Jan. 6, 1953 O. G. WALLACE 2,624,549

METHOD AND MEANS FOR ROTARY DRILLING

Filed March 24, 1947 2 SHEETS—SHEET 1

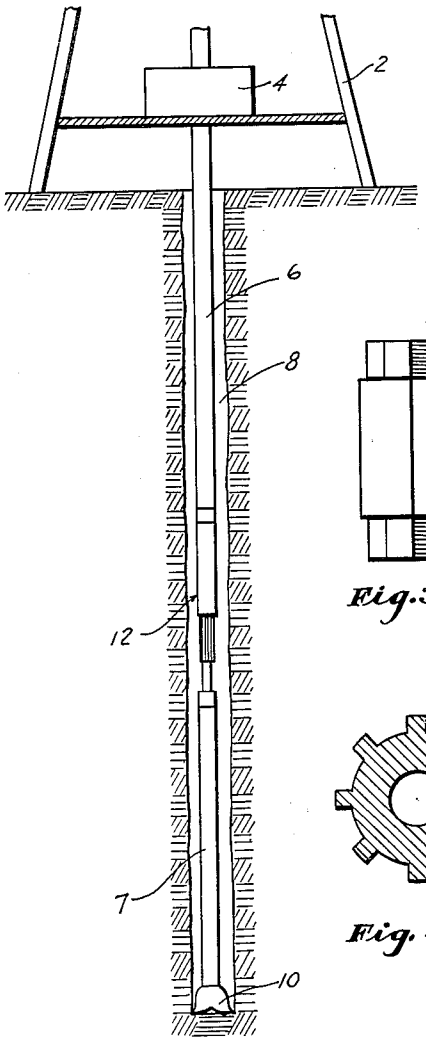

Fig. 1

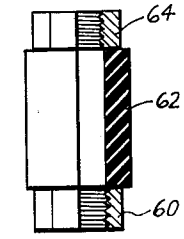

Fig. 3

Fig. 4

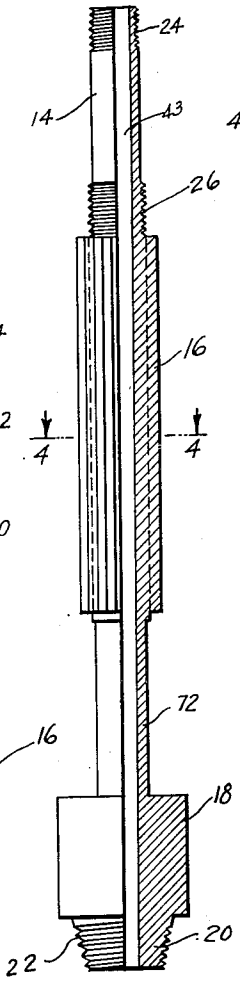

Fig. 2

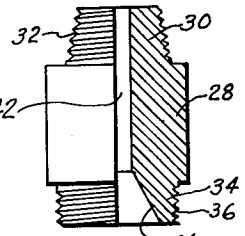

Fig. 5

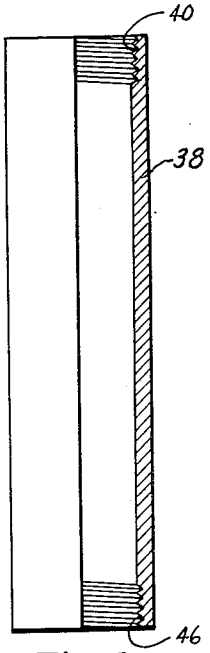

Fig. 6

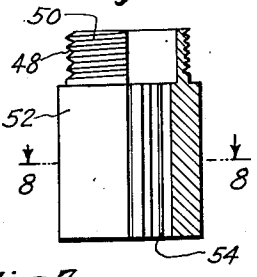

Fig. 7

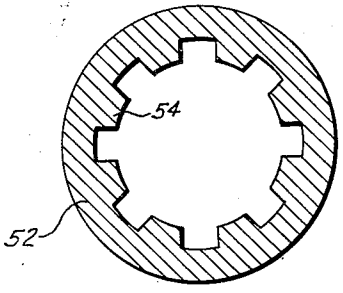

Fig. 8

INVENTOR.
O. G. Wallace
BY
L. M. McKnight

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METHOD AND MEANS FOR ROTARY DRILLING

Filed March 24, 1947 2 SHEETS—SHEET 2

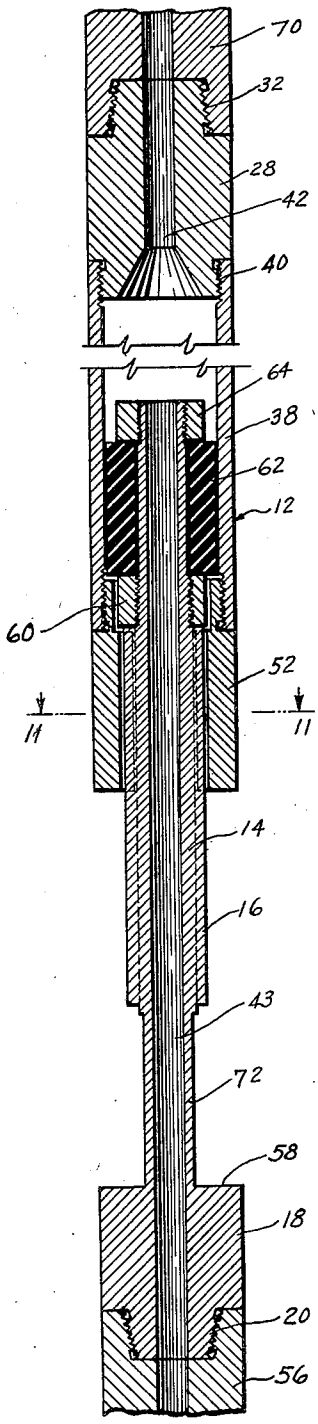

Fig. 9

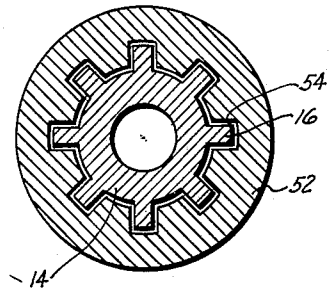

Fig. 11

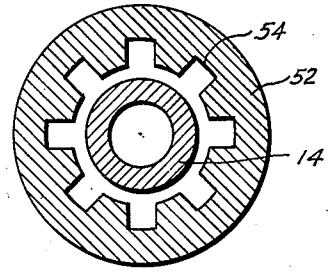

Fig. 12

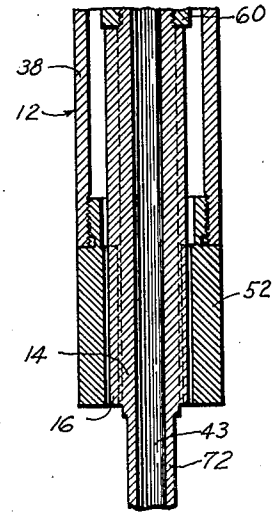

Fig. 9a

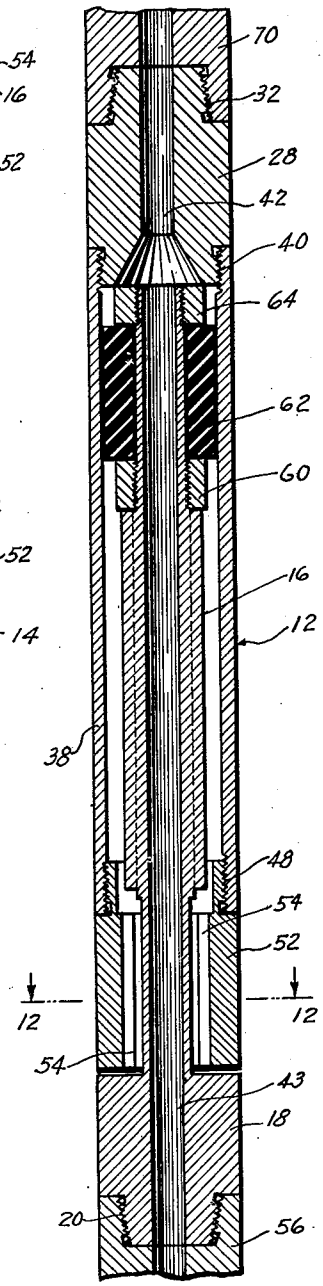

Fig. 10

INVENTOR.

O. G. Wallace

BY

G. M. McKnight

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2,624,549

METHOD AND MEANS OF ROTARY DRILLING

Oakie G. Wallace, Oklahoma City, Okla.

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3 Claims. (Cl. 255—28)

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This invention relates to well tools, and more particularly but not by way of limitation, to a well tool adapted for use in rotary well drilling.

In rotary drilling of oil wells, the weight of the drill string on the drilling bit is a very important factor. This weight is controlled at the surface of the well by a brake apparatus in the rotary drum wherein the driller slacks off the brake apparatus to permit the penetration of more drill pipe and consequent weight thereof into the well bore. In the drilling of deep wells, it is almost impossible to regulate drilling weights at the surface of the well with a weight indicator because of the friction between the drilling string and the wall of the well bore. Furthermore, variation in the drilling formation effect the amount of weight that must be carried on the drilling string, and it has been found that it is a normal tendency of operators to carry too much weight on the drill string and bit. The carrying of too much weight has many detrimental effects on the drilling operation in that it will cause the bearings and teeth on the rotary rock bit to wear much faster, and it will also cause the drill pipe to drill a crooked bore, which in turn sets up a friction between the drill stem and the wall of the bore thereby having a tendency to wear out the drill pipe due to a rubbing contact against the well bore. When the drill pipe wears out or cracks or twists off, the driller is confronted with a "fishing" operation to recover the worn or twisted off drill pipe. Furthermore, too much weight will cause longitudinal vibrations in the drill string between the bit and surface drilling equipment at the surface of the well.

The present invention provides for a pre-determined weight on the drill string by interposing the present weight tool at a pre-determined point above the bit in the drill string, and which will only permit drilling for a pre-determined distance. Any additional weight of the drill string above the tool is precluded from the drill bit, since the tool provides for a stoppage of drilling when subjected to additional weight.

It is an important object of this invention to provide a well tool which will pre-determine the amount of weight on a drill bit in a drilling string in order to prevent the many detriments caused by excessive weight in the drill bit in the drilling string.

A further object of this invention is to provide a well tool controlling the amount of weight on a drill bit in order to assure that a substantially straight bore will be drilled at all times.

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And still another object of this invention is to provide a well tool in a rotary drilling string which permits longitudinally movement therein to eliminate any vibrations in the drilling string from the tool to the surface of the well, thereby maintaining the drilling string swinging substantially free in the center of the well bore and preventing any tendency to create a whipping action thereagainst, which normally cause well bore cave-ins.

And another object of this invention is to provide a well tool interposed in a drill string for limiting the amount of weight thereon and which is capable of acting as a driving tool during a lowering of the drill string to the bottom of the bore.

Other objects and advantages of the invention will be evident from the following detailed description, read in conjunction with the accompanying drawings, which illustrate my invention.

In the drawings

Figure 1 is a vertical sectional view partly in elevation showing the drilling string disposed in the well bore.

Figure 2 is an elevational view of the main spline body.

Figure 3 is an assembly of the upper seating parts adapted to be attached to the spline body.

Figure 4 is a view taken on line 4—4 of Figure 2.

Figure 5 is an elevational view partly in section of a tool joint connection.

Figure 6 is a vertical sectional view partly in elevation of the housing.

Figure 7 is a similar view showing the lower drive collar.

Figure 8 is a view taken on lines 8—8 of Figure 7.

Figure 9 is a view in vertical section showing one operating position of the assembled well tool.

Figure 9a is a similar view showing another position.

Figure 10 is a similar view showing another operating position of the tool.

Figure 11 is a view taken on lines 11—11 of Figure 9.

Figure 12 is a view taken on lines 12—12 of Figure 10.

Referring to the drawing in detail and more particularly Figures 1 to 7 inclusive, reference character 2 designates a well derrick comprising a rotary table 4 having the usual drill pipe 6 suspended in the well bore 8. The lower end of the drilling string is provided with a drill bit 10 which upon rotation of the drill string 6 by a rotary rig (not shown) at the surface of the well pro-

vides a drilling operation. A well tool generally indicated at 12 is interposed in the drill string 6 for a purpose as will be hereinafter set forth.

Referring to Figures 2 to 7, inclusive, the well tool comprises a longitudinal cylinder 14 having a plurality of circumferentially spaced splines 16 provided on the outer periphery thereof. At a point below the splines 16, the cylindrical body 14 is provided with an enlarged flange portion 18 having a reduced tapering neck 20 provided with threads 22 adapted to act as a part of the tool joint for connection with the lower portion of the drilling string as will be hereinafter set forth. The upper portion of the body 14 is provided with threads 24 and below the threads 24 and vertically spaced therefrom are threads 26 for a purpose that will be hereinafter set forth. In Figure 5 is shown a member 28 having a tapered extension 30 provided with threads 32 adapted to provide a tool joint connection with the upper portion of the drill string 6 as will be hereinafter set forth. The body 28 is provided with a lower reduced nipple 34 having exterior threads 36 adapted to be connected with a cylindrical housing 38 by the threads 40 as shown in Figure 6. A central bore 42 is provided in the tool box connection 28 and it is flared at 44 to provide a tapered bore.

The cylindrical collar or housing 38 is provided with threads 46 at its lower end adapted to be connected with threads 48 on a reduced portion 50 of a drive collar 52 as is shown in Figure 7. The drive collar 52 is provided on its inner periphery with a plurality of longitudinally extended and circumferentially spaced spline members 54 (Figure 8). These spline members are adapted to cooperate as will be hereinafter set forth with the male spline members 16 provided on the body 14 as heretofore mentioned (Figure 11).

Referring to Figures 9 and 10 the "on and off" tool 12 for limiting the weight is adapted to be interposed in the drill string 6, at any point desired. It will be apparent that the amount of weight in the drill string and exerted on the drill bit is usually dependent upon the formation as well as the depth of the well bore. If the driller desires to use any pre-determined weight this can be easily determined by knowing the number of sections of drill pipe and multiplying them by the normal weight of each section and will give him the pre-determined weight desired to be exerted against the drill bit. Any variable amount from a few pounds to several thousand pounds may be pre-determined. All rotary rigs have a line scale clamped onto the dead line which weighs all the drill pipe inserted in the well bore. If the driller desires a pre-determined weight dependent upon the amount of drill pipe sections, he merely pulls the remaining sections out of the well bore and interposes the "on and off" tool 12 of this invention into the drill string. By "on and off" is meant that the tool functions in an "on" position to cause operation of the bit, while in an "off" position will preclude such operation.

In assembling the present invention, as shown in Figure 9, the main spline body 14 through neck 20 is connected with a tool joint connection 56 in the upper pipe section of the lower drill string 7 disposed in the well bore below the tool 12. The drive collar 52 is then placed over the spline body 14 and splines 16. The collar 52 is allowed to rest on the shoulder 58 of the projection 18. A collar 60 shown in assembly in Figure 3 is then threaded onto the threads 26 of the body 14. A rubber packing collar 62 is placed on the cylinder 14 immediately above the collar 60 and is secured by the packing nut 64 threaded to the cylinder 14 at 24. The cylindrical collar or housing 38 having the upper tool joint 28 connected thereto by the threads 36 and 40 is then inserted over the spline body 14. It being apparent that the housing 38 will slide over and around the packing 62 and threaded collar 60 and slide by the male splines 16, in order to permit a threaded connection with the lower drive collar 52. In this manner the tool 12 is interposed in the drill string, it being understood that the upper tool joint 28 is connected at 32 with a tool joint 70 secured to the lower section of the drill string 6 disposed in the well bore above the tool 12.

In complete assembly when interposed in the drill string, the tool 12 is ready to function and the drilling string is run into the well bore until the drill bit 10 contacts the drilling formation. The male splines 16 are approximately three feet in length and it is to be understood that they are not limited thereto, and any length practicable may be utilized. Furthermore, the female splines 54 are substantially one foot in length and similarly are not limited thereto. With the tool 12 assembled as shown in Figure 9, the driller merely slacks the brake (not shown) at the surface of the well and upon rotation of the table 4 by the rotary rig will cause rotation of the upper drilling string 6 with a simultaneous rotation of the housing 38 and drive collar 52. With the tool 12 in position as shown in Figure 9*a*, the flexible connection of the female splines 54 with the male splines 16 (Figure 11) which will cause a rotation of the main spline body 14, and the lower drill string 7 disposed below the tool 12 and connected thereto. The weight of the drill string 7 below the tool 12 in conjunction with the rotation of the bit 10 will move the bit through the formation. As the bit 10 moves downwardly or drills off, the cylinder 14 and splines 16 will move vertically downward through the drive collar 52 and housing 38 to a position shown in Figure 9. As soon as the drive collar 52 abuts the nut 60 limiting its up travel, it will be apparent that although the drill string is rotating, the drill bit 10 is not penetrating the formation, and the driller again slacks off the line to permit the upper drill string 6, housing 38 and drive collar 52 to slide down on the cylinder 14 to a position shown in Figure 9*a*, where the drilling operation is repeated. It will be apparent that as long as the splines are connected, rotation of the drilling string need not be stopped.

It will be apparent that if the driller purposely or inadvertently slacks off the brake at the well surface thereby allowing more penetration of the drill string and a consequent increased weight, the drive collar 52 will automatically slide down the cylinder 14 to a position adjacent the unsplined portion 72 to disconnect the splines 16 and 54 to stop rotation of the down string 7 and bit 10, thereby assuring that only the pre-determined weight originally on the drill bit 10 is not increased. With collar 52 disconnected from cylinder 14 the upper drill string will rotate considerably faster, and in order to resume the drilling operation it will be necessary for the driller to stop the rotation and "pick up" the drill string 6 at the surface of the well, in order that the collar 52 is again intermeshed or connected with

the cylinder 14 as in Figure 9a, whereby the drill string is again ready for operation.

The cylinder 14 is provided with a bore 43 in alignment with the bore 42 to permit the circulation of fluid through the drilling string as is usual in rotary drilling operations.

The packing member 62 seals off the drilling fluid from the lower end of the housing 38 and assures that the flow direction will be through the bore 43 onto the bottom of the well. The nuts 60 and 64 maintain the packer 62 in place, and furthermore, the lower nut 60 is adapted to limit the upward movement of the drive collar 52 as clearly shown in Figure 9.

Operation

From the assembly shown in Figures 1, 9 and 10, it will be apparent that the "on and off" tool 12 is interposed in the drill string, and in an "on" position, the rotation of the table 4, the drill strings 6 and 7 are also rotated to cause a simultaneous rotation of the bit 10. Furthermore, the tool 12 provides for a pre-determined amount of drilling at one time. In the present disclosure the drilling length is approximately two feet from the position shown in Figure 9a to the non-drilling or "off" position shown in Figure 9. This is due to the particular spline lengths of the body 14 and collar 52, however the invention is not limited to any particular length for the splines. As soon as the drive collar slides off the splines 16 (Figure 10) the tool is in an "off" position and the bit 10 is prevented from rotating until the collars 38 and 52 are moved vertically upward to an "on" position, when rotation of the drill string 6 causes a repetition of the drilling operation.

The tool 12 does not need any special pipe sections of drill pipe, but may be interposed at any desired point in the usual drill string.

From the foregoing it will be apparent that the present invention contemplates the uses of a tool in a drill string of rotary rig that pre-determines the weight desired on the drill bit so that the proper amount of weight can be carried in conformity with formation being drilled. Especially in a slanting formation, or "crooked hole" terrain, it is desirable to carry a lighter load on the bit to assure the drilling of a straight bore. The present device automatically permits only a predetermined weight, and precludes any additional weight on the bit during rotation thereof which may cause crooked drilling, by stopping all rotation of the bit when such extra weight is either accidently or purposely placed on the bit.

The present invention assures that the drilling length or time is substantially accurate, since the driller knows the instant the tool has drilled "off" by the increased rotation of the upper string. This makes the operation of all drillers on different shifts substantially equal without affording any opportunity for inefficiency or error. Furthermore, the present apparatus can be utilized as a driving tool, during the lowering of the drill string in the well bore, in order to act as a jar down on the bit to drive through shell formations, "bridges" and the like that normally have to be drilled or reamed. Furthermore, when the bit pulls up in a tight place and becomes stuck, the driving action of the tool permits driving the bit down in order to loosen it, thereby eliminating many fishing jobs. The flexible and telescoping connection between the male and female splines substantially eliminates vibration and bouncing

in the drill string thereby eliminating tool joint freezing and gouging. This elimination of the drill string vibrations and bouncing provides for a much more efficient drill operation and especially eliminates considerable wear and tear on the auxiliary drilling equipment and provides a longer life therefore. In Figures 5, 9 and 10 a tool joint pin is shown for connecting the tool with the drill strings, however it will be apparent that a box may also be used.

Changes may be made in the specifications and drawings without departing from the spirit of the invention within the scope of the following claims, as set forth.

What I claim is:

1. In an apparatus for controlling the weight carried on a drill bit during the drilling of an oil well and comprising telescoping members interposed in the drill string and related for longitudinal movement therebetween, said members including a cylinder having a plurality of male spline members thereon, a flange member disposed on the cylinder and adapted to be connected with the lower drill string, an unsplined portion on the cylinder between the male splines and the flange of smaller diameter than the splined portion, a tubular housing adapted to telescope over the cylinder, a drive collar connected with the housing, a tool joint for connecting the housing with the upper drill string, and female splines on the drive collar adapted to cooperate with the male splines in one position of the telescoping members to cause rotation of both the upper and lower drill strings.

2. In an apparatus for controlling the weight carried on a drill bit during the drilling of an oil well and comprising telescoping members interposed in the drill string and related for longitudinal movement therebetween, said members including a cylinder having a plurality of male spline members thereon, a flange member disposed on the cylinder and adapted to be connected with the lower drill string, an unsplined portion on the cylinder between the male splines and the flange of smaller diameter than the splined portion, a tubular housing adapted to telescope over the cylinder, a drive collar connected with the housing, a tool joint for connecting the housing with the upper drill string, and female splines on the drive collar adapted to cooperate with the male splines in one position of the telescoping members to cause rotation of both the upper and lower drill strings, said female splines and drive collar adapted to be moved to the unsplined portion of the cylinder to preclude rotation of the lower drill string, and means providing for fluid circulation through the apparatus to the bit.

3. In a control unit interposed in a drilling string of an oil well for controlling the weight carried on the drill bit, and comprising an outer telescoping member connected to the upper portion of the drill string, and inner telescoping member connected to the lower portion of the drill string, said telescoping members having longitudinal movement relative to each other, a plurality of cooperating spline members between the telescoping members to provide transmission of torque from the upper drilling string to the lower drilling string in one position of the telescoping member, a nut carried by the inner telescoping member for limiting the upward movement of outer member in said position, a portion provided on the inner member of smaller

diameter than the splined portion causing disconnection of the spline members in one portion thereof to preclude transmission of torque to the lower drilling string after a predetermined longitudinal movement between the members, flange means on the inner member for limiting the longitudinal movement in said last mentioned position, and packing means between the inner and outer members to preclude fluid leakage therebetween.

OAKIE G. WALLACE.

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