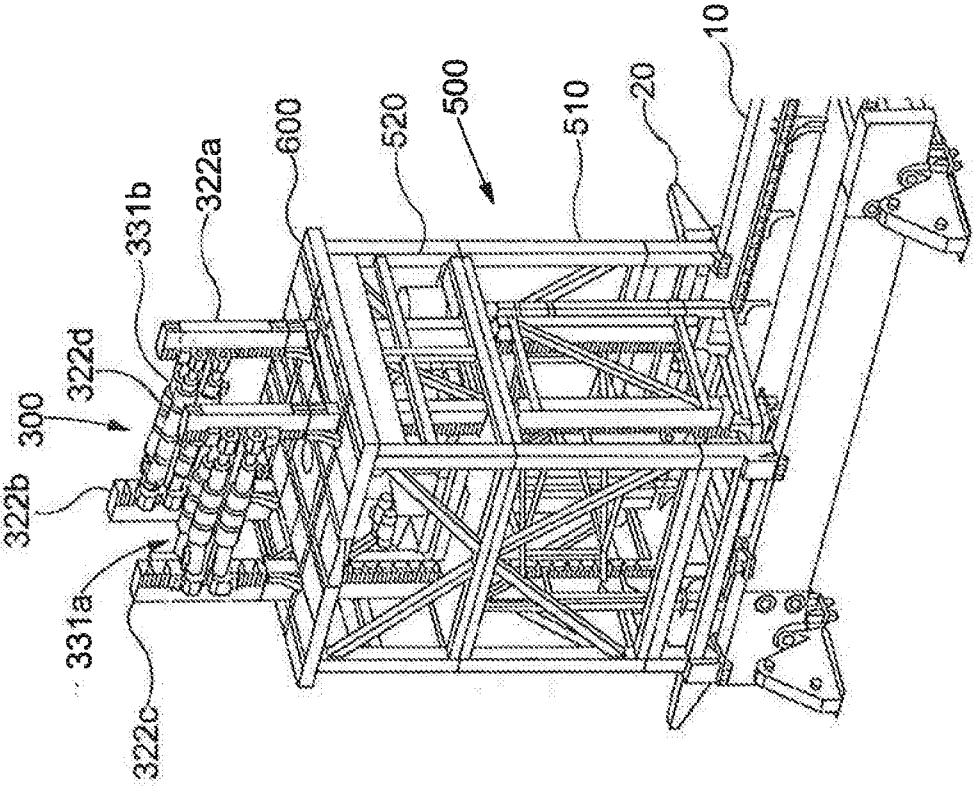


Fig. 16

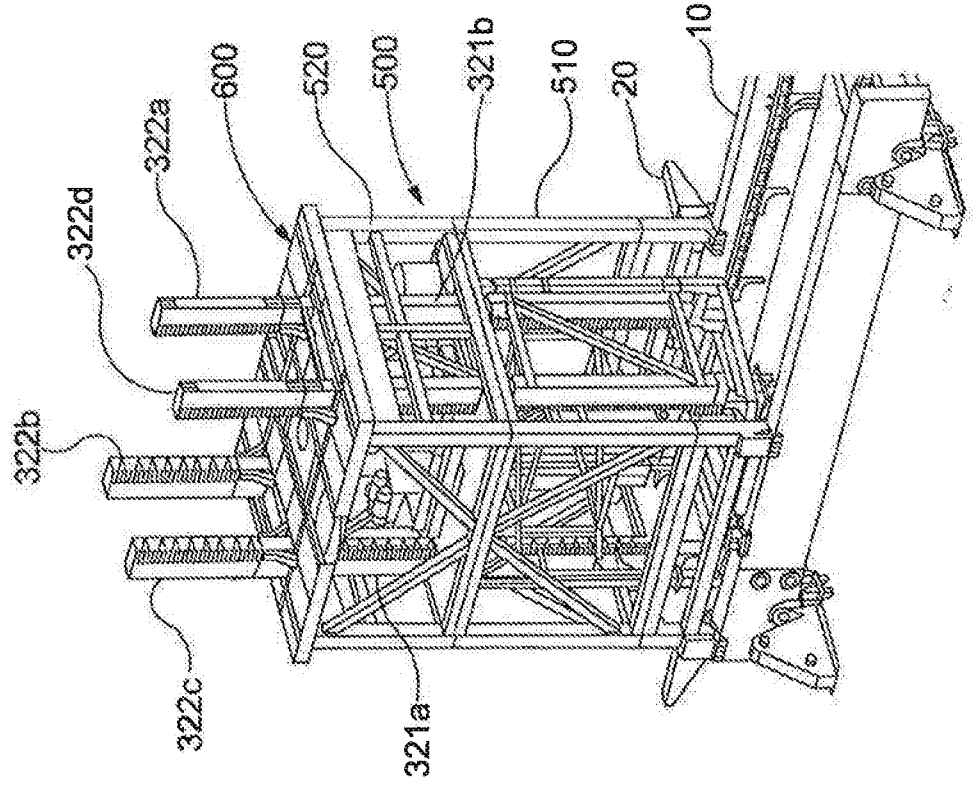


Fig. 17

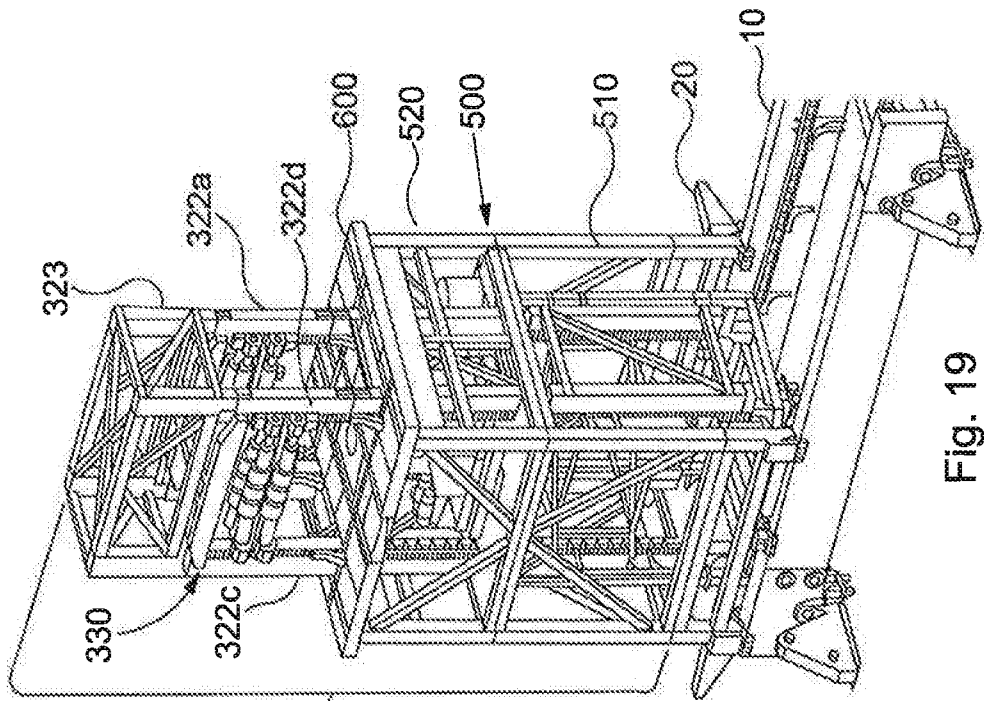


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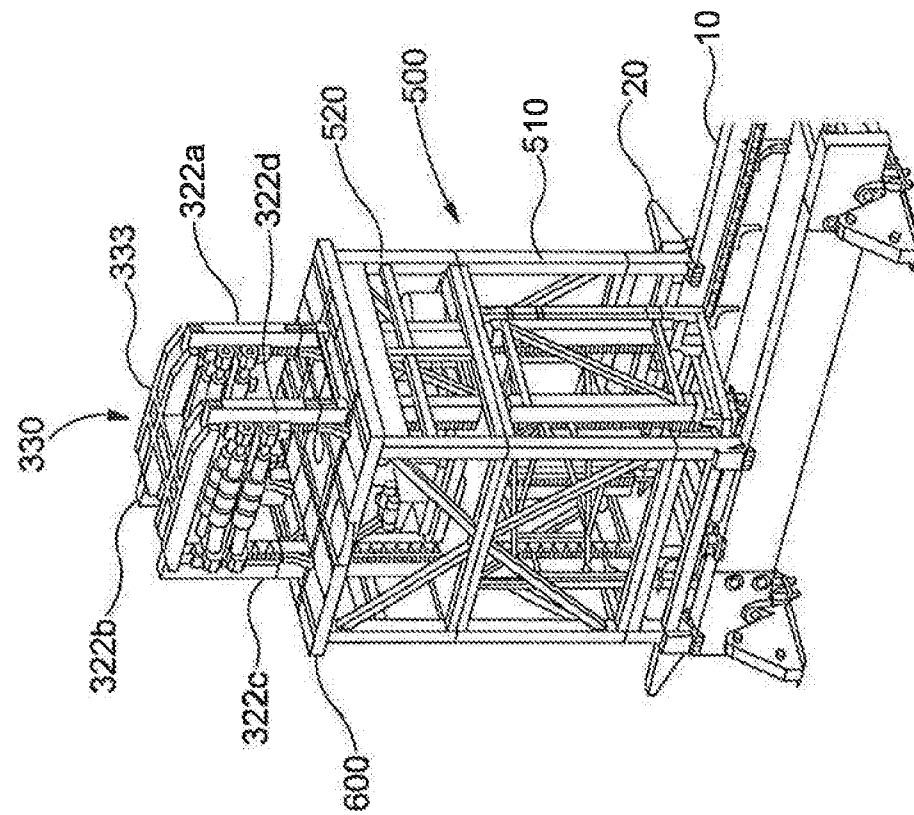


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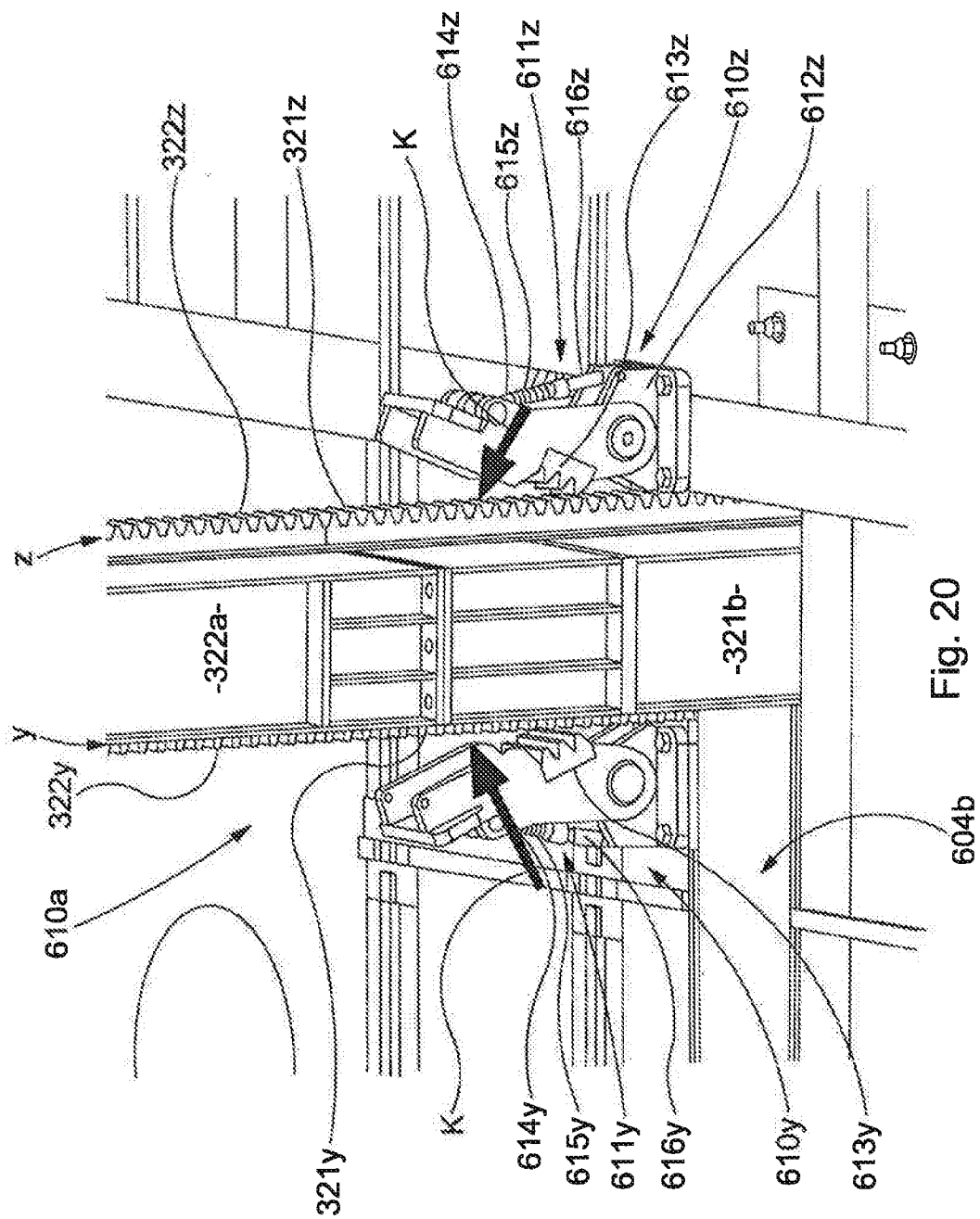
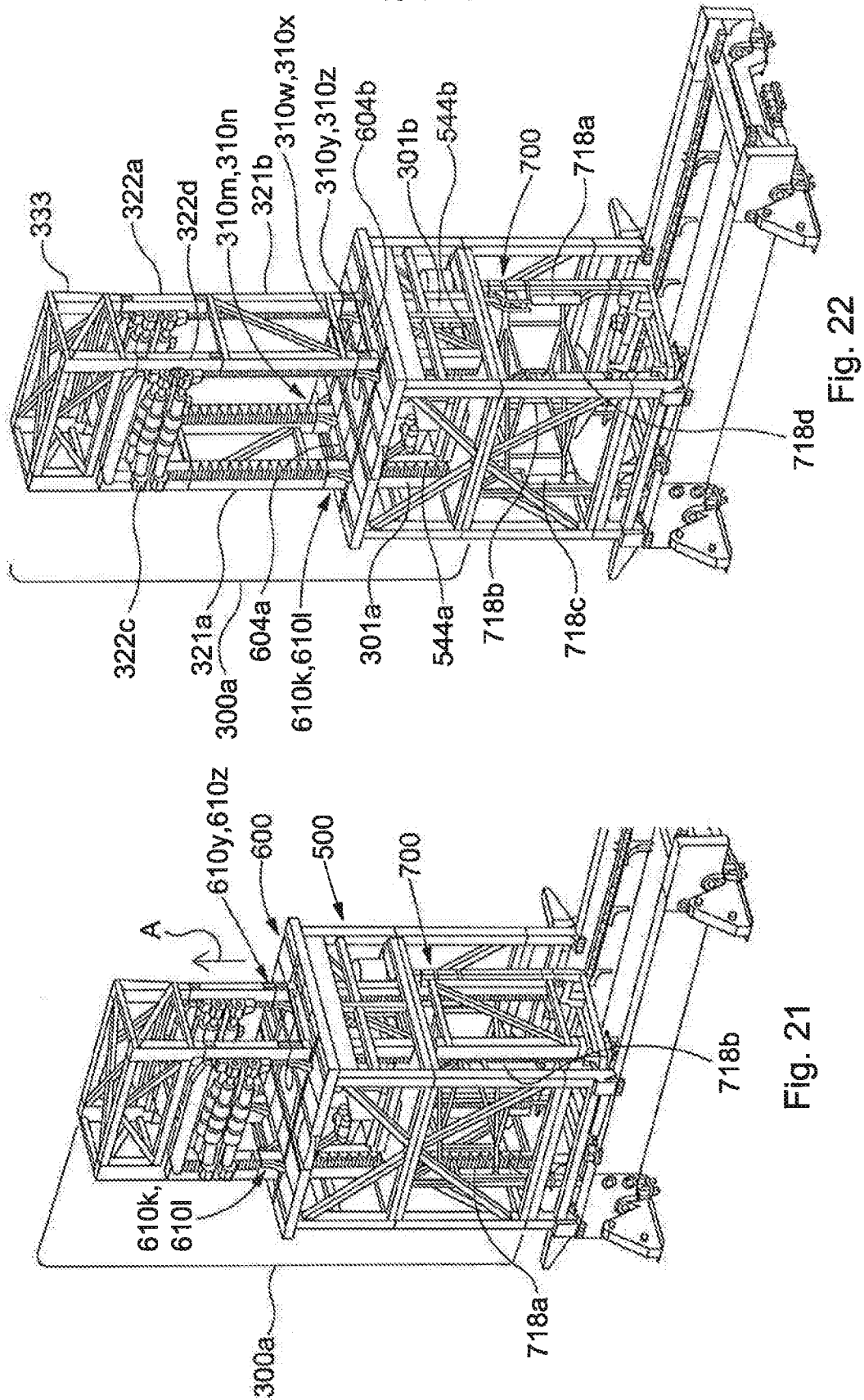


Fig. 20

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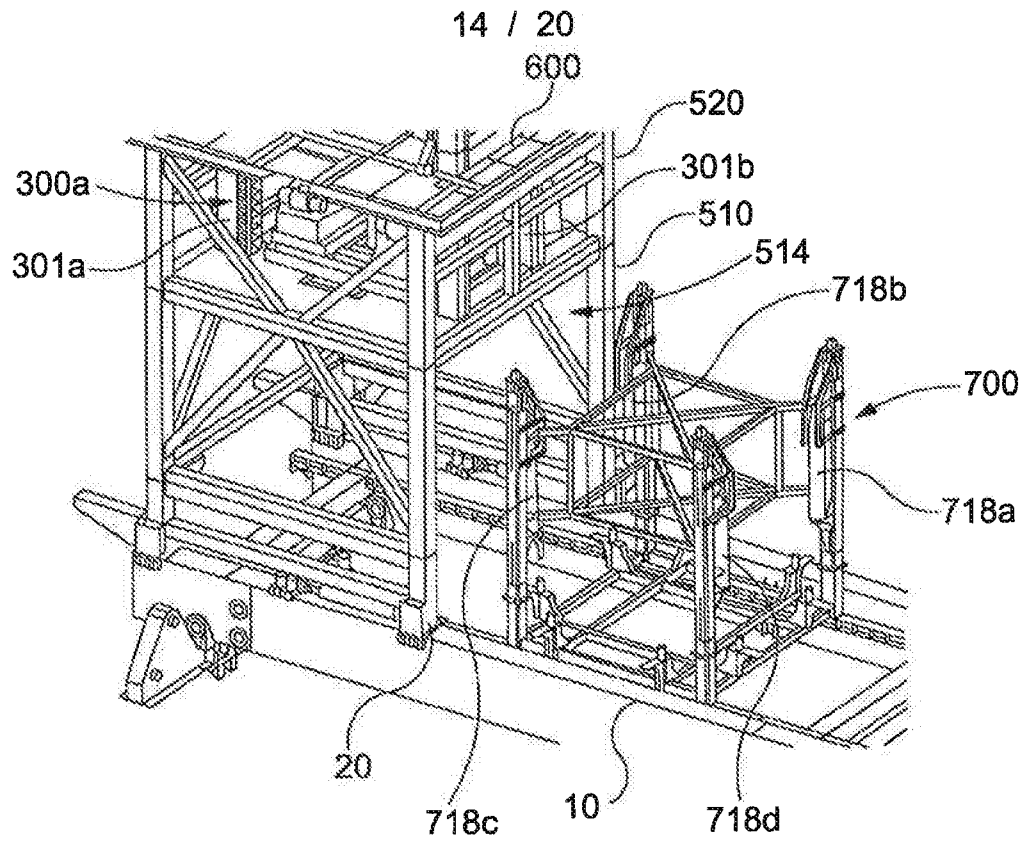


Fig. 23

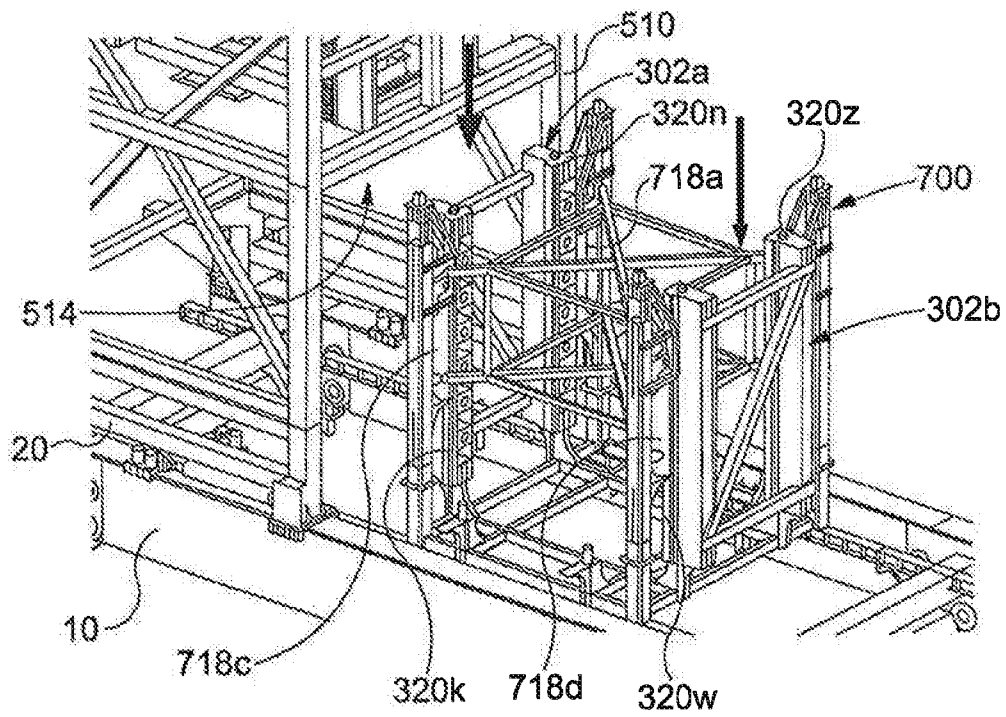


Fig. 24

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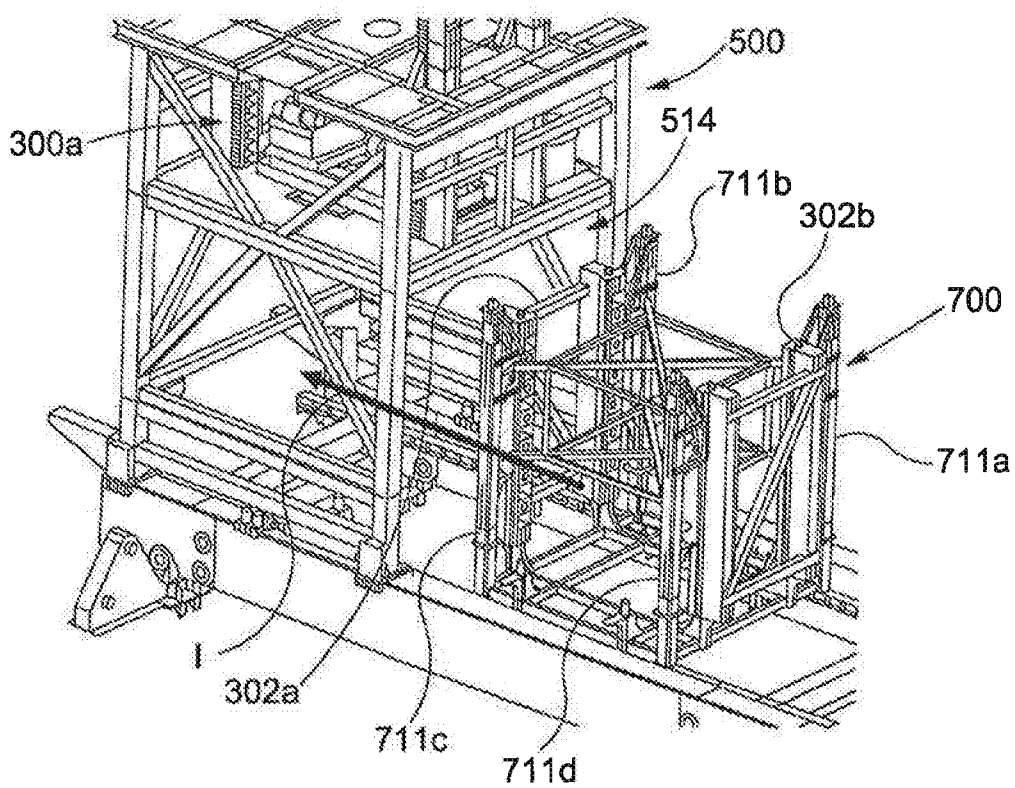


Fig. 25

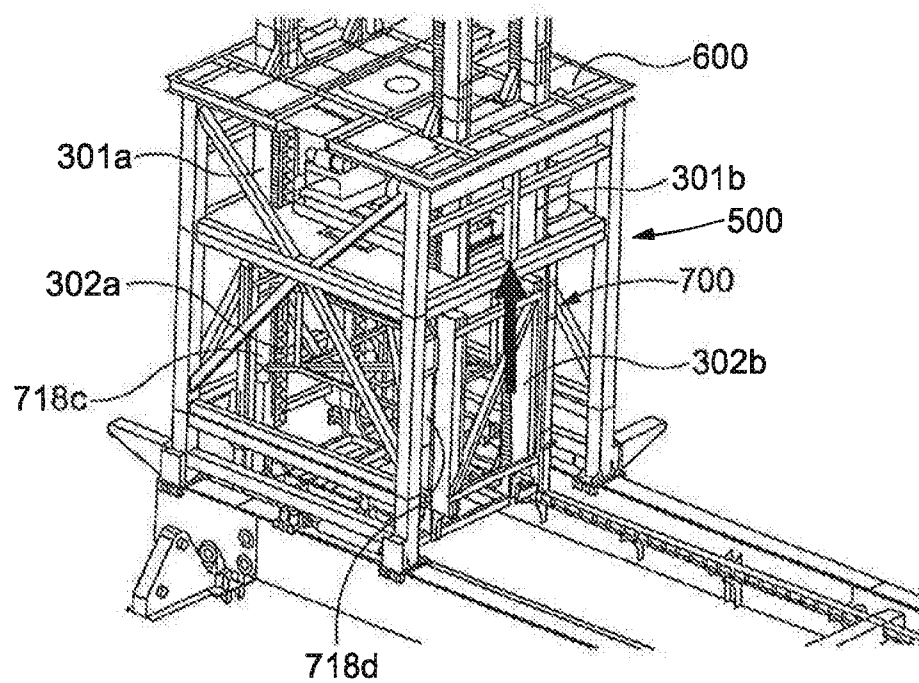


Fig. 26

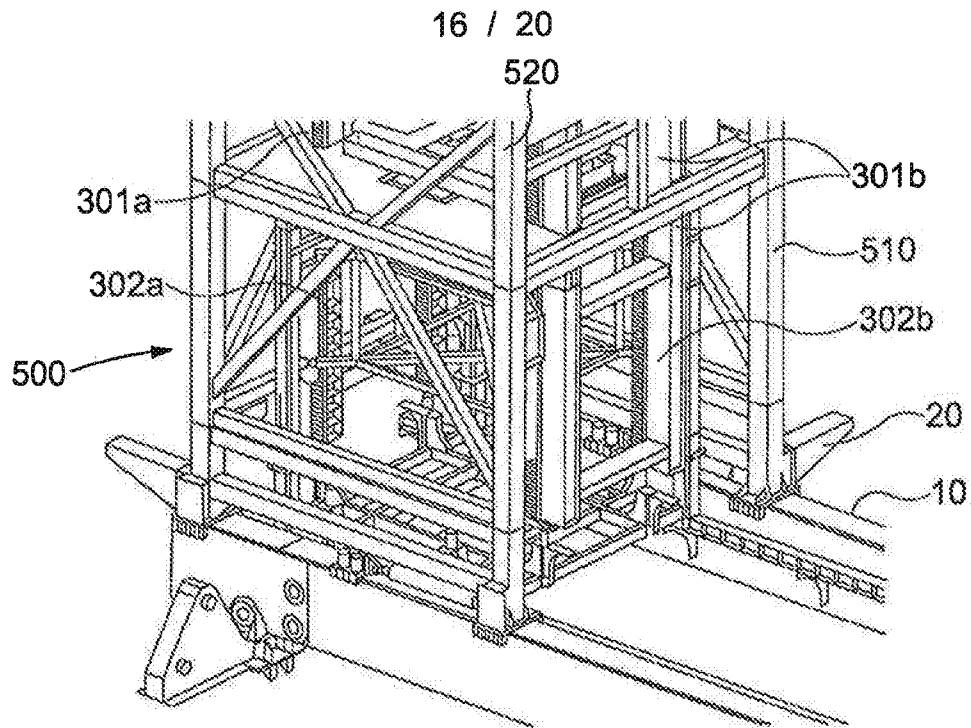


Fig. 27

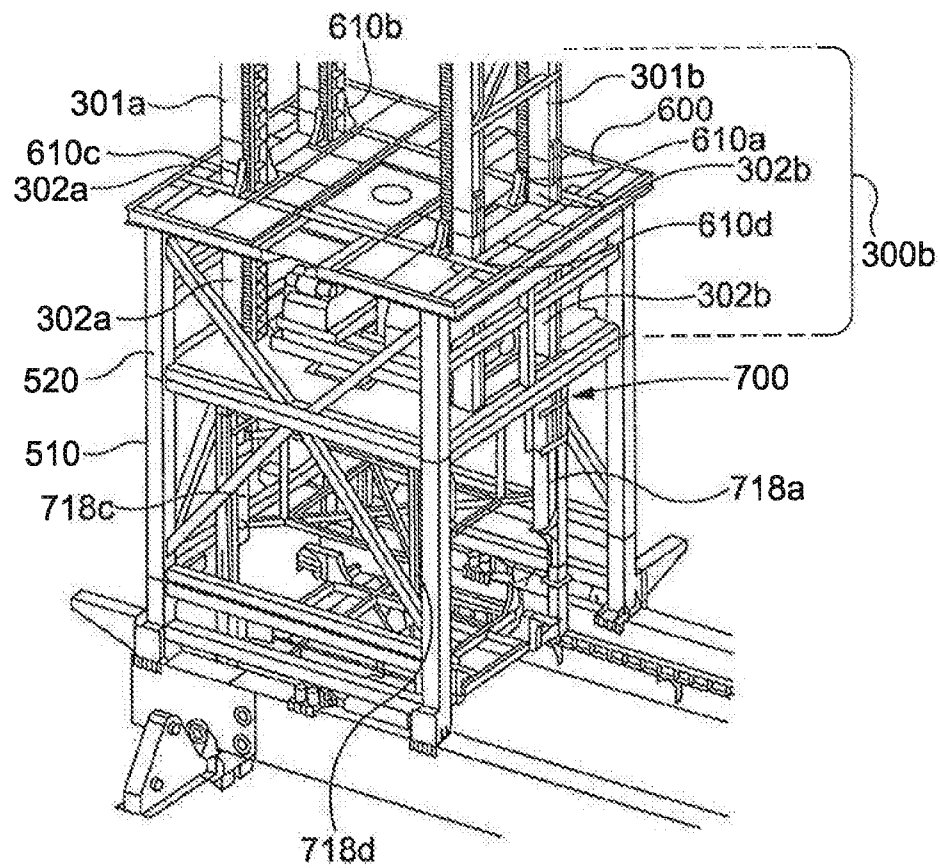


Fig. 28

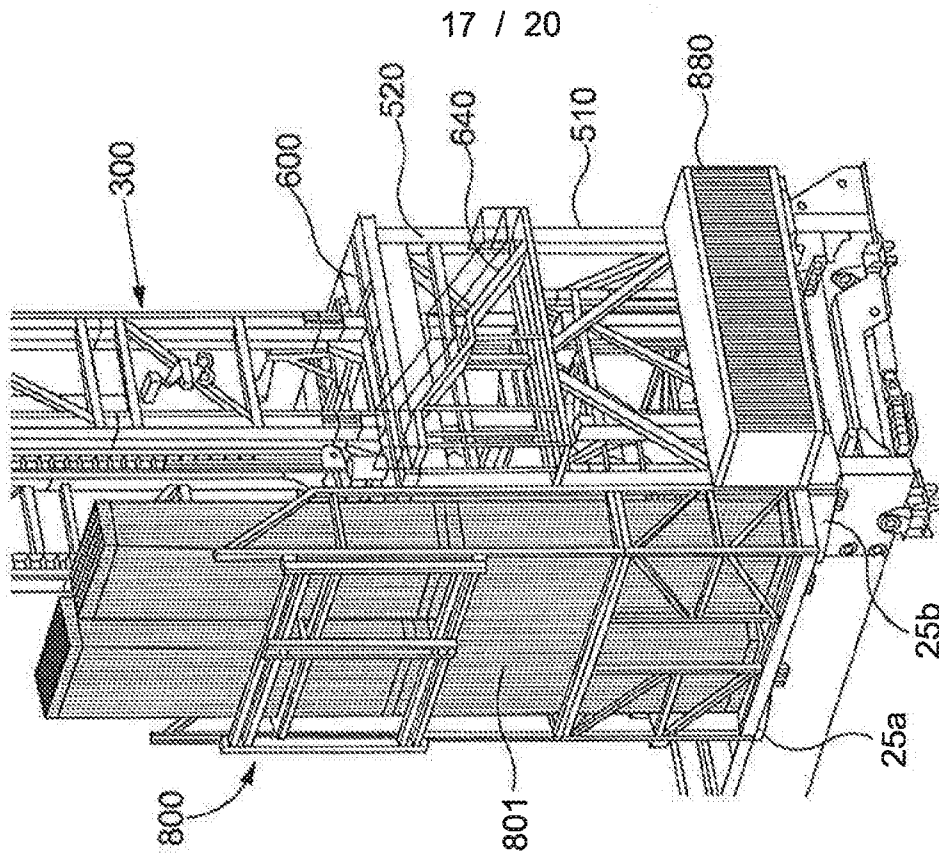


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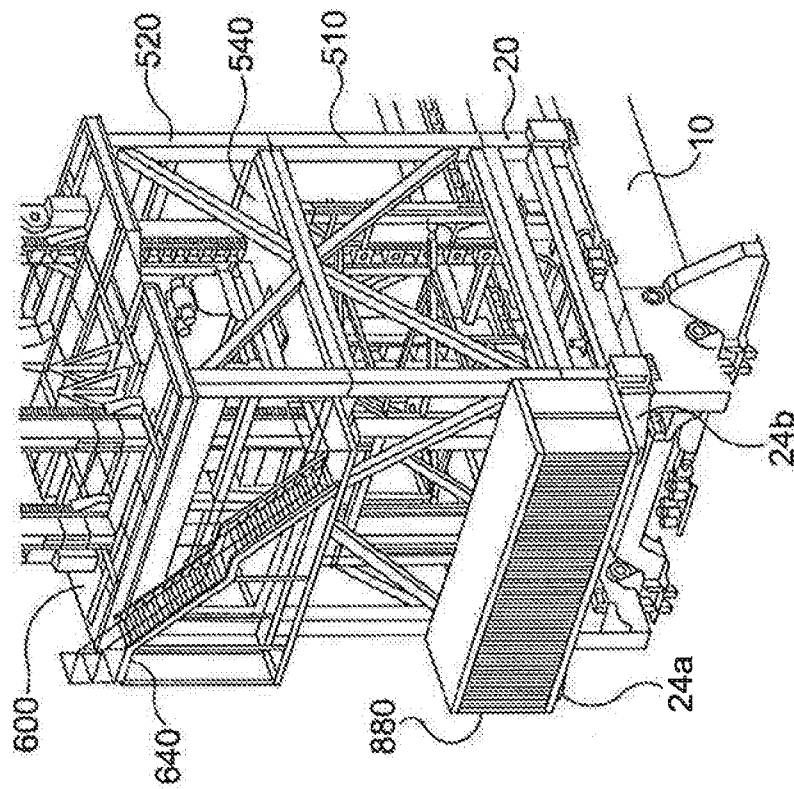


Fig. 29

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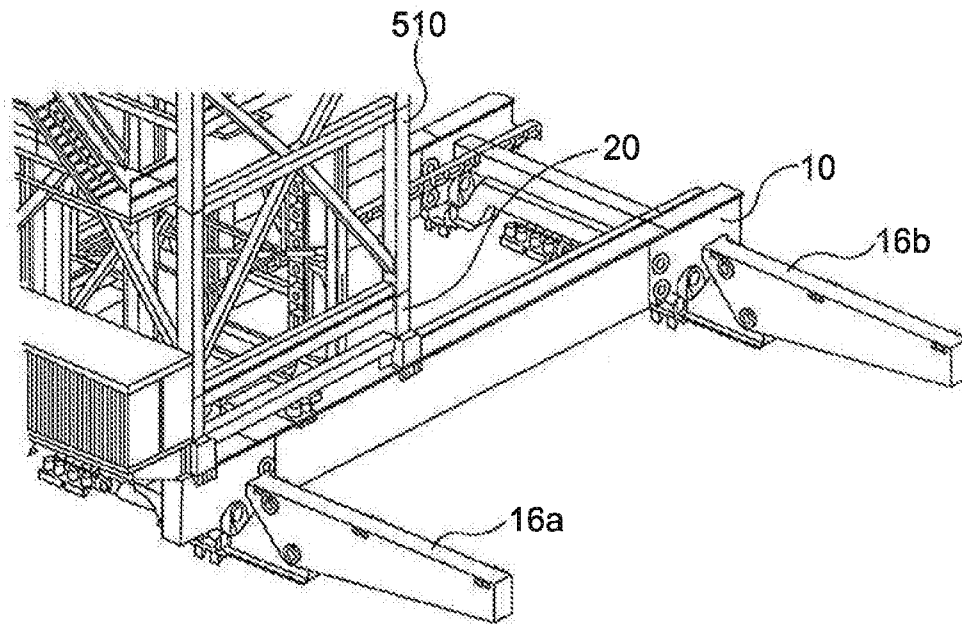


Fig. 31

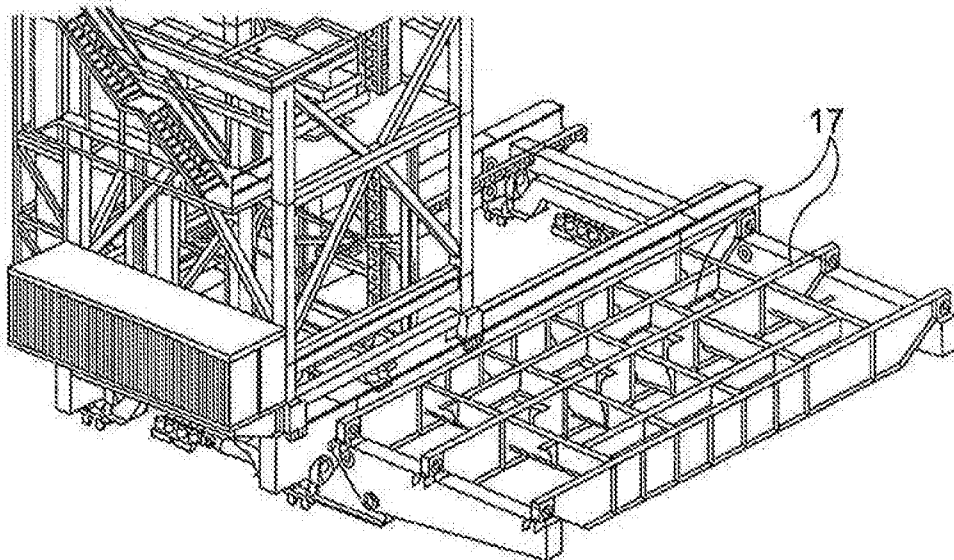


Fig. 32

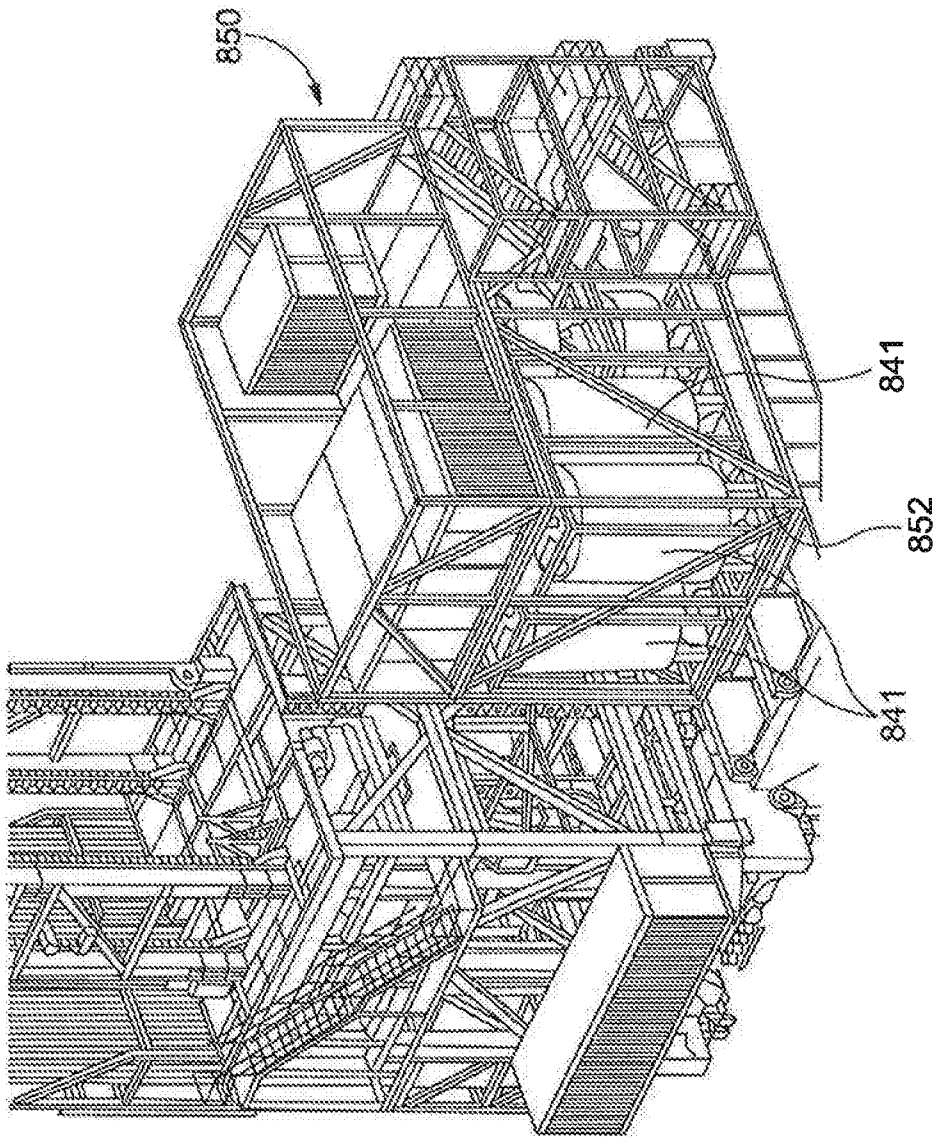
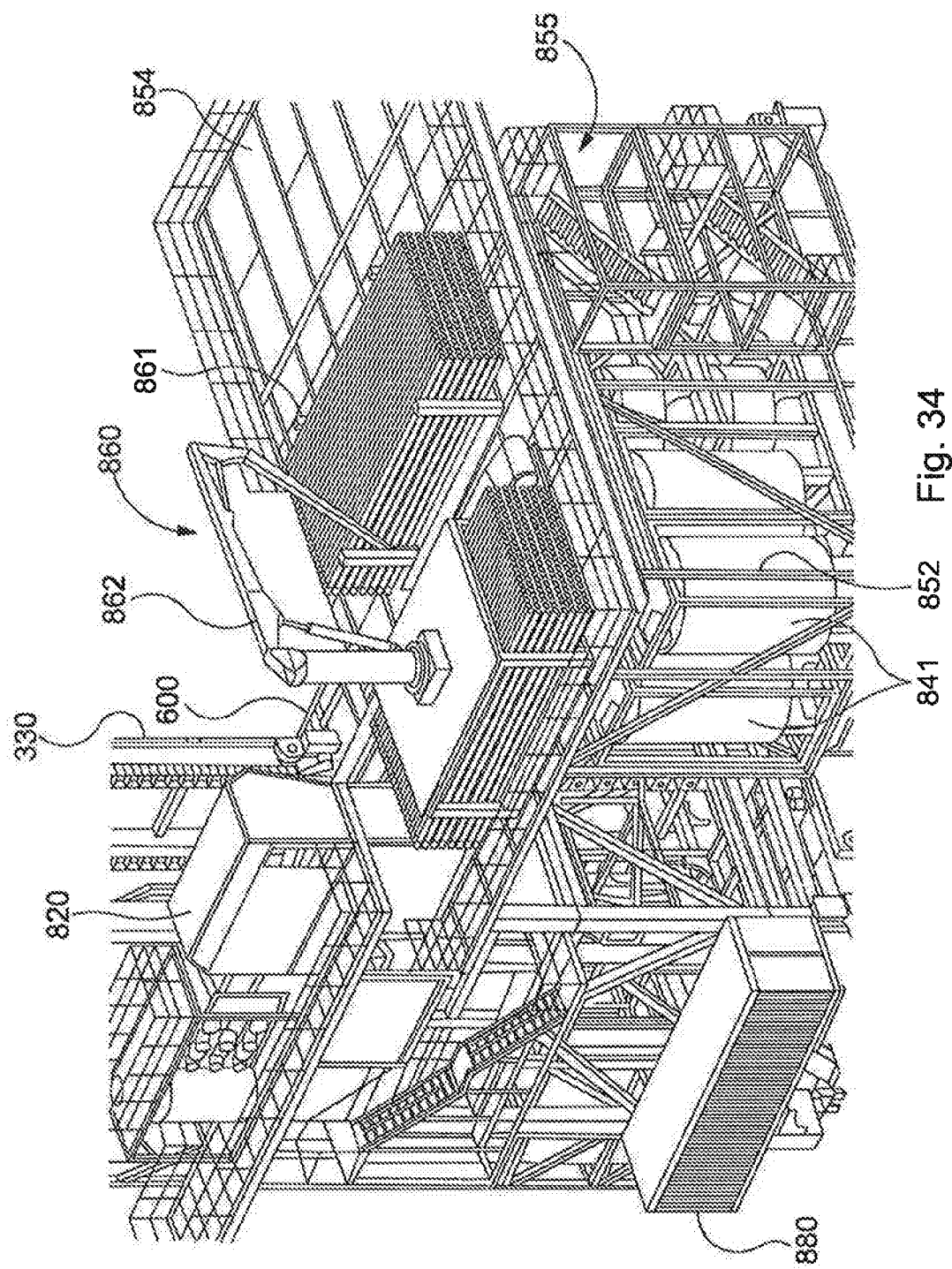


Fig. 33



INTERNATIONAL SEARCH REPORT

International application No
PCT/N02016/050154

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21B15/00 E04H12/34
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)
E21B E04H

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	US 2014/259985 A1 (PETRELLO ANTHONY [US] ET AL) 18 September 2014 (2014-09-18)	1-19
Y	paragraph [0018]; figures 1-9	1-18
Y	----- US 4 329 088 A (LUCAS JOSEPH E) 11 May 1982 (1982-05-11) column 2, lines 53-57 column 4, lines 18-26	1-18
A	----- US 1 360 131 A (MILLER AXEL N) 23 November 1920 (1920-11-23) sentences 82-95; figures 1, 3	1-19
A	----- US 2014/260076 A1 (YUSTUS JOE [US] ET AL) 18 September 2014 (2014-09-18) sentences 1-19; figures 1-15	1-19
	----- -/-	



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

26 September 2016

Date of mailing of the international search report

06/10/2016

Name and mailing address of the ISA/

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Georgescu, Mihnea

INTERNATIONAL SEARCH REPORT

International application No

PCT/N02016/050154

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2003/213647 A1 (ST-GERMAIN ANDRE [CA]) 20 November 2003 (2003-11-20) figures 4, 5 -----	1-19

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/N02016/050154

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