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LARGE-DIAMETER FLUID BYPASS DRILL COLLAR

Filed March 1, 1966

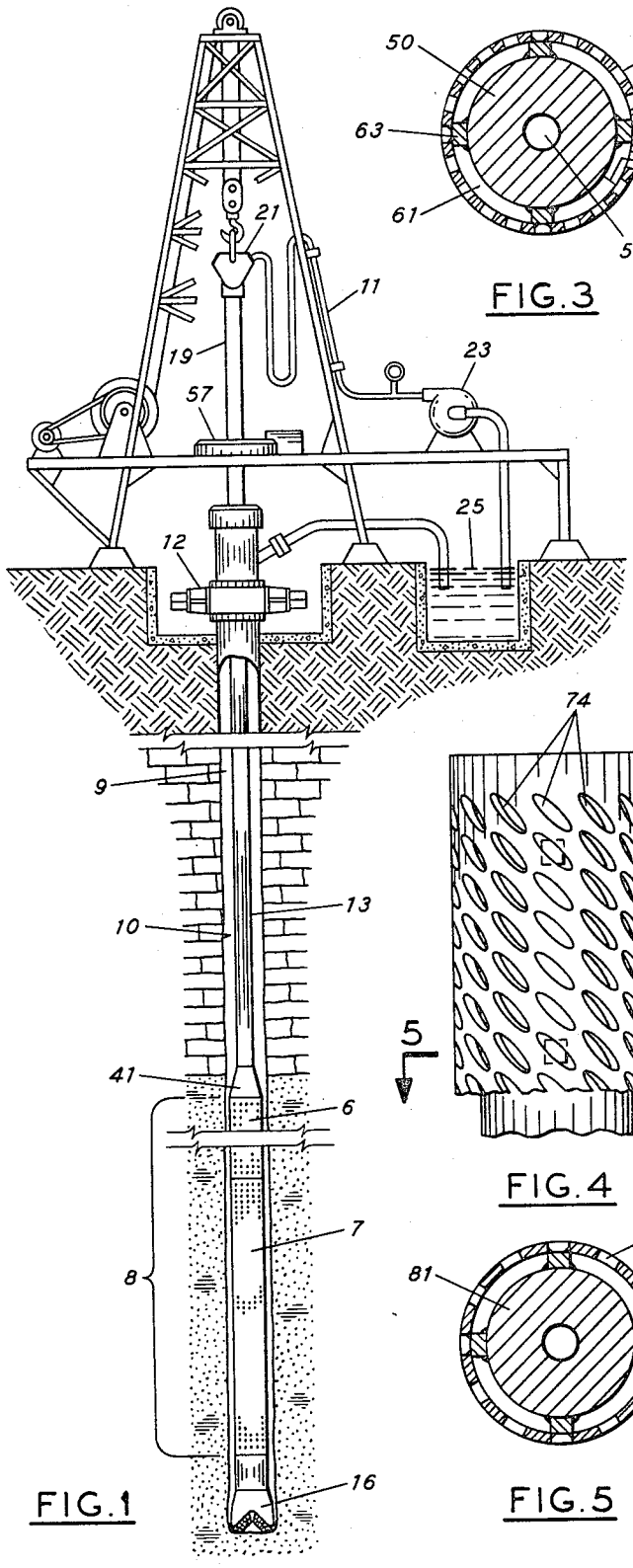

FIG. 1

FIG. 3

FIG. 4

FIG. 5

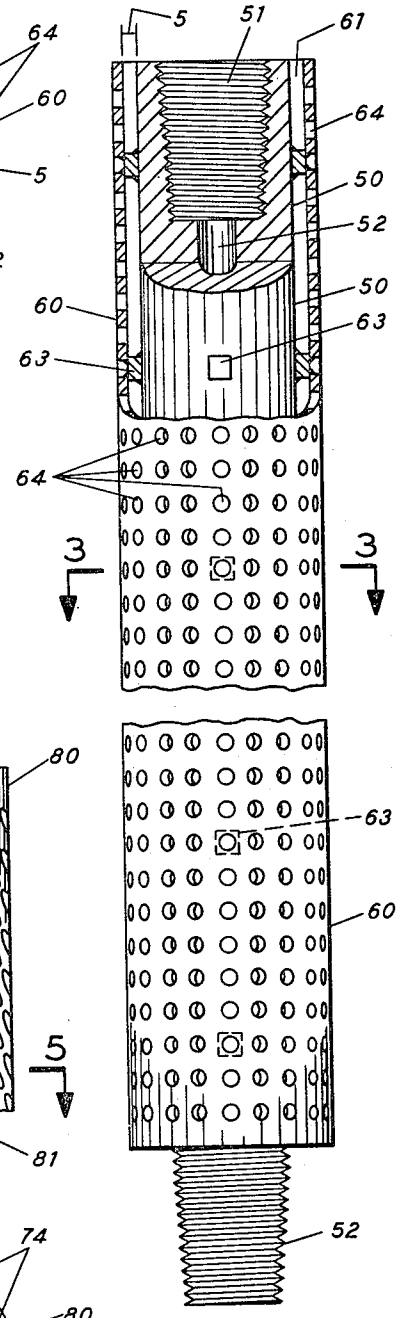

FIG. 2

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LARGE-DIAMETER FLUID BYPASS DRILL COLLAR

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5 Claims. (Cl. 64—1)

ABSTRACT OF THE DISCLOSURE

This invention is designed to prevent drill collars from sticking against the drill hole while in operation. The structure to accomplish the above end consists of a concentric collar around the drill string provided with fluid bypass ports to allow high pressure mud to flow between the drill string and drill hole, thus preventing high pressure wedging by the drill string against the drill hole.

This invention relates to drill collars for use in well drilling operations and, more particularly, this invention relates to large-diameter fluid bypass drill collars useful to provide packed holes while greatly reducing or entirely eliminating the chance of sticking the drill string.

It is a particular object of the present invention to provide a large-diameter drill collar which utilizes fluid bypass ports to allow fluid to flow between an annulus formed by an exterior tubular member and an interior tubular member of the drill collar and an annulus formed by the well wall and the exterior tubular member of the drill collar to prevent sticking of the drill collar in the well.

As is well known in the well drilling art, a drill bit suspended on a drill string is used to advance a borehole into the earth. The drill string is composed of a number of tubular pipes known as drill pipes having one or more heavier, stiffer pipes known as drill collars connected to their lower end to add weight to the drill string and to give stiffness to the lower end of the drill string. It is usually very desirable to use large-diameter drill collars to benefit from the added rigidity that such a collar will provide. By a large-diameter drill collar is meant a drill collar whose diameter approaches the effective cutting diameter of the drill bit. In softer formations, such a collar is also useful as a bearing surface for side loads on the bit to thereby assist in maintaining the direction of the well bore. Large-diameter collars have had limited use, however, due to their greater tendency to become stuck in the hole because of differential pressure sticking or because of inefficient removal of cuttings through the small annulus between the outside of the collars and the well wall.

As has been heretofore recognized, for example, in the 1957 Drilling and Production Practice of the American Petroleum Institute on p. 55 in an article entitled, "Pressure Differential Sticking of Drill Pipe and How It Can Be Avoided or Relieved," the problem of differential pressure sticking can be a severe one in well drilling where formations are encountered which have pressures greatly below the pressure existing in the well. Attempts have been made to overcome the differential pressure sticking problem. For example, U.S. Patent Nos. 2,999,552 and 3,175,374 have been directed at overcoming differential pressure sticking. There is still need, however, for a large-diameter drill collar which completely overcomes the problem of wall sticking caused by differential pressure and by incomplete or inefficient removal of cuttings.

One aspect of the present invention involves apparatus for use in a drill string comprising a first tubular member

having means at its opposite ends for connection to a drill string, means forming a longitudinal fluid passageway through said first tubular member, a second tubular member concentrically arranged around said first tubular member in fixed, spaced-apart relationship therewith to form an annular chamber between the members, means fixedly connecting said second tubular member and said first tubular member in said spaced-apart relationship and port means formed in the wall of said second tubular member to permit fluid to flow into and out of the annular chamber formed by said members.

Further objects and advantages of the present invention will become apparent from the following detailed description read in view of the accompanying drawing which is made a part of the specification, and in which:

FIGURE 1 is a longitudinal view partly in section showing the general arrangement of apparatus assembled in accordance with the present invention;

FIGURE 2 is a longitudinal view with parts broken away for clarity of presentation showing the preferred form of apparatus assembled in accordance with the present invention;

FIGURE 3 is section 3—3 of FIGURE 2;

FIGURE 4 is a longitudinal view of an alternative embodiment of the apparatus assembled in accordance with the present invention; and

FIGURE 5 is section 5—5 of FIGURE 4.

Referring now to the drawings and, in particular, to FIGURE 1, a well **10** is shown penetrating the earth. The well **10** is drilled by means of rotary table **57** turning a drill string, indicated generally as **13**, to cause it **16** to advance into the earth. Drilling fluid is supplied mrom mud sump **25** by means of pump **23** through Kelly bar **19** and swivel **21** by means of mud flow line **11**. A conventional blowout preventer **12** is connected at the well head for use in controlling pressure surges in the annulus **9** between the outside of the drill string **13** and the well wall. A number of interconnected drill pipe sections, such as **30**, **31** and **32**, and a drill collar, indicated generally as **8**, make up the drill string **13**.

In accordance with the present invention, a drill collar indicated generally by the numeral **8**, is connected by appropriate means, such as reducing sub **41**, to the lower end of a drill pipe **32**. The drill collar **8** is made up of individual drill collar sections **6** and **7**. The drill collar sections **6** and **7** are relatively heavy, stiff sections of pipe. The drill collar assembled in accordance with the present invention has a relatively large diameter compared to the diameter of the bit **16**. In this manner, the drill collar aids in maintaining hole direction and also serves to pack the sidewall of the hole. As is evident, the drill collar may be made up of one or more drill collar sections.

Referring now to FIGURES 2 and 3, a preferred form of the apparatus assembled in accordance with the present invention is shown. A first tubular member **50** is provided with thread means **51** and **52** at its opposite ends for connection in a drill string. The first tubular member **50** has a longitudinal fluid passageway **52** extending through its entire length. This permits drilling mud to flow through the inside of the drill collar to the drill bit.

A second tubular member **60** is concentrically arranged around the first tubular member **50** in a manner to provide an annular chamber **61** between the members. Means are provided to fixedly connect the tubular members **50** and **60** in this spaced-apart relationship. For example, studs **63** may be used to space apart members **50** and **60**. The members are maintained in this position by spot welds. The second tubular member **60** is provided with a plurality of port means **64** to permit fluid flow in and out of the annular chamber **61** formed between the members

50 and 60. The width 5 of the annular chamber should be at least as great as the diameter of the ports 64 as described below.

In accordance with the present invention, the port means 64 are spaced in a regular pattern in the second tubular member 60. The total open area of the port means 64 compared to the total area of the surface of the second tubular member 60 should be at least 10 percent and no more than 60 percent. Preferably, the ratio of the total open area of the ports to the total outside surface of the tubular member 60 is between 1 to 5 and 2 to 5. The individual port openings should be between about three-fourths of an inch in diameter and 2 inches in diameter.

Referring now to FIGURES 4 and 5, an alternative arrangement of an apparatus assembled in accordance with this invention is shown. In this arrangement, port means 74 are again formed in a pattern in the outer tubular member 80. In this embodiment, however, the shape of the port means 74 is oval. The total area of the ports in comparison to the total area of the tubular member should again be between 10 to 60 percent of the total outside area of the tubular member 80. The minor axis of the oval should be at least one half inch, and the major axis of the oval should be between 1 inch and 2 inches.

Although only a few embodiments of the present invention have been described in detail, the invention is not to be limited to only such embodiments but rather by the scope of the appended claims.

I claim:

1. Apparatus for use in a rotary drill string comprising a first tubular member having means at its opposite ends for connecting into a rotary drill string, means forming an uninterrupted longitudinal fluid passageway through said first tubular member, a second tubular member concentrically arranged around said first tubular member in fixed spaced-apart relationship therewith to form an annular chamber between the members, means fixedly connecting said second tubular member and said first tubular member in said spaced-apart relationship and passageway means uniformely formed in said second tubular member forming the only exit from said annular chamber to permit fluid flow from the well into and out of the annular chamber formed by said members.

2. The apparatus of claim 1 where the ratio of the area and passageway means uniformly formed in said second tubular member is between about 1 to 10 and 6 to 10.

3. The apparatus of claim 1 where the passageway means comprise a plurality of regularly spaced-apart ports.

4. The apparatus of claim 3 where each of the port openings has a minimum dimension of at least one-half inch and a miximum dimension of 2 inches.

5. The apparatus of claim 4 where the width of the annular chamber is at least equal to the minimum dimension of one of the port openings.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,411,321 November 19, 1968

Glenn A. Schurman

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 31, "it" should read -- bit --; line 32, "mrom" should read -- from --. Column 4, line 4, "uniformely" should read -- uniformly --; lines 7 to 9, "The apparatus of claim 1 where the ratio of the area and passageway means uniformly formed in said second tubular member is between about 1 to 10 and 6 to 10." should read -- The apparatus of claim 1 where the ratio of the area of passageway means to the area of the wall of the second tubular member is between about 1 to 10 and 6 to 10. --; line 16, "miximum" should read -- maximum --.

Signed and sealed this 24th day of March 1970.

(SEAL)

Attest:

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Attesting Officer

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Commissioner of Patents