June 13, 1961 M. B. CONRAD 2,988,144

METHOD AND APPARATUS FOR DRILLING AND COMPLETING UNDERWATER WELL BORES

Filed Sept. 10, 1957 3 Sheets-Sheet 1

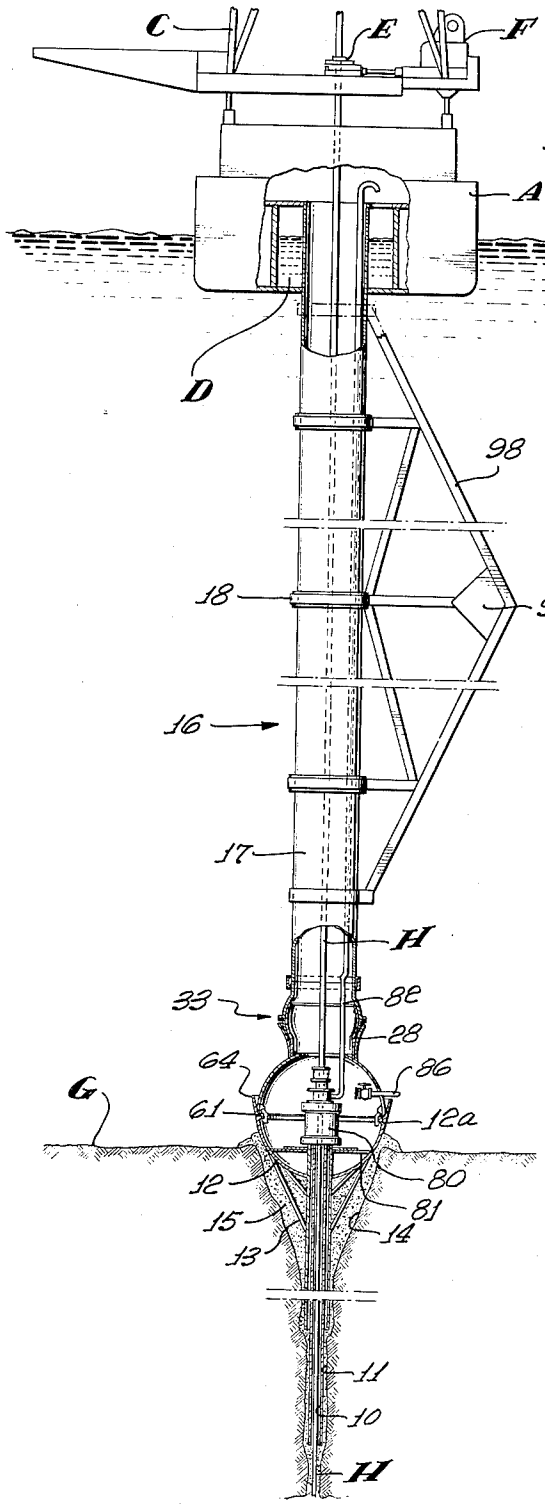


FIG. 1.

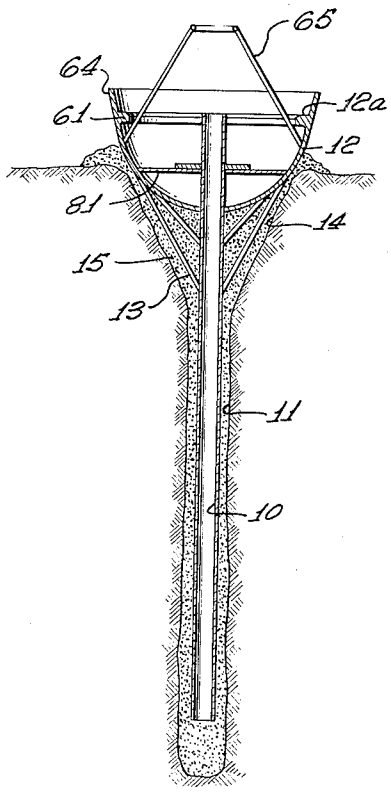


FIG. 2.

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FIG. 3.

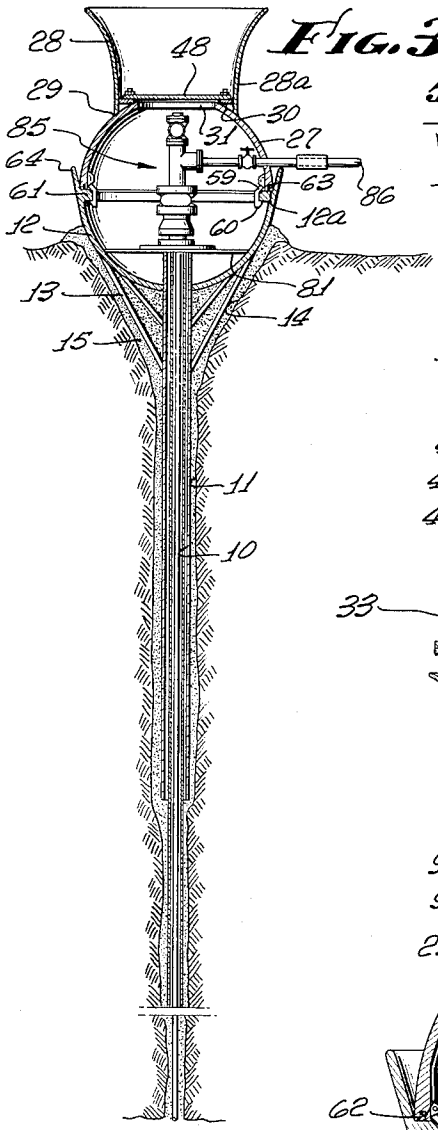
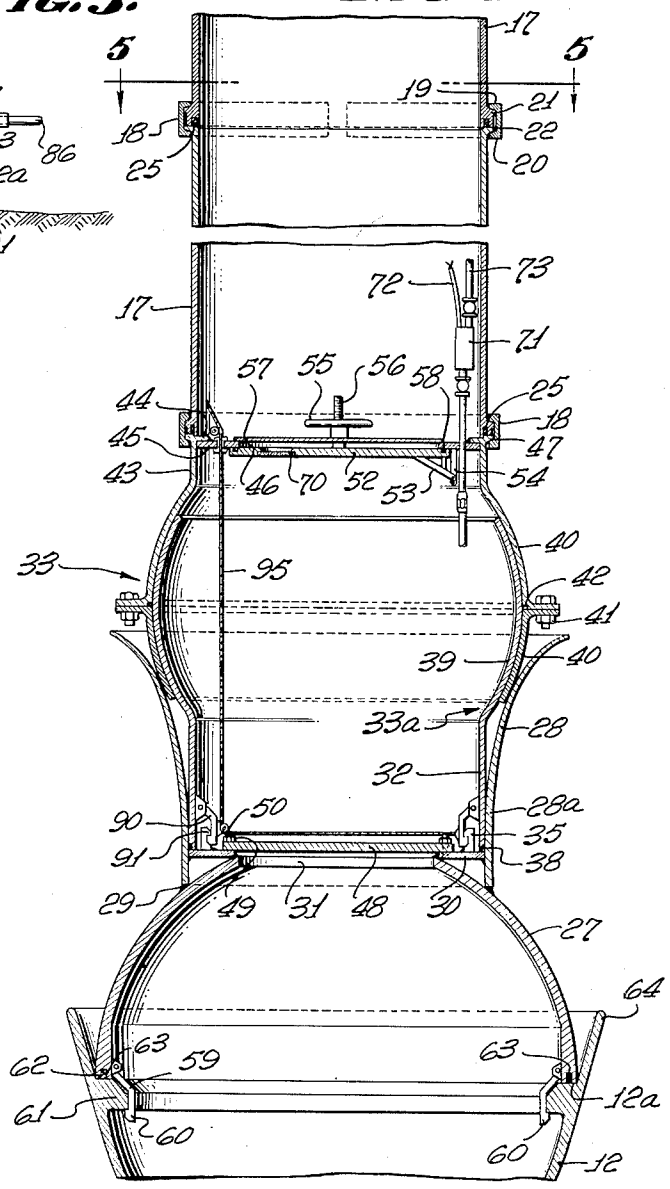


FIG. 4.



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FIG. 7.

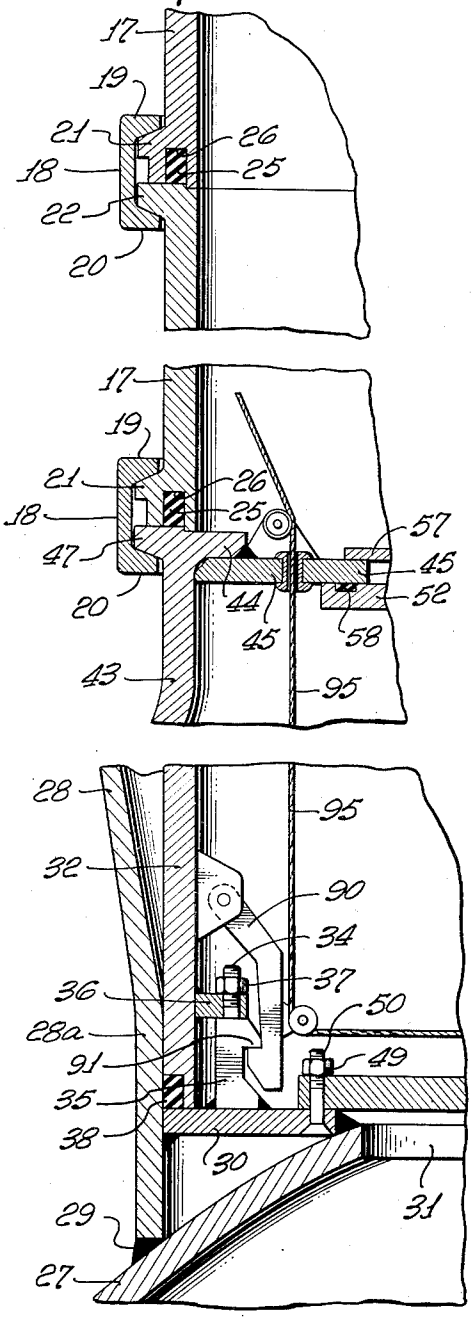


FIG. 5.

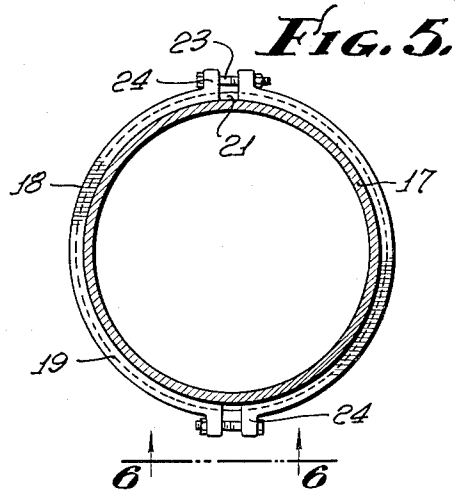
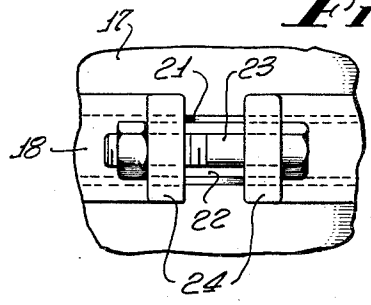


FIG. 6.



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2,988,144

METHOD AND APPARATUS FOR DRILLING AND COMPLETING UNDERWATER WELL BORES

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Filed Sept. 10, 1957, Ser. No. 683,084
12 Claims. (Cl. 166—46)

The present invention relates to methods and apparatus for drilling and completing underwater well bores.

An object of the present invention is to provide an apparatus and method for drilling and completing oil and gas wells at submerged locations where the water is relatively deep.

Another object of the invention is to provide a method and apparatus for drilling and completing oil and gas wells at underwater locations of substantial depth in an economical manner.

A further object of the invention is to provide a method and apparatus for the underwater drilling and completion of oil and gas wells through use of a floating barge and at water depth that can exceed 500 feet.

An additional object of the invention is to provide a method and apparatus for the underwater drilling and completion of well bores, in which most of the equipment can be removed from the well location after its completion and again placed in use in a relatively easy manner to perform subsequent repair or other operations in the well bore.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. An apparatus for practising the method is shown in the drawings accompanying and forming part of the present specification. Such apparatus and method will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

FIGURE 1 is a side elevational view, partly shown in longitudinal section, through an apparatus embodying the invention in condition for the drilling of an underwater well bore;

FIG. 2 is a longitudinal section through the upper portion of an underwater well bore showing an initial stage in the drilling of the well bore;

FIG. 3 is a view similar to FIG. 1, illustrating the underwater well bore in a completed state;

FIG. 4 is an enlarged vertical section through a portion of the apparatus disclosed in FIG. 1;

FIG. 5 is a cross-section taken along the line 5—5 on FIG. 4;

FIG. 6 is an enlarged side elevation taken along the line 6—6 on FIG. 5;

FIG. 7 is an enlarged longitudinal section through a portion of the apparatus disclosed in FIG. 4.

The drilling and completion of oil and gas wells at submerged locations is usually performed by use of an off-shore drilling platform suitably supported on the bottom of the body of water, such as the floor of the ocean, or through use of a drilling barge. There are serious limitations to the use of such equipment, particularly in drilling in relatively deep water. Heretofore, the cost of drilling in off-shore locations has been exceedingly high and the hazards have been very great.

As disclosed in the drawings, it is proposed to drill an oil or gas well at an underwater location through use of a vessel A, such as a drilling barge, floating in a body of water B. This drilling barge carries the necessary drilling equipment ordinarily found on land locations, such as the derrick C, drilling mud pit D, rotary table E, and necessary power mechanisms F for operating it, as well as the usual hook, swivel, traveling block, crown block, (not shown) etc., which are supported from the derrick C. The drilling barge A is suitably anchored at the well location so as to remain substantially fixed with respect to the desired location, although the action of waves, tides, winds, and the like, will cause the barge to rise and fall, and also shift laterally to some extent.

In the drilling of a well bore to the desired depth, beginning at the floor G of the body of water or ocean, a conductor pipe 10 is first appropriately placed in the upper portion of a well bore 11 and this conductor pipe is then cemented in place. Actually, the conductor pipe 10 may be used to drill the upper portion of the well bore from the drilling barge A, the conductor pipe merely being lowered through the body of water by means of a string of drill pipe and appropriately rotated through use of the rotary table E to circulate the cuttings from the well bore and wash them laterally out onto the floor of the ocean.

Specific apparatus for drilling the upper portion of the drill bore through use of the conductor pipe 10 itself, and for cementing the latter in place, is illustrated and described in detail in the application of Ernest H. Clark, Jr., Serial No. 625,990, filed September 3, 1956, for "Well Bore Drilling and Cementing Apparatus."

The upper portion of the conductor pipe 10 has a lower part 12 of a housing encircling it and welded to it. This lower housing portion may be in the form of a hollow hemisphere facing in an upward direction, which has its great circle of much greater diameter than that of the conductor pipe. The lower hemispherical portion 12 may be additionally secured to the conductor pipe by means of intervening braces 13 which are welded to both of the members 10, 12. During drilling of the upper portion of the well bore 11 through use of the conductor pipe, the braces 13 themselves will cut into the floor of the ocean, producing the enlarged frusto-conical upper well bore portion 14 in which the hemisphere 12 may be partly received, and which will also be filled with the cementious material 15, for the purpose of anchoring both the conductor pipe and the lower hemisphere appropriately in place.

After the conductor pipe 10 has been cemented in place the drill pipe is disconnected therefrom and is removed through the drilling barge A from the body of water B. A caisson type of structure 16 is then lowered through the drilling barge to the lower hemisphere for the purpose of connection thereto, to enable the drilling operation to continue. As disclosed, the caisson structure consists of pipe sections 17 which are of relatively large diameter, as for example, six feet, the sections being suitably connected in leakproof relation, as by means of a coupling 18. This coupling is generally U-shaped in cross-section and has upper and lower tapered flanges 19, 20 engaging companion tapered flanges 21, 22 on the lower and upper ends of the adjacent casing sections 17. When the sections of each coupling 18 are drawn circumferentially toward one another, they will force the ends of the casing sections 17 against each other. The coupling sections may be suitably forced and secured together, as by means of bolts 23 extending through the ears 24 of each section. To insure against leakage of fluid between the ends of the adjacent pipe sections 17, a suitable gasket or seal ring 25 may be disposed in an end groove 26 in one section for sealing engagement with the end face of the adjacent section.

The lower end of the caisson structure 16 includes an upper housing portion 27 which is companion to the lower

housing portion 12, and which may be in the form of an upper hemisphere engageable with the lower hemisphere to provide a spherical housing at the upper end of the conductor pipe 10. Extending upwardly from the upper hemisphere 27 is an upwardly flaring guide 28, the lower portion of which is secured to the upper hemisphere, as by use of welding material 29. Additional attachments of the guide 28 to the upper hemisphere 27 are provided by a transversely extending ring 30 welded to both the flaring guide and the upper portion of the upper hemisphere and surrounding a large central opening 31 in the latter. The lower portion 28*a* of the flaring guide 28 is cylindrical to provide a cylindrical seating surface into which the lower cylindrical portion 32 of a swivel 33 can be disposed. This lower swivel portion 32 is initially secured to the upper hemisphere by means of studs 34 suitably secured to a latch ring 35 welded to the annular plate 30 and extending through ears 36 welded to the lower swivel member 32, there being nuts 37 threaded on the studs to clamp the ears against the upper end of the latch ring. Leakage of fluid between the lower swivel member 32 and the flaring guide 28 is prevented by a suitable side seal 38 on the lower portion of the swivel member sealingly engaging the inner cylindrical wall of the guide.

The upper portion 39 of the lower swivel member 33*a* is of spherical shape and is disposed within a companion outer spherical member 40, 40 which may be formed in several sections secured together by bolts 41, one of these sections having a side seal ring 42 for sealingly engaging the spherical surface of the inner spherical member 39, in order to present leakage therebetween. The outer spherical member 40 of the swivel has an upwardly directed sleeve portion 43 which terminates in an inwardly directed flange 44 welded or otherwise suitably secured to an end wall 45 having a large opening 46 therethrough. The upper swivel member also has an outwardly directed flange 47 which is engaged by the lower end of an adjacent caisson section 17, these parts being held together by a coupling ring 18 in the same manner as the pipe sections 17 themselves are secured to one another, there also being a gasket or seal 25 between the upper end 47 of the swivel and the caisson section 17 to prevent leakage therethrough.

The caisson 16 is formed of sufficient pipe sections 17 secured to one another in leakproof relation, so as to extend from the drilling barge A substantially above the surface of the water to the lower hemispherical housing member 12. Water is prevented from entering the interior of the caisson above the upper hemispherical member 27 by a cover plate or door 48 extending across the opening 31 in the upper hemispherical member and secured in position by nuts 49 threaded on studs 50 extending through the plate 48 and suitably secured to the annular ring 30. Because of the disposition of the door 48 across the opening 31, water is prevented from entering the caisson 16 during its lowering through the water to the location of the bottom hemisphere 12.

Another door 52 is provided for closing the large central opening 46 through the end wall at the upper portion of the swivel 33. This door is secured to an arm 53 pivotally mounted upon a suitable support 54 depending from the end wall 45. The door 52 can be swung upwardly into engagement with the lower side of the end wall 45, being clamped thereagainst by means of a hand wheel 55 above the end wall threaded upon a stem 56 secured to the central portion of the door and passing through a cross bar 57 extending across the opening 46 and engaging the upper side of the end wall 45. It is evident that tightening of the hand wheel 55 will cause it to bear against the bar 57 and pull the door 52 upwardly into closed position against the underside of the end wall 45. A suitable gasket 58 may be provided in the door 52 for sealing engagement against such underside of the wall 45.

Pivotally secured within the lower portion of the upper hemisphere 27 are a plurality of circumferentially spaced gravity latches 59 having lower outwardly directed hook portions 60 adapted to engage under a circumferential flange 61 provided at the upper portion of the lower hemispherical member 12, in order to secure the upper hemispherical member 27 to the lower hemispherical member 12, with the lower end of the upper member engaging the upper seating surface 12*a* of the flange 61. A seal ring or gasket 62 is provided in a groove 63 in the end portion of the upper hemispherical member 27 for sealing engagement against the seating surface 12*a*, to prevent water from passing into the spherical device.

The upper hemisphere 27 is appropriately guided into position with respect to the lower hemisphere 12 by an upwardly flaring guide 64 on the lower hemisphere projecting above its flange 61, and also by a tapered stabbing guide in the interior of the lower hemisphere 12, consisting of a plurality of inclined rods 65 (FIG. 2) projecting in an inward and upward direction substantially above the upper end of the flaring guide 64. The stabbing guide 65 will be engaged by the upper hemisphere 27 and will tend to center the latter relative to the lower hemisphere 12, whereby its lower end face may be placed in engagement with the circumferential flange 61 and the hooks 60 then latched against the lower surface of the flange 61 to prevent upward release of the upper hemisphere 27 from the lower hemisphere 12.

After the conductor pipe 10 has been cemented in place, the caisson structure 16, including the swivel 33 and the upper hemisphere 27, are lowered through the water, and the upper hemisphere latched in appropriate position with respect to the lower hemisphere 12, as disclosed in FIGS. 1 and 4. During such lowering action, the lower cover plate or door 48 need not be in place, since the upper door 52 will maintain the caisson thereabove at atmospheric pressure. The appropriate location of the upper hemisphere 27 with respect to the lower hemisphere 12, and its coupling thereto, may be provided by a person lowered in the caisson to a position above the door 52, who can observe the lower regions of the apparatus through one or several glass windows 70 in the door capable of withstanding comparatively high pressure. When the upper hemisphere 27 has been latched in sealed relation to the lower hemisphere 12, the water therewithin can be evacuated, or its level lowered to a position below the door opening 31 by an electric motor driven pump 71 in the caisson section above the door 52. The motor operating the pump may be supplied with current through an electric line 72 running through the interior of the caisson 16 to the barge A. The pump 71 may discharge the water through the discharge line 73 into the ocean B. As soon as the water level within the swivel portion 33 drops below the door 52, a pressure differential exists between the exterior of the caisson structure 16 and its interior, including the spherical housing members 27, 12. Accordingly, such pressure differential will be provided by the depth of the water at which the spherical housing 27, 12 is located, and will clamp the upper hemisphere 27 firmly against the lower hemisphere 12 in leakproof relation. The type of seal ring 62 between the hemispheric sections is such as to increase its sealing effect as the pressure differential externally of the spherical housing 27, 12 increases. All of the water in the swivel 33 and in the hemispherical housing 27, 12 may now be pumped therefrom, the condition of the water level being observed by the workman in the caisson above the door 52. Following the withdrawal of the water within the caisson, the hand wheel 55 can be unthreaded from the stem 56, the bar 57 removed, and the door 52 swung downwardly to a fully open position, allowing entry of men and material into the swivel section 33 and main spherical housing section 27, 12, which contains air only at atmospheric pressure. In view of the relatively large diameter of the caisson pipe sections 17, the swivel 33 and the spherical

housing 27, 12 both men and materials can be lowered through the caisson to the spherical housing. As an example, assuming the pipe sections 17 to be about 6 feet in diameter, the spherical housing 27, 12 can have a diameter of about 10 feet.

A blowout preventer 80 is then installed in connection with the conductor pipe 10, there being a suitable floor 81 in the lower hemispherical section 12 for its support. A suitable connection is also provided at the upper portion of the conductor pipe 10 for the mud return line 82, which extends upwardly through the caisson pipe sections 17 to the drilling barge A, discharging into the drilling mud pit D. Drilling can now proceed in the same manner as if it were being performed on dry land, a suitable drill bit (not shown) being secured to the lower end of a string of drill pipe H and lowered through the rotary table E, drilling barge A and the dry caisson 16 and spherical housing 27, 12 into the conductor pipe 10. The drill bit will remove whatever cement may be present in the conductor pipe 10, and will then proceed to drill the hole below the lower end of the latter. Drilling mud pumped down the drill pipe H during its rotation to effect drilling of the hole carries the cuttings upwardly around the drill pipe into the conductor pipe 10, and through the drilling mud return line 82 to the usual shaker screen or the like (not shown), the drilling mud then returning to the drilling mud pit D.

During the drilling of the hole below the pipe 10, there should be no need for anyone in the caisson 16. The presence of such person or persons is only necessary whenever the connections in the lower part of the caisson are to be made, or in the event the apparatus in the caisson is to be disconnected.

Following the drilling of the well bore and its completion in the usual manner, a Christmas tree 85 can be installed in the spherical housing 27, 12. This Christmas tree is connected to a flow line 86 which can extend through the upper hemisphere 27, the flow line connection being suitably made at the floor of the ocean, as by aid of a diver, or by the aid of other caisson equipment, the flow line running to a shore location or to some gathering point for the well production.

After the connections in the housing 27, 12 have been completed, the cover plate or door 48 is disposed across the upper opening 31 of the upper hemispherical housing member, this door being bolted in place. The workmen then remove the nuts 37 holding the lower swivel member 33*a* to the flaring guide 28. The swivel 33 will then remain connected to the guide 28, since it is held thereagainst by the hydrostatic head of the water externally of the apparatus. The workmen are then raised to a position above the end wall 45 and they swing the door 52 back in position across the opening 46, resecuring it in place through the aid of the hand wheel 55 bearing against the upper cross bar 57, to pull the door snugly against the end wall 45 in leakproof relation thereto. The chamber within the swivel 33, which may be considered to be a transfer chamber, is then filled with water as through the line 73, until the pressure within this chamber equals the water pressure externally thereof. When this occurs, the caisson 16 can be elevated, the lower portion of the swivel moving upwardly out of the flaring guide 28. The caisson can be removed completely from the water, the sections 17, of course, being disconnected as the caisson is raised above the surface of the water. The water is prevented from entering the spherical housing member 27, 12, since the latter is a sealed body.

If at any time, additional work is to be performed in the well, the caisson 16 is lowered through the water B with the door 52 closed, the lower portion of the swivel will engage the upper portion of the flaring guide 28 and will be guided into appropriate position upon the upper plate 30 of the housing section. Latches 90 pivoted to the lower swivel member 32 will move over the inner flange 91 of the latch ring 35 and engage its lower side

to couple the swivel 33 to the upper hemispherical member 27. The caisson above the door 52 is empty, and the water in the transfer chamber 33 can now be pumped out by means of the pump 71. The relatively dry condition of this transfer chamber can be noted by a person above the door 52 looking through the window 70. The hydrostatic head of water outside of the swivel 33 will maintain and clamp it against the upper hemisphere 27 and the flaring guide 28 of the latter, whereupon the door 52 can be opened and swung completely to one side. The workman then removes the nuts 49 holding the cover plate 48 across the spherical housing, to gain access to the interior of the latter.

Proper repair work or work-over operations can then be conducted in the well through the caisson and by aid of the drilling barge A in essentially the same manner as such operations are performed on dry land. After these operations are completed, the plate 48 is rebolted in place, the workman is lifted above the end wall 45 and the door 52 swung back across the opening 46 and resecured in place. The water can then be pumped into the transfer chamber 33, until the pressure internally and externally thereof is equalized, whereupon, the workman will pull on the wire lines 95 extending in a leakproof fashion through the end wall 45, which wire lines are connected to the latches 90, to swing the latter inwardly and disengage them from the flange 91, thereby releasing the swivel 33 from the upper hemispherical member 27. The workman will be raised out of the caisson and the latter can then be removed from the ocean B.

The swivel 33 at the lower portion of the caisson structure 16 permits the barge A to shift laterally to some extent without disrupting the connection of the caisson with the spherical housing 27, 12. The caisson sections can also be stiffened by a suitable truss 98 extending therealong and projecting laterally thereof in one direction. This truss is swiveled around the caisson sections and may have a web 99 secured to one portion to give a rudder effect, and permit the truss to swing about the caisson to the desired position dictated by the ocean currents. The truss 98 may be made in several sections disposed around the caisson, providing lateral bracing to maintain the caisson sections coaxial to one another and to avoid undue bending strains thereon.

It is, accordingly, apparent that a method and apparatus for drilling well bores in submerged locations has been provided which can be manipulated from drilling barges and which can operate effectively in deep water, which may be in excess of 500 feet in depth. The caisson construction does not subject any workmen to pressures above atmospheric, and such workmen can readily operate within the caisson free from the effects of the surrounding water. Once the conductor pipe 10 has been cemented in place, the well can be drilled in the same manner as on dry land. The same drilling barge can be used regardless of the depth of water encountered, the only limitation being the strength of the caisson sections, which can, of course, be made of much heavier wall thickness at the lower portions than at the upper portion, to withstand the greater pressure. Not only can the apparatus be used for the drilling and completing of wells, but it can also be used for subsequent workover operations on such wells as needed.

The inventor claims:

1. The method of drilling a well in formation under a body of water from a floating barge, which comprises providing a generally vertical bore hole in the formation and installing a conductor pipe in the bore hole in a generally vertical position to provide an annulus between the conductor pipe and the wall of the surrounding formation; depositing cementitious material in said annulus, lowering a tubular structure from the barge through the water and attaching it in leakproof relation to the conductor pipe, the structure extending from the conductor pipe to the barge above the surface of the water and being

of a size to accommodate a person and equipment therein, removing any water in the tubular structure to enable the head of water externally thereof to hold it in leak-proof relation to the conductor pipe, lowering a rotary drill string and drill bit attached thereto through the tubular structure and conductor pipe to drill the formation, pumping drilling mud from the barge through the drill string and bit, and returning the drilling mud and formation cuttings through the conductor pipe and tubular structure to the barge.

2. The method of drilling a well in formation under a body of water from a floating barge, which comprises lowering a conductor pipe having a lower housing section secured to its upper portion from the barge through the water to the underlying formation bed, rotating the conductor pipe to drill the well to the depth in which the lower housing section is substantially at the formation bed, cementing the conductor pipe in place by depositing cementitious material around the exterior of the conductor pipe and the wall of the well, then lowering a tubular structure having an upper housing section from the barge through the water and engaging the upper housing section with the lower housing section, the structure extending above the surface of the water and being of a size to accommodate a person and equipment therein, removing any water in the tubular structure to enable the head of water externally thereof to hold the upper housing section in leakproof relation against the lower housing section, and lowering drilling tools through the tubular structure and conductor pipe to drill the formation.

3. The method of drilling a well in formation under a body of water from a floating barge, which comprises lowering a conductor pipe having a lower housing section secured to its upper portion from the barge through the water to the underlying formation bed, rotating the conductor pipe to drill the well to the depth in which the lower housing section is substantially at the formation bed, cementing the conductor pipe in place by depositing cementitious material around the exterior of the conductor pipe and the wall of the well, then lowering a tubular structure having an upper housing section from the barge through the water and engaging the upper housing section with the lower housing section, the structure extending above the surface of the water and being of a size to accommodate a person and equipment therein, removing any water in the tubular structure to enable the head of water externally thereof to hold the upper housing section in a leak-proof relation against the lower housing section, lowering drilling tools through the tubular structure and conductor pipe to drill the formation to the desired depth, completing the well, closing the upper housing section and removing the tubular structure from the upper housing section.

4. In apparatus for drilling a well in formation under a body of water from a floating barge: a conductor pipe adapted to be installed in the formation; a tubular structure adapted to be lowered in the water to said conductor pipe and extending between the barge and conductor pipe; means releasably connecting said structure to said conductor pipe means providing a leak-proof connection between said structure and conductor pipe; closure means in and secured to the lower portion of said tubular structure to prevent entry of water into said structure above said closure means during lowering of said structure in the water; means for removing water from said structure below said closure means after said structure has been connected to the conductor pipe to cause the hydrostatic head of water externally of said structure to hold it in leak-proof relation to the conductor pipe; and means for opening said closure means to permit access through said structure to said conductor pipe therebelow.

5. In apparatus for drilling a well in formation under a body of water from a floating barge: a conductor pipe adapted to be installed in the formation; a lower housing section secured to said pipe; a tubular structure adapted to be lowered in the water to said conductor pipe and extending between the barge and lower housing section; an upper housing section releasably secured to said structure and adapted to engage said lower section in leakproof relation; closure means in and secured to the lower portion of said structure to prevent upward flow of water therethrough during its lowering in the water; means for removing water from said housing sections and tubular structure below said closure means after said housing sections have coengaged in leakproof relation to permit said closure means to be opened and access gained to said housing sections.

6. In apparatus for drilling a well in formation under a body of water from a floating barge: a conductor pipe adapted to be installed in the formation; a lower housing section secured to said pipe; a tubular structure extending between the barge and lower housing section; an upper housing section adapted to engage said lower section in leak-proof relation; means releasable from within said structure for securing said upper housing section to said structure; said upper housing section having an upper opening into said structure; closure means in the lower portion of said structure above said opening to prevent upward flow of water therethrough; means for removing water from said housing section and tubular structure below said closure means after said housing sections have coengaged to permit said closure means to be opened and access gained to said housing sections and closure means adapted to be secured to said upper housing section to close said opening.

7. In apparatus for drilling a well in formation under a body of water from a floating barge: a conductor pipe adapted to be installed in the formation; a tubular structure adapted to be lowered in the water to the conductor pipe and extending between the barge and conductor pipe; means providing a leak-proof connection between said structure and conductor pipe; closure means in and secured to the lower portion of said tubular structure to prevent entry of water into said structure above said closure means during its lowering in the water; means for removing water from said structure below said closure means after said structure has been connected to the conductor pipe to cause the hydrostatic head of water externally of said structure to hold it in leak-proof relation to the conductor pipe; means for opening said closure means to permit access through said structure to said conductor pipe therebelow; and a stiffening member mounted on said tubular structure and extending laterally thereof.

8. In apparatus for drilling a well in formation under a body of water from a floating barge: a conductor pipe adapted to be installed in the formation; a lower housing section secured to said pipe; a tubular structure extending between the barge and lower housing section; an upper housing section releasably secured to said structure and adapted to engage said lower section in leakproof relation; closure means in the lower portion of said structure to prevent upward flow of water therethrough; means for removing water from said housing sections and tubular structure below said closing means after said housing sections have coengaged to permit said closure means to be opened and access gained to said housing sections; said structure including a swivel in its lower portion to permit tilting of said structure relative to said upper housing section.

9. In apparatus for drilling a well in formation under a body of water from a floating barge: a conductor pipe adapted to be installed in the formation; a lower substantially hemispherical housing section secured to said pipe; a tubular structure extending between the barge and lower housing section; an upper substantially hemispherical housing section releasably secured to said structure and adapted to engage said lower section in leak-proof relation to form a generally spherical chamber; closure means in the lower portion of said structure to

prevent upward flow of water therethrough; means for removing water from said housing sections and tubular structure below said closure means after said housing sections have coengaged to permit said closure means to be opened and access gained to said housing sections.

10. In apparatus for drilling a well in formation under a body of water from a floating barge: a conductor pipe adapted to be installed in the formation; a lower substantially hemispherical housing section secured to said pipe; a tubular structure extending between the barge and lower housing section; an upper substantially hemispherical housing section adapted to engage said lower section in leak-proof relation to form a substantially spherical chamber therewith; means releasable from within said structure for securing said upper housing section to said structure; said upper housing section having an upper opening into said structure; closure means in the lower portion of said structure above said opening to prevent upward flow of water into said structure; means for removing water from said housing sections and tubular structure below said closure means after said housing sections have coengaged to permit said closure means to be opened and access gained to said housing sections; and closure means adapted to be secured to said upper housing section to close said opening.

11. In apparatus for drilling a well in formation under a body of water from a floating barge: a conductor pipe adapted to be installed in the formation; a lower substantially hemispherical housing section secured to said pipe; a tubular structure extending between the barge and lower housing section; an upper substantially hemispherical housing section adapted to engage said lower section in leak-proof relation to form a substantially spherical chamber therewith; means releasable from within said structure for securing said upper housing section to said structure; said upper housing section having an upper opening into said structure; closure means in the lower portion of said structure above said opening to prevent upward flow of water into said structure; means for removing water from said housing sections and tubular structure below said closure means after said housing sections have coengaged to permit said closure means to be opened and access gained to said housing sections; and closure means adapted to be secured to said upper housing section to close said opening; said structure including a swivel in its lower portion to permit tilting of said structure relative to said upper housing section.

12. In apparatus for drilling a well in formation under a body of water from a floating barge: a conductor pipe adapted to be installed in the formation; a lower substantially hemispherical housing section secured to said pipe; a tubular structure extending between the barge and lower housing section; an upper substantially hemispherical housing section adapted to engage said lower section in leak-proof relation to form a substantially spherical chamber therewith; means releasable from within said structure for securing said upper housing section to said structure; said upper housing section having an upper opening into said structure; closure means in the lower portion of said structure above said opening to prevent upward flow of water into said structure; means for removing water from said housing sections and tubular structure below said closure means after said housing sections have coengaged to permit said closure means to be opened and access gained to said housing sections; closure means adapted to be secured to said upper housing section to close said opening; said structure including a swivel in its lower portion to permit tilting of said structure relative to said upper housing section; and a stiffening structure mounted on said tubular structure for arcuate movement thereon and extending laterally thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

962,019	Flood et al.	June 21, 1910
2,171,672	Plummer	Sept. 5, 1939
2,187,871	Voorhees	Jan. 23, 1940
2,606,003	McNeill	Aug. 5, 1952
2,669,846	Shannon	Feb. 23, 1954
2,684,575	Pryor et al.	July 27, 1954
2,747,840	Miles	May 29, 1956
2,808,229	Bauer et al.	Oct. 1, 1957
2,854,215	Cox et al.	Sept. 30, 1958