April 26, 1966 V. C. JOHNSON 3,247,672

UNDERWATER WELL HEAD ENCASEMENT STRUCTURE

Filed Aug. 29, 1962 2 Sheets-Sheet 1

FIG. 1.

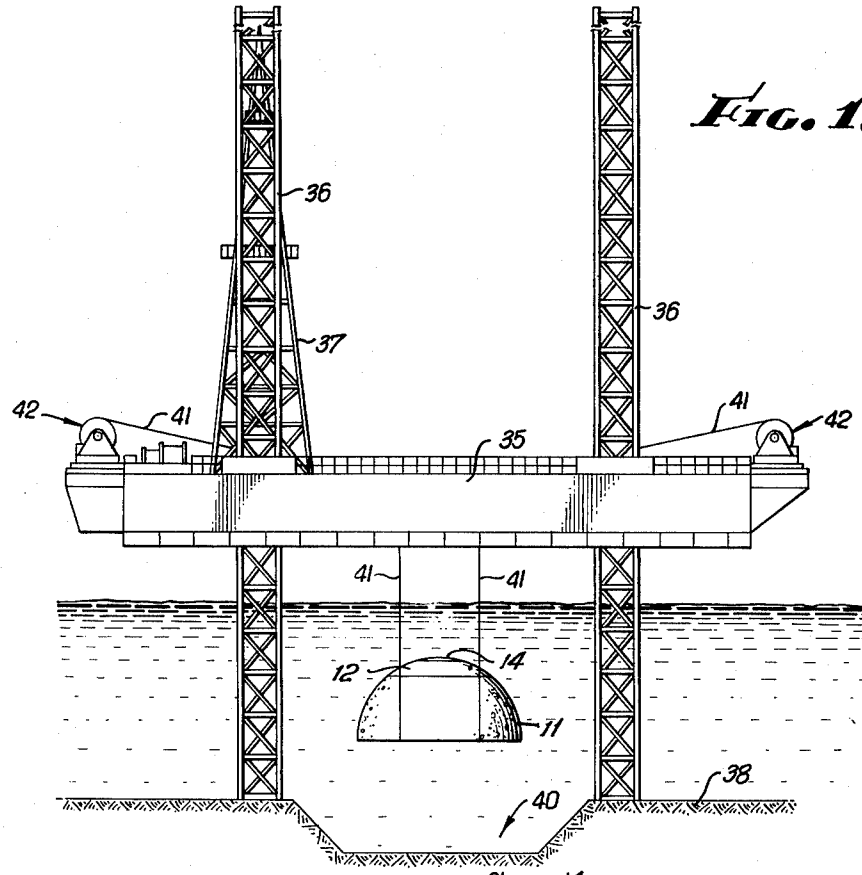


FIG. 4.

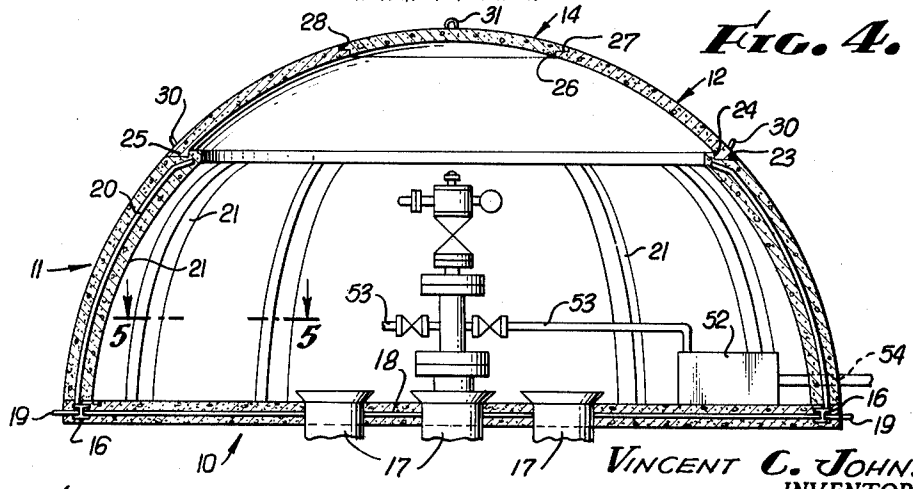
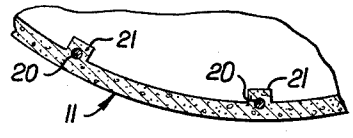


FIG. 5.



VINCENT C. JOHNSON
INVENTOR.

WHANN & McMANIGAL
Attorneys for Applicant

By

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Filed Aug. 29, 1962 2 Sheets-Sheet 2

FIG. 2.

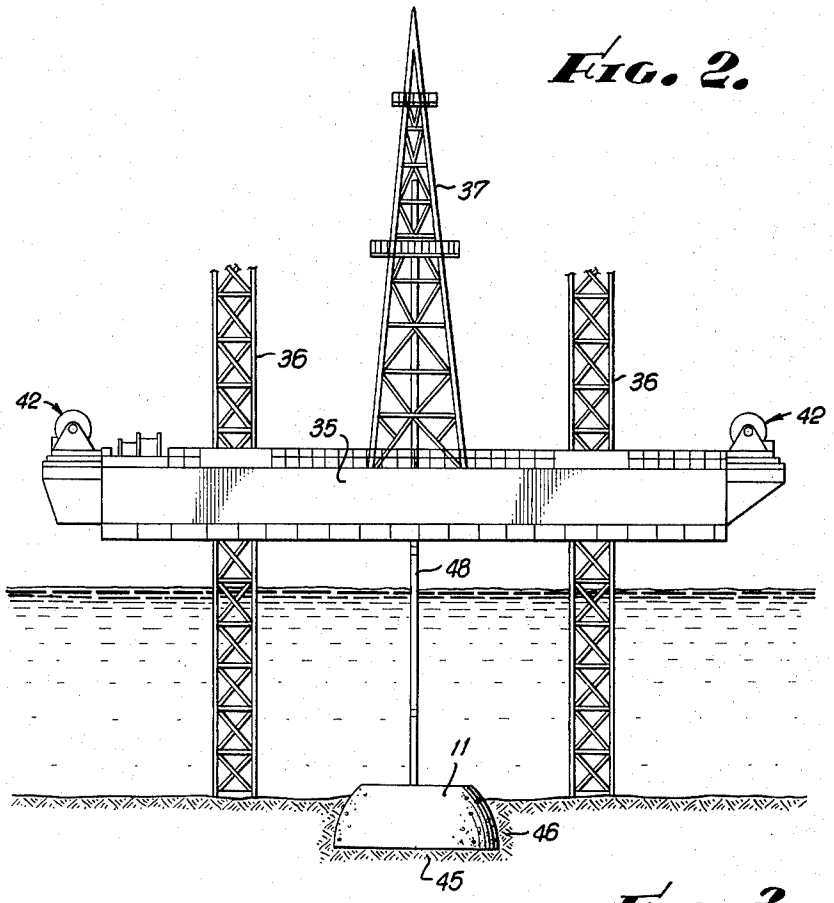


FIG. 3.

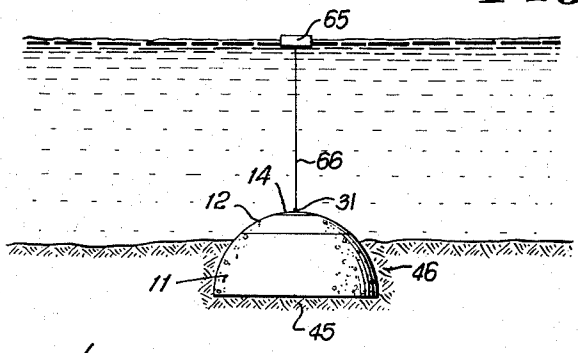
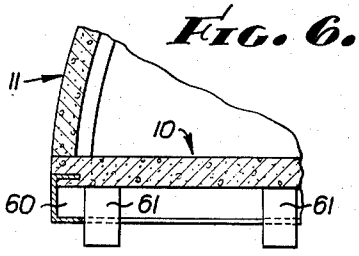


FIG. 6.



VINCENT C. JOHNSON
INVENTOR.

WHANN & McMANIGAL
Attorneys for Applicant

By

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UNDERWATER WELL HEAD ENCASEMENT STRUCTURE

Vincent C. Johnson, 10377 Tennessee Ave., Los Angeles 64, Calif.

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1 Claim. (Cl. 61—46)

This invention relates generally to underwater protective structures and relates more particularly to underwater well head encasement structures.

Various problems have been encountered in underwater oil well drilling and oil well completion installations, particularly in areas of moderate to heavy navigation, primarily because of the extreme vulnerability of such installations to ships' anchors and the possibility of deep draft collision in the shallow water areas. Damage resulting therefrom could lead to serious results, such as well blowouts, fire and pollution. Consequently such underwater oil well installations have been limited to relatively isolated areas.

Various methods have been used or proposed for underwater drilling and the production of oil from such operations, including the ocean floor completion technique. The latter method presents serious difficulties. For example, the network of submarine lines and well head equipment greatly restricts the use of the area as an anchorage for ships. Such ocean floor well installations that presently exist and the previously known means for protecting these installations, include further disadvantages. Typically, complex well head attachments are made at ocean floor level and extend upwardly a minimum of approximately 12 feet. Any such installations are therefore restricted to a water depth of sufficient overhead clearance to allow for passing ships. Harbors, bays and near shore areas are generally not of sufficient water depth to safely permit oil well protrusions from the ocean floor.

Well head structures and the various means of encasement therefor now in existence merely extend the protrusion above the ocean floor and offer little or no safeguard from damage by ships' anchors. Lateral forces also are often found prohibitive to the complete enclosure of the encasement being used, and one type known to be presently used is an open "bird cage" type encasement made of steel pipe materials. Obviously such an arrangement is vulnerable to ships' anchors, even in isolated areas of comparatively deep water.

Further, such known types of protective structures are installed after the drilling and completing of the well which, of course, entails difficulties and problems, particularly in relatively deep water.

It is therefore an object of the present invention to provide protective means which will overcome the above difficulties and solve the problems pointed out above.

Another object of the invention is to provide a structure of this character that is built in its enirety on land, with lifting lugs, etc., that may be required for installation built in the completed assembly.

Still another object of the invention is to provide a structure or apparatus of this character constructed to meet the requirements for a selected well location and exposures related thereto.

A further object of the invention is to provide structure of this character that is embedded in the ocean floor to such an extent that only a small portion is exposed above said floor, the portion exposed above the ocean floor being determined by the depth of the water in which the installation is made.

A still further object of the invention is to provide an encasement structure of this character which offers a deflective surface with no protrusions that might capture and/or hold a dragging anchor or the like.

It is another object of the invention to provide an encasement structure of this character having a contour that is least affected by lateral forces of wave and current.

Still another object of the invention is to provide a structure of this character that does not necessarily have to be water-tight and de-watered, but which will keep the interior free from foreign materials and provide a deterrent to marine growth.

A further object of this invention is to provide an encasement structure of this character which, in the event of leakage from the well head structure or structures, entrap the pollutant fluids and allow for early detection and corrective repairs.

Previous protective structures for underwater well heads have accommodated only a single well and it is another object of the present invention to provide an encasement structure which will accommodate a plurality of such well head structures.

A still further object of the invention is to provide an encasement structure of this character that is sturdy, effective and reliable in protecting well head structures and the like from damage by ships' anchors, other equipment and/or factors.

It is another object of the invention to provide a structure of this character that is relatively easy to install.

It is still another object of the invention to provide an encasement structure of this character that is relatively inexpensive to manufacture.

The characteristics and advantages of the invention are further sufficiently referred to in connection with the following detailed description of the accompanying drawings, which represent certain embodiments. After considering these examples skilled persons will understand that many variations may be made without departing from the principles disclosed, and I contemplate the employment of any structures, arrangements, modes of operation or steps of the method that are properly within the scope of the appended claim.

Referring to the drawings, which are for illustrative purposes only:

FIG. 1 is a diagrammatic view of equipment installing an underwater well head encasement structure showing said structure being lowered into a hole previously excavated therefor;

FIG. 2 is a similar view showing the encasement structure resting on the bottom of the excavation or hole;

FIG. 3 is a view of the structure installed and marked by a buoy;

FIG. 4 is an enlarged vertical section through the encasement structure showing a well head structure therein;

FIG. 5 is a sectional view taken on line 5—5 of FIG. 4; and

FIG. 6 is a fragmentary view of the structure showing an alternative arrangement.

The encasement structure is built in its entirety on land with lifting lugs and any other equipment that may be needed built into the structure which is constructed in accordance with the requirements of any specific installation.

Referring to FIG. 4, the structure is shown as being of precast concrete with steel reinforcements.

More particularly the encasement structure comprises a floor, indicated generally at **10**, the lower dome, indicated generally at **11**, the lid, indicated generally at **12**, and the manhole cover, indicated generally at **14**.

In constructing the encasement structure or cell, a ring of structural steel beams, indicated at **16**, are assembled for the floor and a series of horizontal beams are also set in for the floor supports. A predetermined number of pipe sections or conductor guides **17** are set in a pattern within the steel framework of the floor.

Steel reinforcing bars **18** are also installed within the structural steel framework and lifting lugs **19** are installed at this time.

Forms for concrete are set up in the usual well known manner with spacers to allow the concrete to completely cover the steel framework from inside to the exterior. The concerete is then filled in, the Gunite process being one means that may be used for this purpose. Thereafter the exterior surface is troweled to obtain the exact contour desired.

After the concrete has cured in the floor or principal structure, a steel framework, including the bar **20**, is assembled and fitted. Concreting the dome follows the same procedure as the procedure followed in building the floor or principal structure.

The access cover **12** may be similarly formed as well as the manhole cover **14**.

The dome **11** has internal reinforcing ribs **21** which may be located along the steel reinforcing members **20**. The upper end of the dome is notched at the top to provide a horizontal shoulder **23** and a vertical shoulder **24** for reception of the lower peripheral edge portion **25** of the access cover, said portion **25** being so formed as to seat on the shoulder **23** and to be held against lateral displacement by the shoulder **24**.

Adjacent the upper end of the access cover there is an opening **26** which is surrounded by a peripheral or annular horizontal shoulder **27** from the outer edge of which there is an upstanding annular shoulder **28**. The periphery of the manhole cover **14** is formed so as to extend into the opening **26** with a peripheral portion resting on the shoulder **27**. The manhole cover **14** is held against lateral displacement by the shoulder **28**.

The floor **10** and dome **11** are secured together by any suitable means. For example, reinforcing rods or the like may be left extending upwardly at the periphery of the floor so as to be embedded in the lower portion of the dome when constructed on said floor.

Means for raising and lowering or otherwise handling the floor and dome assembly comprise the lifting lugs **19**. Lifting lugs **30** or other suitable means are provided for handling the access cover and there is a member **31** for handling the manhole cover, member **31** being shown as an eye. The lifting lugs **30** and the lifting lugs **19** may also be formed as eyes.

The first step of the installation procedure is to select the well location and then excavate a hole to rough dimensions. Various equipment may be used for making the excavation, such as clams, draglines, and/or jetting equipment operated from any suitable well known surface equipment. One type of such equipment is the "George F. Ferris" Marine Platform, typical of well known mobile oil drilling platforms. Such equipment is shown in FIGS. 1 and 2.

Referring to FIGS. 1 and 2, the equipment has a float or barge hull **35** with legs **36** adjacent the ends. There is also a derrick **37** which is movable longitudinally and laterally of the barge hull.

After selection of the well location the barge is towed to such location and properly positioned. The legs **36** are then jacked down so that the lower ends rest on the ocean or underwater floor **38**, where a continued jacking operation effects raising of the hull **35** above the water surface.

Thereafter the hole, indicated generally at **40**, is excavated in the undewater formation by the above referred to equipment which is operated in the usual well known manner.

Thereafter the completed encasement structure or concrete cell is placed aboard a work barge at dock side and transported to the well location. At location the barge is towed beneath the platform **35** and cables **41** of bridge cranes **42** aboard the platform are attached to the lifting lugs **19** of the concrete cell. It is to be understood that these lugs **19** are of sufficient number and so

arranged that the encasement structure will be held by the cables **41** in an upright manner so that the structure will not tilt.

After the cell or structure is lifted free the work barge is towed away and the concrete cell is then lowered into the excavation, being held suspended in the exact position for final resting. While in this position fill material is placed and firmly compacted underneath the structure and then around the perimeter thereof. In final position the main opening of the cell will be a suitable predetermined distance above the floor of the ocean. It has been found that having the main opening of the cell at approximately two feet above the ocean floor is a satisfactory arrangement, said main opening being the opening at the top of the dome.

Any suitable well known equipment may be used for compacting the fill material, indicated at **45** and **46** underneath and around the cell respectively.

With the encasement structure thus positioned and secured the access cover is lifted from the dome and set to one side. Any of the usual methods of ocean drilling may then be followed, using either a fixed platform of the type shown in FIGS. 1 and 2 or a floating platform.

It will be noted that the derrick **37** is moved toward one end of the barge hull or platform when the encasement structure is being installed in the opening or hole **40**. When drilling operations are conducted the derrick is moved to a position directly over the encasement structure and in alignment with the usual vertical opening, not shown, in such barge or platform.

The conductor guides in the bottom or floor of the encasement structure are funnel shaped with the large end at the top and serve as guide means for various tools and equipment during the drilling operations. These conductor guides are arranged in a suitable pattern but are so arranged as to be in register with the main opening at the top of the dome so that drilling equipment may be arranged in axial alignment with the various guides **17**.

When drilling operations are conducted from a fixed platform a conductor pipe or the drill stem extends from the platform down into the ocean floor, such conductor pipe being indicated at **48** in FIG. 2. Since the drilling operations may also be from a floating platform or vessel a sub-assembly is used at the underwater floor with exposed drill pipe extending from the vessel to the sub-assembly.

Alternatively, a floating vessel may be used and when used a sub-assembly is provided at the ocean floor with the exposed drill pipe extending from the vessel to the sub-assembly. This method of drilling is also well known and need not be described.

After the well has been completed it is provided with the usual well head attachments which are disposed within the encasement structure, such completions following the usual practice.

The manifold **52** is provided within the encasement structure and attached to the floor thereof by any suitable well known means. The manifold structure **52** is used to gather the individual oil and gas lines, such as conduits **53**, from each of the completed wells. There is an exit opening **54** in the wall of the dome adjacent the manifold **52** for the main lines for oil, gas and remote controls which are connected with the manifold or enter therein. These main lines are disposed in a trench excavated therefor from the cell or encasement structure to a shore station, the trench being deep enough so that these lines are buried to a depth sufficient for protection from ships' anchors and the like.

After drilling and well completion operations are terminated, the access cover is placed back in position on the dome, as shown in FIGS. 1, 3 and 4, the manhole cover being in position on said access cover. Thereafter the well heads are kept free of silt, sand and other foreign material and will be protected from damage from anchors and the like. For example, anchors that may

be dragging on the underwater floor would have nothing to engage and would merely pass over the smooth, rounded exposed portion of the encasement structure.

Consistent with other underwater well completion techniques, there is no particular purpose served in de-watering the encasement chamber. In other words, it is not necessary to maintain a dry chamber. However, with the small projection of the structure above the surface of the ocean floor, the chamber will be kept free of any foreign materials and will prove a deterrent to marine growth. It is to be noted that the access cover is joined to the dome and the manhole cover is joined to the access cover so as to provide a reasonably tight fit to keep such foreign materials out of the encasement structure and deter marine growth. If it is desired to provide a tighter fit between the parts, gaskets may be used.

Moreover, because of the tight connections between the access cover and the dome and the manhole cover and the access cover pollutant fluids resulting from leakage from the well head equipment in the structure will be entrapped and allow for early detection and corrective repairs.

Referring to FIG. 6, there is shown an arrangement wherein there is a depending annular flange **60** carried by the bottom or floor **10** of the encasement structure. This arrangement is used in the event the encasement structure is supported by piles **61** where the underwater formation is too soft to permit the above described type of installation. The upper end of the piles **61** will extend into the area defined by the flange **60** and said flange will prevent the encasement structure from being displaced from the supporting piles **61**, said bottom **10** resting on the upper ends of said piles.

In order to readily relocate any of the encasement structures a buoy **65** is attached to the eye **31** of the manhole cover by means of a rope or other suitable element **66**.

While the present encasement structure has been shown and described as being of reinforced concrete, it may be of steel or other suitable material.

The invention and its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts of the invention without departing from the spirit and scope thereof or sacrificing its material advantages, the arrangements hereinbefore described being merely for purposes of illustration.

I claim:

An underwater hollow oil well encasement structure, comprising:

(A) a floor of concrete;

(B) annular structural steel elements embedded in the concrete, including an annular part adjacent the periphery of said floor;

(C) conductor guides set in a pattern in the floor, said conductor guides extending through the floor and being funnel shaped and having the larger diameter ends at the top;

(D) lifting lugs secured to the concrete floor at predetermined peripherally spaced positions;

(E) a dome comprising a lower terminated dome section secured to the concrete floor and having an access opening at the upper end, said lower dome section being of reinforced concrete with the larger diameter end attached to said floor, there being a groove about the access opening at the upper end of said lower dome section;

(F) an access cover comprising a terminated spherical segment open at both ends, the lower end of said access cover having an enlarged annular portion removably received in said recess at the upper end of the lower dome section whereby the access cover is held in position on the lower dome section;

(G) lifting lugs on the exterior of said access cover;

(H) a shoulder about the opening in the upper end of the access cover;

(I) a manhole cover for the opening at the upper end of the access cover, said manhole cover having its peripheral edge portion formed to the shape of said opening and engageable with said shoulder whereby said manhole cover is removably maintained in position in said opening;

(J) and means on said manhole cover, engageable by lifting means, for removal of said manhole cover.

References Cited by the Examiner

UNITED STATES PATENTS

734,153	7/1903	Baker	50—13
763,708	6/1904	Baker	50—13
871,655	11/1907	Winslow	50—13
876,392	1/1908	Peterson	50—13
891,966	6/1908	Tromanhauser	61—46.5
2,413,243	12/1946	Neff	50—110 X
2,624,931	1/1953	Billner	61—46
2,661,600	12/1953	Hopkins	61—46
2,669,431	2/1954	Crowell	61—46.5 X
2,854,215	9/1958	Cox et al.	166—46
2,988,144	6/1961	Conrad	166—46

CHARLES E. O'CONNELL, *Primary Examiner.*

JACOB SHAPIRO, JACOB L. NACKENOFF, EARL J. WITMER, *Examiners.*