A system and method for accommodating normal, or larger than normal, support footings for the legs of an offshore jack-up rig, with the support footings now to be known as spud cans, and an improved hull design to accommodate legs with attachable spud cans, along with a method of mounting said spud cans by submerging them, lowering each jack-up leg down on the designated spud can and locking the two units in together.
JACK-UP RIG AND METHOD OF INSTALLING THE SAME ON LOCATION OF OPERATION

TECHNICAL FIELD

[0001] The present invention relates generally to offshore rigs, particularly to the jack-up type of offshore rigs. More specifically, the invention relates to a jack-up rig and method of operating a jack-up rig so that it may be installed and operable at a desired location.

BACKGROUND

[0002] Offshore rigs are widely used in many industries, for example in the construction and installation of offshore wind mills, or in the exploration and exploitation of hydrocarbon reservoirs under the seabed.

[0003] Offshore jack-up rigs are typically deployed in waters with depths of up to 150 m. A jack-up rig normally comprises a buoyant hull and three or more jack-up legs, these legs providing support for the floatable hull when in elevated conditions. When a jack-up rig arrives on a location, the legs are lowered until they rest on the soil of the seabed. After this, the hull may be jacked up using a jacking drive system to raise the hull above the water, elevating the hull to a height where operations can be performed in spite of the wave action and current present in open water situations.

[0004] The advantages of a jack-up rig when used in water depths up to around 150 m can be devoted to the mobility and flexibility of the rig; the legs can be raised with relative ease and the floating hull towed or self-propelled to another location if needed, e.g. if weather conditions dictate it or if there is a need for moving the jack-up rig.

[0005] The legs of a jack-up rig are commonly made up of tubular columns or trusses with each truss comprising vertical chords connected with cross braces normally diagonally disposed. The legs typically terminate in a jack-up support structure that rests on the seabed. These structures, known as spud cans, provide an enlarged bearing area in order to distribute the load of the rig evenly over a larger area and reduce the pressure exerted on the soil of the seabed. Typically the use of spud cans provides a reduced penetration depth of the legs required by the support structure to support the jack-up rig and/or ensures safe operation of the jack-up rig. Spud cans may also allow the jack-up rig to be operated in varied locations and soil types without having to change the length of the jack-up legs.

[0006] Spud cans are typically fixed to each jack-up leg, as well as the above mentioned benefits, spud cans also improve the ability of the jack-up rig to be supported on uneven seabeds or slopes, moreover, having spud cans mounted on each leg may allow elevation of each leg independently of each other. Spud cans are typically made up of a generally conical upper half connected to the jack-up leg and a generally conical lower half that acts as the contact interface with the seabed. The conical shape provides some degree of penetration into the seabed, serving to improve anchoring effects of the spud cans and legs in general. Some spud cans may have vertical skirts mounted along the outer edges to further improve penetration and anchoring effects in certain seabed conditions and types of soil.

[0007] In some cases, soil conditions may prove to be too unfavourable to allow safe use of conventional spud cans, hence, not providing a bearing area large enough to distribute the loads of the rig adequately. In such cases it can be necessary for instance to increase the size of the spud cans to a point where it is not feasible to have such large spud cans permanently attached to the jack-up rig. In such cases, solutions have been proposed in the prior art; U.S. Pat. No. 5,807,028 describes a supporting construction to be fastened to the seabed and act as fixed support construction for the jack-up legs. GB 2340161 describes a base which can receive a common foot structure connected to the legs instead of placing the foot structure directly on the seabed.

[0008] KR-A 10-2013-0005787, KR-A 10-2012-0139931 and KR-A 10-2012-0139932 describes a spud can attaching and detaching method on a jack-up platform. The inventions deal with specific methods of attaching and detaching the spud cans through several stages comprising a stage of changing the centre of gravity, followed by a stage of leg climbing, followed by a phase of attaching/detaching followed by a final phase of leg descent.

SUMMARY

[0009] Disclosed herein are embodiments of an offshore rig of a jack-up rig type.

[0010] According to one aspect, disclosed herein as an offshore jack-up rig, comprising a main buoyant hull serving as the platform for the rig's main deck, i.e. the basic construction on and in which the rest of the rig is built. Hulls for jack-up rigs typically have a substantially triangular shape seen in a top view, although other shapes have been known and as such the present invention is not limited to a triangular hull shape. The hull comprises leg wells through said hull each leg well comprising a jack-up leg movably coupled to said hull where each of said leg wells surrounding said legs are formed by one or more walls. Often, the vertical walls forms a triangle in a horizontal cross section, but the cross section may take other shapes e.g. round or square. Each leg well comprising a jack-up leg movably coupled to the hull as explained below and the leg has a lower end suitable for connecting to a spud can.

[0011] In one embodiment, the hull has one or more vertical shafts through said main hull, suitable for receiving jack-up legs, said shafts having inner walls with a substantially straight geometry. These shafts are typically referred to as leg wells and typically a jack-up rig will have three or more leg wells, one for each leg. In principle, it may have two or even one leg, hence, each of said leg wells surrounding said legs are formed by one or more walls with said walls being substantially vertically straight. In one embodiment, substantially straight is taken to mean that no substantial recesses, protrusions or indentations exist on the inside of the shafts at least not on a scale in the order of the spud cans of cross section of the legs. Accordingly, in one embodiment, any recesses, protrusions, indentations or other deviation from vertical inside the leg wells is less than the longest diameter of the circumscribed circle of the cross section of the leg, such as less than 50% of that, such as less than 30% of that, such as less than 20% of that, such as less than 10% of that. As explained further below, the spud cans of prior art jack-ups include a recess at the bottom end of each leg well, arranged so that the spud cans may be retracted substantially or completely into the hull. This makes long distance transit of the jack-up feasible either under its own power, under tow or on a heavy lift. While larger spud cans may be advantageous for installation of the jack-up rig on site, they are not practical on prior art jack-up rigs because the recess must be so large that it is
prohibitive for the construction of the bulk heads of the hull, in particular considering that the torsional forces transferred from the leg to the leg well via the guide rails must be absorbed by a shorter straight section. In one embodiment, a substantially straight geometry is therefore taken to mean that 50% or less of the spud can is retractable into the leg well, such as 40% or less, such as 30% or less, such as 20% or less, such as 10% or less, such as 5% or less, such as 1% or less. In this way the invention may enable the construction of a simpler hull with relatively lower cost and/or more space inside and at the same time enable the use of larger spud cans which may be beneficial, particularly for sites with difficult soil conditions.

In one embodiment, having substantially straight sided inner walls serve the purpose of allowing the legs of the jack-up rig to be moved longitudinally through the leg wells with a relatively smaller clearance in order to save space inside the main hull and potentially simplify the design and construction of the leg wells—and thereby the complexity of the bulkheads supporting the leg wells and the hull around them.

The vertical leg wells through the hull, being substantially straight sided, also comprise an embodiment wherein the lower part of the leg well, opening to the underneath of the hull comprises minor, non-substantial recesses or protrusions. This is to be understood such that the angle between the vertical leg well and the horizontal underside of the hull may be substantially orthogonal, but can also permit depressions and/or protrusions around each leg well, thus resulting in the angle between hull underside and leg well walls being smaller respectively larger than 90 degrees. Accordingly, in one embodiment, this angle deviates less than 30 degrees from 90 degrees, such as 20 degrees or less, such as 10 degrees or less, such as 5 degrees or less.

Further embodiments comprise one or more jack-up legs installed in the leg wells in the main hull. A jack-up leg is typically formed by tubular columns or trusses with such truss comprising vertical chords connected within cross braces normally diagonally disposed. These legs have excellent resistance to the effects of wave action in rough seas. Each jack-up leg is installed in one of the previously mentioned leg wells through the interface of a jacking drive system allowing the jack-up legs to be lowered to the seabed vertically through the hull and lift the jack-up rig from the surface of the sea into a position where the jack-up rig can be operated with significantly less influence from the effects of the sea and wave action.

The spud cans are not limited to a lattice construction design for jack-up legs; hence, the invention can be applied to other types of legs in conjunction with a similar system.

In one embodiment, a jacking drive system is installed and fixed to the hull of the jack-up rig in or around the leg wells in such a way that the system can operate the jack-up legs to be lowered or raised as described above. In one embodiment, the jacking drive system comprises a leg driving structure, typically jacking gears, for driving the jack-up legs vertically up and down relative to the main hull, a support structure for said jacking gears, and a leg guide structure typically referred to as guide rails which support the jack-up legs in the leg wells while allowing the leg to move in the vertical direction. In the following jacking gears will be used as an example of a driving structure and guide rails as an example of a guide structure.
Some embodiments, the invention may reduce cost and/or allow enhanced jack up hulls with more straight leg wells with larger or even normal spud cans.

In one embodiment, the jack-up legs and spud cans attach to each other through a coupling interface system; the coupling interface system may be of various designs. In one embodiment, the interface system is of the same type as jacking drive system of leg rails and rack and pinions used in the jacking gears as may prove advantageous in some embodiments.

In some embodiments, spud cans may be welded in the legs permanently particularly for rigs where the expected use of the rig does not envision long rig moves. While it is typically not advantageous to performing welding requiring high strength under water it may be preferable e.g. out of cost consideration and/or simplicity.

In many embodiments, the spud cans will be connected wet i.e. submerged. Dry connection of the spud cans to the legs may also be feasible. In one embodiment, the jack up is placed on a risible platform such as a large heavy lift and the spud can be placed underneath the jack-up on a dock, barge, boat or floating on its hull.

Another embodiment of the invention has a wedge and groove system for coupling the jack-up leg and the spud can, in which the spud can has special fittings on its upwards facing area to which the legs can attach. Each column of the leg has multiple grooves or teeth fitting into similar grooves or teeth in the spud can. In a further embodiment, these corresponding sets of teeth can be locked together by inserting a wedge in the spud can fitting, thus forcing the corresponding sets of teeth together and locking the spud can and jack-up leg to each other. Such a mechanical coupling has several advantages over for instance a hydraulic coupling: it is simpler, more cost effective and is inherently safer and more reliable when exposed to the harsh conditions of a subsea environment.

In one embodiment, the sets of teeth mentioned in the above is comprised of a single groove in the spud can fitting and a corresponding single groove in the jack-up leg columns. These two are aligned when the column is inserted vertically into the spud can fitting. In this position, the aligned grooves can accommodate the insertion of a wedge that locks the spud can fitting and column together rigidly.

In one embodiment, the wedge mentioned in the above is locked in place by one or more pins inserted into the wedge and the spud can fitting, locking the two together and preventing the wedge from coming loose, consequently preventing the teeth locking the jack-up leg and spud can fitting from losing their connection. This locking mechanism should be engaged when the jack-up leg has connected to the spud can via the coupling interface system.

In some embodiments, the locking mechanism can be activated in different ways. One embodiment includes a remote operated engagement system, for instance via an interface in the main control room of the jack-up rig, or in another instance from the bridge of an accompanying towboat, alternatively from the main deck of the jack-up rig or any other location deemed suitable for controlling the spud cans, e.g. in the same location where the jack-up legs and the jacking drive system itself is controlled and monitored.

In another embodiment, the system is engaged locally on the jack-up leg and/or spud can. This requires direct access to the spud can or jack-up leg and may be accomplished by the use of a remote-operated-vehicle (ROV) or by the employment of divers. This method may be more cost effective compared to a remotely controlled engagement system as the costs and relative rareness of the need for attaching or detaching the spud cans may outweigh the potential time savings of a remotely operated solution, although it may be argued whether the first option is inherently safer than deploying divers.

In one embodiment, the spud can has a ballast system enabling it to adjust its buoyancy, allowing it to either stay afloat or be lowered to the sea floor. In the present context the term sea floor is used to designate a resting place for the spud can as it is submerged—typically the seabed. However, the sea floor may be a subsea construction for holding the spud can or other suitable device for holding the spud can during the connection procedure. For example it may be desirable to have the spud cans floating during transit, being towed to the location of the jack-up rig. When jacking down the legs to the seabed on the other hand, the spud cans should typically not be buoyant but rather be resting on the seabed attached to the jack-up legs. Generally, the spud cans may comprises a flushing system for assisting the release of the spud can when the rig needs to be moved from one operating position to another.

An embodiment of the invention comprises a method with which the spud cans are installed on the jack-up legs of a jack-up rig.

In one embodiment, the method of attaching spud cans to the jack-up legs comprise a procedure where the spud cans are moved, either towed or lifted, to a desired location for mounting the spud cans. This will typically be a place with suitable water depth for performing the operation and preferably sheltered so that the motions of the jack-up can be minimized during installation. In relation hereof, the spud cans are submerged and lowered to the sea floor or other suitable rest e.g. by means of a ballast system, adjusting the buoyancy of the spud cans. Once a spud can is resting on the sea floor, the jack-up rig, floating on its main buoyant hull or on a transport e.g. a heavy lifter, may be moved or towed into position such that it has a jack-up leg positioned directly above and aligned with the spud can. During this process, the leg may be partly extended towards the spud can. When the spud can and leg has been aligned, the jack-up leg is lowered down through the water to the top of the spud can. The coupling interfaces between the jack-up leg and spud may ensure a fit between the two and allow them to be locked together by various means as described above. Alternatively or in combination with lowering the leg to the spud, the spud can may be hoisted up to the leg. With the jack-up leg and spud can connected and locked together the procedure is repeated for remaining jack-up legs until all legs have been fitted with spud cans.

When this is accomplished the jack-up legs are raised to a level where the spud cans are raised to immediately below the main hull or to at least enough clearance to stay clear of the seabed.

In this state, the jack-up rig can be transported to the actual site of operation for which the spud cans have been designed. The jack up rig may then begin operating such drilling a well or building an offshore construction.

In one embodiment, the spud cans of all legs of the jack-up rig are lowered to the sea floor before the jack-up rig is moved into position, in which case the spud cans are placed on the sea floor such that they are aligned with the jack-up legs. Consequently, the legs can be lowered onto the spud cans in a more efficient manner.
In another embodiment, the spud cans are lowered to the sea floor one at a time with the jack-up rig moved into position and the leg jacking down upon said spud can. When one leg is attached and locked to the spud can, the procedure is repeated: another spud can is lowered to the sea floor, the jack-up rig is moved into position and the jack-up leg lowered and fastened and then raised again. This procedure is then repeated until all legs have been attached to their corresponding spud cans.

In one embodiment, the jack-up legs may be lowered into the sea to a designated depth. To fasten the spud can, it is hoisted up from the sea floor and onto the legs, then locked into place.

In some embodiments, the attachment of the spud cans is performed at the site of operation where the spud cans may be optionally lowered to the seabed for installation via any of the above described methods.

The following is an itemized list of some embodiments of the invention:

1. A jack-up rig comprising a main buoyant hull, one or more vertical shafts referred to as lake wells, through said hull, suitable for receiving jack-up legs, said lake wells having inner walls with a substantially straight geometry such that no substantial recesses, indentations or protrusions exist on the inside of the lake wells.

2. The lake wells described in item 1, wherein the lower part of the lake well opening to the underneat of the hull may comprise minor, non-substantial recesses or protrusions.

3. A jack-up rig as described in item 1-2, further comprising one or more jack-up legs.

4. A jack-up rig as described in item 1-3 with said jack-up legs mounted to be lowered or raised by a jacking drive system, said system attached to the main hull to facilitate movement of the jack-up legs vertically through the hull.

5. A jacking drive system as described in item 4, said jacking drive system comprising jacking gears for driving said jack-up legs vertically up and down relative to the main hull, a support structure on which the jacking gears are installed, and leg guide rails for guiding the movement of the jack-up legs and providing structural support of said legs, in the lake wells described in item 1.

6. A jack-up rig as described in item 5 with said jack-up leg guide rails mounted on the inside of the lake well at each end respectively and in such a manner that the lower guide rails are positioned as close to the bottom of the hull of the platform of the jack-up rig as possible.

7. A jack-up rig as described in item 3, further comprising separate spud cans attachable to a jack-up leg.

8. The jack-up leg of item 3, further comprising a coupling interface system allowing the coupling of a spud can and said jack-up leg.

9. The coupling interface system of item 8, being of a design based on a wedge and groove principle in which the columns of said jack-up leg are fitted to appropriate fittings installed on the top faces of said spud cans, with both jack-up leg column and spud can fitting having corresponding sets of teeth or grooves that may be locked together after insertion of a jack-up leg column into a spud can fitting.

10. The coupling interface system of item 8, wherein the spud can fitting and jack-up leg columns have a single groove each, that are aligned when the jack-up leg column is inserted vertically into the spud can fitting.

11. The coupling interface system of item 8-10, in which the interface may accommodate the insertion of a wedge to lock said spud can fitting and jack-up leg column fixedly to each other, in such a way that the wedge pushes the set of teeth of the spud can fitting into the corresponding teeth of the jack-up leg column.

12. The coupling interface system of item 8-10, wherein the wedge described in item 12 is locked in place by the insertion of one or more pins, locking the wedge and spud can fitting mentioned in item 9 together.

13. The coupling interface system of item 8, wherein the coupling interface system is remotely operated, such as from the main control room of the jack-up rig, such as from the same location as the jack-up legs are operated.

14. The coupling interface system of item 8 wherein the coupling interface system requires on site manipulation to be locked such as by the use of a Remote-Operated-Vehicle, such as by diver assistance.

15. The spud cans of item 7 wherein the spud can has a system to adjust buoyancy allowing it to be lowered beneath surface level of a body of water.

16. A method for operating a jack-up rig in which separate spud cans are attached to the legs of a jack-up rig, comprising the following steps:

a. The spud cans are lowered to the seabed in a position accessible to the jack-up rig, allowing the jack-up legs to be attached to the spud cans,

b. The jack-up rig, floating on its main buoyant hull, is moved into position so that the given jack-up leg is located directly above the spud can resting on the seabed,

c. Each leg is lowered through the lake wells in the hull and powered by the jacking drive system until the leg connects with the appropriate spud can on the seabed,

d. The spud can and jack-up leg are fastened together by means of the fastening mechanism described in item 8,

e. The process is repeated for each leg of the jack-up rig until all legs have been connected to a spud can.

17. A method for operating a jack-up rig as described in item 16, where the method is performed on a location with favourable soil conditions in relative proximity to the operational location.

18. A method for operating a jack-up rig as described in item 16, where the method is performed on the location of the operation.

19. A method for operating a jack-up rig as described in item 16, where all spud cans are lowered to the seabed, aligned to the jack-up rig and the jack-up legs are lowered down onto the spud cans.

20. A method for operating a jack-up rig as described in item 16, where one spud can is lowered to the seabed at a time, the jack-up rig moved into place and aligned to the spud can and the leg consequently lowered to and fastened to the spud can.

21. A method for operating a jack-up rig as described in item 16, where the spud cans are lowered to the seabed, the jack-up rig moved into place and aligned to the spud can and the leg consequently lowered into the sea, but not all the way to the seabed, whereafter the spud cans are hoisted from the seabed up onto the legs and fastened.
BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a jack-up rig according to an embodiment of the invention.

FIG. 2 shows a side view of the hull and jack-up leg area of a jack-up rig according to an embodiment of the invention.

FIG. 3 shows a jack-up leg with an attached spud can according to an embodiment of the invention.

FIG. 4 depicts a side view of a detachable spud can with a jack-up leg attached according to an embodiment of the invention.

FIGS. 5a-f illustrate a method of installing detachable spud cans to a jack-up rig according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows an embodiment of a jack-up rig 100 and its main features: a buoyant main hull 101, in which vertical shafts, known as leg wells 102, run from the upper deck to the underside of the hull. Through the leg wells, jack-up legs 103 are installed and connected to a jacking drive system 104, allowing the legs to move up and down vertically to allow the main hull to be lifted out of the water and stand fixedly on the legs, resting on the seabed. At the end of each jack-up leg is installed a spud can 105, the purpose of which is to distribute the load of the jack-up rig across a larger area to reduce penetration depth into the seabed when the legs are lowered into the seabed.

Furthermore, one embodiment of the jack-up rig may comprise a derrick area, an accommodation area 107 of the rig, housing all personnel quarters, mess area, control rooms, etc. and a helipad 108 for delivering and extracting personnel, supplies etc. to the rig during operations at sea.

FIG. 2 shows a cut-out of the main hull 101 of a jack-up rig, specifically the part of the hull containing the leg well 102 through which a jack-up leg 103 runs. The jack-up leg is installed by means of a jacking drive system 104.

The leg wells have substantially straight walls 201 to have as simple and robust construction as possible, reducing the complexity of bulkheads and thus production costs.

The jacking drive system 104 is installed in and on top of the main hull 101 and comprises jacking gears 202 connected to the jack-up legs 103, driving them vertically up or down, along with leg clamping devices 203 fixing the legs in position, when the desired height of the platform has been achieved, and finally several sets of guide rails 204. The guide rails serve to guide the leg as it moves longitudinally along the leg well and ensure the structural integrity of the system; typically, the further apart the upper and lower sets of guide rails are, the less forces are imposed by the legs on the hull, hence, a lighter structure may be used and/or harsher conditions can be tolerated with the same structure emphasizing the benefit of moving the guide rails down to the bottom of the leg wells.

The greyed out areas 205 indicates where there would otherwise be recesses for receiving spud cans for prior art jack-up rigs. In the present invention, since the spud cans are detachable and/or mounted after a longer transit, there is no need for recesses to house the spud cans when the legs are raised into the hull. The spud cans are detachable spud cans 205 with fittings 206 attached. The spud can comprises a hollow construction 301 with fittings 302 attached to the upper face 303 of the spud can. Each fitting is part of the coupling interface system 304 that attaches the columns 305 of the jack-up legs to the spud can itself and lock them in place, creating a fixed construction able to withstand the harsh conditions and forces of a subsea environment.

FIG. 3 shows a jack-up leg 103 with a spud can 105 attached. The spud can comprises a hollow construction 301 with fittings 302 attached to the upper face 303 of the spud can. Each fitting is part of the coupling interface system 304 that attaches the columns 305 of the jack-up legs to the spud can itself and lock them in place, creating a fixed construction able to withstand the harsh conditions and forces of a subsea environment.

FIG. 4 shows a side view of one embodiment of a detachable spud can 105 and in detail an embodiment of the coupling interface system 304. On the upper face 303 of the spud can are installed fittings 302 for each column 305 of the jack-up leg 103. At the lower end of each column a set of column teeth 401 corresponds to a set of fitting teeth 402 on the spud can fitting 302. When the column is inserted into the column slot 403, the column can be locked in place by wedges 404 pushing the fitting teeth into the column teeth, the teeth being able to pivot around a hinge mechanism 407. By inserting pins 405 into slots 406 in the fitting and wedges, the wedges are fastened to the fitting effectively locking the jack-up leg to the spud can once the process has been repeated for all columns. It should be noted that other embodiments utilising other principles of fastening the legs and spud cans to each other may be applied and this particular embodiment is exemplary.

FIG. 5a-f illustrates one embodiment of a method through which detachable spud cans can be installed on the jack-up legs of a jack-up rig. In FIG. 5a, the detachable spud cans 105 are transported by a support vessel 501 to a location in proximity of the intended operational location, but with more benign soil conditions and water depths. The spud cans are lowered to the seabed 502 by a hoisting system 503 on the support vessel 501 and placed such that they are ready to be aligned with the jack-up rig 100.

FIG. 5b shows the jack-up rig 100 floating on the sea surface 504 and positioned directly above the spud cans resting on the seabed. In this position the jack-up legs 103 are lifted completely out of the water and the lower parts encased in the buoyant hull 101 such that the legs are supported entirely by the floating hull.

In FIG. 5c: one jack-up leg has been lowered onto, and fixed to, its corresponding spud can positioned on the seabed. The process is repeated for the remaining jack-up legs in FIG. 5f resulting in all the legs having spud cans installed and resting on the seabed.

In FIG. 5e the legs have been raised once again, allowing the rig to be towed from the spud can installation location to an operation location. FIG. 5f illustrates the jack-up rig on an operation location 505. The jack-up legs have been lowered to the seabed and the jack-up rig is raised above sea level in a position 506 ready for performing operations. In this position the legs completely support the main hull of the rig, effectively removing the main hull from the effects of the sea and wave action to provide safer working conditions compared to being afloat on the sea surface.

The method disclosed in FIG. 5a-f summarises just one embodiment, and it should be emphasized that several variations in the method may be applicable and beneficial on the conditions of the location, the exact design of the spud cans, the coupling interface system, etc.

What is claimed is:

1. A jack-up rig comprising:
a main buoyant hull,
three or more leg wells through said hull,
a jack-up leg in each of the leg wells, the jack-up legs movably coupled to said hull;
each of said leg wells surrounding said legs are formed by
one or more walls, and
said walls are substantially vertically straight.
2. The jack-up rig according to claim 1, further comprising
a jacking drive system, wherein said jack-up legs are mounted
so as to be individually lowered or raised by the jacking drive
system, the jacking drive system attached to the main hull to
facilitate movement of the jack-up legs vertically through the
hull.
3. The jack-up rig according to claim 1, further comprising
a jacking drive system, wherein said jack-up legs are mounted
in each leg well so as to be lowered or raised by the jacking
drive system attached to the hull,
said jacking drive system comprising:
a leg driving structure for driving said jack-up legs ver-
tically up and down relative to the main hull,
a support structure on which the leg driving structure is
installed, and
a leg guide structure for guiding the movement of the
jack-up legs and providing structural support of said
legs,
wherein at least part of the leg guide structure is mounted
close to the bottom of the hull.
4. The jack-up rig according to claim 3, wherein:
the leg driving structure comprises jacking gears; and
the leg guide structure comprises guide rails.
5. The jack-up rig according to claim 3, wherein at least
part of the leg guide structure is mounted within 10 m to the
bottom of the hull.
6. The jack-up rig according to claim 3, wherein at least
part of the leg guide structure is mounted within 7 m to the
bottom of the hull.
7. The jack-up rig according to claim 3, wherein at least
part of the leg guide structure is mounted within 6 m to the
bottom of the hull.
8. The jack-up rig according to claim 3, wherein at least
part of the leg guide structure is mounted within 4 m to the
bottom of the hull.
9. The jack-up rig according to claim 3, wherein at least
part of the leg guide structure is mounted within 3 m to the
bottom of the hull.
10. The jack-up rig according to claim 3, wherein at least
part of the leg guide structure is mounted within 2 m to the
bottom of the hull.
11. The jack-up rig according to claim 3, wherein at least
part of the leg guide structure is mounted within 1 m to the
bottom of the hull.
12. The jack-up rig according to claim 1, further comprising
separate spud cans attached to the lower end of each
jack-up leg.
13. The jack-up rig according to claim 1, further comprising
a coupling interface system allowing the coupling of a
spud can and a jack-up leg.
14. The jack-up rig according claim 13, wherein the coupl-
ing interface system is remotely operated.
15. The jack-up rig according claim 13, wherein the coupl-
ing interface system is remotely operated from the main
control room of the jack-up rig or from a same location as the
jack-up legs are operated.
16. The jack-up rig according to claim 12, wherein said
spud can comprises a system to adjust buoyancy.
17. A method of operating a jack-up rig comprising a main
buoyant hull, three or more leg wells through said hull, a
jack-up leg in each of the leg wells, the jack-up legs movably
coupled to said hull, the method comprising:
submerging a spud can for each leg to a position accessi-
table to the jack-up rig,
allowing a jack-up leg to be directly attached to said spud
can,
floating the jack-up rig (e.g. on its main buoyant hull) and
moving it into position so that the jack-up leg is located
directly above the spud can, and
connecting the leg with the spud can by lowering the leg
through the leg wells in the hull and/or hoisting the spud
cans up onto the leg.
18. The method according to claim 17, wherein the jack-up
rig is floating on its main buoyant hull.
19. The method of claim 17, further comprising raising the
jack-up legs with attached spud cans to a level where the
spud cans have clearance, transporting the jack-up rig to a site
of operation for which the spud cans have been designed, install-
ing the jack-up rig by lowering the spud cans to the seabed,
and operating the jack-up.
20. The method of claim 17, further comprising raising the
jack-up legs with attached spud cans to a level where the
spud cans have clearance immediately below the main hull, trans-
porting the jack-up rig to a site of operation for which the spud
cans have been designed, installing the jack-up rig by lower-
ing the spud cans to the seabed, and operating the jack-up.
21. The method of claim 17, where the method is per-
formed on the location of an operation of the jack-up rig.
22. The method of claim 17, where all spud cans are
lowered to the sea floor, aligned to the jack-up rig, and the jack-up
legs are lowered down onto the spud cans and connected.
23. The method of claim 17, where one spud can is lowered
to the sea floor at a time, the jack-up rig moved into place and
aligned to the spud can, and the leg lowered to and fastened to
the spud can.
24. The method of claim 17, where the spud cans are
lowered to the sea floor, the jack-up rig moved into place and
aligned to the spud can and the leg lowered into the sea, but
not all the way to the sea floor, and the spud can is hoisted
from the sea floor up onto the legs and fastened.