United States Patent

[11] 3,608,652

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[54] **UNDERWATER DRILLING APPARATUS**
3 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** **175/7,** 166/.5, 175/171
[51] **Int. Cl.** **E21b 15/02**
[50] **Field of Search** 175/5–10, 171; 166/.5; 61/63–68

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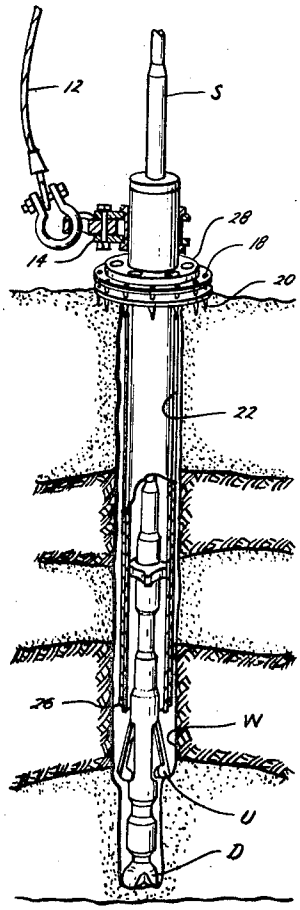
ABSTRACT: The combination of a drill string, a tubular structure such as an underwater anchor or conductor pipe supported on the drill string for underwater drilling and an antirotational device and the device itself wherein the device has ground engaging elements to grip the bottom of the body of water in which the tubular structure is being set and a connection coacting between the ground-engaging elements and the tubular structure to restrain the tubular structure against rotation during drilling.



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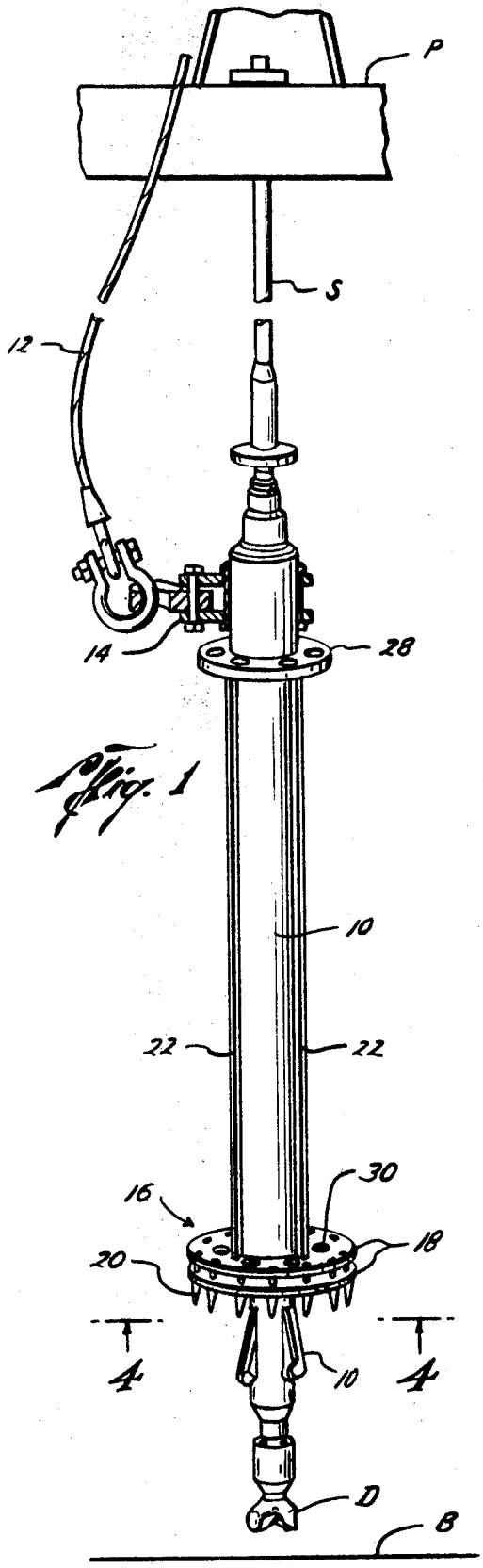

Fig. 1

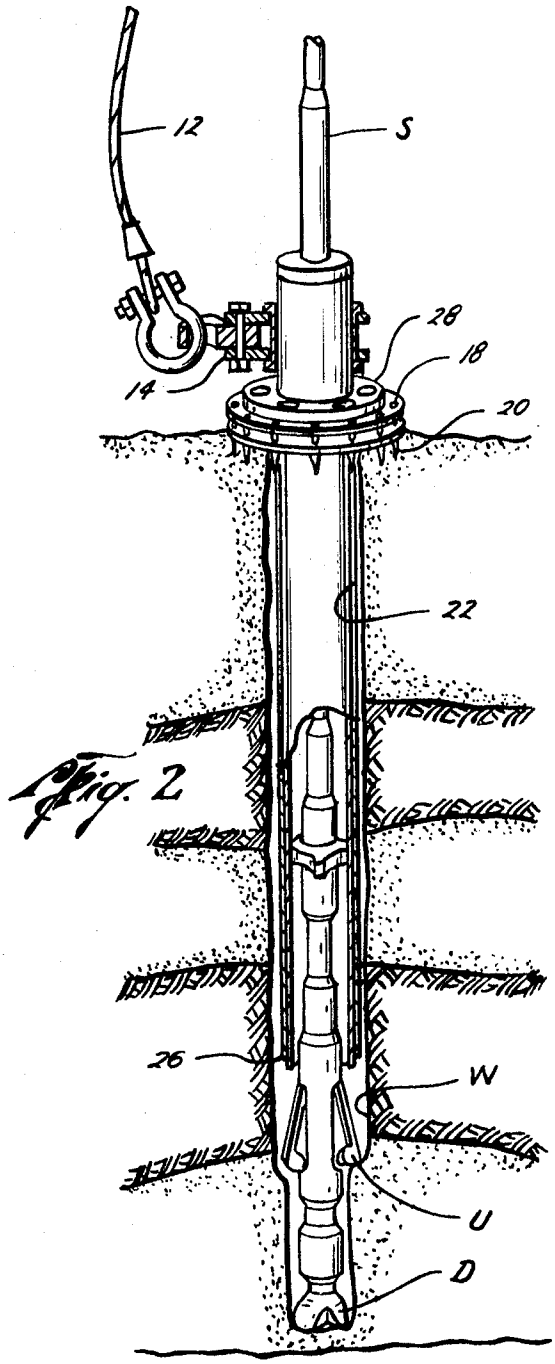

Fig. 2

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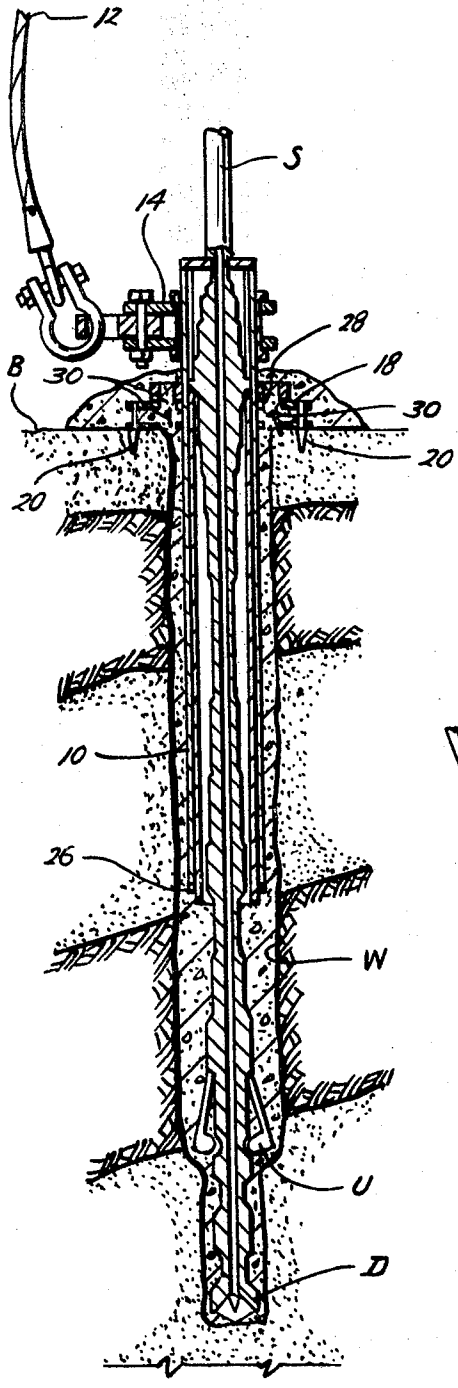

Fig. 3

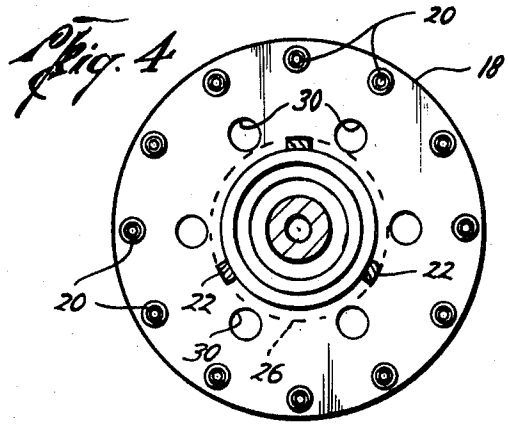

Fig. 4

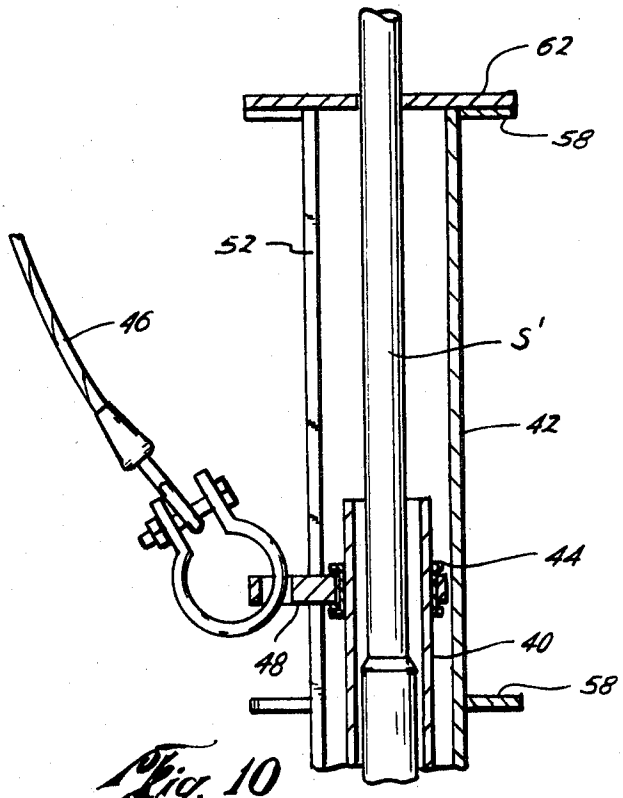

Fig. 10

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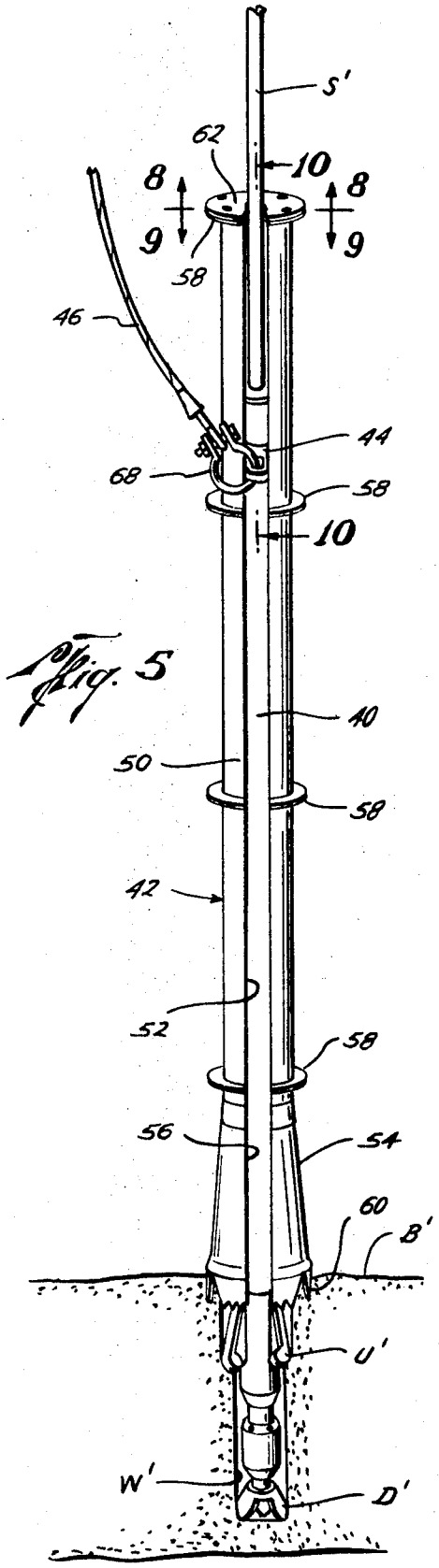

Fig. 5

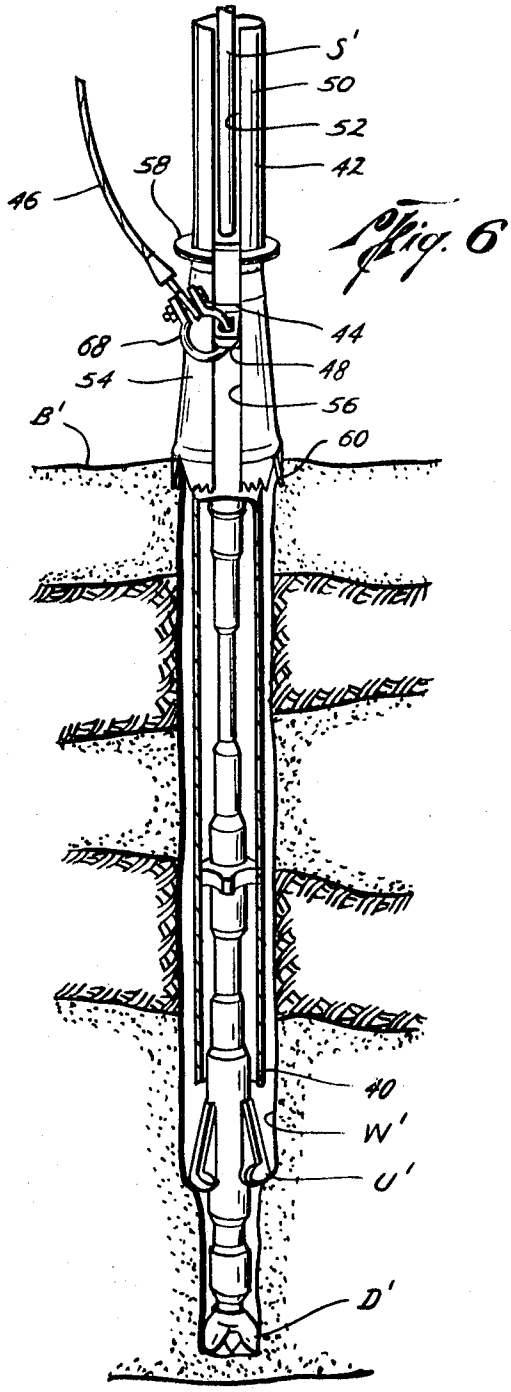

Fig. 6

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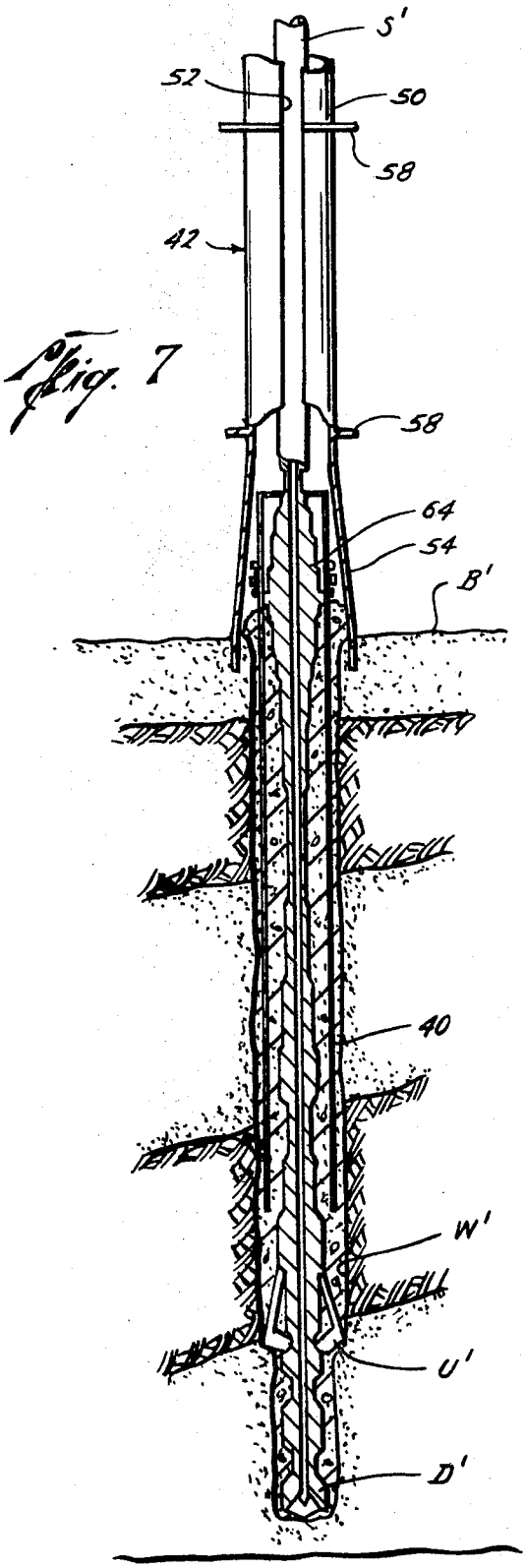

Fig. 7

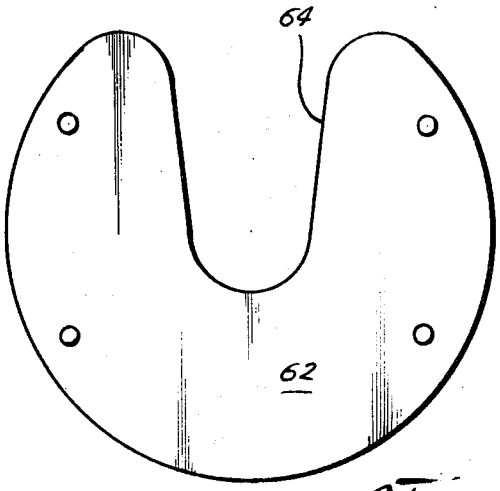

Fig. 8

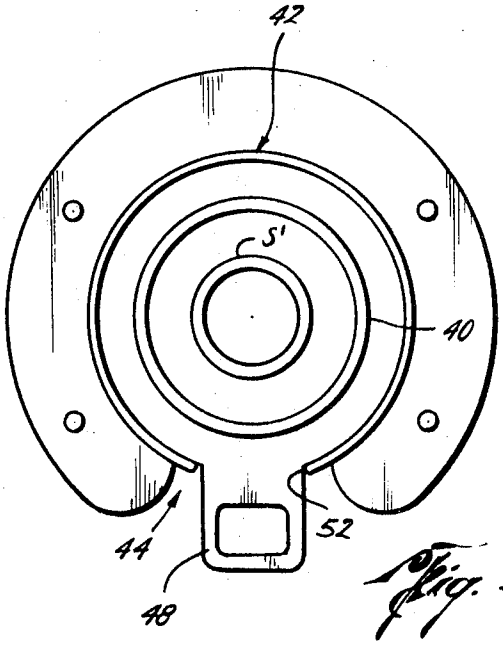

Fig. 9

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UNDERWATER DRILLING APPARATUS

SUMMARY

The present invention relates generally to an improved drilling apparatus for setting an underwater tubular structure and more specifically to an improved antirotational device for use with a drill string and a tubular structure in underwater drilling to set the tubular structure wherein the antirotational device functions to grip the bottom of the body of water and to restrain the tubular structure from rotation when the drill string is rotated during drilling.

An improved method and an improved apparatus have been developed in which an underwater anchor or conductor pipe may be rotationally supported on a drill string as it is lowered into the water and is also lowered into the well bore as the well bore is drilled and including lines extending from such anchor or conductor to the surface. This method and apparatus is disclosed in the application of Lawrence Sanford, Weldon Medders and Jack Chadderdon, Ser. No. 723,129, filed Apr. 22, 1968. The apparatus illustrated in this application includes a swivel connection for the anchor cable connection to the surface for the anchor and a landing base having lines extending to the surface.

It has been found desirable that the tubular structure whether it be an anchor or a conductor pipe, resist the tendency to rotate in order to minimize the possibility of cables and lines extending to the surface becoming fouled.

It is therefore an object of the present invention to provide a structure for setting a tubular structure in a well bore as it is drilled underwater while minimizing the fouling of cables and lines extending to the surface of the water.

Another object is to provide an improved antirotational device for use in underwater drilling with a drill string and a tubular structure which allows the tubular structure to progress into the well bore as it is being drilled by the drill string and restrains the tubular structure against rotation with the drill string.

Still another object is to provide an improved apparatus which is relatively inexpensive and which may be used with a tubular structure that is supported on a drill string during drilling wherein the improved apparatus restrains the tubular structure against rotation with the drill string.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is an elevation view of an anchor having the preferred form of antirotation device showing the anchor being lowered on a drill string.

FIG. 2 is an elevation view, partly in section, showing the completion of drilling for setting the anchor.

FIG. 3 is a sectional view illustrating the cementing of the anchor in place prior to the removal of the drill string.

FIG. 4 is a sectional view taken along line 4—4 in FIG. 1 of the preferred form of antirotation device of the present invention.

FIG. 5 is an elevation view of the initial underwater drilling to set an anchor and illustrates a modified form of the antirotation device of the present invention.

FIG. 6 shows the completion of drilling the well bore with the string shown in FIG. 5.

FIG. 7 illustrates the cementing step of the structure shown in FIGS. 5 and 6.

FIG. 8 is a sectional view taken along line 8—8 in FIG. 5 to illustrate the details of the supporting flange on the modified form of antirotation device.

FIG. 9 is a sectional view of the modified form of antirotation device taken along line 9—9 of FIG. 5.

FIG. 10 is a partial sectional view of the modified form of antirotational device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As illustrated in FIG. 1, the present invention provides an improved apparatus for the drilling and setting of a tubular structure underwater. The tubular structure 10, which may be an underwater anchor or conductor pipe, is supported on the drill string S and lowered thereon into the water from the barge or platform P on the surface of the water. A suitable J-slot and swivel connection is provided to support the tubular structure 10 on the drill string S to allow the drill string S to be rotated within the tubular structure 10 and to allow the drill string S to be disconnected from the tubular structure and pulled when the setting of the tubular structure has been completed. This type of apparatus and method of setting a tubular structure underwater is disclosed and explained in the aforementioned application Ser. No. 723,129.

As the drill bit D approaches the bottom B, circulation of the drilling fluid is commenced. Drilling is commenced by rotating the drill string S. As the drill bit D and underreamer U form the well bore W, the tubular structure 10 is lowered therein with the downward movement of the drill string S. Connection from the tubular structure 10 to the platform P is provided by the cable 12 which is connected by the swivel joint 14 to the tubular structure 10 and extends to the platform P. During drilling it is preferred that the tubular structure 10 does not rotate with the drill string S. The improved antirotation device 16 is provided to restrain the tubular structure 10 against rotation during drilling.

The preferred form of antirotation device includes the spaced-apart annular flanges 18 having spikes or teeth 20 depending from the lowermost of flanges 18 and the splines 22 secured to the exterior of tubular structure 10. The flanges 18 are provided with internal grooves 24 through which the splines 22 extend as best seen in FIG. 4. The flanges 18 are slidable axially on tubular structure 10 and are supported during lowering on the drill string S by the stop segments 26 secured to the lower exterior of tubular structure 10 between splines as best shown in FIG. 4 wherein the exteriors of such segments 26 are shown in dashed lines.

As can be seen from FIG. 1, as soon as drilling is commenced and the well bore is formed a short distance, spikes 20 of the device 16 engage the bottom and thereby prevent rotation of the tubular structure 10 as the drilling proceeds. With continued drilling and the deepening of the well bore 14, the tubular structure 10 slides downwardly through flanges 18. When the flange 28 on the upper end of tubular structure 10 engages the upper end of flanges 18, the drilling is stopped. Thereafter tubular structure 10 is cemented in the well bore W as shown in FIG. 3. When the cement has been placed, flowing upwardly around the exterior of tubular structure 10 and through the holes 30 in the flanges 18, the drill string S is then disengaged from tubular structure 10 and pulled to the platform P. Cementing may be continued as drill string S is being pulled to fill the interior of tubular structure 10 with cement.

The modified form of the invention and its use is illustrated in FIGS. 5 through 10. In FIG. 5, the drill string S' having a tubular structure 40 rotatively supported thereon is shown during initial drilling with the drill bit D' and underreamer U' having just penetrated the earth on the bottom B' . In this form, the modified form antirotation device 42 is provided to restrain the tubular structure 40 against rotation with the drill string S'. The tubular structure 40 is connected by swivel 44 and cable 46 to the surface. The swivel 44 includes the tongue 48 extending outwardly from the remainder of the swivel structure as seen in FIG. 9.

The antirotation device 42 includes the tubular section 50 having the longitudinally extending slot 52 and the flaring section 54 which has a slot 56 forming a continuation of the slot 52. The sections 50 and 54 are reinforced by the C-shaped flanges 58 which are secured as by welding to the exterior of the sections. The lower end of flaring section 54 is formed to define a plurality of depending teeth or spikes 60 which are

suitable for engaging the bottom B' to prevent the device 42 from rotating. A means is provided to support device 42 on the drill string S' as it is being lowered and as it is being pulled after the setting of the tubular structure 40 has been completed. Such means is provided by the top flange 62 which is secured in place on top section 50 after section 50 has been mounted around drill string S' and tubular structure 40. Flange 62 defines the side opening 64 in alignment with slot 52. Opening 64 is sufficiently large to allow drill string S' to rotate and move axially therethrough but is small enough so that flange 62 engages the top of tubular structure 40 for support during lowering and a portion of drill string such as the swivel connection 64 to the tubular structure 40 during pulling.

Since the teeth 60 engage the bottom B' while the drill string S' is drilling the well bore W', the device 42 is restrained against rotation and the engagement of the tongue 48 in slot 52 restrains tubular structure 40 against rotation and prevents fouling of cable 46. Further restraint of the tubular structure 40 may be achieved by providing another tongue (not shown) extending outwardly from and secured to tubular structure 40 and positioned in the slot 52. Also it should be noted that the tubular structure 40 may be set completely in the well bore W' since in the modified form it does not have a stop plate. It is suggested however, that some enlarged device, such as a bar or the clevis 68 which will not pass through the slots 52 and 56, be provided to limit the level to which the tubular structure 40 may be descended in the well bore W' during drilling.

From the foregoing it can be seen that the present invention provides improved apparatus for the underwater setting of anchors and conductor pipes. The combined apparatus includes the drill string with a tubular structure rotatively mounted around the exterior of the drill string and releasable therefrom and an antirotation device adapted to engage the bottom with depending projections, spikes or teeth to restrain the tubular structure from rotating during drilling. By restraining the tubular structure against rotation, many problems such as the fouling of lines and cables is prevented.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. An antirotational device for use with a drill string and a tubular structure in underwater drilling, comprising,

an annular structure surrounding said tubular structure and drill string and adapted to be supported thereon during lowering of the tubular structure and drill string into the water,

said annular structure having projections extending downwardly therefrom for engagement with the bottom whereby said annular structure is held against rotation when said drill string is rotated, and

means coacting between said annular structure and said tubular structure to resist rotation of said tubular structure when said drill string is rotated,

said coacting means allowing said annular structure to be slidable along said tubular structure whereby said annular structure engages the bottom during drilling to hold said tubular structure against rotation while allowing said tubular structure to slide therethrough into the well bore as it is being drilled,

said annular structure including a second tubular structure,

said second tubular structure defining a longitudinal slot extending throughout the length of said second tubular structure,

a flange secured to one end of said second tubular structure and defining a hole therethrough,

said flange hole being larger than said drill string and smaller than said tubular structure whereby said second tubular structure is supported by said tubular structure on said drill string during lowering into the water.

2. A device according to claim 1 wherein said coacting means includes,

a swivel connected to said first tubular structure and having a tongue extending outwardly therefrom,

said tongue engaging in the longitudinal slot in said second tubular structure.

3. An apparatus for setting a structure underwater comprising,

a drill string,

a tubular structure which is to be set in the earth underwater,

means releasably mounting said tubular structure on said drill string whereby said tubular structure is supported on said drill string during lowering and said drill string may be rotated during drilling,

an annular structure mounted around said tubular structure and having a plurality of downwardly projecting teeth,

said teeth being adapted to engage the bottom of the body of water during drilling, and

means coacting between said annular structure and said tubular structure allowing said tubular structure to move axially within said annular structure and to resist rotation of said tubular structure within said annular structure,

said coacting means allowing said annular structure to be slidable along said tubular structure whereby said annular structure engages the bottom during drilling to hold said tubular structure against rotation while allowing said tubular structure to slide therethrough into the well bore as it is being drilled,

said annular structure including a second tubular structure,

said second tubular structure defining a longitudinal slot extending throughout the length of said second tubular structure,

a flange secured to one end of said second tubular structure and defining a hole therethrough,

said flange hole being larger than said drill string and smaller than said tubular structure whereby said second tubular structure is supported by said tubular structure on said drill string during lowering into the water.