United States Patent [19]

Joosse

[11] **3,732,143**

[45] **May 8, 1973**

[54] **METHOD AND APPARATUS FOR DRILLING OFFSHORE WELLS**

[75] Inventor: **Cornelis G. Joosse,** The Hague Netherlands

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

[22] Filed: **May 20, 1971**

[21] Appl. No.: **145,142**

[30] **Foreign Application Priority Data**

June 17, 1970 Great Britain.....29,423/70

[52] **U.S. Cl.** **175/6,** 175/171, 175/101

[51] **Int. Cl.**.....**E21b 43/01,** E21b 7/12

[58] **Field of Search**.....175/257, 171, 173, 175/92, 101, 202, 260, 261, 103, 402, 62, 386

[56] **References Cited**

UNITED STATES PATENTS

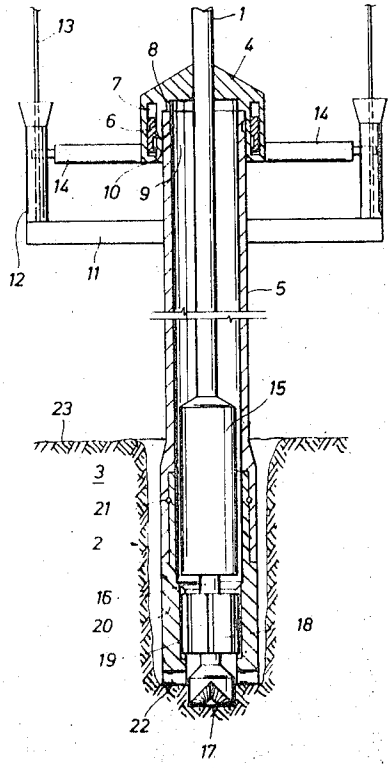
2,512,783	6/1950	Tucker	175/6
2,621,023	12/1952	Click	175/103 X
2,675,213	4/1954	Poole et al.	175/62 X
2,891,770	6/1959	Bauer et al.	175/7
3,077,936	2/1963	Arutunoff	175/107 X
3,585,738	6/1971	Koning	175/6
3,603,407	9/1971	Clark	175/6
3,635,295	1/1972	Cobbs	175/257

Primary Examiner—Marvin A. Champion
Assistant Examiner—Richard E. Favreau
Attorney—Theodore E. Bieber and Harold L. Denkler

[57] **ABSTRACT**

A method and apparatus for drilling offshore wells wherein a base unit and conductor string are lowered in the water by a drill string that is coupled to the conductor string, a rotatable shoe including cutting means being mounted on the lower end of the conductor string. A self-contained drilling unit is disposed in the conductor string below the coupling between the conductor string and drillstring, the drilling unit being used to drive the rotatable shoe to install the conductor string. After the conductor string is installed the drill string and self-contained drilling unit are withdrawn and the conductor string and base unit cemented in place.

15 Claims, 4 Drawing Figures



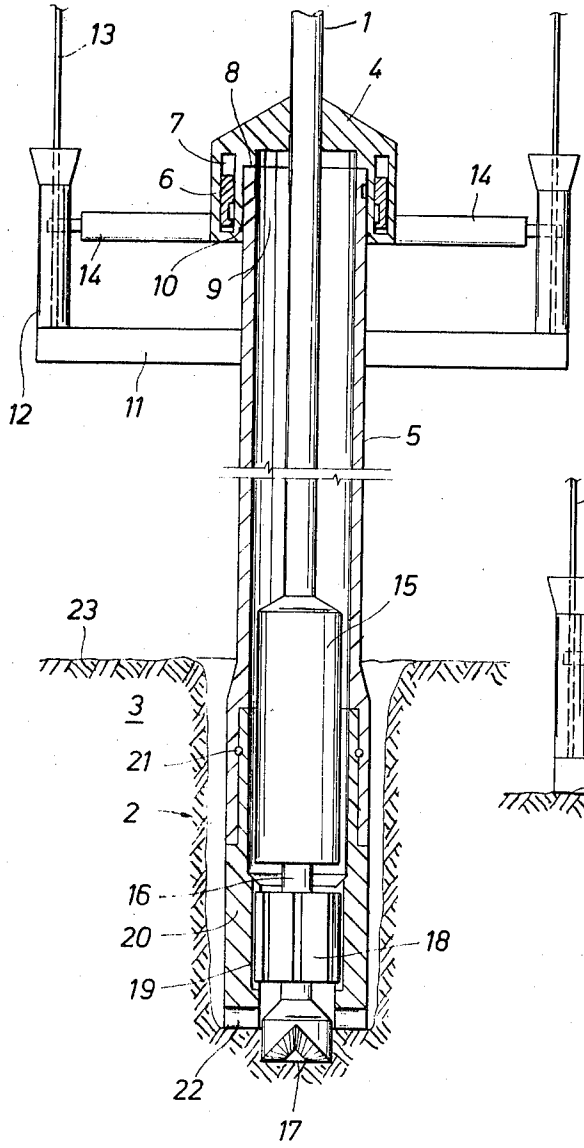


FIG. 1

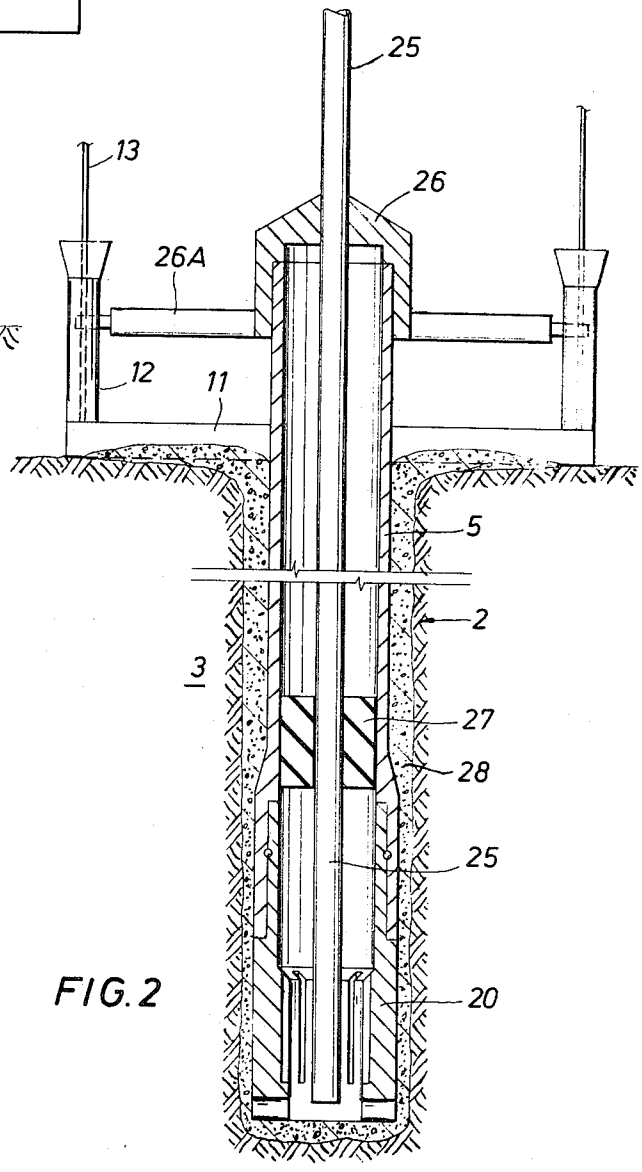


FIG. 2

C. G. Joosse
INVENTOR

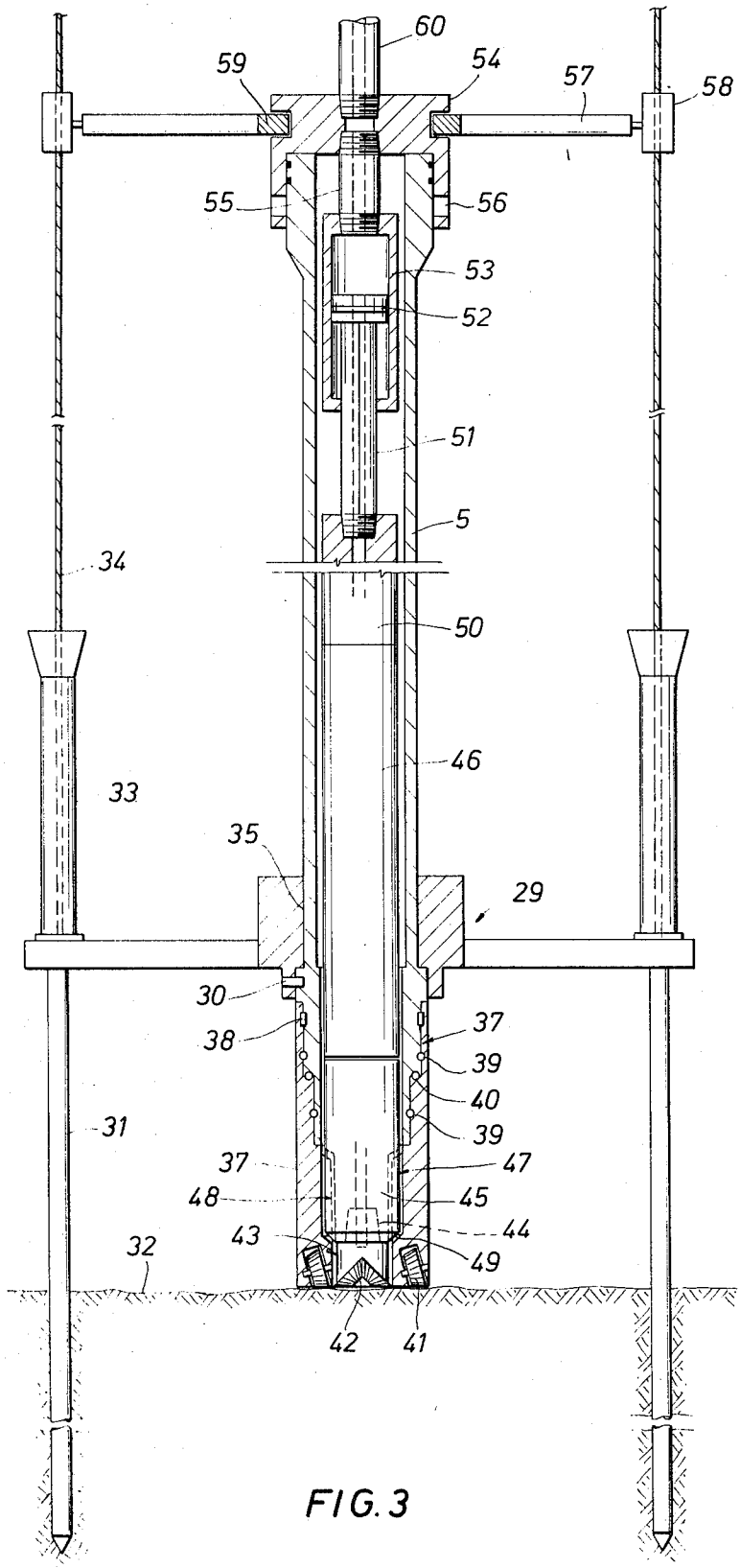
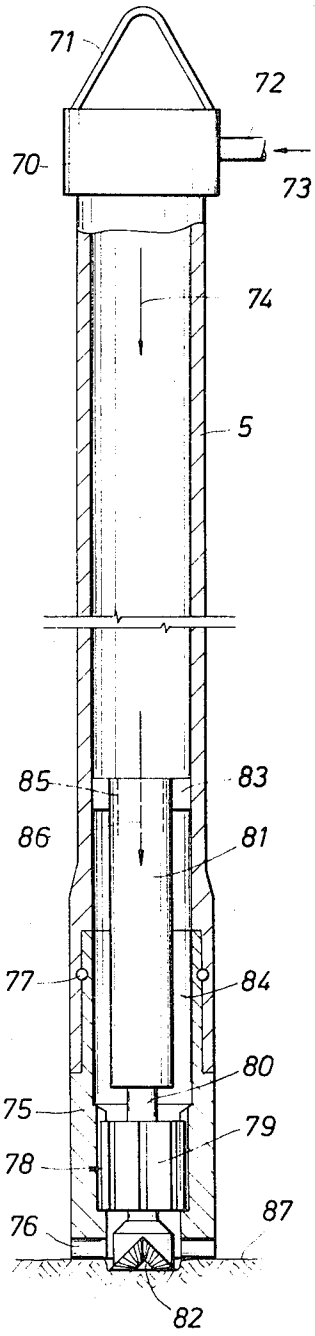


FIG. 3

FIG. 4



C. G. Joosse
INVENTOR

METHOD AND APPARATUS FOR DRILLING OFFSHORE WELLS

BACKGROUND OF THE INVENTION

This invention relates to a method and an apparatus for use in drilling offshore wells, and pertains more particularly to a method and apparatus for the drilling of offshore wells wherein a conductor string is lowered into the bottom of a body of water simultaneously with the drilling of the initial part of the borehole.

By means of such method and apparatus the conductor string need not be introduced into the hole after this hole has been drilled to the required depth, thus obviating possible damage to the hole during running in of the conductor string, as well as the difficulties encountered when the entrance to the hole has to be relocated after retraction of the drill bit and prior to running in of the conductor string.

A base member is often applied in offshore drilling techniques, which base member is provided with means suitable for connecting one or more guide lines to the base member. Such guide lines are at the upper end thereof connected to the drilling barge, floating platform or structure supported by the bottom of the body of water, and are useful in guiding the equipment from the ship, floating platform or structure to the entrance of the borehole and vice versa.

BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to provide an apparatus for use in drilling offshore wells, which comprises a conductor string which can be introduced into the bottom of a body of water in a very efficient manner, wherein the required amount of drilling energy is relatively low.

It is a further object of the present invention to provide a method and apparatus for use in drilling offshore wells, wherein contact with the entrance to the hole is not lost during the initial drilling period.

It is still another object of the present invention to provide a method for drilling an offshore well, without applying a temporary guide base, or a permanent guide base provided with a drive pipe.

It is another object of the present invention to decrease the time required to place and cement a conductor string provided with a guide base, as much as possible.

It is a further object of the present invention to provide a method and an apparatus for use in drilling offshore wells wherein the guide lines, if applied, cannot become entangled during placement of the conductor string in the bottom of the body of water wherein a borehole is being drilled.

According to the invention, an apparatus for use in drilling an offshore well comprises:

a conductor string,

a base member carried by the conductor string,

a drill string connected to the conductor string by coupling means,

a self-contained drilling unit provided with a drill bit and carried within the conductor string at a level below the said coupling means,

a shoe carried by the lower end of the conductor string, which shoe is rotatably arranged with respect to the central axis of the conductor string and provided with means to prevent axial separation between the shoe and the string, the shoe being further provided at the lower end thereof with cutting means and having a central passage in which the drill bit is arranged, and

coupling means arranged between the shoe and the rotatable part of the self-contained drilling unit and suitable for transmitting at least rotational loads.

The drilling unit may either be carried by the conductor string, or by the drill string.

If the drilling unit is carried by the drill string, the coupling means between the shoe and the drilling unit may further be suitable for transmitting axial loads, and a telescopic joint suitable for transmitting rotational loads may be arranged in the drill string between the self-contained drilling unit and the coupling means arranged between the drill string and the conductor string.

The base member may be provided with means suitable for connecting at least one guide line to the base member.

The base member may be connected near the lower end of the conductor string by a coupling means and be provided with downwardly projecting extensions suitable to be inserted into the bottom of a body of water to prevent rotation of the base member. Guidebars may be provided to guide the drill string along the guidelines, the guidebars being rotably arranged with respect to the drill string.

A method for using the apparatus according to the invention may comprise the following steps:

suspending from a drilling ship the lower part of the conductor string provided with the rotatable casing shoe with cutting means at its lower end,

mounting the hydraulic motor having the drill bit connected to the output shaft thereof in the lower end of this part of the conductor string, such that the drill bit protrudes through the central opening of the casing show, and coupling the output shaft to the casing shoe,

lowering the conductor string onto the formation surface by adding conductor pipes to the conductor string,

rotating the drill bit and the casing shoe by supplying pressure fluid to the hydraulic motor via the conductor string and drilling a hole into the formation by simultaneously lowering the conductor string and adding further conductor pipes to the conductor string,

interrupting the drilling operation and mounting the base member provided with guide lines to the top of the conductor string, and coupling the drill string consisting of at least one drill pipe to the top of the conductor string,

resuming the drilling operation by supplying pressure fluid to the hydraulic motor via this drill string and the conductor string and simultaneously lowering the conductor string into the hole by adding further drill pipes to the drill string,

interrupting the drilling operation when the base rests on the surface of the formation,

lifting the hydraulic motor together with the drill bit and suspending it in the conductor string at a higher level,

injecting a solidifiable material through the drill string, the conductor string, and the casing shoe and into the borehole part around the conductor string,

uncoupling the drill string from the conductor string and lifting the drill string, and

lifting the hydraulic motor together with the drill bit from the conductor string.

An alternative method for using the apparatus according to the invention may comprise the following steps:

suspending from a drilling ship the lower part of the conductor string provided at the lower end thereof with the rotatable casing shoe with cutting teeth, and with the base member with downwardly projecting extension,

mounting the hydraulic motor having the drill bit connected to the output shaft thereof in the lower end of this part of the conductor string such that the drill bit protrudes through the central opening of the casing shoe, and coupling the output shaft to the casing shoe,

lowering the conductor string onto the formation surface by adding conductor pipes to the conductor string,

uncoupling the base member from the conductor string,

rotating the drill bit and casing shoe by supplying pressure fluid to the hydraulic motor via the conductor string and drilling a hole into the formation by simultaneously lowering the conductor string and adding further conductor pipes to the conductor string,

interrupting the drilling operation for coupling the drill string consisting of at least one drill pipe to the top of the conductor string,

resuming the drilling operation by supplying pressure fluid to the hydraulic motor via this drill string and the conductor string and simultaneously lowering the conductor string into the hole by adding further drill pipes to the drill string,

interrupting the drilling operation when the hole has reached a sufficient depth,

lifting the hydraulic motor together with the drill bit and suspending it in the conductor string at a higher level,

injecting a solidifiable material through the drill string, the conductor string and the casing shoe and into the borehole part around the conductor string,

uncoupling the drill string from the conductor string and lifting the drill string, and

lifting the hydraulic motor together with the drill bit from the conductor string.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will, by way of example, by described hereinafter in more detail with reference to the drawing, wherein

FIG. 1 shows a longitudinal section through one embodiment of the invention during the placement thereof in the bottom of a body of water,

FIG. 2 shows a longitudinal section through the same embodiment as shown in FIG. 1, but in position in a borehole drilled in the bottom of the body of water and connected to this bottom,

FIG. 3 shows a longitudinal section through another embodiment of the invention during the placement thereof in the sea or ocean bottom, and

FIG. 4 shows a longitudinal section through an embodiment according to the invention, suitable for use in a body of water which has a depth smaller than the length of the conductor string.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2, the drill string 1 carries a coupling member 4 which is suitable for being coupled to the upper end of the conductor string 5. This coupling member 4 is of a conventional type and comprises an annular piston 6 axially displaceable in an annular cylinder 7 and capable of actuating locking dogs 8 which cooperate with a groove 9 in the upper part of the outer wall of the conductor string 5. The piston 6 can be actuated by hydraulic fluid, which is supplied to and drained from the cylinder parts above and below the piston 6 via suitable (not shown) flexible conduits leading to the drilling ship. Suitable sealing means 10 are provided to seal the passage between the coupling member 4 and the conductor string 5.

The conductor string carries a base member or base plate 11 which, as will be described hereinafter with reference to FIG. 2, serves to support the conductor string 5 when the hole 2 is at the required depth.

The base member 11 is provided with guide posts 12 of a conventional type, which guide posts have guide cables 13 connected thereto and running upwards to the drilling ship (not shown). Guidebars 14 connected to the coupling 4 cooperate with the guide cables 13 and the guide posts 12.

The lower end of the drill pipe 1 is connected to a hydraulic turbine 15 of known design, which can be actuated by a flow of fluid being passed through the drill string 1. The drill motor shaft 16 carries a drill bit 17 and is provided with a splined section 18 cooperating with a splined section 19 of a casing shoe 20, which is rotatably arranged on the lower end of the conductor string 5. Locking and rolling means comprising balls 21 running in semi-annular grooves arranged in the shoe 20 and the conductor string 5 lock the shoe 20 against axial displacement with respect to the conductor string 5.

An annular row of cutting teeth 22 is arranged at the lower end of the shoe 20. Thus a cutting element is formed by the bit 17 and the teeth 22 for drilling the hole 2 to a diameter greater than the outer diameter of the conductor string 5. The conductor string 5 can thus be lowered into the hole 2 when the drilling operation is being carried out at the bottom thereof by the bit 17 and the teeth 22 arranged on the rotatable casing shoe 20.

When drilling the hole 2, the whole assembly shown in FIG. 1 is lowered from the ship (not shown) to the surface 23 of the bottom of a body of water by means of the drill string 1. The guide lines 13 are kept in a vertical position by exerting a substantially constant force at the top thereof, e.g., by means of constant tension winches (not shown) mounted on board of the drilling ship.

Hydraulic fluid is pressurized on board of the ship and injected into the upper end of the drill string 1 for actuation of the hydraulic motor 15. As a result, the bit 17 is rotated with respect to the drill string 1. Since the bit 17 is connected to the shoe 20 via the splines 18 and 19, the shoe 20 is also rotated with respect to the drill string 1 and in the same sense as the bit 17. Under influence of the load on the cutting element formed by the teeth 22 and the bit 17, this element enters the formation 3 and drills a hole 2. The load on the cutting

element may be controlled by controlling the load on the hook in the rig from which the drill string 1 is suspended.

The drilling operation continues until the depth of the hole 2 equals the distance between the base member 11 and the cutting teeth 22 of the shoe 20. The assembly is then suspended from the base member 11 resting on the surface 23 of the sea or ocean bottom 3. Subsequently, the locking dogs 8 are retracted from the groove 9 in the conductor string 5 by displacing the annular piston 6 by pumping hydraulic fluid below this piston and by lifting the drill string 1. The hydraulic motor 15, the splined section 18 and the drill bit 17 are subsequently retracted from the conductor string 5. During this upward displacement, the coupling 4 is guided along the guide cables 13 by means of the guidebars 14.

Subsequently, a cementing tube 25 is lowered into the conductor string 5, which tube is provided with a coupling 25 similar to the coupling 4 shown in FIG. 1. The coupling 26 is provided with guidebars 26 A cooperating with the guide cables 13 and the guide posts 12 on the base member 11. The cementing tube 25 carries a packet element 27 known as cement retainer which in the position shown in FIG. 2 seals off the annular passage between the cementing tube 25 and the conductor string 5. Cement is injected into the borehole 2, thereby filling the annular space around the conductor string 5 with a cement layer 28. It will be appreciated that the casing shoe 20 is cemented in the well together with the conductor string 5.

After cementing of the conductor string 5, the cementing tube 25 is removed from the conductor string 5 and the cement retainer 27 prevents backflow from the cement 28 into the conductor string 5. After hardening of the cement, drilling of the borehole proceeds via the conductor string 5 in one of the known manners. It will be appreciated that the equipment required for further drilling of the borehole can be guide along the guide cabels 13 to the entrance of the conductor string 5 or to any equipment mounted on the string 5 (such as blowout preventers and a conically-shaped funnel).

In an alternative embodiment of the invention, the conductor string 5 may be cemented in the borehole 2 by passing the cement or other solidifiable compound via the drill string 1 and the hydraulic motor 15 into the annular space around the conductor string. Preferably, the hydraulic motor 15 and the bit 17 are lifted over a distance within the conductor string, which operation can take place after having uncoupled coupling 4. It will be appreciated that a packer member closing off the annular space between the drill string 1 and the conductor string 5 is suitable to prevent flow of cement through the conductor string 5 in an upward direction. As hydraulic motor suitable for this purpose, use can, e.g., be made of the pump known as a "Moyno" pump manufactured by Robbins and Meyers, Springfield, Ohio. Hydraulic fluid is then injected into the outlet of this pump, and the shaft of the pump is used as a drive shaft for actuating the bit 17. The hydraulic motor and the interior of the conductor string are cleaned of cement after the cementation process by injecting a displacing fluid behind the cement and in an amount sufficient to displace the cement inside the conductor string to the level of the shoe 20. It will be appreciated that the drill string 1 should be lifted sufficiently high prior to cementing so that a large volume of cleaning fluid can pass the hydraulic motor for effective cleaning. In this method total withdrawal of the drillstring 1 is only possible after the cement has hardened.

It is one of the advantages of the apparatus according to the invention, that the conductor string 5 is continuously being lowered in the hole while the later is being drilled, and that this operation requires a minimum amount of energy since, although the conductor string 5 carries rotational cutting members, shoe 20 is the only member in contact with the borehole wall that is rotated in the hole. Moreover, the assembly comprising the conductor string 5 with rotatable casing shoe, the drill string 1 with coupling 4 and turbine/bit unit 15, 17 is of compact design and is easy to operate at large sea depths.

A further advantage is that guide lines 13, if applied, cannot become twisted or entangled during the drilling operation, since the application of the hydraulic motor (or any other self-contained drilling unit such as an electric drill) in combination with the rotatable casing shoe and the coupling between the non-rotating drill string and the conductor string prevents rotation of the guide lines around the drill string. It is true that as a result of the torsion of the drill 1 caused by the operation of the turbine 15 the guide cables 13 are displaced with respect to the string 1 through a certain angle. However, at shallow waters this angle is not so great and this torque will be released when the motor is stopped. At greater depths, however, it may be advisable to prevent such torsion of the drill string 1 by using the equipment according to the invention as shown in FIG. 3.

The conductor string 5 as shown in FIG. 3 carries a base member 29, which is connected thereto by means of shear pins 30 (only one of which is shown). Extension means 31 projecting downwards from the base member 29 are partly driven into the sea bottom 32 when the assembly shown in FIG. 3 is placed on this bottom.

The guide posts 33 having guide cables 34 connected thereto are mounted on the base member 29. This member 29 is further provided with an opening 35 allowing (when pin 30 has been sheared) axial displacement between the base member 29 and the conductor string 5.

The conductor string 5 carries a rotatable shoe 37 at the lower end thereof. Sealing means 38 are arranged between the shoe 37 and the string 5 to prevent passage of fluid between these two elements. Balls 39 are provided between the shoe 37 and the string 5 in grooves with semi-circular cross-section arranged therein for locking the shoe 37 and the string 5 in axial direction and transmitting radial loads exerted on the shoe 37 to the string 5. Balls 40 are provided to transmit axial loads between the shoe 37 and the string 5. The lower end of the shoe 37 carries cutting wheels 41 to drill, in combination with the bit 42 arranged in the central passage 43 of the shoe 37, a hole in the sea bottom 32, which hole has a diameter sufficiently large to allow the passage of the conductor string 5 therethrough.

Bit 42 is mounted by screw thread 44 on member 45 which is mounted on the shaft of the hydraulic motor

46. The member 45 is provided with splines 47 cooperating with splines 48 arranged at the wall of the passage 43 of the shoe 37. The splines 47 rest at the lower ends thereof on the shoulders 49 of the grooves arranged between the splines 48.

The load required on the cutting element consisting of the central bit 42 and the annular bit formed by the elements 41 is provided by the weight of the hydraulic motor 46 and the drill collars 50 arranged on top of the motor 46. The upper end of the string of drill collars 50 is coupled to one side of a telescopic member (a so-called bumper sub) comprising a piston rod 51, a piston 52 and a cylinder 53. To prevent rotation between the piston 51 and the cylinder 53, the outer surface of the rod is non-circular, the opening of the cylinder 53 through which the rod 51 is passed having a corresponding shape.

The upper end of the telescopic member is connected to a coupling member 54 by a pipe 55. The coupling member 54 is provided with J-slots (not shown) for cooperation with pins 56, arranged on the conductor string 5. The coupling member 54, is further provided with guide bars 57 having guide members 58 attached thereto for cooperation with the guide cables 34 in a manner known per se. The guide bars 57 are connected to a ring member 59 which is rotatably arranged with respect to the coupling member 54 and a drill string 60.

The assembly comprising the coupling member 54, the conductor string 5, the telescopic member 51–53, the drill collars 50, the hydraulic motor 46, the bit 42 and the shoe 40 is suspended from the drill string 60 connected to the coupling member 54. It will be appreciated that a passageway of sufficient cross-section is provided through the various elements of the assembly to allow fluid to flow from the interior of the drilling string 60 to the hydraulic motor 46 and to the cutting element formed by the bit 42 and the shoe 37.

The operation of the equipment as shown in FIG. 3 is as follows:

The whole assembly is lowered to the sea bottom 32 by lowering the drill string 60. The guide cables 34 are kept sufficiently taut to prevent entanglement thereof.

On being placed on the sea bottom 32, the lower ends of the extension 31 enter this bottom, and the pins 30 between the base 29 and the conductor string 5 are sheared off when the extensions 31 have entered the bottom 32 over a sufficient distance. When the hydraulic motor 46 is actuated by the supply of drilling liquid via the drill string 60, a hole is drilled in the bottom 32 by the combined action of the bit 42 and the shoe 37. The conductor string 5 is continuously lowered in the borehole, sliding through the opening 35 provided in the base 29. The drill string is subjected to torsion, but since the base 29 is anchored to the seabottom 32 by the extensions 31, and the guide bars 57 are rotatably arranged with respect to the drill string 60, the guide lines 34 cannot be displaced angularly with respect to the drill string 60. Consequently, the cables 34 which are kept in constant tension cannot become entangled during the drilling process.

When the desired borehole depth has been reached, the conductor string may be cemented in the hole in one of the manners as hereinbefore described.

When the depth of the body of water overlying the formation in which a conductor string is to be placed is less than the length of the conductor string, this string is not suspended from a drill string during the initial drilling of the hole. The embodiment of the present invention which enables the placing of a conductor string under these circumstances will now be described with reference to FIG. 4.

A part of the conductor string 5 is now suspended by a coupling 70 provided with an eye 71 suitable to cooperate with the hook (not shown) of a drilling rig. The coupling 70 is provided with a connection 72 suitable to be connected to a (not shown) mud hose. The mud supplied via the connection 72 (vide arrow 73) flows via the coupling 70 into the conductor string 5 (vide arrow 74). The lower end of the conductor string 5 is provided with a rotatable casing shoe 75 provided with an annular row of cutting elements 76. The manner in which the shoe 75 is rotatably connected to the conductor string 5 is only shown schematically. A locking and bearing element comprising balls 77 running in grooves of semi-circular cross-section prevents axial separation between the shoe 75 and the conductor string 5.

The casing shoe 75 carries at the inner wall thereof a splined section 78 designed to cooperate with a splined section 79 carried by the output shaft 80 of the hydraulic motor 81. The shaft 80 carries a drill bit 82 protruding through the central opening of the shoe 75 and forming a drilling element in combination with the cutting teeth 76 carried by the shoe 75. The hydraulic motor 81 is connected to the inner wall of the conductor string 5 by a coupling 83 known per se and suitable to transfer an axial, as well as a rotational load between the conductor string 5 and the hydraulic motor 81, and to seal the passage through the annular space 84 between the hydraulic motor 81 and the conductor string 5.

The entrance for the drive fluid to the hydraulic motor 81 is schematically indicated at 85. The motor 81 is of the type suitable for passing cement slurry therethrough. To this end use can be made of a pump known as a Moyno pump, manufactured by Robbins and Meyers, Springfield, Ohio, by supplying pressure fluid to the outlet of this pump and connecting the bit 82 to the shaft of this pump.

In operation, the assembly as shown in FIG. 4 is suspended from the drilling ship (not shown) and pressure fluid is supplied to the hydraulic motor 81 via the connection 72, coupling 70 and conductor string 5 (vide arrows 73, 74 and 86).

Rotation of the shaft 80 activates the bit 82 and the cutting elements 76 of the casing shoe 75, which cut under axial load a hole into the formation, into which hole the conductor string 5 is lowered by adding further conductor pipes between the top of the conductor string 5 and the coupling 70.

When the length of conductor string suspended from the coupling 70 is sufficiently long for the purpose, the drilling operation is interrupted and a base member (not shown) as well as a drill pipe (not shown) is coupled to the top of the conductor string by coupling means known per se. Thereafter the drilling operation is resumed by supplying pressure fluid via this drill pipe. From time to time, as the depth of the hole increases, new drill pipes are added to the drill string.

When the desired depth of the hole has been reached, the total length of the conductor string will have been lowered into the hole and be suspended from the surface of the formation by the base member resting on this surface.

The drilling operation is then stopped, and the hydraulic motor **81** together with the splined section **79** and the drill bit **82** is detached from the conductor string **5** by uncoupling the coupling **83** and thereafter again reconnected to the conductor string **5** by setting this coupling at a higher level. This operation can be carried out in a manner known per se by means of a (not shown) pipe string.

Subsequently, a solidifiable material is injected via this pipe string, the hydraulic motor **81** and the central passage of the casing shoe **75** into the annular space around the conductor string. After the material has consolidated the drill is uncoupled from the conductor string **5** and lifted. Thereafter the pips string carrying the self-contained drilling unit comprising the hydraulic motor **81**, the splined section **79** and the drill bit **82** is retrieved from the conductor string **5**. Thereafter, the hole is further deepened in a manner known per se.

If desired, the self-contained drilling unit comprising the hydraulic motor **81** may be uncoupled from the conductor string when the drilling operation is stopped and connected to the lower end of the drill string. The self-contained drilling unit is then removed together with the drill string from the conductor string after cementation of this string and solidification of the cement.

In an alternative method, the hydraulic motor **81** is removed together with the bit **82** from the conductor string, whereafter cementation takes place in the manner as described with reference to FIG. **2**.

It will be appreciated that at least one telescopic joint (a so-called casing thumper) may be installed between sections of the conductor string **5**, to compensate for wave action influencing the distance between the coupling **70** and the surface **87** of the formation to be drilled. Such telescopic joints may also be arranged in the drill string.

Although the coupling **83** includes a packer member for sealing the passage between the outer wall of the hydraulic motor **81** and the inner wall of the conductor string **5**, the invention is not restricted thereto. If desired, the packer member may be separate from the coupling **83**. The packer member need not be set when the hydraulic motor **81** is suspended from a higher level during the cementing operation. The cement will then pass around the hydraulic motor on its way downward through the conductor string. The the invention is further not restricted to the use of a base member connected to the top of the conductor string **5** of the system as shown in FIG. **4**. If desired, the base member may be coupled to the lower end of this conductor string by means which are uncoupled when the base member rests on the surface **87** of the formation to be drilled. This base member is then provided with means preventing rotation of the member with respect to the central axis of the conductor string during the drilling operation. In view hereof, reference is made to the base member **29** as shown in FIG. **3**.

If desired, the self-contained drilling units as shown in FIGS. **1** and **3** may be replaced by a self-contained drilling unit as shown in FIG. **4**.

It will be appreciated that the invention is not restricted to the particular designs as shown in FIGS. **1–4**. Thus, the number and construction of the guide posts may differ from the guide posts shown. Further, any other type of coupling suitable for the purpose may be applied instead of the coupling **4** shown, as well as for the spline construction arranged between the rotatable shoe and the central bit arranged within the shoe.

Furthermore, the extensions **31** suitable for anchoring the base **29** to the sea bottom to prevent rotation of the base **29** around its central axis, may be replaced by any other type of anchoring means suitable for the purpose. If desired, the anchoring means may be provied with drilling or jetting elements to improved the penetration.

It will further be appreciated that the hydraulic or electric motor used for actuating the drill bit may be mounted anywhere between the coupling used for connecting the drill string to the conductor string, and the drill bit. Thus, the motor **46** may be mounted just below the telescopic coupling **51–53**.

In the arrangement as shown in FIG. **1**, the drill string **1** may be kept in the center of the conductor string by means of centralizers known per se.

I claim as my invention:

1. Apparatus for use in drilling offshore wells comprising:

a conductor string;

a base member carried by the conductor string;

a drill string connected to the conductor string by coupling means;

a self-contained drilling unit carried within the conductor string at a level below the said coupling means, said drilling unit in addition having a rotable part with a drill bit attached to the rotatable part:

a shoe carried by the lower end of the conductor string, said shoe being rotatably arranged with respect to the central axis of the conductor string and provided with means to prevent axial separation between the shoe and the string, the shoe being further provided at the lower and thereof with cutting means and having a central passage in which said drill bit is arranged; and

coupling means arranged between the shoe and the rotatable part of the self-contained drilling unit and suitable for transmitting at least rotational loads.

2. Apparatus according to claim **1** and in addition a telescopic joint, said telescopic joint being disposed in the drill string above said drilling unit and below said coupling means.

3. Apparatus according to claim **1** wherein the base member is provided with means suitable for connecting at least one guide line to the base member.

4. Apparatus according to claim **1**, wherein the drilling unit is carried by the conductor string.

5. Apparatus according to claim **4**, wherein the drilling unit comprises a hydraulic motor and a packer is placed to seal the space between the inner wall of the conductor string and the outer wall of the hydraulic motor.

6. Apparatus according to claim **1**, wherein the drilling unit is carried by the drill string.

7. Apparatus according to claim 6, wherein the coupling means between the shoe and the self-contained drilling unit is also suitable for transmitting axial loads, and in addition a telescopic joint suitable for transmitting rotational loads, said telescopic joint being arranged in the drill string between the self-contained drilling unit and the coupling means between the drill string and the conductor string.

8. Apparatus according to claim 5, and in addition at least one drill collar, and drill collar being disposed in the drill string between the telescopic joint and the self-contained drilling unit.

9. Apparatus according to claim 1, wherein the base member is connected near the lower end of the conductor string by coupling means and provided with downwardly projecting extensions capable of being inserted into the soil below a body of water to prevent rotation of the base member.

10. Apparatus according to claim 9, wherein guide bars for guiding the drill string along the guide lines are rotatably arranged with respect to the drill string.

11. Apparatus according to claim 10, wherein the extensions project in a downward direction beyond any other parts of the apparatus.

12. Apparatus according to claim 11, wherein the coupling means between the base member and the conductor string are shear means.

13. Method for use in drilling offshore wells comprising the following steps:

suspending from a drilling ship the lower part of a conductor string provided with a rotatable casing shoe with cutting means at its lower end,

mounting a hydraulic motor having a drill bit connected to the output shaft thereof at the lower end of the conductor string, such that the drill bit protrudes through the central opening of the casing shoe, and coupling the output shaft to the casing shoe,

lowering the conductor string onto the formation surface by adding conductor pipes to the conductor string,

rotating the drill bit and the casing shoe by supplying pressure fluid to the hydraulic motor via the conductor string and drilling a hole into the formation by simultaneously lowering the conductor string and adding further conductor pipes to the conductor string,

interrupting the drilling operation and mounting a base member provided with guide lines on the top of the conductor string, and coupling a drill string consisting of at least one drill pipe to the top of the conductor string,

resuming the drilling operation by supplying pressure fluid to the hydraulic motor via the drill string and the conductor string and simultaneously lowering the conductor string into the hole by adding further drill pipes to the drill string,

interrupting the drilling operation when the base rests on the surface of the formation,

lifting the hydraulic motor together with the drill bit and suspending it in the conductor string at a higher level, injecting a solidifiable material through the drill string, the conductor string, and the casing shoe and into the borehole part around the conductor string,

uncoupling the drill string from the conductor string and lifting the drill string, and

lifting the hydraulic motor together with the drill bit from the conductor string.

14. A method for use in drilling offshore wells comprising the following steps:

suspending from a drilling ship the lower part of a conductor string provided at the lower end thereof with a rotatable casing shoe with cutting teeth, and a base member with downwardly projecting extension,

mounting a hydraulic motor having a drill bit connected to the output shaft thereof in the lower end of the conductor string such that the drill bit protrudes through the central opening of the casing shoe, and coupling the output shaft to the casing shoe,

lowering the conductor string onto the formation surface by adding conductor pipes to the conductor string,

uncoupling the base member from the conductor string,

rotating the drill bit and the casing shoe by supplying pressure fluid to the hydraulic motor via the conductor string and drilling a hole into the formation by simultaneously lowering the conductor string and adding further conductor pipes to the conductor string,

interrupting the drilling operation for coupling a drill string consisting of at least one drill pipe to the top of the conductor string,

resuming the drilling operation by supplying pressure fluid to the hydraulic motor via the drill string and the conductor string and simultaneously lowering the conductor string into the hole by adding further drill pipes to the drill string, interrupting the drilling operation when the hole has reached a sufficient depth,

lifting the hydraulic motor together with the drill bit and suspending it in the conductor string at a higher level,

injecting a solidifiable material through the drill string, the conductor string and the casing shoe and into the borehole part around the conductor string,

uncoupling the drill string from the conductor string and lifting the drill string, and

lifting the hydraulic motor together with the drill bit from the conductor string.

15. Method for use in drilling offshore wells characterized by the following steps:

suspending a drilling apparatus from a drilling ship, said apparatus including a conductor string, a base member carried by said conductor string, a drill string and a self-contained drilling unit carried by said drill string,

lowering the apparatus onto the surface of the formation,

rotating the self-contained drilling unit comprising a hydraulic motor by supplying pressure fluid thereto via the drill string, and drilling a hole into the formation by simultaneously lowering the conductor string and adding further drill pipes to the drill string,

interrupting the drilling operation when the hole has a sufficient depth,

uncoupling the drill string from the conductor string,

lifting the string over a distance, wherein the drilling unit remains in the conductor string,

sealing the passage through the annular space between the drill string and the conductor string,

supplying solidifiable material through the drill string, the hydraulic motor and the conductor string to the annular space around the conductor string, and

lifting the drill string together with the hydraulic motor and the drill bit from the conductor string.

* * * * *