United States Patent

[11] **3,575,246**

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[54] **OIL WELL BUMPER SUB**
5 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **175/293,** 175/321
[51] **Int. Cl.** **F21b 1/10,** F21b 17/00
[50] **Field of Search** 175/293, 321; 277/62, 104, 123

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ABSTRACT: An oil well bumper sub in which an elongate cylindrical body is drivingly connected to a drill string supported mandrel that extends therethrough by a plurality of circumferentially spaced, longitudinally extending rows of balls located within the interior of said body, which balls permit limited longitudinal movement of the mandrel relative to the body. An annulus-shaped space that is defined between the mandrel and body is filled with a flowable lubricant and maintained therein by seals at the ends of the body. The lubricant cooperates with the seals and tends to prevent entry of any foreign matter into the interior of the body whereby the lubricant assures free longitudinal movement of the mandrel relative to the body.

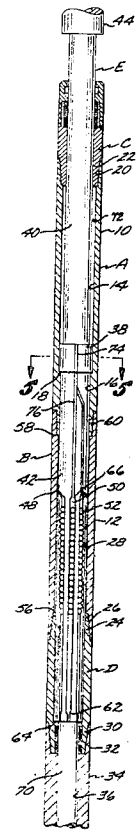

FIG. 1

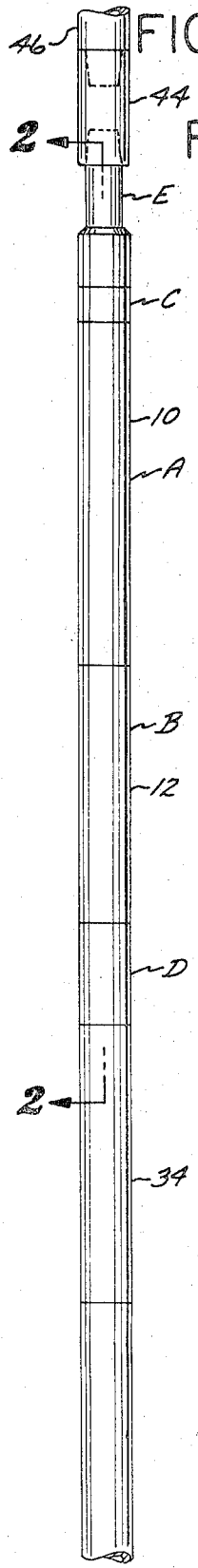

FIG. 2

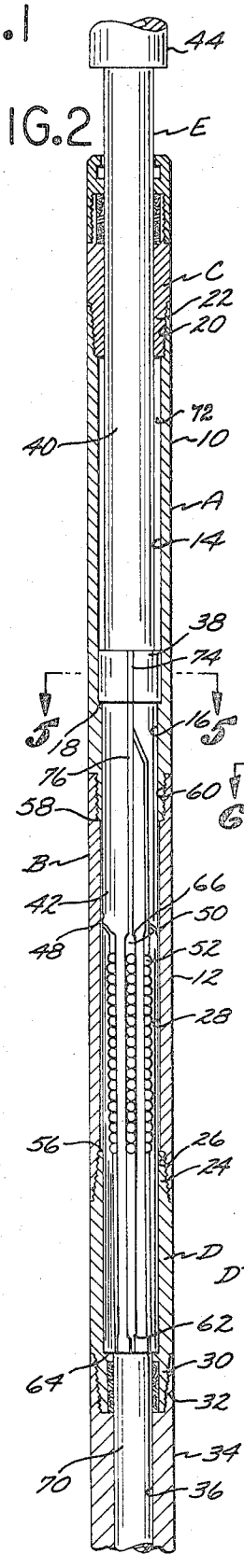

FIG. 3

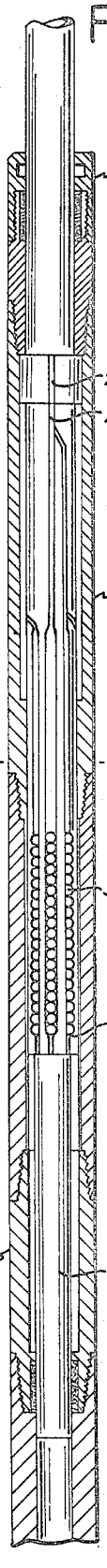

FIG. 4

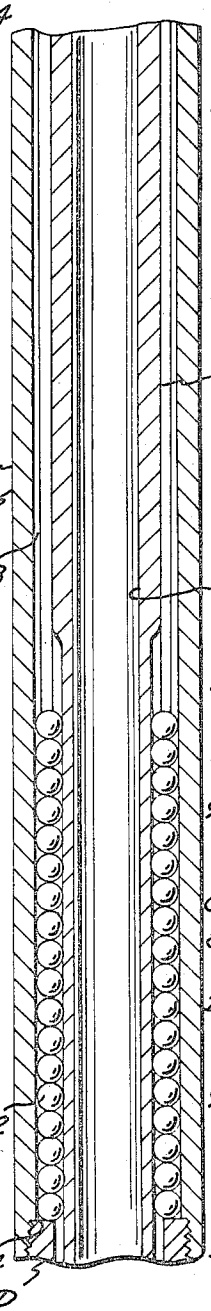

FIG. 5

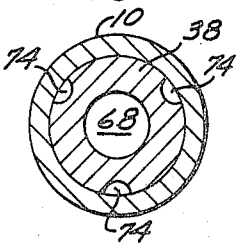

FIG. 6

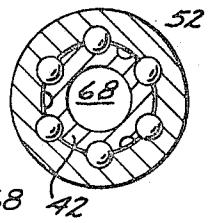

FIG. 7

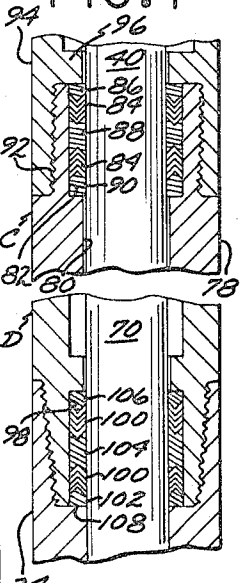

FIG. 8

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OIL WELL BUMPER SUB

BACKGROUND OF THE INVENTION

1. Field of the Invention

A bumper sub for transmitting torque from a drill string to a bit supporting drill collar in such a manner that the drill string may move longitudinally within predetermined limits relative to said drill collar and bit without moving the latter.

2. Description of the Prior Art

Although bumper subs have been used for a number of years in drivingly connecting a drill string to a bit supporting drill collar, one operational disadvantage of such prior devices has been that foreign material and drilling mud tend to enter the interior thereof. When drilling mud dries in the interior of a bumper sub it tends to cement the movable portions thereof together, with consequent performance failure for only limited longitudinal movement of the drilling relative to the bit supporting drill collar is possible without imposing additional strain on the drill collar or drill string. The present invention overcomes the operational disadvantages of prior bumper subs by maintaining the interior of the invention in a lubricant flooded condition, which permits not only free longitudinal movement of parts within the invention, but minimizes the possibility that foreign material and drilling mud might leak into the interior of the invention as well.

SUMMARY OF THE INVENTION

A bumper sub including an elongate, internally and longitudinally grooved cylindrical body through which an externally grooved mandrel extends, with the body and mandrel being removably locked together against relative rotational movement by a number of rows of longitudinally extending balls that are disposed in said grooves. The upper end of the mandrel is attached to the lower end of a drill string, with the lower end of the body being attached to a drill bit supporting assembly.

As enlarged longitudinally grooved stop provided on the mandrel slidably engages the interior of the body, and the stop serves to limit longitudinal movement of the mandrel relative to the body. The interior of the body contains a quantity of flowable lubricant which substantially fills the same and assures that the internal parts of the bumper sub will be freely movable relative to one another. The lubricant also minimizes the possible entry of foreign material and drilling mud into the interior of the body to cause the mandrel to bind therewith.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevational view of the bumper sub connected to a drill string and a drill bit supporting assembly;

FIG. 2 is a longitudinal cross-sectional view of the bumper sub, taken on the line 2–2 of FIG. 1;

FIG. 3 is a longitudinal cross-sectional view of the bumper sub, taken at the same position as FIG. 1, but with the bumper sub in a different position;

FIG. 4 is an enlarged fragmentary longitudinal cross-sectional view of the bumper sub;

FIG. 5 is a transverse cross-sectional view of the bumper sub, taken on the line 5–5 of FIG. 2;

FIG. 6 is a transverse cross-sectional view of the bumper sub, taken on the line 6–6 of FIG. 3;

FIG. 7 is an enlarged fragmentary longitudinal cross-sectional view of the upper portion of the bumper sub; and

FIG. 8 is an enlarged fragmentary longitudinal cross-sectional view of the lower portion of the bumper sub.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The bumper sub A, as may best be seen in FIGS. 1 and 2, includes a cylindrical body B that is preferably defined by upper and lower tubular sections 10 and 12, respectively, that are threadedly connected at the adjoining ends thereof. A first upper bore 14 and second lower bore 16 are formed in section 10, which at the junction thereof define a body shoulder 18.

Internal threads 20 are formed on the upper end of section 10 which are engaged by a lower externally threaded end 22 of a first tubular end piece C. A second tubular end piece D is provided with an externally threaded upper end 24 that engages internal threads 26 formed in the lower portion of lower section 12. A bore 28 extends throughout the length of section 12, and is preferably the same diameter as that of the second bore 14 with which it is in longitudinal alignment.

The lower threaded end 30 of the end piece D engages the internally threaded upper end 32 of a drill bit supporting assembly 34, which assembly is of conventional design. An elongate tubular mandrel E is provided that extends downwardly through first end piece C, body B, lower end piece D, and into a bore 36 formed in the assembly 34. An enlarged cylindrical stop 38 is provided at an intermediate position on mandrel E, and divides the mandrel into an upper portion 40 and lower portion 42. The stop 38 is slidably disposed in the first bore 14, as shown in FIG. 2. The upper end of mandrel E is screw-threaded into a collar 44, which collar in turn is threadedly connected to the lower end of a tubular drill string 46.

A number of circumferentially spaced grooves 48 are formed in the lower tubular section 12, as may best be seen in FIGS. 2 and 4. Grooves 48 are in radial alignment with longitudinally extending grooves 50 provided in the lower mandrel portion 42.

A number of hard, rotatable means 52 are provided, which are arranged in longitudinally extending rows and engage the grooves 48 and 50. The rotatable means 52 may be either hardened balls, as illustrated in the accompanying drawing, or rollers (not shown). The grooves 50 extend in the lower section 12 from points 56 directly above the threads 26 to points 58 directly below the threads 60. Grooves 48 extend upwardly from points 62 above the lower end 64 of a lower mandrel section 42 to points 66 a substantial distance thereabove, as shown in FIGS. 2 and 4. A bore 68 extends downwardly through mandrel E, and is in communication with a tube 70 that depends from lower section 42. The lowermost units of the rotatable means 52 rest on the body shoulder 54 when the bumper sub A is in the position shown in FIGS. 2 and 4.

The rotatable means 52 interlock with the grooves 48 and 50 and prevent relative rotational movement between the mandrel E and body B whereby torque from the drill string 46 may be transmitted to the drill bit support assembly 34. Mandrel E may move longitudinally relative to body B (FIGS. 2 and 3), with downward movement of the mandrel relative to body B being restricted by stop 38 when it contacts body shoulder 18. Upward movement of mandrel E relative to body B is limited by stop 38 when it contacts the lower end of first end piece C, as illustrated in FIG. 3.

The bores 14 and 16 are substantially filled with a quantity of flowable lubricant 72 that not only serves to lubricate the rotatable means 52, but minimizes the tendency of drilling mud and foreign matter to leak into the interior of the bumper sub. After entry into the interior of the bumper sub A, the drilling mud or other foreign matter may solidify and cause binding between mandrel E and body B. Such binding prevents free longitudinal movement of the mandrel E relative to body B, resulting in the imposition of undue longitudinal stresses on the drill string 46.

Longitudinal passes are formed in stop 38, preferably in the form of a number of channels 74 on the exterior surface thereof. The channels 74 communicate with additional channels 76 formed on the exterior surface of lower mandrel portion 42, and these channels communicate with grooves 48. Channels 74 and 76 permit longitudinal flow of lubricant back and forth in body B as the mandrel E travels longitudinally relative to the body.

Upper end piece C includes a cylindrical body 78 situated above the lower threaded end 22 thereof, as may best be seen in FIGS. 2, 3, and 7. Upper mandrel portion 40 is slidably movable in a bore 80 that extends longitudinally through body

78. A cylindrical recess 82 extends downwardly from the top of body 78, and is disposed adjacent to mandrel portion 40.

Two sets of flat sheet resilient sealing rings 84 are situated in recess 82, and are sandwiched between upper, intermediate, and lower circular sealing members 86, 88, and 90, respectively. The transverse cross section of the members 86, 88, and 90 are such as to form the sealing rings into a transverse cross section of chevron design when a downward force is applied to the upper member 86. Threads 92 are formed on the upper exterior surface of body 78. The threads 92 are engaged by an internally threaded apertured cap 94 that has an inwardly extending circular lip 96 which bears against upper member 86. When the cap 94 is tightened on body 78, a desired longitudinal, downwardly directed force may be applied to member 86 to radially expand members 84 into sealing contact with upper mandrel portion 40 and that part of body 78 defining recess 82.

A cylindrical recess 98 extends upwardly in lower end piece D from the lower end thereof. Recess 98 is adjacent to tube 70. Two sets of flat resilient sealing rings 100 are positioned in recess 98 and sandwiched between lower, intermediate and upper circular sealing members 102, 104, and 106, respectively. The lower sealing member 102 pressure abuts against a body shoulder 108 formed in the upper interior part of drill bit support assembly 34, as shown in FIG. 8, which as a result exerts an axial force on the sealing members to radially expand the same into sealing contact with tube 70 and that part of end piece D defining the recess 98.

The sealing rings 84 and 100 are preferably formed from a polymerized resin such as "Teflon," which is resilient but has a slight memory. The rings 84 and 100 are shaped into a transverse cross section of chevron design when they come into pressure contact with the angular faces of the sealing rings 86, 88, 90, 100, 102, and 104, as shown in FIGS. 7 and 8.

The bumper sub A described herein not only permits relative longitudinal movement of the mandrel E relative to the drill bit support assembly 34, but permits drilling mud to be discharged into the assembly through the drill string 46, mandrel E and tube 70. Inasmuch as operation of the bumper sub and the use thereof have been described heretofore, repetition thereof is unnecessary.

I claim:

1. A bumper sub of the type including an elongate cylindrical body in which a circular body shoulder forms a part thereof and from which a first bore extends upwardly as well as a longitudinally grooved second bore that extends downwardly; first and second tubular end pieces removably mounted on the upper and lower ends of said body, with said second end piece being connected to a tubular drill bit supporting assembly; a driven elongate tubular mandrel which extends downwardly through said first end piece, said first and second bores and said second end piece into said drill bit supporting assembly, which bumper sub is characterized by:

a. a cylindrical stop that projects outwardly from said mandrel at an intermediate position thereon and slidably engages said bore;

b. a plurality of rolling means arranged in rows and disposed in radially aligned, circumferentially spaced, longitudinally extending sets of grooves formed in said mandrel below said stop as well as in said body below said body shoulder, with said rolling means locking said mandrel and body together against relative rotational movement but permitting longitudinal movement of said mandrel relative to said body, and with downward movement of said mandrel relative to said body being limited by said stop when it contacts said body shoulder and with upward movement of said mandrel relative to said body being limited by said stop when it contacts said first end piece;

c. a flowable lubricant within said body in sufficient quantity to substantially fill the same, and in which stop a plurality of circumferentially spaced, longitudinal channels are formed on the exterior surface thereof to permit longitudinal flow of said lubricant in said body as said mandrel moves longitudinally relative thereto, with said channels continuing downwardly on said mandrel to communicate with said grooves; and

d. first and second sealing means disposed in first and second cylindrical recesses formed in said first and second end pieces that slidably seal with said mandrel, which sealing means and lubricant cooperatively prevent entry of drilling mud and foreign matter into said bore and first and second bores to impede the free movement of said rolling means.

2. A bumper sub as defined in claim 1 wherein said rolling means comprise a plurality of balls.

3. A bumper sub as defined in claim 1 wherein threads are formed on the upper surface of said first end piece, the lower end of said body, and the upper end of said drill bit supporting assembly and said bumper sub further includes:

e. an apertured internally threaded cap through which said mandrel extends and which threadedly engages said threads on said first end piece; and

f. a circular body shoulder on said drill bit supporting assembly that pressure contacts said lower sealing member when said body and drill bit supporting assembly are threadedly joined.

4. A bumper sub as defined in claim 1 wherein said first sealing means is a plurality of sealing rings, with each sealing ring formed from a flat sheet of a polymerized resin that has no substantial memory.

5. A bumper sub as defined in claim 1 wherein said second sealing means is a plurality of sealing rings, with each sealing ring formed from a flat sheet of a polymerized resin having no substantial memory.