# United States Patent [19]

**Shatto, Jr. et al.**

[11] **3,744,561**

[45] **July 10, 1973**


[54] **DISPLACEABLE GUIDE FUNNEL FOR SUBMERGED WELLHEADS**


[75] Inventors: **Howard L. Shatto, Jr.; Johannes A. W. K. Van Dommelen,** both of The Hague, Netherlands

[73] Assignee: **Shell Oil,** New York, N.Y.



[22] Filed: **Dec. 2, 1971**

[21] Appl. No.: **204,092**

[30] **Foreign Application Priority Data**

Mar. 15, 1971 Great Britain ..... 6,882/71

[52] **U.S. Cl.** ..... **166/.5**

[51] **Int. Cl.** ..... **E21b 33/035**

[58] **Field of Search** ..... 166/.5, .6; 175/7



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,252,528 | 5/1966 | Nicolson | 166/.5 |
| 3,474,858 | 10/1969 | Gibson et al. | 166/.5 |
| 3,547,189 | 12/1970 | Bielstein | 166/.5 |
| 3,662,822 | 5/1972 | Wakefield | 166/.5 |
| 3,688,840 | 9/1972 | Curington et al. | 166/.6 |



*Primary Examiner*—Werner H. Schroeder

*Attorney*—Theodore E. Bieber et al.



[57] **ABSTRACT**

A funnel shaped guide member is provided to guide a marine conductor to a submerged well head said guide member being displaceable to clear the way for the marine conductor to be landed on the submerged well head.


**4 Claims, 6 Drawing Figures**

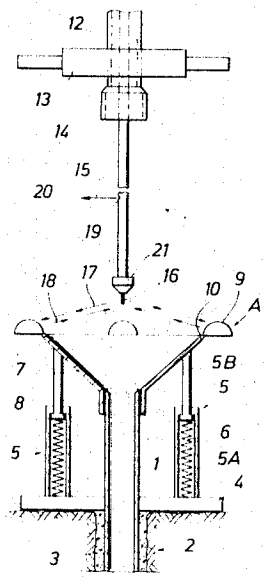


FIG. 1

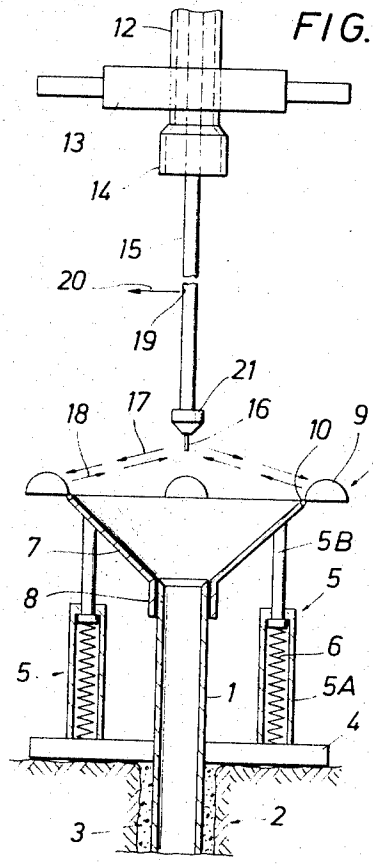



FIG. 2

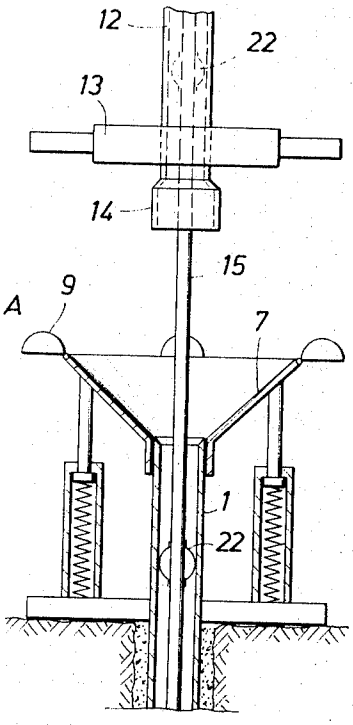
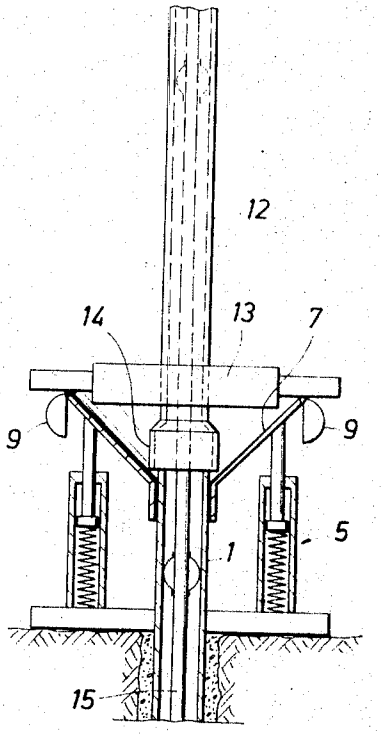



FIG. 3



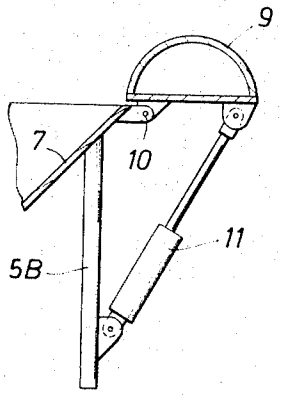
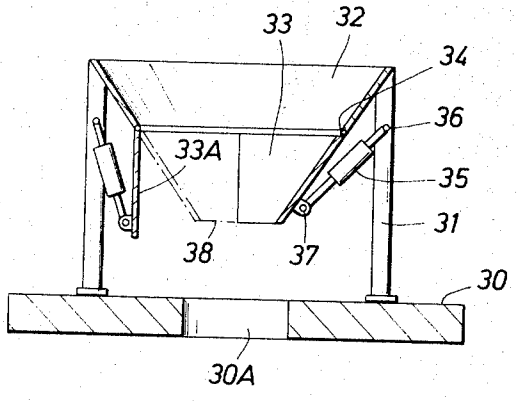




FIG. 5

FIG. 4



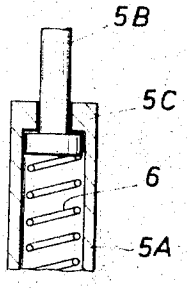




FIG. 6

# DISPLACEABLE GUIDE FUNNEL FOR SUBMERGED WELLHEADS

## BACKGROUND OF THE INVENTION

The invention relates to an apparatus for guiding equipment to an offshore submerged well head, and more particularly to equipment installed on or adjacent to the well head, suitable for guiding a well re-entry tool into or to the entrance of the well head. Such a well re-entry tool may consist of a drill string suspended from a vessel or structure floating above the spot where the well is located. The lower end of the string carries a drill bit and an orienting device such as a television camera or alternately a system capable of transmitting signals and receiving the reflections of these signals and forming an image of the surrounding area by displaying these received signals aboard the vessel. The lower end of the string may also have propulsion means, such as an opening in the side wall of the string through which water may flow in the form of a jet. By rotating the string and controlling the pressure of the water supplied to the upper end of the string, the lower end of the string can be displaced in a desired direction and over a desired distance.

The indications received from the orienting device allow the operator aboard the vessel or floating structure to direct the lower end of the string above the submerged well head and bring the lower end into contact with the well head by lowering the string. To facilitate the contact between the lower end of the string and the well head, the well head is provided with a guide funnel. The small-diameter end of the funnel is just above the entrance to the well head, whereas the large-diameter end is at a higher level. The end of the string which is being lowered onto (or into) the well head is brought into contact with the inner surface of the guide funnel and guided to the small-diameter end thereof, whereafter it passes through the opening at this end of the funnel and is then in alignment with the entrance of the well head. The string is subsequently lowered into the well on which the well head is mounted, and drilling of the hole by rotation of the drill string is started.

A drawback of the above-described guide funnel is, that although it is suitable for guiding a drill string to the well entrance, it prevents the coupling of a marine conductor or blow out preventor stack to the well head.

## SUMMARY OF THE INVENTION

An object of the invention is to provide a means for guidng equipment to an offshore submerged well head, which means when applied on or near a well head will enable a marine riser to be guided along a tubing string and be coupled to the well head in a quick and efficient manner.

Another object of the invention is to provide a funnel-shaped guide suitable to be placed on a well head, which guide will not hamper passage of equipment lowered into the well head along a well head re-entry tubing string which has previously been lowered into the well head by means of the funnel-shaped guide.

The guide member may be movable along its longitudinal axis, spring means being provided for forcing the guide surface in a direction away from the base member.

At least that part of the funnel-shaped guide surface facing the base member may be formed by petal-shaped guide plates which plates can pivot at their edges turned away from the base member such that each plate is movable between two end positions, means being provided for forcing each guide plate to the end position in which the plates formed a closed wall.



## BRIEF DESCRIPTION OF THE DRAWING

The invention will now be described with reference to the drawing in which:

FIG. 1 schematically shows a tubing string being landed using guide means according to the invention which is placed on an offshore submerged wellhead;

FIG. 2 illustrates the same guide means according to the invention to be utilized for landing a marine riser;

FIG. 3 shows the marine riser coupled to the well head after being landed;

FIG. 4 illustrates an alternate embodiment of the guide means shown in FIG. 1;

FIG. 5 is an exploded view of the reflectors shown in FIG. 1; and

FIG. 6 is an exploded view of the telescopic members shown in FIG. 1.

## DESCRIPTION OF A PREFERRED EMBODIMENT

The well head as shown in FIGS. 1–3 consists of the upper part of a casing 1 cemented in a well 2 by an annular layer of cement 3. The casing 1 is connected to a base member 4. The base member 4 has at least three telescopic members 5, two of which are shown in the drawing, the cylindrical housing 5A being rigidly connected to the base member 4. Spring means 6 are arranged inside cylindrical housing 5A of the telescopic members 5 to move plunger 5B into their extended position as shown in FIGS. 1 and 2. Stop members 5C are arranged to prevent the cylindrical housing 5A and plunger 5B of the telescopic members from becoming disengaged.

The plunger 5B of the telescopic members 5 are connected to the guide member 7 which has a frustoconical-shaped guide surface. A cylindrical section 8 surrounding the casing 1 is connected to the small diameter part of the member 7. The central axis of the guide member 7 coincides with the central axis of the casing 1. Reflectors 9 are mounted on the rim of the upper end of the guide member 7. These reflectors are pivotably mounted (at points 10) on the rim of the member 7, and kept in the position as shown in FIG. 1 by telescopic spring means 11 as shown in FIG. 5. As will be described hereinafter, the reflectors 9, which consist of semi-spherical plates, can be displaced against the action of the telescopic spring means 11 so as to make way for equipment which is lowered onto the well head.

As further shown in FIG. 1, a marine riser tubing 12 is suspended from a vessel (not shown) floating on the surface of the water above where well 2 is located. The lower end of the marine riser tubing 12 carries a blow-out preventer 13 and a coupling 14. No details of the blow-out preventer 13 and coupling 14 are given since they are well known to those skilled in the art.

Through the marine riser tubing 12, a tubing string 15 is suspended from the vessel. This string 15 extends beyond the lower end of the marine riser tubing 12 and carries an orienting device 16 of known design and capable of transmitting acoustic signals (arrows 17) and receiving acoustic signals reflected by objects (such as reflectors 9) on the sea bottom. These reflected signals

are indicated by the arrows **18** (FIG. 1). The orienting device is suspended from a cable (not shown) passing through the interior of the tubing string **15**, and extends only partly from the lower end of the string **15**.

A jet opening **19** in the wall of the tubing string **15** allows a jet of water **20** to flow from jet opening **19** to displace the lower end of the tubing string **15**. By rotation of the string **15**, the direction of the water jet **20**, and consequently the direction in which the lower end of the tubing string **15** is displaced, can be chosen at will.

Further the lower end of the tubing string **15** is provided with a guiding head **21**.

The operation of the guiding equipment as shown in FIG. 1 will now be described with reference to FIGS. **1, 2** and **3**.

Centralizers **22** (FIG. 2) are mounted on the tubing string where necessary to maintain a concentric relationship between the well head **1**, the tubing **15** and the marine riser **12**.

The reflections **18** of the signals **17** transmitted by the orienting device **16** are received by device **16** and passed to the vessel (not shown) to enable the operator aboard the vessel to obtain information on the position of the lower end of the tubing string **15** relative to the reflectors **9** and the central axis of the well head **1** since the reflectors **9** are symmetrically arranged with respect to the central axis of the well head **1**. By varying the magneitude and direction of the water jet **20**, the operator can displace the lower end of the tubing string **15** so that it will be directly above the center of the well head **1**. The magnitude of the water jet **20** is controlled by the operator by varying the pressure of the water supplied to the upper end of the tubing string **15**. This water can only escape via the opening **20** as the lower exit of the tubing **15** is closed off by the orienting device **16**. The direction of the water jet **20** is controlled by rotating the tubing string **15** over a limited angle.

When the lower end of the tubing string **15** has been positioned as close as possible to the central axis of the well head **1**, the string is lowered and the orienting device **16** is retracted into the tubing **15** prior to the moment at which the guiding head **21** enters the guide member **7**. When the tubing string **15** is lowered further, the guiding head **21** carried on the lower end of the string contacts the inner surface of the guide member **7** and is guided by it to the entrance of the well head **1**. The tubing string **15** is subsequently lowered into the well head over a length sufficient to prevent accidental withdrawal of the string **15** from the well head **1**.

During lowering of the tubing string **15**, tubing elements are added to the upper end of tubing string **15**, so that the tubing string extends under all circumstances in an upward direction to the vessel or such from which the operations are being carried out.

In the situation as shown in FIG. **2**, the orienting device **16** has been retracted from the string **15** by retracting the cable from which the orienting device is suspended in the tubing string **15**. Subsequently, the marine riser string **12** is lowered along the tubing string **15** by adding new riser elements to the upper end of the string **12**. The marine riser string **12** is guided with the lower end thereof onto the top of the well head **1** by means of the tubing string **15** on which centralizers **22** are mounted. AS a result, the blow-out preventer **13** mounted on the marine riser string **12** comes into contact with the relfectors **9**, thereby pivoting them about their pivot points **10** and against the action of the telescopic spring elements **11** (FIG. **5**). When the marine riser string **15** is lowered further the guide member **7** is pressed downwards against the action of the telescopic spring elements **5, 6**, thereby allowing the coupling member **14** to slide over the upper part of the well head **1**. The member **14** is coupled to the well head **1** in a manner known per se for coupling members used with offshore wells.

The tubing string **15** is then tripped out from the well and from the marine riser string **12**. Thereafter, any equipment to be used in the well for drilling, workover, etc., may be lowered into the well via the marine riser string **12**.

It will be appreciated that the guide member may be left on the well after having guided the lower end of tubing string **15** into the well head **1**. Consequently, it can be used more than once in the re-entry of well equipment when the marine riser has been removed from the well head. Since it need not be removed prior to lowering the marine riser string **12**, the operation of re-entering the well can take place within a relatively short period of time.

As eill be clear from the above description with reference to FIGS. **1–3**, the marine riser string **12** may (for a large part thereof) be suspended from the vessel piror to lowering the tubing string **15** therethrough and onto the well head **1**. Since lowering of the marine riser string **12** over the tubing string **15** is a time-consuming operation, it will be understood that application of the method as described with reference to the FIGS. **1–3** will result in a remarkable reduction in operating time as compared to a method in which the guide member on the well head must be removed prior to passing the marine riser string over the tubing string.

The springs **6** in the telescopic members **5** should be sufficiently strong to prevent displacement of the guide member **7** when the latter is contacted by the guiding head **21** sliding over the inner surface of the member **7** towards the entrance of the well head **1**, but weak enough to allow displacement of the member **7** when the marine riser **12** with blow-out preventer **13** is lowered thereon.

An alternative construction of the guiding means according to the invention is shown in FIG. **4** of the drawing.

The base member **30** consists of a concrete block with a central opening **30A** on which block at least three supporting legs **31** (of which only two are shown in the drawing) are mounted. The guide member consists of an upper surface **32** in the form of a truncated pyramid and is supported by the legs **31** on the base **30**. The lower part of the guide member consists of at least three sections, each section being pivotably connected to the upper part **32**, so that the combination of the part **32** and the sections **33** forms a truncated pyramid, the main axis of which is vertical with respect to the base member **30**. This base member can be placed aruond a well entrance (not shown) so that the central axis of the well entrance coincides with the main axis of the guide member formed by the part **32** and the sections **33**.

Each section **33** is connected to hte upper part **32** by pivots **34** and is held in the position shown in the right half of FIG. **4** by at least one telescopic spring member

35 arranged between a point 36 on the leg 31 and a point 37 on the relevant section 33.

It will be appreciated that when the base member 30 is placed around a well head (not shown) with the central axis thereof coinciding with the main axis of the guide member having an inner surface in the form of a truncated pyramid, the area of the passage through the lower opening formed by the lower edges of the sections 33 can be increased by passing an element (e.g. a coupling member or blow-out preventer) connected to the lower end of a marine riser tubing therethrough. The sections 33 are then pushed aside against the action of the telescopic spring members 35. One section 33A is shown in such a position.

The sections 33 consist of petal-shaped blades which are hinged at their edges turned away from the base member 30. In the situation in which no external pressure is exerted, on the petal-shaped blades they form a closed surface which is suitable for guiding a re-entry tool towards the lower opening 38 of this surface. The blades 33 are held in this position under the action of the telescopic spring elements 35 which are sufficiently strong to prevent the petal-shaped blades from opening under the influence of the force exerted thereon by the re-entry tool being guided along the internal surface of the guide member towards the central lower opening 38 thereof. However, the telescopic spring members 35 will give way to the force exerted on the petal-shaped blades by the marine riser string which is lowered over the re-entry tool which latter is formed by a tubing string similar to the string 15 as described hereinbefore with reference to FIG. 1. Then, the blades 33 open (position 33A of one of these blades), thus increasing the area of the passage through the guide member according to the invention.

The lower parts of the blades 33 may be shaped in such a way that the opening 38 has a circular shape.

It will be understood that the base member of the guiding means according to the invention need not be mounted on the sea bottom, but may also be deisgned in such a way that it can be mounted directly on a well head. If desired, more than one guide means according to the invention may be applied on a well head for guiding well re-entry tools to the well head during the varuios stages of completion thereof. Thus, a guide means according to the invention may be mounted on top of the blow-out preventer 13 (FIG. 1), thereby allowing re-entry of the well after the marine conductor 12 has been uncoupled from the blow-out preventer 13 and removed therefrom.

The invention is not limited to guide means provided with reflectors 9 as shown in the drawing. The reflectors may be omitted, or mounted immovably to the rim of the guide cone or directly to the base member.

We claim as our invention:

1. Apparatus for guiding equipment lowered from the surface of a body of water to a submerged well head on the ocean floor, said apparatus comprising:

a base member resting on the ocean floor and having a central opening;

a casing member extending through the central opening in said base member and extending into said ocean floor;

a guide member having a frusto-conical-shaped guide surface the lower end being slidably connected to said casing member; and

at least three telescopic members extending up from said base member connecting said guide member and base member allowing said guide member to move relative to said base member.

2. The apparatus of claim 1 wherein said telescopic members comprise:

a cylindrical housing rigidly connected to the base member;

spring means contained within said cylindrical housing; and

a plunger connected to the guide member at its upper end its lower end being inside said cylindrical housing resting on said spring means.

3. The apparatus of claim 1 further including symmetrically arranged reflectors pivotably mounted on the upper rim of said guide member whereby signals may be reflected to obtain information on the position of the lower end of equipment relative to said reflectors.

4. Apparatus for guiding equipment lowered from the surface of a body of water to a well head on the ocean floor said apparatus comprising:

a base member resting on the ocean floor and having a central opening;

a casing member extending through the central opening in said base member and into the ocean floor;

a guide member having an upper part in the form of a truncated pyramid and a lower part having at least three sections each section being pivotably connected to the upper part;

said lower sections being petal-shaped blades pivotably connected at their upper edges turned away from said base member, said petal-shaped blades when in a first position form a closed surface suitable for guiding a re-entry tool towards the well head and when in a second position open increasing the area of passage through said guide member for the passage of elements therethrough; and

at least three supporting legs extending up from the base member and connected to the upper part of said guide member thereby supporting said guide member such that the central axis of said guide member coincides with the central axis of said casing member.

* * * * *