Aug. 6, 1968 W. F. MANNING 3,395,755

BOTTOM ACCESS CAISSON

Filed March 30, 1966

FIG. 2

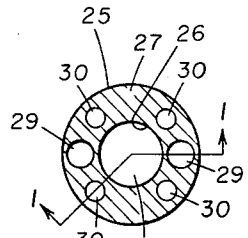
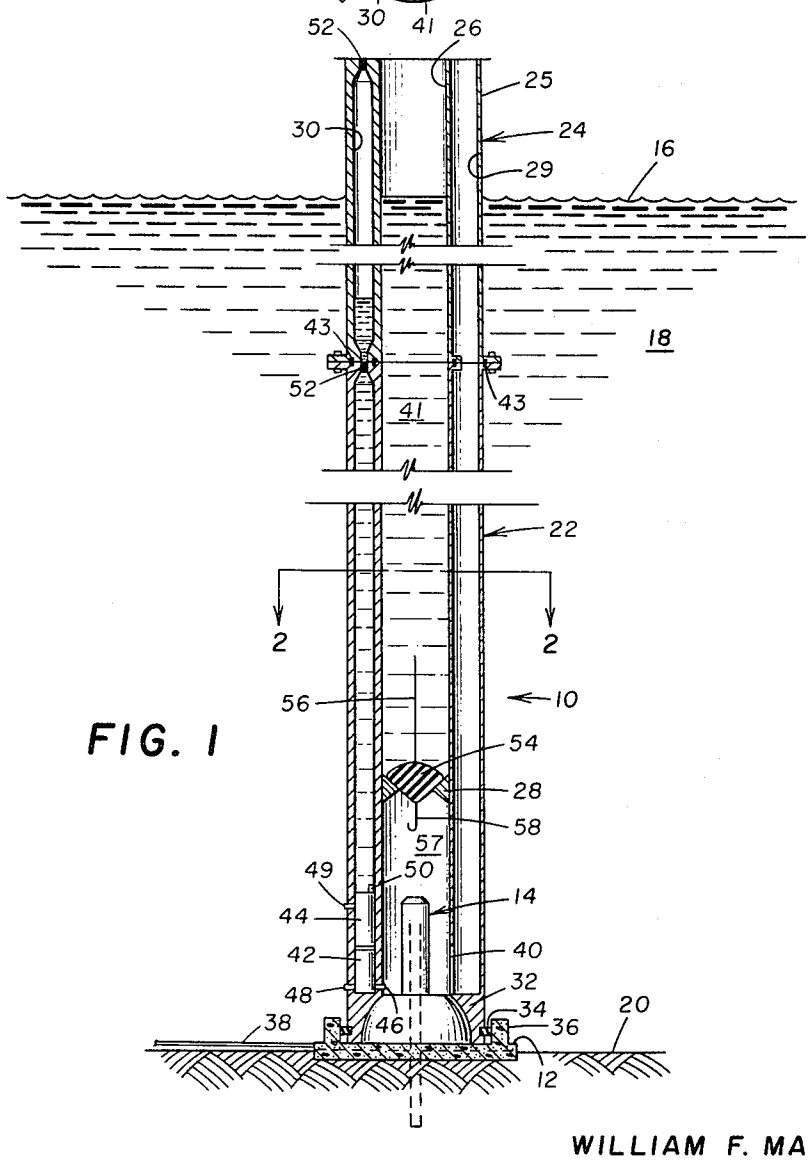


FIG. 1



WILLIAM F. MANNING
INVENTOR

BY Alan G. Paul

ATTORNEY

United States Patent Office 3,395,755 Patented Aug. 6, 1968

3,395,755

BOTTOM ACCESS CAISSON

William F. Manning, Springdale, Conn., assignor to Mobil Oil Corporation, a corporation of New York

Filed Mar. 30, 1966, Ser. No. 538,627
10 Claims. (Cl. 166—.5)

This invention relates to an improved means for obtaining access to submerged wellheads and the like, utilized for the exploitation of subaqueous fluid mineral deposits, more particularly to a removable caisson especially designed for providing an air-filled working chamber at the submerged wellhead.

Heretofore, when a subaqueous well is proven and is to be placed on production, an above-surface, bottom-supported platform is set over the well with a riser pipe extending from the well to the platform deck and a christmas tree (production wellhead) is mounted on the deck above the surface of the water. A number of directional wells can then be drilled from the deck of the platform. If a large field is being produced, a central separator platform station is often erected and a rudimentary support structure is utilized at the riser pipe of each well. Signal lights and other warning devices must be connected to all of the platforms and well riser supports since otherwise they would create a hazard to navigation. Moreover, since the wells and the production wellhead extend above the water they are still subject to damage by vessels and by wave actions, notwithstanding the warning means. Therefore, it would be desirable to position the production wellhead beneath the surface of the body of water, in fact, near the marine bottom.

Other problems arise when the wellhead is situated far beneath the surface of a body of water. One of the most important of these problems is that of servicing and maintaining the well. Divers, while costly, may be used for actuating the various valves and repairing any malfunctions in connection with the wellhead; however, even in shallower waters, of several hundred feet, the time during which a diver can work under water is limited and his effectiveness is less than that of a man working under atmospheric conditions. With the newly developed capabilities of the offshore industry to drill, and later perhaps produce, wells in the waters of the continental shelf and the continental slope, where the depths encountered range from six hundred to two thousand feet, a diver must be entirely dispensed with.

Therefore, it is an object of this invention to provide atmospheric conditions at subaqueous wells completed far beneath the surface of a body of water.

Another object of this invention is to provide an improved removable access caisson to connect the submerged wellhead with a point above the surface of the body of water.

Other objects and advantages of this invention will be apparent from the following description and the accompany drawings.

Referring to the drawings in which is shown a preferred embodiment of the invention:

FIGURE 1 is an elevational cross-sectional view of a bottom-supported caisson of the present invention, taken through line 1—1 of FIGURE 2, fixed over a submerged wellhead and extending above the surface of the body of water;

FIGURE 2 is a cross-sectional view taken through line 2—2 of FIGURE 1.

Referring now to the drawings, FIGURES 1 and 2 show a bottom-supported access caisson, generally designated **10**, resting on a landing base **12** of a submerged wellhead generally designated **14**, and extending above the surface **16** of a body of water **18**. The landing base **12**, which is directly supported on a marine bottom **20** in turn supports the casings and production tubing (not shown) of a well drilled into underlying subaqueous formations. The access caisson **10** is made up of a base section **22** and as many upper caisson sections **24** as are necessary to extend the access caisson above the surface **16** of the body of water **18**. The access caisson **10** is of a hollow cylindrical shape, having a solid annulus **27** defined by the outer wall **25** and the inner wall **26** thereof. The inner face of said inner wall **26**, defining a cylindrical hollow interior of the access caisson has a circumferential abutment means **28** therewithin, situated near the lower end of the access caisson, the purpose of this abutment means being discussed later.

Formed in the solid annulus **27** of the caisson **10**, between the walls, is a pair diametrically opposed access tubes **29** and four elongated buoyancy/ballast tanks **30**, equally spaced around the circumference of the annulus. Although the annulus **27** of the caisson, in sectional view FIGURE 2, is a solid thick walled tube, with a number of passages extending therethrough to form the access tubes **29** and the buoyancy/ballast tanks **30**, in actuality the shell of the access caisson **10** may consist of only inner and outer walls with the tubular access passages and buoyancy/ballat tanks being elongated hollow tubes rigidly fixed therebetween.

The base section **22** of the access caisson **10** terminates in a landing portion **32**. This landing portion has a contoured inner surface to conform to the hemispherically shaped outer surface of the landing base **12**. An O-ring **34** is set in a circumferential groove in the landing portion **32** and cooperates with an outer upstanding circumferential boss **36** integral with the landing base **12** to seal the bottom of the access caisson **10**. Flowlines, such as the illustrated flowline **38**, enter the wellhead from within the landing base **12** so as to protect the flowline **38** from being pinched between the complementary surfaces of the landing base **12** and the caisson **10** as the caisson **10** is lowered into place.

The lower ends of each of the well access tubes **29** are connected by a bulkhead port **40** to the cylindrical hollow interior **41** of the cylindrical access caisson **10**. The interconnections between the sections of the access tubes **29** and the sections of the buoyancy/ballast tanks **30** within the aligned sections of the access caisson **10** must be watertight. This is accomplished by O-ring seals **43** fitting in circumferential grooves in the abutting surfaces. The remainder of the abutting surfaces need not be contiguous since water leaking into the central well will not affect the operation of the apparatus.

A pair of submersible reversible pumps **42** and **44** are mounted in the lower end of each buoyancy/ballast tank **30**. The first pump **42** has a first port **46** opening into the interior of the caisson **10** and a second port **48** opening out into the body of water **18**. The second submersible pump **44** has a first port **50** opening into the interior of the buoyancy/ballast tank **30** in which it is situated and a second port **49**, also connected to the open body of water **18**. A remotely actuatable shut-off valve **52** is fixed in the upper end of each of the sections of the buoyancy/ballast tanks **30** to compartmentalize the tanks **30**. These valves may be electrically operated and controlled by lines connected with an attending surface vessel (not shown). Such a vessel would be necessary, particularly in deep water, for providing the lateral support necessary to keep the access caisson **10** in the upright position. Such a floating vessel would necessarily be either anchored or dynamically positioned to maintain a minimum of movement at the upper end of the caisson.

When it is desired to maintain or repair a particular submerged wellhead **14**, the access caisson **10** of the present invention is shipped out to the area of the wellhead in sections. The sections are floated in quiet water and

bolted together to form as long a caisson as required. The assembly of the access caisson **10** may be accomplished by floating the sections of the caisson on their sides in the water, aligning the adjacent sections of the access caisson and bolting together the portions of abutting end flanges of adjacent sections of the caisson that are above the surface of the water, rotating the caisson **10** to submerge that portion then bolted, and bolting an adjacent portion until the whole circumference of each pair of abutting end flanges of the sections of caissons is bolted together and is rigidly connected. Care must be taken to seal around the sections of the access tubes **28**. If the abutting areas between the sections of the buoyancy/ballast tank **30** are not also watertight, it is necessary to include a shut-off valve **52** (not shown) in the lower end of each of the upper caisson sections **24** also. After the access caisson **10** is completely bolted together to the desired length and towed to well site, its buoyancy/ballast tanks **30** are selectively flooded to tip it over until its axis is vertical. This may be done by utilizing the submersible pumps **44** to fill the buoyancy/ballast tanks **30** in the base section **22** of the access caisson **10**. The air entrapped within the sections of the buoyancy/ballast tanks **30** may be exhausted by opening up the shut-off valves **52**. If the flooding of the buoyancy tanks in the base section **22** is not enough to orient vertically the access caisson, another section may be controllably flooded by the use of the pumps **44** in conjunction with the valves **52** in the buoyancy/ballast tanks **30** between the caisson sections. After the access caisson **10** is vertically oriented it is slowly lowered over the wellhead **14** and into alignment with the landing base **12**. Television cameras may be mounted on the outside of the access caisson **10** to help the above-surface personnel to position the lower end of the access caisson, and as a further help in final positioning, a television camera may be set on the circular abutment **28** within the cylindrical hollow interior **41**. The lower pumps **42**, equally spaced around the access caisson **10** in the tanks **30**, function as jet positioning means selectively drawing the water from the cylindrical hollow interior **41** of the access caisson **10** and ejecting it through the peripheral ports **48**.

Once the access caisson has settled onto the landing base **12**, and the O-rings **34** have sealed the caisson and the landing base **12** together, a sealable plug **54** is lowered down through the cylindrical hollow interior **41** on a wireline **56** to seat on the circumferential abutment **28**, defining a working chamber **57** in the lower end of the interior of the access caisson **10**. The lower end of the wireline **56** beneath plug **54** has a hook **58** for hanging equipment too large and bulky to be brought down by workmen through the access tubes **29**. All the pumps **42** are then turned on to evacuate the working chamber **57** of the access caisson **10** beneath the plug **54**. The water in the working chamber **57**, as well as the connected access tubes **29**, will be evacuated. Two access tubes **29** are not necessary for the functioning of the access caisson; however, the providing of two access tubes permits the structure to continue to be utilized even if one of the access tubes springs a leak during use and must be sealed off from the working chamber **57**. Furthermore, equipment may be lowered down the second access tube while personnel are descending or reascending through the other.

The power and control lines for the submersible pumps **42** and **44**, as well as for the valves **52**, may be supported along the outside of the access caisson **10** or they may be routed through a separate passageway down through the caisson, if the annulus is solid, or directly between the inner and outer walls of the access caisson, if the annulus is hollow, as previously described. With a proper valving arrangement and manifolding system, only one large capacity pump is necessary. This single pump could be valved to pump water, into all of the buoyancy/ballast tanks **30**, from the working chamber **57** of the caisson **10**, through appropriate manifolding or alternately to pump water from the working chamber **57** through selected peripheral ports to jet the caisson **10** into position, and through all of the peripheral ports simultaneously to evacuate the working chamber **57**. The reversing of this pump could be utilized for reflooding the access tubes **29** and the working chamber **57** of the caisson as well as to evacuate the buoyancy/ballast tanks **30**. An intermediate compromise would be to utilize one pump in the lower end of each of the buoyancy/ballast tanks **30**. Such an arrangement would require valving to exhaust or flood either the buoyancy/ballast tanks **30** or the working chamber **57** but would not require any manifolding. The design of the necessary valving and manifolding is well within the capabilities of one skilled in the art and will not be discussed in detail.

After the access caisson has been settled onto the wellhead landing base **12**, the buoyancy/ballast tanks **30** are flooded just enough to support solidly the caisson thereon, but not enough to drive the landing base structure down further into the marine bottom or to damage it. When it is later desired to remove the access caisson **10**, the access tubes **29** and the lower portion of the interior of the caisson **10**, below the plug **54**, is again flooded. The plug **54** may then be brought back to the surface with any damaged wellhead equipment, or repair or maintenance tools, hanging from the lower end of hook **58**.

Although the present invention has been described in connection with details of a specific embodiment thereof, it is to be understood that such details are not intended to limit the scope of the invention. The terms and expressions employed are used in a descriptive and not a limiting sense and there is no intention of excluding such equivalents, in the invention described, as fall within the scope of the claims. Now having described the apparatus and method herein disclosed, reference should be had to the claims which follow.

What is claimed is:

1. An access caisson for providing atmospheric conditions in an area surrounding a submerged wellhead, said access caisson comprising at least one cylindrical caisson section having a cylindrical hollow interior extending the length thereof; means for sealing the lower end of said access caisson to a landing base of a submerged wellhead; means for selectively closing off the lower portion of said cylindrical hollow interior above a wellhead extending thereinto to define a working chamber; at least one watertight access tube connecting said working chamber of said access caisson with the upper end of said access caisson when said working chamber is selectively closed off; and means for evacuating water from said working chamber and said access tube when said access caisson is mounted on and sealed to a wellhead landing base set beneath the surface of a body of water.

2. An access caisson, as recited in claim **1**, having buoyancy/ballast means associated therewith; and means for flooding said buoyancy/ballast means to lower said access caisson from said surface vertically oriented.

3. An access caisson, as recited in claim **2**, wherein said buoyancy/ballast means comprises a plurality of tanks, each extending substantially the length of said access caisson and positioned equidistantly therearound; and pump means mounted in the lower end of each of said buoyancy/ballast tanks for at least evacuating the water from said buoyancy/ballast tanks whereby the distribution of weight, and the overall weight of said access caisson, in the water, can be controlled.

4. An access caisson, as recited in claim **1**, further comprising an outer wall and an inner wall, the inner face of said inner wall defining said cylindrical hollow interior; and at least one access tube extending through an annulus between said inner and outer walls, said access tube being connected to said working chamber of said access caisson whereby a workman can reach the working chamber from above the surface of the body of water.

5. An access caisson, as recited in claim **4**, further

comprising at least two caisson sections; means for aligning and rigidly connecting said sections; and means for sealing around at least the said access tube extending through said sections.

6. An access caisson, as recited in claim 4, further comprising inner and outer walls with a hollow annulus therebetween, said access tube being a tubular member rigidly suspended in said annulus between said inner and outer walls of said caisson.

7. An access caisson, as recited in claim 5, wherein sealing means are provided, between said access caisson sections, only at said access tube whereby the problems associated with sealing the large abutting areas of said access caisson sections are circumvented.

8. An access caisson, as recited in claim 6, wherein a plurality of tubular buoyancy/ballast tanks are suspended in said annulus equally spaced around said cylindrical hollow interior.

9. An access caisson, as recited in claim 8, wherein valve means are provided in at least one of the ends of a portion of each of said buoyancy/ballast tanks in each access caisson section whereby air can be released when water is pumped in and said buoyancy/ballast tanks can be compartmentalized when a plurality of caisson sections are aligned and rigidly fixed together.

10. An access caisson, as recited in claim 1, wherein said selective sealing means comprises a circumferential

flange fixed on the inner face of said inner wall at the upper end of said working chamber; a large plug supported on said circumferential flange, connected to a point above the surface for lowering into said cylindrical hollow interior and onto said flange to seal the upper end of said working chamber; and article carrying means connected to a lower portion of said large plug whereby equipment can be lowered to the working chamber during the sealing of said working chamber.

References Cited

UNITED STATES PATENTS

1,048,194	12/1912	Mitchell	61—82
2,051,926	8/1936	Weiner	61—82
2,524,382	10/1950	Goodman	61—82
2,534,480	12/1950	Shannon	175—8
2,691,272	10/1954	Townsend et al.	175—8
2,854,215	9/1958	Cox et al.	61—82 X
2,965,174	12/1960	Haeber	175—8 X
2,988,144	6/1961	Conrad	61—82
3,020,956	2/1962	Suderow	175—5
3,202,216	8/1965	Watts et al.	166—.6
3,202,217	8/1965	Watts et al.	166—.6

JAMES A. LEPPINK, *Primary Examiner.*