Feb. 11, 1969 W. F. MANNING 3,426,859

TELESCOPED CAISSON

Filed Sept. 2, 1966

Sheet 1 of 2

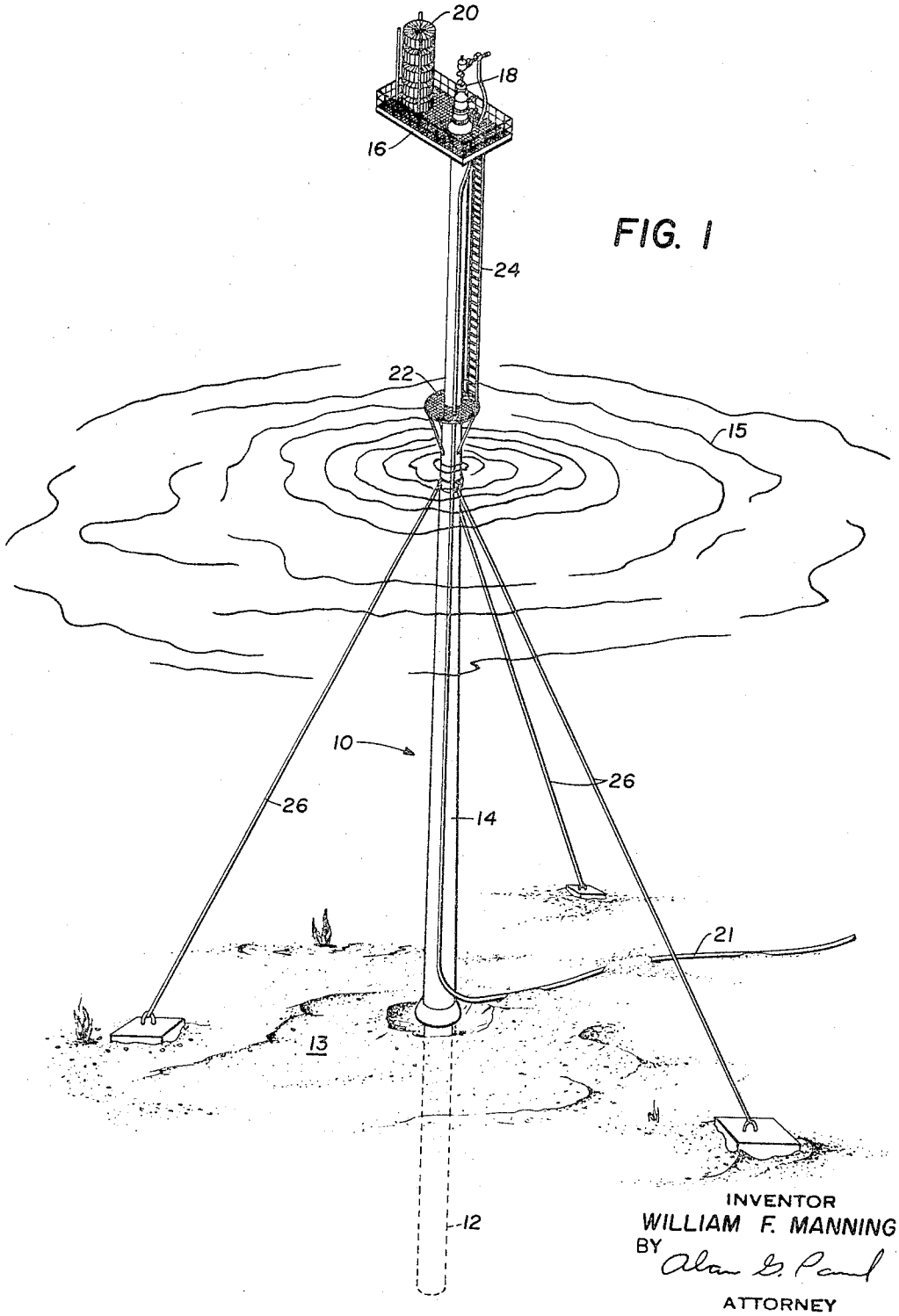


FIG. 1

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Sheet 2 of 2

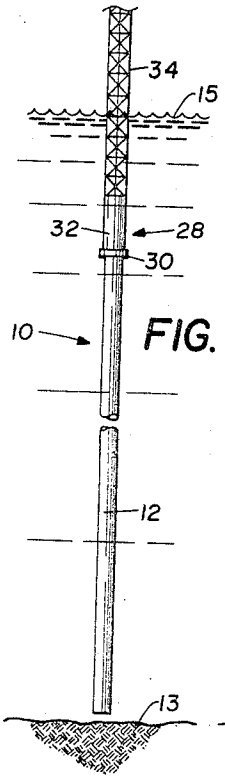


FIG. 2

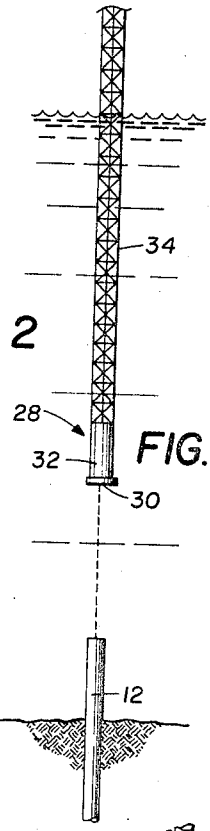


FIG. 3

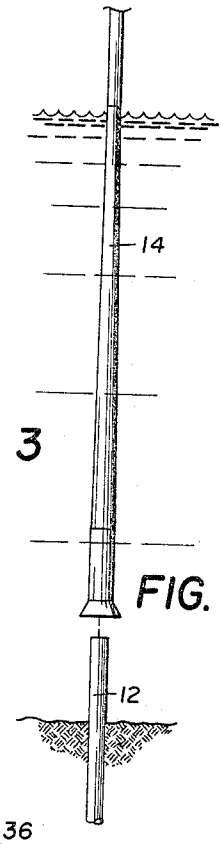


FIG. 4

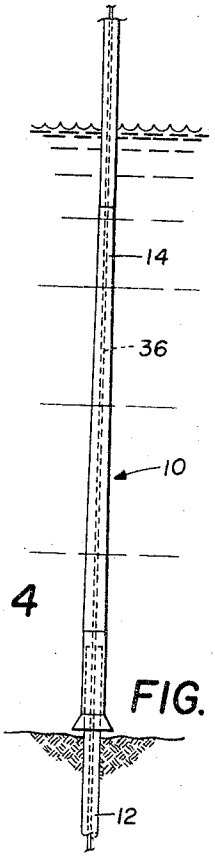


FIG. 5

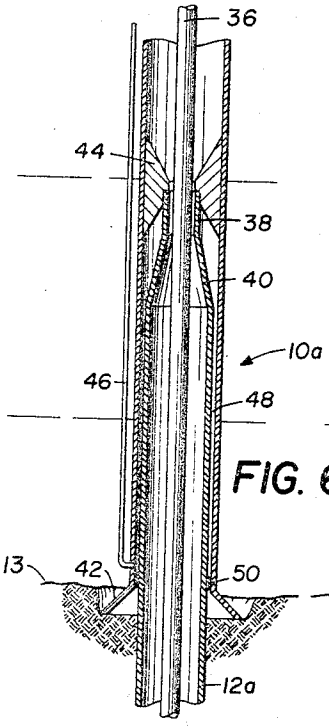


FIG. 6

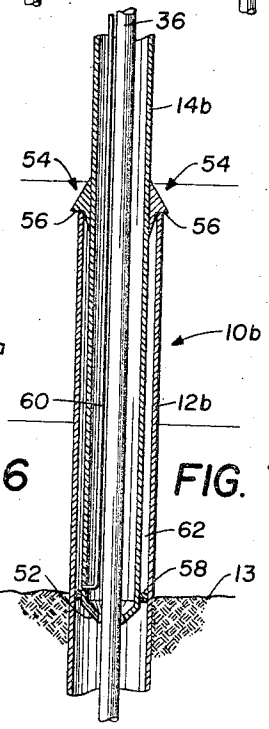


FIG. 7

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3,426,859

TELESCOPED CAISSON

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Filed Sept. 2, 1966, Ser. No. 577,040
U.S. Cl. 175—9 7 Claims
Int. Cl. E21b 15/02, 17/04

ABSTRACT OF THE DISCLOSURE

This specification discloses a method and apparatus for drilling and completing an offshore well above the surface of a body of relatively shallow water. A two-piece well protector is utilized, the well protector comprising interconnecting lower pile and upper caisson sections. The lower pile section is first driven into the formations underlying the marine bottom with one of the recently developed underwater pile drivers. The caisson section is then lowered into the water and stabbed into or over the pile section to form the composite well protector. A well is drilled through the well protector and is completed by a wellhead supported on the upper end of the well protector.

The present invention is directed to a method and apparatus for drilling and completing an offshore well above the surface of the body of water, in relatively shallow water. More particularly, the invention relates to a two-piece caisson type of well protector which is relatively easy to handle and requires a minimum of energy to be driven into the subaqueous formations beneath the marine bottom.

Present developments in the offshore oil and gas industry indicate that drilling and production efforts will be extended to underwater areas such as the outer fringes of the continental shelves and the continental slopes where a submarine production system is the most practical method of reaching the subaqueous deposits. However, the shallower waters are still providing an abundance of hydrocarbon deposits. As the more prolific fields are developed in these shallow waters from above-surface platforms, the industry is searching for less expensive ways of reaching the subaqueous formations so that the less prolific fields will be economically available. One relatively inexpensive device that has been used extensively, particularly in the Gulf of Mexico, is the caisson type of well protector, either self-supporting or utilized in conjunction with a template or guy lines. At the present time one-piece, or welded up, well protectors are used. Driving the entire length of a well protector is inefficient due to the large mass involved, particularly as the water depth increases. In two hundred feet of water, where it is required that the well protector be driven one hundred twenty feet or more into the subaqueous formations, the length of the well protector may even be too long to be brought conveniently into an upright position under the pile driver.

Therefore, it is an aspect of the present invention to provide a two-piece well protector, each of the sections thereof being short enough to be easily handled in the upright position by conventional offshore derrick barges.

A further aspect of the present invention is to provide a two-piece well protector utilizing the advantages of underwater pile driving.

Other aspects and advantages of the present invention will be readily apparent from the following description, when taken in conjunction with the accompanying drawings that illustrate useful embodiments in accordance with this invention, in which:

FIGURE 1 is a pictorial illustration of a two-piece well protector of the present invention erected at a marine site for extending a subaqueous well to a point above the surface of a body of water;

FIGURES 2 through 5 illustrate the erecting of the two-piece well protector at the marine site in conjunction with an underwater pile driver;

FIGURE 6 is a sectional view of a portion of a first embodiment of the well protector of the present invention illustrating the telescoping of the upper section over the lower section which has been driven into the subaqueous formations underlying the marine bottom; and

FIGURE 7 is an elevational sectional view of a portion of a second embodiment of the well protector of the present invention illustrating the stabbing of the upper section into the lower section which has been driven into the subaqueous formations underlying the marine bottom.

The present invention relates to a two-piece telescoping well protector in which the lower, or pile section, is separately driven into the subaqueous formations by an underwater pile driving technique. The invention further relates to the method of installing the two-piece well protector, in which the pile driving operation is terminated when the pile section extends only the minimum distance above the marine bottom necessary for later connecting thereto the upper, or caisson, section designed to project above the surface of the water after installation, and the later step of lowering the caisson section down from the surface into telescopic cooperation with the pile section to form the well protector.

Now looking to FIGURE 1, a two-piece well protector, generally designated **10**, consists of alower tubular section, hereinafter referred to as a pile section **12**, anchoring the structure in a marine bottom **13** and an upper tubular section, hereinafter referred to as a caisson section **14**, for extending the well protector from the upper terminus of the pile section **12** to a point above the surface **15** where a small production deck **16** is supported a distance from the water necessary to insure that waves will not impinge on it, and has extending up therefrom a production wellhead **18**, completing a subaqueous well, the casings and tubing thereof being hung through the unimpeded throughbore of the well protector **10**. While the production deck **16** may in some cases be large enough to accommodate a helicopter, in the more usual instance only enough additional space (for example, a common size is 11′ x 18′) is provided for a fog signal **20** and personnel working on the wellhead **18**. A flowline **21**, supported along the well protector **10** from the upper end thereof to the marine bottom **13**, connects the wellhead **18** with a nearby production facility through a portion of the flowline laid on the marine bottom. A circular landing deck **22** is concentrically fixed to the caisson section **14** at the mean low water line and a ladder **24** extends between the landing deck **22** and the production deck **16** above. While in this illustration the caisson section **14** is shown as being tapered, and supported in part, against lateral loads by a plurality of guy lines **26**, the remainder of this discussion applies equally as well to a constant diameter caisson, and to a caisson supported by a template structure, or completely self-supporting.

Referring now to FIGURES 2 through 5, the procedure to be followed in erecting a well protecter **10** is illustrated. Looking to FIGURE 2, pile section **12** is held suspended beneath the surface **15** of the body of water with its lower end either just above or resting on the marine bottom **13**. The pile section **12** is connected at its upper end to a submerged pile driving device, generally designated **28**, which is in turn supported from a derrick mounted on a floating barge or mobile platform nearby (not shown), by a releasable connection **30**. The connection **30** can be a hydraulically actuated clamp or a simple J-slot connector, or any other type of connection

which can be later remotely released. The pile driving device **28** comprises a casing **32**, containing an anvil and a hammer (not shown), and a framework **34** extending from the upper end of the casing **32** to the derrick. Communication lines extending from the casing **32** to the derrick for actuating the pile driving hammer are supported within the framework **34**.

The pile driving device **28** may be one of those recently developed and offered to the industry for underwater pile driving and which consists of a watertight chamber enclosing a pile driving hammer and anvil. By driving the hammer up in the chamber with compressed air, and then releasing the compressed air so that the hammer will drop down on the anvil, a useful amount of energy can be imparted through the anvil to drive the pile section of the well protector vertically into the formations underlying a marine bottom. A pile driving device of this type is offered by the MKT Corporation and is described in their brochure entitled "MKT—Pile Driving Equipment," published June 1964.

FIGURE 3 shows the pile section **12** after it has been driven the required distance into the formations underlying the marine bottom **13**. The pile driving device **28** is being withdrawn subsequent to the release of the connector **30**. Enough of the pile section **12** is left extending above the marine bottom **13** for stabbing the caisson section **14** thereover.

In FIGURE 4 the caisson section **14** is suspended from the derrick barge and is being lowered through the water to be stabbed over the pile section **12**. A landing base and guidelines as described in the R. F. Bauer et al. Patent No. 2,808,229, issued Oct. 1, 1957, may be utilized to guide the caisson section **14** over the pile section **12**. Alternatively jet guiding means hung in the caisson section **14** may be used in conjunction with an underwater televiewer or a diver radioing instructions to the surface.

FIGURE 5 shows the caisson section **14** stabbed over and grouted to the pile section **12**. A conductor pipe **36** is suspended from above the upper end of the well protector **10** and extends therethrough into the marine bottom **13**. The conductor pipe **36** may be jetted, drilled, or hammer-driven into the underlying formations. The drilling rig for handling the conductor pipe **36**, drilling a well therethrough, setting casings, and the other various operations necessary for completing the well, as well as the mud tank and other equipment, will be located on floating barges or jack-up rigs adjacent the well protector **10**.

FIGURE 6 shows a first configuration of the well protector **10A** comprising a pile section **12A** adapted to have a caisson section **14A** stabbed thereover. A small diameter upper portion **38** and a tapered intermediate portion **40** of the pile section **12A** act in conjunction with a stabbing bell **42** on the lower end of the caisson section **14A** to permit the caisson section **14A** to be stabbed easily over the pile section **12A**. Centering guides **44** are welded within the caisson section **14A** to guide the conductor pipe **36** into the small diameter upper portion **38** of the pile section **12A** and to act as stops to prevent the caisson section **14A** from telescoping too far over the pile section **12A** and sinking into unconsolidated surface formations of the marine bottom **13**. A releasable grout line **46** extends the length of the caisson section **14A** at the lower end of the caisson section **14A** the grout line **46** is connected to a port through the wall thereof, so that grout can be injected into the annulus or chamber **48** between the caisson section **14A** and the pile section **12A**. A grout seal **50** is mounted in the lower end of the caisson section **14A** to prevent the leakage of grout. To hold the caisson section **14A** rigidly to the pile section **12A** while the grout is setting, a remote ballistic connecting device such as that described in my copending application entitled Ballistic Jacket-Pile Connection, Ser. No. 489,527, filed Sept. 23, 1965, may be used.

FIGURE 7 shows a second configuration of the two-piece well protector **10B** in which the caisson section **14B** is designed to be stabbed into the pile section **12B**. In this arrangement a simple tubular pile may be utilized, the caisson section **14B** having a lower tapered portion **52** to facilitate the stabbing operation. Spaced a distance up the caisson section **14B**, a plurality of radially positioned guide plates **54** are welded to the outer surface of the caisson section **14B**, the lower triangular portions of the guide plates **54** acting to center the caisson section **14B** in the pile section **12B** while the integral horizontal surfaces **56** thereabove act to limit the distance which the caisson section **14B** can be stabbed into the pile section **12B**. As in the prior embodiment a grout seal is necessary. The grout seal **58** is mounted on the outside of the caisson **14B** just above the lower tapered section **52**. A grout line **60** would be previously fixed within the caisson section **14B** and connected to a port extending through the caisson wall at the lower end thereof just above the grout seal **58** so that grout could be injected into the annulus or chamber **62** between the walls of the caisson section **14B** and the pile section **12B**. If ballistic connectors are utilized for this embodiment, they should be fastened to the outer face of the wall of the pile section **12B** prior to its being driven into the marine bottom **13**.

Although the present invention has been described in connection with details of the specific embodiments 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. A method for installing a well protector at a marine site, said well protector extending from a distance above the surface of a body of water to a distance into the formations underlying the marine bottom, comprising the following steps in the order recited:

(a) lowering a pile section of said well protector through said body of water with an underwater pile driving assembly attached to the upper end thereof;

(b) driving said pile section into said formations underlying said marine bottom by means of said underwater pile driving assembly until only enough of said pile section extends above the marine bottom to be connected to a caisson section of said well protector to be stabbed down from above said surface;

(c) releasing said pile driving assembly from said pile section and withdrawing said pile driving assembly;

(d) stabbing down said caisson section through said body of water until the lower end of said caisson section is in a telescopic relationship with the upper end of said pile section while the upper end of said caisson section remains above said surface; and

(e) fixedly connecting said telescoped portions of said pile and caisson sections.

2. A method for installing a well protector at a marine site as recited in claim **1**, wherein said pile section is driven into said formations underlying said marine bottom far enough to provide the sole support for a caisson section extending therefrom to above the surface of the body of water and having production equipment on a deck on the upper end thereof.

3. A method for installing a well protector at a marine site as recited in claim **1** where all of said steps are performed remotely by personnel located above said surface of said body of water.

4. A method for drilling a well in formations underlying a marine bottom through a well protector installed at a marine site, said well protector to extend from a distance above the surface of a body of water to a distance

into the formations underlying the marine bottom, comprising the following steps in the order recited:

(a) lowering a pile section of said well protector through said body of water with an underwater pile driving assembly attached to the upper end thereof;

(b) driving said pile section into said formations underlying said marine bottom by means of said underwater pile driving assembly until only enough of said pile section extends above the marine bottom to be connected to a caisson section of said well protector to be stabbed down from above said surface;

(c) releasing said pile driving assembly from said pile section and withdrawing said pile driving assembly;

(d) stabbing down said caisson section through said body of water until the lower end of said caisson section is in a telescopic relationship with the upper end of said pile section while the upper end of said caisson section remains above said surface;

(e) fixedly connecting said telescoped portions of said pile and caisson sections; and

(f) drilling a well through producing formations underlying said marine bottom through said well protector from above said surface of said body of water.

5. A method for installing a well protector at a marine site, said well protector extending from a distance above the surface of a body of water to a distance into the formations underlying the marine bottom, comprising the following steps in the order recited:

(a) lowering a pile section of said well protector through said body of water with an underwater pile driving assembly in contact with the upper end thereof;

(b) driving said pile section into said formations underlying said marine bottom by means of said underwater pile driving assembly until only enough of said pile section extends above the marine bottom to be connected to a caisson section of said well protector to be stabled down from above said surface;

(c) withdrawing said pile driving assembly from contact with the upper submerged end of said pile section;

(d) stabbing down said caisson section through said body of water until the lower end of said caisson section is in a telescopic relationship with the upper end of said pile section while the upper end of said caisson section remains above said surface; and

(e) fixedly connecting said telescoped portions of said pile and caisson sections.

6. A method for completing an offshore well through a wellhead located above the surface of a body of water on the upper end of a well protector installed at a marine

site, said well protector extending from a distance above the surface of a body of water to a distance into formations underlying the marine bottom, comprising the following steps in the order recited:

(a) lowering a pile section of said well protector through said body of water with an underwater pile driving assembly in contact with the upper end thereof;

(b) driving said pile section into said formations underlying said marine bottom by means of said underwater pile driving assembly until only enough of said pile section extends above the marine bottom to be connected to a caisson section of said well protector to be stabbed down from above said surface;

(c) withdrawing said pile driving assembly from contact with the upper submerged end of said pile section;

(d) stabbing down said caisson section through said body of water until the lower end of said caisson section is in a telescopic relationship with the upper end of said pile section while the upper end of said caisson section remains above said surface;

(e) fixedly connecting said telescoped portions of said pile and caisson sections; and

(f) drilling a well into producing formations underlying said marine bottom through said well protector from above said surface of said body of water.

7. A method for completing an offshore well, as recited in claim 6, including the following additional steps:

(g) installing a deck on the upper end of said well protector to be used at least during production operations; and

(h) mounting a wellhead on the upper end of said well protector and completing said well therethrough.

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U.S. Cl. X.R.

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