United States Patent

[11] **3,556,210**

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[54] **DEEP SEA WELL DRILLING STRUCTURE**
8 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **166/.5,** 61/46; 175/7
[51] **Int. Cl.** **E21b 7/12,** E21b 33/035
[50] **Field of Search** 175/5, 8, 9, 7; 166/5; 61/46, 46.5

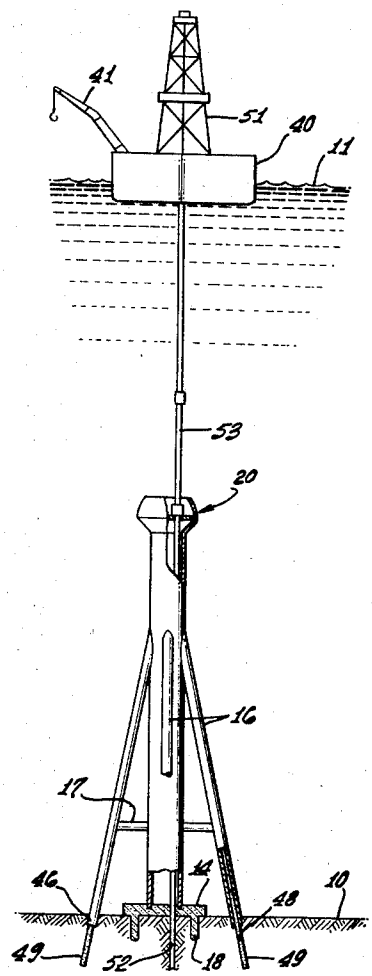
[56] **References Cited**

UNITED STATES PATENTS

2,512,783	6/1950	Tucker	175/8X
2,854,215	9/1958	Cox et. al.	166/.5
3,004,612	10/1961	Kofahl	175/9X
3,196,958	7/1965	Travers et. al.	166/.5X
3,247,672	4/1966	Johnson	166/.5X
3,372,745	3/1968	Holmes	61/46.5X
3,380,520	4/1968	Pease	166/.5
3,474,630	10/1969	Pogonowski	175/9X

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ABSTRACT: An underwater well head encasement wherein a long tubular caisson rests on a base on the ocean floor and is provided with a housing at the top located 100 to 200 feet below the water surface. Hollow diagonal tubes brace the caisson in upright position. Drill guides extend from a chamber in the housing downwardly through the base to accommodate a number of well drilling operations. A closure for the casing is lifted off during the drilling and setting of casings. The closure is replaced after this and a diver can enter the chamber through a manhole and there work on the floor of the housing for installing and manipulating the well head equipment under conditions where the chamber may be either full of water or with the water evacuated.



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SHEET 1 OF 2

FIG. 5.

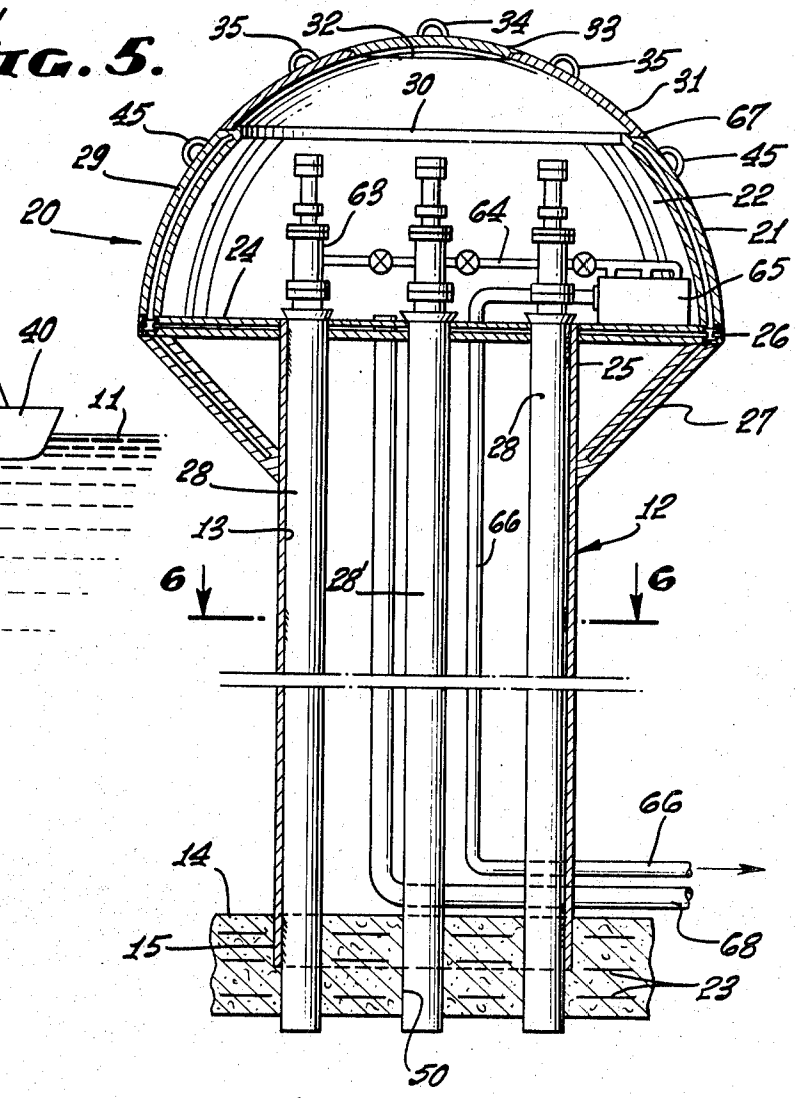
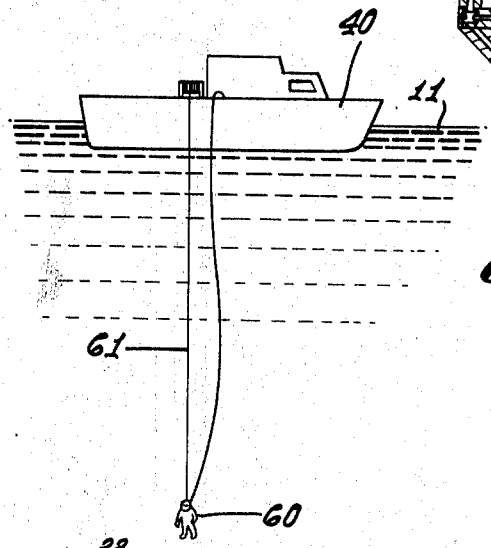


FIG. 4.



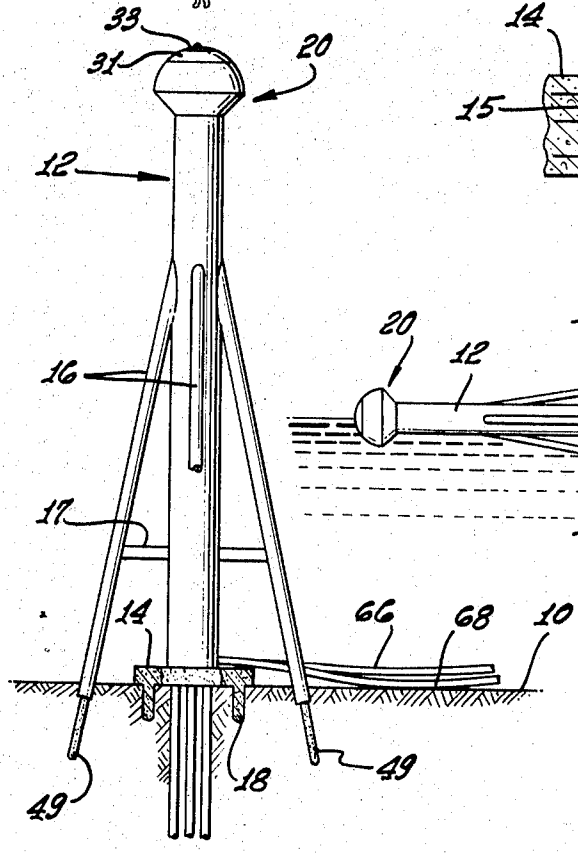
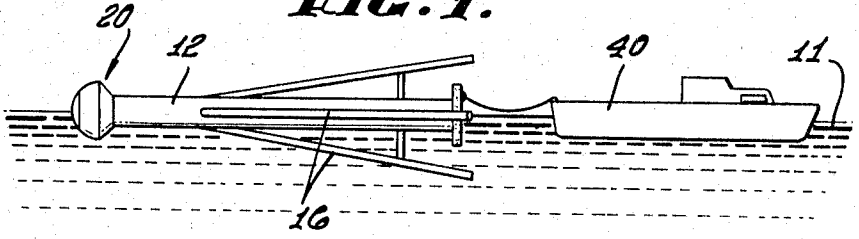


FIG. 1.



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FIG. 2.

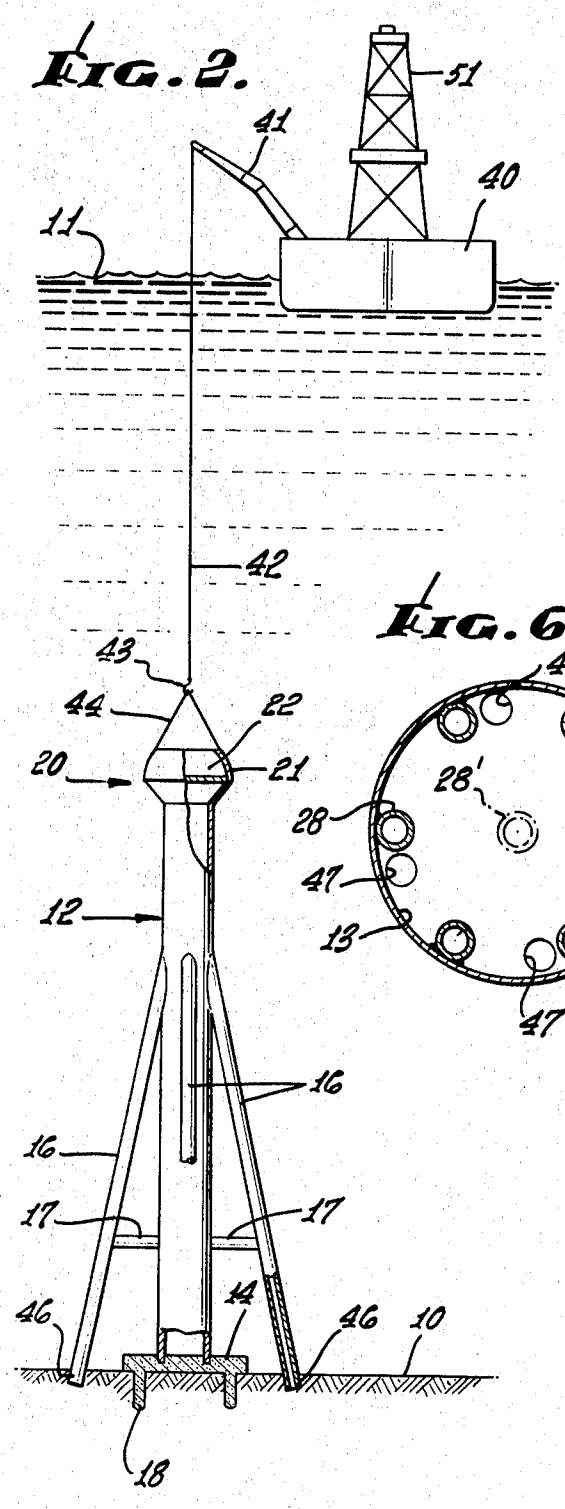
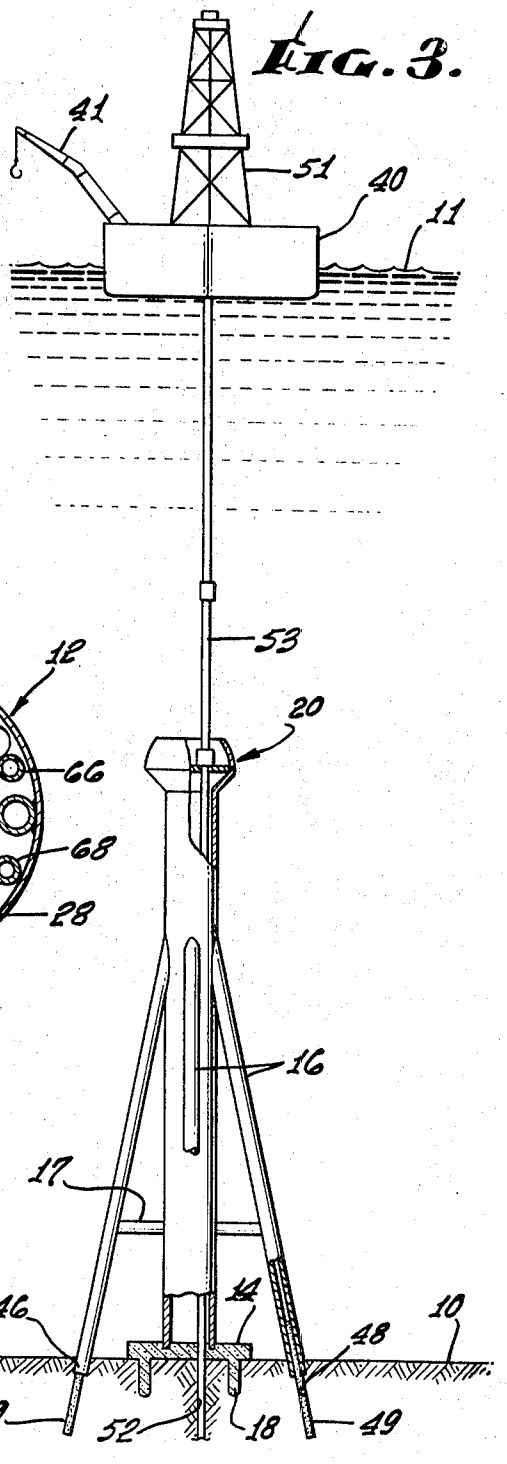


FIG. 6.

FIG. 3.



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DEEP SEA WELL DRILLING STRUCTURE

During recent years there has been an accelerated interest in the drilling of oil wells offshore in the ocean waters. To a great extent operations heretofore have largely been confined to water depths such as permit the placing of legs for stationary platforms on the ocean bottom so that the structure is in effect a man-made island from which drilling operations are first conducted and thereafter from which the drilled wells are produced. The success of such installations has lead to explorations further out in deeper water where it is not feasible nor economical to place the legs of such platforms on the ocean bottom.

An additional difficulty in water of greater depth is the inability of divers with equipment presently available to readily cap wells after they have been drilled and attach the requisite pipes and valving needed to control production of the crude oil and to arrange for its being transported either to shore or to some suitable station from which it can be loaded on tankers and delivered either to refineries or to the market.

Despite the fact that subsurface vehicles have been in the course of development, the drilling of wells and the subsequent equipment installations for producing such wells must be capable of being carried on quickly, easily and in an economical manner to avoid submarginal operations which would make the production of deep sea offshore wells impractical.

It is commonly recognized that although commercial divers can work at depths in excess of 100 to 200 feet, when a diver goes down to depths below this, the working shift for a diver is very short because of the fatigue involved working at such great pressures and a great amount of time is consumed lowering the diver to the necessary depth and then raising him again by successive decompressing stages to the surface.

It is therefore among the objects of the invention to provide a new and improved underwater well head encasement structure which makes it possible to successfully drill oil wells at ocean depths far exceeding the depths at which commercial divers can effectively work, and subsequently produce such wells by bringing casings up to a higher level, where divers can work effectively but still far enough beneath the surface to be entirely clear of ocean navigation and the adverse effects of storms at sea.

Another object of the invention is to provide a new and improved underwater well head encasement structure of such character that it can be prefabricated to a large degree on or near shore and then towed to a location in deep sea water where it can be readily stationed and anchored in place for the drilling of oil wells.

Still another object of the invention is to provide a new and improved underwater well head encasement structure of such character that it can be firmly secured at a selected location by means such as the driving and setting of steel or concrete piles and avoiding employment of permanent anchors attached to the structure by guys and cables the structure and its placement being such that it can be accomplished in a relatively minimum amount of time and by use of currently available floating equipment, and thereby made ready for a multiple well drilling operation with appreciable economy.

Still another object of the invention is to provide a new and improved underwater well head encasement structure which is capable of establishing a chamber for the accommodation of the tops of oil well casings at a level where they not only can be installed and serviced conveniently by a diver but also of such character that production lines can be manifolded and readily attached for leading off crude oil derived from the wells.

Still further among the objects of the invention is to provide a new and improved underwater well head encasement structure of such character and design that it can be opened to readily accommodate the drilling of a multiple number of wells through the structure and thereafter covered to provide a closed chamber in which equipment at the tops of the well casings can be contained in a convenient location, easy of installation, servicing and production.

With these and other objects in view the invention consists in the construction, arrangement, and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims, and illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is a view picturing the towing of the device to a location where it will ultimately be placed in position.

FIG. 2 is a schematic view showing the initial operation of placing the deep sea well drilling structure on the ocean bottom by employment of a floating work vessel.

FIG. 3 is a schematic view similar to FIG. 2 showing the structure after it has been anchored in position and in which a well drilling operation can take place.

FIG. 4 is a view similar to FIGS. 2 and 3 showing the device in operation.

FIG. 5 is a fragmentary longitudinal sectional view of the upper end of the tubular caisson and the housing at the top.

FIG. 6 is a cross-sectional view taken on the line 6–6 of FIG. 4.

In the embodiment of the invention chosen for the purpose of illustration the ocean bottom has been indicated by the reference character **10** and the water surface by the reference character **11**. For purposes of illustration it may be assumed that the level of the bottom is somewhere in the neighborhood of 600 feet or more below the surface **11**, namely at a depth much deeper than a commercial diver with currently available equipment could readily operate.

The structure consists of a central elongated tubular caisson **12** having a central bore **13** extending through it. At the lower end of the caisson is a base **14** which may, if desired, be of steel or reinforced concrete, side portions of which extend outwardly from the wall of the caisson **12** an appreciable distance to provide an acceptable degree of stability. When the base **14** is of concrete as suggested, the lower end **15** of the caisson may be embedded in the base.

Extending diagonally outwardly and downwardly from the caisson **12** are four tubular columns **16** which provide lateral support and diagonal bracing. Suitable horizontal stiffeners **17** of conventional construction are adapted to extend between the tubular columns and also the caisson. The tops of the tubular columns **16** may be attached more or less midway between upper and lower ends of the caisson **12** and be directed outwardly at an angle of some 10° to 20° more or less from perpendicular to provide adequate diagonal bracing, taking into consideration the overall height of the caisson which may differ from time to time as the depth of the water varies. A number of anchoring projections **18** may be constructed as part of the base **14** or secured to it having such length that they project downwardly into the ocean bottom **10** to ensure against horizontal shifting of the base and the bottom of the caisson.

At the upper end of the caisson **12** is a housing indicated generally by the reference character **20**. The housing **20** may be of boiler plate or may on occasions be of reinforced concrete as generally shown and described in U.S. Pat. No. 3,247,672. In the chosen embodiment the housing has a body **21** which encloses a chamber **22**, the body being annular with a smoothly curved exterior wall. Reinforced concrete material has been suggested in which are placed a structural steel frame and reinforcing rods **23**. At the lower end of the housing **20** is a horizontal bottom **24**, shown as constructed of the same material, the bottom extending over and substantially closing an upper end **25** of the caisson **12**. Extending diagonally downwardly and inwardly from a perimetral edge **26** of the body **21** is a perimetral diagonal bracing structure **27** the upper end of which is attached to the edge **26** and the lower end of which is attached to the wall of the caisson **12**.

Extending through the bottom **24** are drill guides **28** which number seven in the present embodiment and which are normally placed about on 6 foot centers, and welded as shown to the caisson **12** for stiffness and strength. On this spacing the diameter of the caisson can be approximately 16 feet. The

length of the drill guides is such that they extend throughout the full height of the caisson **12** and protrude through the base **14** as shown in FIG. **5**.

Around the upper end of the body **20** is a perimetral rim **29** of shouldered construction forming an opening **30** which, when of circular construction, has a diameter at least as large as the diameter of the caisson **12** or preferably appreciably larger. Seated on the shoulder rim **29** is a closure **31** in the form of a spherical segment at the top of which is a manhole **32** closed by a removable manhole cover **33**. The manhole is provided with a lifting ring **34** and similar lifting rings **35** are provided on the closure **31**, so that the closure can be removed and replaced as well as the manhole cover.

In placing the structure use is made of a floating work vessel **40**, provided as suggested with a crane **41** for manipulating a cable **42** at the lower end of which is a hook **43** engaging a sling **44** attached to appropriate lifting rings **45** on the body **21**. The structure is lowered to the ocean bottom **10**, whereupon the weight of the structure will tend to embed lower ends **46** of the tubular columns **16** into the ocean bottom while the base **14** rests on the ocean bottom. Once in this position, a drill (not shown) may be sent down through openings **47** and biased into the respective tubular columns **16**, thereby to drill holes **48** into the ocean bottom through the lower ends **46** of the tubular columns. After the holes **48** have been drilled, concrete piles **49** can be set in them, thereby to firmly anchor the tubular columns **16** in place. After the structure has been effectively anchored in the position shown in FIG. **3**, the central drill guide **28'** may be extended through the bottom **24** and into an appropriate bore **50** in the base **14**. By use of a derrick **51** on the vessel **40** and appropriate conventional well drilling equipment, the wells may be drilled by extending a drill rod through one or another of the drill guides **28** to drill appropriate wells **52** in the ocean bottom, after which well casing lengths **53** are set in the well by extending them downwardly progressively from the vessel **40** into the wells **52**. Upon completion of the setting of an appropriate number of casings **53**, the drilling and casing setting operation is suspended and a diver **60** supported by a line **61** lowered from the service vessel **40** so that he can enter the chamber **22** and attach the well head equipment suggested by the Christmas tree **63** and manifold piping **64**. As further suggested in FIG. **4**, the manifold piping, namely production piping, is attached to a common accumulator casing **65**, if all of the wells are to be produced through one common production line **66** through which all of the production may pass to an appropriate delivery point (not shown).

The closure **31**, in company with the manhole cover **33**, is then lowered into position over the body **21** so that there is a sealed joint between a lower supporting edge **67** of the closure **31** and the rim **29** at the top of the body **21**. The seating of the manhole cover on the manhole may also be a sealed joint.

Thereafter, whenever it may be necessary to service the equipment at the top of the casing, located as it is in the chamber **22** above the floor **24**, all that is necessary is to lift the manhole cover **33** from its position by engagement of suitable tackle in the lifting ring **34** thereby to provide access to the chamber **22** so that a diver can be lowered through the manhole to where he can walk about on the floor **24** for whatever servicing may be required of him.

To insure against accidental contamination of ocean water by crude oil escaping from either a newly drilled well or a completed well under production, there is provided an overflow conduit **68** extending from the chamber **22** downwardly through the caisson **12** and then to a suitable disposal (not shown) on shore of capacity such that it can dispose of spillage from one or more of the drilled wells **52**.

I claim:

1. An underwater well head encasement structure for mounting below the water surface and on the ocean bottom by use of a floating work vessel comprising:

a tubular caisson having a lower end adjacent the ocean floor and having an upper end at a depth below the water surface within which a diver serviced by said vessel can operate;

a base at the lower end of said tubular caisson;

lateral supports for said tubular caisson comprising a plurality of diagonal braces having upper ends in engagement with the wall of the caisson intermediate upper and lower ends, lower ends of said braces being secured in the ocean bottom;

a housing mounted on the upper end of the caisson including a side wall structure forming a chamber over said upper end, a bottom wall closing the lower side of said housing and extending over the upper end of said caisson, a plurality of drill guides extending from said bottom wall to said base, said wall structure having an upper perimetral rim forming an opening at least as large as the interior of said caisson to enable the drilling of wells through said drill guides and the setting of well casings in said wells; and

a substantially annular closure for said housing having a supporting edge on the lower side in removable sealed position on said rim.

2. An underwater well head encasement structure as in claim **1** wherein said diagonal braces comprise tubular columns having upper ends opening into the interior of the caisson and pilings extending from within the lower ends of respective columns downwardly into the ocean floor.

3. An underwater well head encasement structure as in claim **1** wherein said closure has a manhole on the upper side and a manhole cover in removable sealed position on said closure at a location covering said manhole.

4. An underwater well head encasement structure as in claim **1** wherein there are anchoring projections extending from said base downwardly into the ocean floor to prevent lateral shifting of said base.

5. An underwater well head encasement structure as in claim **1** wherein said base is at a location resting on the ocean floor.

6. An underwater well head encasement structure as in claim **3** wherein there are lifting attachments respectively on said annular closure and on said manhole cover to facilitate placing and removal of said annular closure and said manhole cover by operation from said floating work vessel.

7. An underwater well head encasement structure as in claim **1** wherein there is a perimetral diagonal bracing structure between the outside of said caisson and outer portions of said housing.

8. An underwater well head encasement structure as in claim **4** wherein said piling and said anchoring projections are of concrete poured in place.