

June 2, 1964

H. BLACK

3,135,103

FLEXIBLE JOINT FOR DRILL STRING

Filed April 27, 1962

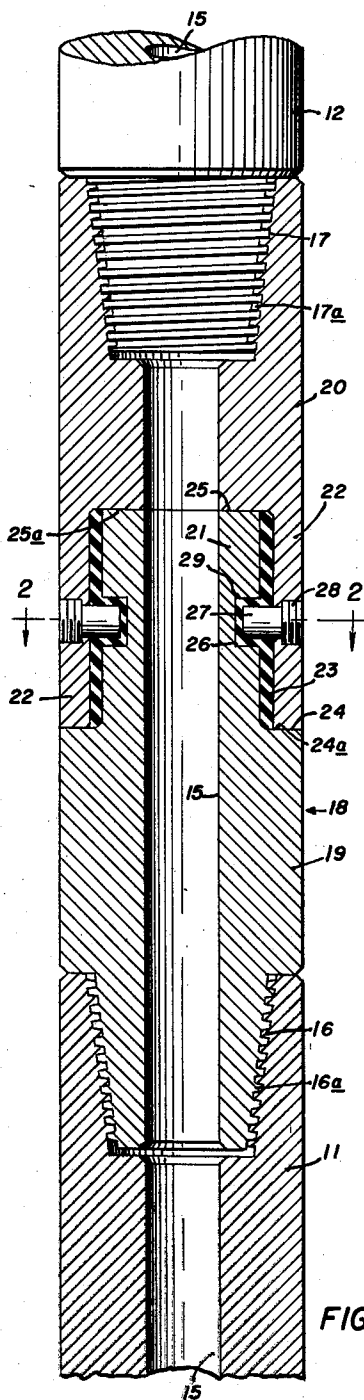


FIG. 1.

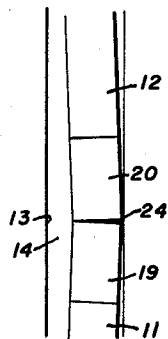


FIG. 5.

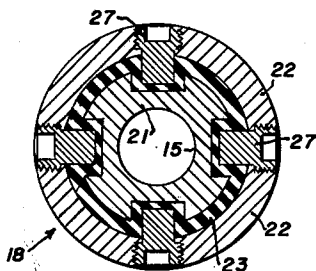


FIG. 2.

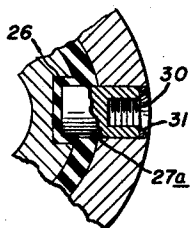


FIG. 3.

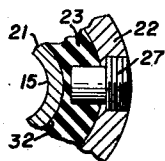


FIG. 6.

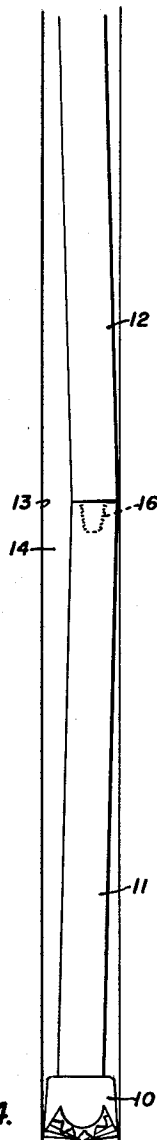


FIG. 4.

HAROLD BLACK
INVENTOR

BY *Herbert J. Brown*
ATTORNEY

1

3,135,103

FLEXIBLE JOINT FOR DRILL STRING

Harold Black, Box 5053, Abilene, Tex.

Filed Apr. 27, 1962, Ser. No. 190,733

2 Claims. (Cl. 64-11)

This invention relates to the rotary method of drilling wells and has reference to a flexible joint to be located in a drill string for relieving stress in pipe and drill collar connecting threads.

In rotary drilling the effectiveness of the drill bit on the formation being cut depends, to a large extent, on the weight of the drill string applied to the bit. Frequently, drill collars, that is, thick wall lengths of tubing are threadedly connected in the drill string to increase weight. The length of the drill string sometimes flexes in the bore hole and the flexibility of the connected lengths of drill pipe usually prevents damaging stress in the threaded pipe joints. However, since the drill collars have thick walls the resulting stresses are concentrated in the connecting threads which tend to break.

It is an object of this invention to provide an intermediate sub with added flexibility to be inserted at the joints between the drill collars to relieve the strain concentrated at the drill collar threads.

It is a further object of the invention to provide a flexible connection which will carry the torque load of the rotary drill without breaking the solid steel to steel vertical contact through the threaded joints.

A further object of the invention is to provide a flexible joint which will prevent the drilling string from separating even though its torque transmitting element is destroyed by overload or deterioration, and which will carry the weight of the string below the joint when it is necessary to pull the string from the well.

These and other objects of the invention will become apparent from the following description and the accompanying drawings, wherein:

FIGURE 1 is a vertical cross section of the stress relieving sub between the ends of the adjacent drill collars.

FIGURE 2 is a horizontal section taken on line 2-2 of FIGURE 1.

FIGURE 3 is a detail of the cross section similar to FIGURE 2, but illustrating a modification of the invention.

FIGURE 4 is a diagram exaggerating the bending of the drilling string near the bottom of the hole.

FIGURE 5 is a diagram exaggerating the bending of the drill string with the invention included.

FIGURE 6 is a transverse section view similar to FIGURE 2 but showing a further modified form of the invention.

As shown in FIGURE 4 the drilling string has a rotary rock bit 10 attached to the end of a drill collar 11 which, in turn, is attached to a second drill collar 12. The drill string thereabove is not shown.

The diameter of the bore hole 13 is determined by the size of the bit 10 and is larger in diameter than the drill collars 11 and 12 or any pipe in the drill string so as to provide an annulus 14 therearound through which the drilling fluid is returned to the earth's surface after having been pumped to the bit through a central bore extending through the drill string including the drill collars as indicated at 15.

The upper and lower ends of the drill collars 11 and 12 have internal and external threads 16 and 17, and the assembled sub 18 comprising the present invention is connected therebetween.

The sub 18 includes a lower tubular portion 19 having threads 16a on the lower end thereof for engagement with the internal threads 16 in upper end of the drill collar 11

2

therebeneath, and a similar upper tubular portion 20 having threads 17a in the upper end thereof for engagement with the external threads 17 in the lower end of the drill collar 12 thereabove. The upper end of the lower part 19 of the sub 18 is provided with a cylindrical axial extension 21 which is retained within and spaced from a cylindrical axial socket 22 in the lower end of the upper part 20. The annulus between the extension 21 and the socket 22 is filled with rubber 23 which is vulcanized or otherwise bonded to both parts of the sub 18. The transverse face 24 of the socket 22 bears against the shoulder 24a at the base of the extension 21 and the transverse face 25 of the extension 21 bears against the flat bottom 25a of the socket 22.

The rubber 23 allows for the bending of the sub 18 between its parts 19 and 20 as shown by the exaggerated diagram, FIGURE 5, yet the bending strain transmitted to the threads 16 and 17 is not beyond their strength. The axial extension 21 is provided with radial round holes 26 to receive the ends of inwardly extending plugs 27 held in the walls of the socket 22 by threads 28. The plugs 27 are spaced within the holes 26, and which spaces are filled with the rubber 23. The torque of the drilling operation is transmitted through the sub 18 by the shear strength and the bond of the rubber 23. The plugs 27 and rubber 23 in the holes lend a part in transmitting the torque and in case of the failure of the rubber 23 through overloading or deterioration the plugs are left intact to bear against the upper surface 29 of the holes 26 and hold the string together while it is pulled from the well for repairs.

An alternate form of plug 27a is shown in FIGURE 3 which is welded instead of being threaded into the socket 22. The outer end of the plug may be provided with internal threads 30 for attaching a tool, not shown, to remove the plugs for repairs to the sub 18 after cutting the weld 31.

The further modified form of the invention shown in FIGURE 6 shows an annular groove 32 in the extension 21 for receiving the inner ends of the plugs 27 which are spaced from the surfaces of the grooves and which groove is filled with rubber 23. While this form of the invention may not carry the torque loads of the first form of the invention, but in the event of failure of the rubber 23 the length of collars and drill string below the sub 18 may be retrieved.

The invention is not limited to the exemplary construction herein shown and described, but may be made in various ways within the scope of the appended claims.

What is claimed is:

1. A flexible sub for connection in a drill string, said sub comprising: first and second axially aligned tubular members, a cylindrical extension of reduced outside diameter on an end of the first said member, a cylindrical socket within an end of the second said member and receiving said cylindrical extension, the axial length of said socket and said extension being substantially equal, the extending end of said cylindrical extension being in substantial abutting contact with said second tubular member, resilient material between the cylindrical wall of said socket and the cylindrical surface of said extension, and means transmitting torque loads from one said member to the other said member, said means being comprised of radially disposed pins carried by one of said members and extending into said resilient material.

2. A flexible sub for connection in a drill string, said sub comprising: first and second axially aligned tubular members, a cylindrical extension of reduced outside diameter on an end of the first said member, a cylindrical socket within an end of the second said member and receiving said cylindrical extension, the axial lengths of said

3

socket and said extension being substantially equal, the extending end of said cylindrical extension being in substantial abutting contact with said second tubular member, resilient material between the cylindrical wall of said socket and the cylindrical surface of said extension, means transmitting torque loads from one said member to the other said member, said means being comprised of radially disposed pins carried by said cylindrical socket and received within radially disposed holes in said cylindrical

5

4

extension, and resilient material within said holes and around the portions of said pins received therein.

References Cited in the file of this patent**UNITED STATES PATENTS**

2,620,165	Crickmer	Dec. 2, 1952
2,765,147	Vertson	Oct. 2, 1956
2,795,398	Ragland	June 11, 1957
2,900,809	Crankshaw	Aug. 25, 1959