Dec. 26, 1967 B. J. BURNETT 3,360,047

WELL DRILLING DEVICE

Filed May 18, 1965

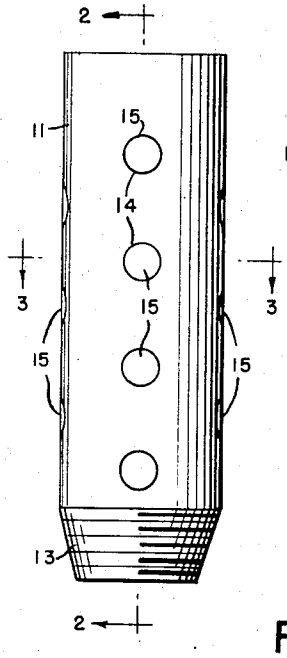


FIG. 1.

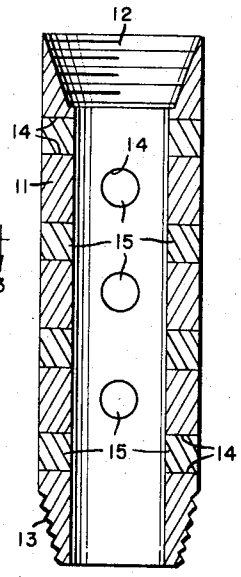


FIG. 2.

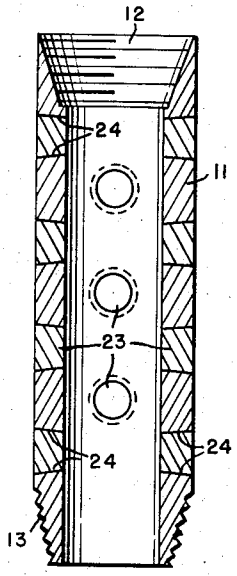


FIG. 5.

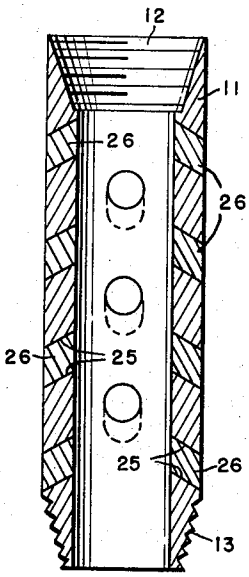


FIG. 7.

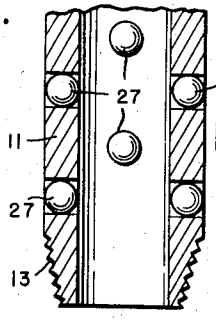


FIG. 6.

FIG. 3.

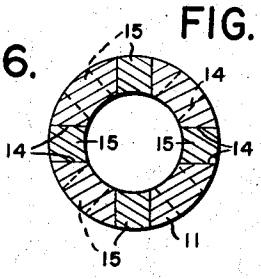
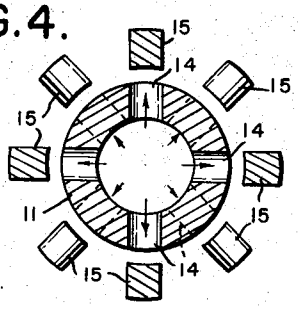


FIG. 4.



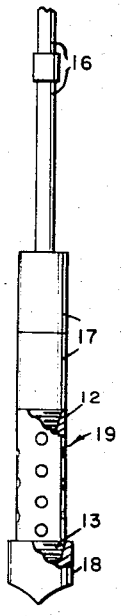


FIG. 8.

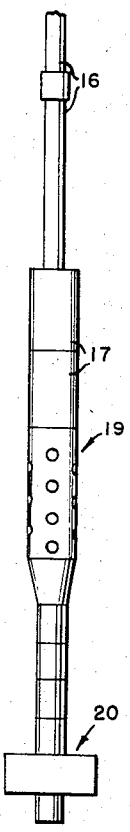


FIG. 9.

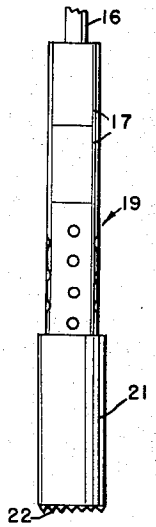


FIG. 10.

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WELL DRILLING DEVICE

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This invention relates to earth drilling devices and it is more particularly concerned with devices relating to the flow of liquids between the interior and exterior of the drill pipe used to support the equipment.

An object of the invention is the provision of a hollow member insertable at different places in a drilling rig string and by means of which fluids can be selectively removed from the string of pipe when required.

Another object of the invention is the provision of such a member which can be converted from an ordinary "sub" to a perforated sub while it is in position below the surface of the ground, without displacing it from a given position in the ground and without the use of any explosive charges.

A further object of the invention is the provision of such a member having a plurality of wall perforations sealed with plugs that are displaceable by fluid pressure below that which would be required to rupture other parts of the wall of the "sub."

These and still further objects, features, and advantages of the invention will be apparent from the following description considered together with the accompanying drawing:

In the drawing:

FIG. 1 is an elevational view of an embodiment of the invention.

FIG. 2 is a vertical sectional view along the lines 2—2 of FIG. 1.

FIG. 3 is a cross-sectional view along the line 3—3 of FIG. 1.

FIG. 4 is a view similar to FIG. 3 with the plug members removed.

FIG. 5 is a view similar to FIG. 2 of a modified form of the invention.

FIG. 6 is a view similar to FIG. 2 of another modified form of the invention.

FIG. 7 is a view similar to FIG. 2, partly broken away, of a further modified form of the invention.

FIGS. 8, 9, and 10 are schematic elevational views of drilling strings, partly broken away, illustrating various ways in which the invention may be used in combination therewith.

Referring to the drawing with more particularly, the embodiment of FIGS. 1, 2, 3, and 4 comprises a tubular member **11** having threads **12** and **13** at either end. The wall of the member **11** is provided with a plurality of cylindrical openings **14** so positioned in relation to each other as to result in a minimum loss of the structural strength therefrom, such as by the staggered arrangement illustrated.

The openings **14** are each filled with a plug **15** of a soft material, such as lead, aluminum, zinc, iron, copper, or a suitable alloy, fitted into the opening under a pressure which renders them secure against removal in a chosen range of internal fluid pressures below the pressure at which the wall material itself would rupture.

This tubular device, which may be referred to as a "sub," can be used in any number of different ways in various drilling procedures. A few typical examples are illustrated in FIGS. 8, 9, and 10. In FIG. 8, a drilling rig comprising a conventional string of drill pipe **16**, drill collars **17**, and a drill bit **18** is provided with a sub **19** in accordance with this invention between the bit and the collars. In FIG. 9, the sub **19** is disposed between drill collars **17** and unit **20** that comprises a conventional tester with packers. In FIG. 10, the sub **19** is disposed between

a conventional core barrel **21** carrying a diamond bit **22** and drill collars **17**.

The general purpose in each case is to be able to pull the string of pipe out of the earth hole on a rig regardless of what is attached to the bottom, such as a drilling bit (FIG. 8), core barrel (FIG. 10), testing tool (FIG. 9), etc. and to have the pipe come out "dry," that is, clear of liquid inside the pipe.

In the event liquid for testing purposes is desirable, for example, such as in running a test on a well, the sub can be attached above the drill collars, core barrel or testing tool. If no liquid needs to be recovered, such as in ordinary drilling, the sub can be attached below or at the bottom of the equipment being run, e.g., above the drilling bit, between the drill collars, etc.

In a typical example, assume that a drilling rig is operating with a pressure of 1800 pounds per square inch. The plugs in the blowout sub would be secured so as to blowout at about 2000 to 2200 pounds per square inch. Should the drilling bit become plugged, the pump pressures would be increased until the plugs were blown out, thereby permitting the withdrawal of the pipe from the hole and changing of the bit without liquid inside the pipe.

As an additional example, in an operation set up for coring a rock formation sample with a core barrel, liquid is conventionally run at about 800 pounds per square inch. Invariably, the core barrel becomes plugged and it is necessary to pull a wet string of pipe. To eliminate this, a sub according to this invention would be placed above the core barrel with a 1000 to 1200 pounds per square inch blow out pressure. The plugs are blown out simply by increasing the fluid pressure. The wet string of pipe is thus eliminated.

As as further example, when a tester is run into a hole to test for oil, or gas, or both, the sub is placed above the tester. (See FIG. 9.) After the test is completed, a pump (not shown) is attached to the string of pipe and the pressure elevated until the plugs are blown out. This eliminates a wet string of pipe, but does not disturb the sample of the contents of the well for which the test is being run.

In the example referred to, it will be apparent that (1) drilling bits, core barrels, testers, etc., at the bottom of a string of pipe can be replaced much quicker, therefore reducing operating cost, (2) the operations are far less hazardous in the absence of liquids, mud, oil, etc., on the floor of the rig for the roughnecks to slip or fall on, and (3) there is added safety in the absence of oil on the equipment. Other advantages from the elimination of the mud, oil, water, etc., will be obvious to those familiar with the operation of drilling rigs.

As a further example, in producing oil wells, a pump is conventionally disposed at the bottom of the tubing. If this pump becomes damaged or needs to be repaired or replaced, the entire string of tubing, filled with oil, must be pulled out of the hole or else a special tool is run down the side inside of the tubing and an explosive charge set off to blow off the tubing and the pump at the bottom, thus enabling the string of tubing to be pulled out "dry." By the use of the present invention, the sub can be installed immediately above the pump. When the pump needs to be replaced or repaired, a Baker type pump at the top of the tubing can be installed to elevate the internal pressure and blow out the plugs, thereby enabling the pulling of the tubing dry. This reduces the operating costs for pulling the tubing and eliminates the hazardous conditions resulting from the pulling of a wet string of tubing.

In the embodiment of FIGS. 1, 2, 3, and 4, the plugs **15** illustrated are essentially cylindrical. In the embodiment of FIG. 5, the plugs **23** are frusto-conical and the holes **22** and **24** in which they are disposed are of a shape to register therewith.

In the modified embodiment of FIG. 7, the holes **25** for the plugs are diagonally disposed and the plugs **26** are of a shape to fit them. This form of the invention results in the fluid being directed downwardly after the plugs are blown instead of horizontally as the case of the embodiments of FIGS. 1 to 5. Thus, by providing the holes in different angular positions, a degree of control in the direction of outward flow of the liquid can be obtained to meet particular conditions that may be encountered.

In the embodiment of FIG. 6, the plugs are in the shape of simple spherical balls **27** which can be used generally in different forms of holes.

What is claimed is:

1. A device of the character described comprising a tubular sub member having a group of tubular connecting means at both of its ends, the walls of the member having apertures therethrough extending from the interior to the exterior, and plug members disposed in said aperatures and frictionally engaged therewith so as to be completely removable explosively under internal fluid pressures below that required to rupture other portions of the member, said apertures being disposed in staggered relation axially of the tubular member and said plug members being contained in the apertures completely within the limits of the thickness of the walls.

2. A device of the character discribed according to claim **1** in which the tubular connecting means comprises threads.

3. A device as defined by claim **1** in which the apertures are cylindrical in shape with their axes at right angles to the longitudinal axis of the member.

4. A device as defined by claim **1** in which the apertures are cylindrical and their longitudinal axes are disposed diagonally relative to the longitudinal axis of the member.

5. A device as defined by claim **1** in which the apertures are of frusto-conical shape and the plug members are of a shape to register therewith.

6. A device as defined by claim **1** in which the plugs are spherical in shape.

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