June 7, 1960 W. S. CRAKE 2,939,290

MARINE DRILLING RIG FOUNDATIONS

Filed Oct. 1, 1954 3 Sheets-Sheet 1

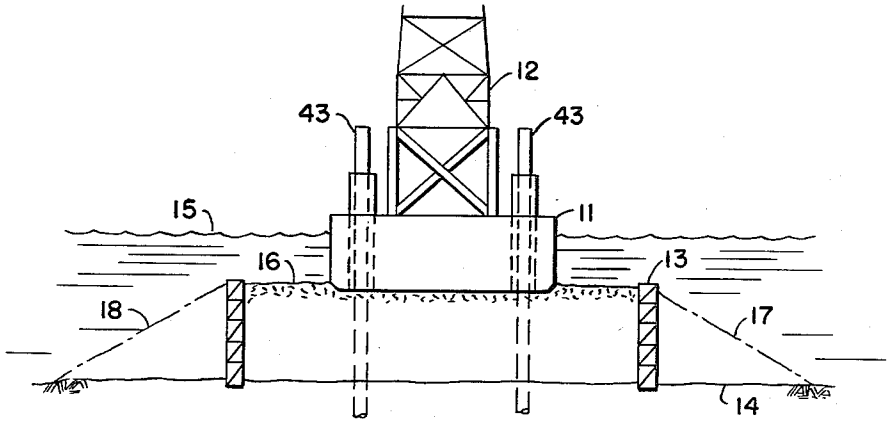


FIG. 1

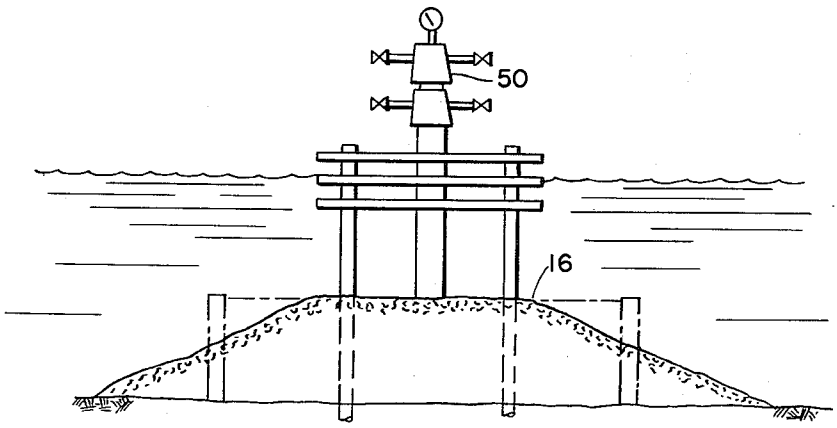


FIG. 7

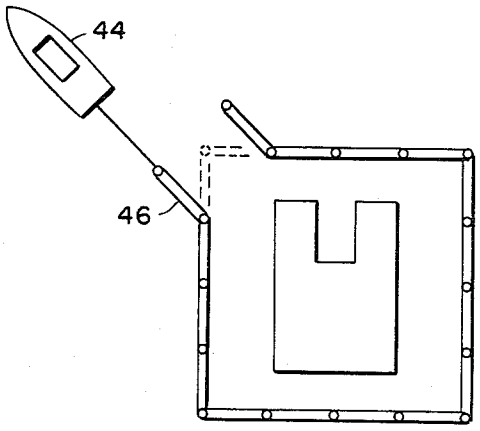


FIG. 6

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MARINE DRILLING RIG FOUNDATIONS

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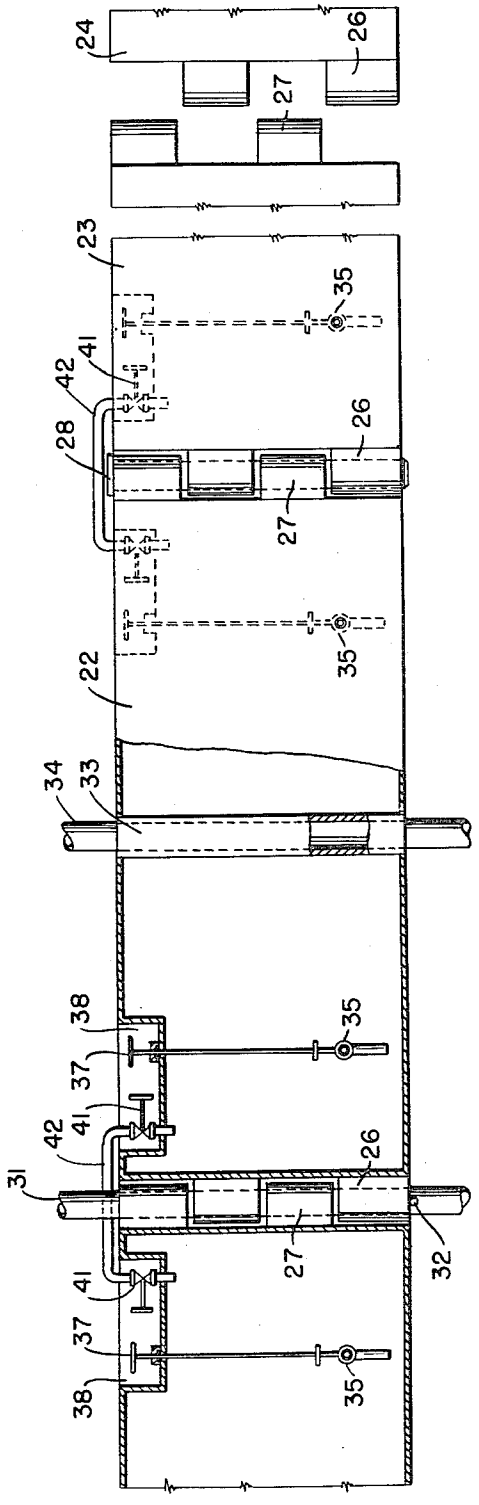


FIG. 4

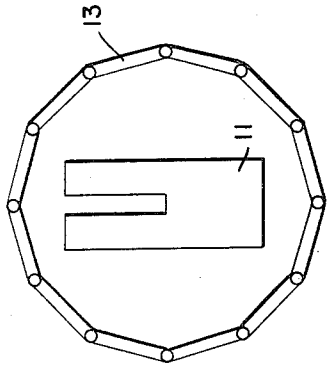


FIG. 3

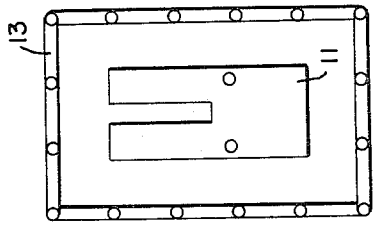


FIG. 2

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MARINE DRILLING RIG FOUNDATIONS

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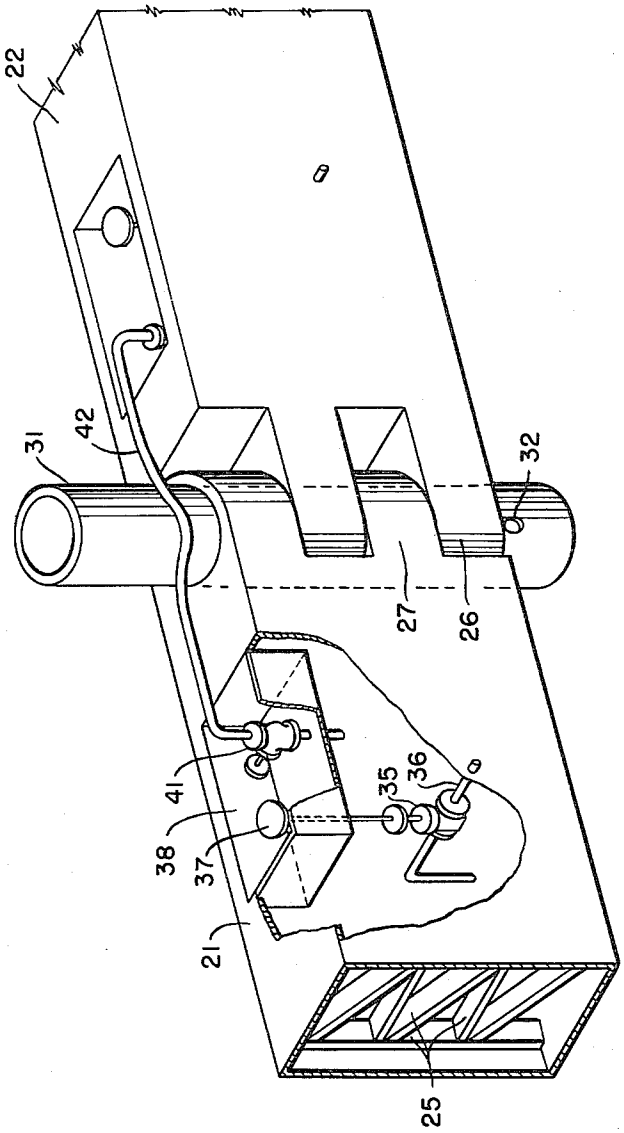


FIG. 5

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MARINE DRILLING RIG FOUNDATIONS

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1 Claim. (Cl. 61—46.5)

This invention relates to marine foundation structures for use in conjunction with a submersible barge for drilling off shore oil and gas wells in offshore or inland waters, and pertains more specifically to a portable marine foundation which is particularly useful in moderately deep bodies of water, and which can be floated into position and removed after it has served its purpose so as to avoid the expense and delay of providing a piling structure to form a permanent foundation.

When drilling oil wells in submerged areas, serious problems are encountered in providing suitable foundations for use beneath conventional marine drilling barges in waters of a depth greater than that for which the drilling barge was designed. Submersible barges, which have been used with considerable success in relatively shallow land-locked water areas, are generally considered to be impractical when used in the greater depths and under the exposed conditions prevailing in offshore drilling. The restrictions on the use of semi-submerged drilling barges in deeper waters are mainly due to the fact that when the barge is sunk to the bottom, the deck or operating platform of the barge is either below the surface of the water or so close to the surface that drilling operations cannot be carried on safely. Thus, in drilling oil wells in submerged areas where the water is about 10 feet or more deep, ordinary submersible drilling barges cannot be used and it is necessary to either build large expensive barges of special design, or to drive pilings on which a permanent offshore drilling platform may be constructed.

In many offshore locations, pads or submerged islands of oyster shells or other materials have been used, in order to spread the load of the drilling barge on poor load-bearing submerged soils, and/or to raise the bottom of the drilling location so that the submersible barge may be used in water deeper than that for which it was originally designed, thus extending the usefulness of the barge and its drilling rig positioned thereon. These islands have been raised as much as 6 feet or more from the bottom of the ocean floor, but due to the angle of repose of the shells or other materials under water, excessively large quantities of shells must be used to form an island having a top of sufficient area for the barge to rest upon safely during drilling.

Since the problem of the actual drilling of an offshore well requires heavier equipment and larger barges, and imposes heavy loads on the supporting mast or rig than does post-drilling work, it is necessary to build larger foundations or islands for drilling than for well repair and maintenance work, which is carried out with lighter equipment and can be accomplished in a much shorter time.

The primary object of this invention is to provide a marine drilling rig foundation capable of carrying the load of a submersible drilling barge and comprising a major structural element which may be salvaged for use elsewhere.

Another object of this invention is to provide a method for erecting a marine drilling rig foundation in such a manner that a major structural element thereof can be salvaged after drilling operations, while the remaining portion provides sufficient space for minor well repairs and maintenance service.

A further object of the present invention is to provide a marine drilling rig foundation adapted to be used with submersible barges and capable of acting as a breakwater for said barges.

Another object of this invention is to provide a marine drilling rig foundation for use with submersible drilling barges, a major portion of said foundation being adapted to be made buoyant and towed to another drilling location.

These and other objects of this invention will be understood from the following description taken with reference to the drawing, wherein:

Figure 1 is a diagrammatic view, partly in cross-section, of a conventional drilling barge positioned on a marine drilling rig foundation formed in accordance with the present invention.

Figures 2 and 3 are schematic plan views of alternate arrangements of the present marine foundation for drilling barges.

Figure 4 is a view, partly in cross-section, of several sections of the floatable barrier which forms that portion of the present marine drilling rig foundation which may be salvaged.

Figure 5 is an enlarged detailed view, partly in cross-section, illustrating portions of two of the floatable sections of the present floatable barrier, and the means by which they are hinged together.

Figure 6 is a schematic plan view illustrating a tug towing the hinged floatable barrier of the present invention away from a drilling site.

Figure 7 is a schematic view illustrating the present invention at its ultimate stage, after drilling operations have been completed and the floatable hinged barrier has been towed to another location.

Referring to Figure 1 of the drawing, a submersible drilling barge **11** with a derrick **12** mounted thereon is illustrated as having been sunk into position on a marine drilling rig foundation of the present invention. This comprises a hinged floatable barrier **13** illustrated in more detail in Figures 4 and 5, which acts as a retaining wall and is filled with shell, sand, rock, or other suitable material **16** to serve as a base upon which the barge **11** can rest. The bottom soil level is indicated at **14**, while numeral **15** indicates the mean water level. If the present barrier **13** were not employed to contain the shell **16**, the normal angle of repose of the shells forming the island or foundation beneath the surface of the water would be substantially that of dotted lines **17** and **18** which illustrate the sloping surface of the additional quantity of the shells which would be needed in such case to form a foundation of the desired size. Furthermore, additional quantities of shells would have to be added to the foundation from time to time to replace shells removed by erosion or wave action during the drilling operations.

In Figure 2, the hinged floatable barrier **13** of the present invention is schematically illustrated as being arranged in a rectangle around the drilling barge **11**. An alternate arrangement is illustrated in Figure 3 which schematically shows the present hinged barrier **13** arranged substantially in a circle around the drilling barge **11**. The barrier **13** of the present invention comprises a plurality of hinged floatable sections sufficient in number to surround the submersible barge **11** being used. Thus, the number of sections making up the barrier depends upon the size of the

barge, the length of the sections, and the arrangement in which the barrier is to surround the barge 11.

Portions, or all of several sections 21, 22, 23 and 24, of the hinged floatable barrier 13 of the present invention are shown in Figure 4 of the drawing. Each of the sections of the barrier is a rigid, hollow, floatable structure which may be reinforced by internal bracing members 25 as shown in Figure 5. The construction and weighting of each section of the barrier is such that the section may be floated to a drilling location with the major axis of each section positioned in a substantially vertical plane, as shown in Figures 4 and 5.

One or more hinge members 26 are fixedly attached to each end of each section 21 to 24 so as to interlock with hinge member 27 fixedly attached to the adjacent end of the adjacent floatable section of the barrier. The hinge members 26 and 27 of adjacent sections 22 and 23 of the barrier may be held together by means of a hinge pin 28 which extends therethrough. Alternatively, any two sections of the barrier, for example sections 21 and 22, may have their hinged members 26 and 27 secured together by means of a spud or small pile 31 which is driven through the hinge members 26 and 27 and down into the ocean floor 14 (Figure 1) thus securely anchoring the barrier in position around the drilling site.

In the event that spuds or piles 31 are employed to secure the hinged sections 26 and 27 of adjacent floatable sections of a barrier together, each spud 31 is provided with suitable means whereby it may be raised and retracted from the ocean floor without being withdrawn completely from the hinged members 26 and 27, thus leaving all sections of the barrier hinged together so that they may be towed in a single flexible unit to another drilling location. Any suitable means may be used for this purpose, for example, each spud 31 may be provided with a hole 32 which passes therethrough and which can accommodate a pin or bolt (not shown) having a length slightly in excess of the diameter of the spud 31 so that when the spud is pulled upward until the hole 32 is above the uppermost hinge member 26 or 27, a bolt can be slipped through the hole 32 to prevent the spud 31 from slipping down through the hinge members again.

In the event that all sections 21 to 24 of the barrier are to be connected together by means of hinge pins 28, several sections of the barrier, such for example as section 22 (Figure 4), should be provided with suitable spud-holding means adapted to receive therein and permit the passage therethrough a spud or pile 34 which is driven into the ocean floor to anchor the entire floatable barrier thereto. The spud-holding means 33 may be either secured to the outside of a section 22 or may be positioned therein. In the event that the spud-holding means 33 is positioned vertically within the fluidtight section 22, the spud-holding means preferably comprises an elongated tubular member welded in a fluidtight manner at the top and bottom to the top and bottom of the section 22. The internal diameter of the tubular spud-holding means 33 is slightly larger than the outside diameter of the spud to be positioned therein. At the same time, the outside diameter of the tubular spud-holding means 33 is less than the internal width of the hollow floatable section 22 in order to allow the passage of air and water readily from one end of the section to the other.

Each section of the barrier, for example floatable section 22, is provided with means for flooding the section such as, for example, one or more flood valves 35, which are in communication either directly or through a short conduit member 36 (Figure 5), with the space outside the section. Preferably the flood valves 35 are positioned within the hollow chamber of each section 21 (Figure 5) to protect them from being knocked off when the barrier is being moved from place to place. However, it is to be understood that the flood valves 35 can be readily mounted on the outside of each chamber. Preferably, each flood valve 35 is provided with an extension handle 37 which extends upward through the top of the section with the end of the handle being positioned in a recessed valve box 38 which protects the valve handle from injury during operations.

Each section of the present barrier is also provided with valve means for introducing air into each section in order to make a flooded section buoyant prior to its removal to another location. Each section is provided with at least one and preferably two air intake valves 41, one of the air intake valves being located at either end of each section. Preferably, the air intake valves at adjacent ends of adjacent sections 21 and 22 are connected together by means of a flexible conduit 42 so that by pumping air into the common space within all the sections, the entire hinged floatable barrier may be made uniformly buoyant when it is desired to raise the barrier and remove it to another location.

In preparing the marine drilling rig foundations to receive a submersible barge in accordance with the present invention, a plurality of hollow floatable hinged members are transported to a drilling location. The barrier to be formed at the drilling location may be previously formed by connecting the several sections of the barrier together by hinge means and then towing the floatable barrier, which may contain some water for ballast, to the drilling site by means of a tug or other vessel. Alternatively, the unhinged sections of the barrier may be transported to the drilling location on a barge on which they have been stacked in an unhinged manner. On arrival at the drilling location, each individual section 22 of the barrier is lowered into the water and hinged to the adjacent section until the entire barrier is formed and floated into position around the drill site. The flood valves 35 in each of the buoyant sections are then opened, allowing the interior chamber within each section to be flooded with water so that the barrier sinks to the bottom of the ocean. At the same time that the flood valves 35 are opened, the air intake valves 41 are also vented to the atmosphere.

With the hinged floatable barrier positioned on the ocean floor around the drill site, spuds or piles 34 are driven down through the barrier and into the ocean floor to hold the barrier in place. The space within the barrier is then filled with sand, rock or shells 16 as shown in Figure 1 of the drawing. A submersible barge 11 is then floated into position above the center of the shell or rock foundation 16 and then sunk so that the bottom of the barge 11 rests upon the top of the shells 16. If desired, spuds 43 may be driven down through the barge to anchor it securely to the shell foundation.

After drilling operations have been completed, a hinge pin which connects two of the sections of the barrier may be removed so that a tug 44 (Figure 6) may attach a tow rope 45 to one section 46 of the barrier. A source of air pressure (not shown) which may be carried by the tug 44, is connected to the air intake valve 41 (Figure 4) of one of the sections so that all the sections are flooded with air after which the flood valves 35 are closed. After all the spuds 34 have been removed from the barrier, the entire floatable hinged barrier may be pulled clear of the sand, shell or rock contained within the barrier by the tug 44. It may then be towed to another drill site. After the barrier 13 (Figure 1) has been removed, the sand, shells or rock which was contained within the barrier falls off slightly, as shown in Figure 7, but still forms a substantial foundation of a sufficient size to permit maintenance work around the wellhead 50. Additionally, the island of shells 16 (Figure 7) serves to some extent as a breakwater around the wellhead 50.

I claim as my invention:

The method of drilling a well at an offshore location, said method comprising the steps of transporting to an offshore drilling location a prefabricated floatable barrier having a plurality of hollow fluidtight flexibly-inter-

connected sections adapted to be flooded, arranging said barrier to form a figure of closed periphery around said drilling location, sinking the barrier to the ocean floor to a sufficient depth for enabling the drilling barge to be floated over the barrier at the drilling location, filling the space within the barrier with crushed solid material, floating a drilling barge into a position disposed centrally over said material, partially submerging the drilling barge so that the bottom of the barge bears on the material, drilling a well from said barge, subsequently disconnecting the adjacent ends of two sections of said barrier to open said barrier, floating said barrier, and

towing said disconnected flexible barrier away from the solid material it surrounds to another location.

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