

July 27, 1954

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2,684,575

SUBMERGIBLE TYPE OFFSHORE DRILLING STRUCTURE

Filed Dec. 22, 1950

2 Sheets-Sheet 1

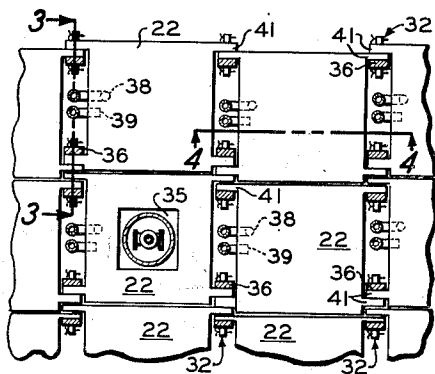


FIG. 2

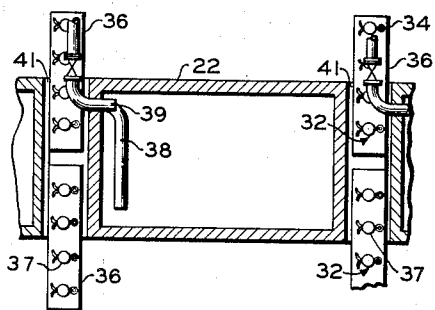


FIG. 4

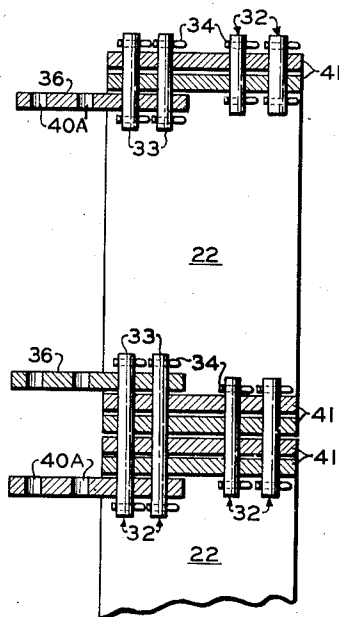


FIG. 3

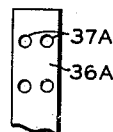


FIG. 9

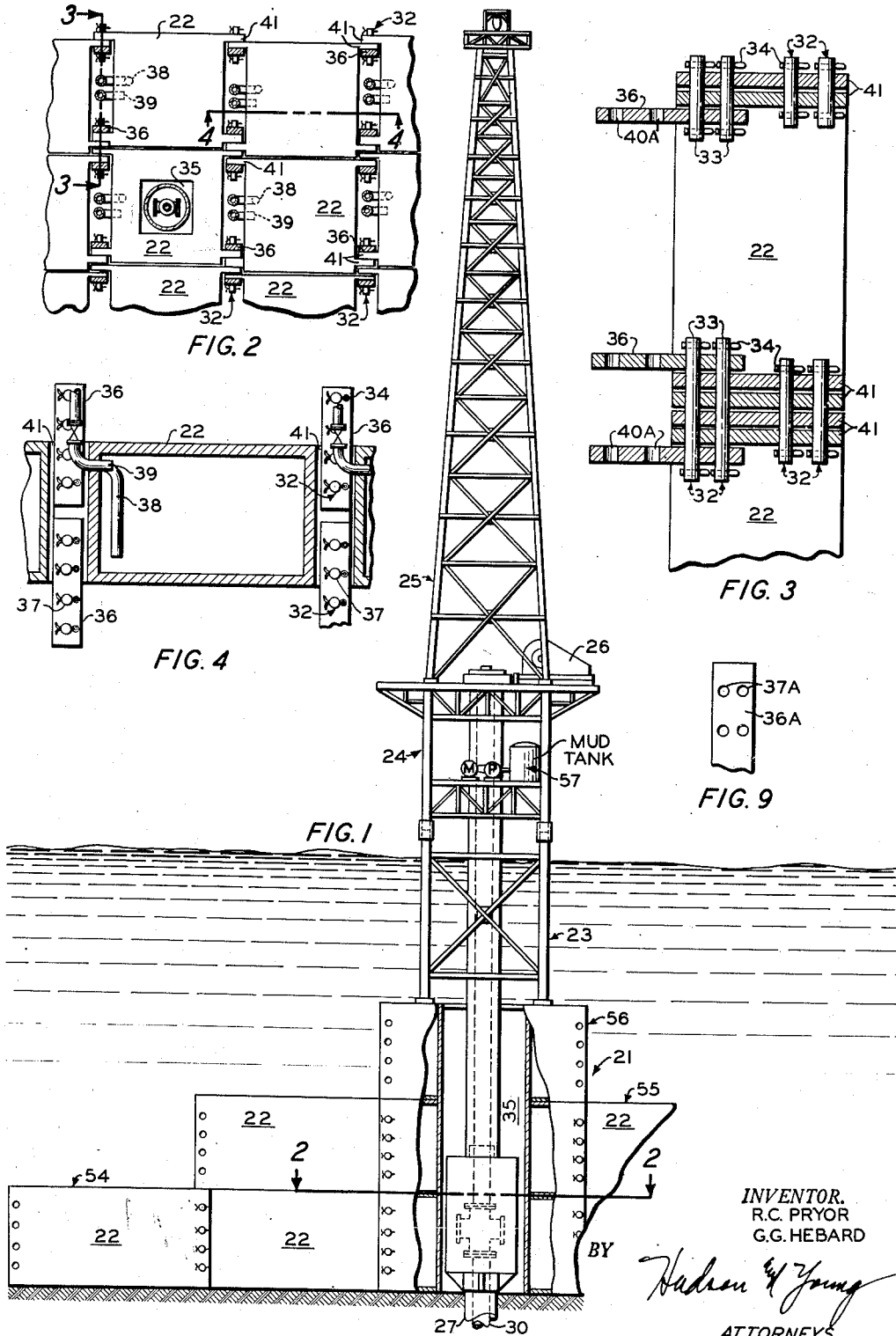


FIG. 1

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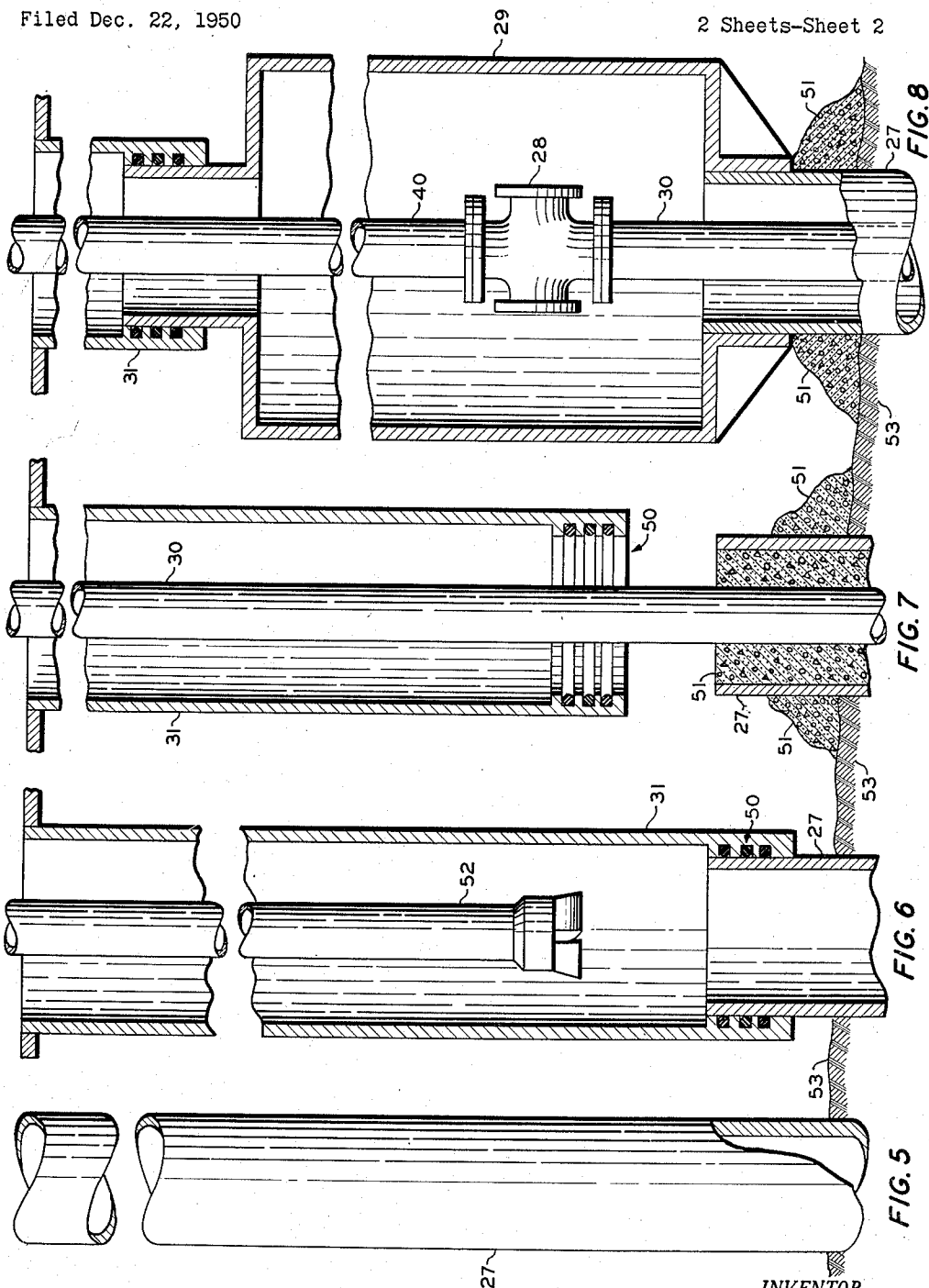
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SUBMERGIBLE TYPE OFFSHORE DRILLING
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6 Claims. (Cl. 61-46)

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This invention relates to off-shore oil well drilling. In one aspect, it relates to off-shore drilling wherein the drilling rig and other drilling apparatus are mounted on a movable or floatable barge. In another aspect, it relates to off-shore drilling apparatus for use in drilling oil wells in off-shore operations wherein the water is too deep for use of conventional drilling barges.

Oil is found under bodies of water, such as bays, lakes, rivers, and oceans. It is old to exploit these fields by drilling the wells from barges upon which are mounted the usual drilling equipment, such as drawworks, derricks, pumps, etc. The usual procedure is to float the drilling barge to location and then open the sea valves to the ballast tanks and sink the barge hull to the bottom. These barges are formed with an open slot so that upon completion of the well the barge may be refloated and removed to another location. Unfortunately, more and more oil development is being made in deeper water so that a shallow water drilling barge cannot be used; consequently, drilling barges of greater draft and height must be used for drilling in the deeper water. This forces the drilling operator to maintain different drilling barges because obviously a shallow water barge cannot be used in deep water because the working deck would be below the water level and a deep water barge cannot be used in shallow water because the depth of water is insufficient to float the barge to and from location.

It is also known to use one or more barges as a sub-platform so that the shallow water barge may rest upon this sub-platform during the drilling operation. Piles are driven to prevent the upper barge from sliding off the lower barge.

It is a purpose of our invention to provide a unit cell apparatus for supporting an oil well drilling derrick for use in water of different depths wherein for deeper water it is merely necessary to insert one or more additional cell units to obtain a greater distance between the bottom of the main base and the drilling platform.

One object of our invention is to provide a re-usable base for the support of off-shore drilling equipment.

Another object of our invention is to provide a re-usable base apparatus which is adaptable for use in water up to at least several hundred feet in depth.

Still another object of our invention is to devise a re-usable base apparatus for the support of off-shore drilling rigs in which, by the use of more or less base units, the drilling platform may

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be positioned at greater or less distances from the ocean floor.

Still another object and advantage of our invention is to provide an off-shore drilling platform support assembly which may be recovered in its entirety upon completion or abandonment of the well.

Still other objects and advantages of our invention will be apparent upon reading the following description which, taken in conjunction with the attached drawing, forms a part of our disclosure.

In the drawing, Figure 1 is an elevational view of the apparatus of our invention in diagrammatic form and with a portion cut away. Figure 2 is a plan view, partly in section, of a portion of the apparatus of Figure 1. Figure 3 is an end elevational view of a portion of the apparatus of Figure 2 on an enlarged scale. Figure 4 is a side elevational view of a portion of the apparatus of Figure 2 on an enlarged scale and taken on the line 4-4. Figures 5, 6, 7, and 8 are elevational views, partly in section, of a portion of the apparatus at different stages in the drilling of an off-shore oil well. Figure 9 is a second embodiment of one portion of our derrick support equipment.

Referring now to the drawing, and specifically to Figure 4, this apparatus part is a floatable unit cell or unit tank. This tank may be cubical, or merely 3-dimensional rectangular in general form. The main requirement in this respect is that a desired number of these tank units may be attached together to form a base having a desired area. At the end of the tank 22 are shown flanges 41. These flanges are provided with perforations 37 as shown. While in Figure 4 it appears that there is one of these flanges 41 at either end of the tank member 22, on reference to Figure 2 it is seen that there is a flange member 41 at each of the four corners of the tank 22. From Figure 2 it may also be seen that as many of the tank units 22 may be attached together as desired for the formation of a base of a given dimension. Corresponding flanges of adjacent tank units are held together by insertion of the pin assemblies 32 through corresponding openings 37 in the flanges. Pins or large diameter rods 33 are held in place by cotter key type pins 34. In this manner, the bottom or base layer of tanks 54 is assembled. Additional tank units 22 may be added above or on top of this lower layer 54 as a second layer 55. The unit tanks of this second layer are attached to one another in the same manner as were the tanks of the lower layer. We have made provision for attaching the

second layer of tank units to the bottom layer so that there can be no horizontal movement of one layer of tank units with respect to the other. For this purpose we provide some bars 36 which contain some perforations 40A which are intended to correspond to the perforations 37 in the tank flanges 41. On reference to Figure 3, it is seen that the bars 36 are attached to the upper portions of the flanges 41 of a lower tank unit 22 and to the lower portion of the flange 41 of an upper tank unit 22. On reference to Figure 2 which is a plan view taken on the line 2-2 of Figure 1, these bar members 36 are shown in cross section. Thus, by this multipoint attachment of an upper layer 55 of tank units to a lower layer 54 of tank units, it is seen that there can be no horizontal slippage of an upper layer of tank units over a lower layer. In the apparatus illustrated in Figure 1, the third layer of tank units consists of only one tank 22 and this one tank is identified by reference numeral 56. This one tank is attached to the tank units immediately below in the same manner as a tank of the second row is attached to the tanks of the bottom layer of tanks. As many additional horizontal layers of tank units may be provided as are required for support of the oil well drilling equipment. It is obvious that the greater the distance from the top of the top tank unit 22 of the base assembly to the top of the derrick, the greater will need to be the diameter of the bottom layer assembly of tanks 22. In Figure 9 is shown a second and preferred embodiment of bar 36A similar in many respects to bar 36. Bar 36A, however, is provided with pairs of openings 37A in place of single openings for structural purposes.

The open structural cell unit 23 is provided for the express purpose of supporting the drilling platform assembly well above the water line. As many of these cell units 23 as required may be installed one above the other.

The tank units 22 and the open cell units 23 may be constructed of any size desired. For illustrative purposes we have shown the height of the tank unit 22 as being 20 feet. Three layers of these tanks units then give a height of 60 feet from the floor of the body of water. The cell unit 23 is illustrated as having a height of 30 feet. The drilling platform assembly is also illustrated as having a height of about 30 feet. With the dimensions as given and the apparatus as illustrated in Figure 1, the drilling platform surface is approximately 30 feet above the surface of water 90 feet in depth. It is obvious that the surface of the drilling platform must be sufficiently high above the high tide level so as to be free from wave action. For use in 120-foot water in place of 90-foot water it is merely necessary to insert a second open cell unit 23. And, accordingly, for each increase of 30 feet in depth of water, it is necessary then to insert one more of the open cell units 23. When using several open cell units 23, it is ordinarily necessary to use an additional layer or two of base support tanks similar to, or, preferably larger than, the tank assembly 54. As mentioned hereinbefore, for use in deeper water the diameter of the bottom layer of the base element must be greater. The use of larger base assemblies of tank elements serves at least two purposes, one of which is to provide a firmer foundation and more resistance to overturning. The second reason is that it is desirable to maintain the center of gravity at as low a point as possible.

The base stabilizer assembly of our apparatus may be assembled for use at the approximate location of the well to be drilled or it may be assembled at a dock along the shore. If assembled along the shore, then the entire base stabilizer assembly 21 may be towed to the location of the new well. If, however, the base assembly is to be assembled at the position of the new well, each of the individual component tanks must then be towed to position and assembled with the assistance of a barge or freighter vessel provided with such equipment, as derricks, as is required to handle heavy equipment. When the assembling of the base is completed, the valves in pipes 33 and 39 may be opened in order to admit water and displace air from the tanks 22. Some or all of the open cell units 23 may be assembled into position prior to sinking of the base assembly, or these cell units may be positioned after the base assembly has been placed in its position on the bottom of the body of water. In case the water is around 200 feet or so in depth, a portion of these open cell units may be positioned prior to sinking of the base assembly; and after the base assembly is positioned, the remainder of the open cell units may be placed in their proper positions. The top of the upper open cell units should be least flush with the surface of the water. After positioning of the open cell units, the drilling platform assembly is then positioned and fixed in place. The derrick 25 is then positioned in an upright manner upon the drilling platform. The main power plant 26 may then be installed followed by installation of the auxiliary equipment such as may be needed for the purpose at hand.

As mentioned hereinbefore, the three centrally positioned tank units 22 are provided with openings 35 through which the well is drilled.

The first step in drilling a well in deep water and with the derrick support as herein disclosed is to install a pipe commonly termed a conductor pipe. Such a pipe is illustrated in Figure 5 and is identified by reference numeral 27. This pipe is of a relatively large diameter, that is, considerably larger in diameter than the well casing pipe which is to be installed subsequently. The conductor pipe is lowered through the opening 35 and is driven into the ground below the body of water a sufficient distance that there will be no opportunity for water to flow or to leak from outside the pipe under and into the pipe. Following this positioning of the conductor pipe, the pipe is cut off a short distance above the mud level 53. After cutting off the conductor pipe, a cage tube 31 having a packing assembly 50, illustrated in Figure 6, is positioned as shown in this figure. A drill pipe with drill 52 is lowered into the end of the conductor pipe and the material within the conductor pipe is drilled out and removed. After removal of the earthy material from within the conductor pipe a section of surface pipe 30, Figure 7, is lowered into position. After positioning of the surface pipe, some cement 51 is pumped down inside the surface pipe to its bottom. The cement flows out the bottom and upward in the annular space between the surface pipe 30 and the conductor pipe 27. Sufficient cement is added so that the cement will rise in said annular space and pass from the cutoff end of the conductor pipe into the cage pipe. Upon continued addition of cement, its level will rise upward in this cage pipe to the surface of the water. When the drilling operators are certain that the bottom portion of this hole is completely filled with cement, the cage tubing is raised from its position on the end

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of the conductor pipe so that the cement within the cage pipe will flow out thereof and onto the floor of the ocean. Following this latter operation, sufficient time should lapse so that the cement remaining within the conductor pipe will have opportunity to set and become hardened. After the cement has hardened sufficiently, the cage tube may be raised from its previous position and the surface pipe cut off and the pipe cross 28 installed. The pipe cross 28 in Figure 8 is a diagrammatic representation only and is intended to represent such apparatus as blow-out preventors, side outlet or inlet for fluid, or the like, such as is required in the drilling of such an oil well. Since the diameter of the element 28 is fairly large, this element is preferably installed prior to installation of the well cell 29. This well cell 29 is ordinarily positioned following the removal of the cage tube 31. This cell may be lowered into its proper position before or after the operation of the cutting off of the surface pipe 30. In any event, the diameter of the upper opening of the well cell 29 is relatively large. This diameter should be sufficiently large to accommodate passage of any necessary apparatus, or workmen. After installation of the well cell 29 and the installation of the same cage tube 31 as previously mentioned or one of larger diameter is made. If desired, the water in this well cell 29 and cage tube 31 may be pumped out so that the workmen may be lowered into this apparatus for working and not be submerged under water. If the well cell 29 and cage tube 31 are positioned as shown in Figure 8 before cutting off the surface pipe, this pipe may now be cut off and the cross 28 installed as illustrated in this figure. After installation of the cross 28, an additional surface pipe 40 is installed which extends from the top of the cross 28 to a point well above the surface of the water, for example, preferably this pipe should extend to the surface of the drilling platform. These surface pipe members 30 and 40 and the cross apparatus 28 are fairly large in diameter since all of the actual drill tubing, drill bits, well casing, and the like, have to be lowered and/or raised through these pipe sections.

The drilling platform assembly 24 is provided with several decks. The upper or main deck provides space for the main power unit 26 and for such other apparatus as is necessary to be positioned at this level. On a lower deck may be the mud storage and pumping and settling apparatus 57.

After completion of the drilling of the well, the drilling apparatus, that is, the drill tubing and bit, are removed from the well and the mud is pumped therefrom. The upper surface pipe 40 is removed from its position and in case the well is to be a flowing well, connections for fastening flexible tubes may be installed to one or both sides of the cross 28. The cage tubing 31 is also removed. When these equipment parts have been disconnected and removed, the derrick apparatus, the drilling platform apparatus, the open cell units, and the floatable base are then prepared for removal from this location. Upon removal of the derrick proper from the drilling apparatus, the valves in pipes 38 and 39 in each of the tank units 22 are operated and air is pumped into the tanks through the pipes 39, and the water which previously weighted this base element to the bottom of the water is forced out and ultimately this base apparatus will float. It is our intention that this base assembly 21 be raised directly vertically so as to free itself from the well cell 29.

When the base assembly has been floated away from the well cell 29, it is ready to be towed to another location preparatory for drilling of another well.

A diver is then sent down to the well cell and enters the same through its top opening. This diver attaches to one or more of the outlets of the element 28 flexible tubing for passage of the oil and gas from the well.

In case the well is not a free-flowing well and has to be pumped, then after removal of the drilling apparatus base assembly, a production platform assembly apparatus has to be installed and made permanent so that a pump with its required auxiliary apparatus can be installed directly above the well for pumping oil.

If it is necessary to pump the well, the upper surface pipe 40 and the cage tubing 31 may be reinstalled so that the space within the cage tubing 31 and within the well cell may be pumped free of water, if desired. This space may be maintained free from water, if desired, or may be permitted to flood. If this space is permitted to flood, a corrosion inhibitor should be added to the water within these members so that corrosion of the metal will be minimized. If the well is a flowing well and a flexible tube is connected to the cross 28 and extends out the upper opening of the well cell 29, this cell 29 will be flooded with water. In this case, also, an inhibitor should be added to the water so as to minimize corrosion, not only of the interior walls of the cell 29, but also of the cross 28 and the conventional apparatus which this element represents.

The above-described support structure is given for illustrative purposes and should not be regarded as limiting the invention, the scope of which is set forth in the following claims.

We claim:

1. An apparatus for off-shore drilling comprising, in combination, a derrick, a drilling platform unit at the base of and supporting said derrick, said unit disposed above the water level, an open support cell disposed under the water level and supporting said platform unit, and a floatable base stabilizer unit supporting said open support cell and adapted to be rigidly attached thereto, said stabilizer unit comprising a plurality of floatable and mutually detachable sections, rigidly attached to one another to form a rigid base for support of said open support cell, a centrally disposed floatable section of said plurality of floatable and mutually detachable sections having an opening throughout its vertical extent for accommodation of the well drilling and tubing apparatus.

2. A support base for an off-shore oil well drilling apparatus comprising, in combination, a plurality of fluid-tight cells disposed horizontally with respect to one another so as to form a rigid bottom base member, an additional fluid-tight cell disposed immediately above and rigidly affixed to the central cell of said plurality of cells, the upper cell provided with support means for attachment of an oil well derrick assembly, an opening disposed vertically through the upper cell and the cell of said plurality of cells immediately below said upper cell for accommodation of oil well drilling, tubing, and casing apparatus.

3. A support base for an off-shore deep water oil well drilling apparatus comprising, in combination, a plurality of fluid-tight cells disposed horizontally with respect to one another so as to form a rigid bottom base member, a second plu-

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ality of fluid-tight cells disposed horizontally with respect to one another so as to form a rigid assembly of cells, this second plurality of cells being disposed on top and rigidly affixed to said rigid base member, an additional fluid-tight cell disposed immediately above and rigidly affixed to the central cell of the second plurality of cells, means for injecting fluid into each cell, means for withdrawing fluid from each cell, said additional fluid-tight cell and the two cells directly below same being provided with openings so vertically arranged as to accommodate oil well drilling, tubing and casing apparatus, and said additional fluid-tight cell being provided with attachment means for supporting an oil well derrick assembly.

4. The support base of claim 3 wherein said additional fluid-tight cell is provided with attachment means for supporting an open cell unit, which in turn is provided with means for supporting a drilling rig apparatus.

5. A fluid-tight cell for use in assembling a support base apparatus for supporting an off-shore oil well drilling apparatus comprising a rectangular, hollow fluid-tight tank, means for introduction and withdrawal of fluid for floating and sinking said tank, and flange means for attachment of said tank to other tanks, said flange means comprising a vertically disposed perforate flange on either end of a vertical side wall for attachment to other tanks, a vertically disposed second perforate flange attached at right angles to either end wall at a distance from the side wall opposite the first mentioned side wall at least equal to the thickness of a flange, the upper and lower end surfaces of said flanges being co-extensive with the top and bottom horizontal surfaces of said tanks.

6. A support base for an off-shore deep water oil well drilling apparatus comprising, in combination, a plurality of fluid-tight cells disposed horizontally with respect to one another so as to form a rigid bottom base member, a plurality of fluid-tight cells disposed horizontally with respect to one another so as to form a rigid assembly of cells, this latter plurality of cells being disposed on top and rigidly affixed by perforate bar means to said rigid base member, an additional

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fluid-tight cell disposed immediately above and rigidly affixed by perforate bar means to a cell of the latter mentioned plurality of cells, said additional fluid-tight cell and the cells directly below same being provided with openings so arranged as to accommodate oil well drilling, tubing and casing apparatus, said additional fluid-tight cell being provided with attachment means for supporting an oil well derrick assembly, each of said fluid-tight cells comprising a rectangular, hollow, fluid-tight tank, means for introducing and withdrawing fluid for floating and sinking said tank, and flange means for attaching said tank to other tanks, said flange means comprising a vertically disposed perforate flange on either end of a vertical side wall of said tank, a vertically disposed second perforate flange attached at right angles to either end wall at a distance from the side wall opposite the first mentioned side wall at least equal to the thickness of a flange, the upper and lower end surfaces of said flanges being co-extensive with the top and bottom horizontal tank surfaces, and said perforate bar means comprising an elongated bar member having at least three openings, two of said three openings being so arranged as to coincide with two openings of a perforate flange member of a next lower fluid-tight cell, a pin for extending through either pair of coinciding openings, the remaining opening in said bar being so arranged as to coincide with an opening of a perforate flange member of a next higher fluid-tight cell, and a pin for extending through these last mentioned coinciding openings.

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