March 1, 1966 W. D. LEAKE 3,237,694

SUBMARINE DRILLING METHOD AND APPARATUS

Filed April 4, 1960

2 Sheets-Sheet 1

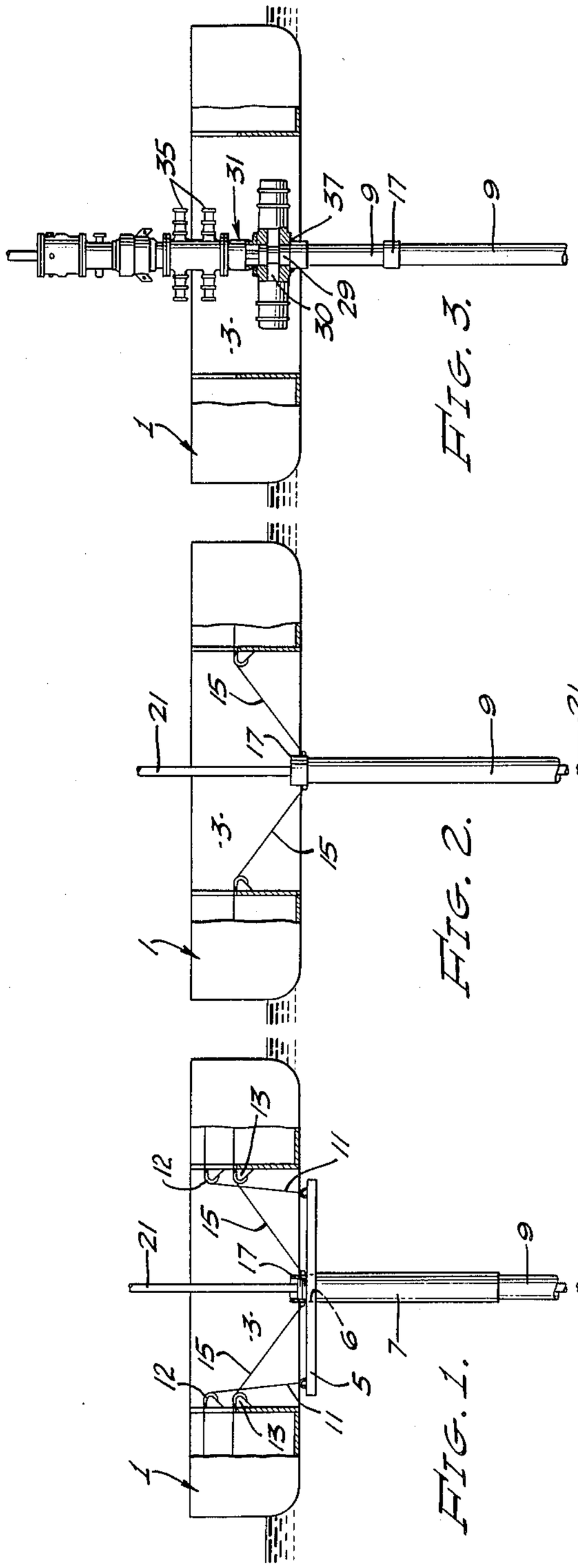


FIG. 1.

FIG. 2.

FIG. 3.

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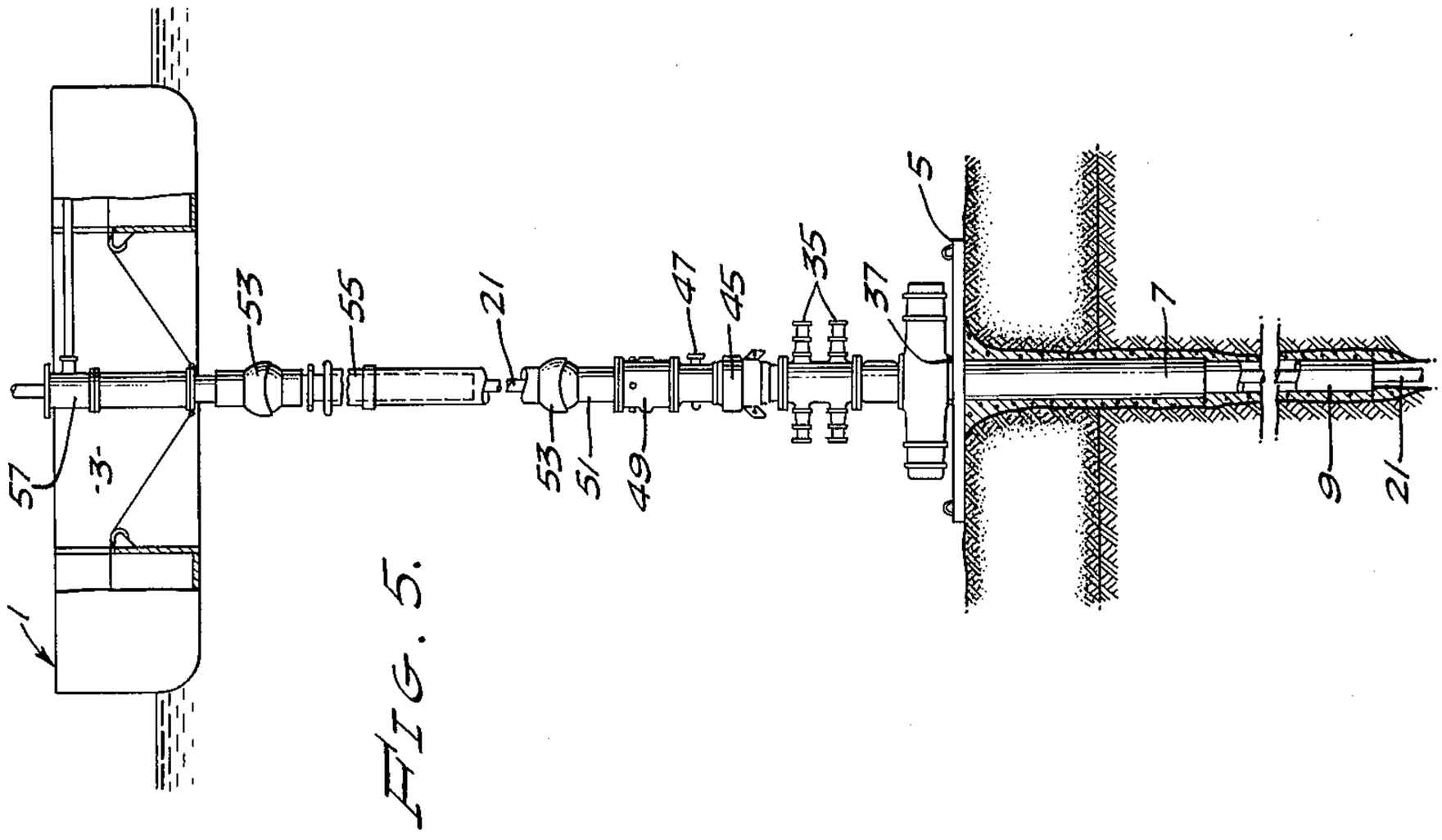


FIG. 5.

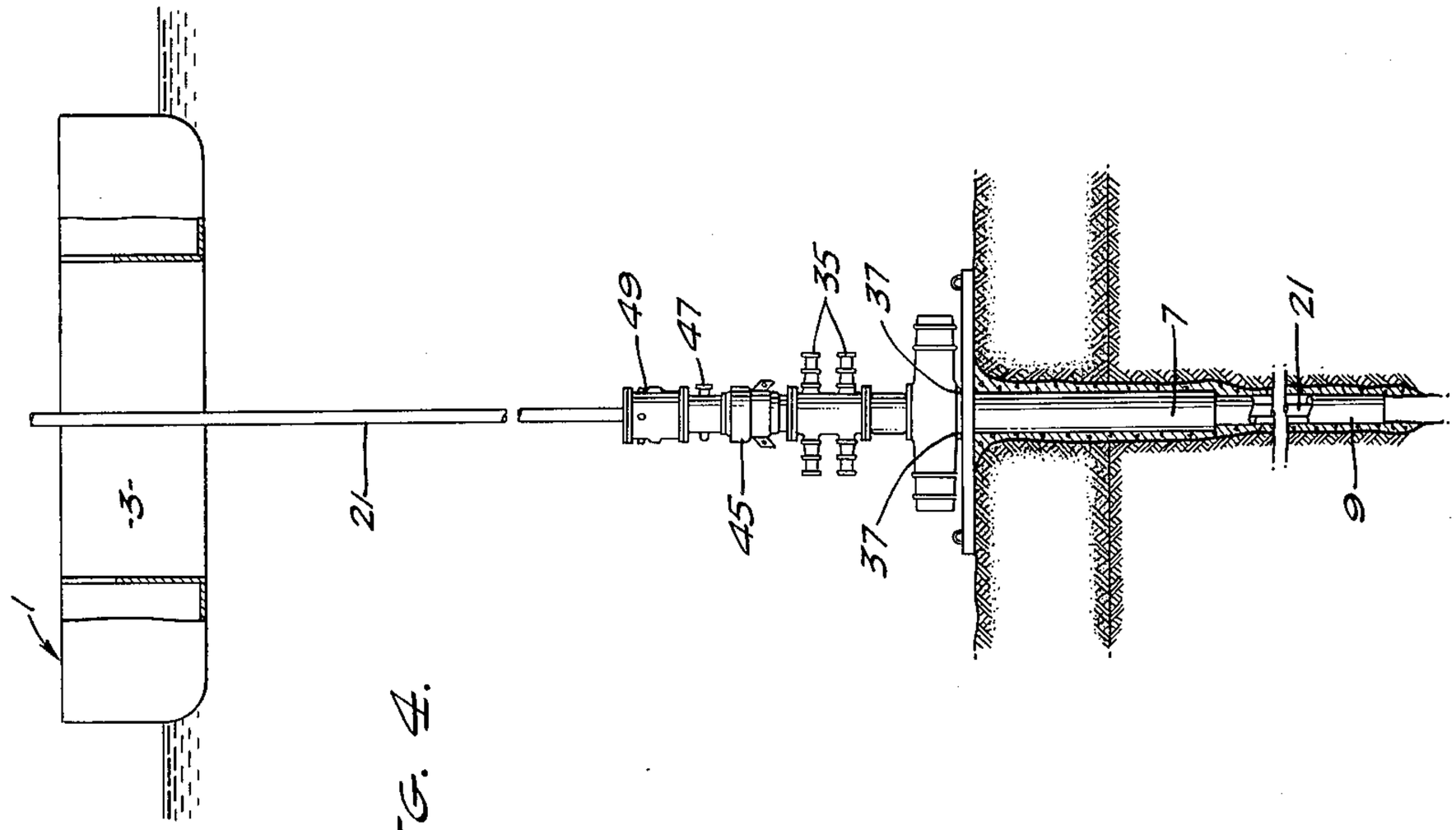


FIG. 4.

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SUBMARINE DRILLING METHOD AND APPARATUS

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1 Claim. (Cl. 166—46)

The present invention relates to a submarine drilling technique and more particularly relates to a method and apparatus for drilling and positively guiding drilling equipment from a floating vessel into a well bore in a formation underlying a body of water.

Drilling into a formation underlying a body of water such as the ocean from a drilling barge presents many difficulties due to movement of the floating drilling barge relative to the ocean floor. In the past, time lost in attempting to re-enter a well bore drilled into the ocean floor or well head equipment mounted thereon has been a substantial factor in offshore drilling costs. Damage to well head equipment and submarine control hoses by drill bits and other drilling equipment has also been excessive and costly.

Recent proposals to re-enter the well head from a floating barge have been to provide cable guide lines extending from the floating barge to a base plate anchored at the ocean floor. These cable guide lines are subject to lateral displacement due to ocean currents, movement of the vessel, and flexibility in the cable guide lines. To minimize this lateral displacement, the lines are tensioned at the vessel by various means such as pulley supported counterweights. However, when heavy equipment such as blowout prevention equipment is lowered to the well using these guide lines, the rigidity of the lines, notwithstanding the tensioning, is not sufficient to consistently register the equipment with the well bore.

Therefore, it is an object of the present invention to provide apparatus and a method for drilling a well bore in a formation underlying a body of water and for positively guiding drilling equipment to the well bore.

It is also an object of my present invention to provide a method and apparatus for drilling a well bore in the ocean floor and positively guiding drilling equipment to the well without employing guide lines.

It is a further object of my invention to provide a method for drilling a well bore in the ocean floor and positively guiding drilling equipment to the well, utilizing primarily conventional drilling equipment.

Other objects and a more complete understandng of my invention may be had by reference to the following specification and the appended claim taken in conjunction with the drawings, in which:

FIGURE 1 shows the manner in which the initial hole is drilled preparatory to landing the conductor pipe and landing base;

FIGURE 2 shows the landing base and conductor pipe in place at the well bore with the surface casing suspending from the drilling vessel into the well;

FIGURE 3 shows the blowout prevention equipment in position for lowering to the well;

FIGURE 4 shows the blowout prevention equipment landed at the well site;

FIGURE 5 shows a casing riser attached to the top of the blowout prevention equipment.

Briefly described, my invention relates to a method for drilling into the ocean floor from a floating drilling barge whereby positive contact with the hole is maintained during the initial drilling operations by suspending the conductor pipe and surface casing independently from the vessel while lowering the drill string through the suspended surface casing to drill an initial hole for the conductor pipe, and subsequently lowering the suspended conductor pipe into the hole pre-attached to a landing base. The drill string is again operated through the suspended surface casing to deepen the hole for the surface casing and the surface casing with blowout prevention equipment hydraulically latched thereto, is lowered into the hole over the drill pipe after the lower end of the surface casing is stabbed into the conductor pipe and made up to the required length. With the blowout prevention equipment in place at the well head, a casing riser is stripped over the drill pipe and latched to the top of the blowout preventer.

With reference to FIGURE 1 a floating drill barge **1** is equipped with offshore drilling equipment as described in my copending application S.N. 19,722, filed April 4, 1960. The ship's well **3** in the drilling barge **1** provides access to the ocean bottom through the hull of the ship. A landing base **5** is affixed to a conductor pipe **7** which exceeds the depth of the over-burden **10** in the submarine formation **8**. Landing base **5** has an aperture **6** through which the upper end of the conductor pipe extends. The conductor pipe is joined to the landing base by any suitable means, such as, welding or providing an enlarged portion or stop at the upper end of the pipe. The landing base **5** is suspended from cables **11** which are hung over pulleys **12** mounted on the drilling barge. Cables **11** may be lowered on pulleys **12** to lower the landing base **5** to the ocean floor. A surface casing **9** is independently supported on cables **15** with pulleys **13** by means of a collar **17** which is attached to the upper end of the surface casing. Surface casing **9** is stabbed through the landing base aperture **6** and conductor pipe **7** as the casing is made up section by section and lowered over the drill string **21** into the well bore **19**.

Drill string **21**, equipped with a conventional drill collar **23**, a rock drill bit **25**, and a two-stage rotary hole opener **27** is lowered through the surface casing **9** and hole **19** drilled sufficiently deep to land the conductor pipe **7**. After the initial hole is drilled with the drill string extending through the suspended surface casing, as shown in FIGURE 1, the landing base **5** with the conductor pipe **7** affixed thereto is lowered on cables **11** to the ocean floor while the drill string is still in the hole so that the drill string **21** positively guides the conductor pipe into the well bore until the landing base **5** is seated on the ocean floor as shown in FIGURE 2.

The setting of the hole opener **27** is then changed to the smaller opening with an appropriate sand line (not shown) and the drill string operated to deepen the hole sufficiently to receive the surface casing **9**. The surface casing **9** is then lowered over the drill string until the casing is stabbed into the conductor pipe. The drill string **21** is then withdrawn from the hole and the remainder of the surface casing made up at the ship's well. A landing mandrel **29** having the same internal diameter as the surface casing and adapted to engage rams **30** of the lower section of a blowout prevention assembly **31**, is connected to the top of surface casing **9**. The blowout preventer is then hydraulically latched to the surface casing landing mandrel **29** and the drill pipe inserted through the blowout prevention equipment extending a relatively short distance into the surface casing. The drill pipe rams **35** in the blowout prevention equipment are closed so that the blowout prevention equipment is firmly latched to the drill string. The surface casing **9** with the blowout prevention equipment latched thereto may then be lowered into the hole with the drill pipe until the bottom lugs **37** of the landing mandrel **29** engage the top of the conductor pipe on the ocean floor as shown in FIGURE 4.

When the blowout prevention assembly and casing are landed at the ocean floor, the drill pipe rams **35** are opened and the drill string **21** lowered to a float shoe at the lower end of the surface casing or to a float collar, if

used, located at the first casing joint. Both the float shoe and float collar are conventional equipment and function to prevent cement from entering the annulus between the drill pipe and surface casing above the float shoe and float collar, respectively. After the drill string is lowered to the float collar or float shoe the drill pipe rams **35** and bag-type blowout preventer **45** are closed to secure the drill pipe in position and cement is pumped down through the drill string to cement the conductor pipe, surface casing and landing base to the formation. After cementing, the drill pipe rams and the bag-type blowout preventer are opened and the drill pipe is withdrawn to just below the blowout preventer and the drill pipe circulated clean with sea water or other available fluid. The cleaning operation removes cement from the lower end of the drill pipe and forces it up the annulus between the drill pipe and the surface casing and out the mud return hose **47**. In the event that sea water is utilized as a drilling fluid and cuttings are not required at the surface, the cuttings and drilling fluid may be discharged onto the ocean floor.

As shown in FIGURE 5, a casing riser **51** may be lowered over the drill pipe and latched by the riser latch **49**. The casing riser is preferably equipped with conventional spherical swivel joints **53** and a longitudinal slip joint **55**. The casing riser provides a return path for the drilling fluid so that it can be returned to the mud shakers and the circulating system through a pitcher nipple **57** provided just under the rotary table (not shown). Pitcher nipple **57** is positioned above the mud conditioning tanks and the ship's deck so that the mud may be returned to the tanks by gravity flow, thus eliminating the need for an expensive sealing device, such as a rotating blowout preventer. The drill string may then be lowered through the pitcher nipple, casing riser, blowout prevention equipment and surface casing to accomplish drilling in the conventional manner.

Although my invention has been described with a certain degree of particularity, it is not to be limited to the details set forth, but should be afforded the full scope of the appended claim.

I claim:

A method for drilling a well in a formation underlying a body of water from a floating vessel with a drill string extending from said vessel to said well, comprising the steps of:

suspending from said vessel an apertured landing base having a conductor pipe vertically depending therefrom in registry with said aperture,

lowering a surface casing through said landing base aperture and conductor pipe,

holding the upper extremity of said casing at said vessel within said suspended base and conductor pipe to provide means for guiding apparatus from said vessel to said formation,

operating said drill string from said vessel through the interior of said casing to drill said well in said formation sufficient to receive said conductor pipe,

leaving the lower end of said drill string in said well whereby said drill string provides means for guiding the lower end of said casing into said well,

lowering said landing base with said conductor pipe depending therefrom to said well whereby said conductor pipe enters said well and said base rests on said formation,

lowering the lower end of said suspended casing into said well over said drill string,

withdrawing said drill string from said well,

guiding said drill string back into said well through said suspended casing to complete the drilling of said well,

latching blowout prevention equipment to the upper end of said surface casing,

lowering said casing with said blowout prevention equipment latched thereto with said drill string whereby said casing is guided into said well and said blowout preventer is guided to said formation with said casing,

stripping a casing riser over said drill pipe to register in the top of said blowout preventer equipment, and

latching said blowout preventer equipment to said casing riser.

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