

Sept. 20, 1971

J. W. WESTMORELAND, JR

3,605,414

SUBMERGED WELL HEAD PLATFORM

Filed Nov. 27, 1968

2 Sheets-Sheet 1

Fig. 1.

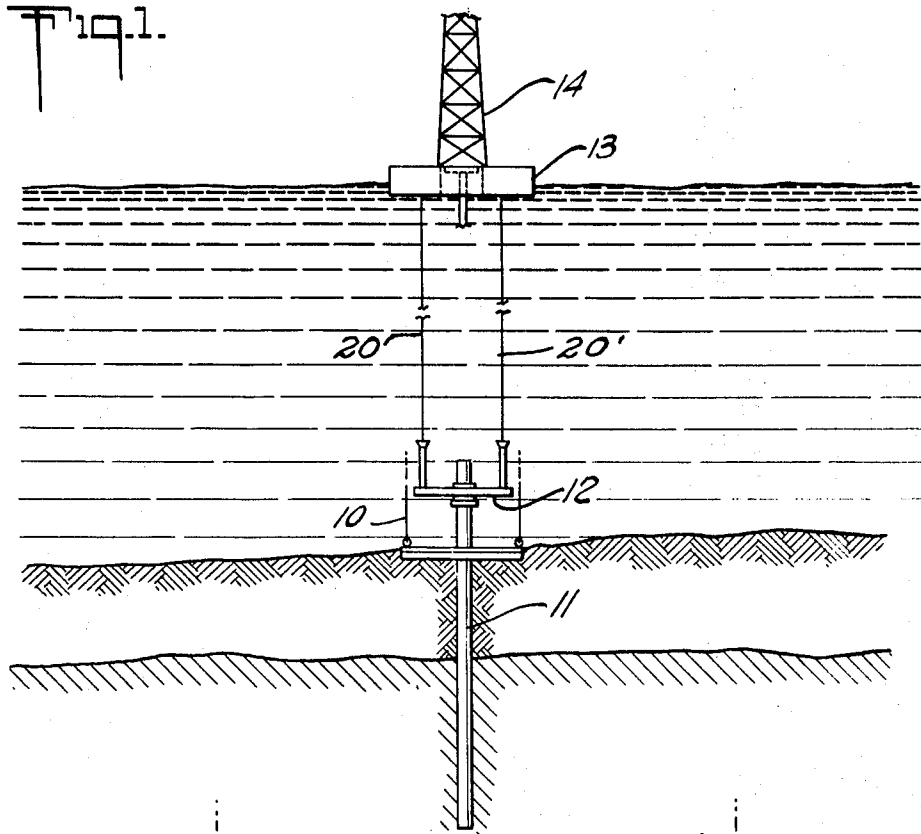
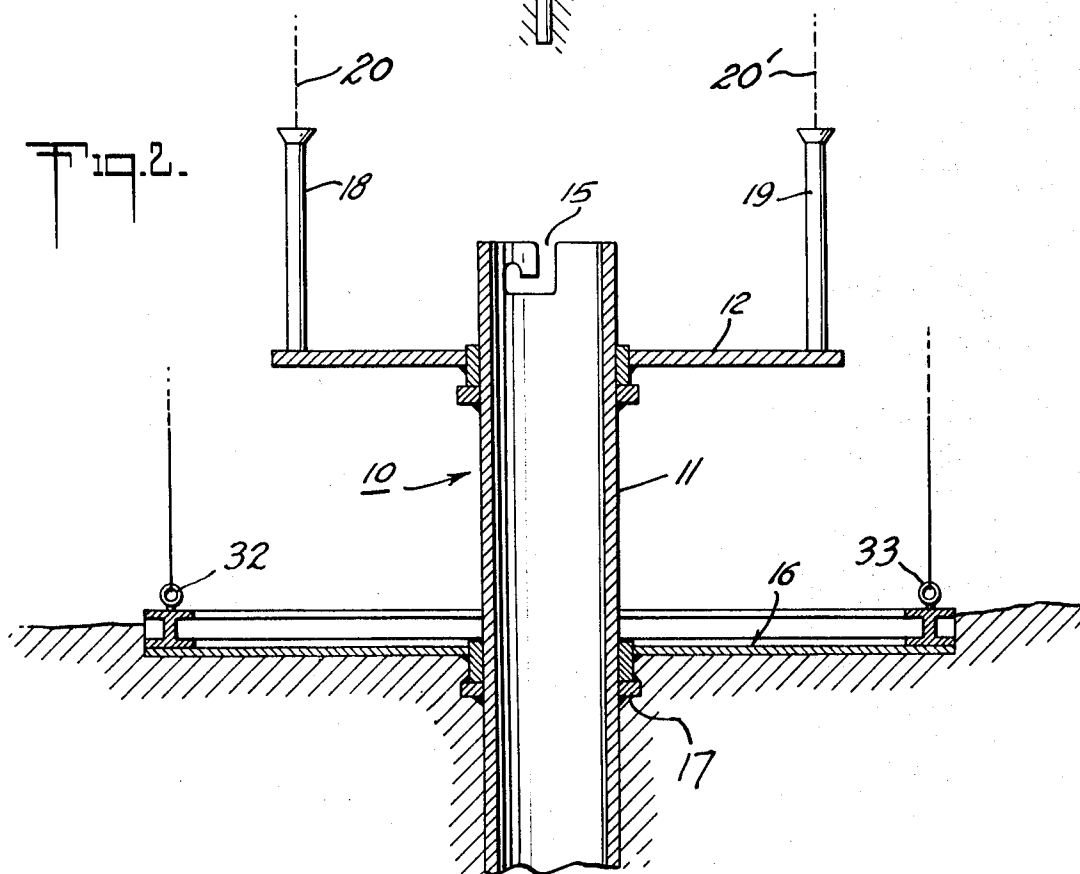


Fig. 2.



Sept. 20, 1971

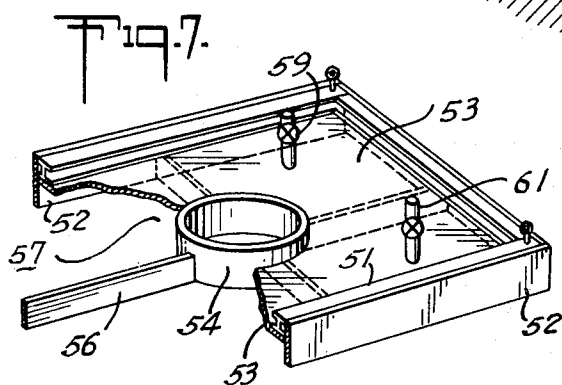
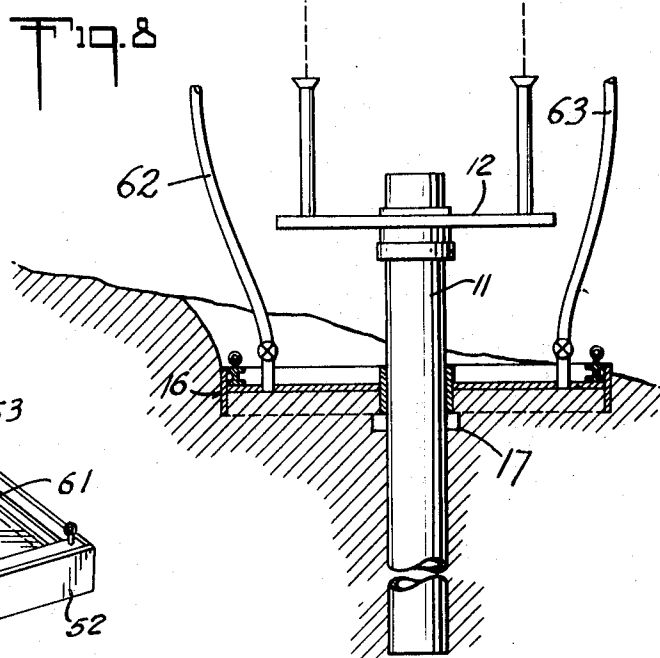
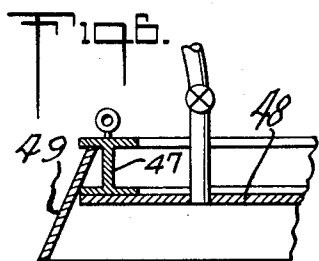
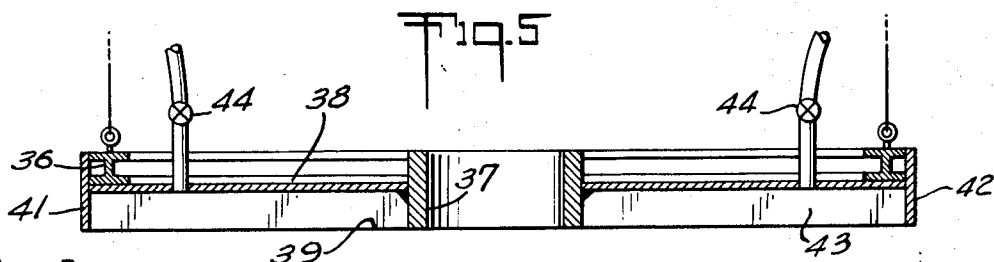
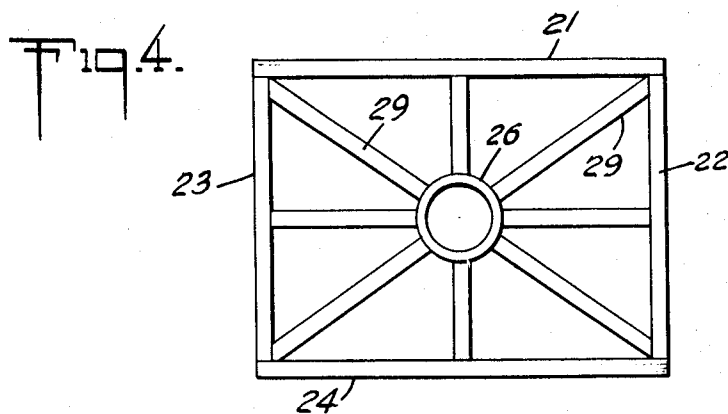
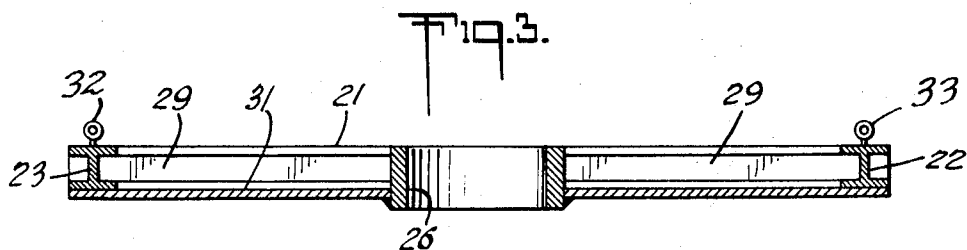
J. W. WESTMORELAND, JR

3,605,414

SUBMERGED WELL HEAD PLATFORM

Filed Nov. 27, 1968

2 Sheets-Sheet 2



1

3,605,414

SUBMERGED WELL HEAD PLATFORM

Joseph W. Westmoreland, Jr., Houston, Tex.

(% Texaco, Inc., P.O. Box 430, Bellaire, Tex. 77401)

Filed Nov. 27, 1968, Ser. No. 779,412

Int. Cl. E02d 27/52; E21b 15/02

U.S. Cl. 61—46

4 Claims

ABSTRACT OF THE DISCLOSURE

The invention relates to an offshore platform adapted to be submerged and positioned on the floor of a body of water whereby to support an under water well head or similar equipment a predetermined distance above the floor. The platform is particularly adapted for use in a substratum characterized by an unconsolidated or muddy composition which would ordinarily be inadequate to stably support the well head as well as drilling casing and the like. A primary support factor is contributed by a foundation pad connected to, and depending from the conductor pipe, which pad is supported at the ocean floor thereby establishing a firm housing for the conductor pipe.

BACKGROUND OF THE INVENTION

In the exploration for, and production of crude oil from offshore locations one of the many problems encountered is the variable density and composition of the ocean substratum. It is known that, as in the instance of offshore locations, the ocean floor will not only vary in physical contour, but the consistency of the substratum will be defined of compositions which must be determined beforehand. The purpose of such preknowledge of the ocean floor is not only to facilitate the determination of the presence of oil-bearing strata, but also to anticipate the most expeditious way of sinking a well to the oil-bearing strata.

The mechanics of drilling and setting a well at a particular offshore location are similar in many respects to the procedure followed at comparable land based installations. However, there is one pertinent difference that can spell a drastic departure from the known technology as applied to land based drilling sites.

In many offshore locations, particularly in the area of the Gulf of Mexico, the substratum encountered is essentially of a muddy nature comprising a substantially semi-fluidic unconsolidated aggregate. In the instance where a particularly fluidized muddy substratum extends for considerable depth, it has proven problematical to properly support the initial well equipment in anticipation of proceeding with the actual drilling operation.

The preliminary step in the normal course of offshore well drilling consists of lowering through the body of water and into the substratum, a conductor casing or pipe which will extend from a point a distance above the ocean floor, to a predetermined depth into the substratum. This casing defines a cylindrical passage through which subsequent smaller diameter casings are inserted as the drilling operation progresses.

The elongated conductor casing is lowered into the substratum from a barge at the water's surface. A guide structure is subsequently connected to the conductor and similarly lowered along with the conductor. The function of the guide structure in the drilling operation is to anchor cables extending down from the surface vessel whereby to guide tools and equipment lowered from the ship. Such tools and equipment are thus lowered and retrieved quickly and expeditiously between the well head and water's surface. Within limitations, the equipment eventu-

2

ally positioned at the well head or on the ocean floor will weight up to several tons.

In the instance of a particular soft or muddy substratum, the conductor pipe is often unable to establish an adequate friction grip in the ocean floor to sustain the conductor casing. The latter as well as its guide platform, will then tend to sink further into the mud as the drilling progresses. In some instances the slippage can be corrected or minimized. On occasion however, wells have had to be abandoned due to the completed well, together with the conductor and casings becoming totally immersed in the mud.

Generally, the ocean topography at a particularly muddy location is relatively flat. This rule, however is not constant since definite irregularities are present due to natural conditions, such as tides, prevailing currents and the like.

It is therefore one of the objects of the invention to provide a novel drilling and equipment guide platform adapted for a subsea, offshore well installation. It is a further object to provide a foundation and drilling guide platform cooperative with an elongated well conductor adapted for supporting the conductor and ancillary producing equipment during the well drilling process. A still further object is to provide a well drilling guide platform for an undersea operation, which platform includes a relatively broad foundation carried on a conductor pipe a sufficient distance from the top of the latter that when the foundation is supported on the ocean floor, the well head will be elevated a substantial distance above the latter.

The above stated problems are at least partially overcome, and the objectives above enumerated are achieved by the provision of a subsea well head platform adapted to stabilize and fixedly position a well in a relatively muddy substratum. The platform comprises in brief an elongated cylindrical conductor casing having a diameter of approximately 30 inches, which casing is normally inserted through the body of water into the substratum in an upright position. A foundation member spaced from the upper end of the conductor is adapted to rest on and be supported by the ocean floor in such a manner to rigidly position the conductor and well head. The well head is raised 15 to 20 feet above the foundation member platform and is preceded during the drilling operation by a guide structure which is attached to the conductor and which includes means for accurately lowering well tools and equipment.

DESCRIPTION OF THE DRAWINGS

In the drawings, FIG. 1 is an environmental illustration of the present well head platform shown positioned at the floor of a body of water. Also shown is a drilling barge floating directly above the platform in the usual manner for drilling and completing a well. FIG. 2 is a cross-sectional elevation of a well head platform imbedded in the ocean substratum. FIG. 3 is a cross-sectional view of the horizontal platform foundation member shown in FIG. 1. FIG. 4 is a top view of the foundation member shown in FIG. 3. FIG. 5 is a cross-sectional view of an alternate embodiment of the foundation member shown in FIG. 3. FIG. 6 is a segmentary view in cross-section of an alternate embodiment of the foundation member construction shown in FIG. 5, and FIG. 7 is an isomeric view having a portion broken away to illustrate the internal construction of the foundation member shown in FIG. 5 and FIG. 8 is a view of the embodiment of FIG. 5 in final position.

Referring to FIG. 1, well head platform 10 is shown imbedded in the relatively muddy substratum of a body of water preliminary to drilling a well. The platform rests on or near the surface of the ocean floor, being

3

supported by the combined reactive support of the muddy substratum, and the frictional hold of the substratum on elongated conductor casing 11. The upper end of the latter extends above the ocean floor for a distance of 15 to 20 feet, where a guide structure 12 is removably or permanently fixed to the conductor 11.

A drilling barge 13 or similar floating vessel at the water's surface is provided with a derrick structure 14 which supports and directs the drilling and well forming equipment from the barge, through the water depth, and to the well head platform. Such drilling in offshore locations is not confined to a particular depth of water. Further the present system can be used accurately and efficiently in relatively shallow depths or in water up to 500 feet and greater. Not presently shown, but a feature utilized in the drilling and completion of an offshore oil well, is illumination equipment such as discretely placed lights which are a part of a closed circuit television system. This equipment at the well head permits a more accurate control of the drilling and completing operations from the water's surface.

FIG. 2 illustrates a preferred embodiment of the well head platform 10 as used, and includes essentially, foundation or bearing member 16 which is fastened to the outer wall of cylindrical conductor 11. A band 17 welded to casing 11 outer wall forms a connection and support base to which foundation member 16 is welded. Following normal practice, conductor 11 comprises cylindrical steel tubing or casing members of a diameter from about 15 to 36 inches, which is end welded into an elongated continuous member.

In the well drilling procedure, casing 11 is initially imbedded into the substratum a sufficient distance to establish a fixed, accessible location for the well opening. The length of conductor imbedment in the substratum varies with the consistency and type of substratum in which the well is to be drilled. In the instance of a relatively muddy ocean floor, the conductor length beneficially will be considerably longer than in the instance of a consolidated or more firm substratum.

The upper end of conductor 11 is provided with a J slot 15 and extends above the ocean floor a sufficient distance as previously mentioned, to maintain the well head equipment above said floor and beyond the reach of mud, and dirtier water associated with the drilling and producing operation. Further by raising the well head equipment, both the drilling and producing operations are expedited since the well opening defined by conductor 11 is above the murkier floor of the ocean which is normally in a state of agitation thereby impeding visibility in the immediate vicinity of the well head.

Guide structure 12 is carried adjacent the upper end of the conductor and includes a plurality of upstanding guide tubes 18 and 19. Such tubes usually number four, and are disposed about, and equidistant from the well center. Guide lines 20 and 21' extending from barge 13 to guide structure 12 through the respective guide tubes, serve to accurately direct equipment moving between the vessel and the well head, either for connection to, or insertion into the well.

After a well has been completed with the usual Christmas tree and/or blow-out preventers, guide structure 12 may be salvaged for reuse but is usually left in place. Thus, the well head equipment will be firmly positioned above the ocean floor at the upper end of the conductor 11 and supported by the foundation member 16 to facilitate subsequent capping or workover operations.

Referring to FIG. 3, one embodiment of foundation member 16 comprises basically a planar element depending from, and normal to the longitudinal axis of conductor 11, to provide widespread bearing surface when in contact with the ocean floor. As a matter of convenience, foundation member 16 is expeditiously made symmetrical with conductor 11 although such a relationship is not essential to the proper functioning of said member

4

in the combination. Further, foundation member 16 may assume any of several geometric configurations to adequately achieve the function of firmly supporting the conductor tube and ancillary well structures at the ocean floor.

As shown in FIGS. 3 and 4, one embodiment of the foundation member includes a four-sided frame comprised of peripherally arranged structural steel members such as I beams 21, 22, 23 and 24. These members are terminally welded into a unit to form a rigid, square arrangement. A casing ring 26 is disposed centrally of the four-sided frame and is sufficiently large in diameter to register on, and be fastened to conductor pipe 11 by ring 17. A plurality of radial bracing bars 29 are terminally connected at one end to the outer surface of ring 26, and at the other end to structural members 21 to 24 inclusive.

A bearing plate 31 carried at the underside of the four-sided frame is formed preferably of a heavy gauge steel plate. Plate 31 is fixed by welding to the respective radiating arms and welded frame. Preferably, bearing plate 31 is peripherally welded to the underside of framed I beams and ring 26 respectively thereby providing a rigid, fluid tight joint.

In a fluid tight condition, plate 31 and the four-sided frame define an open ended compartment beneath the frame structure. Operationally, plate 31 provides in effect an expanded bearing surface for the vertical conductor casing. However, the plate may be provided with apertures or other fluid flow control means such as valves or the like for the purpose to be herein noted.

Lifting eyes 32 and 33 positioned at the corners of foundation member 16 serve to anchor additional guide cables extending upward to the drilling barge 13 to supplement the function of the guide lines 21 and 21' which connect to guide structure 12.

Referring to FIG. 5, an alternate embodiment of the novel bearing or foundation platform is shown and includes essentially a basic frame structure similar to that shown and described with respect to FIG. 3 and which is adapted to cooperate with an elongated conductor. The frame section comprises peripherally arranged and connected I beams 36, an elongated center ring 37 and bearing plate 38. A skirt comprising downwardly extending side plates 39, 41 and 42 depends from the underside of the formation member to be first received in the mud or ocean floor as the conductor is lowered. The skirt provides in effect an elongated plate enclosure sealably welded to the lower edge of the respective I beams. Adjacent ends of the skirt plates 39, 41 and 42 are welded at a fluid tight joint thereby defining beneath plate 38 an open ended stabilizing chamber 43.

Chamber 43 may be provided with flow control means such as valves 44 or the like to regulate the quantity of fluid contained in the chamber. The latter include connection nipples for engaging a hose or conduit passing to the surface for connecting with a fluid or vacuum source. Thus, by regulating the atmosphere of chamber 43, a degree of regulation over the plate as well as the platform is achieved.

A further embodiment of the foundation member skirt is shown in FIG. 6. Said member includes I beam frame 47 to which the bearing plate 48 is assembled. Included are end positioned steel plates 49 which are cantilevered outwardly and end welded to define a flared open end to the chamber formed by the skirt section and bearing plate 48.

A further embodiment of the foundation member is illustrated in FIG. 7 and includes a frame 51 formed of welded I beam structure of the type herein described. Each outer beam of the figure carries a downwardly projecting skirt plate 52. The respective end connected skirt plates 52, together with the bearing plate 53 and center ring 54, define an enlarged, open ended central chamber at the underside of the foundation member.

One or more transverse panels 56 within the chamber, are fastened to ring or collar 54 and to the skirt plates 52

as well as being welded to bearing plate 53. The lower side of bearing plate 53, together with adjacently positioned transverse panels 56, divide the central chamber into a plurality of discrete compartments 57. As here shown, the radially positioned panels 56 function also as a reinforcing member connecting center ring 54 to the peripheral frame and bearing plate 53. In the shown structure, four such radial panel members are provided whereby to divide the chamber into four discrete compartments.

It is appreciated however that the number of compartments so formed is not so limited and is a design consideration dependent on the size of the foundation member and the character of the ocean floor upon which it will rest.

Each of the compartments is separately regulated by a control valve such as 59 and 61, communicated with the respective compartments. The control valves are adapted for connection to a manifold, or to individual conduits 62 and 63, as shown in FIG. 8 extending to the water's surface. Pumping means connected to the respective conduits permit a fluid such as water, air or even a vacuum to be selectively introduced to the respective compartments thereby to regulate the attitude of the foundation member with respect to the substratum as the platform is lowered onto the latter.

With reference to FIGS. 1 and 2, in the method of drilling and completing an oil well embodying the present well head structure, conductor casing 11 is initially supported at barge 13 and lowered in a generally vertical attitude through the water, and into the substratum. Penetration of the latter is to a large extent due to the weight of the conductor casing but may be expedited by jetting or the normal means usually employed for inserting such a member into a permeable ocean floor. In the instance of a soft and unconsolidated substratum, the weight of the conductor itself is usually more than sufficient to carry the latter to a considerable depth.

After reaching the approximate predetermined depth to which the conductor 11 is to be imbedded, foundation member 16 is connected to, and lowered with conductor 11, being welded to shoulder ring 17. Similarly, the guide platform 12 is connected to the conductor 11 and spaced upwardly from foundation member 16 a sufficient distance to assure that the well head equipment carried on the conductor will be elevated above the ocean floor. Surface connections to pressurized water or air or a vacuum source are made to the respective foundation member fluid control valves.

The well head platform is then lowered as a unit with conductor 11 to its position at the ocean floor. Where the floor is relatively irregular the foundation member will tend to seat itself merely by the combined weight of the platform and the conductor. However for stabilizing the unit, thereby to rigidly position the conductor in an upright position, water or compressed air directed from the surface into one or more of the compartments permits a controlled settling of the entire foundation member in an upright position.

Thereafter upon completion of the well the guide structure 12 may be released from the conductor 11 and withdrawn to the surface or preferably left in place. Foundation member 16 will remain in place to support the well structure.

Other modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. A well head structure of a subterranean well located at the floor of a body of water, which floor is comprised in part of an unconsolidated substratum, said structure including;

(a) an elongated conductor casing having opposed upper and lower ends, and being disposed in a generally upright attitude, the casing lower portion being imbedded in the unconsolidated substratum, and said casing upper end extending beyond said floor and into said body of water, said upper end being further adapted to engage well head equipment,

(b) a foundation member including a bearing plate having means in the latter forming a transverse opening therethrough, said conductor casing being registered in said means forming said opening and and fixed to said foundation member, whereby said member is disposed in a plane lying substantially normal to said conductor casing and being at least partially imbedded in the substratum,

(c) a collar depending from said casing outer surface and supportingly fixed to said foundation member,

(d) said foundation member including a ring carried on said bearing plate defining said transverse opening through said plate, said ring being attached to said collar on said casing, and

(e) a guide structure carried at said casing upper end, spaced longitudinally from said foundation member whereby said guide structure is elevated above the floor of said body of water, said guide structure including means to guide well head equipment lowered from the water's surface to engage said conductor casing upper end.

2. In a well head structure as defined in claim 1 wherein; said foundation member includes a frame carried on the periphery of said bearing plate, a skirt extending downwardly from said frame, and a ring carried on said bearing plate to define said transverse opening therethrough, whereby to form a chamber at the underside of said bearing plate intermediate said skirt and ring.

3. In a well head structure as defined in claim 2 including; a plurality of panels engaging said bearing plate underside and being terminally fixed to said skirt and ring respectively, whereby to define a plurality of discrete compartments at the underside of said bearing plate, about said casing.

4. In a well head structure as defined in claim 3 including; valve means communicated with each of said plurality of discrete compartments and being adapted to connect to fluid pumping means whereby to regulate the attitude of said foundation member as the latter is lowered into an unconsolidated substratum.

References Cited

UNITED STATES PATENTS

2,909,901	10/1959	Suderow	61—46.5
2,938,353	5/1960	Vorenkamp	61—46.5
3,336,975	8/1967	Word, Jr. et al.	166—5
3,464,489	9/1969	Thomas	175—7X

JACOB SHAPIRO, Primary Examiner

U.S. Cl. X.R.

61—69; 166—.5