



(12) **PATENT**

(11) **341798**

(13) **B1**

**NORWAY**

(19) NO

(51) Int Cl.

*E21B 33/035 (2006.01)*

*E21B 33/064 (2006.01)*

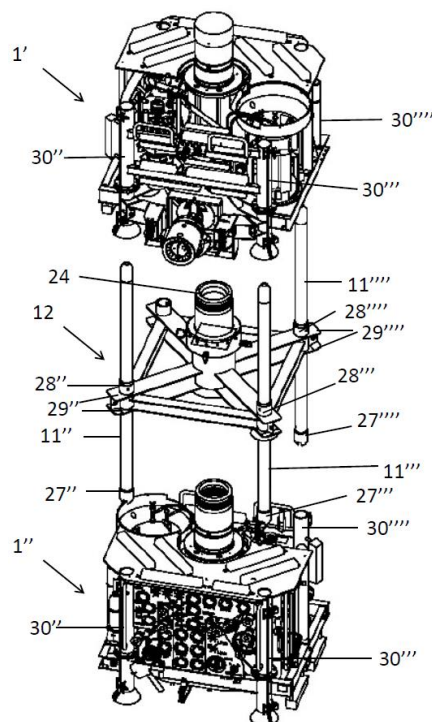
*E21B 41/08 (2006.01)*

## Norwegian Industrial Property Office

(21)	Application nr.	20160122	(86)	International Filing Date and Application Number
(22)	Date of Filing	2016.01.26	(85)	Date of Entry into National Phase
(24)	Date of Effect	2016.01.26	(30)	Priority
(41)	Publicly Available	2017.07.27		
(45)	Granted	2018.01.22		
(73)	Proprietor	FMC Kongsberg Subsea AS, Postboks 1012, 3601 KONGSBERG, Norge		
(72)	Inventor	Ole Thomas Enge, Svibelveien 7, 3228 SANDEFJORD, Norge Inge Magne Sekkingstad, Gosen 28, 5253 SANDSLI, Norge Asbjørn Tautra, Prestasmoget 11, 5357 FJELL, Norge Arne Nikolaisen, Skaretoppen 8, 5174 MATHOPEN, Norge Piotr Przydatek, Metevika 6, 5363 ÅGOTNES, Norge Jan-Frederik Namtvedt, Stavkirkeveien 8 E, 5231 PARADIS, Norge Leif-Erik Solbakken, Svaneviksveien 25, 5063 BERGEN, Norge Christian Knudsen, Festegrenden 4, 5036 BERGEN, Norge		
(74)	Agent or Attorney	Onsagers AS, Postboks 1813 Vik, 0123 OSLO, Norge		

(54)	Title	<b>Method, system and adapter for performing a well operation</b>
(56)	References	
	Cited:	WO 2004/025074 A1, EP 1350918 A2, US 6227301 B1, US 4438817 A
(57)	Abstract	

Method, and associated system, of performing a well operation on a subsea well or wellhead, wherein a first subsea X-mas tree (1') is arranged on top of the wellhead, wherein the method comprises the steps of: a) lifting the first X-mas tree (1') from the subsea wellhead using a lifting equipment to a position above a first or second pre-installed subsea structure, wherein the first or second pre-installed subsea structure comprises means (12) for temporary receiving and parking of the first X-mas tree (1'), b) lowering the first X-mas tree (1') to a parking position on the first or second preinstalled subsea structure and locking the first X-mas tree (1') in the parking position, c) performing a well operation on the wellhead and or well, d) unlocking and lifting the first X-mas tree (1') from the parking position, e) lowering the first X-mas tree (1') back on top of the wellhead and reattach it to the subsea wellhead. The invention further relates to an adapter for use with the method.



The invention relates to a method and associated adapter to be used with said method, as well as a system, for temporary storing of a subsea X-mas tree on another pre-installed subsea installation.

#### Background of the invention

5 X-mas trees are used on both surface and subsea wells, and are arranged on top of wellheads. The wellhead is the component at the surface of a well and provides the structural and pressure-containing interface for the drilling and production equipment. The primary purpose of the wellhead is to provide the suspension point and pressure seals for the casing strings that run from the bottom of the hole  
10 sections to the pressure control equipment on the top of the well. The primary function of a X-mas tree is to control the flow, normally hydrocarbon flow such as oil or gas, out of the well. A X-mas tree may also be used to control the injection of gas or water into a non-producing well in order to enhance production rates of oil from other wells. When the well and facilities are ready to produce and receive oil  
15 or gas, X-mas tree valves are opened and the formation fluids are allowed to go through a flow line. This normally leads to a processing facility, storage depot and/or other pipeline eventually leading to a refinery or distribution center. Flow lines on subsea wells usually lead to a fixed or floating production platform or to a storage ship or barge, known as a floating storage offloading vessel (FSO), or  
20 floating processing unit (FPU), or floating production, storage and offloading vessel (FPSO). A tree often provides numerous additional functions including chemical injection points, well intervention means, pressure relief means, monitoring points (such as pressure, temperature, corrosion, erosion, sand detection, flow rate, flow composition, valve and choke position feedback), and connection points for devices  
25 such as down hole pressure and temperature transducers (DHPT). On producing wells, chemicals or alcohols or oil distillates may be injected to preclude production problems (such as blockages).

A subsea template is a subsea structure which is used as a base for various subsea structures. These subsea structures may be subsea wells, subsea trees and manifolds.  
30 The template may have various sizes dependent on the number of structures attached to it, and may have protective structures covering them.

A subsea manifold is a large metal structure made up of valves and pipes and designed to transfer hydrocarbons and water from wellheads into a pipeline. Manifolds are usually mounted on a template and may have a protective structure.

35 During maintenance operations on a subsea X-mas tree or on a wellhead/well, it is normal practice to lift the X-mas tree to the surface for temporary storage for gaining access to the wellhead and well. Then, after the necessary operation (drilling, maintenance, re-completion, repair) has been finished, the X-mas tree is lowered down to the wellhead again. This is a time-consuming process which

requires heavy duty equipment and storage space topside. Both the lifting equipment as well as the X-mas tree requires storage space topside. For example, considering that the wellhead and X-mas tree is located at up to 3000-5000 meter water depth, it takes a lot of time to lift and lower the X-mas tree over such a distance.

It is known to temporary install a mudmat subsea for performing different operations. Document WO 2004/025074 A1 discloses a method for installing a subsea Christmas tree by lowering the subsea Christmas tree on a mudmat using a cable to the sea floor, proximate the well. The Christmas tree is then lifted from the mudmat on to a wellhead, and the mudmat is retrieved back to the surface.

Prior art includes US 6227301 B1 and US 4438817 A.

An objective of the present invention is therefore to reduce the time needed for gaining access to a subsea well below a X-mas tree, i.e. to ease the access to the well without lowering additional equipment such as mudmats.

More specific, an objective of the invention is to eliminate the need of lifting a X-mas tree to the surface if performing maintenance, repair, re-completion or drilling operations on a well.

Another objective is to render possible maintenance and repair on a subsea X-mas subsea, without the risk of uncontrolled fluid flow from the well.

Another objective of the present invention is to free up space topside during maintenance operations of a subsea well where removal of a X-mas tree is necessary.

Another objective of the present invention is to perform maintenance and repair operations on a subsea well using light intervention equipment, e.g. a light intervention vessel.

#### Summary of invention

The invention is set forth in the independent claims, while the dependent claims describe other characteristics of the invention.

The invention relates to a method of performing a well operation on a subsea well or wellhead, wherein a first subsea X-mas tree is arranged on top of the wellhead, and wherein the method comprises the steps of:

a) lifting the first X-mas tree from the subsea wellhead using a lifting equipment to a position above a first or second pre-installed subsea structure, wherein the first or second pre-installed subsea structure comprises means for temporary receiving and parking of the first X-mas tree,

- b) lowering the first X-mas tree to a parking position on the first or second pre-installed subsea structure and locking the first X-mas tree in the parking position,
- c) performing a well operation on the wellhead and or well,
- d) unlocking and lifting the first X-mas tree from the parking position,
- 5 e) lowering the first X-mas tree back on top of the wellhead and reattach it to the subsea wellhead.

A 'pre-installed subsea structure' shall be understood as any subsea structure which is already present and fixed to the seafloor, i.e. available, subsea. This pre-installed subsea structure may be a subsea structure which has a function e.g. in hydrocarbon recoveries from a well etc., such as:

- a X-mas tree,
- a template comprising a number of slots for X-mas trees,
- a template comprising a dedicated parking position, e.g. an additional separate slot compared to prior art templates, which separate slot does not have a wellhead or well underneath, wherein the separate slot is used only for temporary parking of X-
- 15 mas trees,
- customized manifold having receiving means for a X-mas tree.

Thus, 'the first pre-installed subsea structure' may be a slot or another X-mas tree in the same well template as the first X-mas tree is arranged. 'The second pre-

20 installed subsea structure' may be, but is not limited to, another well template, a slot, a manifold, a second X-mas tree in the other well template or, alternatively, being a satellite well etc. Consequently, the first and/or second pre-installed subsea structure is a component which is fixed to the seafloor and which has a function in fluid extractions from wells or, alternatively, is a component which is arranged in

25 connection with such a component (i.e. a dedicated parking position on a well template or a manifold). A person skilled in the art will understand that a mudmat is not such a pre-installed structure because a mud mat is used temporary and lowered to the seabed for performing a specific operation before it is retrieved back to the surface.

30 The term 'parking/ parking position' shall be understood as not only being a parking position as such, but may refer to a parking position of the first X-mas tree where one can perform tests, maintenance and/or repair on the first X-mas tree. Thus, when the first X-mas tree is in the parking position, an operator may perform necessary work or operations on this parked X-mas tree, e.g. different tests or

35 maintenance work. Some of said work or operations may, for safety reasons, be advantageous to perform when the X-mas tree is not connected to a well.

According to an aspect, the means for temporary receiving and parking of the first X-mas tree may comprise an adapter, and step a) may further comprise the step of:

- installing the adapter on said first or second pre-installed subsea structure.

The adapter can be a mechanical adapter functioning as a connection and supporting element between the first or second pre-installed subsea structure and the first X-mas tree. In addition, the adapter may comprise means such that simple tests may be performed on the first X-mas tree while being parked. Thus, the adapter can in one  
5 embodiment be used for parking without any fluid- or electric connections to the subsea structure below and, in another embodiment, be used for parking and testing of the first X-mas tree.

According to an aspect, the first or second pre-installed subsea structure comprises a second X-mas tree, and the method comprises the step of parking the first X-mas  
10 tree on top of the second X-mas tree.

According to an aspect, the first or second pre-installed subsea structure comprises a dedicated parking position in a subsea template or manifold, and wherein the first X-mas tree is temporary received and parked in said dedicated empty parking position. In this aspect, the dedicated parking position may be an upper surface of a  
15 template or manifold which may have receiving means with an interface corresponding to a lower interface of the first X-mas tree. Alternatively, the dedicated parking position may be an additional separate slot in a template compared to prior art templates, which separate slot does not have a wellhead or well underneath, wherein the separate slot is used only for temporary parking of X-  
20 mas trees.

According to an aspect, the method may further comprise a step of, prior to step a), opening at least one over-trawlable hatch providing access to at least one of said first and or second pre-installed subsea structures located below said hatch. It is to be noted that not only the hatches can be over-trawlable, but also the first and or  
25 second pre-installed subsea structure as a whole shall be over-trawlable if this is required in the specific project. However, in subsea areas where over-trawlability is not an issue, the first and second pre-installed subsea structures as well as the hatches, do not have to be over-trawlable.

According to an aspect of the method, step b) further comprises the step of using an adapter for guiding the first X-mas tree on to the first or second pre-installed subsea structure by;  
30

- attach guide wires running from the first X-mas tree to guide posts linked to the adapter, thereby ensuring proper guiding.

The guide posts may have different properties dependent on the structural  
35 framework of the installation and the requirements in different projects, including:

- if they are formed as part of the adapter, be long enough to guide the first X-mas tree on to the first or second pre-installed structure. In this embodiment, the guide posts on the adapter are long enough to e.g. extend outside of, i.e.

above, the pre-installed subsea structure. If the subsea structure is a well template having hatches above each slot, the guide posts themselves are of such length that they extend above said hatches (hatches are open).

- 5       - be formed as part of the adapter, and being extendable such that they, when not extended, may be of such a length that they can be installed on a pre-installed subsea structure in a slot in a well template with the hatches closed, and when they are extended, extend above the hatches (hatches open).
- 10       - be formed as part of the first or second pre-installed subsea structure, and be long enough to guide the first X-mas tree on to the first or second pre-installed structure,
- 15       - be formed as part of the first or second pre-installed subsea structure and be extendable such that they, when not extended, may be of such a length that they, if arranged in a slot in a well template, have a length short enough allowing the hatches to be closed, and when they are extended, extend above the hatches (hatches open).

If the guide posts are extendable, they may be passive or active. If they are passive, they need an external force to be extended, such as being extended using any wire or other suitable means. If they are active, they may comprise own motive means for extending, and they can be telescopic or similar.

- 20       The maximum extension/height of the guide posts may be limited by the maximum lifting height of the lifting system topside, e.g. the height of the derrick etc. E.g. if a BOP is lifted using a riser string connected to said lifting system (and the slip joint is locked, not allowing any telescopic movement), the maximum possible lifting height is dependent on the height of the derrick. Consequently, the guide posts have
- 25       to be shorter than said maximum lifting height such that the lower part of the BOP (or any other equipment being lifted) can be lifted above said guide posts or, at least in such a height that the lower part of the guide funnels in the BOP are higher than the guide posts.

- 30       The system may further comprise at least one guide wire for cooperation with the at least one guide post, for providing guiding support during installation of the adapter and or the X-mas tree on to the first and or second pre-installed subsea structure.

- 35       However, in another embodiment, the system may be formed without the guide posts or the guide wires. Then the guiding may be performed using other means. E.g. a running tool can stick out/extend below the stack (i.e. the stack is the assembly of the X-mas tree including other components etc. being lifted), for example stick out/extend 1-1.5 meters below the stack. During installation/landing, the running tool is then guided and fit to the subsea structure, such that movements are prevented, before the whole stack is landed on the subsea structure. The

requirements of the guiding system may be different in different parts of the world and at different water depths. For example, in areas having generally good weather conditions, which leads to limited movements of the rig/vessel, there is no need for any additional guiding.

5 Furthermore, during movement of the first X-mas tree, it is of importance that the X-mas tree is not moved vertically above other X-mas trees or subsea components which are in operation and or in fluid communication with the well. This will minimize the risk of dropping/losing/collision of the first X-mas tree on components vertically below the X-mas tree when transported from the wellhead to its  
10 temporary parking position. Such potential incidents may be catastrophic and lead to significant spills and or damages. Thus, it is advantageous to move the first X-mas tree around on the outside of lower components, i.e. not vertically above, such as to reduce the risk of such incidents. For example, if moving the first X-mas tree from a main slot in a well template to another temporary parking position within the  
15 same well template, it may be necessary to lift and move the first X-mas tree on the outside and around the well template, i.e. not the shortest distance between said main slot and temporary parking position (which shortest distance will be above and crossing over the well template).

The invention further relates to a subsea system comprising at least a first pre-  
20 installed subsea structure comprising a first X-mas tree, the first X-mas tree being arranged on top of a wellhead, and the first or a second pre-installed subsea structure comprises means for temporary receiving and parking the first X-mas tree. Thus, the first pre-installed subsea structure may be a slot or another X-mas tree within the same well template, while the second pre-installed subsea structure may  
25 be another well template, a slot, a manifold, a second X-mas tree in the other well template or, alternatively, a satellite well.

In an aspect, the subsea system may further comprise at least one adapter, wherein the at least one adapter is configured to be connected to at least one of said first or second pre-installed subsea structures and wherein the at least one adapter  
30 comprises the means for temporary receiving and parking of the first X-mas tree.

In an aspect of the subsea system, the means for temporary receiving and parking of the first X-mas tree may be formed as an integral part of said first or second pre-  
35 installed subsea component. Thus, a separate adapter will be superfluous because the means for temporary receiving and parking of the first X-mas tree is formed as part of pre-installed subsea structure. The means for temporary receiving and parking may be manufactured as part of said pre-installed subsea structures or may, alternatively be welded, casted or molded, or fastened by other means such as bolts or screws to the pre-installed subsea structure prior to lowering the pre-installed subsea structure to the seafloor.

In an aspect, the subsea system may comprise guide posts linked to the adapter. The guide posts may be connected and form part of the adapter. A detailed description of this specific embodiment is given below. Alternatively, the guide posts may be formed as part of the first and or second pre-installed subsea structure. Then the adapter can be lowered down onto said guide posts, preferable via frame funnels provided in the adapter and, when the adapter is installed on top of the pre-installed subsea structure, the guide posts may extend above said adapter.

In an aspect of the subsea system, the second pre-installed subsea structure may comprise a second X-mas tree, and wherein the first X-mas tree is temporary received and parked on top of the second X-mas tree. The second X-mas tree may have integrated means for temporary receiving and parking of the first X-mas tree, or an adapter comprising the means for temporary receiving and parking the first X-mas tree may be installed on top of the second X-mas tree before the first X-mas tree is parked on top of it.

In an aspect, the subsea system may further comprise at least one over-trawlable structure comprising at least one hatch above said first and or second pre-installed subsea structure, and wherein

- in a closed position of the at least one hatch, access to the first and or second pre-installed structure is prohibited, and
- in an open position of the at least one hatch, access to the first and or second pre-installed structure is allowed, and wherein,

during installation of the first X-mas tree on the first and or second pre-installed subsea structure, the first X-mas tree is connectable to the guide posts for guidance onto the means for temporary receiving and parking of the first X-mas tree.

In an aspect, the second pre-installed subsea structure may comprise a dedicated parking position in a subsea template or manifold, and wherein the first X-mas tree is temporary received and parked in said dedicated parking position.

In an aspect, said dedicated empty parking position may be a slot within the same subsea template as the first X-mas tree is arranged or a position at another subsea template or manifold.

The invention further relates to an adapter for use in the method described above, wherein the adapter comprises a first interface for connection to a top of a lower pre-installed X-mas tree, which interface provides for a stable positioning of the adapter on the pre-installed X-mas tree, and the adapter further comprising a second interface having means for temporary receiving and parking of an upper X-mas tree on top of the adapter, thereby providing a solid base for the upper X-mas tree and minimizing the risk of damage to the lower pre-installed X-mas tree when the upper X-mas tree is parked on top of it.



The adapter may comprise a first (lower) interface for connection to the pre-installed subsea structure and a second (upper) interface for connection to the first X-mas tree, as well as a frame and a connector arranged in the center of the frame. The connector may be a center ring. The frame may have a quadratic shape,

5 however it may also have other shapes dependent on the requirements in the specific project. The connector may be provided with locking elements, and the locking elements may have a ROV interface. Three guideposts may be provided in three of the corners of the frame, wherein in the fourth corner, there may be provided a guiding element for guiding the adapter down onto the first or second

10 pre-installed subsea structure using e.g. a wire. The guide posts in the frame may cooperate with guide funnels on the first and second X-mas trees, respectively. A wellhead profile may be provided in the second (upper) interface of the adapter, which wellhead profile may be similar to a standard wellhead profile where the first X-mas tree can be received and parked. The adapter may work as an interface

15 allowing for parking of the first X-mas tree on a second X-mas tree subsea. The first (lower) interface of the adapter may cooperate with the first and or second pre-installed subsea structure through connector (locking elements) located in connector. The second (upper) interface may cooperate with the first X-mas tree through the wellhead profile, providing possibility of landing the first X-mas tree on

20 the adapter and locking of X-mas tree wellhead connector. A guide funnel, located in the center of frame underneath the connector, may provide guiding functionality during landing of the adapter on the first or second pre-installed subsea structure. The guide posts may have possibility of moving within respective frame funnels located in the corners of the frame and guides the first X-mas tree during

25 landing/parking on the adapter. The guide posts may have restrictions in their axial movement within the respective frame funnels by lower cuffs and upper cuffs, which lower and upper cuffs are provided for cooperation with stopping elements on the frame funnel, thereby limiting the axial movement of the guide posts within their respective frame funnels.

30 According to a second embodiment, it is described a method of lowering at least a first and second X-mas tree in one run from a topside location to a seafloor, wherein the method comprises the steps of:

- preparing a first X-mas tree topside,
- preparing a second X-mas tree topside, wherein the second X-mas tree comprises

35 means for receiving and parking of said first X-mas tree,

- positioning the first X-mas tree on top of the second X-mas tree and attaching said first X-mas tree to the second X-mas tree, thereby providing a stack of at least two X-mas trees,
- lowering the stack to down to the seafloor.

The means for receiving and parking of said first X-mas tree on the second X-mas tree may be integrated in an adapter which is positioned on top of the second X-mas tree, or alternatively, the means for receiving and parking may be formed as an integral part of the second X-mas tree. The adapter may be the same adapter as disclosed in connection with the first embodiment of the invention, i.e. the embodiment where the adapter is positioned on a first or second pre-installed subsea structure. It is obvious that more than two X-mas trees may be stacked on top of each other and lowered simultaneously, such as three, four, five, six or even more X-mas trees. Then one may add additional adapters comprising the means for receiving and parking of another X-mas tree between each of the additional X-mas trees. Alternatively, one or more of the additional X-mas trees may have integrated means for receiving another X-mas tree. Alternatively, if there are three or more X-mas trees stacked on top of each other, there may be combinations of adapters and X-mas trees having integrated means for receiving and parking of another X-mas tree.

The at least first X-mas tree and second X-mas tree can be stacked on a mudmat before they are lowered on the mudmat to the seafloor.

When the at least first and second X-mas tree have been lowered to the seafloor, the first and second X-mas trees may be disconnected and positioned on top of separate wells. If a mudmat is not used, the stack may be positioned directly in a slot or on a wellhead, whereas the lower X-mas tree may be connected to this slot or wellhead and the upper X-mas tree may be lifted to another slot or wellhead.

According to the second embodiment, it is further described an adapter to be used in the method of lowering the at least first and second X-mas trees in one run from a topside location to a seafloor, wherein the adapter comprises a first interface for connection to a top of the second X-mas tree, which interface provides for a stable positioning of the adapter on the second X-mas tree, and the adapter further comprising a second interface having means for temporary receiving and parking of the first X-mas tree on top of the adapter. Thus, the adapter provides a solid connection between the first and second X-mas tree to be lowered to the seafloor, thereby minimizing the risk of damage to any of the X-mas trees during lowering (e.g. installation) to the seafloor.

In the description of the different embodiments above, we have referred to both method steps and constructional features of the subsea system necessary for achieving the objective(s) of the invention. It is clear that the method and the subsea system relate to the same inventive concept and, although some features have only been described in connection with the method or the subsea system, it is clear that the method and subsea system have many features in common and that the disclosed features may be combined in any combination. Thus, features detailed described in

connection with the method may also be used, if appropriate, in the subsea system, and vice versa.

These and other characteristics of the invention will be apparent from the enclosed drawings, wherein;

## 5 Brief description of the drawings

Fig. 1 discloses an overview of a typical subsea arrangement comprising satellite wells with X-mas trees, a manifold, flying leads, a well template etc.;

Figs. 2A-Q disclose an operational first embodiment of the invention where a first X-mas tree is received and parked on top of a second X-mas tree;

10 Fig. 3 shows details of an adapter according to the present invention;

Fig. 4 discloses an embodiment of the invention where a X-mas tree is parked on top of another X-mas tree;

15 Figures 5A and 5B show details of an embodiment of the invention, where two X-mas trees are lowered in one trip on top of each other using an adapter in between;

Figures 6A and 6B show details of an embodiment of the invention, where two X-mas trees are lowered in one trip on top of each other without using an adapter in between;

## Detailed description of a preferential embodiment

20 Fig. 1 discloses an overview of some elements forming part of a typical subsea system 10. The disclosed subsea system 10 comprises satellite wells with X-mas trees 1, a manifold 6, flying leads 5, a well template 2, an umbilical termination assembly 7, umbilical 3, subsea distribution unit 4. It is clear that the subsea system 10 may comprise additional elements not mentioned specifically or disclosed in the  
25 figures.

### First embodiment: first X-mas tree 1' parked on a second X-mas tree 1'' in the same well template 6

With reference to Fig. 2A-Q a possible configuration and operational sequence of a first embodiment of the present invention will be described.

30 Fig. 2A discloses a well template 6 having a number of parking positions 9', 9'', e.g. well slots, for X-mas trees 1', 1''. Each parking position 9' is provided with a hatch 10', 10'', 10''', 10'''. The hatches, and any other of the subsea components, may be over-trawlable, e.g. by providing the upper surfaces smooth. In the embodiment on Fig. 2A, the hatch 10' covering parking position 9' is in an open

position, i.e. a position allowing entrance to the parking position, whereas the remaining hatches 10'', 10''', 10'''' are in a closed position, i.e. a position where the entrance to the parking position is prevented. The top of a X-mas tree 1 is seen in Fig. 2A. A guide wire 8' is attached to the guide post 11' in parking position 9' for guiding of an adapter 12. The adapter 12 is lowered using a wire 13 or similar. Details of the adapter 12 arranged between a first X-mas tree 1' and a second X-mas tree 1'' is disclosed in Fig. 4. The hatch 10'''' covering the main slot, i.e. the slot where the first X-mas tree 1' is to be removed from, is locked.

In Fig. 2B the adapter 12 is landed on top of a second X-mas tree 1''. The second X-mas tree 1'' is already installed in another parking position 9' in the same well template 6. The adapter 12 is locked to the top connector of the second X-mas tree 1''.

With reference to Fig 2C, when the adapter 12 is locked to the top connector of the second X-mas tree 1'', unlock the lifting/installation tool 14 and release guide wire 8' from guide post 11'. The adapter 12 is now in parking position and is ready for receiving the first X-mas tree 1', i.e. the temporary wet parking operation of the first X-mas tree 1' on the second X-mas tree 1'' can now be performed.

With reference to Figs. 2D, 2E, 2F, while in the parking position 9'', where drilling/re-completion operation is going to be performed, i.e. the slot 9'' where the X-mas tree is to be removed from, land BOP (Blow-out preventer) 15 or other subsea equipment and perform all necessary operation necessary prior to unlocking the first X-mas tree 1'.

With reference to Fig. 2G, after all necessary operation on main slot (main parking position 9'') has been performed, unlock X-mas Tree connector and lift up the first X-mas Tree 1' with BOP/Installation Tool/Lifting Tool 15/14.

Fig. 2H: Move whole stack, including BOP/Lifting tool 15/14 and the first X-mas tree 1' over parking position (slot) 9'.

Fig. 2I: Attach three guide wires 8'', 8''' (only two shown in the figure) to guide posts 11'', 11''', 11'''' in adapter 12, move guide posts 11'', 11''', 11'''' up and apply appropriate tension into guide wires 8'', 8''', 8'''' to ensure proper guiding.

Fig. 2J: Land whole Stack, including BOP/Lifting tool 15/14 and the first X-mas tree, on adapter 12 and Lock X-mas Tree Connector to the second (upper) interface of the adapter 12.

Fig 2K: After the first X-mas tree 1' is locked to the adapter 12, lift up BOP/Lifting Tool/Installation Tool 15/14 over the parking position (slot) 9'. Release tension in guide wires and land adapter guide posts. Release guide wires from guide posts.

Fig. 2L: When the first X-mas tree 1' is landed in parking position 9', perform all necessary operations in main well (main parking position) 9''.

Fig. 2M: After all necessary work on main well 9'' is performed; lift up BOP/Lifting Tool/Installation Tool 15/14 over the well (i.e. the slot from where the first X-mas tree 1' has been removed).

Fig. 2N: Move the BOP/Lifting Tool/Installation Tool 15/14 over parking position 9'. Connect guide wires 8'', 8''', 8'''' to the guide posts 11'', 11''', 11'''' in the adapter 12 and apply proper tension to them. Lift the guide posts (best seen in Figures 3 and 4) 11'', 11''', 11'''' up within guide funnels 30'', 30''', 30'''' in the first X-mas tree 1', until the lower cuffs 27'', 27''', 27'''' (details on Figures 3 and 4) comes into contact with stopping elements 29'', 29''', 29'''' at the entrance of the frame funnels 26'', 26''', 26''''. Alternatively, the guide posts may be of such a length that they, when installed, ensures proper guiding of the first X-mas tree and the BOP/Lifting Tool/Installation Tool, thereby they do not have to be extendable.

Fig. 2O: Land BOP/Lifting Tool/Installation tool 15/14 on the first X-mas tree 1' and Lock X-mas tree Connector.

Fig. 2P: Unlock Upper X-mas Tree connector from Adapter Upper Profile and lift up stack, including BOP/ Lifting Tool/Installation Tool and the first X-mas tree 1', over parking position 9'. Release tension from guide wires 8'', 8''', 8'''' and land guide posts 11'', 11''', 11'''' in adapter 12.

Fig. 2Q: Move stack, including BOP/ Lifting Tool/Installation Tool and the first X-mas tree 1' over main well. Land stack, including BOP/ Lifting Tool/Installation Tool and the first X-mas tree 1', on wellhead. Lock X-mas tree connector. The sequence is now complete and the first X-mas tree 1' is back in its original slot.

With reference to Figs. 3 and 4 it is disclosed an embodiment of the invention where an adapter 12 is used for parking a first X-mas tree 1' on a second X-mas tree 1''. In this embodiment, the adapter 12 is the means for receiving and parking the first X-mas tree 1'. The adapter 12 comprises a first (lower) interface for connection to the pre-installed subsea structure (exemplified as a second X-mas tree 1'') and a second (upper) interface for connection to the first X-mas tree 1' (Fig. 4).

Furthermore, the adapter 12 comprises a frame 20 and a connector 21 arranged in the center of the frame 20. The frame 20 having a quadratic shape in the disclosed embodiment, but it may have other shapes dependent on the requirements in the specific project. The connector 21 is provided with locking elements 22 providing interface and locking towards second X-mas tree, the locking elements 22 having a ROV interface. Three guideposts 11'', 11''', 11'''' are provided in three of the corners of the frame 20, wherein in the fourth corner, there is provided a guiding element 23 for guiding the adapter 12 down onto the first or second pre-installed

subsea structure using e.g. a wire. The guide posts 11'', 11''', 11'''' in the frame 20 may cooperate with guide funnels 30'', 30''', 30'''' on the first and second X-mas trees 1', 1'', respectively. A wellhead profile 24 is provided in the second (upper) interface of the adapter 12, which wellhead profile 24 is similar to a standard wellhead profile where the first X-mas tree 1' can be received and parked. The adapter 12 works as interface allowing for parking of the first X-mas tree 1' on a second X-mas tree 1'' subsea. The first (lower) interface of the adapter 12 cooperates with the first and or second pre-installed subsea structure through connector (locking elements) located in connector 21. The second (upper) interface cooperates with the first (upper) X-mas tree 1' through the wellhead profile 24, providing possibility of landing the first X-mas tree 1' on the adapter 12 and locking of X-mas tree wellhead connector. A guide funnel 25, located in the center of frame 12 underneath the connector 21, provides guiding functionality during landing of the adapter 12 on the second X-mas tree 1''. The guide posts 11'', 11''', 11'''' have possibility of moving within respective frame funnels 26'', 26''', 26'''' located in the corners of the frame 20 and guides the first X-mas tree 1' during landing/parking on the adapter 12. The guide posts 11'', 11''', 11'''' have restrictions in their axial movement within the respective frame funnels by lower cuffs 27'', 27''', 27'''' and upper cuffs 28'', 28''', 28'''', which lower cuffs 27'', 27''', 27'''' and upper cuffs 28'', 28''', 28'''' are provided for cooperation with stopping elements 29'', 29''', 29'''' on upper and lower entrance of frame funnel 26'', 26''', 26'''', thereby limiting the axial movement of the guide posts 11'', 11''', 11'''' within their respective frame funnels 26'', 26''', 26''''.

Second embodiment, Figs. 4, 5 and 6, lowering a number of X-mas trees in one trip

Figures 5A and 5B show details of an embodiment of the invention, where two X-mas trees 1', 1'' are lowered in one trip on top of each other using an adapter 12 in between. The Figures 5A and 5B show the first X-mas tree 1' on top of the second X-mas tree 1'' having the adapter 12 in between, seen in two different angles. The details are the same as in Figure 4, but in addition a lifting/installation tool 14 and an associated wire 13, is disclosed.

The adapter 12 is used in the method/system of lowering the at least first 1' and second X-mas trees 1'' in one run from a topside location to a seafloor. The adapter 12 comprises a first interface for connection to a top of the second X-mas tree 1'', which interface provides for a stable positioning of the adapter 12 on the second X-mas tree 1''. The adapter 12 further comprises a second interface having means for temporary receiving and parking of the first X-mas tree 1' on top of the adapter 12. Thus, the adapter 12 provides a solid connection between the first and second X-mas tree 1', 1'' to be lowered to the seafloor, thereby minimizing the risk of damage to any of the X-mas trees during lowering (e.g. installation) to the seafloor.

Figures 6A and 6B show details of an embodiment of the invention, where two X-mas trees are lowered in one trip on top of each other without using an adapter in between. The Figures 6A and 6B show the first X-mas tree 1' on top of the second X-mas tree 1'' in two different angles. The details of the Figures are the same as in  
5 Figures 5A and 5B except that in the embodiment on Figures 6A and 6B, the first X-mas tree 1' is parked directly on top of the second X-mas tree 1'', without using an adapter, but including guide posts, guide funnels etc. Thus, in the embodiment on Figures 6A and 6B, the second X-mas tree 1'' has an interface for receiving and parking of the first X-mas tree 1' on top of it. The lower surface of the first X-mas  
10 tree 1' has an interface which cooperates with the interface of the second X-mas tree 1''. Thus, when the first X-mas tree 1' is positioned on top of the second X-mas tree 1'', it is provided a solid connection between the first and second X-mas tree 1', 1'', thereby minimizing the risk of damage to any of the X-mas trees during lowering (e.g. installation) to the seafloor. In this embodiment, guide posts may be  
15 formed on the second X-mas tree 1''.

The invention is now explained with reference to non-limiting embodiments. However, a skilled person will understand that there may be made alternations and modifications to the embodiment that are within the scope of the invention as defined in the attached claims.

## CLAIMS

1. Method of performing a well operation on a subsea well or wellhead, wherein a first subsea X-mas tree (1') is arranged on top of the wellhead, *characterized in that* the method comprises the steps of:
  - 5 a) lifting the first X-mas tree (1') from the subsea wellhead using a lifting equipment to a position above a first or second pre-installed subsea structure, wherein the first or second pre-installed subsea structure comprises means (12) for temporary receiving and parking of the first X-mas tree (1'), and wherein the first or second pre-installed subsea structure comprises a second X-mas tree (1''),
  - 10 b) lowering the first X-mas tree (1') to a parking position on the second X-mas tree (1'') and locking the first X-mas tree (1') in the parking position,
  - c) performing a well operation on the wellhead and or well,
  - d) unlocking and lifting the first X-mas tree (1') from the parking position,
  - 15 e) lowering the first X-mas tree (1') back on top of the wellhead and reattach it to the subsea wellhead.
2. Method according to claim 1, wherein an adapter (12) comprises a second interface having the means for temporary receiving and parking of the first X-mas tree, and wherein step a) further comprises the step of:
  - installing the adapter (12) on said first or second pre-installed subsea structure.
- 20 3. Method according to claim 1 or claim 2, further comprising, prior to step a), opening at least one over-trawlable hatch providing access to at least one of said first and or second pre-installed subsea structure located below said hatch.
4. Method according to any of the preceding claims 1-3, wherein step b) further comprises the step of using an adapter (12) for guiding the first X-mas tree (1') on
  - 25 to the first or second pre-installed subsea structure by;
    - attach guide wires running from the first X-mas tree (1') to guide posts (11'', 11''', 11''''') linked to the adapter (12), thereby ensuring proper guiding.
5. Subsea system comprising at least a first pre-installed subsea structure comprising a first X-mas tree (1'), the first X-mas tree (1') being arranged on top of
  - 30 a wellhead, the first or a second pre-installed subsea structure comprises means for temporary receiving and parking the first X-mas tree (1'), characterized in that the first or second pre-installed subsea structure comprises a second X-mas tree (1''), and wherein the first X-mas tree (1') is temporary received and parked on top of the second X-mas tree (1'').
- 35 6. Subsea system according to claim 5, wherein the system further comprises at least one adapter (12), wherein the at least one adapter (12) is configured to be connected to at least one of said first or second pre-installed subsea structures and



wherein the at least one adapter (12) comprises the means for temporary receiving and parking of the first X-mas tree (1').

5 7. Subsea system according to claim 6, wherein the means for temporary receiving and parking of the first X-mas tree (1') is formed as an integral part of said first or second pre-installed subsea structure.

8. Subsea system according to any of the preceding claims 6-7, wherein the system comprises guide posts (11'', 11''', 11''''') linked to the adapter (12).

10 9. Subsea system according to claim 8, wherein the subsea system further comprises at least one over-trawlable structure comprising at least one hatch above said first and or second pre-installed subsea structure, and wherein  
- in a closed position of the at least one hatch, access to the first and or second pre-installed structure is prohibited, and  
- in an open position of the at least one hatch, access to the first and or second pre-installed structure is allowed, and wherein,  
15 during installation of the first X-mas tree (1') on the first and or second pre-installed subsea structure, the first X-mas tree (1') is connectable to the guide posts (11'', 11''', 11''''') for guidance onto the means for temporary receiving and parking of the first X-mas tree (1').

20 10. Adapter (12) for use in the method according to claims 1-4, *characterized in that* the adapter (12) comprises a first interface for connection to a top of a lower pre-installed X-mas tree, which first interface provides for a stable positioning of the adapter (12) on the pre-installed X-mas tree, and the adapter (12) further comprising a second interface having means for temporary receiving and parking of an upper X-mas tree on top of the adapter (12),  
25 such that a solid base for the upper X-mas tree is provided.

## PATENTKRAV

1. Fremgangsmåte for å utføre en brønnoperasjon på en undervannsbrønn- eller brønnhode, hvor et første ventiltre (1') er anordnet på toppen av brønnhodet, *karakterisert ved at* fremgangsmåten omfatter trinnene å:
  - 5 a) løfte et første ventiltre (1') fra undervannsbrønnhodet ved bruk av et løfteutstyr til en posisjon over en første eller andre forhåndsinstallerte undervannsstruktur, hvor den første eller andre undervannsstrukturen omfatter midler (12) for midlertidig mottak og parkering av det første ventiltreet (1'), og hvor den første eller andre forhåndsinstallerte undervannsstrukturen omfatter et andre ventiltre
    - 10 (1''),
    - b) senke det første ventiltreet (1') til en parkeringsposisjon på det andre ventiltreet (1'') og låse det første ventiltreet (1') i parkeringsposisjonen,
    - c) utføre en brønnoperasjon på brønnhodet og eller brønnen,
    - d) låse opp og løfte det første ventiltreet (1') fra parkeringsposisjonen,
    - 15 e) senke det første ventiltreet (1') tilbake til toppen av brønnhodet og gjenfeste det til undervannsbrønnhodet.
2. Fremgangsmåte ifølge krav 1, hvor en adapter (12) omfatter et andre grensesnitt med midlene for midlertidig mottak og parkering av det første
  - 20 ventiltreet, og hvor trinn a) videre omfatter trinnet å:
    - installere adapteren (12) på nevnte første eller andre forhåndsinstallerte undervannsstruktur.
3. Fremgangsmåte ifølge krav 1 eller krav 2, videre omfattende, før trinn a),
  - 25 - lukke opp minst én overtrålbar luke for å tilveiebringe aksess til minst én av nevnte første eller andre forhåndsinstallerte undervannsstrukturer anordnet under nevnte luke.
4. Fremgangsmåte ifølge hvilket som helst av de foregående kravene 1-3, hvor
  - 30 trinn b) videre omfatter trinnet å benytte en adapter (12) for å guide det første ventiltreet (1') opp på den første eller andre forhåndsinstallerte undervannsstrukturen ved a:
    - feste ledevaiere som forløper fra det første ventiltreet (1') til guideposter (11'', 11''', 11''') festet til adapteren (12), for derved å sikre riktig guiding.
  - 35
5. Undervannssystem omfattende minst en første forhåndsinstallerte undervannsstruktur omfattende et første ventiltre (1'), det minst første ventiltreet (1') er anordnet på toppen av brønnhodet, den første eller en andre forhåndsinstallerte undervannsstruktur omfatter midler for midlertidig mottak og
  - 40 parkering av det første ventiltreet (1'), *karakterisert ved at* den første eller andre forhåndsinstallerte undervannsstrukturen omfatter et andre ventiltre (1''), og hvor

det første ventiltreet (1') blir midlertidig mottatt og parkert på toppen av det andre ventiltreet (1'').

- 5        6.        Undervannssystem ifølge krav 5, hvor systemet videre omfatter minst én adapter (12), hvor den minst ene adapteren (12) er konfigurert til å forbindes til minst én av nevnte første eller andre forhåndsinstallerte undervannsstrukturer og hvor den minst ene adapteren (12) omfatter midlene for midlertidig mottak og parkering av det første ventiltreet (1').
- 10      7.        Undervannssystem ifølge krav 6, hvor midlene for midlertidig mottak og parkering av det første ventiltreet (1') er utformet som en integrert del av nevnte første eller andre forhåndsinstallerte undervannsstruktur.
- 15      8.        Undervannssystem ifølge hvilket som helst av de foregående kravene 6-7, hvor systemet omfatter guideposter (11'', 11''', 11''') forbundet til adapteren (12).
- 20      9.        Undervannssystem ifølge krav 8, hvor undervannssystemet minst én overtrålbart struktur omfattende minst én luke over nevnte første og eller andre forhåndsinstallerte undervannsstruktur, og hvor
- 25      - i en lukket posisjon av den minst ene luken, så er adgang til den første og eller andre forhåndsinstallerte undervannsstrukturen forhindret, og
- i en åpen posisjon av den minst ene luken, så er adgang til den første og eller andre forhåndsinstallerte strukturen mulig, og hvor,
- under installasjon av det første ventiltreet (1') på den første og eller andre
- forhåndsinstallerte undervannsstrukturen, så kan det første ventiltreet (1') koples til
- guidepostene (11'', 11''', 11''') for guiding opp på midlene for midlertidig mottak og parkering av de første ventiltreet (1').
- 30      10.      Adapter (12) for bruk med metoden ifølge kravene 1-4, *karakterisert ved at* adapteren (12) omfatter et første grensesnitt for forbindelse med en topp av et nedre forhåndsinstallert ventiltre, hvilket første grensesnitt tilveiebringer en stabil posisjonering av adapteren (12) på det forhåndsinstallerte ventiltreet, og adapteren (12) videre omfatter et andre grensesnitt med midler for å midlertidig mottak og parkering av et øvre ventiltre på toppen av adapteren (12),
- 35      slik at det tilveiebringes en solid base for det øvre ventiltreet.

1/14

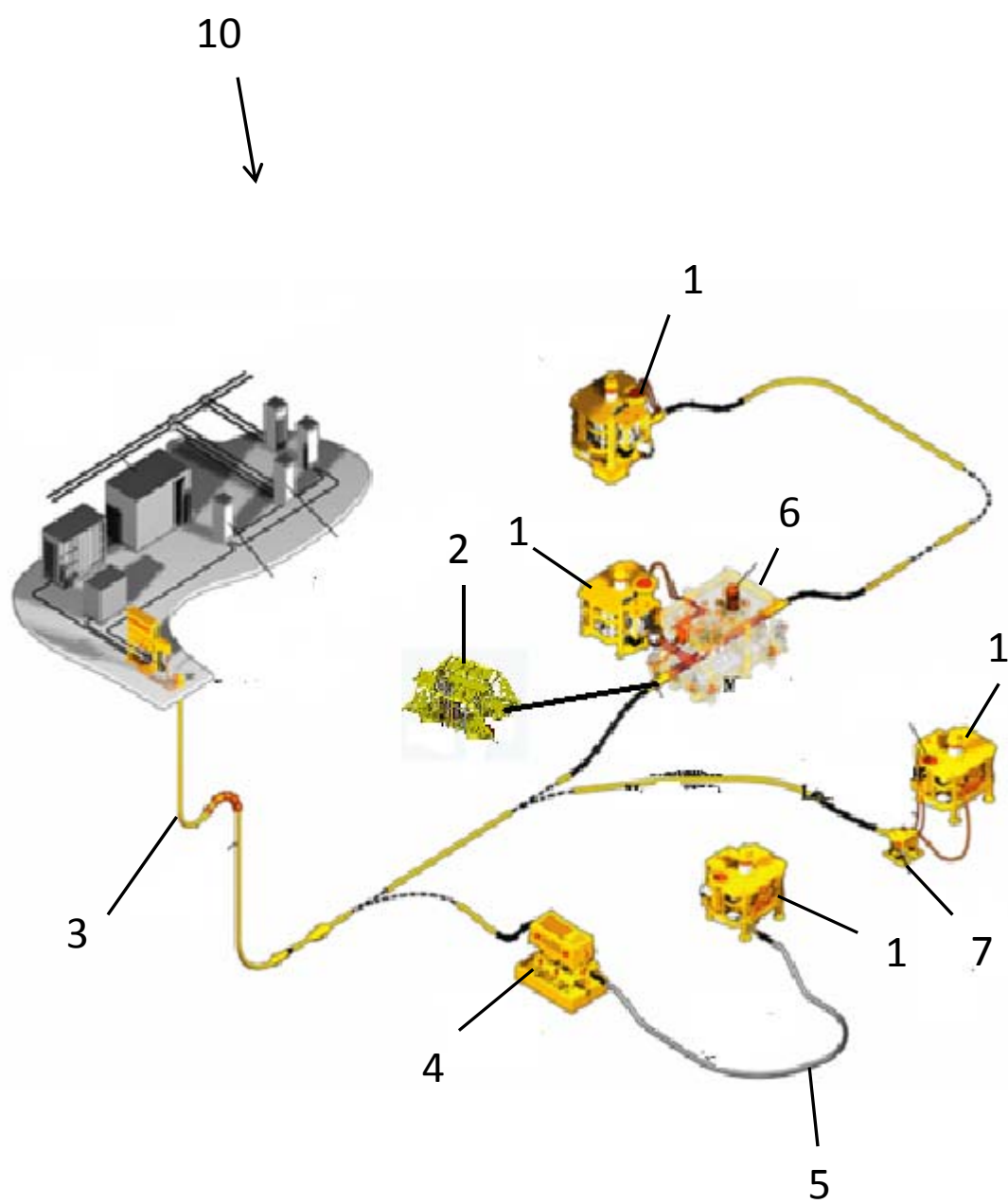


Fig. 1

2/14

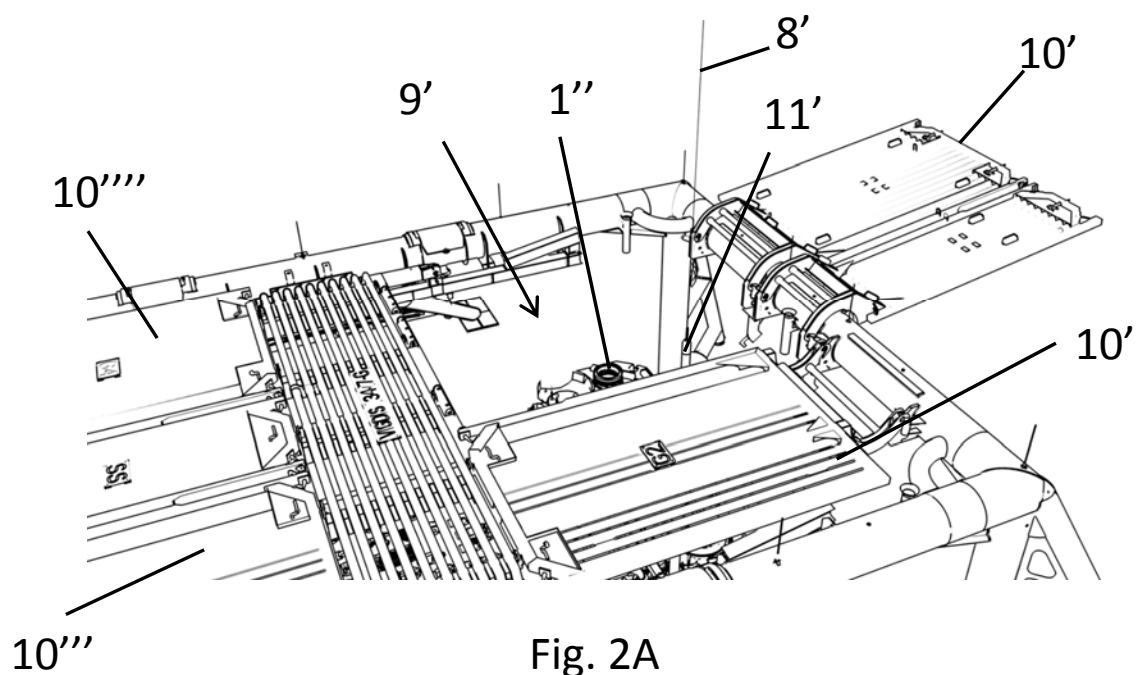


Fig. 2A

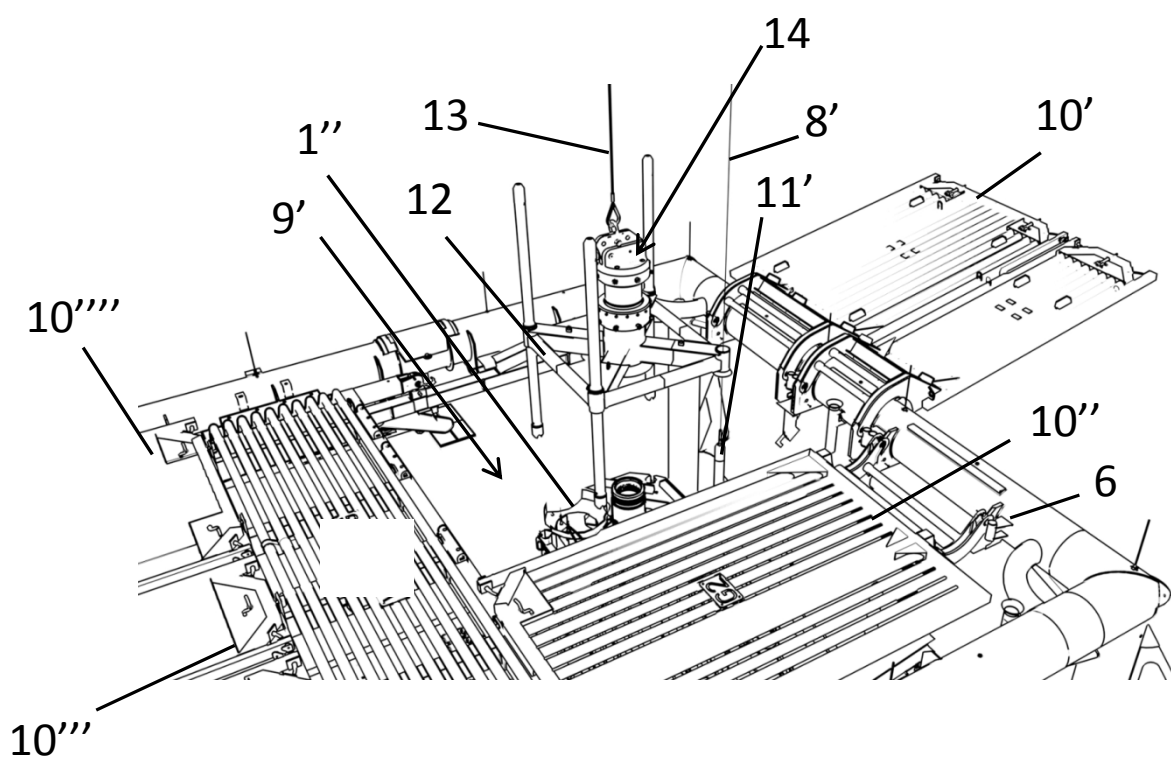


Fig. 2B

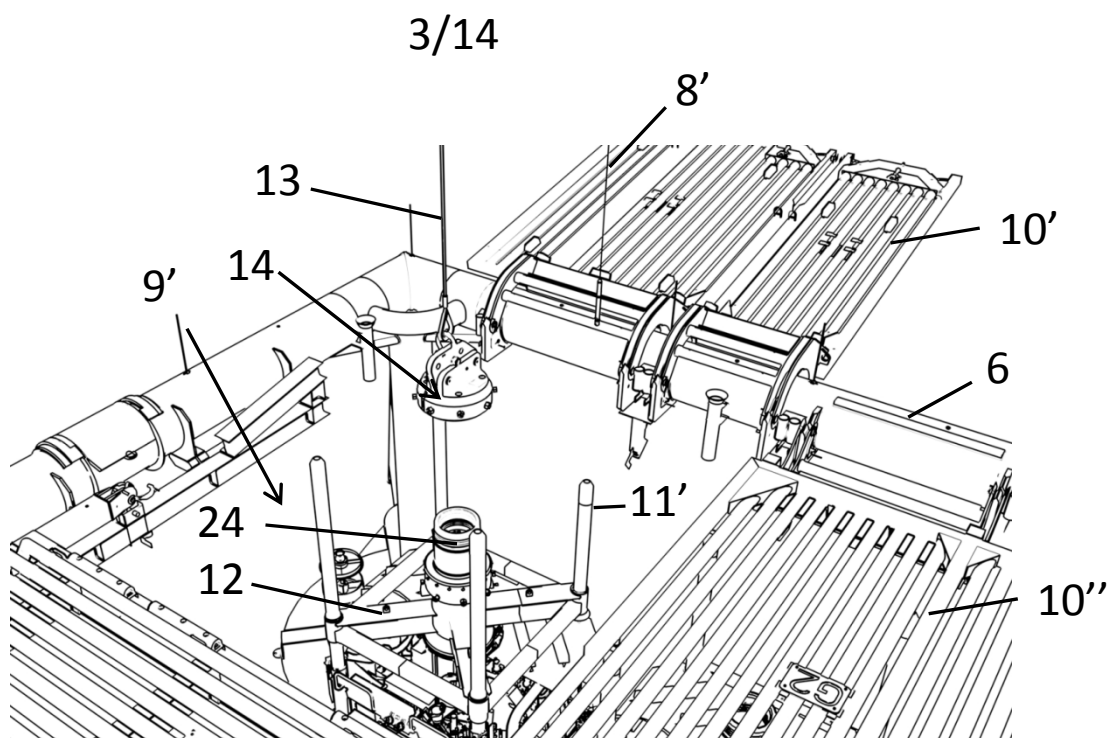


Fig. 2C (parking position)

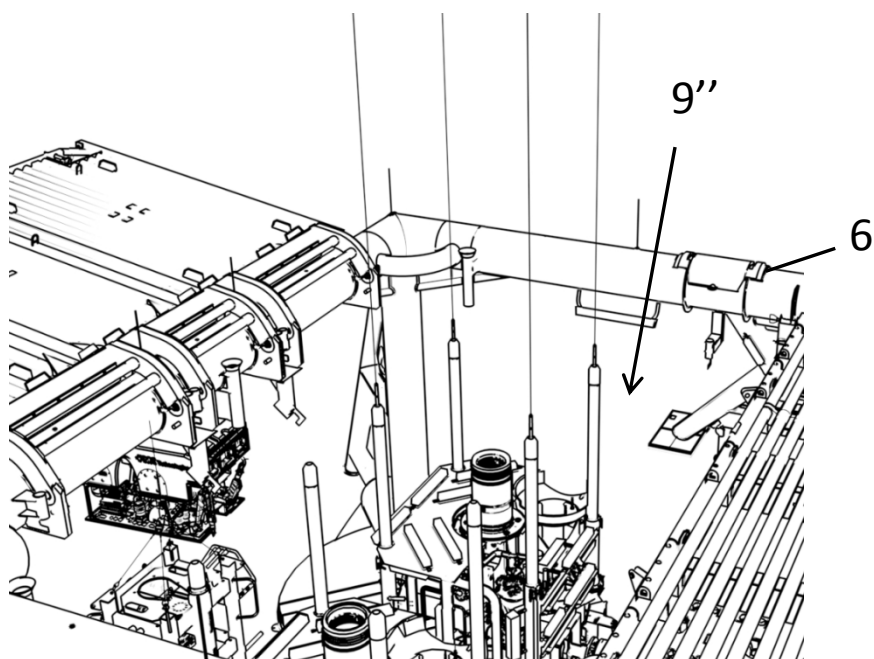


Fig. 2D (main slot)

4/14

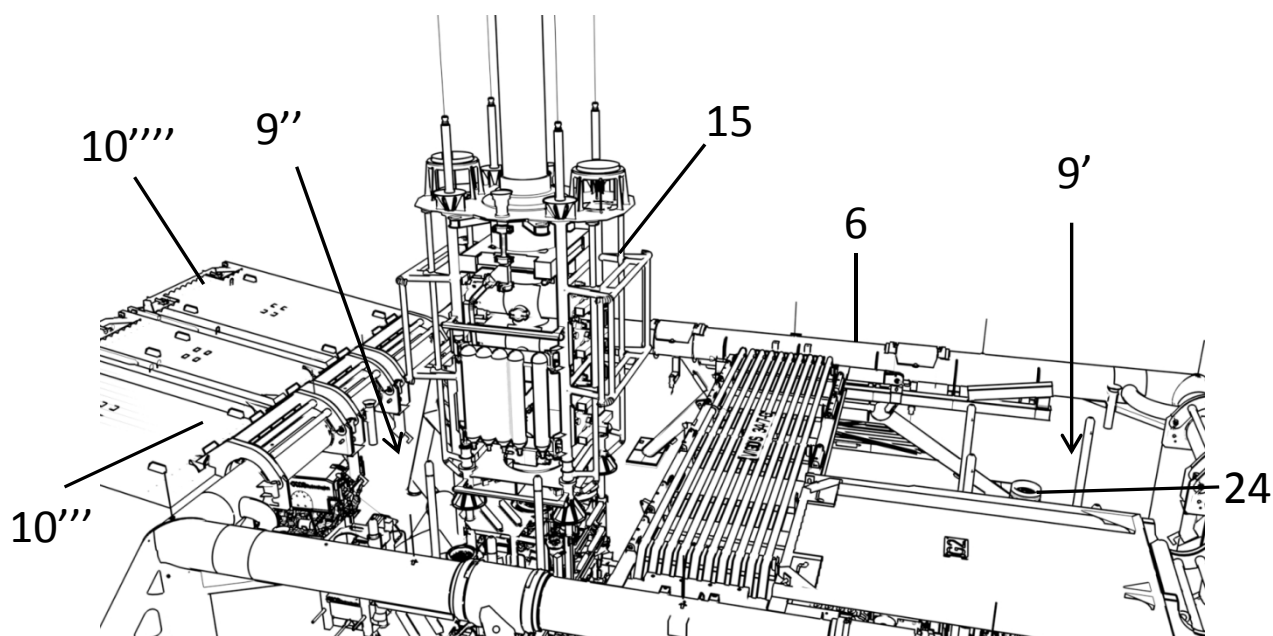


Fig. 2E

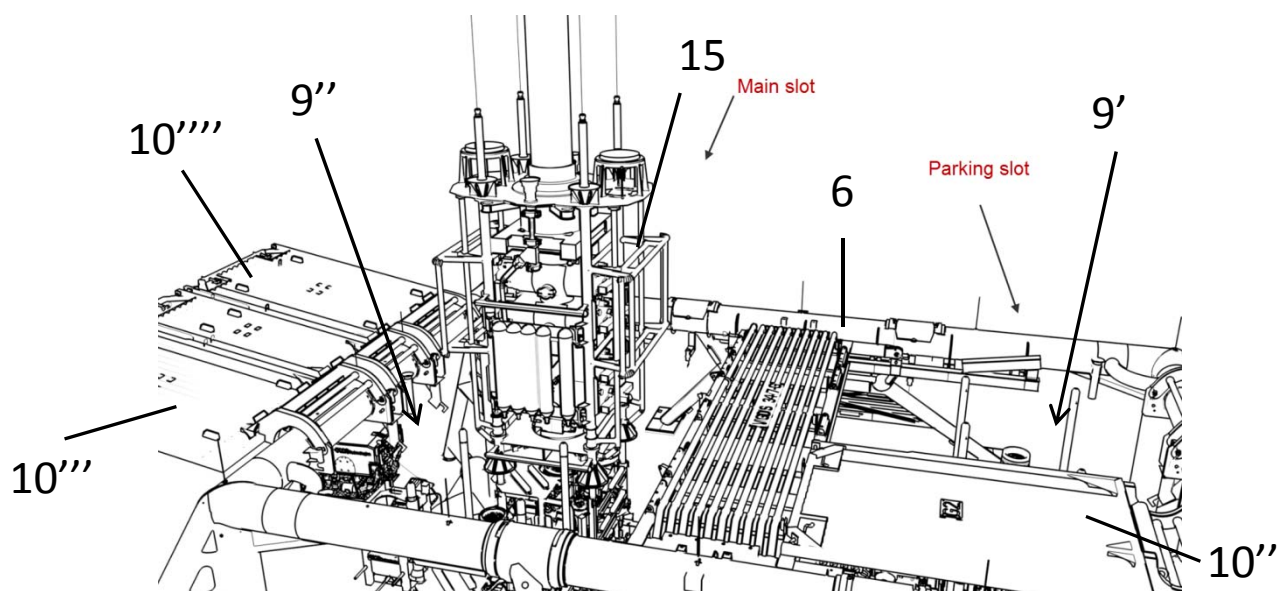


Fig. 2F

5/14

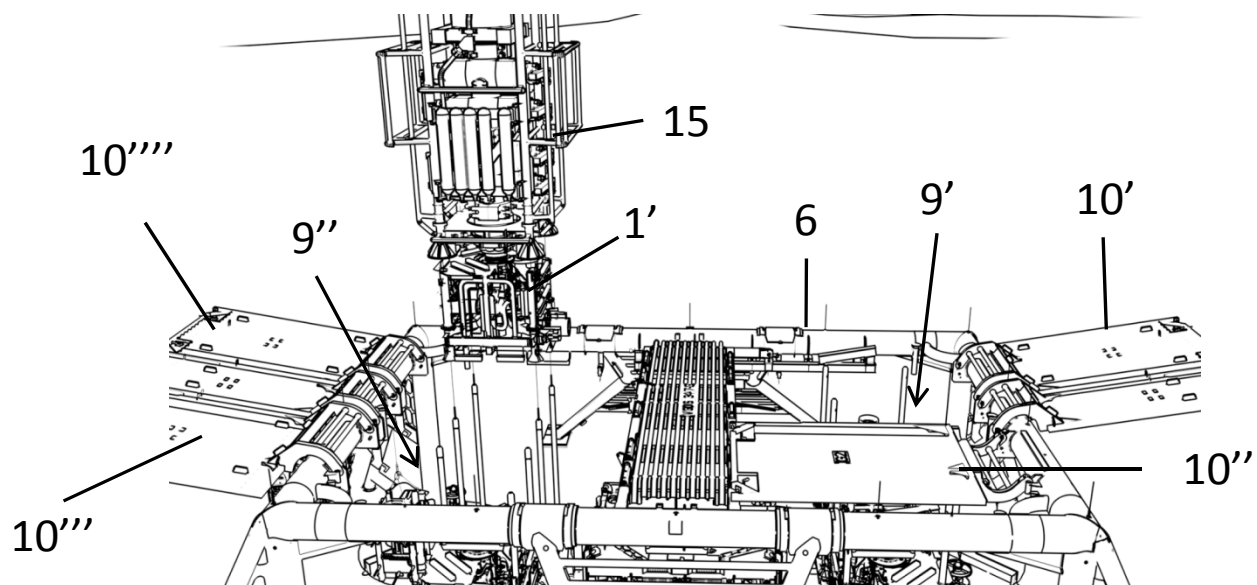


Fig. 2G

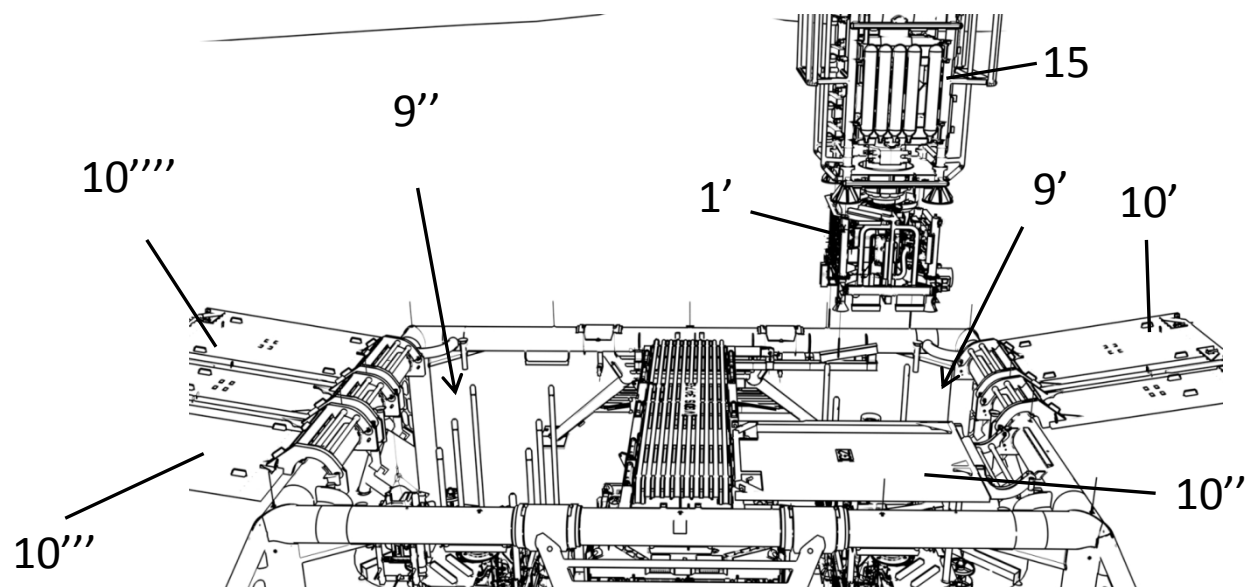


Fig. 2H



6/14

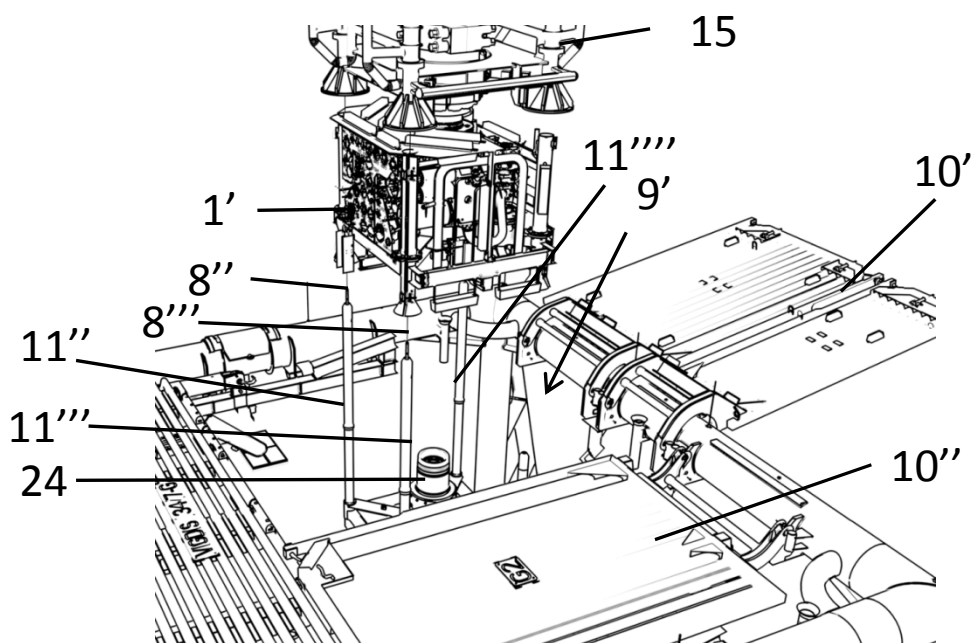


Fig. 2I

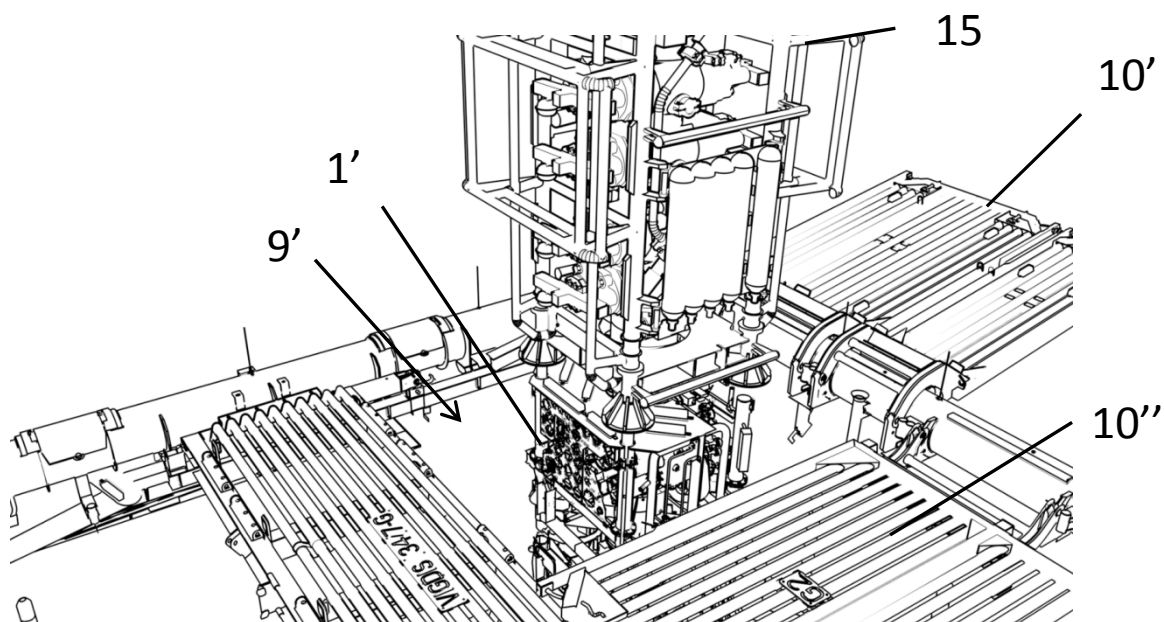


Fig. 2J

7/14

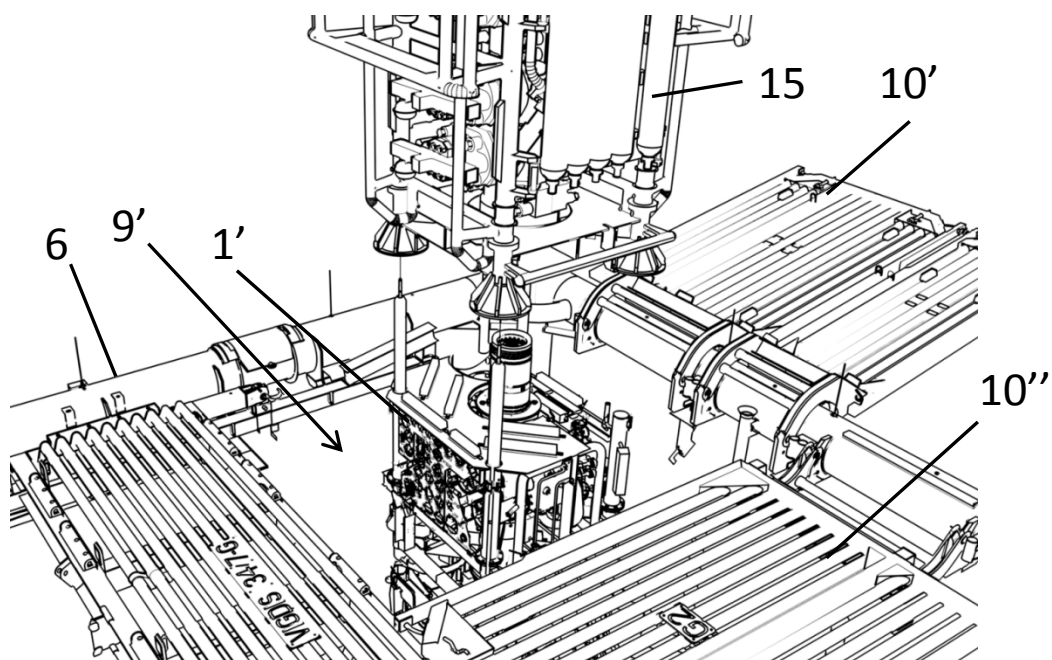


Fig. 2K

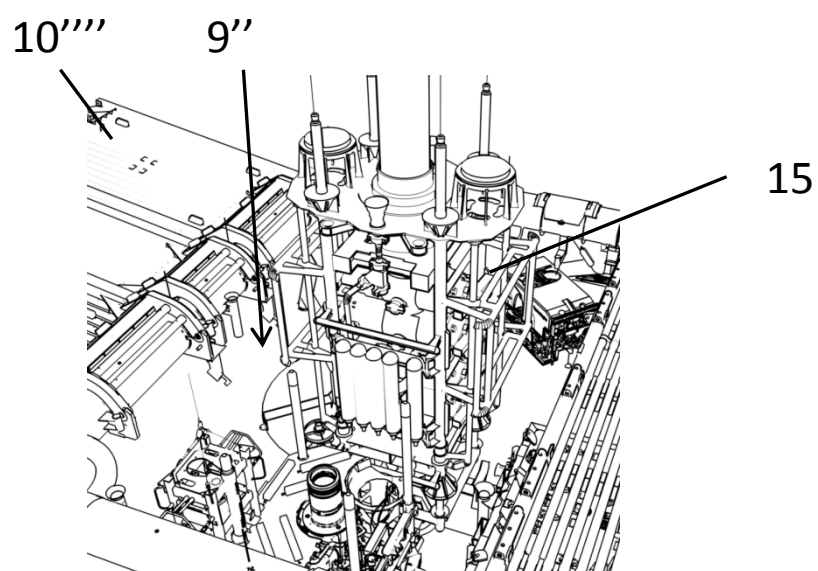
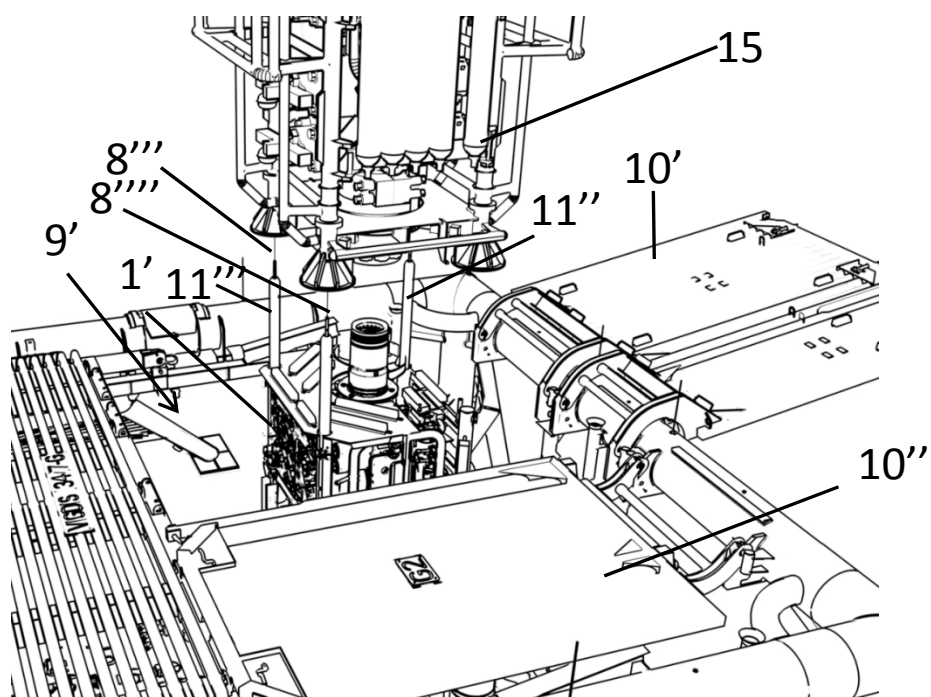
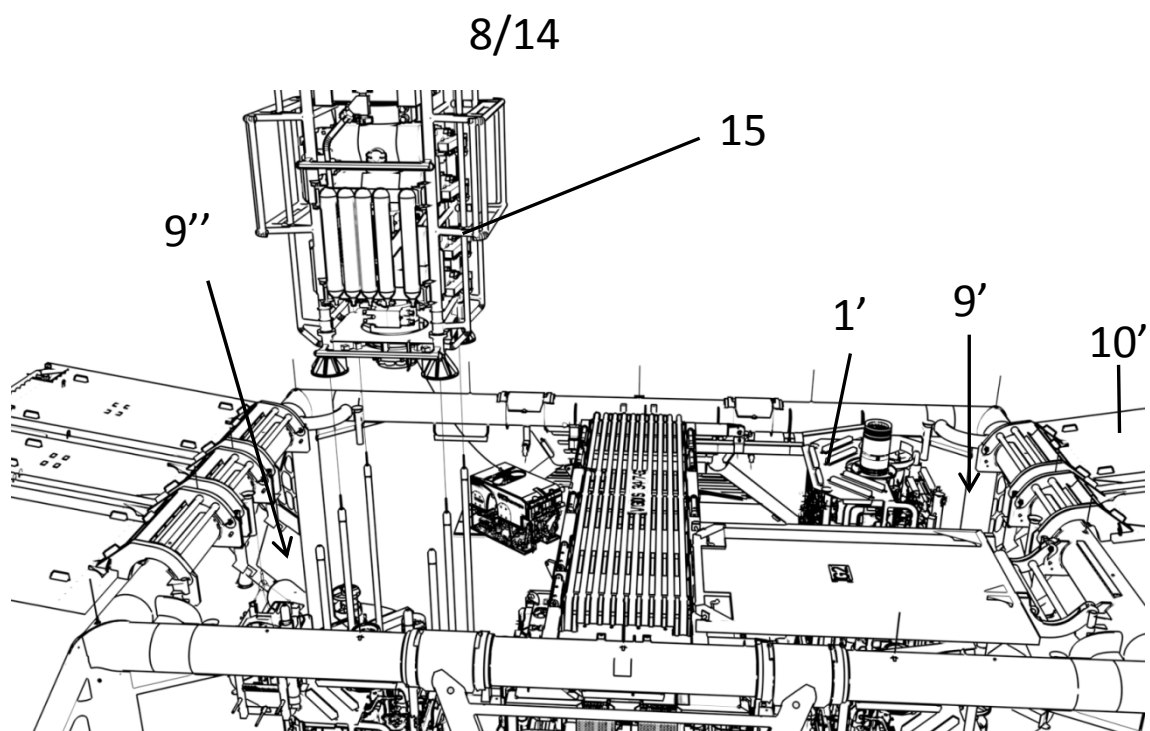


Fig. 2L



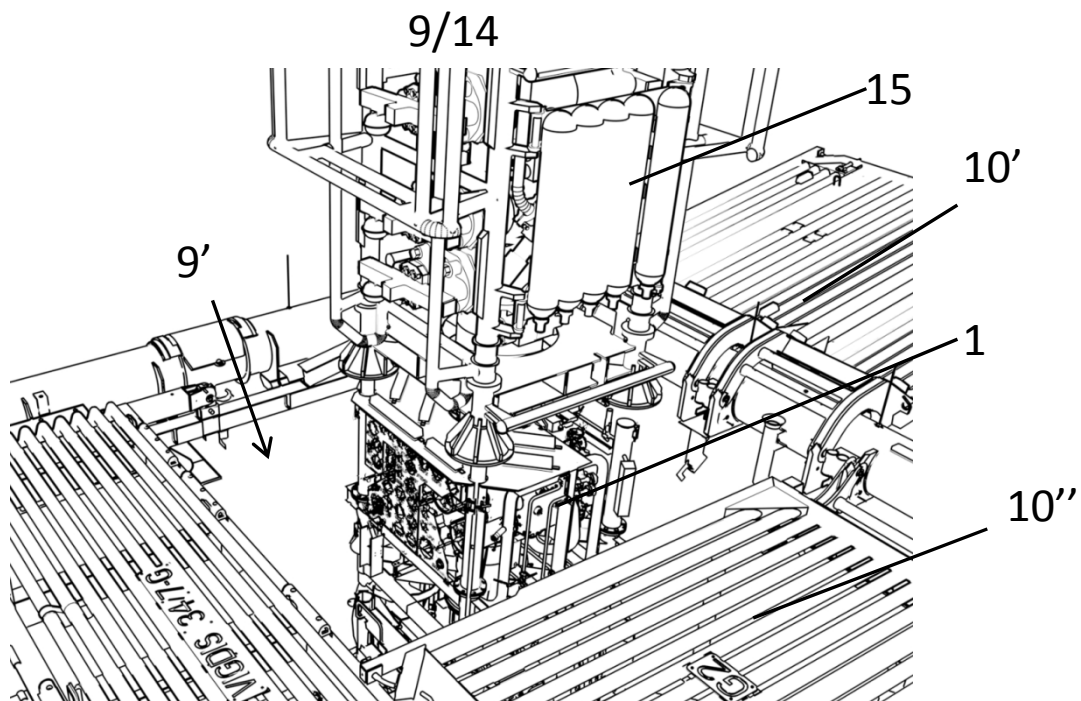


Fig. 20

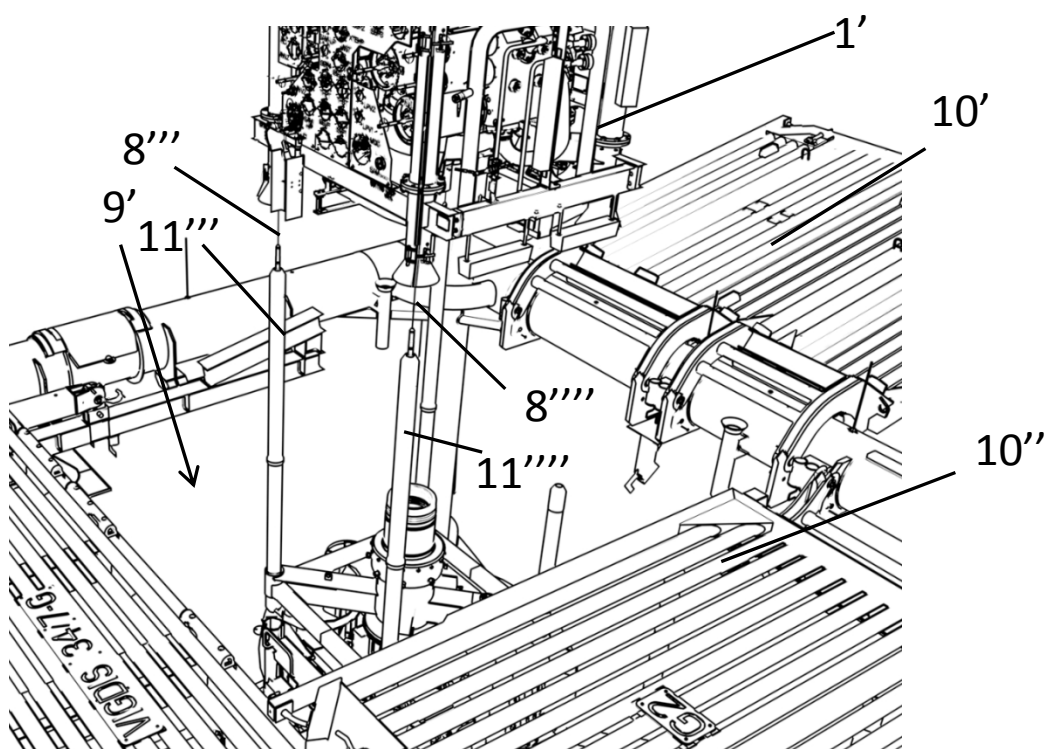


Fig. 2P

10/14

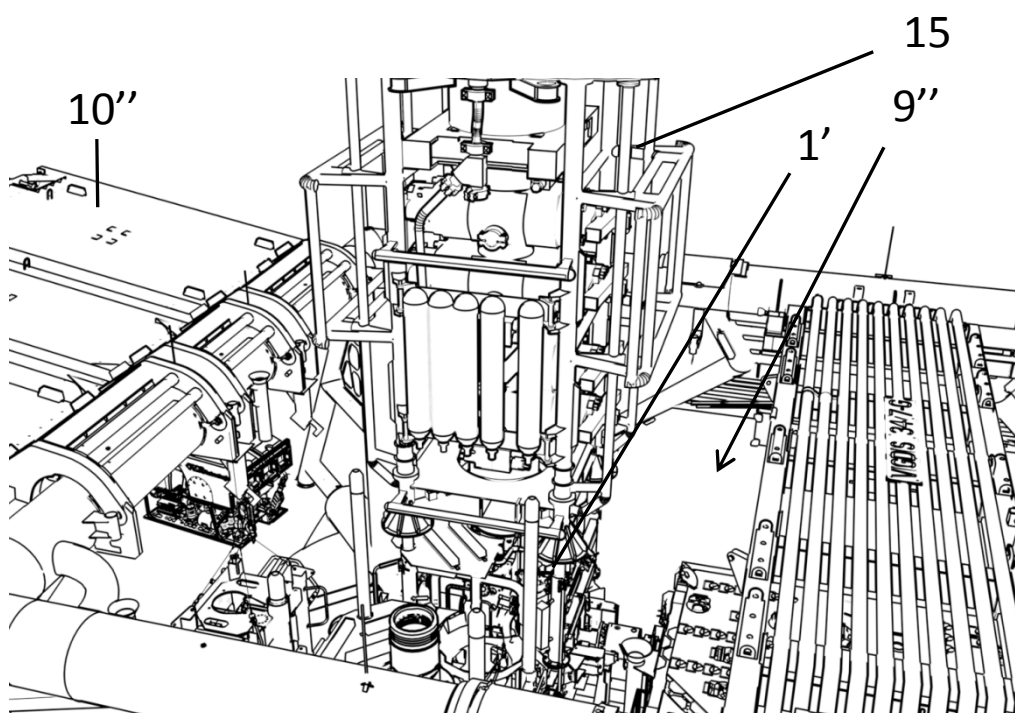


Fig. 2Q

11/14

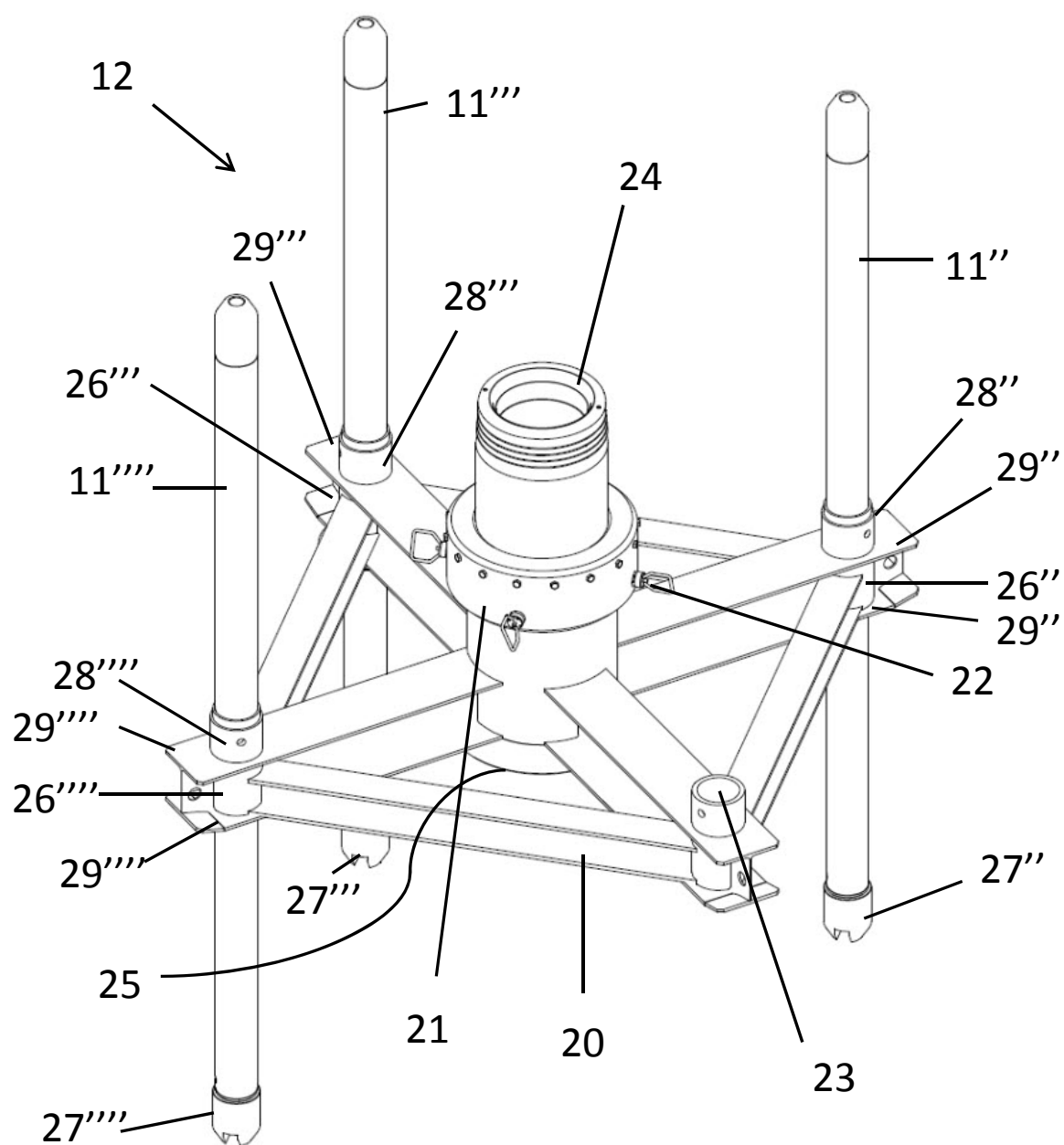


Fig. 3

12/14

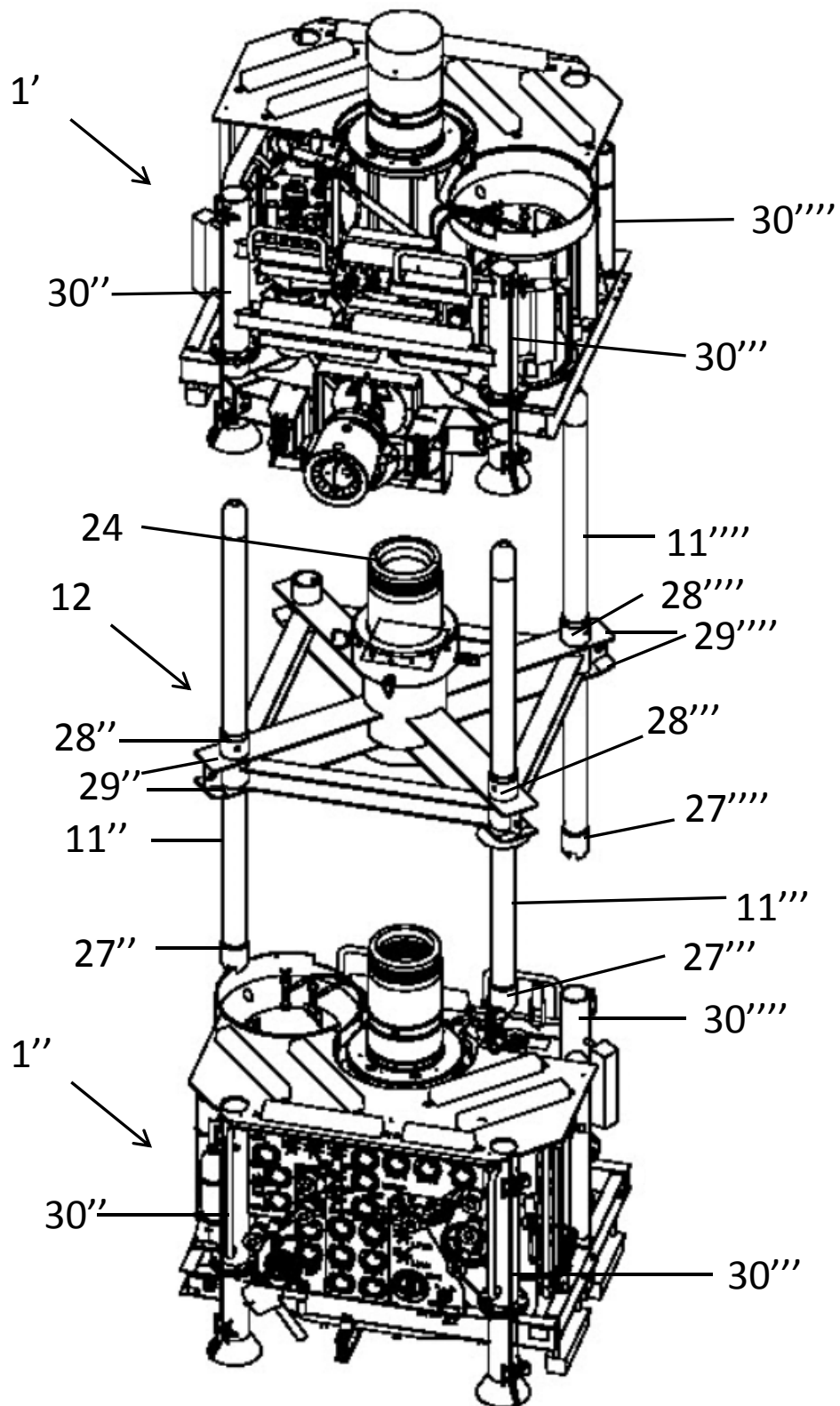


Fig. 4

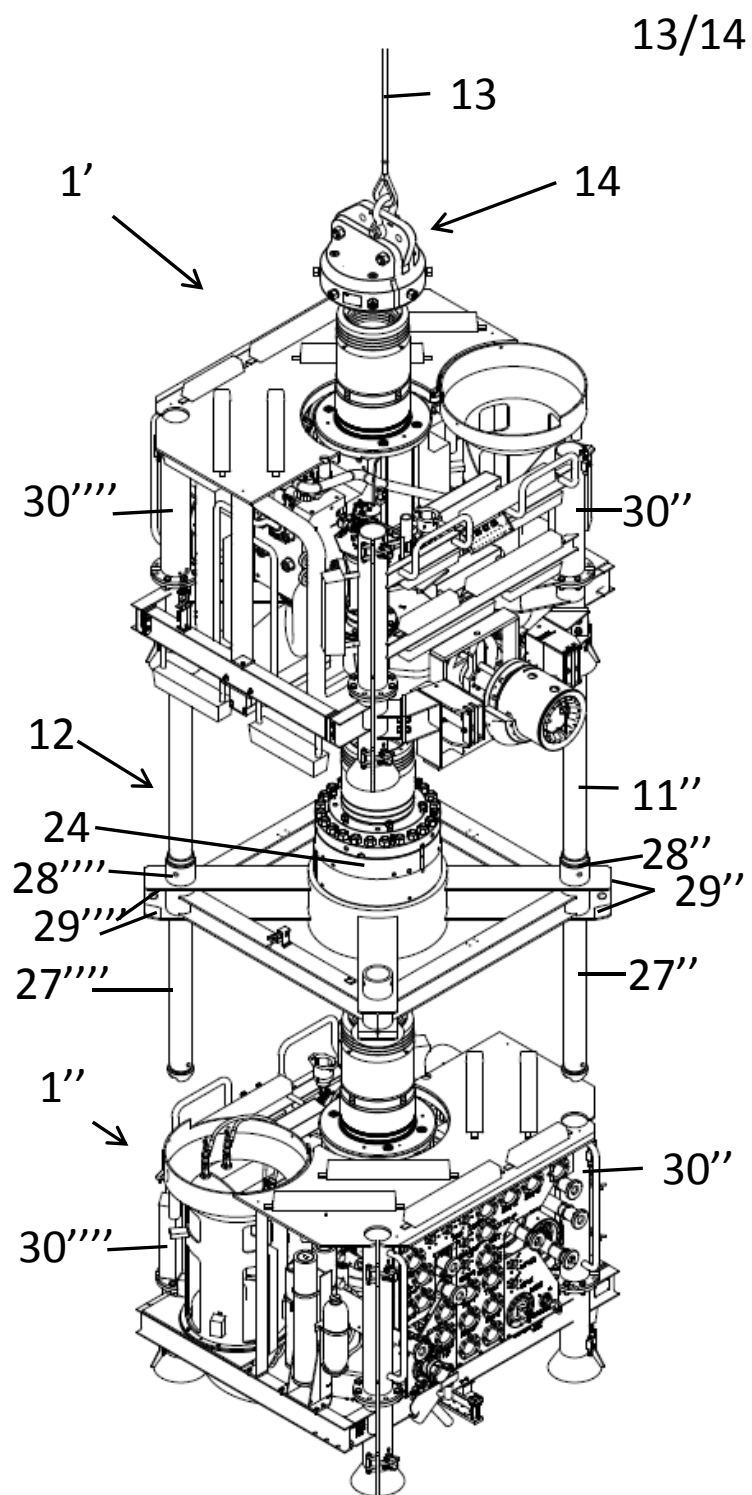


Fig. 5A

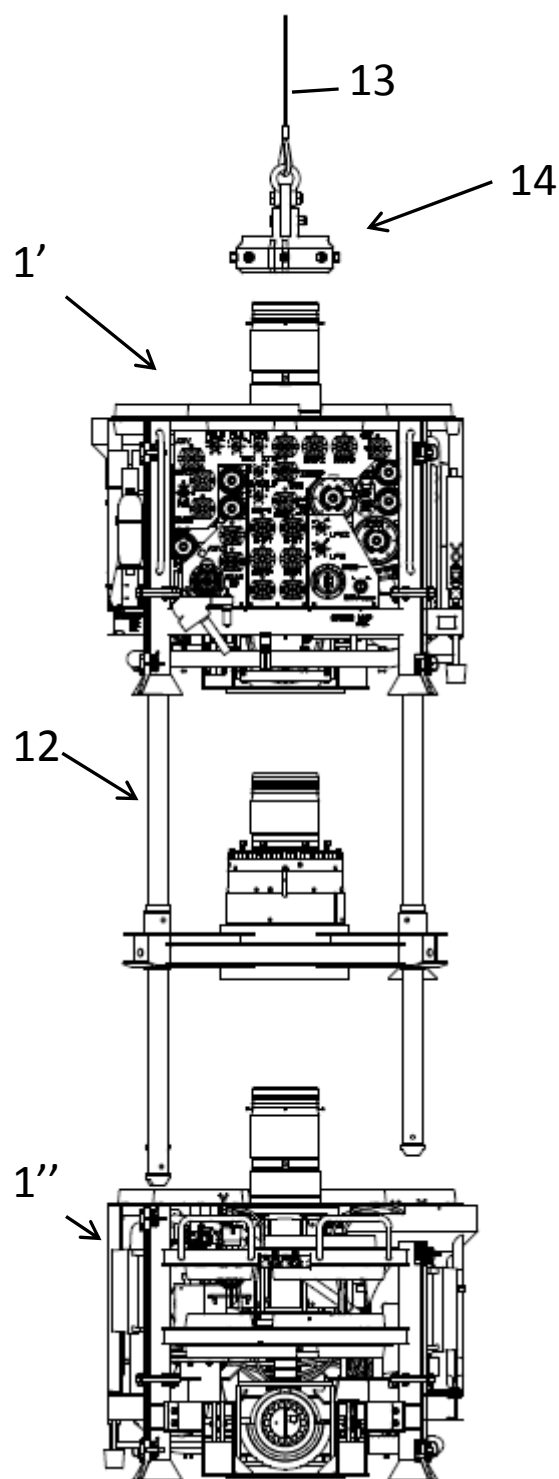


Fig. 5B



14/14

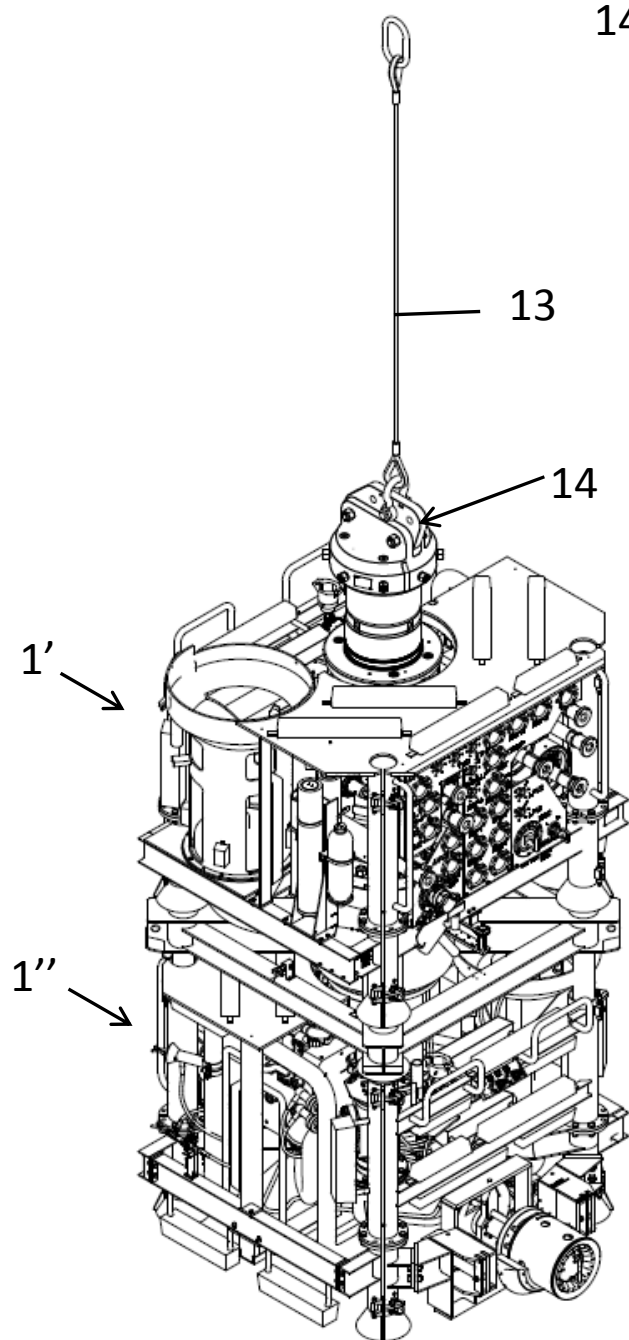


Fig. 6A

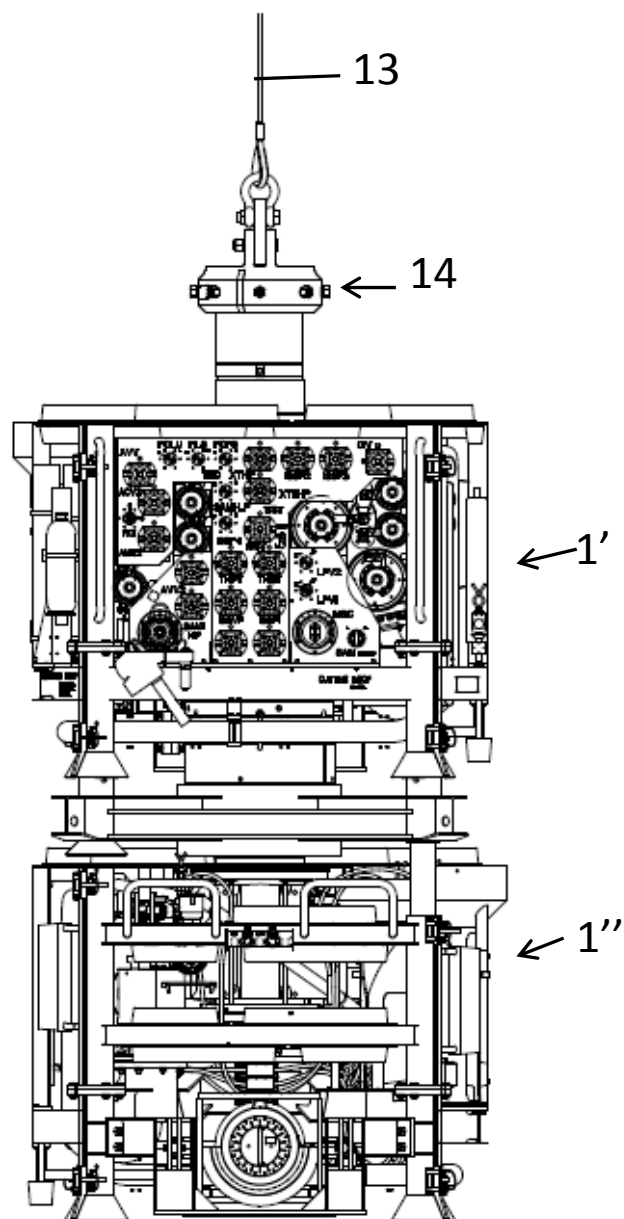


Fig. 6B