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DRAWINGS ATTACHED

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(54) FLOATABLE STRUCTURE FOR SUPPORTING OFF-SHORE WELL-DRILLING APPARATUS

(71) We, THE OFFSHORE COMPANY, a corporation organized under the laws of the State of Delaware, United States of America, of P.O. Box 2765, Houston, Texas 77001, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to a floatable structure for supporting off-shore well-drilling apparatus and includes one or more legs for raising the structure to its desired position for drilling.

An object of the present invention is to provide an improved drilling platform which provides stable footing under all conditions of the bottom which may be encountered at the drilling site.

Another object is to provide an improved drilling platform having legs which are tightly secured in their upper position to prevent vibration during movement of the platform.

Still another object of the present invention is to provide an improved drilling platform having footing tanks which may alternatively be secured to the hull and to the legs and which when secured to the hull, provide a minimum of drag to the movement of the platform through the water.

A still further object is to provide a vessel which includes its own propulsion for movement on water to a marine drilling site and may be jacked up on its legs to provide a stable drilling platform.

A further object is to provide an improved vessel which can be supported in drilling position on legs and which has a sufficiently low centre of gravity to be stable when moving on the water.

According to the present invention there is provided a floatable structure for supporting off-shore well-drilling apparatus including a self-propelled buoyant vessel, a footing tank, and a leg, said vessel and said footing tank defining aligned holes through which said leg extends, means for releasably securing said footing tank to said vessel, means for releasably securing said tank to said leg, and means for positively moving said leg through said vessel and said footing tank in both directions when said tank is secured to said vessel and for positively moving said leg, with said footing tank secured near the lower end thereof, through said vessel so that said vessel may be raised above the water with said footing tank secured thereto and with the footing tank secured to the lower end of said leg, respectively.

Further according to the present invention there is provided a floatable structure for supporting off-shore well-drilling apparatus comprising a self-propelled buoyant vessel, said vessel defining a plurality of of recesses on its underside, a plurality of footing tanks adapted to be received in said recesses, said recesses being of sufficient size to receive the entire footing tanks therein and to thereby minimize the drag against movement of said vessel, a plurality of legs, said vessel and said footing tanks defining aligned holes through which said legs extend, means for releasably securing said footing tanks in said recesses, means for releasably securing each one of said footing tanks to one of said legs, and means for positively moving said legs through said vessel in both directions.

A preferred embodiment of the present invention is hereinafter set forth and explained with reference to the drawings wherein:

Fig. 1 is a plan view of a marine drilling platform constructed in accordance with the present invention.

Fig. 2 is a side elevation of the drilling

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platform shown in Fig. 1,

Fig. 3 is a detail partial sectional view of one leg showing the guides for the legs with the legs in their uppermost secured position.

Fig. 4 is a partial schematic view of the platform and showing one of the legs and the respective footing tank with the leg secured to the vessel and the footing tank in position for movement of the vessel on the water,

Fig. 5 is a similar schematic view of the vessel raised and said one of the legs with the respective footing tank secured to the lower end of the leg to provide an extended bearing surface for the lower end of the leg on the bottom,

Fig. 6 is another similar schematic view showing the vessel raised and said one of the legs with the footing tank secured to the vessel,

Fig. 7 is an elevation view of a joint connection in one of the legs,

Fig. 8 is a sectional view taken across one of the joints of the leg along line 8 - 8 in Fig. 7,

Fig. 9 is a sectional view of the joint shown in Fig. 8 taken along the line 9 - 9.

The platform includes a buoyant vessel 10, which has its own propulsion system, as shown in Figs. 1 and 2. The vessel is provided with the legs 12 which are adapted to be lowered through the vessel 10 with suitable jacking mechanisms. Also, the usual well-drilling equipment such as a derrick and cranes are mounted on the vessel 10. While four legs 12 are shown, the vessel 10 may have three or more of such legs without departing from the scope of the present invention. Each of the legs 12 extends through a well 14 in vessel 10. The lower portion of vessel 10 surrounding the wells 14 defines recesses 16 in which footing tanks 18 are positioned during movement of the vessel 10 on the water. Each of the tanks 18 is designed to receive the respective leg 12 therein and to allow the leg 12 to move therethrough.

As shown in Fig. 3, each of the wells 14 includes lower guides 20 and upper guides 22 for the respective leg. The lower ends of the legs 12 are slightly larger than the remainder of the legs so that when the legs 12 are in their uppermost position they are held tightly within the wells 14. In this position the legs 12 are secured against movement and vibration during movement of vessel 10. To further secure the legs 12 in their uppermost position, suitable wedges 23 are inserted between the legs 12 and the upper guides 22.

The footing tanks 18 each include means 24 for releasably securing the footing to its associated leg 12 and the means 26 for releasably securing it to the vessel 10 within its recess 16. Additionally, means 28 is provided to releasably secure the vessel 10 to each of the legs 12 and to positively move each of the legs 12 in both directions through its well 14 in vessel 10. Each of the means 28 includes upper lock pins 30, lower lock pins 32 and the usual jacking means (not shown) for moving the pins 30 and 32 horizontally relative to the respective leg. The legs 12 each include interconnected structural members and the lower end of each of the legs 12 includes an integral footing tank 34.

The buoyant vessel 10 has its own propulsion means and is sailed to the drilling site with the footing tanks 18 secured in the position shown in Fig. 4. The means 24 secures each footing tank to the lower end of its leg 12 and the legs 12 are secured by the means 28 in the uppermost position so that the footing tanks 18 are held within their respective recesses 16. If desired, the footing tanks 18 may be held in their recesses 16 by the means 26 and the means 24 may be in their released position. This position of the footing tanks 18 minimizes the drag which the tanks cause during the movement of the vessel 10 through the water. With the vessel 10 in position over the preselected drilling site, the type of bottom determines whether the legs 12 should be lowered with the footing tanks 18 secured thereto as shown in Fig. 5 or without the footing tanks 18 secured thereto as shown in Fig. 6. When the bottom is relatively soft and has a limited bearing capacity, the footing tanks 18 are secured to the legs 12 as hereinafter described to provide sufficient bearing capacity to support the vessel 10 in a raised position. If the bottom conditions are such that only a limited bearing area is needed to support the raised vessel, then the footing tanks 18 are held secured to the vessel 10 in their recesses 16 while the legs 12 are lowered.

If it is desired to lower the footing tank 18 with each of the legs 12, the footing tanks 18 are first secured to the vessel 10 by the means 26 and then their legs 12 are lowered a short distance to project a few feet below the lower surface of footing tank 18. Thereafter the means 24 are actuated to secure the footing tanks 18 to their respective legs 12, and then the means 26 are released. The legs can then be positively moved downwardly with respect to the vessel 10. When the tanks 34 and the footing tanks 18 engage the bottom, further relative movement of the legs 12 through the walls 14 raises the vessel 10 above the water to the position shown in Fig. 5. The projection of the lower ends of the legs 12 below the lower surfaces of the footing tanks 18 causes a greater penetration into the bottom and provides lateral stability. The extended

lower surfaces of the footing tanks 18 greatly increases the bearing areas of the legs 12 in engagement with the bottom to thereby provide a greatly increased stability of the vessel 10 in its raised drilling position.

When the drilling site is over a bottom which is relatively hard, the extended bearing areas of the footing tanks 18 may not be desired. Under such conditions, the means 26 are actuated to secure the footing tanks 18 to the vessel 10 in their respective recesses 16 and then the means 24 are released to allow the legs 12 to be positively moved downwardly through the wells 14 of vessel 10 and the footing tanks 18. As shown in Fig. 6, when the tanks 34 of legs 12 have firmly engaged the bottom, further jacking of the legs 12 through the vessel 10 raises the vessel 10 above the water surface to provide a stable platform from which drilling operations can be conducted.

The legs 12 normally are very long with a length of 350 feet being expected. Since the projection of the legs 12 below the vessel 10 would cause drag on the movement of the vessel and may even ground the vessel and the extension of the legs upwardly decreases the stability of the vessel, a portion of the legs 12 is made to be removable. This removable portion may be secured on the deck during movement of the vessel 10. Figs. 7, 8 and 9 illustrate a joint between the removable section 36 and the main section 38. Each of the longitudinal members 40 of the main section 38 has a spigot 42 adapted to be received in the socket 44 on the longitudinal members 46 of the removable section 36. The spigot 42 is an upstanding tubular portion having a reduced external diameter from member 46 and the socket 44 is a tubular section of increased thickness and an internal diameter slightly larger than the spigot 42. Securing means 48 is provided to maintain the spigot 42 in its desired position within the socket 44. When the removable section 36 has been secured to the main section 38, the whole structure functions as a unitary leg for supporting the vessel 10 as previously described.

The securing means 48 includes the arcuate locking segments 50. the screws 52 which control the position of the segments 50, the grooves 54, defined around the interior of the socket 44 and the grooves 56 defined around the exterior of the spigot 42. When the segments 50 are retracted completely within grooves 54. then the securing means 48 is released and the section 36 may be removed from section 38. Actuation of screws 52 to move the segments 50 inwardly so that they are partially within grooves 56 and partially within grooves 54 locks the sections 36 and 38 together. The upper and lower edges of segments 50 are bevelled to match with the tapered shape of grooves 56. Thus when the segments 50 are forced into the grooves 56, the bevels and tapers coact to bring the spigot 42 and socket 44 into the desired secured relationship with each other.

By having the removable sections 36 on the legs 12, the stability of vessel 10 can be improved by storing the removable sections 36 on the deck which lowers the centre of gravity of vessel 10. Also this reduces the dynamic loading on legs 12 during movement of vessel 10.

From the foregoing description, it can be seen that the structure of the present invention provides a stable marine drilling platform in varied conditions of the bottom of the body of water at the drilling site. This structure makes available an extended bearing area which can be secured around the lower end of each of the legs to engage the bottom and thereby increase the stability of the structure. Additionally, the footing tanks which provide these extended bearing areas are releasably secured within recesses defined in the vessel so that drag during movement through the water is minimized and can be releasably secured to the recesses when the legs are lowered through the vessel. The vessel has its own propulsion means and is provided with wells having guides for the movement of the legs therethrough and the legs are slightly enlarged at their lower ends to fit tightly into the lower guides so that the legs and footing tanks are held secure during movement of the vessel to prevent vibration of the legs.

In co-pending application No. 33021/71 (Serial No. 1296930) there is described and claimed an elongate structure comprising a main section and a removable section each having a plurality of longitudinal members, and a spigot and socket being provided between the longitudinal members of said main section and said removable section, and securing means to maintain the spigot within the socket, said securing means including a plurality of segments, an annular groove in each of said spigot and said socket. said segments being wholly contained within said groove of said socket, and means for moving said segments so that they are partially in each of two mating grooves to secure said spigot and socket.

WHAT WE CLAIM IS:—

1. A floatable structure for supporting off-shore well-drilling apparatus including a self-propelled buoyant vessel, a footing tank, and a leg, said vessel and said footing tank defining aligned holes through which said leg extends, means for releasably securing said footing tank to said vessel,

lower surfaces of the footing tanks 18 greatly increases the bearing areas of the legs 12 in engagement with the bottom to thereby provide a greatly increased stability of the vessel 10 in its raised drilling position.

When the drilling site is over a bottom which is relatively hard, the extended bearing areas of the footing tanks 18 may not be desired. Under such conditions, the means 26 are actuated to secure the footing tanks 18 to the vessel 10 in their respective recesses 16 and then the means 24 are released to allow the legs 12 to be positively moved downwardly through the wells 14 of vessel 10 and the footing tanks 18. As shown in Fig. 6, when the tanks 34 of legs 12 have firmly engaged the bottom, further jacking of the legs 12 through the vessel 10 raises the vessel 10 above the water surface to provide a stable platform from which drilling operations can be conducted.

The legs 12 normally are very long with a length of 350 feet being expected. Since the projection of the legs 12 below the vessel 10 would cause drag on the movement of the vessel and may even ground the vessel and the extension of the legs upwardly decreases the stability of the vessel, a portion of the legs 12 is made to be removable. This removable portion may be secured on the deck during movement of the vessel 10. Figs. 7, 8 and 9 illustrate a joint between the removable section 36 and the main section 38. Each of the longitudinal members 40 of the main section 38 has a spigot 42 adapted to be received in the socket 44 on the longitudinal members 46 of the removable section 36. The spigot 42 is an upstanding tubular portion having a reduced external diameter from member 46 and the socket 44 is a tubular section of increased thickness and an internal diameter slightly larger than the spigot 42. Securing means 48 is provided to maintain the spigot 42 in its desired position within the socket 44. When the removable section 36 has been secured to the main section 38, the whole structure functions as a unitary leg for supporting the vessel 10 as previously described.

The securing means 48 includes the arcuate locking segments 50, the screws 52 which control the position of the segments 50, the grooves 54, defined around the interior of the socket 44 and the grooves 56 defined around the exterior of the spigot 42. When the segments 50 are retracted completely within grooves 54, then the securing means 48 is released and the section 36 may be removed from section 38. Actuation of screws 52 to move the segments 50 inwardly so that they are partially within grooves 56 and partially within grooves 54 locks the sections 36 and 38 together. The upper and lower edges of segments 50 are bevelled to match with the tapered shape of grooves 56. Thus when the segments 50 are forced into the grooves 56, the bevels and tapers coact to bring the spigot 42 and socket 44 into the desired secured relationship with each other.

By having the removable sections 36 on the legs 12, the stability of vessel 10 can be improved by storing the removable sections 36 on the deck which lowers the centre of gravity of vessel 10. Also this reduces the dynamic loading on legs 12 during movement of vessel 10.

From the foregoing description, it can be seen that the structure of the present invention provides a stable marine drilling platform in varied conditions of the bottom of the body of water at the drilling site. This structure makes available an extended bearing area which can be secured around the lower end of each of the legs to engage the bottom and thereby increase the stability of the structure. Additionally, the footing tanks which provide these extended bearing areas are releasably secured within recesses defined in the vessel so that drag during movement through the water is minimized and can be releasably secured to the recesses when the legs are lowered through the vessel. The vessel has its own propulsion means and is provided with wells having guides for the movement of the legs therethrough and the legs are slightly enlarged at their lower ends to fit tightly into the lower guides so that the legs and footing tanks are held secure during movement of the vessel to prevent vibration of the legs.

In co-pending application No. 33021/71 (Serial No. 1296930) there is described and claimed an elongate structure comprising a main section and a removable section each having a plurality of longitudinal members, and a spigot and socket being provided between the longitudinal members of said main section and said removable section, and securing means to maintain the spigot within the socket, said securing means including a plurality of segments, an annular groove in each of said spigot and said socket, said segments being wholly contained within said groove of said socket, and means for moving said segments so that they are partially in each of two mating grooves to secure said spigot and socket.

WHAT WE CLAIM IS:—

1. A floatable structure for supporting off-shore well-drilling apparatus including a self-propelled buoyant vessel, a footing tank, and a leg, said vessel and said footing tank defining aligned holes through which said leg extends, means for releasably securing said footing tank to said vessel,

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means for releasably securing said tank to said leg, and means for positively moving said leg through said vessel and said footing tank in both directions when said tank is secured to said vessel and for positively moving said leg, with said footing tank secured near the lower end thereof, through said vessel so that said vessel may be raised above the water with said footing tank secured thereto and with the footing tank secured to the lower end of said leg respectively.

2. A floatable structure as claimed in claim 1, wherein said vessel has a recess on its underside, said recess being of sufficient size to receive said footing tank whereby said footing tank when positioned in said recess during horizontal movement of said vessel on the water, creates a minimum drag.

3. A floatable structure as claimed in claim 1 or 2, wherein said leg has interconnected structural members, and a footing structure secured to said structural members at the lower end of said leg.

4. A floatable structure as claimed in any preceding claim, in which guides are provided in said hole through said vessel adapted to engage said leg, said leg having an enlarged lower end whereby when it is in its uppermost position, it is tightly engaged by said guides and when it is in a slightly lower position it can be moved freely through said guides.

5. A floatable structure as claimed in any preceding claim, further including upper guiding means in said vessel to guide the movement of said leg through said vessel, and lower guiding means in said vessel to guide the movement of said leg through said vessel, the lower end of said leg being enlarged to have a tight fit within said lower guiding means whereby when said leg is in its uppermost position, the leg is tightly held by said lower guiding means.

6. A floatable structure as claimed in claim 5, including wedging means positioned between said upper guiding means and said leg to secure said leg with respect to said upper guiding means.

7. A floatable structure for supporting off-shore well-drilling apparatus, comprising a self-propelled buoyant vessel, said vessel defining a plurality of recesses on its underside, a plurality of footing tanks adapted to be received in said recesses, said recesses being of sufficient size to receive the entire footing tanks therein and to thereby minimize the drag against movement of said vessel, a plurality of legs, said vessel and said footing tanks defining aligned holes through which said legs extend, means fore releasably securing said footing tanks in said recesses, means for releasably securing each one of said footing tanks to one of said legs, and means for positively moving said legs through said vessel in both direction.

8. A floatable structure as claimed in claim 7, in which each of said legs includes a removable section, and provision of means for securing said removable section to the remaining portion of the leg.

9. A floatable structure as claimed in claim 8 wherein each section of said legs includes longitudinal members, and spigots and sockets are provided between the longitudinal members of said remaining portion and said removable section of each leg to secure said removable section to the remaining portion of the leg.

10. A floatable structure as claimed in claim 9 wherein said securing means includes a plurality of segments, a plurality of annular grooves in said spigots and sockets, said segments being wholly contained within one of said grooves, and means for moving said segments so that they are partially in each of two grooves to secure said spigots and sockets.

11. A floatable structure substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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