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DRILLING SLEEVE

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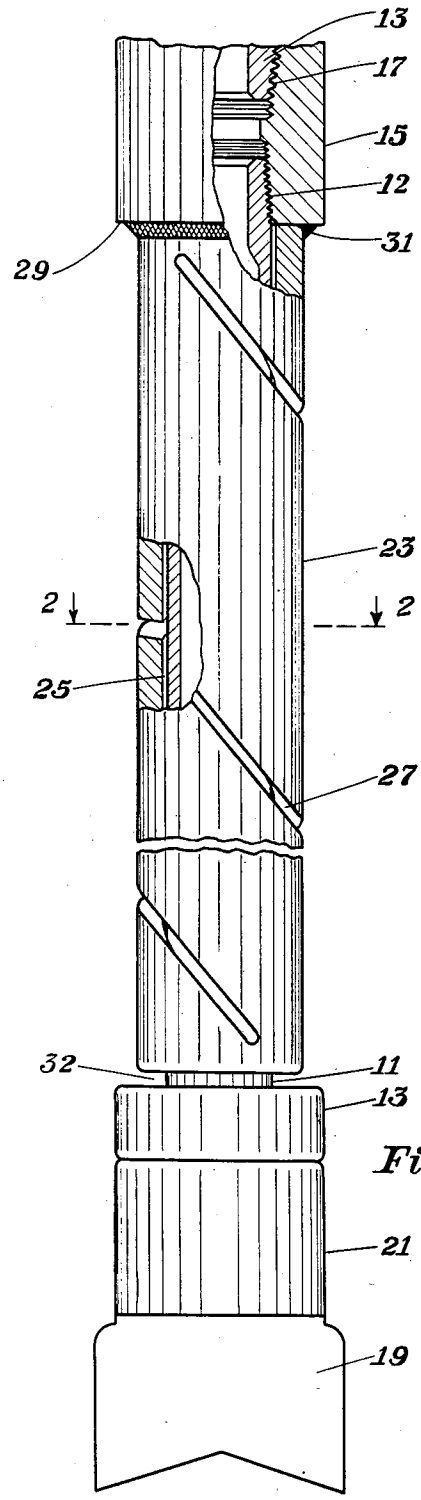


Fig. 1

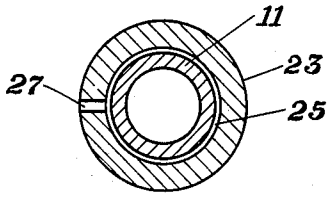


Fig. 2

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DRILLING SLEEVE

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11 Claims. (Cl. 255—28)

This invention relates to drilling strings employed in the rotary drilling of wells, and is more particularly directed to improved bottom hole assemblies.

In order to increase the rate of penetration of the drill bit into the formation, resort has generally been had to two methods, namely, increasing the speed of rotation of the bit and increasing the weight on the drill bit, so that the cutting edges of the bit bear against the formation with increased pressure. Greater rates of penetration can be obtained for a given speed of rotation when the weight on the drill bit is increased.

It is an object of this invention to provide a drilling string having a high proportion of the weight at the lower end thereof, and more particularly, to provide a bottom-hole assembly of increased weight.

It is another object of this invention to provide a bottom-hole assembly having increased weight distributed in such manner as to reduce failures in the drilling string.

It is a further object of this invention to provide weighted bottom-hole assemblies in which the concentration of stresses in the joints is avoided.

It is still another object of this invention to provide a bottom-hole assembly having weighting sleeves of unusually high flexibility mounted thereon.

It is still another object of the invention to provide means for increasing the rate of penetration of the drill in rotary drilling operations.

It is a further object of this invention to provide a bottom-hole assembly having flexible weighting sleeves mounted thereon which may be employed with a minimum risk of becoming lost in a well bore.

Other objects will be apparent from the following description and drawing of which

Figure 1 is a vertical view partly in section of the lower end of a weighted drilling string in accordance with one form of this invention; and

Figure 2 is a cross sectional view taken on the line 2—2 of Figure 1.

Referring to the drawing, standard drill pipe sections 11 are connected through threaded connections such as 12 by tool joints composed of pin elements 13 and box elements 15 preferably of larger outside diameter than the drill pipe. The pin and box elements are joined by a coarse threaded connection 17. A drilling bit 19 is threaded to the assembly on the lower end thereof through the tool joint 21 in a conventional manner.

Between the tool joints 15 and 21 and encasing the drill pipe 11 there is mounted a loose fitting hollow cylindrical weighting sleeve 23, the internal diameter of which is necessarily larger than that of the drill pipe 11 and is sufficiently large to allow for a small amount of annular free space 25 between the sleeve and drill pipe. This annular space may conveniently be from about $\frac{1}{8}$ to $\frac{3}{4}$ inch, the minimum being that which permits the sleeve to fit around the drill pipe without reinforcing the wall thereof and the maximum being that which permits the sleeve to have substantial weight per unit of length while maintaining an outside diameter not substantially in excess of the adjacent tool joints. By leaving a space between the drill pipe 11 and sleeve 23, the drill pipe is free to be laterally deflected and thus absorb over a relatively extended area a large portion of the torsional and bending stresses and thereby avoid a concentration of stresses at the threaded portions of the tool joints such as at 12 and 17. This result is possible only so long as the wall of the drill pipe 11 is more flexible than the threaded portions of the pipe and tool joint connecting elements.

A very small amount of free space between the weighting sleeve and drill pipe may be used and the desired flexibility of the drill pipe maintained by employing a weighting sleeve having a spiral slot or groove 27 which extends completely through the wall of the weighting sleeve. This slot provides for great flexibility in the weighting sleeve and avoids a rigid reinforcement to the drill pipe, even when unusually small clearance between the drill pipe and weighting sleeve are used. The outer diameter of the sleeve 23 may be of any convenient diameter depending upon such factors as the size of the drill bit employed and the weight per foot which it is desired to add to the drilling string, but is preferably not substantially in excess of the outer diameter of the tool joints and may advantageously be of a smaller diameter than the tool joints. The latter construction is preferred since this provides for a shoulder at 29 to which an elevator grip can be conveniently attached and also can be used for attachment of grappling tools in the event that there is a break in the drilling string and a fishing job is required.

The sleeve 23 preferably consists of a single section of tubing which extends substantially the entire distance between tool joints, sufficient space being provided at one end between the

sleeve and adjacent tool joint to avoid any possible transmission of torsional stress from the weighting sleeve to the tool joint. At least one end of the weighting sleeve is in engagement with the drill pipe by means of engagement with an adjacent tool joint so that the sleeve is made to rotate in unison with the drill pipe. This may be conveniently effected by rigidly attaching the upper end of the sleeve to the adjacent tool joint by welding as at 31. Inasmuch as the principal function of the sleeve is to add weight without adding strength to the portion of the drill pipe between tool joints, it is apparent that it is neither necessary nor desirable to rigidly attach the sleeve at both ends to tool joints. The weighting sleeve is preferably of slightly less length than the distance between tool joints as shown at 32. In order to obtain maximum flexibility in the weighting sleeve, the helical slot 27 preferably extends over substantially the entire length of the sleeve. In order to maintain a minimum number of pieces in the event of fracture of a sleeve and thereby simplify fishing jobs, the slot is preferably terminated within a short distance of the upper and lower extremities of the weighting sleeve.

Any suitable number of weighting sleeves may be employed depending upon the pressure with which it is desired that the bit bear upon the formation being drilled and upon the point in the drilling string at which it is desired to maintain the equilibrium between compression and tension forces. For example, if it is desired to maintain a given equilibrium point and at the same time increase the load carried on the bit from 10,000 pounds to 20,000 pounds, a sufficient number of sleeves are added to the lower end of the string to amount to 10,000 pounds additional weight. If 3½" O. D. drill pipe and 5" O. D. tool joints are being used in the lower portion of the string, the weight will be about 16 pounds per foot. Sleeves having 3⅝" I. D. and 5" O. D. are mounted between the tool joints.

To illustrate by means of a particular example, a suitable weighting sleeve may be formed of 4½" O. D. drill pipe. This pipe has an internal diameter of 3.958" and therefore will fit loosely around a drill stem formed of drill pipe having an O. D. of 3½". In this case the annular space between the 3½" O. D. drill stem and the weighting sleeve would be approximately 0.229". A slot may be conveniently cut in the weighting sleeve by means of an oxy-acetylene torch. This is preferably of about ⅜" in width. The vertical distance between turns of the spiral may be varied between relatively wide limits, the preferred construction being that which provides for maximum weight per unit of length together with the desirable flexibility. In this particular example the vertical distance between turns is approximately 12" and the spiral slot terminates approximately 12" from the ends of the sleeve. The sleeve may be conveniently marked for cutting by simply wrapping a strip of paper 8" wide around the sleeve, leaving ⅜" clearance between each turn of the paper.

Weighting sleeves which are attached to drilling strings at the lower ends thereof in the manner previously described have the effect of increasing the rate of penetration of the drill bit into the formation by increasing the weight of the drill bit. This is effected without causing a concentration of stresses in the threaded portions of the drilling string with resultant drill pipe and tool joint failures, even though the annular clearance between the drill pipe and weighting sleeve is very small. By maintaining this clearance very small, a heavier walled weighting sleeve may be employed than is possible when using conventional solid walled sections of weighting sleeve and this is effected without exceeding the outside diameter of the tool joints or undesirably reinforcing the drill pipe.

The sleeves may be used in conjunction with or instead of conventional drill collars, although because of both structural and economic advantages, the latter alternative is preferred. If conventional drill collars are employed, the sleeves are usually positioned above and adjacent to the drill collars.

While a particular form of the invention has been described, it will be apparent to those skilled in the art that numerous modifications thereof may be devised without departing from the spirit of the invention.

What is claimed is:

1. In a drilling string, the combination of sections of drill pipe connected by tool joints of greater diameter than the drill pipe, a weighting sleeve positioned on a lower portion of the string, said sleeve fitting loosely around the drill pipe and being engaged with an adjacent tool joint in such manner as to cause the sleeve to rotate with the string, said weighting sleeve having a helical slot therethrough whereby the flexibility of the weighting sleeve is materially increased.

2. Apparatus in accordance with claim 1 in which the helical slot extends to within a short distance of each end of the sleeve.

3. Apparatus in accordance with claim 1 in which the upper end of the sleeve adjacent a tool joint is of sufficiently smaller outer diameter than the tool joint to provide a shoulder for the attachment of elevators.

4. Apparatus in accordance with claim 1 in which the outer diameter of the sleeve is of uniformly smaller outer diameter than that of adjacent tool joints.

5. In a drilling string the combination of sections of drill pipe connected by tool joints of greater outer diameter than the drill pipe, a weighting sleeve positioned on a lower portion of the string, the inner diameter of the sleeve being less than the outer diameter of adjacent tool joints, the sleeve fitting loosely around the drill pipe and having an end thereof rigidly affixed to an adjacent tool joint, said weighting sleeve having a helical slot therethrough extending over a major proportion of the length of the sleeve.

6. In a drilling string, the combination of sections of drill pipe connected by tool joints of greater outer diameter than the drill pipe, a weighting sleeve positioned on the lower portion of the string between tool joints, the outer diameter of the sleeve being less than the outer diameter of adjacent tool joints, said sleeve fitting loosely around the drill pipe and being rigidly attached to an adjacent tool joint, said sleeve having a helical slot therethrough extending from a point adjacent one end of the sleeve to a point adjacent the other end of the sleeve.

7. Apparatus in accordance with claim 6 in which the weighting sleeve is rigidly attached at its upper end to a tool joint.

8. Apparatus in accordance with claim 6 in which the length of the weighting sleeve is sufficiently less than the distance between adjacent tool joints to fit loosely therebetween.

9. In a drilling string, the combination of sections of drill pipe connected by tool joints and a weighting sleeve positioned on a lower portion of the string, said sleeve having a larger inside diameter than the outside diameter of said pipe and having a helical slot therethrough.

10. The combination in accordance with claim 9 in which the upper end of the sleeve is rigidly fastened to the drill string and the lower end of the sleeve is free and spaced from its adjacent tool joint.

11. In a drilling string, the combination of sections of drill pipe connected by tool joints and a weighting sleeve of larger inside diameter than said drill pipe positioned on a lower portion of the string between adjacent tool joints, said sleeve being in the form of a plurality of helices with one end of said sleeve engaging the drill string in such manner as to cause the sleeve to rotate in unison with said string and the other end of the sleeve being free.

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