

Sept. 12, 1967

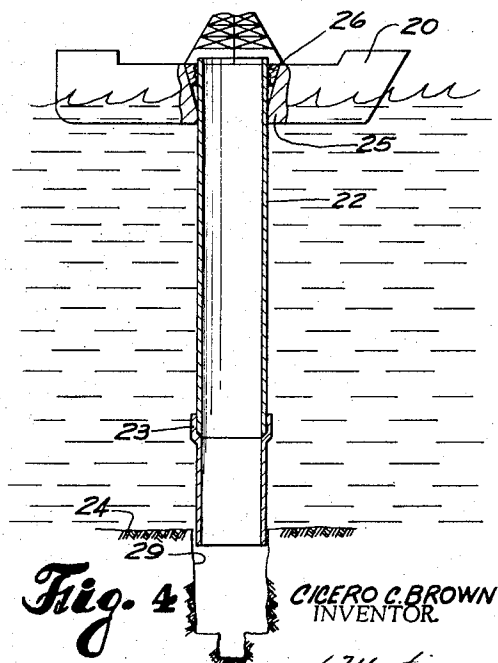
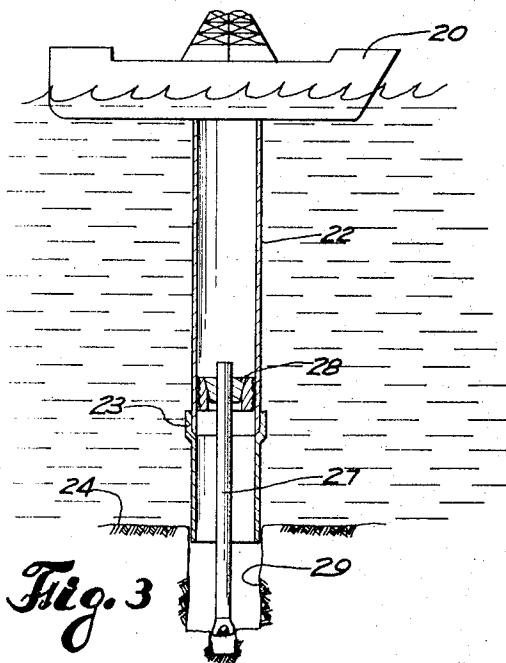
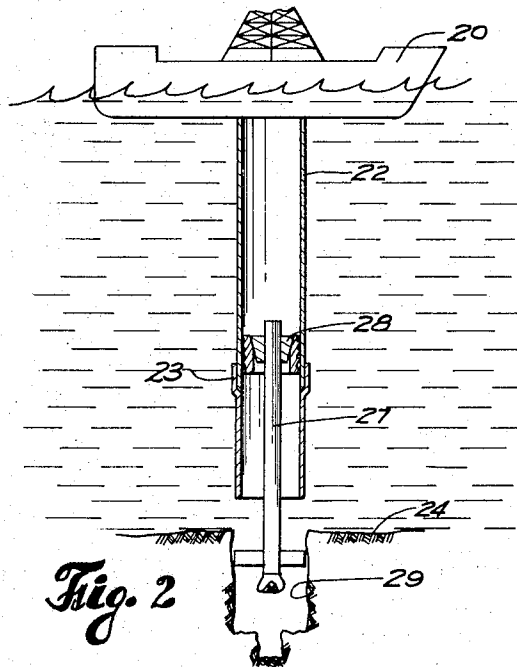
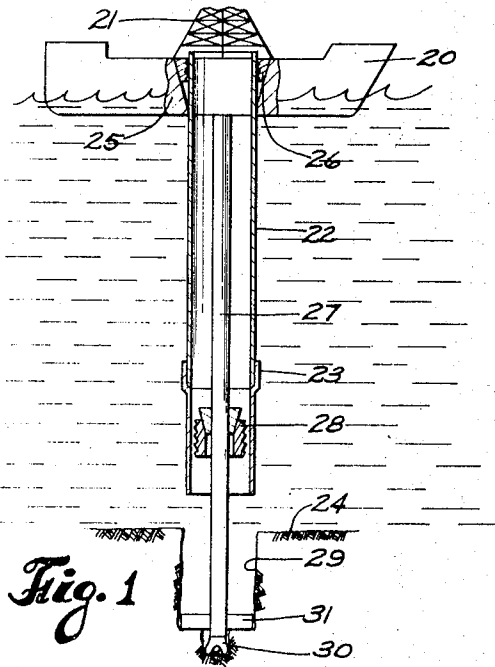
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3,340,928

SUBMARINE DRILLING METHOD

Filed June 1, 1965

6 Sheets-Sheet 1



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SUBMARINE DRILLING METHOD

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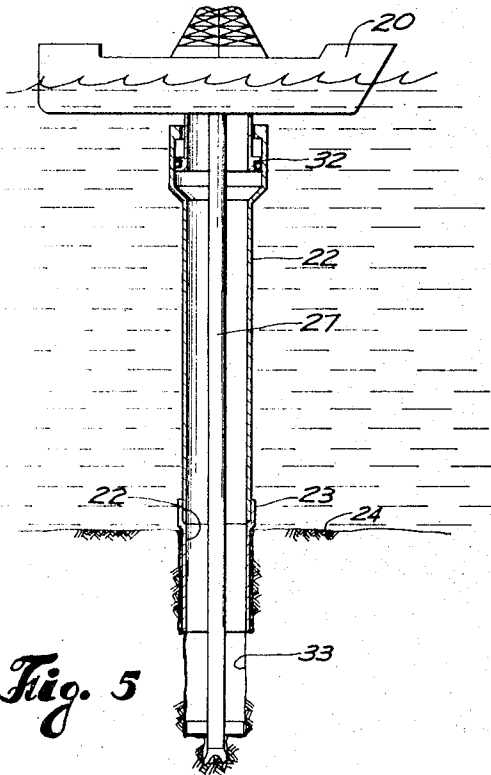


Fig. 5

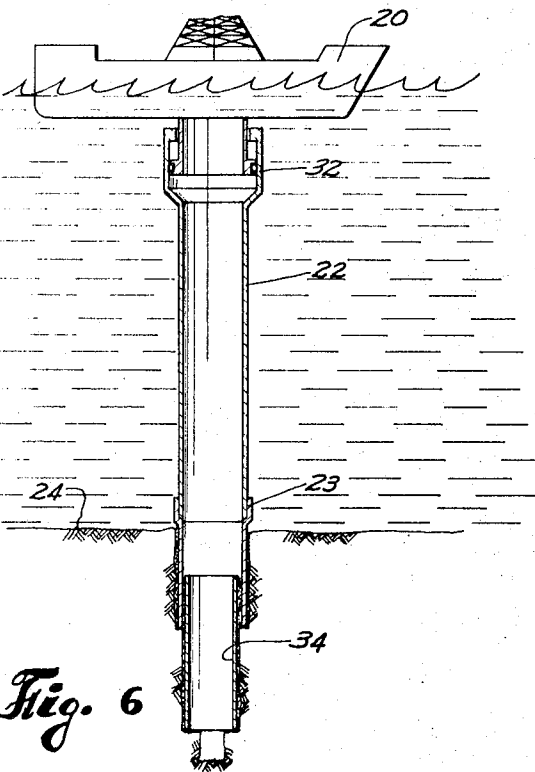


Fig. 6

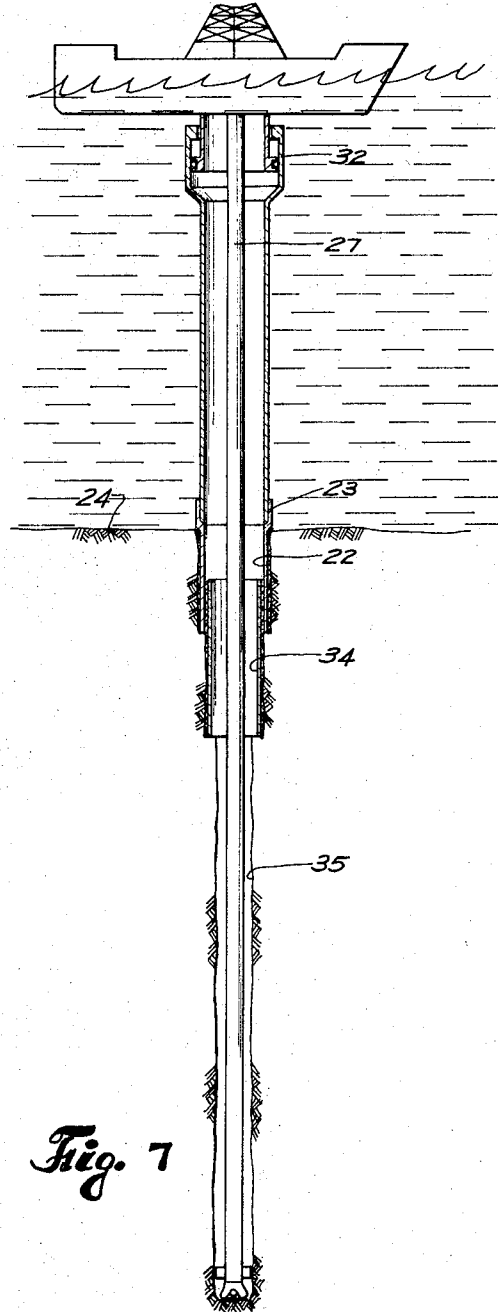


Fig. 7

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SUBMARINE DRILLING METHOD

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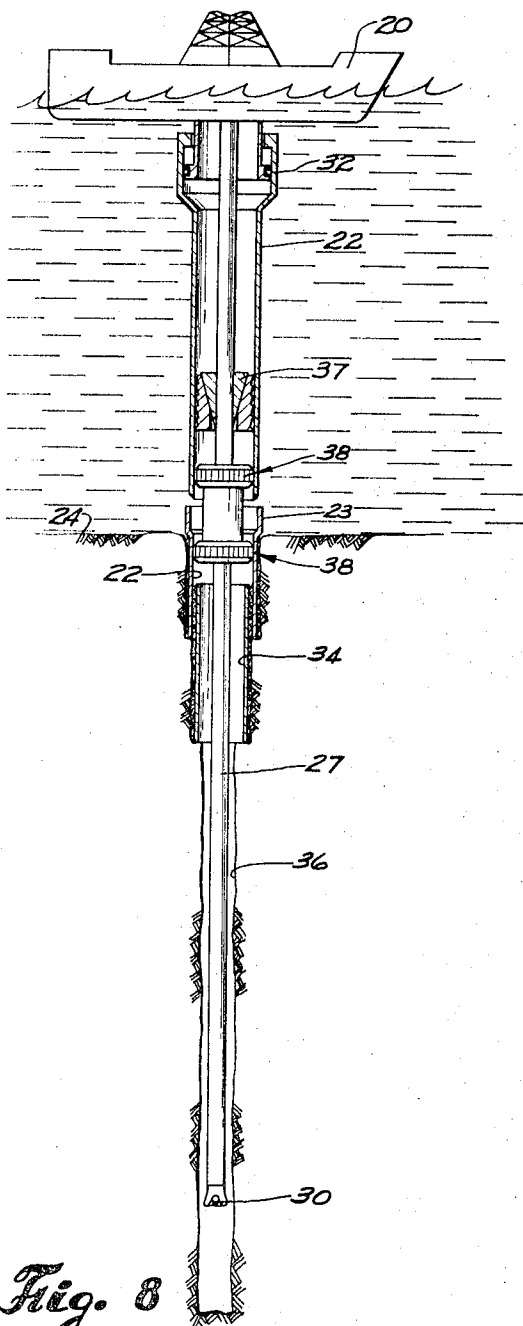


Fig. 8

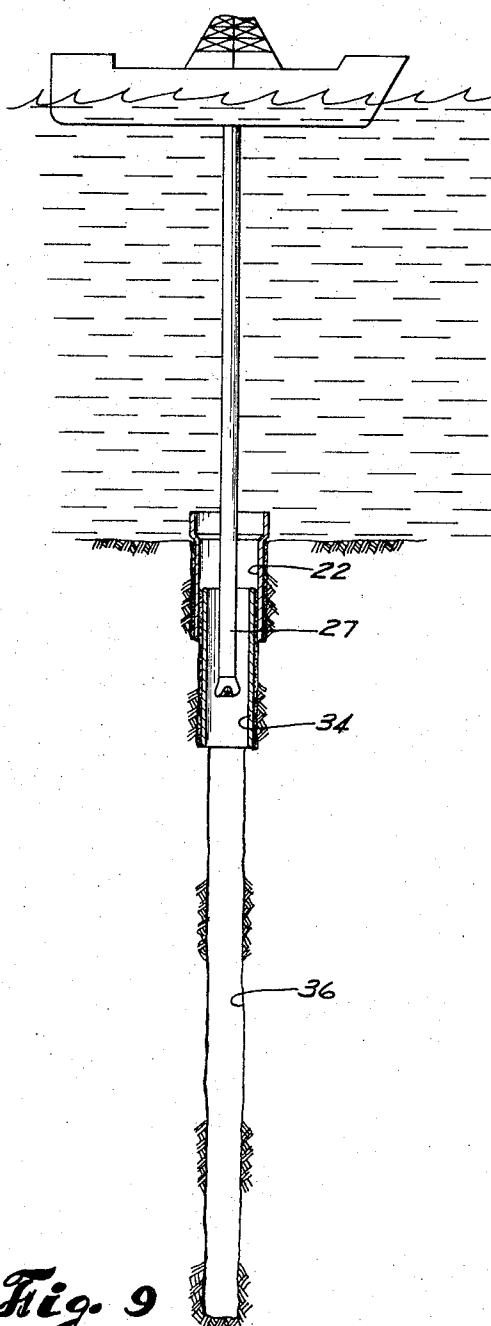


Fig. 9

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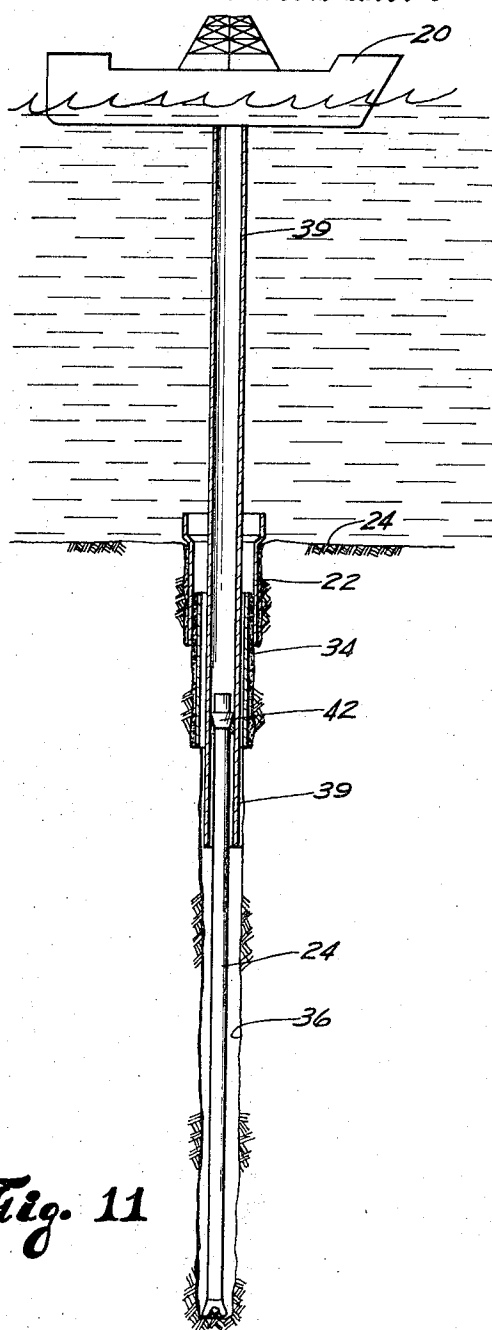
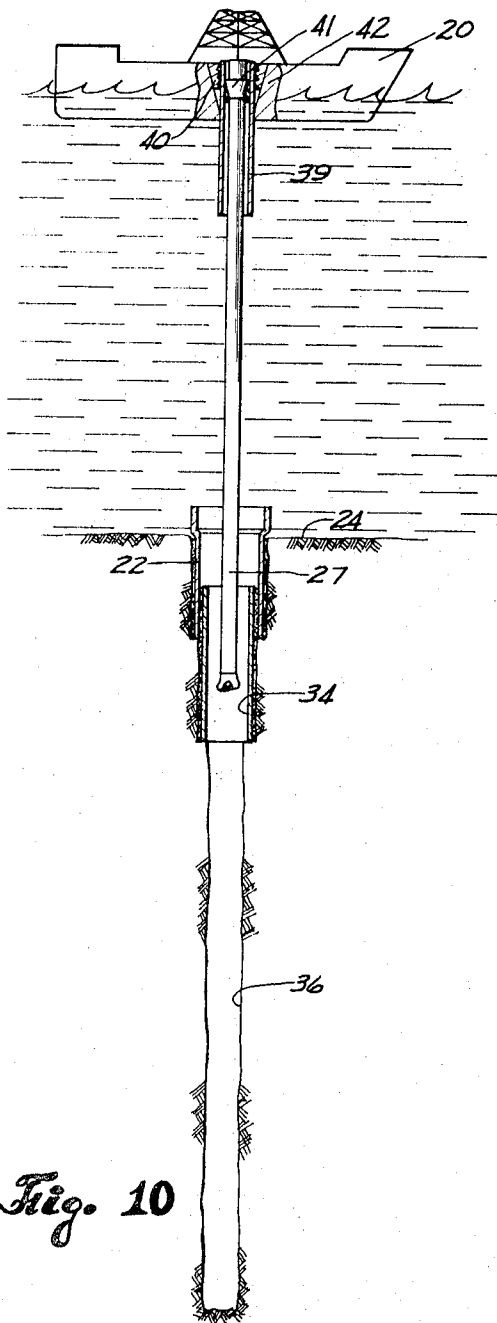
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SUBMARINE DRILLING METHOD

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6 Sheets-Sheet 4



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SUBMARINE DRILLING METHOD

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6 Sheets-Sheet 5

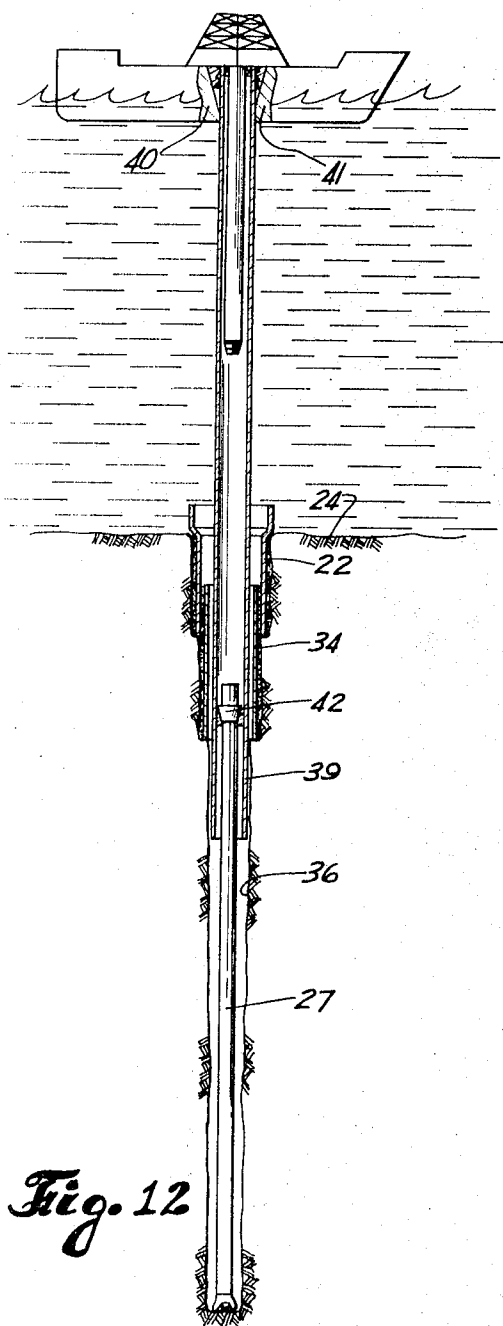


Fig. 12

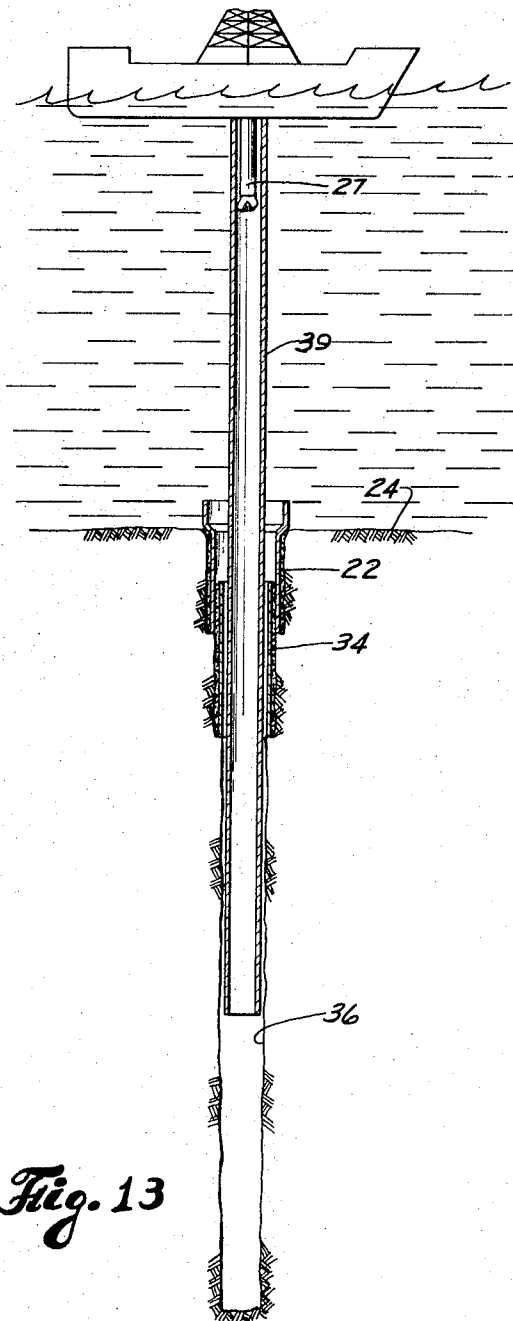


Fig. 13

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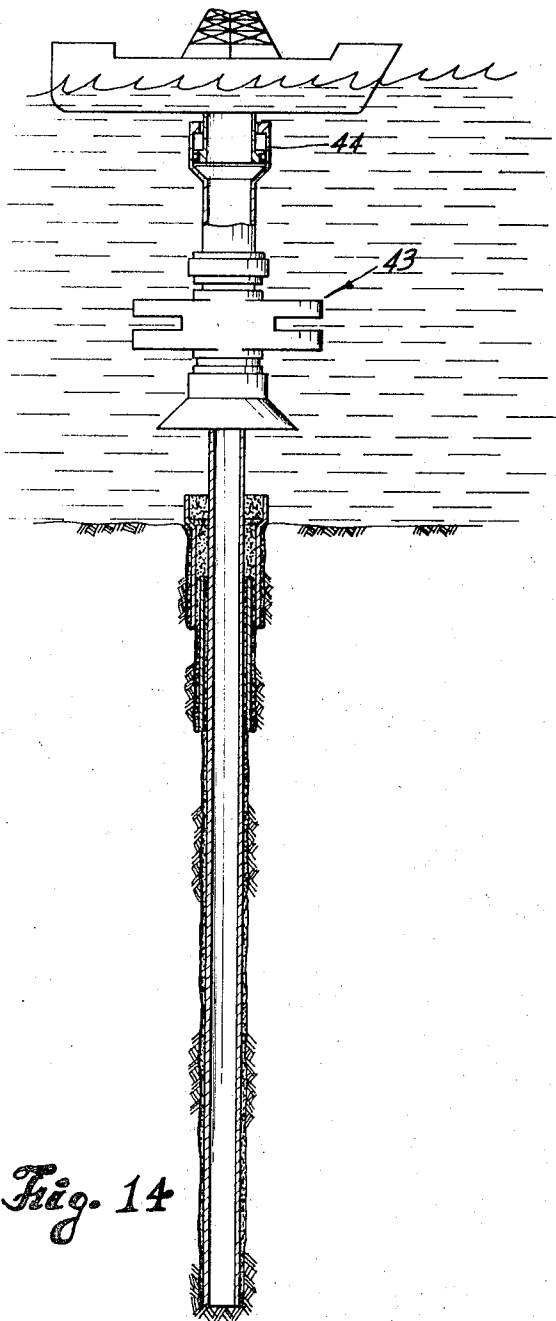
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SUBMARINE DRILLING METHOD

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6 Sheets-Sheet 6



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3,340,928
SUBMARINE DRILLING METHOD
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 Filed June 1, 1965, Ser. No. 460,402
 9 Claims. (Cl. 166—5)

ABSTRACT OF THE DISCLOSURE

A submarine drilling method in which the casing is lowered in the water, the drill string is lowered through the casing, a well bore is drilled, the drill string is raised so that its lower end remains in the well bore, the drill string is anchored to the casing and the upper portion is disconnected above the anchoring, the casing is guided into the well bore by the lower portion of the drill pipe, the anchoring of the drill pipe is released, the casing is set and subsequent steps are taken to complete the drilling of the well bore while maintaining a direct connection from the drilling vessel to the well bore at all times. This abstract is neither intended to define the invention of the application which, of course, is measured by the claims, nor is it intended to be limiting as to the scope of the invention in any way.

The present invention relates generally to a method of drilling a submarine well. More particularly, the present invention relates to the drilling of a submarine well in relatively deep water and the setting of casing in the well bore.

Summary of the Invention

The method of the present invention contemplates the utilization of the drill string and the casing to maintain a direct connection between the drilling vessel and the well bore at all times and includes the steps whereby the drill string is used to guide the casing into the well bore. These steps are accomplished with the usual drilling equipment without the necessity of stripping casing over a drill string and do not require additional hoisting equipment such as has been used in the past to separately lower a casing string over a guide string. Subsequent steps of drilling and guiding casing into the well bore by anchoring the drill string to the casing and thereafter setting the wellhead control equipment are all similarly performed in such a manner that only one pipe string is handled on the drilling vessel at one time.

Submarine well drilling has been common for many years. Platforms have been erected in shallow water, but considerable difficulty has been encountered in deeper water wherein a floating platform is used. In some submarine well-drilling systems, connection at the submarine floor are made by divers. Considerable work has been done in recent years to eliminate the need for divers since the drilling of wells in water too deep for man to descend to the submarine floor has been limited in depth to man's normal diving depth. Much of this work has been devoted to robots to simulate the work of a diver with the aid of closed circuit television from the submarine floor to the floating platform or drilling barge. Even the new developments which have evolved from such work require the use of many guide lines extending from the submarine floor to the floating platform.

Handling guide lines and keeping them from tangling is a very difficult undertaking. Therefore, an object of the present invention is to provide a method of drilling a submarine well without using floor to surface guide lines.

Another object of the present invention is to provide a method of drilling a submarine well in which the drill

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pipe is maintained partially in the well bore to guide the casing into the well bore.

A further object is to provide a method of drilling and completing a submarine well in deep water in which the connection to the well bore from the floating platform is maintained at all times with the casing or the drill pipe.

Still another object of the present invention is to provide a method of drilling a submarine well in deep water solely by manipulation of the casing and drill pipe.

Another object of the present invention is to provide a method of drilling a submarine well in deep water using only the usual drilling equipment.

These and other objects of the present invention are hereinafter more fully explained and set forth in reference to the drawings wherein:

FIGURE 1 is a schematic view of the initial drilling of a submarine well according to the present invention.

FIGURE 2 is a similar view of the apparatus after completion of drilling for the largest casing.

FIGURE 3 is a similar view of the guiding of the largest casing into the well bore.

FIGURE 4 illustrates the position of the largest casing and its support on the floating platform after the drill pipe has been removed.

FIGURE 5 illustrates the largest casing set in the well bore and additional drilling of a smaller well bore therebelow.

FIGURE 6 illustrates the second casing as set in the well bore.

FIGURE 7 illustrates additional drilling below the second casing.

FIGURE 8 illustrates the disconnecting of the largest casing near the submarine floor.

FIGURE 9 illustrates the position of the drill pipe after the disconnected portion of the largest casing has been removed.

FIGURE 10 is similar to FIGURE 9 and further illustrates the support of the third casing and the connection of the third casing to the drill pipe.

FIGURE 11 illustrates the third casing lowered into the well bore guided by the drill pipe.

FIGURE 12 illustrates the lowering of a pipe string to pick up the drill pipe.

FIGURE 13 illustrates the third casing completely set in the well bore.

FIGURE 14 illustrates the usual drilling mandrel, blow-out preventers, flex-joint-type equipment attached to the third casing near the submarine floor.

In describing the method of the present invention it is more easily understood by reference to the following specific example. A well is to be drilled at a point having 1,000 feet of water above the submarine floor. A floating platform is to be used for such operation, and suitable means will be provided to maintain the position of the floating platform at all times over the drilling site. The well is to have 200 feet of 36-inch casing, 300 feet of 20-inch casing and 1500 feet of 13 $\frac{3}{8}$ -inch casing.

As shown in FIGURE 1, the floating platform 20 is provided with a suitable derrick 21 and other usual related equipment for drilling. The platform 20 is positioned over the selected drilling site, and such position is maintained within reasonable tolerances so that the well bore will be at all times directly under the platform 20.

A first casing string 22, being 36-inch casing and having a disconnect joint 23, is lowered from the platform 20 to a position close to the submarine floor 24. Usually the casing 22 will be lowered until it touches the floor 24 and then it will be raised the length of one joint of casing. This distance will be sufficient to prevent the casing 22 from engaging the floor 24 during drilling because of the movement of platform 20 responsive to the surface mo-

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tion of the water. The casing string 22 is supported on the platform 20 by the usual bowl 25 and slips 26. The joint 23 is preferably slightly more than 200 feet from the lower end of casing 22 so that when casing 22 is set, it will be slightly above submarine floor 24.

The drill pipe 27, having an anchor 28 positioned as hereinafter set forth, is lowered through the casing 22. A well bore 29 for the casing 22 is drilled by the drill bit 30 and underreamer 31. Drilling is continued until 200 feet of well bore 29 is completed. This is the position of the parts as shown in FIGURE 1.

With the drilling of well bore 29 completed, the drill pipe 27 is raised approximately 100 feet, and the anchor 28 is set against the interior of casing 22. With anchor 28 set, the drill pipe 27 is disconnected at a joint above the anchor 28. The disconnected drill pipe is raised and removed completely. Removal of the disconnected drill pipe above anchor 28 will facilitate the subsequent lowering of the casing 22 to the position illustrated in FIGURE 3. During this time the portion of drill pipe 27 anchored to casing 22 will never be moved out of well bore 29 and will perform the functions of maintaining a direct connection with the well bore 29 and guiding the casing 22 into the well bore 29 to the position as shown in FIGURE 3.

Thereafter, drill pipe 27 will again be lowered into the casing 22 and suitably guided to engage the portion of drill pipe above anchor 28. With the drill pipe 27 connected, anchor 28 is released and drill pipe 27 is thereafter pulled and stored on the floating platform 20.

With the drill pipe 27 removed, the casing will be supported by the bowl 25 and slips 26 and will extend approximately 100 feet less the length of one casing joint into the well bore 29 as shown in FIGURE 4. A suitable flexible joint 32 is connected to the upper end of casing 22, and the casing 22 is lowered into the well bore 29. With approximately 200 feet of casing 22 positioned in the well bore 29, the casing is cemented in place.

As shown in FIGURES 5 and 6, additional drilling below the casing 22 provides the well bore 33 to receive the second casing 34. In the example this second casing is 20 inches in diameter and approximately 300 feet long. The well bore 33 will extend approximately 200 feet below casing 22 so that casing 34 may be cemented with its upper 100 feet positioned with casing 22.

When casing 34 has been set and cemented in well bore 33, the drilling of well bore 35 is commenced with the drill pipe 27 extending through casing 22 and 34 as best shown in FIGURE 7. In the example the drilling will be completed when the well bore 36 is 1500 feet below the lower end of casing 34.

With the completion of the well bore 36, the drill pipe 27 is raised, and a hanger 37, which is hydraulically actuated, and an internal reversing tool 38 are mounted on the drill pipe 27 approximately 1300 feet above the drill bit 30. Thereafter, the drill pipe 27 is lowered into the position as illustrated in FIGURE 8. In this position the drill pipe 27 is rotated on the platform 20 and the reversing tool 38 will rotate the upper portion of casing 22 above joint 23 to cause the casing to disconnect at the joint 23. This disconnection of the casing 22 by the reversing tool 38 will be better understood by reference to my copending application Ser. No. 416,308, filed Dec. 7, 1964, which is specifically directed to such tool.

With the joint 23 disconnected the anchor 37 is set hydraulically to anchor drill pipe 27 to the interior of the casing 22 above the joint 23. The drill pipe 27 is disconnected at a point immediately above anchor 37. The disconnected portion of drill pipe 27 will then be raised to the platform 20. The remainder of the drill pipe 27 will be hanging from the anchor 37. Thus, as the disconnected portion of casing 22 is raised, the drill pipe 27 will also be raised until all of the disconnected casing has been taken aboard the floating platform 20. At this point, the lower end of drill pipe 27 will extend down from the float-

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ing platform 20 into the upper portion of the well defined by casing 22 and casing 34, both of which have been cemented in the well. This position of the drill pipe is illustrated in FIGURE 9.

The well bore 36 is sufficiently large to receive a third or smallest size casing 39, thirteen and three-eighths inch casing in the example. As shown in FIGURE 10, with the drill pipe 27 suspended in the well, a length of the casing 39 is lowered from the platform 20 in surrounding relation to the upper end of drill pipe 27. The casing 39 is supported by the slips 40 in the bowl 41, and an anchor 42 is placed on the upper end of drill pipe 27 and actuated to be set in the casing 39 so that drill pipe 27 is supported wholly by the anchor 42. The casing 39 is thereafter lowered into the well bore 36 to the position illustrated in FIGURE 11. During this lowering of casing 39 the drill pipe 27 will be in well bore 36 and will guide casing 39 through casings 22 and 34 into well bore 36. Additional drill pipe 27, as shown in FIGURE 12, is lowered through casing 39 which is supported by slips 40 in bowl 41. When the additional drill pipe has been connected to the drill pipe 27 immediately above anchor 42, the anchor 42 will be released and all of the drill pipe 27 will be removed from the well and from casing 39 as shown in FIGURE 13. Thereafter, as shown in FIGURE 14, casing 39 is lowered into well bore 36 and suitable equipment 43, such as a drilling mandrel, a base, connectors and blow-out preventers, is connected to casing 39. A suitable flexible joint 44 is attached to the upper end of casing 39. Thereafter, casing 39 may be cemented and further drilling and running of casing strings can be carried out through the casing 39.

Again, when the well is ready for completion, the drill pipe 27 will be run into casing 39 to a point 1500 feet below the floor 24. The drill pipe would be hung from the lowermost connector which can be disengaged and all of the equipment 43 pulled, leaving about 500 feet of drill pipe in the well to guide the placing of the production equipment (not shown) at the top of casing 39.

From the foregoing description it has been shown that the present invention provides a method of drilling an underwater well without the necessity of connections made by divers or by guide wires. At all times, during all operations from the initial drilling to the final setting of the production equipment, there is a direct connection from the floating platform to the well bore. In this manner, the guiding is accomplished by the drill pipe string or by the casing string. The amount of work and handling of the drilling equipment is minimized while the well bore will at all times be directly connected so that no difficulty will be encountered in lowering casing into position in the well bore.

What is claimed is:

1. The method of drilling a well in water from a floating platform comprising,
 - lowering casing to a position wherein its lower end is immediately above the underwater floor,
 - lowering drill on drill pipe through said casing to the floor,
 - drilling a well bore to receive said casing,
 - securing the drill pipe to the casing, and
 - lowering the casing into the well bore with the drill pipe guiding the casing into the well bore.
2. The method of setting casing in a submarine well bore comprising,
 - lowering casing to a position close to the submarine floor,
 - drilling a well bore with a drill pipe extending through said casing,
 - securing drill pipe against longitudinal movement relative to said casing after at least part or said well bore has been drilled,
 - lowering said casing into said well bore guided by said drill pipe,
 - releasing said drill pipe from said casing, and

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lowering said casing into the desired position in said well bore.

3. The method of drilling a well in water from a floating platform comprising,

lowering casing to a position wherein its lower end is immediately above the underwater floor,

lowering drill on drill pipe through said casing to the floor,

drilling a well bore to receive said casing,

anchoring the drill pipe to the casing,

lowering the casing into the well bore with the drill pipe guiding the casing into the well bore,

disconnecting the drill pipe from the casing, and drilling an additional well bore therebelow.

4. The method of setting casing in a submarine well bore from a floating platform comprising,

lowering casing to a position immediately above the submarine floor,

securing the outer periphery of the upper end of said casing to the floating platform;

lowering a drill on drill pipe through said casing to the submarine floor,

drilling a well bore to receive said casing,

raising said drill pipe off the bottom of said well bore to a position wherein said drill pipe remains partially in said well bore,

anchoring said drill pipe to said casing with said drill pipe positioned partially in said well bore,

disconnecting said drill pipe at a joint above the point at which said drill pipe is anchored to said casing,

removing the disconnected drill pipe from said casing, and

lowering said casing into said well bore whereby said drill pipe anchored to said casing will guide said casing into said well bore.

5. The method of setting a second casing in a submarine well in which the first casing has been set and is provided with a disconnect joint at a point on said first casing immediately above the submarine floor comprising,

drilling a well bore to receive the second casing below said first casing with the drill pipe extending through said first casing,

lifting said drill pipe partially out of said casing after completion of the drilling of said well bore,

installing an anchor and a reversing tool on said drill pipe,

lowering said drill pipe in said casing to position said reversing tool across said disconnect joint in said first casing and said anchor immediately above said joint,

rotating said drill pipe to release said joint with said disconnect tool,

setting said anchor to secure said drill pipe in the lower end of the disconnected portion of said first casing,

disconnecting said drill pipe immediately above said anchor,

removing the disconnected drill pipe,

raising the disconnected portion of said first casing with said drill pipe attached therein,

the lower end of said drill pipe remaining within the set portion of said first casing and below during the raising of said disconnected casing, and

lowering a second casing with said drill pipe anchored in the lower end thereof whereby said drill pipe guides said second casing into said well bore.

6. The method according to claim 5 including the steps of

releasing the anchor between said drill pipe and said second casing,

lowering said casing into its desired set position within said well bore.

7. The method according to claim 6 wherein, said drill pipe is removed from said second casing after said anchor is released and before said second casing is lowered into its desired set position.

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8. The method of drilling a submarine well from a floating platform comprising,

lowering a first casing string into the water to a position immediately above the submarine floor,

securing the outer periphery of the upper end of said casing to the floating platform,

lowering a drill on drill pipe through said first casing string to the submarine floor,

drilling a first well bore to receive said first casing string,

raising said drill pipe from the bottom of said first well bore to a position wherein said drill pipe remains partially in said well bore,

anchoring said drill pipe to said first casing string with said drill pipe positioned partially in said well bore,

disconnecting said drill pipe at a joint above the point at which said drill pipe is anchored to said first casing string,

removing the disconnected drill pipe from said first casing string,

lowering said first casing string into said well bore whereby said drill pipe anchored to said first casing string will guide said first casing string into said well bore,

lowering drill pipe and connecting to the drill pipe anchored in said first casing string,

removing drill pipe from said first casing string,

lowering and setting said first casing string in said first well bore,

drilling a second well bore below said first well bore, lifting the drill pipe used to drill said second well bore

while maintaining the lower end of said drill pipe within one of said well bores,

anchoring drill pipe to said first casing string at a point above the submarine floor,

disconnecting said first casing string at a point below said anchoring of said drill pipe and above said submarine floor,

lifting said disconnected portion of said first casing string and said drill pipe to said floating platform while the lower end of said drill pipe remains in said second well bore,

releasing said anchoring of said drill pipe to said first casing string,

anchoring said drill pipe while still in said second well bore to a second casing string,

lowering said second casing string from said floating platform into said second well bore guided by said drill pipe,

releasing the anchoring of said drill pipe to said second casing string, and

lowering said second casing string into position in said second well bore.

9. The method of drilling a submarine well from a floating platform comprising,

lowering a first casing string into the water to a position immediately above the submarine floor,

securing the outer periphery of the upper end of said casing to the floating platform,

lowering a drill on drill pipe through said first casing string to the submarine floor,

drilling a first well bore to receive said first casing string,

raising said drill pipe from the bottom of said first well bore to a position wherein said drill pipe remains partially in said well bore,

anchoring said drill pipe to said first casing string with said drill pipe positioned partially in said well bore,

disconnecting said drill pipe at a joint above the point at which said drill pipe is anchored to said first casing string,

removing the disconnected drill pipe from said first casing string,

lowering said first casing string into said well bore whereby said drill pipe anchored to said first casing

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string will guide said first casing string into said well bore,
 lowering drill pipe and connecting to the drill pipe anchored in said first casing string,
 removing drill pipe from said first casing string,
 lowering and setting said first casing string in said first well bore,
 drilling a second well bore below said first well bore, setting a second casing string in said second well bore, drilling a third well bore below said second well bore, lifting the drill pipe used to drill said third well bore while maintaining the lower end of said drill pipe within one of said well bores,
 anchoring drill pipe to said first casing string at a point above the submarine floor,
 disconnecting said first casing string at a point below said anchoring of said drill pipe and above said submarine floor,
 lifting said disconnected portion of said first casing string and said drill pipe to said floating platform while the lower end of said drill pipe remains in said third well bore,

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releasing said anchoring of said drill pipe to said first casing string,
 anchoring said drill pipe while still in said third well bore to a third casing string,
 lowering said third casing string from said floating platform into said third well bore guided by said drill pipe,
 releasing the anchoring of said drill pipe to said third casing string, and
 lowering said third casing string into position in said third well bore.

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