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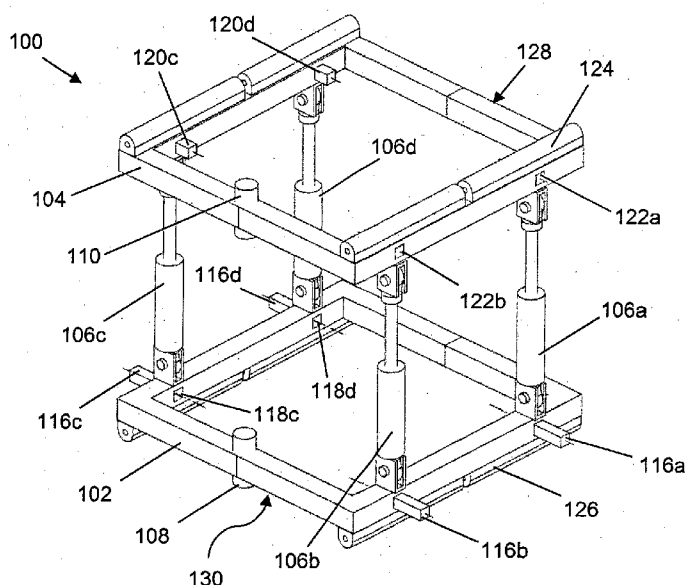


Figure 1a

(57) **Abstract:** A jacking device for a jacket structure, a method of installing a platform deck to a jacket structure, and a method of relocating a jacket structure from a first location to a second location are disclosed. The jacking device includes a first rim configured to be releasably locked to the jacket structure; a second rim configured to be releasably locked to the jacket structure at a position vertically higher than the first rim; and a plurality of linear actuators coupled between the first and second rims, the linear actuators being operable between a retracted position and an expanded position to provide relative movement between the jacking device and the jacket structure, wherein the first and second rims are operable between an open state in which the first and second rims can be assembled to jacket structure from a lateral direction relative to the jacket structure, and a closed state in which the first and second rims fully wrap around the jacket structure.

A JACKING DEVICE

FIELD OF INVENTION

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The present invention relates broadly to devices and methods for raising or lowering heavy objects, and particularly but not exclusively, to a jacking device for a jacket structure, and methods using such a device.

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BACKGROUND

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In offshore hydrocarbon exploration and production, various types of structures have been used. A typical structure includes an elongated jacket having a top end supporting a platform deck and a bottom end connected to e.g. a seabed. For example, the bottom end may rest directly on the seabed together with stabilising weights arranged to minimize sway of the jacket and the platform deck. Alternatively, for operations in deeper waters, the bottom end may be anchored or moored to the seabed using e.g. cables. The platform deck, which contains equipment and materials necessary for operation, is usually at a raised height with respect to the water level such that the platform deck is clear of the waves even in stormy conditions.

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In an existing approach to mount the platform deck to the jacket at a desired height above the water level, the jacket is first secured to the seabed. A vessel having a heavy-lift crane transports the platform deck to the location of the jacket, and lifts the platform deck directly into its position at the top end of the jacket. The platform deck is then secured to the jacket using known techniques. However, this approach has several limitations. For example, the vessel with the required lifting capacity may not be available, thus resulting in delays. In addition, this approach is rather weather-dependent, as it is very difficult to lift and position the platform deck in windy or choppy conditions.

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In another existing approach, jack-up platforms are used. A jack-up platform includes a jacket and a platform deck pre-assembled at the construction

yard and towed to site as a whole, as well as jacking equipment (e.g. strand jacks, gears and/or pulleys) for raising or lowering without another vessel. Typically, the platform deck includes at least one hole formed therethrough for receiving the jacket. At site, the jacket is lowered into the water, while the platform deck is kept afloat using buoyancy means. Once the jacket is secured to the seabed, the platform deck is raised to the desired height above the water level. However, the conventional jacking equipment is typically fixedly mounted to the jack-up platform, thus adding complexity to the structure as well as the installation process. Furthermore, utilization of such jacking equipment is not maximized, since it is normally left idle on the jack-up platform for most of the time.

A need therefore exists to provide a device and method that seek to address at least one of the above problems, or provide a useful alternative.

SUMMARY

According to a first aspect of the present invention, there is provided a jacking device for a jacket structure, the jacking device comprising:

- a first rim configured to be releasably locked to the jacket structure;

- a second rim configured to be releasably locked to the jacket structure at a position vertically higher than the first rim; and

- a plurality of linear actuators coupled between the first and second rims, the linear actuators being operable between a retracted position and an expanded position to provide relative movement between the jacking device and the jacket structure,

- wherein the first and second rims are operable between an open state in which the first and second rims can be assembled to jacket structure from a lateral direction relative to the jacket structure, and a closed state in which the first and second rims fully wrap around the jacket structure.

The first rim may comprise a plurality of releasable first retaining members configured to be received by the jacket structure for releasably locking the first rim to the jacket structure.

The second rim may comprise a plurality of releasable second retaining members configured to be received by the jacket structure for releasably locking the second rim to the jacket structure.

5 The first and second retaining members may comprise pins configured to be releasably inserted into respective holes formed radially about circumferences of the first and second rims.

10 A top surface of the second rim may comprise protective padding attached thereto and may be configured to be attached to a platform deck for raising or lowering the platform deck relative to the jacket structure.

15 A bottom surface of the first rim may comprise protective padding attached thereto and may be configured to be attached to a floating structure for raising or lowering the jacket structure relative to the floating structure.

The first and second rim may each comprise at least two portions hingedly connected to each other.

20 The linear actuators may comprise hydraulic cylinders.

There is also disclosed a jacket structure comprising a plurality of receiving members for releasably locking with the first rim and/or the second rim of the jacking device as defined in the first aspect.

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There is also disclosed a floating structure having a slot formed therein for receiving the first rim and/or the second rim of the jacking device as defined in the first aspect.

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According to a second aspect of the present invention, there is provided a method of installing a platform deck to a jacket structure, the method comprising the steps of:

securing the jacket structure to a seabed such that the jacket structure is substantially vertical;

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assembling the platform deck to the jacket structure from a lateral direction relative to the jacket structure; and

raising the platform deck relative to the jacket structure to a selected height above a water level using the jacking device as defined in the first aspect.

Raising the platform deck relative to the jacket structure may comprise:

- 5 a) locking both the first and second rims to the jacket structure, the second rim being disposed adjacent a bottom surface of the platform deck;
- b) with the linear actuators in the retracted position, unlocking the second rim from the jacket structure while supporting the platform deck using the first rim;
- c) driving the linear actuators to the expanded position thereby raising second rim and the platform deck by an amount substantially equal to a displacement
- 10 between the retracted and expanded positions;
- d) locking the second rim to the jacket structure;
- e) unlocking the first rim from the jacket structure; and
- f) withdrawing the linear actuators to the retracted position.

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The method may further comprise:

repeating steps a) to f) until the platform deck is at the selected height from the water level; and

securing the platform deck to the jacket structure.

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Assembling the platform deck to the jacket structure from a lateral direction relative to the jacket structure may comprise transporting the platform deck on a floating structure, the floating structure having a first slot aligned with a second slot formed on the platform deck, and receiving the jacket structure at the first and

25 second slots.

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Locking the first rim or the second rim to the jacket structure may comprise engaging releasable retaining members disposed on the first rim or the second rim with respective receiving members disposed on the jacket structure.

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The jacket structure may comprise a substantially uniform cross-section about a horizontal plane.

According to a third aspect of the present invention, there is provided a

35 method of relocating a jacket structure from a first location to a second location, the method comprising the steps of:

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assembling a jacking device to the jacket structure from a lateral direction relative to the jacket structure;

detaching the jacket structure from a seabed; and

5 raising the jacket structure to a selected height from the seabed using the jacking device as defined in the first aspect, the jacking device and the jacket structure being supported by a floating structure, for moving the jacket structure from the first location to the second location.

Raising the jacket structure may comprise the steps of:

10 a) locking both the first and second rims to the jacket structure, the first rim resting on the floating structure;

b) with the linear actuators in the retracted position, unlocking the first rim from the jacket structure while supporting the jacket structure using the second rim;

15 c) driving the linear actuators to the expanded position thereby raising second rim and the jacket structure by an amount substantially equal to a displacement between the retracted and expanded positions;

d) locking the first rim to the jacket structure;

e) unlocking the second rim from the jacket structure; and

f) withdrawing the linear actuators to the retracted position.

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The method may further comprise:

repeating steps a) to f) until the jacket structure is at the selected height from the seabed; and

transporting the jacket structure to the second location.

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Locking the first rim or the second rim to the jacket structure may comprise engaging releasable retaining members disposed on the first rim or the second rim with respective receiving members formed on the jacket structure.

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The jacket structure may comprise a substantially uniform cross-section about a horizontal plane.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Figure 1a shows a schematic perspective view of a jacking device in a closed state with the hydraulic cylinders expanded according to an example embodiment.

Figure 1b shows the jacking device of Figure 1a with the hydraulic cylinders retracted.

Figure 1c shows the jacking device of Figure 1b in an open state.

Figure 2a shows a schematic perspective view of an offshore oil platform according to an example implementation.

Figure 2b shows a close-up perspective view of the top end of the oil platform of Figure 2a.

Figure 3a shows a plan view of a rim of a jacking device in a closed state according to an alternate embodiment.

Figure 3b shows a plan view of the rim of the jacking device of Figure 3 in an open state.

Figure 3c shows an exploded plan view of the rim of the jacking device of Figure 3a.

Figure 3d shows a sectional view about a line C-C in Figure 3c and a sectional view about a line D-D in Figure 3c.

Figure 3e shows a side view of the rim in Figure 3a.

Figure 3f shows sectional views of the jacking device about lines A-A and B-B in Figure 3a with the hydraulic cylinders in the expanded position.

Figure 3g shows sectional views of the jacking device about lines A-A and B-B in Figure 3a with the hydraulic cylinders in the retracted position.

Figure 4 shows a schematic side view of a jacket structure being towed according to an implementation.

Figure 5 shows a schematic side view of the jacket structure of Figure 4 as it is being lowered into the water.

Figure 6 shows a schematic side view of the jacket structure of Figure 4 after it has been secured to the seabed.

Figure 7 shows a schematic side view illustrating a platform deck and a jacking device being transported to the jacket structure of Figure 4.

Figure 8 shows a schematic side view and a schematic plan view of a top end of the jacket structure of Figure 4 illustrating assembly of platform deck and jacking device of Figure 7.

Figure 9 shows a schematic side view of the top end of the jacket structure of Figure 4 illustrating raising the platform deck using the jacking device according to an example implementation.

Figure 10 shows a schematic side view of the top end of the jacket structure of Figure 4 after the platform deck is raised to the desired height.

Figure 11 shows a schematic side view of an oil platform during production.

Figure 12 shows a schematic side view of an oil platform during production according to an alternate implementation.

Figure 13 shows a schematic side view of the oil platform of Figure 11 illustrating assembly of a jacking device and a floating structure to the oil platform.

Figure 14 shows a schematic side view of the oil platform of Figure 11 after it is raised from the seabed.

Figure 15 shows a schematic side view illustrating transporting the raised oil platform of Figure 14 from a first location to a second location.

Figure 16 shows a schematic side view of the oil platform of Figure 15 at the second location.

Figure 17 shows a schematic side view and a partial sectional view of the top end of the oil platform of Figure 11 illustrating assembly of a jacking device and a floating structure to the oil platform according to another implementation.

Figure 18 shows a schematic side view of the oil platform of Figure 11 after it is raised from the seabed using the implementation shown in Figure 17.

Figure 19 shows a flow chart illustrating a method of installing a platform deck to a jacket structure according to an example embodiment.

Figure 20 shows a flow chart illustrating a method of relocating a jacket structure from a first location to a second location according to an example embodiment.

DETAILED DESCRIPTION

Embodiments of the present invention provide a jacking device capable of quick assembly to and removal from a jacket structure, in particular, a single-legged jacket structure, as well as raising methods utilising such jacking device.

Figures 1a-1b show perspective views of a jacking device 100 in a closed state according to an example embodiment. Figure 1c shows the jacking device 100 of Figures 1a-1b in an open state. The jacking device 100 includes a first rim 102, a second rim 104 and a plurality of linear actuators in the form of hydraulic cylinders 106a-d. The hydraulic cylinders 106a-d are coupled the first rim 102 at one end and

to the second rim 104 at the other end, and are operable between an expanded position (Figure 1a) and a retracted position (Figure 1b) to create incremental movements, as will be described in detail below. Here, four hydraulic cylinders 106a-d are shown; however, it would be appreciated that the number of hydraulic cylinders, their lifting capacity, and their maximum displacement between the retracted position and the expanded position may be varied depending on e.g. the load to be raised or lowered. Moreover, other linear mechanisms providing linear displacement may be used in place of the hydraulic cylinders 106a-d in alternate embodiments.

The first rim 102 and second rim 104 are typically made from a durable material such as steel. In the example embodiment shown in Figures 1a-1c, the first rim 102 and 104 are essentially identical and have a substantially square shape corresponding to the cross-section of an elongated object, e.g. a jacket structure (not shown), to which the jacking device 100 is assembled. Moreover, the first rim 102 and second rim 104 are operable between the closed state (Figures 1a-1b) and the open state (Figure 1c) such that, in the open state, the jacking device 100 can be assembled to the elongated object from a lateral direction, instead of an axial direction, relative to the elongated object. For example, the first rim 102 and second rim 104 are each made up of two halves coupled to each other by hinges 108 and 110 respectively, as shown in Figures 1a-1c. In other implementations, the first rim 102 and second rim 104 may each be made up of more than two portions. In the closed state, the first rim 102 and second rim 104 fully wrap around the elongated object, and are secured by latches 112 and 114 (Figure 1c) respectively.

In addition, the first rim 102 includes a plurality of first retaining members in the form of pins 116a-d inserted into respective holes 118a-d for releasably locking the first rim 102 to the elongated object, e.g. a jacket structure. Similarly, the second rim 104 includes a plurality of second retaining members in the forms of pins 120a-d inserted into respective holes 122a-d for releasably locking the second rim to the elongated object. The holes 118a-d and 122a-d are formed radially about the circumferences of the first rim 102 and second rim 104 respectively. For example, in Figure 1a, the pins 120a-d are fully inserted e.g. to effect locking of the second rim 104, while the pins 116a-d are fully withdrawn e.g. to effect unlocking of the first rim 102. In other words, the operation of the set of pins 116a-d is independent of the operation of the set of pins 120a-d. The pins 116a-d, 120a-d may each be driven by

respective driving means (not shown). Protective padding 124, 126 made of a resilient material, e.g. rubber, may be attached to a top surface 128 of the second rim 104 and a bottom surface 130 of the first rim 102 respectively to minimise direct impact and damage during transportation and operation of the jacking device 100.

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Figure 2a shows a schematic perspective view of an offshore oil platform 200 according to an example implementation, including the jacking device 100 of Figures 1a-1c. The oil platform 200 includes a base 202, an elongated jacket structure 204 mounted to the base 202, and a platform deck 206 mounted to the jacket structure 204. In Figure 2a, ballasts/storage containers 203 and a flotation device 205 are shown, while facilities and equipment normally associated with the platform deck 206 are omitted for simplicity. As shown, the jacking device 100 is used to raise or lower the platform deck 206 from a middle section 208 to a top end 210 of the jacket structure 204. The jacket structure 204 in this example is a truss structure having a uniform cross-section, e.g. triangular, square, etc., about a horizontal plane. Receiving members in the form of brackets 212 are disposed at equal intervals along the jacket structure 204 from the middle section 208 to the top end 210 for releasably locking the first rim 102 (Figure 1a) and second rim 104 (Figure 1a), as will be described in detail with respect to Figure 2b.

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Figure 2b is a close-up perspective view of the top end 210 of the oil platform 200 of Figure 2a including the jacket structure 204, the jacking device 100, and the platform deck 206. The platform deck 206 includes an elongated slot 214 extending from a side 216 to a middle portion 218 for receiving the jacket structure 204, such that the platform deck 206 can be assembled to the jacket structure 204 from a lateral direction relative to the jacket structure 204. In the position shown, the jacking device 100 has also been assembled to the jacket structure 204 from a lateral direction, and supports the weight of the platform deck 206.

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An example procedure for raising the platform deck 206 up to the top end 210 of the jacket structure 204 is now described with reference to Figure 2b and Figures 1a-1b. It will be appreciated that a similar procedure can be carried out to lower the platform deck 206, if necessary.

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Initially, the jacking device 100 may be supporting the platform deck 206 while the hydraulic cylinders 106a-d (Figures 1a-1b) are in the retracted position. In the

retracted position, at least the first rim 102 is locked to the jacket structure 204 by engaging the pins 116a-d with respective brackets 212 disposed on the jacket structure 204. For example, the pins 116a-d may be fully inserted into holes 118a-d until distal ends of the pins 116a-d rest on respective brackets 212, thereby transferring the weight to the jacket structure 204. In alternate embodiments, other latching or engaging mechanisms may be used to effect locking between the first rim 102 and the jacket structure 204. Preferably, both the first rim 102 and the second rim 104 are locked to jacket structure 204 while the hydraulic cylinders 106a-d are in the retracted position.

After checking that the first rim 102 is locked to the jacket structure 204, the second rim 104 is unlocked from the jacket structure 204, e.g. by withdrawing the pins 120a-d from their engagement with the brackets 212. The hydraulic cylinders 106a-d are then driven to the expanded position, thereby raising the second rim 104 together with the platform deck 206 by an amount substantially equal to the displacement between the retracted position and the expanded position.

While the hydraulic cylinders 106a-d are in the expanded position, the second rim 104 is locked to the jacket structure 204. After checking that the second rim 104 is locked to the jacket structure 204, the first rim 102 is unlocked from the jacket structure 204 (as shown in Figure 2b), and the hydraulic cylinders 106a-d are withdrawn to the retracted position. Once the hydraulic cylinders 106a-d are withdrawn, the first rim 102 is again locked to the jacket structure 204 at the next higher set of brackets 212.

In the above steps, the platform deck 206 is raised by an amount substantially equal to the displacement between the retracted and expanded positions of the hydraulic cylinders 106a-d. By repeating the above steps and providing a series of sets of brackets 212, each set separated with the next higher set by a distance determined based on this displacement, the platform deck 206 can be raised incrementally until it reaches the top end 210. After the platform deck 206 is at the desired height sufficient to provide a clearance from the waves, the platform deck 206 is secured to the jacket structure 204.

Figure 3a shows a plan view of a jacking device 300 in a closed state according to an alternate embodiment. Figure 3b shows a plan view the jacking

device 300 of Figure 3 in an open state. Figure 3c shows an exploded plan view of the jacking device 300 of Figure 3a. Figure 3d shows a sectional view about a line C-C in Figure 3c. Figure 3e shows a sectional view about a line D-D in Figure 3c. Figure 3f shows sectional views about lines A-A and B-B in Figure 3a with the hydraulic cylinders in the expanded position. Figure 3g shows sectional views about lines A-A and B-B in Figure 3a with the hydraulic cylinders in the retracted position.

With reference to Figures 3a-3g, the jacking device 300 is similar to the jacking device 100 as described above with respect to Figures 1a-1c, and comprises a first rim 302, a second rim 304 and a plurality of linear actuators in the form of hydraulic cylinders 306a-f coupled between the first rim 302 and the second rim 304. Also, the first rim 302 and second rim 304 are operable between a closed state (Figure 3a) and an open state (Figure 3b) such that the jacking device 300 can be assembled to a jacket structure 320 from a lateral direction relative to the jacket structure 320. For example, the second rim 304 is made up of two sections 308, 310 coupled to each other by hinge means 312. The first rim 302 and second rim 304 each also includes holes, e.g. 314a-c, formed radially about the circumferences. Retaining members in the form of pins, e.g. 316a-c, are inserted into the respective holes 314a-c for releasably locking the first rim 302 and second rim 304 with the jacket structure 320, represented here by a tubular body with dashed lines. The pins 316a-c may be driven by respective actuating means 318a-c.

In this embodiment, the jacket structure 320 has a uniform circular cross-section. The first rim 302 and second rim 304 thus define a circular area corresponding to the cross-section of the jacket structure 320 when in the closed position (Figure 3a). In addition, as shown in Figures 3f-3g, the jacket structure 320 includes receiving members in the form of holes 322 formed therein for receiving the pins 316a-c to effect releasable locking of the first rim 302 and/or the second rim 304 to the jacket structure 320. Operation of the jacking device 300 is similar to that described above with respect to the jacking device 100 of Figures 1a-1c.

Example uses of the jacking device as described above in conjunction with an oil platform 200 (Figure 2a) are now described with reference to Figures 4-16.

In Figure 4, a jacket structure 400 is towed e.g. from a construction yard along the water level to an offshore location using a tow boat 402, assisted by a

floatation device 404 and ballasts 406 positioned a base 408 of the jacket structure 400. Once the jacket structure 400 reaches the offshore location, the jacket structure is lowered into the water, e.g. by removing the floatation device 404 and filling the ballasts 406, as shown in Figure 5.

Under the effect of gravity, the base 408 of the jacket structure 400 sinks until it reaches the seabed where it is secured. In that position, as shown in Figure 6, the body of the jacket structure 400 is substantially vertical, and a portion of the jacket structure 400 protrudes from the water level.

Next, as shown in Figure 7, a platform deck 410 together with a jacking device 412 is transported to the jacket structure using a floating structure 414, e.g. a barge.

As described above with reference to Figure 2b and shown again in Figure 8, the platform deck 410 includes a slot 416 extending from one side to a middle portion of the platform deck 410. When mounted on the floating structure 414, the slot 416 is aligned with a slot (not shown) formed in the floating structure 414, such that the floating structure 414 together with the platform deck 410 can approach the jacket structure 400 from a lateral direction relative to the jacket structure 400 for assembling the platform deck 410 to the jacket structure 400. The jacking device 412 is also disposed on the floating structure 414 in alignment with the slot 416 just below the platform deck 410, and can be assembled to the jacket structure 400 from a lateral direction in the position shown in Figure 8.

With only the jacking device 412 supporting the platform deck 410 on the jacket structure 400, the platform deck 410 is raised in incremental steps in a manner as described above with reference to Figures 2a-2b. Figure 9 shows a schematic side view of the jacket structure 400 as the platform deck 410 is being raised by the jacking device 412. Figures 10-11 shows schematic side views of the jacket structure 400 after the platform deck 410 has been raised to a desired height that provides a safe clearance from the water level even against large waves. Figure 12 shows a side view similar to that in Figure 11, in which the jacket structure 1200 is implemented with a tubular body instead of a truss body.

In the position shown in Figures 11 and 12, the oil platform 200 may operate until the production level drops to a level that the oil platform 200 needs to be relocated to a different location within the oilfield. In order for the oil platform 200 to be relocated, the oil platform 200 is first removed from the seabed using the jacking device 412 and the floating structure 414, as shown in Figure 13. For example, the jacking device is positioned at the slot formed in the floating structure 414, and the floating structure 414 together with the jacking device 412 engage with the jacket structure 400 from a lateral direction.

Figure 14 shows a schematic side view of the oil platform 200 after it has been removed from the seabed. At this point, the jacket structure 400 together with the platform deck 410 mounted on top are supported by the floating structure 414. For moving to a different location on the oilfield, the floating structure 414 may be towed by a tow boat, e.g. 402, as shown in Figure 15. After reaching the destination, the oil platform 200 is lowered into the water and secured to the seabed as a whole, while the tow boat 402, the floating structure 414 and the jacking device 412 may be freed for other uses.

Figure 17 shows a schematic side view and a partial sectional view of the top end of the oil platform 200 of Figure 11 illustrating assembly of a jacking device 412 and a floating structure 414 to the oil platform 200 according to another implementation. Figure 18 shows a schematic side view of the oil platform 200 of Figure 11 after it is raised from the seabed using the implementation shown in Figure 17. This implementation differs from that shown in Figures 14-15 in that a slot 418 is formed by affixing, e.g. welding, cantilever beams 420, 422 to the floating structure 414 such that the cantilever beams 420, 422 extend from one end of the floating structure 414, rather than forming a slot in the body of the floating structure 414.

With reference to Figure 17 and Figures 1a-1c, an example procedure to raise the jacket structure 400 of the oil platform 200 is now described.

The first rim 424 of the jacking device 412 is received at the slot 418 of the floating structure 414 and is attached to the cantilever beams 420, 422 such that the jacking device 412 is aligned with the slot 418. The jacking device 412 is then assembled to the jacket structure 400 from a lateral direction relative to the jacket structure 400. Next, the jacket structure 400 is detached from a seabed so that it may

be raised in incremental steps. Typically, both the first rim 424 and second rim 426 of the jacking device 412 are locked to the jacket structure 400, and the linear actuators 428 are in the retracted position, as shown in Figure 17. For example, the retaining members of the first rim 424 and second rim 426 may abut the bottom surface of
5 respective receiving members disposed on the jacket structure 400, e.g. brackets 430, thereby transferring the weight of the jacket structure 400 to the floating structure 414.

After checking that the second rim 426 is locked, the first rim 424 is unlocked
10 from the jacket structure 400, with the jacket structure 400 being supported using the second rim 426. The linear actuators 428 are then driven to the expanded position thereby raising second rim 426 and the jacket structure 400 by an amount substantially equal to a displacement between the retracted and expanded positions. While the linear actuators 428 are in the expanded position, the first rim 424 is locked
15 to the jacket structure 400. After checking that the first rim 424 is locked to the jacket structure 400, the second rim 426 is unlocked from the jacket structure 400, and the linear actuators 428 are withdrawn to the retracted position. Once the linear actuators 428 are withdrawn, the second rim 426 is again locked to the jacket structure 400 at the next lower set of brackets 430.

20 By repeating the above steps, the jacket structure 400 can be raised to a selected height from the seabed using the jacking device 412, while the jacking device 412 and the jacket structure 400 are supported by the floating structure 414.

25 Figure 19 shows a flow chart 1900 illustrating a method of installing a platform deck to a jacket structure according to an example embodiment. At step 1902, the jacket structure is secured to a seabed such that the jacket structure is substantially vertical. At step 1904, the platform deck is assembled to the jacket structure from a lateral direction relative to the jacket structure. At step 1906, the platform deck is
30 raised relative to the jacket structure to a selected height above a water level using the jacking device as described above.

Figure 20 shows a flow chart 2000 illustrating a method of relocating a jacket structure from a first location to a second location according to an example
35 embodiment. At step 2002, a jacking device is assembled to the jacket structure from a lateral direction relative to the jacket structure. At step 2004, the jacket structure is

detached from a seabed. At step 2006, the jacket structure is raised to a selected height from the seabed using the jacking device as described above, the jacking device and the jacket structure being supported by a floating structure, for moving the jacket structure from the first location to the second location.

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As described, embodiments of the present invention provide an effective solution for raising structures associated with offshore hydrocarbon exploration and production, e.g. platform deck, jacket, etc. Utilisation is optimized as the jacking device and/or the floating structure (e.g. a barge) can be used for other purposes while production is on-going. Advantageously, assembly of the jacking device is simplified and less risky, thereby reducing the time required for each operation.

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It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. For example, the jacket structure may include a plurality of elongated legs, in which case one jacking device may be used for each leg. Also, the jacking device as described may be used in other applications. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

20

CLAIMS

1. A jacking device for a jacket structure, the jacking device comprising:
a first rim configured to be releasably locked to the jacket structure;

5 a second rim configured to be releasably locked to the jacket structure at a position vertically higher than the first rim; and

a plurality of linear actuators coupled between the first and second rims, the linear actuators being operable between a retracted position and an expanded position to provide relative movement between the jacking device and the jacket structure,

10 wherein the first and second rims are operable between an open state in which the first and second rims can be assembled to jacket structure from a lateral direction relative to the jacket structure, and a closed state in which the first and second rims fully wrap around the jacket structure.

15 2. The jacking device as claimed in claim 1, wherein the first rim comprises a plurality of releasable first retaining members configured to be received by the jacket structure for releasably locking the first rim to the jacket structure.

20 3. The jacking device as claimed in claim 2, wherein the second rim comprises a plurality of releasable second retaining members configured to be received by the jacket structure for releasably locking the second rim to the jacket structure.

25 4. The jacking device as claimed in claim 3, wherein the first and second retaining members comprise pins configured to be releasably inserted into respective holes formed radially about circumferences of the first and second rims.

30 5. The jacking device as claimed in claim 4, wherein a top surface of the second rim comprises protective padding attached thereto and is configured to be attached to a platform deck for raising or lowering the platform deck relative to the jacket structure.

35 6. The jacking device as claimed in claim 4, wherein a bottom surface of the first rim comprises protective padding attached thereto and is configured to be

attached to a floating structure for raising or lowering the jacket structure relative to the floating structure.

7. The jacking device as claimed in any one of the preceding claims,
5 wherein the first and second rim each comprises at least two portions hingedly connected to each other.

8. The jacking device as claimed in any one of the preceding claims,
wherein the linear actuators comprise hydraulic cylinders.

9. A jacket structure comprising a plurality of receiving members for
10 releasably locking with the first rim and/or the second rim of the jacking device as claimed in any one of the preceding claims.

10. A floating structure having a slot formed therein for receiving the first
15 rim and/or the second rim of the jacking device as claimed in any one of claims 1 to 8.

11. A method of installing a platform deck to a jacket structure, the
20 method comprising the steps of:

securing the jacket structure to a seabed such that the jacket structure is substantially vertical;

assembling the platform deck to the jacket structure from a lateral direction relative to the jacket structure; and

25 raising the platform deck relative to the jacket structure to a selected height above a water level using the jacking device as claimed in any one of claims 1 to 8.

12. The method as claimed in claim 11, wherein raising the platform deck relative to the jacket structure comprises:

30 a) locking both the first and second rims to the jacket structure, the second rim being disposed adjacent a bottom surface of the platform deck;

b) with the linear actuators in the retracted position, unlocking the second rim from the jacket structure while supporting the platform deck using the first rim;

35 c) driving the linear actuators to the expanded position thereby raising second rim and the platform deck by an amount substantially equal to a displacement between the retracted and expanded positions;

- d) locking the second rim to the jacket structure;
- e) unlocking the first rim from the jacket structure; and
- f) withdrawing the linear actuators to the retracted position.

5 13. The method as claimed in claim 12, further comprising:
repeating steps a) to f) until the platform deck is at the selected height from
the water level; and
securing the platform deck to the jacket structure.

10 14. The method as claimed in any one of claims 11 to 13, assembling the
platform deck to the jacket structure from a lateral direction relative to the jacket
structure comprises transporting the platform deck on a floating structure, the floating
structure having a first slot aligned with a second slot formed on the platform deck,
and receiving the jacket structure at the first and second slots.

15 15. The method as claimed in any one of claims 11 to 14, wherein locking
the first rim or the second rim to the jacket structure comprises engaging releasable
retaining members disposed on the first rim or the second rim with respective
receiving members disposed on the jacket structure.

20 16. The method as claimed in any one of claims 11 to 15, wherein the
jacket structure comprises a substantially uniform cross-section about a horizontal
plane.

25 17. A method of relocating a jacket structure from a first location to a
second location, the method comprising the steps of:

assembling a jacking device to the jacket structure from a lateral direction
relative to the jacket structure;

detaching the jacket structure from a seabed; and

30 raising the jacket structure to a selected height from the seabed using the
jacking device as claimed in any one of claims 1 to 8, the jacking device and the
jacket structure being supported by a floating structure, for moving the jacket
structure from the first location to the second location.

35 18. The method as claimed in claim 17, wherein raising the jacket
structure comprises the steps of:

a) locking both the first and second rims to the jacket structure, the first rim resting on the floating structure;

b) with the linear actuators in the retracted position, unlocking the first rim from the jacket structure while supporting the jacket structure using the second rim;

5 c) driving the linear actuators to the expanded position thereby raising second rim and the jacket structure by an amount substantially equal to a displacement between the retracted and expanded positions;

d) locking the first rim to the jacket structure;

e) unlocking the second rim from the jacket structure; and

10 f) withdrawing the linear actuators to the retracted position.

19. The method as claimed in claim 18, further comprising:

repeating steps a) to f) until the jacket structure is at the selected height from the seabed; and

15 transporting the jacket structure to the second location.

20. The method as claimed in any one of claims 17 to 19, wherein locking the first rim or the second rim to the jacket structure comprises engaging releasable retaining members disposed on the first rim or the second rim with respective
20 receiving members formed on the jacket structure.

21. The method as claimed in any one of claims 17 to 20, wherein the jacket structure comprises a substantially uniform cross-section about a horizontal
25 plane.

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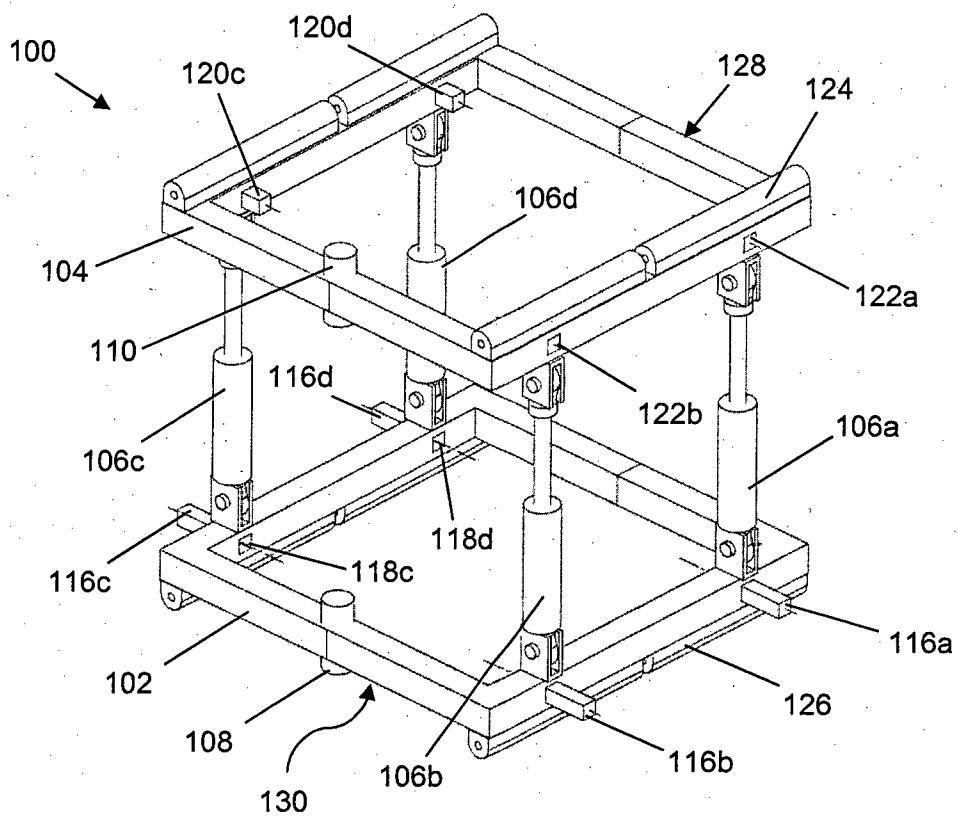


Figure 1a

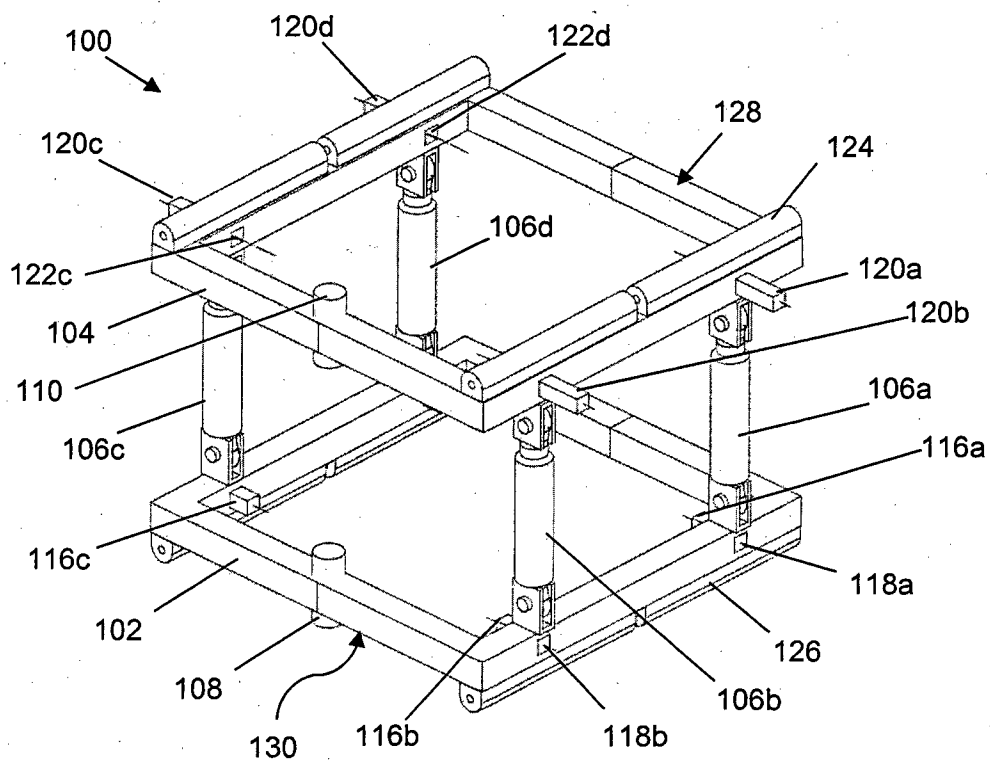


Figure 1b

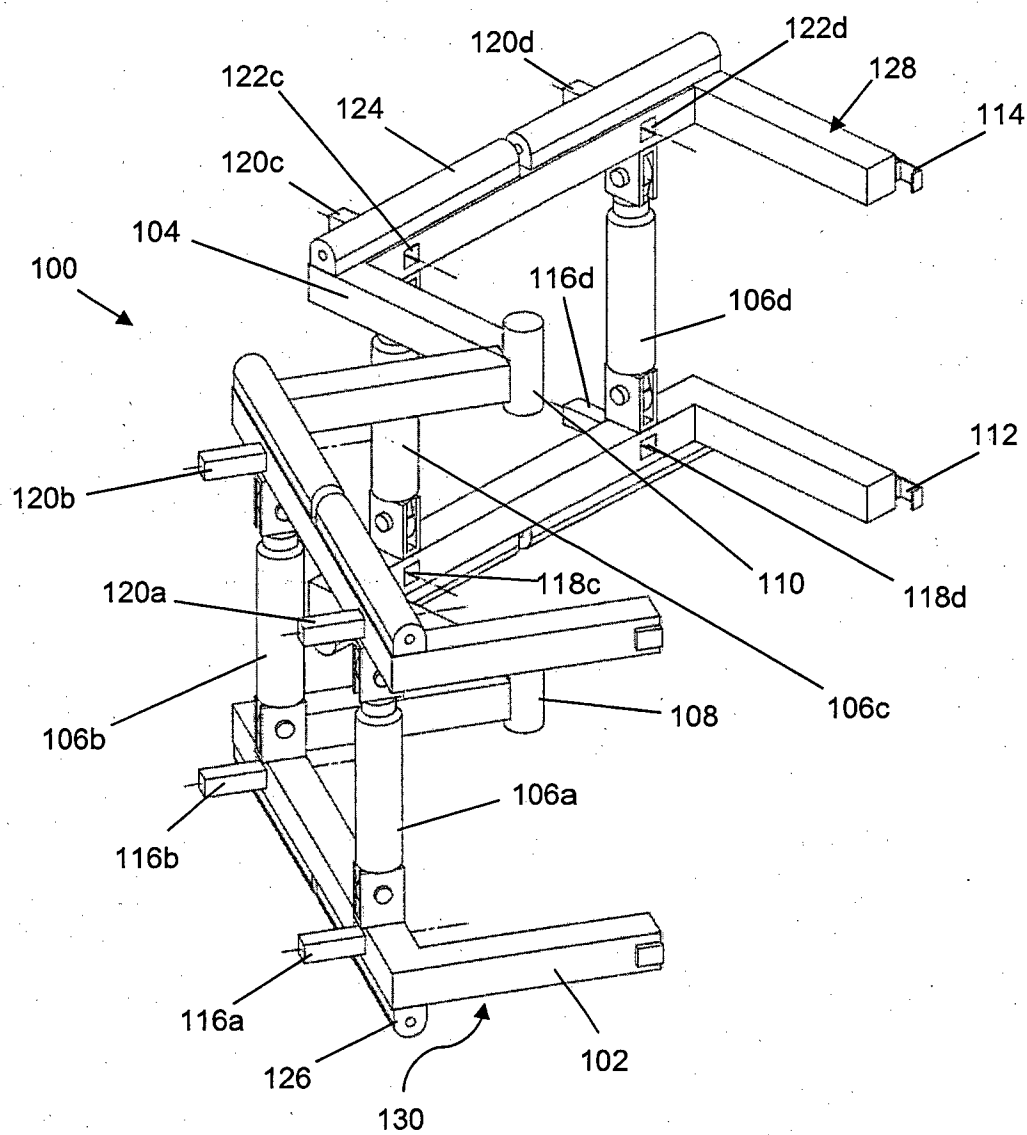


Figure 1c

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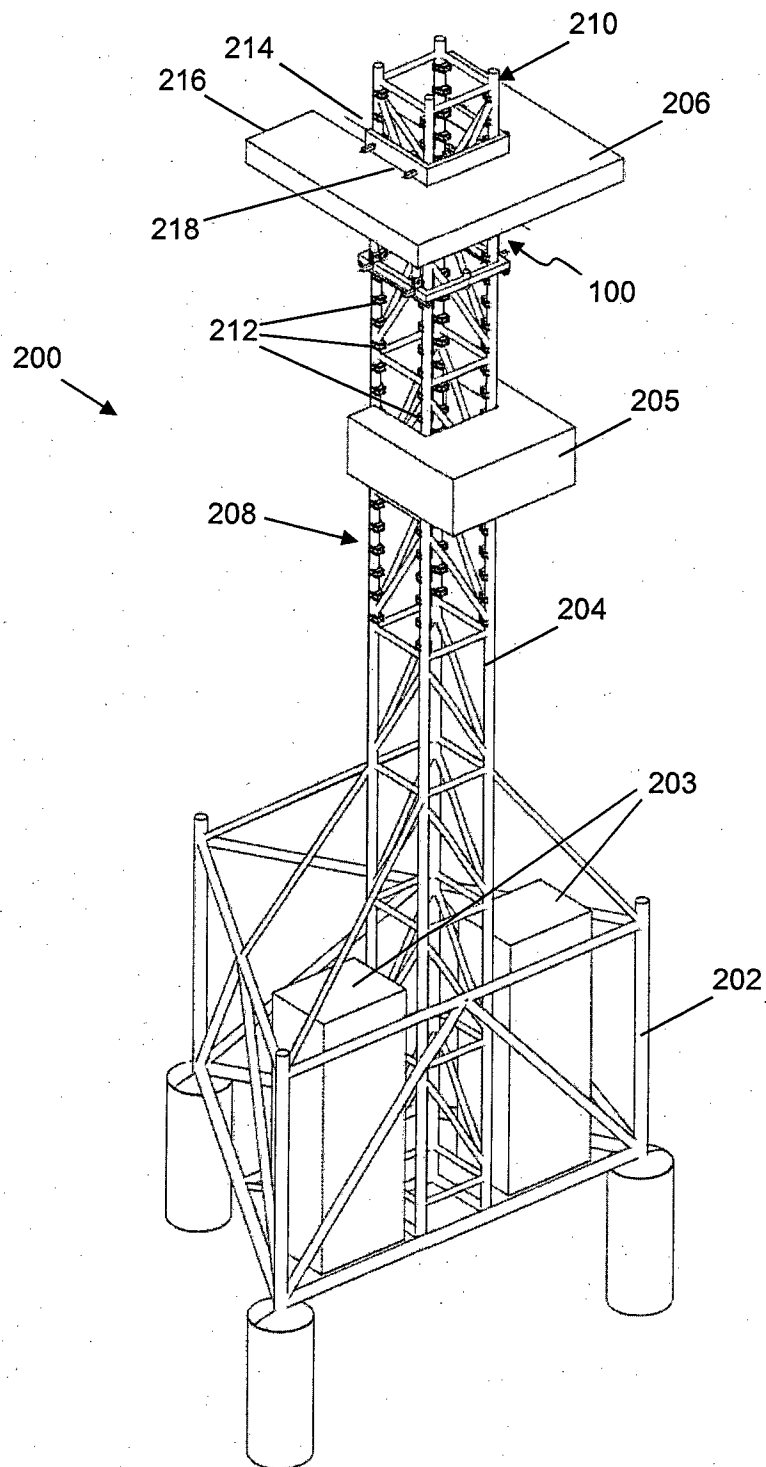


Figure 2a

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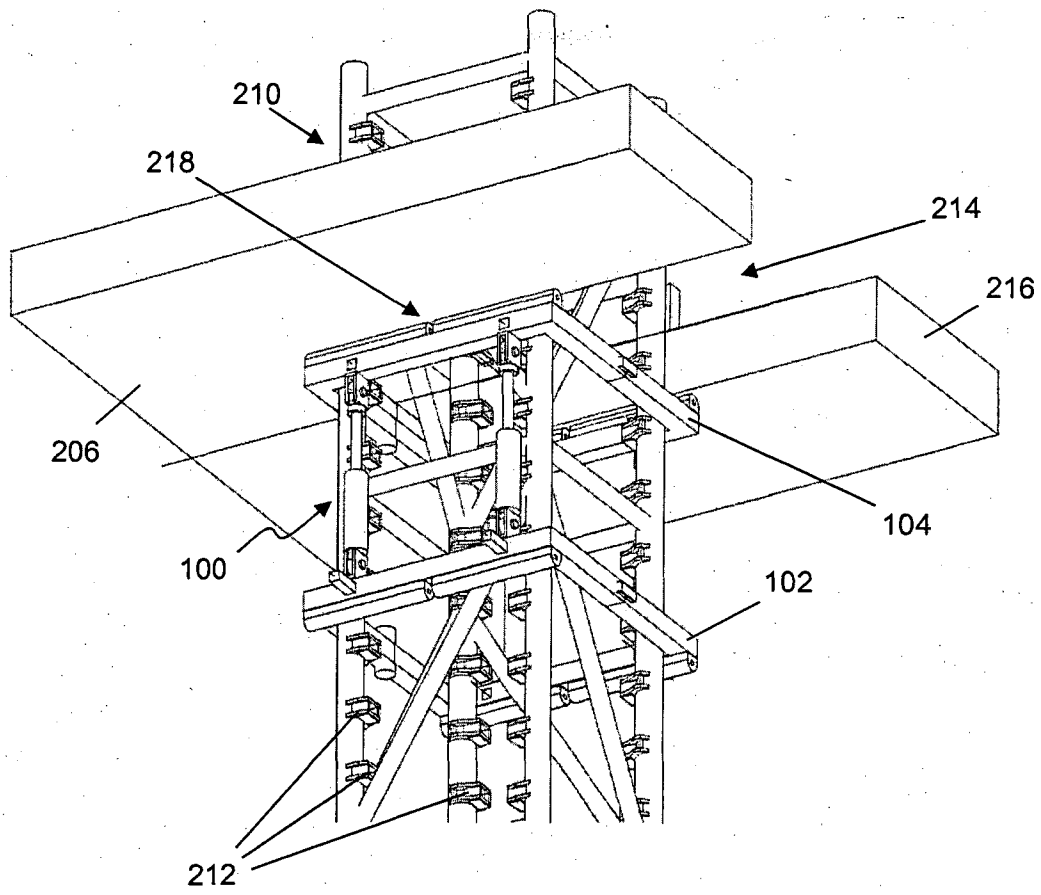


Figure 2b

5 / 20

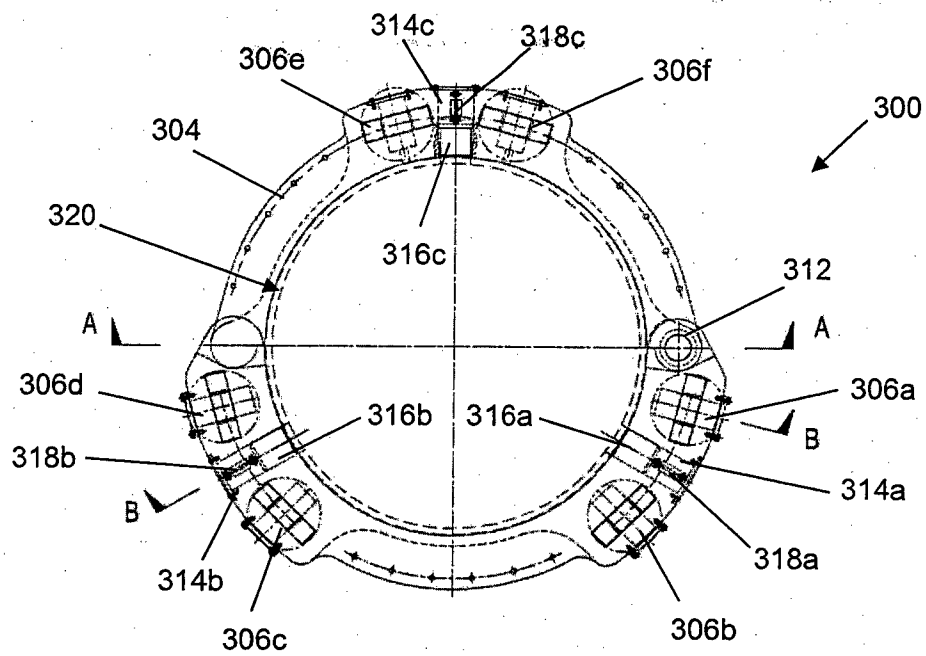


Figure 3a

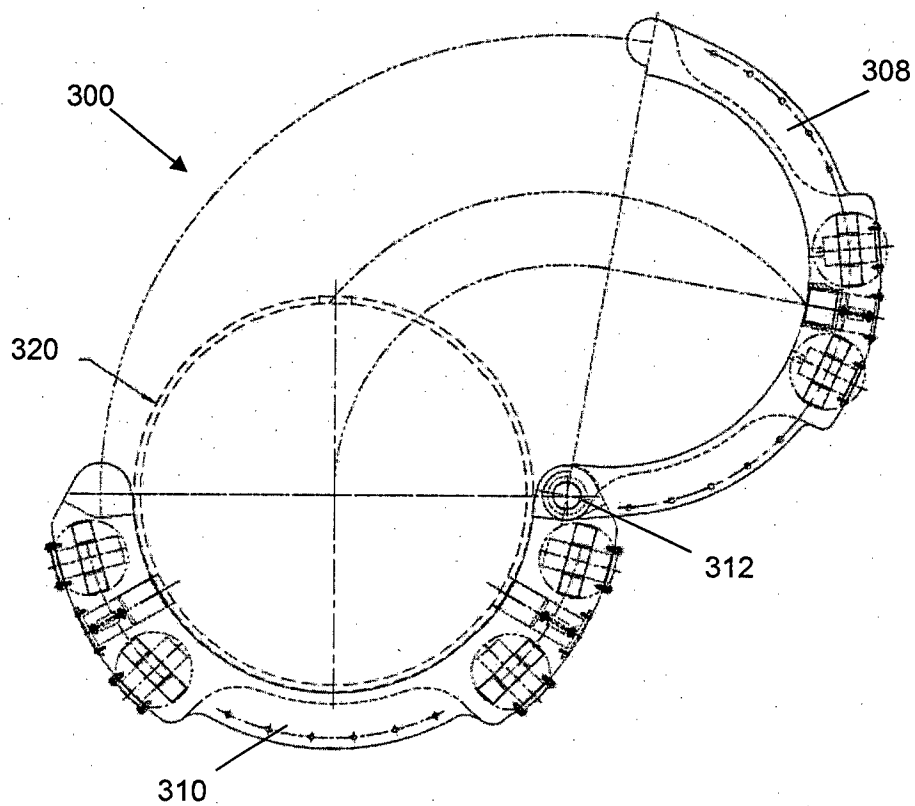


Figure 3b

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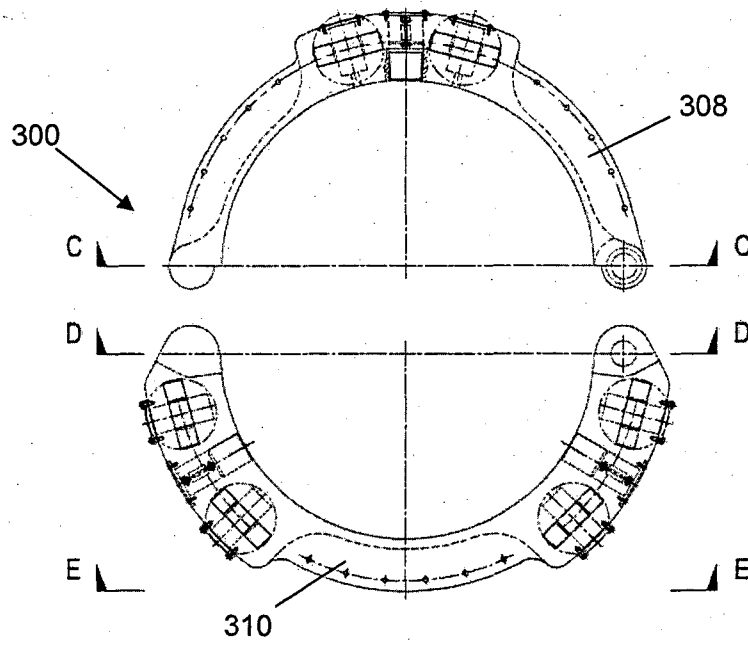


Figure 3c

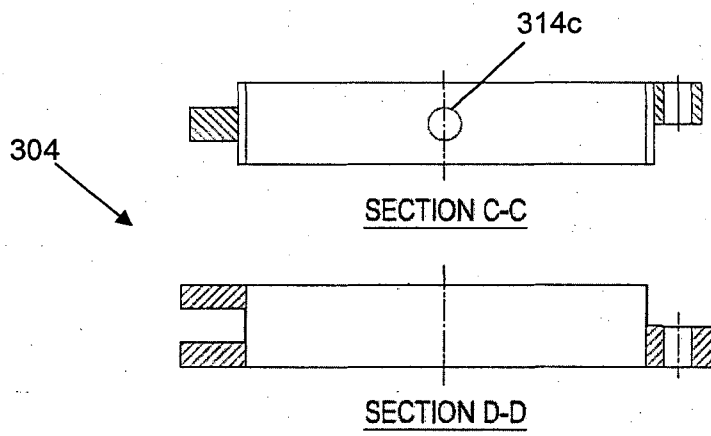


Figure 3d

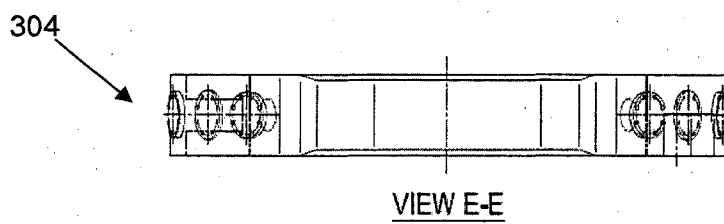


Figure 3e

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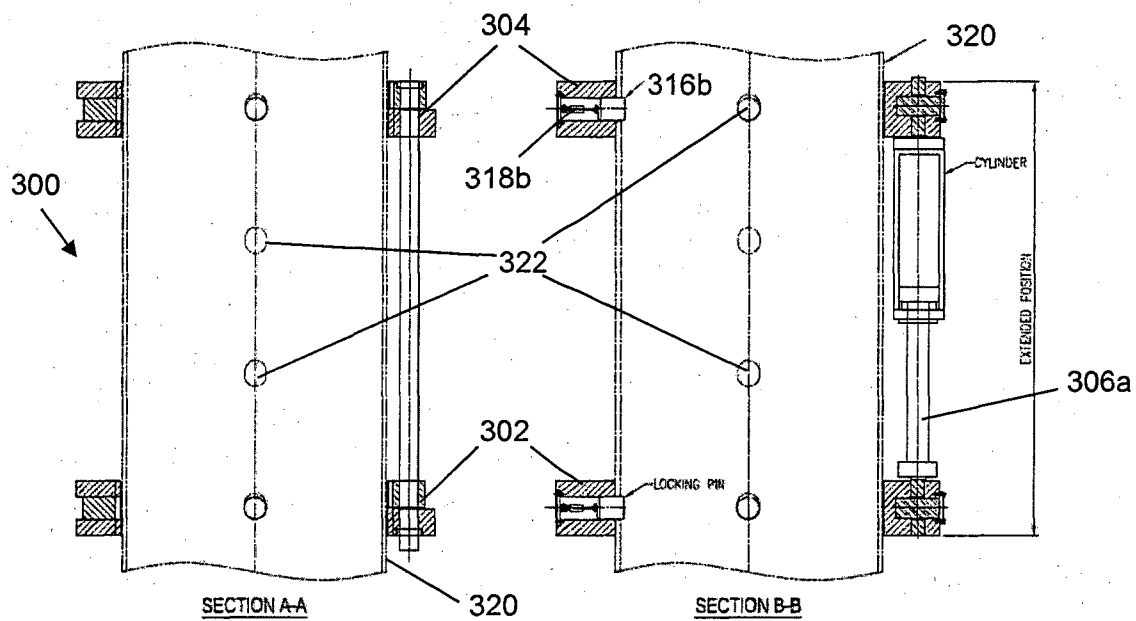


Figure 3f

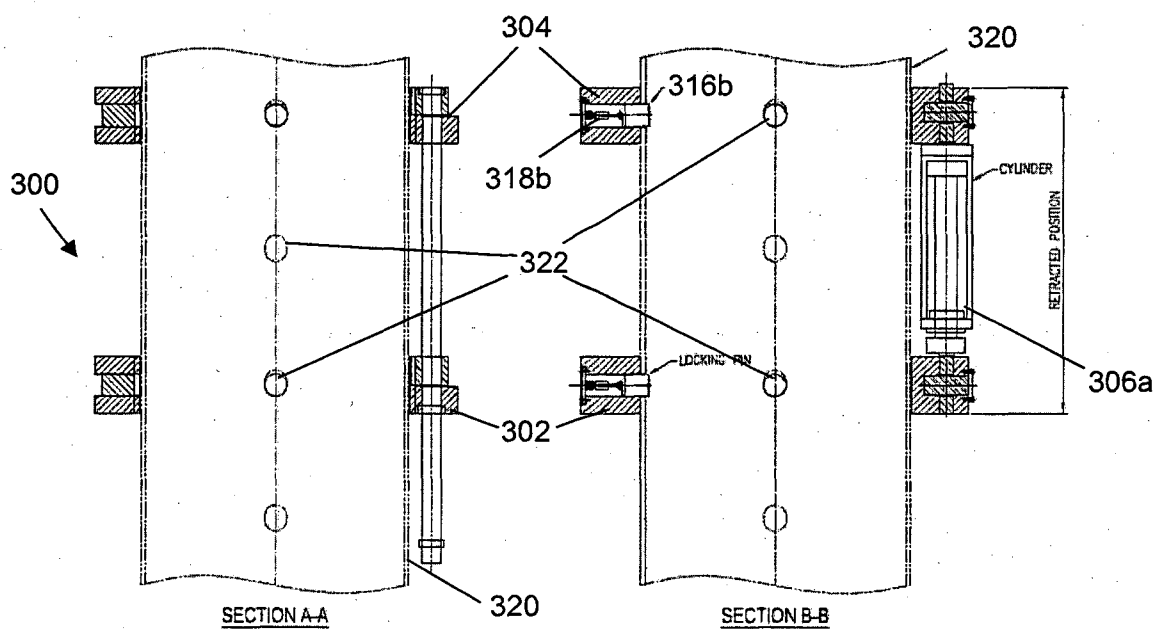


Figure 3g

8 / 20

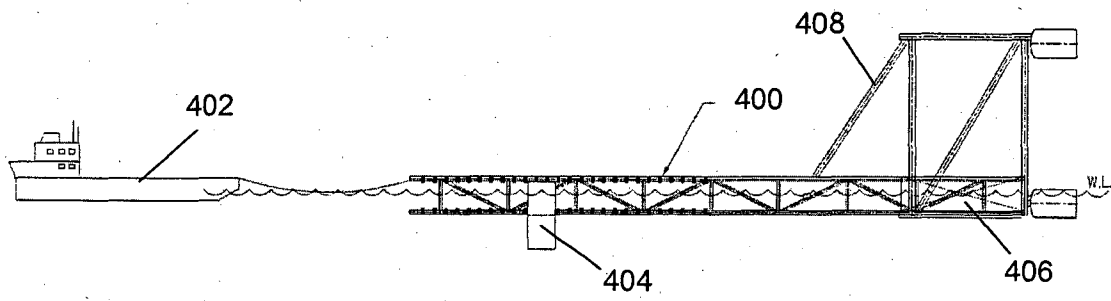


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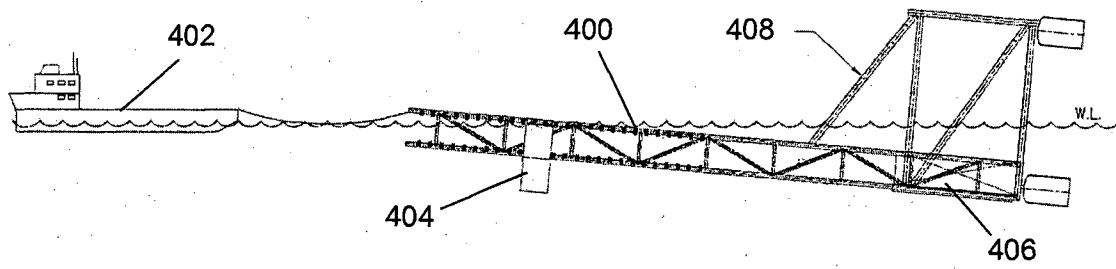


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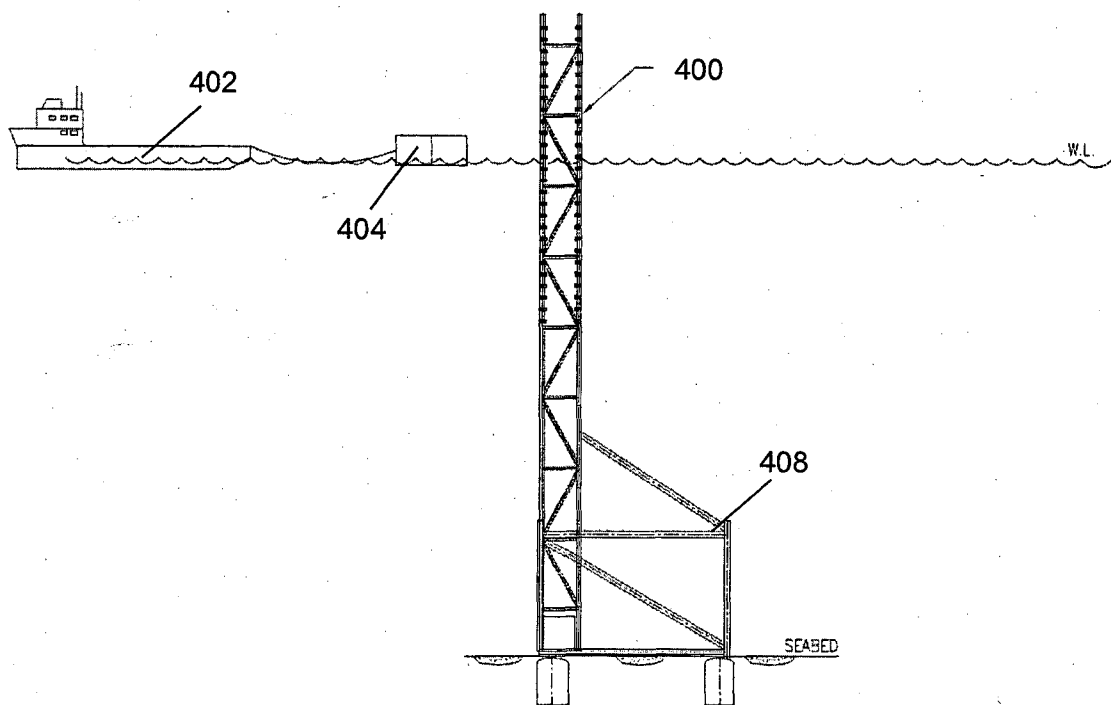


Figure 6

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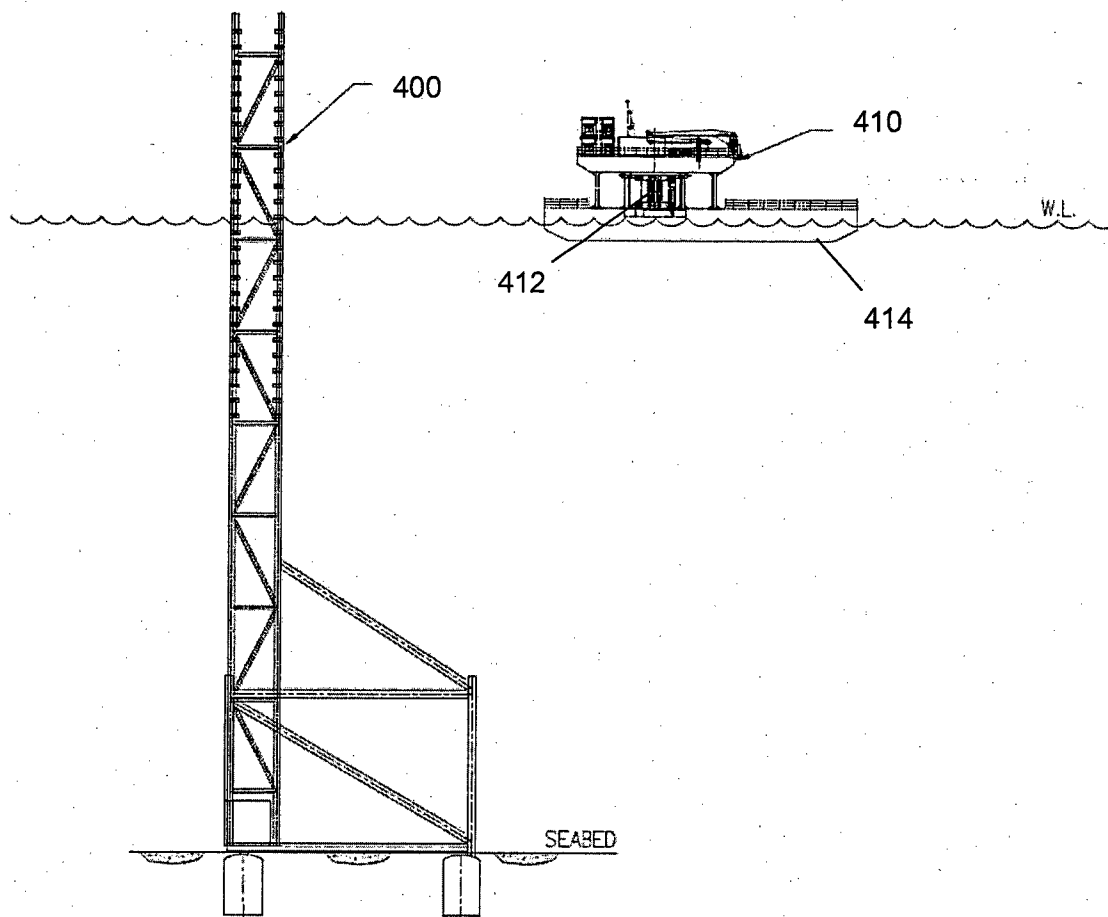


Figure 7

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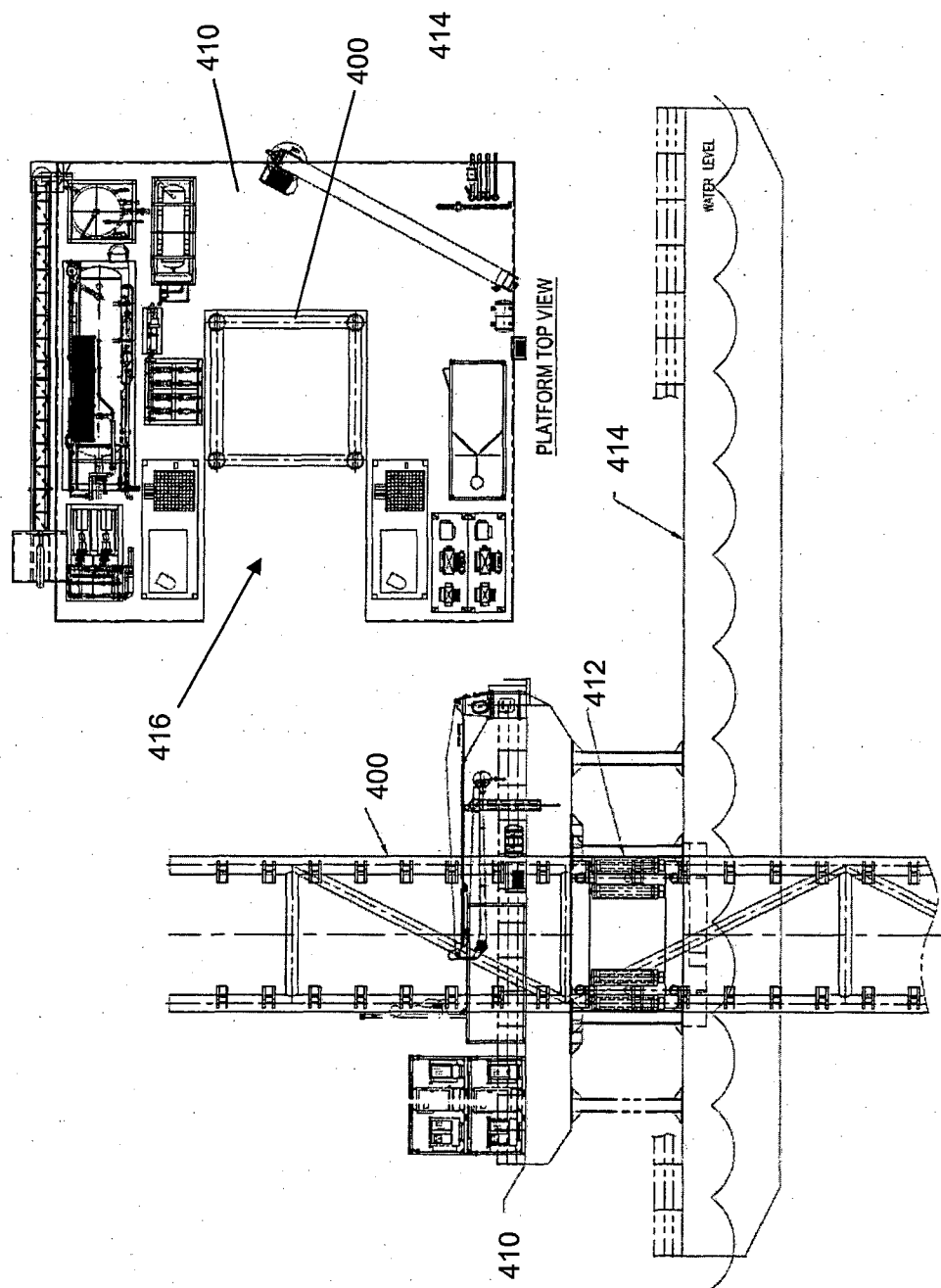


Figure 8

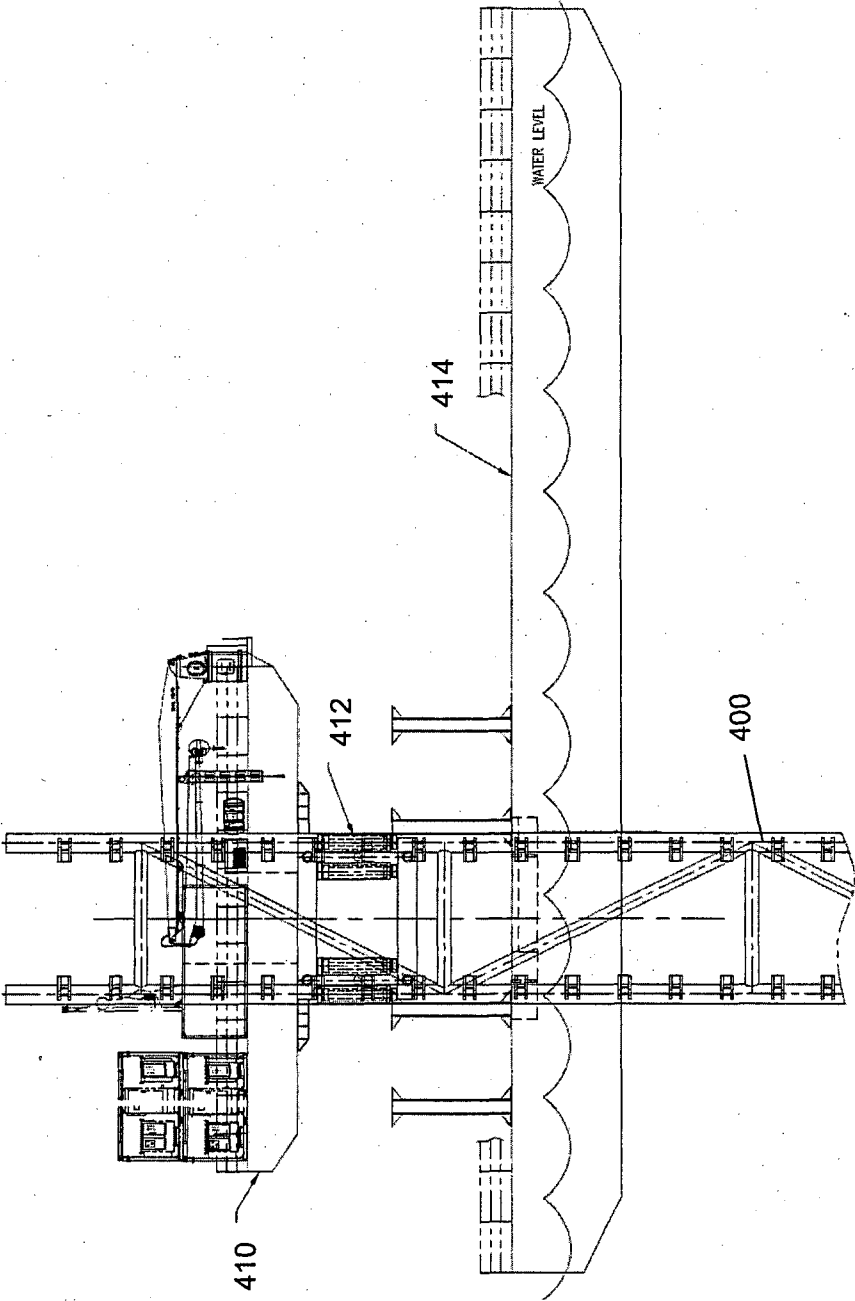


Figure 9

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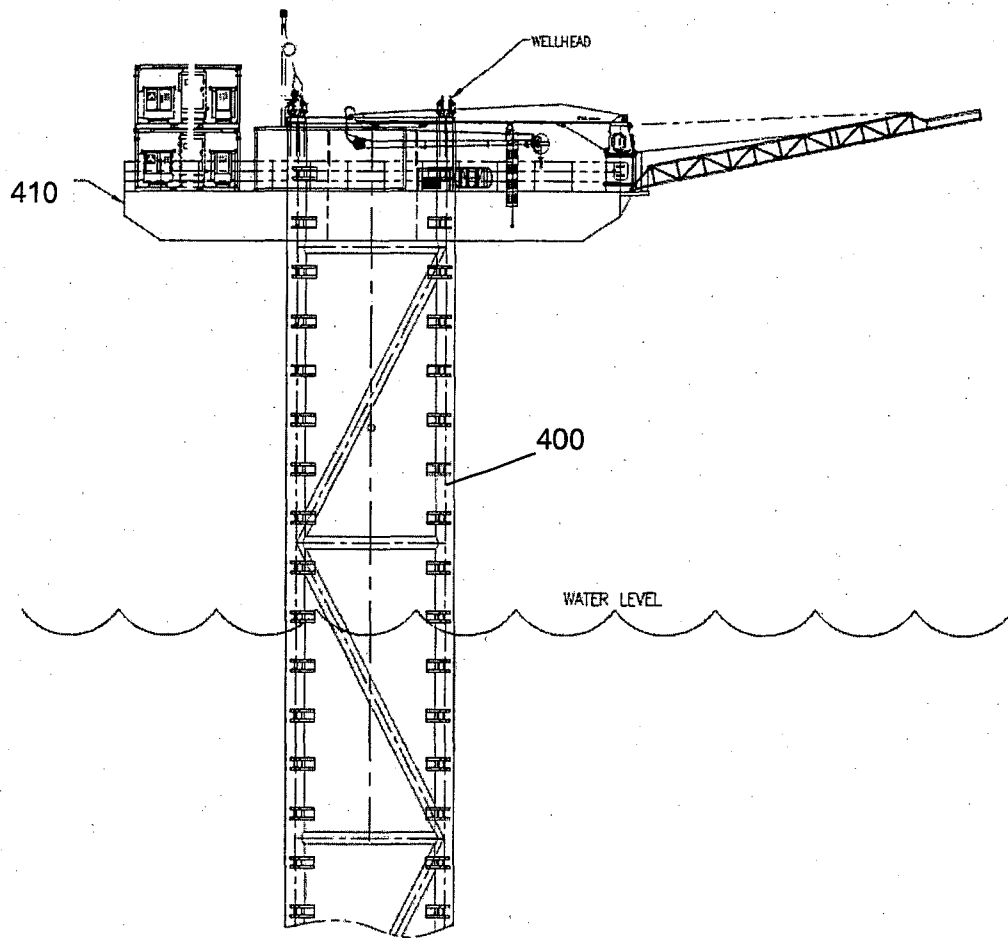


Figure 10

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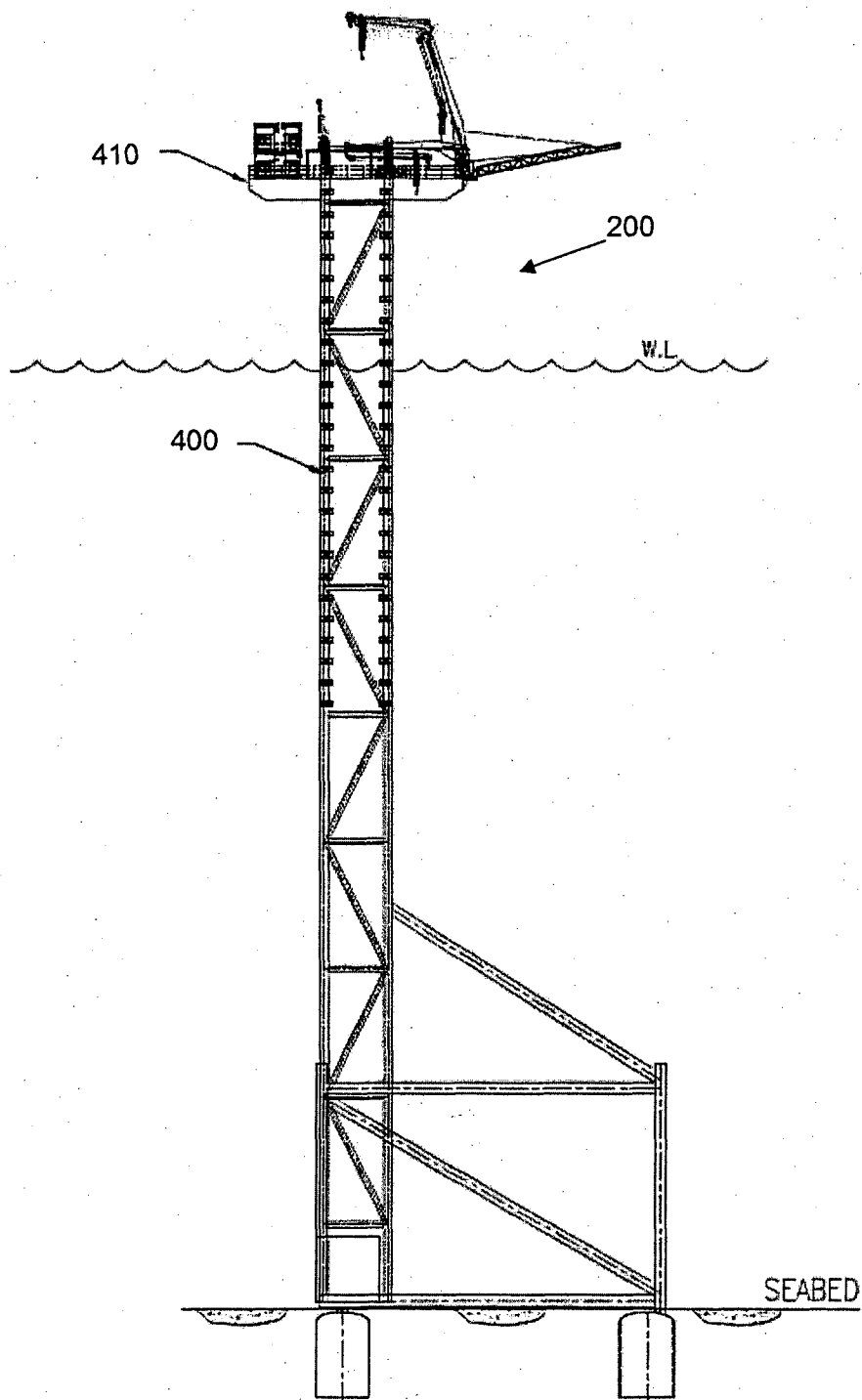


Figure 11

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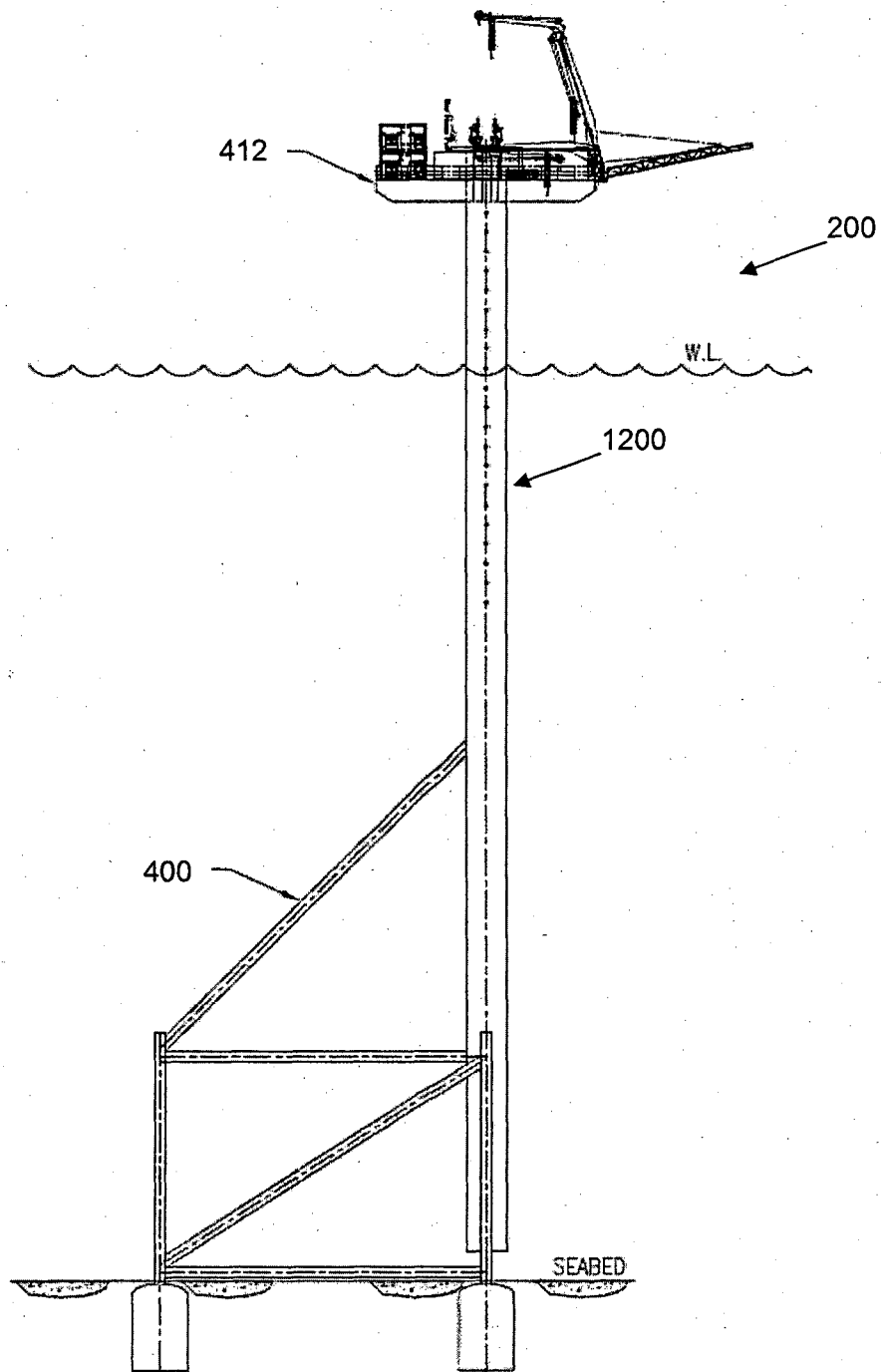


Figure 12

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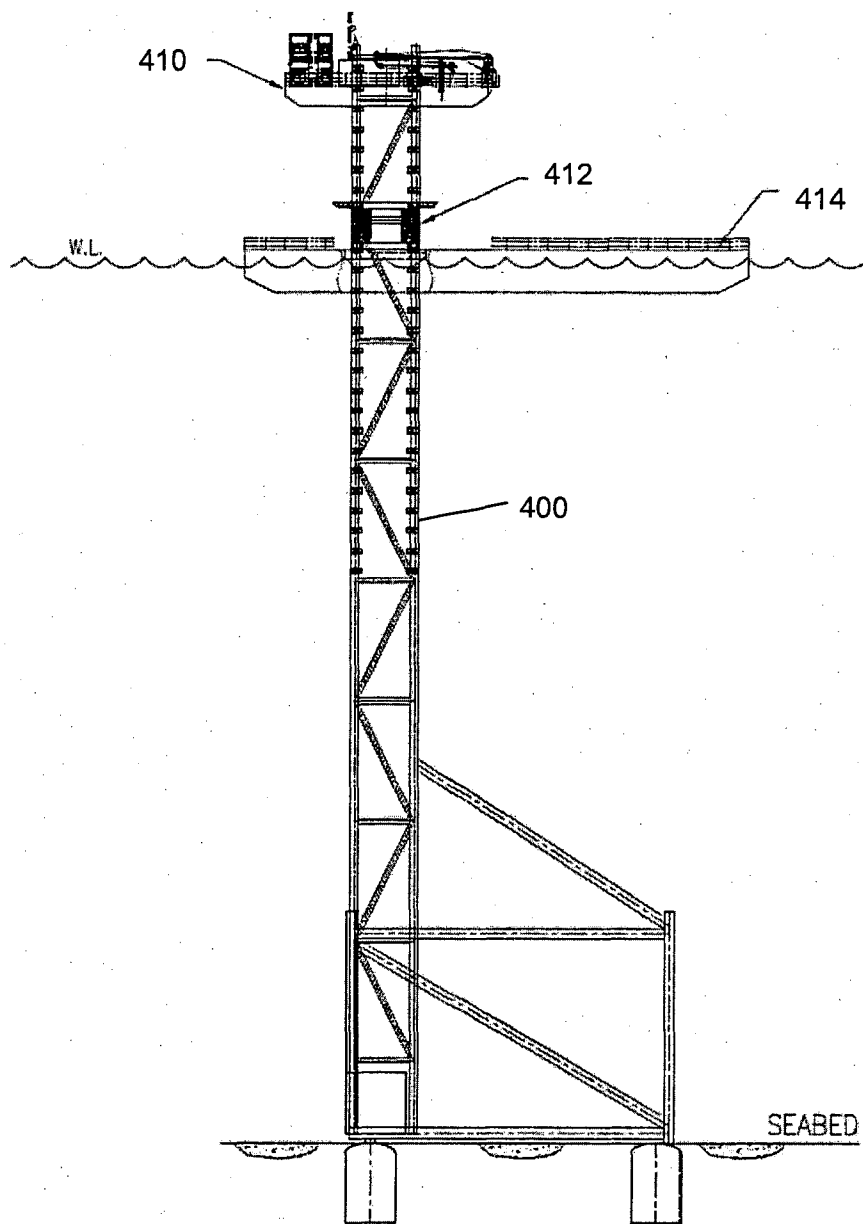


Figure 13

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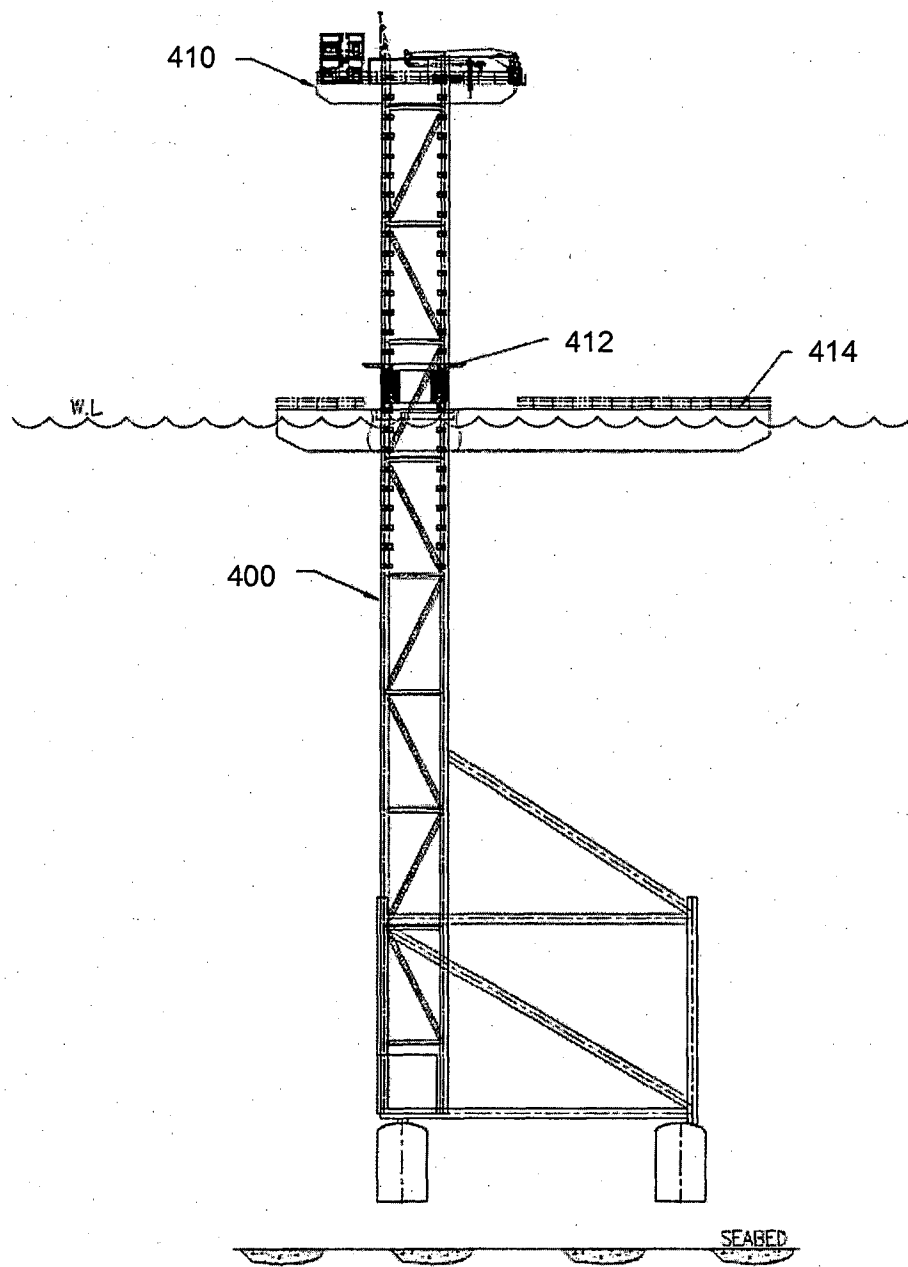


Figure 14

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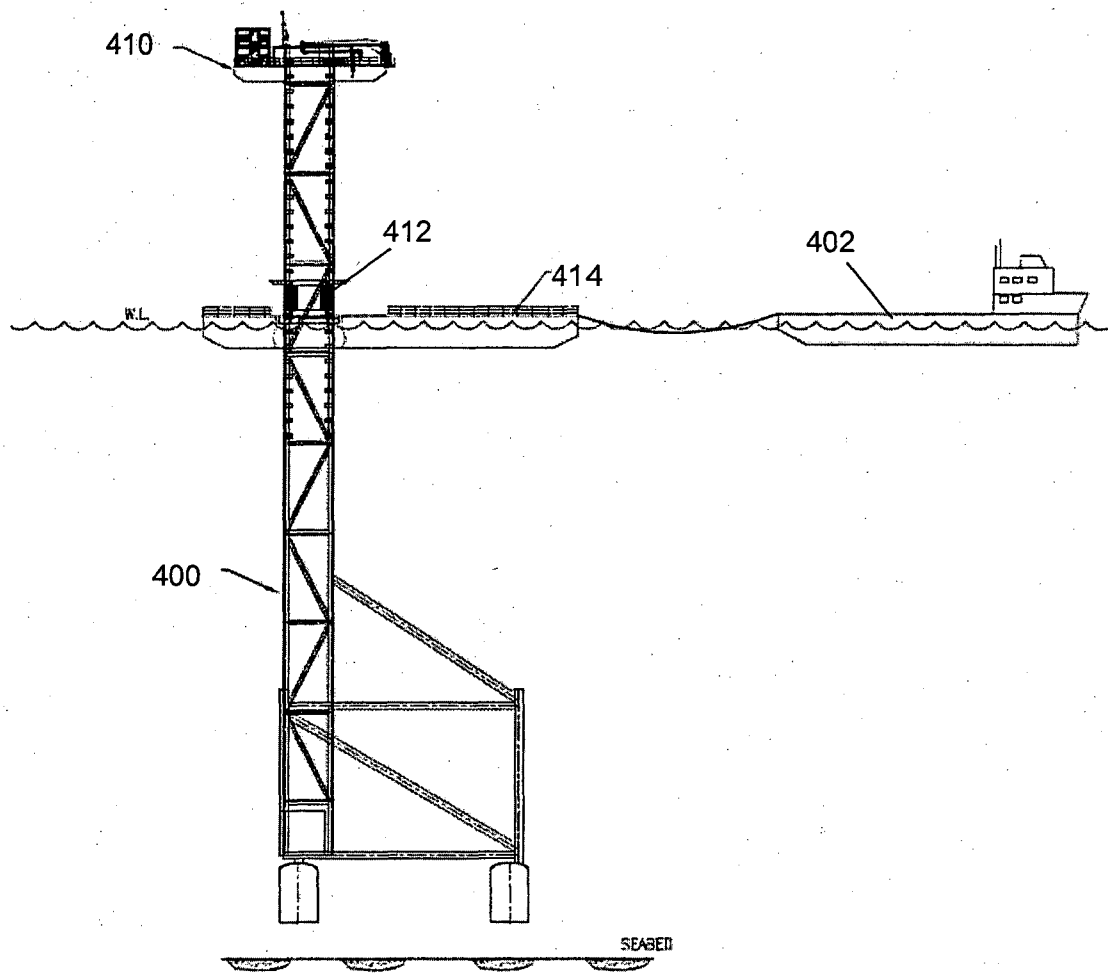


Figure 15

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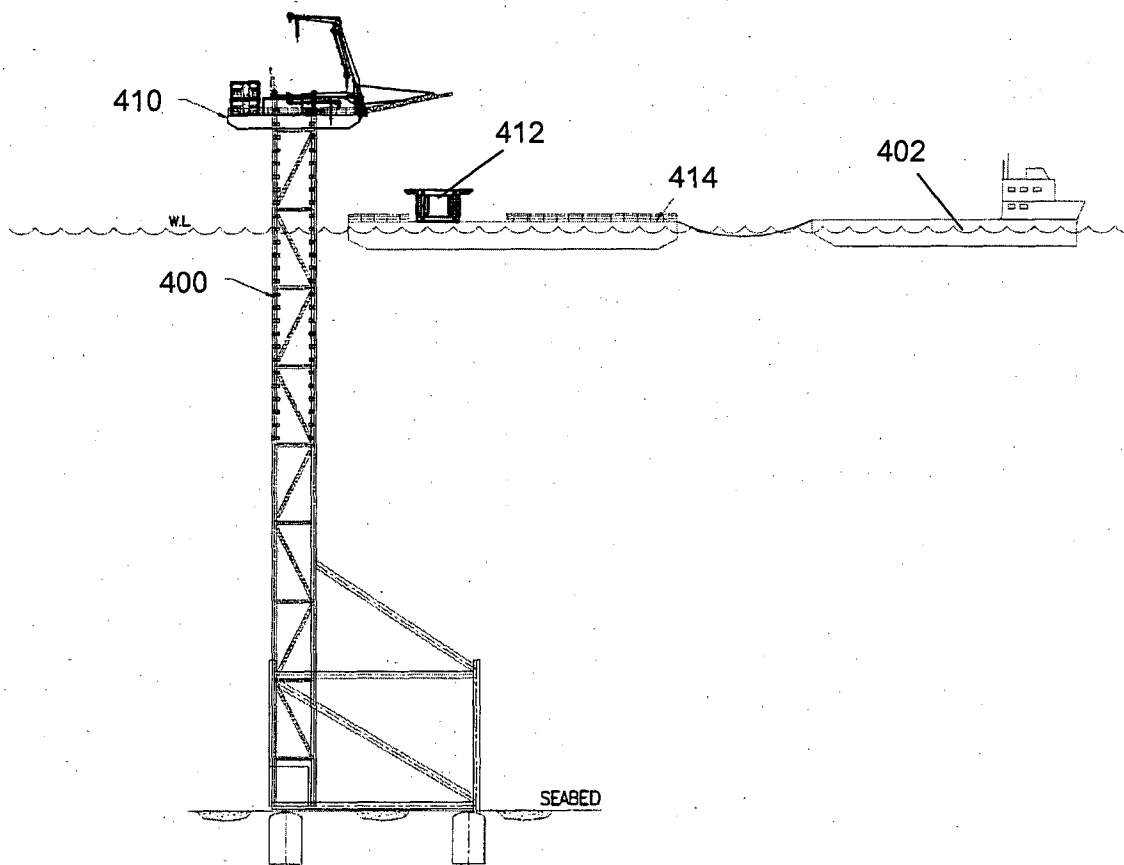


Figure 16

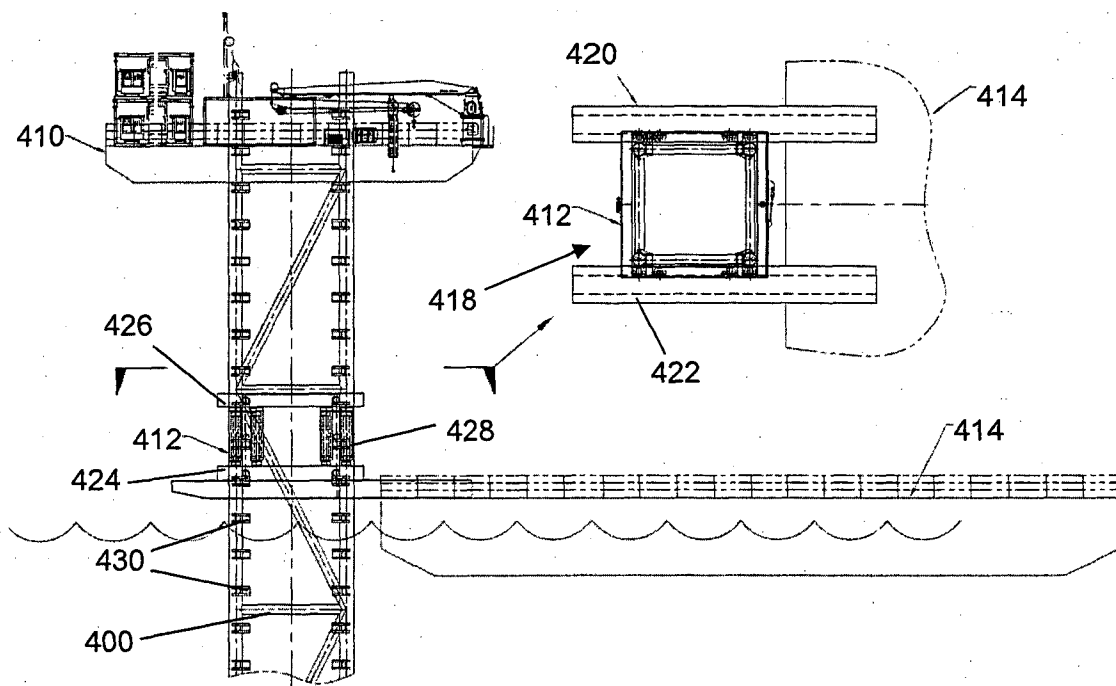


Figure 17

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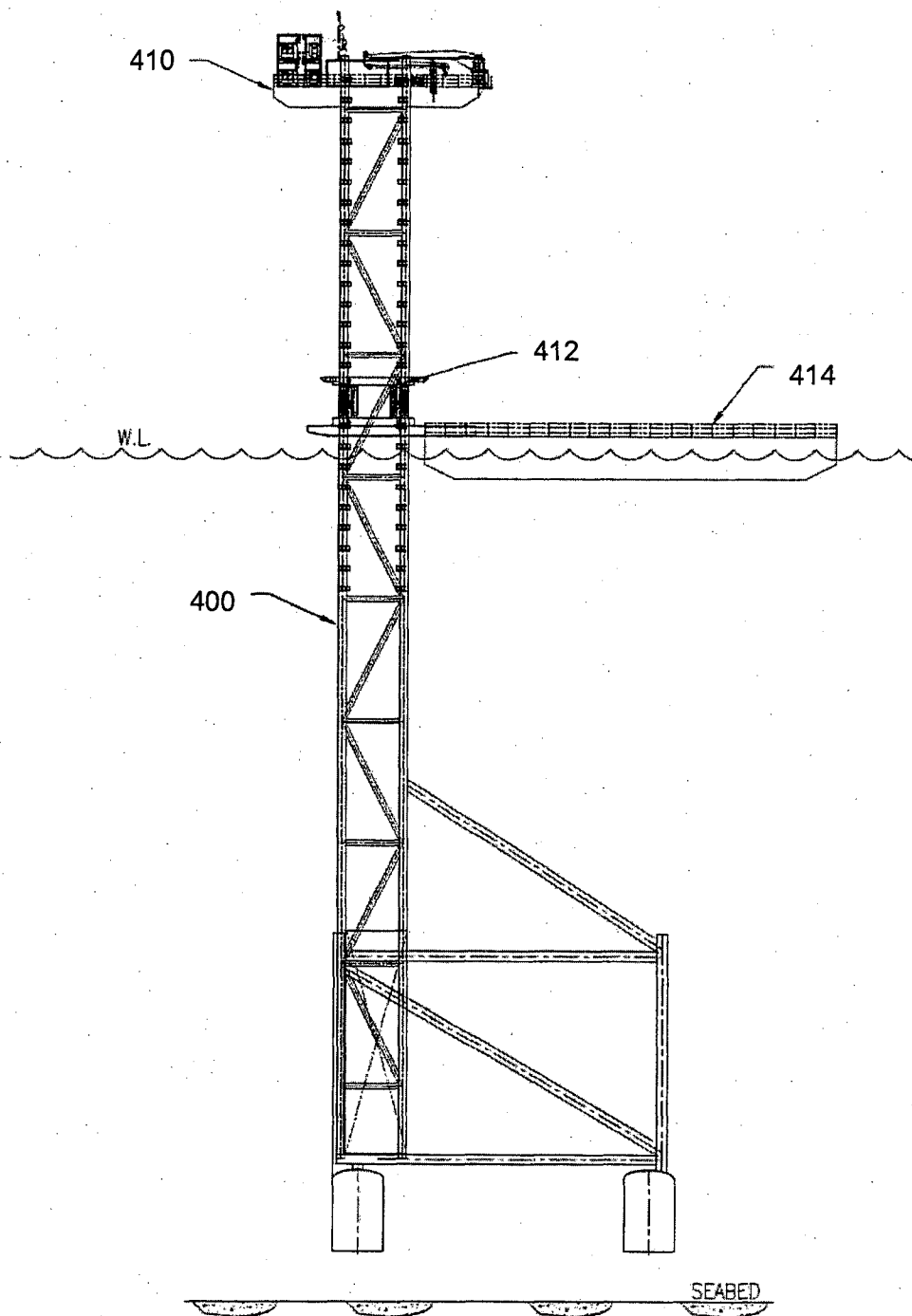


Figure 18

20 / 20

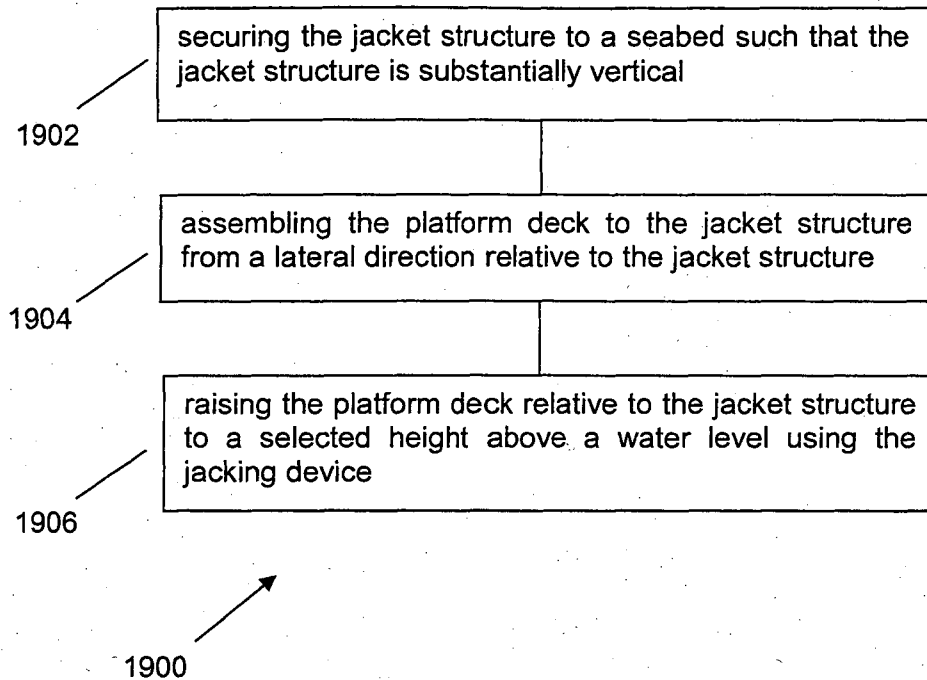


Figure 19

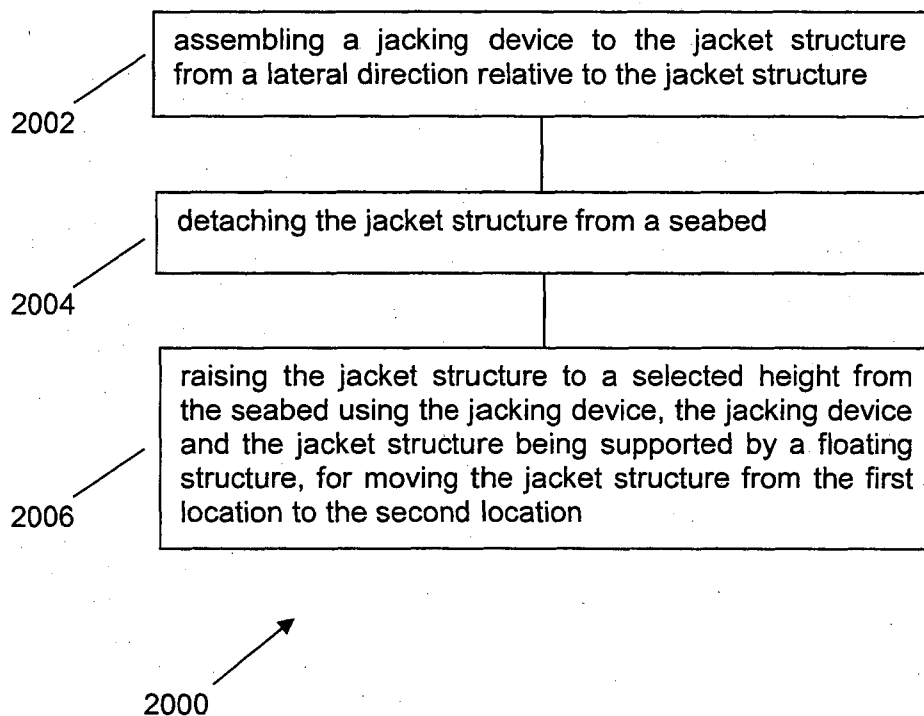


Figure 20

INTERNATIONAL SEARCH REPORT

 International application No.
PCT/SG2014/000270

A. CLASSIFICATION OF SUBJECT MATTER

B66F 1/02 (2006.01) E02B 17/08 (2006.01) E21B 15/02 (2006.01)

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)

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)

DATABASE: EPODOC, WPI, TXTE & IPC: B66F, B66C, E02C5/02, E21B15, E02B17/08 & KEYWORDS: Seperate, Separable, Expand, Hinge, Open, Clam Shell, Release, Frame, Rim, Structure, Surround, Jack, Lift, Climb, Raise, Lower, Skid, Step By Step, Grip, Frame, Rim, Truss, Shell, Open, Close, Clamp, Wrap, Surround, Enclose, Release, Oil, Gas, Offshore, Marine, Hydrocarbon, Pertrol, Platform, Deck and the like terms.

ESP@CENET & APPLICANT: Compass Energy

ESP@CENET & Cited and Citing on most relevant art.

GOOGLE PATENTS & KEYWORDS: "jack" "structure" "pad" "floating" sea platform jack climb hydraulic encircle tree climb

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 28 July 2014	Date of mailing of the international search report 28 July 2014
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au	Authorised officer Matthew Batley AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832589

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/SG2014/000270	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
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		DE 1291486 B	27 Mar 1969
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		GB 1112070 A	01 May 1968
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		FR 2226355 A1	15 Nov 1974
		JP S501503 A	09 Jan 1975
End of Annex			