Fig. 2.

Fig. 1.

Fig. 8.

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Filed Sept. 19, 1947

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The present invention relates to so-called offshore drilling; i.e., the operation of drilling for oil in areas where the ground surface is submerged, such as the localities defined geologically as the Continental Shelf and particularly in the Gulf of Mexico and contiguous bayous where the bottoms are composed of an overburden of alluvial deposits, mud and soft sand.

My invention has for its object to provide a pier or caisson which is capable of being sunk in the soft floor of a sea to whatever depth may be required to reach a firm underlying stratum and may be built upwardly in sections to any desired height for supporting a load above tide level and storm wave height of the water.

Another object of my invention is to provide a pier in the form of a cylindrical caisson built with double exterior walls between which are spiral inclines for displacing the overburden of the sea floor as the pier is rotated.

A still further object of my invention is to provide a pier of cylindrical hollow form of substantial diameter capable of being rotated in situ by two or more surface craft or tug boats and provided around its periphery with means for dislodging material at the sea bottom around a central core to the required depth to engage an underlying supporting stratum.

To these and other ends my invention comprises further improvements and advantages as will be further described in the accompanying specification, the novel features thereof being set forth in the appended claims.

In the drawings:
Figure 1 is a side elevation of a pier or caisson embodying my invention.
Figure 2 is a top plan thereof.
Figure 3 is a vertical central sectional view of the structure taken on the line 3—3 of Fig. 2 shown before commencement of the seating operation.
Figure 4 is a similar view showing the structure when seated.
Figure 5 is a perspective view showing the upper end of a pier or caisson and the method of rotating it by surface craft to cause its lower end to become embedded in the sea bottom.
Figure 6 is a plan view illustrating one of the interior reinforcing braces for the inner cylinder.
Figure 7 is an enlarged fragmentary view of the movable piston head which overlies the central core formed by the descent of the pier.
Figure 8 is an elevational view showing several of the piers assembled as a support for a platform carrying a conventional derrick or drilling rig.

Similar reference numerals, in the several figures, indicate similar parts.

In drilling for oil and/or gas in offshore locations in certain localities, such as those bordering the Gulf of Mexico, in the bayou regions of Louisiana, as well as in the bayous themselves, considerable difficulty is experienced in obtaining a sufficiently firm foundation to support the necessary drilling rig and its appurtenances. This is due to the heavy overburden or silt or un-solidified deposit of earthy matter which is often of such thickness that it is difficult to get a foothold for an underpinning of the usual long piling to support a surface platform on which to erect a derrick, draw works, power plant and casing rack together with the necessary accommodations for the workmen and for their handling of the customary tools, particularly the drill stem used in rotary drilling operations. This fundamental difficulty in obtaining a stable platform I am able to overcome by providing a new form of pile capable of being sunk to a firm foundation, through any depth of alluvial deposit, or soft sand, and by using a plurality of them to provide a platform support of any required area and capable of sustaining a gross weight of many tons without shifting. To the above ends my invention embodies a pile unit characterized by a construction which enables it to be set in operative position by rotary action as distinguished from the customary method of sinking piles used for underpinning by driving them downwardly.

In carrying out my invention I construct my new form of pile in sections somewhat in the nature of a caisson in that it is a hollow shell capable of being built in sections to any desired length. This shell has a large diameter in proportion to its length and in ordinary offshore operations in the Gulf of Mexico an overall diameter of 30 feet is considered proper. The shell comprises an inner cylinder 18 and an outer concentric cylinder 14 sufficiently larger to provide a substantial intervening space which may be in the neighborhood of four or five feet in which there are erected two spiral ramps 12 and 13 which are continuous from diametrically opposite points at the bottom of the shell to its top. These ramps constitute enormous screw threads formed on a pitch which enables the soft mud to be easily displaced or forced upwardly thereon. The inside cylinder is impervious but the outer cylinder is provided with openings or fenestra 14 ar-
ranged in spiral fashion to allow the escape of more or less of the displaced mud. Surrounding the lower end of the outer cylinder is an outwardly flaring flange or skirt which the rim of which extends slightly beyond the leading edge of the outer cylinder bottom and serves to direct ocean bottom mud inwardly onto said ramps and further toward the center of the shell.

Within the inner cylinder is a piston head and the guiding side walls of which the lower end is rounded and carry a ring provided with an annular recess for the accommodation of packing. For holding the latter in contact with the inner periphery of the cylinder I provide semi-circular packing rings which may be adjusted as circumstances require by pressure screws 21 (see Fig. 7). This piston head is initially located at the bottom of the shell, as shown in Fig. 3, and is pushed upward as the shell descends, by the core or central column of mud 22, as shown in Fig. 4. By providing a closure over said core and shunting off the free flow of water into the inner cylinder at a point above the ocean bed the core is caused to aid both in maintaining the shell erect and preventing its lower end from being shifted either by wave action or otherwise. At suitable intervals above the uppermost portion of the piston-like piston, especially when the shell is required to be built up of a number of superposed sections to reach a desired height above tide level I provide therein cross bracing. The latter I make in the form of spiders comprising a number of arms 30 radiating from an apertured center block on which are carried segmental shoes 32 which bear against the inner side of the inner cylinder. In order to provide a simple means of adjusting the shoes I form the sections of the arms on which they are carried as separate pieces and employ threaded turnbuckle collars 33 for connecting the two sections of each arm.

As shown in the several illustrations I provide at the top of each section of the shell an outer collar 40 on the outer cylinder one half of which extends above the upper end thereof and serves to seal the lower end of the succeeding section. The collar in the first instance is secured permanently in place by a row of rivets 41 and when the next cylinder is placed therein it is firmly united thereto by a second row of rivets 42. In practice the use of two or more superposed sections is determined by two factors, one the depth of the water, at the point where the shell is to be placed and the other the thickness of the penetratable depth of the underlying bed in which it may be possible to screw the lower end of the shell. In starting the operation it is desirable to use a single section or such number thereof as will locate the top of the shell as close to the water level as may be and subsequently connect in place additional sectional lengths as may be required. For this reason it is recommended that the uppermost sections be of less length than the preceding ones.

The modulus operandi of sinking the shell consists in placing it in an upright position at the site where its weight will cause its lower end to sink into the mud bottom sufficiently to stabilize or center it when power is applied to its upper end to rotate the shell bodily. This latter operation may be effected in any appropriate manner. The diameter of the shell which provides a large leverage contributes to the successful employment of two or more tugs 50—51 connected by two lines 52—53 to eye bolts 54 on opposite sides of the uppermost section of the shell as shown in Fig. 5. The tow lines may be wrapped around the shell and extend in opposite directions from the two sides of the shell and the tugs move outwardly along straight lines to impart rotary movement to the shell as the lines unwind, or if the lines are connected to the eyebolts the tugs may “steam” in a circular path concentric with the shell as shown in Fig. 5.

The rotational movement of the shell causes the ramps 13—44 to dig into the mud, or other soft strata, that may be encountered and that which is displaced, to accommodate the thickness of the metal, is allowed to escape or is forced laterally out of the window openings 14. When the lower end of the shell reaches an impenetrable underlying stratum or has been screwed down in the ocean bottom mud to a stop point beyond which it becomes impossible to further rotate the shell it will be found that the shell has become solidly anchored, a fact which I attribute to the increasing density of the mud and to the load it adds to the shell as it rests on the ramps, or screw threads, as well as to the contained core 22.

While it is not necessary to continue the ramps in those sections of the shell lying above the ocean bed there is a convenience afforded in so doing since they serve as spacers for connection between the inner and outer cylinders, on the order of stay bolts. In addition to this, however, with sections thus made they become interchangeable in that one of them may be used as a bottom section, irrespective of whether or not, in such instances, the bottom skirt flange 15 is first applied to its lower end.

It will be readily understood that any number of the aforesaid shells may be set up and grouped in any desired pattern to provide a support for a platform 58, as shown in Fig. 8, indicative of a suitable support for a drilling rig indicated generally by the derrick 61.

I claim:

1. A foundation pier for offshore drilling rigs comprising vertically extending spaced inner and outer cylinders, a spiral ramp located in said space, the outer cylinder having openings to permit the escape of material fed upwardly on the ramp as the cylinders are rotated.

2. A foundation pier for offshore drilling rigs comprising vertically extending inner and outer concentric cylinders spaced apart, and two ramps forming parallel spirals located in said space and leading upwardly from the lower ends of the cylinders for feeding subaqueous material upwardly when the cylinders are revolved.

3. A foundation pier for offshore drilling rigs comprising inner and outer concentric cylinders spaced apart, and each open at their ends, ramps spiralling upward from the lower ends of the cylinders located in the space between them and connecting said cylinders, the outer cylinder being provided with apertures spaced along the ramps, forming exit openings for the escape of material thereon.

4. A foundation pier for offshore drilling rigs having an underwater and subaqueous open lower end composed of spaced outer and inner cylinders and a ramp located in said space, the inner cylinder being received into the outer bed core and the outer cylinder and ramp forming a surrounding cutter for such material, said outer cylinder being provided with apertures arranged along the ramp and forming exits for material displaced by the ramp, the pier having an upper end extending above the water line by
means of which said pier may be rotated to sink its lower end in a subaqueous bed.

5. A foundation pier composed of inner and outer concentric cylinders spaced apart having open lower ends, a ramp spirally located in said space and leading upwardly from the lower ends of the cylinders, a piston head located at the bottom of the inner cylinder and movable upwardly under pressure of the core of material formed therein by reason of the sinking of the pier.

6. A subaqueous foundation pier composed of spaced inner and outer concentric cylinders open at their ends composed of a plurality of like interchangeable sections superposed and rigidly connected together, a ramp spiralling upward from the bottom of the cylinders and located in the space between them, the outer cylinder having apertures spaced along the ramp, and a piston initially positioned at the lower end of the inner cylinder and movable upwardly therein under pressure as the pier sinks and its lower end penetrates subaqueous material.

7. A subaqueous foundation pier composed of spaced inner and outer concentric cylinders open at their ends composed of a plurality of like interchangeable sections superposed and rigidly connected together, a ramp spiralling upward from the bottom of the cylinders, and rigidly connecting them, a piston initially positioned at the lower end of the inner cylinder and movable upwardly therein and cross bracing within the inner cylinder located above the limit of upward movement of said piston.

8. The method of constructing foundation piers for offshore drilling rigs consisting first in forming a pile element having a lower end provided with a hollow center and an exterior screw thread of sufficient length to penetrate a soft under water bed and having an upper end projecting above the water line and second sinking the pile by rotating it by means of a plurality of tugs steaming in a circular path around the pile and connected to its upper end by flexible connections.

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The following references are of record in the file of this patent:

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