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OFFSHORE OIL WELL INSTALLATION

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2 Sheets-Sheet 1

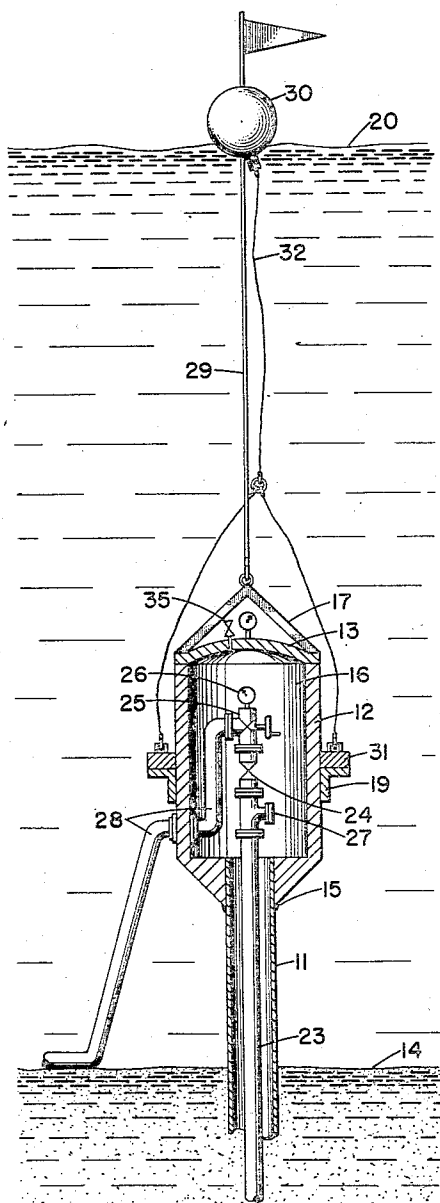


FIG. 1

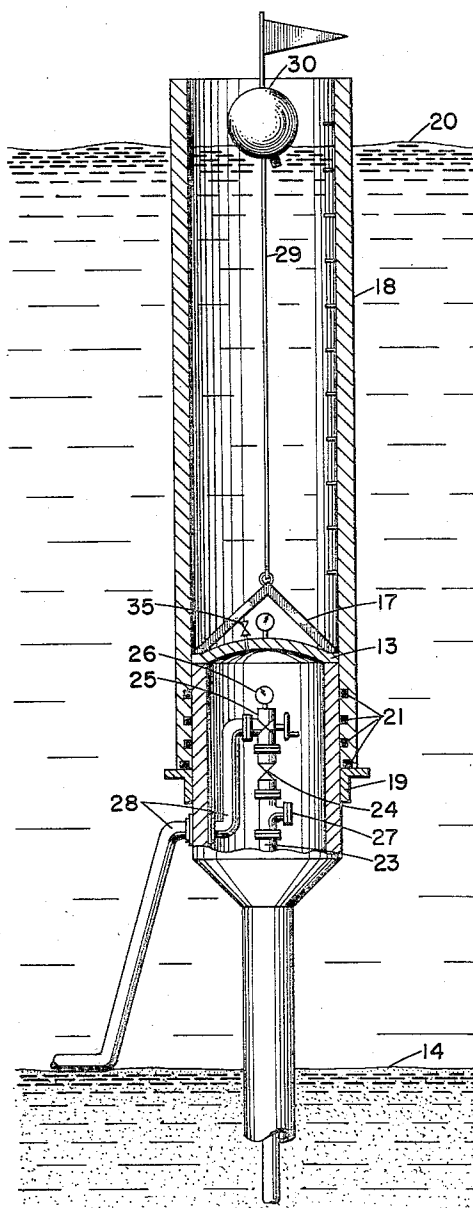


FIG. 2

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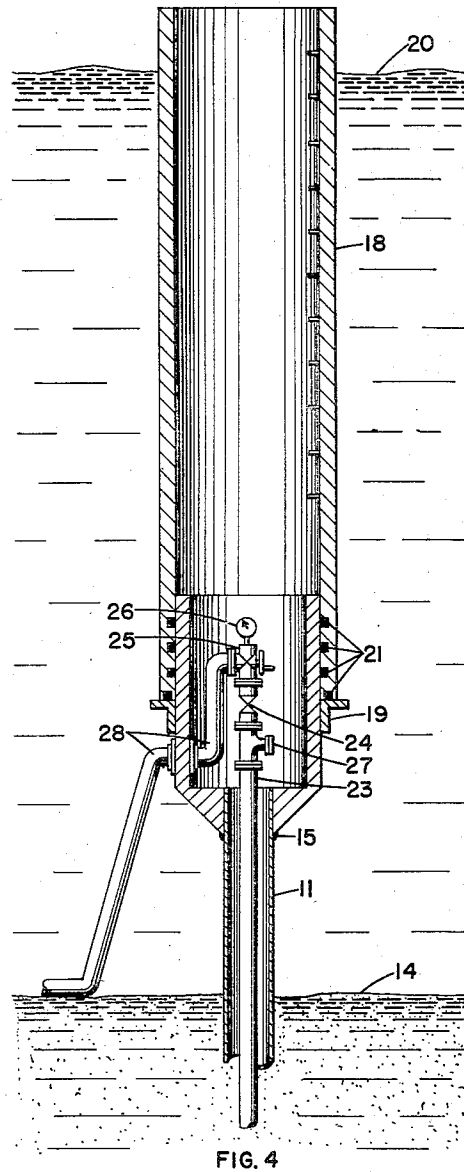
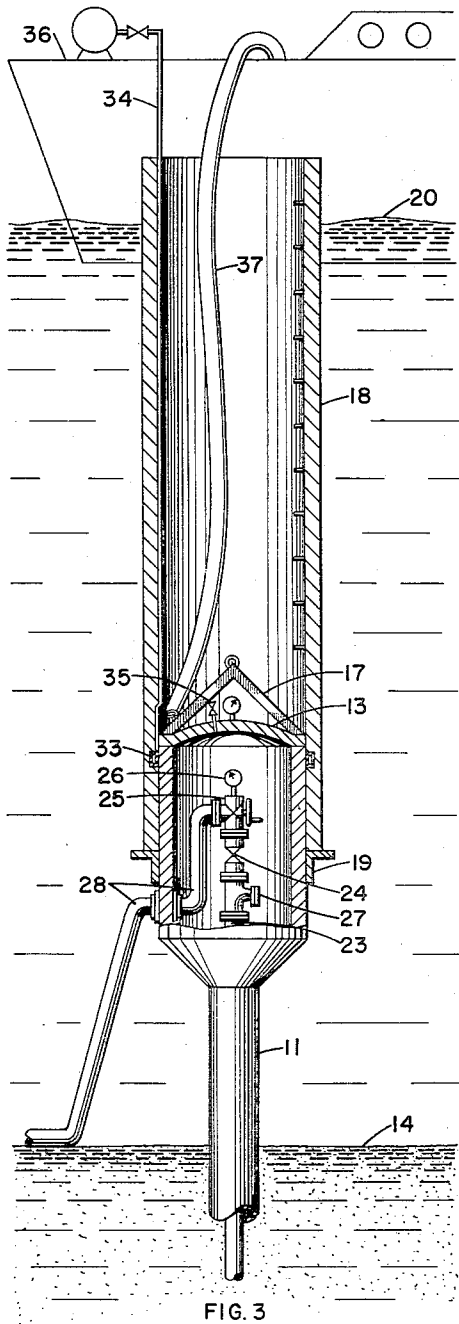
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OFFSHORE OIL WELL INSTALLATION

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5 Claims. (Cl. 255—2.5)

This invention relates to oil well drilling and production equipment for use at offshore locations and pertains more particularly to a method and apparatus for installing or repairing wellhead equipment positioned underwater.

In their search for new oil fields, many oil drilling and producing companies are operating in offshore locations where wells are being drilled in 5 to 100 feet of water. The present procedure of drilling a well at an offshore location is either to provide a stationary platform at that location or to sink a submersible barge there for the duration of the drilling operations. After drilling a well from a permanent platform, at least a portion of the platform is left in place adjacent the wellhead for servicing the well. When drilling from a submersible barge, it is necessary, after the drilling has been completed, to provide a small platform or framework about the casing and wellhead from which the well may be serviced. The platforms left about a producing well also protect the wellhead and the casing extending from the ocean floor to the surface and above from collision with boats.

The production platforms that are left about a wellhead are normally quite expensive, ranging in price, depending upon size and upon location, from \$10,000 to \$200,000. The platforms, together with the wellhead which they surround and/or support, constitute a hazard to navigation, and as the offshore oil fields are being rapidly developed, dozens or hundreds of these wellhead platforms pose a considerable problem to navigation.

It is therefore a primary object of the present invention to provide a method and apparatus for drilling wells and subsequently providing a wellhead structure and/or apparatus which is secured to an oil well casing and production tubing below the surface of the water.

Another object of this invention is to provide wellhead structure and apparatus adapted to be mounted on a well casing below the surface of the water in a water-tight manner and at a level at which it will not be subject to collision with boats.

A further object of this invention is to provide apparatus for servicing the wellhead installation positioned well below the surface of the water.

These and other objects of this invention will be understood from the following description taken with reference to the drawings, wherein:

Figure 1 is a diagrammatic elevation view taken partially in cross section, of an underwater wellhead installation comprising a fluidtight chamber;

Figures 2, 3 and 4 are diagrammatic elevation views illustrating successive steps of an underwater method for gaining access to the wellhead assembly in the fluidtight chamber of Figure 1.

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Referring to Figure 1, a completed underwater well installation is diagrammatically illustrated as comprising a large diameter conductor guide pipe 11 on which is positioned a preferably cylindrical housing 12 normally closed at the top in a fluidtight manner by a cover 13. The conductor guide pipe 11 is of a type generally used in drilling offshore wells and may be 2 or 3 feet or more in diameter. In normal drilling operations a conductor guide pipe of this type is washed or driven 40 feet or more into the ocean floor, while the upper end thereof extends above the water line. The well is then drilled through this conductor guide pipe. In the present invention the conductor guide pipe 11 may only extend a short distance above the mud line 14, but may be extended to a substantial distance above the mud line in very deep water locations.

Prior to driving the conductor guide pipe 11 into the sub-soil, the cylindrical housing 12 is secured to the top thereof in a fluidtight manner, as by welding at 15. A cover 13 may be bolted to the top of the housing 12 in a preferably fluidtight manner. As a safety precaution, the cover may be provided with a pressure indicator 40 which is in communication with the chamber 16 within the housing 12. Thus, before removing the cover 13 from the housing 12, the pressure in said housing may be checked to make sure that it is at a value which permits removal of the cover. Also, it may be desired to pressurize the housing after it is closed to keep any mud and/or sea water out. A valved opening 35 in the cover may be provided for this purpose.

As shown in Figure 2, the cover 13 is provided with two or more guide bars 17 which slope upwardly from the edges of the cover to the center thereof and provide an upwardly-pointing centering guide by which the open end of a cylindrical caisson may be aligned with the housing 12 so that it may be lowered until it surrounds the housing, as illustrated. Fixedly secured to the outer wall of the housing 12 are suitable caisson support means such as bracket or flange means 19.

The caisson 18 is of a length sufficient to extend from the flange means 19 on the housing 12 to a point above the water level 20. The inner diameter of the caisson 18 is just slightly greater than the outer diameter of the housing 12 so that a substantially tight fit occurs between the two elements when they are positioned as shown in Figure 2. Preferably, the inner walls and/or the lower end of the caisson 18 are provided with suitable sealing means 21 such, for example, as cup packers, O-ring seals, or any other suitable type of packers, seals or gaskets. If necessary, the sealing means may be of an inflatable type as shown at 33 in Fig. 3, which is adapted to be inflated by pneumatic or hydraulic pressure supplied through a conduit 34 from the surface. It is to be understood that the sealing means 21 illustrated as provided on the inner surface and bottom edge of the caisson 18 could be provided alternatively on the outer surface of the housing 12 or the top surface of the flange means 19. The inner wall of the caisson 18 is preferably provided with a ladder or steps 22 by which an operator can lower himself to the bottom of the caisson.

The interior of the housing 12 is normally from 6 to 12 feet in diameter, or large enough to enclose the necessary connections and fittings of a wellhead assembly normally secured to the top of a well casing 23, and comprising a control valve 24, choke 25 and pressure gauge 26. A

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blanked-off valved T 27 may be provided through which fluid can be pumped when it is desired to kill a well. The production line 28 leads from the wellhead assembly through the wall of the housing 12 in a fluidtight manner and thence along the ocean floor or to the surface in any desired manner.

Before the caisson 18 is removed from the housing 12, as shown in Figure 1, a buoy line 29 is secured to the top of the cover 13 so that it extends up to a marker buoy 30 which is adapted to float on the surface of the water 20 substantially above the wellhead installation. A protecting ring 31 for the top surface of the flange means 19 may be provided to prevent mud from settling thereon and interfere with the positioning of a caisson. The ring can be removed by means of a cable 32 running up to the buoy 30. When operating in deep water, say at 100 feet, the top of the housing 12 would preferably be positioned below the surface of the water 20 at a sufficient depth, say 40 feet, so that ships can safely pass over the wellhead without causing any damage.

Whenever, it becomes necessary to service an underwater well installation, as illustrated in Figure 1, a service boat 36 (Fig. 3) transports the caisson 18 to the wellhead installation and lowers it over the marker buoy 30 and down onto the housing 12 as shown in Figure 2. A hose 37 may be dropped from the service boat so that the water in the caisson above the cover 13 may be pumped out. The hose 37 is connected to a suitable pump (not shown) which is either carried on the service boat or is lowered down into the caisson. After the caisson is emptied, the marker buoy and its line may be removed as shown in Figure 3. The cover 13 is then unfastened and removed, and the chamber 16 within the housing 12 is opened so that the wellhead assembly may be serviced, as shown in Figure 4.

In drilling a well to which a wellhead of the present invention is connected, the caisson 18 would be mounted on the housing 12 prior to forcing the housing and its conductor pipe 11 below the surface of the water. Thus, during drilling operations the conductor pipe 11, housing 12 and caisson 18 would take the form of that shown in Figure 4 without the well casing 23 or its wellhead assembly in place. If desired, the conductor pipe 11 could extend up through the housing and all the way to the top of the caisson, or above, during drilling operations and then be cut off flush with the bottom of the chamber 16 within the housing 12 after the drilling operations were completed. After the well is drilled and casing set, the wellhead assembly is lowered within the caisson and attached in the usual manner. The housing is then closed and the caisson 18 filled with water prior to removal. The caisson 18 is substantially flooded with water in a similar manner prior to the removal of the caisson after well servicing operations have been conducted.

We claim as our invention:

1. An underwater well installation comprising in combination a well casing extending into the ocean floor, a well-head assembly mounted on the top of said casing at a level below the surface of the water and above the ocean floor, a large diameter guide pipe surrounding said casing, the lower end of said guide pipe being positioned in said ocean floor, a housing fixedly secured on the top of the guide pipe in a fluidtight manner surrounding said well-head assembly, removable cover means closing the top of said housing in a fluidtight manner, a removable caisson adapted to surround at least a portion of said housing in fluidtight contact therewith, said caisson extending from said housing to above the surface of the water and being freely removable from said housing at this point, and support means on said housing for supporting the lower end of said caisson.

2. An underwater well installation comprising in combination a well casing extending into the ocean floor, a well-head assembly mounted on the top of said casing at

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a level below the surface of the water and above the ocean floor, a large diameter guide pipe surrounding said casing, the lower end of said guide pipe being positioned into said ocean floor, a cylindrical housing fixedly secured on the top of the guide pipe in a fluidtight manner surrounding said well-head assembly, cover means closing the top of said housing in a fluidtight manner, a removable caisson adapted to surround at least a portion of said housing in fluidtight contact therewith, said caisson extending from said housing to above the surface of the water and being freely removable from said housing at this point, support means on said housing for supporting the lower end of said caisson above the ocean floor, and sealing means carried between said housing and the lower portion of said caisson forming a watertight seal therebetween, said cover means being adapted to be raised and lowered through said caisson on top of said housing, and said well-head assembly being adapted to be installed and serviced in said housing through said caisson.

3. An underwater well installation comprising in combination a well casing extending into the ocean floor, a well-head assembly mounted on the top of said casing at a level below the surface of the water and above the ocean floor, a large diameter guide pipe surrounding said casing, the lower end of said guide pipe being forced into said ocean floor, a cylindrical housing fixedly secured on the top of the guide pipe in a fluidtight manner surrounding said well-head assembly, cover means closing the top of said housing in a fluidtight manner, a production conduit extending through the wall of said housing in a fluidtight manner and in communication between the well-head assembly and the space outside the housing for transporting production fluid away from the well, a removable caisson adapted to surround at least a portion of said housing in fluidtight contact therewith, said caisson extending from said housing to above the surface of the water and being freely removable from said housing at this point, outwardly-extending flange means on said housing above said production conduit for supporting the lower end of said caisson, and sealing means carried between said housing and the lower portion of said caisson forming a watertight seal therebetween, said cover means being adapted to be raised and lowered through said caisson on top of said housing, and said well-head assembly being adapted to be installed and serviced in said housing through said caisson.

4. An underwater well installation comprising in combination a well casing extending into the ocean floor, a well-head assembly mounted on the top of said casing at a level below the surface of the water and above the ocean floor, a large diameter guide pipe surrounding said casing, the lower end of said guide pipe being forced into said ocean floor, a cylindrical housing fixedly secured on the top of the guide pipe in a fluidtight manner surrounding said well-head assembly, cover means closing the top of said housing in a fluidtight manner, valved conduit means through said cover means whereby said closed housing may be pressurized, a removable caisson adapted to surround at least a portion of said housing in fluidtight contact therewith, said caisson extending from said housing to above the surface of the water and being freely removable from said housing at this point, support means on said housing for supporting the lower end of said caisson, and inflatable sealing means insertable between said housing and the lower portion of said caisson for forming a watertight seal therebetween, said cover means being adapted to be raised and lowered through said caisson on top of said housing, and said well-head assembly being adapted to be installed and serviced in said housing through said caisson.

5. A method for drilling and producing wells in submerged areas comprising the steps of forcing a guide pipe into the bottom of a body of water, forming at the upper part of said guide pipe and in register therewith a tubular

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housing of enlarged diameter, said housing being positioned substantially below the surface of water, surrounding said housing with a caisson sealed in fluidtight external engagement therewith, said caisson extending to the surface, drilling a well from the surface through said caisson, said housing and said guide pipe, removing the drilling tools therefrom, providing the well with the desired casing and tubing, said casing and tubing extending from desired well depths to said housing, lowering through said caisson a well-head assembly and installing it on top of the casing within said housing, establishing a well fluid flow between said assembly and the space outside of said

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housing, sealing the upper end of said tubular housing within said caisson, and raising said caisson to the surface.

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