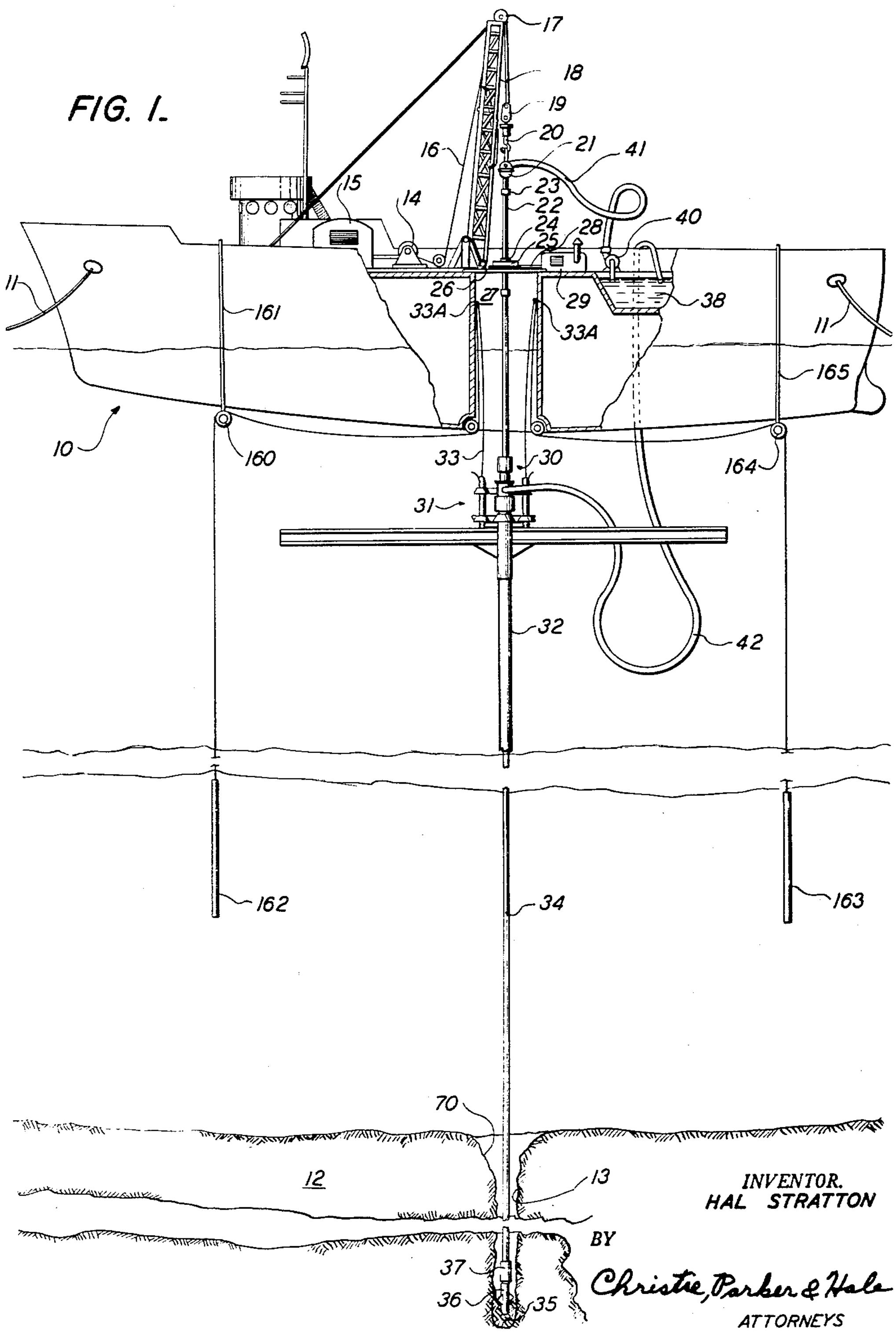
March 22, 1960 H. STRATTON 2,929,610

DRILLING

Filed Dec. 27, 1954 5 Sheets-Sheet 1

FIG. 1.



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March 22, 1960 H. STRATTON 2,929,610

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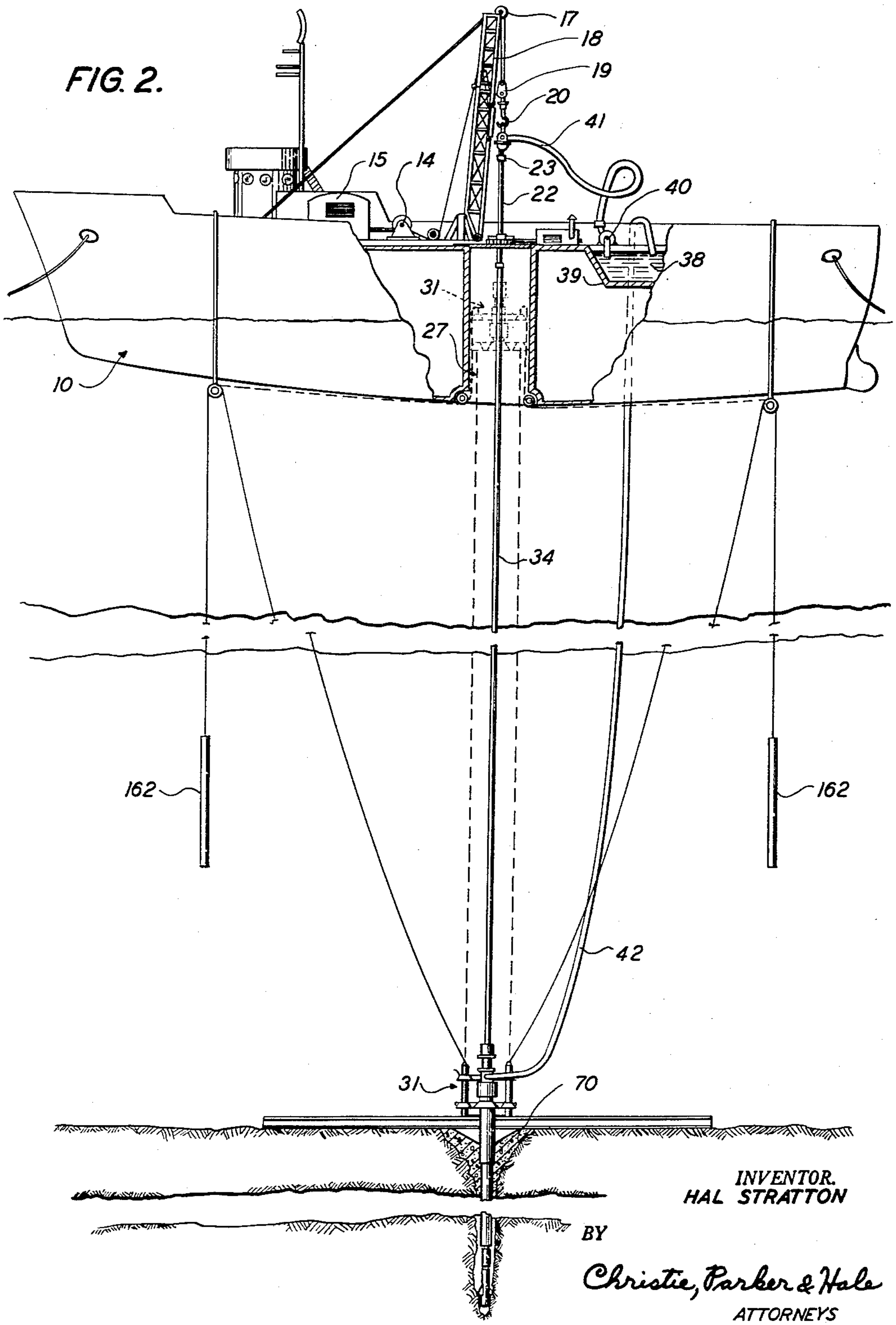
Filed Dec. 27, 1954 5 Sheets-Sheet 2

FIG. 2.



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DRILLING

Filed Dec. 27, 1954 5 Sheets-Sheet 3

FIG. 3.

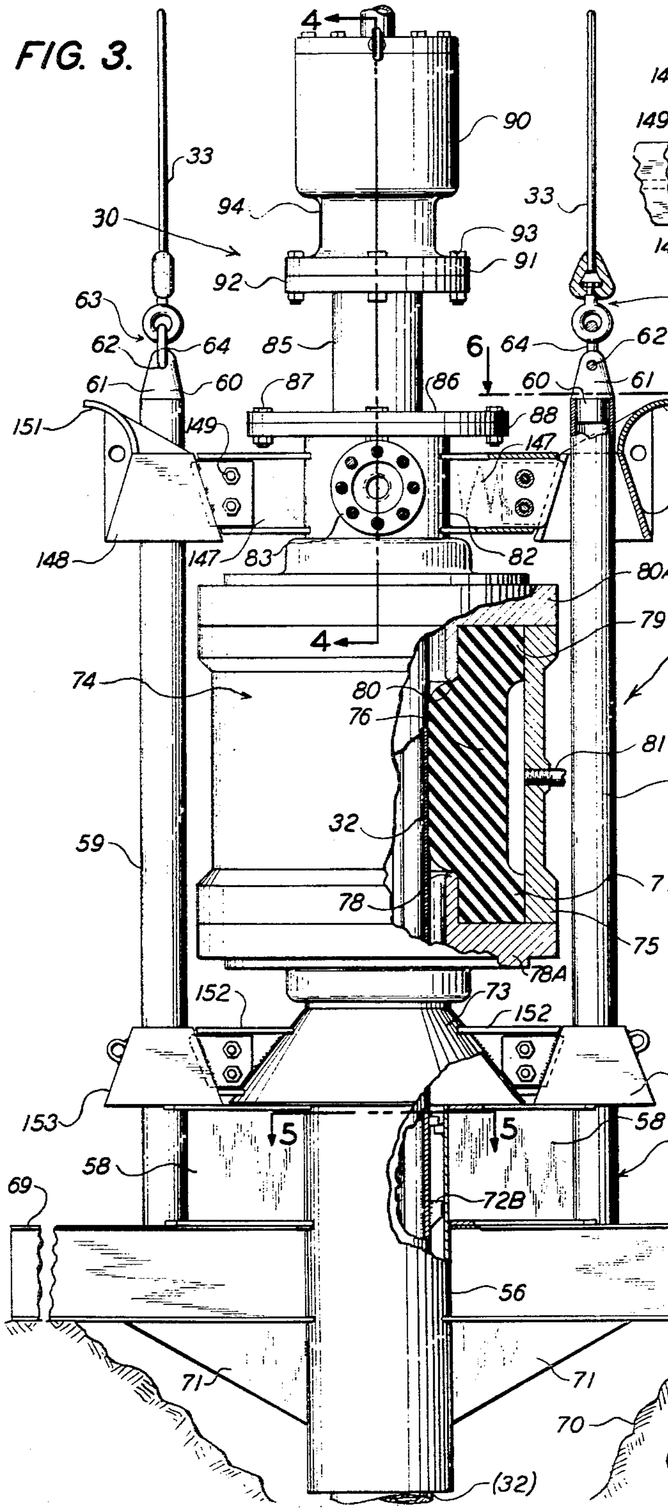


FIG. 6.

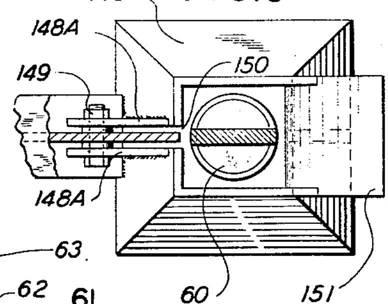
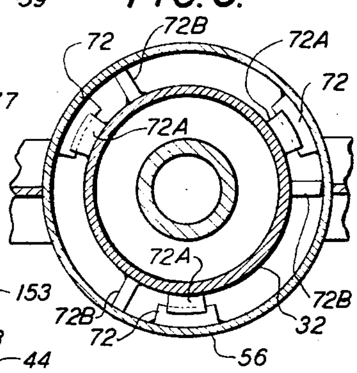


FIG. 5.



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March 22, 1960 H. STRATTON 2,929,610

DRILLING

Filed Dec. 27, 1954 5 Sheets-Sheet 4

FIG. 4.

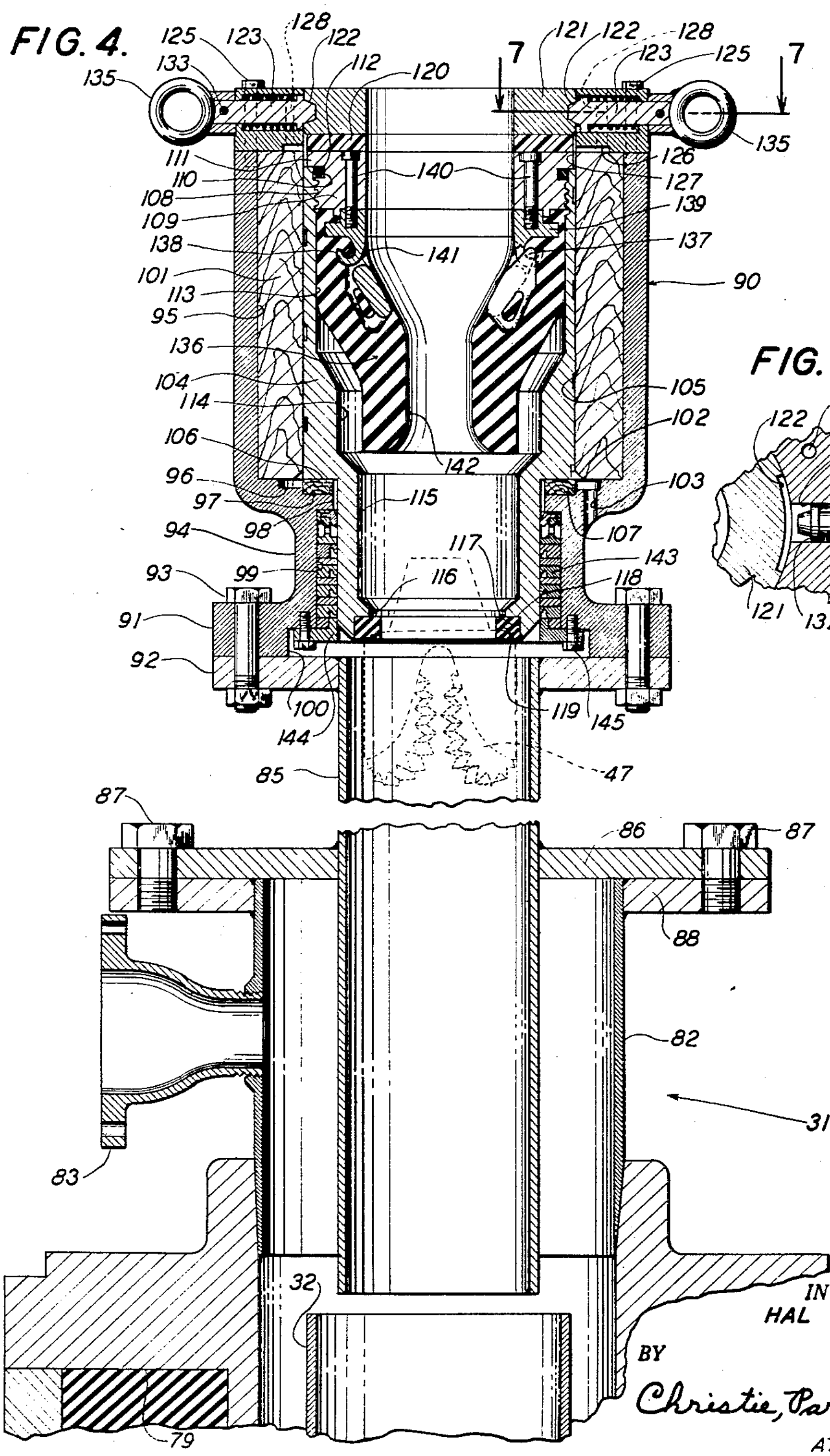
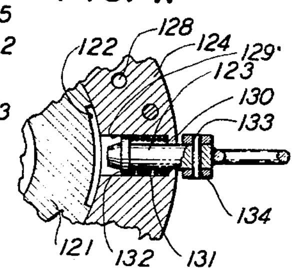


FIG. 7.



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DRILLING

Filed Dec. 27, 1954 5 Sheets-Sheet 5

FIG. 8.

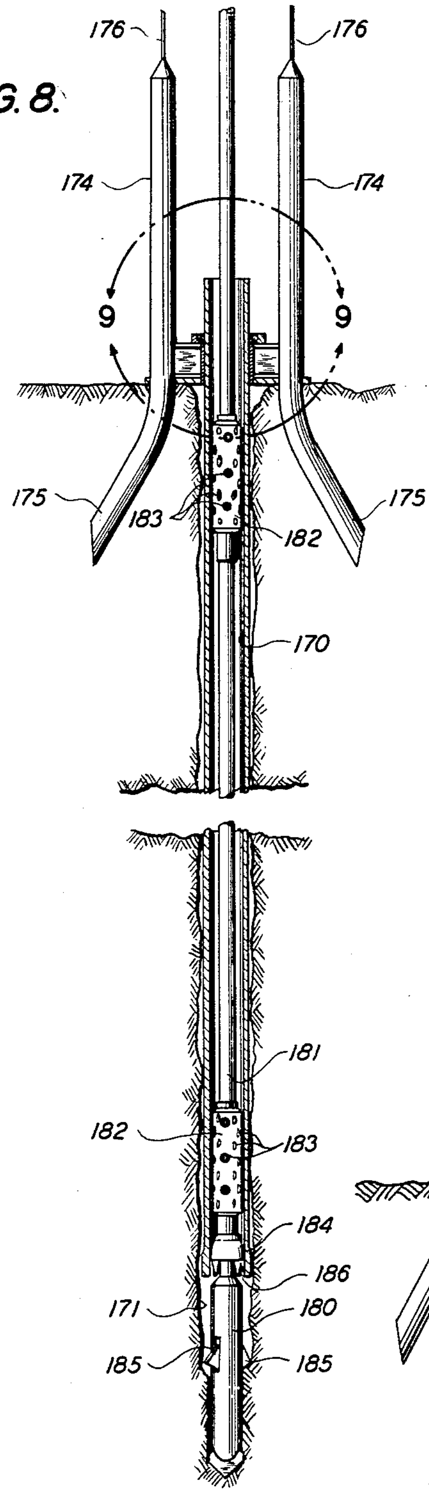


FIG. 9.

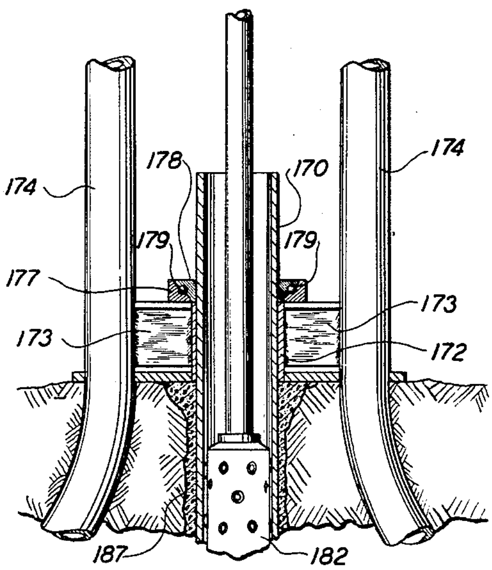
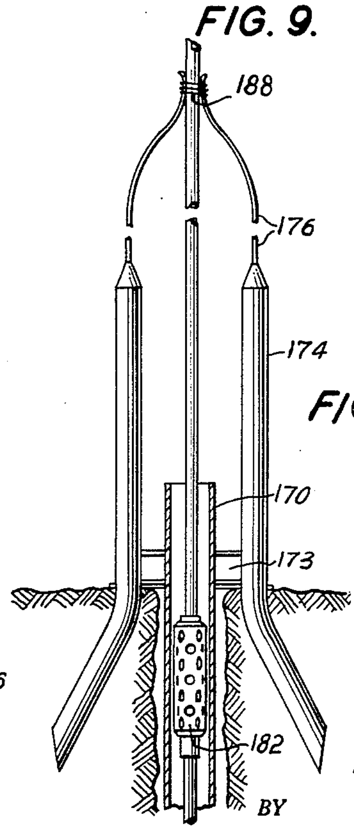


FIG. 10.



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2,929,610
Patented Mar. 22, 1960

2,929,610

DRILLING

Hal Stratton, La Habra, Calif., assignor to Shell Oil Company, Continental Oil Company, both of Los Angeles, Calif., both corporations of Delaware, The Superior Oil Company and Union Oil Company of California, both of Los Angeles, Calif., corporations of California

Application December 27, 1954, Serial No. 477,807

9 Claims. (Cl. 255—1.8)

This invention relates to underwater drilling and more particularly to methods for setting a casing or a well conduit in an underwater well.

At the present time underwater or off-shore well drilling is accomplished from stationary structures rigidly anchored to the underwater formation. These structures provide static bases for drilling equipment and are satisfactory for relatively shallow water, for example, depths of 50′ or less. However, for deeper water, for example, depths of several hundred feet, stationary structures are not always economically practical. Furthermore, the structures are sometimes permanent installations which may become navigation hazards. United States Patent 2,808,229 issued October 1, 1957 on application Serial Number 468,214 filed November 12, 1954, describes in detail apparatus and methods for drilling underwater wells from a floating vessel to overcome the disadvantages of static structures. In that co-pending application there is described a receiver assembly connected to the upper end of a well conduit projecting from an underwater well. The receiver assembly is used to guide drilling equipment from the floating vessel into the well. This invention is concerned with methods and apparatus for positioning the well conduit or pipe and receiver assembly in an underwater well.

One technique for accomplishing this objective is described in co-pending application Serial No. 481,529 filed January 13, 1955, and involves drilling the conduit into the formation by providing cutting means on its lower end and rotating the conduit from the vessel much in the nature of a regular drill string. Many formations, however, are of such nature as to impair operations in this manner and to require more sophisticated drilling techniques for penetration. This invention solves this problem by the method of forming the well, or at least the upper portion of the well, in the formation with a drill pipe and thereafter working the well conduit or pipe down into the well over the drill pipe. The word "formation" is used herein to mean the ground forming and beneath the bottom of a water body.

Preferably, fluid is circulated out the lower end of the well conduit as it is lowered in the well to prevent drill cuttings from being forced up into the well conduit.

In a presently preferred form, the well is drilled with a drill bit and underreamer attached to the lower end of the drill pipe. After the well has been drilled to a depth slightly greater than the total length of well conduit to be positioned, the drill bit and underreamer are raised slightly off the well bottom to avoid sticking of the drill pipe by any material which may slough off the well wall. With the drill pipe, drill bit and underreamer in the well, the well conduit is slipped down over the drill pipe and into the well, the drill pipe serving to guide the well conduit into the well. Thereafter the drill pipe, drill bit and underreamer are withdrawn up through the well conduit to leave the well conduit in the well.

In some situations, for example, where the well wall tends to slough excessively it is desirable to run the well conduit into the well as the well is drilled. This invention also accomplishes this objective by providing method whereby the well conduit is releasably held around the lower portion of the drill pipe as the well is drilled, and is carried into the well as drilling proceeds. Upon drilling the well to the required depth, the well conduit is released and the drill pipe is withdrawn.

In setting pipe in accordance with this invention drilling fluid may be continuously circulated. In conventional procedure drilling fluid circulation is interrupted, i.e. discontinued while the well conduit is lowered. This sometimes allows the drilling mud to lose its proper physical condition and makes resuming subsequent working in the well difficult. Continuous circulation of the drilling fluid, when the well conduit is set in accordance with this invention, avoids this difficulty.

These and other aspects of the invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic elevation, partly broken away, showing the position of the well conduit on the drill pipe after the well has been drilled but before the well conduit has been lowered into the well;

Fig. 2 is a schematic elevation, partly broken away, of the floating vessel and associated drilling equipment of Fig. 1 illustrating the position of the well conduit on the drill pipe after the well conduit has been lowered into the well;

Fig. 3 is an elevation, partly in section, of the upper end of the well conduit set in the well with a receiver assembly and a circulating head mounted thereon in sealed relationship;

Fig. 4 is a view taken on line **4—4** of Fig. 3;

Fig. 5 is a view taken on line **5—5** of Fig. 3;

Fig. 6 is a view taken on line **6—6** of Fig. 3;

Fig. 7 is a view taken on line **7—7** of Fig. 4;

Fig. 8 is a vertical section of an alternate arrangement of a well conduit illustrating an alternate method for positioning the well conduit in a well;

Fig. 9 is an enlarged view taken on line **9—9** of Fig. 8; and

Fig. 10 is a vertical section of a modified form of the apparatus shown in Figs. 8 and 9.

Referring to Fig. 1, a floating vessel **10**, such as a ship, is anchored by means of anchor lines **11**, in a body of water over a formation **12** in which a well **13** is to be drilled. A drawworks **14** and power unit **15** which may be of conventional type, are mounted on the ship to operate a hoisting cable **16** carried over a crown block **17** located at the upper end of a drilling rig **18** erected on the deck of the ship. The traveling end of the hoisting cable carries a traveling block **19** and a hook **20** which supports a swivel joint **21**. A Kelly joint **22** with a conventional Kelly valve **23**, extends downwardly from the swivel through a Kelly bushing **24** in the center of a rotary table **25** mounted on gimbals in a manner such as described in U.S. Patent 2,606,003. The rotary table is supported by a platform **26** directly over a cellar **27** which may be located in the center of a ship as illustrated. Power is supplied to the rotary table through a shaft **28** turned by a rotary table power unit **29**.

A pressure circulating head 30 is releasably sealed to a receiver assembly 31 attached to the upper end of a well conduit 32 hanging vertically beneath the cellar from a pair of guide lines 33 temporarily secured at 33A to the cellar wall. A string of drill pipe 34 is connected to the lower end of the Kelly and extends down through the cellar, circulating head, well conduit, and into the well. A drill bit 35, underreamer 36, and drill collars 37 are attached to the lower end of the drill pipe.

The pressure circulating head forms a seal, as described in detail below, between the rotatable drill pipe and the well conduit so that when the well conduit is sealed in the well as shown in Fig. 2 a drilling fluid or mud 38 may be circulated from a mud tank or pit 39 in the ship by a mud pump 40 through a drilling mud hose 41 to the swivel, down through a central opening (not shown) in the Kelly, drill pipe, and drill collar, out the bit, up the annular space between the drill pipe and the well wall, out the circulating head, and up a flexible drilling mud return hose 42 extending from the circulating head to the mud pit.

The receiver 31 includes an upright sleeve 56 (see Fig. 3) disposed co-axially about the upper portion of the well conduit. The sleeve is rigidly attached to the conduit, for example, by welding. A pair of diametrically opposed and radially extending guide post arms 58 are rigidly attached to the upper end of the sleeve. Conveniently, the guide post arms are "I" beams mounted with the flanges of the beams horizontal. A separate upright cylindrical and hollow guide post 59 is welded in a matching notch formed at the outer end of each guide post arm. Each guide post extends from the bottom of its respective arm to a substantial distance above the arm. A solid plug 60 is welded in the upper end of each guide post so that each plug is flush with the upper end of its respective guide post. A separate upright triangular plate 61 is welded across the upper surfaces of each plug and guide post and is provided with a transverse bore 62. The lower ends of the two guide line cables are separately attached to the upper end of a respective guide post by means of a swivel 63 connected to a shackle 64 which is attached to its respective guide post through the bore.

A pair of opposed elongated support arms 69 are attached to the sleeve 56 under the guide post and extend outwardly a substantial distance from the well. The support arms span a crater 70 which is sometimes formed at the upper end of the well, and prevent the receiver assembly from sinking below the level of the ocean floor prior to the anchoring of the well conduit in its final position. A pair of reinforcing gussets 71 are welded to the support arms of the sleeve for added strength.

Three internal supporting lugs 72 (see Figs. 3 and 5) are welded at 120° intervals within the upper end of the sleeve and provide support for the well conduit by engaging the respective undersides of three matching external guide and landing plates 72A attached to the well conduit at a location spaced from its upper end. The external and internal segments are rigidly attached to each other, e.g., by welding, after the well conduit is suspended in the position shown in Fig. 1. Three external aligning lugs 72B are welded at 120° intervals to the upper end of the well conduit below, and angularly displaced from the guide and landing plates (see Fig. 5).

The circulating head 30 comprises a frusto-conical shell 73 (see Fig. 3) with its upper end connected to a well conduit seal housing 74, having an upright cylindrical wall 75. The lower end of an annular flexible well conduit seal 76 is friction fitted into an upwardly opening annular channel 77 formed in the lower end of the well conduit seal housing between an upwardly extending ring 78 on an annular bottom closure 78A for the housing and the housing wall. The upper end of the well conduit seal is friction fitted into a downwardly opening annular channel 79 formed in the upper end of the well conduit seal housing between a downwardly extending ring 80 on an annular upper closure 80A for the housing and the housing wall. A sealing nipple 81 is threadably engaged in the wall of the well conduit seal housing so that hydraulic pressure may be applied by means of a hydraulic line (not shown) to the well conduit seal and force it to form a fluid-tight seal with the well conduit. This also provides positive gripping means by which the circulating head is held down on the well conduit during drilling operations. The lower end of a drilling mud conduit 82 is sealed into the upper end of the well conduit seal housing. One end of a drilling mud return nipple 83 is threaded through the drilling mud conduit wall. The other end of the nipple is connected to the flexible drilling mud return line 42 (see Fig. 1) which extends to the mud pit 39 in the vessel.

An aligning conduit 85 is co-axially disposed within the mud conduit so that its lower end terminates just above the upper end of the well conduit when the circulating head is in the sealed position illustrated in Fig. 3. An outwardly extending flange 86 attached to the intermediate portion of the aligning conduit is secured by means of bolts 87 to a matching outwardly extending flange 88 provided on the upper end of the mud conduit. The inside diameter of the aligning conduit is smaller than the inside diameter of the well conduit and therefore serves to guide the drill bit into the well conduit and avoid "catching" of the bit on the upper end of the well conduit as the bit is lowered into drilling position.

A drill pipe seal housing or body 90 having an outwardly turned flange 91 at its lower end is secured to an outwardly turned flange 92 at the upper end of the aligning conduit by means of bolts 93. The external diameter of the body is less than that of the well conduit seal housing and the body external diameter is reduced at 94 just above the body flange. The body is provided with a relatively large first internal bore 95 which extends from the upper end of the body down near the portion of the housing which is of reduced external diameter. The bore is then stepped down to a smaller second bore 96 for a short distance, then is stepped down to a third bore 97 for a short distance, then is stepped down to a fourth bore 98 for a short distance, then stepped up to a fifth bore 99 slightly less than that of the third bore to extend to a point near the lower end of the body, and is then stepped up to a larger sixth bore 100 which extends to the lower end of the body.

A sleeve bearing 101, which may be lignum vitae, for example, is disposed within the large bore at the upper end of the body, the lower end of the bearing resting on the shoulder formed at the end of the first bore and its upper end being flush with the upper end of the body. The inner diameter of the sleeve bearing is less than that of the second bore. The inner edge of the lower end of the annular sleeve bearing is beveled at 102 to permit water to flow up through a lubricating inlet port 103 provided in the horizontal section of the body wall above the reduced external diameter of the body. A metal insert 104 having an external diameter at its upper end slightly less than the internal diameter of the sleeve bearing is rotatably disposed within the sleeve bearing so that the upper end of the insert is below that of the bearing. An external spiral groove 105 in the insert wall permits water to be circulated by convection and friction up from the lubricating inlet port to keep the insert cool and lubricated during rotation.

The external diameter of the insert 104 is stepped down to a reduced diameter at the same location where the first bore of the body is stepped down to a reduced diameter to form an external shoulder 106 on the insert which rests on a thrust ring bearing 107 carried in the shoulder formed between the third and the fourth bores of the body. The upper end of the insert is internally threaded at 108 to receive a threaded bushing 109 which has an annular external groove 110 near its upper end and an outwardly turned flange 111 which rests on the upper edge of the insert. An O ring 112 in the annular groove effects a fluid tight seal between the bushing and the insert.

The insert 104 is provided with a relatively large internal first bore 113 at its upper end which tapers to a reduced second bore 114 near its intermediate portion, then tapers again to a reduced third bore 115 in its lower portion, tapers again to a reduced fourth bore 116 and then steps out to an increased fifth bore 117 to provide a lifting shoulder 118 on which there is disposed a cushion ring 119 which may be made of heavy rubber. An upper thrust ring bearing 120, which may be made of Micarta (a phenolic plastic), is disposed on the upper end of the bushing and supports a retaining ring 121 provided with a pair of diametrically opposed slots 122 in its periphery, each slot being adapted to receive a longitudinally movable locking pin 123. A fastening ring 124 is disposed on top of the upper end of the sleeve bearing and the body wall and is rigidly attached to the body wall by means of bolts 125. The inner periphery of the underside of the fastening ring is provided with a groove 126 which communicates with an annular space 127 formed between the upper thrust ring bearing, the upper end of the bushing, the fastening ring and the sleeve bearing. A plurality of vertical lubricating outlet ports 128 in the fastening ring connect with the groove 126 and permit the lubricating water to flow from the interior of the body.

A pair of horizontal bores 129 through the fastening ring house the locking pins. The bores are of reduced diameter at their outer ends to form a shoulder 130. A compression spring 131 is coaxially disposed around each locking pin and bears against a flange 132 attached to the inner end of each locking pin and bears against the shoulder of the locking pin bores. The outer ends of the locking pins extend out beyond the fastening ring and are each provided with a transverse pin 133 which holds a stop collar 134 around the outer end of each locking pin. A ring handle 135 is welded to the outer end of each stop collar to facilitate its operation.

An annular flexible drill pipe seal 136 is coaxially disposed within the insert and is supported at its upper end by a plurality of metal "eyes" 137 molded into the seal and held by corresponding hooks 138 formed integrally on a seal ring 139 secured to the underside of the bushing by means of bolts 140. The drill pipe seal has a relatively large first bore 141 at its upper end and tapers to a reduced second bore 142 at its lower end, and is sufficiently flexible to be expandable to a large enough diameter to permit the passage of drill pipe and drill collars. However, under ordinary drilling operations, the seal clamps tightly around the drill pipe or drill pipe joints so as to rotate with the pipe and effect a fluid-tight seal.

An insert seal 143 is disposed in the annular space formed between the lower end of the insert 104 and the fifth internal bore 99 of the body. The insert seal is held up in position by means of an insert seal retaining ring 144 secured by means of bolts 145 to the shoulder formed between the fifth and sixth internal bores of the body.

Referring to Fig. 3, an upper pair of diametrically opposed and radially extending guide brackets 147 (preferably short sections of relatively small "I" beams) are welded to the external surface of the drilling mud conduit on the circulating head. A separate sleeve 148 in the form of an upright, hollow, truncated, four-sided pyramid is attached to the outer end of each guide bracket by means of a pair of vertical, spaced plates 148A which are welded at one end to the sleeve and arranged at the other end to fit on each side of the guide bracket. The plates are attached to the guide bracket by means of bolts 149. A slot 150 (see Fig. 6) is provided in the sleeve wall between the two plates and a respective guide line 33 is slipped into each sleeve 148 before the sleeve is bolted to the guide bracket 147.

A separate, outwardly extending plate 151, curved concave downwardly, is attached to the upper and outer edge of each guide sleeve to reduce the wear on the guide lines as the circulating head is raised and lowered.

A similar pair of lower guide brackets 152 are attached to the external surface of the aligning funnel 73 at the lower portion of the circulating head. A separate guide sleeve 153 is attached to the outer end of each lower guide bracket, the principal difference from the upper sleeves 148 being that the curved plate is omitted. The guide sleeves are adapted to slip on and off the guide post and accurately align the circulating head on the receiver assembly.

The well conduit 32 is positioned in the well by the method illustrated in Fig. 1 through Fig. 7 as follows: Prior to the lowering of the drill string or pipe 34, the well conduit and the supporting receiver assembly 31 are hoisted over the side of the ship by a conventional ring (not shown). The external guide and landing plates 72A on the well conduit are welded to the internal guide lugs 72 in the receiver assembly sleeve 56. The well conduit and receiver assembly are then lowered in the water beneath the keel of the ship and maneuvered into an upright position to be supported by the guide cables 33 directly under the cellar. The rotatable insert 104 in the drill pipe seal housing 90 is removed and the drill bit 35, underreamer 36, drill collars 37, and drill pipe 34 are coupled together and lowered through the circulating head 30, receiver assembly 31 and well conduit 32 until the bit nears the ocean bottom. The rotatable insert 104 is then slipped on over the upper end of the drill pipe and locked into the drill pipe seal housing 90 by the locking pins 123. The Kelly joint 22 is then coupled to the upper end of the drill pipe and the drill bit is rotated by power supplied to the rotary table 25. Drilling fluid or sea water is pumped down the drill string to wash cuttings out of the well as drilling proceeds. The well is drilled to a depth equal to the length of the well conduit plus an additional amount to allow for sloughing of formation from the wall of the well. After the required depth is reached, rotation of the drill pipe is stopped and the drill pipe is raised slightly off the bottom of the well as shown in Fig. 1. Hydraulic pressure is applied to the well conduit seal 76 so that the circulating head is sealed to the well conduit 32. The guide lines 33 are then lowered to allow the well conduit to slide down over the drill pipe and into the well, as shown in Fig. 2. With the Kelly valve 23 closed, drilling fluid or sea water is pumped into the drilling mud return line (which is temporarily connected to the pump discharge) and out the lower end of the well conduit 32 as it is lowered to prevent drill cuttings from being forced up into the well conduit and possibly sticking the drill pipe 33 to the well conduit 32. The weight of the well conduit and circulating head is sufficient to overcome the friction between the drill pipe and the drill pipe seal 136. The well conduit may then either be cemented or held in the position shown in Fig. 2 until the formation has had sufficient time to settle around the well conduit and anchor it firmly in place.

Pressure is then released from the well conduit seal housing 76 and the drill pipe, underreamer and drill bit are raised. The drill bit engages the internal cushion ring 119 in the drill pipe seal housing 90 and raises the circulating head 30 to the dotted line position shown in Fig. 2. One of the guide lines extends forward under the keel of the vessel, over a supporting pulley 160 carried by a forward bridle 161 slung under the forward part of the vessel. A weight 162 is attached to the free end of the guide line and hangs in the water to maintain a constant tension on the guide line. A similar weight 163 is hung on the free end of the other cable which extends rearwardly under the keel of the vessel and is run through a supporting pulley 164 carried by a rear bridle 165 slung under the rear portion of the vessel.

The position of the guide lines with the drilling head raised to the surface is also shown in dotted lines in Fig. 2.

The drill bit and underreamer combination may then be replaced by a conventional drill bit and drilling may then be carried on to the required depth as described in co-pending application Serial Number 468,214, filed November 12, 1954.

If desired, during the drilling of the well prior to setting the well conduit 32, a sealing unit similar to that of the well conduit seal 76 can be used to replace the drill pipe seal 136 or be mounted on the upper end of the drill pipe seal to provide means for gripping the drill pipe 34 with adjustable pressure. This type of arrangement has the advantage of rigidly holding and aligning the circulating head 30, receiver assembly 31 and well conduit 32 around the drill pipe as the well conduit is lowered into the well.

Figs. 8 and 9 illustrate an alternate method for positioning a well conduit 170 in an underwater well 171. The upper portion of the well conduit is rotatably disposed through a sleeve 172 and the upper end of the well conduit extends above the sleeve. A pair of opposed and outwardly extending guide post arms 173 are attached to the sleeve. A separate, upright guide post 174 is attached to the outer end of each guide post arm. The lower end of each guide post projects downwardly and outwardly past its respective guide arm to form an anchoring spike 175. A separate, upwardly extending guide line 176 is attached to the upper end of each guide post. An annular lower bearing race 177 is attached to the upper surface of the guide post arms and is disposed coaxially around the well conduit. An annular upper bearing race 178 is attached around an upper portion of the well conduit and rides on a plurality of ball bearings 179 carried by the lower race. Thus the well conduit is rotatable with respect to the sleeve, guide post arms, guide posts and guide lines.

A combination drill bit and underreamer 180 projecting below the lower end of the well conduit is attached to the lower end of a drill pipe 181 which extends to the surface of the water to be powered by the drilling rig on the floating vessel as described for the arrangement in Figs. 1 through 6. A plurality of conventional hold-down anchors 182, e.g. of the Guiberson type, are provided in the portion of the drill pipe within the well conduit. An anchor of this type is illustrated in the Composite Catalog of Oil Field and Pipe Line Equipment, twentieth edition, 1954–55, page 1940. A plurality of laterally displaceable plugs 183 in each hold-down anchor are actuated by the hydraulic pressure of the drilling fluid within the drill pipe and are forced out against the interior of the well conduit to the drill pipe. An inverted swab cup 184 is provided around the drill pipe near the lower end of the well conduit to seal the annular space between the drill pipe and the well conduit. Thus the fluid pumped out of the drill bit is forced to return up the annular space between the well conduit and the well wall to avoid the possibility of drill cuttings being carried into the well conduit interior and sticking the drill pipe within the well conduit.

The well is drilled and the well conduit 170 positioned within the well simultaneously as follows: The drill pipe 181 is rotated by the drilling rig causing the drill bit and underreamer 180 to drill a well. The hold-down anchors 181 cause the well conduit to rotate and move down with the drill pipe. During the rotation of the drill pipe, the guide lines 176 extend upwardly and outwardly and are held in a spread position to avoid fouling with the drill pipe as it is rotated. This aids the anchoring spikes 175 to prevent rotation of the guide post arms as the well is drilled. After the required well depth is reached, the hydraulic pressure within the drill pipe is released, thus releasing the hold-down anchors 182 from the well conduit. The retractable blades 185 on the underreamer also move in when the hydraulic pressure is released.

Underreamers of this type are well known in the drilling industry, as for example Baker model "D" rotary hydraulic expansion wall scraper described in the Composite Catalog of Oil Field and Pipe Line Equipment, twentieth edition, 1954–55, pages 523–527. The well conduit 170 may be cemented in place or the formation may be allowed to settle around the well conduit.

As shown in Fig. 10, the apparatus of Figs. 8 and 9 may be modified so the well conduit is rigidly connected to the sleeve guide post arms 173 and guide posts 174, the rotational feature being omitted, and the well conduit set in a manner similar to that described in Figs. 8 and 9. Even with the anchors 175 in the ground and the well conduit rigidly connected to the guide post arms, the assembly will rotate because the first few feet of ocean bottom is generally relatively soft. The casing is carried downwardly with the drill pipe until the anchors are in the ground firm enough to prevent further rotation, thus establishing a firm footing for the upper end of the well conduit. With such an arrangement the guide lines 176 are temporarily secured to the dirll pipe (or to the well conduit initially if the length of the conduit exceeds the water depth) above the water level and are allowed to rotate with the drill pipe. The guide lines may be secured to the well conduit or drill pipe in several ways, the simplest being merely to tie the lines to the conduit or drill pipe with a rope 188. As the well is drilled and the conduit 170 and drill pipe 181 move down, the guide lines 176 are intermittently disconnected and re-secured at a higher point to rotate with the drill pipe. Thus, the guide lines rotate with the drill pipe and well conduit, and do not become tangled, as would happen if their upper ends were held in a fixed location on the floating vessel. The underreamer may also be omitted, the lower end of the well conduit being serrated as shown at 186 (Fig. 8) so that it aids the drill bit in cutting a well of diameter large enough to accommodate the well conduit. After the well is drilled to the proper depth, the well conduit may be anchored in place with cement 187, or the formation may be allowed to settle around the well conduit. The guide lines are released from the drill pipe and secured to supporting pulleys as described for Fig. 2. The hold-down anchors 182 are released and the drill pipe withdrawn from the well conduit 170.

I claim:

1. The method of setting pipe in a formation underlying a body of water comprising locating a floating vessel over the formation, anchoring the vessel with elongated and laterally flexible anchoring means in tension to permit limited horizontal and vertical movement of the vessel by the elements while anchored, supporting a drill string from the vessel extending through the water to the formation and carrying drilling means for forming a hole of larger diameter than the pipe, lowering the drill string from the vessel into contact with the formation, forming in the formation with the drilling means a hole larger in diameter than the pipe, pumping fluid down through the drill string to cause fluid to flow up the annulus between the drill string and the wall of the hole, suspending the pipe in tension around the drill string, lowering the pipe in tension around the drill string while maintaining the drill string in the hole, guiding the lower portion of the pipe into the hole with the drill string, further lowering the pipe into the hole while maintaining the hole substantially full of fluid to provide lubrication between the pipe and the wall of the hole while the pipe is being lowered, and limiting the downward movement of the pipe in the hole and affixing at least a portion of the outer wall of the pipe to the formation while maintaining a flexible connection between the floating vessel and the pipe in the hole to permit lateral displacement of the vessel with the pipe in the hole.

2. The method according to claim 1 in which the fluid maintained in the hole while lowering the pipe is drilling mud.

3. The method according to claim 1 which includes leaving the drill string in the hole while the pipe is further lowered, and pumping fluid down the drill string to maintain a flow of fluid up the annulus between the drill string and the wall of the hole while the pipe is lowered.

4. The method of setting pipe in a formation underlying a body of water comprising locating a floating vessel over the formation, anchoring the vessel with elongated and laterally flexible anchoring means in tension to permit limited horizontal and vertical movement of the vessel by the elements while anchored, supporting a drill string from the vessel extending through the water to the formation and carrying drilling means for forming a hole of larger diameter than the pipe, lowering the drill string from the vessel into contact with the formation, forming in the formation with the drilling means a hole larger in diameter than the pipe, pumping fluid down through the drill string to cause fluid to flow up the annulus between the drill string and the wall of the hole, suspending the pipe in tension around the drill string, lowering the pipe in tension around the drill string while maintaining the drill string in the hole, guiding the lower portion of the pipe into the hole with the drill string, further lowering the pipe into the hole while maintaining the hole substantially full of fluid to provide lubrication between the pipe and the wall of the hole while the pipe is being lowered, limiting the downward movement of the pipe in the hole and affixing at least a portion of the outer wall of the pipe to the formation while maintaining a flexible connection between the floating vessel and the pipe in the hole to permit lateral displacement of the vessel with the pipe in the hole, thereafter advancing the drill string through the pipe, and drilling additional hole with the drill string below the lower end of the pipe.

5. The method according to claim 4 in which the pipe is anchored in the hole by pumping a fluidized cement into the annulus between the pipe and the wall of the hole.

6. The method of setting pipe in a formation underlying a body of water comprising locating a floating vessel over the formation, anchoring the vessel with elongated and laterally flexible anchoring means in tension to permit limited horizontal and vertical movement of the vessel by the elements while anchored, suspending the pipe in tension beneath the vessel, supporting a drill string from the vessel extending through the water to the formation and carrying drilling means for forming a hole of larger diameter than the pipe, lowering the drill string from the vessel through the suspended pipe into contact with the formation, forming in the formation with the drilling means a hole larger in diameter than the pipe, pumping fluid down through the drill string to cause fluid to flow up the annulus between the drill string and the wall of the hole, lowering the pipe in tension around the drill string while maintaining the drill string in the hole, guiding the lower portion of the pipe into the hole with the drill string, further lowering the pipe into the hole while maintaining the hole substantially full of fluid to provide lubrication between the pipe and the wall of the hole while the pipe is being lowered, and limiting the downward movement of the pipe in the hole and affixing at least a portion of the outer wall of the pipe to the formation while maintaining a flexible connection between the floating vessel and the pipe in the hole to permit lateral displacement of the vessel with the pipe in the hole.

7. The method of setting pipe in a formation underlying a body of water comprising locating a floating vessel over the formation, anchoring the vessel with elongated and laterally flexible anchoring means in tension to permit limited horizontal and vertical movement of the vessel by the elements while anchored, suspending the pipe in tension beneath the vessel with a flexible line, lowering a drill string from the vessel through the pipe to contact the formation, the drill string carrying drilling means for forming a hole of larger diameter than the pipe, forming in the formation with the drilling means a hole larger in diameter than the pipe, pumping fluid down through the drill string to cause fluid to flow up the annulus between the drill string and the wall of the hole, lowering the pipe in tension around the drill string by paying out the flexible line while maintaining the drill string in the hole, guiding the lower portion of the pipe into the hole with the drill string, further lowering the pipe into the hole while maintaining the hole substantially full of fluid to provide lubrication between the pipe and the wall of the hole while the pipe is being lowered, and limiting the downward movement of the pipe in the hole and affixing at least a portion of the outer wall of the pipe to the formation, while maintaining the flexible line between the floating vessel and the pipe in the hole to permit lateral displacement of the vessel with the pipe in the hole.

8. The method of setting pipe in a formation underlying a body of water comprising locating a floating vessel over the formation, anchoring the vessel with elongated and laterally flexible anchoring means in tension to permit limited horizontal and vertical movement of the vessel by the elements while anchored, suspending the pipe in tension from and beneath the vessel, lowering a drill string from the vessel through the pipe to contact the formation, the drill string carrying drilling means for forming a hole of larger diameter than the pipe, forming in the formation with the drilling means a hole larger in diameter than the pipe, pumping fluid down through the drill string to cause fluid to flow up the annulus between the drill string and the wall of the hole, suspending the pipe in tension around the drill string, lowering the pipe in tension around the drill string while maintaining the drill string in the hole, guiding the lower portion of the pipe into the hole with the drill string, further lowering the pipe into the hole while maintaining the hole substantially full of fluid to provide lubrication between the pipe and the wall of the hole while the pipe is being lowered, and limiting the downward movement of the pipe in the hole and affixing at least a portion of the outer wall of the pipe to the formation while maintaining a flexible connection between the floating vessel and the pipe in the hole to permit lateral displacement of the vessel with the pipe in the hole, said affixing of at least a portion of the outer wall of the pipe to the formation being accomplished by placing the lower end of the drill string adjacent the lower end of the pipe and pumping cement through the drill string to flow upwardly in the annulus between the pipe and the wall of the hole and allowing the cement to set.

9. The method of setting pipe in a formation underlying a body of water comprising locating a floating vessel over the formation, anchoring the vessel with elongated and laterally flexible anchoring means in tension to permit limited horizontal and vertical movement of the vessel by the elements while anchored, supporting a drill string from the vessel extending through the water to the formation and carrying drilling means for forming a hole of larger diameter than the pipe, lowering the drill string from the vessel into contact with the formation, forming in the formation with the drilling means a hole larger in diameter than the pipe, pumping fluid down through the drill string to cause fluid to flow up the annulus between the drill string and the wall of the hole, suspending the pipe in tension around the drill string with the lower end of the pipe spaced above the formation, lowering the pipe in tension around the drill string while maintaining the drill string in the hole, guiding the lower portion of the pipe into the hole with the drill string, further lowering the pipe into the hole while maintaining the hole substantially full of fluid to provide lubrication between the pipe and the wall of the hole while the pipe is being lowered, and limiting the down-

ward movement of the pipe in the hole and affixing at least a portion of the outer wall of the pipe to the formation while maintaining a flexible connection between the floating vessel and the pipe in the hole to permit lateral displacement of the vessel with the pipe in the hole.

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