Fig. 1
MOBILE SEA PLATFORM

Fig. 4

Fig. 7

INVENTOR.

Robert G. LeTourneau

BY

Attorney
Fig. 8

Fig. 9

Fig. 10
My invention relates generally to improvements in mobile sea platforms, and particularly to floatable vessels which are convertible into stabilized structures over bodies of water, and is a continuation-in-part of my application S.N. 473,885, filed December 8, 1954, and now abandoned. My invention is especially applicable to off-shore or "oildocks" oil exploration, drilling and producing operation. Off-shore drilling platforms of the prior art of which I am aware have included the non-mobile type, built up from or supported by a permanent piling foundation, the mobile type using a sunken re-floating vessel as a base, and the mobile type using various arrangements of extendible and retractable spuds carried by a barge-like vessel. The problems attending the design of a suitable off-shore drilling platform are indeed formidable. Such a platform must be capable of supporting several thousand tons weight above the water surface with a high degree of stability, withstanding the ravages of winds, waves, and tides for all normally expected conditions. Fixed piling type platforms are subject to the serious disadvantage that their entire cost must be recovered from operations conducted at a single location. The sunken vessel type drilling platform, while used rather extensively in inland and protected water areas, does not offer promise of sufficient stability for off-shore operations. The mobile type platform carrying spuds that are extendible and retractable has been considered the most desirable type platform for off-shore operations.

It is a general object of my invention to provide an improved floatable vessel which is convertible into a stabilized structure over a body of water.

Another object of my invention is to provide an improved hull structure for certain barge-like vessels.

Another object of my invention is to provide an improved floatable spud-carrying vessel having effective means for raising and lowering the vessel on the spuds.

Another object of my invention is to provide an improved floatable spud carrying vessel wherein the vessel can be raised or lowered on the spuds within a minimum period of time.

Another object of my invention is to provide a mobile type spud-carrying off-shore drilling platform of simple but extremely rugged construction.

Another object of my invention is to provide a mobile type spud-carrying off-shore drilling platform having a relatively low first cost.

Another object of my invention is to provide a mobile type spud-carrying off-shore platform wherein the total platform load is automatically maintained in equally distributed relation among the platform supporting elements.

Additional objects and advantages of my invention will be apparent from the following description of a preferred embodiment, taken together with the accompanying drawings in which:

FIGURE 1 is a diagrammatic perspective view showing the general appearance of an off-shore drilling barge embodying principles of my invention;

FIGURE 2 is a plan view showing the vessel hull, spud wells, and spuds of a drilling platform of my invention, with a portion of the hull cut away to show corrugated transverse bulkheads;

FIGURE 3 is a side elevational view of the hull structure shown by FIGURE 1, showing extended spuds;

FIGURE 4 is a front elevational view of the structure shown by FIGURE 1, but with the spuds fully retracted;

FIGURE 5 is a perspective view of a spud well;

FIGURE 6 is an enlarged fragmentary view showing details of the arrangement of electric motors and gear boxes in a spud well, operating on a rack fixed to a portion of a spud tower;

FIGURE 7 is an enlarged plan view of a spud well with the cap plate and upper box beam removed, and showing a spud in the spud well;

FIGURE 8 is a schematic block diagram of the electric control system for the spud raising and lowering mechanism;

FIGURE 9 is a perspective view showing a modified vessel structure embodying principles of my invention;

FIGURE 10 is a perspective view showing another modified vessel structure embodying principles of my invention; and

FIGURE 11 is an enlarged perspective view, partially broken away, showing one of the electric motor and gear box units of FIGURE 6.

Turning now to the drawings, in FIGURE 1 there is shown a general arrangement of drilling apparatus on the deck 12 of a barge-like vessel 11. A derrick 13 is mounted over a slot in the forward end of the vessel 11 so that the vessel may be moved out without interference with the permanent well structure. A draw-works 15 is disposed on the side of the derrick 13 rearwardly of the slot. A housing 17 for power plant, equipment storage, etc., extends across the rear end of the deck 12. Pipe racks 19 are located off the forward end of the deck 13 on either side of the vessel 11 adjacent its forward end, the third being fixed to the center portion of the vessel rear end. A spud 23 comprising a tower portion 25 and a caisson portion 27 is carried by each spud well 21.
to, rigid truss work 49. The plates 45, 47 are sized to bear contiguously against the hull sections below their center lines and are welded thereto.

As hereinbefore mentioned, the vessel hull 11 carries three spud wells 21. The structure of these spud wells is best shown by FIGURES 5 and 7. Each spud well 21 is a combination of heavy steel plate members welded together. The outer side walls 50, 52, 54 are made up of vertical panels 51 to form three sides of a rectangle, except that the center portions of the opposite sides 50, 52 have their panels disposed slightly inwardly, and the center portion of the third side 54 has its panels disposed slightly outwardly, to enhance the structural characteristics of the assembly. The inner side walls 55, 53 are made up of vertical panels 53 to form seven sides of a generally octagonal figure. The open side of the spud well fits on to the vessel hull 11. The inner side wall 54 opposite the open side is common to the outer side wall. Next adjacent sides 61, 63 of the octagonal figure present plane surfaces each having a vertical gap 55 at its center, which gap forms the open side of a slot to receive spud gear racks, as will be hereinafter more fully described. The next adjacent inner walls 59, 65 of the generally octagonal figure are disposed slightly outward to enhance the structural strength characteristics of the assembly. The next adjacent inner walls 57, 59, 61, 65 to plane surfaces each having a vertical gap for the purpose above-mentioned. A pair of vertical trough shaped members 69, 77 of generally trapezoidal cross-section, have their open edges welded to the inner face of the spud well outer wall 54 that lies opposite the spud well open side. Each of these trough shaped members serves as a supporting structure for one edge of each of a pair of spaced parallel vertically disposed extra heavy plate members 73, 75 which in turn form the sides of a slot which receives a spud gear rack 77. Supporting structure for the side walls of each of the other two spud well slots is provided by a vertical box beam 79, 81. The box beam is held rigid by two heavy vertical steel plates 83, 85 one of which extends from the box beam to the adjacent outer side wall of the spud well, and the other of which extends from the box beam toward the vessel hull. Heavy steel cap plates 87, 89 cover the top and bottom of the spud well structure and are welded thereto. The open edges of the cap plates are rectangular, while the inner edges are octagonal, to conform to the general shape of the spud well transverse section. A pair of parallel spaced box beams 91, 93 are welded respectively to the upper and lower portions of the outer wall 54 of the spud well, to the open side, the upper spud well on the open side are shaped to conform to the contour of the vessel hull, and are welded thereto.

The spud towers 25 are fabricated of welded steel pipe and they have a generally square cross-section. Four parallel spaced vertical columns 95 made of large diameter pipe form the four corners of each spud tower. The vertical columns are held rigidly by latticed truss-work 27 made of smaller diameter pipe. The spud caissons 27 are large cylindrical tanks fabricated by welding heavy steel plate members. The ends of the tanks are closed by heavy steel caps 99, 101 having a generally conical shape. The tanks have a diameter just small enough to permit them to be retracted into the spud wells. The length of the tank is dependent upon the gross weight of the vessel and its load, for reasons to be hereinafter explained. The spud tower extends down into the caissons and is supported by the caisson bottom cap.

Each spud tower vertical column 95 carries a gear rack 77 mounted on its entire length and which extends into a spud well slot, as best shown by FIGURE 6. The gear racks 77 of diagonally opposite vertical columns of a spud tower lie in a common plane. The side walls 73, 75 of the spud well slots are made of extra heavy steel plate material. Electric motor and gear box units 103 are fixed in staggered relation to the outer faces of the slot side walls. Each electric motor 105 drives a gear box 107 which has an input pinion 109 and an output pinion 109 extending through a hole in the slot side wall to mesh with the gear rack 77. Each electric motor is provided with an electromagnetic friction brake mechanism 111 which is automatically engaged when its motor is de-energized. Details of a typical electromagnetic friction brake of the general type suitable for use in this application are shown by my U.S. Patent Number 2,756,486, issued July 31, 1956. The electric motors are controlled from a single control station. FIGURE 8 is a schematic block diagram of the motor control system. All of the motors on a particular spud tower are connected in parallel. In FIGURE 8, the block 113 labeled "MOTOR Gp. I" represents all of the motors on one spud tower, while the block 115 labeled "MOTOR Gp. II" represents all of the motors on a second spud tower, etc. Power is supplied from the block 119 labeled "ELECTRIC POWER SOURCE" to a main contactor 121 labeled "CONTACTOR ALL Gps.," to all groups simultaneously, and also through an individual contactor 123, 125, 127 for each group, labeled "CONTACTOR Gp. I," etc. All contactors have front and back contacts so that the motors may be reversed. A control station provides toggle switch control of all contactors. Each toggle switch control solenoids which in turn operate the associated contactor in the desired direction. There is a toggle switch 131 labeled "A" to control the main contactor 121, and toggle switches 135, 137, 139 labeled "I, II, III" to control the respective group contactors 123, 125, 127. Each toggle switch has an up and "U", neutral "N," and down "D" position. If the toggle switch "A" is up, all of the motors on all of the spud towers are energized and operate to raise the entire vessel hull on the spuds (or lower the spuds). When the toggle switch "A" is in the down position, all of the motors on all of the spud towers are energized and work simultaneously to lower the vessel hull (or raise the spuds). In the or desired to raise or lower one spud only, then the appropriate group toggle switch is closed in the proper direction.

The dimensions of the vessel hull, spud wells, spuds, etc., will of course depend upon the specific application for which a particular apparatus is designed. Representative approximate dimensions for an off-shore drilling apparatus capable of operation in up to 80 feet of water are as follows: vessel hull length, 140 feet; vessel hull width, 80 feet; width of hull longitudinal side members, 30 feet; diameter of vessel hull cylinders and cylinder support brackets, 20 feet; cylinder depth of spud wells, 20 feet; spud well, distance between adjacent vertical columns, 20 feet; spud towers, length overall, 145 feet; caisson diameter, 28 feet; caisson length, 38 feet.

In the prior art, it has been the practice to design spud caissons to rest with minimum penetration on the water floor. Such design does not provide the optimum degree of stability, and is especially unsuitable in locations where the foundation medium is poor. Applicant's caissons on the other hand are actually designed to obtain substantial penetration in the foundation medium. For areas where the foundation medium is good and the major caisson supporting factor is end bearing, applicant's caissons penetrate sufficiently to obtain substantial support against lateral forces. In some extensive areas, a poor foundation medium obtains for 150 feet or more below the water floor. In such areas, applicant's caissons will penetrate the foundation medium, and the relationship between caisson displacement and caisson loading will be made such that the ultimate bearing capacity of the foundation medium is utilized.

Effective caisson displacement is made variable according to the density of the foundation medium by providing for introduction and removal of liquid ballast to and from the caissons at will. Various means for introduction and control of such liquid ballast are well-known and are therefore thought not to require...
detailed description or illustration herein. By way of example, liquid ballast may be introduced to a caisson via one of vertical columns of the tower structure, and may be forced out of the caisson by means of compressed air, also introduced via a column of the tower structure. Means are also well known for "jetting out" about caissons to facilitate raising them, or to improve footing conditions.

The number and size of motors to be used will of course depend upon the total weight of the vessel hull and its load, and the desired rate of lift. Since motors are mounted to drive pinions meshing with gear racks on each corner of each spud tower, and are mounted on both sides of each spud well slot, it will be apparent that for the representative dimensions given above, about 160 foot of linear motor unit mounting space is available at each spud tower. The use of multiple motors and multiple gear racks makes it possible to employ motors, gear reductions, pinions, and gear racks of a convenient and practicable size.

Applicant’s vessel hull structure is simple and economical to build, and yet is extremely rugged. The structure allows the possibility of multiple compartments uncomplicated by bracing and truss-work, and suitable for temporary storage of fuel, water, drilling mud, and production. The inherent "torque tube" characteristic of the hull construction renders it eminently suitable for carrying the off-side spud wells.

FIGURES 9 and 10 show modified vessel structures embodying principles of my invention. In FIGURE 9, the vessel hull 141 is made up entirely of cylindrical hull sections 143, 145, 147, 149. In FIGURE 10 the longitudinal vessel hull sections 151, 153 each have side portions made of major cylinder segments 155 and top and bottom portions made of minor cylinder segments, 157 all joined by welding to form a closed body. Other modified vessel hull structures will occur to those skilled in the art, without departing from the principles of my invention. It is to be understood that the foregoing disclosure and the showings made in the drawings are merely illustrative of the principles of my invention and are not to be interpreted in a limiting sense.

I claim:
1. A plurality of spud wells carried by a vessel hull, a spud in each spud well, each said spud comprising a tower structure including a plurality of interconnected vertical columns, a rack carried by each column longitudinally thereof, a plurality of gear reduction units fixed to each well adjacent each said rack, said gear reduction units each having an output pinion in mesh with said rack, and an input pinion, an electric motor fixed to each said gear reduction unit and driving said input pinion, an electrical control system providing for selective application of power simultaneously to all of the electric motors associated with each particular spud, an electromagnetic friction brake associated with each said motor, and means for energizing said brake to release same only when said motor is energized.

2. A plurality of spuds carried by a mobile sea platform, each said spud comprising a tower structure including a plurality of interconnected vertical columns, a plurality of racks fixed to said tower structure and extending longitudinally thereof, a plurality of electrically driven gear reduction units fixed to said platform adjacent each said rack and each having an output pinion drivingly engaging said rack, a plurality of electromagnetic friction brakes linked to the gear reduction units associated with each said rack and means for energizing said brakes to release them only when said gear reduction units are energized.

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Earl J. Witmer, Primary Examiner.

William L. Mushake, Jacob Shapiro, Jacob L. Nackenoff, Examiners.