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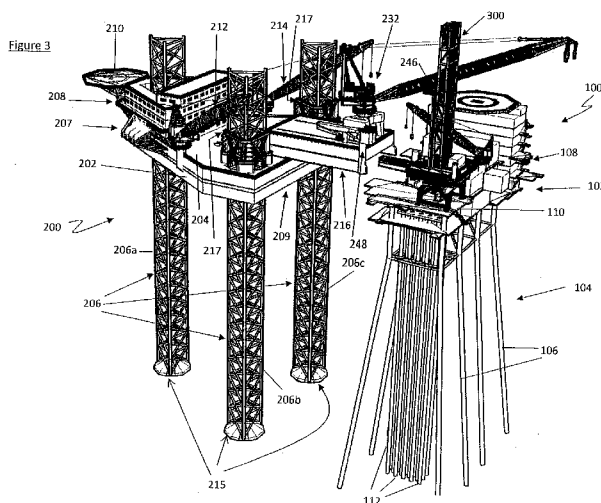
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(54) Title: A MULTI-FUNCTIONAL JACK UP SYSTEM FOR DECOMMISSIONING AN OFFSHORE PLATFORM



(57) Abstract: A multi-functional jack-up (200) for decommissioning an offshore well rig (100) is disclosed herein. In a described embodiment, the jack-up (200) comprises a hull (202) supportable by a number of jack-up legs (206), a cantilever platform (216) movably mounted to the hull (206), a mobile crane (232) and a tubular-handling crane (248) mounted to the cantilever platform and arranged to be operable independently from each other.

A MULTI-FUNCTIONAL JACK UP SYSTEM FOR DECOMMISSIONING AN OFFSHORE PLATFORM

Background and Field of the Invention

5 This invention relates to a multi-functional jack-up for decommissioning offshore platform, such as oil or gas rigs or platforms.

Figure 1 shows a fixed offshore platform 100 used for drilling and production of oil or gas offshore. Such a platform 100 is the most common offshore structure used for
10 mining oil or gas. Typically, the fixed offshore platform 100 comprises a superstructure 102 supported by a jacket 104. The jacket comprises tubular members interconnected together to form a 3-dimensional frame including a number of jacket legs 106. The jacket 104 is anchored to the seabed by driving main piles through the jacket legs 106 to provide stability against overturning moment caused by waves or extreme weather
15 conditions. The superstructure 102 normally includes a few levels and as shown in Figure 1, this includes a production deck 108 and a skid deck 110. The offshore platform 100 also includes conductor pipes 112 set in the seabed to provide the necessary foundations for a wellhead. The conductor pipes 112 are configured to provide passage for drilling fluid and drill string to be lowered down into the wells and
20 the fluid and cuttings to flow back to the rig as well as to prevent formations near the well from caving into the wellbore.

The skid deck 110 is configured to support a drilling rig (not shown in Figures 1 and 2). Typically, the offshore platform 100 would have several well slots in various
25 configurations (i.e. 4 x 6, 5 x 3, etc). These well slots are located between the skid beams. In order to cover the whole well slots area, the drilling rig is typically equipped with skidding jacks. These skidding jacks are latched onto the skid beams and enable the drilling rig to skid from one well slot to the other well slots.

30 Further, the offshore platform 100 includes living quarters 113 and a helicopter pad 114 located above the living quarters 113. Further, the offshore platform 100 includes a platform crane 115 configured for specific lifting operations at the offshore platform 100. Due to limitations of the offshore platform 100, the platform crane 115 does not have sufficient boom reach and lifting capacity to support all the activities at offshore
35 platform (e.g. decommissioning operation).

It is estimated that to-date, more than 4,000 offshore platforms have been built and in operation around the world, with around 150 platforms currently under construction.

- 5 Typical life period of the offshore platform is approximately 20 to 30 years, but if the oil or gas well is not producing sufficient oil or gas to justify the existence of the offshore platform, it is decommissioned which involves flushing, plugging and cementing the well to make it safe to the environment. In certain cases, the offshore platform may have deteriorated to an extent that it is no longer safe to work on the platform and thus,
10 the platform may have to be decommissioned too.

A first recorded offshore platform decommissioning was in the Gulf of Mexico's Outer Continental Shelf in 1973. Currently, there are 1,247 offshore platforms which have been decommissioned and another 97 platforms have been scheduled for
15 decommissioning around the world.

Currently, there are 3 main platform removal methods which are being practiced for the decommissioning:

1. Single lift removal method
20 Single lift removal method involves a floating crane vessel which is capable of heavy lifts to lift the topside deck in a single lift. The topside deck covers everything from the production deck 108 all the way until the highest structure of the platform 100. In other words, topsides are all the things aside from the jacket 104 and the conductors 112.
- 25 2. Reverse installation method
Reverse installation method is a method whereby the topsides of the platform are dismantled into modules in the reverse order of how the topsides were assembled during installation. Reverse installation requires a vessel with lower lifting capacity compared to the single lift removal method, according to the heaviest modules
30 which made up the topsides.
3. Piecesmall removal method
Piecesmall removal method involves cutting and segregating the topsides into small pieces using equipment such as excavators, cranes, etc which are loaded onto containers. The containers are then transported to the decommissioning
35 vessel or to supply vessels for onshore disposal.

Prior to the removal of the platforms, plugging of the offshore wellhead and abandoning of the offshore well are first performed with a drilling/workover rig, i.e. a jack up or a modular rig, or without a drilling/workover rig (rigless), i.e. a well intervention vessel. However, rigless P&A operation is limited to category 1 or 2 wells. A category 1 well is
5 a well which requires it to be plugged and abandoned and ready to be picked up after cutting the wellhead off. A category 2 well requires slight intervention work, such as removal of mud or perforated annuli. A category 3 well requires well control, including the use of tubing.

10 Once the wellheads have been safely plugged and abandoned, operation to remove the platform may start.

It should be appreciated that decommissioning the offshore platform is an expensive and time-consuming process.

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It is an object of the present invention to provide a multifunctional jack-up which alleviates at least one of the disadvantages of the prior art and/or to provide the public with a useful choice.

20 Summary of the Invention

In accordance with a first aspect of the present invention, there is provided a multifunctional jack-up for decommissioning an offshore platform; the jack-up comprising a hull supportable by a number of jack-up legs; a cantilever platform movably mounted to
25 the hull; a first lifting device and a second lifting device mounted to the cantilever platform and arranged to be operable independently from each other.

Decommissioning an oil rig is an act of removal of the offshore well rig according to regulatory requirements to make the well rig safe to the environment. The well rig may
30 be a oil and/or gas rig. The decommissioning involves flushing, plugging and cementing wells to make the wells safe.

As it can be appreciated from the detailed description, the described embodiment aims to introduce flexibility during the well plugging and abandonment by utilizing the
35 multifunctional jack up as a tender assist vessel which supports the offshore platform (e.g. well rig) during the plugging and abandonment operation. In addition to providing

support for the offshore platform, the multifunctional jack-up is able to perform decommissioning of the offshore platform. Specifically when the jack-up acts as decommissioning vessel and with the first and second lifting devices operable independently, the well plugging and abandonment and platform structural removal of structures (buildings, helicopter pad etc) of the offshore platform may be performed simultaneously and this reduces the overall platform decommissioning duration and cost. The described embodiment is preferably used based on either the piece-small removal method or the reverse installation method for platform structure removal.

10 The cantilever platform may include a storage compartment for storing equipment for the decommissioning operation. In this way, space at the cantilever platform or jack-up is optimized. The cantilever platform may include a skidding mechanism configured to skid the cantilever platform between a first position in which the cantilever platform is within boundaries of the hull, and a second position in which the cantilever platform extends at least partially out of the hull's boundaries.

Preferably, the first lifting device is movably mounted to the cantilever platform. The second lifting device may be mounted to a corner of the cantilever platform to maximize the reach of the second lifting device.

20 Preferably, the second lifting device is configured to feed tubulars from the jack-up to a drilling rig for plug and abandonment operation of a wellhead of the well rig. The multifunctional jack-up may further comprise means for assembling a modular drilling rig on the offshore platform for plugging and abandoning the wellhead.

25 In a second aspect, there is provided a method of decommissioning an offshore well rig using a multi-functional jack-up according to any preceding statements, the method comprising: extending the cantilever platform; and operating the first lifting device and the second lifting device independently to decommission the offshore platform.

30 The method may further comprise operating the first lifting device to perform lifting operations to remove topside structures from the offshore platform; and simultaneously operating the second lifting device to provide tubulars for plugging and abandoning a wellhead of the offshore platform.

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The method may further comprise operating scrapping tools on the offshore platform for removal of topside structural parts of the offshore platform.

5 Brief Description of the Drawings

An example of the invention will now be described with reference to the accompanying drawings, in which:

10 Figure 1 is a perspective view of a known fixed offshore platform for mining oil and/or gas;

 Figure 2 is a front view of the fixed offshore platform of Figure 1;

 Figure 3 is a perspective view of a multi-functional jack-up having a movable cantilever platform according to a preferred embodiment of this invention with the
15 multifunctional jack-up arranged to decommission the fixed offshore platform of Figure 1;

 Figure 4 is a side close-up view of the arrangement of Figure 3;

 Figure 5 is a top view of the arrangement of Figure 3;

 Figure 6 is a perspective close-up view of the cantilever platform of Figure 1
20 being arranged to support a mobile crane and a tubular handling crane;

 Figure 7 is a side view of the cantilever platform of Figure 6;

 Figure 8 is a perspective close-up view of the tubular handling crane of Figure 6 in operation;

 Figure 9 is a perspective close-up view of the tubular-handling crane of Figure 6
25 in operation illustrating transfer of tubulars from the jack up to the fixed offshore platform of Figure 3;

 Figure 10 illustrates a drilling rig being constructed on the offshore platform of Figure 1 for plug and abandonment operation;

 Figures 11 and 12 are different side views of the drilling rig and offshore
30 platform of Figure 10; and

 Figure 13 is a typical activity flowchart for plugging and abandoning of offshore wells.

Detailed Description of Preferred Embodiment

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Figure 3 is a perspective view of a multi-functional jack-up 200 according to a preferred embodiment of the invention and the multi-functional jack-up 200 is arranged to

decommission the fixed offshore platform 100 of Figure 1. Figure 4 is a side view of the arrangement of Figure 3, and Figure 5 is a top view of the arrangement of Figure 3.

The multi-functional jack-up 200 comprises a triangular-shaped hull 202 having a main
5 deck 204, three triangular-shaped lattice bracing legs 206 (a first one 206a at the forward side 207, and two legs 206b, 206c at the aft side 209) arranged to support the hull 202. The legs 206 are supported by respective spud cans 205 attached to a jacking system installed in jack cases 217 mounted on the main deck 204 of the hull 202. The jack cases 217 enable the hull 202 to be jacked up and down to raise its
10 height in relation to the ends of the legs 206, subject to the operating area i.e. water depth as well as wave height in the area which the jack-up 200 is operating.

The multi-functional jack-up 200 includes accommodation unit 208 arranged above the first leg 206a at the forward side 207 for providing living quarters for the crew, a
15 helicopter deck 210 cantilevered adjacent to the accommodation unit 208, and two pedestal cranes 212, 214 mounted respectively at the port and starboard side of the multi-functional jack up 200. The pedestal cranes 212, 214 at the port and starboard side of the hull 202 are used for material handling within the jack-up 200 and/or between the jack-up and the supply vessels. The reason that there are two cranes
20 212, 214 on each side of the hull 202 is to be able to cover the whole jack up area during material handling.

The multi-functional jack-up 200 further includes a cantilever platform 216 provided near the aft side 209 of the main deck 204 and this is shown more clearly in Figure 4
25 and also Figures 6 and 7 which are close-up views of the cantilever platform 216. The cantilever platform 216 is coupled a set of skidding system (not shown) mounted on the main deck 204 so that the cantilever platform 216 is skiddable (or extendable) beyond the aft side 209 of the main deck 204. The skidding system comprises four hydraulic cylinders, each fitted with a clamp at its end and fixed to the main deck 204 at its other
30 end. The clamp fitted to the cylinders is used to grip the skidding beams/tracks of the cantilever platform 216. The cantilever platform 216 includes a cantilever housing 218, a top deck 220 arranged on top of the cantilever housing 218 and two elongate engagement shoes 222, 224 arranged to support the cantilever housing 218. The elongate engagement shoes 222, 224 are arranged to engage tracks of the skidding
35 system provided on the main deck 204 to enable the cantilever platform 216 to skid longitudinally.

The top deck 220 of the cantilever platform 216 is arranged with two parallel crane skidding beams 226,228 (see Figures 5 and 6) and is arranged to cooperate with a skidding base 230 (see Figure 6) of a mobile crane 232 to enable the mobile crane 232 to travel along the top deck 220 of the cantilever platform 216. As shown in Figure 5, the cantilever platform 216 includes two long edges 234,236 and shorter front and rear edges 238,240, and the skidding beams 226,228 extends along the length of the long edges 234,236 from near the front edge 238 to near the rear edge 240 so that the skidding beams 226,228 provide a guided movement for the mobile crane 232. An example of the skidding beams 226,228 and the skidding base 230 may be understood from US 2008/0237174.

Figure 5 shows the cantilever platform 216 in an extended position (i.e. with the cantilever platform 216 extended along the aft side 209 of the main deck 204) and the mobile crane 232 moved to one end of the skidding beams 226,228 adjacent to the front edge 238 of the cantilever platform to maximize the reach of the mobile crane 232.

Figures 6 and 7 are close-up views of the mobile crane 232 of Figure 3 and the mobile crane 232 includes the skidding base 230, a slew bearing 242 mounted to the skidding base 230, a control cabin 244 for a crane operator and a lattice boom 246 hinged to the boom pivot joint. The mobile crane 232 is configured to assist with removal of parts of the superstructure 102 of the offshore platform 100 by lifting loads between the offshore platform 100 and the multifunctional jack-up 200 or a supply vessel (not shown).

The cantilever platform 216 includes a second lifting device and this is in the form of a tubular-handling crane 248 arranged at a corner common to the front edge 238 and one of the sides 234 of the cantilever platform 216. The tubular-handling crane 248 is configured to support the drilling or plug and abandonment activity of the well of the offshore platform 100 and operates independently and separately from the mobile crane 232. It is preferred to position the tubular-handling crane 248 at a tip or corner of the cantilever 216 in order to maximize the crane's reach. The top deck 220 of the cantilever platform 216 is arranged with pipe rack as well as loading/unloading area, through which the transfer of material between the jack up 200 and the offshore platform 100 occurs. Sufficient reinforcements on the top deck 220 of the cantilever

platform 216 are required to enable the cantilever platform 216 to withstand the load and activities on the top deck 220.

Figure 8 is a close-up view of the tubular handling crane 248 of Figure 3. The cantilever platform 216 includes a crane pedestal 249 located at the corner of the cantilever platform 216 as explained above. The crane pedestal 249 includes crane slew bearings to which the tubular handling crane 248 is mounted. The crane slew bearings allow the tubular handling crane 248 to rotate 360 degrees about a slewing axis, which is a vertical central axis of the crane slew. The tubular handling crane 248 comprises a main boom 250 and a jib 251 connected to the main boom 250 via a boom pin joint 256. The main boom 250 is pivotably coupled to a crane mover house 259 via a boom pivot joint 257. The tip of the jib 251 is fitted with a pipe gripper 252 and the gripper 252 is interchangeable with a conventional hook block (not shown). The pipe gripper 252 or the hook block is configured for transferring tubulars 253 between the jack-up 200 and the offshore platform 100. The boom 250 and jib 251 are able to be knuckled by extending or retracting hydraulic cylinders 254 connected to the boom 250 and the jib 251. A control cabin 255 is located adjacent to the crane mover house 259. A winch 258 is installed on top of the crane mover house 259 and used when the jib 251 is fitted with the hook block. The pipe gripper 252 is able to rotate about the slew axis 340 degrees in order to provide flexibility in aligning the tubulars to the unloading area.

In general, there are two ways of handling tubulars: 1) using pipe gripper 252; or 2) using a conventional hook block with a spreader bar, and it should be appreciated that the tubular handling crane 248 of this embodiment has an advantage of both options as the pipe gripper 252 and the hook block is interchangeable. It should also be appreciated that the mobile crane 232 includes the lattice boom 246 whereas the tubular handling crane 248 includes a knuckled boom (i.e. formed by the boom 250 and the jib 251 pivotably coupled to each other). As a result, both cranes 232,248 are able to complement each other's lifting operations.

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As mentioned previously, the tubular handling crane 248 is mounted at the corner of the cantilever platform 216 to maximize its reach. As for the mobile crane 232, this is usually much heavier and due to the type of lifting operations, locating the mobile crane 232 near the centre of the cantilever platform 216 is advantageous to avoid any excessive bending on the cantilever lateral ends.

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The cantilever housing 218 is configured as a storage compartment for storing a majority of equipment required for the decommissioning operation and this saves space which is a constraint at the multi-functional jack-up 200 and even the offshore platform 100. In this embodiment, the cantilever housing 218 includes a hatch (not shown) between the two parallel crane skidding beams 226,228 for access to the storage compartment. With the exception of mud pumps, mud tanks, storage tanks and power generating system, which are placed inside the jack-up hull 202, the cantilever housing 218 is arranged with internal compartments which houses the following, but not limited to mud processing equipment and mud processing tanks, cementing unit, cement mixing equipment, cement tanks, hydraulic power unit (HPU), local electrical room (LER) complete with variable frequency drives (VFDs) and motor control centres (MCCs) for a drilling rig 300, coiled tubing unit, room for BOP control unit and stores for drilling equipment spare parts. Typically, the equipment is installed in the cantilever during construction phase.

Figures 10 to 12 show the drilling rig 300 more clearly and the drilling rig 300 or a workover rig is a modular drilling rig having a mast 302, drawworks 304, top drive (not shown) for providing rotation motion to a drill string when performing the drilling operation, blowout preventer (BOP) 306 and other required drilling apparatus. The drilling rig 300 may be equipped with offline standbuilding equipment to enable faster operation. Furthermore, the drilling rig 300 includes a support frame 308 for supporting the mast 302 and the other parts on the offshore platform 100. The support frame 308 enables the mast 304 to skid in two directions by the use of skidding units mounted either on the support frame 308, or on both the support frame 308 and drill floor 310, in order to accommodate various wellheads arrangement on the offshore platform 100. Other than performing drilling activities, the drilling rig is configured for well plug and abandonment activities. When the drilling rig 300 is used to perform well plugging and abandonment, special attention is to be placed on the top drive, whereby the top drive is required to produce a high torque rating for casing milling during the plugging and abandonment of the offshore wells. The drilling rig 300 is modularized and stored in several rig containers during transit, and assembled on the platform upon the jack up's 200 arrival.

Having a modular drilling rig 300 is advantageous as the drilling rig may be assembled/dismantled on situ. Specifically, the mast 302 comprises several modular parts which are connected together during the rig up process.

Figure 13 is a flow chart which illustrates the steps for the plug and abandonment operation performed with assistance of the modular drilling rig 300. During the plug and abandonment operation, the tubular handling crane 248 performs lifting operation of tubulars for the drilling rig 300 to lower downhole tools required for various operations. Examples of such operations are setting up the plug or doing perforations. To elaborate on the plug setup, assuming that the plug is to be set at 10,000ft depth, the drilling rig 300 is configured to support the tubulars (as lifted by the tubular lifting crane 248) so that the tubulars lower the plug until it reaches the required depth.

An operation of the multi-functional jack-up 200 for decommissioning the offshore platform 100 will now be described.

Prior to launching the multi-functional jack-up 200 to the location of the offshore platform 100, the cantilever platform 216 is in its retracted position within the boundaries of the main deck 204 and the mobile crane 232 skidded to its rest position which is at the end of the beams 226,228 nearest to the rear edge 240 of the cantilever platform 216. The required equipment and stores are also loaded up to the jack-up 200. For example, the modularized rig containers are stored on the jack up main deck 204. Required tubulars to perform well plug & abandonment and use by the drilling rig 300, excavators, crawler cranes and other required equipment for platform decommissioning are stored on the main deck 204 of the jack up 200. Alternatively, the rig containers, tubulars, excavators, crawler cranes and other required equipment may be delivered to location by the use of supply vessels.

The multi-functional jack-up 200 is then towed with its legs 206 up and the hull 202 floating on the water to the location of the offshore platform 100.

Upon arrival on location, the jack up 200 is jacked to a level by lowering the legs 206 to anchor the jack-up 200 to the seabed. The jack-up 200 is jacked until the main deck 204 of the hull 204 is approximately at a same elevation with the skid deck 110 of the offshore platform 100 while still maintaining an air gap requirement for operation at the offshore platform 100. Next, the cantilever platform 216 is skidded to its maximum longitudinal reach and extends beyond the aft side 209 of the main deck 204. With the cantilever platform 216 in its extended position, the mobile crane 232 is moved or guided to move along the beams 226,228 to position the mobile crane 232 as close to

the front edge 238 of the cantilever platform 216 as possible to maximize the mobile crane's reach. The rig containers containing the modular parts of the drilling rig 300 are then lifted from the jackup 200 onto the skid deck 110 of the offshore platform 100 by the mobile crane 232 and assembled again with the assistance of the mobile crane 232. Connections for power cable, mud, water, cement, air and other utilities are made once the drilling rig 300 has been completely assembled and the drilling rig 300 is ready to perform the well plug and abandonment operation.

Typical platform removal or decommissioning activity involves the following phases:

1. Offshore preparation
2. Well plugging & abandonment
3. Topsides removal
4. Conductors 112 removal & disposal
5. Jackets 104 removal
6. Seabed survey & cleaning
7. Onshore disposal

The present embodiment may be used to perform the first 3 phases; 1) offshore preparation, 2) well plugging & abandonment, and 3) topsides removal. Depending on the platform structures and requirement, the removal activity may require additional equipment, such as excavators with cutting tool attached at its boom tip, cherry picker and/or crawler cranes.

If the offshore platform 100 is removed using the piece-small removal method, the excavators, cherry pickers and/or crawler cranes are lifted by the mobile crane 232 from the jack up 200 onto the working area of the offshore platform 100 to begin the offshore preparation phase, which includes "frontrunning".

"Frontrunning" includes removal of all light material and/or equipment, removal of hazardous waste, removal of cables and electrical apparatus as well as drainage and sniffing. The removal of the light material and/equipment is performed by the excavators with cutting tools and crawler cranes. Basically, "frontrunning" removes all the material/equipment/portion of the platform which does not interfere with the structural integrity of the platform 100 (i.e. when they are removed, the platform 100 is still able to stay standing). For example, air handling unit (AHU) may be removed

during "frontrunning" because even if the AHU is removed, the platform 100 can still stand.

5 Structural removal or top sides removal (i.e. phase 3) follows upon completion of "frontrunning". Excavators with cutting tool perform the cold cutting works on the structural members of the offshore platform 100. The structural members are basically any structure which made up the platform 100 and this may include deck plating, stiffeners, beams, columns, etc. The production deck 108 and skid deck 110 are part of platform structural members. Scraped parts from the structural members are then
10 loaded into containers, and the mobile crane 232 is arranged to lift these containers from the offshore platform 100 to the jack- up main deck 204. As it can be appreciated from Figure 5, the boom of 246 of the mobile crane 232 provides a much wider working area and reach (covering all possible working area on the platform 100) and thus, the multifunctional jack-up 200 need not be positioned too close to the offshore platform
15 100 and yet the decommissioning operation may still be performed effectively. If required, additional processing, such as hot works, on the scraped parts may be done at the jack up 200 thus, alleviating the space constraints of the offshore platform 100. The containers containing the scraped parts are then transported to supply vessels by using the jack up pedestal cranes 212,214 for disposal which frees up the mobile crane
20 232 to focus on the decommissioning of the platform 100.

Alternatively, the platform structure may be removed using the reverse installation method. During the reverse installation method, the offshore platform 100 is dismantled in the reverse order of how the topsides were assembled during installation and the
25 mobile crane 232 is used to lift the dismantled modules of the offshore platform 100 to the jack up 200 or directly to supply vessels. It should be appreciated that, in a way, the "dismantled modules" are similar to the "scraped parts" of the piece-small removal method. Typically when constructing the platform 100, the yard will construct module by module (i.e. living quarter module, storage tank module, etc). These modules are
30 then joined together to form the platform 100. Reverse installation basically dismantles the platform 100 in the reverse order to how the modules are assembled together during construction phase. This is why when doing reverse installation, the removal is module by module, rather than cutting the steel parts of the platform 100 and loading them into a container.

Conventionally, the operation of "well plugging and abandonment" cannot be performed simultaneously with the topsides removal phase but in the present embodiment, the activities described in the above paragraph are performed at the same time while the drilling rig 300 is performing the plug and abandonment of the offshore wellheads. This is achieved with the tubular-handling crane mounted to the cantilever platform 200 which is operable independently of the mobile crane 232. Such an arrangement has the flexibility of using the mobile crane 232 to support the plug and abandonment activity when needed, for example during rig up (assembly of the drilling rig 300) and rig down (dismantling of the drilling rig 300) process. This enables the plug and abandonment activity to occur simultaneously with the removal activity, where the mobile crane 232 focuses on transporting the scraped parts containers from the platform onto the jack up 200 and the tubular-handling crane 248 focuses on delivering tubulars from the pipe rack on the jack up 200 to the drilling rig 300 to form the "drill string" for the plug and abandonment of the wellbore.

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As it can be appreciated above, the ability to perform the removal operation and the well-plug and abandonment operation simultaneously results in substantial time savings and thus, cost savings. The combination of the cantilever platform 200, the mobile crane 232 and tubular-handling crane 248 enables the jack up 200 to perform simultaneous operations, well plug and abandonment or tender assist drilling and offshore platform 100 decommissioning.

Further, with the equipment for the removal of the topside of the offshore platform 100 and the well plug and abandonment stored in the cantilever housing 218, this provides flexibility and convenience for the decommissioning operations.

The described embodiment is not to be construed as limitative. For example, the embodiment describes the decommissioning of the fixed offshore platform 100 but the present invention may be used for decommissioning other oil or gas rigs such as floating offshore platforms or semi-submersible platforms. The multifunctional jack-up 200 in the described embodiment includes two pedestal cranes 212, 214, but these may not be necessary and the mobile crane 232 may be used for lifting operations at the jack-up 200, although this may not be preferred.

Having now fully described the invention, it should be apparent to one of ordinary skill in the art that many modifications can be made hereto without departing from the scope as claimed.

CLAIMS

1. A multi-functional jack-up for decommissioning an offshore platform; the jack-up comprising
 - 5 a hull supportable by a number of jack-up legs;
 - a cantilever platform movably mounted to the hull;
 - a first lifting device and a second lifting device mounted to the cantilever platform and arranged to be operable independently from each other.
- 10 2. A multi-functional jack-up according to claim 1, wherein the cantilever platform includes a storage compartment for storing equipment for the decommissioning operation.
3. A multi-functional jack-up according to claim 1 or 2, wherein the cantilever
 - 15 platform includes a skidding mechanism configured to skid the cantilever platform between a first position in which the cantilever platform is within boundaries of the hull, and a second position in which the cantilever platform extends at least partially out of the hull's boundaries.
- 20 4. A multi-functional jack-up according to claim any preceding claim, wherein the first lifting device is movably mounted to the cantilever platform.
5. A multi-functional jack-up according to any preceding claim, wherein the second
 - 25 lifting device is mounted to a corner of the cantilever platform to maximize the reach of the second lifting device.
6. A multi-functional jack-up according to any preceding claim, wherein the second
 - 30 lifting device is configured to feed tubulars from the jack-up to a drilling rig for plug and abandonment operation of a wellhead of the well rig.
7. A multi-functional jack-up according to claim 6, further comprising means for
 - assembling a modular drilling rig on the offshore platform for plugging and abandoning the wellhead.
- 35 8. A method of decommissioning an offshore well rig using a multi-functional jack-up according to any preceding claim, the method comprising:

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extending the cantilever platform; and
operating the first lifting device and the second lifting device independently to
decommission the offshore platform.

- 5 9. A method according to claim 8, further comprising:
operating the first lifting device to perform lifting operations to remove topside
structures from the offshore platform; and
simultaneously operating the second lifting device to provide tubulars for
plugging and abandoning a wellhead of the offshore platform.

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10. A method according to claim 8 or 9, further comprising:
operating scrapping tools on the offshore platform for removal of topside
structural parts of the offshore platform.

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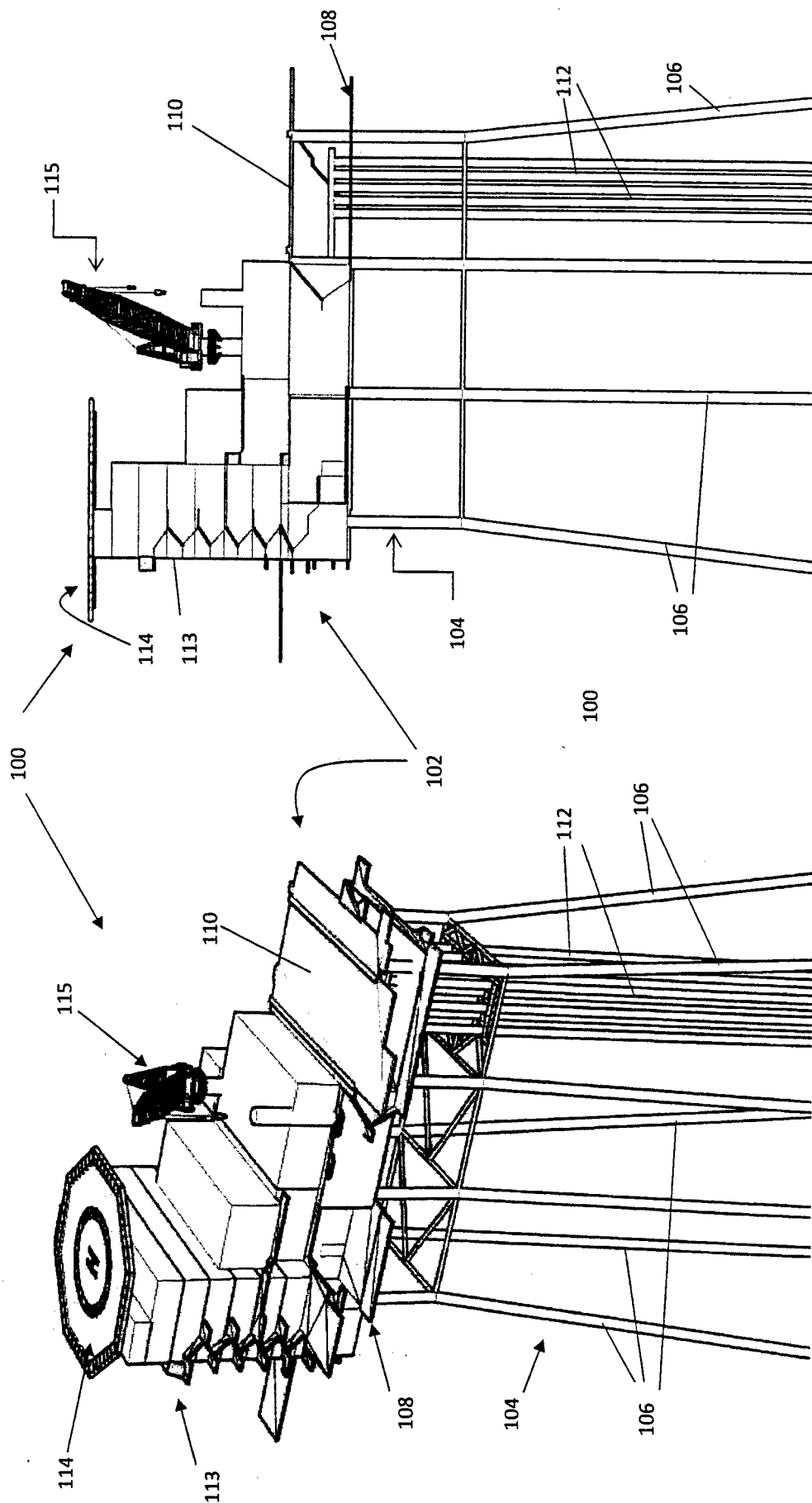


Figure 1

Figure 2

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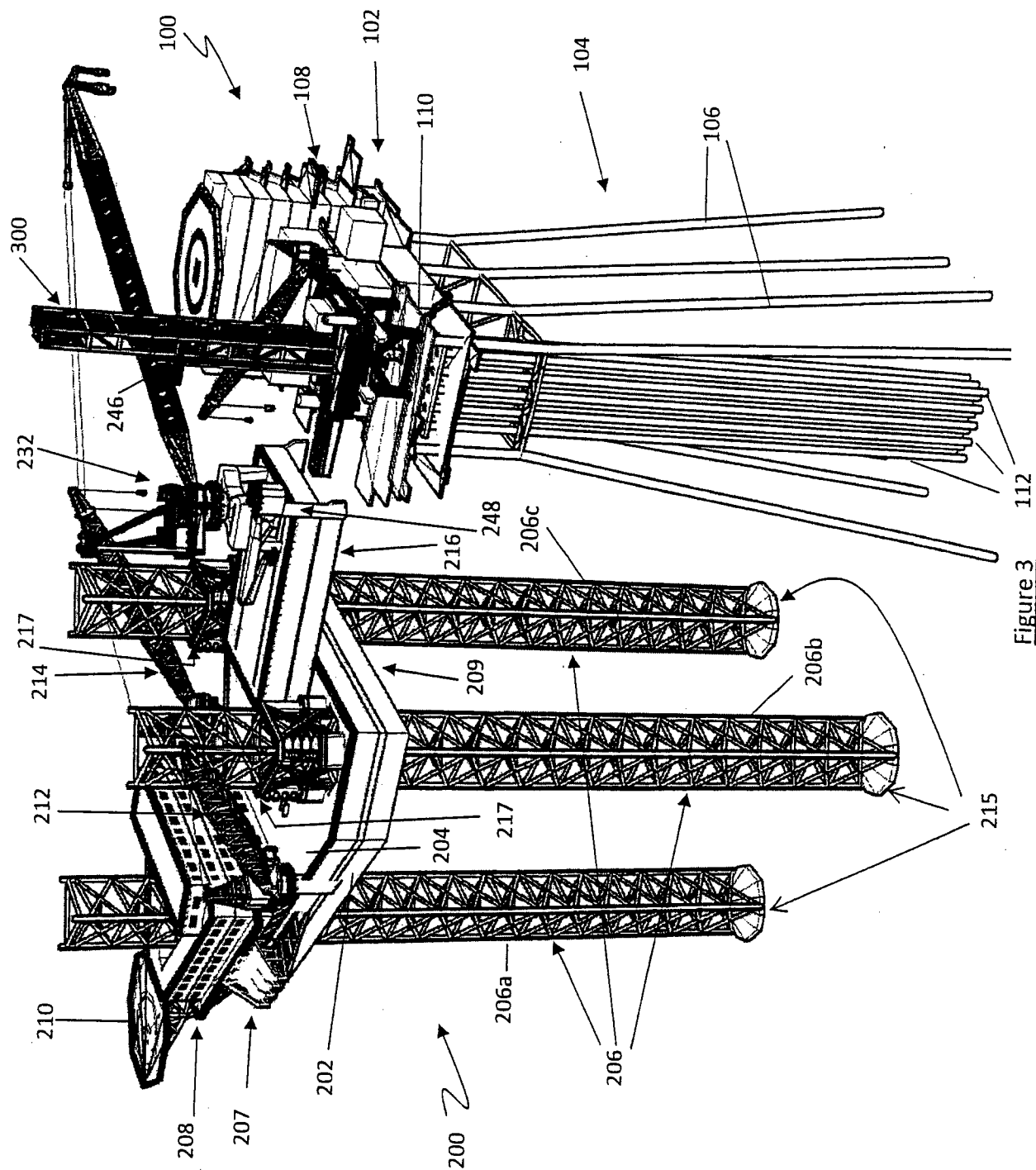


Figure 3

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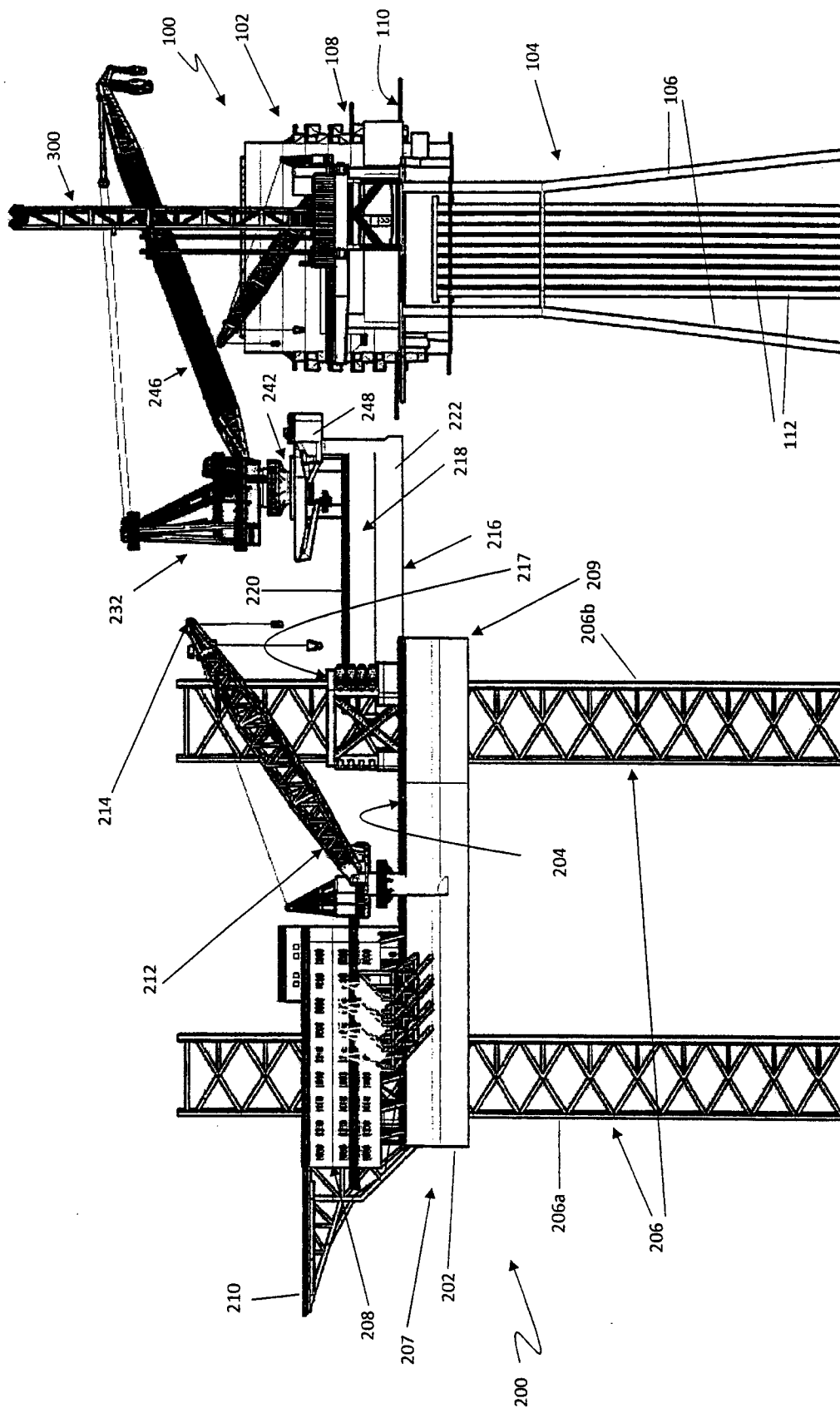


Figure 4

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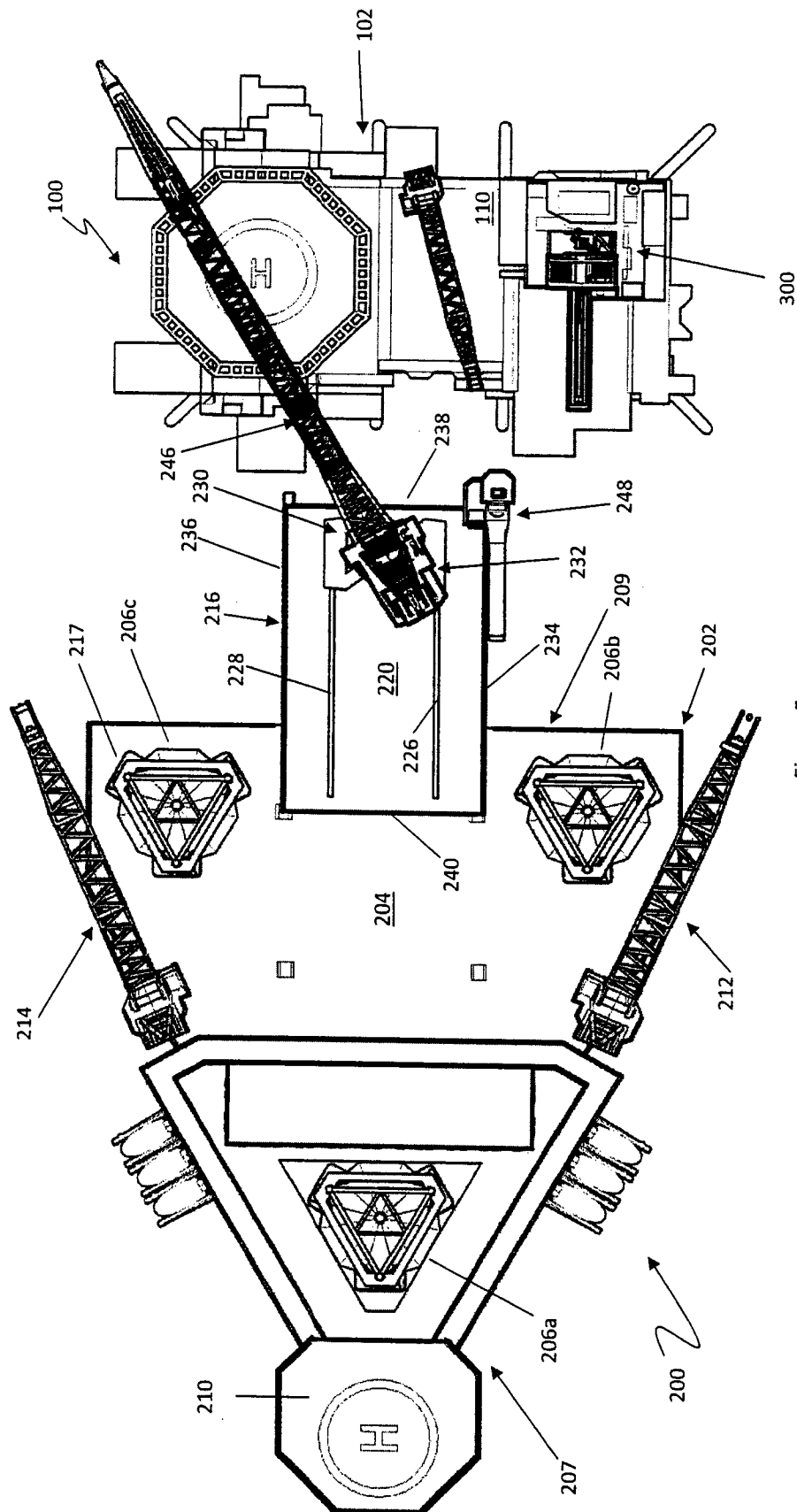
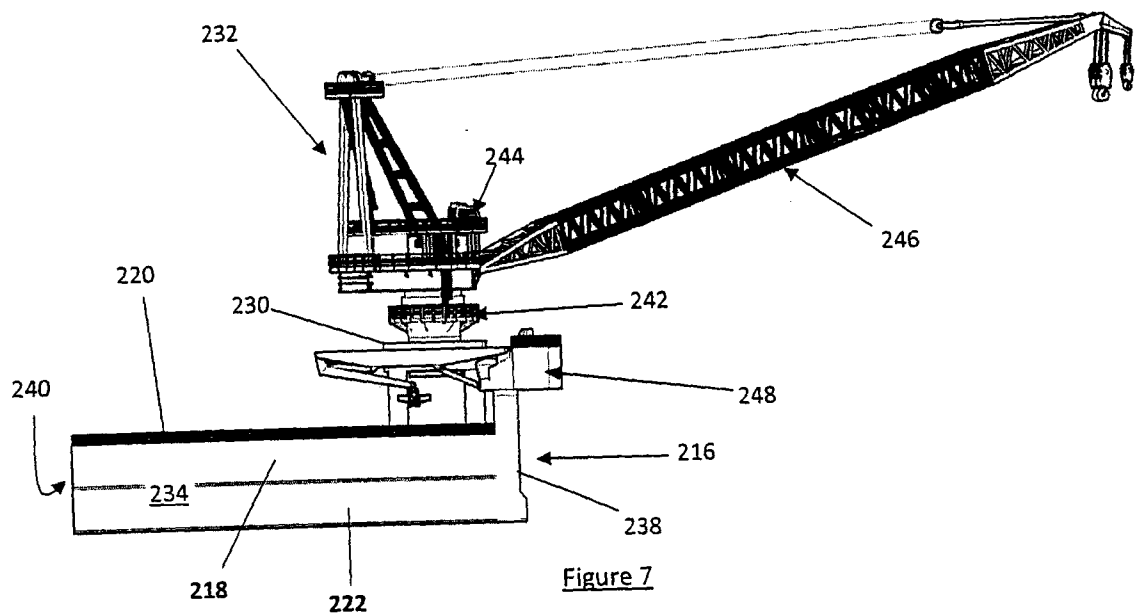
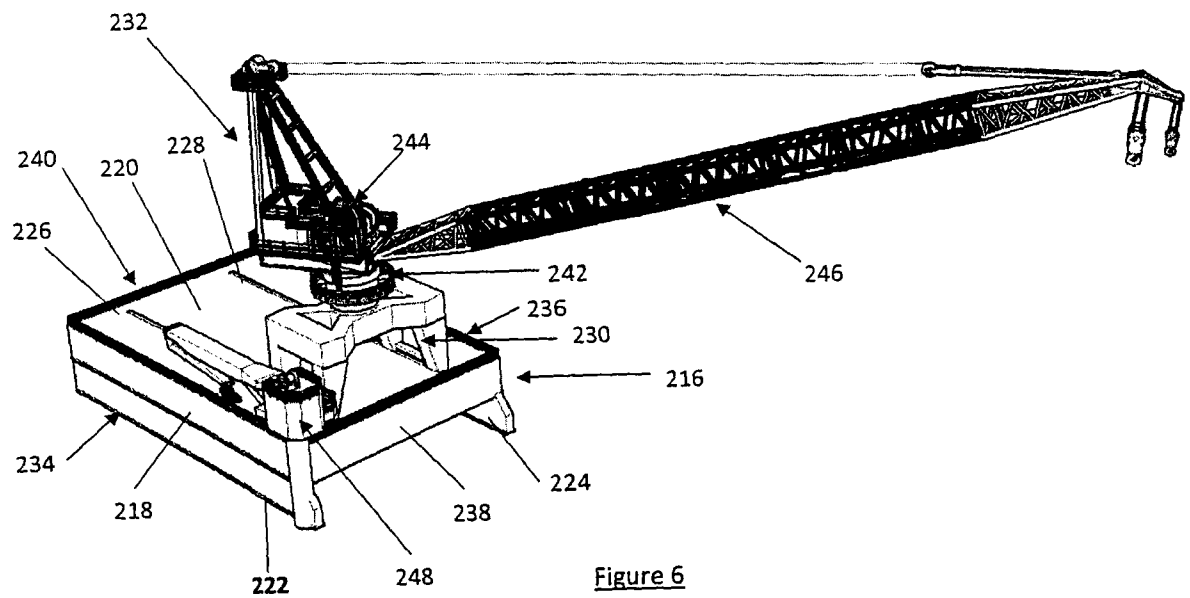


Figure 5

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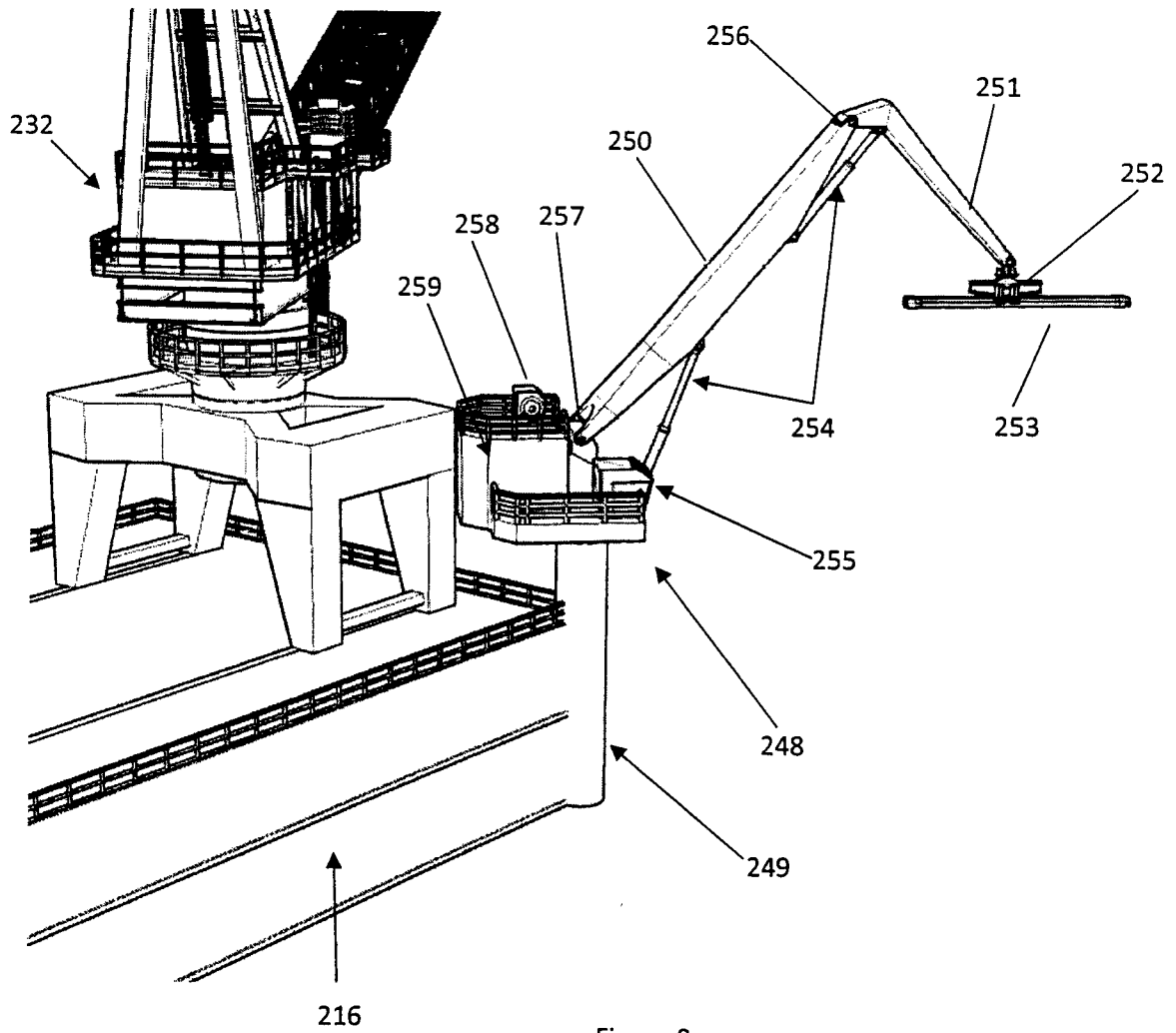
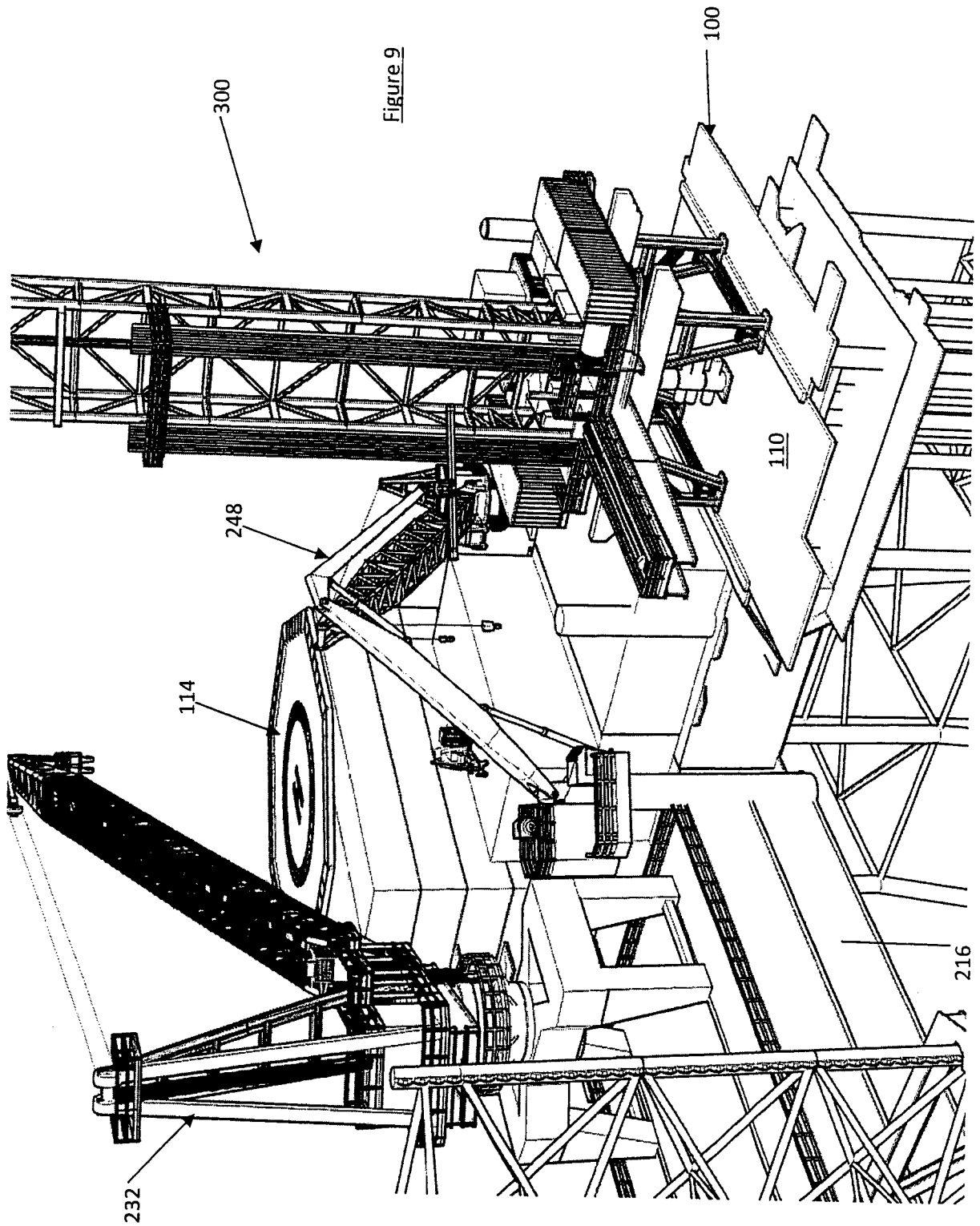


Figure 8

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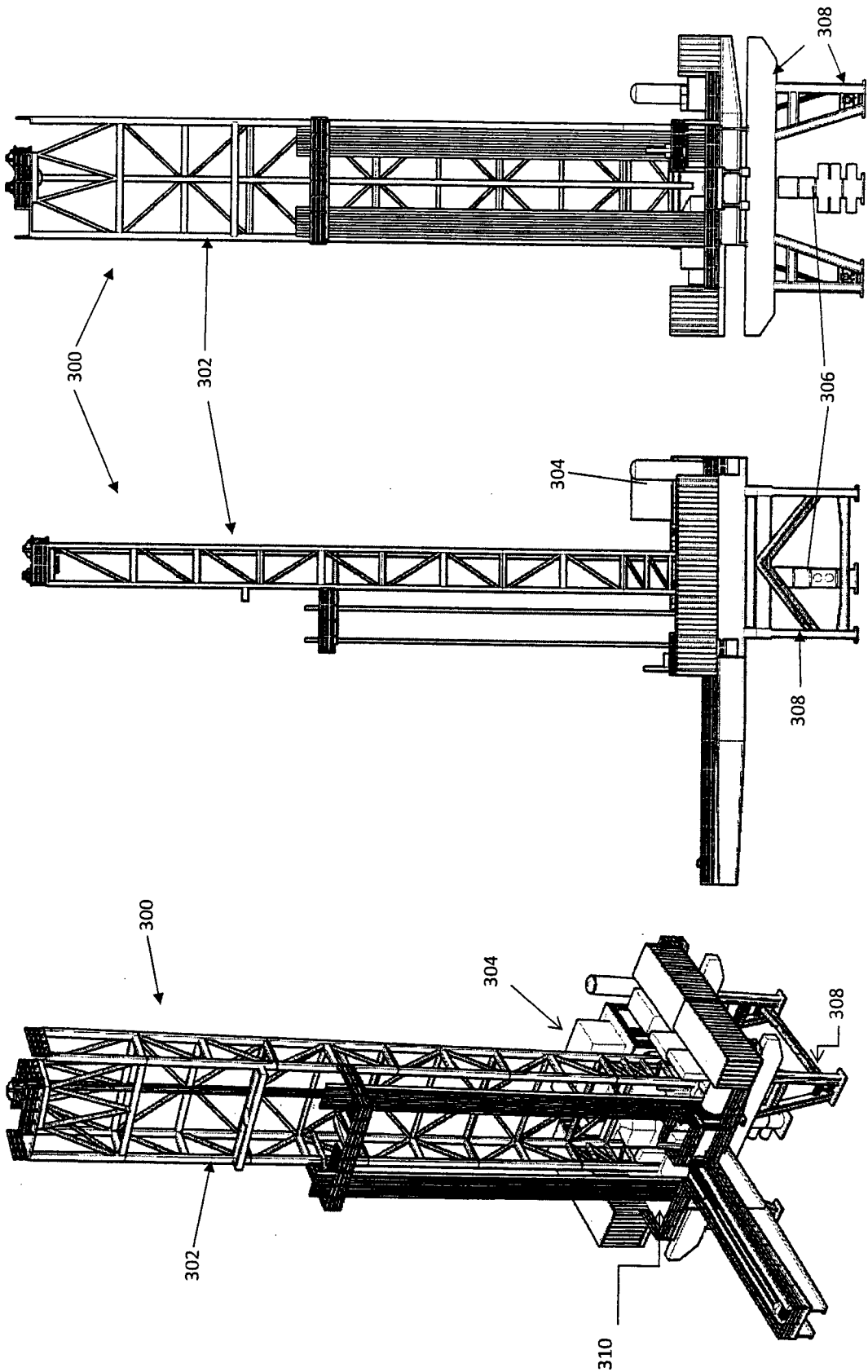


Figure 12

Figure 11

Figure 10

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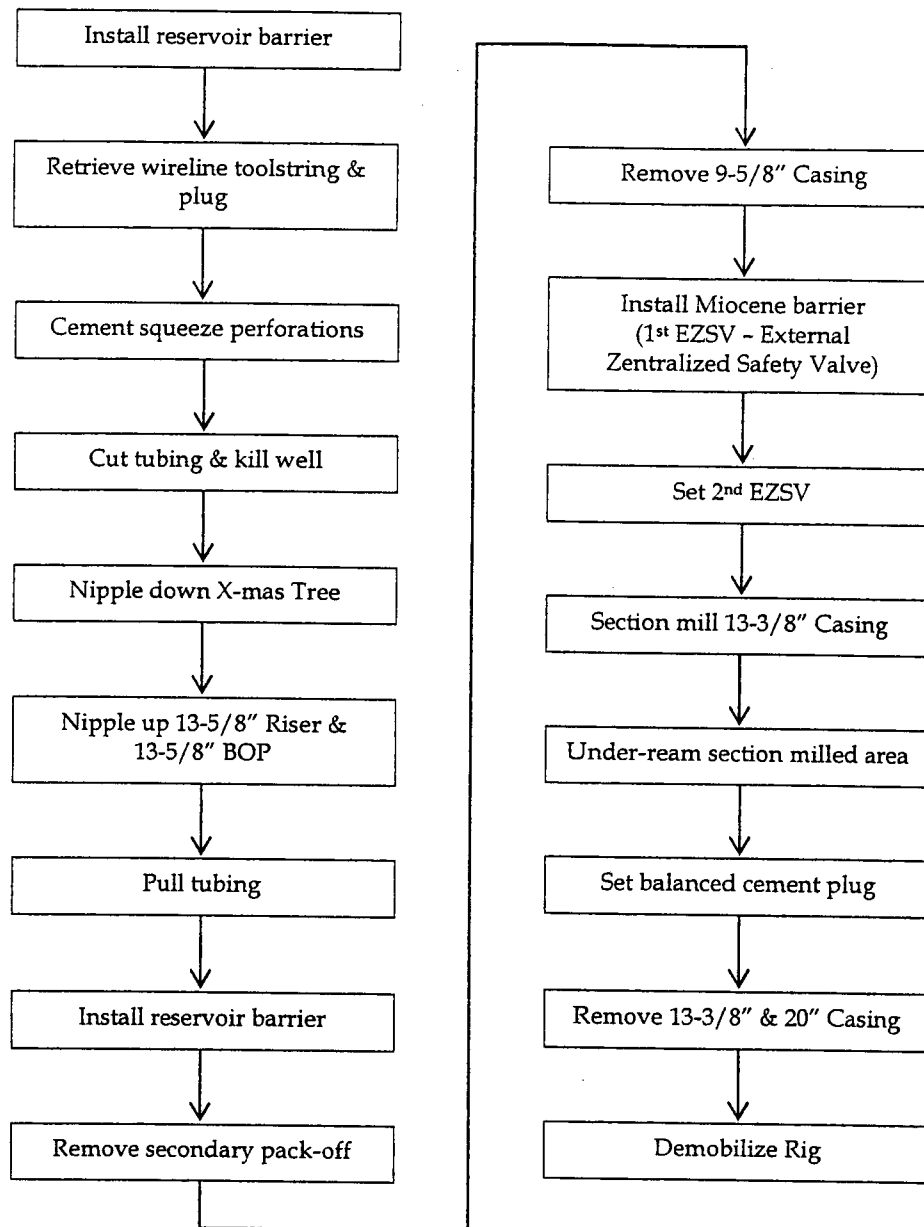


Figure 13

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SG2011/000251

A. CLASSIFICATION OF SUBJECT MATTER																						
Int. Cl.	E02B 17/00 (2006.01)	B63B 35/44 (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) EPODOC, WPI - E02B17 with keywords and keywords alone: disassemble, decommission, dismantle, hull, pontoon, ship, tow, buoyant, vessel, cantilever, slide, offshore, drilling and like terms																						
C. DOCUMENTS CONSIDERED TO BE RELEVANT																						
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																				
X	US 6729804 B1 (ROODENBURG et al) 4 May 2004. See claim 15, Column 4 lines 1-5, 12, 34-36, column 6 lines 52-54, Fig 10, Column 4 lines 6, 7.	1-10																				
Y	Same references.	1-10																				
Y	US 5419657 A (DAVIS) 30 May 1995. See Col 2 lines 10-12, Figs 6, 18, Col 8 lines 29-31.	1-10																				
Y	US 2008/0237171 A1 (ALTMAN et al) 2 October 2008. See paras 62, 63, 68, extension assembly 177, paras 67, 68, Figs 6, 7.	1-10																				
☒ Further documents are listed in the continuation of Box C ☒ See patent family annex																						
* Special categories of cited documents: <table border="0"> <tr> <td>"A"</td> <td>document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T"</td> <td>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</td> </tr> <tr> <td>"E"</td> <td>earlier application or patent but published on or after the international filing date</td> <td>"X"</td> <td>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</td> </tr> <tr> <td>"L"</td> <td>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)</td> <td>"Y"</td> <td>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</td> </tr> <tr> <td>"O"</td> <td>document referring to an oral disclosure, use, exhibition or other means</td> <td>"&"</td> <td>document member of the same patent family</td> </tr> <tr> <td>"P"</td> <td>document published prior to the international filing date but later than the priority date claimed</td> <td></td> <td></td> </tr> </table>			"A"	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		
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"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																			
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Date of the actual completion of the international search 24 August 2011		Date of mailing of the international search report 29.08.2011																				
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. +61 2 6283 7999		Authorized officer David Lee AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2107																				

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SG2011/000251

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6926097 B1 (BLAKE) 9 August 2005. See figs and col 4 lines 35-42.	1-10
Y	US 4973198 A (COX) 27 November 1990. See figures 1-3, column 6 lines 10-20	1-10
Y	GB 2026573 A (PETROLEO BRASILEIRO S.A.) 6 February 1980. See figs 3-6, page 2 lines 66-115.	1-10
Y	CN 101774422 A (NEPTUNE OFFSHORE ENGINEERING DEVELOPMENT CO., LTD) 14 July 2010. See English language abstract, Derwent Abstract WPI – Accession number 2010-M35150.	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SG2011/000251

This Annex lists the known "A" publication level 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 Cited in Search Report			Patent Family Member			
US	6729804	NONE				
US	5419657	NONE				
US	2008237171	CN	101772450	EP	2139755	EP 2142710
		EP	2142711	MX	2009010275	US 7815398
		US	2008237170	US	2008237173	US 2008237174
		US	2008237175	US	2008240863	US 2008243365
		US	2008247827	US	2010067989	US 2011158784
		WO	2008122898	WO	2008142575	WO 2008142578
		WO	2008152512	WO	2008152516	WO 2008155664
		WO	2008155667	WO	2009027825	
US	6926097	NONE				
US	4973198	NONE				
GB	2026573	AR	225138	BE	874521	BR 7804645
		CA	1109279	DE	2855752	DK 469078
		ES	477394	FI	783432	FR 2456167
		JP	55019392	MX	148519	NL 7812049
		NO	783857	PT	68696	SE 7812864
		US	4269542			
CN	101774422	NONE				
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.						
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